Spectrum Access System: Managing Three Tiers of Users in the 3550-3700 GHz Band

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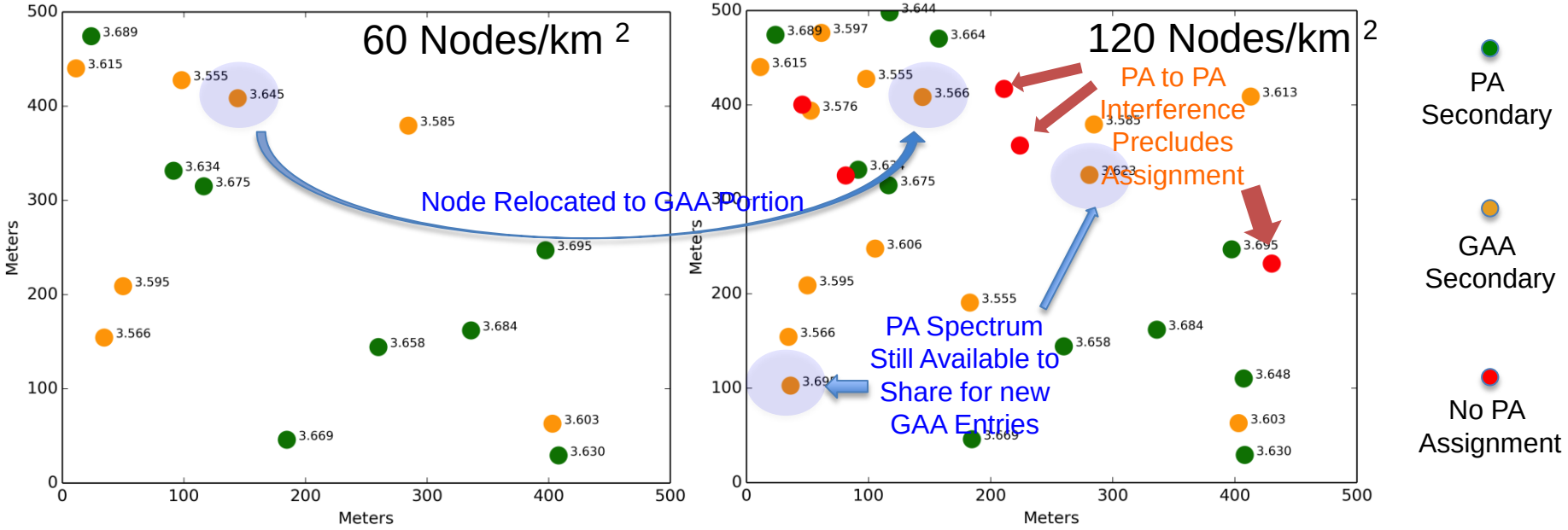
Spectrum Access Systems Revolutionize Spectrum Management

- A 3-tier framework provides maximum flexibility to adapt to user and service needs through diversity of providers and technologies.
  - Examples include CMRS, premises-based Wi-Fi, and carrier Wi-Fi offload.
- Google prototype SAS:
  - Protects federal incumbents from secondary users and protects Priority Access (PA) from GAA interference.
    - Uses the same technology to protect federal incumbents and PA users. (No additional technology challenges are presented by implementing third tier of access.)
  - Accounts for aggregation effects.
  - Protects from co-channel and adjacent channel interference.
  - Accounts for in-channel and out-of-band emissions.
  - Support technology-specific optimizations between spatially and spectrally adjacent users. (For example, ASA/LSA systems can be used within protection perimeters of PA licensees.)

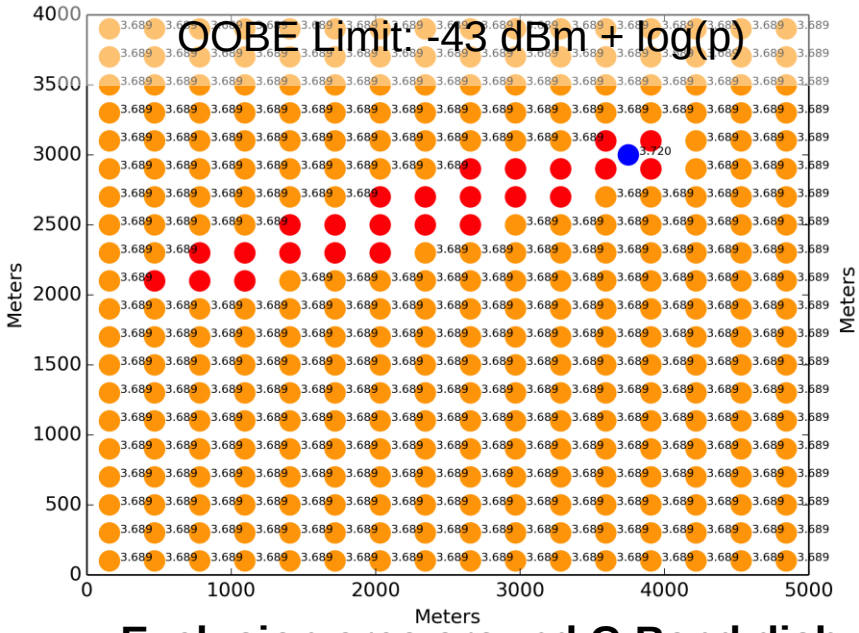
SAS Manages Multiple Tiers with “Use it, or Share it” Principles

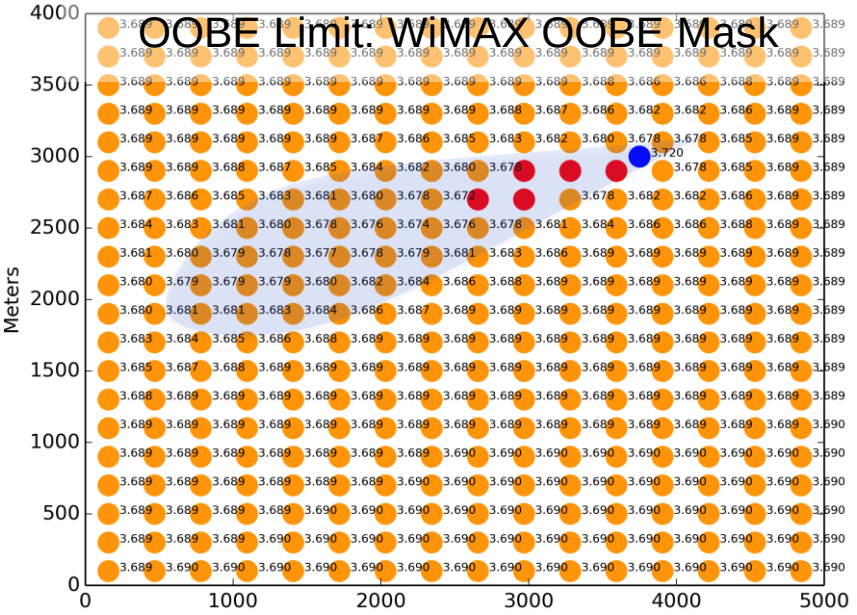


- PA nodes have protected status in upper 50% (above 3.625)
- GAA nodes use entire 150 MHz band and are scattered randomly throughout
- All PA users provided an assignment
- PA Status determined through exclusivity-driven micro-auctions, if necessary

- 3 GAA nodes relocated to de-conflict with PA users
- Several GAA users can still use the full band without conflict with PA users
- 5 PA users not provided an assignment due to conflicts with other PA users
- Unassigned PA users can either use GAA spectrum or can adopt coexistence technologies

SAS Reflects and Incentivizes Improved Device Performance





C-band installation

GAA secondary

No secondary assignment

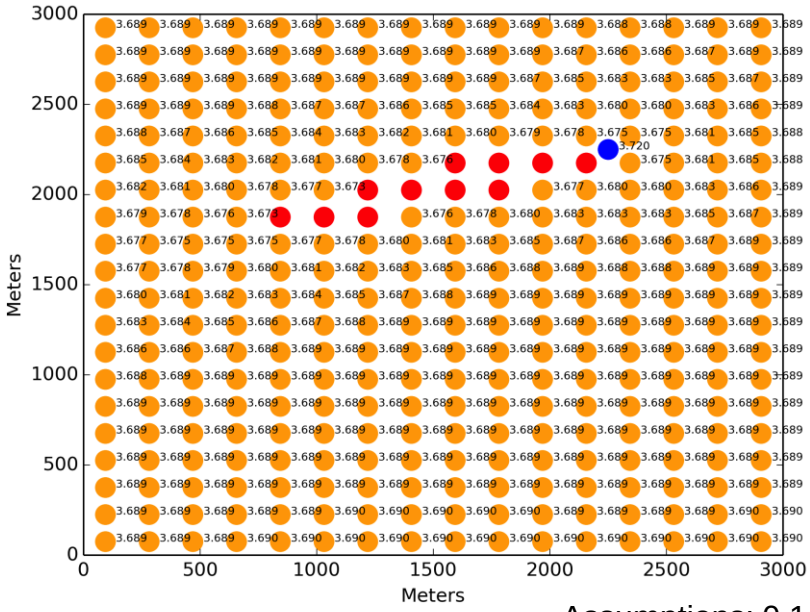
Exclusion area around C-Band dish with 5 degree elevation angle in 3.55 to 3.7 GHz

- Using actual out-of-band emissions shape reduces rejected nodes by factor of five
- Shaded area represents assignments that become possible when SAS uses actual WiMAX mask
- Maximum frequency is adjusted based on secondary users filter skirts

SAS Enables Aggregation Protection

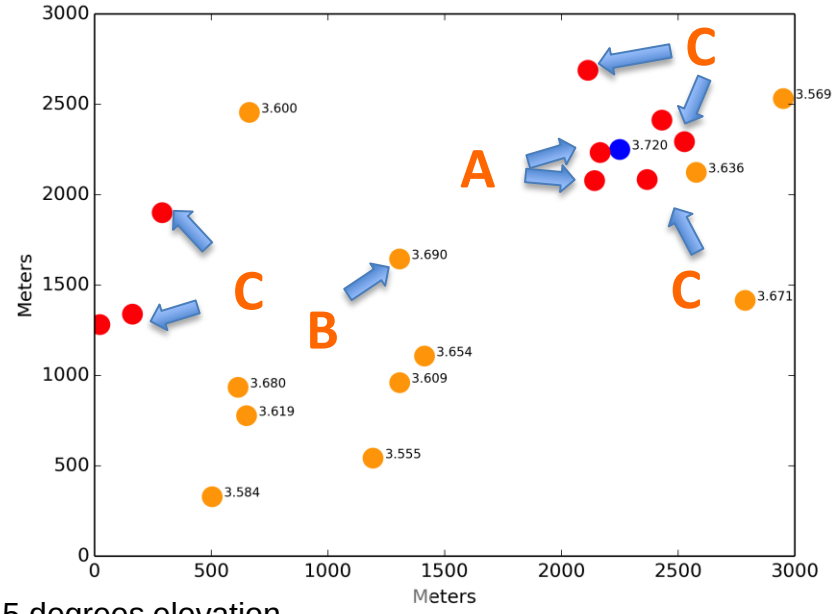
Without aggregation

- Using same C-band example, the out of band emissions from a single, individual node would be acceptable in any orange position.
- Only nodes in red positions would be precluded.



Accounting for aggregation

- A nodes would not have been valid, even singly.
- Node B consumed most of the incumbent out-of-band interference tolerance, so C Nodes are excluded, protecting the primary user.



Assumptions: 0.1 I/N threshold, 5 degrees elevation

All SASs Should Perform Several Basic Functions; Enhanced Capabilities Optional

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Mandatory SAS Functions

- Federal incumbent protection
- Assignments for PA users
- Assignments for GAA users
- Offer alternative spectrum to PA users displaced by federal incumbents
- Offer alternative spectrum to GAA users displaced by incumbents and PA users

Optional Enhanced Capabilities

- Negotiate/facilitate co-existence among PA users
- Identify opportunities for co-existence among GAA users
- Incorporate device-specific characteristics when calculating interference protection and making assignments

Mandatory and Optional SAS Functions Can Be Integrated into a Cohesive Workflow