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MOVING HOSPITALITY FORWARD

5G FOR HOSPITALITY FREQUENTLY ASKED QUESTIONS (FAQ)

2 June 2020

About HTNG

Hospitality Technology Next Generation (HTNG) is a non-profit association with a mission to foster, through collaboration and partnership, the development of next-generation systems and solutions that will enable hoteliers and their technology vendors to do business globally in the 21st century. HTNG is recognized as the leading voice of the global hotel community, articulating the technology requirements of hotel companies of all sizes to the vendor community. HTNG facilitate the development of technology models for hospitality that will foster innovation, improve the guest experience, increase the effectiveness and efficiency of hotels, and create a healthy ecosystem of technology suppliers.

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1 Introduction

This document is intended to provide high-level responses to the most frequently asked questions on the topic of 5G (and how it interacts with Wi-Fi). It is designed to address questions from a number of different constituents in the hospitality ecosystem, so if you don't have time to read this entire document, we suggest that you choose from the following sections based on your needs and interests:

- General Overview
- Technology Definitions Explained
- Guest Experience
- Owner
- Brand
- Operational Advantages
- Appendix: Glossary

If you would like a deeper dive on 5G in hospitality and public venues, HTNG is in the process of creating a 5G white paper, which will be included in the Appendix of this document when the white paper is complete. If there are specific aspects of 5G which you would like to see covered in this white paper, please contact workgroups@htng.org.

1.1 Authors

While over 75 companies participated in the HTNG 5G for Hospitality Workgroup and contributed to the FAQ, the primary authors of this document are as follows.

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2 General Overview

2.1 Who are the standard bodies driving 5G requirements?

5G is not just one thing - it is a set of standards developed by various standard bodies. The 5G standards are expected to take mobile data speeds to new limits, and perhaps even more importantly, will allow for an increase in network efficiency by providing better network performance at lower costs. Dozens of organizations around the world have been formed to help establish research requirements and set the way for the creation of the next generation of mobile connection. Below are two of the biggest organizations expected to help publish 5G standards:

- **ITU-R (International Telecommunications Union Radiocommunication Sector)** works with administrations, network operators, equipment manufacturers, and national and regional standardization organizations to include today's 5G research and development activities in the IMT-2020 global standard for mobile broadband communications.
- **3GPP (3rd Generation Partnership Project)** is a collection of seven global telecommunications standards organizations which develops protocols for mobile telephony. This collaboration has worked to create and organize the standards for a number of mobile communication systems including 2G, 3G, and LTE. They are now engaged in research and development for 5G standardization.
- **What is ITU-R Defining for 5G?**
    - The ITU-R has defined three main uses for 5G. They are Enhanced Mobile Broadband (eMBB), Ultra Reliable Low Latency Communications (URLLC), and Massive Machine Type Communications (mMTC). Only eMBB has been deployed in 2019; in most locations, URLLC and mMTC are several years away.
    - Enhanced Mobile Broadband (eMBB) uses 5G as a progression from 4G LTE mobile broadband services, with faster connections, higher throughput, and more capacity.
    - Ultra-Reliable Low-Latency Communications (URLLC) refers to using the network for mission critical applications that require uninterrupted and robust data exchange.
    - Massive Machine-Type Communications (mMTC) would be used to connect to a large number of low power, low cost devices, which have higher scalability and increased battery lifetime, in a wide area. 5G technology will connect to some of the 50 billion IoT devices.
- **What is 3GPP Defining for 5G?**
    - The leading standards organization for cellular, 3GPP, is defining these three components to fulfill:
    - **5G NR (New Radio)** is the new set of standards the industry has agreed on to make 5G possible.
    - **5G NGC (Next Generation Core)** is employing several techniques to achieve the requirements to operate the 5G network. These will make the 5G network considerably more scalable, flexible and efficient, as well as support the trend toward the "softwarization" of telecommunication networks, which has been a major consideration in the development of 5G NGC specifications.
    - **MEC (Multi-Access Edge Computing)** reduces network stress by moving resources from the cloud to mobile edge. MEC architecture is designed to address latency and bandwidth issues for video analytics, location services, Internet-of-Things (IoT), augmented reality, optimized local content distribution, data caching and many other use cases and application scenarios for hospitality, smart cities, healthcare, disaster management and smart farming.

The scope of 3GPP activity, and of 5G generally, goes far beyond the 5G NR to include the 5G NGC (Next Generation Core), which is what enables enterprise-specific features like network slicing and MEC,

which is essential to low latency applications and the ability to managing overlapping public and private networks, like 5G NR and Wi-Fi. The 5G NGC and MEC are essential to fulfilling the performance, feature and use case requirements of 5G, and are independent of the 5G radio.

2.2 Why is everyone so excited about 5G and how can it be transformational?

5G is not just another G. What distinguishes 5G from its predecessors is that it aims to serve the enterprise. Rather than delivering an outdated network designed to deliver mobile broadband to virtually identical consumer handsets, 5G aims to address a diverse set of enterprise use cases and connected devices. For example, 5G will allow heavy data, time sensitive and latency dependent applications to simultaneously exist. The enterprise focus allows hospitality organizations to begin to choose the applications that sit on a 5G network, customizing service delivery and business models that are more flexible for enterprise deployment.

There are many 5G capabilities which benefit hospitality and will be seen prior to the widespread availability of 5G handsets, such as 5G Fixed Wireless (using 5G for broadband access) and MEC (multi-access edge computing). These functionalities will allow hospitality venues to leverage existing Wi-Fi investments indoors to receive the benefits of 5G outdoors.

2.3 What are the improvements of 5G over 4G/LTE?

5G benefits include faster speed, significantly lower latency, improved power consumption, higher reliability as well as higher capacity and device density for support (massive IoT).

5G's advances over 4G benefit both the guest/customer side and back-of-house operations for hospitality venues. For example, 5G operates with Wi-Fi networks to enhance IoT devices and applications. Coupled with network slicing for autonomous network customization and MEC to enable deep analytics, 5G enables a virtually purpose-built network for hospitality.

The application of network slicing enables public and simultaneous enterprise use of the same network. Through MEC and local breakout techniques, 5G networks will be able to offer visibility and analytics not currently available in 4G networks, allowing businesses to have greater insight into usage and performance analytics to understand and improve the quality of service and guest experience.

2.4 Is 5G a replacement technology or does it complement current technologies?

5G is complementary to Wi-Fi 6 and, over time, will replace older limiting technologies (such as 4G and legacy DAS) to enable new capabilities for property operations and for the guest. 5G brings more bandwidth, lower latency, better quality of service and improved scaling at higher densities that are shared capabilities with Wi-Fi 6. It also brings new advantages with MEC and more granular network segmentation with network slicing. 5G will enable new business opportunities and process improvements, such as:

- Guest personalization through unified identity management
- Mobile carrier services with integrated authentication and native Wi-Fi calling
- Replacing wired Internet circuits with fixed-wireless access 5G Internet
- Seamless mobility between public cellular and property Wi-Fi networks (mobility and continuity of service)
- Moving more business applications to the cloud
- Utilizing more IoT solutions

5G will complement rather than replace Wi-Fi. Continued investment in in-building Wi-Fi, particularly getting to Wi-Fi 6 as quickly as possible, will increase the opportunity for seamless mobility between 5G and Wi-Fi.

When considering the use cases one can expect 5G to serve the components that are available today. Hotels and venues looking to make sure they are on the right path should invest in upgrading their network to Wi-Fi 6, purchasing edge computing resources if they anticipate serving low latency use cases and beefing up their broadband capacity.

2.5 What business models will be available to the hospitality sector?

Venue owners, operators and hoteliers could see new business models emerge, moving from carrier-specific networks, to venue-owned networks with carrier provisioning as well as carriers providing edge computing PaaS (Platform as a Service)/SaaS (Software as a Service) models. 5G's enterprise-focused features could lead to specific tailored improvements in guest experience, upgrades and implementation. Consumers will eventually adopt 5G and will have expectations related to the improved experience, therefore hospitality businesses will need to be prepared with a level of investment that matches the business model they wish to operate within: single private, public or a combination of public carrier and private enterprise deployment.

2.6 Is 5G the only technology that can deliver these transformational benefits?

5G provides all of these transformational benefits in one solution. One way to look at 5G is that it offers hospitality venues an opportunity to leverage existing infrastructure investments in Wi-Fi. Hospitality owners have the ability to take advantage of the best of each technology, whether that be private 4G (CBRS) for back of house, Wi-Fi in building and/or 5G backhaul.

In order to realize the benefits of Wi-Fi/5G convergence, hospitality brands and owners must plan ahead and understand the use cases available for them. As with any technology decision, the balance of cost, deployment, availability and application support will be factors in deciding one technology over another.

2.7 When can we expect national coverage of 5G in most countries?

Carrier led rollouts of 5G offerings began in 2019 in key national and international markets. There are several factors that will determine the timeline for national coverage within countries across the globe, including:

- Government regulations
- Industry standards
- Spectrum availability
- Operator investment
- Device development and release

As with any new technology, the release of features, standards and its spectrum will take time to become fully realized and implemented.

In some markets, this may have a direct impact on the availability of coverage and service definition between the consumer and the enterprise. Rollouts can also be highly dependent on urban density requirements, the availability of infrastructure and the release of specific devices and applications support.

2.8 Will users need new 5G handsets and other devices to use the 5G networks?

Yes; 5G chipsets are needed on devices to take advantage of the new standards and will require either new handsets or other devices to be activated on a 5G network to enjoy the benefits of 5G.

2.9 Do you have to have a 5G end-user device to take advantage of 5G?

No, there are numerous 5G applications which require no 5G devices, such as fixed wireless and multi-access edge computing.

While 5G specifically will see the production of smartphone style devices for consumers, manufacturers are also producing integrated 5G chipsets for a variety of devices such as fixed wireless solutions, IoT and cloud related applications for the enterprise.

2.10 Why would I use 4G vs. 5G vs. Wi-Fi 6?

5G improves upon LTE (4G) security with multiple authentication methods and better key management. At the same time, Wi-Fi security continues to advance. Wireless routers configured with proper access controls and passwords are highly secure with new standards, specifically WPA3 and Hotspot2.0.

The 5G standard does add some new capabilities that 4G does not have, such as the ability for network slicing, higher connection density and MEC.

While these features are new for cellular, they are not new in the market. Enterprise networks, including Wi-Fi, have featured high connection density, network virtualization and edge computing capabilities for decades. When comparing 5G to Wi-Fi 6, the most important functional difference is 5G's ability to offer macro-area coverage and high-speed mobility. Wi-Fi was not designed to incorporate either of these capabilities.

Both Wi-Fi 6 and 5G are extremely reliable when deployed correctly. Although 5G is deployed using a licensed spectrum - which is less subject to interference than unlicensed spectrum - operating on licensed spectrum does not always translate to higher levels of reliability.

Numerous enterprise Wi-Fi customers have achieved extremely high levels of reliability and performance in demanding environments, such as large venues, convention spaces, etc. However, Wi-Fi 6 improves reliability even further. For certain applications, it might make sense to segment a specific private network on either a licensed spectrum, or a different band of unlicensed spectrum (for example, the recent approval for 1.2 GHz of 6 GHz spectrum for Wi-Fi and 5G NR-U or, CBRS for 4G today).

The reality is that Wi-Fi and 5G are both evolving to better serve end users, and both markets will grow to address the trend of connecting devices and analyzing the data generated by these devices. 5G will serve business apps requiring high-speed mobility and macro coverage, while Wi-Fi will continue to prove its value as a reliable, secure and cost-effective access technology for most enterprise applications, as it does today.

2.11 Are there any new privacy and security issues arising from 5G?

With any technology security is a continuous improvement cycle. 5G has improved security using multiple authentication methods and better key management over 4G LTE deployments. That though is not to speculate that 4G security was an issue, in fact, standard encryption methods in these networks are considered secure within the nature of a closed architecture system.

5G is more distributed in nature and with this comes benefits and considerations as an edge networking technology. As an example, when you push activity to the edge you move the impact of choke inspection points but must consider the software defined routing, apply enterprise cyber security rules and monitor solutions.

3 5G Technology Definitions Explained

3.1 Are there different types of 5G?

Regulators and standards bodies have divided the frequency spectrum into three relative areas of interest: Sub 1 GHz, 1-6 GHz, above 6 GHz. Each individual sub frequency area has the potential to offer and support different types of 5G applications. Sub 1GHz is a good candidate for urban dense coverage, IoT devices and in-building penetration. The 1-6GHz band is a mid-band spot in the 5G journey for a balance of bandwidth and coverage, where most mobile devices today sit sub-5Ghz. For the highest speeds that are associated with 5G technologies, the 6GHz band and above (mmWave) are typically where the higher throughput and capacities will be realized for 5G networks. Ultimately, the use of any part of the spectrum will be a combination of country regulation and spectrum availability to operate, matched to devices that are built on specific frequencies.

3.2 What is mmWave (Millimeter wave)?

mmWave (Millimeter Wave) have a wavelength between 1mm and 10mm. The use of these short wavelengths, in the range of 28GHz and 60GHz, will offer the optimum carrier signal and bandwidth to allow the transportation of large amounts of data in gigabits over shorter distances. The trade-off for mmWave is that the coverage of 5G using the 6GHz above spectrum will have a smaller coverage zone and limited (if any) structure penetration.

3.3 What is 5G New Radio (NR)?

5G NR is designed to be the global standard radio interface for 5G. Currently 5G networks are, for the most part, running in a hybrid mode or non-standalone mode where elements of the 4G LTE network are used for something such as control functions. The long term 5G will operate in a standalone mode where the network will use its own signaling and control methods versus 4G.

The idea is that while all the previous Gs have been about connecting phones, 5G will need to connect everything from wearables to utility meters to cars. These standards relate to items including using different kinds of spectrum frequencies, enhancing coverage by using Massive MIMO and advanced beamforming, reducing latency, and improving how capacity is allocated across devices.

3.4 What is 5G NGC (Next Generation Core)?

The requirements for the network for 5G will be particularly diverse. In one instance, very high bandwidth communications are needed, and in other applications there is a need for exceedingly low latency, and then there are also requirements for low data rate communications for machine to machine and IoT applications. Amongst this there will be normal voice communications, Internet surfing and all of the other applications that we have used and become accustomed to using.

To achieve the requirements to operate the 5G network, several techniques are being employed in 5G NGC. These will make the 5G network considerably more scalable, flexible and efficient and support the trend toward the “softwarization” of telecommunication networks, which has been a major consideration in the development of 5G Next Generation Core (NGC) specifications.

- **Software defined networking (SDN)*:*** Using software defined networks it is possible to run the network using software rather than hardware. This provides significant improvements in terms of flexibility and efficiency.
- **Network functions virtualization, NFV*:*** When using software defined networks, it is possible to run the different network functions purely using software. This means that generic

hardware can be reconfigured to provide the different functions and it can be deployed as required on the network.

- **Network slicing*:*** As 5G must support different applications, a scheme known as network slicing has been devised. Using SDN and NFV it will be possible to automatically configure the type of network that an individual user will require for their specific application. In this way, the same hardware using different software can provide a low latency level for one user, while providing voice communications for another using different software. Additionally, other users may want other types of network performance and each one can have a slice of the network with the performance and applications needed.

The 5G NGC network will be able to utilize far greater levels of flexibility to enable it to serve the increased and diverse requirements placed upon it by the radio access network and the increased number of connections and traffic.

3.5 What is the difference between 5G backhaul and 5G end user access?

Backhaul, by definition, is transported from the site (hotel or venue) to the core of the carrier network. 5G end user access is the signal going from the radio/antenna to the device.

3.6 What is MEC (Multi-access Edge Computing) and what does it offer for hospitality?

MEC was originally introduced by ETSI (The European Telecommunications Standards Institute) as "Mobile Edge Computing" which is designed to bring cloud-computing capabilities and IT service environments to the edge of the mobile network. This environment is characterized by ultra-low latency and high bandwidth, as well as real-time access to radio network information, that can be leveraged by applications. Since 2017, ETSI renamed MEC "Multi-access Edge Computing" to better reflect the growing interest in MEC from non-cellular operators ("multi" applies to Wi-Fi, 4G, 5G, etc.). MEC reduces network stress by moving resources from the cloud to mobile edge. Multi-access MEC architecture is designed to address latency and bandwidth issues for the video analytics location services, Internet-of-Things (IoT), augmented reality, optimized local content distribution and data caching along with many other use cases and application scenarios for hospitality, smart cities, healthcare, disaster management and smart farming.

In hospitality, applications and traffic are brought closer to the user, taking advantage of lower latency and added control by the network in which it is operating. A simple example would be caching of video at a site. Instead of having to stream video from a central point via the internet, an MEC instance could cache video streams and play them locally, improving performance and reducing backhaul cost. MEC could also improve the latency and speed of PMS/POS functionality at the edge, smart buildings via IoT, intelligent video security and empower new applications such as AR/VR.

3.7 What is Network Slicing?

Network slicing allows different portions of the available spectrum to be partitioned for enterprise applications. For hospitality, this is an attractive implementation where multiple applications such as IoT, cellular, guest entertainment solutions will have the ability to co-exist, with high capacity and bandwidth in an isolated manner.

As such, this may provide operators and hospitality owners an opportunity to have virtualized spectrum slices allocated by brand, hotel or multi-application deployments within properties.

4 Guest experience

4.1 How can I use 5G to improve my guest satisfaction scores? Including guest engagement?

5G will enable hotels and venues to implement a much richer guest experience and enable guest engagement platforms which require low latency network support and massive compute power. These applications include conversational AI for F&B ordering and retail shopping, implementing video solutions for guest/staff safety and security and in-venue betting, to name a few. 5G opens the door to providing personalized, differentiated "in the moment" experiences which improve the ability for hospitality venues to engage with their fans and guests in a meaningful and frictionless way. Below are a few examples which require low latency and compute power provided by 5G MEC:

- Immersive Virtual Reality (VR) and Augmented Reality (AR) Interaction:
  - Virtual concierge
  - Remote property augmented reality tours of guest rooms and resort areas
  - Self-service pre-stay personalization that interacts with PMS and IoT devices for room service, spa/golf bookings, etc.
- On Property Stay/Venue Visitation
  - Virtual game play and cloud video gaming
  - 4K media streaming to devices
  - Real-time personalization of guest services
  - Video streaming and social media consumption
  - Staff alert solutions
  - IoT room sensors

4.2 When will 5G devices be available and will my guests want to use them?

As of 2020, consumer device manufactures are evaluating their releases of 5G technologies built into cell phones. With any new technology, there are always early adopters and the use within a property will be determined by the carrier Macro network rollout and willingness for enterprises and carriers' agreements to bring the 5G signal into the building.

As with all cellular technologies, guests will have an expectation that 5G will work in-building. What position each hotelier takes – investing in DAS, adding 5G small cells, and/or leveraging Wi-Fi to support 5G in-building, will depend on several factors, including the investment required and the solution best suited for each building.

With converged Wi-Fi cellular and 5G, native Wi-Fi calling may be implemented rather than requiring the 5G signal be brought in-building. This may prove to be the more cost-effective solution.

4.3 Will there be 5G user devices (handsets) that will operate across all 5G bands?

The operation of 5G bands will be a regulatory decision by country, each working with operators and granted license holders. It cannot be assumed that all bands will be available in every country. Device manufacturers will design according to the specific bands of operation allowed in each regulatory and country domain.

4.4 Will I need good 5G coverage across the whole property?

For general property guest access, it is not a requirement to have 5G coverage throughout a property.

It will be important to evaluate areas in properties and venues with the typical applications that will be used, matching this with the appropriate technology to deliver service. In some applications, such as stadium environments, capacity spikes may demand a higher rate of 5G coverage for social and video applications. Whereas within a hotel property, 5G coverage areas may be best suited to public spaces and large capacity venues, such as conference and outdoor spaces while Wi-Fi or other networking technologies may be the lead technology with 5G support. Ultimately, the device in use will need to be able to transition across technology boundaries to support the guests' applications. Increasing the use of IoT and associated applications that support or rely on 5G could change this need (i.e. business driven applications versus the cost of investment).

4.5 Could guests' devices maintain connectivity between areas of 5G coverage and Wi-Fi?

To enable network connectivity across 5G and Wi-Fi coverage areas, the standards bodies have developed standards (3GPP r16/17) which will be implemented over time. Devices generally will have an automated system selection mechanism (connection manager) that the user can likely alter based on their connection preference just like today on 4G LTE and Wi-Fi.

Hotspot 2.0 acts as a bridge between Wi-Fi and cellular technologies, enabling the guests to maintain seamless network connectivity as they move between 5G and Wi-Fi coverage areas. Like cellular networks, it automatically discovers the Wi-Fi network and securely connects to it using existing SIM credentials. Devices must support this capability.

5 Owner

5.1 Have there been any 5G deployments in hospitality?

Yes, most deployments of 5G through early 2020 are focused on large venue deployments. Hard Rock Stadium was enabled with Verizon 5G including mmWave and edge-compute for the super bowl attendees.

There have also been announcements in China for 5G smart hotels that are placing 5G small cell trials for 4K TV, gaming and VR exercise equipment where bandwidth is heavy.

5.2 Should I invest in Wi-Fi upgrades if 5G will be available soon?

Yes, hoteliers and property owners should continue to upgrade their existing Wi-Fi networks to Wi-Fi 6, and implement Hotspot 2.0 to improve guest satisfaction.

Wi-Fi 6 will remain a viable technology for client and data applications in parallel with 5G from mobile operators. Both technologies are complementary to one another for the services they will offer to guest devices and IoT applications in hospitality venues.

Wi-Fi 6 can be seen as a cost effective privately owned solution, designed within the boundaries of a property, whereas initially, 5G will be an operator-led deployment with wider coverage where owners will gain access to operator wireless signals entering the property as in 4G LTE today.

5.3 How can I monetize/take advantage of the presence of 5G on my property?

Initially, operators are focused on a core build out of 5G networks, driving adoption at the consumer level. Therefore, any presence on a hotel property servicing a guest will be with a service plan offered by a mobile operator directly.

However, as 5G evolves and additional portioning of spectrum is undertaken, opportunities for venues and hotel brands to co-operate a private slice of the available spectrum is a possibility. For example, large venues and properties could offer wireless replacement services for wired connections; offer dedicated bandwidth to conventions and concerts and service bandwidth-hungry applications such as cloud gaming and augmented reality applications.

5.4 What are the market conditions that trigger an investment?

Such a trigger could be a result of various factors, including:

- When user density reaches a point where current technology can no longer support (e.g. excessive load, high bandwidth applications)
- When the physical environment does not allow the propagation of the 5G radio waves (e.g. bad cellular coverage)
- When a new use case demands infrastructure upgrades (e.g. Hotspot2.0, edge computing, network slicing)

5.5 Will 5G devices drive an upgrade to the physical connection into my building?

Bandwidth consumption is driven by guests and applications that sit on the physical property network, regardless of 5G service and coverage.

Internet connection upgrades into buildings are being driven by guest devices connected to the property-owned network for Wi-Fi access and guest room entertainment solutions offering streaming and content services.

Conversely, there are cases where property Internet connections are not meeting the bandwidth and usage demand of guests and applications. 5G enabled with unlimited data plans may offer guests the opportunity to offload traffic and consumption of the property bandwidth if in-building 5G coverage and capacity is provided.

5.6 What is the relative cost of 5G vs. Wi-Fi 5?

The current macro deployments of 5G services have no cost impact on owners; 5G deployment is born by the mobile operator deploying service that will surround a property. The relative cost for 5G build out is based on the coverage of an entire cell or metro area and the required supporting cell infrastructure to operate a service.

Wi-Fi 6 will be an owner/property cost as an upgrade to the private property network relative to the size of the property and the needed coverage of Wi-Fi service. If 5G in-building is required by a hospitality venue, then implementation of a DAS and/or small cells will be required. Most likely a DAS, which generally requires a dedicated network infrastructure, is more expensive than a comparable Wi-Fi upgrade but each venue is unique and must be evaluated on a case-by-case basis.

5.7 Is a Wi-Fi 6 upgrade less expensive than upgrading to 5G?

Hotels and venues will need both Wi-Fi 6 and 5G compatibility to serve your guests and future connectivity requirements. Investing in Wi-Fi 6 today will prepare and enable 5G feature adoption once 5G and Wi-Fi 6 interoperate.

5.8 Would 5G mobile operators be interested in offloading onto my Wi-Fi network?

Potentially yes, but this will depend on several factors including:

- The size and type of property and if it is venue operated
- The number of users that are to be offloaded
- The application that requires offloading
- Physical property wired bandwidth capacity

The most critical aspect will be the investment into current solutions such as Hotspot 2.0 as the bridge to 5G.

There will be a balance in play. If we look at stadium events with thousands of attendees, then application segmentation for traffic types to support video replay versus social media streams, we should look to which network service will take and service the request, 5G or Wi-Fi6.

Within the standard guest room at a hotel, it is more often the case that the Wi-Fi network will be the primary point for data to flow from devices, with augmentation from 5G services when a Wi-Fi network is congested. Additionally, there may be IoT and safety applications that will be offloaded to 5G rather than saturating the Wi-Fi spectrum leaving it available for guests on property.

5.9 Could I own a private 5G license?

This will depend on the regulatory and government bodies of each country allowing the use of spectrum for private owners. Spectrum assignments will favor the cellular operators deploying 5G. It is more than likely that assigned cellular operators will have opportunities for private organizations to operate certain sections of spectrum in conjunction with their services. Alternatively, the regulatory bodies that govern the wireless spectrums have opened other technologies for private use in both licensed and unlicensed bands.

5.10 Will my existing DAS (Distributed Antenna System) support 5G?

DAS will continue to play a role in the indoor penetration of cellular signals with some upgrades to existing DAS deployments allowing 5G services to be distributed. Different layers of DAS equipment may be required for different types of 5G (sub 6 GHz, mmWave, etc.). It is highly recommended that hospitality venues, with an existing or planned DAS implementation, begin asking their DAS providers what specific options are available to support 5G (and “which 5G”) in their buildings over the current/planned DAS.

If augmentation is required, it could take several forms, including in-building small cells, active DAS enhancement, fiber optic plant and edge computing.

5.11 Are there any health concerns around 5G radio waves?

Information regarding health concerns should be directed to official sources which provide guidance on these matters. HTNG cannot make any health and scientific statements with regard to 5G.

6 Brand

6.1 When/under what conditions should 5G become part of my brand standards?

If 4G is currently part of your brand standards for staff devices, then you may want to start preparing to add 5G, perhaps initially as an option versus a requirement unless you currently have specific applications which require 5G. Typically, in brand standards, specific cellular technologies are not called out, rather the cellular coverage and capacity is addressed via a DAS brand standard. For this, see section 6.5 below.

6.2 Do I need to have good 5G coverage inside the properties to deliver AR/VR applications?

It will depend which applications are being provided in-building, but consistent frame rates are very important for things like VR, so bandwidth and latency will have specific needs, which will dictate if 5G, and which 5G is required. The same could be said for things such as cloud gaming. AR/VR is being piloted and deployed today and additional developments will emerge once these networks start to be more accessible. We are seeing more and more devices support AR/VR operations as well as third party devices like AR/VR headsets for fixed use. Having a network that supports both high bandwidth and low latency is critical for these types of applications.

6.3 Can I use 5G to augment my guest experience?

Yes, use case examples are given in Section 4.

6.4 How could 5G & Wi-Fi 6 with Hotspot 2.0 help enable improved guest identity?

The owner of the private network also owns the data shared by the guest. There are some restrictions on what can be shared based on PII (personable identifiable information), GDPR, and other privacy regulations. However, many guests and users may grant access to their data in exchange for an improved experience.

A Wi-Fi Hotspot 2.0 profile, which resides on the device, carries the guest identity in an encrypted form. The next generation hotspot system, deployed at the hotel property, is smart enough to automatically identify the guest when they arrive based on the Hotspot 2.0 profile on their device. This can amplify hotel loyalty programs by making guest check-ins seamless and enabling an automatic, cellular-like Wi-Fi connection experience no matter which hotel property they are staying at.

As mobile carriers have adopted Hotspot 2.0, Hotspot 2.0 provides a common bridge for unified authentication, policy, and provisioning between Wi-Fi 6 and 5G. Enterprises should consider adopting Hotspot 2.0 if they want to converge their Wi-Fi 6 networks with 5G. Depending on implementation, native Wi-Fi calling and data offloading may be supported.

6.5 Do I need to revise my Brand Standards for DAS to include 5G?

Some DAS manufacturers may be able to retrofit existing DAS to support some sub-6 GHz 5G services (although maximum 5G speeds may not be realized). 5G mmWave will require a new DAS layer (RF source, head-end as well as remotes, antennas, etc.). It is highly recommended that you speak with your DAS manufacturers and providers to ascertain how 5G will impact your specific DAS implementations from cost, disruption and business value perspectives.

7 Operational Advantages

7.1 Can I use 5G for IoT/sensing applications?

Yes. Internet of Things (IoT) has become an instantly recognizable term. It refers to smart, web-enabled devices that have more of a fixed functionality, as compared to general purpose smartphones, tablets or computers. Examples of IoT devices include connected thermostats, security cameras, door-locks and even connected kitchen appliances.

5G is an enabling technology for IoT, including sensing applications. 5G brings about a massively improved platform to deliver scalable and reliable connectivity to the world. The technology is designed to be high data-rate and low-latency. These two characteristics allow for fast real-time transfer of data between two or more points. This will allow for many new applications to be deployed that were not possible before 5G.

7.2 How does 5G compare with other technologies?

A lot will depend on the bandwidth and latency required. All the applications above are certainly in play for 5G, but could technically also work on 4G, Wi-FI and other standard protocols based on the performance needs. 5G will add network slicing, which will allow tighter control of these devices on the network, a higher level of security as well as data collection if MEC is employed by keeping data on/close to the site. A business can choose to keep some on Wi-Fi and move some, more critical, applications to 5G if they choose.

Whether a particular technology is appropriate for an application is highly dependent on the use case and cost model. Of the technologies listed, only Wi-Fi and 5G were intended to provide a generic wireless data pipe. Each of the other technologies is optimized for a particular type of data profile.

Both LoRA and Sigfox are optimized for sending small packets, very infrequently, over a relatively long range (~20km), using very little power. Sigfox is intended for uplink only where LoRA was designed to be bidirectional. Both technologies are optimized for a "sensor harvesting" use-case where the sensors themselves are typically battery-operated and need to be left unattended for long periods of time. Sigfox base stations (like cellular) are typically owned by network operators. LoRA gateways (like Wi-Fi) are owned/operated by the user.

Bluetooth, BLE and Zigbee are all short-range technologies that typically use the 2.4GHz ISM band; but their similarities end there. Bluetooth was designed for device-to-device wireless data transmission over very short distances (e.g. remote headsets and speakers). Bluetooth Low Energy (BLE) is an extension of Bluetooth designed to carry small packets between a sensor and a gateway at defined intervals with very low power consumption. The typical use case is similar to LoRA but over very short distances (e.g., Fitbit). Zigbee is a mesh network technology typically used in building automation and security systems. In a mesh network, an entire building of sensors may only require a single gateway.

The table below highlights the characteristics of these technologies and compares them to the requirements of a few typical hospitality use-cases.

Tech | Char	Latency	Bandwidth	Power	Optimized Data Profile	Network	Spectrum
5G	Low	Hi	Low – Mid	Any	Public	Licensed and Unlicensed
WiFi	Low	Hi	Low – Mid	Any	Private	Unlicensed
LoRA	Hi	Low	Very Low	Small packets, infrequent bursts	Private	Unlicensed
Sigfox	Hi	Low	Very Low	Small packets, uplink	Public	Unlicensed
Bluetooth	Mid – Hi	Mid	Low – Mid	Medium packets, bursts or streams	Private	Unlicensed
BLE	Hi	Low	Very Low	Small packets, infrequent bursts	Private	Unlicensed
Zigbee	Low – Mid	Low	Low	Small packets, bursty	Private	Unlicensed
App | Req	**Latency**	**Bandwidth**	**Power**	**Typical Data Profile**		
Panic Button	Low – Mid	Low	Low	Small packets, infrequent bursts		
TV Casting	Fixed	Hi	Hi	Hi bandwidth streams		
HVAC	Mid	Low	Low	Small packets, infrequent bursts		
Minibar Monitor	Mid – Hi	Low	Low	Small packets, infrequent bursts		

Figure 1 Technology & Application Details

5G networks are flexible enough to meet all of these use cases with greater security and manageability. While there may be a cost benefit to using one of these other technologies, the total cost of ownership should be considered when deciding on new installations.

7.3 Will I be able to use MEC for back-of-house applications?

Yes. Intelligent video application for security, crowd control and queue management come to mind. Technically, any application can be supported by an MEC environment, including PMS, POS, etc. Any applications requiring low latency, and heavy compute and processing close to the end user, are good candidates for MEC.

7.4 Will I need new 5G/Wi-Fi 6 devices for my staff or my IoT end-points?

In most cases, yes. New technology advancements require devices that support the new technology. This will vary based on the specific technology implementation.

7.5 Will 5G drive more usage on my on-property DAS or Wi-Fi 6 network?

This will depend on the applications implemented. Backhaul is simply the aggregation of the data used by the wireless system. As usage increases with 5G, just like Wi-Fi, backhaul would need to be increased in parallel. The difference with 5G is that the mobile network operator typically pays for the backhaul costs for cellular while the hotel bears the cost of increased Wi-Fi capacity.

7.6 Does 5G benefit building management solutions for properties and venues?

In-building systems such as HVAC, electrical and elevators with their respective thermostats, sensors and IoT devices, could benefit connecting to 5G networks via API and management protocols to form part of an enterprise building or control management platform. 5G cellular connections will be significantly faster than even the fastest LTE speeds currently available. Apart from faster speeds, 5G will bring much greater bandwidth and capacity to networks, just like Wi-Fi 6. This will enable an explosion of devices as networks handle higher usage without a slowdown.

It is important to note the 5G standard has attributes developed to directly embrace and enhance IoT device connectivity which will become available as the network matures. The 5G standard accommodates thousands of more devices per square kilometer, interoperability with other non-3GPP protocols and

provides virtual slices of the network (network slicing) to streamline and provide automatic flexibility directly supporting IoT devices, as well as other requirements.

Many of the systems deployed today are agnostic to an overall venue or property network design. Introducing and integrating a wireless technology such as 5G would allow the connection of machine-to-machine with the enterprise network, providing better visibility into overall property and venue operational needs, maintenance requirements, and integration into applications for guest-facing preferences.

The above, however, will be highly dependent on the cost effective integration of 5G chipsets into the respective in-building system technologies. Other forms of wireless technologies may be integrated by manufacturers of in-building systems, such as Wi-Fi 6, giving a choice of which wireless technology enables enterprise integration to the property and venue network.

8 Appendix

The appendices will be updated with additional content from HTNG workgroups and other resources as submitted to HTNG.

8.1 GLOSSARY OF TERMS

For the purpose of this document the following terms have been defined as follows:

Term	Definition
1G (First Generation)	A generic term to describe analog mobile telecommunication technologies such as AMPS (Advanced Mobile Phone System) and TACS (Total Access Communication System).
1X	Shorthand for CDMA2000 1X (also known as IS-2000), a 2.5G, CDMA-based technology developed by Qualcomm that builds on cdmaOne and is capable of peak data rates of 153 Kbit/s. 1X can be upgraded to 1X Advanced, which increases voice and data capacity for supported systems.
2G (Second Generation)	A generic term to describe early digital mobile communication technologies, such as cdmaOne, GSM and iDEN.
3G (Third Generation)	Technically used to describe technologies that fulfill the ITU's IMT-2000 requirement, but in practice a generic term to describe advanced wireless technologies that are capable of high data rates, such as UMTS and EV-DO.
3GPP	The 3rd Generation Partnership Project (3GPP) was established in 1998 with the goal of setting the standard of 3G. It is a collaboration between different groups that work on setting telecom standards internationally. Since its establishment, it has evolved to encompass 4G and is now working on defining 5G standards.
4G (Fourth Generation)	Used to describe technologies that fulfill the ITU's IMT-advanced specifications, such as WiMAX 2 and LTE Advanced. 4G technologies have flexible channel bandwidths, peak speeds of 100 Mbit/s when mobile and 1.5 Gbit/s when fixed, high spectral efficiency, smooth handoff between different network types and a flat, all-IP network architecture. In practice, 4G is also used to describe technologies that nearly meet these requirements such Mobile WiMAX and LTE. Today's 4G LTE networks use spectrum frequencies below 6 GHz.

4G LTE	4G LTE is the current network infrastructure, and it has been widely adopted and used globally. Until the 5G standard comes into prominence and full-realization, the current 4G LTE infrastructure will be vital to the evolution and functionality of the coming 5G network. In the past, transitions to new networks — 1G to 2G, 2G to 3G, 3G to 4G — involved the construction of entirely new networks. However, 4G LTE will remain a viable option for the foreseeable future. There will be a full transition eventually however, as the current LTE network is being pushed to its technological limits.
5G (Fifth Generation)	Initially, the term was defined by the ITU IMT-2020 standard, which required a theoretical peak download capacity of 20 gigabits. More recently, the industry standards group 3GPP has included any system using NR (New Radio) software. The 3GPP standards do not require any particular performance level. ITU has divided 5G network services into three categories: enhanced Mobile Broadband (eMBB) or handsets, Ultra-Reliable Low-Latency Communications (URLLC), which includes industrial applications, autonomous vehicles and Massive Machine Type Communications (MMTC) or sensors. Initial 5G deployments will focus on eMBB and fixed wireless, which makes use of many of the same capabilities as eMBB. 5G will use a spectrum in the existing LTE frequency range (600 MHz to 6 GHz) and also in millimeter wave bands (24-86 GHz). 5G technologies must satisfy ITU IMT-2020 requirements and/or 3GPP Release 15; while IMT-2020 specifies data rates of 20 Gbit/s, 5G speed in sub-6 GHz bands is similar to 4G.
5G PPP	This stands for '5G Infrastructure Public Private Partnership' which is a partnership between industry manufacturers, telecommunication operators, service providers and researchers aimed at delivering technologies and standards for 5G.
5G mMTC	This is one of the three subsets of 5G use cases. When fully deployed, 5G will be able to connect exponentially more devices per square kilometer. This will support the Internet of Things, with applications like smart homes, smart buildings and smart cities.
5G-NR	5G New Radio (NR) is the new set of standards the industry has agreed on to make 5G possible. The idea is that while all of the previous Gs have been about connecting phones, 5G will need to connect everything from wearables to utility meters to cars. The standards relate to things like using different kinds of spectrum

	frequencies, enhancing coverage by using Massive MIMO and advanced beamforming, reducing latency, and improving how capacity is allocated across devices.
ATIS	This stands for the 'Alliance for Telecommunications Industry Solutions' (ATIS) which allows information and communication technology (ICT) companies to convene to find solutions to their shared challenges. One of its current priorities is advancing the 5G network.
Capacity	The maximum data volume a network can support at one time in a given geography. To support the huge number of new use cases and devices associated with 5G, it is estimated that we will need more than ten times the capacity we are used to today. To get it, operators will need to use more spectrum than before, alongside new technologies like Massive MIMO. As with speed, this will be important for things like VR, 4K (and then 8K) video and other bandwidth-intensive applications.
Cloud Radio Access Network (cRAN)	Cloud Radio Access Network (cRAN) is a proposed architecture for future cellular networks, the deployment of which will not occur without virtualized networks. cRAN would move baseband processing currently attached to the radio into the cloud. This pooling of mobile resources in the cloud will centralize the RAN, make mobile connections more efficient, improve performance and decrease operational costs.
Coverage	The area served by a cellular network, to which devices can connect. Of course, some areas will always need greater coverage than others. There will always be more cell sites in city centers than in open country, but over time 5G will be able to cover the country far more effectively by adding newer, smaller cells (some the size of a suitcase). This means more towers to connect to and a better signal. The world is going to need better, more reliable coverage for things like critical communications, autonomous vehicles and IoT devices – as well as mobile phones and tablets.
DAS	Distributed Antenna System (DAS) is a network of spatially separated antenna nodes that are connected to a common radio and provide wireless service within a geographic area or structure.
Density	The maximum number of connections a network can handle in a given area at the same time. As more and

	more devices connect and work together, you will have a much richer, data-driven experience. But existing mobile towers will face ever-increasing pressure if we do not add to the infrastructure. 5G will not just cope with more devices, it is designed for more devices. Getting this right will open up possibilities such as smart cities and other IoT services that require a massive number of sensors.
EDGE (Enhanced Data rates for Global Evolution)	A 2.5G technology for GSM and TDMA networks that offers peak mobile data downlink speeds of up to 384 Kbit/s in end-user devices.
Enhanced Mobile Broadband (eMBB)	One of the three subsets of potential 5G use cases based on promised faster data speeds – up to ten-times-faster than 4G data speeds. It will allow large amounts of information to be sent and received quickly. It will support applications such as the streaming of high-quality AR onto work goggles out in the field or offsite virtual reality training.
Ethernet	Ethernet is a family of cables and technologies used for LANs (local area networks), physically connecting computers to networking devices.
ETSI	This is the European Telecommunications Standards Institute, which, as the name suggests, develops telecommunications standards.
Fixed Wireless	Fixed wireless broadband is one of two types of 5G services -- the other is cellular technology. Fixed wireless comprises wireless systems and devices in fixed locations, such as offices and homes. Subscribers receive Internet access without a specific wired connection, while operators will likely pay less for deployments, as fiber optics at fixed wireless small cell sites will replace time-consuming fiber optic lines they traditionally roll out.
Frequency	This is the electromagnetic radio-frequency spectrum used to carry mobile signals. Low frequency spectrum is where the distance/time between one wave and another is very long. With high frequency spectrum, the distance/time is very short. Frequency is measured in hertz, which denotes the number of waves per second. In 5G, there are three main frequency ranges: Low-band (below 1 GHz) – can travel long distances but at slower speeds Mid-band (1-6GHz) – can travel long distances at high speeds

	High-band (above 24GHz) – commonly referred to as millimeter, wave travels shorter distances but at very high speeds
G (as in 5G)	'G' stands for generation. Each generation of cellular networking is established by a set of standards that are developed by the 3GPP. These generations provide the theoretical standards that technology companies work toward through continuous improvements and iterations, getting progressively better over time.
GSM (Global System for Mobile Communications)	A TDMA-based 2G air interface technology used throughout the world.
Gbps	This stands for 'Gigabits per second' which is a measurement of data speed. 5G is expected to travel at many gigabits per second.
GHz	This stands for 'gigahertz.' 5G is likely to rely heavily on GHz frequencies.
GSMA	This stands for 'Groupe Speciale Mobile Association' (GSMA) which represents the interests of mobile operators worldwide, uniting nearly 800 operators with more than 250 companies in the broader mobile ecosystem.
HetNet	This stands for 'Heterogeneous Network' which refers to a network connecting computers or other devices with different operating systems or protocols.
IEEE:	This is the 'Institute of Electrical and Electronics Engineers' whose objectives are the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering and allied disciplines.
IoE	This stands for the 'Internet of Everything' and refers to the whole world of the Internet, including all the people and things connected to it, the process used for making those connections and the data that passes between people and devices.
IoT	This stands for the 'Internet of Things' and refers to connected devices beyond smartphones and computers. (e.g. lights, roads, cars, etc.)
IP (Internet Protocol)	Typically, an IP address is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication. An IP address serves two principal functions: a host or

	network interface identification and location addressing.
IP Multimedia Subsystems (IMS)	This refers to a specialized type of architectural framework, designated by the 3GPP, which is used to deploy multimedia services to mobile devices.
ITU	This stands for 'International Telecommunication Union' which is the United Nations specialized agency for information and communication technologies, so it is playing a large role in the development of 5G.
ITU-R	This is the Radiocommunication sector of the International Telecommunication Union (ITU).
Latency	Latency is the time between a data request and a response. For example, high latency is what causes unnatural delays in conversation when you are on a conference call. High latency is when their response seems unnaturally delayed. Although 5G will be a lot closer to real time, it still will not quite be there. Why not? Well, because it is theoretically impossible to get faster than the speed of light. While we will probably never eliminate this lag entirely, there are new solutions we can implement to reduce it, such as bringing the network closer to us, unlocking numerous applications that simply have not been possible before.
LTE (Long Term Evolution)	A OFDMA-based 3GPP standard, generally branded as 4G, that uses an all-IP flat network architecture and is capable of peak downlink speeds 100 Mbit/s and uplink speeds of 50 Mbit/s when deployed in a 20 MHz channel, and even higher rates if used with MIMO to deploy LTE in multiple channels. LTE is generally FDD, but also has a TDD implementation, TD-LTE.
LTE-Advanced	A 3GPP standard that builds off LTE, offering even greater channel flexibility and peak data rates of more than 1 Gbit/s.
mmWave (Millimeter Wave)	The millimeter wave is a band of radio spectrum between 30 GHz and 300 GHz that provides high-speed broadband connections to transfer data. This is the spectrum on which 5G operates. The millimeter wave spectrum travels at high frequencies in short, direct wavelengths, which is called line-of-sight travel. Due to the nature of millimeter wave, atmospheric changes -- like increased humidity -- and physical walls can affect performance and signal strength. The one major drawback to mmWave spectrum is its short propagation range, making it difficult to travel through

	buildings or obstacles. In using the mmWave band spectrum instead of the traditional cell towers, a new technology — small cells — will come into play.
mmMagic	This stands for 'Millimetre-Wave Based Mobile Radio Access Network for Fifth Generation Integrated Communications' which is a project focused on testing millimetre-wave frequency bands
MIMO (Multiple Input Multiple Output)	MIMO stands for multiple input, multiple output -- which is a transmission technology comprising multiple antennas for communication at sources and their destinations. MIMO uses smart antenna technology that combines available antennas for fewer potential errors in data transmissions and for optimized data speeds. In 5G terms, 5G has massive MIMO to help providers prepare their networks to support increased amounts of data.
Multi-User MIMO (MU-MIMO)	MIMO means "Multiple-input and Multiple-output." Antenna and Multi-User MIMO refer to methods by which data signals can be sent and received simultaneously.
MMS (Multimedia Messaging Service)	An improved version of the popular SMS that allows for the inclusion of larger amounts of text, images, audio and even video.
Mobility	This is how well a device can remain connected to a network while moving. As the system improves we will start to expect (and get) closer to the same level of experience on the move as when we are at home. This comes down to two factors – your signal strength and the network's ability to do hand-offs between the different sites you are moving through.
Mobile WiMAX	The common name for 802.16e since the technology includes support for high-speed client mobility. Mobile WiMAX networks are not backwards compatible with Fixed WiMAX networks and offer peak speeds of up to 40 Mbit/s in a single 20 MHz channel.
MVNO (Mobile Virtual Network Operator)	The common name of a mobile network operator whose mobile services are actually on other licensed operator networks.
NetworkEdge and MEC (Multi-Access Edge Compute)	The network edge refers to the most dynamic part of a network where the programmability allows for easier control of the workload. The increased flexibility of computing at the network edge makes it ideal for diverse use cases. It will allow providers to test new services — moving and uninstalling where needed and

	scale out when needed with greater ease and efficiency, all in real-time. When pushing 5G applications to the network edge, the application will run faster due to its physical closeness to the user. Innovation, across technologies today are using the network edge, and 5G will be no different. Edge computing is also sometimes referred to as multi-access edge computing (MEC), and the distinction is getting more blurred. MEC is a cloud-based IT service environment that operates at the network edge, allowing operators to host at the edge, while improving performance and connectivity.
Network Slicing	Network slicing is an architecture that separates virtual networks into individual partitions -- or slices -- that support different services and applications, all residing on the same hardware. Each slice has its own architecture, management and security. This architecture divides the user plane and the control plane, so the user planes move closer to the network edge. Network slicing is a primary feature of 5G.
NFC (Near Field Communications)	A high frequency wireless technology used at an extremely short range. NFC is often implemented in wallet style cards (such as credit, identification or mass transit cards) as an alternative to magnetic strips. This allows users to make so called “blink” transactions where their card is held in front of a card reader instead of being slid through it. NFC chips can also be embedded in mobile devices to allow the device to make blink transactions.
NR (New Radio) Frequencies	This simply refers to new radio frequency bands in which 5G networks can operate. These frequency bands are designated by the 3GPP in each of their releases.
NGMN	This stands for ‘Next Generation Mobile Networks’ which is an alliance dedicated to evolving the mobile broadband experience, with 5G being the next step..
NOMA (Non-Orthogonal Multiple Access)	NOMA is a method by which signals from multiple users can be separated and processed to support more connections to increase bandwidth and throughput.
OFCOM	This is the UK’s Office of Communications which is a government-approved regulatory and competition authority for the telecommunications industry.
OFDM	Orthogonal frequency-division multiplexing (OFDM) is a method of encoding data on multiple carrier

	frequencies: One data stream divides over separate channels with different frequencies. These separate channels help reduce and avoid interference. OFDM encoding is part of 5G's framework, with channels between 100 MHz and 800 MHz
QoS (Quality of Service)	Is the description or measurement of the overall performance of a service, such as a telephony or computer network or a cloud computing service, particularly the performance seen by the users of the network. To quantitatively measure quality of service, several related aspects of the network service are often considered, such as packet loss, bit rate, throughput, transmission delay, availability, jitter and more.
RF	This stands for 'Radio Frequency' which refers to any electromagnetic wave frequencies from 3kHz to 300 GHz.
RTC	With real-time communications, users can instantly share information and data with little to no latency. RTC provides direct access from sources to destinations, as these live communications do not require storage. RTC is a touted promise of 5G networks.
RAN (Radio Access Network)	The physical radio layer at the front of each wireless network that provides the RF connection to the end user device.
Small Cell	Small cells are special, low-powered wireless radio access nodes which have a short range from 10 meters to several kilometers. They are used as an alternative to larger macro cell towers for a variety of reasons. Small cells have the capacity to transfer low-, medium- and high-band data spectrums, such as millimeter wave. Because of 5G's high speeds with limited ranges, small cells will boost and ensure reliable signal strength to benefit 5G signals. Unlike cell towers, small cells are located every few blocks instead of miles. While their portability makes them ideal for urban environments, there are concerns that they will be difficult to arrange in rural areas due to the sheer numbers that would be required.
Small Cell Densification	Effective network planning is essential to cope with the increasing number of mobile customers and bandwidth-intensive services competing for limited

	radio resources. Operators like Optus have met this challenge by increasing capacity, adding multi-antenna techniques and implementing more efficient modulation and coding schemes. However, these measures alone are insufficient in the most crowded environments and at cell edges where performance can significantly degrade. Operators are also adding small cells and tightly integrating these with their larger mobile site networks to spread traffic loads, widely maintain performance and service quality while reusing spectrum most efficiently. Small cells are primarily added to increase capacity in hot spots with high user demand and to fill in areas not covered by the larger mobile site network – both outdoors and indoors. They also improve network performance and service quality by offloading from the larger sites. An example of where Optus has deployed small cells is in the Royal Botanic Gardens in Sydney.
SMS (Short Message Service)	Often referred to as text messaging or simply "texting," SMS is a text-based communication service used to send short messages (generally under 160 characters in length) between mobile phones.
Spectrum	This refers to a specific set of broadband frequencies – measured in Hz – in which a wireless network operates. Licensed - The portion of the spectrum that has been bought from the government by telecommunication providers for their exclusive use and management. Unlicensed - Portions of the spectrum that are free to use. Because these parts of the spectrum are free to use, there can be problems, like interference, and an acceptable quality of service is sometimes harder to achieve.
Speed	Speed is literally how fast data can be transferred. When fully deployed, 5G has the potential to be ten times faster than 4G. Instead of HD, UHD (4K and eventually 8K) will become standard. File size will no longer be an issue. Rich, content-filled websites become a benefit rather than a challenge. This will be hugely important for things like VR, UHD video and cloud-based gaming. And who knows what new use cases businesses will come up with when these speeds become possible at scale.

Radio Convergence	This refers to the ability of 5G to "converge" with Wi-Fi, providing a more seamless experience when used in dense, indoor deployments.
Real-Time Communications (RTC)	This refers to the simultaneous or near-simultaneous communication of data between two points, with negligible latency.
Unlicensed Spectrum	In March of this year 3GPP began a study, led by Qualcomm, about 5G operating on unlicensed spectrum bands, all the way to mmWave. Defined by the FCC as "license exempt," users do not need an FCC license to operate in this spectrum. In bringing this to 5G, it will offer greater capacity, better spectrum usage, and unique deployment scenarios primarily because a wider variety of use cases will have access to the technology, regardless of whether they have a license or not. While 5G will likely not operate solely on unlicensed spectrum, the pairing of both licensed and unlicensed spectrum will allow mobile operators to provide more capacity and bandwidth, making 5G faster for consumers. This model is one that Google supports on the premise of "abundant bandwidth for everyone."
Use Cases	One of the reasons it's taking so long for 5G to be defined is because 5G will be used in a diverse group of use cases. The substantial growth of mobile networks requires these higher 5G speeds for everything ranging from video streaming to virtual reality to automated cars. One likely use case will be health care, where 5G might be used for wireless remote surgery, for example. For automated cars, 5G will enable enhanced safety, awareness, and overall connectivity. Commercial use cases and trials for 5G consistently include video streaming at unprecedented speeds, the solving of video traffic dilemmas, and virtual reality uses. Additional tests and trials are being run by 5G operators.
]Virtual Radio Access Network (vRAN)	The Virtual Radio Access Network (vRAN) involves virtualizing the functions in the RAN. This translates to separating functions from a traditional remote radio unit or base station and running them as virtual network functions (VNFs). This will reduce the total cost of ownership and increase performance and scalability. The deployment of vRAN, ahead of 5G standardization, will enable mobile operators to future-proof their networks in anticipation of 5G updates.

VLAN (Virtual LAN)	Virtual LANs are defined using special software, allowing for network segmentation, traffic filtering, and the splitting of network traffic.
VoIP (Voice over IP)	A term used to describe any service that provides voice communication over a network with IP-based architecture. This could refer to services such as Skype, which provide voice calling over the Internet's IP network, or a voice service for a carrier that is being delivered over an all-IP mobile network.
WRC	This stands for 'World Radiocommunication Conference' which is held every three to four years (the last one was WRC-15 and the next is WRC-19). It is the job of the WRC to review radio regulations and international treaty governing the use of spectrum.
Wi-Fi	A wireless network for connecting computing devices, as defined by IEEE 802.11 in the 2.4 GHz, 3.6 GHz and 5 GHz frequency bands.
WiMAX (Worldwide Interoperability for Microwave Access)	Refers to a set of implementations of the IEEE's 802.16 wireless network standards supported by the WiMAX Forum, which certifies vendor equipment to ensure interoperability. WiMAX requires an all-IP, network architecture, makes use of OFDMA, and generally uses unpaired, TDD spectrum.
WiMAX 2	The common name for 802.16m, which is expected to be the first truly 4G WiMAX technology capable of mobile data speeds up to 120 Mbit/s in a single 20 MHz channel. 802.16m will succeed 802.16e, and it is backwards compatible.