Understanding CBRS Based – Private LTE Networks

A Whitepaper prepared by:

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Abstract: In this whitepaper, we first discuss key factors and elements of a CBRS-based private LTE network, including Spectrum Management, Evolved Packet Core (EPC), Citizens Broadband Radio Service Devices (CBSDs), the CBRS device ecosystem, industry verticals and use cases. Then, we present three case studies to demonstrate that CBRS-based private LTE networks can help the likes of enterprise, venue owners, Mobile Network Operators (MNOs) to address various use cases such as in-building coverage for offices and hotels, additional capacity for large venues (e.g. stadiums), and joint outdoor-indoor ubiquitous coverage for urban campuses from different industry verticals.

1. Introduction

Citizens Broadband Radio Service (CBRS) is an initiative led by the FCC for shared commercial use of spectrum in the 3.5GHz band (3550MHz-3700MHz) announced in April 2015 [1]. This spectrum was traditionally made available exclusively for use only to the military, legacy Satellite Earth Station operators and Wireless Fixed Broadband users. With this new initiative though, the FCC has decided to provide spectrum access to a much wider range of users, such as Enterprise Businesses, MNOs, Service providers and Venue owners to name a few, for commercial deployment.

Since the inception of CBRS, there has been an increasing amount of interest by various industry segments to work towards capitalizing on possible applications and use cases that could stem out from the use of this spectrum. One of the major use cases that the industry has converged to is the development and adoption of Private LTE Networks (5G in the near future), which is branded as *OnGo Technology* by the CBRS Alliance. A Private LTE Network could help us deploy a plethora of data-related applications and use cases for various industry verticals. It can also help us achieve a degree of convergence by bringing together various systems and applications onto one network. Leading players from various industry segments, such as MNOs, System Integrators, Telecom & IT hardware manufacturers and Software Developers, are all working together towards realizing the potential benefits of deploying a Private LTE Network.

The concept of a Private LTE Network is not new to begin with and such networks have been deployed by entities in the oil & gas industry, military, mining, etc. for certain applications. The aim and objective of companies working on developing CBRS-based Private LTE network solutions is to foster and encourage the wider-spread deployment of such networks by various potential industrial verticals.

In this paper, we will be discussing different factors and elements you need to pay attention to while planning to deploy a CBRS-based Private LTE Network. Specifically, we will be addressing the Spectrum Management aspects; Private LTE Network components such as the Evolved Packet Core (EPC), CBSDs; the CBRS device ecosystem, industry verticals and its use cases; and three case studies of CBRS-based Private LTE network deployment in a hotel building, an outdoor urban campus, and a stadium.

2. CBRS Spectrum and Management

2.1 Frequency and Tier Information

CBRS provides 150MHz bandwidth of spectrum from 3550MHz to 3700MHz. This comprises of (15) channels of 10MHz each. An illustration is shown in Figure 1 [1].

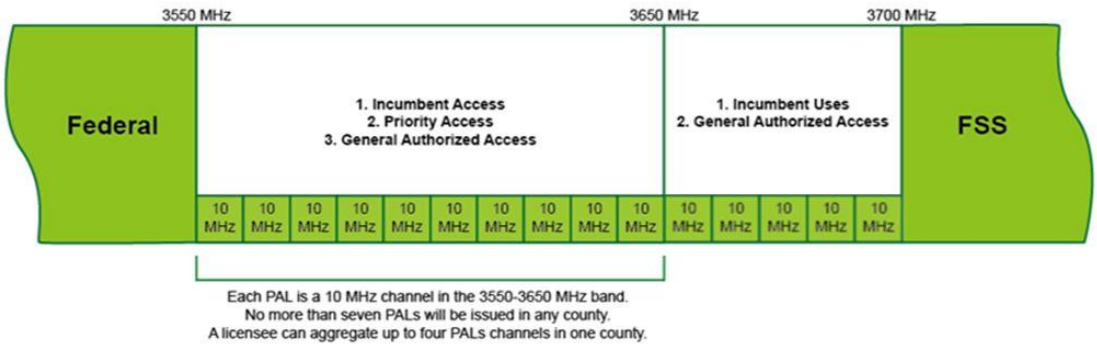

Figure 1. CBRS spectrum breakout

Users will have access to unlicensed as well as lightly licensed spectrum under a dynamic spectrum-sharing rule. Based on this rule, FCC has established a 3-tiered Spectrum Access System [1], as shown in Figure 2:

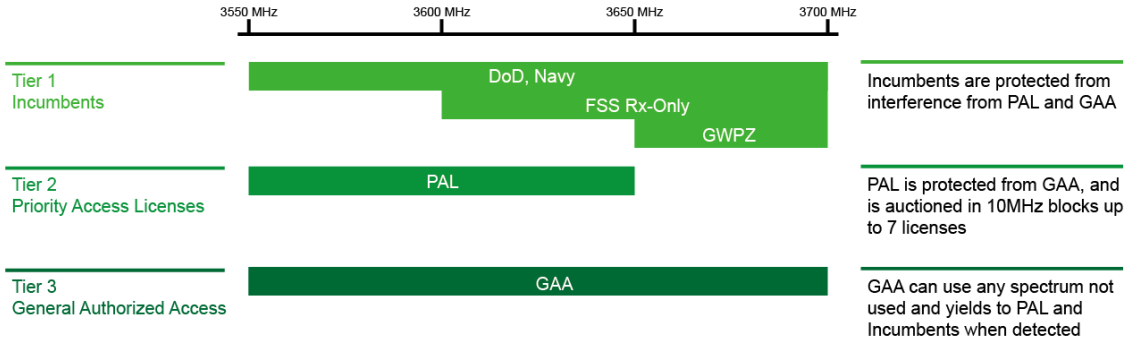

Figure 2. 3-Tier spectrum access

Tier 1: Incumbents

This is the highest tier that comprises of incumbents such as the military radar systems (on-ground and ship-borne), fixed satellite service (FSS) ground stations, and Wireless Fixed Broadband users. The incumbents are to have top priority guaranteed access to the spectrum

when in operation and are protected against interference from the remaining two tiers – PAL and GAA [1].

Grandfathered Wireless Broadband providers in the US were provided protection until April 17th, 2020 as an incumbent user, which fall under the Grandfathered Wireless Protection Zone (GWPZ). After this period, they are now allowed to operate on GAA basis as per the Part 96 rules laid down by the FCC [7].

Tier 2: Priority Access Licenses (PAL)

PAL is the middle tier for spectrum access that consists of (7) 10MHz channels from 3550-3650MHz, and PALs will be bid out on a per county basis. They can be renewed on a 10-year term license basis. It is important to note that any entity participating in the bidding process would be allotted a maximum of (4) channels consisting of 40MHz per county. The PALs have a higher priority access to the spectrum as well as protection against interference from the GAA users; but have a lower priority and are required to accept interference from incumbent users [1].

Tier 3: General Authorized Access (GAA)

GAA is the lowest tier for spectrum access and has the largest bandwidth available to operate on, consisting of the entire spectrum 3550-3700MHz. The GAA must not cause any harmful interference to any on-going active incumbent and PAL user operations. The GAA must however accept any and all interference from these top-tier incumbent and PAL users when they are active. Additionally, there is no requisite requirement of protecting the GAA users from interference among themselves [1].

Table 1 below summarizes key characteristics of 3-tiered spectrum management mechanisms.

Table 1. CBRS spectrum - Tier Information summary

	Tier-1 - Incumbent	Tier-2 – Priority Access License (PAL)	Tier-3- General Authorized Access (GAA)
Who	US Navy, Department of Defense, Wireless Broadband Providers, Satellite Service Providers	Any entity who is willing to purchase the rights of PAL use from the FCC (e.g., Mobile operators, Education entities, Medicare facilities, Factories, Large Enterprises)	Any public or private entity that is looking to use the CBRS spectrum that has no incumbent protection granted by the FCC and does not wish to purchase spectrum rights for PAL use. (e.g., Medium to small Enterprise business, hospitality industry, etc. including all PAL holders as well)
Where	US naval ships, Defense facilities, coastal areas, radar exclusion zones and near Satellite Earth Stations	On any facility or premise that resides in the county that the PAL user purchased the rights to use the spectrum, except on exclusion zones defined by the FCC	On any facility or premise in any and all US counties, except on the exclusion zones defined by the FCC
When	Anytime unrestricted use of spectrum	Anytime unrestricted use of awarded spectrum as long as it is not interfering with any incumbent user	When not interfering with incumbents and PAL users; and interference level in the region is acceptable to other existing GAA users
System Type	Radar, Satellite Earth Stations, Grandfathered registered sites	Private LTE/5G Networks, Mobile Operator Networks, Fixed Wireless Networks	Private LTE/5G Networks, Mobile Operator Networks, Fixed Wireless Networks
How to access	SAS authorization is not required	SAS authorization is required	SAS authorization is required
Spectrum available	3550-3700MHz	3550-3650MHz; Seven Channels of 10MHz each can be allocated by each county with the frequency band stated above; Each PAL licensee can own up to four channels per county;	3550-3700MHz
Channel & Bandwidth	15 Channels - 150MHz spectrum bandwidth	7 Channels per county – 70Mhz spectrum bandwidth	15 Channels - 150MHz spectrum bandwidth