Wirelessly Connecting The DOT's:

Mesh Enabled Architecture (MEA®) Solutions for Intelligent Transportation Systems

INTRODUCTION

Intelligent Transportation Systems (ITS) are bringing new capabilities to both public and private transportation assets. Day to day management of traffic flows, as well as improving the safety of the traveling public are key functions that ITS can provide. The U.S. Department of Transportation has estimated that traffic congestion costs the country about $100 billion a year in lost productivity. The health of the economy and the population suffer due to the added delays and emissions these congestions cause.

Homeland security and disaster preparedness concerns are also helping to drive both funding and increased urgency for ITS deployments. Incidents resulting from natural or man-made disasters can severely strain transportation infrastructure as the public tries to evacuate en-masse.

To address these issues as well as other demands, many new traffic and environmental monitoring devices are being developed to provide real-time information to transportation engineers. This helps them to better respond to transient and long term conditions impacting the transportation infrastructure.

Dealing with these challenges requires leading edge technology not only in the area of sensors and control, but also in networking. New applications like Red Light Running (RLR) camera systems combine video imagery, loop detectors, control systems, and adaptive traffic signals into a sophisticated detection and response network. These and other integrated ITS systems will require a robust and cost-effective communications network that can deliver mobility, high-speed data, video, and geo-location information.

Current solutions that rely on expensive fiber optic or point-to-point radios can't meet the cost efficiency and flexibility needed to deploy modern ITS solutions. Clearly, new and innovative networking capabilities are required to provide the services envisioned by the leaders driving this industry.

THE CHALLENGE

Many new devices available for ITS, such as smart traffic sensors, variable message signs, adaptive traffic signals and video monitoring cameras, require robust and high bandwidth data networking. The data and video gathered is used to control field devices and resources in response to the situation at hand. Likewise, the data gathered is stored and analyzed so that traffic engineers can anticipate bottlenecks and inefficiencies in the transportation infrastructure and react before the public ever experiences a problem. However, the locations for gathering this data are constantly changing due to population growth and urban sprawl, opening or closing new roadways, and public infrastructure construction projects.

To date, fiber optic networks have been extensively deployed to support the networking needs of ITS. Unfortunately, fiber optics deployment can run as high as $4.00 per foot ($21,000 per mile), plus additional expenses for head end equipment, and extensive engineering. Hidden costs include significant disruption to roadways and traffic flow leading to lost productivity and lost business in the community. Once deployed, fiber limits the places ITS devices can be located. Assets become fixed since connectivity is tied to the path of the fiber. Back-up routes for mission critical data typically do not exist; so communication can be lost in the event of a network failure from a cable or fiber break. As a result, the high cost, ease of disruption, limited portability and lack of mobility of hardwired networks limits their use for robust and flexible ITS solutions.

In some cases CDPD or other wireless approaches have been tried as alternatives or supplements to fiber deployments – but these technologies lack the bandwidth needed to be viable substitutes to fiber. However, these wireless solutions do offer a more cost effective (albeit lower capacity) solution for temporary or portable connectivity.

Shared public cellular networks have also been used as part of an overall ITS solution to track and communicate with buses, trains and municipal vehicles. Public transportation agencies have long struggled with the need for real time information and communications to better manage their routes and resources. The low data rates of cellular approaches are not sufficient to support and automate the procedures and applications required to collect the data needed to effectively manage resources, optimize routes and increase revenues. Even with these limitations, the typical on-going cost of a cellular data connection is about $75 to $100 per month/per vehicle. A GPS solution, which is required for Automatic Vehicle Location (AVL) applications, can run an additional $50 per month/per vehicle.

THE SOLUTION

Responding to the needs of ITS, Motorola has developed a complete wireless communications system that offers an integrated approach to cost-effective, high bandwidth and wide area connectivity. By leveraging technology originally developed for battlefield communications, a self-forming self-healing network that supports mobile broadband data, video, voice messaging and geo-location capabilities is now available in its Mesh Enabled Architecture (MEA) solution. This technology opens new opportunities for transportation managers to deploy broadband networks without the expense and disruption associated with fiber. And since its peer-to-peer routing lets every mesh enabled device work as a router/repeater to expand coverage and connectivity, network infrastructure expenses are minimized.

Motorola's MEA solution offers the following set of capabilities that make it low cost, robust, and quick to deploy for ITS solutions today.

Cost Effective and Flexible Deployment

MEA wireless networks are much less expensive to implement and much more capable than conventional cellular or other "centralized" wireless or fiber alternatives. Every device in the network can connect directly, or hop through the network to reach any other device. The ability to hop through other nodes helps eliminate the need for vulnerable and expensive radio towers. Since there are no centralized bottlenecks, it provides consistently high data rates and coverage can automatically increase as more mesh enabled devices are deployed. In essence, as MEA equipped devices are deployed, these same devices actually create the network. No ripping up roadways or forcing the ITS infrastructure to align with fiber runs.

Support for High-Speed Data, Video and Voice

MEA products can wirelessly deliver broadband data rates with burst rates up to 6 Mbps. This enables multiple ITS devices, signs and sensors to share network access points to connect back to the wired world.

MEA technology is not limited to fixed devices or stationary users. Transit and ITS personnel can get wireless access to maintenance logs, traffic or security video, dispatch communication and geo-location information virtually anywhere in the network. Connectivity can be instantly established with portable and mobile signs, sensors and video cameras.

Track and Locate ITS Assets without GPS
Patented geo-location technology is built into every Motorola MEA device. Using this technology, users and devices can quickly determine their location, while the network automatically keeps track of every device, without having to rely on GPS satellites. This means that locations can be determined in places that GPS satellite signals cannot penetrate, like in urban canyons, buildings, tunnels, or other obstructions. Location information is generated quickly and accurately: typically location can be calculated within+/- 10 meters or better in under one second.

Mobile Connectivity – at Highway Speeds and Above
Motorola offers a true mobile wireless solution. Connectivity is available at all times to cars, buses, trucks, trains, and even helicopters, that are moving at high rates of speed. Unlike hotspot solutions that require users to park at fixed locations, MEA meets the needs of highly mobile users. Rolling stock can send and receive maintenance schedules, location, video, and other information while vehicles are en route, eliminating the need to make time-consuming stops to download data. Parking at specific locations to perform end of day routines will be a thing of the past. Motorola's mobile connectivity will change the way ITS and Public Transportation systems are operated and managed.

Self-Forming, Self-Healing Networking
Self-forming networking is just that. As devices are deployed, the network automatically expands allowing each device to connect to neighboring devices, as well as providing additional paths to network access points. New devices immediately join the network as they are deployed. Portable traffic counters, video monitors, air quality sensors or weather sensors can be set-up virtually at any intersection or roadway and networked via a MEA wireless broadband connection.

Motorola's peer-to-peer technology helps eliminate single-points of failure by enabling every device in the network to act as a router/repeater for all other devices in the network. This means that each device can "hop" through its neighbors. This topology routes communications around obstructions or points of failure. MEA create a robust, interconnected mesh that automatically routes around congestion and line-of-sight obstacles. Every device deployed with MEA helps make the network stronger and more robust.

LAN, MAN or WAN Coverage
A MEA solution can be used to create Local Area Networks in train or bus stations, wireless Metropolitan Area Networks throughout cities, as well as Wide Area Networks for county or statewide deployment. By supporting industry standard IP

protocols, information can be shared seamlessly across networks and agencies. This significantly reduces the cost and effort of integration and greatly enhances the flexibility to where and how ITS solutions are deployed. All personnel involved in Public Works, DOT and Public Safety operations can share databases, emails. instant messaging and other IP based applications over a MEA network.

MESH ENABLED APPLICATIONS

A Motorola wireless communications and location network uniquely enables numerous critical operations for ITS and related agencies.

Control and Monitoring of Sensors, Signs and Signals

Mesh enabled environmental sensors, variable message signs and adaptive traffic signals can be deployed with minimal disruption and cost. Instant wireless network connectivity saves installation time and allows continuous monitoring, management and reconfiguration.

Video Monitoring

Video cameras can be quickly deployed to monitor construction sites, traffic congestion points and even potential terrorist targets. Broadband data rates allow live video feeds to be monitored. This video information can provide critical traffic route assessment for ITS managers, public safety agencies, as well as individual commuters.

Emergency Call Box Connection

Using MEA networking to deploy wireless call boxes can provide added security for the public and municipal workers – without the monthly fees of cellular based solutions. Deployment of these mesh enabled call boxes also extends network coverage and can support telematics services along the highway.

Real-Time Fleet Management

MeshNetowrks enabled vehicles can provide continuous updates on their location, maintenance, schedules, routes, fee collection, and other statistics. Change orders, route updates, user information, emergency broadcasts, and even advertisements can be sent to vehicles on the move.

Create Probe Vehicles Out of Existing Rolling Stock
Municipal, public transit and DOT vehicles not only get access to two-way mobile broadband communications, but they can also be utilized as probe vehicles that provide real time traffic information back to the traffic engineering center.

Provide Automatic Vehicle Location (AVL) Services
MEA geo-location technology can support AVL applications and services. Location, as well as detailed information such as the vehicles speed, condition and operating parameters can be monitored. AVL significantly improves fleet efficiencies and reduces the cost of operations.

PARTNERING FOR COMPLETE SOLUTIONS

Motorola has working relationships with ITS Value Added Resellers, Systems Integrators and OEMs. These partners can provide Motorola mesh enabled ITS network solutions to meet the needs of DOT's and Transit Authorities who must deploy ITS solutions today.

SUMMARY AND CONCLUSIONS

ITS is playing an increasingly important role in ensuring the productivity and security of this country. This new role requires the deployment of new devices and applications. More importantly, a flexible, broadband network capable of tying these components together will be crucial if the full return on investment is to be realized. Though fiber still has an important part to play in this network, wireless connectivity will supersede its significance in direct device connectivity. Innovative technologies, like those used in Motorola and MEA products clearly demonstrate the value and cost effectiveness of a wireless approach. Finally, support for mobility and geo-location offer important enhancements and capabilities to today's ITS networks. A mesh enabled ITS architecture offers all these advantages, and at a cost significantly lower than that of alternative hardwired or cellular based solutions.

To learn more about Motorola's MEA products and other mesh enabled solutions, please visit http://www.motorola.com/businessandgovernment/NorthAmerica/en-US/public/functions/browseproduct/productservices.aspx?navigationpath=id_804i.