LEARNING MADE EASY

OnGo Alliance Special Edition

CBRS & OnGo®

for dummies®
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Get started with CBRS

Build powerful, reliable networks

Run your business better

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OnGo alliance™

Steve Kaelble

About the OnGo Alliance

The OnGo Alliance believes that 4G and 5G solutions, utilizing shared spectrum, can enable both in-building and outdoor coverage and capacity expansion at massive scale. In order to maximize the full potential of shared spectrum, the OnGo Alliance aims to enable a robust ecosystem toward making OnGo solutions available. The mission of the OnGo Alliance is to evangelize 4G and 5G OnGo technology, use cases, and business opportunities while simultaneously driving technology developments necessary to fulfill the mission, including multi-operator capabilities. The Alliance also established an effective product certification program for OnGo equipment in the U.S. 3.5 GHz band ensuring multi-vendor interoperability. For more information, please visit www.ongoalliance.org.

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OnGo Alliance Special Edition

by Steve Kaelble

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CBRS & OnGo® For Dummies®, OnGo Alliance Special Edition

Published by
John Wiley & Sons, Inc.
111 River St.
Hoboken, NJ 07030-5774
www.wiley.com

ISBN 978-1-119-74624-9 (pbk); ISBN 978-1-119-74618-8 (ebk)

Manufactured in the United States of America

10 9 8 7 6 5 4 3 2 1

Publisher's Acknowledgments

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Introduction

Ever since the days of Guglielmo Marconi, Reginald Fessenden, and other technological pioneers, the radio frequency spectrum has been a place where exciting things can happen. Today, it's congested and busier than ever, used extensively by virtually everyone in the world. The question is, how can we all share the spectrum as we continually create more and more ways for it to transform our lives and our work?

In the past, it's been more a matter of dividing than sharing. One user would get one part of the spectrum, and another would get its place elsewhere. Now, along comes the concept known as Citizens Broadband Radio Service (CBRS), which opens up a sizable piece of spectrum real estate for lots of sharing and different uses.

CBRS makes sophisticated technologies more available to anyone who needs better wireless coverage. That can mean more powerful and reliable networks for factories, universities, office buildings, stadiums, oil rigs, and countless other possibilities. It can mean opportunities for industry players, too, to offer new services and products. All the while, it promises to make wireless connections more cost-effective.

About This Book

OnGo is the name that the OnGo Alliance has chosen for this technological revolution, and *CBRS & OnGo For Dummies*, OnGo Alliance Special Edition, is your introduction to the revolution. Within the pages of this book, you'll learn how CBRS came into existence, who is sharing the spectrum in the 3.5 GHz band, and how the various parties can coexist successfully.

The book includes information about LTE and 5G NR technology, which becomes more widely available for private networks through the magic of OnGo and sets the stage for new 5G solutions. This book offers plenty of specifics about industries that can benefit, applications that OnGo enables, and business models that can thrive in the world of CBRS. And it provides a general roadmap for getting started with an implementation.

Foolish Assumptions

In writing this book, I've made a few assumptions about you, the reader:

- Your work involves evaluating, integrating, or deploying networks at an enterprise or government institution or perhaps a wireless provider.
- You're open to a new approach to improving wireless connectivity and services while also lowering the cost.
- You're intrigued by the concept of sharing spectrum so that more players can tap into shared licensed spectrum opportunities.

Icons Used in This Book

In the margins of the book you'll spot some helpful artwork. Consider these icons to be waypoints spotlighting extra-special nuggets of information.

REMEMBER

Read all you want, of course. But if you're limited in time or brain bandwidth, please pay special attention to the paragraphs marked with this icon.

TIP

Next to this icon is an actionable piece of advice for succeeding in the world of OnGo.

TECHNICAL STUFF

OnGo aims to make complex technology easier to use, but if you like techie details, you'll find some here.

Where to Go From Here

The next place to turn is, the next page! Or the next chapter. Or the last chapter. Read it all in order, or choose chapters or sections especially pertinent to you. Read whatever suits your fancy and your interests, because this book is intended to be consumed in the way that works for you. Just read on, plug in, and get ready for game-changing wireless opportunities!

IN THIS CHAPTER

- Exploring CBRS
- Sharing the band
- Implementing the FCC's vision for CBRS
- Managing the spectrum

Chapter 1
Getting to Know CBRS

As a best-selling book from the 1980s pointed out, most people learned the most important lessons in life at a very early age, like in kindergarten. One of those lessons, of course, is sharing. When there's something many people want or need, we all end up better off if we can find a way to share. That turns out to be true in the world of communications and data transmission across the radio frequency spectrum.

This chapter begins to tell the story about Citizens Broadband Radio Service (CBRS), as well as the overall concept for defining a slice of the spectrum and figuring out how multiple users can coexist within it. It talks about the vision of the Federal Communications Commission (FCC) for this new arrangement and spells out the basics of how this part of the spectrum is managed.

Exploring Citizens Broadband Radio Service

The best place to begin is with an understanding of CBRS, short for *Citizens Broadband Radio Service*. When they first hear about CBRS, a lot of people may think of citizens band (CB) radio, used for two-way communication by truckers and an indelible part of

1970s American pop culture (including a song that hit the top of the charts).

In reality, CB and CBRS are two completely different things, similar only in name and the fact that they both reside on the radio frequency spectrum. Still, just as CB radios allowed truckers to take vital communication needs into their own hands, CBRS helps enterprises do something kind of similar. They can build their own LTE networks, get into the 4G or 5G world themselves, and take over what until now they've had to rely solely upon service providers to handle.


TECHNICAL STUFF

CBRS lives in the part of the radio frequency spectrum between 3.55 GHz and 3.70 GHz. That's 150 MHz of valuable spectrum asset — when it comes to the spectrum, in fact, this is prime real estate. Just so there's no confusion, note that although this is a 150-MHz stretch of spectrum starting halfway through the 3.5 GHz band, some people like to numerically simplify matters and refer to CBRS as the *3.5 GHz band*.

This band is not unoccupied territory — users including the U.S. military already operate there. Powerful radar systems, including shipborne and ground-based systems, use this band. These types of radar enable military air traffic control, tracking enemy projectiles, and all kinds of other super-important tasks.

Fixed-satellite ground stations live here, too, downlinking transmissions from space. Wireless broadband service providers operate in this band as well. The users that have had access to the band historically are known as "incumbents." But today's technology enables a number of different users to coexist peacefully in this neighborhood of the spectrum.

There are rules and procedures and priorities, and a bit of give-and-take. New commercial users operating within these frequencies must not interfere with the incumbents already using them. But protocols are in place to make it all work smoothly, and most of these protocols are transparent to the user. The 3.5 GHz band is a tremendous opportunity for various organizations such as enterprises, wireless Internet service providers (WISPs), and others to take control of their communications in new and powerful ways while also providing service providers access to new spectrum.

That's good news, because the demand for data-intensive services is constantly growing. New uses are emerging all the time, with an ever-lengthening list of devices. New smart appliances, sensors, and assorted other objects all need to communicate. Service providers need more capacity within whatever part of the spectrum they can access, at a reasonable cost of operation. And enterprises are increasingly calling for their own private LTE services for special demands.


REMEMBER

The answer is *shared spectrum*, but the follow-up question is where to find the spectrum to share. With all the new uses and new radio frequency technologies constantly emerging, there's only so much room on the spectrum. Being able to operate commercial services within this part of the spectrum is a relatively new development.

Around 2010, the FCC went looking for some additional spectrum for mobile communications, and by 2012 started becoming especially interested in this slice of the pie. As a regulator, the FCC needs to ensure the most efficient use of scarce spectrum, and by 2015 it had come up with initial rules for commercial use of the CBRS band.

Sharing the Band


REMEMBER

CBRS works because it establishes a way to share a valuable resource, a specific piece of the spectrum. The basic concept establishes tiers of users, which helps to emphasize the priority of use. Here's how spectrum access is split:

- **Tier 1:** This tier is for the incumbents, those users who were "there first," so to speak. That includes the U.S. military's radar operations, both shipborne and land-based. It also includes fixed-satellite service and wireless Internet service providers. Radar operations use some or all of the 150 MHz of the spectrum between 3.55 GHz and 3.7 GHz (depending on time and location), and fixed-satellite stations are allotted the slice between 3.6 GHz and 3.7 GHz. Wireless ISPs live in the 3.65 GHz to 3.7 GHz range as a part of Tier 1, but in 2020 are mostly transitioning to the lower tiers under CBRS.
- **Tier 2:** This tier is reserved for what are known as *priority access license (PAL) holders*. Up to 70 MHz of the spectrum

within the lower part of the CBRS range is set aside for these users. Tier 2 includes up to seven channels of 10 MHz each. A given PAL owner may use up to 40 MHz in a county-based license area. All PAL owners together may use up to 70 MHz total in each license area.

- **Tier 3:** This tier is for *general authorized access (GAA) users*. They're allowed to use up to 150 MHz of the CBRS spectrum as long as they're not interfering with the needs of an incumbent or an active PAL user (Tier 1 or Tier 2).

REMEMBER

The FCC's three-tier system gives highest priority to the users in Tier 1. Those in Tiers 2 and 3 are not allowed to interfere with the operations of those in Tier 1. As you might guess, Tier 2 comes next in line. The PAL users there are protected from interference by the GAAs in Tier 3.

Up to seven PAL licenses are awarded within each U.S. county. With that 70 MHz spoken for, that frees up at least 80 MHz of frequencies that are available for GAA use as long as Tier 1 incumbents aren't using them. Plus, the GAAs have access to the 70 MHz of frequencies of the PAL licensees when they aren't in active use.

So, to put it simply, the GAAs are essentially second or third in line, but opportunistic based on their location near Tier 1 and Tier 2 users. They are gaining access to valuable spectrum and have plenty of good reasons to sign up for that status.

REMEMBER

First of all, GAA operation is "licensed by rule" and doesn't require an individual license, so the total cost of ownership is significantly lower. Just as important, a dynamic spectrum sharing system makes it all work. Read on for more details, but for now, recognize that it's a bit of technological magic allowing everyone to get what they need out of the shared spectrum.

OnGo: Delivering on the FCC's Vision for CBRS

CBRS, as implemented by the FCC, is compatible with 4G LTE and 5G NR networks. The FCC has promoted CBRS as the first mid-band spectrum available for 5G in the U.S. Technologies such as 4G and 5G are ideal for the deployment of private networks, and

CBRS provides accessible spectrum for that use. There's more on 4G LTE and 5G NR in Chapter 3.

Those familiar with a standard LTE architecture will recognize the term *eNodeB*, short for *Evolved Node B*. This piece of hardware is essentially a base station that makes the actual connection with mobile devices. In the world of CBRS, the transmitting entity or radio is known as a *Citizens Broadband Radio Service Device*, most often abbreviated as *CBSD*.

An LTE/5G NR architecture also has what's known as a *core network* providing 4G/5G services for device authentication, management, routing, and handling of data, text, and voice functions. Sure enough, a core network is a key part of OnGo architecture, too.

Here's one difference you'll see if you compare a basic diagram of an LTE network with a diagram of the CBRS architecture — CBRS has an additional node called the *Spectrum Access System*. Read on for a lot more detail about the SAS, but for now you just need to know that it's the secret sauce that makes CBRS work, the system that allows multiple different kinds of users to live in harmony in the same neighborhood of the electromagnetic spectrum.

To get a bit more detailed about how this architecture works, CBRS rules establish two classes of base stations (CBSDs), known as Category A and Category B. Those that are part of Category A are generally indoor stations, or low-power outdoor stations, with an effective isotropic radiated power no greater than 30 dBm (or 1W) per 10 MHz. These are like "enterprise-class" small cells.

On the other hand, a Category B base station is definitely for outdoor use. It'll have a maximum EIRP of 47 dBm (or 50W) per 10 MHz. It's ideal for fixed wireless and outdoor mobility use.

Managing the Spectrum

It's no secret that there's ever-more traffic on what back in the 1990s was often called the Information Superhighway, which includes the radio frequency spectrum. And what do you need when you have lots of traffic? A way to get all that traffic to the right place efficiently.

REMEMBER

In the case of CBRS, the SAS plays the role of a traffic facilitator. Think of it as kind of like an usher at a football game, who checks tickets to see who's supposed to be sitting where, and gets fans to the correct seats so all can enjoy the game. The SAS in a specific location will be sure various tiers of users are in the right places, all able to make use of the spectrum, all getting along well.

Understanding the SAS

The stadium usher has a map of the seats and makes sure there aren't so many people in one section that they block the view of others. As for the SAS, the job starts with a database of all of the base stations operating within the band. These base stations are the CBSDs. They all operate on specific channel assignments.

The SAS is cloud-based, and the FCC has set up the rules governing how it coordinates channel assignments. The SAS database knows everything pertinent about these CBSDs: their tier status, where they are located geographically, and other important details to coordinate channel assignment and help prevent or manage interferences. First on the to-do list is making sure nobody gets in the way of the important work of the military and the radar systems operating within this band — remember, those are the incumbents.

REMEMBER

To make that work, the SAS uses special sensors known as *environmental sensing capability (ESC)*. These sensors are set up along coastal regions, and their role in life is to detect incumbent activities, predominantly shipborne radar activity.

Although their military functions are incredibly important to the nation, these incumbent users leave behind a lot of excess capacity within the 3.5 GHz band of the spectrum. Because the ESC tracks when this use is happening, it also helps the SAS know when *unused* channels are available for others. CBSDs that want to use the spare space on the spectrum put in requests to the SAS, and the SAS can grant requests when the channels are free.

When an ESC sensor detects that a radar system is in use, it alerts the SAS. The SAS, in turn, automatically communicates with CBSDs in the area that are using the affected channels, causing

the devices to move to a different channel. It's like a traffic cop directing cars to switch lanes so that an ambulance can get through.

REMEMBER

A wide range of users will find the CBRS band to be a welcoming place, and it's up to the SAS to determine the best way to welcome them all. Some of the types of shared spectrum users include cellular carriers, third-party wireless providers, enterprise users, and other consumers.

You may come across articles contrasting CBRS and the SAS architecture with upcoming developments in what's known as the *mid-band spectrum,* (typically in the 3–4GHz range). It's the spectrum where a lot of 5G development is happening around the world.

In many other countries, 5G development is already well out of the gate in the mid-band spectrum, and the U.S. is moving in that direction, too, with CBRS leading the way.

CBRS development is significantly further ahead of the reallocation of the other parts of the mid-band spectrum. That said, 5G networks will live in both places, and CBRS coexists well in that big picture.

IN THIS CHAPTER

- Joining together
- Introducing OnGo by OnGo Alliance

Chapter 2
Meeting OnGo and the OnGo Alliance

Pick your preferred words of wisdom. "Great minds think alike." "Many hands make light work." "Teamwork makes the dream work." Whatever your favorite saying, most people agree on the power of collaboration. And there's a powerful collaboration of major players working hand-in-hand to bring CBRS to life in the United States.

This chapter introduces the OnGo Alliance, discusses why it was formed, and outlines its efforts to promote development of CBRS under the brand name OnGo.

Joining Together

Who wants to venture off into a brave new world or major challenge alone? After all, Han Solo had Chewbacca. Sherlock Holmes had Dr. John Watson. And Batman had Robin (at least in some of the Caped Crusader's crime fighting adventures).

Likewise, there's plenty of helpful company for your venture into the brave new world of CBRS, too. Start with the OnGo Alliance, an organization pulling together a variety of manufacturers,

implementers, managed service providers, and operators all interested in bringing LTE and 5G NR solutions to the world of CBRS.

More than 175 member companies are part of the OnGo Alliance. Founding members include major players such as Google, Qualcomm, Ruckus Networks (now CommScope), Intel, Federated Wireless, and Nokia. The nation's largest mobile carriers are members, too. The organization's mission is to bring innovation and diverse use of the CBRS band with 4G/LTE and 5G technology by:

- Evangelizing LTE and 5G based OnGo technology, use cases, business models, and opportunities
- Driving technology developments necessary to fulfill the mission, including multi-operator capabilities
- Identifying required advocacy steps, such as marketing, promotion, certification, branding, and regulatory issues, and by catalyzing action in these areas
- Establish an effective product certification program for LTE and 5G equipment in the U.S. 3.5 GHz band, ensuring multi-vendor interoperability

REMEMBER

OnGo Alliance has its own set of allies in its work aimed at spreading shared-spectrum solutions. For example, the Wireless Innovation Forum, or WInnForum for short, is a non-profit industry association advancing radio communications and spectrum utilization, which has developed the baseline technology-neutral standards for the CBRS band. It works with OnGo Alliance on such shared goals as supporting the use of 5G NR technology in the CBRS band (you can read more about 5G NR in Chapter 3).

Likewise, the kind of technological evangelism that is part of OnGo Alliance's work couldn't happen without alignment with such organizations as 3GPP. Short for 3rd Generation Partnership Project, it's a longtime industry consortium that sets standards for the wireless communications technologies used around the world.

Introducing OnGo by OnGo Alliance

If you've reached this page, you already have a sense of the technological wizardry that enables life in the CBRS band. Perhaps one of the biggest and most amazing tricks is the fact that this

technology is accessible and usable by people who don't have PhDs. That's the beauty of exceptional technology — it may be complex to create, but for the person or enterprise accessing it, it isn't nearly as complicated.

So, what should people call it? If it's really opening the doors to new possibilities, an acronym for four words is unwieldy. Think of other connectivity developments. Which is easier to remember, "short-wavelength UHF radio waves," or Bluetooth? "A wireless network protocol based on the IEEE 802.11 family of standards," or Wi-Fi?

REMEMBER

Meet OnGo, the brand introduced by the OnGo Alliance in 2018. It's one word that sums up the wireless connectivity that's possible in the 3.5 GHz band. It's a short, easy-to-remember word that represents agility and innovation, encompassing applications such as:

- Capacity augmentation for mobile networks
- Mobile offload for cable operators
- Fixed wireless access
- New Industrial Internet of Things (IIoT) and Internet of Things (IoT) applications
- In-building wireless
- Private LTE/5G networks
- Connectivity in public spaces
- Service offerings by neutral hosts and independent operators

OnGo, however, is more than just a name and a brand. Part of its introduction in 2018 was the launch of the *OnGo Certification Program*, designed to ensure that products operating in this realm enjoy end-to-end interoperability and excellent performance.

The debut of OnGo included the creation of a series of OnGo baseline technical specifications that align with the WInnForum standards, which are used in the regulatory certification process. One aim is to ensure that products carrying OnGo certification can simultaneously receive FCC certification while also being interoperable with the ubiquitous ecosystem of cellular technology devices.

REMEMBER

In launching OnGo, the OnGo Alliance spelled out some important advantages that the development would bring to member companies and the industry as a whole:

- A simple, powerful brand that puts the spotlight on the growing business opportunities tied to spectrum-sharing wireless solutions
- Economies of scale that come from access to the prevalent global wireless standards for mobile cellular radio, which at the time were highlighted by 3GPP 4G LTE with an eye toward 5G NR
- Certification that provides a foundation for interoperability and optimized product performance across the ecosystem ensuring reliable coexistence with incumbent services and between future networks

A term often used to describe OnGo is *uncompromised connectivity*. It's increasingly vital to maintain wireless services that are cost-effective and highly reliable, and that is the ultimate goal of all involved in this effort.

REMEMBER

Businesses have demanded better LTE coverage, but until now have not had an easy time making that happen in a way that's simple to use and inexpensive. This solution is exactly that, and it's a win for enterprises and neutral hosts as well as mobile and cable operators. The OnGo platform ensures that all of these players can enjoy seamless interoperability.

OnGo is far more than a brand name or a seal of approval. It's nothing short of a trust-building exercise offering reassurance to potential partners and users. It's a clear signal that the players in this business are working collaboratively rather than at cross-purposes, that they're designing an amazing today while also future-proofing tomorrow.

IN THIS CHAPTER

- Looking back on LTE history
- Enabling LTE and 5G NR with CBRS
- Understanding the RAN and the Core

Chapter 3
Learning About LTE and 5G NR

Plenty of characteristics distinguish OnGo from the communications paradigms that enterprises have had in place in the past. But one of the biggest selling points is that it has been developed to deliver the magic of LTE, which quite simply works better than what many organizations are using in their buildings, outside, and across their campuses.

This chapter takes a look at the history of LTE, including why and how it came about. It discusses how LTE and 5G NR capabilities unleash opportunities in CBRS. And it discusses the architecture that brings together the RAN and the core network systems in the LTE and 5G NR worlds.

Looking Back

REMEMBER

When historians write about telecommunications, their books are filled with stories of revolution — and also evolution. Technologies have evolved rapidly, creating revolutionary possibilities. Such is the case with the wireless broadband standard known as LTE, short for *Long-Term Evolution,* and also known as 4G.

In "people years," the standard hasn't been around all that long, but it has swiftly brought about astounding capabilities.

In 2004, the Japanese mobile phone operator NTT Docomo proposed what would become LTE. Within three years a global collaboration formed to promote the new standard and get the technology off the ground, hoping to improve upon the standard that was most often known as 3G. By 2009, the first LTE service was launched in Norway and Sweden, and within a year Samsung introduced the first LTE-enabled mobile phone.


REMEMBER

The rest, as they say, is history. LTE was introduced to boost the performance of telecommunications networks. It promised much faster data download and upload speeds than earlier standards, and its low data latency made it a better bet for uses that are highly sensitive to response time, such as gaming and online stock trading.

LTE also promised to use the frequency spectrum much more efficiently, boosting the capacity while also accelerating speed. More users could plug into the same cell capacity and expect better results. And it boasted a more advanced Internet protocol network architecture, while at the same time reducing both capital and operational costs for operators. It was a winning proposition all around.

The technologies that arrived through LTE were a definite improvement over the 3G service to which users had become accustomed. Similarly, 4G was a step up from 3G, in terms of speed, cost, flexibility, latency, and coverage. Together, 4G and LTE enhancements opened the door to new uses and raised expectations for what might come along next.

If you're counting on your fingers, what's after 4G should be 5G, the fifth-generation tech standard for mobile networks. Like all the Gs before it, it's overseen by the industry consortium known as 3GPP, the *3rd Generation Partnership Project*, which has been setting standards since the late 1990s.


REMEMBER

The term *5G* is most closely associated with any system using what's known as 5G NR standards (NR is short for *New Radio*). That definition settled into place in the latter part of 2018, and cellular providers have been deploying the technology around the world since 2019.

It goes without saying that 5G is better than 4G. Bandwidth is greater and download speeds higher. In fact, 5G is so powerful that the new networks can not only serve mobile devices, but also provide Internet service to desktop and laptop computers, directly competing with other ISPs. The revolution enabled by this evolution includes all new applications for Internet of Things (IoT) or Internet of Everything (IoE) devices.

TECHNICAL STUFF

What's the secret? Of course, entire textbooks could be written with all the technological details, but one key to the performance boost is the use of higher-frequency radio spectrum where greater bandwidth is generally available. The 5G model divides network operations into three frequency bands. The lower band is not all that different from what 4G technology uses. The mid-band 5G range makes use of microwaves between about 2.5 GHz and 7 GHz — which not coincidentally includes the CBRS range. High-band 5G lives in much higher frequency ranges. On a global basis, most of the commercial deployment of 5G at this point has been in the mid-band.

Enabling LTE and 5G NR with CBRS

The history lesson outlined in the preceding section has a lot to do with mobile telecommunications and the devices that we all carry around in our pockets or purses. It makes sense that lots of R&D and investment would go into continually advancing technologies that can improve daily life for billions and billions of people.

REMEMBER

That, however, is really only a piece of the story of LTE and 5G NR. Yes, most of those billions of people think of it as phone technology, because they see the little "LTE" and "5G" logos flashing into view at the top of their smartphone screens.

But these technologies offer a lot of value across many industries, for many uses, through the development of private networks. That's where their intersection with OnGo becomes so exciting.

Tapping into LTE

First, step back to consider how vital wireless networks are across just about every industry, from manufacturing to distribution to retailing to corporate offices. What booming business today

doesn't have its own Wi-Fi network? The problem is, so many of today's needs are more intense than technologies such as Wi-Fi can keep up with. Range, robustness, seamless mobility, security, latency, quality of user experience, and quality of service are vital in everything from factories to college campuses to mining operations to logistics operations to office complexes.


REMEMBER

That's where private LTE networks have been catching on — not just as a way to connect mobile phones to a network, but to connect virtually everything else to the world. These are networks tapping into the same technologies that were created for reliable and super-fast public networks, but optimized to meet the needs of enterprise deployments.

This fantastic concept has been around prior to the dawn of CBRS and OnGo. But until now, enterprises interested in their own LTE networks have had to partner with mobile operators within the licensed exclusive-use spectrum.

OnGo opens the door for enterprises to control their own networks because they now have ready access to private use spectrum. This avoids the need to reach some sort of agreement with a mobile operator for spectrum. Those wanting to enter this exciting new world are able to dive into Tier 3, as general authorized access (GAA) users. Or they can seek to acquire a priority access license (PAL) and become a Tier 2 user.

Seeing LTE's advantages


REMEMBER

LTE, by design, is an excellent option for enterprises that have challenging environments across which they need to communicate. For those who've struggled to get what they need from Wi-Fi, an OnGo implementation that brings LTE into the picture may be just what the doctor ordered. Following are some details and attractive benefits of an LTE private radio access network.

Ramping up the range

LTE is significantly better than Wi-Fi when it comes to range because of its high power, and it can work well with low-power IoT devices. Its cellular nature is designed to deal with interference and fading channel conditions, which is a plus in industrial or outdoor cases.

The high-specification RF equipment used in LTE systems can extend the link budget in ways that are challenging for Wi-Fi, including uplink, low-power IoT, mobility, and cases that are not line-of-sight.


TIP

Generally, you'll get about as much coverage from one small LTE cell as you get from two or three Wi-Fi access points, which means that LTE in the CBRS band beats Wi-Fi in the 5 GHz and 6 GHz spectrum.

Obtaining mobility

Given that LTE was developed as a cellular technology, mobility is a given. There's just no comparison.

There's intra-network mobility that uses standard mechanisms for cell handover. And then there's the possibility of inter-network mobility, roaming not just to the public networks but also to Wi-Fi.

Beefing up security

LTE offers high levels of security across the radio access network and its core network services. You can tap into SIM-based security as well as electronic SIM (eSIM), for example.

But more security is always better. Private networks may tap into extra transport security, including IPsec and application layer security.

Gaining spectral efficiency and capacity


TECHNICAL STUFF

The high spectral efficiency of LTE wins the day, for a number of reasons. There are higher efficiencies at the link and MAC level, concepts such as hybrid automatic repeat request, more adaptable schedulers, modulation that is more granular, and a design maximized for mobility and outdoor use.

Capacity also gets a boost from the addition of 256 QAM in commercial products. That's helpful for high-end uses such as 4K video, machine vision applications, and mobile virtual or augmented reality.

Supporting IoT

LTE supports IoT in two main ways:

- The narrowband IoT (NB-IoT) for the smallest of data needs
- LTE-M for full mobility and voice-over-LTE

NB-IoT, as narrowband IoT is called for short, is ideal for use of low power devices such as environmental sensors and meter reading. LTE-M does all kinds of things, thanks in part to the big available device ecosystem that results from support from major mobile providers.

Embracing QoS

LTE's QoS model is ideal for voice-over-LTE and push-to-talk services that are commonplace in industrial and enterprise settings. And it's one reason why LTE is so good for critical automation in such tasks as warehouse robotics.

QoS takes some expertise to deploy in public networks. OnGo products with easy-to-operate management systems can help with that.

Understanding the RAN and the Core

Both LTE and 5G are multiservice architectures that can support a lot of uses, including broadband data, narrowband data, messaging, voice, video, and emergency transmissions. If you plan to build private LTE for your enterprise, you'll find this multiservice capability quite useful, because you're going to have a range of needs, too.

Take a factory as an example. Its radio access network needs to handle communication services, for sure, including push-to-talk and voice services. It'll have low-bandwidth monitoring uses, including lots of different safety and security sensors. And most likely there will be high-bandwidth video moving across the network, too.

All of these services together tap into the radio access network (RAN) equipment. And that all revolves around the core network

systems. If you're operating a 4G LTE network, you'll refer to an evolved packet core or EPC. In the world of 5G, the RAN ties into the 5GC or 5G Core.


TIP

You can obtain small-scale, standards-compliant core network systems created just for enterprise and public safety LTE networks. These are fully featured core network systems, and they work without significant modification in the world of CBRS. All you need to add are the database elements related to spectrum sharing.

The core network system, of course, must be configured correctly to support the deployment. It must be set up to work with the CBSDs in your installation, for example. And it must be configured with the correct network identifiers.

IN THIS CHAPTER

- Spelling out the benefits of OnGo
- Picking the winners with CBRS
- Examining CBRS business models

Chapter 4
Making Use of CBRS and OnGo

The possibilities of wireless technology are breathtaking, especially if you're old enough to remember when a cellphone was simply for making phone calls. Or when security cameras hooked into coaxial cables. Or when the hotel front desk handed you a metal key to unlock your room. Or when assembly lines had more people than robots. Or when you had to leave the bleachers to go to a payphone to call your dad with an update on the baseball game. Wireless transmission of calls and data is making new miracles happen every day.

This chapter goes into greater detail on the benefits of establishing a private LTE network using OnGo to make all kinds of wireless communications possible. It lists some of the kinds of organizations and businesses that will love the technology behind CBRS, and also highlights the various business models for making OnGo work.

Spelling out the Benefits

Think, for a moment, about Wi-Fi. It has certainly enabled powerful uses, whether in-building, across public spaces, or elsewhere. But it isn't the be-all and end-all of connectivity, compared to

what LTE technologies have brought to the way we work and live. OnGo can bring all of the benefits of LTE, but with ease-of-implementation benefits that are more akin to Wi-Fi.


REMEMBER

Coverage, for example. LTE can more than double the range, and so will private LTE enabled by CBRS. The same goes for multiuser capacity — the gains you get through LTE hold up entirely on private LTE through OnGo. Then there's mobility. Handoff to 4G or 5G is limited via Wi-Fi, but no problem with any kind of LTE. Reliability is a huge deal, and LTE wins out in that department, including private LTE.

On the other hand, with Wi-Fi, you don't have to pay for use of the unlicensed spectrum bands. LTE through a mobile network operator, though, is licensed across numerous bands, and licensure adds costs. This is where private LTE via OnGo can be more like Wi-Fi, because access to the spectrum is freely available for GAA users, with enough use limits to keep it for private use.

CBRS has advantages across a wide range of in-building uses, in public spaces, and for those who rely heavily on industrial IoT. Following are some brief summaries of advantages.

Winning with in-building uses


REMEMBER

In the world of education, fast, secure, and reliable wireless connectivity is essential for teachers and students alike. A secure LTE network is ideal for digital recordkeeping and staff management, and in a university setting, it can spread across buildings and into the dorms. It's a differentiator for attracting the best students and faculty alike.

High-performance LTE can serve in-building military needs as well. Secure and interference-free connectivity must be a given, whether troops are on-the-job or keeping in touch with loved ones back home.

Who hasn't been in a big hotel for a vacation or conference, and lost signal in the elevator or in a meeting room down at the end of the hallway? OnGo's good for solving those common problems, too, through LTE that's implemented as easily and cost-effectively as Wi-Fi.

Hospitals also are notorious for insufficient mobile coverage indoors. And the demand for all kinds of secure communications

and data sharing is critical, including accessing sensitive medical files and massive imaging results.

And LTE-level service is a great selling point for both multifamily residential buildings and multitenant offices. Enhancements in data and cellular services take care of tenant needs, and the landlord gains new capabilities for automating such things as building security, access, and energy management.

Organizations using CBRS-based private LTE networks will also have access to data that would give them insight on how their network is used and allow them to customize their network services for a better quality of experience for their users.

All of this occurs on a dedicated band where sharing is managed to ensure the best user experience for all the different connection types.

Beaming signals in public spaces


REMEMBER

Demand for wireless services has exploded in all kinds of entertainment venues, such as sports stadiums and arenas, concert halls, theme parks, and convention centers. OnGo is a solution with higher capacity, along with mobility and security. And it promises the low latency essential for various IoT requirements, point-of-sale connections, ticket scanners, digital signage, and other needs independent of public users of Wi-Fi and cellular.

Governments also are increasingly focused on boosting wireless capabilities in public spaces and tourism districts. And the need for greater digital inclusion for underserved citizens is front-and-center. Private LTE and neutral host business networks can play a key role in meeting these needs, and all of this in turn boosts "smart city" profiles for economic development.

High capacity, mobility, and low latency are musts in the world of retail public spaces. Private LTE using OnGo opens the door to such advances as augmented reality, virtual reality, and smarter building automation.

Enabling industrial IoT


REMEMBER

There's a lot of talk about the next Industrial Revolution — some people call it Industry 4.0. It's marked by increased factory automation, more and more robotics, digital transformation of industrial processes, more powerful analytics, reconfigurable factories,

more connected workers, and more predictive maintenance. You can't make this revolution happen without high-capacity, low-latency, and highly reliable wireless connectivity.

Industrial IoT also is vital to boosting operational efficiencies in such critical industries as mining, oil and gas exploration, and refining. As it happens, these kinds of operations often exist in places not currently well-served by communications, so a private LTE option is essential.

Picking the Winners With CBRS

It isn't an overstatement to say that there are lots of potential users who can come out far ahead through an OnGo deployment. A wide range of business sectors have communication needs well-suited to OnGo, from heavy industry, to transportation, to manufacturing, to distribution, to commercial and high-density residential real estate, to higher education, to sports and entertainment.

Manufacturing things in a smarter way


REMEMBER

Manufacturing processes become more sophisticated and automated all the time, and that calls for ever-more powerful and reliable communications across the factory floor. Many kinds of devices are now supported by factory networks, and connections are critical.

Take, for example, the growing importance of automated guided vehicles (AGVs). They hustle about the facility autonomously, moving materials to where they're needed, transporting and loading pallets, hauling products, even shuttling finished goods to containers for shipping. Vital communications that support mobility and low latency can help ensure AGVs are where they should be, safely doing what they should be doing. And the goods they're carting around must be tracked, as well. AGVs have a tough time getting their job done if their communications must go through a commercial cellular service or have to compete with other Wi-Fi users.

Many other critical real-time processes also must connect. What's more vital in a factory than robotic motion control? IP video cameras are pertinent for security and general monitoring of activity,

and there's a whole host of other security communications to consider. Devices across the facility have integrated modules to communicate, and all will do well when OnGo is the foundation of private LTE networks.

TIP

The bottom line is, industrial IoT requires highly reliable, secure, low latency mission-critical wireless capabilities with seamless mobility support. What has generally been possible in the unlicensed spectrum in the past has not been ideal for such things as manufacturing plants or chemical plants. They require a QoS-capable technology such as LTE.

Ramping up warehousing and logistics

AGVs also have a prominent place in the warehouses of the future (and many of the warehouses of today, for that matter). The same goes for sophisticated pick-and-pack machines.

REMEMBER

Everyone from product manufacturers to vendors to consumers relies on real-time information about products moving through warehousing and logistics operations. Private LTE networks are exceptionally valuable when it comes to connecting and controlling the operations, maintaining records, and tracking goods as they move through the supply chain.

Finding uses in the field

Take a trip into the field — literally, into a wheat field where grain is growing at ground level and wind is being harvested hundreds of feet above ground by a network of turbines. This is a great place for a private LTE network.

Each of the dozens of towers is outfitted with sensors, all of which must be interconnected and are well-served by LTE. Sensors are monitoring the functioning of the turbine and blades. Environmental sensors track important weather-related data that will guide operations of the wind farm.

Meanwhile, the humans tending to the wind farm are connected into this LTE network as well. They're driving vehicles that have network-linked tracking. The workers are using mobile devices while out in the field, also linked into the system.

A different kind of in-the-field application is at remote or offshore sites, which often don't get adequate standard wireless coverage: oil platforms, for example, or mines, or some remote power plants. OnGo can bring flexible LTE coverage to places where it's only been a dream before.

Communicating across the campus

Those who operate large campuses have invested a lot in communications across the property. Whether it's a university campus, a theme park, a stadium complex, a racetrack, or a corporate headquarters campus, it likely is served by various legacy technologies such as land mobile radio (LMR) and Wi-Fi, as well as wired connections linking such things as video, security phones, and informational signs.

REMEMBER

Those legacy systems have their limits, technologically, and they aren't cheap to maintain. Private LTE networks can cost-effectively carry a wide range of critical information in these campus settings, including data, mobile voice, video, closed-circuit TV, and point-of-sale terminals. Higher-education uses, for example, include broadband access in remote buildings, remote/distance learning, campus security, IP video, and building management through IoT devices. These are functions essential for business operations and safety, so network reliability must be rock-solid.

Enabling health care and hospitality

It's mindboggling to consider how connectivity has changed health care since the early days of overhead PA announcements and nurses calling codes from the phone in a patient's room. Today, countless data-rich activities are ripe for a move to a private LTE network.

Wirelessly connected patient monitoring systems zap heart rates and blood pressure metrics into the electronic medical record and to the nurses' station directly, or even to monitoring stations offsite. Nurses and doctors communicate through voice-enabled badge devices that look like "Star Trek" communicators. In-room terminals access medical records hosted in the cloud. Patients select and order their dinner and complete their patient education on wireless tablets. Robotic devices bring meals, and even enter vacant rooms to disinfect them with UV light.

Hotels aren't hospitals, but they're in the business of hospitality, and they are ripe for OnGo advances, too. A private network can carry staff communications, provide broadband access, enable mobile point-of-sales, support building management from HVAC to access control, and provide on-premises communications options for guests.

Linking port operations

Shipping containers play a vital role in the global supply chains of just about everything people buy, as well as practically every kind of material, ingredient, or component part. The journey of these shipping containers includes stops at container ports that have intermodal connections to trains, trucks, river transportation, and inland terminals.

Each one of these massive containers is packed with valuable goods, and any given port deals with countless containers going many, many different places. It takes seamless communications to keep track of that vital economic activity.

Various endpoint devices at ports track the operations of ship and stacking cranes, automated guided vehicles and other trucks, and equipment loaders. Communication devices connect port workers, who are also tapped into PCs and mobile devices. In the past, it's all been hooked together through a mix of Wi-Fi, land mobile radio, and other connections.


TIP

Private LTE offers the opportunity to create more seamless, reliable, and cost-effective tracking and communications systems. One busy port in the Netherlands has done just that, offering a prime example of how it can work. Being outside America, it isn't OnGo, of course, but it's operating in the 3.7 GHz band, which is not far up the dial from CBRS, so it's an excellent demonstration case.

Examining CBRS Business Models

The 3.5 GHz band is a great new playground for both old and new players in wireless communications. Consider that CBRS makes available 150 MHz of spectrum in a favorable range. Although that's shared spectrum, it's a slice of the pie roughly equivalent

to the licensed spectrum of the average American mobile operator. That represents a lot of room for growth. Here are some of the potential business models for LTE solutions that OnGo makes possible.

Augmenting mobile operator capacity

Mobile operators need options to expand their capacity, given the continual growth in the business of mobile connectivity and the ever-increasing demand for unlimited service plans. They're always on the lookout for new licensed spectrum, but the supply is never very far ahead of the demand.

Their efforts to expand coverage and bandwidth by deploying small cells also can't seem to happen fast enough. And they haven't gotten all that far with the concept of *Licensed Assisted Access*, either, which can augment LTE capabilities by leveraging the unlicensed 5 GHz band.

REMEMBER

OnGo, on the other hand, offers the potential to tap into the 150 MHz of spectrum opened up by CBRS. There's no need to share the band with Wi-Fi and other unlicensed uses, and the 3.5 GHz band allows for longer range than is possible in the 5 GHz band. It's a flexible opportunity for both indoor and outdoor needs.

For mobile operators, OnGo can augment capacity in a couple of ways. The GAA spectrum can be used for supplemental data links in a manner similar to Licensed Assisted Access, with an "anchor" carrier in a licensed band. The OnGo bands also can be used for TDD applications transporting both control signaling and data traffic. Either way, it's a better bet than Wi-Fi offload solutions.

TIP

Some mobile operators will choose to secure a PAL license for one of the 10 MHz channels in the CBRS band. That's a great option for serving places with heavy data traffic.

Entering the MVNO market

New entrants such as cable operators can use OnGo to deploy an LTE network. Those with an eye on getting into the mobile wireless business can use it as a traffic offload option, following the *mobile virtual network operator (MVNO)* strategy. Rather than offload to Wi-Fi, these operators can serve up a better user experience with LTE service across a host macro network plus an OnGo small cell network.

REMEMBER

It's a great option for cable operators, who don't tend to own much licensed spectrum. They can use LTE on the 3.5 GHz band plus Wi-Fi on the 2.4/5 GHz bands to facilitate more mobile business while diverting as much traffic as they can from the host mobile operator network, which charges for the traffic.

In fact, the whole success of an MVNO business depends on reducing the paid traffic that must go via the host mobile operator network. This business model makes the most sense when lots of subscriber traffic can be offloaded to owned networks, such as those made possible by OnGo.

TIP

A twist on this business model involves a swap between the host mobile network operator and the MVNO. It's a deal allowing the host operator to let its subscribers roam onto the MVNO's owned infrastructure, such as its OnGo network. In return, the MVNO gets a better deal on the services it buys from the host mobile network operator.

Establishing a neutral host RAN

Direct mobile operators understandably have an interest in big implementations. There are lots of other needs, though, that aren't large enough to get the attention of mobile operators, but are too complex for enterprises to deal with themselves.

And of course, OnGo opens the door to lots of other deployments that need SAS coordination and require core network integration with mobile operators. There are opportunities for implementation in high-rise office or residential buildings, across college campuses, in airports, stadiums, and hospitals. Everyone needs better wireless coverage.

REMEMBER

That's where a neutral host provider can step in, implementing and operating the radio access network, or RAN. For users focused on their core business functions and too small to have their own expertise on-staff, a neutral host can do the technical legwork and manage the relationships with providers.

There are big opportunities for this business model. One study, for example, estimated there's some 30 billion square feet of commercial floor space across the country in need of better mobile coverage for their users who bring their own devices (BYOD). All of the big operators and platform vendors are ready to work with neutral providers to address the need.

Establishing enterprise private LTE

Bigger enterprises have long operated their own traditional Wi-Fi networks to handle data across their operations. And that has worked out okay for what it is, but it's not a great option for ensuring adequate mobile voice services indoors, or serving some outdoor needs.

What about distributed antenna systems? Sure, that's a possibility, but it can get to be a hassle securing signal sources from various mobile operators, and for many enterprises, it's just too expensive and takes too much time to deploy.


TIP

An OnGo radio, on the other hand, can support multi-operator capabilities and run seamless LTE services. A private LTE network can be quite flexible, running applications specific to the enterprise or venue, and letting users tap into other existing device and app functions.

Consider a large corporation that wants to run its own customer relationship management system across its facility, connecting directly with employees' mobile devices. Or a manufacturer that wants to run industrial IoT applications on LTE devices, on its own private network. OnGo makes that easier to implement, and much more cost-effective than has been possible in the past.

IN THIS CHAPTER

- Understanding the device ecosystem
- Gathering application requirements
- Designing the RAN infrastructure
- Scaling and designing the EPC and 5G Core
- Planning the spectrum with CPI and SAS
- Working on network elements

Chapter 5
Planning and Deploying OnGo in the CBRS Band

So you're thinking this OnGo concept makes a lot of sense for your organization. Where do you go from here? It's designed to be a comparatively simple communications solution, but it isn't quite an off-the-shelf installation. Fortunately, there's a roadmap for implementing OnGo, and help is available from the OnGo Alliance if you need it.

This chapter outlines the basics of the implementation process. It spells out many of the questions you'll need to ponder, such as the devices that will live in the ecosystem, what they'll be doing, and what the infrastructure will look like. It has details about designing the CBRS radio access network (RAN) and integrating with a core (EPC), coordinating the spectrum with the SAS, and hammering out other network considerations.

Understanding the Device Ecosystem

REMEMBER

The first task before implementation is understanding the use case and establishing what kinds of devices will be connecting to your network, and operated by whom. These are two vital, interconnected questions, and the answers will provide insights as to how you need to move forward.

For example, will your private LTE network be used solely for employees or a static group of tenants? Or will it need to serve an ever-changing list of visitors and guests? A related matter to consider is whether access is privileged and controlled, what kind of authorization and security is desired, and whether certain users require constant connectivity.

As for the devices themselves, the list of potential items in this ecosystem is long and diverse. It may include a range of Internet of Things (IoT) devices, laptops, tablets, cameras, user mobile devices, gateways, even walkie-talkies. You may be acquiring a whole new set of devices, or you may be aiming to connect existing devices into the new private LTE. Either way, you need an understanding of the interfaces they use.

TIP

Along with an understanding of the types of devices is a sense of the scale. Some networks will support hundreds of connections to users and devices, some will serve thousands, and achieving optimal performance requires accurate scoping of this detail. Gauge the needs now, and also think ahead at least one to three years to envision how many more users, nodes, or sites might be joining in.

The device checklist includes considerations of whether they'll be mobile or fixed-in-place. This question helps decide your network architecture and device management requirements.

And there's the big question of "where?" Is everything indoors, outdoors, or some of each? OnGo private LTE networks work well either way, but the specific environment will determine many aspects of the system.

Gathering Application Requirements

You need to understand not only what must connect to the network, but also what those devices will be doing. Scoping out application requirements is vital to ensuring a highly functioning network.

Take security devices, for example. They may be devices that provide periodic status information such as "door open," which takes little bandwidth, or they may be security cameras that continually stream high-definition video.

In addition, what will users and devices be connecting to? If they're sending data back and forth among themselves, that's one thing, but if they need to connect to other company networks, or to the Internet, then you need to plan for backhaul communications.

Part of understanding what applications your network will be serving is gauging the cybersecurity requirements. Enterprise-grade LTE security is almost effortless with an OnGo network, and that includes such things as device authentication and traffic encryption. Such extra security-based protection takes some additional consideration, and those needs should be spelled out as early as possible in the planning process.

REMEMBER

It's important to start by understanding your current and potential uses of your OnGo solution because there is so much flexibility in how OnGo is deployed. Knowing those uses will guide you in deciding the network components, architectural design, and type of CBRS spectrum that's right for you.

Designing the RAN Infrastructure

As long as you're answering questions, it's worth considering a few base-level queries as you begin to design the infrastructure for the RAN, or *radio access network*. First of all, what data infrastructure is in place already?

TIP

If there's an existing Wi-Fi network, that can become part of the consideration because some devices and data traffic can be allocated there. Carrying traffic in the most appropriate network boosts the performance of both the existing Wi-Fi network and the new LTE implementation.

OnGo is great with mobility, along with coverage in complex RF environments, and connectivity when lots of devices are involved. It could be a win-win to place fixed devices on an existing Wi-Fi network, or wired Ethernet, and use OnGo for mobile devices and those with poor Wi-Fi connectivity.

If there already are some on-premises hosting options, local hosting may be the way to go. Or, some or all of the network and management elements can live in the cloud.


REMEMBER

And here's a key business model question: rent, own, or a hybrid? Your organization may want to capitalize some or all of the equipment, or you may prefer to subscribe to services and leave the equipment to someone else. OnGo can be deployed in whatever way matches your model.

Once basic questions have been answered, then come all the specifics of the actual deployment of the RAN infrastructure. That begins with a detailed site survey, an examination of the area the network will cover to determine how many Citizens Broadband Radio Service Devices (CBSDs) you'll need and where they'll be located.

Your survey and plan must take into account a number of things, including:

- The dimensions of indoor and outdoor areas to be covered
- Where walls and other structures are
- Where power and data sources run and where they're missing
- Where the users will be hanging out and what kinds of users they are, along with where devices will be placed
- Where any onsite infrastructure will be placed, including networking elements and data centers
- Any areas of potential interference, such as incumbents, cell towers, and radars


TECHNICAL STUFF

Generally, an indoor CBSD, which is required to be Category A, is limited to 1 watt EIRP and serves about 10,000 square feet effectively. An outdoor CBSD, called Category B, can be up to 50 watts EIRP, and if that's installed on a 160-foot tower it has a range of about four miles. CBSDs can't always operate at maximum power — they may need to crank it down to avoid interference with incumbents, especially outdoors.

Range is one consideration, and bandwidth is another. A CBSD under optimal conditions can handle about 100 Mbps of throughput on a single 10 MHz channel, but that's a rosy scenario. It's better to plan for about 40 Mbps downstream and 10 Mbps upstream.

With that in mind, consider the applications. A typical voice call requires about 12 kbps, but with video, your needs increase significantly depending on resolution. HD video needs about 8 Mbps, and 4K HD may need 20–25 Mbps. The more bandwidth you expect, the more channels you need.

Scaling and Deploying the EPC and 5G Core

Although private LTE implementation is relatively simple in the grand scheme of technological pursuits, it isn't a weekend DIY project. There are experts your organization may choose to involve. One is an evolved packet core (EPC) vendor.

REMEMBER

As discussed in Chapter 3, EPC is a framework for providing voice and data on a 4G LTE network. CBSDs must connect to an EPC if they're going to function. That's because the EPC brings in the mobile device management functions in the control plane and enables the data packet exchanges between mobile devices and applications in the packet network.

Because CBSDs must interoperate with the EPC, you must choose a compatible EPC. The EPC may be deployed onsite, hosted in the cloud or the edge data center, or co-located with the CBSDs. With an OnGo-enabled private LTE network, you have choices, depending on your budget and technical requirements.

TECHNICAL STUFF

Four main network elements comprise a basic EPC. The Mobility Management Entity (or MME) and Home Subscriber Service (HSS) provide mobility and device access controls. Then there are the Serving Gateway (SGW) and the Packet Gateway (PGW), which route data packets among CBSDs, the local network, and any connected networks.

The EPC you establish for your private network can allow expansion and flexibility to allow mobile devices to hop over to public Internet connectivity. Establish roaming relationships between

the OnGo private LTE network and public LTE mobile network operators, and users can roam back and forth. EPCs can also interoperate with other bands and technologies, which can offer failover opportunities, add capacity, and accommodate 5G technologies.

As the wireless world moves toward 5G, the 5G Core is what lies at the heart of the network, anchoring the various multi-access technologies. The most advanced use cases you may have heard about are made possible by the 5G Core or 5GC.

Planning the Spectrum with CPI and SAS

You may choose to involve experts and specialized vendors throughout the implementation, which will ease the process and ensure its success. In some cases, though, you have no choice but to call in an outside vendor.

In many cases, the FCC requires that CBSDs be professionally installed. The CBRS industry has standardized the use of *Certified Professional Installers* to install such CBSDs and register them with a Spectrum Access System. Check with different CPIs and you'll come across varying payment terms and ancillary services, which may help you make your choice.

You'll also likely work with a SAS vendor, which among other things plugs your private LTE network into the SAS to ensure that it plays nicely with all of the organizations sharing the band. Different SAS administrators offer varying commercial and contract terms — perhaps it's per CBSD, maybe per call, sometimes a flat fee.

REMEMBER

The SAS administrator may also offer extra services such as spectrum planning. You can get help mapping the RF environment, using modeling and measurement to check propagation, and other support that can help you rest assured you'll end up with good coverage.

The SAS administrator can provide guidance on any nearby incumbents, available channels, and any power restrictions that will affect your deployment. Your SAS will need to know how many channels your deployment will use, too.

REMEMBER

If a long list of vendors has you overwhelmed, know that you can always opt for a one-stop shop. That would be what's known as an *integrated solution vendor*, which is equipped to take care of all the details of planning and designing your LTE network, installing it, and supporting operations. The OnGo Alliance website includes a list of members, and among those members are integrated solution vendors.

Working on Network Elements

Your LTE implementation includes a number of additional network tasks and considerations. Here are some examples.

Making an IP networking plan

Your CBSDs connect to the devices across your private LTE network by way of the 3.5 GHz spectrum. So what connects your CBSDs to your internal network and each other?

Most often you can use an existing Ethernet infrastructure established for Wi-Fi to wire the CBSDs to the rest of the world. That said, if the system uses carrier aggregation or already is handling significant traffic, you need to be sure it has the bandwidth available to support the new use.

TIP

Also, if the system is going to interface with other networks, including the public Internet, you need a backhaul connection. That, too, must have sufficient bandwidth for the data your private LTE will be carrying. Whenever you're pondering bandwidth questions, remember that bandwidth is often established by contract. And don't try to cut things too close — leave room for some growth and any unanticipated peaks.

Signing up for identifiers

The OnGo Alliance will assign unique identifiers to be sure your deployment interconnects properly with other LTE networks, and doesn't interfere. You'll need the following numbers to ensure proper operation:

- A single CBRS-NID (that's a *network identifier*). Combine that with the shared home network identifier typically used by private LTE networks, and you'll end up with a unique identifier.

- A single MME Group ID, or MMEGI
- A Macro eNB ID for each of the CBSDs in the deployment

Will your network use devices that connect only to your system? If so, you'll need to get an IMSI Block Number from the U.S. IMSI administrator. The number can be used to generate IMSI numbers to assign to a device's SIM card.


TIP

It's important that your system uses unique tracking area identifiers. Otherwise, devices may have trouble connecting to your network. Your IMSI Block Number can be used for the tracking area code element in the tracking area identifier.

Making other design decisions

You can group CBSDs behind a domain proxy service that communicates with the SAS. It aggregates all communications from the CBSDs and is a single interface. Whether you need one or not depends on how many CBSDs you have and the terms of your SAS vendor.

You can also slice your network into multiple independent virtual networks that have different configurations and features. One virtual network, for example, can give staff access to voice calls and the internal network, while another can serve guests with only public Internet access.

Connecting end-user devices

End-user devices are the many different things that connect into your private LTE network. They can be mobile phones, tablets, laptops, IoT devices, internal communication systems, cameras, modems, gateways, and the like.


REMEMBER

What's really helpful is that OnGo uses LTE as its foundational technology, and there are already industry standards for LTE security, interoperability, and service provision. That means many existing LTE devices will support OnGo. Anything with a chipset supporting the 3.5 GHz band, also known as Band 48 for 4G LTE or N48 for 5GNR, will work. In some cases, conversion may be necessary, but that beats replacement.

IN THIS CHAPTER

- Connecting into an innovative future
- Creating new business opportunities
- Enlivening retail and entertainment

Chapter 6
Eight Reasons Why CBRS and OnGo Are Game-Changing

What can CBRS do for your enterprise? What can OnGo do for the world you live in? Read on for some insights into just a few of the ways this technology is game-changing.

Innovating a New Approach

The CBRS band has sometimes been called the "innovation band," and that's a fitting description. CBRS is, quite literally, a game-changer because it has changed the rules of the game.

The old game involved regulatory divisions of the radio frequency spectrum. All players had their own lanes, commercial and governmental uses were separated, there were lots of exclusive authorizations, there were divisions between carrier networks and private networks. It was very structured, like a neighborhood where every yard has an eight-foot privacy fence.

The new game-changing approach is built on advances in technology and revolutionary ideas in spectrum policy, tearing down

those divisions to determine a different approach for sharing valuable spectrum. Now, licensed operators and mobile providers and lots of other users can share the military's spectrum, accessing it without going through the costly and complicated process of licensure. That is, indeed, a game-changer.

Making a Solid Connection

Wireless communications are increasingly essential across most businesses. Some even think of it as the "fourth utility," right up there with electricity, water, and heating/cooling. There may have been a day when a communication issue was an inconvenience, but these days in many enterprises, the entire world grinds to a halt if there's a problem with the wireless. It's that mission-critical.

OnGo and CBRS give organizations much greater control over their communications. With a private LTE network, you've got the gold standard in technology connecting your people and all of the various technologies that interact with one another. It's quite simply better in many ways, from performance to cost. And you've got it under your own control, as any mission- and business-critical element ought to be.

Checking Out MSO and MVNO Opportunities

The arrival of CBRS creates all kinds of interesting market opportunities for cable multiservice operators. It opens the door to the chance to enhance networks and generate new streams of revenue.

Already, cable operators been thriving in the business of offering broadband and Wi-Fi services to enterprises. CBRS provides more capacity and coverage augmentation capabilities. New premium in-building services could be in the offing. And while they may have huge numbers of household access points already, adding LTE can greatly extend their coverage.

CBRS also makes the whole idea of the mobile virtual network operator that much more viable. Hybrid mobile networks can add shared spectrum to the mix, along with any owned spectrum, Wi-Fi connections, and MVNO relationships.

Turning Things Inside-Out

Where are you when you use your mobile device? More often than not, somewhere inside, according to industry statistics that indicate 80 to 90 percent of mobile sessions are indoors.

That creates a great CBRS opportunity for cable operators. They already have subscribers occupying a big chunk of indoor space. What if they build a giant LTE network through those connections using CBRS, converting their subscriber modems into the equivalent of LTE cell towers providing exceptional coverage across all of that indoor space?

With the indoors conquered, then they can focus on the outdoors. That becomes a strategy nicknamed *inside-out*, and it allows them to build a wireless network in a very cost-effective, powerful, game-changing way.

Turning IoE Loose for Industry

The Internet of Everything, or IoE, is transforming individual life as well as the industrial world. Individual humans are wirelessly connecting everything from their fitness trackers to their air conditioners to their doorbells to their irrigation systems. Industries, meanwhile, are increasingly automating everything in the factory.

In the past, if your enterprise had mission-critical industrial IoT helping to run the show, you needed a cellular operator or other service provider to hook you into a super-reliable network within licensed spectrum. Now, you can establish your own dedicated LTE radio access network, optimized for precisely whatever it is you do in your factory. That's the power of OnGo.

Healing in the Future

It's estimated that more than 70 percent of commercial buildings don't have adequate mobile coverage indoors, and that includes hospitals. The issue is driven by the increasing use of high-energy-efficiency building materials, which are great for blocking heat and cold, but also great at blocking wireless signals,

unfortunately. That's a problem in a sector that is more electronic and wireless all the time.

Already, virtually everything is digitized, from medical records to imaging scans to dinner orders, and caregivers regularly communicate wirelessly. The coronavirus pandemic brought even more activities into the wireless world, including virtual patient visits and doctors' morning hospital rounds.

Needless to say, wireless technology has already been a game-changer in health care. Making wireless service more ubiquitous and more reliable through OnGo is the key to continuing down this revolutionary path.

Augmenting the Retail Reality

Picture this: You're walking down the grocery aisle with your smartphone in front of you. You can see the aisle ahead of you on the screen, but within the picture you also see arrows pointing to all of the things on your shopping list. Or all of the best special offers on items you normally buy.

That's augmented reality, or AR, at work. AR can also show you how you look in a certain outfit, and another, and another, without having to actually try anything on. It's magical, and it eats up bandwidth. It's one of the game-changing things that's on the way in retailing that OnGo can help enable.

Bringing New Life to Entertainment

Augmented reality also is making its way to live entertainment. One pop band set up live karaoke experiences at concerts, allowing fans to use Snapchat to telegraph themselves singing along and creating extra buzz around the event. Another band added to the onstage sights by generating special extra visuals for fans who aimed their smartphone cameras at the stage.

That takes high-end wireless service that a lot of venues don't have at the moment. A private LTE network through OnGo can help bring new live experiences to life.

Achieve better wireless with CBRS and OnGo

The radio spectrum is congested and busier than ever. How can organizations share the available spectrum and make exciting things happen? Citizens Band Radio Service (CBRS) opened a sizeable piece of spectrum real estate. CBRS makes sophisticated technologies more available to anyone who needs better wireless coverage. That can mean more powerful networks, plus opportunities to offer new services and products. OnGo is the name of this technological revolution, and this book is your introduction.

Inside...

- Meet CBRS and the OnGo solutions
- Learn about LTE and 5G NR
- Improve coverage with Private LTE
- Serve indoor needs and public spaces
- Create industrial IoT applications
- Examine CBRS business models
- Deploy OnGo in the CBRS band

Steve Kaelble is an author and corporate communications specialist who enjoys bringing complicated subjects to life in easy-to-understand ways.

ISBN: 978-1-119-74624-9
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