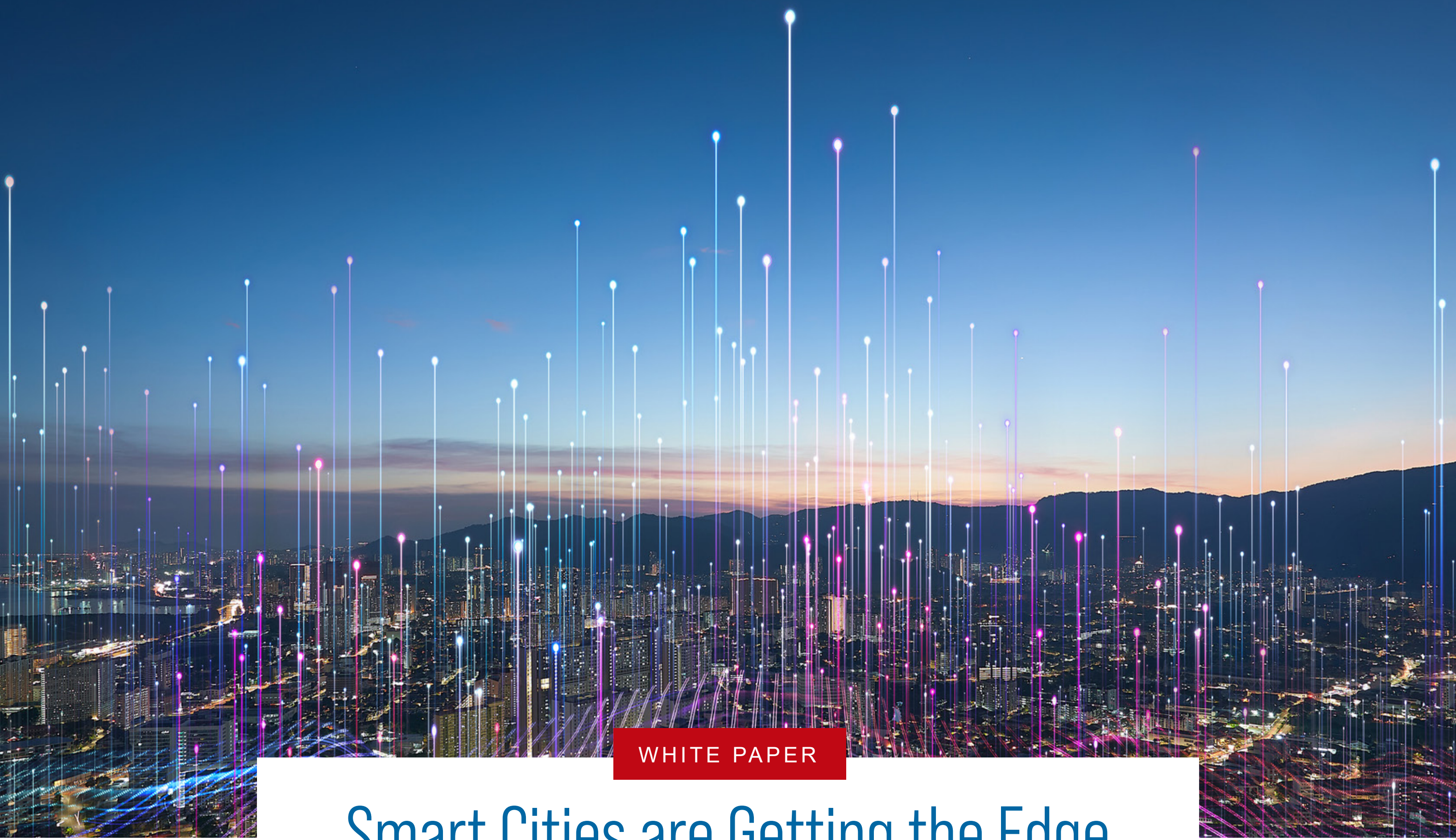

WHITE PAPER

Smart Cities are Getting the Edge Computing They Require

Abstract

Cities around the world are evolving into smart cities. This transition puts them at the confluence ofseveral of today's most prominent technological trends: the internet of things (IoT), artificial intelligence (AI), 5G wireless and, not least of these, edge computing.

AI is necessary to sift meaningful insights out of the large volumes of information that cities gather. That means smart cities must rely on data centers, installations with sufficient computing resources to support sophisticated AI models. The continuous streams of data that smart cities gather via IoT devices – about traffic, water, power, public safety, and other municipal responsibilities – get communicated via secure wide-area networks (WAN) such as 5G.

The payoff on smart city investments increases when the data that cities collect can be used in real time. There's no value in adopting technology to alleviate traffic jams, for example, if the system takes so long to produce solutions that jams dissipate on their own.

Relying on the biggest data centers poses a difficulty for smart cities, however, in that they tend to be located farther from city centers. That means data must take long round trips, which manifest as lags between input and output – latency that makes it hard, if not impossible, to get results in real time.

This is where edge computing comes in. The concept is to build data centers near the network edge, either in cities or close enough that any network latency is negligible.

First and foremost, this serves the smart city goal of producing real-time analytics. It also saves smart cities network usage costs, because the reams of data that would otherwise have been transmitted to distant data centers remains local. This approach has a fringe benefit from the network perspective, in that smart city traffic that remains local does not exacerbate network congestion.

The Smart City Market

The appeal of smart cities is apparent to anyone who has ever waited out a red light at an intersection otherwise devoid of automotive or human traffic.

Traffic control is only one of many smart city applications. Smart city technology can be applied to functions such as energy management, emergency response, waste management, air quality control, and more. One of the smart city applications that municipalities tend to adopt sooner rather than later is video monitoring and surveillance for public safety purposes.

People have been anticipating advanced smart city technology for decades. The potential benefits include greater safety, improved services and better quality of life. Technological prerequisites served as barriers to this progress that only in recent years began to gel into an ecosystem suitable to support advanced smart city functions.
Even with the advent of enabling technologies such as AI, the IoT, fast secure WAN, and edge data centers, upgrading and replacing technology can present challenges for cities. Integration with legacy equipment can be a challenge.

Beyond that, cities rarely have enough latitude in their budgets to adopt new technology. Smart technology can be simply unaffordable, especially for smaller municipalities and cities in developing markets, especially after factoring in long-term operational and maintenance costs.

That said, though the smart city market has been developing slowly, it is already large and is certain to grow. The smart cities market will end up being worth $700 billion by the end of 2025, and could grow to exceed $1.4 trillion by 2030, by one estimate. That figure encompasses everything from sensors (cameras, thermometers, radars, etc.) to communications systems (5G, other WAN technologies, WiFi, etc.) to edge data centers.

There are several uses for edge data centers beyond smart cities, including supporting 5G communications, for caching and delivering frequently requested data (e.g. popular videos), and eventually for supporting vehicle to vehicle (V2V) communications systems. That said, smart city applications are key drivers of growth in the edge data center market, which will be worth about $50 billion globally in 2025 and is projected to more than double in size to $109 billion by 2030 .

Edge Computing

It is important to note that an edge data center is unlikely to resemble a scaled-down version of a hyperscale data center, with a dedicated, environmentally controlled, secure building. As a practical matter, an edge data center is more likely to be a rack unit or two, or a few racks' worth of servers, housed somewhere that might be subject to ambient temperature extremes, dust and other particulates, smoke, environmental vibration, and perhaps even weather.

Many edge data centers will consequently need to be outfitted with equipment guaranteed to be reliable when installed in less-than-pristine conditions. That might require ruggedized versions of the equipment involved.

Wireless at the Edge

Smart cities start with edge devices – with the IoT. A partial list of municipal responsibilities and the IoT devices used to support them include:

- Traffic management – cameras, radars
- Water quality monitoring – sensors to detect and/or gauge pH levels, temperature, turbidity, chemical pollutants
- Parking – cameras
- Streetlight management – light detectors
- Noise abatement – microphones
- Irrigation / wastewater management – soil moisture sensors, weather detectors (thermometers, barometers, anemometers, etc.)

It is simply more practical and cost-effective to connect all the sensors and sensor systems deployed in a smart city by wireless means. That means smart cities require smart devices equipped with reliable antennas, RF components, and point-to-point wireless bridging.

Specific examples include outdoor-rated Wi-Fi 6e omnidirectional antennas, 5 GHz Wi-Fi antennas, 900 MHz Yagi antennas, and 5G/LTE omnidirectional cellular antennas.

Connectivity for Edge Applications

Smart cities depend on IoT devices that connect wirelessly to the network via WiFi, 5G, and other protocols, but the growing variety and number of these devices translates into an increasing amount of data traffic that eventually gets fed into wireline networks. Smart cities create a demand for more bandwidth and higher throughput in physical network infrastructure at the edge.

Fiber optics provide high-capacity, interference-free communication. Fiber optic assemblies support scalable backbone networks. Multi-fiber push on (MPO) fiber optic cables, which use connectors that can accommodate multiple fibers in a single interface, can be useful in more active edge data centers. Edge data centers might be installed in tight spaces where it will be advantageous to use assemblies, patch cables, and connectors that use bend insensitive fiber.

Industrial and military-grade fiber optic cables are available to operate in some of the harsh environments where smart city edge data centers might be located. Similarly, Ethernet cabling and connectors built for industrial environments are widely available.

This includes Ethernet cables, plugs, jacks, high-flex industrial Ethernet cables, ruggedized assemblies, and Cat5e/6/6A industrial cable assemblies.

Beyond network performance and reliability, network and data security are priorities for smart cities. Importantly, optical fiber is harder to compromise than copper, providing an added measure of security to a municipal network.

Power and Integration

Battery power is perfectly sufficient for a great many IoT devices. Think of sensors that need to be activated only intermittently or when triggered, such as an AI anti-theft audio monitor listening for the sound of breaking glass.

Other IoT devices are inevitably going to need to be powered continuously. Deployment can be costly if power lines and data cables are required. A good solution in such cases is power over Ethernet (PoE). PoE can eliminate the need for an external power source, reduce points of failure, minimize costs, and simplify network management.

PoE infrastructure suitable for smart city applications includes industrial-grade PoE switches. A variety of such switches are available providing municipal engineers with maximum flexibility choosing network architectures and configurations. They include managed gigabit PoE switches, multiport industrial PoE+ switches, long reach PoE over coax switches, PoE fast Ethernet switches, and industrial PoE switches with 10G uplinks.

Protection and Reliability

A foundation of electronic system reliability is power stability. Surge protectors and EMI/RFI shielding are essential safeguards for Ethernet and coaxial lines, doubly necessary in outdoor and industrial sites. Respectively they prevent transient voltages and suppress interference that can damage equipment.

In smart city applications, reliability is also dependent on protection from environmental phenomena. NEMA-rated weatherproof enclosures provide protection from weather and other environmental conditions. Depending on needs, these enclosures can be powered or not, and can come with heating and cooling capabilities.

Summary

The evolution toward smart cities will proceed. While paying for smart city technology is a challenge, the potential benefits of smart cities are too big to ignore.
The technological ecosystem is already mature enough to support important real-time municipal applications, providing cost efficiencies that result from reliable, long-term deployment.
Reliable infrastructure, including connectivity, is a foundational requirement for edge success. The reliability of edge infrastructure equipment assures uptime and keeps maintenance to a minimum.
Edge data centers and supporting infrastructure are scalable, accommodating future growth.
L-com has one of the richest portfolios of robust connectivity and networking products, supporting edge computing growth.

References

1. Markets and Markets https://www.marketsandmarkets.com/Market-Reports/smart-cities-market-542.html
2. Ibid. https://www.marketsandmarkets.com/Market-Reports/edge-data-center-market-142018469.html