



CITY OF AMES, IOWA

TRAFFIC SIGNAL MASTER PLAN

FINAL REPORT

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PREPARED BY:

GBA SYSTEMS INTEGRATORS, LLC
Illinois Office: 1701 River Drive Suite 100 |
Moline, Illinois | 61265

800.932.2468
solutions@gbasi.com

gba **Systems
Integrators**



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1.0 INTRODUCTION

The purpose of this study was to define the plan for modern and efficient traffic management for the City of Ames. The existing traffic signal operations system is based on technology that is outdated and inefficient. Existing and ongoing traffic operations are dependent on a copper wire based communications system that interconnects with separate traffic management rings throughout the city. These rings control signalized corridors that are not coordinated with each other and are not able to efficiently synchronize traffic movement throughout the city. The existing traffic control equipment, central office traffic management software, and communication system will not support a modern traffic management system.

This report reviews and analyses the existing signal management infrastructure, defines what options exist for improvements to the operations and management systems, and recommends next steps and incremental improvement projects to modernize the traffic signal system for the City of Ames.

2.0 EXISTING CONDITIONS

The existing traffic management system in the City of Ames, Iowa is based on dated technology: twisted copper interconnect cables, serial modems, closed loop systems and signal controllers that lack desired modern functionality with an ability to use, communicate or integrate with other traffic management and ITS tools.

The following subsections present a summary of Ames’ existing traffic signal system infrastructure. Many of the signals are owned and operated by Ames except for a few that have joint ownership. The summary **Traffic Signal Worksheet** is contained in the **Appendix** to this report, attached.

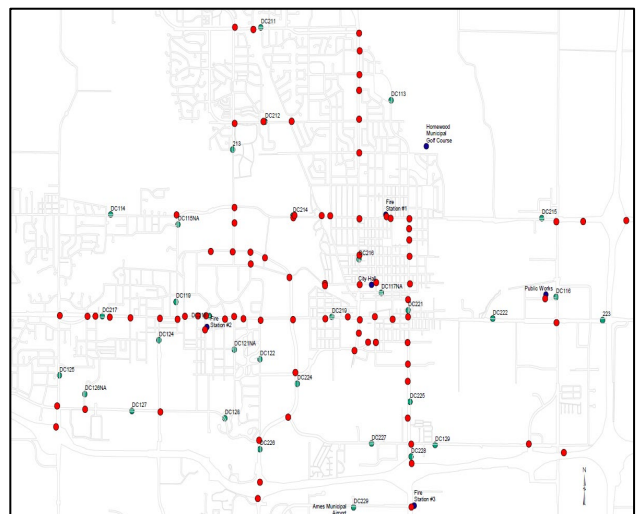
2.1 Traffic Signal System

The components evaluated as part of the **Traffic Signal System** are traffic signals, controllers, cabinets, detection, closed loop systems and software, uninterruptible power supply (UPS), and signal ownership and maintenance agreements.

2.1.1 Traffic Signals

Ames Traffic Division currently operates 92 traffic signals. The 92 signals can be broken down into the following categories: 78 full vehicle signals, 6 school flasher signals, 6 school crossing signals, and 2 pedestrian crossing signals. This breakdown is also listed in **Table 2.1**. **Figure 2.1** (right), shows the existing City signal and ITS element infrastructure.

There are also seven (7) signals maintained and operated by ISU, shown in **Figure 2.2**, which also has plans to install additional new traffic signals in the near future. The ISU owned and operated signals are considered as separate from the





signals owned by Ames, but discussions are ongoing to include these signals in the modernization project if an agreement can be reached that serves the needs of both ISU and Ames. **Figure 2.2** summarizes the number of traffic signals by type.



Type of Installation	Number
Full Signals	70
Pedestrian Signals	3
School Flasher Signals	8
School Crossing Signals	6
RR Xing Signals	17

Table 2.1 – Number of Traffic Signals by Signal Type

Figure 2.2- Traffic Signals Owned by Iowa State University

2.1.2 Traffic Signal Controllers

Ames uses both Siemens and McCain signal controllers. The Siemens controllers are models M10, M40, M42, and M52, while the McCain controllers are ATCex2. The Siemens and McCain controllers operate on Eagle Programmable Actuated Console (EPAC) and OmnieX Intersection Control local software respectively. With the exception of the M52 and the ATCex2 controllers, none of the existing controllers are IP addressable. All of the Siemens controllers are at end-of-life status, as Siemens will no longer be supporting these models of controllers. A breakdown of the controller types for the full signals is detailed in **Table 2.2**.

Table 2.2 – Traffic Signal Controller

Type	Number
Siemens M10	5
Siemens M40	6
Siemens M42	30
Siemens M52	34
McCain ATCex2	3
Total	78

2.1.3 Traffic Signal Cabinets

Ames currently uses two different types of traffic signal cabinets. These cabinets are NEMA TS1 and TS2 Type1. There are three TS2 Type1 type cabinets located at the intersections of Lincoln Way and University Ave., Lincoln Way and Dakota St., and Dakota St. and Mortensen St., while the remaining cabinets across the City are the TS1 type. Ames is currently experimenting with low voltage ATC cabinet option, with the installation of a ATC cabinet at the new signal at the intersection of South Dakota & Hwy 30 WB off ramp. The types of cabinets for all signals are summarized in **Table 2.3**.



Table 2.3 – Traffic Signal Cabinet Summary

Type	Number
TS1	88
TS2 Type 1	3
ATC Low Voltage	1
Total	92

2.1.4 Detection

Ames currently uses three types of vehicle detection system; radar, video, and inductive loop. The radar detectors are MS Sedco while the video detectors are from Gridsmart and Iteris, each IP addressable. Most signals are fully actuated with full detection where there is not a fixed cycle length. Currently, there is no pedestrian detection systems in use with the pedestrian signals relying on activation from a pedestrian push-button. Traffic signals may or may not have detection depending on the function of the signal, with some signals using a combination of detection types.

Table 2.4 summarizes the number of signals that utilize the different types of detection. The actual number of devices that are used for detection is greater than the numbers noted below as some locations have 2 or more devices utilized for detection purposes.

Table 2.4 – Detection Summary

Type	Number
Inductive Loops	26
Video	1
Radar	32

2.1.5 Closed Loop Systems and Software

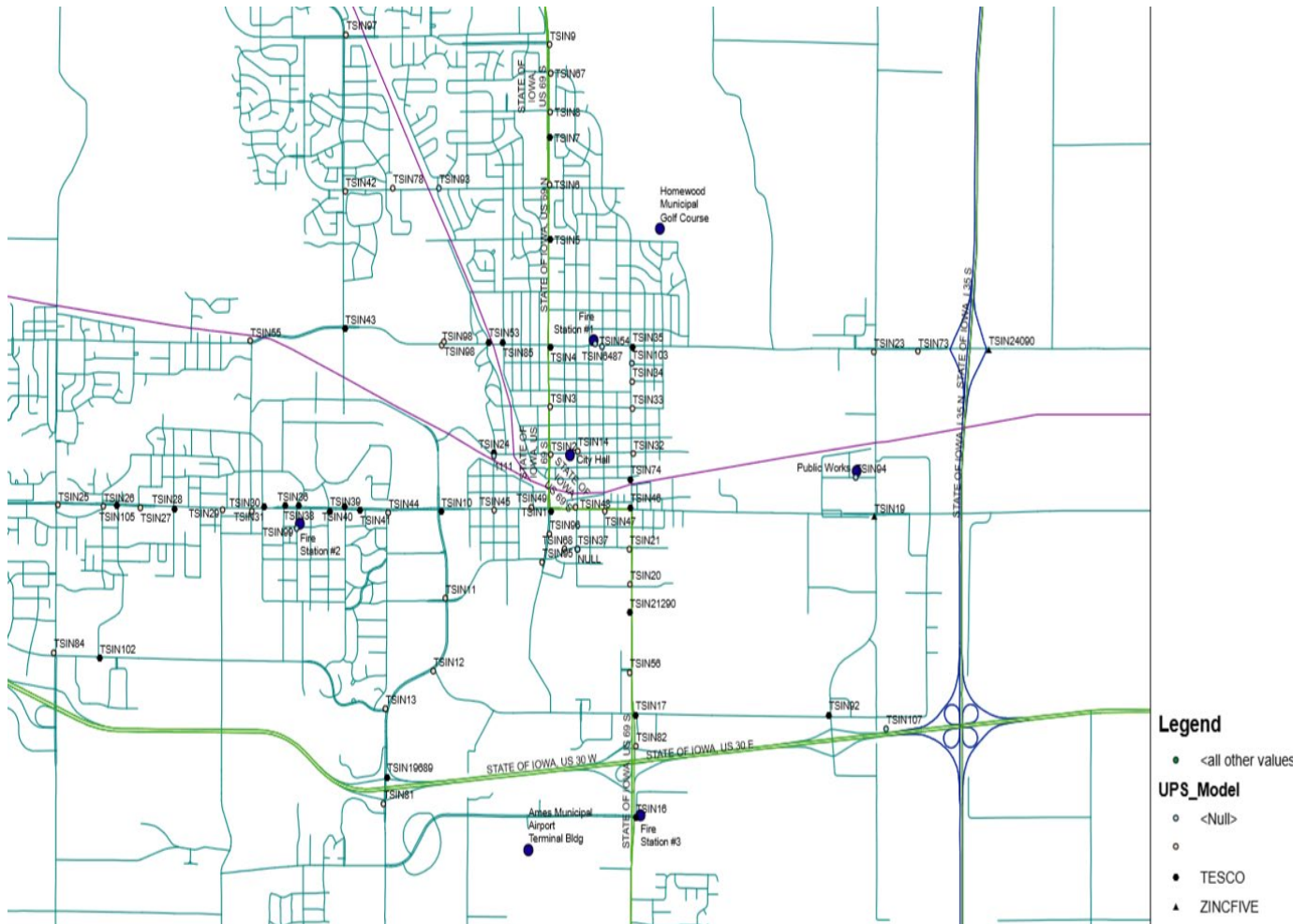
Ames currently uses the Tactics (V 2.1.0) closed loop system for operating time-based coordinated signals operating time of day plans on four corridors. The four corridors that are currently operating under coordinated signal timings are University Avenue, Lincoln Way, Duff/South Duff and Grand Avenue. Signals on these corridors are managed by three (3) on-street master controllers that keep the local signal controller clocks synchronized via twisted pair copper cabling and serial type communication protocols.

2.1.6 Uninterruptable Power Supplies (UPS)

UPS systems are deployed at 28 signals throughout Ames. All but two of the current UPS systems are TESCO battery systems. The other two UPS systems are Zinc Five UPS. These systems require staff to be on-site to determine the operational status.



Figure 2.3 (below) illustrates the locations with UPS systems currently in use.

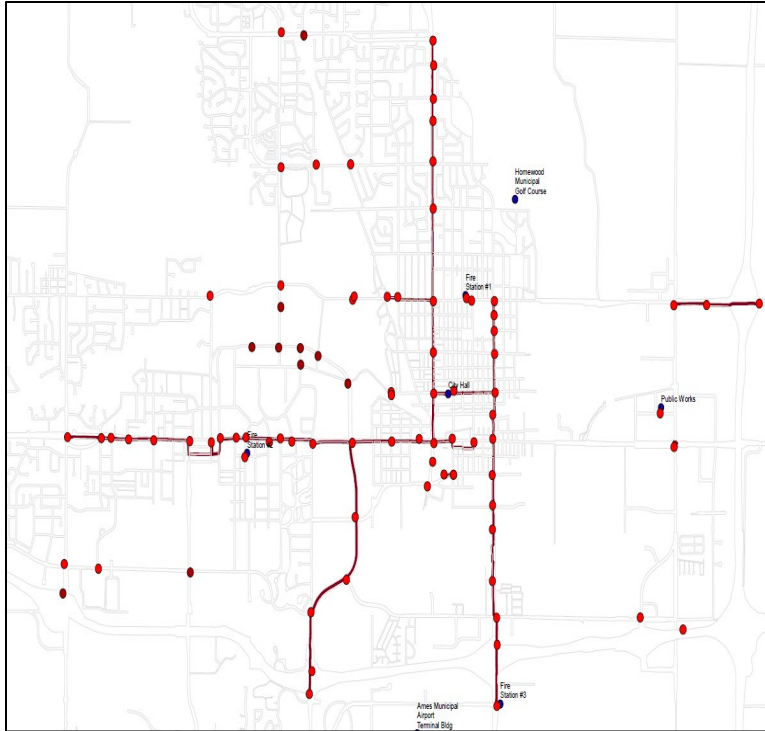


2.1.7 Signal Ownership and Maintenance Agreements with Other Agencies

As stated previously, Ames owns 92 of the 99 signals in the area, with the other seven (7) being owned by ISU. The seven signals owned by ISU are under ISU control and jurisdiction.

2.2 Communications Systems

The current communication media utilized by the traffic signal system across the majority of the City is twisted pair copper. On-street master controllers run the Tactics (Version 2.1.0) closed loop system software and keep the time-of-day clocks of the controllers of a coordinated signal group synchronized via twisted pair copper cabling. The existing communication system does not provide enough bandwidth to allow Ames traffic operations personnel to upload and download signal timing data to/from traffic signal controllers from the central location through an ATMS. At present, Ames traffic operations personnel drive to each signal controller location for updating (update, upload, download etc.) signal timing data. **Figure 2.4** (below) shows general locations the existing communication infrastructure. The existing conduit infrastructure will not be considered for re-use because it was identified by city officials as unreliable and in need of replacement.



2.2.1 Fiber Optic Cable

Ames Traffic Division currently does not have any fiber optic cable for signal communication.

The Municipal Services Electric Department (MSED) has overhead fiber optic cable around Ames. MSED and City IT Department are considering options for the allocation of existing dark fibers available in the overhead fibers to other partner users such as Traffic Division but there is currently no consensus or Memorandum of Understanding (MOU) between the Ames Traffic Division and MSED that establishes the use of any dark fiber. MSED has federal regulatory stipulations and oversight agency security conditions for access to and use of network infrastructure that makes fiber use a difficult option for the Traffic Division.

2.2.2 Signal Interconnect Cable (SIC)

The City primarily utilizes twisted copper pair cable (TWP) for signal interconnect. The Signal Interconnect Cable (SIC) consists of 12-pair, 25-pair, and 50-pair copper cables. The majority of SIC installed is 12-pair cable and is installed within a dedicated SIC conduit and pull box network. The existing twisted pair is in bad condition due to normal wear and tear. Technicians deal with recurring problems with the twisted pair copper due to too many splices, or to age/deterioration of the conduit. The existing twisted pair copper cannot be continued to be used as signal interconnect.

2.2.3 SIC Conduit System

Currently, Ames has access to conduits that have been installed for the SIC. The existing conduit system currently in use for signal communications are in such poor condition that Ames may need to install a new conduit system in many areas for future fiber utilization.

2.2.4 Ethernet Switch

Ames Traffic Division does not have ethernet switches in any traffic signal cabinets. The IT Department uses Cisco Catalyst 2960X switches at network locations, but they are in the process of changing all of the edge switching to Cisco Meraki MS250-48LP. Currently, the City IT Department has seven (7) Meraki MS250-48LP switches in operation.



2.3 Intelligent Transportation Systems (ITS) Devices

2.3.1 Traffic Sensors

Ames currently has 36 Wavetronics traffic detection sensors installed, spread throughout the city, utilizing private cellular connections to communicate. The Iowa Department of Transportation (IowaDOT) has three permanent count stations around Ames, with one located on US-69 (Grand Ave) near 15th street, one located on Northwestern Ave near 24th Street, and one located on US-30 near Y Ave. There is also an IowaDOT count station northwest of Ames, on 190th St near V Ave. **Figure 2.5** illustrates the locations of the existing traffic sensors in Ames.

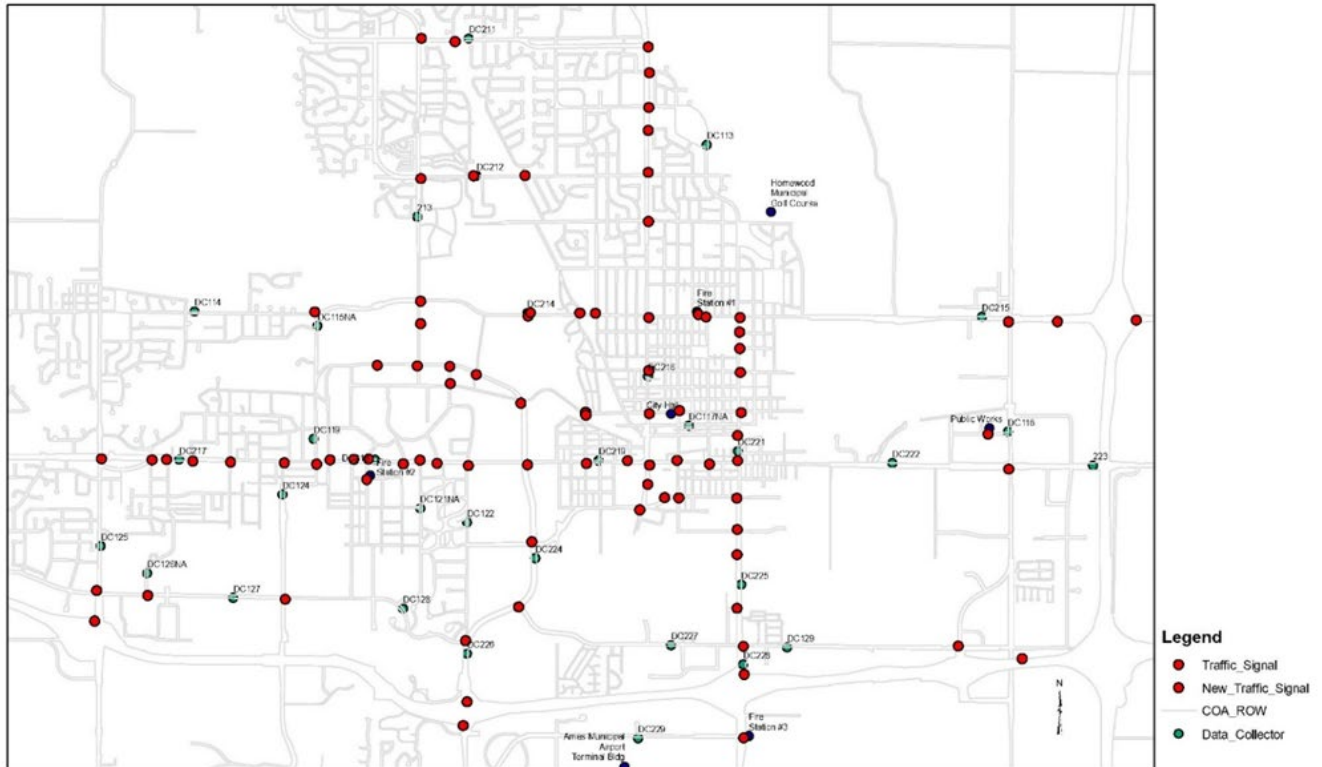


Figure 2.5 – Traffic Sensor Locations

2.3.2 Closed Circuit Television Cameras

Ames does not currently own or operate any Closed-Circuit Television (CCTV) Cameras. During an incident or a special event, Ames does not have a method for quickly or easily managing the congested traffic associated with the incident or special event.

2.3.3 Emergency Vehicle Preemption

Ames has serial Emergency Vehicle Preemption (EVP) on 52 of the 78 traffic signals within the city. The systems are activated from an emitter located on the emergency vehicles and/or from the emergency vehicle station. The existing TOMAR STROBECOM II EVP systems are based on optical preemption and priority control system technology. EVP systems provide preemption for any emergency vehicle (typically police, fire, ambulance) equipped with a transmitter device that approaches an EVP detector equipped traffic signal. Upon receipt of the EVP request from an

emitter, the traffic signal control triggers a special timing program that overrides normal phasing operations to provide priority for the emergency vehicles requested signal phase to reach their destination quickly and safely.

2.3.4 Parking Management System

Ames currently does not have an active parking management system. Ames does have a static map with the number of parking spaces available and the type of parking each space is specified for.

2.3.5 Dynamic Message Signs

Ames does not own or operate any large scale, over-the-road Arterial Dynamic Message Signs (DMS). Ames does own six (6) portable message signs that are deployed as needed for traffic management and construction activities.

2.3.6 Advanced Traffic Management System

Currently, Ames does not have an Advanced Traffic Management System (ATMS) for operation and management of the traffic signals and ITS devices.

2.4 Existing Transportation System Operation and Management

2.4.1 Facilities and Staff

Ames Traffic Division under the Public Works Department manages the traffic signal system, and other infrastructure that manage traffic in Ames (excluding U.S. highways and areas under ISU jurisdiction). The Traffic Division has engineering, maintenance, technician, and administrative staff that are responsible for traffic signals, traffic signs, traffic studies, and street pavement marking. Traffic also maintains the parking system, including parking meters, parking lots, and regulation signs and markings.

Administration and engineering staff, including the City Traffic Engineer, are located in City Hall at 515 Clark Avenue, Ames, IA 50010, while maintenance staff is located at the Public Works Traffic Maintenance at 2207 Edison Street, Ames, IA 50010.

In addition to engineering staff, there is one Traffic Supervisor and four signal technicians at the Public Works Traffic Maintenance. The Traffic Supervisor oversees the activities of the signal technicians. Hours are generally 7:00 am to 3:30 pm on weekdays; however, one signal technician is on-call 24/7. At present, the signal technicians are using cell phones and handheld radios for voice communications during business hours on Monday through Friday and cell phone notification for after hours and during on-call hours.

2.4.2 Traffic Operations Center

Ames staff operate laptop computers at the Public Works Traffic Maintenance facility-which are not capable of viewing the traffic signal system status. Ames does not currently have a formal Traffic Operations Center (TOC) within the Public Works Traffic Maintenance facility.

2.4.3 Customer Call Response System

There is a customer call response system, as well as the Ames "On the GO" App which receives information related to the City of Ames' systems, typically for operations and maintenance. All



calls come to the City of Ames Public Works Department and then depending on the purpose of the call it may be transferred to the Traffic Division. After hours notification will come through e-mail or a call from the police Department if the issue is an emergency.

2.4.4 Traffic Signal Timing

The City Traffic Engineer, with input from the Traffic Supervisor and Traffic Signal Technicians is responsible for the programming and design of the traffic signal systems within city limits, and coordinates management responsibilities with ISU for areas under ISU jurisdiction.

2.4.5 Traffic Signal Preventive Maintenance

Ames has an annual maintenance schedule that requires a technician to visit each traffic signal cabinet at least once per year.

2.4.6 Incident Management

There is no formal incident management program for arterial streets or traffic signals in Ames. Ames and the neighboring jurisdictions have expressed interest in regional incident management; however no such regional incident management system is in place. Ames does not have any special timing plans for managing traffic related to the special events to facilitate ingress and egress out of the event centers. In most cases, the city of Ames, ISU Police Departments, and Ames Public Works Department manually operates traffic signals by placing officers next to traffic signal cabinets.

After-hours maintenance calls go to PW Traffic. If a traffic signal is out, after confirming the call, PW Traffic sets up STOP signs and other necessary measures to keep the intersection safe while the on-call signal technician develops further responses.

2.4.7 Safety Review

Safety review includes analyzing the crash data at each intersection and ranking the intersections by the total number of crashes, crash rate, crash severity and a combination of the three. Ames reviews crash data collected by IowaDOT Crash Mapping Analysis Tool (CMAT) to pinpoint problem streets with higher crash densities and more severe crashes. CMAT is an easy to use software program that provides convenient access to crash data through a simple geographical information system (GIS) interface. By analyzing the crash data, Ames is able to identify areas that need safety improvements to minimize fatalities and injuries.



3.0 NEEDS ASSESSMENT

After assessing the existing communication and traffic signal systems, a high-level needs assessment was conducted to better define and understand the demands that must be satisfied in order to achieve goals and objectives set forth by The City for an upgraded communications and traffic signal system. Once the needs have been identified, a future system will be described and outlined that satisfies these needs.

The future ideal system can then be compared with the existing system, and differences or areas where the existing system is lacking are easily identified. These differences can be systematically organized and ranked to develop prioritized needs and to determine a clear and defined method to achieve the City's goals for the Traffic Signal Master Plan project.

3.1 Needs Categories

Based upon the evaluation of the existing traffic systems and discussions with City staff, the need assessment for the upgraded communication system, traffic signal components, and the ITS were initially organized into eight specific categories, which include:

1. Communications Systems
 - Provides remote access to the traffic signal system components
 - Improve performance of the traffic management system
 - Improve efficiency of engineering and maintenance staff
 - Improve safety and operations for all transportation modes
 - Improve security and scalability of network to support ITS goals
2. Traffic Management System
 - Improve operations for all modes of transportation
 - Improve efficiency of the ITS
 - Improve coordination with neighboring jurisdictions
 - Improve efficiency of engineering, operations, and maintenance staff
3. Safety Systems
 - Improve safety for all modes of transportation
 - Improve safety for drivers making left turns
 - Improve safety for pedestrians at intersections and mid-block locations
 - Improve safety for bicyclists at signalized intersections
 - Improve safety and operations for drivers during winter driving conditions
 - Improve safety for drivers and pedestrians by reducing speed-related crashes
 - Improve safety for drivers by reducing vehicle-to-vehicle crashes
4. Incident Management
 - Improve operations and communications to drivers during incidents
 - Improve coordination with neighboring jurisdictions during incidents
 - Improve safety for the public and emergency response personnel
 - Improve incident clearance time to restore roadways to normal operations

5. Traveler Information Systems
 - Improve operations for drivers by providing pre-trip and en-route information
 - Enhance traveler information system and use various media for delivering alerts (text)
 - Improve reliability of ITS components for disseminating traveler information among jurisdictions

6. Public Transportation
 - Improve operations for transit vehicles at traffic signals
 - Improve safety for transit vehicles
 - Improve operations for vehicle and transit users
 - Improve traveler information to increase transit ridership

7. Parking Management Systems
 - Provides information to drivers regarding parking space availability
 - Improve management of public parking facilities
 - Improve operations for drivers using parking facilities
 - Improve pricing and duration to balance user expectations and system objectives

8. Maintenance and Construction Operations
 - Reduce failures of traffic signal system components
 - Improve efficiency of technician staff
 - Improve safety and efficiency of traffic approaching and moving through work zones
 - Improve efficiency of staff and equipment during maintenance and winter operations
 - Improve preventative maintenance
 - Improve the consistency of traffic signal and ITS cabinet

3.2 Detailed Operational Needs

Through continued discussion and further evaluation of needs identified during stakeholder workshops, increasingly detailed needs were identified based on various operational scenarios. **Table 3.1** summarizes the detailed needs:

Table 3.1 – Detailed Operational Needs

NO.	NEEDS, CONSTRAINTS, AND EXPECTATIONS
1.0	COMMUNICATIONS SYSTEMS & INTEGRATION
1.01	Increase speed, bandwidth, and reliability of field to field communications
1.02	Increase speed, bandwidth, and reliability of center to field communications
1.03	Provide staff in the field access to network
1.04	Provide the ability to transmit video
1.05	Provide central information clearinghouse
1.06	Develop interagency agreements to leverage existing infrastructure
1.07	Provide communications to all signals
1.08	Provide remote access to the traffic signal network for management, software upgrades, and

NO.	NEEDS, CONSTRAINTS, AND EXPECTATIONS
	troubleshooting
1.09	Develop and implement network security protocols
1.10	Develop traffic signal IP schema/architecture for participating stakeholders
1.11	Evaluate IP schema/architecture for future stakeholder integration
2.0	TRAFFIC MANAGEMENT SYSTEM
2.01	Replace existing controllers
2.02	upgraded software on controllers
2.03	Replace traffic cabinets with low power ITS cabinets
2.04	Deploy new ATMS software
2.05	Improve multi-jurisdictional ATMS software compatibility
2.06	Integrate ITS field devices into a single management software
2.07	Designate central location for signal timing databases
2.08	Provide ability to easily update controller settings in the field or remotely from TOC
2.09	Improve system monitoring
2.10	Provide access to management software to various staff in various locations
2.11	Improve ability to remotely modify signal timing
2.12	Provide notification of detector failures
2.13	Deploy timing plans to groups of intersections simultaneously
2.14	Receive automatic notifications for coordination errors
2.15	Setup alarm notifications for user-defined thresholds for various parameters
2.16	Download user-friendly operational reports on signal system operations (such as communications failures), timing data, and traffic data
2.17	Provide alarms for excessive queuing
2.18	Develop an automated logging system
2.19	Automatically archive data
2.20	Conduct traffic flow monitoring in real time
2.22	Provide high-quality real-time traffic information
2.23	Provide timely congestion and incident information to public
2.24	Provide the public with limited access to traffic management tools and activities
2.25	Integrate traffic data collection software with traffic signal system modeling software
2.26	Integrate traffic signal system modeling software with ATMS software
2.27	Improve signal coordination
2.28	Improve multi-jurisdictional coordination
2.29	Maintain high-quality coordination
2.30	Provide the ability to modify coordination correction modes
2.31	Measure signal timing performance
2.32	Develop special event timing for ingress and egress
2.33	Improve coordination among agencies and departments for planned activities/events and unplanned activities/events
2.34	Install adaptive traffic control
2.35	Provide adequate staffing to perform functions
2.36	Provide adequate staff training



NO.	NEEDS, CONSTRAINTS, AND EXPECTATIONS
2.37	Develop interagency agreements
2.38	Evaluate future vehicle-to-vehicle communications systems
2.39	Evaluate pedestrian and bicycle concerns
3.0	SAFETY SYSTEMS
3.01	Provide automatic notifications for power outage and cabinet knockdowns
3.02	Provide indication for status of active UPS systems
3.03	Provide the ability to implement flashing yellow arrow operation for permissive turns within management software
3.04	Provide the ability to implement a pedestrian hybrid beacon within management software
3.05	Provide the ability to implement pedestrian scramble operation within management software
3.06	Provide the ability to implement audible or accessible pedestrian features within management software
3.07	Implement detection and develop timing specific to bicycles
3.08	Monitor speeds in real-time and conduct data collection
4.0	INCIDENT MANAGEMENT
4.01	Improve incident detection
4.02	Verify and monitor incidents
4.03	Provide staff to actively monitor and coordinate
4.04	Improve incident response coordination between agencies
4.05	Reduce traffic delays for emergency response vehicles
4.06	Develop methods for deployment of incident management for select corridors
4.07	Provide better coordination for ending incident management activities
4.08	Provide multi-jurisdictional diversion routes
4.09	Improve signal system compatibility to help coordination across agency boundaries
5.0	TRAVELER INFORMATION SYSTEMS
5.01	Provide traveler information on the roadside
5.02	Provide quality real-time congestion-related information
5.03	Improve and expand traveler information delivery methods
5.04	Improve procedures to get accurate information disseminated in a timely manner
5.05	Provide better work zone information and notification
5.06	Improve integration and coordination of ITS equipment for disseminating traveler information system along multi-jurisdictions
6.0	PUBLIC TRANSPORTATION
6.01	Provide a traffic controller with the ability to accommodate transit signal priority at signals
6.02	Provide traffic signal operations for at-grade transit crossings
8.0	MAINTENANCE AND CONSTRUCTION OPERATIONS
8.01	Conduct preventive maintenance on traffic signals at regular intervals
8.02	Standardize traffic control equipment
8.03	Standardize cabinet setup
8.04	Improve coordination on construction notification and information distribution
8.05	Improve work zone traffic handling plans
8.06	Monitor traffic remotely in and around work zones
8.07	Provide weather and pavement data collection to aid winter operations



3.3 Performance Measures

The project stakeholders shared established performance measures for system enhancements of the Traffic Division of Public Works Department, which included:

- Communication
- Traffic signal hardware
- ATMS
- Adaptive Traffic Control
- Multi-Jurisdictional operations
- Incident management
- Traveler information systems
- Public transit

Based on the operational needs, the following performance measures can be tracked to help document the established goals and objectives being accomplished:

- Communication
 - Percentage of Communications Network Upgraded and Constructed
 - Expansion of the Communication Network and Redundancy
 - Communications Percentage Up-time Existing System
 - Communications percentage Up-time New System
- Traffic Signal Hardware
 - Number of controllers upgraded
 - Number of controllers – software enhancements
 - Number of ITS Devices – Installed
- ATMS
 - Final Acceptance of ATMS upgrade
 - Operational Hours logged in ATMS
 - Remote Operation of ATMS
 - VPN hours logged
 - Number of traffic signals managed within ATMS
 - Number of ITS devices managed within ATMS
 - Number of alarms and notifications from the ATMS
 - Collect and Report Traffic volumes through ATMS
 - Collect and Report Speed information through ATMS
 - Collect and Report Pedestrian information through ATMS
 - Number of Incidents identified through ATMS
 - Collect and Report Device Up-time through ATMS:
 - Signals
 - Emergency Vehicle Preemption
 - DMS
 - CCTV
 - Conflict Monitor Unit (CMU)/Malfunction Monitor Unit (MMU)
- Adaptive Signal Control Technology (ASCT)
 - Number of signals and corridors operating with ASCT
- Multi-Jurisdictional Operations
 - Number of multi-jurisdictional incidents coordinated
 - Number of traffic signals coordinated across multiple jurisdictions
 - Number of ITS devices shared across multiple jurisdictions



- Incident Management
 - Integration and final acceptance of incident management information within ATIS system
 - Number of Incident Management Field Devices – Installed
 - Number of detour timing plans implemented
- Advanced Traveler Information System (ATIS)
 - Final Acceptance of an Advanced Traveler Information System (ATIS) public website
 - Number of unplanned/planned events logged in ATIS
- Public Transit
 - Deployment of Transit Signal Priority (TSP)

Tracking these performance measures during the construction phases of the project will document the stepped deployment and integration of the new system. These measures will also be used during the long-term operations and maintenance of the new traffic signal and communications system. These performance measures will be reviewed with the stakeholders in more detail during the design process to prioritize the list and create a series of performance measures that can realistically be tracked and documented with the limited resources available to Ames.



4.0 HIGH-LEVEL ALTERNATIVES EVALUATION

4.1 Alternative Strategies Considered

In order to meet future goals of improved traffic flow and enhanced safety, Ames needs to operate, manage and monitor the traffic signal system using an Advanced Traffic Management Software (ATMS). In addition, Ames also desires to implement or enhance other advanced traffic management strategies such as Emergency Vehicle Prioritization (EVP), Transit Service Prioritization (TSP), Advanced Signal Control and Timing (ASCT) and Connected Vehicle (CV) based applications that will all benefit from an operational ATMS.

Operating the traffic signal system from a central Traffic Operations Center (TOC) location and implementation of the envisioned advanced traffic management applications requires a broadband communication system with sufficient bandwidth to enable the advanced traffic signal field controllers to communicate with the central software within a very short period of time.

The first step to creating a high functioning, centralized ATMS is an upgrade of the existing communication system. Ames considered the following options regarding its citywide communication system.

- Option 1: Maintain Existing System - No change of the existing communication system will be made in this option. This will limit the usefulness of the new technology and the active management of the traffic signal system. With the stated goals and established needs to deploy a central ATMS and enhanced field devices, the existing communication system does not have the bandwidth or redundancy and needs to be replaced with new system.

Option 1 is not acceptable.

- Option 2: MSED Fiber - Ames Traffic Division would deploy new branch fiber optic cables to the signal cabinets and connects these fibers to the Municipal Services Electric Department's (MSED) overhead fiber as a path for the communication backbone. City and Electric department need to develop a MOU regarding City use of the Electric Department's overhead fiber. The federal security requirements for use of electrical utilities (i.e Municipal Electrical Services Department) communication infrastructure by outside agencies make this option a difficult and an inherently problematic solution to City's communication system upgrade needs. The ability to exchange information from the TOC to the controllers, video components, and other ITS devices could be hampered by the security requirements attached to this fiber.

Option 2 is not preferred.

- Option 3: City Owned Fiber - Design and deploy new city owned and managed fiber optic network for signal cabinets and an underground fiber ring for the signal system communication. This would likely be a phased operation over a five to seven-year period and would be the most comprehensive and flexible solution to Ames' communication needs. This would provide the most solid infrastructure option and allow for robust network connection. This would be the best option for the long-term infrastructure needs of Ames.

Option 3 was selected for implementation.



5.0 HIGH-LEVEL IMPROVEMENT STRATEGIES

5.1 Traffic Signal Controllers and Advanced Traffic Management Software

The evaluation and selection of a traffic controller and central office system is critical to creation of a fully functional and effective traffic management system. Consideration and discussions of what type of controller and Advanced Traffic Management Software (ATMS) system determined that Ames desires to use a Traffic Adaptive type of management system. The discussions also determined the need to ensure that the ATMS and controllers have the latest hardware and software revisions so the manufacturers would not cycle the controllers or software out of service within 10 years of the purchase. This is to prevent manufacturers bidding the project with controllers and software that were near their “end of life” cycle at a low price to win the bid.

Interoperability is also a factor that must be considered when selecting a replacement controller platform and central office system. The interoperability factor is key to assuring that the controller and central office software remain open to other manufacturers in the future and that the system is not tied specifically to a single manufacturer. The importance of interoperability is enhanced by the rapidly changing technology of today’s markets and the products being developed and released every year. The ability to communicate and operate with other manufacturer’s hardware and software broadens accessibility of the system. Consideration of future expansion of the network and possible interoperability with other cities within the Ames Metro Area makes interoperability a priority. The most important factor in this flexibility lies with the ability to function with another manufacturer’s equipment and software and not be tied to a single manufacturer for the entire life-cycle of the controller equipment and central office software.

The controllers and ATMS will need to support Traffic Adaptive signal operations natively. Advanced Signal Control and Timing (ASCT) or Traffic Adaptive intersection control operates by taking the input from the detection system and creating a traffic plan based on the real time traffic flow input to the system. This system is constantly adjusting the traffic plan to accommodate the current traffic flow. Traffic Adaptive operations require highly accurate detection systems to provide the necessary data for proper operation of the system. The various types of Traffic Adaptive programs currently available require accurate detection and high-confidence communication capabilities.

The Traffic Adaptive System may be able to use the current detection systems that Ames have in place if the equipment has the lane specific detection capabilities most often required by Traffic Adaptive operations. Initial evaluation of the thirty-two (32) current MS Sedco radar operated intersections shows these devices have the capacity for advanced single lane detection.

Ames should require traffic signal controller and ATMS demonstrations prior to awarding any procurement bid. These demonstrations should include review of controller menus, functions, and discussions of specific issues pertinent to this project. Some of the basic requirements and functions will involve data base conversion from the current data base to the manufacture’s replacement data base, report and alarm functions, available communications modes, security features, and software updates.

The ASTM demonstration should also verify live area-wide representation of the software as it was being used. The presentation should give an overall view of the functions and capabilities of the product.

The Traffic Adaptive System Ames wishes to create will require a robust communications system that functions on both a peer-to-peer and central-office-to-individual-intersection communication basis. This

will require the establishment of a fiber optics-based communications system with connections to each intersection. This proposed fiber communications network will be further discussed in the Section 5.4 - Communication System.

5.2 Video Management System

The Video Management System (VMS) is also an important component to the Traffic Management System. Closed Circuit TV (CCTV) cameras are a critical component of the Traffic Operations Center (TOC) and overall traffic operations because they allow for the traffic flows to be remotely monitored from a central location for incident management and operational reviews. Parameters will need to be established to assure that the TOC has access to the cameras and has sufficient permissions to allow for efficient monitoring.

The video component of the fiber optic network can create opportunities for a myriad of uses in the traffic, public works, law enforcement, and security sectors. This is an offshoot of the traffic management operations but can provide an asset for numerous agencies and departments within the city. Video feeds could be monitored by emergency response staff to assess accidents or incidents to help them understand the magnitude of the response that would be necessary to handle the situation. Law enforcement personnel could use the video to monitor trouble areas, investigate traffic accidents and provide monitoring around schools for additional security. The network video management system would be set up to allow for prioritization of access to the video cameras, recording policies, and procedures for public access and dissemination.

The decision as to whether the TOC would be recording video and how that video would be stored will need to be determined due to the added load this would add to the server. Policies concerning the use of video recordings and how access to the video recordings will be controlled will need to be developed. A high level comparison of commercially available VMS programs is contained in the **Appendix**.

5.3 Incident Management

Incident management includes various activities that help mitigate non-recurring congestion. Examples of this type of action would be rapid detection and response to crashes and stalled vehicles, provision of congestion-related information to drivers, management of construction and maintenance activities, and management of traffic for special events.

The capability to respond to incidents that affect traffic and create congestion would be greatly enhanced by a staffed TOC with an operational ATMS that could coordinate the necessary changes in signal operations to facilitate more efficient traffic flow and provide video monitoring to emergency services when necessary. The capacity to monitor traffic conditions with strategically located cameras would provide early detection of potential problems and allow for possible mitigation of the issue before it escalates.



5.4 Communication System

The Ames citywide communication system will provide the means to access, manage, and monitor the traffic operations from a central location (i.e. TOC). These functions will be critical to creating, maintaining, and operating a modern traffic management system with the Traffic Adaptive capabilities Ames desires. The ability to visualize the entire city-wide traffic flow from a single location and make the necessary adjustments would create a much more effective platform for managing traffic.

The data gathering capabilities of a modern traffic management system can provide essential statistics for the ATMS operators and traffic engineers. Traffic counts can be gathered and relayed in “real time” back to the Traffic Division, via the communication system, to allow for instantaneous analysis of the current traffic levels or count information can be collected and stored for future analysis. Accurate traffic count and vehicle information is vital data that can be provided instantaneously and accurately with a modern traffic management system and the communication capabilities provided by this plan.

5.4.1 Layer III Switches Ethernet Switches

This traffic signal and ITS communication network will need to be developed outside of the City IT network to avoid security issues and to allow for a more open communications channel between the TOC and the field devices without compromising Ames IT security protocols. Access for the Ames IT Division would be through a Layer III Switch (Cisco 3850 Series or equivalent) connected to the traffic network and isolated from the City network by a firewall. City IT would control security access to the City network through firewall. That will alleviate any security concerns that may accompany the traffic network in relation to the other City networks.

The traffic communications network will need secure locations within city owned buildings where the Layer III switches can be installed that are climate controlled and accessible 24/7 in case of emergencies.

5.4.2 Layer II Ethernet Switches

The model of Ethernet switch that is compatible with the Ethernet switches currently deployed by the Ames IT Division and is the Cisco Meraki M250-48LB. This is an advantage when putting together this network because the switches will have similar programming aspects and the templates for programming can be universalized. This standardization of the switches also allows for easier inventory control for replacement parts. The universalized programming templates allow for simplified procedures for replacing the switches in the field. Each traffic cabinet will have a Layer II switch to permit the routing of the fiber optic communications and to manage the cabinet devices.

5.4.3 IP Addressing

Some adaptation of the existing Ames IP address scheme may also be necessary to accommodate the IP addressing scheme for the Traffic Network and the additional logical design concepts and technologies to be used.

Typically, a fiber optic traffic signal network requires a 16-bit of Class A private IP address block IP subnetting to assign to the network communication devices. An assigned IP address block is unique within Ames and will ensure it will not overlap with other departments. A reserved



10.50.0.0/16 IP block is currently assigned for use by the traffic network infrastructure only. Typically, field device networking techniques create many small broadcast domains, using virtual local area networks (VLANs) to separate domains and to enhance network security, troubleshooting, and maintenance tasks.

5.4.5 Network Monitoring

A SNMPc network monitoring program will need to be integrated into the system to accommodate the communications network and allow the TOC to display the status of the network connections and traffic cabinets. This will help keep the network online and provide notification for interruption of service to a cabinet or corridor. This will also simplify troubleshooting and allow for instant notification of a cable cut or component failure. See the attached **Appendix** for a listing of commercially available SNMPc softwares that could be considered for this project.

In a network topology that includes redundant rings, it is necessary to have some form of network monitoring to alert operators that a link is down because a failed or severed link in a redundant system will cause the system to reroute the network traffic from that link to an alternate path. This can cause a situation where a link is down, but it is not apparent to the operators because there was no interruption of the service.

5.4.6 Servers and Computer Hardware

The traffic network will need to have a server dedicated to the software requirements to operate the network, traffic system, video capabilities, monitoring, and storage needs. This server could be located at the TOC or IT Datacenter. Server hardware requirements are generally determined by the needs of the ATMS software, VMS software and is bid as a component part of that system.

Servers and desktop computers should be of sufficient power and storage capacity to meet the needs of the ATMS and VMS programs. Laptop computers that will be used by the technicians should be hardened units with daylight screens to allow for working out in the field and should have docking stations for working in the TOC or traffic maintenance shop.

5.4.7 Fiber Optic Cable

The recommendation for the fiber optic cable for this project would be a 144-strand single mode cable. This number of strands will be sufficient to handle any needs the Traffic Division may have in the foreseeable future including anticipated connected car or autonomous vehicle applications. This size cable will provide dark fiber that could be used for other City purposes beyond traffic applications to enhance the capabilities of Ames.

5.4.8 Conduit

The conduit for this project was estimated with standard single HDPE duct conduit, 2" minimum in size. During discussions with the Traffic Division it was determined that the right of way areas on many of the corridors that are part of this project are becoming congested. Further discussions were held concerning the viability of using multi duct conduit. It was determined that this would be a decision that would be made outside of this project by the city at their own expense and would not be included in the cost estimates.



5.4.9 Maintenance

Maintenance decisions will include normal periodic inspections, equipment upgrades, and emergency maintenance. Provisions and funding for periodic system component replacement should be part of the annual Traffic Division budget. This will help to maintain the technological capabilities of the system. From the operational perspective the standardization and upgrading of the ATMS software in conjunction with the creation of a robust communications network will allow the system to be controlled from the TOC via virtual private network protocol (VPN) into the controller cabinet. This will reduce the need for on-site visits by the Traffic Technicians and will facilitate remote monitoring of the intersection and equipment operations.

The standardization of signal cabinet equipment will also provide the Traffic Technician with familiarity of the equipment and will allow them to better understand the traffic signal cabinet operation. Maintenance operations will be simplified by standardization in that a universal inventory of replacement parts and equipment can be established. That, in turn, allows for standardized training, troubleshooting, programming, and maintenance procedures which simplifies those facets of maintenance.

5.4.10 Network Management

The Ames Traffic Engineer or an appointed member of the Traffic Division will need to manage the network maintenance, operations, and policy. Operational decisions will include monitoring of the communications network, traffic control operations, video monitoring of the traffic flow, incident management, and personnel management. The decision as to how the TOC will be managed will be one of the primary decisions this person will need to make. The assignment of a person to manage the TOC including the communications network is critical to an efficient operation. Policy decisions concerning network access permissions, personnel management, video access, and system upgrades would also be the responsibility of the network manager.

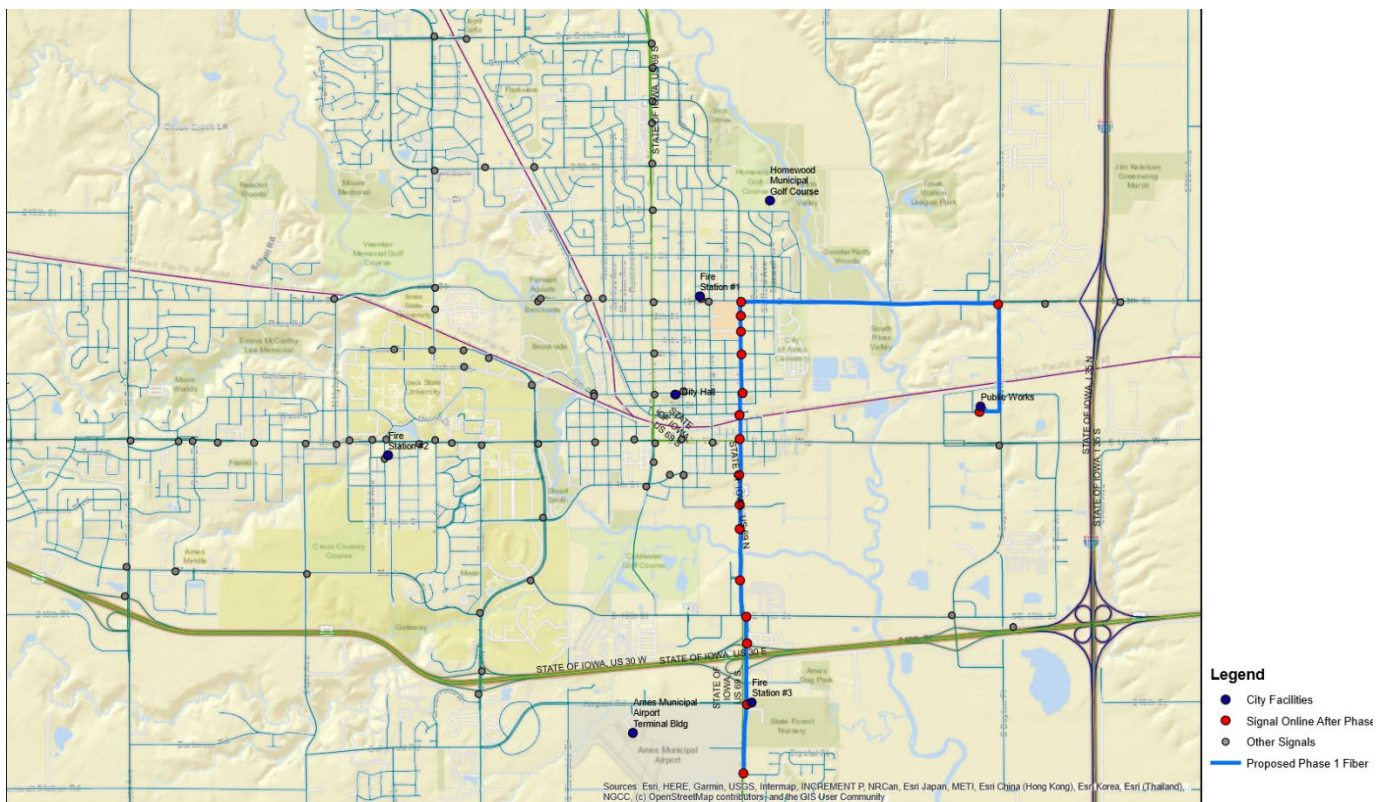


6.0 STRATEGIC DEPLOYMENT PLAN

The development of a logical strategic deployment plan is key to the future success of any multi-year, long term investment project. It is important that the City of Ames have a clear understanding of the multiple phases of this project and the number of years that will need to be committed to for the successful implementation of the Traffic Signal Master Plan.

6.1 Phase One

Phase One of this project establishes the connection from the Edison Street Public Works Building to Dayton. It proceeds north on Dayton to 13th Street, west across 13th Street to Duff, and south on Duff past Highway 30 where it will connect with Fire Station #3. The route will then extend down to Crystal Street. The route for Phase One is shown below in blue.



Phase One Fiber Optic Deployment

Phase One will provide:

- Traffic control and monitoring capabilities primarily to the Duff Avenue Corridor which is one of the most congested corridors in Ames.
- This will establish the connection to the traffic cabinets along the pathway back to the Public Works Building on Edison and will be the first step in connecting the traffic operations, via fiberoptic cable, to the intersections on the street.
- During this phase of the project the TOC in the Public Works Building will be established, as well as the ATMS being installed within the TOC.



- This route will include two Layer III switches with one located at the Public Works Building and one at Fire Station #3.
- The network will also include fourteen Layer II located as one in each of the cabinets along this route.

Intersections Included in Phase One:

1. S. Duff and Airport Road
2. S. Duff and HWY 30 N Ramp
3. S. Duff and S 16th
4. S. Duff and Chestnut
5. S. Duff and Walmart
6. S. Duff and 5th
7. S. Duff and 3rd
8. S. Duff and Crystal
9. S. Duff and Highway 30 S. Ramp (coming Summer of 2021)
10. Duff and Lincoln Way
11. Duff and Main
12. Duff and 6th
13. Duff and 9th
14. Duff and 11th
15. Duff and 13th
16. E. 13th and Dayton

Phase One Budget Level Estimate (2020 Dollars) - \$1,517,600

Item 1: Fiber Cost: \$625,000

144 strand Single Mode Fiber Optic Cable
Hand Holes and Conduit Installation
\$25 @ foot at approximately 25,000 ft.

Item 2: Fiber Terminations Cost at Cabinets: \$47,000

30 terminations per cabinet at 16 cabinets at \$45 @ termination - \$21,600
Miscellaneous patch cords and splice panels - \$32,000

Item 3: Traffic Cabinet and Controller Cost: \$506,512

Traffic Signal Cabinet with Controller at 16 cabinets at \$29,657 @ cabinet - \$474,512
Installation cost at 16 cabinets at \$2000 @ cabinet - \$32,000

Item 4: Network Switches Cost: \$57,000

2 Layer 3 Network Switches @ \$12,500 - \$25,000
16 Layer 2 Network Switches @ \$2000 - \$32,000

Item 5: Traffic Operations Center Costs: \$157,088

Central Office Software (ATMS)/ and Server for 16 intersections - \$37,200
Traffic Adaptive Modules and Intersection Implementation at 16 intersections \$4418 @ - \$70,688
Public Works Building Implementation – (2 laptops and Adaptive Configuration) – \$21,000



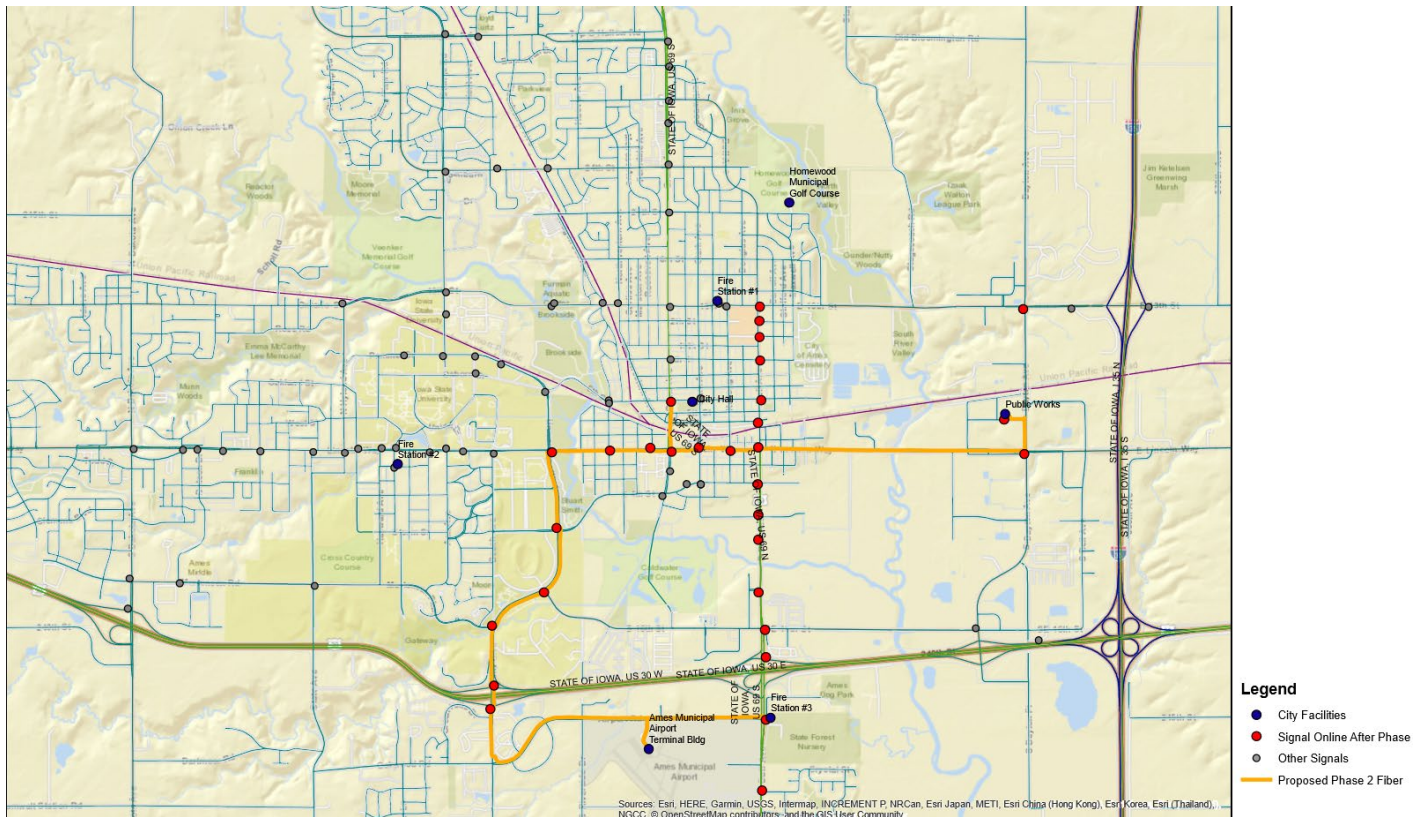
Training 2 trips 2 days each trip - \$13,800
One Year Maintenance and Support - \$14,400

Item 6: Consultant Costs: \$125,000

Infrastructure Design - \$75,000
Network Design and Programming - \$50,000

6.2 Phase Two

Phase Two of this project will connect the Public Works Building on Edison Street out to Dayton Avenue then south on Dayton Avenue to Lincoln Way. It will continue out Lincoln Way west to University Blvd then south on University Blvd to Airport Road. From there the route will go east on Airport Road to Fire Station #3 with a spur south to the Airport Terminal. The route for Phase Two is shown below in Orange.



Phase Two Fiber Optic Deployment

When Phase Two is complete:

- Ames Traffic Division will be connected along Lincoln Way to University Blvd.
- This section would also allow for IowaDOT to access the fiber with a relatively short connection to their office on Lincoln Way.
- The continuation of the fiber south down University Blvd will permit traffic control from the TOC to the signals by Jack Trice Stadium and Hilton Coliseum. This will enhance the ability of the Traffic Division to manage traffic flow resulting from events at these venues.
- The connection to the ramps on Highway 30 will augment their ability to empty the vehicle traffic out of Ames surface roads and onto Highway 30. This will reduce the congestion that results from large numbers of vehicles exiting venues at the same time.



- By following Airport Road east to Fire Station #3 the route will complete a ring back to Duff Avenue and provide redundant pathways for the fiber network back to the Public Works Building.
- Connection to Firehouse #1 and the Layer III switch at that location.
- Redundant connections to Duff Avenue, 13th Street, University Avenue, and Lincoln Way.
- Cabinets, controllers, network switches, and cameras for 14 cabinets on the Lincoln Way and University Boulevard Corridors.

Intersections included in Phase Two:

1. Lincoln Way and Dayton Avenue
2. Lincoln Way and Kellogg
3. Lincoln Way and Clark
4. Lincoln Way and Grand
5. Lincoln Way and Elm
6. Lincoln Way and Hazel
7. Lincoln Way and University
8. University and S. 4th
9. University and S. 16th
10. University and Mortensen
11. University and Hwy 30 N Ramp
12. University and Hwy 30 S Ramp
13. Grand Ave and 6th
14. 6th and Clark

Phase Two Budget Level Estimate (2020 Dollars) - \$1,711,000

Item 1: Fiber Cost: \$900,000

144 strand Single Mode Fiber Optic Cable
Hand Holes and Conduit Installation
\$25 @ foot at approximately 36,000 ft.

Item 2: Fiber Terminations Cost at Cabinets: \$47,000

30 terminations per cabinet at 14 cabinets at \$45 @ termination - \$19,000
Miscellaneous patch cords and splice panels - \$28,000

Item 3: Traffic Cabinet and Controller Cost: \$444,000

Traffic Signal Cabinet with Controller at 14 cabinets at \$29,657 @ cabinet - \$416,000
Installation cost at 14 cabinets at \$2000 @ cabinet - \$28,000

Item 4: Network Switches Cost: \$40,500

1 Layer 3 Network Switches @ \$12,500
14 Layer 2 Network Switches @ \$2000 - \$28,000

Item 5: Traffic Operations Center Costs: \$104,500

Central Office Software (ATMS)/ for 14 intersections - \$28,000
Traffic Adaptive Modules and Intersection Implementation at \$4418 @ - \$62,000
One Year Maintenance and Support - \$14,500



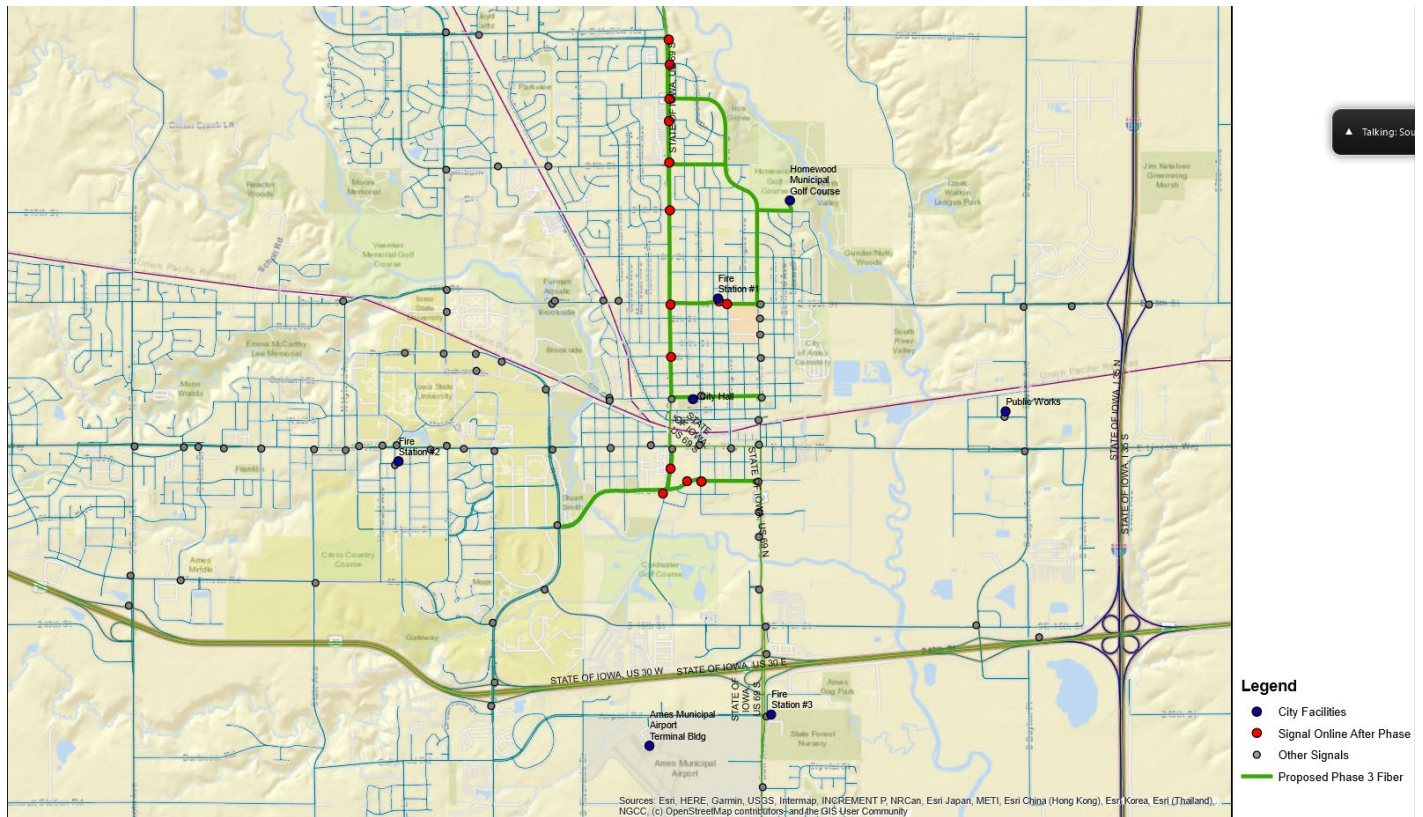
Item 6: Consultant Costs: \$175,000

Infrastructure Design - \$100,000

Network Design and Programming - \$75,000

6.3 Phase Three

Phase Three of this project will include connecting South 4th Street and Duff Avenue West down 3rd Street to University. This phase will connect South 3rd Street and Grand Avenue North to Bloomington Road, Grand Avenue and Duff Avenue South down Duff to 13th Street, 13th and Duff West back to Grand Avenue, and Duff and 24th Street West back to Grand Avenue. It will also include connecting City Hall to Duff down 6th Street and connecting Homewood Golf Course to Duff at 24th Street. The route for Phase Three is shown below in Green.



Phase Three Fiber Optic Deployment

Phase Three includes:

- Traffic control on Grand Avenue.
- Connection to Firehouse #1 and the Layer III switch at that location.
- Connection to Homewood Municipal Golf Course and the Layer III switch at that location.
- Redundant connections to Duff Avenue, 13th Street, University Avenue, and Lincoln Way.
- Cabinets, controllers, network switches, and cameras for thirteen (13) cabinets on the Grand Avenue Corridor and the South 3rd Street Area.



Intersections included in Phase Three:

1. S. 3rd Street and Walnut
2. S. 3rd Street and HyVee
3. S. Grand Ave and S. 4th
4. S. Grand Ave and IDOT Entrance
5. Grand Ave and 9th
6. Grand Ave and 13th
7. Grand Ave and 20th
8. Grand Ave and 24th
9. Grand Ave and 28th
10. Grand Ave and 30th
11. Grand Ave and Wheeler
12. Grand Ave and Bloomington Road
13. Kellogg and 13th Street

Phase Three Budget Level Estimate (2020 Dollars) - \$1,654,000

Item 1: Fiber Cost: \$900,000

144 strand Single Mode Fiber Optic Cable
Hand Holes and Conduit Installation
\$25 @ foot at approximately 36,000 ft.

Item 2: Fiber Terminations Cost at Cabinets: \$44,000

30 terminations per cabinet at 13 cabinets at \$45 @ termination - \$18,000
Miscellaneous patch cords and splice panels - \$26,000

Item 3: Traffic Cabinet and Controller Cost: \$412,000

Traffic Signal Cabinet with Controller at 13 cabinets at \$29,657 @ cabinet - \$386,000
Installation cost at 13 cabinets at \$2000 @ cabinet - \$26,000

Item 4: Network Switches Cost: \$51,000

2 Layer 3 Network Switches @ \$12,500 - \$25,000
13 Layer 2 Network Switches @ \$2000 - \$26,000

Item 5: Traffic Operations Center Costs: \$97,000

Central Office Software (ATMS)/ for 13 intersections - \$26,000
Traffic Adaptive Modules and Intersection Implementation at \$4418 @ - \$58,000
One Year Maintenance and Support - \$13,000

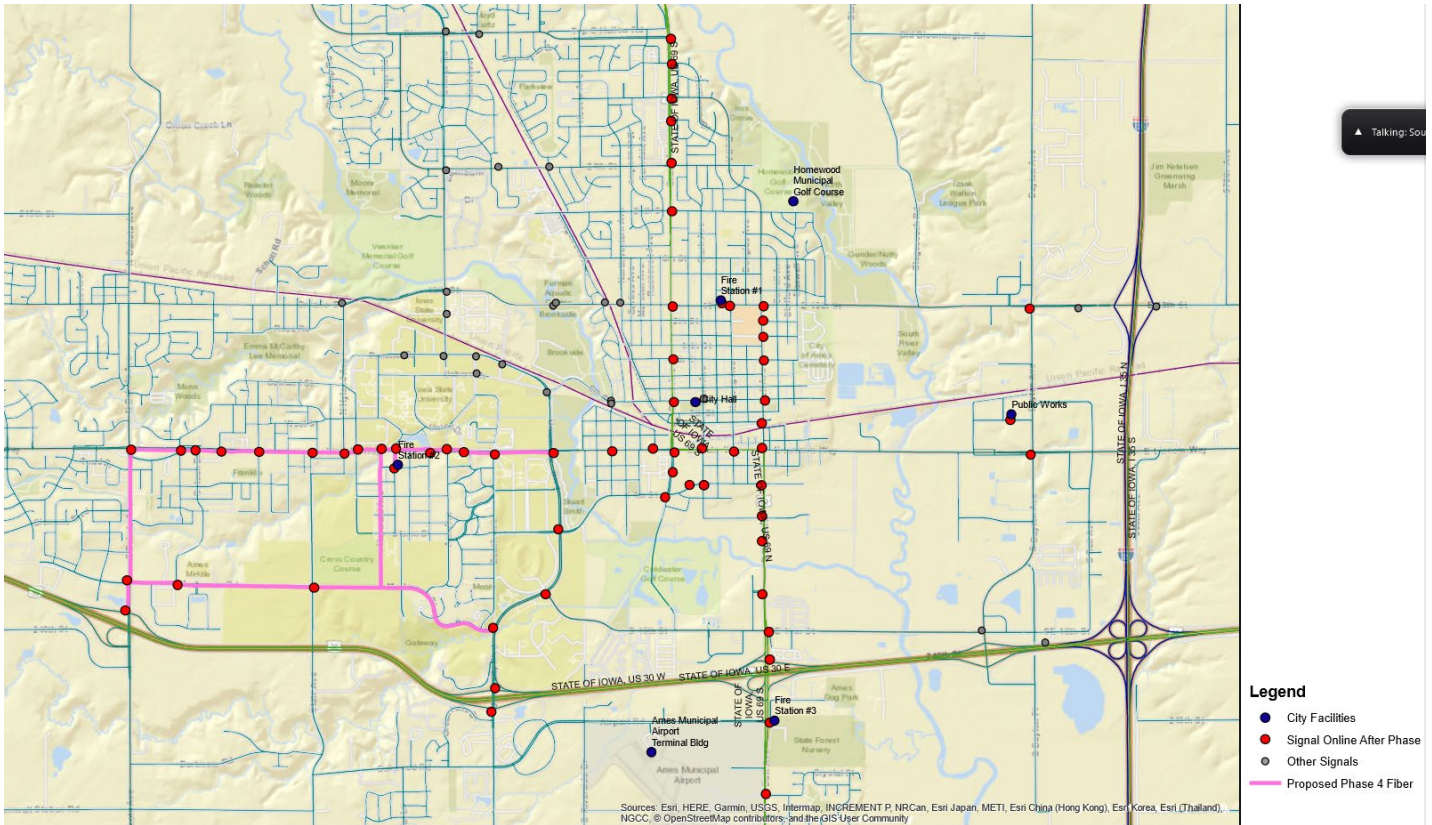
Item 6: Consultant Costs: \$150,000

Infrastructure Design - \$100,000
Network Design and Programming - \$50,000



6.4 Phase Four

Phase Four will start at Lincoln Way and Beach West down Lincoln Way to Dakota. From there the route will go from Lincoln Way and Dakota South to Mortensen and Dakota. Then follow Mortensen and Dakota East to University and Mortensen, spur from Mortensen Course and Dakota South to Hwy 30 west Bound Ramp, Spur on Welch to pick up Firehouse #2, and Lincoln Way and State Avenue South to Mortensen Avenue. The route for Phase Four is shown below in Pink.



Phase Four Fiber Optic Deployment

When Phase Four is complete:

- Traffic control for Lincoln Way
- Traffic control for Dakota
- Traffic control for Mortensen
- Redundant pathway for University Avenue connections, Lincoln Way connections, and Grand Avenue connections
- Cabinets, controllers, network switches, and cameras for nineteen (19) cabinets on the Lincoln Way Corridor, Dakota Corridor, and the Mortensen Corridor



Intersections included in Phase Four:

1. Lincoln Way and Beach
2. Lincoln Way and Union
3. Lincoln Way and Ash
4. Lincoln Way and Lynn
5. Lincoln Way and Welch
6. Lincoln way and Hayward
7. Lincoln Way and Sheldon
8. Lincoln Way and Hyland
9. Lincoln Way and State
10. Lincoln Way and Franklin
11. Lincoln Way and Marshall
12. Lincoln Way and Dotson
13. Lincoln Way and Beedle
14. Lincoln Way and Dakota
15. S. Dakota and Mortensen
16. S. Dakota and Hwy 30 WB Ramp
17. Mortensen and Dotson
18. Mortensen and State

Phase Four Budget Level Estimate (2020 Dollars) - \$1,681,626

Item 1: Fiber Cost: \$738,000

144 strand Single Mode Fiber Optic Cable
Hand Holes and Conduit Installation
\$25 @ foot at approximately 29,520 ft

Item 2: Fiber Terminations Cost at Cabinets: \$62,300

30 terminations per cabinet at 18 cabinets at \$45 @ termination - \$24,300
Miscellaneous patch cords and splice panels - \$38,000

Item 3: Traffic Cabinet and Controller Cost: \$569,826

Traffic Signal Cabinet with Controller at 18 cabinets at \$29,657 @ cabinet - \$533,826
Installation cost at 18 cabinets at \$2000 @ cabinet - \$36,000

Item 4: Network Switches Cost: \$48,500

1 Layer 3 Network Switches @ \$12,500
18 Layer 2 Network Switches @ \$2000 - \$36,000

Item 5: Traffic Operations Center Costs: \$138,000

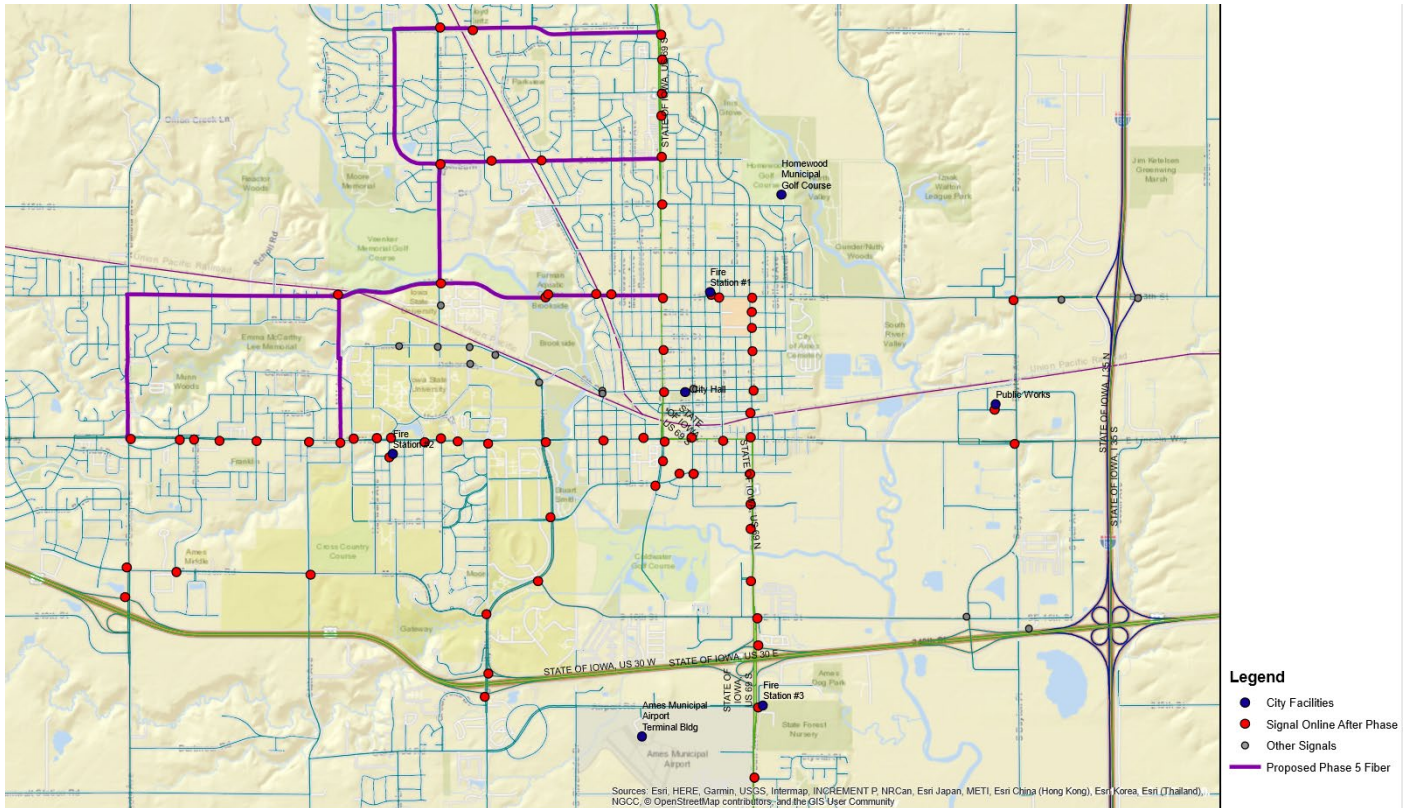
Central Office Software (ATMS)/ for 18 intersections - \$36,000
Traffic Adaptive Modules and Intersection Implementation at \$4418 @ - \$84,000
One Year Maintenance and Support - \$18,000



Item 6: Consultant Costs: \$125,000
 Infrastructure Design - \$75,000
 Network Design and Programming - \$50,000

6.5 Phase Five

Phase Five will include connecting Grand Ave and 13th Street West to Dakota and then going from Dakota and 13th Street South to Lincoln Way. This phase will also include Franklin and Lincoln Way North to 13th Street, connecting 13th and Stange North to 24th Street, 24th and Stange East to Grand Avenue and 24th and Stange West then North on George Washington Carver Ave to Bloomington Road. The route for Phase Five is shown below in Purple.



Phase Five Fiber Optic Deployment

Phase Five will provide:

- Traffic control on 13th Street
- Traffic control on 24th Street
- Traffic Control on the Stange Corridor
- Redundant loop for Lincoln Way and Grand Avenue connections
- Cabinets, controllers, network switches, and cameras for 11 cabinets on the 13th Street Corridor, the Stange Corridor, and 24th Street Corridor.



Intersections included:

1. 13th and Northwestern
2. 13th and Ridgewood
3. 13th and Aquatic Center
4. 13th and Furman
5. 13th and Stange
6. 13th and Hyland
7. Stange and 24th
8. Stange and Bloomington
9. 190th and Hyde
10. Kent and 24th St
11. Hayes and 24th St

Phase Five Budget Level Estimate (2020 Dollars) - \$2,079,000

Item 1: Fiber Cost: \$1,425,000

144 strand Single Mode Fiber Optic Cable
Hand Holes and Conduit Installation
\$25 @ foot at approximately 57,000 ft

Item 2: Fiber Terminations Cost at Cabinets: \$37,000

30 terminations per cabinet at 11 cabinets at \$45 @ termination - \$15,000
Miscellaneous patch cords and splice panels - \$22,000

Item 3: Traffic Cabinet and Controller Cost: \$349,000

Traffic Signal Cabinet with Controller at 11 cabinets at \$29,657 @ cabinet - \$327,000
Installation cost at 11 cabinets at \$2000 @ cabinet - \$22,000

Item 4: Network Switches Cost: \$22,000

11 Layer 2 Network Switches @ \$2000 - \$22,000

Item 5: Traffic Operations Center Costs: \$71,000

Central Office Software (ATMS)/ for 11 intersections - \$22,000
Traffic Adaptive Modules and Intersection Implementation at \$4418 @ - \$49,000
One Year Maintenance and Support - \$18,000

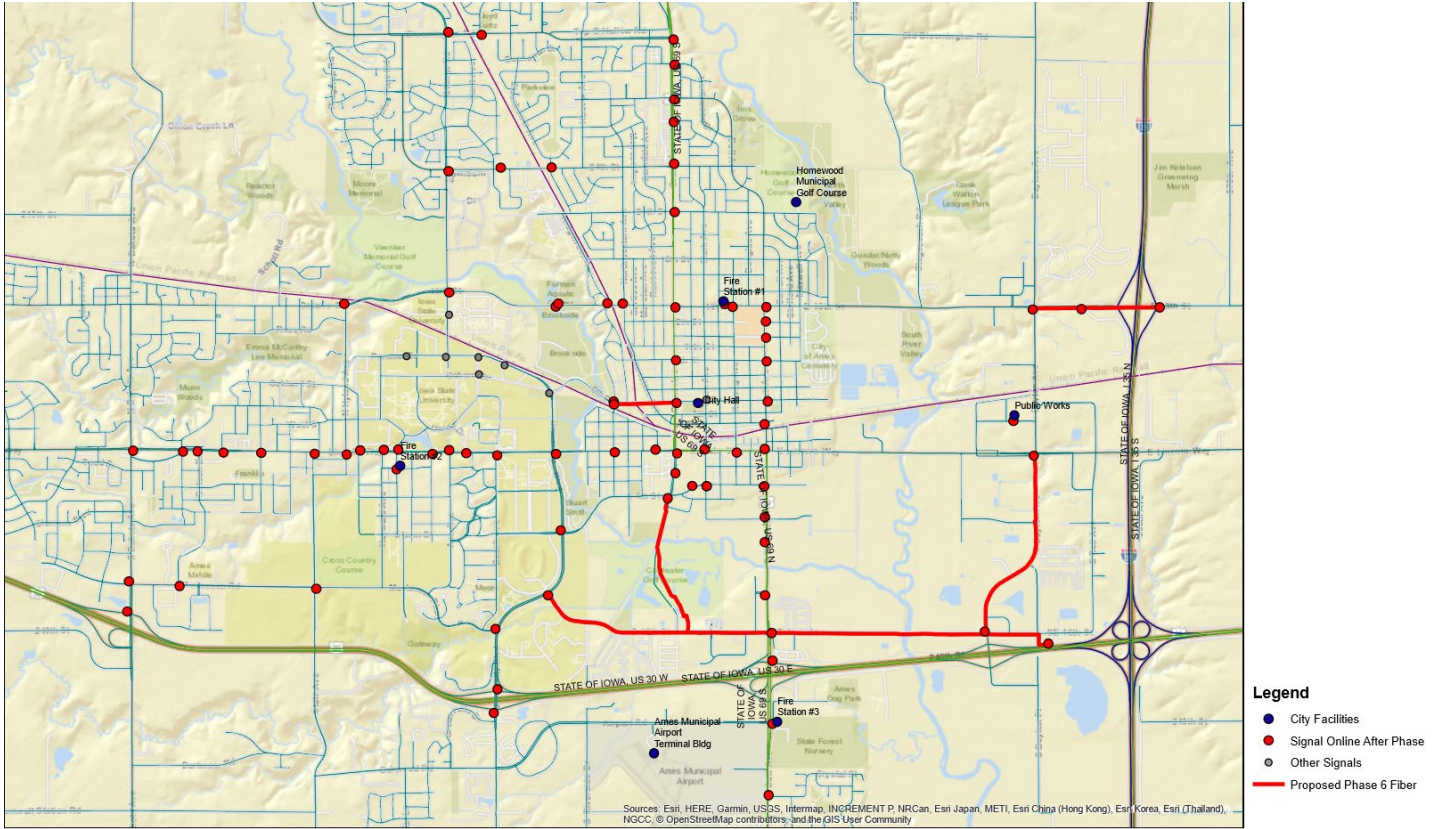
Item 6: Consultant Costs: \$175,000

Infrastructure Design - \$125,000
Network Design and Programming - \$50,000



6.6 Phase Six

Phase Six will include connecting 13th Street and I 35 East and West Ramps west to 13th and Dayton Avenue, Dayton Avenue and Lincoln Way South down Dayton Avenue to Southeast 16th Street, Southeast 16th and Hwy 30 to University and Southeast 16th, Southeast 16th Street North to South 3rd Street, and 6th and Grand West to 6th and Elm. The route for Phase Six is shown below in Red.



Phase Six Fiber Optic Deployment

Phase Six will provide:

- Connection to the I-35 Ramps on 13th Street
- Connection to the Southeast 16th Corridor
- Connection to the Dayton Avenue Corridor
- Redundant loop for University Corridor, Duff Avenue Corridor, Grand Avenue Corridor, and the Lincoln Way Corridor
- Cabinets, controllers, network switches, and cameras for five (5) cabinets on the Dayton and SE 16th corridors.

Intersections Included:

1. E. 13th St and I-35 East Ramp
2. E. 13th St. and I-35 West Ramp
3. S. Dayton and SE16th
4. E. Lincoln Way & Dayton
5. S. Dayton and Hwy 30 Ramp(s)



Phase Six Budget Level Estimate (2020 Dollars) - \$ 1,011,035

Item 1: Fiber Cost: \$656,000

144 strand Single Mode Fiber Optic Cable
Hand Holes and Conduit Installation
\$25 @ foot at approximately 26,240 ft.

Item 2: Fiber Terminations Cost at Cabinets: \$18,750

30 terminations per cabinet at 5 cabinets at \$45 @ termination - \$6,750
Miscellaneous patch cords and splice panels - \$12,000

Item 3: Traffic Cabinet and Controller Cost: \$158,285

Traffic Signal Cabinet with Controller at 5 cabinets at \$29,657 @ cabinet - \$148,285
Installation cost at 5 cabinets at \$2000 @ cabinet - \$10,000

Item 4: Network Switches Cost: \$10,000

5 Layer 2 Network Switches @ \$2000 - \$10,000

Item 5: Traffic Operations Center Costs: \$43,000

Central Office Software (ATMS)/ for 5 intersections - \$10,000
Traffic Adaptive Modules and Intersection Implementation at \$4418 @ - \$27,000
One Year Maintenance and Support - \$6,000

Item 6: Consultant Costs: \$125,000

Infrastructure Design - \$75,000
Network Design and Programming - \$50,000



6.7 Project Budget Level Cost Summary

With the completion of this project the City of Ames will have a modern traffic management system with capabilities that will allow for more efficient operation of their intersections, corridors, and high traffic areas. The ability to manage the vehicular traffic more efficiently will result in the reduction of travel time, fuel consumption, air pollution, and the general frustration associated with traffic congestion. The capacity to monitor and manage traffic signals from a Traffic Operations Center will provide benefits when handling events such as football and basketball games, concerts, Iowa State University functions, and the myriad of special events that take place in a city with a major university. Additionally, Ames will have an extensive fiber optic communication capability via the fiber optic cable and conduit system that will be placed with this project.

The total cost estimated for the project, in Year 2020 dollars, is summarized below:

6.7.1 Total Budgetary Estimated Cost of the Project (2020 Dollars)

Total for Phase One –	\$1,517,600
Total for Phase Two –	\$1,711,000
Total for Phase Three –	\$1,654,000
Total for Phase Four –	\$1681,626
Total for Phase Five –	\$2,079,000
<u>Total for Phase Six –</u>	<u>\$1,011,035</u>
Total for Project –	\$9,654,261

7.0 Data Integration

Data integration is perhaps the most important component of any traffic signal enhancement or ITS expansion project. Data integration brings the “pieces of the puzzle” together to form a composite picture of the current conditions and disseminates that information to the proper recipient. Without it, both the system manager and users will typically only receive a portion of the intended and desired system-wide benefits. There are two separate levels of data integration; system and regional. Although data integration is an important element of the overall system, it is the one piece which the driving public cannot see since it focuses on ensuring the individual elements complement and support the others’ functionality.

7.1 SYSTEM LEVEL DATA INTEGRATION

System level data integration includes taking data prepared by one element or subsystem, and converting that data into information through methods such as data smoothing, synthesizing, etc. Once this process is complete, the information is then transferred to another subsystem for use, such as broadcasting it to the public through either pre-trip or en-route traveler information methods. The process of successfully and automatically moving the data/information from one subsystem to another is commonly referred to as system integration. For this to occur, the data must be prepared using a methodology understood by another subsystem with little or no errors within the process. For the City of Ames, examples of system-level integration include the following:

- The deployment of an ATMS that is envisioned to support traffic signal controllers and other ITS devices.
- The deployment of new communication throughout the City to connect field equipment to various City, ISU, and IowaDOT facilities.

7.2 REGIONAL LEVEL DATA INTEGRATION

This type of integration is similar to system level integration, although on a much larger scale and sometimes with reduced detail. With partnering agency communication and coordination, data sharing between agencies can become a reality. One element of regional integration can be seen through data sharing of the City traffic information with IowaDOT and ISU. The City of Ames can implement an interface to a regional data center for the exchange of traffic data (congestion, incidents, CCTV surveillance video). The City could also provide roadway congestion information to the regional data center for area-wide dissemination. The City could become part of a much larger system giving the ability to disseminate their information to a much broader audience. Conversely, the City will be able to obtain data from other agencies. For the City of Ames, examples of regional-level integration include the following:

- Sharing of information with other City departments, IowaDOT and other surrounding municipalities, and the public.
- Developing coordinated signal timing plans with adjacent jurisdictions.



8.0 STAKEHOLDERS ROLES AND RESPONSIBILITIES

There are numerous stakeholders with interest in the Traffic Signal Master Plan. **Table 8.1** summarizes the ITS System stakeholders and their roles.

Table 8.1 – Stakeholders and Roles for the Traffic Signal System

Stakeholder	Role
City of Ames Public Works Department	Budgeting and project programming
City of Ames Utilities	Managing Fiber Optic communications
City of Ames Traffic Division	Traffic Management and public safety for the City
City of Ames Information Technology Division	Selecting, operating, maintaining, and providing training for computer, software, and telecommunications systems.
City of Ames Municipal Electric Department	Municipal electric department owns and maintains the overhead fiber optic cable around the City.
City Ames Parks and Recreation	Manages parks, trails and other municipal facilities. Also has locations throughout the city that may be used for network equipment.
Ames Police Department	Public safety for the City
Ames Fire	Public safety for the City
Iowa Department of Transportation	Operations and maintenance of the I-35, US 60, and US 69 highway/freeway systems
Ames Area Metropolitan Planning Organization (AAMPO)	Transportation planning, distribute federal funding, project programming, and maintain regional ITS architecture for Ames area
Iowa State University	Traffic Management of 7 University Signals Fiber connection to ITrans and University signals for management
CyRide	Transit provider for Ames Area
Federal Highway Administration (FHWA) Iowa Division	Oversight of projects
Media	Disseminate travel information to the public
Travelling Public	Make travel decisions, users of the Signal System and ITS



9.0 BENEFITS OF THE CITYWIDE CONNECTED TRAFFIC SIGNAL NETWORK

Below is a bulleted list of just some of the benefits that are expected to be realized with the design, deployment and completion of the City of Ames Traffic Signal Improvement Program.

- Traffic control and monitoring capabilities primarily to the South Duff Avenue/US Hwy Corridor which is one of the most congested corridors in the City of Ames.
- This will establish the connection to the traffic cabinets along the pathway back to the Public Works Building on Edison and will be the first step in connecting the traffic operations, via fiberoptic cable, to the intersections on the street.
- During the project the Traffic Operations Center in the Public Works Building will be established.
- Advanced Traffic Management System will be installed in the TOC. This will provide the backbone for the traffic operations and control of the connected intersections
- Ames Traffic Department will be connected to Lincoln Way at University Blvd. This will provide traffic control on the Lincoln Way corridor from Duff to University Blvd with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- This section would also allow for the Iowa Department of Transportation to access the fiber with a relatively short connection to their office on Lincoln Way.
- The continuation of the fiber south down University Blvd will permit traffic control from the TOC to the signals by Jack Trice Stadium and Hilton Coliseum. This will enhance the ability of the Traffic Department to manage traffic flow resulting from events at both of those venues.
- The connection to the ramps on Highway 30 will augment their ability to empty the vehicle traffic out of Ames surface roads and onto Highway 30. This will reduce the congestion that results from large numbers of vehicles exiting the venues at the same time.
- By following Airport Road east to Fire Station #3 the route will complete a ring back to Duff Avenue and provide redundant pathways for the fiber network back to the Public Works Building.
- Connection to Firehouse #1 and the Layer 3 switch at that location.
- Connection to Homewood Municipal Golf Course and the Layer 3 switch at that location.
- Redundant connections to Duff Avenue, 13th Street, University Avenue, and Lincoln Way
- Traffic control on Grand Avenue with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Connection to Firehouse #1 and the Layer 3 switch at that location.
- Connection to Homewood Municipal Golf Course and the Layer 3 switch at that location.
- Redundant connections to Duff Avenue, 13th Street, University Avenue, and Lincoln Way
- Traffic control for Lincoln Way with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Traffic control for Dakota with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Traffic control for Mortensen with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Redundant pathway for University Avenue connections, Lincoln Way connections, and Grand Avenue connections
- Traffic control on 13th Street with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.



- Traffic control on 24th Street with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Traffic Control on the Stange Corridor with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Redundant loop for Lincoln Way and Grand Avenue connections
- Connection to the I-35 Ramps on 13th Street with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Connection to the Southeast 16th Corridor with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Connection to the Dayton Avenue Corridor with connection back to the TOC to allow for remote access to the traffic cabinets and a Traffic Adaptive management system.
- Redundant loop for University Corridor, Duff Avenue Corridor, Grand Avenue Corridor, and the Lincoln Way Corridor



10.0 SUMMARY

The key to modern, effective traffic management is based on the ability to operate current technology and utilize that technology in an efficient manner. This ability is based on communication from a Traffic Operations Center (TOC) to intersections across the city and particularly, to corridors of intersections. The capability to monitor and manage signalized corridors will provide the Traffic Division for the City of Ames with the tools necessary to reduce congestion, the resulting emissions, and decrease fuel consumption.

To define the traffic management system that will accomplish the goals outlined by the Traffic Division in our project meetings, a large list of parameters was considered. Attention was given to factors that would allow for future technological advancements in the traffic management field and provide the operational flexibility that is an essential component of the network.

Consideration was given to the recent actions of Siemens, manufacturer of the majority of the City's traffic signal controllers, in terminating support for most legacy models of their signal controllers and traffic management software. This action essentially antiquated nearly all of the current controllers that are in use by Ames and will necessitate the need to replace the affected controllers.

Since the ATMS software is tied to the current controllers and only includes several closed loop systems in the city, the ATMS would also need to be replaced. The current traffic control devices and management software should be upgraded to ATC units and an ATMS with NTCIP enhanced communication protocol.

The National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) is a family of standards designed to achieve interoperability and interchangeability between computers and electronic traffic control equipment from different manufacturers. These standards will be applied to equipment and software specifications to aid with the interoperability and expansion of the traffic network. This communication protocol will be an essential part of the overall project and will aid in the establishment of a network that will service the communication needs of the traffic operations and other potential users of the assets that will be deployed.

To allow for expansion of the network and to avoid being "locked in" to a single vendor, Ames will require that all future equipment and softwares be interoperable with other traffic vendor's equipment and software to a certain minimum level of operation. This approach is in line with the standardization effort being undertaken by the United States Department of Transportation (USDOT) as part of their ITS efforts. The USDOT, along with many others in the ITS community, have specified that the ATC is the preferred traffic signal controller standard, as the ATC will provide an open platform for hardware and software for a wide variety of traffic and ITS applications. The ATC type controller and any central office software required for this project will be specified as interoperable and NTCIP compliant in any future RFPs. Interoperability is a key component in the expansion and viability of this network and will be given a very high priority.

The implementation of the ATC controller standard provides the foundation for the implementation of more technologically advanced traffic management devices and systems. The Traffic Division has chosen to use a Traffic Adaptive form of traffic management system. This type of system operates on a "real time" basis and creates traffic signal plans based on the inputs it receives from the vehicle detectors. By doing so, the system will "adapt" the traffic signal plans to match the vehicles present in the intersection. This allows for a dynamic signal plan that changes to match the flow of traffic and provides an efficient use of

the traffic signal timing to keep vehicles moving. This system reduces delays and stops along the managed corridors and thereby reduces fuel consumption, travel times, and air pollution.

The implementation of a central management Advanced Traffic management Software (ATMS) within a Traffic Operations Center (TOC) is an important component to this completed system. The ATMS will provide a central location to receive data and video from the traffic intersections, analyze that data and video, and allow for the monitoring and management of the traffic intersections by Ames personnel.

With the proposed fiber optic communication components of this network, information and video feeds can be shared with law enforcement, emergency response personnel, public works officials, and a myriad of other entities in addition to the traffic management personnel. The video component would allow traffic management personnel to monitor the traffic flow and react to incidents that cause congestion from a remote location such as the TOC or a workstation. “On-call” technicians could VPN into the network from their work cellular phones or laptop computers, after hours or when away from the TOC, to monitor trouble calls remotely. This would reduce the need to dispatch maintenance personnel to the intersection to respond to the congestion and allow for a more immediate response to potential traffic issues. This ability for remote monitoring would allow service technicians to be more efficient in managing traffic incidents and/or congestion.

The data gathering capabilities of a modern traffic management system can provide essential statistics for the Traffic Division. Traffic counts can be gathered and relayed in “real time” back to the Traffic Division to allow for instantaneous analysis of the current traffic levels as well as collected and stored for future analysis. This information and data can be valuable for analyzing changes in traffic patterns. This data can be critical for planning future construction of roadways, analyzing the impact of commercial development, and developing warrants to allow for the installation of traffic control at an intersection.

Video feeds could be monitored by emergency response officials to access crashes or incidents to help them understand the magnitude of the response that would be necessary to handle the situation. This capability could provide emergency management personnel with valuable information concerning the nature of the emergency, number of vehicles involved, the amount of response required, and help determine if traffic control is necessary.

Public Works could use the video to do a variety of tasks such as monitoring flooding along rivers and streams, checking on contractors for safety compliance, and to see if their personnel on the job site match the billing amounts. The video feeds could also be used to inspect and monitor work zones on roadways to assure that the work zone is properly set up and functioning as designed.

Law enforcement personnel could use the video to monitor trouble areas, investigate traffic crashes, and provide monitoring around schools for additional security. The video component of this project could provide law enforcement with a valuable tool for enhancing public safety.

The City of Ames Economic Development Department could also use the traffic count information to attract commercial interests by providing accurate numbers for consideration in the decision-making process. Other possible usage of this count information could come from the Iowa Department of Transportation, Ames Area Metropolitan Planning Organization, or Iowa State University. Accurate traffic count and vehicle information is vital data that can be provided instantaneously and accurately with a modern traffic management system.



The network video management system would be set up to allow for prioritization of access to the video cameras. Ames will need to establish recording policies, procedures for public access, and methodology for the dissemination of any recorded video information. The video component of the fiber optic network can create opportunities for a myriad of uses in the traffic, public works, law enforcement, and security sectors. This is an offshoot of the traffic management operations but can provide a valuable asset for numerous agencies and departments within Ames.

By creating a TOC for Ames and standardizing the intersection equipment, management software, and training for the support personnel, the city will provide a platform that is effective and efficient in meeting the traffic control needs of the motorists within Ames. The ability to visualize the entire city-wide traffic flow from a single location and make the necessary adjustments would create a much more effective platform for managing the traffic than the current patchwork approach. This is the primary objective of this project, but the ancillary benefits are substantial and make this project more valuable and viable.

Modernizing signal equipment and softwares and centralizing traffic operations will not only create a more efficient and robust traffic management system, it will also allow for more efficient use of personnel, more efficient training of technicians, standardization of equipment and management software, monitoring of traffic flows on a city-wide basis, the ability to react faster to incidents that affect traffic flows, and near real-time access to traffic data. These are all important factors in providing drivers with a modern and effective transportation system that improves quality of life by reducing travel times, limiting delays and air pollution, minimizing fuel consumption, and mitigating the need to build more lanes to satisfy future vehicle traffic volumes.



CITY OF AMES, IOWA

TRAFFIC

SIGNAL

MASTER PLAN

APPENDIX

SNMPC SOFTWARE ALTERNATIVES

VIDEO MANAGEMENT SOFTWARE COMPARISON

TRAFFIC SIGNAL INVENTORY WORKSHEET

gba **Systems
Integrators**



SNMP SOFTWARE ALTERNATIVES

Castle Rock: SNMPc Enterprise

Key Product Features:

- Monitors SNMP devices, WAN Links, Servers and Applications
- Internet Protocol Version 6 (IPv6) addressing
- Supports SNMP v1, v2c and secure SNMP v3
- Scalable, Distributed Architecture
- Email/Pager Event Notification
- Integrates with SNMPc OnLine web-based reporting
- Live/Standby Servers with automatic failover
- Syslog event logging
- Remote Windows Console
- Automated Network Discovery
- Programming & Scripting Interfaces
- OEM Version Available

Remote access consoles through Windows or web-based client software

A full peer-to-peer architecture is supported where each SNMPc Enterprise can be both a branch and top-level manager simultaneously. This lets you to deploy a scalable fault tolerant management system; to ensure a reliable 24/7 network monitoring solution, SNMPc Enterprise supports live/standby management servers

SNMPc Enterprise delivers improved security and accountability through support for user audit trails. Any user access to the management platform or configuration changes are tracked and written to a log file. Alerts are automatically generated if an intrusion attempt is detected.

SNMPc Enterprise supports a multi-level hierarchical map

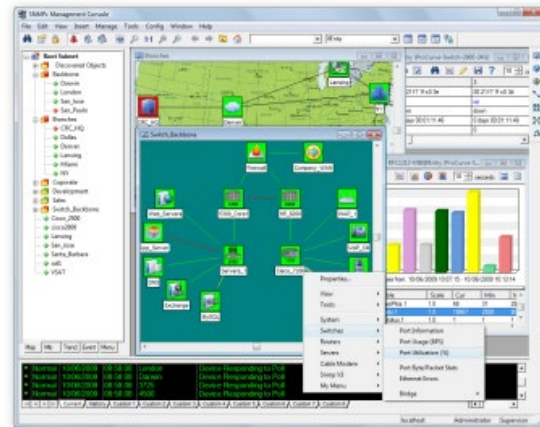
SNMPc Enterprise offers a wide range of event actions including:

- Email, Page, SMS
- Play WAV Sound
- Execute Application
- Forward SNMP Trap
- Pop-up Alarm Window

Annual Updates and Support

Downloadable software updates are free for 3 months. Extended Software Updates increases this period for a further 12 months. Software updates include patches, feature enhancements, and major new versions.

Customers whose extended software updates have lapsed for more than 60 days must purchase out of warranty renewal. This will upgrade customers to the latest version of SNMPc. It also provides a further 12



months of software updates coverage.

Technical support is provided by email and through our helpdesk while you have a valid Annual Updates license. This includes the first 3 months free of charge.

We do not provide telephone support.

To get technical support and software updates you must register at our help desk.

Datasheet:

<https://www.castlerock.com/pdf/snmpc-datasheet.pdf>

Website:

<https://www.castlerock.com/products/snmpc/>

System Requirements

Parameter	Minimum Requirement
CPU	Intel 2 GHz
Memory	8 GB
Disk	100 GB
Operating Systems	Windows 2012, 8, 7, 2008R2

Solarwinds: Network Performance Monitor

Key Features:

Multi-vendor network monitoring
 Network Insights for deeper visibility
 Intelligent maps
 NetPath and PerfStack for easy troubleshooting
 Smarter scalability for large environments
 Advanced alerting

Fully scalable
 Out-of-the box network monitoring scales to handle all the growth your organization can throw at you, today and tomorrow.

Tailor NPM to your needs with multi-vendor support and customizable dashboards, views, and charts.

Create alerts based on simple or complex nested trigger conditions, defined parent/child dependencies, and network topology.

Auto-generating intelligent maps
 View contextual and graphical portrayals of an entity and its physical and logical relationships with auto-updating maps.

Orion Log Viewer to collect, search, filter, and alert on syslogs and SNMP trap data from within the Orion console

Orion Log Viewer helps you to correlate log data with performance and availability metrics on a common timeline so you can get to root cause faster.

REQUIREMENTS

SMALL - SL100, SL250, SL500

CPU - Quad core processor or better
 Hard Drive Space - 10 GB minimum (20 GB recommended)

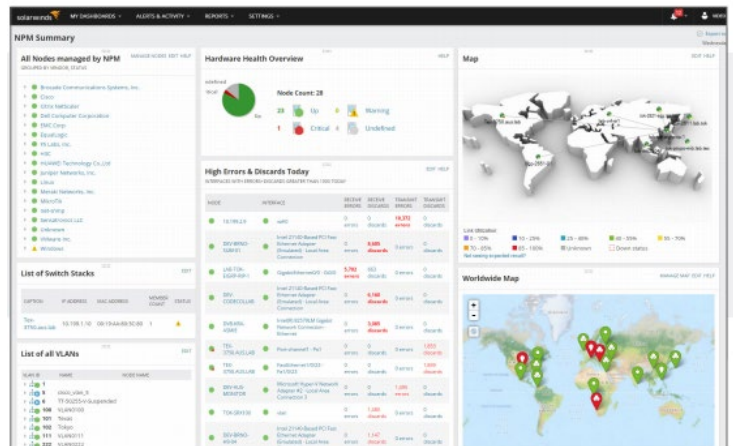
Memory - 6 GB minimum (8 GB recommended)

MEDIUM - SL2000

CPU - Quad core processor or better
 Hard Drive Space - 15 GB minimum (40 GB recommended)
 Memory - 8 GB minimum (16 GB recommended)

LARGE - SLX

CPU - Quad core processor or better
 Hard Drive Space - 30 GB minimum (40 GB recommended)
 Memory - 16 GB minimum (32 GB recommended)



Datasheet:

<https://www.solarwinds.com/-/media/solarwinds/swdcv2/licensed-products/network-performance-monitor/resources/datasheets/npm-datasheet.ashx?rev=9b79d12fae2944b98f3475ad30d9692d>

Website:

<https://www.solarwinds.com/network-performance-monitor>



Paessler: PRTG Network Monitor

Traffic, packets, applications, bandwidth, cloud services, databases, virtual environments, uptime, ports, IPs, hardware, security, web services, disk usage, physical environments, IoT devices and almost everything you can imagine.

Network Autodiscovery

PRTG can scan network segments by pinging defined IP ranges. This way PRTG will automatically recognize a wide range of devices and systems and create sensors from predefined device templates. This saves you a lot of configuration work and you can start monitoring right away.

Maps

With PRTG Maps you can create web pages with up-to-date monitoring data in your desired design. You can even make maps with your monitoring data publicly available. Have an eye on your network like you need it!

Alerts

PRTG alerts you when it discovers warnings or unusual metrics. With our free Apps for Android, iOS, and Windows Phone you can get push notifications directly to your phone. You can easily setup notifications via email or SMS according to your needs. With our powerful API you can even write your own notification scripts.

- Drag & drop map editor for clear and powerful individualized dashboards
- Integrated reporting engine with delivery as HTML, PDF, or CSV
- Documented API for custom data export

Quick customer support: PRTG is backed by a dedicated development and support team. Answer every customer inquiry within 24 hours (on business days).

PRTG 500 – 500 Sensors - \$1600

PRTG 1000 – 1000 Sensors - \$2850

PRTG 2500 – 2500 Sensors - \$5950

PRTG 5000 – 5000 Sensors - \$10500

PRTG XL1 – Unlimited Sensors - \$14500

One-time payment incl. 12 month maintenance (excl. tax)

PRTG 1000 - up to 1,000 sensors (~ 100 devices)

Core Server Hardware - 2 CPU Cores, 3 GB RAM

Disk Space - 250 GB

PRTG 2500 - 1,000 – 2,500 sensors (~ 250 devices)

Core Server Hardware - 3 CPU Cores, 5 GB RAM

Disk Space - 500 GB

PRTG 5000 - 2,500 – 5,000 sensors (~ 500 devices)

Core Server Hardware - 5 CPU Cores, 8 GB RAM

Disk Space - 1 TB

PRTG XL1 - 5,000 – 10,000 sensors (~ 1,000 devices)

Core Server Hardware - 8 CPU Cores, 16 GB RAM



Disk Space - 2 TB

The following Windows versions are officially supported for PRTG "Core Service" and "Probe Service". We recommend 64-bit (x64) operating systems.

Microsoft Windows Server 2012 R2

Microsoft Windows Server 2012, 2016

Microsoft Windows 10**

Microsoft Windows 8.1

Microsoft Windows 8

Microsoft Windows 7*

Microsoft Windows Server 2008 R2*

FAQ:

<https://www.paessler.com/support/faqs>

Website:

<https://www.paessler.com/prtg>



WhatsUpGold: Premium Edition

At-A-Glance Dashboards

WhatsUp Gold provides a unified view and fully encompasses heterogeneous environments and vendors so you can see everything on your network

Automated Discovery

Automatically discover all assets in your network with WhatsUp Gold's powerful Layer 2/3 discovery

Customize notifications about anything that can compromise your network's performance so you can fix problems before users even notice with WhatsUp Gold's advanced alert center.

Network Maps

WhatsUp Gold makes troubleshooting easier with dynamic Layer 2/3 network maps

IP Address Management Software

Automate the discovery, documentation and management of your IP space.

Inventory your entire address space

Get up-to-date visibility into IP address utilization

Categorize and report on devices by type automatically

Determine root cause of IP space problems utilizing an integrated toolset

Eliminate Error-Prone Processes

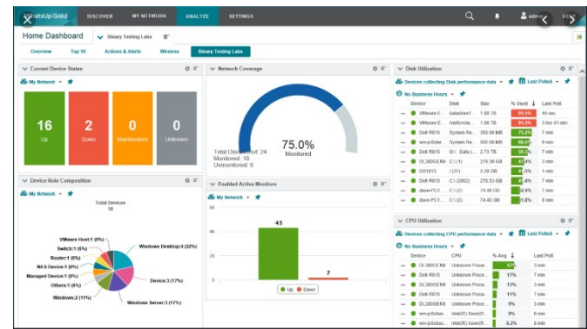
Scan your entire IP address space on a convenient schedule to avoid the tedious and risky task of maintaining IP addresses.

Conflict Prevention

Automatically detects duplicate IP

Pinpoint Specific Device Locations and Validate Connectivity

Save precious time by using WhatsUp Gold to search and discover how devices are connected. With detailed device views, you can quickly zero-in to find out what's connected to what. And, with built-in tools such as Layer 2 Trace and IP/ MAC Finder, WhatsUp Gold offers the industry's fastest approach to finding the location and validating connectivity of any device on the network.



System Requirements

Operating System: Windows Server 2008 R2 (64-bit), 2012, 2012 R2 (64-bit), or 2016

Processor: Quad-Core 2.6 GHz

Memory: 8 GB

Storage (installation): 25 GB

NIC: 100 Mbps

Database: SQL Server 2014 Express included by default

Recommended Browsers: Chrome v57, Internet Explorer 11 or Firefox v53

Datasheet:

<https://www.whatsupgold.com/wp-content/uploads/2018/07/DS-WUG-Premium.pdf>

Website:

<https://www.whatsupgold.com/editions/>