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the race is on

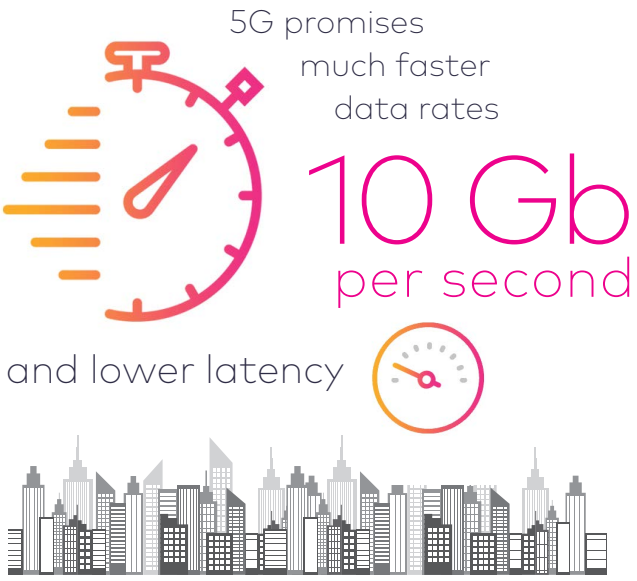
Accelerating Network Rollout

'Faster RAN' series

The 'how-to' guide for accelerating RAN densification and 5G deployment

#2: The gigabit RAN: 5G and network virtualization

With the availability of 5G wireless broadband technology just around the corner, mobile network operators are planning RAN densification, while many cable operators and other fixed broadband service providers are preparing to build entirely new mobile networks. In this technical brief, we'll take a quick look at 5G and network virtualization, and how these new technologies impact the planning and deployment of next-generation mobile networks.



5G promises much faster data rates (up to tens of gigabits per second), lower latency, more capacity, better security and more agile, dynamic traffic management that is capable of supporting a diverse set of new Internet of Things (IoT) applications. 5G is also compatible with the emerging technologies of virtual networks and centralized RAN (C-RAN).

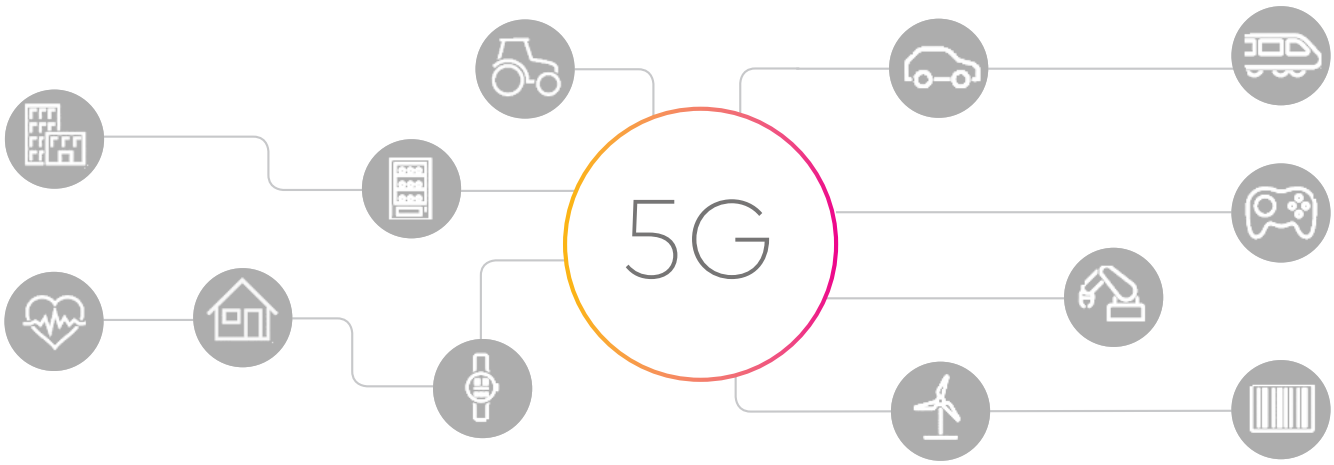
Building tomorrow's network – the challenges

Planners and network engineers will be faced with a very large diversity of evolving technologies in the 5G era. Today's HetNets already consist of a plethora of different radio technologies and cell types, including macro-cells, small-cells, distributed antenna systems (DAS) and Wi-Fi access points, not to mention the various backhaul technologies required to connect them to the core network. With 5G and network virtualization added to the mix, service providers will need to employ new tools and techniques in order to manage a rapidly changing network architecture.

5G and the IoT

As IoT technology becomes increasingly ubiquitous, billions of connected devices will be creating opportunities for totally new applications, most of which haven't even been thought of yet, and which will leverage the enormous amounts of data generated by these devices. Wireless networks will offer the connectivity and flexibility needed by devices across a wide range of industry verticals. These include smart cities, digital health, connected car, smart homes, industrial automation, and wearables, to name just a few.

> *"With 5G and network virtualization, service providers will need to employ new tools and techniques in order to manage a rapidly changing network architecture."*



The Internet of Things opens up a whole world of new applications and verticals, enabled by 5G wireless technology.

5G will be a significant enabler for many wireless applications that require a combination of very fast "always-on" connectivity, high security and low latency over a wide coverage area. Applications such as autonomous vehicles, remote telesurgery, drones, gaming and virtual reality will all require very fast, robust, low-latency networks. For example, self-driving cars are expected to appear on our roads commercially within the next ten years and their success will heavily depend on reliable, high-speed wireless connections. Autonomous vehicles will need to transfer information rapidly between each other (car-to-car) and also between the vehicle, the internet and roadside infrastructure, such as traffic lights, road signs and traffic sensors (car-to-x communication).As a result, network speed, latency, reliability and security will all be crucial for the success of these safety-critical applications.

Some of the key features of 5G will include:

- Higher throughput – up to several tens of gigabits per second
- Lower latency – end-to-end delays reduced from tens to just a few milliseconds
- Increased security and privacy – with network slicing and enhanced device authentication
- Better capacity and coverage
- Improved spectral efficiency
- Support for high-volume machine communications (required by IoT)
- Support for low-power devices with low battery consumption

Planning a 5G network requires a holistic approach to network design, which needs to consider demand planning for both humans and machines that use the network. A focus on network experience will play a key role in achieving optimal network designs, which need to take into consideration both customer experience and machine-to-machine performance.

Enabling a more secure network

Security and privacy are two key areas of major concern today. Previous levels of security on 2G/3G and 4G/LTE networks will no longer be enough for tomorrow's mobile digital ecosystem. With rising incidents of internet fraud, service providers are determined to make their networks even more secure. 5G will provide several security enhancements, two of which are network slicing and enhanced certification & authentication.

Network slicing effectively divides the network into a number of isolated sub-networks, with each having its own separate security objectives that are optimized for specific types of data traffic. By slicing the network like this, it is possible to apply the required levels of security for each application associated within a particular slice. This means that mission-critical traffic such as connected vehicle and emergency services data can be authenticated, secured and transported separately from other types of less-secure traffic like consumer broadband video data. Users and applications of one slice will be completely isolated from other network slices and therefore will not have any means of accessing them. Network slices can also be dynamically managed to vary their capacity according to demand, so low-priority data can be offloaded to unlicensed spectrum (Wi-Fi) as network slices become squeezed.

"One of the key features of 5G is its ability to support network slicing which significantly enhances security."

The impact of network virtualization

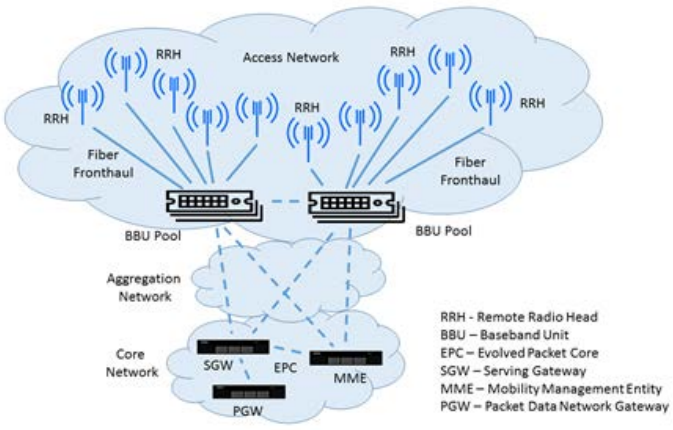
Network function virtualization (NFV) and software-defined networking (SDN) are changing the face of traditional network design and implementation. By replacing physical network elements that performed dedicated network functions, with virtual network functions (VNFs) deployed in a virtual computing environment, significant savings can be made in both cost and operational efficiency. Networks can be designed to be much more flexible and dynamic by automatically spinning-up VNFs on-demand, when and where they are needed, and then removing them to free up computing resources once their useful life is over (which may only be after a few minutes).

Network virtualization can be applied to the core, backhaul and access networks. Virtual evolved packet core (vEPC) and virtual RAN (vRAN) are both good examples. Virtualization offers a more cost-effective way to push some essential processor intensive functions out to the edge of the network where they can provide high-bandwidth, ultra-low latency applications for end-users, such as video servers, cyber security, and voice over LTE (VoLTE) performance management functions.

A vRAN can simplify the radio access network and make it more open and flexible by replacing most of the RAN functions with virtual functions supported on a general-purpose computing platform. Having a standards-based virtual environment and pooling previously distributed functions on a centralized platform can improve efficiency and reduce hardware and upgrade costs.

Building faster, resilient networks by centralizing the RAN

Centralized or Cloud RAN (C-RAN) architecture effectively moves the baseband processing functions out of conventional standalone base stations and consolidates them in a centralized "shared" computing infrastructure. This simplifies the RAN, which ends up simply as a "cloud" of remote radio heads (RRHs), which consist of the radio transceivers and antenna. Fiber optic cable is used to "front-haul" baseband signals between coordinated RRHs and a centralized baseband unit (BBU), which carries out all the processing for the combined



Centralized or Cloud RAN (C-RAN) enables network flexibility and reduces cost

RAN functions. C-RAN networks can take advantage of virtualized RAN technology to achieve this. A C-RAN can provide better control and coordination across a wider cluster of RRHs than a conventional RAN. Centralized computing increases reliability, while significantly reducing overall hardware equipment, power consumption, and backhaul complexity. BBUs can be pooled together, where they can dynamically allocate computing resources to base station software stacks. Many thousands of RRHs can be supported in this way from a single BBU pool.

Summary

5G promises a faster more secure and flexible network architecture that is ready for IoT and the consequent explosion of network devices. Emerging technologies such as network virtualization and C-RAN offer significant cost savings but add further complexity to an already diverse RAN environment. With such a wide range of technologies making up today's advanced RANs, the right skills, tools and deployment approaches are critical. For this reason, network planners, architects and project managers need to start planning and upgrading now the operational platforms needed to deploy the new mobile digital architecture.

The next guide in this series is Demand Planning: Getting smarter at cell placement.