

South Carolina Department of Transportation



Electronic Toll Collection System & Related Services

For the

Cross Island Parkway Toll Facility

Hilton Head, South Carolina

Contract P.O.# 231709

PRELIMINARY SYSTEM CONFIGURATION DOCUMENT

Rev. 1.0

February 1998

LOCKHEED MARTIN



Comments on Preliminary System Configuration Document Rev. 0.0

9/19/97

Comment #	Page #	Section #	Specific Comment	Response
1.	3-12	3.2.1.8	You say "...and with the ETC AVI subsystem disabled or not present." But in the final bullet, you also state that the AVI system records the transaction. Clearly the latter statement cannot happen if the first statement is true.	Deleted the latter statement.
2.	3-12	3.2.1.9	In addition to all the actions you describe, does the VES camera record the violation?	Yes. Document has been corrected.
3.	3-12	3.2.1.11	You have the canopy light going from red to green and then to flashing amber. Is the green light lit while the flashing amber light is lit? If not, why not go to flashing amber without going to green first? The intent is unclear.	Corrected.
4.	3-14		The Process Flow Diagram shows VES for the front license plate, shows E-ZPASS on all of the monitors and a post-class vehicle separation. This diagram should be redrawn to be Cross Island Parkway specific.	Corrected.
5.	3-16	3.2.1.13.1	After paragraph 2, in the "If no tag is detected" series, should you insert "If a valid tag is detected" and change paragraphs 3, 4, and 5 to 1, 2, and 3 under the inserted heading?	Corrected.
6.	3-18		In the Process Flow Diagram for an Attended AVI Mode, you do not show how a cash transaction is handled.	Corrected.
7.	3-19		In the section where you describe "If no tag is detected or if the tag is invalid," you state that the island traffic light will remain amber. It was red before; how did it get to the amber condition? Why should the PFD read "Go Unpaid" in an attended lane? In the last sentence on this page, you have the Island Traffic Light remaining amber. This appears to be the condition for an Unattended lane.	Corrected.
8.	3-20		The diagram on this page shows "front and rear image." Why are you showing a front image?	Corrected.
9.	3-21	3.2.1.14.1	Why are you showing the Go Unpaid message? Where is the description for a normal cash transaction?	Corrected.
10.	3-22		The Diagram for Manual Mode does not line up to the toll terminal screens. For instance, how does the PFD flash a pay amount before the toll collector enters a class?	Corrected.
11.	3-34		The flow line for the treadles shows only a flow out to the treadles. How do the processed axle counts get back to the processor? The canopy light is shown with only two heads.	Corrected.
12.	3-35	3.3.5	We believe you meant to start the second sentence with the word "Unattended" instead of "Attended."	Corrected.
13.	3-44	Figure 3-15	The PFDs show "Amount Due" for a violator. Before, they showed "Go Unpaid" in an Unattended Lane.	Corrected.

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Preliminary System Configuration Document Rev. 1.0

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Proprietary Data

Comment #	Page #	Section #	Specific Comment	Response
14.	3-58	3.5.1.1.1	You state "It allows the collector to input the required PIN number." Since PIN equals Personal Identification Number, the word "number" after the acronym PIN is unnecessary.	Corrected.
15.	3-60	3.5.1.2.1	Where are the "STANDBY" and "STATUS" buttons you mention? In the last paragraph on this page you state "The COMMIT button is used to confirm the operations to . . ." The word 'to' should be changed to read 'of.'	Standby is a button on the Logon/Standby Screen, Toll Collection First Level Screen, Other Payment Screen, and Collector's Screen-Valid and Invalid Pal Pass. Status is not a button, but a readout of the status of specific equipment. The Toll Collection First Level Screen gives updates on the status of equipment such as: "Printer-----Ready." Corrected.
16.	3-62		Do we need this page at all?	Corrected.
17.	3-64	Figure 3-22	Why are you showing a gate button?	Corrected.
18.	3-66		Manual Tag: What is it used for and under what circumstances?	Removed, N/A.
19.	3-67	3.5.2	Will the collector get a red/green light, a tone, or some other alert?	Removed, N/A.
20.	3-71		The diagram on this page and the one on page 3-14 are very different. Which one is correct?	First diagram is correct. Second diagram has been removed.
21.	3-72		The diagram on this page and the one on page 3-18 are different. Which one is correct?	First diagram is correct. Second diagram has been removed.
22.	4-3		How does one access these various screens?	Supervisor Lane Monitor button off of the main application window
23.	4-5		What is an open or close "radio" button?	These buttons open or close the lanes. They are called "radio" buttons because they look like buttons on a radio.
24.	6-3		You state that the numbers of the Revenue Bags repeat for a minimum of 180 days. This sentence should read: "Revenue Bags are pre-numbered with assigned unique identification numbers that do not repeat for a minimum of 180 days."	Corrected.
25.	6-4		Where will this be done? We should have a graphic that shows where all of the activities take place and who performs the activities.	Done at the Plaza Please refer to Figure 6-3, Assign/Return Tab Folder for the screen showing this process.
26.	6-5		How does the supervisor get to this routine?	Assign/Return tab in the revenue bags folder
27.	7-5		Mr. Duke said he did not want the Social Security Number to even be an option.	Corrected in text but not on screen. This is part of software package and is not alterable.

Comment #	Page #	Section #	Specific Comment	Response
28.	7-8		On this page and all the pages that follow in this section that show folders, Agency names such as Rickenbacker should be changed to be reflective of our project.	Corrected.
29.		10	Host Server: We believe that it would be in the best interests of both Lockheed Martin IMS (IMS) and the South Carolina Department of Transportation (SCDOT) if IMS would seriously consider replacing the proposed AlphaServer 1000 with the AlphaServer 4000. The 1000 Server is nearing the end of its production cycle and the 4000 Server offers much more for the same price or less (dependent on features).	1,000 Server is already installed.
30.	11-13		Why is preclass shown on this report? This report needs to be made as good as possible very early on because of its relative importance to everything else.	Part of Base Reports. Pre-Class counts will be zero for SCDOT.
31.	11-26		This report could be made more valuable if it contained traffic deltas and a comparison with the same month of the previous year with a percent of change.	Can be a change request, if desired.
32.	12-17 & 12-18		The last line in the description box on 12-17 is written "The first four (4) digits are the plaza number as specified in the RFP Volume II." The Cross Island Parkway RFP consisted of but one volume. We do not object to your allowance of four digits for a plaza number, but please correct this entry by deleting everything after the word "number."	Corrected.
33.	12-34		Please delete the references to California toll roads in the Service Area bullet.	Corrected. Will there be a replacement answer for this?
34.	14-15	Figure 14-6	Please delete SR91 material.	All figures from this point on are prototypes only and are being developed and will later be included in the Vector software.
35.	14-33	Figure 14-15	Please delete all references to California bridges.	See response 34.
36.	14-35	Figure 14-16	Please delete California references and insert the Cross Island Parkway.	See response 34.
37.	14-52		Where are the input buttons described on this page depicted?	See response 34.
38.	14-54		Where are the input buttons described on this page depicted?	See response 34.
39.			In addition to the comments/questions on the Reference Document, we would like to see a schedule of the rest of the IMS deliverables and have a Progress Meeting scheduled. We would like IMS to suggest agenda items for this Progress Meeting, and we will add our items to those of IMS.	See response 34.

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1. Introduction

1.1 Purpose

Lockheed Martin IMS (LMIMS) has undertaken the design, development, implementation, and maintenance of the Toll Collection and Automatic Vehicle Identification (AVI), and Mark IV software subsystems for the South Carolina Department of Transportation (SCDOT) for use at its Cross Island Parkway Toll Facility. Our design objectives are as follows:

- To create a fully compliant and functional system that applies the highest standards of usability, reliability, maintainability, flexibility, and scaling ability.
- To achieve all of the above by employing proven industry-standard technologies, tools, and methodologies that ensure a high degree of platform independence and quality assurance.

This document contains an analysis of the needs of the SCDOT toll collection facilities and the mapping of those needs into the LMIMS system design.

We recognize that all information technology development is increasingly being driven by business process changes. As these changes have begun to impact the software development community, the Object-Oriented (OO) techniques incorporated into the SCDOT project will shorten the development cycle times through enhanced traceability and reuse. Our approach to the SCDOT project is driven by the following criteria:

- Business processes will drive the approach to ensure that the business requirements are understood, prioritized, and validated.
- The design review is part of our iterative development process and should elicit requirements and accommodate changes as the system evolves.
- An incremental delivery is used to facilitate just-in-time delivery of critical functional items. This important procedure helps to estimate the remaining requirements.

Our development solution is an evolving process which is presented in the following sections. Our present stage in the OO design and implementation cycle addresses the following issues:

- A tightly integrated set of modeling techniques that provide support for the rest of the life cycle from the **Use Cases** into the multi-tiered **Object Models Techniques (OMT)**.
- An iterative process with incremental deliveries of the system design and implementation



1.2 System Overview

The overall system design for the Cross Island Parkway toll facility combines a multi-tiered client/server approach to plaza and lane operations with AVI account management functionality, as illustrated in South Carolina DOT System Overview (Figure 1-1).

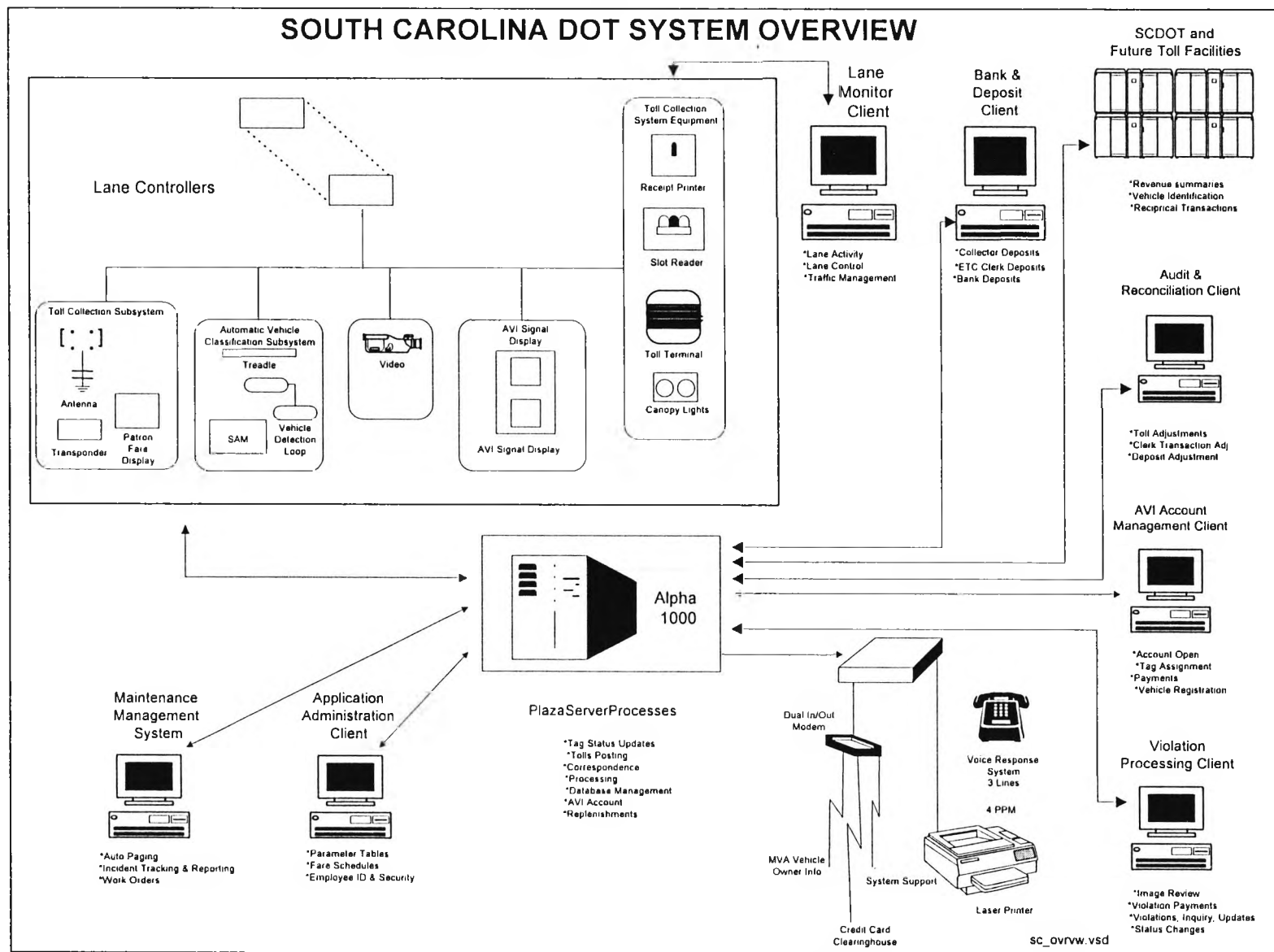


Figure 1-1 South Carolina DOT System Overview

The **Design & Analysis** section of this document lists and elaborates on the application software architecture, as well as the independent data model, tools, and methodologies employed in implementing such architecture and data models. While not intended to be a full-fledged documentation of these tools and methods, this section will adequately describe the development process. The Integrated Software Solution (Figure 1-2) encapsulates our approach to a client/ server solution for the SCDOT system.

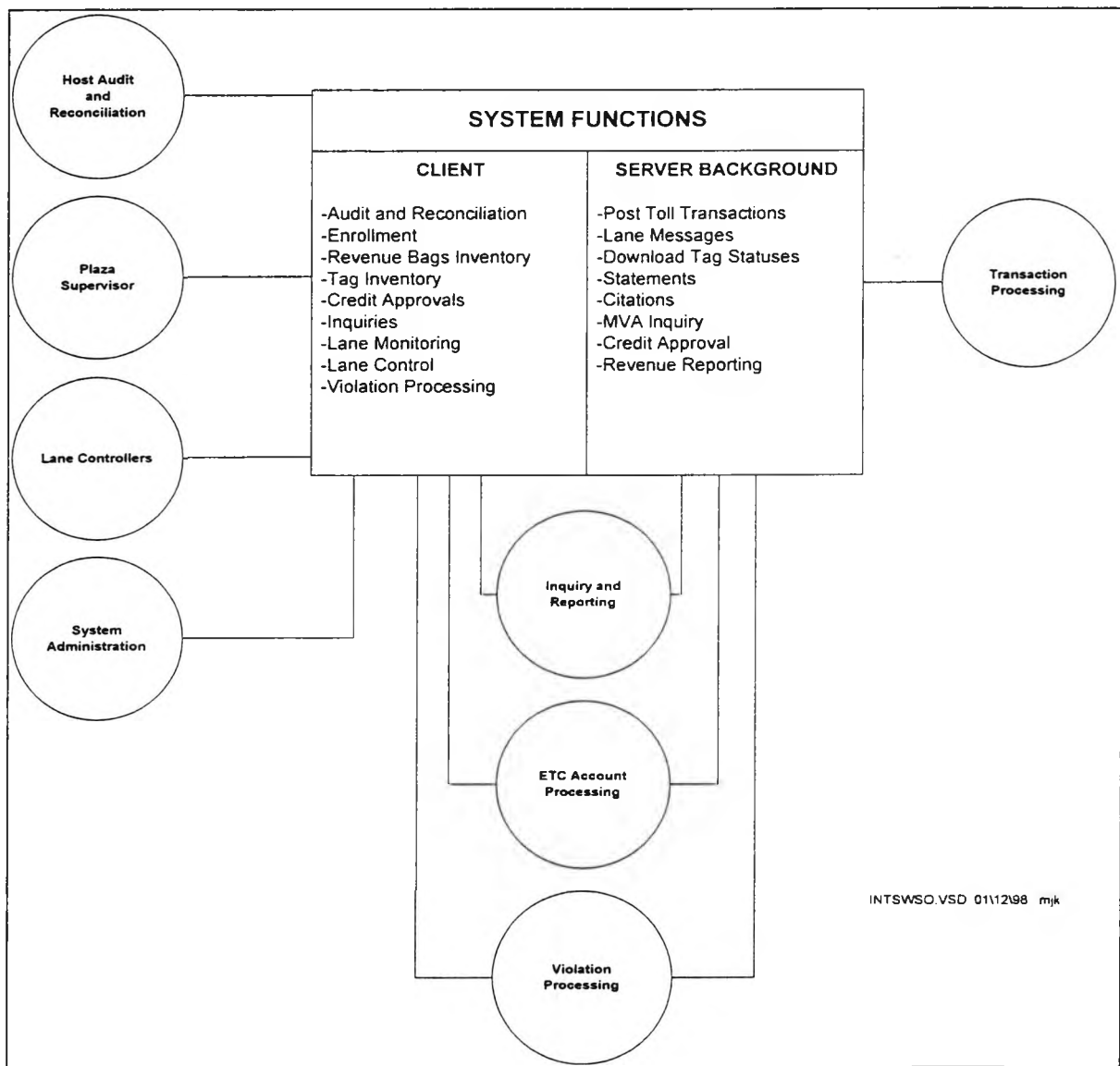


Figure 1-2 Integrated Software Solution Diagram

The **Lane Controller Development Approach** section contains the LMIMS Lane Controller design, including hardware configurations and software processes, with all of the customized functionality required by SCDOT. The lane configuration includes the following components to maximize traffic flow:

- AVI in every lane
- Fiber optic LAN backbone
- Violation Enforcement System (VES) in every lane
- Automatic coin machines (ACMs) limited to ramps

The **Plaza Supervisor Development Approach** section contains a functional description of the proposed hardware and software design for SCDOT.

The **Client Software Design** section contains a comprehensive list of all software components that constitute the client processes with descriptions of each. An overall assertion can be made that this section constitutes the description of the end-user interface (interactive) with the application. Almost all man-machine interactions within the SCDOT Toll Collection system will occur through client processes. Such presentation is achieved by incorporating screens executed by the client user and attaching a "usage brief" for each screen. There are three subsystems which will be presented as (GUI) Client designs. They are as follows:

- The **Host Auditing & Reconciliation** sub-system details the functional processes implemented in our VECTOR software design, which will prevail in order to achieve an integrated and contiguous functional software design.
- The **Violation Enforcement** sub-system section contains the hardware configuration and software processes for the effective enforcement of all toll violators in the SCDOT system .
- The **AVI** sub-system details our current AVI design in use at several toll agencies across the country. This subsystem has undergone customized modifications as required for SCDOT. The design presented in this document is a detailed description of the existing GUI client version of the LMIMS AVI subsystem.

The intention of the **Client Software Design** section is not to be the full-fledged documentation of the client portion of the software. The intention is to present to the reviewer the logical steps within the system for each functional requirement and the relevance of each screen within such a sequence.

The **Server-Based Batch Software Design** section comprehensively lists all batch processes along with a functional narrative of each. This section constitutes the description of the background (non-interactive) processes within the system as they pertain to the centralized data storage architecture. Most of the batch processes are executed on the server.

The **Database Approach** section of this document contains the **Select Enterprise Case Tool** generated database schema of the relational database design in terms of context, entities, interaction of entities, and data representation.



2. Software Analysis & Design

2.1 Introduction

The SCDOT toll collection system architecture incorporates proven and effective technologies into each of its elements. The architecture addresses the goals set in the areas of usability, reliability, maintainability, flexibility, and the ability to scale.

- **Usability** is addressed by combining a tested industry standard graphical user interface with customized development standards (examples are intuitive controls, menu paths, icon design and placement that reflect the natural flow of work).
- **Reliability** is achieved by incorporating a robust database engine, a solid communication interface for client-to-database server connectivity (Pathworks), and control and audit structures within the database schema.
- **Maintainability** is achieved by adopting CASE tools where possible from the design stage and incorporating documentation and software together. Maintainability is further achieved by grouping software into directly related libraries, and by employing the correct degree of object inheritance that enables parent (global changes) and child level maintenance.
- **Flexibility** is accomplished by adopting rules of encapsulation wherever it is deemed advantageous. An open and configurable transaction structure is provided by establishing parameters of all known data elements that dictate policies.
- **Scaling ability** is achieved by combining an upcoming but proven hardware platform (64-bit Alpha), a standard computing environment (TCP / IP, Windows), and a high-performance database engine that features dynamic scaling tools. The application and network designs have been engineered to weed out all bottle-necks and single-point controls that might restrict the ability to expand which is provided by the platforms and the engine.

2.2 Software System Architecture

LMIMS has re-engineered the VECTOR application software in the past year. The VECTOR software product architecture now includes functional enhancements, technology updates, and advanced user interface and reliability features. This includes fully graphical user interfaces, advanced reporting features, a faster real-time transaction processing model for AVI and other toll transactions as well as a contextual, easy to use on-line help system.

VECTOR application software is a client / server architecture, with the exception of the Lane Controllers which can operate stand-alone. The client / server sub-systems of VECTOR incorporate features such as Dynamic Application Partitioning. Forté Runtime Server and Forté Runtime Client licenses are additional system components required in the Host Server and PC client system configurations.

Powerful Graphical User Interface Designed With Work-Flow In Mind			
Ease Of Use	Standard Look & Feel	Intuitive Access & Work Flow	Context Sensitive On-line Help
Left to right, top to bottom screen layout	High level menu structure per Windows standards	Extensive research of operational procedures & work flow	Easy accessibility to written procedures
Incremental selectivity for quick selection from pull-down lists	Function key triggered contextual help	Designed through joint specifications development with end-users	Eliminate frequent supervisory intervention during start-up and re-training
Minimal data entry through smart defaults	Smart icons for rapid cross-referencing and data access	Prototyping approach to eliminate last minute surprises	On-line Help is also available as a printed manual to serve as the user manual
Hot keys and short-cuts for rapid navigation and screen access	Flexible user configurable desk-top using standard windows	QA involvement during design, development, customization and implementation	Help topics can be accessed contextually, by table of contents or through search function

The client component of the application software has been designed using the industry standard and leading development tool. Forté is a true object-oriented tool that generates high volume on-line transaction processing applications for a variety of hardware and software platforms. Forté provides a complete set of tools including a graphical user interface, an object-oriented fourth generation language, a comprehensive set of class libraries, and a repository to support team development.

LMIMS recognizes the advantage of a uniform user-interface design across all functional areas and sub-systems. Such a design facilitates cross-training of personnel, and by minimizing the amount of such training effort, enables a more efficient operation.



2.2.1 Modular Client / Server Design

LMIMS has incorporated client / server technology in the VECTOR solution that supports the inherent distributed and multi-tiered nature of AVI operations. The VECTOR design is built to operate on a multi-tiered client / server architecture to allow for cost effective changes in the program, as directed by the Authority. The business model, shown in the next few pages, is matched by the technology, the software architecture and the development / maintenance methodology.

2.2.2 Audit Trail for Database Changes

Database modifications and changes to static system tables are suited and tracked by two separate mechanisms. The VECTOR system, with its object-oriented approach to system design, tracks every change to static system data (toll schedules, user privileges, General Ledger account numbers, etc.) and previous values are recorded in the system.

All system development changes in software are fully documented, tracked, and auditable. Developers check out, modify, and check in portions they are assigned. Access to the master configuration is controlled according to unit assignment. The software also manages the development compiler, libraries, and tools configuration during the software life cycle.

2.3 Select Enterprise Tool Set

Client / server technology supports the inherent distributed and multi-tiered nature of business. Our solution for SCDOT is being built to operate on a two-tier client / server architecture. The business architecture is matched by the software architecture, the technology architecture, and the development team architecture. Select Enterprise provides a powerful documentation tool for ensuring all design changes are displayed to the user and developer in a clear, concise manner. The following subsections of Software Design were generated by the Select OMT case tool for object-oriented design and development.

The LMIMS design approach is that business processes should drive the approach to ensure that the business requirements are understood and can be prioritized and validated.

The Select Enterprise tool set provides full support for the necessary parts of a successful software development project:

- Integrated support for modeling techniques based on Object Modeling Techniques (OMT) and Use cases
- Support for the modeling and generation of a multi-tiered architecture
- Support for the development process through on-line monitoring, automated document production, etc.
- Support for the maintenance and enhancement process throughout the life cycle of the software.
- Integrated documentation capabilities provided through the ability of Select OMT to be fed changes through Forté development language.

The LMIMS approach to modeling is to have only one overall model of the entire system, which evolves as the life cycle progresses. As this model evolves, more detail is added, bringing users along as we progress. Finally, this model is transformed into code. Thus, there is only one gap between the model which we must bridge: the bridge between our current graphical model of the system and the code. This greatly simplifies traceability and eases and encourages true iterative development.

The following models are geared to the user's perspective whose interest is confined to the support of the business process.

2.3.1 Actor Catalogue

The first step in developing a **Use Case** model is to identify and catalog the actors which interact with the system. An **actor** is an active object that drives the Use Case model by producing or consuming values. Actors are attached to inputs and outputs of a Use Case model. The table on the next page, List of Actors Figure 2-1, defines the actors presented in the following Use Case scenarios employed in the SCDOT business model.

NAME	DESCRIPTION	USE CASES
Account Clerk		Initialize Bank Bags, Prepare Bank Deposits, Receive Bags into Inventory, Verify Bank Deposits, Verify Deposits and Seed Money Returns
Administrator	Plaza administrator maintains plaza schedules, shifts, and slots. The administrator also maintains assignment of collectors to slots.	Browse Employees, Collector / Slot Assignment, Maintain Employees, Maintain Schedules, View Schedules
Clerk	Responsible for the following activities: <ul style="list-style-type: none"> • Open New Accounts • Assign new devices • Add new devices • Enter all account activities • Review violation images • Close accounts 	Add Notes, Additional Device Sales, Assign Devices, Close Accounts, Create Demographics, Create Device Requirements, Create Plan Details, Create Rebill Information, Demographics Changes, Enter Payments / Refunds / Reversals, Generate daily clerk closeout reports, Generate expiring credit cards report, Maintain Vehicle Info, Print Profile, Rebill Information Changes, Register Vehicles, Review Images & Update Plate Number, Tag Status Changes, View Account History
Collector	Toll Collectors operate in lanes according to assignments made by supervisors.	Collector / Lane Assignment, Collector / Slot Assignment
AVI Clerk		Enter deposit for Tour of Duty
Lane Controller	The Lane Controller functions as an external system actor in the context of the Revenue and Reconciliation sub-system.	Record toll transactions from the lanes
Scheduler	A system process responsible for the scheduling of all batch processes.	Generate Monthly statements, Generate Violation Notices, Insert New Violations, Post Customer transactions, Process TOLL transactions, Receive replenishment & update account balance, Request Address Info from DMV for NON-Cust, Send request to BANK, Update address info received from DMV
Toll Auditor	The toll auditor has the responsibility of reviewing and investigating all tour of duty reports for indicated versus actual revenue discrepancies. Each Tour of	Review Tour of Duty Activity, Verify and Correct Tour of Duty Transactions

NAME	DESCRIPTION	USE CASES
	Duty report will present the calculated overage or underage of each Toll Collector or ACM vault. The toll auditor reviews the Exception reports and unusual occurrence receipts (if they exist) and enters the appropriate adjustments for each category of transaction as needed in order to provide a complete, audited representation of the tour of duty for each collection actor (ACM or Toll Collector).	
Toll Collector	Toll Collectors act in the lanes to initiate all toll transactions coming into the Host Revenue and Reconciliation sub-system. In some toll agencies the Toll Collector is responsible for the data entry of all payment deposits and scrip counts for purposes of reconciling the indicated toll classification vehicles, sales in the form of AVI replenishments and / or scrip sales with the actual forms of payment accepted during a tour of duty each collector is assigned to between deposits.	Enter deposit for Tour of Duty, Issue Bank / Revenue Bags
Toll Supervisor	The toll supervisor has the responsibility of managing the revenue bag inventory and assignment to collectors, reviewing the tour of duty deposits as well as entering the physical counts of the tour of duty deposits into the Revenue & Reconciliation sub-system.	Enter deposit for Tour of Duty, Review Tour of Duty Activity

Figure 2-1 List of Actors

2.3.2 Use Case Model

The Use Case Model defines the scope of the project by identifying actors and use cases. Use cases define what should be performed by the system. It is an external view of the system. It shows the services which the system offers to the outside world.

The main purpose of the use cases is to capture and communicate requirements. As suggested by the name, a use case documents a way in which a system can be used by an actor.

The following Use Case diagrams have been developed to identify the high level use cases in the SCDOT toll collection business model:

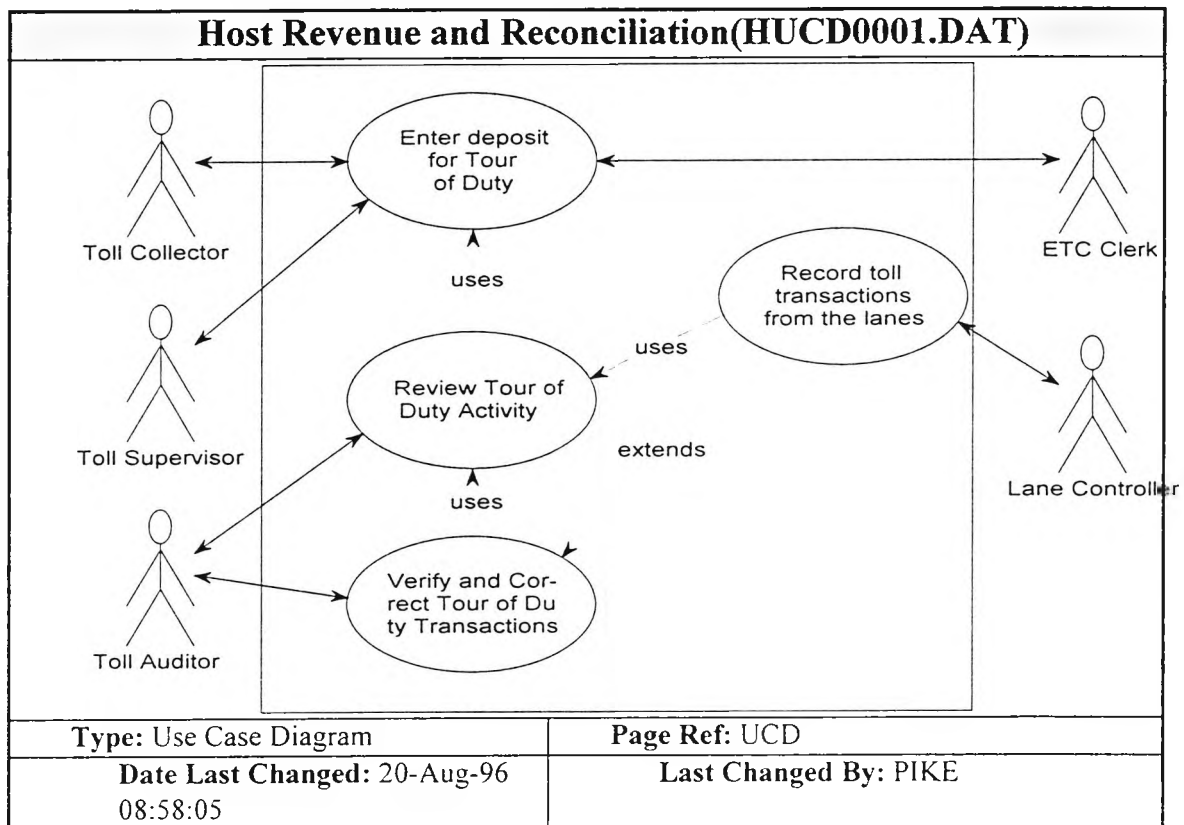


Figure 2-2 Host Revenue and Reconciliation (Use Case Diagram)

2.3.2.1 Name: Enter Deposit for Tour of Duty

Type: Use Case

Description: Collector enters deposits for a tour of duty based on contents of revenue bag or bank return bag.

This item is used on the following diagrams:

- HUCD0001.DAT Host Revenue and Reconciliation
- HUCD0005.DAT Account Clerk Use Cases

This Use Case involves the following Actors:

- Toll Supervisor
- Toll Collector
- AVI Clerk

2.3.2.2 Name: Record Toll Transactions From The Lanes

Type: Use Case

Description: The focus of the **Transaction Manager** is to record all toll activity occurring in the lanes for every plaza.

These transactions come in as event messages in real-time mode through a communications messaging facility. There are three main categories of lane transactions: vehicle classifications, and toll payments and messages. In addition to these main revenue generating transactions, there are exception events: equipment faults, unusual occurrences such as turn-arounds, no funds, etc., and violations in the form of images and data transactions. This use case interprets and records each into its appropriate database table for further processing in other use case scenarios.

2.3.2.3 Name: Review Tour of Duty Activity

Type: Use Case

Description: Each Toll Collector or ACM vault works in a lane within a toll plaza for a specified period of time known as a tour of duty. Each tour of duty can have multiple segments of time divided as the time between logon and logoff in a lane. The system can track physical deposits reported for a segment within a scheduled tour of duty. The toll supervisor or toll auditor can review the Tour of Duty activity to determine if any discrepancies appear between the indicated tour of duty or segment revenue and the actual reported revenue. If further investigation is warranted, reports showing all exception events in the lane such as treadle malfunctions, loop errors, AVI reader malfunctions, violation events, etc. can be used to adjust the transaction events in order to correct an event and possibly balance the Toll Collector or ACM vault to a no discrepancy state.

2.3.2.4 Name: Verify and Correct Tour of Duty Transactions

Type: Use Case

Intent: The toll auditor has the ability to review and cross check toll transactions that are manual, AVI or ACM in origin. The Tour of Duty summary information is displayed and any discrepancies between what the lane indicated as revenue events and the actual revenue deposits is highlighted for the auditor. The auditor has the ability to enter adjustments to the vehicle classification transactions at the tour segment summary level, the actual deposits can be adjusted in the event of user errors such as the wrong deposit being recorded against a Toll Collector. Each audit adjustment is to be coded and a memo field is provided for descriptive details.

This item is used on the following diagrams:

- 'HUCD0001.DAT Host Revenue and Reconciliation

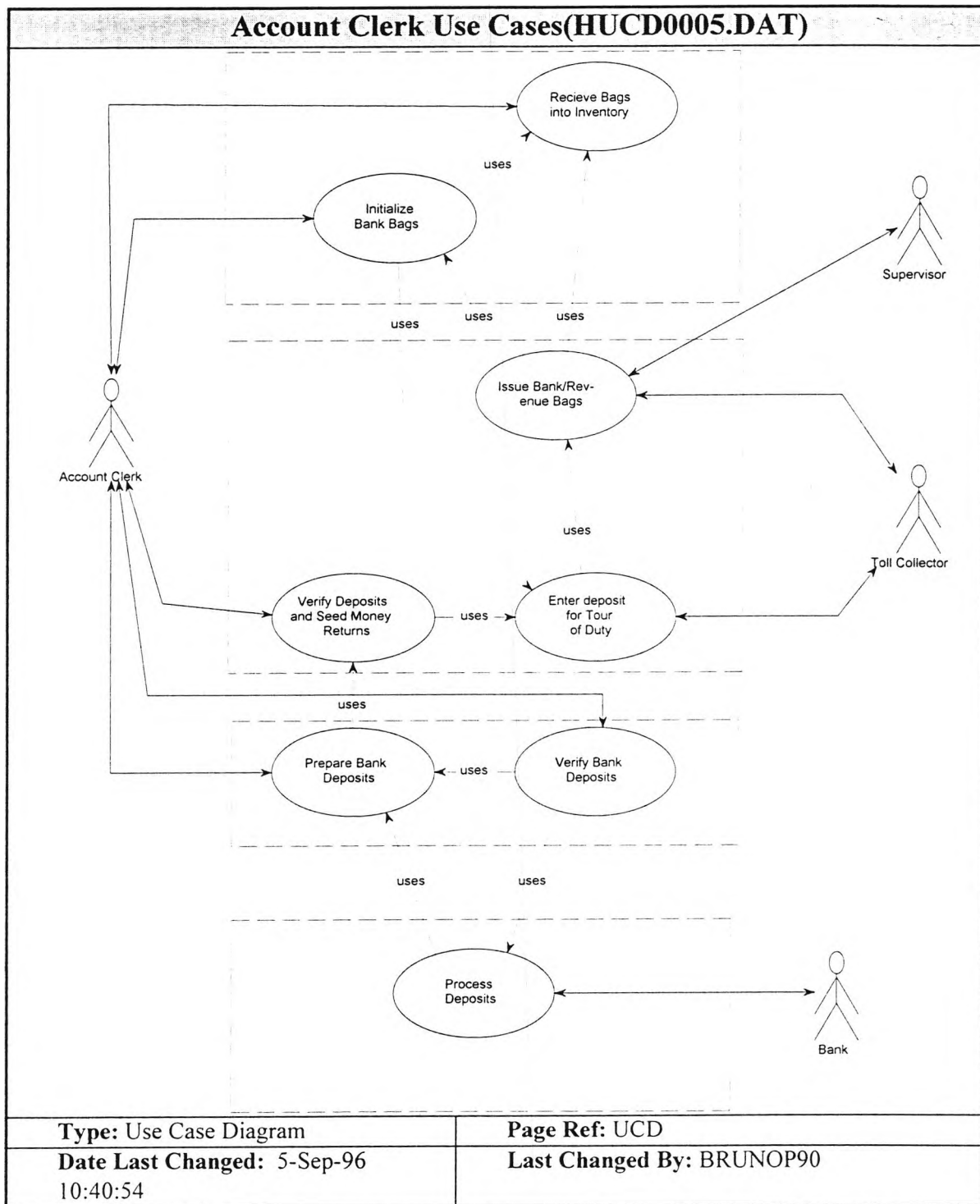


Figure 2-3 Host Revenue and Reconciliation (Use Case Diagram)

2.3.2.5 AVI Account Processing Management Use Case Diagrams

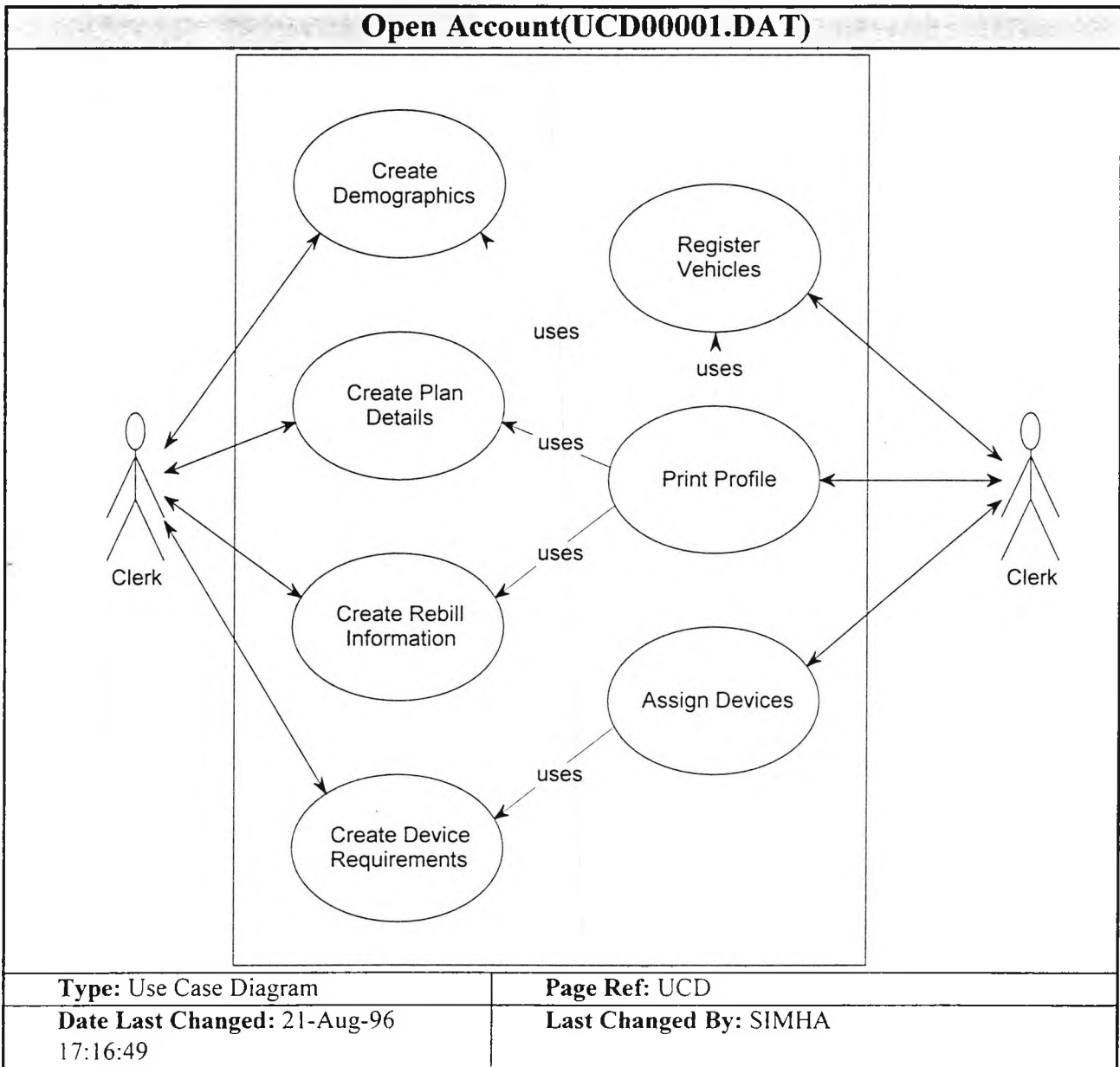


Figure 2-4 Open Account (Use Case Diagram)

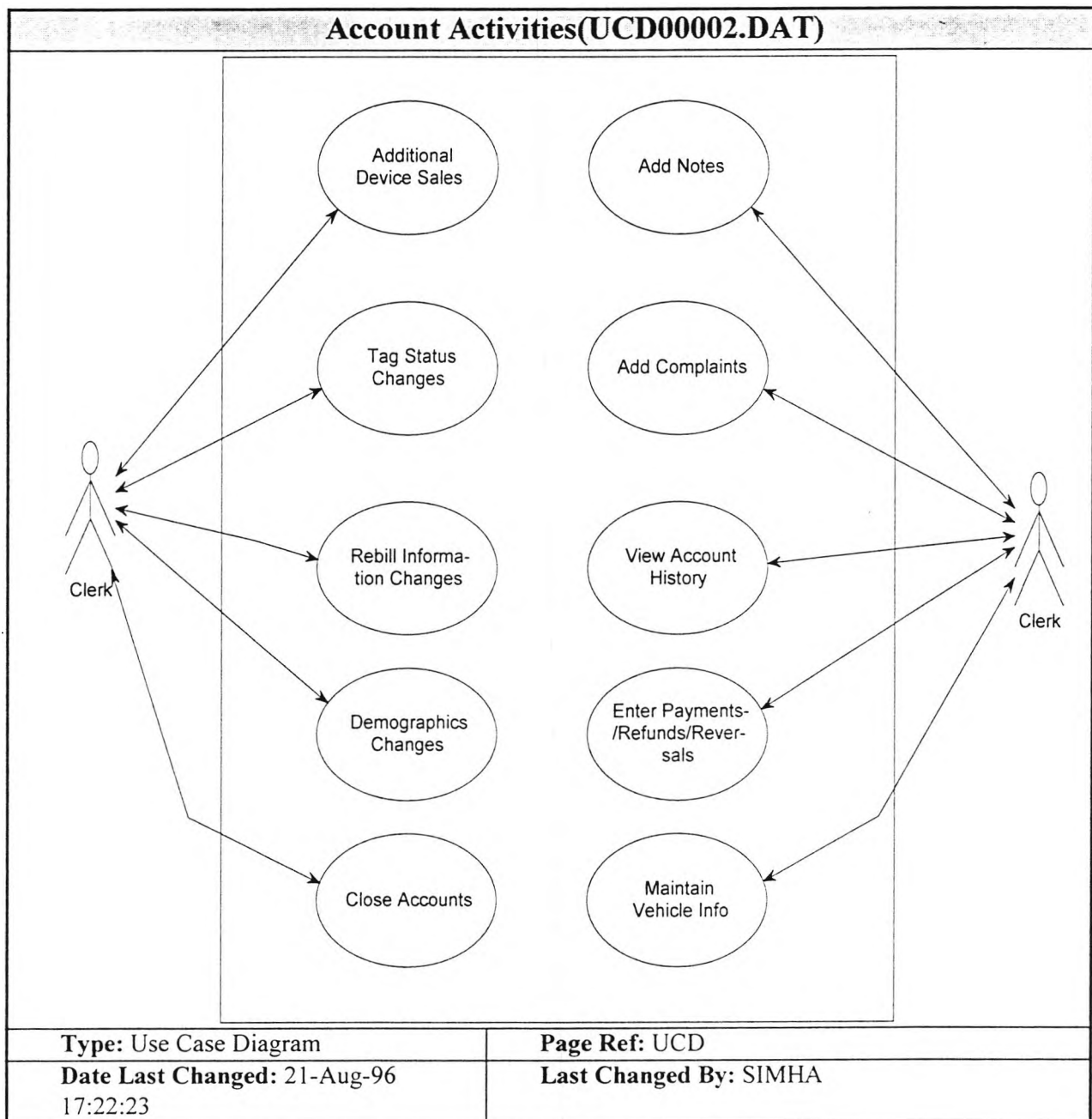


Figure 2-5 Account Activities (Use Case Diagram)

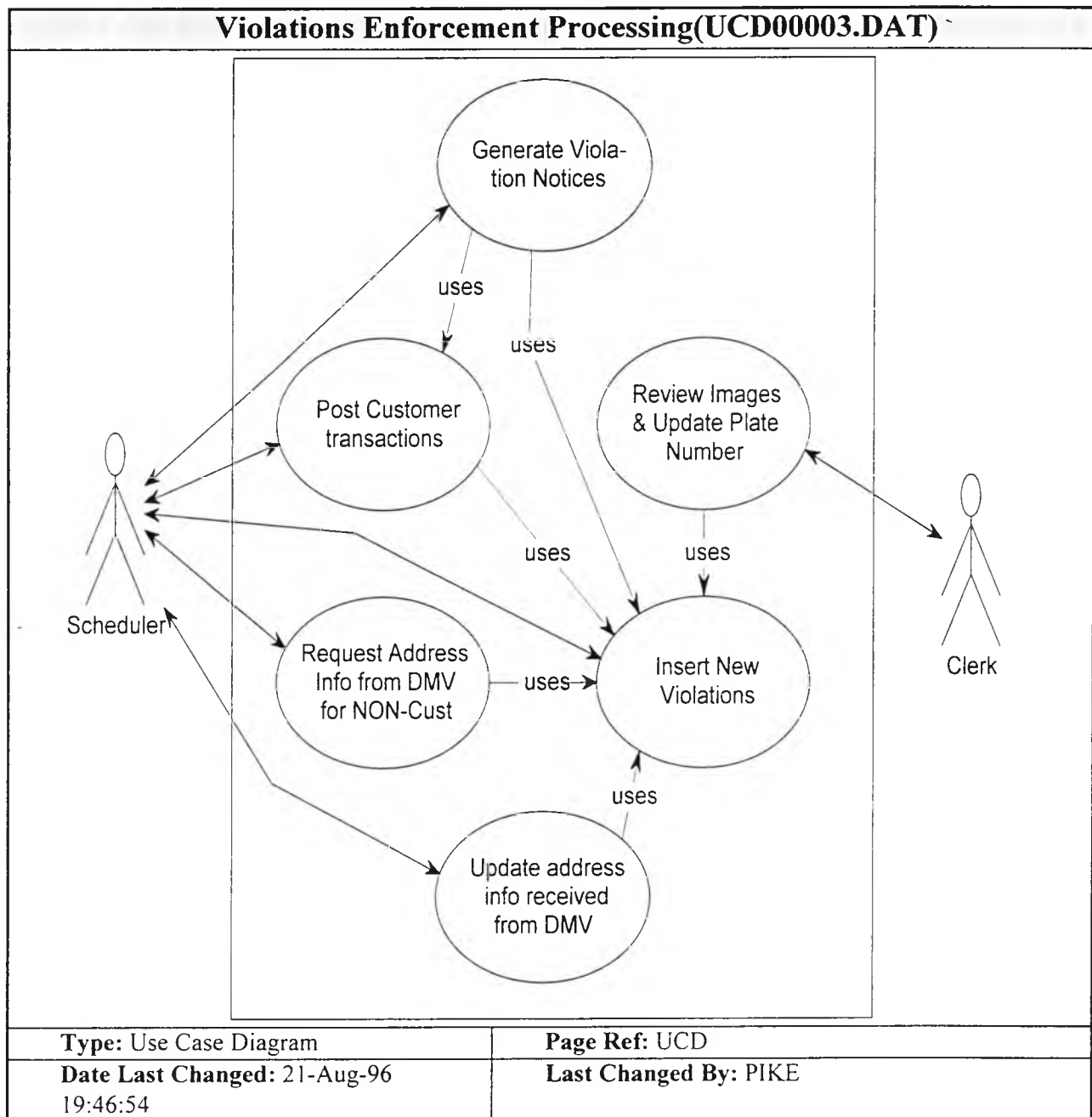


Figure 2-6 Violations Enforcement Processing (Use Case Diagram)

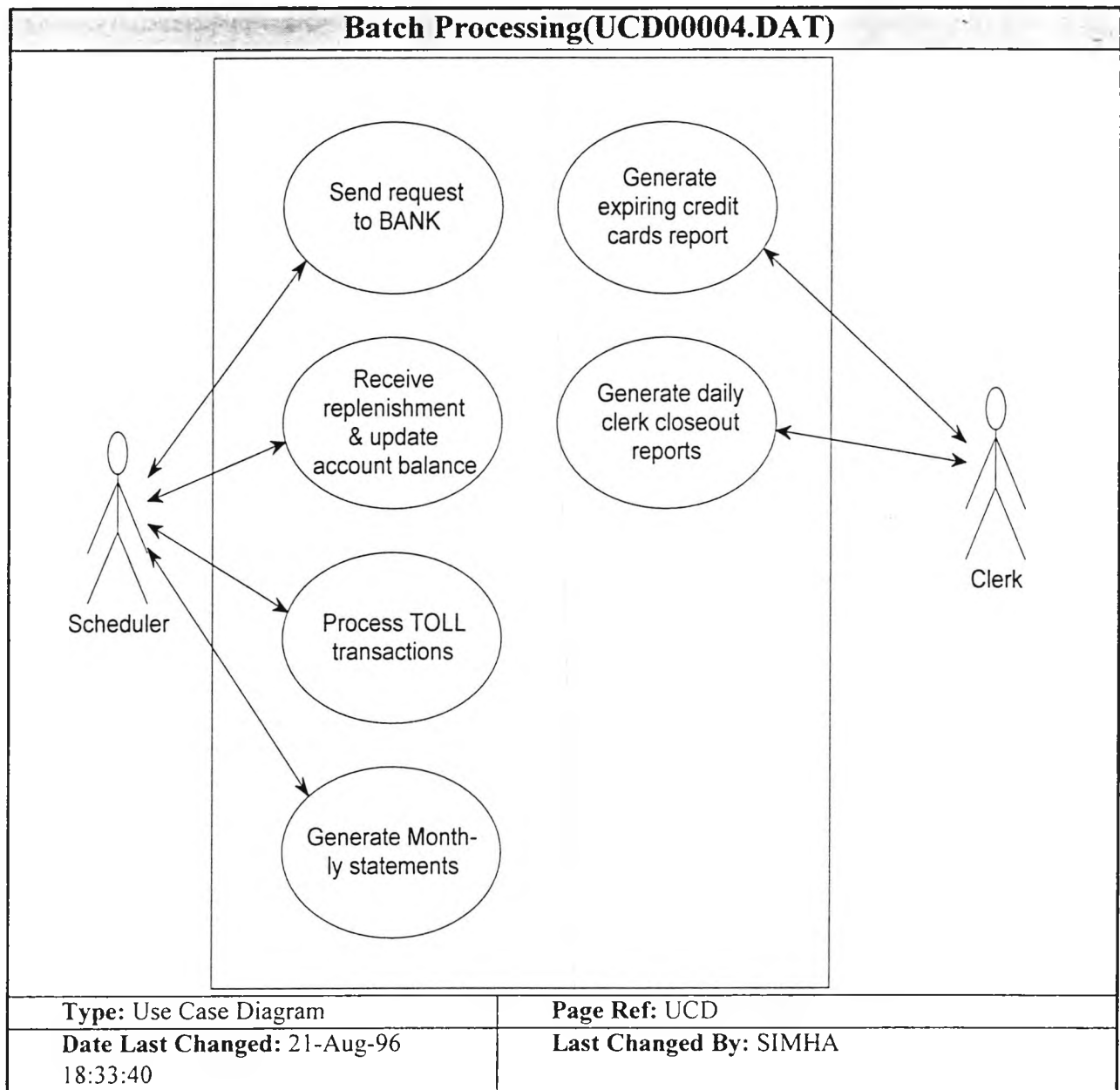


Figure 2-7 Batch Processing (Use Case Diagram)

2.3.3 Local Business Object Model

Local business objects provide the functionality specific to a particular business process. The following object models describe the structure of the objects in the SCDOT toll collection system--their identity, their relationships to other objects, their attributes, and their operations. Changes and transformations are meaningless unless there is something to be changed or transformed. Objects are the units into which we will divide functional characteristics of the toll collection system.

2.3.4 Class Descriptions

2.3.4.1 Class: Account Changes

Description:

The account change master class provides a collection of all changes made to the account. Any non-financial transaction on an account will figure in this group.

Attributes:

[Public]

None

[Private]

change date

clerk ID

location ID

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Account changes:
has no associations!

2.3.4.2 Class: Account Detail Change

Description:

The changes to various account characteristics like the statement frequency are recorded in this class.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Account Detail Change:

Inherits from Non Fin Trans

2.3.4.3 Class: Account Notes

Attributes:

[Public]

None

[Private]

account ID

clerk ID

letter code

note source ref

note text

note type

sent to supv

supv ID

[Protected]

None

Operations:

[Public]

void Insert ()

void send to supv ()

[Private]

None

[Protected]

None

Association Statements

Each Account notes:

records interactions with Is related to 1 AVI Account

2.3.4.4 Class: Account Status

Description:

Accounts have a current status.

Attributes:

[Public]

None

[Private]

short status code

char status description

[Protected]

None

Operations:

[Public]

void Create ()

[Private]

None

[Protected]

None

Association Statements

Each Account Status:

have Is related to 0+ AVI Account

2.3.4.5 Class: Address Change

Description:

Any address change to an AVI account is recorded by storing the previous address in this class.

Attributes:

[Public]

None

[Private]

address line 1

address line 2

address type

city

country

state

zip code

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Address Change:

Inherits from Non Fin Trans

2.3.4.6 Class: Adjustment

Description:

Adjustments are generated by the auditor at the transaction summary level in order to reconcile a Toll Collector tour of duty. All vehicle transactions must correspond to indicated toll transactions. Exception or unusual occurrence events must be accounted for in order to reconcile a vehicle classification to a payment or deposit.

Attributes:

[Public]

None

[Private]

audit code audit code

audit date audit date

char audit status - audit status is the indicator used to determine whether an audit has taken place and is: 1. unaudited, 2. audit complete, 3. audit in progress.

audit time audit time

auditor id auditor id

collector id collector id

description description

lane number lane number

shift shift

shift segment shift segment

transaction type transaction type

[Protected]

None

Operations:

[Public]

void add ()

void view ()

[Private]

None

[Protected]

None

Association Statements

Each Adjustment:

calculates and enters Is related to 0-1 Auditor
are applied to Is related to 0+ Lane Transaction Summary
indicate need for Is related to 1 Unusual Occurrence
are applied to Is related to 1 Deposit

2.3.4.7 Class: Administrator

Description:

The administrator class represents the employee that maintains schedules and assignments of slots to collectors.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Administrator:

Inherits from Employee

Schedules Is related to 1 Toll Collector

Maintains Is related to 0+ Schedule

Created by Is related to 1 Collector / Slot Assignment

2.3.4.8 Class: Attended Lane

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

boolean canAttend (in Toll Collector collector) - Determines whether a given collector can attend this lane. A collector must be assigned to the lane to be allowed to attend it. A relief collector can attend any lane.

[Private]

None

[Protected]

None

Association Statements

Each Attended Lane:

Inherits from Lane

Collector / Lane Assignment Is related to 1 Collector / Slot Assignment

2.3.4.9 Class: Auditor

Description:

This is an actor class. The auditor has responsibility for reviewing the Toll Collector accuracy based upon classification versus indicated payments versus deposits recorded. Any adjustments to the above transactions are performed by the auditor. Reports are generated to aid the auditor in evaluation and adjustment.

Attributes:

[Public]

None

[Private]

access code access code

name name

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Auditor:

verifies and corrects Is related to 0+ Deposit

calculates and enters Is related to 0+ Adjustment

2.3.4.10 Class: Collection

Description:

This is an abstract class used to relate two possible methods of collecting cash and toll payments.
Toll Collector personnel can operate in a lane for a tour of duty.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Collection:

is assigned to Is related to 1+ Tour Segment
takes place in Is related to 1 Lane
records Is related to 0-1 Deposit

2.3.4.11 Class: Collector Cash

Description:

The collector cash is recorded in the Lane Controller and represents the cash which is expected for the particular matching vehicle classification according to the published toll schedule. Each collector's expected cash is summarized for a tour of duty and is reconciled against the collector cash deposit for the tour of duty for the respective collector. The amount expected is recorded as a total monetary value.

Attributes:

[Public]

None

[Private]

amount due amount due

amount paid amount paid

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Collector Cash:

Inherits from Toll Payment

2.3.4.12 Class: Collector Cash Summary

Description:

The collector cash is recorded in the Lane Controller and represents the cash which is expected for the particular matching vehicle classification according to the published toll schedule. Each collector's expected cash is summarized for a tour of duty and is reconciled against the collector cash deposit for the tour of duty for the respective collector. The amount expected is recorded as a total monetary value.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Collector Cash Summary:

Inherits from Toll Payment Summary

2.3.4.13 Class: Commercial Account

Attributes:

[Public]

None

[Private]

company name company name

first contact name first contact name

first contact prefix first contact prefix

first contact title first contact title

next contact name next contact name

next contact prefix next contact prefix

next contact title next contact title

tax exempt status tax exempt status

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Commercial Account:

has no associations!

2.3.4.14 Class: Demographic

Description:

AVI account address information class. An account could have multiple addresses. The addresses are differentiated by the address type.

Attributes:

[Public]

None

[Private]

address country address country

char address line 1

address line 2 address line 2

address line 3 address line 3

address state address state

address type address type

address zip address zip

day phone

fax number

night phone

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Demographic:

is identified through Is related to 1 AVI Account

2.3.4.15 Class: Deposit

Description:

A deposit which includes all non-AVI forms of payment (cash, tickets, scrip, exception slips) is made at the end of each tour of duty for a Toll Collector. This is the generalization class for all categories of deposits including Toll Collector deposits and clerk deposits.

Attributes:

[Public]

None

[Private]

any collection id - Collection ID contains the associated ID number of a collector.

deposit date deposit date

deposit time deposit time

float deposit total value - This is a derived attribute and represents the total dollar value of the deposit entered by a Toll Collector.

segment id segment id

supervisor id supervisor id

tour id tour id

[Protected]

None

Operations:

[Public]

void record ()

[Private]

None

[Protected]

None

Association Statements

Each Deposit:

records Is related to 1 Collection

verifies and corrects Is related to 1 Auditor

are prepared for Is related to 0-1 Bank Deposit

are applied to Is related to 0+ Adjustment

2.3.4.16 Class: Deposit Adjustment

Description:

Each deposit for a Toll Collector as well as a bank deposit preparation can be adjusted in order to correct any data entry errors resulting from mis-matched deposits, keying errors, or mis-counted items for deposit. Bank deposits can be prepared from each collector deposit or as an aggregation of collectors. This provides an added flexibility in deposits to outside financial institutions.

Attributes:

[Public]

None

[Private]

auditor id

any collection id - Collection ID contains the associated ID number of a collector.

deposit date deposit date

deposit time deposit time

segment id segment id

supervisor id supervisor id

tour id tour id

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Deposit Adjustment:

Inherits from Adjustment

2.3.4.17 Class: Device

Description:

Transponders are sold or leased to AVI account holders. The patrons might be required to put down a deposit to cover the cost of the device if it is lost or damaged. The transponder is uniquely identified by programmed numbers.

Attributes:

[Public]

None

[Private]

agency id - If multiple agencies are involved in a system then each agency must have an ID number.

box no

color id

date issued

date returned

device id

expiry date

iag class

iag revenue type

issued by

location id - current location ID for tag. This is a store pointer under normal circumstances. When the device is with a customer the location is set to 0.

mount type

read count

returned by

status code

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Device:

buys or leases Is related to 0-1 AVI Account

Is related to 1 PO receipt

Is related to 0+ Tag transfer

Is related to 1 Tag allocation

2.3.4.18 Class: Device Deposit

Description:

If deposits are required for leasing a device, this class will store the related information of the financial transaction.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Device Deposit:

Inherits from Fin Trans

2.3.4.19 Class: Device PO

Description:

Purchase orders for devices

Attributes:

[Public]

None

[Private]

PO date

PO number

authorized by

clerk id

manufacturer

received date

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Device PO:

Is part of 1 PO Items

Is part of 1 PO receipt

2.3.4.20 Class: Employee

Attributes:

[Public]

None

[Private]

char Address

Boolean DateOfBirth

Boolean HireDate

Boolean HomePhone

Boolean Name

Boolean OccupationCode

Boolean Page

Boolean PageInv

Boolean SSN

Boolean SecurityLevel

Boolean Status

Boolean TerminationDate

Boolean WorkPhone

boolean isFullTime

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Employee:

Assigned to Is related to 0+ Schedule

Assigned Is related to 1 Lane

Is related to 1 Employs(Plaza)

2.3.4.21 Class: AVI

Description:

AVI payment transactions are handled differently than the other payment transaction types coming from the Lane Controller. AVI transactions will not have a discount value defined in the lane. The Transaction Manager process will have to look up the discount value of the passage based upon the tag ID. Each AVI account can have different discount plans depending on agency, plaza, plan type, time of day, etc.

Attributes:

[Public]

None

[Private]

device id device id

device read count device read count

device status code device status code

etc account number etc account number

etc plan type etc plan type

toll status code toll status code

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each AVI:

Inherits from Toll Payment

2.3.4.22 Class: AVI Account

Description:

The AVI account is a generalization of two specific types of accounts: PRIVATE and COMMERCIAL. Private and commercial accounts differ by the type of demographics they require as well as certain business rules governing their management. The AVI account class will contain attributes common to the private and commercial accounts and handle all common operations. The AVI account is associated to all vehicles, devices, and plan management classes for a particular account.

Attributes:

[Public]

None

[Private]

account id account id - Unique account ID

account status account status

account type account type

agency id agency id

close date close date

closing clerk closing clerk

day phone day phone

late payment count late payment count

night phone night phone

open date open date

opening clerk opening clerk

statement option statement option

store id store id

violation count violation count

[Protected]

None

Operations:

[Public]

void CloseFinal () - The toll supervisor has the responsibility of managing the revenue bag inventory and assignment to collectors, reviewing the tour of duty deposits as well as entering the physical counts of the tour of duty deposits into the Revenue & Reconciliation sub-system.

void ClosePending ()

void modify demographics ()

void open ()

void report ()

void suspend ()

[Private]

None

[Protected]

None

Association Statements

Each AVI Account:

- registers its Is related to 0+ Vehicle
- buys or leases Is related to 0+ Device
- is identified through Is related to 1+ Demographic
- have Is related to 1 Account Status
- records interactions with Is related to 0+ Account notes
- Is related to 1+ Transaction
- Is related to 0-1 Rebill

2.3.4.23 Class: AVI Summary

Description:

AVI payment transactions are handled differently than the other payment transaction types coming from the Lane Controller. AVI transactions will not have a discount value defined in the lane. The Transaction Manager process will have to look up the discount value of the passage based upon the Device ID. Each AVI account can have different discount plans depending on agency, plaza, plan type, time of day, etc.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each AVI Summary:

Inherits from Toll Payment Summary

2.3.4.24 Class: Exception

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Exception:

Inherits from Lane Transaction

Is part of 1 Unusual Occurrence

Is part of 1 Violation

2.3.4.25 Class: External Toll

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each External Toll:

Inherits from Toll Transaction

2.3.4.26 Class: Fees

Description:

Various fees applied to an AVI account are modeled by this class. This would include returned check fees, late payment fees, device replacement fees, etc.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Fees:

Inherits from Fin Trans

2.3.4.27 Class: Fin Trans

Description:

Any non-toll transaction that are financial in nature are modeled by this class.

Attributes:

[Public]

None

[Private]

amount

cc auth

cc expiry

cc number

cc ref

check num

check ref

is reversed

payment type

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Fin Trans:

Inherits from Store Transaction

2.3.4.28 Class: Lane

Attributes:

[Public]

None

[Private]

Boolean ETC

Operational Mode Operational Mode

Position number Position number

[Protected]

None

Operations:

[Public]

void Add ()

void Modify ()

[Private]

None

[Protected]

None

Association Statements

Each Lane:

are located in Is related to 1 Plaza

takes place in Is related to 1 Collection

Is made up of 1 Plaza

Assigned Is related to 1 Collector(Employee)when qualified by CurrentDay

2.3.4.29 Class: Lane Revenue

Description:

The lane revenue transaction is comprised of all transaction type coming from the Lane Controller which are the "normal" transactions which generate revenue information captured in the lane. They are: vehicle classifications to gauge the expected toll revenue, toll payments which are sub-classed by payment type.

Attributes:

[Public]

None

[Private]

lane revenue type

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Lane Revenue:

Inherits from Lane Transaction

Is made up of 0-1 Vehicle Classification

Is made up of 0+ Toll Payment

Is part of 0+ Lane Sales

Is made up of 1 Lane Transaction Summary

2.3.4.30 Class: Lane Transaction

Description:

Individual transactions generated in the Lane Controller subsystem are sent to the Host subsystem for posting, summarizing, reporting, and adjusting. Each lane transaction contains different information depending on the type: vehicle classification, payment, unusual occurrence, and sales.

Constraints:

The lane transaction

Attributes:

[Public]

any transaction date - Transaction date is recorded in the Lane Controller and is used to match all transactions with a corresponding tour of duty for purposes of reconciling deposits and payments against vehicle classifications or violations occurring in the lanes during a tour of duty or partial shift.

[Private]

agency id agency id

collector id collector id

date posted date posted

lane id lane id

plaza id plaza id

time posted time posted

unsigned long transaction sequence number - The transaction number is a unique integer used to identify the detailed lane transaction and is generated by the Lane Controller.

transaction status transaction status

transaction time transaction time

[Protected]

None

Operations:

[Public]

void accept from lane ()

[Private]

None

[Protected]

None

Association Statements

Each Lane Transaction:

occurs during a 1s related to 1 Tour Segment

2.3.4.31 Class: Lane Transaction Summary

Description:

This summary object class represents a collection of individual lane transaction objects sent from the Lane Controller subsystem for posting and reconciliation. Each summary object contains a set of summarized lane transactions grouped by shift segment, method of payment, vehicle classification.

Attributes:

[Public]

None

[Private]

char collector id - The collector ID is the designated system identification of each Toll Collector. It is assigned through the System Administrator. Numbering or naming schemes are the responsibility of the System Administrator. Normally numeric ranges indicate a job or hire status, i.e., full-time or part-time.

char lane id

shift segment shift segment

unsigned short tour id - The tour ID designates a tour of duty which is ideally an eight hour period. The tour ID is configurable through system administration functions and is connected to a date / time combination. The tour ID is coded in the lane transaction coming from the Lane Controller.

unsigned short transaction type - The transaction type designates which category the lane transaction is processed as. There are several transaction types:

Vehicle Classification
Vehicle Payment Method
Violation
Unusual Occurrence
Sales and Replenishment

[Protected]

None

Operations:

[Public]

void insert summary ()
void report summary ()
void update summary ()

[Private]

None

[Protected]

None

Association Statements

Each Lane Transaction Summary:

are applied to Is related to 0+ Adjustment
Is made up of 0+ Lane Revenue
Is made up of 0+ Toll Class Summary
Is part of 1 Toll Payment Summary
Is part of 1 Lane Sales Summary

2.3.4.32 Class: No Fund

Description:

No fund transactions are recorded by the Lane Controller if a customer does not have the proper amount to pay the toll. The Lane Controller has the ability to accept a partial toll payment and assign the No Fund payment for the remainder of the unpaid toll.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each No Fund:

Inherits from Toll Payment

2.3.4.33 Class: No Fund Summary

Description:

No fund transactions are recorded by the Lane Controller if a customer does not have the proper amount to pay the toll. The Lane Controller has the ability to accept a partial toll payment and assign the No Fund payment for the remainder of the unpaid toll.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each No Fund Summary:

Inherits from Toll Payment Summary

2.3.4.34 Class: Non Fin Trans

Description:

Non financial transactions include any change to the AVI accounts demographics, payment methods, payment levels (including thresholds and rebill amounts) any additional vehicles registered against the account etc.

Also all notes and complaints on an account are recorded as non-financial transactions.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Non Fin Trans:

Inherits from Store Transaction

2.3.4.35 Class: Non-Revenue

Description:

Non-revenue payment transactions include all categories of non-revenue such as operator overrides (an unusual occurrence event which is recorded as an exception event and depending on agency policy a video image is taken of the vehicle), emergency vehicles, police, authority personnel, authority vehicles, funeral processions, or any category which shall be defined by a payment type code and description. Non-revenue payments represent a discount toll amount of zero dollars, with a matching full cash value of the passage for reconciliation purposes.

Attributes:

[Public]

None

[Private]

nonrev category nonrev category

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Non-Revenue:

Inherits from Toll Payment

2.3.4.36 Class: Non-Revenue Summary

Description:

Non-revenue payment transactions include all categories of non-revenue such as operator overrides (an unusual occurrence event which is recorded as an exception event and depending on agency policy a video image is taken of the vehicle), emergency vehicles, police, authority personnel, authority vehicles, funeral processions, or any category which shall be defined by a payment type code and description. Non-revenue payments represent a discount toll amount of zero dollars, with a matching full cash value of the passage for reconciliation purposes.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Non-Revenue Summary:

Inherits from Toll Payment Summary

2.3.4.37 Class: Payment Adjustment

Description:

Payment adjustments are prepared in the event that a payment event in the lane was improperly reported by the collector or the Lane Controller, or in the event that a vehicle left the lane before the payment method was determined.

Attributes:

[Public]

None

[Private]

float Ind Discount Value Adjust

float Ind Full Value Adjust

short Ind Item Count Adjust - The indicated item count only applies to non-cash payment types for a certain payment category:

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Payment Adjustment:

Inherits from Adjustment

2.3.4.38 Class: Payment Types

Description:

Different payment types related to the AVI account management system.

Attributes:

[Public]

None

[Private]

description

short paytype

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Payment types:

has no associations!

2.3.4.39 Class: Plaza

Description:

Toll collection location

Attributes:

[Public]

char Address - The mailing address or physical location of the toll plaza. Used for reporting. This is a descriptive field only.

char Name - The name the plaza is referred to for reporting purposes. Any alphanumeric string is acceptable.

[Private]

any Date in Service - The date the plaza was placed in service to receive data and control toll lanes.

[Protected]

None

Operations:

[Public]

void Add ()

void Modify ()

[Private]

None

[Protected]

None

Association Statements

Each Plaza:

are located in Is related to 1+ Lane

Is made up of 1+ Lane

Is made up of 0+ Schedule

Has Default Location Is related to 0+ slot

Is related to 1+ Works (Employee)

over-ride location Is related to 0-1 DailyWorkSched

2.3.4.40 Class: PO Items

Description:

Detail items in a device PO.

Attributes:

[Public]

None

[Private]

device type

item no

qty

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each PO Items:

Is part of 1 Device PO

2.3.4.41 Class: PO Receipt

Description:

Receipt details for POs. This is a line item detail for a specific purchase order

Attributes:

[Public]

None

[Private]

clerk id

damaged qty

device type

ending box no

qty received

starting box no

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each PO receipt:

Is part of 1 Device PO

Is related to 0+ Device

2.3.4.42 Class: Prepaid Tolls

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Prepaid Tolls:

Inherits from Fin Trans



2.3.4.43 Class: Private Account

Attributes:

[Public]

None

[Private]

private account type private account type

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Private Account:

has no associations!

2.3.4.44 Class: Rebill

Description:

The rebill class encapsulates information regarding an automatic rebill of an account.

Attributes:

[Public]

None

[Private]

account number

authorization

bank ref

expiration

rebill amount

request date

request status

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Rebill:

Is related to 1 AVI Account

2.3.4.45 Class: Rebill Account Change

Description:

The rebill information changes to the AVI account are recorded in this class. The prior information is stored in the class.

Attributes:

[Public]

None

[Private]

rebill account

rebill amount

rebill expiration

rebill payype

rebill threshold

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Rebill Account Change:

Inherits from Non Fin Trans

2.3.4.46 Class: Regular Account

Attributes:

[Public]

None

[Private]

first name soundex first name soundex

last name soundex last name soundex

middle name soundex middle name soundex

name first name first

name last name last

name middle name middle

name prefix name prefix

name suffix name suffix

ssn ssn

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Regular Account:

has no associations!

2.3.4.47 Class: Regular Toll

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Regular Toll:

Inherits from Toll Transaction

2.3.4.48 Class: Revenue Bag

Description:

Revenue bags are used to transfer money between Toll Collectors and their supervisor. Revenue bags are pre-numbered with unique ID's that do not repeat for a minimum of 180 days. The bags are disposable, intended to be used once and then destroyed.

Attributes:

[Public]

None

[Private]

bag id bag id

bag status bag status

char bag type - There are different bag types: employee bank bags which are used for seed money to start the Toll Collector's cash drawer for a tour, currency bags which are used to transfer currency, checks, and script collected in the lane, and coin bags which are used to transfer coins collected in the lanes.

collector id collector id

segment id segment id

supervisor id supervisor id

tour date tour date

tour id tour id

any tour time

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Revenue Bag:

is used to transport, and is related to 1 Toll Collector Cash Deposit

2.3.4.49 Class: Sales Adjustment

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Sales Adjustment:

Inherits from Adjustment

2.3.4.50 Class: Scrip

Description:

Tickets are a popular form of toll payment. Tickets are normally sold as a group of individual tickets in a book. Tickets, unlike tokens as an alternative to cash, can be tracked individually if a ticket number is encoded on each ticket in bar-code or OCR code format. Tickets vary by payment plan or program for each agency or toll facility as well. Ticket books can be used for full value toll passage and are a viable method for commercial customers who pay high cash tolls and do not wish their drivers to worry about carrying large amounts of cash for paying tolls.

Tickets are a paper version of AVI payments.

Attributes:

[Public]

None

[Private]

book number book number

category category

class class

sequence number sequence number

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Scrip:

Inherits from Toll Payment

2.3.4.51 Class: Scrip Deposit Adjustment

Attributes:

[Public]

None

[Private]

category category

class class

short deposit count adjust

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Scrip Deposit Adjustment:

Inherits from Deposit Adjustment

2.3.4.52 Class: Scrip Summary

Description:

Tickets are a popular form of toll payment. Tickets are normally sold as a group of individual tickets in a book. Tickets, unlike tokens as an alternative to cash, can be tracked individually if a ticket number is encoded on each ticket in bar-code or OCR code format. Tickets vary by payment plan or program for each agency or toll facility as well. Ticket books can be used for full value toll passage and are a viable method for commercial customers who pay high cash tolls and do not wish their drivers to worry about carrying large amounts of cash for paying tolls. Tickets are a paper version of AVI payments.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Scrip Summary:

Inherits from Toll Payment Summary

2.3.4.53 Class: Shift

Description:

A collection of slots.

Constraints:

Start times for work schedules should fall in a consistent range for a particular shift (e.g. shift 1 might contain slots that start between 06:00 and 10:00). Although, these constraints will not be enforced by the system.

Attributes:

[Public]

None

[Private]

char Description

[Protected]

None

Operations:

[Public]

array of slots getSlots () - Get slots corresponding to this shift.

[Private]

None

[Protected]

None

Association Statements

Each Shift:

Is made up of 1 Schedule

Is made up of 0+ slot

2.3.4.54 Class: Store Transaction

Description:

The 'store' transaction class represents all non-toll transactions applied against an account. This includes any prepaid toll replenishments via any method other than a CSC clerk. The system will model those transactions as being originated by a fictitious clerk.

Attributes:

[Public]

None

[Private]

clerk id

is summarized

session id

store id

tran date

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Store Transaction:

Inherits from Transaction

2.3.4.55 Class: Supervisor

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Supervisor:

Inherits from Employee

assigns to lane Is related to 1+ Toll Collector

Created by Is related to 1 Collector / Lane Assignment

2.3.4.56 Class: Tag Allocation

Description:

the daily tag allocation to clerks is tracked by the tag allocation class

Attributes:

[Public]

None

[Private]

box no

clerk id

intial qty

returned qty

supv id

tag id

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Tag allocation:

Is related to 0+ Device

2.3.4.57 Class: Tag Transfer

Description:

Tag transfers between locations are tracked via the tag transfer class.

Attributes:

[Public]

None

[Private]

box no

clerk id

from locn

tag id

to locn

transfer date

transfer id

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Tag transfer:

Is related to 1 Device

2.3.4.58 Class: Toll Class Summary

Description:

The toll class summary consists of each vehicle classification type accumulated at the tour segment level. For example, the total number of post-treadle hits, and the number of vehicles post-class, etc. These summaries are used to reconcile a tour of duty deposit by payment category.

Attributes:

[Public]

None

[Private]

unsigned short AVI classification - is derived from the AVI transponder (tag). Each AVI transponder is encoded with a classification which is valid for passage. Depending on Authority policy, a device which is detected as being used on a vehicle which the Lane Controller determines is different can generate a violation occurrence.

unsigned short etc axle count - is derived from the device read in the Lane Controller sub-system. AVI transponders are encoded with a valid axle count for the device.

unsigned short collector axle count - is derived from the collector's manual classification interface from the Lane Controller. It represents a visual judgment by the Toll Collector. This axle count is considered the lowest priority axle count judgment in a Lane Controller equipped sub-system. It is sometimes used as input to measuring a collector's performance on accuracy.

unsigned short collector classification - is derived from the manual interface in the Lane Controller. It is a visual judgment of a vehicle's defined classification as determined by an authority's toll classification structure.

short post-class axle count - is derived from the post-class component of the Lane Controller. The treadle attached to post-classification logic determines the axle count. This is considered the ruling axle count in determining toll charges in order to reconcile a Toll Collector.

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Toll Class Summary:

Is made up of 1 Lane Transaction Summary

2.3.4.59 Class: Toll Collector

Description:

Employee that can be assigned as a collector in an attended lane.

Attributes:

[Public]

None

[Private]

None

[Protected]

None

Operations:

[Public]

boolean isReliefCollector (in Schedule schedule) - Determines whether a collector is assigned to a relief slot in the specified schedule.

[Private]

None

[Protected]

None

Association Statements

Each Toll Collector:

Inherits from Collection

Inherits from Employee

assigns to lane Is related to 1 Supervisor

Schedules Is related to 0+ Administrator

Hours Determined by Is related to 1 Schedule

Collector / Slot Assignment Is related to 0+ slot

2.3.4.60 Class: Toll Collector Cash Deposit

Description:

The deposit for a Toll Collector can be recorded throughout a scheduled tour of duty. A collector must be able to record a deposit for a shift segment if the collector chooses. All shift segment deposits are to be totaled for a complete tour of duty for reporting purposes. The reconciliation of each deposit to the vehicle classification information is handled at the respective shift segments for which a deposit is made and at the complete tour of duty.

Attributes:

[Public]

None

[Private]

dimes dimes

dollars dollars

fiftys fiftys

fives fives

halves halves

hundreds hundreds

nickels nickels

ones ones

pennies pennies

quarters quarters

seed amount seed amount - Seed amount contains the dollar value of the money given to the collector at the start of tour for making change.

tens tens

twentys twentys

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Toll Collector Cash Deposit:

Inherits from Deposit

are used to transport Is related to 1+ Revenue Bag

2.3.4.61 Class: Toll Collector Cash Deposit Adjustment

Description:

The adjustments made to each Toll Collector's reported deposit is entered through this class.
Each adjustment is kept intact. An unlimited number of adjustments can be made to each deposit.
There is an occurrence of each adjustment made to each deposit recorded.

Attributes:

[Public]

None

[Private]

dimes dimes

dollars dollars

fiftys fiftys

fives fives

halves halves

hundreds hundreds

nickels nickels

ones ones

pennies pennies

quarters quarters

tens tens

twentys twentys

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Toll Collector Cash Deposit Adjustment:
Inherits from Deposit Adjustment

2.3.4.62 Class: Toll Payment

Description:

The payment class consists of all payment method information associated with a corresponding vehicle classification transaction. For example, one vehicle may pay its toll by one or more methods: cash, AVI, tag, non-revenue, insufficient funds, ticket, etc.

Attributes:

[Public]

None

[Private]

discounted amount discounted amount

full amount full amount

revenue type revenue type

[Protected]

None

Operations:

[Public]

void process lane payment ()

[Private]

None

[Protected]

None

Association Statements

Each Toll Payment:

Is made up of 1 Lane Revenue

Is related to 1 Vehicle Classification

2.3.4.63 Class: Toll Payment Summary

Description:

Each payment type category which occurs during a tour segment or complete tour of duty is summarized for reconciliation purposes as well as for summary reporting.

Attributes:

[Public]

None

[Private]

float Indicated Discount Value - is derived from a toll schedule maintained in the Lane Controller sub-system. The indicated discount value of a toll passage is validated against a toll schedule synchronized with the Lane Controller. In the event that the two discount values do not match, an error message is generated and the Host toll schedule overrules the Lane Controller toll schedule.

float Indicated Full Value - designates the cash value (undiscounted) of a toll passage and is derived from the Lane Controller toll schedule.

short Indicated Item Count - designates the total number of toll payment transactions which occurred during a tour segment.

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Toll Payment Summary:

Is part of 1 Lane Transaction Summary

2.3.4.64 Class: Toll Transaction

Description:

Toll transactions are toll events occurring in a specific plaza and lane, usually identified by the detection of an AVI device. All the details of a toll event will be recorded.

Attributes:

[Public]

None

[Private]

agency data - Data on the read / write portion of the tag.

agency id

amount due

amount paid

Vehicle Class class - Vehicle classification resultant class

business date - The different agencies will have differing collection day definitions. Though this attribute can be derived from the toll date, it might be better to treat it as an integral attribute.

expected axles

expected veh class

lane id

lane mode

payment types pay type

plaza id

posting date

revenue type

seq number

tag info

tag status code

Vehicle Class tag veh class - Agency class as recorded on the tag. This is a derived field based on the data extracted from the IAG classification on the tag.

toll date

toll status code

validation status - Validation status as recorded on the tag.

veh speed

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Toll Transaction:

Inherits from Transaction
Is related to 1 Vehicle Class

2.3.4.65 Class: Tour of Duty

Description:

This class refers to the period of time for which a collector, or AVI is reconciled for lane activity versus revenue collected. A tour of duty is defined as the period of time between deposits. A manual Toll Collector is scheduled to work in a tour of duty, normally an 8-hour shift.

Attributes:

[Public]

unsigned long logon date - Logon date represents the actual date the collector logs into the lane in an active or open state. This field is used to synchronize the tour segments which collectively make up a tour of duty.

unsigned long logon time - Logon time represents the actual time recorded in the Lane Controller that the collector is placed in an open state for toll collection. This synchronizes the tour segments (partial shift classes) and places the partial shifts or segments into a tour of duty.

unsigned long tour date - This attribute distinguishes the scheduled date for a collector to be in service in a lane (manual Toll Collector, AVI). This is different from the actual logon date.

unsigned long tour time - Shift time represents the time for which the collector's shift or tour of duty is scheduled to begin in the lane. This is the beginning of the reconciliation period, not the actual logon date.

[Private]

unsigned short tour id - The tour ID designates a tour of duty which is ideally an eight hour period. The tour ID is configurable through system administration functions and is connected to a date/time combination. The tour ID is coded in the lane transaction coming from the Lane Controller.

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Tour of Duty:

Is made up of 0+ Tour Segment

2.3.4.66 Class: Tour Segment

Description:

A tour segment is a class which identifies a period of time between logons and logoffs during a collector's scheduled tour of duty. This division of time can be used to reconcile a collector's lane activity to interim deposits in a single tour of duty. This gives the system the flexibility to accept multiple deposits, such as full deposits or relief collector deposits depending on the authority's policy regarding deposits during a tour of duty. Dividing toll lane activity into smaller segments of time also provides a means to audit a collector for a small period of time and makes the analysis of a collector easier. Classification data is also summarized for a tour segment.

Attributes:

[Public]

unsigned long segment date - The segment date defines the date that the collector was logged into the lane to begin activity. This date comes from the Lane Controller. It is used to separate all activity into segments of time in a schedule tour of duty.

unsigned short segment id - The segment is an attribute used to sequentially number each tour segment, i.e., 1 through 9999. It is incremented each time a new tour segment instance is recognized by a logon record for a particular collector in a specific tour of duty. It resets to 1 (one) for a beginning scheduled tour of duty.

unsigned long segment time - The segment time distinguishes the actual logon time for a collector in a lane during a schedule tour of duty. Time is recorded in the Lane Controller and sent to the transaction manager process for recording.

[Private]

unsigned short lane id - The lane ID designates which lane the tour segment is reporting and grouping transactions for.

unsigned long logout date - The logout date designates when a collector logs out. The log out date is generated in the Lane Controller and enters the Transaction Manager process in a Logout transaction.

unsigned long logout time - The logout time designates when a Toll Collector logs out. The time is generated from the Lane Controller on the Logout transaction message.

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Tour Segment:

Is made up of 1 Tour of Duty

is assigned to Is related to 1+ Collection
occurs during a Is related to 0+ Lane Transaction

2.3.4.67 Class: Transaction

Description:

All activity on an AVI account takes place as transactions. Thus an AVI account object is taken through various states by the transaction events. For purposes of cleaner modeling the transactions are divided into toll transactions and 'store' or clerk transactions.

Attributes:

[Public]

None

[Private]

PostingDate

[Protected]

None

Operations:

[Public]

void Adjust ()

void Reverse ()

[Private]

None

[Protected]

None

Association Statements

Each Transaction:

Is related to 1 AVI Account

2.3.4.68 Class: Unusual Occurrence

Description:

Unusual occurrences are transactions which record an event in the lane that cannot be classified as a vehicle / payment transaction. They include events such as equipment malfunction messages, vehicle classification resets, payment method resets, non-revenue transactions set by the Toll Collector, turn-around vehicles, etc.

Attributes:

[Public]

None

[Private]

description description

event code event code

supervisor authorization supervisor authorization

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Unusual Occurrence:

Is part of 1 Exception

indicates need for Is related to 0+ Adjustment

2.3.4.69 Class: Vehicle

Description:

A class to capture the information regarding the vehicles on which the customer plans to use the AVI transponder.

Attributes:

[Public]

None

[Private]

short axles - Number of axles on the vehicle

short color id - Color of the vehicle

boolean device assigned - A flag indicating whether a device has been assigned to the vehicle or not.

boolean dual tires - A flag indicating whether the vehicle has dual rear tires or not.

short make id - A code indicating the make of the vehicle.

short model id - A code indicating the vehicle model.

country plate country - A country code for the vehicles plate. Related to the country table.

char plate number - The license plate number of the vehicle.

char plate state - A code for the state in which the plate was issued.

short veh agency ref - Any agency specific coding for vehicles.

boolean veh weight - A flag indicating whether the vehicle is over the established weight limit for overweight vehicles.

short vehicle year

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Vehicle:

registers its Is related to 1 AVI Account

2.3.4.70 Class: Vehicle Class

Description:

This is a class to model the characteristics of an agencies definition of a vehicle type.

Attributes:

[Public]

None

[Private]

agency class

axles

dual tires

iag category

iag class

iag type

iag type description

veh weight

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Vehicle Class:

Is related to 0+ Toll Transaction

2.3.4.71 Class: Vehicle Classification

Description:

The vehicle transaction class instance consists of all information pertinent to a vehicle's toll classification based upon the physical measurements of the vehicle including the number axles, vehicle height over each axle, weight, length, dual rear tires.

Attributes:

[Public]

None

[Private]

unsigned short AVI classification - is derived from the AVI transponder (tag). Each AVI transponder is encoded with a classification which is valid for passage. Depending on Authority policy, a transponder which is detected as being used on a vehicle which the Lane Controller determines is different can generate a violation occurrence.

unsigned short etc axle count - is derived from the device read in the Lane Controller sub-system. AVI transponders are encoded with a valid axle count for the device.

unsigned short collector axle count - is derived from the collector's manual classification interface from the Lane Controller. It represents a visual judgment by the Toll Collector. This axle count is considered the lowest priority axle count judgment in a Lane Controller equipped sub-system. It is sometimes used as input to measuring a collector's performance on accuracy.

unsigned short collector classification - is derived from the manual interface in the Lane Controller. It is a visual judgment of a vehicle's defined classification as determined by an authority's toll classification structure.

short post-class axle count - is derived from the post-class component of the Lane Controller. The treadle attached to post-classification logic determines the axle count. This is considered the ruling axle count in determining toll charges in order to reconcile a Toll Collector.

unsigned short post-classification

short pre-class axle count - is derived from the pre-classification component of the Lane Controller. Treadles placed in front of the toll booth record the axle count and a classification is determined from this in an axle-based vehicle classification system.

undiscounted toll amount undiscounted toll amount

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

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Preliminary System Configuration Document Rev. 1.0

SC_DOT\Sys_Config\Rev_1.0\Chap_2.Doc

Proprietary Data

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Each Vehicle Classification:
Is made up of 1 Lane Revenue
Is related to 1+ Toll Payment



2.3.4.72 Class: Vehicle Classification Adjustment

Attributes:

[Public]

None

[Private]

etc axle count etc axle count

etc classification etc classification

collector axle count collector axle count

collector classification collector classification

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Vehicle Classification Adjustment:

Inherits from Adjustment

2.3.4.73 Class: Violation

Description:

Violation transactions generated in the Lane Controller subsystem are the result of a vehicle in violation of toll agency policy including insufficient cash payments, AVI classification not matching AVI class, invalid AVI account status, invalid AVI equipment status.

Attributes:

[Public]

None

[Private]

violation image status violation image status

violation type violation type

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Violation:

Is part of 1 Exception

2.3.4.74 Class: Violation Toll

Description:

A toll generated via violation processing. Additional variable information to characterize such a toll is included in this class.

Attributes:

[Public]

None

[Private]

Violation Type

image present

image review axles

image review class

image review clerk

image review date

image review status

plate number

plate state

vehicle type

violation status

[Protected]

None

Operations:

[Public]

None

[Private]

None

[Protected]

None

Association Statements

Each Violation Toll:

Inherits from Toll Transaction

2.4 Database Documentation

The Select Enterprise toolset generates the requisite database documentation. Maintaining the data model, schema, and documentation inside a single repository ensures that the documentation and database are always in synch.

All interactive functions within the AVI Account Processing can be executed from individual PC-based workstations. These workstations will be configured with the following software components:

- Windows NT 4.0
- Microsoft TCP / IP
- Pathworks
- Hi-resolution video drivers

2.5 On-Line Help

The interactive software incorporates extensive contextual help that has been organized for access in compliance with the industry standard Microsoft Windows help system. For this purpose, the help text has been created as Microsoft Word for Windows documents.

These help documents were compiled and integrated into the AVI ACCOUNT PROCESSING run-time environment using RoboHelp, the leading help text compiler.

This ability to maintain the help text from a standard word-processor enables easy maintenance and updates to the on-line help facility by knowledgeable administrators. In addition, the compiled form of the help text is maintained as separate files within the Windows environment. Therefore, changes can be made and implemented to the help text without having to regenerate the entire application software.

2.6 Client Software Documentation

A higher degree of software integration is achieved automatically by encapsulating procedural logic as part of the screen object definitions. In conformance with programming standards, each event-handling procedure contains on-line documentation as comments. Thus the software maintainer will be looking at detailed software documentation even as he/she is looking at the actual procedural script (code). Preliminary software documentation so generated is attached as part of this design document.

Non-interactive functions such as back-office processes like AVI transaction processing are handled by background and batch processes executing directly in the database server machine.

2.7 Programming Methodology

The software development methodology employed for the SCDOT Electronic MLT is a combination of technologies. Our approach to an accelerated deployment of all software and hardware components prompted LMIMS to re-engineer its solution for the GA400 as an object-oriented solution to all VMS-based software.

The Host Audit and Reconciliation, AVI Account Processing, System Administration, and Violation Processing subsystems will be developed in the Forté software environment. Forté was chosen as our software environment because it supports the full distributed application life cycle, from design through distributed execution.

Forté provides powerful capabilities to partition application software in order to achieve system fail-over for a seamless fault tolerance for all client sessions. Its advanced, object-oriented development technology ensures a speedier deployment schedule for SCDOT requirements. In addition, Forté distributed applications provide environment independence and mission-critical production system support. These capabilities cannot be matched by conventional 3GL tools or other GUI development tools currently on the market today.

In a Forté application, shared business services are implemented as a special kind of object known as a service object. A service object provides a specific service or set of services. The service may be an interface to an existing external resource, such as a DBMS like Rdb. Or, the service may be a set of functions performed on behalf of multiple users, such as managing accounts, assigning tags, recording deposits, or running reports.

Forté service objects have another important property: they can be replicated. Replicating a service object is a way of providing failover to help achieve seamless fault tolerance or load balancing for important application services. Failover means providing backup services if a primary service provider fails. A service may suffer hardware, software, or network failure.

When a service object is replicated for failover, Forté lets you replicate the partition in which the service object resides. This partition is set up on another hardware server in order to provide hardware failover. If the primary provider fails, Forté automatically switches to the secondary replicate without an interruption in service to the user.

The overall life cycle process of a Forté distributed application consists of four sequential stages which are listed below:

2.7.1 Design

In the design stage, designers model the application problem and decide how to divide the functional parts of a distributed application into different interconnected service providers.

2.7.2 Logical Application Definition

Next, developers create a logical application, consisting of classes grouped into different projects. Classes represent the programming logic of the application. Developers create new classes, or use existing classes. The application definition stage does not depend on the details of the target deployment environment.

2.7.3 System Generation

In this stage, developers generate application distribution files. First, this involves specifying a target Forté environment and partitioning the logical application in that environment. Next, the developers generate the application distribution files used to deploy the application. The distribution can include compiled executables for each server partition.

2.7.4 Distributed Execution

In the final stage of the life cycle process, a system manager deploys and manages the application in a deployment environment.

2.7.5 Program Design

All batch programs have been designed to provide at least the following set of controls and run summary information:

- Input files used, if any
- Number of transactions processed / updated / created / failed
- Exceptions and errors encountered
- Run time (when started, when finished, etc.)
- Input parameter values supplied

Most programs have the need for a set of input parameters. Wherever applicable, these parameters have been designed to be supplied by an automated scheduling facility (for routine runs) as well as by human operators (for exceptional/catch-up runs).

The software development process has relied very heavily on robust, industry-leading methodologies and CASE tools at each stage of development. These tools are listed in the table in Figure 2.7-1.

No.	DEVELOPMENT AREA	CASE TOOL & METHOD EMPLOYED
1	Data modeling	Select Enterprise Modeller
2	Database design	Select Enterprise Modeller
3	Database documentation	Select Enterprise Modeller (Entity, Attribute and Model cards)
4	On-Line Help text creation and maintenance	Microsoft Word for Windows
5	On-Line Help compilation for windows	RoboHelp
6	Client Graphical User Interface	Forté
7	Configuration and version control	CMS
8	Software documentation	Microsoft Word for Windows for presentation and production

Figure 2.7-1
Software Development Tools & Methods Table

3. Lane Subsystem

3.1 Overview

The SCDOT lane subsystem serves as the primary point of vehicle detection, classification, and customer toll collection. The lane subsystem includes the IBM PC compatible Lane Controller and associated in-lane devices. LMIMS has identified two different lane types that construct the SCDOT lane subsystem. The SCDOT lane subsystem consists of ETC and manual toll collection as well as unmanned ACM/AVI collection. Section 3.2 describes the equipment placement for a typically configured lane at the Cross Island Parkway toll facility as well as the 2 unmanned road ramp lanes.

In order to classify vehicles and collect the proper fare, LMIMS will utilize the latest technology components. The in-lane devices include the manual toll terminal, collector ID card reader, Mark IV readers, post class devices, Automatic Coin Machines, canopy lights, VES equipment and traffic lights.

This system will use a class-based fare schedule. It will handle a fee-based and OTHER PAYMENT schedule. Collector's classification may override other classifications.

The Lane Controller is an essential component of any AVI system. This sub-system is responsible for interfacing with the Mark IV equipment and correlating the AVI information with other in-lane input such as inductive loops and vehicle separators to determine transactions. In addition to these functions, the Lane Controller must interface with other devices to provide driver feedback, thus ensuring that the AVI program is easy for all customers to use.

The key enabler of a successful AVI program is the technology itself. The SCDOT project team has already selected Mark IV as the supplier of both the tags and the readers that detect them. Each Mark IV reader is capable of supporting eight individual lanes. However, some of the components of the reader are common to all of the supported lanes, and failure of these components will cause a loss of AVI functionality in each of the eight lanes. As a result, redundant readers will be used to ensure that operational ability is not lost in the event of a failure. Should one of the readers fail, a backup device will automatically take its place.

The system software used within the Lane Controller is Component Integrator 2.3 (formerly known as Venix) for SCO UNIXWare 2.x and is provided by Venturecom of Cambridge, MA. SCO UNIXWare provides multi-user application services to systems that put high demands on system reliability, performance, security, and networking. Modern Lane Controllers are in this category of

system. Built on the latest release of System V UNIX (SVR4.2 MP), SCO UNIXWare is the most modern and advanced release of the UNIX operating system on the market. The product of years of research and development, SCO UNIXWare Application Server was designed from the ground up to be a high-performance, multi-processing release of the UNIX operating system while maintaining compatibility with the millions of UNIX systems already deployed by SCO and other market leaders. The Venturecom real-time extensions bring to UNIX the deterministic performance and real-time functionality that was previously available only on proprietary, real-time operating systems. The RTX extensions run on the UNIXWare development system, as well as on the target system, to enable real-time applications to be tested while still in the development environment.

The Lane Controller application software is based on our proven design now in operation at several client locations. This software is currently operating in both Standby mode and Attended AVI environments and has demonstrated its versatility and reliability. The flexibility of the design allows for a single release of software across all lane types. This is extremely important as management of software can be a more daunting and costly task than the maintenance of the hardware. LMIMS has continuously refined the software to report as many system malfunctions as possible, and, when backup devices exist, automatically switch critical functions to the back-up devices. For example, should the vehicle separator fail, the Lane Controller will detect this, report the problem to the supervisor console and the maintenance sub-system, and use the exit loop as the back-up vehicle separator. This allows the lane to continue to function in a downgraded mode until the problem is rectified.

3.2 Lane Subsystem Hardware Design

The lane system is constructed from proven and reliable toll collection equipment that is strategically placed for proper operation of an AVI based lane system. Placement of each component that makes up the AVI system is established with low tolerances. Because of LMIMS' experience in implementing technologically advanced AVI systems, we have developed standard placements for all equipment. Lane software has been developed with flexibility that allows movement of the devices without impacting the operations of the lane. The process of the lane system will be explained in detail in following sections.

Lane Devices on a Typical Lane (Figure 3-1) depicts the placement of the lane devices on a typical lane found at the plaza and ramps. Each site will have slight variations in the placement of the lane devices. The canopy light will be placed on the front of the canopy in clear view and will direct the patrons to the appropriate lane. The canopy light is manufactured by Eagle Signal and is capable of displaying the required indications discussed in later sections.

The first device a vehicle encounters when it enters the lane is the Sensor Activation Module (SAM) located in front of the toll booth. The next device encountered is the AVI antenna, which will be placed approximately at the center-line of the toll collection point.

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Figure 3-1 Lane Devices on a Typical Lane



The AVI antenna is positioned at the collection point with the other collection equipment, Manual Lane Toll Terminal, and Receipt Printer.

When the vehicle exits the lane, it will enter the vehicle classification system comprised of an exit loop, and treadle. The aggregate of the outputs from these devices will assist the lane controller in determining the classification of the vehicle. The classification of the vehicle will determine the amount of tolls to collect.

The Patron Fare Display (PFD) consists of a fixed message (LED) sign, capable of displaying the required messages, and a three tier traffic control signal. The PFD and the traffic signal are capable of displaying messages in red, amber, or green.

At the center of the controlling function of the AVI system is the lane controller, manufactured from proven and reliable components. The Mean Time Between Failures (MTBF) of the lane controller will exceed 10,000 hours. The lane controller is equipped with intelligent peripheral cards and integrated by a team of LMIMS software developers.

3.2.1 Lane Controller Configuration

The LMIMS lane controller is a Pentium based PC in a dual ISA/PCI bus industrial passive backplane configuration. With this rugged configuration all of the PC sub-systems such as CPU, disk controller, Ethernet, frame grabber, PIO controller, etc. are separated onto individual cards. This configuration also reduces the time taken to correct a maintenance problem.

The Lane subsystem design consists of hardware, software and networking components that are described under the following major areas:

- Automatic Vehicle Identification (AVI)
- Vehicle Separation and Classification
- Violation Detection and Image Capture - Violation Enforcement System (VES)
- Driver Feedback - Lane Mode Sign (LMS), Patron Fare Display (PFD)
- Lane Controller Hardware and Real Time Operating System
- Lane Controller Application Software

In the following subsections, a brief description of the components that make up the Lane subsystem design are given.

3.2.1.1 Automatic Vehicle Identification (AVI)

The SCDOT has selected MARK-IV readers and transponders for this application. Each MARK IV reader is capable of supporting up to eight individual lanes. Some of the components within the reader are common to all supported lanes. In order to avoid loss of the operational system by failure of these common components, redundant readers have been configured. Should one of the readers fail, the backup reader will automatically take its place.

3.2.1.2 Vehicle Separation and Classification

Vehicle separation and classification is accomplished through the use of SAM units located with the AVI antennas, and the post classification loops and treadles. The SAMs are manufactured by MBB Inc. The SAMs incorporate eye safe lasers that transmit directly across the lane and reflect back to the receiving unit located in the SAM. The SAM learns the distance of an empty lane dynamically and stores this information within its own memory. As a car enters the lane, the SAM detects the vehicle and toggles a discreet bit in the lane controller.

The SAMs are used to separate vehicles at the AVI read zone. This determines the tag read and assigns the tag read to the right vehicle.

To complete the classification solution LMIMS will use the treadles and loop combination installed at the exit of the lane. The loops will be installed by LMIMS, and interfaced to an intelligent loop detector manufactured by 3M/Canoga. The four channel loop detector is located in the lane enclosure.

The treadles will be installed in a drainless treadle frame manufactured by The Revenue Markets, Inc. (TRMI). Each treadle is a 4-contact treadle interfaced with the Smart Treadle Monitor. The treadle monitor provides the lane controller with detailed reporting of the forward and reverse treadles. The treadle monitor also provides the diagnostic reporting directly to the lane controller.

3.2.1.3 Violation Enforcement System (VES)

The lane controller automatically detects a violator through the violation process algorithm which determines from all the lane devices that the car did not pay the correct toll, or the car classification had a mismatch.

The violation enforcement and violation processing equipment is non-proprietary, industry-standard hardware.

The system will include monochrome, CCD, progressive-scan (non-interlaced) video cameras for rear license plate capture. The Burle TC351A, has the following features:

- High-resolution (659x494 pixels, 500 lines)
- Electronic shutter speeds of 1/60 to 1/10,000 second
- Operating temperature -10 degree to 50 degree C
- Interline transfer CCD pickup device
- Format 1/2 inch

A Burle outdoor video camera housing, model TC9385 will be utilized. This enclosure provides all-aluminum construction, and a removable cover. The housing is sealed and contains a thermostatically controlled heater/defroster. The VES system allows for image capture of vehicle license plates at speeds of 30 mph and is capable of capturing images at up to 90 mph.

The system employs a PCI-bus video capture card (FG-500), which permits images to be moved to the system RAM at speeds greater than video camera frame rate of 30 frames per second.

The VES loop, located after the treadle, is responsible for the triggering of the violation enforcement frame grabber. Once the controller receives the VES loop input the VES process captures and stores a digitized image of the license plate. The image is then saved as an individual file with no digital information overlaid.



3.2.1.4 Driver Feedback, Canopy Light, Patron Fare Display (PFD)

LMIMS is providing driver direction and feedback in the form of Canopy Traffic Signals, Patron Fare Display (PFD), and Island Traffic Signals. The **Patron Fare Display**, manufactured by FP Electronics, (Figure 3-2) will display messages that inform the driver of the status of the current transaction.

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Figure 3-2 Patron Fare Display



The PFD is capable of displaying a number of messages based on the status of the current transaction. **Sign Messages and Signal Indicators** (Figure 3-3) below, displays this process:

<u>Message State</u>	<u>PFD Message Unattended Lane</u>	<u>Island Traffic Light</u>	<u>PFD Message Attended Mode</u>	<u>Island Traffic Light</u>
VALID TAG	THANK YOU	GREEN	THANK YOU	GREEN
INVALID, ZERO BALANCE OR NO TAG	GO UNPAID	RED	PAY \$0.00	RED
STOLEN OR LOST TAG	GO UNPAID	RED	PAY \$0.00	RED
CASH PAYMENT			PAY \$0.00	RED
VALID LOW BALANCE TAG	LOW BAL	AMBER	LOW BAL	AMBER

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Figure 3-3 Sign Messages and Signal Indicators

3.2.1.5 Lane Controller Hardware

To further protect the data stored on the lane controller, our design incorporates a RAID Level 1 disk subsystem (data shadowing). By using an intelligent RAID 1 disk controller and two (2) 2.5 GB disk drives, all data is protected. Any data written to one disk is automatically written to a second disk. Should either disk fail, the system is notified of the error. However, the integrity of the data is maintained by the other copy. The lane controller can continue to operate normally until maintenance can be scheduled at a convenient time. The RAID 1 disk subsystem has been sized for a seven day stand alone capability. Should network communications be lost between the lane controller and the ECH, transaction and image data can be stored locally for a period of seven (7) days.

3.2.1.6 Lane Controller Operating System

The operating system used within the lane controller is Component Integrator 2.3 (formerly known as Venix) for SCO Unixware 2.0 and is provided by Venturecom of Cambridge, MA. SCO UnixWare 2.0 provides multi-user application services while maintaining compatibility with the millions of UNIX systems already deployed by SCO and other market leaders. The Venturecom real-time extensions bring to UNIX fully preemptive multi-tasking, deterministic performance, and real-time functionality. The RTX extensions run on the Unixware development system, as well as on the target system, to enable real-time applications to be tested while still in the development environment.

In order for the AVI equipment to collect data, a Palmetto Pass (RF transponder) is placed on the vehicle for automatic identification of the vehicle as it passes through the lane. Data acquisition, processing, and communications hardware and software are also an integral part of the subsystem.

When a vehicle with a Palmetto Pass enters the lane, the AVI subsystem, in conjunction with the software and data that are resident in the lane controller, automatically detects the tag identification code. The lane controller determines whether the tag is valid and whether the Palmetto Pass account has sufficient funds to pay the toll.

3.2.1.7 General Description of Attended Mode Operating Mode

The Attended Mode Operating Mode consists of an Attended Mode AVI equipped lane with a Toll Collector on duty. Lanes in Attended Mode allow the following operations:

- Cash toll collection by a Toll Collector. The Toll Collector makes use of the existing MLT system for vehicle classification, and the AVI system records the transaction.
- Electronic Toll Collection by means of the AVI system. A transponder-equipped vehicle enters the lane and is classified by the Toll Collector. The AVI system informs the Toll Collector by means of an audible signal and an indicator light that the vehicle is AVI-equipped and the Toll Collector allows the vehicle to continue.

3.2.1.8 General Description of Lane Closed Operating State

The Lane Closed operating state is an AVI-equipped lane which has been closed, either by the toll collector or the plaza supervisor. Lanes in a Closed state allow only the following operation:

- Violation Processing via the AVI subsystem
- The AVI subsystem will record and classify vehicles driving through the closed lane.
- The VES Camera records a violation transaction.

3.2.1.9 Unattended AVI

The description of lane operation sequences for Unattended AVI Lanes shows the interaction between the AVI devices as vehicles move through the lane.

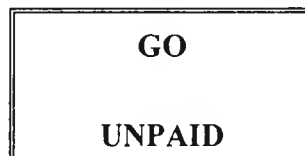
3.2.1.10 Process and Instrumentation Description

When a lane is opened in the Attended mode or AVI Unattended from the Supervisor's console, the lane controller initiates the command to toggle the PIO bit from high to low. For Attended mode, toggling the PIO bit to the low state turns the canopy light from red to green. For AVI Unattended mode, the lane controller sends a command, via the PIO card, to the canopy traffic light amber signal to flash.

The lane controller toggles the assigned PIO bit to a low state, which sets the Island Traffic Light to amber. The lane controller also sends a command to the Patron Fare Display (PFD) to set the sign to blank.

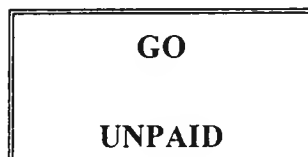
As the vehicle passes under the AVI antenna, it enters the radio frequency (RF) field, which contains trigger pulses. These trigger pulses cause the tag to initiate transmission of the tag number to the Mark IV Roadside Reader. If the tag-to-Roadside-Reader communication is successful, the Roadside Reader then transmits the tag number to the lane controller via the RS 232 communications port provided by the PIO card.

- If the system does not detect a tag, once the vehicle crosses the exit loop, a violation occurs. The lane controller receives a loop detection message via the PIO card. The Island Traffic Light turns red. A command from the lane controller changes the PFD to read:



If the Roadside Reader detects tag information, a tag lookup begins in the lane controller. The lane controller determines if the tag is valid by comparing the tag number to the tag status file, which is resident on the lane controller hard drive.

- If the tag is not valid, the lane controller initiates the violation process. The Island Traffic Light turns red, and the lane controller sends a command to the PFD to read:



- If the tag is valid, the lane controller toggles the assigned PIO bit to a low state, which changes the Island Traffic Light to green. The lane controller also sends a command to the PFD to read:



As the vehicle drives over the exit loop, the loop detector sends a presence "call" to the lane controller via the PIO card. The Smart Treadle Monitor transmits a forward-axle detection message, via the PIO card, for each axle detected. As the vehicle emerges from the vehicle separator, an "end of vehicle" message is transmitted. The treadle count and loop information are combined to classify the vehicle. If there is a class mismatch, then the lane controller initiates the violation process, and the transaction ends. The lane controller stores the transaction on the local hard drive and transmits the data to the host. Once the transaction has ended, the lane controller sets the Island Traffic Light to amber. The lane controller also sends a command to the PFD to set the sign to blank.

3.2.1.11 Diagram of Lane Components and Relationships

The Process Flow Diagram for the Unattended AVI Mode (Figure 3-4) is displayed below:

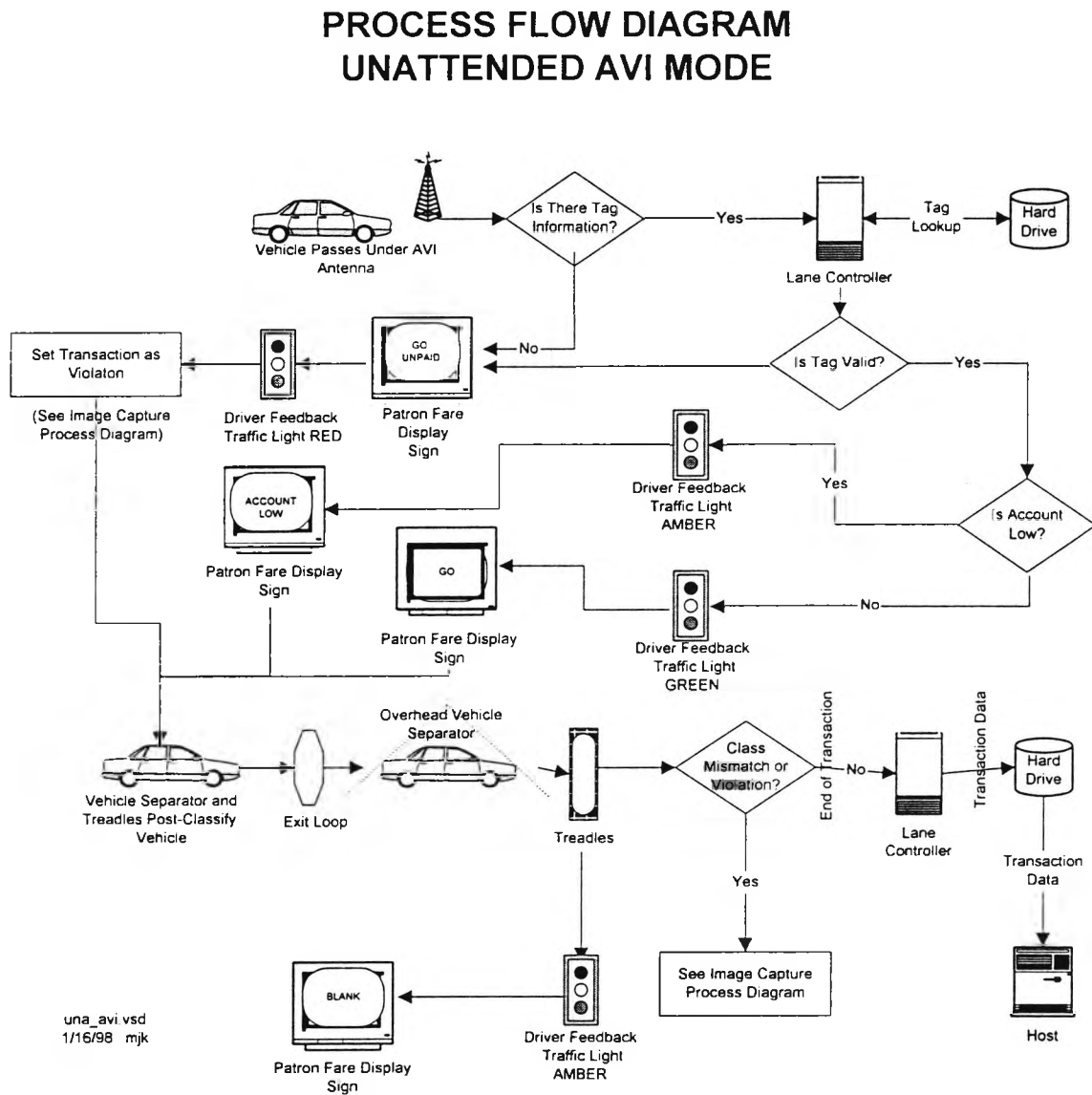
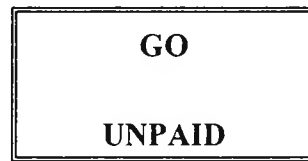


Figure 3-4 Process Flow Diagram for the Unattended AVI Mode

A violation occurs in the Unattended AVI Mode when:

- No tag is detected by the AVI equipment
- The vehicle's tag is determined to be invalid

The absence of a tag read or an invalid tag read triggers the start of a violation transaction. When the vehicle crosses the exit loop, the lane controller receives a loop "call" message via the PIO card. The Island Traffic Light turns red, and the lane controller sends a command to the PFD to read:



The transaction ends, and the captured image is stored with the transaction by the lane controller on the local hard drive. In addition, the lane controller transmits the data to the host. The Island Traffic Light remains amber and the lane controller sends a command to the PFD to set the sign to blank.

The Violation Process Flow Diagram for the Unattended AVI Mode (Figure 3-5) displays the process.

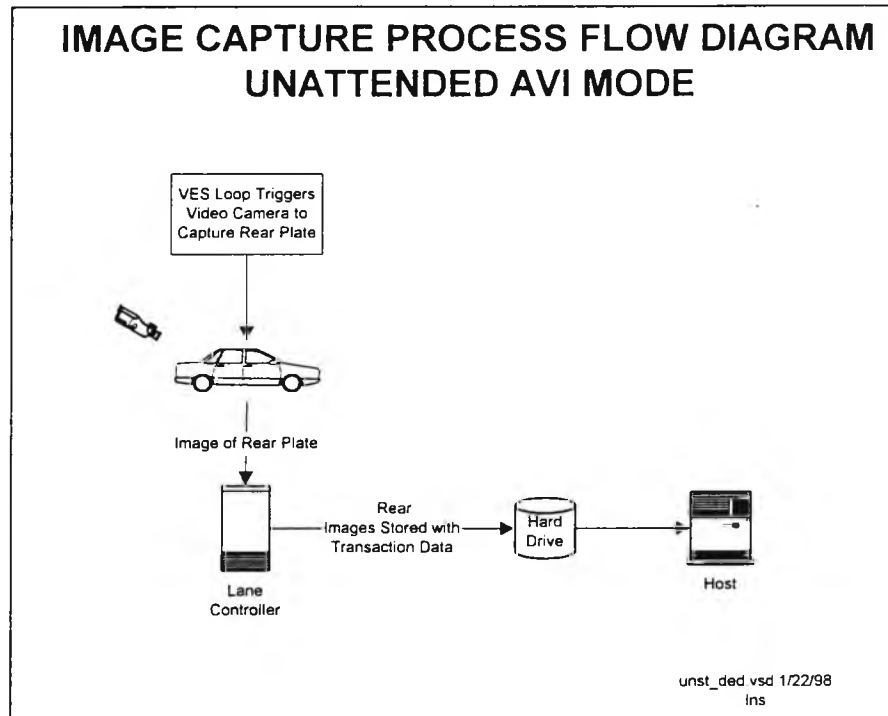


Figure 3-5 Violation Process Flow Diagram for the Unattended AVI Mode

3.2.1.12 Attended AVI Mode

This description of lane operation sequences for Attended AVI Mode demonstrates the interaction between the AVI devices as vehicles move through the lane.

3.2.1.12.1 Process and Instrumentation Description

When a lane is operating in the Attended mode, the Toll Collector logs on to SCDOT's existing Manual Lane Terminal (MLT). When the Collector logs on, the MLT turns the canopy light from red to green and sends a logon message to the lane controller. The Lane controller then sends a command, via the PIO card, to the Lane canopy light to indicate GREEN:



The lane controller sets the Island Traffic Light to red by toggling the assigned PIO bit to a low state. The lane controller also sends a command to the PFD to set the sign to "Thank You."

If the tag is invalid:

1. Once the Toll Collector classifies the vehicle, the Island Traffic Light remains red, and the PFD remains blank.
2. If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button, which is part of the MLT. The MLT then sends a serial message, which the lane controller receives via the PIO card, and the **violation process** is initiated.

If a low-balance tag is detected:

1. The lane controller turns the Island Traffic Light to amber by toggling the assigned PIO bit to a low state.
2. The lane controller sends a command to the PFD to read "LOW BALANCE."
3. The treadle count and loop information are combined to classify the vehicle, if there is a class mismatch, then the lane controller initiates the violation process, and the transaction ends. The lane controller stores the transaction on the local hard drive and transmits the data to the host.

If no tag is detected:

1. Once the Toll Collector classifies the vehicle, the Island Traffic Light remains red, and the PFD remains blank.
2. If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button, which is part of the MLT. The MLT then sends a serial message, which the lane controller receives via the PIO card, and the **violation process** is initiated.

If a valid tag is detected:

1. The lane controller turns the Island Traffic Light to green by toggling the assigned PIO bit to a low state.
2. The lane controller sends a command to the PFD to read "THANK YOU."



3. The treadle count and loop information are combined to classify the vehicle, if there is a class mismatch, then the lane controller initiates the violation process, and the transaction ends. The lane controller stores the transaction on the local hard drive and transmits the data to the host.
4. Once the transaction has ended, the lane controller sets the Island Traffic Light to red again by toggling the assigned PIO bit to a low state. The lane controller also sends a command to the PFD to set the sign to blank.

3.2.1.12.2 Diagram of Lane Components and Relationships

In the following diagram, the **Process Flow Diagram for the Attended AVI Mode** (Figure 3-6) is displayed:

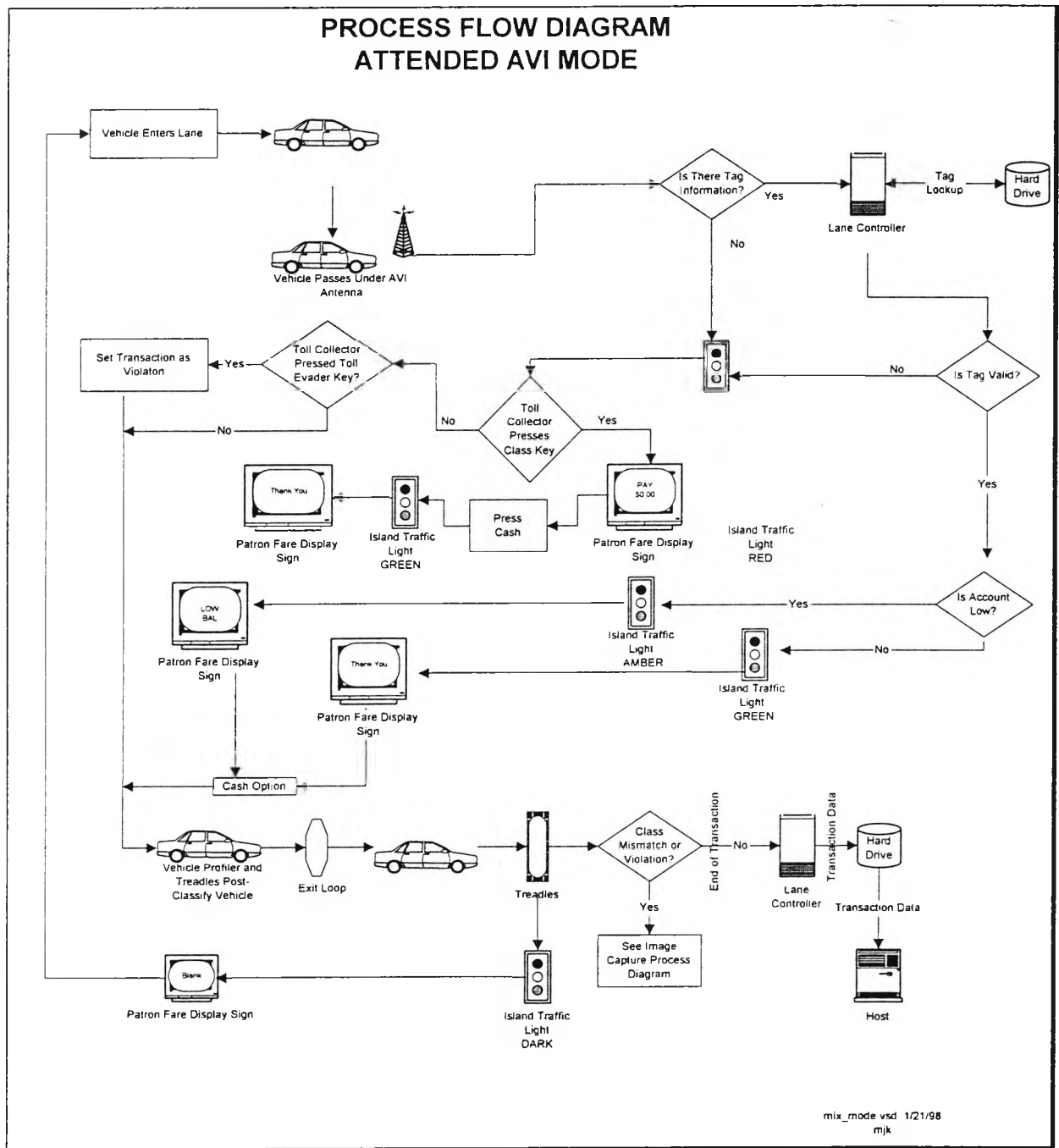


Figure 3-6 Process Flow Diagram for the Attended AVI Mode

3.2.1.12.3 Violation Process in an Attended AVI Mode Operating Mode

A violation occurs in the Attended AVI Mode operating mode when a patron without a valid Palmetto Pass tag does not pay the Toll Collector in cash (toll evader). This process is explained below:

As the vehicle passes under the AVI antenna, it enters the RF field, which contains trigger pulses. These trigger pulses cause the tag, if present, to initiate transmission of the tag number to the Roadside Reader. The Roadside Reader then transmits the tag number to the lane controller via the RS 232 communications port provided by the PIO card. The lane controller determines if the tag is valid by comparing the tag number to the tag status file, which is resident on the lane controller hard drive.

If no tag is detected or if the tag is invalid:

- If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button, which is part of the MLT. The MLT then sends a serial message, which the lane controller receives via the PIO card, and a violation transaction is initiated.

When the vehicle crosses the exit loop, the lane controller receives a loop detect message via the PIO card. The Island Traffic Light remains red.



The transaction ends, and the lane controller stores the captured image with the transaction on the local hard drive. In addition, the lane controller transmits the data to the host. The Island Traffic Light remains amber and the lane controller sends a command to the PFD to set the sign to blank.

In the following diagram, the **Violation Process Flow Diagram for the Attended AVI Mode** (Figure 3-7) is displayed:

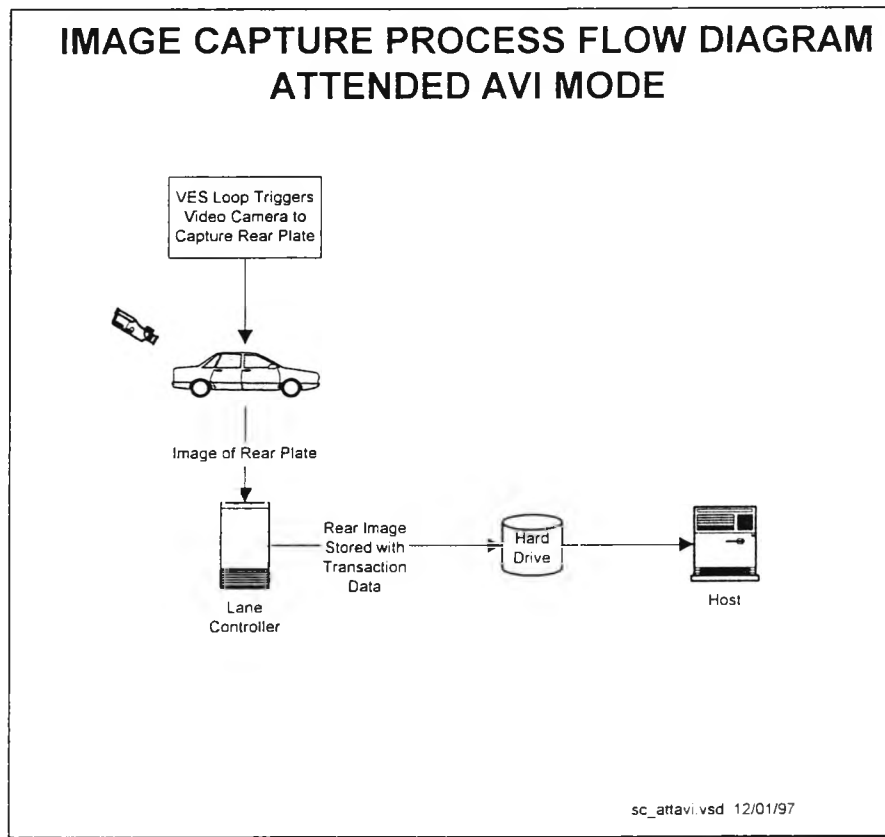


Figure 3-7 Violation Process Flow Diagram for the Attended AVI Mode

3.2.1.13 Manual-Only Mode

This description of lane operation sequences for Manual-Only Mode demonstrates the interaction between the AVI devices as vehicles move through the lane.

3.2.1.13.1 Process and Instrumentation Description

When a lane is operating in the Manual-Only mode, the Toll Collector logs on to the existing Manual Lane Terminal (MLT). When the Collector logs on, the MLT turns the canopy light from red to green and sends a logon message to the lane controller. The lane controller then sends a command, via the PIO card, to the Canopy Traffic Light to indicate GREEN:

The lane controller sets the Island Traffic Light to red by toggling the assigned PIO bit to a low state. The lane controller also sends a command to the PFD to set the sign to blank.

Once the vehicle enters the lane:

1. Once the Toll Collector classifies the vehicle, the Island Traffic Light remains red and the PFD remains blank.
2. If the patron pays, the Toll Collector activates the Cash button, which is a part of the MLT. The MLT then sends a serial message, which the lane controller receives via the PIO card. The traffic light turns green, and the Patron Fare Display reports "Thank you."
3. If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button, which is part of the MLT. The MLT then sends a serial message, which the lane controller receives via the PIO card, and the **violation process** is initiated.
4. As the vehicle drives over the exit loop, the loop detector sends a presence "call" to the lane controller via the PIO card.
5. The Smart Treadle Monitor transmits a forward-axle detection message, via the PIO card, for each axle detected. As the vehicle emerges from the vehicle separator (loop), an "end of vehicle" message is transmitted.
6. The treadle count and loop information are combined to classify the vehicle. The lane controller stores the transaction on the local hard drive and transmits the data to the host.

3.2.1.13.2 Diagram of Lane Components and Relationships

In the following diagram, the **Process Flow Diagram for the Manual-Only Mode** (Figure 3-8) is displayed:

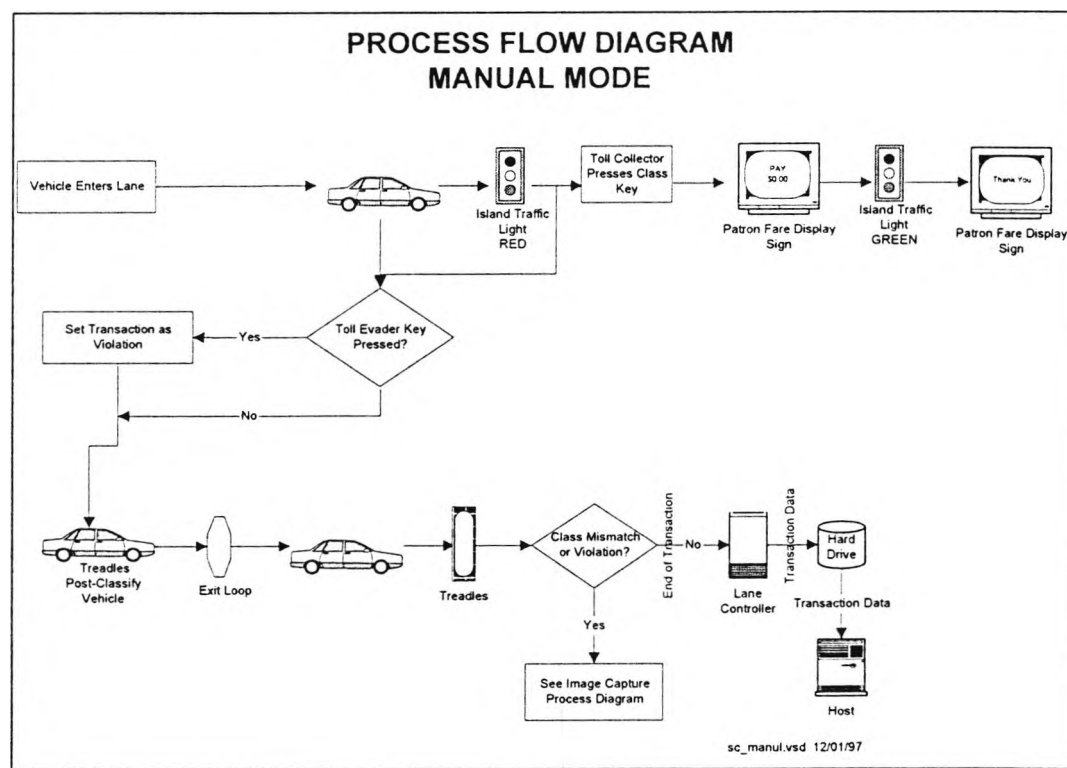


Figure 3-8 Process Flow Diagram for the Manual-Only Mode

3.2.1.13.3 Violation Process in a Manual-Only Operating Mode

A violation occurs in the Manual-Only Mode operating mode when a patron does not pay the Toll Collector in cash (toll evader).

If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button on the MLT. The MLT sends a serial message to the lane controller via the PIO card, and a violation transaction is initiated.

As the vehicle drives over the exit loop and treadles, the Smart Treadle Monitor transmits a forward-axle detection message via the PIO card to the lane controller for each axle detected. The vehicle separator (loop) transmits a vehicle presence message to the lane controller. As the vehicle emerges from the vehicle separator (loop), a vehicle absence message is transmitted. The treadle count and loop information are combined to classify the vehicle. Because the VES has been triggered, a video camera captures the image of the vehicle's rear license plate as it exits the lane.

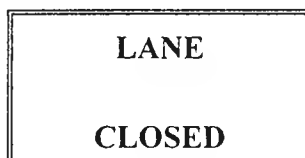
The transaction is completed. The lane controller stores the captured image with the transaction on the local hard drive and the lane controller transmits the data to the host.

3.2.1.14 Lane Closed Operating State

The lane operation sequences for the Lane Closed state demonstrates the interaction between the AVI devices as vehicles move through the lane.

3.2.1.14.1 Process and Instrumentation Description

When a lane is operating in the Closed state, the lane has been Closed by the Toll Collector or Plaza Supervisor. The Lane controller then sends a command, via the PIO card, to the Canopy Traffic Light to indicate RED:



The lane controller sets the Island Traffic Light to red by toggling the assigned PIO bit to a low state. The lane controller also sends a command to the PFD to set the sign to "LANE CLOSED."

Once the vehicle enters the lane:

1. The violation process is initiated.
2. As the vehicle drives over the exit loop, the loop detector sends a presence "call" to the lane controller via the PIO card.
3. The Smart Treadle Monitor transmits a forward-axle detection message, via the PIO card, for each axle detected. The VES trigger loop transmits a vehicle presence message to the lane controller. As the vehicle emerges from the vehicle separator (loop), a vehicle absence message is transmitted.
4. The treadle count and loop information are combined to classify the vehicle. The lane controller initiates the violation process and the transaction ends. The lane controller stores the transaction on the local hard drive and transmits the data to the host.

3.2.1.14.2 Diagram of Lane Components and Relationships

Figure 3-9 displays the Process Flow Diagram for the Lane Closed State::

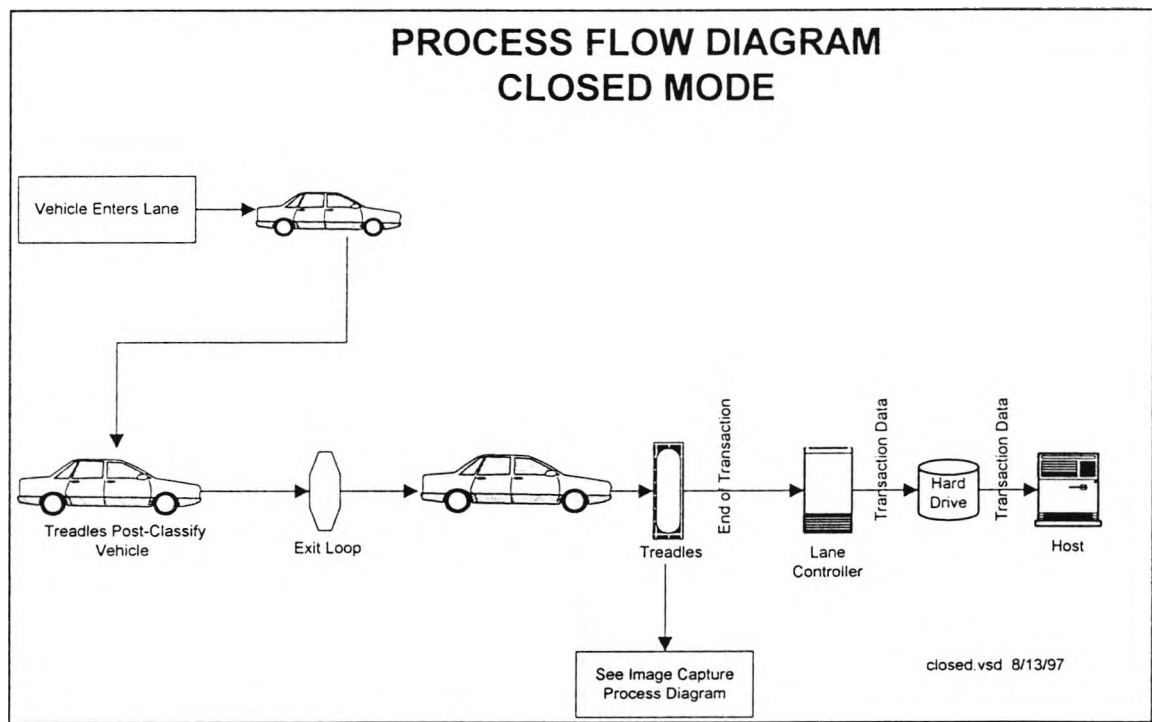


Figure 3-9 Process Flow Diagram for the Lane Closed State

3.2.1.14.3 Violation Process in a Closed Lane

A violation occurs in the closed lane when a vehicle drives through the lane. The violation process is explained below:

As the vehicle drives over the exit loop and treadles, the Smart Treadle Monitor transmits a forward-axle detection message, via the PIO card, for each axle detected. As the vehicle emerges from the vehicle separator (loop), a vehicle absence message is transmitted. The treadle count and loop information are combined to classify the vehicle. Because the VES has been triggered, a video camera captures the image of the vehicle's rear license plate as it exits the lane.

The transaction ends, and the lane controller stores the captured image with the transaction on the local hard drive. In addition, the lane controller transmits the data to the host.

3.3 Lane Subsystem Software Design

The Lane Controller software is a combination of operating system, device drivers and application code. Some of the device drivers are supplied by vendors to support specific hardware while others have been developed by LMIMS to provide certain kernel features that are important to the underlying application code.

3.3.1 Operating System Software

The system software used within the Lane Controller is Component Integrator 2.3 (formerly known as Venix) for SCO UNIXWare 2.x and is provided by Venturecom of Cambridge, MA. Component Integrator includes:

- SCO UNIXWare 2.x Application Server and Software Development Kit (SDK)
- Real-time Extensions (RTX)
- Embedded Operation Extensions (EOX)
- Component Integrator

The EOX and RTX extensions have been developed by Venturecom and are interfaced to UNIXWare in a manner that preserves binary compatibility with third-party software and device drivers. The EOX and RTX extensions have enabled LMIMS to develop a system that is ideally suited to the toll environment.

3.3.1.1 SCO UNIXWare

SCO UNIXWare Application Server provides multi-user application services to systems that put high demands on system reliability, performance, security, and networking. Built on the latest release of System V UNIX (SVR4.2 MP), SCO UNIXWare is the most modern and advanced release of the UNIX operating system on the market. The product of years of research and development, SCO UNIXWare Application Server was designed from the ground up to be a high-performance, multi-processing release of the UNIX operating system while maintaining compatibility with the millions of UNIX systems already deployed by SCO and other market leaders.

As an applications server, the SCO UNIXWare provides all of the facets of business-critical computing. It has proven that built-in security, reliability, and fault tolerance can effectively co-exist on a high-performance environment. One of the striking things about UNIXWare's consistent record breaking performance is that these records were not established on proprietary hardware from a single supplier, but on standard technology components from several vendors. With Intel's establishment of its MP Spec, hardware vendors can compete in developing increasingly high-performance systems that will automatically support the UNIXWare system. This feature is very important when putting together any hardware platform. Dependence on a single hardware vendor can cause devastating problems should that vendor be unable to continue support or provide spares.

With SCO UNIXWare providing an open standards based operating platform, and numerous hardware manufacturers supporting an open **SMP** implementation, SCDOT is assured of increasing performance, increasing value, and the luxury of choice.

3.3.1.2 Real-Time Extensions (RTX)

Real-Time Extensions (RTX) bring to UNIX the deterministic performance and real-time functionality that was previously available only on proprietary, real-time operating systems. The RTX extensions run on the UNIXWare development system, as well as on the target system, to enable real-time applications to be tested while still in the development environment.

RTX provides a real-time API designed to enable applications to directly control special purpose devices and improve their response times. The API includes functions to:

- Perform real-time priority and biased scheduling
- Lock virtual memory and eliminate page fault latencies
- Set up fast clocks and schedule timers
- Perform direct I/O bus reads and writes
- Map physical memory into an application
- Attach a user function to a hardware interrupt

RTX also provides a System Response Time Measurement (SRTM) tool to measure and display system response-time latencies during system operation. This tool has enabled LMIMS to evaluate our Lane Controller application under varying load and hardware configuration scenarios, ensuring a system that is optimally tuned for the target environment.

3.3.1.3 Embedded Operation Extension (EOX)

The Embedded Operation Extension (EOX) includes device drivers and boot support for ROM, flash memory, and disk-based configurations, which can be reconfigured for custom hardware. This allows UNIX applications to run on small-scale target systems and in harsh or rugged environments.

The Lights-Out operation provides support for target systems without a video display adapter (e.g. VGA), keyboard, and pointing device. Kernel messages can be redirected to a serial port. These capabilities are typically used in deeply embedded applications and are not utilized within this design. We prefer to provide video and keyboard services which provide greater flexibility in the development of maintenance applications that execute on the Lane Controller, and provide diagnostic information during maintenance procedures.

The most important component of the EOX is the exception management service. This service provides the control required for unattended operation and remote monitoring, maintenance and administration. EOX enables recovery actions to be pre-programmed and initiated upon the occurrence of specific system or application exception events. Such events include device errors,

resource consumption and general system exceptions, and posted exceptions from applications. Possible recovery actions include starting, stopping or re-initializing device drivers and system services; terminating or starting specified tasks; logging information; and re-booting the system. These features enable use in an operator-less environment. Exception management handling has been refined to a point where technician involvement is rarely required.

3.3.1.4 Component Integrator

Component Integrator is a GUI-based tool which enables developers to design, configure, build, and deploy UNIX-based Lane Controller target systems. It is an easy-to-use tool that reduces the engineering time required to combine Commercial-Off-The-Shelf (COTS) and custom built Lane Controller application software with a UNIX operating system. This tool can create OEM floppies, network images, or disks for field or manufacturing installation. Target systems can be easily scaled from full UNIX workstations down to minimal systems with 4MB ROM and 8MB RAM. The key features of this product are:

- GUI-based builder tool for generating embeddable UNIX targets
- Ability to add third-party and custom software components
- Ability to display and set I/O configuration settings
- Ability to generate customized floppies, disk, and network images for manufacturing and field installation with:
 - ◊ Bootable installation floppy
 - ◊ Installation script to control installation
 - ◊ Install media with target files and values

Experience with this tool has been very favorable. It acts as an extremely effective configuration management tool, tracking all releases of both custom application software and operating system files. All files that are deployed to the target environment are tracked and complete version histories are maintained.

The use of this tool has provided developers with a number of key benefits:

- It allows the development and deployment of special end-user target systems using a general-purpose UNIX Operating System.
- It enhances applications with embedded and real-time features.

- Any UNIX communication service can be used:
 - ◊ TCP / IP
 - ◊ RPC
 - ◊ NFS
 - ◊ Netware
 - ◊ SMTP
 - ◊ SNMP
 - ◊ PPP
 - ◊ SLIP
 - ◊ etc.
- Extensive device driver support to reduce development time and expense
- Small-footprint UNIX target systems can be built that require less memory than a fully configured UNIX system.
- The development process is streamlined with early, rapid and frequent integration and test cycles.
- It assures a high quality, repeatable, and automated target system build process.
- The Lane Controller application is easily maintained and enhanced to extend its life.

3.3.2 Device Drivers

3.3.2.1 Control PIO

The **Control PIO** card is an intelligent I/O controller containing an onboard 80186 CPU. The device driver, supplied by the manufacturer, enables code to be downloaded to the onboard CPU reducing the I/O overheads that are typical with multi-port PIO controllers. It will also be possible to offload all of the error correction protocol handling (**CRC** checks) associated with the Mark IV **Roadcheck** reader onto the **CONTROL** card, further reducing the Lane Controller CPU usage.

3.3.2.2 Frame Grabber

This device driver is responsible for capturing images from the camera input and transferring them into system memory. The device driver provides the open, read, write, and **ioctl** (Input / Output Control) calls necessary for an application process to communicate with the frame grabber hardware.

3.3.3 Lane Processes & Inter-Process Communications

Several techniques were employed including stream pipes, UNIX system V message queues, shared memory and UNIX Streams. The most effective means of providing IPC services proved to be UNIX Streams together with shared memory. When a process needs to send a message to another process it assembles the message in shared memory and sends a token detailing the sending process, the destination process, the length of the message, and the address of the message in shared memory. This technique reduces the message traffic to a minimum. These services are provided as device drivers and are built into the kernel.

In addition to the kernel device drivers, a number of cooperative application processes have been developed to support all lane functionality. These processes are:

- Lane (**lane**)
- Idle (**idle**)
- Garbage Collector (**gc**)
- Maintenance Daemon (**maintd**)
- Programmable I/O (PIO)
- Transaction Log services (**trxserver**)
- Lane Toll Collection (**ltc**)
- Host communications services (**hostcomm**)
- Toll Terminal Interface (**tti**)
- AVI Interpreter (**avi_interp**)
- Light Interface
- Violation Capture (**capture**)
- Patron Fare Display interpreter (**pfd_interp**)

The Lane Controller software is based on a multi-process architecture utilizing a token-based message passing structure. The lane process is responsible for opening and reading into memory the initialization files necessary to correctly configure the lane and then spawning each of the individual processes that together comprise the lane application. As each process is launched it "attaches" itself to a single well-known message queue that is created and managed by the lane process. Once all of the processes have been launched the lane process acts as the central hub for all message passing, distributing the message tokens between the cooperating processes.

3.3.3.1 Lane Controller Process Design

The **Lane Controller** uses an event-driven architecture, and employs a **Streams**-based Inter-Process Communications (IPC) mechanism to relay information between concurrently executing processes. Interfaces to in-lane devices are handled by a number of device interface processes that decode the information received before passing the processed information on to the main controlling program for further attention.

Messages passed from all of the device handlers adhere to a common internal application API. For example, the **AVI_INTERPRETER** process will decode the tag information from the reader and pass this on to the central Toll Collector process (Lane Toll Collector or **ltc**) as a **TAG_READ** message. The message will contain information about the **TAG_READ** event, such as transponder ID, transponder vehicle class, etc.

With this message-based architecture, an efficient IPC mechanism is required. The design employed is based on UNIX Streams pipes. The mechanism is referred to as the Poster Mechanism, and is centrally controlled by the Lane process.

The key feature of the poster mechanism is its "hub" architecture. Each lane process "attaches" to a central hub process, the Lane process. The Lane process stores information about all of the processes that are connected to it. All processes communicate directly with the Lane process, which acts as a central clearing house for **IPC** communications. If a process attempts to send a message to a destination process ID which does not exist, the message is sent to the Garbage Collection (**gc**) process which frees up the system resources associated with the message.

While the Lane process is the center of the IPC mechanism, the Lane Toll Collector (**ltc**) process is the logical heart of the Lane Controller software system. All processes involved in capturing data send their processed information to the **ltc** thread, which assembles this information to compose a profile of the vehicles entering and exiting the lane and their actions within it. The **ltc** process then uses this information to format a transaction, cause violation processing to occur, and take other actions as appropriate, as displayed in **Poster Mechanism** (Figure 3-10).

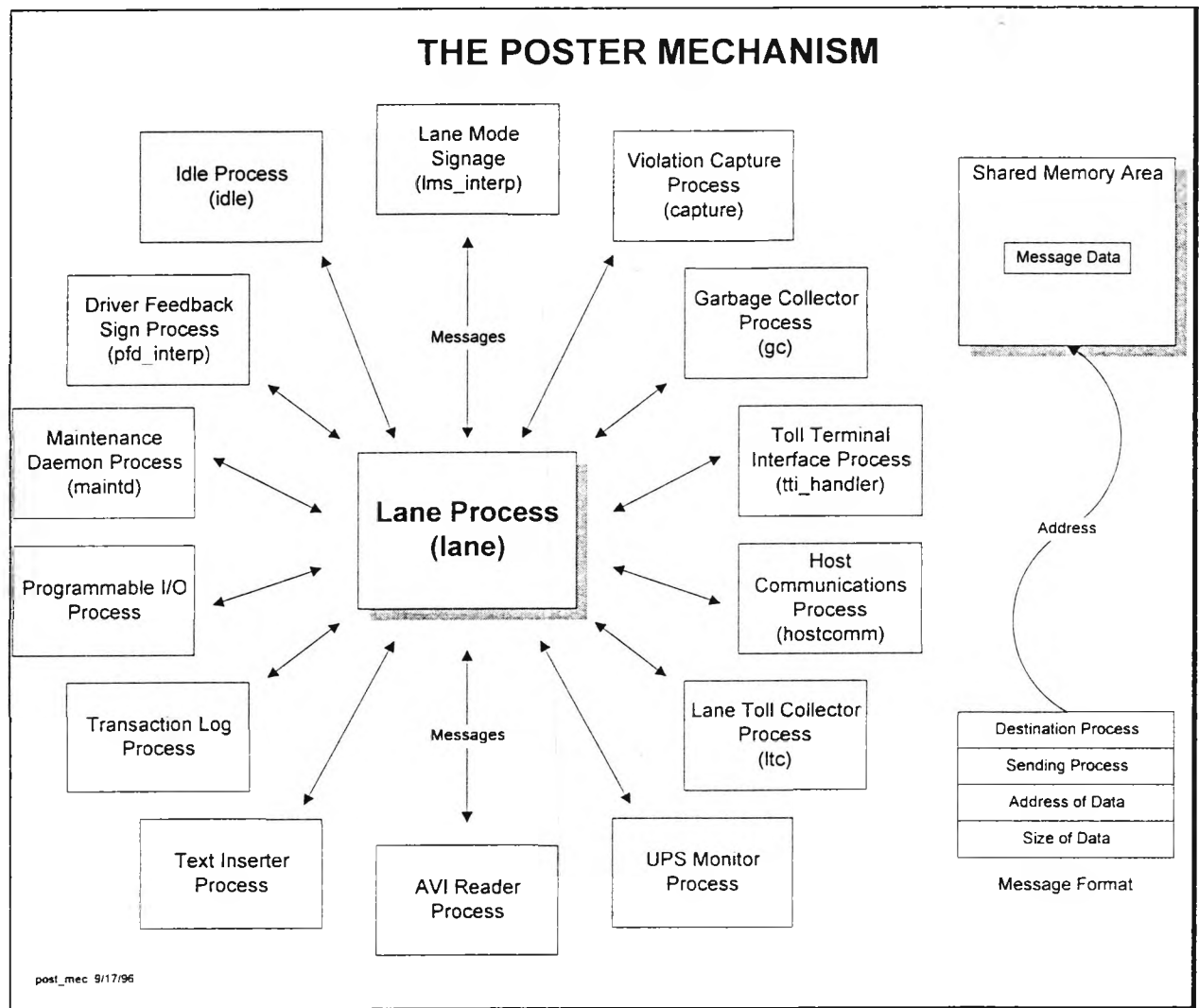


Figure 3-10 Poster Mechanism

The key feature of the poster mechanism is the “Hub” architecture. Each of the processes “attaches” to the hub process (Lane process). The Lane process stores information about all of the processes that are connected. All processes communicate directly with the Lane process which examines the destination process ID and forwards the message. If the destination process does not exist then the poster sends the message to a garbage collection task which frees up the shared memory associated with the message.

Fewer message queues are maintained by using this approach. Each process maintains a single message queue rather than one queue for each process with which an individual task must communicate.

3.3.4 Process Flow Design

Lane Controller Data Flow Diagram (Figure 3-11) displays the major processing elements and the data relationships between them.

As this diagram shows, the main controlling program is the **Lane Toll Collection Process**. This process accepts the event information, correlates the information to form transactions, and passes these transaction events to the Transaction Log process for local storage.

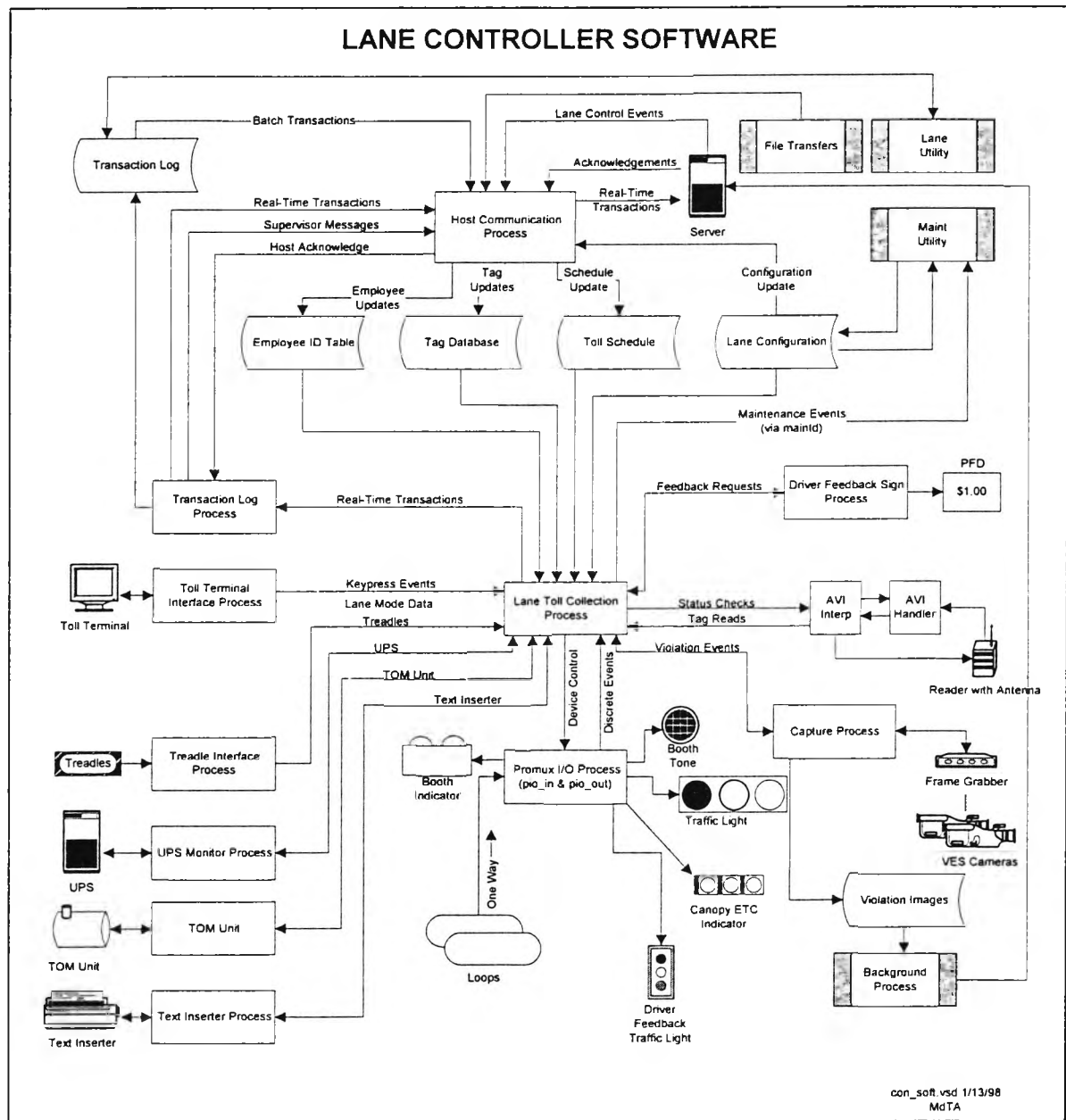


Figure 3-11 Lane Controller Data Flow Diagram

3.3.4.1 General Description Lane Closed Operating State

The Lane Closed operating state is an AVI-equipped lane which has been closed, either by the toll collector or the plaza supervisor. Lanes in a Closed state allow only the following operation:

- Violation Processing via the AVI subsystem
- The AVI subsystem will record and classify vehicles driving through the closed lane
- Records a violation transaction

3.3.4.2 Unattended AVI

The description of lane operation sequences for Unattended AVI Lanes shows the interaction between the AVI devices as vehicles move through the lane.

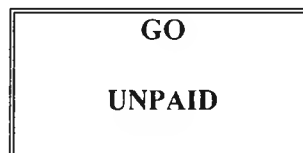
3.3.4.2.1 Process and Instrumentation Description

When a lane is opened in the AVI Unattended mode from the Supervisor's console, the lane controller initiates the command to toggle the PIO bit from high to low. The lane controller sends a command, via the PIO card, to the canopy traffic light amber signal to flash.

The lane controller toggles the assigned PIO bit to a low state, which sets the Island Traffic Light to red. The lane controller also sends a command to the Patron Fare Display (PFD) to set the sign to blank.

As the vehicle passes under the AVI antenna, it enters the radio frequency (RF) field, which contains trigger pulses. These trigger pulses cause the tag to initiate transmission of the tag number to the Mark IV Roadside Reader. If the tag-to-Roadside-Reader communication is successful, the Roadside Reader then transmits the tag number to the lane controller via the RS 232 communications port provided by the CONTROL board.

- If the system does not detect a tag, once the vehicle crosses the VES loop, a violation occurs. The lane controller receives a loop detection message via the PIO card. The Island Traffic Light turns red. A command from the lane controller changes the PFD to read:



If the Roadside Reader detects tag information, a tag lookup begins in the lane controller. The lane controller determines if the tag is valid by comparing the tag number to the tag status file, which is resident on the lane controller hard drive.

- If the tag is not valid, the lane controller initiates the violation process. The Island Traffic Light stays red, and the lane controller sends a command to the PFD to read:

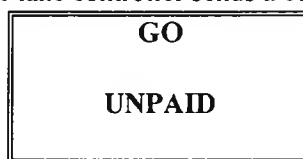
<p>GO</p> <p>UNPAID</p>

- If the tag is valid, the lane controller toggles the assigned PIO bit to a low state, which changes the Island Traffic Light to green. The lane controller also sends a command to the PFD to read:

<p>THANK</p> <p>YOU</p>

As the vehicle drives over the exit loop, the loop detector sends a presence "call" to the lane controller via the PIO card. The Smart Treadle Monitor transmits a forward-axle detection message, via the PIO card, for each axle detected. As the vehicle emerges from the vehicle separator, an "end of vehicle" message is transmitted. The treadle count and loop information are combined to classify the vehicle. If there is a class mismatch, then the lane controller initiates the violation process, and the transaction ends. The lane controller stores the transaction on the local hard drive and transmits the data to the host. Once the transaction has ended, the lane controller sets the Island Traffic Light to red. The lane controller also sends a command to the PFD to set the sign to blank.

The absence of a tag read or an invalid tag read triggers the start of a violation transaction. When the vehicle crosses the exit loop, the lane controller receives a loop "call" message via the PIO card. The Island Traffic Light turns red, and the lane controller sends a command to the PFD to read:



The transaction ends, and the captured image is stored with the transaction by the lane controller on the local hard drive. In addition, the lane controller transmits the data to the host. The Island Traffic Light remains amber and the lane controller sends a command to the PFD to set the sign to blank.

The **Violation Process Flow Diagram for the Unattended AVI Mode** (Figure 3-13) displays the process.

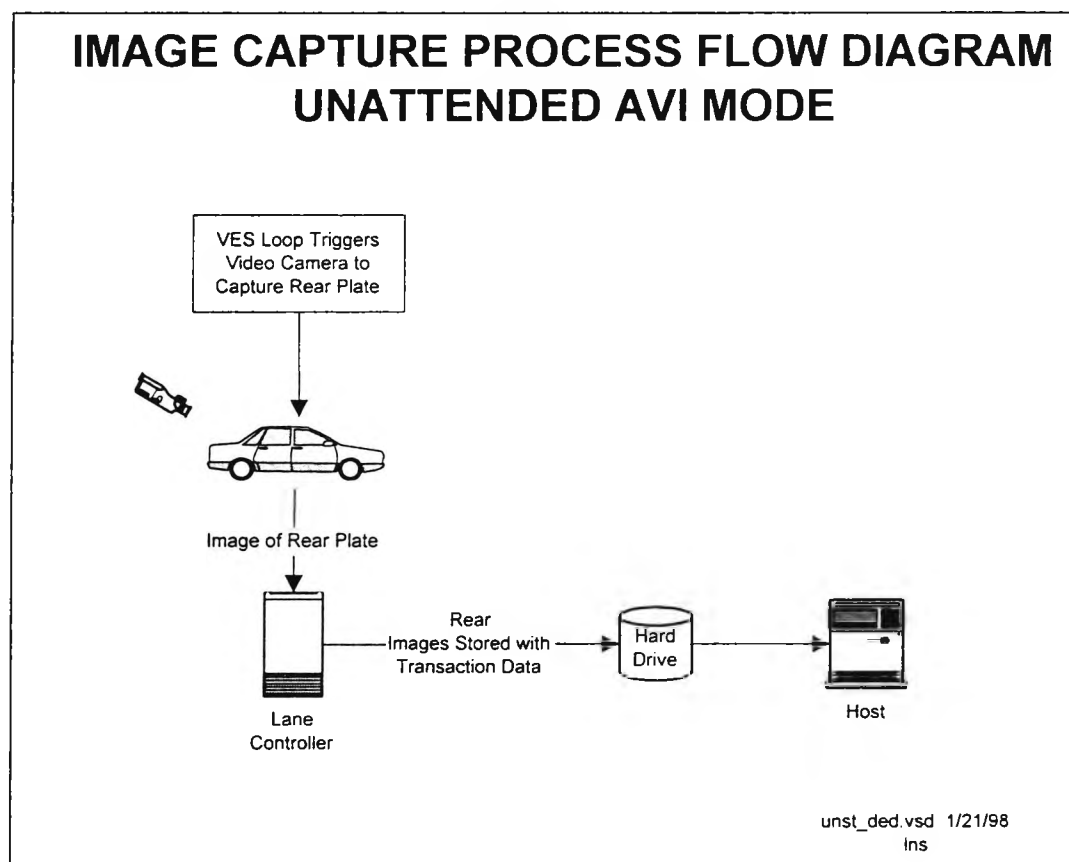


Figure 3-13 Violation Process Flow Diagram for the Unattended AVI Mode

3.3.4.3 Attended AVI Mode

This description of lane operation sequences for Attended AVI Mode demonstrates the interaction between the AVI devices as vehicles move through the lane.

3.3.4.3.1 Process and Instrumentation Description

When a lane is operating in the Attended mode, the Toll Collector logs on to SCDOT's existing Manual Lane Terminal (MLT). When the Collector logs on, the MLT sends a logon message to the lane controller. The Lane controller then sends a command, via the PIO card, to the Lane canopy light to indicate GREEN:



The lane controller sets the Island Traffic Light to red by toggling the assigned PIO bit to a low state. The lane controller also sends a command to the PFD to set the sign to "THANK YOU."

If the tag is invalid:

1. The MLT displays the **S-TAG INVALID** sign.
2. Once the Toll Collector classifies the vehicle, the Island Traffic Light remains red, and the PFD displays the fare to be paid.
3. If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button, which is part of the MLT. The MLT sends a message to the lane controller and the **violation process** is initiated.
4. If the patron pays the fare, the island traffic light turns green and the PFD turns blank.

If no tag is detected:

1. Once the Toll Collector classifies the vehicle, the Island Traffic Light remains red and the PFD displays the fare to be paid.
2. If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button, which is part of the MLT. The MLT then sends a message to the lane controller and the **violation process** is initiated.
3. If the patron pays the fare, the island traffic light turns green and the PFD turns blank.

If a valid tag is detected:

1. The MLT displays the **S-TAG VALID** sign.
2. The lane controller toggles the assigned PIO bits to a low state to turn the Booth Indicator to green and activate the audible signal. This green Booth Indicator light and audible signal notify the Toll Collector that no action is necessary to collect the toll because the toll is being paid electronically.
3. The lane controller turns the Island Traffic Light to green by toggling the assigned PIO bit to a low state.
4. The lane controller sends a command to the PFD to read "**THANK YOU.**"
5. The treadle count and loop information are combined to classify the vehicle, if there is a class mismatch, then the lane controller initiates the violation process, and the transaction ends. The lane controller stores the transaction on the local hard drive and transmits the data to the host.
6. Once the transaction has ended, the lane controller sets the Island Traffic Light to red again by toggling the assigned PIO bit to a low state.

In the following diagram, the **Process Flow Diagram for the Attended AVI Mode** (Figure 3-14) is displayed:

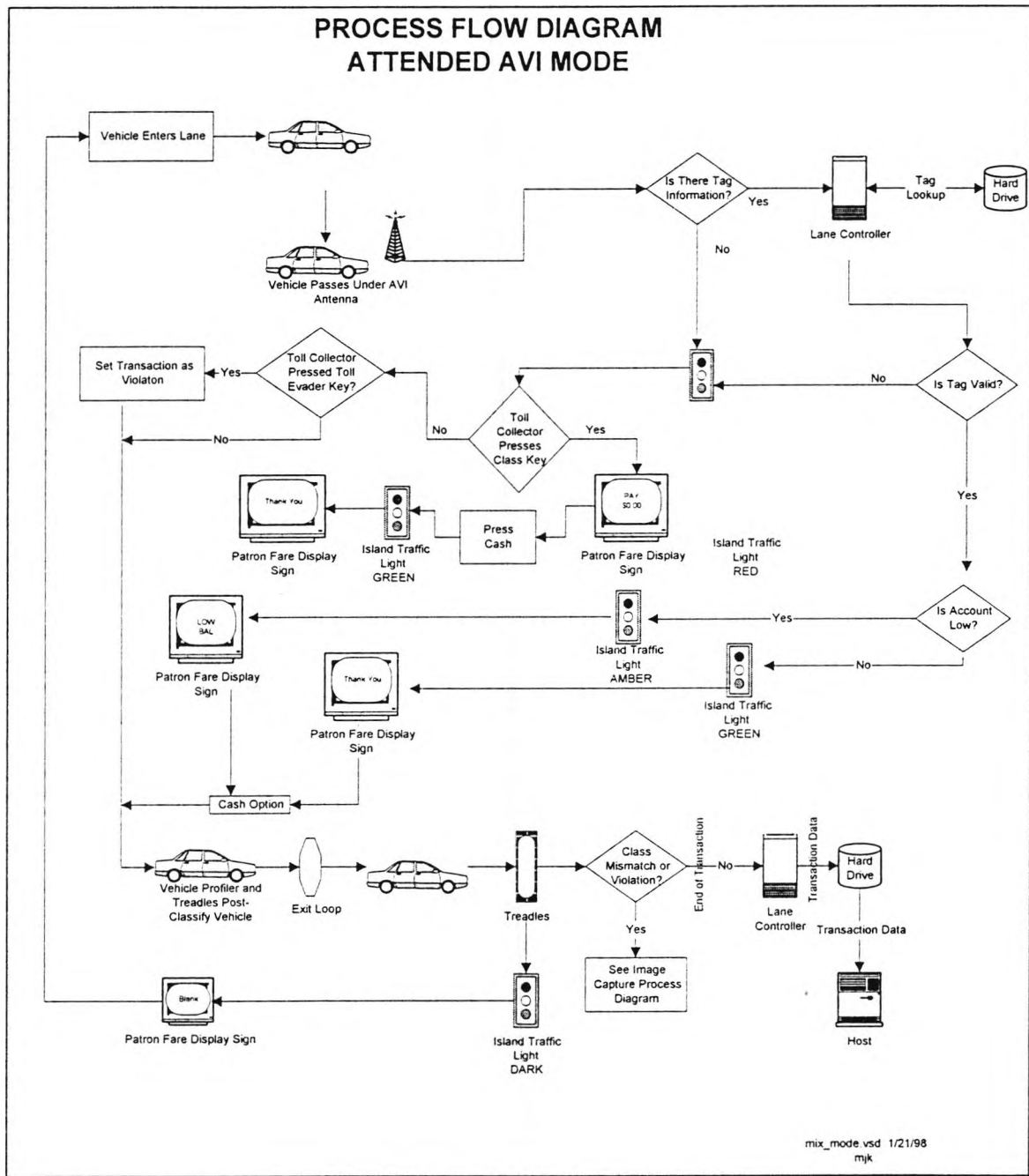


Figure 3-14 Process Flow Diagram for the Attended AVI Mode

3.3.4.3.3 Violation Process in Attended AVI Mode Operating Mode

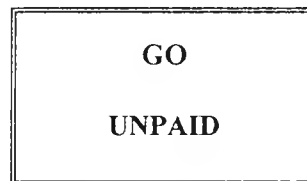
A violation occurs in the Attended AVI Mode operating mode when a patron without a valid Palmetto Pass tag does not pay the Toll Collector in cash (toll evader). This process is explained below:

As the vehicle passes under the AVI antenna, it enters the RF field, which contains trigger pulses. These trigger pulses cause the tag, if present, to initiate transmission of the tag number to the Roadside Reader. The Roadside Reader then transmits the tag number to the lane controller via the RS 232 communications port. The lane controller determines if the tag is valid by comparing the tag number to the tag status file, which is resident on the lane controller hard drive.

If no tag is detected or if the tag is invalid:

- If the patron continues through the lane without paying, the Toll Collector activates the Toll Evader button, which is part of the MLT. The MLT then sends a message to the lane controller and a violation transaction is initiated.

When the vehicle crosses the exit loop, the lane controller receives a loop detect message via the PIO card. The Island Traffic Light turns red, and the lane controller sends a command to the PFD to read:



The transaction ends, and the lane controller stores the captured image with the transaction on the local hard drive. In addition, the lane controller transmits the data to the host. The Island Traffic Light remains red.

In the following diagram, the Violation Process Flow Diagram for the Attended AVI Mode (Figure 3-15) is displayed:

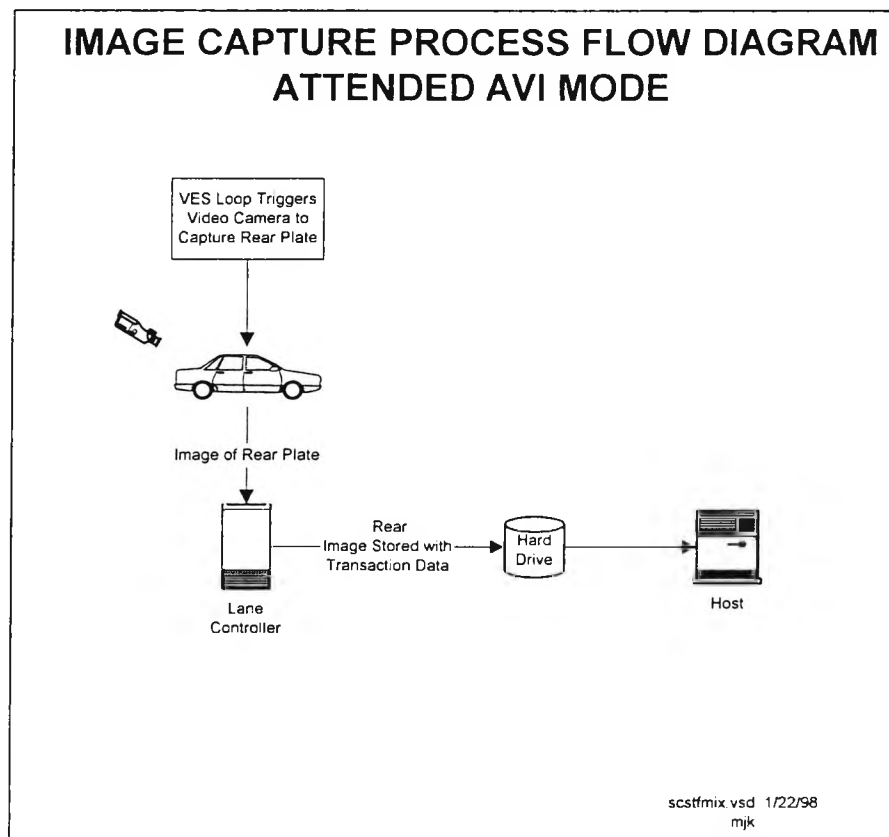


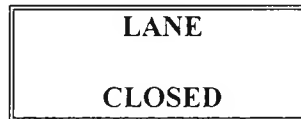
Figure 3-15 Violation Process Flow Diagram for the Attended AVI Mode

3.3.4.4 Lane Closed Operating State

The lane operation sequences for the Lane Closed state demonstrates the interaction between the AVI devices as vehicles move through the lane.

3.3.4.4.1 Process and Instrumentation Description

When a lane is operating in the Closed state, the lane has been Closed by the Toll Collector or Plaza Supervisor. The Lane controller then sends a command, via the PIO card, to the Canopy Traffic Light to indicate RED:



The lane controller sets the Island Traffic Light to red by toggling the assigned PIO bit to a low state. The lane controller also sends a command to the PFD to set the sign to "LANE CLOSED."

Once the vehicle enters the lane:

1. The violation process is initiated.
2. As the vehicle drives over the exit loop, the loop detector sends a presence "call" to the lane controller via the PIO card.
3. The Smart Treadle Monitor transmits a forward-axle detection message, via the PIO card, for each axle detected. The VES trigger loop transmits a vehicle presence message to the lane controller. As the vehicle emerges from the vehicle separator (loop), a vehicle absence message is transmitted.
4. The treadle count and loop information are combined to classify the vehicle. The lane controller initiates the violation process and the transaction ends. The lane controller stores the transaction on the local hard drive and transmits the data to the host.

3.3.4.4.2 Diagram of Lane Components and Relationships

In the following diagram, the **Process Flow Diagram** for the Lane Closed State (Figure 3-17) is displayed:

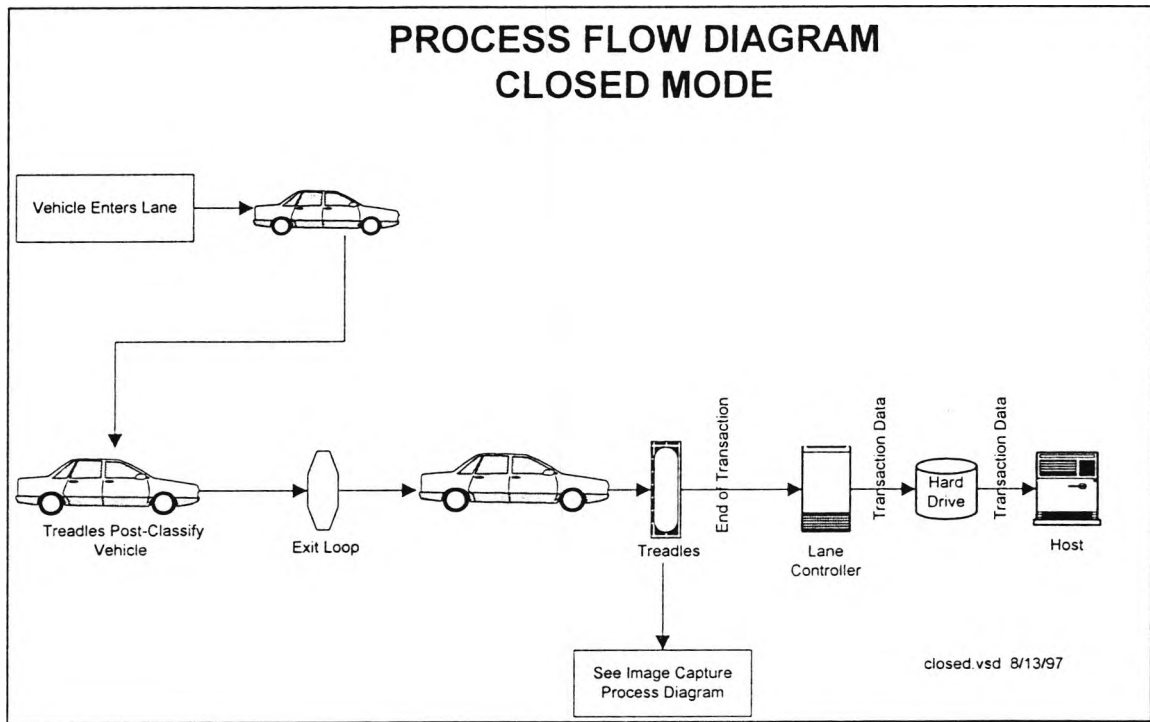


Figure 3-17 Process Flow Diagram for the Lane Closed State

3.3.4.4.3 Violation Process in a Closed Lane

A violation occurs in the closed lane when a vehicle drives through the lane. The violation process is explained below:

As the vehicle drives over the exit loop and treadles, the Smart Treadle Monitor transmits a forward-axle detection message, via the CONTROL card, for each axle detected. As the vehicle emerges from the vehicle separator (loop), a vehicle absence message is transmitted. The treadle count and loop information are combined to classify the vehicle. Because the VES has been triggered, a video camera captures the image of the vehicle's rear license plate as it exits the lane.

The transaction ends, and the lane controller stores the captured image with the transaction on the local hard drive. In addition, the lane controller transmits the data to the host.

3.3.5 Lane Software Design

The South Carolina Department of Transportation will have all toll lanes at the Cross Island Parkway toll facility configured to operate either in the Attended or Unattended mode. Unattended AVI lanes are AVI Palmetto Pass Only. Attended Mode lanes are operated by a Toll Collector receiving cash from patrons while AVI equipment simultaneously allows AVI Palmetto Pass patrons to use the lane and pay tolls electronically.

At the toll supervisor's discretion, an Attended Mode lane can be converted to an Unattended AVI lane. In this event, the lane is opened from the Toll Supervisor console, causing the canopy light to turn amber and read: PALMETTO PASS.

3.3.5.1 Device Drivers

3.3.5.1.1 Control Serial Input / Output

The **Control PIO** card is an intelligent I/O controller containing an onboard 80186 CPU. The device driver, supplied by the manufacturer, enables code to be downloaded to the onboard CPU reducing the I/O overheads that are typical with multi-port PIO controllers. It will also be possible to offload all of the error correction protocol handling (**CRC** checks) associated with the **Mark IV Roadcheck** reader onto the **Control** card, further reducing the Lane Controller CPU usage.

3.3.5.1.2 Frame Grabber

This device driver is responsible for capturing images from the camera input and transferring them into system memory. The device driver provides the open, read, write, and **ioctl** calls necessary for an application process to communicate with the frame grabber hardware.

3.3.5.1.3 Programmable I/O (PIO)

This device driver provides an interface to the PIO board. This interface consists of three eight-bit ports, represented by devices named:

- /dev/pioa
- /dev/piob
- /dev/pioc

The devices can be read and written upon. When a process reads one of these ports, it will "sleep" until the state of one of the ports eight bits changes. Then the process will "awaken" with the new bit structure. It is then up to the process in question to determine which bit changed and take the appropriate action.

A process may change the state of any **PIO** output bit by creating an eight-bit structure (an unsigned char) with the bits in the structure reflecting the desired state of the output bits, and writing this bit into the desired port device.

3.3.5.1.4 SSP

The **SSP** is a **Streams** multiplexing software driver. It provides two-way **Streams** pipes between processes or other **Streams** devices.

3.3.5.1.5 PMUX

This is a **Streams** multiplexing software driver. The **PMUX** device accepts pairs of **Streams** devices (one for input and one for output) and interconnects the pairs attached to it. The messages are sent to one input stream, properly addressed with the identifier of another processes output stream, and will be redirected to that output stream. In practice, a process will first open a **SSP** device, then perform an **ioctl** call on the **PMUX** device with the file descriptor of the **SSP** device as a parameter in order to attach the **SSP** pipe to the **PMUX**.

3.3.5.2 Inter Process Communications

3.3.5.2.1 Lane Processes

In addition to the kernel device drivers a number of cooperative application processes have been developed to support all lane functionality. These processes as previously shown in the Lane Process Flow Diagram are:

- Lane (lane)
- Idle (idle)
- Garbage Collector (gc)
- Maintenance Daemon (maintd)
- Programmable I/O (pio_in & pio_out)
- Transaction Log services (trxserver)
- Lane Toll Collection (ltc)
- Host communications services (hostcomm)
- Toll Terminal Interface (tti_handler)
- AVI Interpreter (avi_interp)
- TreadleHandler (trdl_hdlr)
- Lane Mode Signage Sign interpreter (lms_interp)
- Violation Capture (capture)
- Patron Fare Display interpreter (pfd_interp)
- Text Inserter (text_inserter)
- Send Images (send_images)
- Roll Forward(roll_forward)
- Fall Back(fall_back)

3.3.5.2.1.1 Lane Controller

The **Lane Controller** software is based on a multi-process architecture utilizing a token-based message passing structure. The lane process is responsible for opening and reading into memory the initialization files necessary to correctly configure the lane and then spawning each of the individual processes that together comprise the lane application. As each process is launched it "attaches" itself to a single well known message queue that is created and managed by the lane process. Once all of the processes have been launched the lane process acts as the central hub for all message passing, distributing the message tokens between the cooperating processes.

3.3.5.2.1.2 Idle

The **Idle** process is used to continuously monitor the integrity of the message queues. This process periodically sends a message to all of the processes currently active as part of the lane application to

ensure that the message queues are functioning correctly. Errors can be logged locally or reported to the maintenance terminal for further investigation. In our experience errors rarely occur, but this process has proved itself very useful in detecting kernel resource allocation problems. Due to the nature of the stream pipe IPC mechanism, it is possible for certain kernel resources to become depleted during periods of intense activity. The **Idle** process can identify this problem and kernel tuning can be conducted to address the issue.

3.3.5.2.1.3 Garbage Collector (gc)

The **Garbage Collection Process (gc)** is used to cleanup messages from the global shared memory area that may not have been freed by the recipient process. It is the responsibility of the receiving process to free shared memory used by the message queue. If the lane process receives a message for a process that is not running then it directs the message to the garbage collection task for subsequent cleanup. This enables a much greater degree of flexibility when configuring the lane processes. If a process is not required for any reason (a particular device is not configured) then it is not necessary to execute that particular task. The other processes need not be aware of that fact as **The Garbage Collection Process** cleans up any messages for unknown destinations.

3.3.5.2.1.4 Maintenance Daemon (maintd)

The **Maintenance Daemon** provides a mechanism for providing useful information during maintenance activity. When activated by a maintenance engineer it can "listen in" on the message traffic and route useful information to a graphical screen on the Lane Controller. An example of this feature would be a check of the AVI reader. The maintenance utility would be launched and the maintenance would select **Monitor AVI**. All incoming messages for the AVI reader would be directed to the Lane Controller console. This enables the engineer to quickly determine if communications have been established without the need for a line analyzer. The technician also has the ability to toggle **Programmable I/O (PIO)** outputs and generate test signals for all of the in-lane devices to ensure that all devices are functioning correctly before the lane is opened to traffic.

3.3.5.2.1.5 Programmable I/O (PIO_in & PIO_out)

The **PIO_in** process accepts inputs from the **PIO** controller. The **PIO_out** generates outputs to the **PIO** controller. By utilizing the **PIO**, we are able to standardize on a single lane hardware configuration regardless of the location of the Lane Controller (within the lane or plaza). If any of the processes need to change the state of a discrete device they send a message to the **PIO_out** process, e.g. **TRAFFIC_LIGHT_RED**. This message will be interpreted by the **PIO** process and converted into the correct serial command to the **PIO** to change the state of an output relay which will in turn change the traffic light to **RED**. Inputs received from the **PIO** are decoded and sent to various processes for further action. Input messages received are either status or maintenance events.

3.3.5.2.1.6 Transaction Log Services (trxserver)

The **trxserver** process is solely responsible for the maintenance of the **Transaction Log** stored on the **RAID1** disk storage sub-system. By giving this responsibility to a single process, no file locking problems occur which would be the case if all processes had file access. Any transactions (vehicle, error, key-in, etc.) are sent to the **trxserver** process for storage. The **Transaction Log** is a circular file, sized to meet the stand-alone requirements of the project. This is typically set for 30 days, but is limited only by available disk space. Two pointers are maintained by the **trxserver** process. The head pointer indicates the entry point for the next transaction record. The tail pointer indicates the last transaction successfully transmitted to the host computer (ECH).

3.3.5.2.1.7 Lane Toll Collection (Itc)

The Toll_Proc process is responsible for collecting the payment mode related queue information about each vehicle in the lane (Unpaid Queue). For this propose it gets inputs from the user interface. Toll_Proc also sends a trigger event to QMAN about all the vehicles which have valid 'pay types' associated with them. QMAN then moves those vehicles from 'Unpaid Queue' to 'Paid-Queue'. Figure 3-18 displays the **Software Flow Diagram** and is followed by Figure 3-19, that details the **User Interface State Machine**.

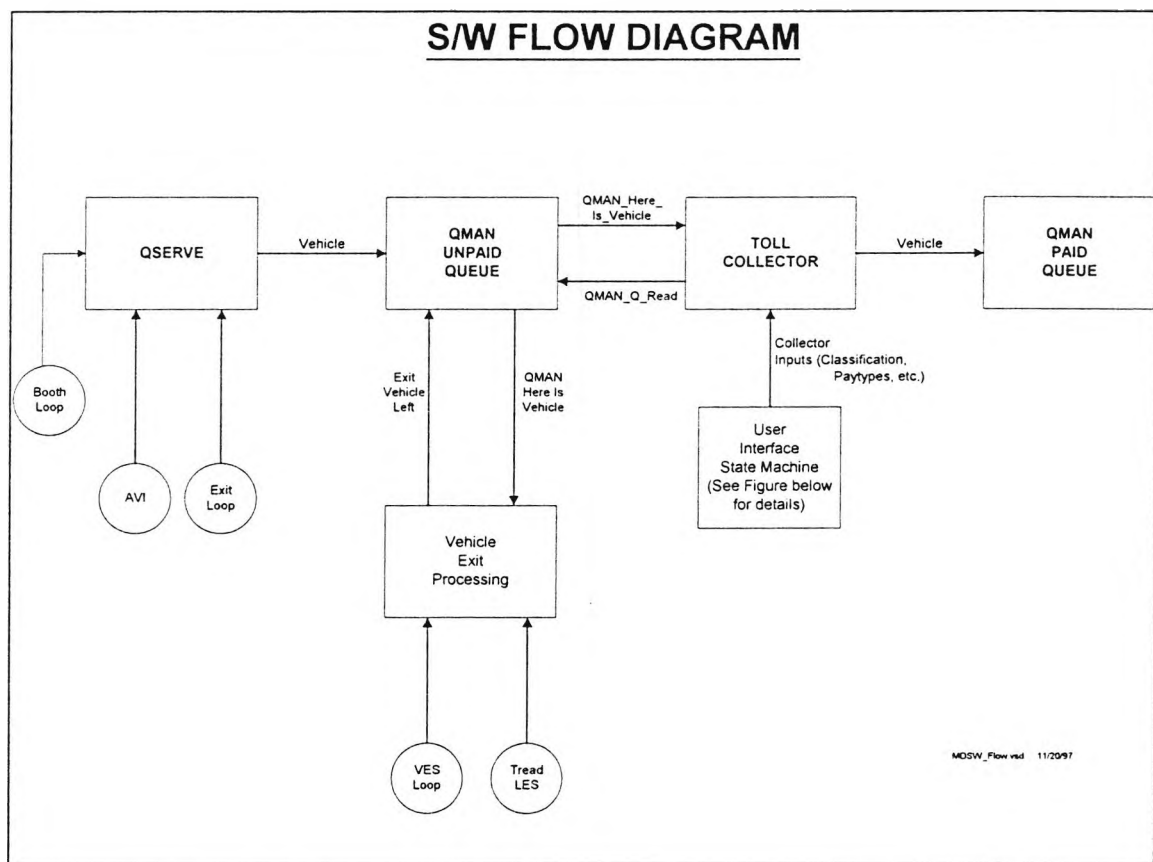


Figure 3-18 Software Flow Diagram

All tags read before Exit Loop presence (High) signal is received belongs to the current vehicle (vehicle last detected). Any tag read after Exit Loop presence signal belongs to the next vehicle. All tags read without a vehicle being detected are thrown away.

The **QServe State Machine** that implements the above functionality is shown below in Figure 3-20.

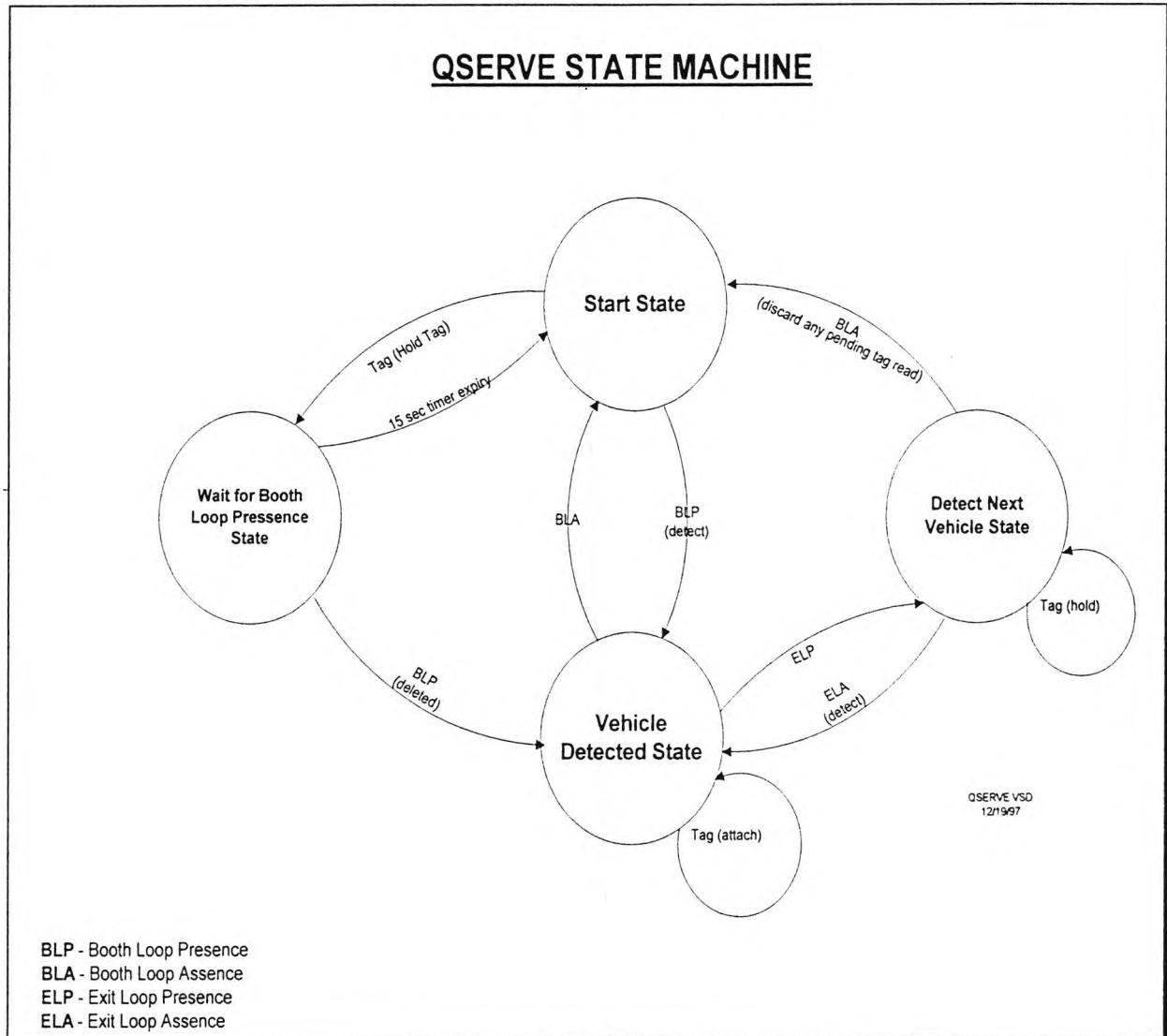


Figure 3-20 QServe State Machine

3.3.5.2.1.9 Qserve Manager (QMAN)

As the name suggests, this process is responsible for managing the 'Unpaid Queue' and 'Paid Queue.' On receiving a trigger event from QSERV, it adds a new vehicle in 'Unpaid Queue.' Similarly, on receiving a trigger event from Toll_Proc, it moves a vehicle from 'Unpaid Queue' to 'Paid Queue.' When a vehicle exits the lane, QMAN carries out the responsibility of judging if it was a valid exit, misclass or violation. It also initiates the process of logging each transaction.

3.3.5.2.1.10 Host Communications Services (*hostcomm*)

The **hostcomm** process is responsible for communications with the ECH and the supervisor application. It establishes the link to the ECH and the supervisor application using the **DECMessageQ** API and maintains these links. The **hostcomm** process receives transactions from the **trxserver** process, transmits them to the ECH and the supervisor and notifies **trxserver** of the result. Problems with the links are addressed by the **trxserver** process and the **DECMessageQ** link layer.

3.3.5.2.1.11 Toll Terminal Interface (*tti*)

The **tti** process receives its input from the RS-232 serial port from the MLT. It decodes these inputs as either classification or log-in/log-out events. These events are then sent to the **ltc** process for further processing.

When the **tti_interp** receives a **Toll Evader keycode** (hex 0x54, ASCII 'T') from the MLT over the serial line, the process will post a **TOLL_EVADER** message to the **TOLL_COLLECTOR** process (**ltc**).

3.3.5.2.1.12 AVI Interpreter (*avi_interp*)

The AVI interpreter and AVI handler processes handle communications between the Lane Controller and the AVI reader. The **avi_hdlr** process reads serial inputs from the AVI reader, verifies their validity by means of a **CRC** check, and passes them to the AVI Interpreter (**avi_interp**) process. The **avi_interp** process then extracts the IAG tag data from the serial data and passes the needed data elements to the Toll Collector (**ltc**) process.

3.3.5.2.1.13 Treadle Handler (*trdl_hdlr*)

The **trdl_hdlr** process is the second-level interrupt handler for the **TRMI Smart Treadle Interface**.

The **trdl_hdlr** process monitors the serial port to which is attached the **TRMI Smart Treadle** treadle monitor, reading in messages, interpreting them, and passing the appropriate messages on to the Toll Collector process.

3.3.5.2.1.14 Canopy Light interpreter (*cl_interp*)

The **lms_interp** process is responsible for all communications with the **Canopy Light (CL)** device. All processes that need to affect the message displayed send the necessary information to the **lms_interp** process which packets it in the format expected by the LMS.

3.3.5.2.1.15 Violation Capture (capture)

The capture process is responsible for the image capture of the rear license plates of violators. The capture process receives triggering commands from the **lrc** process. When a trigger request is received the Frame Grabber device driver is activated which captures a single image of the front of the vehicle and four images from the rear. It then transfers them to a RAM disk to optimize the lower process priority and the speed of storage. The transaction information is included as a header onto each of the image files. A capture process transfers images from the software ramdisk to the **RAID1** sub-system where they are temporarily stored prior to transmission to the AVI by the **send_images** batch process.

The following table presents payment and classification conditions upon exit from the lane and indicates whether a **VES Event**, **Violation**, or **Unusual Occurrence** is recorded in each instance. Reaction to classification mismatches is based upon the assumption that the post-class sub-system is the most reliable, the AVI or tag class is less reliable, and the collector class is the least reliable. Therefore, a post-class disagreement will result in an image review while an AVI versus a collector disagreement will result in an unusual occurrence as indicated in **VES Capture Event Diagram** (Figure 3-21), **VES Attended Lane Process Flow Diagram** (Figure 3-22) and **VES Classification Mismatch Process Flow Diagram** (Figure 3-23).

AVI-Only Mode					
		Image	Viol.	U.O.	Comment
AVI Zero Balance		X	X	-	
No Payment (Violation)		X	X	-	
Class Mismatch:					
	AVI vs. Post	X	-	X	image review
Attended Mode:					
		Image	Viol.	U.O.	Comment
		-	-	-	
AVI Zero Balance		X	X	-	
No Payment (Violation)		X	X	-	
Class Mismatch					
	coll. vs. Post & AVI	X	-	X	coll. error
	coll. & AVI vs. Post	X	-	X	image review
	coll. Vs. Post	X		X	image review
Insufficient Payment		X	X		
Turnaround		X	-	X	
Misclass		X	-	X	correct classification

Figure 3-21 VES Capture Event Diagram

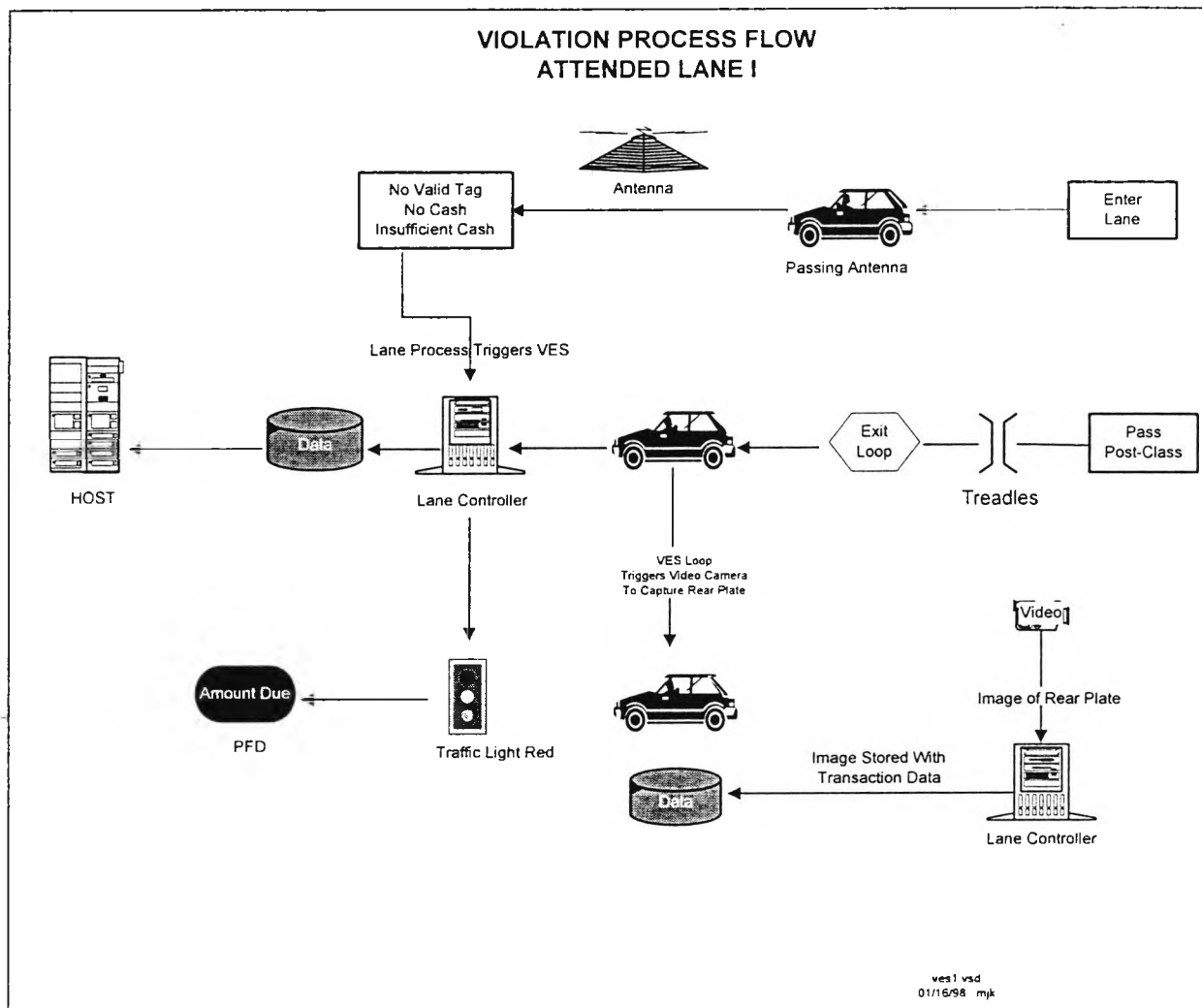


Figure 3-22 VES Attended Lane Process Flow Diagram

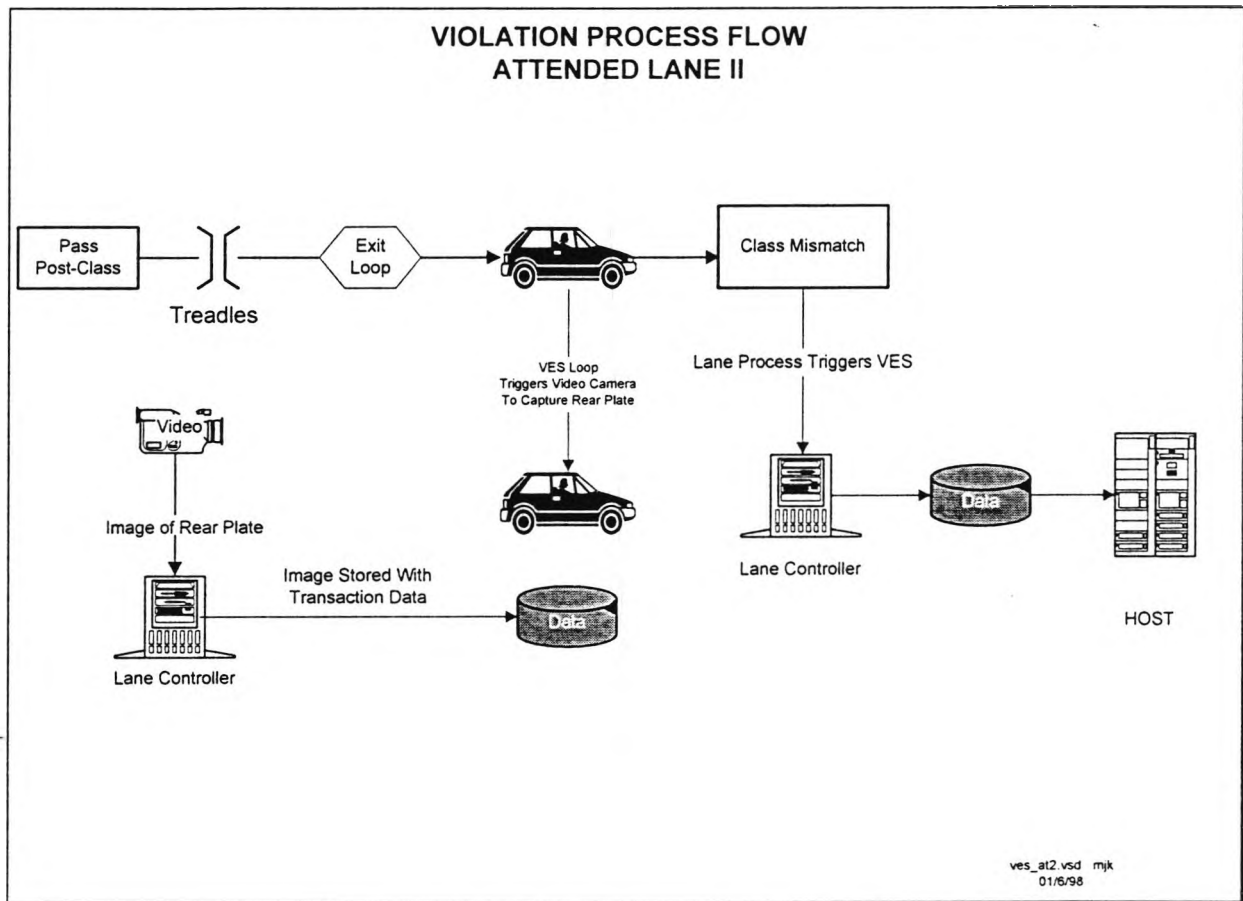


Figure 3-23 VES Classification Mismatch Process Flow Diagram

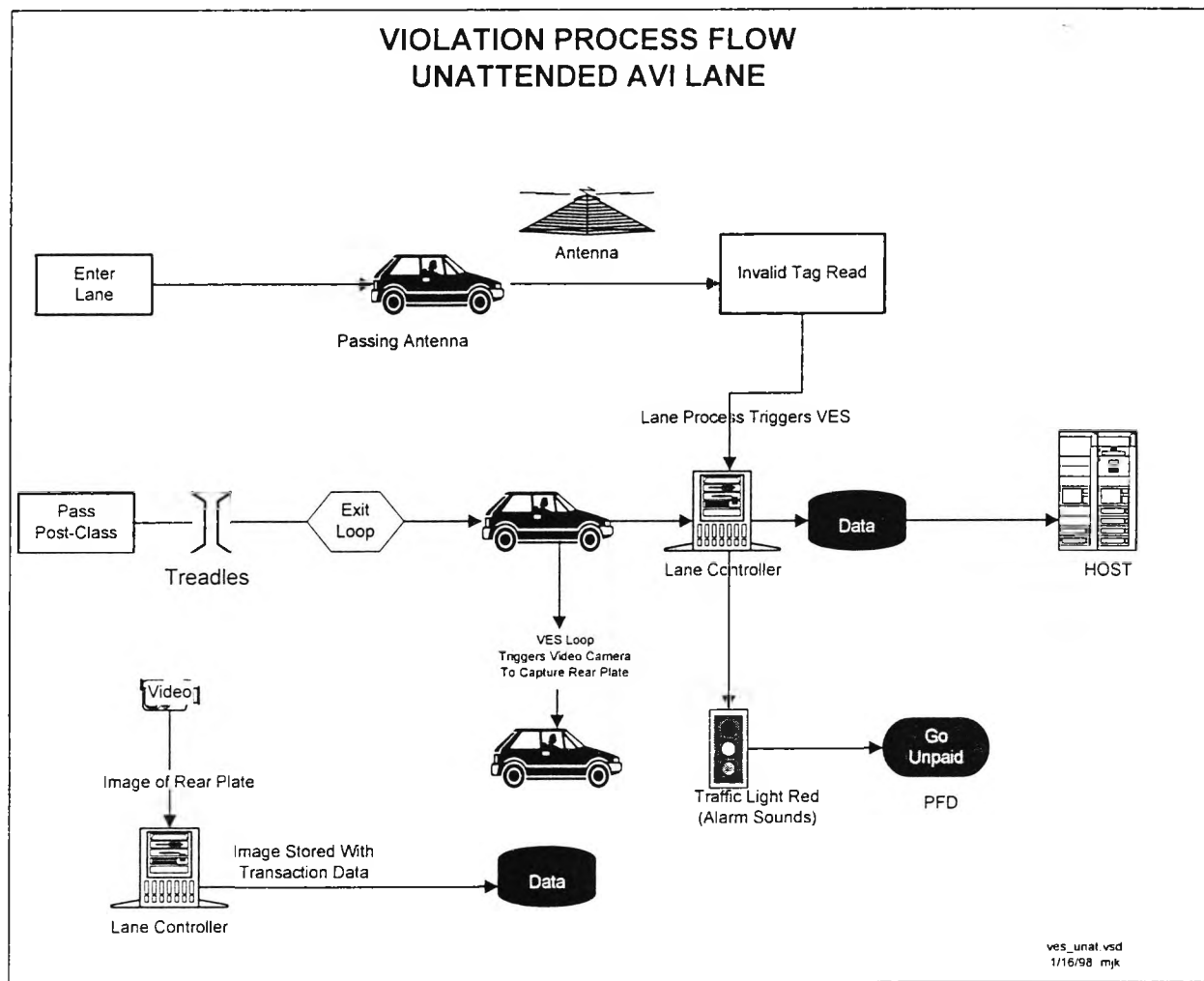


Figure 3-24 VES Unattended Lane Process Flow Diagram

3.3.5.2.1.16 Patron Fare Display Interpreter (pfd_interp)

The **pfd_interp** process is responsible for all communications associated with the Patron Fare Display (PFD). All processes that affect the message displayed send the necessary information to the **pfd_interp**, which packets it in the format expected by the PFD.

3.3.5.2.1.17 UPS Interpreter (ups_interp)

The UPS interpreter process receives status messages from the in-lane UPS via the UPS's RS-232 interface. The process monitors several conditions of the UPS, including inverter temperature, load, and battery level. If these conditions reach pre-determined levels, maintenance alerts are sent to the MOMS interface.

3.3.5.2.1.18 Text Inserter (*text_insert*)

The text inserter process is responsible for all communications with the video text inserter device. The process accepts input from all lane processes which affect the video text inserter display, and packages this input in the format expected by the video text inserter device.

3.3.5.2.1.19 Background Processes

In addition to the device drivers and application processes, there are certain batch scripts which are executed to perform lower priority work. These scripts can be scheduled to run at specific times by the UNIX **cron** scheduler.

3.3.5.2.1.20 Send Images (*send_images*)

The **send_images** process is periodically activated by the UNIX scheduler (**cron**). This batch process transmits the currently available separate image files from the Lane Controller to the ECH using the industry standard FTP program provided by the operating system. By using this approach, image file transfers can be scheduled at times when network activity is lowest providing optimum bandwidth utilization. These image files will be uniquely named by plaza, lane, date, and time for correct reconciliation with its transaction record.

In the event of a process disruption failure, FTP returns an error code and all images from the point of failure and up to the scripted batch of transfer images. Images are moved, not copied, and in the event of an ECH loss of data before backup, images will be lost.

3.3.5.2.1.21 Roll Forward

The roll forward is a program started by the **cron** process. Its function is to set the time forward when transitioning to Daylight Savings Time.

3.3.5.2.1.22 Fall Back

The fall back is a program started by the **cron** process. Its function is to set the time back when transitioning from Daylight Savings Time.

3.3.5.3 Other Background Processes

In addition to the device drivers and application processes, certain batch scripts are executed to perform lower priority work. These scripts can be scheduled to run at specific times by the UNIX **cron** scheduler.

3.4 Communications Interfaces

This section describes the input to and output from the AVI system. The details within can be treated as a preliminary Interface Control Document (ICD).

3.4.1 Lane Controller I/O

The Lane Controller and associated software monitors the sensory input of devices installed and configured in the lane. By monitoring such input, the Lane Controller makes a determination on these events to determine a transaction. The Lane Controller is also responsible for providing certain output to provide collector and customer feedback to facilitate smooth operations and aid in vehicle throughput.

The type of input and output that are presented to, and output from the Lane Controller fall into three distinct categories:

- Discrete I/O
- PIO
- Network

A separate section, Section 5, will be used to describe network communications.

3.4.2 Discrete I/O

These input are generated by a contact (switch or relay) closure. The Lane Controller Programmable I/O board (PIO) can detect when such an event occurs and send information to the controlling program. It is only able to detect two states such as **ON / OFF** or **OPEN / CLOSED**. Each Lane Controller is equipped with a PIO card which provides eight discrete inputs, eight discrete outputs, and an additional eight discrete lines that can be configured as input, output, or a mixture of both.

3.4.3 PIO

All of the serial connections to the Lane Controller use the industry standard RS-232 protocol. Many of the devices connected to the Lane Controller are able to communicate using this protocol through the Mark IV Technologies Roadcheck reader system. This protocol is not restricted to state detection alone. The information conveyed is a function of the Interface Control Document (ICD) which details all of the message formats and content between the transmitting and receiving systems.

3.4.3.1 TRMI Smart Treadle Interface

The communications protocol between the Lane Controller and the TRMI Serial Line Interface (SLI) is asynchronous, full-duplex, and ASCII based. The baud rate is configurable between 300 and 19200 baud. The message protocol is as follows:

1st Byte	2nd Byte	3rd Byte	Description
['0' .. 'B'] ['A' or 'B']	'+'	<cr>	Change of binary input ON
['0' .. 'B'] ['A' or 'B']	'-'	<cr>	Change of binary input OFF
'I'	'I'	<cr>	SLI query response
'F'	'F'	<cr>	Forward axle event
'R'	'R'	<cr>	Reverse axle event
'U'	'U'	<cr>	Treadle activity not forward or reverse
'S'	['1' .. '4']	<cr>	Treadle strip [1 .. 4] shorted
'K'	['1' .. '4']	<cr>	Treadle strip [1 .. 4] OK
'O'	['1' .. '4']	<cr>	Treadle strip [1 .. 4] open
'I'	['1' .. '4']	<cr>	Treadle strip [1 .. 4] intermittent
'E'	['1' .. '4']	<cr>	Treadle strip [1 .. 4] enabled
'D'	['1' .. '4']	<cr>	Treadle strip [1 .. 4] disabled
'A'	'F'	<cr>	Auto disable OFF
'A'	'O'	<cr>	Auto disable ON
'V'	'R'	'###<cr>	Version number (e.g. 2.51)
'E'	'R'	<cr>	Error. invalid command
'C'	'F'	[dddddd]<cr>	Count forward
'C'	'R'	[dddddd]<cr>	Count reverse

3.4.4 Network

The Lane Controller receives control messages from the Alpha Server and the Supervisor workstation via the network. These messages are broadcast to all lanes, but only acted upon if the lane control mask is applicable. By using the control mask approach commands can be sent to individual lanes, all lanes, or a selected subset of lanes.

Each message received by the Lane Controller contains a standard header which is pre-appended to each record. The format of the header record is as follows:

3.4.4.1 Header

Datatype	Variable Name	Size in Bytes	Remarks
unsigned long	rq_timestamp	4	Timestamp request was generated
unsigned char	rq_msg_type	1	Message request type 40 = lane status 42 = hourly counts 43 = AVI transponder status request 50 = Lane Control Record 70 = Individual Tag Status Update 80 = FTP General File Transfer 81 = FTP Tag Status 90 = DB_SERVER advertisement 91 = Data Transmission On 92 = Data Transmission Off
unsigned short	rq_supervisor_id	2	Requesting supervisor ID
unsigned int	rq_target_mask	8	DECmessageQ target mask

3.4.4.2 AVI Transponder Status Request

Datatype	Variable Name	Size in bytes	Remarks
unsigned int	ts_avi_tag_id	4	AVI transponder ID
char	ts_tag_institution	4	Facility Code

3.4.4.3 Lane Control Record

Datatype	Variable Name	Size in bytes	Remarks
unsigned char	lr_lane_state	1	Requested new lane state 1 = open 2 = Closed 3 = Standby
unsigned char	lr_lane_mode	1	Requested new lane mode 1 = avi 2 = attended 3 = manual
unsigned char	lr_reset_flg	1	Device reset to be performed
unsigned char	lr_camera_flg	1	Camera ON / OFF

3.4.4.4 Individual Tag Status Update

Datatype	Variable Name	Size in bytes	Remarks
char	tu_tag_institution	4	Transponder facility code
unsigned int	tu_avi_tag_id	4	Transponder ID to update
unsigned char	tu_avi_tag_status	1	Transponder ID status to
unsigned char	tu_vehicle_class	1	Vehicle Class
unsigned char	tu_vehicle_type	1	Vehicle Type
char	rq_access_path	80	File specification of file to transfer

The format of the individual record types is given in the following subsections:

3.4.4.5 Key-in

Datatype	Variable Name	Size in bytes	Remarks
unsigned char	lo_collector_type	1	Collector Type
unsigned short	lo_supervisor_id	2	Current supervisor ID
unsigned long	lo_login_timestamp	4	Logon Time



3.4.4.6 Key-out

Datatype	Variable Name	Size in bytes	Remarks
unsigned char	lf_collector_type	1	Collector Type
unsigned short	lf_supervisor_id	2	Current supervisor ID
unsigned long	lf_logoff_timestamp	4	Logon Time

3.4.4.7 Transaction

Datatype	Variable Name	Size in bytes	Remarks
unsigned long	tx_logon_timestamp	4	Collector Logon time
unsigned char	tx_expected_class	1	Expected vehicle class
unsigned char	tx_actual_class	1	AVC detected vehicle class
unsigned char	tx_expected_axles	1	Expected number of axles
unsigned char	tx_actual_axles	1	AVC detected axles
long	tx_amount_due	4	Amount due for transaction
long	tx_amount_paid	4	Amount paid for transaction
unsigned char	tx_paytype	1	How payment made ** 1 = AVI 2 = Ticket (Not Applicable to SCDOT) 3 = Cash 4 = Insufficient Payment 5 = Misclass 7 = Written 8 = Emergency Vehicle 9 = Police Vehicle 10 = Maintenance Vehicle 11 = National Guard(Not Applicable to SCDOT)
unsigned char	tx_forward_axles	1	Number of forward axles
unsigned char	tx_reverse_axles	1	Number of reverse axles
unsigned char	tx_violation	1	Violation
unsigned char	tx_overheight	1	Vehicle is overheight

Datatype	Variable Name	Size in bytes	Remarks
unsigned char	tx_doubletire	1	Vehicle has dual-tires
char	tx_tag_institution	4	Facility Code
unsigned long	tx_tag_number	4	Tag ID
unsigned char	tx_tag_read_count	1	Number of times interrogated
unsigned char	av_reader_number	1	AVI Reader number
unsigned char	av_tag_read	1	Last handshake count
unsigned char	av_antenna_number	1	Antenna number
unsigned char	av_tag_read_count	1	Number of tags read
unsigned char	av_sensor_status	1	Sensor status
unsigned char	av_message	21	AVI reader message

3.4.4.8 Lane Status

Datatype	Variable Name	Size in bytes	Remarks
unsigned short	ls_fwd_axles	1	Total forward treadles
unsigned short	ls_rev_axles	1	Total reverse treadles
unsigned short	ls_ent_loops	2	Total number of entry loops
unsigned short	ls_ext_loops	2	Total number of exit loops
unsigned short	ls_trxs_shift	2	Total trxs / shift
unsigned short	ls_trxs_hour	2	Total trxs / hour
unsigned short	ls_trxs_day	2	Total trxs / day
unsigned char	ls_treadle_status	1	Current treadle status
unsigned char	ls_status_flags	1	Value of lane status flags

3.4.4.9 Message

Datatype	Variable Name	Size in bytes	Remarks
char	ms_message	44	Generic message transaction



3.4.4.10 Hourly Traffic

Datatype	Variable Name	Size in bytes	Remarks
unsigned short	veh_ct	24	The last 24 Hours of vehicle traffic / hr

3.4.4.11 Tag Status

Datatype	Variable Name	Size in bytes	Remarks
char	ts_tag_institution	4	Facility Code
unsigned long	ts_tag_number	4	AVI transponder ID
unsigned char	ts_tag_class	1	AVI transponder Class
unsigned char	ts_tag_status	1	AVI transponder status

3.4.4.12 Error

Data Type	Variable Name	Size in bytes	Remarks
unsigned long	ec_error_code	4	Unique error code 200 - 299 AVI Errors 300 - 699 File I/O (open, seek, write, read, exist) 600 - 999 IPC Errors (semaphores, streams, messages, host, etc.) 1000 - 2999 Operational Errors 3000 - 5999 All other errors
char	ec_description	44	Error description

3.4.4.13 Maintenance Event

Datatype	Variable Name	Size in bytes	Remarks
unsigned char	rs_equipment_id	1	Equipment identifier

Datatype	Variable Name	Size in bytes	Remarks
char	rs_equipment_status	44	Equipment status

3.4.5 Collector Login Validation

When a collector tries to login the lane system, the Lane Controller will send a validation request to the host and proceed with the login process upon receiving permission. In the case of host communication failure, the lane has the employee table stored locally and will allow the collector to login only if the swipe identification card is validated in the table mentioned. Card failures can only be overridden by the Toll Supervisor through the Plaza Lane Monitor software. In the event that the network communications are down and the card cannot be read, the collector cannot login into the lane until corrections are made.

All of the above messages can be generated to conduct testing and field checkout after component replacement while the lane is open in a maintenance mode. To ensure that these transactions are not confused with transactions generated when the lane is open for normal use, the record type is "ANDed" with Hex 80 (0x80), effectively setting the top bit of the record type.

3.5 Toll Collector User Interface

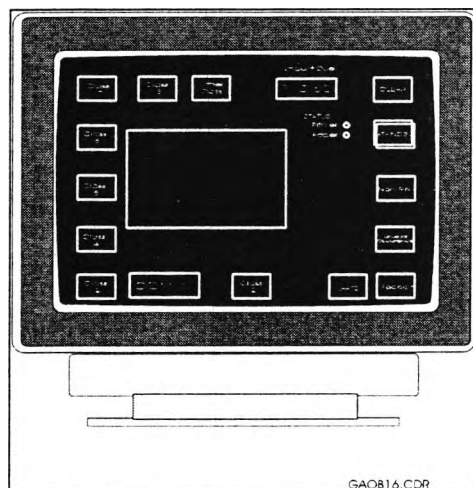


Figure 3-25 Toll Collector Touchscreen

The lane terminal uses a touchscreen as the input device. Collectors' input is done through the "soft" keys on the screen. The touchscreen features a screen display of buttons, and by touching the appropriate button on the touchscreen, the Toll Collector can classify vehicles, generate customer receipts upon request, open remote gates, and perform a variety of other functions.

The **Toll Collector Touchscreen** (Figure 3-25) is mounted in the toll booth and tilts backward, forward, and swivels. The touchscreen interfaces with the receipt printer and has its own diagnostic routines, which report to the Lane Controller.

In order to make the user interface as simple to use as possible, a number of features have been incorporated to ensure commonality across screens.

One of these features happens when a button is pressed and the border illuminates and remains highlighted until the action required is complete. This is true of all buttons on the main screen except the **CLEAR** button which is a momentary action, and only highlights for a short period. This also applies to all numeric keypad buttons.

If a highlighted button is pressed, the action of that button is canceled, (if **OTHER PAYMENT** has been selected and the **OTHER PAYMENT** pop-up is displayed, then a subsequent selection will remove the pop-up and return the **OTHER PAYMENT** button to its off state). This action is true of all buttons that have an associated pop-up screen except **STANDBY**.

If an action on a screen is selected that is exclusive to an initial selection, then the first action is canceled and the second action is initiated. As an example, if **OTHER CLASS** had been selected and the **OTHER CLASS** pop-up was displayed, then selection of **CLASS 6** would remove the pop-up, return **OTHER CLASS** to the off state, and highlight **CLASS 6**.

3.5.1 Manual Toll Collection Process & Screen Layout

The Toll Collector uses several screens to manually or semi-manually handle toll collections. The different scenarios a collector needs to have knowledge of include:

- Customer pays the toll by cash.
- Customer pays the toll by AVI tag through AVI device.
- Customer pays the toll by AVI tag through collector.

All the screens show the current date and time. A basic manual for the toll collection process includes the following steps:

1. Log onto the system.
2. Open lane.
3. Classify vehicles.
4. Make cash changes, if needed.
5. Print receipt, if requested.
6. Set Lane to **STANDBY** mode and **CLOSE** lane.
7. Log off from the system.

The following subsections describe the screens used in the toll collection process.

3.5.1.1 Logon Screen

The logon screen displays a numeric keypad. It provides a means for the collector to logon to the system. The collector can either use the magnetic card reader to input their badge ID or type in the ID through the touchscreen. The touchscreen has a screen saver feature which will blank the screen after several minutes of inactivity. The screen saver feature will be enabled only when no one is logged onto the terminal. The **Logon Screen** (Figure 3-26) describes the layout of the screen.

The image shows a logon screen with two main sections. The left section is titled 'LOGIN' and contains the text 'Insert Badge Into Card Reader' followed by 'or' and 'Manually Login By Entering Collector ID'. The right section is titled 'ENTER COLLECTOR ID' and features a text input field at the top. Below the input field is a numeric keypad with buttons for digits 1 through 9, 0, a backspace key (indicated by a left arrow and two dashes), and an 'Enter' key.

LOGIN		ENTER COLLECTOR ID		
Insert Badge Into Card Reader		<input type="text"/>		
or				
Manually Login By Entering Collector ID				
		1	2	3
		4	5	6
		7	8	9
		<--	0	Enter

Figure 3-26 Logon Screen

3.5.1.1.1 Logon / Standby

After a successful logon, the **Logon / Standby Screen** (Figure 3-27) is displayed. It receives confirmation to either open the lane, log the collector off, or continue to standby.

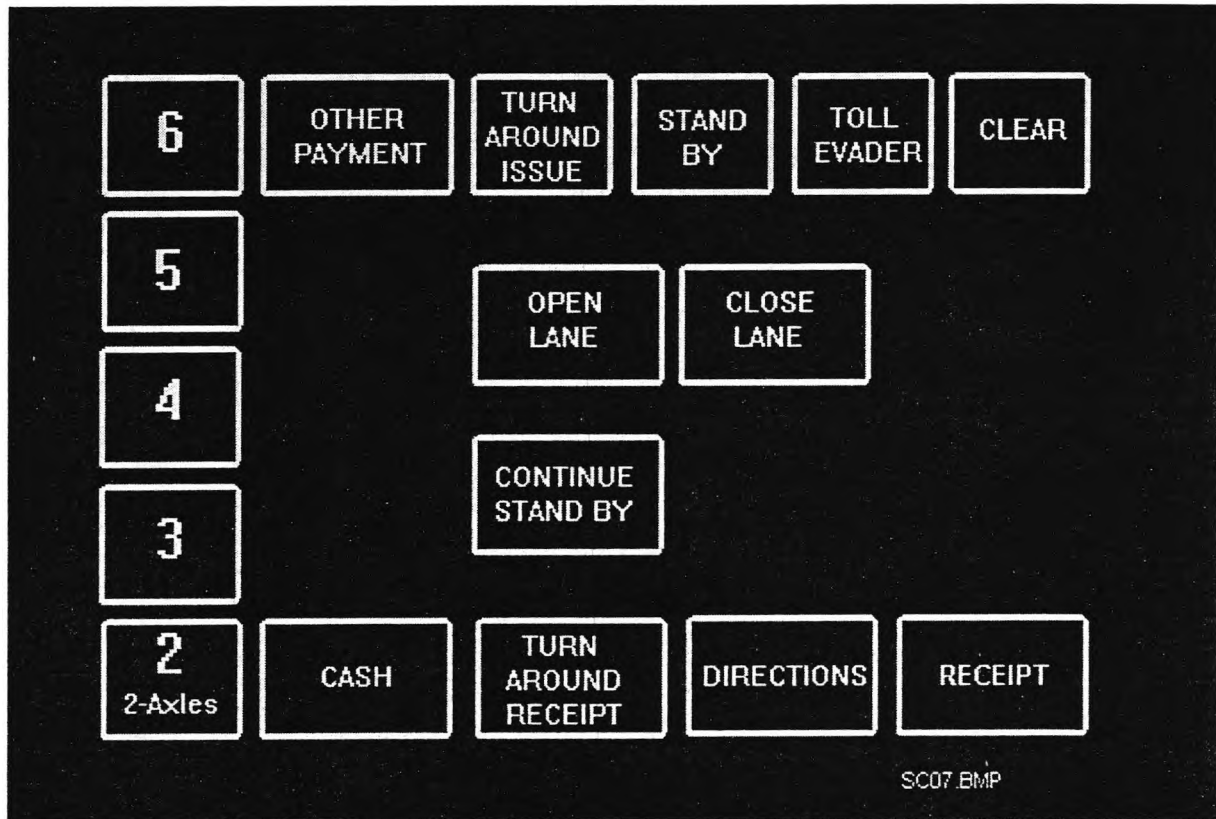


Figure 3-27 Logon / Standby Screen

3.5.1.2 Toll Collection Screens

3.5.1.2.1 First Level Screen

The **First Level Toll Collection Screen**, illustrated in Figure 3-28, allows collectors to classify vehicles that are not ETC-equipped, indicate method of payment other than ETC, manually enter an ETC tag number through the keypad pop-up, request directions to up to six (6) locations from the plaza, clear a classification or payment method, signal a toll evader to the VES, and go to the second level screens for more classifications or other forms of payment.

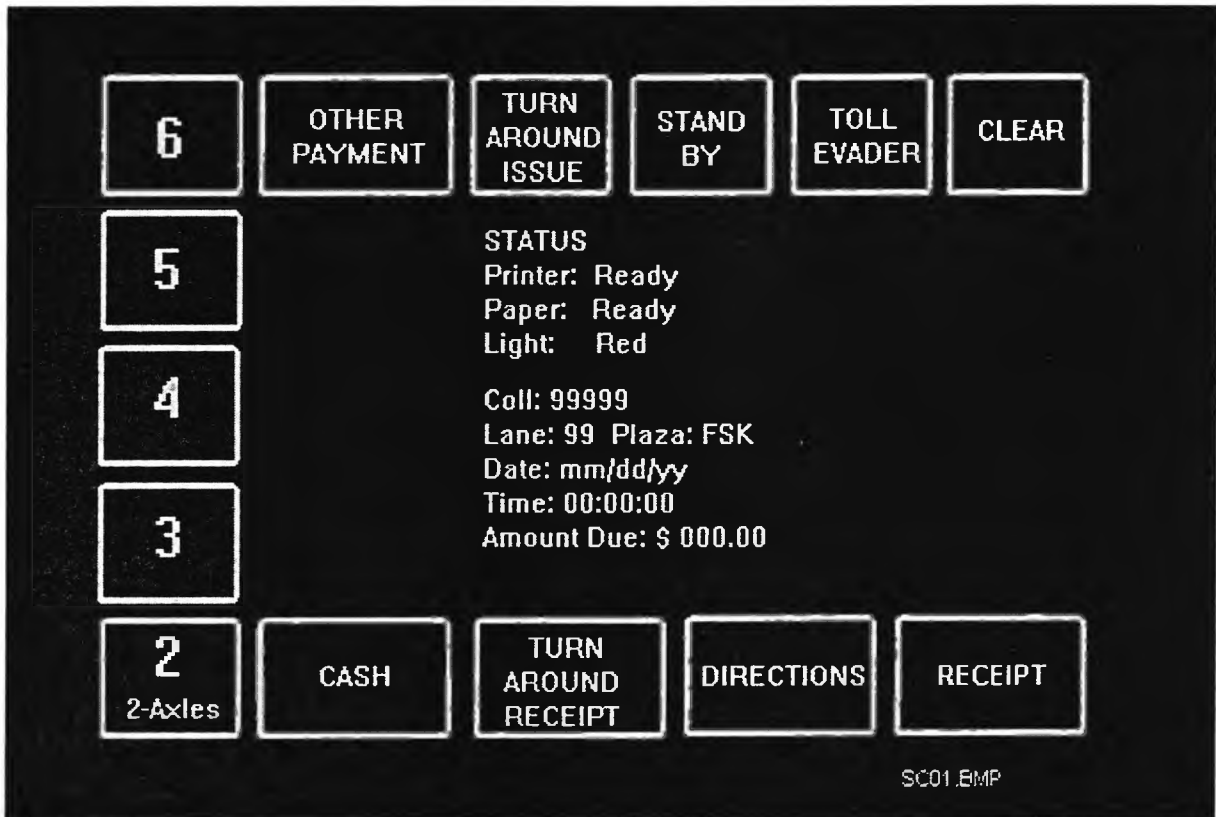


Figure 3-28 First Level Screen

Before the collector touches any keys on the screen, the only active buttons of the first level screen are:

- All class-related buttons for class selection
- TOLL EVADER button
- STANDBY button
- CLEAR button

All other screen areas are inactive, generating no action if pressed.

After pressing a Class button, pressing **OTHER PAYMENT**, **NO TAG READ**, or **DIRECTIONS** buttons will cause pop-up windows with a second level of buttons to appear in the text area of the screen. If an additional classification is needed other than two (2) through five (5), the collector is instructed to press the **OTHER CLASS** button to get to a second level screen for the extra classes.

The **CASH** button is pressed if the customer pays by cash. The **COMMIT** button is used to confirm the operations of the second level pop-up window. Pressing the **CLEAR** button before pressing a payment type button will cancel all previous buttons and clear the screen.

3.5.1.2.1.1 Turn Around

When a customer needs to make a U-Turn, the **TURN AROUND ISSUE** button is used. The system will generate two receipts when this button is pressed: one to keep and place in the tour of duty deposit bag and the other to hand to the customer to be used as turn around pass in the return or turnaround trip through the return plaza within ten (10) minutes of generation. The system will display an alert on the supervisor's screen. A collector receiving the turn around pass will press the **TURN AROUND RECEIPT** button.

3.5.1.2.1.2 Toll Evader

If the collector does not classify a vehicle and the vehicle exits the lane without paying, the collector classification is set to zero (0). The collector can press the **TOLL EVADER** button before the next vehicle is classified by the collector. Or before the next transaction is complete for write. The payment type is set to Toll Evader and the transaction is a violation.

3.5.1.3 Directions and/or Receipt Request

A receipt printer is installed in the Toll Booth. The toll collector issues a receipt command to the printer from the touchscreen via the **RECEIPT** button when a customer requests a receipt. The **DIRECTION** button is used when the customer requests instructions to certain destinations. Pressing the **DIRECTION** button results in the display of a pop-up window with a list of destination names. The collector can choose from the list of names based on the customer's request. Directions to these destinations will be printed on the receipt printer for the customer as illustrated in **Directions and / or Receipt Request** (Figure 3-29).

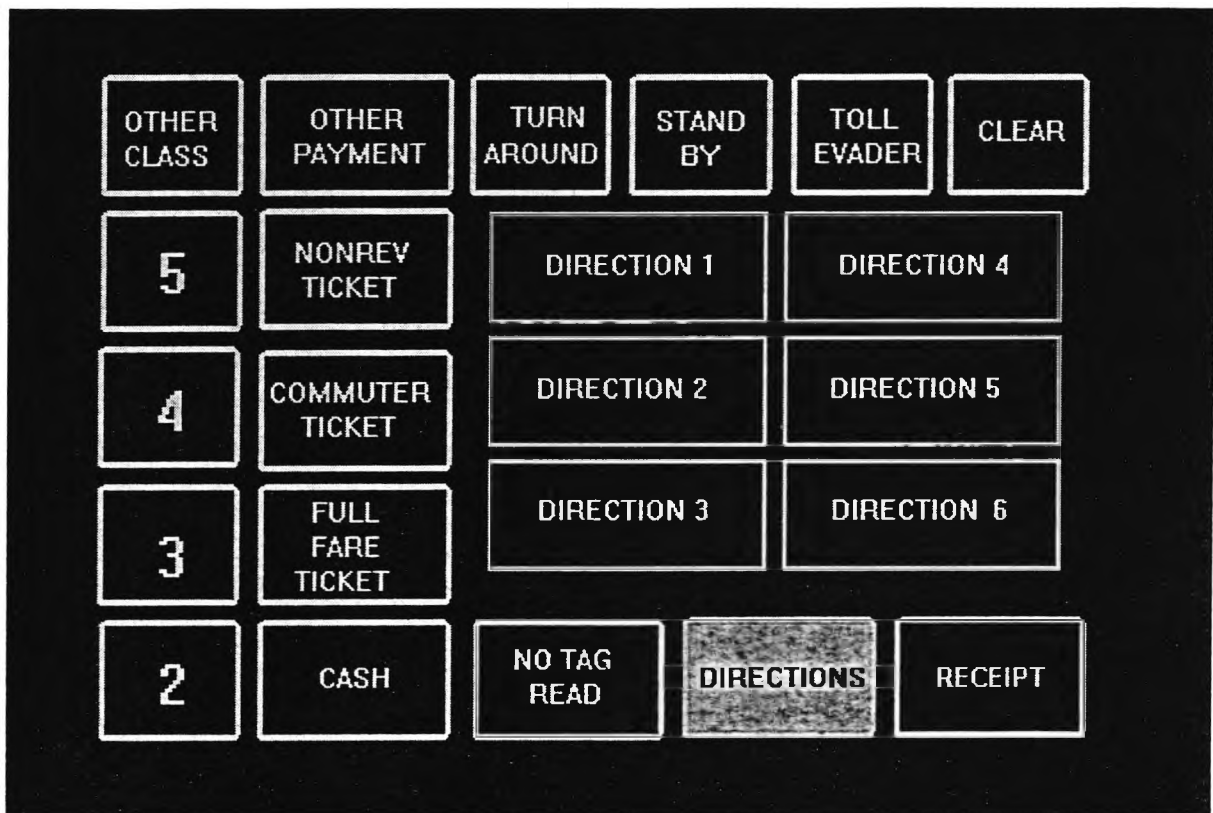


Figure 3-29 Directions and / or Receipt Request

3.5.1.4 Other Payment Methods

Other payment methods for SCDOT manual toll collection include the following:

- PLEDGE PAYMENT
- CHARGE ACCOUNT

Figure 3-30, **Other Payment Methods**, displays the **OTHER PAYMENTS** pop-up window.

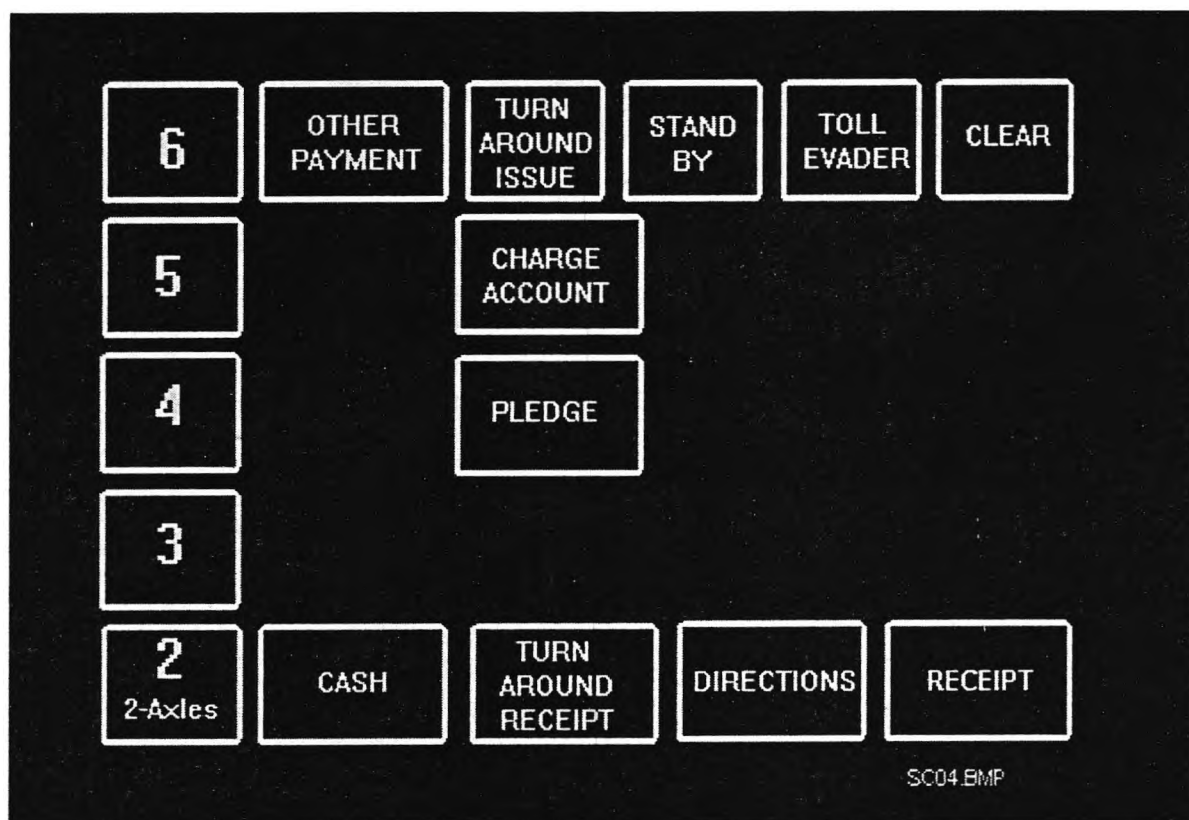


Figure 3-30 Other Payment Methods

3.5.1.4.1 Pledge

If the customer does not have sufficient funds, the collector needs to handle an Insufficient Payment case. The operation sequence is;

1. Press the **OTHER PAYMENT** button.
2. Press the **PLEDGE** button on the second level screen.

This results in the receipt printer producing two forms:

1. One for the customer
2. One for the Toll Collector to record the license plate number of the vehicle and one to turn into the Plaza Supervisor at the end of the shift.

The following occurs in the lane:

1. The Lane Controller changes the traffic light to **GREEN**.
2. Customer exits the lane.
3. As the customer exits the lane, the Lane Controller notifies the Server of the unusual occurrence.

3.5.1.4.2 Charge Account

In order to accommodate the current policy of SCDOT in regard to charge accounts for tolls, the **CHARGE ACCOUNT** button is to be pressed by a collector when a charge account customer enters the lane. The system will generate two receipts when this button is pressed. A place is provided on the receipt to enter the license plate information and company name. One copy is to be given to the driver and one copy is to be placed in the collector revenue bag for later reconciliation review.

3.5.1.5 ETC Tag Detected

When a tag is successfully read by the tag reader or an ETC tag is detected, the **Collector's Screen** displays a status message as displayed in Figure 3-31 and Figure 3-32. Possible messages include the following:

- VALID PAL PASS
- INVALID PAL PASS

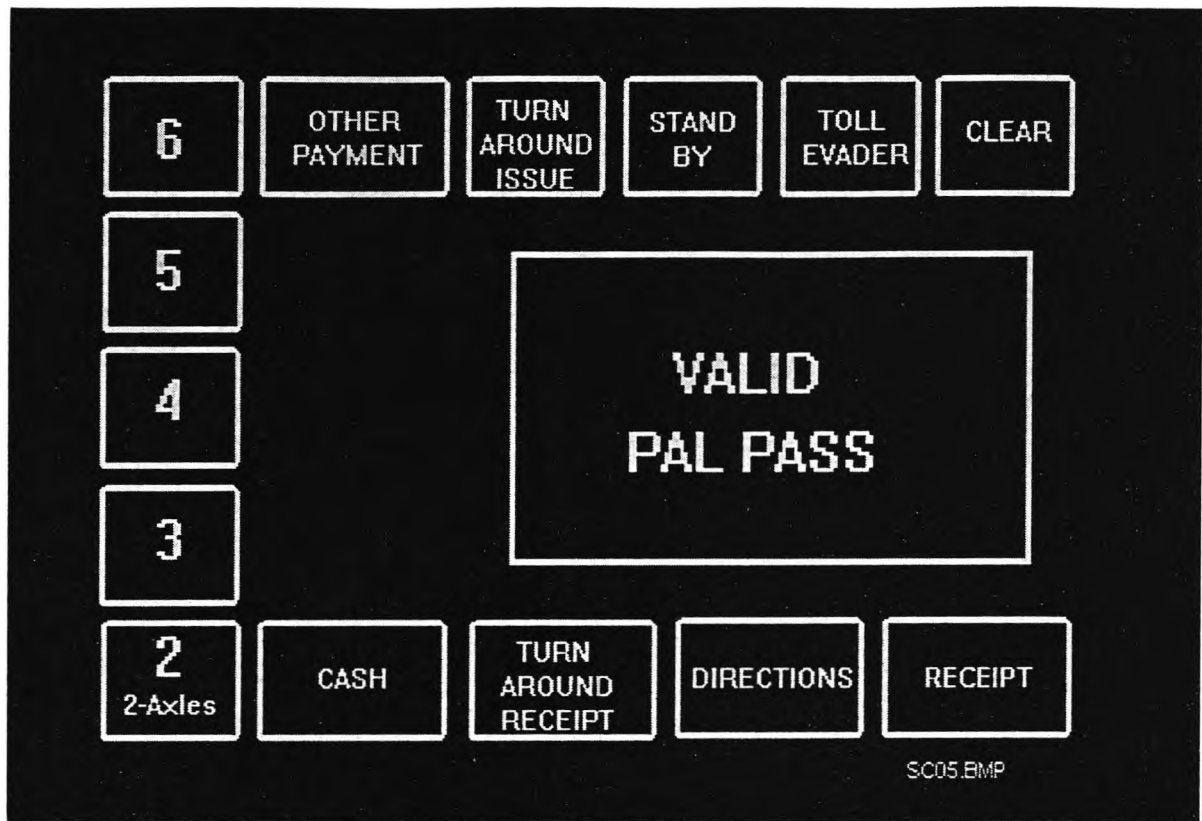


Figure 3-31 Collector's Screen - Valid Pal Pass

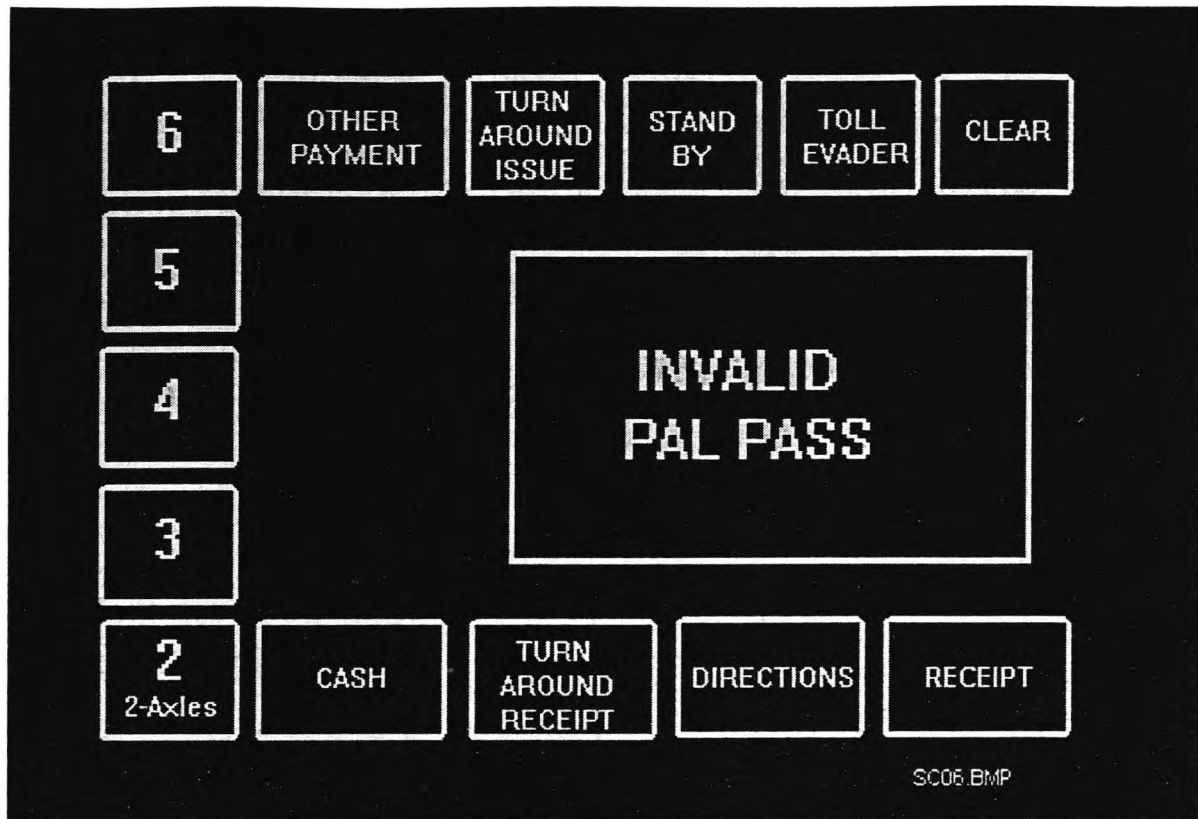


Figure 3-32 Collector's Screen - Invalid Pal Pass

4. Plaza Supervisor

4.1 Functional Description

The Plaza Supervisor subsystem provides the functions necessary to monitor and control toll collection operations. It will be the most commonly used subsystem by the Toll Supervisors. The **Process Hierarchy Diagram** (Figure 4-1) displays the subsystems. The subsystem includes screens to monitor current lane activity at each plaza, review lane history, view current lane messages, review message history, control the opening and closing of lanes, and view trend analysis graphs.

4.2 Process Hierarchy Diagram

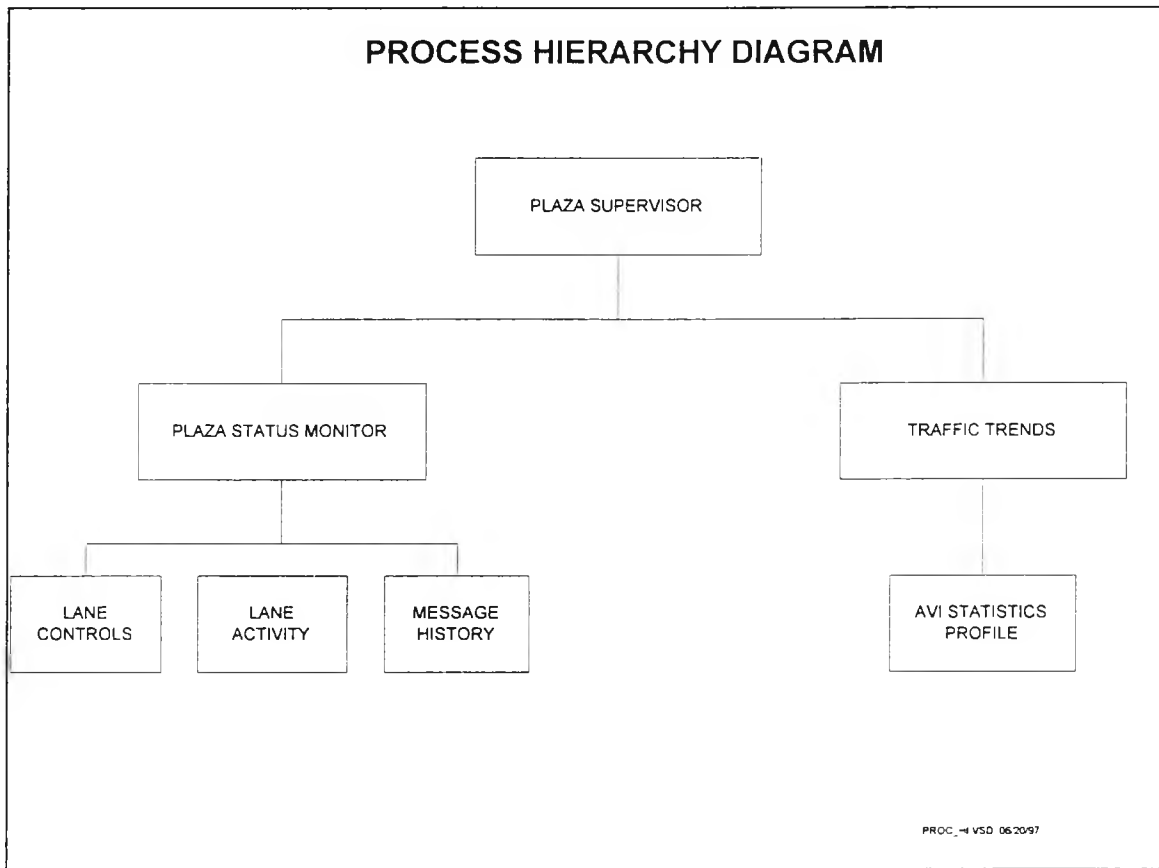


Figure 4-1 Process Hierarchy Diagram

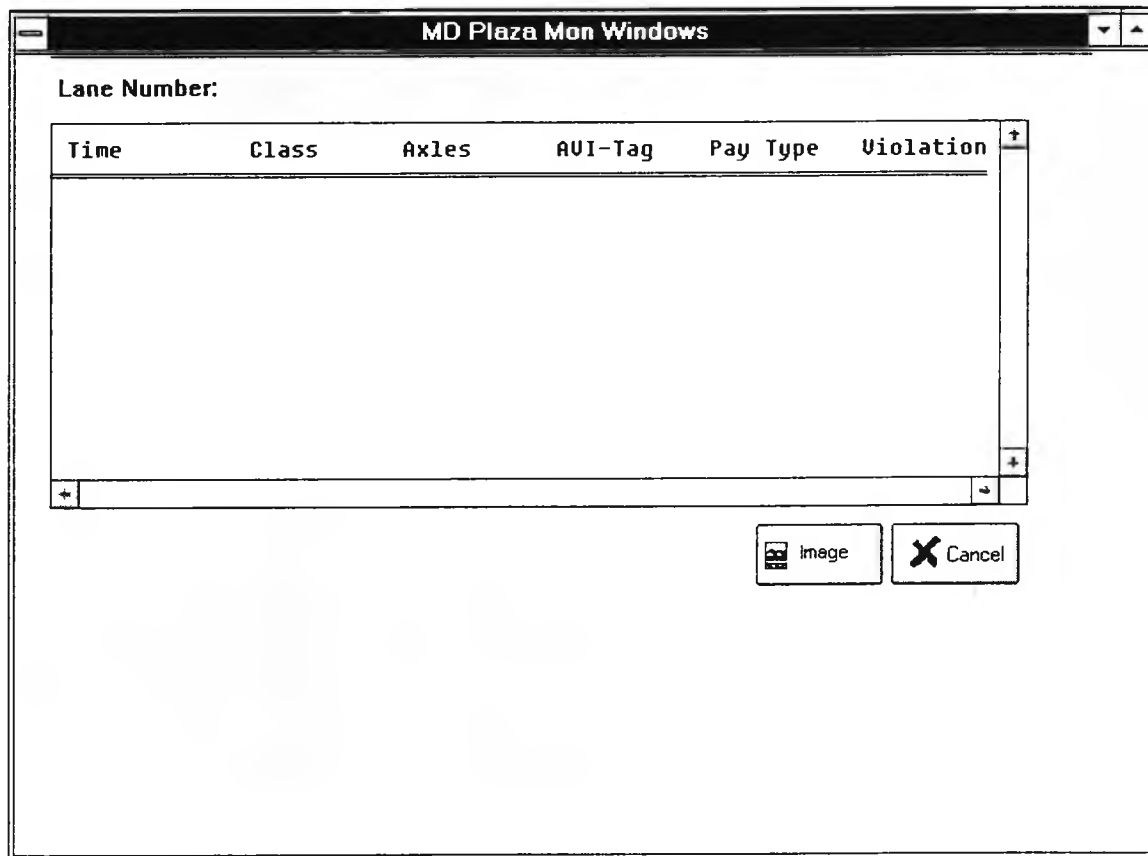


Figure 4-2 Plaza Mon Windows

4.2.1 Monitoring A Plaza

The AVI Plaza Status Monitor screen provides a real time monitoring system for the plaza supervisor. The supervisor selects a particular **Plaza Mon Windows** (Figure 4-2) to monitor and after the selection is made, a scrolling list containing information on all the lanes in the plaza is displayed. The information includes the current mode of the lane (e.g. Unattended AVI, Attended, Closed, Standby), as well as information on the current and five prior transactions processed at the lane. The transaction information includes the Toll Pay Type (e.g. Cash, Ticket, Non-revenue, AVI), the vehicle's class, the vehicle's axle count, and the expected cash value of the toll. Any transaction that was a violation will be displayed in red.

4.2.2 Viewing Recent Lane Activity

In addition to the main scrolling region of the AVI Plaza Status Monitor, there is a scrolling region that displays the last ten transactions processed at whichever lane is highlighted in the main scrolling region. The information displayed includes the time of the transaction, the vehicle's class, the vehicle's axle count, and the AVI Tag Identification Number.

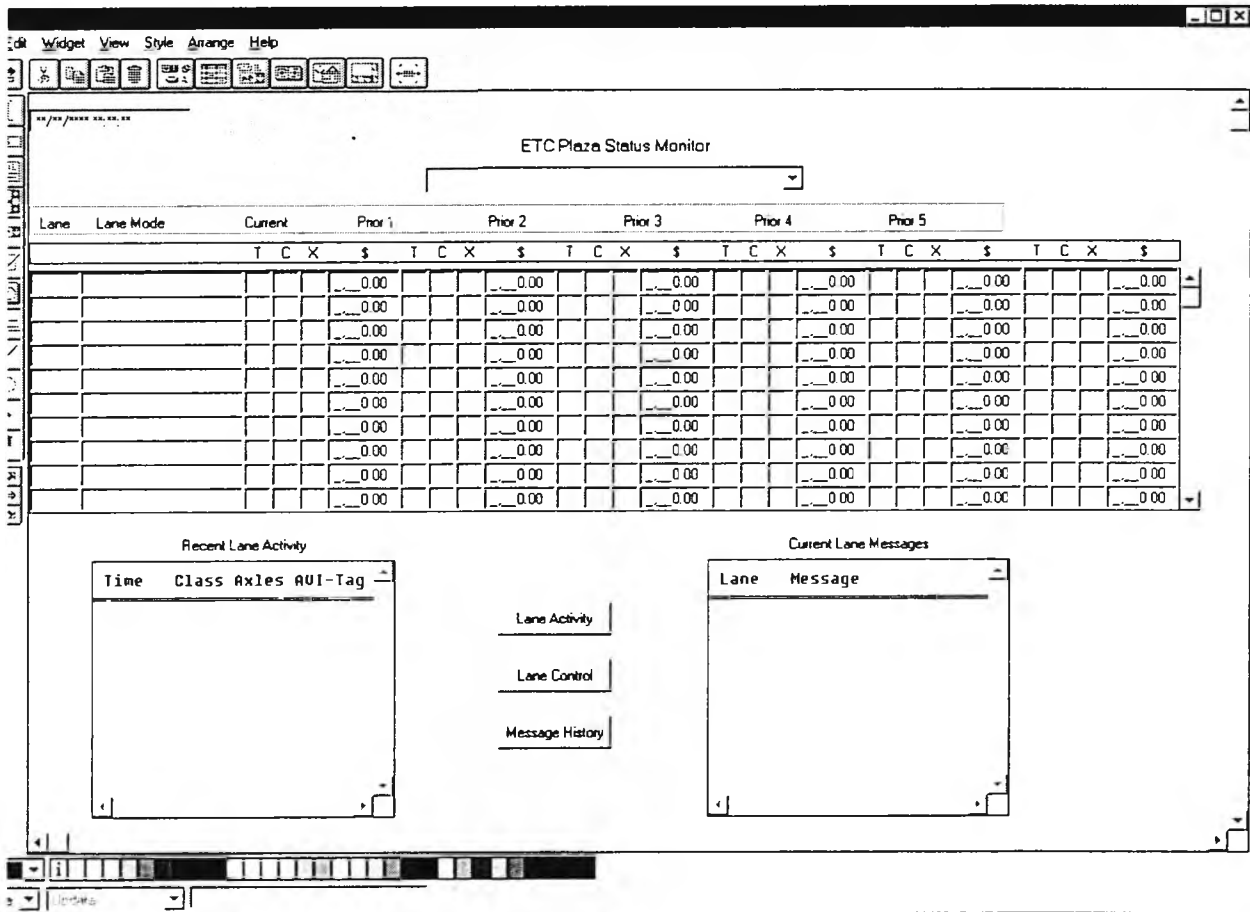


Figure 4-3 AVI Plaza Status Monitor

4.2.3 Current Lane Messages

There is a third scrolling region on the AVI Plaza Status Monitor screen to display the last 10 lane messages and on which lane they occurred. The lane messages will include equipment fault, violation, lane status change, and collector logon and logoff messages. See Figure 4-3 AVI Plaza Status Monitor

4.2.4 Lane Activity History

The Plaza Supervisor may review historical information on a particular lane by highlighting the lane in the main scrolling region of the AVI Plaza Supervisor Monitor screen, and clicking the LANE ACTIVITY button. Another window will be displayed, **Lane Activity** (Figure 4-4), with a scrolling list of the lane's transactions including the time of the transaction, the Toll Pay Type, the vehicle's class, the vehicle's axle count, the AVI Tag Identification Number, and a Violation Indicator. A window may be displayed with an image of a violating vehicle, by highlighting a violation transaction and then clicking on the IMAGE button.

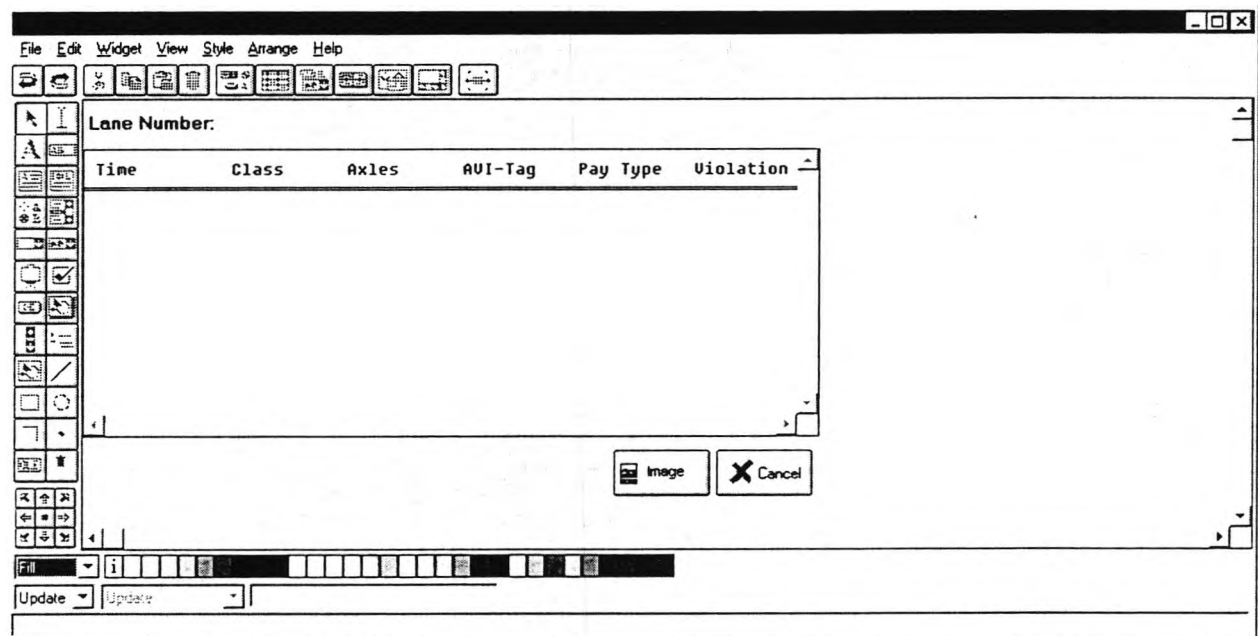


Figure 4-4 Lane Activity

4.2.5 Lane Control

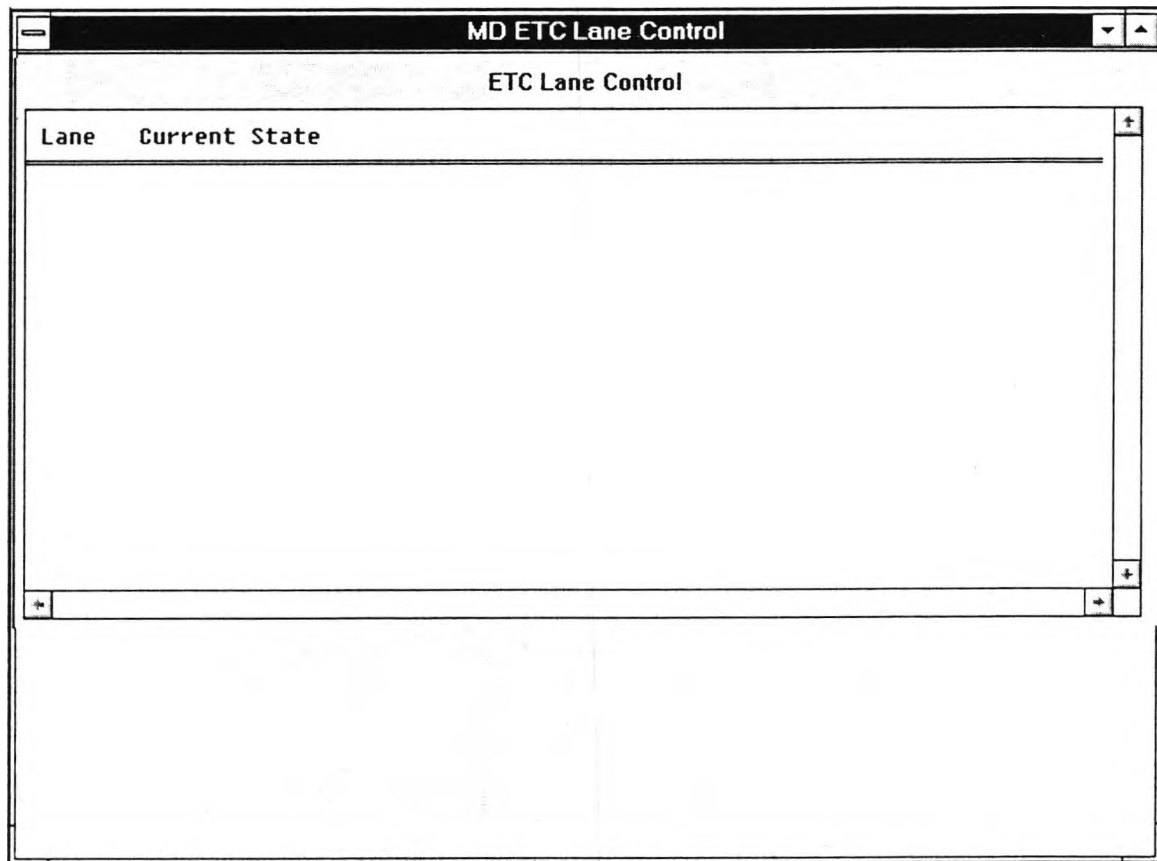


Figure 4-5 ETC Lane Control

The Plaza Supervisor may open and close Unattended AVI lanes by clicking on the LANE CONTROL button of the AVI Plaza Supervisor Monitor Screen. The **ETC Lane Control** window (Figure 4-5) will be displayed with a scrolling list of the Plaza's Lane Numbers and their current state (Open, Closed). When a lane is highlighted, the Lane Number and Current State of the lane are displayed on the lower left quadrant of the screen. The Plaza Supervisor may change the state of the lane by clicking on either the OPEN or CLOSE radio button and then clicking on the UPDATE button. The lane's state will be changed and the change will be reflected in the scrolling list of lanes.

4.2.6 Lane Message History

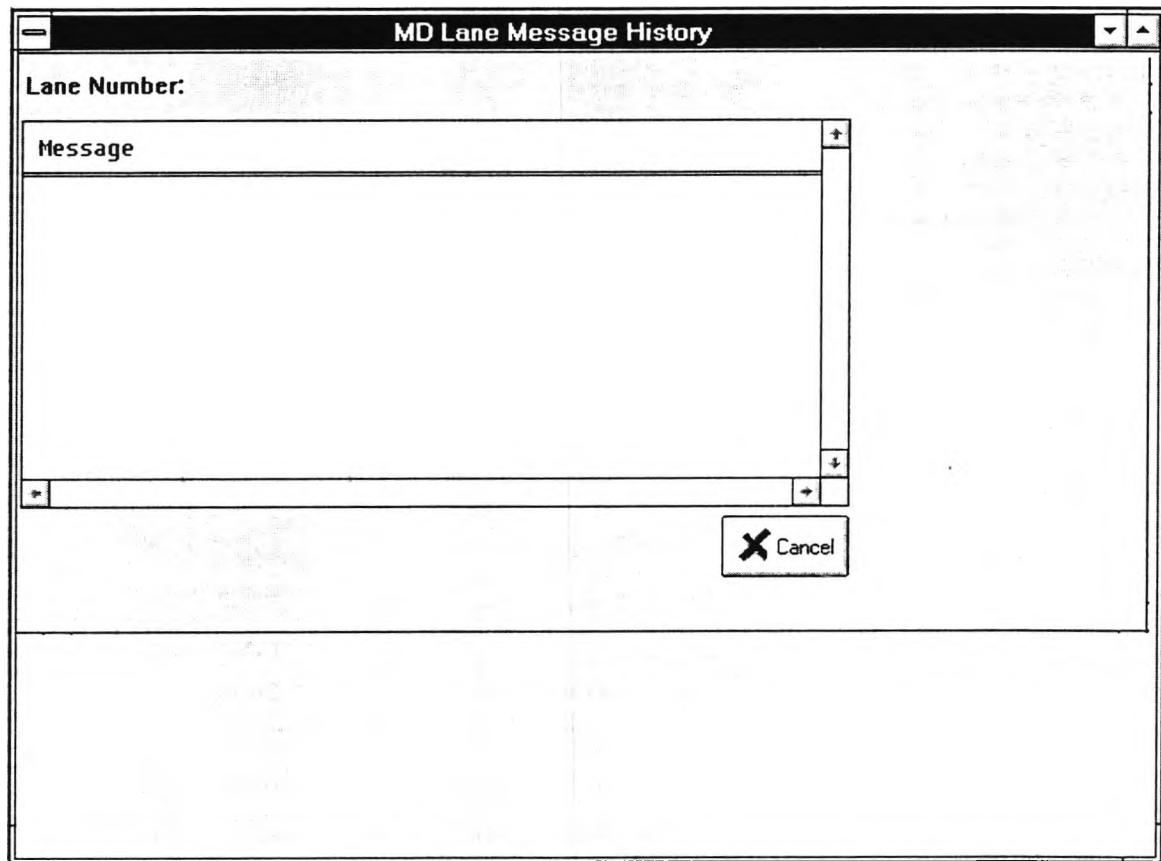


Figure 4-6 Lane Message History

The Plaza Supervisor may review historical information on messages for a particular lane by highlighting the lane in the main scrolling region of the AVI Plaza Supervisor Monitor screen and clicking the MESSAGE HISTORY button. The **Lane Message History** window (Figure 4-6) will be displayed with a scrolling list containing a history of all the lane's messages.

4.2.7 Collector Logon Request

Plaza		Lane Number:	
Collector:		Logon Requested	***/*/* **.*.*
		<input type="button" value="Authorize"/> <input type="button" value="Deny"/>	

Figure 4-7 Collector Logon Request

The Plaza Supervisor may periodically need to logon for a collector. The collector will initiate a message from the lane and a window will automatically pop-up on the Plaza Supervisor's screen. The **Collector Logon Request** window (Figure 4-7) will show the Collector, the Plaza ID, the Lane Number, and the time the logon was requested. The Plaza Supervisor may click on the AUTHORIZE button to allow the collector to logon or click on the DENY button to disallow the logon.

4.2.8 Trend Analysis

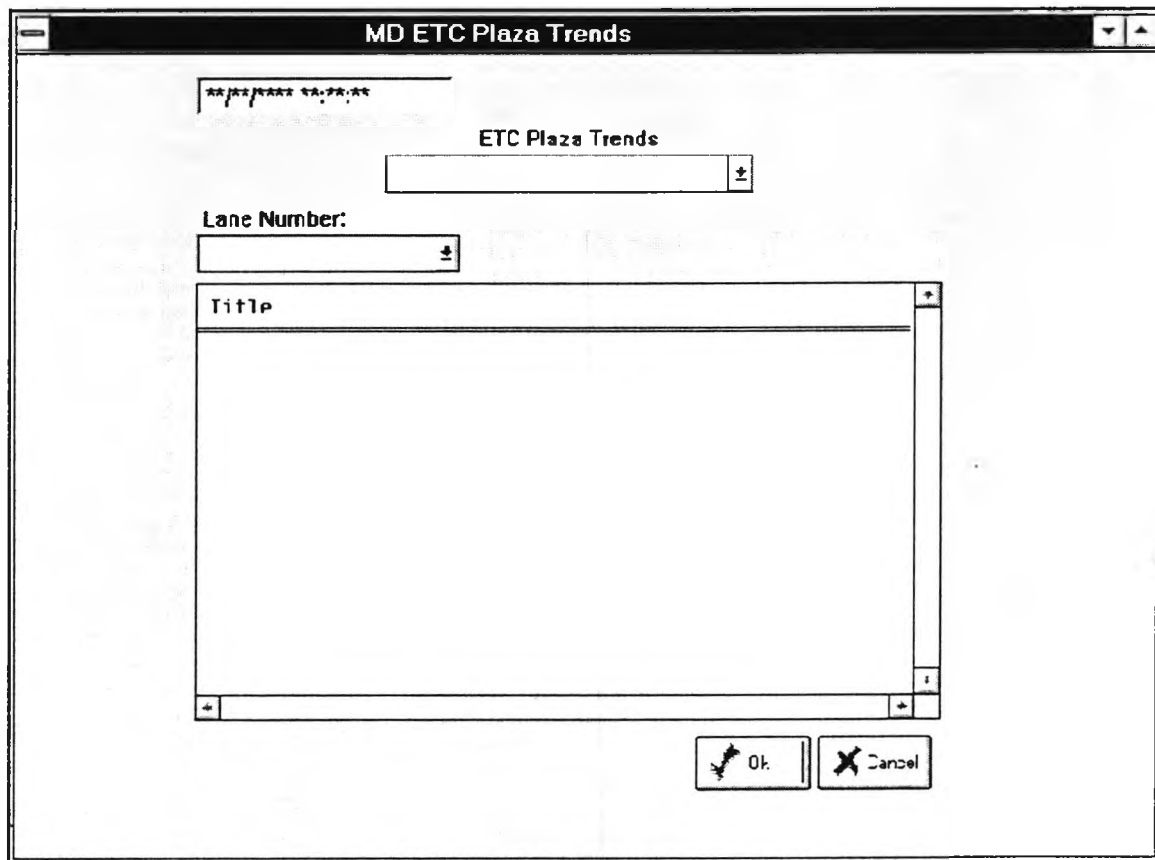


Figure 4-8 ETC Plaza Trends

The Plaza Supervisor may examine trends for a particular lane from the **ETC Plaza Trends** screen (Figure 4-8). A Plaza ID and a Lane Number are selected. The title of the Trend Analysis desired is highlighted and the OK button is clicked. The **ETC Trend Analysis** (Figure 4-9) will be displayed in another window.

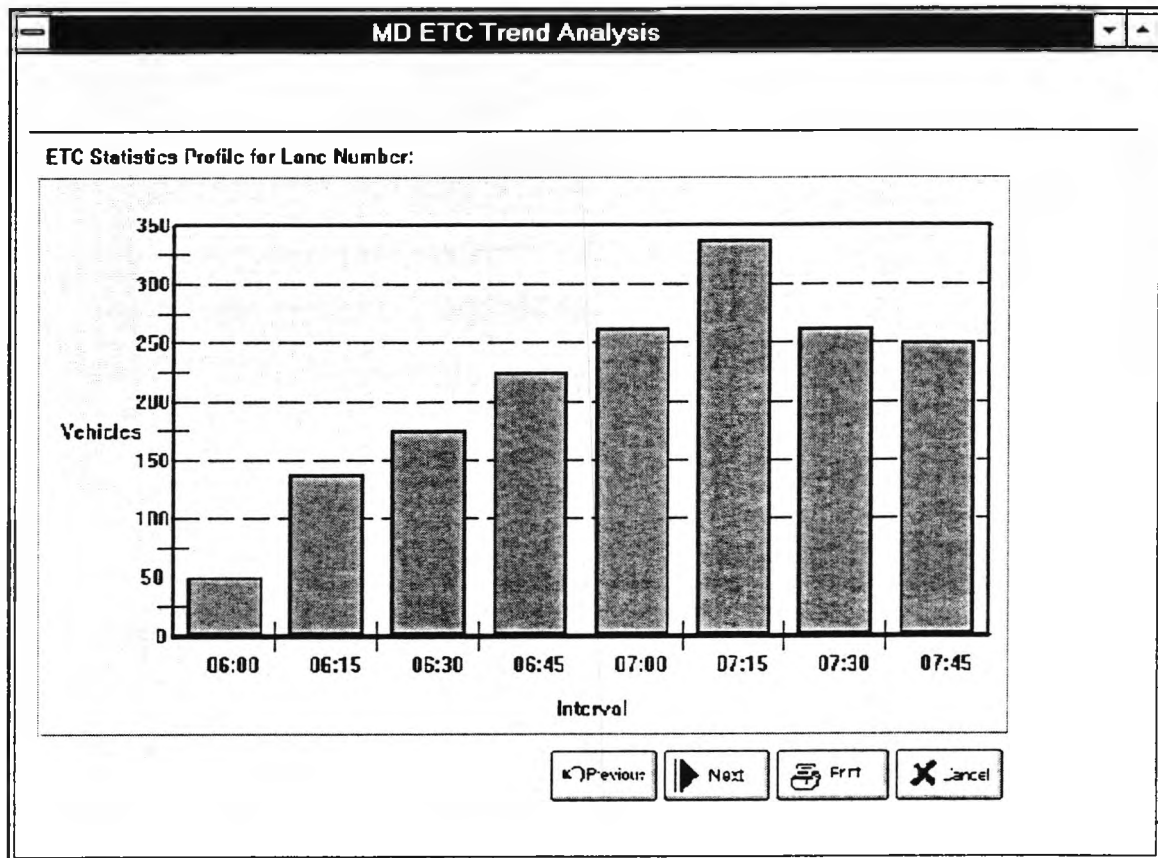


Figure 4-9 ETC Trend Analysis

5. Client Software Design

5.1 Introduction

The client component of the application software will be developed using Forté, the leading industry-standard development tool. This development process incorporates the principles of object-oriented design and programming with adaptations for today's transaction processing and enterprise-wide applications. This is accomplished through the use of the Select Enterprise toolset as described in Section 2, Software Analysis & Design.

5.2 Graphical User Interface

5.2.1 Overview

Using a graphical user interface (GUI) presents special challenges and requires its own set of guidelines and standards. Programmers and designers must be aware of the common philosophy underlying all currently-used GUIs in order to produce products that will satisfy users.

Part of the fundamental design of GUIs is to give a user control of an application, rather than the reverse. One area of control is allowing a user the capability of customizing every aspect of an applications GUI. Though user customization is beneficial in GUI, design, time constraints often limit the customization features included in the final product. Adding user customization capabilities can substantially lengthen the time required to code the features. The GUI design is coded in a way that allows user customization to be added early in the near future.

Programmers must take the need for consistency within the application and across applications into account. This document primarily addresses matters of internal, application-wide GUI consistency- the presentation of a coherent "look and feel." Consistency with other standard applications using the same GUI is also important, as users quickly learn to expect this. An example of inconsistency would be a Windows application created with a File or Edit menu arranged in ways radically different from other Windows applications, which would confuse and irritate the user. Software system features common to other systems employing the same GUI should follow the published standards for that GUI. Therefore, published guidelines for each GUI should be utilized when creating a program based on the same GUI (e.g., *The Windows Interface*, Microsoft's "official" standards, documents the Windows GUI).

In particular, the following general GUI design rules will be observed:

1. The application should follow GUI standards.
2. The application should have the same look and feel as others running under the same GUI.
3. The application should always notify the user when an action is taking place.
4. Destructive actions should generate warnings and require confirmation before they occur.
5. The user should be able to exit the application at any time.

5.2.2 General GUI Standards

The development of effective GUIs requires adherence to guidelines and standards. An effective standards document will reduce the number of design decisions to be made by programmers, thereby decreasing development time. This will allow programmers to focus on application issues related to the business model instead of being distracted by GUI implementation details. A standard document provides a framework of requirements for development of reusable libraries. As these common objects are developed, the standards are further reinforced by their use.

5.2.2.1 Design Objectives

Several general principles of GUI design will be used across all development. These principles will provide an underlying framework for all screen development. The results are effective solutions for user business problems.

These subsections address matters of internal, application-wide GUI consistency. Programmers must take the need for consistency within the application and across applications into account.

5.2.2.1.1 Look and Feel

The presentation of a coherent look and feel is fundamental to the consistency objective.

5.2.2.1.2 Consistency With Other Standard Applications

Consistency with other standard applications (such as *Microsoft Word*) using the same window system is generally expected by users. For example, File and Edit menu bar options should be arranged in the same ways as other commonly used MS-Windows applications. A program designed in this way is easy to learn and more comfortable for the user.

5.2.2.1.3 Published Standards for the Target Window System

Software system features common to other systems employing the same GUI should follow the published standards for that GUI. Therefore, published guidelines for each GUI shall be used when creating a program based on the same GUI (e.g., *The Windows Interface*, Microsoft's "official" standards, documents the MS-Windows GUI).

5.2.2.1.4 Usability

The following goal characteristics of GUI systems indicate strong usability:

- Easy to learn:
Screens will be modeled with the end user's perspective in mind. Mapping between the screen and the dynamic business flow for the job being performed will be obvious to the user.
- Efficient to use:
Examples include the incorporation of short-cuts, mnemonics, and appropriate use of feedback.
- Easy to remember:
Good GUI design employs appropriate icons for commonly-referenced objects. A strong relationship between screen terminology and end user job function terminology makes screen functions easy to remember.

- Minimizes number of user errors:
Usability testing reveals “number of errors per unit time” statistics to measure this aspect of usability.
- Recoverability from errors:
Built-in anticipation of common mistakes with an “undo” mechanism.
- Feedback
 - ◊ Pop-up dialogs (default response shall be least destructive)
 - Informational (process-completion)
 - Warning (affirmative response, the default, shall be preventive)
 - Critical messages (system failure or other high-severity events)
 - ◊ Time progress bars on lengthy functions
 - Known wait should use a *percentage complete* message
 - Unknown wait should indicate elapsed time
 - ◊ Micro-help status lines
 - ◊ Use of sound indicators (secondary)
- Help:
Float over, micro-help, status line, text

5.2.2.1.5 Screen Behavior Modeling

The following goal characteristics of GUI systems indicate

- User-centric Design:
End user driven; identifies target user according to:
 - ◊ Technical expertise
 - ◊ Application skill
 - ◊ Frequency of use
 - ◊ Business frame of reference
- Speed Use User:
Emphasize intuitive, clear screens
- Keyboard intensive:
Emphasis on mnemonics, shortcuts, and accelerators
- Business Process Flow:
 - ◊ Model screen functionality according to business process flow
 - ◊ Place window controls in the natural order of use
 - ◊ Group related fields
 - ◊ Provide logical tabbing order

- Navigational assistance (auto-focus):
Anticipation of frequently performed operations according to a business model

Proper choice of controls is the data dynamic or static known domain (Enumerated types), or free form entry: Long list or short list (list box or radio control)

5.2.2.1.6 Screen Presentation Guidelines

- Visual consistency (Placement and Appearance):
 - ◊ Follow *The Windows Interface* standards document
 - ◊ Use cursor modes sparingly
 - ◊ Commonly used menu-bar options are picture buttons with tool-bar just below menu-bar
 - ◊ Float over text for all push buttons and text entry fields
 - ◊ Consistency for all menu bars (FILE; EDIT; VIEW; OPTIONS; APPLICATION; WINDOW; HELP when appropriate)
- Text Entry:
 - ◊ Field validation whenever possible
 - ◊ Appropriate and consistent presentation formats for money, dates, and times
- Color Usage:
 - ◊ Use color judiciously (many users have color-confusion)
 - ◊ No more than three non-neutral colors per screen
 - ◊ Allow user to choose colors through system color controls
- Borders:
 - ◊ Default borders around logical groups of components

* Labels	none
* Headers	none
* Static text	none
* Editable data	3D Lowered
* Read-only data	3D Lowered / Grayed background
* Controls	3D Lowered
* Data window	3D Lowered
- Titles:

Dialog titles include the *<operation-type>: <target>*
(e.g. edit-detail : employee-id)

- Consistent use of fonts:
Throughout all applications the mapping shown in **Definitions of Typeface Values** (Figure 5-1) will be used:

Value	Definition
TF_SYSTEM_DEFAULT	The window system's standard proportionally spaced font.
TF_COURIER	The window system's Courier font.
TF_SYSTEM	The window system's standard proportionally spaced font.
TF_SYSTEM_DATAENTRY	The window system's data entry font.
TF_SYSTEM_ICONLABEL	The window system's icon label font.
TF_SYSTEM_MONOSPACE	The window system's standard mono-spaced font.
TF_SYSTEM_PROPORTIONAL	The window system's standard proportionally spaced font.
TF_SYSTEM_TERMINAL	The window system's standard terminal emulation font.
TF_TIMESROMAN	The window system's Times Roman font.

Figure 5-1 Definitions of Typeface Values

- Controls:
 - ◊ Limited to less than 20 per window
 - ◊ Based on the type of data being represented
 - ◊ Controls will be used according to the contexts shown in **Control Item Number Table** (Figure 5-2):

Control	Number Of Items
Menu Bar	<10
Pull-down Menu	<12
Cascading menu	<5 (only one deep)
Pop-up menu	<10
Push Button	<6 per dialog
Check box	<10 per group (aligned vertically)
Radio-button	<6 per group (aligned vertically)
List Box	<50 display <10
Drop-down list	<20 (display one)
Combination list box	<20 (display one)
Spin button	used to set < 10 values

Figure 5-2 Control Item Number Table

- **Effective Grouping:**
Sets of related controls should be grouped visually into panels.
- **Effective Placement:**
 - ◊ Placement of control groups are based on order of importance and sequence of use.
 - ◊ More important (or used sooner) are placed to the upper left.
 - ◊ Sequences are top to bottom and left to right.
 - ◊ Push button controls relating to display controls are placed to the right of the related display.
- **Consistent behavior:**

The general GUI design rules **Screen Widget Behavior Table** (Figure 5-3) will be observed regarding screen behavior:

Control	Behavior
Menu Bar	Static (grayed for unavailable)
Pull-down Menu	Static (grayed for unavailable)
Cascading menu	Static (grayed for unavailable)
Pop-up menu	Static (grayed for unavailable)
Push Button	Static (grayed for unavailable)
Check box	Static (grayed for unavailable)
Radio-button	Static (grayed for unavailable)
List Box	Dynamic
Drop-down list	Dynamic
Combination list box	Dynamic
Spin button	Dynamic

Figure 5-3 Screen Widget Behavior Table

5.2.2.1.6.1 Reserved Word Table

The evolution of the GUI standards will include a reserved word table establishing the contexts and behavior for certain text labels relative to menu items and buttons. **Reserved Word Table** (Figure 5-4) is displayed below:

Text	Behavior	On Button	Menu	Mnemonic
OK	Accept or acknowledge data entered; remove window	Yes	No	None
Cancel	Do not accept data entered; remove window	Yes	No	None
Close	Close current task and continue working with the application; close view of data.	Yes	Yes	Alt+F C
Exit	Quit the application	No	Yes	Alt+F X
Help	Invoke application's help facility	Yes	Yes	Alt+F H
Save	Save data entered and stay in current window	Yes	Yes	Alt+F S
Cut	Remove marked item from its current location into a clipboard	No	Yes	Alt+E T
Paste	Paste object from clipboard into marked location.	No	Yes	Alt+E P

Figure 5-4 Reserved Word Table

5.2.2.1.6.2 Resizable Windows

A base class (*AppWinResizable*) will be provided which will resize and reposition status lines and a top level panel. It will post a "resize" event so that subclasses can react appropriately. However, resizable windows should be utilized when it is essential, because there are significant coding issues involved in getting the proper behavior.

5.2.2.1.7 Forté Development Guidelines

All Forté "projects" involve "supplier plan" relationships. Care must be taken not to create circular sequences of supplier plans. With this limitation in mind, the projects and supplier relationships will be organized into a particular framework.

5.2.2.1.8 Method Coding Guidelines

Use built-in dialogs whenever appropriate. These include the following Window methods:

- messageDialog
- openFileDialog
- fileSaveDialog

Method Coding Values (Figure 5-5) are specified by the following:

Value	Definition
MT_WARNING	A warning message.
MT_INFO	An informative message.
MT_ERROR	An error message.
MT_DEFAULT	Same as MT_INFO.

Figure 5-5 Method Coding Values

5.2.2.1.8.1 Field Validation

Use Field validation templates whenever appropriate. Formatting specifications are established for a data field by assigning values to one of its three template attributes, NumericTemplate, CharacterTemplate, or DateTemplate. The MaskType attribute must be set to MK_TEMPLATE.

Each template attribute sets a template to format data of specific types, according to the **Field Validation Templates** (Figure 5-6) listed below:

Template	Class Data Types	Simple Data Types
CharacterTemplate	TextDataTextNullable	string
NumericTemplate	IntegerData	integer
	DoubleData	long
	DecimalData	double
	IntegerNullable	float
	DoubleNullable	
	DecimalNullable	
DateTemplate	DateTimeData	none
	DateTimeNullable	

Figure 5-6 Field Validation Templates

Each template uses its own group of formatting codes to define a format. For data input, the arrangement of these codes specifies what keystrokes are acceptable for the format. The field uses the format to validate input on each keystroke. When characters not conforming to the format are entered into the field, the system beeps and returns the input focus to the field. When a null value is entered into the field, it is converted to the appropriate data type - if it is a nullable type. If it is not nullable, it is an error.

If ValidateOnKeystroke is set to TRUE, the display system sends an AfterValueChange event, and transfers the value of the field to the mapped TOOL variable whenever the end user types a keystroke on the field. This attribute should be turned on sparingly, only when you need to track the value of a field upon every keystroke (the Menu Workshop uses this to maintain synchronization between the name of the menu command and the name in the menu hierarchy display). It requires use of considerable additional resources.

5.2.2.1.8.2 Exceptions

Use Forté exception classes for all exception conditions.

All methods should begin with a standard documentation header.

```
//Documentation header for methods
// [METHOD NAME]
// [DESCRIPTION]
//      What the method does (not how or in what order)
// [INPUTS]
//      Parameters, tables, files, external functions with descriptions of each
// [ASSUMPTIONS]
//      Any assumptions made in the code or preconditions that must exist
// [RETURNS]
//      describe return values and their interpretation
// [CHANGE LOG]
// [NAME]      [DATE]      [CHANGE DESCRIPTION]
//
// [LOCAL VARIABLE DECLARATIONS]
//
```

Only one "return" statement should be present per method.

5.2.2.1.8.3 Naming Conventions

Naming Conventions (Figure 5-7) will be used for all widgets created as window component attributes:

Widget	Attribute Name Prefix
Domain Widget	dw_
Data Field	df_
Text Field	tf_
Text Edit Field	te_
Picture Field	pf_
Toggle Field	tg_
Push Button	pb_
Picture Button	pic_
Scroll Bar	sb_
Outline Field	of_
OLE Field	ole_
Radio List	rl_
Scroll List	sl_
Drop List	dl_
Fillin Field	ff_
Text Graphic	tg_
Picture Graphic	pg_
Line	l_
Rectangle	r_
Ellipse	e_
Polyline	pl_
Point	p_

Figure 5-7 Naming Conventions

5.2.2.1.8.4 Event Handlers in Forté Windows

All Window classes should have a top level event handler entitled "*winEventHandler*" for all events handled by this class (other event handlers for this class can be "*registered*" by "*winEventHandler*"). Event loops in a "*display*" method for a window should not include "when clauses" that would prevent subclasses from being derived. This way subclasses can register all the parent event handlers by only registering "*super.winEventHandler*". Also, clauses that handle an event that is of potential interest to a subclass or containing class must post an analogous event (this is because the original event is removed from the queue when the first handler is found).

**6. HOST AUDIT &
RECONCILIATION**

6. Host Audit & Reconciliation

6.1 Recording & Tracking of Revenue

Because recording and tracking of revenue is an important function in a toll collection system, extremely tight security is required for functions that enter, adjust, or track revenue. Manual cash deposits recorded during tours of duty and real-time lane transaction updates, provide SCDOT an “instant” audit capability of the toll collection process. The **Integrated Audit / Client Design** software solution (Figure 6-1) addresses the auditing process of Toll Collector revenue activity.

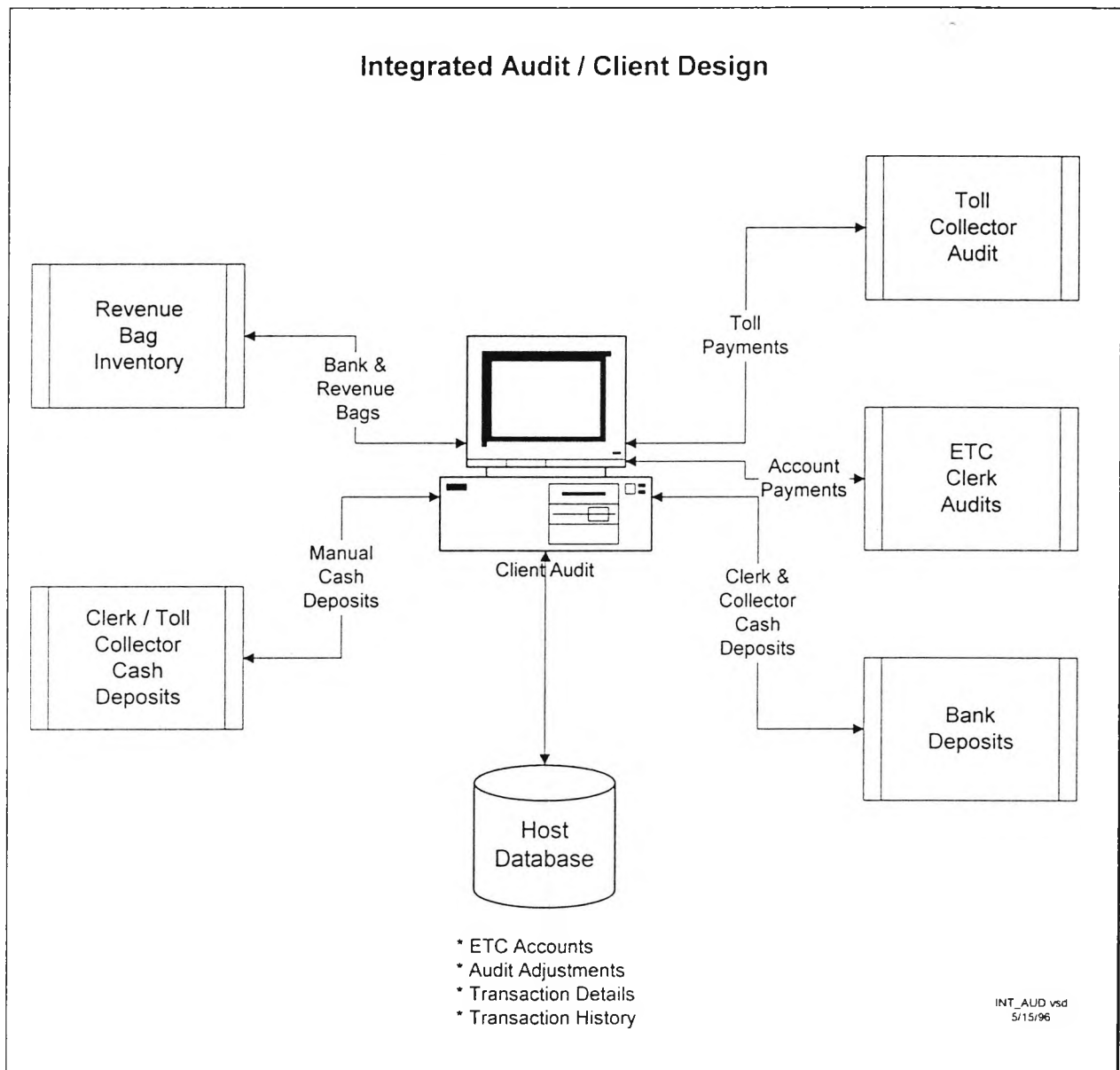


Figure 6-1 Integrated Audit / Client Design

A requirement of SCDOT is inventory control and distribution of revenue bags to employees for tour-of-duty deposits and seed money management. A high-level explanation of the proposed LMIMS solution is provided in the following subsections. The detailed system design is provided in Section 2, Software Analysis & Design. The understanding of these procedures is the result of discussions with the SCDOT and the SCDOT Toll Collection System Standard Operating Procedures.

6.2 Revenue Bag Inventory

Revenue Bags are used to transfer money between Toll Collectors, AVI Clerks, and their supervisors. Revenue Bags are pre-numbered with assigned unique identification numbers that do not repeat for a minimum of 180 days.

The three types of revenue bags are as follows:

- **Employee Bank Bag** (Seed Money Bag) — Used to transfer a nominal amount of money (coins and currency) required to start the Toll Collector's or AVI Clerk's cash drawer.
- **Currency** — Used to transfer currency, checks, and script collected in the lane.
- **Coin** — Used to transfer coins collected in the lane.

The Revenue Bag Inventory folder allows the on-line entry of new revenue bags into inventory. The process of entering bags into inventory is also referred to as **initialization**.

The **Revenue Bag Inventory Folder** (Figure 6-2) allows the initialization of a maximum of 100 sequentially numbered bags with the same two-letter prefix. To initialize a group of revenue bags, the user normally does the following:

1. Enter the two-letter prefix in the **Revenue Number Prefix** field.
2. Enter the lowest bag number in the group in the **Starting Revenue Bag #** field.
3. Enter the highest bag number in the group in the **Ending Revenue Bag #** field.

6.2.1 Process

At the Revenue Bag Inventory Folder (Figure 6-2):

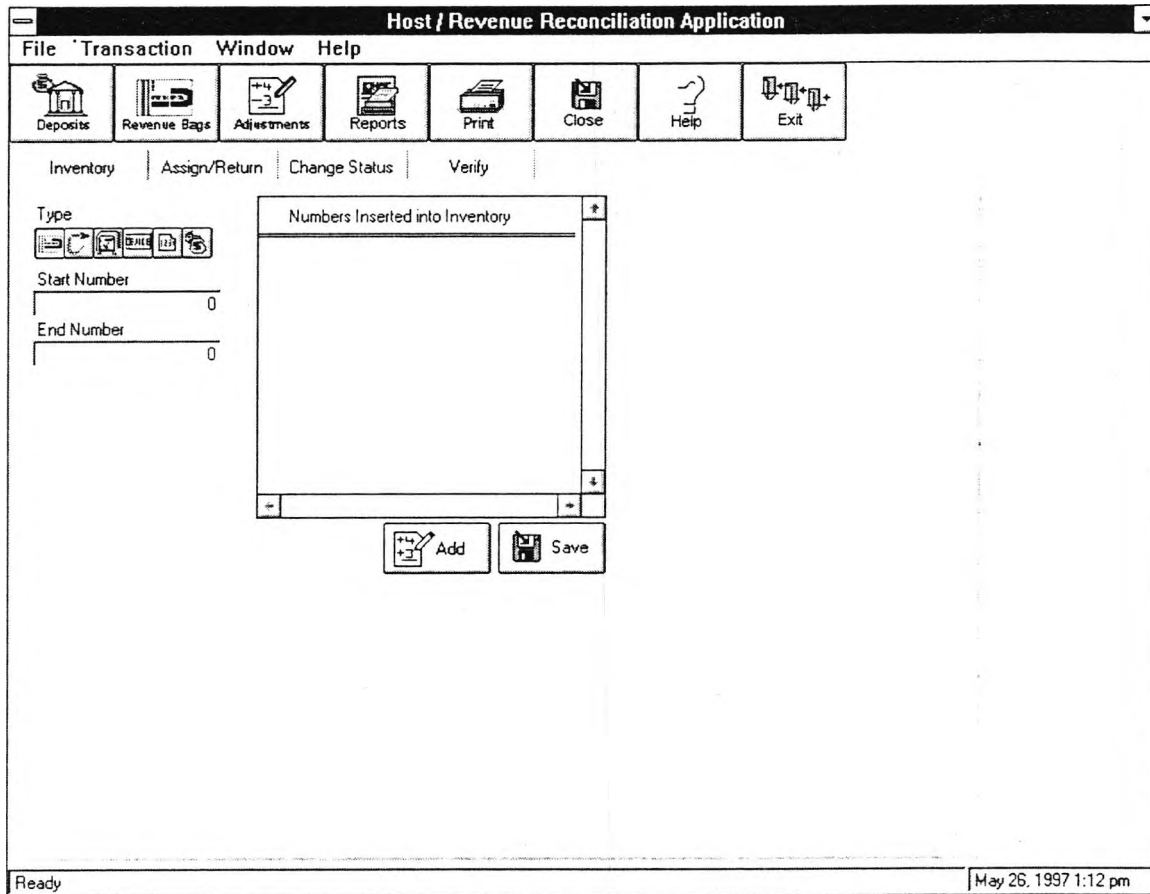


Figure 6-2 Revenue Bag Inventory Folder

The system tracks revenue bags to employees, but the bags must first be entered into the database through the inventory folder. The clerk uses the following steps:

1. Click on the bag-type icon located at the top left corner of the folder. Press **Tab**.
2. Enter the starting serial number of the block of Revenue Bags. Press **Tab**.
3. Enter the ending serial number of the block of Revenue Bags.
4. Click on the **Add** button. All the Revenue Bags are displayed in the data window.
5. Either click on **Close** to save the bags in the database and close the **Revenue Bags** folders
Or
6. Click on **Save** to save the group of bags.

Multiple bags can be entered in the same folder session.

These activities are all performed at the Plaza.



6.3 Assign / Return Revenue & Seed Bags

At the **Assign / Return Tab Folder** (Figure 6-3):

Inventory Assign/Return Change Status Verify

Revenue Bag Number

- 114
- 115
- 116
- 117
- 118
- 9902
- 9903
- 9904
- 9905
- 9906

Occupation **COLLECTOR**

Employees

- 85003 TEST3 TEST3
- 80950 THOMAS MARY
- 120
- 83130 RANGANATHAN SUDARSHA
- 85004 TEST4 TEST4
- 9983

Assign Return

Figure 6-3 Assign / Return Tab Folder

At the start of the Toll Collector's **Tour of Duty (TOD)**, the Supervisor issues the following revenue bags to the Toll Collector:

- Seed bag containing money to start the cash drawer
- Empty bag to return the seed money
- Empty bag to turn in currency collected in the lane
- Empty bag to turn in coins collected in the lane

The Supervisor accesses this information through the Assign / Return Tab Folder in the Revenue Bags Folder.




The Toll Collector can make multiple currency and coin deposits using the assigned revenue bags during the TOD. Only one employee bank (seed money) deposit per TOD is allowed. The Supervisor must issue additional revenue bags, as needed.

At the end of the Toll Collector's TOD, the Toll Collector must deposit all seed money (employee bank) and revenue. Each time a Toll Collector returns a bag, before logging in to the toll system, the money to be deposited must be counted using the bill and coin counters. The Toll Collector separates coins from the currency, then sorts each by denomination; for example, quarters, dimes, \$1 bills, \$5 bills, etc. The Toll Collector also separates checks and script. When the Toll Collector records a revenue deposit, they enter amount-by-type and denomination.

When the Toll Collector makes multiple currency and coin deposits, all deposits are added for a collective total at the end of the Toll Collector's TOD. To determine the collective total, the Toll Collector adds the amounts printed on copies of the deposit receipts.

6.3.1 Assign Seed, Revenue Bags or Seals

1. For the process refer to the **Assign / Return** Tab Folder (Figure 6-3). Click on the arrow of the dropbox to select the **Occupation**. The **Employee** data window will display all the employee occupations.

If a  is next to the Employee, the employee has been assigned revenue or seed bags. To close the employee file, click on the . When the arrow is displayed , this means that revenue or seed bags have been assigned to the employee.

Either

Click on either a **Seed, Revenue** bag, or a **Seal**. Hold the left button down on the mouse and drag it over to the **Employee** for which the bag or seal is to be assigned and release the button.

Or

1. Highlight the **Employee**.
2. Highlight the **Seed, Revenue** bag or **Seal**.
3. Click on the **Assign** button. The bags or seals will be displayed under the corresponding employee.
4. Repeat for all employees as needed.

6.3.2 Return Seed, Revenue Bags or Seals



ONLY empty Revenue Bags, unused Seed Bags and unused seals and unopened Bags can be returned!

Either

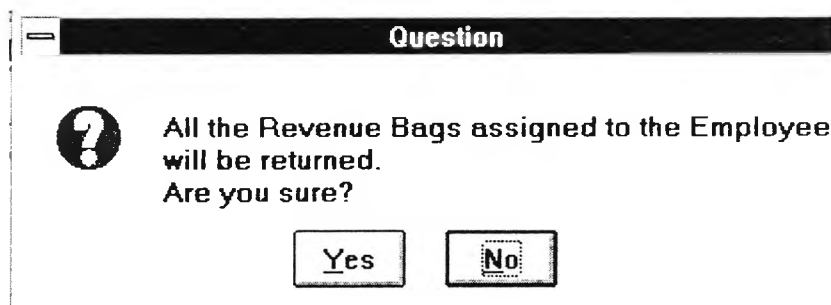
Click on the empty revenue bag, unopened bag or unused seal that is under the employee returning the item. Hold the left button down on the mouse and drag it from the **Employee** to the **Revenue Bag** data window and release the button.

Or

1. Highlight the **Seed, Revenue** bag or **Seal**.
2. Click on the **Assign** button. The bags or seals will be returned.
3. Repeat for all employees as needed.

Or if an employee wants to return ALL unused bags / seals

4. Highlight the **Employee**.
5. Click on the **Return** button. The following will be displayed.



6. Click on **Yes**. All the empty revenue bags and unused seals assigned to the employee will be returned. The revenue bags or seals are deleted from the Employee section and displayed to the Revenue Bag section.
7. Click on **No** if not, and follow the prior procedure.

6.4 Change Status of Revenue Bags

At the Revenue Bag — Change Status Folder (Figure 6-4):



Inventory	Assign/Return	Change Status	Verify
<div>Revenue Bag Number</div> <div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div></div>			
<div>Bag Number</div> <div>10</div>		<div>Bag Type</div> <div>BAG</div>	
<div>Bag Status</div> <div>UNASSIGNED</div>		<div>Bag Role</div> <div>INVENTORY</div>	
<div><input type="checkbox"/> Seed</div> <div><input type="checkbox"/> Void</div> <div><input type="checkbox"/> Group Void</div>			
<div> Change</div>			

Figure 6-4 Revenue Bag — Change Status Folder

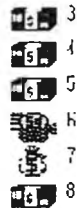
The Revenue Bag - Change Status Folder (Figure 6-4) allows the Bag Inventory Clerk to change the tracking status of a bag entered into the system.

6.4.1 To Prepare a Seed Bag

1. Manually take a Revenue Bag or Seal out of inventory and find the serial number.
2. Click on the scrollbar to find and highlight the corresponding number.
3. Click on the box next to **Seed**. The **Amount** defaults to \$200.00.
4. Count \$200.00 into the bag.
5. Click on the **Change** button. The Seal or Revenue Bag changes to be displayed as .


6.4.2 To Void Revenue Bags, or Seals

- Every used Coin or Bills Bag must be voided once it has been unsealed. These are




represented by bills or coins.

- Every inventory bag or seal that has been damaged or broken must be voided.
- Every seal that has been cut must be voided once it has been cut.

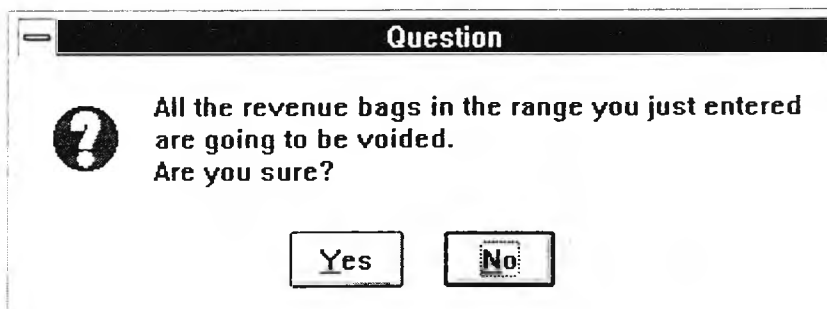
1. Select the Coin bag, Bill bag, Revenue bag, or Seal that is to be voided.
2. Click on the box next to **Void**.
3. Click on the **Change** button. The Seal, or Revenue Bag changes to be displayed as a .

6.4.3 To Void Seed Bags

1. Double click on the seed bag that is to be voided. A supervisor ID window will be displayed.
2. A Supervisor must enter the **Supervisor ID** and click on OK button.
3. Click on the **Change** button. The Seed Bag changes to be displayed as a .

6.4.4 To Group Void (must be sequential)

1. Highlight the first bag.
2. Click on **Group Void**. A **Start Number** and **End Number** fields will be displayed.
3. The bag number selected will be automatically entered in **Start Number**.
4. Enter the **End Number**. The following pop up message will be displayed:



5. Click on **Yes**.

6.5 Verify Revenue & Seed Bags

At the **Verify Tab Folder** (Figure 6-5):

The interface includes the following components:

- Navigation Tabs:** Inventory, Assign/Return, Change Status, **Verify**.
- Revenue Bag Number:** A text input field.
- Revenue Bags to Be Verified:** A list box containing:
 - 1053
 - 1060
 - 1061
- Bill Counts By Denominations:** A series of input fields for:
 - Ones: 0
 - Twos: 0
 - Fives: 0
 - Tens: 0
 - Twenties: 0
 - Fifties: 0
 - Hundreds: 0
 - Scripts: 0
- PayType, Counts, Amounts:** A table with two rows and three columns.
- Total:** A text input field showing \$0.00.
- Revenue Bag Number List:** A list box containing:
 - 1096
 - 1150
 - 1151
 - 1152
 - 1153
 - 1154
 - 1155
 - 1156
- Revenue Bag Number, Amount, Original Bag:** A table with three columns and three rows.
- Icons:** Two icons at the bottom right, one showing a bag and the other showing a document.

Figure 6-5 Verify Tab Folder

The Verify tab folder allows the Account Clerk to verify revenue and seed bags.

One of the main duties of the Account Clerk is to verify the deposits that have been made by:

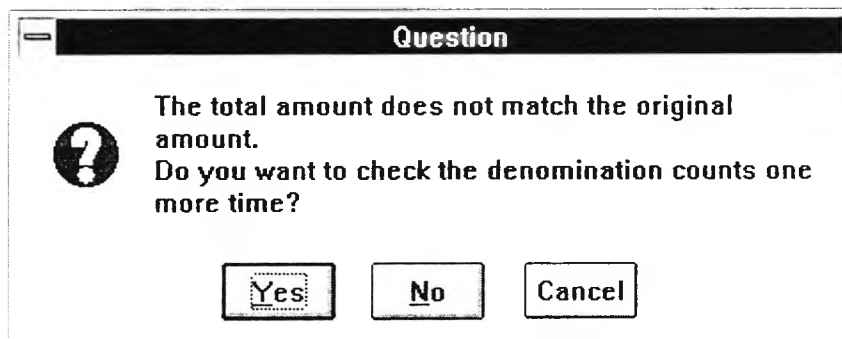
- Toll Collectors
- Card / Pass Sales Clerks
- Causeway Managers

The types of deposits that are made are:

- Revenue Deposits
- Vault Deposits
- Returned Seed Deposits

6.5.1 To Verify Revenue / Vault Deposits

1. Highlight the Revenue Bag number in **Revenue Bags To Be Verified** data window.
2. Double click on the bag. The number will be displayed in the **Revenue Bag Number** field. The system recognizes whether the bag is a bill, coin or returned Seed Bag.
3. Count the money using the Coin Counter and the Bill Counter (as applicable).
4. Enter the amounts in the applicable fields.
5. Put the money into a new Revenue Bag.
6. In the **Revenue Bag Number** data window, find the number of the Revenue Bag in which the money has been placed.
7. Double click on the **Revenue Bag Number**. The system will compare the original amount and the new amount. The following question will be displayed if the amounts do not match:

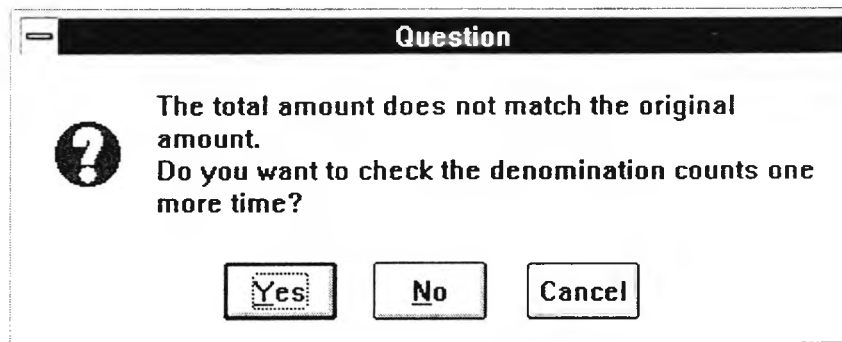


8. Click on **Yes** to re-verify.
9. Click on **No** to save the information. The **Revenue Bag Number** will be displayed in the lower right, with a check to display that the **Revenue Bag** has been checked.

6.5.2 To Verify Return Seed Deposits

1. Highlight Returned Seed Bag number in **Seed Bags To Be Verified** data window.
2. Double click on the bag. The number will be displayed in the **Seed Bag Number** field. The system recognizes it as a Returned Seed bag.
3. Count money using the Coin Counter and the Bill Counter (as applicable).
4. Enter the total in the applicable field.
5. Put the money into a new Seed Bag.
6. In the **Seed Bag Number** data window, find the number of the Revenue (Seed) Bag in which the money has been placed.

7. Double click on the **Seed Bag Number**. The system will compare the original amount and the new amount. The following question will be displayed if the amounts do not match:



8. Click on **Yes** to re-verify.
9. Click on **No** to save the information. The **Seed Bag Number** will be displayed in the lower right, with a check to display that the **Seed Bag** has been checked.

6.5.3 Save

1. Click on the **Save** button. The checked Seed Bags will no longer be displayed.
2. Repeat the verification process as necessary before exiting.

6.6 Entering Toll Collector / Clerk Revenue Deposits

At the **Collector / Clerk / Misc. / Vault Deposit Folder** (Figure 6-6):

Collector/Clerk/Misc./Vault Deposit | Bank Deposit

Employee ID: 80281
Revenue Bag Number: 0

☐ Lane Deposit
☐ Clerk Deposit
☐ Misc. Deposit
☐ Vault Deposit

Bill Count By Denominations

Ones	0
Twos	0
Fives	0
Tens	0
Twenties	0
Fifties	0
Hundreds	0
Scripts	0

PayType	Count	Amount

Sub Total: \$0.00
Total: \$0.00

Bank Deposit

Plaza: [dropdown]
TourOfDutyDate: Choose a Date [dropdown]
Tour Of Duties: [dropdown]

Shift Start Time: MM/DD/YYYY HH:MM:SS
Shift End Time: MM/DD/YYYY HH:MM:SS

☐ Bills
☐ Coins
☐ Returned Seed

Revenue Bag Number: [large field]

Revenue Bag Number	Amount

[Add] [Save]

Figure 6-6 Collector / Clerk / Misc. / Vault Deposit Folder

Toll Collectors and clerks have their indicated cash deposits recorded in the SCDOT database at the end of their respective TODs. Our proposed audit and reconciliation solution requires that the actual cash deposits are recorded to reconcile activities recorded in the database, using the following steps:

1. Log into the main **VECTOR** menu.
2. Select **Host Revenue Reconciliation**. This brings up the Revenue Reconciliation subsystem main menu. The only menu tool bar button enabled for collectors and clerks is the **DEPOSITS** button.
3. Click on **Deposits**.

The Collector / Clerk / Misc. / Vault Deposit Folder (Figure 6-6) is displayed. It contains the Employee ID of the user logged in and the **Revenue Bag Number** drop list button contains all revenue bags assigned to that employee without deposits recorded.

4. Select the revenue bag to record.

5. Click on the type of deposit:

- Lane
- Clerk
- Misc
- Vault

The tour of duty date for which the employee is recorded in the system is displayed in the drop list titled **Tour of Duty Date**.

The drop list **Tour Of Duties** contains all times for the TOD worked that day.

6. Click on the type of revenue bag deposit:

- Bills
- Coins
- Returned Seed Money

7. Enter the currency and coin counts from the revenue bag.

8. In the Pay Type array field, record, by item type, any miscellaneous scrip; for example:

- Credit card slips
- Tickets
- Unusual occurrence slips

A sub-total and cumulative total is displayed.

9. Click the **ADD** button in the folder to add the revenue bag deposit into the **Revenue Bag Number and Amount** array field.

When all coin and currency deposits are made, the system reconciles the record payments against the transactions recorded during the respective tour of duty. If a discrepancy is found, a pop-up screen instructs the employee to recount and / or re-enter the counts. If the counts are re-entered incorrectly a second time, the system accepts the counts and the tour of duty auditor must analyze and adjust the counts. The amount of discrepancy is never displayed to the employee.

6.7 Entering Bank Deposit Information

Authorized users have controlled, modular access to the following client software features:

- Automated deposit preparation, which automatically generates a grand total of deposits recorded electronically or manually and supports the reconciliation of toll collections by the Toll Collector or Clerk
- Report generation, which allows the generation of numerous auditing reports

The bank deposit functions support the preparation of bank deposits. Along with the standard access security and electronic mail, authorized users will have access to the following features:





- Deposit preparation
- Bank deposit reconciliation
- Report generation

The **Bank Deposit Folder** (Figure 6-7) depicts the manual data entry window for bank deposits.

The screenshot shows the 'Bank Deposit' window. At the top, there are two tabs: 'Collector/Clerk/Misc./Vault Deposit' and 'Bank Deposit'. The 'Bank Deposit' tab is active. Below the tabs, there are several input fields: 'Prepared By' (with the value '80280'), 'Verified By' (with a cursor), 'Plaza' (with a dropdown arrow), 'Bank Deposit Slip Number' (with the value '0'), and 'Bag Type' (with a dropdown menu showing 'All Bags'). Below these fields are two lists of bank deposit bags. The left list is titled 'Bank Deposit Bag' and contains a list of bag numbers from 5000 to 5008, each preceded by a small icon of a bag. The right list is titled 'Revenue Bag Number' and contains a list of bag numbers from 1061 to 1073, each preceded by a small icon of a bag. At the bottom of the window, there are three buttons: 'SelectAll', 'Add', and 'Save'.

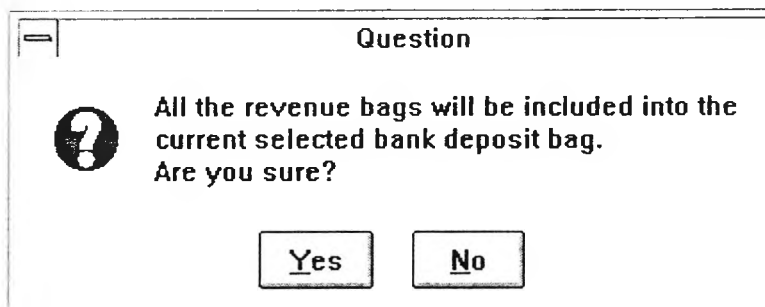
Figure 6-7 Bank Deposit Folder

6.7.1 Process

1. The **Prepared By** field defaults to the Account Clerk that is preparing the deposit. This is the Employee ID of the Clerk that is logged into the system.
2. Enter the Employee ID of the Clerk that is verifying the process in the **Verified By** field.
3. Click on the  of the  to select the **Plaza**. Press **Tab**.
4. Enter the **Bank Deposit Slip Number**. Press **Tab**.
5. Click on the  of the  to select the **Bag Type**. Press **Tab**.
6. Highlight the **Bank Deposit Bag** that is to be used.

6.7.2 To Select All Revenue Bags

1. Click on **Select All**. All the Revenue Bags move to the Bank Deposit Bag data window under the bag that was highlighted. The following message will be displayed:



2. Click on **Yes**.

6.7.3 To Assign One Bag at a Time

Either

1. Highlight a **Revenue Bag Number** in the **Revenue Bag Number** data window.
2. Drag and drop on previously selected bank deposit bag number.

Or

1. Highlight the Revenue Bag Number in **Revenue Bag Number** data window.
2. Click on **Add**.
3. If too many Revenue Bags have been assigned to a **Bank Deposit Bag**, return it to the **Revenue Bag Number** data window by dragging and dropping it back the **Revenue Bag Number** data window.

6.7.4 To Save

1. Click on the **Save** button. The information will be saved to the database. The **Deposit Slip** and the **Bill of Lading** are automatically printed out. Both the **Deposit Slip** and the **Bill of Lading** will have all of the Revenue Bags numbers that are being deposited.
2. Make sure that everything is bagged and sealed.
3. Place **Revenue Bags** in the vault with the **Deposit Slip** and **Bill of Lading** ready for the Wells Fargo pick-up.

The first feature provides the automated preparation of deposits and supports the reconciliation of toll collections by the collector as well as ETC Account Processing clerk activity. The deposit preparation feature automatically generates a grand total of deposits recorded manually.

After the final transaction is made, the system generates a bank deposit statement to accompany the transportation and deposit of the collected tolls or clerk payments.

6.8 Tour of Duty Adjustments

Transactional data entered by the Toll Collector and transactions recorded by the Lane Controllers are transmitted to the host system in real-time mode. All transactions are available for further processing in support of the audit function at the audit workstation client.

One of the most important items included in the data provided is the amount that should have been deposited for the ETC Account Processing Clerk or Toll Collector's TOD. In reporting this amount, the system excludes non-cash items; for example, AVI transactions. The treadle counts and classification data associated with AVI transactions are separated in the reconciliation reports from the treadle counts and classifications associated with cash transactions.

As with every functional area in the application software system, access to this interface on the audit workstation is strictly controlled. The integrated toll audit features give comprehensive access to the following:

- ETC customer records
- Equipment maintenance history
- Unusual occurrence event records
- Bank deposit data
- Violation reports

This feature allows the auditor access to revenue and traffic records and statistics for all levels, from the lane to the entire system. The auditor can review and cross-check manual and ETC transactions.

Reconciliation reports, such as the Toll Collector Tour of Duty Report, will also be available for instant on-line display or background run requests through the Auditor Client Software for immediate audit capability.

Unlike other users, the auditor must have the ability to correct erroneous transactions, along with the necessary audit trail created. A list of reason codes will be developed and presented in the final system and software documentation. Figure 6-8 represents an interactive update interface that allows the auditor to enter classification and toll payment type adjustments.

Adjustments are automatically applied and the corresponding reconciliation of traffic to revenue is displayed for the auditor. Adjustments do not change the value of the original transaction; they are additional transactions added to the original transaction to produce a net change in value. Adjustments require a reason code to ensure accurate cross-checking and audit trails.

Adjustments to the TOD Report are made by first entering the selection criteria for adjusting the TOD. The auditor must enter the date of the TOD to be adjusted—all other fields are optional. The system responds with a list of Toll Collectors for that set of criteria. The auditor then selects a Toll Collector from the list whose TOD needs to be adjusted.

Figure 6-8 Tour of Duty Classification Adjustments

When the actual revenue and indicated vehicle classification by payment type are adjusted, an Audited Toll Collector TOD Report should be run and displayed for the verified TOD balances. Other reports available on-line to the Toll Auditor for assisting in the audit process include the following:

- Toll Collector Performance
- Toll Collector Revenue
- Daily Exceptions
- Daily Treadle Activity

6.9 Audit Deposit

6.9.1 Deposit Adjustment

The **Deposit Adjustment** (Figure 6-9) allows adjustments to collector counts caused by a miscount during the data entry process; for example, the wrong bag contents entered for the wrong collector or clerk bag number.

The amount of the adjustment for a particular denomination of currency, coins, or tokens can be entered on the screen. This feature can be used by the SCDOT as an optional tool if the policy of SCDOT is to disallow the change of any deposit data entered for any reason. There are two screens—one for a clerk and one for a collector.

Tour of Duties		Class Adjustments		Deposit Adjustments	
Tour of Duty	Collector Name	Start Time	End Time		
633630	1 CLINTON, BILL	10/29/1997 08:40:14	10/29/1997 17:47:55		
Total Deposit Amount	Deposit Amount Adjustment	Adjusted Total Deposit Amount	Transaction vs. Deposit Amount		
\$30.65	(\$30.00)	\$.65	(\$0.65)		

Deposits						
Emp ID	Deposit Date	Depoist Type	Total Deposit Amount	Adjusted Amount	Deposit ID	Adjustment
1	10/29/1997	MISC	\$30.65		631432	☐
1	11/13/1997	MISC		-\$30.00	632635	☑

Auditor ID	Audit Date	Adjusted Amount	Audit Code	Adjustment Complete	Comments
0	xx/xx/xxxx	\$.00		<input type="checkbox"/>	




Figure 6-9 Deposit Adjustment

7. ETC Account Management

7.1 ETC Account Management Sub-System On-Line Functions

The requirements of the ETC Account Management sub-system are derived from the business level functionality described in the RFP.

This document summarizes, at a detailed level, the functional requirements of the ETC Account Management subsystem and presents the system processes and preliminary layouts of key on-line windows that LMIMS has designed to accomplish these functions.

In general, interactive functions used by ETC Account Processing personnel (for example, opening a new account, issuing a tag, receiving payment from customers, etc.) are designed as client processes to be executed from PC-based workstations. Each client process has one or more on-line screens that implement the business rules associated with their respective business functions; for example, default amounts, field validations, etc.

The ETC Account Processing subsystem consists of the following:

- Collection of client processes
- Server-based processes
- Operational procedures

The following non-interactive functions are designed as batch processes to execute on database server machines:

- Receiving ETC transactions and updating them to customer accounts
- Sending tag status change information to the ETC system
- Summary reporting functions

Additional server processes have been designed to handle maintenance functions such as data archival and periodic housekeeping.

The ETC Account Management subsystem is designed to provide the following on-line functions by implementing PC-based client applications that access the database server for storing and retrieving data into or from the database:

- Tag Inventory Process
- New Individual Account Creation
- New Commercial Account Creation
- Transponder Assignment
- Receipt of Payments / Posting to Customer Accounts / Adjustment & Reversals
- Vehicle Information
- Account Information
- Account History
- Customer Account Maintenance Functions
- Search Functions by Various Key Information

The detailed layout of the screens and associated functions are described in the following sections. An important design consideration was built into **VECTOR** to improve on the workflow of previous software releases currently in operation at our client sites. The tab folder organization of the GUI enables a distribution of labor in a large service center operation such as the SCDOT will experience. For example, in the **Account Maintenance** process, an account number can be assigned before any payment is accepted. Only nominal demographic data must be obtained in order to assign an account number and place the account in a **PENDING PAYMENT** status. At this point, the work can be distributed to other clerks for financial or tag assignment functions.

7.2 Menu Organization

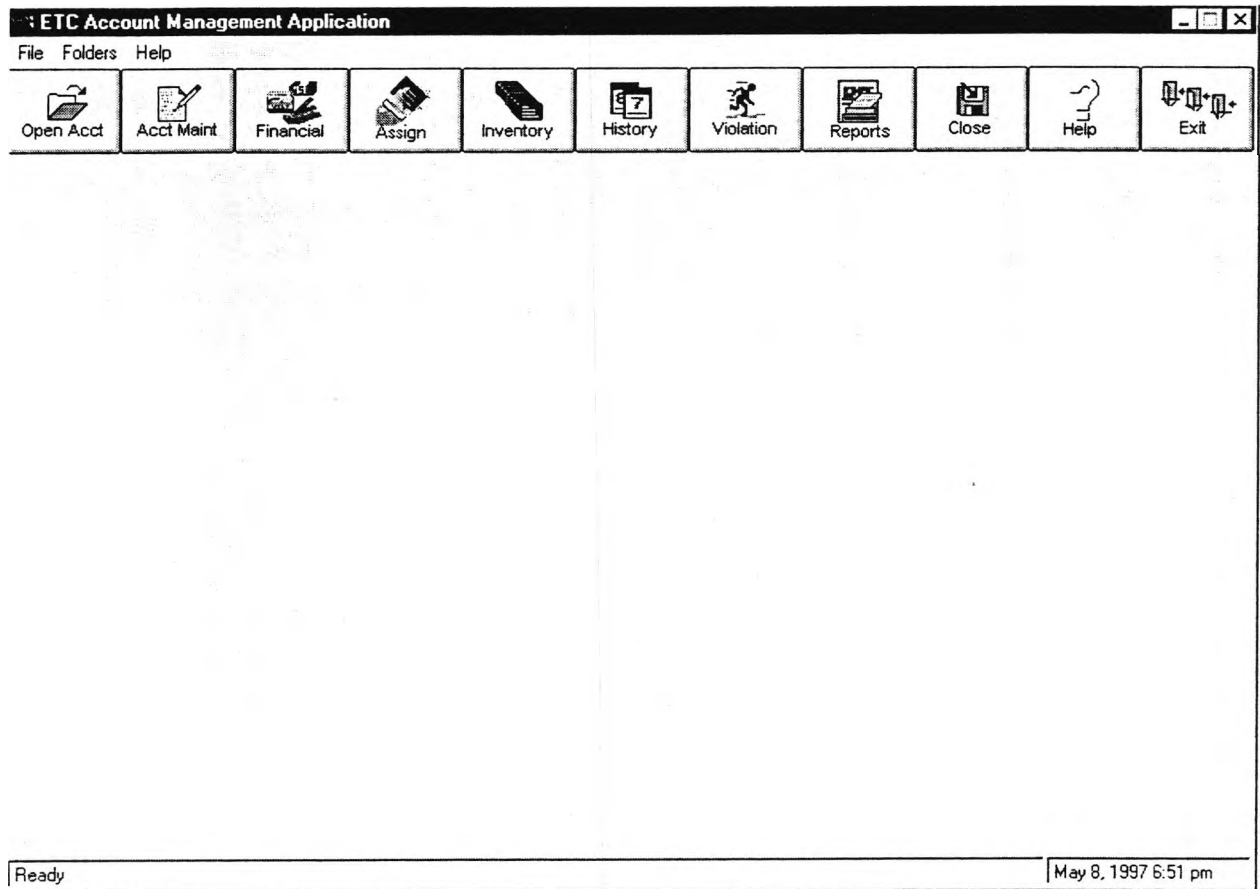


Figure 7-1 Menu Organization

The main menu toolbar for the SCDOT ETC Account Management software is comprised of the following items:

- Open account folders
- Account maintenance folders
- Financial transaction folders
- Device assignment folders
- Device inventory folders
- Account history folders
- Violations management folders
- Reports
- Other functions necessary for the operation of the Service Center

With the click of a mouse, the toolbar provides instant access to frequently used functions.

7.3 Open Account — Demographics Folder

Figure 7-2 Open Account - Demographics Folder

7.3.1 Input

The **Open Account - Demographics Folder** accepts the following input:

- **Account Type** (Private, Commercial, Non-Revenue) - entering **Commercial** enables the bottom portion of the folder to accept company information
- **Agency** - agency ownership of an account is a feature that enables the management of multiple agencies operating in the same service center operation. This feature is disabled for SCDOT.
- **Driver's License No., DL State, DL Country** - optional
- **Primary Account Holder's Name** - Last Name, First Name, Middle Name, Title.
- **Primary Account Holder Address Type** - allows for multiple addresses to be recorded for an account (Billing, Shipping, Correspondence).

- **Primary Account Holder's Address** - entering the zip code automatically fill in the city/state fields
- **Phone Type** - allows for multiple phone numbers to be recorded for an account (day, night, fax, cellular, work, home).
- **Contact Telephone Number** (Day and Night) and Fax Number - optional
- **Statement Delivery Method** - (Mail, Fax, None).
- **Statement Period** - (Monthly, Bi-Monthly, Annually, etc.).
- **Company Name** - on commercial account types, this becomes the primary account holder name and the name at the top of the folder becomes the first contact name on the commercial account.
- **Surety** - optional field to be used in the future for accounts receivable processing of commercial accounts.
- **DBA Name** - doing business as name, if other than company name
- **Second Contact Name** - second contact last name, first name, middle initial, and title

7.3.2 Purpose

The purpose of this folder is to enter all demographic information for either a private or commercial account to open a new account for any customer type.

7.3.3 Process

- When the folder is shown, all default values must be shown on appropriate fields (where applicable). When required, all controls with multiple options (usually drop-down list box type) will be populated with required data from the database tables (usually static system tables).
- All entered data must be validated for correctness and completeness. User will not be allowed to create an account until all required data are entered and validated.
- Entered data will be encoded (if required) and grouped (for example, address-related information, payment-related information, replenishment-related information, etc.).
- New records will be created in appropriate database tables specifically established for creating a new account. A unique account number will be generated for each newly-created account. This number will be used throughout the system for identifying and / or relating information to this account.

7.3.4 Output

The new account number will be displayed on the window for the clerk to make note (if required). This is also an indication that the account creation process is complete.

7.4 Open Account - Sub-Accounts Folder

ETC Account Management Application - Open Account

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Devices Plans

Agency Account Maintenance Account Name

CROSS ISLAND P JONES, RICHARD

SubAccount #	Name	Status	Req. Devices	Assign. Devices	Vehicles
0	JONES, RICHARD	PENDING	0	0	0
1	SUSAN	PENDING	0	0	0

SubAccount # Name Status Req. Devices Assign. Devices Vehicles

PENDING

Address Type Address

BILLING Clear

Zip Code City State Country

Add

Account Maintenance Apr 24, 1997 2:03 pm

Figure 7-3 Open Account - Sub-Accounts Folder

7.4.1 Input

The **VECTOR Account Maintenance Sub-Accounts Folder** is a new feature that allows private and commercial accounts to track cost specific trips on SCDOT facilities. No financial balances are carried on the sub-account. No financial balances are carried on the sub-account.

7.4.2 Purpose

The purpose of this folder is to record the replenishment information of the customer.



7.4.3 Process

- When the folder is shown, all default values will be shown on appropriate fields (where applicable).
- Only fields relevant to a specific pay-type will be shown in the window.
- All entered data will be validated for correctness and completeness; for example, for payment type credit card, the following information must be present and valid:
 - ⇒ credit card
 - ⇒ credit card name
 - ⇒ credit card number
 - ⇒ expiration date

7.5 Open Account - Replenishments Folder

ETC Account Management Application - Open Account

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Devices Plans

Agency Account No. Account Name

CROSS ISLAND P JONES, RICHARD

Method of Replenishment

CASH

Card Number Expiration Date Authorization Code

MM/YY

Ready Apr 24, 1997 2:04 pm

Figure 7-4 Open Account - Replenishments Folder

7.5.1 Input

The **Open Account - Replenishments Information Folder** will accept the following input (all inputs are dependent on pay-type selection):

- For pay-type cash and check, select **CASH** from the drop-down list selection for method of replenishment.
- For pay-type **CREDIT CARD** (for example, VISA13, VISA16, DISCOVER, etc.), the inputs are:
 - ⇒ credit card number
 - ⇒ authorization code
 - ⇒ credit card expiration date

7.5.2 Purpose

The purpose of this folder is to record the replenishment information of the customer.

7.5.3 Process

- When the folder is shown, all default values will be shown on appropriate fields, where applicable.
- Only fields relevant to a specific pay-type will be shown in the window.
- All entered data will be validated for correctness and completeness; for example, for payment type credit card, the following information must be present and valid:
 - ⇒ credit card
 - ⇒ credit card name
 - ⇒ credit card number
 - ⇒ expiration date

7.6 Open Account - Vehicles Folder

ETC Account Management Application - Open Account

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments **Vehicles** Devices Plans

Agency Account No. Account Name

CROSS ISLAND P JONES, RICHARD

SubAccount #	Plate #	State	Country	Make	Model	Color	Year	Axles
0	123444	LA	USA	BENTLY	BIG	BLUE	1997	2

Listing of Vehicles

SubAccount Plate# State Country Make Model

0 123444 LA USA BENTLY BIG

Color Year Axles Dual

1997 2

Add

Highlight Vehicle to Update or Delete Apr 24, 1997 2:05 pm

Figure 7-5 Open Account - Vehicles Folder

7.6.1 Input

The **Vehicles Folder** is used to record pertinent vehicle registration information for assigning appropriate tag-types and later image identification. The folder also accepts the following input:

- Plate Number
- State
- Plate-Type
- Year
- Make
- Model
- Class

7.6.2 Purpose

The **Vehicles** folder allows the user to add vehicle information to a customer account.

7.6.3 Process

- Opening the folder will display any vehicles currently belonging to the selected account.
- The user can click the **ADD** button, which will insert a new row onto the vehicle list. The newly-inserted row can be filled in by the user. The **Plate Type**, **Make**, **Model** and **Vehicle Class** columns contain drop-down lists from which the user can choose.
- The **DELETE** button can be used to remove entries, but cannot be used to remove vehicle data that has been committed to the database during the opening operation.
- The **UPDATE** button is used to make any corrections to the list of vehicles belonging to the customer account.

7.6.4 Output

New vehicle records are inserted into the database as needed and the customer account record is updated to reflect any new vehicles.

7.7 Open Account - Devices Folder

ETC Account Management Application - Open Account

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Devices Plans

Agency Account No. Account Name

CROSS ISLAND P JONES, RICHARD

SubAccount #	Status	Request Type	Count	Device Type	MountType	CScrip Start Date	CScrip End Date
0	NEW	WALK-IN	1	C-PASS	INTERIOR		

SubAccount Request Status Request Type Device Count

0 NEW WALK-IN 0

Device Type Mount Type C-Scrip Start Date C-Scrip End Date

C-PASS INTERIOR xx/xx/xxxx xx/xx/xxxx

Add Cancel OK

Ready Apr 24, 1997 2:06 pm

Figure 7-6 Open Account - Device Request Folder

7.7.1 Input

The **Device Request Folder** requires the user to input all information necessary to issue a device assignment request. Vehicle-type information is necessary to verify that the device-type (external, internal, etc.) is matched properly to the physical needs of the customer vehicles. The following information is required:

- **Sub Account** - devices are assigned at the sub-account level to facilitate account tracking of tolls incurred
- **Request-Type** - drop list of all user defined assignment queues to facilitate device assignment by pre-defined work flows. (Walk-in, Mail-in, Commercial, etc.)
- **Device Count** - number of devices requested for a particular device type and mount-type
- **Device-Type** -- contains all applicable device types for SCDOT. (Read Only, Read / Write, Tickets, etc.)

- **Mount-Type** - contains all possible mount-type devices for assignment. (External License Plate, Internal Windshield, Rooftop, etc.)

7.7.2 Purpose

The **Device Request** folder allows the user to request any number of devices by device and mount type for a sub-account. Financial transaction are created in the background to generate a tag deposit to be paid at the end of the account opening process. All tag deposit charges are stored in a database table so that the user does not have to enter the amounts.

7.7.3 Process

- Opening the window will display any device requests belonging to the selected account.
- The user can click **ADD**, which will insert a new row onto the device request list. The newly-inserted row can be filled in by the user.
- The **DELETE** button can be used to remove newly-added entries, and in **Account Maintenance** folders it can also be used to remove device request data that has been committed to the database during the opening operation.
- The **UPDATE** button is used to make any corrections to the list of device requests belonging to the customer account.

7.7.4 Output

New device request records are inserted into the database as needed and the customer account record is updated to reflect new device requests.

7.8 Open Account - Plans Folder

ETC Account Management Application - Open Account

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Devices Plans

Agency Account No. Account Name

CROSS ISLAND P JONES, RICHARD

SubAccount #	Plan	Start Date
0	COMMUTER	04/24/1997
1	NRV-ACCTAUD	04/24/1997

SubAccount Plan

1 COMMUTER

Add Cancel OK

Ready Apr 24, 1997 2:07 pm

Figure 7-7 Open Account - Plans Folder

7.8.1 Input

The **Open Account - Plans Folder** requires the user to input all information necessary to choose an appropriate ETC payment plan for the sub-account. Plan selection information is necessary to calculate the appropriate pre-paid toll charges summarized at the end of the **Account Opening** exercise. The **Payments** folder will display an open order of items requested including plans and device deposits. Activation of the account is dependent on the complete posting of all accrued items during this entire process. The following information is required:

- **Sub-account** - devices are assigned at the sub-account level to facilitate account tracking of tolls incurred
- **Plan** - drop-down list of all user-defined ETC payment plans. SCDOT must provide pertinent discount or policy information to complete the definition of logic to be applied in this module and in the **Toll Posting** module.

7.8.2 Purpose

The **Open Account - Plans Folder** allows the user to request plans and combinations for a sub-account. Financial transactions are created in the background to generate a pre-paid deposit to be paid at the end of the account opening process. All pre-paid deposits are stored in a database table so clerks do not have to manually calculate and enter the amounts.

7.8.3 Process

1. Opening the window will display any account payment plans currently belonging to the selected account.
2. The user can click the **ADD** button, which will insert a new row onto the account payment plan list. The newly-inserted row can be filled in by the user.
3. The **DELETE** button can be used to remove newly added entries, and in **Account Maintenance** folders it can also be used to remove account payment plan data that has been committed to the database during the opening operation.
4. The **UPDATE** button is used to make corrections to the list of account payment plans belonging to the customer account.

7.8.4 Output

New account payment plan records are inserted into the database as needed, and the customer account record is updated to reflect any new account payment plans. At the end of the opening process, the user should click the **CLOSE** button on the main menu toolbar to commit information to the database and generate the following:

- An account number
- A composite financial transaction, including all calculated pre-paid toll deposits, tag deposits, and associated fees (if applicable to SCDOT)

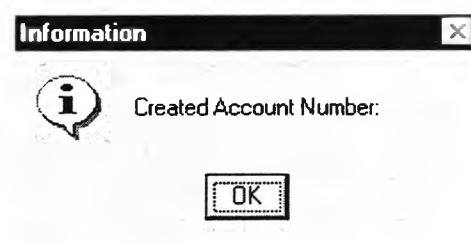


Figure 7-8 Open Account - Account Created Window

After the account is created, the following pop-up window, depicted in Payment Prompt Pop-Up (Figure 7-9), prompts the user to consider making a payment on the pending account. This allows devices to be assigned and the account can be activated for use in the toll lanes.

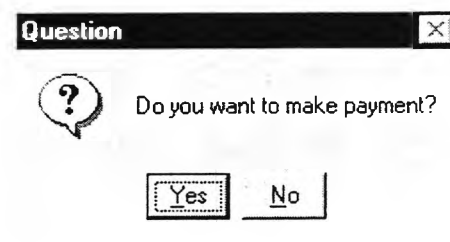


Figure 7-9 Payment Prompt Pop-Up

7.9 Open Account - Payments Folder

ETC Account Management Application - Financial

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Payments Reversals Disbursements Adjustments Write-Offs Forfeitures

Agency Account No. Account Name Current Balance Financial Status

CROSS ISLAND P 515516 JONES, RICHARD \$0.00 PENDPAY

Item	Date	Store	Employee	Total	Category	SubCategory	Unit Price	Qty	Extension	Manual
50930	04/24/1997 14:13:50	1	86720	\$55.00						
					TOLDEPOSIT	COMMUTER	\$30.00	1	\$30.00	
					TAGDEPOSIT	C-PASSINT	\$25.00	1	\$25.00	
					TOLDEPOSIT	NRV-ACCTAUD	\$0.00	1	\$0.00	

Category SubCategory Unit Price Qty Extension

TOLDEPOSIT PREPAYMENT \$0.00 0 \$0.00

Payment Type Payment Ref. Number

CASH

Auth. Code

Amount Tended \$60.00

Total Due \$55.00

Change Due \$0.00

Apply Change to Balance

All Partial None

Amount \$5.00

Save

Figure 7-10 Open Account - Payments Folder

7.9.1 Input

The **Open Account - Payments Folder** will accept the following input:

- Amount tendered
- For pay-type credit card (i.e., VISA13, VISA16, DISCOVER, etc.) - credit card name, number, authorization code, and expiration date
- For pay-type check - Payment Reference check number
- Pay-type direct debit is not allowed as a payment option

7.9.2 Purpose

The purpose of this folder is to record the payment details of the customer. This folder located in the **Financial** set of folders found on the main menu toolbar.

7.9.3 Process

- When the folder is shown, all default values will be shown on the appropriate fields (where applicable).
- Only fields relevant to a specific pay type will be shown in the window.
- All entered data will be validated for correctness and completeness; for example, for payment type credit card, the following information must be present and valid:
 - ⇒ credit card
 - ⇒ credit card name
 - ⇒ credit card number
 - ⇒ expiration date
- This folder will close when all entered data is correct or the **CANCEL** button is pressed. Program control will return to the main menu toolbar.

7.10 Account Maintenance - Demographics Folder

There are two pop-up windows that appear when the user selects the **Account Maintenance** folders from the main menu toolbar; the **Find Customer Account** followed by the **Find Customer Account List**, if an exact match is not found.

The screenshot displays the 'ETC Account Management Application' window. The title bar includes 'File Folders Help'. The menu bar contains icons for 'Open Acct', 'Acct Maint', 'Financial', 'Assign', 'Inventory', 'History', 'Violation', 'Reports', 'Close', 'Help', and 'Exit'. The main area shows a 'Find Customer Account' dialog box with the following fields:

Agency	Account No.	Last Name	First Name	MI
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Device ID	Customer Last Name		State	
<input type="text"/>	<input type="text"/>		<input type="text"/>	
Company Name	Company DBA			
<input type="text"/>	<input type="text"/>			

At the bottom right of the dialog box are 'Find' and 'Cancel' buttons. The status bar at the bottom of the application window shows 'Account Maintenance' on the left and 'May 9, 1997 12:47 pm' on the right.

Figure 7-11 Account Maintenance - Find Customer Account Search Window

ETC Account Management Application

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Find Customer Account List

Agency	Account #	Last Name	First Name	Middle Initial	City	Zip Code
CIP	272958	PACE	LEE		HILTON HEAD	29926
CIP	301211	PACE	ROCCO	W	HILTON HEAD	29926
CIP	295960	PACHECO	ANA	R	CONWAY	29920
CIP	327809	PACHECO	HERBERT	A	CONWAY	29920
CIP	327024	PACHECO	SONIA		CONWAY	29920
CIP	290634	PACHOWICZ	JOSEPH	M	SAVANNAH	29820
CIP	307965	PACINI	PIERANGELO		HILTON HEAD	29926
CIP	311308	PACKMAN	ANDREA	RUTH	BEAUFORT	29924
CIP	368337	PAEZ	DORA	S	HILTON HEAD	29923
CIP	324063	PAEZ	RENE	ANTONIO	HILTON HEAD	29923
CIP	381321	PAGAN	ANGEL	GUSTAVO	SAVANNAH	29820
CIP	267580	PAGAN	CLAUDIA		SAVANNAH	29820
CIP	287095	PAGAN	JUAN CARLOS		SAVANNAH	29820
CIP	380091	PAGAN	ZAMIRA		SAVANNAH	29820
CIP	355645	PAGLIARULO	JEFFREY	RICHARD	BLUFFTON	29922
CIP	369603	PAIS	LILY	M	BLUFFTON	29922
CIP	349331	PAISLEY	ADELIA		MYRTLE BEACH	29770
CIP	268445	PAISLEY	SHERRI	E	MYRTLE BEACH	29770

Account Maintenance May 9, 1997 12:49 pm

Figure 7-12 Account Maintenance - Find Customer Account List Selection Window

When the desired account is found - either through the search window or through selecting the account from a matching list of accounts - the following folder, shown in Figure 7-13, is opened for updating or viewing by the user:

Figure 7-13 Account Maintenance - Demographics Folder

7.10.1 Input

The **Account Maintenance - Demographics Folder** will accept the following input:

- **Account Type** (Private, Commercial, Non-Revenue) - entering **Commercial** enables the bottom portion of the folder to accept company information
- **Agency** - agency ownership of an account is a feature that enables the management of multiple agencies operating in the same service center operation - This feature is disabled for SCDOT.
- **Driver's License No., DL State, DL Country** - optional
- **Primary Account Holder's Name** - Last Name, First Name, Middle Initial, Title



- **Social Security Number** - optional
- **Primary Account Holder Address Type** - allows for multiple addresses to be recorded for an account (**Billing, Shipping, Correspondence**)
- **Primary Account Holder's Address** - entering the zip code automatically fill in the city / state fields
- **Phone Type** - allows for multiple phone numbers to be recorded for an account (day, night, fax, cellular, work, home)
- **Contact Telephone Number (Day and Night) and Fax Number** - optional
- **Statement Delivery Method** - (Mail, Fax, None)
- **Statement Period** - (Monthly, Bi-Monthly, Annually, etc.)
- **Company Name** - on commercial account types, the primary account holder name and the name at the top of the folder becomes the first contact name on the commercial account
- **Surety** - optional field to be used in the future for accounts receivable processing of commercial accounts
- **DBA Name** - doing business as name, if other than company name
- **Second Contact Name** - second contact last name, first name, middle initial, and title

7.10.2 Purpose

The purpose of this folder is to enter all demographic information for either a private or a commercial account to make changes to any identifying information in an account for any customer type.

7.10.3 Process

- When the folder is shown, default values must be shown on appropriate fields (where applicable). Where required, controls with multiple options (usually drop-down list box type) will be populated with required data from the database tables (usually static system tables).
- Entered data must be validated for correctness and completeness. The user will not be allowed to create an account until all required data is entered and validated.
- Entered data will be encoded (if required) and grouped (e.g., address-related information, payment-related information, replenishment-related information, etc.).
- New records will be created in appropriate database tables for creating a new account. A unique account number will be generated for a newly-created account. This number will be used throughout the system for identifying and / or relating information to this account.



7.10.4 Output

The modified information is displayable in any open folder during the maintenance exercise for the user to view before pressing the **CLOSE** button on the main menu toolbar. If financial transactions were created during the session, a pop-up window requesting whether a payment is to be made at this time appears. If the user answers **Yes**, the payments folder is displayed with the transactions for payment. If the user answers **No**, the pending transaction is held as an open item and financial payments can be handled through the **Financial** set of folders at any given time.

7.11 Account Maintenance - Sub-Accounts Folder

ETC Account Management Application - Account Maintenance

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Device Request Device Maint Plans Notes

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 295960 PACHECO, ANA R. \$0.00 PENDPAY

SubAccount #	Name	Status	Req. Devices	Assign. Devices	Vehicles
0	PACHECO		0	0	1

SubAccount # Name Status Req. Devices Assign. Devices Vehicles

PENDING

Address Type Address

BILLING Clear

Zip Code City State Country

USA

Add

Ready May 9, 1997 1:17 pm

Figure 7-14 Account Maintenance - Sub-Account Folder

7.11.1 Input

The **Vector Account Maintenance Sub-Accounts Folder** is a new feature that allows private and commercial accounts to track cost specific trips on SCDOT facilities. No financial balances are carried on the sub-account. The customer can setup sub-accounts for different types of toll activity reporting. A customer can change the setup of sub-accounts for different types of toll activity reporting.

7.11.2 Purpose

The purpose of this folder is to record the sub-account demographics information of the customer.

7.11.3 Process

- When the folder is shown, all default values will be shown on appropriate fields (where applicable).
- Only fields relevant to a specific pay-type will be shown in the window.

7.12 Account Maintenance - Replenishments Folder

ETC Account Management Application - Account Maintenance

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Device Request Device Maint Plans Notes

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 295960 PACHECO, ANA R. \$0.00 PENDPAY

Method of Replenishment Replenishment Amount Replenishment Threshold

CASH \$0.00 \$0.00

Card Number Expiration Date Authorization Code

Ready May 9, 1997 1:18 pm

Figure 7-15 Account Maintenance - Replenishments Folder

7.12.1 Input

The **Account Maintenance - Replenishment Information Folder** will accept the following input (all inputs are dependent on pay-type selection):

- For pay-type cash and check, select **CASH** from the drop-down list selection for method of replenishment.
- For pay-type **CREDIT CARD** (for example, VISA13, VISA16, DISCOVER), the inputs are credit card number, authorization code, and credit card expiration date).

7.12.2 Purpose

The purpose of this folder is to record the replenishment information of the customer.



7.12.3 Process

- When the folder is shown, all default values will be shown on appropriate fields (where applicable).
- Only fields relevant to a specific pay type will be shown in the window.
- All entered data will be validated for correctness and completeness; for example, for payment type credit card, the following information must be present and valid:
 - ⇒ credit card
 - ⇒ credit card name
 - ⇒ credit card number
 - ⇒ expiration date

7.13 Account Maintenance - Vehicles Folder

ETC Account Management Application - Account Maintenance

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments **Vehicles** Device Request Device Maint Plans Notes

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 295960 PACHECO, ANA R. \$0.00 PENDPAY

SubAccount #	Plate #	State	Country	Make	Model	Color	Year	Axles
0	LME66Y	FL	US	FORD	SW	SILVER	1992	2

SubAccount Plate# State Country Make Model

0 USA

Color Year Axles Dual

1997 2

Add

Ready May 9, 1997 1:19 pm

Figure 7-16 Account Maintenance - Vehicles Folder

7.13.1 Input

The **Account Maintenance - Vehicles Folder** is used to record pertinent vehicle registration information for assigning appropriate tag types and for later image identification. The folder also accepts the following input:

- Plate Number
- State
- Plate Type

- Year
- Make
- Model
- Class

7.13.2 Purpose

The **Vehicles** folder allows the user to add vehicle information to a customer account.

7.13.3 Process

- Opening the folder will display any vehicles currently belonging to the selected account.
- The user may click the **ADD** button which will insert a new row onto the vehicle list. The newly inserted row may be filled in by the user. (The Plate Type, Make, Model and Vehicle Class columns contain drop-down lists from which the user may make choices.)
- The **DELETE** button can be used to remove newly added entries, but cannot be used to remove vehicle data which has been committed to the database during the opening operation.
- The **UPDATE** button is used to make corrections to the list of vehicles belonging to the customer account.

7.13.4 Output

New vehicle records are inserted into the database as needed and the customer account record is updated to reflect new vehicles or changed registration information on an existing vehicle.

7.14 Account Maintenance - Device Request Folder

ETC Account Management Application - Account Maintenance

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Device Request Device Maint Plans Notes

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 295960 PACHECO, ANA R. \$0.00 PENDPAY

SubAccount # Status Request Type Count Device Type MountType CScrip Start Date CScrip End Date

Listing of Device Requests

SubAccount Request Status Request Type Device Count

0 NEW 0

Device Type Mount Type C-Scrip Start Date C-Scrip End Date

C-PASS INTERIOR

Add Update Delete

Highlight Device Request to Update or Delete May 9, 1997 1:19 pm

Figure 7-17 Account Maintenance - Device Request Folder

7.14.1 Input

The Devices Request folder, illustrated in Figure 7-17, requires the user to input all information necessary to issue a device assignment request. Vehicle-type information is necessary to verify that the device-type (external, internal, etc.) is matched properly to the physical needs of the customer vehicles. The following information is required:

- **Sub-account** - devices are assigned at the sub-account level to facilitate account-tracking of tolls incurred
- **Request-Type** - drop-down list of user-defined assignment queues to facilitate device assignment by pre-defined workflows (Walk-in, Mail-in, Commercial, etc.)
- **Device-Count** - number of devices requested for a particular device-type and mount-type.

- **Device-Type** - drop-down list of applicable device-types for SCDOT (Read-only, Read / Write, Tickets, etc.)
- **Mount-Type** - drop-down list of possible mount-type devices for assignment. (External License Plate, Internal Windshield, Rooftop, etc.)

7.14.2 Purpose

The **Device Request Folder** allows the user to request a number of devices by device and mount-type for a sub-account. Financial transactions are created in the background to generate a tag deposit to be paid at the end of the account opening process. All tag deposit charges are stored in a database table so clerks do not have to enter the amounts.

7.14.3 Process

- Opening the window will display any device requests belonging to the selected account.
- The user may click **ADD**, which will insert a new row onto the device request list. The newly-inserted row can be filled in by the user.
- The **DELETE** button can be used to remove newly-added entries and, in **Account Maintenance** folders, it can also be used to remove device request data that has been committed to the database during the opening operation.
- The **UPDATE** button is used to make corrections to the list of device requests belonging to the customer account.

7.14.4 Output

New device request records are inserted into the database as needed, and the customer account record is updated to reflect any new device requests.

7.15 Account Maintenance - Device Maintenance Folder

ETC Account Management Application - Account Maintenance

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Device Request Device Maint Plans Notes

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 339315 ABBOTT, PAUL \$0.00 PENDPAY

SubAccount #	Device Number	Device Status	Last Read
--------------	---------------	---------------	-----------

SubAccount # Device No. Device Status Last Read

xx/xx/xxxx xx:xx

Date Changed Changed By

xx/xx/xxxx

Ready May 9, 1997 1:22 pm

Figure 7-18 Account Maintenance - Device Maintenance Folder

7.15.1 Input

The **Device Maintenance Folder**, shown in Figure 7-18, requires the user to input all information necessary to change a status on a particular device. The following information is required:

- **Sub-account** - devices are assigned at the sub-account level to facilitate account tracking of tolls incurred.
- **Device Number**- contains the number of the device selected from the outline field of available assigned devices on the sub-account selected.

- **Device Status** - field the user inputs to change the status of a device based on the following status:
 1. **LOST**
 2. **STOLEN**
 3. **RETURNED**
 4. **RETURNED DEFECTIVE**
 5. **DAMAGED**
 6. **ACTIVE**

7.15.2 Purpose

The **Device Maintenance** folder allows the user to change the status of a device for a sub-account. Financial transactions are created in the background to generate a refund tag deposit. All tag deposit charges are stored in a database table so clerks do not have to enter the amounts.

7.15.3 Process

- Opening the folder will display devices belonging to the selected account.
- The **UPDATE** button is used to make corrections to the list of devices belonging to the customer account.

7.15.4 Output

New device status records are inserted into the database, as needed, and the customer account record is updated to reflect any new device statuses.

7.16 Account Maintenance - Plans Folder

ETC Account Management Application - Account Maintenance

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Device Request Device Maint Plans Notes

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 339315 ABBOTT, PAUL \$0.00 PENDPAY

SubAccount #	Plan	Start Date
0	RB-ANNUAL	03/14/1997

SubAccount Plan

0 COMMUTER

Add Update Delete

Highlight Account Plan to Update or Delete May 9, 1997 1:22 pm

Figure 7-19 Account Maintenance - Plans Folder

7.16.1 Input

The **Account Maintenance - Plans Folder** requires the user to input all information necessary to choose an appropriate ETC payment plan for the sub-account. Plan selection information is necessary to calculate the appropriate pre-paid toll charges summarized at the end of the **Account Opening** exercise. The **Payments** folder will display an open order of items requested including plans and device deposits. Activation of the account is dependent on the complete posting of all accrued items during this entire process. The following information is required:

- **Sub-account** - devices are assigned at the sub-account level to facilitate account tracking of tolls incurred
- **Plan** - drop-down list of user-defined ETC payment plans. SCDOT must provide pertinent discount or policy information to complete the definition of logic to be applied in this module and in the **Toll Posting** module.

7.16.2 Purpose

The **Account Maintenance - Plans Folder** allows the user to request a number of plans and combinations for a sub-account. Financial transactions are created in the background to generate a pre-paid deposit to be paid at the end of the account opening process. All pre-paid deposits are stored in a database table so clerks do not have to manually calculate and enter the amounts.

7.16.3 Process

1. Opening the window will display account payment plans belonging to the selected account.
2. The user can click **ADD**, which will insert a new row onto the account payment plan list. The newly-inserted row can be filled in by the user.
3. The **DELETE** button can be used to remove newly-added entries and, in **Account Maintenance** folders, it can also be used to remove account payment plan data that has been committed to the database during the opening operation.
4. The **UPDATE** button is used to make any corrections to the list of account payment plans belonging to the customer account.

7.16.4 Output

New account payment plan records are inserted into the database as needed, and the customer account record is updated to reflect new account payment plans. At the end of the opening process, the user should click the **CLOSE** button on the main menu toolbar to commit information to the database and generate the following:

- An account number
- A composite financial transaction, including all calculated pre-paid toll deposits, tag deposits, and associated fees (if applicable to SCDOT)

7.17 Account Maintenance - Notes Folder

ETC Account Management Application - Account Maintenance

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Demographics SubAccounts Replenishments Vehicles Device Request Device Maint Plans Notes

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 521313 PIKE, BRETT M. \$30.00 GOOD

Date Title

05/06/1997

Note Detail

Add Update Delete

Financial Transaction May 6, 1997 12:34 pm

SubAccount Plan

0 COMMUTER

Add

Ready May 6, 1997 12:33 pm

Start RezSolution Forte Distributed Workspace: SPike Project: VECTOR Metro-Dade County To... ETC Account ... Financial 12:35 PM

Figure 7-20 Account Maintenance - Notes Folder

7.17.1 Input

The **Account Maintenance Notes Folder** is an added feature offered in **VECTOR** that allows the clerk to enter notes on the account for special handling or complaints filed by the customer. The following information is required to create a note record in the database:

- **Note Title** - brief description of the memo record to quickly identify the note in a history window or selection window for further viewing
- **Note Detail** - a 300-character free form field for adding additional information to the note or complaint



7.17.2 Purpose

The **Account Maintenance Notes Folder** allows the service center personnel to enter free form information about the account for future reference.

7.17.3 Process

1. Opening the window will display any notes currently belonging to the selected account.
2. The user can click **ADD** , which will insert a new row onto the notes list. The newly-inserted row can be filled in by the user.
3. The **DELETE** button may be used to remove newly added entries; and in Account Maintenance folders, it may also be used to remove any notes data which has been committed to the database during the opening operation.
4. The **UPDATE** button is used to make any corrections to the list of notes belonging to the customer account.

7.17.4 Output

New **Notes** records are inserted into the database, as needed, and the customer account record is updated to reflect new notes. If the user presses the **CLOSE** button on the main menu toolbar, the following pop-up window, Figure 7-21, is displayed and the user can choose to save the information or discard all changes in any of the folders.

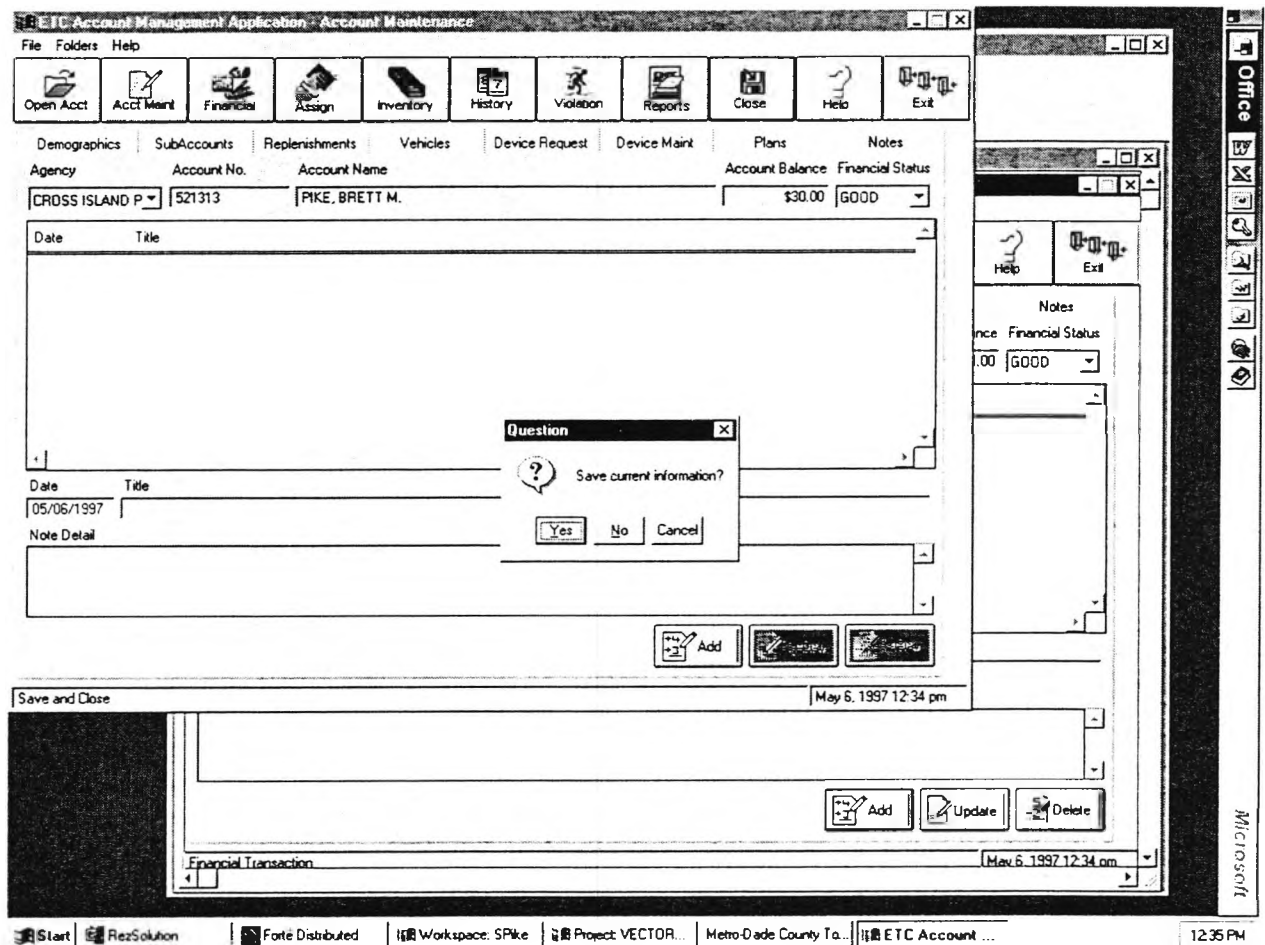


Figure 7-21 Account Maintenance - Close Window



7.18 Financial - Payments Folder

ETC Account Management Application - Financial

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Payments Reversals Disbursements Adjustments

Agency Account No. Account Name Current Balance Financial Status

CROSS ISLAND P 281573 DAMICO, SYBIL L \$0.00 PENDPAY

Item	Date	Store	Employee	Total	Category	SubCategory	Unit Price	Qty	Extension	Manual
▼ *	05/09/1997 13:27:21	1	80280	\$20.00	TOLDEPOSIT	PREPAYMENT	\$20.00	1	\$20.00	

Listing of Open Items

Category	SubCategory	Unit Price	Qty	Extension
TOLDEPOSIT	PREPAYMENT	\$20.00	1	\$20.00

Add

Payment Type Payment Ref. Number

CASH

Auth. Code

Amount Tendered \$0.00

Total Due \$0.00

Change Due \$0.00

Apply Change to Balance

All Partial None

Amount \$0.00

Ready May 9, 1997 1:33 pm

Figure 7-22 Financial - Payments Folder

7.18.1 Input

The **Financial - Payments Folder** will accept the following input:

- Amount tendered
- For pay-type credit card (VISA13, VISA16, DISCOVER, etc.) - credit card name, number, authorization code, and expiration date
- For pay-type check - Payment Reference check number.

7.18.2 Purpose

The purpose of this folder is to record the payment details of the customer. This folder is in the **Financial** set of folders found on the main menu toolbar.



7.18.3 Process

- When the window is shown, all default values will be shown on appropriate fields (where applicable).
- Only fields relevant to a specific pay type will be shown in the window.
- All entered data will be validated for correctness and completeness; for example, for payment type credit card, the following information must be present and valid:
 - ⇒ credit card
 - ⇒ credit card name
 - ⇒ credit card number
 - ⇒ expiration date
- This folder will close when entered data is correct or the **CANCEL** button is pressed. Program control will return to the main menu toolbar.

7.19 Financial - Reversals Folder

The reversal of financial transactions requires the user to select the composite transaction for which a single payment has been posted by highlighting the desired transaction from the outline field list of all transactions on the folder. A pop-up window, the same one shown in Figure 7-23, will contain the details of the composite transaction and the user should press the **REVERSE** button on the bottom right-hand corner of the folder. The transaction is now reversed.

ETC Account Management Application - Financial

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Payments Reversals Disbursements Adjustments

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 521313 PIKE, BRETT M. \$30.00 GOOD

Type Category Sub Category Pay Type Start Date End Date Find

ALL ALL ALL ALL 04/06/1997 05/06/1997

Financials

SubAcct#	Date Received	Trans#	Type	Category	SubCategory	Pay Type	Price	Quantity	Amount	Rev/Adj	Employee
0	04/25/1997 10:04:24	31913	R	TAGDEPOSIT	C-PASSINT	CASH	\$25.00	1	\$25.00		80290
0	04/25/1997 10:04:24	31913	R	TOLDEPOSIT	COMMUTER	CASH	\$30.00	1	\$30.00		80290

Ready May 6, 1997 12:38 pm

Auth. Code Total Due \$0.00

Apply Change to Balance Change Due \$0.00

None \$0.00

Open New Account May 6, 1997 12:37 pm

Start RezSolution Forte Distributed Workspace: SPike Project: VECTOR... Metro-Dade County To... ETC Account ... 12:38 PM

Figure 7-23 Financial - Reversals Folder

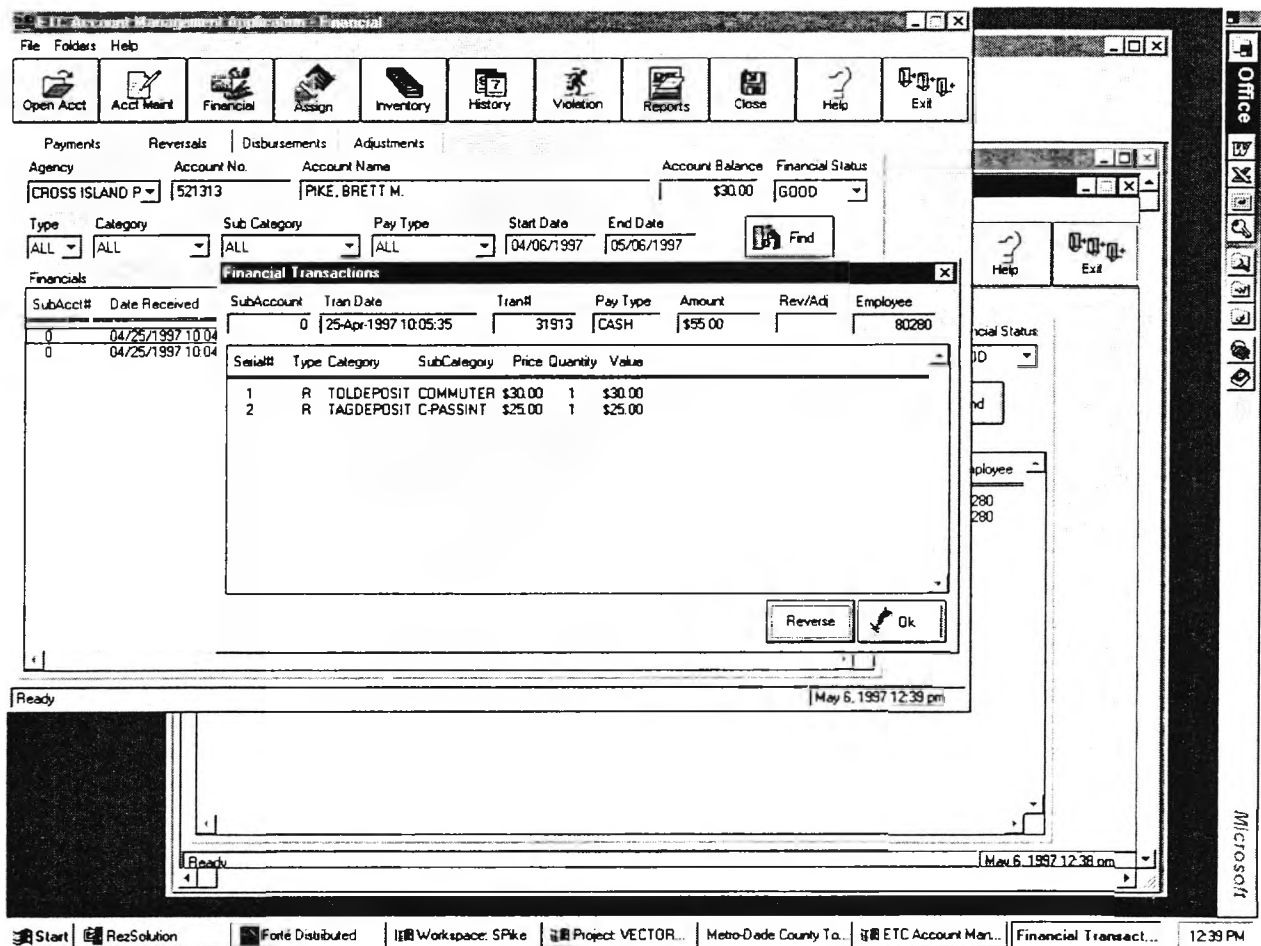


Figure 7-24 Financial - Reversal Window

7.19.1 Input

The **Financial - Reversal Window** will allow only the user to click and highlight the desired transaction for reversing.

7.19.2 Purpose

The purpose of this window is to record the reversal of originating transactions for the customer. This window is a folder in the **Financial** set of folders located on the main menu toolbar.

7.19.3 Process

- When the window is shown, all default values will be shown on appropriate fields (where applicable).



- Only fields relevant to a specific pay-type will be shown in the window.
- All entered data will be validated for correctness and completeness; for example, for payment-type credit card, the following information must be present and valid:
 - ⇒ credit card
 - ⇒ credit card name
 - ⇒ credit card number
 - ⇒ expiration date

7.20 Financial - Disbursements (Refunds) Folder

ETC Account Management Application - Financial

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Payments Reversals Disbursements Adjustments

Agency: CROSS ISLAND P. Account No.: 521313 Account Name: PIKE, BRETT M. Current Balance: \$30.00 Financial Status: GOOD

Item	Date	Store	Employee	Total	Category	SubCategory	Unit Price	Qty	Extension	Manual
<p>Category: TOLDEPOSIT SubCategory: REFUND Unit Price: \$0.00 Qty: 0 Extension: \$0.00</p> <p>Buttons: Add, Reverse, Ok</p>										

Disbursement Type: CASH Payment Ref. Number: Auth. Code:

Ready May 6, 1997 12:48 pm

Start RezSolution Forté Distributed Workspace: SPike Project: VECTOR... Metro-Dade County To... ETC Account ... 12:48 PM

Figure 7-25 Financial - Disbursements (Refunds) Folder

7.20.1 Input

The **Financial - Disbursements (Refunds) Folder** will accept the following input:

- **Category / Sub-category** of transaction to be refunded. Only toll deposits are refundable in the current version of the software. Discussions are necessary with SCDOT to decide on refund policies for implementation
- **Unit Price** to be refunded
- For disbursement-type credit card (i.e., VISA13, VISA16, DISCOVER, etc.) - credit card name, number, authorization code, and expiration date
- For disbursement-type check - payment reference check number

7.20.2 Purpose

The purpose of this folder is to record the transaction refund details of the customer. This folder is a in the **Financial** set of folders found on the main menu toolbar.

7.20.3 Process

- When the window is shown, all default values will be shown on appropriate fields (where applicable).
- Only fields relevant to a specific pay-type will be shown in the window.
- All entered data will be validated for correctness and completeness; for example, for payment type credit card, the following information must be present and valid:
 - ⇒ credit card
 - ⇒ credit card name
 - ⇒ credit card number
 - ⇒ expiration date

7.21 Financial - Adjustments Folder

ETC Account Management Application - Financial

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Payments Reversals Disbursements Adjustments

Agency Account No. Account Name Current Balance Financial Status

CROSS ISLAND P 281573 DAMICO, SYBIL L \$0.00 PENDPAY

Item	Date	Store	Employee	Total	Category	SubCategory	Unit Price	Qty	Extension	Manual
------	------	-------	----------	-------	----------	-------------	------------	-----	-----------	--------

Category SubCategory Unit Price Qty Extension

TAGDEPOSIT C-CARD \$0.00 0 \$0.00

TAGDEPOSIT

Add

Enter Category of Transaction May 9, 1997 1:49 pm

Figure 7-26 Financial - Adjustments Folder

7.21.1 Input

The **Financial - Adjustments Folder** will accept the following input:

- **Category / Sub-Category** of transaction to be adjusted. Only tag deposits are refundable in the current version of the software. Discussions are necessary with SCDOT to decide on adjustment policies for implementation.
- **Unit Price** to be applied as an adjustment transaction.

7.21.2 Purpose

The purpose of this folder is to record the transaction adjustment details of the customer. This window is in the **Financial** set of folders found on the main menu toolbar.



7.21.3 Process

- When the folder is shown, default values will be shown on appropriate fields (where applicable).
- Only fields relevant to a specific pay type will be shown in the window.

7.22 Assign - Device Assignment Folder

ETC Account Management Application - Device Assignment

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Device Assignment

Agency Account No Account Name

0

Pending Requests

Sub#	Plan Start-Date	Sub#	Dev Mount Date Request Assigned Ref	Scrip-Start	Scrip-End
------	-----------------	------	-------------------------------------	-------------	-----------

Sub#	State License Axles	Sub#	Dev Type Device No Color Mount Axles License Ref	Scrip-Start	Scrip-End
------	---------------------	------	--	-------------	-----------

Rqst Date Rqst Qty Dev Type Mount Type

0

Device No License

Cancel Next Find Add Delete Save

Ready May 9, 1997 1:57 pm

Figure 7-27 Assign - Device Assignment Folder

7.22.1 Input

The Assign - Device Assignment Folder, shown in Figure 7-27, accepts the following input:

- **Device Number** to be assigned
- **License Plate Number** of the vehicle associated with the device-type (internal tag, external tag, ticket, etc.) and the mount-type (license plate, roof top, windshield, etc.)

7.22.2 Purpose

The **Assign - Device Assignment Folder** allows the user to assign devices to a sub-account based on various policies including:

- **Plan-Type**
- **Vehicle Physical** features; for example, windshield type or toll classification

7.22.3 Process

1. The user clicks on a pending request and the information is filled in the **Request Date**, **Request Quantity**, **Device-Type**, and **Mount- Type** fields below the outline field of **Pending Requests**.
2. The user then enters the device number of the device fitting the request-type and presses the **ADD** button on the folder. At this point, the device is displayed in the outline field above the **Device No.** field indicating the successful assignment of the device to the specific sub-account.

7.23 Assign - Device Inventory Folder

ETC Account Management Application - Inventory

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Device Inventory

Location	Device-Type	Mount-Type	Color	Start-Device	End-Device	Expiry-Date
----------	-------------	------------	-------	--------------	------------	-------------

Store Device Type Mount Type Device Color Start Device No End Device No

CROSS ISLAND P [] INTERIOR BEIGE 0 0

Add []

Ready May 9, 1997 2:34 pm

Figure 7-28 Assign - Device Inventory Folder

7.23.1 Input

The **Assign - Device Inventory Folder** accepts the following input:

- Store for which the inventory is being assigned
- Device-type being entered into inventory
- Mount-type being entered into inventory
- Device color being entered into inventory
- Beginning and ending device number of the group being entered as **INVENTORY** status in the database.

7.23.2 Purpose

The **Assign - Device Inventory Folder** allows the user to enter a range of device numbers into inventory in order to eliminate the need to enter individual devices.

7.23.3 Process

1. The user enters all necessary information and presses the **ADD** button on the folder to add the device into the outline field for later saving to the database.
2. The user then closes the window by pressing the **CLOSE** button on the main menu toolbar and all devices are saved to the database.

7.24 History - Toll History Folder

ETC Account Management Application - History

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Toll History Financial History Non-Financial History

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 322476 SAMPEDRO, FRANCES E. \$0.00 PENDPAY

Agency Plaza Device Start Date End Date Find

ALL ALL * 10/14/1582 05/09/1997

Toll Transactions

Agency	Date	Time	Device	Plaza	Lane	Status	Plan	FullFare	DiscountFare
--------	------	------	--------	-------	------	--------	------	----------	--------------

Ready May 9, 1997 2:45 pm

Figure 7-29 History - Toll History Folder

7.24.1 Input

The **History - Toll History Folder**, illustrated in Figure 7-29, retrieves and displays existing customer toll information from the database. The window accepts the following input:

- Date Ranges
- Plaza from which the toll transactions originated

7.24.2 Purpose

The purpose of the **History - Toll History Folder** is to allow the user to display toll transactions on a particular account.



7.24.3 Process

1. When **Customer Account History** is selected by the user, the **Find Account** window is displayed. When the appropriate account is located and selected, the **Account History** window will be displayed for that account.
2. The **Toll History** folder first displays all toll transactions in chronological order by date range.
3. A different Date Range can be chosen by the user.
4. Clicking on the **CLOSE** button will close the window.

7.24.4 Output

The **History - Toll History** for an individual account is displayed on screen.

7.25 History - Financial History Folder

ETC Account Management Application - History

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Toll History Financial History Non-Financial History

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 322476 SAMPEDRO, FRANCES E. \$0.00 PENDPAY

Type Category Sub Category Pay Type Start Date End Date Find

ALL ALL ALL ALL 04/09/1997 05/09/1997

Financials

SubAcct#	Date Received	Tran#	Type	Category	SubCategory	Pay Type	Price	Quantity	Amount	Rev/Adj	Employee
----------	---------------	-------	------	----------	-------------	----------	-------	----------	--------	---------	----------

Listing of Financial Transactions

Ready May 9, 1997 2:46 pm

Figure 7-30 History - Financial History Folder

7.25.1 Input

The **History - Financial History Folder** retrieves and displays existing customer store-related financial information from the database; for example, pre-paid toll deposits, tag deposits, refunds, transaction reversals, replenishments, toll adjustments, etc. The window accepts the following input:

- Date ranges
- Transaction-type:
 - ⇒ R - Originating Receipts
 - ⇒ X - Reversals
 - ⇒ A - Adjustments
- Category of transactions: (TOLLDEPOSIT, TAGDEPOSIT, etc.)

- Sub-category of transaction: (Plan type, Pay type, etc.)
- Pay-Type of Transactions to be displayed

7.25.2 Purpose

The purpose of the **History - Financial History Folder** is to allow the user to display financial store transactions on a particular account.

7.25.3 Process

- When **Customer Account History** is selected by the user, the **Find Account** window is displayed. When the appropriate account is located and selected, the **Account History** window will be displayed for that account.
- The **Financial History** folder first displays toll transactions in chronological order by date.
- A different **Date Range** can be chosen by the user.
- Clicking on the **CLOSE** button will close the window.

7.25.4 Output

The **History - Financial History** for an individual account is displayed on screen.

7.26 History - Non-Financial History Folder

ETC Account Management Application - History

File Folders Help

Open Acct Acct Maint Financial Assign Inventory History Violation Reports Close Help Exit

Toll History Financial History Non-Financial History

Agency Account No. Account Name Account Balance Financial Status

CROSS ISLAND P 322476 SAMPEDRO, FRANCES E. \$0.00 PENDPAY

Category Sub Category Start Date End Date Find

ALL ALL 04/09/1997 05/09/1997

Non Financial Transactions

SubAcct #	Tran Date	Tran#	Category	SubCategory	Employee
-----------	-----------	-------	----------	-------------	----------

Listing of Non Financial Transactions

Ready May 9, 1997 2:46 pm

Figure 7-31 History - Non-Financial History Folder

7.26.1 Input

The **History - Non-Financial History Folder**, shown in Figure 7-31, retrieves and displays customer non-financial information from the database. The window accepts the following input:

- Date Ranges
- Category of transactions: (CHANGEACCT, etc.)
- Sub-category of transaction: (DEMOG, VEHICLE, etc.).

7.26.2 Purpose

The purpose of the **History** window is to allow the user to display non-financial transactions on a n account.

7.26.3 Process

1. When **Customer Account History** is selected by the user, the **Find Account** window is displayed. When the appropriate account is located and selected, the **Account History** window will be displayed for that account.
2. The **Non-Financial History** folder first displays non-financial transactions in chronological order by date.
3. A different **Date Range** can be chosen by the user.
4. Clicking on the **CLOSE** button will close the window.

7.26.4 Output

The **Non-Financial History** for an individual account is displayed on screen.

8. Violation Image Review

This chapter summarizes, at a high level, the functional components of the Violations Image Review sub-system. The system processes and preliminary layouts of key on-line screens designed for execution of these functions are displayed.

8.1 Violation Image Review Processing Description

The Violations Image Review sub-system receives the violation transactions and associated image files from the lane sub-system and performs a series of processing activities that culminate in the issuance of a citation to the registered owners of the identified violating vehicle. In the process, several filters are executed to ensure that only true violators are cited. The various steps executed for each violation in its processing cycle can be listed as follows:

1. Receive violation transaction.
2. Verify and eliminate violation transactions created because of lane equipment malfunctions.
3. Verify whether a valid tag has been read and, if so, re-designate transaction as a toll transaction and post as such, subject to sufficient pre-paid balance in the account.
4. Verify whether a valid image file is available. If not, stop further processing of the transaction and account for it as a non-enforceable violation.
5. Review the image file and update violation transaction with license plate information.

8.2 Violations Image Review Sub-System Interactive Processes (Clients)

This sub-system implements the following on-line interactive processing functionality through a graphical user interface. It includes Violations Account Maintenance, Violations Image Review, and Violations Report Generation.

8.2.1 Violations Account Review

The **Violations Account Review Folder** (Figure 8-1) allows the user to display the violation information for a particular account. It requires the user to input the account number in order to retrieve the violation information for the account.

The screenshot displays the 'Violation Process Management Application' window. It features a menu bar with 'File', 'Folders', and 'Help'. Below the menu is a toolbar with icons for 'Img. Review', 'Identify Viol.', 'View Acct.', 'Close', 'Help', and 'Exit'. The main area has two tabs: 'Account Review' (selected) and 'View Image'. The 'Account Review' tab contains a form with the following fields:

- Account No.: 143419
- Agency: RB
- Account Type: PRIVATE
- Account Status: GOOD
- Last Name: RAMCHANDRAN
- First Name: AMBALAVANAN
- M.I.: M
- Address: MY BILLING ADDRESS MODIFIED6
- Zip Code: 94111
- City: SAN FRANCISCO
- State: CA
- Phone Type: DAY (selected from a dropdown)
- Telephone No.: (111) 111-1111
- Ext.:

Below the form is a table with the following data:

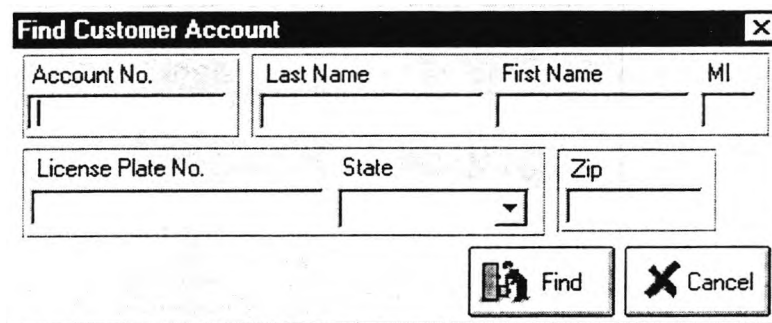
SubAcctNo	Date	Plaza	Lane	TollTrxType	TollRevType	ViolationType	ViolationStatus
0	06/30/1997 16:35:12	GWBL	62	VIOLATION	AVI	UNUSUALD	DMVREQUEST
0	06/11/1997 17:36:28	BB	08	VIOLATION	AVI	NO PAYMENT	RECLASSD
1	06/11/1997 17:36:29	BB	08	VIOLATION	AVI	NO PAYMENT	RECLASSD

The status bar at the bottom shows 'Ready', '80282 - ZHAO (451980)', and 'Aug 1, 1997 2:15 pm'.

Figure 8-1 Violations Account Review Folder

8.2.1.1 Process

1. When Violations Account Maintenance is selected by the user, the Find Account window is displayed. When the appropriate account is located and selected, a Violations Account Maintenance window is displayed.



The image shows a software dialog box titled "Find Customer Account" with a close button (X) in the top right corner. The dialog contains several input fields: "Account No." (a text box with a vertical cursor), "Last Name" (a text box), "First Name" (a text box), "MI" (a small text box), "License Plate No." (a text box), "State" (a dropdown menu), and "Zip" (a text box). At the bottom right, there are two buttons: "Find" (with a magnifying glass icon) and "Cancel" (with an X icon).

2. To change the violation status, click on the Violation Status drop list and highlight the appropriate status code.
3. To modify the address, click on the MODIFY ADDRESS button to activate the Violation Address and Phone Numbers window.
4. To find the next violation account, click the NEXT button.
5. To find the previous violation account, click the PREV button.
6. Click the FIND button to activate the Find Account window.
7. To review image, click the IMAGE REVIEW button.
8. To close the window and save the updated information, click the OK button.

8.2.2 Violations Image Review

Rear view images of violating vehicles are captured by video enforcement equipment in the lanes. In addition to the image, an accompanying violation record is created in the integrated database, which provides the necessary input to the Image Review clerk for successful manual image review. The plate identification is based on a visual examination of the image. The **Violations Image Review Folder** (Figure 8-2) is used for two purposes. One is to enter plate information identified by the Image Review clerks. The other is to review the image for Violations Account Maintenance.

Image Review							
Plaza	Lane	Axes	Pre	Post	Coll	Actl	Tag
			0	0	0	0	0
Transaction Date		Device No					
xx / xx / xxxx							

Batch Number		
Plaza	Lane	
From Date	To Date	Find
xx / xx / xxxx	xx / xx / xxxx	

Total Image(s)	Reviewed	Skipped
0	0	0

PLATE INFORMATION	
Plate	State
Country	Make
USA	

Image Rejection Code

Next	Save
------	------

Figure 8-2 Violations Image Review Window

8.2.2.1 Process

1. When the Violations Image Review option is selected by the user, the Violations Image Review window is displayed.
2. Click the FIND button, to find an image or to activate the Find Account window. Once the appropriate account is located, the violation account information and the image will be displayed.
3. To review a new image, click the NEW IMAGE button.
4. To rotate the image, click on the Rotate drop list and select 90, 180, or 270 degree.
5. To reload the image, click on the RELOAD button. This will reload the image in its original form before the changes.
6. To print the current image, click on the PRINT button.
7. To close the window and save the updated information, click the OK button.

8.2.3 Violation Address and Phone Numbers

When the Modify Address on Violations Account Maintenance window is clicked, the **Violation Address & Phone Numbers Window** (Figure 8-3) is displayed. Click on the fields to be modified and change only what is necessary. To commit the information to the database, click the OK button. The Message "Address Update Completed" will be displayed in an information window. Click the OK button and the information window will close. To close the Violation Address and Phone Numbers window, click the CANCEL button.

Demographics		SubAccounts		Replenishments		Devices		Vehicles		Plans		Notes	
Account Type		Agency		Account No.		Drivers License No.		DL State		DL Country			
PRIVATE		RICKENBACKER		161434									
Last Name		First Name		M.I.		Title		Social Sec. No.		Date of Birth			
LAY		DENNIS THE MENANCE		M		MR.		312-32-1231		01/23/1980			
Address Type		Address											
BILLING		MY BILLING ADDRESS											
Zip		City		State		Country							
28765		PENLAND		NC		USA							
Phone Type		Telephone No.		Ext.		Statement							
DAY		[231] 231-2312		12312		Delivery Method		MAIL					
						Period		MONTHLY					
Company Name		Surety											
DBA Name		Tax Exempt											
2nd Contact Last Name		2nd Contact First Name		M.I.		Title							

Figure 8-3 Violation Address & Phone Numbers Window

8.2.3.1 Process

1. Click Account Maintenance button from tool-bar.
2. Enter the last name of the patron for the account that is to be changed in the Last Name field.
3. Click on the Find button.
4. Select the account from the list by clicking on it once.
5. Click OK.
6. Change the address and click CLOSE from the tool-bar.
7. Click YES.
8. Click OK and note the account number.



8.2.4 Violation Reports

8.2.4.1 Violation Notice

The **Violation Notice** will be provided per the specifications required by SCDOT. This notice will be printed on customized forms provided by SCDOT. No prototype is provided in this document .

8.2.4.2 Violations Issued Report

The **Violations Issued Report** provides a list by Violation Notice, number of Violation Notices issued, and violator's name and address.

8.2.4.3 Violation Tracking Report

The **Violation Tracking Report** provides for tracking Violation Notices issued from date of issue until closed.

8.2.4.4 VES Event Reconciliation Report

The **VES Event Reconciliation Report** provides a list by clerk of the results of review of all VES event images, no problem, ticket should be issued, a problem with the collector, etc..

8.2.4.5 Name & Address Requests Report

The **Name and Address Requests Report** lists the outstanding requests for vehicle owner information. Violation number, ETC transponder number (if available), date of violation, and date last reviewed are listed, along with the vehicle license number. Requests can be made by violation number or by state and license number.

8.2.4.6 Violation Occurrence Report

The **Violation Occurrence Report** provides all pertinent violation information for a given date range including: the date, time, plaza, lane, collector identification number, license number and state, external tag identification number, tag status, and violation number. Violation number are also cross-referenced to the lane serial number.

8.2.4.7 Violation Status Report

The **Violation Status Report** provides the following information: violation status, violation number, plate number, plate's state of origin, violation date and time, account number, sub account number, violation amount, amount due, lane, and plaza.

9. Violation Processing

9.1 Basis Of Requirements Specification

The requirements of the Violations Processing sub-system (VIOL) have been derived from the business level functionality described in the RFP.

This document summarizes at a high level, the functional requirements of the VIOL sub-system and presents the system processes that LMIMS has designed for execution of these functions.

9.2 Violation Processing Description

The VIOL sub-system receives the violation transactions and associate image files from the lane sub-system and performs a series of processing activities that culminate in the issuance of a citation (8CC or UTC) to the registered owners of the identified violating vehicle. In the process several filters are executed to ensure that only true violators are cited. The various steps executed for each violation in its processing cycle can be listed as follows:

1. Receive violation transaction.
2. Verify and eliminate violation transactions created because of lane equipment malfunctions.
3. Verify whether a valid tag has been read and, if so, redesignate the transaction as a toll transaction and post as such, subject to sufficient pre-paid balance in the account.
4. Verify whether a valid image file is available. If not, stop further processing of the transaction and account for it as a non-enforceable violation.
5. Review the image file and update violation transaction with license plate information.
6. Verify if the license plate entered exists in the AVI Customer Account database. If it does and if sufficient pre-paid balance exists, redesignate the transaction as a toll transaction and post it as such.
7. Search the violations database and if the license plate is found in a previous violation (within a reasonable time frame) for which name and address information has already been acquired, use that name and address instead of a new request to DMV (assuming that the license plate stays with the registered owner and does not go with the vehicle when sold).
8. If the license plate is from a state other than South Carolina, stop further processing, and account for the transaction as non-enforceable.
9. Create a Name & Address request record for those violations with a South Carolina license plate and include in the transmission to the DMV.
10. Receive responses to Name & Address requests from the DMV. Mark the transaction as non-enforceable for those requests for which valid and usable name & address information is not received.
11. Update the database with the name & address information and mark for citation those violations for which usable name & address information is received.
12. Generate citation with details of required payment to the County Clerk.
13. Receive periodic report of citation disposition notification from the County Clerk and update the violation record accordingly.
14. If payment is received in the Plaza, log the receipt of such payment and forward the payment to the County Clerk.

9.3 Violations Processing Sub-System Software Architecture

The VIOL sub-system consists of a set of server-based batch processes and associated database structures.

Violations Subsystem High Level Process Flow Diagram (Figure 9-1) describes the processes and main data flow from a high level perspective:

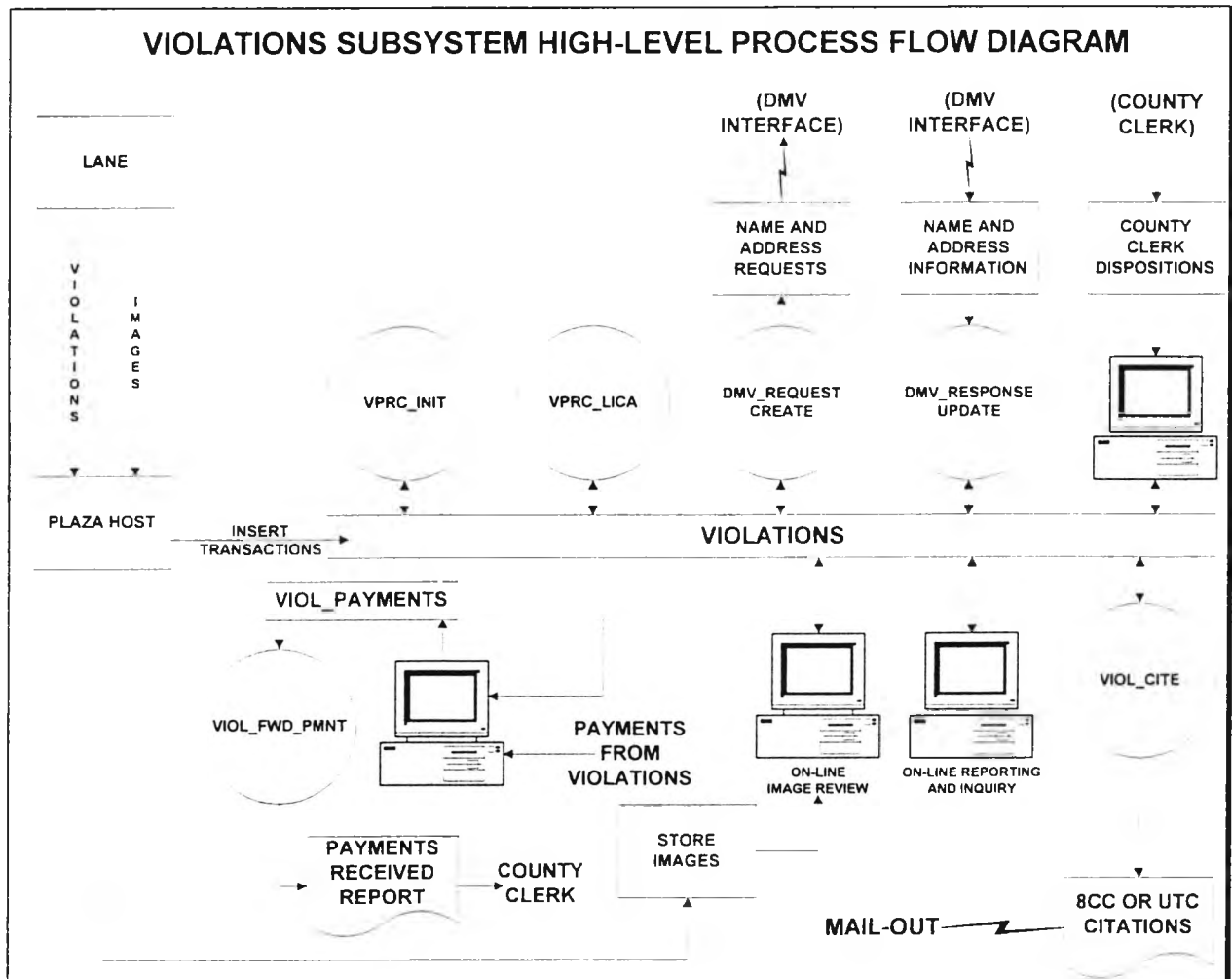


Figure 9-1 Violations Subsystem High Level Process Flow Diagram

9.4 VIOL Sub-System Batch Processes (Server-Based)

9.4.1 VIOL_INIT Process

The VIOL_INIT process performs the initial filtering of the violation transactions to identify false violations due to equipment malfunctions as well as those that have a valid tag read. In case of the latter, it generates a VTOL transaction and debits the toll amount due to the corresponding customer account. It also verifies the availability of a valid, usable image file and if so, marks the violation for image review.

9.4.2 VIOL_LICA Process

The VIOL_LICA process performs a set of additional filters on those violation transactions for which image review has been completed. During this process, it verifies that the particular license plate registered is a valid customer account with sufficient pre-paid balance, if so, it generates a VTOL transaction and debits the account. If the name & address information is already available from a previous violation, it updates the transaction with that name & address and marks it for generation of citation.

9.4.3 DMV_REQUEST_CREATE Process

The DMV_REQUEST_CREATE process identifies those violations for which a name & address request must be sent to the DMV and creates a request in pre-determined format.

9.4.4 DMV_RESPONSE_UPDATE Process

The DMV_RESPONSE_UPDATE process updates the violation transactions with name & address information received from the DMV. If the DMV returns a 'not found' status for a request, this process updates the violation transaction status as nonenforceable.

9.4.5 VIOL_CITE Process

The VIOL_CITE process selects those violations for which citations need to be generated and generates the same for mail-out. The transaction status is updated as such.

9.4.6 VIOL_FWD_PAYMENT Process

The VIOL_FWD_PAYMENT process is executed on a daily scheduled basis and generates a report of payments received in the Plaza against violation citations.

10. Host Server

10.1 The Host Computer Configuration

The host computer acts as the hub of the entire SCDOT Toll Collection System. In this role, the batch and background processes residing on the host direct and control the flow of data between the integrated system components. Several functions, because of their nature, are best performed on the server. Most of these functions either require large scale manipulation of the database or periodic execution (for example, daily functions run at a specific time). The server is better suited to compute these intensive operations because of the greater power and its capabilities of performing groups of operations on a regular basis.

The following main sections are addressed in this section:

- Host Computer Hardware
- Communications Network Architecture
- Software Process Configurations

10.2 Host Computer Hardware

The Host Computer System provides dedicated computing and memory resources, meets the current processing, transaction, and database-related functions required by SCDOT, and has provisions for future expansion of capability.

10.2.1 Hardware Selection

A high-performance Digital AlphaServer 1000 with multi-processor capabilities is utilized in the ETC Computer System. This system, which offers growth and flexibility through board-level upgrades for memory and storage expansion, derives its outstanding performance from a powerful RISC-based CPU and enhanced cache and memory subsystems. With balanced I/O, Digital 1000 systems deliver superior application response times and virtually unlimited availability.

After analyzing SCDOT's estimates for ETC usage, comparing those estimates against our experience in similar projects, and applying the results against Digital's products, LMIMS determined that the proposed Digital AlphaServer 1000, configured with one CPU, will easily meet and exceed the processing needs of SCDOT.

The Digital 1000 Server is being configured with one CPU, 256 Megabyte (MB) of random access memory (RAM), and 86-gigabyte (GB) hard disk drive, an adequate amount of high-speed SCSI hard disk storage controlled by one 3-channel RAID 5 controller. The outcome of the sizing analysis portion of selection methodology was a determining factor in selecting the host.

10.2.1.1 Host Computer System Sizing

Proper sizing of the Host Computer System is critical to a successful ETC operation. The system will have ample power to provide good response times to users at the SCDOT plaza, as well as the required horsepower for the processing-intensive batch cycle. In the batch cycle, the System must perform operations such as receiving toll and violation transactions from each plaza, updating the ETC account database, sending customer validation files and various reports back to each plaza, as well as a number of other miscellaneous tasks.

Currently there are several similar systems in operation that perform ETC functions. Given projected staffing levels for the SCDOT ETC system, it is estimated that approximately 20 concurrent users may be on-line, actively using the system at peak times during the day.

Since transaction-based applications such as the SCDOT ETC are common, the Transaction Processing Council promulgated a standard specification known as TPC-A Benchmark developed to properly size these applications. The TPC-A Benchmark is based on both the number of transactions per second (TPS) and application needs. Given its prominence in the marketplace, TPC-A Benchmark is used by most manufacturers to measure the speed of their processors. TPC-A Benchmark TPS requirements of the batch cycle were calculated in order to determine which

processor would meet the batch cycle needs of the SCDOT ETC. The calculations show that the processing power of the Host Computer System in 1997 must be at least 150 TPC-A TPS. These calculations are fairly straightforward and take into account real-world computer system operations.

After calculating the necessary TPC-A TPS rating for the SCDOT ETC, the entire Digital AXP product line was carefully analyzed to select the proper configuration for the Host Computer System. A Digital AlphaServer 1000 configuration was mandatory to ensure the highest levels of reliability and availability for ETC. **TPC-A Ratings Table** (Figure 10-1) demonstrates a comparison between the processor configurations which were considered and their TPC-A TPS ratings. The first column in this figure cites the Digital systems considered and the second column each system TPC-A TPS rating, as published by Digital Equipment Company.

Evaluation of TPC-A Ratings		
Processor	TPS	Lockheed Martin Adjusted Rate 30%
1000 1 CPU	285	199.5
2000 4/233	420	299.0
2000 4/275	625	437.5

Figure 10-1 TPC-A Ratings Table

Most computer manufacturers conduct tests to determine the rated TPC-A TPS of their computers in very sterile and controlled environments. They typically load the test machine with the maximum amount of memory it can possess and outfit it with the fastest hard disks from their product line. Additionally, they conduct several practice tests, allowing them to retune the test machine constantly. This constant returning assures that the best possible results are obtained when the official TPC-A TPS rating test is conducted.

Production systems operating in environments similar to the SCDOT ETC deliver only 70 percent (approximately) of the manufacturers' stated TPC-A TPS ratings. For this reason, it is standard practice to adjust a manufacturer's published TPS rating, using a 30 percent safety factor to determine a more realistic TPC-A TPS rating. Applying the adjusted TPC-A TPS ratings, a Digital AlphaServer 1000 configured with one CPU was selected to serve as the Host Computer System. This configuration provides a conservative, real-world transaction rate of approximately 285 TPC-A TPS, exceeding the requirements of the SCDOT ETC system. This technology is exceptionally expandable, and the processing power can be greatly increased by addition of faster processors.

10.2.2 1000 Digital Server

The 1000 Server is Digital's latest, most cost-effective, and highly regarded architecture, supporting a wide range of computing demands. The Digital Alpha AXP systems provide a virtually unlimited range of expansion and custom options. The AlphaServer 1000 is initially configured with one processor and 86GB of RAID-5 disk space. In this configuration, Digital equipment provides the benefits of both high availability and scalability within a single, easily managed, secure environment.

Storage Sizing – the storage requirements for the Host were assessed and an architecture was developed that fully addresses those requirements, in terms of both the on-line access and off-line data retention.

Careful analysis of the transaction volumes in our current operations enabled us to determine precise data storage requirements. Scaling constants were applied to these systems to determine the storage needs of other systems with a high degree of accuracy. Based on the assumptions given for the number of tags in circulation, expected traffic volumes, and the requirement to store 90 days of data, it has been determined that the required disk space is close to 86GB. The analysis includes added storage space for system software, temporary images, 30 percent free disk space which is recommended by Digital, and other system requirements.

Storage Design – Digital's RZ29 hard disks and PCI/SCSI Storage Controllers were selected for the Host Computer System after consideration of system storage requirements as well as DBMS performance.

The Digital RZ series of hard disks offers a range of performance and capacity configurations, and utilizes the Small Computer System Interface (SCSI) architecture. This conforms to an ANSI standard, and ensures that disk compatibility is maintained through the life of the SCDOT ETC System.

The Host Computer System will be configured with twenty-six 4.3GB hard disks, providing a total storage capacity of 86GB for live data and image storage. As shown in Figure, the RZ29s are controlled by a single channel SCSI controller via two HSZ40 RAID 5 controllers. The twenty-six disks are distributed between each controller, thereby providing increased performance and allowing automatic failover in case of a malfunctioning controller. The RAID 5 subsystem provides low-cost data redundancy, media error correction, and parity integrity in the event of a disk failure and a Mean-Time-Between-Data-Loss greater than 10 years.

ETC HOST SYSTEM RACK MOUNT CONFIGURATION

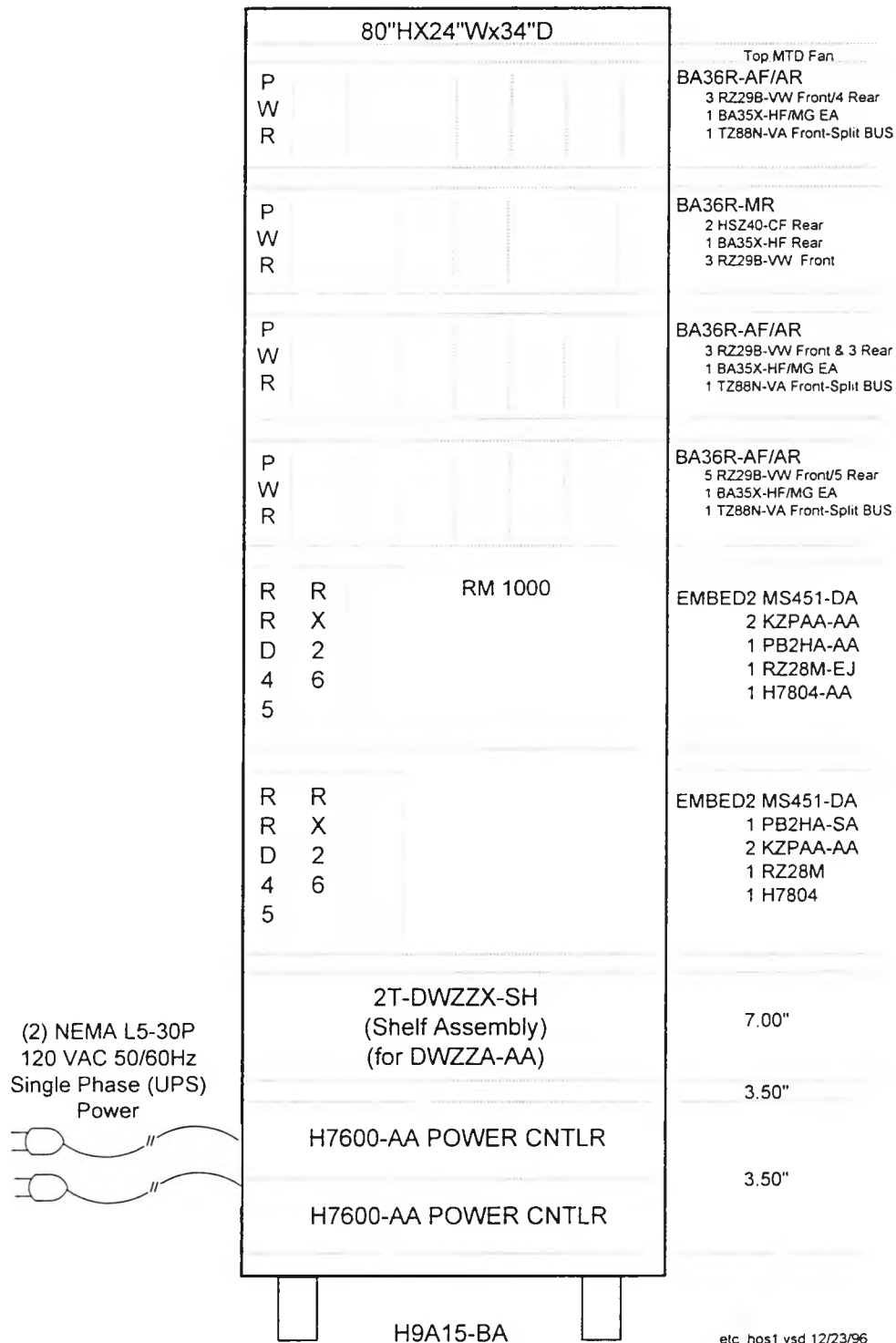


Figure 10-2 ETC Host System Rack Mount Configuration



Replace with ACAD Drawing, use PA0080

Figure 10-3 Network Rack Configuration

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The RAID 5 supports “hot swapping” of disks, allowing hard disks to be removed and replaced while the system continues to operate. This provides the Host with tremendous flexibility on how and when to respond to a component failure. For example, if the failure occurs early in the daily processing window, it may be advantageous to proceed with the hot swap or rebuild. If the failure occurs in the middle or at the end of the day’s operations, it could be desirable to postpone the disk rebuild until all of the transactions from the previous day have finished processing.

10.2.2.1 Magnetic Tape Subsystem

The Digital high-capacity TZ87 Tape Subsystem is used to provide daily system backups. The TZ87 Tape Cartridge Subsystem is a single-ended SCSI tape drive with a capacity of 20GB per cartridge, 40 GB when data compression is used. It also has extensive troubleshooting features, including embedded diagnostics and self-test software. It provides an extremely economical way to retain an application database and system backups

A SCSI device, the TZ87, is controlled by a single port, PCI-based, high-performance SCSI-2 controller.

10.2.2.2 Host and Plaza Computer System Equipment List

A list of all equipment proposed for the SCDOT Host Computer System and all plazas is provided at the end of this section. An overview of this equipment is provided below:

- **15-Inch Monitor** One Monitor, directly connected to the Digital AlphaServer 1000, serves as a System Console. This device is used by system administration personnel to monitor system operations. Facilities within the Open VMS Operating System allow for various system events, such as all successful/unsuccessful logins, errors, and completed batch jobs to be automatically displayed on the monitor.
- **Plaza Workstations** The Standard Workstation, which will be used by SCDOT personnel, is a Digital Venturis 5100 Pentium Processor with 16MB of RAM, 256 KB secondary write-back cache, 3.5" 1.44 MB floppy disk, 630MB hard disk, a 15" color monitor, and a 32-bit PCI Ethernet Card.
- **Laser Printers** The SCDOT Host/Plaza’s are equipped with 14 pages-per-minute network laser printers.

See **ETC Host System Rack Mount Configuration** (Figure 10-2) and **Network Rack Configuration** (Figure 10-3).

10.3 Communications Network Architecture

10.3.1 System Level Communications Network

LMIMS has provided a high level overview of the proposed network. Our communications network design incorporates the latest technology in network operating systems, cabling, and network interface cards. Initial configuration or hubs will be accomplished by LMIMS. Configuration maintenance will be accomplished as part of system maintenance. Network monitoring will be performed by the system maintenance.

10.3.1.1 Host Communications

The host is located in the Cross Island Plaza computer room. It is connected to the Local Area Network (LAN) via the 10BaseT repeater located at the plaza facility.

10.3.1.2 Local Area Network

The Multistack HUB is configured with a 16-port 10BaseT repeater and 6 port 10BaseFL repeaters providing connectivity for the printers, workstations, personal computers, and lane controllers associated with the plaza.

The lane controllers are connected to the LAN through use of Multimode Fiber Optics (MMFO), providing excellent electrical and network properties. The lane controllers are constructed with a FO network Ethernet card manufactured by Codenoll that provides point to point FO connectivity.

Replace with ACAD Drawing use PA0080

Figure 10-4 Connectivity Overview

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LOCKHEED MARTIN



Preliminary System Configuration Document Rev. 1.0
SC_DOT\Sys_Config\Rev_1.0\Chap_10.doc
Proprietary Data

Host Server • 10-9

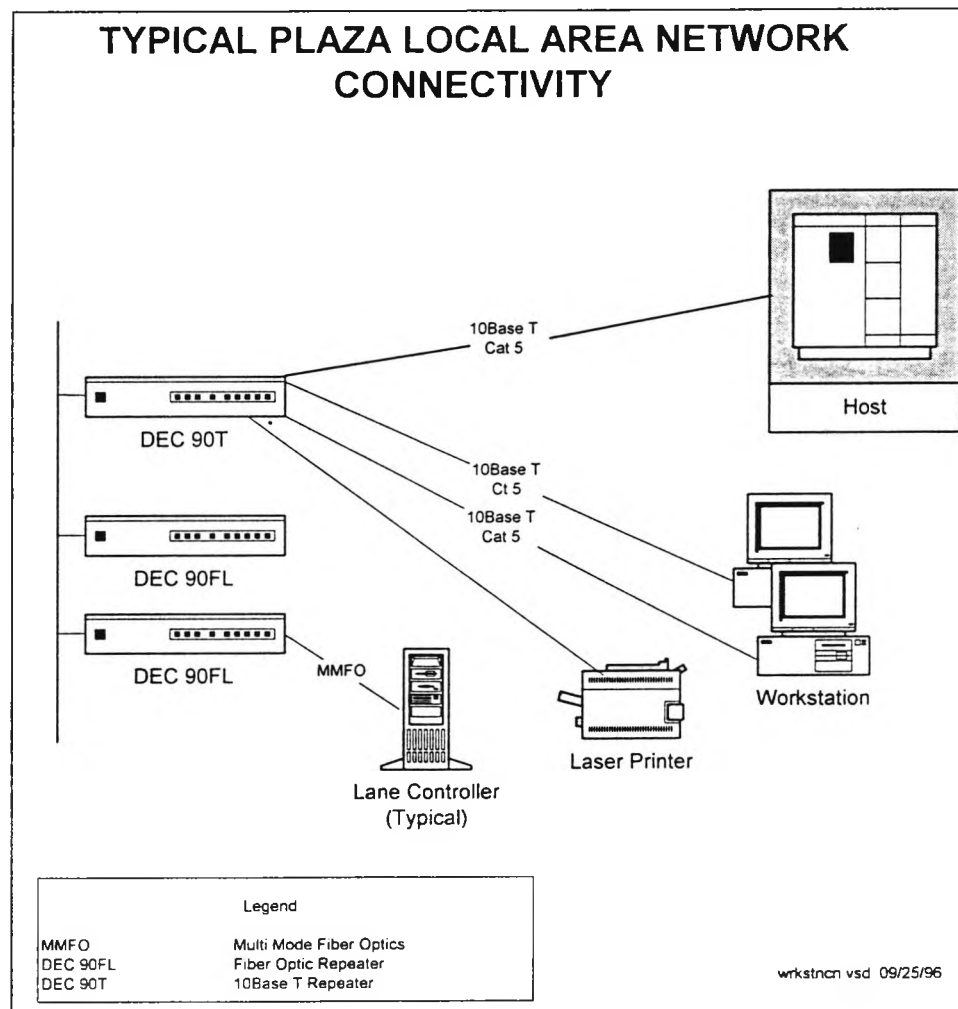


Figure 10-5 Workstation Connectivity

10.3.2 Workstation Communications

All workstations are connected to the Host computer via their local LAN connection as depicted in Figure 10-5, **Workstation Connectivity**. The workstations are equipped with 10BaseT Ethernet, Simple Network Management Protocol (SNMP) manageable, network interface cards (NIC). Lockheed Martin IMS will install Category 5 UTP cable from each workstation to its local network hub.

10.3.3 Lane Controller Communications

All lane transaction, diagnostics messages, MOMS messages, system updates, ETC validation tables, and maintenance messages, from the Lane Controller will be immediately placed on the LAN via the fiber optics and sent to the Host computer for immediate processing and database storage. DEC MessageQ intelligent transaction routes will send the transaction to the Host and Plaza workstation automatically. The Host computer continuously monitors the network connections to the lanes and notifies the MOMS of a lane disconnection. The MOMS, in turn, immediately notifies the maintenance staff. The lane controllers will be connected to their local area network via Multimode Fiber Optics (MMFO) cabling providing the optimum connectivity to the Host.

10.3.4 Plaza Level Component Description

10.3.4.1 Digital MultiStack

The Digital MultiStack provided by Digital Equipment Corporation (DEC) provides the flexibility required in the multiple media type installation consistent with SCDOT. LMIMS will configure the MultiStack hub with the necessary modules to provide the Ethernet and Serial communications required. The MultiStack unit provides the network manager with the flexibility to run Digital's low cost management tool, HUBwatch, from any PC on the network. A typical plaza configuration will include:

- MultiStack Unit
- DEC repeater 90T-16 (16 Port, 10BaseT connectivity) or 90FL FOIRL for remote lane controller configuration

10.3.4.2 DECrepeater 90T-16

The DECrepeater 90T provides a 10BaseT-compliant repeater that will connect the Plaza workstations, printers, and remote lane controllers to the Ethernet LAN. The repeater is configured with front panel LED indicators to easily monitor the status of the network at a glance. The repeater will be mounted in the DEC Multistack. The 90T is manageable by SNMP when installed into the stack with the appropriate agents.

10.3.4.3 DECrepeater 90FL

The DECrepeater 90FL is a multiport fiber optic repeater that will interconnect the local lane controllers to the Ethernet LAN. The 90FL is 10BaseFL compliant, providing a star-wired environment. Lane controllers that are installed near the lane will be configured with a 10BaseFL Network Interface Card described below and will be connected directly to the DECrepeater 90FL. This provides isolation from stray EMI or RF fields that are associated with the toll environment. The repeater identifies malfunctioning ports and automatically segments or restores them. The 90FL will be managed remotely through the use of SNMP.

10.3.4.4 Modems

LMIMS will provide, as part of the back-up system, dial-up modems connected to the DEC RouteAbout for dial backup capability. Additional dial-in maintenance modems will be provided at the ECH.

10.3.5 Software and Protocols

10.3.5.1 Transmission Control Protocol/Internet Protocol (TCP/IP)

The Host, workstations, and lane controllers are configured with the industry standard TCP/IP network protocol. All systems will be addressed using the standard Class B addressing schemes.

The SCDOT is responsible for issuing the IP addresses and host names for all nodes residing on the network. The tables below represent the nodes that will require IP addresses and host names.

System	Function	IP Address	IP Backup	Host names
HOST Computer #1	Primary Computer	TBD		TBD

10.3.5.1.1 Cross Island Plaza

System	Function	IP Address	IP Backup	Host names
Workstation #1	Plaza workstation	TBD		
Workstation #2	Plaza workstation	TBD		
Workstation #3	Plaza workstation	TBD		
Workstation #4	Plaza workstation	TBD		
Workstation #5	Plaza workstation	TBD		
Workstation #6	Plaza workstation	TBD		
Workstation #7	Plaza workstation	TBD		
Workstation #8	Plaza workstation	TBD		
Printer #1	Plaza network printer	TBD		
Printer #2	Plaza network printer	TBD		
Lane Controller #1	Lane Controller for lane devices	TBD		
Lane Controller #2	Lane Controller for lane devices	TBD		
Lane Controller #3	Lane Controller for lane devices	TBD		
Lane Controller #4	Lane Controller for lane devices	TBD		
Lane Controller #5	Lane Controller for lane devices	TBD		
Lane Controller #6	Lane Controller for lane devices	TBD		
Lane Controller #7	Lane Controller for lane devices	TBD		
Lane Controller #8	Lane Controller for lane devices	TBD		
Lane Controller #9	Lane Controller for lane devices	TBD		
Lane Controller #10	Lane Controller for lane devices	TBD		
Lane Controller #11	Lane Controller for lane devices	TBD		
Lane Controller #12	Lane Controller for lane devices	TBD		
Lane Controller #13	Lane Controller for lane devices	TBD		
Lane Controller #14	Lane Controller for lane devices	TBD		



10.3.5.1.2 Real Time Lane Communication

The microprocessor-based lane controller runs a real-time UNIX operating system developed by VentureCom Corporation. This POSIX-compliant operating system supports embedded applications with rigorous real-time requirements. The multi-tasking operating system provides software prioritization that assures processor resources are allocated to time-critical functions when needed. The lane application software is a real-time data collection and control system featuring a user-friendly maintenance interface for user communication with the host system, and features for constructing and managing the user's in-lane systems.

The Ethernet TCP/IP network uses 10Base-T and Category-5 Unshielded Twisted Pair cabling between the lane controller and the plaza hub. The lane controller immediately sends transaction messages, diagnostics messages, Maintenance Online Management System (MOMS), system updates, ETC validation tables and maintenance messages to the host computer in real-time via a reliable transaction router. VE images and validation tables are transmitted via FTP.

10.3.5.2 System Components

10.3.5.2.1 10BaseT Network Interface Card

The 3C503 Network Interface Card (NIC), manufactured by 3COM, is one of two cards that will be used in the proposed design. This card provides the work station with 10BaseT Unshielded Twisted Pair (UTP) connectivity to the network HUB

10.3.5.2.2 FOIRL Network Interface Card

The 8341 NIC, manufactured by Codenoll, fully complies with the lane controller operating system (VENIX) which uses its standard WD8003 NIC device driver, providing the SCDOT with an industry standard NIC. By using the WD8003 NIC device driver the SCDOT has the ability to migrate, swap, or replace the NIC with a comparable card without any changes to the operating system or application software.

The 8341 NIC provides the lane controller with a fiber connection for those lane controllers installed near the toll lane. The lane controller will interface to the Host via this fiber connection. The fiber connection implemented meets the industry standard for Fiber Optic Inter-Repeater Link specifications via dual strand of Multi-mode fiber optics.

The lane controller will communicate with the lane devices directly from the Control Serial I/O card. The 8341 NIC will provide Ethernet connectivity to the plaza hub via dual strand MMFO cable.

10.4 Software Process Configurations

This section presents function narratives for all batch programs of the following subsystems:

- Host Audit
- ETC Account Processing
- Violation Processing

The following process narratives are those requiring modification to meet SCDOT requirements. A detailed analysis will further identify all exact changes and will introduce new processes to develop. The requirement for a transaction interface with the SCDOT financial system is at least one new process which will require a ground-up development. Additional input from SCDOT will be needed in the near future to complete our design for this process. Each existing program function narrative includes the program's inputs, process, frequency, exceptions, routines / headers, and outputs.

10.4.1 Server-Based Anniversary Process

10.4.1.1 Inputs

ANNIV_DATE_START - Start date for anniversary processing.

ANNIV_DATE_END - End date for anniversary processing.

10.4.1.2 Process

Anniversary Processing updates the anniversary date for accounts. This process is used for calculating applicable monthly fees (service fees, statement fees, etc.).

10.4.1.3 Frequency

Daily.

10.4.1.4 Outputs

Updates **ETC_ACCOUNT** table by updating anniversary date.

10.4.2 Archival

10.4.2.1 Inputs

- **T_ARC_CTL** table entries
- Runtime parameter specifying the table to be archived
- Runtime parameter specifying the **LOG** level

10.4.2.2 Process

This process does the archival for all volatile tables. The archival is controlled by the **T_ARC_CTL** table entries. This table contains information regarding the retention period and current state of the archival process. The process is completely table driven. Separate processes have to be started to trigger archival for separate tables. A runtime parameter specifies, for each invocation, the table to be archived. The main logic is as follows:

1. Check if the table requires archival at the current time. If not, exit.
2. Check if there are any child tables requiring archival.
3. If there are child tables, wait for their completion for the in-progress date.
4. If there are no child tables or if this is a child table in itself, then archive for the in-progress date.
5. Archive for current in-progress date.
6. Read and unload all records for in-progress date.
7. Create an ***.ARD** file containing the record specification for the unloaded file.
8. Delete all records that have been unloaded.
9. Repeat process until retention period is reached.

The program uses dynamic SQL to access the database and, as such, is a generic archival process for any table in the database for which an archival basis field can be specified. The base field has to be a date field since currently the logic uses a time-based (retention period) parameter to determine the class of records that await archival.

10.4.2.3 Frequency

The archival for highly volatile tables will be scheduled on a continuous basis starting at 2:00a.m. every morning or at 7:00 p.m. every night. For low-volume tables, archival will be scheduled on a weekly basis on Saturdays starting at 3:00 p.m.

10.4.2.4 Exceptions

The batch log will contain messages for any abnormal terminations. The **TCSSLOG** file will contain program error messages. The process will normally terminate with a message of "Archival not required at this time."

10.4.2.5 Outputs

The process generates *.ARD and *.UNL files in the **TCSSARCHIVAL** directory. The record layout of the *.UNL files are determined at runtime and recorded in the corresponding *.ARD file, which is an ASCII text file. The files are named <table-name>_YYYYMMDD.ARD and <table_name>_YYYYMMDD.UNL.

10.4.3 Host Transaction Manager (HostTxMgr)

10.4.3.1 Process

Processing of lane data consisting of transactional data entered by the Toll Collector, ETC transactions, and lane messages (e.g., equipment status, collector entry/ exit) can be broken down into the following components:

- Reliable transmission of lane transactions to the host computer from each of the lanes
- Processing of these transactions on the host computer based on the type of transaction

The messaging mechanism ensures not only accurate and timely delivery of lane transaction transmissions, but also reliability.

The transmission of the lane transactions to the host system is handled through a reliable messaging mechanism. DECMessageQ is Digital's industry leading messaging software and is used for this purpose.

The server process that receives these transactions processes them based on the transaction type. Lane messages will be stored in appropriate database tables for maintenance reporting and inquiry. Toll transactions are categorized into ETC and non-ETC transactions. ETC as well as non-ETC transactions are summarized and stored in database tables for use in auditing, accounting, and management reporting functions. These transactions are also available for plaza and toll supervisors to access for operational management, in both detailed and summarized forms.

Valid ETC toll transactions are sent via DECMessageQ to another process, **ETCTxMgr**, and are posted against the appropriate ETC customer accounts under the processing rules of the various discount, commuter, or non-revenue plans; vehicle classifications; and applicable toll schedule(s). The **ETCTxMgr** procedure also updates account financial balances in real-time and generates SCDOT revenue-accounting transactions for subsequent file transmission to SCDOT financial management software.

To accommodate the current and future SCDOT toll-pricing plans, the software handles variable toll usage rates. These rates could be based on commute plans, time of day, and / or day of week, etc. Toll usage rates will be set in the database and can be administered by system administrator personnel.

The system also has mechanisms to charge maximum applicable toll rates, as per SCDOT policies and/ or generate correspondence to inform customers thereof.

All toll transactions will be used to update and maintain traffic trends that would be stored in the database. These trends will be available to plaza and toll supervisors, as well as SCDOT management personnel.

The software will have the capability of handling vehicle class mismatches on ETC as well as non-ETC transactions as detected by the equipment. The system can be set to charge based on actual or expected

class and set up necessary data for noticing to collect differential toll amounts and any fines due based on SCDOT polices.

Violation transactions from the lanes will be stored in appropriate violation tables for subsequent action by the violation processes.

10.4.3.2 Frequency

Continuous background process.

10.4.3.3 Outputs

TBD

10.4.4 ETC Transaction Manager (ETCTxMgr)

10.4.4.1 Process

The server process that receives the ETC transactions from the **HostTxMgr** process performs all customer account validation and posting and updating of account financial balances per the lane ETC transaction. The **ETCTxMgr** process has the responsibility to ensure that all ETC transactions are summarized and stored in database tables for use in auditing, accounting, and management reporting functions. These transactions are also available for plaza and toll supervisors to access for operational management, in both detailed and summarized forms.

The **ETCTxMgr** process posts the ETC toll transactions against the appropriate ETC customer accounts under the processing rules of the various discount, commuter, or non-revenue plans; vehicle classifications; and applicable toll schedule(s). The **ETCTxMgr** procedure also updates account financial balances in real-time and generates SCDOT revenue accounting transactions for subsequent file transmission to SCDOT financial management software.

To accommodate the current and future SCDOT toll pricing plans, the software handles variable toll usage rates. These rates could be based on commute plans, time of day, and/or day of week, etc. Toll usage rates will be set in the database and can be administered by system administrator personnel.

The system also has mechanisms to charge maximum applicable toll rates, as per SCDOT policies and/or generate correspondence to inform customers thereof.

The software will have the capability of handling vehicle class mismatches on ETC as well as non-ETC transactions as detected by the equipment. The system can be set to charge based on actual or expected class and set up necessary data for noticing to collect differential toll amounts and any fines due based on SCDOT policies.

10.4.4.2 Frequency

Continuous background process.

10.4.4.3 Outputs

The tables updated in this process are as follows:

TBD

10.4.5 Credit Card Server

10.4.5.1 Inputs

- Client transaction requests
- Control parameters from **T_PROCESS_PARAMETERS**
- **TRACE_FLAG** - A bit-mapped value that determines the type of information logged by the server
- **TRACE_STD** - Standard trace: Startup and version information
- **TRACE_DMQ** - DMQ trace: Logs DMQ actions like *get* and *put* on the queues

10.4.5.2 Process

The LMIMS credit card server implements either an on-line or a batched interface for automatic credit card charges. The current design uses the batched interface, but is capable of using the on-line interface with additional hardware and software. Detailed design and implementation issues have not been discussed, pending a decision on the specific credit card processor named for the project.

The batched interface uses the COTS package software **ICVerify** to communicate with the chosen bank. The **Rebill Request Creation Process** (RRCP) and **Automatic Replenishment Posting Process** (ARPP) use this batch file interface to perform the create, send, receive, and update processes associated with automatic replenishment.

The server is multi-threaded and can accept and process multiple requests. The "client" requests are queued through DMQ (DECMessageQ). The server accepts these requests and queues them in an internal buffer queue. The server can simultaneously send several requests for credit processing to the credit processor depending on the number of Tag IDs requested. The server uses these merchant IDs in a "round-robin" fashion.

10.4.5.3 Frequency

Always on.

10.4.5.4 Exceptions

The batch server log will contain processing information. The level of detail is determined by the setting of the **TRACE_FLAG** in the **T_PROCESS_PARAMETERS** table.

10.4.5.5 Outputs

Authorization codes for the credit card transactions are sent to the requesting clients.

10.4.5.6 Routines / Headers

CCSRV.C
ETC ACCOUNT PROCESSING_CC_SERVER.H
ETC ACCOUNT PROCESSING_CC.H

10.4.6 Statement Creation

10.4.6.1 Inputs

End Date - last date for which to process statements

10.4.6.2 Process

The **Statement Creation** process produces an anniversary statement file for processing by a mail house. The process takes the last date as an input for which to process statements and starts processing with a date in the **PP_PAR_VALUE** field in the **T_PROCESS_PARAMETERS** table in the database with the field **PP_PROCESS='STMT'** and the field **PP_PAR_CODE='LAST_STATEMENT_DATE'**. The process loops for each date from the last statement date until the input parameter date. The statements are created for all accounts with **ANNIVERSARY_DATE** in the **ETC_ACCOUNT** table equal to one month from the current date being processed. The process then picks up a **MONTHLY_BALANCES** record for the account **BALANCE_DATE** equal to the current date being processed and one month before the current date being processed. The process then creates records based on **T_COMPOSITE_TRANSACTION** and **T_ETC_TX** records from the previous month of the current date being processed. Once finished, the process updates the **LAST_STATEMENT_DATE** parameter field in the **T_PROCESS_PARAMETERS** table.

10.4.6.3 Frequency

Daily.

10.4.6.4 Exceptions

TCSS_FAILURE

10.4.6.5 Outputs

A statement file in the **TCSSRPT_DIR** with the following naming convention:
DD_MON_YYYY_MTA_STMT_ST.DAT

10.4.6.6 Report Format

Page: 1

Statement of Account
South Carolina Department of Transportation

Account Number: 163549-0
Type of Account: Individual
Statement Date: 06/29/1995
For the Period From: 06/04/1995 to 07/04/1995
Current Tag Deposit: \$80.00
Replenishment Amount: \$50.00

GEORGE BROUSSARD
110 WEST CLUB DRIVE
CHARLESTON, SC 29401

Please remit the following amount:

---Date/Time---	Transaction-----	Tag---	Plz-	Ln-	Amount	Balance
06/04	Beginning Balance					\$8.00
06/02 15:06	TOLLDEPOSIT				\$8.00	\$8.00
06/13 06:30	TOLL	0000024697	07	4	\$1.00	\$7.00
06/13 08:30	TOLL	0000024697	07	4	\$1.00	\$6.00
06/13 12:30	TOLL	0000024697	07	4	\$1.00	\$5.00
06/13 13:30	TOLL	0000024697	07	4	\$1.00	\$4.00
06/13 18:30	TOLL	0000024697	07	4	\$1.00	\$3.00
07/04	Ending Balance					\$3.00

Attention all SCDOT customers! SCDOT is offering a special incentive next month. For all customers who use their toll tags more than 100 times during the month of July, we will issue a certificate good for 100 frequent flier miles on American Airlines.

Figure 10-6 Sample Statement of Account Report

10.4.7 Tag Status File Creation

10.4.7.1 Inputs

None.

10.4.7.2 Process

The **Tag Status File Creation** process writes the tag status file for downloading to the lanes. This process first loops through all tags and creates an array of detail records in memory with information about each tag needed in the lanes:

- record number
- agency_id
- serial_number
- iag_coded_class
- revenue_type
- control_information

When all tags are loaded into memory, the process loops through all plaza groups (plaza groups are based on like toll schedules) to create an individual file for each plaza group. This way, each individual detail record is checked for a balance lower than the toll for that specific plaza group. The completed file is placed in the directory **FROM_HOST**.

10.4.7.3 Exceptions

TCSS_FAILURE

10.4.7.4 Outputs

Files named by plaza group and date stamp with the extension **TS**.

10.4.7.5

```
Date: 06/05/96                                Report: SERV-001
Time: 13:32:11                                Page No: 1

                                TAG STATUS REPORT

                                ETC Account Processing

                                Tag Extraction Processing completed
                                at 13:32:11 on 06/05/96

-----

                                29278 tags were read from the database
                                29278 tags written to the tag file

                                98 tags with undefined status
                                29180 tags with good status
                                0 tags with lost status
                                0 tags with stolen status
                                0 tags with low balance
                                0 tags with zero balance
                                0 tags with negative balance
                                0 tags with temporary disabled status
                                0 tags with non-revenue status

-----

                                **** END OF REPORT ****
```

Figure 10-7 Sample Tag Status Report

```
199506060925.etc                                19950606092518000000029307
0000|260096|0|
0001|260096|1|
0002|260096|1|
0003|260096|1|
.
.
.
0632|260124|1|
0633|260124|1|
0634|260124|1|
000002930700000008597a81
```

Figure 10-8 Sample ASCII Output File

10.4.8 Close Accounts

10.4.8.1 Program Title

CLOSE ACCOUNT

10.4.8.2 Module Name

closacct.c

10.4.8.3 Program Description

This program looks through the database for accounts where the account status is **CLOSEPEND**. If the account status has been **CLOSEPEND** for at least **CLOSEDAYS** number of days, the record is processed. The status of these records is changed to **REFUND**, if the balance + the deposit is greater than zero, **CLOSED** if the balance is equal to the deposit, and **WRITEOFF** if the balance is greater than the deposit. Accounts will not be closed until all business day assignments for all days have been received. Accounts will not be automatically written off at any time.

All tags associated with an account whose status was modified and have a status of **CLSP** will have their status changed to **INVN**. If a status is changed, a record is written to the history file by a trigger function.

Log messages concerning this program are written to a log file which is located in the directory pointed to by the environment variable **TCS\$LOG_DIR**.

Error messages are also written to the log file.

Special Considerations:

- Runs daily, preferably at night when activity is low.

10.4.8.4 Inputs

None.

10.4.8.5 Outputs

A report called **closacct.rpt** located in **TCSRPTDIR**

10.4.8.6 Report Format

Date: 04/05/95	CLOSE ACCOUNT			Report: SERV-021
Time: 09:34:02				Page No: 1
ETC Account Processing				
Account Number	Sub Account	Toll Balance	Tag Deposit	New Status
0046	0000	25.00	30.00	Changed to ACTIVE
0082	0000	25.00	70.00	Changed to REFUND
Center Totals				
32 CLOSEPEND records found				
2 records processed				
1 records changed to CLOSED				
1 records changed to REFUND				
0 records changed to WRITEOFF				
Summary Totals				
32 CLOSEPEND records found				
2 records processed				
1 records changed to CLOSED				
1 records changed to REFUND				
0 records changed to WRITEOFF				
**** END OF REPORT ****				

Figure 10-9 Sample Close Account Report

10.4.9 DMV Request (DMV)

10.4.9.1 Program Title

DMV VIOLATIONS REQUEST

10.4.9.2 Program Description

This program generates a file of violator plate numbers which is sent to the Department of Motor Vehicles (DMV) for identification.

The program scans the violations table for all violations whose status is **NEW**. Information is extracted and formatted into an ASCII file in the format required by the DMV. The status of the records in the violations table is then changed to **REQUESTED**.

10.4.9.3 Special Considerations

Runs daily after the violations update program has run.

10.4.9.4 Environment Variables

TCSRPTDIR - directory where the ASCII file will be located

TCSLOGFIL - full path and name of the log file

10.4.9.5 Inputs

None.

10.4.9.6 Outputs

ASCII file to be sent to the DMV

10.4.10 DMV Posting

10.4.10.1 Program Title

DMV POSTING

10.4.10.2 Program Description

This program processes information received from the DMV on violators and posts that information to the **ETC Account Processing** database tables.

The ASCII file from the DMV will associate names and addresses to the license plate numbers sent using the DMV request program. The file, which is returned from the DMV, is processed and the appropriate tables in the database are updated. The status of the processed records are changed from **REQUESTED** to **POSTED**.

Errors and status messages are written to the log file.

10.4.10.3 Special Considerations

Runs when information is received from the DMV.

10.4.10.4 Environment Variables

TCSRPTDIR - directory where the ASCII file from the DMV is located

TCSLOGFIL - full path and name of the log file

10.4.10.5 Inputs

Pending final approval of the full DMV processing policies, this is a batch process. The name of the file to process is read from the command line.

10.4.10.6 Outputs

If posting is successful, the DMV file received will be copied to a directory. If posting is unsuccessful, the next run of the batch program will see the DMV file and attempt to post the file again. The log file generated will identify any problems with record posting.

10.4.11 Rebill Request

10.4.11.1 Program Title

REBILL REQUEST

10.4.11.2 Program Description

This program scans the customer account table for accounts that are eligible for rebill and places them in the rebill request table.

To be eligible for rebill, an account must be active (accounts whose status is not **CLOSED**, **CLOSEPEND**, **REFUND**, or **WRITEOFF**). Second, an account must have a balance that is less than the rebill threshold. Third, the account must have rebill authorization information. Finally, the account cannot have a rebill status of **DECLINE**, **HOLD**, or **REQUEST1**. In other words, the account must not have been declined before, in the request process already, or placed on hold for some reason.

Eligible accounts are extracted and the rebill information, including the credit card number, expiration date, and rebill amount are placed in the rebill request table. The rebill request process will submit two requests to the selected bank. The rebill status of the account is changed to **RQS1** if this is the first request or **RQST** if a request has already been made. After the second decline, the request will be written to a history table and the request record will be removed from the rebill request table. If the decline is a replenishment, the replenishment pay type is changed to cash until the credit card problem is resolved. This will eliminate the request being placed in the request table a second time. A letter will be generated and sent to the customer for notification.

Error messages and status messages are written to the log file.

10.4.11.3 Environment Variables

TCSLOGFIL - full path and name of the log file.

10.4.11.4 Inputs

None.

10.4.11.5 Outputs

None.

10.4.11.6 Report Format

None.

10.4.11.7 Sample Report

None.

10.4.12 Rebill Posting

10.4.12.1 Program Title

REBILL POSTING

10.4.12.2 Program Description

This program posts the outcome of the rebill request which is received from the bank or clearing house to the customer account.

When a response is received from the bank or clearing house, both the rebill request table and the customer account are updated. If the request is approved, the rebill status is set to **AUTH** for authorized. The toll balance is updated by the amount of the request and a financial record is submitted to the financial system.

If the request is declined and this is the first request, the rebill status in the rebill request table is set to **DCL1** and the request will be processed again the next time the rebill request program is run. If the request is declined and the current status is **DCL1**, the status is set to **DECL** and the request is not tried again. Requests which generate exceptions are written to a report and their status is set to **HOLD**. Requests on **HOLD** will not be retried until an operator has performed the necessary operations to remove the **HOLD** status.

Error messages and status messages are written to the log file.

10.4.12.3 Special Considerations

Runs in batch, preferably during off-hours, to keep productivity at a high level.

10.4.12.4 Environment Variables

TCSRPTDIR - directory where the report file will be located

TCSLOGFIL - full path and name of the log file

10.4.12.5 Inputs

None.

10.4.12.6 Outputs

Report of exceptions located in the directory pointed to by the environment variable **TCSRPTDIR**.

10.4.12.7 Report Format

Date: 07/04/95		POST REBILL REQUESTS			Report: Post Rebill	
Time: 23:45:02					Page No: 1	
ETC Account Processing						
Account	Sub	Acct	Toll	Rebill	Rebill	Rebill
Number	Acct	Status	Balance	Thresh	Amount	Status

1001	0	ACTIVE	10.00	25.00	50.00	AUTH
1044	0	ACTIVE	15.00	25.00	45.00	HOLD
1098	0	ACTIVE	20.00	25.00	65.00	DECL
3 rebill requests were processed						

* * * END OF REPORT * * *						

Figure 10-10 Sample Post Rebill Requests

11. Inquiry & Reporting

11.1 Reporting Flexibility

Lockheed Martin IMS' experience in designing and developing reports has demonstrated that a flexible system of reporting across varied subsystems and geared to customized SCDOT requirements is our preferred approach to report design. This strategy is the most cost-effective and involves the least amount of risk, since this reporting system is already implemented and in production. The following inventory of reports is a completed set of reports to be developed for the sub-systems customized for SCDOT.

The following reports can be viewed on-line or printed as directed by the user. They can also be requested from a batch process. Printed reports are identical to those viewed on the screen.

11.2 Supervisory Reports

Supervisory Reports are a useful tool for toll supervisors and provide employee scheduling information and revenue bag inventory tracking at all SCDOT toll facilities.

11.2.1 Employee Identification Report

The **Employee Identification Report** gives employee security access information to the SCDOT Toll Collection System.

The following database tables are accessed:

- T_EMPLOYEE
- T_CODES
- T_PLAZA
- T_WINDOW_PERMISSIONS

11.2.1.1 Selection Criteria

Plaza (Use a scroll list to display and choose name from **T_PLAZA**) - Select all employees from **T_EMPLOYEE** where **plaza_id = plaza_id** in **T_PLAZA**

Beginning Employee ID to ending Employee ID - Select all **employee IDs** between begin and end **emp_ids**

Titles (Use a scroll list to display and choose **DESCRIP_SHORT** from **T_CODES** where **code_type = OCCUPATION_CODE**) - Select all employees where **occupation_code** in **T_EMPLOYEE = code_id** in **T_CODES**.

Access (Use a scroll list to display and choose group from **T_WINDOW_PERMISSIONS**) _ Select all employees where **security_level** in **T_EMPLOYEE = security_group** in **T_WINDOW_PERMISSIONS**.

11.2.2 Lane Messages Report

The **Lane Messages Report** is similar to the **Exception Report** found in the Host Audit and Reconciliation section. It is limited to messages regarding unusual occurrences, MOMS, manual gate openings, and is sorted by lane, facility, and tour of duty.

11.2.3 Employee Schedule Report

The **Employee Schedule Report** provides an employee schedule by facility.

11.2.4 Employee Random Lane Schedule Report

The **Employee Random Lane Schedule Report** provides an employee random lane assignment schedule by tour of duty.

11.2.5 Bank Bag Assignment Report

The **Bank Bag Assignment Report** lists the bank bag that was assigned to each toll collector by tour of duty.

11.2.6 Supervisory Override Report

The **Supervisory Override Report** lists all instances the house card is used and any override of the lane controller sub-system by the supervisor.

11.2.7 Sample Supervisory Reports

11.2.7.1 Employee Identification Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Employee Identification Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: SUPV0001
Page: 99

Employee ID	Employee Name	Title	Plaza	Access
99999999 (emp_id)	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXX	XXXXXXXXXXXXXX

Rating - Reliability Rating
Plaza - Primary Plaza Assigned to
Access - Level of Access of System
Ex: Management
Administration
Collector



11.2.7.2 Lane Messages Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Lane Message Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: SUPV0002
Page: 99

F	Lane	Time	Message Number	Message Description	Collector Name
xx	xxx	HH:MM:SS	999999999	xxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxx

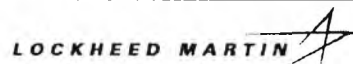
F - Facility (Plaza)
LN - Lane

Selection Criteria:

Backup Type:

Date
Message Number
Lane
Facility (Plaza Collector)

Full
Incremental



Preliminary System Configuration Document Rev. 1.0

SC_DOT\Sys_Config\Rev_1.0\Chap_11.Doc
Proprietary Data

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11.2.7.3 Employee Schedule Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Employee Schedule Report Date: Mm/Dd/Yy To Mm/Dd/Yy

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: SUPV0003
Page: 99

Plaza	Collector ID	Collector Name	Mon	Tue	Wed	Thu	Fri	Sat	Sun
xxxx	999999999	xxxxxxxxxxxxxx	HH:MM- HH:MM	HH:MM- HH:MM	HH:MM- HH:MM	HH:MM- HH:MM	HH:MM- HH:MM	HH:MM- HH:MM	HH:MM- HH:MM

Selection Criteria:

Plaza

All



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11.2.7.4 Employee Random Lane Schedule Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Employee Random Lane Schedule Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: SUPV0004
Page: 99

Date	Shift	Collector ID	Collector Name	Plaza	Lane
mm/dd/yy	HH:MM: TO HH:MM	9999999	xxxxxxxxxxxxxxxx	xxx	99

Section Criteria:

Date

Shift

Collector ID

Collector Name

Plaza

Lane



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11.2.7.5 Bank Bag Assignment Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Bank Bag Assignment Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: SUPV0005
Page: 99

Bag ID	Plaza	Collector ID	Collector Name	Date Assigned	Time Assigned	Assigned By	Date Removed
99999999	xxxxxxxx	9999999	xxxxxxxxxxxxxxxx	mm/dd/yy	HH:MM:SS	xxxxxxxxxxx	mm/dd/yy

Selection Criteria:

Bag ID Number
Plaza
Collector
Date
Time
Assigned By



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11.2.7.6 Supervisory Override Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Supervisory Override Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: SUPV0006
Page: 99

Date	Time	Plaza	Supervisor	House Card	Override	Reason
mm/dd/yy	HH:MM:SS	xxxxxxxxxx	xxxxxxxxxx	xxx	xxx	xxxxxxxxxxxxxx

Selection Criteria:

Date
Time
Plaza
Supervisor
House Card
Override



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11.3 Host Audit & Reconciliation Daily Reports

Daily Reports show lane vehicle and payment transaction data gathered on a daily basis. These reports show activity in various areas of the lane toll transactions versus the lane payment transactions. These reports are to be used as a basis of auditing and reconciling the toll collection activities at all SCDOT toll facilities.

11.3.1 Tour of Duty Report

The **Collector Total Shift Report** selection allows you to display or print a report that shows a toll collector's total shift information for one shift. A total shift consists of all partial shift data entered during any working day for all lanes worked by a toll collector. This report includes data on vehicle classification counts, indicated axle counts, treadle-recorded axle counts, cash transactions, token transactions, and ticket transactions. The report also reflects count out data from collector deposits and the Supervisor / Money Counting Room deposits.

11.3.2 Exception Report

The **Exception Report** is generated for each of the specified collectors or lanes. This report provides a list, by lane and collector, of all daily exceptions that occurred on the date requested. This report is a useful aid to the auditor in determining the explanations for apparent shortages or overages in a collector's tour of duty.

11.3.3 Detailed Transaction Report

The **Detailed Transactions Report** provides a listing by lane and/or collector, of all vehicle transactions that occurred during the time date period requested. These reports have been proven to be valuable in auditing collector and ETC activity.

11.3.4 Daily Revenue Reconciliation Report

The **Revenue Reconciliation Report** provides a reconciliation picture of revenue to collectors, ROC deposits, bank deposits, and calculates the variances to each.

11.3.5 Variance Report

The **Variance Reports** provides a summary view of all variances reported for a particular tour of duty, collector, or lane.

11.3.6 Denomination Breakdown Report

The **Denomination Breakdown Report** provides breakdown information of revenue that is deposited by denomination.

11.3.7 Bag Number Information Report

The **Bag Number Information Report** provides by date, tour of duty, and employee the numbers of the money bags used.

11.3.8 Collector Performance Report

The **Collector Performance Report** provides a daily and/or monthly report of collectors for a particular plaza. It compares the collector's expected revenue with the revenue that was actually realized after adjustments are applied. It includes any variances between the indicated revenue and actual revenue deposited, the number of axles counted by the pre and post class components of the lane controller sub-system.

11.3.9 Collector Revenue Report

The **Collector Revenue Report** provides a daily and/or monthly record of all cash and charge transactions for each collector for selected dates. It reflects adjustments applied to individual collector tour of duty summaries.

11.3.10 Deposit Receipt Summary Report

The **Deposit Receipt Summary Report** provides a summary of all deposits made, time, depositor, and amounts by denomination, checks, scrip, and credit cards.



11.3.11 Monthly Revenue Report

The **Monthly Revenue Report** provides a monthly summary record of all revenue type transactions for each collector. It reflects adjustments applied to individual collector tour of duty summaries.

11.3.12 Adjustment History Report

The **Adjustment History Report** lists all revenue and Classification adjustments, who made them, and a brief explanation of each.

11.3.13 Sample Host Audit & Reconciliation Reports

11.3.13.1 Tour of Duty Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

DATE PRINTED: 07/16/96

TIME PRINTED: 05:06:44

REQUESTED BY: R. Clerk

REPORT: HOST 001

PLAZA: W

PAGE NO: 1

Collector Tour Of Duty Report

TOUR OF DUTY DATE: 11/16/95

TOUR OF DUTY ID : 2 (LANE: 5) (COLL ID: 4 Joe Collection)

REVENUE BAG IN/OUT: 110 226

SEG LN	LANE OPEN	LANE CLOSE	TOT
DATE	TIME DATE	TIME HRS	

1	11/16/96	09:00:00 11/16/96	13:00:00 4
2	11/16/96	14:00:00 11/16/96	18:00:00 4

(FIRST SECTION OF THE REPORT)

(SECOND SECTION OF THE REPORT)

REVENUE TYPE: xxxxxxxxxxxx ETC DISCOUNT PLAN: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

VEH	PRE CLASS			COLL CLASS			POST-CLASS			AVI			ACTUAL			ACTUAL VEHICLES			TOLL	EXPECTED
AXL	AXL	ADJ	N-A	AXL	ADJ	N-A	AXL	ADJ	N-A	AXL	ADJ	N-A	AXL	ADJ	N-A	VEH	ADJ	N-A	RATE	REVENUE
2	1288		1288	1288		1288	1288		1288	1		1	1		1	2585		2585	1.50	1932.00
2	1		1	1		1	1		1	1		1	1		1	3		3	3.00	3.00
3	1		1	1		1	1		1	1		1	1		1	4		4	2.50	2.50
4	1		1	1		1	1		1	1		1	1		1	5		5	3.00	3.00
TOTALS FOR: xxxxxxxxxxxx																				
	1291		1291	1291		1291	1291		1291	4		4	4		4	2588		2588		1940.50

TOD REPLENISHMENT	=	463.50
CASH TOLL PYMTS	=	1318.00
NON CASH TOLL PYMTS (CASH VALUE)	=	1096.00
TOD ACTUAL REVENUE (CASH VALUE)	=	2877.50
CASH DEPOSIT	=	1753.00
NON CASH DEPOSIT	=	274.00
CASH DEPOSIT ADJ	=	0.00
TOD DEPOSIT	=	99999.99

ACTUAL REVENUE VS DEPOSIT
DIFFERENCE

-99.99



Section 1 of report is taken right from the tour segment table and is a list of all tour segments for the collector or vault where **t_tour_segment.vault_tod_id = t_tour_of_duty.tour_duty-id** for **t_tour_of_duty.collector_type = 2(vault)** or where **t_tour_segment.collector_tod_id = t_tour_of_duty.tour_duty-id** for **t_tour_of_duty.collector_type = 1(collector)**

SEG	t_tour_segment.tour_segment_id
LN	t_tour_segment.source_id
LANE OPEN DATE TIME	t_tour_segment.start_ts
LANE CLOSE DATE TIME	t_tour_segment.end_ts
TOT HRS	end_ts minus start_ts

Section 2 of the report is taken from **t_toll_summary** where **t_toll_summary.tour_segment_id = t_tour_segment.tour-segment_id**, sorted by **t_toll_summary.payment_type, vehicle_class**.

REVENUE TYPE This repeats for every new **t_toll_summary.toll_revenue_type** and is **t_codes.descrip_short** where **t_codes.code_type = "toll_revenue_type"** and **t_codes.code_id = t_toll_summary.toll_revenue_type**

ETC DISCOUNT PLAN **t_codes.descrip_long** where **t_codes.code_type = "plan_type"** and **t_codes.code_id=t_toll_summary.plan_type**

Each row in this section is a sum of all **t_toll_summary** rows for the **t_tour_of_duty.collector_tod_id** or **t_tour_of_duty.vault_tod_id**.

VEH AXL **t_toll_summary.vehicle_class**
PRECLASS AXL **sum(t_toll_summary.preclass_axles)**
PRECLASS

VEHICLE IND REV is the total indicated value of all class summary transactions taken from Section 2 of the report. Simply re-print the total here.

DISCOUNT PAY DIF is the computed difference between the discount value of the revenue from the redeemable totals and the full value totals from Section 3.

COLL INDIC REV is the sum of those rows.



Section 4b of the report is:

- **TOD REPLENISHMENT**
total of the replenishment transaction summary for the tour of duty
- **CASH PYMTS INDIC**
total of all cash payment type toll transactions (this does not include replenishment transactions)
- **(CASH VALUE)NON CASH PYMTS INDIC**
total of all other payment type toll transactions at the full or cash value (this does not include replenishment transactions)
- **(CASH VALUE)TOD PYMTS REVENUE INDIC**
sum of the rows in the section

Section 4c of the report is:

- **CASH PYMT REV IND**
total of cash payment type toll transactions at the full value with adjustments applied (this include replenishment transactions)
- **CASH DEPOSIT**
the actual total cash deposit without adjustments applied
- **CASH DEPOSIT ADJ**
the total adjustments for all cash summaries in the tour of duty
- **CASH REVENUE RATE**
extracted from the toll schedule table based on cash pay type and appropriate class and axle count of the transaction

PRE-CLASS is an unalterable part of the software program design. For the purposes of SCDOT, pre-class counts will be listed as **ZERO**.



11.3.13.2 Exception Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Daily Exception Report

DATE PRINTED: MM/DD/YY
TIME PRINTED: HH:MM:SS
REQUESTED BY: T. MANAGER
DATE: MM/DD/YY

REPORT: HOST 002
PLAZA: E
PAGE NO: 1

TIME	LANE	COLL	CLASS	DESCRIPTION
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	901 COLLECTOR RESET CLASS 1
HH:MM:SS	99	9999	9	902 NON-REVENUE TYPE 9
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	901 COLLECTOR RESET CLASS 2
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	902 NON-REVENUE TYPE 2
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	900 VIOLATION
HH:MM:SS	99	9999	9	902 NON-REVENUE TYPE 9
HH:MM:SS	99	9999	9	900 VIOLATION

*** COLLECTOR 99 TOTALS ***

VIOLATIONS	RESETS	NON-REVENUE
999	99	0

DATE: MM/DD/YY

*** COLLECTOR 9999 TOTALS ***

VIOLATIONS	RESETS	NON-REVENUE
0	0	99.99



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11.3.13.3 Detailed Transactions Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Detailed Transaction Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No: HOST 003
Page: 999

Axle Count						Payment Method				Repl Acct															
							Time	Time	TE	RE	PRE	COLL	PST	Rate	PRE	COLL	PST	AMT	Cash	AVI	AVI	Scrip	Money	AMT	CH/CS
Trans	Trans	Collector	Collector	F	RC	LN	Date	In	Out	AXL	A	XA	AXL		AMT	AMT	AMT	Due		Tag	Card		VAR		
99999	99999	xxxxxxxx	xxxxxxxx	x	xx	99	mm/dd/yy	HH:MM:SS	HH:MM:SS	99:99	9	9	9	9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

F = Facility [1]=Cross Island Parkway
RC SH = Relief Collector Shift
LN = Lane
TE = Time Elapsed
RE = Receipt [0]=Standard [1-6]=optional
PRE AXL = Pre-classification axle count
Coll = Collector axle count
[A]=Axle [xa]=Extra axle
PST AXL = Post-classification axle count
EF = Problem with equipment flag [Y]/[N]
REPL ACCT= Replenish account [CK]=check [CS]=Cash

Bold Fields = Should appear in heading if selected

Sort:
Date/Time
Plaza
Lane

Selection Criteria:
Plaza
Transaction code
Collector
Lane
Date (from to)
Time (from to)
Axle match
CCTV code
Vehicle type
RC SH

Payment methods: Transaction code:
- Cash - Open
- AVI tag - Close
- AVI card - Security card
- Tokens- No money
- Scrip - Unusual occurrence
- Replenish account
- Etc.

Subtotal:
Collector number
Lane
Shift
Axle match:
PRE COL POST
Y Y N = PRE
Y N Y = PRE
N Y Y = POST
Y Y Y = PRE
N N N = PRE



11.3.13.4 Daily Revenue Reconciliation Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY Daily Revenue Reconciliation

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: HOST 004
Page: 99

F	Date	Collector Amount	Clerk (1) Amount	Clerk (2) Amount	Deposit ROC	Bank Deposit	Variance Bank/ROC	Variance Bank/COLL
x	mm/dd/yy	99,999.99	99,999.99	99,999.99	99,999.99	99,999.99	999.99	999.99
Total		99,999.99	99,999.99	99,999.99	99,999.99	99,999.99	999.99	999.99

F = Facility (Plaza)
COLL = Collector

Selection Criteria:
Date (from - to)
Facility (Plaza)

(YTD by month needed)



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11.3.13.5 Summary Variance by Collector Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Summary Variance By Collector/Clerk

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

REPORT NO.:HOST 05
PAGE: 99

Clerk Collector ID	Clerk Collector Name	F	LN	Shift	Date	Variance CALC/COLL	Variance CALC/CLK1	Variance CALC/CLK2	Variance Calc/Bank	Adjustment Amount
9999999	xxxxxxxxxxxxx	x	99	99-99	mm/dd/yy	999.99	999.99	999.99	999.99	999.99

Collector Subtotal:	9999.99
Collector Shift Total:	9999.99
Lane Subtotal	9999.99
Facility Total:	9999.99

Selector Criteria:	Sort:
Collector	Date/Time
Lane	Lane
Shift	
Date	
Facility (plaza)	



11.3.13.6 Denomination Breakdown Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Denomination Breakdown

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report NO.: Host 006
Page: 99

Collector	Collector	F	LN	Shift	Date			
999999999	xxxxxxxxxxxxx	x	99	99-99	mm/dd/yy			
		Coins:	TC	Bank		\$ Bills	TC	Bank
		Pennies:	9.99	9.99		One:	999	999
		Nickels:	9.99	9.99		Two:	999	999
		Dimes:	99.99	99.99		Five:	999	999
		Quarters:	999.99	999.99		Ten	999	999
		Half:	9.99	9.99		Twenty:	999	999
		SBA:	9.99	9.99		Fifty	999	999
		Total	9,999.99	9,999.99		Total	9,999	9,999

F = Facility
LN = Lane
SBA = Dollar Coin (Susan B. Anthony)

Selection Criteria:	Sort:
Collector ID	Date/Time
Lane	Lane
Collector ID	Shift
	Date/Time



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11.3.13.7 Bag Number Information Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Collector Bag Number Information

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: HOST 007
Page: 99

MONEY BAG INFORMATION

Collector ID	Collector Name	F	Ln	Shift	Date	Initial NUM In	Collector NUM Out	Clerk (1) NUM Out	Clerk (2) NUM OUT
999999999	XXXXXXXXXXXXXXXXXXXX	x	99	99-99	mm/dd/yy	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX

Selection Criteria:
Collector
Lane
Shift
Date
Facility (plaza)
[All]

Sort:
Date/Time



11.3.13.8 Deposit Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Deposit Information

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: HOST 008
Page: 99

F	Date	Time	Type	Number	Amount	Number	Amount	Adjust
X	mm/dd/yy	HH:MM:SS	X	99999	999,999.99	99999	999,999.99	999.99

Bag	Bag Amount
999999	999,999.99
999999	999,999.99
999999	999,999.99
Total	9,999,999.99

X	mm/dd/yy	HH:MM:SS	X	99999	999,999.99	99999	999,999.99	999.99
---	----------	----------	---	-------	------------	-------	------------	--------

Bag	Bag Amount
999999	999,999.99
999999	999,999.99
999999	999,999.99
Total: 9,999,999.99	9,999,999.99
	9,999.99

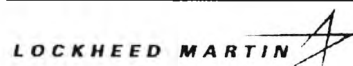
F = Facility (plaza)

(Bold fields should appear in heading if selected)

TYPE:
[E] = Emblem
[T] = Tolls
Etc.

Selection Criteria:
Date (from to)
Facility (plaza)

Sort:
Facility
Date/Time



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11.3.13.9 Collector Performance Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY Collector Performance Report

DATE PRINTED: 07/16/96
TIME PRINTED: 05:10:39
REQUESTED BY: T. Manager

REPORT HOST 009
PLAZA
PAGE NO. 1

November 16, 1995 TO November 16, 1995

DAY ID	COLLECTOR	C-PASS TRANS	C-CARD TRANS	TOKEN TRANS	NONRV TRANS	NOFND TRANS	CASH TRANS	ACM UNACC	TOT IND REVENUE	CASH ERROR	AMT% DIFF	COLL AXLES	TRDL AXLES	+/- AXLE	% DIFF
16	4 U Ragan	0	0	548	0	0	875	0.00	2055.500	-28.50	-1.6	2585		2585	0.0
16	14 U Malloy	0	0	262	13	0	282	0.00	754.750	-62.25	-10.0	1014	1014		0.0
16	21 U Goins	0	0	196	0	1	1094	0.00	4228.750	-454.75	-11.0	3516	3505	11	0.3
16	24 U Moore	0	0	150	1	0	873	0.00	3651.500	-501.50	-14.0	2933	2913	20	0.7
16	26 U -----	0	0	88	0	0	356	0.00	2281.250	-82.50	-3.7	1797	1823	-26	-1.4
16	31 U Brewster	0	0	250	2	0	1478	0.00	3362.500	-121.25	-3.7	3712	3656	56	1.5
16	35 U Forester	0	0	0	3	0	705	0.00	1236.750	-1236.75	-100.0	2004	430	1574	366.0
16	48 U Testa	0	0	428	5	0	515	0.00	1262.750	-75.00	-7.2	1728	1734	-6	-.3
16	49 U Tilley	0	0	150	0	1	386	0.00	2456.500	-315.00	-13.2	1863	1844	19	1.0
16	61 U Piaskowski	0	0	109	0	0	524	0.00	1715.500	1190.25	71.7	2434	2435	-1	0.0
16	161 U Rees	0	0	378	0	0	1456	0.00	2549.500	-68.25	-2.9	3484		3484	0.0
16	164 U Daunno	0	0	148	0	0	811	0.00	4124.500	-263.75	-6.5	3252	3246	6	0.2
SHF	2 TOTALS	0	0	3007	24	2	9364	0.00	29679.750	-2019.25	-7.1	30322	22600	7722	34.2
DAILY	TOTALS	0	0	3007	24	2	9364	0.00	29679.750	-2019.25	-7.1	30322	22600	7722	34.2



11.3.13.10 Collector Revenue Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

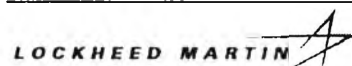
Collector Revenue Report

DATE PRINTED: 07/16/96
TIME PRINTED: 05:11:37
REQUESTED BY: T. Manager

REPORT HOST 010
PLAZA
PAGE NO. 1

TOUR DATE: 11/16/92

LN	SHF	ID	COLLECTOR NAME	C-PASS RESIDENT	C-PASS FULLFARE	C-CARD COMMERC	C-PASS PERMIT	TOKENS	NON REVENU	NOFUND	CASH	TOTAL SALES	TOTAL REVENUE	CASH DEPOSIT	CASH OVER/UNDR
5	2U	4	Ragan	0.00	0.00	0.00	0.00	274.00	0.00	0.00	1318.00	463.50	2055.50	1753.00	-28.50
1	2U	14	Malloy	0.00	0.00	0.00	0.00	131.00	19.50	0.00	422.25	201.50	754.75	561.50	-62.25
7	2U	21	Goins	0.00	0.00	0.00	0.00	98.00	0.00	7.50	3300.25	451.00	3849.25	3668.50	-82.75
7	2U	24	Moore	0.00	0.00	0.00	0.00	75.00	3.00	0.00	2716.50	431.75	3223.25	3075.00	-73.25
12	2U	26	-----	0.00	0.00	0.00	0.00	44.00	0.00	0.00	1948.00	186.50	2178.50	2154.75	20.25
6	2U	31	Brewster	0.00	0.00	0.00	0.00	125.00	3.00	0.00	2519.75	717.75	3362.50	3116.25	-121.25
1	2U	35	Forester	0.00	0.00	0.00	0.00	0.00	4.50	0.00	1056.75	180.00	1236.75	0.00	-1236.75
2	2U	48	Testa	0.00	0.00	0.00	0.00	214.00	7.50	0.00	772.50	276.25	1262.75	973.75	-75.00
13	2U	49	Tilley	0.00	0.00	0.00	0.00	75.00	0.00	1.50	1888.75	242.25	2206.00	2065.00	-66.00
11	2U	61	Piaskowski	0.00	0.00	0.00	0.00	54.50	0.00	0.00	1367.25	218.75	1640.50	2851.25	1265.25
4	2U	161	Rees	0.00	0.00	0.00	0.00	189.00	0.00	0.00	2189.25	171.25	2549.50	2292.25	-68.25
8	2U	164	Daunno	0.00	0.00	0.00	0.00	74.00	0.00	0.00	3508.50	329.00	3911.50	3786.75	-50.75
TOUR 2 TOTAL				0.00	0.00	0.00	0.00	1353.50	37.50	9.00	23007.75	3869.50	28230.75	26298.00	-579.25
DAILY TOTAL				0.00	0.00	0.00	0.00	1353.50	37.50	9.00	23007.75	3869.50	28230.75	26298.00	-579.25



11.3.13.11 Deposit Receipt Summary Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Deposit Receipt Report

Date Printed: mm/dd/yy

Report No.: HOST 011

Time Printed: HH:MM:SS

Page: 99

Deposit Bills		Employee Name	Receipt No.	Deposit Bag No.	Coins								Total	Deposit Bag No.	Coins						Credit		Scrip No Value	Checks No Value	Card No Value	Grand		
Date	Time				1	2	5	10	20	50	100	1¢			5¢	10¢	25¢	50¢	1.00	Total								
mm/dd/yy	HH:MM:SS	xxxxxxxxxxx	999999	999	99	99	99	99	99	99	99	99	999.99	999	99	99	99	99	99	99	99.99	99	9999	99	9999	99	9999	9999

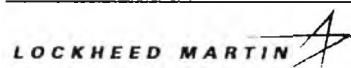
Selection Criteria:

Date

Time

Employee Name

Deposit Bag No.



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11.3.13.12 Monthly Revenue Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Monthly Revenue Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: HOST M01
Page: 99

Month	Cash	AVI Tag	AVI Card	Tokens	Scrip	Total Revenue	Total Non-revenue
January	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
February	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
March	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
April	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
May	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
June	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
July	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
August	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
September	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
October	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
November	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
December	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99	9,999.99
Total	99,999.99	99,999.99	99,999.99	99,999.99	99,999.99	99,999.99	9,999.99

Selection Criteria: (Selection criteria needs to appear in heading if selected)
Facility (Plaza)
Collector
Year (Starting on month MM)

Needed:
- Month comparison (current year and previous)
- 12 months ending (current year and previous)

Selection Criteria:	Adjust Type:
Date	Customer Amount
Adjust Type	Bank Deposit Error
Date Removed	
Made By	
Amortized By	



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Proprietary Data

11.3.13.13 Adjustment History Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Adjustment History Report

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: HOST M02
Page: 99

Date	Time	Adjust Type	Made By	Auth. By	Account No.	Deposit Amount	Deposit Number	Adjust Error	Amount	Adjust ROC #	ROC #	Reason
mm/dd/yy		HH:MM:SS		xxxxxx	xxxxxxxx	xxxxxx	999999	999.99	999999	9999999	999.99	999999

Selection Criteria:
Date
Adjust Type
Made By
Authorized By

Adjust Type:
Customer Account
Bank Deposit Error



11.4 ETC Account Management Transaction Reports

The purpose of the various Daily Transaction Reports (DTR) is to present data on a detailed transaction basis as related to each Customer Service Representative (CSR)

The DTR by Account report presents a detailed listing of all transactions by Account type which occurred within a specified date range grouped by CSR ID and sorted by individual account numbers. Totals for each clerk and a grand total are also reported.

11.4.1 DTR Payment Details

The **DTR by Payment Details Report** presents a detailed listing of all transactions by Payment type which occurred within a specified date range grouped by CSR ID and sorted by transaction number. Totals for each clerk and a grand total are also reported.

11.4.2 DTR by Tran Type

The **DTR by Transaction Type Report** presents a detailed listing of all transactions sorted by Transaction type which occurred within a specified date range grouped by CSR ID.

11.4.3 DTR NSF Checks

The **DTR NSF Checks Report** presents a detailed listing of all NSF fee transactions which occurred within a specified date range grouped by CSR ID. Totals for each clerk and a grand total are also reported.

11.4.4 DTR Write-Offs

The **DTR Write-Offs Report** presents a detailed listing of all write-off transactions which occurred within a specified date range grouped by CSR ID. Totals for each clerk and a grand total are also reported.

11.4.5 DTR Refunds

The **DTR Refunds Report** presents a detailed listing of all refund transactions which occurred within a specified date range grouped by CSR ID. Totals for each clerk and a grand total are also reported.

11.4.6 DTR Adjustments

The **DTR Adjustments Report** presents a detailed listing of all adjustments which occurred within a specified date range grouped by CSR ID and sorted by transaction number. Totals for each clerk and a grand total are also reported.

11.4.7 DTR Reversals

The **DTR Reversals Report** presents a detailed listing of all reversals which occurred within a specified date range grouped by CSR ID and sorted by transaction number. Totals for each clerk and a grand total are also reported.

11.4.8 Daily ETC Transactions

The **Daily ETC Transaction Report** lists each toll transaction occurring for the specified bridge. The date/time and the toll amount is reported for each transaction. This report is sorted by plaza and lane.

11.4.9 ETC Transaction Summary

The **ETC Transaction Summary** report presents a listing of the tolls, replenishments and collector totals for a given day in a given lane.

11.4.10 Sample Transaction Reports

11.4.10.1 DTR by Clerk by Account

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/30/95

Time: 12:30:21

DTR by Clerk by Account

From : Jun 08, 1995 To : Jun 18, 1995

Report : SERV-0001

Page # : 1 of 1

Acct No/		-----	Transaction			Sub		Pay	
Clerk	Citation No	Number	Date/Time	Type	Category	Category	Type	Amount *	Total**
43	163549	413456	06/08/95 16:32:22	R	TAGDEPOSIT	ASSIGNTAGI	VISA13	\$50.00	
	163549	413456	06/08/95 16:32:22	R	TOLDEPOSIT	PREPAYMENT	VISA13	\$150.00	
	166722	435552	06/18/95 16:52:56	R	FEE	STATEMENT	CASH	\$2.00	
									\$202.00
45	4252529	413256	06/08/95 12:37:42	R	TOLDEPOSIT	PREPAYMENT	CHECK	\$100.00	
	4252529	545552	06/11/95 09:22:23		FEE	STATEMENT	CHECK	\$2.00	
									\$102.00
Grand								Total=	\$302.00

*The Amount column represents the sum total of all line items of a transaction.

**The Total column represents the sum total of all line items of a transaction.

LOCKHEED MARTIN



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11.4.10.2 DTR by Transaction Number

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/31/95 - Wednesday

Time: 12:30:21

DTR by Transaction Number

From : Jun 08, 1995 To : Jun 08, 1995

Report : SERV-0002

Page # : 1 of 1

Transaction Number	Date/Time	Clerk	Account Number	Tran. Type	Category	Sub Category	Pay Type	Amount*	Total**
413456	06/08/95 16:32:22	43	163549				VISA13		
				R	TAGDEPOSIT	ASSIGNTAGI		\$50.00	
				R	TOLDEPOSIT	PREPAYMENT		\$150.00	
									\$200.00
413256	06/08/95 12:37:42	45	4252529				CHECK		
				R	TOLDEPOSIT	PREPAYMENT		\$100.00	
				R	FEE	STATEMENT		\$2.00	
									102.00
Grand Total =								\$304.00	\$304.00

The report is sorted by ascending transaction number.



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11.4.10.3 DTR by Transaction Type

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

DTR by Transaction Type
From : Jun 08, 1995 To : Jun 18, 1995

Report : SERV-0003

Page # : 1 of 1

Type	Transaction Date/Time	Number	Clerk	Account Number	Tran Code	Category	Sub Category	Pay Type	Amount*	Total**
R	06/08/95 16:32:22	413456	43	163549	2	TAGDEPOSIT	ASSIGNTAGI	VISA13	\$50.00	\$50.00
R	06/08/95 16:32:22	413456	43	163549	2	TOLDEPOSIT	PREPAYMENT	VISA13	\$150.00	\$150.00
R	06/18/95 16:52:56	435552	44	166722	8	FEE	STATEMENT	CASH	\$2.00	\$2.00
R	06/08/95 12:37:42	413256	45	4252529	2	TOLDEPOSIT	PREPAYMENT	CHECK	\$100.00	\$102.00
				2	FEE	STATEMENT		\$2.00	
GRAND TOTAL =									\$304.00	\$304.00



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Proprietary Data

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11.4.10.4 DTR NSF Checks

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/30/95

Time: 12:30:21

DTR NSF Checks

From : Jun 1995 To : Jun 1995

Report : SERV-0004

Page # : 1 of 1

Clerk	Transaction Date/Time	Number	Account Number	Tran Code	Category	Sub Category	Pay Type	Amount*	Total**
43	06/08/95 16:32:22	413456	163549				CHECK		
				8	FEE	NSF		\$15.00	
	06/18/95 16:32:23	435552	166722				CHECK		
				8	FEE	NSF		\$15.00	
									\$30.00
45	06/08/95 12:37:42	413256	4252529				CHECK		
				8	TOLDEPOSIT	NSF		\$100.00	
	06/11/95 09:22:23	545552	6363722				CHECK		
				8	FEE	NSF		\$15.00	
									\$115.00
							GRAND	TOTAL =	\$145.00

This report provides details of all NSF activity occurring the previous day. Only the original NSF entry appears in the report.



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Proprietary Data

Inquiry & Reporting • 11-33

11.4.10.5 DTR Writeoffs

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 04/10/96-Wednesday

Time: 01:17:37

DTR Write Offs

From : Mar 1996 To : Apr 1996

Report : SERV-0005

Page # : 1 of 1

-	Transaction	Account No	Tran	Sub	Pay					
Clerk	Type	Date/Time	Number	Citation No	Code	Category	Category	Type	Amount*	Total* *
43	A	04/09/96 16:47:12	99457	989461				NONE		\$10.00
					76	FEE	WRITEOFF		10.00	
GRAND TOTAL=									10.00	\$10.00



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11.4.10.6 DTR Refunds

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/30/95

Time: 12:30:21

DTR Refunds

From : Mar 1996 To: Apr 1996

Report : SERV-0005

Page # : 1 of 1

		Transaction		Account No	Tran			Sub	Pay		
Clerk	Type	Date/Time	Number	Citation No	Code	Category	Category	Type	Amount*	Total**	
43	D	06/08/95 16:32:22	413456	163549					CHECK		
					19		REFUND		(\$5.00)		
						TOLDEPOSIT					(\$5.00)
									GRAND TOTAL =	(\$5.00)	(\$5.00)



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11.4.10.7 DTR Adjustments by Clerk

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

From :

DTR Adjustments By Clerk

Jun 08, 1995 To : Jun 18, 1995

Report : SERV-0006

Page # : 1 of 1

-----Transaction-----		Account No	Tran	Sub		Pay	Transaction	
Date/Time	Number	Citation No	Code	Category	Category	Type	Amount*	Total**
Clerk 43								
06/08/95 10:32:22	413456							\$40.00
		163549	50	TAGDEPOSIT	ASSIGNTAGI	Check	\$40.00	
06/08/95 10:45:10	434532							\$40.00
		166722	50	TAGDEPOSIT	ASSIGNTAGI	VISA 13	\$40.00	
06/10/95 11:44:23	435552							\$25.00
		166543	24	TOLDEPOSIT	PREPAYMENT	Check	\$25.00	
06/18/95 14:00:54	437332							\$80.00
		166775	50	TAGDEPOSIT	ASSIGNTAGI	MC	\$80.00	
06/18/95 15:57:01	438923							\$25.00
		169004	24	TOLDEPOSIT	PREPAYMENT	MC	\$25.00	
						Clerk ID 43	Total	\$210.00
Clerk 44								
06/05/95 09:37:42	413256							
		4252529	24	TOLDEPOSIT	REFUND	Check	\$40.00	
06/14/95 14:22:23	545552							
		6363722	24	TOLDEPOSIT	REFUND	MC	\$40.00	
						Clerk ID 44	Total	\$80.00
						Grand Total	All Clerks =	\$290.00



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Proprietary Data

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/30/95
Time: 12:30:21

DTR Reversals By Clerk

From : Jun 1995 - Jul 1995

Report : SERV-0007
Page # : 1 of 1

Clerk	Type	Transaction Date/Time	Reversal Tran No	Account No/ Citation No	Pay Type	Tran Code	Category	Sub Category	Amount*	Total**
43	R	06/01/95 17:29:09	99274	99276	989514-0	CASH				
						4	TOLDEPOSIT	PREPAYMENT	\$5.00	\$5.00
43	X	06/08/95 11:21:39	99274	99274	989514-0	VISA1 3				
						24	TOLDEPOSIT	PREPAYMENT	(\$5.00)	(\$5.00)
GRAND TOTAL =									\$0.00	\$0.00



11.4.10.8 ETC Transaction Daily Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95
Time: 12:30:21

ETC Transaction Daily Report

Report : SERV-0015
Page # : 1 of 1

Activity Date : June 01, 1995

Plaza : 07

Lane	Account #	Tag ID	Date	Time	Amount	Lane Total	Plaza Total	Net Total
1	163549:0	0000024697	06/01/95	06:30:00	\$1.00			
			06/01/95	08:05:45	\$1.00			
	166363:0	0000024673	06/01/95	06:32:32	\$1.00			
			06/01/95	05:20:56	\$1.00			
	172727:0	0000023547	06/01/95	08:23:34	\$2.50			
			06/01/95	17:29:54	\$2.50			
	172792:0	0000023567	06/01/95	16:45:32	\$1.00			
	186627:0	0000299286	06/01/95	17:30:32	\$3.00			
						\$13.00		
2	1677282:0	0033900238	06/01/95	06:30:22	\$1.00			
	1678727:1	0020200299	06/01/95	07:30:23	\$2.00			

						\$25.00		



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11.4.10.9 ETC Transactions Summary Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 05/22/96
Time: 12:30:21
Toll Date : 4/1/96

ETC Transactions Summary Report

Report SERV-0007
Page # : 1 of 1

PLAZA :	Tolls	Replenishments	Collector Total
<hr/>			
Lane : 12			
Toll Collector ID 3	\$1.00	\$0.00	\$1.00
Lane 12 Totals :	\$1.00	\$0.00	\$1.00
<hr/>			
	PLAZA TOTAL:		\$1.00

LOCKHEED MARTIN



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11.5 ETC Account Management Status Reports

Status Reports present data resulting from requests or analysis. The outcome of various billing processes and the data justifying the results as grouped within the Status Reports.

11.5.1 Rebill Analysis Report

The **Rebill Analysis Report** presents the data used in the calculation of the current rebill amount. An initial rebill amount is set upon account opening. Each month the rebill amount is adjusted based on the average of the previous three months of toll usage.

11.5.2 Rebill Transaction Report

The **Rebill Transaction Report** lists the rebill requests and the status of these requests for a given date range. Credit card or bank account data is also listed.

11.5.3 Credit Denied Report

The **Credit Denied Report** lists the accounts in which credit was denied for the indicated billing request date. The reason code for the credit denial is also shown. The report is sorted by account number.

11.5.4 Credit Card Status Report

The **Credit Card Status Report** lists the account information for all customers whose credit card expires in the specified date range. Day and night phones are listed for situations in which supervisors require customer communication.

11.5.5 Summary Account Status Report

The **Summary Account Status Report** lists the account information for all customers in a specific account type or who opened an account in a specified date range or who closed an account in a specified range. Day and night phones are listed for situations in which supervisors require customer communication.

11.5.6 Sample Status Reports

11.5.6.1 Rebill Analysis Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 03/01/96 - Wednesday
Time: 12:30:21

Rebill Analysis Report

Report : SERV-0008
Page # : 1 of 1

For
Mar 1996

Acct No	Name	Last Rebill	Toll Usage			*New Rebill
		Amount	Dec	Jan	Feb	Amount
0020002-000	SANDRA ADAMS	\$ 100.00	\$ 80.00	\$ 100.00	\$ 150.00	\$ 110.00
0062727-000	BARBARA SMITH	\$ 510.00	\$ 600.00	\$ 720.00	\$ 400.00	\$ 573.00
0078839-001	FAST TRACK, INC.	\$4,500.00	\$4,800.00	\$5,000.00	\$6,400.00	\$ 5,400.00
.....
.....

*New indicates that this is the initial creation of the rebill request record.

The report is sorted first by rebill status and then by pay type.

Subtotals for each rebill status and a grand total will be provided.



11.5.6.2 Rebill Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 05/23/96 - Thursday

Time: 12:30:21

Rebill Status Report

Report : SERV-0009

Page # : 1 of 1

From: Mar 1996 To: Apr 1996

Status	Acct No	Pay Type	CC Acct No	Amount	Auth No	Ref No	ABA Route No	Request Date	Status Change Date	Auto/ On-Line
RQST	989881-0	VISA13	4123456789012	\$35.00				3/21/96	3/26/96	<u>On-Line</u>



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11.5.6.3 Credit Card Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Credit Card Status Report

Report : SERV-0012

Page # : 1 of 1

From: July 01, 1995 To: Sept 30, 1995

Service Center:

Account Number	Name	Pay Type	Credit card #	Day Phone	Night Phone
Month of Expiration : July, 1995					
0020002-000	SANDRA ADAMS	MC	5398560000676710	(504) 454 7600	(504) 868 8484
0062727-000	BARBARA SMITH	VISA13	4132342424425	(414) 828 3838	(414) 525 7272
0078839-001	FAST TRACK, INC.	MC	552626262626254	(525) 727 2727	(525) 727 2727
.....
Month of Expiration : August, 1995					
0010032-000	BARBARA MEEHAN	VISA16	448560000676710	(504) 454 7600	(504) 868 8484
0032727-000	GORGE PIKE	VISA13	4132342424425	(414) 828 3838	(414) 525 7272
0042339-000	NANCY TURNBULL	MC	5535636677782323	(525) 536 3731	(525) 536 9474
.....
Month of Expiration : Sept, 1995					
0012002-000	ADAM PILSBURY	MC	5398560000676710	(504) 454 7600	(504) 868 8484
0023483-000	TAPAN BISWAS	VISA16	4525000200023093	(504) 435 3737	(504) 743 3838
0053839-001	MICROSOFT INC.	MC	5536378127663092	(408) 637 7373	(408) 637 7373

****End of Report****



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11.5.6.4 Credit Denied Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95
Time: 12:30:21

Credit Denied Report

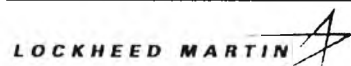
Report : SERV-0010
Page # : 1 of 1

As of Date: May 12, 1995
Service Center:

Account Number	Name	Payment Type	Total Amount	Credit card Account Number	Expiry Date	Checking Account Number	ABA#	Reason Code
0020002-000	SANDRA ADAMS	AMEX	\$ 100.00	388383283773752134	06/96			09
0062727-000	BARBARA SMITH	DRDB	\$ 65.00			85797903	18/8828	16
0078839-001	FAST TRACK, INC.	VISA13	\$ 1000.00	452525626262676	07/98			09
.....
.....

Customer accounts receiving a credit denied status from the bank will receive an automatic correspondence letter from the Service Center. The letter will request a replacement credit card or other form of payment. The letter will include the account balance as of the letter date. Violations will be issued for those accounts at zero or in a negative balance.

****End of Report****



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11.5.6.5 Summary Account Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 03/01/96 - Wednesday
Time: 12:30:21

Summary Account Status Report

Report : SERV-xxxx
Page # : 1 of 1

For
Mar 1996

Acct		Opened	Closed	Account	Account		Devices Issued	Vehicles	Account Activity/ Financial
Type	Acct No	Date	Date	Name	Balance	Tags	Cards	Registered	Status
Indiv	0020002-000	01/01/1996		SANDRA ADAMS	\$ 100.00	1	0	2	ACTV/ GOOD
Indiv	0062727-000	01/01/1996		BARBARA SMITH	\$ 510.00	0	0	2	PEND
Comm	0078839-001	01/01/1996		FAST TRACK, INC.	\$ 4,500.00	0	0	1	NEW

Total No. of Accts: 99999
Total No. of Vehicles: 99999
Total No. of Tags: 99999
Total No. of Cards: 99999



Filter Criteria:

Account Type

Account Open Date (present a To/From range)

Account Closed Date (present a To/From range)

Sort Method:

Account Number/Subaccount number

Column Heading	Database Table	Database Field Name
Acct Type	t_etc_account	account_type
Acct No	t_etc_account	account_no
Opened Date	t_etc_account	open_dt
Closed Date	t_etc_account	close_dt
Account Name	t_subaccount linked to t_etc_account by etc_account_id	subaccount_name
Account Balance	t_etc_account	current_balance
Tags	t_device linked to t_etc_account by etc_account_id	count(*) device_id for tag_type = 1
Cards	t_device linked to t_etc_account by etc_account_id	count(*) device_id for tag_type = 2
Vehicles Registered	t_vehicle linked by subaccount_id to t_subaccount linked to t_etc_account by etc_account_id	count(*) vehicle_id
Account Financial Status	t_codes linked to t_etc_account by acct_fin_status	descrip_short where code_id = acct_fin_status and code_type = "acct_fin_status"
Account Activity Status	t_codes linked to t_subaccount by acct_act_status	descrip_short where code_id = acct_fin_status and code_type = "acct_act_status"

11.6 ETC Account Management Daily Reports

Daily Reports show transaction data gathered on a daily basis. These reports show activity in various areas of the Service Center, including clerk and toll transactions.

11.6.1 Daily Activity Report

An individual **Daily Activity Report** is generated for each specified clerk, sorted by session ID. This report will group each financial transaction that occurred within the grouped session. A total amount per session and a grand total will be reported.

11.6.2 Daily Activity Summary Report

An individual **Daily Activity Summary Report** is generated for each specified clerk, and sorted by session ID. This report will show for each session the amount debited and credited to each general ledger account. A total for each session and a grand total will be reported.

11.6.3 Clerks Activity Report

The **Clerks Activity Report** totals the transactions performed for each clerk at the specified Service Center. The transaction types totaled are financial transactions, non-financial transactions, number of adjustments, and number of reversals. This report can be used for performance appraisal.

11.6.4 Daily Financial Status Report

The **Daily Financial Status Report** shows both the source of funds and the applications of funds on a daily basis. The total from each of these funds should balance. The source of funds section of the report groups data by pay types and sorts the information by employee ID. Total number of transactions and total amounts are listed for each employee. The application of funds section of the report groups data by category and sub-category. Within each category and sub-category, totals are listed for each bridge/fund code.

11.6.5 Sample Daily Reports

11.6.5.1 Clerk Activity Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 05/23/96 - Thursday

Time: 12:30:21

Clerk Activity Report

Report : SERV-0016

Page #: 1 of 1

Date: May 23, 1996

Date	Session	Employee ID	Employee Name	No of Financial Transactions	No of Reversals
3/22/96	629	44	MELANIE ROQUES	2	0
3/22/96	628	43	PHILIP DEBECKER	3	9
3/22/96	630	43	PHILIP DEBECKER	25	10
TOTALS =				30	19

****End of Report****



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11.6.5.2 Daily Activity Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date: 04/22/96 - Monday

SERV-0013

Time: 12:30:21

Activity Detail Report

Service Center

Report :

Page # : 1 of 1

Date: April 22, 1996

Clerk : 43 PHILIP R. DEBECKER

-----Transaction-----								
No	Time	Type	Acct No	Sub Acct No	Category	Sub-Category	Pay Type	Amount
Session No : 646			Session Total : \$25.00					
000099460	09:04:25	R	0989916	0	TOLDEPOSIT	PREPAYMENT	VISA13	\$25.00
Total for Clerk # 43 : \$25.00								



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11.6.5.3 Daily Activity Summary Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 04/11/96 - Monday

Time: 14:52:13

Activity Summary Report ETC Account Processing

Report : SERV-0014

Page # : 1 of 1

Date: Jul 01,1995

Clerk ID	Session	Tran Code	Type	Category	Sub-category	Amount
43	630	20	R	TOLDEPOSIT	PREPAYMENT	\$25.00
		4	R	TOLDEPOSIT	PREPAYMENT	\$50.00
43	630	8	A	FEE	NSF	\$15.00
43	630	16	A	TOLL	ETC	\$1.00
43	630	34	R	TAGDEPOSIT	ASSIGNTAG	\$10.00
GRAND TOTAL=						\$101.00

Authorized users may generate this report prior to business date completion.



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11.6.5.4 Daily Financial Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Daily Financial Status Report

Date : 06/01/95
Time: 12:30:21
SOURCE OF FUNDS

Report : SERV-0017
Page # : 1 of 2

Pay Type	Employee ID	No. of Transactions	Amount
CASH	01	20	200.00
	03	10	50.00
			250.00
CHECK	01	5	250.00
	02	20	3,000.00
			3,250.00
DISCOVER	02	15	350.00
	04	35	4,005.00
			4,355.00
MASTERCARD	01	23	5,360.00
	32	20	5,530.00
			10,890.00
VISA13	01	5	245.00
			245.00
VISA16	02	25	2,500.00
	30	30	3,005.00
			5,505.00
LANEREPLENISHMENT	16	200	550.00
	17	245	890.00
			1,440.00
DIRECT DEBIT	7373	25	2,445.00
			2,445.00
ETC TOLLS	6262	54,503	2,90,902.00
			290,902.00
TOTAL		55,943	323,544.00



SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Daily Financial Status Report

Report : SERV-0017

Page # : 2 of 2

APPLICATION OF FUNDS

Category	Sub-category	Bridge	Fund Code	Amount
TOLDEPOSIT	PREPAYMENT	Turnpike	12	25,000.00
		Fairoaks	12	45,500.00
		River Ridge	13	35,550.00
				106,050.00
TAGDEPOSIT	ASSIGNTAG-INT	Turnpike	12	20,000.00
		Fairoaks	12	25,000.00
		River Ridge	13	3,000.00
				48,000.00
FEE	NSF	Turnpike	12	1,000.00
		Fairoaks	12	500.00
	STMT	Turnpike	12	1,500.00
		Fairoaks	12	300.00
	STMT	River Ridge	13	250.00
				3,800.00
FINE	VIOL	Turnpike	12	1,250.00
		Fairoaks	12	1,750.00
		River Ridge	13	1,000.00
				3,000.00
REFUNDS	PREPAYMENT	Turnpike	12	(750.00)
	TAGDEPOSIT	Turnpike	12	(250.00)
				(1,000.00)
PAYMENT	STMT-PROCESS	TurnPike	12	(2,700.00)
				(2,700.00)
TOTAL				323,544.00



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11.7 ETC Account Management Monthly Reports

Monthly Reports summarize daily detailed transactions into monthly totals.

11.7.1 Monthly Account Statement Report

The **Monthly Account Statement Report** is used to produce monthly statements for ETC customers upon request. This report is similar to the batched statements produced. Each payment and toll transaction is listed, deriving the customer's current account balance.

11.7.2 Monthly Summary of Accounts Report

The **Monthly Summary of Accounts Report** summarizes the financial transactions associated with each account. Financial totals summarized are opening toll balance, deposits, toll usage, tag deposit, fees, and fines. Totals for all accounts are also computed and shown.

11.7.3 Revenue Summary Report

The **Revenue Summary Report** summarizes financial totals for each day of the specified month. Financial totals summarized are prepaid toll usage, fines, fees, refunds, and net revenue. Totals for the month are also shown.

11.7.4 Monthly Financial Status Report

The **Monthly Financial Status Report** shows both the source of funds and the applications of funds on a monthly basis. The total from each of these funds should balance. For each day of the month, the source of funds section of the report groups and totals data by pay type.

The application of funds section of the report groups data by fund code. Within each fund code, accounting category totals are listed for each day of the month.

11.7.5 Sample Monthly Reports

11.7.5.1 Monthly Account Statement

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 07/01/95

Time: 12:30:21

Monthly Account Statement

Report : SERV-0018

Page # : 1 of 1

Statement Period From : May 1996
To : May 1996

Account Status : CKPEND
Account Number : 989952-0
DEBORAH O'CONNOR
250 WESTWOOD DRIVE

KENNER

LA 70065-

Tag Lease

Opening Balance : \$70.00

New Payments : \$50.00

Closing Balance : \$120.00

Prepaid Tolls

Opening Balance : \$0.00

New Payments : \$0.00

Toll Usage : \$0.00

Closing Balance : \$0.00

No. of Tags

Int : 0

Ext : 0

	Date-Time	Plaza	Lane	Tag ID	Amount
TAGDEPOSIT	5/7/96 09:16:22	---	---	---	\$50.00



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11.7.5.2 Monthly Summary of Accounts

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 05/22/96 - Wednesday

Time: 12:30:21

Monthly Account Summary Report

Report : SERV-0019

Page # : 1 of 1

Statement For May 1996

Acct No	Status	Name	-No of Tags-		-----TAG LEASE-----			-----PREPAID TOLLS-----			
			In	Ext	Opening	New	Current	Opening	New	Toll	Current
			t		Balance	Leases	Balance	Balance	Payments	Usage	Balance
989961-0	CKPEND	KAYLA O'CONNOR	-1	0	(\$10.00)	\$0.00	(\$10.00)	(\$6.00)	\$0.00	\$0.00	(\$6.00)
989952-0	CKPEND	DEBORAH O'CONNOR	0	0	\$70.00	\$50.00	\$120.00	\$0.00	\$0.00	\$0.00	\$0.00



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11.7.5.3 Revenue Summary Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Revenue Summary Report

Report : SERV-0020

Page # : 1 of 1

Reporting Period: May 1, 1995 to May 31, 1995

Service Center: Oakland

Date	Prepaid Toll Usage	Fines	Fees	Refunds	Net Revenue
05/01/95	\$ 1,200.00	\$ 300.00	\$ 450.00		\$ 1,950.00
05/02/95	\$ 2,500.00	\$ 300.00	\$ 450.00	\$ 300.00	\$ 2,950.00
.....
TOTAL	\$32,204.00	\$ 3,990.00	\$ 2,800.00	\$ 2,590.00	\$ 36,404.00



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11.7.5.4 Monthly Financial Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Monthly Financial Status Report

Report : SERV-0022

Page # : 1 of 2

For the month of June, 1995

APPLICATION OF FUNDS

FUND CODE : 0

DATE	TOLLDEPOSIT PREPAYMENT	TAGDEPOSIT ASSIGN TAG- INT	TAGDEPOSIT ASSIGN TAG -EXT	FEE NSF	FEE STATEMENT	FEE OTHER	FINES VIOLATION	REFUND TOLLDEPOSIT	REFUND TAGDEPOSIT	OTHER EXPENSES	TOTAL
8/23/95	\$240,750.00	\$667,400.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$908,150.00
TOTAL	\$240,750.00	\$667,400.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$908,150.00

LOCKHEED MARTIN 

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11.7.5.5 Monthly Financial Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Monthly Financial Status Report

Report : SERV-0022

Page # : 2 of 2

For the month of May, 1995

SOURCES OF FUNDS

DATE	CASH	CHECK	VISA13	VISA16	MC	AMEX	DISC	LANERPL	DRDEBT	TC TOLLS	TOTAL
8/23/95	\$383,455.00	\$74,360.00	\$70,625.00	\$62,720.00	\$69,740.00	\$80,305.00	\$76,750.00	\$0.00	\$90,195.00	\$0.00	\$908,150.00
TOTAL	\$383,455.00	\$74,360.00	\$70,625.00	\$62,720.00	\$69,740.00	\$80,305.00	\$76,750.00	\$0.00	\$90,195.00	\$0.00	\$908,150.00



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11.8 ETC Account Management Annual Reports

Annual Reports show data gathered on a yearly basis. These reports are useful for end-of-year accounting purposes.

11.8.1 Annual Financial Status Report

The **Annual Financial Status Report** shows the source of funds and the applications of funds on a yearly basis. The total from each of these funds should balance.

For each month, the source of funds section of the report groups and totals data by pay type.

The application of funds section of the report groups data by fund code. Within each fund code, accounting category totals are shown for each month.

11.8.2 Sample Annual Reports

11.8.2.1 Annual Financial Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Annual Financial Status Report

Report : SERV-0022

Page # : 1 of 2

July 1995 to July 1996

APPLICATION OF FUNDS

FUND CODE : 0

MONTH	TOLLDEPOSIT PREPAYMENT	TAGDEPOSIT ASSIGNTAG- INT	TAGDEPOSIT ASSSIGNTAG- EXT	FEE NSF	FEE STATEMENT	FEE OTHER	FINES VIOLATION	REFUND TOLLDEPOSIT	REFUND TAG DEPOSIT	OTHER EXPENSES	TOTAL
August	\$240,750.00	\$667,400.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$908,150.00
TOTAL	\$240,750.00	\$667,400.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$908,150.00



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11.8.2.2 Annual Financial Status Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Annual Financial Status Report

Jul 1995 to Jun 1996

Report : SERV-0022

Page # : 2 of 2

SOURCES OF FUNDS

MONTH	CASH	CHECK	VISA13	VISA16	MC	AMEX	DISC	LANERPL	DRDEBT	TC TOLLS	TOTAL
August	\$383,455.00	\$74,360.00	\$70,625.00	\$62,720.00	\$69,740.00	\$80,305.00	\$76,750.00	\$0.00	\$90,195.00	\$0.00	\$908,150.00
TOTAL	\$383,455.00	\$74,360.00	\$70,625.00	\$62,720.00	\$69,740.00	\$80,305.00	\$76,750.00	\$0.00	\$90,195.00	\$0.00	\$908,150.00



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11.9 ETC Account Management Tag Inventory Reports

Inventory Reports are generated to obtain tag inventory information. Both detailed and summary reports are available.

11.9.1 Tag Distribution Report

The **Tag Distribution Report** shows total number of tags in each of the various tag statuses. A total number of tags is also given.

11.9.2 Tag Inventory Detail Report

For each tag in the specified tag ID range, the **Tag Inventory Detail Report** itemizes information related to each tag. Information listed includes: the account, last transaction data, current status, and the internal tag ID. This report is sorted by tag status.

11.9.3 Tag Inventory Summary Report

The **Tag Inventory Summary Report** is not currently available.

11.9.4 Sample Tag Inventory Reports

11.9.4.1 Tag Distribution Daily Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95
Time: 12:30:21

Tag Distribution Report

Report : SERV-0024
Page # : 1 of 1

Tag Status		No. of Tags
ETC Account Processing		
GOOD	BALANCE > THRES	63633
INVN	IN INVENTORY	73733
LBAL	LOW BALANCE	564
FTRD	FAILED TAG READ	536
LOST	TAG WAS LOST	737
ETC Account Processing Total :		12629
GRAND TOTAL		12629

This report reflects real-time inventory information.



11.9.4.2 Tag Inventory Detail Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Date : 06/01/95

Time: 12:30:21

Tag Inventory Detail Report ETC Account Processing

Report : SERV-0025

Page # : 1 of 1

Tag	External	Tag	Tag	Sub	-----Last read-----				
Status	Tag ID	Facility ID	Serial #	Box ID	Acct No	Acct	Plaza	Lane	Date
INVN	0001029288	100101	0006	01002200					
	0001029289	100101	0007	01002200					
	0001029290	100101	0008	01002200					
	0001029291	100101	0009	01002200					
	0001029292	100101	0010	01002200					
	0001029293	100101	0011	01002200					
	0001029294	100101	0012	01002200					
	0001029295	100101	0013	01002200					
	0001029296	100101	0014	01002200					
	0001029299	100101	0017	01002200					
	0001029300	100101	0018	01002200					
ACTIVE	0001029285	100101	0003	01002200	101020	000	02	06	05/30/95 12:22:23
	0001029286	100101	0004	01002200	726262	000	03	04	05/28/95 03:01:55
	0001029287	100101	0005	01002200	737373	000	02	05	05/30/95 22:22:23
LOST	0001029297	100101	0016	01002200	535356	000	02	06	04/20/95 23:32:11
	0001029301	100101	0019	01002200	526266	000	02	06	03/30/95 33:22:33



11.10 ETC Account Management Violations Reports

Violation Occurrence reports are generated to obtain violation occurrence and status information.

11.10.1 Violation Notice

The **Violation Notice** will be provided per the specifications required by SCDOT. This notice will be printed on customized forms provided by SCDOT. No prototype is provided in this document .

11.10.2 Violations Issued Report

The **Violations Issued Report** provides a list by Violation Notice, number of Violation Notices issued, and violator's name and address.

11.10.3 Violation Tracking Report

The **Violation Tracking Report** provides for tracking Violation Notices issued from date of issue until closed.

11.10.4 VES Event Reconciliation Report

The **VES Event Reconciliation Report** provides a list by clerk of the results of review of all VES event images, no problem, ticket should be issued, a problem with the collector, etc..

11.10.5 Name & Address Requests Report

The **Name and Address Requests Report** lists the outstanding requests for vehicle owner information. Violation number, ETC transponder number (if available), date of violation, and date last reviewed are listed, along with the vehicle license number. Requests can be made by violation number or by state and license number.

11.10.6 Violation Occurrence Report

The **Violation Occurrence Report** provides all pertinent violation information for a given date range including: the date, time, plaza, lane, collector identification number, license number and state,

external tag identification number, tag status, and violation number. Violation number are also cross-referenced to the lane serial number.

11.10.7 Violation Status Report

The **Violation Status Report** provides the following information: violation status, violation number, plate number, plate's state of origin, violation date and time, account number, sub account number, violation amount, amount due, lane, and plaza.

11.10.7.1 8CC Violations Issued Sample Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Violations Issued

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: 9999
Page: 99

Date	Time	Plaza	Lane	License Number	Violator Name	Violator Address	Image Number	CVN Number	Reason
mm/dd/yy	HH:MM:SS	xxxxxx	99	999-xxxxx	xxxxxxxxxx	xxxxxxx	9999999	999999	xxxxxxxx

Selection Criteria:

Date
Plaza
Name
CVN#

Reason:

Insufficient Funds
Improper Use of Tag
Improper have Usage
Run through



11.10.7.2 8CC Violations Tracking Sample Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Violation Tracking

Date Printed: mm/dd/yy
Time Printed: HH:MM:SS

Report No.: 9999
Page: 99

Image No.	CVN No.	Violator Name	Date Processed	Appeal Date	Hearing Date	Finding	Fine Amount	Fine Paid Date	Lien Filed Date	Lien Amount	Lien Paid Date	CVN Closed DA
999999	99999	xxxxxxxxx	mm/dd/yy	mm/dd/yy	mm/dd/yy	xxxxxxx	\$xxxxx	mm/dd/yy	mm/dd/yy	\$xxxxx	mm/dd/yy	mm/dd/yy

Selection Criteria:

CVN No.
Violator Name
Process Date
Appeal Date
Hearing Date
Lien Filed Date
Lien Paid Date
CNN Closed Date

Findings:

G - Guilty
NG - Not Guilty



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11.10.7.3 VES Event Reconciliation Sample Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

VES Event Reconciliation Report

Plaza: XXXXXXXXXXXX

Date Printed: mm/dd/yy

Time Printed: HH:MM:SS

Report No.: 9999

Page: 99

Date	Time	Lane	Trans. Number	Image Number	Equipment Status	Collector	Collector Error	Violation	Issue Citation	Remarks
mm/dd/yy	HH:MM:SS	99	99999999	99999999	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX

Selection Criteria:

Date

Time

Plaza

Lane

Trans. Number

Image Number

Collector

Collector Error: Yes/No

Violation: Yes/No

Issue Citation: Yes/NO



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11.10.7.4 Violation Occurrence Sample Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Violation Occurrence Report

Date: 5/23/96 - Thursday
Time: 03:19:44

From: Jun 01, 1995 To: May 23, 1996

Report: SERV-0025
Page No: 1 of 1

Date/Time	Plaza	Lane	Collector ID	-----License-----		Ext Tag ID	Tag Status	Violation No
				Number	State			
11/2/95 12:12:12	07	10	10	SUN 2123	SC		LBAL	100001
11/6/95 17:34:37	07	09	0	2NWN59	SC	1000000008.0		100002
11/7/95 14:31:47	07	01	0	+FAIL	SC	1000000009.0		100003
8/20/95 15:04:27	07	05	130	TEST	SC			100004
8/20/95 15:04:54	07	05	130	V128	SC			100005
8/20/95 15:05:20	07	05	130	28	SC			100006
8/20/95 15:09:01	07	05	981	TEST	SC			100012
8/20/95 15:05:47	07	05	130	8	SC			100007
8/20/95 15:06:19	07	05	130	28	SC			100008
8/20/95 15:06:33	07	05	130	1GV1	SC			100009
8/20/95 15:07:10	07	05	130	TEST	SC			100010
8/20/95 15:07:34	07	05	130	TEST	SC			100011



11.10.7.5 Violation Status Sample Report

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION CROSS ISLAND PARKWAY TOLL FACILITY

Violation Status Report

Date : 5/23/96 - Thursday
Time : 03:20:15

Report : SERV-0012
Page No: 1 of 1

Viol Status	Violation No	Plate No	Plate State	Viol Date/Time	Acct No	Sub Acct	Viol Amount	Amount Due	Lane	Plaza
NOT2	100001	SUN2123	SC	11/2/95 12:12:12	1000	0	1.00	16.00	10	07
CITE	100002	2NWN59	SC	11/6/95 17:34:37	0	0	1.00	21.00	09	07
CITE	100003	+FAIL	SC	11/7/95 14:31:47	144	0	15.00	37.00	01	07
CITE	100004	TEST	SC	8/20/95 15:04:27	0	0			05	07
CITE	100005	V128	SC	8/20/95 15:04:54	0	0			05	07
CITE	100006	28	SC	8/20/95 15:05:20	0	0			05	07
CITE	100012	TEST	SC	8/20/95 15:09:01	0	0			05	07
CITE	100013	349743	SC	11/2/96 11:00:00	0	0	1.00		10	07
DMVR	100007	8	SC	8/20/95 15:05:47	0	0			05	07
CITE	100008	28	SC	8/20/95 15:06:19	0	0			05	07
CITE	100009	IGV1	SC	8/20/95 15:06:33	9999	12			05	07
CITE	100010	TEST	SC	8/20/95 15:07:10	0	0			05	07
CITE	100011	TEST	SC	8/20/95 15:07:34	0	0			05	07



11.11 MOMS CONCERT Reports

The **Concert** software provides to SCDOT the capability of reporting data into a variety of management reports as demonstrated by the various sort screens. All reports can be printed and most can be displayed on the MOMS terminal screen. Some reports can be printed as many times as may be required. Other reports can only be printed once, either because the specific report contains data that may change immediately following the printing or because standard accounting practices limit duplication.

11.11.1 Service Engineer Directory Report

The **MOMS Service Engineer Directory Report** displays pertinent information regarding the Technicians and Engineers assigned to the maintenance of the SCDOT project. This information consists of data directly related to service calls, as well as accounting, administrative, and personnel data. A sample Service Engineer Directory is provided in Section 11.11.1-1.

The data presented in the Service Engineer Directory Report includes:

- SE ID
- SS Number - Social Security number
- SE Name
- Title
- Address 1
- Address 2
- City
- State/Zip
- Country
- Home Phone
- Region
- Base Address
- City
- State/ZIP
- Country
- Base Phone
- Beeper Phone
- Hire Date
- Pay Rate

- Last Review Date
- Skill Level
- Next Review Date
- Equipment Skill
- Last Training Date
- Discipline Skill



~~11.11.1.1~~ Service Engineer Directory Report Sampler

10-08-96

12:40

LOCKHEED IMS

Page 1

Service Engineer Directory

From 0000
To 9999

SE ID: 00001 SS Number:
SE Name: ALAN T. OLWELL
Title: FIELD SERVICE MANAGER
Address 1:
Address 2:
City: HILTON HEAD
State/Zip: SC 29926
Country: USA
Home Phone:
Region: Service Center:
Base Address 1234 MAIN STREET
City: HILTON HEAD
State/Zip: SC 29926
Country: USA
Base Phone:
Beeper Phone:
Hire Date: Pay Rate: 0.00
Last Review Date: Skill Level:
Next Review Date: Equipment Skill:
Last Training Date: Discipline Skill:

SE ID: 00002 SS Number:
SE Name: DAVID T. GARVER
Title: SENIOR FIELD TECHNICIAN
Address 1:
Address 2:
City: HILTON HEAD
State/Zip: SC 29926
Country: USA
Home Phone:
Region: Service Center:
Base Address: 1234 MAIN STREET
City: HILTON HEAD
State/Zip: SC 29926
Country: USA
Base Phone:
Beeper Phone:
Hire Date: Pay Rate: 0.00
Last Review Date: Skill Level:
Next Review Date: Equipment Skill:
Last Training Date: Discipline Skill:

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11.11.2 Customer Directory Report

The **Customer Directory Report** contains information required to conduct daily activity with each customer. The report may be run for all customer sites or a partial listing can be obtained. A partial sample Customer Directory is provided in Section 11.11.2.1. For the SCDOT ETC program, our customers are defined as SCDOT and each individual installation site.

The data presented in the Customer Directory Report includes:

- Customer Number
- Customer Name
- Address (includes street, city, state, zip and country)
- Phone
- Contact Name
- Contact Phone
- Credit Status - N/A
- Total Locations
- Total Units
- Tax Exempt
- Tax ID
- SE ID

11.11.2.1 Customer Directory Report Sample

10-08-96

12:58

LOCKHEED IMS

Page 1

Customer Directory (full)

From 000000
To ZZZZZ

Customer Number: 000001
Name: SCDOT
Address 1: Suite 0000
Address 2: 111 Anywhere Street
City: HILTON HEAD
State: SC Zip: 29926
Country: USA
Phone:
Contact Name: THOMAS JONES
Contact Phone:

Credit Status:
Total Locations:
Total Units:
Tax Exempt: Y
Tax ID:
SE ID: 00004
Ext:

Customer Number: 2882734
Name: SCDOT
Address 1: Suite 0000
Address 2: 111 Anywhere Street
City: HILTON HEAD
State: SC Zip: 29926
Country: USA
Phone:
Contact Name: WILLIAM SMITH
Contact Phone:

Credit Status:
Total Locations:
Total Units:
Tax Exempt: Y
Tax ID:
SE ID: 00004
Ext:

Customer Number: 2882735
Name: SCDOT
Address 1: Suite 0000
Address 2: 111 Anywhere Street
City: HILTON HEAD
State: SC Zip: 29926
Country: USA
Phone:
Contact Name: GEORGE JOHNSON
Contact Phone:

Credit Status:
Total Locations:
Total Units:
Tax Exempt: Y
Tax ID:
SE ID: 00004
Ext:

Customer Number: 2882736
Name: SCDOT
Address 1: Suite 0000
Address 2: 111 Anywhere Street
City: HILTON HEAD
State: SC Zip: 29926
Country: USA
Phone:
Contact Name: ED EVANS
Contact Phone:

Credit Status:
Total Locations:
Total Units:
Tax Exempt: Y
Tax ID:
Ext:

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11.11.3 Vendor Directory Report

The **Vendor Directory Report** provides information on the various vendors who supply services or products for the SCDOT program. A partial sample Vendor Directory is provided in Section 11.11.3.1.

The data presented in the Vendor Directory Report includes:

- Vendor Number
- Account Open Date
- Address (includes street, city, state, zip and country)
- Vendor Phone
- Contact Name
- Payment Terms
- Last Year Amount - last calendar year dollar volume
- YTD Amount - year to date dollar volume.

11.11.3.1 Vendor Directory Report Sample

10-18-96

15:20

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Page 1

Vendor Directory

From 000000
To ZZZZZ

Vendor Number:	000001	Acct Open Date:	10-10-96
Vendor Name:	ABC Moving & Storage	Payment Terms:	
Address 1:	3939 Main Street	Last Yr Amt:	0.00
Address 2:		YTD Amt:	0.00
City:	HILTON HEAD	Tax ID:	
State:	SC		
Zip:	29926		
Country:	USA		
Vendor Phone:	555-555-5555		
Contact Name:	IRVING LINDER		

Vendor Number:	00002	Acct Open Date:	10-22-96
Vendor Name:	Able Lock and Safe Co	Payment Terms:	
Address 1:	9382 Second Ave	Last Yr Amt:	0.00
Address 2:		YTD Amt:	0.00
City:	HILTON HEAD		
State:	SC		
Zip:	29926		
Country:	USA		
Phone:	555-555-5556		
Contact Name:	FRED BROWN		

Vendor Number:	00003	Acct Open Date:	10-12-96
Vendor Name:	Fastway Supplies	Payment Terms:	
Address 1:	8833 West North Ave	Last Yr Amt:	0.00
Address 2:		YTD Amt:	0.00
City:	HILTON HEAD		
State:	SC		
Zip:	29926		
Country:	USA		
Phone:	555-555-5557		
Contact Name:	RICHARD THORNTON		

Vendor Number:	0004	Acct Open Date:	10-11-96
Vendor Name:	Safe-T Equipment Co	Payment Terms:	
Address 1:	3333 Industrial Rd	Last Yr Amt:	0.00
Address 2:		YTD Amt:	0.00
City:	HILTON HEAD		
State:	SC		
Zip:	29926		
Country:	USA		
Phone:	555-555-5558		
Contact Name:	ED EVANS		

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11.11.4 Equipment Directory

The **Equipment Directory Report** describes each component or piece of equipment that must be maintained during normal operation or may require emergency service. A partial sample Equipment Directory is provided in Section 11.11.4.1.

The data presented in the Equipment Directory Report includes:

- Equipment Type
- Equipment Description
- Model Date
- Vendor Number
- Manufacturer/Purchase Cost
- List Price
- Total Installations
- MTBF to Date in Months/Days
- MTTR to Date in Hours
- Install Time in Hours
- PM Time in Hours / Minutes
- Move Time in Hours
- Upgrade Time in Hours
- Remove Time in Hours

11.11.4.1 Equipment Directory Report Sample

10-08-96

15:20

LOCKHEED IMS

Page 1

Equipment Directory

From 000000

To ZZZZZ

Equipment Type: 12V PWR SUPP
Equipment Description: INC IN LANE CONTRLR
Model Date:

Vendor Number: 0083
Manufacturer/Purchase Cost: 0.00
List Price: 0.00

Total Installments: 4

Equipment Type; 3C503
Equipment Description: 3COM ETHERNET CARD
Model Date:

Vendor Number: 0037
Manufacturer/Purchase Cost: 0.00
List Price: 0.00

Total Installments: 1

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11.11.5 Customer Installed Directory

The **Customer Installed Directory Report** contains information pertaining to all installed products or equipment types at the various customer locations/sites. The report may be run for all customer sites or a partial listing can be obtained. A partial sample Customer Installed Directory is provided in Section 11.11.5.1. For the SCDOT ETC program, our customers are defined as SCDOT and each individual installation site.

The data presented in the Customer Directory Report includes:

- Customer Number
- Name
- Contract Number
- Equipment Location Phone
- Equipment Type
- Serial Number
- Regular SE ID
- Purchase Date
- Bill To Number
- Owner Code
- Installation Date
- Warranty Effective Date
- Required Response
- Warranty Expiration Date
- PM Cycle
- Contract Expiration Date
- Billing Cycle
- Revision Level
- Contract Renewal Date
- Contract Amount
- Last PM
- Contract Class
- Last Service Date
- Discount Parts
- Contract Terms
- Discount Labor
- Special Instructions

11.11.5.1 Customer Installed Directory Report Sample

10-18-96

13:20

LOCKHEED IMS

Page 1

Customer Installed Directory

From 000000
To ZZZZZ

Customer Number: 2334300
Name:
Contract Number:
Equipment Location 555-555-1233
Phone:

Equipment Type: 12V PWR SUPP
Serial Number: 123456567
Purchase Date: 04-12-96
Installation Date: 04-20-96
Warranty Effective Date:
Warranty Expiration Date:
Contract Effective Date:
Contract Renewal Date:
Last PM:
Last Service Date:
Contract Terms:
Special Instructions:

Regular SE ID: 00003
Bill to #: 339922
Owner Code; P
Required Response: 0002
Billing Cycle:
PM Cycle: 12
Contract Amt: 0.00
Contract Class:
Discount Parts: 0.00
Discount Labor: 0.00

Customer Number: 2334300
Name:
Contract Number:
Equipment Location 555-555-1234
Phone:

Equipment Type: AVI CABINET
Serial Number: 123456557
Purchase Date: 06-12-96
Installation Date: 06-17-96
Warranty Effective Date:
Warranty Expiration Date:
Contract Effective Date:
Contract Renewal Date:
Last PM:
Last Service Date:
Contract Terms:
Special Instructions:

Regular SE ID: 00003
Bill to #: 339922
Owner Code; P
Required Response: 0002
Billing Cycle:
PM Cycle: 6
Contract Amt: 0.00
Contract Class:
Discount Parts: 0.00
Discount Labor: 0.00

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11.11.6 Parts Inventory Directory

The **Parts Inventory Directory Report** provides a listing of all parts currently in inventory and provides a snapshot view of usage, quantity, reorder information, vendors, etc. A sample of the Parts Inventory Directory Report is provided in Section 11.11.6.1.

The data presented in the Parts Inventory Directory Report includes:

- Part Number
- Part Description
- Selling Price Effective Date
- Selling Price
- Last Date Used
- Standard Unit Cost
- Usage - period, YTD, TD
- Quantity - on hand, on order
- Reorder - level, quantity
- Vendor Number
- Last Purchase Price
- Last Purchase Date.

11.11.6.1 Parts Inventory Directory Report Sample

10-18-96

13:55

LOCKHEED IMS

Page 1

Parts Inventory Directory

From 000000
To ZZZZZ

Part Number:	1 1/2" EMT FITT	Unit:	EA	Part Descr 1:	1 1/2" EMT CONDUIT
				Part Descr 2:	FITTINGS
Selling Price Effective				Selling Price:	0.00
Date:					
Last Date Used:				Std Unit Cost	

Usage	Quantity	Reorder
Period: 0	On Hand: 29	Level: 1
YTD: 0	On Order: 0	Quantity: 10
TD: 0		

Vendor Number:	Last Pur Price	Last Pur Date
00444	0.00	

Part Number:	1" FLEX CONNECT	Unit:	EA	Part Descr 1:	1" FLEXIBLE CONDUIT
				Part Descr 2:	CONNECTORS
Selling Price Effective				Selling Price:	0.00
Date:					
Last Date Used:				Std Unit Cost	

Usage	Quantity	Reorder
Period: 0	On Hand: 34	Level: 1
YTD: 0	On Order: 0	Quantity: 10
TD: 0		

Vendor Number:	Last Pur Price	Last Pur Date
00232	0.00	

Part Number:	1" MINERALLAC	Unit:	EA	Part Descr 1:	1" MINERALLAC
					CLAMPS
Selling Price Effective				Part Descr 2:	
Date:				Selling Price:	0.00
Last Date Used:				Std Unit Cost	

Usage	Quantity	Reorder
Period: 0	On Hand: 9	Level: 1
YTD: 0	On Order: 0	Quantity: 10
TD: 0		

Vendor Number:	Last Pur Price	Last Pur Date
0344	0.00	

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11.12 List of all Maintenance Personnel

The report in Section 11.12.1 was printed by the MOMS. It is a partial sample report of the complete Service Engineer Directory. The report includes all maintenance personnel directly responsible for the first response maintenance of the SCDOT.

The lists of AT&T and DEC personnel providing subcontract support are not included in this document. These Service Engineers will not be listed in the MOMS. When work is performed by AT&T or DEC, it will either be performed at a depot or the assigned Service Engineer will track the call data to ensure its inclusion in the MOMS databases.

11.12.1 Maintenance Personnel Report Sample

10-18-96

13:55

LOCKHEED IMS

Page 1

Service Engineer Directory

From 000000
To ZZZZZ

SE ID:	00001	SS Number
SE Name:	ALAN T. OTWELL	
Title:	FIELD SERVICE MANAGER	
Address 1:	3838 Maple Drive	
Address 2:		
City:	HILTON HEAD	
State:	SC	Zip:29926
Country:	USA	
Home Phone:	555-555-0000	
Region:	Service Center:	
Base Address:	4848 EAST SECOND ST	
City:	HILTON HEAD	
State/Zip:	SC 29926	
Country:	USA	
Base Phone:	555-555-9999	
Beeper Phone:	555-555-8373	
Hire Date:	Pay Rate:	0.00
Last Review Date:	Skill Level:	
Next Review Date:	Equipment Skill:	
Last Training Date:	Discipline Skill:	

SE ID:	00001	SS Number
SE Name:	DAVID T. GARVER	
Title:	SENIOR FIELD TECHNICIAN	
Address 1:	7661 WALL STREET	
Address 2:		
City:	HILTON HEAD	
State:	SC	Zip:29926
Country:	USA	
Home Phone:	555-555-0474	
Region:	Service Center:	
Base Address:	4848 EAST SECOND ST	
City:	HILTON HEAD	
State/Zip:	SC 29926	
Country:	USA	
Base Phone:	555-555-9999	
Beeper Phone:	555-555-7676	
Hire Date:	Pay Rate:	0.00
Last Review Date:	Skill Level:	
Next Review Date:	Equipment Skill:	
Last Training Date:	Discipline Skill:	

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11.13 List of all Equipment

The report in Section 11.13.1 is the customer-installed database. This report lists all the equipment that is currently loaded into the customer installed database.

The various customer numbers in this report represent different locations. The first four digits are the RFP specified plaza number and the last two digits represent the lane number. A lane number of 00 refers to common equipment that is not attached to a particular lane.

11.13.1 Database Equipment Report Sample

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13:21

LOCKHEED IMS

Page 1

Customer Installed Directory

From 000000
To ZZZZZ

Equipment Type	Serial Number	Equipment Description	Telephone	Warranty/Contr Exp Date
----------------	---------------	-----------------------	-----------	----------------------------

Customer Number: 22340

Name:

12V PWR SUPP	39322293	INC IN LANE CNTRLR	555-555-1234	
AVI CABINET	39399393	366A AL CABINET-AVI	555-555-1234	
AVI READER	57736398	AVI ROADSIDE READER	555-555-1234	
CARDKEY STI	9939-3823	SMRT TERM I/F CRDKEY	555-555-1234	
CCTV CAMERA	3882662	CLOSED CIR TV CAMERA	555-555-1234	
CCTV HOUSING	333710940	CLOSD CIR TV HOUSING	555-555-1234	
MOUNTING H/W	38883224		555-555-1234	
RAMP ID REDR	383883421	ID CARD READER	555-555-1234	
TVS CAMERA	33812776	AUTOSCOPE CCTV CAMERA	555-555-1233	

Customer Number: 22341

Name:

AVC SER CABL	88181777	SERIAL CABLE-AVC	555-555-1232	
AVI ANTENNA	4388723	READER ANTENNAS-AVE	555-555-1232	
HOSTESS BOX	39999332	RS 232/422 I/F	555-555-1232	
IS TRAF SIG	338821215	ISLAND TRAFFIC SIGNAL	555-555-1232	
LANE CONTRLR	00098774	LANE CONTROLLER -ALR	555-555-1232	
LGHT CURT CO	399883BA	LIGHT CURTAIN CNTRLR	555-555-1213	
LH LGHT CURT	882882AR	LH LIGHT CURTAIN-AVC	555-555-1232	
LOOP DETECT	K48828745	LOOPS/LOOP DETECTORS	555-555-1232	
LOOP WIRE	39939123	LOOP WIRE & SEALANT	555-555-1232	
PTD STANCHIN	RS399484	STANCHION PTD	555-555-1232	
TREADLE	9121367	4-CONTACT TREADLE	555-555-1232	
UPS	U388282	LANE UPS	555-555-1232	
VES CAMERA	CC389828	CCTV CAMERA-VES	555-555-1232	
VES FRAM GBR	G8872232	FRAME GRABBER CARD	555-555-1232	

Customer Number: 22344

Name:

AVI ANTENNA	37712661	READER ANTENNAS -AVI	555-555-1232	
TREADLE FRM	BG555884	TREADLE FRAME	555-555-1232	
TREADLE MONI	FR338840	TREADLE MONITOR & I/F		

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11.14 List of all Spares

The report in Section 11.14.1 is a partial printout of the Spares Inventory Directory. This inventory covers all equipment, parts, and modules located in the stockroom at the Lockheed Martin IMS Project Office.

In addition to all equipment on this list, the equipment in the test lane can be utilized to bring the system back on-line during an emergency.

The test lane equipment is not considered to be equipment because the test lane is in use during business hours. It only serves as an emergency backup source of spares.

11.14.1 Spares Inventory Directory Report Sample

10-18-96

13:55

LOCKHEED IMS

Page 1

Parts Inventory Directory

From 000000

To ZZZZZ

Part Number:	1 1/2" EMT FITT	Unit:	EA	Part Descr 1:	1 1/2" EMT CONDUIT
				Part Descr 2:	FITTINGS
Selling Price Effective Date:				Selling Price:	0.00
Last Date Used:				Std Unit Cost	
Usage		Quantity		Reorder	
Period: 0		On Hand: 29		Level: 1	
YTD: 0		On Order: 0		Quantity: 10	
TD: 0					

Vendor Number:	Last Pur Price	Last Pur Date
00444	0.00	

Part Number:	1" FLEX CONNECT	Unit:	EA	Part Descr 1:	1" FLEXIBLE CONDUIT
				Part Descr 2:	CONNECTORS
Selling Price Effective Date:				Selling Price:	0.00
Last Date Used:				Std Unit Cost	
Usage		Quantity		Reorder	
Period: 0		On Hand: 34		Level: 1	
YTD: 0		On Order: 0		Quantity: 10	
TD: 0					

Vendor Number:	Last Pur Price	Last Pur Date
00232	0.00	

Part Number:	1" MINERALLAC	Unit:	EA	Part Descr 1:	1" MINERALLAC CLAMPS
				Part Descr 2:	
Selling Price Effective Date:				Selling Price:	0.00
Last Date Used:				Std Unit Cost	
Usage		Quantity		Reorder	
Period: 0		On Hand: 9		Level: 1	
YTD: 0		On Order: 0		Quantity: 10	
TD: 0					

Vendor Number:	Last Pur Price	Last Pur Date
0344	0.00	

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12. MAINTENANCE ON-LINE
MANAGEMENT SYSTEM

12. Maintenance On-Line Management System

12.1 Introduction

The Maintenance On-Line Management System (MOMS) Concert software package was developed by Micro Design, Inc. LMIMS chose to use this package because of its standard option of interaction to digital pagers. LMIMS and Micro Design created the necessary interfaces needed to coexist with the plaza design, using existing codes as a foundation.

Figure 12-1 depicts a high level hardware architecture view of the components needed to construct MOMS. The heart of the MOMS system is the MOMS PC that operates the MOMS application software. The MOMS software creates and maintains multiple databases. The major databases are also indicated in Figure 12-1. The lane devices send error messages to the lane controller for processing. The diagnostic process determines the validity of an error and reports to the plaza computer for prioritizing and processing to MOMS. MOMS updates the appropriate database and starts the paging process, if necessary. Remote access is accomplished via the standard security call back modem.

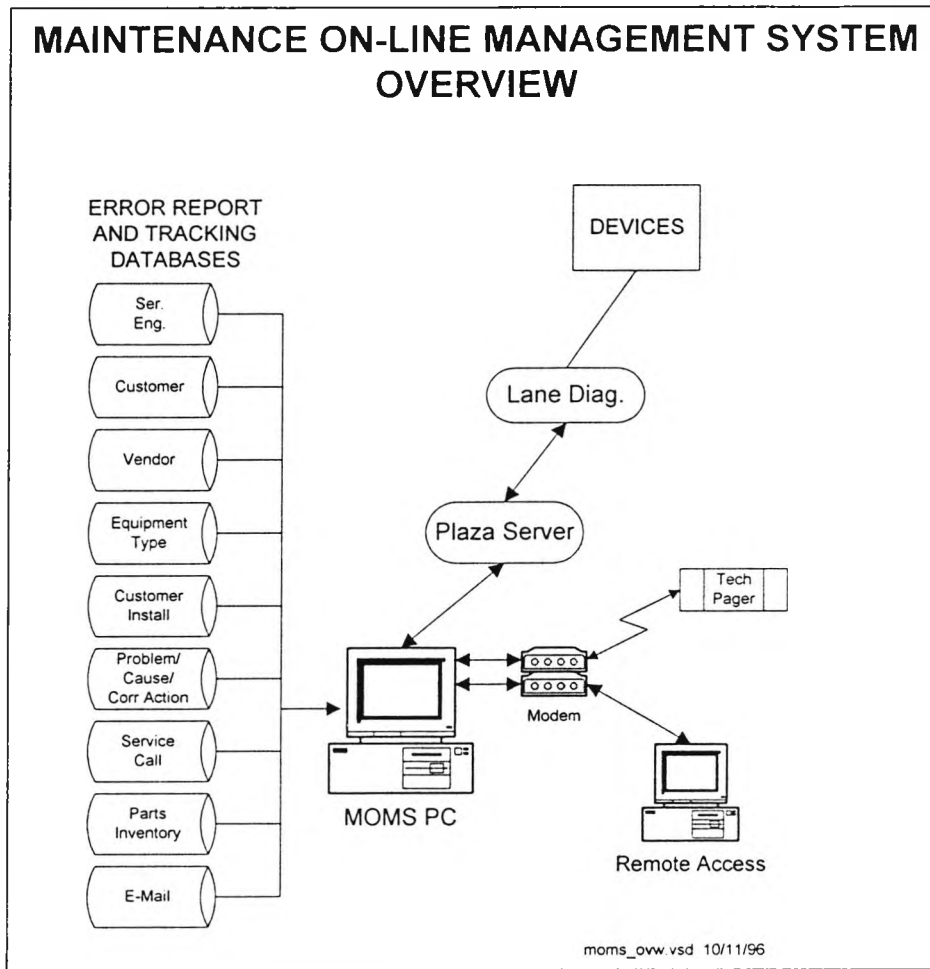


Figure 12-1 Maintenance On-Line Management System Overview

Maintenance On-Line Management System Overview (Figure 12-1) depicts a high level hardware architecture view of the components needed to construct MOMS.

12.2 Lane Data Flow

Figure 12-2 depicts the lane data flow process and each device is monitored by its device handler. Some lane devices, i.e., treadle monitor, report errors automatically without interrogation from the lane device handler. Other devices need interrogation by the device handler to determine the status of the device.

When an error is detected, the lane device handler passes the error to the Diagnostic Process for formatting and verification. The Diagnostic Process then writes an error transaction to the lane tranlog via the HostTxMgr Process. The HostTxMgr logging process is responsible for writing the error transactions to the host-based tranlog and to DECMessageQ for prioritizing and processing by MOMS.

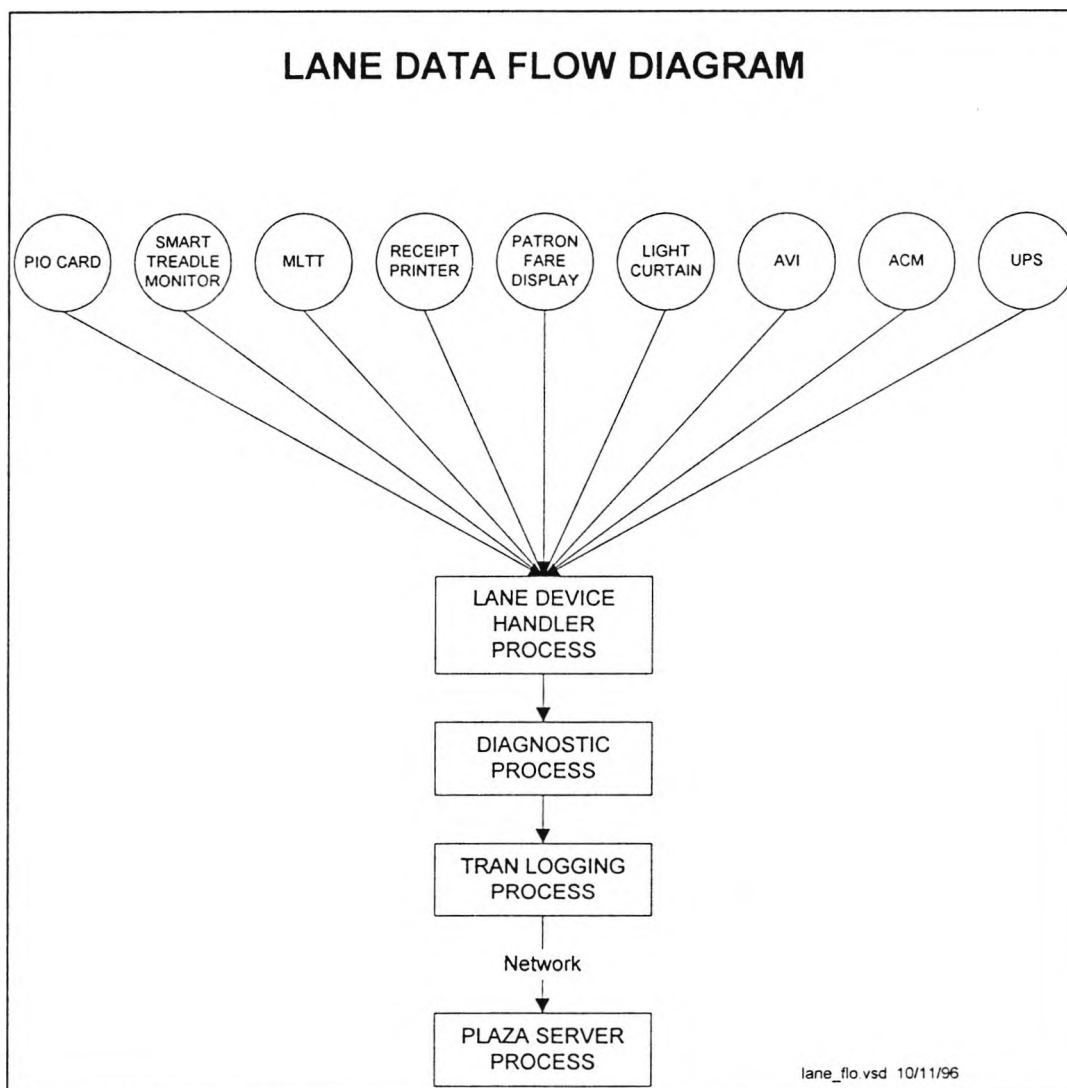


Figure 12-2 Lane Data Flow Diagram

12.2.1 MOMS Data Flow

The MOMS process #34 is continuously monitoring the MOMS.IN file for new error messages written by the server-based C program, MOMS_SERVER. When MOMS receives an error message, MOMS writes an ACK to the MOMS.OUT file in response. MOMS then verifies the customer code in the Customer Installed Database. If the customer code is not found, MOMS ignores the message from EQPEXPT. If the error message contains a valid customer code, MOMS checks the priority of the message. A priority message assigned a priority one (1) will begin the paging process and update the Service Call database. The paging process checks the Service Engineer (SE) database to determine the assigned active technician. After the Service Call Database is updated, the Dispatch Grid is updated to include the new service call.

The Field Service Technician completes the service call by using the MOMS option #22, Update Service Call. The update service call process allows the technician to enter the part used along with the time spent in the service call. When the technician closes the service call on option 22, the parts inventory database and the MTBF and MTTR database are updated automatically.

The dedicated MOMS PC runs process #34 at all times except during database recovery. Database recovery is a utility provided by Micro Design that keeps the databases in good condition. This utility should be run approximately once per week.

To perform other functions in MOMS while process #34 is running, additional personal computers are linked to the server. All data entry and updating functions are performed on the additional PCs. See Figure 12-3 for the MOMS data flow diagram.

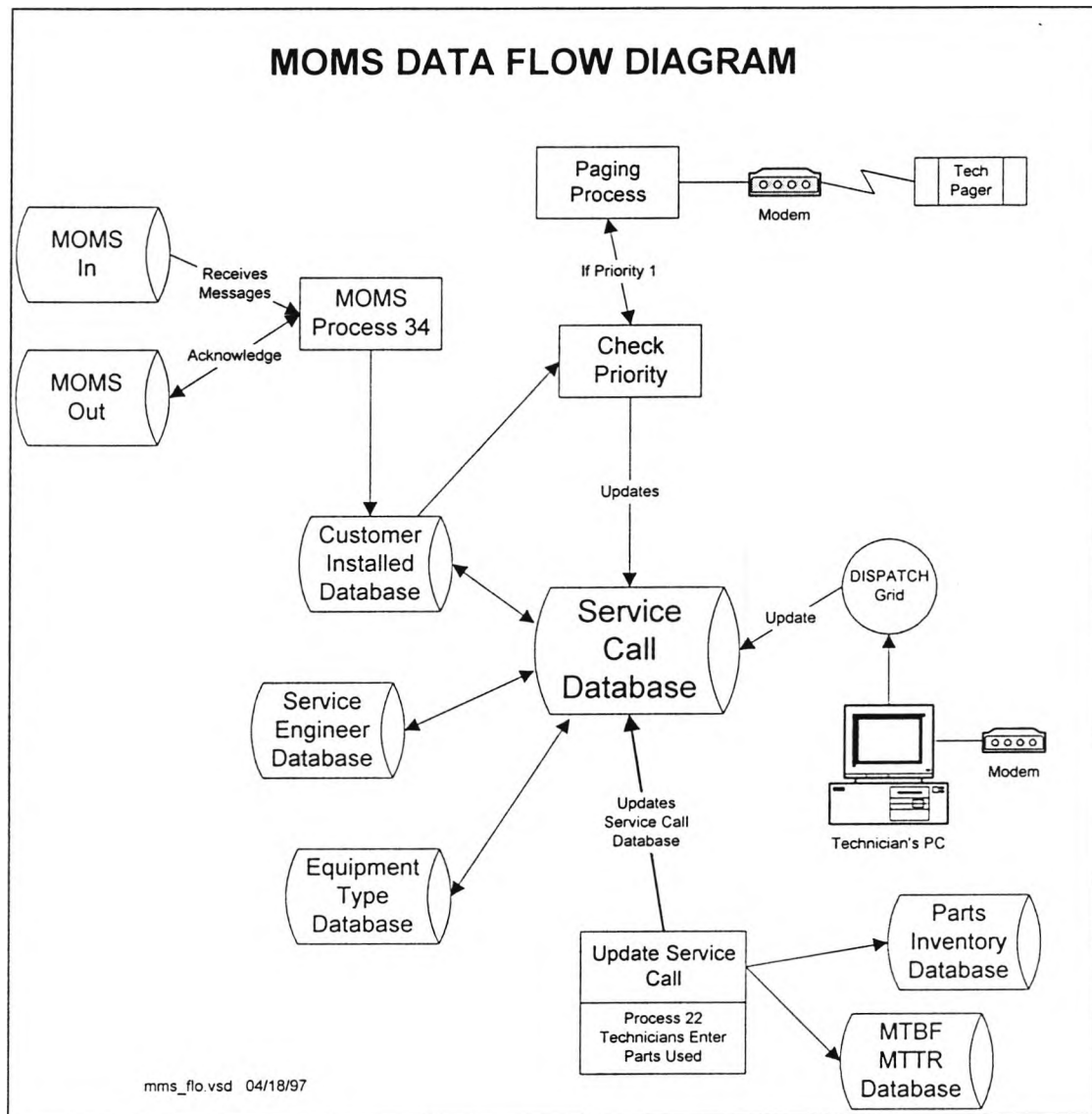


Figure 12-3 MOMS Data Flow Diagram

12.2.2 Method for Data Entry -- Automatic

The MOMS PC is configured to run under Windows NT. This allows process #34 to run continuously without stopping for daily data entry. In addition to the maintenance PC, the MOMS software is fully network compatible. This allows any terminal or PC on the SCDOT ETC network with the proper authorization to access and run any MOMS processes except #34. LMIMS has set up the Facilities Maintenance Manager and the Maintenance Technician with the ability to enter service call or check inventory from their respective work environment.



When process #34 is evoked, MOMS monitors the MOMS.IN file for any error message being sent from the plaza. When MOMS detects an error message in the MOMS.IN file, it will write an ACK to the MOMS.OUT file to confirm receipt of the error. MOMS then creates a service call with a unique service call number of future reference. If the error is a priority one (1) error, MOMS pages the active service engineer. Lower priority service calls are dispatched by the Field Service Technician. When the technician is paged, the pager displays the plaza and lane number. The technician then dials into the SCDOT secured modem and starts a virtual DOS session to start the Concert application. The Field Service Technician can run process #26 and view the dispatch grid for the priority one (1) service call that generated the page. All information about the service call is available.

All error messages received by MOMS are placed on the dispatch grid automatically. A call number is generated and the call is added to the service call database. The malfunction data automatically entered by MOMS into the service call includes the call number and customer number. The customer number is a six-digit number that includes the plaza number and the lane number. For example, a call at SCDOT on lane one will have a customer number of 223501. Other information automatically brought into the service call includes:

- Telephone number
- Address
- Equipment type
- Date and time and call was opened
- Problem code and description
- Service engineer assigned
- ETA
- Call priority
- Status
- Type

This data is automatically entered into the service call database.

12.2.3 Method for Data Entry -- Manual (Option #21)

This option is used to enter a new service call. The first screen of option #21 contains the following information:

- Ship-to company name and address
- Equipment type
- Serial number
- Warranty and contact information
- Date and time call was opened
- Date and time call was dispatched
- Date and time call was closed
- Date and time SE arrived
- Date and time call was completed

It also displays information about the customer such as required response, credit status, marketing segment and when Preventative Maintenance (PM) is due. The bill-to name and address, and contact name and phone number are also displayed on screen one. Screen 2 is used to enter the problem/resolution text, with an additional six pages of eighty-eight lines, seventy-seven characters per line of text available. The problem/cause/action codes are entered on Page 2. The regularly assigned service engineer is displayed and their workload and availability can be reviewed while entering the call. Estimated Time of Arrival (ETA) can also be entered on Page 2. The mean time to repair (MTTR) for the equipment is displayed to assist in establishing the amount of time it will take to perform this service request. The call type and status can be entered to properly code the call. A spare part sale can be generated using option #21.

Option #22 allows manual updating and closing of existing service calls. Once any changes on Pages 1 and 2 have been made, pressing F9 will open Page 3 for call closing. Page 32 is used to enter any non-inventory charges that are applicable to this call. Page 4 is used to enter any inventory activity associated with this call. Option #22 can also be used to generate up to nine sub-calls as part of an original service call. A service call stays on the dispatch grid until its status has been manually changed to closed.

12.2.3.1 Service Engineer Database

This file contains information about the Service Engineer. Some of this information is directly related to the service calls, but this file also contains accounting, administrative, and personnel information.

12.2.3.2 Customer Database

This master file provides the system with the customer name, customer number, address, phone, tax status, contact name, credit line amount, customer balance, total locations, and total units. When entering a service call, the system must be supplied with the name, customer number, or phone number. The screen will then display the appropriate historical information for that customer. This saves the user from having to re-enter the same information each time the company calls. It works similarly to a file cabinet where customer information is stored in logical order. Instead of looking up the information in the file cabinet, the user merely retrieves the same information electronically.

12.2.3.3 Vendor Database

This database keeps track of the vendors from whom the company purchases products. It retains the following information:

- Vendor number
- Vendor name
- Address
- Phone
- Contact person's name
- Account opening date
- Payment terms
- Last year's dollar volume
- Year-to-date volume

This database is used for ordering parts and updating inventory information.

12.2.3.4 Equipment Database

This database tracks all types of equipment serviced by your company. It records equipment type and description, the vendor who supplies the product, purchase and list price, and total installations. It also tracks the Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), installation time, preventive maintenance time, move time, upgrade time, and remove time. The labor and other rates for invoicing are also in this file.

12.2.3.5 Installed Base Database

This database maintains the records of all equipment owned by each company, covered by warranty, or under contract. It tracks the serial number, system number, equipment type and location, contract and billing terms, warranty information, and any discounts afforded to the customer. It also

maintains the order number, project number revision data and level. There are an additional six pages (eighteen lines by seventy-seven characters/page) of freeform text available to record details of the contract.

12.2.3.6 Problem/Cause/Action (P/C/A) Database

This database keeps records of possible problems with each equipment type serviced by your company. In addition to tracking up to ninety-nine possible problems with each piece of equipment, four causes and four actions can be assigned to each problem. This file is especially helpful in promoting phone fixes that can save the company time and money. When a customer calls with a simple problem, you can check the P/C/A database, identify the problem, and possible actions to be taken to rectify the problem. If the problem cannot be solved over the phone, a service engineer can be dispatched to the site.

12.2.3.7 Skills Name Database

This file contains all the user defined skill names pertinent to the user's service operations.

12.2.3.8 Service Engineer Skills Database

This file lists the particular skills of each service engineer.

12.2.3.9 Parts Database

This database tracks all parts in the inventory. It maintains the following:

- Part number
- Part description
- Last purchase price and date
- Selling/exchange price
- Vendor for the part
- Quantity on hand
- Reorder-level quantity
- Last date used
- Manufacturer code
- System the part is used for
- User-defined type code

This information is used in tracking the inventory, suggesting future order information, identifying slow-moving parts, and in determining invoicing guidelines.

12.2.3.10 Serialized Parts Database

The file keeps a record of serialized parts within the system, including the following:

- Part number
- Part description
- Serial number
- Model number
- Location
- Revision level
- Revision data
- Status
- Warranty effective date
- Warranty expiration date
- Locator fields

12.2.3.11 Equipment Malfunction and Repair Data

The following tables and their fields represent the data stored in MOMS for tracking, logging, and managing equipment malfunction and repairs. The Enter a Service Call Database contains the information required to schedule a service call. The data fields are as follows:

- Part Number
- St - Status (S = Swapped)
- Loc - Location (From)
- Serial Number
- Loc - Location (To)
- Serial Number
- Qty - Quantity
- Extended Price

12.3 Assigning Error Priorities

12.3.1 Maintenance Monitoring and Alarms

The following section details the Maintenance Monitoring and Alarms function provided by the MOMS system. The MOMS PC is connected to the network backbone, which means the MOMS data is available to any personnel authorized on the network. The MOMS PC continuously monitors the MOMS.INI file for errors being sent from the Host function.

The errors from MOMS are prioritized. A brief summary of these priorities follows:

- | | |
|-----------------------|---|
| Priority One | These include a toll lane or plaza in an inoperative state or the loss of a single or primary toll audit data. An example of this data would be the loss of a plaza computer. Such reports require immediate response. |
| Priority Two | These include a subsystem or part that is failing or has failed, but does not influence operations of the lane or plaza. An example of this would be the loss of one treadle strip contact. Corrective action is required the next working day. |
| Priority Three | These include a subsystem or part that is beginning to fail but would not cause the loss of toll audit data. An example of this would be a communication error correctable by software. Corrective action is scheduled for a future date. |

The initial error priority is set to one (1) by the Host function resident in the plaza computer. The priority is programmable by the MOMS administrator through the System Administration function accessible through the plaza software.

12.3.2 Polling Import For Unlogged Equipment Messages

12.3.2.1 Maintenance Monitoring Functions

The MOMS is constructed with devices capable of reporting errors, i.e., lane controller, plaza, etc.. MOMS is a system made up of smart lane devices, interrogating lane software, and plaza filtering controls. The SCDOT ETC system is constructed from various vendors and manufacturers providing the on-line diagnostics needed.

Each device has its own function in the schema of MOMS.

Lane Device	Reports errors to the lane controller for reporting to MOMS.
Lane Controller	Interprets and reports each viable error code to the MOMS file.
Plaza	Provides a storage area for error handling, prioritizes and distributes each error to MOMS.
MOMS PC	Interprets and tracks each error, prints work orders, calculates MTBF and MTTR, tracks trouble spots, etc.

MOMS is an integrated solution to monitor the SCDOT ETC system.

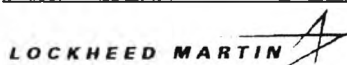
12.3.2.2 Lane Monitoring Functions

12.3.2.2.1 Lane Controller

The SCDOT ETC lane controllers are configured to be monitored by the plaza computer. The plaza computer continuously monitors the lane controllers for the absence of a network connection from the plaza. The loss of network connection is indicative of a lane controller failure. If the lane software fails or the lane computer has a hardware failure, the network connection is lost, in which case the plaza reports to the MOMS a priority one (1) message. The MOMS system then pages the technician listed as on-call within the MOMS.

12.3.2.2.2 MOMS Alarms/Lane Controller

When the plaza utility for monitoring lanes has determined that a lane has become disconnected, it sends a priority one (1) message to MOMS. MOMS then creates a service call for the error and begins paging the assigned active technician. The Dispatched grid under option #26 of the Concert package is updated to display the service call created.



12.3.2.2.3 Treadle Monitoring

The treadle monitor can disable strips that the monitor has determined to have malfunctioned. The disabled strip-messages, i.e., D1, D2, D3, and D 4 messages are sent to the plaza for processing to MOMS. LMIMS has prioritized these messages as priority two (2) according to the RFP definition.

If non-treadle information is received during a normal vehicle sequence (receipt of entry loop and light curtain data), the lane controller generates a priority one (1) error representing a treadle monitor failure. The plaza then reports this error to MOMS.

12.3.2.2.4 MOMS Alarms/Treadle

The lane sends a treadle strip disable message to be prioritized by the plaza as a priority two (2) error. MOMS, upon receipt of this error, creates a service call and updates the Dispatch Grip. MOMS does not page for this error.

The lane sends a treadle failure error to the plaza for priorities as a priority one (1) error. Upon receipt of this error, MOMS creates a service call and updates the Dispatch Grid. MOMS then starts the paging process and page the assigned active technician.

12.3.2.2.5 Receipt Printer Monitoring

The lane controller monitors the receipt printer for a paper jam error and reports to MOMS for priorities. This is a priority two (2) error, which allows the technician to check for possible alignment problems in the paper feed transport. The paper jam can, in most cases, be solved by the Toll Collector.

The lane controller monitors the communication connection state using the status message to determine if the communications with the receipt printer has been disconnected. The lane controller sends an error message to the plaza for assignment as a priority one (1) error message.

12.3.2.2.6 MOMS Alarm/Receipt Printer

When a paper jam error is received, MOMS creates a service call and updates the Dispatch Grid.

When a communication error is received, MOMS creates a service call, updates the Dispatch Grid, and pages the assigned active technician.

12.3.2.2.7 Patron Fare Display (PFD) Monitoring

The lane controller is configured to poll the PFD periodically for its status to determine if communication is still established with the lane controller. When the lane controller determines that the PFD is no longer connected, a priority one (1) error message is reported to MOMS via the plaza.

12.3.2.2.8 MOMS Alarms/PFD

MOMS creates a service call and updates the Dispatch Grid upon receiving the error message from the plaza. The plaza encodes the error as a priority one (1), the paging procedure begins, and the assigned technician is paged.

12.3.2.2.9 MOMS Alarms

The plaza encodes the error with the priority level listed in column three. Upon receipt of any priority one (1) message, MOMS creates a service call and updates the Dispatch Grid. MOMS starts the paging procedure and pages the assigned active technician. MOMS adds a service call and updates the Dispatch Grid on all priority two (2) errors.

12.3.2.2.10 UPS Monitoring

The lane controller monitors the Line Fail message from the UPS and reports any priority one (1) messages to the plaza. A line fail error is a priority one (1) error message.

The lane controller monitors and reports to the plaza when the lane controller receives a message from the UPS indicating a low-battery condition. A low UPS battery condition is prioritized by the plaza as a priority one (1) error message.

The lane controller monitor has a load percentage every three minutes. Because of the need to poll the UPS, LMIMS has selected a threshold setting that, if exceeded, notifies MOMS before any damage can occur to the UPS or its supporting devices. A priority one (1) message is generated and reported to MOMS when the load percentage reaches 80% or greater. The lane controller reports to the plaza a UPS_THRESHOLD error and the plaza assigns a priority level of one (1) to provide a prompt response by a maintenance technician. LMIMS's philosophy for this type of error is to correct it immediately before a future emergency call is required.

The lane controller monitors the UPS for a message indicating an abnormal condition every three (3) minutes. An abnormal condition suggests a processor or other monitoring electronic failure. The lane controller reports the message to the plaza to be assigned a priority level. LMIMS has set the priority level of this error to one (1). Until more historical data is gathered on this error, LMIMS will continue to maintain this priority level. The abnormal UPS status will be assigned with a priority one (1).

12.3.2.2.11 MOMS Alarms/UPS

All priority one (1) messages create a service call and update the Dispatch Grid. MOMS then pages the assigned active technician. All priority two (2) messages create a service call and update the Dispatch Grid.



The error reporting and monitoring listed in these sections are the initial implementation of the MOMS. LMIMS updates, modifies, and adds error messages.

12.3.2.2.12 Entry Loop Monitoring

The Entry loop is continuously monitored by the lane controller for possible failure. The Entry loop is prioritized as a priority two (2) error. Loss of the entry loop does not jeopardize the toll audit data. The entry loop is monitored for an open loop and/or shorted loop condition.

The entry loop diagnostic routine determines a loop failure when four vehicles enter the lane and normal vehicle information is received, i.e., treadles without the loop reporting this information. The Lane then generates an Entry Loop Failure and sends it to the plaza for processing.

12.3.2.2.13 MOMS Alarms/Entry Loop

The plaza prioritizes the Entry Loop Failure message as a priority two (2). The failure of the entry loop does not affect the operation of the lane.

12.3.2.2.14 Exit Loop

The lane monitors the exit loop for open and shorted conditions by determining that the paid or unpaid queue is not decrementing while cars are continuing to enter the lane. This process takes nine vehicles entering the lane to determine if the lane's exit loop has failed. During this time, the traffic light remains green until the lane determines exit loop failure. On the tenth vehicle, the Lane reports an Exit Loop Failure to the plaza. The Lane then synchronizes the queue via the auto flush process and turns the traffic light to red. The tenth vehicle will have the correct fare displayed and the traffic light will be red. This vehicle deposits its fare and the traffic light turns green. After two (2) seconds, the Lane turns the traffic light to red. The patron will not be aware of a problem in the lane after this point.

The exit loop is used to trigger the VES camera to capture a violating patron. In the case of an exit loop failure, the VES will not be functional.

12.3.2.2.15 MOMS Alarms/Exit Loop

The Lane generates an Exit Loop Failure message and reports it to the plaza. The Plaza Supervisor prioritizes this error as a priority one (1). MOMS then generates a service call and starts the paging process and assigns a technician.

12.3.3 Maintenance Terminal

The initial implementation of the SCDOT ETC system has configured the lane controller with a maintenance port via the Hostess 186 Control interface box. This allows the technician to monitor the current state of the lane controller via UNIX commands. The technician can check the status of the processes, determine hard drive capacity, determine percentage allocated, etc.

There is no capability of running diagnostics on the lane controller when the system is operating. The technician can test all devices when the lane is closed and the Lane application software is stopped. LMIMS has carefully chosen its hardware devices so that most on-line diagnostics are available through MOMS.

12.4 MTBF, MTTR, and Failure Tracking

12.4.1 Introduction

This section describes the methods MOMS uses to track calls (failures). It also discusses the cost control methods associated with each work order. Critical measures of reliability and maintainability, such as MTBF and MTTR, are also discussed. Maintenance efficiency measurements are described, along with the methods for trouble spot analysis. The method for providing individual equipment histories is included.

12.4.2 Failure Tracking

Failure tracking in MOMS is accomplished with the use of service calls. Each individual failure causes the generation of a service call through automatic or manual means.

Automatic generation of a service call occurs when MOMS receives an error message from the server-based reporting program. The message received is a thirty-six character ASCII file. This file has the following format:

- Record number -- four numeric characters
- Data -- six numeric characters
- Time -- six numeric characters
- Plaza and Lane Location -- six numeric characters
- Equipment Code -- four alpha numeric characters
- Problem Code -- four numeric character
- Priority Code -- two numeric character
- Dispatch To -- four alpha numeric characters

MOMS automatically generates a service call upon receipt of this message. The information transmitted by the ASCII file is used to generate the service call. The information is utilized in the following manner:

Item	Description
Call Number	a seven digit number generated by Concert. The call numbers are generated sequentially in ascending order. The last digit will always be a one to allow for the generation of sub calls.
New Account	automatically set to the value N indicating that the call is not a new account.
Customer ID	a six (6) digit location field found in the file received from the host-based program. The first four (4) digits are the plaza number. The last two (2)

Item	Description
	digits correspond to the lane number. If the equipment is dedicated to the plaza and not to a specific lane, the last two (2) digits will be 00.
Equipment Type	equipment field in the ASCII file.
Open Date	date field in the ASCII file.
Open Time	time field in the ASCII file.
Dispatch Date	system date when the technician is paged; occurs only on priority one (1) calls.
Problem Field Line #1	problem code field in the ASCII file.
SE ID	ID number of the technician assigned to the call. In the case of a priority one (1) call, the active service engineer is assigned. For a lower priority call, the technician with PM responsibility for the specific plaza is assigned.
ETA Data	call open date.
ETA Time	call open time.
Priority Code	last digit of the priority code received in the ASCII file.
Call Type	set to a value of S indicating a service call.
Call Status	set to a value of AS indicating that the service call has been assigned.

Service calls can also be entered manually by selecting the main menu item number 21 and filling in the appropriate information.

The first page of the service call entry screen includes fields for entry of the following data:

The Call Number	a seven digit number assigned to a specific service call; increases with each new service call. The last digit is always ONE.
New Account	indicates whether the call is for a new customer. In the case of the SCDOT ETC, this field will always be NO.
Customer Number	six (6) digit customer number. The first four digits are the plaza number. The last two (2) digits are the lane number.
Operator ID	logon ID of the operator entering the service call.

The phone number and address information is automatically filled in from the customer database after the customer number has been entered.

The equipment can be manually entered or selected from the equipment database. Serial numbers and descriptions can be entered in the same manner.



There are fields that indicate the revision number and warranty status of the equipment if it is selected from the installed equipment database.

There are several fields such as contract, credit, and billing in the service call entry screens that are not used. They are fields that would be used for time and material billing generation.

There are five time and data fields to track call response and handling. The first is the call opened time and date. For manual entry, this is the time and date that notification of a problem was received. The second set of time and date fields is the dispatched time and date fields. For manual entry, this is the time and date that the problem was given to a technician for repair.

The third set is for call closing. After the repairs are complete, the time and date closed are the time and date that the service call is closed in the database. The other two time and date sets record the technician response. The fourth set (arrived) is the time and date that the technician arrived on site. The fifth set (completed) is the time and date that the technician completed the repair efforts.

The second page of the service call entry contains fields for data entry of the problem and the resolution of the problem. There are also fields for entering the technician assigned, priority, call type, and status.

After a call has been closed, the service call database is again updated. However, the call no longer appears on the dispatch grid. All calls are retained in the service call database. If the service call is for equipment that is in the equipment database, the results of the call will be added to the data used to derive MTBF and MTTR.

Call history may be reviewed at a later date by printing call history reports. The call history reports can be printed or viewed by customer number (lane) or by equipment type.

As long as a service call is open, it appears on the dispatch grid and is present in the call database. After a service call is closed, it no longer appears in the dispatch grid but remains in the service call database. All failures are tracked in the service call database in this manner.

Most failures will automatically enter the service call database. Any failures that occur that do not send messages automatically to MOMS will be manually entered. The MOMS will have records of all failures experienced by the SCDOT ETC system.

12.4.3 Work Order Tracking

Work order tracking will be accomplished utilizing the service call entry and updating screens.

After the service call is entered, either automatically or manually, a work order can be printed for the call. The work order will print out all information on the first two screens of the service call entry option. The work order is tracked in the system as a service call using a unique numeric call number.

The service call/work order can be updated after completion to include cost items in order to arrive at a cost for a repair.

Page three of the service call update screen allows for calculation of labor and travel costs incurred during a service call.

MOMS can facilitate cost controls in the parts inventory database screens. The parts inventory database entry screen has five sets of fields at the bottom to allow for inputting of different vendors for a spare part. There are fields for vendor number from the vendor database, last purchase price and last purchase date. These fields can be used to review and compare the cost of a part from various vendors.

12.4.4 MTBF and MTTR Tracking

MTBF and MTTR are both tracked automatically by the Concert software used for MOMS.

MTBF tracking is based on the equipment. The calculations are performed automatically whenever the MTBF report is run. The Concert program only allows this to be done once a month because of the calculation algorithms used. The MTBF takes into account the number of installed pieces of equipment and the number of service calls closed on the same equipment. MTTR tracking is also performed automatically. It is recalculated every time a service call is closed on a particular equipment type for that equipment type. The MTTR is calculated by averaging the time between arrival on-site and completion of the repair.

12.4.5 Maintenance Efficiency

MOMS allows several views of maintenance efficiency. Two of the industry standards are MTBF and MTTR. MTBF and MTTR are reported in the monthly status reports.

Generally, maintenance can be considered to be efficient when the MTBF meets or exceeds the projected values. Another general barometer of maintenance efficiency is whether the MTTR is near the projected value. While these are general guidelines, they are not absolute.

Two other measures of maintenance efficiency reported are average response time and preventive maintenance completion percentage. These two factors can be analyzed by both workforce and by technicians.

One of the most important measurements of maintenance efficiency is callback rate. This is reported every month. If the problem is repaired the first time, then less time, energy, and materials are used. This also maximizes the system uptime.

12.4.6 Trouble Spot Analysis

Trouble spot analysis is performed in several ways. The first of these is through MTBF tracking. Every month an MTBF report is run. Any equipment type with an abnormal MTBF will be analyzed

to determine if there is a potential trouble spot. Another way that trouble spot analysis will be performed is by reporting on call activity by customer location. This is a report available from the MOMS. If a particular location is experiencing an abnormally high call volume, this could indicate a site problem. Examples of site problems are a noisy electrical distribution system or a mechanical system that is weak or loose and causing excessive vibration. Trouble spot analysis will also be performed by observing call activity and call escalation. Call activity could be abnormally high at a location that is exposed to high winds. If this type of occurrence is noted, increased preventive efforts will be devoted to that particular trouble spot.

In summary, many different reports are run by the MOMS on a monthly basis. These reports include:

- Call history by customer location
- Call history by equipment
- Call escalation
- PM date escalation
- MTBF
- MTTR
- Call response time, and
- Call activity

One purpose of these reports is to analyze and note anything unusual. Unusual items can be trouble spots or caused by trouble spots. The monthly reports also include an analysis of trouble spots. Ongoing failure analysis of trouble spots is performed to isolate and eliminate them in a continuous process.

12.4.7 Individual Equipment History

MOMS has two reports that provide call history by equipment and customer location. By running these two reports every month, the individual equipment history can be observed. Each report provides customer number information which describes locations and equipment type information, which describes a specific piece of equipment. These two reports are run monthly for the most recent month. They can also be run in a cumulative fashion to show all failures. In setting up the report, the operator enters the starting and ending call closing dates.

12.4.8 Database Maintenance

The Concert software package uses several databases to accomplish its maintenance and support functions. Those databases, their purpose, and the contents are described in the Database Design section of this document. All database maintenance activities are performed by the Field Service Technician using utilities provided as part of the Concert software package. The available maintenance functions are described below.



12.4.8.1 Database Creation

Creating the Concert databases is the most important step in preparing for operation. Although it is possible to begin processing service calls without doing this step first, it is not advised. If calls are entered before creating Concert databases, not all the information necessary for reporting purposes is captured. Moreover, it is important that all fields be entered to preserve the integrity of the data. Once a database is created, the system performs most subsequent operations automatically as the databases are updated.

Databases creation must be done in the displayed order on Master Menu One. This is necessary because each database relies on the information entered into the previous databases.

The three character region code, assigned while creating the user file using option #81 on Master Menu two, is automatically added to the database names. This code should not be changed without consulting the Concert supplier for instructions. Actual data input is accomplished using a series of screens specific for each database.

12.4.8.2 Data Recovery

A database can be completely lost (i.e., corrupted) if a system or power failure occurs. If a database is lost for any reason, Concert displays a message indicating that a database was corrupted. If this happens, the System Utilities menu option #84 on Master Menu Two can be used to recover the lost or damaged database. From the menu choices on the System Utilities Menu, select the database recovery option matching the name of the affected database (e.g., Service Call Recovery). All other users must be out of Concert when this option is invoked.

12.4.8.3 Purge Function

The purge function allows better database maintenance by providing a method of selectively deleting information. A strict audit trail is still maintained, which does not permit purging of active data, such as open calls, invoices, cash receipts, and so on. Both database records and SE messages may be deleted.

When deleting any record or group of records, information must be deleted in the appropriate order. Records must be deleted in the order exactly opposite the order in which they were entered. The order in which records may be deleted is as follows:

1. Fixed Job
2. Parts
3. P/C/A
4. Customer Installed Base
5. Equipment
6. Vendor



7. Customer
8. Service Engineer
9. Tax

If a customer record is deleted before all of its customer installed base records, the Customer Installed Base database will become inconsistent and unstable, and therefore unusable.

12.4.8.4 Deleting a Single Database Record

To delete a database record, the database from which the record must be deleted is selected by entering its option number. Once the appropriate database screen appears, retrieve the record to be deleted by entering the selection criteria. After the record has been retrieved, pressing F9 will delete the record. The delete function works only for the database listed as options #1 through #7, #10 - #13, and #27 in the Concert Master Menu.

To delete a record in the Customer Installed Database, position the cursor in the field labeled Owner Code and press F9.

12.4.8.5 Database Purge

This function is selected from the System Utilities Menu. It allows the purge of any database in its entirety (option #20). The system displays a warning message before completing the database purge. Press RETURN after the warning displays to complete the purge process.

When the database purge function is selected, all Concert databases, with the number of records in each, display. A database is purged by entering the number assigned to that database and pressing RETURN. All database tables can be purged by selecting 99 and answering Y at the Concert prompt.

12.4.8.6 Service Call Record Purge

This function enables the archiving of calls containing invoice and call history information. It also allows the user to enter a range of call status codes, call closed dates, or call numbers to be archived. The process takes approximately one minute per one hundred service calls purged.

Before invoking this function from Concert, the following step should be performed:

1. At the CONCERT prompt, type: DIR 991501*.* and press ENTER.
2. It is important to note the amount of disk space these files take up and how much disk space is left. For this function to work properly, the available space must be two to two-and-a-half times the size of these files. It is also advisable to back up all the Concert files before beginning the purge. All other users must be out of the CONCERT directory when this option is invoked.

3. Service call record purge is selected from the System Utilities Menu (option #21). Select the range type by pressing F1, F3 or the F5 key as indicated at the bottom of the menu screen and entering the range desired. The system then processes the call records to be purged. When finished, the system displays the number of calls archived and the number of calls remaining on-line.
4. The system writes the archived call records to two files: 99150101.ARK and 99150102.ARK. After copying these two files to a safe place, they can safely be deleted from the system.

12.5 Inventory and Personnel Control

12.5.1 Introduction

This sub-section describes the procedures used to track inventory, including the methods used to evaluate the level of inventory, adjust the level of inventory, and replenish the level of inventory. Additionally, the minimum inventory level for a given part is discussed, and the sub-section describes the toll maintenance schedule for personnel.

12.5.2 Spares

To provide effective and efficient system maintenance, an adequate number of known good spare parts and assemblies must be maintained. One industry standard sparing level is ten percent of the module population or two, whichever is greater. The philosophy ensures that there are always at least two spare modules. If a failure occurs, one spare is used to correct the failure while one spare is still available for future failures.

In this distribution of spares facilitates, meeting response, and repair requirements ten percent sparing is a guideline. As more experience is gained with the system components, the recommended percentage can be adjusted up or down as needs dictate.

12.5.3 Purchase Order Tracking

The Concert software used for MOMS has comprehensive purchase order tracking capabilities. The system has the capability to generate a purchase order notification whenever a spare part inventory level drops below a predetermined amount. It also accepts manual entry or manual updating for generating a purchase order.

When the purchase order is complete, MOMS can print the purchase order. After the purchase order is printed, it can no longer be modified.

Another MOMS function available is receiving on a purchase order. This function keeps track of the items received, quantities, dates, and items still back-ordered. It also automatically adds the received parts to the inventory locations specified in the purchase order.

Closed purchase orders can also be purged from the system databases. This feature can be useful when entering a new year and purchase orders that are two years old and have been filled, need to be deleted.

12.5.4 Toll Maintenance Schedule for Personnel

The toll maintenance schedule for personnel for the SCDOT ETC system is simple. MOMS is modified to allow the days to be worked to be assigned on a monthly basis. Plaza assignments and on-call assignments are also on the monthly calendar, which allows the field service manager to generate a schedule every month that includes the following:

- Which technician is working on any given day
- Which technician is assigned to which plaza on any given day
- Who is on call for which plaza on any given day

12.5.5 Toll Maintenance Schedule for Operations

The toll maintenance schedule for operations will be the preventive maintenance (PM) schedule. As operations continue, it is possible that certain refinements to the schedule may become necessary. Recommendations will be made in the monthly PM reports if an adjustment in PM frequency or procedure appears to be necessary. It is also possible that some PMs could be performed too often. Replacing a consumable item too soon or performing a procedure that causes wear more often than necessary are examples of this type of adjustment to a PM schedule.

12.5.6 Inventory Control

Inventory control is achieved through the use of the MOMS.

The first steps toward inventory control are to take a complete physical inventory of all spare parts in the stockroom and to enter the results of the inventory into the parts inventory database. Once these initial steps have been completed the parts inventory resides in the parts inventory database.

When service calls are updated and closed, the parts used are entered on the fourth page of the service call entry screen. When the service call is closed, the parts used are automatically removed from the inventory.

As discussed above, when a receiving record on a purchase order is filled out, those parts received are automatically added to the MOMS parts inventory database. MOMS has a transfer inventory function that allows inventory to be transferred between various stock locations. For example, this function allows a part to be removed from the stockroom and entered into a technician's car stock. At a later date when the part is used, the car stock can then be adjusted.

The inventory transfer function has a flag for effective/defective. This flag allows a replaced part to be tagged as defective. It can then be tracked through the system.

MOMS has an inventory adjustment function that can be used to adjust inventory after a physical inventory has been performed. The results of the physical inventory and the data in the parts inventory report can be compared. Adjustments can be made if any inaccuracies appear between the two compilations of parts inventory.



All inventory transactions are entered into MOMS at the time of the transaction. As parts are taken into or out of the stockroom, inventory transfers are entered into the database. In this way, MOMS maintains an up-to-date, real-time spare parts inventory.

The last component of inventory control is replenishment. Each record in the parts inventory database contains a field for the minimum quantity to keep on hand. As the inventory level drops below this threshold, a purchase order notification is generated.

The parts inventory is a real-time accurate inventory because of the use of the following functions:

- Receive on a P.O.
- Transfer inventory
- Update a service call

The Concert software has the following features for parts tracking:

- Parts status by quantity and value
- Parts status by location and condition
- Parts planning
- Parts inventory summary
- Parts activity summary

12.6 Concert Software

12.6.1 Introduction

The Maintenance On-line Management System (MOMS) utilizes Concert software as the database tool to monitor and manage all aspects of the SCDOT ETC maintenance function. This section describes the various menus, screens, and reports available within the Concert software. Concert is a Commercial Off-The-Shelf (COTS) product containing options and features that are available but not applicable to SCDOT ETC. Therefore, only the applicable screens used in the day-to-day operations are described.

12.6.2 System Overview

The Concert software provides a series of screens that allows data entry and report generation from a menu-driven format. The system is accessed by entering a four character Master Password, pressing RETURN, and then entering a three character Operator Identification Number. The system then displays the first of a series of Master Menus which guide the user through the system. Concert is centrally-driven and therefore does not contain sub-menus in most areas. Only the System Utilities option contains sub-menus. Figure 12-4 through Figure 12-7 depict the series of Master Menus.

```

MS-DOS Prompt
03-31-97 14:17:12 CONCERT(R) Master Menu-1 Version 3.91
S/N: 07355 Licensee: LOCKHEED MARTIN IMS

1. Area tax                21. Enter a service call    40. Print purchase orders
2. Service engineer        22. Update a service call   41. Enter purchase orders
3. Customer                23. Review SE assignments   42. Receive on a P.O.
4. Vendor                  24. Review call history     43. Transfer inventory
5. Equipment type          25. Match-up SE skills      44. Adjust inventory
6. Customer installed      26. The Dispatch GRID       45. Review PM's
7. Prob/Cause/Action       27. Electronic mail         46. Purge old P.O.'s
8. Skills list             28. Rev customer installed
9. SE skills               29. Rev Prob/Cause/Action

10. Parts inventory
11. Serialized parts
12. Fixed price jobs
13. Bill from point

34. Process MOMS files

Menu number [ _ ]

F1=Menu-1 F2=Menu-2 F3=Menu-3 F4=Menu-4 ESC=Quit
```

Figure 12-4 First Master Menu



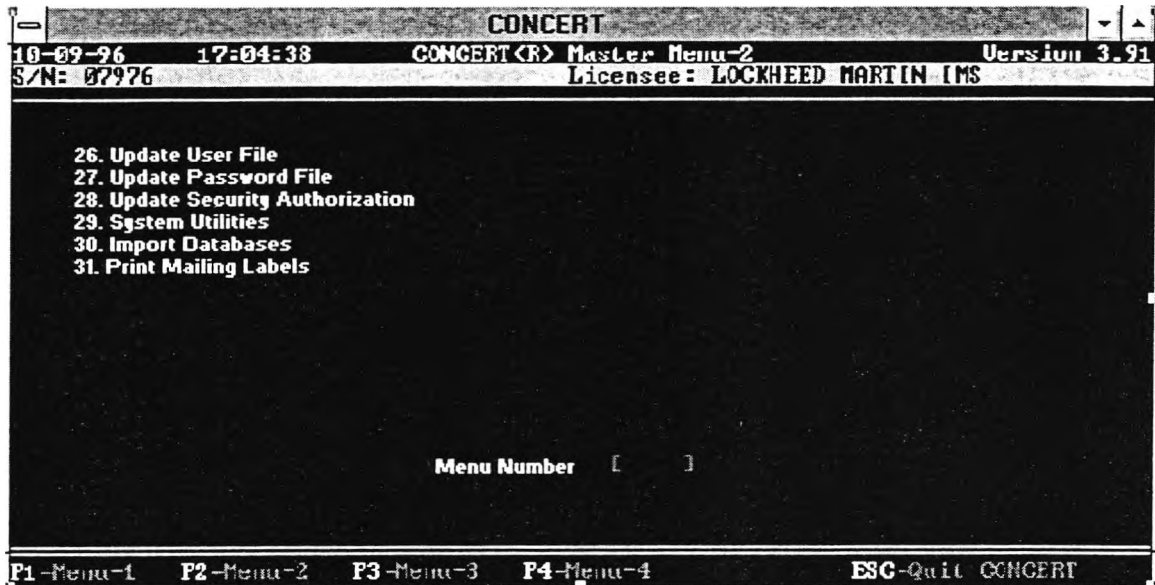


Figure 12-5 Second Master Menu



Figure 12-6 Third Master Menu

CONCERT			
10-09-96	8:57:22	CONCERT (R) Master Menu-4	Version 3.91
S/N: 07976		Licensee: LOCKHEED MARTIN INS	
<div> <div> 55. Parts Status by Qty and Value 56. Parts Status by Location/Condition 57. Parts Planning 58. Open Purchase Orders 59. Purchase Order Activity summary 60. Parts Activity Summary </div> <div> 61. Contract Renewal 62. Contract Summary 63. Contract Present Value 64. Contract Rev/Exp by Equipment </div> </div>			
Menu Number []			
F1-Menu-1	F2-Menu-2	F3-Menu-3	F4-Menu-4
			ESC-Quit CONCERT

Figure 12-7 Fourth Master Menu



12.6.3 Display and Database Entry Screens

The typical Concert display screen has four main information areas:

The Header Area	displays the date, real-time clock and the screen title
Record Data Fields	the data already in the system
Input Data Fields	the data to be entered into the system
F-Key (function key)	prompts displaying available function keys for a particular screen

Each Concert database screen contains two types of data entry fields -- required data and optional data. If the user does not input data into a required field, Concert will not accept the screen. Upon completion of the required and optional data, Concert displays the following message:

IS THE ABOVE INFORMATION CORRECT -- PLEASE ENTER Y OR N

The operator has the option of committing the data to the database.

12.6.3.1 Service Engineer -- Concert Screen 2

The Service Engineer (SE) Database Entry screen contains information about each Service Engineer involved in the maintenance of the SCDOT ETC program. Figure 12-8 displays the Service Engineer Database Entry screen.

10-09-96 8:58:03 Service Engineer (SE) Database Entry

SE ID	BEEPER PHONE
SE NAME	PROFIT CENTER
SS NO.	PAY RATE
TITLE	HIRE DATE
ADDRESS 1	LAST REVIEW
ADDRESS 2	NEXT REVIEW
CITY	LAST TRAINING
STATE	
ZIP	
COUNTRY	SKILL LEVEL
HOME PHONE	EQUIPT SKILL
REGION	DISCIPLINE SKILL
SERVICE CTR	ACTIVE CODE
BASE ADDR	
BASE CITY	
BASE STATE	SCHEDULED DAYS OFF
BASE CTRY	from to
BASE PHONE	COMMENTS

CTRL+F1-Function keys

Figure 12-8 Service Engineer Database Entry Screen

The data fields for the Service Engineer (SE) Database are shown in the following table:

SE ID Number	identification number specific to individual service engineer (required field)
SE Name	required field
SS Number	Social Security number
Title	SE's title
Address 1	SE's home address
Address 2	SE's home address
City	SE's home address city
State	SE's home address state
ZIP	SE's home address zip code
Country	SE'S home address country
Home Phone	SE's home phone number
Region	region covered by SE
Service Center	used if more than one Service Center is required
Base Address	street address
Base City	
Base State	
Base Zip Code	
Base Country	
Base Phone Number	
Beeper Phone	telephone number for individual SE
Profit Center	
Pay Rate	SE's hourly rate
Hire Date	
Last Review	
Next Review	
Last Training	
Skill Level	
Equipment Skill	list of equipment SE is qualified to work on
Discipline Skill	code designating SE's specialty skills
Active Code	enter Y if SE is present or N if SE is on vacation, sick leave, etc.

Scheduled Days Off	required field
Comments	used for more detailed information if required



12.6.3.2 Customer -- Concert Screen 3

The Customer Database Entry screen contains information about each customer or service area site. Figure 12-9 displays SCDOT ETC Customer # _____ -- SCDOT Off Customer Database Entry screen.

Ucar: 57% GDI: 17% Mem: 122 Mb CONCERT 8:58 AM 10/10/96

10-09-96 8:58:30 Customer Database Entry

CUSTOMER NUMBER	CUSTOMER PHONE	EXT
CUSTOMER NAME		
ADDRESS LINE 1		
ADDRESS LINE 2		
CITY		
STATE	ZIP	
COUNTRY		
CONTACT NAME		
CONTACT PHONE	EXT	
MKT SEGMENT CODE		
SERVICE AREA		
TOTAL UNITS		
TOTAL LOCATIONS		
COMMENTS		
SE ID		

Wardw

CTRL+F1-Function keys

Figure 12-9 Customer Database Entry Screen

The data fields for the Customer Database are as follows:

- Customer Number (required)
- Customer Phone Number
- Customer Name
- Address Line 1
- Address Line 2
- City
- State
- Zip Code
- Country
- Contact Name (individual with whom all contact is to be made)
- Contact Phone Number
- Market Segment Code (not applicable)
- Service Area --
- Total Units (leave blank; number provided by Concert)

- Total Locations (not applicable)
- Comments
- SE ID

12.6.3.3 Vendor -- Concert Screen 4

The Vendor Database Entry screen contains the complete information on all vendors supplying equipment or supplies for the SCDOT ETC Maintenance System. Figure 12-10 displays a Vendor Database Entry screen.

10-09-96 8:53:46 Vendor Database Entry

VENDOR NUMBER []
 VENDOR NAME
 ADDRESS 1
 ADDRESS 2
 CITY
 STATE ZIP
 COUNTRY
 VENDOR PHONE EXT
 VENDOR CONTACT NAME
 ACCOUNT OPEN DATE
 VENDOR PAYMENT TERMS
 LAST YEAR DOLLAR VOLUME
 YTD DOLLAR VOLUME

CTRL+F1-Function keys

Figure 12-10 Vendor Database Entry Screen

The data fields for the Vendor Database are as follows:

- Vendor Number -- used to identify specific vendor (required field)
- Vendor Name -- required field
- Address 1
- Address 2
- City
- State
- Zip
- Country
- Vendor Phone
- Vendor Contact Name

- Account Open Date
- Vendor Payment Terms -- Net 30; Net 10, etc.
- Last Year Dollar Volume -- dollar amount spent last calendar year
- YTD Dollar Volume -- dollar amount spent year-to-date

12.6.3.4 Equipment Type -- Concert Screen 5

The Equipment Type Database Entry screen contains information pertaining to all products or equipment types that are serviced for SCDOT ETC. Figure 12-11 displays an example of an Equipment Type Database Entry screen.

The screenshot shows a terminal window titled "Equipment Type Database Entry". The window contains a list of data fields for equipment entry, organized into two columns. The fields are:

EQUIPMENT TYPE []	
EQUIPMENT DESCRIPTION	
MODEL DATE	
MANUFACTURERS CODE	
VENDOR NUMBER	
MANUFACTURE/PURCHASE COST	
LIST PRICE	
CONTRACT AMOUNT	
BUSINESS UNIT CODE	
TOTAL INSTALLATIONS	
MTBP TO DATE IN MONTHS	
MTIR TO DATE IN HOURS	
INSTALL TIME IN HOURS	LABOR RATE
PM TIME IN HOURS	OTHER RATE
MOVE TIME IN HOURS	NEW LABOR RATE
UPGRADE TIME IN HOURS	NEW OTHER RATE
REMOVE TIME IN HOURS	NEW RATE EFF DATE

At the bottom of the screen, there is a prompt: "CTRL+F1-Function Keys".

Figure 12-11 Equipment Type Database Entry Screen

The data fields for the Equipment Type Database are as follows:

- Equipment Type -- required field
- Equipment Description
- Model Date -- date model was released into the market
- Manufacturers Code -- code to identify specific manufacturer
- Vendor Number
- Manufacture/Purchase Cost
- List Price
- Contract Amount -- amount normally charged for a yearly contract. This will be displayed when creating the Customer Installed Base database
- Business Unit Code -- N/A

- Total Installations -- N/A
- MTBF to Date in Months -- leave blank -- this field will be updated automatically each time a service call is closed on this piece of equipment
- MTTR to Date in Hours -- leave blank -- this field will be updated automatically each time a service call is closed on this piece of equipment
- Install Time in Hours -- leave blank -- this field will be updated automatically each time a service call is closed on this piece of equipment
- PM Time In Hours -- leave blank -- this field will be updated automatically each time a service call is closed on this piece of equipment
- Move Time In Hours -- leave blank -- this field will be updated automatically each time a service call is closed on this piece of equipment
- Upgrade Time In Hours -- leave blank -- this field will be updated automatically each time a service call is closed on this piece of equipment
- Remove Time In Hours -- leave blank -- this field will be updated automatically each time a service call is closed on this piece of equipment
- Labor Rate -- the labor rate charged on this equipment type -- required field
- Other Rate -- Not used
- New Labor Rate -- a new labor rate amount upon the effective date -- required field
- New Other Rate -- required field
- New Rate Effective Date -- required field

12.6.3.5 Customer Installed Database Entry -- Concert Screen 6

The Customer Installed Database contained all installed products or equipment types at a particular customer location. For the SCDOT ETC applications this would be a specific ramp or plaza or the LMIMS Program Office. Figure 12-12 displays an example of a Customer Installed Database Entry screen.

10-09-96 9:00:06 CONCEAL 9:00 AM 10/10/96
 Customer Installed Base Database Entry Page 1

CUSTOMER NUMBER	SERIAL NUMBER	BILL TO
CUSTOMER NAME		
EQUIP LOCATION PHONE	EXT	
EQUIPMENT TYPE		
OWNER CODE		
SYSTEM NO.		
SERVICE AREA		PURCHASE DATE
CONTRACT NUMBER		INSTALLATION DATE
CONTRACT CLASS		WARRANTY EFF DATE
CONTRACT TERMS		WARRANTY EXP DATE
REQUIRED RESPONSE		CONTRACT EFF DATE
PM CYCLE		CONTRACT EXP DATE
BILLING CYCLE		LAST PM DATE
CONTRACT AMOUNT		LAST SERVICE DATE
REGULAR SE ID		CONTRACT RENEWAL DATE
COMMENTS		% DISC PARTS
MANUFACTURERS CODE		% DISC LABOR
SPECIAL INSTRUCTIONS		

Undlv
 CTRL+F1-Function Keys

Figure 12-12 Customer Installed Database Entry Screen

The data fields for the Customer Installed Database are as follows:

- Customer Number -- required field
- Serial Number -- number used to identify specific pieces of equipment (required field)
- Bill To -- used if customer has separate bill to and ship to address -- default is to ship to customer number (required field)
- Customer Name
- Equipment Location Phone
- Equipment Type -- required field
- Owner Code -- field is used to indicate whether this equipment is leased, purchased or rented
- System Number
- Service Area -- automatically extracted from the Customer database
- Contract Number -- required field if under contract
- Contract Class -- N/A
- Contract Terms -- example, Net 30
- Required Response -- required field if under contract -- response time in hours
- PM Cycle -- Preventative Maintenance cycle
- Billing Cycle
- Contract Amount
- Regular SE ID -- automatically updated based on information from the Customer database
- Comments



- Manufacturers Code
- Special Instructions
- Purchase Date
- Installation Date
- Warranty Effective Date
- Warranty Expiration Date
- Contract Effective Date
- Contract Expiration Date
- Last PM Date
- Last Service Date
- Contract Renewal Date
- % Disc Parts -- percentage allowed on discounting parts
- % Disc Labor -- percentage allowed on discounting labor

12.6.3.6 Problem/Cause/Action Database Entry -- Concert Screen 7

The Problem/Cause/Action Database is used to define up to ninety-nine problems are known to be associated with each product or equipment type. Each problem can be accomplished with up to four causes and actions. This database can prove very useful in diagnosing equipment failures/problems. Figure 12-13 displays an example of a Problem/Cause/Action Database Entry screen.

10-09-96 9:00:25 Problem/Cause/Action Database Entry

EQUIPMENT TYPE []

EQUIPMENT DESCRIPTION

PROBLEM CODE

PROBLEM DESCRIPTION

----- CAUSE -----

No. DESCRIPTION

----- ACTION -----

No. DESCRIPTION

CTRL+F1-Function keys

Figure 12-13 Problem/Cause/Action Database Entry Screen

The data fields for this Database are as follows:

- Equipment Type -- required field
- Equipment Description -- supplied automatically by the system
- Problem Code -- required field
- Problem Description
 - ◊ Cause
 - ◊ Action

12.6.3.7 Skills List Database Entry -- Concert Screen 8

The Skills List Database contains all the skill names that are pertinent to the service organization. Figure 12-14 displays an example of a Skills List Database Entry screen.



Figure 12-14 Skills List Database Entry Screen

The data fields for this Database are as follows:

Skill -- enter the names of pertinent skills

12.6.3.8 SE Skills Database Entry -- Concert Screen 9

The SE Skills Database contains all the skills that each Service Engineer has mastered. Figure 12-15 displays an example of a SE Skills Database Entry screen.



User: 572 GBI 4/26 Mem: 122 Mb CONCERT		9:01 AM 10/10/96
10-09-96	9:01:22	Parts Inventory Database Entry Page 1
PART NUMBER [MTD USAGE
PART DESCR 1		YTD USAGE
PART DESCR 2		TD USAGE
PART TYPE		PREV USAGE
SYSTEM USED ON		
BIN NUMBER		PRICE EFF DATE
SHelf NUMBER		SELLING PRICE
UNIT OF MEASURE		EXCHANGE PRICE
DEFECTIVE VALUE %		REORDER LEVEL
QUANTITY ON HAND		REORDER QUANTITY
QUANTITY ON ORDER		STANDARD UNIT COST
LAST DATE USED		EXCHANGE COST
LOCATION		COMMENTS
VENDOR #	LAST PUR PRICE	LAST PUR DATE

Ctrl-P1-Function keys

Figure 12-16 Parts Inventory Database Entry Screen

The data fields for this Database are as follows:

- Part Number -- required field
- Part Description 1
- Part Description 2
- Part Type
- System Used On
- Bin Number
- Shelf Number
- Unit of Measure
- Defective Value %
- Quantity on Hand
- Quantity on Order
- Last Date Used -- automatically incremented from the Call Handling screen
- Location
- MTD Usage -- the amount used month to date -- calculated field
- YTD Usage -- amount used year to date -- calculated field
- TD Usage -- total amount used to date -- calculated field
- Previous Usage
- Price Effective Date



- Selling Price
- Exchange Price
- Reorder Level
- Reorder Quantity
- Standard Unit Cost
- Exchange Cost
- Comments
- Vendor Number -- Concert will allow you to enter up to five vendors
- Last Purchase Price
- Last Purchase Date

Next Screen:

- Manufacturer Code
- Type Code -- to distinguish between consumable or non-consumable

12.6.3.10 Serialized Parts Database Entry -- Concert Screen 11

The Serialized Parts Database monitors all movement of the serialized inventory in stock. Figure 12-17 displays an example of a Serialized Parts Database Entry screen.

Serialized Parts Database Entry

10-09-96 9:01:37

PART NUMBER []

PART DESCRIPTION

SERIAL NUMBER

MODEL NUMBER

LOCATION

REVISION LEVEL

REVISION DATE

STATUS

WARRANTY EFF.

WARRANTY EXP.

LOCATOR

CTRL-F1-Function keys

Figure 12-17 Serialized Parts Database Entry Screen

The data fields for this Database are as follows:



- Part Number
- Part Description
- Serial Number
- Model Number
- Location -- inventory bin/shelf location
- Revision Level
- Revision Date
- Status
- Warranty Effective
- Warranty Expiration
- Locator -- code

12.6.3.11 Enter a Service Call Database Entry -- Concert Screen 21

The Enter a Service Call Database contains in the information required to schedule a service call. Figure 12-18 displays an example of an Enter a Service Call Database Entry screen.

The screenshot shows a terminal window titled "Service Call Entry" with a "Page 1" indicator. The window contains a form with the following fields and values:

Call No	New Acct	Cust Number	Operator Id	ERT
10-09-96	9:02:29	SHIP TO:		
Name		Name		BILL TO:
Addr1		Addr1		
Addr2		Addr2		
City		City		
State		State		
Zip		Zip		
Country		Country		
Sys No.		Contact		
Equipment		Phone		
Description		Market Seg		
Warranty Exp			Opened	10-09-96 0902
Contract No			Dispatched	
Contract Class			Closed	
Contract Term			Arrived	
Req'd Response			Completed	
			PM Due	
			Credit Status	
Special Instructions				

At the bottom of the screen, there is a prompt: "CTRL+P1-Function Keys".

Figure 12-18 Enter a Service Call Database Entry Screen

The data fields for this Database are as follows:

- Call Number
- New Account
- Customer Number



- Operator Id
- Bill To
- Phone
- Name
- Address 1
- Address 2
- City
- State
- Zip
- Country
- System Number
- Ship To
- Name
- Address 1
- Address 2
- City
- State
- Zip
- Country
- Contact
- Phone
- Equipment
- Description
- Market Segment
- Warranty Expiration
- Revision Number
- Opened
- Contact Number
- Dispatched
- Contract Class
- Expires
- Closed
- Arrived

- Contract Terms
- Completed
- Required Response
- Completed
- PM Due
- Credit Status
- Special Instructions

12.6.3.12 Update a Service Call Database Entry -- Concert Screen 22

The Update a Service Call Database screen allows the user to revise or update information regarding a specific service call. The fields are the same as Concert Screen 21. Figure 12-19 displays an example of an Update A Service Call Database Entry screen.

Figure 12-19 Update a Service Call Database Entry Screen

The data fields for this Database are as follows:

- Call Number
- New Account
- Customer Number
- Operator ID
- Bill To:
- Phone

- Name
- Address 1
- Address 2
- City
- State
- Zip
- Country
- Ship To
- Name
- Address 1
- Address 2
- City
- State
- Zip
- Country
- Sv Area
- Phone
- System Number
- Contact
- Equipment
- Description
- Market Segment
- Warranty Expiration
- Revision Number
- Opened
- Dispatched
- Contract Number
- Contract Class
- Expires
- Closed
- Contract Terms
- Arrived
- Completed

- Required Response
- Completed
- PM Due
- Credit Status
- Special Instructions

12.6.3.13 Review SE Assignments Screen -- Concert Screen 23

The Review SE Assignments screen option enables the user to select an SE for assignment and review assignments by call number, customer name, weekday, scheduled ETA by date and time, scheduled completion by date and time, and time between calls. Figure 12-20 displays an example of a Review SE Assignments screen.

SE ID	SE NAME	SE PHONE	CALL NO	CUSTOMER NAME	WK DAY	SCHEDULED ETA DATE/TIME	SCHEDULED COMPLETION DATE/TIME	TIME BETWEEN CALLS DD/HMMH
DATE FROM	DATE TO							

Figure 12-20 Review SE Assignments Screen

The data fields for this Database are as follows:

- SE ID
- SE Name
- SE Phone
- Date From
- Date To
- Call Number
- Customer Name


```

User: 57% GDI: 47% Mem: 12.4 Mb CONCERT 1:12 AM 10/01/96
10-89-96 9:12:12 Review Customer Installed Base

```

CUSTOMER NO.	NAME	PHONE
EQUIPMENT TYPE	SERIAL NUMBER	INSTALLATION DATE
		MAINTENANCE EXP
		LAST SERVICE DATE

CTRL-F1 - Function Keys

19-16-96 14:56:26 Enter a Purchase Order				
P O NO	P O DATE	SCHED DEL		
VENDOR NO	VENDOR INFO :			
LOCATION				
OUR PART NUMBER	DESCRIPTION	QTY	UNIT COST	EXT COST
		TOTAL		
CUSTOMER	COMMENTS			
<div> <div> </div> </div>				

Ctrl+F1-Function keys

Figure 12-24 Enter Purchase Orders Screen

The data fields for this Database are as follows:

- Purchase Order Number -- required field
- Purchase Order Date
- Scheduled Delivery Date
- Vendor Number -- required field
- Vendor Information
- Inventory Location ID -- required field
- Our Part Number -- required field
- Description
- Quantity
- Unit Cost
- Extended Cost
- Customer
- Comments
- Total

12.6.3.18 Receive on a Purchase Order Screen -- Concert Screen 42





- 

12.6.3.21 Review Preventive Maintenance Screen -- Concert Screen 45

From this screen, the user can review the scheduled Preventive Maintenance per a combination of search criteria. Searches can be performed by customer name, equipment type, PM date, days to PM and SE ID. An example of a Review Preventive Maintenance screen is shown in Figure 12-28.

The screenshot shows a terminal window titled "Review Preventive Maintenance". The window has a header bar with the date "10-09-96", time "9:14:16", and the title "Review Preventive Maintenance". Below the header, there is a table with the following columns: "CUSTOMER NUMBER", "EQUIPMENT TYPE", "PM DATE", "DAYS TO PM", "SE ID", "CUSTOMER NAME", "EQUIP TYPE", "PM DUE DATE", and "DAYS TO PM". The table is currently empty. At the bottom of the screen, there is a prompt "CTRL-F1-Function keys".

CUSTOMER NUMBER	EQUIPMENT TYPE	PM DATE	DAYS TO PM	SE ID	CUSTOMER NAME	EQUIP TYPE	PM DUE DATE	DAYS TO PM
-----------------	----------------	---------	------------	-------	---------------	------------	-------------	------------

Figure 12-28 Review Preventive Maintenance Screen

The data field for this screen is as follows:

- Customer Number
- PM Date
- Days to PM
- SE ID
- Equipment Type
- PM Due Date
- Days to PM
- Customer Number
- Serial Number
- Customer Name

12.6.3.22 Concert Screens 100 - 109, 120 - 130, and 140 - 146

Concert screens 100 through 146 are screens that allow the user to input various parameters to produce a large variety of reports. These reports can be displayed on the terminal or can be printed in hard-copy form. Each of these screens require the user to enter a specific range -- either date, part number, vendor number, etc.

12.6.4 Report Generation

The Concert software provides to SCDOT ETC the capability of reporting data into a variety of management reports as demonstrated by the various sort screens. All reports can be printed and most can be displayed on the MOMS terminal screen. Some reports can be printed as many times as may be required. Other reports can only be printed once, either because the specific report contains data that may change immediately following the printing or because standard accounting practices limit duplication.

The user selects report functions from any Master Menu. Note that for all reports, unless otherwise specified, the user must enter the desired range, as well as the output device, and the number of copies. A twenty-line description of each report option is available to the user through the Main Menu.

For the SCDOT ETC program, seven major database reports are currently available:

- Area Tax Directory
- Service Engineer Directory
- Customer Directory (Full and Partial)
- Vendor Directory
- Equipment Directory
- Customer Installed Directory (Full and Partial)
- Parts Inventory Directory

The Database reports are described in Chapter 11 - Inquiry and Reporting. One example of each is presented. In normal daily operation and maintenance, the data is presented in a variety of sorts or parameters depending upon the needs of management.

13. Security

LMIMS combines centralized and decentralized security administration procedures to ETC system security. This combination provides tightly controlled user access and auditing features while ensuring rapid turnaround to the user group. This approach provides controlled system and physical security controls. It prevents unauthorized access to the database and guards against theft of property and services.

LMIMS uses established and operationally-proven security policies, procedures, and standards that are incorporated to ensure that all SCDOT ETC system functions, data elements, and property are protected.

13.1 Funds & Revenue Handling

Funds from all Service Center clerks and toll collectors are fully balanced to system transactions at the end of each shift and recounted by a deposit clerk. All funds and tags maintained overnight are stored in the restricted vault room.

13.2 Facility & Physical Assets

LMIMS is responsible for plaza facility and equipment security. This is accomplished by a security intrusion system and environmental monitoring for the computer room.

Card swipe readers at all entrances, and an additional numeric keypad for the vault room will control Access to the all parts of the facility.

A panic button alarm is installed at the tag sale cashier counter for added protection and video surveillance is installed in the plaza to monitor personnel for safety and security reasons.

The Host computer and associated equipment is housed in the ETC processing facility and is under the physical security control. To aid in maintaining system integrity and security, standard commercial security features on the installed equipment is provided .

Communications circuit points-of-presence and equipment, such as: modems, communications controllers, and servers, are physically located in secured areas. The secured placement of communications equipment will prevent line tapping, monitoring, or other access to transmitted data by unauthorized personnel.

13.3 Tag Security

Operational and physical access controls ensure the integrity of the tag inventory throughout the process of encoding, testing, storage and distribution.

13.4 Communications & Data Security

To prevent unauthorized use, modification, or loss, the LMIMS designed ETC system provides specialized database query functions to authorized users. This is accomplished by assigning and granting access to the database by user ID.

Each client workstation will have a unique user-account on the server, with a corresponding user ID and password, and must connect to a valid database. The user ID determines which components of the application can be accessed by System Administration. All data elements are individually defined, segregated, and access is provided only to those users who are authorized to access these files.

Our communications solution also provides a secure communications system that prevents fraud, viruses, and unauthorized access. The use of industry-standard and accepted methods, a resilient network, and strategies to maintain transmission integrity ensure secure, timely, reliable, and error-free transmissions for SCDOT.

13.4.1 Network Access

When launched, the client application incorporates two additional security schemes. One is an overt application login user ID and password that is verified against the employee data stored in the database. An invisible security layer verifies the user ID and password from within those files before such application login can take place. The security layer is incorporated as part of the I-NET configuration files (which in turn was verified by the Application Verification Process earlier). This verification ensures connection only for the correct users, the correct client workstation, and to the correct database on the correct server. The last two layers of security are in addition to LAN access security implemented at the LAN system software levels.

13.4.1.1 Communications Security

The use of proven, industry standard communications protocols and practices ensures timely, accurate, and reliable transmissions.

The network solution provides timely, accurate, and reliable communications. The solution must also guard against unauthorized access to communication facilities as well as to system and data resources.

13.4.2 Database Server Access

Access to the Database Server is restricted to the System Administrators. The C2 level security mechanisms provided by the DEC VMS Operating System will be implemented. Such access provides for system maintenance, software upgrades, and performance monitoring and tuning. This does not include any access to areas of the sub-system storage containing the database, important non-database files, configuration files, reports, or service center application software.

Only System Administrators are granted full read-write access to the database files for the purpose of maintenance, backup, tuning, archival, and restoration. Such access is logged and all actions conducted by the System Administrator is recorded. All System Administrator related activities are performed through Oracle Rdb utilities and command files. If a dynamic SQL-based update to the database is required, then such updates are performed with documented SQL command files that are fully logged and filed.

13.4.2.1 Data Protection

The design incorporates a centralized storage facility for all data. All data resides within an Oracle Rdb on-line database that is located in mirrored data spaces. A log file is also maintained outside the database to be accessible when the database itself is down for any reason. In addition, for data received from external interfaces, the source data as received is stored in external files and are inserted into the appropriate table within the database.

13.4.2.2 Backups

Backup procedures have been developed to ensure that all Host server-based AVI data is secure and available for disaster recovery in the event of an emergency. These procedures include:

- Using Oracle Rdb utilities on a daily basis, an incremental backup is taken at night when the processing load is lowest.
- On a weekly basis, a full database backup as well as an incremental backup of the rest of the storage system is taken.
- On a monthly basis, a full system backup including all storage devices is taken.
- Backups are scheduled to occur only at times when the processing load is lowest.

13.4.3 Application Access

Control for Internal and External System Access is accomplished by using fully auditable security policies, procedures, and standards. These measures ensure the integrity and reliability of data, programs, and systems. The methods include:

- The use of user ID naming conventions
- The implementation of global user ID controls
- The implementation of password control parameters
- Regularly scheduled audits of user IDs
- Physical segregation of operational functions

13.4.3.1 Application Function Access

All user-access to the information, within the database, is only provided through the client portion of the application software. All functions within the client application are comprehensively listed within the database. Distinct combinations (functional groups) or subsets of available functions are created within the database by the System Administrator. Access to each function is designated to be *none*, *read-only*, or *read-write*.

Each employee is assigned a system generated employee ID that is unique throughout the system. Each employee ID is associated with a single security group. This has the effect of allowing each employee access only to those components of the system that are relevant to his / her function. At the same time, by providing the ability to create an unlimited number of functional security groups, the act of varying job functions, such as cross-trained employees, substitutes, etc., is easily accomplished.

The functional access within the application is database driven. For each employee, the security is further restricted by the type of access (Read, Update, and None).

The login process verifies the database for permissible accesses for the user being logged in and constructs the menu with options available to the user.

13.5 Security Checks

Client security must cover two distinct areas. First, ensure that the configuration of the client workstation and the application software have not been altered and secondly, provide access control to the database. Security measures in the second phase incorporate the following checks:

13.5.1 Application Software Check

The process is initiated by ensuring that the application software is correct. A check is made of the master client application software on the host file system. If the local application software vary from the resident on the host, it is replaced with the host copy. Log files are maintained on the server, detailing which clients have replaced application software. The log files are mailed to the System Administrator for investigation. This procedure allows an easy method of updating application software to a later version. Once the master client application software has been updated on the host server, the client workstations need only to be re-booted for it to take effect.

13.5.2 Account Validation

Once the client application is launched, a component of the Oracle Rdb database logs the client workstation on to the host server. The connection-configuration, conducted by the System Administrator, identifies a client workstation to the host. The client workstation must have a valid account on the server with a corresponding user ID and password, and must be connected to a valid database. This information is known only to the System Administrator. The first level of application security ensures that only those workstations known to the host may run client applications. The employee is unaware of the process and therefore cannot determine the host ID or password. This information is stored in an encrypted form on the local workstation.

If the first level of security is successful, the user is prompted to enter his / her employee ID and password. The employee ID and password is entered manually through a logon screen. The employee ID determines which components of the application is accessed.

13.5.3 Access Control

All functions within the application are comprehensively listed within the database. Distinct combinations (functional groups) or subsets of available functions are created within the database by the System Administrator. Each function is designated with an access permission of *none*, *read-only*, or *read-write*.

Each employee is associated with a single security group, this allows employee access only to components of the system that are relevant to that employee's function. By providing the ability to create an unlimited number of functional groups, the act of varying job functions, such as cross-trained employees, substitutes, etc., is easily accomplished.

13.5.3.1 Access History Report

The system captures every security system change, including the issuance of new or deleted user IDs. This data is stored on a restricted security audit file that can only be read, but not modified, by the administrator. The audit file generates a report that provides:

- The date and time of each change
- The user ID of the administrator who effected the change
- The user ID which was modified
- The specific authorized resource and, where applicable, the level of access granted

This report enables security personnel, and internal and external auditors, to perform a concise, one-for-one audit of each change recorded by the system along with corresponding paperwork.

14. System Administration

The **System Administration** subsystem creates and maintains tables accessed by all applications of the Toll Collection System.

When the user selects a System Administration function, the user's privilege to execute the selected option is validated. If the user does not have the privilege to access the selected option, an insufficient privilege message will be displayed and the option will not be executed.

14.1 New Employee Information

14.1.1 Inputs

- Employee Id
- Last Name
- First Name
- Middle Initial
- Title
- Status
- Type
- Position
- Seniority
- Location
- PIN
- Login Name
- Social Security Code
- Address
- Zip
- City
- State
- Country
- Phone
- Start Employment Date
- End Employment Date

14.1.2 Process

This process is for creating employees to access VECTOR software. The supervisor inputs the values mentioned above to create an employee record in the system. After creating the employee record, add the relevant roles to that employee record through the window shown in Figure 14-1. After entering the data, click the SAVE button to save the data. For modification to an existing employee record, find the employee record that needs modification, modify the data, and click the SAVE button to save the data.

System Administration Application - Employee Administration

File System Help

Employee Security Report Maint Toll Fares Batch Jobs Reports Close Exit

Employee Roles

Employee ID Last Name First Name M.I. Title

ALCATORRE ANTOINE F MR.

Status Type Position Seniority Location PIN

ACTIVE FULL ACCONT. CLERK REGULAR South Carolina Department of Transportation

Login Name Social Sec. No. Date of Birth

ANTOINEFERNAND 01/01/1965

Address

Zip City State Country

Phone Type Telephone No. Ext. Start Emp Date End Emp Date

DAY Clear 04/28/1997 01/01/2010

Figure 14-1 Creating An Employee Record

After creating the employee, add the relevant roles to that employee through the window displayed in Figure 14-2.

System Administration Application - Employee Administration

File System Help

Employee Security Report Maint Toll Fares Batch Jobs Reports Close ? Exit

Employee Roles

Employee ID Employee Name

5 ALCIATORE, ANTOINE F.

Employee Role	Primary Role	Start Date	End Date
DIRECTOR		06/12/1997	06/19/1997

Listing of Employee Roles

Figure 14-2 Employee Roles

14.1.3 Output

There is no printed output for this process. The records are inserted into the database tables.

14.2 System Security & Access Control

This process permits the system administrator to control and restrict access to the system by employees, depending upon the employee's role in the organization. When a new employee is entered into the system, the security access is automatically set according to the employee role that is assigned to the employee.

The security can be defined for every TAB Folder / Screen , Report. For each screen, the supervisor can set up the mode as NO Access, View, or Update. Figure 14-3 is the window for setting up the various roles and modes for reports and screens.

System Administration Application - Security Administration

File System Help

Employee Security Report Maint Toll Fares Batch Jobs Reports Close Exit

Permission

Role: **DIRECTOR** Resource Type: **ALL** Find

Number found: 1276

Name	Access Mode
AccountPlanTab	NO ACCESS
AcctHistoryFin	NO ACCESS
AcctHistoryNonFin	NO ACCESS
AcctHistoryToll	NO ACCESS
AcctMaintTabController	NO ACCESS
AcctSetupTabController	NO ACCESS
AdjustClassTab	NO ACCESS
AdjustDepositTab	NO ACCESS
AdjustTODTab	NO ACCESS
AdjustTab	NO ACCESS
AdjustmentTabController	NO ACCESS
AdminWin	NO ACCESS

Access Mode: **NO ACCESS** Close

Figure 14-3 System Security & Access

14.3 Report Creation & Maintenance

This process allows the system administrator to add new reports and update or delete existing reports. The following screen, Figure 14-4, allows the system administrator to input the report name, sub-system, category, number, and executable name. The Reports categories are:

- Daily
- Weekly
- Monthly
- Annual

The choices of subsystems are:

- Service Center
- Host
- Supervisory
- Violations

After inputting the data, click the SAVE button to save the newly added or modified data.

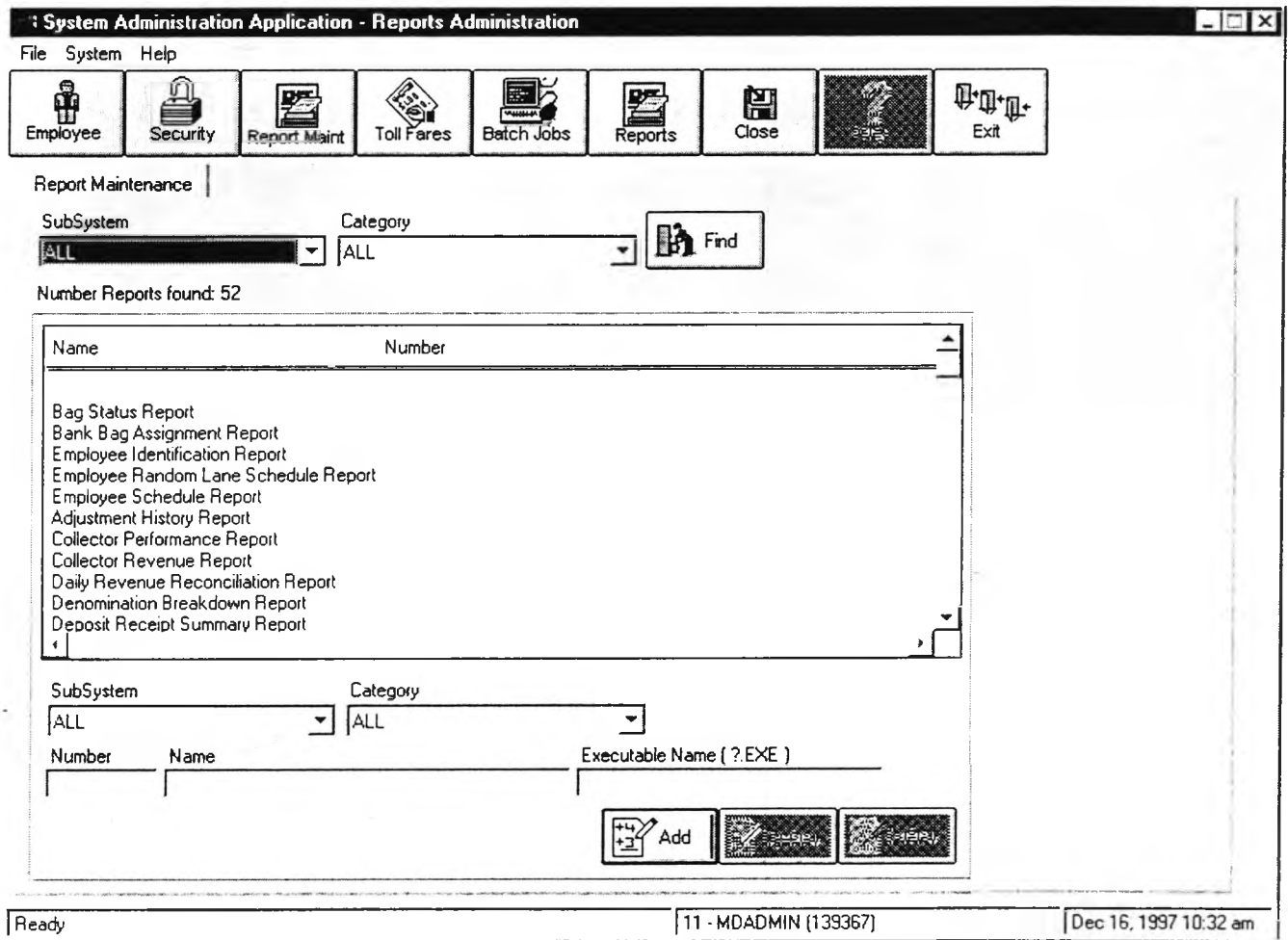


Figure 14-4 Report Maintenance

14.4 Toll Fare

This process is used for maintaining the toll fares for various plazas and vehicle classes. The toll fares are created for all plans. The input for creating the toll schedule tables are: Toll Plaza, Revenue Type, Plan Type, Vehicle Class, Full Fare & Discount Fare. The choices of revenue types are as follows:

- ETC
- Cash

The current SC plans are:

- Standard
- Non revenue

After inputting these values, click the SAVE button to save the data. The information is stored into the database table and used by various processes for toll calculation.

Following is Figure 14-5 which is used for maintaining toll fares:

System Administration Application - Toll Fares Administration

File System Help

Employee Security Report Maint Toll Fares Batch Jobs Reports Close Exit

TollFares

Plaza Revenue Type Plan Type Find

ALL ALL ALL

Plaza	Plan Type	Revenue Type	Vehicle Class	Full Fare	Discount Fare
LANE	STANDARD	AVI	2	1.00	0.50
LANE	STANDARD	AVI	3	1.75	1.50
LANE	STANDARD	AVI	4	2.50	2.25
LANE	STANDARD	AVI	5	3.25	3.00
LANE	STANDARD	AVI	6	4.00	3.75
LANE	STANDARD	CASH	2	1.00	1.00
LANE	STANDARD	CASH	3	1.75	1.75
LANE	STANDARD	CASH	4	2.50	2.50
LANE	STANDARD	CASH	5	3.25	3.25
LANE	STANDARD	CASH	6	4.00	4.00

Plaza Revenue Type Plan Type

Vehicle Class Full Fare Discount Fare

0 0.00 0.00

Add Save Print

Figure 14-5 Maintaining Toll Fares

Glossary of Terms

ACM

Automatic Coin Machine

ARPP

Automatic Replenishment Posting Process

ASCII

American Standard Committee for Information Interchange

AVI

Automatic Vehicle Identification

AVI_interp

AVI Interpreter

Capture

Violation Capture

CL

Canopy Light

CM

Corrective Maintenance

COTS

Commercial Off-the-Shelf

CPM

Critical Path Method

LOCKHEED MARTIN 

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Proprietary Data

Glossary of Terms • 1

CPU

Central Processing Unit

CSC

Customer Service Center

CSR

Customer Service Representative

DEC

Digital Equipment Corporation

DEF

Defective Count

DMQ

DECMessage Q

DMV

Department of Motor Vehicles

DTR

Daily Transaction Report

E / D

Effective / Defective

ECH

ETC Central Host

EFF

Effective Count

EMI / RFI

Electromagnetic Interference / Radio Frequency Interference

EOX

Embedded Operation Extensions

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Proprietary Data

Glossary of Terms • 2

ETA

Estimated Time of Arrival

ETC

Electronic Toll Collection

ETCTxMgr

ETC Transaction Manager

FDR

Final Design Review

GB

Gigabyte

gc

Garbage Collection

GUI

Graphical User Interface

Hostcomm

Host Communication Services

HostTxMgr

Host Transaction Manager

I/O

Input / Output

ICD

Interface Control Document

ID

Identification

ioctl

Input / Output Control

LOCKHEED MARTIN 

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Proprietary Data

Glossary of Terms • 3

IPC

Inter-Process Communication

LAN

Local Area Network

LED

Light Emitting Diode

LMIMS

Lockheed Martin IMS

LMS

Lane Mode Sign

LMS_interp

Lane Mode Sign Interpreter

LPO

Lockheed Martin IMS Project Office

ltc

Lane Toll Collector

Maintd

Maintenance Deamon

MB

Megabyte

MLT

Manual Lane Terminal

MMFO

Multimode Fiber Optics

MOMS

Maintenance On-Line Management System
Data retrieval and reporting management system used for toll maintenance purposes; can also be used for diagnostics with toll system control applications

MTBF

Mean-Time-Between-Failures

MTTR

Mean-Time-To-Repair

NIC

Network Interface Cards

NSF

Non-Sufficient Funds

OCR

Optical Character Recognition

OMT

Object Modeling Techniques

OO

Object Oriented

P / C / A

Problem / Cause / Action

PC

Personal Computer

PFD

Patron Fare Display
A device on the toll booth that displays the patron's traffic toll fee

PFD_interp

Patron Fare Display Interpreter

LOCKHEED MARTIN 

P I/O

Programmable Input / Output

PM

Preventive Maintenance

PO

Purchase Order

RAM

Reliability, Availability, and Maintainability

RF

Radio Frequency

RFP

Request for Proposal

RRCP

Rebill Request Creation Process

RTX

Real-time Extensions

SAM

Sensor Activation Module

SCDOT

South Carolina Department of Transportation

SCSI

Small Computer System Interface

SE

Service Engineer

SLI

Serial Line Interface

LOCKHEED MARTIN



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SC_DOT\Sys_Config\Rev_0.0\Predesgn.doc

Proprietary Data

SNMP

Simple Network Management Protocol

SQL

Structured Query Language

SRTM

System Response Time Measurement

Supervisor

Person responsible for a complete shift at a mainline plaza; responsibilities may include associated ramp plazas adjacent to the mainline plaza

TBD

To be determined

TCP / IP

Transmission Control Protocol / Internet Protocol

TOD

Tour of Duty

TPC

Transaction Processing Council

TPS

Transaction Per Second

Trdl_hdlr

Treadle Handler

Trxserver

Transaction Log Service

tti

Toll Terminal Interface

tti_handler

Toll Terminal Interface

UTP

Unshielded Twisted Pair

VES

Violation Enforcement System

Video or photographic system designed to capture an image of the rear license plate of vehicles that violate the toll system. A violator is any vehicle passing through a toll lane without paying the proper toll or having a valid AVI transponder read by the system. Additional data relative to the transaction that is generated by the toll equipment is also added to the captured image.

VIOL

Violations Processing Sub-system

VMS

Virtual Memory System

VTOL

Violations Lane Transaction

YTD

Year-To-Date