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**WORLD REPORT**

September 2017

## Future of Connectivity - 5G!


**5G—the Future of Connectivity**

**Reshaping Telecoms: Rise of OTT, IoT and Big Data**

**5G will offer three times spectrum efficiency relative to 4G**

**How to Design Wi-Fi Networks**

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# From the Editor

**Zia Askari**
*Editor, TelecomDrive.com*

# Disruptions, Innovations and Future of Telecoms

## *What does the future hold for Telecoms of Tomorrow?*

Over the recent past, global telecommunications industry has witnessed drastic changes due to technological breakthroughs. As the end of this decade approaches, it is expected that the year 2020 will carry new challenges as well as vast opportunities for the telecommunications industry.

According to a recent GSMA report, the number of unique mobile subscribers around the world will surpass 5 billion later this year, and the subscriber growth over this period will be driven primarily by large telecoms adoption in Asian markets such as India, which alone is forecast to add 310 million new unique subscribers by 2020.

All this means that these are quite exciting times for telecom space as these forecasts promise a higher number of mobile network connections and increased smartphone adoption in the future, however there is more to these numbers than that.

These forecasts also hint at the kind of strain that these future networks will bear and hence, telecom operators require to plan and expand their operations and bring infrastructural changes to solve challenges that come with technology advancements and mass adoption.

The exponential surge in data usage and the consequential decrease in voice and SMS – should be taken as an opportunity to bring out innovative services to the market. Services that previously utilized cellular network are being replaced by mobile applications running on data. This trend is expected to persist in the future. According to forecasts, the year 2020 will witness an explosive growth in data traffic and bandwidth requirement around the globe and operators must be ready for this surge.

In such a scenario, it is only innovation that can help on the long run – for instance Europe's Deutsche Telekom has initiated a unique initiative christened 'immmr'. Based in Berlin, it is a communications app which lets users connect on any device, anywhere, with anyone. The company was founded in 2015 by a small team out of T-labs. Initiatives such as this will go a long way in enabling innovation led disruptions.

### Embracing Digital Transformation, Future-Proofing Investments

When it comes to telecoms and even the enterprise space - today there is only one way to future-proof your investments – and it is to embrace digital transformation of networks. This is where SDN and NFV are gaining rapid market traction today and this will further continue in the near future.

Additionally, this requires operators to invest in software-driven new age technology capabilities that can inject flexibility and agility into their networks – while at the same time help operators address the issue of handling increased capacity and coverage in an network-efficient manner. For example - GENBAND's Kandy a cloud based, real-time communications platform is enabling global Service Providers, ISVs, and Enterprises to rapidly create and deploy high value communications services that are truly next-generation ready.

Another challenge that the telecommunication companies will have to face in the future is the saturation of mobile penetration levels in developed markets. This requires a shift of efforts from the developed markets and calls for a change in approach to target developing markets where the population has lower purchasing power, the political conditions are relatively unstable and there is a great margin for expansion of mobile network connections.

In order to benefit from this situation, Telcos need to make use of innovative strategies like "digitization of industries" and efforts aimed at promoting financial inclusion must be deployed. For example – Airtel Payment Bank is an innovative initiative towards considerably increasing the financial inclusion envelope to the next level.

Another great example of this is the amazing digital push happening in India – from web-scale players such as Amazon, Flipkart to payment applications such as Paytm – threads of digital enablement are binding the consumer ecosystems together and creating great opportunities, delivering amazing experiences for the user communities.

Whether it is one of the biggest operator: like India's Bharti Airtel or Surinam based Telesur – Kenya's Safaricom or Canada's Telus – new age customers are looking for next generation content without any compromise on quality. And hence, operators must innovate on delivering unique data experience and gain long term customer loyalty – this is the only way to succeed, the only way to win!

## CONTENT

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# Massive MIMO, Carrier Aggregation, Small Cells – Paving Way for 5G

As telecoms inch towards 5G – operators are now more focused towards considerably enhancing the customer experience and evolve their network infrastructure. This is where technologies such as Massive MIMO, Carrier Aggregation and Small Cell deployment are coming forward as key market differentiators in the market.

Even though, commercial deployments of fully standardized, standalone mobile 5G technology are not expected to happen before 2019-20. We are expecting that mass deployments of 5G systems will only happen by year 2024.

And in the meantime, operators are going to invest heavily on technologies that will help them gain more out of their network investments – and hence technologies such as Massive MIMO, carrier aggregation and small cell become extremely important in today's scenario.


The costs of deploying 5G will be extensive and operators will only invest in 5G technologies if and when these can offer clear benefits compared to 4G standards Most operators will first want to make sure that the three use cases mainly associated with 5G, namely - massive IoT, ultra-reliable communications and enhanced mobile broadband (eMBB) are economically viable for them.]

## Massive Opportunities on Massive MIMO

New active antenna technologies play a major role in the evolution of mobile broadband networks and mobile operators, especially in mature LTE markets where data usage is high, need more network capacity.

Massive MIMO provides an effective way to inject new capacity into those networks. Massive MIMO increases network capacity without the high costs of buying more spectrum or adding new base station sites. Also, massive MIMO has a long lifespan because it can be used with 5G so it has a long term network evolution value attached to itself.

5G wireless communication system raises new requirements on spectral efficiency and energy efficiency. A massive multiple-input multiple-output (MIMO) system, equipped with tens or even hundreds of antennas, is capable of providing significant improvements to spectral efficiency, energy efficiency, and robustness of the system.

For the design, performance evaluation, and optimization of massive MIMO wireless communication systems, realistic channel models are indispensable.

Mobile operators should look at massive MIMO as one of a series of enabling technologies that will help them achieve gigabit LTE along with eventually deploying 5G.

Furthermore, mobile operators should not view massive MIMO as just a solution for TDD spectrum; it can be used in FDD bands as well. Given the never-ending growth of data traffic, massive MIMO provides a very efficient way for operators to increase network capacity to meet that data traffic growth.

## Scalable Small Cell Indoor Solutions

As licensed spectrum is a scarce resource. Mobile RAN technology has reached its limits in terms of spectral efficiency. Tighter spatial reuse enabled through cell densification through small cells has been positioned for many years as the main solution for addressing exponentially increasing mobile data usage. Yet to date, small cells have not been deployed en masse as predicted. This has left Wi-Fi, with its increasingly attractive 5 GHz unlicensed spectrum and native multioperator support, as the primary offload technology for 3G and 4G macro networks. this will change in a 5G era and hence operators will distance themselves from WiFi and move to embrace Small cells in a better way.

As we approach 5G standards and the 4G LTE to 5G evolutionary period, there are trends toward simplified and virtualized networks through network function virtualization (NFV) and software-defined networking (SDN).

The second is the network function centralization that decomposition facilitates, moving some functions out of the small cell base station to enable a range of new capabilities in the RAN and allow each operator to more cost-effectively participate in small cell deployments.

As demands on networks increase, exciting new approaches to small cell deployments have the potential to make small cells more affordable and attractive to both MNOs and vertical enterprises.

With NFV and SDN, simplified and virtualized networks provide the solution building blocks for enhanced capabilities through function centralization.

Moving functions out of the small cell base station leads to a range of new capabilities and business models based on a reimaged, multioperator RAN that can now be consumed as a service. Moving forward, Small Cells will bring more benefits with the help of 5G deployments and deliver unique connectivity propositions for operators.

## Carrier Aggregation – Harnessing the Power of Networks

As operators evolve their networks – one of the most important aspects of this evolution is the search for developing a synergy for using legacy networks in an efficient manner. This is where Carrier Aggregation will continue to play a critical role.

LTE network operators are trying to reduce and consolidate the different mobile networks they have to maintain. This results in a fragmented set of carriers possibly spread across different bands. With the introduction of LTE-Advanced, operators have an opportunity to use features such as Carrier Aggregation (CA) to maximize their RF capacity and efficiency. This holds great importance for regions such as India where there is huge scarcity of spectrum resources.

Multi-Radio Access Technology (multi–RATs) carrier aggregation is a technique that allows channels from different RATs to be aggregated and allocated to the end user. This technique allows for an efficient utilization of the fragmented and crowded spectrum, as well as for coordination and load balancing between the different RATs. And hence, while deploying CA – operators can utilize multiple set of spectrum bands and address issues on coverage and capacity.

As a technology that is helping operators converge on their spectrum resources – more and more operators are set to deploy Carrier Aggregation and gain more confidence while evolving towards 5G era.

## Small Cells – Scaling Networks to 5G

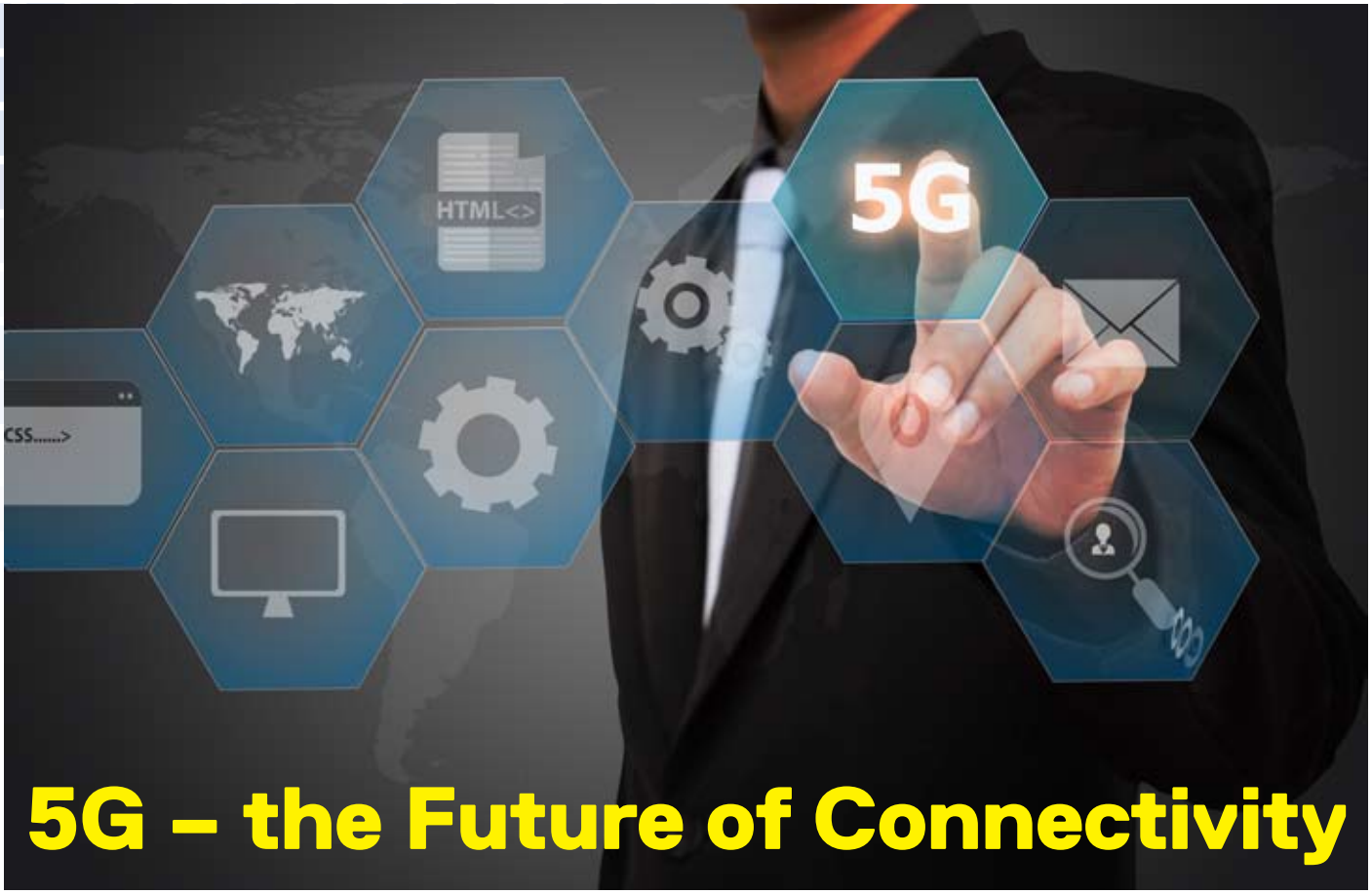
Carriers will have to deploy an army of small cells—possibly on the order of millions—within the next 10 years.

Because of spectrum limitations, 5G will deploy on a very high frequency, including mmW. This means that traditional cell towers cannot deploy that spectrum, even with advanced beam-forming techniques. And yes, it is true that small cells are the only way to deploy the mmW spectrum. So in a 5G era – small cells are going to gain even more importance and play a critical role in a telecom network.

This means carriers will have to deploy an army of small cells—possibly on the order of millions—within the next 10 years. Since small cells have design, maintenance, and repair needs just like macrocells, there will be a huge uptick in field work, engineering, construction, and related job duties.

With spiraling traffic volumes experienced by mobile networks around the world, small cell radio access network (RAN) has been proposed as the way to accommodate billions of users with a myriad of devices and demanding applications.

With the coming of fifth generation (5G) networks, several small cell architectures and technologies have been proposed to reengineer the small cell environment that has yet to proliferate in 3G and 4G networks.




# 5G – the Future of Connectivity

***Enabling seamless connectivity between multiple set of device ecosystems – 5G promises to considerably elevate the communications experience and delivery to the next level***

Generational shifts in the world of technology capture the imagination, and promising the opportunity to push the envelope of connectivity to the next level and do things in entirely new ways. The story of 5G is no different, it will be a transformational enabling force that will drive new services, connect new industries, and empower new user experiences for the next decade—and beyond.

As a matured technology - 5G promises to deliver much more than just higher data rates and more capacities for consumers. It targets new kinds of ultra-reliable, mission critical services. Examples include applications that will allow doctors to remotely control medical procedures or give consumers new levels of control over their homes or cars, and beyond. 5G aims to effectively connect virtually everything—from simple sensors to complex robots, all while further enhancing traditional mobile broadband service experience for consumers.

That means next generation of applications, services and use cases will have extreme variation in requirements. To meet this challenge, 5G will require a whole new user-centric design that can scale and adapt to billions of connected things, provide new ways of connecting everything, and enhance cost and energy efficiency.

This user-centric design approach represents a new way of thinking about networks and devices. From a connectivity perspective, users will no longer be mere end-points; they will be integral parts of the network. But it's not only connectivity 5G is after, also computing and content need to be distributed closer to the actual user, be it, human, vehicle, machine or "thing" as it is sometimes referred to as.

5G is being developed to be a unified platform for all types of spectrum and bands, from low bands below 1 GHz to emerging higher bands like mmWave, supporting a wide range of new kinds of services, while offering opportunity for new deployment, subscription, charging and business models. A key enabler is a unified air interface design that is scalable and adaptable across all these spectrum and service types.

While 5G continues to be defined, with commercialization anticipated around 2020, as a technology 4G continues to evolve in parallel. And enhancements to 4G will bring new capabilities far beyond what is possible today, and steer LTE Advanced in the same transformational path envisioned for 5G. Multimode devices and simultaneous 5G, 4G, and Wi-Fi connectivity will allow for a seamless and phased 5G introduction. Furthermore, 5G's single core network is envisioned to support 4G and Wi-Fi access, ensur-

ing that operators' current and future investments are protected.

**Connecting, Enabling, Empowering**

If we go back in history, 3G introduced the concept of mobile broadband, and the popularity of smartphones combined with the advent of 4G resulted in the explosion of ever-increasing mobile data traffic that we call the 1000x mobile data challenge. Thanks to the rapid development of mobile computing and the robust LTE Advanced roadmap, the industry is on track to meet the challenge. The 1000x challenge is being addressed by 3G, 4G, and Wi-Fi, and through the growing deployment of small cells along with more spectrum.

**New Fabric of Network**

Given that positive prognosis for the future, the question arises, why do we need 5G in the first place, and what can it do for us that 4G cannot? The answer lies in the coherent vision for 5G which is to not only provide better broadband with higher capacity and higher data rates at much lower cost, but also to address entirely new challenges that span far beyond, to enable new services, empower new types of user experiences, and connect new industries.

Looking beyond today's trends, 5G aims to connect virtually everything, to go beyond needs of what humans can currently perceive, to meet requirements for new classes of services, with new levels of reliability and latency, and to bring new capabilities for control, discovery, and awareness to life.

A vision of this magnitude requires not just a new way of thinking but a different kind of a network. 4G LTE initially provided better mobile broadband, but LTE Advanced in many ways is already heading in the same transformational direction as 5G.

**Such a network could be defined by three characteristics:**

*SCALABILITY AND ADAPTABILITY*

5G will have the ability to scale and adapt across an extreme variation of use cases such as uniform, fiber-like broadband everywhere (not just higher peak data rates) services; ultra-reliable, mission-critical services such as controlling the power grid or remote medical procedures (where failure is not an option); and connecting everything from simple sensors to complex robots, which also means supporting billions of ultra-low energy devices needing expansive coverage, at very-low data rates and at ultra-low cost.

*USER CENTRIC DESIGN*

The design approach for 5G is rooted in keeping the user at its center. Whether the user is a human, a device, or a "thing," it will bring content, connectivity, and computing close to the user. For connectivity, users are more than mere end points, they are integral parts of the network (offering "edgeless" connectivity). This distributed approach combined with virtualized network functions will not only reduce latency, but also significantly improve cost and energy efficiency, which are key objectives for any new-generation technology.

*UNIFIED PLATFORM*

5G will unify access across all types of spectrum and bands, unify all that has been added to 4G, (such as LTE broadcast), and improve upon new, broader dimensions (beyond that of previous generations) to enable a wide range of new kinds of services. And the unified platform needs to be scalable for new deployment, business and pricing models as well as be suited for realizing new breeds of applications, services and use cases.

A key enabler in this is the unified air interface that is scalable and adaptable across all spectrum types and across an extreme variation of services.

5G is not just a new generation of technology, but a fundamentally new kind of a network needed to address the expanded connectivity needs of the next decade and beyond.

The stated aim of 5G is to enable new kinds of services, connecting new industries, and empowering new user experiences. The needs of existing and new use cases are vastly different on many dimensions. Extreme improvements in one dimension generally requires a tradeoff in another dimension. In other words, one can't get ultra-high reliability and ultra-low cost at the same time, so 5G has to scale up to right level of performance for one service, but scale down in cost for another service.

For example, new mission-critical services need highly-reliable links because failure is not an option and down time is absolutely not permissible. Ultra-low latency is a must because of the immediate nature of action needed. Finally, high security and flawless mobility are absolute requirements for many of these kinds of services.

On the other hand, when you consider the massive number of connected "things" anticipated in the future (e.g., integrated sensors in many personal, industrial, and enterprise applications), many of those things need to offer ultra-low energy consumption, years of battery life, deep coverage to reach very unconventional places, and relatively slow data rates, all at an extremely low cost.

At the same time, the next generation of mobile broadband services will have the ability to scale up and aggregate much wider spectrum in order to provide much higher performance and peak data rates, consistently high data rates uniformly across the coverage area, along with the ability to incorporate other dimensions of improvement.

The addition of contextual awareness will enable differentiated services and enhance user experiences, but also allow the networks to be optimized for cost and energy efficiency. Case in point, if the network knows

how the connectivity is to be used, e.g., for stationary use cases only, then the network does not need to provision for certain network functions needed for mobility. Having that capability will considerably reduce costs and save energy for the operator's operations.

The key is that 5G will allow extreme use cases like these to coexist in the same unified 5G design, without compromising the performance of each other.

People have an uncanny ability to apply technology in unexpected ways; we are certainly not be able to imagine all the opportunities the ultra reliable, ultra-low latency and secure 5G link will enable in 2020. So apart from addressing extreme varieties of known use cases, it should also have the ability to scale and adapt to use cases that have yet to be imagined.

*A user-centric design*

To scale for billions of connected things, reduce latency, and improve cost and energy efficiency, 5G needs a holistic approach that keeps the user at the center. This means, bringing not only connectivity, but computing and content close to the user.

Depending on the use case, the user could be a human with a device or wearable, a connected thing such as a sensor, or a connected vehicle such as a car. Bringing the connectivity, computing and content closer to the user is of paramount importance to provide instant and immersive visual and audio experiences based on real-time input from on-device cameras and sensors, on-device content (or content cached at the network edge), as well as a way to utilize new ways of discovering and connecting directly to relevant things around the user.

With the user-centric approach, network intelligence and control are also distributed closer to the users—sometimes referred to as the "edge" of the network.

In a world with billions of connected things, 5G will make it possible for the user to connect to relevant things that are nearby and, in many cases that connection will be made directly, without having to go back and forth through a central network.

In 5G where connectivity is user-centric, the user is no longer the endpoint of the network, but rather an integral part of it. New ways of connecting will be possible. Devices will connect with one another directly, for both discovery and communication.

Devices will "multi-hop," relaying connectivity to things around the user (and the device).

- Device-to-device connectivity seeks out (discovers) relevant information within proximity of the user, and has the ability to communicate directly with other devices. Already introduced in 4G, the proximal discovery concept will be leveraged and expanded further in 5G.
- Multi-hop is a mode of connectivity where devices act as hubs and relays for other devices, even forming a mesh network.

It will be controlled by operators utilizing their licensed spectrum, as well as by users using unlicensed spectrum. A sample use case is in machine-to-machine (m2m) communication where a simple device lacks the power needed to reach macro towers or small cells.

In such a scenario, other devices that are connected to the macros/small cell form a "multi-hop" or mesh network to extend the coverage and connect the unconnected device.

- Base stations with integrated access and backhaul will be important for further small cell densification, helping solve the challenges of installing fixed backhaul. Integrated access and backhaul is particularly useful for deployments that use higher spectrum bands such as mmWave.

Leveraging the user-centric connectivity approach, 5G can bring truly "edgeless" connectivity where the coverage of macro towers and small cells won't be a limiting factor, and devices will no longer be mere endpoints.

**A unified platform for expanded connectivity needs**

Network virtualization goes hand-in-hand with the distributed architecture approach, where network functions are virtualized and, in many cases, distributed close to the user—in effect, closer to the "the network edge". This user-centric approach reduces cost, latency, backhaul needs, and energy consumption, and is essential to meeting the varying requirements of next-generation applications, services, and use cases.

The 5G network needs to leverage network virtualization and software-defined networking, anticipated to be introduced in many 4G networks ahead of 5G. The processing ability could be dynamically balanced between centralized and distributed based on the context—placing the control closer to the user for low-latency applications, and relying on centralized processing for other applications.

A key example of the value of this flexibility is when a mobile-capable device is engaged in a stationary use case. Leveraging the improved network awareness, the network understands the context and avoids the unnecessary setting up of network resources for full mobility.

At the same time, the network is ready to rapidly bring mobility functions whenever the need arises, setting up control and user plane resources closer to the user to reduce latency.

That virtualization enables more efficient scaling of the core network so that nodes can scale based on data and signaling loads, and cater to various deployment models; from hotspots and residential-type of deployments, to Local Area and Wide Area Networks.

In addition, edgeless connectivity will deliver a more uniform broadband experience everywhere—regardless of proximity to a base station. That new level of uniform broadband expe-

riences will likely be more meaningful to users than theoretical claims about higher peak data rates.

Other features that will help provide a more uniform broadband experience include spatial multiplexing techniques and beam forming, coordinated across nodes on a massive scale, along with receiver advancements. Advancements in these areas will also help increase network capacity—especially when combined with the ability to leverage more and wider spectrum, and with further optimizations for hyper-dense unplanned small cells. All this will enable 5G to build on the progress made by 4G in meeting the 1000x data challenge.

The basic design principle of 5G envisions a platform that will unify access across all types of spectrum and bands; unify all of the types of connectivity that have been added to 4G (LTE broadcast, etc.).

The unified platform will enable a range of new kinds of services and use case—apart from improvements in classic dimensions such as capacity and data rates—it will also target improvements on dimensions like security, reliability, awareness, and scalability. But, 5G will transform more than just technology. It will also transform businesses and industries, enabling new deployment models, infrastructure, and service sharing models, as well as new subscription models.

Imagine a third party service provider implementing its own virtualized network functions hosted by a shared 5G network that enables next-generation services to be quickly introduced. Or one, dynamic subscription for all of a user's connectivity and lifestyle needs such as his or her home, car, wearable device, etc.

5G could also enable new types of subscriptions for the massive number of connected things that consume small amounts of data. And it could make new services possible that don't need traditional provisioning or subscriptions, but are instead paid through by either the application service provider, or by the value created by free services.

For operators, 5G will enable new business opportunities to host services and compete in the enterprise and residential environment while reducing costs (similar to the Wi-Fi deployment model for example), while continuing to provide full control.

Unified Air Interface

Additionally, 5G can decouple different assets such as spectrum, network, processing, and secure billing, etc., so that operators can leverage these assets individually or mix and match some or all of those assets, to enable new business models. For example, the coverage and advanced processing capabilities of 5G could be used to host a new, vertical machine-to-machine service to compete with other low-cost deployments.

The unified air interface concept is a key enabler to the unified 5G platform. It will be scalable and adaptable for all spectrum types, be it licensed or unlicensed, for both higher and lower spectrum bands, and for all types of services and use cases.

The unified air interface will need to support bands below and above 6 GHz, including the much talked about mmWave bands. The bands below 1 GHz offer longer range, which is essential to reaching the massive number of connected "things" in a cost-effective way. The bands below 6 GHz are needed for wide-area mobile broadband and mission-critical uses. The bands above 6 GHz are suitable for shorter range mobile broadband and target capacity deployments such as those for public venues and city centers.

As mentioned earlier, the scalable and flexible 5G core network will follow the user-centric philosophy to reduce cost, latency, backhaul needs, and energy consumption. One key contributor to these benefits is network virtualization, which goes hand-in-hand with the distributed architecture approach.

Taking advantage of these techniques for 4G and Wi-Fi access creates the opportunity to achieve cost reductions. That is the vision—to have a single, common 5G core network that will also support 4G and Wi-Fi radio access. This also allows for the continued evolution of 4G and Wi-Fi in parallel with 5G, without burdening operators with the need to operate and maintain a legacy core network.

With a common core network and 3G/4G/5G/Wi-Fi multimode devices, comes the vision of simultaneous connectivity of 5G with 4G and Wi-Fi. This simultaneous connectivity builds on the "dual-connectivity" paradigm introduced in 4G, which allows the devices to connect and aggregate links from two networks at the same time (not just switching from one to the other or aggregating spectrum, but from the same base station as is done with regular carrier aggregation).

Simultaneous connectivity and a single core network also makes possible the seamless and phased introduction of 5G, allowing operators to continue to fully leverage their investments in 4G technology as well as Wi-Fi.

## Leveraging Legacy

When it comes to deployment, as with previous generations, the availability of spectrum will govern how 5G networks are deployed. Phased build-outs could start using dedicated 5G spectrum below 6 GHz, or re-farmed 2G spectrum as it becomes available, and gradually add higher bands above 6 GHz (like mmWave) with hotspots for more targeted capacity deployments. However, it is important to note that access to lower bands is crucial when offering new kinds of 5G services on a wider scale, across the network.

To summarize, the vision of 5G is to not just provide incremental improvements and a few new capabilities—it is envisioned to be a modular platform that will scale from hotspots and residential-types of deployments to Local Area and traditional Wide Area Networks. It will also employ a fundamen-

tally different approach, with a unifying platform to address the expanded connectivity needs of the next decade and beyond.

4G LTE and LTE Advanced have had tremendous success and will continue to grow for the foreseeable future. While the definition of 5G continues (commercialization is anticipated around 2020), 4G will continue to evolve in parallel—bringing new capabilities that expand far beyond what is possible today. LTE Advanced is headed in the same transformational direction that 5G is headed, enabling new services, connecting new industries, and empowering new user experiences.

The evolution of LTE Advanced brings new types of connectivity and services, taking it beyond the traditional objective of simply providing enhanced mobile broadband. A few of the new flavors, such as LTE Direct, have already been standardized in Rel. 12, and a few more such as LTE-MTC (Machine Type Communications) are slated for Rel. 13 and beyond.

LTE-MTC breaks the traditional path of progressively increasing data rates, data capacity, latency, etc. Instead, it optimizes LTE to scale down in complexity to provide years of battery-life, low-data rates, and reduced device costs, which will enable even more 6 Driving 4G to its full potential, in parallel to 5G things (machines, sensors etc.) to connect. The Internet of Everything will not wait for 5G to happen, so LTE Advanced, along with other connectivity solutions like Wi-F and Bluetooth, will be further optimized to connect a massive number of things ahead of the advent of 5G.

LTE Direct brings an innovative, direct device-to-device discovery platform to market that can revolutionize proximity based apps and services. By addressing the biggest hurdles of proximity awareness—privacy and scalability—LTE Direct opens a new world of opportunities for many verticals such as social networking, mobile advertising, and more. Leveraging the power of user-centric connectivity and direct communication between devices, LTE Direct will continue to evolve in parallel with the launch of 5G. The evolution of LTE Broadcast goes beyond mobile TV. For instance, it's being considered as the candidate for terrestrial broadcast in Europe to address all kinds of TV receivers beyond just mobile devices such as TVs, set-top boxes, etc.

The LTE Advanced evolution also has the opportunity to further reduce latency, which will be useful for mission-critical services. Since many of these services, such as aviation and medical procedures, have new or different regulations (other than telecomm regulations), the enhancements have to comply with them as well and help similar 5G services.

Spectrum sharing is another critically area of focus for both the evolution of 4G and the development of 5G. A case in point is underutilized government spectrum that cannot be released in a timely fashion or at all locations.

So, while the conceptualization, definition and technology development of 5G is getting off the ground, LTE Advanced will continue to evolve in the same transformational way envisioned for 5G. Many of the ideas and features from LTE Advanced will be natively supported in 5G, and some new 5G ideas will also flow back to 4G.

This, coupled with the seamless integration of 4G and Wi-Fi access networks with the 5G core network, ensures that operators can fully leverage their current and future investments in both technologies for a long time, even after introduction of 5G.

At the dawn of the new generation of wireless, the vision for 5G is still aspirational, yet deeply rooted in the collective wisdom gained though many years of technology development and commercialization. The extreme variations of anticipated needs for the next-generation is guiding its development. The vision is to create a new generation of technology that is scalable and adaptable enough to support new kinds (and levels) of services and use cases ranging from connecting simple sensors to mission-critical applications like remote control medical procedures to complex robots. The goal is not only to make mobile broadband faster and better, but to provide uniform, "fiber-like" broadband everywhere.

## The Road Ahead

The same he user-centric approach is at the heart of 5G, where connectivity, computing, and content all come together, close to the user, be it a human, a vehicle, a machine, or a thing. From a connectivity perspective, these users will no longer be mere end-points, they will be integral parts of the network, creating "edgeless" connectivity.

5G is envisioned to be a unified platform to address the expanded connectivity needs of the next decade and beyond, not only providing the most appropriate connectivity, but also offering opportunities for new deployment models, sharing models, charging/subscription models.

A key enabler is the unified air interface that is scalable and adaptable across all spectrum types, both below and above 6 GHz, licensed and unlicensed spectrum, and across an extreme variation of services.

Through its common single core network, 5G will support 4G and Wi-Fi access, as well as simultaneous 5G, 4G, and Wi-Fi connectivity with multimode devices enabling seamless introduction of 5G services, and protecting operators' investments. The vision for 5G is to usher in a new era in which connectivity, computing, and content become inseparable parts of every "body" and every "thing," making invisible magic happen. It aims to be a transformational force in enabling new services, connecting new industries, and empowering new user experiences of the next decade and beyond, where LTE Advanced is blazing a similar path—a transformative path forward.

# How Nokia is driving inter-section of networks with Cloud, SDN and NFV

RANDEEP RAINA,
Head of Technology

***As global networks are stretched to their limits by addition of huge number of devices and data – operators need to incorporate efficient and agile wireless access strategies in order to do more with less. This is where Nokia's solutions can play an important part in defining the future-ready network possibilities.***

***Randeep Raina, Head of Technology, Nokia India speaks with Zia Askari from TelecomDrive.com about the way Nokia is positioning its innovations in the wireless access space and how evolution towards 5G will open up a new world of opportunities to connect the unconnected.***

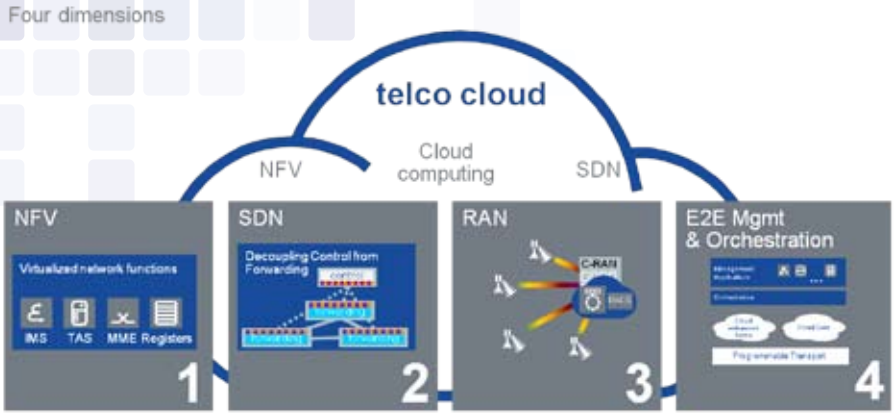
**Wireless access seems to be the best way to connect the unconnected. How is wireless access evolving to meet challenges of the future?**

Wireless access is evolving at a fast pace towards higher data-speed with lower latency and supporting more and more number of devices. The network thus will enable a fully mobile and connected society. Technology is advancing towards usage of licensed, unlicensed and a mix of both spectrums with further enhanced techniques for high spectral efficiency.

**How best should wireless access be enabled inside smart cities and new townships?**

Smart city is a complex ecosystem with many stakeholders. It is important that city administration deploys reli-

able and secure wireless access apart from wireline IP broadband network infrastructure for the use for applications, anytime and everywhere. Wireless access would form an important part of connectivity and help to provide uniform platform for smart city applications.




### What are some of the best practices that can be followed?

The Administration & regulatory bodies may layout clear guidelines for wireless access networks, authentication mechanism etc. Data usage policies & governance structure must be clearly defined and increased awareness around the benefits of the initiatives along with citizen participation should be encouraged.

### What are some of the big innovations that are being spearheaded by your organization today?

Nokia is in the forefront in building the technology and leading compact site solution. With its portfolio, it offers a wide set of options for network deployment based on varieties of use case(s).

It brings innovative products around the licensed, and unlicensed spectrum augmented with its edge computing capabilities for a better user experience. Nokia operates at the intersection of networks, supporting Cloud, Software Defined Networking and Network Function Virtualization technologies.

Nokia is at the crossroads of intelligent analytics, artificial intelligence and machine learning which is critical in the programmable world. To grow the IoT ecosystem, we are leading the convergence of infrastructure and devices. Nokia helps in providing best services by maximizing the performance of network infrastructure and blurring the lines between mobile, fixed and hybrid network technologies.

Our portfolio doesn't limit us to traditional service providers, technology-led enterprises, webscale players, public sector and consumer markets. But, we are also addressing many societal segments, including healthcare, transportation, energy, smart cities and public safety.

### In a future of 5G, IoT era how can wireless access solve the issue of spreading connectivity to rural areas?

Due to low rural population density and their technology need, the cost of deploying fiber or dedicated wireless network is prohibitive. In such circumstance, a shared wireless network with innovative solutions like "LTE To The Home" help in connectivity and providing a decent broadband coverage to the remote and rural areas.

5G performance targets stretch far beyond speed and capacity, including lower costs for connected sensors, low energy, zero latency and more. 5G will enable very diverse use cases, each with requirements that vary between extremes. 5G will be the first mobile generation designed from the beginning for machine type communication.

5G is the new generation of radio systems and network architecture delivering extreme broadband and ultra-robust, low latency connectivity and massive networking for the Internet of Things to enable the programmable world, which will transform our individual lives, economy and society.

What 5G will be good for and what technical requirements that imposes on the network have become quite clear. The industry has widely adopted Nokia's view that 5G will be about people and things as per the following three use case categories:

1. Massive broadband that delivers gigabytes of bandwidth on demand
2. Critical machine-type communication that allows for the immediate, synchronous eye-hand feedback that enables remote control over robots
3. Massive machine-type communication that connects billions of sensors and machines

A key design principle for 5G networks is flexibility, to cater to unknown use-cases of the future. And related to flexibility is another key design principle of 'reliability'. With the flexible integration of different technology components, we will see a step away from best effort mobile broadband towards truly reliable communication and bridge the digital divide.

### In your opinion what are the top three challenges that lie ahead in this space today? How can these be solved?

Better use of unlicensed spectrum, proper policy for its usage, wireless access security in unlicensed space can be areas that need to be addressed to remove hurdles in this space.

# Reshaping Telecoms: Rise of OTT, IoT and Big Data

***Today's telecom landscape is reshaping fast - with the help of new age OTT players, deployment of IoT driven solutions and implementation of big data applications and solutions.***

**Ram Prasad Mamidi, CIO, Tata Teleservices Limited *interacts with* Zia Askari *from TelecomDrive.com about the company's IT vision and the changing role of a CIO today.***

**RAM PRASAD MAMIDI, CIO**

**How do you look at the changing role of the new age CIO today?**

CIO roles are evolving to proactively adopt newer technologies for growth. According to IDC, a CIO's job has become difficult in the digital era with pressure to lower costs, maintain consistent infrastructure and innovate. Many CIO's are integrating innovations rather than driving them.

Over 40% of LOB (Line of Business) executives view CIO's as innovation officers responsible for leading delivery services. Today, in most progressive organizations including TTSL (Tata Teleservices), IT drives business results with CIO's partaking in strategy initiatives alongside C-suite executives.

They're responsible for customer experience, analytics leveraging, and driving innovations. Especially in high-tech, service-dominated industries such as telecom, CIO roles enable market differentiation and competitiveness. This means they work closely with the business, understand its priorities, and ensure IT readiness, rather than being reactive and trying to hold it all together.

Despite technology advancements CIO's successes will be defined by their vision and risks they are willing to take for their company. Some prerequisites include collaboration across business functions, being "security-aware", strong communication, and of course, tech-savviness. The new-age CIO has hence moved beyond traditional roles of technologist, project executor and cost manager. We may also soon see more business managers becoming CIO's and CIO's becoming CEO's.

**What are some of the big IT trends that are reshaping the telecommunications sector?**

Continuous technical transformation and information waves have driven high growth in the telecom industry and we are seeing the following trends that are reshaping the industry

- Rise of over-the-top players: Over-the-top (OTT) players, which offer apps and streaming content directly to consumers through the Internet, have increased their dominance, even in core communication services such as messaging and voice. WhatsApp, Viber, Skype etc. represent more than a huge percent of all messaging and international voice traffic
- Internet of Things: One the major trends that has been impacted the telecom industry is the explosion of connected devices. This is adding billions of new connected data sources and the upswing of all of these devices is seeing an astronomical growth in data volumes; we will quickly push through exabyte volumes and enter the world of zettabytes per year
- 5G: While the technology has not yet been fully defined, the promise of 5G more speed, greater efficiency, and less latency will be essential to supporting connected things in the future
- Big Data: On its own, big data has gained a firmer foothold with telecom operators as hyper-competition

drives them to strengthen their data management and analytics capabilities to drill deep and wide, gaining better insights to enhance customer experience at every stage of interaction.

- Security: In the wake of several high-profile data breaches, it's become more important for telcos to consolidate and strengthen their security systems. As custodians of the networks, operators play a pivotal role in fighting the new threats that are emerging. Customers will begin to expect, then demand, more proactive protection from the entire internet value chain, and they will be expected to support these expectations with a range of technical and operational innovations.

**What is the role of Big data applications in delivering personalised telecommunications services for consumers as well as businesses?**

Big data applications can help in acquiring a deeper understanding of users and in improving their experience at every touchpoint. Telecom operators can use the application of big data on customer and network data to generate a real-time view of customer preferences and network efficiency enabling targeted and customized delivery. Some of the ways big data can help:

- Optimizing routing and quality of service by analyzing network traffic in real time
- Analyzing call data records in real time to identify fraudulent behavior immediately
- Allowing call center reps to flexibly and profitably modify subscriber calling plans immediately
- Tailoring marketing campaigns to individual customers using location-based and social networking technologies
- Using insights into customer behavior and usage to develop new products and services Big data can even open new sources of revenue, such as selling insights about customers to third parties

Tata Teleservices has been using big data for a while now, emphasis while using it has been on the end to end customer experience management strongly. It has been helping us to define systems to measure stage-wise experience parameters for a given customer and correlate them for personalized delivery, not to forget the predictive tools and robust data warehousing which are in place. While these solutions enable us to leverage structured data, we are also looking at available options for effective mining of unstructured data. Using the Hadoop framework, we have leveraged Big Data for more effective Vigilance Tracking and Monitoring.

**Today there is an increasing importance of data centres with the explosion of data services. In such a scenario, what should be the best model that CSPs can take in order to do more with less?**

Data centers have transformed into important stockades of valuable data, containing crucial insights for companies, enabling them to reach business goals with relative ease. Cloud and software-defined datacenters and help CSPs to open a range of opportunities by unlocking evolutionary levels of insight, flexibility and scale. Typically, CSPs should take a top-down approach by focusing on specific business problems that big data might solve, and then gathering the data needed to solve them.

However, there can be two challenges in this strategy: First, the business problem often exceeds the capacity of the available data to solve it, and second, the process of gathering the right data to help solve the problem is not adequately understood by many companies. To circumvent this problem, companies should begin with the inverse approach, viewing the opportunity from the bottom up - examine the data currently available, and only then determine the business problems the data might help solve, with the help of any additional structured or unstructured data that might be needed. The best way to get started with this approach is through pilot programs.

Keeping initial expectations reasonable, a dedicated team gathers all available data, analyzes it to allow new and unexpected opportunities to reveal themselves, and then tests the efficacy of the results in solving one or more real business problems. This tactic offers telecom operators and others a concrete strategy, a more realistic assessment of the benefits of big data, and a better understanding of what is needed to achieve those benefits in the long term

By virtue of the above approach data multiplicity is reduced to a large extent and data consolidation is achieved to meet disparate requirements from various functions while maintaining single source of truth and efficiently using infrastructure at the same time reducing TCO.

**What are some of the big technology challenges that you see today? How do you want to overcome these tech challenges?**

India is gearing to have full teledensity by 2020 and the target seems to be fully achievable with telecom service operators who are expanding their reach every quarter and with renewed focus on rural areas. As India is steadily on-boarding the digital bandwagon and expansion in rural and suburban areas has become critical.

However, these untapped areas not only lack basic infrastructure but also face scarcity of trained personnel, which further creates obstacles in deployment of services in these areas. Tata teleservices has been constantly focusing on expanding and strengthening services in semi urban towns and cities.

# Digital Disruption is Changing Every Industry – Can CSPs Find a Way to Thrive?

Digital disruption impacts everyone from individuals to the world's biggest companies – in fact some of today's behemoths, with their billion dollar valuations, were born from this new-landscape.Although Communications Service Providers (CSPs) predate this revolution, they have a critical role to play in how this space will ultimately be shaped.

One of the key characteristics of this new world is enhanced communications embedded everywhere. WebRTC, with its unique capabilities to enable communications between people, between machines, or between people and machines, offers CSPs a chanceto seize the opportunity and reinvent themselves for growth and continued relevance rather than handing their subscribers over to the new breed of independent challengers .

What follows are some of the ways in which embedded real time communications are already changing our world. For the smart provider, these enormous upheavals are a chance to rethink, retool and reengage.

## Health

"Without your health you have nothing" – your grandmother was right and today the inner workings of our bodies are tantalizingly close. Medical wearables have moved beyond wellness into sophisticated applications that measure our heart rate, breathing, blood pressure, insulin levels and brainwaves. We're able to get readings on all of these functions in real time, perform our own mini diagnostics, and alert medical resources if something iswrong.

Where RTC comes in: RTC is a key part of emergency room solutions that make it possible to intake a patient in distress in minutes, measure their vitals, and contact their physician and specialists. Within seconds, messages can be routed to the right

person while medical records can be pulled up and shared via video conferencing, screen sharing and more, enabling potentially life-saving decisions to be made quickly, based on a comprehensive understanding of the situation. This market, which didn't even exist a decade ago, is now a massive opportunity, and some CSPs are already building secure private networks, that comply with relevant regulations.

### Our Social Lives

Today, meeting in person is just one option among many, as a wealth of online possibilities have taken flight, be it meetups for like-minded hobbyists, dating apps, business meeting facilitators or websites for the marriage-minded. No matter the scenario, these tools all give us new ways to connect with others, and as always, communication is the secret sauce.

Where RTC comes in: Dating sites have moved well beyond the databases, profiles, and photos, to enabling video meetings on their platforms. In the business world, sites like LinkedIn include highlypopular messaging platforms that increase the volume and velocity of idea exchange. Supporting voice and video on these platforms, across mobile and desktop, requires capabilities that CSPs can deliver much more reliably than other providers, enhancing the user experience and ultimately the human connection.

### Reality (or is it?)

Virtual Reality (VR) experiences aren't just for individual fun and games – rather they're becomingusefu tools that help us learn new skills more intuitively and with less risk. Among other things, VR is being used to perform surgical procedures remotely, to train fighter pilots, and teach driver's ed. These situations require precise coordination and instantaneous access to information.

Where RTC comes in:Think about more and more real time gaming with multiple gamers, and you'll appreciate the need for the network to support media and signaling in new ways. It's one thing to stream content, it's another thing to support contextual sessions with multiple parties located anywhere in the world. Again, it takes advanced capabilities to support these communications with the requisite quality and reliability.

### Autonomous Vehicles

Self-driving cars are no longer a "maybe" but a "when," with companies including Mercedes Benz, BMW, Tesla and Google being at various points along the continuum to execution and deployment. One of the key benefits autonomous vehicles are expected to usher in is safety. Some sources estimate that self-driving cars could save 300,000 lives per decade in the US alone.

Where RTC comes in: These cars of the future will need to be equipped with every possible communications service in order to accurately assess their environment, communicate with other vehicleson the road andmake the best, safest "decisions," all in real-time and at the speed of thought. Again, these are high-stake situations that require flawless reliability and QoS, something that CSPs are best poised to deliver.

### Content Creation and Sharing

The digitization of music has had a tremendous impact on the industry, as companies like Spotify have become more valuable than all of the traditional record labels combined.Today, fans and artists have established direct connections on platforms like Pledge Music, where artists sell content and merchandise while raising funds for new projects.

Where RTC comes in: Whether it's enabling fans to communicate with artists and with each other or streaming live performances that significantly enhance their reach, it takes a range of high quality communications services to build, develop and maintain these personal and business relationships, and CSPs are built to deliver these services and help grow this new world.

### Conclusion:

Disrupt or be disrupted.While the first wave of the digital disruption was something of a shock to the system for CSPs who saw massive competition floodtheir networks and make billions of dollars over infrastructure they had themselves built, it may have been salutary as well. Today CSPs are more aware than ever of their innate strengths and the opportunities that lay ahead IF... they transform their networks, create new services, embed RTC for better experiences and engage in the cloud. Visit kandy.io for more.

# Refarming to Multiplexing: Huawei's CloudAIR Can Super-Enhance Efficiency of Future Networks

***Spectrum Cloudification can help operators do considerably more with their existing network infrastructuire and Huawei is ready to support with its solutions in this space***

***Global Telecoms market is fast moving towards a scenario where there will be no room for second class experience providers – only the best will survive. This is where Huawei is betting big on its innovations such as CloudAIR technology to help script truly future ready telecom networks that will prosper and grow in a data-hungry world.***

**Chandan Kumar, Director, Marketing and Integrated Solutions, Huawei *India*, *speaks with Zia Askari from TelecomDrive.com about the way Huawei India is moving ahead with introducing innovations in the Indian market and how it is helping telecoms address challenging scenarios in the spectrum and data space.***

**CHANDAN KUMAR, Director, Marketing and Integrated Solutions**

**What is your prime focus about the present situation wherein operators are using HD content and video and lot of focus has been on the experience side? In this scenario what are the priorities that Huawei has?**

We are focusing on three domains. Firstly, it is connecting the unconnected so along with operators and all other stakeholders, we are working on that domain because when we talk about connecting the unconnected we are focusing on rural areas and secondly, we are utilizing the existing infrastructure and also the quality of service as it is important for India's ranking in the broadband index or if it is about overall user experience as that is how we keep our customers in business through high quality service.

Thirdly, we are addressing the modern users need where there are several aspects which we define as ROADS which stands for Real time, On-demand, All-online, Do it yourself and Social. In order to provide ROADS experience the existing network need to transform their network end to end.

So we are working on that expect where video can be part of the ROADS experience. Also we are working on the network transformation toward cloudification and cloudification is a step towards 5Gbecuse if your network is not cloudified and digitazied, you cannot have 5G network. So overall we are working with all stakeholders on these aspects.

**How is Huawei helping telecom community at the forefront of innovation with regards to driving and managing huge volumes of data wave that is coming?**

Keeping all the aspects discussed above in mind and the need to connect the unconnected especially rural areas that are still not well connected. In India, we have 600,000 villages and if you go by the recent government report, still 8-9% of the villages are not connected. If you dive deep down as to why these areas are not connected, you will find that it does not make a business case for operators, second the geographical condition of those areas are such that connecting it is very difficult and for that you need to have some kind of innovative solutions.

Another challenge is that commercial power is not available and if you deploy a network which works on diesel or unconventional sources, it will become very expensive. So to address this we are offering very innovative solutions.

Secondly one is – how to utilize the existing infrastructure so to give you an example of copper infrastructure but the operators think that this cannot be used to provide high speed broadband. So we are providing innovative solutions where we can still use the existing copper to provide 100Mbps throughput on existing copper infrastructure.

Also, now the technology has standardized where we call it vectoring and zeroed fast and in India, we have already deployed that. So these can be used to provide broadband on existing infrastructure which can be used for next 5 years.

The Bharatnet project by government of of India is fully dependent on fibre infrastructure and laying fibre infrastructure is a very time consuming and expensive work. Upon consultation with the stakeholders, we have come to the conclusion that instead of completely relying on fibre, we can utilize microwave technology wherever the fibre has not reached.

The beauty of microwave is that it can used upon being deployed and once fibre is available in that route, the link can be taken out and applied in an area where it does not exist.

Earlier the challenge was the inability of the microwave to provide the huge bandwidth. We now have the new technology which is called eband spectrum. It is a microwave technology which uses the millimicro waves; 71Ghz, 56 Ghz spectrum. Using that kind of a spectrum, we can provide 1gb/s, 5gb/s, or even 10 gb/s.

**Is millimeter wave available in India?**

So that's one of the challenges that it is not open. But we have had discussions with DOT wherein we have been informed about its availability soon. It can be utilized in areas that require high bandwidth and also the highly densely populated urban areas where fibre link is difficult.

**Operators look for innovative solutions based on the spectrum efficiency. How do you look at those solutions consideration the situation in India given that Huawei is the leading vendor?**

The challenge is the existence of multiple spectrums, bands and technologies. Considering that 2G, 3G and 4G customers exist, they need to have the networks in place and spectrums utilized.

We recently showcased CloudAIR, which is Cloudification of spectrum, in MWC 2017 wherein we feel that instead of spectrum refarming, we can move towards spectrum multiplexing. Hence, we can have a pool of spectrum which can be utilized depending upon its application. This will enhance the efficiency in the spectrum and pave another move towards cloudification.

**What does the term "CloudAIR" mean?**

We call it spectrum multiplexing; proceeding from spectrum refarming to spectrum multiplexing. Operators still need to keep 2G spectrum because customers are still buying in it. Even by the end of 2020, there would still be 25% 2G customers globally. But when they move towards spectrum cloudification, depending upon the requirements of the service, they can allocate the spectrum. Hence, customers who use the small portion of 2G spectrum to utilize it either for calls or by owning 2G handsets can also avail the spectrum for 4G services.

**How do you look at the applications of these technologies in India?**

It is a positive movement towards 5G with regards to the evolution from voice and just data services. This technology will add value wherein the wireless and mobile technology will be used in the verticals. CloudAIR is going to direct the utilization of this mobile technology across industries. Some applications needs well off carrier, channel and bandwidth.

IoT sensors need to transmit some bits or pulses. There will be some applications which need huge bandwidth like virtual reality, driverless car. The latensity requirement of each application is also quite different.

When the progression towards Clou-

dAIR happens, the spectrum will be allocated dynamically based on its requirement. My equipment will be intelligent enough to allocate the spectrum for an application based on the same.

**What is your opinion about the operators trying to build and future proof their networks? How will these technologies and revolution towards 4.5G or even 5G shape the future networks?**

Our present engagements are heading towards the right direction. When they buy new products, conditions about equipment being SDN are specified. So, they are purchasing the hardware which is future proof. Few years back they were moving towards IP creation, during the movement towards 3G.

Now the transformation is for the cloud era where SDN and will play major role. The equipments which they are being purchased consist of those features. Core network will be the first piece that will be cloudified or digitized. Many operators are also moving towards cloud code. Similarly, when 4G is being deployed, equipments with capabilities are used. It very clearly shows that it will be helpful for the migration towards 4.5G and 5G.

**How does Huawei look at the potential of 5G today? There are varied thoughts coming forward from the industry. Many proponents of 5G say that this is going to be the Industrial Internet of Things (IIOT) which is going to primarily drive the intake.**

There are two aspects to look at. First, the application and service of 5G; second is the network transformation which will be in different phases. Some of the features of 5G which are ready for adoption are being adopted in 4G, which is termed as 4.5G.

This is helping the operators in utilizing their mobile network across industries like IoT, transport industry, health and agricultural sector.

Applications were designed after 3G networks were available. Similarly, bandwidth hungry applications came forward when 4G networks were deployed. 5G deployment will happen maybe towards end of 2019 or 2020. The designers are developing the applications now based on the features which 5G will be able to provide. For example, driverless car services which will be successful when we have latency of less than 1 millisecond that a huge bandwidth of 5G will be able to furnish. So applications are being developed first, followed by technology.

**Driverless car, artificial and virtual reality are being actively pursued by operators in telecom eco-system. Data compression technology is going to play a critical role towards delivering right experience at the end of the demonetization. So being the leader of the team in this telecom segment, what are some of the innovations that Huawei is working on with regards to data compression?**

Data in India is growing at a rate of almost 100%. The pattern and nature of data are changing too. Videos are getting generated more. Managing video data is completely different from old traditional data. Cashing and compressing become very important for high data. The quality of video content is another crucial aspect.

We are moving towards HD, 4K, 8K videos which will consume high bandwidth. So, we are now adopting these technologies within the access product system. If the access node has to serve the customers which are in its vicinity, it is not necessary to have a dedicated channel from the access node to the core network. Because it will occupy that channel till the download finishes.

We are trying to provide a solution where the cashing can be done locally so that only the last leg of the complete end to end network is used and is delivering the data and rest of the networks is free for other services. Hence, in our products itself, the compression and local cashing features are been done. Video content is the new area which will help our customers monetize the data networks.

Though, we are not a big player in video content acquisition or in content generation but we are providing them solutions, which can help enable them to become video service providers. We can provide them like content aggregation, solution, and video on demand which will help them to roll out the video services and hence, monetize the data network.

**What is the cloud strategy that you are presenting to the telecom community today?**

We call it all cloud or end to end cloud. Excess network is about cloudification of the spectrum. And then we have, cloud fix excess network where there are clear boundaries between the different kinds of customers. Pieces are separate for home network or entrepreneur customers.

We are trying to integrate cloud fix excess network where only one network will be able to serve different kinds of customers. We also have cloud metro network which is nothing but shortly defined wide area access network SDM wise say PSDM, transport SDM and SDM for IP network so excess aggregation of network for cloud based architecture.

And fourth is the cloud core which will help our customers to use the time to market. Just for example, the OTT players who are quickly responding to their customer needs while the traditional telcos want to roll out new service, they will take time to do it but if they are new to cloud architecture, even then they would be able to roll out the service quickly on completion of the core so we are talking about the access of the core network on cloud architecture which makes their network flexible, agile and make them service their customer demands.

# "5G will offer three times spectrum efficiency relative to 4G"

***LS telcom, is a global provider of premium solutions for spectrum management, radio monitoring, spectrum data analysis and consulting – the organization is on the forefront of research and development when it comes to delivering innovations around spectrum efficiency solutions.***

**CEO and board member of LS Telcom, Manfred Lebherz *interacts with* Zia Askari *from TelecomDrive.com about the evolution of spectrum management and what kind of innovations are being driven by LS telcom.***

**MANFRED LEBHERZ, CEO and Board Member**

**What are the key priorities for LS telcom today?**

LS telcom's key priorities have been and will be to develop and deliver innovative and robust solutions and services addressing the efficient use of radio frequency spectrum and the optimal operation of radio communication services.

We are a provider of spectrum management and radio monitoring systems,

including innovative data mining and analysis capabilities. In parallel, spectrum users in all markets rely on our experts and software for the planning and design of optimized radio networks. We plan networks of all generations and technologies, including IoT.

Our priority is the research and development in these areas, in particular in data mining techniques, new direction finding methods and network planning software for upcoming wireless technologies.

Our ultimate aim is, of course, to best serve our customers and to support them in achieving maximum spectrum efficiency.

**What are the emerging opportunities towards enabling greater level of spectrum efficiencies for telecoms?**

There are two key considerations when determining spectrum efficiency. The first is from the regulatory perspective in which regulators determine how best to make efficient use of the spectrum. This is done by developing appropriate spectrum policy and by automating spectrum management and licensing procedures.

Highly modern IT systems, based on advanced computing techniques, automate and streamline frequency licensing and radio monitoring processes and reduce license attribution cycles. Fully automated and combined enterprise-class spectrum management and monitoring systems are being installed for analysis and comparison of frequency license data with real spectrum usage data. Modern data mining and data analysis capabilities, applied on frequency license data and measured data, will provide maximum efficiency in spectrum attribution and use.

On the policy side, the introduction of new spectrum distribution methods based on economic principles will increase future spectrum efficiency. Spectrum sharing is one particular approach. Regulators have permitted and facilitated sharing for many years by allowing new users to share on a geographical, temporal or spectrum basis with incumbents. However, new techniques such as licensed shared access (LSA) and dynamic spectrum access (DSA) are being trialed and considered for adoption to increase the amount of sharing possible.

The other area for enabling greater levels of spectrum efficiency is from improvements in wireless technology. The evolution of cellular technology in particular has achieved continued improvements in spectrum efficiency. For example, with each new release of 3GPP's standards the spectrum efficiency has incrementally improved. This is due to the introduction of new techniques such as MIMO and advanced modulation and coding. Spectrum efficiency in this case is measured in bits per second per Hz (bps/Hz) and the higher the number of bits that can be squeezed into Hz of spectrum, the better the spectrum efficiency.

*Our priority is the research and development in these areas, in particular in data mining techniques, new direction finding methods and network planning software for upcoming wireless technologies.*

The emerging technology 5G will deliver a leap in spectrum efficiency. The techniques being developed in 5G will offer around three times the spectrum efficiency relative to 4G. LS telcom has conducted studies, which compare wireless technologies to quantify and assess how to deliver the improved spectrum efficiencies from both a technological and regulatory perspective.

**What are some of the big innovations that LS telcom is bringing to the market today?**

LS telcom is the global leader in spectrum efficiency. We provide premium solutions for spectrum management, radio monitoring, spectrum data analysis and consulting.

Key to a more efficient use of the spectrum is to know what is supposed to be on-air and what is really on-air at any given time and location, meaning complete spectrum situational awareness. This is why we are the first company to bring spectrum management and radio monitoring data together and analyze the complete data. We apply data mining in spectrum management and radio monitoring, that's what we call spectrum analytics.

We provide totally integrated spectrum management and radio monitoring systems that provide a unique view on licensed, used and underused spectrum. Monitoring data supports efficient frequency licensing, re-farming and spectrum policymaking. Spectrum management data is the basis for more precise monitoring "Is the licensed spectrum really in use in a particular area?" Finally, this permanent spectrum inventory, the comparison of license data and measured data, is the basis for the next level/leap in spectrum efficiency.

Our mySPECTRA system, the most advanced IT system for spectrum management, is a fully web-based e-government solution, automating a vast number of process flows for frequency licensing. We also provide database technology for dynamic spectrum access.

Our highly innovative LS OBSERVER radio monitoring system measures and, in addition, records all the radio monitoring data in the remote unit to have it ready to be analyzed whenever needed. The system geo-locates sources of interference, based on recorded data. This means, you can detect the interfering emitter, even when the signal is not on air anymore. In addition, we have developed direction-finding techniques that consider reflection and tell you, if there is more than one interferer. The results

of this technique are much more precise compared to conventional techniques.

Our techniques of data mining and analysis leverage huge volumes of spectrum data in a purposeful way. The way we make the data available to spectrum regulators and operators is totally new on the market. Our SpectrumMap, a cloud-based system, gathers real spectrum usage data from many sources, such as fixed monitoring sites, mobile, handheld and portable devices. Users can zoom in on a map and display the monitoring data in the way they need it. The data can be visualized for the area of interest by band, channel or service type. In contrast to conventional control units of monitoring stations, system users of the SpectrumMap do not need any knowledge of monitoring stations and do not need to know where the stations are located.

The data can be displayed in many target- and task-oriented ways, so that it can be interpreted by anyone familiar with the spectrum business in the regulator's or operator's organization - by management, business analysts, policy makers, engineers and administrative staff.

In addition, LS telcom has unparalleled expertise in spectrum and wireless technology advisory and consulting. We have 25 years of experience working in the wireless and regulatory domain and have developed a keen insight into the emerging developments for radio planning, radio propagation and effective use of measured data. Our most recent studies have considered demand for spectrum and mobile data, telecommunications infrastructure capability with a view to supporting 5G. We can bring this unique knowledge and insight into technology developments to the wider telecommunications industry.

This is particularly valuable to the vertical sectors such as transport, utilities and healthcare that depend on wireless technology to function properly and depend on experience of experts like LS telcom to support their future technology strategy.

Finally, we provide network planning and optimization software for all wireless technologies. Our software CHIRplus_TC already includes planning functionality for IoT networks.

**Spectrum management is a complex realm - as it involves a lot of policy intervention as well as multiple levels of technologies. What are the challenges that you see in front of the industry in this space?**

Spectrum management is complex - in particular with the shift towards market mechanisms driving spectrum policy rather than the now 'old' command and control approach. The idea of the new spectrum distribution methods is that intervention should be minimized to a point that enables the market determine the most efficient use of spectrum. This has been driven by economic analysis to determine the value of spectrum to licensees and users. Thus, an efficient market should result in the most valuable use of the spectrum. Nevertheless, there is a requirement for the regulator to support all users of the spectrum and protect those with national safety and security interests in parallel.

*Our most recent studies have considered demand for spectrum and mobile data, telecommunications infrastructure capability with a view to supporting 5G.*

Currently global regulators are in the midst of conducting coexistence studies in preparation for next WRC in 2019. The workload is a particular challenge for smaller regulators that have to cover the numerous agenda items proposed. This in turn will need to be translated into national regulatory policy and development of suitable licensing policy.

There is the additional requirement to achieve harmonization with these bands, which is challenging at a global level. Given, the US, Korea and Japan have already decided to deviate from globally recognized bands for 5G and push the use of 28 GHz for example, which most countries in the world have decided not to adopt as a 5G band.

At the same time, technologies and systems have to be implemented, combined and interfaced to support the policy changes and various new distribution methods. With more and more wireless technologies and increasingly dense use of the spectrum, regulators face even greater volumes of data – more radio services, more applications and licenses, more spectrum users.

This will be reflected in new system requirements for spectrum management systems. Regulators will have to define new specifications and workflows to accommodate more data volumes.

The market driven spectrum distribution methods entail great technology challenges, too. Dynamic spectrum access (DSA), for example, relies on dynamic whitespace databases including the whitespace spectrum assignments, registration and authorization as well as interconnection to the spectrum license database and the end user devices.

The market driven spectrum distribution methods and the increasing use of frequencies in the higher bands entail a change in monitoring techniques away from the traditional monitoring based on large stations. The new radio monitoring systems rely on a network of cost-effective small and smart sensors, which measure and record all the measurement data. Greater capacities in computing power allow the storage of terabytes of real measurement network data for network analysis and optimization purposes.

The use of datamining capabilities in spectrum management is just at its beginning...

**How can these challenges be addressed? What role is being played by LS telcom in this space?**

We see our role as being a facilitator to industry and regulators in tackling the

many new challenges that arise in spectrum management with the dawn of 5G, IoT, and new spectrum distribution methods.

We have over 25 years of experience in the industry. Our investment in research & development is reflected in our large market share: customers in over 100 countries worldwide trust in our know-how and in our products. We have established memberships with many industry associations and organizations and cooperate with leading technology universities. We are also a sector member of the ITU-R and ITU-D and are ISO 9001:2015 certified.

This is how we ensure to stay innovative on all fronts: spectrum management systems, intelligent monitoring, spectrum analytics and consulting.

Our most innovative systems are currently being implemented at customers, such as a nationwide LS OBSERVER intelligent radio monitoring, data collection and analysis system, our SpectrumMap for the purposeful display of monitoring data to business analysts and policy makers, as well as the latest mySPECTRA spectrum management solution, including BPMN process automation.

Our radio monitoring and spectrum management systems enable regulators to implement new spectrum distribution methods. Our modern database technologies provide capabilities for licensed and unprotected spectrum access.

At the same time, LS telcom has been playing a direct and active role in providing expertise to organizations and customers that require support with understanding the regulatory implications for changes to frequency allocation. Our experience in licensing policy development for regulators and industry has helped identify the challenges and benefits for new technology roll out.

LS telcom is already assisting governments and regulators with developing their spectrum policy and regulations towards 5G. For example, we have assisted the UK government with a report on 5G infrastructure requirements in the UK, and are working on a project that examines the approaches to spectrum assignment in the EU with a view to the future availability of 5G. As a member of the UK's 5G Innovation Centre (at the University of Surrey), we are at the leading edge of 5G developments.

LS telcom's consulting team guides you through the jungle of new licensing, access and connectivity methods as well as current and future technologies. We help you set up a technical and legal environment, in favor of prospering 5G and greatest economic efficiency.

Besides our drive for innovation, we set great store by service and maintenance and accompanying our customers all along their striving for spectrum efficiency.

**As we move towards 5G era - how do you look at the future of spectrum management?**

Spectrum management will need to evolve so that there is sufficient regulatory certainty thus providing a stable environment for operators to be able to invest in new spectrum, new technology and network infrastructure.

Spectrum management systems will have to support different access methods and frequency allocation will be based on real spectrum usage data. This will be possible through wide-area monitoring networks. Spectrum management and radio monitoring cannot be seen as different entities anymore, but have to be well connected.

There will be greater volumes of data to manage - more license types, more wireless technologies, more infrastructure, more wireless users and a myriad of connected objects – and the use of data mining and data analyses of spectrum data will play an even greater role than today to make sure spectrum is continuously used in the most efficient way.

New authorization models will come into play given the new mmWave frequency bands and new approaches as to how these will be authorized and assigned.

There will be a fresh approach and thinking towards radio modeling in the mmWave bands. This is because the variations at these frequencies can be significant and over short distances can impact the quality of service that will be provided by operators. We have seen a study done by Ordnance Survey for the UK government, which has looked at 3D mapping to determine coverage in mmWave spectrum. However, this was a proof of concept demonstrator, and the challenge will be when it comes to commercialization and the computing power needed to process the vast quantities of data.

*Our radio monitoring and spectrum management systems enable regulators to implement new spectrum distribution methods.*

**What kind of growth are you expecting from the market and where will this growth be coming from?**

The most significant development activity is occurring in 5G and Internet of Things (IoT). In particular, the vertical sector will be an area of growth in wireless. There are new devices appearing on the market all the time that have been enabled from the evolution in regulations but mainly due to research, development and investment from tech companies large and small.

There will be developments in LTE-Advanced, LTE-LAA, evolution of Wi-Fi with commercial deployments of 802.11ad, IoT in particular NB-IOT from the mobile operators with China making a big push. In Europe, 5G seems to be the big focus, but also shifts in solutions for emergency service (move from TETRA to LTE as in the UK) and rail (new technology to replace GSM-R and on board connectivity) will see a change in the near future.

# HOW TO DESIGN WI-FI NETWORKS

## 1. INTRODUCTION

In the past, WiFi network design meant little more than placing access points (APs) in conference rooms and break rooms. Nowadays,design requires strategic thinking that takes into consideration AP placement and coverage control, dominant use case, vertical markets, interference management, Radio Frequency band steering and capacity planning. This white paper addresses these topics in detail, and outlines best practices forWi Fi network design.

Figure 1: Examples of Incorrect AP Placement (Source: 7signal Solutions)

## 2. THE KEY NETWORK DESIGN CONSIDERATIONS

### 2.1 AP PLACEMENT

One source of AP interference is scattering and reflection from metal objects such as chain-link fences, wire mesh, and large metal surfaces. If located near an AP, those may alterthe AP'santenna pattern.Another source of interference is anRF sourceclose to an AP, which may increasenoise at the AP. These are shown in Figure 1.

### 2.2 AP COVERAGE CONTROL

In the early days, APs were routinely installed with their default transmit power. However, doing so in dense networks may lead to mismatched AP-client power, RF co-channel overlap and hidden nodes.

#### 2.2.1 Mismatched AP-Client Power

If some clients transmit at lower power than the AP, there is a zone where those clients can hear the AP but the AP cannot hear them. In the figure below you can see the difference in coverage the black and the blue smart phones, one transmitting at the same power as AP, and the other at 5 dB less. The area between them is "dead zone" for the blue phone, and to eliminate it, AP transmit power should be reduced by 5 dB.

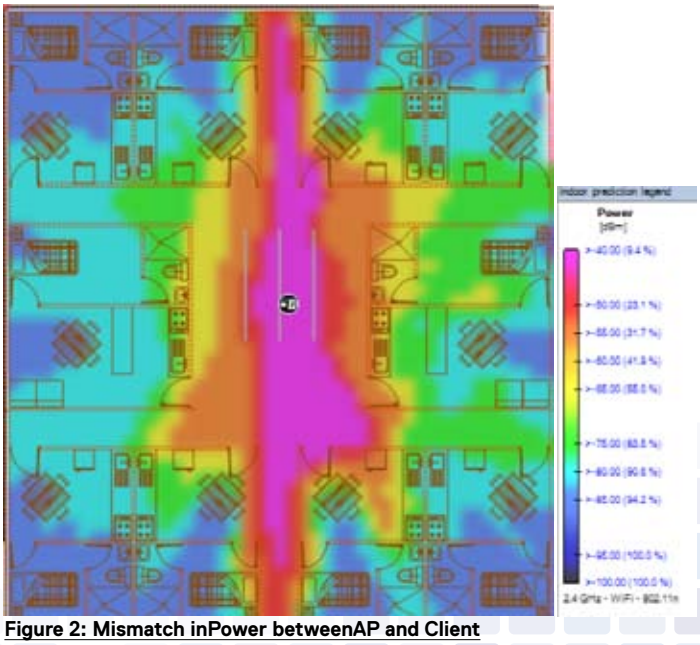


Figure 2: Mismatch inPower betweenAP and Client

#### 2.2.2 RF Co-channel Overlap

Co-channel overlap is of great concern at 2.4 GHz where only 3 non-overlapping channels exist. A client may find itself in a location in between two co-channel APs (Figure 3). In that case, both APs will defer transmitting when the client is transmitting.

The solution is to put another AP in between (Figure 4). The signal difference between the twoChannel 6 APs is now approximately 20 dB, which is considered sufficient isolation. This is easier to achieve if AP power is set lower than the default value.

#### 2.2.3 Hidden Nodes

If AP coverage is too large, clients at opposite ends of the coverage cannot hear each other and may transmit at the same time, which leads to packet errors and retransmissions. This phenomenon is called 'hidden node'.

Figure 5 shows an example of a hidden node in a hotel. The smartphones areat the far end of each hallwayand can easily connect to the AP, but are unable to hear each other. Their packets will often collide at the AP, causing retransmission.

AP coverage can also be controlled by disabling the lower data rates. In Figure 6, all data rates are enabled initially for the 802.11g AP. To control the coverage, lower data rates are disabled, which shrinks the coverage.

### 2.3 THE DOMINANT USE CASE

The dominant use case in a Wi Fi network determines coverage design parameters. Most manufacturers rec-

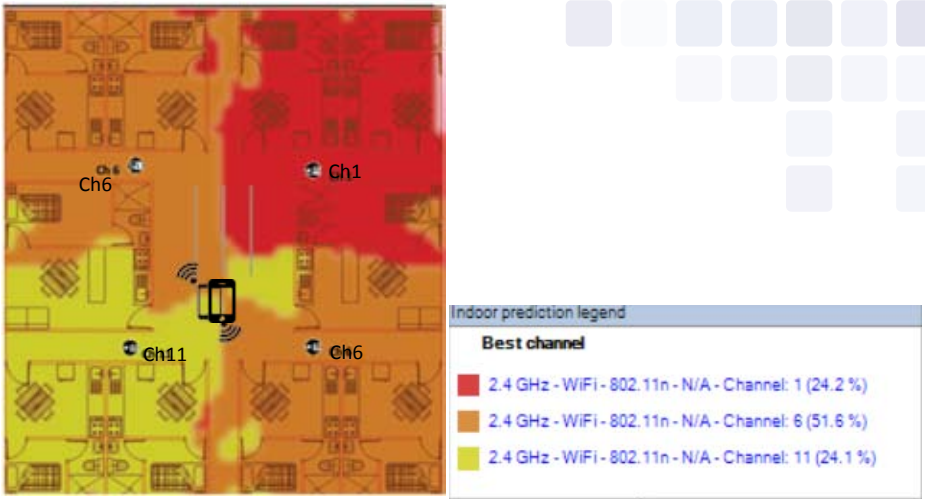



**Figure 3: Clients at Cell Edge and Co-channel Interference (CCI)**

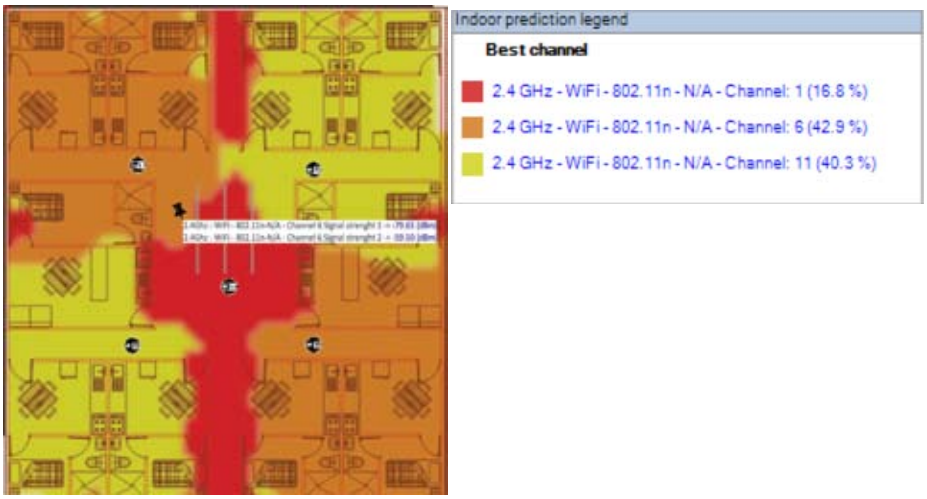



**Figure 4: Recommended Co-channel Signal Isolation**

ommend the following in Table 1 target design levels.

As an example, for high data rate use casewith a measured ambient-noise level of 70 dBm, the minimum signal level should be 70+20 = 50 dBm.

## 2.4 VERTICAL MARKETS

While identifying proper design target KPIs and setting AP transmit power to a value a bit lower than the default- provides a good starting point, design specifications must also consider vertical market specifics, as vertical markets differ in terms of user density, use cases, and level of ambient noise.

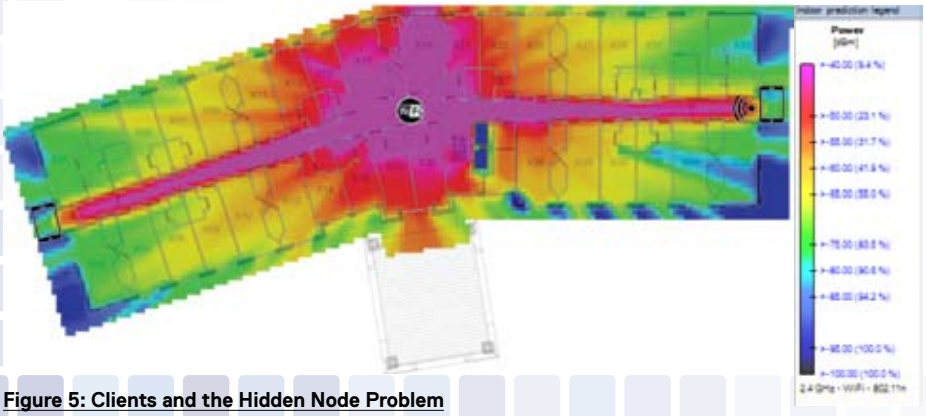


**Figure 5: Clients and the Hidden Node Problem**

### 2.4.1. Educational/Classroom

The number of tablets in a classroom is equal to the number of students, and sometimes they all access the network at once. To address the capacity, a general rule of thumb is to place one AP in every other classroom.

### 2.4.2 Warehouse/Manufacturing

Warehouses and manufacturing venues often deploy wireless handheld devices such as the bar code scanners which are used for taking inventory. These devices require only a low data rate, so this design is for coverage.

### 2.4.3 Retail

Wi Fi networks have a few use cases:

- Retail operations equipment;
- Tracking retail analytics;
- Location-based mapping and tracking services;

All the above requiresonly lowdatarate connectivity.

### 2.4.4 Healthcare

The primary healthcare use case is access to patient medical data and real-time location tracking. However, some medical telemetry may operate on proprietary technology, and cause interference. To help identify the frequencies and technologies used at the hospital, a person or department that keeps track of wireless devices should be interviewed during a site survey visit.

### 2.4.5 Stadiums

Stadiums are by far the densest Wi Fi networks and the noisiest venues; it is common to find ambient noise between 80 and 70 dBm during an event. Most stadium data traffic is video and picture upload and download. The network also needs to provide reliable connectivity for points of sale, video surveillance, ticketing, and other stadium infrastructure services.

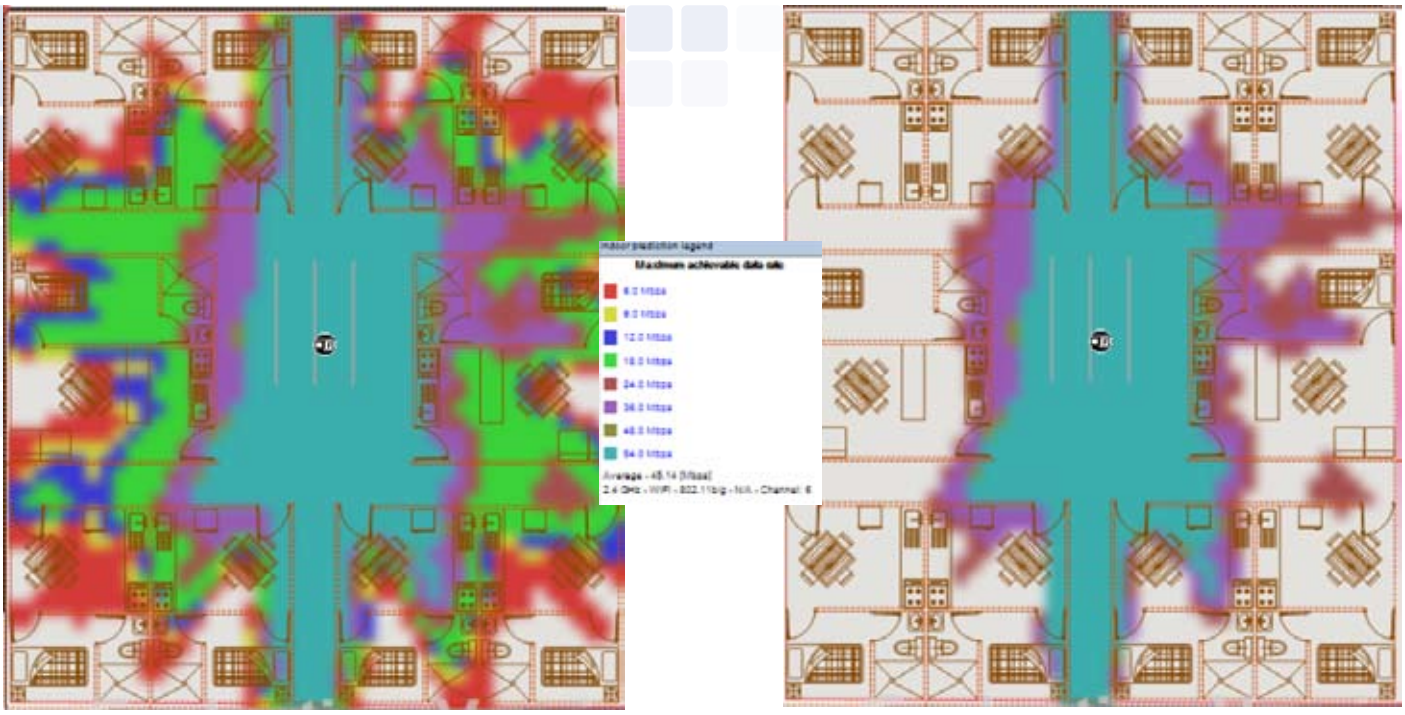


Figure 6: Coverage Control by Disabling Lower Data Rates

| USE CASE | LOW NOISE (< 90 dBm) Signal Strength, dBm | HIGH NOISE (> 90 dBm) SNR, dBm |
|---|---|---|
| Low Data Rate (Handheld scanners, POS) | 73 | 18 |
| High Data Rate (Video Streaming, File sharing) | 70 | 20 |
| VoWi Fi | 67 | 25 |

Table 1: Typical Design Key Performance Indicators (KPIs)

Vertical market characteristics are summarized in Table 2.

## 2.5 INTERFERENCE MANAGEMENT

Two types of interference can affect the operation of an 802.11 network: broadband and narrowband.

Broadband interference affects most or all RF channels in the band. One example is having many Frequency-Hopping Spread Spectrum (FHSS) devices, such as Bluetooth and DECT cordless phones, within a dense client environment, such as call center.

Narrowband Interference affects only a portion of the spectrum and may therefore affect only some channels. An example is radiation from microwave ovens, which operate in the upper portion of the 2.4 GHz spectrum.

Source of interference are listed in Table 3.

| Vertical Market | AP Density | Use Case | Design criteria |
|---|---|---|---|
| Educational | High | Low to High data rate | Capacity |
| Warehouse | Low | Low data rate | Coverage |
| Retail | Low | Low data rate | Coverage |
| Healthcare | High | VoWi Fi, RTL | Coverage |
| Stadium | High | High data rate (high noise) | Capacity |

Table 2: Summary of Vertical Market Characteristics

## 2.6 RF BAND STEERING

"Friends don't let friends use 2.4 GHz" is a slogan that is popular in the Wi Fi community for good reason. The high band is the preferred band, as 2.4 GHz has only 3 non-overlapping 20 MHZ channels in the 2.4 GHz band, while 5 GHz has up to 22 non-overlapping channels.

The practice of directing a dual-band-client to connect to a preferred spectrum band is called "RF band steering". Band steering is simplyanother name for load balancing between the frequency bands.

## 2.7 CAPACITY PLANNING

In most venues, traffic is a mix of various applications: VoWi Fi; email; web browsing; file downloading; video

| 2.4 GHz | 5 GHz |
|---|---|
| Bluetooth radios (cordless mouse, keyboard, headset…) | Cordless phones |
| Cordless phones | Radar |
| Wireless video cameras | Perimeter sensors |
| Nearby WLAN | Digital satellites |
| Microwave ovens | Nearby WLAN |
| Fluorescent bulbs | Outdoor wireless 5 GHz bridges |
| Elevator motors | |
| Plasma cutters | |

**Table 3: Sources of Interference in the 2.4 and 5 GHz Bands**

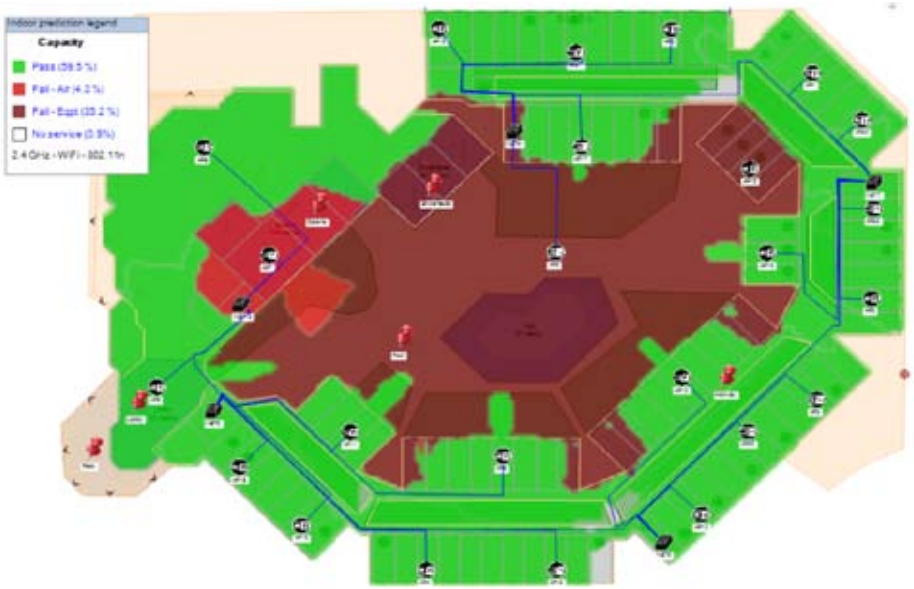


**Figure 7: Capacity Coverage Map Identifies Passing (green) and Failing 2.4 GHz APs (light & dark red)**

streaming; etc.To calculate capacity, several parameters must be specified/ assumed:

- Traffic, in MB, that an active client carries during busy hour;
- The percentage of active clients during busy hour;
- Airtime utilization percentage;
- Hotspots and the number of clients within each hotspot;
- The client split between the two bands;
- The technology overhead due to airtime contention and control and management frames;
- A mix of 1, 2, 3 and 4-stream client devices;

A good starting point is to design the network for coverage first and then calculate the capacity coverage map (Figure 7). This map will show if an AP can support the specified data traffic load (green), or if itwill fail either because it exceeds the specified air-time utilization (bright red) or because it connects to too many clients (dark red). Moving APs around and/or moving more clients to high band may remedy the situation.

An average-data-rate-per-client coverage map (Figure 8), is another useful heatmap. The average data rate per client coverage map is valid for the specified data traffic during busy hour. It should not be confused with the instantaneous client data rate during active transmission.

## 3. CONCLUSION

Wi-Fi network densification, along with proliferation of non-802.11 devices operating in the ISM and U NII unlicensed bands, has made Wi-Fi network planning a much more complex task than it was just a few years ago. Planning of 802.11 networkswill become even more complex with upcoming mass deployment of License Assisted Access LTE (LAA-LTE)small cells and LTE-enabled devices in the 5 GHz U NII band.

**The White Paper can be downloaded from the below mentioned link**
http://www.ibwave.com/LP/White-Paper_7-key-factors-to-consider-when-designing-Wi-Fi-networks.html

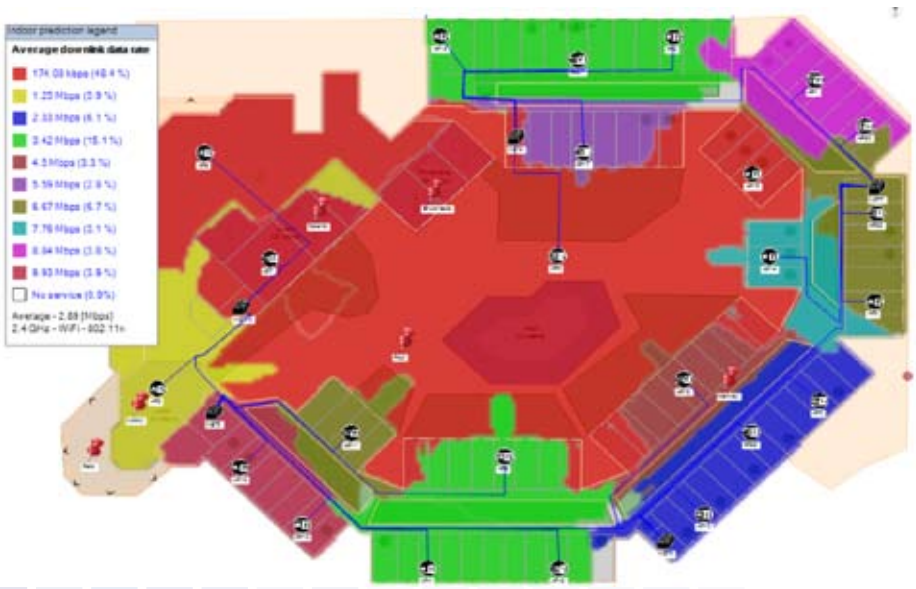


**Figure 8: Average Data Rate per Client during Busy Hour**

# ITU: Exploring Opportunities in Smart Digital Transformation

**HOULIN ZHAO, Secretary-General**

***The International Telecommunications Union's authority and experience as the UN's specialized agency for ICTs enables it to convene a unique international audience from emerging and developed markets from all around the world.***
***Today – ITU is exploring new age opportunities in smart digital transformation that the industry can address - with the help of deliberations around collaborative regulation, connected cars, smart sustainable cities, Industry 4.0, digital skills, security in the age of smart technologies and the ethics of AI.***
***ITU Secretary-General, Houlin Zhao interacts with Zia Askari from TelecomDrive.com ahead of the upcoming ITU Telecom World 2017 to be held in Busan, Republic of Korea.***

**What are the top priorities for ITU today?**

Developing new and more advanced ICT technologies and services, bridging the digital divide and fostering the use of ICTs to accelerate the United Nations' Sustainable Development Goals (SDGs) are top priorities for ITU.

ITU is working on 5G, Big Data, cloud computing, IoT, cybersecurity, Smart Cities, artificial intelligence.

ICTs are driving substantial transformation in many development- related sectors, from health and education to financial inclusion and food security. Yet today, more than half of the world's population is still offline, unable to benefit from the positive impact that ICTs could have on their lives.

ITU, together with its Members and partners, is committed to leaving no one offline.

**Even though we are living in a fast-paced telecom world – there are 5G**

**networks being deployed – there are many geographies that have very limited connectivity. How is ITU looking at promoting telecom adoption for such geographies?**

The scale of the infrastructure that must be built to help connect the unconnected is unprecedented.

Our focus is to create a better environment for investment, with close public-private partnerships that cut across industries and sectors – in particular in those hard-to- reach areas with no Internet access. And we need to focus our efforts on SMEs – which are vital to the digital economy in terms of jobs, innovation and growth.

It's crucial to help policymakers strengthen their digital development strategies. A recent joint survey by ITU and the United Nations Conference on Trade and Development (UNCTAD) found that less than 25% of these strategies contain details on investment requirements for infrastructure – and less than 5% on investment needs beyond infrastructure, including for the development of digital industries.

In your opinion, what are some of the big challenges that you see in front of the telecom community today. How can these challenges be overcome?

Big Data, artificial intelligence, the Internet of Things, 5G and other emerging technologies will shape our digital future. But we must ensure that they shape our future for the better – and for all.

There are several emerging challenges, ranging from growing digital inequality to gaps in transmission speeds.

Many tools and platforms created for high-resource environments are not fully designed to function with the constraints of low-resource environments. In addition, some of these technologies can prove to be too expensive or less suited where unreliable electricity, intermittent connectivity and limited expertise present everyday challenges.

The development of these technologies will benefit from globally harmonized standards that can improve interoperability across borders. ITU is well-positioned to help in this regard.

Our work on international mobile telecommunications (IMT) is setting the stage for 5G research activities emerging around the world. It is the on-going enabler of new trends in communication devices – from the connected car and intelligent transport systems to augmented reality, holography and wearable devices. IMT-2020 will be the global cornerstone for all activities related to broadband communications and the Internet of Things for the future – enriching lives in ways yet to be imagined.

There are also a range of challenges in regard to privacy and security. ITU is working hard with all our partners to build a universally available, open, secure, and trustworthy Internet. ITU is assisting several Member States assess their national cybersecurity preparedness and response capabilities.

**How does ITU look at the recent developments in the telecoms space – more and more networks are embracing digital transformation, network evolution today?**

There are encouraging developments as networks embrace digital transformations to better serve more customers in an agile and cost- effective way.

Our hope is that the digital transformations underway enable providers to go far beyond just connecting people to each other. We hope that the changes unleash the unprecedented power of emerging technologies to improve people's daily lives – including their health, well-being, jobs, and access to financial services.

**In your opinion how will future networks look like? How can operators move towards delivering an all-inclusive connectivity today?**

ICTs now form the backbone of today's digital economy. Connecting the next billion people is, therefore, both a challenge and tremendous opportunity.

It is estimated that 85% of the world's population is covered by at least 3G services, but still we have less than 50% of the population connected. We are facing many challenges.

Connectivity alone won't be enough. Digital inclusion can only be effective and meaningful if and when everyone feels empowered to use the technology – and when the technology is affordable, attractive and safe. Digital skills and literacy must be increased in order to boost demand in many parts of the world where people remain unconnected. The relevance of local content also plays a key role and could be a big opportunity in emerging and frontier markets.

**Whether it is a large operator in India or a small operator in Surinam, innovation has become very important for telecoms today. How does ITU promote innovation in various geographies?**

Through events such as ITU Telecom World 2017 and many other initiatives, we are committed to helping bring public and private stakeholders together to discuss how best to stimulate the right environment needed for tech SMEs to flourish. This is critical to industry disruption, market growth and job creation -- in both developed and developing markets.

The next World Telecommunication Development Conference organized by ITU will start in Buenos Aires on 9 October. It is an opportunity for all stakeholders to shape the future of ICT development. At WTDC-17, we will develop our strategies and actions over the next four years, including our goal to encourage investment and innovation in ICT infrastructure. Promoting investment in broadband connectivity from a broad range of sectors can help achieve the full potential of ICTs and bring the world closer to the goal of an inclusive digital society accessible by all.

# Seamless Communications: Telit Modules Helps Prompt Softech Streamline Dairy Operations

Prompt Softech is a division of Prompt Group which began its journey in 2011 and is focused towards providing IT solutions for the Diary Industry. The company provides reliable solutions for dairy management which improves productivity, reduces overall cost of operation and thus guarantees greater availability of milk and dairy products. The solutions help dairy clients achieve transparency and uniformity in the communication from dairy's head office to the members of dairy farms across the country.

It's core product BMC Smart Box which is designed and developed by Prompt Softech is gives you greater control over milk quality and economics. This has been the core of all the solutions developed by Prompt Softech.

**Prompt's Challenge:**

Connectivity of the dairies with the dairy head office is very important. The head office provides regular milk rates, information, online money transfer to farmers banks and regular important information on weather, quantity of milk collected at each dairy, changing milk production patterns, information on cattle feed and medicines etc.

For this to be successful connectivity, performance and speed are the key parameters. Any breakdown in these parameters leads to a total breakdown in communication which impacts cost of milk production, lack of information which in turn impacts overall sales.

"We used Telit's GE910 2G module, UL865 3G module. Now, we are planning to use LE910 4G module. We use all the modules specifically for data transfer as we get better performance for speed on Telit. The modules were used for Embedded products like BMC Smart Box which is used to monitor Bulk Milk Coolers, Prompt E-Panel a digital signage system designed specifically for the dairy industry, Data Processor Unit (DPU) a hardware device used for milk collection in Village Dairy Cooperative Societies (VDCS) and for Prompt AMCS (Automatic Milk Collection System) which is a common application for Village Diary Cooperative Societies and Milk Unions. Many of our customers mentioned that due to Telit's reliable and fast services, they could store their data easily and quickly over cloud, thereby saving time. Overall Telit provides excellent support like solutions for technical issues, design reviews and logistics", says Bhautik Kothadia, Project Manager, Prompt Group.

Earlier we were using modules that had connectivity and speed issues.

However, after shifting on to Telit, we did not come across such problems. Prompt used Data Dongles to connect PCs to their cloud network for connectivity but in villages, connectivity is a major problem, hence external antenna is required for proper connectivity. For every new module, the company had a separate data dongle which resulted in driver related problems. Moreover, with the data dongle Prompt could not connect external antenna or booster for better connectivity. All these impacted Prompts client's businesses due to unreliable connectivity and speed.

**The Solution:**

To overcome the above problems Prompt designed a modem with Telit module in which they could connect the external antenna and no need to change the USB driver of PC.

The company used Telit's GE910 2G and U865 3G modules to build this modem. All modules were used for data transfer. With Telit modules they not only got much better performance and speed but it also provided better support like solutions to solve technical issues and schematic and layout review. Now, the company is planning to use LE910 4G module to develop it further.

The picture below shows the Telit module for PC based modem.


Prompt uses PC's SMPS supply for modem and mounts it into PC's cabinet.

Most of the modules were used for embedded products like BMC Smart Box, Prompt E Panel, Data Processing Unit (DPU) for milk collection and Prompts AMCS(Automatic Milk Collection System)-PC based system for Village Co-operative Dairy Societies.

The benefits for each product by using Telit modules are listed below:

BMC Smart box- BMC Smart box is our embedded product which is used to monitor Bulk Milk Cooler (BMC). Here, the companies monitor parameters like milk quantity in tank, temperature of milk, Agitator on/off status, Compressor on/off status, Power grid on/off status, and Generator on/off status. By using Telit modules Prompt's clients were not only able to do it efficiently but with more speed and reliability.

Prompt E-Panel- It's a digital signage system designed specifically for the dairy industry. It is being used by Milk Societies to display the messages such as milk rates, important circular and/or announcements from the Milk Unions' office to the members/farmers of the Milk Societies. The messages are sent over GSM network. The LED digital display has multiple language options and thus the message is communicated to all the dairy farms without any ambiguity. Usage of Telit modules has not only improved the speed but also reliability and connectivity which is very crucial to the farmers on a day to day basis.

DPU (Data Processor Unit)- DPU is a hardware device used during/for milk collection in Village Dairy Cooperative Societies (VDCS). DPU captures data from electronic weighing machine, EMT/Milk Analyzer. It also accepts milk producer's details manually, allows processing milk billing and writes processed data on Micro SD card or prints it in a specific report format. It has a built-in Printer that allows printing of slips and reports. Continuous connectivity is very crucial here and


Telit modules with an external antenna have been a game changer in the efficient functioning of DPU.

Prompt AMCS (Automatic Milk Collection System) – PC based Application Prompt AMCS is a common application for Village Dairy Cooperative Societies. The most successful example is the implementation by Amul in India. Its AMCS (Automatic Milk Collection System) is an initiative by GCMMF (Gujarat Cooperative Milk Marketing Federation) in association with the Prompt group. It provides an end to end solution to the Village dairy co-operative societies that embark on digital transformation as the way of doing business.

This implementation by Amul is the biggest IT integration in the history of the dairy industry. It has created a common digital platform for farmers and milk unions where every step is transparent and each party knows how much milk is collected. It also provides information on seasonal fluctuations, problems and solution if any, milk rates, weather patterns impacting cattle feed, data collection at each co-operative unit and online payment to farmers. It is a step towards building a cashless and an organized society.

Its application and implementation by Amul, has revolutionised the way business is done between Amul and the dairy farmer co-operatives. Prompt has successfully implemented the AMCS solution which has been made possible by using Telit modules which guaranteed reliability, connectivity and speed for such a massive transaction between hundreds of people.

**For more information, please visit www.promptsoftec.com**

# SCF: "We are focused on plotting a roadmap to future platforms and 5G"

***As operators look for increasing network coverage and capacity – deployment of small cell is a great way to achieve more with less effort. It is also paving the way for future-ready network evolution and eventually embracing 5G. David Orloff, Chair of Small Cell Forum interacts with Zia Askari from TelecomDrive.com on the growing importance of Small Cells and how this technology can shape future evolution of networks.***

**DAVID ORLOFF, Chair of**

**What are the key priorities for SCF today?**

Today it's widely recognized that small cells are providing the technology required for the densification of today's networks and services. And in the process, they are also laying the foundations for 5G.

Our work currently focuses on removing barriers to implementing small cells at scale. A recent analyst report argued that urban centers will require 800 per cent more cells by 2022. This transformation of network management and architectures has required broadening the scope of the Forums' activities and working with a wide range of partners to drive harmonization in all layers of the 5G network.

Of course, as small cells have become a central component in so many different deployment scenarios, so the Forum's core purpose has diversified. We are focused on facilitating implementation today, while also plotting a roadmap to future platforms and 5G.

You could say that our priorities are multi-layered: setting technical specifications, defining practical processes to ease deployment, and driving services and business models on top of the network itself. We then have the crucial task of joining all those dots: linking all the aspects of densification to create a unified platform, and working closely with industry partners to limit fragmentation as the networks evolve to 5G.

**How does the Forum see the growing importance of small cells as far as telecoms is concerned?**

In the 10 years since SCF was founded, small cells have grown to become a crucial part of the mobile landscape. The advent of true mobile broadband networks, and ubiquitous smartphones, has placed mobile at the heart of people's lives and made it increasingly essential to have a strong signal and high data rate in every possible location.

That has led directly to the need for small cells – to fill coverage gaps, boost capacity and enhance quality of experience. Initially this was focused on the home, but now small cells are deployed in cities, remote areas, workplaces and leisure locations, and are starting to appear in vehicles – and even on drones. And 5G will accelerate this activity.

Many uncertainties remain about 5G, but one area of agreement is that it will involve vast numbers of cells. Operators are already planning to use even smaller access points, often in high frequency and flexibly licensed spectrum, to drive density into many areas of their networks. This will accelerate the roll-out of small cells, but if the underlying platform is to remain harmonized, it must also support coexistence with LTE.

**How big is the small cell market today? And where it is moving in the coming months?**

The market is in a really exciting place right now. It's driving how we will implement 5G networks. The next couple of years will therefore be intense, with further deployment of dense HetNets and SON, an enhanced role for new technologies like MEC and work in unlicensed spectrum.

- The global small cell market, including indoor and outdoor small cells, grew 26 per cent year-over-year in 2016, to $1.5 billion
- Small cell indoor unit shipments outstripped outdoor shipments in 2016, with much operator focus on enterprise and public venue deployments to support consistent indoor voice and data performance
- Asia Pacific led the regional share of small cell unit shipments with 59 per cent in 2016 (Figures from IHS Markit)

Forecasts indicate that the global small cell market will grow at a compound annual growth rate (CAGR) of 8.4 per cent from 2016 to 2021, when it will reach $2.2 billion. Outdoor revenue will continue to be higher than that of indoor — despite the much smaller shipment volumes — because outdoor small cells are significantly more expensive on a per-unit basis compared to smaller, and often simpler, indoor units. The drive for densification towards 5G will also drive the continuing growth of shipments.

More important than numbers and forecasts, however, is the value small cells are bringing to operators' businesses, and mobile users' experiences, around the world. In 2007, the femtocell was a small access point designed to improve the signal within a home. From those origins, the small cell's form factor has diversified, with power levels moving both upwards and downwards, and with the flexibility to be mounted in a huge range of locations, from pavement manholes to backpacks to drones.

**What kind of trends in this space do you think will help signpost a renewed growth plan for operators?**

The integral role that small cells will play in 5G will continue to drive interest and demand. Today, our members are promoting solutions that include small cell/Wi-Fi integration, SON evolution and automation, virtualization of the small cell layer, driving mass adoption via multi-operator neutral host, ensuring a common approach to service APIs to drive commercialization and the integration of small cells into 5G standards evolution. All of these, plus the real need to create and enable the digitized enterprise, mean that there is plenty of room for growth for small cells.

Small cells can also enhance the operator business model – by enabling new revenues from initiatives including indoor coverage (of venues or enterprises, for example), from IoT with ubiquitous coverage, and from personalized services thanks to MEC and location awareness.

As more and more operators look forward to deploying small cell solutions in order to improve coverage and capacity, how is SCF helping in this regard? Is there any way you handhold such operators?

We are carrier-led, meaning our operator members establish requirements that drive the activities and outputs of our technical groups. Our Release Program has now established business cases and market drivers for all the main use cases, clarifying market needs and addressing barriers to deployment for residential, enterprise, rural & remote, and urban small cells.

This provides a blueprint for operators to follow when deploying small cells in many scenarios, reducing their time to market and their risk. The operator advisory council, and the opportunities to exchange experiences in forum calls and meetings, all help to support operators and help them overcome any deployment barriers – technical, commercial, and also cultural.

This latter is important: small cells require significant cultural changes, including changes to deployment processes and even changes to the way network infrastructure is funded.

How do you involve government regulatory boards or authorities when it comes to accelerating adoption of small cells in the telecom space?

Scaling down the administrative processes involved in small cell deployments, which in turn will expedite the flow of documents through local planning agencies, is a vitally important step on the path to densification. SCF recommends that small cell siting be streamlined where possible to use local infrastructure policies and design guidelines. This is because small cells are similar to access points, and as such should not be considered large pieces of network equipment (unlike macrocells, for example). For this reason no specific planning permissions should be required to roll out such networks. Standard deployment procedures for small cells should be developed and established in all markets to allow for faster deployments and less administrative obstruction. To this end, the Forum and its partner organisations are consulting with regulatory bodies to develop processes that can expedite the deployment process and circumvent bureaucratic bottlenecks which could stifle innovation. We have been collaborating with GSMA and 5G Americas to provide carriers and national and local regulators with the information they need to simplify processes and also underline the economic value of network densification.

Please share with us some of the core activities that SCF is undertaking in order to develop the overall small cell ecosystem

As networks continue to densify and evolve, the Forum is becoming an increasingly vital hub for industry activity around densification and 5G. It is gathering many inputs from a wide range of members and partner organizations, and is starting to coordinate these to create a unified output which will underpin future platforms. These inputs come from operators, our membership, enterprise customers, and industry partnerships. The industry will continue to look to Small Cell Forum for guidelines, business models, processes, and technology understanding to ensure a successful evolution toward hyperdense networks and 5G.

SCF has clearly identified the aspects of the 5G platform where it can make a real contribution, based on its core knowledge and experience. These aspects define the scope of the 5G roadmap and work program.

SCF believes 5G will be characterized by:

- hyperdense zones of capacity
- virtualization
- flexibility to harness many technologies and spectrum bands
- edge computing and distributed cloud
- intelligent automation
- optimal connectivity for many different vertical and IoT services

This year, our priorities include:

1. Responding to specific needs of Enterprise verticals
2. Elaborating new commercial models for ownership and operations
3. Developing technical and commercial models for rural and remote connectivity
4. Communicating scalable, repeatable deployment processes
5. Defining technology needed for densification and to drive ecosystem support
6. Supporting open & interoperable standards to healthy unfragmented ecosystem
7. Driving industry consensus on the prioritised sequence of investments needed to take today's networks into the 5G era

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