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April 2018

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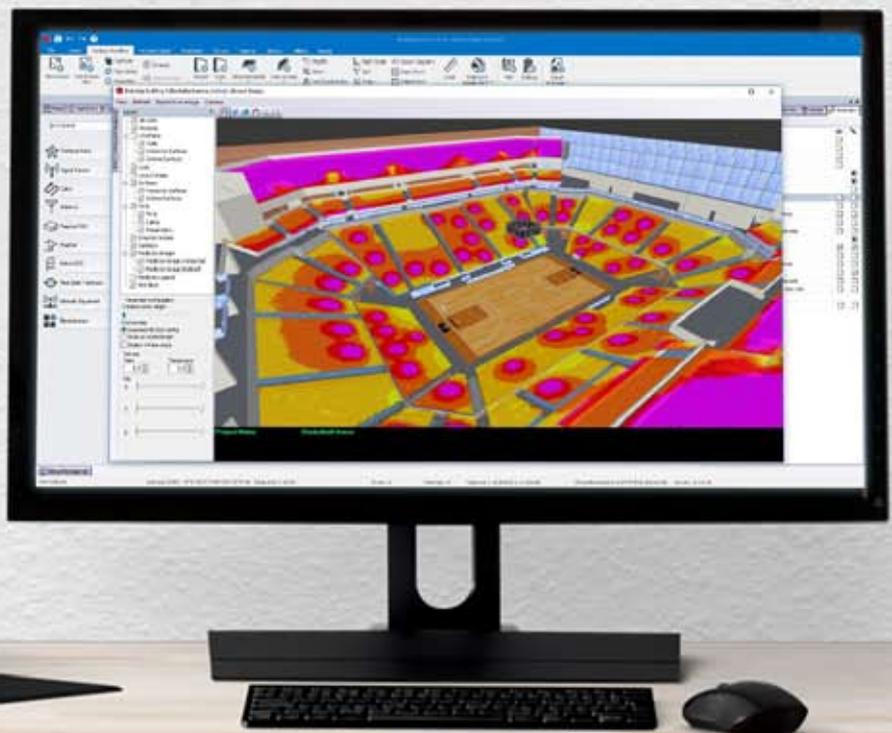


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From the Editor



Zia Askari
Editor, TelecomDrive.com

5G is Coming, Is Your Network Prepared?

From smart cities to asset tracking, to smart utilities, to agriculture – 5G will drive new age of communications where AR, VR will play a major role in terms of redefining communication experiences

As we move ahead towards the 5G era - the 5G wireless standard will deliver a unifying connectivity fabric that will bring huge enhancements to today's mobile broadband services, the experiences delivered and expand mobile networks to support a vast diversity of devices and new-age services.

And most importantly – the introduction of 5G will revolutionize the Internet of Things (IoT) ecosystem, enabling a huge number of innovative 5G-communications driven use cases and applications.

Some popular 5G driven use cases are coming to the fore, as we move towards 2020. The following are the most talked-about 5G use cases, focusing mainly on the broader categories of connected services.

Most Important 5G Use Cases

Enhanced Mobile Broadband: The 5G standard promises to usher in the next era of immersive and cloud-connected experiences with faster, more uniform data rates at lower latency and lower cost per bit. The 5G standard will take mobile computing performance to the next level with high-speed, always-on, always-connected Internet links with real-time responsiveness.

Fixed Wireless: As touted by many telecoms experts, one of the top 5G use cases will come in the segment of fixed wireless access. In a 5G era, fixed wireless will provide Internet access to homes using wireless network technology rather than fixed lines. In this scenario, beamforming and mmWave will play a critical role to boost wireless broadband services and deliver ultra-broadband to users.

Massive IoT Ecosystem: The most anticipated and talked about 5G use cases are around massive IoT segment – it is the ability to seamlessly connect embedded sensors and create IoT ecosystems that can talk to each other seamlessly. As predicted by Cisco - the industry foresees huge numbers — as many as 50 billion — of potential IoT devices in service by 2020. And hence, IoT is one area where 5G will play a major role, from smart cities to asset tracking, to smart utilities, to agriculture – everything connected in a single plane.

Ultra-Reliable Low-Latency Communications: This is where connected cars and connected vehicle ecosystems will emerge as big use cases under 5G umbrella of communications. This category includes new services that will transform industries with ultra-reliable/available low-latency links, such as remote control of critical infrastructure, and self-driving vehicles as well. The level of reliability and latency will be vital to gain control on smart-grid, industrial automation, robotics, drone control etc.

5G, the Road Ahead

Once we are living in a 5G era, applications and use case opportunities will exponentially increase and drive telecom networks to deliver great user experiences. There is no doubt that as a technology – 5G holds great promise and there is huge potential for further 5G use cases in future services and applications around – healthcare, smart cities, remote industrial automation, drone technology, e-governance, e-education etc. Telecoms just need to prepare their network infrastructure in order to reap full benefits of this future-ready communications technology.

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Preparing for 5G – 8 Use Cases, Unlimited Possibilities



5G is here – how are you preparing your network to adopt new age technologies and embrace 5G?

5G networks will offer an unprecedented leap in bandwidth speeds in comparison to previous mobile networks. For example, downlink peak data throughput could reach 20 Gbps, while uplink peak data rates could be as high as 10 Gbps.

5G will also reduce latency and improve overall network efficiency. Streamlining network architectures will deliver end-to-end latency requirements of less than 5 ms. This will allow 5G to offer ultra-reliable low-latency communication for machine-to-machine and public safety applications.

As it delivers new infrastructure solutions, 5G will depend on an end-to-end digital service transformation, which will minimise OPEX, deliver efficiencies, and drive revenue growth. For 5G to deliver an attractive busi-

ness model to mobile network operators and their customers, the network must enable efficient provisioning of a wide variety of new services for varied customers with different service level needs and performance requirements. Not only will operators need to provide services to customers across enterprise verticals efficiently, but they will need to commercialize those services rapidly and effectively.

We are presenting 8 applications that will harness the versatile capabilities of 5G and future proof telecoms profitability.

Digital technologies enable continuous innovation across a diverse range of industries. The ICT, media, finance, and insurance sectors are the current leaders in digital transformation. But this digitalization is also accelerating in the retail, automobile, oil and gas, chemical engineering, healthcare, min-

ing, and agriculture sectors.

Key technologies that underpin digitalization include software-defined devices, big data, cloud computing, block chain technology, network security, latencysensitive networks, virtual reality (VR), and augmented reality (AR). Communication networks are the key to connectivity of everything.

There is unprecedented buzz around 5G, because it can create a world boasting services and products like “Mobile Beyond Giga”, “Real-Time World”, and “All-Online Everywhere”. Mobile networks have emerged as fundamental to productivity, enabling digital transformation throughout all industries.

To support a wide enough range of different services, continuous and long-term network development is absolutely necessary. We can see from the applications we use in our daily

lives that they are always changing and evolving. The single biggest change is the improvement in online video.

Mobile networks are designed to create a super connected world, in which the generated data is contextualized, constructed and processed over the cloud, continuously creating value. Connected cars, smart manufacturing, global logistics tracking, smart agriculture, smart metering, and other applications are some of the first, most promising areas for IoT to focus on. These applications are poised to rapidly develop in the 5G era.

We have selected these 8 use cases after in-depth analysis, to help better understand the market opportunities introduced by these new network capabilities. We hope that this will help a wide range of diverse industries understand wireless progress, and proactively embrace digital transformation and industry trends.

1) Virtual & Augmented Reality – Opening Doors to Unlimited Possibilities

The bandwidth requirements for VR/AR to work effectively are substantial, as most VR/AR applications are very data intensive. Advanced VR/AR content will depend on cloud servers to meet growing demands for realistic experiences provided to consumers at affordable prices.

While an average throughput of 100 Mbps might be possible over existing 4G network, some premium VR/AR applications will demand even higher speeds and lower latency.

Real-time Computer Rendering Gaming/Modeling

Virtual reality (VR) and augmented reality (AR) are transformative technologies poised to revolutionize the consumption of content in both the consumer and the enterprise sectors.

VR/AR require significant data transfer, storage, and compute capabilities. These data- and compute-intensive tasks will therefore move to the cloud,

which provides abundant data storage and can provide the necessary high-speed computing capability.

1. This will greatly reduce device costs – making consoles or devices affordable for end users.

2. The cloud market is growing rapidly at 18% YoY. In the next 10 years, homes and offices will increasingly dispense with PCs and laptops, and switch instead to cloud-connected display screens and a variety of human/machine interfaces activated by voice command and/or touch. 5G will significantly improve access to these cloud-based services.

The VR market today is largely oriented around the gaming and video/advertising segments. Sponsorship models and VR experiences created to promote other premium content/events have predominated in the video market, although select experiences such as sporting events (e.g., Intel True VR) and live events (e.g., NextVR) have helped VR develop beyond these early lifecycle short-form experiences.

Orange has released a mobile-dependent head mounted display (HMD) unit for Android and iOS smartphones, price at €50 to support its Orange VR 360° application. SK Telecom unveiled its “360 Adaptive VR Live Streaming Platform” at MWC 2017 and is planning to show 360° views in the upcoming 2018 Winter Olympics. SK Telecom has also selected three companies, Looxid Labs, Red Bird, and ELROIS to develop

5G VR/AR services, by the means of a “5G Realistic Media & Convergence Service Exhibition” that is hosted with mobile game developer UnityKorea.

2) Connected Automotive – Driving on 5G Future

Key players in the autonomous car value chain include: vehicle vendors, software vendors, platform providers, and telco operators. Telcos have the potential to explore alternative business models in the value chain, e.g., platform development, advertising, Big Data, and vertical enterprise services.

The Connected Car market is set for a radical transformation, as the role of connectivity grows beyond legacy entertainment and convenience functions, developing into a critical enabler of safer, more sustainable mobility.

Key technology trends driving the mobility revolution - autonomous driving, cooperative mobility, vehicle life-cycle maintenance and sensor data crowdsourcing require secure, reliable, low-latency and high-bandwidth connectivity.

These attributes are essential for delivering the necessary performance both at highway speeds and in dense urban environments. Only 5G can satisfy all of these rigorous connectivity requirements.

5G has the potential to be a unifying connectivity technology addressing all major requirements of the future connected, shared, tele-operated, autonomous, and cooperative vehicle. 5G



can replace, or at least complement, alternative connectivity technologies (for example, 5.9 GHz DSRC currently in the process of being mandated for V2V technology in the United States).

V2X to achieve a reliable and ultra-low-latency connection between vehicles for collision avoidance.

3) Smart Manufacturing – Nurturing Innovation, the 5G Way

Innovation is at the heart of manufacturing. Major developments include the moves toward lean manufacturing, digitalization, and greater flexibility in work processes and production. Recent times have also seen a strong shift in favor of the industrial Internet of things (IIoT). Historically, manufacturers have relied on wired technologies for their connected applications. However, wireless solutions, such as Wi-Fi, Bluetooth, and WirelessHART have taken a foothold in the manufacturing workplace, but these wireless solutions face limitations in security and reliable bandwidth.

The underlying business rationale for implementing smart manufacturing is to bring higher-quality products to market faster with more flexible and efficient production systems. Key benefits include:

- Increased productivity through collaborative robotics and AR smart glasses that assist workers throughout assembly processes. Collaborative robots exchange an-

alytics to synchronize and coordinate automated processes. Smart glasses empower workers to do their jobs quicker and more accurately.

- Reduced down-time and maintenance costs through condition-based monitoring, machine learning, physical-based digital simulations, and digital twins that can accurately forecast future performance, optimize the maintenance schedule, and automatically order replacement parts.
- Reduced costs for inventory and logistics by optimizing accessibility and transparency of data internally and externally with suppliers. Cloudbased network management solutions are smart manufacturing offerings that share data in a secured environment.

Mobile telcos can assist manufacturers and logistics centers with their smart manufacturing transformations. 5G network slicing and MEC enable mobile telcos to offer a variety of value-added services on top.

They already offer control centers to handle large numbers of remote devices and send over-the-air software updates to these devices, as well as data stream management tool sets.

Bosch predicts significant demand for real-time meshing of data and analytics from different types of sources. In June 2017, Bosch demonstrated its wireless Programmable Logic Control-

ler (PLC) software on its mPad mobile control unit. The mPad used a 5G connection to control a Bosch APAS collaborative robot. Users could configure and monitor the robot from the mPad; Bosch believes Wi-Fi is not reliable enough for these operations.

Moreover, Bosch has plans for active assist intelligent laser-guided work stations to communicate with AR headsets and collaborative robotics. Sensors on the wearables, headsets, and robots will send alerts to slow down the robots when a worker approaches and stops them if necessary, preventing safety threats to the workers.

This communication between the active assist, AR, and robots requires wireless technologies, and 5G provides the necessary bandwidth and ultrareliable low-level connectivity.

4) Wireless Health – Powered by 5G

Both in the West and in Asia, populations are rapidly aging. The percentage of the world population that is 55 years and older will almost double between 2000 and 2030 from 12% to 20%. Moody's Analytics, based on UN data, has reported that some countries (the United Kingdom, Japan, Germany, Italy, the United States, and France) will become "super-aged," where 20% or more of the population is 65 years or older.

Over the past 5 years, there has been increasing adoption of wireless Internet in medical devices. Healthcare professionals have begun to integrate solutions such as remote audio/video diagnosis, remote surgery, resource databases, and remote health monitoring using wearables/portable devices.

The healthcare industry has the opportunity to develop a fully personalized medical advisory service that is complemented by doctor-driven AI medical systems connected by 5G. These AI medical systems can be embedded into hospital call-in centers, home medical advisory assistants, local doctor clinics, and even traveling out-



station clinics that lack on-site medical staff. Tasks include:

Both in the West and in Asia, populations are rapidly aging. The percentage of the world population that is 55 years and older will almost double between 2000 and 2030 from 12% to 20%. Moody's Analytics, based on UN data, has reported that some countries (the United Kingdom, Japan, Germany, Italy, the United States, and France) will become "super-aged," where 20% or more of the population is 65 years or older.

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- Real-time health management systems that track patients, their medical records, recommend treatments and appropriate medicines, and set up follow-up appointments
- Taking contextual information into account, such as genetic information, patient lifestyle assumptions and the current physical condition of the patient, when developing medical prognoses
- Proactive monitoring of patients by AI models that can suggest changes to treatment plans

Other advanced use cases include medical robotics and medical cognitive computing. They outline uninterrupted connectivity requirements for high-end applications, such as biotelemetry, VR-based medical procedure training, ambulance drones, bioinformatics, and real-time data transmission.

Mobile telcos can actively partner with the healthcare industry, medical system integrators, and the community at large to create a favorable ecosystem, providing loMT connectivity and related services, such as analytics and cloud services, to support various technology deployment initiatives.



In 2016, Sweden's Umea University has demonstrated the use of remote ultrasonic robots, wearables, and tele-ECG devices to monitor patients more than 100 miles away.

One specific use case – remote diagnosis – is particularly dependent on the lower latency and higher QoS offered by 5G networks.

For example, a tele-ultrasound robot in the Hospital of Belle Île en Mer (a French island off the coast of Brittany) ensures proper healthcare is attainable in this remote location, and allows for advanced consultations to be provided by doctors and clinicians on the mainland while reducing the costs of medical transport and transfers.

Such tele-ultrasound robots are already available commercially. They implement force feedback functions – an example of the "tactile internet" – to engage with patients with more precision to minimise pain during examinations.

5) Wireless Home – Harnessing 5G for Entertainment

One of the very first commercial use cases for 5G is fixed wireless access, which is an established means of providing internet access to homes using wireless mobile network technology rather than fixed lines. Fixed wireless access, or WTTx ("wireless-to-the-x"), can often prove more convenient to set up as it accesses existing tower sites and spectrum.

Say Hello to UHD 8K Video & Cloud Gaming

By August 2016, there were nearly 10 million 4K/UHD TV service users worldwide. 4K/UHD TVs already make up more than 40% of the global market and 8K TVs will soon be available. According to forecasts, lower prices and new subscription-based UHD TV services will attract half of TV watchers worldwide to use 4K/8K TVs by 2020. 8K video using data rates of over 100 Mbps will require the high bandwidth 5G WTTx provides.

Other video-based applications, such as home surveillance, content streaming, and cloud gaming, will also benefit from 5G WTTx. For example, current cloud game platforms do not generally provide levels of image quality greater than 720p, but 5G is expected to offer responsive and immersive 4K gaming experience at 90 fps, which requires data rates greater than 75 Mbps and less than 10ms latency.

The capital expenditure required to implement WTTx is much lower compared to other technologies. According to Australia company NBN, fixed wireless deployment is 30% to 50% lower than fiber-to-the-premise. WTTx saves mobile network operators from the necessity of laying fibre to every household and significantly reduces the amount of capital expenditure spent on poles, cabling and trenches.

TV, gaming and home applications place the telco at the center of the

smart home. With WTTx, the telco can provide a platform for a number of smart home value-added services that can be enhanced by AI digital assistant integration, data aggregation analysis, and software app development.

This WTTx-enabled smart home ecosystem allows telcos to offer:

- Unified family packages, integrated broadband, and video services at competitive prices
- Very low latency immersive HD and higher video and gaming content at competitive prices
- Integrated third-party smart home applications that leverage the telco gateway
- Assured carrier-class privacy and security

The world's first 8K live broadcast was used during the 2016 Rio Olympic Games. On August 1, Japan's public broadcaster NHK, began testing 8K TV broadcasting and broadcasted the opening and closing ceremonies, swimming events, and track and field events the games.

Additionally, NHK plans to broadcast during the 2020 Tokyo Olympic Games. South Korea also plans to broadcast the 2018 PyeongChang Winter Olympics in 8K.

6) Connected Drones – Delivering Safety and Surveillance in 5G Era

The global market for unmanned aerial vehicles (UAVs) has grown significantly over the last decade. UAVs, also known as drones, are now established delivery platforms for a diverse set of commercial, government, and consumer applications.

Significant efficiency gains and safety improvements can be rapidly achieved through the deployment of drone platforms. 5G networks will allow new levels of automation and enable analytic solutions that will have a transformative impact across multiple industries. For example, rather than live visual inspection of potential rotor blade damage on a wind turbine by a trained human drone operator, an au-

tonomous drone fleet deployed across a wind turbine farm could capture video. Similar vertical solutions may help protect essential property and key resources, such as oil & gas pipelines and installations, or increase productivity in the agricultural sector, for example.

Drone use and applications are also accelerating in the security and transport fields.

Drone operators are tapping into the on-demand, "as-a-service" economy, delivering their services to end users in a similar manner to the cloud-consumption model. For example, in the agricultural sector, a farmer can access crop monitoring services on a PAYG basis, or a monthly contract. Meanwhile, drone operators are building an increasing number of partnerships to create drone service marketplaces and app stores, furthering the enterprise and consumer appeal of their services.

Further, drone operators and their marketplace partners can aggregate and anonymize the data that they collect from customers in order to improve their services and tap into the data analytics monetization market. Aggregated and anonymized industry sector data may provide financial services organizations with an indication of commodity/input cost future price trends, or may potentially be useful to logistics/shipping companies and government agencies for forward planning.

At the moment, the main traction for drone usage comes from the civil construction industry. Drones are deployed to monitor buildings and cell towers for mobile network operators. Drones equipped with LIDAR technology and thermal imaging technology can conduct aerial surveillance.

7) Ultra-Social Networks – Powered by 5G

UHD/Panoramic Live Broadcasting

As of the end of 3Q-2017, there were

approximately 10 billion monthly active users (MAUs) on the top 10 social networks. The top 3 social networks were Facebook with 2 billion monthly active users, YouTube 1.5 billion and WeChat with 963 million.

Smartphone has been a critical technology for social networking. Approximately 60% of MAUs access Facebook via their mobiles. However, consumers are increasingly updating their family and friend social networks via personal wearables that can communicate live video, even 360° video, sports performance, stepcounts, even their mood on a real-time basis.

The popularity of social networks indicates that its users are becoming increasingly comfortable at sharing content, including live video. By definition, live video streaming does not need the content captured by the host to be stored on the device then uploaded to a hosting platform afterwards. Instead, the content is transmitted directly to the streaming platform and viewed almost instantly.

The real-time feedback nature of a conversation is built in on smartphones and enabled by mobile video live streaming platforms, making this new type of "one to many" communication much more interactive and social. With the capability of interaction between viewers added to the experience, there is also a "many to many" social dimension to live video streaming.

Immersive video recordings are expected to be enthusiastically adopted by social networkers, extreme sport, fashion bloggers and trendsetters. Facebook launched its 360° live video platform in 1Q-2017. The company has updated the platform to make it more accessible to both creators and viewers. Bloggers can now stream live 360° video on Facebook in up to 4K resolution.

Viewers can view the content in virtual reality. Commercial live stream video cameras that are compliant with Facebook include Garmin VIRB 360,

Giroptic iO, three Insta360 models and Nokia's Ozo Orah 4i. As the streaming cameras continue to shrink we will see an increasing number of sport activities livestream "in-person" video content.

Live broadcasting is supported by LTE but 5G will address its challenges in 3 key ways:

- End-to-end network latency will decline from 60~80 ms to less than 10 ms;
- HD video feeds will typically require 50 Mbps but that figure could go up to 100 Mbps due to 4K, more fields of vision, and/or data analytics overlay;
- Massive UL throughput of 10 Gbps will allow the upload of high-definition images and videos.

Sports broadcast is proving to a pioneer of this novel live 360X streaming service. Examples include:

- Multi-view streaming - In Formula One Shanghai 2016 competition, China Mobile realized the first live multiview streaming service from the race track – which gave its users a unique point of view perspective.

The audience can switch from commentators booth to embedded immersive 360° camera angles in an instant.

Ultra-compact cameras and location sensors were used to transmit real-time 4K video from the player's own point of view. Audience watched the live matches from the perspective of players. The Bobsleighs reached speeds of 120 -150 Km/h and viewers can select from a number of multiple-angle cameras.

8) Smart City – AI-enabled Video Surveillance with 5G

City video surveillance is an invaluable tool that not only enhances security but also energize the productivity of businesses and civic institutions. Video surveillance systems are invaluable for monitoring:

- Busy public places (squares, activity centers, schools, hospitals)

- Business areas (banks, shopping centers, plazas)
- Transportation centers (stations, docks)
- Major intersections
- High-crime areas
- Institutions and residential areas
- Flood prevention (canals, rivers)
- Critical infrastructure (energy grid, telecom data centers, pumping stations)

Demand for video surveillance is primed by the innovation in video camera technology, the cloud Smart City

A smart city holds a competitive advantage in that it can be proactive rather than reactive to the needs of its residents and businesses. To become a smart city, civic authorities not only need to invest in data sensors that can take the pulse of the city but video surveillance cameras that can monitor the flow of traffic and the safety of its neighborhoods.

AI-enabled Video Surveillance

Video Monitoring Services Play an Essential Role in the Smart City storage that supports data collection and analytics and by price competition.

Notable video camera innovations include:

1. 4 megapixel IP cameras (IPC) which currently dominate the market, and 6mp and 8mp cameras with 4K capability which will gain traction from 2020;
2. Novel application scenarios such as body-worn cameras, and in-vehicle cameras which are used by Emergency First Responders and also individual car owners.

The enhanced features of the latest video surveillance cameras such as high frame rates, HD video and WDR (Wide Dynamic Range, which allows for imaging even in challenging lighting conditions) will contribute to significant new data traffic being generated.

For the next generation of video monitoring services, the smart city will need to move away from the traditional business model based on the

concept of "building the system and walking away". Instead smart cities will migrate to a Video Surveillance as a Service (VSaaS) model. In VSaaS video recording and storage, management, and hardware and services monitoring are provided to the users via cloud-based delivery and managed by the service provider.

The cloud provides flexible data storage as well as the Data Analytics/ Artificial Intelligence layer. Standalone storage systems for a video surveillance system owner have significant upfront capex and ongoing opex costs that will be ameliorated by economies of scale. Cloud storage may be priced dynamically according to need. In peak retail seasons, the video cameras may be configured to a higher resolution while at other times, the resolution is scaled back to reduce cloud storage costs.

Telcos can create an advantage in offering Artificial Intelligence to enhance their cloud services. AI can enable computers to interpret large amounts of data in the form of images, sound, and text. AI will enable face recognition, vehicles, license plate recognition or other video analyses. For example, the detection of an intruder by the video surveillance system could trigger the automatic locking of all the adjacent doors, confining the intruder until the arrival of law enforcement personnel. Alternatively, the video surveillance system could be triggered by another system. For example, a POS system could notify the video surveillance system every time a transaction is made and alert a camera to record the scene before and after the action.

Single wireless cameras do not consume much bandwidth at the present time. But along with the introduction of central cloud and mobile edge computing, telco cloud infrastructure could support more AI assisted surveillance applications, where cameras stream video, 24/7, non-stop.



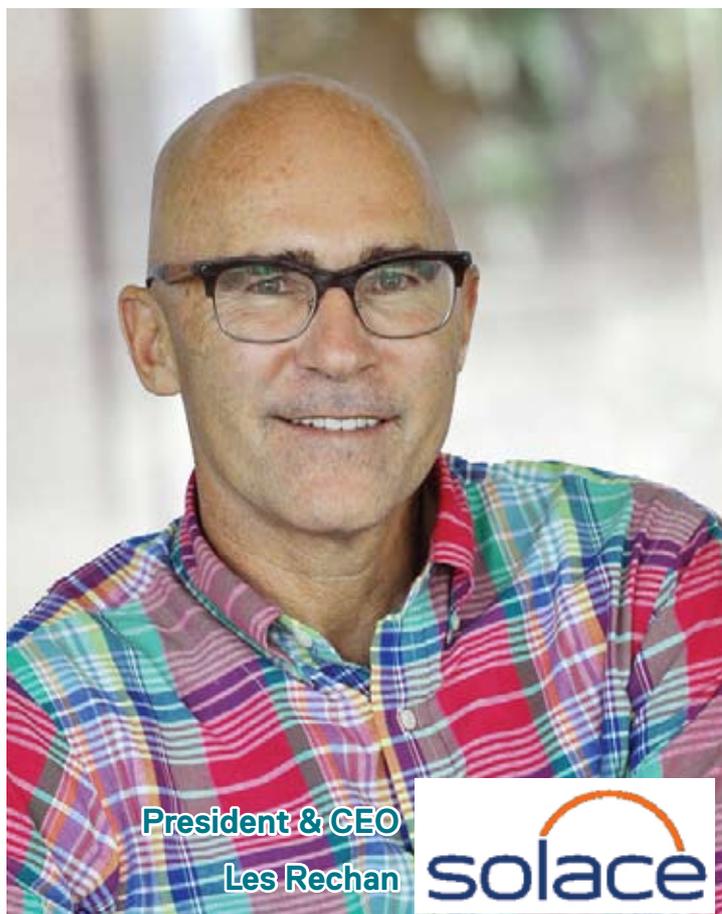
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**WE DESIGN,
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SMARTER
DIGITAL NETWORKS**



Solace, the “One-Stop Shop” Enterprise-Grade Messaging Fabric



President & CEO
Les Rechan



How do you view the changing landscape around the way data is moving in fast-paced digital economies such as India?

Arvind: Fast-paced digital economies both produce and consume massive amounts of data. India is a shining example of this, as our government has made digital growth and literacy one of its core tenets. When you combine that with widespread mobile use and the rapid rise of mobile network operators such as Reliance Jio and Bharti Airtel, it's easy to see why India is the world's top mobile data consumer.

Maintaining such growth depends on the usually unheralded data movement infrastructure that allows it all to happen. When you think of a country such as India, where digital ini-

As data is increasingly gaining importance for enterprise, telecoms and government segments – Solace is powering innovative solutions to enable event-driven communications across all on-prem, public cloud and private cloud environments.

In an interesting discussion with Zia Askari from TelecomDrive.com - Les Rechan, President and CEO, Solace and Arvind Khurana, Regional Vice President, Indian Subcontinent, Solace – describe how the company is bringing data-driven innovation towards handling multiple cloud environments, big data and IoT on a unified platform.

tiatives are spread across the government and private sectors, it's critical that the infrastructure can scale with the pace of growth and maintain reliability during unexpected usage spikes.

What role can Solace play to reduce data movement complexities?

Les: Solace lets enterprises and government agencies meet all of their data movement needs with a single technology that's easy to deploy and manage, and is battle-tested in its ability to remain secure and scale. We do this by supporting all kinds of messaging, by running in all of the most popular clouds and containers, and by embracing open APIs and protocols to free folks from any risk of vendor lock-in.

What are some of the big advantages that you bring to the table for government, enterprise and telecoms customers who are looking forward to doing more with their existing data?

Les: Solace is unique in that we can handle hybrid cloud, IoT, big data, and microservices use cases with

a unified, high-performance platform and solution set. We help our customers break down data silos, move data faster and more secure than ever before, and get into the mindset of acting on real-time data now rather than storing it for after-the-fact analysis. By allowing leaders across the organization to tap into a flow of real-time information and events, they can do their job more efficiently, and more quickly.

Please share some of the innovations that Solace is spearheading today in the middleware space?

Les: Solace is the only company committed to enabling event-driven communications across all on-prem, public cloud and private cloud environments. We're actively opening pathways between legacy systems and microservices, enabling event-driven architecture that spans not just applications and cloud services but the sensors and control systems of the Internet of Things. This allows us to impact a variety of sectors – from telecom and aviation to trading and speech analytics.

Please share your global go-to-market, as well as your plans for India

Arvind: As the leading provider of enterprise-class messaging middleware, our go-to-market plan revolves around making our technology more easily accessible in the leading clouds and containers. This includes the introduction of a completely managed service called Solace Cloud that lets companies establish event-driven communications between applications, devices and microservices without the overhead associated with deploying or managing messaging infrastructure. This strategy is especially important in India, where the massive scale of all kinds of digital initiatives leads companies to migrate workloads to the cloud for cost effective capacity and burst handling during periods of peak volume.

We offer a solution for every customer requirement: appliances for those needing unparalleled capacity and performance for their serious big data, cloud and IoT initiatives; VMR (Virtual Message Router) software for localized messaging, hybrid cloud and NFV strategies; and Solace Cloud for distributed environment requirements and those needing to spin up a world-class messaging fabric in minutes.

How do you look at the competition in this space? How is Solace different from the rest?

Les: Solace is the only provider of messaging middleware that offers a truly one-stop-shop solution to meet all messaging needs, runs in all on-prem, private and public cloud environments and supports all APIs and protocols so customers are never locked in to any approach or architecture – not even our own. We provide reliable messaging infrastructure at very high scale. We are also a great smart data movement solutions partner to our customers, offering them best-in-class expertise, support and services on a global scale at every step of their digital transformation journey.

India is becoming very big in terms of embracing digital space and a lot of cities here are moving towards creation of smart city infra. How does Solace look at these two trends and how do you target such opportunities?

Les: For years Solace has been at the forefront of enabling “smart city” initiatives. Our work with the world’s largest rail operators and the gov-



**Regional Vice President,
Indian Subcontinent,
Arvind Khurana**

ernment of Singapore has seen our technology link mission-critical infrastructure and vehicles with back-end applications and interactive dashboards. At the same time, our work in the financial services sector is enabling cashless transactions, which paves the way to increasingly electronic, automatic recognition of individuals as they consume services provided by not just businesses but government agencies.

We're uniquely capable of helping cities “get smart” because our technology breaks down barriers between physical and digital worlds through the smart movement of data. We target these opportunities by showing cities how our data movement infrastructure and solutions can solve their most pressing digital transformation challenges. With our deep capabilities and experience, we can positively impact and accelerate smart cities initiatives in areas as diverse as transportation, healthcare, and housing, just to name a few.

Hypernet of Things

Conference & Expo 2018

Strategic IoT Technologies &
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5 – 6 July 2018

Wisma MCA, Kuala Lumpur

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“In the 5G Era, Wireless Access will be Ubiquitous”: Sooktha



As the telecoms world is inching towards embracing 5G – deploying and managing 5G networks will be radically different from the way cellular wireless networks are being managed now and Sooktha Consulting is ready to make its mark in the 5G space.

Balaji Rangaswamy, Managing Director and CEO, Sooktha Consulting Pvt. Ltd *interacts with Zia Askari from TelecomDrive.com about the company's strategy to drive development towards 5G and be ready with its set of innovations.*

What are the key priorities for Sooktha today?

The key priorities for Sooktha today are to continue leveraging our 4G LTE eNodeB and EPC solutions in multiple segments and to execute on our 5G development plan effectively to be ready for trials by the end of the year.

How does the company look at the emerging trends in the wireless access segment?

We see continued investment in LTE not only in the consumer broadband space but in niche segments like Rural Broadband, Public Safety, Defense, Railways, and Industry. Smart Cities, Smart Grids, and Smart Meters will be enabled by the Narrow Band Cellular Internet of Things technology (NB IoT) standard. In the consumer broadband space we see continued demands for capacity leading to even further densification of cells in urban spaces.

5G opens up the opportunity for more verticals and has well defined migration options so that the investment in LTE is protected. We see LTE being around for the next decade while being increasingly supplemented by 5G.

There is also a move towards virtualization and cloud architectures in the wireless access segment.

What is the company doing to tap on the big opportunities in this space?

We have an end-to-end portfolio of solutions in 4G LTE access space, which is further being augmented by the development of our own baseband software and hardware this year (we were earlier dependent on third parties for these). We are building on this extensive portfolio to offer early 5G solutions and gain first mover advantage. We will be showcasing our solutions in multiple forums globally this year and engaging in lab and field

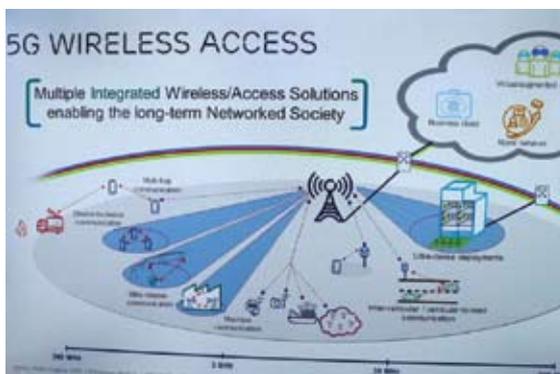
trials with a number of prospective customers.

What kinds of innovations are being driven by Sooktha today and what are your plans to drive further ahead on the road to innovations?

Sooktha is focusing on the cloud architecture for wireless access and also developing solutions that can address various deployment scenarios and the challenges that are unique to each of them. We are building end-to-end test beds in our labs this year to give us the freedom to experiment and continue to drive innovation at a rapid pace.

Please share details on your go to market strategy? What are the key markets that you are targeting?

We have a number of go-to-market options. The approach that we take depends on the specific opportunity.



The standard model we would adopt would be use a contract manufacturer (CM) to mass-produce our designs. In the higher volume opportunities we would have a large OEM or System Integrator sell our products, which we would offer to them as white-label products. We may also brand, sell, and support directly for lower volume opportunities and niche segments.

We are primarily targeting the India region for our 4G LTE solutions where we aim to address both the consumer broadband space as well as cater to

the requirements of the defense and public sectors. We will expand our market base to South East Asia, Africa and Tier-2 operators and MVNOs globally in the coming years.

We will offer end-to-end NB-IoT solutions in the India and China markets. We will continue to offer our solutions to the Test & Measurement requirements globally.

How do you look towards the development of 5G today? What role will be played by wireless access in 5G era?

5G specifications are still being finalized. We expect that the development of 5G solutions will happen in this year and the next with first roll outs happening in 2020. 5G is highly flexible and supports a wide variety of applications and network architectures. There is a very determined move towards virtualization. Deploying and managing 5G networks will be radically different from the way cellular wireless networks are being managed now. So how the legacy networks will co-exist with the new 5G architecture and now the two network architectures will be blended and managed will be interesting to watch unfold.

In the 5G era, wireless access will be ubiquitous. It will revolutionize the way we live with concepts such as Virtual Reality and Augmented Reality being supported over cellular wireless access networks. Higher bandwidths will allow more rich and high-definition content to be delivered to us.

Everything – humans and all the devices, gadgets, and machines we use will be wirelessly connected. Secure communications will be more critical than ever. Managing this wide variety of applications will be a new challenge that the industry has to address. Network operators will continue to move beyond offering a data pipe and will instead offer more and more content, applications, and services.

Programmable Networks Here & Now: Empowering Innovations for Enterprise

By Patrick Joggerst

One are the days of enterprise private networks requiring capex-heavy budgets for hardware, real estate, multiple software licenses, difficult to manage and expensive private lines, complicated contracts and frustrating vendor lock-ins.

Enterprise networking has been liberated, and enlightened IT teams and their service providers are switching things up from legacy telephony to virtualized, software-defined and innovation-driven programmable networks empowering businesses to meet the challenges of the hyper-connected, always-on world of digital commerce.

Software, web and mobile applications, which are changing the way businesses attract and serve customers, drove us to the cloud. Communications networks are adapting to support the cloud, and the apps that simply run better in distributed computing environments, including real time voice, messaging and video collaboration.

Programmable networks adapt quickly, improve performance, and evolve, scaling up and down to meet the changing needs of global enterprises. Transformed pure IP networks are helping the largest banks, hospitals, educational institutions and governments seize opportunities and reduce expenses.

Even more critically, when engineered with quality and precision, they help protect the most valuable



assets: data, proprietary information, private information and physical assets when those networks support things as well as people.

What do programmable networks allow enterprise IT teams to do?

- 1) Embrace digital transformation and quickly respond to customers
- 2) Enable immediate and/or automated service provisioning
- 3) Plan and manage computing resources, bandwidth and access from the edge to the core
- 4) See and support traffic patterns associated with applications
- 5) Control which applications are prioritized and when
- 6) Unify systems for greater transparency and governance
- 7) Connect headquarters and branch offices more efficiently and flexibly
- 8) Support remote workers with secure, high-performance mobile applications
- 9) Re-design contact centers into customer engagement hubs at dramatically lower costs and higher satisfaction scores
- 10) Support innovation of new applications through more agile

DevOps capabilities

Enterprise CIOs should ask themselves and their teams: will our network be flexible and strong enough to support our business ambitions for years to come?

Enterprise CFOs should take a hard look at the numbers, and determine at which point it makes sense to pivot away from technical debt and move into an all-opex communications as a service environment.

The benefits of transformation can be stunning.

The cloud paved the way for on demand cloud communications-as-a-service by improving the quality, performance and economics of computing.

Bringing voice, video and messaging to the cloud only makes sense as a second act, and in fact will lead to what could be the massive third act for cloud – and that is supporting not only computing, but communications and IoT. Bringing together systems which allow enterprises to operate better – blending people and things – could be the greatest ultimate pay-off.

In the meantime, the second wave of network transformation is supporting human collaboration, internally and externally, including leveraging embedded communications (click to call, click to chat, click to visually interact) to improve productivity and customer service.

The transformed Wide Area Network (WAN) must become not just application-aware but application-driven, and virtualized. Software defined networking approaches make that not only possible but inevitable.

As programmable networking evolves, enterprises across all industry



verticals, as well as large government agencies, educational institutions and media companies will benefit from an expanding array of network, managed services, security, cloud and application services that can be ordered, provisioned and managed in real time via a unified dashboard, even when the network is supporting multiple third party applications. How? Through the magic of APIs.

Programmable networks enable enterprises and organizations to easily build and access applications, and secure the perimeter more easily and cost-efficiently than we could have imagined even recently. Connecting headquarters, branch offices, retail locations, remote workers, ecosystem partners, and sales channels on demand is simple when network designers can point and click up networks.

Better experiences for all, more adaptive capabilities, better economics and tighter security are among the many benefits of transforming legacy networks into the programmable real time communications networks. Extra benefits? Going forward, intelligent automation will reduce the burden of network management and provide more visibility and therefore better

governance and compliance, which are becoming increasingly challenging – and important – to companies who must protect not only their internal data but their customers' data as well.

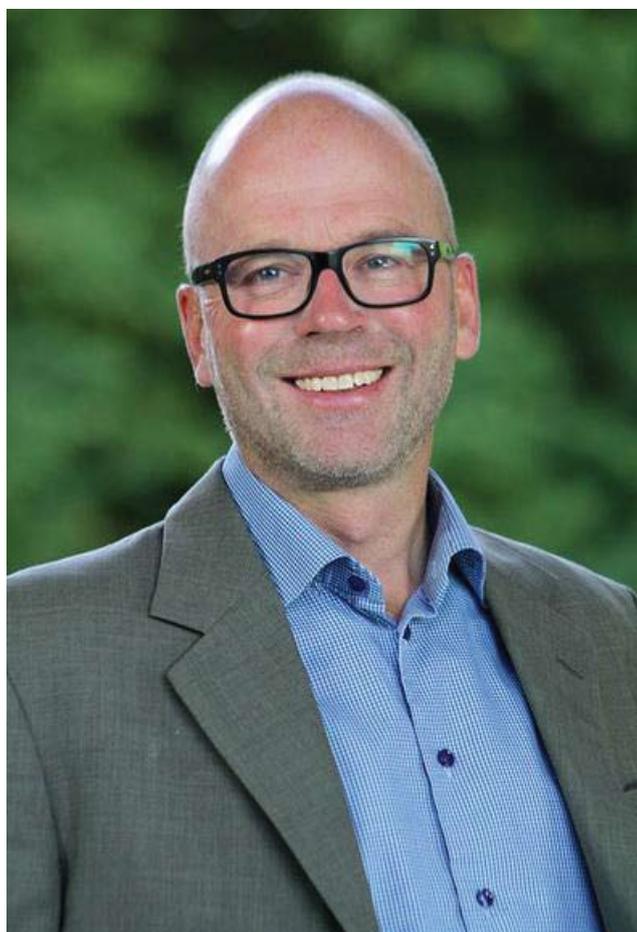
Programmable networks that enable enterprises or their managed services providers to self-provision network capacity, services and applications, prioritize traffic, manage low latency and ultra-low latency applications, and ensure the right level of bandwidth is always available – including for business continuity – are changing the game. And the winners in their business games understand this and are moving forward with a liberated mentality.

PATRICK JOGGERST is the Chief Marketing Officer and Executive Vice President of Business Development for **Ribbon Communications**, a secure real time communications company. Previously, Patrick was EVP of Global Sales & Marketing for GENBAND. He has an accomplished career in communications spanning three decades, having managed sales and marketing organizations for both telecommunications service providers and technology suppliers.

Looking into the Future of Wireless

As we move ahead towards consuming greater amount of data, more and more networks are embracing wireless technologies in order to address the ever-growing capacity issues in a cost effective manner.

Looking ahead to the year 2018, Johan Terve, VP Marketing, Aptilo Networks shares his set of predictions for the wireless industry.



Revival of offloading and carrier Wi-Fi due to unlimited plans

Carrier Wi-Fi and offloading will experience a revival. So far, it has been mostly the users that have driven the Wi-Fi offload agenda. Wherever they could find a free Wi-Fi network, they connected. In most countries people spend more time with their smart-

phones on Wi-Fi than on cellular. Now, with more and more unlimited cellular data plans, the smartphone will still continue to be primarily a Wi-Fi device. Why?

Many cellular-centric operators have not realized just how much data their users are eating.

It's been a merry-go-round, with carriers offering more all-you-can-eat data plans to stay competitive — with the expectation that users will jump to Wi-Fi. Now, when users actually do use their data plans, the carriers are realizing... whoa! We need to provide more capacity, especially indoors, as

cost-effectively as possible. It reiterates the need for carriers to have a holistic solution in place, one that offers a robust Wi-Fi network to supplement their unlimited data plans. And this allows carriers to be flexible with their business models, because you never know what the future holds.

Besides, Wi-Fi offloading is a good

business especially if operators combine it with managed B2B guest Wi-Fi services which provide the indoor coverage and offload capacity so much needed at high-traffic areas.

B2B is where the growth is

All operators will turn to B2B to achieve growth and indoor capacity in 2018. The majority of operators already have some B2B plan in the works. For example, NOS in Portugal is offering their massive network of cinemas, multi-site retail venues and more with opportunities to sell Wi-Fi to their own customers, whether they be end-users or mall tenants looking to engage their own audiences. We know that 77 percent of shoppers spend more time at stores when you offer Wi-Fi. That kind of draw is compelling. Operators know this.

With that, we believe 2018 will be the year when operator-managed B2B Wi-Fi services will really take off. Look at Spectrum Business (former Time Warner Cable Business Class®), a company that has prepared itself to address this. Same with Telia in Sweden as well as NOS, two carriers that have made the leap to managed Wi-Fi services. Why is this? Because managed services allow carriers to be nimble to meet the rapid changes of the industry. IT departments don't typically have the capacity to handle today's complex,

dynamic deployments and to keep up with demanding users who expect the same excellent Wi-Fi they have in their homes. As such, carriers will be relying heavily on cloud-based managed services to tackle these challenges.

Wi-Fi calling ramps up with more affordable IMS

Here's the reality check with Wi-Fi calling: only 30-50 operators out of 700 have rolled it out, so while everyone knows that Wi-Fi calling is crucial to obtain indoor coverage for mobile operators' voice services, it still has yet to break its stride with regard to adoption. It's because IMS and handset-readiness hasn't been there. In 2018-19 we expect more readiness on the handset side, with more operators putting the IMS in place. So don't be surprised if Wi-Fi calling adoption starts to pick up the pace – fast.

More affordable IMS solutions will be the spark for this development. MVNOs will take on IMS delivered to them as software-as-a-service, making Wi-Fi calling a more affordable proposition for them and, therefore, increasing deployments. Few MVNOs can take on the investment of an IMS as-is.

Small cells need to learn from Wi-Fi

Small cells have long been a disappointment in the industry. Part of the problem has been challenges in site acquisition. In the macro-cell world, mobile operators just rent space from property owners to mount their base stations. Now they need to place their small cells into sites like shopping malls, and they're encountering resistance. Just think about it. What will it mean for the business owner allowing a mobile operator with, let's say, 40% marketshare to deploy their small cells? The business owner will instantly lose the insights and engagement that Wi-Fi offers with up to 40% of their visitors. Especially in countries that have all-you-can-eat cellular data plans, where many users do not actively look

for Wi-Fi.

We think that operators will continue to have problems deploying their small cells in many locations unless they adopt a Wi-Fi-like business model. They need to offer the same analytics, user engagement and marketing capabilities to their business customers as Wi-Fi does. Otherwise business owners will just continue with their Wi-Fi services relying on visitors to connect in order to save on data allowances and to get better indoor coverage.

More or less every small cell that goes out will have a Wi-Fi radio in them anyway, so operators will have the opportunity to use both the small cells and Wi-Fi in their offering to their business customers. And with the increasing appetite for data capacity, they need both.

In 2018 and beyond, Wi-Fi-like business models will become the main vehicle for small cell deployments. Mobile operators will use both Wi-Fi and small cells and offer their business customers the same analytics, user engagement and marketing tools for both technologies.

The needs will differ from site to site. Some business owners do not care about user engagement while others see it as a must. The ability to engage with a visitor through a captive portal, SMS or e-mail must therefore be set per location and subscriber type through advanced policy management.

5G is a framework not a technology

The industry is finally coming to terms with the fact that 5G is a framework and not a technology. Wi-Fi is a natural part of that framework. Especially in dense environments, Wi-Fi coupled with core networks will increase the 5G access network capacity and benefit users' wireless experience. The role of Wi-Fi as an integral part of 5G is driven further by new technologies such as 802.11ax which use the similar control mechanisms (OFDMA) as LTE.

This will vastly improve the Wi-Fi experience in dense areas. The argument that "Wi-Fi" is only best effort will soon fade away.

The closer we get to testing out 5G, the more carriers will realize how to truly leverage Wi-Fi in this framework and that doing so is necessary to keep up with the demand for data capacity.

IoT needs a horizontal communication layer

There's a strong need for a "horizontal communication layer" for IoT. Today there are siloed end-to-end solutions. Say, one solution for my car, another for my home appliances etc. In 2018 more operators will offer IoT connectivity services from a horizontal communication platform offering connectivity for multiple IoT radio technologies such as 4G, NB-IoT, Wi-Fi, LoRa and SigFox.

Another thing worth remembering before hyping cellular technologies for IoT too much, is that the vast majority of the billions of IoT devices will be short-range (Wi-Fi, Bluetooth and other proprietary technologies). According to Ericsson Mobility report 06-2017 there will be 15.5 billion short-range IoT devices by 2022, but only 1.5 billion cellular IoT devices.

GDPR limbo

The General Data Protection Regulation, which was enacted to address the need for data privacy, is an important initiative. Unless operators work with vendors who understand and can support them in being GDPR compliant, service providers and businesses will be stuck in limbo as they, together with technology solutions providers, race to develop GDPR-compliant products and services. In 2018 GDPR is here for the greater good, but will also take the greater part out of European productivity gains. It will take some time and established best practices in how to interpret GDPR regulations before productivity of European businesses is back on track.

5G: Expanding Frontier on Speed, Coverage and Latency

Exponentially expanding the frontier on broadband speed, coverage and latency - the convergence of 5G wireless and fiber wireline technology will dramatically improve the performance of communication networks.

Stephane Bendayan, Solutions Director - Carrier Wireless **iBwave** talks to **Zia Askari** from **TelecomDrive.com** about the importance of 5G and how iBwave is positioning its innovative solutions in this space.

Stephane is a seasoned telecom professional with more than 15 year of international telecom experience in various management roles for both operators including Belgacom, Tata communications and equipment vendors including Nortel and Alcatel. At iBwave, he oversees the solutions portfolio for the wireless carrier market.



How does the company look at 5G as an enabling technology?

The insatiable demand for greater bandwidth to support everyday mobile activities such as streaming videos and the need for always-on wireless IoT ultra-low-delay connectivity means that the current 4G technology won't be able to handle all these new broadband services for tens of billions of connected machines and human users.

That's why iBwave is excited to see that the ever-evolving telecom industry is trending in a new direction with 5G to deliver fiber-like speeds over a wireless connection.

The convergence of 5G wireless and fiber wireline technology will dramatically improve the speed, coverage, and latency to enable massive IoT, mission critical services or enhanced Mobile Broadband (eMBB) for applications like smart cities, automated manufacturing, intelligent homes, Virtual Reality.

These applications will rely on new network fabrics combining the powerful performance capabilities of both fiber and 5G to handle this massive data traffic deluge. That's why it will be strategic for operators to consider a more unified approach for 5G roll-out. This should be done in conjunction with their fiber deployment to offer "best of breed" connectivity capabilities to their fixed/wireless subscribers and their connected IoTs.

What is the broad strategy that iBwave has towards 5G today?

iBwave plays a leading role in this transformation. With 80% of mobile communications taking place indoors, iBwave has already enabled mobile connectivity for over 100,000+ Global venues including airports, stadiums, metros, large enterprise campuses/warehouses. By leveraging our extensive expertise for in-building HetNet design (DAS, Small Cells, and Wi-Fi) and in close collaboration with our large

operator customers, we are already working on enabling network convergence to pave the road towards 5G.

Multiple important technical aspects must be taken into consideration such as network densification while taking advantage of massive MIMO and carrier aggregation. Network slicing and cloud RAN for more dynamic capacity allocation, New Radio (NR) frequency including mmWave, increased in-building fiber for more front-haul and back-haul connection. From an in-building network design standpoint, all these elements will have to be fully integrated to deliver the optimal 5G indoor experience.

From an operator's standpoint - How different will be the laying of 5G infrastructure... when compared to their existing 4G in-

"The convergence of 5G wireless and fiber wireline technology will dramatically improve the speed, coverage, and latency to enable massive IoT"

frastructure? To what extent they can utilize their existing infra and yet leapfrog towards embracing 5G?

With the use of higher 5G frequency, while adding more data capacity, the carrier will make better use of their networks by shrinking the cell size. Network densification will lead to the deployment of many more small cells to increase total number of connections that can be supported for connected objects and subscribers in crowded venues.

The increased densification, also means that carriers would have to plan for more fiber deployment for backhaul connections. As such it would be criti-

cal to have a fully integrated converged network design to take advantage of 5G fully.

What kind of innovations can we expect from iBwave in this space?

We are actively working with large North American, European and Asian operators to offer a truly converged solution for in-building network infrastructures.

According to your opinion what factors can contribute heavily towards faster adoption of 5G?

The success of iPhone introduced in 2007 and massive adoption of smartphones by early 2010, fueled increased demand for better data services from mobile consumers triggering 4G adoption. Now, one can expect that the Internet of Things will reproduce a similar market effect to accelerate 5G adoption if the carrier can fully monetize the business potentials of those new services.

What are some of the early use cases of 5G that can set the trend towards this technological advancement?

With 28 billion IoT connected devices predicted by 2021, Massive IoT applications will consist of many different devices operating on different radio technologies. iBwave already supports these technologies including Wi-Fi, LoRA, sigfox, NB-IoT that would co-exist with 5G.

What will be the future of Small Cells in a 5G era?

Small cells will be playing a major role for 5G network densification in conjunction with RAN virtualization. It is expected that the first 5G deployment will rely heavily on small cells with OEMs already committed to supporting 5G for indoor small cells to deliver 1Gbps and more. The iBwave software solution is already Het-Net ready to provide a fully integrated design across multiple technologies including Small Cells, Cellular, and Wi-Fi.

Incognito: Driving Innovation in the OSS/BSS Space

At a time when telecom operators look for software driven efficient management of their network assets – Vancouver, Canada based Incognito is bringing a lot of innovation to its customers, with the help of its software portfolio.

Pete Koat, Chief Technology Officer, Incognito interacts with Zia Askari from TelecomDrive.com about the company's current focus and its future plans.

Please introduce Incognito software to us – what are your key focus areas of operations and priorities in the market today?

Incognito is an independent software development company, which creates end-to-end OSS, BSS solutions for our global customers. With digital transformation a key driver for global CSPs, Incognito is focused on home broadband management device and service provisioning and monetization. With our solutions, CSPs can leverage automation and analytics to reduce operational costs around device and service provisioning and deliver a great customer experience.

Keeping in mind our unique capabilities, globally renowned broadband operators of all sizes — including over half of the top ten operators in the United States — trust Incognito to eliminate segregated work silos and streamline provisioning, activation, and subscriber

service management processes with the utmost quality and reliability.

We offer innovative solutions around digital home experience, fiber service activation, DOCSIS provisioning, network monetization and firmware management, IP address management — all with a focus on residential broadband services. Our priority is to help our customers scale while keeping operational costs in check and delivering greater customer experiences and quality.

How can operators and CSPs future proof their OSS / BSS strategy? What are your key offerings in this direction?

When it comes to future proofing the OSS/BSS strategy, it is going to be all about open architectures and virtual-



ized services. With the help of our solutions, we are implementing standards, open APIs, and we are uniquely vendor and device agnostic. We continually invest in our solutions, delivering the latest advancements that incorporate virtualization, automation, analytics, and orchestration.

Incognito is part of the new ETSI working group on zero touch network and service management group, exemplifying our focus on closed loop automation processes to help our customers maximize operational excellence in the future.

How do you look at the growing importance of SDN and NFV for the telecoms today – what role is being played by Incognito here?

Incognito is playing a very critical role here. Here is an example: as global operators and CSPs look for greater level of efficiency and innovation from SDN and NFV, software defined networking at its core is meant to automate core and edge router functions by abstracting the physical elements from the functional platforms.

Incognito bridges into SDN by automating scope deployments to PE routers within its IPAM solution, part of our DDI portfolio, where configuration changes will automatically be pushed out to the routing elements, abstracting the physical component from the intent. This will use the normal interface API whether it is CLI, SOAP, or a modern API like netconf.

Ultimately the big driver here for both SDN and NFV is virtualizing the solutions from big-iron vendors so that as the demand/load grows the platform can scale, benefiting from the lowering costs afforded by Moore's law. Adjacent to this is a driver to leverage decades of advancements in automation and machine learning to improve the reliability while reducing operating expenses.

Incognito is a pure software vendor, and is growing its portfolio with NFV offerings; many Tier 1 operators have had our virtualized offerings deployed for years. Moving forward, as more and more telecom operators and deploying SDN and NFV infrastructure and orchestration inside their networks, we see potential for our portfolio to drive greater levels of synergy with our customers. With open source projects like ONAP, CORD, and TIP, we will start to see a greater level of interoperability between vendors and ideally some standardization or consolidation around platforms and projects. We are already starting to see this with the Linux Foundation's new Networking Fund that brings together multiple open source projects.

Please share details on your key global geographies and how are you targeting these geographies. What is your go to market strategy?

As of now, more than 160 million subscribers are being provisioned by solutions from Incognito. Global providers are already using Incognito software to realize new revenue streams from multi-play services.

When it comes to our go to market strategy, we work very closely with our channel partners — who can design and deliver our solutions for our customers.

In a constantly shifting technological landscape of high data-services penetration, Incognito helps customers develop an actionable vision for the future. We provide deep broadband services experience and technical expertise to optimize infrastructures, streamline operations, and improve the customer experience. Incognito R&D and professional services lead the industry in standards-based and customer-requested solutions that ensure performance quality for everyday operations while scaling to accommodate future demands.

How do you look at the future growth of the company – from a technology and a business standpoint? Where is this growth going to come from?

Future growth will come from multiple areas:

- NFV
- Fiber
- IoT

These are broad topics but they represent a general trend in the marketplace around digital transformation of back end operations. These themes tie back to enriching and personalizing the service offerings for the customers; improving automation so that the operator can truly deliver the experience the customer wants today, while having the capacity to be agile and adapt to the changing marketplace.

More and more Telecom operators and CSPs look forward to doing more with less in terms of investing in technologies – what are some of your innovations that can help operators do more with less?

SmartCSR is a great example of our innovation within the home broadband experience domain, with a focus on customer call centers. We use machine learning, AI, and automation to determine root cause analysis for troubleshooting when customers are calling in with an issue. This greatly reduces the amount of time required during an interaction, improves first-call resolution rates, as well as reduces the volume of costly truck rolls. Automation is key to reducing OPEX as operators grow.

Another area for doing more with less can be seen in the benefits that software can provide. Lets take, for example, WiFi within the home. There are many advanced mesh-based WiFi routers on the marketplace, but much of the optimization techniques employed could be done in software remotely using existing deployed gateways; gateways that might not even support TR-069 protocol — all of which could be fully autonomous. This is exactly what we do with our Customer Experience platform.

Please share your plans and vision for your Indian operations?

Incognito has been in India for over 10 years; predominantly in the cable space. As our offerings have grown beyond the HFC plant we plan on introducing Incognito solutions to operators in South East Asia, and deploying and growing in-country expertise on our solutions. Each operator is unique, and so our flexible solutions deployed at hundreds of operators around the world will be able to map to the unique workflows and access network topologies required by service providers. This ensures that our software deployments are non-disruptive and are completed quickly.

Eight Global Stories of Massive MIMO

MIMO deployment uses multiple antennas that are located at both the source (transmitter) and destination (receiver). Those antennas are linked in order to minimize error and increase efficiency of a network.

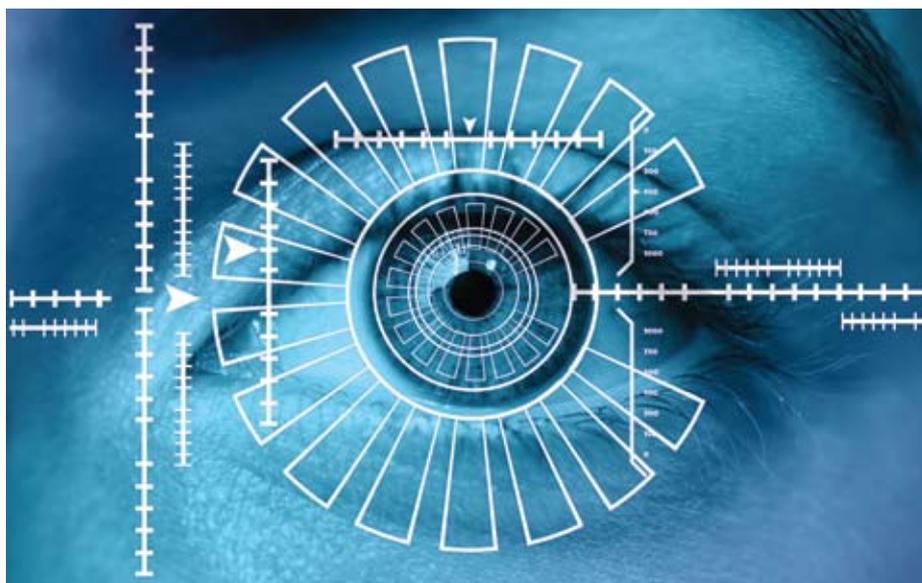
Massive MIMO, takes MIMO technology and scales it up to hundreds or even thousands of antennas and terminals. These antennas, attached to a base station, focus the transmission and reception of signal energy into small regions of space, providing new levels of efficiency and throughput for the telecoms network.

As the next generation of wireless data networks, or 5G, must address not only future capacity constraints but also existing challenges—such as network reliability, coverage, energy efficiency and latency—with current communication systems. And hence, Massive MIMO, offers significant gains in wireless data rates and link reliability. It allows for data consumption from more users in a dense area without consuming any more radio spectrum or causing interference. This results in fewer dropped calls, a significant decrease in dead zones, and better quality data transmission, without spreading thin the increasingly scarce radio spectrum.

We are presenting some of the best global stories on Massive MIMO deployments:

Airtel deploys Massive MIMO Pre-5G across IPL match venues

Massive MIMO expands network capacity by 5-7 times on the same spectrum and Airtel customers are enjoying seamless and superfast data speeds despite the very large number of users



in and around the stadiums where IPL matches are being played.

Customers can enjoy rich and interactive content on Airtel TV app to add to their in-stadia experience; can share, upload and stream content seamlessly

Airtel – India’s fastest mobile network, is making sure that its customers continue to enjoy superfast data experience on Airtel 4G when they are at Indian Premier League (IPL) 2018 match venues.

Airtel has deployed advanced Massive MIMO Pre-5G technology across IPL match venues. Massive MIMO expands existing network capacity by five to seven times over existing spectrum, thereby improving spectral efficiency. Customers are able to experience superfast data speeds on Airtel’s 4G network despite the very large number of concurrent users on the network sites at the venue.

Speaking on this development, Shyam Mardikar, CTO – Mobile, Bharti Airtel, said, “As part of our endeavour to offer a seamless high speed 4G experience to our customers, we are deploying this

advanced Pre-5G solution to enable a high speed and high capacity in-stadia network experience at IPL match venues. We believe this will enhance the digital experience for our customers and enable them to share, post and stream content seamlessly even in locations with massive crowds.”

Airtel was the first mobile operator in India to commercially deploy Massive MIMO.

Globe Taps Huawei to Deploy Commercial FDD Massive MIMO in the Philippines

Philippines Globe Telecom has partnered with Huawei to commence the trial of the world’s first FDD Massive MIMO commercial product.

FDD Massive MIMO is expected to boost cell capacity by a factor of two to three times based on legacy terminals compared to the current LTE deployment.

This enhancement in cell capacity will provide a better experience for more consumers.

Globe began building LTE networks

in 2013 and is utilizing LTE technology to provide mobile broadband and fixed wireless broadband services. Mobile data traffic has been growing rapidly driven by increased smartphone penetration.

LTE networks have been the major contributor to this growth over the last few years. Massive MIMO technology can enhance network capacity without adding additional spectrum resources and deferring to the construction of new sites. Massive MIMO is also seen as one of the key technologies for the future 5G era network.

Robert Tan, Chief Technical Advisor of Globe Telecom, said, "We are committed to provide users with high-quality and high-speed connectivity to support their digital lifestyle. Video and rich multimedia content is driving the growth in data demand and the need for a better customer experience. The Massive MIMO technology utilizes spectrum more efficiently and enables us to deliver superior customer experience with a tremendous boost in data capacity to support the exponential growth in wireless data consumption from our increasing base of MBB and WTTx customers. We are glad to see the timely introduction of Huawei's FDD Massive MIMO commercial products. It is a natural evolution of our network towards the 5G era."

Veni Shone, President of Huawei's LTE Product Line, emphasized that "Since the release of commercial TDD Massive MIMO products two years ago, such products have been deployed by over 40 operators. This shows Huawei's technology accumulation and experience in Massive MIMO deployment. Now, Huawei is launching the FDD Massive MIMO commercial product. This is the most compact product available in the industry, and provides excellent performance and high reliability. We are pleased to see that Globe has chosen Huawei's Massive MIMO solution to cope with its growing wireless data traffic. It is our hope that Huawei's active-antenna technologies supporting all RATs and multiple bands can effectively

help global operators embrace the era of massive connections and maximize spectral efficiency. We also hope it can effectively facilitate operators' digital transformation and further support a continuous evolution towards the 5G era."

Road to 5G: Verizon, Qualcomm, and Ericsson Align to Trial Massive MIMO

Verizon, Ericsson and Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated extended their technology innovation leadership by completing the first successful FDD Massive MIMO trial with a fully compatible customer device.

This achievement builds on the momentum from the deployment of FDD (Frequency Division Duplexing) Massive MIMO (Multiple Input – Multiple Output) on Verizon's wireless network in Irvine, California.

"We don't wait for the future, we build it. And this is another great example of moving the industry forward," says Nicola Palmer, Chief Network Engineer and Head of Wireless Networks, Verizon. "Massive MIMO is a critical component of our 4G LTE Advancements and will play an important role in 5G technology that will result in single digit latency and scalability in the billions of connections."

In this trial, the three companies used the latest Ericsson Massive MIMO software and hardware on Verizon's network, along with a mobile test device powered by the Qualcomm® Snapdragon™ 845 Mobile Platform with X20 LTE using TM9 (Transmission Mode 9). TM9 is an enhancement for consumer devices that will make them fully compatible with Massive MIMO, enabling a better experience.

Massive MIMO is a key technology component in the evolution towards 5G. It has the potential of greatly improving network capacity and the customer's experience. To realize the gains, both the network and devices need to support new TM9 functionality which leverages advanced beamforming schemes

between the network equipment and the mobile device. This will raise network spectral efficiency and customer speeds.

Joe Glynn, vice president, business development, Qualcomm Technologies, Inc. says: "This milestone further demonstrates Qualcomm Technologies' leadership and commitment to continually bring innovative technologies to consumers to improve their mobile experiences. We look forward to continuing our work with Verizon and Ericsson to push the limits of LTE while ushering in a world of 5G."

Niklas Heuvelod, Head of Market Area North America, Ericsson, says: "Advanced Antenna Systems and Massive MIMO are key technology enablers for 5G, and 4G LTE service providers and end users will also benefit from the superior capacity and network performance these technologies enable. The latest trial is another important step in the collaboration we have with Verizon and Qualcomm Technologies to further evolve 4G and prepare the network for 5G."

The Ericsson Massive MIMO portfolio is expected to be available next year, putting it well in line with commercial smartphones with the TM9 compatible chipset, which are expected to hit the markets in the first half of 2018.

Road to 5G: ZTE's Pre5G Massive MIMO Helps Japan's SoftBank Build a Smart Gym

ZTE Corporation, has helped Japan's SoftBank Hawks seal a 4-3 victory over its opponent and won the championship at the main venue Yahuoku! Dome during the 2017 Japan Series.

When preparing for the match, SoftBank worked with ZTE to deploy Pre5G Massive MIMO 2.0 (antenna 64T64R) after replacing some previous Macro sites at the Fukuoka Yahuoku! Dome.

Faced with high traffic, the MIMO 2.0 solution guaranteed proper communication for the whole championship and served as a comprehensive solution to the coverage, capacity, and user experi-

ence problems, helping SoftBank build a smart and high-performance gym network.

As the home field of SoftBank's Hawks, the Fukuoka Yahuoku! Dome can hold nearly 40,000 people. Held on a magnificent scale, the championship attracted a large audience, with the attendance rate reaching nearly 100%. It also formed a network guarantee scenario with the densest communication and most concentrated services in Fukuoka recently. The high-density traffic raised serious challenges for the capacity of the existing network.

ZTE, which strove to guarantee proper communications services for the championship, carefully deployed onsite communications equipment, applied customized solutions such as simulation, onsite surveys, and optimization of core parameters (Massive MIMO antenna beamforming), and deployed Pre5G Massive MIMO 2.0 products to help SoftBank build a smart and high-performance gym.

In Tokyo, Japan, ZTE and Japan's SoftBank Group officially signed a memorandum of understanding on joint research and development of Pre5G in July 2015. In September 2016, SoftBank announced that the "5G Project", a project based on the next-generation high-speed communications standard 5G, was kicked off. SoftBank was the first operator to put the Massive MIMO technology into commercial use, with ZTE being its major supplier.

ZTE's Pre5G has been highly recognized in the industry. To date, its Pre5G-related products and solutions have been deployed for more than 60 networks in over 40 countries, including China, Japan, Austria, Singapore, Spain, Malaysia, Thailand, and Indonesia.

Evolution to 5G: SmarTone, Ericsson trial FDD Massive MIMO

Ericsson and SmarTone, the mobile network operator in Hong Kong are trialing FDD (Frequency Division Duplex) Massive MIMO (Multiple Input, Multiple Output) technology as part of the op-

erator's network evolution plan towards 5G.

The trial, involving FDD Massive MIMO on 1800 MHz, represents the first of its kind for operators in Hong Kong. It is proving the capabilities of this key technology ahead of the live deployment in 2018 of AIR 3246, Ericsson's new radio that can support Massive MIMO over 4G/LTE with Ericsson's 5G Massive MIMO Plug-In.

Massive MIMO is a key technology that bridges network evolution from 4G to 5G, adding intelligent capacity and boosting user experience. Massive MIMO on FDD yields a multi-fold increase of network capacity and increase user throughput by up to five times, boosting performance for end users.

Stephen Chau, Chief Technology Officer of SmarTone, says: "Our extension of the strategic partnership with Ericsson in October last year includes a five-year network evolution plan towards 5G. This trial represents a significant milestone in our collaboration, and reinforces SmarTone's leadership in the network evolution journey. Ericsson's FDD Massive MIMO solution will play an instrumental part in providing our customers in dense urban environments with enhanced user experiences they have come to expect from SmarTone."

Nishant Batra, Head of Product Area Network Infrastructure, Ericsson, says: "We are working closely with SmarTone to develop, trial, and deploy key 5G technologies that will further enhance the user experience. The recent LAA field trial, and now the trial of FDD Massive MIMO, enable us to jointly shape the next-generation network technology."

Ericsson has recently launched its first radio, AIR 3246, supporting FDD Massive MIMO for both 4G and 5G. The technology enables operators – especially in metropolitan areas – to bring 5G to subscribers using today's mid-band spectrum and boost capacity in their LTE networks.

Massive MIMO: Entel drives net-

work partnership towards 5G with Ericsson

Ericsson has extended its 20-year strategic partnership with Entel, the largest telecommunications company in Chile. Under the terms of the new contract, Ericsson will prepare Entel's network in the evolution path towards 5G by deploying its latest LTE FDD network technologies and LTE TDD Massive MIMO (Multiple-Input, Multiple-Output).

This will allow Entel to increase its competitiveness and capture additional revenue streams. Entel will be the first operator in Latin America to deploy Massive MIMO nationwide.

Massive MIMO is a wireless technology that uses multiple transmitters and receivers to transfer more data at the same time. Multi-antenna transmission is playing a critical role in the evolution of 4G and 5G networks.

Entel will also evolve the Radio Network Controllers and EVO controllers across the network, including remote locations such as Easter Island, and upgrade the transport network with the introduction of Ericsson's microwave solutions, a section of which now tap into E-band spectrum to cater for capacity increases in backhaul and fronthaul.

Alfredo Parot, Vice President of Technologies and Operations, Entel, says: "Entel has a long-standing partnership with Ericsson that is based on a history of excellence in product and service delivery. Now, as we evolve our network to capture the new business opportunities of Gigabit LTE and the evolution towards 5G and IoT, we naturally extend this partnership with Ericsson in these areas. Our subscribers and enterprise customers will enjoy the benefits of a very high performance network in the region for years to come."

Arun Bansal, Senior Vice President and Head of Market Area Europe and Latin America, Ericsson, says: "With mobile traffic volumes expected to increase exponentially through 2020 and beyond, operators around the world are bolstering their existing networks to deliver

higher speeds and lower latency to their subscribers. We write a new chapter in the history of our strategic partnership with Entel by evolving their network to Gigabit LTE and paving the way to 5G and beyond, cementing their leadership position among operators in the Latin American region.”

Within the agreement, Ericsson will also deliver several strategic core network projects intended to upgrade Entel's voice and data networks to the latest generation in order to provide new end-user services, enable increased broadband capacity and higher data speeds, enhanced voice quality, optimized latency, and reduced network operation costs.

Ericsson has introduced its Adaptive Network Inventory solution (EAI) which will become an integral part of Entel's Digital Transformation project. Deployment of the core network projects begins immediately and will be completed in different phases throughout 2018 and 2019.

Telenet Belgium, ZTE debut FDD Massive MIMO field application in Europe

ZTE Corporation and Telenet have announced the first FDD Massive MIMO field application in Europe. The field demonstration site was chosen in Werchter, home of Rock Werchter music festival.

The field application used 20MHz of spectrum and 6 terminals to complete an 12-stream verification, achieved an average single user speed of 120Mbps, 710Mbps peak cell speed, and improved spectrum efficiency by 3.3 times compared to traditional LTE base stations.

With the rapid growth of mobile broadband services, user data requirements have been increasing exponentially, but 4G spectrum limitations cause a bottleneck in network capacity improvement. Massive MIMO is a key 5G network technology, and a ZTE Pre5G core solution, introducing 5G capabilities into existing 4G networks. ZTE was the first vendor to make Massive MIMO

technology available for all FDD-LTE networks, which account for 85 percent of the world's LTE networks. It will help operators significantly increase network capacity without the requirement of costly additional spectrum. More importantly, the deployment of FDD Massive MIMO does not require changes to the existing 4G network architecture, and is fully compatible with current 4G terminals. This brings immediate commercial benefits to the operator while boosting the customer experience.

Telenet and ZTE have been in a long-term strategic partnership since 2016, and ZTE is the sole radio network vendor. “We're very excited that, with ZTE, we have completed the first FDD Massive MIMO trial in Europe, achieving the highest single cell throughput within the 20MHz spectrum. This new speed record is a milestone along our evolution to 5G, and we will continue to build a faster network with higher capacity, improving mobile users' broadband experiences.” said Micha Berger, Telenet's CTO.

“ZTE is very proud to work with Telenet in realising Europe's first field application for FDD-LTE Massive MIMO technology. We believe that this solution can significantly improve Telenet network performance, delivering the best broadband experience to Telenet customers,” said Wenhao Tang, Vice President, CTO of Europe and America Region of ZTE. “In addition, ZTE will work closely with the Telenet Innovation Center, where we will continue development of new solutions and products for network performance improvement to provide an improved user experience and new services. This will help Telenet continuously improve network competitiveness and brand value.”

Optus Taps Huawei to Demo Massive MIMO, 3CC Carrier Aggregation in Live Network

World first achievement in pairing pre-5G technologies Massive MIMO with 3CC Carrier Aggregation in live network

Optus has announced the successful live network testing of combined Mas-

sive MIMO (Multiple Input Multiple Output) and 3CC Carrier Aggregation technologies, 3CC Massive MIMO.

The network trial, conducted on live traffic at Macquarie Park in June 2017, attained a highest speed of 818 Mbps. It was completed with technology partner Huawei.

Both Massive MIMO and multiple Carrier Aggregation technologies are considered key to enabling 5G technologies, with Optus the first in the world to complete a successful combined live network implementation of the massive MIMO and 3CC CA technologies together in the same equipment.

Dennis Wong, Managing Director of Optus Networks, said “Earlier this year, Optus launched a 4.5G network and completed Australia's first field trial of Massive MIMO technology.

“We're committed to leading Australia in terms of 5G development and testing, and this recently completed world-first 3CC Massive MIMO test is further testament to our commitment and developments we have been able to achieve in this space.

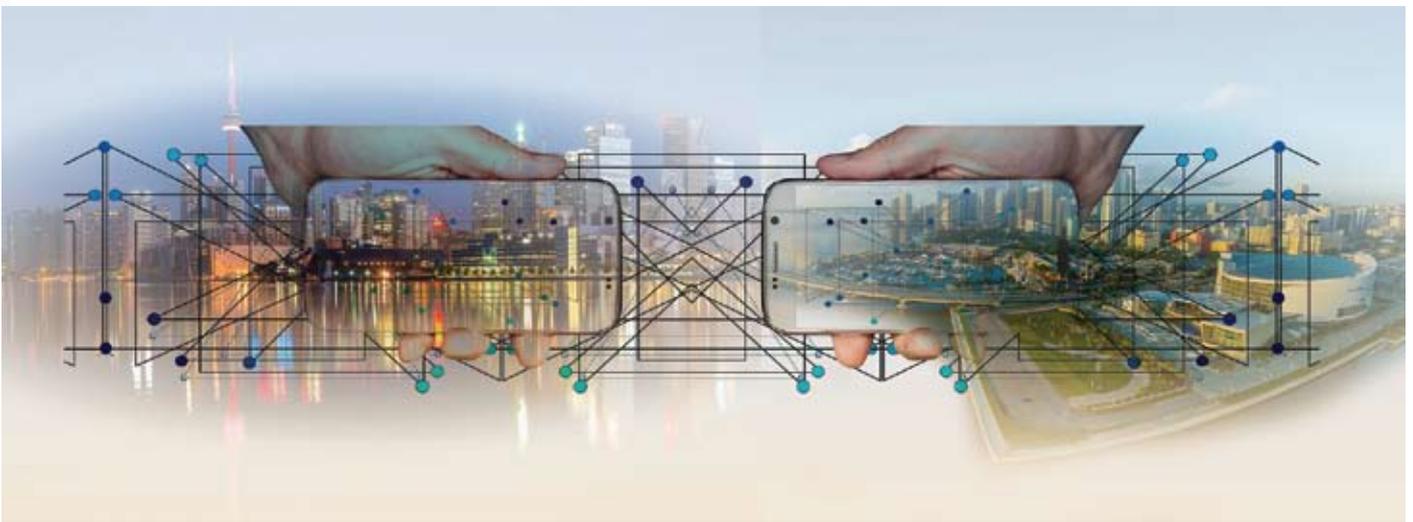
Site capacity during the live testing was significantly improved by almost four times compared to that of legacy 4T4R MIMO base stations.

Massive MIMO is expected to be a key technology in 5G through the use of intelligent spatial diversity and 3D beamforming features, allowing a theoretical improved spectral efficiency up to 6 times that of a traditional antenna system.

The Massive MIMO Integrated Antenna system used in the live site was supplied by Huawei and capable to deliver 64T64R MIMO, supporting up to 80MHz of all four carriers of Optus' 2300MHz TDD band.

Optus plans to rollout Massive MIMO sites in selected capital cities starting from the end of 2017. Optus' customers will be able to directly benefit from Massive MIMO especially in high data traffic areas and should expect improved download speeds in congested areas.

Seven Global Stories of Narrow Band-IoT Deployment



NB-IoT is all about enabling widespread IoT and this is where this technology is going to play a critical role in terms of powering 5G networks. NB-IoT is a technology designed to take IoT from niche to mainstream. A number of segments such as Critical Communications can utilize the power of NB-IoT and harness robust connectivity, while delivering more value to end customers.

5G promises even further IoT enhancements in the form of narrowband 5G, meshing, mission-critical control, not to mention the addition of network slicing for flexible use case support.

In the near-term, enhanced mobile broadband use cases will dominate early 5G interests. NB-IoT provides a foundation for future-ready IoT deployments by enterprise and telecoms, delivering scalable IoT capabilities

while providing a path towards evolution to 5G-based IoT.

We are presenting some of the best global stories on NB-IoT deployments:

Network Transformation: Telia first with network upgrade to NB-IoT in Finland

Telia is the first operator in Finland to bring the Narrowband IoT (NB-IoT) technology to its network.

The new technology, designed for the Internet of Things, makes it possible to easily connect a huge number of sensors directly to the mobile network in order to collect real-time data, even in challenging places.

“Many businesses across the Nordics and Baltics, large and small, are looking to IoT to drive efficiency in their operations by monitoring assets or steering production processes for example, and to innovate richer services for their

customers. The upgrade in Finland, which was made to our entire network, enables the Internet of Things to reach massive scale, cost effectively, which can help smart cities and smart homes develop, and even track our pets and monitor our health. We are rolling out this upgrade across the Telia footprint, and anticipate launching commercial services in all main markets by year end,” says Björn Hansen, Head of Telia Company’s IoT business.

Smart mailbox

One of the first users is the Finnish postal service Posti, which has cooperated with Telia in developing the world’s first smart mailbox utilizing the NB-IoT technology

“The new IoT technology is the most significant step we have taken in our network since the launch of the 4G network. Low-cost sensors can be

used wherever data is to be collected, and the network is able to meet the connection needs of a huge number of sensors. This type of sharing of network capacity for different purposes is one of the features that has been expected of 5G networks," says Telia Finland CTO Jari Collin.

Narrowband with good coverage

NB-IoT is a new network technology that uses only a small amount of network bandwidth to connect IoT devices to the network affordably and reliably. A single base station can serve thousands of highly energy-efficient devices – a simple sensor can provide measurement data for ten years with the same power source.

Good coverage guarantees that measuring and monitoring can also be carried out in areas with weaker coverage, such as a basement or underground premises.

"Adding NB-IoT in our networks across all markets means that we basically will have everything in place to enable our customers to fully utilize the best of what mobile networks have to offer on the journey towards 5G. Many customers' use cases will develop with NB-IoT and LTE-M and some continue to evolve once 5G functionality is here," says Gabriela Styf Sjöman, Head of Group Networks, Telia Company.

STC Picks Ericsson to Drive LTE-A, NB-IOT Deployment in Saudi Arabia

Ericsson has been chosen by Saudi Telecom Company (STC) Group for a major nationwide expansion of its 4G network in Saudi Arabia, including the deployment of LTE Advanced and Narrow Band-Internet of Things (NB-IoT) in Radio Access Network.

The deal spearheads STC's drive to revolutionize mobile broadband-driven data experiences for its subscribers and open up new enterprise opportunities in IoT, while laying the groundwork for evolution to 5G.

The LTE Advanced expansion, which

got underway in December 2017, includes the deployment of Ericsson's 5G-ready baseband hardware in the network. LTE Advanced will be deployed in a new 700MHz band spectrum acquired by STC. It will increase STC network throughput in 4G/LTE by up to 50 percent for smartphones.

In addition to the data-driven content access speed delivered by LTE Advanced, subscribers will benefit from extended coverage, much longer battery life, and low-cost devices enabled by the new cellular IoT technology, NB-IoT.

The digital transformation also sees STC deploying Narrow Band-IoT (NB-IoT) in RAN across its expanded network to drive and support enterprise IoT Ecosystem innovation and business opportunities. This includes Massive IoT applications for smart city purposes, such as metering, parking sensors, and connected cars.

Nasser Al Nasser, Group CEO at STC, says: "At STC, our main goal is to ensure that the country's Saudi Vision 2030 ambitions are met. We do that by always making sure we offer our subscribers the latest innovative technologies. LTE Advanced and NB-IoT are exactly what we need to pave the way to 5G."

Rafiah Ibrahim, Head of Market Area Middle East and Africa, Ericsson, says: "By making digital transformation real and effective for STC through 4G expansion, we will enable their customers to enjoy enriched experiences, whether that means lightning speed video and media access for subscribers, or IoT business innovation and opportunities for enterprises. Our partnership with STC shows 4G network evolution is already happening and paving the way for 5G."

STC has already deployed multiple 4G layers across various frequencies (LTE 1800, LTE 2300, and LTE 2100).

COSMOTE Taps Ericsson to enable NB-IoT Driven Network in Greece

Ericsson has completed the deploy-

ment of the first cellular NB-IoT clusters in the COSMOTE 4G network in eleven Greek cities and hotspots, to support emerging mMTC (massive Machine Type Communications) use cases.

Ericsson upgrades part of the COSMOTE LTE network with software that supports NB-IoT technology, enabling massive IoT use cases.

In addition, Ericsson and COSMOTE aim to develop use cases and build the local ecosystem. In collaboration with local partner Fuelics, and using Ericsson IoT Accelerator Platform, the companies designed, tested and introduced a novel NB-IoT use case using COSMOTE's commercial network for asset management – fuel tank capacity monitoring – at the Democritus University of Thrace.

George Tsonis, OTE Group Executive Director of Network Planning & Development, says: "COSMOTE, fully recognizing the potential of massive IoT technology, is the first in Greece and one of the firsts in Europe, to trial NB-IoT and evolve its network. We're poised to evolve beyond merely providing mobile broadband connectivity, to play a leading role in the rapidly developing IoT market and create through technology and innovation a better world for all."

George Pappas, Head of Ericsson Greece, says: "NB-IoT will accelerate the development of the IoT market in Greece and open up vast opportunities for innovation and entrepreneurship in many industries, such as transport and healthcare, resulting in new services that will significantly improve quality of life."

Built using 3GPP standards, NB-IoT enables a wide range of devices and services to be wirelessly connected using cellular telecommunications bands.

This IoT technology is relatively cost-efficient and brings many other advantages, including low power consumption, extensive coverage, massive connectivity, and a high reliability of transmission. Leveraging on existing

LTE footprint, COSMOTÉ can deploy a wide range of new IoT use cases and services in smart cities, logistics handling, utilities and more.

Singtel Taps Ericsson to roll out Singapore's first commercially available NB-IoT network

Singtel in partnership with Ericsson has become the first operator in Singapore to make a nationwide cellular Internet of Things (IoT) network commercially available.

This advanced mobile network technology will help accelerate the proliferation of IoT devices by offering the best coverage, power efficient and cost-effective solutions to enterprises.

Supporting CAT-M1 and NB-IoT devices, Singtel's IoT network allows businesses to benefit from applications with low-power consumption that help prolong the devices' battery life and provide deeper wireless coverage and multiple connections. Singtel will also harness its cyber security expertise to support enterprises in implementing secure and reliable IoT solutions.

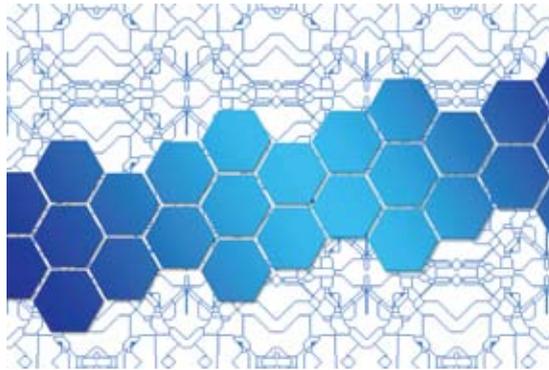
Diomedes Kastanis, Head of IoT at Singtel, says: "IoT will play a key role in realizing Singapore's Smart Nation Vision and we are committed to working with our partners to address the growing demand for IoT services both in the enterprise and consumer space. With our Singtel IoT Innovation Lab and our capability to quickly introduce new services, we will bring industry-leading IoT and 5G innovation to businesses and consumers. These leading-edge technologies will enable Singaporeans to seamlessly manage all their devices at the tip of their fingers."

Singtel and Ericsson have recently signed an agreement to establish the Singtel IoT Innovation Lab to facilitate IoT deployments and the development of a local IoT ecosystem for enterprises and consumers. As more and more partners join the IoT Innovation lab, Singtel's goal is to reduce the time to market for the introduction of new

services, eliminate any technological barriers and redefine existing business models.

In addition, Singtel's IoT network also offers a universal connected life management application that enables any device or service to interact with one another – at home, work or on the move – regardless of the service provider or technology. The open connectivity platform allows for easy and manageable data sharing among family and friends, including on-the-go tracking for safety and security.

Since 2016, Singtel has been exploring IoT usage with local companies and large corporations across a diverse range of applications, including environmental sensing, asset tracking,



waste management and monitoring of medicine consumption. It has been conducting trials with several partners including bike-sharing company Mobike, smart metering solutions provider EDM Limited and modem chip maker SIMCom Wireless Solutions. The roll out of the nationwide cellular IoT network will accelerate businesses' adoption of such innovative technologies and help them create exciting new products and services for consumers.

Martin Wiktorin, Head of Singapore, Brunei and Philippines, Ericsson, says: "The launch of the Singtel IoT Innovation Lab will help boost the IoT ecosystem in Singapore. Ericsson is bringing its extensive ecosystem partners, comprising devices, security and applications to work on opportunities together with Singtel."

Digital Transformation: Jio Taps

Samsung to Deploy NB-IoT Network in India

Samsung is all set to supply Reliance Jio with equipment to boost LTE network coverage and capacity, and deploy a next-generation cellular IoT network.

Reliance Jio Infocomm and Samsung Electronics have announced their continued partnership to bring LTE coverage to 99 percent of the Indian population and significantly improve network capacity across the country. Adding to the joint effort is the deployment of a nationwide cellular IoT network.

It has not been long since Jio brought a radical digital revolution to India. Now, the company is ready to pave the way for a fully digital India, in which IoT will reach every corner of the country's society and economy. The IoT network, the first of its kind in the country, will support a variety of consumer and enterprise use cases such as vehicle tracking, smart appliances, smart metering, security, surveillance and more.

"Making sure that everyone benefits from mobile broadband that is both available and affordable to all is our top priority. We will once again partner with Samsung to offer a suite of innovative services for all users," said Jyotindra Thacker, President of Reliance Jio Infocomm.

"We are delighted to contribute to Jio's success story and rapid growth. We have been striving to offer the best experience possible to all users at Jio. Jio's LTE network will unlock the potential of IoT and promise a much more convenient and safe environment for users," said Youngky Kim, President and Head of Networks Business at Samsung Electronics.

The NB-IoT service not only utilizes the existing spectrum held by Jio, but is also enabled by a simple software upgrade of the already installed base stations. Further deployed is the new and dedicated Cellular IoT virtualized core. The commercial NB-IoT network successfully established by Jio

and Samsung in Mumbai in February 2018 will soon impact other parts of the country with new and compelling use cases.

The agreement represents another phase of collaboration between the two companies, in which the targeted outcomes are faster internet access for users across India, as well as the generation of unexplored services and business models for enterprises.

ZTE, velcom Initiate First NB-IoT Commercial Deployment in Belarus

ZTE Corporation, a major international provider of telecommunications, enterprise and consumer technology solutions for the Mobile Internet, and velcom, a branch of A1 Telekom Austria Group, have announced the deployment of the first scaled commercial Narrowband IoT (NB-IoT) network in Belarus.

The network was deployed in Minsk city first and then in other regions accordingly as scheduled. So far, velcom has verified smart metering and smart city solutions in the network.

The cooperation of NB-IoT between velcom and ZTE has started since the end of last year. In April's Tibo exhibition, the end-to-end gas metering service demo has been successfully demonstrated. Following that, more lab tests and field tests were carried out.

velcom has highly appreciated ZTE's commitment in this market. "We are very excited that, with ZTE, we have provided abundant services to our customers. Within the project, we installed equipment that will allow us to implement NB-IoT technology. This is an incredible breakthrough in the field of telecommunications, and we are happy to complete it together. We are sincerely glad to have such a partnership and looking forward to further cooperation," said Christian Laque, CTO of velcom.

Pu Yingchun, Vice President of ZTE and General Manager of FDD Products, said: "ZTE is very proud to work

with velcom to release the first NB-IoT commercial deployment overseas. The achievement signifies ZTE's capabilities of providing operators with the smooth evolution solution towards 5G."

velcom is one of the leading mobile operators in Belarus dedicated to providing customers with the cutting-edge communication services. It started its 3G network rollouts in March 2010. In February 2016, velcom was the first to launch UMTS-900 throughout the whole country, bringing dramatic coverage extension and high mobile data quality.

NB-IoT Deployment: Huawei, Nextek and Quectel to Drive IoT Expansion in the Middle East

Huawei has signed an agreement with two global companies to promote the growth of the Internet of Things (IoT) and build a IoT ecosystem in the Middle East: Nextek Solutions, a global IT & software provider and integrator, and Quectel, a supplier of wireless modules. The two entities will cooperate with Huawei to build Narrowband IoT (NB-IoT) solutions that target the needs of regional organizations.

In the Middle East, the Internet of Things is being driven by Smart Cities. Governments from this region have made smart city expansion a key goal of their national agendas, leading to the deployment of innovative projects that stand as a reference for smart city development worldwide.

The Smart City Center of Excellence in Dubai acts as a platform for industry leaders to share their knowledge and collaborate to keep progressing the field.

"Huawei believes that the key to driving Smart City development in the region is to create an ecosystem of partners and vendors working together to co-create solutions that precisely target the needs of their respective vertical sector," says Su Wang, Vice President of Marketing, Huawei Middle East. "We are eager to work with part-

ners like Nextek and Quectel to drive IoT development and commercialization in the region. Through joint investments and collaboration between manufacturers, operators, ICT providers, application software developers, research institutes, and even governments, the pace of growth of IoT will keep accelerating."

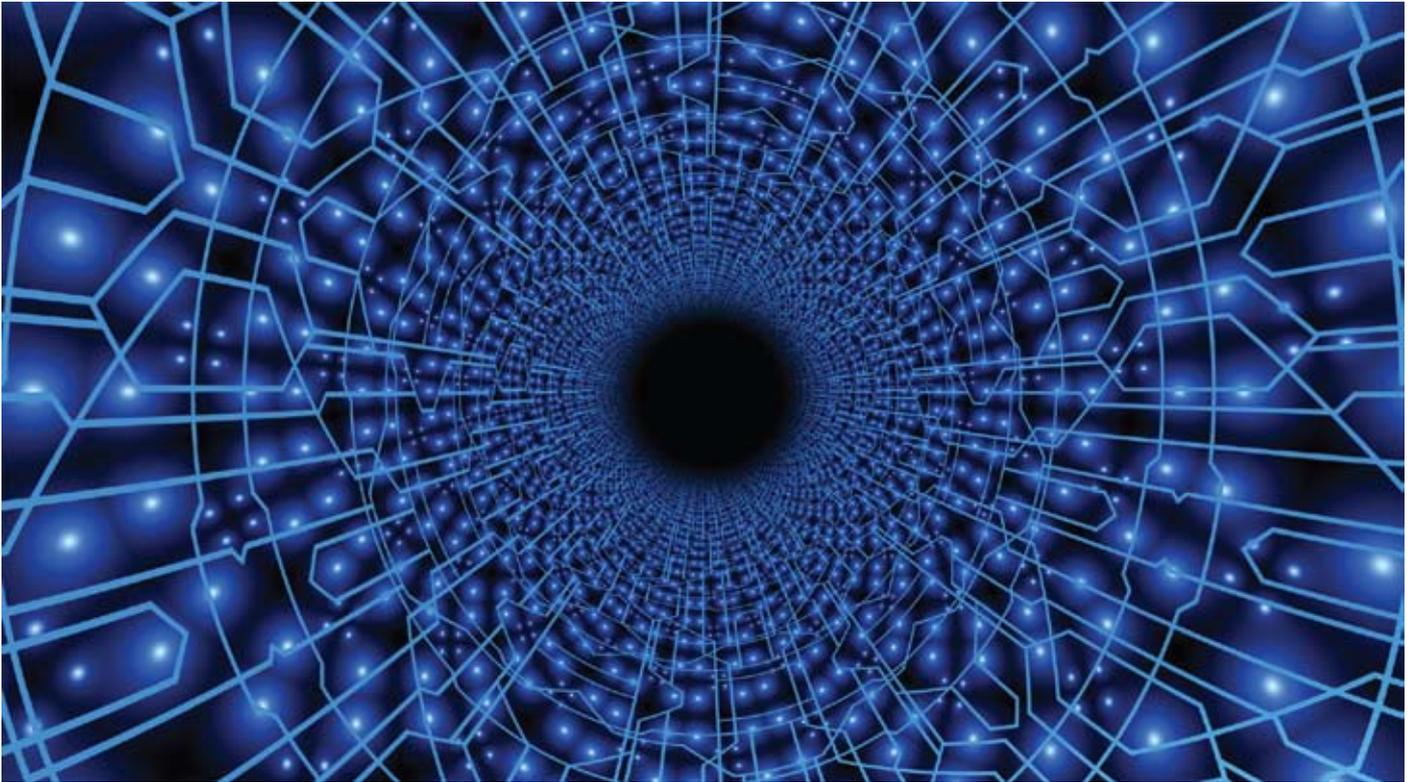
"Nextek is very eager to cooperate with Huawei for IoT and Smart Cities project in the Middle East and globally. We understand the local markets very well and the need for IoT solutions for various verticals. Nextek is well positioned to contribute as a software provider and integrator," said Karim Rahemtulla, Managing Director of Nextek.

"As one of the first NB-IoT module manufacturers in the world, Quectel is willing to explore the Middle East market together with partners across the industrial chain including operators, local IoT device vendors and distributors to contribute to the smart city vision in the Middle East region," said Doron Zhang, Senior Vice President of Quectel.

Huawei has been active in IoT development across the Middle East, collaborating with Etisalat to launch the first successful trial of Smart Parking in the region. Huawei partners with Jeddah Municipality to implement groundbreaking smart city solution in the region. Zain has already deployed IoT solutions in KSA with the help of Huawei, aimed at ensuring a better life for its citizens.

In order to accelerate the development of the IoT industry and enrich the ecosystem, Huawei has deployed its Hosting Center that serves as a secure platform for operators in the region. Huawei's OpenLab in Dubai provides regional partners with a platform to test and customize a variety of technologies to target the vertical sectors most relevant to the Middle East, particularly Public Safety, Smart Cities, Transportation, Education, and Oil & Gas.

SDN and NFV – Stretching the Boundaries of Network



Legacy heterogeneous networks have become very complex and hard to manage due to upgrade and interoperability challenges, evolving protocols, and management techniques traditionally hardcoded into the underlying hardware platform. SDN addresses these problems by decoupling virtual resources from the physical resources, abstracting control planes and data forwarding planes, and automating network management while enabling centralized orchestration.

The networking and communication industry is at a critical inflection point as it looks to embrace new technologies such as Software Defined Networking (SDN) and Network Functional Virtualization (NFV).

While there are incredible advan-

tages to deploying an SDN network, there are challenges as well: SDN and NFV require a revamping of network components and structures and new approaches to writing software for network management and implementing that code in the hardware.

A remarkable point to note is that SDN is not a new concept. Centralized network control and visibility have been around for a number of years, but what's been missing until recently is a holistic view of networks and technology, with standardized separation of the control and data planes. SDN provides this capability and can efficiently enable data center and service providers to manage network configuration, management, routing, and policy enforcement for their evolving multitenant heteroge-

neous network.

The Need for SDN

Traditional network platforms have both control plane and data plane functionalities in a single physical unit. In this traditional network, routing and switching decisions are made at each individual unit on a dynamic basis. SDN, however, depending on deployment models (described in a later section), moves the control plane to a centralized location and keeps only the data plane in the switches.

SDN aims to solve the following issues found in traditional networks:

In traditional networks, forwarding decisions are based on predefined rules over which network operators have no control. Thus, all packets going to the same destination are routed

along the same path and treated the same way. If there were traffic congestion at any given link along the path, all traffic would suffer from congestion even though an alternate path is available with less traffic.

In addition, legacy networks use a spanning tree protocol that limits the use of multilink/ bundling, which can increase bandwidth between nodes.

From the network architecture perspective, the current multitier network architecture (i.e., multiple switches connecting switches for switches) requires many more ports than the actual number of servers or end nodes. When virtual switches (vSwitches) are deployed, it further adds another tier to the network. This multitier architecture increases the complexity in the network structure. SDN architecture can simplify the multitier network architecture by virtualizing layers in the network.

From a network scalability and expansion perspective, a cloud infrastructure-based network with multiple tenants using numerous applications requires logical isolation from each other. However, traditional VLAN technology is unable to provide enough network segments to facilitate this. The future network requires scalable LAN segmentation. SDN networks can provide scalable LAN segmentation to effectively manage cloud infrastructure environments.

Network operators need to have the agility to quickly and easily upgrade their network infrastructure, but they're often impeded by challenges, including real-time debug processes, recovery time requirements, backward compatibility constraints, and more.

SDN can enable much shorter development times and easier management of the network through the utilization of common, general purpose hardware, while providing a holistic way of managing and controlling the network. Consequently, network operators can achieve CAPEX and OPEX savings.

As defined by the Open Networking Foundation, SDN decouples the network control and forwarding functions, enabling the network control to become directly programmable and the underlying infrastructure to be abstracted for applications and network services.

Unlike server virtualization, which enables sharing of a single physical resource by many users or entities, virtualizing network resources enables a consolidation of different physical resources by overlaying another or multiple layers of networks on heterogeneous networks, resulting in a homogenous network.

SDN Trends and Challenges

There are several different SDN

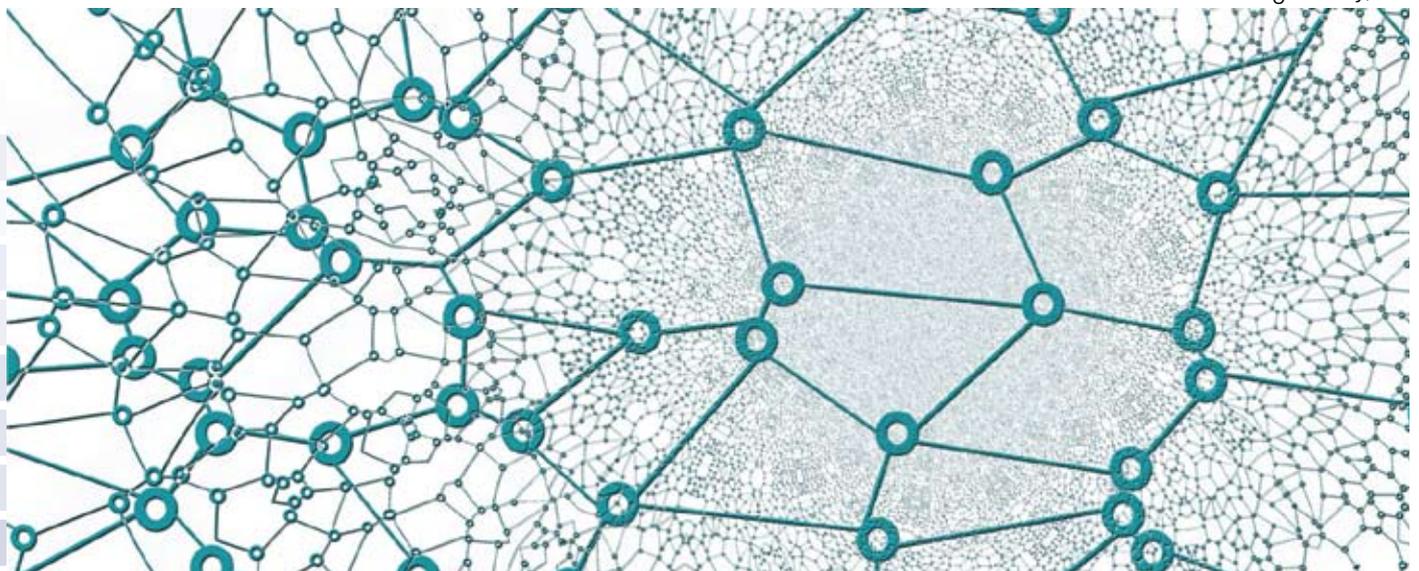
deployment scenarios in the industry, although the original SDN concept proposes to have a centralized control plane with only the data plane remaining in the network.

On the controller implementation, a few variations have been considered in the industry. A central or distributed architecture has one or more SDN controllers, and it controls all the switches or subset of switches in the network. Distributed architecture administers a cluster of switches via a dedicated controller, and there are many such clusters with several SDN controllers in the network.

Challenges in SDN are still emerging as the definition of SDN continues to evolve. The scaleout network paradigm is evolving as well. Due to these uncertainties, abstraction mechanisms from different vendors will compete or co-exist. In addition, creation of SDN controllers and switches requires resolution of design challenges in many hardware platforms.

SDN Use Cases – Data Center

The data center environment is the most common use case for SDN. In the traditional data center network, there are ToR (Top of Rack), EoR (End of Row), aggregation, and core switches. Multitier networking is a common configuration. To increase data center network manageability,



SDN can abstract physical elements and represent them as logical elements using software. It treats all network elements as one large resource across multiple network segments.

Therefore it can provide complete visibility of the network and manage policies across network nodes connected to virtual and physical switches.

Use Case 2: Wireless Mobile Edge - Seamless Roaming between 3g/4g + WiFi

A wireless network is another good use case for deployment of SDN. The growing explosion of handheld devices such as smartphones and 3G/4G-enabled tablets has increased bandwidth consumption per device in hyper-scale, causing spectrum availability and coverage issues in many areas. As mobile spectrum is expensive and limited, one proposed solution to these congestion issues is to use an SDN solution that leverages unlicensed spectrum via Wi-Fi to both offload spectrum and increase spectrum density.

This solution is very effective for special events where many people gather in small areas (such as stadiums). The SDN solution also addresses network management challenges, supporting fast, seamless voice, data, and video transition from 3G/4G network to Wi-Fi networks.

In this case, the SDN solution dynamically partitions access points and cell radios based on carriers, usage, identity, and device type to enable optimal usage of spectrum, Wi-Fi and mobile backhaul links to ensure that the maximum number of users can access network resources. The SDN controller also provides a holistic view of the network and dynamically allocates resources based on the status of the network.

In wireless networks, SDN can also be used for separating the control plane from the traditional gateways where there is a control path and forwarding path combined. A centralized

SDN controller runs the control plane and manages the gateway platform's data plane, resulting in a simpler gateway platform architecture. This approach enables dynamic control plane updates and scalability.

Use Case 3: Carrier Network

Carrier networks are mission critical. They are the backbone of the communications infrastructure and are expected to be reliable and fully functional all the time. The costs of building and maintaining these critical networks are tremendous, and it can be extremely difficult and time-intensive to modify them. SDN for carrier networks is especially complex.

5.4 Use Case 4: Network Application Management

SDN can enable easy platform upgrades and migration for applications such as firewalls. In this example, an SDN controller can obtain firewall rule information from existing firewall appliances (through CLI) and extract firewall ruleset and route information.

Then the SDN controller transfers firewall rulesets to a newer firewall platform, while the SDN controller programs an OpenFlow switch connected to both old and new firewall appliances to redirect the traffic from the old to the new firewall appliance.

Route information extracted from the old firewall appliance can be used to program the OpenFlow switch, as the route information would indicate which flows are going through the firewall appliance. Once this process gets established and processes are standardized, full automation can be achieved.

Consequences of SDN

SDN introduces a new approach to network resource utilization and management, and each networking vendor in the market is looking into their own way to build SDN solutions. One key action that needs to be taken to enable SDN is to open up the

intelligence of switches and routers to enable the abstraction of proprietary vendor technologies.

Many equipment vendors that have been traditionally reluctant to open up their proprietary technologies have slowly opened up their APIs in response to the growing adoption of SDN. Mega data center players (Amazon, Google, Facebook and the like) are implementing technologies that will allow them to enable greater flexibility and lower costs. Amazon and Google are building their own networking (white box) switches so that they don't have to rely on the platforms produced by OEM vendors. Facebook is driving the Open Compute Platform (OCP) to develop specifications for open architecture switches that will be manufactured by low-cost original device manufacturers. The open architecture approach from Facebook is creating an ecosystem where standard, high volume commodity platforms could be used to minimize CAPEX and OPEX costs.

Clearly the white box and open architecture approaches are creating major concerns for networking equipment manufacturers who prefer to add their own value-added technologies into hardware and software.

SDN disrupts these existing technology and business models, but is creating more openness and enabling new and different business models.

SDN will drive toward a more software-centric architecture and implementation. Thus, it becomes difficult to provide platform differentiators. With SDN, the need for less expensive and easy-to-access hardware becomes paramount, and platform-specific, value-added services are deprioritized.

Final Conclusion

SDN aims to minimize the complexity of heterogeneous networks, protocols and management techniques, thereby achieving CAPEX and OPEX savings.

service providers began to implement SDN and NFV into their legacy public networks. While a long-term effort, service providers see the benefits of moving towards future networks as soon as possible. In addition to hardware, they are using SDN and NFV to remove the vast number of vendor and device-specific application program interfaces (APIs) from their transport, access, and CPE operations support systems (OSSs).

By dismantling their legacy network management and OSS silos, they are clearing a path for cost savings and new opportunities their old networks would be unable to support.

Service Provider Focus

By deploying SDN and NFV in

their networks, service providers are transforming their business models to embrace today's "app culture" wholeheartedly. As they update their networks, they are in an increasingly better position to anticipate and meet the rapidly changing demands of their customers and respond to ever-shifting market dynamics.

Their ability to implement and program "virtualized" customer premises equipment (CPE), which does not need to be physically installed, maintained, or amortized, gives them a host of new options. For example, service providers can choose best-in-class suppliers and implement or replace solutions as needed. They can also work with third parties for apps, services and outsourcing of network operations, or,

insource software development.

Future networks reflect the reality that focusing on customers instead of the limitations of legacy networks is the more profitable business model. Future networks allow customers to determine which apps are on top, how long they thrive and how quickly they emerge.

By architecting their networks to respond to customer needs, service providers also are better able to balance service velocity with what are sure to be unprecedented network growth rates. For example, instead of spending a disproportionate amount of time and resources on implementing large and infrequent software releases, service providers can switch to more manageable and cost-effective micro software release schedules.

Future-Ready Programmable Networks Are Here

Equipped with SDN and NFV, tomorrow's access networks will more closely resemble data center networks than legacy networks thanks to the reduced OpEx, increased service levels, and unlocked networks the two technologies enable.

For example, SDN- and NFV-equipped Next-Generation Broadband Access Networks will incorporate features such as OpenFlow and service chaining, which will enable service providers to rapidly create and support new microservice models and support expanded service offerings through cloud peering capabilities. Both features will allow service providers to be very responsive to the changing market demand.

Future networks also will offer significant operational benefits to service providers. Those benefits include centralized policy management with virtualized residential gateways (vRG) and virtualized customer premises equipment (vCPE).

The implementation of network self-optimization and real-time analytics will go a long way toward improving customer satisfaction and reducing expensive service calls and truck rolls. These innovations will enable future networks to do a better job of proactively managing element resources through advanced troubleshooting. In addition to taking good care of customers, this will impact service providers' bottom lines positively. Time that used to be spent managing their networks and responding to trouble tickets will be spent on profitable efforts such as creating and selling new apps and services to customers.

Likewise, Next-Generation Broadband Networks' support of multi-domain, multi-vendor programmability enables service providers to truly embrace a best-of-breed, app-based approach which maximizes the customer experience. Future networks' vendor neutral architectures will unlock single-vendor scenarios that have hindered service provider innovation for decades.

As their networks evolve, so will service providers and their business models. SDN and NFV provide a unique opportunity to serve their own interests and their customers' demands simultaneously.

Only time will tell exactly how much service providers will be able to accomplish as their legacy networks reach new increasing degrees of SDN and NFV saturation.

Reviewing India's Telecom Landscape

By Rajesh Mishra

The year 2017 changed the entire landscape of the Indian telecommunications industry. The service providers had to fight battles on multiple fronts in the year 2017.

While on one end, consolidation wrecked havoc and on the other end the Average Revenue Per User (ARPU) hit rock bottom and the telcos struggled to maintain profitability.

The service providers have little choice but to explore newer technologies, geographies and consumer segments to add to their revenue streams. There is also an acceptance of the fact that the era of providing just plain voice and data services has come to an end. The service providers realize that they need to come up with innovative services to compete with the internet operators.

The world over the communications service providers are transforming themselves into digital service providers, and Indian telcos are also moving in that direction. In this background, below are the trends that will dominate the year 2018:

Harnessing The Rural Potential

The year will see the Indian telcos go beyond the urban market. Innovations like 4G feature phones, a significant drop in the cost of smartphones and rock-bottom tariffs have made the telecom services affordable for the rural subscribers.

On the other hand, the recent recommendations in the Indian Telecom Policy proposes to increase the rural teledensity from the current 56.9% to 100% will further push the service providers to start addressing this segment seriously.

So, the urban market is saturated and the rural market has matured, indicating that the time is now right for the service providers to address this segment.

The main challenges faced by the service providers in catering to the rural market are the high cost of deploying and maintaining the network. Couple this with the low ARPU and uneven population density and it is no wonder that the telcos have traditionally shied away from this segment.

However, they will need help from in-

novative technology solutions to remain profitable even as they meet the unique requirements of the rural market. Fortunately, there are a number of options available now, including virtualization and low maintenance base stations among others, which allow them to offer viable connectivity solutions to the rural market.

IoT Takes Off

Led by Government initiatives like Smart City Mission and Digital India, IoT will come on its own in 2018. A few Indian telcos have already started to take baby steps to capture a part of this growing market and will witness increased traction in this segment.

A key advantage of IoT is collection and analysis of the data generated by connected things and this requires fundamental changes in their networks. An agile and scalable network is almost a prerequisite to enable millions of sensors to talk among themselves. Software-defined radio, which can be easily upgraded to 3G or 4G will not only allow the service providers to bring down the deployment time but also enable faster rollout of services.

The Challenge Of Addressing Enterprise Segment

With the ARPUs hitting rock bottom in the retail market, it is only natural that the telcos will be focusing on the enterprise market, but this is not without challenges.

In an increasingly digitally connected world, more and more enterprises are using a number of collaborative tools and mobile apps. A robust indoor communications infrastructure is a must, which unfortunately has been the Achilles heel of service providers across the globe. Nearly 60% of enterprises have significantly poor indoor coverage, according to report by Small Cell Forum.

Seamless connectivity in an indoor environment is possible with HetNet solution based on Network Functions Virtualization (NFV) and Software Defined Networking (SDN). It not only provides reliable indoor connectivity but also brings down the complexity of deployment and maintenance. Indian telcos should go for such

technologies to tackle the problem of indoor connectivity, which in turn will allow them to add to their revenue by meeting the demands of the enterprise market.

Virtualization Angle

An ultra-competitive environment in the country's telecommunications market means that the telcos have to launch newer products faster. This is possible with Virtualization. The approach is critical for telcos to transition from communications services provider to digital services provider, so they can leverage newer market opportunities emerging as digitalization takes hold. The Indian telcos have already warmed up to the concept of virtualization and the year 2018 will see a greater adoption of virtualization in their networks.

LTE For Public Safety

India has witnessed one of the fastest expansion of the 4G networks. It is safe to say that the country has leapfrogged the 3G technology and 2018 might see the country's administration start to use the technology for public safety.

LTE allows first responders to leverage data network to share real-time videos and location leading to overall better quality of public safety services and enhanced operational efficiency.

As the year 2018 begins, it is time to put the chaos of consolidation in 2017 behind us and leverage the opportunities in the rural, IoT and enterprise segment by making use of technologies such as NFV and SDN.

Rajesh Mishra is the Founder, President, and CTO of Parallel Wireless. Rajesh co-founded the company after 21+ years of reimagining the wireless, wireline, and cable industry and he leads the technology behind the Parallel Wireless' solutions.

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