The 6GWG @*Wireless Innovation Forum*

International Spectrum Sharing Workshop: 6G Work Group @*WInnF*

6/26/2024

Patent Call

This meeting is being held under the Intellectual Property Rights Policy adopted by the Forum. If you do not have a copy of this policy, please see me during the meeting or view and download a copy of that policy (SDRF Policy 007) from the Policies and Procedures section of the Forum's website.

If you are personally aware of any claims under any patent applications or issued patents that are likely to be infringed by an implementation of a specification, software code or other work product which is the subject of this meeting, please inform me or an Officer of the Forum. You need not be the inventor of such patent or patent application in order to inform us of its existence, nor will you be held responsible for expressing a belief that turns out to be inaccurate.

Participants are also reminded that Contributions and Submissions containing AI generated content, in whole or in part, also fall under the Forum's Intellectual Rights Policy.

Reminder on Restricted and Controlled Information Policy

Participants in this meeting are reminded that the Forum is an international organization, and they are prohibited from disclosing export restricted or controlled information during the course of this meeting.

In addition, participants are reminded that they are prohibited from making input contributions containing export restricted or controlled information to the Forum. Members wishing additional information on these prohibitions are referred to the Forum's Policy on Restricted and Controlled Information (SDRF Policy 009) available on the web.

6GWG, WInnForum International Spectrum Sharing Workshop

Where have we come to?

- *Chartered goals*
- *6GWG/RAC JTG Mini-Workshops*
- *Key Inputs*

Where are we going?

- *Draft 7-8GHz TR*
- *Guiding Themes*

6GWG, WInnForum International Spectrum Sharing Workshop

Where have we come to?
Key Inputs

6GWG@WInnForum: Chartered Goals

***GOAL*:** In support of an interoperable, secure, resilient, sustainable, open, innovative and scalable global 6G wireless marketplace and ecosystem:

To contribute WInnForum's leading Spectrum Sharing and Wireless Innovation voice to the evolution and complementary advancement of 6G technology development, collaborating with other international SDO's and other industry organizations.

To develop the WInnForum 6G Strategy for value-added contribution to the rapidly evolving 6G ecosystem towards improved spectral efficiency, capacity, effectiveness, usability & market commercialization.

Agree a **reasonable, updatable definition of 6G** to feed into core WInnF Topic Area**:**
"The Role of Spectrum Sharing in 6G", initially by review/survey with other SDO's, industry, academic, and government groups, as well as through the lens of 5G-IMT and MSS experience to date.

…to better support innovation, commercialization/industrialization, & advancement in emerging global 6G technology.

Key Inputs:

6GWG/Regulatory Advisory Committee Joint Mini-Workshops

6GWG@WInnForum: 6GWG/RAC JWG Key Inputs

Wireless Innovation Forum Regulatory Advisory Committee
Sharing Native 6G Mini-Workshop

WInnF Regulatory Advisory Committee
Mini-Workshop Meeting:

Evolving Frameworks Towards Sharing Native 6G and the new era of open spectrum

4/16/2024

- **Sharing and the multi-lateral 6G principles… What is 6G? New era of spectrum? Target bands?**
- **What is spectrum sharing by design in the context of 6G, aka "Sharing Native 6G" ?**
- **What are "Sharing Native Spectrum Dependent Systems/SDS's"?**
- **Minimum viable spectrum sharing functions?**

6GWG/RAC JWG: Initial flexible sharing framework reference input documents

1) 6G Principles Joint Statement
2) ITU IMT-2030 Framework, Rec. ITU-R M.2160-0
3) WInnF/ETSI JWG Spectrum Sharing Reports
4) WInnF Spectrum Sharing May ’23 Infographic
5) US FCC TAC Advanced Spectrum Sharing & 6G WG’s
6) US National Spectrum Strategy, NTIA, OSTP, et al.
7) UK Ofcom 6GHz “hybrid” approach; Shared Access
8) EU CEPT/ECC common position on Upper 6GHz
9) Japan NICT B5G/6G Whitepaper
10) India ITU-APT Spectrum Issues Summary
11) UAE Spectrum Report
12) US National Spectrum R&D Plan RFI
13) US NSF Spectrum Program Solicitation (Spectrum Eras 3 & 4)
14) NextG Comms Research/Dev Gaps Rept, US NIST, et al.
15) ITU Council Strategic Plan 2024-2027

Sharing in the multi-lateral 6G Principles

Ref: 6G Principles Joint Statement

THE WHITE HOUSE

FEBRUARY 26, 2024

Joint Statement Endorsing Principles for 6G: Secure, Open, and Resilient by Design

BRIEFING ROOM › STATEMENTS AND RELEASES

The Governments of the United States, Australia, Canada, the Czech Republic, Finland, France, Japan, the Republic of Korea, Sweden, and the United Kingdom concur on these shared principles for the research and development of 6G wireless communication systems; and recognize that by working together we can support open, free, global, interoperable, reliable, resilient, and secure connectivity. We believe this to be an

*"6. **Spectrum and Manufacturing***

- *6G technologies that have secure and resilient supply chains.*
- *6G technologies that promote a globally competitive market along the ICT value chain and in all elements of the compute and connectivity continuum, with multiple software and hardware suppliers.*
- *6G technologies that could make use of new spectrum allocations or spectrum that has already been allocated for wireless services.*
- ***6G technologies that use spectrum efficiently and incorporate spectrum sharing mechanisms by design to coexist with incumbent service providers."*** AKA *"Sharing Native 6G"*

Ref: 6G Principles Joint Statement

THE WHITE HOUSE

FEBRUARY 26, 2024

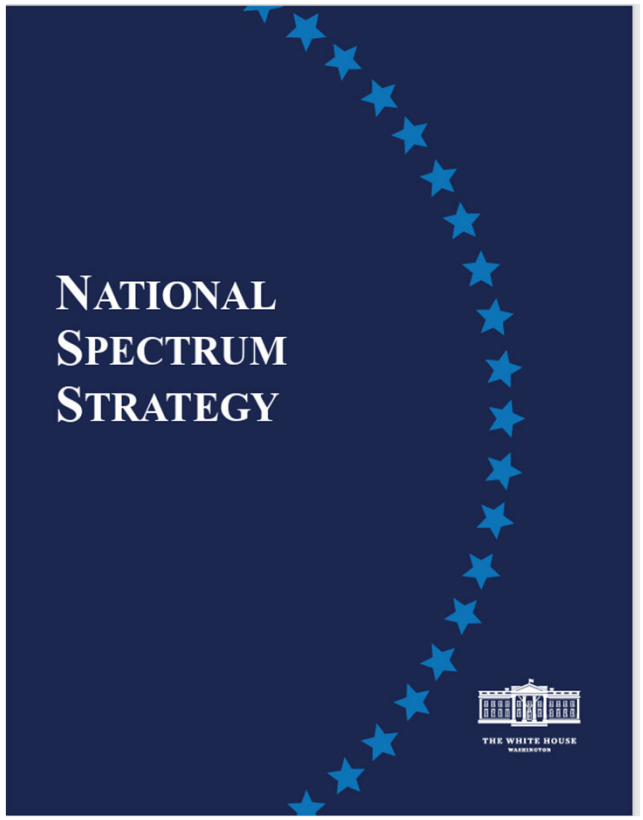
Joint Statement Endorsing Principles for 6G: Secure, Open, and Resilient by Design

BRIEFING ROOM › STATEMENTS AND RELEASES

*"3. **Global Industry-led and Inclusive Standard Setting & International Collaborations***
•6G technologies that are built on global technical standards, interfaces, and specifications that are developed through open, transparent, impartial and consensus-based decision-making processes."

*"4. **Cooperation to Enable Open and Interoperable Innovation***
•6G technologies that use technical standards in line with principles laid down under the Global Industry-led and Inclusive Standard Setting & International Collaborations principle and interfaces to enable seamless interoperability between products from different suppliers, including software and hardware."

Ref: US National Spectrum Strategy, NTIA, OSTP, et al.



"…a comprehensive strategy to modernize spectrum policy and make the most efficient use possible of this vital national resource to enhance the quality of life for all Americans. This Strategy will expand access to advanced wireless broadband networks and technologies, whether terrestrial-, airspace-, satellite- or space-based, for all Americans. And it will drive technological innovation (including innovative spectrum sharing technologies)"

national_spectrum_strategy_final.pdf (ntia.gov)

Ref: US FCC TAC Advanced Spectrum Sharing & 6G WG's

Federal Communications Commission – Technological Advisory Council
Advanced Spectrum Sharing Working Group

A Preliminary View of Spectrum Bands in the 7.125 - 24 GHz Range; and a Summary of Spectrum Sharing Frameworks

August 17, 2023

SpectrumSharingReportforTAC.pdf (fcc.gov)

"spectrum is a finite resource and can be exclusively allocated to only a handful of users. Additionally, many wireless systems prefer to deploy in certain parts of the spectrum due to various technical and commercial reasons, such as better propagation and infrastructure cost. Hence, the only practical way to satisfy the demands of all applications -- commercial, scientific and federal -- is to encourage spectrum sharing among incumbent users and new entrants.

FCC Technology Advisory Council

6G Working Group Position Paper

Co-Chairs: Abhimanyu Gosain,Northeastern University and Brian Daly, AT&T

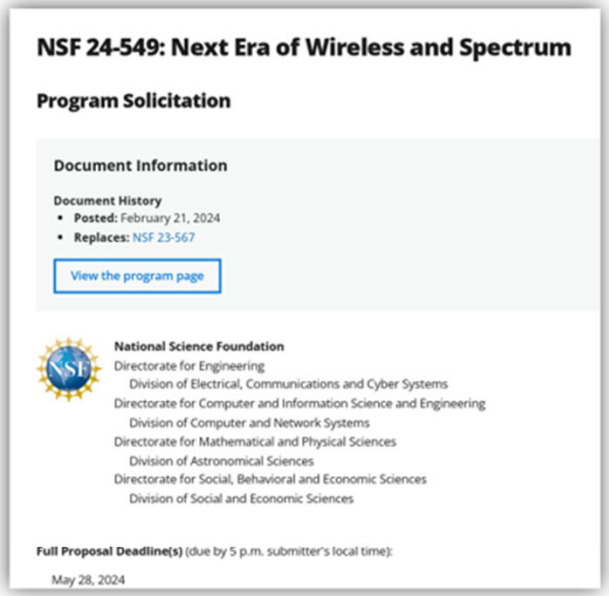
FCC Liaison: Michael Ha, Martin Doczkat and Kamran Etemad

August 17 2023

Consolidated_6G_Paper_FCCTAC23_Final.pdf

"better use of existing spectrum: a) Flexible Access to Unused Spectrum: require or incentivize licensees to cede use of spectrum when it is not in use or is under-utilized. (This can also be one avenue to address one facet of the rural digital divide.) b) Spectrum Sharing among different services (e.g., federal radiolocation and commercial mobile or satellite communication), and among same services (e.g., terrestrial and non terrestrial, including satellite)"

US National Science Foundation/NSF Spectrum Program (Spectrum Eras 3 & 4)



NSF 24-549: Next Era of Wireless and Spectrum

Program Solicitation

Document Information

Document History

- **Posted:** February 21, 2024
- **Replaces:** NSF 23-567

View the program page

National Science Foundation
Directorate for Engineering
Division of Electrical, Communications and Cyber Systems
Directorate for Computer and Information Science and Engineering
Division of Computer and Network Systems
Directorate for Mathematical and Physical Sciences
Division of Astronomical Sciences
Directorate for Social, Behavioral and Economic Sciences
Division of Social and Economic Sciences

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

May 28, 2024

"Development of fundamentally new models and paradigms of spectrum access and management, along with enabling technologies, is needed before it becomes too costly to accommodate new innovations and essential services, or too late to sustain the digital transformation and growth of key industries and public services. This program seeks to develop the intellectual capital enabling the U.S. to smoothly and quickly transition to effective new ways of using and managing the radio and optical spectrum after the end of the current spectrum era of long-term exclusive-use license auctions, thereby sustaining and advancing the social, economic, scientific, and U.S. national leadership benefits derived from the electromagnetic spectrum."

"In Spectrum Era 4, a fundamentally different spectrum management approach enabled by new wireless device, system, computational, and automation capabilities will be used to overcome congestion, enable a wide range of applications, assure spectrum access for the common good, and promote innovation."

6G Awareness for the International Sharing Ecosystem

What is 6G ?

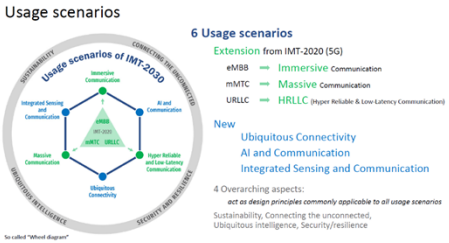
What is 6G *& what would you like it to be?*

It's important to note that 6G is still in the research and discovery phase, with definitions still emerging across the wireless ecosystem.

That said, 6G is a term that we'll use to refer to the sixth generation of wireless networking technology, which is expected to surpass "5G" or "ITU IMT-2020" by both enhancing the existing IMT-2020 capabilities (throughput, latency, security, spectral efficiency +) and providing new capabilities (sensing, interoperability, sustainability, positioning +).

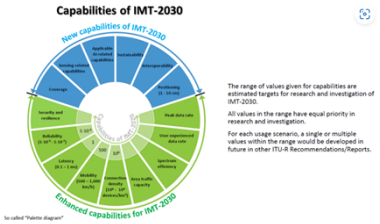
A 6G network of networks—or "heterogeneous network"—in operation is expected to provide unprecedented performance, reliability, and effectiveness empowering people and businesses to use it and innovate with it for a broader and deeper set of use cases, environments, and sectors. Just some examples include augmented intelligent transportation systems, smart homes and cities, and healthcare.

What is 6G & *what would you like it to be?* p2



A few of the key pillars of the still-emerging definition of 6G:

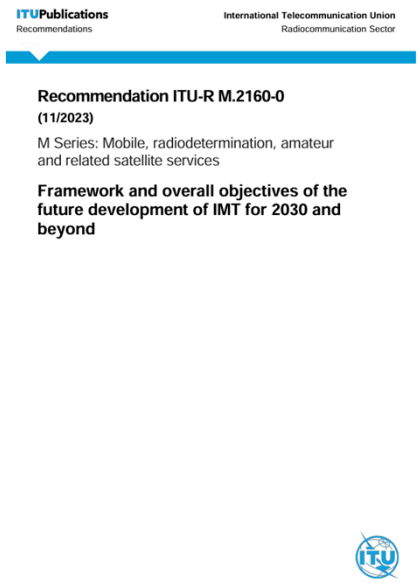
- Includes new and extended key Usage Scenarios (see “Wheel diagram”)
- Includes new and enhanced key Capabilities (see “Pallette diagram”)
- Includes spectrum sharing, per ITU re: it’s developing definition of “IMT-2030”
- Interoperability across a “Sharing-Native” heterogeneous network of networks, or “HetNet” including though not limited to:
  - terrestrial and non-terrestrial
  - mobile and fixed services and infrastructure, core and edge
  - indoor and outdoor public and private nets, both WAN and LAN
  - consumer, business, and industrial in urban, rural, remote, and maritime environments.



Spectrum sharing in these various contexts is an area in which the Wireless Innovation Forum's 6GWG will contribute to the ecosystem by helping to build cross-ecosystem awareness and education as well as inter-system/inter-service sharing contributions.

Sharing in IMT-2030, 6G Use Cases/Scenarios & Capabilities

Ref: IMT-2030 Framework, Rec. ITU-R M.2160-0


ITUPublications
Recommendations

International Telecommunication Union
Radiocommunication Sector

Recommendation ITU-R M.2160-0
(11/2023)

M Series: Mobile, radiodetermination, amateur and related satellite services

Framework and overall objectives of the future development of IMT for 2030 and beyond

"IMT-2030 systems are expected to continue to utilize a mixture of different frequency bands as in the current IMT system, but with potentially larger bandwidths and higher operating frequencies. Spectrum utilization can be further enhanced by efficiently managing resources through different technologies such as advanced carrier aggregation (CA) and distributed cell deployments, as well as spectrum sharing technologies and technologies for broader frequency spectrum."

R-REC-M.2160-0-202311-I!!PDF-E (itu.int)

Ref: IMT-2030 Usage scenarios, Rec. ITU-R M.2160-0

ITUPublications
Recommendations

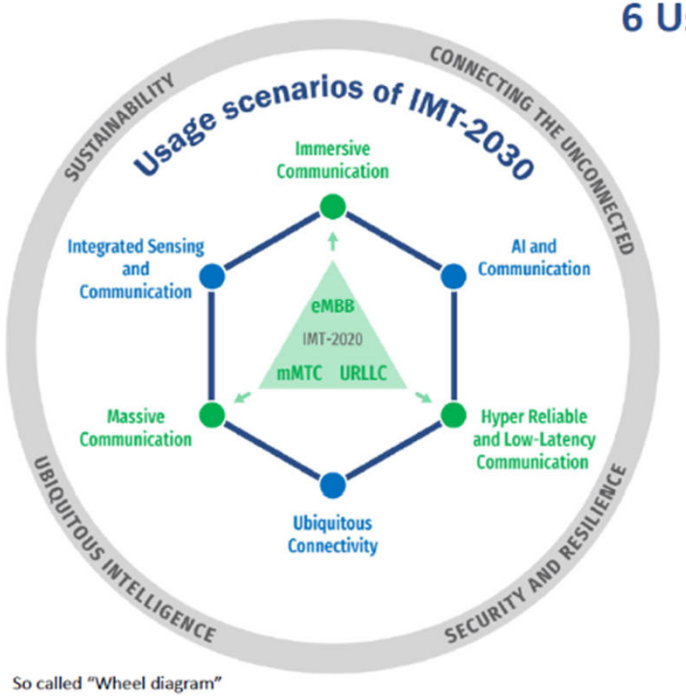
International Telecommunication Union
Radiocommunication Sector

Recommendation ITU-R M.2160-0
(11/2023)

M Series: Mobile, radiodetermination, amateur and related satellite services

Framework and overall objectives of the future development of IMT for 2030 and beyond

Usage scenarios



So called "Wheel diagram"

6 Usage scenarios

Extension from IMT-2020 (5G)

- eMBB ➡ Immersive Communication
- mMTC ➡ Massive Communication
- URLLC ➡ HRLLC (Hyper Reliable & Low-Latency Communication)

New

- Ubiquitous Connectivity
- AI and Communication
- Integrated Sensing and Communication

4 Overarching aspects:

act as design principles commonly applicable to all usage scenarios

Sustainability, Connecting the unconnected, Ubiquitous intelligence, Security/resilience

Ref: IMT-2030 Capabilities, Rec. ITU-R M.2160-0

ITUPublications
Recommendations

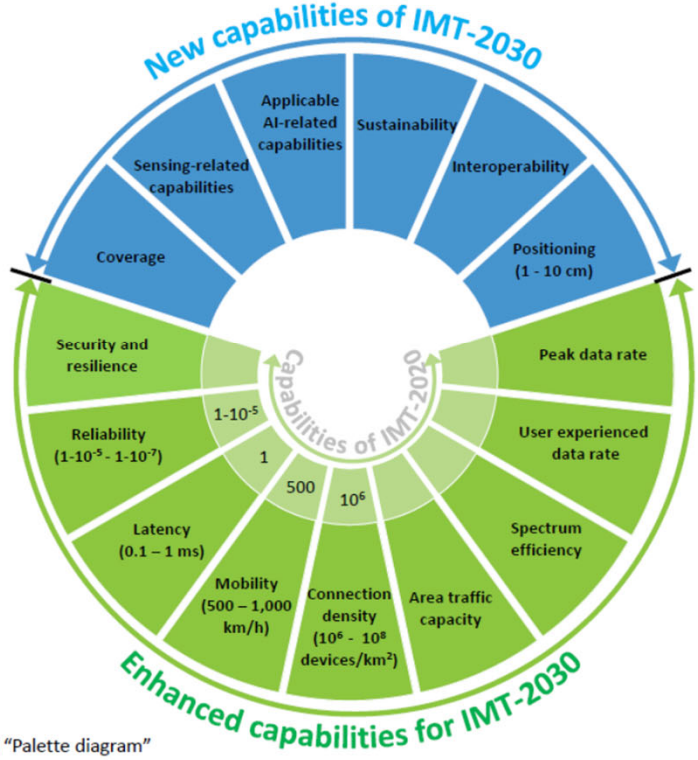
International Telecommunication Union
Radiocommunication Sector

Recommendation ITU-R M.2160-0
(11/2023)

M Series: Mobile, radiodetermination, amateur and related satellite services

Framework and overall objectives of the future development of IMT for 2030 and beyond

Capabilities of IMT-2030



So called "Palette diagram"

The range of values given for capabilities are estimated targets for research and investigation of IMT-2030.

All values in the range have equal priority in research and investigation.

For each usage scenario, a single or multiple values within the range would be developed in future in other ITU-R Recommendations/Reports.

Key Inputs: CBRS & 6GHz AFC efforts outputs

SECRET INGREDIENTS?

Probably more "Spectrum Social Science"

Early multi-sector collaboration, fact-based evaluation (episodic), minimized hyperbole and absolutism:
Building confidence & trust in (more or less) evidence-based spectrum sharing progress

Key Inputs:

Related 6GWG Contributions excerpts

Ref: 6GWG #23-09092023_1 Spectrum Sharing based on the O-RAN Architecture, contribution

WF 6GWG WINNF-23-09092023_1,
A. DAMNJANOVIC & D. KNISELY

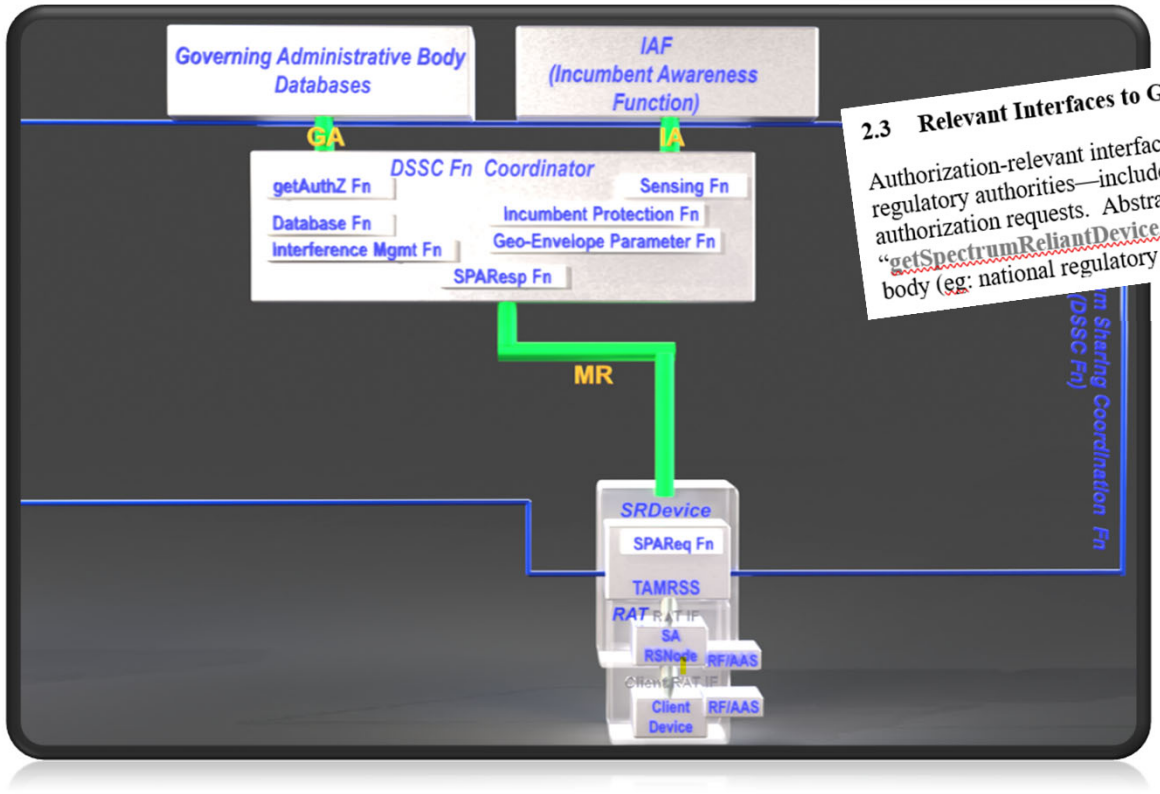
9 September 2023
WInnForum Workshop
Reston, VA

Spectrum Sharing based on the O-RAN Architecture

Aleksandar Damnjanovic
Douglas Knisely
Qualcomm Technologies, Inc.

Qualcomm

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023



2.3 Relevant Interfaces to Governing Administrative Body

Authorization-relevant interfaces to governing administrative bodies—including national regulatory authorities—include *though are not limited to* automated Spectrum-Reliant Device authorization requests. Abstractly, these governing-side interfaces can include functions such as "getSpectrumReliantDeviceAuthorization" as specified by a given governing administrative body (eg: national regulatory authority or other).

Figure 1: Very-high level contextual view of the DSSC Functional architecture

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023

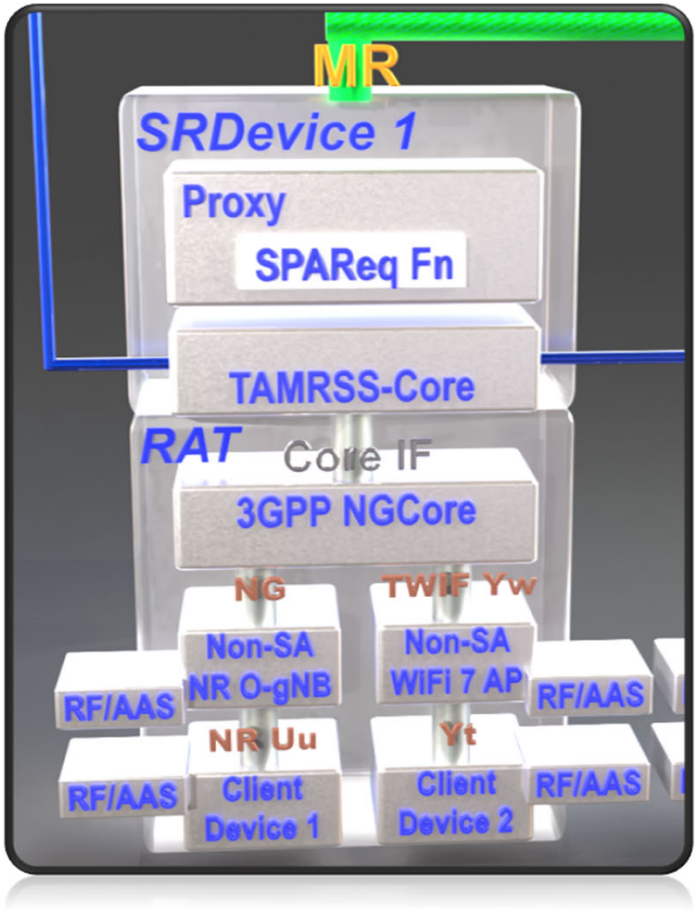


Figure 4: Example SRDevice-Proxy Detail

As a technology-agnostic multi-RAT function, given Radio Service Node (RSNode) RAT's may include though are not limited to:

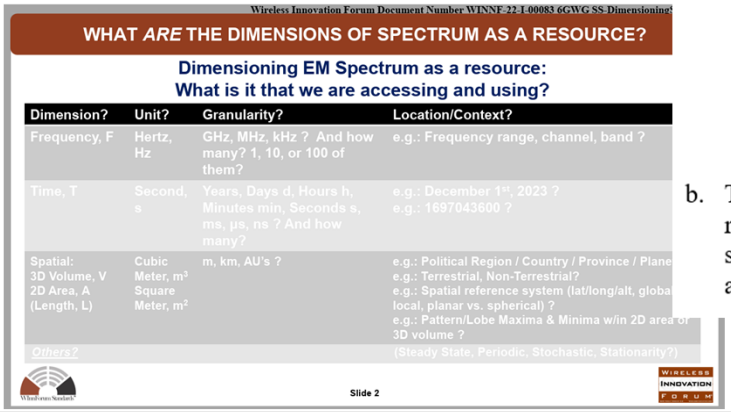
1. *3GPP NG-RAN NR-based* gNB RSNodes and UE client devices.
2. *3GPP NR-based* SideLink-Relay RSNodes and client devices.
3. *O-RAN Alliance 3GPP NG-RAN NR-based* O-gNB RSNodes.
4. *Wi-Fi Alliance/IEEE Wi-Fi 7 802.11be-based* RSNodes and client devices.
5. *3GPP NG-RAN IoT NTN (LTE-M)-based* ng-eNB RSNodes and UE client devices.
6. *Other Non-3GPP* NG-RAN RSNodes and Air Interfaces, such as UWB.
7. *Proprietary* RSNodes and their client devices.
8.

Ref: 6GWG #23-86 DSSC *notional* spectrum resource parameters

a. Implementing the northbound SPAReq Fn (Spectrum Access *Request* Function):

   i. Generates a SPAReq resource demand request with parameters including though not limited to:

      1. SRDevice identifier,
      2. resource demand identifier,
      3. priority/KPI indicator,
      4. relevant geographic location and area/volume,
      5. carrier frequency capabilities,
      6. channel bandwidth,
      7. resource reservation time duration, and
      8. the spectrum availability inquiry subfunction.
      9.



a. Implements the SPAResp Fn (Spectrum Access Request-*Response* Function):

   i. SPAResp Fn authorizes access through frequency grants and confirmation of cessation of frequency use.

   ii. SPAResp Fn responds to requests including Spectrum Access Requests and associated Spectrum Availability Requests.

   iii. Provides a SPAResp resource allocation response with parameters including as appropriate—though not limited to:

      1. resource allocation identifier,
      2. relevant geographic location and area/volume,
      3. carrier frequency,
      4. channel bandwidth,
      5. resource reservation time duration, and
      6. maximum transmission power limits.
      7.

b. The SPAResp Functions implement a spectrum sharing framework with spectrum resource envelope authorizations specified in Time, Frequency, &/or Geographic spectrum resource unit dimensions, and are governed directly or indirectly by associated statutes and regulations.

Ref: 6GWG #24-17 Spectrum Sharing in 6G, contribution

WF 6GWG WINNF-24-I-00017,
A. MUKHOPDHYAY

Spectrum Sharing in 6G

Amit Mukhopdhyay, Ph.D.

February 13, 2024

Spectrum Sharing Examples

Source: FCC-TAC Advanced Spectrum Sharing WG Report – August 2023

Sharing Situation	Share by Geographic Separation	Share by Time Separation	Centralized/ Database Managed	Aggregate Interference	Incumbent Sensing
TV White Space	x		x		
CBRS	x	x	x	x	x
6 GHz AFC	x		x		
AMBIT (3.45 GHz Service)	x	x		x	

Intersection of WRC-23 and US NSS

WRC-23 resolutions likely impacting 5G-Adv/6G

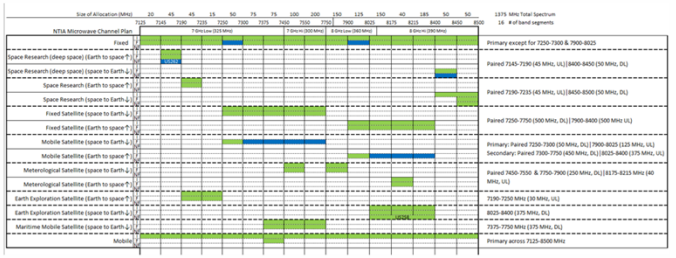
- Identification of **3.3-3.4** GHz for IMT
- **Upper 6 GHz band** (6.425-7.125 GHz) is identified for IMT, not only in **EMEA** but also per footnote in **Mexico**, **Brazil**, and **some Asian** countries.
  - Recognition of the use of wireless access systems (WAS)/RLAN for some countries is also part of the identification deal
  - The top 100 MHz (7025-7125 MHz) were identified for IMT for the Asia Pacific region. Potentially, **additional countries in Americas and Asia Pacific** can join the upper 6 GHz band footnote @ WRC-27, identifying the entire 700 MHz for IMT.
- **New IMT/6G** Agenda Item for WRC-27 **is approved**, which gives positive outlook enabling suitable studies to be conducted. Bands agreed for study are:
  - **4400-4800 MHz** (in EMEA and Asia)
  - **7125-8400 MHz** (excluding 7250-7750 MHz in Europe due to use by HATO)
  - **14.8-15.35 GHz** (global

US position at WRC-23 and NSS

- Following new bands were proposed by the US delegation at WRC-23 as study item towards WRC-27 for wireless broadband use:
  - **3.1-3.3 GHz**: DoD determined that sharing is feasible if certain advanced interference mitigation features and a coordination framework to facilitate spectrum sharing are put in place. Additional studies will explore dynamic spectrum sharing and other opportunities for private-sector access in the band, while ensuring DoD and other Federal mission capabilities are preserved, with any necessary changes.
  - **12.7-13.25 GHz**: The FCC is further considering options for flexible use of the 12.7- 13.25 GHz band (the "Upper 12 GHz band"), which has in-band and adjacent-band federal operations that may need to be protected
- The HSS proposed these additional bands for further investigation by the US government:
  - **7.124 – 8.4 GHz** (on a licensed and/or unlicensed basis); a variety of mission-critical Federal operations in this band (including Fixed, Fixed Satellite, Mobile, Mobile Satellite, Space Research, Earth Exploration Satellite, and Meteorological Satellite services) that will make it challenging to repurpose portions of the band while protecting incumbent users from harmful interference
  - **37 – 37.6 GHz;** further studied to implement a co-equal, shared-use framework allowing Federal and non-Federal users to deploy operations in the band

5 © 2023 Nokia | Public

7.125 - 8.5 GHz



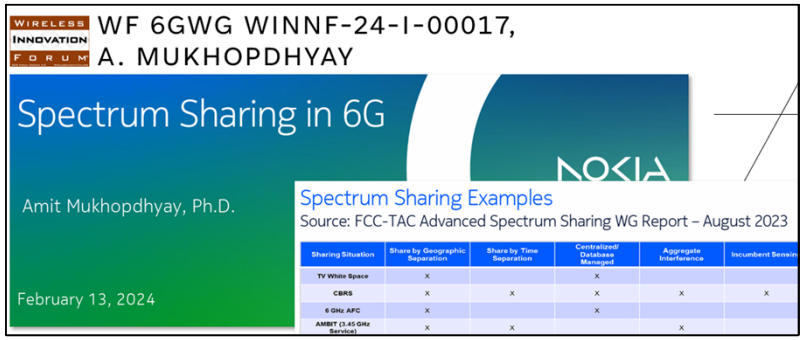
Source: Commscope

Key takeaways:

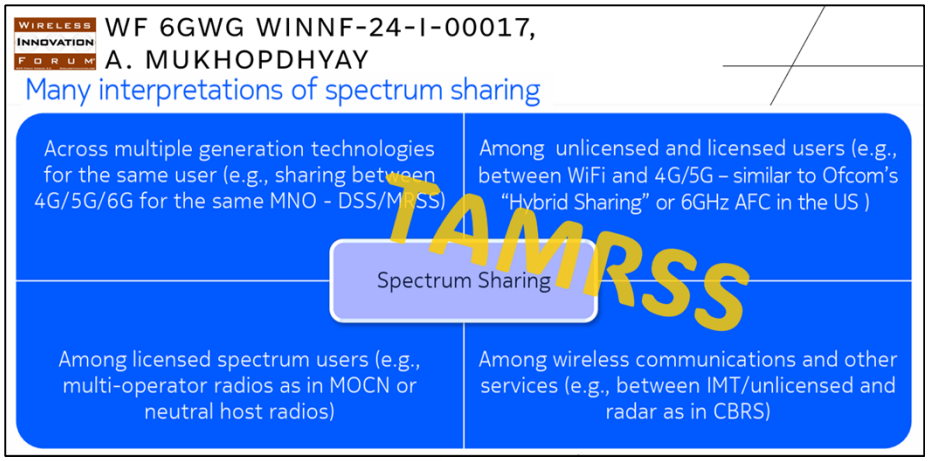
- FS, FSS and MSS are the largest current allocations and will be the biggest challenge for sharing with terrestrial mobile systems.
- Approximately 20% of FS use is by the Department of Defense (DoD), and the satellite allocations also include DoD operations.
- Other uses may not be ubiquitous and hence perhaps more amenable to sharing.

3 © 2024 Nokia | Public.

Ref: 6GWG #24-17 Spectrum Sharing in 6G, contribution



Sharing Situation	Share by Geographic Separation	Share by Time Separation	Centralized/ Database Managed	Aggregate Interference	Incumbent Sensin
TV White Space	x		x		
CBRS	x	x	x	x	x
6 GHz AFC	x		x		
AMBIT (3.45 GHz Service)	x	x		x	



Many facets of spectrum sharing

Key incumbent characteristics

- Whether the services are **ubiquitous or limited** in geographies
- Whether the services are **intermittent or continuous**, including the level of susceptibility to interference from commercial users
- **Whether** the services always need the entire spectrum range or not
- I lational **security** considerations, including the level of transparency possible between concurrent or shared uses of the spectrum
- Technology/service **sunset/evolution**, including repacking possibilities and incentive mechanisms to enable transition of obsolete equipment towards a more efficient utilization of spectrum. Also to encourage continuous technology upgrades by incumbents to maximize spectrum utility.

Spectrum sharing enablers (not mutually exclusive)

- **New entrant capabilities**: Avoid causing interference to incumbents (as well as other potential new entrants) so that their performance degrades. Be resilient to certain level of interference from other users of the spectrum
- **Incumbent capabilities**: Develop features to accept certain level of interference from new entrants and/or minimize interference towards new entrants
- **External system capabilities**: Assess the needs of all users of a given spectrum band and instruct users about required transmit/receive characteristics.
- **Harm reporting capabilities**: Both incumbents and new entrants should be able to report interference above interference levels agreed upon so that the aggressor system can provide relied for victim system

Spectrum sharing enablers need to matched with incumbent parameters and operating conditions

6 © 2024 Nokia | Public

NOKIA

WInnForum Standards™

Ref: WInnF/ETSI JWG Spectrum Sharing Repts

ETSI The Standards People

WIRELESS INNOVATION FORUM

Spectrum sharing frameworks for temporary, dynamic, and flexible spectrum access for local private networks

"After an extraction of the most challenging use case parameters and a comparison of all sharing frameworks against it, the present document summarizes the following features which need to be supported by a sharing framework for temporary and flexible spectrum access, namely: • ensuring incumbent protection and inter-system coordination between secondary users, • allowing for usage independent of specific frequency bands and RF technology, and • introducing a high degree of flexibility and scalability to adapt to the specifics of the frequency bands, incumbents, and secondary users"

ETSI-WinnForum-WPSpectrum_sharing_frameworks_for_temporary_dynamic_and_flexible_spectrum_access_for_local_private_networks.pdf (wirelessinnovation.org)

tr_103885v010102p.pdf (etsi.org)

WInnForum Standards

WIRELESS INNOVATION FORUM

6GWG, WInnForum International Spectrum Sharing Workshop

Where are we going?

6GWG@WInnForum Path to Spectrum Sharing Commercialization & Value

Moving Forward:
2H24 & 2025, 6GWG Guiding Themes:

- Elaboration of *Sharing Native 6G* & HetNet SDS Spectrum C2
- Emerging global 6G 'golden' bands + refarmed *pre-6G* bands
- 6G *nodes in motion* architectural implications:
  - NTN/SCS Native 6G, V2X, + tech-agnostic TAMRSS
- *Essential 6G*: Multi-sector, needs-driven… What is essential to *6G end-users, public/private sectors, & commercialization*?
- Continued cross-ecosystem collaboration & awareness
  - Jointly building confidence & trust in evidence-based spectrum sharing progress

WInnForum Standards

WIRELESS INNOVATION FORUM

Sharing Native 6G
&
Sharing Native SDS

What is "Sharing Native 6G"? *What might it be to you?*

- "***Sharing Native 6G***", Monisha Ghosh, 2022
- "*AI-native, API-native, spectrum sharing-native, security-native,… in short let's call that* ***X-native designs for 6G"***, Bell Labs President Peter Vetter, Spring '24 6G Symposium
- Our X-Native 6G focus? Sharing-Native 6G (*SN6G*), where spectrum sharing in the 6G era is a fundamental capability incorporated *"By design"*
- What might *"Sharing By Design"* mean to you and the spectrum regulatory community?

Sharing Native 6G / Sharing By Design?

- Part of 6G HetNet & one of the "X-Native 6G" pillars (AI Native 6G, NTN Native 6G, Security Native *6G +) **Sharing Native 6G*** refers to a wireless communications architectural and design approach where the spectrum sharing capability is, ***by design****, deeply integrated into the 6G system, enabling enhanced spectrum efficiency, effectiveness, capacity, and multi-service/multi-allocation inter-system/inter-service coexistence.
- For *all* forms of national regulatory authority authorized spectrum licensing and use.
- Designed and built to seamlessly integrate with one or more sharing regimes or frameworks at various granularities of frequency/temporal/spatial envelopes.

* *6G Principles Joint Statement*, Feb 26, 2024

Sharing Native SDS's/SN-SDS?
Minimum Viable Spectrum Sharing System Functions?

How about sharing native spectrum dependent systems (SDS') of all types?

Broadly speaking, for SDS's to be part of a Sharing Native regime by design, they will need to be connected to a spectrum command and control function of some sort, and use it to provide spectrum status information to, and receive directives from, a decision function within a DSS/Dynamic Spectrum Sharing system.

A "Sharing Native SDS" (comms, radar, PNT, etc.) would, at a minimum:

1. Be able to **provide information about the spectrum it's using**, its "spectrum footprint" (it's frequency, temporal, geo-resource envelope)
2. Be able to **report the interference it is receiving**
3. Be able **to modify its operating parameters upon receipt of a directive** to do so (and change its spectrum footprint/spectrum resource envelope)

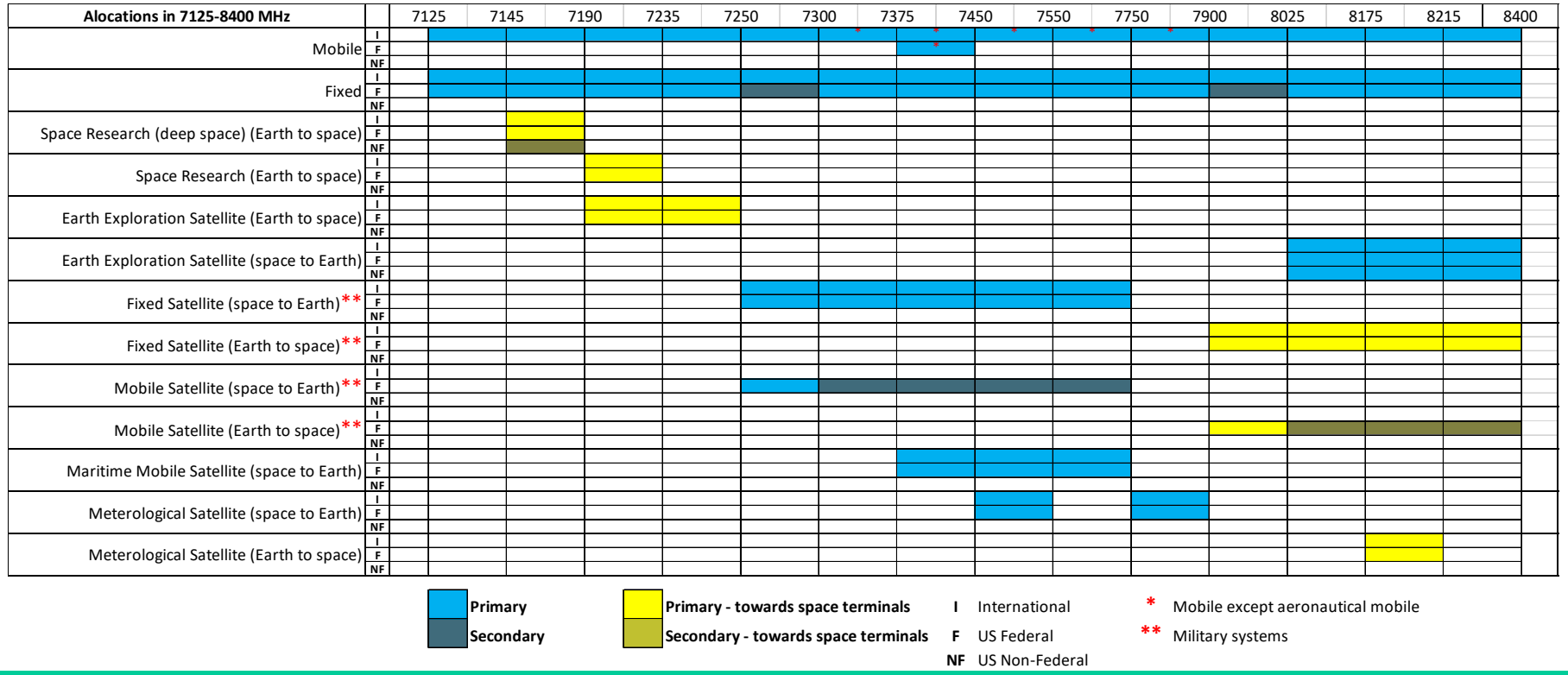
A *Sharing Native* SDS would be designed *from the ground up* to support or implement these key functions.

New 7-8 GHz TR Draft: *WINNF-TR-1021-V0.0.0-r1.1 -Options for Sharing in the 7-8GHz Band*

(excerpts)

International Spectrum allocations in 7.125-8.4 GHz

International, US Federal and US Non-Federal allocations



Mostly Fixed Service (FS) and various satellite services (FSS, MSS, EESS) aligned with international allocations, only exception is MSS

3 Main Types of Allocations Internationally

Different challenges of spectrum sharing

Fixed service

- Allocated over the entire spectrum range
- Generally, very challenging to share on a dynamic basis
- Band segmentation, if possible, is a more practical option
- Possibility of co-existence/sharing depends upon the density of links

Satellite uplink service

- Allocation spread between the lower (7145 -7250 MHz) and upper (7900-8400 MHz) parts of the spectrum range
- Studied for coexistence in other bands, no need for dynamic sharing
- Stringent requirements on ground-based equipment on radiation patterns and emitted power

Satellite downlink service

- Allocation mostly in the middle part of the range (7250-7750 MHz) and one in upper part (8025-8400 MHz)
- Small number of EESS Earth Stations in the upper part (including non-federal) where co-existence may be suitable
- The middle part is most challenging and will require dynamic spectrum management schemes

7-8GHz global emerging 6G 'golden band'

Potential sharing/dynamic spectrum control solution options

Fixed services	• ***Evolved " ~AFC+ " type*** **dynamic spectrum control function** • And also: frequency separation/packing
Satellite *downlink*	• **For MSS: *Evolved " ~SAS prime' " type* dynamic spectrum control function** • For FSS/Maritime: international and US joint sharing concepts
Satellite *uplink*	• Perhaps "Static coexistence", rather than "dynamic sharing"

Towards NTN Native 6G

SCS-informed NTN Native 6G?

4 families:

- **3GPP defined NR based satellite access network**: a NG-RAN based o… nodes, connected to a 5GC, and providing connectivity to 3GPP define… It supports the New Radio (NR) access technology enhanced with… specified by 3GPP. It may also provide connectivity to IAB nodes.
- **3GPP defined NB-IoT/eMTC based satellite access network**: a E-… network based on satellite access nodes, connected to an EPC, and p… to 3GPP defined user equipment. It supports the NB-IoT and eMTC… enhanced with NTN capabilities specified by 3GPP.
- **Non 3GPP defined satellite access network connected to a 5…** network, connected to a 5GC via an interworking function, whic… services to non 3GPP defined terminals. Such access network supports a… radio protocol. It may support some 3GPP features.
- **Satellite backhaul**: A transport network over satellite that provides connectivity between 5GC and gNB. This transport network may be based on 3GPP or non 3GPP defined radio protocols. It may support/maintain the 5G slices.

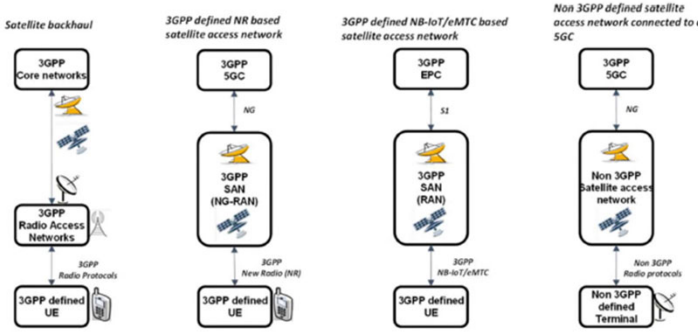


Fig. 1a Fig. 1b Fig. 1c Fig. 1d

Figure 1: Emerging Taxonomy for Satellite Network Solutions for 5G

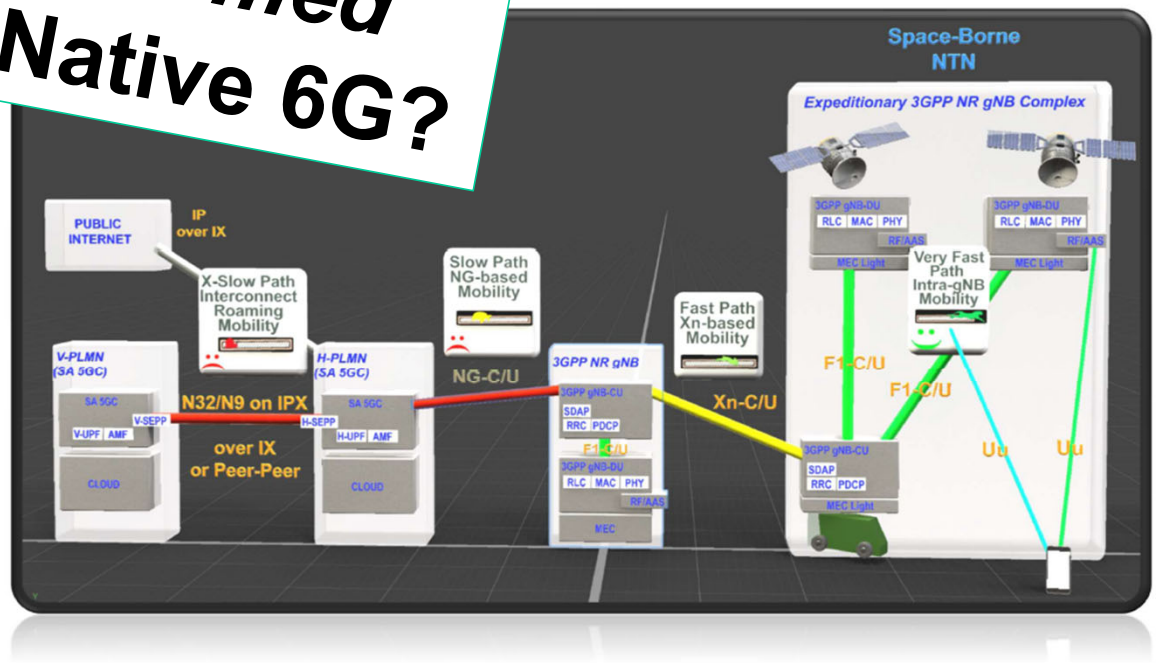


Figure 2: 5G System Overview with Simplified mobility types: Inter-Operator, Intra-5GCore, Inter-gNB, Intra-gNB inter-beam

WInnForum Standards™

NTN Native

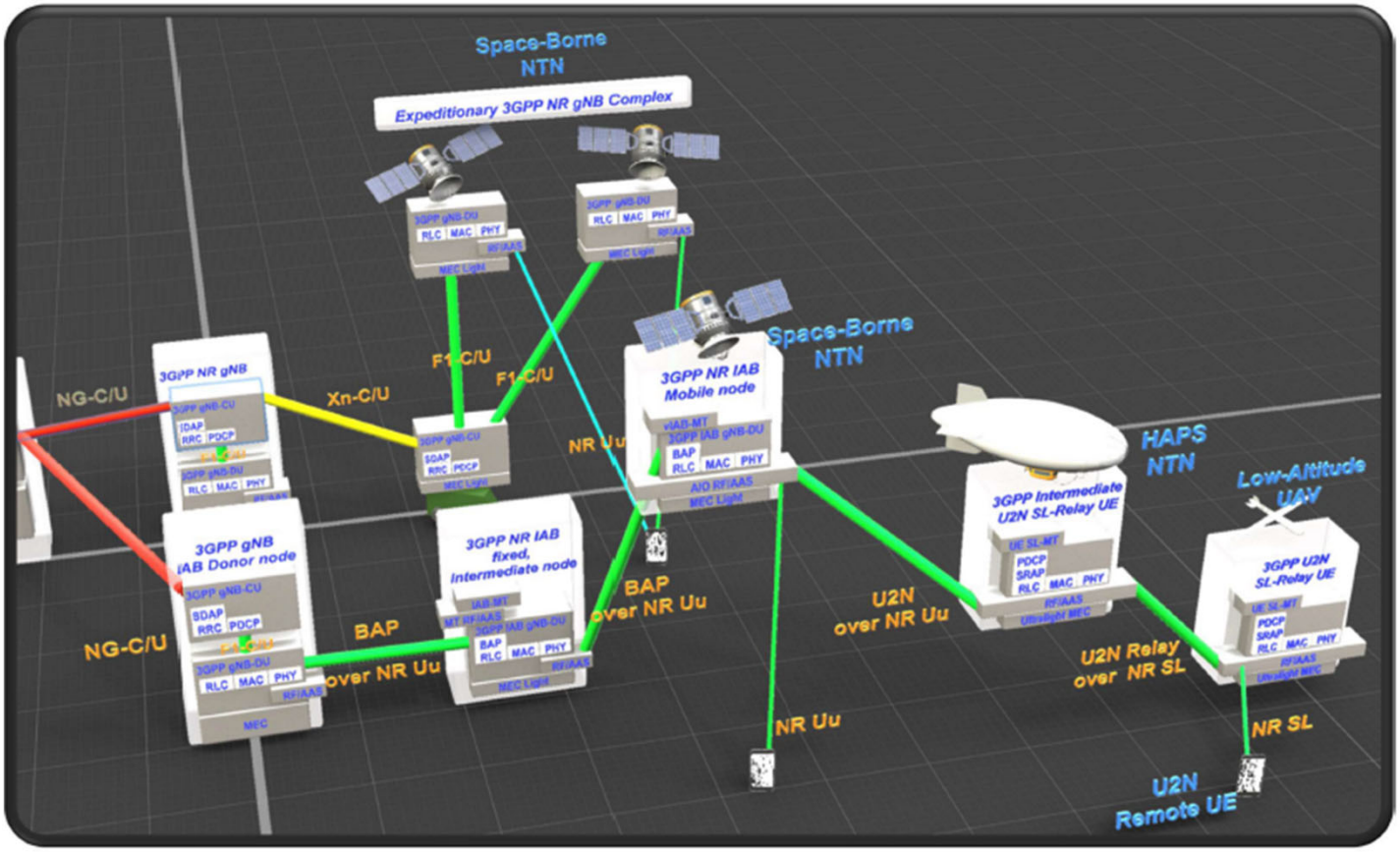
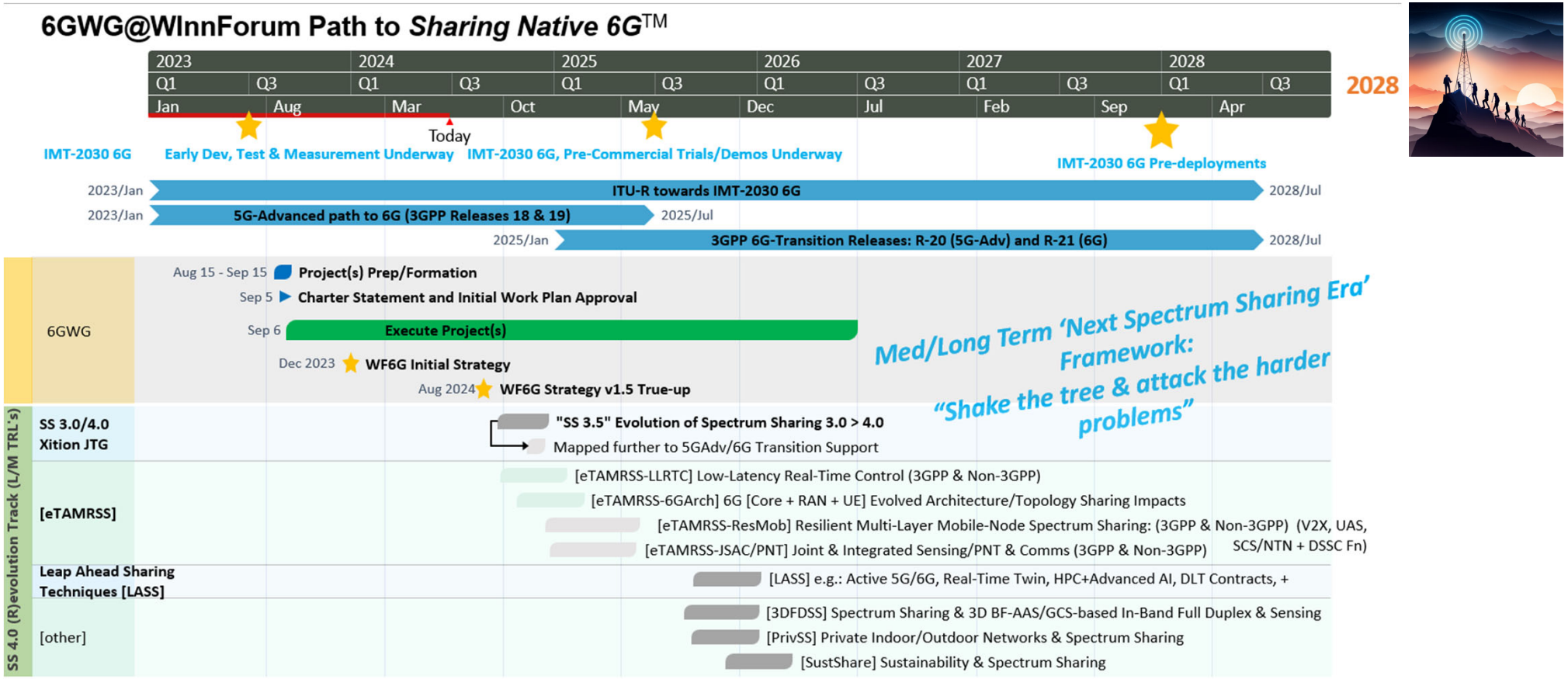


Figure 4: Example SL-Relay Device-side Radio Service Nodes in 5G RAN Architecture

6GWG@WInnForum Path to *Sharing Native 6G*™



Next Steps

- *Today's Meeting:* ***International Spectrum Sharing Workshop, June 26, 2024***

- *As follow up to today's workshop:*
- _____
- _____
- _____

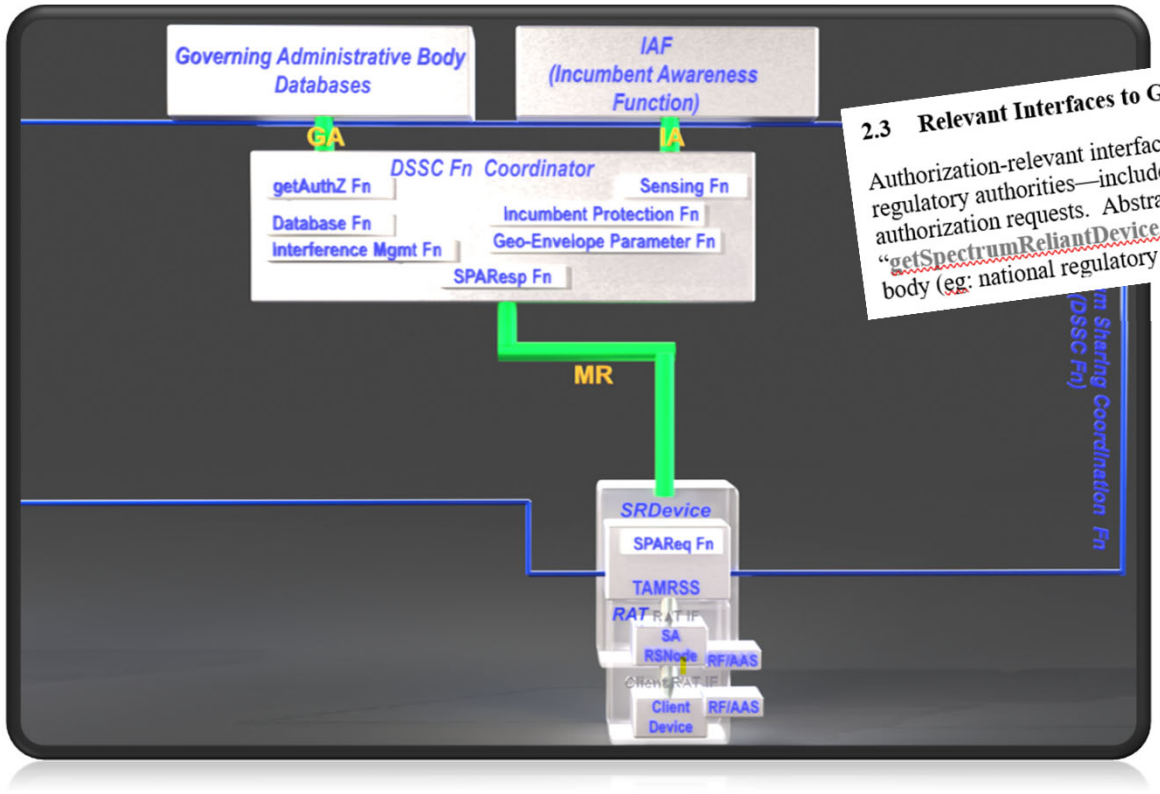
- *Questions/Comments?:*

Colby Harper, colby@pathfinderwireless.com & Prakash Moorut, moorutp@shure.com

Thank You

BACKUP

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023



2.3 Relevant Interfaces to Governing Administrative Body

Authorization-relevant interfaces to governing administrative bodies—including national regulatory authorities—include *though are not limited to* automated Spectrum-Reliant Device authorization requests. Abstractly, these governing-side interfaces can include functions such as "getSpectrumReliantDeviceAuthorization" as specified by a given governing administrative body (eg: national regulatory authority or other).

Figure 1: Very-high level contextual view of the DSSC Functional architecture

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023

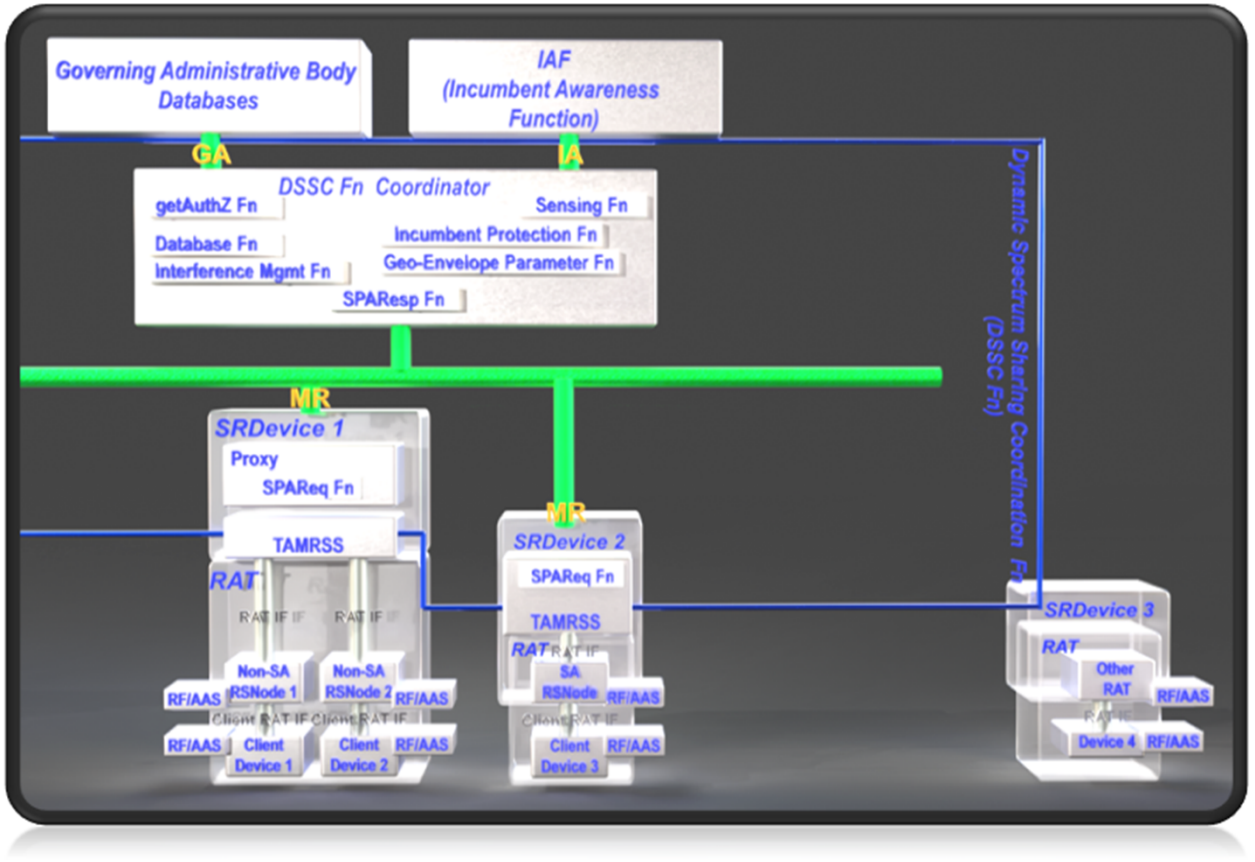


Figure 2: High-level view of DSSC Functional architecture

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023

viii. Technology-agnostic southbound EM spectrum-side MR interface to one or more Spectrum-Reliant Devices (SRDevices):

a. Implements the SPAResp Fn (Spectrum Access Request-*Response* Function):

i. SPAResp Fn authorizes access through frequency grants and confirmation of cessation of frequency use.

ii. SPAResp Fn responds to requests including Spectrum Access Requests and associated Spectrum Availability Requests.

iii. Provides a SPAResp resource allocation response with parameters including as appropriate—though not limited to:

1. resource allocation identifier,
2. relevant geographic location and area/volume,
3. carrier frequency,
4. channel bandwidth,
5. resource reservation time duration, and
6. maximum transmission power limits.
7.

b. The SPAResp Functions implement a spectrum sharing framework with spectrum resource envelope authorizations specified in Time, Frequency, &/or Geographic spectrum resource unit dimensions, and are governed directly or indirectly by associated statutes and regulations.

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023

ii. Technology-Agnostic Multi-RAT Spectrum Sharing Function (TAMRSS) providing termination of the MR interface, and

a. Implementing the northbound SPAReq Fn (Spectrum Access *Request* Function):

i. Generates a SPAReq resource demand request with parameters including though not limited to:

1. SRDevice identifier,
2. resource demand identifier,
3. priority/KPI indicator,
4. relevant geographic location and area/volume,
5. carrier frequency capabilities,
6. channel bandwidth,
7. resource reservation time duration, and
8. the spectrum availability inquiry subfunction.
9.

ii.

b. Implementing support interfaces to core networks including 3GPP NGC Core, and other Core networks, including proprietary.

i. E.g.: 3GPP N1/N2 interfaces to NGC Access and Mobility Management Function (AMF) and User Plane Function (UPF).

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023

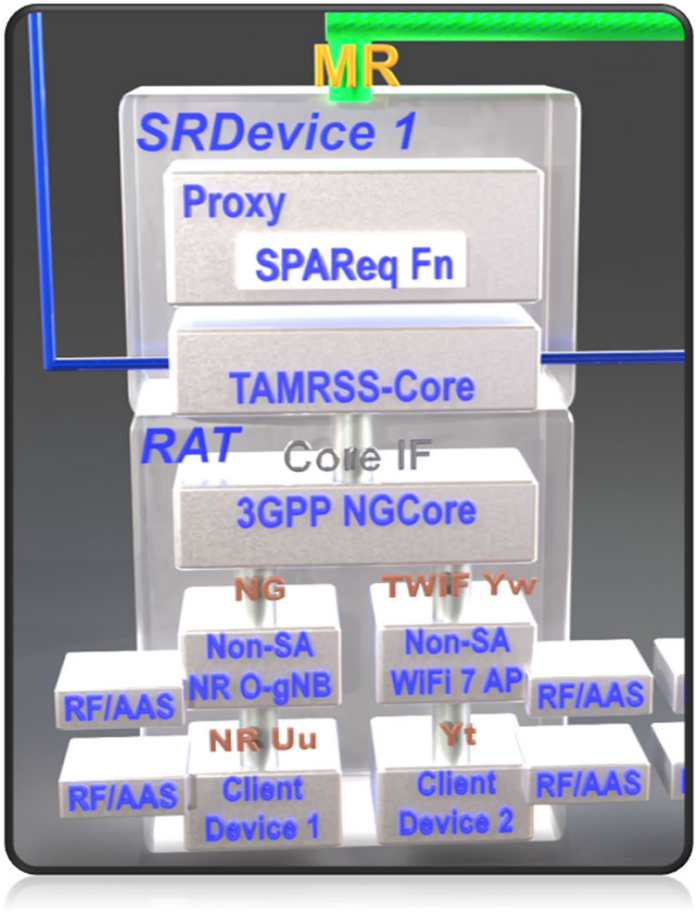


Figure 4: Example SRDevice-Proxy Detail

As a technology-agnostic multi-RAT function, given Radio Service Node (RSNode) RAT's may include though are not limited to:

1. *3GPP NG-RAN NR-based* gNB RSNodes and UE client devices.
2. *3GPP NR-based* SideLink-Relay RSNodes and client devices.
3. *O-RAN Alliance 3GPP NG-RAN NR-based* O-gNB RSNodes.
4. *Wi-Fi Alliance/IEEE Wi-Fi 7 802.11be-based* RSNodes and client devices.
5. *3GPP NG-RAN IoT NTN (LTE-M)-based* ng-eNB RSNodes and UE client devices.
6. *Other Non-3GPP* NG-RAN RSNodes and Air Interfaces, such as UWB.
7. *Proprietary* RSNodes and their client devices.
8.

SSFwk Dynamic Spectrum Sharing Coordination Functional Architecture Draft TR (r0.3c) December 11th, 2023

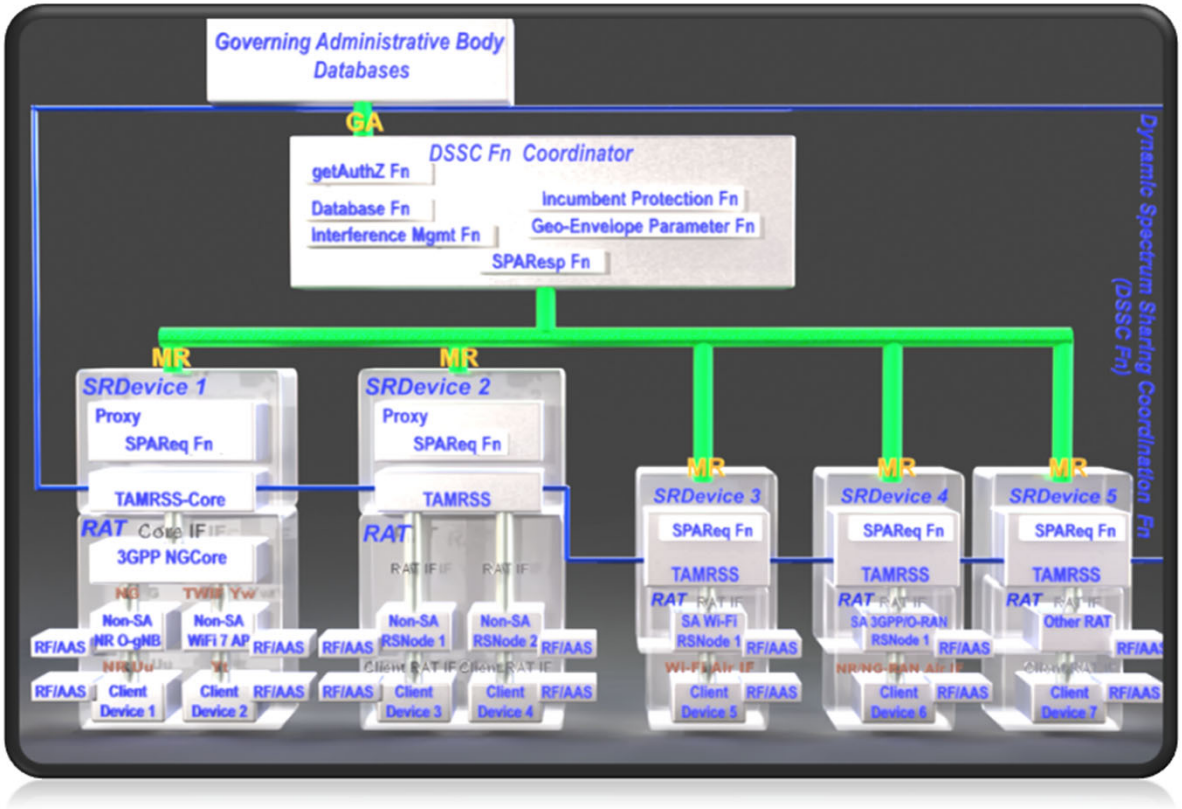


Figure 5: Notional 6GHz Band/AFC-based DSSC Functional architecture example

6GWG Charter
& Initial Topic Areas

WInnForum 6G WG: Exec Summary

***GOAL*:** In support of an interoperable, secure, resilient, sustainable, open, innovative and scalable global 6G wireless marketplace and ecosystem:

To contribute WInnForum's leading Spectrum Sharing and Wireless Innovation voice to the evolution and complementary advancement of 6G technology development, collaborating with other international SDO's and other industry organizations.

To develop the WInnForum 6G Strategy for value-added contribution to the rapidly evolving 6G ecosystem towards improved spectral efficiency, capacity, effectiveness, usability & market commercialization.

Agree a **reasonable, updatable definition of 6G** to feed into core WInnF Topic Area**:**
"The Role of Spectrum Sharing in 6G", initially by review/survey with other SDO's, industry, academic, and government groups, as well as through the lens of 5G-IMT and MSS experience to date.

…to better support innovation, commercialization/industrialization, & advancement in emerging global 6G technology.

Sharing Native 6G, RAC, and the 6GWG@WInnF

The Wireless Innovation Forum 6G Work Group, *6G@WInnF*, is focused on *Sharing Native 6G* in the international context:

HOW CAN WE COLLABORATE MORE CLOSELY?
WHAT'S NEEDED? WHAT'S MISSING?

6GWG@WInnF is collaborating with the technical and regulatory standards- and market-development ecosystem to translate *Sharing Native 6G* to reality for *all* sectors.

The 6GWG@WInnF builds on WInnF's extensive spectrum sharing commercialization and translation experience and expertise.

6GWG greatly appreciates the WInnF Regulatory Advisory Committee's input and guidance.

AUDIENCE for RAC/6GWG JTG OUTPUT

Spectrum-related technical, business, regulatory, and policy bodies and individuals active in and benefiting from the global spectrum and spectrum-reliant offerings ecosystem and market.

The Wireless Innovation Forum is the leader in standards building in spectrum sharing bands. Addressing standards in the **rapidly emerging *next spectrum era***, WInnF and the RAC/6GWG Joint Task Group collaborate across the broad international technical and regulatory standards- and market-development ecosystem.

Bridging across key technical standards, industry, regulatory, and policy stakeholders, WinnF provides an international platform and forum for industry and government to shape and translate spectrum sharing by-design—AKA ***Sharing Native 6G***—goals and requirements into commercial reality for all sectors public and private.

Initial topic areas to address

Initial Topic Areas:

Reasonable working definition of 6G to feed into core WInnF Topic Area: "The Role of Spectrum Sharing in 6G"

The Role of Spectrum Sharing in 6G:

- Sharing Architectures Overview/Clear Definitions-Taxonomies, Awareness/Interop
- Standards and 6G Bands as discussed in groups such as 3GPP, ITU, O-RAN, IEEE+
- Sharing Innovation, advancement, & marketplace commercialization
- Ecosystem engagement
- Spectrum Sharing *for 6G…* and 6G *for Spectrum Sharing*

…to better support innovation, commercialization/industrialization & advancement in emerging global 6G technology

Value-added WInnForum contribution areas

What value does a 6G effort bring to WInnForum?

eg: Supporting WInnForum objectives including:

1. As the preferred venue for the ***international spectrum sharing community***, &
2. As a mature, multi-stakeholder technical collaborative exchange on innovative hybrid-licensed wireless systems, standards, & solutions ***in the 6G context***

eg: WInnForum Advocacy/Innovation/Education & Commercialization Agendas in:

- *Topic/Contribution Areas:* Innovation/Advancement of Hybrid Spectrum Regulatory Models, Essential & Critical Communications, Interoperability and Security *in the 6G Spectrum Sharing Context*

Value-added WInnForum contribution areas, *cont'd.*

To what areas of the broader SDO(+) 6G ecosystem can WInnForum best contribute and add value?

eg: Explore where WinnForum can add value as an ***international***, ***multi-stakeholder*** wireless technology ***SDO*** whose members bring ***key spectrum sharing ecosystem experience and expertise*** to topic areas such as those outlined.

eg: WInnForum will ***complement***, ***accelerate*** and ***reinforce*** related *standards*, *marketplace commercialization*, R&D, & policy efforts both up and downstream.

ABBREVIATIONS, p1

3DFDSS: Spectrum Sharing & 3D Beamforming-Advanced Antenna System (BF-AAS) / Global Coordinate System (GCS)-based In-Band Full Duplex & Sensing
6GArch: 6G Architecture
AI: Air Interface
AFC: Automatic Frequency Coordinator
CBRS: Citizens Broadband Radio Service
C-C: Commercial-to-Commercial spectrum sharing
DSSC Fn: Dynamic Spectrum Sharing Coordination Function
eTAMRSS: evolved Technology-Agnostic Multi-RAT Spectrum Sharing
F-C: Federal-to-Commercial spectrum sharing
IAF: Incumbent Awareness Function
JSAC/PNT: Joint Sensing And Communications/Positioning, Navigation, & Timing
JTG: Joint Task Group
LASS: Leap Ahead Spectrum Sharing
LLRTC: Low-Latency Real-Time Control
MRSS: Multi-RAT Spectrum Sharing
NTNSS: Non-Terrestrial Networking Spectrum Sharing
PrivSS: Private Indoor/Outdoor Networks & Spectrum Sharing

ABBREVIATIONS, p2

RAN: Radio Access Network
RAT: Radio Access Technology
RSN: Radio Service Node
ResMob: Resilient Multi-Layer Mobile-Node Spectrum Sharing
ResShare: Resilient spectrum sharing
RIT: Radio Interface Technology (ITU Standards Term)
RSU: Road-Side Unit
SAS: Spectrum Access System
SEnv-C-C: Small-Envelope Commercial-Commercial spectrum sharing
ShRel-3GPP+ORAN: Sharing-Relevant External Interfaces to 3GPP Core + RAN + UE and O-RAN RAN
SpecStds WFD: Spectrum Standards and Engineering Work Force Development
SSFwk: Spectrum Sharing Framework
SustShare: Sustainable Spectrum Sharing
TAMRSS: Technology-Agnostic Multi-RAT Spectrum Sharing
UAS: Unmanned Aerial System
UE: User Equipment
V2X: Vehicle-to-Everything