Safe Cities: A Revolution Driven by New ICT

Introduction

For the first time in history, there are more people living in urban areas than in rural areas. Moreover, this migration is set to continue as cities offer better employment, improved living standards and financial prosperity. However, prosperity comes at a cost. Urbanization is putting pressure on the infrastructure, resources and security of cities around the world pushing leaders to invest in solutions to combat these challenges.

The Internet of Things (IoT) is driving a revolution in how cities are organized. Cities are leveraging integrated information and communications technology (ICT) to help solve problems with transportation, energy supply, social infrastructure, economic stability, physical infrastructure and security.

Security and Safety form the basis of the Safe City concept and can be defined as follows:

"A safe city integrates more than one type of security-related information onto a consolidated IT platform. The consolidated IT platform is able to combine public-safety information obtained through video surveillance and other security-related sensors, sometimes with additional city-specific information related to infrastructure. The aim of the consolidated IT platform is to provide situational awareness to the various stakeholders."

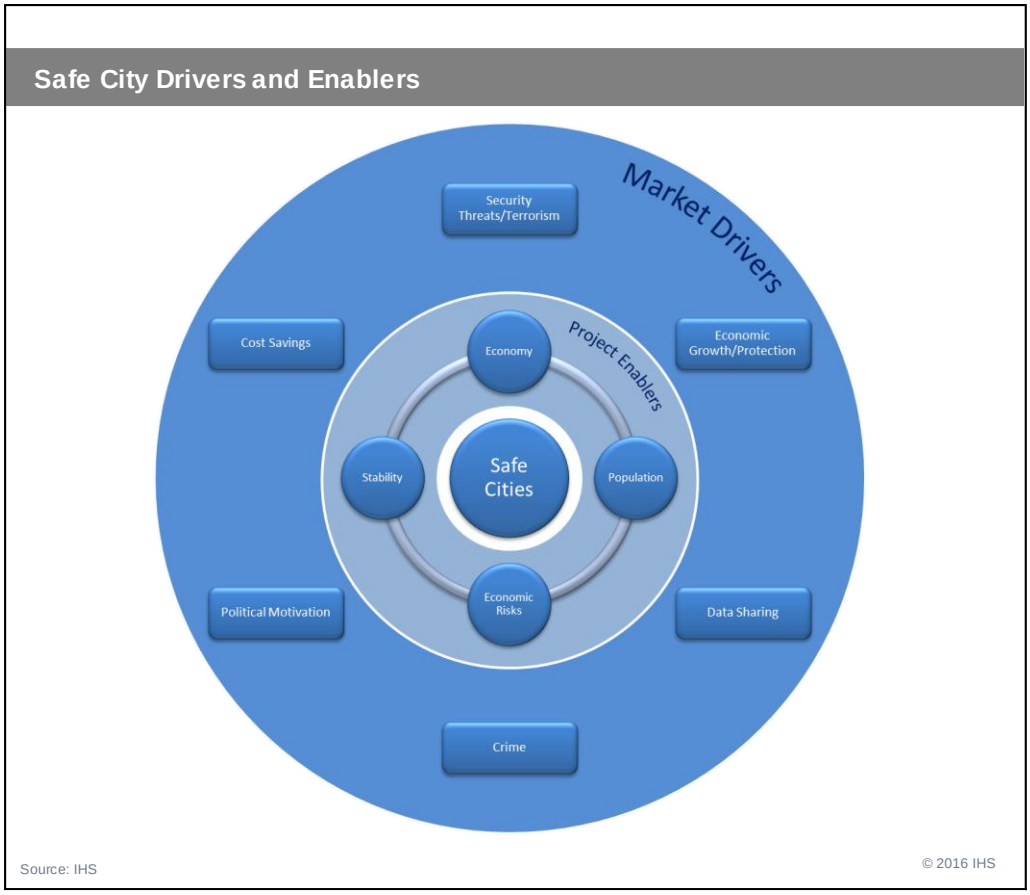
Market Drivers and Project Enablers

The risks that modern cities face range from high impact-low probability threats such as terrorism and natural disasters, to low impact-high probability scenarios such as petty crime. In the modern climate there is a clear need to protect public spaces from terrorist and lone-wolf attacks. Terrorist attacks have devastating consequences and are difficult to identify with traditional physical security systems. Consequently, data and intelligence sharing along with new techniques, such as social media analysis, could be a game changer for public safety.

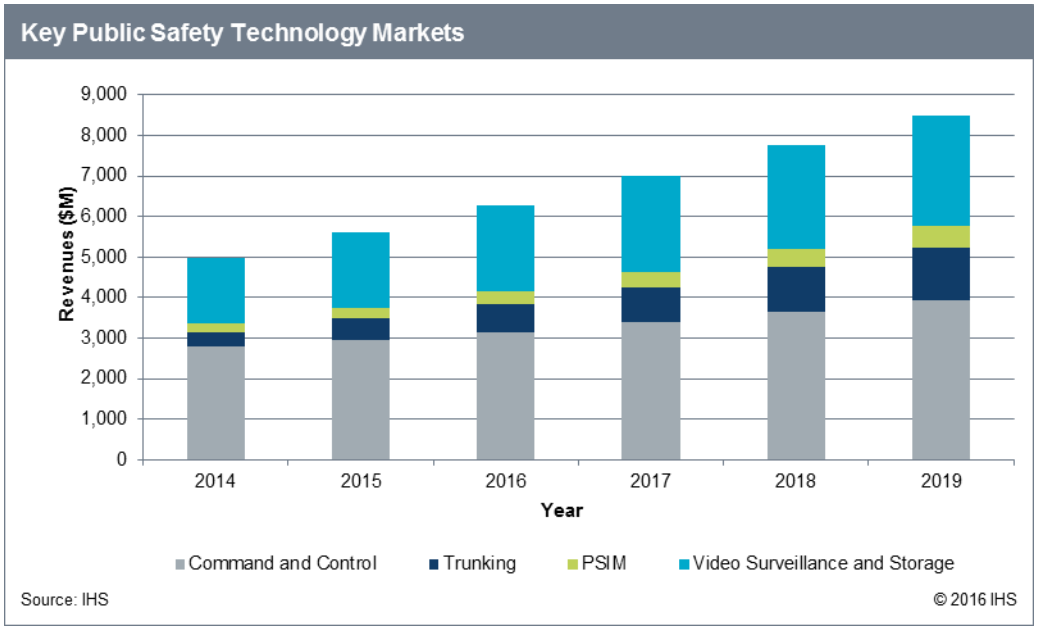
Safe cities can also use communication technologies to provide early warning and facilitate clear action planning in the event of a natural disaster: saving lives and reducing the economic impact of these events. In addition, crime prevention is huge driver for public safety systems, protecting citizens from the effects of crime and improving the general well-being of the city's inhabitants. As criminals and terrorists change their behavior, new and innovative technology solutions are required to protect cities from these actions.

Political motivation is another driver of Safe City projects. Improving the perceived safety of a city is a vote winner as well as a catalyst to drive economic growth and job creation. There is also an opportunity to leverage big data as these projects pull together inputs from an array of sensors in the IoT.

The implementation of a Safe City project is often the combination of one of these market drivers and the ability of the city to implement or fund the project. Consequently, project enablers are important in making these projects happen. Enablers include economic prosperity, population growth, and stability.



Governments around the world are highly motivated to protect their citizens from threats to their security and safety. More than $5.5 billion was spent on public safety solutions such as command and control, trunking, PSIM (Physical Security Information Management), video surveillance and storage equipment in 2015. This investment is forecast to increase to over $8 billion by 2019.



Technology, Connectivity and the IoT

A safe city project is primarily focused on the security of the city's property and assets, the safety of its citizens and visitors, and its emergency-service operations. Safe cities involve collaboration between government agencies, corporate enterprises and, in some instances, the citizens that work and live in the city. Connectivity and technology are at the core of these projects. The safe city concept can be broadly viewed from a security, safety or operations viewpoint as each has in large part distinct associated technologies.

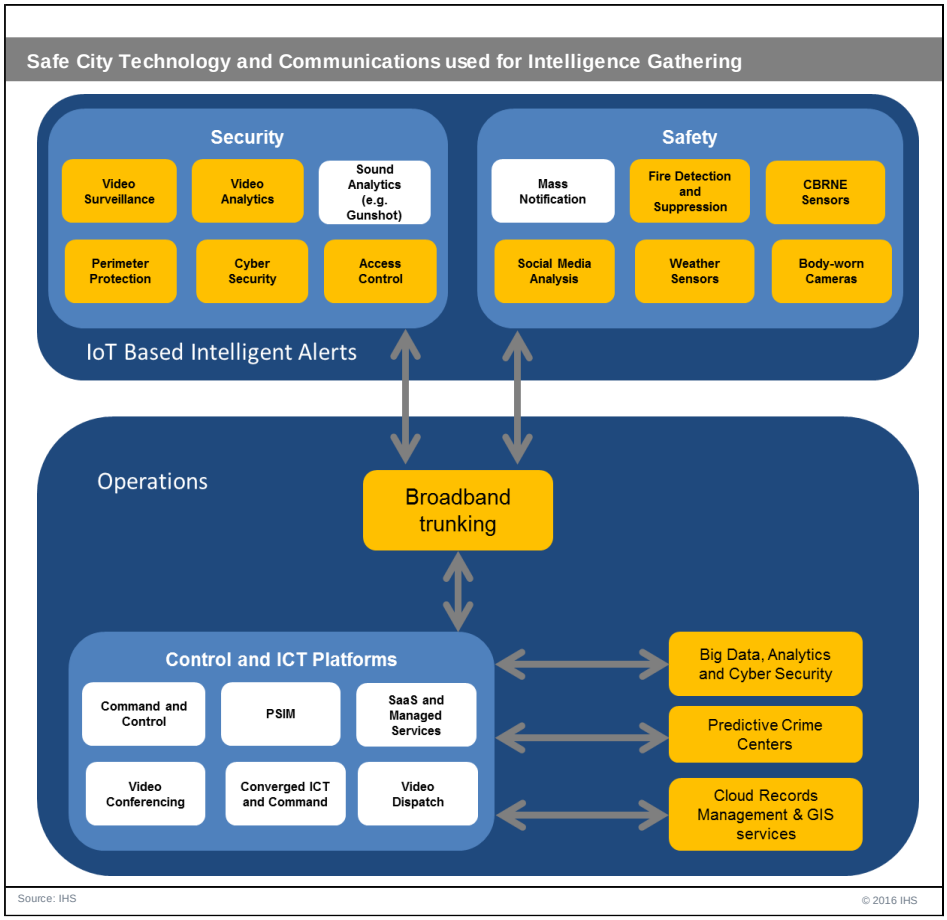
The internet of things will have a significant impact on the Safe Cities of the future. Near ubiquitous connectivity and inexpensive processing and sensor solutions means new connected devices and services can be integrated into the city's control solution using converged communication technology and advanced ICT platforms. New inputs - anything from social media analysis to gunshot detection - can communicate directly to the command and control and PSIM platforms, creating the potential for big data and analytics to help cities make more informed, and ultimately better, decisions in real-time. Moreover, a consolidated IT and technology platform allows cities to optimize their budgets and integrate technologies into an efficient and reliable solution: a solution that increases situational awareness.

Safe City projects typically provide the following functionality:

- **Intelligence gathering:** to provide reliable and comprehensive security measures to detect threats and hazardous situations.

Before an event, sensor systems in the city will proactively gather intelligence. This is driven by the connectivity inherent in the Internet of Things (IoT). These sensors may include video surveillance cameras, CBRNE sensors, audio and video analytics, and weather sensors. Identification technologies, such as face recognition and license plate recognition (LPR), are also important in the intelligence gathering process as they can help authorities in recognizing suspect people and vehicles. The type of sensor used is determined by the scope of the safe city project and how much interoperability is required. Intelligence can be used to prevent a particular threat or situation from occurring and is the most difficult element of a Safe City.

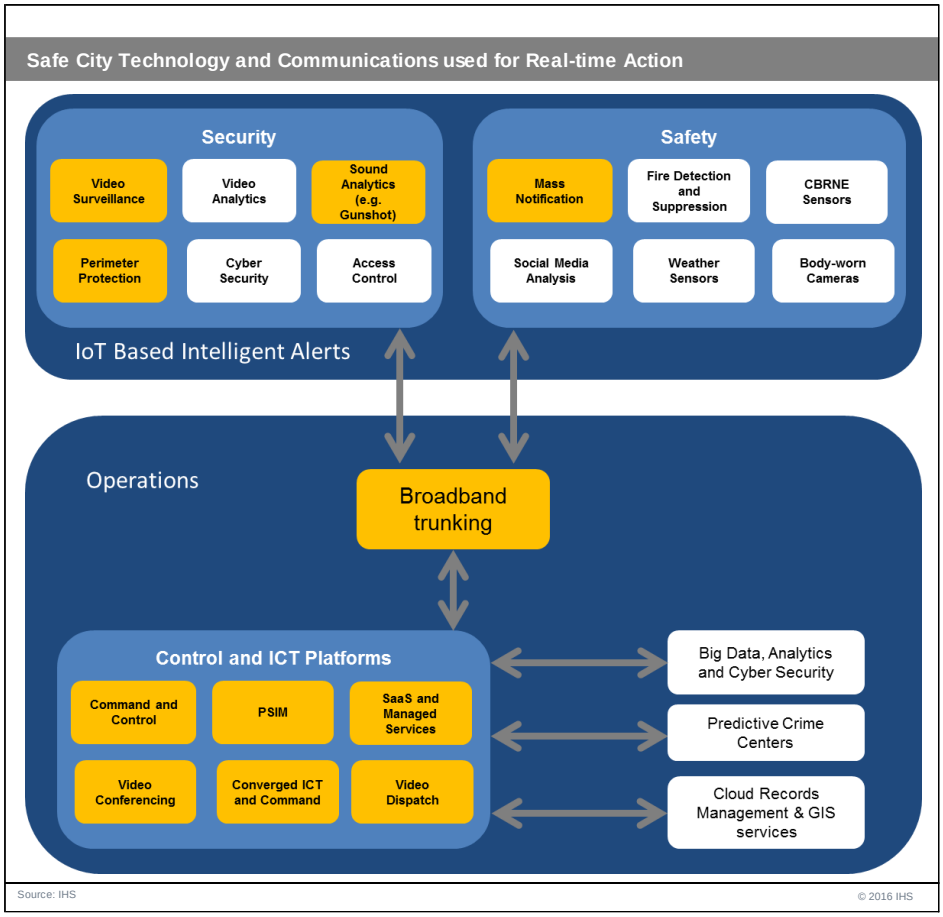
The intelligence gathering phase is well suited to big data solutions which analyze numerous inputs from the IoT sensors in the Safe City. Sensor fusion is a concept whereby patterns are recognized from analyzing multiple inputs at one time. This can help identify a threat that might not have been identified by just looking at each individual sensor and is one example of the predictive crime center. Cloud architectures can support these technology solutions by providing the networking and necessary processing power.



- **Real-time action**: to provide a common operational picture, raise situational awareness and enable cities to identify and react to security threats in real time.

City authorities must be able to quickly identify a hostile event and prevent it from escalating. A safe city project enables effective response by using the consolidated IT platform to provide a common operational picture to all relevant agencies, including law enforcement and fire and ambulance services, which also helps to raise the situational awareness for each of the responding agencies. Each agency has operating procedures in place, allowing for an effective response.

To support real-time action, converged command systems can provide operators with easy access to the various command and control systems in one user interface. Computer aided dispatch, video dispatch, geographical information systems and information/data sharing can vastly improve the operator's situational awareness as well as the city's ability to react quickly and effectively.

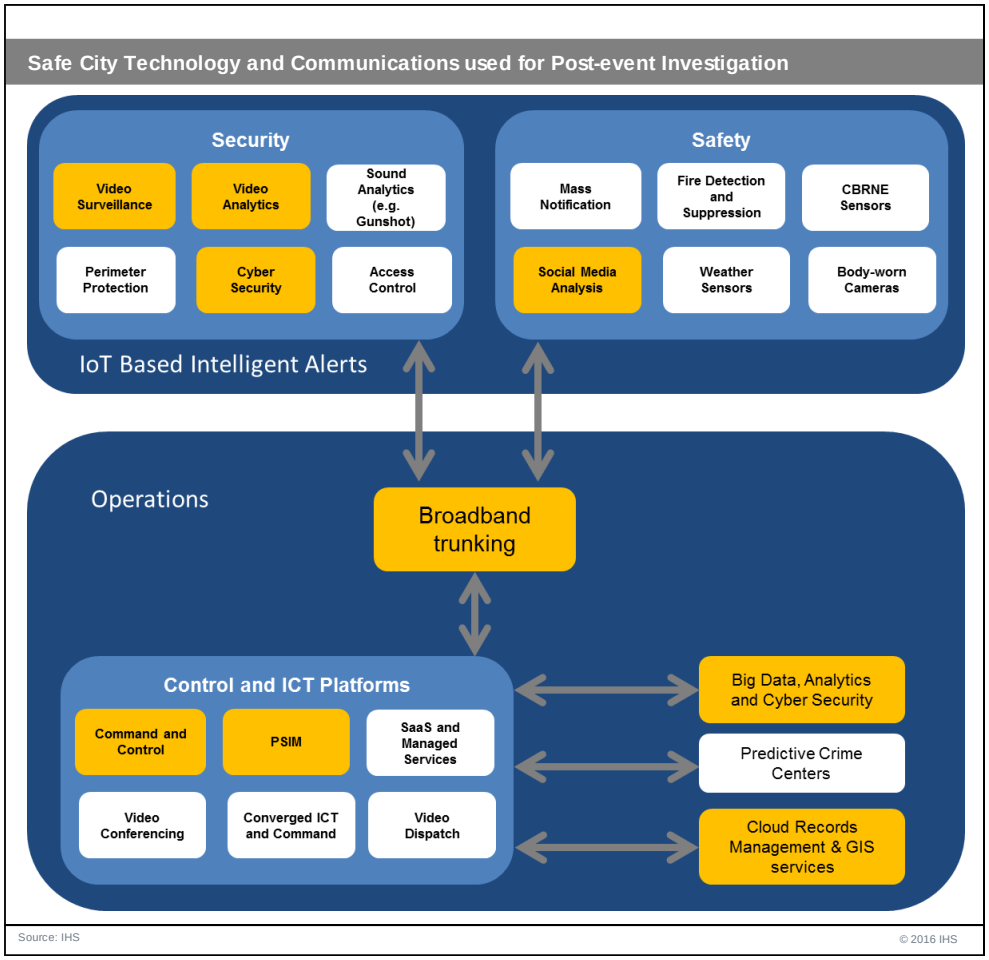


- **Post event Investigation:** to support post-event examination and analysis.

After an event, city authorities must be able to quickly examine and analyze all data received from relevant sensor systems as this helps speed up the investigation and subsequent search for suspects as well as begin the process of building a case based on incriminating evidence.

Video analytics solutions are increasingly providing metadata search functionality. This allows the user to quickly find video that features the searched for object: for example a red car or person with a blue backpack. Big data is another powerful post event tool, helping to correlate the sensor inputs and identify patterns to quickly make decisions on what happened.

The cloud is providing an alternative infrastructure and the required processing power for both video analytics and big data applications. It also provides a solution for video storage, especially in the case of body-worn cameras where legacy systems are not in place. A further benefit of cloud networks is that they can support larger scale in terms of concurrent users of the safe city's systems; something which can save time in a post event investigation.



While each of the technologies mentioned plays a part in a Safe City, the primary sensors (video surveillance and video analytics), control systems (command and control and PSIM) and network infrastructure (LTE/trunking) are pivotal in driving the evolution of the market.

Video surveillance and video analytics

Safe cities use a network of video surveillance cameras to protect city locations, such as parks, streets, car parks, and other public areas. Video images are crucial in providing evidence following events such as a terrorist or lone-wolf attack, petty theft, graffiti or shoplifting. Video surveillance also plays a part in a city's response solution, providing live information that police and other city agencies can use to make real-time decisions.

Video analytics add intelligence to this visibility. Video content analysis (VCA) algorithms are used to detect, classify and track predefined objects and behavior patterns. They can help automate the monitoring process, removing the burden solely from the city surveillance operator, who is liable to fatigue over long monitoring periods increasing the chance that an event will be missed. Video analytics can be particularly effective in identifying events as they happen and extracting information or event data from recorded video.

Historically, the video analytics market has been damaged by over-selling of the technology's accuracy. This is changing, slowly. The market is beginning to embrace new algorithms that more reliably track people, identify objects and mitigate changeable weather conditions. As technology

vendors improve the next generation of analytics, cities will start to look at technology ranging from face recognition algorithms to smarter analytics that learn and improve over time. They will also start to combine analytics with audio and social media analysis to make smarter decisions.

Command and Control

Command and control room systems are at the heart of any safe city project. A safe city integrates all security-related information onto a consolidated IT platform. This platform may be an advanced video-management software (VMS) solution, PSIM software solution, or command and control software. Command and control software can integrate technologies such as:

- ***Computer-aided dispatch (CAD*)** technology is used to dispatch resources and track incidents. CAD software typically uses a database containing street addresses and a list of units (police, ambulance and fire response teams) that can respond to an alarm at a given location. CAD is usually integrated with other technologies within a command and control solution.
- ***Call-taking software*** allows public safety answering points (PSAPs) to manage the first step of emergency response – answering the incoming call. The software can be combined with CAD to create a more effective solution by providing access to various sources of information through an organized user interface.
- ***Geographic-information systems (GIS***) use layers of geographical data to build a comprehensive mapping system. They are developed to support geographical inquiry and decision making. A GIS gathers data from a wide range of sources, unifying complex spatial information with descriptive information and allowing users to organize, analyze and view selected data easily.
- ***Records management software*** allows the control room to keep an accurate record of previous events and forms generated from previous calls. This can interface with the CAD system and allows the dispatcher to easily access information on previous incidents at addresses.
- ***Video dispatch*** allows the operator to video conference to one user, group of users, or all users via a console attached to the command and control system at the dispatch center. It also allows coordination and real-time data to be relayed back to the control room from teams responding at the scene. Providing reliable, high-quality audio and visual communication between all emergency personnel is essential to enable command and control.

Another important trend in the command and control system is convergence. Integrating the command and control solution with all of the other sensors and data sets in a safe city means the operator's situational awareness is enhanced and they can more successful respond to an event.

Trunking

Long term Evolution (LTE) or trunking provides the primary communication network for a Safe City. In addition, police, firefighters and emergency medical service personnel rely on their land mobile radio (LMR) networks for mission-critical voice connectivity.

As the Safe City concept evolves, control room operators are increasingly dealing with large amounts of new data. Private LTE networks can provide the capability to stream this data and can alter the

way in which first responders receive the information in the field. In some countries, private LTE networks for public safety are making rapid advances. In particular, the United States is leading the way with the deployment of FirstNet.

FirstNet is a high-speed broadband data network dedicated to public safety. It provides emergency service providers with a high-speed network using a nationwide spectrum license to provide a single platform for daily public safety communications. FirstNet was built to public-safety grade standards using Long-term Evolution wireless technology with the aim of delivering greater coverage, capacity, connectivity, cybersecurity and resilience than the current multiplicity of diverse public safety wireless systems.

In Europe, authorities need to establish a spectrum dedicated for private LTE. This is challenging and expensive. However, there has been progress recently in countries such as the UK and France. Realistically, the impact from private LTE rollouts will take time but the evolution of the Safe City will drive the need for these dedicated high-speed networks.

Big Data and the Predictive Crime Center

The uptake of digital recording, evidence management and statistical reporting from control rooms has resulted in an increase in the deployment of 'predictive crime centers'. Although examples are isolated, rollouts in many countries are, in the long term, hoping to use data to curb crime rates.

Big data will play an important role in the future of the safe city. Video surveillance, mobile devices, and social media will generate vast amounts of data that command and control centers will need to interpret, analyze and action in conjunction with incident histories and response policies. The control room is where this data will converge.

This trend will change the way dispatchers and operators manage emergencies and dispatch assistance and will result in more statistical output from the control room. It will be essential to design CAD platforms to facilitate the flow of information from both the caller and first responder. In response, there has already been an increase in the number of CAD tenders including a wide range of analytical capabilities and smart applications. This is evidenced by suppliers looking toward solutions which will stream inputs from body-worn cameras straight through to the control room.

Situational awareness and a user defined operating picture have become increasingly important as users look toward more focused data. The challenge within the GIS/Analytics market is the training gap, which suppliers are addressing through thought leadership conferences and robust training programs. There is a strong need for training with regard to these solutions as their capabilities have expanded dramatically. The most successful suppliers have included training programs with their platforms to ensure clients can work as efficiently as possible.

One consequence of the trend to big data is an overflow of information routed to dispatchers. It is likely that even in the most developed regions with established emergency response facilities, increases in staffing levels will be required to cope with the increasing information and evolving emergency response processes in a command center. Fundamentally, analytics and big data will transform the safe city command center from a reactive hub to a predictive crime center.

Cloud in the Safe City

Managed or SaaS (Software as a Service) solutions provide an alternative to the fixed systems commonly installed in Safe City projects. In cloud architectures, software, applications, hardware, and storage are provided to users as services. Rather than committing upfront to a fixed cost, billing for these services is done on a periodic basis based on usage rates. Consequently, usage on a cloud network is designed to be scalable, rapidly elastic, and require minimal management, allowing increasing demand to be met dynamically. Data stored in the cloud also can be accessed anywhere and shared seamlessly with other qualified users, and at much larger scale, at any time, across multiple devices.

One of the factors hindering adoption of safe city projects is financing. Cloud-based technology has the potential to alter the way safe city projects are funded by changing the projects from a capital expenditure to an operational expenditure. Operational expenditures typically cover the day-to-day costs of running a city and include rent, payroll, utility bills, and maintenance. Two benefits of an operational expenditure model versus a capital expenditure model are that cities can deploy safe city projects in a more incremental fashion and there is no long-term commitment. Another benefit of the shift to operational expenditures that cloud-based technology provides is that it shifts the responsibility and risk away from the city itself and on to the provider of the technology.

While Cities have been slow to adopt cloud technology in Safe City installations around the world, regions such as China have led the way in showing how cloud can be implemented as a scalable affordable alternative to traditional security and safety deployments. Safe cities could leverage solutions such as video surveillance as a service (VSaaS), deploying hundreds of cameras without the capital outlay. Similarly, GIS as a service can provide command and control functionality as a cloud service which could benefit the command centers of cities in the future. In the future, records management solutions will also leverage the cloud.

Market Drivers for Safe Cities

The Safe City market is driven by different challenges and requirements depending on the country and region. The following figure provides a representation of the regional differences.

Safe City Market drivers by Region

	Middle East	Latin America	North America	Europe	Asia Pacific
Security Threats/Terrorism	■		■	■	■
Economic Growth/Protection	■	■	■		■
Data sharing	■			■	■
Crime		■	■		
Political Motivation					■
Cost Savings				■	

Source: IHS

Middle East

Terrorism remains a significant threat in the Middle East. In response, the region has been quick to adopt the latest technology, such as facial-recognition and license plate recognition (LPR). These solutions often go beyond standard LPR and into the realms of video analytics, recognizing the vehicle type, make, model, and color.

Data sharing has also become an important issue for many of the cities in this region as the authorities try to interconnect security systems to achieve mass surveillance. The requirement for mass surveillance typically involves bringing the data into a control center and has resulted in successful PSIM deployments. A third driver of safe city projects in the region is the need to foster economic growth. Safer cities can attract foreign investment and help diversify the economies of Middle Eastern countries which have significant oil dependence.

Latin America:

Relative to other regions, Latin America has been slow to adopt city-wide video surveillance systems. As the major cities in the region catch-up, they are deploying network-based systems.

The threat of terrorism is not a primary driver for safe city projects in Latin America. However, crime is a major issue in many of the largest cities, whether organized crime, as is prevalent in Mexico, or petty theft, which is prevalent in Brazil. A primary objective of safe city projects is therefore to combat these crimes.

Another reason for safe city projects in this region is to foster economic growth. In many Latin American cities, there are informal settlements, some very large, which pose a challenge for public safety and security. The crime rate is above average in these informal settlements. Furthermore, natural events, including earthquakes and, more frequently, landslides have to be dealt with. Thousands of people die each year in Rio de Janeiro, Brazil, and La Paz, Bolivia because they have no access to prior warning of these events. Cities which experience these natural disasters have an incentive to protect themselves and their citizens.

North America

Most safe city projects in North America are in the United States and are federally funded and driven by counterterrorism. Funding for safe city projects is highly focused on counterterrorism, to the extent that the technologies chosen are often specific to counterterrorism measures. Examples include video analytics to identify abandoned packages and chemical and biological sensors.

These technologies do not protect against other activity, for example organized crime and gang warfare, and they do not directly foster economic growth. Larger cities using federal funding for safe city projects are concerned not only with their citizens and assets, but also in protecting the visitors that these cities attract.

There is interest from some smaller cities in the public-safety and law-enforcement aims of safe city projects. These projects will not typically use high-end technology. Their aim will be to decrease organized crime and gang activity and improve response times for both emergency and non-emergency services.

Europe

The primary driver for safe city projects in Europe is the desire to share data between agencies to proactively protect a city. European cities want to centralize their data into a command center which is then used as an operations center for the various stakeholder agencies in a city. These projects are generally not focused on using the most advanced technology available, but instead focus on integration and connectivity.

The desire to share data is driven by factors including budget cuts affecting staffing levels, the requirement to improve counterterrorism operations, and the need to improve policing and crowd-management operations. The desire to improve counterterrorism operations is important. Recent terrorist attacks have highlighted the challenges in protecting city center locations as well as the need for a common operational picture and the ability to identify and act in real time to these threats.

Asia-Pacific

Asia-Pacific is a large, geographically diverse market with many cities at different stages of development. Developed countries, including Australia, Japan and New Zealand, have mature cities which are facing vastly different challenges than cities in developing countries such as China, India, and Pakistan.

In the developed markets safe city projects follow similar drivers to Europe with a focus on data sharing to improve emergency service responses and counterterrorism operations. In developing countries, safe city projects are driven by economic growth, data sharing, and political considerations.

India's approach to safe city projects is similar to the approach taken in the Middle East – the focus is on automating the systems currently in place. Safe city projects tend to be focused on aggregating data and projects present big data problems. In China, political considerations are an important driver for safe city projects with city leaders ensuring that their city is protected as outlined in China's five year plan.

Conclusion

The Safe City represents the future of urban security and safety. A future built on data, connectivity and interoperability. Cities are looking towards smarter solutions to meet the challenges created by an ever increasing population. Key to this is providing more efficient emergency response services and quicker threat mitigation processes, ensuring public safety.

- **Video surveillance, LTE and command and control solutions** are the backbone of the Safe City, representing the main sensor, network and control system, respectively. These technologies are critical in driving the adoption of Safe Cities.
- **The IoT is an important trend** driving an increase in the number of sensors generating data and the importance of ICT technology and converged communications in managing this information. Cloud services and big data will also play a part in the Safe City market.
- **Safe Cities vary by country and region;** however, the key market drivers can be summarized by the following: security threats, economic growth, data sharing, crime, political motivation and cost savings. Project enablers are also critical in delivering and funding Safe City projects.