Great expectations

Boston's highway reconstruction plan implements ITS on a grand scale

by Tim Gregorski

The city of Boston, Mass., is notorious for traffic—and the eyes of the intelligent transportation systems world are watching to see if their resolution sets the wheels of change in motion.

Consistently rated among the "Most Congested Areas of the U.S.," according to the Texas Transportation Institute, Boston is currently investing $12.2 billion in the Central Artery/Tunnel (CA/T) project to remedy the situation.

Rebuilding multi-level interchanges and constructing new tunnels and bridges over 161 lane miles of highway in a 7.5-mile corridor, the CA/T is the largest overall highway reconstruction project in the U.S.

Approximately $250 million in ITS-related applications will be installed once the project is completed.

"The CA/T project is scheduled to be completed in 2005, including all ITS activities," said Sergiu F. Luchian, CA/T ITS manager.

As of press time, the ITS implementation has been gradually introduced with more applications going online as the days pass.

"The 'brains' of the system, the two redundant, mirror-image CPUs and the Operations Control Center, are already humming," said Luchian.

What can the driving public expect when the CA/T project is completed?

"The public should expect a much higher capacity roadway system and a safe and efficient roadway system," said James Kerasiotes, chairman of the Massachusetts Turnpike Authority, earlier this year before he was removed from his position due to budgetary complications on the CA/T project. "The OCC, with its advanced systems, skilled operators and response crews supporting the police and other public service agencies, plays a major role in meeting these expectations."

ROADS & BRIDGES takes a look at what might become the template for mass-scale ITS projects around the globe.

Alphabet soup

Located in South Boston, the state-of-the-art OCC is ground zero for all ITS operations involved in the CA/T project and beyond.

The OCC receives and processes data from a full spectrum of ITS applications.

"The goals of the system are efficient travel control; rapid incident detection and incident management; to provide support for the police and fire agencies; assure that the tunnels are environmentally safe; and to support efficient operations and maintenance," said Kerasiotes.

Within the overall system, over 1,400 loop detectors measure traffic volume and occupancy, including video detection systems, which are currently being

Rebuilding multi-level interchanges and constructing new tunnels and bridges entails some of the most detailed ITS-related applications.

field-tested, to supplement these loop detectors and integrate traffic surveillance and monitoring.

In order to monitor the traffic, a CCTV system consisting of over 430 pan-tilt-zoom color cameras pinpoint the site, type and severity of an incident. Located at 495-ft intervals in the covered sections and 1,320 ft in open areas, the CCTV system provides integrated, efficient and cost-effective traffic monitoring and incident management.

Screening and diverting trucks and other vehicles that exceed tunnel clearance limits are 25 electronic height detectors.

Finally, as part of a quick response system, carbon monoxide detectors are installed in the ventilation exhaust ducts of the tunnel network.

Information from these devices is supplemented by signals from fire alarm pull boxes spaced along the roadway, cellular phone repeaters throughout the tunnel sections and the monitoring of two-way radio systems.

Data is then processed by local field controllers and remote terminal units located in the cross-passageway/utility rooms. From there, data is sent to the central computer system via the dual loop fiber optic backbone, further processed and graphically displayed on the computer workstations and rear-projection wall screen at the OCC.

"Incident management is the most important goal, and it will be accomplished," said Luchian.

Real-time information

Through a variety of output devices, the OCC has the ability to provide real-time information to drivers of the Boston area.

Operating a specialized vehicle that has the capability to tow cars, trucks and buses, the trained response team can extinguish small vehicle fires until the fire department arrives.

With such an elaborate amount of ITS-related equipment, the kinks in the system quite naturally had to be ironed out.

"Some of the systems have taken longer than planned to bring online," said Kerasiotes. "These potential delays were anticipated in the original contract, which called for a basic set of surveillance and control functions to be delivered."

Luchian agreed, saying "the only setbacks that we have had so far are related to technology advances—it is sometimes too slow for our goals, and it overwhelms our contractors."

Listed below is a detailed roster of the OCC's real-time information capabilities:

- Approximately 130 variable message signs displaying both advisory and regulatory messages provide specific traffic information. Messages are operator selected from a pre-programmed library or they can be typed directly within the control center. Verification of display upon the message signs are provided by the CCTV system;
- Variable speed limit signs complementing the variable message signs are used in some locations to help optimize traffic flow during rush hours and incident recovery;
- Over 400 lane control signals provide real-time status on traffic lanes. As a part of the traffic management and incident response recovery plans, these signals also are used for routine maintenance activities, such as light installation or tunnel washing;
- Traffic signals located at each tunnel portal and toll plaza are an effective means of stopping traffic in case of full tunnel closure;
- Highway advisory radio, with media links, offer traffic advisories with improved time response over present commuter traffic reports;
- AM/FM broadcasting via receivers/transmitters are in the radio equipment rooms of ventilation buildings so drivers in the tunnel receive normal reception. During emergencies, operator messages can override all underground AM/FM frequencies. Used in conjunction with variable message signs, this system is an information tool

The Operations Control Center receives and processes data from a full spectrum of ITS applications.

that can be utilized during unusually long or severe incidents;

- Electronic toll and traffic management in the East Boston toll plaza makes use of technology recently deployed along the entire Massachusetts Turnpike corridor. Read/write devices allow for travel-speed electronic transactions at the toll facility which also can be utilized to indicate traffic-flow patterns and slowdowns;
- Dedicated short-range communications, deployed initially on I-90, provide travel time information as well as origin-destination data; and
- An over-height detection ring

The Operations Control Center has two amphitheater rows of five workstations each facing a wall-sized rear-projection screen and a bank of 54 color monitors.

located ahead of all tunnel entrances activates signs to divert over-height vehicles.

Inside the OCC

Designed to operate around the clock with a minimum of one shift supervisor and three operators on duty, the OCC has two amphitheater rows of five workstations each facing a wall-sized rear-projection screen and a bank of 54 color monitors.

Workstations consist of two computer screens, flanked on each side by three-color monitors that allow operator-viewing capacity for incidents and emergencies. The operator's interface includes alarm, commands, device status, traffic status and map displays that are integrated and consistent throughout the system.

Additionally, the status screens are map-based, color-coded with zoom capabilities.

During major events or incidents, the back row of the workstation is for use by operations supervisors, while command and control consoles can be used by jurisdictional authorities.

Supervisors have full access to all capabilities of the central system and have the ability to dynamically assign incidents to operators working on discrete areas of the Metropolitan Highway System.

"The OCC integrates advanced traffic surveillance and control with environmental monitoring and an advanced facilities monitoring and control system," said Kerasiotes.

Looking up from an operator's viewpoint, one sees a 13- x 46-ft large-scale map of the Metropolitan Highway System upon the rear-projection screen, where the overall systems status and traffic flows are displayed, including real-time incident locations, traffic conditions and device status via a color-coded scheme.

Wheels in motion

When an accident occurs, the system interface automatically selects the proper camera to display upon the operator's monitor. The operator also has the ability to manually control cameras to view the incident site, including the ability to program simultaneous scanning by a group of cameras.

Once an incident is confirmed, pre-programmed response plans are provided to the operator, with manual modification capabilities available. A checklist of manual operation helps to ensure that all required activities are successfully performed and logged.

Both operators and supervisors then have the ability to immediately notify life safety and jurisdictional authorities via broadcast paging, two-way radio or telephone hit lines, while pre-programmed response plans are being initiated.

"This means the operator can react swiftly to respond to incidents and maintain a safe roadway," said Kerasiotes.

Incident response

The front line response comes from trained Massachusetts Turnpike Authority employees located at strategic points within the CA/T project. Operating a specialized wrecker that has the capability to tow cars, trucks and buses, the trained response team also can extinguish small vehicle fires until the fire department arrives. The quick response teams are accompanied by a state police vehicle and are dispatched from one of five emergency stations.

During morning and evening rush hours, four additional emergency platforms are staffed with tow truck and police vehicle teams, allowing fast access to any tunnel section.

After the initial alarm and visual verification by MTA operators, incident response is coordinated through activities of the operators, emergency response teams and fire/life safety agencies.

Traffic activities such as lane or tunnel closures, vehicle evacuation or emergency vehicle access are coordinated with the operators in the OCC via two-way radio. MTA operations, state police and MTA maintenance teams also coordinate incident cleanup and traffic restoration.

"Because the OCC is remotely monitoring all of the systems, we can efficiently operate and maintain the many ventilation systems, pump stations and electrical stations," said Kerasiotes.

Regional operations center

When completed within this year, a regional traffic operations center is to provide traffic advisories and incident management for major highways in areas immediately outside of Boston.

"The Massachusetts Highway Department's regional transportation operations center will be functional by the end of 2000," said Luchian.

With monitoring and control devices similar to the OCC, the regional center is soon to evolve into a statewide traffic information hub staffed full time by trained operators.

The ability to monitor and control traffic from one location streamlines the decision-making process and provides a consistent source of information to participating agencies and the public. RB