There’s no question about the benefits of connectivity when it comes to traffic management; connected cities enjoy reduced maintenance costs, improved data collection, optimized traffic signal timing, and can synchronize traffic intersections with each other. But just how to achieve comprehensive and reliable connectivity within the constraints of limited budgets, in the context of growing cities, changing traffic patterns, and an ever-changing offering of IT solutions can be a challenge for traffic signal engineers. Adding to the challenge are the frustrations of legacy equipment that cost a fortune to install, but is failing or only being used in a limited capacity, devices that are not connected to the network, unreliable or poor performance of old, overtaxed networks or sometimes exorbitant monthly fees paid to a service provider such as a phone company.

Wireless technologies have been around for 20 years, and offer an excellent means of closing the gaps in current systems, and accommodating for change and expansion at a low cost. But with the ever-changing world of technology, knowing what technology to use, when and how, can be daunting.

A Brief History

Wireless data communication became a viable option 20 years ago with limited use in traffic management systems. At the time, mostly copper wire, and occasionally (increasingly) fiber-optic cable were installed to connect a limited number of intersections along main thoroughfares. The late 1990s saw the introduction of wireless FSK and RS232 systems that required licenses to operate. These only offered low bandwidth and required a lot of maintenance. The new millennium brought in a dramatic change in wireless data with the introduction of ENCOM’s 900 MHz Frequency Hopping Spread Spectrum radios, offering better bandwidth in more challenging terrain and the advantage of operating without the requirement of an FCC license. Around 2005, as Ethernet gained strength, power, and applicability, traffic control devices started to be equipped with Ethernet ports… and the communication infrastructure evolved to keep up. The first wireless 5.8 GHz Ethernet bridges for long-range outdoor communications in traffic management systems were introduced, and these are now the standard in the industry.

See Chart 1 that compares the features of wireless technology available today.

Common Connectivity Problems

Despite the technology out there, currently many cities have poor or no connectivity, and no underground conduit. Some municipalities have pockets of FSK or RS-232 fiber optic communication, but only on specific corridors. Other cities have existing underground infrastructure (copper of fiber), but under the constraints of staff shortages and lack of maintenance, these networks are not working — and getting the system back on line would entail tremendous, costly work. Over the years, to address these problems — and keep pace with the growing need for data collection and traffic flow management, certain cities have upgraded to Ethernet on some signals, so are now dealing with multiple, disparate systems without central connectivity. Most cities have some version of closed loop or central software but due to the lack of connectivity, it is ineffective for improving the efficiency of the traffic system. Finally, sometimes communication is on leased lines — these come at the price of ongoing service charges that can exceed hundreds of thousands of dollars per year, and given the reliance on an external service provider, are unreliable, with outages being common.

Wireless Solutions

How to integrate legacy equipment with the old and new technologies of wireless? How can wireless help reduce costs and improve efficiency? Wireless can be simple, but there are important design and engineering
factors that vary from city to city. Let’s take a look at how a wireless networking company can solve connectivity problems in three different settings. Following are the stories of Stanville, Barclay, and Pleasanton (fictional cities). They are all different sizes, have different existing infrastructure, different budgets, but share the same goals of increased transportation system efficiency, enhanced mobility and improved public safety through streamlined connectivity.

**Stanville**

Stanville is a large city, pop. 1 million, with about 1,000 intersections. It enjoys a healthy economy and public works projects are well funded. Stanville is a green city, with a mixed terrain of some hills and some flat areas, as well as a downtown core with tall buildings.

Stanville’s current traffic management system started in the early 1990s, and was added to over the years as the city grew and technologies emerged. Most recent changes were made in 2007, and communications are now a mix of leased and owned copper wire, fiber optic, and wireless. Seventy percent of the city’s intersections are connected.

Underground FSK copper wire in the core of the city connects half the signals. The copper wire is a mix of city-owned, installed in mid-1990s, and lines leased from phone companies. Another 20% of Stanville’s intersections are connected with a 900 MHz spread spectrum wireless RS-232 network.

An IP fiber optic backbone follows the light rail tracks and reaches all 4 corners of the city. Fiber optic cable also connects the libraries, recreation centers, and fire halls, but does not go to any intersections and is currently not being used for traffic management system.

In 2002, Stanville installed over 100 analog cameras along freeways, major corridors, and at key intersections. Unfortunately, because the analog cameras utilize a combined video encoder/wireless bridge, the images are poor and mostly unusable and the system is not flexible enough to enable future applications.

The city’s traffic management system engineers want to connect the remaining 30% intersections: these include outlying intersections and those in difficult to reach areas. They would like to improve their video quality from their cameras and they want to reduce operating costs by eliminating their use of leased phone circuits. Today, thanks to advances in technology, there is a wireless solution for each of these problems. Connectivity has never been easier.

First of all, the city should leverage the fiber optic backbone by installing wireless IP broadband gateways at the light rail transit stations, which would connect nearby intersections to the fiber optic network. A commonly-used system is the E-Lite 5.8 or COMM-PAKBB900. Depending on the environment, there are different options for wireless connectivity. The 900 MHz frequency-based systems are ideal for non-line-of-sight (NLOS) environments. Although these low frequency systems will have less bandwidth than their 5.8 GHz cousins, they get through obstructions. In areas with good line-of-sight (LOS), an excellent option is the 5.8 GHz broadband systems. It is important to design and build a strong core wireless network as it will enable connectivity to additional intersections whether they are RS-232 or IP based. Once the backbone is in place, other applications can be enabled such as School Zone beacon management with the Safe2School system (see Diagram 1).

For the extreme outlying intersections without access to the fiber optic backbone or FSK circuits, the department can use a cellular connection combined with broadband equipment to get them online. Rather than having a cellular gateway at every intersection, they can use a single 3g/4g cellular IP gateway at a key location, then link intersections to the gateway with either our COMM-PAK BB 900 MHz or E-Lite 5.8 GHz Ethernet bridges depending on LOS vs. NLOS terrain.

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As city-owned infrastructure expands and reaches these areas, the cellular gateway can be eliminated as everything connects with broadband. This type of strategy maximized connectivity and value for the investment (see Diagram 2).

The leased phone lines are a substantial and ongoing cost and the City has a goal of eliminating them. An excellent alternative to leased lines is a 900 MHz spread spectrum wireless system that connects to the FSK circuit by hardwire and to surrounding (up to 20 mi) intersections wirelessly. An example of this type of system is Pulse. Pulse is a long-range RS-232 or FSK communication system designed specifically for traffic applications. A Pulse C Master radio at an optimal site creates a wireless FSK gateway to which all intersections within wireless range can connect directly, license free, with no ongoing costs. Field proven by over 13 years of service, this type of wireless system is a great fit for traffic controller interconnect applications and it provides years of maintenance free connectivity. By eliminating the costs associated with the leased phone lines, most cities realize a strong return on investment within 1–2 years. Once the system is paid for, the city can allocate the additional budget to improving traffic flow rather than continuing to pay the service provider (see Diagram 3).

To address the poor video images from the analog cameras, the encoders need to be replaced. Once the encoders are upgraded, the city can install our E-Lite 5.8 GHz broadband system, which will allow the option of keeping existing cameras or replacing the analog for IP cameras. The city will finally have crystal clear, full motion images at their TMC.

Barclay

Barclay is a medium-sized city, pop. 400 000, with just under 100 intersections. City hall is restructuring and staff is being cut. There is RS-232 fiber optic cable under some main corridors that was installed in the 90s, but a tight budget has squeezed out maintenance funds, so the lines haven’t been repaired and often...
don’t work. Half of the city is on this network and has intermittent connectivity. Most intersections have 2070 traffic controllers, but they were purchased from different vendors at different times, so they are equipped with a mixture of Ethernet and Serial ports. The result is pockets of intermittent connectivity with no centralization. Barclay currently has no Ethernet communication infrastructure. Unsynchronized lights and delays in repair has led to poor traffic flow, and, in a recent poll, citizens put road congestion as the no. 1 issue they want dealt with by city hall.

Barclay’s best option is to switch to an above-ground option, namely wireless. They can cost-effectively replace the bad fiber optic connections with a 900 MHz spread spectrum wireless system. This will quickly and easily bring all of their intersections online. Wireless modems enabling RS-232 communication and designed specifically for 2070 traffic controllers exist. The Pulse 2070 plugs directly into a 2070 traffic controller so they can go to any existing site that is on the system, add the PULSE 2070, and tie into all traffic signals around it (see diagram 4).

The advantages of an above-ground solution are that it is easy and inexpensive to install, requires limited infrastructure, does not require time-consuming line troubleshooting, has low maintenance costs, and is easily updated to keep up with advances in technology. 900 MHz Pulse radio networks are easy to design and will provide years of reliable service.

It is important to note that, while industry is leaning towards Ethernet, it is not the best option for everyone because the switch means complete and costly replacement of old traffic controllers and other devices. In places with legacy technology, wireless solutions provide the opportunity to get online with RS-232, enjoy the benefits of total connectivity without the cost of a complete overhaul.

**Pleasanton**

Pleasanton is a small city, pop. 135,000, with less than 50 signals. Municipal funds are limited and the traffic department has a tight budget. The signals are

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well-planned, well-documented, and
tenance costs when handed a
agement, operational, and main-
tems are more reliable than systems
creased since commissioned sys-
clists, pedestrians or simply taxpay-
missioned systems are also owners,
ners. They benefit from the more
veloped process may be difficult to
there may also be costs associ-
making changes to the system to im-
prove its performance. When these
improvements are not reflected in
direct cost savings to the project —
but rather an increase in project costs
— it may make short-sighted agen-
ies unwilling to foster these im-
provements, even if they would
result in significant operational and
aintenance savings in the future.

The purpose in commissioning or
etro-commissioning a system is to
sure that the system is perform-
ing as it was designed and intended
to by the owner and that those who
operate and maintain the system are
well trained and able to perform
system functions. Many would
consider it cheap at any price to
commission a system that provides
level of service that validates the
vestment that built it.

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equipped with NEMA traffic con-
trollers from two vendors; so one
part of the city has red controllers,
the other blue. Some controllers are
Ethernet, some are RS-232, and
one are connected. The city traffic
engineer wants to get the signals on-
line, and has requested that any in-
rastructure installed going forward
be Ethernet.

The engineer heard about EN-
ERGY wireless broadband Ethernet
system at a recent trade show, and
so consulted the manufacturer for
more information and help choosing
the best solution. We provided
guidance in the system design, tak-
ing into consideration municipal
terrain, budget, and existing equip-
ment. They proposed the ENERGY
5.8 GHz radio in areas with good
LOS between intersections, the
COMMPAK BB 900 MHz in areas
with NLOS. To integrate the legacy
signals without upgrading the
traffic controllers themselves, the
COMMPAK TS-1 terminal server
can be added, which enables an

Ethernet to Serial conversion. This
solution is quick to install, easy to
expand, and makes maintenance a
breeze.

The wireless solutions outlined
above are powerful, and they pro-
vide substantial benefits. They in-
crease connectivity, save time, save
money, improve performance, and
deliver results. Experts exist to as-
sist in the design and installation of
wireless networks; companies such as
ours provide start-to-finish guidance
on optimal use of wireless products,
as well as ongoing support and
training. Wireless is reliable, wireless
is proven, and wireless is here to stay.

About ENCOM Wireless Data Solutions:
Trusted by municipalities for over 25 years, EN-
COM Wireless is the industry leader at manufac-
turing reliable outdoor wireless equipment for
traffic management systems. We have offices in
Addison, TX and Calgary, AB. Contact us anytime
at 1-800-617-3487 or visit www.encomwire-
less.com for more information.

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It is quite common for system
projects to experience immediate
benefits attainable only through the
commissioning process. Decreased
change orders and construction
delays are among the many docu-
mented instances of the process
benefits. This is because commissi-
oning finds problems and ways to
improve the system while changes
remain economically feasible and
timely or while the system remains
under warranty. The system owner
is also likely to benefit in the future
by the reduced operating costs asso-
ciated with a high performing sys-
tem and the perceived, as well as
actual value of the system is in-
creased since commissioned sys-
tems are more reliable than systems
that are not.

Operationally, the managing
agency can expect decreased man-
agement, operational, and main-
tenance costs when handed a
well-planned, well-documented, and