Connected Living

Mobile Smart City Benchmarking Report

Summary of mobile smart city best practice for partnerships between operators, vendors and government

Contents

The GSMA's Smart Cities initiative and the Mobile World Capital Barcelona

The GSMA Smart Cities initiative works to accelerate the adoption of mobile-based solutions and services to enhance the quality of life in the world's cities and create new business opportunities. For more information, please see: http://www.gsma.com/connectedliving/smart-cities/

The GSMA is also supporting the Mobile World Capital Barcelona, an initiative designed to convert Barcelona into a global mobile technologies leader, a place where individuals, companies and institutions work together to harness the potential of mobile technologies to transform daily life and create new business opportunities.

The Mobile World Capital is designed to be an urban laboratory for new applications that will transform companies and people's lives through the development of an industrial and technological fabric based on the potential of mobility in various areas, including health, the automotive sector, transport, the agro-food industry, mobile payments and leisure.

Mobile World Capital Barcelona rests on four pillars: MWHub and MWCongress, focusing on industrial and business development; and Mobile World Centre and Mobile World Events, which are more focused on the impact of mobile technologies on people's everyday lives.

Mobile World Capital Barcelona is supported by the Ministry of Industry, Energy and Tourism, the Regional Government of Catalonia, the City of Barcelona, Fira Barcelona, and the GSMA. The GSMA, which represents nearly 800 mobile telephony operators around the world and over 200 companies in the mobile ecosystem, appointed Barcelona as the Mobile World Capital for the period from 2012 to 2018.

The Mobile World Capital Barcelona initiative leverages the city's differentiating assets, such as the Barcelona "brand," the fact that it has been successfully hosting the Mobile World Congress, and the strength of strategic sectors, such as health, tourism, smart cities, automobiles and creative industries, among others. In addition, the Mobile World Capital draws upon Barcelona's existing assets, such as its talent and knowledge – universities, research centers and technology parks – and the city's outstanding infrastructure.

Executive Summary

Connected devices, distributed sensors and Internet technologies are enabling cities to capture valuable data, deploy new services and enhance existing services, ushering in the era of smart cities. These services can improve the effectiveness of city management, generate new growth opportunities for local businesses and raise the quality of citizens' lives.

Mobile technologies and services are playing a pivotal role in enabling smart cities around the world. Real-time data from mobile phone networks can underpin key smart city services, such as intelligent traffic management systems and disaster response solutions. Mobile networks can provide very detailed information about where individuals, devices and machines are located, how fast they move from one location to another, how clustered devices are together, and how this data changes over time and in relation to historical patterns.

Designed to highlight best practice in this emerging field, this paper considers how to maximize the potential of mobile technologies and services to improve urban life. Drawing on GSMA case studies covering smart city services in Finland, Germany, Japan, South Korea, Spain and the U.S., the paper identifies the following success factors:

Building productive partnerships: Successful smart cities services are often underpinned by a strong partnership between the local government, one or more telecoms operators and, in many cases, a systems integrator or technology supplier. In several of the smart city programmes tracked by the GSMA, the public sector has helped finance early projects and the city administration has worked with the private sector to reconcile commercial objectives with public policy goals. However, the involvement of too many stakeholders may slow smart city projects down and increase complexity.

Smart and interoperable ICT: Most smart city projects need to harness data from multiple sources, which may change and evolve over time. To meet this requirement, the underlying information and communications technology (ICT) architecture needs to be both flexible and interoperable with existing city ICT systems, as well as a wide range of sensors. If smart city services are to achieve their full potential, the cost and complexity of connecting large numbers of sensors to mobile phone networks may need to fall.

Capture and distribute actionable information: To be really effective, smart city services have to enable citizens and organisations to make well-informed decisions in a timely fashion. As the value of information can fall rapidly, smart city services need to be capable of capturing relevant information in real-time and distributing it in a format that citizens and organisations can act on immediately.

Potential business models: If they are to be sustainable, smart city services need to have an income stream that covers their costs and reflects the value they are delivering. In many cases, the business model may regard smart city ICT as a platform that will become more valuable over time. Once the smart city infrastructure required to capture, process, store and share large volumes of data has been built, it can act as a platform for new business opportunities that use cloud services, data analytics and business intelligence to create new services and applications for consumers and enterprises.

Engaging citizens and developers: To have a major impact, smart city programmes need to engage citizens and app developers in a systematic and sustained way. The potential engagement channels range from apps that enable citizens to flag everyday concerns, such as potholes or vandalism, to asking citizens and app developers to help identify new service concepts and create new projects. City administrations and private companies may need to work together to explain the value of smart city services to citizens and manage end-user expectations: Ensuring the active involvement of citizens requires a creative and committed approach.

Focus on solving specific problems: Today's sophisticated ICT networks can be used to address a wide range of challenges facing city administrations. But rather than trying to tackle many different aspects of city life simultaneously, most successful smart city programmes have initially homed in on a specific problem, before going on to address related issues and challenges: Start with a simple use case and expand from there.

The roles of mobile operators: Smart city services rely on secure, reliable and responsive connectivity, generally delivered via telcos' wireless networks. This connectivity can both capture valuable data from sensors and deliver real-time information to citizens' mobile handsets. Mobile operators can help to realise the full potential value of this connectivity by delivering other key elements of the overall solution, such as systems integration with existing ICT and cloud services.

1. Building productive partnerships

Successful smart cities services are often underpinned by a strong partnership between the local government, one or more telecoms operators and, in many cases, a systems integrator or technology supplier. In several of the smart city programmes tracked by the GSMA, the public sector has helped finance early projects and the city administration has worked with the private sector to reconcile commercial objectives with public policy goals. However, the involvement of too many stakeholders may slow smart city projects down and increase complexity.

Public funding can play a key role in kickstarting smart city projects. Using €6 million of research funds from the European Union, a consortium of 25 partners led by telco Telefónica has turned the Spanish coastal town of Santander into a smart city laboratory. The city's smart city projects are in line with the EU's Future Internet initiative, which involves the creation of facilities to support experimentally-driven research in the field of information and communication technologies (ICT).

In South Korea, Busan's Green u-City programme, which has a budget of approximately USD 452 million, is using a cloud-based infrastructure delivered by a collaboration between Busan Metropolitan City, technology supplier Cisco, and telco KT. This public-private-partnership shares both the costs and the risks of the project. Building on their successful collaboration in Busan and Korea's Incheon Free Economic Zone, Cisco and KT have since established a joint venture, KCSS, which is now providing a range of ICT solutions to other cities in Asia.

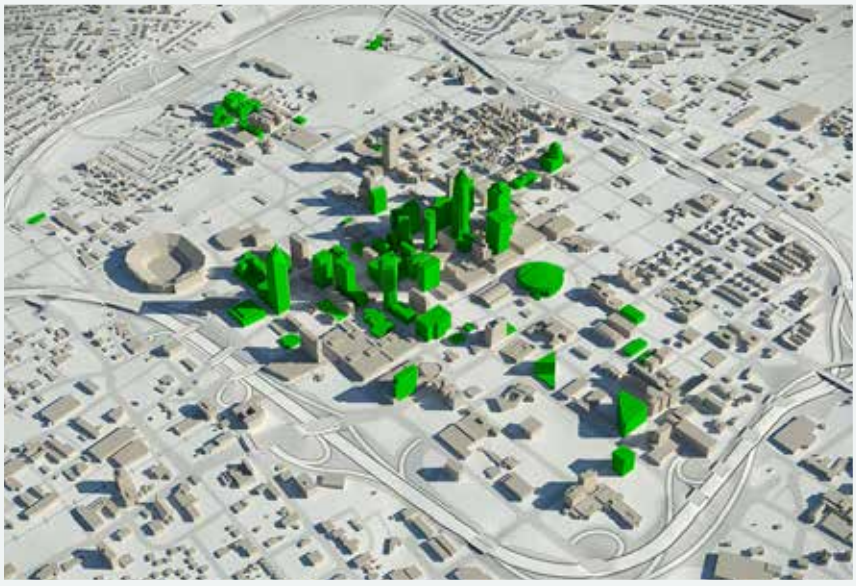
In the U.S. city of Charlotte, in North Carolina, Bank of America, Wells Fargo bank, Duke Energy, Charlotte Center City Partners and consultancy Intelligent Buildings, LLC, along with other key community stakeholders, have set up a non-profit organization to run its Envision Charlotte programme. The first pillar of the programme, Smart Energy Now™, is run as a partnership between the city administration, the electric and water utilities, office building owners and managers, mobile operators and technology vendors. Initiated in October 2011, the project is improving energy efficiency in office buildings with more than 10,000 square feet in downtown Charlotte (see graphic) by supplying the occupants with near real-time information on their energy usage.

However, public private partnerships can be complicated by the different city budget cycles of commercial companies and city administrations. And few municipalities have CIOs who have a holistic view of the "smart city" infrastructure and services. Moreover, any changes to local government leadership could see public private partnerships being reviewed.

In some cases, a telco may need to take the lead, building its own smart city ecosystem that can then replicate projects across multiple different cities. In Germany, for example, Deutsche Telekom works with a wide range of partners to pilot complex projects, such as smart metering or Home Network 2.0, in the T-City of Friedrichshafen in the south of the country. DT is using the programme to explore how a telecoms operator can act as a systems integrator on smart city projects, while gaining a better understanding of the regulatory limitations around the ownership of customer data.

The new products and services DT and its partners test in Friedrichshafen are refined and then showcased to other cities and industries. The ecosystem of partners is now deploying smart city solutions elsewhere in Germany and internationally.

Figure 1: The Smart Energy Now programme serves office buildings in downtown Charlotte.



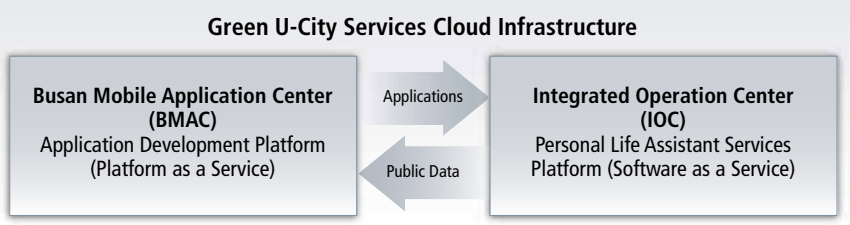
2. Smart and interoperable ICT

Most smart city projects need to harness data from multiple sources, which may change and evolve over time. To meet this requirement, the underlying information and communications technology (ICT) architecture needs to be both flexible and interoperable with existing city ICT systems, as well as a wide range of sensors. If smart city services are to achieve their full potential, the cost and complexity of connecting large numbers of sensors to mobile phone networks may need to fall.

In South Korea, Busan's Green u-City programme combines an ubiquitous, high-speed IP network with a cloud infrastructure made up of an intelligent city management system – an Integrated Operation Centre (IOC) – and an application development platform (see diagram). This architecture is designed to be a multi-service open platform that enables the straightforward delivery of both commercial services for the city and free services for its citizens that can be expanded over time.

Many smart city programmes depend on sensors in the field, which can be used for multiple purposes. Santander in Spain has installed more than 12,000 sensors around the city, covering an area of approximately 35 kmsq, or 13.4 square miles. The sensors measure a variety of variables, from light and pressure to humidity and temperature. Vehicles also broadcast their positions in real time, while other sensors measure air quality levels, for example. This sensor infrastructure is wirelessly connected through the backbone network to the Telefónica machine-to-machine service platform.

Figure 2: Busan's Green u-City architecture features a cloud-based Integrated Operation Centre (IOC) and application development platform.



This technology enables the network of sensors to transmit data back to the project hub as often as every two minutes. Once there, Telefónica's platform enables the enormous amounts of big data to be analysed and observed in real time by the Council's employees. The City Council is able to see, at any time, a snapshot of the entire network of sensors.

These sensors are enabling an array of valuable services:

- Real-time view of traffic jams and available car parking spaces
- Precise measurement of air quality and ozone levels across the city
- Remote dimming of street lamps on empty streets. New bulbs are also automatically ordered when needed
- Optimised watering in city parks, so no water is wasted
- Only garbage bins that are full are collected, minimizing needless trips by municipal workers
- Traffic jams and accidents are tracked in real time

In Santander, a large proportion of sensors are hidden inside white boxes and attached to street infrastructure such as street lamps, buildings and utility poles, while others were buried into the actual pavement. Not all of the sensors are static; some were placed on the city's public transport network, including buses, taxis and police cars. By downloading an app to their smartphones, even the residents of Santander could become moving sensors in their own right.

Telefónica says it is now working to get more connected devices into the hands of the developer community through a partnership with Arduino, which has developed the new Arduino GSM Shield to simplify the process of building Internet of Things applications that use mobile phone networks. The telco is also working to make connected sensors more affordable and accessible to a mass market by creating a simple modular technology for people to connect sensors to mobile networks.

3. Capture and distribute actionable information

To be really effective, smart city services have to enable citizens and organisations to make well-informed decisions in a timely fashion. As the value of information can fall rapidly, smart city services need to be capable of capturing relevant information in real-time and distributing it in a format that citizens and organisations can act on immediately.

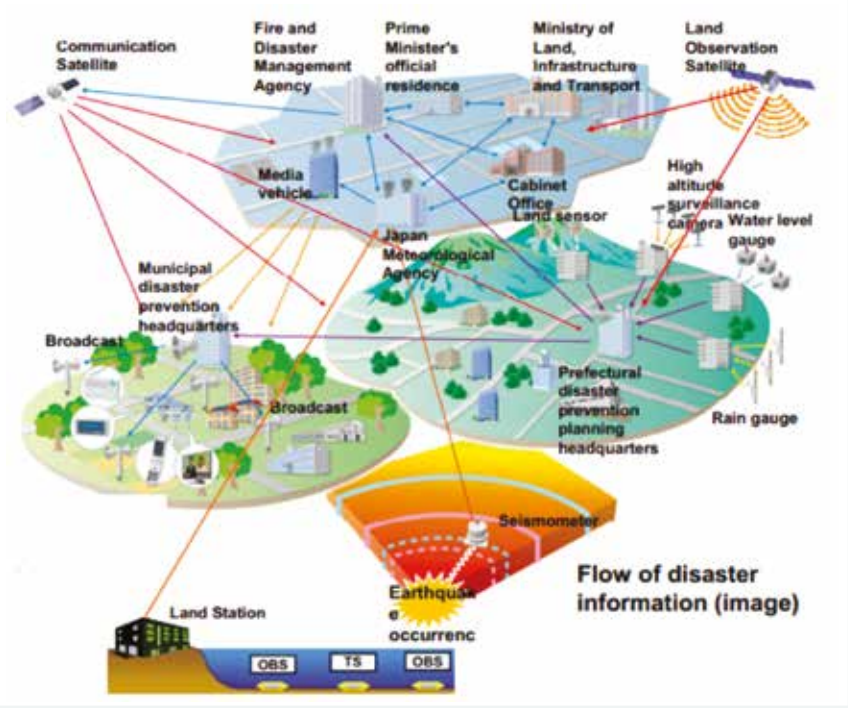
Cities' ability to process, store and share vast amounts of data is crucial for building up their resilience and preparedness for natural disasters. Japan, for example, has deployed a sophisticated disaster resilience solution incorporating observation systems, information gathering capabilities, data analysis and decision making aids, together with an intelligent warning system, all linked together in an interoperable manner (see diagram). In the case of the major earthquake in March 2011, Japan's Ocean Bottom Observation Systems and building seismometers detected the first minor waves at 14:46:48. The second, much stronger, waves burst at 14:47:17 giving Japan a window of 29 seconds to prepare. Japan Meteorological Agency oversaw a series of actions that were initiated during this very short time interval:

- NTT DoCoMo, Au and SoftBank Mobile used the Cell Broadcast Service System, which was created for this very purpose, to send out a message in five languages to mobile phone users warning them about the earthquake. As mandated by a 2007 law, all 3G phones were able to receive this service.
- The Japanese Broadcasting Corporation (NHK) alerted the population. TV broadcasts flashed an alert that an earthquake was expected, showed the epicentre and identified the areas that will be heavily-exposed. Radio stations transmitted similar messages.
- In Tokyo, in line with the Tokyo Metropolitan Government's Plan5, the Shinkansen bullet trains received a warning to stop, Tokyo's subways were evacuated, surgical operations ceased, gas was disconnected and nuclear reactors received an order to enter the shutdown process. All runways at Haneda and Narita airports were closed, and destinations for 86 flights heading for these airports were changed. Tokyo Electric Power Company (TEPCO) started preparing for power outage and prioritisation of power distribution for electric grid. High priority was given to hospitals, power and nuclear plants, traffic control agencies, as well as governmental bodies responsible for collecting and analysing data.
- Cranes lowered materials, cars pulled over and factory lines were suspended. Emergency services, such as police, fire brigades and hospitals, received signals to raise readiness levels.

In a different vein, ICT can also be used to make cities more accessible and welcoming for visitors. In the summer of 2011, Forum Virium Helsinki initiated the Walk and Feel Helsinki project to help cruise passengers become acquainted with Helsinki and provide them with a new way to explore the city. Tourists can use their mobile handsets to tap NFC tags or scan 2D barcodes attached to signposts, to access a range of digital information about nearby points of interest, on their way from the harbour to the city centre. Access to this information is provided via the mobile phone's web browser or a dedicated app.

In Charlotte, North Carolina, the Smart Energy Now programme uses Verizon's LTE network to provide each participating building manager with confidential, detailed information on their energy usage on a near-real-time basis. Part of the service also includes additional insights on "what can I do with all this usage information?"

Figure 3: The elements of Japan's comprehensive disaster resilience solution.



4. Potential business models

If they are to be sustainable, smart city services need to have an income stream that covers their costs and reflects the value they are delivering. In many cases, the business model may regard smart city ICT as a platform that will become more valuable over time. Once the smart city infrastructure required to capture, process, store and share large volumes of data has been built, it can act as a platform for new business opportunities that use cloud services, data analytics and business intelligence to create new services and applications for consumers and enterprises.

Smart city services can be underpinned by publicly-funded financial incentives for private companies to deliver services that fulfil government's policy objectives and cut the city administration's costs over time. For example, as part of Charlotte's Smart Energy Now programme, the North Carolina Utility Commission pays Duke Energy a return if the education programme achieves reductions in energy usage above a specific threshold. At the same time, the energy consumption data resulting from the project is giving Duke better knowledge of energy demand patterns, supporting the company's smart grid technologies and energy efficiency strategy, and delaying the need to build expensive new power plants.

Some telcos are using smart city projects as part of a broader research and development programme designed to create commercial propositions that deliver a return on investment. This is the approach taken by Deutsche Telekom in Friedrichshafen in southern Germany. For example, the city's HomeNetwork 2.0 project tested intelligent networking systems to enable the management of electronic appliances in the home. Since July 2010, 50 households in the city have been able to use mobile devices, such as iPads or smartphones, to control garage doors, window shutters, TV sets and lights. Furthermore, the householders can programme heating systems and other appliances to switch on or off at specific times. The smart metering and smart home projects trials in Friedrichshafen led to the development of a multi-vendor platform Qivicon, which is now offered across Germany on a commercial basis (see diagram).

About one half of DT's projects in Friedrichshafen have concluded in a straightforward commercialisation; some products were modified and integrated with others, and a minority were discontinued.

Another approach is to subsidise free smart city services with commercial services. In South Korea, Busan's mobile application centre (BMAC) is pursuing this so-called freemium model. An incubator of smart city services, BMAC's multi-service platform is used to develop a combination of free public services and value-added commercial services designed to improve different aspects of a Busan resident's daily life.

Once smart city infrastructure has been built, it can give rise to new business opportunities for many stakeholders, including mobile operators and technology companies. KT, the telco involved in the Busan Green u-City programme, sees today's smart city projects as an investment that will help it develop the skills and capabilities it will need in future. "This isn't a one-off release or consulting partnership, but a way of developing a long-term cooperative business model, which is by far the more meaningful," says Suk-Chae Lee, Chairman and CEO, KT. "Through this project, KT's core aim is not just the commercialization of smart space solutions, but the accumulation of business experience and the fostering of talented human resources and many other goals in other business fields also that can be accomplished through the strengthening of our global competencies."

Figure 4: Smart metering and smart home trials in Friedrichshafen led to the development of a multi-vendor platform Qivicon, which is now being offered by Deutsche Telekom across Germany.

5. Engaging citizens and developers

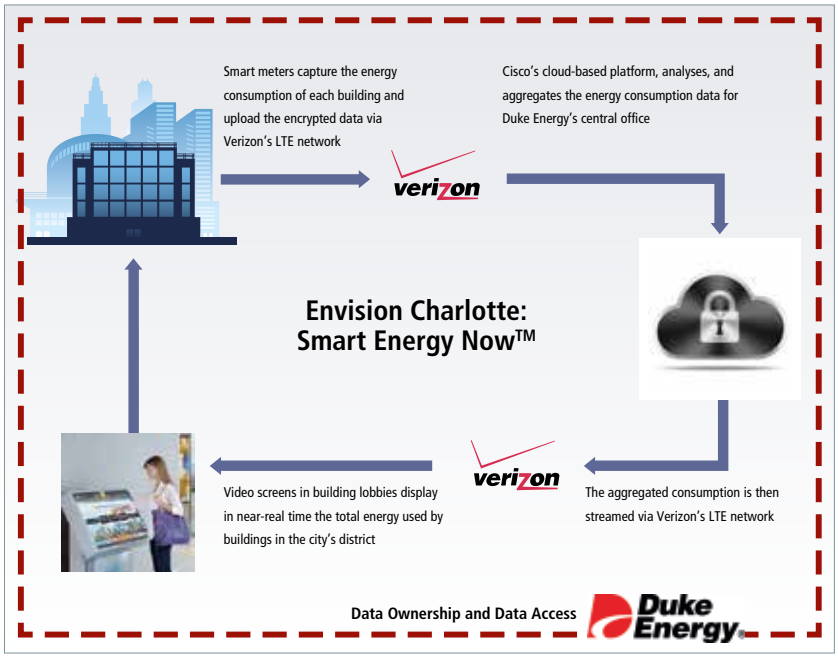
To have a major impact, smart city programmes need to engage citizens and app developers in a systematic and sustained way. The potential engagement channels range from apps that enable citizens to flag everyday concerns, such as potholes or vandalism, to asking citizens and app developers to help identify new service concepts and create new projects. City administrations and private companies may need to work together to explain the value of smart city services to citizens and manage end-user expectations: Ensuring the active involvement of citizens requires a creative and committed approach.

The Smart Energy Now programme in Charlotte, North Carolina, engages office workers by streaming near-real-time aggregated energy consumption for the buildings in the district on to Cisco video monitors in each building's lobby (see diagram).

Supported by behavioural training programmes to help educate the users of the participating buildings, Charlotte also runs an Energy Champions Scheme, whereby each building has a certain number of energy champions on every floor who remind colleagues to be mindful of energy consumption, switching off unnecessary appliances and adopting an energy saving mode.

A smart city initiative on South Korea's Jeju island is also enabling householders to view their energy consumption data on in-home displays, TVs, tablet PCs and smartphones. Moreover, every household can compare its usage with comparable houses and neighbours. By 2030, the South Korean government plans to engage 30% of all citizens in a real-time power trading market, giving them choice of electricity rates and allowing them to sell renewable energy back to the grid.

Figure 5: Charlotte's Smart Energy Now systems feed near real-time information back to the building's occupants.



Source: Duke Energy

To that end, Jeju Island's Smart Grid Information Centre (SGIC) has been educating householders through meetings, presentations, conferences and forums. Even so, progress has been slow in some areas, where large proportions of the population are elderly. According to the 2010 Jeju Statistical Yearbook, for example, 44 per cent of the Gujwa-eup test area's 3,282 residents were over the age of 65, and most would struggle to understand what to do with new smart meters and information home displays. Such educational programmes will need to be replicated when smart grid services are transposed to a wider commercial base, both in Korea and abroad.

To realise their full potential, smart city platforms also need to tap the talents and ideas of app developers. In South Korea, the Busan city administration is using its Mobile Application Centre (BMAC), a shared application development platform that uses open city data, to engage with developers. As an incubator, BMAC provides a physical space, virtual tools, testing and consultation services for small and medium-size businesses developing citizen-centric mobile applications and services. Once the selected businesses complete their start-up mission, or start generating revenue, they prepare to move their base from BMAC to other locations, such as smart work centres. During the first year of the operation of the BMAC, 13 companies were established and 70 applications developed by small creative start-ups.

In Helsinki, the public-private partnership Forum Virium Helsinki has set out to give potential end-users of smart city services an important role right from the start, making them equal partners with public and private sectors and academia in the process of submitting, testing and developing new concepts and ideas. Forum Virium Helsinki's process for

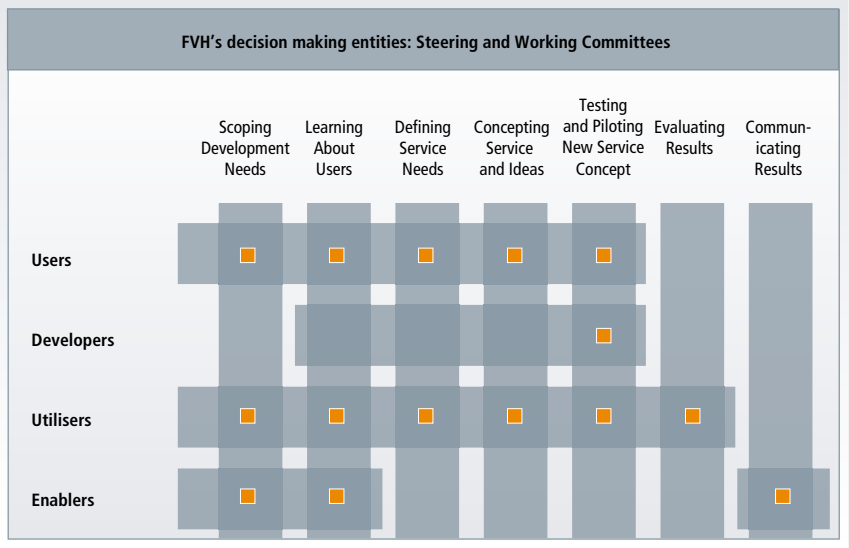


Figure 6: Both citizens and developers are involved in Forum Virium Helsinki's project initiation and evaluation process.

advancing smart city projects follows the seven stages in the model shown in the diagram. During the first three stages, the city's development needs are identified, drawing on input from end-users and citizens, and from municipal and private service providers. As part of this process, "developers" collect end-user feedback, comments and improvements, analyse this data and report it to the utilisers. "Utilisers" (private or public companies that develop products and services) then collaborate with the "enablers" – municipalities and financiers that deploy general city infrastructure, such as roads, traffic systems and street furniture, to develop the final product. The steering committee appoints a working committee to set the operational direction of the projects and design and test the services through trials during the last four stages of the process.

Helsinki is also using other mechanisms to engage citizens. The city's Region Infoshare project has made 1,000 different data sets, including information on the living conditions, economy, wellbeing, employment and mobility of the region, available for free and in a usable format on the web. Making public data accessible is designed to enhance citizens' knowledge and understanding of their region and municipality, encouraging active citizenship. The project is coordinated by the City of Helsinki's Urban Facts and managed by Forum Virium Helsinki.

Apps4Finland, a competition organised by Forum Virium Helsinki and the Finnish Association for Internet Democracy for the past four years, has released environmental data and spatial information through the Helsinki Region Infoshare site. The data has been used for a wide range of applications, such as Helsinki Public Transport Visualized, Tax Receipt, which allows citizens to calculate the total amount of direct and indirect taxes they pay monthly, and Visualisointi, which provides information on the most popular public library books in the past four years.

As early as 2009, the Helsinki Region Transport Authority (HRT) opened all of its public transportation data interfaces to the developer community. It has led to very promising results, as now HRT has approximately 50 mobile applications – made by the developers – serving different needs of the commuters and travellers in Helsinki Region.

In Spain, Santander's "Pulse of the City" app enables Santanderians to report municipal annoyances, such as potholes or damages directly, to the council. To do so, they simply take a picture of the problem and upload it to the authorities via the app. The report is tagged with geolocation data and the public are able to track its progress through city hall, including how long it takes the council to rectify the problem. Santandarians can also use their mobile devices to plan their travel routes based on real time traffic information, or find readily accessible (and free) car parking spaces. They can use maps to see when the next bus is due or find out what concerts are coming up at the city hall. Those with asthma, can plan their days to ensure they avoid areas with high pollution, while tourists can point their phones at landmarks to learn more about the local history.

6. Focus on solving specific problems

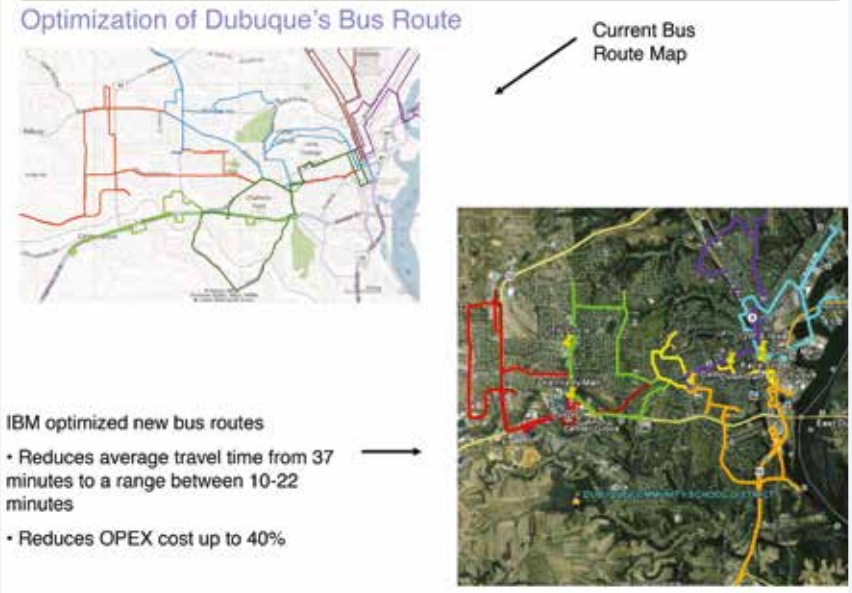


Figure 7: Big data can be used to optimise public transport, easing traffic congestion – one of the most urgent issues facing large cities.

Today's sophisticated ICT networks can be used to address a wide range of challenges facing city administrations. But rather than trying to tackle many different aspects of city life simultaneously, most successful smart city programmes have initially homed in on a specific problem, before going on to address related issues and challenges: Start with a simple use case and expand from there.

Although the ambitious Envision Charlotte programme in Charlotte, North Carolina, has ambitions to address the city's challenges in four areas (energy, water, air and waste), it is taking a step-by-step approach, which may provide valuable lessons for other cities. Segmenting the city into small manageable submarkets, Envision Charlotte decided to start with a well-defined market segment, selecting 65 commercial office buildings with more than 10,000 square feet in the central business district of Charlotte, excluding hotels and other retail properties. Involvement in the programme is not mandatory, but as many as 98% of eligible buildings agreed to participate contractually. That means there are fewer players at the table making it easier to agree upon community goals, significantly lowering the level of complexity. The programme has also tried to minimise the need for expensive retrofitting of office buildings to encourage real estate companies to participate.

Another potential area on which to focus is transportation, which is often one of the most urgent issues and single biggest infrastructure challenges a city. Effective transport is central to a city's economic competitiveness, and severe congestion is known to have a severe economic cost, estimated at between 1 and 3 percent of GDP in developed and developing countries. Equally important, transport is an experience shared by almost all of a city's inhabitants and directly affects their wellbeing. Cars and public transport are also responsible for a large share of greenhouse has emissions, which public authorities increasingly want to control.

Building intelligence into roads and cars, with roadside sensors, radio frequency tags, and global positioning systems, is more cost-effective and more practical than building new roads and new lanes. Public transport can also harness ICT. With knowledge of real time transportation patterns using up-to-the-minute information from telcos' networks, city officials can optimize existing transportation networks (IBM and Vodafone are engaged in this kind of project in Istanbul). The location data captured by mobile phone networks can be supplemented with fare card data or any other type of real-time data capture, such as a smart phone app that passively records GPS information. For example, IBM analysed data on travel patterns in the city of Dubuque in Iowa to optimise the city's bus routes (see diagram). In so doing, it cut average journey lengths for passengers and operating costs for the service providers.

7. The roles of mobile operators

Smart city services rely on secure, reliable and responsive connectivity, generally delivered via telcos' wireless networks. This connectivity can both capture valuable data from sensors and deliver real-time information to citizens' mobile handsets. Mobile operators can help to realise the full potential value of this connectivity by delivering other key elements of the overall solution, such as systems integration with existing ICT and cloud services.

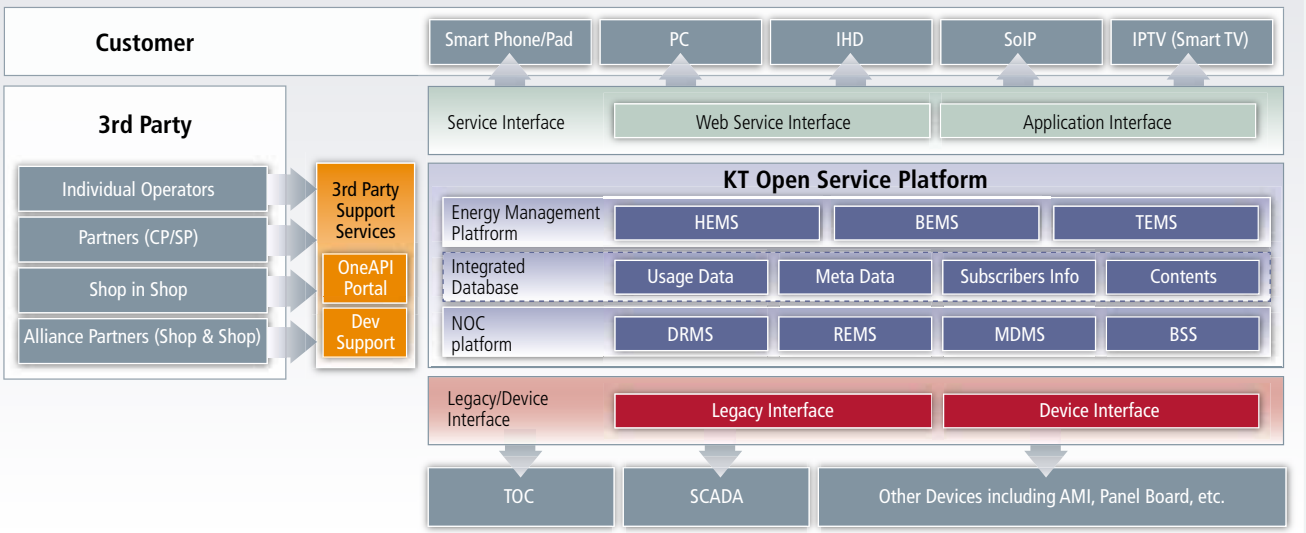
In Japan, mobile operators play a crucial role in the country's disaster resilience solution. They are involved throughout the entire process of city crisis planning, coordination and recovery. Mobile networks have been beefed up to connect all stakeholders, including police, hospital and nuclear plants, to complement existing proprietary networks, observation systems and global satellite systems. Mobile networks are also used to connect a wide range of sensors, in order to monitor land and ocean changes, and accurately measure crucial parameters, such as wind speed, waves, radiation, and salinity.

Smart energy grids also need to be underpinned by highly reliable ICT networks, capable of low latency communications, that won't compromise the stability and security of the grid. As well as optimising and monitoring the communication network performance, telcos involved in smart grid projects may also be required to process and analyse the enormous amounts of data captured by smart meters and other connected monitors.

On South Korea's Jeju Island, for example, mobile operator KT's role in supporting the smart grid goes well beyond providing communications networks and infrastructure. KT is testing a range of solutions for smart home and building energy management, as well as electric vehicle mobility solutions through the KT Consortium, which consists of 14 corporations, such as Samsung, Hyosung, Omni system, ABB, and four research institutes for advanced technologies, such as Korea Institute of Energy Research and Korea Electronics Technology Institute. At the heart of KT's operations is a smart grid NOC (network operating centre), built on its Open Service Platform (see diagram). The platform inter-works with a variety of connected devices and the legacy grid network, and provides third-party support services through an open API portal.

In Busan, in South Korea, the role of the mobile operators in the Green u-City model also goes beyond providing connectivity. KT, for example, has been instrumental in supporting and investing in the design and development of the Busan u-City, and manages the overall operation of the project. KT is also providing several key technology enablers. As well as providing high-bandwidth and extensive connectivity via its mobile broadband network, KT is making cloud-based applications accessible via mobile and embedded devices.

Figure 8: On Jeju Island in Korea, mobile operator KT provides an open service platform, as well as the underlying connectivity.



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