Capgemini engineering

# THE CAPGEMINI ENGINEERING 4G/5G CBRS SOLUTION

Introduction

Over the last decade, wireless broadband has become an indispensable service for us all, providing both mobile communications and internet access. It will become even more important as the Fifth Generation Mobile Communications System, commonly called '5G', is rolled out over the next few years.

5G is a game changer, promising to connect billions of smart devices, such as wearables, autonomous vehicles and Internet of Things networks, all of which will generate a significant increase in network data traffic. As 5G drives demand for mobile communications, it will increase the demand for spectrum, which is necessary for mobile network operators (MNOs) to expand their capacity.

On April 21, 2015, the U.S. Federal Communications Commission (FCC) released a report and order that created a unique Citizens Broadband Radio Service (CBRS). This authorized the commercial use of 150 MHz of spectrum in the 3550-3700 MHz band, called the '3.5 GHz band', which was previously occupied exclusively by military and government users.

This dynamic spectrum-sharing system has been formulated under the Spectrum Access System (a frequency coordination system that manages the Citizens Broadband Radio Service (CBRS) spectrum in the 3.5 GHz band) by The Wireless Innovation Forum (WinnForum).

To date, CBRS has been introduced on LTE-compatible time division duplex (TDD) bands, primarily targeting small-cell applications that complement primary mobile networks. This new band has opened a bundle of opportunities for MNOs, mobile virtual network operators (MVNOs), cable operators and new enterprises in the wireless domain.
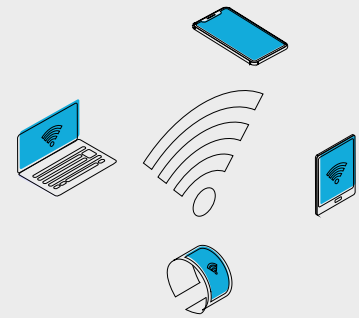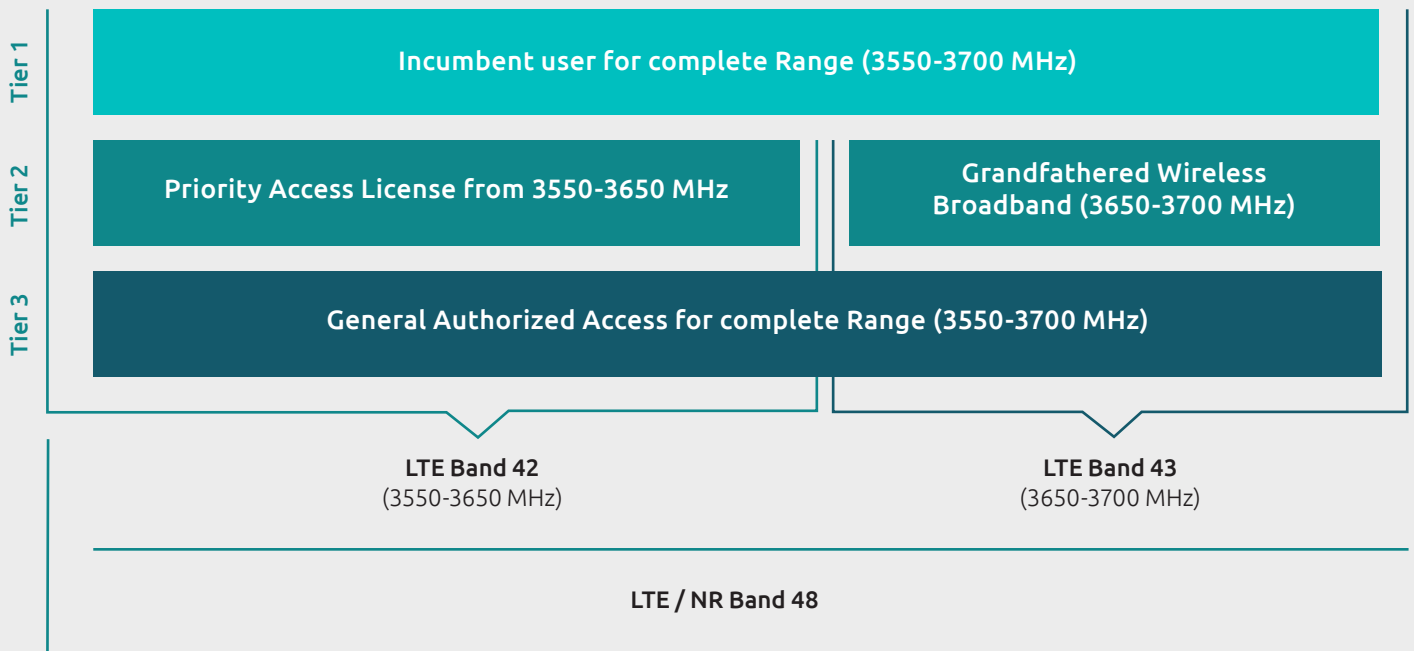

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CBRS Technical Overview

The FCC defines CBRS as an "innovation band," which can assign spectrum to commercial mobile broadband (MBB) systems, such as 3GPP LTE, on a shared basis with incumbent radar and fixed-satellite service (FSS) systems. The CBRS spectrum allocation of 150 MHz includes three tiers:

- Tier 1 - Incumbent Access (IA)

- Tier 2 - Priority Access (PA)

- Tier 3 - General Authorized Access (GAA).

Figure 1 below identifies the three tiers and elaborates on the different use cases and how they are supported.

Tier 1

Incumbent user for complete Range (3550-3700 MHz)

Tier 2

Priority Access License from 3550-3650 MHz

Grandfathered Wireless Broadband (3650-3700 MHz)

Tier 3

General Authorized Access for complete Range (3550-3700 MHz)

LTE Band 42
(3550-3650 MHz)

LTE Band 43
(3650-3700 MHz)

LTE / NR Band 48

The 3.5 GHz spectrum has increased the efficiency of spectrum use around fast-growing and converging mobile broadband and media traffic services. It has also paved the way for new innovations, like Internet of Things (IoT) for 5G networks.

CBRS 3.5 GHz and WiFi (WiGig) combined (LTE/5G) under single box system to deliver localized connectivity in a small cell can have experience of 5G eMBB.

Figure 1: Allocation of the Three Tiers of the CBRS spectrum

There are specific rules that apply to the dynamic spectrum allocation for each of the three CBRS tiers. The rules get more restrictive as you move from Tier 1 to Tier 3.

TIER 1

Incumbent licensees include incumbent federal government users and FSS operators. These incumbents will have complete interference protection from the two lower CBRS tiers.

TIER 2

Priority Access licensees are authorized to use unpaired 10 MHz channels in the 3550-3650 MHz range in a specific geographic service area for a predefined period. PA licensees must provide interference protection for Tier 1 incumbent licensees and accept interference from them. However, PA licensees are entitled to interference protection from Tier 3 operators.

TIER 3

General Authorized Access operators are permitted access to 80 MHz of the 3.5 GHz band that is not assigned to either Tier 1 or Tier 2 licensees. GAA operators receive no interference protection from Tier 1 or Tier 2 operators and must accept interference from them both.

CBRS Supported Use Cases and Capgemini Engineering Solution Mapping

CBRS offers a cost-effective small-cell solution for mobile operators by leveraging shared spectrum through carrier aggregation. A CBRS small cell is an exceptionally efficient way to provide fixed broadband services to hotspots, business customers and, in some cases, residential customers. CBRS could provide a sustainable Fixed Wireless Access (FWA) spectrum option for private LTE/NR networks to serve enterprises or residential customers. Also, there is an opportunity for cable operators seeking to enter the wireless industry using the CBRS band to improve their business case.
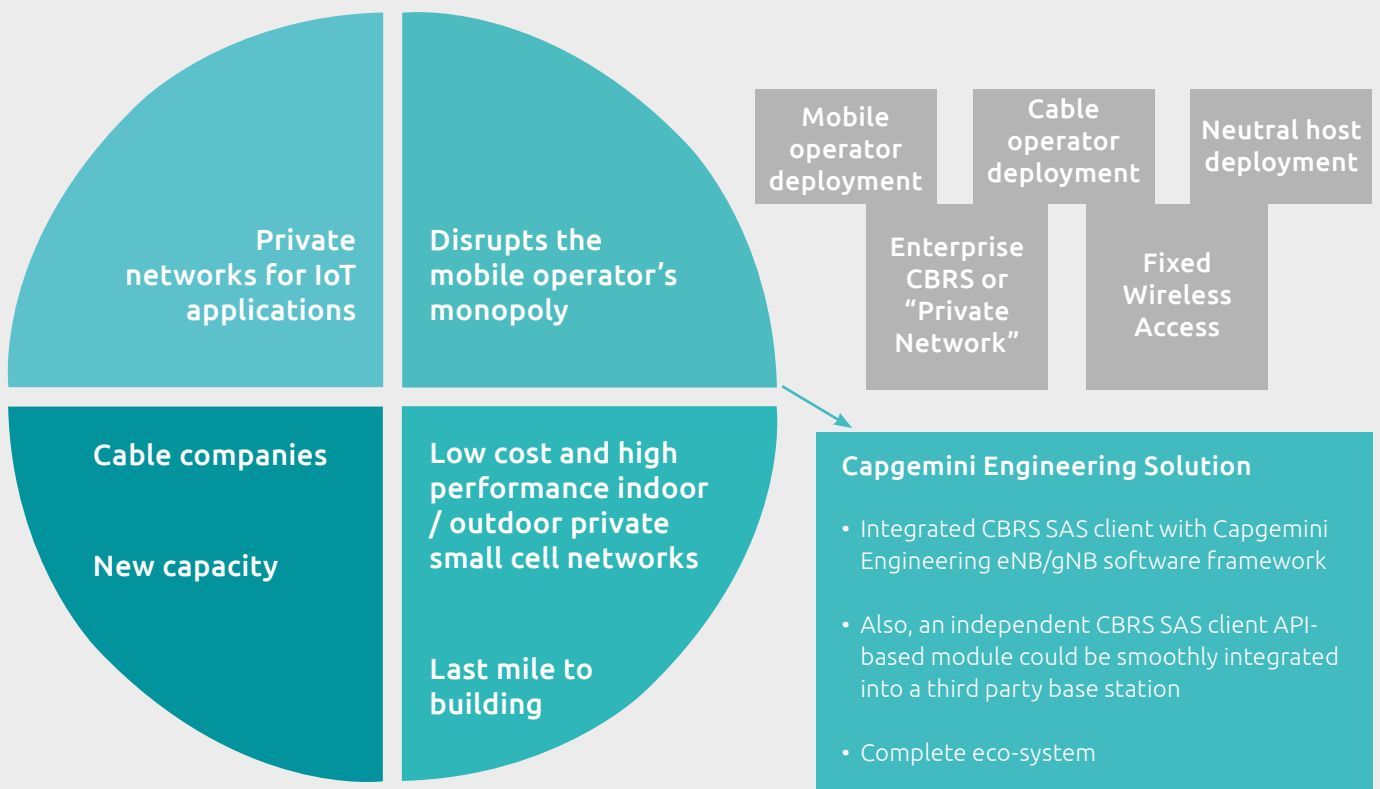

Figure 2: CBRS Use Cases Covered by Capgemini Engineering Solution

Details of Neutral Host Use Cases Supported by CBRS

A neutral host small-cell network in the shared CBRS spectrum offers a modest, low-cost venue and enterprise deployment option for multiple wireless service providers. The innovative spectrum sharing approach of CBRS opens new market opportunities for neutral host providers to provide small-cell service at airports, hospitals, large arenas, high-rise residential and office buildings, hospitality venues and university campuses, where a neutral host provider can effectively provide a mobile wireless "as-a-service" offering that uses the CBRS spectrum, as shown in Figure 2.

Capgemini Engineering CBRS SAS Client IP

The Capgemini Engineering CBRS SAS client is an API-based module that is compliant with the Winn Forum standard specification for SAS to Citizens Broadband Radio Service Device (CBSD) Technical Specification. This module is integrated into the Capgemini Engineering LTE/NR Software Framework with the operations and maintenance (O&M) module, along with other Capgemini Engineering LTE/NR stack modules.

Since the CBRS SAS client is an API-based independent module, it can be integrated into a third-party system O&M module to provide an interface with the SAS CBSD server. The Capgemini Engineering CBRS SAS client IP can enable all transmission devices - 2G/3G/4G/5G - to interface with the SAS server. This module can also be integrated into the required target platform, if desired.

Figure 3 below provides an overview of the CBRS SAS client architecture developed by Capgemini Engineering and the supported protocols of the standard specification.
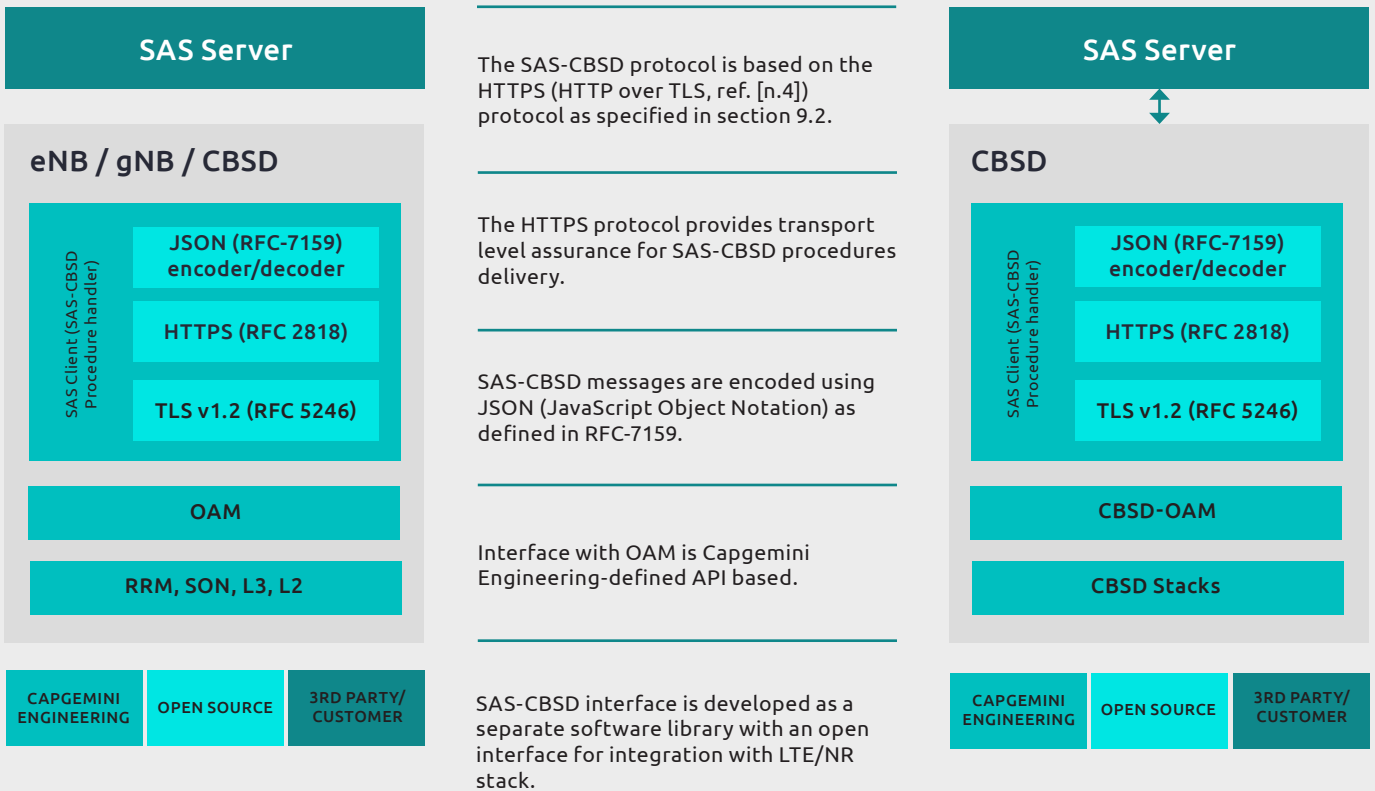
SAS Server

eNB / gNB / CBSD

SAS Client (SAS-CBSD Procedure handler)

JSON (RFC-7159) encoder/decoder

HTTPS (RFC 2818)

TLS v1.2 (RFC 5246)

OAM

RRM, SON, L3, L2

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The SAS-CBSD protocol is based on the HTTPS (HTTP over TLS, ref. [n.4]) protocol as specified in section 9.2.

The HTTPS protocol provides transport level assurance for SAS-CBSD procedures delivery.

SAS-CBSD messages are encoded using JSON (JavaScript Object Notation) as defined in RFC-7159.

Interface with OAM is Capgemini Engineering-defined API based.

SAS-CBSD interface is developed as a separate software library with an open interface for integration with LTE/NR stack.

SAS Server

CBSD

SAS Client (SAS-CBSD Procedure handler)

JSON (RFC-7159) encoder/decoder

HTTPS (RFC 2818)

TLS v1.2 (RFC 5246)

CBSD-OAM

CBSD Stacks

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Figure 3: Capgemini Engineering CBRS SAS Client Architecture

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