

PALs, Licensing, Use of Claimed Areas & PCAs

Overview

April 2016

Max Solondz

Excerpts from: Working Document WINNF-16-P-0109 27 January 2016

WG1: PAL Task Group statement of purpose: to create and define

- The requirements and protocols for how PAL licensees report their coverage area to the SAS for end-to-end use of the licenses
- How PAL licensees request to operate in a particular geographic area within their license boundary
- How credentials are defined, conveyed and managed
- Also: How the SAS accomplishes such protections

This task-group will establish the high level WG1 requirements guidelines for adoption of uniform industry working standards for the use of PAL license rights to be consistent with the protection of PAL spectrum as defined in the FCC order for the 3550-3650 MHz band.

- 1) **Creating a ‘*credentials*’ based method of getting access to reserved PAL channels**
 - Credentials are secure, used at point of use: during channel allocation request from CBSD

- 2) **Creating ‘sub areas’ of *PAL Claimed Areas (PCAs)* that meaningfully define use**
 - PAL Licensee claimant submits polygon of desired protection area and CBSD cluster list

- 3) **Allow the *SAS* to ‘*vet*’ the original PCA claim to prevent overclaiming**
 - If the coverage is deemed adequate, the claimed PCA is registered and SAS issues:
 - a system wide unique PCA ID number,
 - and that number also ties it back to the original issued PAL license (tract & channel),
 - a security feature that allows the PCA to self-authenticate to the SAS.

PAL Requirements

Make PALs into 'Credentials:'

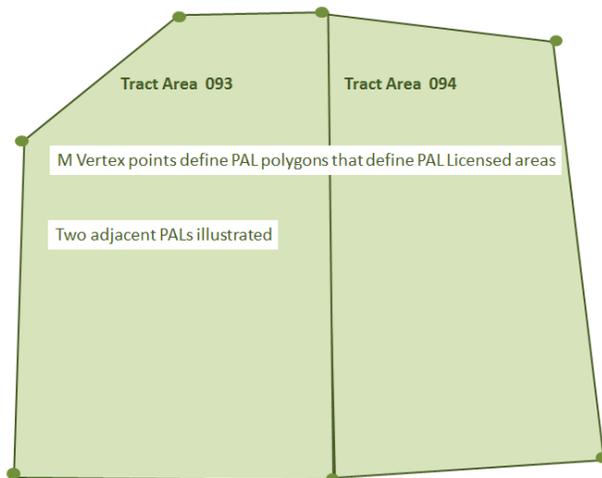
FCC N-1 Auction results conveyed to SAS overall system

System-wide unique **PAL-ID** number for every PAL

Embedded **Frequency Slot Identifier** (A – G correspond to up to 7 PALs in one area)

M Vertex points that correspond to the Census Tract area (area based)

PAL-ID Authentication Code for machine based authentication



3550	A	B	C	D	E	F	G	8	9	10	3650	GAA	GAA	GAA	GAA	GAA	3700
	1	2	3	4	5	6	7	8	9	10		11	12	13	14	15	

Purpose & Intent of PCAs

PAL Claimed Areas (PCAs). Six New Capabilities:

- 1) Establishes **'Credentials Based' method** for any CBSD to request a PAL protected channel allocation from any SAS
 - Used at time of Channel Allocation Request
 - Not tied directly to the Owner (User) nor the device (CBSD)
- 2) **Define Use:** Used areas are Claimed
 - Priority Access License (PAL) Claimed Area (PCA)
 - Defines used area with a rational polygon, ▪ claimant defined, ▪ SAS vetted
 - Freeing remainder of PAL for others' use
- 3) Allow Managing SAS to **Vet the claimants PCA claims** against a Cluster List
- 4) Allows Claimant (PAL licensee) to **Sub-divide a PAL** into manageable pieces
- 5) Allows Claimant to **engineer coverage** within the PCA boundary
 - Design to a QoS different from the -80 dBm SAS Boundary value
- 6) Allows secondary market **trading of PCAs**

PAL Claimed Area Requirements (PCAs)

Make PCAs into 'Credentials:'

PCAs are based upon PAL Licensee claims made via SAS

PCAs are claimed sub-areas within valid PALs

PCAs are also credentials based

PCAs are 'children' of PAL credentials

System-wide unique **PCA-ID** number for every PCA

Embedded PAL identifier: identify parent PAL

Embedded **Frequency Slot Identifier** (A – G correspond to up to 7 PALs in one area)

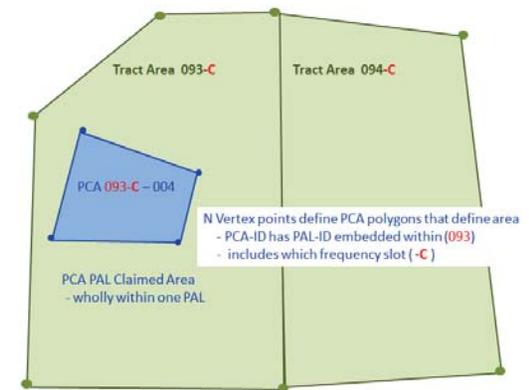
N Vertex points that correspond to the claimant's identified area (area based)

PCA-ID Authentication Code for machine based authentication (all SAS can authenticate)

PCA 'Cluster List' of CBSDs provided by claimant

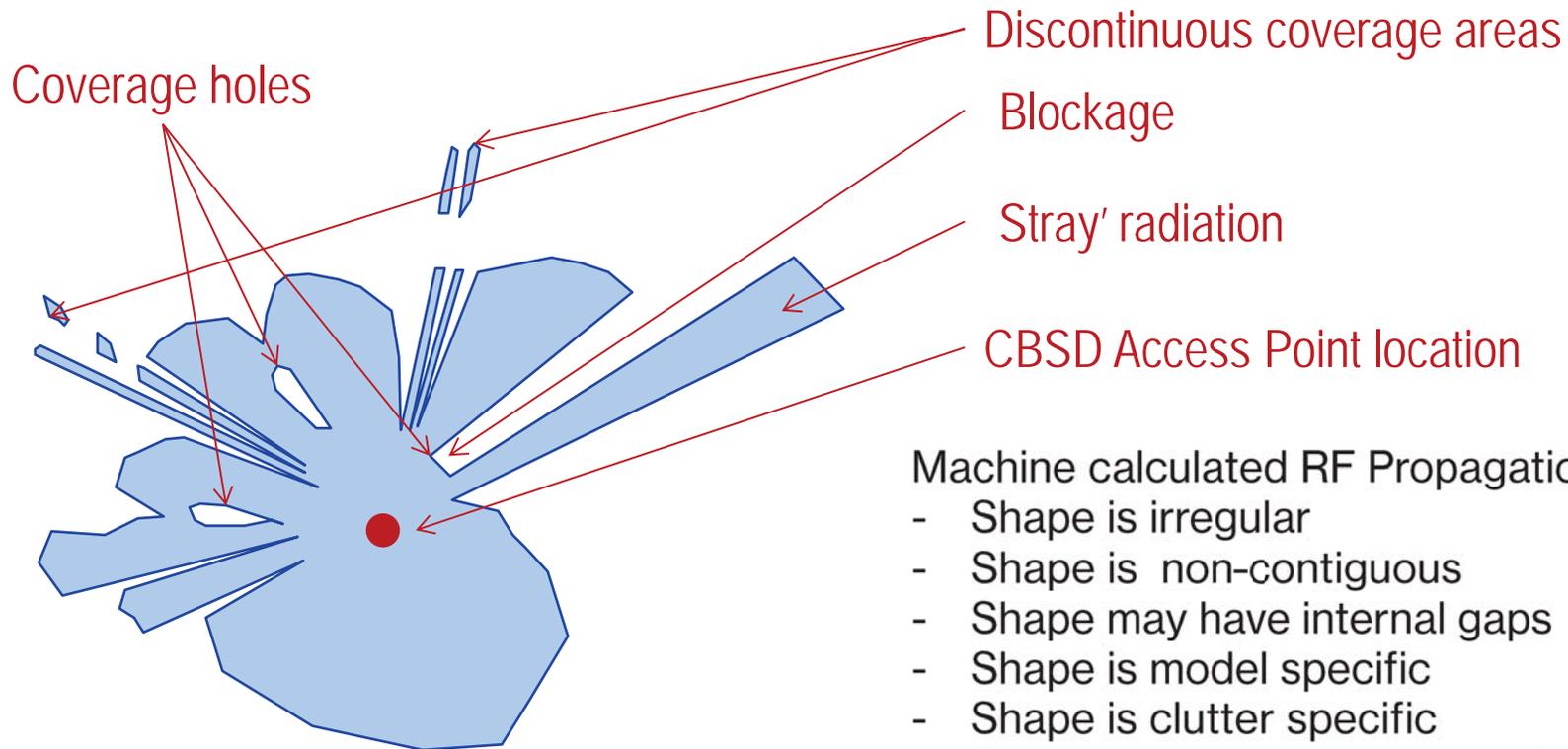
Managing SAS vets the claim using the cluster list

Once issued, all SAS protect PCAs



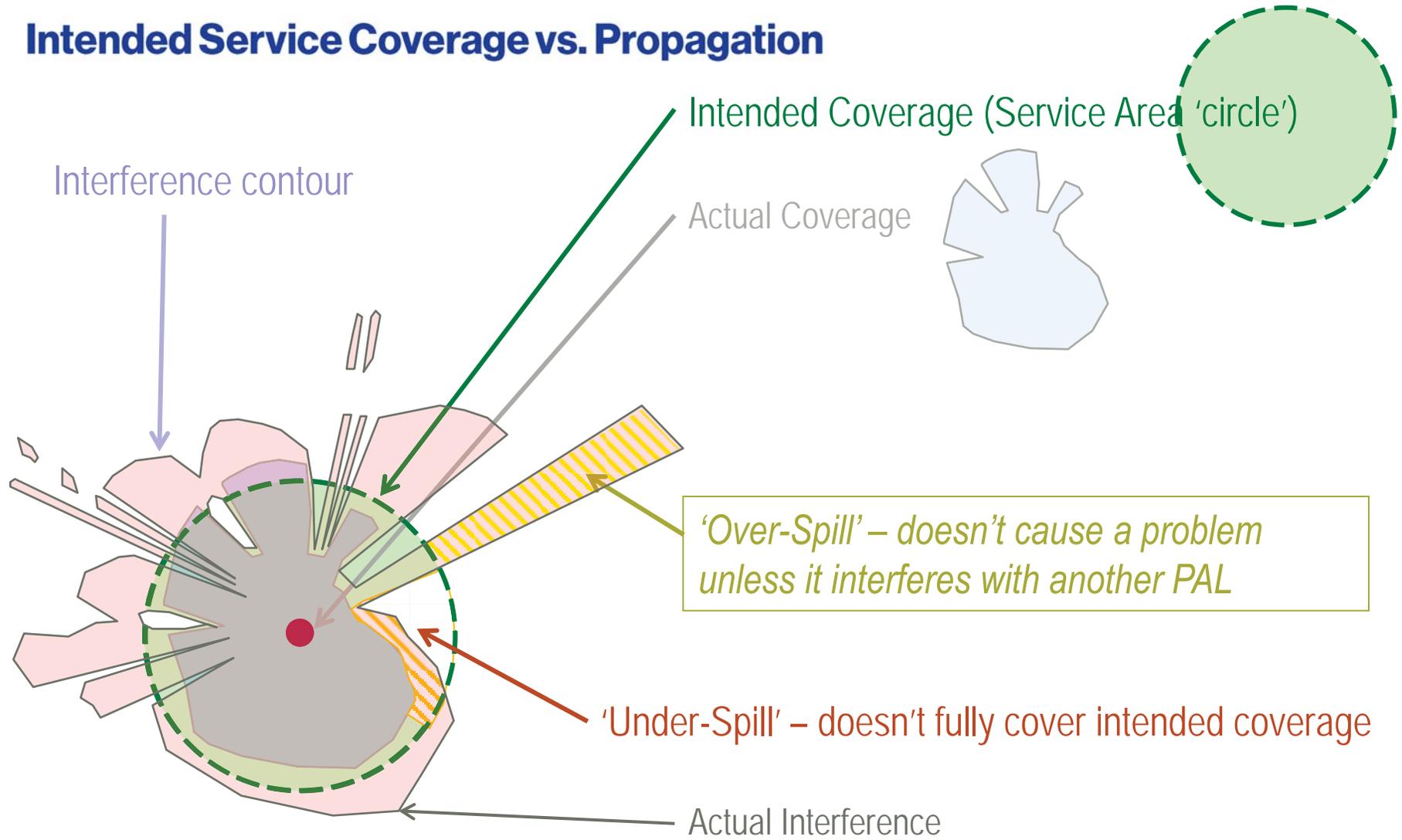
RF Propagation or RF Propagation Modeling creates 'realistic' irregular Contours

- This may be to a **coverage level** (say Reference Sensitivity of - 90 dBm)
- This may be to an **interference level** (say -105 dBm)

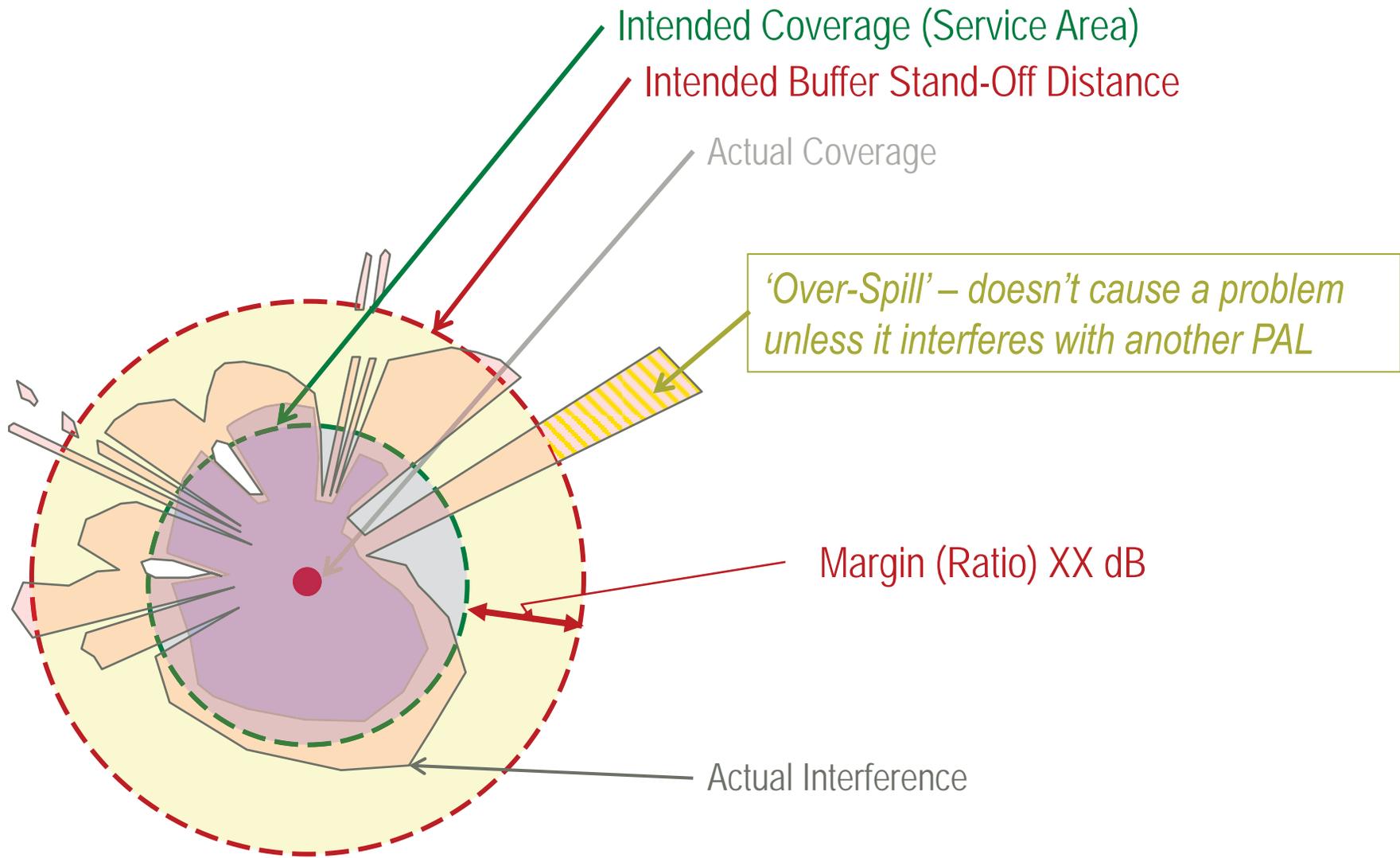


- Machine calculated RF Propagation Model:
- Shape is irregular
 - Shape is non-contiguous
 - Shape may have internal gaps
 - Shape is model specific
 - Shape is clutter specific
 - Shape is emplacement specific
 - Shape is not based upon coverage intent

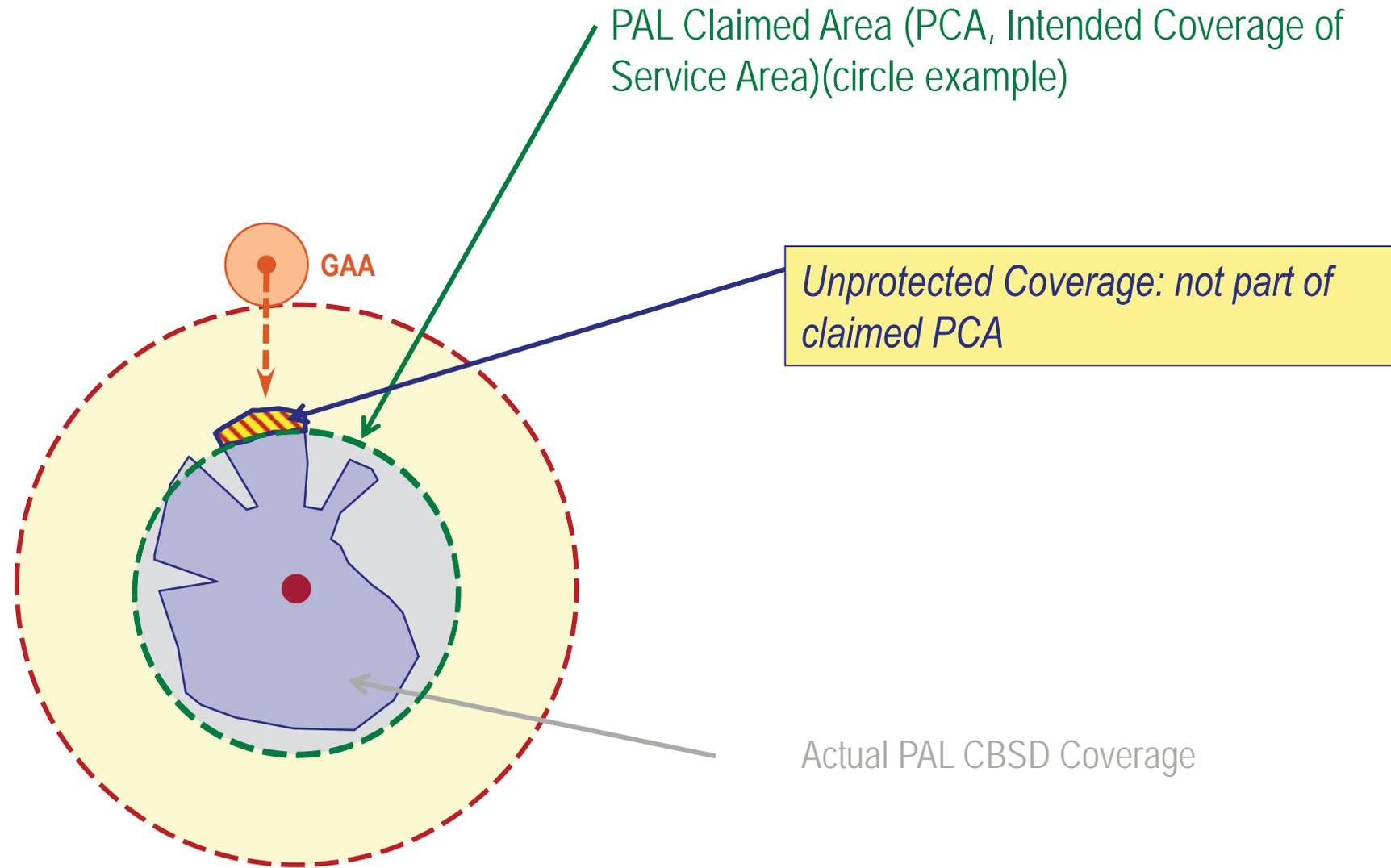
Intended Service Coverage vs. Propagation



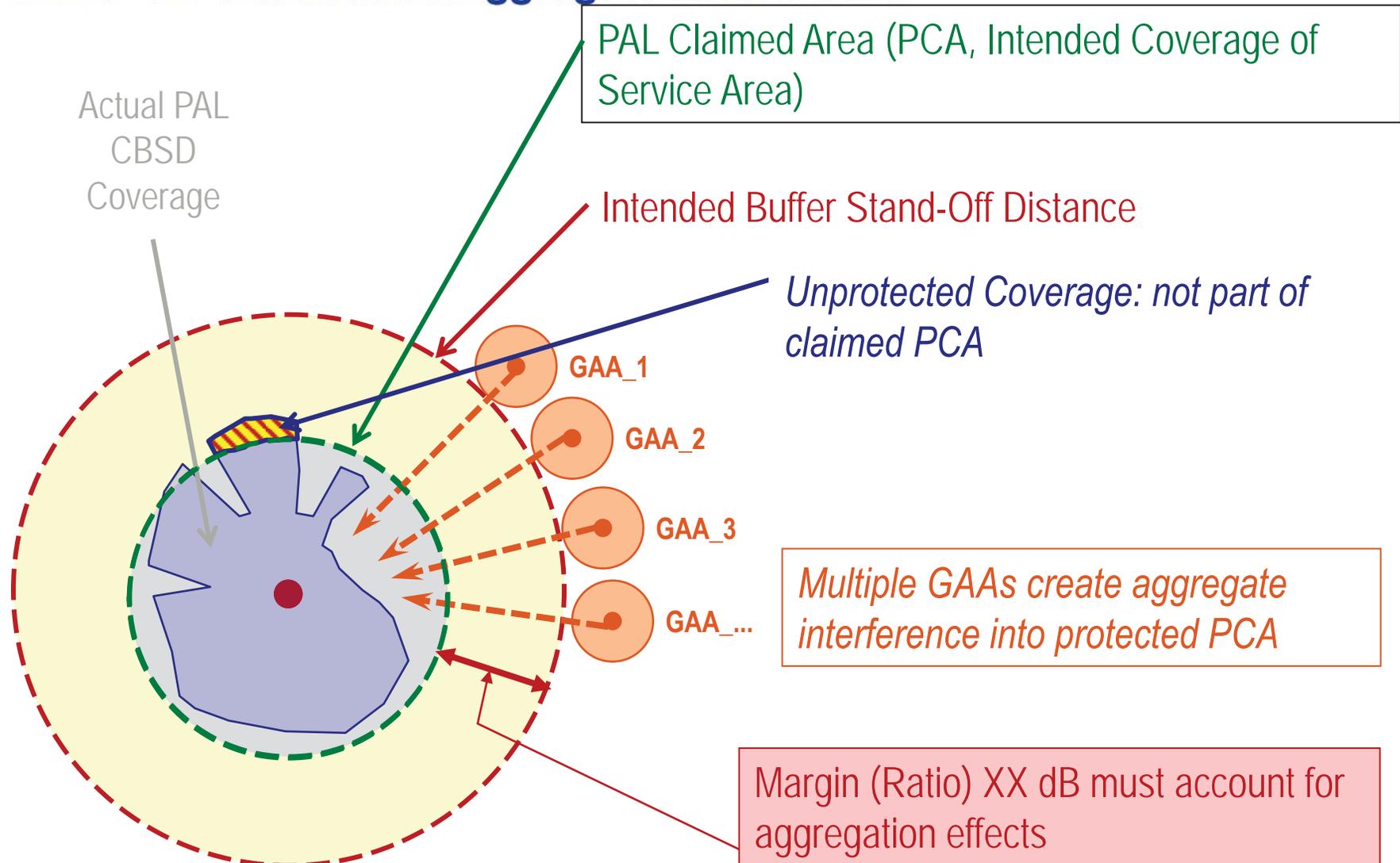
Intended Buffer Zone vs. Propagation



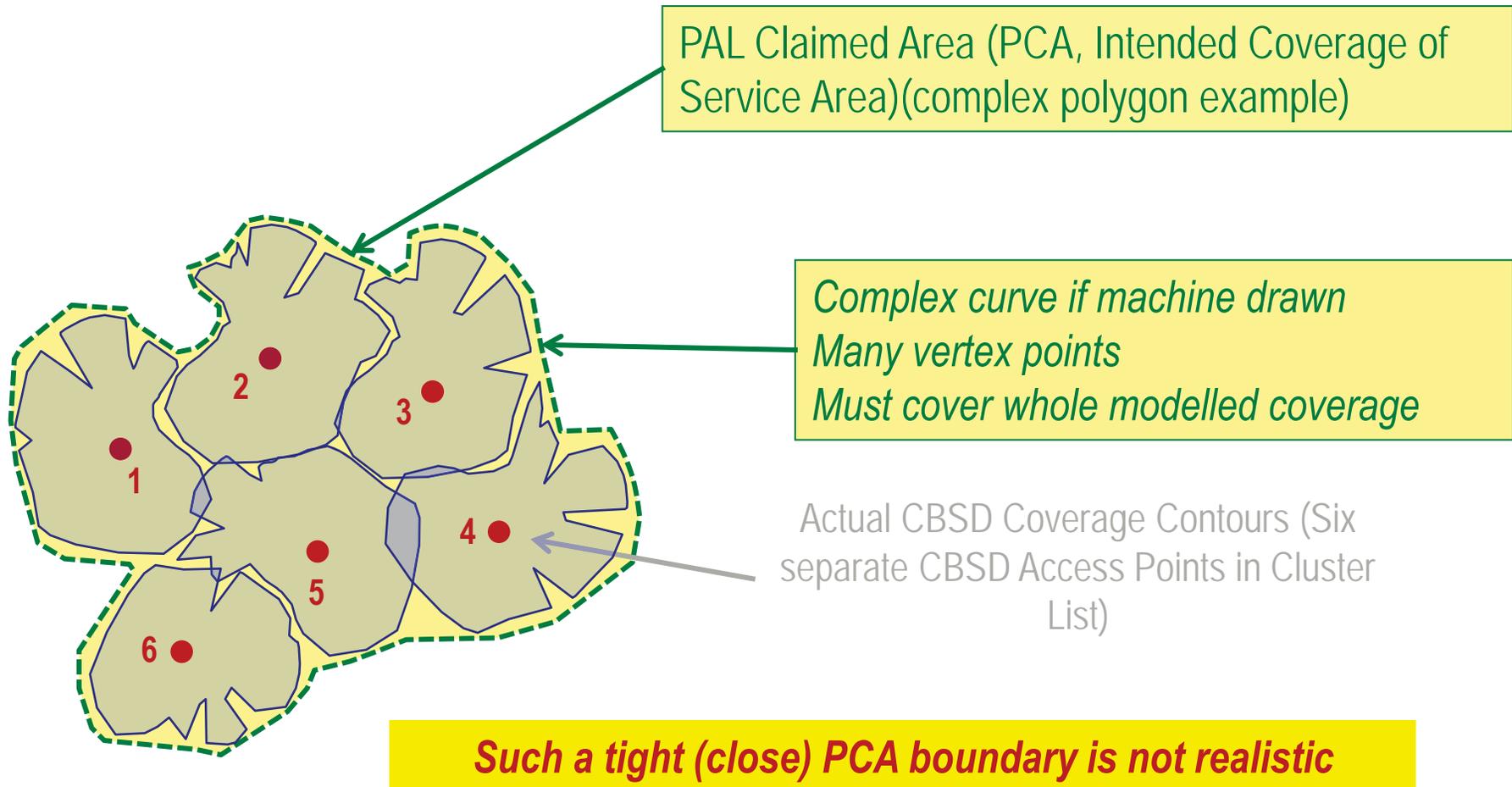
Beyond PCA Claim, PAL coverage need not be protected by SAS



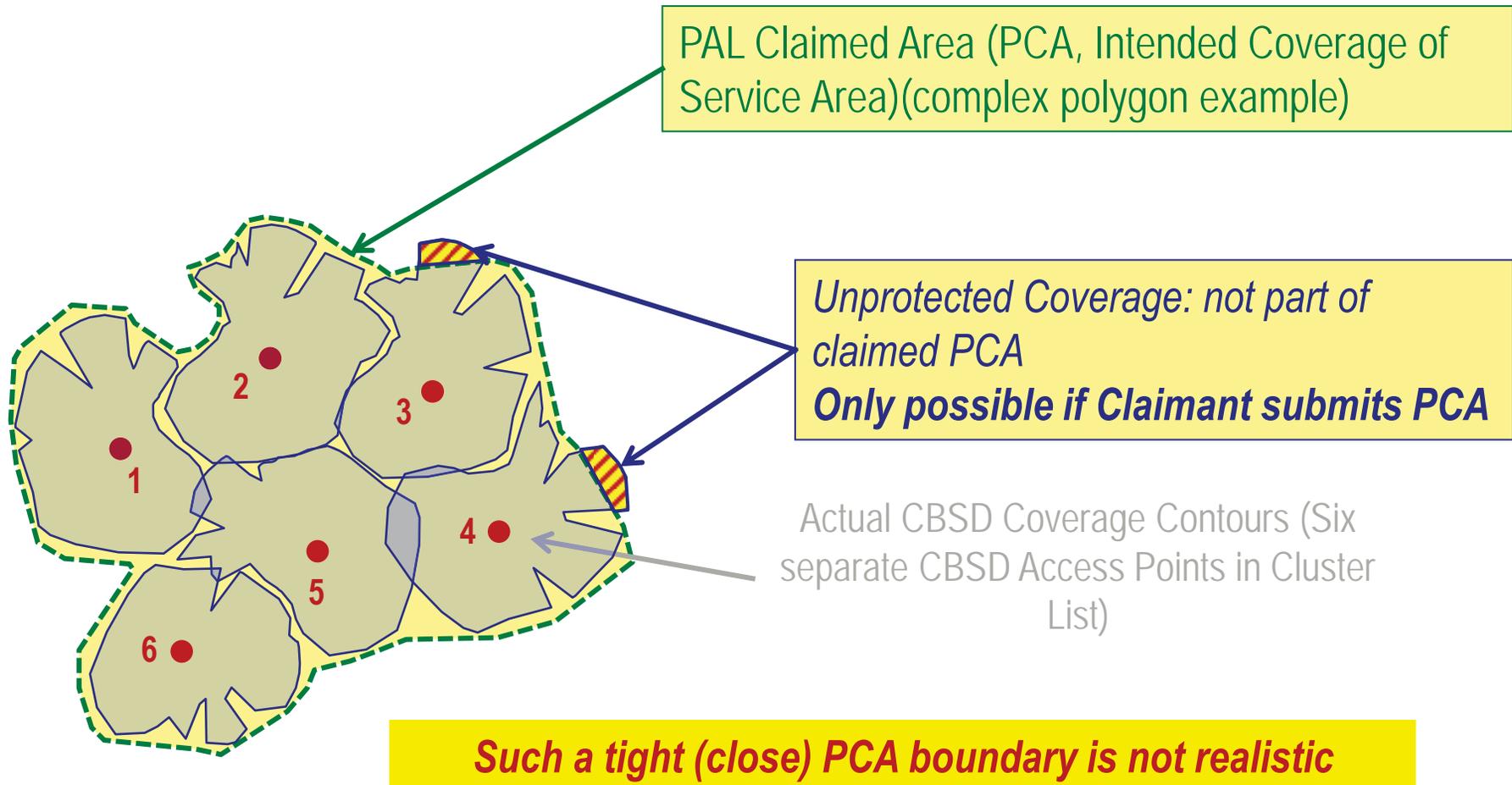
Stand-Off to GAA use & Aggregate Interference



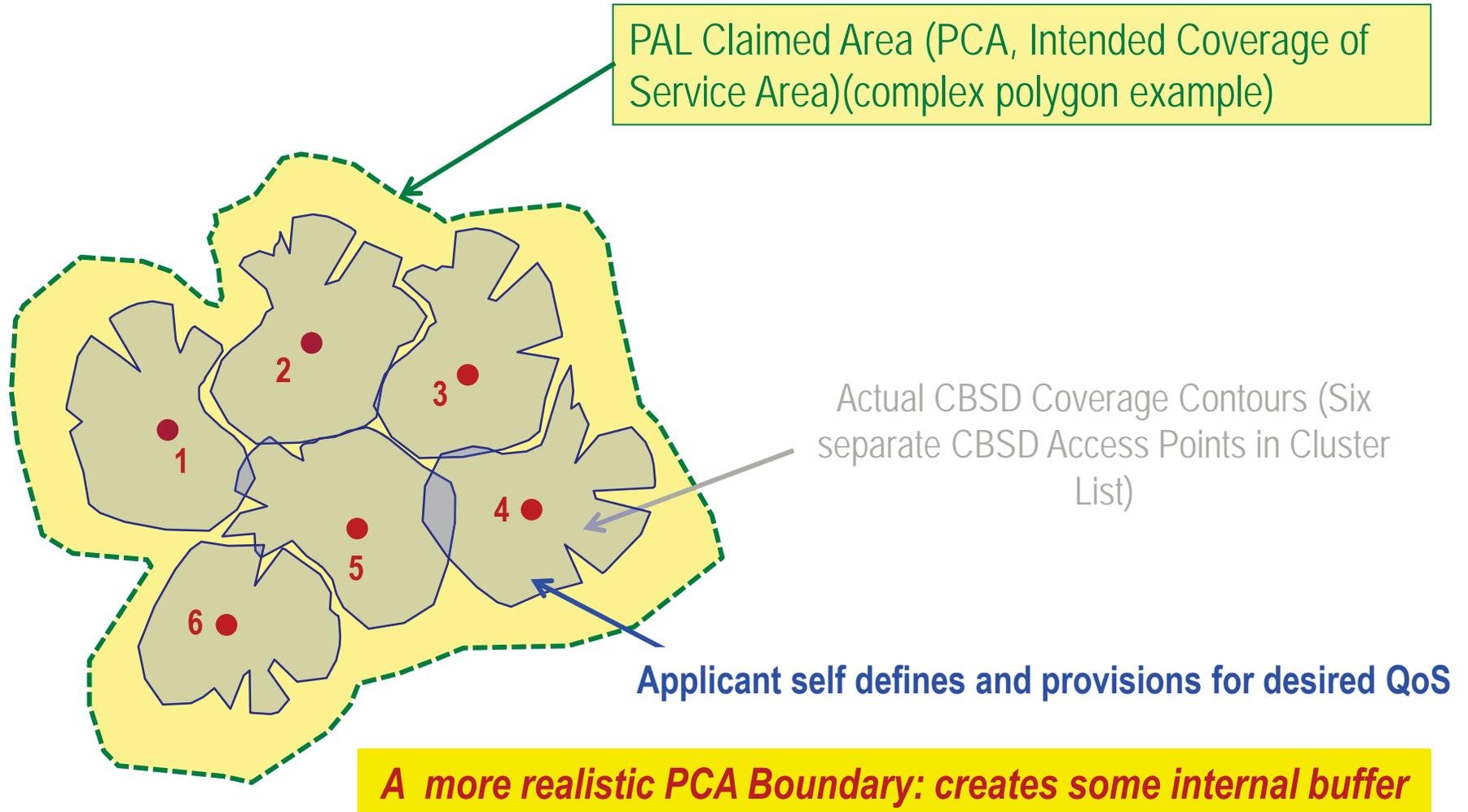
A Polygon PCA Claim with CBSD Cluster List (1 of 4)



A Polygon PCA Claim with CBSD Cluster List(2 of 4)

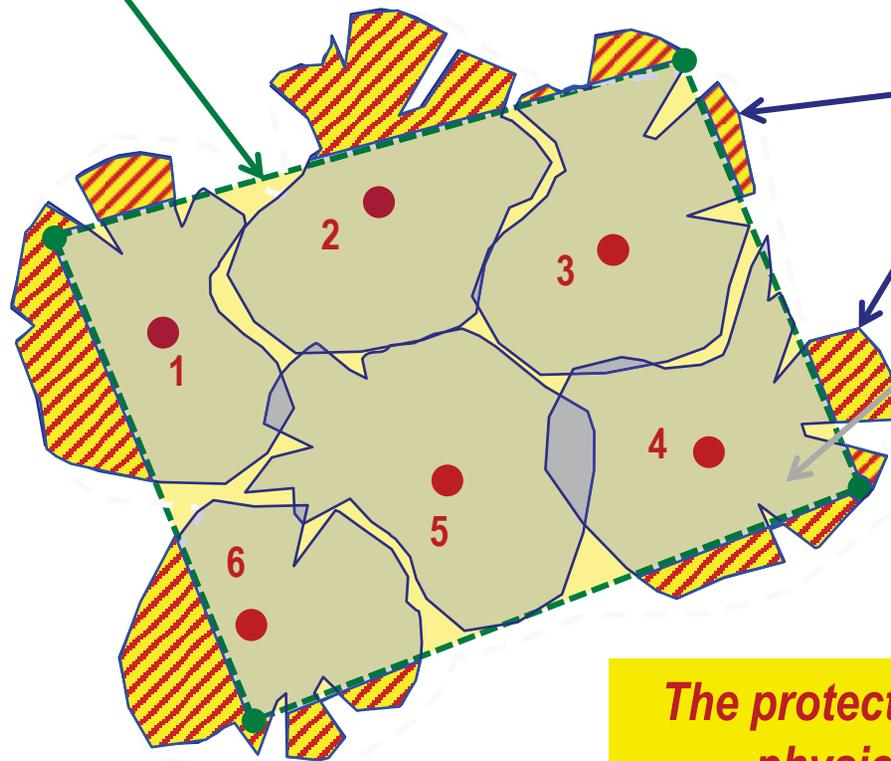


A Polygon PCA Claim with CBSD Cluster List: More realistic (3 of 4)



A Polygon PCA Claim with CBSD Cluster List: Most realistic (4 of 4)

PAL Claimed Area (PCA, Intended Coverage of Service Area)(complex polygon example) (Defined by N Vertex points): **Claimant Defined**



Unprotected Coverage: not part of claimed PCA

Actual CBSD Coverage Contours (Six separate CBSD Access Points in Cluster List)

A more realistic PCA Boundary corresponds to a physical space: parking garage, etc.

The protected PCA should correspond to something physically meaningful: not RF propagation.

Issues: Desire of Claimant, Definition, Conveyance, Rational, Enforcement

PCA Coverage Areas

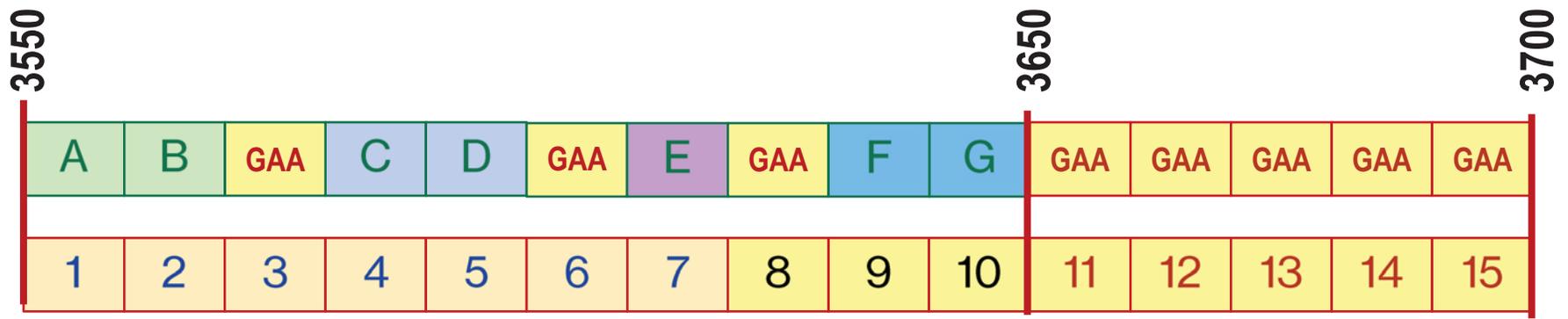
PAL Licensee Claimants submits 'Rational' polygon definition of intended protection area

- **Polygon corresponds to meaningful 'political' boundaries (property lines, etc) - not irregular RF propagation modeling results**
- **Corresponds to real 'intended' coverage – spillover need not be protected**
- **Corresponds to a submitted CBSD cluster list**
- **SAS may 'vet' the applicants' claims for adequate coverage: prevent overclaiming**
- **Still allows for independent Radio Network Planning, service differentiation**

Other have proposed that the SAS Machine use RF Propagation modeling tools to determine aggregate CBSD multi-cell coverage and have the SAS define the protection boundary

- **This creates irregular, hard-to-convey, and meaningless protection boundaries**
- **Conveyance problems**
- **Enforcement problems**

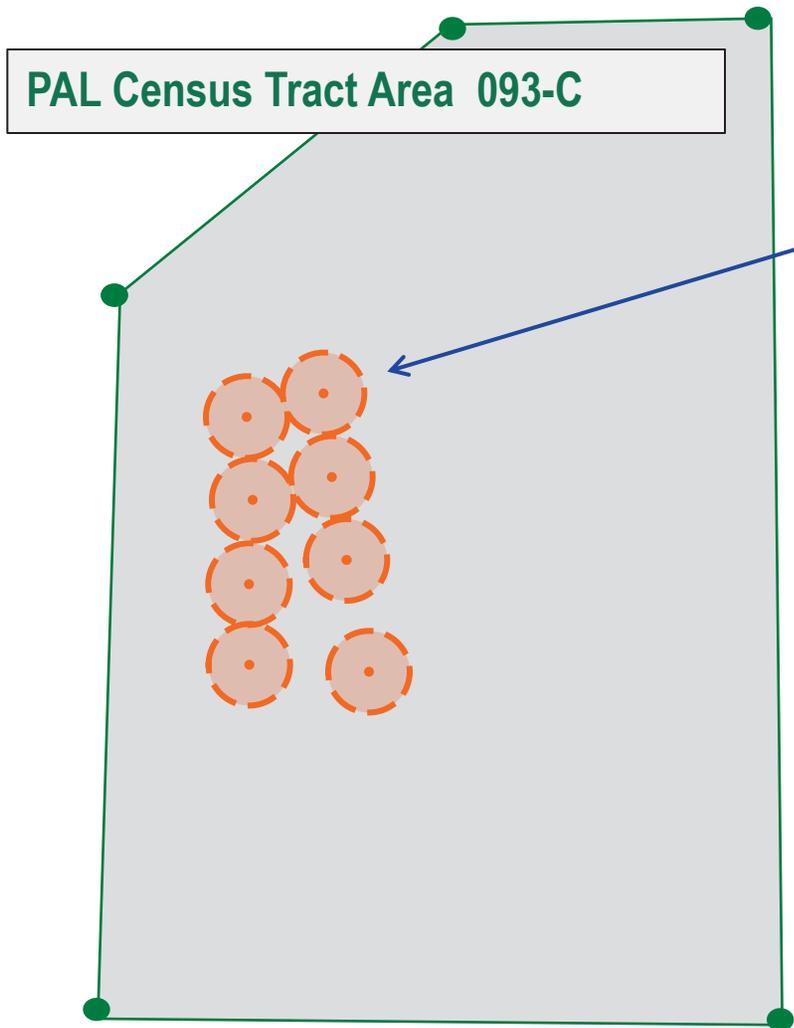
Use of PAL channels in dense crowded areas: Use of Guard Band GAA channels



- In Best case scenario, SAS can properly pack PAL channels together and intersperse GAA channels as guard bands within first 10 MHz and still create all 'seven' PALs (A – G)
- **Example:** Carrier I = A+B, Carrier II = C+D, Carrier III = E, Carrier IV = F+G Totals = 7 PALs
- The created interstitial three **GAA** guard bands are NOT USED by GAA, PAL use has priority
- Many scenarios of channel use possible
- Many channel use scenarios (if greater number of owners, and fewer adjacent pair PAL channels used for 20, 30, or 40 MHz wide channels) – no way for SAS to pack and allow for interstitial guard bands between different owner PAL channels
- Conclusion: in some cases, SAS cannot allow all possible 7 PALs to be used in same Tract

Engineering a PCA Coverage Area

(1 of 6)



PAL Licensee buys/acquires PAL rights to 093-C

PAL Licensee defines sub-area within PAL to be covered by laying down proposed CBSD locations

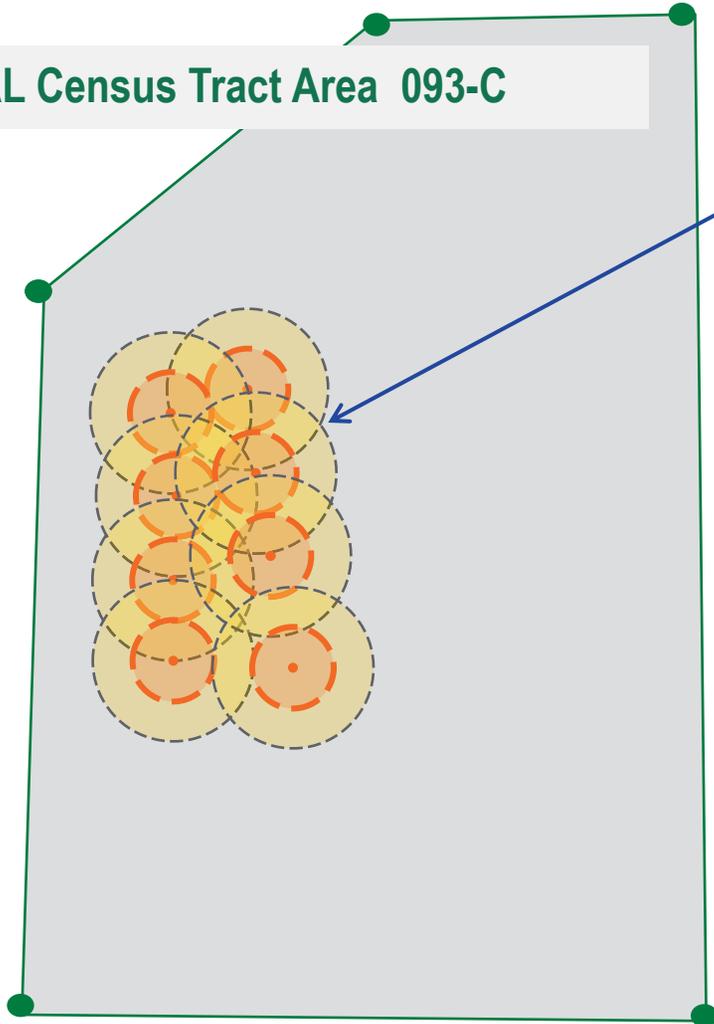
Licensee places CBSDs at appropriate inter-site spacing to accomplish coverage goals

Example: Eight CBSD Access Points

Engineering a PCA Coverage Area

(2 of 6)

PAL Census Tract Area 093-C



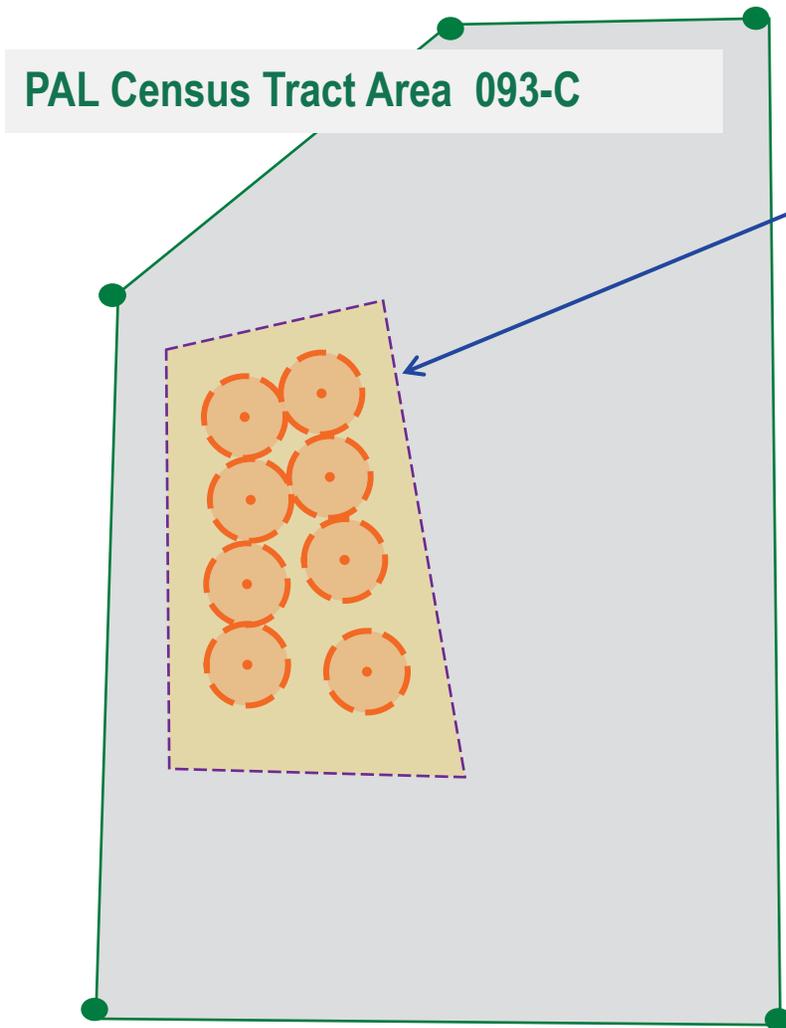
Claimant engineers coverage considering:

- Required SNR (sensitivity thresholds)
- Requires SIR (Interference)
- QoS & coverage may be 'below' -80 dBm
- Handoff between cells
- Interference Management between Cells

Licensee engineers handoff zones and QoS by establishing appropriate RF levels 'between' the CBSDs

Engineering a PCA Coverage Area

(3 of 6)

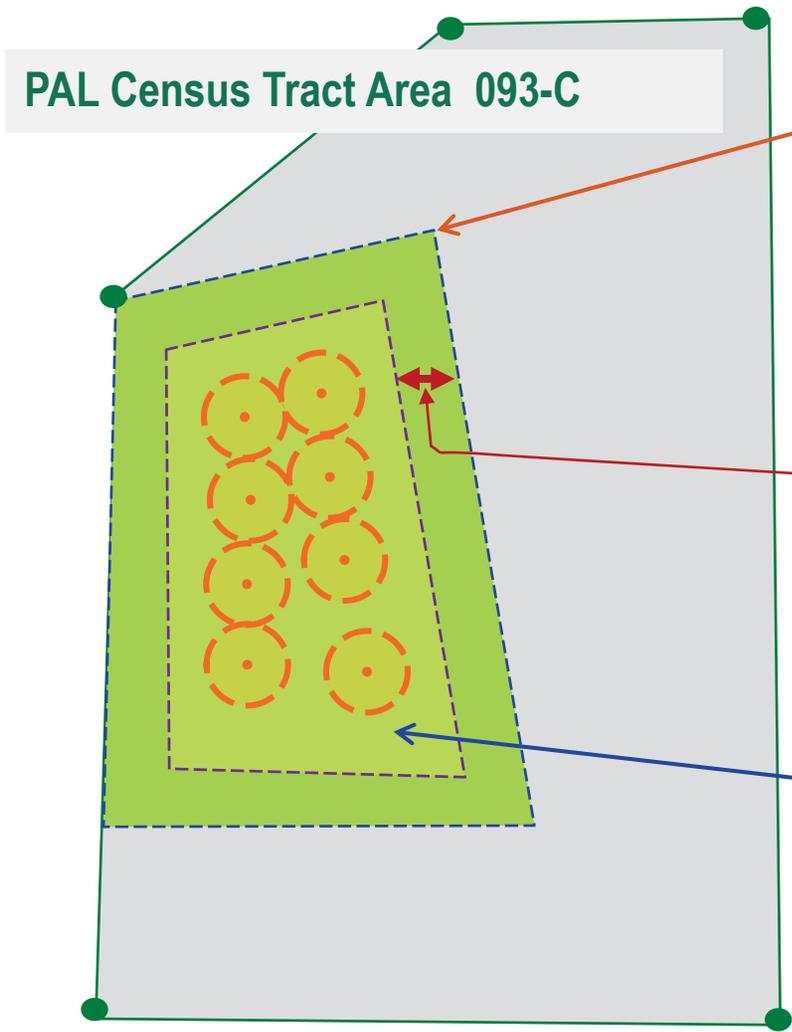


Licensee establishes the actual service coverage zone that meets the desired QoS serving metrics

These will later define the internal 'stand-off' margin to the external -80 dBm SAS protected Boundary

Engineering a PCA Coverage Area

(4 of 6)



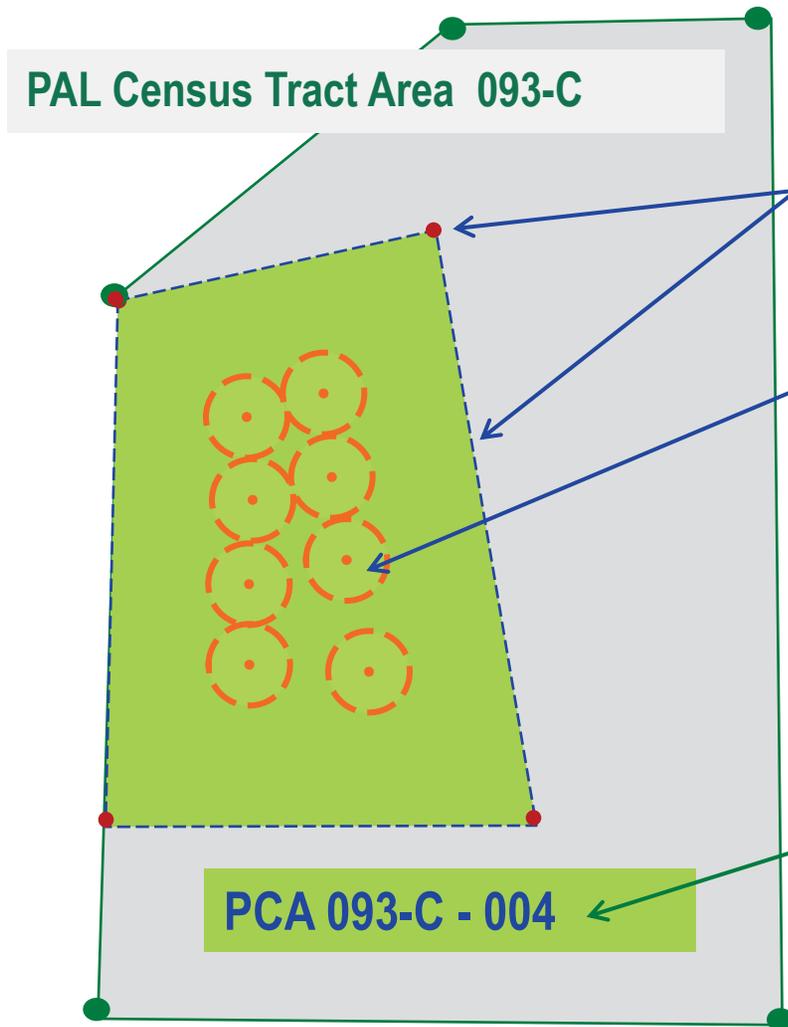
Licensee establishes the actual PAL Claimed Area (PCA) that is desired for the -80 dBm external interference level that the SAS will enforce

This may include an appropriate 'internal' stand-off margin to achieve the internal QoS level desired by the claimant to properly protect the internal service zone

Note that the claimant may wish to operate at levels below the boundary -80 dBm at locations interior to the PCA boundary

Engineering a PCA Coverage Area

(5 of 6)



PAL Licensee (Claimant) defines the PCA boundaries and vertex points for the PCA claim to the SAS

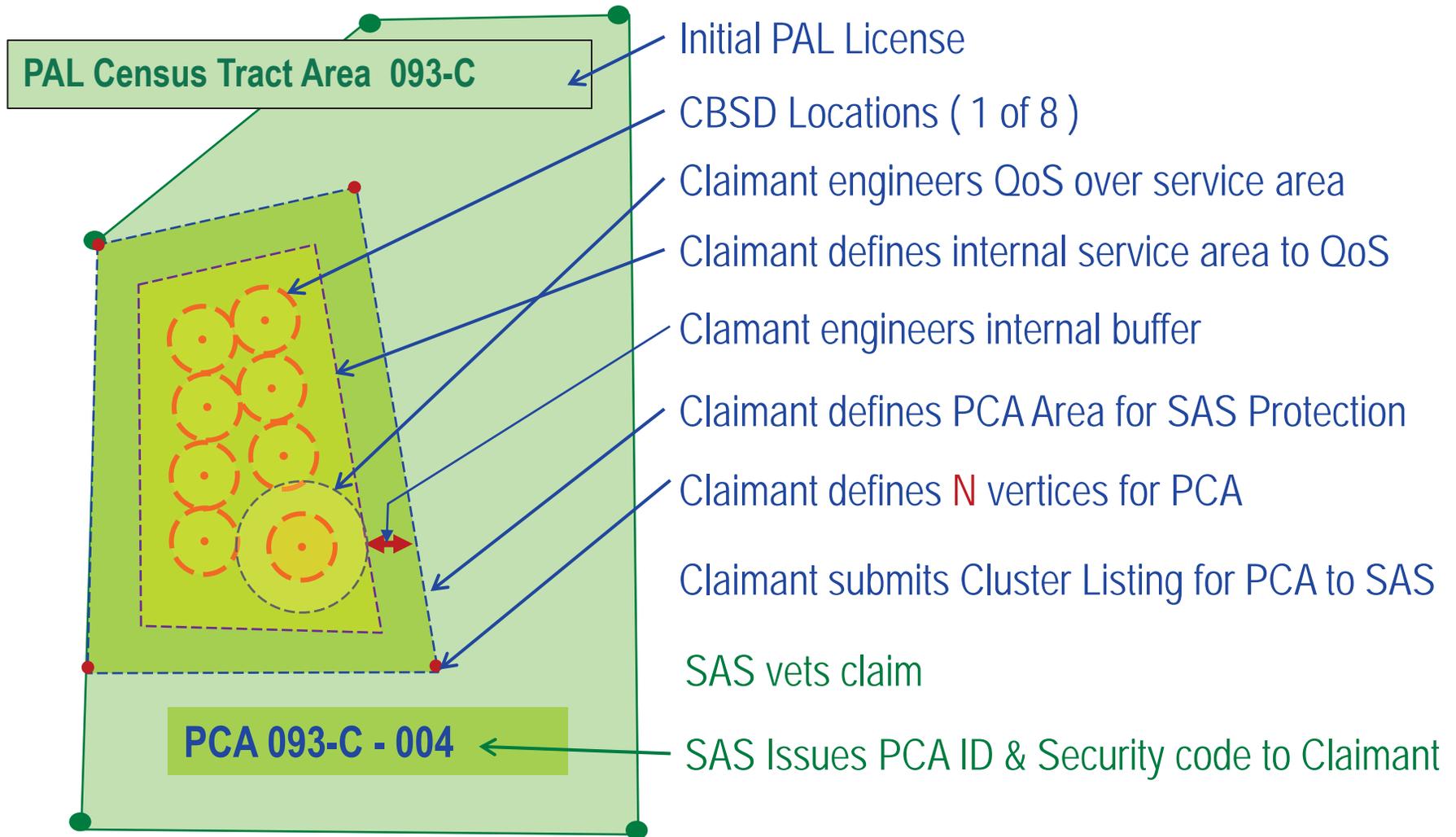
Claimant submits the CBSD 'Cluster List' to the managing SAS

The SAS uses the Cluster List to check and vet the coverage for the claimed PCA area to ensure adequate coverage (to some metric)

SAS issues the PCA ID (credential) and security (self authentication) feature to the claimant

Engineering a PCA Coverage Area: Review

(6 of 6)



Managing SAS vets PCA Claims

PAL licensee is Claimant who defines sub-area to be protected within valid PAL

Claimant defines PCA area (area definition) within owned PAL license

Three methods:

Polygon defined by claimant with N vertex points: for areas containing one or more CBSDs

Circle (center and radius) defined by claimant: for areas containing only one CBSD

Circle (center and radius) defined by managing SAS: simplified method for areas containing only one CBSD

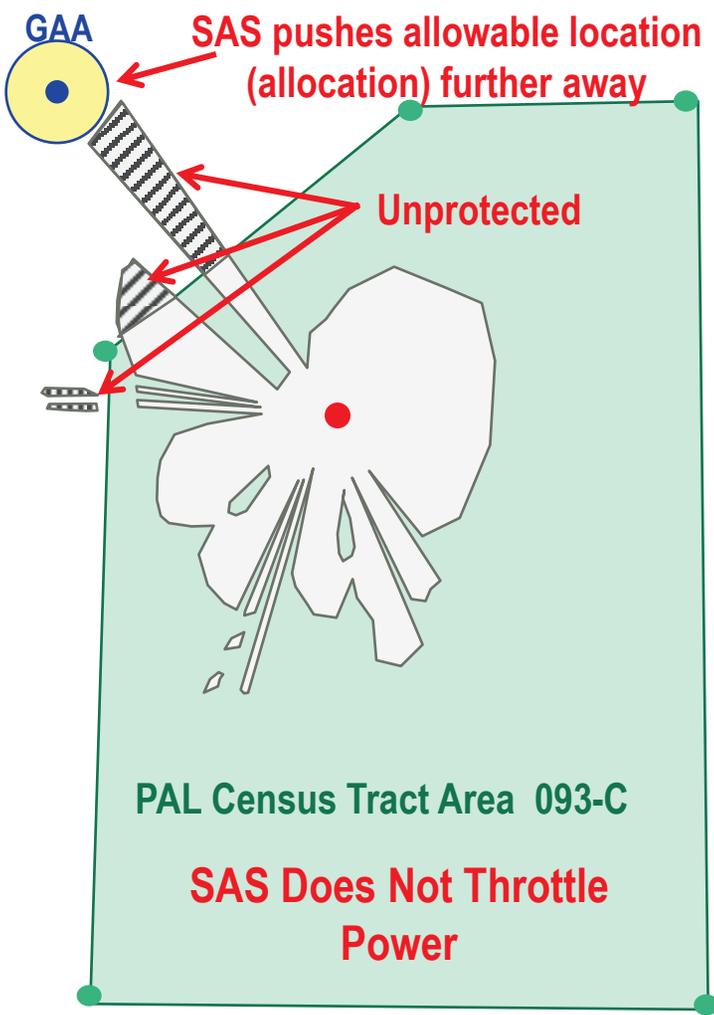
Claimant provides 'Cluster List' of CBSDs that cover intended PCA area

Managing SAS checks that covered area meets target metric

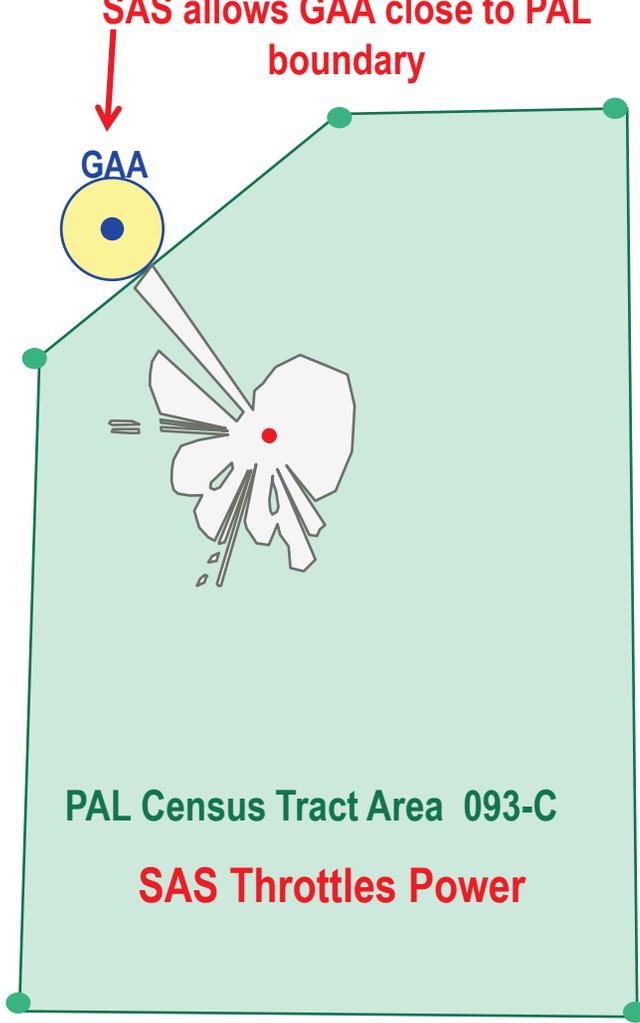
To prevent unsupported extravagant PCA claims

Managing SAS issues PCA credentials: PCA-ID, authentication code,...)

PAL interference may go beyond PAL Boundary

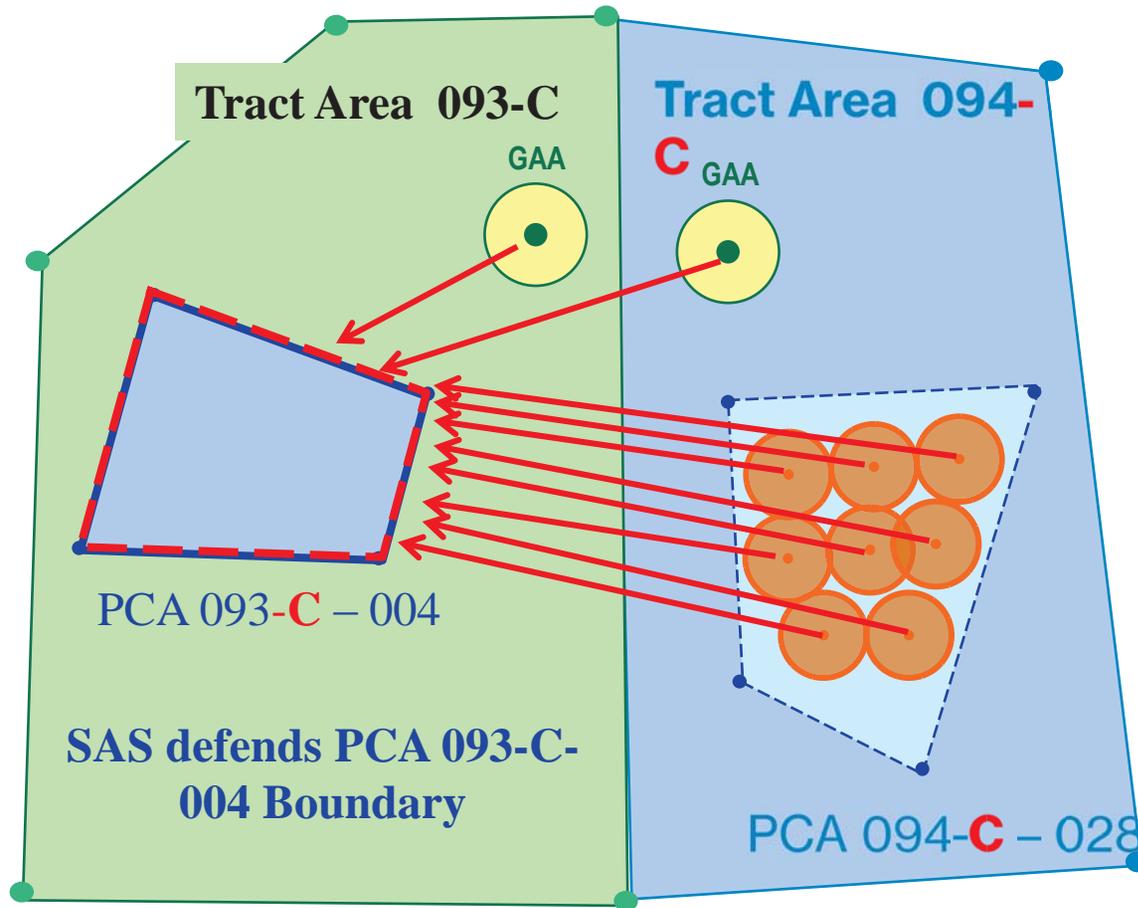


SAS may Throttle CBSD EIRP



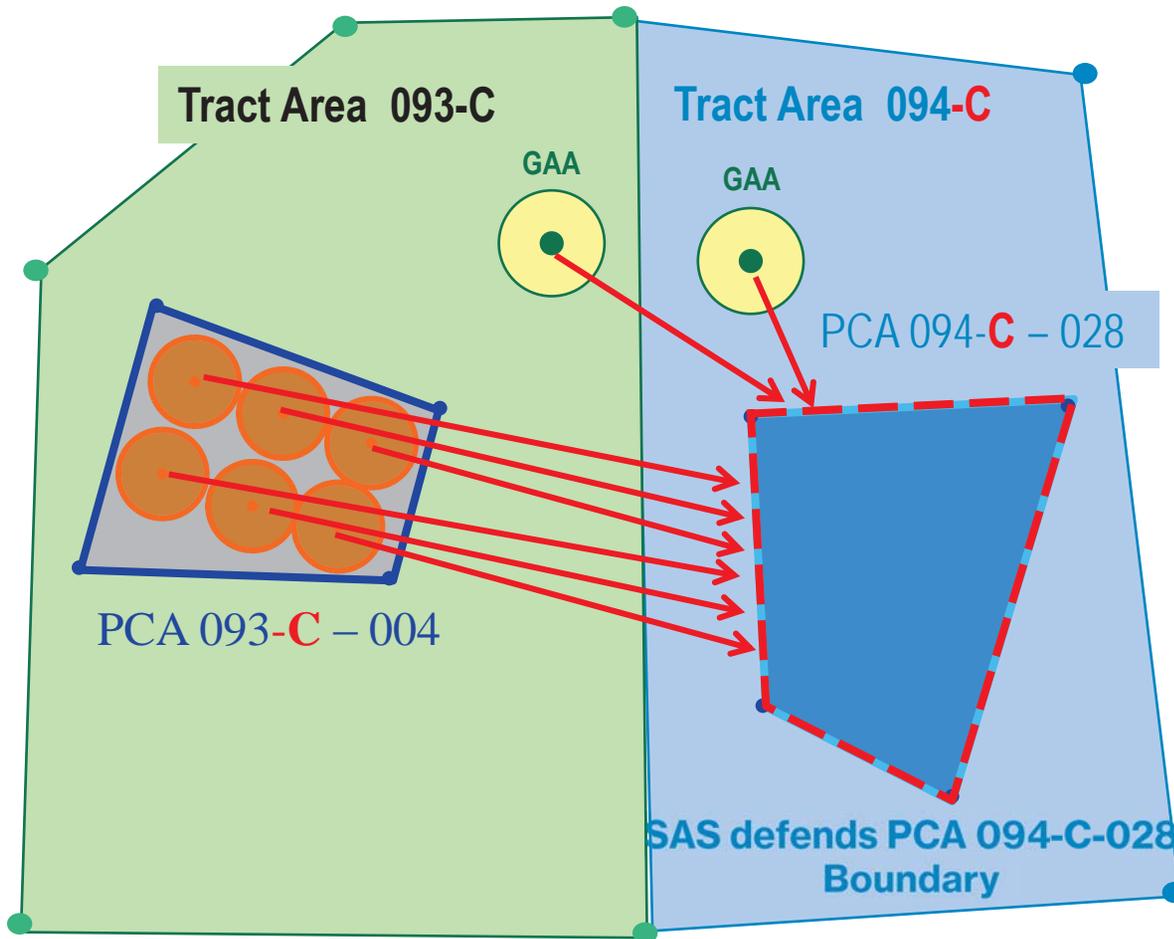
SAS analyzes interference to Allocate Channels:

1) Protect PCAs from INBOUND interference



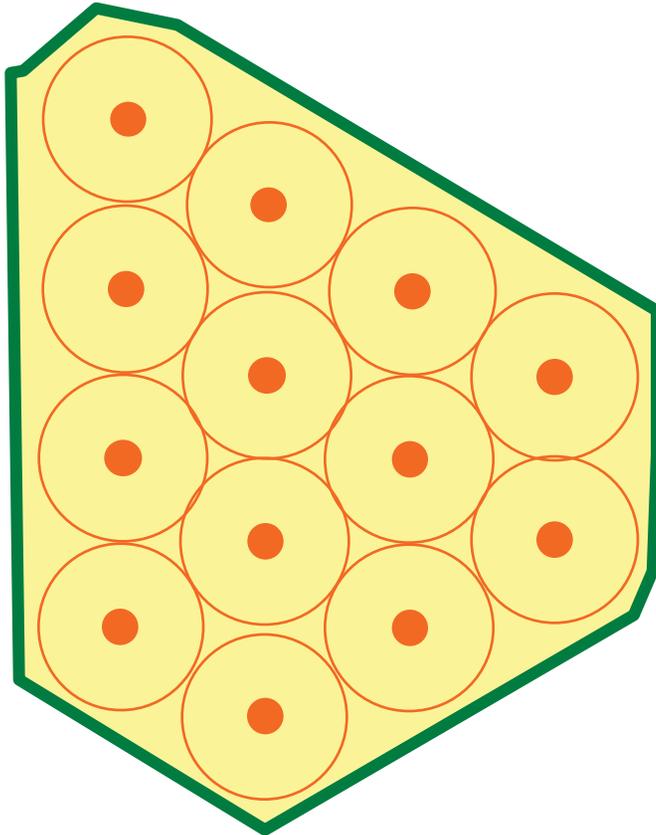
- Co-channel on 'C'
- 094 has different PAL owner than 093
- SAS Defends **093** PCA Boundary
- SAS need not know **093** CBSD Victim Receiver Locations
- SAS must know CBSD Potential Interferer Transmitter Locations

SAS analyzes interference to Allocate Channels: 2) Protect other PCAs from INBOUND interference



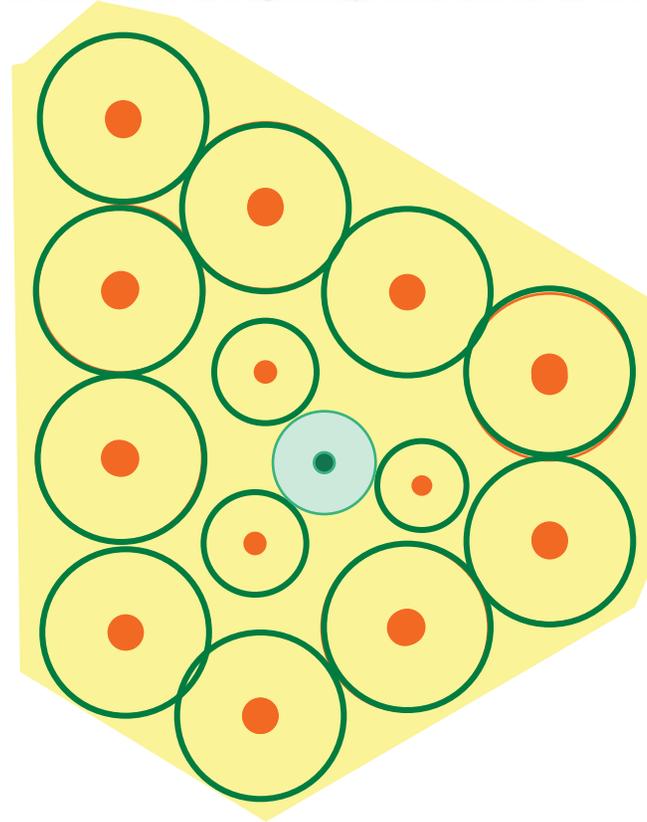
- Co-channel on 'C'
- 094 has different PAL owner than 093
- SAS Defends **094** PCA Boundary
- SAS need not know **094** CBSD Victim Receiver Locations
- SAS must know CBSD Potential Interferer Transmitter Locations

PAL provider coverage intent



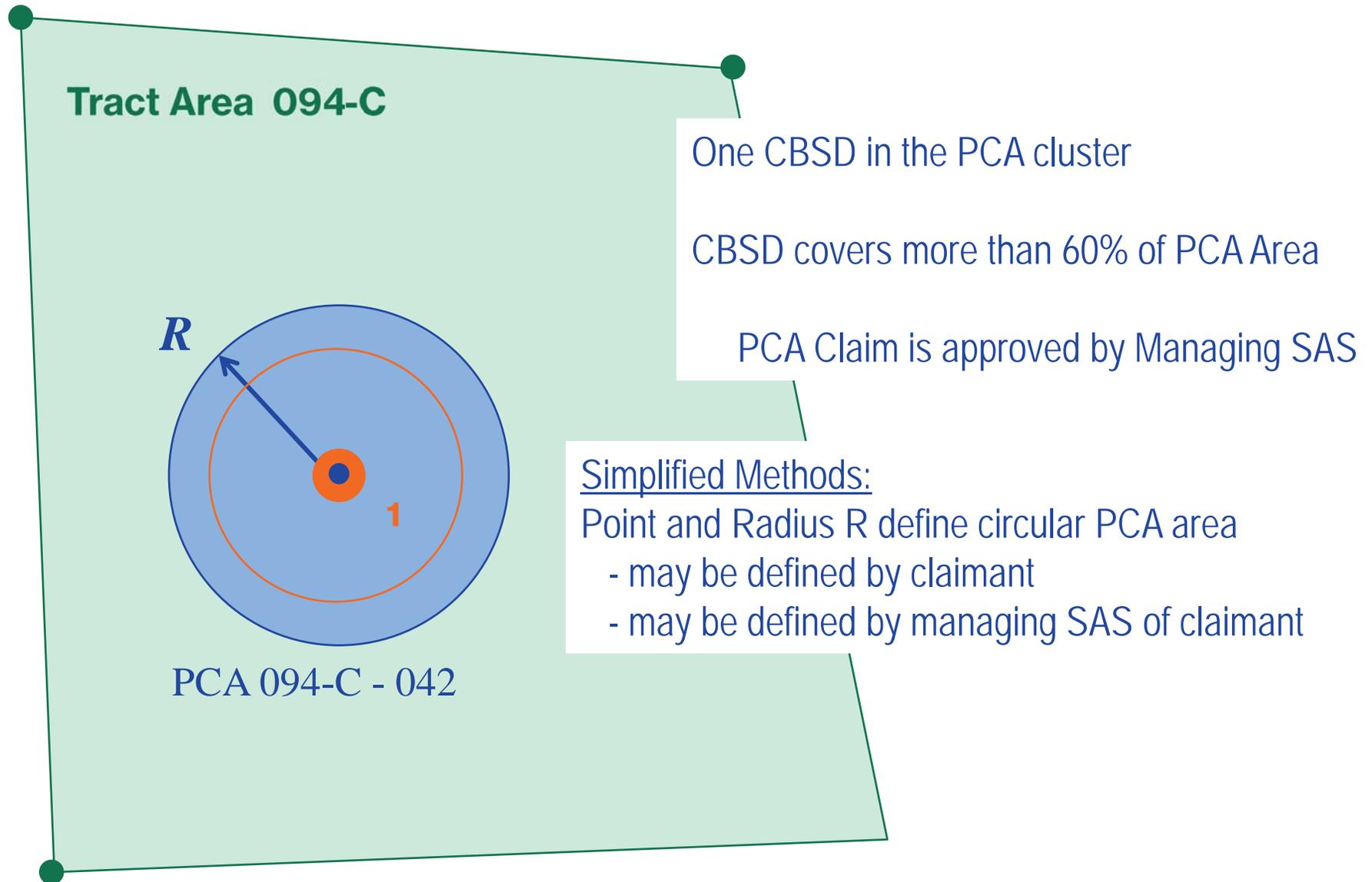
SAS protects PCA Boundary
PAL Licensee engineers the RAN
QoS in intercell space

SAS has right to power throttle
Opportunistically Squeeze in a GAA?



SAS protects each CBSD
Individually
with right to power throttle
NOT THE RIGHT INTENT

Simplified Method: Center Point and Radius defined PCA area



Use of PCAs to sub-divide PAL into useful segments

