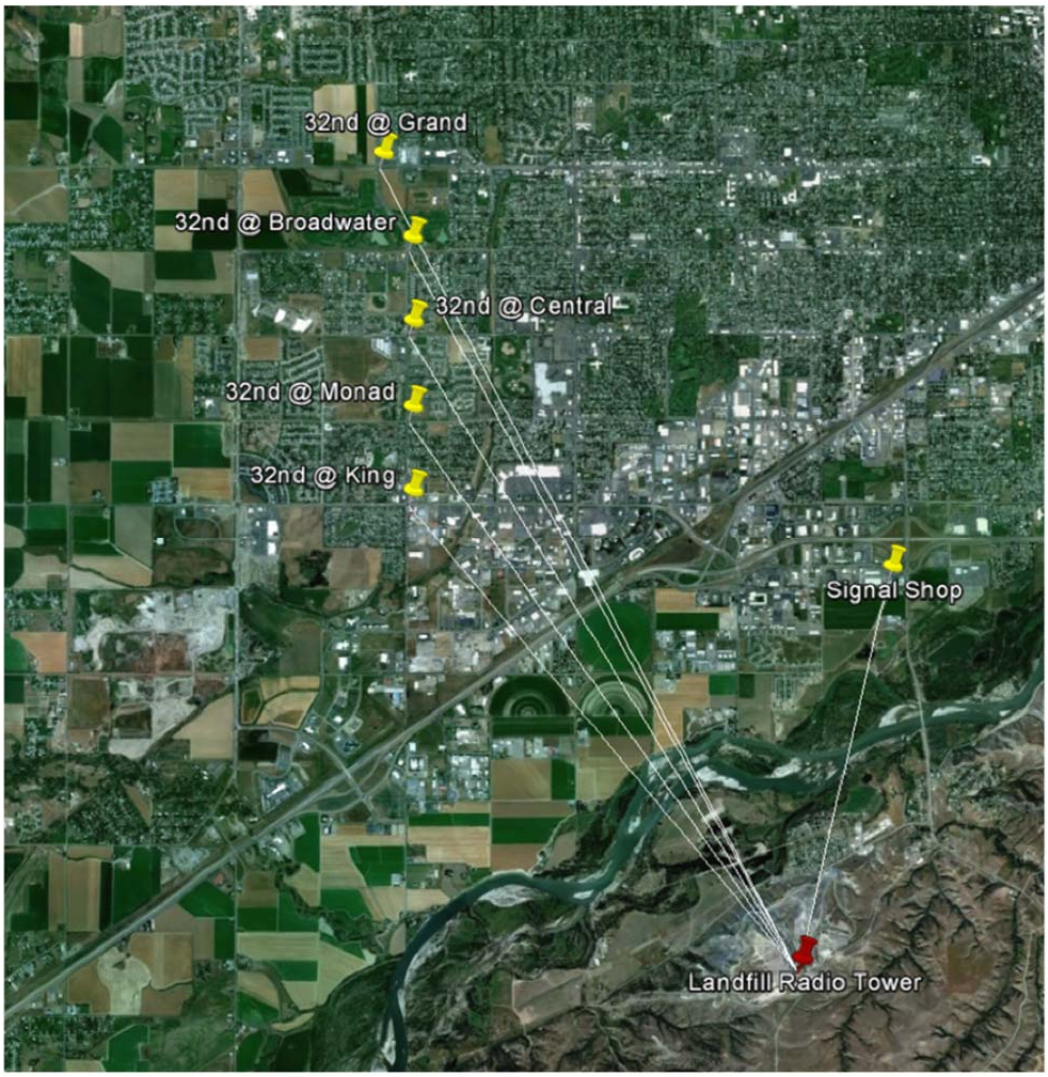
Response to City of Billings W.O. 13-09: City-Wide Traffic Signal Controller Upgrade







Intermountain Traffic LLC

May 15, 2013

Intermountain Traffic LLC

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May 15, 2013

Office of the City Engineer
ATTN: City-Wide Traffic Signal Controller Upgrade
2224 Montana Avenue
Billings, MT 59101

RE: W.O. 13-09 City-Wide Traffic Signal Controller Upgrade - Including Addendum No. 1

Dear Mr. Erin Claunch and Members of the Selection Committee:

Intermountain Traffic appreciates the opportunity to participate in this solicitation for the City of Billings. We are the exclusive dealer for Trafficware (the recently merged entity of Trafficware, Ltd. and Naztec, Inc.) in the state of Montana. Trafficware is the only traffic signal hardware engineering, manufacturing and software development firm that performs ***all*** activities in the United States. We proudly support jobs in America and take further pride in contributing to the recovery of our economy. In addition to our industry-leading technical expertise, our demonstrated commitment to "Made in America" clearly separates us from every competitor proposing on this project. We are hopeful the evaluation team considers this criterion, rebuilding America, in the proposal evaluation process.

We are excited to offer the City of Billings a turn-key solution utilizing Trafficware's fully-developed, commercial off-the-shelf, Advanced Traffic Management System Central Software, *ATMS.now* and ATC controllers. The following are the major items we are proposing to supply:

- ATMS.now Advanced Traffic Management System Software
- Dell Server – Can be either purchased directly or furnished by Intermountain Traffic, LLC
- 980 ATC NEMA TS2 Type 2 Controllers
- "D" Interface cables – ONLY if needed
- Mountain Secure Systems Ethernet Radios – Optional part of this RFP
- Integration, Installation, Training, Configuration & Verification

Intermountain Traffic has more than 100 years combined industry experience supplying and integrating Traffic Signal Devices such as Signal Cabinets/Controllers, Emergency Vehicle Preemptions Systems, Loop Detection Systems, Video Detection Systems, and Closed Circuit Television (CCTV) into Traffic Management System Software using a wide range of communications mediums and devices. Trafficware's hardware products (Naztec Engineered) have been refined and perfected based upon 33 years of experience in designing, engineering, and manufacturing all three levels of products that are critical to the success of the ATMS.

I certify that I am formally submitting this Proposal on behalf of Intermountain Traffic, LLC. I am Scott Meyerhoff, Project Manager and partner at Intermountain Traffic. I certify that we meet all requirements of this RFP. A review of our proposal will demonstrate our project team has the ***qualifications, experience, capacity and desire*** to successfully complete your system upgrade on time and within budget.

We are looking forward to being selected for further evaluation and discussion. If there are any questions or you require additional information, please do not hesitate to contact me directly via Email at smeyerhoff@intermountaintraffic.com, or cell phone at (775) 313-5854.

Sincerely,

Scott Meyerhoff
Project Manager

Intermountain Traffic, LLC

PROJECT IMPLEMENTATION PLAN

Existing Controller Upgrade on 32nd St West Corridor

Hardware

- Dell PowerEdge R710 Server with Rack Bundle
  - This can be furnished by Intermountain Traffic or by the City of Billings
  - Specification of Server Attached
- Windows based Client connected to server (City of Billing Supplied)
- Trafficware/Naztec 980 ATC Controllers
- Ethernet Radios
- Ethernet Switches

Communication

Trafficware has implemented Ethernet support in the ATMS.now as a "virtual serial port", so RS-232 and Ethernet hardware devices can be integrated into the system together. This communication system fully supports the NTCIP protocol.

Ethernet communication is the communication method for today and the foreseeable future and is our recommended communication method for the City of Billings. As we have discussed with the City of Billings Traffic departments and IT departments, this Ethernet communication network can be either a separate traffic network or be part of the existing IT department network. Ethernet communication can be accomplished using radios, fiber-optic, twisted pair or a combination of several mediums. As fiber-optic communication is currently unavailable on the 32nd Street phase, radio connectivity is recommended and included with our response.

For the initial phase of deployment using Ethernet radio communication, we propose to first establish a communication link with radios between the server location and the radio tower at the top of the City of Billings landfill. At the radio tower, a dual radio will be installed to establish communication to the radio at the TMC and the first five locations identified on 32nd Street. Radios installed at each of the five intersections and the TMC will have line of site links to the radios at the landfill tower. We are confident in this communication network at the City of Billings **as we have proven it with our ATMS.now and radio demonstration using this existing radio tower at the landfill.**

Deployment

Intermountain Traffic proposes a controlled system upgrade approach that reduces the complication and disturbance to the public. This is accomplished by proper planning on our part with review and sign off by the City of Billings.

Deployment Preparation and Radio Installation

- City of Billings furnishes GIS Arcview files to Intermountain Traffic to be loaded on supplied configured server
- Intermountain schedules training dates compatible with City of Billings staff after delivery of the server
- Intermountain conducts Field Evaluations
- Surveys for Radios – and access to City of Billings Network
- City of Billings installs Ethernet radios furnished by Intermountain Traffic, LLC who will be on hand to provide technical assistance

Integration week with Training

- Prior to training week, the ATMS.now Comm configured Server and Administrator programs delivered. It will come pre-installed with City of Billings supplied GIS files
- ATMS.now Central System Server installed at City of Billings
- Install software & verify connectivity on City of Billings furnished workstations/laptops
- One week of training will be conducted by Al Bonificio from Trafficware per the training outline described in this response. Our experience shows training prior to the implementation is beneficial so that Billings personnel and our personnel make informed decisions together about the implementation process. The 5 controllers will ultimately be deployed in the field so we utilize them in the training. The controllers will leave the classroom programmed, verified, and ready for intersection deployment

Upgrading of Existing Controllers

- Create controller database template specific for the City of Billings
- Transfer signal timing data into five new controllers
- Verify controller programming
- Intermountain and City of Billings installs five new controllers into existing cabinets
- Verify functionality of controller itself as well as coordination, preemption, etc.
- Verify functionality of ATMS.now system server, clients and communication to controllers
- Intersection Graphics for 5 intersections on GIS interface are created

Complete System Upgrade

After phase one, Intermountain Traffic, LLC will continue to provide controller and ATMS training. A stepped method of deployment and continual training mixes field experience and classroom training to create a thorough learning process.

The second part of the plan is to upgrade the remainder of the controllers in the City of Billings. After initial training and deployment, typically, most of our customers take on the responsibility of converting the controller databases, adding additional communication links, and controller replacements with their own staff. With ATMS.now, installing additional controllers is quick, seamless and user intuitive. Intermountain Traffic, LLC currently makes frequent visits to the City of Billings. During these visits, we will assist the City of Billings with any implementation issues at no charge to the City.

Support and Maintenance

For the City of Billings, Intermountain Traffic is the point of contact for support and maintenance for all Trafficware products. Intermountain Traffic will perform all maintenance and support services in a professional manner, consistent with industry standards. Any software upgrades or required modifications will be provided to the City of Billings at no extra cost for the life of the system, which we assume is 10 years.

Intermountain Traffic office hours are Monday through Friday, 8:00 AM to 5:00 PM Mountain Time. We provide full maintenance and support twenty-four (24) hours per day, seven (7) days per week. Intermountain Traffic will provide technical support via multiple avenues:

- **On-site support:** Intermountain Traffic will make every effort to provide **same or next day on-site support, as needed**.
- **Telephone support**: Intermountain Traffic will provide unlimited phone support.

- **Text messaging**: Intermountain Traffic will provide unlimited text messaging support.
- **VPN support:** Intermountain Traffic will provide unlimited support through VPN access.
- **Personal Visits:** On-site training continues as we cultivate our goal of ***total customer satisfaction***.
- **Quarterly visits**

Software Operating System and Networking

ATMS.now will be installed on Windows Server 2008 supported by SQL Server communicating to the field via Ethernet and/or serial communications.

Warranty Statement

Naztec, Inc. (dba "Trafficware") warrants that all products manufactured by the company will be shipped from its place of manufacture in merchantable quality, and that it will, at the company's option, either replace or repair such products found to be defective in materials or workmanship within 18 months from the date of shipment, unless expressly quoted otherwise. Damages or defects incurred after the product has left the company, or while in transit to the customer, are not encompassed by the warranty. All company warranties are expressly conditional based on proper installation, operation, and maintenance by the purchaser.

Integration with Future Traffic Management Center

If Traffic Management Center integration is needed, there are several ways to accomplish this of which the first would be to install a network connection to the City of Billings ATMS.now server and add a Traffic Management Center client. Naztec/Trafficware also has a variety of C2C (center to center) success implementations across the country. We are confident we can meet C2C connectivity requirements of the City of Billings as well as other agencies when defined.

TRAINING PLAN

The City of Billings can expect comprehensive training on controllers and system software as proposed in this RFP by both Trafficware and Intermountain Traffic personnel. This training will address the needs of Traffic Engineering, System Operators, Traffic Signal Technicians and IT Personnel. We will provide an outline which will be helpful for City staff to determine whether or not they want to attend portions of the training that pertains to their role. For instance, the IT department does not benefit from attending coordination training. The training will be conducted during a week long course and is unlimited to the number of attendees from the City of Billings.

Training Courses

There are two primary "hands on" training courses that will be covered during training week, Trafficware ATMS.now and Trafficware Controller.

Trafficware ATMS.now

This course will go over the ATMS.now and upon completion, students can expect to be able to navigate ATMS.now, setup Intersections and upload and download to controllers.

Course Outline:

I. Introduction and General Overview: Goals and Objectives of Training Session

II. ATMS.now – System Architecture and Components

- System Architecture
- System Components

III. ATMS.now – Overview

- Starting ATMS.now
- ATMS.now layout
- Pane layout
- ATMS.now Views
- ATMS.now Modules

IV. ATMS.now - Intersection Setup

- Define a Controller
- View a Controller
- Edit a Controller
- Copy/Paste by row, columns, table, or entire database
- Using filters and tab folders
- Controller Online/Offline

V. ATMS.now – Database Management

- Database File System
- Database Upload
- Saving Upload file to Standard and Permanent
- Database Download
- Download with Verify
- Download No Verify
- Database Compare
- ATMS Partner Synchronization

Trafficware Controller

This course will take approximately 2 days and cover controller programming, coordination and preemption.

TRAINING PLAN

Course Outline:

I. General Overview of Training Course

II. Overview of Controller Operational Features

- Naztec Controller Platform Types
- Major Controller Highlights

III. Interface & Navigation

- Controller Menu Simulator
- Front Panel Connectors
- Navigating the Keyboard & Menus
- Controller Unit Electronics

IV. Database Initialization

- Run Timer
- Overview of the process of initializing controller database

V. Controller Operation

- Pre-timed Mode
- Semi-Actuated Mode
- Full-Actuated Mode
- Rings, Sequences & Concurrency
- Phase Times - Definitions & Illustrations
- Phase Options - Definitions & Illustrations
- Utility to Copy Phases and Timing

VI. Detection

- Vehicle Parameters/Illustrations
- Pedestrian Parameters/Illustrations
- Detector Configuration
- Detector Delays and Extensions
- Detector Calling and Sourcing
- Detector Status Screen, Definition and Interpretation of Terms
- Detector Diagnostics—Interpretation of Fault Messages and How to Correct

VII. Channel Outputs and Mapping

- Channel Types
- Channel Flash Parameters
- Channel I/O Parameters
- MMU Permissive
- Misc Channel programming
- SDLC Device programming
- Clearing Critical SDLC Faults
- SDLC Status Display

VIII. Unit Parameters and Ring Sequences

- Unit Parameters
- Ring Sequence

IX. Time-Base Scheduling

- NTCIP Time of Day Scheduler
- Theory of Operation

- Programming Time/Date
- Advanced Scheduler
- Easy Scheduler
- Day Plan Table
- Action Table
- Time Base Parameters
- Time Base Status
- Special Function Programming

X. Coordination

- Theory of Coordination
- Type of Coordination
- NTCIP Coordination
- Coordination Modes
- Coordination Mode Source Hierarchy
- Pattern Definitions
- Split Definitions
- Transition
- Coordination Status Display
- Coordination Diagnostics and Faults

XI. Hands-On Exercise

- Programming a Controller – Example Problem and Data Entry

XII. Preemption

- Theory & Definition
- Operation
- Preemption Times
- Preemption Phases
- Options
- Functions & Features
- Parameters
- Low Priorities

SUPPLIER BACKGROUND & EXPERIENCE

BACKROUND

Intermountain Traffic, LLC

Intermountain Traffic LLC

P.O. Box 11159
Reno, NV 89510-1159
Tel: 866.677.7828
Fax: 970.776.1697

Tax ID: 51-0578730

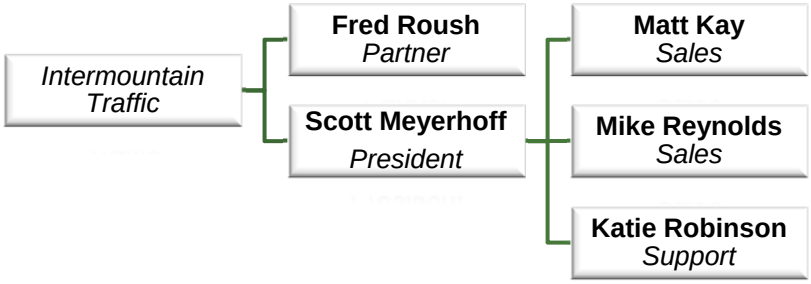
Founded by Scott Meyerhoff and Fred Roush in 2006, Intermountain Traffic boasts over 100 years of combined industry experience in Advanced Traffic Management Systems, Actuated Traffic Signal Controllers, Video and Loop Detection, Emergency Vehicle Preemption, CCTV Systems, Pedestrian Safety and Traffic control equipment. This expertise enables us to do our own system integration and offer multifaceted traffic solutions to our clients. Intermountain has experience interfacing with end-users in all aspects of traffic control products from design consultation, field installation, system implementation and software and maintenance training.

The technical expertise of our staff is the backbone of our success. Our philosophy is to create and maintain very close working relationships with our customers, cultivating our goal of total customer satisfaction by providing unparalleled customer service and support.

As the exclusive authorized distributor for Trafficware in six (6) states, including Montana, Intermountain Traffic has successfully implemented and maintains multiple ATMS.now systems communicating with thousands of devices.

Dedicated to the traffic signal system business in our territory, Intermountain Traffic opened a second office in Colorado in 2011. To further enhance customer support, a test lab was built to simulate any questions our customers may have. This lab includes a fully functioning ATMS.now system, controllers (2070, NEMA, TS2 and ATC), cabinets, etc. As a system integrator, this lab is essential for us to support and train our customers. Our staff even has 24/7 VPN access to the ATMS.now system.

As a distributor, we are a vital link in the traffic industry, bringing tangible benefits to both the manufacturers and end-users of ATMS products. **What sets us apart is we will provide the City of Billings deployment expertise and provide long term supply and technical support for your system.**



Trafficware, Inc

Trafficware
Engineered by Naztec

522 Gillingham Drive
Sugar Land, TX 77478
Tel: 281.240.7233
Fax: 281.240.7238
www.trafficware.com

Trafficware is an engineering and manufacturing firm providing ATMS systems and components meeting the needs of transportation agencies in North and South America. Since 1979, the company has been providing high-quality electronic product development services to engineering firms. Trafficware currently employs engineering, research and development, and manufacturing staff at the Sugar Land plant located in Southwest Houston. With over 90,000 square feet of combined manufacturing and engineering office space, the headquarters location has sufficient resources to handle numerous high technology projects. All of Trafficware's hardware products are designed, manufactured, tested, and shipped from this facility. Furthermore, their extensive suite of software solutions, including Synchro, SimTraffic, and SynchroGreen, are developed in house by an elite team of traffic engineers.

PROJECT TEAM

Intermountain Traffic's Scott Meyerhoff will act as the responsible party, your go-to person to answer all your questions and respond to all your needs. He will ensure his team coordinates, integrates and implements a successful system deployment, while verifying reliable and predictable results.

Our Project Manager Scott Meyerhoff, Deputy Project Manager Katie Robinson, and other Intermountain Traffic personnel will work closely with City staff to implement the upgrade and direct the project to completion.

The primary business success and focus of both Intermountain Traffic and Trafficware is our integration, deployment, and support of our ITS and ATMS systems. Because this is our core focus, we have the experienced and knowledgeable staff for effective and efficient project management.

The core contributors of this project each have 30 years of experience developing and deploying over 200 ATMS systems. This is of value to the City of Billings as we will quickly integrate and deploy this system. This organization of people will effectively work to establish the requirements of the City's ITS and ATMS systems and successfully put these plans in place, setting a clear path for Billings signal system upgrade.

Our staff has the expertise to easily identify challenges and effectively find solutions based on many lessons learned from previous implementations. Our staff also has the expertise to integrate at all levels of your ATMS, and all have experience installing controllers in environments similar to that of Billings

PROJECT ROLES & RESPONSIBILITIES

Intermountain Traffic

Intermountain Traffic will be responsible for project management and integration.

- **Scott Meyerhoff:** Scott's technical background is the backbone of his success in the traffic signal industry. Scott has installed numerous controllers, cabinets, closed loop systems and central systems throughout the world. Scott has instructed many classes on controllers, cabinets and systems training to technical staff and engineering staff on design, setup and programming.

  With over 33 years of experience in the traffic signal industry, Scott started his career as an end-user. While working for distributors and manufacturers, he interfaced with end-users in all aspects of traffic control products from design consultation, field installation, system implementation and software/maintenance training. This experience added to his knowledge of the working needs of the everyday user of system software and products. Scott brings experience in systems, detection, preemption and traffic control equipment, as well as production, operations, distribution management, sales, marketing, customer relations and support expertise. Scott has worked closely with Ada County, Reno, Loveland and Douglas County who are all listed in our references.

- **Katie Robinson:** Katie will provide extensive networking and project management experience. She will be responsible for equipment procurement, project scheduling and server/client installation. With 12 years of system administration and project management experience, Katie will be a valuable asset in managing this project from start to finish.

  Not only has Katie worked alongside Scott in the implementations of Loveland and Douglas County, but has also supported Ada County and Reno throughout her employment at Intermountain Traffic.

- **Mike Reynolds:** Mike will facilitate Technical Support supporting both Katie and Scott from Intermountain Traffic.

SUPPLIER BACKGROUND & EXPERIENCE

Trafficware

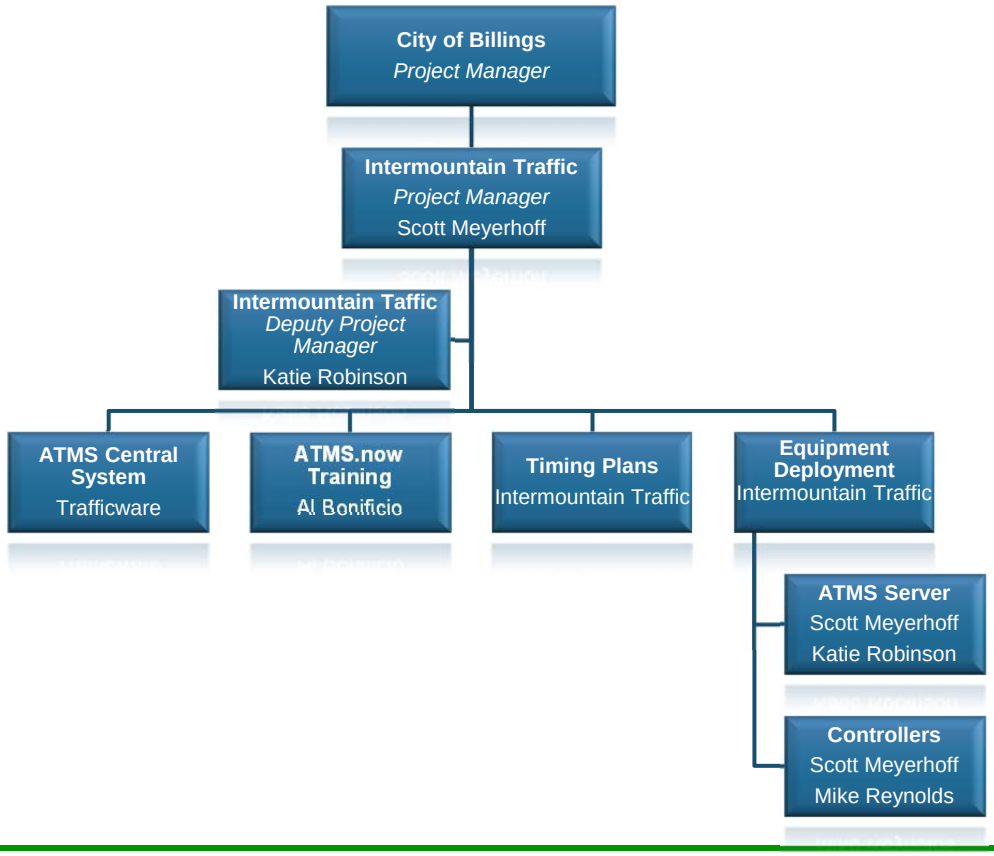
Trafficware will be responsible for supplying the ATMS.now software, server configuration, and ATMS.now training. Available to Intermountain Traffic and the City of Billings is a number of staff at Trafficware; however we are highlighting Al Bonificio.

- **Al Bonificio**: Al has been assigned as Project Manager from Trafficware for this ATMS.now deployment. Al brings over 30 years of progressive experience in system design, development, integration, and management experience to this assignment. He has gained extensive knowledge and experience through training field personnel in traffic control, signal coordination, and field troubleshooting for various agencies throughout the US and Canada. For 10 years, he supervised the NYSDOT Traffic Signal Laboratory, the central acceptance, repair, and design facility for New York's State's Traffic Operations hardware and software, which includes over 6,000 intersections. As a result, Mr. Bonificio has represented New York State as an AASHTO representative for the Advanced Transportation Controller (ATC) on the Joint AASHTO/ITE/NEMA National Committee. Here he also served as a member of the ATC Controller Working Group and as an AASHTO Representative on the NTCIP Profiles Standards Committee.

  As Trafficware's project manager on the Intermountain Traffic team, Al will be an integral part of the server installation and configuration, and he will as conduct the ATMS.now training. Supporting Al is team of staff at Trafficware to ensure this ATMS.now deployment is a smooth transition for the City of Billings.

MANAGEMENT APPROACH

At Intermountain Traffic, support is our number one priority for all of our customers. Our customer service



philosophy is exceeding expectations before, during and after the sale. What does great customer service look like? For us, it's all about the customer experience and the success of their project whether it be a small pedestrian project or a large system upgrade. Our efforts are **always** rewarded with customer loyalty.

Being a distributor, we have to be well versed in many technologies that are constantly evolving. We don't manufacture and offer one product line, instead we are experts in many product lines. In addition to deploying different types of systems, we are continually being provided with factory training in different technologies from each respective supplier. We learn the competitions features and benefits, in addition to our own, and keep a pulse on our ever changing industry with pinpoint accuracy.

Furthermore, having the right person for the different aspects of a project is where Intermountain excels. We have the right person for every aspect of this job. Katie Robinson has a degree in IT and is our systems expert. Katie can handle all aspects related to networking and proliferation of IT Devices over a network. Scott Meyerhoff began as a signal technician and has been in the signal industry for over 30 years. He is well versed in systems, cabinets, controllers and virtually every aspect of what goes on inside the signal cabinet and at the intersection. Mike Reynolds prides himself on excellent customer follow up and service. He excels at being available and coordinating service and processing requests. A good team needs an expert at every position and Intermountain strongly believes having the right personnel for each aspect of this job is crucial to a successful system deployment in Billings.

REFERENCES

Five ATMS.now references are listed below, four of which are references of both Intermountain Traffic and Trafficware. Palm Beach County is one of Trafficware's largest system deployments.

Ada County Highway Department, Idaho - *Largest Idaho Deployment*

ACHD
Committed to Service

Jim Larson, Congestion Management Supervisor
Ada County Highway Department
3775 Adams Street
Garden City, ID 83714
Tel: 208.387.6196
Fax: 209.387.6219
jlarsen@achdidaho.org

Originally deployed with serial communications, Ada County upgraded their Streetwise system in 2008 to Ethernet based ATMS.now. Ada County has over 400 TS2 Type 1 controllers on line and is in the process of implementing Transit Signal Priority and Adaptive.

Reno, Nevada - *Recent Intermountain Traffic Deployment*

BIGGEST LITTLE CITY IN THE WORLD
CITY OF RENO

Steve Bunnell, Traffic Engineer
City of Reno
1 East 1st Street, 9th Floor
Reno, Nevada 89501
Tel: 775.334.2333
Fax: 775.334.1226 bunnell@ci.reno.nv.us

SUPPLIER BACKGROUND & EXPERIENCE

In April 2007, Intermountain Traffic supplied and integrated ATMS.now in the City of Reno. With the new system in place and Naztec TS2 Type 2 NEMA Controllers, the City upgraded their serial communications to Ethernet, and now uploads complete databases for approximately 200 online controllers in less than a minute.

Loveland, Colorado - *Recent Intermountain Traffic Deployment*

Bill Hange, *Traffic Engineer*
City of Loveland
105 West 5th Street
Loveland, CO 80537
Tel: 970.962.2528
Fax: 970.962.2907
hangeb@ci.loveland.co.us

In February 2010, the City of Loveland chose Intermountain Traffic to supply and integrate ATMS.now with Naztec 970 controllers for their signal system upgrade.

During 2010, ATMS.now and the first set of controllers were deployed. Over the next few years, the city continued their upgrade and currently has over 60 controllers on-line.

Douglas County, Colorado - *Recent Intermountain Traffic Deployment*

Mark Zink, *Signal Supervisor*
Douglas County Government
100 Third Street
Castle Rock, CO 80104
Tel: 303.663.6167
Fax: 303.663.2063
mzink@douglas.co.us

In early 2011, Intermountain Traffic's customer Douglas County, Colorado began their upgrade to ATMS.now. Currently, the Douglas County system not only manages over 140 2070 controllers, but also their emergency vehicle preemption.

Palm Beach County, Florida - *Established ATMS.now installation*

Giri Jeedigunta,Signal Systems Manager
Palm Beach County
2300 N. Jog Rd - 3rd Floor East
West Palm Beach, FL 33411
Tel: 561.684.4168
Fax: 561.478.5770
GJeedigu@pbcgov.org

Trafficware's ATMS.now controls 1,200+ signalized intersections using Naztec controllers, 15,000 devices over Ethernet via two separate command centers, and VPN remote access for 36 of the 38 Municipalities.

COST PROPOSAL

Qty	Item	Price Each	Total Price
REQUIRED ITEMS:			
1	Trafficware ATMs.now Professional Software License * Does NOT include Server Hardware	-	$ 30,000
5	980 ATC TS2 Type 2 Local Controller	$ 2,900	$ 14,500
1	Factory Training - 5 Days	-	$ 12,500
5	Database Conversion/configuration	INCLUDED	
5	Intersection Graphics	INCLUDED	
	Integration Services	INCLUDED	
	On-Site Installation & Configuration	INCLUDED	
	Detection Monitoring	INCLUDED	
	Alarm Logging & Configuration	INCLUDED	
	Signal Timing Split Monitoring	INCLUDED	
	Verification	INCLUDED	
TOTAL			**$ 57,000**
OPTIONAL ITEMS:			
1	Dell R710 Server	$ 8,000	$ 8,000
1	Dell Server Rack	$ 2,000	$ 2,000
1	Sixnet EL228-AA-1 Switch for Server - 28 ports, 4 Gb + 6 10/100MB ports populated, managed *The above 3 items can be purchased separately, however they are required for system functionality	$ 2,435	$ 2,435
5	Sixnet SLX-5ES-1 Switch, 5 ports; unmanaged *One per Traffic Signal Cabinet	$ 275	$ 1,375
6	Ethernet Radio, Single, 5.8Ghz *One per Traffic Signal Cabinet and Signal Shop	$ 1,320	$ 7,920
1	Dual Ethernet Radio *Landfill	$ 1,575	$ 1,575
7	200' PoE Cable	$ 175	$ 1,225
6	PoE Power Supply, for Single Radio	$ 40	$ 240
1	PoE Power Supply, for Dual Radio	$ 60	$ 60
5	"D" Interface Cable	$ 150	$ 750
TOTAL			**$ 25,580**
GRAND TOTAL			**$ 82,580**

Pricing for controllers listed on the cost sheet of this response shall remain unchanged through May 15th, 2015 (a period of two years). Additional controllers can be purchased at the same price as listed on our cost proposal for this two year period.

The CPI (Consumer Price Index) is designed to protect the consumer from being forced to pay unreasonable price increases. Escalation agreements often use the CPI—the most widely used measure of price change—to adjust payments for changes in prices. Intermountain Traffic assures the City of Billings that after May 15th, 2015, if applicable, price increases on controllers will not exceed the CPI index.

We would like to reference the City of Loveland, Colorado, who implemented a Trafficware system in April, 2010. Loveland has yet to experience a price increase in over 3 years.

Intermountain Traffic understands it may take several years to complete the upgrade beyond May 15th 2015. We agree to not increase the cost of controllers beyond the Consumer Price Index.

CONTROLLER SPECIFICATIONS

TABLE OF CONTENTS

Model 980 ATC Traffic Controller with Ethernet & USB

Traffic Responsive Master/Secondary

The Series 900 ATC Traffic Signal Controller is designed using state of the art electronics for reliability, long life, and superb performance in all signal control applications.

Design of the Series 900 ATC Controller is based on the ATC and NEMA TS2 standards and includes advanced functionality for complex phasing, detector processing, coordination, preemption, communications, adaptive timing, and systems operation as a master or a secondary controller.

The advanced LCD display and menu driven software provide a user-friendly approach to programming and access. Built-in diagnostics permit rapid evaluation of operational status. The on-board Flash File System allows software upgrades without PROM replacements. The front panel mounted USB port facilitates the upgrade process and file access with ease. The Ethernet-enabled controller allows communication across a TCP/IP network.

Distributed by: Intermountain Traffic, LLC
PO Box 11159
Reno, NV 89510-1159
info@intermountaintraffic.com

Toll Free: 866.677.7828
Fax: 970.776.1697

Naztec, Inc.
ATMS Solutions

Model 980 ATC Traffic Controller with Ethernet & USB

FEATURES

FLASH FILE SYSTEM	**The Series 900 Controller is easily configured to various firmware versions by the utilization of Flash File System which eliminates the need for obsolete EPROM technology. A complete traffic controller firmware update requires only seconds. No hardware changes or EPROM replacements are required.**
MASTER/SECONDARY	**Operation in a Closed Loop System requires only one Series 900 Controller to be located at the master cabinet. Both the master and secondary functions are simultaneously provided by a single controller.**
DISPLAY	**A back-lighted 8-line by 40-character LCD display provides full menu screens for ease of data entry. Optimum contrast and brightness are automatically maintained by temperature-compensating circuitry. The menu-driven format and context sensitive help screens eliminate the need for special codes or front panel identification characters.**
EASILY SERVICED	**The modular design of the Series 900 Controller allows quick sub-assembly level problem isolation. Printed circuit board components are clearly labeled with silkscreen. No special tools or extender cards are needed for troubleshooting**
REAL-TIME CLOCK	**The real-time clock maintains accurate timing by utilizing a "super capacitor" and crystal controlled circuitry which allows accuracy of 0.005%.**
BARRIERS	**Unique to the Naztec traffic controller product line is the flexibility of user programmable barriers. Four (4) separate barriers allow programming for applications from one (1) to eight (8) phases in each barrier.**
KEYBOARD	**A custom 23-key keypad containing 4 red function keys, 10 white numeric keys, 7 cursor and menu navigation keys, and 2 LCD contrast adjustment keys. Each key has a tactile feedback built-in to provide user-friendly enhanced data entry.**
DIAGNOSTICS	**Built-in diagnostics provide for improved maintenance and easier repairs. It allows operator tests on all input and output signals, RAM devices, memory, LCD, keypad, etc.**
COMMUNICATIONS	**Four EIA-232 ports are available. These ports are keyboard programmable with selectable baud rates up to 115K with full and half duplex options. Various communication configurations allow the user multiple interfaces to other cabinet devices: conflict monitor, preemption equipment, detectors, WWV clocks, modems, notebooks, printers, etc.**
ETHERNET	**10/100 Mbps port with LED indicators. TCP/IP supported.**
USB	**Ordinary USB memory devices can be inserted into the port for software upgrades, configurations, and file retrievals.**

Voltage:	89 to 135 VAC
Frequency:	60 +/- 3 Hz
Temperature:	-30^0 to 165^0 F
Humidity:	5 to 95 percent
Dimensions:	Height: 10.50"
	Width: 14.75"
	Depth: 8.38"

Intermountain Traffic LLC

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SPECIFICATION FOR ATC CLASS CONTROLLER (980 ATC)

Hardware Requirements

1. Shall be compliant with NEMA Standard TS2-2003.
2. Shall incorporate an "Engine Board" as the main processing element that shall be compliant with the hardware requirements of the ATC Standard, version 5.2b.
3. The Engine Board processor shall be a Freescale PowerQUICC processor of the 82xx or 83xx families.
4. The Engine Board processor shall be rated at 500 MIPs minimum at the CPU clock rate used. The main memory (DRAM) shall be zero-wait-state and full-bus-width.
5. The Engine Board shall have a minimum of 64MB DRAM.
6. The Engine Board shall have a minimum of 128MB Flash Memory storage.
7. The Engine Board shall include and use the Linux operating system
8. All serial communication ports shall be integral to the controller. ATC/2070 Communication slots shall not be utilized or provided.
    a. NEMA TS2 serial ports P1 and P2 shall be provided.
    b. NEMA TS2 serial port P3 shall be supported. An asynchronous FSK modem shall be available as an option that is internal to the controller chassis. The FSK modem option(s) shall support up to 9600 baud. The FSK modem shall be hardware-configurable to be attached to serial ports SP1 and SP2 of the Engine Board.
    c. An EIA-232 connector shall be available for serial port P3 in lieu of the FSK option. If the FSK modem is installed, the EIA232 connection may still be used. The controller shall sense when an appropriately wired cable is attached to the EIA232 connector and automatically disable the internal FSK modem.
    d. Two additional EIA232 ports shall be provided for interfacing to other devices. These shall be routed to SP2 and SP8 of the Engine Board.
9. The controller shall provide a 10/100 Ethernet port with status indicators for Link/Activity and 10/100 speed. The LED indicators shall be water-clear and high-brightness with a minimum luminosity of 90mcd for visibility in high-ambient-light conditions.
10. The controller shall provide a USB port for Memory Storage Device support per the ATC v5.2b standard. It shall support USB 2.0 Full-Speed operation.
11. The display shall be an LCD type and shall provide a minimum of 8 lines by 40 characters. It shall incorporate a backlight.
12. The display contrast shall be temperature-compensated and adjustable by use of two dedicated keypad keys. One key shall lighten the contrast, the other shall darken it.
13. The keypad shall provide, inherently, both tactile and audible feedback ("click") when keys are pressed. Spacing between key centers shall be 0.6 inch minimum for operation keys and 0.5 inch minimum for contrast adjust keys. Membrane style keypads shall not be provided.
14. Both NEMA TS2-1 and TS2-2 configurations shall be available.
15. For the NEMA TS2-2 configuration, the "D" connector shall be a 57 pin circular connector that mates with AMP (Tyco) part number 206437-1.

Naztec Inc.

Submittal

For

Apogee Actuated Signal Controller Software

These specifications describe the features of Apogee software and the functional requirements of a 2070N Actuated Signal Controller running Apogee software.

Table of Contents

Scope

This specification sets forth the minimum requirements for a sixteen-phase full-actuated traffic signal controller unit with internal Time-Based-Coordination (TBC), railroad/fire/transit emergency vehicle preemption, and closed loop secondary operation. The traffic signal controller unit shall fully comply with the latest publicized draft for NTCIP Object Definitions for Actuated Signal Controllers. Prior to acceptance of the proposed controller, the vendor shall demonstrate full NTCIP compliance for the Object Definitions using independent 3rd party NTCIP Device Testing Software at the contractor's expense.

All 2070 and NEMA TS-2 actuated traffic controller units provided shall meet or exceed the latest draft requirement for the following National Transportation Communications for ITS Protocol (NTCIP):

- NTCIP 1101 (formerly TS 3.2)—Simple Transportation Management Framework (STMF).
- NTCIP 1201 (formerly TS 3.4)—Global Object Definitions.
- NTCIP 1202 (formerly TS 3.5)—Objects for Actuated Traffic Signal Controllers.
- NTCIP 2001 (formerly TS 3.3)—Class B Profile

Interpretation and definition of compliance to this specification shall be at the sole discretion of the City of Avondale.

2070L CONTROLLER SPECIFICATIONS

The controller shall be the "lite" version Model 2070L (Caltrans Rack Mount type) ATC traffic controller per California Department of Transportation's (Caltrans) specification, and shall conform to the Transportation Electrical Equipment Specifications (TEES) dated November 2002 or later. http://www.dot.ca.gov/hq/esc/ttsb/electrical/TEES.pdf

The controller shall be equipped with the following modules:

2070-1B	CPU with Ethernet Port
2070-2A	I/O Module for 332 cabinets
2070-3B	8x40 Line Display
2070-4B	Power Supply
2070-7A	Dual Serial Port Card

- **2070-1B**

  The 2070-1B shall be equipped with an Ethernet port. The controller software operating on the 2070-1B shall be capable of utilizing the Ethernet port for data transfers. The operating system shall allow the user FTP and Telnet access via the Ethernet port.

- **2070-7A**

  The 2070-7A shall conform to the latest TEES specification. The 2070-7A shall be optically isolated and capable of asynchronous serial communication for ports C215 and C225. On-board jumpers shall be provided to allow either DCE or DTE operation for each port.

- **2070-4B**

  Power supply must have high-side and low-side monitoring on all DC output voltages

- **EEPROM Socket**

  An EEPROM socket must be available to reload a unit to factory defaults

- **Operating System**

The 2070 controller shall operate on the 2070-1B using Microware OS9 v3.2 or higher. The operating system shall be field proven (not less than 150 intersections) while communicating using Ethernet. The controller shall operate trouble free in an IP storm environment. Upon request the controller manufacturer shall provide references to substantiate proficient operation in the aforementioned environment. It shall be the controller hardware manufacturers' responsibility to remedy any performance issues relating to compatibility between the operating system, any related hardware drivers, and the intersection control software.

- **Testing**

  Prior to delivery, each controller assembly shall be configured and tested by the supplier. The controller shall be "plug and play" ready for the City's existing 332 cabinets.

- **Installation and Training**

  A factory certified representative for the manufacturer shall be on-site during signal turn-on for support.

  A factory certified representative for the manufacturer shall be on-site for installation and support on the intersection control software.

  The supplier shall provide a maximum of four hour of technical training for City staff within four weeks after controller delivery.
  The Actuated Signal Controller manufacturer must be a registered Cisco Partner with experience exceeding 150 intersections of Cisco series 2955 equipment and 12 intersection of 3200 series wireless equipment. The Actuated Signal Controller supplier must also be located in the Phoenix metropolitan area and also be a registered Cisco partner.

- **Warranty**

  The controller assembly shall be warranted by the manufacturer against mechanical and electrical defects for a period of 1 year.

  The supplier shall correct any defects in design, workmanship or material during the warranty period at no cost to the City. All cost of labor, parts and transportation shall be borne by the supplier for the duration of the warranty period.

  The vendor shall provide all revisions to any equipment furnished under these specifications, at no cost to the City.

Functional Requirements for Free Operation

Phase Timing

NTCIP Requirements for Phase Timing

The following NTCIP objects related to phase timing are mandatory requirements under this specification and shall be demonstrated by using an independent 3rd party software. The definition and range of each parameter (minimum and maximum value) are specified under the NTCIP specifications.

1) Minimum Green
2) Gap, Extension (or Passage Time)
3) Maximum 1
4) Maximum 2
5) Yellow Clearance
6) Red Clearance
7) Walk

8) Ped Clearance
9) Red Revert Time (programmable on a per phase basis)
10) Added Initial
11) Max Initial
12) Time Before Gap Reduction (TBR)
13) Cars Before Gap Reduction (CBR)
14) Time to Reduce (TTR)
15) Reduce By (optional gap reduction method to TTR)
16) Minimum Gap
17) Dynamic Max Limit – this parameter serves as an upper limit to the current maximum setting (Max 1 or Max 2)
18) Dynamic Max Step - the dynamic max may grow or shrink by the dynamic max step value programmed for each phase

Additional Requirements for Phase Timing

The following additional functions related to phase timing are mandatory requirements under this specification:

1) Ped Delay – this phase feature shall delay the pedestrian WALK interval by a programmable amount (0-99 seconds) after the vehicle Min Green interval begins timing
2) Green Delay– this phase feature shall delay the vehicle Min Green interval by a programmable amount (0-99 seconds) after the pedestrian WALK interval begins timing
3) Omit Yellow Display – this phase feature shall omit the yellow display output when a specified phase is timing yellow clearance
4) Redirect Pedestrian Outputs – this phase feature shall allow the pedestrian outputs of a phase to be redirected to another phase
5) Start Yellow, Next Phase – this phase feature shall control the next phases serviced after the controller start-up sequence returns to the yellow interval of the specified startup phases
6) Bicycle Clearance Time – this feature holds the programmed phase in Red until the Bike Clearance time expires.
7) Alternate Phase Timing

   A minimum of five (5) additional complete and separate Alternate Phase Timing tables shall be provided to vary phase time parameters by time-of-day. This time-of-day operation shall be accomplished by associating the table with a pattern as described in Section 6. The minimum number of Alternate Phase Time parameters varied per table shall include:

   Minimum Green

   Gap, Extension (or Passage Time)

   Maximum 1

   Maximum 2

   Yellow Clearance

   Red Clearance

   WALK

   Ped Clearance

Bike Clearance

Phase Options

NTCIP Requirements for Phase Options

The following NTCIP objects related to phase options are mandatory requirements under this specification. The definition and range of each parameter (minimum and maximum value) defined in this Section, 3.2.1, are also specified under NTCIP.

1) Enable Phase (a phase that is not enabled is omitted)
2) Min Recall
3) Max Recall
4) Ped Recall
5) Soft Recall – a recall is placed on a phase only when a true detector call exists
6) Detector Lock Calls (also called "memory on")
7) Auto Flash Entry Phases
8) Auto Flash Exit Phases
9) Dual Entry Phases
10) Enable Simultaneous Gap-out
11) Guaranteed Passage Time
12) Rest-in-Walk
13) Non-Actuated Ring 1
14) Non-Actuated Ring 2
15) Added Initial Calculation - this phase option shall allow added initial to be summed for all detector inputs calling the phase or to be calculated using the greatest number of actuations of each detector calling the phase.

Additional Requirements for Phase Options

The following additional functions related to phase options are mandatory requirements under this specification:

1) Phase Reservice – this phase option shall allow a phase to be conditionally reserviced after the phase has left to conditionally service another phase.
2) Pedestrian Clearance Through Yellow - this phase option shall allow the end of pedestrian clearance to time with the yellow clearance interval.
3) Skip Red if No Call During Yellow Clearance – this phase option shall allow all-red clearance to be skipped if no vehicle calls are issued to the phase during the yellow clearance interval.
4) Red Rest – this phase option shall enable red rest for individual phases on a phase by phase basis
5) Max II – this phase option shall allow Max II to be enabled on specified phases when Max I timing is in effect.
6) Pedestrian Delay – this phase option causes the Walk to be delayed after green by the Green/Ped delay time.
7) Green/Ped Delay – this phase option allows selection of time to delay Walk-after-Green or Green-after-Walk.
8) Conflicting Phases – defines a phase that is otherwise concurrent to conflict with selected phase.
9) Omit Yellow/Yellow Phase – allows yellow of this phase to be omitted when in yellow of the entered phase.

10) Pedestrian Output/Overlap – allows for an overlap of the Pedestrian movement for the phase selected, which must be the next phase in the ring sequence.

11) Start Yellow/Next Phase – when a phase is set to start up in yellow, this allows the selection of which phase the controller will enter next.

12) Call Phases - this phase option shall allow phase calls on one phase to indirectly call another phase. Each Actuated Signal Controller (ASC) phase shall assign a minimum of four Call Phases. When the assigned phase is green and applying a min or max recall or receiving a detector extension, a call shall be indirectly sourced to each of the Call Phases.

13) Inhibit Phases – this feature shall apply a software omit on all programmed Inhibit Phases when the program phase is timing green, yellow or all-red clearance.

14) Redirect Phase Calls – this phase option redirects phase calls from one phase to another phase when the programmed phase is green and the phase called is red.

15) Alternate Phase Options

A minimum of eight (8) separate Alternate Phase Options tables shall be provided to vary phase option parameters by time-of-day. This time-of-day operation shall be accomplished by associating the table with a pattern as described in Section 6. The minimum number of Alternate Phase Options parameters varied per table shall include:

Assign Channel to Phase

Lock Calls

Soft Recall

Dual Entry

Enable Simultaneous Gap-out

Guaranteed Passage Time

Rest-in-Walk

Conditional Service

Reservice

Non-actuated 1

Non-actuated 2

Green/Ped Delay Inhibit

Conflicting Phases

16) A minimum of two alternate tables shall be provided to vary the call phase, inhibit phase and redirect phase call phase options by time-of-day. This time-of-day operation shall be accomplished by associating the table with a pattern as described in Section 6.

17) The Actuated Signal Controller (ASC) shall provide a minimum of two auxiliary outputs to drive a flashing display for an advance-warning beacon. These outputs shall become active whenever a phase assigned to the output has timed out a value initiated at the start of green for that phase. This feature may be used to provide a flashing display in advance of the yellow clearance interval to warn approaching drivers with limited visibility of the signal display.

Ring, Phase Concurrency and Sequence Programming

1) Each Actuated Signal Controller (ASC) shall provide sixteen (16) phases assignable to one (1) to four (4) separate rings.

2) Phase concurrency definitions shall control the compatible phase groups in each ring establishing a barrier between phases that are not concurrent.

3) A minimum of 16 phase sequences shall be provided to vary the sequence of concurrent phases in each ring.

4) Each phase sequence shall allow a maximum of eight (8) sequential phases to be programmed in each of the four rings. A maximum of 16 sequential phases may be assigned to ring 1 if rings two (2), three (3) and four (4) are not used.

Vehicle and Pedestrian Detection

1) Each Actuated Signal Controller (ASC) shall provide 64 separate vehicle detectors and eight (8) separate pedestrian detectors with separate program features applied to each detector.

2) The actual hardware detector inputs may be provided in a variety of ways based on the controller specification selected in Section 2 and the target cabinet (or terminal facility) configuration.

3) The requirements in this section shall govern the features required for vehicle and pedestrian detection.

NTCIP Requirements for Detection

The following NTCIP objects related to detection are mandatory requirements under this specification. The definition and range of each parameter (minimum and maximum value) defined in this Section, 3.4.1, are also specified under NTCIP.

1) Call Phase – each vehicle and pedestrian detector shall specify a single call phase

2) Switch Phase – each vehicle detector shall provide the capability of switching the call to the specified switch phase when the switch phase is green and the call phase is red.

3) Delay Call – a constant vehicle detector call may be delayed by this setting in increments of 0-25.5 seconds for a call detector

4) Extend – a vehicle detector call may be extended a programmed amount (0-25.5 seconds) while the call phase is being serviced for each extend detector

5) Queue – extension for a vehicle detector call may be inhibited after the specified queue time expires. The queue time is measured from the beginning of the Min Green interval.

6) Vehicle and Pedestrian Detector Diagnostics

   These diagnostics shall be performed for each vehicle and pedestrian detector. A zero value programmed for any diagnostic effectively disables that diagnostic for the detector specified.

   a) No Activity – this detector diagnostic shall fail when the specified No Activity period (0-255 minutes) expires before a detector call is received

   b) Maximum Presence – this detector diagnostic shall fail when a constant call applied to the detector exceeds the Maximum Presence time (0-255 minutes)

   c) Erratic Count – this detector diagnostic tests for an erratic count input (or chattering detector). Erratic if the number of detector counts per minute exceeds the Erratic Count parameter, this diagnostic will fail.

   d) Fail Time – this detector diagnostic parameter controls the minimum recall placed on a phase called by a failed vehicle detector. A value of zero shall prevent a failed detector from calling the phase (even if the detector has failed due to a constant call). The Fail Time value (1-255 seconds) extends the called phase by the greater of the Fail Time value or the Min Green time.

7) Each detector may be individually programmed to call and/or extend the call phase.

8) Added Initial shall be enabled or disabled for each detector.

9) Lock Calls shall be enabled during the red or yellow or both red and yellow intervals of the phase called by the detector.

10) Volume and occupancy sampling may be individually enabled or disabled for each detector.

11) The Actuated Signal Controller (ASC) shall provide a real-time status display of each vehicle call input and each alarm condition (set when any of the NTCIP detector diagnostics fails for that detector).

12) The Actuated Signal Controller (ASC) shall display the delay and extend timers for each detector.

13) The detector sample period shall be programmed in seconds or minutes as required by NTCIP.

14) The Actuated Signal Controller (ASC) shall display the real-time volume and occupancy accumulators for each detector for the current sample period.

Additional Requirements for Detection

The following additional functions relating to vehicle and pedestrian detection are mandatory requirements under this specification:

1) Occupancy-on-Green/Yellow/Red MOE – this measure of effectiveness allows the occupancy for each detector to be sampled during the green interval, yellow interval, red interval or any combination of these intervals of the phase called by the detector.

2) Delay Phases – a minimum of two phases may be specified to limit the vehicle detector delay feature by applying the delay only when these phases are green.

3) Alternate Detector Modes

   a) The **NORMAL** mode setting of a vehicle detector shall apply standard NTCIP mode features

   b) The **STOP_A** mode shall allow a detector to extend the call phase until the Extend parameter times out or until a gap-out occurs. After the Extend timer expires, the detector input shall be ignored. However, once the detector gaps out, the detector cannot be reset.

   c) The **STOP_B** mode shall allow the Extend parameter to serve as a secondary gap timer for the detector. If the Extend timer expires before a detector call resets the timer, the detector will be disabled for the remainder of the green interval.

   d) The **Normal Red Rest** mode shall modify the Delay time assigned to the detector. Once the Delay time expires, the controller shall move to a red rest condition for one second before servicing the next phases called in the sequence.

   e) The **Bike** mode resets the bicycle extension time for each actuation when the call phase is green.

   f) The **Q-Alarm** mode sets a queue alarm if an actuation exceeds time in queue.

4) Detector Input Source – this feature shall allow a vehicle detector to be sourced by another vehicle detector input. A Detector Input Source of 0 shall imply that an active hardware input is associated with the detector. A Detector Input Source of 1-64 shall imply that the detector is indirectly sourced by the hardware input of another active detector 1-64.

5) Alternate Detector Parameters

   A minimum of three (3) separate Alternate Detector Parameter tables shall be provided to vary detector parameters by time-of-day. This time-of-day operation shall be accomplished by associating the table with a pattern as described in Section 6. The minimum number of Alternate Detector Parameters varied per table shall include:

   Call Phase (vehicle and pedestrian detector)

   Switch Phase

   Delay Time

   Extend Time

   Queue Time

   No Activity Diagnostic (vehicle and pedestrian detector)

   Maximum Presence Diagnostic (vehicle and pedestrian detector)

   Erratic Count Diagnostic (vehicle and pedestrian detector)

Fail Time Parameter (vehicle detector)

Occupancy-on-green measure

Delay phases

Detector type/Mode

Detector input source

6) Alternate Detector Options

A minimum of three (3) separate Alternate Detector Option tables shall be provided to vary detector options by time-of-day. This time-of-day operation shall be accomplished by associating the table with a pattern as described in Section 6. The minimum number of Alternate Detector Options varied per table shall include:

Call /Disable Call Detection

Enable/Disable Extend Detection

Enable/Disable Queue Detection

Enable/Disable Added Initial

Enable/Disable Red Locking

Enable/Disable Yellow Locking

Enable/Disable Volume Measurement

Enable/Disable Occupancy Measurement

7) A Volume/Occupancy collection function shall be provided for a programmable collection period.

8) A Speed Detector function shall provide for sixteen (16) dual detector configurations for measuring speed.

9) A copy function shall be provided to copy the existing detector programming from one detector to another.

10) Any detector inputs of the Actuated Signal Controller (ASC) may be used as a system detector by a closed loop master controller. The ASC shall record volume and occupancy counts based on a user-selectable time period for each detector and report this data as requested by the master controller.

Overlap Operation

1) Each Actuated Signal Controller (ASC) shall provide a minimum of 16 separate overlaps.

2) Each overlap may be assigned to any output channel by a software assignment associating the overlap number with the channel number.

3) Overlaps are typically serviced along with their programmed included phases. Programmed modifier phases shall alter the overlap operation depending on the overlap type.

4) Each Actuated Signal Controller (ASC) must provide separate yellow clearance, all-red clearance and green extension timing for each overlap and allow clearance times to time with the included phase(s) as an option.

5) A status display shall be provided to show the timing of the active phases and the green, yellow and all-red intervals for each of the 16 overlaps in the unit.

NTCIP Requirements for Overlap Operation

The following NTCIP objects related to overlap operation are mandatory requirements under this specification. The definition and operation of each overlap type defined in this Section, 3.5.1, are also specified under NTCIP.

1) Normal Overlap Type – This overlap type is serviced when included phases are on or next. The

overlap outputs are dark when the programmed modifier phase is timing a green, yellow or all-red interval.

2) Green/Yellow Type – this overlap type is serviced when the included phases are on or next, but will go to red as soon as the programmed modifier phase is green.

Additional Requirements for Overlap Operation

The following additional functions related to overlap operation are mandatory requirements under this specification:

1) Permitted Left-turn Type - this overlap type is serviced when the included phases are on or next; however, when both through phases are assigned as modifiers, the beginning of the overlap is suppressed until the adjacent through phase turns green.

2) Flashing Red Type – this overlap type is serviced when the included phases are on or next; however, the red output will flash when the overlap green and yellow are not active, the modifier phase is green and not timing walk or ped clearance.

3) Fast Flash – this overlap type flashes green at 60-180 per minute for Canadian left-turn indication.

4) Right-turn Type - this overlap type is serviced when the included phases are on or next; however, the overlap changes from green to red (without yellow clearance) when an included phase that is also a modifier turns green

5) Pedestrian Overlaps - this overlap type services pedestrian outputs when two sequential included phases time their walk and ped clearance intervals sequentially.

6) The Actuated Signal Controller (ASC) shall provide conflicting programming for each of the 16 overlaps that inhibits the overlap from being serviced or terminates an active overlap when a conflicting vehicle or pedestrian phase or another overlap is serviced.

Unit Parameters

Unit parameters are program features that apply to all operational modes of the Actuated Signal Controller (ASC) and which may not be modified by the Time Base Scheduler or programmed by a pattern.

NTCIP Requirements for Unit Parameters

The following NTCIP objects related to unit parameters are mandatory requirements under this specification. The definition and range of each parameter (minimum and maximum value) defined in this Section, 3.6.1, are also specified under NTCIP.

1) Start-up Flash Parameter - The Start-up Flash Parameter (0-255 sec) shall determine the duration that the controller remains in a flashing condition following a power interruption or after initializing the unit. During start-up flash, the Fault Monitor and the Controller Voltage Monitor outputs shall be inactive.

2) Unit Red Revert Time - The Unit Red Revert Time (0-25.5 sec) shall determine the minimum time for red revert on all phases. Each phase may override this parameter with an individual red revert time if it is larger than the unit red revert time. The red revert time is the minimum amount of red indication time following a yellow interval and prior to the next display of green on the same phase.

3) Backup Time Parameter – The Backup Time shall be the maximum amount of time, in minutes, that the controller waits before declaring its system supervisor to be offline. A system supervisor is either an on-street master controller or a central computer system. The value programmed in the backup time is used to reset the backup delay timer every time a communications message is received. When the backup timer expires, the controller shall consider the system device to be offline and reverts to its internal time based scheduler as its operating mode.

4) Automatic Pedestrian Clear Parameter - This option shall determine the behavior of the pedestrian clearance interval for the controller when manual control is enabled. When enabled, the pedestrian clearance interval shall not be terminated by the Interval Advance input.

Additional Requirements for Unit Parameters

The following additional functions related to unit parameters are mandatory requirements under this specification.

A unit parameter shall be provided to turn off all outputs from the device prior to parameters being changed that would leave the operation in an unknown state under service. The parameter shall deactivate the outputs whenever the phase mode is changed, the unit is initialized or when a new firmware program is flashed to EEPROM.

1) Hardware Station ID - this parameter shall cause the controller to use the Address inputs of the Terminal and Facilities to establish the unit's Station ID for system communications.
2) Local Flash Start – when enabled, this feature shall cause the controller to automatically perform an "External Start" when the Local Flash input signal transitions from active to inactive.
3) Red Revert – allows minimum time to be set for Red Revert
4) Backup Time – this entry sets a period of time for no communication before declaring system supervisor offline.
5) Auto Pedestrian Clearance – allows pedestrian clearance to be terminated by Initial Advance during Manual Control.
6) Unit Phase Mode – the Actuated Signal Controller (ASC) shall provide an operator selectable phase mode to default the phase sequence and concurrencies to standard 8 phase, quad sequential, 8 phase sequential or a user defined phase mode. The ring, sequence and phase concurrency shall be automatically programmed at start-up for standard 8 phase, quad sequential and 8 phase sequential operation.
7) Local Flash Start – sets external start when returning from local flash.
8) Start Red Time – this parameter shall apply when power is applied to the unit or when an applicable SDLC fault is cleared. The Start Red Time value shall be used when the programmed startup phases are set for RED CLR (red clearance at startup).
9) Enable Less Than 3 Sec Yellow Clearance – this entry shall allow yellow clearance to time less than the 3-second minimum prescribed by the MUTCD. If set to OFF, entries of 0 to 2.9 seconds are not accepted for any active phase in the Actuated Signal Controller (ASC).
10) Allow Skip Yellow - this feature must be enabled in order to use the Omit Yellow phase option.
11) Disable Initial Ped – allows start-up without pedestrian movements.
12) Free Ring Sequence – allows choice of ring sequence when coordinator is Free.
13) Stop Time Over Preempt – allows stop timing to have priority over preempt.
14) Invert Rail Input – allow for inverting preempts #1 and #2, #1 only, or neither.
15) Tone Disable – this parameter shall disable audible tones for keyboard operations when set to ON. When set to the default value, OFF, the tone sequences that provide audible feedback will be sounded as appropriate.
16) TS2 Detector Faults – allows detector BIU’s faults to log events
17) SDLC Retry Time – allows time to be set to clear SDLC fault retry counter for terminal facility BIU’s or MMU.
18) Cycle Fault Action – allows programmed response in event of cycle fault.
19) Max Seek Track – allows entry for expected Max time for rail preempt to track clearance
20) Max Seek Dwell – allows entry for expected Max time from track clearance to preempt dwell.
21) A unit parameter shall be provided to set the TS2 I/O mode required to vary the input/output definitions of any ABC connectors called for under the TS2 (Type2) or 2070N specifications.

Flash Operation

1) Whenever the Automatic Flash input is activated, the controller insures that the minimum green and ped clearance time of the current phase is satisfied and moves to the programmed Automatic Flash Entry Phases as quickly as possible without skipping any phases in the sequence waiting to be serviced.

2) Whenever the Automatic Flash input is deactivated, the controller times a separate set of yellow and all-red clearance intervals programmed for flash operation.

3) The unit shall then return to the Automatic Flash Exit phases and resume normal stop-and-go operation.

NTCIP Requirements for Flash Operation

The following NTCIP objects related to flash operation are mandatory requirements under this specification. The definition and range of each parameter (minimum and maximum value) defined in this Section, 3.7.1, are also specified under NTCIP.

1) Channel Flash Parameters – the Channel Flash Parameters shall allow each output channel (or load switch) to be flashed red, yellow or dark during Automatic Flash.

2) Alternating Flash Outputs – a flash parameter shall be provided to control whether the flash output occurs on the positive or negative half of the 1-second flash duty cycle

Additional Requirements for Flash Operation

The following additional functions related to flash operation are mandatory requirements under this specification:

1) Flash Mode – a flash mode setting shall determine whether the flash operation is programmed through the channel settings, the phase/overlap programming or the volt-monitor (cabinet flash).

2) Input Source – a parameter shall be provided to select the input source for Automatic Flash from the D-connector, TEST A or TEST B.

3) Phase/overlap programming shall be provided to program the yellow flash output for each phase and overlap. All other phases and overlaps not programmed to flash yellow shall flash red.

Startup Sequence

1) Upon restoration of power, a vehicle call (as a minimum) shall be placed on all phases in use by the current configuration.

2) The start-up sequence shall be programmable to start at the beginning of the green or yellow interval of any selected phase or non-conflicting phase pair.

3) Unless otherwise stipulated in the contract documents, the start-up sequence shall begin with the major street (movements 2 and 6) green interval and serve in preferential sequence, all phases with at least a minimum recall or the summation of pedestrian walk and clearance interval. The start-up sequence shall end with the beginning of the major street left turn green interval (movements 1 and 5), at which time the controller unit shall operate as an actuated controller or respond to system commands if present.

Channel Settings and I/O Mapping

Output channels (or load switch) programming shall allow any phase, pedestrian or overlap output to be assigned to a maximum of 24 output channels as determined by the terminal facility (cabinet) configuration.

NTCIP Requirements for Channel and I/O Mapping

The following NTCIP objects related to channel settings are mandatory requirements under this specification. The definition and range of each parameter (minimum and maximum value) defined in this Section, 4.1, are also specified under NTCIP.

1) Channel Source Parameters – The Channel Source Parameter and Channel Control Type shall combine to define each load switch output. This feature shall allow any phase, ped or overlap output to be mapped to any hardware output channel. Valid entries shall be 1-16 corresponding with phase, ped or overlap outputs 1-6. An entry of "0" shall make the channel inactive (all channel outputs shall be dark).

2) Channel Control Type – The Channel Source Parameter and Channel Control Type shall combine to define each load switch output. The Channel Control Type parameter shall indicate the type of Control Source. The Control Source Type may be a Vehicle phase, Pedestrian phase, or an Overlap (VEH, PED, OLP). The Channel Control Type shall correspond with the Channel Source Number defined for each channel.

3) Channel Dim Parameters – The Channel Dim Parameters shall allow the green, yellow and/or red outputs of each channel to be dimmed independently. A separate parameter shall control on which half of the AC duty cycle (+ or -) the output is dimmed.

Additional Requirements for Channel and I/O Mapping

The following additional functions related to channel settings are mandatory requirements under this specification:

1) A parameter shall be provided to set the default configuration of any D-connector called for in the equipment specification

2) Alternate Terminal Facilities BIU Mapping – allows the selection of alternate BIU mapping.

3) I/O Modes – allows the selection of up to seven (7) alternate I/O modes.

4) 2070 I/O Modes shall be software programmable. These modes shall provide user selections to program the individual inputs and outputs of the C1 connector and any ABC and D-connector harnesses specified for the unit.

5) Preempt/External Coordinator Outputs – allows the selection for external coordination or preemption outputs through the D connector.

Functional Requirements for the System Time Base

1) The System Time Base shall use the sixty (60) Hz power line frequency as time base when AC power is present over the 89-135 VAC range defined by TS-2 §2.1.2. A super capacitor shall maintain the time-of-day clock and digital data during a power outage lasting up to 2 consecutive days. The use of batteries is unacceptable as means of compliance with this section.

2) The System Time Base shall be maintained to within ± 0.005 % at 20° C and to within a ± 0.02 % over the full specified operating temperature range, as compared to Coordinated Universal Time (WWV) standard for a period of thirty days, during periods when AC power is not applied.

3) The System Time Base shall be easily set to the year, month, day of month, day of week, hour, minute, and second.

4) The Actuated Signal Controller (ASC) shall adjust the system time base for US Daylight Savings Time without operator intervention. A parameter shall be provided to enable or disable Daylight Savings as required by NTCIP.

5) The Actuated Signal Controller (ASC) shall perform an automatic calendar adjustment for leap year.

6) The Actuated Signal Controller (ASC) shall provide a Day Plan database copy feature.

7) The Actuated Signal Controller (ASC) shall allow for a manual change to the local Day Plan operation for Pattern, Auxiliary Functions, and Special Functions.

8) The Actuated Signal Controller (ASC) shall perform a time sync reference from a local GPS time reference and display a GPS/WWV time sync status.

Functional Requirements for Scheduled Operations

1) The NTCIP Time Base Scheduler shall automatically select a time-of-day schedule for the current date and time (system time base) of the Actuated Signal Controller (ASC). The definition of the Time Base Scheduler provided in this Section 6 is also specified under NTCIP.

2) Each Actuated Signal Controller (ASC) shall provide a minimum of 100 time-of-day schedules per unit with each schedule providing a minimum of 16 time-of-day events. The ASC shall provide the ability to expand the number of time-of-day entries in each schedule to 32 entries per day plan schedule by combining schedule tables.

3) Each time-of-day schedule shall provide 16 independent action events called by time-of-day event. A minimum of 100 time-of-day actions shall be provided with each Actuated Signal Controller (ASC).

4) Each time-of-day action shall call a pattern and select any (or all) of the three (3) auxiliary and eight (8) special function outputs provided by the Actuated Signal Controller (ASC). This feature shall allow time-of-day actions to vary the state of the auxiliary and special function outputs independent of the pattern.

5) Free Patterns and Coordination Patterns activated by the Time Base Scheduler shall be used to vary the following minimum set of functions of the Actuated Signal Controller (ASC) by time-of-day:

    a) Alternate Phase Times listed in Section 3.1.2 – 6)

    b) Alternate Phase Options listed in Section 3.2.2 – 9)

    c) Alternate Detector Parameters and Options listed in Section 3.4.2

    d) Overlap Deactivation – overlaps one thru eight may be individually inhibited by pattern

    e) Call to Non-Actuated (CNA) Operation

    f) Max 2 Enable

Functional Requirements for Coordination

NTCIP based coordination shall be based on a pattern having a fixed cycle length and a designated coord phase used to reference the pattern offset to a system time reference.

NTCIP Requirements for Coordination

The following NTCIP objects related to coordination are mandatory requirements under this specification. The definition and range of each parameter (minimum and maximum value) defined in this Section, 7.1, are also specified under NTCIP.

1) NTCIP based coordination shall provide a minimum of 48 patterns each defined in the pattern table by an individual cycle length and offset (in seconds), a split table index and a phase sequence index. The phase sequence index shall reference the sequence table specified in Section 3.3 of this specification.

2) NTCIP based coordination shall provide a minimum of 32 individual split tables referenced by index 1-32 in the pattern table. Each split table shall designate split times (in seconds) for each of the 16 phases and allow any phase to be programmed as a coordinated phase. A phase omit or recall (min, max, ped or ped+max) may be applied to any phase in the split table overriding the normal recall mode of the phase when the pattern is in effect.

3) NTCIP calls for three force-off methods – FIXED, FLOAT and OTHER. The FIXED force-off method shall apply any unused split time acquired from a non-coordinated phase to the next phase in the sequence. The FLOAT force-off method shall insure that unused split time from the non-coordinated phases is provided to the beginning of the coord phase programmed for the pattern.

4) NTCIP based coordination shall provide a per unit selection to select LONG way or LONG / SHORT way as the offset correction method. Each pattern in the Actuated Signal Controller (ASC) shall provide a shortway % parameter, a longway % parameter and a dwell parameter to select the transition method and correction applied during transition.

    During shortway transition, each phase shall be shortened by the programmed shortway % parameter.

    During longway transition, each phase shall be lengthened by the programmed longway % parameter.

    During dwell transition, the coord phase shall dwell for the programmed dwell time when force-off and repeat this dwell extension each cycle until the programmed offset is in synch.

5) NTCIP based coordination shall provide a Maximum setting that controls whether Max 1 timing or Max 2 timing is in effect, or whether all max timers are inhibited during coordination.

6) NTCIP based coordination shall provide a Return Hold parameter for each pattern that places a hold on the coord phase until it is forced-off.

7) NTCIP based coordination shall provide an Early Yield parameter for each phase that controls when a coord phase may yield to the non—coordinated phases if the Return Hold is not set for that pattern. This feature shall allow a coord phase to gap-out prior to the force-off point to service non-coordinated phases.

8) Coordination Diagnostics shall be provided to insure that the sum of the split times in each active ring equals the programmed cycle length. In addition, the coordination diagnostic shall insure that the split times provided are adequate to service the minimum vehicle and pedestrian times programmed for each phase. The coordination diagnostic shall also insure that the sums of the split times on the same side of the barrier in each ring are equal. These coordination diagnostics shall consider all programming features applicable to the minimum phase time requirements including shortway% and any features allowing the minimum pedestrian time to be violated.

9) A free pattern shall be defined as Pattern 0, Pattern 254 or any Pattern 1-48 having a zero second cycle length. Free patterns may be called by the Time Base Scheduler to modify the alternate phase times and options and detector features attached to the pattern.

10) Each Actuated Signal Controller (ASC) shall provide a manual pattern override mode via keyboard entry to override the active pattern and any future pattern called by the Time Base Scheduler or closed loop system.

Additional Requirements for Coordination

The following additional functions related to coordination are mandatory requirements under this specification:

1) The NTCIP force-off parameter defined as OTHER shall provide additional force-off methods that are manufacturer specific. Any OTHER methods provided in addition to FIXED and FLOAT shall allow patterns to be specified in terms of force-offs, yield points and permissive windows within the cycle.

2) A parameter shall be provided on a per pattern basis to reference the offset to either the beginning or end of the specified coord phase for that pattern.

3) It shall be possible to disable a maximum of four phases from shortway transition on a pattern-by-pattern basis. This feature shall control the exclusion of the shortway% correction on a phase-by-phase basis.

4) A parameter shall be provided to disable coordination diagnostics related to minimum pedestrian time requirements. In no case shall this feature defeat the minimum pedestrian times programmed for any phase. Programmed walk, ped clearance, yellow clearance and all-red clearance times shall always be serviced based on the programmed phase times applied to the Actuated Signal Controller (ASC).

   This coordination feature shall allow an occasional pedestrian actuation to overrun the split time programmed for a phase and provide a quick transition method to resynchronize the programmed offset and re-enter coordination within one cycle .

5) The Actuated Signal Controller (ASC) shall provide the ability to select phases that rest-in-walk during coordination such that the ped clearance times for those phases end at either the beginning or end of yellow clearance. This operation shall be provided with or without an external Walk-Rest-Modifier input applied to the unit to allow the coordinated phase(s) to rest-in-walk.

6) The Actuated Signal Controller (ASC) shall have an Early Yield setting to allow NTCIP modes to yield prior to the coordinated phase force-off point.

7) The coordination Offset reference point shall reference the End-of-Green or Beginning-of-Green.

8) During coordination, the WALK indication is not reserviced if a pedestrian recall is applied to the phase unless a conflicting phase is serviced. Therefore, the Actuated Signal Controller (ASC) shall provide a Walk Recycle parameter that controls the recycling of the WALK interval of the coordinated phase. This feature shall allow the WALK to be recycled immediately or inhibit the recycle during the time in the cycle allocated to phases 3478 or 1526.

9) The Actuated Signal Controller (ASC) shall provide a dynamic split adjustment that allows specified split times to grow or shrink based on whether these phases gap-out or max-out during the signal cycle. Any excess slack time from the phases that gap-out shall be applied to the end of the specified coord phases.

10) The Actuated Signal Controller (ASC) shall provide 48 additional Alternate Pattern Tables that can call any unique coordinated phase, phase times (split) table, detector group, call or inhibit phases, disable Overlaps,

Max 2 enable, and enable Diamond Mode by Time-of-Day.

11) External coordination shall be provided through the D-connector inputs (if called for in the hardware specification). These external inputs shall be associated with offset and plan numbers that are correlated with an NTCIP pattern through a lookup table programmed in the unit.

Functional Requirements for Preemption and Priority

1) The internal preemptor supplied shall be user programmable for priority preemption in the minimum sequences outlined in the following order: railroad (2 train sequence), emergency vehicle (4 high priority sequences), and bus/transit (4 low priority sequences). Each preemption sequence shall have separate timing intervals. A decoded input to the controller shall be provided to discriminate the priority level. A steady state low level input is defined as a high priority signal, and a pulsing low level input is defined as a low priority signal.

2) Phases shall be selectable such that a limited signal sequence may be operational during preempt (PE). It shall be possible to add phases to this special limited sequence which are not in the intersection sequence, without needing to add external logic.

Preemption Interval Definitions and Timing

8.1.1 NTCIP Requirements for Preempt Intervals

The following minimum preempt intervals shall be provided using the timing ranges specified by NTCIP for each interval. While in preemption, a controller status display will clearly identify each interval as it is timed. Yellow and red clearances from the phase timings may be utilized in place of the clearance intervals shown as a program option.

The preemption intervals below are listed in sequential order following the receipt of a preemption call.

1) Delay - This time shall start immediately when the preempt command is received. It shall not affect the normal operation of the controller unit until the delay time out occurs. This interval may be used for emergency vehicle (fire lane) preemption delay. If 0 (zero) time is set, the interval shall be omitted.

2) Minimum Duration - The preempt sequence shall not terminate until the preempt input signal is removed and the Minimum Duration time has expired.

3) Maximum Presence – The maximum amount of time that an active preempt input is considered valid.

4) Minimum Green - Any vehicle signal that is Green at the time this interval becomes active shall not terminate unless it has been displayed for at least the time programmed in this interval. If 0 (zero) time is set, the interval shall be omitted.

5) Minimum Walk - Preempt Minimum Walk Time in seconds. A preempt initiated transition shall not cause the termination of a Walk prior to its display for this period.

6) Ped Clearance - At the time of preempt call, WALK indications shall immediately change to Pedestrian Clearance interval. The Pedestrian Clearance interval shall not terminate unless it has been displayed for at least the time programmed in this interval. If 0 (zero) time is set, the interval shall be omitted.

7) Track Green - Signals programmed as track (or fire lane) signals shall remain Green or be changed to Green. All other signals shall be red. This interval shall be optionally programmable to zero during emergency vehicle PE.

8) Minimum Dwell Time - This parameter controls the minimum timing for the dwell movement. The phase(s) allowed during the Dwell interval shall be selectable to include all phases that do not cross the track. The Dwell interval shall not terminate prior to the completion of Preempt Duration Time, Preempt Dwell Time, and the call is no longer present. Each signal shall be keyboard programmable for red, red flash, yellow flash or Green. As an alternative, a limited cycle shall be programmable for use with railroad preempts.

8.1.2 Additional Requirements for Preempt Intervals

The following additional minimum preempt intervals shall be provided using the timing ranges specified for each interval. While in preemption, a controller status display will clearly identify each interval as it is timed. Yellow and red clearances from the phase timings may be utilized in place of the clearance intervals shown as a program option.

The preemption intervals below are listed in sequential order following the receipt of a preemption call.

1) Exit Ped Clear - Preemption Exit Pedestrian Clear Time in seconds. This parameter controls the pedestrian clear timing for a Walk signal transition to the Exit Phase(s).

2) Exit Yellow - This interval shall provide a solid yellow clearance for indications that were green or flashing yellow. Red and flashing red displays shall display solid red.

3) Exit Red Clearance - This interval shall be an all red clearance in preparation for return to the normal cycle. Return phases shall be programmable from the keyboard.

4) Max Call - This interval is the amount of time that a preempt call may remain active and be considered valid. When the preempt call has been active for this amount of time, the controller shall return to normal operation. The preempt call shall be considered invalid until the call is no longer active.

Requirements for Preemption

NTCIP Requirements for Preemption

The following NTCIP objects related to preemption are mandatory requirements under this specification. The definition and range of each parameter (minimum and maximum value) defined in this Section, 8.2.1, are also specified under NTCIP.

1) Preempt sequences shall be selectable using external inputs. Preempt priority shall be assigned with #1 being the highest. If a higher priority preempt input is received during a preempt sequence, the controller unit shall immediately transition to the new sequence, subject to the constraints of PE Minimum Green and PE Minimum Walk. Provisions shall be made to clear two conflicting track phases from a single preempt input. This may be provided by two track clearance phases for a single preempt, or by combining two preempts.

2) Preempts #1 and #2 shall be reserved for priority railroad preempts. If more than two preempts are provided, it shall be possible to delete the priority override for all but the railroad preempt. If a lower priority preempt is activated during another preempt cycle, the one in progress shall continue through its entire cycle. If the second preempt input is still active when the first one is completed, the controller unit shall then initiate the low priority preempt. When all preempt inputs are removed, the controller unit shall proceed through the normal sequence to Return Red Clearance (Interval 10).

3) Once the controller unit has entered the first timed interval following Preempt Delay (Interval 1), the sequence shall continue to the end even if the preempt call is dropped. If the call returns and extends beyond the Minimum Preempt Duration (Interval 2), the controller should reinitiate track green and complete the preempt sequence.

4) The controller unit shall be programmable to be in flash, or in limited sequence. If flash is specified, the phases shall flash yellow or red, as user programmed. Flash shall be implemented by simultaneously flashing the appropriate channel driver outputs. If limited sequence is selected, all phases shall be programmable, even if not normally used in the intersection sequence.

5) Should a preempt command be present, after power restoration following an electrical outage, the controller shall power up in cabinet flash operation and remain in such state until the PE command is removed.

6) Overlap phases shall begin and terminate with the parent phases, as described in TS-2. If the PE call occurs during yellow or red displays between parent phases, the overlap phase shall display a minimum of three (3) seconds of yellow and a minimum of one (1) second of red clearance.

7) Don't Walk shall be displayed throughout the preempt sequence unless a limited cycle is run.

During a limited cycle (Interval 7), the pedestrian heads may be programmed to be dark.

8) Preempt routines shall have priority over all controller functions.

9) The controller shall be programmable to allow multiple track clearance phases either within a single preemption sequence, or by mapping multiple preempts together in all modes of operation.

10) The controller will have an entry that allows it to coordinate during limited sequence operation. When operating in this mode, the controller will perform a soft transition to the preemption return phases.

Additional Requirements for Preemption

The following additional functions related to preemption are mandatory requirements under this specification:

1) Priority Type – this feature shall allow two preempts to be activated from the same preempt input using the standard adopted by 3M Corporation and Tomar Inc. for high priority / low priority emergency vehicle preemption. A constant low input shall indicate a high priority on this input pin, while an oscillating input source shall indicate a low priority preempt.

2) Output - this feature allows the preemption output to be programmable based on three separate marks:

   - TS-2 Mode – sets the output to be active from the end of the call delay period until the preempt is complete.
   - Delay Mode – sets the output to be active from the beginning of the delay period until the preempt is complete.
   - Dwell Mode – sets the output to be active when the preempt dwell state is reached.

3) Max 2 – this feature sets the exit phases to reference the Max 2 timing.

4) Skip Track if Override – this feature allows track clearance to be skipped if this preempt is overriding a lower priority preempt input.

5) Pattern – this feature allows a specific coordination pattern to be called by a preempt input instead of a specific preempt phase(s). This pattern will operate for the duration of the preempt input including the dwell interval.

6) Coord + Preempt – this feature shall allow the controller to return to coordination in synch without having to go through a transition or offset correction period. The controller shall maintain a background cycle during coordination allowing the Actuated Signal Controller (ASC) to return to the phases currently being serviced in the background cycle, without violating any Minimum times, rather than return to the Exit phases specified in the preempt sequence.

7) Voltage Monitor Flash – this feature shall allow the controller to flash during preemption through the cabinet by dropping the power applied to the conflict monitor, thus transferring the flashing operation to the cabinet flashers.

8) Return Max / Min – this feature sets the exit phases to reference the Min or Max timing.

9) Overlaps Plus - It shall be possible to select individual overlaps to service simultaneously with track phases and dwell phases or to be inhibited during preemption when the included phases defining the overlap are being serviced. This extended preempt feature shall be provided for each preempt.

10) The Actuated Signal Controller (ASC) shall provide for a preempt to initiate a higher priority preempt after timing clearance.

11) The Actuated Signal Controller (ASC) shall provide a preempt output signal using the auxiliary outputs to drive a confirmation display alerting the driver of the emergency vehicle that the preempt input has been received.

Requirements for Transit Priority

NTCIP Requirements for Transit Priority

The following NTCIP objects related to transit priority are mandatory requirements under this specification. The definition and range of each parameter defined in this Section, 8.3.1, are also specified under NTCIP 1211.

1) Transit Priority service shall be provided within the coordination programming and shall be performed while in coordination, without any transition.

2) Transit Priority programming shall be provided for each of the 16 phases. Each phase shall have the capability to program Reduction or Extension time on a phase-by-phase basis.

3) Eight (8) Strategy Tables shall be provided which allow for assignment of transit priority phase(s) and for the selection of any combination of Phase(s) or Ped(s) to be omitted for each strategy table. The Strategy Table shall be bound to the standard Split Tables, which can be called by Time-of-Day.

4) Each Split Table shall allow for the selection of a Strategy Table for each of the four low priority input channels. The Strategy Table shall reference the Transit Signal Priority (TSP) phases to be served for that channel, and which phases or peds to omit. The Split Table shall provide for programming of Time of Service Desired and Time of Estimated Departure for each of the four low priority input channels.

5) Time of Service Desired (TSD) – this is the arrival time of the transit vehicle at the stop-bar after it is first detected via the low priority signal. The TSD includes any dwell time to discharge and load passengers at a nearside stop and any expected congestion delay in the estimate of the arrival time.

6) Time of Estimated Departure (TED) – this is the time required for the transit vehicle to clear the intersection after it is first detected.

Additional Requirements for Transit Priority

The following additional functions related to transit priority are mandatory requirements under this specification:

1) Low Priority Type – this parameter shall allow the user to select the preemption type for preempt channels 7-10 (low priority channels). Each channel shall be able to programmed for any of the following types:

    - Emergency – this allows any of the channels to be programmed for high priority emergency vehicle preemption
    - Transit Priority - this sets the preemption channel to serve the low priority input to be served as programmed without skipping phases
    - Transit Preemption – this sets the preemption channel to serve the low priority input to be served immediately after the active phase has terminated normally.

2) Transition % - this method enables the user to enter a shortway% and longway% to be applied to all phases for a low priority input. The Shortway% sets the percentage of the split that will be shortened to service the requested phase. The Longway% sets the percentage of the split that will be lengthened to service the requested phase. Shortway% and Longway% will never override the controller's programmed Min or Max times.

3) Transit Preemption – this parameter allows the active phase to complete and terminate normally when a low priority input call comes in. After the active phase terminates by Gap Out, Max, or Force Off, all other phases will be skipped and the low priority call phase will be serviced next.

Functional Requirements for System Communications

The functional requirements for System Communications shall conform to the mandatory hardware

requirements of the specification selected in Section 2. In addition to these mandatory requirements, the following requirements are also mandatory if applicable to the hardware specification in Section 2:

1) The Actuated Signal Controller (ASC) shall support the NTCIP protocol as well as manufacturer specific protocols

2) The RS-232 asynchronous data communication port shall provide a maximum programmable baud rate of 57.6 Kbaud (full or half-duplex).

3) Laptop computers and Palm O/S devices shall be used to upload/download the controller database, flash the controller firmware program (stored on EEPROM) and set the System Time Base of the Actuated Signal Controller (ASC).

4) Internal and external FSK modems shall be supported providing a minimum data transfer rate of 9600 baud over twisted pair.

5) The controller shall support an internal Ethernet port if applicable under the hardware specifications. The controller with on-board Ethernet support shall provide two programmable TCP/IP addresses, subnet mask address and gateway address. Menus shall be provided to set these addresses from the controller keyboard as part of the controller database. The TS-2 controller shall also provide for the added security of a fixed host IP address and subnet mask.

6) Auxiliary RS-232 communication ports shall be provided by the Actuated Signal Controller (ASC) to interface the conflict monitor, temperature alert devices, optical phase discriminator cards, and GPS time-based antennas. The controller shall be capable of converting communication between these auxiliary RS-232 devices within the cabinet and Ethernet with no additional media converter devices. The auxiliary communication port shall allow data logs from these external devices to be uploaded to the area wide ATMS through the Actuated Signal Controller (ASC).

Functional Requirements – Closed Loop/Traffic Responsive Operation

1) Closed loop operation shall consist of one primary master per sub-system capable of addressing up to 32 secondary controllers and/or sub-masters. Each sub-master controller shall be capable of addressing an additional 32 secondary controllers and/or sub-masters.

2) A primary master or sub-master controller shall operate combined within an Actuated Signal Controller (ASC) unit controlling an intersection. The primary master or sub-master shall maintain two distinct databases each identified in the ATMS system by a unique Station ID address.

3) The primary master or sub-master may be included within the control hierarchy of an area ATMS or operate independently supervising the secondary controllers and sub-masters defined in the sub-system. The primary master or sub-master shall exert control over the closed loop system under one of the following modes of operation (these operation modes are listed in priority order):

    a. System Override Mode – the operator may manually force every controller in the closed loop system to a specified pattern (including flash or free operation) from the master keyboard

    b. System Failure Mode – the closed loop system shall detect failure conditions (including communication and system detector failures) and provide a fall-back response from the primary master based on programming features and thresholds customized by the user.

    c. System Time Base Schedule Mode – the System Time Base Schedule in the primary master database shall be independent of each secondary Time Base Schedule in the subsystem. The System Time Base Schedule shall drive the operation of all secondary controllers and sub-masters defined in the closed loop system. The System Time Base Schedule shall be capable of placing the sub-system in flash or free operation, a specified pattern, traffic responsive operation or isolated operation by time-of-day.

    d. Local Control Mode – in this mode, the master serves only as a communications hub between the secondary controllers and the area-wide ATMS. The master is still responsible for updating the System Time Base and gathering event and alarm status for the sub-system; however, all control is performed at the local level from each secondary Time Base Scheduler.

4) The primary master or sub-master shall collect volume and occupancy data from a minimum of 48 system detectors sampled by the Actuated Signal Controllers (ASC) within the master's sub-system. The volume and occupancy data may be uploaded to the area wide ATMS or processed by the master to calculate traffic responsive parameters used to select a pattern for the system under traffic responsive mode.

5) The traffic responsive calculations related to the sampled volume and occupancy data shall be as follows.

   a) Each system detector shall be assigned to an inbound, outbound or cross street detector group.

   b) The volume and occupancy of each detector shall be individually smoothed based on a programmable weighted average of the previous sample.

   c) The smoothed volume and occupancy data shall be weighted against full-scale volume and occupancy values provided by the user to produce Vol% and Occ% for each detector.

   d) The Vol% and Occ% values shall be combined for each detector group (inbound, outbound and cross) using operator supplied scalers that allow Vol% and Occ% to be weighted differently for each detector. This calculation shall produce a combined V+O value for the inbound, outbound and cross street detector group.

   e) The V+O values for each detector group shall be used to calculate Cycle, Offset and Split parameters that shall be used to select a traffic responsive pattern for the closed loop system using lookup tables and matrices defined by the user. These lookup tables may be customized by the user to favor an inbound/outbound pattern selection, an arterial/cross street preference, or a pattern selection that only varies cycle length.

6) It shall be possible to configure the traffic responsive system such that the default operation of the closed loop system is based on the operation called for in the local Time Base Schedules unless the traffic responsive calculations determine that a traffic responsive action is necessary to service the volume and occupancy conditions within the system.

Functional Requirements for System Events and Alarms

The ASC controller shall provide for the logging of intersection alarms and events. Events are specific conditions stored in the events buffer of the Actuated Signal Controller (ASC) and uploaded to the supervisory master or ATMS (if present in the system). The controller shall be capable of storing at least 50 events. Alarms are special events that are reported as soon as possible to the supervisory master or ATMS depending on the communication method deployed and the polling rate of the system. The controller shall provide for a minimum of 128 alarms. The Actuated Signal Controller (ASC) shall tag each event and alarm with the date and time based on the System Time Base of the unit.

Mandatory Requirements for Events and Alarms

The following are deemed mandatory events and alarms recorded by the Actuated Signal Controller (ASC):

1) Power Up / Power Down
2) Stop Timing
3) Cabinet Door Open
4) Coordination Failure
5) External Alarm #1
6) External Alarm #2
7) External Alarm #3
8) External Alarm #4
9) External Alarm #5
10) External Alarm #6
11) Manual Control Enable

12) Coordination Free Switch Input
13) Local Flash Input
14) Cycle Fault
15) Cycle Failure
16) Coordination Fault
17) Controller Fault - Intersection in Flash
18) Local Detector Failure
19) Request Database Download From Field
20) Preempt 1 Input
21) Preempt 2 Input
22) Preempt 3 Input
23) Preempt 4 Input
24) Preempt 5 Input
25) Preempt 6 Input
26) Preempt 7 Input
27) Preempt 8 Input
28) Preempt 9 Input
29) Preempt 10 Input

Additional Requirements for Events and Alarms

The following are deemed mandatory events and alarms recorded by the Actuated Signal Controller (ASC) if the specific event and alarm applies to the hardware defined under these specifications.

1) Closed Loop Disabled
2) MMU Flash Input
3) MMU Fault
4) Detector SDLC Failure
5) MMU SDLC Failure
6) Critical SDLC Failure
7) SDLC Response Frame Fault
8) EEPROM CRC Fault
9) Temperature Alert #1 - temp/status
10) Temperature Alert #2 - temp/status

Functional Requirements for Local Status Displays

Local status displays are important features of any Actuated Signal Controller (ASC) because they provide display information needed to interrogate the device and interpret the current operation.

An areawide ATMS will typically provide remote status displays of each Actuated Signal Controller (ASC) provided in the system. However, the local status displays listed in this section shall be accessed from a keypad and display device provided on the face of the Actuated Signal Controller (ASC) unit.

Requirements for Local Status Displays

The following are deemed mandatory status displays required for the Actuated Signal Controller (ASC):

Phase Timing Display

1) Intervals and phase timing for the two primary rings
2) Active and next status for all 16 phases in the unit
3) Local counter display
4) Vehicle, pedestrian call and pedestrian recall, and extension status for 16 phases
5) Minimum and maximum recall status
6) Phases that are not enabled shall be displayed as omitted phases
7) The current status of the unit (flash, free or coord status)
8) The current sequence table and phase mode in operation

Coordination Display

1) The current active pattern and next pattern to be serviced
2) The current status of the active pattern indicating coord or free status
3) The source of the current active pattern
4) The current pattern sourced by the closed loop system, local time base schedule, manual override and remote ATMS control
5) The current cycle length and offset referenced by the active pattern from the pattern table
6) The active local cycle counter and system cycle counter
7) The current offset error and correction method being used to transition the unit if it is not in SYNC
8) The current system time base in hours, minutes and seconds
9) Transit Priority counter

Coordination Diagnostic Displays

1) Coordination diagnostic displays shall indicate if the next pattern to be serviced has failed any of the diagnostic tests
2) Status displays shall indicate the cause for any diagnostic failure and the specific phase causing this failure if possible
3) Coordination failures resulting from a vehicle or pedestrian call not being serviced for more than three (3) cycles shall be clearly indicated along with an indication of the phases that were skipped.

Alarm and Event Status

The real-time status of each alarm and event provided by the unit shall be clearly indicated.

Com Port Status

The real-time status of each communications port shall provide as a minimum an indication of the separate transmit and receive activity on each active port.

Detector Status

The controller shall display the following detector status:

1) The real-time status of each detector input and alarm condition for each of the 64 detectors in the unit.
2) The real-time volume and occupancy measure for each of the 64 detectors in the unit.

Overlap Status

The controller shall display the following overlap status:

1) The real-time status of the timing interval of each of the 16 overlaps in the unit
2) The current phase and interval of each of the four rings in the unit shall be simultaneously displayed with the overlap intervals to correlate overlap operation with the state of the included (or parent) phases defining each overlap.

Volume, Occupancy and Speed Status

The controller shall provide a status report function to gather Volume, Occupancy, and Speed data for a sample period of time.

MMU Status

The controller shall provide real-time and history event status from the MMU.

1) The controller shall store MMU fault logs.
2) The controller shall store MMU trace reports.
3) The controller shall provide current MMU on line status.

Phase Inhibit Status

The controller shall provide a status screen that displays which phases are inhibited by the following:

1) Coordination – shows which phases are inhibited by the coordinator
2) Preemption – shows which phases are inhibited by a preempt sequence
3) Auxiliary Inputs – shows which phases and peds are omitted by auxiliary input

Calculation Status

The controller shall provide a status screen with the current calculations for the active coordination pattern, displaying the following:

1) Primary Force-Off Point
2) Secondary Force-Off Point
3) Vehicle Yield – point in the cycle that a vehicle call can be serviced
4) Vehicle Apply – point that the coordinator applies an inhibit to the call until the next cycle
5) Ped Yield – point in the cycle that a pedestrian call can be serviced
6) Ped Apply – point that the coordinator applies an inhibit to the call until the next cycle
7) Float Max – displays force-off points when Float Max is utilized
8) Ped Leave – displays the end of the Rest-In-Walk period

Additional Status Displays

1) Status displays showing all internal force-off and yield calculations of the active pattern. These calculations shall be automatically performed by the unit under NTCIP force-off methods FIXED and FLOAT and used for diagnostic purposes.
2) Status displays showing the internal software inhibits used to inhibit phases during coordination and preemption
3) Status of the 8 hold, phase omit and ped omit inputs defined under the TS-2 specifications
4) Status of external temperature devices.

SOFTWARE SPECIFICATION

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Trafficware
Engineered by Naztec

ATMS.now

Trafficware's Advanced Transportation Management System (ATMS) is a TCP/IP client/server application that provides a multi-user ATMS over Windows NT/95/98/2000/XP networks. Over 250 systems and over 25,000 controllers have been deployed since 1994. This long track record has given Trafficware the opportunity to hear ideas and suggestions from users around the country.

We have considered every single client request and built an **ATMS.now** platform that performs unlike any other ATMS. Using simple to use screens, **ATMS.now** offers complete traffic and data management including real-time reporting, integration with Crystal Reports™, XML data exchange, GIS interface, and hundreds of other features.

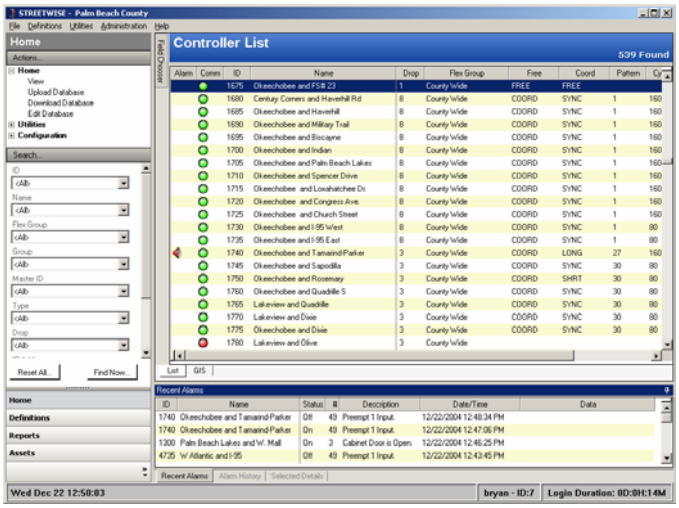
ATMS.now brings together all of your traffic network data into a single repository for a completely integrated, 360-degree view of your ATMS operation. Featuring high-performance parallel database technology, a full suite of data access and management tools, and robust data mining capabilities, Trafficware's **ATMS.now** delivers powerful performance.

Feature	Description	Benefit
Multi-Edit Capability	**ATMS.now** enables users to select multiple intersections simultaneously and edit them as a set. This includes every activity from simple intersection definition to controller parameter database management.	Traffic engineers and signal technicians can get more done in less time with reduced potential for error.
Scalability	**ATMS.now** is built as a multithreaded transactional system that takes advantage of available hardware resources to meet capacity demands.	Customers can protect their investment by purchasing hardware that can expand as their needs grow.
Availability	Using SQL Server and IIS, **ATMS.now** can take advantage of redundant installations such as database clustering and network load balancing to provide maximum system uptime.	Agencies of any size can design a deployment configuration that meets their needs. The system can be deployed on any hardware platform ranging from a laptop to a datacenter. Datacenter hardware is engineered for fail-over redundancy and data integrity.
Open Architecture	**ATMS.now** implements a Web Services interface (SOAP, XML). The underlying database can be deployed using simple dBase files or on SQL Server 2000.	Promotes interoperability with a wide range of software applications and tools.
Presentation Quality Reports	**ATMS.now** includes Crystal Reports™-based reporting features.	Reports are easy to use and can be presented to a wide audience.
Real-Time Updates	Splits, alarms, and user edits are broadcast in real time to workstations.	Workstations are instantly updated without degrading server or client performance.
Integrated Time-Space Diagram	**ATMS.now** includes a time-space diagram based on real-time split information. The diagram is easy to set up and can span an arbitrary number of intersections.	Users can instantly visualize the actual progression performance of intersections.
Asset Management	**ATMS.now** incorporates a module to track inventory deployed in the field or stored in a warehouse, plus enables the user to track repair events associated with the inventory items.	Users have instant access to equipment information and repair history.
GIS Navigation	**ATMS.now** renders an intersection network based on geographic information and can incorporate multiple layers as needed, including aerial images.	Users can intuitively navigate their traffic network and observe patterns immediately.

ATMS.now

Some examples of the **ATMS.now** enhanced system features are provided below.

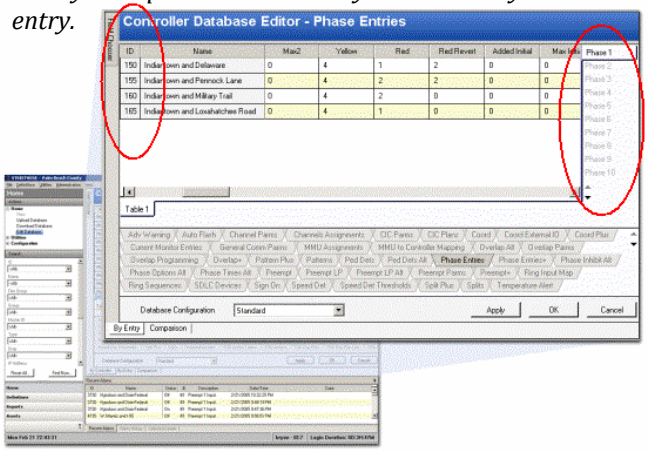
Default Home Page View—The user is presented with a real-time view of alarm, pattern, cycle, coordination, and split information of all intersections in the network.



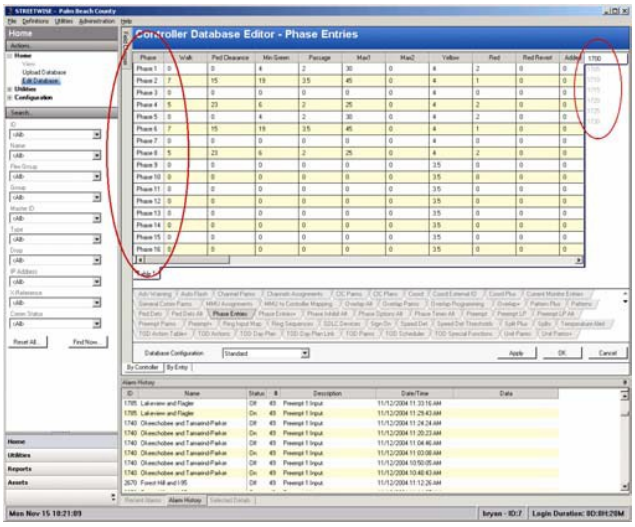
The main view provides a summary of the current network state. The docking views in the lower portion of the screen display detailed alarm information and contextual controller information including splits, alarms, and time-space plot.

The navigation tools to the left enable the user to choose actions to perform on sets of selected controllers, filter the list of controllers, and navigate between modules.

The system provides the ability to edit many controllers by entry.

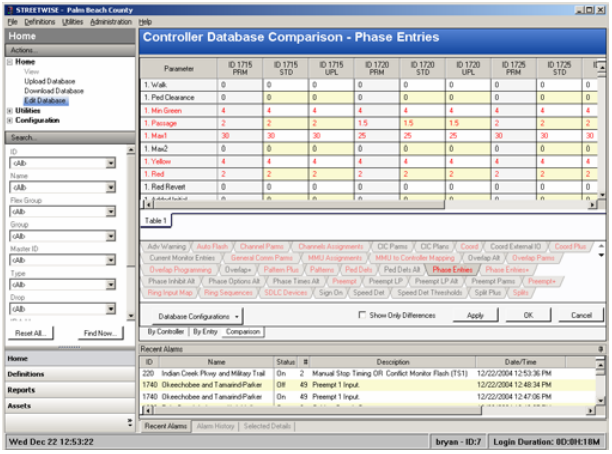


The following feature allows database changes per ID of all entries in one screen. Notice the list of selected controllers, allowing the user to quickly copy/paste from ID to ID. The user can copy and past cells, rows, columns, and grids. Users navigate between entries using tabs on the right.

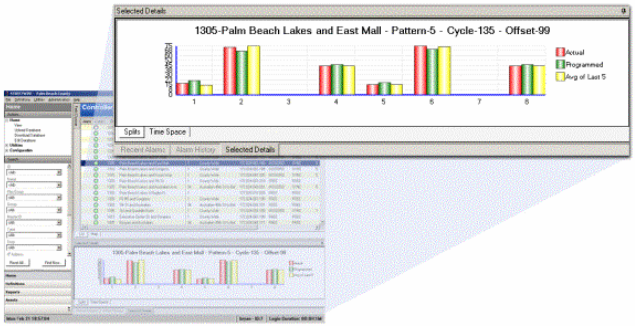


The user can jump from one view to another, then download only the edited cells to strictly the edited controllers with one click.

Controller Database Comparison—This screen compares across multiple configurations and controllers simultaneously.

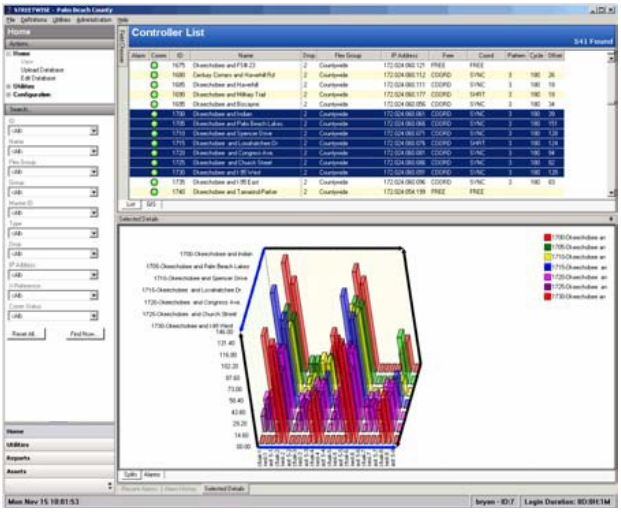


Real-Time Split Screen—This screen provides the user with a single intersection's real-time split information in graphical form. Both the tabular data in the main view and graph near the bottom of the screen will update as the split data changes.

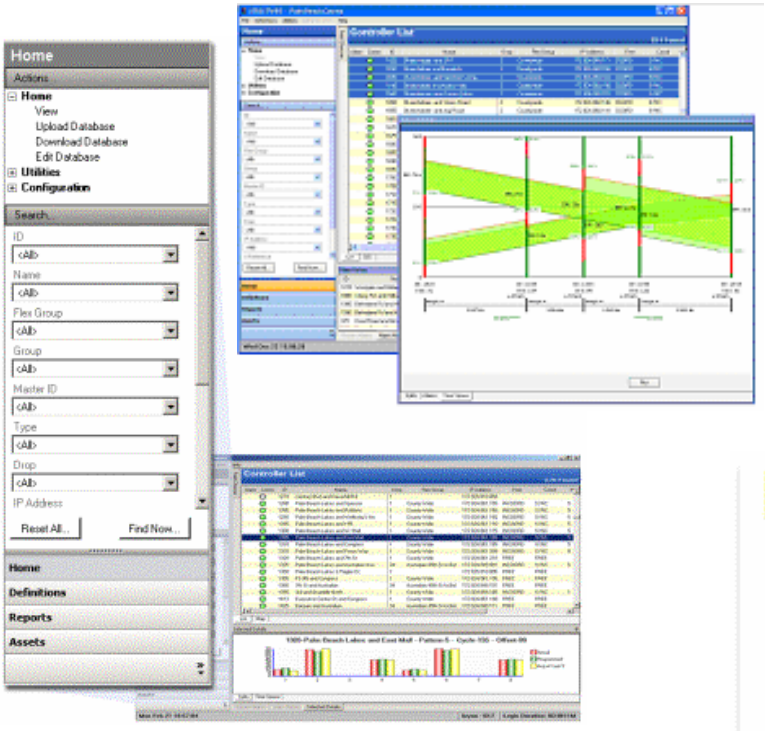


522 Gillingham Sugar Land, TX 77478 281-240-7233 Trafficware.com

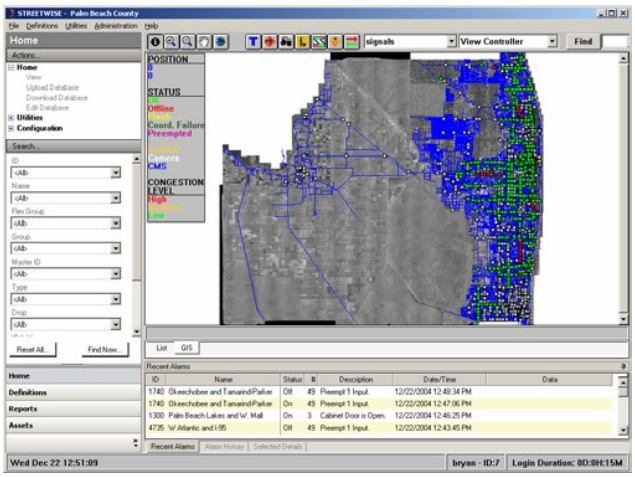
Another feature provides for multiple selected intersections and plots a 3-D graph of splits for all selected. This view is useful in comparing relative values across intersections.



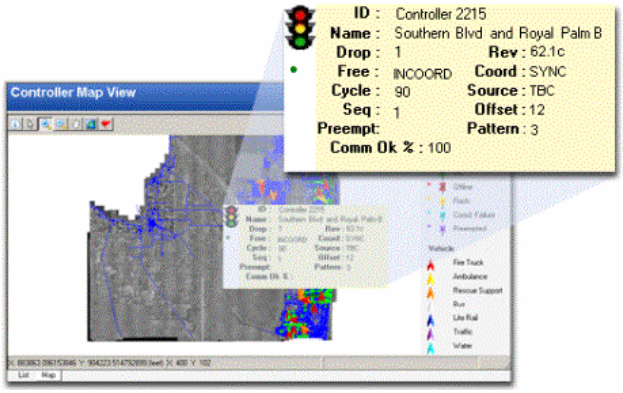
Time-Space Diagram—The user can plot a real-time time-space diagram by selecting a group of controllers. The resultant diagram shows split times, offset times, bandwidth values, speed, and a few other enhancements. The split data used in the diagram is obtained in real time.



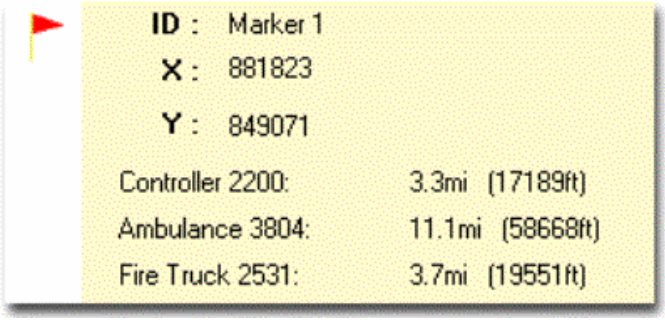
Sample GIS View—A complete system network can be displayed, including multiple layers and images.



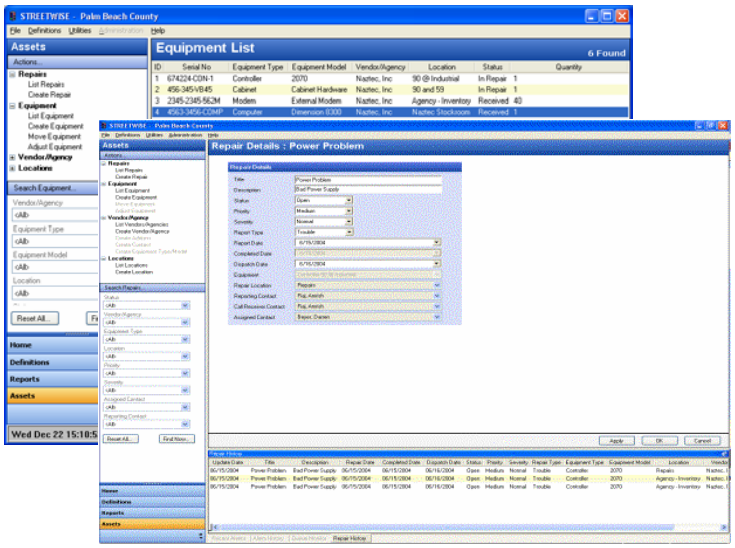
Controller Data Updates in Real-Time—By placing the cursor over a particular controller, the user is presented with detailed current information.



Distance Marker—The user can designate a point of interest by placing a marker on the map. The system will calculate the distance from market to the nearest instrumented objects in the network.



Asset Management Module—The user can track equipment inventory and repair history.

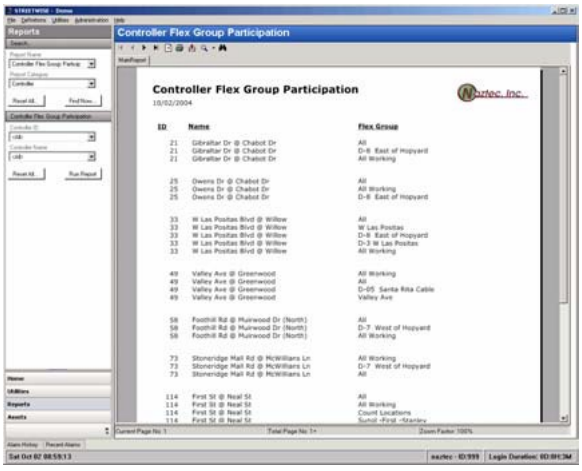


Crystal Reports™ Integration

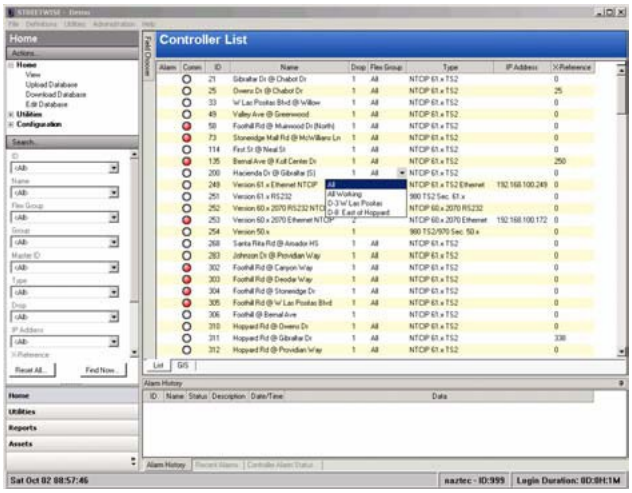
Through the integration of Crystal Reports™, the user can transform system data into presentation-quality information to make better operating decisions, with compelling views of key features and characteristics created easier and faster than ever before. Through this interface, the user now has the ability to:

- Design reports quickly and easily
- Create the right report
- Build compelling data views
- Maintain a seamless flow of data
- Share information
- Integrate smoothly

The figure below shows a report that can be run to determine a controller's Flex Group(s) participation.

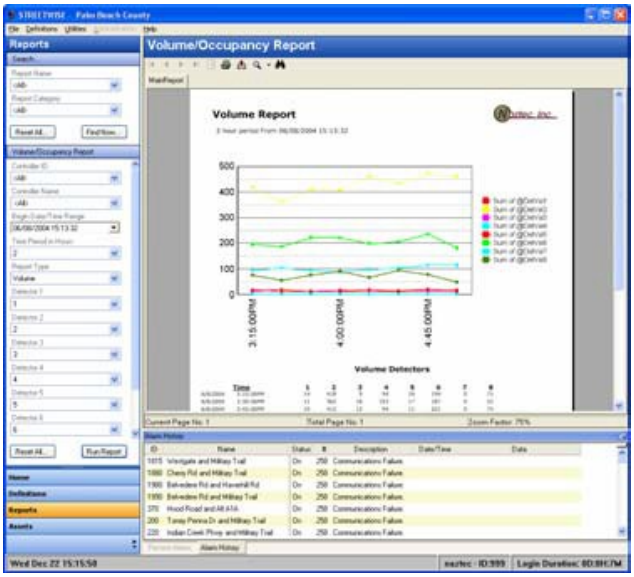


The next figure shows the complete list the user would be working from. The user can just click on the Flex Group(s) for a controller and the screen will display all of the controller's assigned Flex Group(s).



Users can also reduce the list of controllers by using "Flex Group" as a search criterion. The user is then able to edit/upload/download these controllers together. Reports can be exported to RTF, PDF, or Excel format.

The following report contain data presented in graphical format.



Functional Software Specification

For

ATMS.now™

Advanced Traffic Management System (ATMS)

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1.0 General System Requirements Overview

This specification sets forth the minimum requirements for an Advanced Traffic Management System "ATMS" Central Software package. The ATMS shall be capable of monitoring and controlling ten thousand of intersection controllers using state-of-the art architectures including TCP/IP and NTCIP. The system shall consist of a TCP/IP based client/server application providing multi-user access to all ITS field devices from an ATMS center and also center-to-center.

The communications system interfacing the ATMS with the field devices is not covered in this specification. However, the ATMS shall be capable of supporting any combination of FSK (Serial), Wireless, Dial-Up, DSL, and Ethernet based data communications that comply with current NTCIP specifications.

The primary ITS field devices supported by this specification shall include Actuated Signal Controllers (ASC) that comply with NEMA TS1 and TS2 specifications, 170 and 179 based controllers upgraded with TS2 compatible prom modules, 2070 and 2070N specifications. The ATMS shall support the functional requirements of these devices incorporated into the system. The following specifications shall be mandatory to the intent of these specifications and shall be considered part of the basic ATMS Central Software product without the required purchase of additional software modules.

The ATMS software and controller(s) shall conform to all corresponding Federal NTCIP sections as listed below:

NTCIP 1101, NTCIP Simple Transportation Management Framework (STMF)

NTCIP 1102, NTCIP Octet Encoding Rules

NTCIP 1201, Global Object Definitions

NTCIP 1202, NTCIP Objects for ASC

NTCIP 2001, NTCIP Class B Profile

NTCIP 2102, NTCIP Sub-network Profile – PPP / RS-232

NTCIP 2104, NTCIP Sub network Profile – Ethernet

NTCIP 2301, NTCIP Application Profile – STMF

NTCIP 2301, NTCIP Application Profile – TFTP

NTCIP 2301, NTCIP Application Profile - FTP

These documents may be ordered from:

NEMA
1300 North 17th Street, Suite 1847
Rosslyn, Virginia 22209
(703) 841-3200

or

Institute of Transportation Engineers

1099 14th Street, N.W., Suite 300 West

Washington, DC 20005-3438

(202) 289-0222mum Required System Performance

The primary system objectives shall be as follows:

1. System-wide signal coordination
2. Coordination backup
3. Continuous once-per-second full status monitoring of all controllers via NTCIP
4. Unlimited number of workstations attached to user interface network
5. Central system transmits and receives data (once-per-second) to all local controllers simultaneously over multiple communications formats
6. Operational failure logging, indicating control and communications failures by date, times of occurrence and location of failure
7. Measures of Effectiveness (MOE) summaries obtained from local system detectors and stored for historical reference in the central database system
8. Real-time full status received continuously on a once-per-second basis from local controllers
9. System Map level status display with real-time information in GIS layer format for all intersections and system devices.
10. Intersection status displays with real-time information in multiple, simultaneous graphic formats for operator selected intersections. Displays shall include real-time signal status as a GIS layer, General Information, Detector Status, Alarm Status, Controller Front Panel display, and Controller Coordination Display for each selected intersection
11. Manual or automatically-generated uploading and downloading of all local timing data parameters to/from field controllers via the communications network
12. Dynamically re-configurable sections based on operator command or schedules
13. Automatic reporting of failures and malfunction to users and designated administrators
14. Controller data base management for a minimum of eight (8) databases per controller
15. The workstation software shall be able to run natively in Windows XP, 2003, Vista and Windows7
16. The server software shall be able to run natively on Windows Server 2003 or Windows Server 2008, and utilize Microsoft SQL Server 2000/2005, or newer, both on dedicated hardware or Virtual Machine “VM” platform

1.1 ATMS Components and Options

The ATMS shall offer a software solution that supports the following within the core product:

- School Zone Flashers
- *Alpha* BBS Integration
- Integrated *Traficon* Video Detection
- *Opticom* Optical Preemption Systems
- Real-Time Split Monitor and Time-Space MOE's
- *Trafficware* Synchro 7/8 and SimTraffic Integration
- Incident Detection and Triggering
- Road Temperature Sensor Detection
- *Jamar* Counter File Integration

The ATMS shall offer the following enhanced software solutions, available as additional modules:

- CMS, VMS Signs
- CCTV Surveillance
- Light Rail Control Systems
- Transit Priority System with Automatic Reporting
- Traffic Responsive with Central ATMS Master
- Traffic Adaptive with Central ATMS Master
- Traffic Adaptive with SynchroGREEN Master
- HOV Lane Control
- Reversible Lane Control Signals
- Freeway Management
- Public Information Web Interface

1.2 System Architecture

1) The overall architecture of the system shall be a client/server design based on distributed open architecture concepts. Processing shall be distributed and "open" communications protocols shall be used for all interfaces, such as NTCIP and AB3418/E.

2) The system shall be implemented using standard, commercially available Personal Computer (PC) hardware.

3) The software shall be portable across multiple hardware platforms and shall be designed to integrate with off-the-shelf PC software. For example, the standard ATMS software shall provide the ability to exchange files with common Geographic Information Systems (GIS), databases, Computer Aided Design (CAD), and spreadsheet products.

4) The ATMS software shall be built upon Microsoft .NET Framework and utilize XML Data Exchange.

5) Intersection controllers shall be microprocessor based and shall include coordination, time-based control, preemption, and communications capability. The system shall be capable of managing up to 9,999 controllers.

6) Control modes shall be provided to allow the system user the ability to control the system at multiple levels.

7) Controller level control modes shall be provided for Traffic-responsive, time-of-day, manual, failed, off-line, and flash.

8) Central level control modes shall be provided for Traffic-responsive, time-of-day, manual, and central-flash.

9) System Level control modes shall be provided for Off-Line and On-Line intersections.

10) System design shall provide backup capabilities to allow continuation of a satisfactory level of coordinated operation should a central office, communications hub, communications link, or intersection controller failure occur.

11) At the central office, a local area network (LAN) shall support the distributed client/server architecture. Client workstations shall access network computers that perform traffic management, database management, and real-time traffic control functions. Field communications processing shall be distributed between the central server, optional communication hubs, and local controllers without the use of network drive sharing within the agency or between the ATMS software and the Client workstations.

12) System operation shall be performed by the system user(s) to:

    a) Generate and display real time GIS-based maps for full System, Regional, and Intersection level views.

    b) Issue manual commands to the intersection controller(s).

    c) Provide intersection controller data base management as follows:

- Upload database from controllers
- Edit database and save on disk
- Download database to controllers
- Compare controller databases
- Copy controller databases, partial or whole.
- Retrieve detector logs and event logs from local controllers

d) Generate reports from system data directly from the field or server.

e) Provide eight (8) complete databases for each intersection controller definition.

13) The system shall be designed to enable expansion without redesign of any of the system components. Expansion shall require only the addition of hardware components, software replication, and expanded database creation.

1.3 Local Area Network (LAN) Compatibility

The system software shall be capable or operating in the public agency's LAN configuration with a minimum of one server computer and unlimited workstations. The LAN shall provide the capability of having multiple users and multiple workstations working simultaneously on a common database. The ATMS server shall provide a bi-directional, web-based data transaction with the Client workstations, without the need for mapped network drives, folder shares, or file shares.

1.4 Software Installation and Updates

The ATMS system software shall be loaded into the specified server computer hardware by the supplier and operationally verified by the supplier. A web-based, menu driven installation program shall be provided for loading each ATMS Client to the workstation computer(s). The use of CD's, DVD's, or Floppy Disk Media will NOT be accepted to load the server or the workstation client software.

The furnishing supplier of the ATMS software shall provide a site wide software license to the agency for its use on all computers within the agency. Standard software upgrades, corrections or required modifications for proper system operation per this specification shall be furnished to this agency at no additional cost for the life of the system. All ATMS updates shall be applied only to the server, and each ATMS client shall automatically update when the next login occurs for each workstation location. No other methods of applying ATMS Client updates will be accepted.

2.0 Main-Home Interface

2.1 Graphical User Interface "GUI"

All traffic system reports, graphic displays, and dialogues shall be functions of the user interface software running on individual workstations. Each workstation shall access data as needed from the ATMS Communication/Database server(s). The operator shall access system functions using GIS map-based graphical displays.

1) The ATMS software interface shall be comprised of three main sections: 1) Main Interface (Home), 2) Systems Definitions, and 3) Report Generation.

2) Graphical icons shall be used on the graphical displays as layers to represent system devices within the GIS mapping system. The icons shall provide easy access to traffic control data and timing, real-time signal status, congestion LOS information, Cameras, DMS/CMS signs, Network Switches, and general device control.

3) All workstation user interface functions shall be implemented using a MS Window-based graphical user interface (GUI) concepts conforming to Microsoft Windows standards. Proprietary software framework and tools will not be accepted.

4) The GUI shall use pictures, symbols, line graphs, and multiple fonts in conjunction with a pointing device (e.g. a mouse or track ball) to interact with and allow an operator to enter decisions, draw graphics, issue commands, and receive information from the system.

5) Graphical symbols (icons) shall maintain its precise coordinates and proportional map size as the GIS map view is zoomed in and out.

6) The graphic map shall act as a system selection palette enabling the operator to make a selection by pointing to a particular system object (i.e. controller, camera, changeable message sign, etc.). When that system object is selected, it shall be uniquely identified by being "highlighted" or a secondary marking such as a "pin" marker, and a more detailed status window shall be capable of being displayed from the selection.

7) The GUI shall utilize Microsoft "Tool Tip" to display real-time status for all devices represented on the GIS system map. The "Tool Tip" shall appear when the cursor is placed over the device icon on the map corresponding to its activation on the GIS Legend.

8) The GUI shall provide access to all monitoring and control options from a single point. As a result, all operator actions shall be immediately visible as graphical status changes and on screen display windows. All status or programmed changes to the system shall be immediately visible to all other users logged on the system, without a manual refresh or required re-login into the system.

9) The GUI shall allow for navigation between all system functions from within a single visual windowing framework. All functions will be accessible through tab-style menu navigation, with the principle screen area used for the current task at hand. The user interface shall also allow for real-time alerts to be visible at all times regardless of the application context. Secondary screens and "pop-up" windows for main system navigation, editing screens, and system control will NOT be accepted.

10) The GUI shall enable moving from one task to another given a user-selected set of intersections without the need to re-select the intersections in between tasks.

11) Controlling actions within the GUI shall be achieved via standard mouse control, “right-clicking” and by a fixed menu, each offering the identical menu of control.

12) The GUI shall provide two primary control interfaces, a tabbed “List” view and a GIS map-based view. Each interface shall provide the identical real-time status information and control. Controller selection from one format (List or GIS map) shall immediately display the same selection criteria on the other format, meaning that List and GIS map shall be completely corresponding with each other in navigation, selection and function.

13) The GUI (List or GIS map) shall provide real-time at-a-glance intersection status information including

    a. TBC
    b. Local Counter
    c. Cycle
    d. Offset
    e. Phase Sequence
    f. Preempt Status
    g. Controller Firmware Revision
    h. Free and Coord Status
    i. Current Operating Mode
    j. Current Split Index
    k. Last Data/Time from Intersection
    l. Total Number of Communication Transactions
    m. Number of Successful Communication Transactions
    n. Percentage of Successful Communication Transactions
    o. Number of Failed Communication Transactions
    p. Percentage of Failed Communication Transactions
    q. Current Communications Status
    r. Current Alarm Status

14) The GUI shall provide a search engine filtering mechanism to quickly navigate the List or GIS map view to a specific, targeted group of controllers. The search engine shall provide look up by the following criteria:

    a. Intersection ID

b. Intersection Name
c. Group assignment
d. Master Intersection
e. Controller Type
f. Communication Port
g. IP Address
h. Communication Status
i. Current Pattern
j. Flash
k. Coordination Failure
l. Preempted
m. Current Cycle
n. Alarm Status

15) The GUI shall enable intersection operations to be performed against multiple intersections simultaneously within one window. This includes:
    a. Controller Database Editing
    b. Controller Database Viewing
    c. Controller Database Uploading
    d. Controller Database Downloading
    e. Controller Database Comparison
    f. Controller Coordination Diagnostics
    g. Viewing of Real-time Metrics, including
        i. Phase 1 – 16
        ii. Overlap 1-16
        iii. Call 1-16
        iv. Ped Phase 1-16
        v. Ped Call 1-16
        vi. Controller Firmware Revision
        vii. Current Pattern
        viii. Current Preempt

ix. Successful Communications Percentage
x. Ring 1-4 Min
xi. Ring 1-4 Max
xii. Ring 1-4 Ped
xiii. Current Cycle Length
xiv. Current Phase Option
xv. Current Time Based Counter
xvi. Current Offset
xvii. Current Phase Time
xviii. Current Local Counter
xix. Current Split Number
xx. Current Detector Group
xxi. Current Transition
xxii. Current Sequence
xxiii. Current Free
xxiv. Current Call/Inhibit
xxv. Current Source
xxvi. Detector Calls 1-64
xxvii. Controller Front Panel Display
xxviii. Real-time Dynamic Graphics Displays
1. Show dynamic layout against a GIS background
2. See Dynamic Graphics Displays below

h. Instant Pattern
i. Instant Preemption
j. Download of System Time
k. Conflict/MMU Reporting
l. Opticom Reporting
m. Coordination Failure
n. Clear Alarms
o. Edit Controller Definition
i. Name

ii. IP Address/Communications Port

iii. Master Controller Identity

iv. Group Assignment

p. Phase/Detector Lane Assignment

q. Linkage to Adjacent Controllers

r. Congestion Level Specifications

s. Customized Detector Groups

16) The GUI shall provide interactive viewing filter to enable each system user to customize the viewing screens and amount/type of dynamically displayed data. The ATMS shall store the viewing preferences of each user and present the specific, customized view for each user upon next login.

17) The GUI shall provide for an optional window that actively tucks away or can be set to format within the main active window. This optional window shall provide for the display of select controller status windows such as General Information, Alarms, Detector status, Coordination status, and Front Panel. This window shall also provide auxiliary system display for information such as temperature, etc.

2.2 List Interface

The List view interface shall provide full real-time status information and control for each intersection. The List view shall provide organization of data in a user-defined set of columns and rows. The controller status information, which shall be displayed in columns, shall display based on each user's selected preferences for displayed fields. The ATMS shall remember the display preferences for each user. The List view shall provide for the user to re-arrange any of the data columns in a specific order, and maintain that order for all subsequent logins for that user.

The List view shall display the controllers based on search engine filtering and/or GIS map selection. All ATMS system control and edit actions shall be available through the List interface.

The List view shall display all dynamically-collected data objects from the controllers as the system collects it.

2.3 GIS Map Interface

1) The GIS Map view shall provide a real-time, GIS-based, status map display of all of the system elements. All standard GIS zoom functions and layer actions shall be integrated in the GIS map. The user shall be able to select any combination of GIS layers to be displayed at any time. The specific controllers that are displayed on the GIS Map view shall be directly controlled by selection activity from both the Search Engine and the GIS Map.

2) The GIS Map view shall offer a Legend, which shall enable the user control over the displayed layers on the map. Each data type, such as Controllers, Events, Congestion, Switches, Cameras, CMS signs, Bus Routes, Light Rail, Fire Stations, etc, shall be displayed as a distinct layer on the map. Layers that represent devices that dynamically change status such as Controllers and Congestion shall be updated in real time as per the scheduled ATMS system programming. The real-time condition of each object on the map shall be color-coded according to the Legend.

3) The ATMS shall provide for direct integration to third-party software interfaces such as Cisco, Traficon Video Detection, Actelis Networks, Core-Tech, and Industrial Video & Control. These interfaces shall be accessed directly through their respective layer on the GIS Map interface. Selection of the device icon shall launch the products' distinct software program without interruption to the ATMS operation.

4) The ATMS software shall provide a Microsoft "Tool Tip" window when placing the cursor on a specific object. This window shall provide vital object information such as status and location. For the Traficon Camera interface, the "Tool Tip" shall initiate a request for video feed, and display a full-streaming camera image within the window instead of numerical status.

5) The GIS Map control shall be offered from a GIS toolbar for the following functions:

   a) Information – Selecting this function will provide real-time information of the active layer using a "Hover Balloon", by placing the mouse over the desired map object. The hover balloon displays real-time status for any of the active layers on the GIS map, including Controllers, Congestion, Cameras, CMS signs, Switches, etc.

   b) Select – Selecting this function enables the user to "Wrap-Around" the desired object or group of objects to launch control. When this is used to select Controllers, the user can "Right-Click" to open a small Action pane window on the GIS map.

   c) Zoom-In – Selecting this function will allow the user to click on a point on the map and wrap around a desired area to zoom.

   d) Zoom-Out – After selecting this, clicking once on the map will zoom out 1 measure of extent.

   e) Pan – This enables the user to "grab" the map and slide it in any direction.

   f) Full Extent – By clicking this icon, the GIS map will zoom out to the fullest extent.

   g) Marker – The user can place a marker anywhere on the map to calculate distances to nearest system components.

   h) Event – This shall enables the user to select an exact point on the GIS map, create an Accident, Construction Zone, or Slow Zone, and place it directly on the GIS map in real-time or can be scheduled for activation at a future date. This action shall add the newly-created Event to the "Events" layer on the GIS map at the programmed activation time. At the time of creating this Event, the user can program the ATMS for date and time of Event activation, and de-activation, which includes placing and removing the Event icon on the GIS map. The Event shall also have the ability to be indefinite, requiring manual removal.

   i) Create GIS Preset – This function shall enable the user to create any number of preset views on the GIS mapping system, with the full zoom value reached within one action. The GIS preset shall allow for the view to be specific to a creator or all system users.

j) Previous View – This shall enable the user to quickly navigate the map back to the previous view.

k) Preset View List – The GIS toolbar shall display a list of all available pre-programmed presets for the logged-in user. By selecting a preset the GIS will automatically navigate to the programmed view.

2.4 GIS Legend

A GIS Legend shall provide layer view and layer-based element control on the GIS map to enable the user to control the amount of displayed information. The layer-based element control shall enable the user to exercise system control of a specific ATMS device type where there are many ATMS objects represented on the map, navigating directly through to the desired object. The Legend shall offer two separate layer control check boxes, one to activate the layer for viewing on the map, the second to activate the layer for communication and control. Each distinct layer shall be capable of toggling "ON" or "OFF". Any combination of views shall be offered at any time, and the layer views shall be adjustable in real-time.

The GIS Legend shall be able to be "tucked-in" or "pinned-up" by using the Push Pin, just like the Field Chooser screen. The layout of the GIS Legend, layer display, and information columns shall be memorized by the ATMS on a user-by-user basis, creating real-time system preferences for the next log in session.

2.5 Detailed System Information

1) The ATMS software shall display real-time secondary system information and tools for the user, including detailed alarm information, weather updates, split monitoring, time-space monitoring, Opticom event reporting, currently logged-in users, monitor reporting and viewing of indexed document information by intersection. In sections that display multiple types of categories, such as alarm information, a customized data filter shall be provided to control the types of displayed information by user. The portion of the screen that this detailed information is displayed shall be re-sizeable and provide an option to "tuck-away" behind the edge of the screen.

2) Incoming Alarms shall be displayed with a time, date, intersection, alarm type, and alarm state. The system shall provide a view of the most recent alarms during the logged-in session and a brief historical list of the 100 most recent system alarms. All alarm descriptions shall be capable of being customized by the user. All system alarms shall be stored in the ATMS database and capable of being searched in the Reports section of the ATMS. All incoming alarms shall be able to be forwarded to agency personnel via paging, text messaging, or e-mail alert.

3) The Opticom system information shall be real-time discriminator log information retrieved from Opticom model 752 and 754 discriminator cards. The ATMS shall capable of retrieving the most recent EVP information from the appropriate Opticom card within a maximum of 5 seconds of the local EVP event. The ATMS shall initiate a retrieval of the full pre-emption event from the discriminator card via the traffic controller communications, and display all of the Opticom event information including time, date, EVP channel, emitter ID code, activation time, emitter range, etc. A historical database of all Opticom preemption events shall be stored in the ATMS database and a report template shall be provided to generate an Opticom report based on date, time, and intersection.

4) The Split information shall be provided both graphically and numerically in real time. The split monitors shall track split information for the current cycle as well as historically during the active pattern. The

historical tracking shall provide running calculations of number of Force-Offs, Max-Outs, and Gap-Outs, as well as percentage of split time utilization. All information shall be provided for each operating phase.

5) The Notes and Documents indexing capabilities shall be fully integrated with third-party applications such as Adobe Acrobat, AutoCAD, Notepad, Word, etc. All Notes and Documents shall be stored and displayed by their assigned intersection for easy indexing and retrieval.

6) The ATMS shall provide real-time weather report information that actively monitors National Weather Service alerts for the agency's region. The ATMS shall provide audible, visible and paging alerts to specified users.

7) The ATMS shall monitor and provide a real-time list of users that are logged on to an ATMS Client at any time.

8) The ATMS shall be capable of retrieving and storing all CMU/MMU logs by intersection and by system. The logs shall be easily accessed though the main list and displayed through a web-browser interface upon selection.

9) The ATMS shall be capable of interfacing with a GPS logging device for the purposes of overlaying travel-time information within the system's Time-Space diagram to evaluate progression performance.

2.6 System Actions

1) The ATMS shall be capable of instantly editing, viewing, uploading, downloading, comparing, or performing coordination diagnostics simultaneously on multiple controllers. These functions shall be performed within the main view without "pop-up" windows. The user shall have the ability to download a minimum of seven (7) distinct databases to the field at any time, without data loss to the other databases. The download function shall offer an optional verification utility for database integrity, that performs and initial field upload and compare/check prior to performing the download to the field.

2) The coordination diagnostics shall match the diagnostic logic in the controller(s), and shall specifically identify any parameter within the timing database that will prohibit the coordination pattern from properly operating. The coordination diagnostics shall be capable of being simultaneously performed on multiple controller databases.

3) The ATMS shall provide the ability to copy selected data parameters or complete databases from one controller to another through a simple navigation and selection process.

4) The ATMS shall store a time-stamped copy of each database into a dedicated archive folder each time the ATMS downloads a new database. The archived database shall include information regarding the date and user that performed the action. Each archived shall be available to compare against any other database to determine field changes and the person performing them.

5) The ATMS shall provide real-time intersection information in multiple display formats for one or more intersections simultaneously. This information shall launch a dedicated window that can be moved to a dedicated monitor without disrupting the main ATMS user interface operation. The real-time intersection information shall provide windows for General Information, Detector status, Alarm status, Coordination status, GIS aerial view with indications, and the Front Panel of the controller display.

6) The ATMS shall be capable of instantly downloading a user-selected Pattern, Preempt, or Special Function to a controller or group of controllers. The instant function shall immediately override the active pattern or function for a corresponding duration of time. The user will select the intersection or group of intersections, choose the desired operation and download to the field.

7) The ATMS shall be capable of manual and system generated controller time synchronization from the server.

8) The ATMS shall provide a CMU/MMU event, trace, and programming reports retrieval for users to upload the NEMA monitor information via the controller's communications port. The monitor information shall be sent to the server database, where a specific log can be viewed manually or generated in the Report section.

9) The ATMS shall be capable of downloading the server's time to any Opticom unit that is connected to the selected controller(s). This will enable a constant time reference to be used by both the controller and the Opticom units, and enable the Opticom logs to display accurate event data.

10) The ATMS shall provide a utility to upload the results of the controller coordination diagnostics from the selected controller at any time, for evaluation.

11) The ATMS shall provide a utility to reset any coordination diagnostic failures (errors), so that the controller can attempt to transition back into coordination while the same pattern is active.

12) An alarm-clearing selection shall be available for users to clear the real-time alarm data from a controller, group or flex group of controllers.

13) The ATMS shall provide a Time of Day Schedule printout, which presents a printable calendar of coord data. This data shall be displayed and printed in Daily, Work Week, Weekly, or Monthly formats.

14) The ATMS shall provide for system notes and documents to be assigned to specific controllers for indexing and organized archiving.

15) The ATMS shall provide an import and export utility with Trafficware Synchro 7/8 signal timing optimization software. The ATMS shall have full UTDF database integration between Synchro7/8 and the ATMS SQL database. The Synchro Import/Export utility shall provide the ability to Export traffic counts and FREE timing as a combined ".csv" file (native format) to Synchro for processing and optimization. The Import function shall provide the ability to import a combined ".csv" file which includes a combined Phasing and Timing tables from the Synchro7/8 program directly into a controller database file. Synchro 7 combines the "Timing.dat" and "Phasing.dat" files into a single ".csv" file.

16) The ATMS shall provide for the ability to send a text message to other users logged into the ATMS system.

17) The ATMS shall provide an Export utility that directs controller database parameters directly into a user-defined Excel file.

18) The ATMS shall provide for the ability to send a time synchronization directly to the controller or its Opticom cards through a simple, manual command.

19) The ATMS shall provide for controller creation, editing, and delete functions.

20) The ATMS shall provide the user to define and edit an intersection's Turning/Phase Movement definitions for the purposes of proper report generation. The *Turn/Phase/Directions* section shall take incoming controller detector count and preemption information and associate it with the correct phases and directions for proper report generation.

21) The ATMS shall provide the user to define and edit an intersection's approach speed and distancing definitions for the purposes of proper Time-Space Diagram generation. The intersection link and speed shall be used to associate the controller's active pattern and offset information and associate it with the current cycle timer by providing the necessary approach information for the intersection. This information includes Intersection at the other end of the approach leg, approach Speed, and Distance between intersections.

22) The ATMS shall provide congestion level programming that will enable the user to define and edit an intersection's congestion level definitions for the purposes of proper display on the "Congestion Level" layer of the GIS map. The ATMS shall take inbound traffic counts from each controller and classify the value against the Congestion Level thresholds for LOW (Displayed in GREEN), MEDIUM (Displayed in ORANGE), and HIGH (Displayed in RED) for that collection period. Congestion level calculations shall be provided based on volume counts and occupancy.

23) User Defined Detector Groups shall enable the user to define custom groups of detector assignments for the purposes of customized report generation. The User Defined Detector Groups create special detector group sets within the ATMS. A user shall define up to four different groups of any combination of ten detectors.

2.7 Database Management

1) Database management shall allow programming of intersection controller databases. Each intersection controller shall have separate database programming pages. These pages shall contain all the programming options unique to each intersection. Each intersection shall have a permanent database, the current field copy (the uploaded file), a working-edit copy and five additional complete databases that the user can edit, modify and download for any reason. The ATMS shall have a total of eight databases for each intersection.

2) All database parameters shall be based on their NTCIP data type. The NTCIP ObjectID and parameter name shall be available from within the database editor of the ATMS.

3) All programming entries shall be represented using values consistent with their NTCIP data type. Integral values shall be depicted and validated as integers. The validation shall also enforce the upper and lower bound as specified by the NTCIP definition. Likewise, decimal data types shall be depicted and validated as decimal numbers. String data types shall enforce the appropriate string length. Enumerated data types shall display all possible data types as appropriate for the controller type.

4) During program entry, the new data shall overwrite the old data. If the data is in error, changes shall not be permitted and the error shall be highlighted on the screen.

5) The GUI shall enable printing of all or some of the controller database information. The user shall be able to choose which database information to print.

6) The GUI shall enable exporting of the database information into Excel format

7) The GUI shall permit simultaneous editing of an unlimited number or controller databases. The database editor shall enable the user to see all entries for a single controller or the same entry across multiple controllers.

8) The GUI shall enable the user to select which data fields are to be displayed for any given data category.

9) The GUI shall enable the user to simultaneously maintain all eight different database configurations and allow comparisons between them.

10) The GUI shall be able to represent the physical turning movement and/or lane assignment of phases and vehicle detectors from within the database editor.

11) The GUI shall enable copying of parameter data between cells, entries, categories, and controllers. The GUI shall enforce applicable NTCIP rules for parameter information when copying.

12) The GUI shall provide a navigational filter to display the targeted data types for editing and viewing.

13) The GUI shall provide a compare utility with the ability to feature only differences between selected databases.

2.8 Uploading and Downloading of Databases

1) All controllers shall use upload/download for database programming from the ATMS.

2) Upload/download shall transfer the entire programmable data base from/to the selected intersection controller(s).

3) All upload/download data shall use block transfer techniques and be verified. Non- verified data shall cause termination of the upload/download with no data transfer taking place. It shall not be possible to load erroneous interval and configuration information to the controller.

4) Upload techniques shall not cause the section or intersection controller to go off-line. Traffic control operation shall remain intact in all respects.

5) Following an upload, it shall be possible to compare the database of any intersection controller to the database on file. The compare function shall be executed by a simple menu selection or keyboard technique and shall identify any differences between uploaded and file data. The system operator shall be able to correct, use, or substitute data values and proceed with further comparison.

6) The user shall be able to perform downloads based on parameters that have most recently changed in lieu of performing a complete database download.

7) The upload function shall allow the user to direct the database upload directly to the record copies in the ATMS, or to only the “upload” copy for comparison.

8) All upload and download functions shall provide progress bars with percentage complete status.

9) The ATMS shall provide two different download functions. The first shall generate an upload and database comparison, then download upon verification that only proper, known changes will occur. The second download type shall download and overwrite the controller database without employing check and balances. Any of the databases shall be capable of being downloaded using either method, given proper user permissions.

10) The ATMS shall provide an interface for Palm PDA database storage and transfer. The Palm PDA shall be capable of “Hot-Sync” utility that compares most current controller file dates and transfers the most current files between the ATMS Server and Palm PDA. The Palm program shall be capable of storing the official databases for all controllers within the ATMS system. For file integrity protection, the PDA shall not provide editing capability to the controller databases.

3.0 System Definitions

1) The ATMS shall provide a dedicated section for defining ATMS system parameters outside of primary controller definition. The system definitions section shall include, at a minimum, definition parameters and utilities for the following:

    - Alternate Alarm Description
    - Alarm Notification
    - Controller, Camera, and CMS Incidents
    - Camera Tours
    - Controller Grouping
    - Database Backup and Archiving
    - GIS Shape File and Layer Editing
    - Incident Triggers
    - Jurisdictions
    - Messages for CMS/DMS
    - Real-Time Status Layer Builder
    - Report Criteria Templates
    - System Scheduler
    - System Devices
    - Users and User Groups
    - JAMAR Road Tube Counter Import

2) Where applicable, each category of the system definitions shall provide for “List”, “Create”, “Create From”, “Edit”, and “Delete” of the items within the category. All functions that are displayed within the ATMS shall be permitted for the user that is logged in. An unauthorized action shall not be displayed, grayed-out or otherwise, if it is not allowed for the specific user.

3) The system definitions section shall provide a search engine for easy navigation where navigating though large data sets is required.

4) The ATMS shall provide for the user to create an alternate naming system for all of the controller alarms. These alternate names shall appear in all locations that display incoming alarms, including reports and notification messages.

5) The ATMS shall provide for Alarm Notification setup. This shall enable the user to create a system-generated notification schedule to send a page, e-mail or web message to a specified user when certain alarms are detected by the system. The notification shall be customized by user, alarm type, and time-of-day.

6) The ATMS shall provide for controller-initiated system behavior of other controller(s). This shall be system-generated controller actions based on a reported alarm input from a single controller. These

local inputs shall cause a pre-programmed reaction of another controller or group of controllers. An example of this would be to cause a complete coordinated arterial to automatically transition to "FREE" operation if a critical intersection in that arterial issued a "Coord Fail" alarm to the ATMS. Each event shall be logged in the ATMS database for future report generation and reference.

7) The ATMS shall provide a utility to enable the user to perform SQL and controller database backup through the ATMS while the system is running. The Archive shall store all a copy of the entire systems SQL database with the SQL data and log files, as well as all of the controller databases in a zipped format. All backups shall be copied to a user-programmed file or server location.

8) The ATMS shall provide a utility to archive the SQL database within a user-defined amount of time. This utility shall cut and eliminate the SQL database that does not fit within the programmed date in order to reduce the size of the overall SQL database on the server.

9) The ATMS shall provide the ability to assign controllers to On-Line and Off-Line status. This function shall allow the user to limit the communication of information to only those devices that are actually "online" and communicating to the central server. By designating controllers that are offline, the user can isolate the controllers that are not ready for communication from the controllers that are operational and need to communicate to the ATMS.

10) The ATMS shall provide for Controller or Congestion Level-initiated camera and CMS behavior. This function shall provide system-generated Camera and/or Changeable Message Sign behavior based on an incoming field alarm from a controller or congestion level thresholds for a specific intersection approach. Upon the receiving the alarm the ATMS shall launch the camera view interface and PTZ to a pre-programmed preset view, and the CMS sign shall display the assigned pre-programmed message. Each event shall be logged in the ATMS database for future report generation and reference.

11) The ATMS shall provide camera tour integration with Industrial Video & Control. The camera tour feature shall provide for a pre-programmed "Touring" of selected camera sites and preset views. Each preset view is to be programmed for a dwell time before going to the next camera view. This feature shall be used to save time by eliminating the need to manually launch multiple cameras and navigate to a desired PTZ location.

12) The ATMS shall provide for the user to create secondary ATMS system devices. The integration with the system devices shall provide the ability to communicate and control additional system Devices through the main control interface. The ATMS shall incorporate various hardware devices, such as cameras, network switches, CMS signs, sensors, etc. After they are created, the user shall be able to place each device on the GIS map for direct control. At a minimum, the ATMS shall communicate with the following devices:

- Cisco Switches
- Actelis Switches
- Traficon Video Detection Cameras
- IP Cameras
- IV&C Cameras
- Core-Tech Video Encoders
- ALPHA & ADDCO brand CMS signs
- IP Temperature Sensors
- Alpha BBS

13) The ATMS shall provide the user a GIS shape file editing utility for the purposes of adding or moving system devices (Controllers and Devices) and Events on the GIS map. This is performed by enabling the user to define a geo-reference value of Latitude and Longitude for any System Device or Event in the database. A full GIS-based tool set shall be incorporated within the ATMS software to enable real-time layer modification.

14) The ATMS shall provide for any combination of controller grouping.

15) The ATMS shall provide the ability to create agency or system events directly though the GIS navigation toolbar, or through the system definition section. The system definition method shall enable the user to manually Create, Edit (including activating and de-activating), and Delete each event.

16) The ATMS shall provide the ability to import complete GIS shape files, providing an easy method for updating of the controller list from an ESRI-compatible ".shp" file that contains signal points, into the GIS mapping system. This function shall offer a single-step alternative to manually creating a controller definition and manually assigning it a geo-referencing value, and shall be available within the application.

17) The ATMS shall provide a utility to export GIS information from controllers, devices and events into Microsoft Excel.

18) The ATMS shall provide for jurisdictional assignment to limit access, editing, and control privileges for departmental grouping within an agency or within an inter-agency architecture. This is a way to enable multiple agencies to safely share the same database. This feature shall enable a user to be assigned to multiple Jurisdictions for enhanced levels of control to multiple sets of controllers. A controller shall be capable of being assigned to multiple Jurisdictions.

19) The ATMS shall provide a utility to create, edit, and delete messages for CMS/DMS signs. The message center shall provide 3 full ASCII capable message lines and be stored in the ATMS database. The messages shall be sent through the CMS layer of the GIS map interface.

20) The ATMS shall provide a utility for creating line segments on the GIS map for color-coding incoming detector counts. This utility shall provide a full tool set for creating and editing the congestion layer of the GIS map interface by drawing parallel lines to the GIS centerlines displayed in the Editor. This editor shall also provide the ability to create routes within the GIS, enabling the GIS mapping system to display recommended alternative routes for the public.

21) The ATMS shall provide a utility to create a new layer by hand to dynamically display real-time status conditions on the GIS map. This display shall offer the user the ability to select which inputs and outputs are dynamically displayed on the GIS layer, as well as their icon parameters. The utility shall allow the user copy and paste selected objects or full intersection layout from one intersection to the next. The utility shall offer a full complement of data point editing, moving and re-sizing tools. This layer shall be capable of real-time GIS status display and having a selectable view on the map.

22) The ATMS shall provide an automated system administer that performs pre-programmed, automated tasks such as full controller status, data collection, time synchronization, database verifications, etc. This utility shall be easily programmed to save staff time and have accurate information ready or more easily accessible for the user. The collected information shall be stored on the server and be available for retrieval at any time. All automated functions shall be available to the user to manually generate without waiting to be performed at its scheduled time. The ATMS shall offer the following manual and automated tasks:

    a) Alarm Polling

    b) ATMS Master Polling

    c) CRC Database Calculations (for 7 databases)

d) Database Compare (for 7 databases)

e) Detector Event Polling

f) Diagnostics Report

g) Download Database w/No Verification (for 7 databases)

h) Download System Time

i) Download Database w/Verification (for 7 databases)

j) Field Master Polling

k) Full Status Polling

l) GPS Time Synchronization

m) Local Event Polling

n) Local Volume & Occupancy Uploads

o) Monitor Report Uploads

p) Real-Time Compare with Field

q) Set Opticom Time

r) Speed Trap Data Collection

s) Split History Data Collection

t) Sync Controller Time to Server

u) Temperature Check

v) Time Synchronization from Internet

w) Time Synchronization from Dial-Up

x) Upload Database (for 7 databases)

23) The ATMS shall provide for the assignment of system users with specific control for each. The users section shall allow the system administrator to define and edit user privileges and control to ATMS system devices, databases, information and other security functions. Any ATMS function shall be enabled or disabled on a function-by-function basis for each user. Each user shall be capable of being assigned to jurisdictions through the user setup utility. All specific user information such as passwords, e-mail address, etc, shall be maintained through this function. This utility shall also provide for the ability to create a new user from the information of another user.

24) The ATMS shall provide for the creation or user groups. A user group shall have a full set of system privileges and permissions, which will serve as the primary rules for each member user, regardless of the user's individual settings. There shall be no limit to the number of user groups in the system. A user shall only be allowed to be a member of one user group.

25) The ATMS shall provide an import utility for count data from third-party road tube counters such as JAMAR, into the ATMS database. This utility shall convert the count data file to Microsoft SQL format and make this data available from the ATMS system reports section in a pre-designed Crystal Report template.

4.0 System Reports

The ATMS shall come with a reports section, which provides the user the ability to generate reports from a library of pre-formatted report templates from the ATMS database. The ATMS server shall store all imported and system-generated data into the system's main SQL database, and make it available for future report generation. The reports section shall offer a "dual" search engine utility to search and generate reports in the ATMS system. The first search engine shall provide for quick navigation and selection of a specific report or report type. The second shall provide for report parameters for the selected report.

The use of reports shall be programmable and allowed on a user-by-user basis within the user property setup of the ATMS software.

1) The reports section shall offer pre-defined report templates from the following database categories:
    a) Controller Data (Inventory, Groups, Alarms, Volume/Occupancy, Coordination Reporting, etc)
    b) Users (Log-In reporting, Upload/Download activity, etc)
    c) Timing Sheets
    d) GIS (Incident Reporting)

2) The following report templates shall be available with the ATMS software:
    a) CMS Report-Daktronics
    b) Compare Controller Database Configurations
    c) Conflict Monitor & MMU Reports
    d) Controller Communication Errors
    e) Controller Logins
    f) Controller Pattern Changes
    g) Controller Preemptions
    h) Database Comparisons
    i) Field Alarms
    j) Flex Group Listings
    k) Inventory by Communication Drop
    l) Inventory by Controller Group
    m) Inventory by IP addresses
    n) Inventory by Master
    o) Inventory by Controller Type
    p) Level-of-Service Average by Day
    q) Level-of-Service Hourly Graph
    r) Level-of-Service Multi-Day Graph

s) Opticom History Log Report

t) Real-Time Status Changes

u) Real-Time Congestion Data

v) Split History by Controller

w) Turning Movement Volume & Occupancy-Graphical

x) Turning Movement Volume & Occupancy-Data

y) Volume & Occupancy per Day-Graphical

z) Volume & Occupancy per Lane-Graphical

aa) Volume & Occupancy per Lane-Data

bb) Volume & Occupancy per Multiple Days-Graphical

cc) Volume & Occupancy by Controller (1 day)

dd) Weekly Road Tube Detector Output

ee) GIS Incident Report

ff) User Logins to ATMS

gg) User Transactions on ATMS

The ATMS shall provide the ability for the user to create Report templates for any of the system reports so they can be individually named and quickly re-created again at another time.

3) The report section shall offer the following print and navigational tools:

a) Page Forward/Backward – Selecting the corresponding arrow will navigate to the next page of the report when a multiple-paged report is generated.

b) First Page/Last Page – Selecting the corresponding arrow will navigate to the first or last page of the report when a multiple-paged report is generated.

c) Go To Page – Allows specific page navigation when a multiple-paged report is generated.

d) Print – Allows the report to print to a printer(s) that are configured to the computer.

e) Export – Allows the report to be saved as a .pdf, .xls, .doc, or .rtf document.

f) Zoom – Allows controlled sizing of the report.

g) Find Text – Allows a user to search for key words in the report.

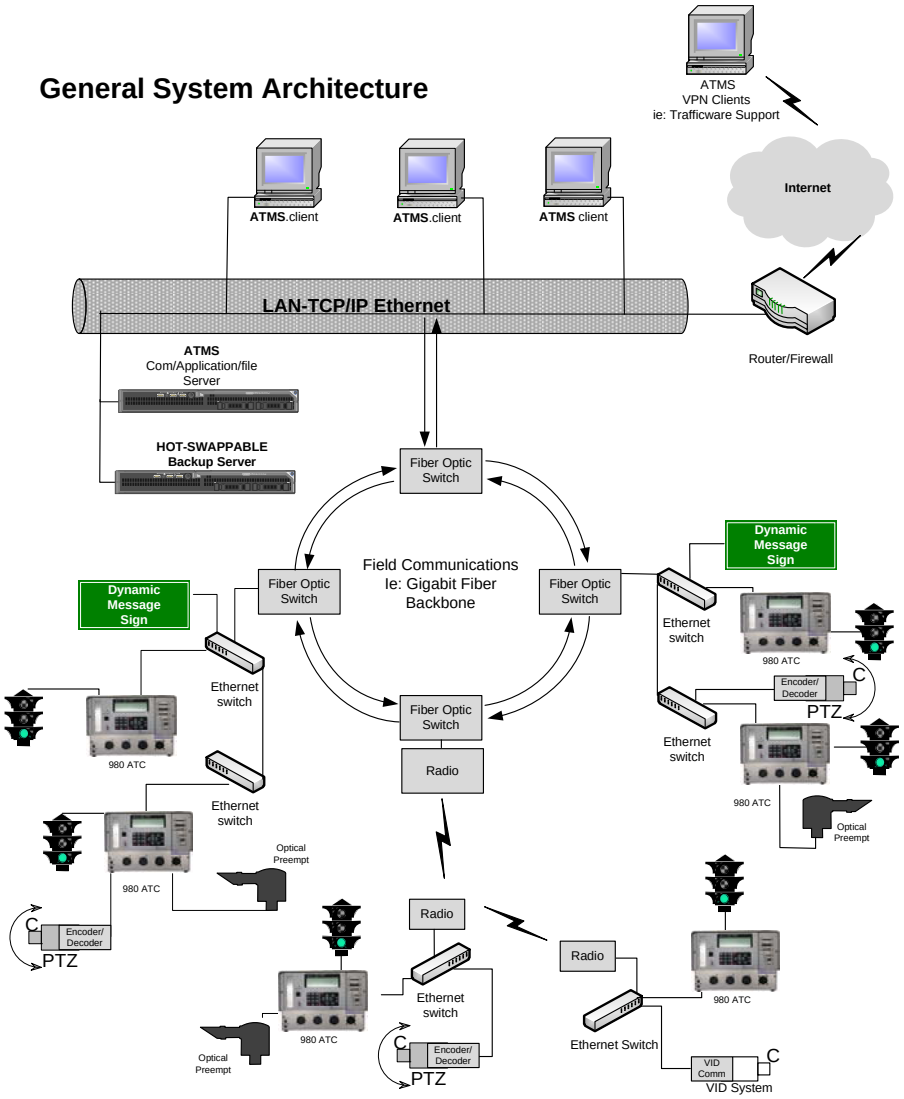
TABLE OF CONTENTS

TRAFFICWARE'S ATMS.NOW

Trafficware has considered every single client request and built ATMS.now on a platform that performs unlike any other ATMS. Utilizing easy-to-use screens, ATMS.now offers complete traffic and data management, including real-time reporting, integration with Microsoft SQL server, .Net, Internet Server Services (ISS), Crystal Reports™, XML data exchange, ESRI & Mapguide-based GIS interfaces, AutoCAD, and hundreds of other 3rd party applications.

ATMS.now brings all traffic network data into a single repository for a completely integrated, real-time, 360-degree view of all ATMS operations. Featuring high-performance parallel database technology, a full suite of data access and management tools, robust data-mining capabilities, Trafficware's ATMS.now is a powerful performance and engineering tool.

ATMS.now is capable of handling up to 9,999 intersections and up to 64 detectors per controller, or a total of 64 x 9,999 = 639,000+ detectors.



SYSTEM DESCRIPTION

HARDWARE

ATMS.now is a multi-threaded transactional system that takes advantage of available hardware resources to meet capacity demands and is a distributed multi-user client-server application built on TCP/IP, communicating with field devices using RS-232 (serial) or TCP/IP (Ethernet) protocols.

Trafficware system software has been successfully installed on over 200 systems using a variety of hardware platforms and Microsoft operation systems.

Minimal Server Requirements:

- Microsoft Windows Server 2003 or greater
- Internet Information Services with Microsoft .NET 1.1
- Microsoft SQL Server 2005 or greater

GIS Requirements:

- Signal Shape File with the Controller ID as one column, in state plane coordinate system in feet
- Roads/Centerlines Shape File with a unique Segment ID as one column, in state plane co-ordinate system in feet.
- Background Aerial in MrSid format

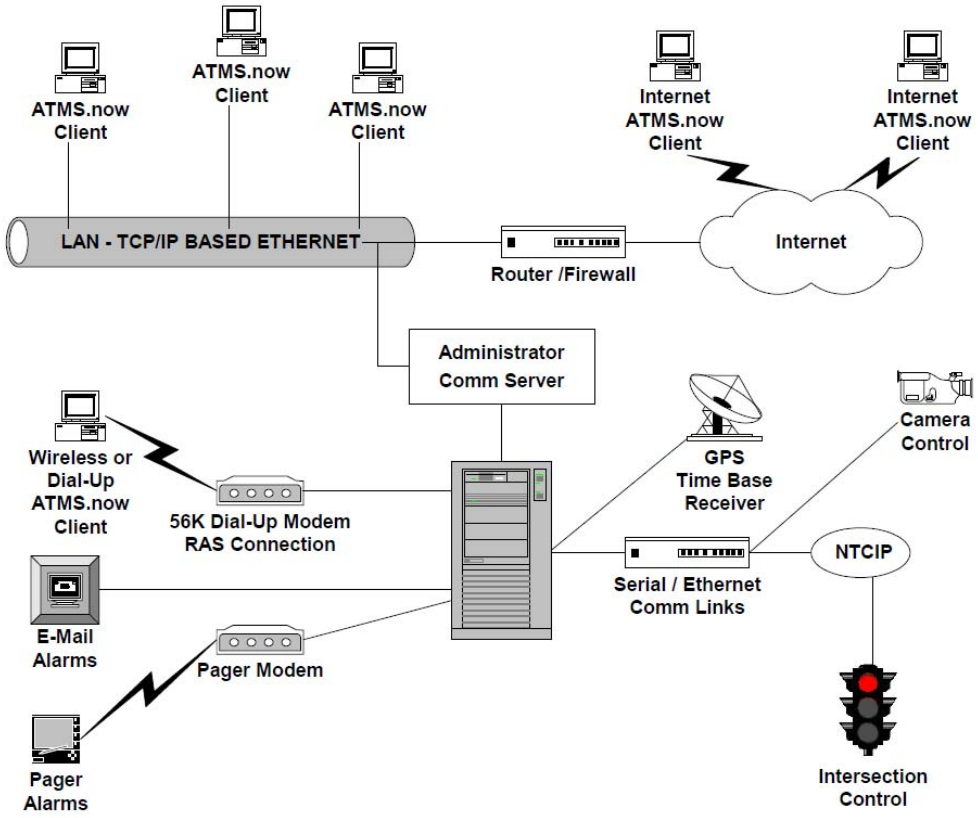
To ensure high availability and redundancy, Intermountain Traffic proposes the installation of a second server which will act as a real-time backup and eliminate downtime from any type of hardware failure. This second server will be an exact replica of the first.

ATMS.now' s communication infrastructure uses an Open Systems Interconnection (OSI) communications model utilizing TCP and UDP at layer 4, IP at layer 3 and Ethernet at layer 2. This allows real-time status to be received continuously on a once per second basis from local controllers with true Ethernet interfaces. Real time information includes phase status, current timing plan, mode of operation and equipment status. This infrastructure enables all communication and transaction processing to be done on a single hardware server.

System communication may be point-to-point from the central server or distributed using on-street masters embedded in TS2 and 2070-based controllers. In addition, central based masters can support dynamic group assignment by time-of-day over multiple communication channels.

The ATMS.now system communication utilizes a hybrid of communication channels including twisted pair, fiber, wireless radio, Ethernet, dial-up, etc.

SOFTWARE



ATMS.now consists of the following three software components:

1. *Communications Server*
   The Communications Server, or "Comm Server", provides access to all field controllers. The Comm Server receives communication requests from the Administrator and Client and retrieves the requested data from the field. The Comm Server is capable of taking mixed communication methods and speeds (forms of serial and IP), and sorting them by "Drops". The different types of data flow seamlessly into the user interface (Client) without being obvious to the user. ATMS.now currently offers up to 200 definable drops.

2. *Administrator*
   The Administrator is the system component that replies to requests from multiple (multi-user) clients, as well as handles programmed system tasks from the "Scheduler". If the data necessary to respond to the request is already available, then a report is immediately generated and returned to the client. If the requested data is not available, then the Administrator forwards the request to the Communications Server, which gathers the requested data from the field and returns it to the client.

ATMS.now Communication and Administrator Servers

3. *Client*
   The Client provides a graphical user interface (GUI) for multiple workstations distributed across a TCP/IP network. The Client allows the user(s) to view the current status of the system, exercise system control, and generate reports from historical data.

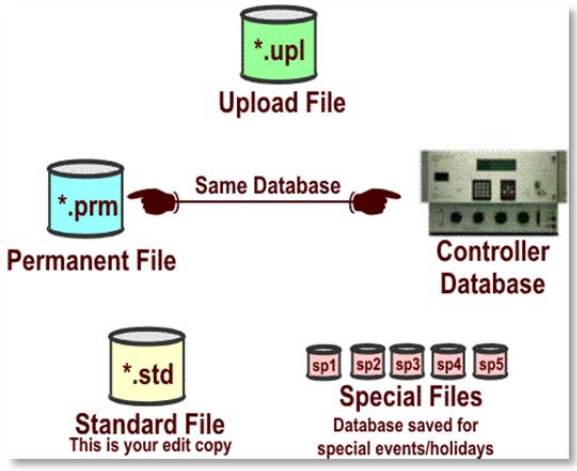
FILE SYSTEM

Database Recovery

ATMS.now provides a database utility for backup and recovery that will automatically compress and back-up the database on an operator-specified time-of-day, or upon operator commands; and restores the back-up copy of the database.

File Structure

ATMS.now maintains several file copies of the controller database in the server directory /nazserv/data. This section explains the purpose of each of these files and how ATMS.now maintains a copy of the field controller database in the Permanent File. Understanding the file system is the key to understanding upload/download procedures and how StreetWise Partner performs a hotSync between the Palm Pilot and the ATMS.now database.



The standard file is the users edit copy of the controller database. This is often referred to as the "working" database file. Typically, the user edits the Standard File and downloads the edited copy to the controller. After a successful download, ATMS.now saves the Standard File to the Permanent File. ATMS.now saves a copy of the uploaded controller database to the

upload file. This file system insures that the edited copy of the database is separated from the permanent copy residing in the controller.

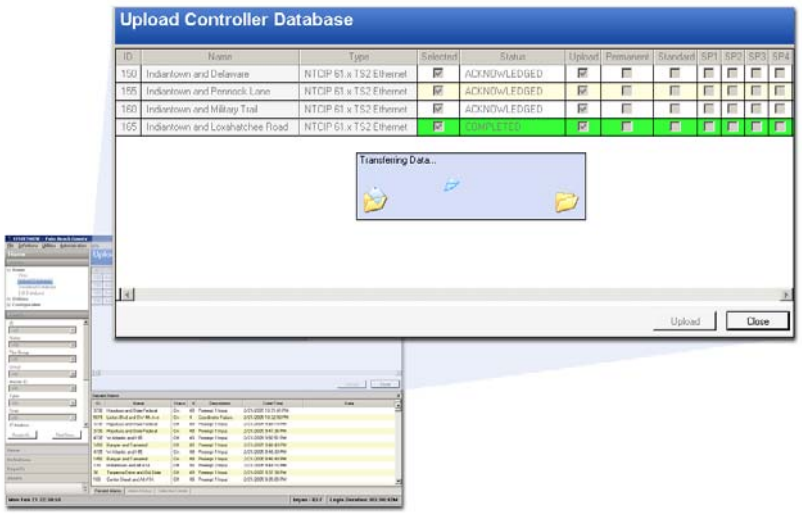
Special files are edited copies of the controller database saved for some specific purpose. For example, the user can name special files with descriptive titles such as “Christmas shopping period,” “football game day,” etc. that make them easy to identify. Five special files are provided for each controller defined in the system.

ATMS.now allows the user to edit the standard and special files. The permanent and upload database may only be viewed or copied to the standard file. This structure preserves the integrity of the last successful download to each controller.

Included within ATMS.now are over 20 report viewing templates for viewing statistical movement and lane counts for individual intersections, or entire arterials in several different styles and formats. The reporting function combines Microsoft SQL database with Seagate Crystal Reports engine to offer a comprehensive library of built-in report utilities or allow the user to generate their own custom report templates with ease.

Upload/Download

Any of the aforementioned files can be downloaded to a controller or Flex Groups of controllers as a complete database, groups of timing parameters, or as individual timing parameters. Furthermore, individual or groups of timing parameters can be downloaded to multiple actuated signal controllers. An example would be, edit all your Yellow Clearance Intervals for selected phases and download this to multiple controllers in a Flex Group that represent an arterial.



To accomplish this, all mandatory and manufacturer specific NTCIP objects had to be developed for the Actuated Signal Controller. Upload/download uses dynamic objects to transfer entire databases. This reduces data transfer overhead and uses the constituent Mandatory or Manufacturer Specific Objects when individual timing parameters are transferred.

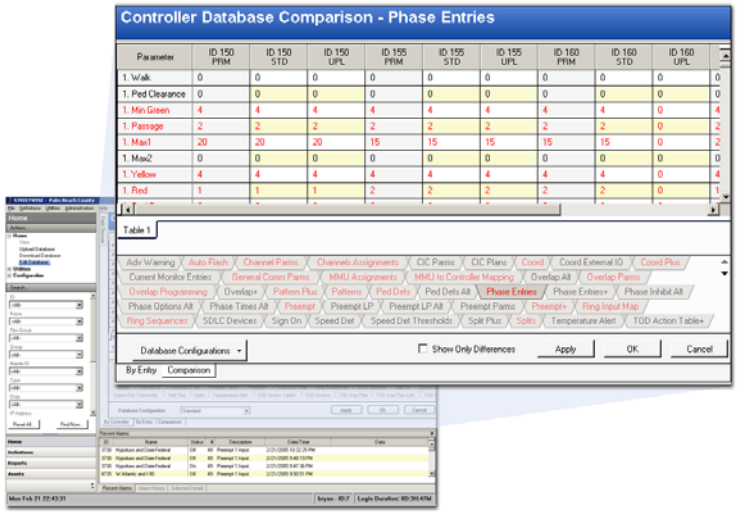
Trafficware fully supports NTCIP as the communications and database standard for all ITS field devices. Trafficware has made a major investment in developing and testing NTCIP for all TS-2 and 2070 products and the emerging ATC controller standard. The Protocol Analyzer and Object Tester built into Trafficware’s StreetWise ATMS ensure compatibility with the 12,855 NTCIP objects and MIB's currently implemented in the Trafficware family of ITS devices. Trafficware ensures future enhancements to NEMA standards and its own MIB objects are fully tested and supported.

SYSTEM DESCRIPTION

Trafficware's Signal Controllers have true 10 Mbps Ethernet. Trafficware does not employ internal serial to Ethernet conversion in the Controller, as it limits the communication speed common to serial transfer rates of 19.2 kbps.

ATMS.now uploads and downloads all Mandatory and Trafficware Manufacturer Specific objects that represent timing parameters in the Actuated Signal Controller including, but not limited to the following data:

- Intersection timing parameters
- Detector data from at least 64 detectors per intersection controller
- Controller and cabinet alarm data
- Event data
- Universal date and time
- Controller date and time; and others specified elsewhere in these Functional Requirements.



The user has the ability to compare any combination of the eight databases in ATMS.now. This feature allows for identification of database differences necessary for maintaining database integrity and comparing records against the file copy (permanent). ATMS.now identifies differences by color coding each database category tab and the corresponding database parameter in RED.

ATMS.now allows multiple intersection database editing of controller parameters within a single window.

Flex Groups

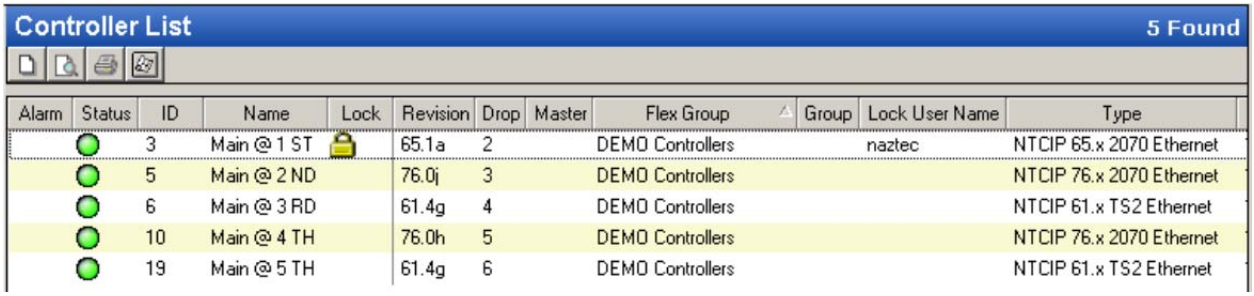
Flex Groups allow controllers to be identified with multiple groups of intersections, allowing more system flexibility and control. ATMS.now also contains *Groups* if desired by the user; however, they are a legacy feature that has the limitations of single group membership.

Controllers can be grouped in anyway desired regardless of physical location or communication drop in what we call *Flex Groups*. We allow controllers to be a member of more than one "Flex Group". All actions on intersections/detectors can be performed on a *Flex Group* basis either manually or TOD using the Scheduler.

ATMS.now has no limitations on the number of *Flex Groups*.

Database Lock

An added safeguard in ATMS.now is the Lock User Feature. This feature prevents multiple users from simultaneously editing the same database.



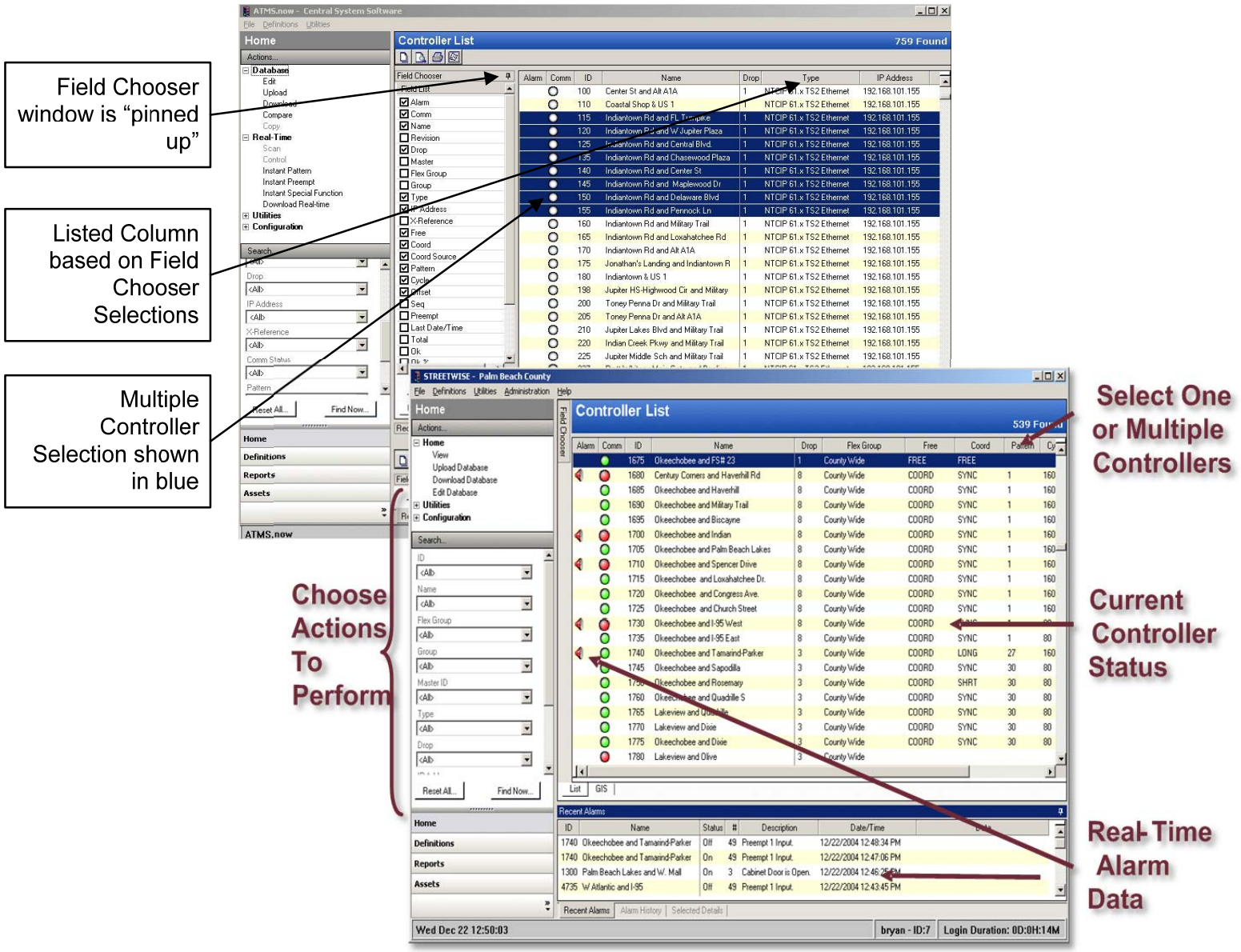
Alarm	Status	ID	Name	Lock	Revision	Drop	Master	Flex Group	Group	Lock User Name	Type
		3	Main @ 1 ST		65.1a	2		DEMO Controllers		naztec	NTCIP 65.x 2070 Ethernet
		5	Main @ 2 ND		76.0j	3		DEMO Controllers			NTCIP 76.x 2070 Ethernet
		6	Main @ 3 RD		61.4g	4		DEMO Controllers			NTCIP 61.x TS2 Ethernet
		10	Main @ 4 TH		76.0h	5		DEMO Controllers			NTCIP 76.x 2070 Ethernet
		19	Main @ 5 TH		61.4g	6		DEMO Controllers			NTCIP 61.x TS2 Ethernet

USER INTERFACE

ATMS.now uses re-sizable “Pane” windows within a single Client screen to allow the user to create the desired screen space for each work area. This eliminates older-style “Pop-Up” screens when working on standard operations. ATMS.now does still operate “Pop-Up” screens for real-time “Scan” windows and video windows when camera feeds are launched.

List View

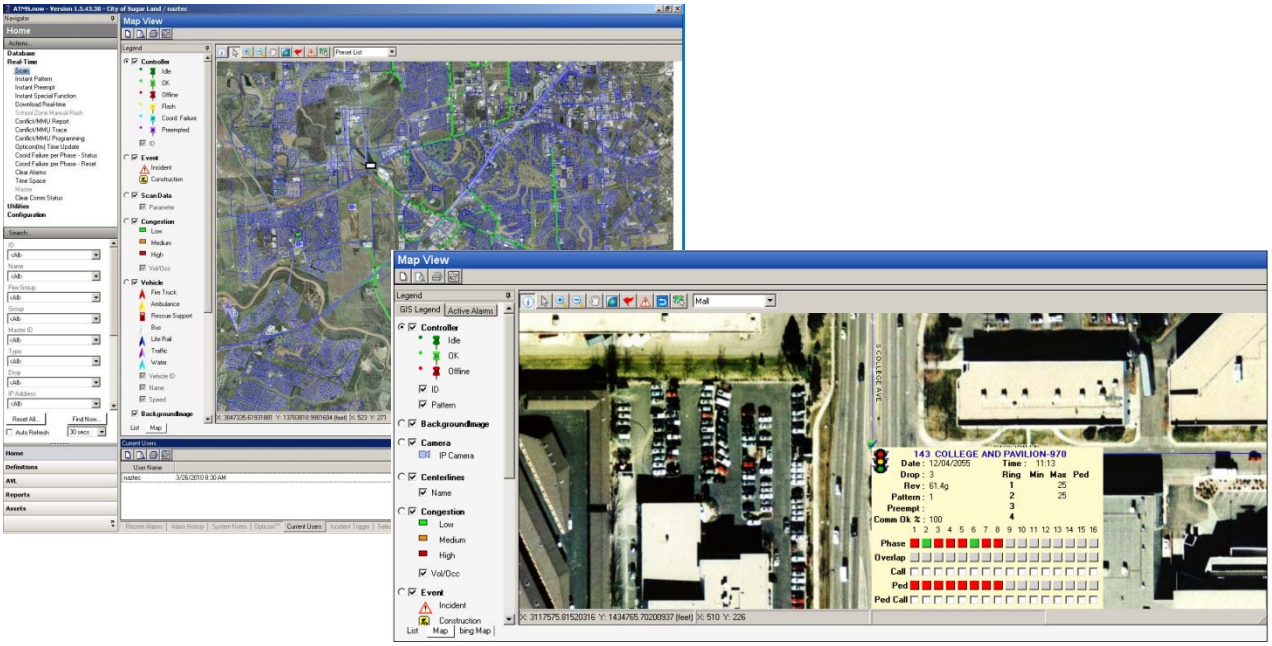
Real-time information such as active pattern, communication status, controller/group configuration, coordination status, real-time R/Y/G status, and detector input status is shown for each controller on the *List View.*



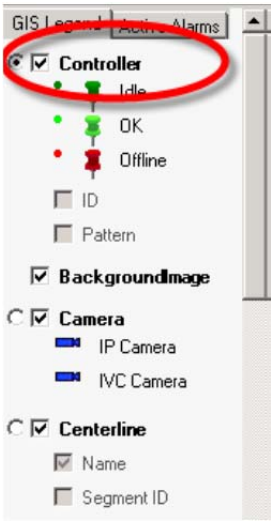
Map View

The GIS Map view provides a real-time, GIS-based, status map display of all of the ATMS.now system elements. The base map utilizes GIS files provided by the City and shows the roadway centerlines of arterials and collector streets, freeway centerlines, rail lines, and major landmarks.

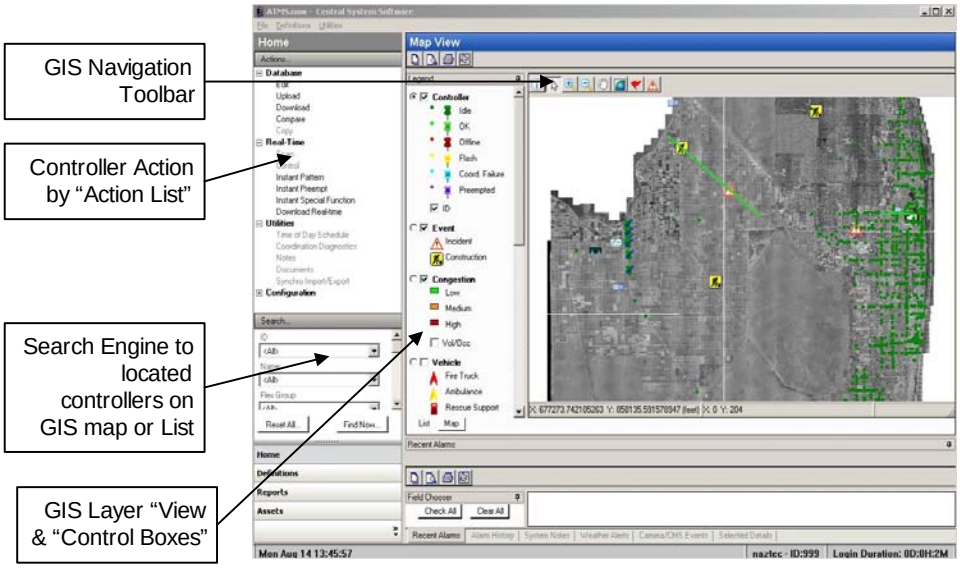
All standard GIS zoom functions and layer actions are integrated into the map and the user can select any combination of GIS layers to be displayed at any time. The specific controllers that are displayed on the GIS Map can be directly searched, identified, and controlled. Further functionality is provided by right-clicking the controller on the GIS Map tab.



The GIS Map view offers a filtering legend, which allows the user to toggle on or off viewing the layers on the map. Each data type such as Controllers, Scan Data, Events, Congestion, Switches, Cameras, BBS, CMS signs, Light Rail, Fire Stations, etc., can be displayed as a distinct layer on the map. Layers representing devices that dynamically change status, such as Controllers and Congestion, are updated in real time through the Scheduler programming. The real-time condition of each object on the map is color-coded according to the Legend and displays the corresponding color to the “Status” column of the List View tab.

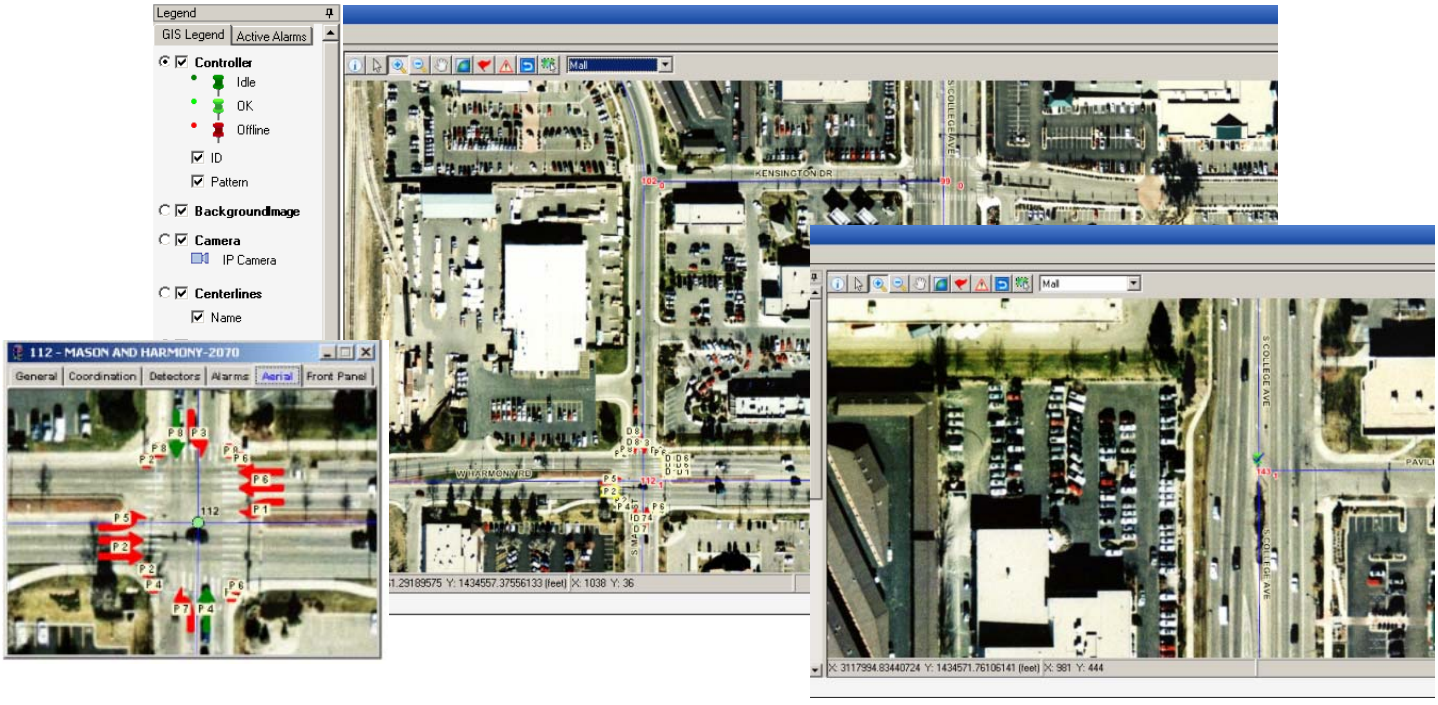


SYSTEM DESCRIPTION



The signal system GUI provides an easy to use intersection add utility that allows the administrator to easily add devices to the system through the use of templates and drag and drop items. Once created the system user can simply drag and drop onto the map. No line entries in the database or programming are needed.

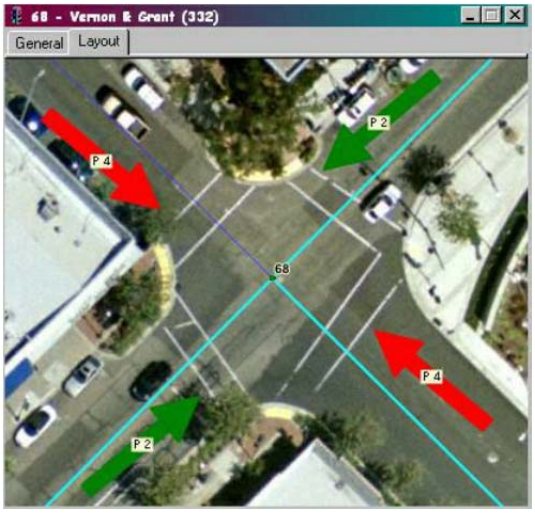
Standard zooming capabilities are provided in ATMS.now map views. Users can zoom in to specific points on a map or zoom out by increments of one measure of extent. By zooming in to a selected intersection, users can get a more detailed view, including the controller ID or Pattern number.



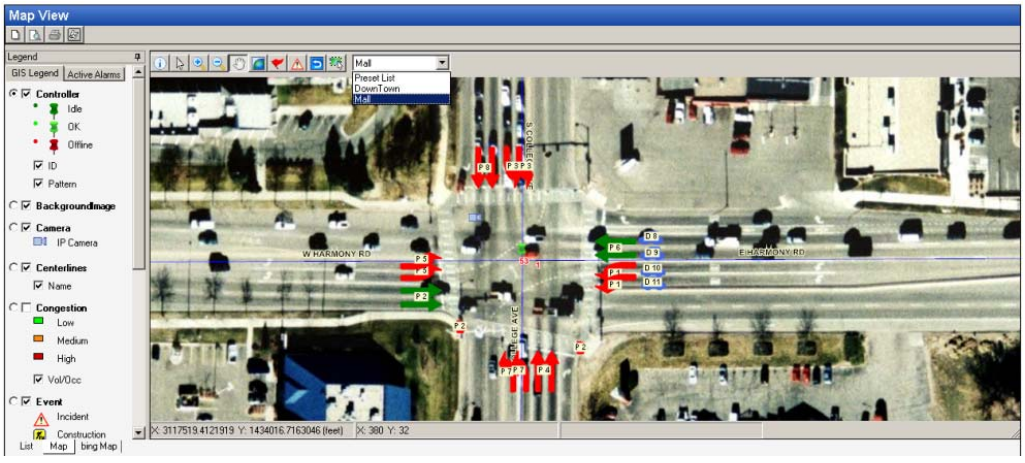
All layers represented on the Legend are actively monitoring and provide control capability from the GIS Map. The viewing state of each distinct layer can be toggled on or off, controlling whether or not it is displayed at that moment. ATMS.now tracks the user preferences on the GIS Map view with the “stickiness” feature, displaying the last active layers when returning back to the GIS Map tab. Each layer can be enabled for view and control by turning it on or off.

An example of a status-only layer is the “Scan Screen” layer. ATMS.now takes the real-time polling information and enables the system to display programmed signal, pedestrian, and detector information on a “Scan Screen” layer on the GIS Map. When set up for each intersection, the “Full Status” polling will continue collecting. The information is collected and ready within ATMS.now, whether or not the Scan Screen is programmed, or an actively displayed layer. This real-time status can be displayed for single or multiple intersections. If the “Parameter” box is checked, the phase or detector value will appear on each scan point, such as “P2” for Phase 2, etc. The picture shown below is what can be seen when the “Scan Screen” layer is active for an arterial view.

When a Controller Hover appears, you can double-click on it to make it permanently “Pin Up” as a dedicated window. The picture to the right shows that a pinned hover offers two view options, the General Information and Layout (GIS) view tab.



One of the GIS map tools allows users to save presets. Presets enable the user to zoom to a saved view on the GIS map. To select a specific “Preset View” for navigation, users simply select the drop-down menu on the GIS toolbar. A list of the available Preset Views for that user will display. Upon selection of the desired Preset View, ATMS.now will automatically navigate and zoom to the programmed GIS view. The figure below shows a sample of a preset view.



Dynamic Displays

System Map

When maximized, graphical views return to the scale at which they were displayed immediately prior to being minimized.

Zoom/Pan

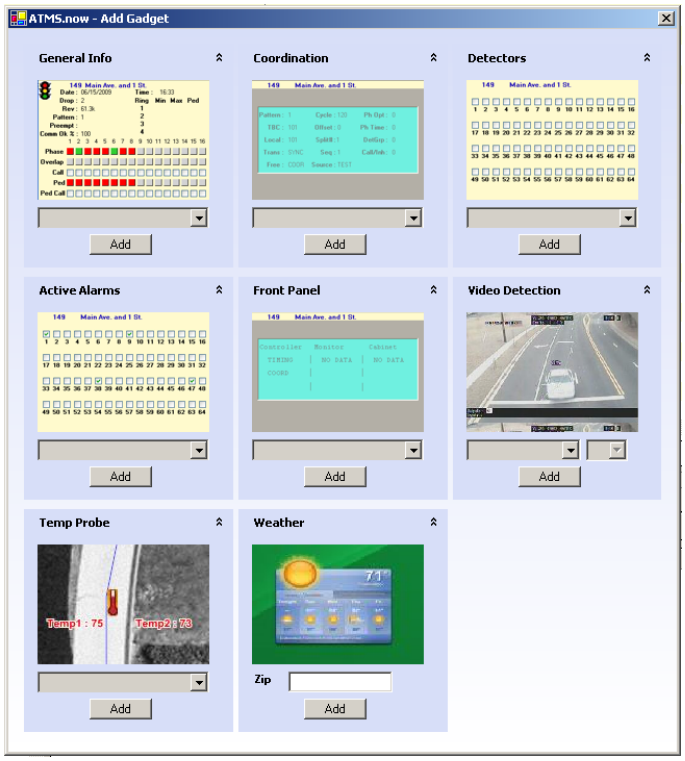
Dynamic mapping incorporates full pan/zoom capability. The operator has the ability to set up both dynamic and static informational layers that are displayed at different view scale levels by defining these levels in a zoom level set-up configuration database table. By setting the zoom scale range and appropriately enabled/disabled layers, the operator is able to control which layers display at different zoom scales

Global Parameter Changes

ATMS.now allows Global changes to be made on a system-wide, section, or intersection basis without requiring the operator to enter data one intersection at a time.

Gadgets

ATMS.now enables users to quickly access devices through the Gadget pane. This provides users with the ability to group together targeted items that need to be monitored into one window within the main workspace. The Gadget pane displays real-time information such as weather, video feeds, road temperatures, and controller screens. By default, the Gadget pane is “tucked-in” and can be “pinned up” for constant viewing. Each user creates their own Gadget view arrangement and ATMS.now will remember the unique settings for each person by user login.



ATMS.now allows users to organize the system’s displays on the Gadget pane, which is designed to give the user the ability to monitor targeted items within the main workspace. The Gadget pane displays controller screens such as general information, detectors, alarms, Coord status, etc. By default, the Gadget pane is “tucked-in” on the upper right side of the Overview pane. It can be “pinned up” for constant viewing.

Each user creates their own *Gadget* view arrangement and ATMS.now will remember the unique settings for each person by user login. Populating the Gadget window is very simple and can be done by selecting the desired gadget from a drop-down menu.

Additional Displays

Device Status

Various methods are built into ATMS.now for viewing real-time status updates of many device types. By using the GIS Map view, users can view a real-time, GIS-based, status map display of all of the ATMS.now system elements. All standard GIS zoom functions and layer actions are integrated into this GIS map view. The user can select any combination of GIS layers to be displayed at any time. In addition, details can be accessed in other areas, allowing users to view information of the active layer, including real-time status for Controllers, Congestion, Cameras, CMS signs, Switches, etc. Additional methods for viewing real-time status updates include:

- Real-time status report: displays the current real-time status of controllers.
- Scan Screens: displays the real-time status from one or more intersections.
- Coordination status tab: displays the same coordination status as displayed on the controller and any alternate phase time tables, phase option tables, alternate detector groups or call/inhibit tables associated with the active pattern.
- Detector status scan tab: displays real-time detector channel inputs for up to 64 channels.
- Vehicle Trigger Status Report: provides a report of vehicle trigger status.

Current Users

The Current Users tab displays all of the users that are actively logged onto the system. This feature is useful in a variety of situations, such as to assist in determining which users can be contacted through the Broadcast Message feature, or who is logged in to the system when the server needs to be shut down for updates. ATMS.now also provides reports of logins, which will display a history of the dates and times users logged on to a controller and on to the server.

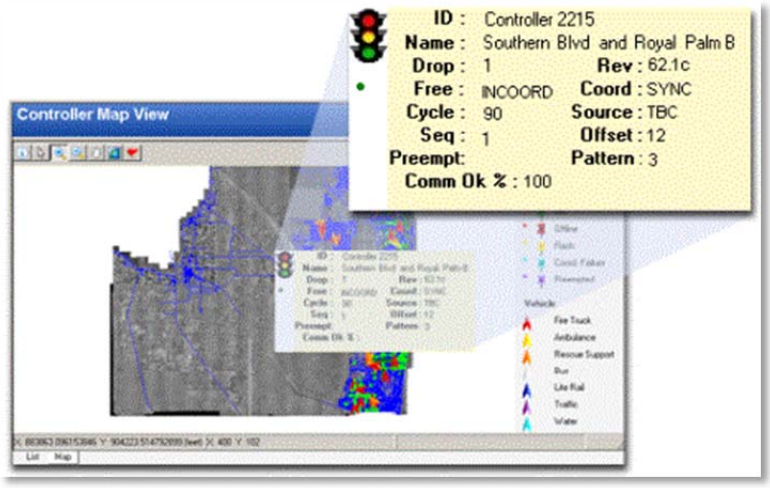
Alerts

ATMS.now enables users to view real-time details on the number of open alerts and the importance of each alert. The Alarm History log displays a full history of the most current 100 system alarms and controller Alarms and Events as programmed in each controller. Both cleared, or “acknowledged”, and un-cleared alarms will appear in this tab. As discussed in “Maintenance Malfunction and Notification,” alerts are categorized using a customizable color-coded priority system. This allows the user to indicate the importance of an alert.

GREEN	RED	YELLOW	CYAN	PURPLE	GREY
On Line and communicating	Off Line and should be communicating	Intersection is in Flash	Intersection has reported a Coordination Failure	Intersection is in Preemption	Off Line and not being polled for status

Intersection Display Hover View

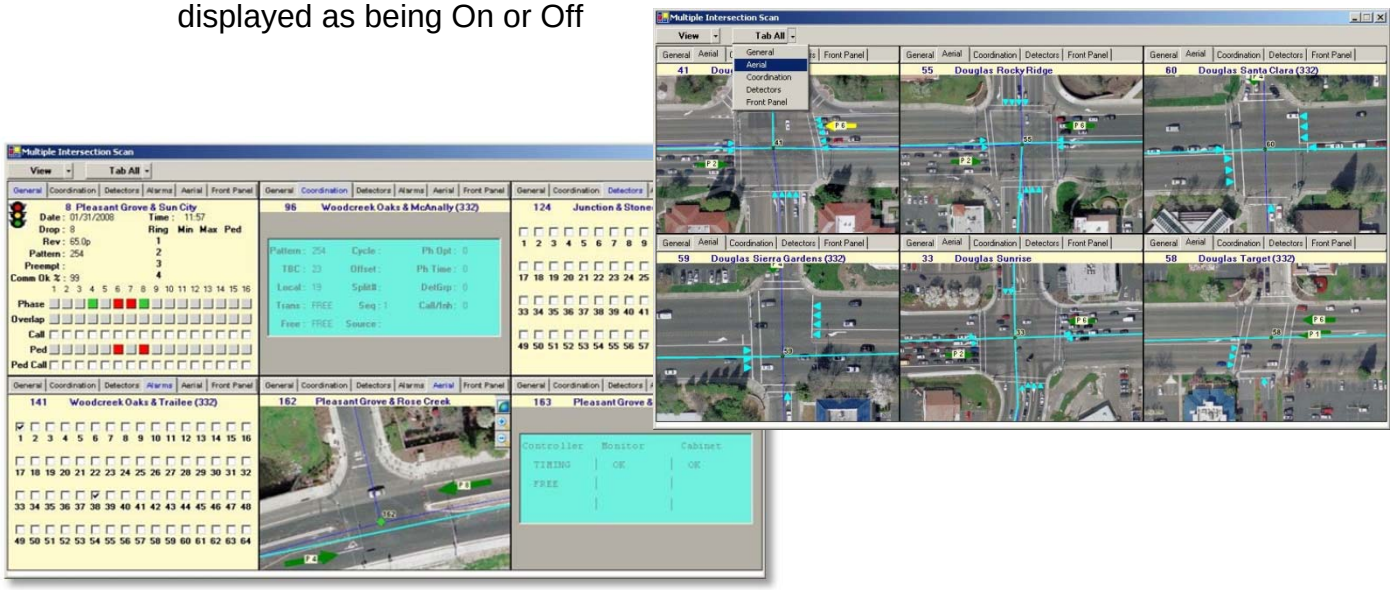
By placing the cursor over a particular controller, the user is presented with detailed current information.



Scan Screens

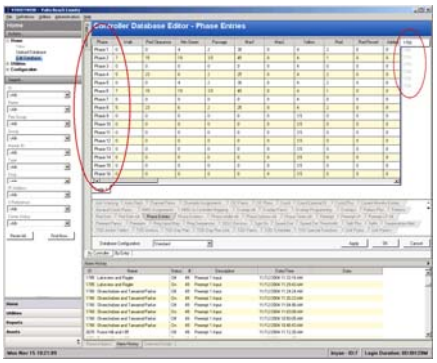
The real-time status of one or more intersections can be displayed with the Scan Screen. Various individual windows provide the user with the capability to view:

- General Information: displays phase timing and coordination status, the Active Ring, Recalls, Local Counter, Time, Pattern, Split, Preempt, and successful communication attempt percentage
- Aerial: displays a zoomed view from the GIS map
- Coordination: displays the controller coordination status, any alternate phase time tables, phase option tables, and alternate detector groups or call/inhibit tables associated with the active pattern
- Detectors: displays real-time detector channel inputs for up to 64 channels
- Front Panel: displays the status on the TS2 or 2070 controller
- Alarms: 64 active alarms operate in real-time from the controller and are displayed as being On or Off

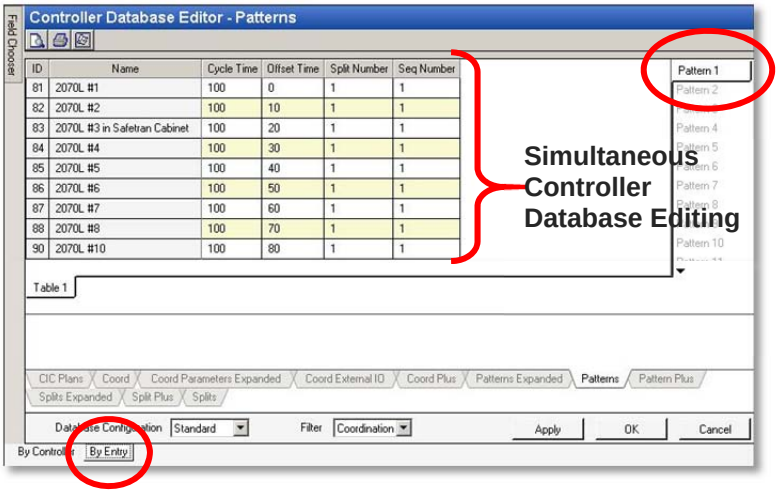


Database Editing

In order to alleviate repetitive data entry, users can copy and paste data to and from other Windows™-based applications as well as copy/compare database fields between controllers. In the graphic to the right, the circled list of selected controllers in the Controller Database Editor allows the user to quickly copy/paste from ID to ID. The user can copy and paste cells, rows, columns and grids.



By selecting the "By Entry" tab in the Controller Database Editor, the user can view and manipulate the same data across multiple controllers.



The search engine can filter intersections by ID, drop, status, IP address, pattern, name, Group, Flex Group, or Master ID. In addition, the search engine in the reports module filters by report name, report category, controller ID, controller name, Flex Group, Begin date, End date, Begin Time and End Time.

The user can use the "Print Screen" function provided with each database screen in ATMS.now.

MODES OF OPERATION

ATMS.now operates in a distributed mode, making use of the intelligence in the Actuated Signal Controllers. ATMS.now uploads and downloads to the controller all the parameters required to operate the local intersection including time-of-day/day-of-week (TOD/DOW) schedules. The system also monitors all intersection controllers on a real-time basis communicating at a rate of 10,000 Kbps. Upon system startup, ATMS.now is configured to establish communications with all intersection controllers and begin real-time monitoring. ATMS.now is designed for unattended operation twenty-four (24) hours per day, seven (7) days a week, without requiring an operator to be logged into the system.

ATMS.now provides system control by coordinating intersection operation on an individual, Flex Group, or system-wide basis. ATMS.now includes the following defined control modes, which are operator-selectable from the Graphical User Interface (GUI): Local TBC (TOD/DOW), Special Event, Remote (Manual), System (Traffic-Responsive), Off-Line (Standby), and Flash.

The Active Pattern drives the operation of the local signal controller. NTCIP defines Opmodes, Src as the source of the Active Pattern. The source of the active pattern may be Remote, System, or TBC. If the system is in standby mode then the active pattern is set to TBC generated by the local Time of Day schedule.

In the event that, while in software-commanded override, a controller does not receive a valid timing plan number from the central signal system software within an operator-defined time frame, ATMS.now reverts back to its local TOD/DOW schedule.

In the event of a failure other than power failure or the severing of communications between ATMS.now and the controller manual programming overrides all modes.

Stand-By

ATMS.now has a Controllers Offline function that allows the user to limit the communication of information to only those devices that are actually online and communicating to the central server. By designating controllers that are offline, you can isolate the controllers that are not ready for communication from the controllers that are operational and need to communicate to ATMS.now. Both the List View in the GUI and the Icon in the GIS show the deactivation by disabling color-coded controller conditions. It is possible to manually schedule controllers on an intersection basis or Flex Group basis. The whole ATMS or specific functions can be set to “View” privileges only, limiting command and editing capabilities on a function-by-function basis.

Flash And Free/Flash

In the flash mode, the controller does not provide green time to any movements at the intersection. FLASH is defined as Pattern 255 by NTCIP. Flash can be initiated from the central by either manual control or through the scheduler.

In the free mode the controller runs uncoordinated. FREE is defined by Pattern 254 by NTCIP. FREE mode can be initiated from the central by either manual control or through the scheduler.

Both Actuated Signal Controller conditions are represented via List View in the GUI and the Icon in the GIS show by a color-coded pin or button.

Temporary And Permanent Commands

A control window with Time Range, Date Range Monday thru Sunday date Fields entered in ATMS.now allows the scheduler to implement any command on a Temporary basis, permanent, or recurring basis.

Remote (Manual Commands)

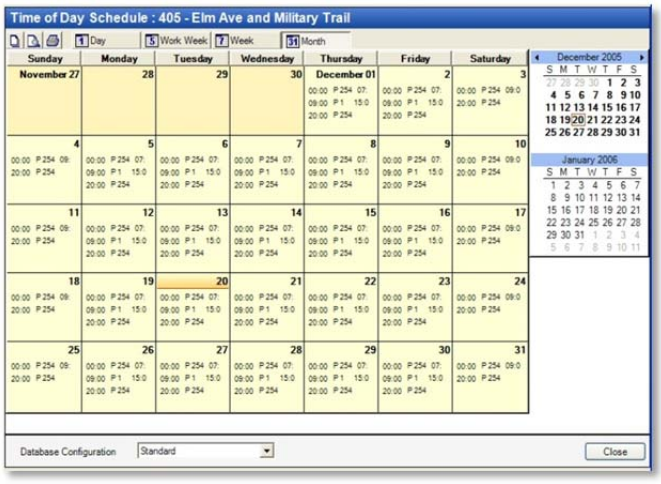
ATMS.now provides an extensive list of commands that can be manually or automatically scheduled for override and release in any time frame. Some of these commands include patterns, preemption, special events, special functions, download real-time clock, and collection of events, traffic volumes and occupancies. These commands can be done on a controller, Group, or Flex Group basis. Manual commands are the highest level of the control hierarchy in ATMS.now.

The Actuated Signal Controller provides 24 Special Functions for users which can be activated by Day Plan Actions or manually controlled by ATMS.now. The user can manually control a controller, Group, or Flex group of controllers by immediately overriding or adding to the current operation with a special function output and running that special function for a duration of time or indefinitely. The user can use the scheduler to automatically activate the Day Plan Action containing the Special Function or Functions

Remote Stop Time

Trafficware implemented Stop Time as a pattern in ATMS and the controller. Stop Time is executed remotely via the Instant Pattern function, only when accompanied by a time value (in seconds). The controller internally freezes the timer just as if it receives a Stop Time from the cabinet, only it requires a time value to execute it, preventing intersection lock up.

Time Of Day (Tod)



By default ATMS.now uses TBC mode for controlling traffic conditions at the local intersection. In this mode, each controller automatically selects and implements the locally stored traffic signal timing plans in accordance with the defined schedule. The ATMS.now Schedule is a fully compliant NTCIP based time-of-day schedule. NTCIP defines an annual schedule in terms of day-of-week, month, and day-of-month. This implies that the schedule applies to the current year. The Schedule selects the Day Plan for the current day. The Day Plan contains the time-of-day events for the current day used to select actions from the Action Table. The Actuated Signal Controller

updates the current TBC pattern once per minute based on the scheduled events from the action table.

Each day the controller checks the Scheduler to determine the most applicable Day Plan. If the current day is not specified in the Scheduler, the controller will run free in Pattern# 0. The controller checks the current Day Plan once per minute to retrieve the current time-of-day action. The controller then performs a lookup in the Action Table to determine the active TBC Pattern. The TBC pattern determines the current time-of-day of the controller. NTCIP defines 48 Patterns, 100 Actions and 32 Day Plans. All Patterns, Actions and Day plans are stored in the ATMS.now SQL database Permanent File so that ATMS.now "knows" which parameters are stored in the controller.

Special Events

The Actuated Signal Controller provides 48 patterns, 100 Actions and 32 Day Plans conforming to NTCIP standards for users which can be activated by Day Plan Actions or manually controlled by ATMS.now. The user can manually control a controller, Group, or Flex group of controllers by immediately overriding or adding to the current operation with a special function output and running that special function for a duration of time or indefinitely. The user can use the Scheduler to automatically activate the Day Plan Action containing the Special Function or Functions.

The Scheduler performs pre-programmed, automated tasks such as controller status, data collection, time synchronization, database verifications, and Special Functions. Although all these functions can be performed manually, they are easily automated to save time and have accurate information ready or more easily accessible to the user. All information gathering is stored on the server in SQL and can be retrieved at any time. The operator can make an unlimited number of entries multiple years in advance. The Scheduler allows the user to make the commands permanently, temporarily, or repetitively by individual controller, Group, or Flex Groups.

The ATMS.now operator is able to schedule any command for execution at any time if granted permissions in the User Module. The system administrator can inhibit commands from being entered into the event scheduler on a user basis.

In ATMS.now Manual (Remote) commands have priority over scheduled entries in the event scheduler. The operator has the ability to make entries into the event scheduler multiple years in advance. An unlimited number of entries are permitted in the ATMS.now scheduler: however, the controller is limited and defined by NTCIP for the number of events in the NTCIP controller. The scheduler has the capability to load multiple commands for the same time and to execute those commands at the same time, but for events scheduled at the same time, the execution are sequential by priority.

Traffic Responsive Control

Trafficware's ATMS.now includes a powerful suite of traffic responsive operation (TRO), with a choice of utilizing on-street field master controllers, or central based TRO. One further advantage to Trafficware's approach is that both the Model NT-981, 6-port TS2 master and Model 2070 master, include a local secondary controller, within the same

chassis. Trafficware is presently the only vendor in the industry who offers a field master and local unit within a single controller.

The layout and TRO strategy for these units are laid out identical to the requirements of NTCIP standard 1210 “Field Management Stations (FMS) – Objects for Signal System Masters.”

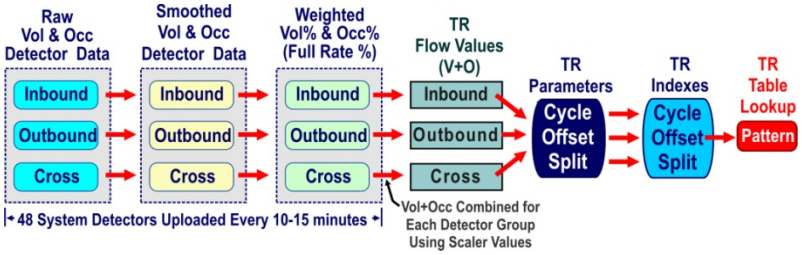
Traffic Responsive Operation (TRO) smooths raw volume and occupancy data, to “average” the data with the previous sample. This smoothed data is weighted using the Full Rate% values supplied by the user to calculate Vol% and Occ% for each detector. Vol% and Occ% are then weighted using Scalars to compute TRO Flow Values for the Inbound, Outbound and Cross-direction. The TRO Flow Values are used to calculate Cycle, Offset and Split Parameters which are in turn used to reference a Cycle, Offset and Split Index. Lastly, the indexes are used to “lookup” a pattern from the TRO pattern tables.

Traffic volume and occupancy measures vary greatly from one sample to the next, especially if the sample period is less than 10–15 minutes. Therefore, 10 or 15-minute samples are “smoothed” or “averaged” with the last “smoothed” sample. The Smooth Value is assigned for each detector and applied to the formula below to “smooth” each volume and occupancy sample. If the Smooth Value is “0”, then the current sample is not averaged with the previous volume or occupancy sample and no smoothing takes place.

$$SmoothedValue = \frac{\left(NewValue * (100 - SmoothVal) + OldValue * SmoothVal\right)}{100}$$

Vol %

Volume % compares the sampled volume (converted to a one minute flow rate) with the “Full Rate %” which is a full-scale reading of flow rate expressed in vehicles per minute.



Since flow rate is also a function of green time (g/C) provided over the detector, Volume “Full Rate %” must be approximated.

For example, assume that volume “Full Rate %” is 18 veh/min for a smoothed 15-minute sample. The measured flow rate is 150 vehicles, sampled over the 15-minute period (volume must first be converted to a one-minute flow rate because “Full Rate%” is expressed in vehicles per minute).

Vol (rate per minute) = 150 veh / 15 minutes = 10 veh / min
Vol % = measured flow rate / full rate % = (10 / 18) = 56%

Occupancy % is a measure of total vehicle presence over the detector during the sampling period. Full occupancy at 100% is equivalent to a constant call on the detector. NTCIP standards require occupancy to be expressed as an integer value, in the range of 0-200, so the resolution can be measured within 0.5 %. However, occupancy is always 100% of occupancy if a detector call is constant, over the entire sample period.

Trafficware NEMA controllers provide an enhanced "plus" detector feature called occupancy-on-green to measure occupancy only during the green or green + yellow clearance interval. This feature provides a useful measure of occupancy for detectors at or near the stop bar when standing queues are stopped over the detector during the red interval. Occupancy-on-green + yellow are measured during the portion of the sample time equivalent to the total split time.

Occupancy "Full Rate %" is a full-scale reading of occupancy expressed in %. Since occupancy is a function of the green time (g/C) over the detector and occupancy-on-green feature, occupancy "Full Rate %" must be approximated.

For example, if occupancy is measured during the green + yellow interval of the phase, then the maximum occupancy is roughly equivalent to the split time of this phase. If occupancy "Full Rate %" for this detector is 60% and measured occupancy is 12%, then the Occ% value is calculated as follows:

Occ % = measured occupancy / full rate % = 12 / 60 = 20%

Central level traffic responsive operation will provide a real-time status display of Vol% and Occ% for each system detector similar to the status display provided in the master.

TRO Flow Values - Inbound, Outbound and Cross Detector Groups

Each system detector is assigned to the Inbound, Outbound or Cross-detector group and assigned an occupancy Scalar (kx) and a volume Scalar (cx). TRO Flow Values are computed for each detector group using the formula below. Each TRO Flow Value (Inbound, Outbound and Cross) is a weighted average of the Vol% and Occ% values for the detectors sampled for each detector group.

$$FlowValue = \frac{(k1 * Occ_1 + k2 * Occ_2 + ... + kx * Occx) + (c1 * Vol_1 + c2 * Vol\ 2 + ...cx * Volx)}{k1 + k2 + ... + kx + c1 + c2 + ... + cx}$$

Central level traffic responsive operation (via ATMS.now in lieu of On-Street Masters) will provide real-time status displays of all TRO calculations for each active flex group. These status displays will include real-time TRO Flow Value for the Inbound, Outbound and Cross detectors assigned to each flex group. A table lookup is used to select the current Cycle, Offset and Split Index from these parameters.

Cycle, Offset and Split Parameters

The *Cycle, Offset and Split Parameters* are calculated from the *TRO Flow Values* as follows. These parameters range from 0 to 100% and are used to perform a table lookup to select the *Cycle, Offset and Split Index*.

Cycle Index = Max. Inbound V+O <*or*> Max. Outbound V+O
Offset Index = ((Outbound – Inbound) / (Outbound + Inbound)) * 50 + 50
Split Index = ((Cross – Cycle Index) / (Cross + Cycle Index)) * 50 + 50

Cycle, Offset and Split Index

The TRI and TRE calculations perform a table lookup using the calculated Cycle, Offset and Split Parameters to select a *Cycle, Offset and Split Index*. Separate threshold tables are selected depending on whether the C*ycle, Offset and Split Parameters* are increasing or decreasing. This reduces the hysteresis or "bounce" in successive data samples.

Separate threshold tables will be provided for each flex group. One table will be used to reference the index if V+O are increasing and the other table will be used if V+O are decreasing compared with the last sample. Below is an example *Cycle Index* lookup table for both cases. Similar threshold tables will be provided to select the *Offset and Split Index* as they are currently used in the field master.

CYCLE LENGTH THRESHOLDS

CYCLE LENGTH INCREASING
FREE to CYCLE 1 : 25
CYCLE1 to CYCLE2 : 35
CYCLE2 to CYCLE3 : 41
CYCLE3 to CYCLE4 : 48
CYCLE4 to CYCLE5 : 56
CYCLE5 to CYCLE6 : 99

CYCLE LENGTH DECREASING
CYCLE1 to FREE : 17
CYCLE2 to CYCLE1 : 28
CYCLE3 to CYCLE2 : 36
CYCLE4 to CYCLE3 : 40
CYCLE5 to CYCLE4 : 49
CYCLE6 to CYCLE5 : 99

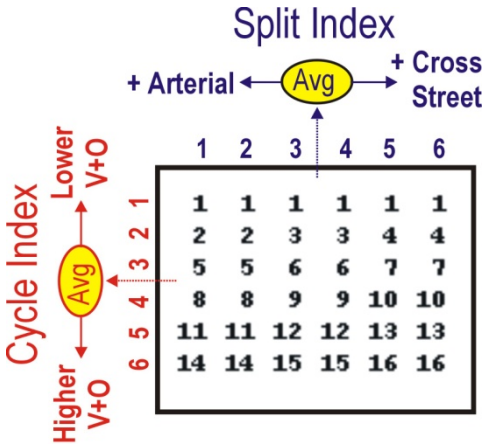
In the example above, suppose the current *Cycle Index* is "4" and the *Cycle Parameter* has <u>increased</u> during the last 15 minute sample period from 52% to 55%. A lookup from the <u>increasing</u> table will retain the *Cycle Index* at "4" because 55% is less than the threshold of 56% necessary to change to *Cycle Index* "5".

However, once the *Cycle Index* moves to "5", the *Cycle Parameter* will have to drop to 49% (from the <u>decreasing</u> table) to move back to *Cycle Index* "4". Without separate threshold tables, the TR system could become unstable if the measured *Cycle Parameter* began oscillating from 55 to 56. This method reduces the hysteresis or "bounce" in the V+O data measured by the system.

TR Pattern Lookup Procedure Using the Cycle, Offset and Split Index

The traffic responsive pattern is selected by a table lookup procedure using the calculated *Cycle, Offset and Split Index* values documented above. Four separate offset tables (cycle/split matrixes) are provided for each flex group defined in the system. Any of the 48 patterns within the secondary controllers may be assigned to these lookup tables.

The pattern lookup procedure described below illustrates the relationship between the inbound, outbound and cross street preferences within the system.



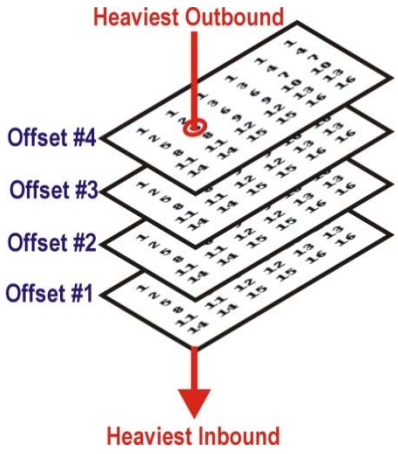
1) *Cycle Index* varies cycle length with arterial V+O

Patterns assigned to the same row typically share a common cycle length. For example Cycle 1 (row 1) could be assigned to free operation, Cycle 2 (row 2) assigned to 80" patterns, Cycle 3 (row 3) to 90" patterns, etc. *Cycle Index* then increases with V+O driving the cycle length higher with each successive row of patterns.

2) *Split Index* varies splits based on *Arterial* vs. *Cross*

Patterns within the same row share a common cycle length; however, different patterns may be used to adjust split times to favor an arterial or cross street preference.

CIC (Critical Intersection Control) is an adaptive split feature, which provides an alternate way of adjusting split times (see Chapter 13 of the controller manual).



3) *Offset Index* is based on an *Inbound* vs. *Outbound* relationship in the volume + occupancy data and adds a third dimension to the decision of selecting a traffic responsive pattern.

The four offset matrices can be visualized as four separate layers of the *Cycle / Split Index Tables* as shown to the left. *Offset Index* is the relationship between the highest *Outbound* V+O compared with the highest *Inbound* V+O.

Traffic responsive operation applies the *Offset Index* to select a *Cycle / Split Index Table* favoring a strong inbound or outbound demand in the network.

The controller provides a maximum of 48 patterns, with 32 unique split tables to define these matrices. However, there are 144 unique patterns that can be assigned to this matrix (4 offset tables * 6 cycles * 6 splits).

ATMS.now maintains a separate lookup table for each flex group, to emulate the mode table within the traffic responsive master. The possible modes assigned to each index are:

TR – Implement the current traffic responsive operation pattern for the flex group
TOD – Implement the current time-of-day for the flex group
SBY – Central stand-by operation

The mode table allows traffic responsive to select the operating mode of each flex group based on the calculated *Cycle Index* value. The mode table under master and central control can be configured to select time-of-day patterns from the secondary controller

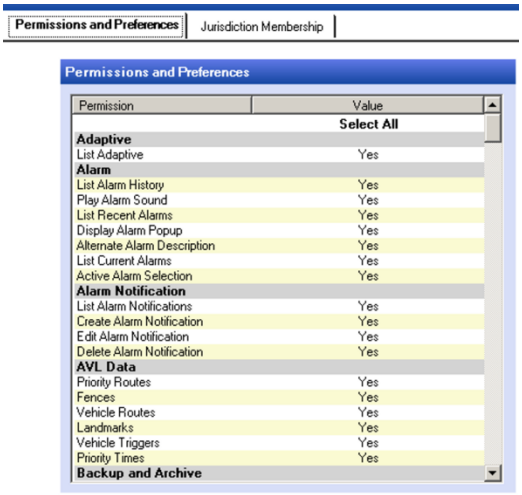
schedules as a default under low volume and occupancy (V+O) conditions and switch to a traffic responsive pattern at high V+O conditions to respond to incidents.

ATMS.now will maintain a separate lookup table for each flex group that provides traffic responsive outputs within the defined by NTCIP 1210 – Traffic Signal Masters. The NTCIP command table is primarily used to program special function outputs controlled by the traffic responsive pattern selected.

SECURITY AND SYSTEM ACCESS

Each user in ATMS.now is assigned security access in relation to all functions within the system. Typically, the system administrator (ADMIN) is the only user who can define other users and assign access rights. This level of security ensures control over which users have total access to the system and those which only have viewing access.

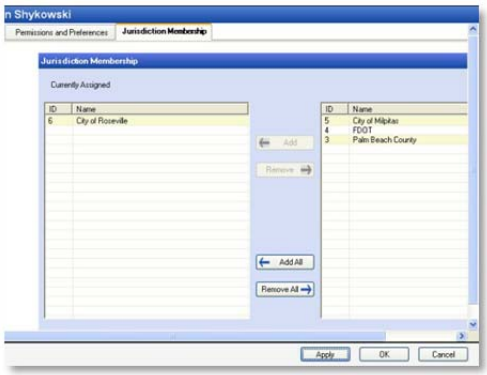
Each user can be programmed for different allowable operations to be performed on selected controllers only. This allows the City to select who has access to the system and which controllers are being accessed. This is a high-level security feature to minimize system problems created from unauthorized sources.



ATMS.now has several levels of security features, which may be enabled at multiple levels. Since the architecture of the central software is client/server based, the security settings for each authorized client connection are established upon connection, per the user account login.

Outside jurisdiction clients may be granted limited access to view their shared intersections only, while non-related intersections in other parts of the City are removed from the selection list, and “blinded” to these guest accounts.

The system administrator can set user’s access rights for all the components within the system. Any number of security levels can be created and users can be created from other user access rights



In addition to system administrators, ATMS.now provides multi-jurisdictional controls that provide Full, Partial, or Read-Only access rights to other agency’s devices, status’, and logs.

Individual user profiles can be customized by the System Administrator to allow or deny access to various components of ATMS.now. Among the many user-based permissions and preferences are those related to:

- Alarms (including incidents and triggers)
- AVL data

- Cameras
- Backup and archiving databases
- Controller configurations
- Congestion parameters
- Database parameters
- Devices
- Events
- GIS interface parameters
- Incident triggers
- User and jurisdictional rights
- Access and control of approved auxiliary devices, such as monitors and Opticom
- Real-time control screen access
- Reports
- Utilities
- Vehicle classification access
- Weather alerts

User Groups allows the system administrator to assign privileges to Group types, and assign users to those groups. This feature creates an easy way to manage privileges and control in large agencies.

Successful completion of the log-in results in execution of a session start-up procedure. The start-up procedure establishes privileges, object menu options, windows, and tools the operator may utilize. Only functions that a particular operator has permission to access are displayed.

If the operator logs off of any individual workstation, all windows and applications that are part of the central signal system software close.

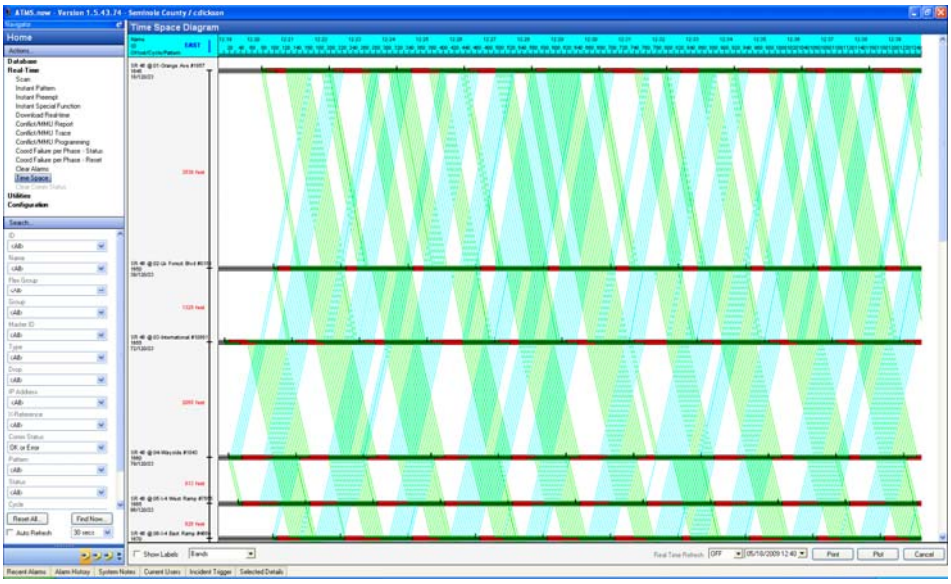
ATMS.now provides assignable pop up alarms, color coding of status, and assignable audible notification.

The ability to track changes made to each controller whether at the TMC or in the field and provide logs of who and when changes were made, including notifying staff when changes appear between the controller and the central database is currently under development and very close to completion.

MoE: MEASURES OF EFFECTIVENESS

Time/Space Diagrams

Generate time-space diagrams from both real-time data and from historical data contained in the database and to display such time-space diagrams on-screen.



Perform “on-screen fine-tuning”, using click and drag methods to adjust the offsets, with the resulting changes in the widths of the progression bands being displayed. Then save the resulting changes in offset for that timing plan.

Fine-tune crossing arterial progression by generating the time-space diagram for each street in a separate window. The on-screen adjustment of the offset of the common window result in changes in the widths of the progression bands in both windows.

Real-Time Split Monitor

The Splits tab provides real-time graphical split monitoring for a single controller based on controller selection from the Controller List or GIS pane. The split monitor graphically displays three values for each active phase:

- Actual (real-time)
- Programmed
- Average of 5 cycles

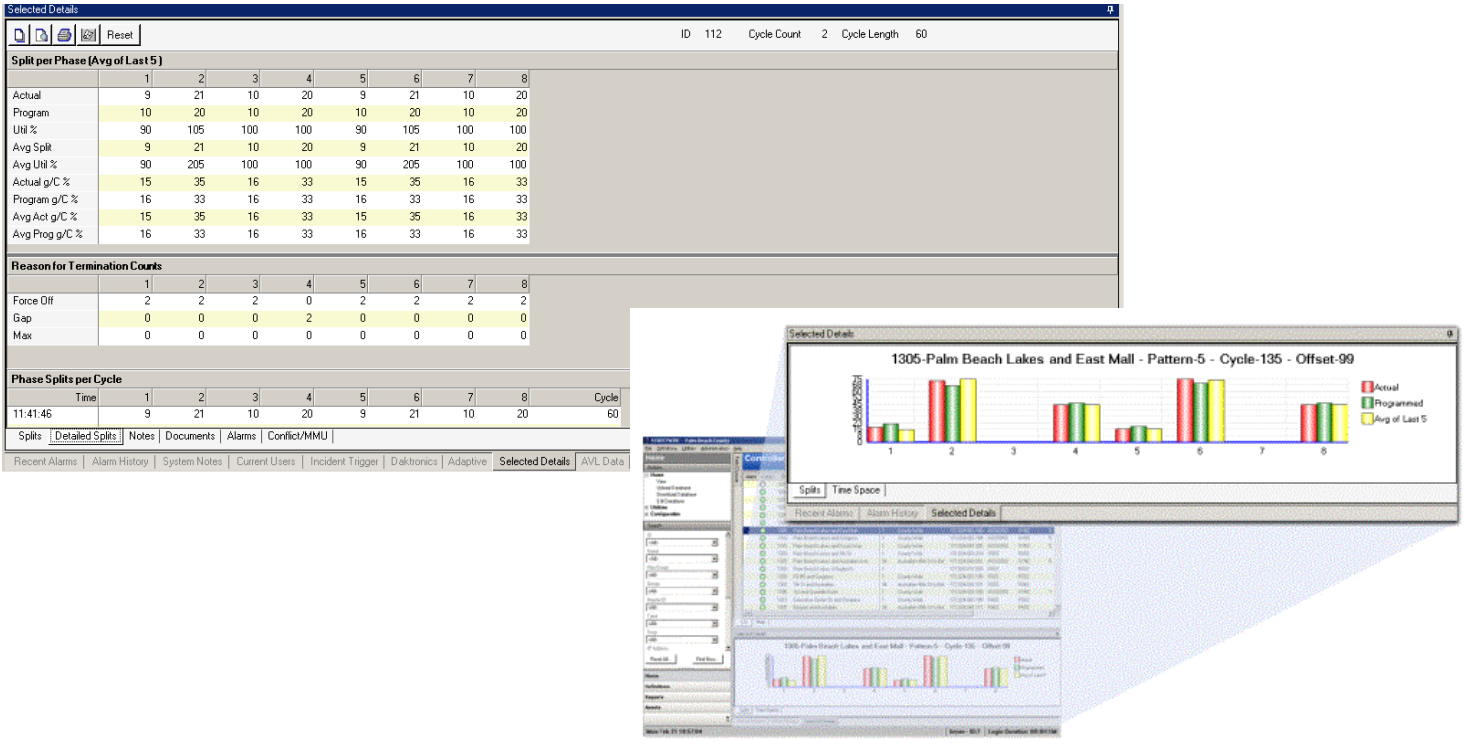
The real-time split information is gathered during the system’s “Full Status” activity for the programmed group(s) in the Scheduler, and historical reports for the Split data can be retrieved in the Reports module of ATMS.now. A Detailed Splits monitor allows information about a specific intersection to be viewed, providing real-time numerical split monitoring for a single controller.

SYSTEM DESCRIPTION

The Detailed Splits tab displays real-time split information on a per phase basis for both free and coordinated intersections. This will include:

- Actual (real-time)
- Programmed
- Util %
- Avg split
- Avg Util %
- Actual g/C %
- Program g/C%
- Avg Act g/C %
- Avg Prog g/C%
- Reason for Phase termination counters per cycle by
    - Force Offs
    - Gap
    - Max

In addition to the Detailed Splits, ATMS.now also provides a real-time graphical Splits tab for monitoring a single controller. The split monitor graphically displays three (3) values for each active phase: actual (real-time), programmed, and average of five (5) cycles. The real-time split information is gathered during the system's "Full Status" activity for the programmed group(s) in the Scheduler, and historical reports for the Split data can be retrieved in the Reports module of ATMS.now.



DIAGNOSTICS

Communication Statistics

ATMS.now provides communication statistics including the number of communication attempts, successes, failures, and percentage of successful communications per intersection, per channel, and per system.

Failure Summary

ATMS.now provides malfunction detection from the Controller for Coordination Failure, Coordination Fault, Cycle failure, Cycle fault, MMU fault, Controller fault, Detector SDLC fault, MMU SDLC fault, Terminal Facility SDLC fault, SDLC response frame fault, EEPROM CRC fault, Detector Diagnostic fault, Ped detector fault, and coordination diagnostic fault.

Upon detection of the failure, ATMS.now enables an alarm and initiates the notification to an operator. The occurrence of each alarm is recorded in the system log referencing the intersection name and ID.

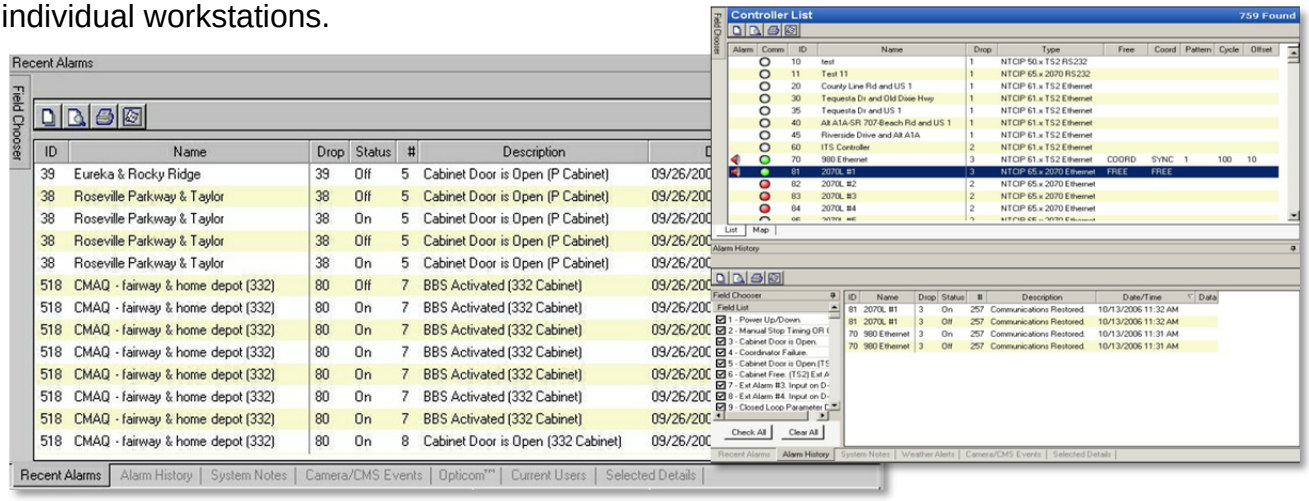
Failure Monitoring

ATMS.now provides a distinction between low-priority events and high-priority alarms. Events are uploaded periodically (perhaps once per day) for historical purposes, whereas alarms are typically relayed to the central as soon as possible. These alarms are logged and time stamped and displayed visually to the operator.

A maximum of 128 events and alarms may be enabled through separate controller menus; however, each numbered event refers to the same numbered alarm. If an alarm is enabled it must first enabled as an event. However, an event may be enabled as an event without being enabled as an alarm. This allows the user to define high-priority alarms to be reported immediately to the central while low-priority events are stored for record purposes.

Audible Alarms

ATMS.now software can generate audible alarms for specified, user-defined failures, concurrent with graphical alerts and alphanumeric paging. Operators disable/enable the audible alarm feature quickly and easily. The source of the audible alarms comes from individual workstations.



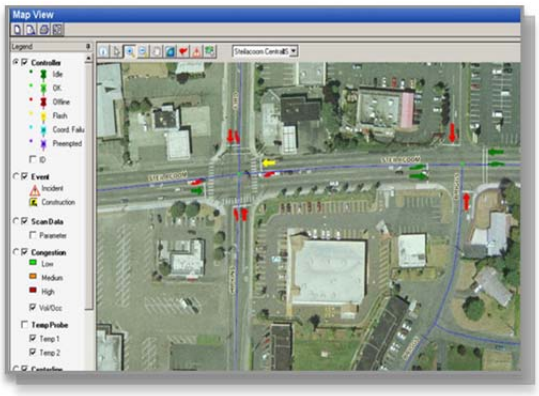
Alarms And Paging User Notification

ATMS.now has the ability to create a system-generated notification schedule to send a page, email or web message to a specified unattended user when specified alarms are detected by the system. The notification can be customized by user, alarm type, and start and end times of day, days of week, and date. The phone number, email address and critical trigger alarms are incorporated in the User Module of ATMS.now.

ATMS.now can be programmed to send e-mail, text, page, and web-based messages to any recipient by alarm type and TOD. Our standard installation does not include .wav file setup, but this function can be activated upon request. The alarm notification view is programmable on a user-by-user basis through an Alarm Field Chooser window.

Detector Monitoring

When a detector alarm is active the Occupancy Value represents a NEMA specified error code for the failed detector diagnostic. These detector Diagnostic faults are: Max Presence Fault, No Activity Fault, Open Loop Fault, Shortened Loop Fault, Excessive Inductance Fault, Watchdog Fault, and Erratic Output fault. These failure modes are provided on the main detector programming and are also available on three separate full programming tables for TOD-based failure programming.



Event Status and Failure Monitoring

In a properly designed communication infrastructure choosing an Open Systems Interconnection (OSI) communications model utilizing TCP and UDP at layer 4, IP at layer 3 and Ethernet at layer 2, real-time status is received continuously on a once per second basis minimum from local controllers with true Ethernet interfaces. Real time information includes phase status, current timing plan in effect, mode of operation, and equipment status.

The ATMS.now System Administrator program monitors high level requests against lower-level requests, and executes them based on priority. An example of this is when the system is about to perform a pre-programmed system time broadcast and a user has requested a database Upload, the System Administrator program will suspend the time broadcast and perform the Upload first, then execute the time broadcast. The priority level of each ATMS function is hard-coded within the ATMS.now Administrator program.

OTHER ATMS FUNCTIONS

Scheduler

Events can be scheduled to occur automatically, allowing the System Administrator to define time-of-day polling for the system. Scheduled events include, but are not limited to automatic data uploads, comparing databases, synchronizing the field clocks within the system, gathering alarms, and uploading logs. All system activities can be scheduled by time-of-day and executed by the system without operator intervention.

Time Synchronization

ATMS.now provides multiple schedule options to keep the server time in sync with the field controllers.

- USNO Time: Collects time from the US National Observatory via Internet and updates the server time
- Sync Controller Time to Server: Synchronizes ATMS server time from a specific controller.
- Download Real-Time: Download server time to controller(s)

These options are default tasks in the Scheduler. As stated previously, the Scheduler gives the user full control on time and frequency of performed tasks, from once/second to annually.

ATMS.now updates the controller clock when the controller is added to the Time Sync Group in the system Scheduler. It will be performed at the frequency level of the system Scheduler. A manual command is available in the main system window for quick time sync at any time.

Timing Patterns

ATMS.now defines Cycle length, offset, split, and sequence combination as a pattern. NTCIP defines 50 patterns, 1-48 user definable and Pattern #254 as Free and Pattern # 255 as Flash. Trafficware provides 32 spit tables and all 16 combinations of Lead/Lag for phase sequence flexibility. Each Pattern allows a unique timing value for the Cycle Length and Offset. All 50 patterns are stored in the controller's database for implementation upon command by central signal system software. The Actuated Signal Controller provides both automatic calculations of permissive periods and the ability for the operator to input desired values for the beginning and end permissive periods. ATMS.now allows for as many special signal timing plans as desired within the 48 pattern limitation to accommodate unusual traffic flow patterns during special events. ATMS.now provides a complete copy utility for transferring controller databases from one to another. ATMS.now provides for all 16 combinations of lead, lag, lead/lag phasing and can be configured to recognize first and third-car left turn lane detection.

Arrival Distribution

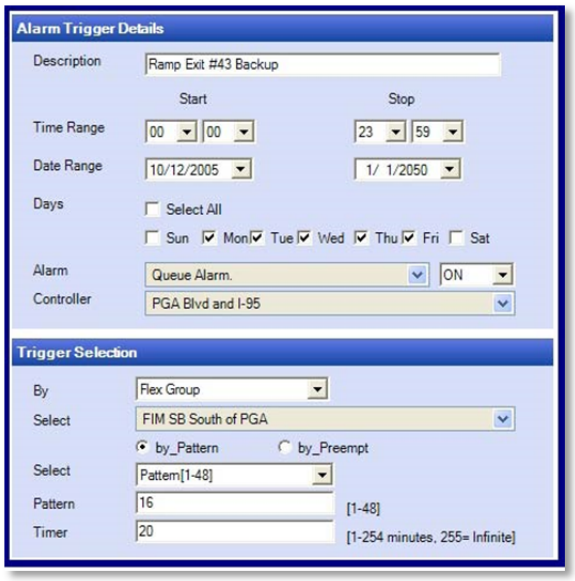
ATMS.now allows an Arrival Distribution graph that plots counts across the cycle length and shows the relationship of how cars arrive by direction to the intersection.

Turning Movement Counts

Query turning movement counts, data formulated by average 85th and 90th percentile.

Communications Interface

For specific network performance, the ATMS.now interface provides a switch layer to control network elements that provide network-level information. This provides the monitoring/collecting of specific network communication statistics.



Vehicle Preemption

ATMS.now correctly recognizes the occurrence of a locally-initiated emergency vehicle, transit or railroad preemption not as a coordination failure, but as a preemption, as the local controller has been preempted. The beginning and ending times of all preemption events are time stamped, recorded and stored in the SQL database for report generation. Types of preemption follow the NTCIP definitions and are differentiated as follows:

- Preempt 1&2: Railroad
- Preempt 3-6: Emergency Vehicle
- Preempt 7-10: Transit Priority.

Alarm Triggering

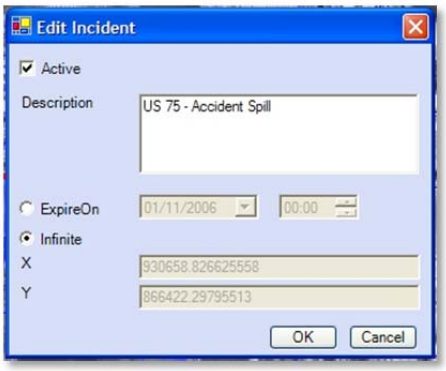
Alarm Triggers are system-generated controller or other device actions based on a reported alarm input from a single or multiple controller. These Alarm Triggers can cause a pre-programmed reaction of another Controller, Group, or Flex Group, or other devices such as CCTV and CMS. An example of this would be to cause a complete coordinated arterial to automatically transition to “FREE” operation if a critical intersection in that arterial issued a “Coord Fail” alarm to ATMS.now. This feature can be used to solve a variety of problems that cannot be addressed by time-of-day control or traffic responsive operation. This feature has been used successfully in control applications that are not predictable and can be triggered by an alarm response. Another example of the use of alarms triggers based on an incident would be a queue detector. The example illustrates how a pattern can be sent down to a control group when a Queue Detector Alarm is received by ATMS.now

In the example, a queue detector is provided at the “PGA Blvd & I-95” interchange. A trigger is generated when this alarm state changes to ON. When the trigger is activated, Pattern 16 is downloaded as the REMO pattern to the Flex Group labeled “FIM SB South of PGA”. Note that this flex group may contain not only the interchange, but also nearby signals affected by the event. In this example, a CCTV or CMS could also have been automatically activated to display a camera preset or a predefined message.

Note that any of the alarms of the NTCIP Controller may be used to activate an alarm trigger.

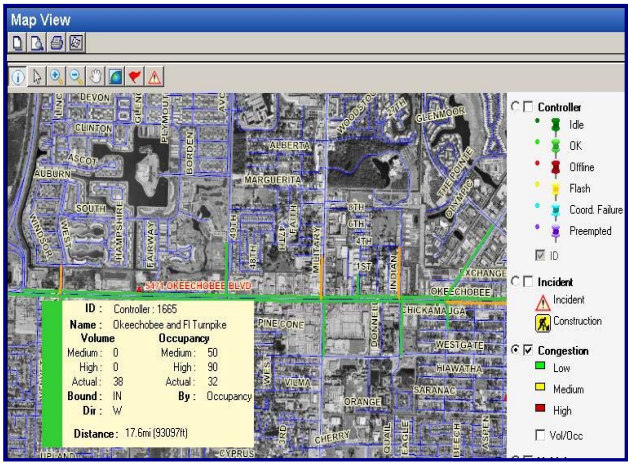
Incident and Construction Notification

Incident or construction zones can be indicated on the GIS map, and provide details specific to that incident, for ATMS.now or web viewing.



Detector Data Processing

View real-time intersection status and detector volume, occupancy, and speed data overlaid on the GIS map or hyperlinked files.



The ATMS.now software has a configurable detector data processing resolution, as frequent as every one (1) minute for traffic responsive operation to every 15 minutes in a standard system.

All detector inputs, whether from loop, video, or radar, can be simultaneously used as detectors for volume, occupancy, extension, added initial and work as switching detectors. Each detector channel has individual failure programming. Detector alarms are reported to the ATMS system in real-time while the actuation records are reported at the programmed interval. Detector status is monitored in ATMS in real-time. This includes all 64 vehicle detector and 8 pedestrian detector activations and Alarms.

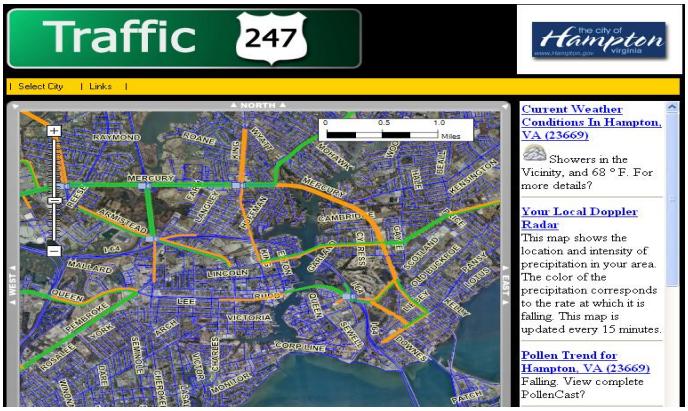
Collection and Retrieval

ATMS.now automatically records detector data in the database and archives the data onto external media. Raw detector data can be stored in memory on a five minute basis. Up to four weeks of five-minute detector data for each intersection can be stored on the system disk by the database program. Each five-minute block can be date and time-tagged. The user has the ability to enable or disable the detector data collection feature.

ATMS.now does not require compressing of the detector data for collection or archive, with the exception of archival of the SQL database using the standard SQL backup tools. ATMS.now does provide an embedded functionality to Backup and Archive on a schedule. This function will archive the core controller databases and the SQL database to an archive location, based on a system schedule. ATMS.now does not define data as bad or good.

Congestion Level Traffic Monitoring

Collect detector data and compare with thresholds for reporting and monitoring traffic congestion. This information is displayed graphically with three threshold levels. Low is displayed in green, medium is displayed in yellow and high congestion level is displayed in red. With another module, this information and maps have the ability to be exported and sent to outside sources such as websites or FTP servers.



Distance Marker

The user can designate a point of interest by placing a marker on the map. The system will calculate the distance from the marker to the nearest instrumented objects in the network.

Remote Access

ATMS.now supports multiple users distributed over local and wide area networks and remote access users over dial-up, VPN and thin-client connections to the LAN. Remote access users have full access to the database, GUI, and central signal software controls.

SYSTEM AND OPERATIONAL REPORTS

ATMS.now has seamlessly integrated Crystal Reports into the Reports Module. The reports module provides the user the ability to generate reports from a library of pre-formatted report templates from the ATMS.now database. ATMS.now stores all imported and system generated data into the system's main SQL database and makes it available for future report generation. The operator can generate custom reports as well as export to common formats such as text comma-delimited, text space-delimited, and text tab-delimited.

ATMS.now embeds pre-formatted Crystal Reports within the application. This is due to the two search engines that drive the Reports. The customer can request to have Trafficware take their favorite reports and implement them into the next ATMS update (we do this all of the time), or they can utilize Crystal Reports outside of the ATMS application without harming the database.

Using Seagate Crystal Reports, Standard ATMS.now reports can be printed in .pdf, .doc, .xls, and .txt formats.

ATMS.NOW DELL SERVER SPECIFICATION

PowerEdge R710:
Chassis for Up to 6, 3.5-Inch Hard Drives
SHIP:
PowerEdge R710 Shipping
Processor:
Intel® Xeon® E5640 2.66Ghz, 12M Cache,Turbo, HT, 1066MHz Max Mem
Installation Services:
No Installation
Memory:
24GB Memory (3x8GB), 1333MHz Dual Ranked RDIMMs for 1 Processor, Optimized
Additional Processor:
Single Processor Only
Operating System:
Windows Server 2008 R2, Standard Edition,x64, Includes 5 CALS
Hard Drive Configuration:
RAID 5 for H700 or PERC 6/i Controllers
Internal Controller:
PERC 6/i SAS RAID Controller, 2x4 Connectors, Internal, PCIe,256MB Cache,x6
Hard Drives:
QTY 6 - 2TB 7.2K RPM SATA 3.5in HotPlug Hard Drive
Power Supply:
High Output Power Supply, Redundant, 870W
Power Cords:
NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord
Embedded Management:
iDRAC6 Express
Microsoft SQL Server:
Microsoft®SQL Server™2008R2 Workgroup w5 CALs, OEM, NFI,w/Media
Rails:
ReadyRails™ Sliding Rails With Cable Management Arm
Bezel:
Bezel
Internal Optical Drive:
DVD+/-RW, SATA, Internal
System Documentation:
Electronic System Doc, OpenManage DVD Kit with Dell Management Console
1st Hard Drive:
HD Multi-Select
Power Cords:
No Additional Power Cords
Feature Upgrades for Embedded NIC Ports:
Dual Two-Port Embedded Broadcom® NetXtreme II 5709 Gigabit Ethernet NIC
BIOS Setting:
Power Saving BIOS Setting
Riser Card:
Riser with 2 PCIe x8 + 2 PCIe x4 Slot
Hardware Support Services:
3Yr Basic Hardware Warranty Repair: 5x10 HW-Only, 5x10 NBD Onsite
Proactive Maintenance:
Maintenance Declined

Dell PowerEdge R710

The Dell™ PowerEdge™ R710 helps you operate efficiently and lower TCO with enhanced virtualization capabilities, improved energy efficiency, and innovative system management tools.

Strong IT foundation

You want a data center built for organic growth and the ability to scale based on your company's changing requirements. You need complete solutions that let you focus your time and money on managing and growing your business. Dell responds with an expanding portfolio of enterprise servers, storage technologies, and services with a single goal: to help you simplify IT.

Purposeful design

With Dell's system commonality, once your IT managers learn one system, they understand how to manage next-generation Dell servers. Logical component layout and power supply placement provide a straightforward installation and redeployment experience. The PowerEdge R710 provides an interactive LCD for system health monitoring, alerting, and control of basic management as well as checking the AC power meter and ambient temperature thermometer included with each server.

Enhanced virtualization

Featuring embedded hypervisors, large memory capacity with 18 DIMM slots, and 4 integrated network connections, the Dell PowerEdge R710 delivers better overall system performance and greater virtual machine-per-server capacity. The latest Intel® Xeon® processor technology adapts to your software in real time, processing more tasks simultaneously. With optional factory-integrated virtualization capabilities, you get tailored solutions that allow you to streamline deployment and simplify virtual infrastructures. Choose your hypervisor from market leaders such as VMware®, Citrix®, and Microsoft®, and enable virtualization with a few mouse clicks.

Energy-optimized technologies

The PowerEdge R710 reduces power consumption while increasing performance capacity versus previous generation servers using Energy Smart technologies and standards-based components along with right-sized efficient power supply units, improved system-level design efficiency, and policy-driven power and thermal management. Dell's advanced thermal control delivers optimal performance at minimal power consumption without compromising enterprise performance.

Simplified systems management

The Dell OpenManage™ suite offers enhanced operations and standards-based commands designed to integrate with existing systems for effective control.

Lifecycle Controller

Lifecycle Controller is the engine for advanced systems management integrated on the server. Lifecycle Controller simplifies administrator tasks to perform a complete set of provisioning functions such as system deployment, system updates, hardware configuration and diagnostics from a single intuitive interface called Unified Server Configurator (USC) in a pre-OS environment. This eliminates the need to use and maintain multiple pieces of disparate CD/DVD media.

Dell Management Console (DMC)

DMC, powered by Altiris™ from Symantec™, delivers a single view and a common data source into the entire infrastructure. DMC is an easily extensible, modular foundation that can provide basic hardware management or more advanced functions such as asset and security management. It helps reduce or eliminate manual processes so less time and money is spent keeping the lights on and more time can be spent on strategic uses of technology.

Dell Services

Dell Services can help reduce IT complexity, lower costs, and eliminate inefficiencies by making IT and business solutions work harder for you. The Dell Services team takes a holistic view of your needs and designs solutions for your environment and business objectives while leveraging proven delivery methods, local talent, and in-depth domain knowledge for the lowest TCO.

The Dell PowerEdge R710 server with the performance of Intel Xeon processor 5500 and 5600 series offers you a 2U rack to efficiently address a wide range of key business applications.

Feature	PowerEdge R710 Technical Specification
Form Factor	2U rack
Processors	Quad-core or six-core Intel® Xeon® processor 5500 and 5600 series
Processor Sockets	2
Front Side Bus or HyperTransport	Intel QuickPath Interconnect (QPI)
Cache	Up to 12MB
Chipset	Intel 5520
Memory[1]	Up to 288GB (18 DIMM slots): 1GB/2GB/4GB/8GB/16GB DDR3 up to 1333MT/s
I/O Slots	**4 PCIe 2.0 slots + 1 storage slot:** two x8 slots, two x4 slots, one x4 storage slot
RAID Controller	**Internal:** PERC H200 (6Gb/s) PERC H700 (6Gb/s) with 512MB battery-backed cache; 512MB, 1GB Non-Volatile battery-backed cache SAS 6/iR PERC 6/i with 256MB battery-backed cache **External:** PERC H800 (6Gb/s) with 512MB of battery-backed cache; 512MB, 1GB Non-Volatile battery-backed cache PERC 6/E with 256MB or 512MB of battery-backed cache **External HBAs (non-RAID):** 6Gbps SAS HBA SAS 5/E HBA LSI2032 PCIe SCSI HBA
Drive Bays	Eight 2.5" hard drive option or six 3.5" hard drive option; optional flex bay expansion to support half-height TBU Up to four 3.5" drives with optional flex bay, up to six 3.5" drives without optional flex bay, or up to eight 2.5" SAS or SATA drives with optional flex bay **Peripheral bay options:** Slim optical drive bay with choice of DVD-ROM, Combo CD-RW/DVD-ROM, or DVD + RW
Maximum Internal Storage[1]	Up to 18TB
Hard Drives	**Hot-plug hard drive options:** 2.5" SAS SSD, SATA SSD, SAS (15K, 10K), nearline SAS (7.2K), SATA (7.2K) 3.5" SAS (15K, 10K), nearline SAS (7.2K), SATA (7.2K) **Solid state storage cards:** Fusion-io® 160GB ioDrive PCIe solid state storage card Fusion-io 640GB ioDrive Duo PCIe solid state storage card Fusion-io 320GB ioDrive Mono PCIe solid state storage card Fusion-io 640GB ioDrive Mono PCIe solid state storage card Fusion-io 1.28TB ioDrive Mono PCIe solid state storage card
Communications	Four embedded Broadcom® NetXtreme® II 5709c Gigabit Ethernet NIC with failover and load balancing; TOE (TCPIP Offload Engine) supported on Microsoft® Windows Server® 2003 SP1 or higher with Scalable Networking Pack; Optional 1GBe and 10GBe add-in NICs Broadcom NetXtreme II 57711 Dual Port Direct Attach 10Gb Ethernet PCI-Express Network Interface Card with TOE and iSCSI Offload Intel Gigabit ET Dual Port Server Adapter and Intel Gigabit ET Quad Port Server Adapter Dual Port 10GB Enhanced Intel Ethernet Server Adapter X520-DA2 (FcoE Ready for Future Enablement) **Optional add-in NICs:** Brocade® CNA (1020) Dual Port Server Adapter **Optional add in HBAs:** Brocade 8 GB HBAs Emulex CNA iSCSI HBA stand up adapter OCE10102-IX-D Emulex CNA iSCSI HBA stand up adapter OCE10102-FX-D
Power Supply	Energy Smart – two hot-plug high-efficient 570W PSU or high-output two hot-plug 870W PSUs **Uninterruptible Power Supplies:** 1000W–5600W 2700W–5600W High-Efficiency Online Extended Battery Module (EBM) Network Management Card
Availability	DDR3; hot-plug hard drives; optional hot-plug redundant power supplies; dual embedded NICs with failover and load balancing support; PERC 6/i; hot-plug redundant cooling; tool-less chassis; fibre and SAS cluster support; validated for Dell/EMC SAN
Video	Matrox® G200 with 8MB of cache
Remote Management	iDRAC6 Enterprise (optional)
Systems Management	Dell™ OpenManage™ Microsoft® System Center Essential (SCE) 2010 v2
Embedded Hypervisor	Optional Embedded SD Media
Rack Support	ReadyRails™ sliding rails with optional cable management arm for 4-post racks (optional adapter brackets required for threaded hole racks); ReadyRails static rails for 2-post and 4-post racks
Operating Systems	Microsoft® Windows Server® 2012 Microsoft Windows® Small Business Server 2011 Microsoft Windows Small Business Server 2008 Microsoft Windows Server 2008 SP2, x86/x64 (x64 includes Hyper-V®) Microsoft Windows Server 2008 R2 SP1, x64 (includes Hyper-V v2) Microsoft Windows HPC Server 2008 R2 Novell® SUSE® Linux® Enterprise Server Red Hat® Enterprise Linux® Oracle® Solaris™ **Virtualization Options:** Citrix® XenServer™ VMware® vSphere™ ESX® and ESXi™ For more information on the specific versions and additions, visit Dell.com/OSsupport.
Featured Database Applications	Microsoft SQL Server® solutions (see Dell.com/SQL) Oracle database solutions (see Dell.com/Oracle)
Thermal Operation	**Continuous Operation:** 10C to 35C, 10% to 80% relative humidity (RH). **10% of annual operating hours:** 5C to 40C, 5% to 85%RH. **1% of annual operating hours:** -5C to 45C, 5% to 90%RH. For in-depth detail, check your user manual.

[1] GB means 1 billion bytes and TB equals 1 trillion bytes; actual capacity varies with preloaded material and operating environment and will be less.

OEM Ready Models Available

OEM Ready platforms are grab-and-go products for OEM customers delivering a fast and simple path to a custom-branded solution. For more information, please visit Dell.com/OEM.

See the benefits at Dell.com/PowerEdge

DELL POWEREDGE 4220 AND 2420 RACKS

NEXT GENERATION RACK ENCLOSURES

The solid, versatile 42U Dell™ PowerEdge™ 4220 rack enclosure introduces important new power distribution, cooling and cabling options, and is designed for use in any environment from the data center, to a wiring closet or factory floor. A 24U version of the rack, Dell PowerEdge 2420, is also available for those environments that need less density for their equipment, such as small and mid-sized businesses.

NEW POWER BENEFITS

The new Dell 4220 rack provides more choices in the types and form factors of power distribution units (PDUs) that can be mounted in the rack. In addition to U-space PDU mounting, the rack also offers toolless PDU mounting at the rear of the rack. For mounting full-length PDUs alongside the rear door, the Dell 4220 rack provides the maximum distance between the back panels of the server to the PDU outlets, keeping the cables from impeding airflow.

BETTER AIRFLOW AND COOLING

The surface area of the doors on the Dell 4220 rack is 80% perforated to allow for better airflow—this is one of the highest perforation ratings among the leading data center racks sold worldwide. Finally, air dams have been included at the front of the rack frame to block hot air from traveling from the back to the front of the server, a common thermal issue with similar racks.

For hot-aisle/cold-aisle thermally efficient data center topologies, the footprint of the rack matches standard 2' floor tile placement, optimizing sub-floor cable and cold-air access without conflict.

EASIER CABLE MANAGEMENT

To provide support for deep server dimensions and to allow additional space for cable management, the total depth of the Dell 4220 and 2420 rack enclosures has been increased to 1070mm from 1000mm. Additionally, dual side panels on both sides of the rack make accessing cables easier—simply remove the top or bottom section of the panel. Finally, the back frame of the rack features removable tailbars at the top and bottom, eliminating a common obstacle to routing power and communication cables. These tailbars can be securely replaced after the IT cabling is complete.

Rack Features
Large open base for cable entry and exit Dual rear doors and split side panels Adjustable vertical mounting rails slide forward or backward within the rack 80% of the surface area of front and rear doors are perforated to aid in the thermal management of ultra-dense environments Rack-top cable exits with adjustable, sliding door Reinforced frame for stability Unique side-rack PDU options for Dell PDUs Reversible front door can be configured to open from left or right Front and rear doors are removable Rotating rear casters to easily position rack Ideal base dimensions for 2-tile placement in data center U-space numerical markings on both front and rear server mounting posts Easily accessible leveling feet Height allows movement through standard doorway

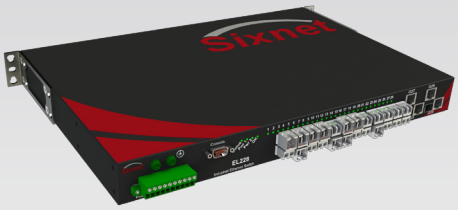
Rack Specifications	
2420 Dimensions	Height 47.3" (1202mm) Width 23.82" (605mm) Depth 42.15" (1070mm)
2420 Static Load Rating	1,500 lbs.
4220 Dimensions	Height 78.7" (1999mm) Width 23.82" (605mm) Depth 42.15" (1070mm)
4220 Static Load Rating	2,500 lbs.
Rack Weights	
2420 frame, doors, sides	94.5kg
4220 frame	86kg
4220 frame, doors	106kg
4220 frame, doors, sides	135kg
Total Weight with Crate for Air Shipping	
2420	162.5kg
4220 frame	176.5kg
4220 frame, doors	196.5kg
4220 frame, doors, sides	225.5kg
Total Weight—Ground Shipping	
2420	120kg
4220 frame	114kg
4220 frame, doors	135kg
4220 frame, doors, sides	163kg

SIMPLIFY YOUR SERVERS AT DELL.COM\POWEREDGE\RACK

DATASHEET

EL228 Layer 2 Industrial Ethernet Switch

ExtremeLine Managed Industrial Connectivity



PRODUCT HIGHLIGHTS

- KEMA tested and approved for IEC 61850 and IEEE 1613
- Enterprise-class functionality and security future proofs the network
- Powerful management and monitoring simplifies deployment and provides fault isolation
- Extreme port flexibility allows for seamless field configuration and upgrade
- Up to 26 fiber optic ports offer the ultimate in noise immunity
- Universal mounting (patent pending) simplifies ordering and deployment

ADVANCED INDUSTRIAL RATINGS

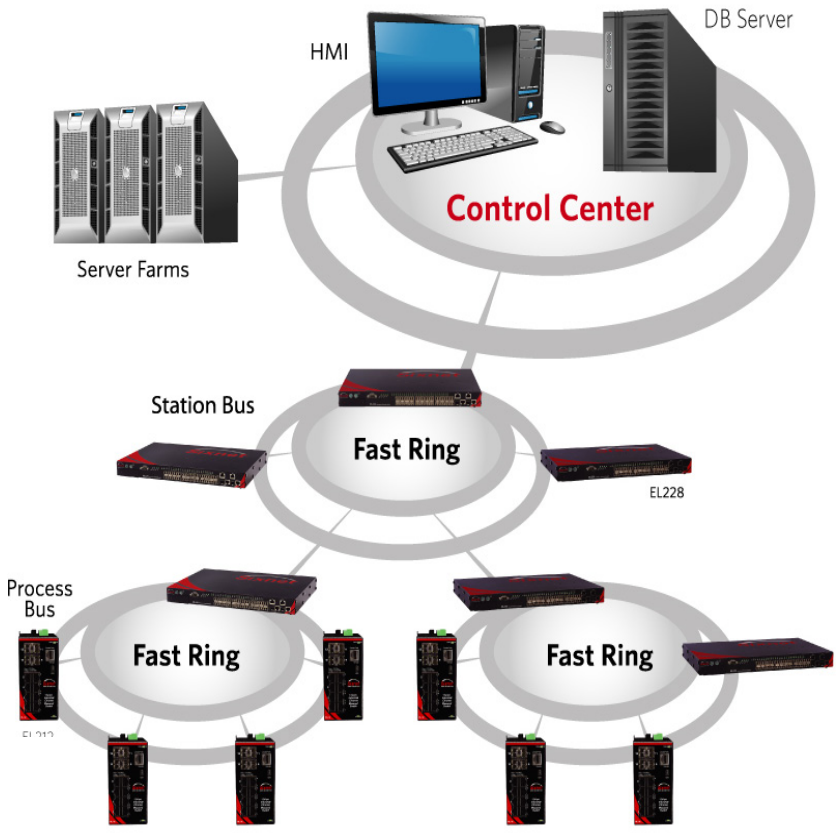
- IEC 61850 and IEEE 1613 for utility substation automation and other power applications
- NEMA TS-2 for traffic control systems
- EN 50155 and EN 50121-4 for railway installations
- ISA 12.12 and ATEX for Zone 2 hazardous locations

CONNECT. MONITOR. CONTROL.

The Sixnet EL228 is a 28 port (24 + 4G) managed industrial Ethernet switch designed to meet the extreme requirements of power substations, traffic control, railway and other harsh environments. It combines the high performance and security of an enterprise-class switch with rugged packaging and protected circuitry to meet the needs of the most demanding applications.

24 fast Ethernet SFP ports for fiber or copper links can be mixed and matched on the fly to provide the ultimate in port flexibility. Sixnet's universal mounting features LEDs, power/ground connections, console ports and bracket positions on both the front and back of the switch simplify ordering and deployment. By combining all of these features in one hardened package, the EL228 provides users with the lowest total cost of ownership of any industrial Ethernet switch in its class.

APPLICATION SCENARIO: POWER INDUSTRY



EL228 Layer 2 Industrial Ethernet Switch
ExtremeLine Managed Industrial Connectivity

INDUSTRIAL CONNECTIVITY

Sixnet's industrial Ethernet switches combine enterprise-class performance with rugged reliability to provide a "best of both worlds" solution for many of today's industrial applications. Our hardened switches are ideally suited for harsh and outdoor environments that include power substations, Smart Grid, military, utility, transportation and other industries where real-time performance under extreme operating conditions is required. Built-in redundancy coupled with advanced security and network management ensures the infrastructure stays up and running while providing tools for monitoring and tracking.

CONNECT. MONITOR. CONTROL.

FEATURES & BENEFITS

Rugged, Reliable Operation

- **Supports deployment in extreme environments**
- **Provides high reliability in the toughest applications**
  - Heavy industrial ratings for power, traffic, railway and hazloc applications
  - KEMA approved for IEC 61850 & IEEE 1613
  - Superior EMC performance and EMI immunity
  - Designed and tested from -40° to +85°C operating temperature (no fans)
  - Rugged corrosion-resistant metal enclosure
  - Sealed IP50 protects against dust, dirt and debris
  - UL/CSA, FCC and CE compliant
  - Dual-redundant AC or DC power supplies

Advanced Networking & Redundancy

- **Ensures fast recovery from faults**
- **Prioritizes handling of mission-critical data**
  - Real-Time-Ring™ for fast redundant rings
  - RSTP (Rapid Spanning Tree) provides complex redundancy
  - MSTP (Multiple Spanning Tree) per-VLAN redundancy
  - VLAN (GVRP, Q-in-Q) for convenient traffic segregation
  - LACP (Link Aggregation) increases bandwidth
  - IGMP for multicast filtering (snooping and querying)
  - QoS/CoS/DS provides real-time message prioritization
  - Jumbo frame (10K) support on Gigabit ports
  - Virtual stacking for up to 36 EL228 switches

Universal Mounting

- **Lowers overall cost of ownership**
- **Maximizes efficiency - one model does it all**
  - Universal mounting supports both front and reverse wiring
  - Status LEDs on front and back of switch for easy viewing
  - Console RS232 port on front and back of switch for local management
  - Space efficient 1U rack-mount design fits onto EIA, WECO and ETSI racks from 19" to 24"

Powerful Management & Monitoring

- **Simplifies configuration and management**
- **Provides fast and easy troubleshooting**
  - Easy configuration via Web or CLI
  - SNMPv1, v2, v3 network management
  - LLDP for universal network identification
  - sFlow for network-level monitoring
  - RMON and port mirroring for advanced diagnostics
  - Event/Error/System logging and system monitoring
  - UPnP, OAM and Banner support
  - Dual firmware upgrade system
  - Relay output contact to signal alarms

Ultimate Port Flexibility

- **Simplifies on-site configuration**
- **Reduces "fork-lift" upgrades**
  - 28 total Ethernet ports (24 + 4G)
    - 2 Gig RJ45 ports support auto 10/100/1000 Mbps
    - 2 Gig RJ45/SFP combo ports for copper or fiber links
    - 24 fast SFP ports - mix 100M fiber or 10/100 copper
  - Fiber transceivers support multimode, singlemode, bi-directional single-strand and long haul up to 120km
  - Up to 26 total noise-immune fiber optic ports

Advanced Cyber Security

- **Prevents against unauthorized access**
- **Protects from unwanted intrusion**
  - Static and dynamic port security
  - Authentication - SNMPv3, 802.1x, RADIUS, TACACS+ AAA/3.0, Web and MAC
  - Encryption - MD5, TLS, TTLS, TACACS+ AAA/3.0
  - Access Control List (ACL) per IP/MAC/VLAN/TCP/UDP
  - Secure Web (HTTPS/SSL) and Telnet (SSH)
  - Rate limiting and multicast storm protection
  - IP Source Guard, DHCP Snooping and Option 82

SPECIFICATIONS

Ethernet Performance
- 28 total Ethernet ports (24 + 4G)
- 24 SFP ports for a mix of copper or fiber
- 4 Gigabit with 2 RJ45 ports and 2 RJ45/SFP combo ports
- RJ45 ports: auto-negotiation (speed/duplex) and auto-crossover
- Non-blocking, store and forward, wire-speed
- Switching capacity and forwarding rate: 12.8 Gbps/9.5 Mpps
- Jumbo frame: 10K on Gigabit ports
- Ethernet isolation: 1500 Vrms 1 minute

Switching Features
- Flow control: IEEE 802.3x (Full Duplex) and Back-Pressure (Half Duplex)
- Spanning Tree Protocol (STP per IEEE 802.1D) plus
  - IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)
  - IEEE 802.1s Multiple Spanning Tree Protocol (MSTP)
  - BPDU forwarding and filtering
- Real-Time-Ring for high-speed, fault-tolerant rings
  - Link loss recovery: 50ms/hop
  - Switches in ring: <50 for best performance
  - Multiple rings are supported (4 per switch)
- Virtual Local Area Networks (VLANs)
  - 802.1Q tag-based with 256 VLANs and 4K VLAN ID
  - 802.1v protocol and port-based VLAN
  - Voice and Private VLAN
  - GVRP and Q-in-Q (double tagging)
- Link Aggregation Control Protocol (LACP per IEEE 802.3ad)
  - Static trunk (8 trunks and up to 8 ports per trunk)
  - Traffic load balancing
- Internet Group Management Protocol (IGMP)
  - IGMP v1, v2 and v3 with up to 255 multicast groups
  - IGMP snooping and querying
  - Immediate leave and leave proxy
  - Throttling and filtering
- Multicast VLAN Registration (MVR)
- IEEE 802.1ab Link layer Discovery Protocol (LLDP)
- Quality of Service (QoS) with 4 priority queues
  - Scheduling schemes: WRR and Strict priority
  - CoS per IEEE 802.1p and IP DSCP-based
  - DiffServ (DS): ingress, egress and remarking
- Rate limiting (ingress and egress)
  - 64Kbps to 100/1000 Mbps
  - Per port CoS

Security
- Enable/disable ports
- Port security (MAC-based): static and dynamic
- DHCP Snooping and Option 82
- IP Source Guard
- IEEE 802.1X Network Access Control
  - Port-based with single or multiple host mode
  - Authentication: EAP-MD5, PEAP, TLS, TTLS
  - MAC and web authentication
  - Guest VLAN and Auto VLAN assignment
- RADIUS and TACACS+ AAA
  - Authentication, Accounting and Authorization
  - 5 servers for RADIUS, 1 server for TACACS+
  - Encryption: MD5, TLS, TTLS, TACACS+ AAA/3.0
- Access Control List (ACL)
  - IP and MAC-based
  - VLAN and TCP/UDP port
- Storm Control for broadcast and multicast messages
- HTTPS/SSL for secure Web access
- SSH v1.5/2.0 for secure Telnet access
- SNMPv3 authentication and encryption
- Username and password authentication
- Management access filtering

All specifications are subject to change. Contact Sixnet to learn more.

Management & Monitoring
- IP Address assignment: Static, DHCP and BOOTP
- CLI (Command Line Interface) via console or Telnet
- Web interface (HTTP/HTTPS/SSL)
- SNMP v1, v2, v3 (Simple Network Management Protocol)
- SNMP Traps for event notification
- RMON I (Remote Monitoring): Groups 1, 2, 3 and 9
- sFlow network-wide traffi c monitoring
- Dual firmware update system
- Configuration download and upload
- Software upgrade via TFTP
- Port mirroring
- Event/Error/System log
  - Local flash
  - Remote server via system log (Syslog RFC 3164)
  - SMTP (RFC 821) email alarming
- Network Time Protocol for time synchronization
  - SNTP (RFC 2030) and NTP (RFC 1305)
- DNS (Domain Name Server) client
- Universal Plug and Play (UPnP)
- IEEE 802.3ah OAM (Operational Administration Maintenance)
- Banner commands

Power Input & Alarm Output
- Dual-redundant internal power input option
- 10-pole screw block can be positioned in front or back
- Power input options:
  +/- 24-48 VDC, (D option)(absolute min & max): +/- 18-75 VDC
  +/- 110-250 VDC or 100-240 VAC (50/60 Hz)(A option),
  (absolute min & max): +/- 90-300 VDC or 85-264 VAC
- Power consumption: 60 Watts typ. with all ports linked
- Protection: current overload and reverse polarity
- Alarm output: form -C relay (NO and NC contacts)
  - Max. voltage: 250 VAC, 30 VDC
  - Max. current: 2A @ 30 VDC or 250 VAC

Mechanical
- Universal mounting (Sixnet exclusive feature - patent pending)
  - Front or rear/reverse wiring with power in front or back
  - 1U rack mount (19" brackets included)
  - Optional 23", 24", EIA, WECO, ETSI and wall brackets available
- Ingress protection: IP50 sealed from dust and contaminants
- Heavy-gauge corrosion-resistant metal enclosure
- Dimensions (HxWxD): 1.75(1U)x17.3x12' (45x439x305mm)
- Weight (typical): 9.5 lbs (4.3 kg)

Environmental
- Operating/storage temperature: designed and tested from -40° to +85°C per IEC 60068-2-1/2
- Humidity: 5 to 95% RH (non-condensing) per IEC 60068-2-30
- Vibration: 20mm/s from 1 to 150 Hz per IEEE 1613 Class V.S.3
- Vibration: Amp: 3mm from 2-9 Hz, 1g from 9-200Hz, 1.5g from 200-500 Hz per IEC 61850-3
- Shock: 30g @ 11ms per IEC 61850-3, free-fall: 250mm distance

Standards & Compliance
- Power Systems: IEC61850-3, IEC60870-2-1/2; IEEE1613
  - KEMA tested and approved
- Traffic Control: NEMA TS-2
- Railway Systems: EN50155 & EN50121-4
- Safety: UL508 / CSA C22.2 No.142 / EN61010-1 / CE
- Hazardous Locations: ISA12.12.01/CSA C22.2 No.213 (C 1, Div 2, Grps A, B, C, D)
  - EL228-AA-1 and EL228-A0-1 models, T3C@60C (Ambient)
  - EL228-DD-1 and EL228-D0-1 models, T4@60C (Ambient)
- ATEX: EL228-DD-1 and EL228-D0-1 only (Zone 2, Cat3, T4@60C)
- EMC: IEEE c37.90.1/2/3, IEC61000-6-2, IEC61000-6-4, IEC/TS61000-6-5, IEC60870-2-1, IEC61000-4 Series, FCC Part 15, EN55022/CISPR22, CE
- Dielectric and Impulse: IEC60255-5 & C37.90
- RoHS, WEEE and REACH compliant
- MTBF: >200,000 hours GB @ +40°C per MIL-HNDBK-217F2
- ISO9001:2008 certified company

Warranty
- 5 years on design and manufacturing defects

EL228 Layer 2 Industrial Ethernet Switch
ExtremeLine Industrial Connectivity

SELECTION GUIDES

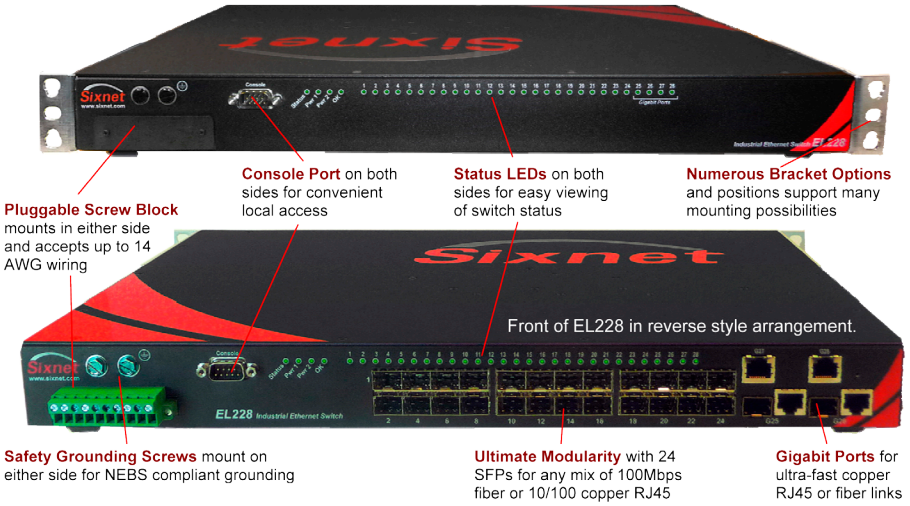
MODEL	DESCRIPTION
EL228-AO-1	with single universal VAC/VDC power input
EL228-AA-1	with dual universal VAC/VDC power supplies built in (with load share operation **)
EL228-DO-1	with single 24/48 VDC power input
EL228-DD-1	with dual 24/48 VDC power supplies built in (with load share operation **)

**See user manual for more details

ACCESSORIES MODEL	DESCRIPTION
EK1-BRCKT-19	Set (2) of 1U 19" brackets (one set included with each switch)
EK1-BRCKT-23	Set (2) of 1U 23" EIA/WECO
EK1-BRCKT-2324	Set (2) of 1U 23/24" EIA/WECO
EK1-BRCKT-ETSI	Set (2) of 1U 536 mm ETSI brackets
EK1-BRCKT-WALL	Set (2) of wall brackets

FIBER TRANSCEIVERS	SPEED	MODE	NOM. MAXIMUM DISTANCE	PORT COMPATIBILITY
FCOPPER-SFP-100	10 / 100 Mbps	Cooper RJ45	100 meters	Ports 1 thru 24
FMFIBER-SFP-4K	100 Mbps	Multimode	4 kilometers	Ports 1 thru 26
FSFIBER-SFP-30K	100 Mbps	Singlemode	30 kilometers	Ports 1 thru 26
FSFIBER-SFP-60K	100 Mbps	Singlemode	60 kilometers	Ports 1 thru 26
FSFIBER-SFP-100	100 Mbps	Singlemode	100 kilometers	Ports 1 thru 26
GMFIBER-SFP-500	Gigabit	Multimode	550 meters	Ports 25 and 26
GMFIBER-SFP-2K	Gigabit	Multimode	2 kilometers	Ports 25 and 26
GMFIBER-SFP-10K	Gigabit	Singlemode	10 kilometers	Ports 25 and 26
GMFIBER-SFP-30K	Gigabit	Singlemode	30 kilometers	Ports 25 and 26
GMFIBER-SFP-50K	Gigabit	Singlemode	50 kilometers	Ports 25 and 26
GMFIBER-SFP-80K	Gigabit	Singlemode	80 kilometers	Ports 25 and 26

Note: Special applications (such as BiDi) or extra long haul (up to 120 km) transceivers are available by special order.



About Red Lion

As the global experts in communication, monitoring and control for industrial automation, Red Lion has been delivering innovative solutions to customers for forty years. Our award-winning technology enables companies worldwide to gain real-time data visibility that drives productivity. Product brands include Red Lion, Sixnet and N-Tron. With headquarters in York, Pennsylvania, the company has offices across the Americas, Asia-Pacific and Europe. Red Lion is a Spectris company.

For more information, visit www.redlion.net/sixnet, call +1 (518) 877-5173 or email info@redlion.net

Sixnet a red lion business

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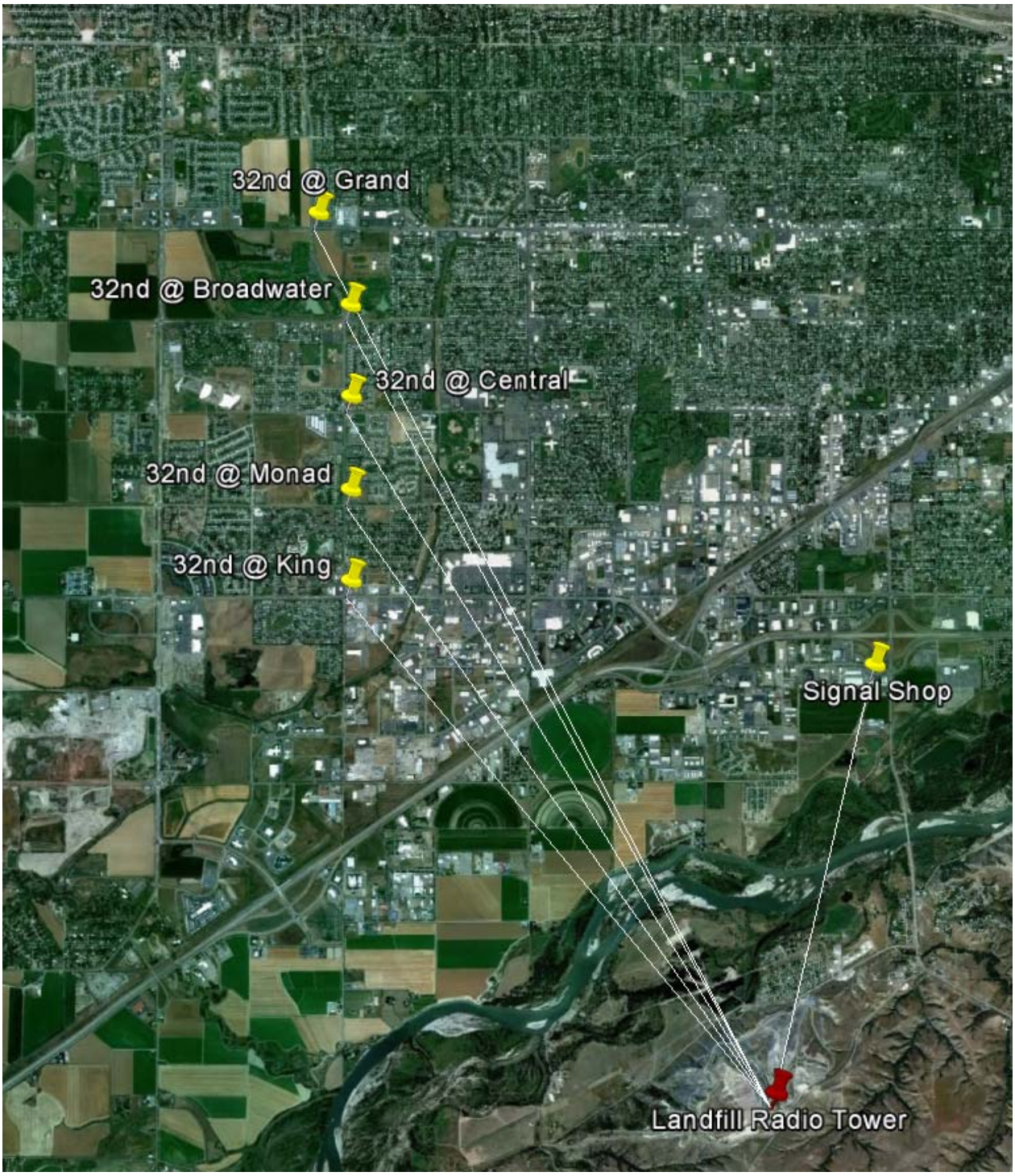
CONNECT. MONITOR. CONTROL.

WIRELESS SPECIFICATIONS

TABLE OF CONTENTS

WIRELESS PLAN



MOUNTAIN SECURE SYSTEMS
RUGGED & WIRELESS SOLUTIONS

SUMMIT SERIES SINGLE RADIO DETAILED SPECIFICATIONS

SUMMIT OUTDOOR WIRELESS PRODUCT ENCLOSURE PHYSICAL SPECIFICATIONS	
Size	12 " x 12 " x 3 " with integrated antenna
Weight	6 lbs.
Mounting	Wall and pole mount
Pole Size	.5 to 3 " outside diameter
External Connectors	RJ45 Power over Ethernet and N Type Female
AZ/EL Control	Both
Temperature	-55C t 85C
Vibration	MIL-STD-810F and IEC 60721-3-4 4M5 random
Shock Mechanical	MIL-STD-810F and IEC 60721-3-4 4M5
Humidity	100%
Water Ingress	IP67 / NEMA6 / IEC 529
Solar Radiation	ASTM G53 1000h
Ice Load	25mm radial
Salt Fog	MIL-STD-810F and IEC 68-2-11 Ka 500 hours

SUMMIT OURDOOR WIRELESS PRODUCT INTERFACE FREQUENCY SPECIFICATIONS			
FREQUENCY RANGE	2.412 TO 2.462 GHZ	4.945 TO 4.985 GHZ	5.745 TO 5.825 GHZ
Peak Transmit Power & Transmit Power Control (TPC)	28 dBm (600mW) – Yes	26 dBm (400mW) – Yes	27 dBm (500mW) – Yes
Modulation Type with DFS Support	OFDM – No	OFDM – No	OFDM – Yes
IEEE Protocol	802.11 b/g and proprietary	802.11 a and proprietary	802.11 a and proprietary
Data Rates	6Mbps, 9Mbps, 12Mbps, 24Mbps, 36Mbps, 48Mbps. 54Mbps	6Mbps, 9Mbps, 12Mbps, 24Mbps, 36Mbps, 48Mbps. 54Mbps	6Mbps, 9Mbps, 12Mbps, 24Mbps, 36Mbps, 48Mbps. 54Mbps
TX Channel Width	5, 10, 20, and 40 MHz	5, 10, 20, and 40 MHz	5, 10, 20, and 40 MHz
Security	WPA, WPA2, AES-CCM & TKIP encryption, 802.1x, 64/128/152bit WEP	WPA, WPA2, AES-CCM & TKIP encryption, 802.1x, 64/128/152bit WEP	WPA, WPA2, AES-CCM & TKIP encryption, 802.1x, 64/128/152bit WEP
Receiver Sensitivity	-74 to -97 dBm	-74 to -94 dBm	-74 to -94 dBm
Outdoor Range (Antenna Dependent)	30 miles	30 miles	30 miles
FCC Part 15	Yes	Yes	Yes
CE Mark	Yes	Yes	Yes
Industry Canada RSS-210	Yes	Yes	Yes
RoHS Compliance	Yes	Yes	Yes
ESD/EMP Protection	Yes	Yes	Yes
MTBF Rate	160,000 hours	160,000 hours	160,000 hours

see reverse

SUMMIT SERIES SINGLE RADIO DETAILED SPECIFICATIONS

Summit Ourdoor Wireless Product IEEE Networking Standards and Description	
802.1d	Ethernet and bridging
802.1p	Traffic prioritization
802.1q	Virtual Local Area Networks (VLAN)
802.1s	Spanning tree protocol
802.1w	Rapid spanning tree protocol
802.3ab	Gigabit ethernet
802.3ac	Q-tag support for 802.1Q VLAN information and 802.1p traffic priority information
802.3ad	Link aggregation for parallel links (now IEEE 802.1AX)
802.3i	10 Mbps ethernet
802.3u	100 Mbps ehternet with auto-negotiaton
802.3x	Full duplex and flow control
802.11e	WMM and QoS
802.11h	DFS and TPC

Included Configuration and Control Software Features	
Name	Features
SpeedCONFIG®	IP discovery tool
	Local and remote configuration
	Bandwidth test tool (on board and external)
	Spectrum analysis
	Real Time Received Signal Quality Indicator (RSSI)
	Client Connection Quality (CCQ)
	Antenna alignment tool with audio
	System file configuration management and scripting
Summit View Network Monitoring System	IP discovery tool
	Network and node management with link to configuration tools
	Real Time Received Signal Quality Indicator (RSSI)
	Real time wireless interface data rate monitoring
	Wireless event reporting tool (audio and email capability)
Web Configuration	Device can be configured via standard web browser using web interface

Made in the USA
SDVOSB
CAGE Code: 09FR8
9001:2008
AS9100C
J-STD-001

Mountain Secure Systems
Rugged & Wireless Solutions

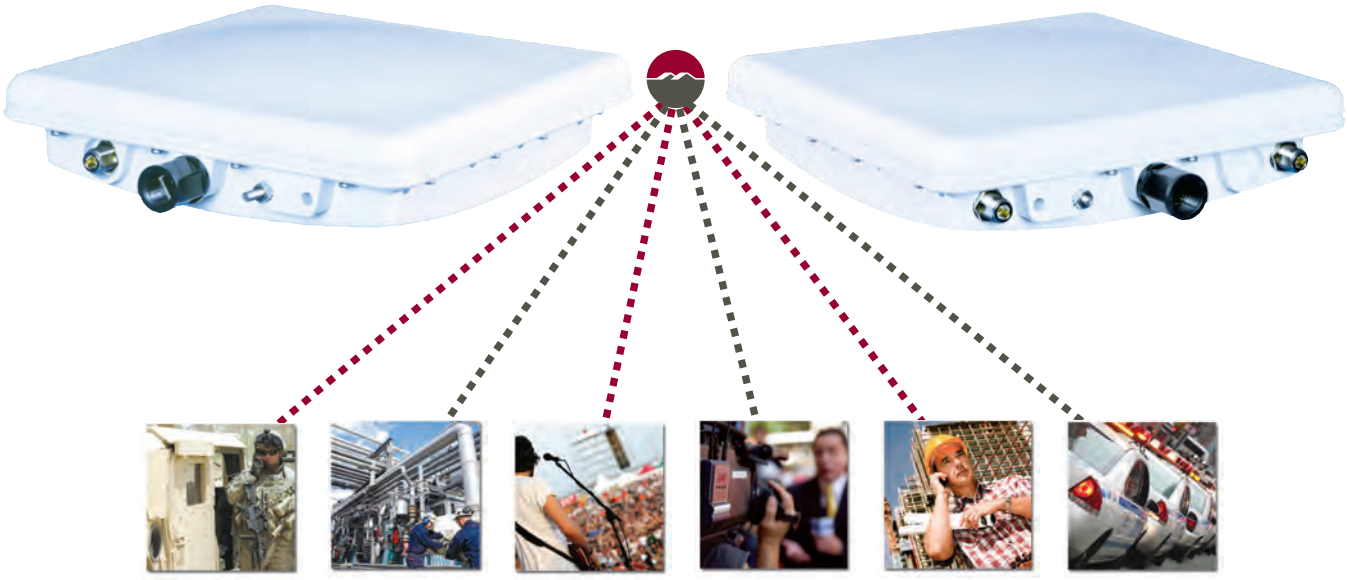
1350 Kansas Avenue,
Longmont, CO 80501 USA
888-884-9344
MountainSecureSystems.com

ISO 9001:2008 AS9100C CAGE 09FR8 SDVOSB

MOUNTAIN SECURE SYSTEMS
RUGGED & WIRELESS SOLUTIONS

SUMMIT SR DUAL BRIDGE/ROUTER WIRELESS RADIO

Summit Single Router (SR) Dual Bridge/Router Outdoor Wireless Network products from **Mountain Secure Systems** (MSS) are designed to deliver the best cost-to-performance ratio in the wireless network industry for video, voice and data applications. **A single device is capable of point-to-point, point-to-multipoint or wireless mesh network configuration.** Our devices also include all configuration and network management software. No additional license fees or add-on controllers—a one cost solution!



Summit SR Dual Bridge/Router Outdoor Wireless Network products from MSS have two complete wireless devices installed in one enclosure and either device may be configured as a router or as a bridge. They may also be individually configured for point-to-point, point-to-multipoint, wireless mesh, or repeater operation. **The following configurations are available:**

MSS Part#	Unit Description and Operating Frequency
MSS-54001	Summit SR Dual Wireless Bridge/Router certified for 2.4GHz band operation on both devices
MSS-54002	Summit SR Dual Wireless Bridge/Router Certified for 4.9 GHz Public Safety Band (PSB) operation on both devices
MSS-54003	Summit SR Dual Wireless Bridge/Router Certified for 5.8 GHz band operation on both devices
MSS-54004	Summit SR Dual Wireless Bridge/Router Certified for 4.9 GHz PSB or 5.8 GHz band operation on both devices
MSS-54005	Summit SR Dual MIMO Wireless Bridge/Router Certified for 2.4GHz or 5.8 GHz band operation on the both devices
MSS-54006	Summit SR Dual Wireless Bridge/Router Certified for 2.4 GHz or 4.9 GHz PSB band operation on both devices
MSS-54007	Summit SR Dual Wireless Bridge/Router Certified for 2.4 GHz band operation on the first device and 5.8 GHz band operation on the second device
MSS-54008	Summit SR Dual Wireless Bridge/Router Certified for 4.9 GHz PSB operation on the first device and 5.8 GHz band operation on the second device
MSS-54009	Summit SR Dual Wireless Bridge/Router Certified for 2.4 GHz band operation on the first device and 4.9 GHz PSB or 5.8 GHz band operation on the second device

see reverse

Best of all, Summit wireless network radios are:

Reliable:

- Built in the USA at a world-class manufacturing facility that meets stringent quality management requirements for military and aerospace
- Industry-leading 2-Year Standard Warranty

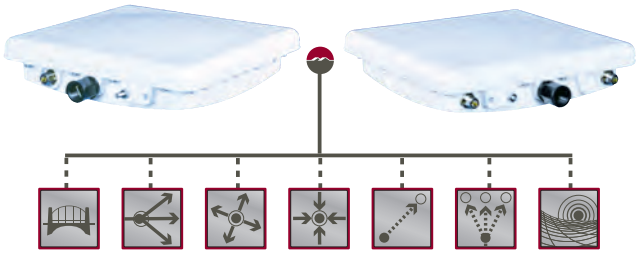
Fast:

- The non MIMO optionprovides 40 Mbps of real throughput in a 20 MHz channel; software configurable for up to 60 Mbps
- The MIMO option provides up to 150 Mbps of real throughput in a 40 MHz channel

Flexible

Every Summit radio can be configured as either a **bridge** or a **router** in any of the following network configurations:

- Access Point (AP)
- Client
- Point-to-point
- Point-to-multipoint
- Wireless Mesh



Secure

Summit products offer security features, such as:

- AES Wireless Encryption (WPA2) 64/128/192 Bit
- Built-in Firewall
- FIPS 140-2 Validation is available

Extremely Rugged:

Mountain Secure Systems has a long history of providing rugged products to the military that perform flawlessly under harsh conditions. Our products exceed the following standards for both the US and Europe and can be operated worldwide:

- Operating Temperature: -40 to 175F (-40 to 80C)
- IP67-rated enclosure meets MIL-STD-810F standards for mechanical shock, humidity, salt fog and solar radiation
- EN 300-019-2-4 Class T4.1E and Class 4M3 (humidity, shock and vibration)
- Powered by IEEE 802.3af standard POE (Power over Ethernet)

For more information about Summit outdoor wireless network products from Mountain Secure Systems, please call 888-884-9344, or visit us on the web at MountainSecureSystems.com.

MADE IN THE USA
SDVOSB
CAGE CODE: 09FR8
9001:2008
AS9100C
J-STD-001

MOUNTAIN SECURE SYSTEMS
RUGGED & WIRELESS SOLUTIONS

1350 Kansas Avenue,
Longmont, CO 80501 USA
888-884-9344
MountainSecureSystems.com

ISO 9001:2008 AS9100C CAGE 09FR8 SDVOSB

UNMANAGED INDUSTRIAL ETHERNET SWITCHES

The SL/SLX-5ES and SL/SLX-8/9ES are 5 and 8/9 port industrial Ethernet switches that provide advanced performance that enables you to achieve real-time deterministic operation. These ruggedized switches are hardened to provide superior reliability. They require no user setup and immediately start operating as soon as you power them up. Sixnet switches are designed to make your job easier, ensuring your system will keep running for many years to come.

SLX Models

PRODUCT HIGHLIGHTS

- Slim packaging fits on your Din-rail
- High performance and value
- Truly industrial hardened design
- Plug & play saves you time and money

REAL-TIME ETHERNET PERFORMANCE

- Fast wire-speed switching
- Intelligent message routing - No collisions!
- Ideal for any system

PLUG & PLAY SIMPLICITY

- Auto-sensing for speed and duplex
- Auto-mdi/mdix-crossover works with straight or crossed cables
- Auto-polarity corrects for crossed signals

TROUBLE FREE OPERATION

- Ultra-reliable 1,000,000+ hours MTBF
- Dual power inputs with industrial spike protection
- DIN-rail or direct panel mounting
- UL/CSA (CUL), CE, hazardous locations (Zone 2) and maritime rated

Sixnet Knows Industrial

We have been designing industrial hardware such as Remote Terminal Units for over 30 years and have used this expertise to design the toughest Ethernet switches on the market. Don't trust your critical communications to so-called industrial hardware from commercial switch manufacturers. Sixnet switches give you proven assurance that your system will keep running for years to come.

SL Models

ETHERNET PERFORMANCE

- Unmanaged with 5, 8 or 9 Ethernet ports
- Store & forward wire-speed switching
- Automatic address learning, aging and migration
- Full duplex operation with flow control (no collisions)
- All IEEE 802.3 Ethernet protocols supported
- 1024 MAC addresses supported
- Memory bandwidth 3.2 Gbps
- Typical latency (varies on load)
  - @ 100 Mbps: 5 µs + frame time
  - @ 10 Mbps: 16 µs + frame time
- Ethernet isolation 1500 VRMS 1 minute

ETHERNET PORTS

- Shielded RJ45 ports for 10/100BaseTX
  - Auto-negotiation for 10 or 100 Mbps
  - Auto- MDI/MDIX-crossover for either cable type
  - Auto-polarity corrects for crossed +/- signals
- Fiber optic port speed 100BaseFX (100 Mbps)
- Fiber duplex operation: Full duplex
- Fiber wavelength: 1300 nm center (typical)
- Fiber max. distance (full duplex) (see web for details)
  - 4 km for multimode 50 or 62.5/125 µm (SC or ST)
  - 20 km for singlemode 9 or 10/125 µm (SC or ST)
  - 40 km (long haul) or more (contact Sixnet)

ETHERNET COMPLIANCE

- IEEE 802.3 (10Mbps Ethernet supports legacy devices)
- IEEE 802.3u (Fast Ethernet 100Mbps for newer devices)
- IEEE 802.3x (Full-Duplex with Flow Control)

POWER INPUT

- Power input voltage: 10-30 VDC
- Redundant input terminals
- Input power (typical - all ports active at 100 Mbps)
  - 2.0 W (5-port without fiber)
  - 3.0 W (5-port including 1 fiber)
  - 4.0 W (8-port without fiber)
  - 5.0 W (9-port including 1 fiber)
- Transient protection: 15,000 watts peak
- Spike protection: 5,000 watts (10 times for 10 uS)

ENVIRONMENTAL

- Operating temperature
  - SLX models: -40 to +85°C (cold startup at -40)
  - SL models: -40 to +60°C
- Storage temperature: -40 to +85 °C
- Humidity (non-condensing) 5 to 95% RH
- Vibration and shock: IEC60068-2-6

STANDARDS COMPLIANCE

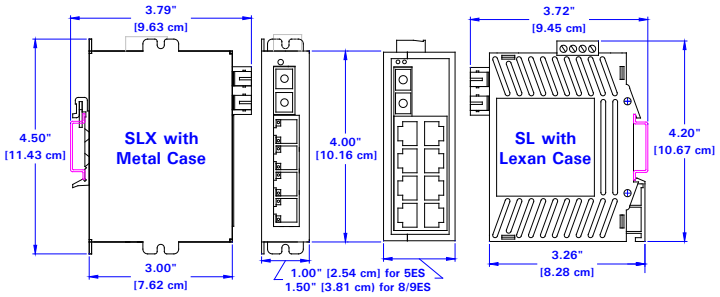
- Electrical safety - UL508/CSA C22.2/14, EN61010-1, CE
- EMC - FCC part 15, ICES-003, EN55022, EN61000-6, CE
- Hazardous locations: ISA 12.12.01 / CSA C22.2/213 (Class I, Div. 2); EN60079-15 (Zone 2, Category 3), CE (ATEX)
- Maritime rated for marine & offshore per ABS
- Eye safety (fiber models) - IEC60825-1, Class 1; FDA 21 CFR 1040.10 and 1040.11

PHYSICAL

- Din-rail or direct panel mounting
- Ingress protection: SLX models - IP40, SL models - IP40
- Case: UL94V0 Lexan (SL) or Aluminum (SLX)
- Weight:
  - 4 oz (0.11 kg) – SL-5ES
  - 6 oz (0.17 kg) – SLX-5ES, SL-8/9ES
  - 8 oz (0.23 kg) – SLX-8/9ES
- Dimensions – see mechanical diagram below

All specifications are subject to change. Contact Sixnet to learn more.

MECHANICAL DRAWINGS



ORDERING GUIDE

SLX-5ES-1	5 RJ45 10/100 ports
SLX-5ES-2SC	4 RJ45 ports and 1 mm fiber SC, 4 Km
SLX-5ES-2ST	4 RJ45 ports and 1 mm fiber ST, 4 Km
SLX-5ES-3SC	4 RJ45 ports and 1 sm fiber SC, 20 Km
SLX-5ES-3ST	4 RJ45 ports and 1 sm fiber ST, 20 Km
SLX-6ES-4/5	Dual fiber - see separate datasheet
SLX-8ES-1	8 RJ45 10/100 ports
SLX-8ES-6/7	Three fiber - see separate datasheet
SLX-9ES-2SC	8 RJ45 ports and 1 mm fiber SC, 4 Km
SLX-9ES-2ST	8 RJ45 ports and 1 mm fiber ST, 4 Km
SLX-9ES-3SC	8 RJ45 ports and 1 sm fiber SC, 20 Km
SLX-9ES-3ST	8 RJ45 ports and 1 sm fiber ST, 20 Km
SL-	w/Lexan case and limited temperature
ET-PS-024-02	2 Amp, AC to 24 VDC Power Supply
SP-ETH-2	Dual Ethernet port surge & lightning protector

Contact Sixnet for special or long haul fiber transeivers up to 120 Km.

Sixnet a red lion business

www.redlion.net/sixnet
+1 (518) 877-5173 | info@redlion.net

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