



Embracing mobile networks in the 5G era

By Edward Deng, President of Huawei Wireless Solution

Human history is a history of connections. The pursuit of communication promotes the development of connections, and the development of connections promotes the development of society.

In the coming 5G era, all things in daily life will be connected and all industries will be transformed through digitalization.

Mobile has already changed how we communicate and now it's changing how we live. In the future, mobile will change society and reshape the world. Mobile will be the foundation and enabler of transformation in all industries and the development of society.

Looking to the future, new opportunities will bring new

growth, new requirements, and new challenges to mobile networks. Are we ready for all these changes?

Three challenges

First, network capabilities will face new challenges. The extreme user experience and new industrial applications require more powerful network capabilities and must have more dimensions.

From 4G to 4.5G to 5G, multi-dimensional network capabilities must keep improving to support increasing service requirements.

Second, network architecture will face challenges. Services and scenarios will become more diverse. For example, AR and VR services require more than



As the 5G era approaches, we can expect huge opportunities along with big challenges. New opportunities will bring new growth and new growth needs new capabilities. I believe future mobile networks will bring amazing changes.



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Gigabit speeds and ultra-low latency, while smart metering requires only kbps speeds and has no special demands on latency. The requirements of these two services have a 1-million-fold difference, but must be supported on a single network. So networks must be flexible and agile enough to support diversity, and at the same time shorten time to market to help operators seize business opportunities.

Another challenge will come from network management efficiency. Site numbers will increase and more spectrums will be released, which will result in increased network complexity and OPEX.

TCO mainly increases due to OPEX rather than CAPEX, so it's important to introduce more

technologies to reduce OPEX and reorganize the proportions of OPEX and CAPEX to achieve higher ROI.

To meet all these challenges, we expect future mobile networks to have the following features:

First, they must provide powerful capabilities. As 5G is approaching, SingleRAN will evolve to enable 5G to provide much more powerful capabilities.

Second, they must have flexible and agile network architecture, so new mobile cloud architecture should be introduced to meet these requirements.

Third, networks must be efficiently managed to improve user experience and reduce OPEX, which



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calls for more intelligent wireless networks.

Powerful network capability: 5G era SingleRAN

5G, cloudification, and intelligence are the most important elements of future mobile networks. In the 5G era, SingleRAN should have three major capabilities: high capacity, seamless coverage, and low latency.

To know is easy, but to do is difficult. There are certain obstacles we have to overcome to achieve these capabilities.

Boosting capacity

Site capacity is highly dependent on bandwidth and spectral efficiency. With more bands and antennas from 2T, 4T to 8T8R and MM with 64T64R, the network has the capability to increase capacity by dozens of times per site. But, the main obstacle is how to add so many boxes with limited site space.

Now, with 5G technologies we can provide equipment with wider bandwidth and higher integration, for example, one antenna for all sub-3G bands, one radio unit for dual-bands or even multi-bands, and one AAU or MM unit with a combined antenna and radio unit.

In the past we did addition; in the future we should do

subtraction to make the sites simpler and to lower OPEX.

Improving coverage

C-band will be the first global roaming band for 5G. Higher frequency gives lower coverage, so improving C-band coverage to provide continuous 5G coverage is another obstacle.

Now with Massive MIMO and high transmission power, C-band can provide similar coverage at 1800 MHz in downlink. Uplink coverage is still bottlenecked due to antenna quantity limits and the transmission power of phones.

To overcome these obstacles, we've proposed a disruptive innovation. In the 2G, 3G, and 4G eras, uplink and downlink must be deployed on the same band. But why don't we deploy uplink from C-band to lower bands like 1800M and share with LTE? Then we can create a new band combination for cell edge users. At the same time, cell center users can still use the DL and UL of C-band.

This disruptive proposal has already been accepted by 3GPP R15, which will enable co-site deployment of C-band and 1800 MHz to provide continuous C-band coverage with site resources.

In addition, to enhancing deep coverage and high capacity, the number of new sites will keep increasing in the future, not only traditional macro sites, but also

the new pole sites and outdoor small cells and indoor coverage systems.

But how can we increase new sites in an easy, low-cost way? We provide a series of scenario-based site solutions, including TubeStar, PoleStar, RuralStar, and a multi-hop outdoor small cell and indoor Lampsite solution, so we can deliver the most suitable E2E site solution for various site scenarios.

Reducing latency to ms level

Another challenge in the 5G era is low latency and reliability, especially for some industrial applications.

For air interface latency, innovative technologies such as short TTI, grant-free and self-containment, we've already reduced latency to less than 0.5 ms in the IMT-2020 test this year.

For network latency, we need simplified network architecture, and we must decouple service functions and network locations to be able to deploy services on-demand, making services close to end users to reduce latency.

These innovations enable ultra reliable low latency with 1 ms and five 9s reliability, which fully meets industrial requirements.

To support these capabilities, I'm proud to release the portfolio of the 5G Era SingleRAN. This is the first time we've released a 5G series product at MBBF, with 5G and 5G technology leveraged to 4G.

Our 5G Era SingleRAN is part of our 5G series of products.

Agile network architecture: Mobile Cloud

We first released our Mobile Cloud Solution at the

last MBBF, comprising CloudEdge, CloudRAN, and CloudAIR. These started a new mobile cloud era.

Our CloudEdge solution is already mature. To date, we've signed more than 120 commercial contracts and commercially deployed 30 networks, with commercial subscribers topping 60 million.

As 5G approaches, CloudEdge will pave the way for a welcome upgrade to 5G cloud-based core networks.

Huawei first released its CloudRAN solution last year, and we've already finished the POC testing with several tier-1 operators to verify performance in terms of flexible network architecture. CloudRAN is scheduled to support pre-commercial use in Q1 2018 and full commercial deployment is scheduled for the end of next year, along with 5G.

At last year's MBBF, we released CloudAIR, which is designed to dynamically share spectrum, breaking the limits of traditional spectrum refarming.

This disruptive innovation enables different access technologies to dynamically share the same spectrum simultaneously according to traffic changes, which significantly improves spectrum and network efficiency.

LTE and NR can share spectrum in both the time and frequency domains, so sharing performance will be even better than that of the current GUL, which will greatly accelerate NR deployment on the low band in sharing mode rather than traditional refarming, because it has less impact on current 4G services.

We released CloudAIR 1.0 in September. And over 30 operators will commercially launch CloudAIR by the end of this year. Next year, we expect over 100 operators to be using this innovative solution. With the joint effort of leading operators and other industrial partners, LTE and NR spectrum-sharing has already

been accepted in 3GPP, and will be supported in R15, which represents huge progress for the whole industry.

Moving from refarming mode to sharing mode is a milestone in the mobile industry.

Our next task is to upgrade CloudAIR 1.0 to 2.0. Currently, 24 percent of spectrum can be dynamically shared. This will reach around 44 percent in 2.0, which means 10 MHz spectrum. LTE can use a full 10 MHz while GSM can use up to 4.4 MHz simultaneously.

For LTE and NR, the proportion of shared spectrums will reach almost 90 percent and they can be shared by UL or DL and UL separately due to support from the new R15 standard and new NR devices. All 4G devices can support it. So we can expect that in the 5G era, the spectrum sharing mode between LTE and NR will become mainstream. Actually in 5G RFI and RFP, spectrum sharing is already mandatory.

Greater collaboration

From the start, existing spectrum should be allowed for 5G to support spectrum sharing.

The whole industry chain of 5G, especially device and chipset vendors, should support this feature based on 3GPP R15. Almost all vendors have released CloudAIR-type spectrum sharing solutions, but continuous R&D and innovation are necessary to further improve sharing performance.

Is all this enough?

We don't think so. In the future, network complexity will far exceed what we can imagine. In fact, optimization and maintenance will increase one-hundred-fold, which will bring huge challenges and ultra-high costs. Future networks will be like a complex flyover transportation system. If there's a lack of an intelligent coordination and scheduling, network efficiency will decline sharply.

In addition, with the boom in new services, service-oriented recognition and prediction will be a basic condition to ensure user experience of various services with limited network resources, which will also need a new mechanism. To address these challenges, we believe that future wireless networks must be more intelligent to make things simple.

Efficient network management: Wireless intelligence

First, with intelligence, network O&M will be easier and more efficient, and will gradually transform from automated to autonomous, fully realizing network potential for the best user experience and network performance.

With wireless big data and machine learning algorithms, networks will be more intelligent and provide more new capabilities.

Wireless tech in action

To deploy massive indoor small cells, automated and simple operations are a must. Huawei's new intelligent LampSite solution can greatly shorten deployment duration through self-configuration and self-awareness.

At the same time, it can also enhance user experience by surrounding traffic detection and the automated optimization of cell configuration such as cell splitting and cell merging to simplify operations. In the future, with the development of automated capabilities, the network can continuously enhance operating efficiency and make things simple.

MM is a typical product in the 5G era with powerful capabilities and flexible configuration in various scenarios.

To achieve the best network performance, our



The wireless intelligence solutions for smart carrier aggregation ensures the device is always on the best carriers with multi-dimension input.



wireless intelligence pattern tuning solution can adaptively select the most suitable parameter combination. For example, if a sports event is happening, most people are probably in concreted areas. MM would adaptively change to a narrower beam to improve capacity and respond to the number of users. After the event finishes, it will change back to wide beam to improve coverage.

In addition, mobile networks also have the capability for self-learning to understand which patterns have better KPIs and user experience, so eventually the network can achieve best performance by running on the best configuration.

The next phase of wireless intelligence is to explore more possibilities with big data and machine learning. We can logically split each cell into thousands of virtual grids and each grid can store all wireless parameter data from the control plane, user plane, and management plane, both real-time and historical data. With all this data, networks can understand real scenarios more accurately and network resources can be used more efficiently.

The wireless intelligence solution for smart carrier aggregation ensures the device is always on the best carriers with multi-dimension input.

And that's just the beginning. We're linking more

data and characteristics into virtual grids to build a unique network fingerprint. We can thus imagine new capabilities and applications. For example, as hotspots become less predictable, wireless intelligence can automatically predict a possible instant hotspot and call for a new mobile site, such as UAV, to set up, self-configure, and self-optimize with the whole wireless network, thus meeting traffic requirements in advance. That's an intelligent network.

Another case in the near future, is achieving sub-meter level positioning with a unique network fingerprint to achieve 10 times greater accuracy than GPS, both indoors and outdoors, which will enable new applications such as interactive mobile gaming with AR.

Our understanding of wireless intelligence is just starting. But, we will step up R&D investment to bring more innovation to our customers. I believe this intelligent brain will make our wireless networks smarter, more flexible, agile, and efficient, and it will far exceed our expectations of the future.

5G, mobile cloud, and wireless intelligence are combining to provide powerful network capabilities with flexible and agile network architecture that can be efficiently managed. This will help operators achieve more commercial success, with Everyone on Mobile, Everything with Wireless, and Every Industry plus Wireless. [www](#)