Submitted to

Los Angeles County

City of South Gate System Architecture Diagram – Draft (Deliverable 2.1.9.3)

Gateway Cities Traffic Signal Synchronization and Bus Speed Improvement Project - I-105 Corridor (Phase II)

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NATIONAL ENGINEERING TECHNOLOGY CORPORATION

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1. INTRODUCTION

The purpose of this document is to develop a detailed design for the Advanced Traffic Management System (ATMS) for the City of South Gate as part of the I-105 corridor project. This document is based on the recommendations included in the *I-105 Corridor - Draft Conceptual Design Report*. The City of South Gate is one of the cities within the I-105 corridor area is planned to be contributor of traffic data to the Information Exchange Network (IEN). The system architecture for the I-105 corridor is shown in Figure 1-1. South Gate is highlighted to indicate where this agency fits into the overall system. This system architecture is decomposed for the City of South Gate into each system component that comprises the South Gate ATMS. Subsequently each component is further decomposed to develop a detailed design that will result in a list of required equipment and the allocation of system components to the various procurement vehicles for implementation in the City of South Gate.

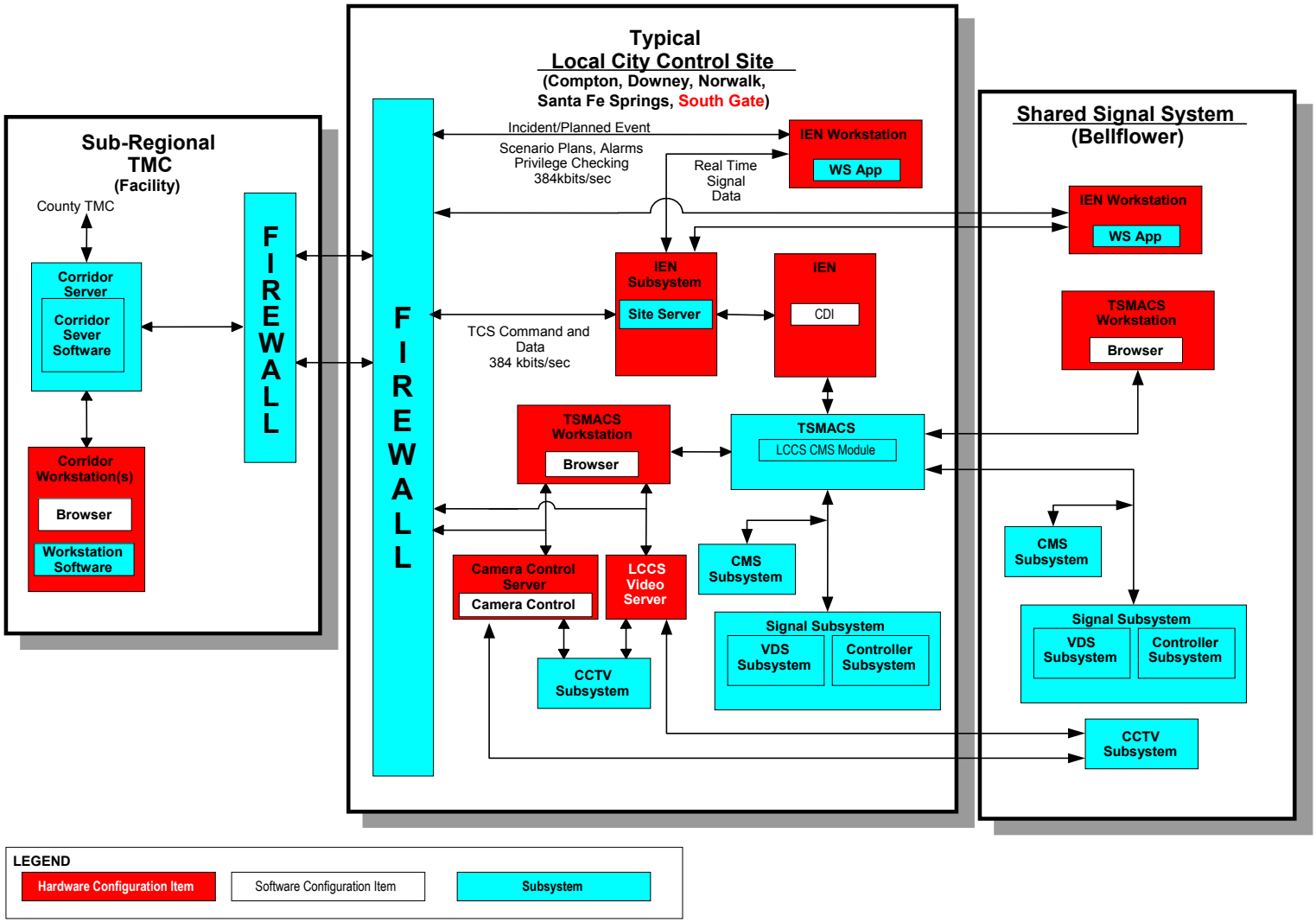

Figure 1-1: I-105 Corridor System Architecture

2. CITY OF SOUTH GATE ADVANCED TRAFFIC MANAGEMENT SYSTEM (ATMS)

The Advanced Traffic Management System (ATMS) for the City of South Gate consists of three subsystems: traffic signal subsystem and the video subsystem, and the communications subsystem that supports both of them. The configuration items in Figure 1-1 that are addressed in this document can be assigned the ATMS subsystems for the City of South Gate as follows:

Traffic Signal Subsystem:

- Traffic Signal Monitoring and Control Subsystem (TSMACS)
- Controller Subsystem
- Vehicle Detection Station (VDS) Subsystem

Video Subsystem:

- Camera Control Server
- Video Server
- CCTV Subsystem

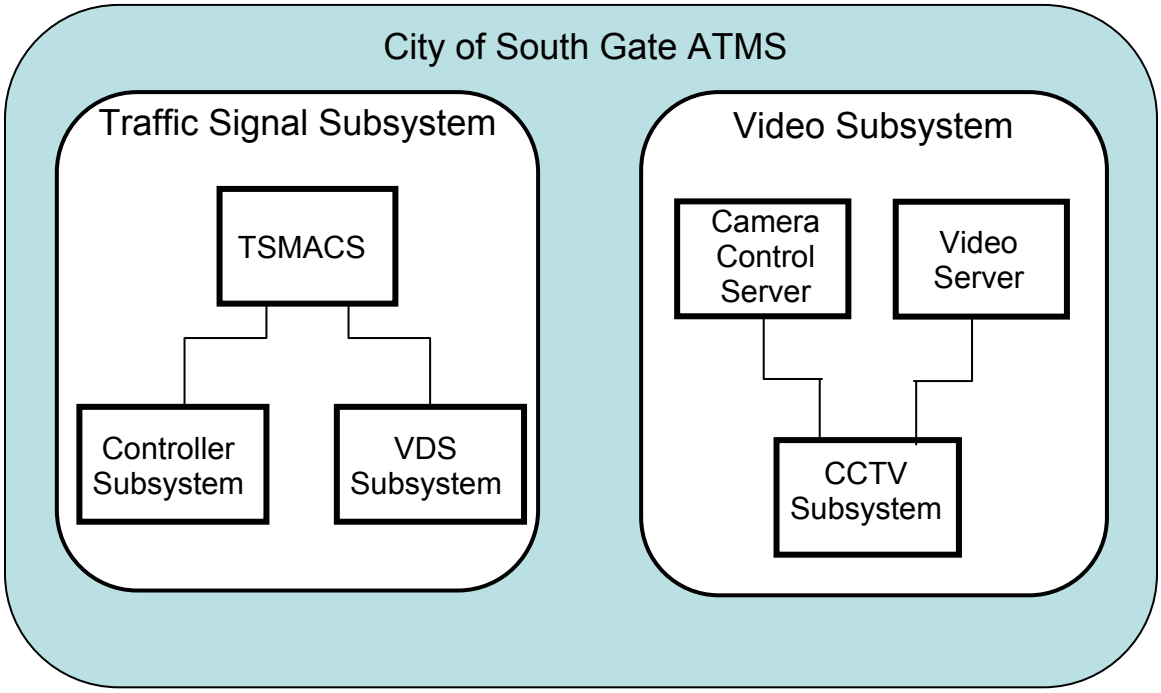

Figure 2-1: South Gate ATMS System Architecture

Figure 2-2 shows the geographic locations of the proposed field components as part of the ATMS in the City of South Gate. These field components include CCTV cameras as signalized intersections and traffic signal controllers to be connected to the TSMACS.

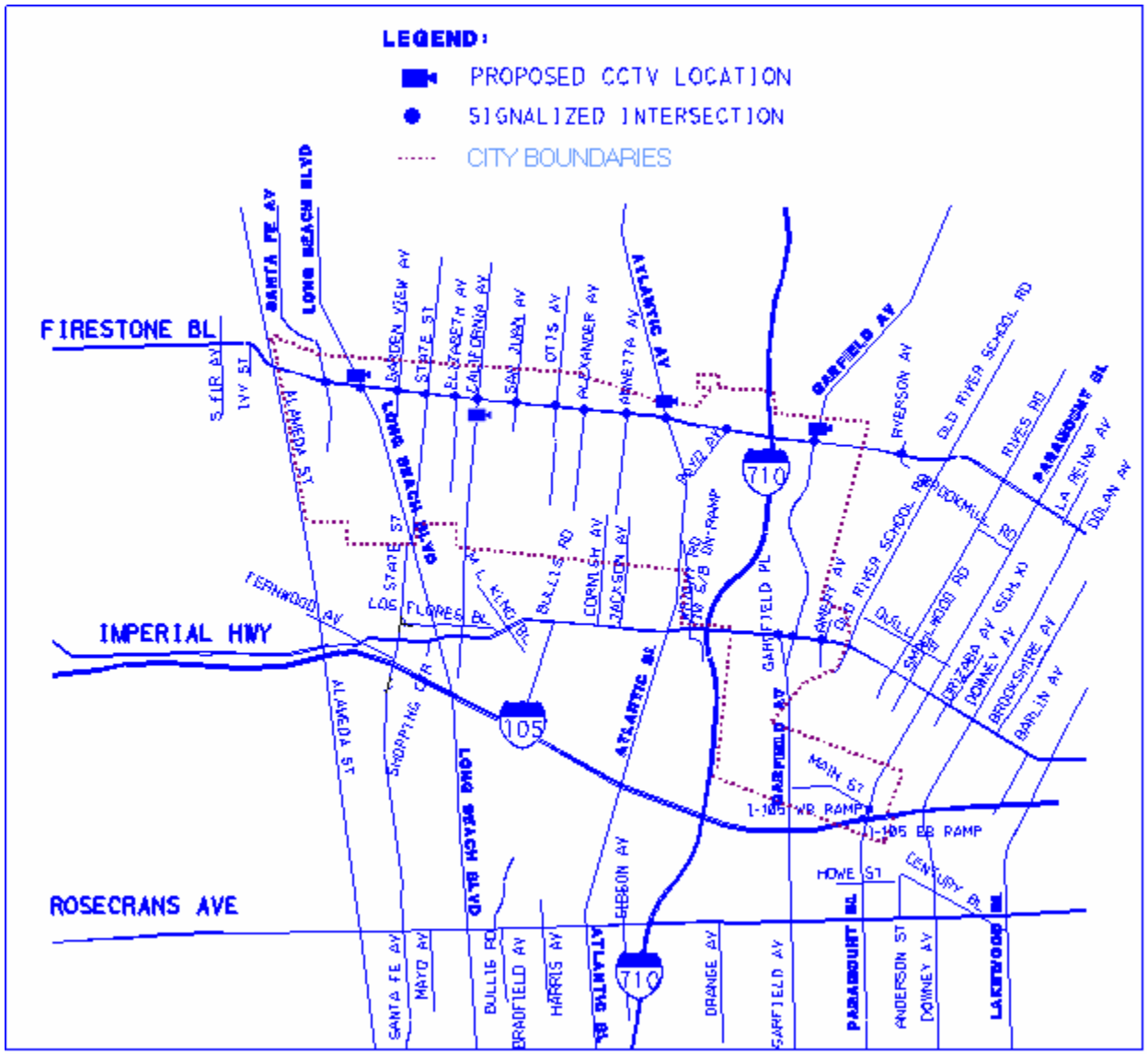

Figure 2-2: Geographic Layout for South Gate Field Components

Twisted pair cable and fiber optic communications cable are currently exist in the City of South Gate, in the following locations as shown in Figure 2-3:

- Twisted-pair cable along Firestone Blvd. between Santa Fe Ave. & Garfield Ave.
- Twisted-pair cable along California St. between Firestone Bl. and City Hall

- Fiber optic cable between City Hall and the City Yard.
- Traffic signal controllers along Firestone Bl. are currently linked to the City Hall over the twisted-pair cable. It is proposed that the new CCTV cameras also use this cable to transmit video images to the LCC via City Hall. CCTV camera locations will be addressed in later sections of this document.

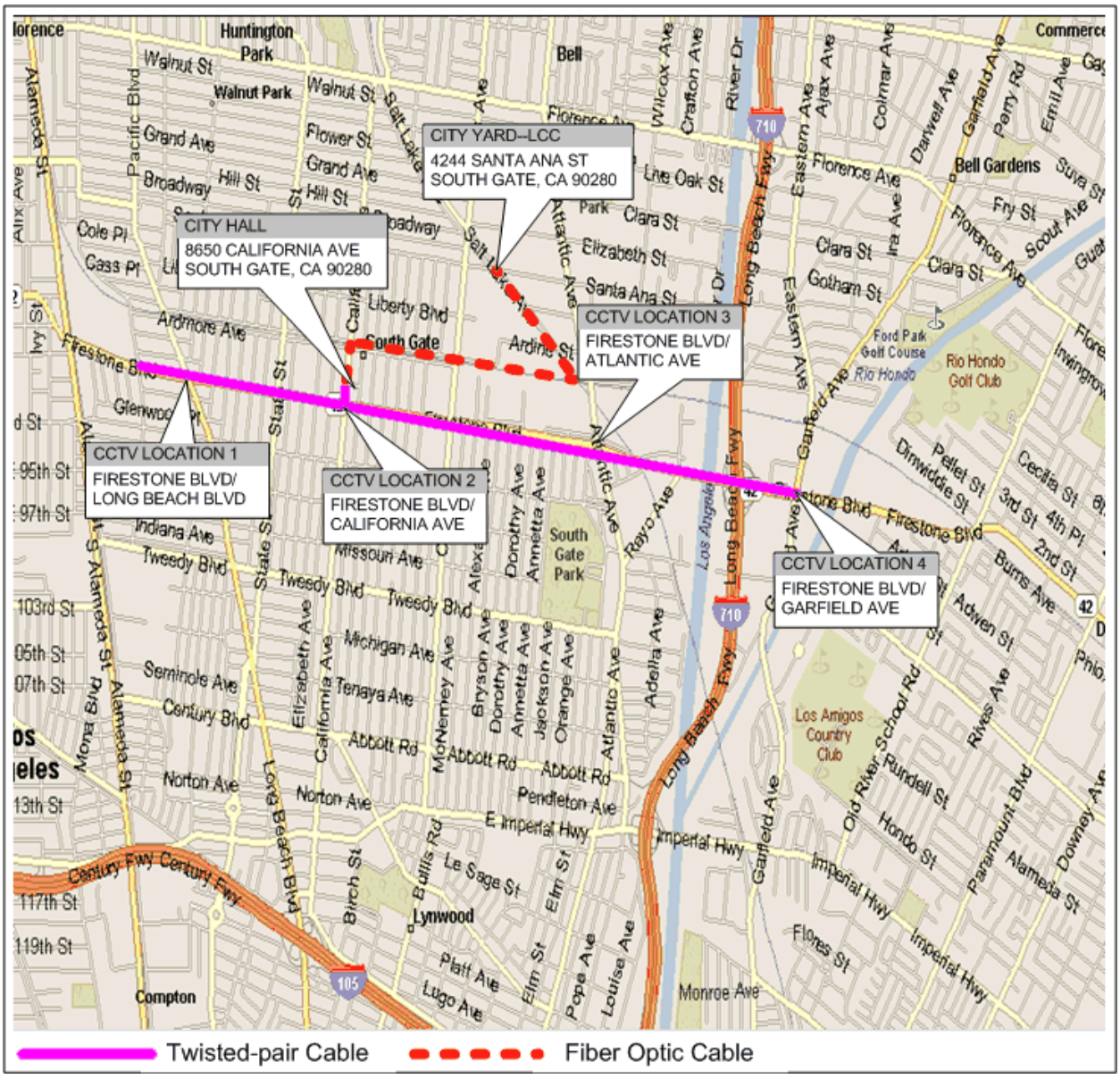

Figure 2-3: Existing Twisted-pair Cable and Proposed CCTV Locations in South Gate

2.1 Traffic Signal Subsystem

The traffic signal subsystem consists of three components: the Traffic Signal Management and Control System (TSMACS), traffic signal controllers, and vehicle detection stations (VDS). In the following subsections, a functional description and the proposed design approach are provided for each component of this subsystem. Figure 2-4 depicts the equipment interconnection for the traffic signal subsystem. The traffic signal controllers collect traffic flow data from the advance detectors.

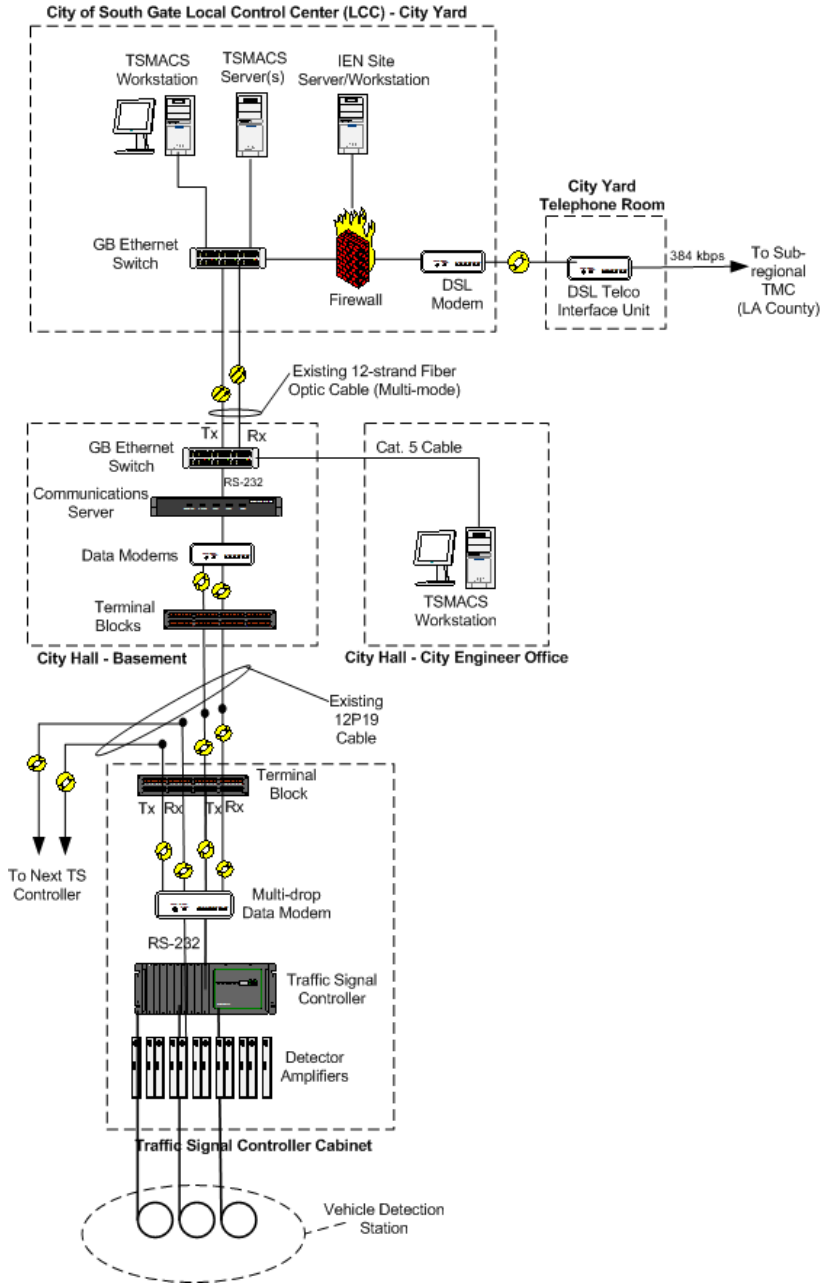

Figure 2-4: Traffic Signal Subsystem Physical Architecture Diagram

2.1.1 Traffic Signal Management and Control System (TSMACS)

The TSMACS provides the monitoring and control of traffic signals and interfaces with the traffic signal controllers. Currently, there is an Econolite Icons system located in the City Hall which will be upgraded as part of this project. Functional requirements were developed during the high-level design phase for I-105 Corridor project. These requirements can be grouped into the following areas:

- Traffic Signal (TS)
- Information Exchange Network (IEN)
- User Interface (UI)

Traffic Signal (TS):

TS functional area consists of the functionality related to traffic signal monitoring and control, as well traffic data archiving and reporting.

Information Exchange Network (IEN):

The IEN are consists of requirements related to providing a data interface between the TSMACS and an external system. This allows the IEN to retrieve traffic data from each TSMACS for overall corridor coordination.

User Interface (UI):

The UI area consists of functionality related to the graphical user interface, such as dialogs and map displays for the TSMACS to control and monitor field equipment.

The selected TSMACS may not meet all functional requirements using an off-the-shelf software package. The I-105 Corridor Conceptual Design Report specified three vendor offerings that could provide the City of South Gate with their TSMACS. These are as follows:

- Econolite ***icons***
- Siemens i2TMS
- Transcore Series 2000 (or Transuite)

Technical specifications for the selected TSMACS will be provided in *Deliverable 2.1.9.3 – South Gate Draft ATMS Specification and Scope of Work.*

The following system components are included in the TSMACS subsystem:

- Traffic Applications Server – provides signal timing control and monitoring functions.
- Database Server – provides a repository for timing plans and system configuration data.
- Communications Server – provides the communications interface to the traffic signal controllers.

- User Workstations – provides a the graphical user interface for operators to interact with the system.

2.1.2 Traffic Signal Controllers (TSC)

2.1.2.1 Functional Description

The traffic signal controllers in South Gate along Firestone Bl. are Econolite ASC/2-1000. These controllers are compatible with the TSMACS proposed above, however a firmware upgrade may be needed to enable communications using the AB-3428 protocol. Table 2-1 lists the intersections to be connected to the TSMACS.

Table 2-1: Proposed Traffic Signals to be Connected to TSMACS

No.	Primary Street	Cross Street
1	Firestone Blvd	Santa Fe Ave
2	Firestone Blvd	Long Beach Blvd
3	Firestone Blvd	Garden View Ave
4	Firestone Blvd	State St
5	Firestone Blvd	Elizabeth Ave
6	Firestone Blvd	California Ave
7	Firestone Blvd	San Juan Ave
8	Firestone Blvd	Otis Ave
9	Firestone Blvd	Alexander Ave
10	Firestone Blvd	Annetta Ave
11	Firestone Blvd	Atlantic Ave
12	Firestone Blvd	Rayo Ave
13	Firestone Blvd	Garfield Ave
14	Firestone Blvd	Ryerson Ave
15	Imperial Hwy	Garfield Pl
16	Imperial Hwy	Garfield Ave
17	Imperial Hwy	Amery Ave
18	Paramount Blvd	Main St - T

2.1.2.2 Design Approach

Traffic signal controllers that are to be connected to the TSMACS are proposed to use existing twisted pair cable. The communications interfaces that link the controllers to the South Gate LCC are described in Section 2.3.

2.1.3 Vehicle Detection Stations (VDS)

2.1.3.1 Functional Description

Vehicle detection station is a term that is used to describe a set of advance vehicle detectors on a single intersection approach. These detectors are typically about 300' to 400' from the intersection (depending on approach speeds) and are located in each adjacent lane. These vehicle detectors measure volume, occupancy, and speed or VOS (speed may be derived by the system) to allow the TSMACS to adjust timing when operating in a traffic-responsive mode. These vehicle detectors are also used for extending the green interval on a given phase when the controller is operating in free operation mode. The VOS data is typically retrieved by the TSMACS at end of a cycle or fixed frequency and used for traffic flow analysis or timing adjustments. The VOS data is also retrieved by the external systems such as the Information Exchange Network (IEN) to allow other agencies in the corridor to monitor traffic flow conditions on arterials that cross jurisdictional boundaries. In some cases detectors in separate lanes share a single Detector Lead-in Cable (DLC). A VDS with this configuration produces VOS data is not as accurate as VDS locations, which have a separate DLC for each lane. Several signalized intersection approaches are proposed to have additional DLC added to allow the VDS to measure VOS data from individual lanes. These intersections will be specified in the Plans, Specifications, and Estimate package.

2.1.3.2 Design Approach

Typically, when adding DLCs to an existing conduit run, the existing DLC must be removed and re-installed with the new cables. An additional detector amplifier is also required for each additional DLC to provide a separate input channel to the traffic signal controller.

2.2 Video Subsystem

The video system consists of the following components:

- CCTV Controller
- Video Server
- CCTV Subsystem

Figure 2-5 depicts the physical architecture for the video subsystem.

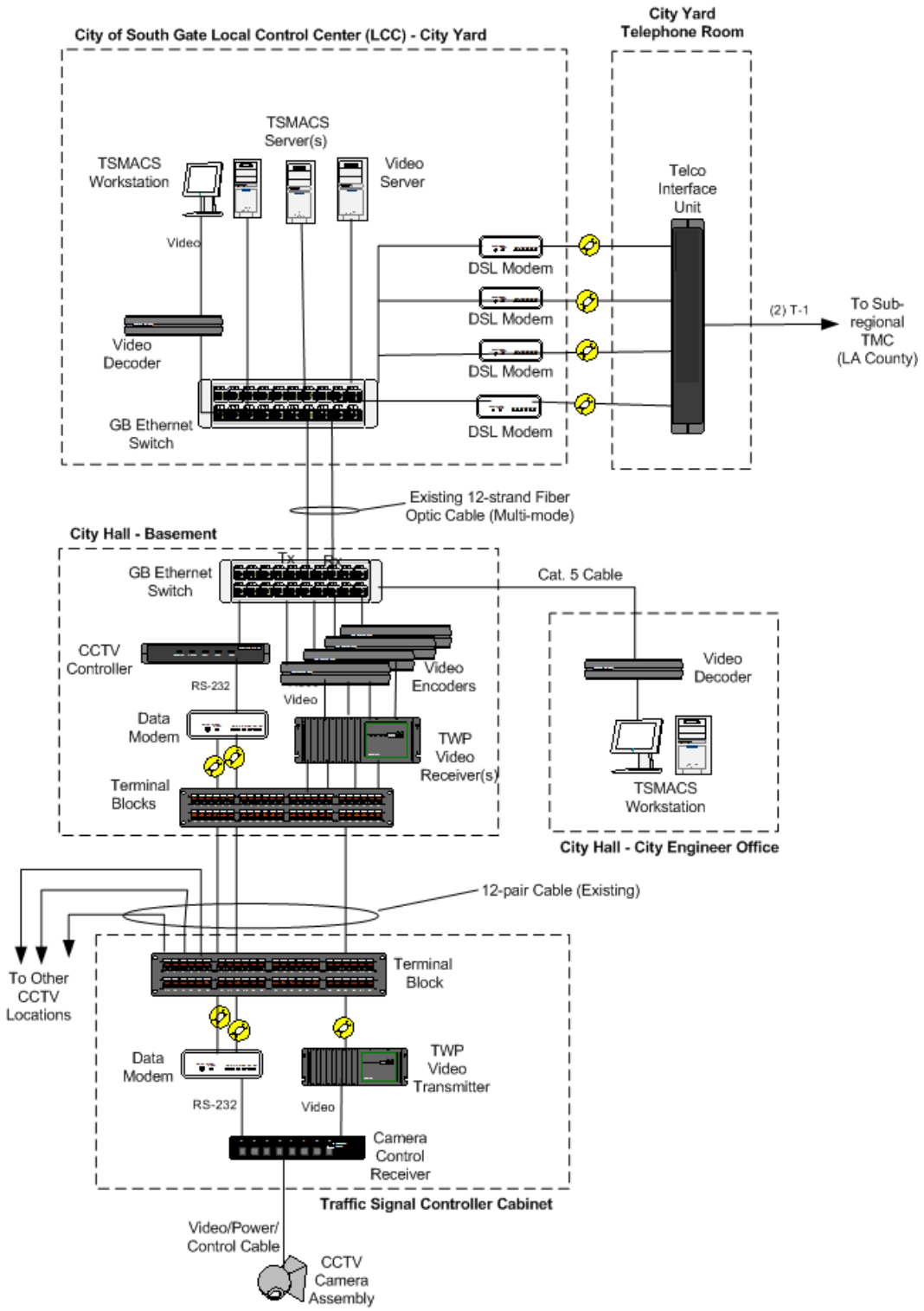

Figure 2-5 Video Subsystem Physical Architecture Diagram

2.2.1 CCTV Controller

2.2.1.1 Functional Description

The CCTV Controller component provides the ATMS with the ability to remotely control CCTV cameras from the Local Control Center (LCC). Control functions generally consist of panning, tilting, zooming, focus, iris, pre-set positioning, and color balancing. Additional control features are available depending on the vendor package selected.

2.2.1.2 Design Approach

The CCTV Controller component may or may not be included as part of the TSMACS depending on the vendor package that is selected. This component consists of a user interface (either joystick or computer graphical user interface) communicating with a CCTV controller unit or server to send commands to the camera control receiver in the field. For the purpose of this document it is assumed that there is a separate device required in the LCC. The communications interface between the CCTV controller and the CCTV camera in the field is typically a serial interface. This serial communications is accommodated by a multi-drop data modem circuit over twisted-pair cable to allow data transfer from the CCTV controller to the camera control receiver units at each CCTV location.

2.2.2 Video Server

2.2.2.1 Functional Description

The Video Server component may or may not be included as part of the TSMACS depending on the vendor package that is selected. This component provides the South Gate ATMS with the ability to collect the video images from the cameras in the field and distribute the images to display devices within the LCC and to other agencies in the I-105 corridor.

2.2.2.2 Design Approach

This Video Server component is currently under design as part of Task 7, therefore this document addresses this component at a high-level. Due to the fact that these images may be transferred over both fiber optic networks and low-bandwidth networks, MPEG-4 or MJPEG encoding may be best suited for application in the City of South Gate.

2.2.3 CCTV Subsystem

The CCTV subsystem consists of the CCTV camera equipment located at selected signalized intersections.

2.2.3.1 Functional Description

The CCTV subsystem consists of the CCTV camera field equipment located at selected signalized intersections. The intersections listed in Table 2-2 are proposed to have CCTV camera locations.

Table 2-2: Proposed CCTV Camera Locations for South Gate

No.	Cross Street	Communications
	Firestone Blvd	
1	Long Beach Blvd	Twisted Pair
2	California Ave	Twisted Pair
3	Atlantic Ave	Twisted Pair
4	Garfield Ave	Twisted Pair

The CCTV subsystem allows operators at the South Gate LCC to view video surveillance images at signalized intersections and control the position of these cameras for an optimum field of view for all approaches.

2.2.3.2 Design Approach

The CCTV camera location consists of the following equipment:

- CCTV camera assembly (camera, lens, pan-tilt unit) inside an environmental enclosure.
- Camera Control Receiver Unit
- Video Transmitter
- Data Modem (Camera Control)
- Twisted Pair Terminal Block

CCTV Camera Assembly

The design approach for CCTV camera locations is to mount a dome enclosure to an existing traffic signal pole just below the mast arm, as shown in Figure 2-6. The enclosure houses the camera, lens, and pan-tilt unit. A single cable egress is to be installed to allow a hybrid cable to be installed between the camera control receiver unit in the existing traffic signal cabinet and the CCTV dome enclosure. The hybrid cable consists of multi-conductors for camera control and power, as well as a coax cable for video transmission all contained within an outer jacket.

CCTV Interface Equipment

The CCTV interface equipment is to be located in the existing traffic signal controller cabinet using available shelf space. This equipment consists of a camera control receiver unit which relays camera control commands to the lens and pan-tilt unit. This unit also provides a video output port and camera control panel to reduce the need for a bucket truck during maintenance activities. A video transmitter is used to send the analog video signal from the camera to the LCC over existing twisted pair. A data

modem is utilized to provide camera control from the LCC to the camera control receiver.

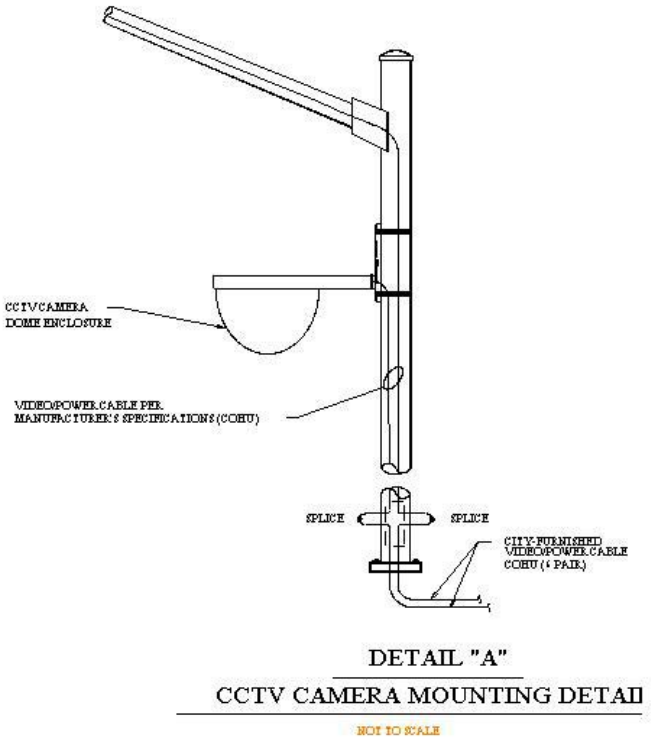

Figure 2-6: CCTV Dome Enclosure

2.3 Communication Subsystem

The communications subsystem supports the Traffic Signal and Video subsystem. There are two categories used to describe the communication subsystem for the City of South Gate: 1) center-to-field and 2) center-to-center. Center-to-field is the part of the communication system that links the field equipment to the LCC for the transfer of data and video images. Center-to-center is the part of the communication system that links the South Gate LCC with other agencies' LCC in the I-105 Corridor.

2.3.1 Center-to-Field

2.3.1.1 Cable-based Communications

The City of South Gate has existing twisted-pair and fiber optic cable linking the field equipment with the LCC. A 12-pair cable runs along Firestone Boulevard between Santa Fe Avenue and Garfield Avenue. There is an existing fiber optic cable that links the City Hall to the City Yard located on Santa Ana Street. The City Yard is the

proposed location of the LCC. Figure 2-7 depicts the proposed communications architecture for the video transmission subsystem. The video images are transmitted from the camera control receivers over twisted-pair using twisted-pair video transmitters to the City Hall. These images are then transmitted to the LCC at the City Yard over fiber optic cable.

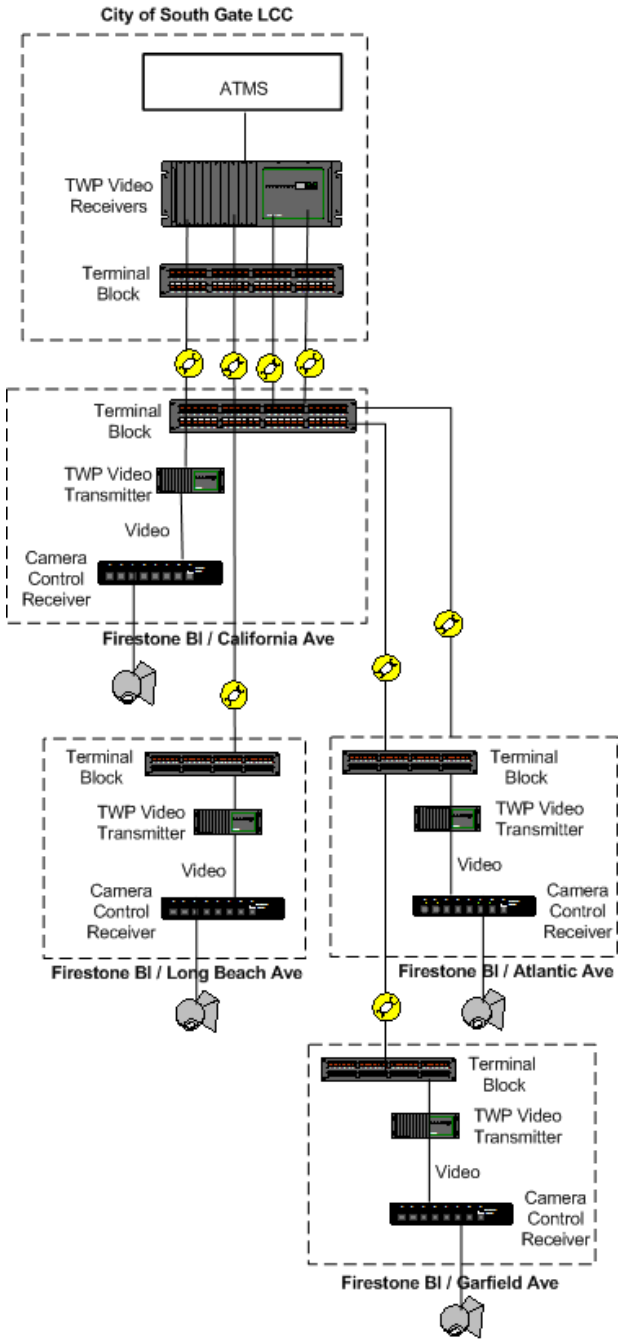

Figure 2-7: Communications Architecture (Center-to-Field) for Video Subsystem

Multi-drop modems operating at 9600 baud are used to connect the traffic signal controllers to the TSAMCS Communications Server located in the basement of South Gate City Hall, as shown in Figure 2-8. Each modem is connected to the controller's serial interface and utilizes two twisted pairs (transmit and receive) within the 12-pair #19 interconnect cable that exists along Firestone Bl. There is also an existing leased-line data circuit that links the controllers along Imperial Hwy and Paramount Bl. to the City Hall.

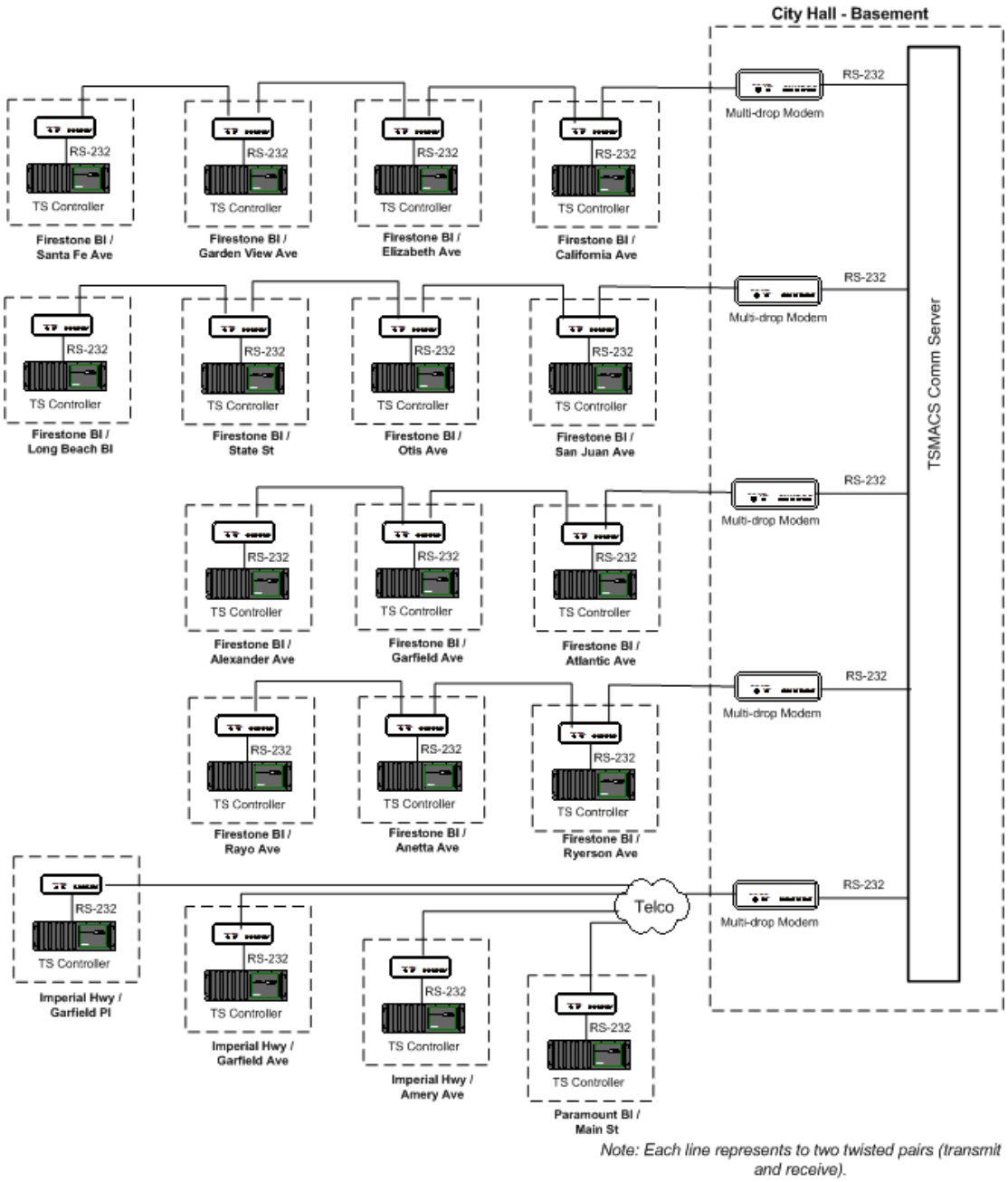

Figure 2-8: Communications Architecture (Center-to-Field) for Traffic Signal Subsystem

2.3.2 Center-to-Center

DSL lines are used to link the South Gate LCC to the sub-regional TMC at LA County. A single, 384 kbps line is dedicated for data exchange between these facilities. Four 384 kbps lines are also allocated between South Gate to and each of these agencies to allow a single video channel to be set up between each agency.

3. LIST OF EQUIPMENT FOR SOUTH GATE LOCAL CONTROL CENTER (LCC)

Table 3-1 lists the equipment that comprises the ATMS for City of South Gate. Rack elevations and console layout are provided in *Deliverable 2.2.0.1 – Specifications for Console and Racks*. The floor plan layout for the South Gate LCC is provided in *Deliverable 2.2.9.1 South Gate Draft Site Report & LCC Layout.*

Table 3-1: List of Equipment for City of South Gate

No.	Item Description	Qty	Location	Mounting	Supplied by
1	TSMACS Application Server	1	City Yard	Rack	TSMACS Vendor
2	TSMACS Database Server	1	City Yard	Desktop	TSMACS Vendor
3	TSMACS Comm Server	1	City Hall	Rack	TSMACS Vendor
4	TSMACS Workstation	2	City Hall / City Yard	Desktop	TSMACS Vendor
5	GB Ethernet Switch	2	City Hall / City Yard	Rack	TSMACS Vendor
6	CCTV Controller	1	City Hall	Rack	TSMACS Vendor
7	Video Encoder	4	City Hall	Rack	PS&E
8	Video Decoder	2	City Hall / City Yard	Rack	PS&E
9	Data Modem (CCTV Control)	5	Field	Shelf	PS&E
10	TWP Video Transmitter	4	Field	Shelf	PS&E
11	TWP Video Receiver	1	Field	Rack	PS&E
12	Camera Control Receiver	4	Field	Shelf	PS&E
13	CCTV Camera Assembly	4	Field	Pole	PS&E
14	Data Modem (Traffic Signals)	18	Field	Shelf	Existing
15	Data Modem (Traffic Signals)	4	City Hall	Shelf	Existing
16	IEN Site Server	1	City Yard	Rack	IEN Project
17	IEN Workstation	1	City Yard	Desktop	IEN Project
18	Video Server	1	City Yard	Rack	IEN Project
19	Firewall	1		Rack	IEN Project