An Exploration and Celebration of the Next Evolution of CBRS

WInnForum Webinar Series #33

9 July 2024

Webinar Administrivia

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- http://www.wirelessinnovation.org/webinars

Recorded Webinar will be available on the Forum's You Tube Channel

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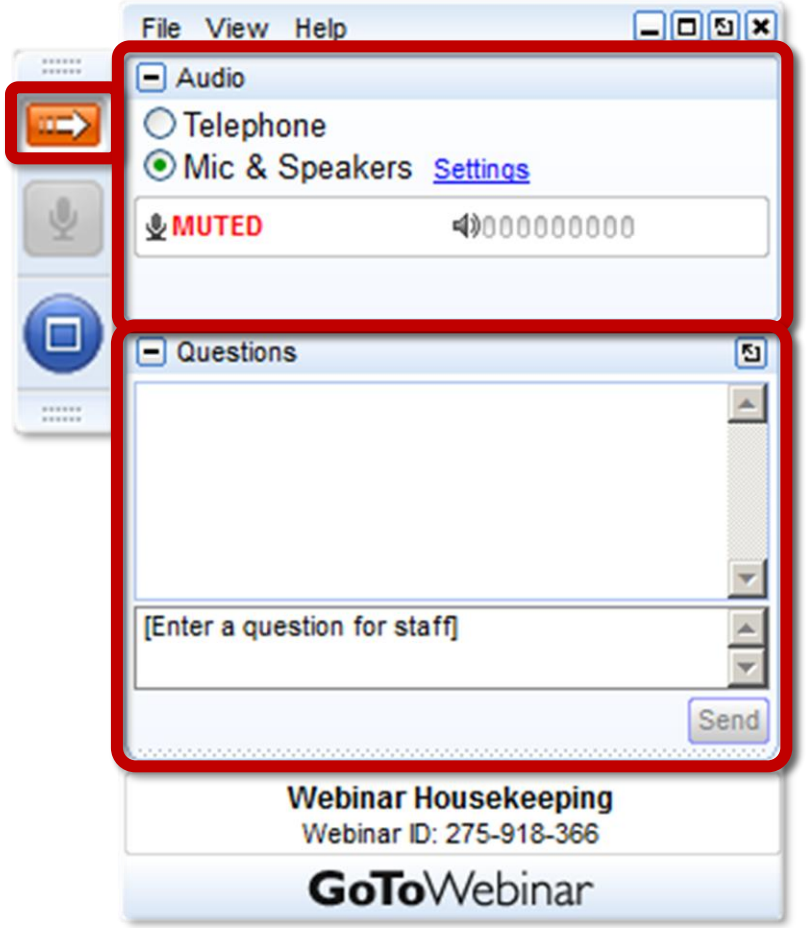

Why we are here

Extensive work amongst SAS Administrators, government agencies, and industry through WInnForum and OnGo Alliance has resulted in changes in requirements for CBRS

These changes have been captured by the WInnForum in associated CBRS Standards, and should result in:

- More spectrum in more places, so more opportunity to deploy
- Higher reliability and higher quality in impacted areas
- Improved access for business-critical applications in impacted areas
- New uses because of the higher reliability and "ready for business-critical applications"

This webinar will present these changes in some detail

References

WIRELESS TELECOMMUNICATIONS BUREAU AND OFFICE OF ENGINEERING AND TECHNOLOGY APPROVE CERTIFIED SAS ADMINISTRATORS TO USE MODIFIED AGGREGATE INTERFERENCE MODEL

- https://docs.fcc.gov/public/attachments/DA-24-643A1.pdf

WInnForum Follow Up on DA 24-553

- https://www.fcc.gov/ecfs/document/106133915099231/1

WIRELESS TELECOMMUNICATIONS BUREAU AND OFFICE OF ENGINEERING AND TECHNOLOGY ANNOUNCE MODIFIED AGGREGATE INTERFERENCE MODEL USED BY SPECTRUM ACCESS SYSTEM ADMINISTRATORS

- https://docs.fcc.gov/public/attachments/DA-24-553A1.pdf

NTIA Notice to FCC re Reduced CBRS DPAs:

- https://www.fcc.gov/ecfs/document/1061155768162/1

WIRELESS TELECOMMUNICATIONS BUREAU ANDOFFICE OF ENGINEERING AND TECHNOLOGY ANNOUNCE MODIFIED CITIZENS BROADBAND RADIO SERVICE DEVICE REAUTHORIZATION PROCEDURES

- https://docs.fcc.gov/public/attachments/DA-23-867A1.pdf

NTIA Notice to FCC re CBRS Reauthorization Period

- https://www.fcc.gov/ecfs/document/10918103597534/1

CBRS WInnForum Standards®

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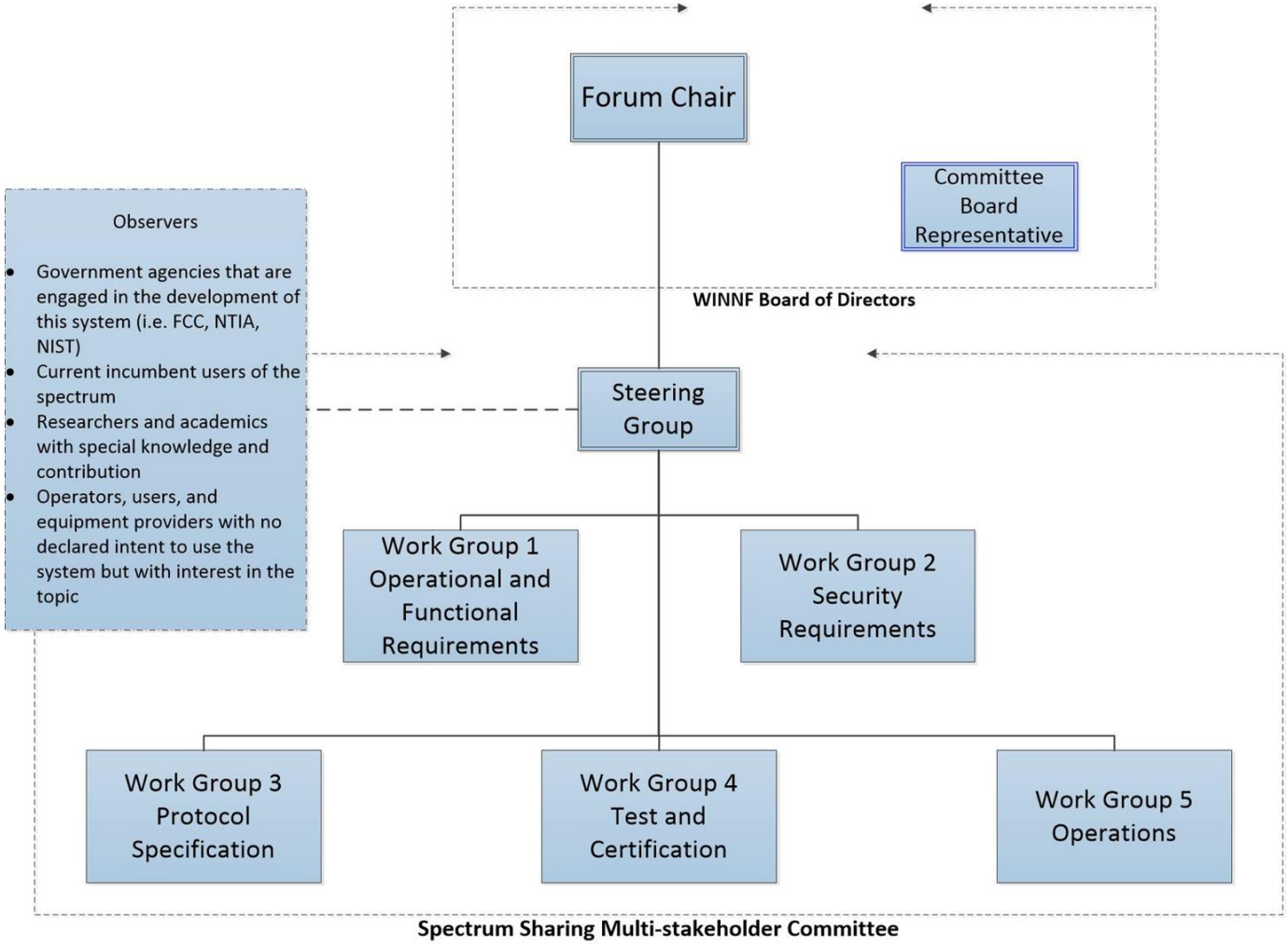
About the WInnForum CBRS Committee



WInnForum CBRS Release 1+ Standards and CBRS 2.0

Release 1	Release 1+	Release 2
Baseline Standards Used for Initial Certification	Post Initial Certification Revisions to Baseline Standards Addressing Regulatory Changes	Enhancements to Baseline Standards Addressing Industry Need

WInnForum's CBRS Committee Release Plan, as approved by the Committee Steering Group is available here: https://winnf.memberclicks.net/assets/CBRS/WINNF-SSC-0004.pdf

The next evolution of CBRS presented in this webinar is captured in WInnForum's CBRS Release 1+ standards.

Note: These standards have been adopted by OnGo Alliance as a part of their CBRS 2.0 initiative.

- The OnGo Alliance purpose is to "Support the common interests of members, implementers and operators for the development, commercialization, and adoption of LTE and 5G NR solutions for the US 3.5 GHz Citizens Broadband Radio Service" (https://ongoalliance.org/about-the-ongo-alliance/)
- Analogy: WInnForum CBRS Release 1+ Standards are branded by OnGo Alliances as CBRS 2.0 in the same way that IEEE SA 802.16be is branded by the Wi-Fi Alliance® as Wi-Fi 7™

CBRS WInnForum Standards®

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Today's Agenda

Changes in Grant Reauthorization and Dynamic Protection Areas

- presented by Nick LaSorte of NTIA

Supporting changes in the WInnForum standards

- presented by Andy Clegg of Google, WInnForum CTO and Chair of the CBRS Requirements Work Group (WG1)

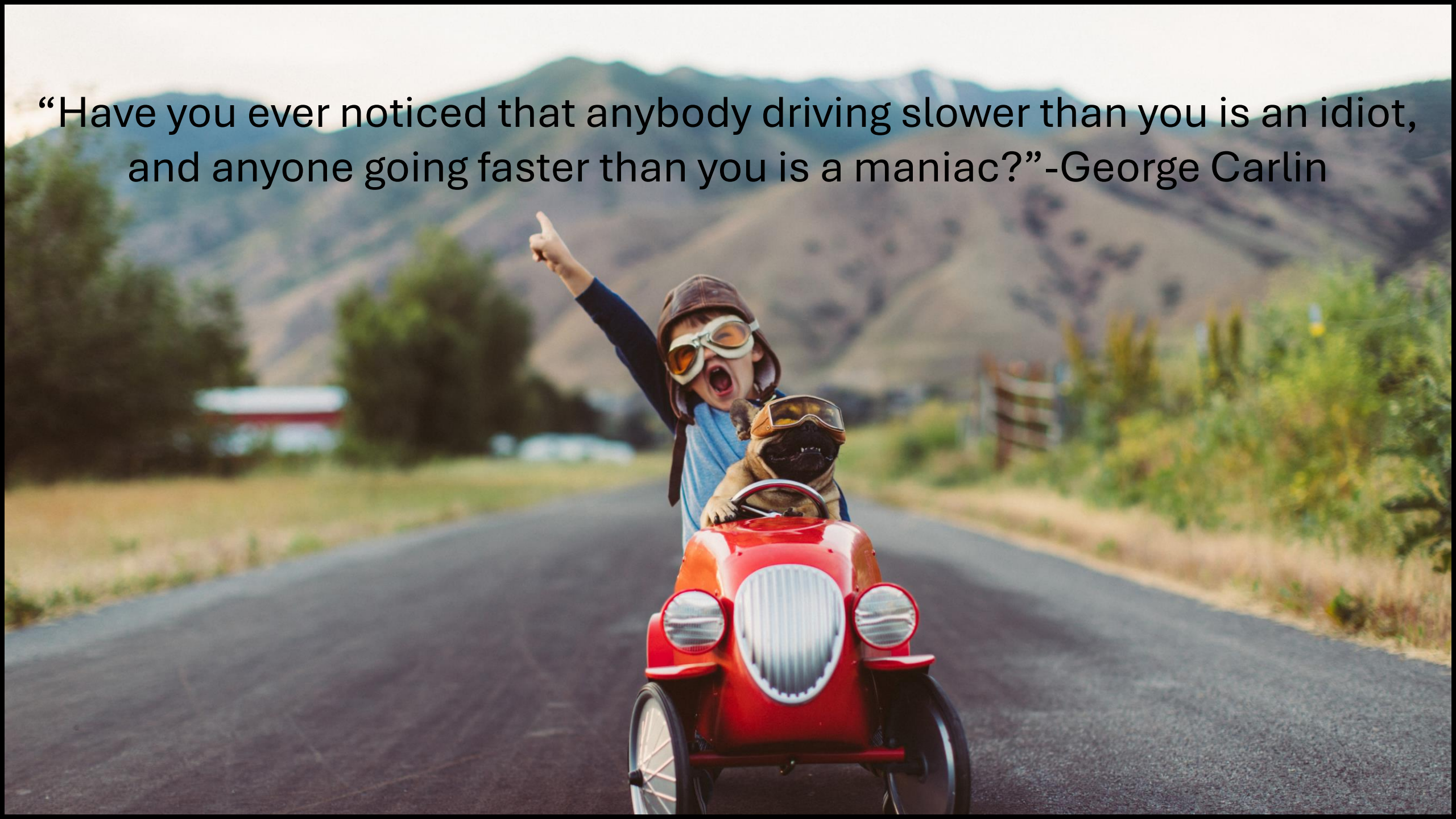
Impact of these changes on CBRS Operators and Users

- presented by Max Solondz of Verizon and member of the WInnForum's CBRS Committee Steering Group

The Next Evolution of CBRS

WInnForum

July 9, 2024


“Have you ever noticed that anybody driving slower than you is an idiot, and anyone going faster than you is a maniac?”-George Carlin

CBRS Improvements

Who?

What?

Why?

Department of the Navy
DoD-CIO

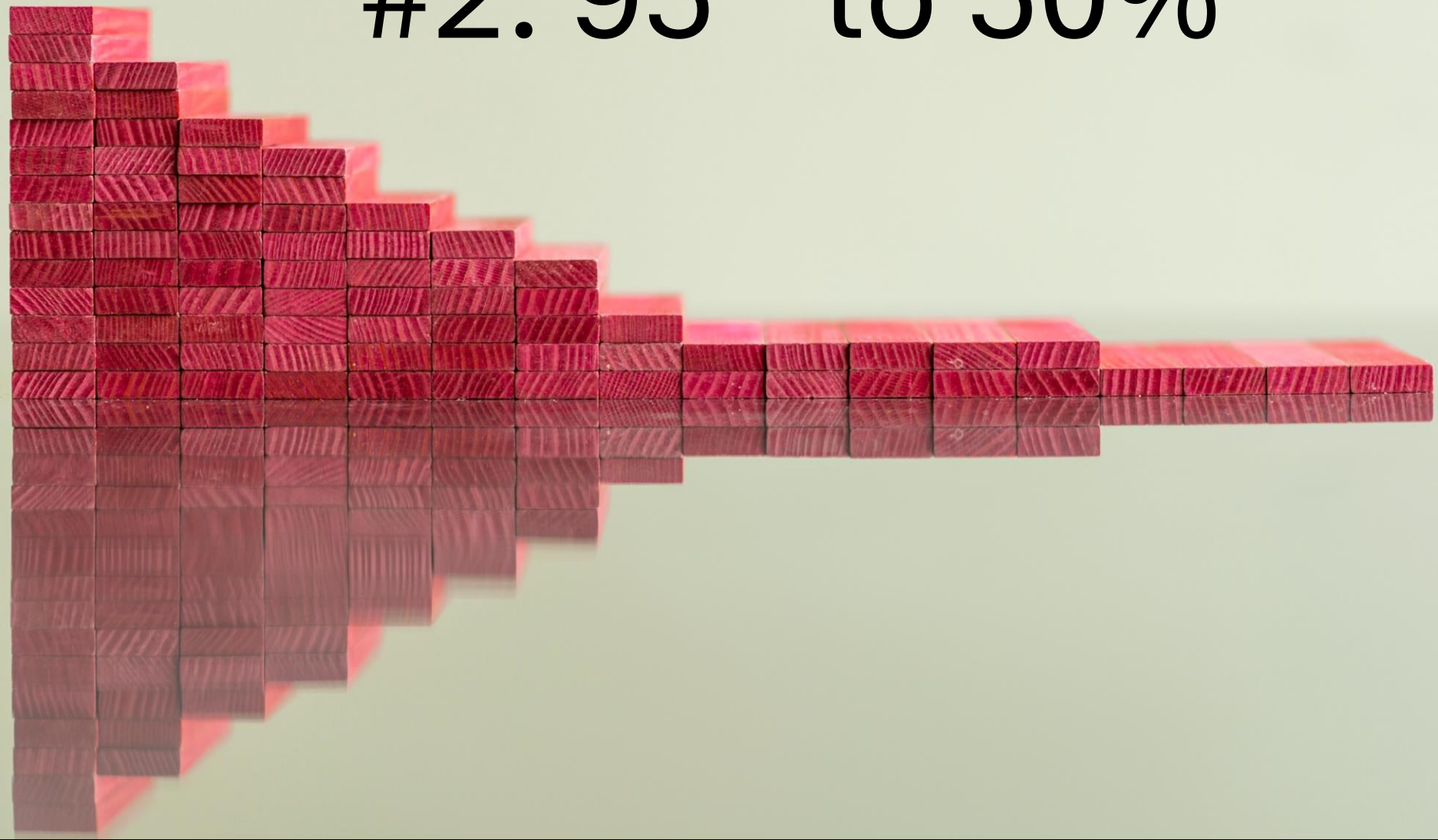
DoD-CIO: Lower 3GHz Sharing Report

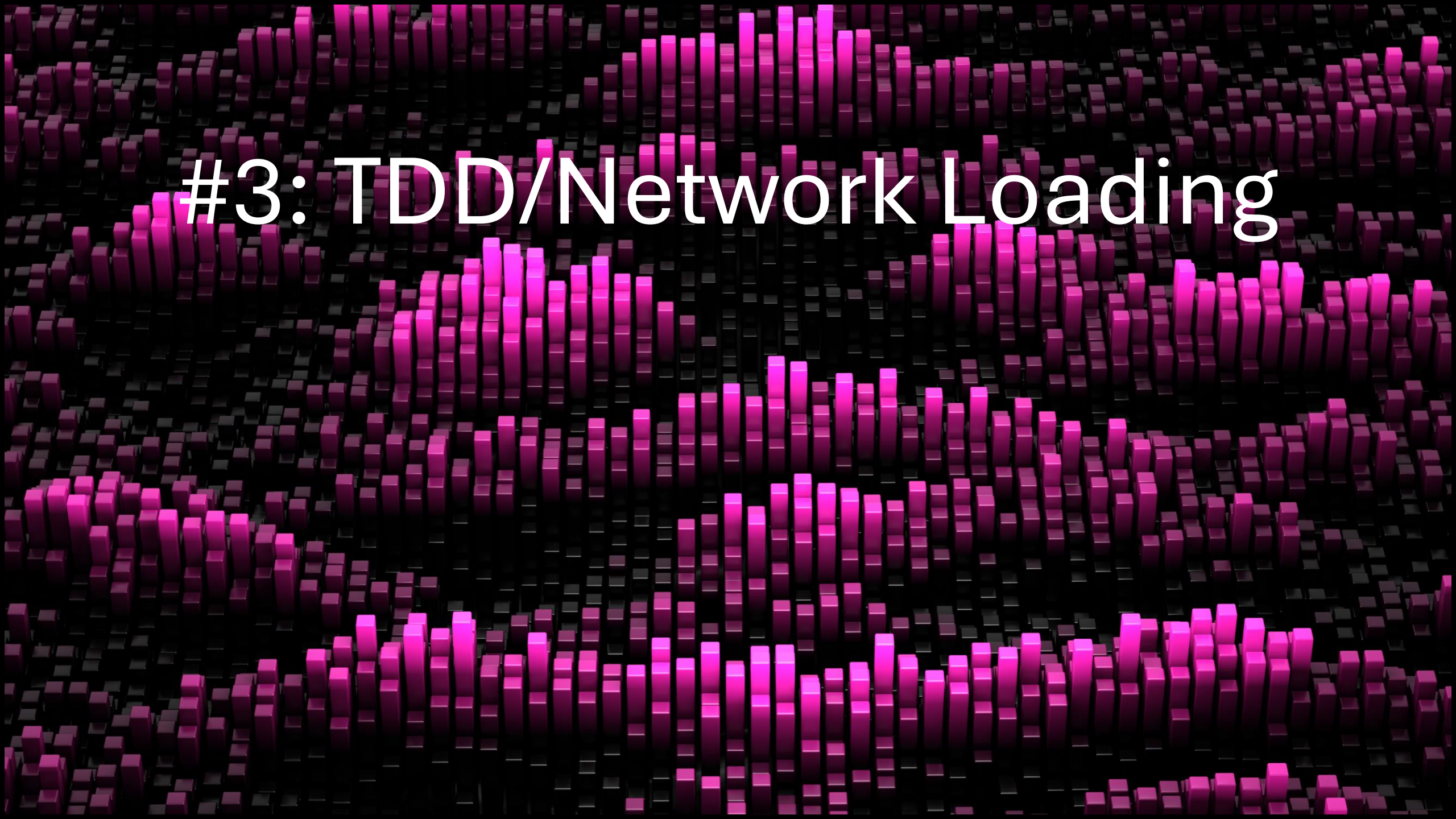

Nationwide Experiment
A.C. VOLTS

3 Improvements

#1: Clutter

#2: 95th to 50%




#3: TDD/Network Loading


Shrinking the
Neighborhood Areas

The Next Set of Improvements?

We’d Love to Hear Your Suggestions?

Join Us For The Next Set of Studies

Updated WInnForum Standards to Implement the Next Evolution of CBRS

Andrew Clegg

WInnForum CTO and CBRS Working Group 1 Chair

Changes to CBRS

For devices at or below 6 meters (about 20 ft) above ground level:

1. **Propagation models now take into account the impact of clutter (i.e., buildings and foliage)**

For all devices:

1. **Adoption of less conservative statistical assumptions regarding time-variable propagation losses**
2. **Refined considerations about typical power output from CBRS devices that take into account the average activity factor of the signals, instead of always assuming maximum power output**
3. **For devices outside of areas impacted by incumbent radar activity, SAS check-in required only every 24 hours, instead of every five minutes**

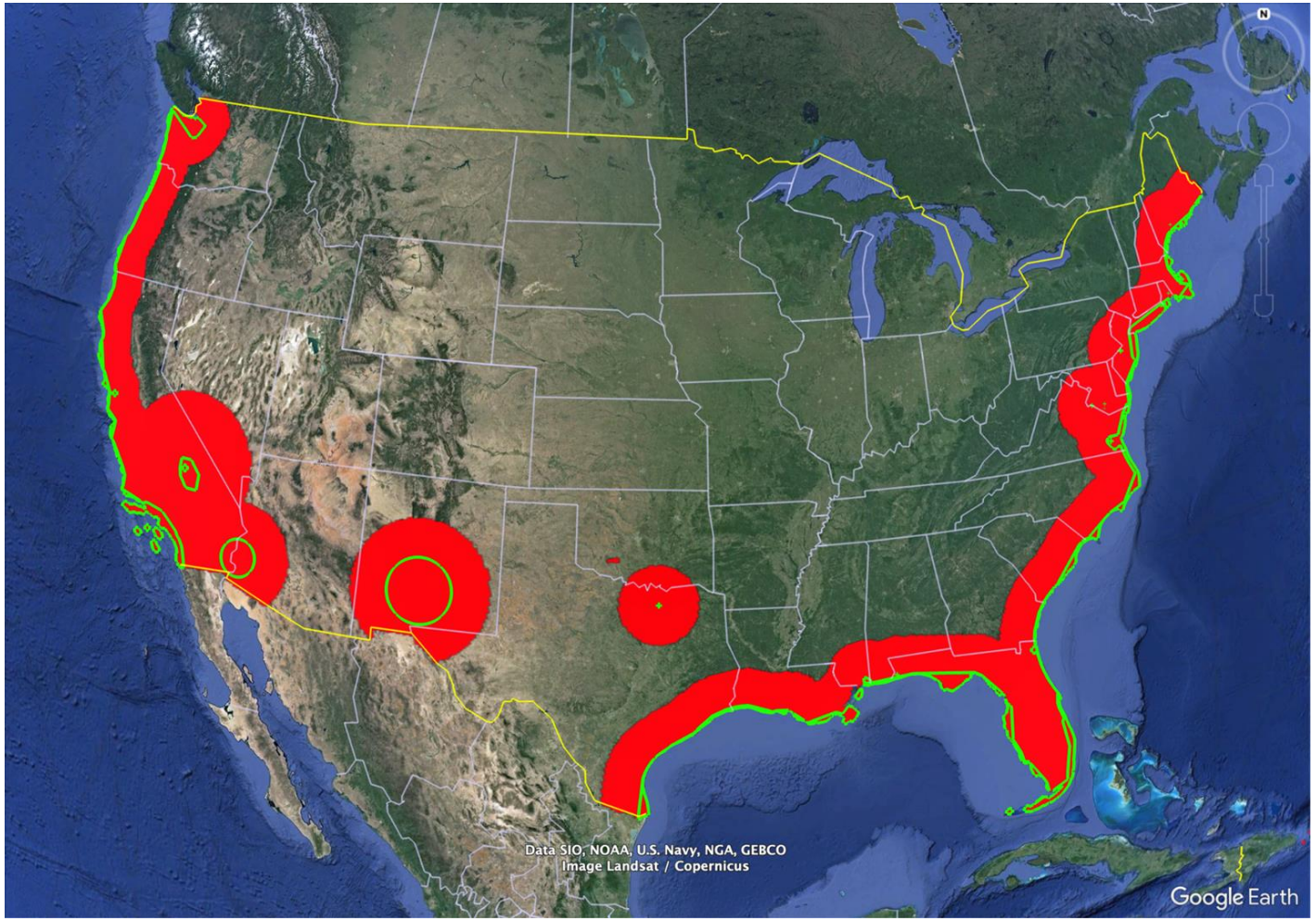
Impact of Changes

1. **Area of country in which CBRS devices are subject to service interruptions due to incumbent activity (called Dynamic Protection Area neighborhoods) is *greatly reduced* (by as much as 98%)**
2. **For devices still within DPA neighborhoods, *disruptions will be reduced***
3. **Devices outside of DPA neighborhoods will be *much more robust* to temporary loss of connectivity to SAS**

In short:

- **Greater number of devices completely immune to service interruptions**
- **Fewer disruptions for remaining devices**
- **Recognition of deployment-specific models (even better confidence for indoor and/or low-mounted devices)**
- **Greater reliability for all devices**

Category A Indoor Below 6 m

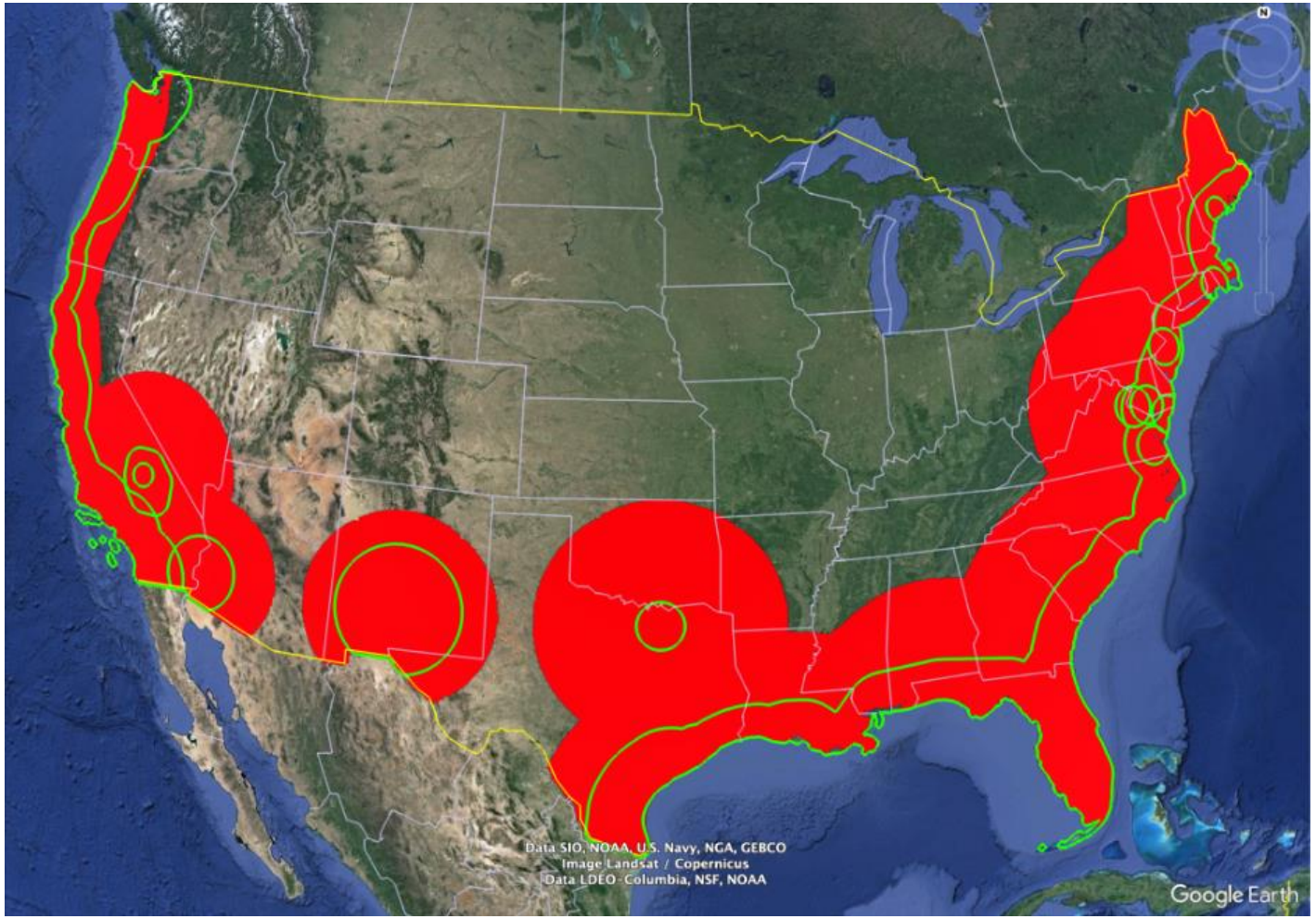


Comparison of existing DPA neighborhoods (solid red) with the new DPA neighborhoods (green outline), for indoor Category A devices below 6 m height above ground level.

In coastal areas, the new neighborhoods generally extend just a few km inland from the coast.

Increases the population outside of impacted areas by about 40 million.

Category B Outdoor Above 6 m



Comparison of existing DPA neighborhoods (solid red) with the new DPA neighborhoods (green outline), for Category B devices above 6 m height above ground level, showing substantial reduction in size.

Increases the population outside of impact areas by over 70 million.

Updated WInnForum Standards

- **The fundamental Release 1 CBRS functional and operational standards are contained in WInnForum Technical Standard TS-0112**
  - The latest version of TS-0112 can always be found at this link.
- **WInnForum consolidates all operational and functional CBRS standards updates that are required due to changing FCC rules and/or NTIA/DoD procedures which have gone into effect after initial certification of SASs in 2020 into a separate standard, TS-1020, *Post Initial Certification Revisions to CBRS Baseline Operational and Functional Requirements Specification***
  - This is often referred to as Release 1+
- **The changes to the propagation model and other changes presented by NTIA in the previous presentation are incorporated in TS-1020**
  - The latest version of TS-1020 can always be found at this link
- **This presentation will summarize these changes to TS-1020**
- **WInnForum's CBRS Test & Certification specification was also updated to reflect the changed operational and functional requirements for SAS**
  - The corresponding Test & Cert addendum is TS-4010, *Post Initial Certification Revisions to Test and Certification for CBRS; Conformance and Performance Test Technical Specification; SAS as UUT*
  - TS-4010 is the Release 1+ addendum to the Release 1 Test and Certification standards document TS-0061, *Test and Certification for Citizens Broadband Radio Service (CBRS); Conformance and Performance Test Technical Specification; SAS as Unit Under Test (UUT)*

Release 1 to 1+

WInnForum CBRS Standard	Initial Certification Version (Release 1)	Addendum to the initial certification standard due to updated procedures notified by FCC Public Notice (Release 1+)
Functional and Operational Requirements	TS-0112	TS-1020
SAS Test & Certification	TS-0061	TS-4010
SAS-to-SAS Interface	TS-0096	TS-3010

Note: To fully understand current CBRS standards, you must refer to both Release 1 and Release 1+ documents

FCC Public Notice	Release Date	Impact
DA 23-867	September 19, 2023	Increases maximum grant reauthorization time in many circumstances
DA 24-553	June 12, 2024	Modifies aggregate interference calculation method
DA 24-643	July 3, 2024	Approves SASs to implement modified aggregate interference

Be Sure to Refer to Both Release 1 and Release 1+ Standards

- **To fully parse current CBRS standards, you must refer to both Release 1 and Release 1+ standards**
  - Some requirements in Release 1 are heavily modified or deprecated in Release 1+
  - The standard as modified in Release 1+ is the controlling standard
- **In the Release 1+ standards, "REL1Ext" is prepended to the requirement number to designate the requirement as a Release 1 extension**

Related Release 1+ Requirements in TS-1020

Requirement	
REL1Ext-R2-SGN-02	For interference calculations into DPAs: • Implements ITU-R P.2108 clutter model • Adds TDD activity factor • Adds network loading factor
REL1Ext-R2-SGN-04	Implements 50% reliability factor for aggregate interference calculation into DPAs
REL1Ext-R2-SGN-06	Expands DPA neighborhood consideration from current two CBSD categories (A and B) to six categories: • Cat A outdoor above 6 m AGL • Cat A outdoor at or below 6 m AGL • Cat A indoor above 6 m AGL • Cat A indoor at or below 6 m AGL • Cat B above 6 m AGL • Cat B at or below 6 m AGL
REL1Ext-R1-IPM-03	Implements up to 24-hour reauthorization period for grants that meet either of the following criteria: • In 3550-3700 MHz but outside of any DPA neighborhoods • Within one or more DPA neighborhoods but operating in 3650-3700 MHz Maintains max 300 second reauthorization period for all other grants

New Tests

- **New requirements in TS-1020 resulted in new and/or modified test(s) in our SAS test & certification standard**
- **These are incorporated in TS-4010**
- **The tests confirmed the following capabilities with respect to propagation models used for DPA protection:**
  - Apply section 3.2 of ITU P.2108 defined clutter loss for CBSDs with transmit antenna AGL height equal or below 6 m when calculating path loss or interference contribution towards any DPA protection point,
  - Apply 8 dB reduction, which is derived using duty cycle and network loading factor, to all CBSDs when calculating path loss or interference contribution to any DPA protection point.
  - Change the DPA aggregate interference statistics from Monte Carlo 95-percentile to 50% (Median), applied to offshore, inland and out-of-band DPAs.
- **The SAS Administrators worked jointly with government to develop test vectors that would exercise a wide array of scenarios**
  - Test harness: https://github.com/Wireless-Innovation-Forum/Spectrum-Access-System
- **Each SAS Administrator self-administered the tests and submitted a report on the test results to FCC for review by FCC, DoD, NTIA, and others**
- **The July 3 FCC Public Notice indicates successful review of the test reports and approval to implement the changes in the SASs**

Schedule

- New WInnForum standards are balloted, approved, and ready to go
- SASs have implemented the changes in non-production SASs for the purpose of test and certification
- FCC has reviewed the changes and has approved implementation
- SASs are expected to implement the changes in production before the end of July
- Tens of millions of more CBSDs will enjoy either no disruptions or reduced disruptions

Appreciation

- **WInnForum would like to thank the hard work of the government and its representatives in implementing the next evolution of CBRS:**

  - DoD, in particular
    - Navy: Elvira Pearce, Mike Mearns
    - CIO: Keri Pasquini-Thompson, Vernita Harris
    - DISA: Kasey Pugh
    - MITRE: Dawn Szelc, Mei Lang, Raina Rahman
  - NTIA (in particular Nick LaSorte, Ed Drocella, Charles Cooper)
  - FCC (in particular Paul Powell, Ira Keltz, Kamran Etemad, Navid Golshahi)

Updated WInnForum Standards: Release 1+

Impacts to Deployers

Max Solondz

Verizon

Updated WInnForum Standards: Impacts

- **FCC has approved the changes to the SASs' aggregate interference model (ITM) (Irregular Terrain Model) for protecting Tier 1 Incumbents from aggregate interference:** similar to line of sight R squared, no allowance for clutter in original ITM aggregation model

- **Changes only impact SAS softwares:**
  - No changes to: DPA boundaries, ESC, interfaces, ESC-to-SAS, SAS-to-SAS, SAS-to-CBSD, CBSDs, deployments

- **SAS-NTIA-FCC ' ITM+' Relaxations:** Changes to SASs' interference model (ITM) for incumbent protections: greatly relaxed interference criteria dramatically reduce Neighborhoods and Move Lists: major impacts

- **Other New 'relaxed' SAS Features:** 1) Longer Expiry Time for 3650-3700 or outside any neighborhoods, 2) Extend old expiring CPI credentials for unchanged CBSDs (registered parameters), 3) NRQZ Quiet Zone NRQZ_ID codes for registration

- **FCC proposes new NPRM:** possible changes: sunset grandfathered WBLs (Part 90z WISP uses) , offshore CBRS uses, relaxed OOBE, relaxed ESC approvals process. Further possible simplifications: CPI renewals, band swap for GAA at 3550-3600, higher power Category C power levels.

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Updated WInnForum Standards: ITM Changes

1) **Clutter losses: ITU P.2108 clutter model for CBSDs below 6 meters**:
   - maximum of **30.8 dB** losses at 1400 meters distance

- **In-Building Penetration losses:**
  - **15 dB** allowance **for Indoor Category A CBSDs** (*as before*)

2) **50-percentile (Mean) for aggregate interference statistics, allowing to use 50% reliability for all CBSDs:** law of large numbers: greatly simplifies:
   - **8 -12 dB** effective relaxation: **all CBSDs**, especially for CBSDs further than 10 km from DPA boundary

3) **TDD activity and Network Loading factor:** TDD radios (e.g. 4G LTE and 5G) not on 100% of the time:
   - **8 dB** relaxation for **all CBSDs**

Updated WInnForum Standards: ITM Changes

CBSD use case and factor(s)	Initial ITM	Modified ITM +
All CBSDs (aggregate interference statistics)	95% (0 dB)	[50%] 8 – 12 dB
All CBSDs (TDD activity and Network Loading factor)	100% (0 dB)	8 dB
1) Category A Indoors below 6m: clutter: penetration loss:	None (0 dB) 15 dB	P.2108 clutter (30.8 dB at 1400m) 15 dB
2) Category A Indoors above 6m: clutter: penetration loss:	None (0 dB) 15 dB	0 dB (None) [Future TBD] 15 dB
3) Category A Outdoors below 6m: clutter:	None (0 dB)	P.2108 clutter losses (up to 30.8 dB loss at 1400 meters)
4) Category B Outdoors below 6m: clutter:	None (0 dB)	P.2108 clutter losses (up to 30.8 dB loss at 1400 meters)
5) Category B Outdoors above 6m: clutter:	None (0 dB)	0 dB (None) [Future TBD]

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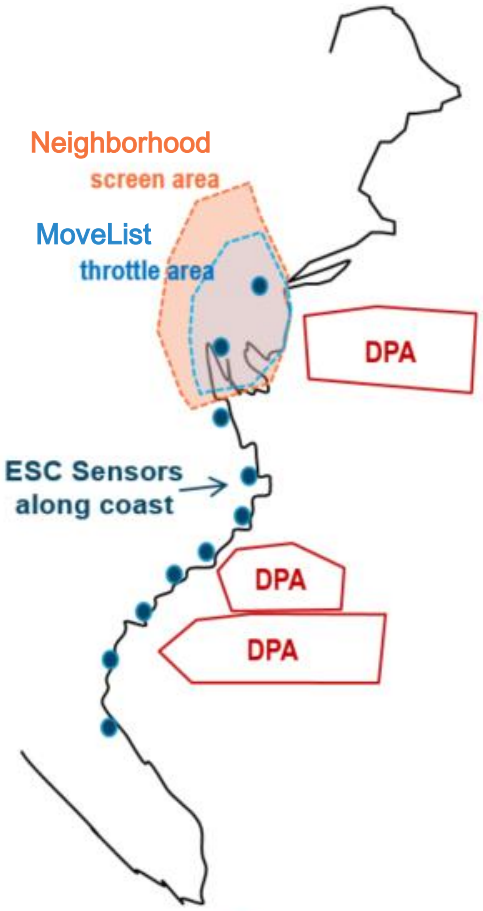
Updated WInnForum Standards: Total Additional Losses

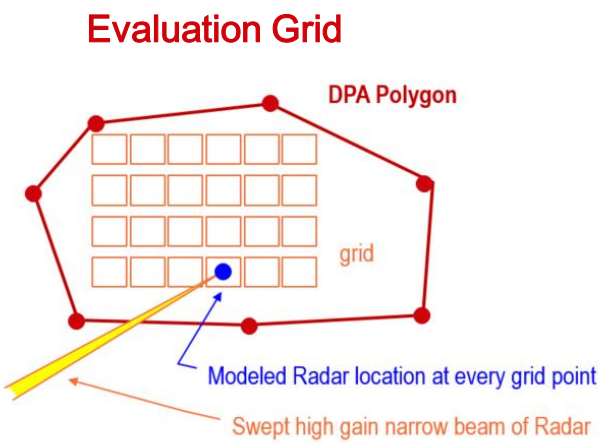
	Category	AGL	Prop Model	50% Confidence Interval (vs 95%)	Clutter Model	Building Pentration Loss (for indoor)	TDD Activity Factor (for all)	Max Total Added Loss
1	Category A Indoor below 6 m	<= 6 m	ITM	8-12 dB relaxed	P.2108 (up to 30.8 dB)	15 dB	8 dB	65.8 dB
2	Category A Indoor above 6 m	> 6 m	ITM	8-12 dB relaxed	None (yet) [TBD for > 6m]	15 dB	8 dB	35 dB
3	Category A Outdoor below 6 m	<= 6 m	ITM	8-12 dB relaxed	P.2108 (up to 30.8 dB)	None	8 dB	50.8 dB
4	Category B Outdoor below 6 m	<= 6 m	ITM	8-12 dB relaxed	P.2108 (up to 30.8 dB)	None	8 dB	50.8 dB
5	Category B Outdoor above 6 m	> 6 m	ITM	8-12 dB relaxed	None (yet) [TBD for > 6m]	None	8 dB	20 dB

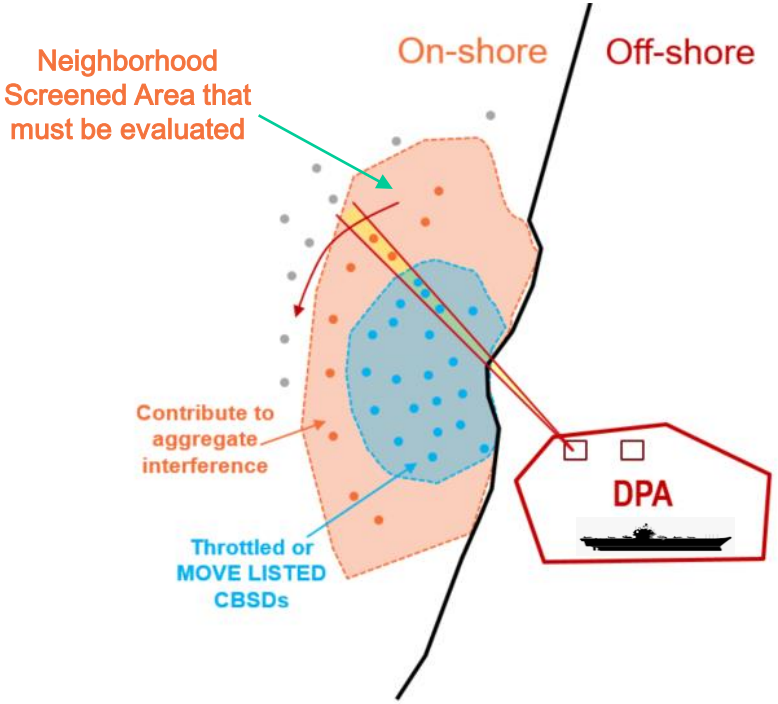
Updated WInnForum Standards: Refresher Overview

- **Dynamic Protection Areas:** Off-Shore CONUS DPA polygons are Predefined by NTIA (KML shape file also with Neighborhoods)
- **Neighborhood Screen Area:** On-Shore screen area to be evaluated by SAS: predefined by NTIA (aka *DPA Neighborhood Area*)
- **Move List** : On-Shore resultant list of CBSDs that would interfere and must move off granted channel within NSA. *This is not a pre-defined area and depends on the amount of interference caused by each individual CBSD as determined by SAS.*
- SAS must RF Model & Pre-evaluate 'MOVE LIST' – those CBSDs that must abandon channel grant to avoid generating aggregate interference to DPA
- DPA may activate within 300 seconds, so SASs must evaluate MOVE LIST for every 10 MHz channel in advance during overnight CPAS evaluations
- SAS must evaluate all CBSDs' radiated interference into Navy's off-shore radar's high gain antenna beam as it sweeps over land (modeled)
- SASs must collectively analyze aggregate interference from all CBSDs that may interfere
- 'MOVE List' known: used when • E-DPA is activated by ESC sensing, • P-DPA when notified by Portal, and • GB-DPAs are always activated (exclusion zones)
- With ESC Sensing Operational, or notified by portal: Only Active Off-shore DPAs are protected (when Navy is operating the radar)
- Shallow Terrain & No clutter in ITM 1.0 Model creates large on-shore Neighborhoods (screen area) which SASs much evaluate
- Category B Neighborhoods are larger than Category A Neighborhoods

Updated WInnForum Standards: Refresher Overview

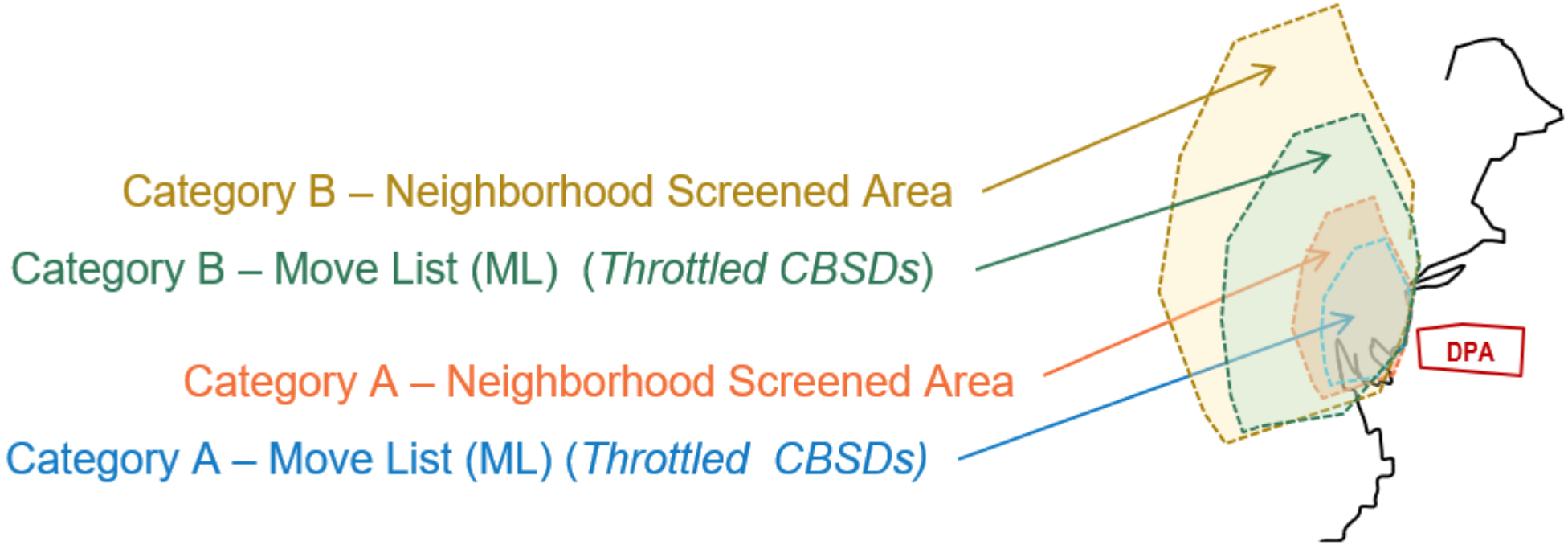






Updated WInnForum Standards: Initial ITM

Neighborhoods: initial ITM: Two Neighborhoods: Category A & B



- **DPA**: (Dynamic Protection Area) NTIA defined Off-Shore polygon (KML) to be protected for Tier 1
- **Neighborhood**: NTIA defined On-Shore screened area for that Category and Use Case (kml offset)
- **ML**: Move List: SAS calculated CBSD radios that are deemed interferers by SAS

Updated WInnForum Standards: ITM +

Neighborhoods: initial ITM +: Now Five (actually six) Neighborhood Types

5) Category B Outdoor above 6m

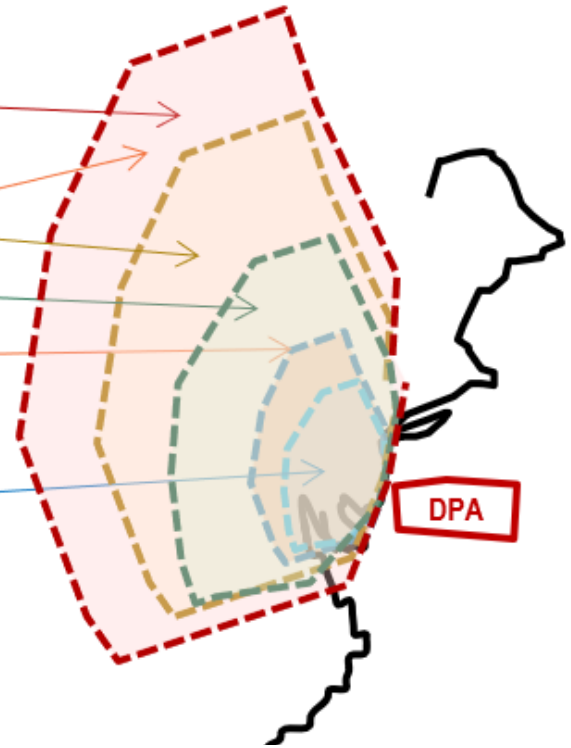
4) Category B Outdoor below 6m

3) Category A Outdoor below 6 meters

2) Category A Indoor above 6 meters

- [Also Category A Outdoors above 6 meters AGL (rare case)]

1) Category A Indoor below 6 meters



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- **ML**: Move List: SAS calculated CBSD radios that are deemed interferers by SAS

Updated WInnForum Standards: Deployment Gamechangers

- **More Categories of Neighborhoods:**

  five neighborhood types for the five specific propagation conditions

- **Much more realistic modeling of interference effects: not so overly protective of Off-Shore DPAs**
- **Reduced size of On-Shore Neighborhood Areas (as will be defined by NTIA's KML shape files)**
  - **Many Fewer CBSDs impacted: Deployers will know which CBSDs outside any Neighborhood**
  - **Much lower work load for SASs: Much faster & simpler for SASs to run CPAS analysis**

- **Outside the Neighborhoods:**
  - **SASs not required to aggregate interference (easier work load)**
  - **CBSDs never have to move off of their assigned channels: much less bumping**
  - **Channel surety & availability in these areas**

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Updated WInnForum Standards: Deployment Gamechangers

- **Supports new use cases that require 100% availability (primary uses)**
- **Stimulate more uses, installations, and investments**

- **Many deployments are now not susceptible to channel bumping: high availability**
- **Could use CBRS channels and channels set for Primary Channels rather than only SDL-SUL Carrier Aggregation**

  New Primary Channel uses of CBSDs (PLTE, IoT, warehouses, industrial factories) will have 100% channel availability
- **Beneficial especially for OPLTE and PLTE private networks with primary CBRS channels**
- **Could now reconsider a higher power Category C EIRP power level for outdoor cells: for Macrocell and/or rural deployments**

  Will show higher power proposed Category C CBSDs are not catastrophic

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Updated WInnForum Standards: NPRM Further Changes

FCC proposes new NPRM for CBRS Changes

- **Sunset the grandfathering of the GBWLs (Broadband Wireless Licensees) (Part 90z WISP uses in 3650-3700)**
- **Add definitions for Tier 1 Incumbent protections**
- **Align protection methodologies to adjacent bands (relax the -25 dBm OOBE to the conventional – 13 dBm level)**
  - Both adjacent bands now cleared of the vulnerable incumbents (FSS above 3700, DoD below 3550)
- **Revisit ESC approval procedures** (sitings and approvals)
- **Allowance for new CBSDs outside the contiguous US** (offshore uses)

- Possibly other simplifications and relaxations