dish wireless

DISH WIRELESS
Next Generation of Guest Experience in Hospitality

White Paper – September 24, 2021

This white paper explains how DISH's private 5G wireless network will allow the hospitality industry to improve guest loyalty, increase efficiency and prioritize the safety of employees by leveraging historical investments in connectivity solutions.

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EXECUTIVE SUMMARY

The hospitality industry is evolving at an unprecedented pace. Properties must solve for expanded and differentiated guest expectations driven by new technologies and changed traveler behavior, as well as create improved operating efficiencies through automated solutions. The emergence of COVID-19 sent shockwaves throughout the travel industry, forcing operators to think of innovative ways to provide guests with an environment that makes them feel safe while optimizing the operators' finances. As a result, connectivity has become a major factor in guests' overall experience and satisfaction. Many of these solutions rely on autonomous data collection and wireless control requiring low latency, increased connection capacity and high reliability -- the three pillars of 5G. Robust wireless connectivity enables properties to understand their guests' behaviors and how efficiently their property is being operated.

Historically, standalone Wi-Fi installations have been the norm for public guest connectivity, allowing properties to enhance their guests' experience, but as technology evolves and the number of connected devices increases, new solutions are required to enable further innovation. The next generation of cellular connectivity is poised to improve upon these infrastructures to take the guest experience to the next level while providing increased longevity of technology and reduced need for hardware upgrades.

Today, private 5G networks are emerging as a strong complement to Wi-Fi networks, offering enhanced performance and an improved way to manage disparate applications that traditional cellular networks have been unable to provide. The purpose of this white paper is to explain how DISH's private 5G wireless network will enable the hospitality industry to significantly improve guest loyalty, increase operational efficiency and prioritize the safety of their employees by leveraging historical investments in connectivity solutions. Private 5G will not only leverage previous investments in Wi-Fi, but it will also bring new capabilities for operators' guests and employees. DISH's private 5G network will serve as a neutral host, allowing guests and employees to enjoy a seamless experience between the public 5G network and a venue's private 5G network, regardless of service provider. And, through enhanced authentication, guests will be able to move between the 5G network and Wi-Fi without a drop in connection, even if a guest has never been to the property.

This evolution is made possible by DISH's commitment to build the United States' first, cloud-native, O-RAN-based 5G network. The private 5G network DISH is building will empower hospitality brands to deliver personalized experiences by harnessing the rising demand for enhanced connectivity for both guests and the business itself.

BUILDING A BETTER ON-PROPERTY SOLUTION TOGETHER: 5G AND WI-FI

Many view private 5G and Wi-Fi as competing solutions; however, in reality it's quite the opposite. Private 5G networks are designed to not only work with existing Wi-Fi solutions, but enhance Wi-Fi capabilities and create a more robust and reliable connectivity solution. Combining a private 5G network with Wi-Fi will allow end users to experience the best of both solutions while enabling a variety of new use cases.

A private 5G network can integrate with existing Wi-Fi and other unlicensed, low-power, wireless protocols that IoT devices use, making for a more simplified and seamless network solution that leverages properties' prior network investments. And, while there will continue to be a need for devices that operate over Wi-Fi and other technologies across the hotel property, such as mobile phones and laptops, Wi-Fi and 5G are complementary technologies that will benefit from coexistence.

Using DISH 5G as a complement to Wi-Fi infrastructure allows the property to realize a higher return on investment due to the longer life cycle of cellular vs. Wi-Fi and the cloud-native nature of the network. In general, new Wi-Fi generations are released every few years, requiring properties to upgrade access points and compatible devices to the latest standard to provide the speeds and coverage expected by guests. Alternatively, cloud-native network updates are software-based and don't require lengthy downtimes to replace access points or costly hardware.

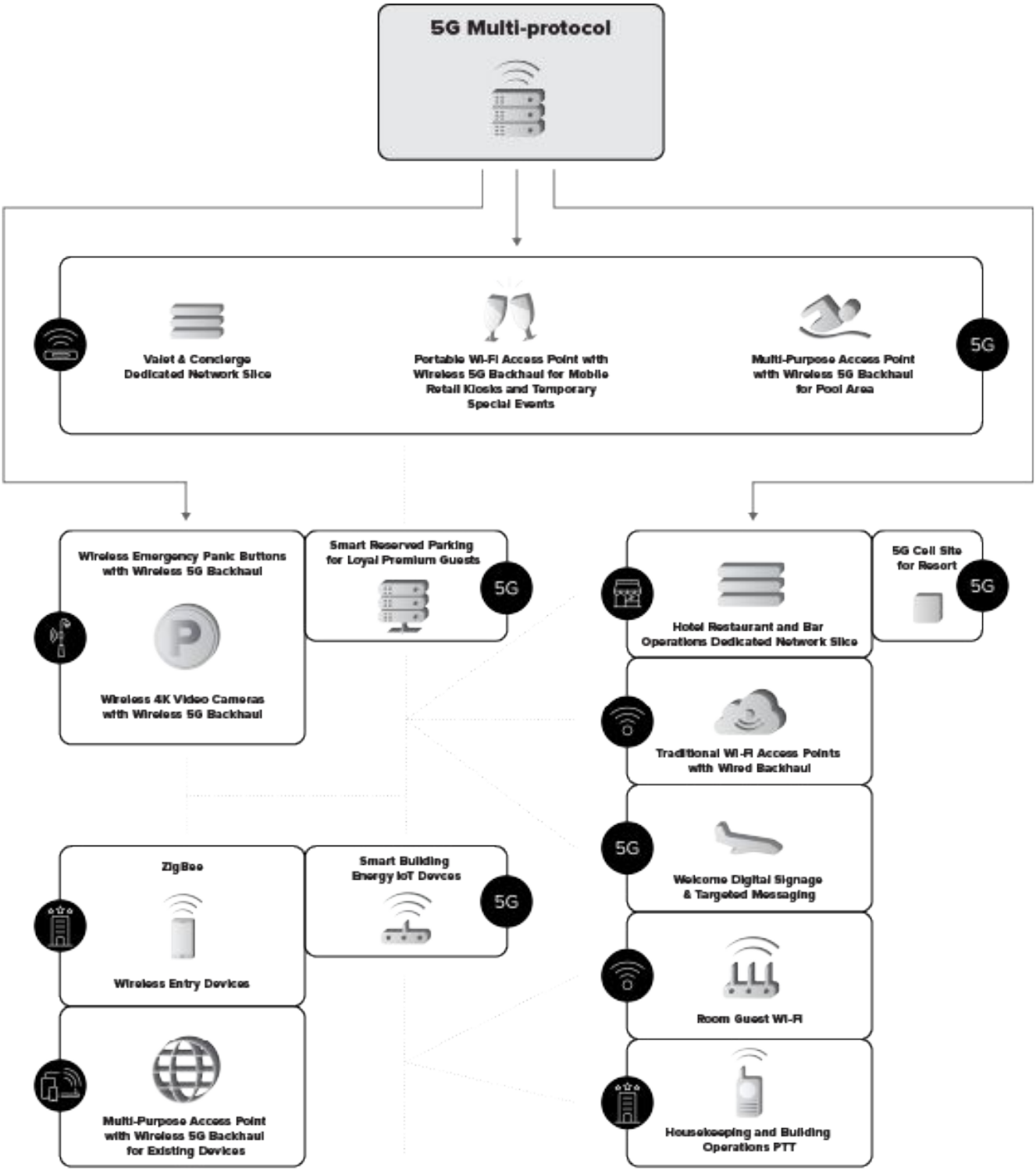
From a property coverage perspective, Wi-Fi is ideal for indoor use cases, while the characteristics of 5G can help supplement these networks outdoors where Wi-Fi leaves gaps in coverage. In properties with large outdoor spaces like pools, beaches or outdoor dining areas, the costs of filling these gaps with Wi-Fi can add up quickly. Supplementing the gaps with 5G is a significantly more economical solution.

The 3rd Generation Partnership Project (3GPP) has set the foundation for the convergence of Wi-Fi and 5G by including integration specifications for untrusted Wi-Fi in "Release 15" and trusted Wi-Fi in "Release 16." A single 5G core can integrate Wi-Fi and 5G, and offer a seamless experience for devices that may benefit from connecting over both signal protocols, enhancing the value of Wi-Fi for pertinent applications. This gives hotels flexibility so they don't have to immediately

replace or upgrade Wi-Fi access points. Furthermore, the integrated network can support seamless voice and data session handovers between Wi-Fi and 5G. Mechanisms in the private 5G management framework will identify authorized Wi-Fi networks and connect using a device's 5G credentials, enabling authorized devices to leverage Wi-Fi and 5G radio equipment simultaneously.

By utilizing both an existing Wi-Fi network and modern 5G technologies to create a private network, properties will be able to create robust connectivity solutions — not only for their guests, but also for their property management. **Figure 1** shows how a property can utilize a private 5G network to complement existing infrastructure for the enablement of new use cases. This will lead to more effective and efficient operations, saving the property money, driving new revenue opportunities and improving the guest experience.

Figure 1 - Private 5G Network Example



CREATING NEW OPPORTUNITIES THROUGH PRIVATE 5G NETWORKING

In addition to complementing current technologies, private 5G networks offer new opportunities for a variety of properties. First, private 5G utilizes many different licensed spectral frequencies, including CBRS. The use of licensed spectrum allows for a range of frequencies (low-, mid- and high-band) to be allocated and/or reserved for specific customer needs, providing an intentional customer experience. The dedicated spectrum can then be managed more effectively, since the single license holder has full control over its authorized use. Furthermore, outsiders cannot legally operate equipment in the licensed band without permission from the license holder, so the risk of interference from unauthorized users is virtually eliminated. A private 5G network can also designate quality of service (QoS) parameters for specific users or device groups through network slicing. Private 5G networks offer hospitality operators the capabilities to dynamically provision and partition a set of network services, functions and resources (slice) from end-to-end, including the spectrum itself. Each individual slice can be tailored to specific needs within the property operations. For example, one slice could provide a minimum required data throughput for guest connectivity, offering each guest room a guaranteed amount of capacity based on the individual guest's loyalty status. Another slice could be allocated for building safety, such as video surveillance, providing both data prioritization and cybersecurity while keeping hotel operations' data traffic segregated from guest-generated traffic. Yet another slice could be used to dictate how the most sensitive data traffic remains in compliance and within the network boundaries to meet customer proprietary network information.

Property Management and Operations

Hotel and resort properties have invested in wireless networks to serve the needs of guests and the general operations of the business. With the introduction of smart building automation, management of these properties is yielding new opportunities to increase energy efficiency, reduce operating costs, enhance guest comfort, create new revenue streams and invest in overall safety. This includes devices such as IoT sensors and industrial-IoT (IIoT) control system equipment that integrates with a building's electrical, mechanical and HVAC systems using cloud-based applications to significantly reduce energy consumption and

associated costs. Properties utilizing modern technology solutions can fully outfit guest rooms with control devices to minimize waste due to customer behavior. To illustrate this, data suggests that most guests do not take the time to re-adjust the thermostat, turn off lights or turn off the TV when they depart, resulting in an average per room energy cost of $2,200 per year. With the increased number of devices that a private 5G network can serve, properties can automate these actions to be performed as soon as the guest checks out or leaves the room. These types of automated efficiency solutions can reduce operating expenses while improving the operators' bottom line. While installations can be done using Wi-Fi, 5G enables a larger quantity and diversity of devices to be connected, and gives each device an intentional networking experience suited to specific requirements. A private 5G network can communicate with most IoT or IIoT devices or sensors, regardless of the wireless protocol it uses. A customer's existing IoT systems can be routed through gateways that convert wireless protocols to be compatible with a 5G core. This allows properties to implement a new 5G network and integrate existing equipment instead of requiring costly upgrades, with the added benefit of giving the property the opportunity to control all IoT devices from a single management platform. To realize the full benefits enabled by a next-generation wireless platform, a private 5G network's core should be cloud-native, making it easier to interface with cloud-based tools and reducing the amount of time required to provision new services on the network. A cloud-native network allows properties to quickly respond to fluctuations in demand, giving capacity where it is needed and immediately impacting the customer experience. The network is then able to self-realize changes and automate resource dedication. These efficiencies not only benefit the end-customer, but also result in a more cooperative, cost effective property operation.

Properties with a private 5G network can also improve guest and employee security. For instance, the high bandwidth and lower latency of 5G can be utilized to enhance a property's security cameras by live-streaming 4K resolution without adding additional cabling or hard-wired infrastructure to the security camera system. Having multiple live-streaming 4K cameras on the premises allows for an increased level of threat detection that is only made possible through next-gen wireless technology.

Through network slicing, a property is able to segregate traffic carrying sensitive data onto a slice of the network, providing a heightened level of security with reduced-access policies and enhanced threat monitoring. Moreover, malicious content can even be segregated out of a production environment and onto its own virtual network, which improves property security while preventing and reducing the threat of future cyberattacks. In short, network slicing helps to keep guests' and operators' data and information safe and secure.

Private 5G Enhances the Guest Experience

As 5G technology evolves, the guest experience will be enhanced in a number of different ways, benefitting both the hospitality industry and its guests. These enhancements will improve the hospitality experience of today, and will positively impact future use cases that have yet to be implemented. Thus, the availability of a highly flexible 5G solution that thrives in innovation is imperative to the future of the industry.

Smart Guest Room and Contactless Service

The demand for greater control and customization of a guest's stay is growing quickly as technology erases boundaries that previously stood in the way of properties meeting their customers' demands. With Wi-Fi and 4G, limits on device connections and bandwidth can prevent total room integration with IoT devices. Performance becomes significantly reduced as the number of devices connected to each gateway increases. Due to improved device connection capacity with 5G, hotels can outfit guest rooms to be fully controllable through a guest's mobile device. Using a brand-specific application, guests will be able to perform actions, such as setting the temperature, opening or closing blinds, turning the lights on and off and even managing the in-room entertainment, in a personalized and contiguous manner.

These smart capabilities improve the overall customer experience by allowing guests to configure their room to their specific preferences before arrival and throughout their stay.

A guest's ability to control their stay doesn't stop at their room; it can extend throughout the property. Certain use cases can only be enabled through the near-real-time response and high bandwidth that 5G delivers. By leveraging a 5G private network, a property can deploy fully autonomous robots to perform services that historically required an employee. This is increasingly important as guests begin to return in a post-pandemic world. For example, guests ordering room service, requesting laundry services or needing something from the on-site market could use their smartphone to request a service, define where and when the service is expected and manage the delivery mechanism, which could include a contactless, autonomous vehicle or connected robot.

Guest and Partner Connectivity Throughout the Hotel Property

Smart Parking Solutions:
Guest connectivity includes more than smart room capabilities. The entire property can be connected to ensure the guest receives the highest quality experience from the beginning of the stay to the end. When a guest arrives at a venue, parking can be an inconvenience. Valuable time is often wasted looking for an open parking spot. It can leave a bad first

impression on the guest and get their stay off on the wrong foot. While current wireless technologies have created early use cases of smart parking solutions, a private 5G network can enable more advanced, manageable and interactive smart parking solutions to operate efficiently and effectively, allowing customers to park easily without the help of a parking attendant or spending valuable time searching for an available spot. Using a network of IoT devices, parking facilities can proactively inform guests of capacity levels in real-time and indicate where open spots can be found. This takes the guesswork out of searching the garage for an open parking space and eliminates unnecessary stress for the guest. Properties have the unique opportunity to take smart parking a step further by combining it with AI capabilities. Using a mobile app, guests can find an open spot that is most convenient to their final destination, whether it's the guest's room, the spa, conference center or any other location.

Guest Entertainment:
DISH has the unique capability to provide hospitality customers with both wireless connectivity and TV entertainment, not only in-room, but around the property. As a longtime player in the satellite TV industry, DISH will be able to provide customized bundles that allow its hospitality customers to use DISH for their wireless connectivity and TV solution needs. As a single provider of both wireless and TV, DISH is able to offer customers cost savings and convenience by bundling solutions.

Using DISH's proprietary SmartBox technology, properties can provide their guests with up to 96 HD channels, a customizable guide and private channels while maintaining brand standards. The SmartBox supports any size property with a single unit taking up 93% less space than normal cooling racks and 90% less power with no costly rewiring.

Retail Experience:
A guest's retail experience can also be transformed by a private 5G network. When an operator allows onsite vendors to have their own slice of the network, they will not have to deal with the typical interference or security issues that often arise when using Wi-Fi. Vendors will be able to operate POS and check inventory without interruption. They will also be able to stream video in their stores, yielding interactive demonstrations to help them be more effective in their sales and delight guests with a more tailored experience.

Connectivity Across Properties:
Extending the experience outdoors, the nature of 5G technology makes it the optimal choice for continuity of experience. Properties with a private 5G network can offer guests and vendors seamless connectivity throughout the property. As a guest moves from indoor to outdoor, they will transfer their session onto the 5G network without the disruption in their connection that often occurs when moving between Wi-Fi access points. Using 5G, networks can be designed to provide coverage to areas like the pool, beach or green spaces throughout the property at a

fraction of the cost of deploying Wi-Fi to connect these spaces.

Multi-Access Edge Computing For Advanced Guest Services:
A key differentiator of 5G is the added capability for Multi-Access Edge Computing (MEC) to allocate computing power and storage closer to the devices and applications that require them most.

Moving processing power closer to the private network significantly reduces the latency for the acquisition and analysis of data, providing faster response times to people, machines and other IoT devices in real-time. This is accomplished by reducing the proximity required to compute the data, thus significantly reducing latency, in some instances to under 1 millisecond. The higher throughput and lower latency capabilities of 5G, combined with MEC supports a faster turnaround, allows for real-time analytics and high-throughput data use cases to be performed. These important improvements would be impossible to execute with legacy technology and today's traditional wireless networks.

Properties will have the ability to capture, analyze and act on customer behavior in real time and open new monetization opportunities. For example, 5G enables interactive digital signage, where data can be used to promote items that guests are likely to purchase based on learned behavior. This technology can be used throughout the property to suggest items/activities, or to improve experiences in the spa, dining options, retail space and property partners.

By utilizing MEC, hotels and resorts can implement new, state-of-the-art features, including biometric/facial scan check-in, room keys and personalized experiences for guests using historical data collected from their previous interactions with the brand or its mobile app. For instance, once a customer enters the property and is identified, they can experience auto check-in, have their room customized to their preferences, guide them through the property, suggest a plan of the guest's stay at the property and even recommend local attractions that might interest them. These recommendations can include new capabilities, such as immersive AR/VR that allows guests to purchase a multi-sensory experience where sights, sounds, smells and touch are conveyed in real-time. With the implementation of this innovative technology, properties have the ability to provide travelers the opportunity to "try before you buy" and sample local attractions before making the decision to visit or purchase a tour. The possibilities are endless with the implementation and integration of advanced technological capabilities coupled with modern MEC solutions.

WHY DISH?

DISH's approach to the deployment of its network puts the company at a unique advantage. By building a state-of-the-art, greenfield, cloud-native 5G network, without the burden of legacy 2G, 3G and 4G systems, DISH and its customers have the opportunity to fully realize the power of 5G at a nationwide scale.

DISH is taking a customer and developer centric approach to its 5G network implementation. The enterprise demand for 5G connectivity is growing exponentially, with diverse and diverging requirements. Instead of building a one-size-fits-all network and making assumptions about enterprise customer needs, DISH is embracing an open business model where customers and developers can utilize a 5G standalone network to do things more productively and efficiently and to innovate new products and services pertinent to their own business models. By engineering its network using O-RAN technology, DISH will offer its customers the ability to build a network that is tailored to their business requirements with the added flexibility of using best-of-breed technology partners of today, tomorrow and the future as capabilities evolve, without vendor lock-in.

DISH's 5G network is cloud-native, which means that it can leverage the unique capabilities of a cloud. Since the cloud can host network resources, like the network functions, these can be conveniently accessible from anywhere within the network coverage map. Redundant network functions can live in the cloud as a backup in case there is a service disruption, such as a power outage. Unlike traditional networks, cloud-native network infrastructure upgrades can occur with little to no network disruption. Cloud-native does not imply that the network resources are only in the cloud. Rather, it means that resources can be conveniently located in the cloud to support physical network infrastructure where it matters most. These same advantages apply to private 5G network infrastructure, providing flexibility to hotel operators.

DISH is dedicated to disrupting the industry by allowing customers to have unprecedented control over their network and the data behind it. DISH believes that allowing customers to have greater visibility into how their network is being used will allow them to make the best business decisions for themselves. In today's world, data is the key ingredient to any business that can be monetized in a variety of ways. DISH believes that the customer is the rightful owner of all performance and utilization

data created on their network, which means the data generated stays with the customer and can be used as they see fit. With cloud-native 5G, DISH will partner with the hospitality industry to transform guests' experiences into individualized, tailored stays, which will translate into improved property performance. These hospitality innovations form the foundation for future opportunities and enable a wireless-connected world to yield benefits tomorrow, not possible today.

Universal Modem Compatibility and eSIM

The traditional approach of carriers is to manage the modem and SIM cards for a specific user device. This causes two main problems for its customers: First, it requires customers to be committed to a carrier for their wireless needs. Second, it leaves them with bulky SIM cards that inhibit their use in small IoT devices.

Consistent with a cloud-native and open-networking approach, DISH believes competition is good for the market and will drive both innovation and best-in-class networking. To address these issues, DISH is adopting the "universal modem" support strategy for its customers. With this approach, enterprises can download different profiles from different carriers without being locked into any single provider for their connectivity needs. Multiple profiles can be supported simultaneously and devices will be able to dynamically optimize connectivity to the cloud, based on the objective function.

Another benefit for the hospitality industry is the smaller footprint of eSIMs rather than traditional SIMs. These eSIMs allow their use in sensors that would not typically be able to have cellular connectivity. This would work in devices such as an emergency panic button on a property that would normally have to be tethered to someone's phone. It will also work on smaller sensors that could be used to monitor different systems throughout the property. eSIM ensures that properties are operating at the highest levels of safety and efficiency.

Private 5G Network using Licensed DISH CBRS Spectrum

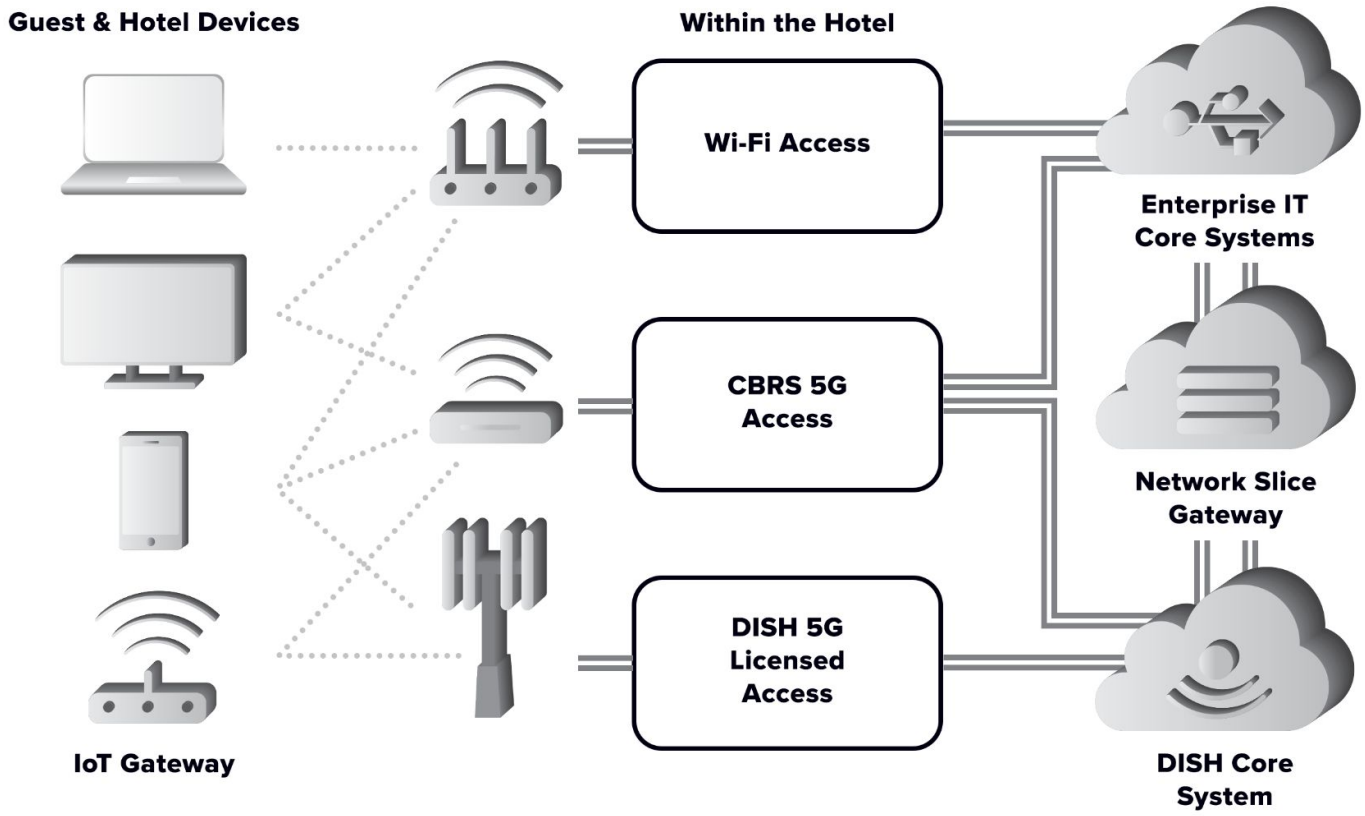
DISH was a major participant in the recent CBRS spectrum auction, acquiring Priority Access License (PALs) spectrum in every zip code in the lower 48 United States. PALs give DISH a unique opportunity to offer the benefits of CBRS private networks to the hospitality industry. Some advantages of a CBRS network include heightened security, uninterrupted spectrum access, enhanced mobility and the ability to use in conjunction with other technologies to leverage embedded capital for specific future use cases.

DISH holds a Tier 2 PAL license for CBRS spectrum. This licensed spectrum provides both uninterrupted access to CBRS spectrum over a private network and enables heightened security through the use of a Spectrum Access System (SAS), which is an automated frequency

coordinator that governs the CBRS spectrum, ensuring the private network remains secure. **Figure 2** depicts how a 5G private network supplemented with CBRS licensed spectrum can work together with existing wireless infrastructure.

Next-gen cellular technology improves on the security shortcomings of 3G and 4G by encrypting more user information, and because key functions are software-based, carriers can maintain a higher level of monitoring for threat identification. DISH has partnered with leaders of the industry with expertise in cybersecurity to design a state-of-the-art, zero-trust threat protection system to secure the network and ensure data integrity. DISH will implement containerized firewalls, DDoS protection and container security monitoring that will automate security functions, such as real-time threat correlation and dynamic security enforcement, allowing for efficient scaling and control. Using this model, DISH can rapidly respond to changing security needs and ensure all elements in the network, including people, are allowed access to which they are granted. The protection DISH offers is a total end-to-end solution, with monitoring occurring across all network elements, from the device to the user plane to the core.

Figure 2 - A complete connectivity solution for the property and its guests
5G-Grade Security



CONCLUSION

In the hospitality industry, Wi-Fi has traditionally been the wireless solution implemented to meet guest demands. However, as technology progresses and more devices become connected, the need to build upon existing infrastructure is paramount to meet all customer requirements, differentiate properties and further solicit and reward loyalty from customers.

DISH is taking a unique approach to building a 5G network for its customers. This network will unlock new potential while enhancing current experiences, all without requiring properties to completely replace, retrofit and rework existing infrastructure. By complementing Wi-Fi, 5G will not only fill the shortcomings of existing wireless solutions with more centralized control, lower latency and faster speeds, but it will also fuel the continued innovation that guests require in an experience-centric world. In the hospitality industry, DISH's private 5G networks will improve the guest experience and the way properties and employees are managed. With this combination, it will contribute to higher guest satisfaction and more efficient operations.

A DISH private 5G network has a distinct advantage over other carriers. Through adoption of eSIM, a large portfolio of CBRS spectrum and a commitment to providing the highest level of security to their customers, DISH is able to provide solutions that meet every customer need through customized network builds.

In today's connected world, the businesses that adopt next-generation technology will have an edge over those who are satisfied with the status quo. DISH is dedicated to being on the forefront of the change that 5G will bring to society and disrupting the current state of the wireless industry.

Table 1 - 4G/LTE Private Network vs 5G Private Network Implications

	4G Private Network	5G Private Network	Implications
Spectrum Efficiency	1-2 bps/Hz	> 3-4 bps/Hz	Lower Cost per MB/GB
Latency	Voice optimized	Data and application optimized	Real-time control and support from MEC
Reliability	Voice – Drops/Blocks	Packet loss and SLA Driven	99.9999% s and 99.99999% network reliability
Address Space	Consumer phone centric	IoT	> Connectivity Density
Device Authentication	Carrier Controlled	Enterprise Controlled	Integration with Enterprise applications
Security	Carrier Controlled	Enterprise Controlled	VPN level control from device to application

ACRONYMS

2G / 3G / 4G / 5G ..... Second / Third / Fourth / Fifth Generation

3GPP ..... 3rd Generation Partnership Project

AI ..... Artificial Intelligence

AR ..... Augmented Reality

CBRS ..... Citizens Broadband Radio Service

DDos ..... Distributed Denial-of-Service

eSIM ..... embedded SIM

IoT ..... Internet of Things

IIoT ..... Industrial Internet of Things

LTE ..... Long Term Evolution

MEC ..... Multi-Access Edge Computing

O-RAN ..... Open Radio Access Network

PAL ..... Priority Access License

PTT ..... Push-To-Talk

QoS ..... Quality of Service

RAN ..... Radio Access Network

SAS ..... Spectrum Access System

SIM ..... Subscriber Information Module

VR ..... Virtual Reality

About DISH

DISH Network Corporation is a connectivity company. Since 1980, it has served as a disruptive force, driving innovation and value on behalf of consumers. Through its subsidiaries, the company provides television entertainment and award-winning technology to millions of customers with its satellite DISH TV and streaming SLING TV services. In 2020, the company became a nationwide U.S. wireless carrier through the acquisition of Boost Mobile. DISH continues to innovate in wireless, building the nation's first virtualized, O-RAN 5G broadband network. DISH Network Corporation (NASDAQ: DISH) is a Fortune 200 company.

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