YINCHUAN SPECIAL REPORT:
SMART CITIES
RECOGNIZING SMART CITY EXPERTS

The Vice Mayor of Smart Yinchuan, Mr. Guo Baichun, accredited the following individuals as Smart City Experts for their outstanding contributions to the development of smart cities around the world at a ceremony on September 8, 2016. The ceremony was staged as part of the TM Forum InFocus Smart City event, held for the second year running at Smart Yinchuan, China. The recipients’ achievements were applauded by over a thousand delegates.

- **Ning Jiajun**, Member of National Informatization Consultation Committee
- **Shan Zhiguang**, Deputy Director of Informatization Research Department of National Information Center, Secretary of China Smart City Development & Research Center
- **Wan Biyu**, Chief Scientist of National Smart City Joint Lab of China Society for Urban Studies
- **Wang Yukai**, Deputy President of China Society of Administrative Reform, Deputy Director of E-Government, Consultation Committee of Chinese Academy of Governance
- **Guo Renzhong**, Academic, Chinese Academy of Engineering
- **Yao Jianquan**, Academic, Chinese Academy of Sciences
- **Carl Piva**, Vice President, Strategic Programs, TM Forum, Head of Smart City Forum
- **Pierre Gauthier**, Chief Architect, API Program, TM Forum (award accepted on his behalf by Nik Willetts, TM Forum)
6 Bringing smart cities into sharp focus
Yinchuan hosts Asia’s fastest growing smart city event
Welcome to this Special Report, a unique collection of articles, drawn from experts from all over the world. They cover many of the diverse and fascinating aspects of one of the twenty-first century’s most crucial phenomena – smart cities.

8 An official welcome to Smart Yinchuan
Mr. Xu Guangguo, Member of the Standing Committee of the CPC of Ningxia Hui Autonomous Region, the Secretary of Yinchuan Municipal Party Committee gave this address at the Opening Ceremony of TM Forum Smart City InFocus 2016 on September 8th.

10 Smart City, Wonderful Life
Yinchuan’s Vice Mayor Guo Baichun welcomed delegates to his city and talked about how the Yinchuan had approached its journey towards becoming smart, its great progress and the recognition it has received worldwide, and next steps.

12 Giving voice to smart cities and a new world
Jane Chen, CIO and CSO, ZTE Corporation, and Chairman, ZTEsoft, gave a keynote focused on giving voice to smart cities in a new era of technology, M-ICT 2.0. This is her company’s vision of the technology-enabled, brand new world that is on the horizon and will be reality by 2020.

14 The city as a platform
TM Forum’s President and CEO, Peter Sany, outlined the social, environmental and economic imperatives for cities to become smarter by acting as platforms and enable digitalization, openness and a common architecture. Collaboration is critical to the success of smart cities the world over; together we can shape the future for the benefit of all.

16 Catalonia: Pioneering a smart region strategy
Jordi Puigneró, Secretary of Telecommunications, Cybersecurity and Digital Society, Government of Catalonia, described the strategy for implementing Europe’s first smart region – smartCATALONIA.

18 Toronto: Being a world-class contender on the Waterfront
Rob Meikle, CIO, City of Toronto, opened his presentation saying, “We [cities] must continue to change and transform if we want to remain relevant...That means how we interact with people, businesses and also engaging a talented workforce.” Toronto’s Waterfront, one of the biggest revitalization projects in the world, demonstrates this approach.

20 Pakistan prioritizes safe cities
Abrar Hussain, Joint Secretary, Ministry of Information Technology, Government, Pakistan, described some of the challenges facing Pakistan’s cities. In particular, he described how making cities smart is a way of making them safe too, in the face of the ongoing threat of terrorism, which has accounted for more than 85,000 deaths since the turn of the century.

22 Developing a smart city roadmap for Atlanta
Torri Martin, Director, SMARTATL, shared the City of Atlanta’s approach to smart city transformation. It started by asking its citizens about their pain points living in the city, such as the issues created by its population of around 400,000 swelling to around 5 million as people come into the city to work.

24 Palo Alto: Tapping Silicon Valley’s other trillion-dollar opportunities
Jonathan Reichental, CIO, City of Palo Alto, spoke about a number of key challenges that are driving smart initiatives in the birthplace of Silicon Valley. Cutting greenhouse gases are a particular concern and there is much to learn from how the city has empowered young people in their city’s evolution.

26 Cities are ecosystems of citizens – empower them
Dr. Igor Calzada, Senior Research Fellow & Lecturer in Urban Transformations, University of Oxford, warned that in many cases, technological solutions have been implemented in cities without first looking at the needs of citizens and the usability of the solutions – resulting in “a socio-technical misalignment”.

28 Phoenix: Changing organizations and culture make goals sustainable
Karen Peters, Deputy City Manager, Phoenix, tackled perhaps the most difficult issue associated with any kind of transformation – achieving organizational and cultural change. In this context she was talking about within a city’s government concerning how to achieve ambitious sustainability goals.

30 New York: Leading by influence is the top skill for any smart city CIO
Minerva Tantoco, until recently CTO for New York, shared some fascinating insights about her achievements in an interview with Carl Piva, Head of TM Forum’s Smart City Forum. She talked about how to get the buy-in of all departments, how to lead with little formal authority and her top five pieces of advice for anyone applying for the job.
CREATING COLLABORATIVE AND INNOVATIVE SMART CITIES

32 Brisbane: Opportunities, innovation and looking outward
Sarma Rajaraman, CIO, Brisbane & South East Queensland, talked about the challenges of competing globally as a New World City, what this pioneering city has learned about being innovative and smart so far, and its next steps.

34 Bonn: Reinventing partnerships in the city of Beethoven
Goodarz Mahbobi is Chairman of the Advisory & Innovation Board, Digital Bonn. From Beethoven to smart lighting, he describes how this city’s digitalization plan rewrote the rules for public-private partnerships. Perhaps the single biggest lesson so far is if you want help, just ask.

36 Indonesia: Developing a new business model for public private partnerships
Sigit Hadi Prayoga, Vice Chair, Smart Cities, TELKOM Indonesia, explored the key role that telcos can play in smart cities. He looked at how local government can secure sufficient budget and collaborate with partners including academics, business, community and government.

38 4 lessons from Boston’s New Office of Urban Mechanics
Nigel Jacob is Co-Chair for the Mayor’s Office of New Urban Mechanics, City of Boston – a people-centered R&D lab, embedded into local government that’s focused entirely on the needs of residents.

40 Bristol: Managing multi-agency, industry partnerships to get smart
Until recently, Paul Wilson was Managing Director, Bristol is Open. The city is a real pioneer in partnering – taking a far-thinking and unique approach to being smart and helping others become smart too. He talked to TM Forum’s Head of the Smart City Forum, Carl Piva.

42 New York University: The surprising role of science in smart cities
Masoud Ghandehari, Associate Professor, New York University, Center for Urban Science and Progress, provides examples of why cities are such great places to carry out research – especially when you look at things through a different lens, including unusual combinations of data sources.

44 Tel Aviv’s ‘citizens’ club’ provides personalized city services
Zohar Sharon, Chief Knowledge Officer, City of Tel Aviv told delegates the city’s residents have a lot of typical smart city projects like smart cameras, street lighting, traffic lights, irrigation management and so on, but the really smart thing is the information its citizens share and the services that enables.

46 Mayoral panel: Meeting the needs of smart citizens
Four mayors from cities in Australia, France and Peru had a lively discussion about their strategies for ensuring their smart city plans are designed around the needs of citizens. Carl Piva, Head of TM Forum’s Smart City Forum, moderated.

SPOTLIGHT ON GREENFIELD SITES

48 Masdar: Designing a ‘greenprint’ for sustainable urban development
The discovery of oil in 1958 fostered rapid economic and social development in the United Arab Emirates (UEA). Today, with a GDP of $360 billion, it is committed to maintaining economic growth and diversifying its economy by investing in human capital development and innovation, as Anthony Mallows, Director, Masdar City, Abu Dhabi, explained.

50 Dholera: Building greenfield smart cities
Alkesh Kumar Sharma, CEO & MD, Delhi Mumbai Industrial Corridor (DMIC) and Jagdish Salgaonkar, Senior Vice President, Major Programs, AECOM, told delegates about how you approach the mammoth task of building a smart city from the ground up.

DATA ANALYTICS AND IoT

52 Milton Keynes: The art of data-driven cities
Milton Keynes is one of the fastest growing cities in the UK. Alan Fletcher, Chief Liaison Officer, MK:Smart, called it a “fantastic economic success story” and explained that while many cities face issues related to post-industrial decline, Milton Keynes’ challenges are around terrific growth.

54 Johannesburg: Leveraging big data and analytics for transformation and decision making
Tinashe Mushayanyama, Director of Research & Strategic Information, and Zayd Ebrahim, Director of Research, both from the City of Johannesburg, explained how addressing great inequality is one of the chief drivers of making their city smart, along with sustainability, growth and good governance.

56 Buenos Aires: Share data, rethink infrastructure and get creative
Martin Alalu, Open Government Director, Province of Buenos Aires, shared his experience of using data to manage an emergency in the City of Buenos Aires. He showed how sharing data and being creative can enhance the policy-making process and improving citizens’ lives.

58 Tampere scales data – “One city is not a market”
Jarkko Oksala, CIO, City of Tampere, shared the progress that has been made on building an economy of data in one individual city, how this has been successfully scaled up to data sharing across six of them and what’s next.
60 Singapore: Regulators face challenges with IoT and smart cities
Chng Ken-Wei, Center Director (China), Infocomm Development Authority of Singapore (IDA), First Secretary, Embassy of the Republic of Singapore, Beijing, outlined some thought-provoking challenges and opportunities regulators are grappling with concerning the Internet of Things in the context of smart cities.

STANDARDS AND BEST PRACTICES

62 Enabling cities as platforms for innovation and growth
Juanjo Hierro, CTO, FIWARE, explained how this global open source community is moving from open data to enabling the economy of data, and how to build smart, so that applications and data can be used anywhere, not just their home city.

64 Why platform and APIs are fundamental to the data economy
The Smart Yinchuan Innovation Center is a ground-breaking collaboration between TM Forum, the city of Yinchuan and ZTE. George Zhang, Marketing Director, ZTEsoft, and Carl Piva, Head of TM Forum’s Smart City Forum, explained how it can contribute to the global economy of data and much else.

SMART MOBILITY

66 Dubai: Making people happy through smart mobility
Abdulla Ali Al-Madani, Chief Executive Officer –Technology Sector, Roads and Transport Authority, Government of Dubai (UAE), presented a case study about the innovative approach to smart mobility taken by the city as a key part of its smart city strategy.

68 Panel: Exploring the future of smart mobility
Projjal Dutta, Director, Sustainability Initiatives, Metropolitan Transportation Authority (MTA), New York, Abdulla Ali Al-Madani, CEO, Road & Transport Authority, Dubai, and Sami Pippuri, MaaS Global represent diverse places, but found they are in fundamental agreement. Not least that a smart city means smart, integrated public transport.

SMART ENERGY

70 Enabling smart energy communities
H. Dieter Waffel is CEO of AllMerus Energy, which is Germany’s largest green energy retailer with 1 million customers. He outlined the trends that are reshaping the global energy sector and some green solutions for local communities and smart cities, at home and abroad.

72 Smart energy: Driving behavior change
Smart Energy GB was established by the UK Energy Minister as the independent voice of the smart meter rollout. As Rob Smith, Head of Policy & Public Affairs, Smart Energy GB, related, this is not just about upgrading technology, but driving behavioral change in energy consumers, which he sees as being about creative communications. Meet Gaz and Leccy – if you dare.

SMART HEALTH

74 South Korea: Developing IoT-based healthcare services and an incubation project
Jong-Tae Park, Professor, Kyungpook National University, and Director, Daily Healthcare Demonstration Complex Construction Agency, South Korea, describes how government-private sector partnerships are running proofs of concept projects for specific health services in their quest to create a domestic and overseas market.

THE FUTURE OF THE SMART CITY

76 Smart City InFocus: City leaders share their top takeaways
At the end of a packed three days at the TM Forum Smart City InFocus event, six experts shared their top takeaways. This year strong themes emerged around collaboration, citizen-centricity and different approaches to being smart.
I had the privilege to chair the TM Forum Smart City InFocus 2016 event, held in Yinchuan, China, from 7 to 9 September 2016. And I must say that it exceeded all our expectations – see infographic, right. It was the second TM Forum Smart City InFocus held in the city in partnership with Smart Yinchuan and ZTE.

**Event gains new, national status**
The event has been officially nominated as one of only three major, state-level ICT conferences in China, and will become an annual fixture and the only one focused on smart city development. Smart Yinchuan is one of China’s leading smart cities, having been selected as a pilot back in 2013. After more than two years of investing in smart city infrastructure and construction, the city has achieved success in 13 areas including smart government, transportation and environmental protection.

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Fittingly, and in the best TM Forum tradition, the big themes at this year’s event were:

- how cities can learn from each other, saving time and money, and leveraging innovation;
- the critical importance of citizen centricity; and
- assessing the maturity of smart city transformations to prioritize investments.

Participants included C-level executives, government ministers and senior officials, renowned smart city experts and world-class academics, along with 50 upstream and downstream manufacturers.

A center of excellence for innovation
Yinchuan is also home to the Smart Yinchuan Innovation Centre, a collaboration between TM Forum, the city and ZTE. The Innovation Center features a city platform for Smart Yinchuan using TM Forum and FIWARE’s best practices and open APIs. It demonstrates the economy of data concept – that is, how to create a secure, transparent environment where public data can be made available and combined with third parties’ data and ideas. These are the raw ingredients needed to create new, innovative services, business models and value for cities, their citizens and local businesses.

The center ultimately aims to answer the question: How can city platforms be used to enable economic growth by connecting data providers with application developers, and all while driving citizen value and social inclusion?

So far people living in 20 residential zones enjoy services such as smart transportation with electronic bus stops showing latest travel information, intelligent garbage bins, free Wi-Fi and facial recognition to gain access to smart developments. The number of zones is expected to expand to over 100 by the end of this year.

In addition, a new smart health project is designed to bridge the gap between the government and citizens to help solve citizens’ health problems and to speed up treatment through, for example, remote registration and diagnosis. A range of diseases can be treated from first diagnosis to long-term management, substantially reducing waiting time for patients. More services will follow, as illustrated by the new, futuristic gallery in City Hall showing what life could be like for smart citizens of the future.

Spectacular backdrop
Against a spectacular backdrop, surrounded by millions of flowers, I had the privilege of opening the outdoor banquet on Wednesday evening. Under the stars, the Mayor of Yinchuan, Bai Shangcheng, gave a welcome speech, in which he told us that his smart city is the response to the challenges of urbanization, and that it “has been designed for the people, it will work for the people and bring benefit to the people”.

Dinner guests were treated to a staged selection of local songs and stories performed in traditional costume – setting the scene perfectly for the two-day conference that followed. Throughout the more than 40 excellent presentations from leading speakers from as far afield as Peru and Pakistan, one message was clear: Although every city has its unique characteristics, they all share fundamental common challenges. Working together to solve these challenges will greatly reduce the burden on cities to invent everything themselves, as we move into the era of city-to-city collaboration.

Our summary of each of these outstanding presentations form the basis for the articles in this publication.

For centuries, cities have been good at sharing experiences and keeping the dialog going. The normal movement of people between cities ensures that some of the culture is also being exported. What cities are struggling with, however, is codifying best practices in such a way that my city could benefit from what has been developed by some other city, with minimal effort or modification. This plug and play culture doesn’t exist between cities – yet.

TM Forum is playing a key role in making some of the common foundations available to all smart cities (see page 14), making it easier for city officials to focus on the truly differentiating capabilities in their respective domains. You can learn more about TM Forum’s Smart City Forum here and/or contact me directly via cpiva@tmforum.org if you’d like to get involved.

Carl Piva, Chair
VP, Strategic Programs, TM Forum
Head of the Smart City Forum
AN OFFICIAL WELCOME TO SMART YINCHUAN

Mr. Xu Guangguo, Member of the Standing Committee of the CPC of Ningxia Hui Autonomous Region, the Secretary of Yinchuan Municipal Party Committee, gave this address at the Opening Ceremony of TM Forum Smart City InFocus 2016 on September 8th.

Distinguished CEO of TM Forum, Mr. Peter Sany, ladies and gentlemen, friends – good morning!

This beautiful lake city is honored to have you here to attend TM Forum Smart City InFocus 2016 – an abundant place outside the Great Wall this golden autumn. First of all, on behalf of Yinchuan Municipal Party Committee, the Government and 3 million people of Yinchuan, I’d like to express our sincere welcome and heartfelt thanks to the distinguished guests, experts and scholars and news media at home and abroad!

City is the symbol of human civilization. For thousands of years, the city has evolved and developed. Now humans have entered the information age, and countries around the world have put forward the strategy of smart city to support and promote the transformation and optimization of urban economic structure, organizational form and management mechanism.
This is to enhance the expanding capacity of the urban economy and population, and the role of radiation – spreading ideas out from the center – and leading, which have become the trend for future urban development. Ahead of the opportunities and challenges, there are important missions faced by leaders and managers of every city to innovate urban development, improve the quality of and association between cities, and to enhance residents’ well-being.

The blue ocean
The earlier and wider you dive into the blue ocean of ‘Internet plus city’, the more advantages you will have. Yinchuan has seized this great historical opportunity, the new innovation revolution of science and technology, and the wave of information industry, to promote its transformation and development through a smart city strategy. Speeding up the pace of internationalization of the modern city, Yinchuan is leading the innovation and practice of smart city.

Through the innovative architecture of ‘One Cloud, One Internet and One Figure’, Yinchuan has broken out of information islands and realized inter-departmental data-sharing across all departments. This has enabled great achievements in aspects of Smart Government, Smart Community, Smart Industries, etc.

“Aligning closely with TM Forum’s collaborative development concept, we will create a more pragmatic alliance with operators and information enterprises.”

Yinchuan has won many international and domestic awards, such as the TM Forum Smart City President’s Award in 2015, China’s Leading Smart City Award, the Fifth China (2015) Smart City Application and Innovation Award and so on. The Cloud Data Center of Smart Yinchuan is approved as a pilot unit of national green data center, becoming a leader in the field of smart city in China.

Smart Yinchuan as the exemplar
A few days ago, the Ordinance of Promoting Smart Yinchuan was passed by legislation. Practice has proved that the construction of Smart Yinchuan is a necessary requirement to adapt to the new urban situation, to improve the comprehensive strength of the city and to move smart city development to the next stage.

The achievements of constructing Smart Yinchuan are the crystallization of wisdom and power combined. We have benefited from great assistance by TM Forum, the concerns and supports from state ministries and every local related department and bureau, and the solid cooperation with ZTE.

Constructing a smart city needs more wisdom, so this summit is to be held in our city. The distinguished guests, experts and scholars, and industry elite from home and abroad attending the meeting will seek common ways to develop around the theme of “Smart city makes life more wonderful”. We sincerely hope that this summit acts as a platform on which we can carry out extensive exchanges, and discuss and share the latest achievements and experience of smart city, to make cities smarter and life better. Yinchuan will have further in-depth and extensive cooperation with ZTE to bring smart city to the whole world.

Creating strategic alliances
Aligning closely with TM Forum’s collaborative development concept, we will create a more pragmatic, strategic alliance with operators and information enterprises, jointly promoting smart city to wider areas and at a higher stage of development.

Yinchuan is strategically placed and has common characteristics – the location is not too far from Beijing, the altitude is not too high or too low, between 1100m and 1200m, and the climate is neither too hot nor too cold.

We will construct Yinchuan as a modern, international city, and as China’s leading smart city so that it can make new and greater contributions to the construction of smart cities across China.

“The achievements of constructing Smart Yinchuan are the crystallization of wisdom and power combined.”

Ladies and gentlemen, dear friends, we will win by uniting all efforts and we will succeed through collective wisdom. With your participation, the city will be smarter and the life will be better! Warmly welcome friends from all walks of life, both at home and abroad, to invest and live in Yinchuan, where we will have common prosperity and make great progress. Finally I wish the summit a complete success!

May you have good health and good luck, thank you very much.
Mr. Guo Baichun, Vice Mayor of Yinchuan, delivered the keynote speech entitled *Smart City, Wonderful Life* at TM Forum Smart City InFocus 2016.

First of all, Mr. Guo introduced the smart manufacturing industry that is powered by Smart Yinchuan. He gave an example of a smart factory located in the city, which can produce 30 million shirts and 3 million suits annually. He explained how the shirt can be produced within three hours of the order being placed.

The Vice Mayor said that Smart Yinchuan’s innovative model attracts attention worldwide and has five functions:

- to help solving city diseases
- to provide precise services to its citizens
- to help industry development
- to manage the city more effectively
- to help government innovate with governance
Mayor Guo introduced the concept of how Smart Yinchuan has achieved its innovation goal via top-level design. Before the city started the transformation journey, Yinchuan’s government studied many other cities’ practices and discovered that most cities are still in the blueprint and proposal stage: Data is stored in the isolated government departments and cannot be aggregated, which results in ‘fake smartness’.

“Many cities are still in the blueprint and proposal stage. Data is stored in isolated departments and cannot be aggregated.”

In order to avoid such problems, the Yinchuan government innovated a Business Model, Government Model and Technical Architecture, and implemented these three dimensions. In the journey to transform from Smart Yinchuan 2.0 to Smart Yinchuan 3.0, the city’s local legislator set up the Big Data Bureau to ensure data sharing and data openness under the protection of law.

On September 1, 2016, Yinchuan local legislation released the local regulation, Facilitate Yinchuan Smart City Construction. This is the first local regulation to encourage smart city development domestically and began implementation on October 1. Mayor Guo said Smart Yinchuan will be assured of its long-term development by law.

There are many highlights in Smart Yinchuan’s platform, such as Smart Environment Data Collection, Smart Trash Bins, SMS Warning Service, Smart Online Hospital, Smart Transportation Guide Service and so on. The Mayor believes Smart Yinchuan will provide substantial development and will bring a Wonderful Life to its citizens.

“The Mayor believes Smart Yinchuan will provide substantial development and bring a Wonderful Life to its citizens.”
GIVING VOICE TO SMART CITIES AND A NEW WORLD

Jane Chen, CIO and CSO, ZTE Corporation, and Chairman, ZTEsoft, gave a keynote focused on giving voice to smart cities in a new era of technology, M-ICT 2.0. This is her company’s vision of the technology-enabled, brand new world that is on the horizon and will be reality by 2020.

The new world will involve man-to-man interaction, as well as man-to-machine and machine-to-machine. It will have ubiquitous intelligence through big data and artificial intelligence, which will automate ever more business processes and enable systems to self-heal and self-adjust. Big video, augmented and virtual realities will proliferate, and the physical and virtual will be increasingly integrated. Traditional IT will shift to cloud architectures: infrastructure, platform and software as services will be worth a combined total of more than $150 billion by 2020, according to Garner.

And all of these things will make an open and sharing digital economy possible, whereby devices, resources, capabilities and software can be shared across people, companies and industries.

Cities need VOICE

The goal of a smart city based on M-ICT 2.0 is comfortable lives for citizens through an improved environment and better services, and thriving businesses – all enabled by creative, efficient and data-fueled management of the city. Or as Ms. Chen put it, “Manage, Analyze, Monetize.”

She acknowledged that each city has its particular challenges, but added that “the problems are multiple and familiar” – and that the solutions are through VOICE-enabled, vertical smart services – see Figure 1.

Smart Cities 1.0 were hampered by data silos, isolated modules and being decentralized. At the moment, we are in Smart City 2.0 mode, where we are beginning to aggregate data and address common objectives, architecture and overall resource planning. In the future, Smart City 3.0 will be characterized by WISE2 – Wisdom, Infrastructure, Sharing, Ecosystem, Internet of Everything.

Wisdom

Wisdom comes from gathering information and using it intelligently and creatively, through one platform that enables two usage models: first for the city government to provide better services more efficiently, and second open data that can be monetized. There are three kinds of users:

Figure 1: The five technology trends that will enable M-ICT 2.0 for Smart City 3.0

- **V** Big video, VR/AR, virtual resources
- **O** Open, open source, shared ecosystem
- **I** Big data, AI, ubiquitous intelligence
- **C** Cloud, pipe acceleration, fusion
- **E** Everything connected, sensed, coordinated
Government – to support decision-making, provide a view of the macro-economic situation and evaluate social credit;

Citizens – to keep them informed about their city, provide personalized e-services and access to education, transportation, social services and more; and

Businesses – to monetize open data, introduce innovative business models and transform industries.

Infrastructure
The infrastructural architecture will be based on cloud, connection and collection:

- **Cloud** includes artificial intelligence, distributed cluster computing, and internet or virtual data centers.
- **Connection** embraces 5G, 400G, software-defined networking (SDN) and network functions virtualization (NFV) and urban Internet of Things.
- **Collection** involves information from virtual and augmented reality, business intelligence management, intelligent sensing and data crowdsourcing.

Sharing
A data-sharing mechanism will break down information silos and activate data value to create a sharing economy. This will be facilitated by:

- **two systems** – a legislative umbrella, and standards and norms;
- **three types of data** – from industry, citizens and government; and
- **four capabilities** – collection, processing, analytics and applications.

Ecosystems – four in one
Ecosystems will be realized by four main groups, for the benefit of everyone:

- **Industry alliances**, which will develop standards to ease and speed integration;
- **Business investors**, who will provide better capabilities to offer urban services;
- **Product providers**, who will strengthen urban infrastructures; and
- **Solution providers**, who will modernize the thinking behind and the design of smart cities.

Internet of Everything
We are already living in a world of cities, and the globalization of IoE and smart cities' best practices will ease inter- and intra-city joint developments (see Figure 3) – a twenty-first century, global version of the Silk Road. This is the final, essential aspect we need to make Smart City 3.0 happen.
Building an ecosystem of ecosystems: the city as a platform

In September 2016, the Hangzhou G20 Summit took place in China and concluded with the world’s two biggest economies, China and the US, ratifying the Paris Climate Change Agreement, which now will become binding for the world. In his keynote, Peter Sany, President & CEO, TM Forum explained why this is so important to making smart cities a global success.

In a very short time 80 percent of the world’s population will live in cities – 80 percent of global GDP will be generated in them, but they will produce 80 percent of the pollution and waste too. These are serious challenges, but if we have smart cities, we can develop solutions and maximize the benefits together, and play a huge part in making the Paris agreement work.

Last year, Yinchuan’s Vice Mayor Mr. Guo Baichun, showed us how the city has successfully connected ecosystems together to be smart. Now we need to widen our thinking and accept the world will become an ecosystem of smart cities. This is not a hierarchy, but an intermeshed value system where everything can talk to everything else in the ecosystems.

Those of us who work with others will be the winners. Collaboration and co-creation are essential: Think about 25 years ago when the largest airline, American Airlines, built a reservation system, Sabre, which it opened up to all its competitors. Now that system is worth more than all the airlines put together. By making it accessible, American Airlines created massive new value, despite the many lawsuits and the rival systems that have followed.

Creating platforms for people
More recently, Booking.com in the Netherlands saw how cumbersome it was to book a hotel, so offered a service to hotels to enable them to connect more easily with potential customers. It collects all the data from the hotels, and last time I looked, its market capitalization stood at $61.59 billion.

Now Booking.com also offers flights, dinner bookings, massages in your room and so on. It got closer to customers, putting them at center of its business. Now it has some control over airlines too, telling them what capacity they need on routes, and makes a margin of between 5 and 35 percent.

Arguably Alibaba is even closer to the customer. It is more generic and agile so can integrate all these types of services, resulting in a market capitalization of $192.82 billion.

Smart cities as platforms
These and many more examples show that if you are open, if you can create a platform, if you develop a real sense of what your customers need, then you can create massive
value for all stakeholders. A city is a platform that connects people: Never forget the most important, fourth ‘P’, for people, when you’re talking about the PPP – the public-private partnership – model for smart cities.

That’s why the Forum talks about the Internet of Everything (IoE), rather than just the Internet of Things, because if you forget the people, your solution might be technically interesting, but it brings no value. We need to create collective genius, which is exactly what Uber, Airbnb and all those companies have done.

“Never forget the most important, fourth ‘P’, for people, when you’re talking about the PPP model.”

It is easy to say everything should be connected to everything, because many typically public, but some private, organizations co-created the global communications infrastructure, on which our entire digital, information age is based. In the not too distant future, we’re talking about linking together 200 billion sensors emitting data of all sorts from a staggering variety of sources – whether from home heating, industrial energy control or drones.

In this rapidly approaching era of IoE, cities need to provide a platform to connect and collect data emitted by these sensors so that they can expose data in a secure and organized fashion, for free or for a fee, depending on the parties involved and their purpose.

App city, intermeshed world
Imagine lots and lots of apps, from government, companies, non-commercial organizations and individuals. Not everyone will have access to everything, but this simple system approach is paramount: If we replicate it globally, one platform feeds other platforms and they can be intermeshed across the world.

Smart Yinchuan has built its systems on open standards from European Union organizations, TM Forum and others. It works with many partnerships, which have co-created solutions and services. We all attended the Forum’s Yinchuan event to see who else has great services and apps, so we can create an economy of data at a global level that can be monetized to further improve the lives of our citizens.

At TM Forum, we have started the next level of development with our Open API Manifesto, which is a key element in being able to create this global intermeshing. By committing to use these open, standardized APIs, communications infrastructure providers can expand and scale, quickly and easily, beyond their own geographies through partnerships with their counterparts in other regions and countries.

APIs are hugely flexible: The humbly named Trouble Ticket API could be part of the process when someone calls to report a fire to emergency services, but also to immediately connect usually separate systems and services together to ensure the best outcome from the crisis. Think of APIs being like Lego bricks – what you can do with them is only limited by your imagination. The can reused in different configurations endlessly – simple or complex.

World’s first maturity model
We also have the first ever, comprehensive Smart City Maturity & Benchmark Model, which draws on best practice from all over the world. Any city will be able to assess how far it is along the journey to being smart, enabling it to identify gaps and prioritize areas for investment and other resources.

For the benchmarks, we will regularly collect data from thousands of data points in cities and analyze them so that members of our Smart City Forum can figure out where they are, where they want to be and devise the best way of getting there. Members will be able to see that City C is really good at this, whereas City B is not so good. Other cities can learn how City C made a success of any given aspect without reinventing the wheel, and wasting a lot of time and money in the process.

“We want this model to be a platform for growth through co-creation, and we want all of you to be part of it.”

We want this model to be a platform for growth through co-creation, and we want all of you to be part of it. We are very proud that all leading smart city organizations have partnered with us for this, so that the whole setup is agreed, standardized and meaningful. Put another way, this approach provides control cycles for us all to improve.

Clearly, we cannot develop everything ourselves, as so many industries and organizations did in the past. You must trade with each other, export and import the innovation you are creating – it makes no sense to have a great system in one city that cannot be transposed elsewhere without starting over.

The Forum is the platform where you can congregate. We are very grateful to Smart Yinchuan for the opportunity to come together and work together to create better health, new wealth, future prosperity and a sustainable planet.
BUILDING SMART CITY FOUNDATIONS

Catalonia: Pioneering a Smart Region Strategy

Jordi Puigneró, Secretary of Telecommunications, Cybersecurity and Digital Society, Government of Catalonia, described the strategy for implementing Europe’s first smart region – smartCATALONIA.

The autonomous community of Catalonia is in the northeast of Spain and about the size of Denmark, with its capital in Barcelona. smartCATALONIA was first in the European Union to have an approved smart region strategy, back in 2014. smartCATALONIA has the ultimate goal of smart regions, and even smart countries, collaborating and sharing to provide us all with solutions.

Back to basics
There are no smart cities without connections, whether delivered through fiber optic, 3G, 4G or 5G technologies, which will change everything in the next ten to 15 years. The European Union has set goals for 2020 that all citizens should have access to 30 Mbps broadband and 50 percent of the population to 100 Mbps. It is the Government of Catalonia’s intention to achieve them.

Where this provision is not economically viable, the government has stepped in to prevent there being first- and second-class cities. The aim is that access everywhere should be like in Barcelona.

Three drivers of smart
Smart citizens, smart government and smart economy are tightly linked and each relies on the others to succeed. They are enabled by a framework of three main components:

- services – cloud, big and open data, and high performance computing;
- electronic infrastructure – data centers, network and sensors; and
- legal – regulatory framework for e-communications, to prevent digital exclusion, ensure trust, protect privacy and provide cybersecurity.

The cloud data is stored in a data hub in Barcelona; although Catalonia uses cloud services around the world, it’s important to have a base in your own country. Catalonia has created it over the last five years to ensure high-level security and help cities develop smart city plans. It also needs to learn from smart city failures.

A data-driven economy will be key for future industry and we are trying to help companies thrive in this kind of economy – indeed, the European Commission is urging governments to embrace the potential of big data and feed open data back to companies and citizens for future services.

“Smart citizens, smart government and smart economy are tightly linked and each relies on the others to succeed.”
Figure 1 above shows just some of the areas in which smartCATALONIA has projects.

Just some smart goals and projects
The future of cars is ICT; the government wants the region to be the first in Europe to have autonomous cars on its motorways [freeways] and has a cluster of vehicle manufacturers in the area, including SEAT and Nissan working on this.

Another big question is how to produce goods in the future and the potential of 3D printing. We will see how factories’ production changes and moving goods to consumers will also change. It is likely we will produce goods close to where the customer is and maybe we will consume products differently too. HP has a Global Center of Excellence in Barcelona.

We are concerned about smart industry. The Internet has penetrated many established industries and we need to act. So we are creating shared platforms for all our industries. This initiative was launched last year.

There are projects that are small but very innovative. If Maslow were alive today he’d have to add batteries and Wi-Fi to his hierarchy of needs. We have a €5 million projects addressing smart grids, that is batteries, which is co-funded with the EU. This has had a huge impact on three counties in Catalonia and 25 municipalities. Based on a public-private initiative, we are changing the way we consume energy. Until now it has been distribute-transform-consume.

Now Catalonia wants prosumers – that is consumers to produce their own energy using renewable sources such as solar and feed the excess back into the grid. So the next generation of energy supply will move to a two-way process between consumers/prosumers and the grid.

In conclusion
The ITU, the OECD and the World Bank all teach the same lesson: If you want to be rich, these are the things you have to invest in – unless you have oil. And indeed, China’s President, Xi Jinping, is saying same thing about China and the importance of these sectors.
TORONTO: BEING A WORLD-CLASS CONTENDER ON THE WATERFRONT

Rob Meikle, CIO, City of Toronto, opened his presentation saying, “We [cities] must continue to change and transform if we want to remain relevant.” He added, “That means how we interact with people, businesses and also engaging a talented workforce.” He explained how Toronto’s Waterfront, one of the biggest revitalization projects in the world, demonstrates this people-focused approach.

Toronto has been ranked as one of the most liveable cities in the world by indices such as the Sustainable Cities Index and the Economist’s Best Place to Live. The city is also seeing tremendous growth, including substantial high rise development.

Meikle said, “A city needs to have a purpose… We want to build a city where the quality of life for people to live, work and play is very attractive globally...to do that we had to build around some strategic pillars – including economic prosperity, environmental sustainability but also social advocacy.”

He talked about a “tremendous opportunity” which requires good governance, so that decisions are made based on information, as well as a sound digital infrastructure. The city is creating a master plan which takes advantage of the city’s core services and looking at its digital infrastructure, as well as where it wants to be in the future.

Meikle said, “One of the things that we have recognized is that innovation not only comes from the city and its administration, but innovation comes from the businesses, the citizens, the whole community that we are part of – the ecosystem. We can’t limit this to what the city just does, but how do we build that ecosystem where we can get the best practices that are shared amongst all?”

“A city has to have a purpose...We want to build a city where the quality of life for people to live, work and play is very attractive globally.”
He noted that citizens are increasingly demanding; they expect services in an integrated, seamless and simple manner. They’re looking for services any time.

He said, “What we focus on is what we magnify so instead of just looking at all the things we don’t have we have also learned to focus on what we do have – and when you focus on those things you begin to realise that there are several pieces that exist today. When we recognize that these pieces exist today the opportunity is how do we build a framework that enables us to build on those foundations?”

**Waterfront Toronto**

He shared the case study of Waterfront Toronto, which he described as a “tremendous, once-in-a-lifetime opportunity”.

The initiative will transform 800 hectares (2,000 acres) of disused, neglected industrial land into beautiful, sustainable mixed-use communities and dynamic public spaces. For example, every business will be screened before being accepted for the Waterfront Toronto community – each must demonstrate a 25-year sustainability business case. There will also be homes for people of all income levels and approximately 20 percent of the residential units will be affordable housing.

Meikle said, “Instead of just redevelopment, we embarked on one of the largest revitalization projects in the world. We said, let’s start all over. How would we do this?”

The aim is to create 40,000 new homes, 40,000 new jobs and 300 hectares of park space...”a community where people can live, work and play”. It will take 25 years and $34 billion investment to build out the Waterfront.

The city is approaching the project with an integrated planning approach. Meikle said, “We have used this as a springboard for a catalyst of innovation, not just for the waterfront area but for the entire city. “

**Master-planned communities**

It’s an urban design for a waterfront community, but it’s also on a human scale, Meikle said. So there is priority for pedestrians, there are cycle trails and all residents will live within a five-minute walk of public transit.

Meikle talked about “master-planned communities” such as one of the neighborhoods that was comprehensively planned and then built almost overnight as part of the Toronto 2015 PanAm Games. It was touted by experts as one of the best athletes’ villages and is now being occupied as a brand new neighborhood.

Meikle said, “We have been able to leverage that investment.” It includes integrated sustainable systems, such as a feature that attracts visitors and teaches about water quality and how water is collected, treated and made useable once again.

One of the things Meikle said the city is very excited about is its Innovation EpiCenter. The purpose-built facility has a community of organizations that are driving innovation, not just for the city but for global use. The center will eventually have work space over 2,000 employees.

**Planning for tomorrow**

“The overall goal is to be future-ready,” Meikle said. “How can we plan for today, but also tomorrow?”

Toronto was the Innovative City Forum’s Global Intelligent Community of the Year award winner in 2014 and Meikle points out that leadership was a critical factor in this. He said the city recognizes that it needs a framework that is sustainable.

This framework is built on six pillars: Broadband, Knowledge workforce, Innovation, Digital equality, Sustainability and Advocacy.

Meikle said, “The intelligent community is based on those six pillars and it provides us an opportunity to really drive out some ultra-broadband and Wi-Fi solutions that will be consistently upgraded to future proof our community.”

He concluded by reiterating, “For us, smart city is not a destination. It’s not a place or a time that we want to be – smart cities for us is a journey, it’s something that we continue to build on.”
PAKISTAN PRIORITIZES SAFETY FOR ITS CITIZENS

Abrar Hussain, Joint Secretary, Ministry of Information Technology, Government, Pakistan, described some of the challenges facing Pakistan’s cities and the government’s smart city vision.

“Terrorism is the largest threat in Pakistani cities,” he noted. Between 2000 and 2015, there were 85,000 citizen deaths from terrorism in Pakistan. Ninety percent of these deaths occurred in the six major cities.

Hussain said, “We are a country that has scarce resources; we don’t have unlimited funds...Therefore, the government has prioritized the setting up of safe cities in major urban areas.”

Hussain explained how the safe city initiative provides “…the basis for the smart city of the future. We are starting this initiative with the hope that...sometime in the near in the future, we will be able to set up smart cities.”

He also said that the government would work with businesses and the not-for-profit sector in public-private funding initiatives to provide citizens with better, cheaper services faster.

PAKISTAN: CITY CHALLENGES

- POPULATION: 180 MILLION
- MOBILE CONNECTIONS: 133.2 MILLION
- BROADBAND CONNECTIONS: 32.5 MILLION
- URBANIZATION INCREASING 2X RATE OF POPULATION GROWTH
- HALF POPULATION CLUSTERED AROUND 8 CITIES
- 2025: HALF OF COUNTRY EXPECTED TO LIVE IN CITIES
- 9 PAKISTANI CITIES HAVE 1 MILLION+ PEOPLE
- ADDITIONAL CHALLENGES: TRANSPORTATION, ENVIRONMENT, RESOURCES, SECURITY, EDUCATION, HEALTH, SUPPORT FOR THE AGED, GOVERNANCE
BUILDING SMART CITY FOUNDATIONS

The first phase of the safe cities initiative is a pilot project in the capital city of Islamabad.

The way forward
The safe cities initiative will be rolled out across other major cities in Pakistan, with Lahore City already underway, Quetta City scheduled for the first half of 2017 and Gwadar City for the second half. In early 2018, work will begin on the next five cities. Coverage of 15 major urban centers is planned by 2020.

Hussain said, “Along with setting up the safe city projects, we are trying to integrate elements of smart cities…based on their objectives.”

Challenges and inspiration
Hussain also spoke about the challenges Pakistan’s safe and smart cities initiatives face, such as financing, “weak local government institutions and HR issues”, “multi-tiered governance systems” and a historic “lack of city master plans”.

He concluded saying, “We have been excited to be here in Yinchuan, and Yinchuan offers a way forward for smart city novices and enthusiasts alike. There are companies within China like ZTE which we can collaborate with in areas such as civil administration, traffic control, waste management, public security and community services, as we saw [during the tour of Smart Yinchuan]. I hope we will be able to replicate some of these innovations in the near future in Islamabad and other cities in Pakistan.”

His closing statement echoed the theme of collaboration which was loud and clear throughout the event. He said, “On this journey to provide better services to the citizens, we hope to partner with and seek the collaboration of Yinchuan City government, ZTE and all of you present in this hall.”

“The safe cities initiative will be rolled out across other major cities in Pakistan, with Lahore City already underway, Quetta City scheduled for the first half of 2017 and Gwadar City for the second half.”
Atlanta has a population of 750,000 but every day that swells to around 1 million as people flock to jobs in the city. This creates big challenges for the city and its citizens. And that’s where Atlanta started, by surveying its citizens to ask them about their pain points – the importance of citizen engagement was one of the key themes that emerged during the Smart City InFocus event.

Interestingly, overarching patterns emerged, but issues’ rankings varied in different locations in the city, depending on how people there were affected by them. From this exercise, Atlanta was able to map its primary smart city objectives (see below).

**ATLANTA’S SMART CITY OBJECTIVES**

<table>
<thead>
<tr>
<th>Category</th>
<th>Objectives</th>
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<tbody>
<tr>
<td><strong>ECONOMIC GROWTH</strong></td>
<td>• Increased number of financial transactions</td>
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<tr>
<td></td>
<td>• Increase in permit requests</td>
</tr>
<tr>
<td></td>
<td>• Increase in new construction</td>
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<td></td>
<td>• Increase in number of new jobs created</td>
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<tr>
<td></td>
<td>• Number of new startups</td>
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<tr>
<td><strong>MOBILITY</strong></td>
<td>• Reduce traffic/congestion</td>
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<tr>
<td></td>
<td>• Reduce trip time</td>
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<tr>
<td></td>
<td>• Improve public safety</td>
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<td></td>
<td>• Reduce pollution from transportation</td>
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<tr>
<td><strong>CITIZEN ENGAGEMENT</strong></td>
<td>• Number of Residential Surveys</td>
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<tr>
<td></td>
<td>• Number of Citizen Meetings</td>
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<tr>
<td></td>
<td>• Increase participation in Neighborhood Planning Units (NPPs)</td>
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<td></td>
<td>• Increase website traffic</td>
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<tr>
<td><strong>SMART GOVERNMENT</strong></td>
<td>• Number of E-Government Services</td>
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<tr>
<td></td>
<td>• Decline in the number of 311 calls</td>
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<td></td>
<td>• Increase in digital signage</td>
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<td></td>
<td>• Smart City Dashboard</td>
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<tr>
<td><strong>PUBLIC SAFETY</strong></td>
<td>• Reduce response times</td>
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<tr>
<td></td>
<td>• Increase clearance rates</td>
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<tr>
<td></td>
<td>• Lowering overall crime rates with more resolution and more prevention</td>
</tr>
<tr>
<td></td>
<td>• Reduction in vehicle and pedestrian accidents</td>
</tr>
<tr>
<td><strong>ENVIRONMENT &amp; WATER</strong></td>
<td>• Reduce pollution</td>
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<tr>
<td></td>
<td>• Improve water quality and conservation</td>
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<tr>
<td></td>
<td>• Improve waste prevention, recycling, reuse</td>
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<td></td>
<td>• Encourage clean/renewable energy power generation</td>
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**DEVELOPING A SMART CITY ROADMAP FOR ATLANTA**

Torri Martin, Director, SMARTATL, shared the City of Atlanta’s approach to smart city transformation.

Making it happen: Breaking silos
What makes Atlanta smart? “We (the city) collectively leverage a strategic and data-centric approach to improve mobility, public safety and sustainability, ultimately enhancing citizen wellbeing and fostering the economic growth of our city,” Martin says.

Atlanta has recently established a centralized smart city initiative and Martin is the dedicated Director. “We quickly realized that a lot of our departments were working in silos, so we created my office within the Atlanta Information Management department and so I have responsibility over all smart city projects.”

**A data-driven approach**
Atlanta is focused on how it can use data to achieve its primary aims and has identified three key applications for data generated. They are to be: “descriptive, prescriptive and predictive”.

**DATA SHOULD BE:**

- **Descriptive** Situational Intelligence
  What’s going on, anywhere and everywhere

- **Prescriptive** Real-time Optimization
  Use advanced computing to make things as good as possible, in real-time

- **Predictive** Preventative Maintenance
  Predict problems and opportunities in time to take action
Martin and his team are also exploring the opportunities offered by fostering an “economy of data”. This includes looking at ways to allow citizens to interact with data and establishing a culture of working with businesses, entrepreneurs and startups to help with developing solutions.

“The city doesn’t have limitless resources so we are looking to actively partner with startups and the business community to help solve that issue,” he said.

In partnership with Georgia Tech, the City of Atlanta is developing a ‘store’ to house all the data collected from smart city technology. “We’re setting up a governance structure around data, we’re developing APIs that help us interface with the business and local community. We’re also developing good formats for the citizen to utilize this information.”

The ability to monetize data in this new economy was another common theme throughout the event. As part of this process, Atlanta’s use of data is governed by Georgia’s Open Record Laws,” he said. “So the city has to be creative when looking at ways to monetize data.”

**Step by step**

In terms of the steps to becoming a smart city, Atlanta refers to ‘6Cs’: Capture and communicate, collaborate and crunch, configure and control.

The city tests solutions before scaling up deployments. “Before we deploy city-wide we like to take a smart intersection to a smart corridor to a smart district. Right now we are identifying about five smart districts in the City of Atlanta, which will be used as a test lab for companies and the city to test technology.”

One key testbed area in the city, for example, is North Avenue, a major corridor that includes businesses and residential areas.

**The power of partners**

Martin spoke about the power of partnerships in smart cities, both with internal departments and citizens as well as with vendors and suppliers. “The City has limited resources to address all of these problems so we are really working with vendor partners to help us navigate all of this.”

He added that public-private partnerships “have been a tremendous asset to us in helping build a smart city strategy.”

**Benchmarking maturity**

Finally, Martin shared how the City of Atlanta has used TM Forum’s Smart City Maturity and Benchmark Model to create a comprehensive roadmap. The exercise, which involved leaders from all the major departments in the city, was a chance to “really sit back and really reflect on what we were doing.”

“There were a lot of great questions that we hadn’t really thought about or not from that perspective. The Maturity Model gives us a great benchmark to say ‘this is what we started out from and by deploying these technologies and working with companies like TM Forum this is what we were able to achieve’.”

Martin concluded by saying, “We’re at the beginning [of our smart city transformation]. We’re new to it, but we’re looking to make great strides.”

Watch this back-stage video interview where Martin outlines what his role involves, its challenges and rewards, what a typical day looks like and what keeps him awake at night.

**THE 6 Cs OF BECOMING A SMART CITY**

**CAPTURE & COMMUNICATE**

- Run fiber to traffic signal enclosure
- Connect to switch and enable Wi-Fi
- Connect smart devices to Wi-Fi
- Transmit data to DATL data store
- Augment DATL with datasets from city servers and third-party clouds
- Establish baseline and target values for in-scope smart city goals
- Make DATL data accessible to Metrolab and private sector partners
- Apply big data analytics to inform decisions to achieve target goals

**COLLABORATE & CRUNCH**

**CONFIGURE & CONTROL**

- Test solutions on smart intersection and corridor
- Establish baseline to determine solution efficacy
- Expand to district-wide deployment if target is achieved and sustained

“The city doesn’t have limitless resources so we are looking to actively partner with start-ups and the business community.”
Jonathan Reichental, Chief Information Officer, City of Palo Alto, spoke about a number of key challenges that are driving smart initiatives in the birthplace of Silicon Valley. Cutting greenhouse gases are a particular concern, and there is much to learn from how the city has empowered young people in its evolution.

Traffic
Like many cities, Palo Alto has a major traffic problem. Most people travel in a car by themselves – and that isn’t sustainable. “We haven’t invested over the decades in public transport...and now we are paying a significant price for that,” Reichental explained. There are related issues too – you can’t find a parking space so people can’t go places they want to, for example.

Reichental said, “If we could make it easier for people to find parking spaces we could reduce the traffic significantly just from that change alone.”

Climate
The environment and climate change are also big drivers for Palo Alto. Over the last century, the planet has heated up by 1 degree. Last year was the hottest year on record and July this year was the hottest month ever recorded.

“It doesn’t sound like a lot, but you just need a few degrees and life can’t exist. We are very, very fragile,” Reichental said. “If we’re going to solve this problem, we’re going to solve it in cities.”
‘Peak car’
With these key challenges in mind, the city is spending a lot of time on transportation. Reichental explained, “If you were to intersect transportation with the environment, you’re going to fix it with cars.” If the city can reduce car usage and, where necessary, encourage the use of electrical cars, that solves a big problem.

Reichental said cars are going to become autonomous, connected and electric and will be part of the sharing economy. “We are already seeing peak car,” he said. Fewer people are now buying cars in the United States and there’s a whole generation of people who don’t want a car – after all, “It’s not safe, it’s very expensive and you can’t find a parking space.”

When you start to play with cars, particularly in a US context, you are actually talking about changing the very nature of behavior in cities. If cars drive themselves and they talk to each other, why do you need traffic signals, signposts or parking spaces? It’s going to happen faster than we think.

Palo Alto is already working on mobility as a service and is progressive when it comes to switching from fossil fuels to renewables and electric cars.

Citizen focus
Today, people want to interact with government in the same way they interact with companies as consumers.

Instead of going to city hall, they should be able to do the vast majority of what they need to using a mobile phone. “This gets us to the conclusion we need smart and connected communities to enable us to solve the transportation issues in the region, to solve our environmental changes, to connect people together and business together,” Reichental said.

The ultimate weapon of mass democratization
Like many cities, Palo Alto has an app (PaloAlto311) where people can report fixes required, etc. The important part is the underlying data, which he called the “ultimate weapon of mass democratization” because it will underpin the innovation around transportation, the fixes we need to save our planet and the power of apps.

Palo Alto is focused on leveraging data – “the only thing that we have in abundance.” It uses the data from the app, for example, to aggregate a picture of the city. They can see issues as they are reported and understand the “cadence of the city” so they can make decisions in near real time.

Open data by default
The key to innovation is sharing the data. So Palo Alto takes the data from the app and makes it available to everybody, including data around crime, energy, transportation, sustainability and more. Even the city’s much-loved trees are an urban forest of data. (El Palo Alto is a type of tree and Palo Alto in Spanish means a tall stick or tree.)

You can view, download and use Palo Alto’s data here. People are doing “fascinating things” with the data, perhaps not surprisingly as Silicon Valley is synonymous with innovative tech companies. Cities have problems which they often don’t have the time, skill or money to solve. If cities share their data, people can solve challenges with it, while at the same time building businesses and creating jobs.

“The role of the community is to step up and try to solve problems.”
Reichental told delegates. “We have to give data to people with great incentives, so they can make the apps and solutions themselves and we can benefit as a community.” Palo Alto’s data is now open by default. “Make it political and make it central, then things can happen,” Reichental said.

Palo Alto Apps Challenge
In 2014, the city ran the Palo Alto Apps Challenge. The city’s role was to make the data available. “The role of the community is to step up and try to solve problems,” Reichental said, and they did that in the hundreds. When the challenge was over, a number of solutions had been created.

But what excited Reichental most was that 30 percent of the people who participated were under the age of 18. Young people often feel separated from public life and have no power, he said. “We empowered them to build solutions to actually change the community they live in.”

The challenge garnered media and TV coverage, and Reichental wrote a book about it to help other cities interested in trying similar initiatives – it’s available free here: www.CityofPaloAlto.org/AppsPlaybook

A new city operating system
Reichental closed, saying, “The future is very exciting. It’s a multi-trillion dollar opportunity to change our cities in a way that is positive for every single one of us... So I have a challenge for you: Will you join me in creating a new city operating system for the future?”
CITIES ARE ECOSYSTEMS OF CITIZENS – EMPOWER THEM

Dr. Igor Calzada, Senior Research Fellow & Lecturer in Urban Transformations, University of Oxford, warned that in many cases, technological solutions have been implemented in cities without first looking at the needs of citizens and the usability of the solutions – resulting in “a socio-technical misalignment”.

Dr. Calzada outlined some of the challenges faced by cities around the world, from terrorism and slums, to climate change, natural disasters and financial turbulence. He commented, “I am not saying that technology is not useful – of course it is, but be careful because what we are doing in many cities is adding the technological layer first, and then trying to understand how the city works. That’s why in some cases, smart cities are failing.

Calzada didn’t want to focus on the dystopian view, but to be “critical but constructive” and he shared three important principles around the governance of a smart city:

- Rather than systems of systems, systems of data, systems of algorithms, cities should be viewed as ecosystems of citizens.
- We cannot reduce smart cities to the simulation and ‘datafication’ of urban life.
- We need to unplug, to disconnect smart cities for a while until we’ve thought further.

Technology should be used to empower citizens by adapting technologies to suit their needs rather than expecting people to adapt their lives to technology. We need “transitions” in our smart city projects and to get away from the ‘smart city in the box’ view.

Expanding on the idea of ‘plugging’ he noted:

- Being digitally connected/plugged in is no guarantee of being smart (Evans 2002:34); and
- Technology is never neutral, and it has the potential and capacity to be used socially and politically for quite different purposes (Williams 1983:128).

Despite what the glossy websites and videos might suggest, there isn’t a clear vision around smart. Instead there is a sense of ‘smart matters’, but without any real clarity about why and how, or any certainty about how and why to get different groups working together, from government departments to civil society groups, private companies and ordinary residents.
Looking ahead

There are new skills and roles emerging in smart cities and we need to move to a horizontal authority, rather than work within a more traditional, vertical hierarchy; also, the interaction of public managers with society is essential.

Necessary new skills include city planning capabilities, legal competency, ‘soft skills’ and financial resource management, as well as political independence and honesty.

He gave five key takeaways:

1. It is important to enable interdependencies between stakeholders, including the city (public), companies (private), civil society, academia and social entrepreneurs.
2. We need democratic mechanisms to manage data.
3. We need to scale up urban solutions to metropolitan and city-regional levels.
4. We need to provide comparative, evidence-based data, through benchmarking, for example, to enable city to city co-creation.
5. We need to establish quantitative but also qualitative rankings and city dashboards that enable adaptation rather than replication.

Issues to consider

Calzada left the audience with three questions to consider:

1. What prospects are there for alternative funding and business models for smart cities?
2. What are the practical and political interventions needed (within business, local government and communities)?
3. Is another type of smart city possible – a third-way between the state and the market, which is based on understanding the city first, before implementing technology?

For more related to this topic, read Calzada’s research paper here: Unplugging: Deconstructing the Smart City.
Phoenix is a 140-year old city with a desert climate (it has only about 8 inches/20 cm annual rainfall) in the south-western state of Arizona. It is the US’ sixth largest city with a population of 1.6 million. The whole metropolitan area has more than 4 million residents, making it one of the largest in the country.

The big issue
Our premise is that cities have a huge role to play in the sustainability of the planet, as this is where most people live, where more people will migrate and where the vast majority of waste is produced. Yet cities struggle to change because, apart from greenfield urban developments, they typically have operational silos and legacy systems. Those in Phoenix cannot be adapted to support its environmental goals of becoming a carbon-neutral city.

Hence underground infrastructure maintenance schedules can’t be coordinated with pavement maintenance, so a street that was just repaved is torn up to replace an underground pipe, to the huge frustration of drivers and local residents. The processes to manage the projects wouldn’t talk to each other, much less to those of utilities such as telecoms, water, electricity and gas.

How do you make the changes?
Cities are finding changes are made by setting ambitious, community-driven goals that need innovation to address climate change. Phoenix has engaged residents in envisioning projects for long-term sustainability, like zero-carbon by 2060, zero waste by 2050 and an on-going 100 year supply of clean and fresh water. Without such goals, departmental heads might have just set their sights on incremental reductions, not eradication which will require innovation and business process design.

How is it to be funded? Solutions that radically reduce waste, energy, work time and so on, can also cost dramatically less. For example, as an interim goal towards zero waste by 2050, the city set out to reduce waste going to landfill by 40 percent by 2020, through recycling, reuse and transition to a circular, instead of linear, paradigm. So Phoenix is collecting less residential waste every week from about 440,000 households over an area of over 540 square miles.

Cutting costs is a winner
But that’s not all: The waste is taken to a transfer station where its reloaded for long-haul transit. On their daily rounds the garbage trucks generate thousands of tons of greenhouse gases. In November 2015 Phoenix started to implement automated vehicle locator technology to manage and improve operations. Installation of the hardware on more than 400 units, from administrative cars, foreman picks-ups and several variations in garbage trucks, was completed in three months.

Information was available to city staff as soon as the
installation was completed on a unit. Two additional months were used to review the data (see infographic) and determine how the web application would be set up for monitoring and tracking purposes.

Training was provided to management and administrative staff on how to use the data for business decision-making. Drivers and foreman were trained on how to use the technology to improve their day-to-day operations.

Data is refreshed every minute to address immediate calls to the hotline about “how’s my driving”. This has improved driving behavior, reduced fuel costs and increased safety. The administration also has real-time communication with the driver about bad behaviors – alerts pop-up on their tablet.

The control center imports routes and electronically sends them out to trucks. They provide turn-by-turn driving instructions, which are important for new drivers and ensure the most efficient routes are used. This also cuts the amount of paper involved in the driver keeping their logs, route books and pre- and post-trip inspections.

Next steps
Phoenix plans to build on these innovations. It is evaluating the use of electric garbage trucks as well as combining waste collection with remote water meter reading to eliminate duplicated mileage and effort.

The city is also a pilot site for Google’s self-driving cars and already the city is thinking about all the changes autonomous vehicles will bring to transport in the longer term, and how to design the city to get the maximum benefit.

Self-driving vehicles need much less space on the roads and should reduce car ownership, but enable young, old and those with impaired sight and other disabilities to get around much more easily – and at the same time electric vehicles, self-driven or not – could help to improve air quality massively.

The city has also partnered with Arizona State University in an Innovation Center, which is an 88-acre site designed to attract manufacturers and investors, and develop converged technologies. The goal is to change the paradigm of how the city uses materials, moving from a linear and wasteful process to a circular, environmentally advantageous and energy-efficient, closed loop.

Already the Innovation Center is home to a new business that uses waste palms from tree palms – a material that is virtually impossible to compost and is a huge problem in the Phoenix area.

Different approach to cost
Cities are finding that if they could get a 90 percent reduction in carbon emissions, they might get a similar reduction in costs. A recent study suggests cities globally could save $17 trillion just by reducing their greenhouse gas emissions. Many of the innovations that are underway already will dramatically reduce all kinds of waste.

Cities need to be smart and sustainable places to attract talented individuals as well as businesses, but how will they fund the necessary innovations? Cities have substantial budgets for capital projects: Phoenix alone will have a budget of $200 billion to spend on capital projects over the next 35 years, assuming budgets remain the same over that period.

“Cities are finding that an 80 to 90 percent reduction in emissions can result in similar levels of cost savings.”

For the US as a whole, city budgets will provide investment of $40 trillion for infrastructure – and that is not state or federal dollars, just the city budgets. How can US cities invest that $40 trillion to achieve sustainable outcomes while building their infrastructure? That is the question being asked in cities, and it will be the catalyst to create organizational and cultural change. If we do that, sustainable cities are an achievable goal.
Carl: How did New York’s smart city initiative and CTO position come about?
Minerva: It was created by Mayor Bill de Blasio, who promised to create the post of CTO to implement a city-wide technology strategy. I took the role after 30 years in the private technology sector, which included starting my own company in Palo Alto. When I went into the office in New York, I didn’t even have a chair waiting for me.

There are 8.25 million people living in New York, including 1.1 million school kids, and the city has an operating budget of $70 billion. I had no office, staff or desk, so I took empty desk in the bullpen and in two years built a startup inside city hall.

Carl: So what happened? Did you have 100 days to come up with a good plan?
Minerva: I had to have a tailored plan – I knew I’d have to rely on PPP [public-private partnership]. LinkNYC quickly put NYC [New York City] on the smart city map. I realized no one used the 7,500 pay phones in the five boroughs anymore, so we used that infrastructure and turned them into free Wi-Fi hotspots to help the 22 percent of New Yorkers who don’t have fast broadband at home.

We were first to offer the fastest free Wi-Fi in the world at up to 1Gbps – and people can use the kiosks to make free phone calls too. They have USB chargers and emergency call buttons for 911, and 311 for information about the city – and it won’t cost the city a penny. It’s all paid for by digital advertising in the kiosk provided by the city’s partner in this venture, CityBridge. Instead it will generate money for the city. [Editor’s note: around half a billion dollars, according to the website].

There is the kernel of a great business model there and it spun out a whole series of digital initiatives. The lesson is: Use existing infrastructure to generate new revenue through new business models; be innovative.

Carl: Is social inequality a serious issue for you?
Minerva: Yes. I looked at how we could collect and use data to solve some of the toughest urban challenges, so it’s about the end result of technology, its social impact, and that was where the Smart City, Equitable City strategy came from. You can’t be smart without being equitable.

You can pretty much predict life expectancy based on your postal code. There is a stark distinction between type of environment, income and services available, based on where you live. So you need a map of social metrics to track crime statistics, income and health statistics by area and use it to define policies and measure their effectiveness to make sure you use resources where they will have greatest impact. So when we did that, we were able to show, for example, that through LinkNYC (we started with 7,500 and now we’re up to 10,000 of them), we’ve already provided half a million people with Wi-Fi access, many of whom couldn’t have afforded internet access.
Carl: How do you lead and drive change?
Minerva: I got to define the role, and to impact the City of New York I created a three-part strategy.

First, you have to have talent. Then you need to provide access, so you need to install broadband in low-income housing as well, so people can take courses and find jobs. We’ve already got one person who finished college education through Wi-Fi.

Third is innovation. We created that culture, giving lightening talks within the administration, and set out smart city, Internet of Things guidelines for all the agencies. For instance, we worked with the Parks Department and now we have smart park benches that are solar powered to provide a free charger station. The bench also counts the number of of people who go by: You need good data to design better parks – to know how often you need to do maintenance, if you need to add more officials, and if a place is not much used, why not?

Now the Parks Department understands it needs a data plan and upgrade plan, an operations plan and training too – it’s not just buying a park bench and a light bulb any more.

Carl: How did you mandate it with so many different boroughs and agencies?
Minerva: It was a combination of push and pull. Early successes are very helpful. Then by moving towards agile development and cloud, we could be prepared to share data more efficiently. That also provided the motivation; we are all about making each agency successful at what it does. We wanted more efficiency and especially wanted to engage people themselves and get them involved, so we opened a Neighborhood Innovation Lab in each of the five boroughs.

An example is traffic signal prioritization. We connected buses to traffic lights so that they get priority over other traffic. We implemented a pilot to show this reduced commute times by 20 percent. As a commuter, that has a big impact on you personally, and now that’s deploying across all five areas.

Carl: When political leaderships changes, you can lose momentum. Do you have to codify what you’ve done so it continues?
Minerva: Yes. We created an executive order so that the CTO office, the Information Technology Office, the Office of Management and Budget – that is the strategists, the implementers and those who handle the budgeting – are mandated to work together to reach the goals of the city administration. So yes, it will continue.

CP: What will you be most proud of that you achieved?
MT: A main motivation was that as an immigrant, from Queens, and a woman of color to demonstrate that you can arrive in US and become the CTO of New York. I wanted to encourage more New Yorkers to get into ICT and see what a great career it is.

And I wanted to come to Yinchuan to see what you could do with a blank slate and look at what you could do all at once. In New York, you have to work with existing infrastructure and limitations about where you can put fiber and so on – in a 400-year old city it’s a retro-fit. That is a challenge for many cities that are looking to upgrade and it needs a lot of creativity. William Gibson [the science fiction writer] said, “The future is already here – it’s just not evenly distributed.” Our job is to improve that distribution.

Carl: What would be the top five things you’d give as advice to anyone applying for the job?
Minerva: We have set a lot of the foundations; now the city needs to continue data sharing and open data. Add more of the social services aspect to unique problems, such as unequal incomes, but also take advantage of diversity – because people in the administration are hungry for innovation, and see the value of it, so we were able to modernize many approaches.

Most importantly, it’s about the people, building the right resources for all the people in New York.

Give a computer science education to all school kids to drive innovation.

Finally, you cannot run by command. There are too many people and agencies, so you need to influence and encourage. With 325,000 [city] employees, being able to lead by influence is the number one skill for the CTO.

Watch a second, backstage interview with Minerva below:
BRISBANE: OPPORTUNITIES, INNOVATION AND LOOKING OUTWARD

Sarma Rajaraman, Chief Information Officer, Brisbane & South East Queensland, talked about the challenges of competing globally as a New World City, what this pioneering city has learned about being innovative and smart so far, and its next steps.

Brisbane is on the east coast of Australia and the capital of the state of Queensland, which covers 1.7 million square km – about a quarter of Australia. It is the third largest Australian city by population; the city and surrounding area are home to 3.4 million of Queensland’s total population of 4.7 million. The city has the largest local government in Australia.

Brisbane describes itself as a New World City. They typically are: smaller with strong specializations; agile; offer a high quality of life; competitive and globalizing. Brisbane appointed the world’s second chief digital officer for a city in 2012 and launched its Digital Brisbane Strategy in 2013.

The city needs to innovate to ensure future prosperity and move away from its historic dependence on natural resources. At the same time, disruption is increasing across the globe through new business models and technology, and Brisbane needs to build the capacity to thrive in such a disruptive environment. It needs to compete for talent against established world cities like Sydney, London and Beijing, as well as against other New World Cities.

There is also a growing expectation from the local community for knowledge about, engagement with and data from the city.

The plan
In 2015, the city developed Brisbane’s New World City Action Plan 2022 in consultation with more than 1,000 individuals and organizations to consolidate efforts to date, set the direction for future initiatives, and drive the next wave of economic development.

The plan includes seven key priorities and targets eight industry growth sectors. It is guiding efforts to complete the innovation ecosystem Brisbane is building.

SEVEN KEY ECONOMIC PRIORITIES
It’s important to note that the plan is driven by residents, local businesses and visitors, not technology. Customers help shape the council’s front-line services, it delivers around 130 different services to over 1.1 million residents and the same number of visitors a year.

Brisbane City Council’s budget is A$3 billion ($2.3 billion) in 2016/17 and there are more than 7,500 (full-time equivalent) employees across 200 different occupations delivering these services. The council is working on initiatives to enhance and optimize front-line services, leveraging technology, such as:

- advanced analytics for traffic management and intelligent transport systems;
- integrated parking solutions;
- smart LED lighting;
- virtual Brisbane for 3D modeling for major projects and city planning; and
- customer service integration through application program interfaces.

The city is now interconnecting services more too, for example, smart garbage whereby the trucks have cameras and sensors so they can identify and report potholes and other issues while on the road.

“The plan is driven by residents, local businesses and visitors, not technology.”

Looking outward
Looking at the services the council provides is only one perspective. Looking outwardly, it recognizes that the ecosystem includes many other important stakeholders such as:

- leading education and research partners in schools and universities;
- neighboring local governments across the region, country and globally; and
- state and federal governments.

The council has a number of programs to build capabilities to develop talent and skills, for example: CoderDojo, which teaches children to code; and power-up workshops to teach social media, digital marketing, e-commerce and web design skills to small businesses. Study Brisbane provides support to international students at schools and universities.

The city provides entrepreneurial support to encourage a thriving start-up ecosystem by bringing global technology entrepreneurs to inspire and encourage the local community. Also, the Lord Mayor’s Budding Entrepreneurs Program offers grants to fund practical support to some of the city’s best emerging startups.

“Brisbane offers a free Wi-Fi network covering the central business district, many parks, libraries, ferries and key precincts.”

To support small and medium businesses, the council provides a business support hotline helping businesses on a range of topics including licensing, development applications, business opportunities and procurement. Innovative Proposals is a process set up to propose innovative ideas to the council.

Moving forward with lessons learned
Brisbane offers a free Wi-Fi network covering the central business district, many parks, libraries, ferries and key precincts. This also benefits visitors and residents. The city is planning to expand its free Wi-Fi network to over 300 access points and The Capital initiative was announced last December with a A$5 million ($3.8 million) funding commitment. Opening later this year, The Capital is an innovation hub located in the central business district to bring Brisbane’s startups together and complement state and federal innovation programs, and other private innovation initiatives.

Brisbane’s successes in summary:

- recognizing the importance of culture and values;
- engaging with the community and industry to test the market for innovation capability;
- focusing on problems and challenges to solve, not exciting tools or technology;
- collaboration across all stakeholders within the council and beyond;
- engaging with customers and partners; and
- realizing that no one vendor has the complete solution.

The city thinks the biggest single challenge is achieving interoperability across other government bodies, but Rajaraman concluded, “These are truly exciting times and I am really proud of where Brisbane is and the opportunities ahead.”
CREATING COLLABORATIVE AND INNOVATIVE SMART CITIES

Manufacturing is the backbone of the German economy and over 90 percent of jobs in Germany are in small and medium-sized businesses. So it is important for Germany to save these jobs, now and in the future. The government assembled an expert team to help it address these issues and they put their ideas in a paper that is very famous now, Industrie 4.0 strategy – see panel on next page.

The paper included smart cities, which will be enabled by the same technologies, because we need to find a better way of life for citizens. Since October 2014, Industrie 4.0 has been a prominent part of the German-Chinese Innovation Partnership, of which smart cities are an important part.

Transforming Bonn
Germany’s former capital city of Bonn recognized an acute need for action regarding digital transformation so that it could address both the challenges and chances arising from it.

The challenges are:
- The increasing digitalization of business processes, information and communication as society progresses.
- The digital transformation will cause profound structural changes in the economy, cities and society in the next few years.
- Studies forecast, for example, a fundamental change in today’s work environment with, on the one hand, job losses and on the other many new opportunities for business activities.

The chances are:
- The city cannot avoid digital transformation, rather it must position itself now to maintain and expand its position within the European Union.
- Bonn can make use of available skill sets by bringing all the key players in the region to the table.

To this end, the Mayor of Bonn started the initiative Digitales Bonn at the end of 2015, with the IT and management consultancy Axxessio, the Economic Development Board of Bonn and the Chamber of Commerce for Bonn and Rhein-Sieg.

Next an Advisory Board was set up in March, which includes the chairmen of Deutsche Telekom and Deutsche Postbank, academics, local businesses and the Mayor. The Innovation Board followed in April, made up of about 50 experts in the regional economy, politics and science. Participants of the boards agreed that,

“Bonn will put the opportunities of the digital transformation for the economy, administration, politics, education and civic participation into practice.”
Taking action to achieve goals

To achieve this, the Innovation Board was divided into four thematic groups (see Figure 2) with an initial schedule to develop projects running until the end of October, when they will be handed over to the Chief Digital Officer for the city.

The idea is to create lots of ideas and bring them together, put milestones in place, then hand them over to Bonn’s Chief Digital Officer. We agreed each project must focus on the objectives of the overall plan and needed to look at who would run the projects, who would benefit from them and who would pay for them? The government cannot pay for everything, so sponsors would have to contribute too.

In this, Bonn reinvented the idea of the public–private partnership, which is a government service or private business venture that is funded and operated through a partnership of government and one or more private sector companies. It included small and medium-sized businesses, academics, not-for-profit organizations and individual citizens – not just large corporations, which is more typical – and it did not only ask for funding, but for expertise. The Beethoven app is a good example of how this works.

Progressing the city of Beethoven

Bonn is the city where Beethoven was born and many tourists come to the city because of this, but the board realized the city was not using new technology to help them. The first sponsor was Bonn University, which said it would develop a Beethoven app for free and the Japanese Embassy offered to translate it into Japanese. The app gives tourists a virtual tour of the city with information about the life and work of the great composer.

Another project on a different scale is setting up a data hub in Bonn. Already some 20 private enterprises, the University of Bonn, the University of Bonn and Rhein-Sieg, the local Chamber of Industry and Commerce, as well as other foundations and organizations, have joined forces to support the idea. The kick off meeting took place in September. The intention is to encourage startups in the city through making data about the city available to them.

Smart lighting is yet another project. Here ZTE is providing streetlight hardware, which is being tested under laboratory and real-life conditions by members of the Digital Transformation working group. Other partners are developing new business models for a comprehensive use of intelligent street lighting. All of the people working in this project are working for nothing, bringing their experience, expertise and resources.

This project has brought a lot to Bonn’s thinking about new technologies. The first 20 lamps will be installed in the first two months of next year. The city has explored use cases to find out which ones are suitable and where the starting point is for Bonn. There are two different views about that – concerning the usage and the investment.

There is also an app for the people living in Bonn, if they just want to find a restaurant, say. This will be handed to the government after we’ve finished.

Perhaps the single biggest lesson from the City of Bonn, was that if you want help, you need to ask for it and you will be surprised by what is offered.

### Industrie 4.0 – made in Germany

Among experts in Germany, the term Industrie 4.0 has become synonymous with the industry of the future. Since the first industrial revolution driven by steam power (Industrie 1.0), manufacturing has undergone continuous development.

The beginning of the twentieth century saw the introduction of the assembly line (Industrie 2.0).

Industrie 3.0 began in the 1970s with the advent of robots and programmable logic controllers, and still defines manufacturing today.

The next phase, Industrie 4.0, will be characterized by intelligent, connected machines and workpieces, augmented reality, cloud computing and big data (informatization). Machines will work, make decisions and optimize largely autonomously, but in collaboration with humans. Production processes will become more flexible, transparent and efficient. We will see the mass production of personalized products to individuals’ specifications through mass customization.
INDONESIA: DEVELOPING A NEW BUSINESS MODEL FOR PUBLIC PRIVATE PARTNERSHIPS

Sigit Hadi Prayoga, Vice Chair, Smart Cities, TELKOM Indonesia, explored the key role that telcos can play in smart cities. He looked at how local government can secure sufficient budget and collaborate with partners including academics, business, community and government.

Smart city is now becoming a national strategy in most part of the world including emerging countries like Indonesia, where some cities have already announced their plans to become smarter. Indonesia comprises 17,000 islands and is the fourth most populous country in the world with 255 million people. The incumbent communication services provider, TELKOM Indonesia serves 157 million mobile subscribers plus 15 million fixed line subscribers.

It is looking at how, as a telco, it can help local and central governments deploy smart city strategies; that is, to build cities that attract people and retain them for a long time, for example by providing efficient workplaces that are easy to commute to and from.

In TELKOM Indonesia’s definition and the basis of its research, smart city is about helping a city to achieve its mission by using smart and intelligent solutions and technologies. These solutions and technologies play an important role in improving the efficiency and effectiveness of a city so that it can achieve its smarter mission.

Common and particular problems

Based on its extensive research, TELKOM found that every city apparently has its own unique problems, although at the same time, we found some cities share the same issues, such as congestion and flooding, and problems associated with street vendors and garbage – not to mention the problems in the education sector, healthcare, road infrastructure and public services.
Other important factors that must be considered in managing the city are People, Processes and Technology, all of which play very important roles in achieving the vision and mission of city mayors.

Therefore, smart city should become an approach and enabler used by many mayors and governors to build the kinds of cities their citizens expect. It should act as a guide for mayors and city administrations on how to deliver public services more effectively and efficiently, and in keeping with digital lifestyles of the future.

**Assessing business models**

Our comprehensive study to assess which new business models can be developed and implemented well for smart city was carried out successfully on the basis of two categories:

1. **Projects that can be funded by government’s annual budget:**
   - Model 1-A – the government has the on-going annual budget to finance the project
   - Model 1-B – the government does not have enough budget to invest at once, but has budget in the longer term.

2. **Projects that cannot be funded by government’s annual budget:**
   - Model 2-A – the government does not have enough budget to finance the project, even in the longer term, but we can generate income from the services, and the service is feasible as a business
   - Model 2-B – the government does not have enough budget to finance the project even in the longer term, and we cannot generate income from the services.

**A new approach**

Model-2B is obviously new and can be considered as a public-private partnership (PPP) business model in Indonesia – the government has no budget but can generate income.

It is an appropriate model to implement smart city in most Indonesian cities as they do not have enough budget to develop all the key components themselves. We also believe that this model could be appropriate for most developing countries.

“TELKOM invites cities to carry out tests [in Nusantara] and by early September 2016 had had 27 visits from local governments, helped by ZTE”

TELKOM Indonesia has built a SmartCity Living Lab in Nusantara to focus on helping cities solve their problems, customizing solutions from many technology owners and providing a bundled ICT solution, including network and devices. TELKOM invites cities to carry out tests here and by early September 2016 had had 27 visits from local governments, helped by ZTE.

The Lab’s work could act as the basis for government officials’ discussions with smart city experts and support collaboration in smart city areas like transportation, health, citizens, government and so on, as the basis for smart city strategy.
CREATING COLLABORATIVE AND INNOVATIVE SMART CITIES

Watch all the videos and interviews from the event

CREATING COLLABORATIVE AND INNOVATIVE SMART CITIES

Boston’s Office of New Urban Mechanics was launched by Mayor Thomas Menino in 1993, who, according to Jacob, had “a particular vision around the role of local government and mayor, and especially leadership, with respect to driving change and innovation.” When Menino’s successor, Mayor Walsh, took over in 2014, he scaled the department up and it’s now 14-people strong.

Jacob shared the four key lessons that the office has learned so far:

1. How you build is as important as what you build
How you surface the challenges you’re going to work on – that process is as important as the end goal. The team has a three-stage model, explore, experiment and evaluate, which is an iterative approach based on prototyping and experimental solutions.

The team spends a lot of time looking for opportunities and challenges, by talking to the community, peer government agencies, researchers, startups, social entrepreneurs and others. It looks for projects that have the potential to impact people in the city and scale.

The team pushes these ideas hard. One of its mantras is, ‘If we’re not failing periodically then we are not trying hard enough.’ More often than not, failure is the middle path: In many cases, the experiment works to some degree but can’t scale sufficiently.

The team found that it is important to stay involved in the scaling of projects to get them off the ground, instead of just handing them off to the department concerned.

In action
The office was asked to help create a lab to focus on middle-income housing in Boston. The city has lots of expensive luxury housing and a lot of subsidized housing but little to offer middle-income earners who often can’t afford to live there.

The ‘housing innovation lab’ started by working to understand who middle-income earners are. They developed a series of personas, based on collaborative events, interviews in people’s homes and other research. Through this people-centric design approach, the team was able to develop unique functional insight.

4 LESSONS FROM BOSTON’S OFFICE OF NEW URBAN MECHANICS

Nigel Jacob is Co-chair for the Mayor’s Office of New Urban Mechanics, City of Boston – a “people-centered R&D lab, embedded into local government that’s focused entirely on the needs of our residents.”

The team found that it is important to stay involved in the scaling of projects to get them off the ground, instead of just handing them off to the department concerned.
2. Build what people actually want
When confronted by a new challenge, local government tends to look at how issues have been addressed previously and redeploy some of those solutions. Boston is striving to change this.

In action
Until 2012 registering your child for school was a “horrible user experience”. Parents had to read a complex document with information on all the available schools, then select their top three choices. This put many parents off and their children ended up in schools that weren’t as good. So rather than assuming that if you give parents all the information they will make the right decision, the team set out to improve the user experience around the information. The team developed a platform called Discover to make the navigation of the school options easier, like TripAdvisor, allowing parents to compare schools.

“The idea was to enable citizens to go out and do something directly, with support from the city.”

Interestingly, the same complicated algorithm powered the new system — all the team did was hide the complexity and make it much easier to interact with the bureaucracy.

3. Use technology to build trust
Although many ongoing discussions focus on how to use technology and innovation to drive efficiency, which is critical, there is another level beyond the transactional way governments traditionally work. This is much more relational and is about developing real, working collaboration with residents based on trust.

From surveys, the team discovered the public’s perception of government was as some faceless bureaucracy and looked at how it could use technology to facilitate more direct and human dialog between the residents and government.

In action
For example, via the city’s BOS:311 app, citizens can report things that need fixing, like potholes or public lighting. Once fixed, the city worker responsible snaps a photo of the repair and sends it to whoever reported the fault. Some include a team photo. The idea was that if the city administration could show citizens that there are real people fixing the problems, not robots, citizens would feel differently about the experience. This proved true.

When photos are included, it is more likely that citizens will report issues in future. This might not be exactly about trust, but it’s part of the continuum of building a trust-based relationship between city and citizen, Jacob explained.

4. Be delightful
Civic engagement is often used to inform the public or to get the public to engage in decision-making, but this is missing the opportunity to rethink engagement. Rather than the citizens simply telling the city what they wanted, the idea was to enable them to go out and do something directly, with support from the city.

In action
The team launched an initiative called the Public Space Invitational and put out a call for creative designers to make public space more fun, delightful and approachable. This resulted in a “landslide of ideas”. One of the projects was looking at Boston City Hall, which is often considered to be an ugly and forbidding building. The team was approached by an artist who suggested simply putting colored tape along the steps, which resulted in the Stairs of Fabulousness.

This inexpensive solution resulted in people being naturally drawn up the stairs to an area that until that had been unused.

“We realized we had to do something with that [area], which took us on a whole new journey – based on something as simple as tape,” Jacob concluded.
Carl: Tell us about your city.

Paul: Bristol a city in the southwest of England with just under a million people. It is the second wealthiest city in the UK after London. It has a bit of a radical edge – a strong university with lots of young people. It loves tech, it loves music, it loves food.

We got excited about the whole smart city thing and did something unusual – we decided to create our own R&D testbed that could be used by the whole world, in Bristol. We upgraded the fiber in the streets. We built a wireless mile of 5G technology. We put a mesh network across the city and enabled lampposts and other fixtures for free Internet connectivity.

Then we worked with a whole bunch of agencies in the city, including those for the @Bristol Science Centre where we upgraded the planetarium to be a 4K Ultra High Definition, 360 degree-view dome, which is spectacular. We began to show 4K content across the whole city using some BBC technology and experimenting with the BBC.

Our whole approach was experimentation as a service (see Figure 1).

FIGURE 1: BRISTOL IS OPEN – EXPERIMENTATION AS A SERVICE
As shown in Figure 1, we have a top layer of decision-making using algorithms. Then we have a software-defined network (SDN), then virtualization optimizing the network, then all the things in the city we enable through this infrastructure. This was not just for the city council’s benefit. It was for everyone involved – the hospital, the small startup, you and me. The SDN allowed us to slice and dice the entire digital infrastructure.

Carl: What does experimentation as a service mean, especially in the context of industrial partners?
Paul: We formed a long-term relationship with NEC, Nokia, Zeetta Networks and InterDigital, and they’ve been proving out our technology offerings at city scale in our testbed. Another aspect it that this represents a lot of legal work – more than 20 different legal contracts, which in itself required setting up a company as a vehicle to do it.

We were also working with five different stakeholders, the Council, the University and three others. Getting a consensus among the ecosystem was a challenge. Getting money to do it was a challenge. And we had to convince all our stakeholders that we knew what we were doing; sometimes we did know and sometimes we made it up.

Carl: Last year, you joined our leadership team on smart cities...
Paul: Yes, I came here last year and was astounded. About five cities joined the Forum’s leadership team and as part of that, suggested the Smart City Maturity Model to us. I was amazed because of all the links back to best practices from people like International Standards Organisation, the British Standards Institute, United Nations and in fact every organization I’d come across in the context of smart city best practices.

Over the summer, you and I began developing it into an app, which will be easy to use, built on interesting visualizations. As you work through the different aspects – security, privacy, digital inclusion, how many resources you’re using – you can assign responsibilities within a team and build consensus locally about what’s going on.

Carl: Looking back, what were your big learning points?
Paul: The most challenging thing of all was agreeing what we were trying to do, because we couldn’t copy anyone else on anything, because no one else had done it. So getting a united vision was hard.

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New York University (NYU) is of the city and part of the city because there was no room to build a campus. Instead it’s a collection of buildings on different streets and students roam between them.

When real estate prices went up in the 1980s, NYU also became very rich, so it spent money on hiring people, which was a great investment. It has had 36 Nobel Prize winners. Also, it chose urban studies as one of its major areas and is one of the leaders, or even the leader in this field.

So when we consider the role of innovation and technology in the rising population and increasing urbanization, there’s going to be a lot of business to be done there if you do it right. There is a lot of positive change one can make over the next 35 years to make things better than they are now. That increase in population and the shift to urbanization are definitely things to be concerned about.

NYU’s story
At the center where I work, we have students and we work with people locally, such as in agencies. Our model for teaching what to do about cities is to think about how you acquire information, such as from those agencies and sensors and other technologies, and how you put them together to understand more.

It’s not just a question of logistics, but an amazing opportunity to learn about people, places and the environment, in terms of sociology, psychology and whatever it is that people do. Cities are great to study because of the proximity of people and the sheer number of interactions. It’s about moving from data and data analysis to identifying phenomena and their causes.

Figure 1 represents a very complicated set of sources for acquiring and sensing data – they are all ongoing projects.

Figure 1: From data to phenomenology

Source: New York University, Center for Urban Science and Progress
by students, working directly with agencies, which provide data to a data center managed, very rigorously, by the university, in these following areas.

**Exposure and health outcomes** – if you want to quantify exposure, you can use a pollution map of NYC. The critical thing to remember here about pollution is its effect on people. Classically, research on pollution was done by measuring density of pollution, with super algorithms and density of sensors and so on, but really the question is what, within the exposed population, does each person experience?

This is a new project funded by a foundation that is tracking 10,000 New Yorkers over 10 years, collecting details from their health records and looking at where they are, at what time, the decisions they make and what they do. This is what I mean about what an amazing lab cities can be for learning about things we could not do otherwise.

**Service and resilience** – the 311 number is for non-emergencies to report problems, for example, to multi-agencies. Over five years, we found there had been almost 300,000 calls about sewer back-ups. We want to look at patterns, at the part that extreme rain played, for example, and which parts flooded and which didn’t. But equally importantly, we want to know who calls and who doesn’t? Who claims ownership of the problem and acts?

**Safety** – we are researching this issue by collaborating with a major insurance company. The aim is to reduce the number of deaths caused by accidents. The thing here is that we know there are a lot of close calls – a lot of near misses. We need information about them too, such as analysis of conflict in traffic flows, to deduce things like is there something about the geometry of a certain junction which makes an intersection particularly dangerous? For this, the data is drawn from the street camera network.

**Neighborhood quality** – we’ve been modeling daily the waste from 253 community areas over 10 years, correlated with residential population density. There are yearly cycles, so seasonal frequencies, but overall it works out to about 2.5 pounds (just over a kilogram) of garbage per person, per day. There are extreme events that cause erratic changes, that are not very easily predictable, but there are also these low frequency level declines, which we can think about from the point of view of the impact of policies or other changes over 10 years.

A lot of speakers have mentioned the importance of the richness of information – and what we mean by phenomenology is precisely that. What is it in these few megabytes of data that can tell us so much? This is not a lot of data, even if it is daily for 10 years. There is a lot of work to be done here.

**Energy performance and compliance** – another case of obtaining information you would not normally be able to get. In this case, refrigerants causing damage to the ozone layer – we need to eliminate CFCs [chlorofluorocarbon]. In NYC we have a system where every single building has an ID and is mapped. We know exactly where it is, when it was built and so on. In this very interesting study, we looked at the city’s West Side by remote monitoring using a hyper-spectral, low-energy camera to see gases. An amazing amount of refrigerant leakages were detected – including HCFCs [Hydrochlorofluorocarbons], which both the UN and the US are anxious to achieve zero percent by 2020. The city wanted them phased out by 2015, but this is when the study was done.

Technologies definitely have a place in smart cities, there is no doubt about that. This is an example of a student working in a national lab as well as with a company. It’s also a good example of how technology developed for defense and military applications apply.

**The human element**

Finally, we need to develop human resources. There are around 3 million students under 12 in NYC. Imagine if these kids understood the significance of learning about the environment in a new way that they hadn’t experience before. They would feel a different relationship with it. New Yorkers spend a lot of time on the subway, which is a horrible experience, and we wish someone would do something about it. And the really noisy streets – they are deafening – although the pollution is getting better.

Regarding human resource development at government level, government employees can gain much by interacting. So in the mayor’s office, there is a lot of interaction. I look forward to something that delivers great value to both. One thing that really works for us is having total similarity of process for astrophysicists, computer scientists, analysts of various kinds, sociologists and psychologists of various kinds. That is what makes this work with government and industry, the same processes so we can work together.

We need to get citizens involved to do something about it, not just from the point of view of providing a data pipeline, but from the point of view of understanding what is going on. Now that’s what I’d call human resource development.
He said the city is focused on “improving citizens’ lives through engagement.” Echoing a major theme of the event overall, Sharon said, “We are using technology as an enabler – the technology is not the most important thing. We need technology to give good services to our residents.”

Change from within
Sharon said, “Our approach to this is government-to-government projects, government-to-citizen projects and citizen-to-citizen projects.” And this meant starting with internal change.

He explained that the city understood that in “order to give good services to citizens, we have to start internally – we
CREATING COLLABORATIVE AND INNOVATIVE SMART CITIES

Watch all the videos and interviews from the event

have to change the organizational culture and structure” and you “…must share knowledge and information with each other before you can with citizens.”

So this is where the Tel Aviv focused its smart strategy for the first five years. Sharon explained the early efforts were about, “integration, breaking the silos, matrix thinking and workers’ empowerment…to help you achieve your goals.”

What do you think of your city?
When it came to citizens, though, the findings were surprising. “We thought that we are the best city in the world… We have a lot of e-services and information and data…but we weren’t so focused with our citizens,” he said.

“We said that in every moment in life, the city is with you and for you…we understood we have to focus on each resident’s needs.”

The city asked citizens two questions: Firstly, what do you think about the city of Tel Aviv? Everybody said, “Great city, we love the city.”

The second question was what they thought about the municipality of Tel Aviv. The answer? “Opposite, opposite, opposite.”

“Terrible answers,” Sharon said. “So I thought? ‘How can it be?’” From this, he continued, “we understood that it’s not enough to give good services or open data or transparency. It’s very important to do it, but it’s not enough – you have to give information according to the citizens’ needs.”

The intelligently active city
Tel Aviv created the Digi-Tel Residents’ Club and City Card, a ‘citizen club’ like a loyalty club with points.

“We said that in every moment in life, the city is with you and for you,” Sharon explained. “We understood that we have to focus on each resident’s needs; it’s not enough to give some information and to think that everybody will read it. So we took the municipality from a reactive municipality to an intelligently active municipality. The aim of the municipality is giving good services. The intelligently active municipality is giving services to citizens before they know they need it.”

Each member gets a smart card and receives personalized city information, benefits and e-services. For example, if a street is to be closed for construction work or a fireworks display is planned in an area, only citizens who are living in the street or area get this text message,” rather than everyone.

Similarly, if parents need to register their child for pre-school or kindergarten, they will get a text message or email and can register via the link provided without having to attend in person.

“The aim of the municipality is giving good services. The intelligently active municipality is giving services to citizens before they know they need them.”

This system is also a good way to solicit feedback from citizens. For example, if money has been allocated for construction in their neighborhood, they can be consulted if they are affected. “We know they are living there because we have the data,” Sharon explained. “And, most importantly, their permission to use it.”

Give a little, get a lot
Sharon said that people are generally happy to share their data and details because they get a lot of clear benefits in return – such as discounts and targeted offers, which are exclusive to City Card holders. For example, when there are unsold theater seats, members receive alerts that last-minute tickets are available at half price. “The theatres are full in 15 minutes,” he said, which is good news for businesses and venues.

“We cannot solve all the problems of our citizens but we can give them enabling tools to solve their own problems with our help.”
Mayoral Panel: Meeting the Needs of Smart Citizens

Four mayors from cities in Australia, France and Peru had a lively discussion about their strategies for ensuring their smart city plans are designed around the needs of citizens. Carl Piva, Head of TM Forum’s Smart City Forum, moderated. Here are the highlights.

Meet the panel
Moderator Carl Piva, TM Forum’s Head of the Smart City Forum, is on the left, then from left to right above, our panelists are: Christian Tordo, Deputy Mayor in charge of economic Development, Digital Innovation and Urbanism, City of Nice (France)
Jorge Muñoz Wells, Mayor, City of Miraflores (Peru)
Paul Pisasale, Mayor, City of Ipswich (Australia),
Frédérique Macarez, Mayor, St. Quentin & Vice President, St. Quentin Urban Community (France)

Christian: Most of the presentations today has shown some expectation of what the citizen is waiting for; and we are on that journey. They are much more demanding of the city administration because they realize the potential of digital and data acquisition.

Jorge: They do forget sometimes, but we have to try to give them the best. I was thinking about what brought me here – in 2011 we started trying to learn, each day, what people want and to give them the best we can.

Frédérique: I represent a middle-sized city with 57,000 people and in this kind of city, it is very easy to speak with people and have meetings and prepare projects. But with the new technology we have new ways to speak with them and to younger people, who express themselves differently.

Paul: The issues are the same [in Ipswich] – the opportunities and requests – what is changing is the role of the mayor. People expect more because they communicate across the country and want to pay less and less. In a small
community like Australia, you have a small percentage that complain all the time. If you only follow those people, you miss good things and new things.

Carl: When you remodel your entire, business around the customer, you realize you had inside-out thinking before. Is it possible to turn thinking around like that in cities?

Christian: The mayor is elected, which is important to remember. All of us here are convinced that technology will help connect government to citizens. We have to deal with the bureaucracy and administration; and there’s nothing wrong with that, but you can’t manage democracy in the same way as a big public company. A big cultural change needs to take place, so we can all benefit. That necessitates education for the administration to make the transition.

Talking about smart city and the citizens and how get participation, we need to also address the digital divide so that all citizens feel part of it.

Carl: Sometimes you feel cities miss that part because the people you talk to are those who are already responding

Paul: You have to keep everything simple. Citizens want to know how things will affect them – that’s the most important thing. We’ve told them that everyone has a responsibility, not just the officials with titles. You just have to show them how they can share that responsibility and get involved.

Carl: What will the role of the mayor of the future be? How will the role change?

Jorge: It is changing because the mayor will be able to have a personal relationship with people. It is not possible right now because the world is going faster each day. Technology is a tool to facilitate a relationship with all of the community through communication. In Peru, first we are improving citizen participation and we are creating ways to communicate in a massive way between them and City Hall and also with me.

This makes us improve our own internal processes in the municipality. We are working to be more transparent and on open data through the people. A lot of young people are working voluntarily… and this will help us to prove that services provided by the city are for the people. We have worked to treat the people as people and technologists have to give them what they need.

Carl: So citizens as enabling platforms, in a way?

Jorge: Yes.

Frédérique: Smart city helps us respond more precisely to their needs, such as through personas. So we can say, “You are a man, with two children at this school and you do this…” so we can respond to you personally. At the same time as we have the chance to do this we also have an obligation to those who don’t use technology, maybe because they are senior. We have done some developments: We have a specific bus or car and we drive it in neighborhoods for people without an Internet connection.

Paul: For young people it is all Snapchat and Facebook – I think of it all as Youwtwface. We have to get our message out on all those things, but the problem with all this technology is you still have to keep that personal contact – you’ve got to be real. Once a month I go to a coffee shop and I get people and that’s where I get my best ideas over coffee.

Technology is not going to take over, it is just one of the tools in the toolbox, for young people most of all because they are the ones who will be driving in future. They see it’s everyone’s responsibility to become part of the journey and join in.

Christian: We have to be very careful not to see technology as the ultimate objective; rather the intimate objective is improving life for citizens, their experience in the city, generating economic development and so on. We have started with the open data approach so they can create applications and it has been a good way of reaching the citizen as a person on environmental issues.

The next step we’re looking at is how to get feedback from the citizen? We are working on a project where they take over the data, which is empowering the citizen to be much more involved in city management. We are only at the beginning of that and it will take a long time.

Carl: So we are working towards the place where we are listening to them and co-creating the future with them. What will be the next steps?

Paul: If you want to get something done in the city, get the children on your side. They educate their parents as they know more about the technology – three- and four-year olds have their iPads.

The next journey will be to make sure no person in the community goes unnoticed – you need different programs at different levels with different areas of technology, so it’s hard for a mayor now to make sure no community or residents are overlooked. It’s hard, but very rewarding. Keep it simple!
MASDAR: DESIGNING A ‘GREENPRINT’ FOR SUSTAINABLE URBAN DEVELOPMENT

The discovery of oil in 1958 fostered rapid development in the United Arab Emirates (UEA). Now, with a GDP of $360 billion, the UAE ranks third in the Middle East North Africa region, and thirtieth in the world. Anthony Mallows, Planning and Delivery Director, Masdar, explains, it is committed to growth and diversifying its economy by investing in human capital development and innovation.

The discovery of oil in 1958 fostered rapid economic and social development in the United Arab Emirates (UEA). Today, with a GDP of $360 billion, the UAE ranks third in the Middle East North Africa region, and thirtieth in the world. It is committed to maintaining its economic growth and diversifying its economy by investing in sectors that encourage human capital development and innovation.

This thinking was enshrined by the late Sheikh Zayed bin Sultan al Nahyan, Founding Father of the UEA, who said, “We must not rely on oil alone as the main source of our national income...We have to diversify the sources of our revenue and construct economic projects that will ensure a free, stable and dignified life for the people.”

Masdar Smart City is itself part of Masdar, a subsidiary of the Mubadala Development Company, which is mandated to expand the UAE’s energy portfolio by advancing, commercializing and deploying future energy and clean technologies. It operates across the industry value chain by merging higher education, R&D, investment and large-scale clean energy development. Our holistic business model fosters innovation and commercializing viable technologies – see Figure 1.

FIGURE 1: A PIONEERING APPROACH TO BEING SMART

Source: Masdar
Integrated approach to renewable energy
The vision is to make Abu Dhabi the pre-eminent source of renewable energy, knowledge, development, implementation and the world’s benchmark for sustainable development. The mission is to advance renewable energy and sustainable technologies through education, R+D, investment, commercialization and adaptation.

The Masdar Institute of Science and Technology was established in collaboration with the Massachusetts Institute of Technology. It is an independent, graduate-level research university dedicated to advancing renewable energy and sustainable technologies, carrying out research into:

- water
- environment and health
- energy systems
- micro-systems and advanced materials
- biomass-derived fuels
- smart-grid applications
- saltwater desalination and
- energy-efficiency technologies.

As a commercial-scale, renewable energy developer, we have built some of the world’s most sophisticated clean energy projects. The UAE is the only OPEC nation delivering both hydrocarbons and renewable energy to international markets.

Investing in the Future
Masdar Capital manages third-party capital under a license from the UAE Central Bank. It invests in the world’s most promising cleantech companies and matures technologies that will power a more sustainable tomorrow.

Masdar City
Masdar City is powered entirely by renewable energy, is one of the most sustainable urban developments in the world. It is a cleantech cluster, free zone and investment zone, designed to attract companies from all over the world to commercialize and deploy new energy technologies.

The vision is that some 50,000 people will work in Masdar City and some 40,000 people will live there. The site is about 600 hectares, with over 20 percent of the area as open space. About 60 percent of it will be residential, 17 percent commercial, 12 percent for community facilities, and 11 percent for light industrial use and R&D. The gross floor area will be 3.7 million square metres.

Organizing principles
Mixed uses are integrated: There are pedestrian and prioritized clusters; narrow, shaded streets; low-rise, high-density urban fabric; high-performance, low-carbon buildings; and a mobility strategy linked to transit. The city’s orientation is based on solar and the direction of prevailing winds and its buildings cooled by wind, water and innovative façade shading (see main picture on page 48).

Masdar City uses SoFI, a high performance software tool, developed by Masdar Institute to measure, benchmark and forecast their sustainability performance. Figure 2 shows impact the development and deployment of these green technologies has had on the Irena Global Headquarters in Masdar City, opened in June 2015.

Its development principles are pioneering, with the city intended to be a sustainable urban development that will serve as a ‘greenprint’ for cities of the future. It is pushing the boundaries of sustainability, through architecture, design and technology.

Masdar City’s building design requirements must take the following into account, given its location:

- energy consumption
- renewable energy provision
- interior water use
- exterior water use for landscaping
- construction waste management
- operation waste management
- embodied carbon in materials
- sustainability rating system
- building performance monitoring
- economic performance over time after the global financial crash of 2008, and in a change to the original thinking, the city is to be financially self-sustaining, offering business opportunities as an R&D hub, investment zone and free zone.

Masdar has built 200,000 square meters of buildings since it started six years ago and will build the same again every year for the next five years.
India is one of the world's fastest growing economies and urbanization is increasing rapidly. Some 600 million people will live in Indian cities by 2030, which need to be rethought to become smarter to cope with this rise in urban population and its accompanying issues.

There are two types of city in India's smart city initiative: Greenfield cities (developed from the ground up), which fall under the Ministry of Commerce & Industries and where the Delhi Mumbai Industrial Corridor Development Corporation (DMICDC) plays a key role for; and brownfield cities (revamping existing cities), which are part of the overall Ministry of Urban Development initiative. Dholera is one of the greenfield cities along the DMICDC.

DHOLERA: BUILDING GREENFIELD SMART CITIES

Alkesh Kumar Sharma, CEO & MD, Delhi Mumbai Industrial Corridor (DMIC) and Jagdish Salgaonkar, Senior Vice President, Major Programs, AECOM, told delegates about how you approach the mammoth task of building a smart city from the ground up.

The greenfield cities are aimed at enhancing industrialization and manufacturing and creating jobs. Dholera has been selected as a greenfield site for a number of reasons, such as its large areas of government land and strong transport links.

**Where to start**

How do you start with such a huge initiative? Salgaonkar gave some insight into plans and learnings so far. Dholera has started with an ‘activation area’ of around 22 km².

The first phase is building all the trunk infrastructure. This will cost about $1 billion, which has come from seed capital from the government. However, after that the project will be self-sustaining. About 50 percent of the land in the activation area is dedicated to industry, sitting alongside residential, commercial and mixed-use developments and green spaces.

**Benchmarking**

Salgaonkar told the audience that in planning the city, the Dholera team has looked at best practice from around the world. For example, they looked at the performance of the best cities in the world in each infrastructure discipline — such as water, waste-water and power etc. They took the key parameters and benchmarked Dholera against them, designing Dholera to match or improve on what they have achieved.
There will be over 10,000 sensors across the city, related to pollution, leak detection, traffic management, smart grid, automation and more. There will also be a City Integrated Operations Center – city data will be combined with analytics and used for smart decision-making, through a city portal for citizens and a dashboard for city managers.

City governance
India is looking at a new way of managing cities – rather than being politically led, they are run through special purpose vehicles (SPVs). These are run by a managing director who reports to a board of directors against a set of key performance indicators. This idea is to make it easier to do business and have accountability for smart city initiatives. Salgaonkar called this a “major step forward”.

“Initially the city of Dholera is interested in attracting businesses such as aviation and manufacturing firms.”

Community
Dholera is also focused on community: “It won’t just be a manufacturing city, but also a community that people are joining,” Salgaonkar said.

Planners have created the concept of REAPE, as in:
- Recreation
- Education
- Awareness
- Public art
- Economic growth

Salgaonkar explained, “We have addressed each of these components so people can have a good life.”

Open spaces was one of the things they benchmarked. So, within 400 meters of every residence there will be neighborhood park, and within 800 meters there will be a community park. There are also larger city parks.

The planners have mapped out key pieces of social infrastructure such as pharmacies, kindergartens, hospitals and even hawker [street seller] zones, so that citizens and businesses will know for certain how close these facilities will be.

Planning and designing is complete. Dholera is now in the construction phase. In 2018 it will be ready for business, Salgaonkar told delegates.
MILTON KEYNES: THE ART OF DATA-DRIVEN CITIES

Milton Keynes is one of the fastest growing cities in the UK. Alan Fletcher, Chief Liaison Officer, MK:Smart, called it a “fantastic economic success story”.

Fletcher said that while some cities are facing problems related to post-industrial decline, Milton Keynes’ challenges are around growth.

Milton Keynes’ population is forecast to grow to over 300,000 by 2026. This will create demand for up to 28,000 new homes, as well as new jobs. It could also increase travel demand by 60 percent. At the moment it is rare to experience traffic congestion in Milton Keynes, but that could quickly change unless the city acts. It has already taken a number of key steps, including putting together the MK:Smart initiative.

**MK:Smart**
MK:Smart was created to understand how the city could bring all the potentially siloed projects together in one place – therefore, at the heart of MK:Smart is the Data Hub. All the smart city projects produce an enormous amount of data and also rely on a large amount of data to make them work.
We started to think about what you can really do with that data in a way that makes sense for the city.” Fletcher said. Like many of the speakers, Fletcher talked about the importance of understanding and involving city stakeholders: “Unless you begin to include stakeholders, you don’t get the groundswell of involvement that creates real applications. If you don’t recognize the people in the city you are not going to get very far. Smart city isn’t something you do to people; you want them to be involved.”

Refining the new oil – data
It’s often said that data is the new oil. Fletcher said the important thing now is, “How do you refine it so it will make a difference?” So the Data Hub is about much more than storage – the most important thing is the curation.

“I like to think of it like art gallery curation,” Fletcher said. “Like the National Gallery: it takes you on a journey through art history. And there’s about 10 times as much stuff stuck in the basement.”

He described the role of the curator – whether that’s data or art – as exposing exactly the right things that people can make sense of and use. This is growing in importance as data is growing exponentially.

As well as collecting open data that already exists in government, Milton Keynes is also encouraging citizens and businesses to think about what their data might mean, and working to make sharing data simple. Then, applications and services can be built using that data.

This will only ever work if you build a support network around it. Fletcher said, “It’s not good enough to say ‘build it and they will come’ – we’ve got to get out there and promote it.” The city has developed a support network with local and national businesses.

Creating a marketplace of data
Milton Keynes is looking at how to create a marketplace of data, including tackling issues such as: What are the models around who will pay? How much will they pay and how will they pay? This is something that the city has been exploring through a TM Forum proof-of-concept Catalyst project.

“Smart city isn’t something you do to people, you want them to be involved.”

The Data Hub includes lots of different types of data sets as well as simple visualizations and a developer sandbox. MK:Smart has built some early applications using the data to show people the types of capabilities there are.

This includes work around mapping where and when traffic accidents typically occur then using predictions to try and reduce them. Another initiative is around water and using social nudging to help citizens understand and reduce water consumption – Milton Keynes is one of the driest region in the UK. There’s another stream of work around energy, and how to best balance the load of energy in the city.

Citizens: At the heart of change
The MK:Smart platform allow citizens to have a voice and share ideas. “What is really surprising is that they told us things we didn’t know or hadn’t thought about in that way,” Fletcher said.

He added, “Citizens are at the heart of change: If we want to make our city smarter, engaging citizens is one of the most important things we can do.”
JOHANNESBURG: LEVERAGING BIG DATA AND ANALYTICS FOR TRANSFORMATION AND DECISION MAKING

Tinashe Mushayanyama, Director of Research & Strategic Information, and Zayd Ebrahim, Director of Research, both from the City of Johannesburg, explained how addressing great inequality is one of the chief drivers of making their city smart, along with sustainability, growth and good governance. Big data will play a key role.

Johannesburg recognizes that being a smart city is more than just technology – it is about people. It is South Africa’s economic powerhouse, yet it is a divided city, with the digital divide mirroring its socio-economic disparities – see Table 1.

A smart city is a platform for innovative applications in ways such as:

■ control centers combining data from more than 20 departments (integrated operations center);
■ predicting crime like we predict the weather;
■ using broadband and Wi-Fi to allow free education; and
■ digital city services.

Data and information can enable a ‘smarter’ Johannesburg, so the city can become more liveable, workable and sustainable – and make the most of its strategic location and position as South Africa’s financial hub.

The city in its context

To put Johannesburg into context, the city is situated within the polycentric Gauteng city-region, which has an estimated population of 13.9 million people in 2016, the largest of any of the country’s regions. South Africa’s overall population increased from 51.77 million in 2011 to 55.65 million in 2016.

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Source: City of Johannesburg

Johannesburg’s population represents 8.9 percent of South Africa’s total population and is the country’s most populous city. It receives about 3,027 migrants a month. In 2011, the city had 1.43 million households and now has 1.85 million – an increase of 29.2 percent. Between 2011 and 2016, the city’s population increased by 11.6 percent to 4.94 million.

People between the ages of 15 and 34 years’ old account for a third of Johannesburg’s population, falling from...
42 percent in 2011. The prevalence of HIV is 29.5 percent and unemployment rate is 29.8 percent.

The potential of smart city
Johannesburg defines a ‘smart city’ as a one that uses ICT as an enabler, to merge the dimensions of smart utilities, smart mobility, smart economy, smart environment, smart education, smart people, smart living, smart health, smart planning and smart governance.

The ‘smart city’ concept brings together all the characteristics associated with organizational change, technological advancement, economic, social development and other dynamics of a modern city.

In Johannesburg 58 percent have access to internet and although only 15 percent have a landline, strong evidence suggests that 93 percent of individuals have access to cell phones, which is an important opportunity for bridging the digital divide. Technology could offer solutions to serious challenges, such as intelligent infrastructure, smart health and safety issues.

If becoming a smart city is to be realized, then an integrated approach towards achieving growth and development strategy is imperative:

- to address inequality;
- for sustainable infrastructure provision;
- to ensure inclusive growth; and
- for good governance.

Johannesburg’s smart city strategy is to ensure that it enables the use of all available information to make better decisions and, can be summarized as:

- do more with less – being more efficient across the whole city saves enormous costs;
- do it better by being more effective and raising the quality of the services; and
- do new things by being innovative and utilizing new opportunities, experimenting with new concepts.

Johannesburg has taken a phased approach, cascading data from strategy to delivering services: The preparation phase was between 2013 and February 2014, followed by putting best practices and processes in place, up to July 2014, which also saw the first smart city projects started. The initiative is now in the Urban Living Lab Phase, putting a roadmap of smart city projects in place and working on a yearly update cycle.

The smart city of Johannesburg should:

- Help social development, such as greater social cohesion and human development at scale.

Improve the efficient delivery of services, which should be interoperable, leveraging service delivery in communities, lowering the cost of service delivery and tracing defaulters.

Support better decision making, using citizens’ input and taking into account all available, relevant data through improved governance.

Stimulate economic activity, that is, job creation through startups and small- and medium-sized businesses, foster entrepreneurship and make it easier to do business.

Provide universal internet access – use technology to bridge the digital divide, including leveraging high cell phone penetration.

Encourage active citizen participation with citizens acting as co-creators and improve communication with all citizens, providing accessible information for communities.

Create a sustainable and liveable environment so that people can live safely and have sustainable use of resources.

Big data is at the apex of achieving smart city objectives. Although it faces some big challenges – see Figure 1 – the plan is for the city of Johannesburg to use it in many ways. They include:

- for policy making and strategy development, and sound monitoring and evaluation;
- to enhance learnings from other cities so Johannesburg can be innovative in its delivery of services to citizens; and
- as a reliable foundation – globally standardized big data will assist cities in building core knowledge for decision making and enable comparable insight and global benchmarking.

**FIGURE 1: LOOKING FORWARD TO OVERCOMING DATA CHALLENGES**

| Big data is not readily available at city level | In South Africa this means a 10 year gap. Where data is at city level, it is often based on modeling estimates and therefore not always official |
| International frameworks for data analytics | Reliance on international frameworks for data analytics – definitions are not always applicable to Johannesburg domestification is a must |
| Big data is sometimes overwhelming for cities | There is a need to balance the use of big data with some continuity or traditional approaches |
| Lack of capacity | Both technical and user capacity. Going forward, capacity building and resourcing will be key |
| Transforming data | Traditionally incubated within the halls of National Statistics Dept. Need to include practitioners, civil society, the private sector, and even the beneficiaries themselves |
BUENOS AIRES: SHARE DATA, RETHINK INFRASTRUCTURE AND GET CREATIVE

Martin Alalu, Open Government Director, Province of Buenos Aires, shared his experience of using data to manage an emergency in the City of Buenos Aires. He showed how sharing data and being creative can enhance the policy-making process and improve citizens’ lives.

In 2012, Buenos Aires suffered a massive power outage which left thousands of people without power for several days. The challenge was to solve the power problem technically (the responsibility of the private power companies), but also to provide assistance to the public (the city’s responsibility).

The major obstacle was that the power companies refused to provide information about where the power outage was happening, so the city could not answer even basic questions like:
Where is the power outage happening?
For how many hours or days is it going to last?
How many people live in affected areas?
Who lives there – for instance, especially vulnerable people?
How many buildings are there and what are they used for?

“The major obstacle was that the power companies refused to provide information about where the power outage was…”

Alalu’s team had to think about different ways to understand where the power outage was happening and who was affected. They wanted to build a platform that showed them the status of the power on every block and street in the city.

“We were forced to be creative,” he said.

Use what you’ve got
The team started to think about the city as a platform and how they could use the infrastructure that was already in place to gather real-time information about what was going on. The first thing they identified was the “network backbone”, such as the more than 300 Wi-Fi hotspots throughout the city. These could also be used as sensors to inform the city whether they had a power supply or not.

By using existing assets, they gained real-time data from 900 data points, but they still needed more information. Next they looked at the more than 60,000 streetlights that are on every block and street. They have a management system to show whether they have a power supply or are damaged, etc., so could also act as sensors.

Alalu’s team met with the streetlight office and Philips Lighting. The Philips’ API reported the status of the streetlights every five minutes and much can be concluded from the results: If one streetlight is out, maybe it’s an isolated problem; if there are others, you might have an outage.

The team built an interactive platform for the emergency team to understand where the power outages were happening and for how long. They also tried to engage citizens, offering them a way to report power outages. They could also act as ‘sensors’.

When the team looked at the newspaper coverage on the outages and compared it with their platform, the information on outage locations was the same, which validated their approach.

Actionable data
Next, to make things easier for emergency services, Alalu’s team built a dashboard that answered questions on the location of power outages, the number of houses affected, how many schools had been impacted etc. Although this gave the emergency services a quick picture of what was happening, they still needed time to interpret this information, when the really needed fast, data-driven decisions about priorities and where to go first. For example, get to houses that had been without power for a long time and elderly people. Like many cities, Buenos Aires has demographic differences in different areas, and this data helped them rank priorities.

The teams used:
- census data (open data)
- street grid (open data)
- land use (open data)
- streetlight location (open data)
- streetlight status
- the network backbone

Although much of the data was open, Alalu said what made the project a real success was people sharing information

What’s next?
Now the focus is on opening up data right across the province of Buenos Aires and engaging citizens with it. “It’s a huge challenge,” Alalu said, but it is well supported. The new governor of Buenos Aires has signed the first ever executive city order to make all city agencies open their data to increase innovation and improve citizens’ lives.

“Wish me luck”, Alalu concluded. “I hope to share more good news next time.”
TAMPERE SCALES DATA – “ONE CITY IS NOT A MARKET”

Jarkko Oksala, CIO, City of Tampere, shared the progress that has been made on building an economy of data in one individual city and between a number of them.

Tampere is a city in southern Finland, built between two lakes. It is the most populous of any in the Nordic countries and its vision is to be an “internationally recognized sustainable smart city, attractive for business and citizens.”

Its objectives are to:

- achieve growth and value for all participants in Tampere’s smart ecosystem;
- increase the ecosystem participants’ international competitiveness;
- attract and grow talent, knowledge and skills;
- contribute to a sustainable Tampere community; and
- improve the quality of life in Tampere.

Oksala said, “The Smart Tampere Ecosystem success depends on various ecosystem participants all contributing and gaining from the ecosystem.” This ecosystem includes citizens.

SMART TAMPERE ECOSYSTEM

The Smart Tampere Ecosystem success depends on various ecosystem participants all contributing and gaining from the ecosystem.

“The Tampere’s vision is to be an internationally recognized sustainable smart city, attractive for businesses and citizens.”
To achieve these goals, a number of strategic decisions were taken:

- The City of Tampere pledged to lead the way and set the example for smart cities.
- It is committed to publishing its information resources as open data.
- It recognizes that to adapt to the increasing speed of change, internal processes must be changed too.
- The city plans to lead the way in developing novel, open innovation platforms and co-creation environments.

Tampere’s smart city strategy states, “The information provided by the city is open and it facilitates spontaneous, citizen-led activities.” By opening its data and fostering engagement with it, Tampere has already learned a number of key lessons.

- You need to change the city’s culture so that it is open by default – and that’s a really big change.
- You need to rethink skills and roles; for example, the city needs to act as a platform and an enabler for citizens, students and businesses to work on and innovate with using the data.
- New skills are needed around the procurement of new technologies, such as to support rapid development and analytics.
- Public-private partnerships are important for developing new business models.
- One city is not a market – we need to find partners in other cities.

**SIX CITY STRATEGY**

Helsinki  |  Vantaa  |  30% of Finland’s population
Espoo    |  Oulu    |  
Tampere  |  Turku   |  

**Six Cities Strategy**

The realization that building a market required more cities led to Tampere co-forming the European Union-financed Six City Strategy in 2014. The scheme will run until 2020 and has three focus areas: Open participation, open platforms and open data and interfaces. The coalition is between Finland’s six largest cities – Helsinki, Espoo, Tampere, Vantaa, Oulu and Turku, which collectively covers 30 percent of the country’s population.

This co-operation enables the cities to experiment in a larger context than just one city. They engage the whole urban community to create smarter and more viable cities. One element is an open data project, whose aims are to:

- mutually agree data models and application program interfaces (APIs);
- speed up data-driven business in Finland;
- share best practices and bring the six cities to the same level; and
- open data as part of the cities’ normal functions – “open data by default”.

Vainu, a fast-growing start-up is a good example of how a business can be created and scaled on top of open data. It’s stated aim is that, “We are building a database of 100 million companies. Vainu uses big data analysis to gather company insights into one place. You’ll find the most valuable prospects and know the right time to contact them.”

**Going global**

This team effort was working well – but “six cities is still not a market,” Oksala said. “We need even wider collaboration.”

So, now Tampere is active in Open and Agile Smart Cities, with the goal of creating an open smart city marketplace.

**OPEN AND AGILE SMART CITIES (OASC)**

89 cities  |  19 countries in Europe and beyond

The future looks very promising, “Open data is just one ingredient of cities, but I believe there will be many opportunities for citizens, cities and companies,” Oksala concluded.
DATA ANALYTICS AND IoT

We are all facing some common global challenges:

- Urban density – two-thirds of the world will live in cities by 2025;
- Healthcare – by 2025, there will be 9 billion people, 800 million of whom will be over 65 with high healthcare needs;
- Energy sustainability – global demand for energy will rise 37 percent by 2035;
- Ageing population – the world is ageing fast and by 2050 more than 2 billion people will be over 60; and
- Mobility – people are moving into more congested centers and as urban travel will triple by 2050, congestion could bring cities to a standstill.

See the infographic for how these problems are manifest in Singapore.

SINGAPORE:
REGULATORS FACE CHALLENGES WITH IOT AND SMART CITIES

Chng Ken-Wei, Center Director (China), Infocomm Development Authority of Singapore (IDA), First Secretary, Embassy of the Republic of Singapore, Beijing, outlined some thought-provoking challenges and opportunities regulators are grappling with concerning the Internet of Things in the context of smart cities.

The big question is, how will this shape costs and infrastructure when it comes to our future healthcare system? Our leaders have said technology will be key to making Singapore a smart nation, able to address these challenges.

This strategy will be enabled through providing pervasive connectivity (a combination of the national broadband network, public access points to broadband, a Smart Nation Platform), for sensors, open data and the co-creation of new services. Heterogeneous networks – or hetnets – will be important for seamless roaming between networks.

Better homes are being addressed by using technology to create new homes and estates, such as in Punggol town as a smart precinct and Smart Yuhau as a brownfield site.

SINGAPORE IS THE WORLD'S MOST DENSELY POPULATED NATION

IT HAS 8,000 PEOPLE PER SQUARE KM, COMPARED WITH 265 PEOPLE PER SQ KM IN THE UK AND 35 IN THE US

2015 – 300,000 OR 1 IN 9 OF ITS CITIZENS ARE ELDERLY

2030 – 900,000 OR 1 IN 5 OF ITS CITIZENS ARE ELDERLY

THE LENGTH OF SENIORS’ STAYS IN HOSPITAL HAVE INCREASED 30%

PUBLIC HOSPITAL OCCUPANCY RATES ARE AT 90%

11,000 MORE HOSPITAL BEDS WILL BE ADDED BY 2020

1 MILLION CARS ON THE ROAD ROADS TAKE UP 12% OF LAND

DEMAND FOR POWER WILL INCREASE 30% BY 2050
Aspirations for better health and successful aging are being addressed through tele-trials, the most recent trial being remote monitoring of vital signs for hypertensive patients. Learning from these trials will be applied to the national deployment. Successful Aging is a massive undertaking, with a $3 billion action plan.

In all of these and other endeavors, Internet of Things will be a key for Singapore’s Smart Nation vision. “Our bottom-up analysis for the applications we size estimates that IoT has a total potential economic impact of $3.9 trillion to $11.1 trillion a year by 2025,” McKinsey (2015).

**The regulatory framework for IoT**

Professor Ian Brown of the Oxford Internet Institute, University of Oxford, UK, published a discussion paper for the Global Symposium of Regulators in 2015. In *Regulation and the Internet of Things*, he wrote that regulating the IoT is not likely to be straightforward because of the different scales of deployment and different communication models.

Brown outlined four common communications models describing the Internet Architecture Board:

- back-end data sharing;
- device-to-gateway;
- device-to-cloud; and
- device-to-device.

The Professor’s paper also outlined three different scales of deployment:

**Individual** – typically spans smartphones and wearables used by individuals, where the intended audience for the data is likely to be the user themselves, perhaps their immediate friends and family, or maybe a bank (for mobile money apps) or their employers for work-related use.

**Community** – includes connected cars, health devices and smart homes, linked to intelligent transport systems, remote alarms and heating systems, blood pressure monitors and so on. The data will be about speed, distance, airbag, crash locations, heart rate, blood pressure and diet, and so on. The audience for that data will be doctors and other healthcare givers, car insurance companies, police, social networks, and a wider circle of friends.

“Regulating the IoT is unlikely to be straightforward due to the different scales of deployment and communication models”

**Society** – meaning large systems like smart cities and smart grids, that rely on smart electric, gas and water meters, and traffic monitoring. The data will be based around consumption and billing, and traffic flow data. The audience for the data is regulators and authorities, utilities and other citizens.

**5 big areas for concern**

Several regulators are looking at common challenges posed by IoT regarding some of the most pressing issues which are: security, data protection, interoperability and standards, licensing, spectrum and resource allocation.

Here are Singapore’s approaches to them:

**Security** – the plan here is to minimize cyber security breaches through close collaboration with multiple stakeholders. There is a need to manage consumers’ expectations and no single security policy will cover everything from a Fitbit to smart grid. Telecom regulators will have to work closely with cyber security agencies and industry players. Security should be implemented by design, across a product’s lifecycle.

**Protecting personal data** to enhance consumer trust in IoT – regulation and public education will be key to safeguard consumer interest. Companies will have to comply with Singapore’s Personal Data Protection Act (2012), including those which are collecting personal data via IoT.

**Technical interoperability and standards** are being addressed by IDA’s Telecommunications Standards Advisory Committee, working on various IoT-related standards in line with the ITU-T work program.

**Licensing framework to evolve to meet the challenges of IoT** by addressing key concerns while facing operational challenges, for instance, whether to register billions of devices.

**Maintaining flexibility to ensure IoT devices have sufficient spectrum.** It’s unclear whether most IoT devices will use licensed or license-exempt spectrum, and what types of devices they will be.

Finally, **monitoring availability of network addresses** for IoT is essential, as there will be billions of devices, so IPv6 will play a key role. IDA has launched regulatory and industry initiatives to support IPv6 in Singapore.

All these things will play their part in the vision is Smart Nation Singapore – many smart ideas, one smart nation.
ENABLING CITIES AS PLATFORMS FOR INNOVATION AND GROWTH

Juanjo Hierro, Chief Technology Officer, FIWARE, explained how this global open source community is moving from open data to enabling the economy of data, and how to build smart, so that applications and data can be used anywhere, not just one city.

Smart cities are not just about providing municipal services more efficiently, but about transforming cities into engines of economic growth and ensuring the well-being of citizens. How will this happen? We can achieve this by transforming cities into ICT platforms for applications that can deliver all kinds of services. The kind of platforms cities need must be able to handle huge amounts of data and to incorporate data for third-party applications.

How? By combining infrastructure with application program interfaces (APIs), and with open data. We need to offer APIs to third parties and open big data, in real time – this is what cities need to provide to fuel apps that will impact daily operations of business and so much else. So we are talking about providing data sets, which also means providing an API to give access to them.

Parking app for Porto – and Santander
An example of a real service that is enabled in this way is in the Portuguese city of Porto, which provides smart car navigation, with real-time information about parking slots. This is taken from the UrbanSense platform that is embedded in most cars, based on FIWARE’s standards. But a single city is not a market; to create a market to gain the economies and other advantages of scale, you need to develop once and ensure it can be used in any city without significant modifications. Hence the cities of Porto and Santander have used the same APIs and same information model: The application in each city recognizes a car from the other and allows it to use the system.

Making a global market
Altogether 89 cities in 19 countries have begun using FIWARE for exposing data to foster and support the evolution of standards for smart cities and their spread worldwide. You can find out more about this global Open & Agile Smart Cities (OASC) initiative here.

Let’s look in a little more detail at what our common, open source approach involves:

- The community agreed to API use defined by FIWARE to access information about context – real-time data – it may not be perfect, but it is common and open.
- We agreed on the need for a common language, for example, the way you describe traffic, which necessitates a common information model – and the cities are collaborating on this to use with the APIs to gain access and share.
How to publish data? Many cities already have an open data platform, but mostly they support access to files and records of a static view. We have been working on a method in FIWARE of having real-time data testing so end users can connect to an open data portal and get one-time data sets in real-time for use with an API – so we need to understand what kind of data fields are needed.

Evolution of the Next Generation Service Initiative (NGSI) API is key to the pivotal point of interoperability (PPI) for RESTful APIs, enabling access to context.

From open data to the economy of data
To move from simply making data open, we are working with TM Forum to transition to the economy of data. This is where a city provides infrastructure for sharing data, and only for data from the city, but from third parties too. They could monetize this, charging for enabling sustainable services creation.

Economy of data = sovereignty of data + business APIs

Establishing the sovereignty of the data – who owns the data – is important. A city needs to provide policies that say, for instance, “This data can be used without charge for health services, but charged for if used in other apps…”

About a year ago we produced an open source reference implementation of the economy of data, and TM Forum brought a good set of technologies and applications to it.

TM Forum’s Open APIs, including Product Catalog, Product Ordering and Product Inventory, will be incorporated within the specifications and open source reference implementation of the FIWARE Business Framework.

“What’s important is having a vision for where you want your city to be.”

Now it’s time to execute. Some OASC cities are working on a number of collaborations, including participation in TM Forum proof-of-concept Catalyst projects. They are focusing on specific challenges using FIWARE APIs and grading information models to create a vision of portable solutions. There are many different levels of maturity, and TM Forum is carrying out work in this area too.

The aim is to focus on civic and city challenges, involving real cities, their partners, APIs for solving challenges and creating common data models that can be universally adopted. It doesn’t matter that your city might not be very mature in its transformation to becoming smart, the really important thing is where you want your city to be.

Dream big; it works. The future is all about portable solutions.

FIWARE and TM Forum’s enabling partnership
In November 2015 TM Forum and FIWARE announced they would work together to deliver the key building blocks for enabling and connecting smart city ecosystems.

The Forum now supports FIWARE NGSI REST-based APIs for real-time access to contextual information for cities. This enables more efficient management of municipal services in areas such as mobility, water, waste, energy and environmental management, and also paves the way for the development of smart applications by third parties.

In turn, the Forum’s Open APIs, including Product Catalog, Product Ordering and Product Inventory (see Figure 1 on page 62), will be incorporated within the specifications and open source reference implementation of FIWARE’s Business Framework. The Framework enables the management and the monetization of different kinds of digital assets involving multiple partners.

TM Forum’s suite of 18 lightweight REST-based APIs have been crowdsourced from within TM Forum’s diverse membership over the past three years and leverage more than 25 years of TM Forum’s complex management systems expertise in billing, catalog management, service level agreements and policy. More APIs are in the pipeline and anyone is welcome to use and evolve those that are already publicly available.

Both organizations are members of the global Open & Agile Smart Cities initiative.
Why Platforms and APIs Are Fundamental to the Data Economy

The Smart Yinchuan Innovation Center is a ground-breaking collaboration between TM Forum, the city of Yinchuan and ZTE. George Zhang, Marketing Director, ZTEsoft, and Carl Piva, Head of TM Forum’s Smart City Forum, explained how it can contribute to the global economy of data and much else.

One of the Smart Yinchuan Innovation Center’s goals is to show how the economy of data can be built and shared by cities. We have established a city platform for Smart Yinchuan (see Figure 1) with a number of data sources. The long term aim is to bring all the aspects of the city to its citizens’ fingertips – such as real-time information about weather, public parking, environmental and bus travel data. This data could originate from the city or from other cities and third parties. In the Innovation Center exemplar, this data is fed into a common platform for the city using TM Forum and FIWARE’s (also see page 63) best practices and open APIs.

Why is this so important?

A recent estimate put the value of the API [application program interface] economy – what we describe as the economy of data – at $2.2 trillion by 2018: Data is the raw material, if you like, and APIs are what enables us to bring different data sources together to be collected, collated, analyzed and acted on.

You’re thinking, APIs are not new; for years they’ve enabled conversations between software systems for a multitude of purposes. That’s true, but the technology they are built on, their functions and roles have evolved radically. In particular, in the digital era, open – that is, publicly available, standardized APIs – have proliferated massively and are used to plug and play many companies, including Airbnb, Alibaba, Amazon, Apple, Didi Chuxing, Facebook, Google, Uber and other household names that have grown massively in a relatively short time and totally transformed multiple sectors. They enable the rapid and simple setting up, changing and tearing down of mashed up services by being standardized and public – they can be configured and used in almost limitless ways – think Lego bricks.

Considering the importance of APIs today, read what Jeff Bezos of Amazon said about the critical use of open APIs back in 2002 on pain of being fired. Managing APIs as a strategic asset critical to realizing business plans and goals is why Google just bought the enterprise API management company, Apigee, for a reported $625 million.

How we can help – now

TM Forum’s member organizations have developed a suite of 18 open APIs, with more in the pipeline, to help them open up their valuable assets. Note that although the open APIs have been developed by communications
Watch all the videos and interviews from the event

and technology providers, their application is by no means limited to the communications industry, as has been demonstrated at our ongoing series of open hacks, where teams of developers from around the world have put them to an amazingly diverse range of uses. They have been designed for digital partnering in the emerging globally connected data economy.

As we went to press, eight leading technology ecosystem participants have officially endorsed TM Forum’s suite of Open APIs for digital service management – including IBM, Oracle, Ericsson and Huawei. These visionary companies follow in the footsteps of nine of the world’s largest communications service providers – Axiata, Bharti Airtel, BT, China Mobile, China Unicom, NTT-Group, Orange, Telefónica and Vodafone – who made a similar commitment in May 2016.

Smart cities are very well placed to enable a share of the huge economy of data-enabled market because they are sitting on masses of data, and by acting as a platform, can enable others to create new services, based on innovative models, by combining data from many sources.

These services could even contribute to the city’s revenues, supporting further investment in making it smarter and a better place to live and work for all its stakeholders. This could be in terms of greater social inclusion, more accessible education for people of all ages, better public transportation, improved air quality, more efficient energy, waste and water management, reduced traffic congestion, new digital health services and much else.

Not only about money
Clearly, making cities smart is not about turning them into revenue centers, they are primarily about much improved engagement with citizens, helping them to shape and enjoy where they live, and building trust between the city and citizens. They are about creating powerful innovation hubs that can enable a growing local economy. Platforms are also a great way to break data out of departmental silos, so that cities can make better, more transparent decisions based on data from multiple sources, such as real-time environmental data and traffic management patterns, for instance.

By setting up policies in the platforms, cities can combine for free with paid for models, enabling all kinds of business opportunities for data providers and application developers. This could be on a transactional basis, by subscription, pay as you go, for access to the data or even using an API. Policies will also enable cities to protect citizens’ privacy and data, which is critical to the success of smart cities and keeping citizens’ trust.

Nevertheless, as so many speakers here said, cities are typically chronically short of money: Estimates of what it would cost the US to make the necessary repairs to major roads, bridges and sewage vary widely, ranging from $3 trillion to $4.7 trillion in October 2016 alone: The Federal Highway Trust Fund has an annual funding deficit of $13 billion. The same is true for most nations in the world. Public-private partnerships will play a critical part in upgrading and building new city infrastructure the world over.

Adopting the platform model (which means both the right IT architecture combined with the right processes and business approach, plus open APIs) makes such partnerships viable operationally, technologically and economically, without asking citizens and local businesses to dig deeper into their pockets. Further, platform-based organizations can scale massively and evolve to meet new needs rapidly without any major reworking, due to their modular structure.

Taking the next step
Platforms’ modular structure and scalability also mean that cities can start to share and combine data, and use the same applications instead of reinventing the wheel – which is expensive, slow and wasteful. That way, everyone is able to leverage the economies and other advantages of scale and collaboration: While all cities are unique with different priorities, they face many common challenges. This represents a new paradigm for cities and will require more insights and business acumen from city leaders.

Finally, the larger the audience or user base, the more compelling the proposition for developers, innovators and businesses. If we follow this proven trajectory of collaboration and scale, we can have smart cities, smart regions, smart countries and ultimately a smart world. And the really good news is that we already have many of the building blocks we need to move to the next stage – see Figure 2.

FIGURE 2: TAKING THE NEXT STEP AND COLLABORATING WITH OTHER CITIES
In 2013, Shaikh Mohammed, Vice President and Prime Minister of UAE, Ruler of Dubai Emirate, announced the aim of making Dubai the smartest and happiest city on Earth. The key planks of the smart city strategy are:

- efficiency through optimized use of the city’s resources;
- seamlessness by integrating daily-life services;
- safety by anticipating risks and protecting people and information; and
- impactful to enrich life and business experiences for all.

Along with the economy, living, governance, environment and people, mobility is seen as one of the key drivers of Dubai’s smart city strategy, which is largely the responsibility of the Roads and Transport Authority’s (RTA).

Happiness is central to RTA’s corporate strategy, and as a government agency, it needs to know what people want to fulfill its ambitions. The Dubai Smart Mobility Master Plan was created in 2015 and these are its main areas of focus:

- Transportation
- Traffic Management
- Road Infrastructure
- Sustainable modes of public transport
- Non-motorized modes of transport
SMART MOBILITY

The strategy’s goals include:

- making traffic congestion almost a thing of the past
- people’s transport needs are catered for individually
- the city can predict journeys and plan accordingly
- an integrated mobility infrastructure provides choice and smooth transfers.

Figure 1 shows how RTA plans to achieve these goals. Good progress has been made in a number of areas.

Smart apps
The suite of smart apps makes information about the city and services accessible 24/7. The RTA Dubai app, the RTA Drivers and Vehicles app, and the RTA Corporate Services app provide a wide range of information and functions, such as how much time left at your parking slot before you need to move the car, about renewing driving licenses, vehicles and fines, the Salik toll road system, taxi bookings and much, much more.

“The nol Smart Card is being extended for use for micropayments in selected stores, museums and parks."

You can make transactions online, from buying tickets for public transport, to renewing your license, to renting a bus or boat, and, of course, the Happiness Meter where users report on how they feel about their experiences of using the apps and services.

The Enterprise Command and Control Center (EC³)
This is a key RTA initiative to improve Dubai’s environment to make it better for living, business and tourism. The project will be a true multimodal, multi-agency center and a major contributor to making Dubai the world’s smartest city. It is due to have a ‘soft launch’ in December 2016, becoming fully operational in May 2017 and reaching full maturity in 2021.

EC³ will be responsible for event planning and management, enterprise transportation management, information management, data acquisition and strategic reporting, act as a center of excellence and IT security operation center.

RTA Smart Card (nol) – Unified Automated Fare Collection
There are anonymous and personalized card types; these e-wallets are available for corporate and individual use – there are five different categories of cards.

The Dubai Metro went live in September 2009. At the time of the presentation, 19,000 products had been sold, there were 2.4 million transactions daily and 3.4 billion transactions in total since launch.

The nol Smart Card is being extended for use for micropayments in selected stores, entry to the Etihad Museum and Dubai’s public parks.

RTA Smart Bus Shelters
The bus shelters are very important in extremely high temperatures. So far we have in place 100 smart bus shelters to cover 15 districts of Dubai with a host of facilities such as:

- real-time information for passengers
- free Wi-Fi
- smart kiosks
- chargers for mobile phones
- mini-marts (available in 25 bus shelters only).

They have been deployed using a public-private partnership model, so at zero cost to the city.
Projjal Dutta, Director, Sustainability Initiatives, Metropolitan Transportation Authority (MTA), New York; Abdulla Ali Al-Madani, CEO, Road & Transport Authority, Dubai; and Sami Pippuri, CTO, MaaS Global, represent diverse places, but were in fundamental agreement. Not least on the idea that a smart city means smart, integrated public transport.

He compared a low-rise business park with a high-rise office block of a similar capacity. Regarding the pollution generated from lighting and heating, there is typically little to choose between them. However, if you measure the carbon emissions incurred by getting people to and from them, typically with one person per car, then the urban business park is indirectly generating almost five times the pollution – despite public transport to the city site using ‘dirty’ transport such as traditional diesel buses.

Dutta said, “We have come up with a way to place a monetary value on this. We call it “transit-avoided carbon” – see Figure 1. Dutta said this is a universal measure. MTA emitted about 2 million tons (1.81 tonnes) of greenhouse gasses last year and he chose to talk about one approach in particular that the authority is taking to reduce this number – electric buses.

There a number of challenges: If electric buses can only be charged when they return to the depot, which is known as deep charging, they need huge batteries. Such batteries are heavy and take up a lot of room, meaning the buses can carry fewer passengers and aren’t energy efficient either.

Opportunistic charging
One solution would seem to be opportunistic charging – that is boosting smaller, more efficient batteries at every opportunity. There are various ways of doing this: By the driver pulling up on a metal induction grid that charges the
battery while passengers get off and on or by charging via a pantograph and overhead cables. Both could be made more viable by leveraging a common power infrastructure for trams, trains and buses, as the city of Vienna has done already.

“Electric buses are too well-behaved... self-driving buses needed to become assertive.”

Self-driving, smaller and more frequent electric buses are a subject of considerable interest too, but as Dutta points out, one of the problems with them is that, “They are too well behaved; they always let other vehicles go first and so stand still for a long time.” Hence self-driving buses needed to become more assertive.

Finally, Dutta sees cities’ shared bike systems as an important part of the sustainable mix – see Figure 2 below.

Sami Pippuri, CTO, MaaS [Mobile as a service] Global, agreed that thinking about modes of transport separately is outdated and inefficient, and not passenger-friendly. To encourage us all to use public transport more, he suggests that cities should offer “a subscription model so that there are no worries about cost or buying tickets” that could be used for all modes of public transport, seamlessly.

He says cities “could offer business packages, off-peak packages and everything in between.” The interface would, of course, be an app, “disguising all that complexity behind pricing and timetables, and other things that drive most of us crazy”.

Octopus – a multi-strand approach
Abdulla Ai Al-Madani, CEO, Road & Transport Authority, Dubai, described what his city has done to integrate different types of transport better and make it easier to use them. Dubai has partnered with the payment system, Octopus, in Hong Kong, to provide its citizens with a multi-purpose smart card to pay for journeys on the bus, metro, tram and taxis. It will also provide admission to the Etihad Musem when it opens next year, as well as to public parks, and enable all kinds of micropayments (also see article on page 66).

What about the future? Will cities and their smart mobility needs diverge as they evolve? Dutta commented, “I don’t think that the differences between cities regarding smart mobility are about principles, they are about particulars and degree – for example, most cities are very interested in autonomous vehicles and their green potential.”

“I don’t think that differences between cities regarding smart mobility are about principles, but about particulars and degree.”

This includes Dubai, which is looking at driverless cars and their likely impact. It has announced aggressive timelines to introduce them: Shaikh Mohammad’s initiative calls for 25 percent of all transportation trips in Dubai to be smart and driverless by 2030 as part of Dubai’s strategy to become the smartest city in the world with a sustainable economy.

This is a joint venture between the Roads and Transport Authority and Dubai Future Foundation, with a strategy focusing on four pillars: Individuals, Technology, Policies and Legislations and Infrastructure. Testing is underway now for public buses. As Al-Madani said, “It’s about making it safer and smoother for people to move to their destinations”.

The journey as destination
Dutta agreed, saying, “The working title of my book is Taking the car out of carbon – it’s a big emission source, but doesn’t have to be. I foresee a world where people run into each other, rather than cars do it, and where we have happy accidents instead of wrecks. Our transportation journey should become the destination instead of a hated part of the day.”

FIGURE 2: SUSTAINABILITY MODEL
= TRANSIT + BICYCLING + WALKING
For the last decades, power companies have supplied us with electricity across large, reliable grids and a supply network, but now we are moving away from large centralized power plants to many more, smaller energy bases, green power and software control (see infographic). This is a global trend, especially strong in Europe; last year Portugal generated over 50 percent of its electricity through renewable sources.

Between 2009 and 2015 the cost of solar power dropped by 80 percent and now you can be a producer as well as a consumer – a prosumer. As a home owner, put solar panels on your roof and even in countries like Germany that are not so sunny, you can enjoy up to 60 percent independence from the electricity provider and sell spare energy to it.

H. Dieter Waffel is CEO of AllMerus Energy, which is Germany’s largest green energy retailer with 1 million customers. He outlined the trends that are reshaping the global energy sector and some green solutions for local communities and smart cities, at home and abroad.

**ENABLING SMART ENERGY COMMUNITIES**

The three global megatrends that are turning the energy world upside-down:

- **Decarbonization**
- **Decentralization**
- **Digitization**

**RESHAPING THE GLOBAL ENERGY INDUSTRY**
Virtual power plants
Beyond this, we can aggregate power generated by renewable sources to create a virtual power plant for communities – see Figure 1.

This system needs to be managed by very intelligent software – out of our 500 employees, 20 percent are software developers. The Lichtblick Virtual Power Plant has been in action since 2010. It has more than 1,000 energy units and is in commercial operation 24/7.

It has a full range of optimization applications including:

- maximized onsite consumption;
- spot market sales at the Energy Exchange;
- provides load relief to distributions system operators (DSO – which in the European Union are responsible for providing and operating low, medium and high voltage networks for regional distribution of electricity as well as for supply of lower-level distribution systems and directly connected customers); and
- providing secondary frequency control to transmission systems operators (TSO – again a term defined by the EU which refers to is an entity entrusted with electrical power on a national or regional level, using fixed infrastructure).

Support for field tests
The grid – We are involved in Germany’s largest field test with a DSO to provide load relief in areas where the grid is constrained. Our SchwarmDirigent platform optimizes the performance of combined heat and power (CHP) plants to facilitate grid requirements, effectively providing load relief.

Electric vehicles – we are providing secondary frequency control for 20 electric vehicles in a field test in Berlin that involves the integration and pooling of mobile batteries. We are providing secondary balancing power, which takes users’ unpredictable behavior into account. Our partners in this field trial are Volkswagen, SMA and Fraunhofer IWFES, working in cooperation with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Commercial energy communities
Germany – Gelbes Viertel in Berlin (see main picture) is the largest solar roof system (at 1.9MW) in Germany which covers around 3,000 apartments across 50 buildings. LightBlick markets green electricity directly to tenants, around 500 of whom are customers.

Vietnam – this microgrid solution optimizes the energy supply from distributed energy resources within an off-grid eco-lodge hotel, replacing fossil fuel (diesel) generation with clean energy from wind and solar. This is cheaper as well as greener, and reliable. The microgrid solution could be scaled for the whole island.

The Philippines – community energy is provided here managing batteries to optimize local consumption in a housing community, providing affordable and reliable energy. In future, surplus energy could also be sold on the Philippines’ spot market.

In summary
Lichtblick is developing an energy-sharing platform for communities and smart cities – see Figure 2 – to:

- provide them with clean energy;
- make efficient use of clean technologies;
- provide a reliable energy source;
- enable them to participate in the wider energy world; and
- facilitate energy trading between people.
Smart Energy GB was established by the UK Energy Minister as the independent voice of the smart meter rollout. As Rob Smith, Head of Policy & Public Affairs, Smart Energy GB, explained, this is not just about upgrading technology, but driving behavioral change in energy consumers. He said this can be achieved through creative communications. Meet Gaz and Leccy – if you dare.

The UK’s national initiative will see 53 million smart meters installed in UK homes by 2020. Smart meters are part of the plan to bring energy systems up to date. Smith said, “They have a role to play in taking us towards a low-carbon economy, greater use of renewables and a secure energy supply.”

He outlined the “crucial task” of engaging consumers with their gas and electricity use to drive behavioral change. He noted, “This is really a creative communication task, rather than a technical one."

Beyond this, smart meters will be help the nation as a whole as part of a smart energy grid, sending data back to suppliers and generators. In turn, this creates social and commercial opportunities within the energy sector and far beyond.

Energy and equality
Smart energy can also play a role in tackling inequality. The poorest in society typically pay the most for their energy – pre-pay customers pay an average of £226 ($324) a year more than customers on credit plans. Around 16 percent of UK householders are on prepaid energy meters, typically people living in fuel poverty, which means their energy bill accounts for more than 10 percent of their income.

The UK has many legacy issues around housing stock, which is not energy efficient, and smart meters will be transformative for the poorest energy customers.

Rolling it out
Energy use is predicted to increase significantly across the UK, creating the pressing need for a smart grid. Nobody will be obliged to have a smart meter fitted – this is one of the key learnings Smart Energy GB has taken from the experience so far. However, energy companies must take all reasonable steps in every home and micro business (companies with fewer than 10 staff). The rollout is already underway.
ROLLING OUT SMART METERS

Over 3.5 million smart meters have been installed

4 in 5 with smart meters are using less energy

79% with a smart meter would recommend to others

Source: Smart Energy GB

Smith said, “It’s our job to help everyone understand smart meters. As we have heard so many times [at this conference] we need to put people at the center of smart and that means all people.”

The challenge is engaging people with a sector that has very low levels of consumer interest. Realistically, people don’t spend a lot of time thinking about their energy data. Smart Energy GB needed to grab their attention by demonstrating the absurdity of an unlogged system and estimated billing, and they put together a social media and video campaign around the topic. It reached millions of consumers.

Here’s an example video.

Next they needed to show how smart meters are part of the solution. To do this they created two characters, Gaz and Leccy, to empathize with the way people feel about their gas and electricity use.

Research had shown them that people felt that energy use wasn’t something they were able to get under control. The Gaz and Leccy campaign will be rolled out more widely over the coming months.

Bringing smart energy to life

Other initiatives have included:

- Late last year the Royal Philharmonic Orchestra performed A Requiem for Meters, a three-minute piece of music played entirely on instruments made from old gas and electricity meters. The Requiem was recorded at Abbey Road Studios and released for free on Spotify to raise awareness of smart meters.
- Great British Bake Off finalist Ian Cumming released a series of energy-saving recipes, developed with the help of his smart meter. (Great British Bake Off is a hugely popular TV show in the UK).
- A range of traditional educational resources, available free and translated into six different languages.

Partnerships

Partnerships are also being used to gain consumer confidence in smart meters. Smart Energy GB has a formal partnerships program, which provides funding, resources and training to organizations that are helping to spread the word. This is particularly important when engaging with vulnerable groups, for example, as many of these people will have existing relationships with third sector bodies and local government.

The aim is for the campaign to extend and deliver well beyond the 2020 date, delivering long-term consumer behavior change. “That’s how we will know we have achieved a legacy from this rollout,” Smith said. “In some ways the rollout of smart meters is a once-in-a-generation opportunity to change how people think about their use of energy.”

Smart energy and smart cities

Smart cities can harness smart energy to tackle rising demands for energy, create efficiencies and develop community energy infrastructure – Nottingham, Manchester and Glasgow in the UK are examples of authorities that have already set up their own energy companies.

Smart meters mean smart grids and for cities this means more and better data. Cities can build a platform for the development of smart city applications that will promote innovation and develop better quality of life – and the use of energy data plays a part in that.

Here are some examples:

- Smart meter data can be used to support people who are struggling to pay their energy bills.
- Smart meters can alert an energy supplier when a pre-pay meter runs out of credit.
- Integrating smart energy data with other sensors such as internal temperature, personal health information or movement sensors could open up the potential for the provision of more services.
- With consent, data could be sent to a person’s GP to help them remotely monitor a patient with a long-term condition.
- A hospital could top up a patient’s account directly to avoid readmission to hospital if they are vulnerable and have been sent home to a cold house.
- Apps could be developed with data from smart meters to alert next of kin if something changes, helping vulnerable people to live independently.
- Startups could develop new products in the energy sector, perhaps in areas that we haven’t even thought about yet.

Smith closed by encouraging city leaders who are interested in smart energy to get in touch and share experiences.
The objective of this healthcare initiative, which is based in Daegu City, is to improve people’s quality of life through Internet of Things-based (IoT) healthcare services and to facilitate business incubation schemes with better regulatory support. It is a joint effort between government and the private sector; the government is identifying potential service providers to create and promote a technology-enabled care service market.

Through the Ministry of Science, ICT and Future Planning, and the National Information Society Agency, the Korean Government wants to promote an IoT-based healthcare services industry with a strong revenue growth and to create jobs in the sector.

Daegu is providing budget as well as the policy support and spaces for the service trials. It is an inland city with a population of about 2.5 million, on the Nakdong River. It has hosted a number of international events and is well on its way to becoming a global, as well as a smart, city.
Progress so far
During 2015, six potential services were tested with 2,700 Daegu citizens and more services are being evaluated in 2016 – as shown in Figure 1.

The Open IoT Healthcare Platform will be based on a common IoT-Platform that uses a single machine-to-machine (M2M) standard, integrated with international healthcare standards. It will provide:

- open application program interfaces (APIs) to participants;
- guidance for small and medium-sized enterprises; regarding service development and commercialization;
- compatibility with legacy healthcare systems;
- tried and tested platform; and
- support projects by Daegu Technology Park.

Projects that are being evaluated in 2016

**Chronic disease management** – The aim will be to help 200 patient participants keep track of their biometric indexes and ensure their guardians and caregivers are informed. It will monitor blood pressure, glucose and activity levels, and weight. Participants will include people with heart conditions, diabetes and high or low blood pressure.

**Pregnant women and maternity care** – in Korea it is commonly said that maternity care requires pregnant women and those with babies under six months old to minimize their activity and eat more, hence balancing exercise and diet is important. This trial will have 100 participants.

**Gene analysis-based healthcare** – the cost of gene analysis has fallen sharply and there are services commercially available, but none is providing tailored activity and diet monitoring continuously. This trial will have 50 participants.

**Fitness apps connected to fitness centers** – fitness clubs are very popular in Korea, but professionals are needed to help those using personal fitness apps. KT’s Personal Fitness App will be used in this trial with 100 participants.

**Fatigue recovery for air force pilots** involves Version 2 of the successful system built in 2015. Pilots’ rapid recovery from fatigue is vital to their performance and could be applied to other critical operators like train drivers.

**International Collaborative Diagnosis Service** will use smart bands and blood pressure devices to monitor overseas hypo- and hypertension patients at the Kyungpook National University Hospital’s Medical Institute.

**Healthcare big data analysis** will combine 16 sources of data from the healthcare center – such as patients’ heart rate, weight, temperature and blood pressure – and government data on aspects such as the weather, public health and environment. Analytics will be developed and embedded in the processes of deep learning and statistical analysis to improve predictions and visualize results. For example, to predict the risk of heart disease from pattern analysis of abnormal and normal states.

Next steps
The next phase of the initiative will see a number of new or refocused organizations play key roles in making the city’s ambitions reality. They include:

**Medi-City Daegu, Medical Capital of Korea** – the city has a top-level medical infrastructure that consists of over 18,000 medical personnel and includes approximately 6,000 medical doctors in six university hospitals, 29 general hospitals and 30 oriental medical centers.

**Medivalley** is based on a nationally unparalleled medical capacity, and aims to spearhead the globalization of Korean medical industries by serving as a stronghold for globally competitive IT-based high-tech medical devices and synthesized drugs.

**The Daegu-Gyeongbuk Medical Innovation Foundation** will seek to become a basis for the development of the country’s medical industry by utilizing the region’s advanced medical capabilities and infrastructure to produce research results that can lead to the development of innovative products that can also be commercialized at an early date.

**Suseong Medical District** is one of the eight special economic districts in the Daegu-Gyeongbuk Free Economic Zone. It will become the leading free economic district for high-quality healthcare service, medical R&D, software and IT industries in Korea and Northeast Asia. The District intends to attract global, top-tier medical centers and research laboratories, plus world-class hotels, and multinational IT and software firms.
It’s about people

TM Forum’s President and CEO, Peter Sany, told delegates in his opening keynote that there’s a flaw in the PPP (public-private partnership) model. “There are four ‘P’s,” he said. “You have to start with people.” He added, “Without people, I don’t see the value creation.” This was confirmed in presentations throughout the two-day conference and in the panel’s conclusions.

Jessie Adcock, Chief Digital Officer, City of Vancouver, Canada, pointed out that people includes staff and citizens, saying, “Richard Branson said this best when he said you can’t be outward [what you aren’t inward]: You can’t be smart and technological if your workforce isn’t mobile and digital as well, so invest in people and their capabilities and ensuring that they are part of the journey.”

She added, “It’s about being very smart about how we leverage technology to expand the scope of conversation. And ensuring data insights, analytics and tools are used to ensure that more people know about the journey and where you’re going from and getting to, and why you’re doing what you’re doing. That will lead to achieving that future state vision.”

CITY LEADERS SHARE THEIR TOP TAKEAWAYS

At the end of a packed three days, a panel of experts shared their top takeaways. As you will have seen throughout this report, strong themes emerged around collaboration, citizen-centricity and different approaches to being smart.

Shawn Slack, CIO, City of Mississauga, Canada, said a key takeaway for him was that, “Smart cities are really for people: We really need to remember that in context... smart city technology has to suit the community you’re putting it in. In Mississauga, we are based on a series of smaller communities and some communities’ needs are different from others...You have to engage the community in that process so you have a quality outcome.”

“Smart cities are for people...smart city technology has to suit the community you’re putting it in.”

Ron Zimmer, President & CEO, CABA, highlighted great examples of citizen-centricity shared throughout the event, including Tel Aviv’s DigiTel Residents’ Club and City Card, which are based around creating personalized services for citizens and Palo Alto’s citizen App Challenge, which empowered people, especially under-18s, “to build solutions to change the community they live in.”
'Having chaired this conference over two days, with 105 international and 65 Chinese smart cities in the room, one of the things that really hit me is the importance of not allowing technology to rule citizens; but rather to view technology as an enabler for citizen value, citizen inclusion and city sustainability. If we can drive the smart city movement with the citizen at heart, we can avoid being trapped by technology,” added Carl Piva, Head of TM Forum’s Smart City Forum.

Collaboration is key
The power of sharing knowledge, information and best practices – between cities, countries and wider stakeholders and the private sector – was another recurring topic during the event, with many speakers and delegates sharing failures as well as wins.

Shawn Slack said, “I am really happy to see the stories being told of the successes, but also the lessons learned because it’s hard to tell that. It’s great in this forum that people will come out and say what’s worked and what hasn’t worked.”

“The power of sharing knowledge, information and best practice was a recurring topic.”

Jessie Adcock agreed on the power of pooling knowledge and experience. On what keeps her awake at night, she said, “If you had asked me 48 hours ago, I’d have said messing up while you’re [in the] driving [seat]: You’ve got the future of a city and taxpayer money and all of this pressure on you, and you’re trying to lead that change. But now, having sat amongst this group for the last two days, I feel a little bit better, actually, that maybe the collective power here can help solve some of the issues.”

Privacy and security could be a particularly strong area for collaboration because more discussion is needed in this area. Adcock said, “I think that some people have blinders on and they’re just driving right by. The privacy and security discussion is very difficult and folks don’t always have the stomach to have it. I don’t think we are having the dialog at the coordinated level that we need to.”

No one ‘smart’ fits all
Jong-Sung Hwang, Vice President, ICT Policy Group, National Information Society Agency (Korea), said a major takeaway for him was that, “There are many types of smart city – some are based on technology, some are based on modernizing existing cities. In the future more and more cities will be technology-driven and make use of technology and data analytics.”

The event saw presentations from greenfield cities such as Masdar and Dholera, as well as brownfield initiatives to revitalize older cities. These different but related approaches can inform each other, though, the experts agreed.

Shawn Slack said, “I am really happy to see these greenfield cities being built from scratch because the level of innovation and application of technology can move much quicker. For us, where we’re redeveloping existing forms, we can learn from that and it lowers our risk in adopting some of that technology.”

Roadmaps and frameworks
Ron Zimmer concluded, “Events like this are incredibly important…and what TM Forum is doing in terms of sharing knowledge is going to be truly instrumental in smart city transformation.”

This need for frameworks was highlighted by Jessie Adcock, who listed it as one of her top three takeaways. She said we need, “Frameworks for how you make investments and how you architect solutions and…frameworks for how you manage budgets in general, as well as ‘target states for interoperability and connectivity.”
CATALYSTS SHOW SMART CITY INNOVATION IN ACTION

TM Forum’s proof-of-concept Catalyst projects act as an accelerator to complement the R&D efforts of the companies involved by bringing them together to address specific business and technology challenges. The companies work closely on projects lasting from three to six months, culminating in live demonstrations at TM Forum’s major events. The five live Catalyst demonstrations at Smart City InFocus all have direct relevance to the development of smart cities.

**Customer-centric Service Assurance**
This Catalyst showed how service providers that have successfully migrated from being network centric to a service-centric operational model can take the next step of providing customer-centric service assurance. The aim is to develop best practice to achieve this, based on the Business Process Framework (eTOM) and other TM Forum assets – thereby demonstrating their value in this context. The project is championed by Smart Dublin and Eir, with participation from Galileo Software, Liverpool John Moores University, MICTA and Monolith Software.

**Digicoplife – Smart Life: My City, My Home, My Planet**
This Catalyst demonstrated the foundation for an agile IoT ecosystem that can deliver a broad range of smart digital services. It also shows how different vertical domains can be interconnected into a seamless service bundle. The IoT promises a safer, simpler and more ecofriendly lifestyle through automated security and energy management solutions.

Services are provisioned on a single integrated platform that is easy to configure and even easier to use. Physical devices (for energy, security, temperature control and so on) are triggered automatically, based on the location and movement of the customer.

Orange championed this Catalyst, with participation from ESRI, BaseN, Infonova/BearingPoint and NTS.

**Prescriptive Geolocations Analytics with Sentimental Tinge**
As the name so graphically explains, the purpose of this Catalyst is to enable companies to unleash the value of their data, with especial focus on validating customers’ emotions as a new driver for business growth. This is accomplished by bringing together geographic information and sentiment analytics (based on Twitter) to create innovative approaches to prescriptive and predictive analytics, offering businesses a sophisticated solution to better understanding customers. In turn, this enables operators to better tailor services to the needs of individual customers. It is championed by T-Mobile, with participation from Pervasive, Atos and EMC.
Service Level Management for Smart City Ecosystems and Trust IoT

The MK (Milton Keynes) Data Hub brings together the whole smart city ecosystem on one platform, including end users, service providers such as energy and water companies, government, sensor network providers, data providers, and developers.

All the sensor data, from traffic flow to waste bin/trash can information, is pulled into the Data Hub. Developers can then access and use it to create smart applications. Other parties, like government departments, can also pull useful reports from the data — to see how resources can be managed more efficiently, for example.

The first iteration of this Catalyst looked at monetization opportunities in smart city ecosystems — the Data Hub allows each party to define how they want to make money from their data. More recently, the team looked at testing commercial viability and trust— both of which will be essential to making a smart city data economy a reality.

This team has also focused on ensuring that data collection is secure, meaning that only authorized devices (e.g. sensors, gateways) can connect to the platform. ‘Rogue’ devices, which could send false data, will be rejected.

NFV ecosystem enabler: A well-enabled VNF package (Phase 2)

The primary focus of the first phase of this Catalyst project was to integrate, harmonize and enhance existing standards to derive industry agreement on how virtualized network services should be packaged, especially from operational and procurement aspects. The project aims to transform and augment NS, VNF descriptors into procurable packages, including non-functional elements to support procurement decision-making, automation and end-to-end operation.

If you would like to know more about TM Forum’s Catalyst projects or get involved, please contact Jean-Pierre Dufresne direct via jdufresne@tmforum.org.
Smart your smart city journey with the Smart City Forum
www.tmforum.org/smart-city-forum

or write to Carl Piva, Head of TM Forum’s
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