CBRS Network Service Technical Specification

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1 Introduction and Scope
This document is a Technical Specification that provides requirements for the operation of LTE radio networks in the CBRS band. The requirements shall be requirements on the Stage 2 and 3 specification work. Different use cases for providing network services in the CBRS band are also described.

1.1 Key Words
The key words "required", "shall", "shall not", "should", "should not", "recommended", "may", and "optional" in this document are to be interpreted as described in RFC-2119 [8]. In addition, the key word “conditional” shall be interpreted to mean that the definition is an absolute requirement of this specification only if the stated condition is met.

The terminology “it shall be possible” means that the applicable feature or function shall be supported in the stage 2 and stage 3 specifications, but implementation is not mandatory by a vendor.

2 References
[6] 3GPP TS 32.455: Key Performance Indicators (KPI) for the Evolved Packet Core (EPC); Definitions.
[7] 3GPP TS 32.426: Performance Management (PM); Performance measurements - Evolved Packet Core (EPC) network.

3 Definitions and Abbreviations
3.1 Abbreviations
• 3GPP: Third Generation Partnership Project
3.2 Definitions

- **CBRS Network**: One or more CBSDs, along with their related network elements, operated in compliance with 47 CFR Part 96, all other relevant FCC regulations, and all relevant technical and operational recommendations of the CBRS Alliance.

- **MNO (Mobile Network Operator)**: A mobile network operator, also known as a wireless service provider, wireless carrier, cellular company, or mobile network carrier, is a provider of wireless communications services that owns or controls all the elements necessary to sell and deliver services to an end user including radio spectrum allocation, wireless network infrastructure, back haul infrastructure, billing, customer care, provisioning computer systems and marketing and repair organizations.

- **MSO (Multiple System Operator)**: A company which owns multiple fixed access systems and offer services such as (but not limited to) Internet Access, Video, Voice, etc. to residences and enterprises. A MSO may also own or control the elements necessary to deliver wireless services, in which case it would also be considered a MNO.

- **NHN (Neutral Host Network)**: A Neutral Host Network is a network deployed and operated by a NH operator, who may also be an independent entity, a MNO, or a MSO where the network resources are being shared by multiple wireless services provider.

- **NHN Core Network (NHN CN)**: The Core Network part of a NHN.

- **NHN RAN**: The RAN part of a NHN deployed in the CBRS band.

- **Participating Service Provider (PSP)**: A PSP is a Service Provider (SP) offering services to its subscribers via a NHN.
• **Private CBRS Network**: A Private CBRS Network provides services to employees, machines and other devices as authorized by the provider of the network.
• **Private UE**: A Private UE is a UE with a private network subscription.
• **PSP Core Network (PSP CN)**: A core network operated by a PSP.
• **PSP RAN**: A 3GPP RAN network operated by a PSP. Only a PSP which is an MNO is expected to have a RAN.
• **Service Provider (SP)**: An entity provides services to its Subscribers and can authenticate and authorize its Subscribers. Any entity that has a service agreement with Subscribers can act as a SP.

4 Network Services Use Cases for CBRS

4.1 General

This section describes the different use cases that can be enabled via the CBRS band. It defines the roles involved in providing service, and describes how specific entities fulfill the roles in each use case. It is important to recognize the difference between role and entity, and to recognize that a single entity may fulfill more than one role in a given use case.

The following text from the FCC Report & Order [ref. 1, Pg. 107, Parag. 8] outlines some use cases anticipated for the CBRS band by [1].

*As a result of the Commission’s actions in the R&O and Second Order and Order on Reconsideration, small business will have access to spectrum that is currently unavailable to them. The potential uses for this spectrum are vast. For example, wireless carriers can deploy small cells on a GAA basis where they need additional capacity. Real estate owners can deploy neutral host systems in high-traffic venues, allowing for cost-effective network sharing among multiple wireless providers and their customers. Manufacturers, utilities, and other large economic sectors, can construct private wireless broadband networks to automate industrial processes that require some measure of interference protection and yet are not appropriately outsourced to a commercial cellular network. All of these applications can potentially share common wireless technologies, providing economies of scale and facilitating intensive use of the spectrum.*

There are three roles involved in CBRS service use cases; Service Provider, CBRS Network Operator, and Subscriber.

A Service Provider (SP) authenticates and authorizes its subscribers, and provides services to them. Any entity that has a service agreement with Subscribers can act as an SP. For example, entities like traditional communications providers including MNOs, MSOs, or MVNOs are SPs that provide services to their customers. An entity like an enterprise plays a SP role in providing services to its employees, customers, or other related parties. A Service Provider must have the technical ability to provide suitable Authentication and Authorization of its Subscribers; it may or may not have other
components of a traditional EPC. Services offered by SPs include, e.g., VoLTE, Internet access, IoT, etc. A Participating Service Provider (PSP) is an SP offering services via the specific Neutral Host.

A CBRS Network Operator deploys a CBRS network with an intention to provide connectivity and/or enable services to Subscribers of participating Service Provider(s). A CBRS network may be deployed in a variety of locations, including public venues (malls, airports, city squares) and enterprises (offices, hotels, etc.). Any entity that deploys a CBRS Network plays a role of a CBRS Network Operator. For example, when an SP deploys its own CBRS network, the SP also plays a role of CBRS Network Operator.

A Subscriber is authenticated and authorized by one or more Service Providers it has service agreement with, and upon successful authentication and authorization, is provided with services from SPs. For clarity, the term “Subscriber” may refer to a person or a device; it is the device that is subject to authentication and authorization.

Figure 4-1 describes the relationships among three different roles.
1. Subscriber – Service provider relationship: A Subscriber has a service agreement with a Service Provider for the services offered by that Service Provider. The Service Provider has all the information about the Subscriber enabling it to provide authentication of the Subscriber, authorization of the services for the Subscriber, and Subscriber management. The service agreement could be, for example, a traditional monthly-billing arrangement, or may take other forms such as on-line sign-up, pre-installed certificates, or vending-machine SIMs. A subscriber may have a service agreement with more than one Service Provider.

2. Service Provider – CBRS Network Operator relationship: a CBRS Network Operator has a business agreement with one or more Service Providers to provide connectivity and/or enable services on one or more of its CBRS Networks to the Service Providers’ Subscribers. The business agreement includes all the aspects for SPs to be able to provide services to their Subscribers on CBRS networks. This business agreement can include, for example, technical arrangements enabling the Service Provider to provide at least authentication and authorization of its Subscribers when they use the CBRS Network.

Note also that this relationship diagram only covers the relationship between CBRS roles. The existing business relationship among Service Providers, including traditional roaming agreement, continues to be in place independent of the relationship among CBRS roles. For example, Subscribers of SPs may be able to roam onto the CBRS Network deployed by other SPs using conventional 3GPP roaming procedures if there is a roaming agreement between those SPs.

Depending on the roles the entities play, different use cases arise. Each use case is described in more detail in subsequent sections.

4.2 SP Use Case

For the SP use case, an SP deploys the CBRS network itself and, hence, plays the role of a CBRS Network Operator as well as a SP. Subscribers of the SP benefit from improved user experience and/or an extended coverage through CBRS network.

Figure 4-2 shows an example of SP use case. In this example, SPs could represent traditional MNOs and MSOs, and other traditional types of SPs. MNO1 deploys a CBRS Network itself; hence plays the role of both SP and CBRS Network Operator. Subscribers of MNO1 have access to the CBRS Network deployed by MNO1. Other SPs (MSO1 and MNO2 in this example) have no relationship with the CBRS Network deployed by MNO1; hence the Subscribers of MSO1 or MNO2 do not have access to this CBRS Network.

For the SP use-case when the SP is a MNO, the 3GPP defined architectures in [9] using S1 can be used. In this case, if other SPs have traditional roaming agreements with MNO1, then Subscribers of those SPs may be able to roam onto the CBRS Network deployed by MNO1 using conventional 3GPP roaming procedures.
4.3 NHN Use Case

The NHN (Neutral Host Network) use case involves the deployment of a CBRS network by a Neutral Host provider with the intention of providing service to the Subscribers of one or more participating Service Providers through the CBRS Network while the Subscribers are on the CBRS Network. Subscribers have no direct association with the NHN Operator. All subscriber management functions (e.g., billing and payment, customer care, provision of SIMs or certificates) are performed by the SP. The NHN Operator has a business agreement with a SP to provide service to participating SP’s subscribers while they are on the CBRS Network. Note that there is no direct service or business relationship between Subscriber and CBRS Network Operator. A CBRS Network Operator simply provides connectivity and/or enables services to the Subscribers of participating SPs.

Figure 4-3 shows an example of NHN use case. In this example, SP entities MNO1 and MSO1 have business agreements with a NHN Operator which is a CBRS Network Operator. Through these business agreements, MNO1 and MSO1 become Participating Service Providers (PSPs) for this CBRS Network and the Subscribers of MNO1 and MSO1 have access to the CBRS Network deployed by the
NHN Operator. MNO2 does not have a relationship with this NHN Operator; hence Subscribers of MNO2 do not have access to this CBRS Network deployed by the NHN Operator.

4.4 Private Network

4.4.1 Single Subscription UE Use Case

Private CBRS network is deployed to provide service to employees, machines and other devices as authorized by the Private Network provider. In this case, the private network operator plays the roles of both SP (providing services to the authorized users/devices) and CBRS Network Operator (deploying the CBRS network). A private network operator that deploys and manages an LTE Core network and an LTE RAN that operates in the CBRS band provides services exclusively for its own Subscribers. The end user devices in a private network shall have a business relationship with the private network operator.
Figure 4-4 shows an example of private network use case. In this example, Enterprise 1 deploys a CBRS Network; hence playing the role of both SP and CBRS Network Operator. Employees or customers of Enterprise 1 can access the CBRS Network deployed by Enterprise 1. Enterprise 1 does not have any business relationship with MNO1 or MSO1; hence the Subscribers of MNO1 or MSO1 do not have access to the CBRS Network deployed by Enterprise 1.

4.4.2 Multi-subscription UE Use Case

This is a variation of the Private Network use case where a UE used in a Private Network has, in addition to a subscription with the Private Network, a subscription with an MNO. The MNO subscription can be used to access the MNO’s network when the Private Network coverage is unsatisfactory or when a Subscriber wants to access MNO services. The device uses separate credentials for access to the Private Network and to the MNO’s network. A Subscriber may use an MNO subscription to access MNO services using a Private Network as an untrusted network. In this case, the subscriber can use untrusted non-3GPP access procedures to access MNO services. The
tunnel is setup using IP connectivity provided by a Private Network after gaining the connectivity by authenticating with the Private Network using Private Network credentials.

Figure 4-5 shows an example of a Private Network use case with dual subscription. In this example, Enterprise 1 deploys a CBRS Network and provides private services to the authorized users. Enterprise 1 does not have any business relationship with MNO1. An employee of Enterprise 1 also has a subscription to MNO1 with a separate MNO1 credential. This employee can access the private network services through the CBRS network deployed by Enterprise 1. The employee can also access the MNO services with the CBRS network acting as an untrusted non-3GPP access (e.g., the UE can connect to the MNO’s ePDG to access MNO network/services).
The hybrid use case combines more than one use case described in above sections. Specifically, the hybrid use case combines the NHN use case with the other use cases, i.e. SP use case or Private Network use case. In hybrid use case, SP or Private network operator provides services to its own Subscribers while at the same time provides access to CBRS network it deployed to the PSPs’ Subscribers.

Figure 4-6 shows an example of a hybrid use case.
SP1 (MNO/MSO/Enterprise) deploys the CBRS network for its own Subscribers and other PSPs’ Subscribers. SP1 has a business relationship with MNO1 so that MNO1’s Subscriber can access the CBRS network. The Subscriber of SP1 accesses the CBRS network deployed by SP1 to access the SP1 services. The Subscriber of MNO1 accesses the CBRS network deployed by SP1 to access the MNO1 services.

MNO2 does not have a business relationship with SP1 for CBRS access, hence, the Subscriber of MNO2 does not have the access to CBRS network deployed by SP1.

Figure 4-6: Hybrid Network Use Case Example

5 Requirements

These requirements support the use cases defined in section 4.

5.1 Network Sharing Requirements

This section includes requirements for sharing LTE radio access and the NHN Core network among multiple Participating Service Providers.
5.1.1 General Technical Requirements

RAN-Share-001. It shall be possible to organize a set of LTE CBSDs as a Neutral Host Network (NHN) providing LTE radio access to multiple Participating Service Providers (PSPs).

RAN-Share-002. It shall be possible to organize a set of LTE CBSDs to provide LTE radio access to private network services.

RAN-Share-003. It shall be possible to configure a NHN to provide different portions of available radio resources to each PSP based on business agreements.

5.1.2 Measurement Technical Requirements

The requirements in this section do not apply to Private Network use case.

RAN-Meas-001. A NHN shall be capable of providing Key Performance Indicators (KPIs) to a PSP regarding the service and resources provided to the PSP.

RAN-Meas-002. A NHN shall allow a PSP request to fetch KPIs per a mutually agreed SLA.

RAN-Meas-003. A NHN shall provide individual and aggregated KPIs to the PSP per a mutually agreed SLA.

RAN-Meas-004. A NHN shall be capable of providing byte counts of user data transmitted between the PSP and the UE in both uplink and downlink directions via the NHN.

RAN-Meas-005. A NHN shall support a minimum set of KPIs consistent with those specified by 3GPP per a mutually agreed SLA.

RAN-Meas-006. A NHN shall support, per PSP, the KPI and counters related to Call / Session establishment Success Rate as specified by Accessibility KPI in [4] and by counters to calculate this KPI in [5].

RAN-Meas-007. A NHN shall support, per PSP, the KPIs and counters related Attach success rate as specified by Accessibility EPS Attach Success Rate KPI in [6] and by counters to calculate this KPI in [7].

RAN-Meas-008. A NHN shall support, per PSP, the KPI and counters related to Call / Session Drop rate as specified by Retainability KPI in [4] and by counters to calculate this KPI in [5].
5.1.3 **NHN RAN Discovery Requirements**

RAN-Disc-001. A NHN shall broadcast system information that enables discovery of the NHN and associated PSPs.

5.1.4 **Mobility Requirements**

RAN-Mob-001. A NHN shall support mobility between the cells of the NHN RAN per 3GPP specifications (intra-NHN mobility).

RAN-Mob-002. A NHN shall support the continuity of PDN connections using handover procedures defined in 3GPP specifications when the device is associated with a PSP that also operates its own RAN, e.g., an MNO. (inter-NHN-MNO PDN continuity)

5.2 **Security Requirements**

This section provides requirements regarding the security aspects of a NHN.

5.2.1 **General Security Requirements**

Security-001. A NHN shall be capable of cooperating in the authentication of a device by the PSP’s core network.

Security-002. A NHN shall be able to securely provide the KPIs to the PSP as per the mutually agreed security policies.

Security-003. A NHN shall not disclose KPIs of a PSP to other PSPs.

5.2.2 **Authentication Requirements**

AUTH-001. A NHN shall be able to cooperate with the PSP's network to support one or more of the following:

a. authentication using USIM-based credentials.

b. authentication using certificate-based credentials,

c. authentication using Username/Password.

AUTH-002. A NHN shall be capable to support one or more of the following:

a. local authentication with an authentication server dedicated to the network,
b. authentication using external authentication server(s).

AUTH-003. It shall be possible for a NHN UE to support multiple authentication protocols.

AUTH-004. It shall be possible for a NHN UE to establish a secure tunnel with a service provider’s ePDG using credentials associated with the service provider’s subscription.

AUTH-005. A Private Network and a NHN that has its own subscribers shall be able to authenticate its own subscribers.
Appendices (Informative)

Appendix A: Revision History

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