WHITE PAPER ON CBRS like Licensing System

1. News Item on FCC's CBRS proposals

"FCC to rule on 900 MHz spectrum for private LTE and 5G networks for smart utilities"

The Federal Communications Commission (FCC) has said it will consider allowing the 900 MHz band in the US to be used by energy companies for private LTE and 5G networking.

The move is a response to a long-standing request by private networking firms to open the 900 MHz band for private usage.

It follows the liberalisation of spectrum for private and shared networking in several markets, which have taken their lead from the **FCC's decision to re-farm CBRS spectrum at 3.5G-3.7 GHz.**

The utility and enterprise ecosystems plan to put this spectrum to work fuelling industrial 5G and delivering the benefits of secure, innovative, private LTE broadband networks. This decision will lead to new jobs, new investment, and new technology development."

WE can plan somewhat on similar lines for private mobile networks using some of the bands suggested in Para 3 above.

There is a news item in Telecom Economic Times of 19th October 2021 as referred in the link suggesting similar approach.

https://telecom.economictimes.indiatimes.com/news/trai-may-reserve-25mhz-of-mid-band-spectrum-for-private-networks-report/87132558

2. **Annex A, has a proposal that was already submitted by some Indian Start ups in May 2021 on which possibly decision is awaited. The present White Paper resubmits the earlier proposal.**

The Paper requests for **allocation of spectrum like CBRS spectrum in US for private enterprise networks in India** also.

One possible option could be reservation of NR band 71 in the range of 663-698MHz for rural broadband network and 5Gi technology. Annex B is also relevant.

This is a premium frequency band that can give large coverage. With 5Gi, the range can be extended further. This can be a strategy for promoting 5Gi also for which a parallel White Paper is being submitted.

Additional Recommendations based on NDCP

- **Policy to open spectrum bands (either unused or no with product ecosystem) to TSPs making use of Indigenous products**

- **Incentive bands where there are Indian products**

ANNEX A

CBRS Like Licensing Model for India
A Proposal from Start Ups

Sooktha, Lekha, &

Guna Bala Shekar, Ayush Sharma (Industry Expert Contributors)

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1 Introduction

This note is created by Telecom Industry Startups and Industry Experts as an urgent input to DoT towards the Spectrum Policy formulation for the next ten years. The note recommends consideration of a spectrum licensing and usage model similar to the Citizen Band Radio Service (CBRS) model in the US. The model is a multi-tier model that enables shared and unlicensed access to spectrum.

This note is the first draft being submitted to DoT as an industry representation. The proponents will follow-up with further deliberations within standardisation bodies and make recommendations on this topic as appropriate. DoT is also requested to kindly consider this input and issue liaison request(s) to standardisation bodies and start consultations with Industry as appropriate.

2 CBRS Overview

The FCC in the US freed 150 MHz of spectrum from incumbents as a shared spectrum for meeting **custom** and **regional** wireless networking needs. The CBRS alliance (an industry association) has enabled the designation of a band by 3GPP for this purpose (Band 48). This band also overlaps with two traditional LTE bands (Band 42 and Band 43) and two traditional 5G NR bands (n77 and n78).

The CBRS spectrum sharing rules were defined to support wireless access to the general public and to protect incumbent users from interference. The protection was critical because the CBRS band is already being used by the US Military and Navy. Asking these incumbent users to give up this spectrum was not an option. At the same time all of that spectrum was actually not being used in many locations.

The CBRS model therefore helped create new opportunities regarding the use and distribution of this spectrum to a broader user base while not asking the incumbents to give up the spectrum. It further ensured the cooperation of the incumbents by assuring them full protection from interference. The model achieved this by organizing the spectrum use into three tiers:

1) **Incumbent Access**: The first tier is where **Incumbents** are placed. These are systems such as Navy RADARs, US Military, and Fixed Satellite Stations (Space-To-Earth). This tier has priority on the entire 150MHz (over the lower tiers), but it does not always use the entire band at every location.

2) **Priority Access**: The second tier is where priority access devices are placed and operate under a **Priority Access License (PAL)**. The license is granted on a county-by-county (high geographical area granularity) basis through competitive bidding. Each PAL consists of a 10 MHz channel within the 3550-3650 MHz band. PALs are 10-year renewable licenses. For purposes of the PAL service, counties are defined using the United States Census Bureau’s 2017 counties. Up to seven PALs may be licensed in any given county, subject to a four PAL channel aggregation cap for any licensee. PALs must meet a substantial performance requirement by the end of the initial license term. PALs must protect and accept interference from Incumbent Access users but receive protection from General Authorized Access users.

3) **General Authorized Access**: This tier is referred to as the **General Authorized Access (GAA)**. This tier is unlicensed and therefore shared. The GAA tier is licensed-

by-rule to permit open, flexible access to the band for the widest possible group of potential users. GAA users can operate throughout the 3550-3700 MHz band including opportunistic use of any PAL spectrum that is unused. GAA users must not cause harmful interference to Incumbent Access users or Priority Access Licensees and must accept interference from these users. GAA users also have no expectation of interference protection from other GAA users. However, all of this is managed automatically by a Spectrum Allocation Server (SAS).

2.1 Benefits

The following key benefits may please be noted when considering this model for India:

- **Reuse of spectrum** owned by incumbents while guaranteeing them primary usage. Therefore, any incumbents that are holding this spectrum already may not have to be requested to relinquish it fully. They only need to be convinced to share with the guarantee that there would be no interference.

- **Extended range** allowed by the provision for both indoor and outdoor deployments therefore allowing for larger range and better Quality of Service guarantee (as compared to WiFi).

- **Distributed licensing** over smaller geographical areas (much lesser than the "circle" concept used for licensed cellular wireless spectrum). This significantly lowers the licensing fee barrier for new entrants to bid and acquire the license to offer innovative services and applications. At the same time, when accumulated over a large number of such smaller areas, it may represent significant licensing revenue.

- **Automated spectrum administration** with technology supported real time spectrum administration enabled by the Spectrum Allocation Server (SAS) and Environmental Sensing Capability (ESC) networks. There are already several certified SAS and ESC sensor vendors.

- **Maximum utilization of spectrum** by allowing unlicensed use of any unused spectrum akin to WiFi.

- **Ecosystem support** and reliability of cellular wireless networks (Band 48 accepted by 3GPP). There are mature certification programs for CBRS base stations and several popular smartphone models (Apple, Samsung, Google) supporting CBRS bands.

- **Significant barrier reduction** for "private" LTE networks, local service providers, and therefore MSMEs, SMEs, and Startups.

- **Stimulation of applications and multiple use cases** with ability for local or smaller scale services and networks to take the lead and establish a model that could potentially be scaled up into commercial networks.

2.2 Key Statistics

The CBRS Alliance already boasts of Tier-1 Industry representation with companies such as Google, Cisco, Ericsson, Nokia, AT&T, Verizon, Dish, T-Mobile, Comcast, Charter, Cox, and Qualcomm backing the alliance. This section reproduces some more key statistics regarding CBRS from [8].

2.2.1 CBRS by the Numbers

- **100k+** deployed CBSDs (CBRS Devices, i.e., CBRS compliant base stations)
- **$4.6 billion** bid in CBRS PAL Auction
- **>100** total number of CBSD models in the FCC-ID database

- **>2.5k** CPIs (Certified Professional Installers)

Approved Vendors

Certified Professional Installer Training Programs: 5

To meet the FCC Part 96 rules, CPIs must be trained and certified. The Forum's CPI Accreditation Standard provides guidelines for this procedure.

Root CA Operators: 4

Subscribers should install all WInnForum authorized CBRS Root CA certificates in their device trust anchor stores to validate received certificates.

- **WInnForum Accredited Testing and Certification Labs: 16**
  To be FCC certified to operate in the CBRS Band, an equipment manufacturer will need to show that their CBSD can communicate with a Spectrum Access System and follow its directives as per Part 96.

PAL Auction Summaries

Winners

Enterprise Users: 15
Misc: 30
MSO/MNO/MVNO: 22
Utilities: 14
WISPs: 85
Local Telco: 61

- **Priority Access Licenses** Enterprise Users: 185 Misc: 1,242
  MSO/MNO/MVNO: 14,328
  Utilities: 503
  WISPs: 2,013
  Local Telco: 2,323

2.2.2 Key Takeaways

This section reiterates some of the key takeaways from the auctions [9]:

- The auctions raised USD 4.6 billion from spectrum that was previously deemed unavailable as it was held by incumbents.
- More than 220 companies bid in the auction and won more than 22,000 licenses.
- The top bid was from one of the leading Telco Service Providers in the US, Verizon, at USD 1.8 billion.
- A green field service provider, Dish has the next highest bid at close to USD 1 billion.
- Cable companies Cox, Charter, and Comcast rounded out the top five.
- However, many small Wireless Internet Service Providers (WISPs), companies like Chevron, and even Academic Institutes like Texas A&M were among the bidders and winners.
- There is representation from segments such as Enterprise, Cable, Education, and Industry in the bidders list.
- Further a secondary market of CBRS spectrum is also expected to flourish in the US with several companies offering spectrum “on-demand”.

This shows the diverse interest in this band and the vast array of services and applications it is expected to stimulate.

2.3 Market Research Samples

The figure below shows the market share between different types of service providers from an SNS Telecom report [10]:

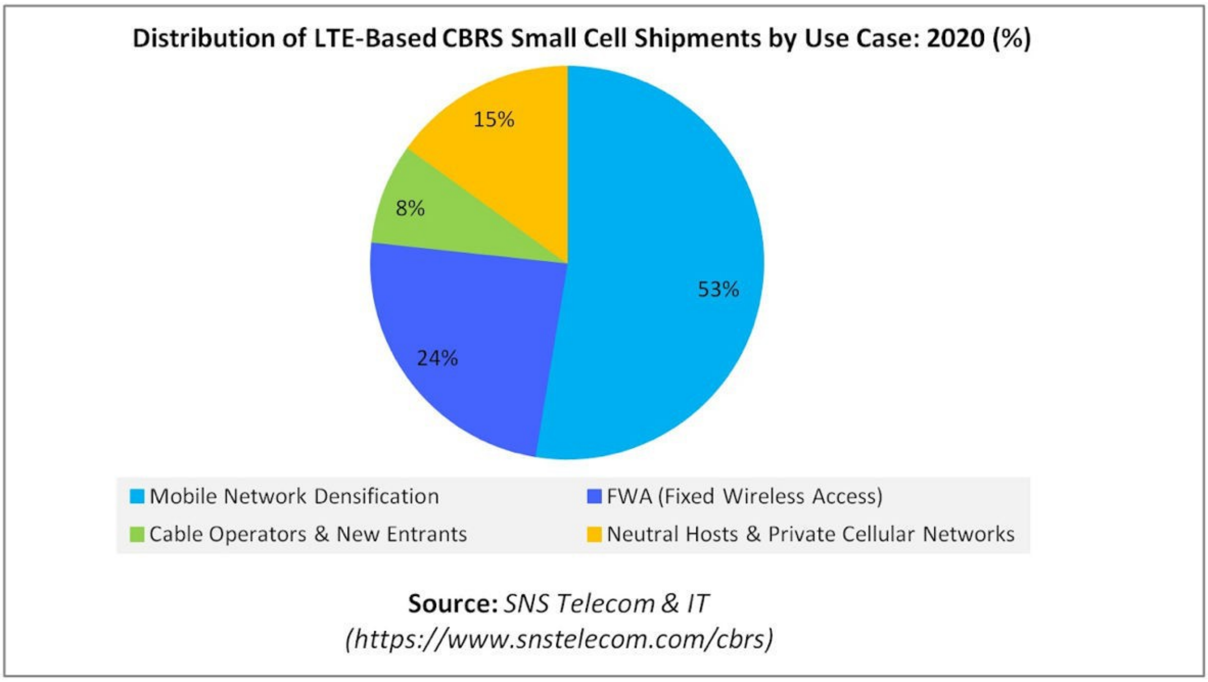

Figure 1: CBRS Network Usage Segments [10]

As per the above report, the RAN small cell shipments themselves are expected to surpass USD 1 Billion by 2023. This projection is backed by another report from ResearchnResearch [11]. Another takeaway from the SNS report [10] is that alternate licensing models supplement the licenses owned by traditional Telecom Service Providers (TSPs) by providing them another option for regional and local mobile network densification.

A report in the ISE magazine [12] highlights the significant role CBRS will play in rural, utilities and other private networks.

The figure below is a snapshot of the private networks market based on a Grand View Research report [13]:

Figure 2: Private Networks Market Snapshot [13]

Alternate licensing models are required to stimulate this private network market. CBRS networks may be reasonably assumed to capture at least 40% of this market.

As per a former FCC commissioner (see [14]):

- The estimated market value of CBRS ranges up to $15.6 billion
- The estimated annual consumer surplus of CBRS is between $8 billion-$26 billion
- The estimated net present value of consumer surplus is between $80 billion-$260 billion

3 Use Cases/Applications

A number of use cases are stimulated by a model such as CBRS. Some examples are provided below:

1) Indoor/Inbuilding
   a) Education
   b) Healthcare
   c) Hospitality
   d) Multitenant units (Apartments)
   e) Enterprises (Offices)
   f) Indoor public spaces (Auditoriums, Malls, Theatres)
2) Outdoor/Public Spaces
   a) Venues (Stadiums, Exhibition Space, Trade Fair Space)
   b) Government Users
   c) Retail Networks
   d) Adhoc (Disaster management supplementary)
3) Private Networks/Industrial IoT
   a) Manufacturing
   b) Mining
   c) Oil & Gas
   d) Utilities (Power, Water)
   e) Transportation

Under each of the above high level use-case categories a large number of applications are possible. The use cases have a potential to stimulate local service providers, neutral host infrastructure, and privately owned networks which may act as platforms for hosting a number of innovative applications. This has potential to go significantly beyond the OTT, smartphone vendor bundled, or Telco provided classes of applications that exist today.

3.1 Societal Benefits Examples

Some societal benefits from various use cases are reproduced from a GSMA report [15] in this section. The GSMA report addresses the benefits arising from these use cases in the context of 5G mmWave deployment. However, most of the use cases are just as effectively enabled in the mid-band. Further, both mid-band and mmWave will need innovative spectrum policies to stimulate the ecosystem required to unlock the full potential of these use cases.

3.1.1 Healthcare

In healthcare, expanding remote treatment opportunities and using data analysis from wearables to drive better research and increasingly personalized treatment plans can increase access to and the quality of healthcare.

The automation of objects such as smart syringes, supply cabinets, and hospital beds may lead to more efficient management of resources, and reduce the opportunities for errors in drug administration.
Applications such as remote diagnosis and remote surgery may expand access and availability to healthcare by moving the care closer to patients and caregivers without requiring an in-person visit, especially in areas lacking local specialists.

3.1.2 Education

The provision of high-speed broadband is expected to increase access to and quality of education, especially in cases where online learning opportunities are a better alternative to local classes, or where students were previously unable to access education.
Virtual reality and meeting applications allow skills usually taught in person, like fine motor skills, to be learned at a distance with the help of haptic feedback and high-speed broadband.

3.1.3 Industrial IoT/Automation

Industrial IoT and automation use cases are expected to significantly improve the industrial production processes in a number of ways. First, industrial automation can enable various components of the production process to communicate wirelessly, thereby cutting down on outages and malfunctions. Additionally, the integration of high-speed imaging in machines can improve quality assurance and data collected by automated machines can be used to proactively prevent faults and modify processes.
Additionally, the remote control of equipment and vehicles (including unmanned ground or aerial vehicles) is expected to increase safety by preventing human workers from operating machinery in dangerous situations, and providing first responders with new tools for reconnaissance and rescue in emergency situations.
Additionally, industrial/workplace education can improve worker safety by teaching skills used in dangerous situations in a safe VR/AR setting. Virtual applications are also predicted to improve production processes by enabling real-time high-quality assistance from remote experts supporting factories or construction sites to solve mechanical or technical issues, or by enabling virtual walk-throughs of buildings for architects and engineers

3.1.4 Transportation

A number of societal benefits are expected from next-generation transport connectivity applications including increased mobility, shorter commute times, improved road safety, and reduced pollution. Autonomous driving could increase mobility for the elderly and disabled persons and improve road safety by limiting the potential for human error to cause accidents. Intelligent transportation systems that use data from connected vehicles and smart infrastructure could improve commute times and reduce pollution by optimizing pedestrian routes and public transportation.

3.1.5 Disaster Management

Disaster response is significantly improved by supporting enhanced, secure, mission-critical communications, as well as providing network capacity to support connected ambulances and unmanned ground and/or aerial vehicles. Additionally, it is also predicted to increase safety by maintaining network coverage in heavily trafficked areas—such as during emergencies where there are many outgoing calls in dense areas, and extending service to out-of-coverage areas by leveraging adhoc networks in cases of infrastructure failure.
Additionally, autonomous vehicles or driving assistance for emergency responders could increase safety when driving in disaster areas or in hazardous terrain during rescue missions.

3.2 Economic Benefits Projection

The below snapshots reproduced from [15] best represent the economic benefits.

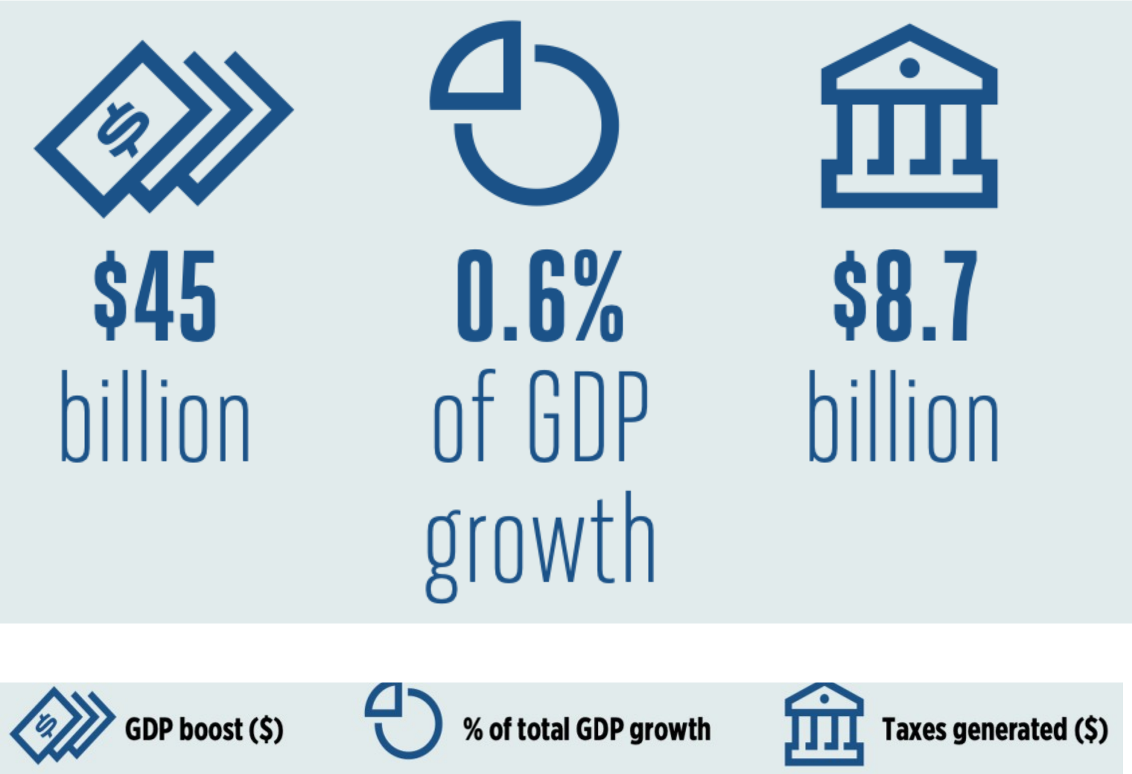

Figure 3: South Asia, South East Asia & Pacific Islands GDP Contribution of Use Cases [15]

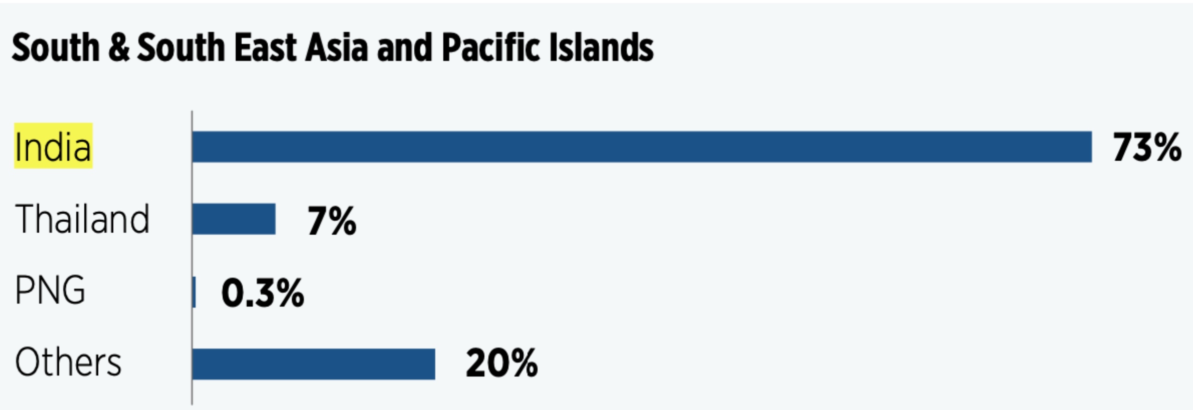

Figure 4: India Share of Regional Use Cases GDP contribution [15]

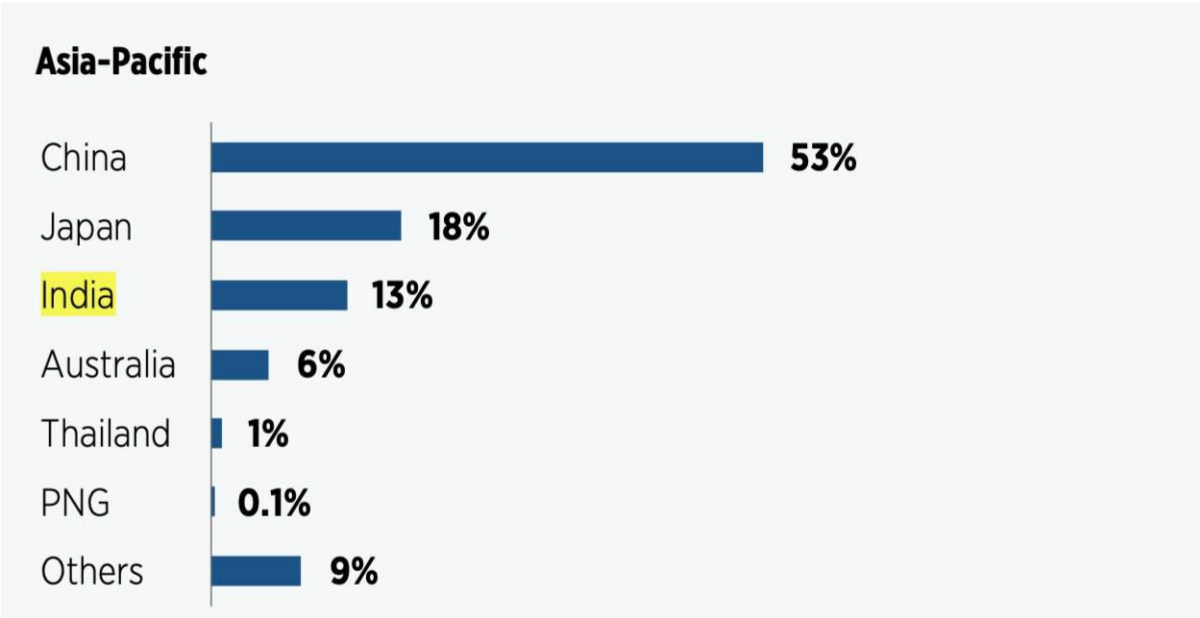

Figure 5: India share of Asia-Pacific Use Cases GDP Contribution [15]

A very small portion of the use cases listed are being served today by the traditional Telecom Service Providers (TSPs) and by the traditional licensing models. While the TSPs are expected to evolve to support a larger percentage of these use cases they will need new spectrum licensing models. However, this alone will not be sufficient and a larger ecosystem will be required to unlock the full potential of these use cases.

Further while the projected GDP contribution from India is a healthy 73% at a regional level it is only projected to be 13% at an Asia-Pacific level. There is an opportunity for India to significantly improve this percentage and improve its share in the Asia-Pacific and Global levels. Innovative spectrum licensing policies will be one of the keys to enabling this increased contribution.

4 India Proposal

The proponents recommend consideration of this model for spectrum policy and allocation in India. The proponents believe that the consideration of this spectrum will be extremely critical from the following perspectives:

1) Stimulate an ecosystem of startups, SMEs, MSMEs and local service providers.

2) Act as an easy first policy step to stimulate “private” networks.

3) Stimulate a plethora of innovative use cases and applications – that may further enable more effective usage of the traditionally licensed spectrum as well.

4) Maximize spectrum utilization by ensuring spectrum is used effectively in every square kilometre of geographical area.

5) Act as model whose technology (SAS and ESC) may also be used for administering and tracking experimental licenses in future.

Location information is an integral part of automated spectrum management in this model and the integrity of national networks may be maintained by using IRNSS/NavIC technology for location information.
The model may be considered for bands (low band, mid band, and mmWave) where spectrum may be held by the incumbents such as MoD, ISRO, and Prasar Bharti but not fully utilized in all locations.

The proponents recommend that such a model be considered when planning spectrum allocations and licensing policy for the next ten years. We further recommend that DoT may consider TRAI consultations to seek industry inputs as well as issue liaison requests to standardisation bodies for any necessary studies.
Finally, the proponents suggest that the model may be considered not only as-is but also as also a basis to evolve innovative spectrum sharing and licensing models specific to India.

5 Summary

5.1 Recommendations

The proponents recommend that DoT consider the CBRS as a model for further evaluation for applicability and evolution in the Indian context and that this be an essential aspect of the spectrum allocation plan and spectrum policy consideration for the next decade.
The proponents also recommend that further information may be gathered via TRAI consultations and by issuing liaison requests to standardisation bodies to conduct studies as a first step. The standardisation and certification bodies may also requested to enable certification as a subsequent step.

5.2 Next Steps

This section contains suggestions for immediate next steps. The proponents would be glad to deliberate and make more detailed recommendations on these next steps on request from DoT.

5.2.1 Spectrum Studies

The following next steps are recommended:

- Consider existing spectrum used by incumbents for the CBRS model and initiate necessary studies.
    - Consider unlicensed spectrum for a migration to the CBRS model (to allow larger range and adoption of cellular model).
    - Consider any new spectrum that may not be allocated yet (spectrum that may be already committed to other entities) for adoption of the CBRS model.
- Initiate studies on technical issues where required/appropriate.

5.2.2 Use Case Analysis

The following next steps are recommended:

- Issue consultation to get inputs from different segments on their needs and the applicability/utility of CBRS model.
- Initiate studies on use-cases and applications impact of the CBRS model.

- Initiate more detailed studies on the economic impact of such a model.

Bibliography

The following are recommended for further information on the scope of this document.

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ANNEX B

1. **Extracts from NFAP 2011 (September 2011)**

'India Remarks' in the National Frequency Allocation Table (Sept 2011) Foot Notes are as below:

IND 50

Requirements for Micro cellular low powered, telecommunication systems with maximum EIRP up to 4 Watts, FDD access techniques may be considered at specific locations for indigenously developed systems and technology, in a small chunk, in the frequency band 900 MHz presently used by existing wireless users of captive systems subject to co-ordination on case-by-case basis.

IND55

Requirements for Micro cellular low powered telecommunication systems with maximum EIRP up to 4 Watts, FDD access techniques may be considered at specific locations for indigenously developed systems and technology, in a small chunk, in the frequency band 1800 MHz presently used by existing wireless users of captive systems subject to co-ordination on case-by-case basis.

We can support indigenously developed private mobile systems in the country based on NFAP plan 2011 itself?

A decade back some domestic companies had designed private GSM networks where the PABX was acting as the MSC and all features & functions were configured exactly the way customers were doing it for the PBX. BSC & BTS were configured for RF functions. There was lot of traction from Defense, NDMA, Railways and large PSU "factory cum residential" complexes but eventually no license free approach was not entertained at that time.

Similar past precedence have existed prior to 2007 for Cordect that reserved spectrum for Indian R&D based products.