CSMAC 5G SUBCOMMITTEE FINAL RECOMMENDATIONS

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2 STUDY QUESTIONS

1. What technologies (including waveforms and architectures) might be included in 5G standards to facilitate sharing between federal and non-federal systems?
    a. Among other things, please consider specifically the key receiver performance requirements for sharing, particularly with respect to IoT devices, including a device's capacity for resilience and interference detection and avoidance.
    b. Consider any 5G-specific technologies that might facilitate interference prevention, detection, and resolution.
    c. Identify the standardization challenges with respect to such technologies and what actions NTIA should take to address these challenges.

2. What commercial 5G deployment scenarios (e.g., specific commercial use cases) exist that could potentially maximize the shared use of this spectrum (e.g., dynamic shared access between federal and non-federal users)?

3 RECOMMENDATION: INTERFERENCE MITIGATION TECHNOLOGIES TO FACILITATE FEDERAL / NON-FEDERAL SYSTEMS SHARING

The responses to the questions in this document represent a general overview of potential technologies, methodologies, and techniques for interference mitigation. Such mitigation technologies must be evaluated for suitability to facilitate spectrum sharing based on all relevant factors, including specific frequency band under consideration, nature and use cases of the federal and non-federal systems, and whether the interference to mitigate is a co-frequency or adjacent/near-adjacent frequency case. When considering compatibility, both receiver and transmitter characteristics must be considered as well as the system design and performance requirements. For these reasons and others, a specific recommendation on technologies to implement in federal systems is not possible.

Keeping this is perspective, CSMAC 5G subcommittee has following recommendations for NTIA:

1. Open one or a series of Notice of Inquiries (and/or Requests for Information) designed to collect information on potential spectrum bands that could be considered for sharing including proposals for how these bands could be shared with the incumbents. Develop a list of information that is needed for interference mitigation that would improve sharing. This list should include information about the legacy waveform and operation that is required to design and develop sharing approaches, and the information needed to co-exist.
2. Recommend that NTIA request that FCC consider a counterpart processes inquiry on which commercial bands and which technology steps should be considered for bi-directional sharing.
3. A review of the new technologies that are being developed in 3GPP that can address sharing between federal and nonfederal systems. For instance, 3GPP Release 14 incorporates means to reduce uplink interference at the receiver by utilizing MMSE-IRC (minimum mean square error – interference rejection combining).

4 RECOMMENDATION: INTERFERENCE MITIGATION TECHNOLOGIES TO FACILITATE FEDERAL / NON-FEDERAL SYSTEMS SHARING (CONTINUED)

4. Beamforming, active antenna system (AAS), massive MIMO and network/cooperative MIMO can help reduce the effect of interference at the receiver and reduce interference in a shared environment.
5. NTIA should evaluate the technologies outlined above based on spectrum, technology, application, and functional requirements of the federal communication systems that needs to share spectrum with a non-federal entities.
6. Expedite workshop on bi-directional sharing recommended in last round of CSMAC deliberations. (As proposed in WG Report dated June 2016 and by CSMAC at August 2016 meeting.)
7. Hold a workshop with the objective to establish a platform for an industry-led consensus on solutions to fundamental questions on sharing and interference mitigation.
8. Currently, there are no regulations governing the design of wireless receivers, or their performance. Protection from noise and interference is achieved through stringent requirements for the performance parameters like ACS (adjacent channel selectivity), blocking characteristics, spurious response, and intermodulation response. Propose NTIA examine receiver technology, in existing and future systems that could allow federal and non-federal systems to co-exist with minimal performance degradation in a spectrum sharing scenario.

5 RECOMMENDATION: SPECTRUM MANAGEMENT UTILIZING AUTOMATED COORDINATION (DATABASE)

1. Monitor the activities with regards to the SAS in the 3.5 GHz to determine how effective the regulatory framework allows spectrum sharing while at the same time managing interference.
2. Investigate participation in standards organizations where technology developments to facilitate sharing are discussed. Sharing scenarios can be considered for standardization.
3. Open one or a series of Notice of Inquiries (and/or Requests for Information) designed to collect information on potential spectrum bands that could be considered for sharing including proposals for how these bands could be shared with the incumbents while minimizing the burden and complexity of the sharing arrangement.
4. Establish a formal working group with the FCC (under existing MOU?) to target relevant bands for sharing and develop specific, actionable goals and objectives.
5. Develop a list of legacy information that is needed for database sharing approaches and the potential challenges to this approach. This list should include information about the legacy waveform and operation that is required to design and develop sharing approaches, and the information needed to operate a sharing system.
6. Use probabilistic risk assessment (i.e. calculating likelihood-consequence distributions for multiple hazard scenarios) rather than worst-case analysis (i.e. focusing on the one hazard with the most severe consequence, regardless of its likelihood) as the basis for determining sharing frameworks.

6 RECOMMENDATION: STANDARDIZATION CHANGES FOR SHARING

Introducing sharing mechanisms in SDOs needs technical analysis, industry partnerships, and due process by the SDO. This process could take years and it would also need to be monitored and updated as technology evolves. Therefore, it is important for NTIA to view this as a long-term engagement, which would require a different resource requirement at different times and depending on the activity. NTIA should investigate the possibilities around this engagement and perhaps leverage groups such as ITS which have done similar work in the past. This group and/or individuals may also additionally:

1. Hold workshops: to gather contributions from a wider group representing the industry, including manufacturers, network operators, academic institutions, industry verticals and research firms, to address standardization changes. Since some contributors may also participate in various standardization forums, this workshop will provide an important platform for an industry-led consensus on solutions to fundamental questions on sharing. The workshops could also be used to educate the broader industry of inherent challenges in spectrum sharing and invite ideas on how these challenges can be overcome either through 5G standards or via other methods that are feasible to implement.
2. Consider liaising with industry trade organizations such as NGMN and 5G Americas, or alliances such as ATIS. These groups advocate for better features and functionalities of next generation wireless technologies. These industry organizations influence what use cases need to be addressed by standard bodies and address related spectrum requirements and policy.
3. Consider working with other administrations, through ITU, CITEL or others, to develop a unified view on spectrum sharing requirements and asking the standardization bodies to address them. For example, 3GPP has a direct liaison with the ITU.