FINAL

Multi-Modal Traveler Information System

Gateway Interface Control Requirements Document #17350.02

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GARY-CHICAGO-MILWAUKEE CORRIDOR
MULTI-MODAL TRAVELER INFORMATION SYSTEM
GATEWAY INTERFACE CONTROL REQUIREMENTS

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

The Multi-Modal Traveler Information System (MMTIS) project involves a large number of Intelligent Transportation System (ITS) related tasks. It involves research of all ITS initiatives in the Gary-Chicago-Milwaukee (GCM) Corridor which are currently deployed as well as proposed ITS identified in regional strategic plans and early deployment studies. This information will be used to recommend a MMTIS Corridor Architecture that best suits the characteristics of the diverse needs and resources within the Corridor.

The deployment of the Gateway Traveler Information System (TIS) will provide a comprehensive, integrated, and multi-modal transportation system that serves the needs of travelers and operators within the GCM Corridor. This system will focus on the collection and distribution of transportation related information and the management of regional multi-modal transportation systems for the benefit of the Corridor. It will also provide the communications mechanism for the implementation of cooperative control procedures for cross agency control of ITS devices.

There will be a minimum of a two phased implementation for the GCM Corridor MMTIS. "Initial" and full build-out or "Ultimate." The primary difference between the initial and ultimate phases of the Gateway TIS will be the type of data connections to the data source systems. The Gateway serves as the central collection and distribution hub for traveler information within the GCM Corridor. Together with the regional hubs and connections to ITS subsystems within the Corridor it composes the Gateway TIS.

1.2 PURPOSE

The purpose of this document is to identify and define the overall requirements for interfacing between the Gateway and components of the Corridor Architecture (specifically regional hubs and Illinois ITS subsystems) in support of the Multi-Modal Traveler Information System.

These requirements are identified in order to support the design of the Gateway. They provide details regarding interfaces between the Gateway defined in Document #17150 (*Gateway System Definition Document*) and the remainder of the Corridor Architecture. This document, in combination with Document #17250 (*Gateway Functional Requirements*) is intended to be used to gain a more complete understanding of the system. These requirements are intended as testable statements of system design and operation.

As the Gateway is part of the overall GCM Corridor Architecture, the system will also conform to requirements presented in Documents #17200 (*Corridor Architecture Functional Requirements*) and #17300 (*Corridor Architecture Interface Control Requirements*).

1.3 GOALS

This document has the following goals:

- Provide a set of requirements to serve as a baseline for the Gateway design, system integration, validation, and verification.

- Reduce the cost of the design and development effort for the Gateway by minimizing omissions, misunderstandings, and inconsistencies early in the design cycle.
- Provide a basis of understanding among the system designers, participants, and users.
- Provide input to the design and update of ITS within the Corridor, in order to facilitate communications and connection to the Gateway.

These requirements will be changing, evolving, and expanding over time. This document will be revised to reflect the changing requirements of the Corridor Architecture. The scope and behavior of a number of ITS projects within the GCM Corridor have not been completely identified or determined at the initial writing of this document.

The Gateway development is targeted in two phases, the initial and the ultimate. These requirements are directed towards both phases. The goal is for complete implementation of these requirements for the ultimate phase.

Note that this document does not describe interface controls in a traditional sense of operating an embedded system or electronic device. Rather this document discusses the movement of information between agencies, specifically the electronic communications between computing equipment involving the passing of agency data and cooperative control requests through this communication line.

1.4 INTENDED AUDIENCE

This document is intended for:

- The GCM Architecture, Communication, and Information Work Group and the Deployment Committee.
- Members of various design groups that have development responsibility for the Gateway, the Gateway TIS, and for other ITS projects within the Corridor.
- ITS agencies who wish to communicate through the Gateway TIS and with the Gateway.
- Other parties who may be contemplating the design of a similar ITS communication infrastructure.

1.5 DOCUMENT ORGANIZATION

This document is organized into different sections. **Within each section, specific requirements will be distinguished by being formatted to the fifth heading level (i.e., 9.2.1.3.1)**. Section 2 presents an overview of the Gateway system and its position and purpose within the Corridor Architecture. Section 3 discusses requirements for physical communications connections between Corridor Architecture regional hubs, various ITS subsystems, and the Gateway. Section 4 discusses requirements for data exchange between regional hubs, the Gateway, and various ITS subsystems. Section 5 reviews the interfaces between the regional hubs and the Gateway system. Section 6 reviews the ITS subsystems which will connect to the Illinois regional hub and the interfaces between these systems and the Illinois regional hub. Appendix A depicts the multiple LAN diagrams and details the requirements for the LAN configuration.

1.6 TERMINOLOGY

In the text of this document, the term “shall” means the statement calls out a necessary requirement which must be included in the design of the Gateway.

The term "may" means the statement indicates a potential capability which need not be initially implemented in the Gateway, but that the Gateway design must allow for that capability to be implemented in the future.

1.7 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

Document #17100-1 (*MMTIS Project Glossary*) contains all definitions, acronyms, and abbreviations associated with this project along with pertinent TIS, communications, computer technology, and other standards in general.

Base GCM LRMS	The location referencing message specification that will be used throughout the GCM Corridor. The profile that will be used initially will be the Geographic Coordinate Profile (latitude, longitude, altitude and street name) with the possibility of supporting more profiles in the ultimate phase.
Borman ATMS	The Indiana regional hub responsible for collecting and disseminating traveler data and information to/from the various ITS subsystems within Northwestern Indiana and providing that information to the Gateway. It will also serve as the interface between these subsystems and the Gateway.
CDSI	Communication and Data System Infrastructure - The Wisconsin Regional Hub responsible for collecting and disseminating traveler data and information to/from the various ITS subsystems within Southeastern Wisconsin and providing that information to the Gateway. It will also serve as the interface between these subsystems and the Gateway.
Corridor Architecture	The standards and practices associated with the design of the MMTIS which provide a recommended design for ITS subsystems, data sharing, and cooperative control within the Corridor.
Data Pipe	The communication network interconnecting the Gateway, regional hubs and ITS subsystems within the GCM Corridor.
Gateway	The physical hardware and software, resident in a central facility, that is responsible for collecting, routing and disseminating all the traveler information collected by the regional hubs.
Gateway TIS	The logical collection of regional hubs and ITS subsystems connected within the GCM Corridor to the Gateway, excluding field devices.
GCOM	GCM Corridor Object Model - The Corridor wide object models which describe ITS objects in the Corridor as well as additional control and coordination objects needed to support the Gateway and other systems within the Corridor.
Illinois Regional Hub	The facility responsible for collecting and disseminating traveler data and information to/from the various ITS subsystems within Northeastern Illinois and providing that information to the Gateway. It will also act as the interface between these subsystems and the Gateway.
ITS Subsystem	A facility within the GCM Corridor which is capable of providing and/or receiving traveler information to/from the Gateway TIS.

MMTIS	Multi-Modal Traveler Information System - The combination of all traveler modes and forms of transportation systems operated through various ITS subsystems within the project limits of the GCM Corridor.

1.8 RELATED DOCUMENTS AND WORKING PAPERS

This document is a part of a series of documents and working papers produced to support the design of the GCM Corridor Multi-Modal Traveler Information System.

Related documents and working papers include:

- Document #17001 - *Project Operating Plan*
- Document #17100-1 - *Project Glossary*
- Document #17150 - *Gateway Traveler Information System (TIS) System Definition Document*
- Document #17200 - *GCM Corridor Architecture Functional Requirements*
- Document #17250 - *Gateway Functional Requirements*
- Document #17300 - *GCM Corridor Architecture Interface Control Requirements*
- Working Paper #18250 - *Cellular 911 - State of the Practice*
- Working Paper #18380 - *Corridor User Needs and Data Exchange Elements*
- Working Paper #18400 - *Current and Proposed ITS Initiatives*
- Working Paper #18500 - *GCM MMTIS Strategic Plan*
- Working Paper #18520 - *Performance Criteria for Evaluating GCM Corridor Strategies and Technologies*
- Working Paper #18550 - *Alternative GCM Corridor Technologies and Strategies*
- Working Paper #18600 - *System Interfaces and Information Exchange*
- Working Paper #18700 - *Information Clearinghouse - Initial Administrative Network*
- Working Paper #18790 - *Information Clearinghouse - Final Network*
- Working Paper #18830 - *Weather Detection System Standard Message Sets*
- Working Paper #19140 - *Gateway Phased Implementation Plan*
- Working Paper #19210 - *Lessons Learned*
- Working Paper #19220 - *Gateway Design Options*
- Working Paper #19840 - *Variable Message Signs (VMS)/Highway Advisory Radio (HAR) State of the Practice*
- Working Paper #19845 - *Variable Message Signs (VMS)/Highway Advisory Radio (HAR) Suggested Guidelines*

2. GATEWAY OVERVIEW

2.1 CORRIDOR ARCHITECTURE TOPOLOGY

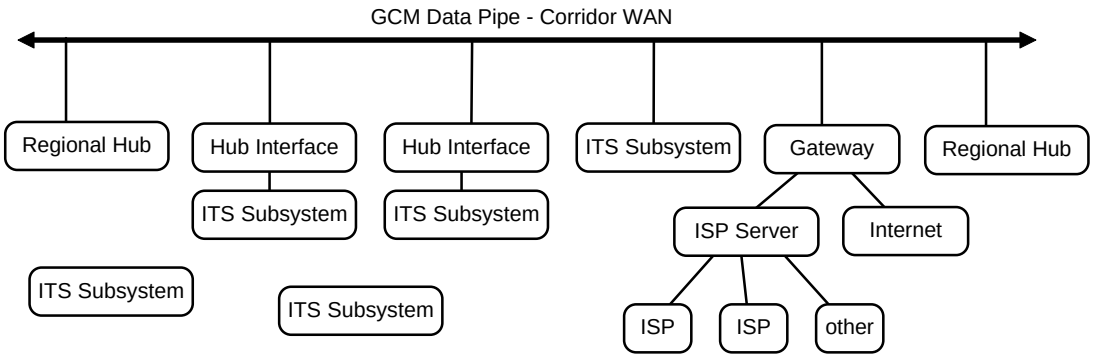

Figure 2-1 - Corridor Architecture (Logical View)

One of the goals of the Corridor Architecture and the Gateway TIS is to coordinate all available traveler information within the Corridor for public dispersal, cooperative agency control and planning, cooperative agency response, and to support more advanced ITS initiatives and concepts. To accomplish this goal, the Corridor Architecture provides a Data Pipe connecting ITS agencies and their computer systems through regional hubs to a centralized information system — the Gateway.

This design is a hybrid centralized system where local responsibilities are located at regional hub systems but main coordination is accomplished by a central "hub". This design provides important benefits:

- It allows local developments at regional hubs which do not have to be part of the entire Gateway TIS.
- It reduces the effects of system outages within the Gateway TIS, specifically an outage of the central hub.

The infrastructure created for data sharing among computer systems within the Corridor is part of a Corridor wide communications mechanism referred to as the GCM Data Pipe. The part of the Data Pipe being discussed here is configured as a Wide Area Network (WAN) and will be referred to as the Gateway TIS WAN.

Logically, the connections to the WAN are peer-to-peer (as shown in Figure 2-1). Physically, where dedicated connections are used, they shall be from ITS subsystem to regional hub and from regional hub to the Gateway. Where a switched networking strategy is used, routing shall be from ITS subsystem to regional hub and from regional hub to the Gateway.

2.2 CORRIDOR ARCHITECTURE LEVELS

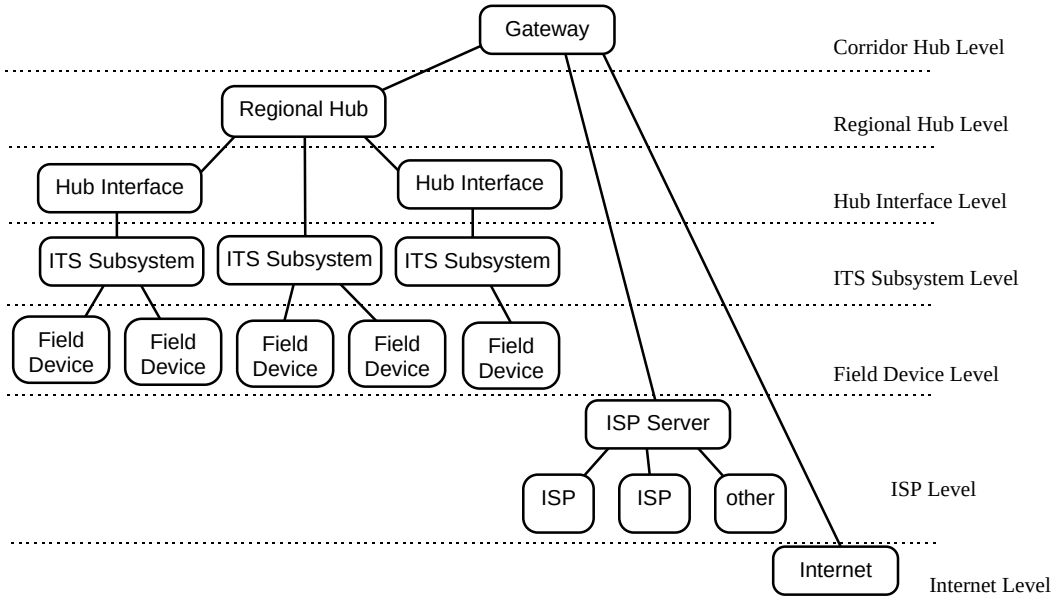

Figure 2-2 - Corridor Connections Hierarchy (Generic View)

Systems within the Corridor Architecture can be organized into levels of connection type and responsibility for data sharing and network routing. The following sections detail these various levels in the Corridor Architecture as shown in Figure 2-2.

2.2.1 Corridor Hub Level

The Corridor Hub for the GCM Corridor Gateway TIS will be the Gateway. The Corridor Hub is the central data collection and distribution point for all traveler information within the Corridor. The Corridor Hub connects to the various regional hubs and provides routing between the various state ITS subsystems within the GCM Corridor.

2.2.2 Regional Hubs Level

There will be three regional hubs within the GCM Corridor Architecture. These are regional hubs for Illinois, Indiana, and Wisconsin. An additional Illinois Transit Hub will also be used to coordinate data from Illinois based transit providers before passing that data on to the Illinois regional hub. The ITS data sources and data users within each state in the GCM Corridor will connect to the appropriate state hub to provide or receive data.

2.2.3 Hub Interface Level

In order to support legacy ITS subsystems within the Corridor, a number of hub interfaces will be fielded within the Corridor. The responsibility of these systems is to convert from legacy protocols and data formats into the Corridor standard protocols and data formats. The hub interface will normally be collocated with legacy ITS subsystem and will provide the connection between the ITS subsystem and its regional hub. In cases where ITS subsystems are compliant with the Corridor Architecture and can interface directly through the GCM Data Pipe to their regional hub, the use of hub interfaces will not be needed.

2.2.4 ITS Subsystem Level

This level describes all ITS subsystems that are part of the Gateway TIS. These systems will connect through the GCM Data Pipe to their appropriate regional hub (either directly or through a hub interface). The systems provide ITS data to the Gateway from their field devices. They may also receive ITS data from their regional hub or from other ITS subsystems through the Gateway.

2.2.5 Field Device Level

This level describes field devices. Field devices are associated with a particular ITS subsystem and a particular agency. They are not considered directly part of the Gateway TIS. They are connected to their respective agency (ITS subsystem). The ITS subsystem (in cooperation with a hub interface, if needed) will convert the raw data from field devices into Corridor standard formats. All control of field devices will stay with the ITS subsystem. Cooperative control of field devices will be accomplished through software programs at the ITS subsystem (or hub interface) level.

2.2.6 ISP Level

This level describes independent agencies within the Corridor who need ITS data for dissemination or analysis purposes. It also includes dissemination devices such as kiosks, personal data devices, in-vehicle devices, etc. It also includes broadcast media as well as research organizations. These organizations would mainly be users of ITS information rather than providers. They will not connect directly to the Gateway, but would access data through a separate server, secured from the Data Pipe by a firewall.

2.2.7 Internet Level

The Corridor Architecture will also include connections to the Internet to provide data for use by the general public. The Internet connection may also provide more detailed data to Corridor ITS organizations and ISPs through the use of multiple secured, password protected, pages.

2.3 GATEWAY ARCHITECTURE TOPOLOGY

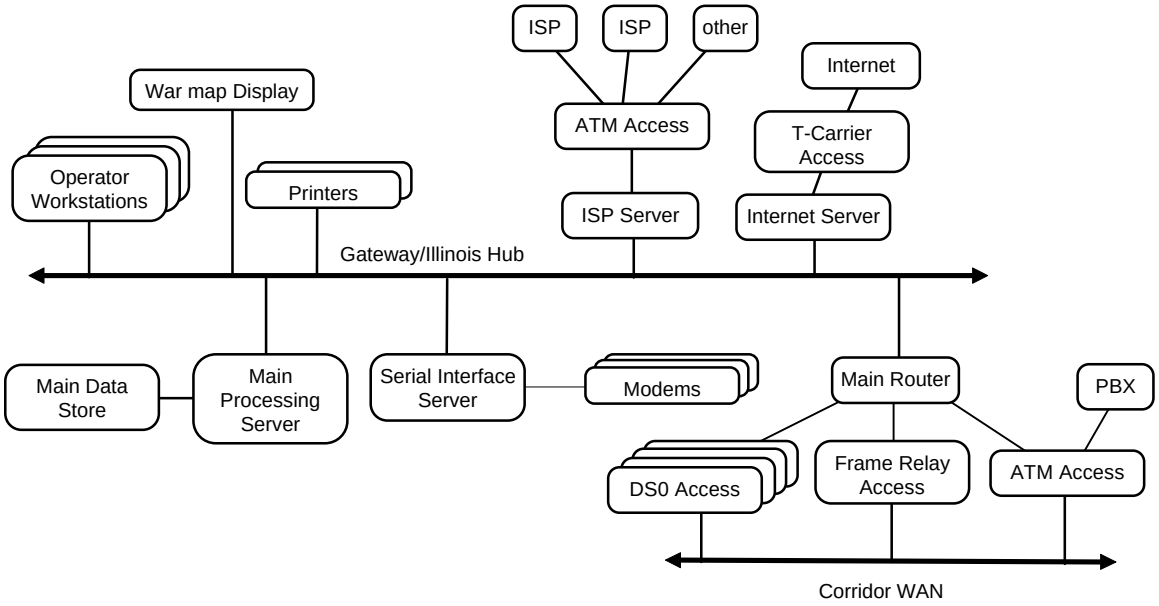

Figure 2-3 - Gateway/Illinois Hub LAN

The Gateway is the central information server for the GCM Corridor. It will centralize the data sharing information, perform data dissemination to the media and the general public, and provide management facilities for the Corridor WAN.

The Gateway system will be initially located in Illinois and will be combined with the Illinois regional hub system. Though their responsibilities are logically different, these two systems may be implemented in the same local area network and may initially share physical servers for their processing.

The Gateway and Illinois regional hub system will consist of a range of communication and networking devices (switches, routers, modems, etc.) for communicating with the regional hubs, the Illinois ITS data sources, ISPs, the media, and the Internet; a number of server machines for data processing and storage; a number of operator workstations and system consoles for system control and monitoring; and, additional peripherals such as printers, faxes, pagers, etc.

The Gateway and Illinois regional hub system will be configured into a Local Area Network (LAN). This network will be referred to as the Gateway/Illinois regional hub LAN as noted in Figure 2-3.

3. COMMUNICATION REQUIREMENTS

3.1 TOPOLOGY

3.1.1.1.1 All electronic communication between systems in the Gateway TIS shall conform to the following requirements:

- It shall conform to the NTCIP standards.
- It shall use networking protocols (e.g., ATM, TCP/IP, etc.) and be organized as a Wide Area Network (WAN).
- Where it is a permanent high speed link (DS1 or greater), it shall be an ATM (Asynchronous Transfer Mode) network.

3.1.1.1.2 The physical components of the network may include several types of physical media including (but not limited to) leased lines (dedicated and dial-up), privately owned fiber, microwave transmission, public switched networking, etc.

3.2 NTCIP REQUIREMENTS

3.2.1.1.1 The NTCIP Class E protocol specification is pertinent to center to center communications. Currently, the draft Class E protocol specification indicates the use of TCP/IP (Transmission Control Protocol/Internet Protocol) as the primary network protocol. The exact requirements for running NTCIP over an ATM network have not been completely evaluated at this time. However, based on the analysis to date, this will most likely be accomplished by operating an IP over ATM networking scheme. The Corridor Architecture shall conform to these standards when they are available.

3.3 BANDWIDTH REQUIREMENTS

The sections below indicate requirements for overall bandwidth for electronic connections between the specific ITS subsystem and its regional hub within the Corridor Architecture. Bandwidth requirements are based on the following rules.

3.3.1.1.1 Subsystems that provide or receive raw detector information shall connect with at least a bandwidth equivalent to a DS1 level connection (1.5Mbps).

3.3.1.1.2 Subsystems that will provide or receive audio (or voice) communications shall connect with at least a bandwidth equivalent to a DS1 level connection (1.5Mbps).

3.3.1.1.3 Subsystems that provide or receive frequent incident information (more than 1 per hour) shall connect with at least a bandwidth equivalent to a DS0 level connection (56kbps or 64kbps).

3.3.1.1.4 Subsystems that provide or receive infrequent incident information (less than 1 per hour) may connect with standard analog dialup over traditional phone lines.

3.3.1.1.5 10Mbps of bandwidth must be provided for each simultaneously available video feed a subsystem transmits or receives.

3.3.1.1.6 Subsystems that provide or receive a combination of the above data shall provide additional bandwidth sufficient to allow for all required transmission and reception.

3.3.1.1.7 The connections between the regional hubs and the Gateway shall support at least a DS3 level connection (45Mbps). Thus, the Corridor Architecture will support 4 video feeds (plus additional 5Mbps for data and voice) through the regional hubs.

3.3.1.1.8 The bandwidth of an incoming line into the Gateway and into the regional hubs must be greater than the combined bandwidth value of all their data suppliers.

3.4 PROTOCOL REQUIREMENTS

3.4.1.1.1 Networking between the Gateway and the regional hubs shall operate using the ATM protocol.

3.4.1.1.2 The networking shall operate IP (Internet Protocol) over ATM and will connect the local LANs at the Gateway and at each regional hub.

3.4.1.1.3 Networking between ITS subsystems and the Illinois regional hub shall, if the bandwidth requirements are DS1 or greater, be a similarly compliant ATM network.

3.4.1.1.4 Lower bandwidth connections between the Illinois regional hub and ITS subsystems shall either be PPP (Point to Point Protocol) connections or shall be Frame Relay connections.

3.4.1.1.5 The PPP or Frame Relay connections shall operate the IP protocol.

3.4.1.1.6 The connections between the Illinois regional hub and an ITS subsystem may be LAN to LAN connections; they are, however, not required to be. Instead, various firewalls may be used to control and secure the connection.

3.5 PHYSICAL MEDIA REQUIREMENTS

3.5.1.1.1 The Gateway design shall make no requirements on physical media used in connecting from ITS subsystems to the Illinois regional hub or from the regional hubs to the Gateway. Requirements are only that the physical media support the requirements for bandwidth and for protocol operation.

3.6 HARDWARE REQUIREMENTS

3.6.1.1.1 The Gateway and the regional hubs shall provide ATM switching and access devices.

3.6.1.1.2 Connections between Illinois ITS subsystems and the Illinois regional hub will require hardware on either side to operate the communications line. The Illinois regional hub shall provide necessary communications hardware to support its ITS clients.

3.6.1.1.3 Connections between the Gateway ISP server and ISPs and the media shall be a high speed ATM connection.

3.6.1.1.4 The Gateway Internet server shall be connected to the Internet through a DS1 connection or greater. The protocol operated on that connection shall be selected based on the requirements of the Internet service provider.

3.6.1.1.5 To support voice communications between ITS agencies within the Corridor, the WAN shall route digital voice data (as well as standard data and video information).

3.6.1.1.6 Agencies receiving or sending voice shall include an ATM multiplexer and PBX system to distribute voice data from the WAN to telephones within the agency.

3.7 CONNECTION TYPES

This section presents types of connections between systems in the Corridor. The types are distinguished in the following manner:

- Bandwidth (high to low)
- Continuity (permanent or temporary)
- Connection (dedicated or switched)

The Corridor Architecture allows for a variety of different connections based on the nature of the data transfer between the systems involved. There are five compliant types. All non-compliant systems are categorized as type 6 systems. It is the intention to have no type 6 systems within the Corridor. In the event that a legacy system cannot support a type 1-5 connection on its own, a hub interface system shall be fielded at that agency (or at the hub) to facilitate compliance.

3.7.1 Type 1 Connection (High Bandwidth Switched)

3.7.1.1.1 A type 1 connection is a high speed connection (DS1 or higher) which is implemented through a telecommunications company public switching system. Such a connection is often defined by its allotted bandwidth. Dedicated high speed lines are used to connect the agencies to the public switch. Multiple destinations can be reached by an agency through the same connection and multiple sources can communicate with an agency through the connection. Routing between agencies is handled by the telecommunications company under a level of service agreement. This system is highly flexible and reduces equipment costs, but increases periodic costs.

3.7.1.1.2 The ATM protocol shall be used across these connections. The WAN may also operate an IP over ATM scheme to increase LAN interoperability and conform to NTCIP.

3.7.1.1.3 To support the ATM protocol, an ATM switch will be necessary to connect to the external media. Additional capabilities for the ATM switch may be needed to connect to an internal LAN. The agency's ATM switch must then be connected to an ATM port on the public switched network. This connection line may be copper wire or fiber or other technology. Multiple outgoing and incoming connections will use the same switch and connection line.

3.7.1.1.4 As a result of their flexibility, the initial high speed connections between subsystems and the Gateway and Illinois regional hub shall all be type 1 connections until less expensive, agency owned, communications media can be constructed or made available.

3.7.2 Type 2 Connection (High Bandwidth Dedicated)

3.7.2.1.1 A type 2 connection is a high speed connection (DS1 or higher) which is implemented through a dedicated channel between two particular agencies. This line can be leased from a telecommunications company or other organization, or it could be an agency owned connection. The connection could be wireline or wireless.

3.7.2.1.2 The ATM protocol shall be used across these connections. The WAN may also operate an IP over ATM scheme to increase LAN interoperability and conform to NTCIP.

3.7.2.1.3 To support the ATM protocol an ATM switch will be necessary to connect to the external media. Additional capabilities for the ATM switch may be needed to connect to an internal LAN. A port must be available on the ATM switch for each outgoing connection.

Because of the less flexible and inherently point-to-point nature of dedicated connections they are not recommended in lieu of switched connections unless upkeep costs are significantly reduced. However, higher bandwidth requirements (rising above 100Mbps) may make agency owned microwave or fiber networks appropriate.

3.7.3 Type 3 Connection (Low Speed Switched)

3.7.3.1.1 A type 3 connection involves a lower bandwidth connection using a public switched technology. The type 3 connection shall be recommended where high bandwidth in and out of an ITS subsystem is not required. This might, for example, be where no voice or video feeds are being sent or received and data connection requirements fall to less than a DS1 type.

3.7.3.1.2 Because ATM is not appropriate over lower bandwidth connections, Frame Relay shall be used for these connections.

3.7.3.1.3 To support the Frame Relay protocol, a Frame Relay access device (FRAD) will be necessary to connect to the external media. Additional capabilities for the FRAD may be needed to connect to an internal LAN. The FRAD must then be connected to a Frame Relay port on the public switched network. This connection line may be copper wire or fiber or another technology. Multiple outgoing and incoming connections will use the same switch and connection line.

3.7.4 Type 4 Connection (Low Speed Dedicated)

3.7.4.1.1 A type 4 connection is a lower bandwidth connection through a dedicated line. The most common line would be a standard DS0 connection. These often provide a bandwidth of 56kbps or 64kbps. ITS subsystems shall not be connected with a lower bandwidth dedicated line than 56kbps.

3.7.4.1.2 Connections between agencies through such a dedicated line will involve the use of an access unit at each location to maintain the line. Note that these are digital connections. No dedicated analog connections shall be used.

3.7.5 Type 5 Connection (Dialup)

3.7.5.1.1 A type 5 connection involves a dialup connection using standard analog lines and modems. The Gateway will support at least 28.8kbps modems (and may provide 56kbps modems if available). These modems shall support speeds from their highest baud rate (56kbps or 28.8kbps) down to 1200 baud.

3.7.5.1.2 In keeping with NTCIP requirements, all connections over dialup modems will connect using PPP. This implies no serial or terminal emulation connections.

3.7.6 Type 6 Connection (Non-Compliant)

3.7.6.1.1 Type 6 connections are non-compliant with the above categories. While existing legacy systems or phased implementation plans may allow for some non-compliant connections within the Corridor Architecture, such use must be accompanied with a plan for movement to a compliant communications type in order to stay compliant with the National ITS Architecture.

3.8 SECURITY REQUIREMENTS

3.8.1.1.1 The Gateway and Illinois LAN shall be secured from the Corridor WAN by the use of a firewall or a firewall router.

3.8.1.1.2 Dialup PPP connections shall require the use of a user name / password combination.

3.8.1.1.3 Password encryption conforming to the PPP standard shall also be used.

3.8.1.1.4 The firewall hardware or software shall be configured to allow only necessary communication between the Corridor WAN and the Gateway/Illinois regional hub computers. The firewall shall:

- Prevent unused protocol requests from entering the LAN (including Telnet).
- Prevent access from unknown sources.
- Limit requests based on source computer (e.g., SMTP requests only from approved e-mail exchange sources).
- Provide tracking and monitoring services.

4. DATA EXCHANGE REQUIREMENTS

4.1 TOPOLOGY

4.1.1.1.1 Data shall flow in two directions in the Gateway TIS (See Figure 4-1).

4.1.1.1.2 Specific data information from field devices or other sources (e.g., construction schedules) shall flow from ITS subsystems through regional hubs to the Gateway.

4.1.1.1.3 The Gateway shall then coordinate and collect data at regular intervals and make that data available to the regional hubs, and through the regional hubs, to the ITS subsystems in the Corridor.

4.1.1.1.4 The data shall also be made available from the Gateway to various ISPs through a separate ISP server.

4.1.1.1.5 Data shall also be distributed through the Internet using HTML and Java through standard HTTP requests.

4.1.1.1.6 Separate, protected Internet compliant pages, shall be made available to ISPs.

4.1.1.1.7 Additional protected Internet compliant pages, referred to as the “war map” shall be made available to operating agencies in the Corridor.

4.1.1.1.8 In addition to the mainline flow, various ITS subsystems and regional hubs may make other arrangements to share data with ISPs, the Internet, and each other. These additional data sharing arrangements may make use of excess bandwidth in the Corridor WAN which is not required for supporting the Gateway or they may be conducted using separate communications media.

4.1.1.1.9 As part of a phased implementation plan, various agencies may continue to use non-electronic means (e.g., faxes) to provide information to the regional hubs.

4.1.1.1.10 These non-electronic connections shall eventually be replaced through standard computer to computer electronic networking connections.

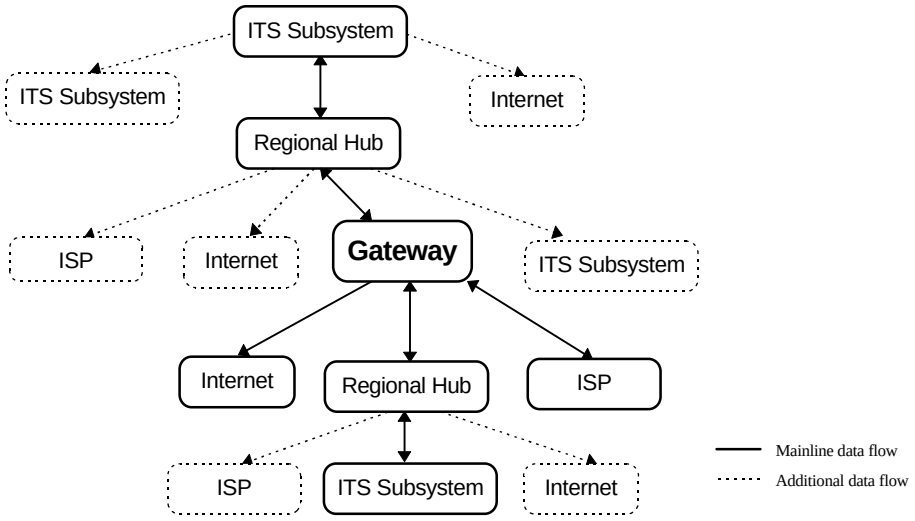

Figure 4-1 - Data Flow (Generic View)

4.2 GCM CORRIDOR OBJECT MODEL

4.2.1.1.1 A Corridor wide object model shall be established early in the Gateway design phase.

4.2.1.1.2 This object model shall be created with the support of ITS agencies within the Corridor.

4.2.1.1.3 The GCOM shall describe ITS objects in the Corridor as well as additional control and coordination objects needed to support the Gateway and other system within the Corridor.

4.2.1.1.4 IDL (Interface Definition Language) wrappers and initial implementations for these objects shall be created and distributed to agencies within the Corridor.

4.2.1.1.5 The GCOM will be compatible with the standards set by the National ITS Architecture and the NTCIP regarding object design.

4.3 LRMS REQUREMENTS

4.3.1.1.1 The Location Referencing Message Specification (LRMS) is a standard format for describing locations begin adopted by the National ITS Architecture. The GCM Corridor Architecture shall also use the LRMS standard.

4.3.1.1.2 LRMS provides a number of “profiles” for describing locations. The initial LRMS profile used by the Gateway will be the Geographic Coordinate Profile. This shall be referred to as the base GCM LRMS profile.

4.4 EXCHANGE TECHINQUES

4.4.1.1.1 There shall be two exchange techniques compliant with the Corridor Architecture. These are communication through the GCM Corridor Common Object Model (GCOM) using the Common Object Request Broker Architecture (CORBA) or through Web technologies (HTTP, HTML, CGI, Java).

4.4.1.1.2 In the event that a particular connections real time transfer requirement cannot be supported by CORBA, a unique sockets level program shall be used. These situations shall be kept to a minimum.

4.4.2 CORBA

4.4.2.1.1 All interprocess communications between the Gateway and the hubs and between the Illinois regional hub and its client ITS systems shall be through remote method invocations on GCOM objects using CORBA.

4.4.2.1.2 Each system shall operate an CORBA ORB. The hubs and Gateway shall operate a subset of available CORBA services (as determined by system design).

4.4.2.1.3 A common set of IDL shall be made available throughout the Corridor which describes the GCOM objects and the server interfaces for the hubs and for the Gateway.

4.4.3 Web (HTTP/HTML/CGI/Java)

4.4.3.1.1 Data shall also be shared using Web technologies. These include standard HTTP transactions against web servers and the production of results in standard HTML with allowed Java extensions.

4.5 DATA ACCESS SECURITY

4.5.1.1.1 The CORBAsecurity specification shall be followed in providing security services for the CORBA access layer.

4.5.1.1.2 The CORBAsecurity layer shall request user name / password authorization for access to CORBA objects and shall maintain access lists for which source computers and which username / password combinations may access particular CORBA objects.

4.5.1.1.3 Where possible, encrypted password sessions shall be performed using Public Key technology. Actual data transfer shall be accomplished with encryption using Public Key or Session Keys as appropriate.

4.5.1.1.4 Any direct sockets connection within the Corridor WAN shall also include code to check the source and authorization of the incoming requests. Direct sockets programs may use the CORBAsecurity objects to perform this action or may provide an equivalent capability.

4.5.1.1.5 E-mail transfer shall also make use of username / password and encryption where necessary.

4.5.1.1.6 Standard user name / password and the use of Secure Sockets Layer (SSL) shall be used over the Internet (for the protected pages).

4.6 DATA INPUT

This section discusses the format requirements for input data to the Gateway and to the Illinois regional hub.

4.6.1 Regional Hub to Gateway

4.6.1.1.1 Data coming into the Gateway shall be from the regional hubs.

4.6.1.1.2 Data shall be sent from each hub to the Gateway at least once per minute. This data shall consist of all data that has arrived since the last transmission.

4.6.1.1.3 The Gateway shall be able to indicate errors in receiving information from the hubs and shall be able to cause that data to be resent.

4.6.1.1.4 A standard set of data formats shall be established for hub to Gateway communications (refer to Section 4.2).

4.6.1.1.5 The data shall include all information provided to the hub by its ITS subsystem clients since the last data communication.

4.6.1.1.6 Data not pertinent to the national highway system/strategic regional arterials and other major arterials shall not be included.

4.6.1.1.7 The data shall all have been converted into GCOM (see section 4.2) representation.

4.6.1.1.8 The data shall all have been converted into the base GCM LRMS Profile.

4.6.1.1.9 CORBA IDL calls will be designed to exchange each report format.

4.6.2 ITS Subsystem to Illinois regional hub

4.6.2.1.1 ITS subsystems which submit data to the Illinois regional hub shall conform to the input data type requirements presented in this section.

4.6.2.1.2 This conformity can be directly from the agencies systems or by the interposition of a hub interface. For example, where the requirement states data shall be in the base GCM LRMS format, this requirement may be accomplished by the agency using the base GCM LRMS, or converting the values before sending to the hub, or it may be accomplished by the hub interface for that agency converting the values. To save transmission bandwidth, the locations of fixed devices may be replaced by an internal code. If this is the case, the source agency shall provide a lookup table from the internal codes to values for the locations and the hub will map these to the base GCM LRMS.

4.6.3 Input Data Types

4.6.3.1 Detector Data

4.6.3.1.1 Detector data shall be provided for the national highway system routes/strategic regional arterials and other major arterial roads only. Any other data shall not be included or shall be stripped off by the hub or the hub interface.

4.6.3.1.2 Detector data shall be provided with the location of the detector in the base GCM LRMS format (or shall be converted to the base GCM LRMS by the hub or hub interface), the value for the volume, occupancy and/or speed as available.

4.6.3.1.3 CORBA IDL calls shall be designed to exchange detector information.

4.6.3.1.4 Detector data shall be provided by the source agency at regular periodic intervals. In practice, this data should be sent every minute, every five minutes, or less frequently, depending on the capabilities of the source.

4.6.3.1.5 The detector data may be adjusted by normalizing all the detector reports obtained at the source over the period between transmissions.

4.6.3.2 Travel Times

4.6.3.2.1 Travel times shall be provided for the national highway system routes/strategic regional arterials and other major arterial roads only. Any other data shall not be included or shall be stripped off by the hub or the hub interface.

4.6.3.2.2 Travel time data shall be provided with the locations of the end points in the base GCM LRMS format (or shall be converted to the base GCM LRMS by the hub or hub interface) and the speed or time between those endpoints.

4.6.3.2.3 CORBA IDL calls shall be designed to exchange travel time data.

4.6.3.2.4 Travel time data shall be provided by the source agency at regular periodic intervals. In practice, this data should be sent every minute, every five minutes, or less frequently, depending on the capabilities of the source.

4.6.3.3 Incidents

4.6.3.3.1 Information regarding traffic impacting incidents shall be provided for the national highway system routes/strategic regional arterials and other major arterial roads only. Any other data shall not be included or shall be stripped off by the hub or hub interface.

4.6.3.3.2 A standard incident reporting format shall be designed which shall be used to internally format all electronically communicated incident reports. This information shall include the location of the incident; the type of incident; data on what section of roadway is affected, if known; the time and date; the expected duration, if known; the severity, if known; and the number of units responding. The location of the incident (and any affected roadways) shall be provided in base GCM LRMS format (or shall be converted to base GCM LRMS by the hub or hub interface computer).

4.6.3.3.3 CORBA IDL calls shall be designed to exchange the incident reporting format.

4.6.3.3.4 Incident information shall be reported in a timely manner after it is entered in a source agencies computer system.

4.6.3.3.5 Default incident durations shall be calculated by the Gateway based on the nature of the incident. When the duration expires or notice is received of its clearance, the incident shall be removed from the Gateway output.

4.6.3.3.6 Source agencies may (and are encouraged to) send reports indicating that incidents have been cleared. If such a report arrives, they will be used, and the incident shall be considered expired and removed from the Gateway output immediately.

4.6.3.4 Construction/Maintenance Events

4.6.3.4.1 Information regarding construction and maintenance shall be provided to the MMTIS for the national highway system routes/strategic regional arterials and other major arterial roads only. Any other data shall not be included or shall be stripped off by the hub or hub interface.

4.6.3.4.2 Data on all construction and maintenance events which are scheduled (including those scheduled for future date) shall be provided.

4.6.3.4.3 A standard construction and maintenance event reporting format shall be designed which shall be used to internally format all electronically communicated construction and maintenance events reports. This information shall include the location of the construction or maintenance, the start and end time and date, data on lane closures (if any), ramp closures, road closures, etc.

4.6.3.4.4 The location of the event (and any affected roadways) shall be provided in the base GCM LRMS format (or shall be converted to the base GCM LRMS by the hub or hub interface).

4.6.3.4.5 CORBA IDL calls shall be designed to exchange the construction and maintenance event reporting format.

4.6.3.4.6 ITS subsystems which schedule construction and maintenance on the national highway system routes/strategic regional arterials and other major arterial roads shall provide their regional hub a daily report on schedule construction and maintenance.

4.6.3.4.7 The hubs shall make any such daily reports available to the Gateway.

4.6.3.5 VMS

4.6.3.5.1 Agencies which maintain Variable Message Signs (VMS) on the national highway system routes/strategic regional arterials and other major arterial roads shall provide information regarding the current text displayed on those signs and the current status of the sign.

4.6.3.5.2 Graphics information will not initially be supported by the Gateway system.

4.6.3.5.3 A standard VMS report format shall be designed which shall be used to internally format all electronically communicated VMS reports.

4.6.3.5.4 The VMS report shall include the location of the VMS (in the base GCM LRMS format, or it shall be converted to the base GCM LRMS by the hub or hub interface), the VMS status, and the text displayed on the VMS.

4.6.3.5.5 CORBA IDL calls shall be designed to exchange this VMS information.

4.6.3.5.6 VMS text and status shall be provided by the source agency at regular periodic intervals. In practice, this data should be sent every five minutes or when it changes.

4.6.3.6 Weather and Road Condition

4.6.3.6.1 Data from SSI detectors (made available through IDOT for the Corridor) shall be provided for locations where sensors exist in the GCM Corridor.

4.6.3.6.2 Weather detectors shall provide two types of reports: (1) pavement condition data, and (2) environmental condition data.

4.6.3.6.3 Standard weather detector report formats for each of these detector types shall be designed which shall be used to format all electronically communicated weather detector reports.

4.6.3.6.4 The weather detector reports shall include the location of the detector (in the base GCM LRMS format, or it shall be converted to the base GCM LRMS by the hub or hub interface) as well as the pertinent weather information produced by that detector.

4.6.3.6.5 CORBA IDL calls shall be designed to exchange each type of weather detector information.

4.6.3.6.6 Weather detector information shall be provided by the source agency at regular periodic intervals. In practice, this data should be sent every five minutes.

4.6.3.7 Traffic Signal Data

4.6.3.7.1 Agencies operating traffic signal systems on the national highway system routes/strategic regional arterials and other major arterial roads shall provide reports when signals malfunction and are repaired.

4.6.3.7.2 Systems shall contact the regional hub when a traffic signal malfunction is detected (once only for each signal).

4.6.3.7.3 Systems shall again contact the regional hub when previously reported traffic signal malfunctions are repaired.

4.6.3.7.4 A standard signal malfunction report format shall be designed which shall be used to internally format all electronically communicated signal malfunction reports.

4.6.3.7.5 The signal malfunction report will include the location of the signal (in the base GCM LRMS format, or it shall be converted to the base GCM LRMS by the hub or hub interface).

4.6.3.7.6 The regional hubs shall not be directly contacted by signal field devices. Agencies which operate signals shall implement a system (or systems) which receives all their signal malfunction information and contacts the regional hub in a coordinated fashion.

4.6.3.7.7 In the future, traffic signal system may also provide detector data for calculating travel times. This data shall be provided at a set frequency by direct connection to the appropriate regional hub.

4.6.3.8 Ramp Meter Data

4.6.3.8.1 Agencies operating ramp metering systems on the national highway system routes/strategic regional arterials and other major arterial roads shall provide information regarding location, status (on/off) and possibly ramp meter rates.

4.6.3.8.2 Ramp meter locations shall be given in base GCM LRMS format.

4.6.3.8.3 CORBA IDL calls shall be designed to exchange ramp meter information.

4.6.3.8.4 Ramp meter data shall be provided by the source agency at regular periodic intervals. In practice, this data should be sent every minute, or less frequently, depending on the capabilities of the source.

4.6.3.9 Transit Schedules

4.6.3.9.1 Data regarding the schedules for mass transit providers for the national highway system routes/strategic regional arterials and other major arterial roads shall be made available to the Corridor. Transit providers are also anticipated to provide their own web pages. The Gateway shall include a link to the transit providers web pages.

4.6.3.10 Transit Schedule Adherence

4.6.3.10.1 Data regarding real-time schedule adherence for mass transit providers for the national highway system routes/strategic regional arterials and other major arterial roads shall be made available to the Corridor. Transit providers are also anticipated to provide their own web pages. The Gateway shall include a link to the transit providers web pages.

4.6.3.11 Voice

4.6.3.11.1 The Corridor architecture shall also include the facility to connect voice data from ITS subsystem to ITS subsystem through the Corridor WAN. The necessary hardware shall be fielded at each agency upon connection to the Corridor WAN.

4.6.3.11.2 Agencies shall field a telephone system and PBX system which shall be connected to an ATM multiplexer in order to convert voice data to digital ATM information.

4.6.3.11.3 The regional hubs shall route the voice data to the destination agency (through the Gateway, if necessary).

4.6.3.12 Video

4.6.3.12.1 Data from video cameras located on the national highway system routes/strategic regional arterials and other major arterial roads may be provided to the Corridor by those agencies which operate such video systems.

4.6.3.12.2 The Corridor Architecture shall support the transmission of at least four (4) streams of full motion video data throughout the Corridor WAN. If various video feeds are slow scan or stop frame, then additional feeds may be supported by the communication infrastructure.

4.6.3.12.3 Video feeds shall be provided to those agencies who the proper bandwidth connection to their regional hub. Other agencies may view video (albeit, not full motion) through the Internet.

4.6.3.12.4 Video transferred through the Corridor Architecture shall conform to the following:

- It shall be digitally encoded.
- It shall be encoded using MPEG-2 or Motion-JPEG encoding.

4.6.3.12.5 Video network feeds will be designed so that bandwidth requirements can be dynamically varied to allow a video signal to consume less bandwidth (at the cost of frames or detail) so that more video signals or other data can be transferred over the Corridor WAN.

4.6.3.13 Airport Information

4.6.3.13.1 Traveler information (possibly including schedules, schedule adherence information, parking data, and local traffic congestion information) for airports within the Corridor shall be made available to the Corridor. Airports are anticipated to provide their own web pages, if this is the case, the Gateway shall include a link to the airport web pages.

4.6.3.14 Hazmat Information

4.6.3.14.1 For incident management purposes, data regarding the type of hazmat being transported in the Corridor, the schedule and route being taken, and if available, the current location of hazmat transport for the national highway system routes/strategic regional arterials and other major arterial roads shall be made available to the Gateway by agencies who maintain such information.

4.6.3.14.2 A standard hazmat reporting format shall be designed which shall be used to internally format all electronically communicated hazmat reports.

4.6.3.14.3 The location of the hazmat (as well as the route) shall be provided in the base GCM LRMS format (or shall be converted to the base GCM LRMS by the hub or hub interface).

4.6.3.14.4 CORBA IDL calls shall be designed to exchange hazmat reporting format.

4.7 DATA OUTPUT

4.7.1 Corridor WAN

4.7.1.1.1 The Gateway will provide services to distribute up-to-date information to the regional hubs. This distribution can come in one of two ways:

- A condensed transfer of all currently pertinent traffic information (the GCM data stream).
- A set of services which can be used by the regional hub to request information (the GCM data server).

4.7.1.1.2 This communication will occur through CORBA objects.

4.7.1.1.3 The Illinois regional hub will provide the same services, as noted in 4.7.1.1.1, to its ITS subsystems.

4.7.1.1.4 ITS subsystems may request a subscription to the GCM data stream. ITS subsystems which have registered their subscription shall receive updated Corridor-wide data at one minute intervals from their regional hub.

4.7.1.1.5 The Gateway shall send the data stream to the regional hubs in one minute intervals.

4.7.1.1.6 The format of the data stream shall be standardized in the design phase and shall include all travel time information, incidents, construction events, etc.

4.7.1.1.7 The Gateway and the regional hubs shall also support a CORBA based data server from which agency programs can request specific data.

4.7.1.1.8 The data server shall provide its services through CORBA interfaces which shall be published and provided to the ITS agencies within the Corridor.

4.7.1.1.9 Data shall follow the GCOM (Corridor Object Model).

4.7.1.1.10 Data shall initially only provide locations in the base GCM LRMS Profile. The use of additional LRMS profiles shall be considered and integrated in at later dates.

4.7.2 ISPs

4.7.2.1.1 The Illinois regional hub will maintain an ISP server which can be used by a range of ISPs and other agencies to obtain traveler information.

4.7.2.1.2 This ISP server will provide the same two distribution options as are provided through the Corridor WAN (data stream and data services).

4.7.3 Internet

4.7.3.1.1 The Gateway will also maintain a connection to the Internet and shall publish web pages as detailed in Document #17250 (*Gateway Functional Requirements*), in Section 8 (*Web Interface*).

4.7.3.1.2 Data on the Internet shall only be provided using HTTP/HTML/CGI/Java technologies.

4.8 COOPERATIVE CONTROL

4.8.1.1.1 The Gateway and the Illinois regional hub shall provide the ability for agencies to communicate with one another in order to support cooperative control of field devices (such as VMS and traffic signals).

4.8.1.1.2 The Gateway and the hub shall serve as a physical “pass through” only, routing the communication between the agencies.

4.8.1.1.3 Agencies may implement the cooperative control transactions in CORBA or through Intranet technologies (e.g., intranet web pages and CGI/Java programs).

4.8.1.1.4 All cooperative control in the Corridor shall be subject to the approval of the operating agency and shall provide appropriate security (passwords, limited access, etc.) to insure that only the minimum permitted control is allowed.

4.8.1.1.5 The owning agency shall have primary priority/control of their field devices.

4.8.1.1.6 The operating agency shall be able to deny cooperative control at any time.

4.8.2 Video Selection

4.8.2.1.1 The Gateway shall have authority to select and manage the video feeds from the various agencies which are being propagated through the Corridor WAN.

4.8.2.1.2 Agencies shall be able to make requests of video feeds from other agencies.

4.8.2.1.3 As the Corridor WAN cannot support a complete pass through of all video data within the Corridor, only selected video feeds shall be active at any given time.

4.8.2.1.4 It is initially anticipated that only four (4) video feeds shall be propagated through the Corridor WAN.

4.8.2.1.5 Agencies shall field equipment which allows the Gateway to request a particular video feed be sent over the WAN and which allows the Gateway to request the termination of such a transmission.

4.8.2.1.6 The Gateway may also make video feeds available over the Internet.

4.8.2.1.7 Priority in selecting feeds shall be given to ITS agencies before Internet users.

4.8.2.1.8 Video feed requests shall time out at a set interval (set by the Gateway) to allow other users in the Corridor access to desired video information.

4.8.2.1.9 Cooperative control of PTZ (pan-tilt-zoom) cameras shall also be provided by the Corridor.

4.8.3 VMS

4.8.3.1.1 Control of VMS shall allow appropriate agencies within the Corridor to modify the text displayed on the operating agency's VMS.

4.8.3.1.2 The operating agency shall provide a programming interface that shall allow VMS requests to be recognized, approved, and traced. The operating agency software shall perform the actual communication to the VMS.

4.8.4 Traffic Signals

Control of traffic signal systems shall allow agencies within the Corridor to determine signal timing plans and perform temporary changes to signal timings as appropriate.

4.8.4.1.1 The operating agency shall provide a programming interface that shall allow traffic signal timing requests to be recognized, approved, and traced. The operating agency software shall perform the actual communication to the traffic signal system.

5. GATEWAY CONNECTIONS

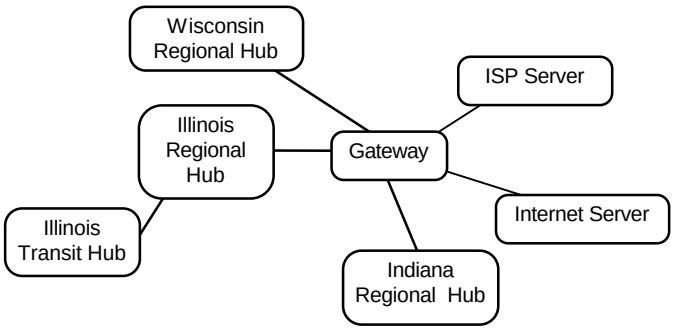

Figure 5-1 - Gateway Connections

5.1 ILLINOIS REGIONAL HUB

5.1.1.1.1 The Illinois regional hub shall provide regional hub services for the ITS subsystems in Illinois. In addition, the Illinois regional hub will provide services for the Illinois Transit Hub.

5.1.1.1.2 It is envisioned that the Illinois regional hub shall be collocated with the Gateway. As a result, communications between the Illinois regional hub system and the Gateway system shall be through direct LAN connections.

5.1.1.1.3 The Illinois regional hub and the Gateway may share physical system resources such as servers, disk storage, databases, operator workstations, etc.

5.2 INDIANA REGIONAL HUB

5.2.1.1.1 The Indiana Hub shall provide regional hub services for the ITS subsystems in Indiana as well support the capability to maintain the Indiana ISP server.

5.2.1.1.2 As the Indiana Hub shall be located in Indiana, a high speed, DS3 or greater, ATM connection shall be established between the Indiana Hub location and the Gateway.

5.3 WISCONSIN REGIONAL HUB

5.3.1.1.1 The Wisconsin Hub shall provide regional hub services for the ITS subsystems in Wisconsin as well as support the capability to maintain the Wisconsin ISP server.

5.3.1.1.2 As the Wisconsin Hub shall be located in Wisconsin, a high speed, DS3 or greater, ATM connection shall be established between the Wisconsin Hub location and the Gateway.

5.4 ILLINOIS TRANSIT HUB

5.4.1.1.1 The Illinois Transit Hub shall provide regional hub services for the transit related ITS subsystems in NE Illinois.

The Illinois Transit Hub shall connect to the Illinois regional hub. Additional information is found in the next section.

6. ILLINOIS REGIONAL HUB CONNECTIONS

The following sections describe requirement for connections to various subsystems in the Illinois area which shall connect to the Illinois regional hub. These connections range from the initial to the ultimate development phase. Some connections may continue to use alternative communication techniques (e.g., fax) until future planned upgrades are implemented.

All subsystems directly connected to the Illinois regional hub may obtain data from the GCM data server or through the GCM data stream dissemination techniques or from the Corridor Intranet. Note that those subsystems not directly requesting or receiving data can still obtain data over the Internet.

6.1 IDOT TRAFFIC SYSTEMS CENTER

The TSC is responsible for managing congestion on the 150-mile IDOT District 1 expressway system. This system includes vehicle detection, ramp metering, Close Circuit Television (CCTV), Variable Message Signs (VMS), and CB radio monitoring sites.

6.1.1 Data Provided

6.1.1.1.1 The TSC receives real time data from over 2200 loop detectors along the regional expressway system and Lake Shore Drive. This data shall be volume, occupancy and/or speed information and provided to the Illinois regional hub.

6.1.1.1.2 Transmission of data for every loop detector shall be performed in a block of at least one minute intervals to the Illinois regional hub.

6.1.1.1.3 Additional transmission of loop detector information from the TSC may be needed by other ITS subsystems in the Corridor at faster rates than one minute. The TSC (through the hub interface) shall provide this data also.

6.1.1.1.4 The TSC operates algorithms which can detect the possibility of traffic incidents based on changes in loop detector data. Where incident likelihood is determined from detector data, the possible location of the incident shall be provided to the Illinois regional hub during the next available block data transfer.

6.1.1.1.5 The TSC operates approximately 20 variable message signs (VMS). Every 5 minutes, the TSC shall include the VMS data (text message and sign status) in the block data transfer to the Illinois regional hub.

6.1.1.1.6 The TSC currently has 3 CCTV cameras located along the Kennedy Expressway. These cameras have pan-tilt-zoom (PTZ) capabilities. Additional cameras are being installed in strategic locations along the expressway system. The TSC shall provide digital video feeds from these cameras to the Corridor.

6.1.1.1.7 The TSC operates and manages the ramp metering devices for the Illinois District One highway system. The TSC shall provide the Illinois regional hub with ramp meter information such as: location, status (on/off) and possibly ramp meter rates.

6.1.1.1.8 Transmission of data for every ramp meter shall be performed in a block of at least one minute intervals to the Illinois regional hub.

6.1.1.1.9 Additional transmission of ramp meter information from the TSC may be needed by other ITS subsystems in the Corridor at faster rates than one minute. The TSC (through the hub interface) shall provide this data also.

6.1.2 Data Requested

6.1.2.1.1 The TSC shall field a computer for the purposes of displaying the GCM warmap. The warmap shall be obtained by standard HTTP/Java transactions from the Gateway (through the Illinois regional hub).

6.1.2.1.2 The TSC may obtain additional detector data (at more frequent intervals than used by the Gateway) from other ITS subsystems within the Corridor through the Corridor WAN.

6.1.2.1.3 The TSC may view video feeds from other ITS subsystems within the Corridor.

6.1.3 Cooperative Control

6.1.3.1.1 The TSC shall field a program that will allow other ITS subsystems within the Corridor to set messages on the TSC VMS (subject to TSC approval).

6.1.3.1.2 The TSC may need to set the VMS text of other ITS subsystems within the Corridor (subject to the operating agency's approval).

6.1.3.1.3 The TSC shall field a program that will allow the Gateway and other ITS subsystems to operate the PTZ capabilities of its CCTV cameras (subject to TSC approval).

6.1.3.1.4 The TSC shall field a program that will allow the Gateway and other ITS subsystems to select which of the TSC cameras it wishes to receive a video feed from.

6.1.4 Summary

6.1.4.1.1 The TSC shall need a high speed connection to the Illinois regional hub through a DS3 or higher bandwidth connection.

6.2 IDOT COMMUNICATIONS CENTER

The Communications Center (COM Center) acts as the 24 hour incident management center for IDOT's District 1 and has control over the Highway Advisory Radio (HAR) system and the Kennedy Expressway reversible lane control (RevLac) system. During off hours, the COM Center operates the TSC's VMSs

Initially, IDOT District 1 agencies (ETP, construction/maintenance, traffic, etc.) shall provide data to the COM Center which shall in turn provide that data to the Illinois regional hub. In the future, direct connections from various IDOT District 1 agencies to the Illinois regional hub may be established.

6.2.1 Data Provided

6.2.1.1.1 Data regarding special events which affect traffic shall be sent to the Illinois regional hub as information is available to the COM Center.

6.2.1.1.2 The COM Center shall provide the Illinois regional hub with information on the direction of the reversible lanes on the Kennedy expressway. When the reversible lanes are changed, the COM Center shall inform the Illinois regional hub.

6.2.1.1.3 The COM Center currently has a range of cameras to view the status of the reversible lanes of the Kennedy Expressway. Additional cameras are being installed in strategic locations along the expressway system. The COM Center shall provide digital video feeds from these cameras to the Corridor.

6.2.2 Data Requested

6.2.2.1.1 The COM Center shall field a computer for the purpose of displaying the GCM warmap. The warmap shall be obtained by standard HTTP/Java transactions from the Gateway (through the Illinois regional hub).

6.2.2.1.2 The COM Center may need to view video feeds from other ITS systems within the Corridor.

6.2.3 Cooperative Control

6.2.3.1.1 The COM Center shall field a program that will allow other ITS subsystems within the Corridor to set messages on their VMS (subject to COM Center approval).

6.2.3.1.2 The COM Center may need to set the VMS text of other ITS subsystems within the Corridor (subject to the operating agency's approval).

6.2.3.1.3 The COM Center shall field a program that will allow the Gateway and other ITS subsystems to operate the PTZ capabilities of its CCTV cameras (subject to COM Center approval).

6.2.3.1.4 The COM Center shall field a program that will allow the Gateway and other ITS subsystems to select which of the COM Center cameras it wishes to receive a video feed from.

6.2.4 Summary

6.2.4.1.1 To support its video feeds, the COM Center shall be connected to the Illinois regional hub using a DS3 or greater connection.

6.3 IDOT ETP

IDOT provides an Emergency Traffic Patrol capability known as the IDOT Minutemen. These ETP vehicles provide road service for disabled motorists and assists in traffic incidents.

Initially the ETP shall provide data to the COM Center which shall in turn supply that data to the Illinois regional hub. In the future, a direct connection between the Minutemen and the Illinois regional hub may be established.

6.3.1 Data Provided

6.3.1.1.1 The ETP shall provide data on incidents to the Illinois regional hub (possibly through the COM Center) as they occur. This does not exclude direct paging from the Minutemen.

6.3.2 Data Requested

6.3.2.1.1 TBD.

6.3.3 Cooperative Control

6.3.3.1.1 TBD.

6.3.4 Summary

6.3.4.1.1 A DS0 level connection may be established to the Illinois regional hub or a single high speed connection from IDOT District 1 to the Illinois regional hub may be established which can be used by the ETP.

6.4 IDOT TRAFFIC

IDOT Traffic coordinates construction and maintenance activities on IDOT roadways.

Initially IDOT Traffic shall provide data to the COM Center which shall in turn supply that data to the Illinois regional hub. In the future, a direct connection between IDOT Traffic and the Illinois regional hub may be established.

6.4.1 Data Provided

6.4.1.1.1 IDOT Traffic shall provide data on planned and active construction and maintenance to the Illinois regional hub (possibly through the COM Center) as they occur or on a scheduled basis.

6.4.2 Data Requested

6.4.2.1.1 TBD.

6.4.3 Cooperative Control

6.4.3.1.1 TBD.

6.4.4 Summary

A DS0 level connection may be established to the Illinois regional hub or a single high speed connection from IDOT District 1 to the Illinois regional hub may be established which can be used by IDOT Traffic.

6.5 IDOT SSI CONNECTION

The Scan System is composed of electronic equipment located at several remote field locations and at one central monitoring location. The equipment consists of surface and environmental sensors. The surface sensors, embedded in the pavement, provide surface condition information. The environmental sensors provide information such as air temperature, relative humidity, dew point and level of precipitation. There are currently between 60 and 70 sites with 250 pavement sensors in the three state area.

6.5.1 Data Provided

6.5.1.1.1 SSI pavements sensors are distributed throughout the a multi-state area including the GCM Corridor. The sensors provide information about the pavement surface condition (icy, wet, snow covered, etc.). SSI provides this data to IDOT. IDOT shall make this data available at their District 1 headquarters and shall provide the data to the Illinois regional hub through an electronic connection on a 5 minute periodic basis.

6.5.1.1.2 SSI environmental sensors are distributed throughout the a multi-state area including the GCM Corridor. The sensors provide information about the local air temperature, humidity, dew point, precipitation, wind speed and direction. SSI provides this data to IDOT. IDOT shall

make this data available at their District 1 headquarters and shall provide the data to the Illinois regional hub through an electronic connection on a 5 minute periodic basis.

6.5.2 Data Requested

6.5.2.1.1 None.

6.5.3 Cooperative Control

6.5.3.1.1 None.

6.5.4 Summary

6.5.4.1.1 To support the data transfer, the IDOT District 1 SCAN computer which has the SSI data needs to connect to the Illinois regional hub with at least a 56kbps type connection. In the future a single high speed connection from IDOT District 1 to the Illinois regional hub may be established which can be used by SCAN computer.

6.6 IDOT TRAFFIC SIGNAL SYSTEMS

Throughout IDOT District 1 there are in excess of 180 traffic signals operated in Closed Loop Signal Systems (CLSS) on IDOT maintained roadways. These systems are comprised of on-street master controllers with actuated intersection controllers and a dial-up modem connection to a central location. The purpose of a CLSS is to allow real-time traffic monitoring and modifications from a remote centralized location, to allow automatic traffic response control based on actual vehicle traffic, and to provide a simple real-time notification and tracking of signal malfunctions.

6.6.1 Data Provided

6.6.1.1.1 IDOT's traffic signal system shall alert the Illinois regional hub when a signal malfunction is detected. It shall then alert the Illinois regional hub when the signal is operational.

6.6.1.1.2 In the future, detector information for travel time and other calculations shall also be provided to the Illinois regional hub from various traffic signal systems on the national highway/strategic regional arterials or other major arterials system within the Corridor.

6.6.2 Data Requested

6.6.2.1.1 None.

6.6.3 Cooperative Control

6.6.3.1.1 TBD.

6.6.4 Summary

6.6.4.1.1 Alerts from IDOT's signal systems shall be accomplished through dialup procedures to the Illinois regional hub. In the future a single high speed connection from IDOT District 1 to the Illinois regional hub may be established which can be used by IDOT Traffic Signal Systems..

6.6.4.1.2 Data from IDOT's signal systems should be coordinated in a central machine or machines which should then contact the Illinois regional hub when malfunction data is available.

6.7 ISTHA

The Illinois State Toll Highway Authority includes the North-South Tollway (I-355), the Tri-State Tollway (I-94 + I-294 + I-80/I-294), the Northwest Tollway (I-90) and the East-West Tollway (I-88). ISTHA is currently installing electronic toll collection equipment at all toll lanes in the system. In addition to collecting and processing toll payments automatically, plans include a process to determine vehicle travel times from the toll tag transactions. ISTHA also maintains VMSs and has an emergency dispatch capability (Highway Emergency Lane Patrol, or HELP). Future plans may include the addition of CCTV cameras along the tollway system.

6.7.1 Data Provided

6.7.1.1.1 ISTHA will be able to calculate travel times over the tollway system through electronic toll collection devices (located in vehicles) and roadside detectors and toll plaza based detectors. This data shall be provided to the Illinois regional hub.

6.7.1.1.2 Transmission of data for every road segment shall be performed in a block at five minute intervals to the Illinois regional hub.

6.7.1.1.3 ISTHA operates several VMS. Every 5 minutes, ISTHA shall include the VMS data (sign status and message text) in the block data transfer to the Illinois regional hub.

6.7.1.1.4 ISTHA shall provide the Illinois regional hub with construction and maintenance schedules on a daily basis.

6.7.1.1.5 Additional data regarding special events which affect traffic shall be sent to the Illinois regional hub as information is available to ISTHA.

6.7.1.1.6 ISTHA shall provide data on incidents known to HELP to the Illinois regional hub as they occur.

6.7.1.1.7 ISTHA may implement a number of cameras located along the tollway system. In the future, ISTHA may provide digital video feeds (at least 4) from these cameras to the Corridor.

6.7.2 Data Requested

6.7.2.1.1 ISTHA shall field a computer for the purposes of displaying the GCM warmap. The warmap shall be obtained by standard HTTP/Java transactions from the Gateway (through the Illinois regional hub).

6.7.2.1.2 ISTHA may need to view video feeds from other ITS systems within the Corridor.

6.7.3 Cooperative Control

6.7.3.1.1 ISTHA may field a program that will allow other ITS systems within the Corridor to set messages on ISTHA VMS (subject to ISTHA approval).

6.7.3.1.2 ISTHA may need to set the VMS text of other ITS systems within the Corridor (subject to the operating agency's approval).

6.7.3.1.3 ISTHA shall field a program that will allow other ITS systems to operate the PTZ capabilities of its cameras (subject to ISTHA approval).

6.7.3.1.4 ISTHA shall field a program that will allow other ITS systems to select which of the ISTHA cameras it wishes to receive a video feed from.

6.7.4 Summary

6.7.4.1.1 As a result of its video feed capability, a DS3 or greater line should be installed between ISTHA and the Illinois regional hub.

6.8 CHICAGO DEPARTMENT OF TRANSPORTATION (CDOT)

CDOT operates and maintains a range of transportation infrastructure within the City of Chicago. The coordinate construction and maintenance efforts. CDOT also operates a number of monitored signalized intersections in the downtown area and plans to expand its centralized monitoring capability to include all of the City's 2700 signalized intersections. In the future, CDOT may install CCTV cameras at strategic points within the Chicago transportation infrastructure. As well, CDOT may install VMS on major arterials in the Corridor.

6.8.1 Data Provided

6.8.1.1.1 CDOT shall provide the Illinois with construction and maintenance schedules on a daily basis.

6.8.1.1.2 In the future, CDOT shall provide VMS data to the Illinois regional hub.

6.8.1.1.3 CDOT's traffic signal system shall alert the Illinois regional hub when a signal malfunction is detected. It shall then alert the Illinois regional hub when the signal is operational.

6.8.1.1.4 In the future, detector information shall also be provided to the Illinois regional hub from various traffic signal systems on the national highway/strategic regional arterials or other major arterials system within the Corridor.

6.8.2 Data Requested

6.8.2.1.1 CDOT shall field a computer for the purposes of displaying the CGM warmap. The warmap shall be obtained by standard HTTP/Java transactions from the Gateway (through the Illinois regional hub).

6.8.2.1.2 CDOT may need to view video feeds from other ITS systems within the Corridor.

6.8.3 Cooperative Control

6.8.3.1.1 CDOT shall field a program that will allow other ITS systems to operate the PTZ capabilities of its cameras (subject to CDOT approval).

6.8.3.1.2 CDOT shall field a program that will allow other ITS systems to select which of the CDOT cameras it wishes to receive a video feed from.

6.8.3.1.3 CDOT may field a program that will allow other ITS systems within the Corridor to set messages on CDOT VMS.

6.8.3.1.4 CDOT may need to set the VMS text of other ITS systems within the Corridor (subject to operating agency's approval).

6.8.4 Summary

6.8.4.1.1 To support receiving video feeds from CDOT, a DS3 or greater connection is needed.

6.8.4.1.2 Data from CDOT's signal systems shall be coordinated in a central machine or machines which should then contact the Illinois regional hub when malfunction data is available.

6.9 CHICAGO SKYWAY

The Chicago Skyway operates one toll plaza. Plans exist to upgrade that plaza to include electronic toll collection. If additional detectors are also included, the Chicago Skyway can provide travel time information to the Illinois regional hub. Construction and maintenance data on the Skyway shall be provided by CDOT.

6.9.1 Data Provided

6.9.1.1.1 TBD.

6.9.2 Data Requested

6.9.2.1.1 TBD.

6.9.3 Cooperative Control

6.9.3.1.1 TBD.

6.9.4 Summary

6.9.4.1.1 Connection to the Skyway should be supported through the main connection between CDOT and the Illinois regional hub.

6.10 NORTHWEST CENTRAL DISPATCH

Northwest Central Dispatch (NWCD) serves as the Police and Fire dispatch agency for seven cities in the Northwest suburbs of Chicago. NWCD handles traffic and non-traffic related emergency incidents. Traffic related incidents are filtered at NWCD and are currently provided to the C-TIC.

6.10.1 Data Provided

6.10.1.1.1 NWCD will provide data on traffic related incidents to the Illinois regional hub as they occur.

6.10.2 Data Requested

6.10.2.1.1 TBD.

6.10.3 Cooperative Control

6.10.3.1.1 TBD.

6.10.4 Summary

6.10.4.1.1 Connection to NWCD shall be through a DS0 Frame Relay circuit. In the future, a higher bandwidth, more interactive, connection may be established to provide the GCM warmap, video feeds and other data from the Gateway (if a Corridor Architecture compliant system is implemented).

6.11 *999

The Chicago metropolitan area currently uses a public sponsored, dedicated number, cellular emergency system, *999, to cover the City of Chicago and the surrounding six counties. There is a single command center for this operation which is staffed 24 hours a day. The operators receive in excess of 300,000 calls per year dealing with a variety of roadway based emergencies. The operators receive each call, note the incident information from the motorist, and relay the calls to the appropriate service providers.

6.11.1 Data Provided

6.11.1.1.1 *999 will provide data on traffic related incidents to the Illinois regional hub as they occur.

6.11.2 Data Requested

6.11.2.1.1 TBD.

6.11.3 Cooperative Control

6.11.3.1.1 TBD.

6.11.4 Summary

6.11.4.1.1 Connection to *999 shall be through a DS0 Frame Relay circuit.

6.12 ILLINOIS STATE POLICE (DISTRICT 15)

The Illinois State Police (District 15) provides policing services on the Illinois Tollroads.

6.12.1 Data Provided

6.12.1.1.1 The Illinois State Police (District 15) will provide data on traffic related incidents to the Illinois regional hub as they occur.

6.12.2 Data Requested

6.12.2.1.1 TBD.

6.12.3 Cooperative Control

6.12.3.1.1 TBD.

6.12.4 Summary

6.12.4.1.1 It is anticipated that the District 15 State Police shall share the main ISTHA to Illinois regional hub link. As such, they may access the CGM warmap.

6.13 ILLINOIS STATE POLICE (DISTRICT CHICAGO)

The Illinois State Police (District Chicago) provides policing services in the Chicago area, specifically on the national highway system/strategic regional arterials.

6.13.1 Data Provided

6.13.1.1.1 The Illinois State Police (District Chicago) will provide data on traffic related incidents to the Illinois regional hub as they occur.

6.13.2 Data Requested

6.13.2.1.1 TBD.

6.13.3 Cooperative Control

6.13.3.1.1 TBD.

6.13.4 Summary

6.13.4.1.1 Connection to Illinois State Police (District Chicago) shall be through a DS0 Frame Relay circuit. Alternatively a higher bandwidth, more interactive, connection may be established (if a Corridor Architecture compliant system is implemented in the future) which can provide the GCM warmap, video feeds and other data from the Gateway.

6.14 DUCOM

DuCom provides centralized emergency dispatch service for 28 police and fire departments in the DuPage County area. DuCom is in the process of installing a new CAD (computer aided dispatch) system which will fully automate their operations. Connection to DuCom would be similar to that of NWCD and *999. Alternatively a higher bandwidth, more interactive, connection may be established which can provide the GCM warmap, video feeds, and other data from the Gateway (if a Corridor Architecture compliant system is implemented in the future).

6.14.1 Data Provided

6.14.1.1.1 DuCom may provide data on traffic related incidents to the Illinois regional hub as they occur.

6.14.2 Data Requested

6.14.2.1.1 TBD.

6.14.3 Cooperative Control

6.14.3.1.1 TBD.

6.14.4 Summary

6.14.4.1.1 Connection to DuCom shall be through a DS0 Frame Relay circuit (or higher bandwidth connection).

6.15 POLICE DEPARTMENTS

Various police departments in the Illinois section of the GCM Corridor have jurisdiction over parts of the national highway system/strategic regional arterials and other major arterials. Connections shall be made to as many local police dispatch systems as available. Connections to local police departments would be similar to that of NWCD and *999. Alternatively a higher bandwidth, more interactive, connection may be established which can provide the GCM

warmap, video feeds, and other data from the Gateway (if a Corridor Architecture compliant system is implemented in the future).

6.15.1 Data Provided

6.15.1.1.1 Local police departments may provide data on traffic related incidents to the Illinois regional hub as they occur.

6.15.2 Data Requested

6.15.2.1.1 TBD.

6.15.3 Cooperative Control

6.15.3.1.1 TBD.

6.15.4 Summary

6.15.4.1.1 Connections to local police departments shall be through DS0 Frame Relay circuits (or higher bandwidth connection).

6.16 ILLINOIS TRANSIT HUB

The Illinois transit hub shall coordinate transit information from the following sources:

- The Chicago Transit Authority (CTA)
- Pace
- Metra
- The Regional transit Authority (RTA)
- Amtrak

It is envisioned that this hub will make transit schedules, schedule adherence, fare rates and other pertinent information from the above sources available to the public via the Internet and to other GCM participants through the Corridor WAN by way of a connection to the Illinois regional hub. Note that the Transit hub will not be available until after the ultimate phase of the Gateway implementation. In the interim, direct, dedicated electronic connections from the above sources to the Illinois regional hub is recommended.

6.16.1 Data Provided

6.16.1.1.1 The CTA shall be capable of providing information on current bus and train schedules (i.e., delays, schedule adherence, fare rates, etc.).

6.16.1.1.2 The CTA shall be capable of providing bus locations (probe information), utilizing their AVL system, which can then be calculated into travel time information for NHS/SRA roadways.

6.16.1.1.3 The CTA shall be capable of providing traffic related incidents on NHS/SRA roadways as they occur.

6.16.1.1.4 Pace shall be capable of providing information on current bus schedules (i.e., delays, schedule adherence, fare rates, etc.).

6.16.1.1.5 Pace shall be capable of providing bus locations (probe information), utilizing their AVL system, which can then be calculated into travel time information for NHS/SRA roadways.

6.16.1.1.6 Pace shall be capable of providing traffic related incidents on NHS/SRA roadways as they occur.

6.16.1.1.7 Metra and Amtrak shall be capable of providing information on current train schedules (i.e., delays, schedule adherence, fare rates, etc.).

6.16.2 Data Requested

6.16.2.1.1 The CTA may field a computer for the purposes of displaying the GCM warmap.

6.16.2.1.2 The CTA may need to view video feeds from other ITS systems within the Corridor, specifically in the Chicago land area.

6.16.2.1.3 The CTA, Pace, Amtrak and Metra shall be capable of receiving Corridor data through a direct connection during the Initial phase and through the Transit hub after its implementation.

6.16.3 Cooperative Control

6.16.3.1.1 There shall be no cooperative control necessary for these ITS subsystems.

6.16.4 Summary

6.16.4.1.1 Connection to the Illinois Transit Hub shall be through a DS1 ATM circuit.