Busan Leverages IoE Connections to Improve Public Safety and Security

EXECUTIVE SUMMARY

Objective

- Enable centralized management of risks due to natural disasters and urban crime
- Monitor tunnel and road hazards, and alert the public of traffic conditions

Strategy

- Use the city's high-speed broadband network as a platform for eight distinct public safety initiatives

Solution

- Integrated fiber-optic network with 10-Gbps broadband capability
- Wired and wireless sensor and video networks monitor the public infrastructure for air quality, road conditions, fissures, fires, flooding, and other hazards
- High-definition video monitoring for crime prevention in risk-prone areas
- Remote medical care for patients in ambulances

Impact

- More efficient traffic management; reduced loss of life and property from natural disasters; improvements in air quality and patient care
- Comprehensive citizen alert system enables the public to better prepare for and cope with natural disasters, traffic, and fires in tunnels, underground markets, and other public places

Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

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About Busan's U-City Safety & Security Initiative

Busan Metropolitan City is South Korea's second-largest city and home to the fifth-largest port in the world. The Busan government has invested in a widespread high-speed broadband infrastructure — and in a broad combination of "U-City" initiatives based on the idea of *ubiquity* supported by *information technology* ("U-IT") to enable the exchange of information anywhere, anytime.

Busan's U-City Safety & Security initiative is a wide-ranging effort to monitor and collect data relating to city safety issues. Officials use the data to make preemptive decisions and to keep citizens informed. U-City Safety & Security encompasses eight main programs focused on natural disaster monitoring and alerting, traffic and transit efficiency, infrastructure, and crime prevention. Each program involves different governmental and ministry partners, although some are solely funded and operated by Busan Metropolitan City.

Kim Gwang Hoi is Busan Metropolitan City's strategy and finance officer. He oversees the Busan U-City Safety & Security initiative.

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Objective

The 2004 South Asian tsunami and a 2005 earthquake off the coast of Japan spurred Busan's desire to implement technology-based safety and readiness measures. The city built a network to enable centralized management of risks from natural disasters and urban crime, and in 2007 established a warning system for earthquakes and tsunamis.

At a basic level, this warning system analyzes forecasts and provides alerts to the public. To facilitate the systematic collection and sharing of data in emergencies, Busan's system utilizes cutting-edge video, high-speed Internet, sensors, and closed-circuit television (CCTV) technology. Through a combination of initiatives, Busan can disseminate information about a situation, enable quick and appropriate response, and minimize loss of property and life.

While natural disasters occur rather infrequently, traffic-related dangers can occur daily. So Busan also created a monitoring and alert system for the city's tunnels. "Busan has many tunnels: if an accident happens in one and traffic begins to back up, it quickly becomes a safety matter," Mr. Kim explained. So we built a platform for integrating the security infrastructure with the warning systems and CCTVs we had already set up to monitor tunnel collapse and creek flooding."

As the city tackled issues surrounding natural disasters and traffic safety, it became apparent that other areas could also benefit from centralized, smart management.

Strategy

In 2007, Busan laid 1,278 kilometers of fiber-optic cable capable of handling large information flows. Previously, the city had relied on the services of a major local telecommunications company, but the network speed was slow and the service expensive. By using its own network, the city now has the capacity to monitor multiple elements, and to operate application services that push information to users' devices for free.

The Busan U-City Safety & Security programs comprise eight initiatives that utilize technology to collect and disseminate safety data for the citizenry:

- **U-City Safety System Strategy** and U-IT-based smart service systems are disaster management models that work with departments responsible for disaster relief. This initiative includes intermediate and long-term disaster management plans for the overall system. One example is the use of mobile video-conferencing technology in ambulances, which enables doctors to communicate with emergency responders in the vehicle. It was completed in 2007.

- The **Earthquake and Tsunami Forecast and Warning System** issues real-time earthquake-related tsunami warnings. It works in conjunction with the civil defense warning system by connecting 42 warning terminals and seven CCTVs at strategic areas along the coastline. It was built from 2005 to 2007 with funds from both Busan City and the central Korean government.

- The **Integrated Platform for U-Safety Infrastructure** enables central management of disasters across Busan and is a joint project with the Ministry of Land, Infrastructure and Transport. A Central Disaster Management Center has real-time monitoring capabilities of three pump stations, a wireless infrastructure net comprised of 21 CCTVs, and 15 wireless transmission stations. The Busan City Disaster Safety application provides disaster, weather, and traffic-related information to the public. This system was built from 2007-2009, and was jointly funded by the central and city governments.

- The **Ubiquitous Sensor Network (USN)-Based Tunnel Monitoring System** monitors tunnel interiors and ensures prompt responses to hazards. A total of 79 sensors and four electronic displays operate in the Mahn-deok and Gu-deok tunnels. A wireless system allows the city to monitor for hazards, control traffic, and respond quickly to emergency situations. This is a joint project of the Ministry of Information and Communication and the Busan Infrastructure Corporation, built from 2007 to 2009.

- The **U-IT-Based City Facilities Safety Model,** a joint project with the Ministry of Security and Public Administration, uses CCTVs to collect information and monitor traffic along the city expressway. Completed in 2011, it also has a sensor system that detects traffic flow and road conditions. In the Nampo and Gwangbok underground marketplace, CCTVs detect fires and other facility safety issues, and sensors measure indoor air quality.

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- The **U-Safety Flood Forecast System** uses video monitoring in five locations to collect and analyze rainfall volume and water level data. Information is then disseminated to the public through the Busan City Disaster Safety application, which is available on any Internet-enabled device. "So many people have built their homes along the banks of the Nak-dong and Soo-yeong Rivers, which have become heavily occupied residential areas," explained Mr. Kim. "Our first priority was to manage these two riversides, and we have so far successfully avoided damage when flooding has occurred." Built in 2012, the project was jointly funded by Busan and the Ministry of Land, Infrastructure and Transport.

- The **Security CCTV System** was installed to monitor criminal activity in child protective areas, city parks, and other high-risk locations. Between 2009 and 2014, nearly 3,000 closed-circuit video monitoring cameras were installed.

- The **Integrated CCTV Control Center** was developed to analyze data collected from video monitoring cameras from different areas and agencies. The data center facilitates prompt response to emergencies, and permits communal use of video resources among agencies.

Busan utilizes a complex integrated network and CCTV monitoring system to facilitate its safety and warning systems. These technologies collect data, analyze it for official purposes, and then transmit relevant information to citizens via the Internet.

As U-IT projects require both substantial up-front investment and research and development, a large portion of the project was funded and sustained by the federal government. Of the 64.7 billion Korean won (US$62.8 million) spent on the combined projects, 27.6 billion won (US$26.7 million) was contributed by the federal government. "The central government was on the same page as our city government about the importance of an integrated approach," Mr. Kim said. "So, financially, the central government budget and city budget were combined to build the system." An annual system maintenance budget equivalent to a certain percentage of the total purchase amount is allotted by the city government.

Solution

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Busan Metropolitan City planned and implemented the project. Although each city agency is responsible for operating its specific part of the program, Busan maintains operational control of program outcomes. Such centralized ownership helps stabilize operations and facilitates remediation if malfunctions occur. Having a unifying umbrella also enables collaboration and data sharing among the different initiatives. An IT firm provides services, maintenance, and advisory support when necessary.

Integrated Network

The network infrastructure consists of 1,278 km of optical-fiber cable, 334 individual pieces of equipment, an integrated network management system, and an integrated security control system. It features transmission speeds of 622 Mbps to 10 Gbps, three 10G backbone networks, 23 2.5G access networks, and 71 server-

accessing networks. "Our security system and transit system collect data via wired and wireless networks," Mr. Kim explained. "We also have a network system for collecting data from sensors and video, and this data is sent to our control centers via the wired network."

CCTV, Sensors, and Monitoring

Busan's U-Safety Flood Forecast System is an onsite monitoring system that manages and collects data from sensors and transmits the data to remote hardware. CCTV records images that are then sent to video servers for data storage and transmission. An IP network facilitates long-distance communication between the operating system and onsite monitoring system. There are five total CCTVs in different locations, and information is relayed to citizens via the Disaster Safety application.
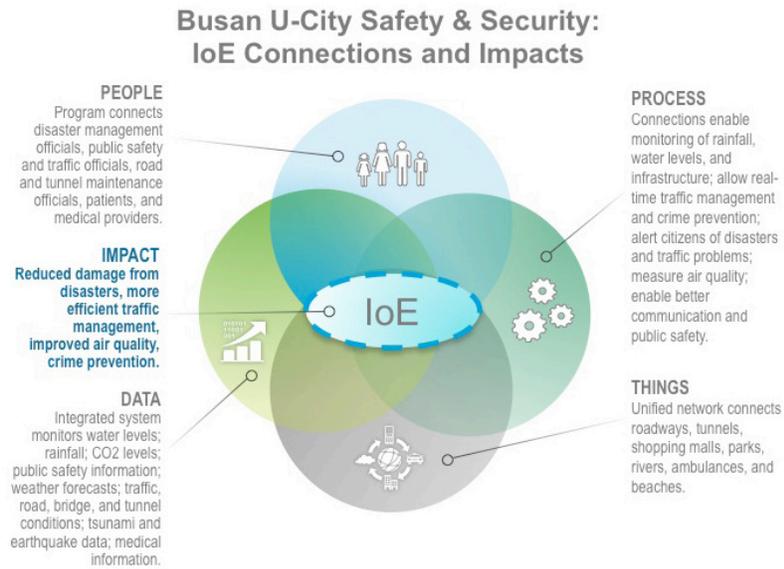
Busan's Integrated Platform for U-Safety Infrastructure provides real-time monitoring of three pump stations, a wireless infrastructure net consisting of 21 CCTVs, and 15 wireless transmission stations. It also manages the Busan City Disaster Safety application, which provides disaster, weather, and traffic-related information to the public.

The Ubiquitous Sensor Network Tunnel Monitoring System uses 10 types of sensors to monitor vibrations and structural deformations in the tunnels. It employs a wireless monitoring system to analyze collected data for illumination, air quality, and the presence of smoke and/or fissures in the structure. Four electronic displays relay information to commuters.

The U-IT-Based City Facilities Safety Model has two CCTVs, along with a sensor system to detect traffic flow, speed, roadbed conditions, and fissures. At the Nampo and Gwangbok underground marketplace, CCTVs and automated indoor air quality sensors monitor facilities to ensure safe management. Two electronic displays relay traffic information to the public.

The Security CCTV System was created using the IPv6-based Busan Information Highway, the city's 10-GB broadband infrastructure. The network includes optic converters and L3 switches to allow rapid high-definition video monitoring for the 2,995 CCTVs currently installed. CCTVs consist of cameras, poles, and control boxes.

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Figure 1. Busan: New and Better Connections.

Source: Cisco Consulting Services, 2014

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Reduced Damage

By integrating data and forecasting, the Busan Metropolitan U-City plan can both enable preparation for natural disasters and limit the loss of life and property when disasters occur. The system also predicts areas at high risk for flooding by analyzing weather data and precipitation characteristics.

Efficient Traffic Management

The USN Tunnel Monitoring System allows real-time management of tunnels, enabling traffic management officials to stop inbound traffic and quickly respond to emergency situations. It enables officials to identify traffic congestion situations within one minute, and quickly return traffic conditions to normal. By increasing its efficiency, Busan was able to reduce staff and material costs by 50 percent, and to lower its electrical costs as well.

Disaster Alerts

In the event of a natural disaster such as flooding or earthquake, citizens can receive information and instructions through the Busan City Disaster Safety app and SMS messaging, along with coastal warning sirens.

Information Sharing

The Integrated Platform for U-Safety Infrastructure allows Busan to analyze and respond to situations through centralized management, and to share information among relevant organizations.

Air Quality and Service Improvement

The U-IT-Based City Facilities Safety Model has improved environmental air quality, and expedited response to fire incidents through real-time unified fire monitoring. It also reduced maintenance costs by assisting in the renovation of existing non-functioning hardware.

Crime Prevention

The Security CCTV System helps prevent crime in risk-prone areas. It enables rapid response by transferring data collected from high-definition video monitoring through the Busan Information Highway. The Integrated CCTV Control Center unifies operation and management systems, preventing overlap. It also creates jobs for the regional economy with the hiring of staff for the control centers.

Saving Lives and Improving Health

According to Mr. Kim, Busan's U-Health project (under the U-City Safety System Strategy) has brought the benefits of ubiquitous connectivity to the level of the individual citizen by connecting ambulances with hospitals using telemedicine and sensors for patients' vital statistics. "A patient in an emergency vehicle can be saved by the 'presence' of a remote doctor," he explained. "This program has become very popular among our citizens, and doctors are relieved because they can advise emergency management technicians about what to do, even though they are not present in the emergency vehicle."

According to Mr. Kim, public support for the overall program has not been measured in an official capacity, but the government can measure success based on the applications downloaded and used by citizens, especially with the popular bus and subway schedule apps. "We can measure the citizens' satisfaction with these types of services because they use them every day," he said. "However, disaster service applications have not been used often enough to measure citizen response. Government officials use the system more often because they monitor and announce current information to citizens."

Mr. Kim says that a disaster or flood will be the true test of the system's effectiveness, enabling the city to understand public reception of the disaster applications more clearly. "Citizens have not yet been exposed to extreme dangers, but if a sudden disaster occurs in the future, they will discover how well the system is working," Mr. Kim said. "So far, I think citizens are happy about our service and information delivery."

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Lessons Learned/Next Steps

Busan's biggest challenges with regard to its U-City Safety & Security programs involve maintaining existing sensors and technology, and determining which services are returning the most value for the city and its residents.

Ongoing Maintenance

Smart systems require continued upkeep to deliver return on investment. Some existing carbon monoxide and smoke sensor systems have suffered breakdowns because of the tunnel environment. The particular needs of such environments require continuous attention and support to ensure efficient operation.

Determining Services

"Because it is a complex, time-consuming process," Mr. Kim explained, "our biggest challenge today is defining which systems should be developed first and which services should be offered to citizens." Since multiple systems make up the complex U-City project, Busan often struggles under the sheer weight of data to determine which initiatives provide the best return on investment and citizen benefit. "Due to the complexity of the systems, we have not been able to quantify their efficiency," Mr. Kim laments. "We will keep working on verifying future network needs — learning how they will improve citizens' lives, and how we can retrieve more information from established systems."

Technological Evolution and Governance

According to Mr. Kim, one of the most important lessons Busan learned was how to keep the U-City systems up to date with evolving technologies and methodologies. Many people provided useful input, and Mr. Kim acknowledges, "Our city has been managed more efficiently utilizing new technologies, and we have learned so much in the process. Today we are much more technologically advanced." Each advancement has spurred even further growth. "We have become smarter from the perspective of city management," Mr. Kim elaborated. "Rather than figuring out how to utilize our existing technologies, now we are focused on learning how to create service models in developing technologies."

Busan Metropolitan City officials also learned that laws need to catch up with technology in order for services to be effective. Mr. Kim cited the ability of medical personnel to treat patients remotely — the patient could be at home or in an ambulance — using information from sensors. While the technology has been available for six years, it was only this year that the government amended laws to make remote treatment legal. "A service model can be born from technological evolution and accumulated experiences, but it also needs systematic support from the government, which takes a long time," Mr. Kim said. "Our big-picture plans have not been implemented as fast as we'd hoped, but they will be realized faster in the future."

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Future Plans: Expansion and Information Sharing

With 13 out of 16 city subdivisions and counties already outfitted with Integrated CCTV Control Centers, Busan Metropolitan City plans to complete implementation across the rest by 2017. Busan is also implementing the seventh phase of Security CCTV installation, adding 470 more crime-prevention CCTVs.

To fully realize the potential of the U-City initiative, Busan is releasing all government-owned information to private sector entities for the benefit of citizens. "A well-built service model is critical," Mr. Kim explained. "Several elements factor into building it successfully – supportive government, business entities, engaged users, systematic regulations, adequate funding, and others. Although we are still in an initial stage, we have accumulated several small, successful use cases to build on." Busan plans to improve the service model faster by sharing experiences.

Next Steps: Accessibility and Integration

Perhaps the most complex next step will be to fully integrate all of the systems so they provide automatic warnings and alerts, and deliver key information to applications on any device that can be accessed conveniently by anyone. According to Mr. Kim, "This integrated system should provide all information requested, regardless of location, time, day, established network services, or device."

Along with enhancing accessibility, Busan is looking toward one-stop shopping in the context of data. It is designing an integrated application that will inform citizens about dust in the air, weather, and leisure activities, as well as safety and security. "I don't believe citizens are happy with the safety and security system alone," Mr. Kim explained. "We are trying to establish a comprehensive infrastructure for comprehensive service offerings. Our mission going forward is to create a system that contains all information in one place: a citizen lifestyle application."

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