City of Fort Collins Advanced Traffic Management System
Final Report

Executive Summary

The Fort Collins Advance Traffic Management System (ATMS) was a FY01 earmarked project. The objective of the overall project was to rebuild the City's entire traffic management system to utilize and provide Intelligent Transportation System (ITS) capabilities to its community and to the future regional transportation efforts. The earmarked funds were utilized for one component of that overall project goal, the fiber optic communications network (FON), which ties all the parts and capabilities together.

Since the base ATMS project was completed in 2004 travel times have been reduced from 2% to 28% and the City is fully ready to tie into any regional ITS functions as well as share data and services with the City's other agencies and services (Police department, Fire department, Transit, web sites for public access, etc).

Project Overview

In March 2000, the City of Fort Collins Traffic Operations Department embarked on a multi-year project to replace the antiquated and unreliable traffic control system with a modern Advanced Traffic Management System (ATMS). The old system for traffic control was a Multisonics 330 centralized computer system that was installed in 1978 and relied completely on leased telephone lines for communication.

The core of the new ATMS is a modern traffic signal control system, which will reliably maintain coordination for traffic with the ability to provide future priority to transit vehicles and enhanced service to pedestrians and bicycles. This system is consistent with the U.S. Department of Transportation's National Intelligent Transportation System (ITS) Architecture. Consistency with the Architecture will provide the City with an open, non-proprietary system that, in turn, will provide future benefits to the City.

Early in the process, transportation services staff determined some overall goals of the project. The goals were as follows:

- Establish a Transportation Management Center where centralized control of the system could be maintained efficiently.
- Develop our own communication system and not be dependent on the inefficiency and lack of reliability of the leased telephone lines. The communications system will be a hybrid system based on a fiber-optic core. The fiber-optic core provides a high bandwidth network for the ATMS. Other communications methods, especially wireless communication, will be used for select links based on specific conditions.
- The traffic signal system will be a distributed system with traffic responsive

control. A distributed system is less vulnerable to communications failures, and the traffic responsive control will allow the City to adjust timing plans to be more appropriate to the actual traffic conditions.

- The new system must be able to incorporate transit and pedestrian options.

The successful completion of the above-stated goals was an expensive endeavor. A variety of funding sources were used to pull this project together in a cohesive manner. The City was extremely fortunate to receive several Federal grants that were instrumental in completing the project. The table below describes the funding sources that went into this project over the past five years as well as a description of the line item each funding source provided.

Funding Source	***ATMS Line Items***	***Amount***
General Fund	Fiber Optic Communication, cabinets, controllers, equipment, *ICONS System*	$5,000,000.00
Federal ITS	*Fiber optic communication system*	*$ 992,018.00*
Federal CMAQ	Video monitoring system	$ 345,628.00
Federal CMAQ	Fiber optic communication, equipment	$ 827,899.00
Total		***$7,165,545.00***

The Traffic Operations Department moved into the new traffic facility in November 2002. The facility is approximately 9500 square feet and houses the traffic engineers, work area traffic control personnel, administration, the traffic signal maintenance crews, and the Transportation Management Center

The building of this facility was a key initial component of the implementation of the ATMS. For many years the Traffic Operations Department, including the traffic control computers, were housed along with Utilities at 700 Wood Street. The department had long ago outgrown the space and the implementation of a new system was not feasible without the new facility in place. Utilities Services also needed the space for their staff.

Source: City of Ft. Collins, Colorado Traffic Operations Department

The Transportation Management Center (TMC) is located within the facility in an area completely dedicated to the function of the traffic operations. Located inside the TMC are the main computer system,

the electronics, and equipment for the fiber optic communication system and multiple workstations. Traffic engineers can monitor traffic as well as observe real-time signal operations from the 10 closed-circuit TV cameras located throughout the city as well as other system monitors. With the assistance of these cameras and monitors, the traffic engineers can adjust timing plans, analyze traffic conditions, and make changes to the system on a moments notice.

The actual traffic control system purchased is the Econolite ***ICONS*** System. The ATMS software provides the traffic engineers with a process that can integrate the operation of the traffic signals, communications, and data analysis through a graphical "point and click" format for controlling the system. National and international standards and protocols are used to the fullest extent possible. The system can adapt to changes in technology and increased functionality over time with minimum impact on individual system components.

The on-street equipment portion of this project was also critical to the success of the project. Each signalized intersection received new cabinets and controllers that actually operate the signals at each intersection. The existing on-street equipment was antiquated and proprietary rendering it useless as far as this project was concerned. Unfortunately, there was no new system we could put into place and use the existing equipment, as it was old and unsupported by the vender.

The City decided to use the state-of-the-art 2070 controller. The 2070 controller is a powerful microcomputer that will allow the city to manage traffic conditions in the most efficient ways possible. There are several manufacturers of this equipment that allowed the City to bid the equipment and obtain good pricing. The same is true for the cabinet hardware. The future of traffic signalization throughout the country will be based on the 2070 controller and the City of Fort Collins is one of the cities leading the way with its implementation.

A key component of the system is the fiber optic communication network (FON). The Traffic Operations Department installed over 33 miles of fiber optic communication cables as well as installed wireless communication to a number of signals. The Department formed partnerships with Platt River Power Authority (PRPA), the City Utility Service Area, the Poudre Fire Authority (PFA) and the Communication and Technology Services (CTS) Department to put together a communication system that was efficient as well as cost effective. As of the end of December 2004, there were no longer any signals communicating over leased telephone lines. The City now owns a FON with high quality broadband capability that can be used by a variety of public and/or private entities.

The 33 miles of fiber cable installed is over twice the amount the City originally estimated it could install with the Federal ITS funding and matching City funds. In fact, it became a job in itself to get the funding expended as boring bid prices kept coming in at half or less of project estimates. The City was in the right place at the right time for boring work and fiber optic cable purchases. The fiber optic cable installation environment was in a very slow period and bidding was tight and very competitive. At the end of the project, the City went from original estimates of less than a third of the City's signalized intersections being converted to fiber to nearly all City monitored signals being on the fiber network.

In general, the implementation of the ATMS project has resulted in the following successes:

1. Completion of a Transportation Management Center
2. Installation of an Advanced Traffic Management System
3. 161 cabinet and controller changes
4. 155 signalized intersections communicating over fiber optic lines
5. 29 signalized intersections utilizing wireless communication technology over fiber optic lines
6. 6 stand-alone signalized intersections (outlying intersections that are not coordinated with the system)
7. 33 miles of City installed fiber optic communication lines

As each corridor has undergone implementation, new timing plans have been part of the installation process. The timing plans that have been implemented are "initial deployment plans." The Traffic Operations Department recognizes that there is a significant amount of fine-tuning that still needs to occur. In 2005, the principal retiming work started and has further improved our travel time conditions. There are other measures and benefits that the Department will continue to measure and calculate as part of the ATMS project. These measures include fuel consumption, number of stops, air quality, queue lengths, and average speeds. The tables below display the travel time improvements along several of the major corridors that are a result of the Advanced Traffic Management System.

Shields Street ***(minutes)***				
	AM Northbound	AM Southbound	PM Northbound	PM Southbound
Before	9.1	7.7	8.3	10.1
After	7.6	7.2	8.1	8.3
Improvement	17 %	7%	2%	18%

College Avenue ***(minutes)***				
	AM Northbound	AM Southbound	PM Northbound	PM Southbound
Before	8.2	8.1	11.8	11.6
After	6.6	6.8	8.7	8.0
Improvement	20 %	16%	36%	31%

Mulberry Street / SH 14 ***(minutes)***				
	AM Eastbound	AM Westbound	PM Eastbound	PM Westbound
Before	7.6	6.2	7.5	7.2
After	6.4	6.4	6.5	6.4
Improvement	11%	(3%)	13%	11%

Harmony Road / SH 68 ***(minutes)***				
	AM Eastbound	AM Westbound	PM Eastbound	PM Westbound
Before	7.1	7.1	6.9	6.4
After	7.7	6.8	5.6	6.8
Improvement	(9%)	4%	19%	(6%)

The project that was originally envisioned is complete. All of the signals have been tied into the new system and the old system has been put out to pasture. However, there is still a significant amount of work to do and the potential capabilities of the system are virtually untapped. Additional fine-tuning of the plans is required. Travel time has improved for the public and many motorists have noticed the improvements in travel time. Additional improvements will occur when timing plans are further refined.

The Department believes that additional off-peak timing plans need to be in place as well as weekend plans. Additional items that could easily be included in the system, should funding become available, and the budget allow, are as follows:

1. Traffic-responsive timing plans based on the real-time traffic conditions of the roadway.
2. Data gathering from the detectors in the system so that timing plans can be modified on a continual basis based on the growth of traffic
3. A web based traveler information page that can give drivers real-time traffic information
4. Transit priority timings to help keep transit vehicles on schedule
5. Pedestrian advance timings that will allow pedestrians to have a “head start” to make a safer crossing environment
6. Connecting and sharing resources with CDOT, Police Services, PFA, and neighboring communities
7. Continued installation of additional monitoring cameras to monitor the traffic operation on any City arterial streets

Lessons Learned

1. **Integration is the most difficult part of ITS work.**
   The City's signal control system was a collaboration of two company's products, Econolite's Icons System and Siemen Gardner's 2070 firmware. The two companies had a 10-year joint working agreement regarding their two products. Even with that close a relationship, some normal traffic functions did not work and/or still do not work. As problems arose during and after the integration phase, the City has had to contend with some amount of each vendor saying the problem is the other vendor's cause. Ultimately, the two companies dissolved the agreement within 2 years of the City's purchase. At some point in the future, the City will have to choose one company or the other with which to pursue a long-term relationship. At present, there is no such thing as "Plug and Play" in electronic traffic control products or electronic service products.

2. **The national family of standards National Transportation Communications for ITS Protocols (NTCIP) is improving but does not yet provide specification or policy that is cleanly providing interconnectivity between products and manufacturers so that ITS across jurisdiction lines are remotely easy to accomplish.**
   Each manufacturer is still left with the ability to meet NTCIP guidelines and specifications, as it deems appropriate. Therefore, inter-jurisdictional integration is still the biggest hurdle and expense. At present, there is no such thing as "Plug and Play" in implementing NTCIP standards.

3. **Expect vendors to over-promise and under-deliver and build vendor commitments into contracts.**
   Almost all the vendors offering products or services employed in the project promoted the impressive capabilities of their products and services. Yet vendors could actually meet their commitments. Frequently, products and services fell short of their touted capabilities. Some vendors' contracts had to be terminated because their products or services failed to perform as contracted, or even, in one case, failed to perform at all.

4. **Conduct all product testing ("Dog and Pony" shows) where the product has to work.**
   Having vendors show their product at their facility means little when the equipment will not work on-site. It is important to make sure vendors prove their products will do what they say by testing their products in on-site ***before any agreements are drafted***. It is also important to learn about vendors' products in order to test them appropriately. The electronics environment within transportation infrastructure is becoming very high-tech, very detailed, and very complicated, making it very difficult to be knowledgeable of all facets of the equipment available for meeting customers' needs.

5. **Have knowledgeable people on staff or under contract from the beginning, to assist in filtering out the hype and to assist in guiding decisions and planning.**
Poor use of scarce resources is an easy trap to fall into in the high-tech environment. Even though traffic control is not considered cutting-edge, often it requires products and services that the industry has not utilized in the past (video, fiber optics, Ethernet, various electronic converters, software/firmware, communications to tie it all together, wireless technologies, etc). ITS require familiarity with a high-tech environment, even if some do not think such familiarity is necessary.

6. **When planning and installing a communications network, install as much capability as possible and use it sparingly.**
It becomes surprisingly easy to waste communications capacity due to poor planning, particularly with the overuse of video, which is uses a large amount of bandwidth. A common pitfall many transportation agencies encounter is when a device has lower throughput than it was expected to have when developing the overall communications design. Many products are still not Ethernet-capable and may require converting or single-stranding the communications medium to meet goals. Conversely, many products are Ethernet-capable, but to what extent can become an unexpected question or problem.

7. **Employ sound up-front planning, quality contracts, and prudent oversight of all aspects of the project.**
Often, a well-written contract cannot make up for poor project oversight, nor will it protect agencies' interests during failure of certain aspects of the project. Often, these failings result in litigation which, even when the agency wins, has resulted in time and money better spent elsewhere. In addition, it is often not possible to simply return large purchases when products fail to perform as promised.

8. **Resist, to the fullest extent possible, external pressures to promise the impossible in terms of project performance, schedule, and cost.**
Its easy to underestimate the effect public pressure and City Councils place on a project, often squeezing timelines from well-planned to "scramble mode."

9. **Create relationships with other agencies that have any level of common interests.**
Throughout the project, the City was in touch with anyone doing underground work and tried to "co-trench" in order to get conduit in the ground at reduced costs. Eventually, utilities and agencies and contractors contacted the City, asking about plans to dig in their areas, which helped reduce their costs as well. The City's biggest partnering success was with an electrical utility, which had already installed a fiber optic network around Ft. Collins. The City government was able to partner with the power agency to use 12 strands of fiber around the whole network. These 12 strands form the communications backbone of the City's integrated traffic signal control system.

This project has been very successful. It has culminated in a capable traffic control system ready to meet the City's needs and is also capable of integrating with surrounding jurisdictions. Achieving this success was either easy nor inexpensive. However, the system is robust and allows for managing daily traffic much better and more efficiently than could be done previously. Only a few upgrades have been needed since the installation of the base system. Lastly, the fiber optic-based communications network is a vast improvement over the old leased telephone lines, as performance has increase and maintenance costs have been drastically reduced.