

# SPECTRUM SHARING COMMITTEE WORK GROUP 3 (WG3) PROTOCOL WEBINAR

## Presenters:

**Prakash Moorut (Nokia)**

**Yi Hsuan (Google), Masoud Olfat (Federated Wireless)**

**Greg Billock (Google), James Ni (Federated Wireless)**

**June 16<sup>th</sup>, 2016**

Slide 1

# Outline

- **Introduction & Roadmap (25 minutes)**
- **SAS-CBSD Protocol (60 minutes)**
- **SAS-SAS Protocol (30 minutes)**
- **Summary (5 minutes)**

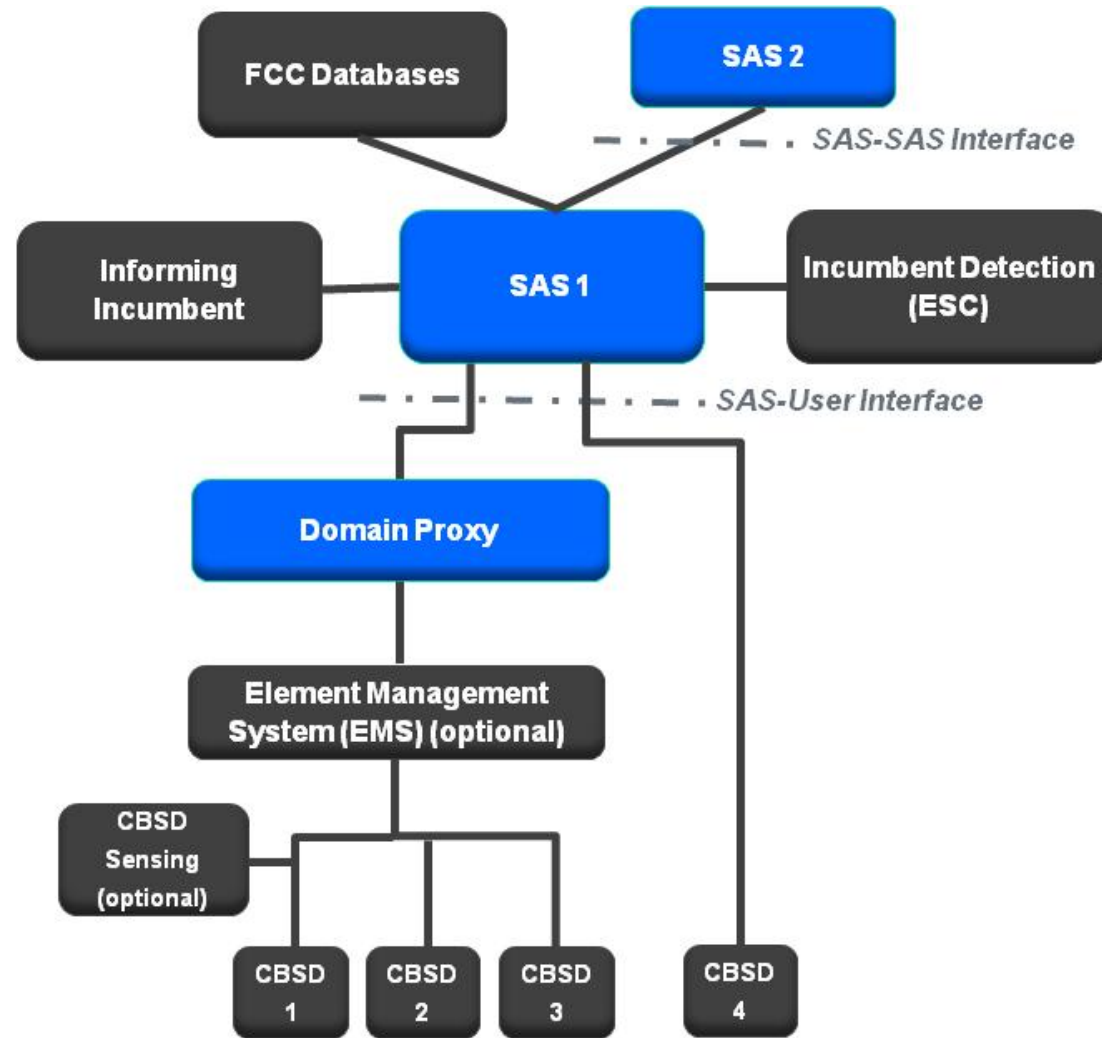
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# Spectrum Sharing Committee Work Group 3

## **Charter: Define the detailed protocols for data and communications across the various open interfaces within the system**

Spectrum Access System (SAS) interface specifications should be limited to the minimum requirements needed for an open and interoperable system.

# WINN Forum Functional Architecture



## Acronyms:

ESC: Environmental Sensing Capability  
 CBSD: Citizens Broadband Radio Service Device  
 SAS: Spectrum Access System

## Notes:

- A SAS may not need to support all interfaces.
- Each CBSD domain may optionally include some sensing capability (including possibly an ESC).

- The SAS to User Protocol enables CBSDs to access the 3.5GHz band
- The SAS to SAS Protocol enables SAS multi-party interoperability

# Domain Proxy Functionality

**A Domain Proxy is a managing intermediary.**

**A Domain Proxy's function is to:**

- Accept a set of one or more available channels and select channels for use by specific CBSDs, or alternatively pass the available channels to the carrier EMS for CBSD channel selection
  - EMS may optionally be co-located with the domain proxy
- Back report selected channels to SAS optionally received via EMS
- Receives confirmation of channel assignment from SAS
- Performs bidirectional bulk CBSD registration and directive processing, optionally through carrier EMS if present.
- Perform bidirectional information processing and routing.
  - E.g. interference reporting, etc.

# WG3 : Organization

## Group Chairs

**Jesse Caulfield**  
Key Bridge  
**Prakash Moorut**  
Nokia

Deliverables,  
organization,  
policies,  
resources

## SAS-CBSD Protocol

**Prakash Moorut**  
Nokia

Specification,  
contributions,  
editorial

## SAS-SAS Protocol

**James Ni**  
Federated  
Wireless

Specification,  
contributions,  
editorial

## *Other Protocols*

*Other protocols  
and  
specifications as  
required*

# WG3 : Execution Strategy



## Technical Specifications

- Complete Capture
- WINNForum Adoption

## Technical Reports

- Incremental Capture
- Group Consensus

## Functional Architecture

- Multi-group Consensus
- Broad Collaboration



# WG3 : Group Participation

103 Professionals across 35 Organizations

WINNForum Members

Industry Experts

SAS  
Operators

ESC  
Operators

Device  
Mfrs

Wireless  
Operators

Other  
Interests

Incumbents

Experts

Observers

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# Committee Standards are Being Developed in Phases

## Early Release

- SAS to SAS and SAS to CBSD Protocols Technical Reports (TRs)

## Version 1.0.0

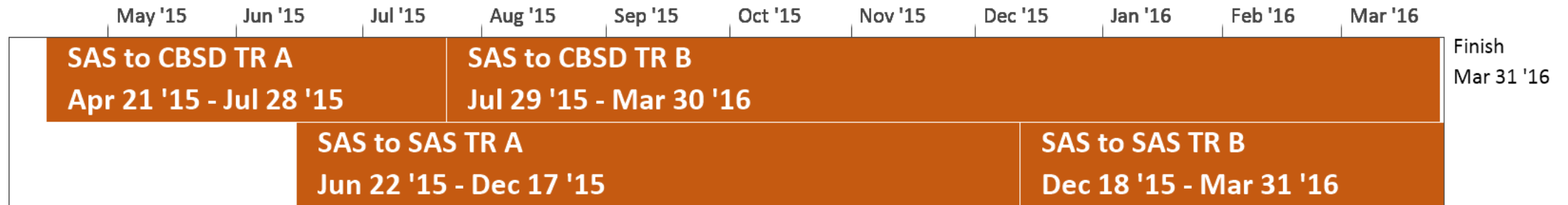
- FCC 1<sup>st</sup> R&O, GAA Category A, Domain Proxy support for managed networks, limited support for PAL and Certified Professional Installer
- Comments to Technical Reports postponed to Technical Specifications phase.
- Possible interim releases.

## Version 2.0.0

- FCC 2<sup>nd</sup> R&O & Reconsideration, Initial support for PAL and Category B, Full GAA, Measurement Reporting and Inter-SAS Communications
- Possible interim releases.

**Other phases will be added as required**

# Early Release Publication Timeline

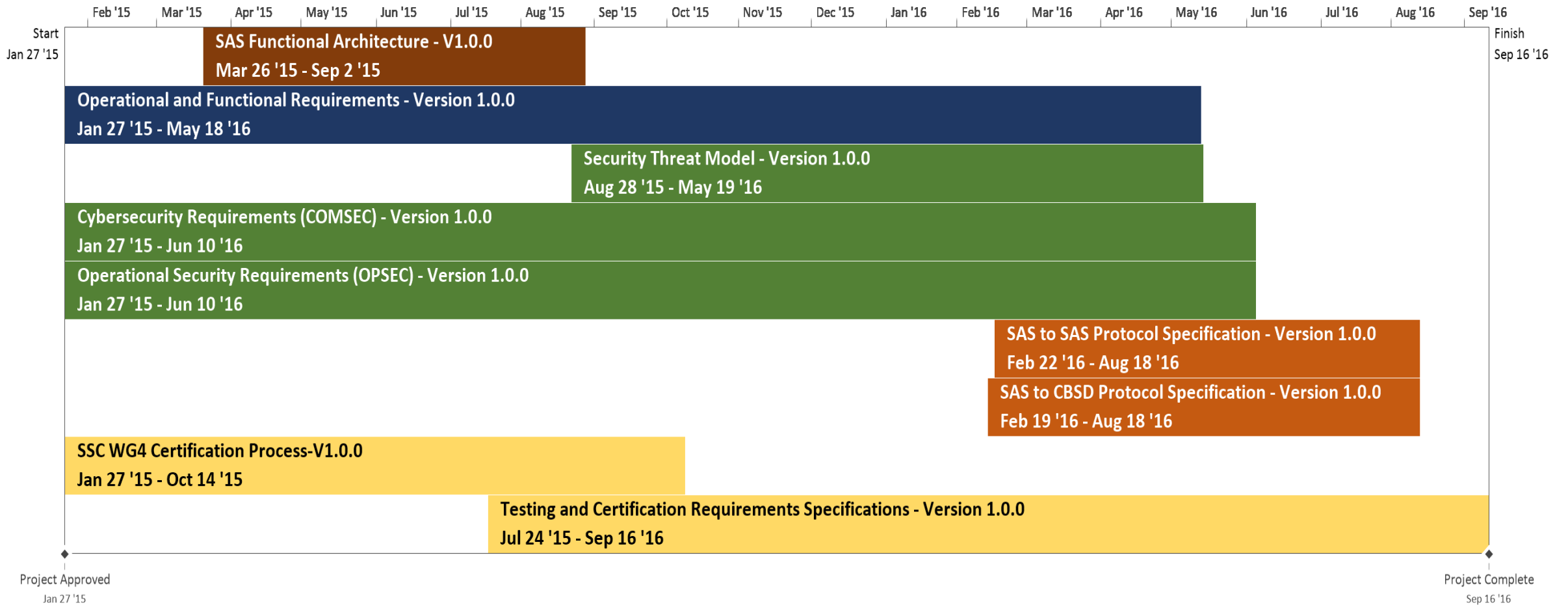


## Notes

1. TRA = Technical Report A, TRB = Technical Report B
2. Finish/publication dates include planned ballot period throughout this document

See <http://groups.winnforum.org/Reports>

# Version 1 Publication Timeline



# What is addressed in the Version 1 Specifications

## FCC First Report and Order (17 April 2015)

### Communications Security

- The communications security policies governing SAS and CBSD communications interfaces. These policies describe a Public Key Infrastructure (PKI) which governs communications within the CBRS ecosystem and provide authentication and authorization for messages exchanged within the SAS ecosystem.

### Domain Proxy

- The baseline Operational and Functional Requirements of the CBRS Domain Proxy for initial testing and trials.

### Environmental Sensing Capability (ESC)

- The requirements for implementation of an Environment Sensing Capability, and protecting federal incumbents.

# What is addressed in the Version 1 Specifications (cont.)

## Exception Management

- The requirements for how trouble tickets or exceptions are managed, including from FCC input, reports from incumbents, and reports from PAL.

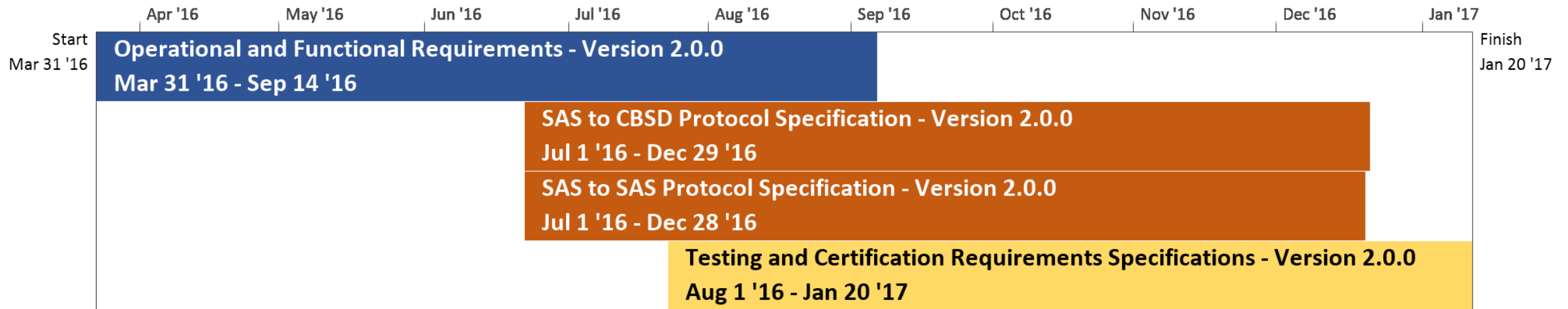
## Operations Security

- The overall system operational security requirements to include handling of incumbent data, obfuscation of spectrum data, and processes associated with auditing and governance of the SAS infrastructure.

## Registration Processing

- The requirements for how a CBSD registers with a SAS, including owner registration, professional installer registration and CBSD registration.

# Version 2 Publication Timeline (Preliminary)



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# What will be addressed in Version 2

## **CBSD Measurement Reporting**

- Requirements for CBSD measurements of their local interference environment, and reporting those data back to the SAS.

## **Information Sharing**

- Requirements for information sharing among SASs, between CBSDs and SASs, and with the general public.

## **Professional Installer**

- Guidelines for adoption of uniform industry working standards and curriculum required to be consistent with the protection of spectrum, both licensed and GAA, for sharing in the 3550-3700 MHz band.

# What will be addressed in Version 2 (cont.)

## Priority Access License

- Requirements on how PALs reports their coverage area to the SAS for end-to-end use of the licenses. This includes how PAL licensees request to operate in a particular geographic area within their license boundary , how credentials are defined, conveyed and managed, and how the SAS accomplishes such protections.

## 2<sup>nd</sup> R&O & Reconsideration

- FSS Protection
- Grandfathered 3650 Protection
- Other

## Change requests from Version 1



# Additional Items

## Border area management

- Requirements on Implementing international agreements to protect Canada and Mexico

## Channel assignment

- Requirements on how a CBSD acquires, maintains, adjusts, and relinquishes channel assignments.
- Requirements on how assignments are synchronized across SASs.
- Requirements on how PAL channels will be assigned.

## Coexistence

- A framework to mitigate the negative impacts from multiple signals, possibly across multiple air interface technologies, occupying the same and adjacent channels. This can be used by other organizations in establishing technology specific coexistence agreements.

## Differentiation

- Requirements defining how SASs using different propagation models will handle interference margins and other issues

# Noteworthy

- **>80 input contributions to date**
- **SAS-CBSD Technical Report-A & Technical Report-B Published**
- **SAS-SAS Technical Report-A & Technical Report-B Published**
- **Started Technical Specifications on SAS to CBSD Interface and SAS to SAS Interface**
- **Following slides are based on the Technical Reports (TRs)**
- **While Technical Specifications will contain similarities with the TRs, we can expect some changes.**

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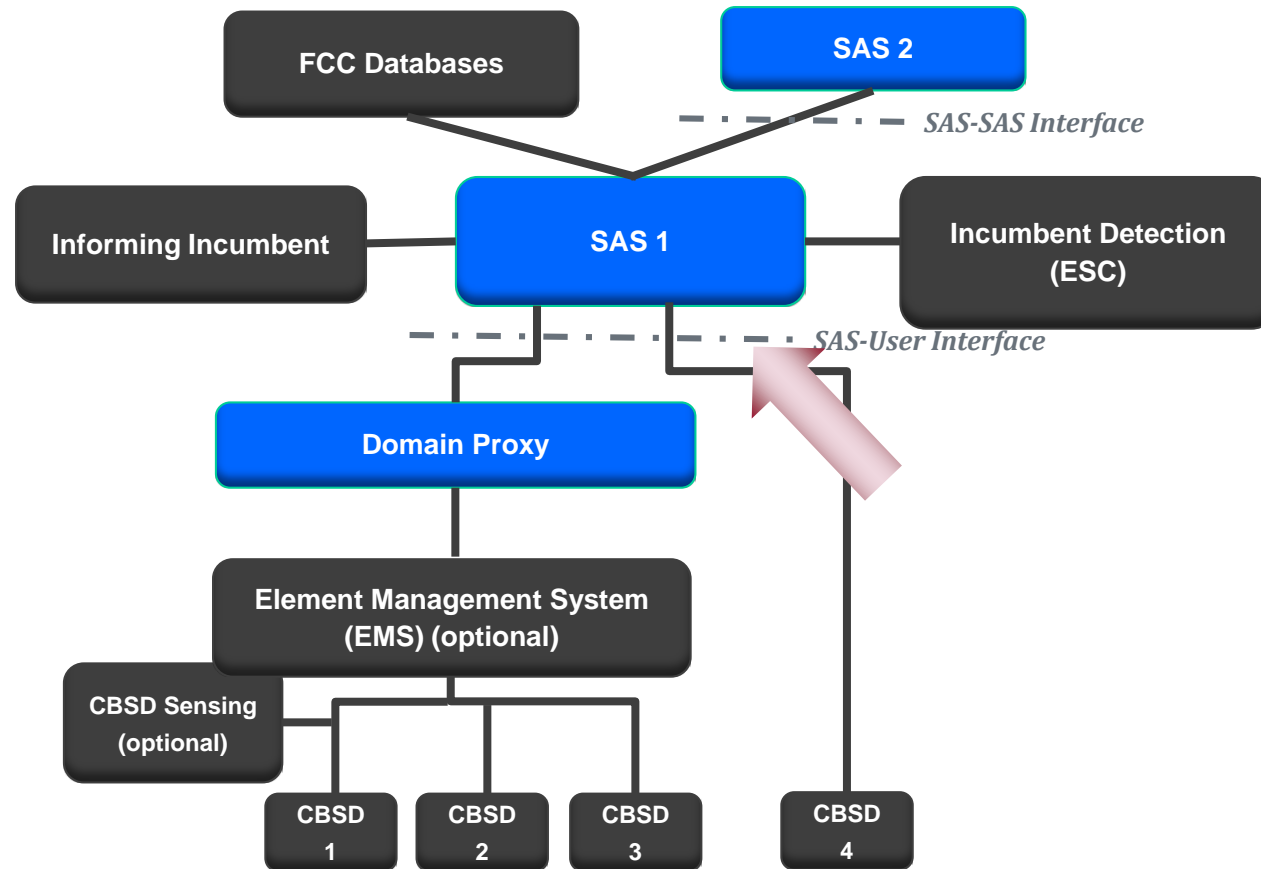
# WG3 Protocol Webinar -- SAS-CBSD Protocol

**Yi Hsuan, Google**

**Masoud Olfat, Federated Wireless**

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# SAS Functional Architecture



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# SAS Pre-Requisite Procedures

Note: These Procedures are out of scope of WG3 Protocols

- CBRS Owner Pre-Registration
  - Owner obtaining an Owner ID
  - CBSD to Owner Association
- PAL pre-Registration, including PAL rights management and PAL ID registration.
- Device Type parameters Pre-entered into a database accessible to SAS
  - it could be through Professional installers.
- Communication security.
  - Includes both Authentication and integrity of communications between different entities
- (not in current documents) Potentially New Procedures required by 2<sup>nd</sup> R & O
  - PPA ID (PAL Protection Area)
  - Leased Areas notification

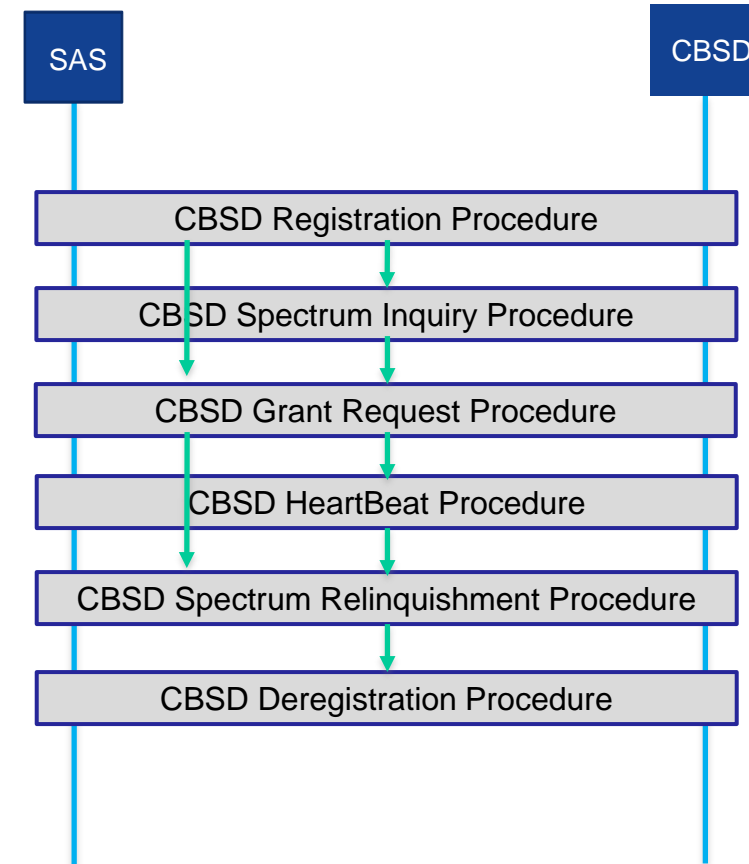
# SAS Discovery

- SAS Discovery by CBSD and Domain Proxy
- Static methods:
  - SAS connection information is provisioned into the CBSD
  - provisioned information is used to initiate CBSD Registration
- Dynamic provisioning:
  - protocols like Domain Name System (DNS)/ Dynamic Host Control Protocol (DHCP) are to determine the SAS connection information.
- The SAS discovery provisioning method is outside the scope of WINNF.
- SAS discovery Failure:
  - SAS URL configuration errors
  - DNS configuration errors.

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# Key Procedures Supported by SAS-CBSD Protocol

- **CBSD registration procedure**
  - Allows a CBSD registers with a SAS
  - Includes SAS-CBSD TLS Authentication Procedures
- **CBSD spectrum inquiry procedure**
  - Allows a CBSD finds available spectrum
- **CBSD grant request procedure**
  - Allows a CBSD requests SAS approval to use a part of the CBRS band
- **CBSD heartbeat procedure**
  - Allows a SAS dynamically controls CBSD transmission
- **CBSD spectrum relinquishment procedure**
  - Allows a CBSD relinquishes an existing grant
- **Deregistration procedure**
  - Allows a CBSD deregisters from a SAS



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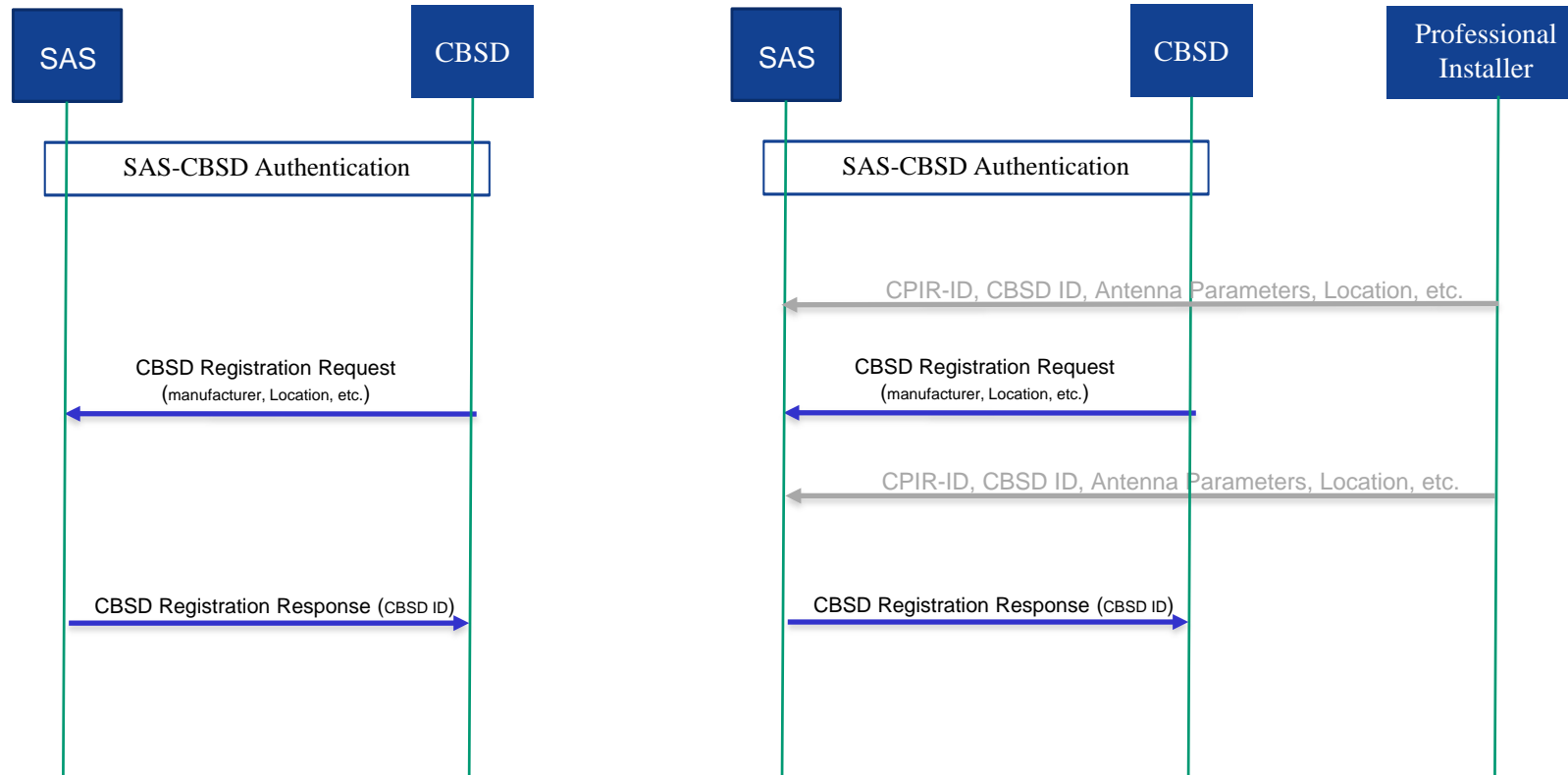
# CBSD Registration Procedure

- CBSD registration:
  - Includes SAS-CBSD Authentication
  - CBSD parameters provided to SAS including CBSD category, S/N, FCC ID, Call Sign, manufacturer ,maximum grants, location information, Antenna characteristics, Radio Technology, Sensing Capability. and other installation parameters.
  - Followed by SAS response accepting (along with a globally unique CBSD ID) or rejecting (along with Error codes) the request
- Modes of Registration
  - Single Step (Machine to Machine)
  - Multi-Step Registration (Professional Installer)
- Possible Error Codes
  - Registration Pending
  - Blacklisted
  - Invalid Parameter
  - Missing Parameter

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# CBSD Registration Procedure

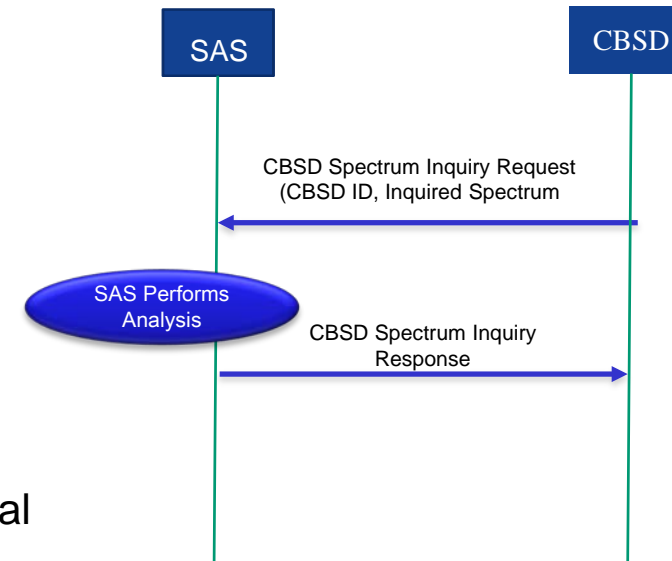


Single Step Registration

Multi Step Registration

# CBSD Spectrum Inquiry Procedure

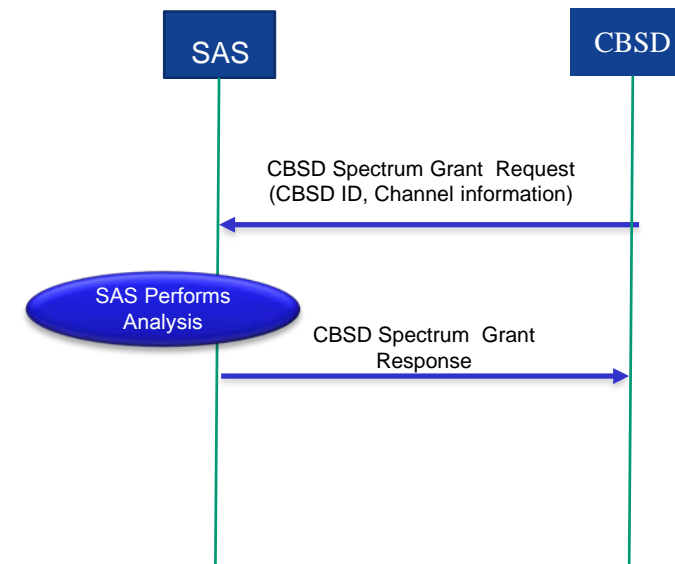
- CBSD Request for information about available spectrum managed by a SAS.
  - CBSD Registration is a pre-requisite
  - Optional Procedure
  - Information provided by the SAS is not guaranteed
  - Provides Information about available spectrum for the CBSD to request spectrum grant later
  - CBSD may request about the availability of both PAL (along with PAL Credential) and GAA
  - OPSEC concerns
  - Message includes CBSD ID, optional PAL Credential (optional), and inquired Spectrum Range.
  - The available Channel object in the response contains a list of frequency ranges available for the CBSD for grant requests, along with its channel type.



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# CBSD Grant Procedure

- CBSD send a Grant Request Message to the SAS (both for PAL and GAA)
  - Includes selected channel(s), maximum EIRP, and PAL Credentials for PAL Requests.
- A grant is a contiguous channel assignment with a peak power and channel type
- After detailed channel interference assessments, SAS decides whether requested channel is acceptable.
  - If so, SAS response with Grant ID, and the duration of Grant
  - Otherwise SAS could optionally recommend alternative operational parameters including PAL Credentials, desired frequency range, peak power
- A CBSD may have multiple simultaneous grants
- If SAS-CBSD connectivity is lost, the CBSD must Cease transmission on all grants
- Heartbeat is required prior to activating (transmission) any channels assigned during the grant request.



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# CBSD HeartBeat Procedure

- Independent HeartBeat Process for each Grant
- Serves Two purposes
  - Keep alive message for CBSD (still using the grant)
  - provides means to SAS send commands to CBSD (such as changing parameters, suspending or terminating the grant)
- The time between two consecutive Heartbeats (HeartbeatDuration) is communicated by the SAS through Grant Response, and following HeartBeat Responses.
- CBSD send HeartBeat procedure anytime prior to expiration of the Heartbeat Duration timer.
- The Heartbeat Response includes CBSD ID, Grant ID, grant expiration time, HeartBeat Duration, suggested operation parameter, and measurement Configuration.

# Reassignment / Revocation Through HeartBeat Procedure

- Through Heartbeat Procedure, SAS either revokes or reassigns the channel to the CBSD as a result of a higher priority user requiring access to the assigned spectrum.
  - Pre-Condition is CBSD having grant
- Reassignment: SAS provides alternative grants to the CBSD
- Revocation: SAS doesn't provide alternative frequency assignment to the CBSD
- In both cases CBSD needs to send a new Grant Request

```
IF errorCode = SUCCESS
  Initiate radio transmission if initial heartbeatRequest
  Update parameters based on heartbeatResponse
  Continue operation (or resume operation if grant was
  suspended)

ELSE IF errorCode = SUSPENDED_GRANT
  Turn off radio transmission (suspend radio operations)
  Update parameters based on heartbeatResponse
  Reset heartbeat timer if there are no new operational
  parameters
  Resend heartbeatRequest after timer expires
  Issue relinquishmentRequest if new operational
  parameters
  Issue grantRequest with new operational parameters

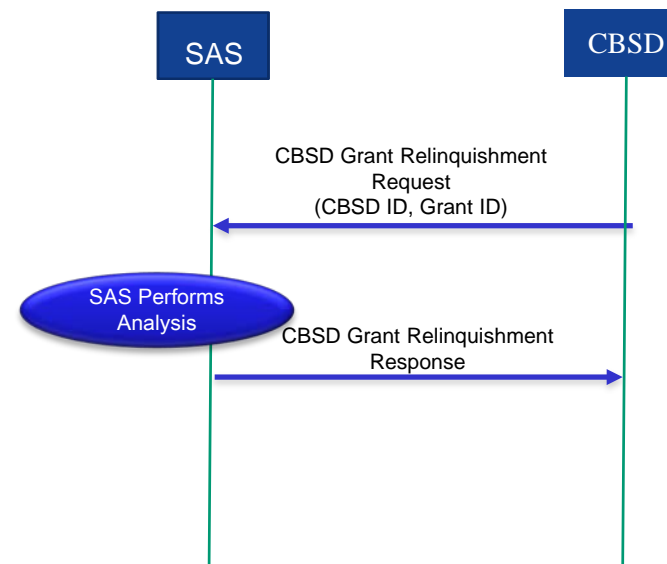
ELSE IF errorCode = TERMINATED_GRANT
  Turn off radio transmission (terminate radio operations)
  Issue relinquishmentRequest
  Issue grantRequest if new operational parameters

END
```

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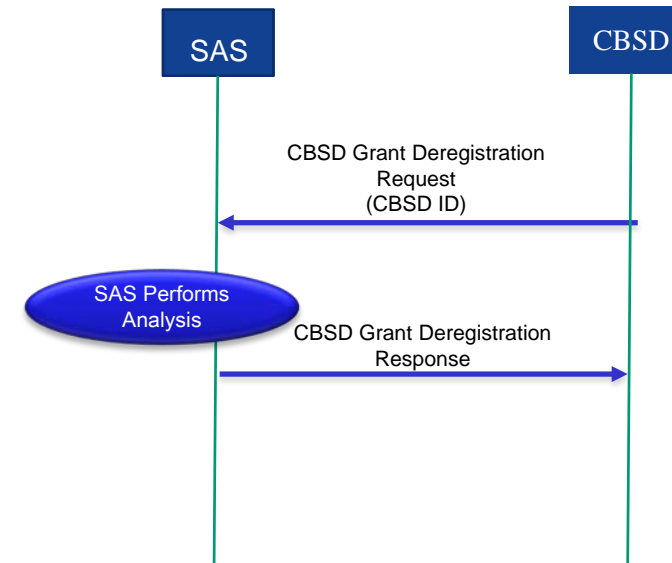
# SAS-CBSD Spectrum Relinquishment Procedure

- CBSD requests SAS to relinquish spectrum grant
  - Having Spectrum Grant is a pre-requisite
  - Required if CBSD doesn't need the spectrum prior to expiration of the Grant.



# SAS-CBSD Spectrum DeRegistration Procedure

- CBSD requests to be deregistered from the SAS
  - Deregistration automatically terminates all CBSD grants.



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# SAS-CBSD Message Design

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# Basics of SAS-CBSD Protocol Design

- **SAS service is a cloud service that protects higher tiers users and optimizes frequency use for users in the CBRS band**
- **HTTPS (HTTP+TLS), a well-established internet transport protocol, is used for communication between servers (SAS) and clients (CBSD)**
- **HTTP is a request-response protocol, where the client submits an HTTP request to the server and the server returns a response to the client**
- **WINN forum standardizes a suite of request and response messages for SAS-CBSD communications**

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# Key Procedures Supported by SAS-CBSD Protocol

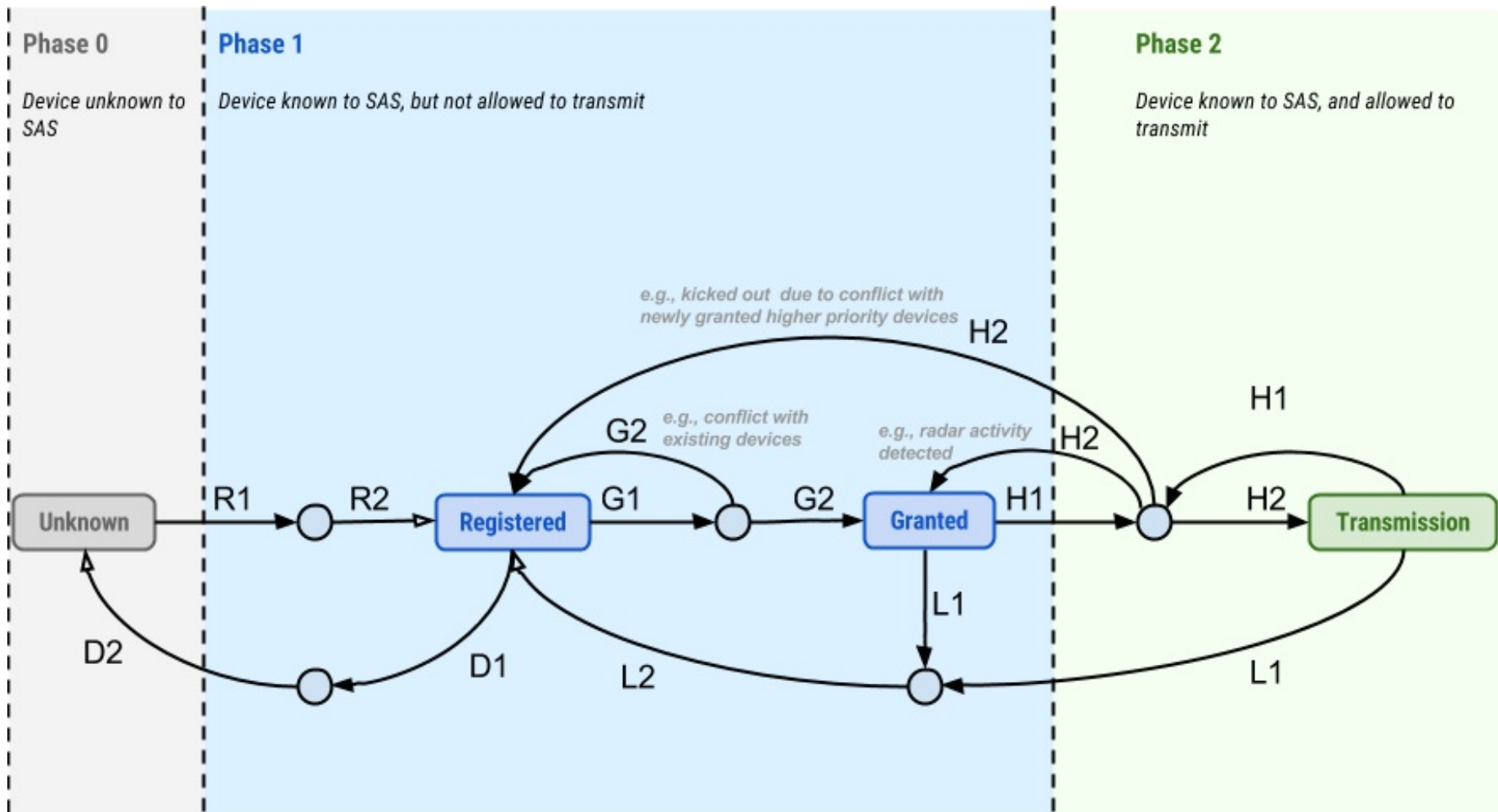
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# Messages of SAS-CBSD Protocol

- **Registration Request (R1) and Response (R2)**
- **Spectrum Inquiry Request (S1) and Response (S2)**
- **Grant Request (G1) and Response (G2)**
- **Heartbeat Request (H1) and Response (H2)**
- **Relinquishment Request (L1) and Response (L2)**
- **Deregistration Request (D1) and Response (D2)**

# CBSD State Diagram



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# Registration Request

Parameter Name	Data Type	Required/ Optional	Description
userId	string	Required	The identifier of a CBSD user.
fccId	string	Required	The FCC certification identifier of the CBSD. It is a string of 19 characters as described in FCC Administration Topics Review.
cbsdSerialNumber	string	Required	A serial number assigned to CBSD by the CBSD device manufacturer.
cbsdManufacturer	string	Conditional	A unique name for the CBSD manufacturer.
callSign	string	Conditional	A device identifier provided by FCC.
cbsdCategory	string	Conditional	Device Category of the CBSD. Allowed values are "A" or "B" as defined in Part 96.
maximumGrants	number	Conditional	The maximum number of grants that the CBSD can use simultaneously.
airInterface	object: AirInterface	Conditional	A data object that includes information on the air interface technology of the CBSD.
installationParam	object: InstallationParam	Conditional	A data object that includes information on CBSD installation. Installation information may be provided to SAS through a separate interface between SAS and installers.
sensingCapability	array of string	Conditional	The array describes all sensing capabilities of CBSD relevant to SAS operation. Examples of sensing capability include "esc", "receivedInterferencePower".

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# Registration Request (Cont')

- **installationParam:** latitude, longitude, height, heightType, horizontalAccuracy, verticalAccuracy, indoorDeployment, antennaAzimuth, antennaDowntiltMech, antennaDowntiltElec, antennaGain, antennaBeamwidth, antennaModel
- **airInterface:** radioTechnology, supportedSpec
- **sensingCapability:** TBD

# Registration Response

Parameter Name	Data Type	Required/ Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS. Definition of this ID is FFS.
error	object: Error	Required	This parameter includes information on whether the corresponding CBSD request is approved or disapproved for a reason.

Error object:

Parameter Name	Data Type	Required/ Optional	Description
errorCode	number	Required	An integer to indicate the type of error. 0 means the corresponding CBSD request is approved.
errorMessage	string	Optional	A short description of the error.
errorData	errorCode dependent	Optional	Additional data can be included to help CBSD resolve error. The data type depends on the value of the error code.

# Spectrum Inquiry Request

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
palCredential	array of string	Optional	If the CBSD owner has PAL right, the PAL credential(s) should be included here. Credentials are formatted as an array of strings. This field is not included if the CBSD has no PAL right.
inquiredSpectrum	array of FrequencyRange	Required	This field describes the spectrum in which CBSD seeks information. The parameter is an array of the FrequencyRange data object.

## FrequencyRange Object:

Parameter Name	Data Type	Required/Optional	Description
lowFrequency	Number	Required	The lowest frequency of the frequency range in Hz.
highFrequency	Number	Required	The highest frequency of the frequency range in Hz.



# Spectrum Inquiry Response

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
availableChannel	array of AvailableChannel	Required	This parameter is an array of a data object, AvailableChannel, which describes a channel that is available for the CBSD.
error	object: Error	Required	This parameter includes information on whether the corresponding CBSD request is approved or disapproved for a reason.

## AvailableChannel Object:

Parameter Name	Data Type	Required/Optional	Description
frequencyRange	FrequencyRange	Required	This parameter is frequency range of the available channel.
channelType	string	Required	“PAL”: the channel is a PAL channel based on the credentials provided in the spectrum inquiry request. “GAA”: the frequency range is for GAA use.
ruleApplied	string	Required	The regulatory rule used to generate this response, e.g., “FCC Part 96”.

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# Grant Request

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
operationParam	object: OperationParam	Required	This data object includes operation parameters of the requested grant.

## OperationParam Object:

Parameter Name	Data Type	Required/Optional	Description
palCredential	array of string	Optional	PAL credential(s) shall be provided here if the grant requires PAL protection. This field is not included if the CBSD does not demand PAL protection for the grant.
peakPower	Number	Required	Peak transmission power to be used in the grant. The peak power is in the unit of dBm/MHz.
operationFrequencyRange	FrequencyRange	Required	This parameter is frequency range of a contiguous segment.

# Grant Response

Parameter Name	Data Type	Required/ Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
grantId	string	Optional	An ID provided by SAS for each approved grant. If the request is rejected, this field must not be included.
grantExpireTime	string	Optional	If the request is approved, SAS shall include this field to indicate the UTC time when the grant expires. It is expressed using the format, YYYY-MM-DDThh:mm:ssZ, as defined by "Date and Time on the Internet: Timestamps" [RFC3339].
heartbeatDuration	number	Optional	If the request is approved, SAS shall include this field to indicate the time interval in seconds between two consecutive heartbeat requests.
measReportConfig	object: MeasReportConfig	Optional	Configuration for CBSD to perform various measurements (interference, incumbent, etc) and report to SAS.
operationParam	object: OperationParam	Optional	If grant request is disapproved, SAS can optionally provide a new set of operation parameters for the CBSD.
error	object: Error	Required	This parameter includes information on whether the corresponding CBSD request is approved or disapproved for a reason.

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# Heartbeat Request

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
grantId	string	Required	An ID provided by SAS for each approved grant.
grantRenew	boolean	Optional	If set to True, CBSD asks for renewal of the current grant. SAS should include a grantExpireTime in the following heartbeatResponse.
operationState	string	Optional	If operationStatusReq is True in the previous heartbeat response, CBSD operation state (Transmission or Granted) should be included.
operationParam	Object: OperationParam	Optional	If operationStatusReq is True in the previous heartbeat response, operationParam should be included.
measReport	object: MeasReport	Optional	If CBSD is configured to report measurements, this field includes the measurement reports.

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# Heartbeat Response

Parameter Name	Data Type	Required/ Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
grantId	string	Required	An ID provided by SAS for each approved grant.
operationStatusReq	boolean	Optional	If True, CBSD should include operation parameters and operation state in the next heartbeat request.
transmitExpireTime	string	Required	If the request is approved, this field indicates the time CBSD can transmit until. It is UTC time expressed in the format, YYYY-MM-DDThh:mm:ssZ
grantExpireTime	string	Optional	If grantRenew is set to True in a heartbeatRequest, SAS should include this field in heartbeatResponse.
heartbeatDuration	number	Optional	SAS can change the future heartbeat duration with this.
operationParam	OperationParam	Optional	If heartbeat request is disapproved or SAS intends to change CBSD operation parameters, SAS can provide a new set of operation parameters to the CBSD.
measReportConfig	object: MeasReportConfig	Optional	Configuration for CBSD to perform various measurements (interference, incumbent, etc) and report to SAS.
error	object: Error	Required	This parameter includes information on whether the corresponding CBSD request is approved or disapproved for a reason.

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# Relinquishment Request/Response

## Relinquishment Request:

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSID registered to SAS.
grantId	string	Required	An ID provided by SAS for each approved grant.

## Relinquishment Response:

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSID registered to SAS.
grantId	string	Required	An ID provided by SAS for each approved grant.
error	object: Error	Required	This parameter includes information on whether the corresponding CBSID request is approved or disapproved for a reason.

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# Deregistration Request/Response

## Deregistration Request:

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.

## Deregistration Response:

Parameter Name	Data Type	Required/Optional	Description
cbsdId	string	Required	This is a globally unique identifier for each CBSD registered to SAS.
error	object: Error	Required	This parameter includes information on whether the corresponding CBSD request is approved or disapproved for a reason.

# WG3 Protocol Webinar -- SAS-SAS Protocol

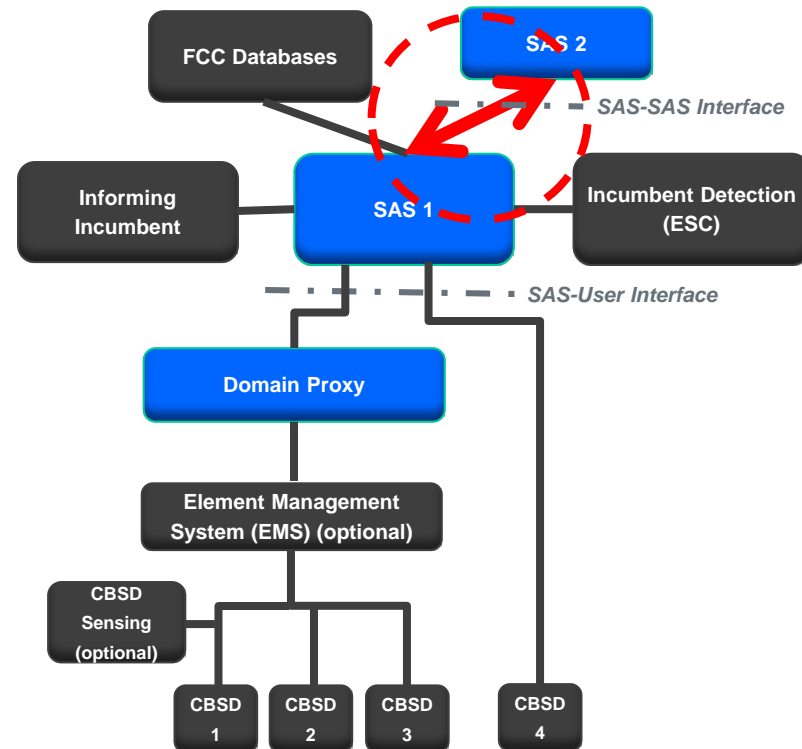
**Greg Billock, Google**

**James Ni, Federated Wireless**

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# SAS – Functional Architecture (Approved)



#### Acronyms:

ESC: Environmental Sensing Capability  
CBSD: Citizens Broadband Radio Service Device  
SAS: Spectrum Access System

#### Notes:

- A SAS may not need to support all interfaces.
- Each CBSD domain may optionally include some sensing capability (including possibly an ESC).

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# SAS-SAS Protocol Objectives

## Meet the FCC requirements in the following aspects

- a. Information sharing
- b. Security and confidentiality
- c. Support aggregated interference protections for tier 1 and tier 2 users
- d. Inter-SAS-operator coordination (e.g. on enforcement actions and alternative arrangements)

## Some common information currently out of scope for SAS-SAS Protocol

- a. PAL channel assignments
- b. Regulatory priors (e.g. border definitions, census tract boundaries, incumbent databases)
- c. Protection methods and common propagation models

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# SAS-SAS protocol basics

## **SAS Autonomy**

## **Partition Tolerance**

→ No real-time communications

## **Variety of possible SAS-SAS relationships**

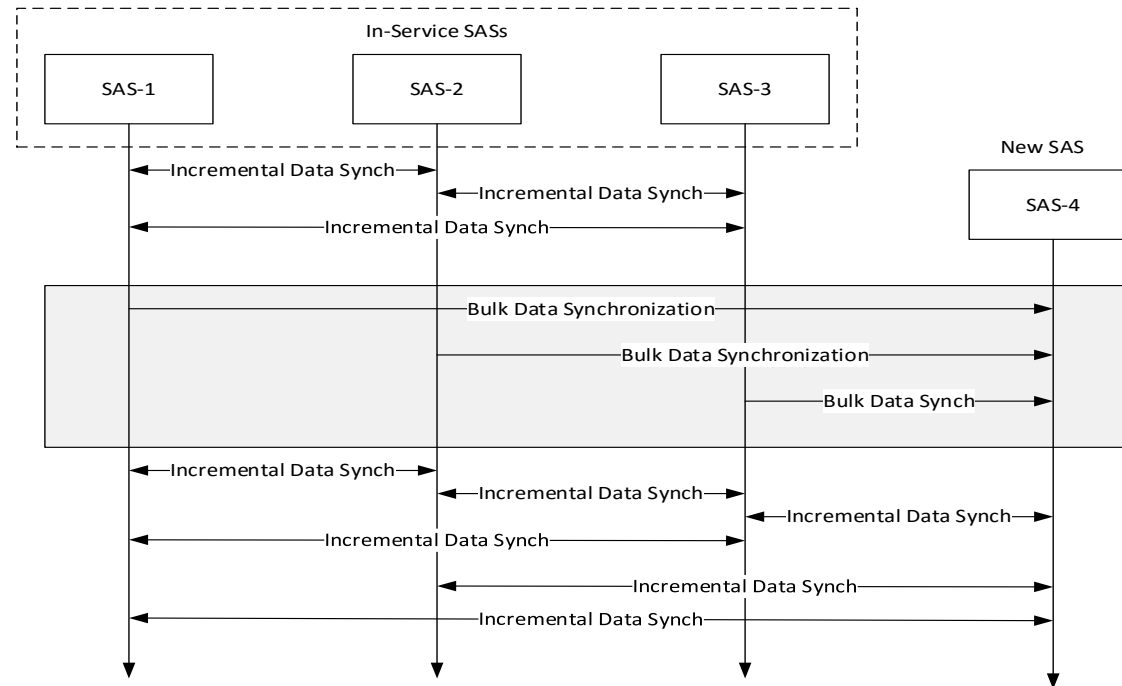
## **Variety in nature of data exchanged**

→ Flexibility in style of communications (push vs pull)

## **Different requirements for bulk and record exchanges**

→ Support for bulk exchange and event-based notifications

# SAS-SAS information exchange procedures



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# SAS-SAS Information Exchange Data

**Bulk and incremental data exchange is built around proactive request of or notification of change to particular data records. (Pull or push)**

**Types of records correspond to entities defined in the Part 96 rules**

**Methods of exchange can be made flexible to accommodate different use cases and exchange needs.**

# SAS-SAS Information Exchange Security

**Data exchange performed over secured connections (TLS)**

**SASs authenticate each other using their PKI certificates to ensure data is coming from a certified peer**

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# SAS-SAS Record Types

SAS Administrator	Manage specific SAS implementations. There may be many implementations maintained by a single SAS administrator.
SAS Implementation	A particular certified SAS implementation.
ESC Administrator	Manage specific ESC implementations.
ESC Implementation	A particular ESC implementation.
Incumbent	Specific incumbent devices (FSS earth stations or grandfathered wireless broadband service installations) which are known to the SAS.
CBSD Operator	Entities which operate CBSDs. The SAS is required to track particular information related to such entities as received during the CBSD registration process.
Domain Proxy	Entities operating networks of CBSDs. From the point of view of Part 96, such entities are a particular kind of CBSD operator, but since they have different certification and capability sets within the SAS ecosystem they are referred to separately
Professional Installer	Entities vouching for particular CBSD metadata.
CBSD Device Type	Particular equipment certified for operation in the CBRS band. Certification will be by the FCC and reflected in a unique FCC_ID number.

# SAS-SAS Record Types (continued)

CBSD	Specific devices which will operate in the CBRS band and gain spectrum use authorizations from the SAS.
Zone	Geographical areas with various meanings within the SAS. For example, census tracts (PAL license areas), WISP protection areas, ad hoc protection zones, etc.
Coordination Event	Part 96 rules require formal exchange of information regarding a wide range of events, such as GAA/FSS arrangements, PAL/PAL arrangements, enforcement actions by FCC, etc. Names for particular coordination events will be assigned by the SAS administrator in which the coordination event is registered



# SAS-SAS Record Naming

## Records keyed within a global namespace Record type identified by name prefix

- SAS/ESC Administrators (namespace “admin”)
- SAS implementations (namespace “sas”)
- ESC implementations (namespace “esc”)
- Incumbents (namespace “incumbent”)
- CBSD Operators (namespace “operator”)
- Domain proxies (namespace “domain”)
- CBSD types (namespace “cbsd-type”)
- Professional Installers (namespace “installer”)
- CBSDs (namespace “cbsd”)
- Zones (namespace “zone”)
- Coordination events (namespace “sas/\$SAS/coordination”)

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# SAS/ESC Administrator Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable name of organization
Public Key	X.509 public key certificate
Contact Information	Address, phone numbers (human-readable)
FCC Registration Info	(if any)

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# SAS Implementation Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable name of the SAS
Administrator	ID of SAS Administrator
Public Key	X.509 public key certificate
Contact Information	Address, phone numbers (human-readable)
FCC Registration Info	(if any)
FCC Certification Date	YYYY-MM-DD
Certification Phase	"1" or "2"
ESC	ID of the ESC(s) this SAS uses, if any (for phase 2)
URL	Publicly-facing human-consumable URL for this SAS.
SAS-CBSD URL	The root url for SAS discovery of the SAS-CBSD protocol.
SAS-SAS URL	The root url for SAS discovery of the SAS-SAS protocol.

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# ESC Implementation Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable name of the ESC
Administrator	ID of ESC Administrator
Public Key	X.509 public key certificate
Contact Information	Address, phone numbers (human-readable)
FCC Registration Info	(if any)
FCC Certification Date	YYYY-MM-DD

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# Incumbent Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable name of the incumbent
Manufacturer	Human-readable name of manufacturer
Source	Source for data about this incumbent (e.g. IBFS)
Certification Date	YYYY-MM-DD
FCC Registration Info	(if any)
Deployment Parameters	Antenna configuration, location, etc.
Operational Parameters	Frequency of operation, etc.

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# Operator/Domain Proxy Record

ID	Machine-readable unique name (ideally also human-readable)
Public Key	X.509 public key certificate (if any)
User ID	Machine-readable unique reference to this operator
Contact Information	Human-readable contact information, or a reference to contact information. <i>For list of available fields see WINNF-15-I-0125</i>
Acknowledgement of interference from federal radars	Human-readable information about the state of acknowledgement

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# Professional Installer Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable name of the installer
Contact Information	Address, phone number (human readable)
Public Key	X.509 public key certificate
Certification Date	YYYY-MM-DD
Registration parameters	<i>Possibly data from WINNF-I-15-0125 related to state of registration of the installer</i>

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# CBSD Device Type Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable name of the CBSD class
Manufacturer	Human-readable name of manufacturer
FCC ID	Certification ID
Certification Date	YYYY-MM-DD
FCC Registration Info	(if any)
Air Interface Type	LTE, WiFi, etc



# CBSD Record

ID	Machine-readable unique name (ideally also human-readable)
Public Key	X.509 public key certificate
Installation parameters, user parameters, etc. See TR-A.8(R1)	<p><b><u>Registration Parameters</u></b> FCC ID Serial Number Max number of grants CBSD Category Call Sign User ID (may be same field as call sign) Sensing capability <i>Possibly other information from WINNF-15-1-0125 if desired</i></p> <p><b><u>Installation parameters</u></b> Location (lat, lng, height) Indoor/outdoor Antenna azimuth, tilt, gain, beamwidth Professional installer ID</p> <p><b><u>Grant parameters</u></b> Frequency range Maximum power PAL ID Expiry information <i>Extensible to provide value-add coordination parameters if identified (e.g. service contours from recon petition, interference margin levels, alignment capability).</i></p>

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# Zone Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable zone name
Creator	Who created this zone
Usage	Type of zone record (e.g. PAL Protection Area, Ad Hoc Exclusion Zone)
Zone	GeoJSON definition of the zone

# Coordination Event Record

ID	Machine-readable unique name (ideally also human-readable)
Name	Human-readable record name
Creator	Who initiated this coordination record (a user ID or the FCC)
Creation Date	YYYY-MM-DD HH:MM:SS
Expiration Date	YYYY-MM-DD HH:MM:SS
Coordination Type	FSS coordination, FCC exception record, FCC enforcement action, SAS exceptions, ESC activations, etc.
Description	Human-readable description of the coordination
Device	If this coordination is relative to specific device, this is the device ID.
Zone	If this coordination is relative to a specific zone, this is that zone ID.
Device-Type	If this coordination is relative to a specific device type, this is that device type ID.
Type-Specific Data	Type-dependent <i>(e.g. activation of a particular ad-hoc zone, blacklist of a particular FCC ID or serial number)</i>

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# SAS-SAS Next Steps for Technical Spec

- **Define a synchronization protocol which uses a subset of the interactions defined in the TR**
- **Establish required and optional fields based on discussions in the WG1 Information Sharing Task Group**
- **Any records needed in the context of the 2<sup>nd</sup> Report and Order**

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# Summary (1/2)

WG3 is chartered to define the detailed protocols for data and communications across the various open interfaces within the system.

We are presently working on two industry standards:

- **SAS to CBSD** Protocol Specification
- **SAS to SAS** Protocol Specification

Specifications are incrementally developed through technical reports.

WG3 may address other communications paths in the future.

# Summary (2/2)

- A lot of good work to date and continuing.
- Heavy participation.
- Technical Reports (TRs) published. See <http://groups.winnforum.org/Reports>
- Technical content presented today is based on TRs.
- Technical Specifications work started- Version 1 expected in August 2016. Some content will differ from TRs.

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