COORDINATED HIGHWAYS ACTION RESPONSE TEAM
STATE HIGHWAY ADMINISTRATION

WO 48 LCP Phase 4 System Architecture

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1 INTRODUCTION

1.1 Purpose

This document presents the architecture of the Coordinated Highways Action Response Team (CHART) Lane Closure Permit (LCP) System. The architecture of the LCP system is presented as a number of different "views", with each view representing a different perspective of the system.

1.2 Views Descriptions

Each view is described in Table 1-1. In addition, there are various appendices, described in Table 1-2.

Table 1-1. LCP Architecture Document Views

View Name	Description	Typical Stakeholders	Section
Feature List View	Provides a brief high-level overview of LCP and describes the features available in the system	Representatives from other agencies interested in LCP's capabilities, as well as operators, support personnel, developers, and managers	2
Functional View	Describes basic LCP functionality and some key operational concepts that drove how the functionality has been implemented	Developers, managers and officials from other organizations, looking to interface with or build a system like the LCP	3
System View	Shows system components and how they connect to each other	System administrators, software developers and architects and others interested in the system-level architecture	4
Interface View	Describes the LCP external interfaces	Representatives from other agencies interested in LCP's capabilities, specifically software and system architects who may be looking to interface with LCP	5
Data View	Describes how data moves into, out of, and around the LCP system	Database administrators (DBAs), management, developers, and stakeholders of connected systems	6
Deployment View	Describes the various LCP deployment configurations	Operations & Maintenance personnel, network engineers	7
Subsystem View	Describes LCP software/ hardware subsystems and Commercial Off-The-Shelf (COTS) products	Developers, configuration managers, and management	8

View Name	Description	Typical Stakeholders	Section
Standards View	Describes LCP support for mapping interface standards.	MDSHA management, developers, and those looking to interface with CHART Mapping for the purpose of consuming/display LCP data.	9
Business Architecture View	Describes LCP from a business process perspective	Business Area Architecture (BAA) process participants, those interested in CHART's business plan and its mapping to LCP's capabilities	10
System Maintenance View	Describes Operations and Maintenance aspects of the LCP system	System administrators, software and system architects, others interested in LCP maintenance tasks	11

Table 1-2. LCP Architecture Document Appendices

Appendix	Description
A	Design studies performed during the development of the LCP
B	Database entity-relationship (ER) diagrams describing the design of the LCP database
C	Release history of LCP

1.3 Applicable Documents

Relevant documents associated with the system architecture are listed in the Table 1-3 below.

Table 1-3. Document References

Requirements and Vision
EORS Release 4 Software Requirements, August 10, 2012, W020-RS-001
EORS Release 4 Phased Release Plan, October 11, 2012, W020-AR-001
WO40 Lane Closure Permit Application Phase 2 Software Requirements Validation, December 20, 2013, WO40-RS-001
Design
LCP Phase 1 Detailed Design, February 12, 2013, WO34-DS-001
LCP Phase 2 Detailed Design, February 28, 2014, WO40-DS-001
LCP Phase 4 Detailed Design, September 16, 2015, WO48-DS-001

2 FEATURE LIST VIEW

2.1 View Description and Typical Stakeholders

This view provides a brief high-level overview of the LCP system and describes the features available in the system. This section is suitable for those who would like to have an easy-to-digest list of features LCP provides, such as representatives from other agencies interested in LCP's capabilities, as well as operators, support personnel, developers, and managers just coming in who are new to LCP, or who would like a quick refresher.

2.2 LCP Overview

The LCP system consists of a combined database/application server hosting LCP which provides information to other CHART applications such as the Advanced Traffic Management System (ATMS), the CHART Intranet Map, and the public CHARTWeb web site (via the CHARTWeb database). There is also a server (known as the iMap server) that serves LCP information (along with other data) to entities that are external to CHART, such as MEMA's Osprey system.

The basic components of the LCP applications include the LCP desktop web application and the LCP Data Exporter that provides information to other applications.

The LCP applications run on Windows Server 2008R2, and utilize MS SQL Server 2008R2, .NET Framework from version 4.5, CSS, JavaScript/JQuery and HTML 5.

The routine operations of the LCP application include:

- Permit Management – Provides the capability to add, edit, update and delete lane closure permits.
- List Permits – Provides the capability to list, activate and print lane closure permits
- Permit Workflow – Provides the capability to manage workflow rules for permit states to determine permit approval types
- Permit Reports – Provides capability to generate PDF reports for active and approved permits
- Permit Mapping – Provides the ability to map the geolocation of a lane closure permit. This functionality is provided by LCP through integration with external web services and a UI interface provided by the CHART Mapping application.
- LCP Data Exporter services – Provides an interface for external applications to get LCP permit data. There are two basic interfaces: CHART Mapping and Public. The Public service resides in the DMZ outside of the MDOT network. The Public interface contains a subset of the data available internally, although the data is much the same.

2.3 Feature List

The complete list of all features supported by the LCP is shown below:

- Permit Management
  - Create, Edit, Delete Permit Data
  - Lane Configuration Diagrams
  - List Permits
  - Permit Details and Permit Details Reports
  - Permit Reporting
  - Permit Approval
  - Permit Search
  - Permit Type Support
- User Management
  - Request User Account
  - Approve, Reject, Suspend User Accounts
  - Assign and Manage user Roles
- Permit Workflow Management
  - Roadway Approval Manager
  - District Approvals By Permit Type
  - Workflow Manager Logging
- LCP Data Archive
  - Long Term Permit Archival Storage
- LCP Data Exporter
  - Query Permit Data Through Web Service
  - Client Subscriptions To Permit Data Changes
  - Two Way Communication Between Geospatial Map Server and LCP
- Geospatial Integration
  - Manual and Automatic Permit Location Mapping
  - Geolocation data
- Integration with CHARTWeb and CHARTWeb Mobile Public Internet Web Sites
  - Near real-time updates
  - System messages
- Integration with CHART ATMS
  - Near real-time permit state updates
  - Permit activation, deactivation, queuing, extension

3 FUNCTIONAL VIEW

3.1 View Description and Typical Stakeholders

This view into the LCP describes basic functionality and some key operational concepts that drove how the system was constructed. This is not a User's Guide or tutorial. Although some design concepts are presented, it does not get to the level of a formal design document. See the LCP User's Guide for additional information. This view is useful for anyone interested in how LCP works at a high level, including developers, SHA management, MDOT management, and officials from other organizations, looking to interface with or build a system like LCP.

3.2 Permit Management

3.2.1 Create, Edit, Delete Permit Data

Permit creation provides the ability to create lane closure permits and designate which lanes are allowed to be closed along with approved date/time ranges, locations, days of the week, and contact information.

Permit editing allows an authorized user to edit the data for an existing permit. When an existing permit is edited and saved it will re-enter the LCP permit workflow at the same point as a new permit. This will enforce all workflow rules, including workflow approval, for the edited permit.

Permit deletion is present in LCP in two forms. In the first case permits that have been pending approval for more than seven days will be permanently deleted from the LCP application automatically. This is a true delete and the deleted permit cannot be recovered. Alternatively, some permits can be manually deleted by an authorized user. These deletes do not actually remove permit data from the database; rather the state of the permit is set to "Deleted". This allows the application to safeguard permits with potentially useful histories from being deleted while providing the ability for an authorized user to remove the permit from use in LCP's daily workflow.

3.2.2 Lane Configuration Diagrams

The LCP application consumes web services provided by the CHART system that provide the ability for users to visually create a lane diagram to better describe the lane closure. These diagrams appear as images in the permit details report and are also exported for use on the CHARTWeb web site.

3.2.3 List Permits

List Permits provides the ability to browse for permits as well as filter permit listings by district, location, date and permit state. Listing permit data is a function used primarily by district users when they are looking at the collection of permits from a macro level. Examples might include the number of currently active, pending or queued permits.

3.2.4 Permit Details and Permit Details Reports

Permit Details provides an interface to view the details of a permit and to perform actions on the permit including edit, copy, delete, activate, deactivate, approve and reject. LCP also provides a Permit Details report that contains all of the information associated with a single permit in the application. This report can be generated with and without the history log included in the report.

3.2.5 Permit Reporting

The LCP application currently provides three permit reports: Active Permits Report, Approved Permit Report and Combined Active/Approved Permit Report. Each report will display all permits that were active, approved or both on any given day for any district.

3.2.6 Permit Approval

Permit Approvals provide the ability to view permits that are awaiting approval and the ability to manually approve or reject them.

3.2.7 Permit Search

LCP provides the ability for a user to search for permits in the application either by specifying details to search for or by finding a permit based upon a known tracking number. The search permit functionality includes both working permits and the permit archive.

3.2.8 Permit Type Support

The LCP application provides the following permit types as a means to classify lane closure permits. These permit types are included by the LCP application and defined by the districts. In addition, each permit type can be configured separate in the permit approval process.

- Bridge
- Construction
- District Maintenance
- Landscape
- Long-term Continuous
- Materials & Testing
- Other
- Shop Maintenance
- Survey
- Traffic
- Utility
- ITS Device
- Mobile
- District Maintenance

3.3 User Management

The LCP application provides the ability to manage user level accounts. All accounts are assigned to individual users with individual user permissions managed by roles in the LCP application. These roles allow users to have different permission levels by district. Each district supports at a minimum three primary roles: Create Permit, Approve Permit (includes all permissions assigned to Create Permit) and District Administrator. User accounts can be approved, rejected and suspended by LCP administrators.

3.4 Permit Workflow Management

The LCP application provides the ability to manage the workflow of a permit by permit type and permit location.

3.4.1 Roadway Approval Manager

The LCP application allows users with appropriate permission to alter the permit approval workflow for individual roadways in counties within their districts. Any roadways that appear in the list will require manual approval. Note that the District Approval by Permit Type module must defer approvals to the Roadway Approval Manager.

3.4.2 District Approval by Permit Type

The LCP application allows users with appropriate permissions to alter the permit approval workflow rules by district for each permit type. District managers may designate that a permit type must automatically approve, require manual approval or defer to the settings defined in the Roadway Approval Manager.

3.4.3 Workflow Manager Log

The LCP application maintains a log of all actions taken with the District Approval by Permit Type and Roadway Approval Manager. The Workflow Manager Log provides the visibility to districts and system administrators when workflow rules are altered.

3.5 LCP Data Archive

The LCP application provides long term storage for permits that are no longer in active service. The archive is a separate database and schema that closely resembles that production database schema and is populated by a nightly server job that archives permits that have been expired for more than 60 days. Archived permit data is searchable from the LCP standard Search Permits interface and may also be copied into new permits.

3.6 LCP Data Exporter

LCP provides web interfaces to allow external systems such as the Intranet Map application to connect to LCP to retrieve permit information through a REST web service interface which allows a client application to query for LCP permit information, maintain current permit information, and manage permits within LCP. The LCP Data Exporter utilizes digital signatures (using private/public keys) to ensure that the data posted is coming from a known client application and to ensure that the document received contains exactly the same data as it did when it was signed with the private key.

3.7 Geospatial Integration

The LCP application provides the ability to specify lane closure locations using integrated geolocation web services. These services allow the application to provide populated form fields to assist the user with locating a closure in a specific county. In addition, when the closure location can be found in the web service the LCP application is able to save the latitude and longitude of the location and provide that data to the intranet and internet mapping applications.

3.8 Integration with CHARTWeb and CHARTWeb Mobile Public Internet Web Sites

The LCP Application provides near real-time updates for permit data, state and locations to the public internet web site. Data flows from the LCP data exporter to an exporter client that communicates directly with the database that feeds the CHARTWeb and CHARTWeb Mobile public web sites.

3.9 CHART ATMS Application Integration

The LCP Application provides ability to queue, activate and deactivate permit states from the CHART ATMS application. The ability to perform these actions is provided through a secure web service interface.

4 SYSTEM VIEW

4.1 View Description and Typical Stakeholders

The System View describes what the LCP hardware components are, how they are configured, what they support, and how they connect to each other. This view focuses on the internal structure of the system and its components (the view from within), whereas the Interface View focuses on external interfaces (the view from outside). This view will be of primary use to system administrators, software developers and architects and others interested in the system-level architecture.

4.2 System Overview

4.2.1 CHART Description

Figure 4-1 presents an overview of the CHART Program Architecture organized according to the Enterprise Architecture Framework as defined by the National Institute of Standards and Technology and how the LCP application fits within it. This approach gives a holistic view of the enterprise and is organized into 5 layers:

Enterprise Business Architecture Layer

Enterprise Information Architecture Layer

Enterprise Application Architecture Layer

Enterprise Application Integration Architecture Layer

Enterprise Infrastructure Architecture Layer

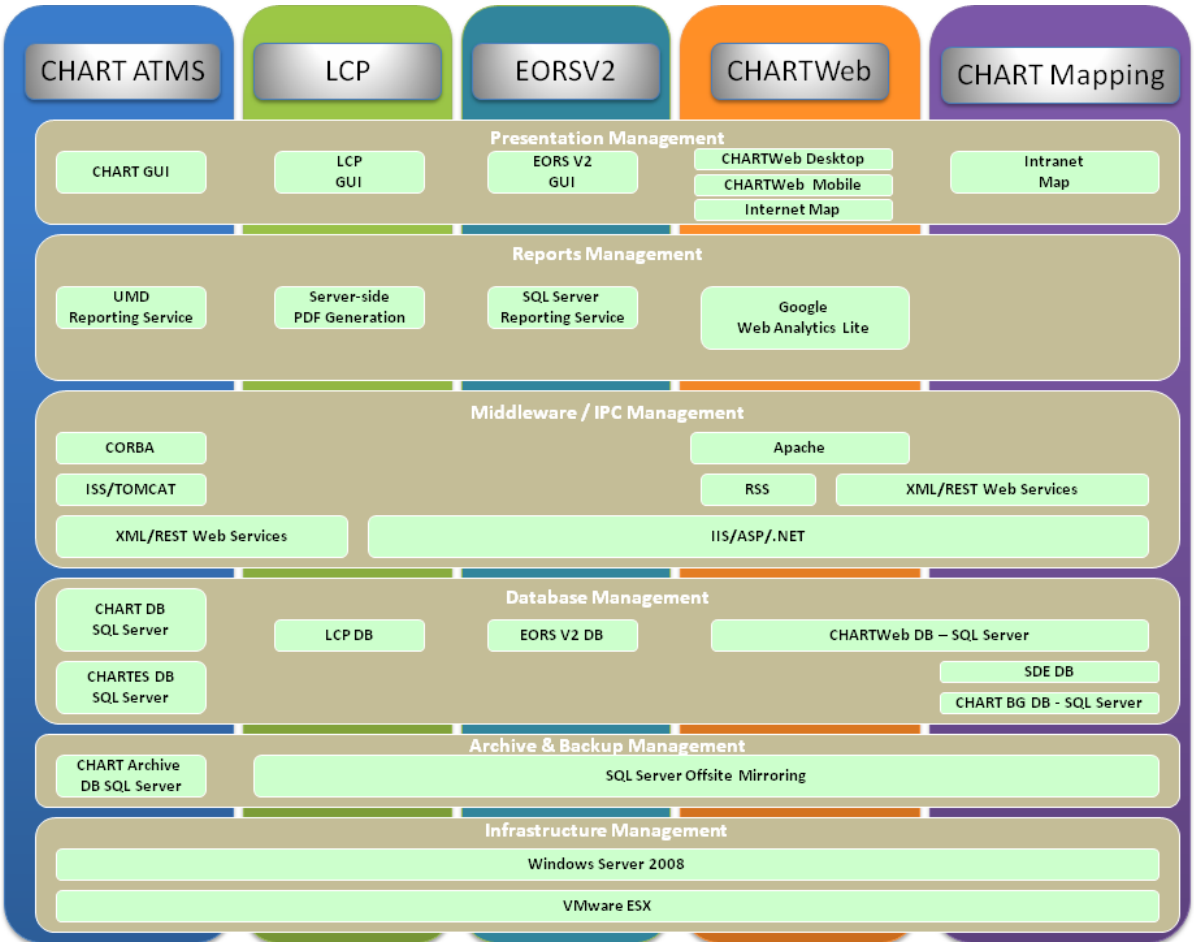

Figure 4-1. CHART Architectural Overview

The next two diagrams show various views of the CHART system architecture and how LCP fits within it. Figure 4-2 presents a high-level connection oriented architecture diagram showing how all of the internal and external systems connect to each other. Figure 4-3 presents a more detailed view of the components specific to the LCP System.

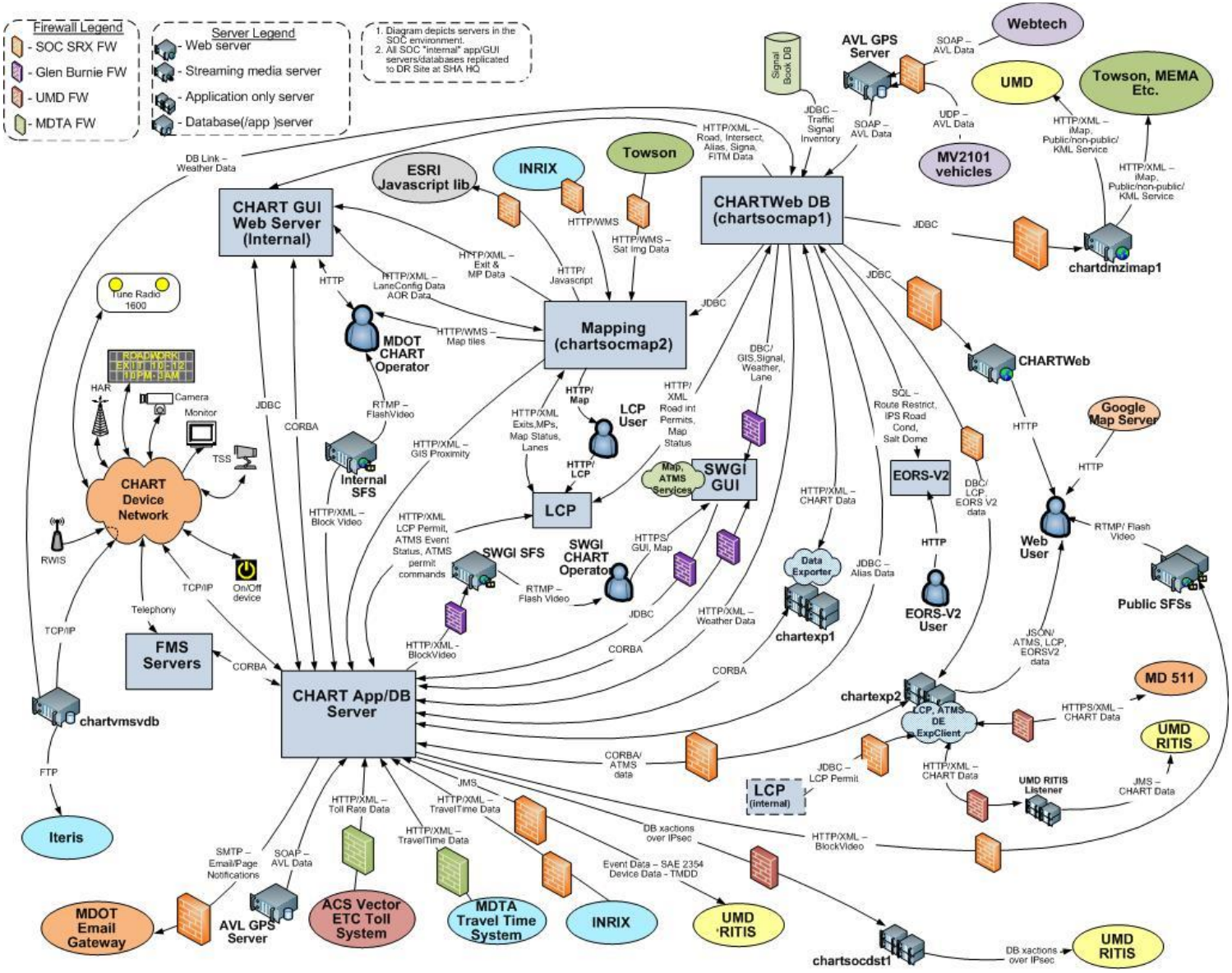

Figure 4-2. High Level CHART Systems Architecture

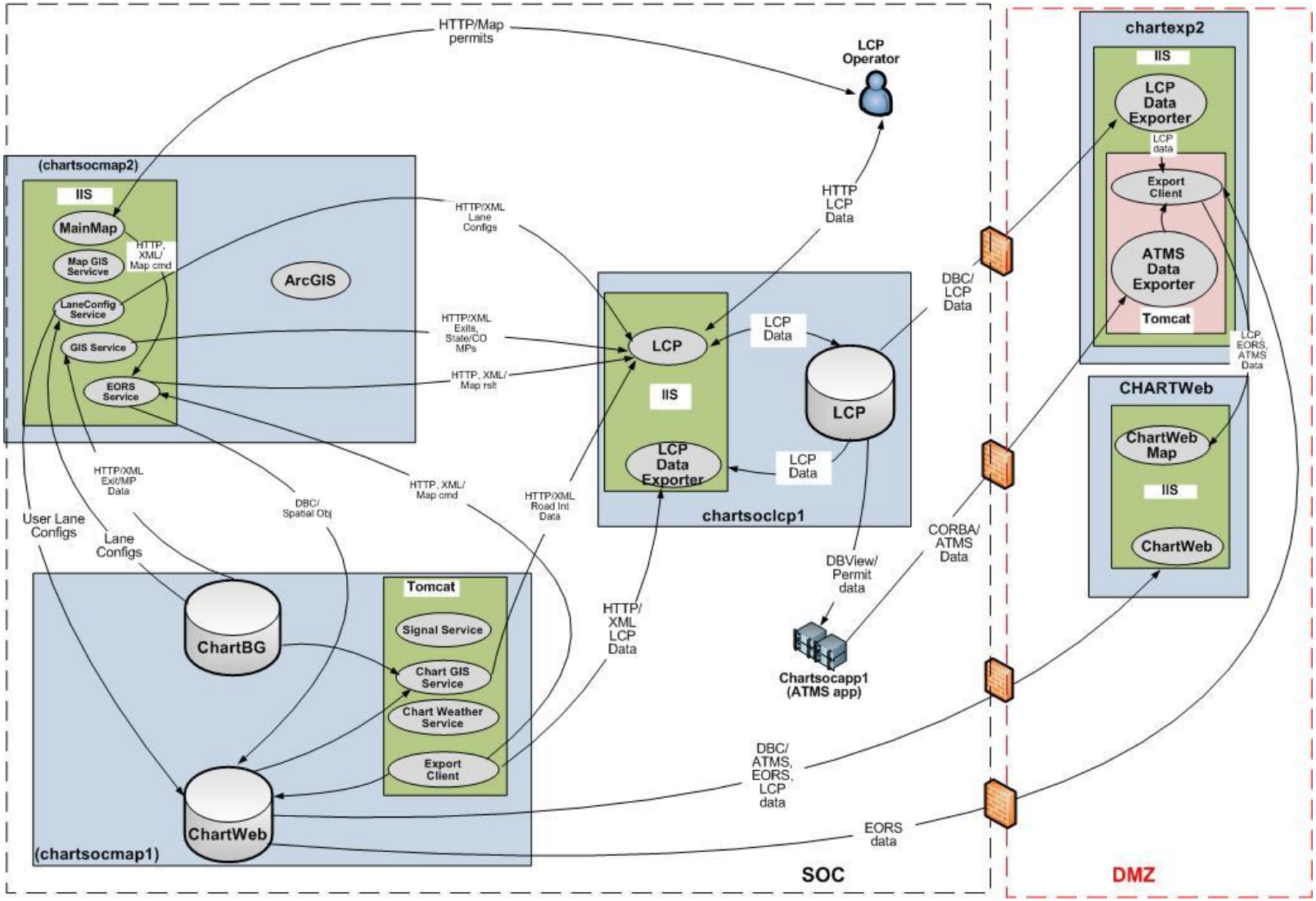

Figure 4-3. Lane Closure Permits (LCP) Detailed System Architecture (connect oriented)

4.3 Software components

4.3.1 Software CIs

There are 6 software CIs comprising the LCP system.

LCP Intranet Map UI – While technically part of the intranet mapping application, this CI consists of those services providing direct support to LCP users that create geolocations manually for LCP permits. The URL for mapping the locations of permits are provided by the LCP application.

LCP Desktop Web Application – This CI consists of the web based user interface used by MDSHA and MDTA personnel to create and manage LCP permits.

LCP Data Exporter – This CI consists of those services which provide data to consumers external to LCP.

COTS – This CI is a collection of all the COTS packages used by the LCP application. These are collected into a CI for configuration control purposes.

Database Instances – This CI consists of the databases: LCP and LCPArchive. These databases are accessed only through the LCP Desktop Web Application or LCP Data Exporter with the exception of the CHART ATMS application which reads directly from a database view in the LCP database to retrieve permit data. This functionality is expected to be converted to use the LCP Data Exporter in LCP Release 4.

4.3.2 Communications

4.3.2.1 Database communications and LCP Exporter

The CHART ATMS application queries permit data directly from the LCP database. All other external applications including the CHART Intranet Map, CHARTWeb and external users such as The University of Maryland CATT Lab will obtain permit data from the LCP Data Exporter.

4.4 Database

The overall LCP database architecture is shown in Figure 4-4.

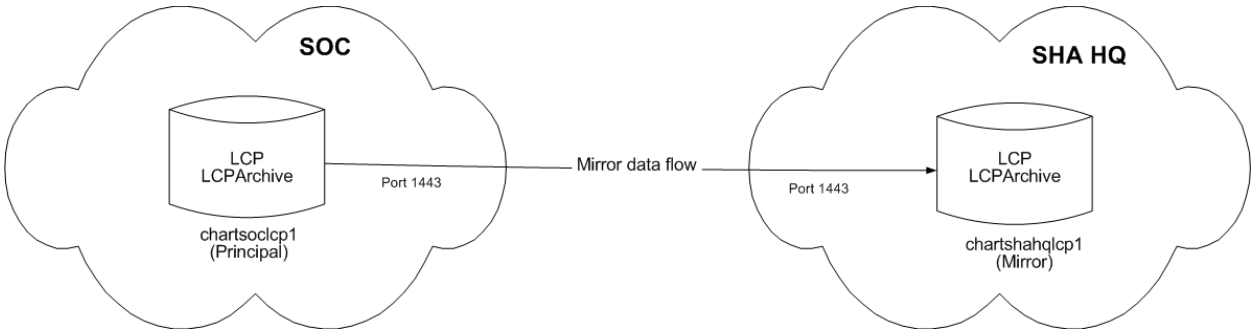

Figure 4-4. LCP Database Architecture

Both databases are mirrored to SHA Headquarters. The mirror databases are used for disaster recovery scenarios.

4.4.1 Archiving

Permit data in the LCP database is archived locally using a daily SQL Server database job that copies Expired permits into the LCPArchive database. The data in the LCPArchive is stored indefinitely and used as an access point to historical permits and related reports

4.4.2 Mirroring

The two LCP databases, LCP and LCPArchive, are mirrored from the Principal location at the SOC to the Mirror location at SHA Headquarters (HQ). This provides a duplicate copy of each database at SHA Headquarters, to be used by LCP services running at the SHA Headquarters failover site. This service is not running routinely. Before they can run, the mirrored databases at SHA Headquarters must be set to be Principal.

4.5 Hardware components

This section presents the hardware CIs that make up the LCP application. Each hardware CI is described and a list of major components is provided.

4.5.1 Hardware CIs

There are two hardware CIs for the LCP application.

LCP Application Server – Supports the LCP web based application as well as the web services used for the LCP Data Exporter. Also includes the database server.

CHARTEXP2 Server – This server lives in the CHART DMZ and supports the DMZ LCP Data Exporter, LCP DMZ Data Exporter Client (to feed CHARTWeb and CHARTWeb Mobile), the ATMS Data Exporter and Watchdog services.

4.5.2 LCP Application Server Description

The LCP application server system supports the LCP software CIs while the CHARTEXP2 server provides for the LCP Data Exporter and LCP Data Exporter Client in the CHART DMZ. These systems consist of a server along with associated storage array and network connection devices. These systems are currently deployed in a virtual environment at the SOC in Hanover. The LCP application server is also deployed and on an identical backup at SHA Headquarters in Baltimore. Currently no DMZ servers, including the CHARTEXP2 server, are deployed at SHA Headquarters.

The LCP Application Server system configuration is:

Intel XEON X5650 4 processor 2.67 GHz

12 GB Total SDRAM

70 GB C drive (OS), 40 GB D drive (Data), 20 GB G drive (Log), 100 GB H drive (Backup), 20 GB T drive (TempDB)

DVD Drive

Gigabit NIC card

The CHARTEXP2 Server system configuration is:

Intel XEON X5650 2 processor 2.67 GHz

5 GB Total SDRAM
40 GB C drive; 40 GB D: drive
Gigabit NIC card

5 INTERFACE VIEW

5.1 View Description and Typical Stakeholders

The Interface view describes connections to systems and users outside of LCP. LCP has external connections to ingest data for use in the LCP application. It also has interfaces to provide data to external entities that may then re-package the information for presentation to their end-users.

Typical stakeholders of this section are representatives from other agencies interested in LCP's capabilities, specifically software and system architects who may be looking to interface with LCP.

5.2 External Interfaces

Figure 5-1 shows the external interfaces to the LPC application.

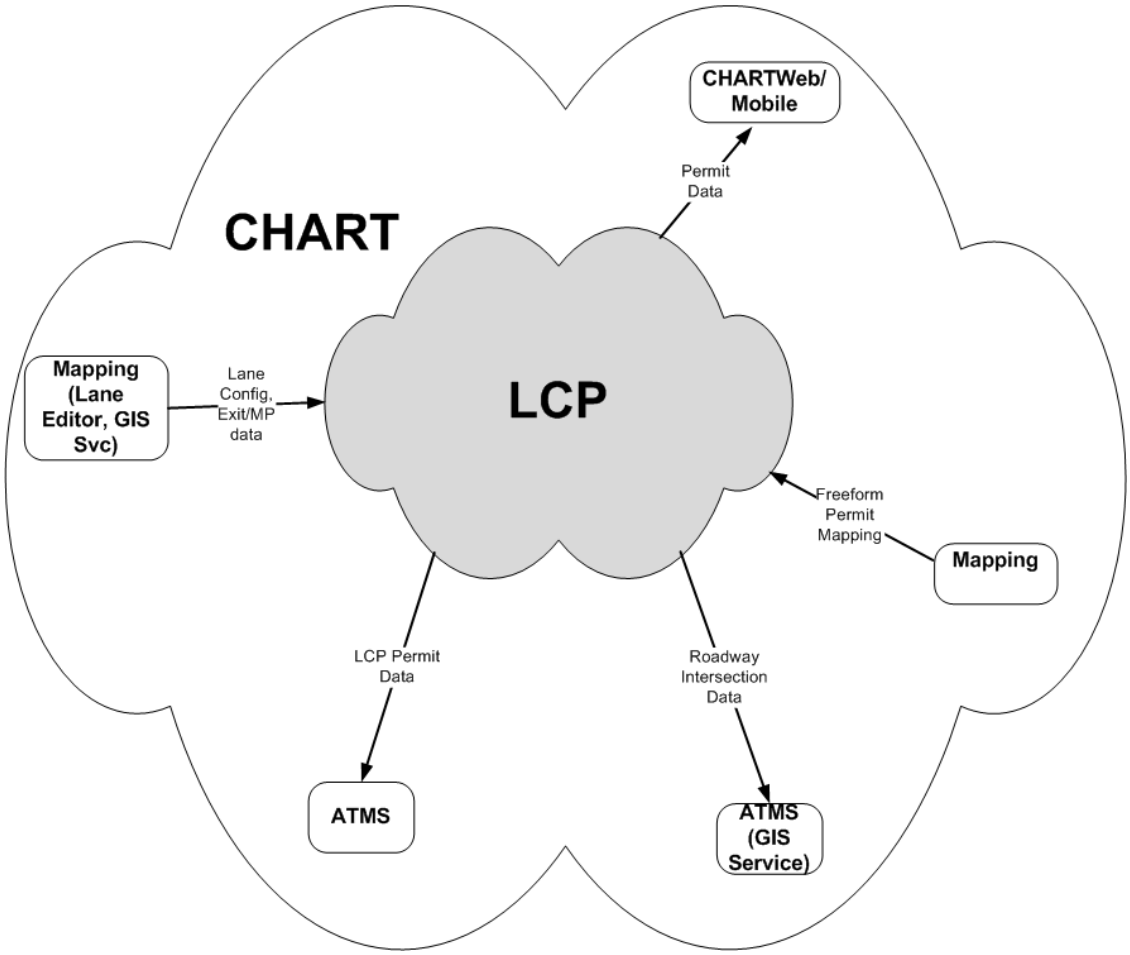

Figure 5-1. LCP External Interfaces

LCP's external interfaces consist of:

CHARTWeb – This public-facing site displays LCP Data (lane closure permit data) obtained via the CHARTWeb database.

CHARTWebMobile – This public-facing mobile-friendly site displays LCP Data (lane closure permit data) obtained via the CHARTWeb database.

CHART Advanced Traffic Management System (ATMS) – ATMS queries the LCP database directly to obtain LCP permit data. Future plans include providing this data through the LCP Data Exporter. LCP consumes roadway intersection data via a web service interface provided by the CHART ATMS application.

CHART Mapping – LCP provides data to the CHART Mapping application via the LCP Data Exporter. The LCP Data Exporter pushes permit data to the mapping application when new permits are created or changed. It also provides and interface that allows the CHART Mapping application to request permit data. In addition, LCP consumes data from the CHART Mapping application by requesting geolocation and lane configuration information. The CHART Mapping application also calls the LCP Data Exporter interface to inform LCP of changes to permit location as a result of a user changing locations using the CHART Mapping permit locator user interface. This is a required part of the LCP permit workflow when managing permits with free-form locations.

6 DATA VIEW

6.1 View Description and Typical Stakeholders

This view into LCP shows how data move into, out of, and around LCP and describes at a high level how LCP data is stored in the operational databases associated with the LCP application. This view is useful for LCP DBAs, management, developers, and stakeholders affiliated with the various systems with which the LCP application interfaces.

6.2 Data Flow

Data flows for the LCP application are illustrated in Figures 6-1 and 6-2.

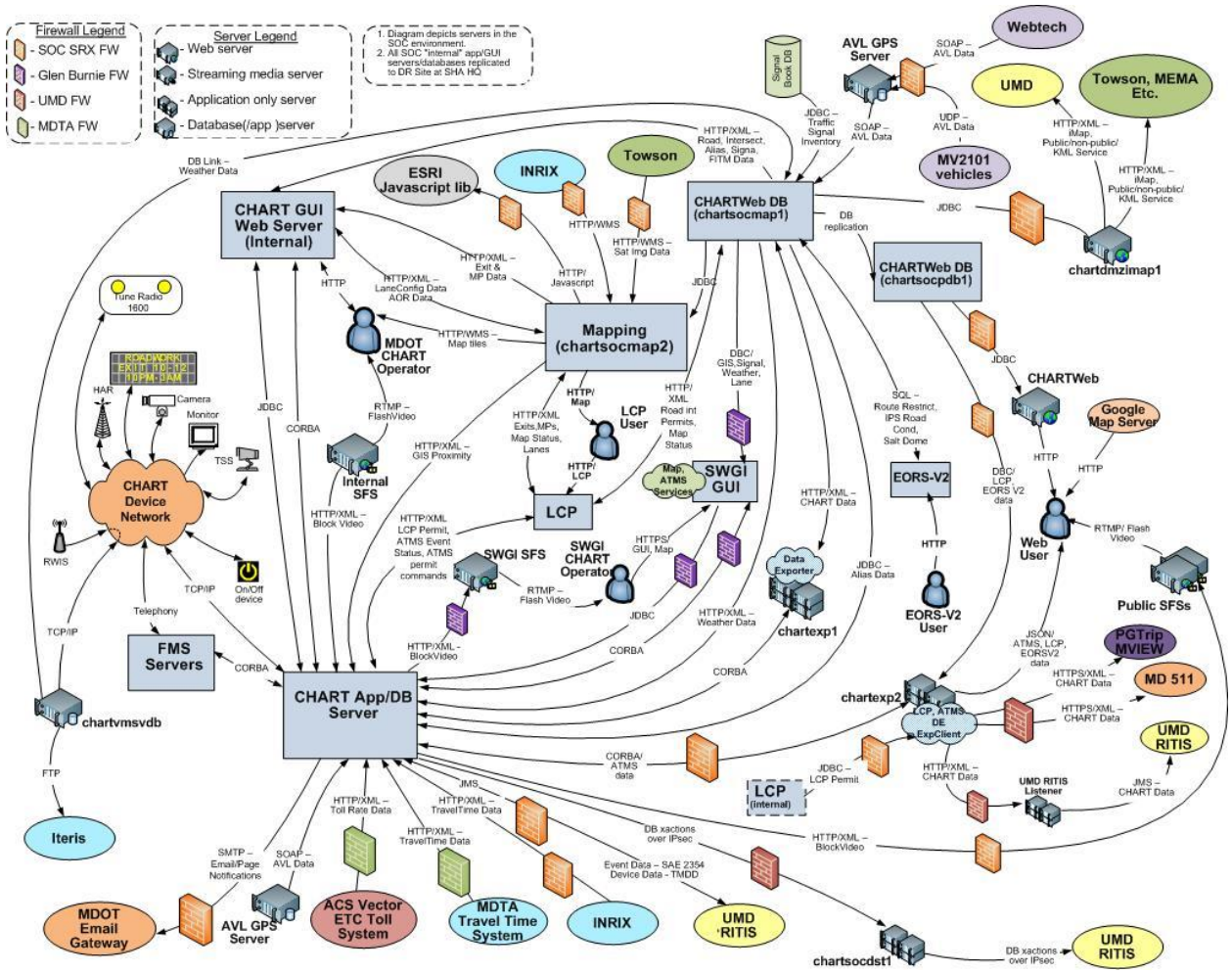

Figure 6-1. CHART High Level Data Flow

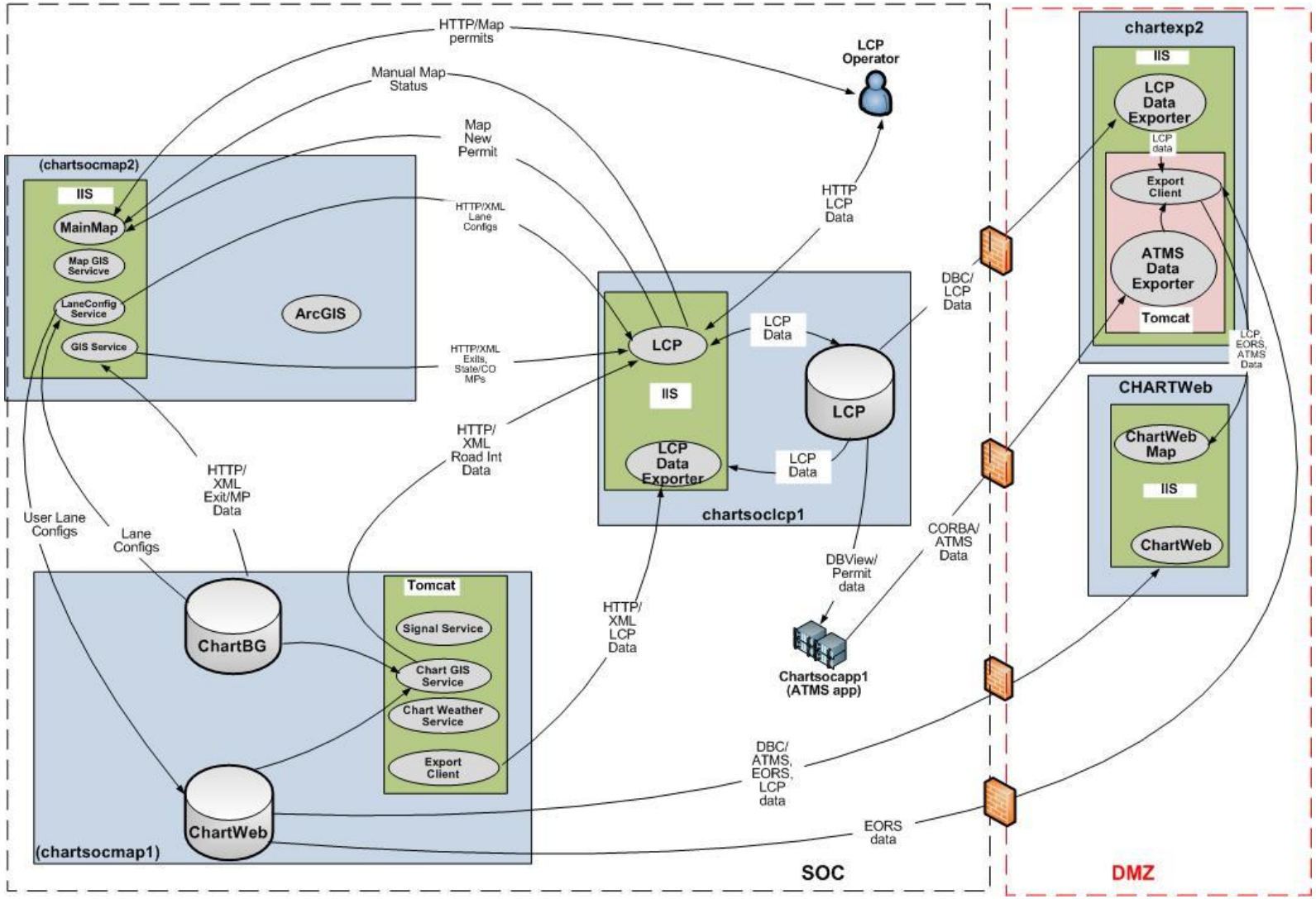

Figure 6-2. LCP Detailed Data Flow

6.3 Database

This section describes the LCP operational database design, at a high level. The database has static and dynamic data, multiple views, stored procedures, functions, database links, and jobs to copy data. The database design consists of these major areas:

- Lane closure permit data
- Static TCS and location data
- Lane closure permit data archive

6.3.1 Lane closure permit data

The Lane Closure Permit Data permit related data, including tracking number, type, location, and other attributes by type including lane configuration and permit state, contact information and geolocation data. This data is primarily operator driven and dynamic as 100+ lane closure permits may be activated each day, with numerous status changes.

6.3.2 Static TCS and location data

The static TCS and location area encompasses Traffic Control Standards entries and various static location data such as districts and counties. This data is subject to change over time but in general remains fairly static.

6.3.3 Lane closure permit data archive

The Lane closure permit data archive area encompasses permit data that is no longer needed for operations rather it has been stored for historical purposes. This data will grow over time as lane closure permits reach their end of life and are sent to the archive for long term storage. These permits may be copied into a new permit creation form but may never be altered once placed in the archive.

7 DEPLOYMENT VIEW

7.1 View Description and Typical Stakeholders

The deployment view describes the physical locations of servers and services. This view is useful for Operations and Maintenance personnel to identify relationships within and between servers. Network engineers may be particularly interested when identifying which protocols are expected between any pair of servers in the system.

7.2 Deployment Configurations

The nominal LCP software service configuration is shown in the table below. Under normal conditions the primary server executes all LCP services. In a fail-over situation, the failover virtual environment supports all LCP services. The required COTS packages to support LCP are also installed on each server per the LCP Operations and Maintenance Guide.

Table 7-1. LCP Deployed Services Per Site

Site	Server	Purpose	Service Name
Hanover -SOC	chartsoclcp1	LCP and LCP Archive Database	SQL Server(MSSQLSERVER)
		LCP Application	World Wide Web Publishing Service
		LCP Data Exporter	World Wide Web Publishing Service
Hanover -SOC	chartexp2	LCP Data Exporter (DMZ)	World Wide Web Publishing Service
Baltimore SHA HQ	chartshahqlcp1	<failover only> * (See Hanover - SOC chartsoclcp1 for details.)	* (See Hanover - SOC chartsoclcp1 for details.)

7.3 LCP Network/Deployment Diagram

Figure 7-1 shows the network diagram for CHART, including LCP.

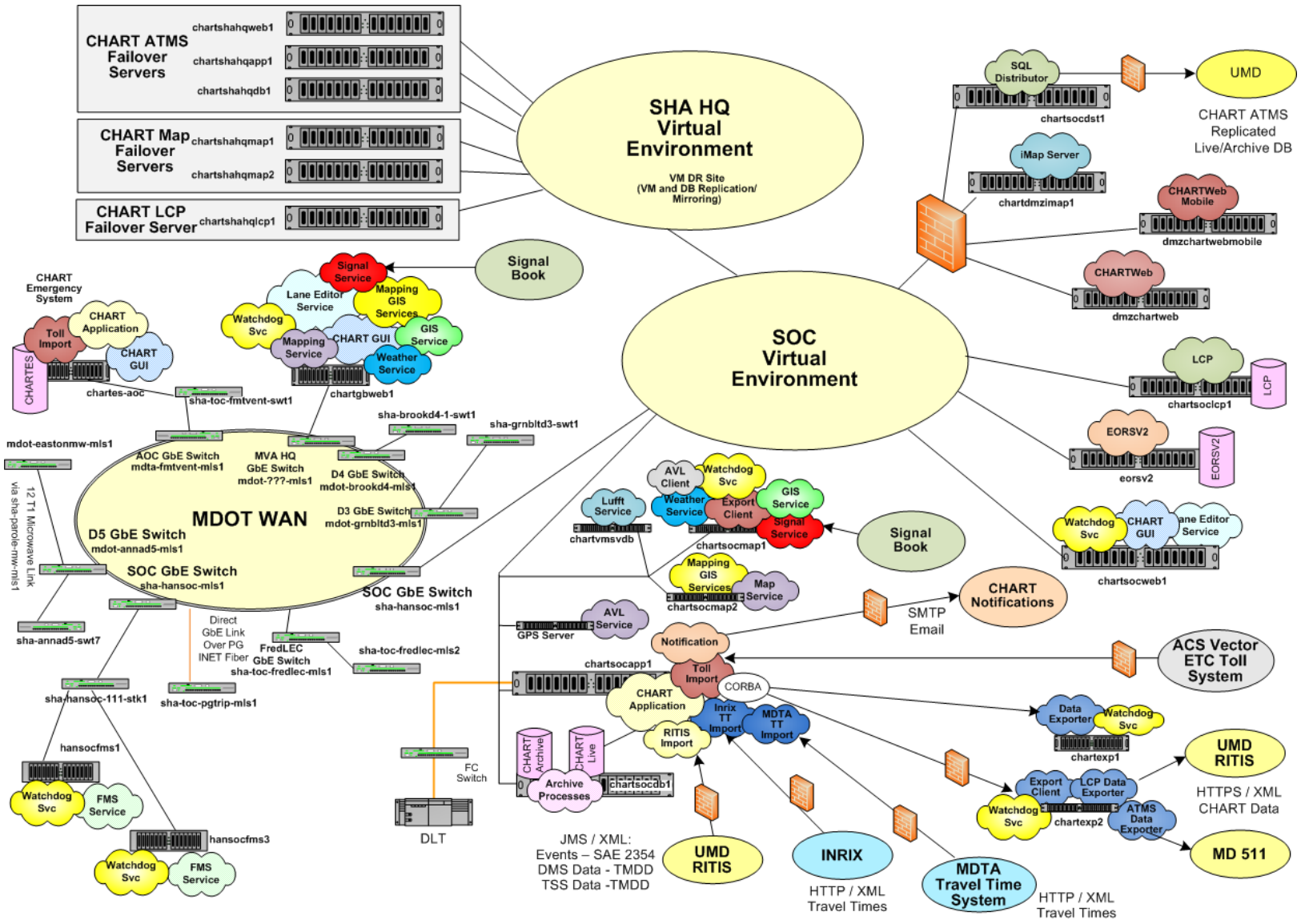

Figure 7-1. CHART Server/Switch Deployment

7.4 Facilities

This section presents the recommended deployment of hardware at each facility.

7.4.1 Node Sites

LCP database and application servers are primarily located at the SOC. The SOC houses the CHART virtual environment and is the central site for the coordination of CHART activities. The list below describes the equipment to be deployed at each site.

1. Hanover Statewide Operations Center (SOC) –
   Virtualized LCP application/database server
   CHARTEXP2 DMZ server
2. Baltimore SHA Headquarters
   Virtualized LCP application/database server

7.5 System Management and Support

This section discusses CHART system management activities and support provided for system monitoring and problem tracking.

7.5.1 Data Backup and Recovery

vRanger is used to create snapshots of the virtual machines then copies them to the failover site (Baltimore SHA HQ). The procedures responsible for performing the backups run automatically and require only periodic checks from LCP personnel to verify correct operation.

The system architecture and design minimizes the likelihood of having to recover an entire disk volume. The use of RAID 1 and RAID 5 arrays means that the system can perform self recovery in most instances. A more likely scenario would be the recovery of data due to corruption of some type. By taking periodic snapshots of the mission critical data and maintaining the Virtual Machine (VM) snapshots for a reasonable period of time a corrupted file could be restored to its last uncorrupted state.

7.5.2 System Monitoring

Transportation Business Unit (TBU) personnel monitor LCP server performance using Veeam ONE.

7.5.3 Problem Identification and Tracking

The CHART project uses the problem tracking tool Mantis to support CHART system problem reporting and tracking. Problems discovered prior to delivery of a release to operations are recorded as Level B Problem Reports (PRs) and problems discovered in an operational release are recorded as Level A PRs. PRs are handled as described in earlier documents “Level B System Problem Reporting in ClearQuest, CHART-CM-TE-006, June 2009” and “Level A System Problem Reporting in ClearQuest, CHART-CM-TE-004, June 2009”. Although the CHART Program has switched issue tracking systems, from IBM/Rational ClearQuest to JIRA, the essence of the workflow described in these documents is generally unchanged.

Problems discovered by the NOC are logged in the NOC’s Maximo system. Problems determined to be LCP software problems are used to create problem reports in the CHART Mantis system for tracking and resolution.

8 SUBSYSTEM VIEW

8.1 View Description and Typical Stakeholders

The Subsystem View describes the subsystems of the LCP application, their purpose, and how they are used. It describes all the COTS used in the system, and the source, version, usage, and redistributability of all the COTS. This view will be of primary use to developers, configuration managers, and management of CHART.

8.2 Software Subsystems

Table 8-1 lists each software and hardware Configuration Item (CI) and the subsystems comprising the CI. The sections that follow provide functional descriptions for each CI.

LCP is dependent upon network services provided through the MDOT backbone network. The management and control of the network is outside the scope of this document.

Table 8-1. LCP Configuration Items and Subsystems

CI Name	Subsystems
LCP Data Exporter Web Services	World Wide Web Publishing Service (IIS)
LCP Web Application	World Wide Web Publishing Service (IIS)
LCP Map UI (via Intranet Map)	World Wide Web Publishing Service (IIS)
Operational Database Instance	LCP Operational DB
Archive Database Instance	LCP Archive DB
COTS	.NET framework 4.5 Microsoft Visual Studio Ultimate 2013 Microsoft SQL Server Microsoft Windows Subversion Subversion browser TortoiseSVN

8.2.1 LCP Data Exporter Web Services

The software services comprising the LCP Data Exporter Web Services CI are briefly described below.

8.2.1.1 World Wide Web Publishing Service

This service is used to provide the ASP.NET Web API services that provide the LCP Data Exporter services to external entities.

8.2.2 LCP Web Application

The software services comprising the LCP Web Application Services CI are briefly described below.

8.2.2.1 World Wide Web Publishing Service

This service is used to provide the ASP.NET MVC services that support the LCP Web Application.

8.2.3 Database Instance Subsystems

There is only one software subsystem comprising the Database Instance CI. This subsystem is briefly described below.

8.2.3.1 Operational DB

This subsystem comprises the live Microsoft SQL Server databases used by LCP. There are two databases: LCP and LCPArchive. The LCP database stores all permit related data. The LCPArchive database stores all archived permits that are no longer in operational use.

The LCP and LCPArchive databases are mirrored to the SHA Headquarters backup site for redundancy purposes.

8.2.3.1.1 Mirroring

This subsystem comprises the Microsoft SQL Server functionality that mirrors the LCP databases between the primary LCP site located at the Statewide Operations Center (SOC) in Hanover and the backup LCP site located at State Highway Administration (SHA) Headquarters in Baltimore. Both the LCP and LCPArchive databases are mirrored. Mirroring is configured, monitored, and managed by the CHART DBAs.

8.2.3.1.2 Query

This subsystem provides the ability to query the database, for purposes of examining the database and manipulating data in the database, from a program perspective and via the SQL Management Studio, and also, not formally part of the LCP application.

8.2.4 COTS

The COTS CI collects all COTS packages into a single CI for configuration control purposes. This CI is used to track the COTS packages and versions used. Rather than list each subsystem in paragraphs, the COTS packages used throughout the system are described in Table 8-2 below. Package redistributability is designated as Open source, Free (freely available, but without source), or Proprietary (purchased or otherwise restricted). Usage is listed as Development, Runtime, both Development and Runtime, or Administrative. For COTS that is both Development and Runtime, the predominant usage, if that makes sense, is listed first. Administrative usage is listed when the product is not required to build the system, even if the product is a key part of the development effort, such as Microsoft Visual Studio, which developers use extensively.

Table 8-2. COTS Packages

Product Name	Version	Description/Purpose	Redistributability	Usage
Atlassian JIRA	6.4	The CHART Program uses JIRA for project management and tracking PRs.	Proprietary	Administrative
Microsoft SQL Server	2008 R2	LCP uses Microsoft SQL Server 2008 to host its databases.	Proprietary	Runtime
Microsoft Visual Studio (including .NET 4.5)	2013 Ultimate	LCP uses Microsoft Visual Studio 2012 Ultimate for C# source code development. Necessary library files are used in the runtime environment.	Proprietary	Development Runtime
Microsoft Windows	2008 Server	LCP uses Microsoft Windows 2008 Server as its standard runtime platform for the LCP application/database servers.	Proprietary	Runtime
RedGate SQL Backup Pro	6	LCP uses these parts of the RedGate DBA Bundle monitoring tools to support the backup and restore processes and to monitor database performance	Proprietary	Runtime
RedGate SQL Monitor	2.3.0			
Sparx Enterprise Architect	9.3.934	LCP developers use Enterprise Architect by Sparx for UML modeling and design tool.	Proprietary	Administrative
Subversion	1.6	LCP uses Apache Subversion for source code control.	Open source	Development
Subversion browser TortoiseSVN	1.6.15	Official LCP builds use TortoiseSVN subversion browser. Some developers may use TortoiseSVN as well.	Open source	Development
vRanger Backup & Replication	5.3.1	The CHART Program uses vRanger Backup & Replication by Quest Software to maintain system backups. This subsystem is not part of the LCP per se, but serves in a support role. Therefore it is listed as having Administrative usage, rather than Runtime usage.	Proprietary	Administrative
XML Spy	2009 Pro SP 1	LCP developers use XMLSpy to visualize, edit, and generate XML and XSLT used by the LCP and by some of the external systems which interface with the LCP.	Proprietary	Development

9 STANDARDS VIEW

9.1 View Description and Typical Stakeholders

This view into the LCP application describes how LCP supports interoperability through the .NET Web API. This view is useful for MDSHA management, LCP developers, and those looking to interface with LCP for the purpose of consuming/display LCP data.

9.2 Standards Overview

The LCP application sits on the Microsoft .NET Architecture and supports a number of interoperability standards.

The LCP application supports multiple approaches to interoperability:

- Web—XML, REST
- Enterprise Integration—XML, SQL
- Application Content—PDF

10 Future LCP Releases

Future releases of LCP include features to support/communicate with other CHART applications.

Table 10-1 LCP Future Release Functions

CI	Subsystem	Function
CHART ATMS Application Integration	CHART ATMS	Integrate ability to perform operations on permit data through web service interfaces.
CHART Intranet Map Integration	CHART Intranet Map	Integrate map into LCP user interface. Conflict detection. Location alias.
Application Management	LCP	Web Application Manager Permit Message Scheduler

10.1 Near Term Goals

10.1.1 CHART Intranet Map Integration

The CHART Intranet Map user interface is used to specify permit locations for permits that do not utilize the location presets in LCP. This user interface is currently only available in a separate browser instance or tab. This effort seeks to integrate the mapping user interface directly into the LCP user interface. Other future items include using location and permit data for conflict detection and location aliases.

10.1.2 LCP Application Management

LCP Application Management will provide application-wide enhancements that allow an administrator to take the site down for maintenance activities and post messages site wide. The Permit Message Scheduler will provide the ability to display custom messages related to permit management. An example would be a message that reminds users not to activate a given permit during a holiday weekend.

11 SYSTEM MAINTENANCE VIEW

11.1 View Description and Typical Stakeholders

This section provides a view into the high level LCP maintenance tasks. This includes system maintenance (including backup and recovery), database maintenance, and routine software maintenance. The LCP Operations and Maintenance Guide contain much more detailed information on these routine maintenance tasks. Interested stakeholders would be system administrators, software and system architects, and any other parties interested in a high level view of maintenance tasks for LCP.

11.2 Data Backup and Recovery

Data backup and recovery are implemented at both the system level and the database level. Database level backups are needed in order to guarantee transactional integrity and to prevent database backup corruption.

11.2.1 Data Backup

11.2.1.1 Virtual Environment

Procedures for backing up the virtual environment are not covered in the LCP Operations and Maintenance Guide. These tasks are performed by Transportation Business Unit (TBU) personnel following procedures maintained by TBU staff. Most of these procedures can be found in the CHART Virtualization Operations and Maintenance Guide.

The ability to "snapshot" a virtual server provides the ability to roll back a server to a previous state should an issue occur with that server, and simplifies maintenance and administration by allowing patches and upgrades to be easily and quickly backed out if necessary.

Full image snapshots are taken nightly and copied to an offsite location at SHA Headquarters (HQ) in Baltimore. Included in these snapshots are local snapshots with file and image-level restore functionality.

11.2.1.2 Database

Database backup tasks and the procedures for executing those tasks are detailed in the LCP Operations and Maintenance Guide. Backup jobs are run using the SQL Backup tool by Redgate. Those tasks include:

Full database backup

Transactional database backup

Differential backup

In addition, the LCP databases are mirrored from the SOC to the backup site at SHA HQ. The database mirroring procedures are described in the LCP Operations and Maintenance Guide. The mirrored databases can be recovered to the prime site at the SOC or utilized at SHA HQ in a failover scenario.

11.2.2 Data Recovery

11.2.2.1 Virtual environment

The site at SHA HQ exists as a redundant and disaster recovery capable location where individual pieces or the entire suite of CHART applications (CHART ATMS, CHART Mapping, LCP, etc.) can exist if necessary. All CHART servers may be instantiated at SHA HQ, including both theLCP server and other servers within the CHART enterprise, including a number of applications that LCP interfaces with. Should a full site recovery at SHA HQ be necessary, all non-database data would be recovered within a datastore replication window. For LCP, all relevant data is stored in the database and the database recovery process is executed as an additional step after servers have been instantiated at SHA HQ.

11.2.2.2 Database

Database recovery can be accomplished through these mechanisms as detailed in the LCP Operations and Maintenance Guide:

Recovering database backup

Recovering mirrored database from SHA HQ

Utilizing mirrored database at SHA HQ

11.3 System Monitoring

Cern Virtual Infrastructure (CVI) administrators will access the environment through a variety of tools, depending upon the task and required method of access.

11.3.1 Virtual environment

The vSphere Client provides the most comprehensive access to the VMware environment, allowing administrators to add, delete, modify, move, and monitor the physical and virtual machines. “Console” access is granted through this tool, as well as providing basic monitoring and environmental health visible through the client. The client may be downloaded via web browser using the address of the vCenter server, one of the individual hosts, or from www.vmware.com.

A Secure Shell (SSH) client, such as Putty, may be used for access into the root console of the VMware hosts for administration or maintenance that is not available within the vSphere Client. This typically is used for application of hotfixes and upgrades to the physical hosts, detailed log viewing, or high-level administrator activities.

vFoglight provides monitoring capabilities with limited access to virtual machines and physical hosts. vFoglight is accessed via web browser through a specific port for both monitoring and configuration. vFoglight is used to monitor CPU usage, memory usage, disk usage, and I/O statistics, etc. vFoglight can generate alarms and notifications based on defined thresholds.

Hewlett-Packard (HP) 4000 Centralized Management Console (CMC) provides access to the storage backend. This is where new volumes are created and deleted and assigned or unassigned from servers.

Integrated Lights-Out (iLO) provides access to the HP hardware, which can be managed from the Blade Enclosure management connection, or from a web browser pointed to the

correct IP address. In addition, hardware can be managed from a Liquid Crystal Display (LCD) screen on the front of the blade enclosure, directly connecting into the blade via a dongle connection, or through keyboard-video-mouse (KVM) switch connection to the Storage Area Network (SAN) or Blade hardware.

11.3.2 Database

Database backup jobs are monitored using Red Gate SQL Backup tools. These tasks are detailed in the LCP Operations and Maintenance Guide. Specific tasks include:

Observing last backup run time and status

Check of physical file backup on the appropriate server

The database mirroring process is also monitored using Red Gate tools. These procedures also are described in detail in the LCP Operations and Maintenance Guide.

11.4 High Availability

The CHART system design provides high availability through these methods.

Redundancy within virtual environment

Redundancy of communications paths

Database mirroring

Offsite backup capabilities for LCP and the entire virtual environment

Each of these methods will be discussed in more detail below.

11.4.1 Redundancy within the Virtual Environment

The CHART Virtual Infrastructure provides redundancy through the implementation of a cluster of hardware and software packages.

Storage is provided by a multi-node Internet Small Computer System Interface (iSCSI) SAN cluster with redundant network connections accessible by all devices. This storage is replicated nightly to the SHA HQ site. The current configuration allows several individual component failures within the SAN without loss of data or the need to fail over.

Hardware hosting the virtual servers provides protection against data and service loss with several components having 100% redundancy. For instance, the “Flex 10 networking modules” are completely redundant. The physical hosts themselves can tolerate the loss of 1/3 of the available physical hosts and still maintain full capabilities when the impacted virtual hosts are moved to the remaining physical hosts(s).

Network and power redundancy are also at 100% with the ability to lose a full network or power feed without adversely affecting the environment.

Local backups provide an additional layer of security, allowing the retrieval of full VMs instantly, and file-level recovery without resorting to SAN backups.

VM Application and hardware configuration provides automatic failover of many components, including the ability to distribute resources, re-locate virtual servers on demand, take snapshots of servers prior to updates/upgrades, etc.

11.4.2 Redundancy of Communications Paths

There are redundant or backup communications paths for the CHART Backbone network traffic.

11.4.3 Database Mirroring

SQL Server mirroring has been established between the databases at the principal node at the CHART SOC data center and mirror node at the SHA HQ data center. Both the LCP and the LCPArchive operational databases are mirrored. A single identically configured server resides at each of the nodes from both a hardware (virtual) and software perspective.

As database transactions are committed in the principal node these transactions are copied over to the mirror node. The copying happens in real time and the data is in a synchronized state between the nodes. The level of synchronization can be set to be either dual commit or single commit mode. In a dual commit mode the database transaction is written to both nodes and only then will the relevant locks be released. In a single commit synchronization mode, transactions are committed at the principal node and locks are released. As a follow-on action these transactions are forwarded to the mirror node.

The LCP database is configured in a single commit synchronization mode. In a future release, the LCP application could be modified to take advantage of automatic failover, in which case the dual commit synchronization mode with automatic failover could be used.

In case of a database failure at the principal node, the LCP database will be manually failed over to the mirrored node. A pre-configured LCP application installation exists at the mirrored node to point to the mirrored database. This allows failover to a secondary site in minimal time as the data will be copied in real time to the secondary site.

11.4.4 Offsite Backup Capabilities for the Virtual Environment

Full image snapshots are taken nightly and copied to the SHA HQ location in Baltimore. Included in these snapshots are local snapshots with file and image-level restore functionality.

The site at SHA HQ exists as a redundant and disaster recovery capable location where individual pieces or the entire CHART system can exist if necessary. Currently, the entire CHART network at the SOC can be failed over to SHA HQ. Details are provided in the CHART Virtualization Operations and Maintenance Guide. It is also possible for just LCP to be run at SHA HQ, although there are few if any scenarios where this would be beneficial.

Details of the LCP manual failover procedure can be found in the LCP Operations and Maintenance Guide.

Additional details on LCP failover to SHA HQ can also be found in the LCP Application Recovery Plan.

11.5 Software Distribution

This section presents the procedures and processes used to control and manage the development and distribution of the LCP software.

11.5.1 Configuration Management and Version Control

The overall Configuration Management (CM) plan for CHART is presented in the document "CHART Configuration Management Plan, PM-PL-004, August 2008." The specific objectives of the CHART CM program are to ensure that:

CHART hardware, software, and data configuration items (CIs) are appropriately selected and identified

CHART project baselines are established at the correct time

Changes to the CHART baselines are authorized, evaluated, implemented as approved, verified, and tracked in accordance with established procedures

Commercial off-the-shelf (COTS) tool upgrades are fully assessed and their impact evaluated

The status of CHART baselines and proposed and approved changes is accounted for and reported

Baseline and other required CM audits are carried out and the results reported

The integrity of the system design is maintained

The delivered system and all accompanying deliverables are accurately defined and described

The LCP development team is using Subversion as the configuration management tool to support LCP software development. The configuration management policies and procedures for the LCP software are defined in a set of standards and procedures documents. These standards and procedures documents are listed below.

Review and Approval of COTS Upgrades, CHART-CM-PR-001, 2/2009

11.5.2 Software Installation

The installation of new versions of LCP software components is controlled through a Software Control Notice (SCN) as described in the document "Software Control Notice Procedure, June 2009". The detailed plan for executing the installation is contained in the LCP Implementation Plan that is customized for each LCP software release. For new site installations the software components are installed and configured prior to integration of the system into the operational environment. Appendix A of the LCP Operations and Maintenance Guide presents instructions for performing software installations on operational system components. This includes installation of both COTS and of the LCP software proper.

11.6 Training

Training of CHART operations staff in the use of the LCP is provided via several means.

LCP can be installed in a training environment where users can operate the system without interfering with production.

A training plan is developed for each LCP software release. Training sessions are conducted by MDSHA at their discretion.

LIST OF ACRONYMS

The following table lists the acronyms used in the document.

Acronym	Description
AOC	Authority Operations Center
API	Applications Programming Interface
ATMS	Advanced Traffic Management System
AVL	Automatic Vehicle Location
BAA	Business Area Architecture
BHT	Baltimore Harbor Tunnel
CATT	Center for Advanced Transportation Technology
CCTV	Closed Circuit Television
CHART	Coordinated Highways Action Response Team
CM	Configuration Management
COTS	Commercial Off-The-Shelf
CVI	Cern Virtual Infrastructure
DB	Database
DBA	Database Administrator
DCDOT	District of Columbia Department of Transportation
EORS	Emergency Operations Reporting System
ER	Entity Relationship
ERD	Entity Relationship Diagram
FC	Fibre Channel
FMT	Fort McHenry Tunnel
FSK	Francis Scott Key [Bridge]
GUI	Graphical User Interface
HA	High Availability
HISD	Highway Information Services Division
HP	Hewlett-Packard
HQ	Headquarters
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
I	Interstate

Acronym	Description
ICD	Interface Control Document
iLO	Integrated Lights-Out
IP	Internet Protocol
iSCSI	Internet Small Computer System Interface
JSON	JavaScript Object Notation
KVM	Keyboard-Video-Mouse [Switch]
LCD	Liquid Crystal Display
LCP	Lane Closure Permits
MD	Maryland
MD511	Maryland 511 (Maryland's 511 Traffic information System)
MDOT	Maryland Department of Transportation
MDSHA	Maryland State Highway Administration
MDTA	Maryland Transportation Authority
NOC	Network Operations Center
PR	Problem Report
REST	Representational State Transfer
RITIS	Regional Integrated Transportation Information System
RSS	Really Simple Syndication
RTMS	Remote Traffic Microwave Sensor
SAN	Storage Area Network
SCSI	Small Computer System Interface
SHA	State Highway Administration
SOC	Statewide Operations Center
SOP	Standard Operating Procedure(s)
SP	Service Pack
SSH	Secure Shell
SSP	Safety Service Patrol
SwGI	Statewide Government Intranet
TCP	Transmission Control Protocol
TOC	Traffic Operations Center
UMD	University of Maryland
US	United States
vCPU	Virtual CPU

Acronym	Description
VM	Virtual Machine
WAN	Wide Area Network
WMS	Web Map Service
WYSIWYG	What You See Is What You Get
XML	Extensible Markup Language

A DESIGN STUDIES

This section provides information on analysis, prototyping, and trade studies dating from the initial system design effort to the current time.

A.1 CHART Systems Database Strategic Plan

The purpose of this study, completed in April 2011, was to identify database options for the full CHART Program that would maximize technical and financial benefit to SHA's business goals. The subsequent CHART Work Order Scope and Estimate Request Form requested the production of a white paper document to recommend a 5 year strategic plan for the CHART systems databases and also, after a checkpoint with SHA, to create a plan including a schedule, assumptions and risks to implement the approved recommendations.

The assessment was approached using the Enterprise Architecture Framework as defined by the National Institute of Standards and Technology. This approach gives a holistic view of the enterprise. The Enterprise Architecture has 5 layers. The five layers are:

- Enterprise Business Architecture Layer
- Enterprise Information Architecture Layer
- Enterprise Application Architecture Layer
- Enterprise Application Integration Architecture Layer
- Enterprise Infrastructure Architecture Layer

The Enterprise Business Architecture Layer review for SHA was carried out previously by CSC and is reflected in the Business Area Architecture document: BAA Report Revision 6, January 2011. The recommendation for this layer was to continue on those specified in BAA.

The Enterprise Information Architecture Layer is comprised of the Presentation Management and Reports Management layers. In the Presentation Management layer of SHA, there are several Graphical User Interfaces identified. These are CHART GUI, EORS V2 GUI, LCP (known as EORS Legacy at the time) GUI, CHARTWeb Desktop, CHARTWeb Mobile and the Intranet Map. The recommendation for this layer was to establish a single EORS (LCP) GUI, establish CHART Analytics GUI, establish an Attention Admin GUI and continue to use the following GUIs; CHARTWeb Mobile, CHARTWeb Desktop, CHART GUI, Intranet Map (ArcGIS) and implement a portal tool that will unify and enable a role-based Single-sign on.

In the Reports Management portion of the Enterprise Information Architecture, several report conduits were identified: SREE, SQL Server Reporting Service, Legacy Reporting Service, and Google Web Analytics Lite. The recommendation for this layer was to retire SREE, consolidate all SQL Server Reporting services, establish CHART dashboards, CHART Analytics (Business Intelligence tool) and use Google Urchin.

The Enterprise Application Architecture Layer is comprised of four core applications, which are the CHART ATMS, LCP (EORS at that time), CHARTWeb and CHART Mapping. The recommendation at this layer was to continue to have the applications remain independent of each other and integrate in the middleware layer.

The Enterprise Application Integration Architecture Layer is comprised of the middleware/IPC management layer. The CHART middleware management is using CORBA, Apache Tomcat, IIS, ASP, .NET, RSS, XML Web Services, and REST Web Services. The recommendation for this layer was that CHART is already on a good path and should continue to

use Tomcat, IIS, ASP, .NET, RSS, and Apache. It was recommended that CHART implement an Enterprise Service Bus (ESB), establish web orchestration using BPEL, establish a form of Workflow mechanism using BPM, and establish a Web Services Manager and Service Registry. These middleware upgrades could possibly lead to the replacement of CORBA as an IPC solution for the CHART ATMS at some point in the future.

The Enterprise Infrastructure Architecture Layer is comprised of Database Management; Archive and Backup Management; and the physical Infrastructure Management. The recommendation for the Database Management portion was for SHA to use web services for communication and take the "Federated Option" which consists of the following components:

Attention Database (paging system)

A consolidated CHART Database

CHART BG Database (SDE & Mapping)

A consolidated database for LCP (EORS at that time)

CHART Web Cache Database

CHART Analytics Database (CHART-A)

This recommended approach would give SHA flexibility for growth, while systems and development cycles remain independent. It also provides a quicker patching cycle and keeps all application communication at the middleware layer. At the database layer, the recommendation is to consolidate databases where possible and implement an enterprise data governance strategy. The recommendation for the physical Infrastructure Management portion is for SHA to continue on the path of establishing VMware ESXi and upgrading to a more recent version of the Windows Server operating system. The ArcServe Backup product recommended by CHART's infrastructure team will be implemented.

B RELEASE HISTORY

CHART systems have been evolving over a long period of time. The LCP application began as a subset of the original Emergency Operations Reporting System (EORS) application now referred to as Legacy EORS. The Legacy EORS Road Closures module was later given a technology upgrade and ported into a new free standing application now referred to as Lane Closure Permits (LCP). A summary description of the system capabilities for each of the LCP releases is presented in the following sections.

C.1 LCP Release 1

Following is a summary of the major features provided by LCP Phase 1:

- **Permit Creation**

  Permit Creation provide the ability to create a permit and designate which lanes are allowed to be closed.

- **List Permits**

  List Permits provide the ability to search for permits as well as filter and browse permits listings.

- **Permit Details**

  Permit Details provide an interface to view the details of a permit and to perform actions on the permit including edit, copy, delete, etc.

- **Permit Reports**

  Permit Reports provide a Permit Details report that contains all of the information associated with a single permit in the application.

- **Permit Approval**

  Permit Approvals provide the ability to view permits that are awaiting approval and the ability to approve or reject them.

- **Server Jobs**

  Server Jobs provide automated actions of the system such as automatically deactivating permits using server side scheduled jobs.

- **User Management**

  User Management provides user authentication, authorization and role management for the application.

The table below shows packages used to support the LCP Phase 1 build.

Package Name	Package Description
LCP.App	This main package supports the new Lane Closure Permit application functionality.
LCP.ExternalInterface.CHART	This package supports communication to external CHART GIS and MAPGIS web services.
LCP.App.Permit	This package contains functionality necessary to manage permits.
LCP.App.UserManagemant	This package contains functionality necessary to manage roles, users, and to utilize user profiles.
LCP.Utility	This package contains common utilities to support the Lane Closure Permit application.

C.2 LCP Release 2

Following is a summary of the major features provided by LCP Phase 2:

- **District Approvals by Permit Type**

  The District Approvals by Permit Type module provides the ability for a district administrator to designate that certain permit types will automatically approve, require manual approval, or defer to the settings in the Roadway Approval Manager. This feature is part of an updated permit workflow that will determine the approval state for the permits.

- **Roadway Approval Manager**

  The Roadway Approval Manager allows a district user to designate which primary routes will require approval. This feature is part of an updated permit workflow that will determine the approval state for the permits.

- **Workflow Manager Log**

  The LCP Workflow Manager Log management module was developed to display the logged actions for the Roadway Approval Manager and the District Approval by Permit Type modules.

- **Search Permits**

  This feature provides additional features to allow users to search for permits in order to view the permit data or run reports.

- **Permit Reports**

  This module provides three additional permit reports was well as new user interfaces for the creation of permit reports in PDF format.

C.3 LCP Release 3

Following is a summary of the major features provided by LCP Phase 3/ CHART Mapping R15 and CHART ATMS 13.2:

- **Permit Archive/Server Jobs**

  LCP Phase 3 will implement a permit data archive that will reside within the overall LCP application. This archive will provide the ability to separate permits into those permits that are currently needed for day to day operations and the permits that have been in the "expired" state for a period of sixty days and are no longer needed for day to day operations. These expired permits will be classified as "archived" and will moved daily into database tables that are distinctly separate from those used to store current permits thereby reducing the number of permit records that need to be traversed by the application during daily use by district and SOC operational staff.

- **Search Permits**

  The LCP Phase 1 Release provided the ability for a user to list the permits in the application and to perform simple searches and filtering. The LCP Phase 3 release will enhance that capability by providing performance enhancements combined with additional search functionality. Performance upgrades will be achieved through updates to both the user interface as well as server side improvements to the way permit records are retrieved and sent to the user interface. In addition, the LCP Phase 3 Release will expand the search capabilities to allow the search results to include those permits that have been archived in the application as well as displaying visual cues to distinguish archived from non-archived permits.

- **LCP Data Exporter**

A new set of web services is included in Phase 3 to allow external systems such as the Intranet Map application to connect to LCP to retrieve permit information. These new services also provide faster permit data update for Intranet map and public CHART Web. The LCP Data Exporter also provides the ability for an external application to subscribe to and receive updates as permit data changes.

- **PRs**
  - <u>PR7114: LCP: Update username and password rules</u>
    - Removes the requirement for any special characters in the password. They can still be used at the discretion of the user but not required by the application.
    - Modifies LCP to remove the restriction that previous password cannot be reused.
    - New Passwords will now require minimum of 1 capital letter, minimum of 1 lower case letter, minimum length of 8 characters, a maximum length of 32 characters, restrict the use of any white space, and allow special characters but not require it.

- Update LCP application to simplify the passwords that are generated for users when recovering lost passwords. Easy to read passwords with characters and/or numbers and no special characters.
- User name lengths will range from 4–32 characters.
- Logon names can only contain alphanumeric characters

- PR7118: LCP: LCP export to ATMS not providing data for all permits
  - The LCP application will no longer provide a bit masked representation of lane configuration data to ATMS. Instead, this data will be provided as a simple text string. Changes to Chart_Permit_View will be made to send the text to ATMS.

- **Intranet Map Updates**

  CHART Mapping R15 provides users with the ability to filter the barrels displayed for active, planned or pending closures by district(s) on the map. The legend for the Intranet Map is being enhanced in this release to provide the list of district(s) for selection by the user. The districts that will be available for selection on the legend display are:

  - District 1
  - District 2
  - District 3
  - District 4
  - District 5
  - District 6
  - District 7
  - MDTA (Maryland Transportation Authority).

  Additional changes to the legend include removing the capability to display Closure Segments for Planned, Pending and Active lane closure permits on the Intranet Map. The Hauling Restriction Segments legend item is being moved under the Roadwork level along with Route and Area Restrictions.

  The Intranet Map currently provides the capability for the user to map or unmap a permit when transitioned from the LCP web interface. CHART Mapping R15 will add the ability to notify the external LCP web service regarding user initiated changes to the geographical location for the permit. This change will ensure the two systems are in synch with changes performed regarding permits.

- **Export Client**

  CHART ATMS 13.2 will supplement export client with a new “permits” module that will be responsible for keeping the permits data cache in the system database up to date. The export client will subscribe, authenticate and query permit data from the external LCP Data Exporter. The messages exchanged between the export client and LCP Data exporter will comply with the published ICD and xsd.

On startup and at periodic intervals, export client will initiate a full inventory request to synchronize the permits stored in the system database cache. In the interim it will rely on the subscription updates provided by the external LCP Data Exporter to keep its cache current.

Imported permits data will be available for viewing only on the Intranet Map website.

C.4 LCP Release 4

Following is a summary of the major features provided by LCP Phase 4:

- **CHART ATMS Application Integration (WO 48/49)**

The CHART ATMS Application Integration task provides the ability to queue, activate and deactivate permit states in LCP from the CHART ATMS application through a secure web service interface.

- **System Announcements.**

The LCP System Announcements Module is a new feature that will be added that allows site administrators to post site wide announcements that all users will see.

- **Summary Reports**
    - Permits By Route By Day
    - Permits By County By Day
    - Active By Date/Time By Route.
    - Active By District By Date/Time or Date Range
    - By Type By County By Date Range
- **Updates to LCP History Logs**

LCP Phase 4 will include updates to provide additional details in the LCP permit history when a permit is edited.

- **Prioritized PRs**

LCP Phase 4 will include a group of Level A PRs prioritized by SHA. The following 11 PRs will be addressed in this release:

    - PR6837 LCP: Update reports to ignore fields and titles for blank entries (This feature was moved to WO49)
    - PR6838 LCP: Streamline contacts and permittees user interface
    - PR6841 LCP: Add the ability for users to edit remarks
    - PR6845 LCP: Provide view only versions of list permits and permit reports
    - PR7032 LCP: Add report to provide a total count on how many Lane Closure permits were entered for date range
    - PR7094 LCP: DAPT for should have a submit button to provide a better user experience

- PR7104 LCP: Details pages for some permits are slow to load when their permit histories contain a lot of entries.
- PR7107 LCP: Users should not be able to delete permits after they have been approved.
- PR7174 LCP: Provide members of Create role the ability to edit permits
- PR7221 LCP: Investigate adding the ability to change usernames so they match MDOT login names
- PR7356 LCP: Unmapped Approve Permit