How New Network and Infrastructure Trends are Making Meaningful Advances in Smart Cities & Transportation Systems

Thoughtful network design and planning, as well as utilizing the latest in new infrastructure trends, is delivering huge gains in both smart cities and transportation systems. Here, we outline the latest city and transportation infrastructure trends and showcase real success stories with real technology.
Cities & Transportation Departments Are Exploring New Infrastructure Upgrades—Here’s Why

Thoughtful network design and planning and utilization of the latest in new infrastructure trends is delivering huge gains in both smart cities and transportation systems. More and more cities, both large and small, are either educating themselves on attainable infrastructure upgrades or actively implementing them. The reasons are clear. In larger populated areas, mass urbanization has led to numerous issues in terms of transport, economic stability, energy consumption, and the environment.

Municipalities of all sizes are looking to improve mobility and public safety for residents, pedestrians and motorists alike. For transportation, there are numerous elements cities need to manage: human motorists and motorcyclists, commercial trucks, public transit, pedestrians in wheelchairs, cyclists, walking pedestrians, and more. A smart city transformation with network infrastructure upgrades can help solve these issues and give valuable insight into operational systems for future improvements.

IIoT Connectivity and Data—Key Factors in Successful Intelligent Transportation Initiatives

One of the main goals of any Industrial Internet of Things (IIoT) solution comes down to Big Data—information that will help those analyzing it get a better pictures of how things work, where improvements can be made, and how to predict what’s to come.

For example, a city utilizing intelligent IoT solutions in order to conduct real-time monitoring can gain insight into a variety of local conditions, such as weather conditions, traffic conditions, security surveillance, emergency responders, public lighting, electric vehicle charging, energy usage, and more. The collected data is then used for subsequent analysis to provide actionable feedback and insights to optimize the city’s smart capabilities.

When it comes to the transportation industry, various Intelligent Transportation Systems (ITS) applications act in the same way. ITS applications include traffic signal communication, adaptive control systems, traffic response systems, maintenance management systems, real-time data collection and analysis, remote management, and more. The objectives of these varied IIoT applications, and the subsequent collected data, is the same:

- Improve Safety
- Increase Mobility & Efficiency
- Reduce Environmental Impacts

To accomplish these objectives with IIoT technology and infrastructure upgrades, it’s important to follow the three following principles: 1) have intelligence at the network edge; 2) have interoperability; and 3) make sure the infrastructure integration is planned, designed, and implemented correctly.
Following these principles allows for transportation and operations data to be utilized in order to see major benefits of ITS applications, such as:

- **Traffic flow optimization and reduced congestion.** Cities are able to see how they can perform system optimization to achieve flow planning, progress reporting, reduced environmental impacts, and more.
- **Improved transportation system operations.** System alerts, asset monitoring, and traffic flow monitoring allows cities to have proactive responses to emergencies and perform preventative maintenance on equipment.
- **Improved incident management.** Traffic incident responders need prompt incident notification with timely and accurate incident information.
- **Improved operational efficiency at intersections.** Connected intersections offer a simplified signal timing process and automated monitoring of equipment failures.
- **Improved traveler communication and passenger engagement.** Connected, dynamic signage allows travelers to be informed and safe.
- **Adaptive responsiveness in rapidly changing traffic conditions.** ITS communication networks are the enabling technologies that allow adaptive signal control to be deployed.

**Improved Safety through Smart City and Transportation Projects**

A main objective for all transportation and smart city infrastructure projects comes down to safety. Achieving benefits, such as reduced traffic congestion and improved incident management, means everyone who lives and works in any given area experience increased safety. Many ITS applications focus on achieving increased safety, such as traffic management, signal management, CCTV surveillance, speed monitoring, dynamic traveler information systems, dynamic signage, and more.

The concept of “Vision Zero” in transportation departments is also growing across the nation. The goal of utilizing a Vision Zero plan is to reduce fatalities and serious injuries to zero in transportation systems, because no loss of life is acceptable. Vision Zero has five main principles:

1. Life is not negotiable; no loss of life is acceptable.
2. Traffic deaths are preventable.
3. Humans are fallible and make mistakes.
4. We need a systems approach, not only individual responsibility.
5. We have a right to safe transportation.

The Vision Zero concept was first adopted in 1997 in Sweden and has gained worldwide growth within the last 10 years. To accomplish Vision Zero, cities, regions, and countries focus on improving existing infrastructure so that it is optimized for mobility. When optimizing for mobility, safety is also improved.

Strategies to build a safe environment and infrastructure for all users are implemented and work hand-in-hand with data-driven decisions from analyzed collected data. Examples of these strategies can include: lowering city-wide
speed limits, installing speed cameras, utilizing red light cameras, and more. Policy and legislation and a push for an overall culture of safety also play an important role in Vision Zero.

In addition to Vision Zero, the concept of “Complete Streets” also leads to increased safety in transportation and smart city infrastructure projects. The Complete Streets concept means transportation systems are designed and operated for all types of users and all modes of transportation. It has a much wider scope than Vision Zero and focuses on economic, health, environmental, and social benefits.

Complete Streets approaches vary based on the community. They may address a wide range of elements, such as sidewalks, bicycle lanes, bus lanes, public transportation stops, crossing opportunities, median islands, accessible pedestrian signals, curb extensions, modified vehicle travel lanes, streetscape, and landscape treatments. According to the National Highway Traffic Safety Administration, adopting a Complete Streets policy has shown to be one of the most statistically effective methods to meet Vision Zero goals.

Both Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) connected vehicle technology and public transportation improvements are also helping to increase safety in cities and municipalities across the U.S. Improvements in connectivity technology are also playing a large part in increased safety, such as the dedicated LTE network from AT&T, FirstNet. We’ll explore each of these factors in more depth.

V2I and V2V Connected Vehicle Technology on the Rise

In addition to numerous ITS traffic management solutions, more infrastructure network upgrades are considering the place of connected vehicle technology. Connected vehicle technology aims to tackle some of the biggest challenges in the surface transportation industry — safety, mobility, and environment.

Connected vehicle systems, both Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V), allow for cars, buses, trucks, trains, roads and other infrastructure, and connected devices to “talk” to one another through an interoperable, wireless communications network. Connecting vehicles in the overarching infrastructure allows transportation departments to access edge data analytics on the following:

- SPAT/MAP/TIM Broadcasts
- BSM Receipt and Forwarding
- Emergency Vehicle Preemption
- Transit Signal Priority
- Pedestrian in Signalized Crosswalk Warning
- Curve Speed Warning
- Queue Warning
- Vehicle Turning in Front of a Transit Vehicle and more

Together, all of these elements mean safety and operations are improved. Connected vehicles can dramatically reduce the number of fatalities and serious injuries caused by accidents. The user experience for motorists, bicyclists, and
pedestrians is also improved.

Private signals shared between vehicles and infrastructure can generate new data about how, when, and where vehicles travel. Connected vehicle mobility applications can help drivers navigate roads more efficiently, as well as help system operators improve transportation system operation, reducing traffic congestion, reducing travel delays, and improving overall mobility.

Elements of the Connected Vehicle System

1. **On Board Unit (OBU)** - vehicle-mounted device capable of Dedicated Short-Range Communications (DSRC) in order to transmit and receive messages from roadside equipment and other vehicles.
2. **Roadside Unit (RSU)** - device with a fixed position relative to the roadway capable of transmitting and receiving DSRC based messages to vehicles.
3. **Roadside Equipment (RSE)** - used to describe the complement of equipment to be located at the roadside; the RSE will prepare and transmit messages to the vehicles and receive messages from the vehicles for the purpose of supporting the V2I applications.

The Critical Role of Public Transportation in Smart Cities

According to the American Public Transportation Association (APTA), public transportation is one of the safest ways to travel—and often an overlooked element of improving safety for pedestrians and motorists in cities. APTA has found that U.S. cities that significantly improved public transportation services and increased transit ridership experienced large reductions in traffic casualty rates compared with similar cities with less transit-supportive policies. Additionally, crash rates tend to decline as public transit travel increases in a community.

Increased traffic safety due to public transportation, however, can be overlooked: individuals tend to exaggerate public transit risks; planners tend to overlook safety benefits when evaluating public transit improvements; and traffic experts seldom consider pro-transit policies as safety strategies. Through its research, APTA has found the following to be true:
• Transit-supportive policies can provide substantial traffic safety benefits, which result in saving lives and reducing injuries.
• Modest increases in public transit mode share can provide dis-proportionally larger traffic safety benefits.
• Safety strategies intended to reduce higher-risk driving become more effective if implemented in conjunction with public transportation improvements.
• Public transportation investment is one of the most cost-effective ways to enhance traffic safety for a community.

Technology Considerations for Smart City and ITS Infrastructure Networks

When upgrading, improving, or implementing a new infrastructure project, there are many items to consider. One of the most important is what communication technology is the best fit for your project, as well as managing and maintaining that technology. Options include LTE Cellular, Legacy Serial, Ethernet, Fiber, Wireless, IoT Wireless Sensing—a lot to consider. To help make the decision process easier, there are five important aspects you need to consider:

1. Physical Device Location and Topology Visualization
2. Third-Party IP Device Integration and Accessibility
3. Network Performance Indication and Status Reporting
4. Network Device Maintenance
5. Cost Model Consideration
For integration, the network must be designed to be inclusive of existing technology whenever possible in an effort to reduce the burden of costly network improvements in the future. Special attention also must be paid to embedded intelligence hardware and software management functions—they can make the difference in realizing a fully-integrated network. To assure seamless data management, interoperability is key. A flexible network allows for adoption of the best technologies as they arise, and all without the past “rip and replace” model of yesterday.

The Role of LTE Technology and FirstNet in Connectivity Improvements

The transportation industry is ever-evolving, and several market drivers are pushing many to look at innovative connectivity infrastructure solutions, such as LTE cellular networks. LTE stands for “Long Term Evolution,” and carriers have invested (and continue to invest) billions of dollars into LTE infrastructure.

Smart city initiatives—and federal grants to support them—are on the rise for intelligent parking, weather monitoring, driver safety, traffic monitoring, signal management, and more. Plus, throughout the U.S. there are more toll roads, connected vehicles, and wireless devices than ever before. Additionally, there is a growing population shift to more urban areas. All these reasons and more are increasing the use and popularity of LTE cellular networks for city and transportation infrastructure.

Connectivity is more reliable when utilizing Wi-Fi, and in many instances it is a less costly and less complicated option than adding and implementing new fiber networks. Utilizing LTE also mean the environmental impacts are lessened when implemented. Additionally, remote areas in transportation networks are not ideal for fiber networks.

The top three options for LTE networks for ITS applications are a private network, dedicated network, or a managed VPN.

- **Private Network** – A private network segments IP traffic from the public Internet and has the needed security level, but you don’t always get network priority. It is network dependent, such as with Verizon.
- **Dedicated Network** – A dedicated network, such as FirstNet, uses a dedicated LTE Band 14 and accomplishes both top security and priority. FirstNet is built by AT&T and network dependent.
- **Managed VPN** – Using a managed VPN means all the IP traffic is contained in a VPN tunnel. It’s carrier independent and can be more costly than other options. It accomplishes security needs, but not priority.

LTE network prioritization technology is also paving the way for safety in mission-critical ITS communications by allowing ITS applications to use the same dedicated wireless communication system used by First Responders. This means new and exciting benefits for emergency and event-based traffic management.

FirstNet, built with AT&T, is the first high-speed nationwide wireless broadband network dedicated to public safety.

*T*ransportation systems management and operations (TSMO) strategies are increasingly at the forefront of transportation agencies’ responses, but TSMO strategies continue to change and evolve, as technologies continue to advance and experiences with various strategies mature.”

– John Hibbard, Operations Director in the greater Atlanta area for the Georgia DOT
Only FirstNet-certified devices may access the network, making it highly secure and less prone to congestion than other networks. The interoperable communications platform allows public safety agencies and first responders to get more information quickly. They are able to work faster and in turn are better equipped to make better working decisions.

“When it comes to mission-critical applications in public safety, highly-secure, fast communication is key. FirstNet is the answering that call,” said Andrew Lund, director of LTE solutions for Advantech. “Public safety workers have to send and receive high-data messages, video, images, voice, text, and they can’t be bogged down with network congestion.”

Featured Product Solutions

ICR-3241, FirstNet-certified LTE Gateway

- Memory: DDR4 REG 2666/2400/2133/1866 MHz DIMM, up to 384GB
- 4G LTE Cat.4 VPN Gateway for Industrial IoT applications
- LTE B2, B4, B5, B12, B13, B14, B66, B71
- Carriers support: Verizon, AT&T, T-Mobile, FirstNet (Public Safety)
- Powerful CPU with 1.3 GB storage to host customer SW applications
- 2x SIM with cover, Dual SIM + eSIM
- 2x Ethernet 10/100, 1x RS232, 1x RS485 and I/O
- Robust metal cover with DIN and wall-mount options
- Operational temperature range from -40°C to +75°C
- Sleep mode, power ignition, and backup real-time clock

BB-SR30510420, SmartFlex 4G Router and Gateway, 3x ETH, 1x RS232, 1x RS485, Wi-Fi, Metal

- LTE cat.3, 3G/HSPA+, GPRS/EDGE, NAM, 2x SIM
- LTE B2, B4, B5, B13, B17
- Powerful CPU and memory, hosting of SW IoT applications
- DIN rail mounting, sleep mode
- 3x ETH
- 1x RS232, 1x RS485/422
- WiFi 2.4/5 GHz, GPS, USB, I/O 2x DI + 1x DO, MicroSD
- Operating temp. –40°C to +75°C, power supply 10 to 60 V DC
- Certifications: CE, FCC/IC, AT&T, Verizon
- Advanced networking, diagnostics, VPN support, firewall

BB-SR30518120, SmartFlex 4G Router and Gateway, 5x ETH, WiFi, PoE PSE, Metal

- LTE cat.3, 3G/HSPA+, GPRS/EDGE, NAM, 2x SIM
- LTE B2, B4, B5, B13, B17
- 2x Ethernet port with PoE support, DIN rail mounting
- Powerful CPU and memory, hosting of SW IoT applications
- 5x ETH, PoE PoE+, PoE+ IEEE 802.3at & 802.3af on 2x ETH
- WiFi 2.4/5 GHz, GPS, USB, I/O 2x DI + 1x DO, MicroSD
- Operating temp. –40°C to +75°C, power supply 10 to 60 V DC
- Certifications: CE, FCC/IC, AT&T, Verizon
- Advanced networking, diagnostics, VPN support, firewall

Cutting-Edge Traffic Monitoring Happens with Artificial Intelligence

Artificial Intelligence (AI) at the edge enables real-time decision making without the limitation of latency, cost, bandwidth, power consumption, and other considerations. AI technology is helping to improve traffic monitoring,
data analytics, and more in the smart transportation sector.

For traffic monitoring, AI allows for greater detection accuracy and real-time responsiveness to reduce congestion and enhance safety. Detection accuracy using AI in identification and classification offers significant benefits compared to traditional rule-based intelligent video analysis applications.

Thanks to high performance GPU computing, training servers can now handle huge data sets from the field to produce even better trained data models every day. After deploying trained models, edge inference systems can also leverage the GPU to make inference accuracy and prediction in real-time possible.

Advantech's deep learning solution library accelerates development in server training by deploying deep learning models that for example count the number of people on the street or that analyze traffic flow in real time. In surveillance for example, traditional rule-based algorithms often encounter lots of false alarms or overkills in different environmental conditions. Lights, shadows, and even camera specifications all influence the counting results, and even setting rules can directly impact accuracy.

Through deep learning, however, all events occur in rule-based algorithms meaning accuracy issues are reduced significantly. Even more, the inference accuracy can be improved by recursively training servers, or using rules that can be applied repeatedly to produce better trained servers ready to be deployed.

### Featured Product Solutions

**MIC-770, Compact Fanless System with 8th Gen Intel® Core™ i CPU Socket**

- Intel® 8th Gen Core™ i CPU socket-type (LGA1151) with Intel® Q370/H310 chipset
- Wide operating temperature (-10 ~ 50 °C)
- VGA and HDMI output
- 2 x GigaLAN, 2 x USB 3.1 and 6 x USB 3.0
- 2 x RS-232/422/485 and 4 x RS232 serial ports (Optional)
- 1 x 2.5” HDD/SSD, and 1 x mSATA
- 9 ~ 36 VDC input power range
- Supports 2 x LAN, isolation COMs, and 32-bit GPIO modules
- Supports Advantech i-Modules
- Supports Advantech SUSIAccess and embedded software APIs

**MIC-710AIX, AI Inference System based on NVIDIA Jetson**

- Compact fanless design
- NVIDIA® Jetson™ Xavier NX embedded
- 2 x embedded LAN port
- Linux OS with board support package (BSP)
- Supports deep learning trained models
- Wide operating temperature range
Featured Product Solutions

MIC-720AI, AI Inference System based on NVIDIA Jetson Tegra X2

- Fanless and compact design
- Supports NVIDIA Jetson® Tegra X2
- 2 USB 3.0 ports and 1 internal USB 2.0
- 1 IEEE 802.3af POE port
- Linux OS with BSP (board support package)
- Supports deep learning trained models
- Wide operating temperature

MIC-730AI, AI Inference System based on NVIDIA Jetson Xavier

- NVIDIA Jetson™ Xavier embedded
- Fanless compact design
- Supports 1 x MiniPCIe & 1 x M.2 (PCIex4 NVMe)
- Bundles with Linux Ubuntu 18.04
- Low-power consumption
- Supports 1 x PCIex8 + 1 x PCIex4 expansion (Optional by iModule MIC-75M20)

IoT Wireless Sensing for Environmental Monitoring in Intelligent Transportation Applications

Wireless sensing technology delivers the data you need to manage and monitor Intelligent Transportation Systems applications. Wireless IoT and IIoT sensor solutions make it easy to non-intrusively capture inaccessible data from existing equipment and operations to increase productivity and efficiency while avoiding downtime, which can lead to lessened safety and higher operation costs. For applications, such as environmental monitoring for transportation hubs, users can monitor temperature, humidity and Uninterruptible Power Sources (UPS) in the hubs without wasting expensive man hours for inspections.

Advantech's environmental monitoring solution has integrated temperature and humidity monitoring, and is fully expandable in both rugged hardware and software. Additionally, with Advantech's solution, alarms and alerts can be set up when optimal environmental conditions are not met.

Featured Product Solutions

WISE-4012, 4-ch Universal Input and 2-ch Digital Output IoT Wireless I/O Module

- 2.4 GHz IEEE 802.11b/g/n WLAN
- Supports both wireless client and server modes that can be accessed directly without AP or router
- Supports mobile device web configuration with HTML5 without the platform limitation
- Supports file-based cloud storage (preliminary) and local logging with RTC time stamp
- Supports RESTful web API in JSON format for IoT integration
- Supported Protocols: Modbus/TCP, TCP/IP, UDP, DHCP, HTTP, MQTT
- Supports 3000 Vrms isolation protection with dual watchdog timer for system and communication
Ethernet Technology for ITS Network Infrastructure Upgrades, Management, and Maintenance

The biggest challenges city and transportation departments face when deploying new Ethernet networks is the time-consuming processes, cost allocations for labor, and the potential of human error. To increase efficiency and reliability in network installation for smart traffic signal systems, fast deployment, and flexibility of network topology is a boon. But the reality is deploying and setting the configuration of a large number of devices, such as managed Ethernet switches, can be challenging for traffic engineers. There are various tools that can help with these challenges.

Firstly, an Intelligent Provisioning Tool can save time, cut costs, and prevent human error during new network deployment processes. IXM Intelligent Provisioning from Advantech is one such tool.

Currently in traffic signal network set-up, engineers must configure each device separately. The traffic engineer also needs to set up the virtual local area network (VLAN) or network management protocols in each individual Ethernet switch. With multiple groups of switches in any given deployment, it’s a time consuming and challenging task—not an ideal situation. Previously, there was no existing protocol or technology for fast deployment and maintenance of multiple groups of managed Ethernet switches.

IXM™ technology from Advantech attempts to take on these deployment and configuration challenges for traffic signal networks. The goal of IXM technology is to solve pain points and issues traffic engineers have with network deployment, configuration, management, and maintenance. IXM technology allows the assignment of a fixed range of IP addresses to many devices at the same time. Without IXM, engineers have to install the network utility first, and then check to make sure there are no extra issues, such as operating system dependence or revision issues. The SYNC mode performs a synchronization of industrial device configurations and firmware from one device to many devices. A batch process is performed automatically with the press of a button, saving installation time. Another benefit of deployment with IXM technology is the ease of firmware synchronization. The engineer chooses the firmware location and target devices, then performs the firmware upgrade.

Another useful tool is Network Operation Software, or NMS. An NMS system can help improve management effectiveness and reduce maintenance costs of the ITS network in the field. For an NMS to be successful in overcoming common network challenges, it should have the following five components:

1. Intuitive Network Status Monitoring
2. A Built-In Remote Network Diagnostic Tool
3. Smart PoE Management and Failure Prevention
4. Local Discovery for attached IP Devices
5. Secure Hot-Swap Replacement without Configuration

Featured Product Solutions with Built-In IXM Technology

**EKI-9728G-4X8CI-AE, 4 x 10GbE + 16GE + 8GE Combo L3 Managed Switch**
- 16 x Gigabit RJ-45 ports + 4 x 10GbE SFP ports + 8 x Gigabit combo ports
- L3 function: Static route, RIP v1/v2, OSPF v2, VRRP
- SFP socket for easy and flexible fiber expansion
- Management: SNMP v1/v2c/v3, WEB, Telnet, Standard MIB
- Security: 802.1x HTTPS, SSH, and SNMPv3
- Dual power input and 2 relay output
- -40°C ~ 85°C wide-range operating temperature

**EKI-7716G-4F4CI-AE, 8GE+4SFP+4G Combo-Port Managed Redundant Switch**
- 12 ~ 48 VDC power input and 1 relay output
- -40°C ~ 75°C wide-range operating temperature
- EN50121-4 approval for railway trackside deployment
- NEMA TS2 for traffic control
- Management: SNMP v1/v2c/v3, WEB, Telnet, Standard MIB, Private MIB
- Security: 802.1x (Port-Based, MD5/TLS/TTLS/PEAP Encryption), RADIUS
- IXM function enables fast deployment
- Redundancy: X-Ring Pro (ultra-high-speed recovery time < 20 ms), RSTP/STP and MSTP (802.1w/1D/1s)
- SFP socket for easy and flexible fiber expansion
<table>
<thead>
<tr>
<th>Switch Model</th>
<th>Port Configuration</th>
<th>Features</th>
</tr>
</thead>
</table>
| EKI-7720G-4FI        | 16 Gigabit Ethernet + 4 SFP ports   | • 16 Gigabit Ethernet ports + 4 SFP ports  
• SFP socket for easy and flexible fiber expansion  
• Redundancy: X-Ring Pro (ultra-high-speed recovery time < 20 ms), RSTP/STP (802.1w/1D)  
• IXM function enables fast deployment  
• Security: 802.1x (Port-Based, MD5/TLS/TTLS/PEAP Encryption), RADIUS  
• NEMA TS2 rated for Traffic Control  
• EN50121-4 approval for railway trackside deployment  
• -40°C ~ 75°C wide-range operating temperature  
• Dual 12~48 VDC power input and 1 relay output |
| EKI-7712G-4FI        | 8 Gigabit Ethernet + 4 SFP ports    | • 8 Gigabit Ethernet ports + 4 SFP ports  
• SFP socket for easy and flexible fiber expansion  
• Redundancy: X-Ring Pro (ultra-high-speed recovery time < 20 ms), RSTP/STP (802.1w/1D)  
• IXM function enables fast deployment  
• Security: 802.1x (Port-Based, MD5/TLS/TTLS/PEAP Encryption), RADIUS  
• NEMA TS2 rated for Traffic Control  
• EN50121-4 approval for railway trackside deployment  
• -40°C ~ 75°C wide-range operating temperature  
• Dual 12~48 VDC power input and 1 relay output |

**Why to Consider Power over Ethernet Solutions—Power and Data on One Wire**

When it comes to the deployment dilemma of power and network services, Power over Ethernet (PoE) technology is always the key. The reliability and cost effectiveness of providing both data and power over a single cable are improved with PoE.

PoE is an elegant technical solution that allows cables to carry electrical power and administrators to have control over power distribution to industrial equipment. Since acceptance of the IEEE 802.3af PoE standard in 2003, equipment vendors have been designing standards-based products that leverage the numerous advantages and benefits of PoE. High-bandwidth applications, such as video surveillance applications, are seeing wider integration with PoE due to reduced power demand from devices and greater availability of PoE+ equipment.

**Safety**

The basic principle is that PoE is a safe power solution, protecting both legacy equipment from damage and users from hazards of electrical power. Maximum voltage is under the limit for “high voltage” applications. To avoid damaging devices or accidental contact with even this relatively safe level, the power sourcing equipment (PSE) sends a 10-volt test current to verify there's a 25 ohm resistor at the powered device (PD) before full power is applied. If the PD stops using power, power from the PSE stops and testing resumes.

Over-current, under-current, and fault protection are also part of the PoE standard. The delivery is specially designed to protect network equipment from overload, under-powering or mistakes during installation. System integrators can set the power limitation for each port on the PoE switch. This can help protect the switches from providing too much power.

**Cost Savings**

One cable for both data and power for the network connection is most cost effective, for both installation and maintenance. With PoE, you are reducing the time and expense of having electrical power cabling installed, in addition
to the installation costs of conduits and outlets. Plus, network cables do not require an electrician to fit them.

**Flexibility**

PoE is standards based, so interoperability across vendors is guaranteed. All variations of network topologies can be configured with PoE, including ring, mesh, and other networks. Plus, industrial network management tools, such as RSTP/STP, IGMP, and VLANs, are available on high-quality industrial PoE switches. Single-cable power and data delivery, typical in Fieldbus networks, is available with PoE.

Plus, configuration changes on the factory floor are made simple by PoE. It makes sense to do it with a single cable instead of two, where possible. PoE technology is designed to operate over standard network cable, such as Cat 5, using conventional RJ45 connectors.

The flexibility of location should also be considered. Without having to be bound to an electrical outlet, devices like IP cameras and wireless access points can be located where they need to be—not just where an outlet is available. Using industrial PoE switches, system integrators can get network access almost anywhere.

**IEEE 802.3at Standard for PoE+**

Other implementations of PoE exist, such as the enhanced standard IEEE 802.3at, also known as PoE+. PoE+ increases the power available at the powered device up to 25.5W on ports, allowing devices that require more than 15.4W to power on when connected. PoE+ provides added power so that high-bandwidth devices, such as Pan-Tilt-Zoom security cameras, thin clients, video phones, and WiMAX transmitters, can be connected to the network.

**Advantech PoE Product Offerings**

Meeting NEMA TS2 Requirements for Traffic Control

The National Electrical Manufacturers Association (NEMA) TS2 is a standard for traffic control assemblies, such as traffic lights, emergency road condition signs, and walk/don't walk signs. The standard is designed for manufacturers to meet or exceed a set of minimum requirements to ensure high network reliability in Intelligent Transportation Systems.

Many ITS applications share the following characteristics: remote, outdoor enclosures; equipment that needs to support a wide temperature range; equipment that needs to survive a wide humidity range; and solutions that often have a combination of several different communication technologies.

Advantech has tested products to meet or exceed the environmental aspects of the NEMA TS2 standard. The Advantech product range covers traffic control cabinet applications that require Ethernet Switches, Fiber Media Converters, Serial Isolators, Ethernet Extenders, Ethernet Routers, and Wireless communications equipment.

**NEMA TS2 Product Benefits**

**Why Ethernet Routers?**
- Supports VPN tunnels for secure private communications to remote sites
- Provides firewalls — address, port, and protocol filtering limits network access in either direction
- NAT for public to private IP — there's no need to pay for a public IP address for each device
- Supports HTTPS and SSH for secure encrypted communications

**Why Ethernet Switches?**
- Manages and connects multiple Ethernet devices
- PoE options available for cameras and access points
- Gigabit options for high bandwidth applications
- Fiber options for extended distance connections

**Why Ethernet Media Converters?**
- Converts and extends Ethernet over fiber
- 100 base fiber or gigabit fiber options
- Multi-mode or Single-mode fiber

**Why Wireless and Cellular Products?**
- Supports remote connectivity
- Eliminates the need for long cable runs

**Why Ethernet Extenders?**
- Eliminates the need to install new fiber
- Extends Ethernet over copper wire up to 1,200 meters

**Why Ethernet Serial Servers?**
- Ethernet enables traffic controllers with an Ethernet to Serial communications converter
- Connects digital signs
- Monitors roadside radar

**Why Serial Products?**
- Uses isolators to protect the serial interfaces
- Converts RS-232 to RS-485
Featured NEMA TS2 Product Solutions for Traffic Control

IMC-350I-SE-A, Miniature Media Converter
- 100Base-TX/FX, Single-mode 1310nm
- Centralized powered IMC-318I chassis
- Supports Link Fault Pass through (LFPT)
- IEEE802.3af compliant (IMC-350I series as PoE-PD)
- Industrial grade design that supports an extended operating temperature
- Metal enclosure with compact size

EKI-7710G-2CPI-AE, 8 Gigabit + 2 Gigabit Combo Managed Switch with IXM
- 8 Gigabit ports + 2 Gigabit Copper/SFP combo ports
- SFP socket for easy and flexible fiber expansion
- Redundancy: Gigabit X-Ring Pro (ultra-high-speed recovery time < 20 ms), RSTP/STP (802.1w/1D)
- IXM function enables fast deployment
- Security: 802.1x (Port-Based, MDS/TLS/TTLS/PEAP Encryption), RADIUS
- Management: SNMP v1/v2c/v3, WEB, Telnet, Standard MIB, Private MIB
- -40°C ~ 75°C extreme operating temperature
- Dual 12~48 V DC power input and 1 relay output

Featured NEMA TS2 Product Solutions for PoE Cameras

IMC-390-SE-US, Miniature PoE+ Media Converter
- 1000Mbps, single-mode 1310nm, 40km, SC type, w/ AC adapter
- Supports IEEE802.3at PoE+ (25.5W) and IEEE802.3af PoE (15.4W) standards
- Serves as a power sourcing equipment (PSE) device
- Supports jumbo frame functionality (up to 10240 bytes)
- Supports multiple mounting options (desktop, DIN rail or wall-mount)
- Features in configurable PoE reset on fiber LOS
- Supports Link Fault Pass Through (LFPT)

EKI-7710G-2CPI-AE, 8 Gigabit + 2 Gigabit Combo Managed Switch with SFP Option
- 8 Gigabit ports + 2 Gigabit Copper/SFP combo ports
- SFP socket for easy and flexible fiber expansion
- Redundancy: Gigabit X-Ring Pro (ultra-high-speed recovery time < 20 ms), RSTP/STP (802.1w/1D)
- IXM function enables fast deployment
- Security: 802.1x (Port-Based, MDS/TLS/TTLS/PEAP Encryption), RADIUS
- Management: SNMP v1/v2c/v3, WEB, Telnet, Standard MIB, Private MIB
- -40°C ~ 75°C extreme operating temperature
- Dual 12~48 V DC power input and 1 relay output

>> Want to learn more? Check out “Meeting NEMA TS2 Requirements for Traffic Control Applications” on the Advantech website at https://www.advantech.com/resources/case-study/meeting-nema-ts2-requirements-for-traffic-control-applications.
Here, through real success stories from North America, we explore how the latest in networking technologies are making a difference in successful smart city and transportation infrastructure projects.

Upgrading a Traffic Infrastructure System for FirstNet Connectivity on an LTE Cellular Network

A U.S. state department of transportation needed to upgrade its 3G modem connectivity network for intelligent transportation applications, such as CCTV, signal management, digital signage, ramp metering, and more, and it did not have any existing fiber infrastructure in place. It also wanted to have the ability to access the FirstNet network where available.

FirstNet, built with AT&T, is the first high-speed nationwide wireless broadband network dedicated to public safety. Only FirstNET-certified devices may access the network, making it highly secure and less prone to network congestion. The interoperable communications platform allows public safety agencies and first responders to get more information quickly. They are able to work faster and in turn are better equipped to make better working decisions.

The district had 17,000 miles of pavement to cover and 7,700 signals, signs, and sensors. The department found it would be too costly to add a new fiber system, and several of the locations were also quite remote where fiber connections would not have been ideal. To access the FirstNet LTE network, the district also had to consider FirstNet-certified LTE devices where needed.

The Solution

To solve the department’s connectivity upgrade, it decided to implement an LTE cellular network. Connectivity is more reliable over Wi-Fi and implementing the LTE network had less environmental impacts and installation challenges than adding a fiber network. To accomplish the LTE cellular network, the department utilized the SmartFlex IoT Gateway and ICR-3241 FirstNet-certified LTE Gateway from Advantech.

The district chose the SmartFlex because of its comprehensive I/O interface and low-power features. Using a private or public carrier network, such as Verizon or AT&T, the LTE network could then easily send data to the department’s traffic management center.

SmartFlex also offered secure open space for the user development in a Linux OS environment. Central management software options, on premise or cloud-based, were also major perks to the LTE upgrade with SmartFlex. Advantech WebAccess/DMP is a software package that provides remote device management and provisioning for Advantech.
routers, IoT gateways, and Wzzard wireless sensor nodes. WebAccess/DMP device management and provisioning includes the following:

- Remote application management and delivery
- RESTful APIs
- “No-Touch” provisioning for mass deployments
- Remote device status monitoring
- Remote device configuration
- Multi-Tenancy options
- Flexible delivery options
- Emu-Edition for on-premises installations
- Google Maps and GPS location integration
- Cross-browser, cross-platform based on HTML5

The FirstNet-certified ICR-3241 4G router and gateway offers secure, high-speed Internet access to first responders and others in critical agencies, such as law enforcement, fire departments, and traffic management. The ICR-3241 is not only ideal for public safety and first responder applications, but also for critical infrastructure applications.

The Product Solution

**BB-SR30510110-SWH**, SmartFlex Modular LTE Router with WebAccess/DMP

- LTE cat.3, 3G/HSPA+, GPRS/EDGE, NAM, 2x SIM
- LTE B2, B4, B5, B13, B17
- Powerful CPU and memory, hosting of SW IoT applications
- DIN rail mounting, sleep mode
- 5x ETH
- Wi-Fi 2.4/5 GHz, GPS, USB, I/O 2x DI + 1x DO, MicroSD
- Operating temp. –40 °C to +75 °C, Power supply 10 to 60 V DC
- Certifications: CE, FCC/IC, UL C1D2/Atex, AT&T, Verizon
- Advanced networking, diagnostics, VPN support, firewall

SmartFlex cellular routers provide secure Internet connectivity for devices and LANs via cellular networks. They provide automatic wireless fail-over for wired networks, wireless connectivity for devices in remote locations where cable run are impractical, and wireless connectivity for mobile assets. With upload speeds of up to 50 Mbps and download speeds of up to 100 Mbps, SmartFlex provides ample bandwidth even for applications requiring video and surveillance devices.

**ICR-3241**, FirstNet-certified LTE Gateway

- Memory: DDR4 REG 2666/2400/2133/1866 MHz DIMM, up to 384GB
- 4G LTE Cat.4 VPN Gateway for Industrial IoT applications
- LTE B2, B4, B5, B12, B13, B14, B66, B71
- Carriers support: Verizon, AT&T, T-Mobile, FirstNet (Public Safety)
- Powerful CPU with 1.3 GB storage to host customer SW applications
- 2× SIM with cover, Dual SIM + eSIM
- 2× Ethernet 10/100, 1x RS232, 1x RS485 and I/O
- Robust metal cover with DIN and wall-mount options
- Operational temperature range from -40°C to +75°C
- Sleep mode, power ignition, and backup real-time clock

With its FirstNet certification, the ICR-3241 LTE gateway is the ideal way to connect IP or serial devices to a cellular network. It offers LTE Cat.4 upload speeds of up to 50 Mbps, download speeds of up to 150 Mbps, and powerful 802.11ac MIMOWi-Fi providing ample bandwidth for high-data demanding applications using high-speed PCs, tablets, or surveillance devices.
Implementing an Advanced Traffic Management System with a Network Infrastructure Upgrade

A city traffic department in the Midwest needed to implement an advanced traffic management system that included traffic detection, traffic cameras, adaptive traffic control management capabilities, and a wireless radio system. Additionally, in order to meet the needs of the new advanced traffic system, the existing field traffic network structure had to be upgraded. The field network structure had to move to a full Gigabit Ethernet connection with multiple fiber uplinks and multiple functionalities in the network system.

The design requirements of the new network structure included the following:

- High-bandwidth Gigabit Ethernet connection with multiple fiber uplink/downlink streams; at least 3 fiber connections
- High-power PoE capabilities delivering up to 30 watts for outdoor PTZ IP cameras without running additional power cabling
- Network managed features to operate network segmentation, security, and redundancy
- Rugged devices to operate in a traffic cabinet safely without potential failure issues

The Solution

To solve the city’s network system upgrade requirement, Advantech recommended its EKI-7712G-4FPI-AE L2 managed switch, which supports a 12-port 10/100/1000M + 4 GbE SFP physical configuration. With a full suite of L2 managed features, VLAN for network segmentation between video detection, traffic controllers, traffic cameras, and wireless radio is available.

The compact, mechanical design of the EKI-7712G-4FPI-AE was a significant benefit to the city engineers due to the limited space in traffic cabinets. Because of the design, traffic engineers didn't need to upgrade the entire existing cabinet; they simply upgraded the single network device.

Additionally, utilizing Advantech's X-Ring allowed a build-up of the overall networking redundancy in the entire city traffic network. The device supports PoE+ capabilities that directly power outdoor PTZ cameras through Ethernet; the entire POE budget can run up to 240 watts. Plus, the managed switch has NEMA TS2 certification, which solves any harsh environmental issues present due to Midwest seasonal weather.

IXM technology — Intelligent Provisioning technology — is an exclusive built-in WebGUI feature in the managed Ethernet switch that allows engineers to mass deploy and mass upgrade the network system. The one-time process for deployment, configuration, and IP assignment is convenient and useful for system deployment in the field.

The Product Solution

**EKI-7712G-4FPI-AE, 8-port GbE(PoE/PoE+) + 4 GbE SFP Full L2 Managed Ethernet Switch**

- SFP socket for easy and flexible fiber expansion
- Redundancy: X-Ring Pro (ultra-high-speed recovery time < 20 ms), RSTP/STP (802.1w/1D)
- IXM function enables fast deployment
- Security: 802.1x (Port-Based, MD5/TLS/TTLS/PEAP Encryption), RADIUS
- NEMA TS2 for Traffic Control
- EN50121-4 approval for railway track-side deployment
- -40°C ~ 75°C wide-range operating temperature
- Dual 48 VDC power input and 1 relay output

The EKI-7712G series supports an NMS to help IT managers with networking maintenance and failure prevention. Additionally, the EKI-7712G series is equipped with X-Ring Pro, which can achieve ultra high speed recovery time of less than 20 ms to ensure network stability. The switch also features a wide -40°C to 75°C operating temperature and NEMA TS2 rating, making the switch an ideal solution for use in traffic applications.
PSD-A120W48, DIN Rail AC to DC 100-240V 120W 48V

- Extra compact design with 120 watts output
- High power density: 3.72 watts per cubic inch
- Input range 85 ~ 264 VAC/ 110 ~ 375 VDC
- Power boost with 150% peak load
- Full protection with auto recovery function
- Full load output up to 60°C
- Adjustable output

Successful Environmental Monitoring for Transportation Main Networking Hubs

When it comes to the overall networking infrastructure of a transportation system, the main networking hub is fundamental. These hubs usually also connect to additional networking systems, such as public works or emergency department networking systems. The hubs are unmanned, secure stations. When something goes wrong in the mission-critical Main Networking Hub, the whole system can experience downtime and maintenance is timely and expensive.

Specifically, high temperatures in these hubs can cause equipment to shutdown, overheat, breakdown, or even catch fire. To avoid such expensive catastrophes, a Department of Transportation in the U.S. was having trouble finding a solution to combat high temperatures in its Main Networking Hubs. For this particular department, the hubs are the main interface point for local cameras, radar, and speed detectors across its interstate system.

The transportation department needed a way to monitor temperature, humidity, and Uninterruptible Power Sources (UPS) in the hubs without wasting expensive man hours for inspections. UPS is an electrical apparatus that provides emergency power to a load when the input power source or mains power fails. If an AC unit fails, it doesn't take long for equipment and fans to overheat.

Additionally, if the room is too humid, it can lead to corrosion that damages and breaks down the equipment. In looking for a solution for environmental monitoring in the Main Networking Hubs, the department was finding most of the popular solutions were too complicated to implement and too expensive to run. Additionally, many popular solutions are cloud-based, which is not ideal for a transportation department with security and data concerns.

The Solution

Working with Advantech, the department implemented a solution from a one-stop shop with all required components, such as sensor node, wireless communication gateway, I/O data acquisition module, power supply and mounting kit, as well as a pre-configuration/programming service.

The Advantech environmental monitoring solution has integrated temperature and humidity monitoring, and is fully expandable in both rugged hardware and software. Utilizing the industrial WISE-4220-S231A wireless node to wirelessly measure humidity, temperature, and current, a SmartStart LTE IoT Gateway is also transmitting data back to the central control room. The WISE-4220 series is an Ethernet-based wireless IoT device, integrated with IoT data acquisition, processing, and publishing functions.

Utilizing the Advantech solution, alarms and alerts can be set up when the optimal environmental conditions in the Transportation Main Networking Hubs are not met. In terms of security, the SmartStart IoT Gateway has a standard ETH port to connect into the department’s secured private network directly, eliminating concerns of running data
outside the network. The SmartStart gateway also utilizes Node-RED for visual programming, making it a simple task for the transportation department’s contractor to set up and maintain.

**Node-RED: A better way to approach unique demands of IIoT applications**

Node-RED is a powerful—yet simple to use—applications programming environment optimized for processing data streams. It’s a flexible tool ideal for users of any level to be able to program to connect physical I/O, databases, and more.

Node-RED enables owners, operators, and integrators of remote assets to integrate data from assets into IIoT applications. Users drag and drop function nodes to acquire, process, and output data via an internal web server interface.

The Node-RED environment is able to create and serve local dashboards or flows, providing a mechanism to serve summary data to engineers, managers, or operational staff. The flows created in Node-RED are stored using JSON, which can be easily imported and exported for sharing with others. Node-RED can be run locally, on a device, or in the cloud.

**The Product Solution**

**WISE-4220-S231A**, Wi-Fi IoT Wireless Sensor Node with Built-in Temperature and Humidity Sensor

- Wi-Fi 2.4 GHz IEEE 802.11b/g/n WLAN
- Application-ready sensor solution
- Supported protocols: Modbus/TCP, TCP/IP, UDP, DHCP, HTTP, MQTT
- Supports RESTful web API in JSON format for IoT integration
- Supports file-based cloud storage and local logging with RTC time stamp

Advantech’s WISE-4220 series modules leverage Wi-Fi to provide high-performance modularized wireless sensor nodes that can be easily integrated into existing networks. Aimed at industrial applications, WISE-4220 modules feature an internal sensor for collecting and logging environment data that can be wirelessly transmitted to a server or cloud using the MQTT protocol or RESTful web services.

**WISE-4012-AE**, 4-ch Universal Input and 2-ch Digital Output IoT Wireless I/O Module

- 4-ch universal input and 2-ch digital output
- 2.4GHz Wi-Fi reducing the wiring cost during big data acquisition
- Easily extend the existing network by adding APs, and share existing Ethernet software
- Configured by mobile devices directly without installing any software or apps
- Zero data loss using the log function with RTC time stamp
- Data can be automatically pushed to Dropbox or computer
- Supports RESTful web API in JSON format for IoT integration

Advantech’s WISE remote I/O devices bring an IT-oriented spirit to the market with the advanced concept of data A-P-P (data Acquisition, data Processing, data Publishing) fulfilling mobile monitoring and controlling needs. Broad adaptability has made WISE a reliable source of big data, benefiting users in identifying next steps and actions to take.

**BB-SL30210110-X**, SmartStart Intelligent LTE Router & Gateway

- LTE cat.1, 3G/HSPA+, NAM, 2x SIM
- LTE B2, B4, B5, B12, B13
- Powerful CPU and memory, hosting of SW IoT applications
- Wall or DIN rail mounting, sleep mode
- 1x ETH
- 1x RS232
- Wi-Fi 2.4 GHz, I/O 1x DI + 1x DO
Updating More than 200 Traffic Signals and Video Communication Networks

A traffic engineering department in the U.S. Southwest needed to upgrade its traffic signal network in-cabinet devices as transportation applications continued to evolve—smart traffic signals, video detection cameras, traffic cameras, and potential DSRC radios. But, the existing network devices couldn’t handle more than eight connections locally since the network was designed several years ago. They needed a device upgrade for system success.

As the traffic engineering department kept adding more advanced traffic equipment, it needed devices that could support 16-port connections and fiber uplinks for intensive network connections.

Additionally, the new Ethernet switch had to fit and operate within the existing network structure, including VLAN and networking redundancy settings, in order to migrate from the older network system.

The Solution

To solve network complexities, Advantech provided its EKI-7720G-4FI, a 16-port 10/100M and 4 GbE SFP Full L2 Managed Industrial Ethernet Switch. The traffic engineers needed a switch that could operate and fit in the existing network structure within the existing cabinet. With the compact size of EKI managed switches, it allowed engineers to simply swap out the existing equipment directly while saving additional space outside of the original design.

The EKI-7720G-4FI supports a full suite of L2 managed features including VLAN for the network segmentation between video detection cameras, traffic controllers, traffic cameras, and wireless radio. With RSTP configured, the
managed switch lives within the existing network with wireless radio to build up the overall networking redundancy. The device also supports a wide operating temperature, -40°C to +75°C, allowing it to work in various weather situations with reliability.

IXM technology is an exclusive built-in WebGUI feature in the managed Ethernet switch that allows engineers to mass deploy, and mass upgrade the network system in the future.

Even if other vendors offer Ethernet switches with L2 software management features, IXM Intelligent Provisioning Technology is an exclusive, leading benefit of EKI switches for traffic engineers with its mass deployment and configuration features.

The Product Solution

EKI-7720G-4FI, 16GE+4G SFP Managed Ethernet Switch

- 16 Gigabit Ethernet ports + 4 SFP ports
- SFP socket for easy and flexible fiber expansion
- Redundancy: X-Ring Pro (ultra-high-speed recovery time < 20 ms), RSTP/STP (802.1w/1D)
- IXM technology function enables fast deployment
- Security: 802.1x (Port-Based, MD5/TLS/TTLS/PEAP Encryption), RADIUS
- NEMA TS2 for Traffic Control
- ENS0121-4 approval for railway track-side deployment
- -40°C ~ 75°C wide-range operating temperature
- Dual 12~48 VDC power input and 1 relay output

Intelligent Video Traffic Monitoring for a Traffic Signal Control System

Cities consist of roads and streets where all types of vehicles intersect—pedestrians, bicycles, cars, buses, etc. Traffic signal controls at intersections highly impact vehicle activity, conflicting movement, and capacity. To achieve an effective transportation solution that maintains safety, but also permits better traffic throughput, accurate traffic monitoring is needed to understand vehicle movements and flows throughout the city.

Traditional detection methods, such as ultrasonic, microwave radar, or infrared sensors, either cost too much to deploy or lack the necessary recording detail.

Video detection systems can overcome these disadvantages and can, with artificial intelligence (AI), generate essential traffic meta data. Valuable information, such as vehicle numbers, direction, waiting time, etc., can all be acquired easily using video equipped with edge-based AI systems—a revolution in traffic monitoring.

The Solution

To meet these challenges, an AI traffic monitoring solution can be implemented, including a self-adaptive traffic light system, edge AI system, and a backend AI inference server—all integrated into a carefully designed data flow. The
After traffic monitoring is completed at the roadside, raw data is transmitted back to a central control room. The AI inference server leverages high processing power to meet massive inference processing requirements and to be able to analyze the set of metadata via pre-trained deep learning models. Then, the self-adaptive traffic lights can be managed from the traffic center control room.

Advantech’s MIC-720AI compact modular computer, based on the NVIDIA Jetson Tegra X2 (TX2), can be used as the edge AI system. MIC-720AI leverages AI inference technology to perform traffic monitoring on the massive amounts of collected data; surpassing traditional vehicle recognition methods used for object tracking. MIC-720AI fulfills deep learning computing requirements at the roadside where metadata is packaged and transmitted to a central control room. MIC-720AI also provides multiple interfaces to integrate with other traffic equipment.

Integrated with an intuitive dashboard in the control room, an Advantech SKY-6100 AI inference server can not only receive metadata from all edge AI systems, but can also monitor all traffic conditions through deep learning models. If any abnormal situations occur, the AI server can recognize it and manage the traffic lights adaptively.

Through the analytic power of SKY-6100, a self-adaptive traffic signal control system helps traffic in the city flow smoothly and efficiently. The city can have a high-level overview of all traffic in real time. Moreover, traffic data and information are constantly needed to assess current and past performance and to predict future performance. All this helps for proactive transportation planning, such as traffic impact assessments, public transportation, and road design, to make a better future with transportation infrastructure.
The Product Solution

**MIC-720AI**, AI Inference System based on NVIDIA® Jetson™ Tegra X2 256 CUDA Cores

- Fanless and compact design
- Supports NVIDIA Jetson® Tegra X2
- 2 USB 3.0 ports and 1 internal USB 2.0
- 1 IEEE 802.3af POE port
- Linux OS with BSP (board support package)
- Supports deep learning trained models
- Wide operating temperature

MIC-720AI is an ARM-based system integrated with an NVIDIA® Jetson™ Tegra X2 System-on-Module processor, providing 256 CUDA® cores on the NVIDIA® Pascal™ architecture. With wall mount brackets and a fanless design, the MIC-720AI can easily be utilized in rugged environments. This small embedded system is ideal for AI inference edge and deep learning applications.

**SKY-6100**, 1U Rackmount Dual Intel® Xeon® Scalable GPU server

- Processor: Dual Intel Xeon Scalable Processor
- Memory: DDR4 2666 MHz ECC-REG type up to 512 GB
- Remote Management: IPMI function support
- Expansion: Supporting 1 x PCIe x16 double-deck FH/FL card + 1 x PCIe x16 single-deck FH/HL card or 5 x PCIe x16 single-deck HH/HL cards
- PSU: 1200W 1+1 redundant power supply with 80 PLUS Platinum level certification

SKY series industrial-grade server products include open standard server products: server chassis (HPC) and server boards (ASMB). And proprietary server products for critical applications: GPU Servers, IoT storage servers, carrier-grade servers, and multi-node servers. Advantech cooperates closely with partners to help provide a multitude of solutions for a wide array of applications, such as AI solutions for smart city applications in transportation.

Utilizing PoE Routers for Roadside Traffic Data Collection

A department of transportation in the southern United States needed help sending data from its 150 individual roadside traffic data collectors to its traveler information system boards. The sites included a 250-mile stretch of major highways, alternate routes on minor highways, and areas of various work zones.

The Solution

Transportation systems need to provide travelers with real-time information, and LTE routers can provide reliable, high bandwidth, wireless data communications anywhere there’s cellular service. Where mobility is required, cellular routers provide that, too. Versatile and wireless, LTE routers simplify communications with remote locations and equipment while simultaneously providing them with enhanced capabilities.

The department decided to implement Advantech's SmartFlex LTE Router with PoE/PoE+ support in its traffic data collector sites. The SmartFlex LTE router provides secure Internet connectivity for devices and LANs via cellular networks. It can be used to provide automatic wireless fail-over for wired networks, wireless connectivity for devices in remote locations where cable connections are impractical and wireless connectivity for mobile assets.

The Product Solution

**SR30508120-SWH**, SmartFlex Modular LTE Router

- LTE cat.3, 3G/HSPA+, GPRS/EDGE, NAM, 2x SIM
Cost Effective Street Light Management at the Network Edge with the Power of the IoT

Public lighting is among the most significant—and expensive—infrastructure assets owned and operated by municipalities and utility providers. As many municipalities look to become more energy efficient and provide improved security, they are finding areas where Advantech can deliver immediate benefits.

A customer operating in the public lighting market was looking to help cut operating expenses by setting up systems for real-time remote monitoring and control. By equipping streetlights with photoelectric sensors, the provider looked to cut overall power usage while ensuring the bulbs lasted longer. Remote sensors would monitor bulb health, making it possible to dispatch maintenance crews more efficiently.

The Solution

Communicating with the streetlights presented challenges as the lights were located all over the city and many were installed to enhance security for only single users on commercial and residential private property. The key challenge was to find sensors that could report to the control center and receive instructions back in return.

Advantech equipped the remote locations with SL30200110-XSWH SmartStart LTE routers. The routers provided Internet connectivity for the remote sensors and allowed them to communicate wirelessly. Where lights were clustered close together, the routers created a local area Ethernet network and a single router managed the entire group. In certain instances, Advantech routers provided connectivity for additional equipment, such as security cameras, and motion sensors.

The Product Solution

SL30200110-XSWH, SmartStart LTE Router

- LTE cat.1, 3G/HSPA+, NAM, 2x SIM
- LTE B2, B4, B5, B12, B13
- Powerful CPU and memory, hosting of SW IoT applications
- Wall or DIN rail mounting, sleep mode
- 1x ETH, 1x RS232
- I/O 1x DI + 1x DO
- Operating temp. –40°C to +75°C, power supply 9 to 36 V DC
- Certifications: FCC/IC, UL 60950-1, AT&T, Verizon, UL MX CoC
- Advanced networking, diagnostics, VPN support, firewall
Want to Learn More?

To learn more about Advantech’s solutions for smart city and transportation infrastructure, please visit our Intelligent Transportation Systems learning center at: [https://www.advantech.com/solutions/intelligent-transportation-systems](https://www.advantech.com/solutions/intelligent-transportation-systems).

Additional information can also be found in the following brochures:

- [Cellular Routers & Gateways for Industrial IoT & Enhanced Networking](https://www.advantech.com/solutions/cellular-router-guide)

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