RADCOM

OPTIMIZING 5G RAN RUNNING IN MILLIMETER WAVE SPECTRUM

RADCOMized FOR 5G

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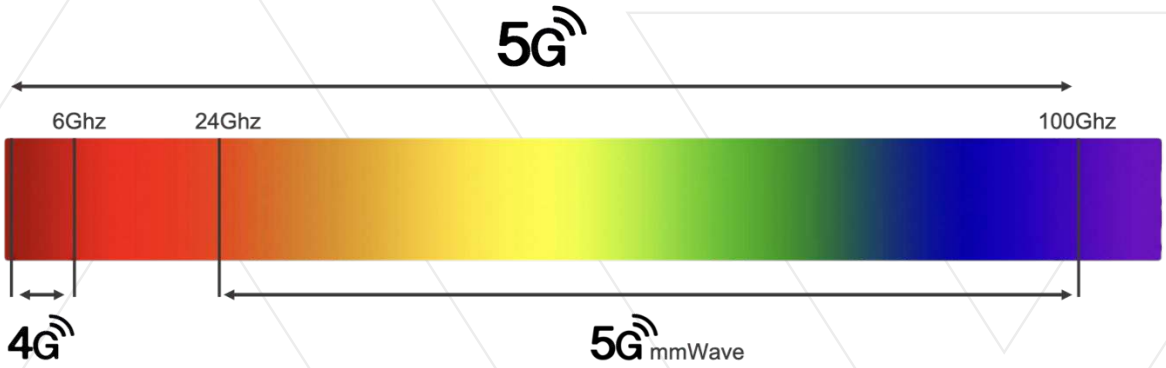
INTRODUCTION

By the end of January 2021, 144 operators had launched commercial 5G Non-Standalone (NSA) networks, and 65 operators were already investing in 5G Standalone (SA). In total, there are already 229M 5G subscribers worldwide. That means 5G adoption is proceeding at a pace four times faster than 4G, making it the fastest-growing mobile technology in history. However, 5G expectations are high, with operators promising a significantly enhanced customer experience through blisteringly fast data speeds, higher capacity, and lower latency. So far, 5G has been delivered using a similar low-band spectrum as 4G, so it's no surprise that speeds and performance are similar. The next iteration of the 5G experience will be enabled by a high-band or millimeter wave (mmWave) spectrum that will significantly enhance the speed and services we receive from a mobile network.



RIDING THE HIGH WAVE

Millimeter-wave delivers super-fast speeds over short distances and can accommodate more capacity and bandwidth than any other spectrum. It can move data — 10 gigabits (or 1250 megabytes) per second, an estimated 600x faster than 4G (using a low-band range). In other words, a subscriber can download a 4k video in a second. With the increased bandwidth, more subscribers are served. For operators, the short wavelength of mmWave allows for very small antennas, which helps with beamforming for enhanced coverage with massive MIMO and spectral efficiency. mmWave can also be a good solution indoors where the propagation characteristics become an advantage to avoid inter-cell interference.

Millimeter-wave delivers the types of speeds and performance that will enable next-generation use cases. Fast home broadband services through fixed wireless access (FWA) and new consumer and business services such as edge computing, augmented and virtual reality (AR/VR), and telemedicine. As of January 2021, 106 operators hold public licenses for 5G networks using mmWave spectrum, and twenty-four operators are known to be already deploying 5G networks using mmWave. Some examples are the recent launch of AT&T's millimeter-wave 5G service (branded as 5G+) in parts of Tampa, Florida, including Tampa International Airport. The service is designed to provide subscribers a high-band 5G service for faster streaming and downloading of movies and games, secure access to demanding business applications, and logistics like navigating around the airport and flight updates. In Japan, Rakuten Mobile launched 5G services on sub-6GHz frequency and mmWave in September.

Ookla[1] recently published benchmark data crowdsourced from actual users in commercial networks, comparing average 5G mmWave throughput to those of 5G sub-6 GHz and LTE. The finding shows that 5G mmWave performs up to expectations, achieving 3 Gbps in peak speed and average throughputs that are 6x+ faster than 5G sub-6 GHz and 20+ times faster than LTE in many cases.

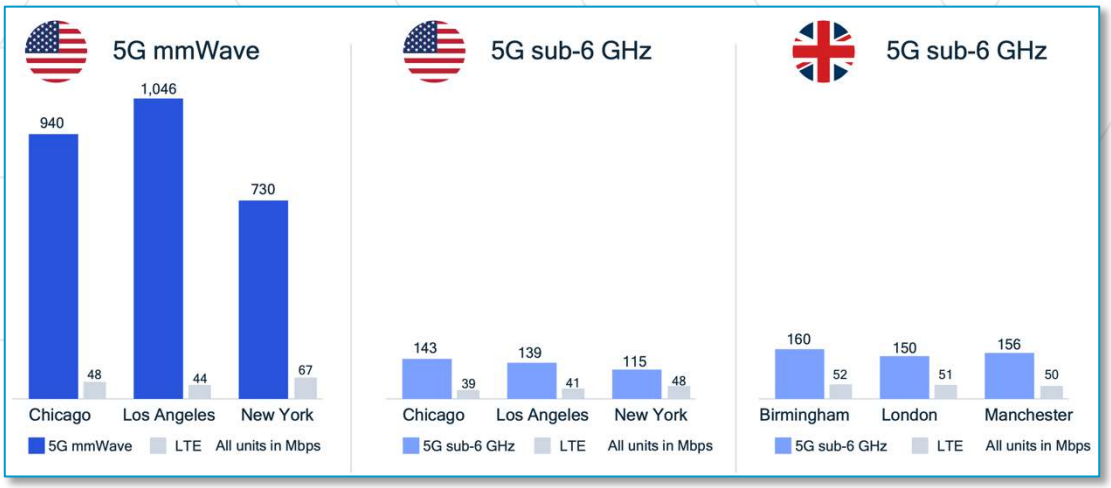


Figure 1 – Benchmark data shows mmWave is performing up to expectations

[1] https://www.qualcomm.com/news/onq/2020/06/01/mmwave-5g-devices-powered-qualcomm-snapdragon-can-deliver-4x-faster-5g

MILLIMETER WAVE USE CASES

- **Fixed Wireless Access (FWA)** for urban cities, suburban towns, rural villages. The Gigabit data rates of 5G mmWave will replace broadband to the home.

- **Outdoor venues.** Providing increased capacity in high-demand public spaces and venues such as concerts and sport stadiums. With cell sizes around 100m, small 5G mmWave access points can be placed on poles or buildings to provide the required coverage.

- **Mission-critical control applications.** Autonomous vehicles, vehicle-to-vehicle communications, drone communications, and other latency-sensitive, high-reliability applications scenarios will be enabled by 5G mmWave with a projected network latency of less than a millisecond.

- **Indoor hotspot cells.** Airports, shopping malls, offices, and other indoor areas such as manufacturing require a high-density of 5G mmWave microcells. These small cells will potentially support download speeds of up to 20 Gbps, providing seamless access to cloud data and the ability to support multiple applications, as well as various forms of entertainment and multimedia.

- **Industrial IoT.** Covering such uses as in factories, warehouses, and logistic hubs connectivity of IoT devices for data collection, control, and analysis. This can also cover smart home applications, security, energy management, logistics and tracking, healthcare, and many other industrial operations.

CHALLENGES WITH MILLIMETER WAVE

Millimeter-wave provides Line-of-Sight (LOS) coverage similar to Wi-Fi. Typically covering up to ~100 meters, although some testing has resulted in a range up to 5 miles being achieved).

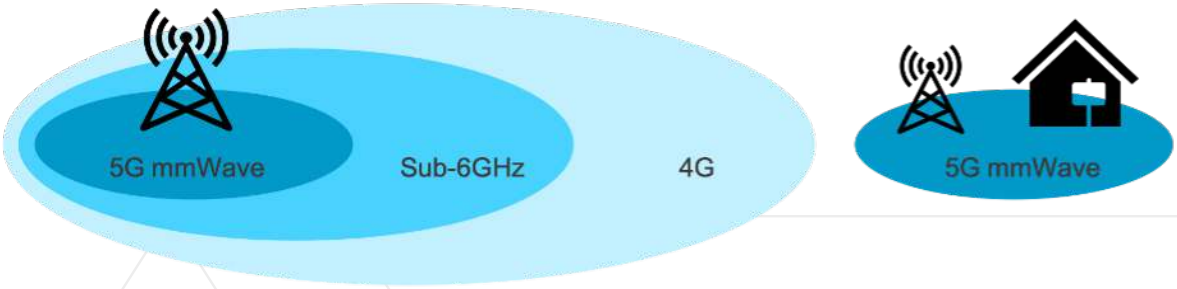


Figure 2 - mmWave delivers blistering speeds over Line-of-Sight (LOS) Coverage

These signals are also susceptible to interference from obstacles like trees and buildings and have difficulties penetrating through material, particularly concrete, glass, and wood. As radio frequencies get higher, they act like radar, bouncing off things instead of going through them. As operators roll out mmWave, a consistent customer experience needs to be provided to subscribers, particularly in transitioning from 4G areas and in handovers between cells running in high-band spectrum vs. low-band 5G spectrum. Some of the challenges operators need to overcome as they roll out mmWave:

DEPLOYING GREENFIELD NETWORKS

4G RAN is a known quantity, but 5G RAN is a greenfield technology. Also, many operators are opting to virtualize their 5G RAN. This can be in the form of Open RAN or vRAN. Open RAN (ORAN) is about splitting a Base Transceiver Station (BTS) into three parts and introducing one new network function, with open interfaces between these parts. Virtualized RAN (vRAN) means that the Baseband functions, such as L1, L2, L3, and transport processing, or at least some of them, are run by General Purpose Processors (GPP) on top of any Commercial off-the-Shelf (COTS) platform. (Before vRAN baseband functions run on purpose-built hardware). Moving to Open RAN or vRAN makes access networks more flexible and brings down the cost of managing and maintaining the network. However, this is a greenfield technology for all operators that needs to be learnt and the technology needs time to mature.

Operators are also deploying 5G RAN that runs different spectrum from low to mid and high-band, which is a huge challenge to manage and optimize. Gaining visibility into this greenfield technology through automated, end-to-end assurance will help operators mature, optimize and manage the technology and integrate these new RAN deployments into the legacy network, ensuring that customers receive a good 5G user experience.

ENSURING A CONSISTENT 5G EXPERIENCE

Because coverage is limited, the customer experience change can be huge, going from a standard 5G NR cell to a 5G mmWave cell. So, operators need to carefully monitor the quality of experience for subscribers so that the change in the customer experience is not drastically different—the same for throughput. Operators need to ensure that throughput doesn't parachute from Gigabits to Megabits in a few seconds transitioning the subscriber from blistering 5G mmWave speeds to much slower 4G speeds in the blink of an eye. Smartly monitoring the handover and transitions from these cell sites is critical and has to be part of any service assurance offering for 5G. Operators need to gain real-time subscriber analytics that provides customer-focused indicators into handovers and transitions from cells to optimize the customer experience and ensure that early adopters of 5G receive value for their money.

Optimizing cell location and coverage

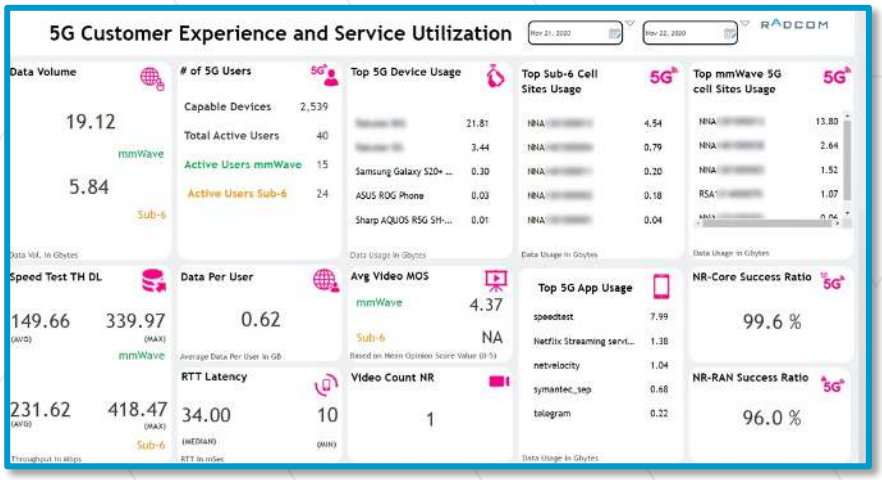
With their LOS coverage, mmWave cells are deployed outdoors in dense urban areas where there is a good concentration of subscribers, in a shopping mall, at the seafront, around airports, and train terminals. They will be positioned on lighting posts and advertising stands rather than rooftops. These deployments will provide multi-gigabit speeds with virtually unlimited capacity for a vast number of subscribers. Millimeter-wave will also be used indoors to complement existing wireless services offered by Wi-Fi. Inside convention centers, concerts, stadiums. However, with their limited coverage, the placement and optimization of these sites are critical. There are lots of challenges for operators as they roll out this technology and configure each site. Deploying an automated assurance solution will help operators smartly monitor their mmWave cell locations and optimize coverage. Once initial sites are deployed, automated assurance will also help operators pinpoint the best spots to place other sites and plan neighboring cells.

OPTIMIZE YOUR MILLIMETER WAVE DEPLOYMENTS

RADCOM ACE – our automated assurance platform for 4G and 5G - is already deployed today by customers to monitor 5G RAN, running mmWave spectrum. Our probe-based solution fully supports RAN/vRAN/O-RAN and offers real-time subscriber analytics and advanced end-to-end troubleshooting capabilities by monitoring both the control and user plane. RADCOM ACE provides Key Performance Indicators (KPIs), and Key Quality Indicators (KQIs) for 5G RAN running high-band spectrum, enabling you to optimize your mmWave and sub-6 GHz band deployments.

RADCOM's solution helps you. :

- Manage and optimize cells running mmWave
- Integrate mmWave into your legacy network
- Improve cell location
- Plan neighboring cells



RADCOM ACE enables you to see the different parameters for each cell, how they perform, monitor handovers, and help with planning additional cell deployments by mapping out all the devices and where extra coverage is needed. RADCOM ACE can show you where there are coverage holes in the current network (for example, by showing that there are many subscribers in certain areas and that they are not receiving the expected 5G service).

RADCOM ACE provides RAN monitoring as part of an end-to-end monitoring solution that enables you to gain complete network visibility and understand the root cause of an issue and the correct actions required to resolve it. RAN data includes core metrics such as Packet Jitter, Packet Loss, Timeouts, Throughput, and Connection Release Cause that can be collected and measured. As part of an end-to-end monitoring solution, these metrics, combined with the Core data, help you optimize the customer experience. In deploying this greenfield mmWave technology (with new frequencies, new coverage areas), integration is different to 4G. RADCOM ACE provides visibility into the customer experience level and not just at the service-level to ensure a smooth rollout of greenfield RAN technologies and ensures an enhanced user experience.

For mmWave, a loss of service or drop in quality is vital and much more essential than a standard cell as the effect on the customer experience can be significant. As these cells continue to be deployed, operators can utilize RADCOM ACE to monitor the quality, coverage, and subscriber usage to iron out the kinks and optimize their mmWave deployments. RADCOM's solution helps operators ensure mmWave by continually monitoring:

- Loss of service
- Low throughput
- The control plane (to troubleshoot drops in performance)

RADCOM understands the challenges and can help you assure these rollouts. It is crucial to integrate these new mmWave cells into the legacy network and optimize cell coverage to provide an excellent and consistent customer experience (whether the subscriber is at home, in the shopping center, or at the airport) and to plan further cell deployments. RADCOM ACE helps you manage, configure and deploy new cells and integrate them into the legacy network.

Figure 3 - RADCOM ACE shows cell performance on a map

Once a few mmWave sites are deployed, you can use RADCOM ACE to plan the best places to position other sites and then plan neighboring cells. Using RADCOM's solution, engineers can see each cell's different parameters, how they are performing, and handovers. All this information can be displayed on a map to show where devices are located in relation to the cell towers and where coverage is needed.

RADCOM ACE helps you manage, configure and deploy new cells and integrate them into the legacy network

SUMMARY

RADCOM ACE provides you with end-to-end visibility into greenfield RAN technology (running low, mid, and high-band spectrum). Enabling you to seamlessly integrate mmWave into your network, optimize 5G RAN performance, and provide a consistent, high-quality customer experience. RADCOM's solution offers dynamic, on-demand service assurance and network troubleshooting at a macro and micro level so customer-affecting network (RAN and core) degradations can be resolved quickly with minimal effort. RADCOM ACE is explicitly designed for telecom operators. It delivers Automated, Containerized, and End-to-end network insights that can collect smartly, process, and correlate data providing the necessary insights for the highest level of Quality of Experience (QoE).

RADCOM ACE utilizes built-in machine learning capabilities to deliver RAN insights automatically, saving the operator time in performing root cause analysis and detecting anomalies. Some of the different AI/ML use cases for the RAN are:

- IMSI journey
- Identify data hoggers
- Cell outage predictions
- Discover coverage holes
- Ping-pong effect identification
- Anomaly Detection
- Automated Root Cause Analysis

The solution seamlessly integrates into an operators' cloud infrastructure. It is controlled by leading network orchestration solutions such as Kubernetes (K8s) that manage all the assurance microservice components' lifecycle for a closed-loop and automated approach to service assurance.

For more information about RAN monitoring, visit: https://radcom.com/solutions/ran-monitoring/

RADCOMize your mmWave for 5G with RADCOM ACE

Visit our website at:
www.radcom.com