“Intelligent Transportation Systems (ITS) encompass a broad range of wireless and wireline communications-based information and electronics technologies. When integrated into the transportation system’s infrastructure, and in vehicles themselves, these technologies relieve congestion, improve safety and enhance American productivity.” USDOT website.

Over the past 10 years, technological advancements in ITS have been plentiful. One thing, however, has been consistent: from the introduction of closed-loop traffic-management systems to the expansion of full-blown ITS infrastructure, communications has always provided the backbone of these systems. Mission-critical data is typically collected from a variety of devices, such as detectors (loops, video, radar), traffic controllers, PTZ cameras etc. This data is then used to implement efficient timing plans, operate variable message signs (VMS), and control flashing beacons in order to appropriately manage traffic flow and traffic incidents.

Currently, North America is leading the world in developing and implementing the next generation of Intelligent Transportation Systems. Throughout the continent, systems are being upgraded at a rapid pace, allowing us to more effectively manage our city streets, our freeways, and our interstate highways. One major requirement of these new systems is increased communication capacity, functionality, and flexibility. Currently there is a trend to move away from the physical limitations of existing FSK (Frequency Shift Keying) copper-wire communication lines. Nowadays when underground cabling is required, fiber-optic cable is the medium of choice, at least where budgets allow. Fiber-optic cabling offers extremely high data throughput and can be used for all ITS applications.

Although fiber-optic cabling offers great data throughput, it is typically impractical to run fiber to every remote site in any given system. For this reason, most ITS design architectures utilize fiber-optic cable as a backbone for the system, typically communicating from the Traffic Management Center (TMC) down major arterials to areas that require the most intense management systems.

Going beyond the fiber-optic backbone
Today, spread-spectrum wireless-communications systems have become the accepted industry standard to extend communications beyond the fiber-optic backbone. Wireless communications has been proven to provide reliable communications at a fraction of the cost of traditional underground cabling. By utilizing 900MHz license-free spread-spectrum wireless modems, ITS designers and operators can maximize a systems’ effectiveness by providing coverage to large geographical areas.

Most ITS infrastructure that has been deployed over the last 10-15 years are communicated using 1200bps-to-19.2Kbps Serial (RS-232 Standard) data communications. This standard is compatible with all communication mediums, however, it does have a limited range over copper...
wire, hence the need for fiber-optic modems and wireless data systems. Most “legacy” systems in place today are based on RS-232 serial data transfer or FSK between the TMC and remote sites. Typically, all equipment at a remote site is equipped to communicate through their RS-232 serial port or FSK port. This is true for traffic controllers, conflict monitors, vehicle detectors, and uninterruptible power supplies (UPS) systems. Spread-spectrum wireless-communications systems, such as that shown in Figure 1 (page 49), are deployed throughout the continent and are operating effectively with a wide range of traffic-control products in a variety of configurations.

A good example of such a system is the one in Gilbert, Arizona. In a system that covers 52 square miles, the town has a total of 83 controlled intersections, 61 of which incorporate wireless communications. A 13-mile fiber-optic backbone was installed down the major arteries that contain the highest traffic volume. Sites along this backbone are connected directly to the TMC cable through fiber-optic-to-serial-data (RS-232) modems. For the remainder of sites in the system, which are not located along the fiber-optic lines, spread-spectrum radio modems have been successfully deployed. These modems provide reliable communications to remote sites at distances up to seven miles. Town officials report that communications are flawless, and that system expansion is simple and cost effective.

Moving to computer networking protocols
Recently, there has been a trend in the industry towards advancing ITS systems to the next level. This will accommodate the ever changing demands of the world’s rapidly growing traffic volume. At the root of this advancement is a shift in communication standards within intelligent transportation systems. Specifically, the industry is moving toward incorporating computer networking (TCP/IP) protocols into ITS infrastructure. The use of IP-based devices is just now becoming available and accepted within our industry. Ethernet communications utilizing both Local Area Networks (LAN) and Wide Area Networks (WAN) provide many benefits to an ITS system, including, high data rates capable of transmitting video images, the ability to connect multiple remote devices to one communication line, etc.

The use of Ethernet (TCP/IP) communications systems is increasing in popularity, and most new ITS systems are designed around this standard protocol. For brand new systems with all new equipment, TCP/IP communications is used from the TMC to the cabinets on the street, typically with a combination of underground fiber-optic cable and wireless technologies. In the future, all devices within a system will have an Ethernet port on board (Figure 2). Certainly this is something to look forward to, however, most traffic-control devices that are currently deployed on the street today are NOT Ethernet enabled.

Making the move gradually and affordably
There are literally hundreds of thousands of “legacy” devices in use throughout North America. These devices were designed to communicate...
using the RS-232 serial data communication standard only. Christian Traue, CEO of ENCOM Wireless, points out that, “Ethernet is the communications standard of choice for new and future ITS implementations. However, no DOT or city signal shop can cost-justify replacing their existing serial and FSK infrastructure. Migration through stepwise conversion is the only viable option.”

If a logical progression is followed, overall costs can be minimized and system functionality can be maximized. Firstly, as an owner of a legacy system it is important to realize that current RS-232 based ITS systems are effective and that they do operate reliably. These systems provide similar functionality to Ethernet systems. Secondly, with currently available wireless solutions, serial-based ITS systems can be integrated seamlessly into the expanding TCP/IP Ethernet infrastructure. Wireless Ethernet-to-Serial Server technology bridges the gap between RS-232 and Ethernet-based systems.

For existing system owners, a gradual progression to the Ethernet standard is possible and advisable, especially given today’s budget constraints. It is possible to implement Ethernet communications along the communication backbone without having to swap out all of the existing RS-232 enabled (legacy) equipment in the field and replace it with Ethernet-enabled devices. For example, with a fiber-optic backbone in the ground, a hybrid Ethernet / RS-232 system can be used. The wireless technology is currently available from leading spread-spectrum wireless-system manufacturers such as ENCOM Wireless. For example, a device that is called a “Wireless Ethernet-to-Serial Server” (Figure 3) can provide RS-232-based devices with a gateway to an Ethernet communications system. This concept can be applied to currently deployed wireless serial-data (RS-232) based systems.

Integrating serial-data-based devices into TCP/IP networks
Devices such as the ENCOM Wireless Ethernet-to-Serial Server allow the incorporation of serial-data-based devices into TCP/IP-based networks, providing a complete hardware and software solution for adding wireless network connectivity to serial-based legacy applications. A Wireless Ethernet-to-Serial Server consists of a...
spread-spectrum wireless serial-data modem with an integrated Ethernet port which is connected to the LAN/WAN Ethernet.

These wireless gateway products can connect multiple serial devices (traffic controllers, vehicle detectors, variable message signs, etc.) to a TCP/IP based LAN/WAN connection. Wireless Ethernet-to-Serial Servers are specifically engineered to accept serial data over the wireless link, convert it to Ethernet packets, transmit the information onto the LAN and reconvert it to serial at the other end. Communications with the existing legacy serial devices can be handled without changing existing serial software programs. All software and hardware will run as they did when the system was entirely serial based.

The most common method of incorporating a Wireless Ethernet-to-Serial Server is to install a driver at the TMC in the mainframe computer that will open a “Virtual Communications” port between the computer and the Wireless Ethernet-to-Serial Server. In a Windows-based application, the new comm. port will appear in the Windows device manager typically as comm. 1,2,3 or 4. The traffic-management software running on the PC is directed to communicate through the virtual comm. port and connects with the Wireless Ethernet-to-Serial server located inside of a roadside cabinet. Windows applications use standard Windows API calls to communicate through the virtual connection with no changes to the software. After virtual comm. port connection, the LAN is transparent to the application, and the serial-based devices communicate as if connected directly to the comm. port on the back of the computer. The wireless network is deployed to communicate with all remote devices in the field, and integration is seamless (Figure 4).

In conclusion

There is no question that TCP/IP based systems will form the backbone of future ITS communications, yet one must not overlook the effectiveness of the current RS-232 based systems. Through the use of devices like the Wireless Ethernet-to-Serial server from ENCOM Wireless, a system operator can take advantage of Ethernet communications without having to deploy an entirely new system in the field all at once. The system can be upgraded as funds become available without sacrificing functionality.

About ENCOM:

ENCOM Wireless Data Solutions, Inc. provides wireless solutions for Traffic Monitoring & Control and SCADA applications, designs and builds wireless data products for specific customer and industry requirements. ENCOM integrates wireless data expertise and experience with innovative products, software, and services to replace industrial hardwire applications.