

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, D.C. 20554

In the Matter of

Amendment of the Commission's Rules  
with Regard to Commercial Operations in  
the 3550-3650 MHz Band

GN Docket No. 12-354

**GOOGLE INC. RESPONSE TO CALL FOR PAPERS  
ON PROPOSED SPECTRUM ACCESS SYSTEM**

Austin Schlick  
*Director, Communications Law*  
Aparna Sridhar  
*Counsel*  
**GOOGLE INC.**  
1101 New York Avenue, NW  
Second Floor  
Washington, DC 20005  
(202) 346-1100

January 3, 2014

## **I. Introduction.**

The Commission's proposal to enable shared use of the 3.5 GHz band for commercial broadband is an important part of a broader effort to meet the rapidly growing demand for wireless bandwidth. In order to maximize use of this band, the Commission should set high-level rules for dynamic Spectrum Access Systems (SASs), which will coordinate access among and within different classes of users. As a general matter, these high-level rules should establish baseline criteria for interference protection while encouraging innovation in the development of SASs, free from regulatory micro-management. Below, Google sets forth specific responses to the Commission's recent Public Notice calling for comments regarding the technical requirements, architecture, and operational parameters of SASs.<sup>1</sup>

## **II. General Responsibilities and Composition of an SAS: The SAS Should Authorize Priority Access and General Authorized Access Uses and Implement Interference Protection Standards.**

In prescribing rules for the operation of SASs in the 3.5 GHz band, the Commission should focus on the core functionalities necessary to allow multiple tiers of users to operate without unacceptable interference. Any SAS must be able to perform two basic functions: (1) authorize Priority Access and General Authorized Access (GAA) users, and (2) provide interference protection for incumbent and Priority Access users. To perform the latter function, an SAS must be capable of communicating with the federal government to obtain information about federal incumbent operations. Based on this information and registration information from Priority Access users, an

---

<sup>1</sup> Public Notice, *Wireless Telecommunications Bureau and Office of Engineering And Technology Call for Papers on the Proposed Spectrum Access System for the 3.5 GHz Band*, GN Docket No. 12-354 (rel. Nov. 18, 2013) ("Public Notice").

SAS should authorize use and provide protection by relying on baseline interference-protection criteria set by the Commission.

In order to foster innovation and competition among SAS providers, the FCC should permit any qualified database operator to offer these services. Authorizing competitive database operations would be consistent with the precedent the Commission established when it enabled unlicensed access to the television broadcast bands via competitively provided TV white space databases.<sup>2</sup> To ensure harmonious operations with multiple SASs, the Commission should require SAS providers to exchange information regarding protected reservations and the presence of secondary users (both Priority Access and GAA) in the 3.5 GHz band. The parameters for synchronization (such as response times and protected areas) should be dictated by the protection requirements for incumbent and Primary Access systems. For example, the FCC should specify a maximum time between notification of federal incumbent usage and the clearing of commercial users from the protected spectrum.

Beyond these basic requirements, however, further mandates could limit innovation and beneficial differentiation among SASs. So long as Priority Access users are protected from interference by GAA users and federal incumbents are protected from all commercial users in accordance with the Commission's rules, database operators should be free to pursue independent methods of interference protection.

In particular, specific methods of implementing coordinated operations—such as architectural or technological choices or service level guarantees—should be left to

---

<sup>2</sup> *Unlicensed Operation in the TV Broadcast Bands, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, Second Report and Order and Memorandum Opinion and Order, 23 FCC Rcd. 16807, ¶ 204 (2008) (“TVWS Second Report and Order”).

industry. SAS providers likewise should be permitted to provide capabilities beyond baseline authorization and interference protection as a means of differentiating themselves. For example, in order to further improve spectrum utilization, an SAS provider should be permitted to offer additional cooperative interference management, such as LTE interference alignment, timing mechanisms or other means of coordination and coexistence, on an optional basis. At the same time, the FCC's rules for SASs should be technology-neutral, and therefore should not require technology-specific sharing regimes (e.g., sharing methods unique to LTE) as a prerequisite for operating in the band as a secondary user.

Overall, the Commission can best ensure interference protection and foster innovation and investment by establishing baseline requirements and interference criteria, while leaving implementation to industry.

### **III. Key SAS Functional Requirements: An SAS Must Provide Devices Sufficient Information to Operate While Protecting Incumbents; Enhanced Functionality Should Be Optional.**

SASs and devices must meet basic functional and information-sharing requirements in order to maximize use of the 3.5 GHz band. Throughout this discussion, Google uses the term "devices" to include both emitting end-points (e.g., femto-cells or Wi-Fi access points) that will communicate with an SAS, and intermediate levels of network operations that will communicate with an SAS, such as those used by LTE systems to coordinate access points. To be clear, Google does not envision that end-user handsets would communicate directly with an SAS. Rather, such handsets would receive information about available spectrum from their access points.

**Baseline Device Information and Characteristics.** In order to authorize use, an SAS will need to receive the following data regarding a device's proposed use: intended mode of operation, location, desired power range, and preferred frequency range. Individual SAS implementations may collect and utilize additional information as well, such as coexistence techniques, or operator network identification. To make most efficient use of the band, an SAS should be permitted to rely upon the actual performance characteristics of end-user devices—not just minimum mandatory performance requirements—in calculating interference protection. While the Commission should not require an SAS to take into account technical information for particular devices, it should make such information readily available for delivery to database providers that choose to use it. To that end, as part of the Commission's certification process, manufacturers of devices that are authorized for operation in the 3.5 GHz band should be required verify and report key performance characteristics that drive interference avoidance, such as out-of-band emissions and receiver susceptibility.

**Baseline Information SASs Provide to Devices.** SASs must give devices sufficient information to adequately protect incumbents, such as geographic range of permissible operation, maximum transmit power within that range, and available frequencies. This information could be conveyed either to a trusted intermediary such as a network operator, or to an end-user access point such as a Wi-Fi hotspot.

**Trust and Security.** The Commission should establish baseline trust requirements for communications between an SAS and the devices it authorizes in the 3.5 GHz band. Carriers might elect to interact with an SAS via their radio resource management architecture, while systems that have no intermediate level of control—

such as most Wi-Fi access points—might interact directly with an SAS. Either approach should be equally acceptable: The Commission should not mandate one particular method for interacting with an SAS.

In order to protect against tampering, the FCC should require that devices have a “software anti-tamper” boundary that ensures that all software that controls the RF operation of the device has been certified for use in the band.<sup>3</sup> The Commission should not, however, expand the hardware protection requirements provided in certified systems today. The risk of illegal manipulation of radios exists in every band the FCC regulates, whether the incumbent is a government entity, a private company, or an individual. To protect against such manipulation, the Commission has equipment certification requirements that are overseen by the Office of Engineering and Technology, and enforcement tools that include large monetary fines and license revocation, including where critical government users are affected.

The FCC should continue to rely on these mechanisms for the 3.5 GHz band, rather than adopting command-and-control technology mandates and limitations for equipment. Such hardware regulations would limit innovation by locking manufacturers into one technological approach, and increase costs because manufacturers would have to design and develop specialized equipment configurations for the 3.5 GHz band.

---

<sup>3</sup> See, e.g., *Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies*, Report and Order, 20 FCC Rcd 5486, ¶¶ 4, 20 (2005) (permitting the development of software-defined radios that have the hardware capability to operate outside authorized United States frequency bands, but requiring software controls to limit operation to authorized bands and establishing rules to prohibit unauthorized modifications to the software); 47 C.F.R. § 2.1(c); 47 C.F.R. § 2.944; see also 47 C.F.R., Part 15, Subpart H (establishing required security measures for television white space devices but declining to adopt specific hardware security requirements).

Hardware rules are also unlikely to make a significant difference in actually reducing harmful interference, because direct manipulation of hardware requires significant technical sophistication that goes beyond the expertise of most wireless users. Such illegal tampering is likely to be limited to isolated instances that can be addressed through the Commission's enforcement processes.

Furthermore, robust SASs provide a new and powerful tool for the Commission to further reduce rule violations that threaten harmful interference. Devices will need to obtain an authorization from an SAS *before* commencing operations, and this function will prevent many instances of accidental interference. To the extent that an SAS can incorporate individual device characteristics collected by the FCC during the certification process (e.g., range of operation, out-of-band emissions characteristics, maximum power levels), use of this information in issuing authorizations provides a further check on interference caused by misunderstandings regarding device operation and range. In addition, because an SAS will have the ability to revoke device authorizations if the Commission finds that devices are intentionally violating the Commission's rules, SASs have the potential to streamline enforcement.

**Dynamic Reassignment.** To maximize usage of the 3.5 GHz band, SASs must be permitted to dynamically reassign users within the band, and user equipment must be capable of implementing these relocation instructions. For example, an SAS with basic interference-avoidance capabilities might accomplish reassignment by informing a Priority Access user that the 10 MHz channel it has been using must be vacated for an incumbent, and offering the Priority Access user the option of shifting to another, unoccupied channel. The Priority Access user could then elect either to move or to

suspend its operations during the incumbent's use. The same set of options would apply to a GAA user displaced by a Priority Access user.

A more sophisticated SAS, such as the prototype demonstrated by Google at the Innovative Spectrum Sharing Technology Day demonstration hosted by the National Telecommunication Information Administration on October 5, 2013, itself accomplishes avoidance of the incumbent user by arranging temporary hand-off to another Priority Access node, relocation of the original node to other frequencies within the 3.5 GHz band, and, when the incumbent concludes its use, re-establishment of service on the initial frequencies. Google welcomes an opportunity to demonstrate its prototype SAS at the FCC's workshop on January 14, 2014, that will explore the characteristics of SASs.

**Ensuring continuity.** If the Commission allows multiple database providers to offer competitive SAS services, as Google recommends, it should consider establishing some basic rules to protect against unreasonable service interruptions as providers enter and exit the database market. First, as noted above, each SAS provider should be required to share incumbent and device registration information with all other SAS providers. Second, the issuance of authorizations should be sufficiently generic that an SAS provider cannot deem its authorizations proprietary; this will ensure that authorizations can be transferred in the event a provider terminates its service. Finally, while equipment manufacturers, network operators, and database providers are best positioned to negotiate service level agreements among themselves, discontinuance of an SAS provider's service could in some circumstances jeopardize existing wireless offerings. Therefore, as is provided in the Commission's rules for television white space

databases, the Commission may wish to require that in the event there is a lone operational database provider, that provider must sell its database to a willing purchaser at a reasonable price rather than simply ceasing operations.<sup>4</sup>

#### **IV. SAS Monitoring and Management of Spectrum Use: SASs Can Improve Spectrum Utilization.**

The Commission can employ the usage-tracking capabilities of an SAS to encourage effective use of the 3.5 GHz band. First, SASs can facilitate actual use of spectrum and discourage spectrum hoarding if the Commission (1) requires Priority Access users to certify, when renewing their licenses, that they are actually using their assignments for wireless operations, and (2) makes unused assignments available to new registrants via the SASs.<sup>5</sup>

Second, by allowing flexible geographic reservations with boundaries that correspond to real-world radio frequency characteristics, rather than basing reservations on rigid geographic boundaries that were established for unrelated purposes, an SAS will maximize availability of spectrum.<sup>6</sup> Priority Access users will be able to tailor their reservations to reflect the spectrum they actually intend to use, freeing up unused portions of the band for other Priority Access licensees and GAA devices.

#### **V. Issues Related to Initial Launch and Evolution of SAS and Band Planning: The FCC's Band Plan Should Encourage Flexible Use.**

The Commission should permit a wide variety of uses and services in the 3.5 GHz band. It should not require entrants to offer a particular service, use a particular technology, or adopt particular technical standards as a condition of entry. Similarly, the

---

<sup>4</sup> TVWS Second Report and Order at ¶ 221.

<sup>5</sup> See Comments of Google Inc., GN Docket No. 12-354, at 8-10 (filed Dec. 5, 2013).

<sup>6</sup> *Id.* at 5-8.

FCC should not segment the band by use case. Fragmenting the band in that way would reduce the potential market for each type of equipment designed for the band, thereby driving up per-unit equipment costs and hampering successful deployments.

For the same reasons, the Commission should not mandate different power levels for Priority Access and GAA users. To the contrary, all equipment—whether intended for Priority Access or GAA use—should be capable of operating through the entire band, from 3550 MHz to 3700 MHz. Such a requirement will help to minimize equipment costs and ensure that end users are not left with stranded, obsolete equipment if their Priority Access service provider ceases or moves its operations. Interoperability also maximizes opportunities for reassignment of GAA users to avoid interference.

While the Commission should provide for operability throughout the band, it should not mandate *interoperability* among networks. The latter requirement would necessitate that all operators deploy a standard air interface, thereby limiting the ability of the band to accommodate a wide range of uses. The Commission should instead allow operators to deploy the network technologies of their choice, consistent with the band plan, channelization, and operational rules for the 3.5 GHz band. This approach does not preclude tighter management of interference through voluntary, technology-specific extensions—such as interference alignment between adjacent LTE users—but instead ensures that the underlying sharing regime will be both technology- and service-neutral.

## VI. Conclusion.

For the reasons stated above, enabling effective SASs will maximize the use of the 3.5 GHz band for wireless broadband. In order to realize the potential created by these systems, the Commission should move forward quickly to establish core rules for the band.

Respectfully submitted,



---

Austin C. Schlick  
*Director, Communications Law*  
Aparna Sridhar  
*Counsel*  
**GOOGLE INC.**  
1101 New York Avenue, NW  
Second Floor  
Washington, DC 20005  
(202) 346-1100

January 3, 2014