OUTDOOR SURVEILLANCE: A POWERFUL TREND FOR A SAFER SOCIETY

TECHNOLOGY CONSIDERATIONS FOR CREATING A SAFER, MORE SUSTAINABLE SMART CITY ECOSYSTEM

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The smart city ecosystem effectively integrates physical, digital and human systems to help drive a sustainable, prosperous and inclusive future for all who live and work there. A networked infrastructure commonly serves as a foundation to improve economic and political efficiency and helps enable social, cultural and urban development, as well as to help foster social and environmental sustainability.

Technology designers and manufacturers commonly have key roles in helping to create long-term growth in this ecosystem. Consider this: As of October 2020, the projected global smart cities market is expected to grow from USD $410.8 billion to $820.7 billion by 2025, at a compound annual growth rate (CAGR) of 14.8% during the forecast period[i]. Increases in government initiatives, urban population numbers and demand for public safety seem to be driving this growing trend—and even though the COVID-19 pandemic seems to be driving some people at least temporarily away from cities, the pandemic is also helping accelerate smart city trends.

As smart cities evolve in urban areas around the world, surveillance can play a powerful role in improving quality of life and the safety of our societies. Technologies such as real-time video surveillance, facial recognition and license plate reading are becoming widely used to help ensure public safety. In this trend paper, TE Connectivity (TE) will explore some of the demands and trends in smart surveillance technology within the smart city ecosystem and review what many engineers may need to consider when designing smart surveillance products and components.

MARKET TRENDS IN GROWTH INDUSTRIES

Urbanization—shifts of population from rural and suburban areas to the cities—can put stress on an aging infrastructure and create greater inefficiencies in governance, energy use, traffic management, waste management, pollution and more. Consider these statistics[ii]:

- 50% of the global population currently lives in cities, with an expected increase to 68% by 2050
- By 2025, migration from rural areas will add 2.3 billion people to urban areas, mostly in South Asia and Sub-Saharan Africa
- By 2025-2030, around 630 million people will live in close to 40 megacities

Though the COVID-19 pandemic seems to have affected this rise in urbanization, it is still unclear whether the pandemic's effect on this population shift will be temporary or long-term. Regardless, smart city technologies can help overcome many of these social, economic and environmental challenges and can help foster more livable, inclusive cities globally. The following are some of the trends that support this assertion.

5G And Digitization

As 5G rollouts grow globally and in emerging markets, offering faster data transmission and the ability to connect significantly more devices at once, more cities will probably dive deeper into the smart city trend. 5G capabilities can make smarter technology more accessible and can open new market opportunities for Internet of Things (IoT) solutions, such as in outdoor surveillance, physical security, government and transportation/traffic control. Gartner's Market Trends: 5G Opportunities in IoT for Communications Service Providers report predicts that 5G IoT installed endpoints for outdoor surveillance cameras will reach 2.5 million in 2020, 6.2 million units in 2021 and 11.2 million units in 2022, with the largest addressable market being surveillance cameras deployed by city operators or used to provide intruder detection and ensure building security.

In 2016, 95% of all businesses and 83% of all adults in OECD (Organisation for Economic Co-operation and Development) countries had access to high-speed broadband, with 50% of this population accessing public services or health information online.[iii] By 2025, smartphone penetration will reach 80% globally. Even in emerging market countries, internet usage has grown by about 20% a year, with smartphones normally being the first point of internet access. While the sort of social connectedness that results from this widespread connectivity can be difficult to quantify, some studies suggest that digital platforms could nearly double the share of residents who feel connected to the local community and nearly triple the share who feel connected to local government.

Public Safety

Crime normally plays a large role in quality of living, real estate value and more in urban areas and citizens seem to be getting more comfortable with the idea of surveillance playing a role in crime prevention. According to a Capgemini survey, two-thirds of respondents were comfortable with the idea of using AI-enabled cameras to detect and track potential crime in public areas and over half saw the benefit of facial recognition technologies to track offenders.

While closed-circuit television (CCTV) has been found to be the most effective in reducing crime in car parks and residential areas, city-wide surveillance systems in conjunction with body-worn cameras and gunshot detectors help reduce robbery, burglary and assault incidents by 30-40%.[iv]

With the increasing number of businesses and residents using IoT surveillance devices, police and governments have the opportunity to plug into these private systems (with permission) to gain a broader view while not having to invest in the technology themselves across every location. As a result, the smart city market seems to really entail both public- and private-owned devices.

Aging Infrastructure Crisis

In 2017, the U.S. received a D+ on its infrastructure report card from the American Society of Civil Engineers—meaning deteriorating roads and bridges across most U.S. cities were not only dangerous, but likely "impeding our ability to compete" in the global economy and spurring job and GDP losses by the millions and trillions, respectively. However, the U.S. is not the only country faced with an expensive dilemma of confronting its aging infrastructure problem. Globally, there is a $18 trillion investment gap and an urgent need for viable solutions.

At CES 2020, a panel of experts discussed how infusing new technology into these crumbling infrastructures can offer renewable solutions. Smart city technology, as well as and often in conjunction with other existing digital technology, can reduce infrastructure project costs in some regions by as much as 45%.[v] Smart street lights, connected cars, automated traffic programs, surveillance programs and more can help create communities that are resilient and sustainable if the right public-private partnerships can be created to defuse some of the costs. Rather than look at each problem individually, the most benefit, experts say, would come from looking at solutions from a holistic view—something to think about in product innovation and design.

Gartner predicts that by 2022, the digitization and leveraging of the IoT will save consumers and businesses $1 trillion a year in maintenance, services and consumables on a global level.

Increasing Sustainability And Addressing Environmental Concerns

Sustainability is a long-term trend that should also be considered in that holistic view. Urbanized areas account for a major portion of global energy consumption, releasing up to an estimated 80% of greenhouse gases (GHG)[vi]. Smart city solutions can reduce GHG emissions by at least 10-15% and could help cities make significant progress toward meeting 70% of the U.N. Sustainable Development Goals [vii].

Surveillance cameras and sensors can monitor air and noise pollution in cities, monitor and adjust street lighting and reduce and regulate water consumption in buildings and in park irrigation systems. Networked cameras can monitor the intensity of rain and snow and send data that can be used to assess its impact on local traffic conditions, pollution and housing and roads in flood-prone areas.

Cybersecurity And Privacy

It's important to note that while many people are becoming more comfortable with smart city technology and surveillance in their cities, privacy issues remain and should be considered along with cybersecurity as trends to be aware of when designing for the smart city market.

## OPPORTUNITIES FOR SMART CITY SURVEILLANCE

Crime Detection And Prevention

Hundreds of cities now seem to use smart policing to predict when and where crime is most likely to occur. Sound sensors, for example, can detect gunshots and help police pinpoint the potential crime location so they can rapidly secure an area. Video cameras can aid police in solving crimes after they happen, as well as deter new crimes from occurring. The city of Atlanta, Georgia in the U.S., for example, has reduced crime through its use of smart street lights. These lights have integrated sensor technology that can increase or decrease light as needed, detect and monitor traffic and parking, detect gunshots, record video and more.
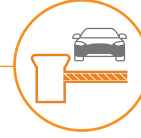
Parking Control

Smart parking can lead drivers quickly to open spots, reducing congestion from circling vehicles and frustration that could keep some visitors out. Sensors or cameras can monitor vehicles for parking violations without sending personnel out on the street. Car owners can pay for more time through an integrated app instead of cutting short their shopping trip or entertainment. All of this could lead to smart cities seeing an increase in parking revenues and in retail tax revenues, since shoppers spend less time worrying about parking and more time buying or attending local events.
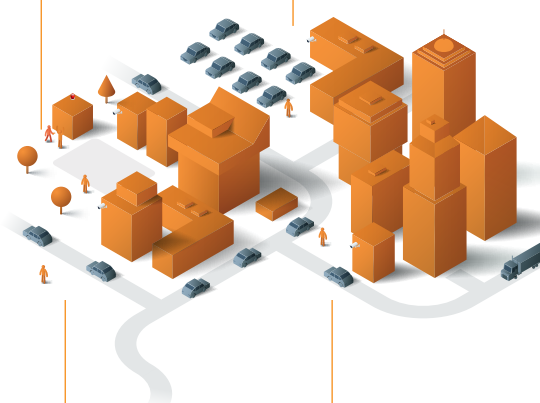
Emergencies And First Responders

Along with public safety, surveillance solutions can enhance police officer safety as well through video and data-gathering capabilities. These smart surveillance systems can help police identify certain problem areas, which they can then patrol more frequently or implement additional crime prevention measures. Dispatch and emergency response operators can view real-time video from a location to determine whether an officer, firefighters or ambulance should be dispatched, helping eliminate wasted time from responding to non-events or sending the proper personnel more efficiently. A dispatcher can also continue to monitor video and can provide up-to-the-minute insight into what is happening as a police officer responds to the incident. Responding officers and other emergency personnel dispatched can view and monitor video from an in-car computer or smart device. This real-time situational awareness can enable officers to take the safest, most effective response.
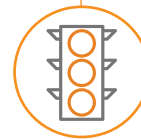
Traffic Control

Data from embedded sensors, video cameras, crowd-sourced traffic information and other sources can help cities better understand traffic and pedestrian patterns and make improvements. This could lead to less congestion during rush hours, less pollution as fewer cars are left to idle for long periods of time, more efficient routing of emergency response vehicles, safer placement of bike lanes, and potentially more effective city planning as government officials have more detailed information on which to base their decisions.

In addition to enhancing safety and efficiency, smart surveillance tools can help cities and police departments more efficiently manage their limited budgets and better allocate resources, giving them a greater return on their investment.

HOW COVID IS ACCELERATING SMART CITY DEVELOPMENT

While the COVID-19 pandemic has motivated some people to move out of urban areas, as mentioned earlier, it also seems to accelerate smart city development and shifting priorities as many cities around the world are realizing the potential for technology to help their people, government and businesses adjust. Smart city technology can help reduce the spread of COVID-19 as well as rejuvenate economic growth and digital inclusion.

In June 2020, the government of Singapore announced a planned 30%[viii] increase in its investment to help businesses digitize. Officials said some key areas of focus included using data analytics, artificial intelligence and sensors to modernize government initiatives and developing new technological tools to respond to COVID-19.

In the United Arab Emirates, the government implemented an AI-based system that involved "smart helmets" worn by local police. The helmets could help detect (from a safe distance) people who might be infected, using an integrated thermal camera and were also equipped with sensors for facial recognition and vehicle license plate reading to identify people who were in public or on roads without the necessary authorization.

In India, 45 cities used operational integrated command and control centers (ICCCs), established as part of the government-funded Smart Cities Mission launched in 2015, to help officials make emergency decisions, manage contact tracing activities and monitor lockdown efficiency. In Varanasi (northern India), officials used a geographic information system (GIS)-based dashboard to identify quarantine violations, deliver essential supplies and conduct emergency alert responses.

Overall, while some smart city projects have been cancelled or postponed, the pandemic has highlighted a need for accelerated digitalization in city planning and greater communication with citizens for sustainability and public safety. The goodwill existing during this pandemic between the public and private sectors can be fostered to invest in digitizing more systems to better enable remote work and leverage accessible data to help promote public health and safety, among countless potential initiatives. Cities with a digital platform in place before COVID saw the benefit of being able to help collect and analyze data to rapidly understand some areas where attention needed to be focused and adjustments needed to be made.

WHAT DESIGN ENGINEERS NEED

Outdoor smart surveillance tools, devices and systems can present several challenges for design engineers. The following includes important considerations for designing certain outdoor smart surveillance devices. Note that many of the components mentioned may address more than one of the considerations listed below:

Durability

Most outdoor surveillance devices may need to be durable enough to withstand harsh weather, temperatures and ultraviolet (UV) light, as well as, in some cases, wildlife contact and vandals. Ruggedized components and sealed connectors should be used where possible in devices that are commonly exposed to these harsh elements. Flat Flexible Cable (FFC) Connectors are just one example of a versatile interconnection solution that can enable flexibility and durability in high-performance applications.

Rugged USB Type-C connectors with IPX8 waterproof ratings are a useful choice for outdoor surveillance devices. This connector can support a variety of different protocols and transfer data at speeds up to 10 gigabits per second (Gbps). TE's USB Type-C connectors are designed to accept a mating plug in any direction, enabling quick, reliable mating and have an added protective feature on the back of the receptacle shell to help eliminate unwanted EMI leakage. These connectors can be useful with outdoor USB Type-C cables for maximum robustness and performance in rugged environments.

Strong casing on devices or components that are resistant to vandalism could interfere with signal integrity or connectivity. This may need to be considered and a ruggedized external antenna could be used as a potential solution. For example, the M2M MiMo Cellular/LTE antenna is compact with a robust low-profile housing that is weatherproof and can commonly be fitted on a non-conductive panel if needed. It contains two antenna elements with effective isolation and correlation which can cover all current global cellular and LTE bands and the asset tracking version includes an active antenna for GPS/GNSS/Galileo/Beidou applications that need to send back data on position or timing.

High Data Rate And Bandwidth

Consider the current and potential future bandwidth needs for each device or system, as it may vary depending on the purpose and the network it will be sending data on. For example, traffic control devices may require more bandwidth than parking control to accommodate the data and speeds often needed for the functionality. Anything with video or facial recognition normally needs even higher bandwidth capabilities to capture and deliver clear images. As more data throughput is required, better antennas may be needed—consider multiple antennas or MiMo antennas to optimize data speed. USB Type-C connectors and high-speed board-to-board connectors can offer reliable signal integrity and excellent signal speed, transferring data at up to 10 Gbps data speeds and beyond.

TE has developed free height board-to-board connectors capable of 32 Gbps and higher speeds that can deliver higher reliability through a strong plug/receptacle mechanical design, often maintaining the same performance when de-mated up to 0.5mm.

Miniaturization

Outdoor surveillance devices often need to be small so as not to stand out in their environment. In addition, there may need to be quite a bit of functionality designed into that small space, so miniaturized components can be key. Some design considerations can include small centerline or pitch spacing, lower profile heights and lighter interconnect solutions. Many of these components, of course, normally must also be ruggedized and/or sealed to function optimally in extreme weather, temperatures and humidity.

There are many miniaturized components designed for tight spaces, high data speeds and many for harsh environments, such as:

- SMA/SSMA and micro coax cables and connectors
- AMP CT, AMP Mini CT and AMP Micro CT interconnects
- FPC connectors
- .5mm, .6mm, .8mm and 1mm free height connectors
- Mobile battery connectors
- USB Type-C connectors
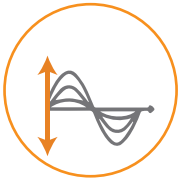
Signal Integrity

Especially in most smart surveillance devices used for crime detection and prevention, throughput and signal integrity are often key. Poor throughput can reduce bandwidth and compromises data and video output, such as blurry images in video or facial recognition. "Oftentimes, the importance of antennas and their proper implementation is well underestimated," said Rickard Barrefelt, field application engineering manager at TE. "When dealing with an outdoor environment with many other connected devices and a multitude of interference possibilities, antenna design and signal integrity play a significant role in the device's performance—design and placement can be critical to cut through the noise."

Spring fingers help prevent EMI noise and static, can provide a highly reliable connection and a cost-effective solution for antenna feeds as well as allow versatility in design because of the limited space they take up. Board-level shielding can be used to isolate board level components, which can help reduce EMI susceptibility and minimize crosstalk without impacting system speed. One-piece and two-piece board-level shields can be useful for thinner devices with multiple antennas, higher data rates and increased operating frequencies.

Wireless Connectivity

Wireless connectivity outdoors has often presented certain challenges with multiple sources of potential interference and signal blocking. Tall buildings, landmarks and weather, for example, can all influence connectivity and integrity of the network. As engineers across industries design in more wireless communications technologies for advanced functionality, the complexity of the communications environment and the likelihood of radio interference normally increases.

With its speed, reliability and device density connection capability, 5G technology can be the cornerstone of the smart device ecosystem as it can provide interoperability and capability for end-to-end solutions like never before. Preventing interference from outdoor elements and from other device components maybe key, which also means the choice of antenna can be critical to a device's reliability and function.

TE's broad range of antenna types include standard antennas and custom antennas which can be used in a wide variety of IoT, industrial, transportation, energy management, smart environment, consumer and medical applications. Our antenna solutions can provide high-quality transmissions in wireless devices in a wide variety of frequencies including, but not limited to 5G, LTE, Cat-M, NB-IoT, GNSS, Wi-Fi, Bluetooth, V2X, ISM and LPWAN bands. We operate antenna design and manufacturing facilities worldwide, with implementation support and testing capabilities in active and passive antenna performance, near and far field patterns, efficiency optimization, throughput optimization, scattering parameters, environmental testing, acoustic and industry compliance. "As antennas are commonly embedded as part of the device and, in turn, the entire device essentially can become part of the antenna, antennas should not be seen as individual passive components," said Barrefelt. "Proper implementation can be critical for the device's overall success, so in my opinion the antenna must be considered from the start of the concept and design process."

Modular Design

Today's engineering designs often require high performance, signal integrity, electromagnetic compatibility (EMC) compliance and high-speed data transfer with power and signal connections. Connectors commonly have smaller profiles to use less space, are lighter in weight and often have to withstand varying environmental conditions. The right interconnects can help design engineers adapt and be flexible to continually push the boundaries of design, allowing engineers to address tough design specs without compromising on connection reliability.

Low-profile flexible printed circuit (FPC) connectors, like our dual-contact FPC connector and others from TE, can give designers flexibility and space-saving capability to include more technology into smaller spaces. Our lightweight FPC connectors can be useful where small centerline spacing makes larger wire-to-board interconnects impractical. In addition, many applications require connectors that can provide reliability such as latching features along with gold plating for more precision and accuracy.

For example, durable high-performance interconnects offer versatility with vertical and horizontal (right angle) connector mounting as well as square-peg technology which can enable mating with many other like products in the industry. TE's wire-to-board HPI connector systems can offer low-profile versions with a locking feature that can provide a secure connection between the plug assembly and the receptacle for reliable wire-to-board signals or low-power connections. There are also gold plating options that help protect against erosion in harsh environment applications.

FROM 5G CONNECTIVITY TO SENSORS TO DURABILITY – TE CONNECTIVITY (TE) CAN ADDRESS YOUR DESIGN NEEDS

TE understands the challenges inherent in IoT applications, especially in harsh environments. When designing smart outdoor surveillance products, our engineers have vast experience at identifying the right products to address your design and manufacturing needs. As 5G continues to rollout and cities look for ways to improve infrastructure, safety and quality of living, taking a holistic view of how components and the end devices potentially could work together and what that means for design is becoming more and more important.

TE's experience across multiple business areas and industries combined with our sensors and data connectivity expertise offers customers a broader product portfolio and knowledge base to draw from to better optimize their designs. We know that performance is important, but so is manufacturability and we keep innovating to make products that are more durable, higher performing and easier to manufacture in high quantity.

With our combination of antenna, sensor, connectivity and harsh environment expertise, TE can provide an ideal combination of technical expertise with industry understanding to address smart city and smart surveillance requirements. Take advantage of this growing smart city trend with a partner committed to helping you win in your markets.

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