FEBRUARY 2018

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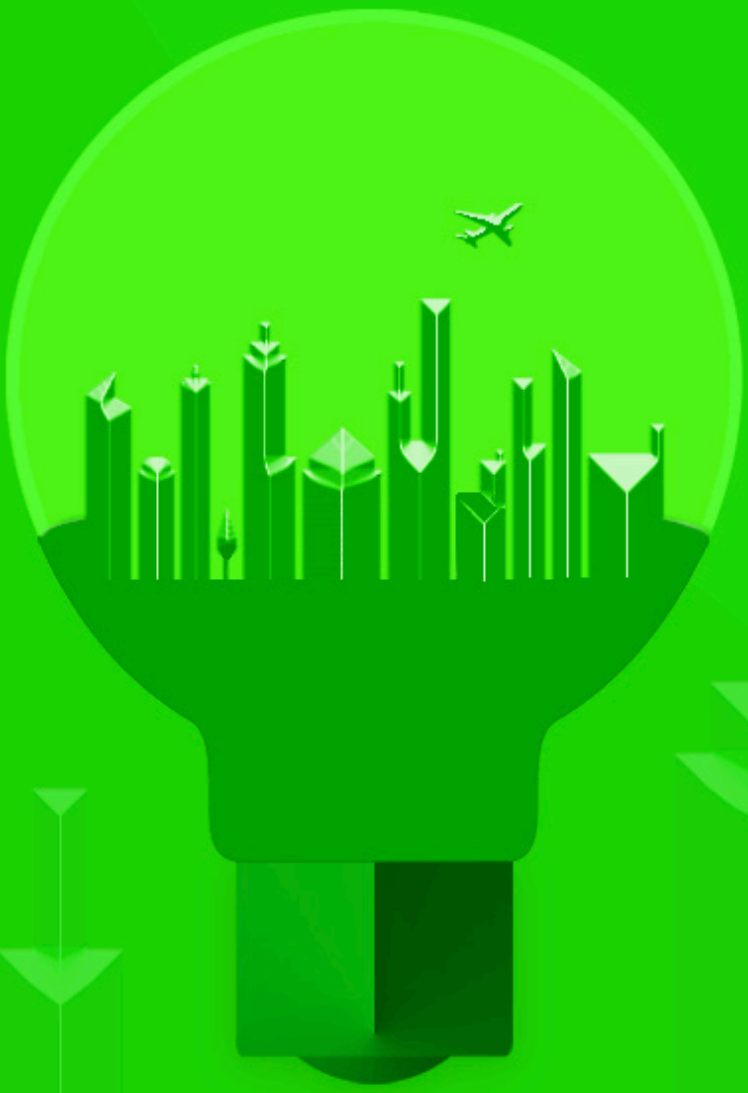

SMART CITY TECHNOLOGIES

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Foreword by James Barton

James Barton
DEVELOPING TELECOMS
Senior Editor

Welcome to Developing Telecoms' Special Report on Smart City Technologies in Emerging Markets. Featuring insight from contributors as varied as analysts, vendors, administrative officials and thought leaders, this report will explore the state of smart city deployments in emerging markets while examining the use cases of the available technologies for potential future applications.

While the term 'Smart Cities' might conjure up images of futuristic, heavily-developed cities, the reality is that the initiatives underway today are already using technology to address issues both specific to emerging markets and common to cities across all regions. Advances in IoT (Internet of Things) technology allow for the connection and integration of myriad administrative-level services to allow for smart metering and monitoring, as well as enabling the citizens that use these services to provide meaningful contributions.

To better explain how emerging markets are implementing Smart City initiatives, we've consulted with ministries and departments focused on these technologies in cities such as Moscow and Santiago de Chile. Contributions from analysts including Beecham Research and IHS Markit focus more broadly on regions including Asia and Africa, a submission from Huawei explores how new financial protocols offer expanded possibilities for smart city development, and the security benefits of smart city technologies are examined by the UN-Habitat. Our report leads with an overview of how cities in emerging markets are adopting smarter technologies, provided by noted smart city specialist Robert Muggah of the Igarapé Institute.

I would like to thank all of our contributors for providing their insight and expertise to the latest entry in our Special Reports series, and in particular I wish to thank our sponsors Huawei and Seacom for their support, which has enabled us to make a new high-quality Special Report available to our readership free of charge.

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Building Smarter Cities in Emerging Markets by Robert Muggah

Cities are where the future happens first. They are also hugely varied in scale and sophistication. North America and Western European cities expanded relatively gradually throughout the nineteenth and mid-twentieth centuries. By contrast, cities in Africa, Asia and the Americas have expanded rapidly in the late twentieth and early twenty-first centuries. There are enormous opportunities for many cities in emerging economies to benefit from this urban transition, especially when it comes to new technologies. But the form and character of cities - and the risks they face - must not be overlooked.

Robert Muggah
IGARAPE INSTITUTE
Co-Founder & Director of Research

The world is undergoing an unprecedented urban transition. The United Nations recently observed that more than half of the world´s population lives in urban settings, and that this would rise to two thirds by 2030. This compares to just three per cent of the global population living in urban environments during the 1800s. Some media outlets mischaracterized this as 50 per cent of the world living in cities, especially mega-cities. In fact, just 5 per cent of the world´s population lives in one of the world´s 40-odd mega-cities (with 10 million people or more). Instead, most “urban dwellers” live in relatively small and medium sized towns.

While it is true that emerging economies are rapidly urbanizing, most population growth involves the shift of rural populations to towns and villages not currently designated as “cities”. While it is easy to be mesmerized by super-, hyper- and mega-cities such as Lagos, Manila, Mumbai, and Shanghai, most urban growth will occur in cities with less familiar names. Even so, Africa and Asia will witness the vast majority of urban growth: China, India and Nigeria alone will generate 40 per cent of city population growth by 2030. Yet the urban experience in these areas will be unevenly distributed, with many residents lacking access to roads, electricity, and basic amenities. Moreover, the “city” designation does not necessarily translate into an “urban” experience: ostensibly rural realities may very well persist.

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Fast growing cities across Asia, Africa and the Americas are rapidly adopting new technologies to improve services, increase efficiency and expand opportunity. The approach adopted by cities varies dramatically and depending on both needs and capacities. There is enormous enthusiasm in the prospect of building "smart cities" in the coming decade to address the requirements of hundreds of millions of citizens. In some countries, a digital backbone is being built from scratch while in others, new technology platforms are being grafted into existing infrastructure.

There are great expectations among technology companies and urban authorities around the potential of smart cities. By 2025, industry experts predict the smart city tech market to be worth some $1.7 trillion annually. While major advanced economies are rewiring their cities, the focus is increasingly on the expanding economies in China, India, Southeast Asia, and parts of Sub-Saharan Africa. As infrastructure investment in advanced economies stabilizes and even declines, spending in emerging economies is likely to rise dramatically.

China and India are leading the way, having announced ambitious plans to make their cities smarter. In 2017, more than 500 Chinese cities reportedly initiated an array of smart city transformations. Just as Google is teaming up with cities such as Toronto, the Chinese city of Hangzhou is collaborating with Alibaba and Foxconn to fully digitize a city of 9 million people where data on infrastructure, water consumption and people are uploaded into a database backed by artificial intelligence to enhance the efficiency and effectiveness of city services and planning. The launch of social credit schemes to rank citizen behaviour is making many civil liberties and privacy groups nervous.

A core priority for emerging city markets is in building and upgrading their physical and digital infrastructure. Mayors and urban officials across the regions are calling for solutions that make buildings, transport, energy, water, waste management and healthcare more efficient, inclusive, safe and sustainable. According to industry analysts, the most significant economic impact areas for IoT applications in cities are in public health and safety, transportation and resource management.

Take the case of pollution, which kills an estimated 9 million people a year, or airborne contaminants which are today reportedly a leading cause of mortality in urban settings around the world. Cities such as New Delhi and Beijing are notorious for air pollution, and they are hardly alone; according to the World Health Organization, some 98 percent of cities in low- and middle-income countries do not meet the minimum WHO air quality guidelines. Smart infrastructure connected to IoT can gather real-time data on air, water and soil quality to better inform policy, improve environmental monitoring, and prioritize clean-tech investments.

When it comes to public safety, after years of decline, global homicide rates rose for the first time in 2017. While violence in North American and European cities has been on the decline, trends are pointing in a different direction in Latin America and parts of Africa. Indeed, roughly 43 of the 50 most homicidal cities in the world are in Latin America. A new generation of crime forecasting tools combined with accurate real-time data could help stem this trend. Driven by powerful mapping software, data processing and social media, predictive policing technologies could make our world safer. Tools that promote more gender inclusive designs to mobility on public transport could also reduce incidents of sexual violence and promote safer cities for all.

Likewise, car accidents continue to be a major public health concern in cities globally. Globally, more than one million people are killed as a result of road traffic injuries. The majority of these deaths occur in cities across Africa and Asia. Adaptive traffic controls, autonomous vehicles and emergency service systems with sensors installed in intersections that regulate

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traffic efficiently and give priority to ambulances and emergency vehicles when required could potentially reduce accidents and save lives.

Leveraging IoT to deliver effective resource management is another growth area. Real-time data that tracks and regulates water and energy usage have already been tested in cities across Latin America, Sub-Saharan Africa and South Asia, resulting in significant savings. With some 90 percent of waste volume over the next five to ten years expected to be generated in these regions, market trends for smart waste management represent another high growth sector.

Tapping the potential of cities in emerging markets will depend on a number of technical, financial and regulatory factors. A priority is filling the skills gap in emerging markets to enhance digital citizenship, and data literacy should be a priority. Governments and businesses will have to invest in a cadre of human resources capable of implementing and managing smart city systems. This will require working with universities, technical colleges and schools, promoting partnerships between tech companies together with investment in research and development.

Another challenge involves bridging the finance gap. McKinsey estimates that there is a $350 billion gap in financing smart cities globally each year. Creative and sustainable financing strategies are required and attracting adequate investment for projects. Solutions include replicating pooled funding models to co-fund projects promoted by initiatives such as the European Innovation Partnership on Smart Cities and Communities or finding ways for cities to leverage private financing by making cities credit-worthy.

When it comes to government policy and regulatory frameworks, cities that have succeeded in implementing smart solutions have typically had well developed regulatory frameworks backed by agencies and departments with the technical capacity to monitor and promote interoperability across IoT systems. Yet, most city administrations in emerging economies still lack effective urban planning capabilities and data governance models. In particular, there are growing worries about how privacy concerns will be addressed in an IoT environment that collects significant amounts of personal data. Policies that regulate who owns the data, how long the government should be allowed to retain it, and under what conditions data can be shared and destroyed need to be clarified.

The final challenge is to ensure that smart city growth is inclusive and sustainable. There are already more than 1.2 billion urban residents living in slums and this is set to grow to 2 billion by 2030. These individuals are often off the grid and especially exposed to disasters and crisis. Far from being a liability, they potentially represent a massive opportunity for financial, social and political inclusion. Solutions that integrate them into smart infrastructure and services are essential. For example, the potential of using mobile technology to make solar power available to slum dwellers are being explored in East Africa and show great promise. Fostering safer and more habitable cities requires smart policy and smart technology. Yet, to reach that goal, these technologies need to be driven by a human-centric strategy designed to improve the quality of life for all residents.

Building Smarter Cities in Emerging Markets by Robert Muggah

BIO

Robert Muggah is a specialist in cities, security, migration and new technologies. He co-founded the Igarapé Institute - a think-and-do tank working on data-driven safety and justice across Latin America and Africa - where he is currently the director of research. He also co-founded the SecDev Foundation and Group - organizations devoted to cyber security and the digital economy, especially in the Middle East and Eurasia, and South Asia regions. He consults with governments, the UN, the World Bank, and firms ranging from Google to McKinsey. He is known for designing award-winning interactive data visualizations that track the global arms trade, homicidal violence, fragile cities, and climate change. He has also developed open source body cameras for police accountability and predictive crime dashboards.

Robert is a fellow or faculty at Singularity University, the University of Oxford, the University of San Diego, the Catholic University of Rio de Janeiro, the University of British Columbia, the Chicago Council on Global Affairs, the Canadian Global Affairs Institute, and the Graduate Institute Switzerland. He is the co-founder and executive editor of Stability and is on the editorial boards of several academic journals. Dr. Muggah serves as a senior adviser to the Inter-American Development Bank, UN agencies, and the World Bank. He routinely advises national and city governments, international organizations and civil society groups on security and development. Between 2012 and 2013 he was an adviser to the High Level Panel on the post-2015 development agenda and in 2016 he was nominated by the UN Secretary General to serve on an expert panel for Youth, Peace and Security.

IGARAPÉ INSTITUTE

The Igarapé Institute is an independent think-and-do tank devoted to evidence-based policy and action on complex social challenges in Brazil, Latin America, and Africa. The Institute's goal is to stimulate debate, foster connections and trigger action to address security and development. Based in the South, the Igarapé Institute undertakes diagnostics, generates awareness, and designs solutions with public and private partners, often with the use of new technologies. Key areas of focus include citizen security, drug policy, cybersecurity, building peace and safer cities. The Institute is based in Rio de Janeiro, with personnel across Brazil, Colombia, Mexico and the United States. It is supported by bilateral agencies, foundations, international organizations and private donors.

Smart Cities: A Crucial Driver in China's Connectivity Strategy by Christina Patsioura

Christina Patsioura
BEECHAM RESEARCH
Senior Research Analyst

Urban infrastructure projects powered by digital communications have ushered in a new era of urban living conditions and citizen capabilities, brought together under the umbrella term of "Smart Cities". The term was immediately adopted by policy organisations as well as technology companies that were quick to engage with services and applications for addressing the so-called Smart Cities space in emerging markets.

The challenges of improving environmental conditions and tackling pollution, achieving greater sustainability of resource management, optimising urban transportation and utilities management, public administration, and all manner of challenges associated with citizens' health and education issues are all areas where the Smart Cities agenda, as it brings together new technological means and data-enabled technologies, fits well with the goals set.

Among the many major technology vendors that have been quick to engage with Smart Cities services, telecommunications providers have been playing a key role by aligning existing offerings with the Smart Cities agenda and through their collaboration with public authorities and organisations that brought many benefits to fruition.

While Europe has undoubtedly been the leading force in the adoption of Smart Cities initiatives, other parts of the world, wanting to respond to their own special challenges, have been increasingly implementing Smart Cities projects. Asia can be deemed as the single most dynamic market currently when it comes to the Smart Services and all adjacent fields such as Smart Industry, Smart Grid and Smart Energy management etc., with Smart Cities included of course.

In this short report, we are going to focus on the Chinese Smart Cities scene and the role that the major telecommunications providers landscape has been playing insofar to that direction, as well as the dynamics that shape this very market, such as policy making organisations, market trends, etc.

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SMART CITIES / SMART SPACES DEFINITIONS

In the world of Emerging Technologies, we tend to talk about Smart Solutions and Services that are comprised of different market segments. These segments divide into enterprise-centric and consumer-centric, according to the end users of the technologies in discussion. The former has segments such as the Smart Industry or Smart Manufacturing, the Smart Energy and the Smart Grid, Smart Logistics and so on, while the latter includes segments such as Smart Home and Smart Health where the individuals are the consumers of smart technologies.

Smart City "spaces" are multiservice environments that go beyond enterprise processes or single mobile applications for individuals. A Smart City encompasses all applications that aim at improving citizens' lives, and can benefit local businesses and the local economy in general.

A Smart City application must by necessity include three of the following elements:

- It deploys digital and intelligent Information Communication Technologies (ICT) (e.g. IoT, cloud computing, open data, mobile applications, etc).
- Its scope is citizen-centric; beyond upgrading a city's infrastructure, the first aim of a Smart Cities application is to improve the lives of citizens, making them more comfortable and happy. Smart Cities also foster civil participation, aim to make public services easily accessible, and create tools that will be widely used by the citizens.
- It aims at fostering sustainability (e.g. minimise carbon emissions, apply pollution control, encourage use of non-fossil energy, etc).
- Its infrastructure is characterised by resilience (robust infrastructure, reliable transport networks, accessible public authority services, etc).
- It promotes openness in the so-called open data mentality, which aims at the open accessibility of anonymised data, in order to promote collaboration and coordination among city departments and promote further utilisation of Smart City data by citizens, organisations, schools and hospitals.
- It ensures applications are accompanied by strict security and privacy rules over their lifecycle.

The most prevalent Smart City areas of applications are the following:

- Smart Water Management – covers the management of water supply and demand, sewage, drainage and pollution control systems of the city. Essential tools include smart meters, wireless sensors for pressure, humidity, water levels etc., along with application enablement platforms that can perform the data management - often in real time – to enable the authorities to take decisions through the provision of advice and trigger actions.
- Smart Energy – Smart Energy systems monitor, control, operate and manage efficiency of energy generation, transmission and distribution systems. Components for Smart Energy infrastructure include smart meters, information systems that can handle real time data in order to optimise the network's operation, from energy production and storage units. Smart Energy systems will need to cover Electric Vehicles and vehicle-to-grid solutions, real-time energy consumption pricing, and demand response applications.
- Smart Transportation – intelligent transportation systems are centrally controlled information systems that manage all types of public vehicles, buses, trains, trams, bikes etc., and provide services and assisted decision-making to all stakeholders in the transportation industry, including individual travellers, policemen, firemen and other government institutions.
- Smart Health – enabling of remote patient monitoring and the deployment of remote communication of doctors with patients. In-hospital smart health applications can include patient log and data collection, screening and diagnosis based on patient digital records, remote image transfers, remote consultation. Support for individuals with disabilities and chronic diseases is further enhanced through the usage of digital technologies that have been implemented in the context of Smart Cities applications.
- Smart Lighting – includes solutions for intelligent management of street lights and traffic lights that can also interact with other systems for incident detection, noise and air quality monitoring,

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etc. Smart lighting installations require sensor networks and the relevant wireless communications, as well as central management systems that coordinate all the elements.

- Smart Parking – what is usually needed is mobile applications that have drivers as their end-users. The mobile applications communicate via wireless IoT-based communication systems with the smart parking system in order to get informed on the availability of spaces, then get guidance on how to locate it via location technologies, such as GPS, while further capabilities are provided through the interaction with other systems such as smart lighting, etc.

SMART CITIES AROUND THE WORLD

Cities around the world are creating and deploying smart city strategies. Of course, following up with a consistent project planning is not always easy nor are all cities in need of the same Smart City strategy. In different parts of the world, Smart Cities initiatives take different shapes according to the local needs and challenges. For example, we can see European countries focusing on improving living conditions and aligning their plans around reaching environment-related targets, while countries in Africa are focusing on improving utilities networks while urban centres in Latin America pursue safety-related Smart Cities solutions.

South East Asia and particularly China are areas of rapid urbanisation that requires tackling new challenges with the use of ICTs whose popularity is increasingly growing. In this direction, the three major telcos have been playing a very important role in the general adoption of Emerging Technologies, hence playing a key part in Smart Cities projects. It is estimated that more than 300 cities in China developed at least a pilot Smart City project in 2017.

CHINA MARKET OVERVIEW

According to the GSMA, China is leading the world in adoption of Internet of Things connections, with 74 million at the end of 2014* representing almost one third of the global base. This figure is expected to grow at a compound annual rate of 30% by 2020 when the number of connections will be 336 million. As a result of China's entry to the World Trade Organization (WTO) in 2001, a new regulatory regime is being established and foreign operators can have been able to access the market.

However, infrastructure and economic status in China varies significantly among different regions. Not all cities are in the position to deploy the new generation seen in cities like Beijing and Shanghai - which have been the leading Smart Cities of China - so Smart City projects are still in their early stages, although the significant scaling capabilities of the Chinese market have provided many big deployment projects already.

CHINESE TELCO MARKET OVERVIEW

China can generate enormous economies of scale, while the country's rapid economic growth is driving adoption of new technologies as the urban population grows and the middle class expands. In China, new digital technologies benefit from both government support and international vendors contributing with significant investments.

Underpinned by strong government support, China's major telecommunications providers China Mobile, China Unicom and China Telecom are making significant investments domestically and are forging partnerships with multinationals. Companies such as Alcatel-Lucent, Cisco, Ericsson, Huawei and Siemens have all been active in China and have already contributed in a number of Smart Cities projects in the country.

China Mobile controls the vast majority of its domestic mobile services market with a 70% market share. China Unicom and China Telecom have 20% and 10% shares, respectively.

TELCOS ALIGN THEIR STRATEGY TOWARDS SMART TECHNOLOGIES

When it comes to moving beyond the traditional telco business of selling connectivity, all Chinese mobile operators have undoubtedly been moving towards added value services models in the past few years, keeping up with the national state-initiated strategy of evolving towards Emerging Technologies with particular focus on the Internet of Things – an indispensable part of Smart Cities applications. All three major telcos in China

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have been working towards adding layers such as connectivity management applications on top of the traditional air time offering for businesses and individual consumers.

Indicative of this is the fact that telecommunications providers are increasingly deploying their cellular networks for Smart Utilities Management, such as Smart Electricity Metering and Smart Grid applications, and are working together with the State Grid Corporation of China and China Southern Grid - the two major state run utility enterprises - in the direction of upgrading the energy network infrastructure with the support of relevant governmental initiatives.

MAIN TELECOMMUNICATIONS PROVIDERS IN CHINA AND THEIR INVOLVEMENT WITH SMART TECHNOLOGIES

China Mobile is the world's largest mobile telecommunications corporation, and also the world's largest mobile phone operator by total number of subscribers with over 873 million subscribers as of August 2017. A state-owned enterprise, China Mobile has historically held a greater share of the rural market than its competitors. It also offers services targeted at the rural market including an agricultural information service, which facilitates the sale and purchase of agricultural products, access to market prices for produce and crops, wire transfers, bank withdrawals, and payments, etc. China Mobile was the first operator to launch M2M services and develop an IoT Platform. It has launched services such as "Car Service Link", "Elevator Guardian" and "Fire Control Systems", and has developed an "Internet of Vehicles" company together with Deutsche Telekom.

China Unicom is a Chinese state-owned telecommunications operator. China Unicom maintains the second biggest market share of the Chinese market, and has been working on the Smart Home area launching services for households. The company has signed deals with more than 20 car manufacturers that provide 4G services for more than 3million vehicles today. China Unicom is working with Volvo allowing for the usage of 3G and 4G cellular networks in China to provide consumers with smart car services, such as infotainment apps, eCALL, VOC apps, etc.

China Telecom Corp.is a Chinese Telecommunications company, also state-owned. China Telecom has also invested heavily in IoT with greater focus on automotive – presumably building on its long relationship with Toyota, while having developed activities in the video surveillance and the smart home area.

POLICY INITIATIVES IN CHINA

With the National Investment Plan in place, various sectors of the Chinese economy, including technology vendors, utilities, telcos, logistics and retail companies are looking to make relevant investments in the areas of smart technologies, such as the Internet of Things, Cloud Computing and Big Data among others.

The key policy makers in China include the central government, the ministries in charge of relevant agendas, as well as the regional government bodies. The following major policy acts are aimed at allowing companies and cities shape their strategy accordingly.

- According to the Chinese government's 2014 Smart City Industry Policy & Environment Program, total smart city investment over the next 10 years will be RMB 2 trillion (approximately US$300 billion).
- "National New Urbanisation Plan 2014-2020" was approved by the National State Council of the People's Republic of China. The Plan includes a chapter titled "Advance Smart Cities Development" and call on urban development with the deployment of new generation technologies, such as the IoT, Cloud Computing and Big Data. Companies are expected to be investing according to that plan, by prioritising the areas of healthcare, social insurance, education and low-carbon construction all under the framework of Smart Cities development.
- Smart Cities agenda is being pushed by many local governments in their efforts to tackle administration problems and public infrastructure challenges. Smart City projects of bigger and smaller scale alike are estimated to have been implemented in hundreds of Chinese cities. More than 500 Chinese cities have commenced smart city programs.

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- The Chinese Ministry of Industry and Information Technology released a 12-year Development Plan aiming to scale the IoT market to $163 billion by 2020. The midterm plan also underlined the Central Committee's focus on IoT and Cloud adoption, stating to incentivize the IoT, software and semiconductors industries through tax benefits.

MAJOR SMART CITIES PROJECTS

Rail Automation – Siemens: Since 2016, Siemens has been providing China's rail network with signalling systems, Unattended Train Operation (UTO) and digital services in 14 cities, accounting for a third of the entire length of operating metro lines in China. Siemens has been participating in Smart Cities initiatives in China, helping form infrastructure and urban mobility plans based on digital technologies. Integrated transport solutions include smart parking and smart lighting, and cover the networks of buses, metro, trams, high-speed and intercity trains.

Hong Kong Smart Digital Hub - Siemens: This hub will be powered by MindSphere, the cloud-based IoT operating system from Siemens. Siemens has also extended its cooperation with Zhuhai for a tailored intelligent traffic management solution and deployed Embedded City Sensor Boxes in the Suzhou Industrial Park to help reduce congestion and air pollution, optimize infrastructure operation and improve public safety.

City of Zhenjiang transportation system - IBM: IBM contributed with hardware, software and services-based solutions with the digital transformation of the city's public transportation system. Mobile applications are made available for the citizens to view public transport schedules in real time, use the local bike sharing service, and book hospital appointments.

Various cities' public administration systems – Alibaba: Following Beijing's transfer of all of its administration services to the Alibaba cloud - as was previously done in Shanghai, Guangzhou and Shenzhen - the city of Macao signed an agreement with Alibaba to upgrade the city's systems with cloud and artificial intelligence capabilities.

Beijing Municipal Health Bureau - China Unicom: the two partners worked together in order to enable online medical services, such as online appointments and health information services for 114 hospitals in Beijing, while China Unicom provided 112 emergency medical centres' smart ambulances with 3G connectivity and video surveillance systems.

Yingtan – China Telecom: Yingtan is a city with more than 10 NB-IoT use-cases implemented, including widespread smart parking, urban equipment management, industrial controls, agroforestry monitoring and intelligent transport systems.

Schneider Electronics has participated in many Smart Cities projects, including water and energy management, transportation and buildings.

ARUP, the major engineering consultancy and construction company, has been involved in a number of Smart City projects in China.

Siemens, the industrial automation and energy equipment conglomerate, has developed Smart City solutions for energy, transportation and buildings among others in China.

Veolia, the multinational waste and water management company, has collaborated with a number of Chinese stakeholders for the development of Smart City related solutions, in water and utilities management etc.

OPPORTUNITIES & CHALLENGES

Both China Mobile and China Unicom have adopted NB-IoT, the standard for cellular connectivity fit for IoT applications, and have already completed many projects in the areas of utility meters, smart parking, smart street lighting. Huawei has been playing a key role in these developments. All companies have committed to achieve substantial growth with their IoT projects which means growth for Smart Cities as well.

As a result, the opportunities for companies and local authorities increase as they can move towards or benefit from smart water metering, pipe network monitoring and water quality monitoring services, which can help them to manage their infrastructure and upgrade their services while reducing operating costs.

NB-IoT is increasingly relying on a large and growing ecosystem of module makers and device manufactures that benefit from creating services on top of the IoT standard.

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NB-IoT services - China Unicom: China Unicom is offering commercial NB-IoT services in more than 20 cities across China, including Shanghai, Guangzhou, Shenzhen and Fuzhou. China Unicom has contributed in the implementation of smart parking, smart lighting and water metering Smart City applications in China, and is now proposing the deployment of NB-IoT for similar applications and is working towards commercial roll out of LTE-M in next year.

China's connected car market is growing beyond navigation and location services to the electric and connected cars, safety and telematics with IoT elements (such as the embedded SIMs in smart cars) as well as in-car infotainment services. Some automakers are already partnering with telecoms in order to provide these kinds of additional services through traditional cellular 4G networks. More or less, all of the telecom operators are targeting the transportation sector.

For mobile operators, connected cars present a major opportunity to tap into existing and new customers. Remote SIM provisioning and LTE to the car enables content-related support and other services.

Smart Utilities Management and Smart Grid: due to the importance of these applications for national strategy, the government is subsidising the use of modules which as a result come at a very low cost and make it easy for them to be deployed in electricity meters on cellular networks run by the major telcos.

Mobile operators are also making moves in the electric bikes area, looking to provide connectivity that will push navigation, location and safety application on them. Currently, there are more than 200 million electric bikes in China.

CONCLUSIONS

Smart Cities are on the rise throughout the world. Smart City initiatives are applicable in both urban environments and rural areas where networks and services are increasingly relying on Internet Communication Technologies (ICTs) and data-enabled technologies such as the Internet of Things, cloud computing and Artificial Intelligence in order to improve their citizens' lives, provide opportunities for local businesses, and solve the city's challenges in a reliable way that fosters sustainability.

China presents a unique case of a country that is moving very fast with the adoption of Smart Cities. Its unique characteristics, such as the ability to scale and implement successful top-down initiatives, has made this country one of the leading examples when it comes to the emerging technologies, as is the case of Smart Cities initiatives.

Among the key drivers to these efforts are the Chinese network operators and telecommunications providers, along with a number of multinationals that operate in China, such as Siemens, IBM, Schneider and Ericsson. Along with Chinese-based conglomerates such as Huawei and other numerous middle-sized Chinese companies, the adoption of Smart Cities applications of all sorts is developing at a fast pace.

Furthermore, an extensive set of goals with regards to Smart Cities is defined across many policy acts by the Chinese government, as is the rollout of NB-IoT is part of China Mobile's "Big Connectivity" strategy for the years 2016 to 2020.

Having said that, a lot of opportunities stemming from a massive market that is driven by organised initiatives and has leading technology suppliers - as well as a rapidly increasing market demand - are emerging for businesses.

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AUTHOR BIO

Christina Patsioura is a Senior Research Analyst at Beecham Research, with a particular focus on the Internet of Things (IoT) and Smart Services (areas include IoT Platforms, Industry 4.0, LPWA and telcos, Smart Cities).

Since 2015, she has been working as an IoT Industry Analyst in Germany and the UK, monitoring the overall market activity, performing analyses of companies and working with clients coming from the entire IoT value chain, namely technology and solutions providers, adopters of these technologies as well as companies who want to make investments in these areas. She has co-created IoT Pilot, the first vendor-independent online tool that assists adopters with the selection of an IoT Platform, she has co-authored an extensive report on Industrial Data Analytics and she has delivered conference presentations in events such as the IoT Tech Expo, Smart Cities Summit and Smart Manufacturing Europe.

She holds a MEng in Mechanical/Industrial Engineering and she has completed a thesis on the topic of Investment Analysis for the Telecommunications sector, towards the adoption of Smart Services and the network upgrade to support LTE technologies.

BEECHAM RESEARCH LIMITED (BRL)

Beecham Research Limited (BRL) is a leading technology market research, analysis and consulting firm established in 1991. We have specialized in the development of the rapidly-growing Connected Devices market – often referred to as M2M (machine-to-machine) and IoT (Internet of Things) – worldwide since 2001. We are internationally recognised as thought leaders in this market and have deep knowledge of the market dynamics at every level in the value chain. We frequently participate in conferences and organize our own events with partners.

We draw on many different processes and techniques to get great results for our clients, including a wide range of techniques for both nationwide and international surveys, often incorporating multiple languages. We also have representation and research partners in many parts of the world.

Our clients come from all parts of the value chain including: Hardware (silicon level, modules, gateways and terminals, user devices); Connectivity (network operators, connectivity providers – fixed, satellite, wireless); Solution Builders (system integrators, solution providers, application developers and platform services providers); Security Providers; Distributers: Enterprise Users.

We are experts in M2M/IoT services and platforms and also in IoT solution security, where we have extensive technical knowledge. We are the leading analysts in satellite M2M and Wearable Technology is also a primary area of activity. In addition to these, we provide wide-ranging support for business and sales development activities, including sales execution programmes.

Fibre Optics Will be the Backbone of Africa's Smart Cities Of the Future by Steve Briggs

Steve Briggs
SEACOM

Chief Commercial Officer

Right across Africa, municipalities and national governments are looking to transform major urban areas into smart cities. They envision cities where connected sensors and devices—such as smart traffic lights, CCTV cameras, drones and sensors—drive transport systems, emergency services, utilities like water and power, and even services such as garbage collection.

These sensors will produce massive pools of data that city managers can use to optimise the performance of infrastructure such as the power grid and water system and to manage urban problems such as energy efficiency, criminal activity and traffic congestion. Cities will have the big data at their fingertips they need to make informed decisions about housing development, deployment of police, and so much more.

For residents, too, the benefits are immense. The Digitisation of government services will allow them to enjoy seamless and reliable municipal services. Increasingly, they will also enjoy free Internet services provided by their cities, allowing them to easily access a wealth of government, educational, health and commercial services and information.

Fibre Optics Will be the Backbone of Africa's Smart Cities Of the Future by Steve Briggs

Commuters in Cape Town, South Africa, for instance, can already access Wi-Fi on the MyCiTi buses, as well as in many urban metros, allowing for the democratisation of internet access. In Kigali, Rwanda, a number of interesting smart city proofs of concept are currently been rolled out. Some examples include sensors in buildings to monitor air quality, smart buses with Wi-Fi connectivity, and a precision farming initiative that uses sensors to monitor water consumption and crop yields.

Rwanda is also home to one of the world's first commercial drone delivery services, using San Francisco-based Zipline drones to deliver blood to many of the country's blood transfusion centres. Orders are sent via text, phone, or WhatsApp, all reliant on a stable, integrated communication infrastructure. Such examples are just the beginning—but to take the smart city vision further, Africa needs access to high-speed, reliable communication infrastructure.

In particular, bringing the smart city vision to life will demand significant investments in Africa's fixed-line telecoms networks. One such investment, back in 2009, saw SEACOM launch the first submarine cable system along Africa's east coast, connecting people, governments and businesses to fast, affordable Internet services. More submarine cables followed off the east and west coasts, creating a resilient ring of fast connectivity.

Meanwhile, local and regional telecoms players have invested in connecting metropolitan areas in major economies with fibre, as well as in building national and regional fibre backbones to connect towns and cities to these submarine cables and the rest of the world. Many other elements of the ecosystem have come together for a boom in high-speed Internet access. An explosion in local data centres and the deployment of on-continent content caches have brought global content closer to the end-user, further improving their experience.

With fibre links from city-to-city and fibre rings around many key cities, the missing piece of the puzzle is ubiquitous fibre to the premises. The industry is making investments in fibre to the home and business, as well as LTE/4G in many of the larger cities, but we've only just begun. Much more must be done to deliver universal access to seamless, fast, high quality fibre connectivity in every African city.

Why fibre in a mobile-dominated continent like Africa? Because only fibre can truly deliver the high bandwidth and performance we will need in cities where millions of people use content-rich applications from their mobile devices and where millions more connected sensors, robots and automated systems gather data and talk to each other. Mobile technologies like 4G and 5G will have an instrumental role to play, but we'll still need fibre in the last mile, as well as the backhaul network.

Fibre offers the capacity to move large amounts of data at

Fibre Optics Will be the Backbone of Africa's Smart Cities Of the Future by Steve Briggs

high speed, with the ability to provide symmetrical upload and download speeds. It isn't as prone to theft and other environmental issues as is copper cabling, and it isn't constrained by the line-of-sight challenges or spectrum limitations faced by many mobile and wireless options. While installation can be expensive and lengthy, fibre is a good long-term investment for a city's future. What's more, new technologies are making deployment faster and cheaper.

Fibre provides the low latencies needed to support Internet of Things applications where responsiveness matters. For example, a city that hopes to one day introduce autonomous vehicles for public transport will need low-latency connectivity to deliver real-time information about road conditions to the vehicle. A second of poor connectivity-driven lag could be the difference between having or avoiding a collision.

Another benefit of fibre is its limitless capacity. Once the fibre is in the ground, boosting capacity is a simple matter of lighting up more equipment. As a dedicated resource, fibre allows each end-user to enjoy boundless capacity without much congestion. By contrast, wireless is a shared medium where end-users will vie for spectrum and latency is higher.

Though the technology is improving as we migrate from 3G to 4G and then to 5G, taking advantage of the new capacity demands massive upgrades to the network's core infrastructure. Many urban areas in Africa are not yet covered by 4G and some operators are still rolling out 3G—and a standardised version of 5G may still be years away. But fibre and Wi-Fi are already ready for the Internet of Things and the smart city. Fibre along with Wi-Fi is a great investment for cities because it leads to happy ratepayers.

The world's most connected and smartest cities are leveraging massive fibre networks to deliver their services, offering an illustration of the business case for African cities. Yinchuan, China—where pilot projects see people authenticate themselves for bus payments with facial recognition and where smart bins alert collectors when they are full—invested in an 8000GB fibre optic network.

Barcelona in Spain, meanwhile, is leveraging some 500 kilometres of fibre optic cable within the city for its strategy. It has deployed smart meters to monitor and optimise energy consumption and smart bins to optimise collection routes. There are sensors embedded in the asphalt to track whether parking spaces are in use to help drivers locate parking.

Barcelona estimates such improvements are helping it save $58 million on water and $37 million on power as well as to increase parking revenues by $50 million per year. Case studies like these are why we at SEACOM are putting fibre in the ground in African cities, one example being our first infrastructure project in Meyersdal, just south of Johannesburg in South Africa.

Connecting smart cities can even start in regions where local government and incumbent telcos aren't taking the lead. Private network operators are connecting office precincts and new residential complexes with fibre, so that they can take advantage of the latest technologies. Every office complex, university campus and housing development can be a small smart city in its own right, allowing people and organisations to take advantage of the latest technologies.

Smart office precincts will enable African organisations to embrace the cloud to fast-track modernisation of their IT infrastructures—in turn, allowing them to integrate with the global digital economy. For companies, benefits include seamless access to cloud-based applications such as those provided by Amazon, Microsoft, Google, Salesforce.com and a range of African service providers.

Fibre Optics Will be the Backbone of Africa's Smart Cities Of the Future by Steve Briggs

They will be able to more effectively use video for collaboration and provide richer digital services to customers and employees. Businesses will also be able to transform many elements of the workplace experience by rolling out smart office solutions. TenCent's new high-tech head-office in Hong Kong is a glimpse of the future. It will feature hologram tour guides, conference rooms that adjust temperatures based on attendance, and send alerts to visitors and workers about parking spots.

Residential fibre is an exciting opportunity, too. Fibre to the home in connected complexes will promote user-generated content and collaboration, especially on video, as people flock to Facebook, YouTube, Skype and so on, to share and communicate. As the end-user experience on the web improves, local content will proliferate and people will become content creators and drivers rather than mere consumers.

Homes will also become smarter, with people able to use sensors, cameras and other connected devices for a range of applications. They will be able to, for example, manage power consumption with devices like smart lighting and thermostat—promoting greener cities and relieving pressure on stressed power grids.

Smart sensors could be used to monitor water leaks, or even to track whether elderly people living alone are following their usual routine so that help can be mobilised if they're ill. Such applications can improve quality of life for individuals, while helping government to manage its resources more effectively.

The vision I've painted of the future shows why taking control of Africa's urban environments should be a priority for all stakeholders who want to ensure the prosperity and stability of the continent into the future. According to United Nations statistics, 62% of African urban residents currently live in slums. By 2050, Africa is forecast to be 54% urbanised with around 1.2 billion people living in cities—many of them megacities of more than 10 million residents.

The African telecoms industry, local government, national government, business, real-estate developers and other stakeholders should all be working together to plan the fibre networks African cities will need today, tomorrow and beyond. Fibre should be seen as a part of the city infrastructure that is as vital as water and power utilities.

Smart technologies, underpinned by robust fibre infrastructure, can help African businesses to become more efficient and more integrated with the rest of the world, thanks to the cloud. For consumers, social media, video streaming, and other rich media services will quickly form a part of everyday life.

Governments will be enabled to deliver richer electronic services – for example, health and education – to their citizens. And the technology could provide the level of data and automation we need to start resolving many of the challenges that African cities face today—from managing pollution and traffic congestion to improving urban planning and enhancing energy efficiency.

Fibre Optics Will be the Backbone of Africa's Smart Cities Of the Future by Steve Briggs

BIO

Steve Briggs is Chief Commercial Officer of Seacom where he oversees sales operations, helps optimise the company's product portfolio, champions digitisation, and drives superior customer experiences across the company's commercial and operational portfolio.

An experienced leader of digital technology firms in disruptive industries Steve Briggs has over twenty years experience in telecoms, banking, digital payments, digital products and operations. His experience includes time spent with both start-ups and major businesses including positions at Vodacom, Jasco, Standard Bank and MTN. He is based in Johannesburg, South Africa.

SEACOM

SEACOM is the preferred supplier and partner for African enterprises, network carriers and service providers, offering a full suite of resilient and scalable data services and a vast supply of high quality and affordable Internet bandwidth to Africa's growing ICT community.

SEACOM has the best and most advanced data network in Africa and has earned trust from carriers, MNOs and ISPs to deliver their international data connectivity through its ownership of Africa's most extensive ICT data infrastructure - including multiple subsea cables and a resilient, continent-wide IP-MPLS network – SEACOM provides flexible, scalable and high-quality communications services that enable the growth of the continent's economy.

SEACOM Business leverages its infrastructure and last-mile partnerships to provide the African enterprise market with best-in-class connectivity and cloud services at highly competitive prices. SEACOM Business now delivers data connectivity directly to corporates.

SEACOM is privately owned and operated, allowing it the agility to rapidly deploy new services, commercial structures and infrastructure in response to customer requirements.

Moscow's Smart History by Andrey Belozerov

Andrey Belozerov
MOSCOW DEPARTMENT OF INFORMATION TECHNOLOGY

Strategy and innovations advisor to CIO of Moscow - Moscow IT Department

Moscow Department of Information Technologies

Many smart cities and cities that wish to be smart are discussing the prospect of a bottom-up approach to city management. Moscow's experience clearly shows that this approach only works when the government has created an efficient digital environment both for internal managerial processes and for the citizens.

Moscow's path to being a smart city started in 2011, when the new mayor Sergey Sobyanin took office and the overall city development strategy underwent a number of major changes. One of the key initiatives was aimed at automation of all city functions. To implement this initiative, Moscow Government centralized the tech development within one department, and so the Department of IT was created. Since 2011, it was proven that such centralization leads to reducing costs thanks to economy of scale. It also made it possible to implement unified citywide standards for information systems and data processing.

Since 2011 Moscow has come a long way: it became one of the Top7 Intelligent Communities of 2017, became a finalist of the Smart City Awards in 2015 and 2016, and is frequently mentioned as one of the leading cities in smart city reports by leading analysts.

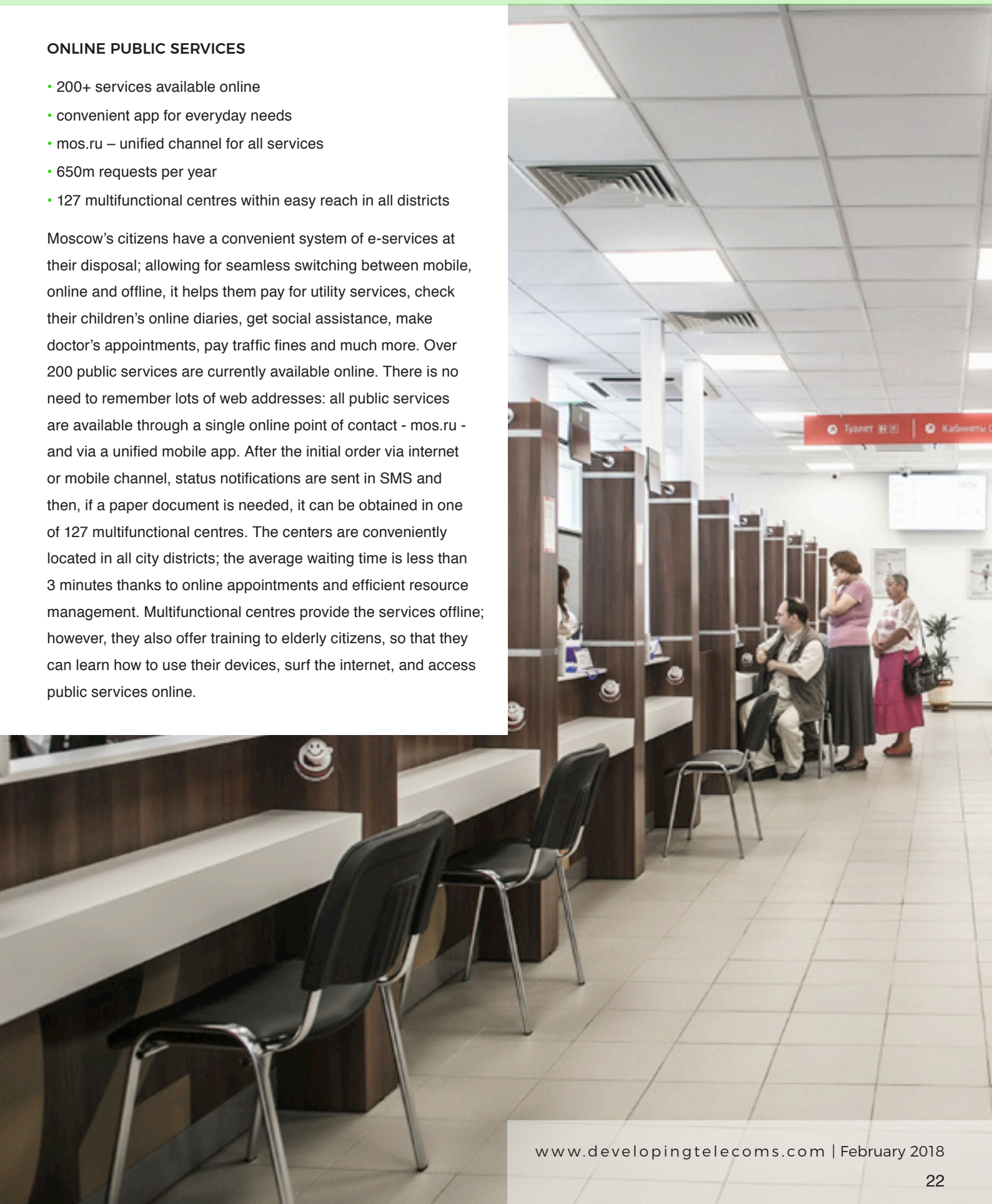
Our strategy is citizen-centric: we view the city as a service platform that provides easy access to everything that the Muscovites need, and even predicts their needs. A comfortable physical environment – well-kept streets, safe roads, accessible public transport network, and easily reachable recreational areas – makes a city liveable and lovable. Easy access to public services in all spheres saves the citizens' time and makes them feel like they are not on their own with their day-to-day tasks. They also have the possibility to take part in the decision-making process and have an easy-to-use tool to report any problems they see, engaging in direct communication with the city authorities.

Moscow's Smart History by Andrey Belozerov

ONLINE PUBLIC SERVICES

- 200+ services available online
- convenient app for everyday needs
- mos.ru – unified channel for all services
- 650m requests per year
- 127 multifunctional centres within easy reach in all districts

Moscow's citizens have a convenient system of e-services at their disposal; allowing for seamless switching between mobile, online and offline, it helps them pay for utility services, check their children's online diaries, get social assistance, make doctor's appointments, pay traffic fines and much more. Over 200 public services are currently available online. There is no need to remember lots of web addresses: all public services are available through a single online point of contact - mos.ru - and via a unified mobile app. After the initial order via internet or mobile channel, status notifications are sent in SMS and then, if a paper document is needed, it can be obtained in one of 127 multifunctional centres. The centers are conveniently located in all city districts; the average waiting time is less than 3 minutes thanks to online appointments and efficient resource management. Multifunctional centres provide the services offline; however, they also offer training to elderly citizens, so that they can learn how to use their devices, surf the internet, and access public services online.



Moscow's Smart History by Andrey Belozerov

HEALTHCARE AND EDUCATION

IMIAS – integrated medical information analytical system: 9m connected patients, 22,000 connected physicians, 660 connected clinics and labs

- cloud-based electronic health records
- 85m online appointments per year
- 25m e-prescriptions per year
- 97% of prescriptions are digital
- maximum waiting time is 20 minutes

IMIAS – Integrated Medical Information and Analytical System of Moscow – aims to make free medical services accessible, high quality and convenient. For patients it means fewer queues and easier appointment booking. For the health specialists, IMIAS means more time spent on communication with the patient and analysis of symptoms, as there is less paperwork to do and all the required information is readily available in patients' electronic medical records.

IMIAS covers all the outpatient facilities of the city. Medical institutions use IMIAS to manage patient flows, human and other resources, and the Moscow Department of Healthcare uses collected data for efficient decision making and governance.

- Moscow Online School: 980,000+ connected pupils, 65,000 connected teachers, 773 connected schools
- 800,000 units of online educational content
- online school diary and registry
- Wi-Fi in each classroom
- 15% growth of academic performance

Moscow's Smart History

by Andrey Belozerov

While some countries introduce regulations prohibiting use of mobile devices in school, Moscow is aiming to make the modern technology serve the educational needs. Today every school in Moscow has high-speed wireless network that enables "Moscow online school" platform to function. This centralized platform solves three main tasks: 1) organization and control of the educational process from teacher level to the level of Moscow Government; 2) equipping schools with up-to-date laptops, interactive whiteboards, and digital checkpoint systems; 3) provision of high-quality educational materials for all pupils.

Teachers, parents and pupils have access to online diaries and online class register. It is a unified system with separate interfaces for each group, so parents can not only check marks but also communicate with teachers online.

Lesson scenarios have substituted lesson plans. The teachers can use them as they are or introduce improvements, and the pupils can follow the scenario on their tablets during the lesson. The scenarios interface looks different for pupils and teachers: teachers have some additional tips, and pupils have tasks to perform and tests to complete.

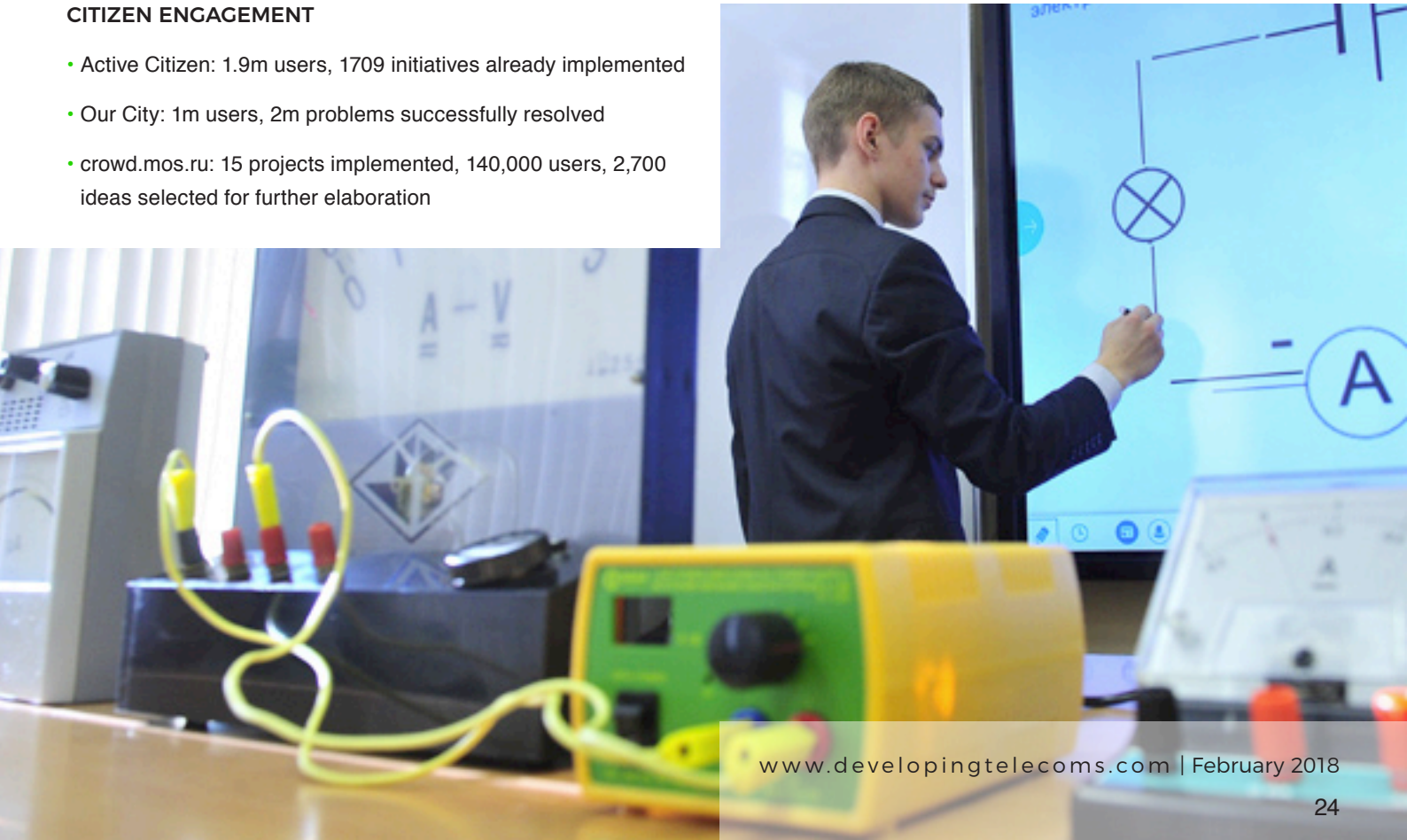
CITIZEN ENGAGEMENT

- Active Citizen: 1.9m users, 1709 initiatives already implemented
- Our City: 1m users, 2m problems successfully resolved
- crowd.mos.ru: 15 projects implemented, 140,000 users, 2,700 ideas selected for further elaboration

People in Moscow have the right to speak and they know they will be heard. The digital platforms Active Citizen, Our City, and crowd.mos.ru together form an easily accessible channel for communication with the city authorities without any middlemen.

Users of Active Citizen vote on public transport route improvements, speed limit restrictions, street renaming, educational programs, and make other decisions that matter to them. Our City is a platform to report problems, like slow garbage removal, potholes, or a broken swing at the playground. It saves expenses for inspectors and makes it possible to resolve the problems more swiftly. Crowdsourcing platform crowd.mos.ru is used for generation and discussion of new ideas on city improvement.

The highly developed infrastructure and e-readiness play a major part in the success of these platforms: 77% of Moscow citizens use smartphones, 99% of the territory is covered with high-speed 4G and broadband networks, and an average Moscow citizen spends 1% of income on broadband, so everyone is online and ready to resolve the problems and take part in city management.



Moscow's Smart History by Andrey Belozerov

TRANSPORT

- Intellectual Transport System: 1,900 cameras, 3,600 speed sensors, depersonalized geo data from mobile operators and 2,500 smart traffic lights
- Optimization of the public transport system: 350 000+ Moscow drivers have switched to public transport thanks to introduction of convenient routes and Troika unified payment card

The Intelligent Transport System of Moscow is aimed at traffic modelling and regulation. Thanks to the system, transportation systems are more safe and predictable for the citizens, and city authorities are able to manage them more efficiently. Regulation of traffic makes it possible to create convenient conditions for all drivers. City residents can see information on traffic situation on large screens installed along the roads. This information system helps drivers make reasonable decisions and choose appropriate route options.

The public transport routes are optimized based on data obtained by using GPS and GLONASS sensors that tracks their efficiency and speed. Apps for public transport users and car owners help them plan their routes more efficiently.

ENVIRONMENT FOR BUSINESSES AND TECHNOLOGY STARTUPS

- 90% of public services for companies are available online
- 12 business accelerators, 15 business incubators, 31 technology parks
- 70,000 technology companies

Businesses – from individual entrepreneurs to big companies – benefit from online public service systems just like the citizens. Today it is possible to register a legal entity online, obtain necessary permits, licences and accreditations, and get legal advice and support online. The government procurement system is open for all suppliers who wish to register on the city supplier portal.

Moscow is a fast developing technology hub, and the city authorities are determined to promote this development. Innovative companies can get grants and subsidies; they also profit from special conditions provided by research and technology parks. There are many initiatives aimed at lowering administrative barriers and promoting business in the capital of Russia, such as portals that provide essential information for start-ups and the development of small and medium-sized business and business incubators that help technology startups to grow. Moscow Innovation agency is a one-stop shop service for innovation enterprises, promotion and provision of information about opportunities for innovation activity in the city.

Moscow's Smart History by Andrey Belozerov

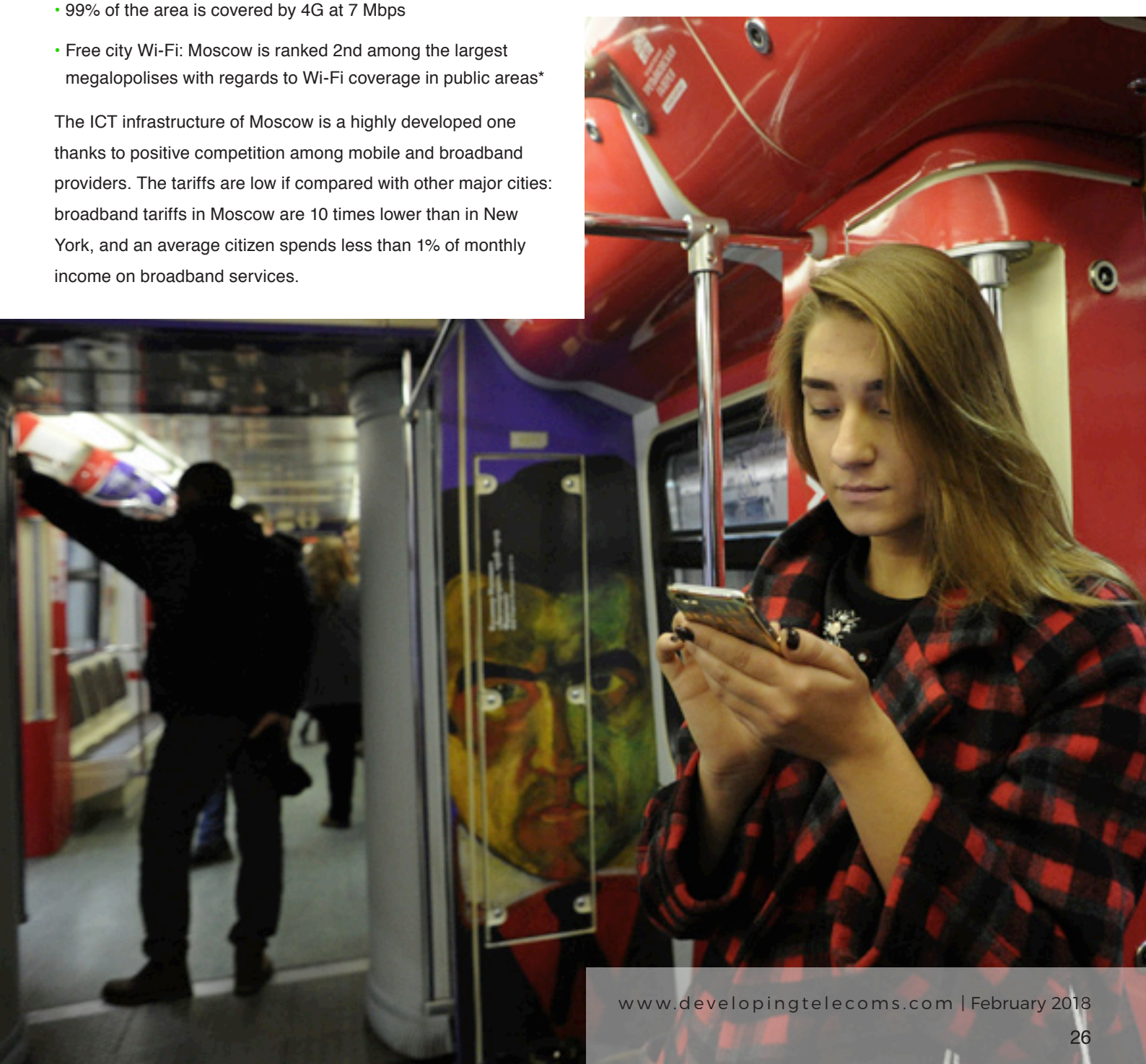
STRONG AND RESILIENT INFRASTRUCTURE TO HANDLE EXISTING TASKS AND MEET NEW CHALLENGES

The infrastructure of a smart city shall be capable of handling the existing tasks and, most significantly, be ahead of time and ready for future challenges.

- Broadband connection is available in 99% of the territory
- Low tariffs: an average Moscow citizen spends less than 1% of monthly income on broadband
- 99% of the area is covered by 4G at 7 Mbps
- Free city Wi-Fi: Moscow is ranked 2nd among the largest megalopolises with regards to Wi-Fi coverage in public areas*

The ICT infrastructure of Moscow is a highly developed one thanks to positive competition among mobile and broadband providers. The tariffs are low if compared with other major cities: broadband tariffs in Moscow are 10 times lower than in New York, and an average citizen spends less than 1% of monthly income on broadband services.

Moscow public Wi-Fi system is a joint project of the Moscow Government and private investors. The Wi-Fi system on the Moscow metro has no counterparts in the world: some cities have Wi-Fi access at the stations, but only Moscow provides access in the cars in the tunnels. There is also the public Wi-Fi network in the city centre with seamless handover. This system is being developed not just for the citizens' convenience; it is also used for data transfer by the city systems, being one of the backbone networks for existing and future IoT implementations.



Moscow's Smart History by Andrey Belozerov

DISRUPTIVE TECHNOLOGY FOR SMART MOSCOW – WHAT'S NEXT?

Blockchain: Moscow has become the first city to introduce blockchain in e-voting. Now users can monitor polls in real time and verify the authenticity of results. Every vote in Active Citizen becomes a publicly viewable transparent smart contract. Once the vote is placed, it will be listed in a public ledger consisting of all votes taken place across a peer-to-peer network. For now this is a pilot project.

Pre-delivery of public services: Today we provide over 200 services online. Pre-delivery will be the next step, meaning that a citizen doesn't need to apply for a service, as the state acts proactively. E.g., when a child turns 7 years old, his/her parents are automatically informed by the state authorities on 3 possible school options located in their neighbourhood. Another example is when citizens get reminders to change passports when they turn 20 or 45 years old. We are using big data to make this level of service possible.

AI and machine learning: we are currently uploading over 6000 computer tomography (CT) and X-ray images in our Artificial Intelligence systems teaching the machine to diagnose lung cancer and further diseases with the aim to support clinical decision-making. Our target is 97% success rate (this is actually a technological limit at the moment). We also use the data of Unified Medical and Analytical System to build decision-supporting system for the doctors and predictive analytics of illness frequency.

5G: Moscow government is currently in negotiations with private telecom operators regarding implementation of next generation 5G wireless networks. We are expecting to reach agreements with operators by the end of 2017. The installation of 5G stations in Moscow is planned for 2019-2020, so Moscow will become first world capital to switch to 5G.

VR and AR for education: we completed a pilot project and aim to replicate it in all Moscow schools. In the virtual labs pupils can carry out experiments that would not be possible in real life: use Geiger counters to measure uranium radioactivity or observe a cross-section of operating combustion engine. Biology lessons also become much more interesting in virtual reality, where pupils can study body systems and viruses via 3D models.

Video analytics: Moscow CCTV system, which features over 160,000 cameras throughout the city, uses advanced video analytics. Motion analysis makes the work with video archives much faster, and face recognition makes the city safer, allowing for fast search of missing persons and alleged criminals.

Moscow's Smart History by Andrey Belozerov

BIO

Andrey Belozerov
Strategy and Innovations Advisor to CIO of Moscow
Moscow IT Department

Andrey is a lifelong technology executive with deep expertise in delivering innovations in both governmental and commercial sectors. He joined Moscow Department of IT in 2011 and is now responsible for developing and implementing smart solutions for the city. Public city Wi-Fi, citizen engagement platform, system of online public services, and mobile apps for the Moscow residents are only a few among successful projects implemented in Moscow under his guidance. Before this role Andrey was in charge of Electronic Government initiative of the Russian Government.

Andrey is a frequent speaker at international conferences and forums, such as Smart City Expo World Congress (Barcelona), Arab Future Cities Summit (Dubai), ICF Summit (New-York), CeBIT Global Conference (Hannover), Mobile World Congress (Barcelona). In 2017 Andrey moderated Russia Singapore Business Forum at Open Innovations Forum (Moscow).

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MOSCOW SMART CITY LAB

Smart City Lab was created in 2016 to coordinate the processes aimed at smart city development and increase their efficiency, and today we are working on piloting new technologies in Moscow and integrating world best practices.

Beyond the Financial Sector: The Value of Blockchain in Smart Cities by Edwin Diender

Edwin Diender
HUAWEI

Vice President, Government and Public Utility Sector

Much has been written on blockchain, and most of the available information relates to the financial services industry and the so-called digital (or crypto) currencies, like BitCoin. So, what is blockchain? And what is the value of blockchain beyond the financial sector?

WHAT IS BLOCKCHAIN?

If a consumer buys something via the Internet, they will of course be required to pay. Typical online payment methods currently require the customer to fill out a form providing their contact information and bank details, then direct the buyer to a secure webpage to authenticate and authorize the payment. Following the transaction, they may be redirected to the online shop for further browsing or to close the session.

The redirection to a specific secured webpage to authenticate and authorize a payment is conducted via a third party; it is not a direct interaction between the customer and the online shop owner. This third party is the control mechanism for the online payment; in legal terms, it is the 'ledger'. In terms of information security, this third party function is prone to breaches and requires many mechanisms and cryptographic protocols to secure the whole process of authentication and authorization.

Blockchain is a principle where this third party is not required. Additional security mechanisms are also unnecessary, as they in fact expose multiple points of failure, and therefore multiple security risks. Blockchain appears to be a great leveller for preserving the safety and security of the exchange of value and information between two trusted parties.

In the financial services space, the utility of these benefits is very clear. But are there potential applications across other industries?

Blockchain also has clear potential applications across Smart City ecosystems. When constructing a Smart City, we encounter a complex mesh of systems across industry domains like transportation, energy, water, education, healthcare, etc. By centrally

Beyond the Financial Sector: The Value of Blockchain in Smart Cities by Edwin Diender

managing these sectors, a Smart City enables the sharing of data and capabilities through and across such systems. As sharing increases over time, the most innovative and widely adopted applications will establish the trend lines for intelligent infrastructure development, public service convenience, social management refinements, ecosystem health, and optimized industry structures.

HEALTHCARE

The potential for Blockchain in healthcare is apparent: medical specialists would surely welcome a means of securely exchanging value and information – and doubtless patients would appreciate this level of security in their communications with doctors or pharmacies. Blockchain technology could also be used to protect information sent between - for example - an MRI scanner and the application server that processes the medical images, or between computers used by medical specialists and the medical imaging database.

GOVERNMENT

In terms of government, the protection offered by Blockchain has clear applications for protecting data, particularly with regard to taxation or tax payments, which could be similar to the idea behind creating a two-party mechanism for online payments. However, securing the exchange of information between government departments and citizens could have many applications, such as the renewal of driving licences or passports, online visa applications, paying fines, registering births and deaths, or changing addresses. eGovernment platforms can be linked to different information systems and application servers using blockchain to secure links and exchange valuable information between systems and services.

This is particularly useful when a data centre is offline. Blockchains are able to provide a strong foundation for data redundancy between the connections in a distributed architecture. The technology can therefore be applied for replicating data in shared services centres, making it invaluable for recovering data following a disaster or unexpected event.

EDUCATION

Within the education sector, blockchain can be applied to online exams for students working remotely by securing the integrity of the answers between students and their teachers. In addition, it could be used for functions such as payment of student tuition fees, the safe and secure usage of online curricula, and accessing digital libraries.

TRANSPORTATION

For transportation, it is a logical next step to use blockchain for recording the payment of speeding tickets or other fines, road taxes, or toll fees. In the domain of 'connected cars,' blockchain will facilitate the secure exchange of safety-critical data between trusted terminals and endpoints. The exchange of information and value between cars and back-end processing systems can be built on blockchain.

PUBLIC SAFETY

To consider the impact blockchain can have in the realm of public safety, we have to consider the issue from three different angles: before an incident, during an incident, and after an incident.

For early warnings and notifications we look to incorporate information from camera and sensors that can be converged in the command centres.

During an incident, audio and video streams are overlaid onto GIS maps. Integrated reports and combined information streams are dispatched in real-time towards emergency response teams, and collaboration and real-time sharing are enabled across teams, departments and agencies.

After an incident, while investigations are underway in order to resolve cases, the time required for manual searches can be reduced by piecing together videos and images from a multitude of sources to search for and find candidates.

In each of these stages, the secure and safe exchange of value and information is required. The principle of blockchain in all these scenarios demonstrates the value of not needing third party solutions or components to achieve end-to-end security.

Beyond the Financial Sector: The Value of Blockchain in Smart Cities by Edwin Diender

BIO

Edwin Diender currently holds the position of Vice President, Government and Public Utility Sector, in the Global Industry Solutions Department of Huawei Enterprise, where he is focused on Smart City/Safe City Economics, eGovernment and Government Cloud, Big Data Analytics and Digital Transformation for Smart Cities.

Mr. Diender is experienced in digital transformation and bringing to-market concepts and solutions for Smart City/ Safe City and eGovernment, including Collaboration-enabled Business Process (CEBP), Big (Video) Data Analytics, and the Economics of Smart Cities.

HUAWEI

Huawei is a leading global information and communications technology (ICT) solutions provider. Driven by a commitment to sound operations, ongoing innovation, and open collaboration, Huawei has established a competitive ICT portfolio of end-to-end solutions in telecom and enterprise networks, devices, and cloud technology and services. Huawei's ICT solutions, products, and services are used in more than 170 countries and regions, serving over one-third of the world's population. With 180,000 employees, Huawei is committed to enabling the future information society, and building a Better Connected World.

Safer Cities: The Role of Local Government and Smart Technologies by Juma Assiago

Juma Assiago
UN-HABITAT

Global Coordinator of the Safer Cities Programme

The article focuses on UN-Habitat's Safer Cities Programme approach, applied to and institutionalised in cities through local government policies and programmes over the past 20 years. The approach is based on crime prevention principles and on the coproduction of safety and security for all. Its adaptation to technology innovations is a recent development at the level of data collection where cities/local governments are encouraged to use mobile phones to engage citizens in safety audits, specifically to bring out the perception of citizens on the safety of their streets and open spaces (the Safetipin application).

The UN-Habitat Safer Cities Programme is now entering its second phase with Huawei Technologies to develop a White Paper on Big Data for Safer Cities by November 2018 that will define the set of baseline indicators for local government crime prevention policies to measure their interventions on the local governance of safety. These indicators will largely be process-oriented indicators, and will inform future development of a city safety monitoring system in line with the 2030 Development Agenda and the New Urban Agenda. Subsequently, with Korea Land and Housing Corporation, UN-Habitat shall establish a Global Award on Smart Safer Cities to incentivise cities to advance/review their existing crime prevention policies with a lens on smart technologies.

Since the 1980s, the notion of crime prevention has expanded and evolved substantially, from being seen as a relatively narrow policing function to one which involves a much broader transversal approach, and multiple state and community actors. This has mirrored a more general shift among governments away from assuming exclusive responsibility for safety and security for all their citizens, acknowledging the limitations of their ability to provide such security. It can also be linked to the evolution of policing approaches away from centralised and hierarchical models, to more community-based and problem-solving approaches which engage with the concrete concerns of local citizens. Finally, it is in recognition that relying only on the criminal justice sector, in terms of policing, court systems or correctional facilities, is not a sufficient response to crime and its control, much can be done to prevent crime and victimisation before the intervention of the justice system.

Safer Cities: The Role of Local Government and Smart Technologies by Juma Assiago

It is now recognised that prevention takes many forms, that it involves many sectors and levels of government and civil society, and that local authorities and communities have a major role to play, supported by strong sub-regional and national strategies and policy. There is accumulating evidence that many prevention programmes are not only effective in reducing offending and victimisation, but cost-beneficial, resulting in considerable long-term savings for the investment entailed, and bringing social and economic benefits well beyond reductions in crime.

This evolution in crime prevention has been marked at the international level by the development and adoption of standards for crime prevention, which are an essential component for encouraging and guiding the development and implantation of good policy and practice. These have included the technical guidelines for crime prevention adopted in 1995, and the UN Guidelines on Crime Prevention adopted by ECOSOC in 2002 (UNODC, 2002). These Guidelines lay out the principles on which good crime prevention policies need to be based, and the steps which should be taken to establish supportive governmental policies at all levels. They also underline the important role of local government in setting up sustainable prevention policy and practice on safer cities. With new lessons learnt on over two decades of local government practice on crime prevention, in line with both the new global plans of action – the 2030 Development Agenda (SDGs 2030) and the New Urban Agenda (NUA) - UN-Habitat is set to release new UN system-wide Guidelines on Safer Cities in April 2019 to further guide the integration of crime prevention policies in local government-driven urban strategies and interventions.

Yet this evolution has also occurred during a period when crime and its control have increasing come to dominate public concern and political agendas in many countries. Insecurity about crime and violence among citizens is only partially related to increasing rates of crime. Fear levels remain high in the new millennium, even though crime levels have fallen considerably, especially in North America and Europe. Greater media attention to crime and a more generalised sense of insecurity and concern with minimising risk is now evident, particularly over the last decade.

International communications technology and the reporting of incidents and violent events have become so fast and extensive, that it is now much more urgent to look at how countries and cities are responding to these challenges. Yet the exponential changes in communication have also made it much easier to exchange experience and practices internationally. Crime policies and practices are beginning to travel and expand at a much faster rate than has been the case even in the recent past.

With the growth of crime prevention practice internationally has come a range of associated concerns and problems: about the appropriateness of interventions, including the impact of security technologies on quality of life in cities, the difficulties of evaluating their effectiveness, of the capacities of local actors to implement good programmes, about the difficulties of sustaining interventions beyond their initial pilot phase, or scaling up to city-wide or country-wide applications, and about the difficulties of sustaining interventions after changes of personnel or government.

'What works' in crime prevention does not depend solely on having well-designed programmes. Much depends on the capacity of the actors in the field to establish the conditions for implementing programmes well, and to manage the 'process'. It also depends on policy makers understanding the need for longer-term investment and planning, and not focusing only on short-term results. Ensuring that strategies are maintained, well-monitored and sustained beyond the life of a government is a further challenge.

One of the major lessons learned about policy transfer from one country to another in the past ten years has been that

Safer Cities: The Role of Local Government and Smart Technologies by Juma Assiago

local conditions, local needs and local constraints must be taken into account. Programmes which have been carefully developed and replicated in one setting and found to be effective in reducing crime or insecurity may not work in another country or city. This has been well demonstrated in Africa with the UN-Habitat Safer Cities Programme pilots; for example, where some city crime prevention policies approaches developed with the model of the north have proved to be inappropriate for a highly centralised African system of government. But even among developed countries, it is clear that programmes are rarely precisely replicable.

Smart Technologies require more than ever before to take into cognition these realities on the nature, trend and causes of crime to provide better fit to support sustainable crime prevention in cities and at the local level. For instance, the development of the Safetipin app in India has prioritised the need for using mobile technology as an innovative method to collect data with citizens' engagement using a previously developed manual version of UN-Habitat's safety audit tool. The safety audit is a way of examining spaces in cities to determine what exactly makes it safe or unsafe. While the safety audit tool has been used over the past decade, it has been used primarily as a qualitative method of data collection. The key innovation of Safetipin is to take this qualitative methodology and transform it into a quantitative method culling out the key factors that appear to have an impact on women's feeling of safety in the city. The Safetipin app has now assumed a global profile using eight variables - lighting, openness, visibility, presence of people, presence of women, nearness of public transport, state of the walk path, and visible policing or security to populate crime hotspots based on the perception of citizens in streets and open spaces. Based on the data collected, a Safety Score is given to areas. For example, in Delhi city alone, the app has recorded over 10,000 points that have been audited. With Safetipin data collection, it is possible to cover large parts of the city with safety audits. While a lot of data exists about the conditions of streets and cities, none of it is taken at night after the city turns dark. We know that this is the time that women feel most unsafe and insecure in cities and thus need to improve the situation at the time. Furthermore, the app is now in a new innovative piloting whereby a camera is mounted on a moving vehicle to capture photographs of the street across the city at night. Based on these photographs, codification is carried out and these pictures are examined on the same eight criteria, resulting in safety audits across the city. The advantage of this app is that data can be collected at regular intervals to measure change and impact of certain programmes and interventions undertaken by stakeholders.

As a next phase, to reinforce the use of such data collection apps to provide a source for concrete actions, UN-Habitat Safer Cities Programme has entered into an agreement with Huawei Corporation to work towards the establishment of a local government-driven city safety monitoring system. This will require partnerships to be forged between private sector and city government stakeholders so that local governments are collaborators in using this data and deciding the areas and intervals of data collection so that they can effectively measure change. Through this agreement, a White Paper on Big Data for Safer Cities will be developed, establishing key performance indicators for local government-driven crime prevention policies by end-2018.

In addition, in September this year UN-Habitat Safer Cities Programme and the Korea Land and Housing Corporation will roll out a global cities incentive scheme for cities - 'the Global Challenge on Smart Safer Cities" to assist cities to conduct peer to peer reviews of their existing crime prevention policies and to further implement them integrating smart technologies to enhance transformation, efficiency and effectiveness towards making cities safer.

Safer Cities: The Role of Local Government and Smart Technologies by Juma Assiago

AUTHOR BIO

Juma Assiago, an Urbanist and Social Scientist, is the Global Coordinator of the Safer Cities Programme at UN-Habitat. He holds a Masters of Science degree in Sustainable Urban Development (Oxford University, United Kingdom). He has accumulated 18 year international working experience providing technical support to both national and local governments on the development and implementation of city crime prevention and urban safety strategies.

UN-HABITAT

UN-Habitat is the United Nations programme working towards a better urban future. Its mission is to promote socially and environmentally sustainable human settlements development and the achievement of adequate shelter for all.

Cities are facing unprecedented demographic, environmental, economic, social and spatial challenges. There has been a phenomenal shift towards urbanization, with 6 out of every 10 people in the world expected to reside in urban areas by 2030. Over 90 per cent of this growth will take place in Africa, Asia, Latin America, and the Caribbean. In the absence of effective urban planning, the consequences of this rapid urbanization will be dramatic.

In many places around the world, the effects can already be felt: lack of proper housing and growth of slums, inadequate and out-dated infrastructure – be it roads, public transport, water, sanitation, or electricity – escalating poverty and unemployment, safety and crime problems, pollution and health issues, as well as poorly managed natural or man-made disasters and other catastrophes due to the effects of climate change. Mindsets, policies, and approaches towards urbanization need to change in order for the growth of cities and urban areas to be turned into opportunities that will leave nobody behind. UN-Habitat, the United Nations programme for human settlements, is at the helm of that change, assuming a natural leadership and catalytic role in urban matters.

Success Stories: Development of Smart Cities in the Mobility Sector by Nicolás Grandón

Nicolás Grandón
MINISTRY OF TRANSPORTATION AND TELECOMMUNICATIONS OF CHILE

Head of the Smart Cities Division

In Chile, the automotive fleet has increased by 114.2% in the last thirteen years (2,218,062 to 4,751,130 vehicles between 2002 and 2015)[1]. This explosive growth has generated greater pressure on road infrastructure and associated services, as well as the agencies that carry out transportation planning and management. The management of mobility has become more complex, forcing the authorities and the private sector to adapt to this new scenario. In this context, the implementation of Intelligent Transportation Systems (ITS) in urban areas has become an effective tool for mitigating congestion - and therefore the harmful effects of it – as well as increasing safety levels and making the transport system as a whole more efficient in terms of traffic management, inspection, operation of public transport, and urban logistics operations.

[1] National Institute of Statistics (INE)

Ciudades Inteligentes
Una mejor movilidad la construimos entre todos

1. SMART CITIES THROUGH MOBILITY: A CHILEAN CASE STUDY

In the case of Chile, Santiago began its transformation into a smart city by looking for technological solutions through ITS and complementing these with the incorporation of other ITS technologies in the field of public transport and inspection.

Once the city was prepared for answers, protocols and dynamic and complex emergencies, it was propitious that in the following years an approach was incorporated where new players recognized the importance of mobility, exercising their participation and role in the city. More active, informed and determined citizens require a suitable institutional government counterpart. For this reason, the incorporation of this line of work began in 2011 at the Ministry of Transport and Telecommunications, resulting in the 2012 creation of the Smart Cities Unit (UCI). By understanding that mobility concerns all of us - and therefore everyone can contribute to it – cities become a collaborative effort for their inhabitants, using tools of social innovation and technologies that allow designing and implementing sustainable integral solutions for the delivery of better services. This vision is outlined in the Smart Cities Strategy for Transport Chile 2020 presented in 2014.

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2. INTELLIGENT TRANSPORTATION SYSTEMS AS A TECHNOLOGICAL BASE TO MOVE TOWARDS SMART MOBILITY IN CHILE.

2.1. THE TRAFFIC CONTROL OPERATIVE UNIT (UOCT) IN CHILE.

The first example of ITS came about at the beginning of the 90s, when the Traffic Control Operative Unit (UOCT) was created: a technical unit in charge of operating and managing the network of traffic lights and traffic monitor cameras in Santiago de Chile.

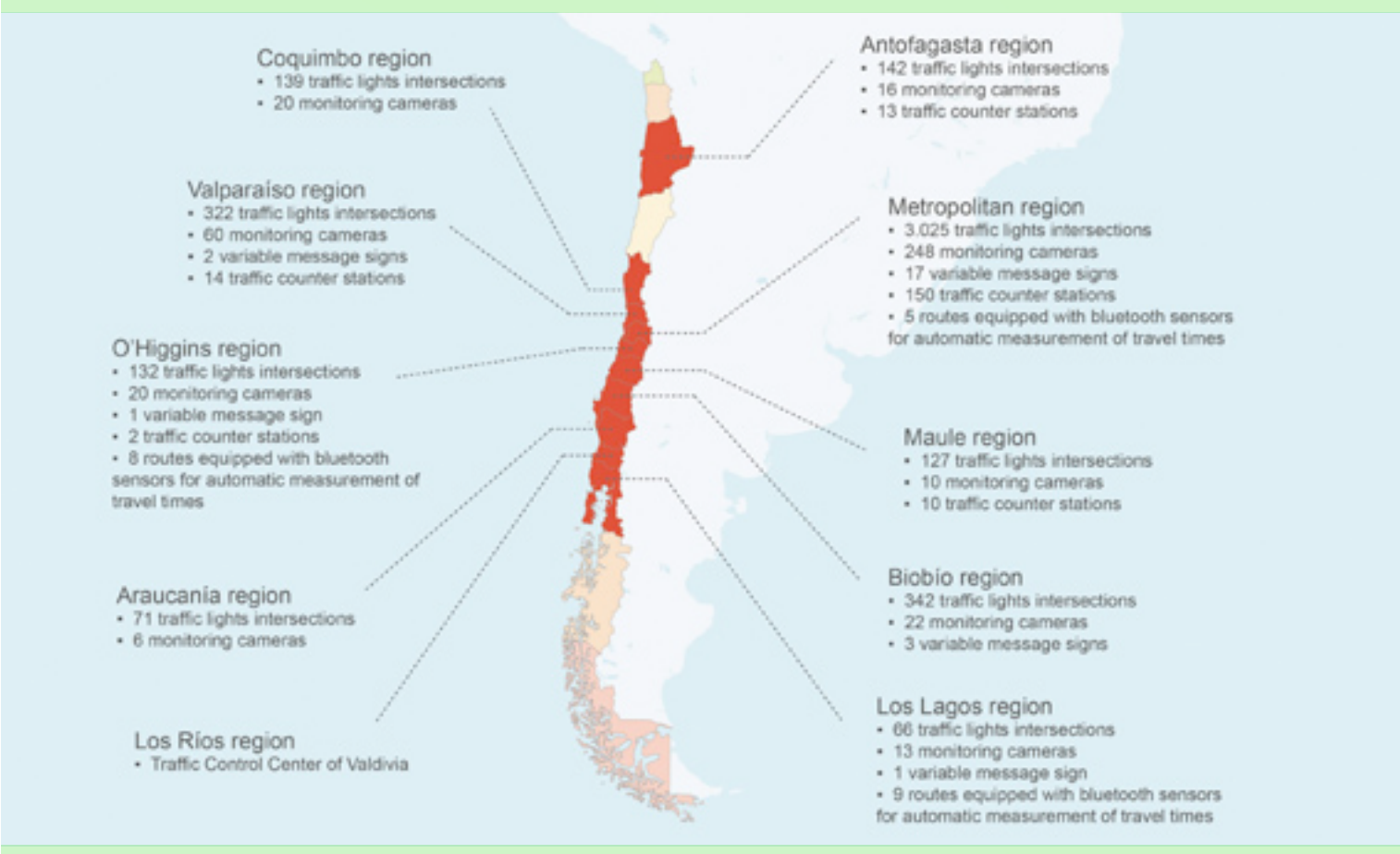

Figure 1: UOCT in Chile 2017.

The UOCT, currently deployed in 10 regions of the country, is responsible for managing and operating traffic control systems and other complementary support systems, such as closed television circuits (CCTVs) located at key points in the city, variable message signs (VMS) for drivers on the roads, vehicular automatic counting stations, and other ITS elements. It has a centralized traffic control system, which allows for real time managing and supervising of the operating conditions of traffic light intersections integrated in the system. One of the main characteristics of this control system is that it allows monitoring and modifying the schedules of each traffic light online, or to implement special programmes for traffic lights during mass events.

2.2. TECHNOLOGICAL ADVANCES IN URBAN HIGHWAYS IN CHILE.

The electronic toll payment in Chile was established as a national standard since its implementation by the urban road concessions

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in 2004 in the city of Santiago. In the private sector, deploying ITS in concessioned highways represents another use case for the transport sector. In Chile, the urban highways have different technologies; one of them is the free flow toll collection system (free flow), which operates through an electronic device called TAG which is interoperable on multiple urban highways. The device emits magnetic signals captured by the gantries' receivers which are interpreted by the system to then remotely charge the toll fee to the vehicle's owner.

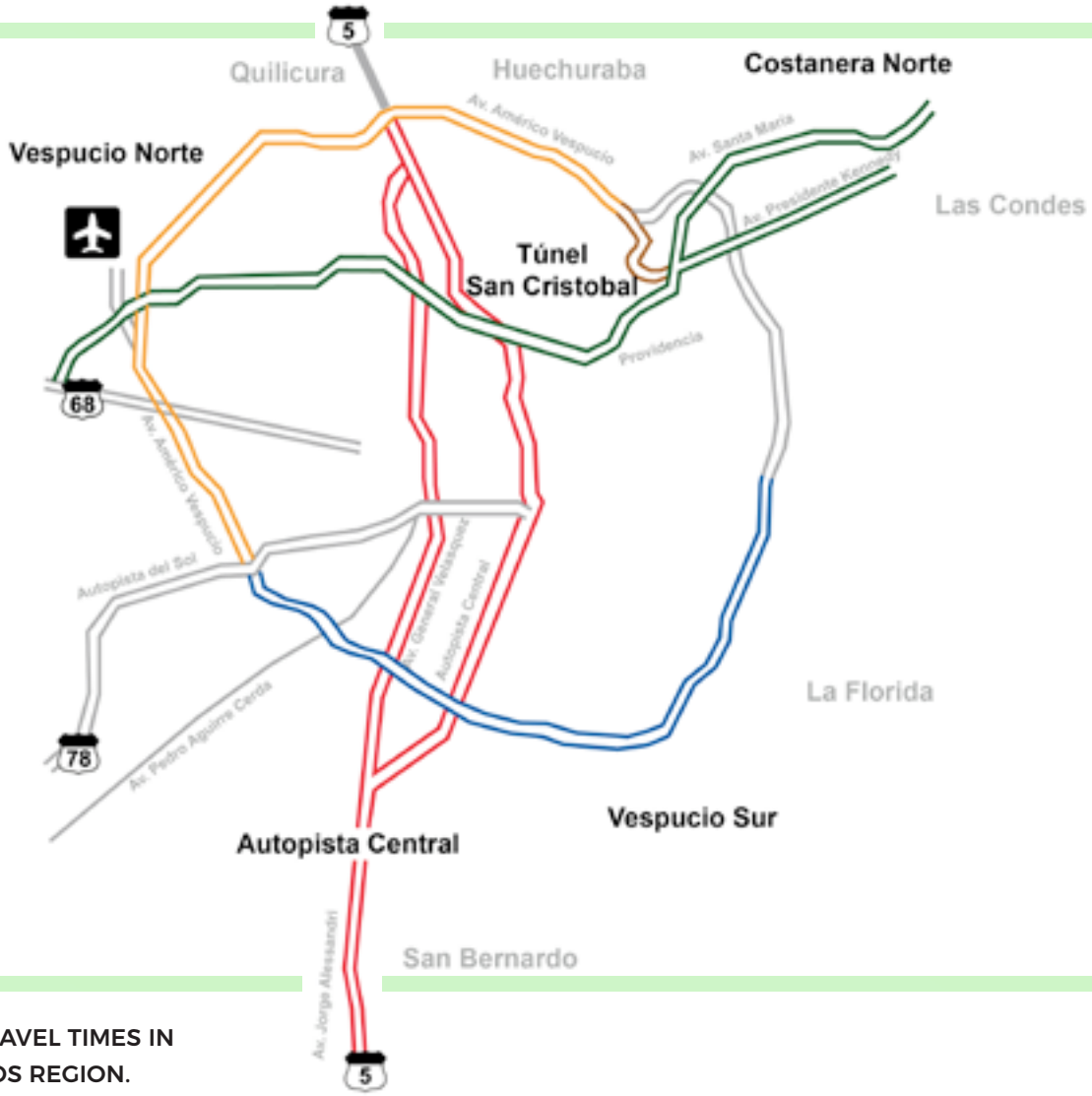

Figure 2: Urban highway network concessioned in Santiago - Chile.

2.3. MEASUREMENT OF TRAVEL TIMES IN PUERTO MONTT, LOS LAGOS REGION.

One of the first projects led by the UCI was the implementation of sensors with bluetooth technology to measure travel times in the city of Puerto Montt. This project consisted of developing an automatic online measurement and information system for travel times for users, which was divided into two stages.

The first stage was a pilot project in 2012, which implemented sensors and made to determine approximate penetration levels of the active devices in the test vehicles across the specific routes.

The second stage began in 2014. Sensors were installed on three alternative routes that connect a more elevated sector with the city centre, thus providing continuous information on variable message signs that allow better travel planning.

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Figure 3:

Travel Times Project, with Bluetooth technology, Puerto Montt - Chile.

2.4 INTELLIGENT TRANSPORT SOLUTIONS IN THE METROPOLITAN REGION

The metropolitan public transport in Santiago has offered an ideal scenario to take advantage of the potential of technologies since its implementation in 2007. Technologies on board the bus can provide all the necessary elements that allow transport service providers and the responsible authorities to gather information to improve control and management of the public transport fleet. In addition, during the currently ongoing process of redesigning the metropolitan public transport system of Santiago, connected technological equipment such as cameras and validators are expected to be incorporated in order to increase opportunities for system improvement. The urban public transport systems of other major Chilean cities have also incorporated GPS systems with the aim of improving the control of the fleets.

2.4.1. PAYMENT TECHNOLOGY IN THE METROPOLITAN REGION PUBLIC TRANSPORTATION SYSTEM

The transport system of the city of Santiago is fully integrated in operational terms, in its tariff management, and in its technological component.

Operationally Integrated: allows users to transfer from one service to another to complete their trip, independently of transport mode (Bus, Metro, Train, other).

Integrated Tariff: The price for accessing transportation services is based on the concept of travel, which is defined as the transfer of a person using different transportation services within a defined time range. Each of the transport services that participate in a single trip constitute its sections, and the rate scheme must recognize each segment to integrate and generate the final price according to the integration rules determined by the Ministry of Transport and Telecommunications.

Technologically integrated: it includes the devices, equipment, applications, systems, processes and decisions required for the provision of complementary services that are common and affect all the players in the System.

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2.4.2. INCORPORATION OF ELECTRIC BUS FLEET

In terms of improving the quality of public transport throughout the country and as a way to contribute to actions that mitigate climate change, the Ministry of Transport has opted to push the incorporation of electric buses. So, in mid-November of 2017, the first electric buses were incorporated into the fleet of the Metropolitan public transport system of Santiago, and a total of 90 units is expected by 2019.

In this context, the Ministry has encouraged the creation of a public-private consortium to jointly address the challenges that this technological transformation entails in public transport buses in Santiago and the country, including operational character, cargo infrastructure, human capital development, and more.

2.5. RAILWAY TRANSPORT

In the field of outstanding rail transport, we have the experience of Metro in Santiago, Valparaíso and Metrotrain in Concepción, all featuring different technologies and characteristics for their operations.

2.5.1. METRO SANTIAGO

Founded in 1975, Santiago Metro covers the Metropolitan Region of Santiago.

This subway is one of the most modern systems in Latin America, being the second longest after that of Mexico City, and it is the seventh most regular in frequency worldwide. Currently, it has 6 lines, 118 stations, 1154 wagons and an extension of 118 km, well below the approximately 2900km covered by the Transantiago system (Bus). Through it, around 2,266,000 passengers are transported daily, fulfilling an articulating role in the city's public transport system, as it is integrated with other means of transportation in the city.

In November 2017 the subway line 6 was inaugurated, introducing automatic piloting technology, optimizing travel times and offering greater precision when stopping at a station. Currently, line 3 is under construction and it is expected that in the coming years it will be inaugurated.

2.5.2. METRO-TRAIN CONCEPCIÓN

The Metro-Train of Concepción, founded in 1999 and remodelled in 2005, is a metropolitan suburban railway system, which covers part of the Concepción. It provides services to Talcahuano, Hualpén, San Pedro de la Paz, Coronel, Chiguayante and Hualqui, all of them in the Biobío Region.

The Metro-Train, also known as "Biotrén", had a track extension of 66.6km, divided into urban and rural areas, with different travel times, two lines with 25 stations, transporting around 18,000 passengers a day. The most important features are the Intermodal Stations (EIM) that have integrated bus synchronization (BIOBUS), bicycles (BIOBICI) and Taxis (BIOTAXIS).

2.5.3. METRO VALPARAÍSO

Valparaíso Metro founded in 2005, making it the newest line. Its network covers part of the cities of Valparaíso, Viña del Mar, Quilpué, Villa Alemana and Limache, all of them in Valparaíso Region. Also known as Merval, it consists of 35 carriages, a track extension of 43Km, and a line with 20 stations, transporting around 20,567,000 passengers per year. This Metro is an intermodal Bus-Metro system that connects the communes of Quillota, La Cruz and La Calera at Valparaíso Region.

2.6. USER INFORMATION SYSTEMS FROM THE PERSPECTIVE OF SMART CITIES IN CHILE

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2.6.1. TRANSPORTEINFORMA (TRANSPORTATION REPORT)

TransporteInforma is one of the Smart City initiatives that the Ministry of Transport and Telecommunications has promoted in recent years with the aim of providing comprehensive, reliable, useful and timely information regarding the state of the various transport services in the region. It is currently available in the Coquimbo region, Valparaíso region, Metropolitan region, Biobío and Los Lagos regions. The initiative seeks to contribute the development of cities, improving connectivity and supporting the decisions of the people, through collaborative work between the different players in the region.

The web "www.transporteinforma.cl" is divided into sections that provide the user with access to information according to their needs, such as a news section in which there is timely and updated information on traffic events that are affecting the normal functioning of the different transport services. This information is divided in programmed incidents - which are those that report alterations previously defined for different reasons - and last minute incidents which are unforeseen events that happen in real time.

2.6.2. TRAVEL PLANNERS IN PUBLIC TRANSPORTATION

Travel planners are tools that allow users to plan their trip on public transport at cities via a platform.

Through an interface, the user enters their origin and destination, and the tool will show the optimal route and transport services for the journey, as well as provide information on combinations with other transport modes (depending on the region), nearby stops, itinerary, and the approximate time of transfer to the destination. The types of transport that are integrated in these systems are: Buses (rural or urban), Metro, Trains, Ferries and Barges.

The standard General Transit Feed Specification (GTFS) is used to consolidate the data in order to characterize the public transport system by grouping information on routes, trips, operators, itineraries, transfer times, georeferencing of stops, fares, and other factors related to public transport.

Currently, the Ministry of Transport works through collaboration agreements with Moovit apps and Google Transit, with 17 and 12 cities respectively, which have these services.

2.6.3. INTEGRATED MOBILITY CENTRE OF CONCEPCIÓN, BIOBÍO REGION

The Integrated Mobility Centre is located at Concepción, the second most populated conurbation in the country after Santiago. It is the result of an initiative outlined in the Smart Cities Strategy for Transport Chile 2020, born in a context where the demand for public transport has increased by 39% of daily trips in the last 6 years. There is likely to be significant increase in exclusive lanes for public transport, which will also increase signalized intersections connected to the local UOCT. New investment initiatives in mobility are projected, boosted by the pressure exerted by the growth of the vehicle fleet (40% increase between 2010 and 2015)2 and the potential represented by the high use of the public bus transport system and the suburban train connects to the main communes of the conurbation.

In this context, we want to advance in the implementation of the first Integrated Mobility Centre, whose objective is to improve the supervision, management, coordination and increase the capacity of response to programmed events, incidents and emergencies that affect mobility, optimizing the operation of the transportation in the city of Concepción.

2 PyD-SECTRA, based on MOP-Minvu, June 2017

2.6.4. INNOVATING IN AN OBSERVATORY OF URBAN CARGO TRANSPORT

Urban cargo transport plays a key role in the economic development of cities, representing a fundamental part of commercial activity and services, generating a direct effect on

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the final costs of the product consumed and creating a high impact on the efficiency of the economy in the region.

In this field, the Ministry has promoted - together with the academy and the Development Corporation for Productivity (CORFO) - the creation of an urban cargo Transport Observatory that seeks to generate and analyze relevant and timely information on the movement of cargo in the Metropolitan Region of Santiago, with the purpose of providing and contributing information that allows the improvement of coordination between players in the chain, increasing the competitiveness and efficiency of companies and institutions linked to urban cargo transport in the metropolitan region, reducing information asymmetries, and helping guide public policies aimed at reducing the impact of urban cargo transport on the living conditions of citizens.

2.6.5. PROMOTING A CULTURE OF INNOVATION AND ENTREPRENEURSHIP IN MOBILITY

The transport system plays a key role in the level of competitiveness of cities, and transversally supports the system of activities that compose them. Improvements that are sought for mobility in an urban context require the collaboration of all those who are part of it; the creation or strengthening of ecosystems of innovation around transport that empower collective intelligence, public and social innovation and citizen participation will therefore allow for the mitigation or solution of problems in mobility.

In recent years, the creation of permanent and sustainable spaces for co-design, co-creation (living labs), and urban laboratories (urban labs) for technological innovations in transport - where work has been promoted together with Universities, Technical Training Centres and incubators - has been key in bringing together knowledge societies, in the collective search for solutions that help solve local problems.

3. CHALLENGES AND NEXT STEPS IN THE CONSTRUCTION OF INTELLIGENT MOBILITY IN CHILE.

In the technological field, the main challenges of smart mobility for the cities of Chile are to:

- Develop the Electromobility Strategy with a focus on Public Transport.
- Advance in the creation of the Integrated Mobility Centre
- Advance in the ITS architecture for the improvement of the interoperability of the technological systems
- Develop open data platforms in real time - Improve and sophisticate the delivery of information to users
- Expand the coverage and the creation of new knowledge around the Urban Cargo Logistics.
- Advance in the sensorization and adoption of Bigdata's analytical tool to support mobility management and planning
- Advance in the understanding of the Autonomous Vehicle.

Success Stories: Development of Smart Cities in the Mobility Sector by Nicolás Grandón

BIO

Nicolás Grandón is the Head of the Smart Cities Division of the Ministry of Transportation and Telecommunications of Chile. As a Telematic engineer, he has a 7 year experience in management, promotion and development of social and technological innovation initiatives aimed at improving the mobility of people in cities, from a Smart City approach.

The Smart Cities Unit is part of the Planning and Development Coordination of the Undersecretary of Transportation of Chile. This Unit was created under the principles of collaboration, innovation and participation in order to incorporate a more integral and collaborative approach to transportation and answer new issues of mobility arising in our cities.

MINISTRY OF TRANSPORTATION AND TELECOMMUNICATIONS OF CHILE

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Global Problems within a Local Setting: Africa and the Future of Smart Cities by Pablo Tomasi

Pablo Tomasi
IHS MARKIT

Senior Analyst, Smart Cities & IoT

Africa is a unique region as it holds the promise of massive growth and opportunities while at the same time facing multiple unique obstacles and roadblocks. Compared to more mature markets, one of the key problems slowing down the development of smart cities across the region is the presence of needs that cannot be resolved by IoT or smart cities solutions. For instance, in more mature markets where electricity is widely available and reliable, utility companies now face the dilemma of how to improve service and how to increase customer engagement. However, in markets where access to electricity is a problem on its own, connecting households to the electric grid becomes the first and foremost need for cities and rural areas.

SETTING THE SCENE:

The population in Africa is growing fast, with the continent's urban population set to reach 60% of its total by 2050. Rapid population growth and a strong trend towards urbanization results in increasing stress on cities' infrastructure and services. In order to secure services and quality of living, these problems need to be addressed by new solutions with the help of ICT technology and innovation.

So far Africa has only seen marginal investment in smart cities, and as of the third quarter of 2017 - according to IHS Markit's Smart City Database - Africa-based smart city projects represented only 2.1% of total projects. However, the growing population and urbanization mean an increasing need for the continent to look at smart cities as a beacon towards a sustainable future.

Global Problems within a Local Setting: Africa and the Future of Smart Cities by Pablo Tomasi

TECHNOLOGY TO DELIVER SMART CITIES IN AFRICA: THE ROLE OF LOW POWER WIDE AREA NETWORK (LPWAN)

The first building block for any IoT and smart city application is connectivity, and currently there is a plethora of competing technology standards. Connectivity technologies can be wireless or wired using licensed or unlicensed spectrum, long or short range, and supporting large or modest data transmission. While different technologies address different needs and diverse use cases, low power wide area network (LPWAN) technologies are well suited for many (albeit not all) smart city applications given their long reach, low power consumption, deep coverage, cost-effectiveness, and relative simplicity of deployment and management. With their numerous advantages, LPWAN technologies can play a leading role in the development of smart cities and smart communities in Africa. From proprietary technology such as LoRaWAN, SIGFOX, and RPMA to 3GPP standards such as NB-IoT and LTE Cat-M1, multiple technologies are competing to dominate smart cities.

In Africa, all issues affecting the global smart city market are heightened, hence business model and costs - which are common roadblocks across all markets - become of primary importance. Consequently, low pricing becomes an essential feature of any connectivity technology. Along with pricing, the presence of a large ecosystem is key for any technology. With cities at a very early stage of smart city development, there is a huge opportunity for multiple projects delivering various benefits, therefore cities may look at technologies that can guarantee a strong ecosystem capable of supporting multiple applications and projects with its products and services.

While recently the global market has been shaken by the aggressive deployment of NB-IoT and LTE Cat-M1, the African continent has remained relatively excluded from these new technologies. This is because both technologies – standardised in June 2016 – rely on licensed 4G spectrum and thus require the existence of LTE networks. So far, the African region has demonstrated a limited interest in 4G and this means that NB-IoT and LTE Cat-M1 will only play a marginal role in the smart cities and IoT developments of the next few years. NB-IoT could play a relevant role in fostering smart cities only in countries characterised by a more widespread coverage and deployment of 4G technology, such as South Africa. In order for this technology to fully impact the regional development, spectrum and 4G networks need to be widely available across the region.

Looking at proprietary technologies, Semtech's LoRaWAN model is attracting more interest than others, since there is a low barrier to deployment and the technology is leveraging a wide partner ecosystem. LoRaWAN is expected to play a large role in the development of smart cities in Africa surpassing other competing technologies, including SIGFOX. Both Semtech and SIGFOX have similarities as they leverage control over one point of their respective value chain, however while Semtech is focusing on the semis layer, SIGFOX has taken on the higher risk role of service provider.

TWO PILLARS FOR BUILDING THE SMART CITY MARKET: BUSINESS MODEL AND LEADERSHIP

Connectivity is essential to deliver smart city projects, but it is not enough. One of the greatest roadblocks to smart cities both globally and regionally is funding and the creation of long-term sustainable business models. Multiple financing models exist in the smart city market such as traditional public funding, private investment, city bonds, and crowd-sourced financing. The importance of business models is further heightened in the region by the issue of local currency. While products may be acquired in foreign currencies (e.g. US dollars), the revenues or savings generated are in local currency, making it more difficult to create a successful business model.

In a smart city, value can be generated in the form of savings, new revenue streams, by selling data to third parties, or by connecting a project with the business case of an adjacent vertical. For instance, in a smart street lighting project, equipping selected street lights with small cells allows for leveraging the core business need of carriers to strengthen the project's business model. Carriers can cover the deployment cost of the light, as by using the small cell within the pole they can improve and strengthen their network. By deploying a small cell into a lighting pole, operators can deploy in areas otherwise difficult to reach due to regulatory restrictions.

Global Problems within a Local Setting: Africa and the Future of Smart Cities by Pablo Tomasi

Overall, similarly to other regions, the private-public partnership model is taking the lead as a main mode of delivering smart city solutions as it allows leveraging assets and strengths from both the public and private sectors while also ensuring that both parties reach the desired targets.

Smart city initiatives need to be the priority for both governments and cities. National and city plans are an essential step which helps not only with the release of specific funding and budgets, but also with focusing the industry attention on the potential for smart city transformation in the region, and for the testing and creation of use cases. Examples from other regions are abundant, from the Smart City Mission and Challenge in India to the Department of Transport (DoT) Smart City Challenge in the United States. City plans are also a common feature of cities willing to become smart cities from New York, US, (OneNYC), to Singapore (Smart Nation).

A first step in this direction was taken with the adoption of the Smart Africa Manifesto in 2013 aiming to bring socio-economic development through ICT. The manifesto was endorsed the following year by all the Heads of State and Government of the African Union. On the back of the Smart Africa Manifesto, the Smart Africa Alliance was created as a framework to implement, monitor, and assess the Smart Africa Manifesto and make it into a reality. Besides governments, private companies such as Ericsson, Inmarsat, Huawei, and Intel joined the Alliance.

Leadership in the form of key figures or specific smart city units are needed to navigate the city through the complexity of smart city solutions, challenges, and benefits. Many cities are adopting such measures, such as London (United Kingdom) which has a Smart London Board and a Chief Digital Officer.

SMART CITY APPLICATIONS IN AFRICA: WHAT ARE THE VERTICALS READY TO GROW?

While the market and the region are fragmented, it is possible to identify categories that are more ready than others to witness the development of smart city projects. Opportunities created by needs can be seen in improving mobility and transport in increasingly congested cities, improving electricity reliability and sustainability, water, healthcare, security, and city services.

Energy and resource efficiency including smart energy and smart water are key needs across the region. As seen in other emerging markets, smart grid developments can be deployed to ensure electricity reliability for the city, preventing downtime and increasing efficiency while reducing costs. A smart grid can also ease the introduction of alternative energy sources such solar. Similarly sensors to detect leaks in the water systems can be used to detect waste and minimise costs. Sensors applied to the water grid can help utilities mange water pressure, reduce water waste, analyse water quality and limit sewer overflows. These applications are fairly mature within the wider smart city market, consequently they have been tested and in many regions they are deployed at scale.

Safety and security is also going to be a key priority across the continent. Given the relevance of security as a foundation of any city, this is going to be a prime priority for many cities wishing to become a smart city. Increasing security can have a measurable impact on the quality of life for citizens, and this helps generate positive feedback for the development of smart city projects. Cameras can also be used to provide further information and support diverse applications beyond security; for instance in the mobility and transport field. As a result, along with security, mobility projects to improve traffic flow, and congestions will grow rapidly.

BETWEEN POLICY AND DEPLOYMENT: CASE STUDIES

While various countries are active in the smart city field or in one of its many verticals, Rwanda is at the crest of the wave to smart city development. As part of the Smart Africa Alliance of countries that are testing different projects and technology, Rwanda is working for the expansion of Smart Cities.

In May 2017, Rwanda, launched the “Smart Sustainable Cities: A Blueprint for Africa”, a document created to provide essential information for cities and officials across the region on the benefits, required steps, and options such as financing models and policy recommendations for the expansion of smart cities. The blueprint highlights the importance of smart cities as hubs for economic development and competitiveness but also as drivers for social development.

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The case studies are not bound only to the governance side. In May 2017, Kigali launched a city-wide LoRaWAN network to support IoT and smart city applications. The network was launched by Inmarsat in partnership with Actility and will be active for an initial period of one year providing a connectivity platform supporting different IoT (and smart cities) applications. The network is meant to support a variety of organisations and departments to develop, test, and deploy applications, which can potentially address many verticals from mobility to energy and education. To foster the local ecosystem, proof of concepts were deployed to showcase solutions and applications. These included environmental monitoring and smart buses.

Fostering the local element and providing success stories is pivotal for reaching smart city goals; this is because local companies, start-ups and developers are essential players for any smart city ecosystem given their understanding of local dynamics and pain points. Efforts have been started to grow the local ecosystem as a means of supporting smart cities and IoT growth as exemplified by Inmarsat's case. Another example is provided by MTN which in 2015 launched its Mind-2-Machine Challenge which was later expanded into a larger event (Internet of Things Conference and Awards).

UNIQUE MARKET CHALLENGES AND THOUGHTS FOR THE FUTURE

As in other regions, funding is a key topic in Africa. However, while in other regions such as Europe governments are unlocking large amounts of funding or setting aside specific budgets to develop smart cities, Africa is lagging behind. Once central funding becomes more widely available, cities should bear in mind that projects should not be deployed lightly. While central funding is helpful to jump start the market or at least to test solutions, cities should always remember the importance of long term sustainable business models.

Not all companies active in this sector have experience in emerging markets, and in a market like smart cities where global problems are heavily shaped by local factors, it is important to understand the socio-cultural-political dynamics that constitute the wider framework for any project. A failure to understand the local peculiarities will result in unsuccessful projects. For instance, the physical security of the device deployed on the field must be taken into consideration while deploying a solution as in some city areas there could be higher risks of device theft. International experience needs to be adapted to the local reality; therefore developing the local ecosystem and local players is a must.

Another massive challenge that smart cities need to address is solving pain points while delivering equitable growth, a task not easy to accomplish in societies which may have a high level of inequality. A smart city needs to be resilient, equitable, and sustainable for all; delivering projects that reduce inequality and ensuring that all citizens can benefit from them is crucial for the success of any smart city.

Overcoming roadblocks such as legacy regulation and policy is also needed to aid the growth of smart cities. City planning may struggle to keep up with fast city growth and high urbanization rates and this can create further issues around smart city developments - for instance in the form of conflicts between private versus public owned lands, which can result in delays and obstacles to deploying infrastructure. Speeding up policy and city planning, easing procurement, and streamlining the application for launching smart city projects will help the delivery of the smart city promise.

Cities need to take on the role of innovators by creating specific smart city plans which are tailored around their needs and provide the industry with practical and specific help in the form of funding, fostering collaboration, and setting goals. City plans not

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only focus the industry's attention, but are also key to help cities concentrate on the problems and on the importance of internal collaboration, as well as the need to break down internal silos.

Security and political instability in Africa is higher compared to many other regions and this problem will have a long term influence in the development of smart cities. Companies may be unwilling to invest in countries and cities where the lack of stability may halt smart city projects. While the need for security will boost projects such as safe cities and video surveillance and analytics, if security continues to remain a primary concern across the region this will slow the development of other smart city projects. Stability for the people and for the industry is essential.

CONCLUSIONS: CITIES TAKING THE LEAD TO DELIVER REGIONAL GROWTH

The technology is available, from connectivity standards to cloud and edge computing, it needs to be adapted to meet the needs of cities. Given their characteristics of deep coverage, long battery life, and low cost, LPWAN technologies will be a key building block for smart cities across Africa.

Key areas that need to be further refined across the whole region are business models, long term plans, policies and regulations. Energy, mobility, and security are verticals that will grow faster than others and this will provide the region with success stories which will, in turn, foster market development. The growth of smart cities also requires a local ecosystem and knowledge, so proof of concept projects and accelerators will play a role.

Smart cities are needed to ensure economic and social improvements while future-proofing city development. To face current and future challenges, cities need to become smart in taking the lead as a growth engine for the country, the industry, and most importantly the people.

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Pablo Tomasi is a Senior Analyst covering Smart Cities and IoT at the research and consulting firm IHS Markit. Within the company, he is the Leading Analyst responsible for the Smart Cities IoT Intelligence Service, providing insight and analysis on the current and future state of the smart city market.

Pablo participated as a speaker and moderator in numerous events including among others, the Smart Cities Week, the IoT Tech Expo, the Smart to Future Cities Conference, and the Total Telecom Congress. Some of the topics he discussed in these events include the future of urban mobility, how to justify smart city investments, monetizing IoT projects, and the long term development of smart cities.

He produced research on pivotal topics including the role and impact of smart city platforms, strategies, investments and business models in smart cities, the smart city ecosystem, and trends shaping the future of the smart city market.

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Across IHS Markit Technology we track over 300 connectable devices, the use cases and the emerging business models leveraging connectivity. This breadth and depth of coverage underpins the granularity of our IoT research, which spans over 25 connectivity technologies (across cellular, low power, WiFi, wired), many verticals and a growing range of building blocks, such as chipsets, gateways, modules, networks, platforms and operators.

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