# CSMAC 5G Subcommittee Final Recommendations

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# Work Plan

**NTIA Question:** What are the technology and standardization challenges unique to 5G that are associated with federal/non-federal spectrum sharing, and what specific roles/actions should NTIA take to address these challenges?

- The subcommittee has also prepared an extensive report. The report shall be provided in July.

- The subcommittee also recognizes that some of the recommendations don't have an immediate action involved, but would have an action as 5G is further developed and/or if a specific band is referenced.

# 5G Unique Attributes

While the specifications for 5G networks are being defined, there are aspects that are currently known, while others are being developed:

a) Deployment scenarios for 5G will be different: specific spectrum could be used either for traditional broadband, or machine-type communications, or critical communications. Additionally initial 5G technologies are likely to be deployed first in urban, high-density environments where building penetration and clutter may greatly impact propagation especially in the case of higher frequencies. A band that is sparsely used by incumbents for critical communications may be shared to support non-critical, delay insensitive IoT type applications such as smart meters and atmospheric sensors.

b) Large frequency bandwidths: 3GPP is considering utilizing different waveforms depending on the frequency bands, i.e. a waveform X can be supported between Frequencies A and B, a waveform Y between frequency B and C and henceforth. Further, in many cases due to the large envisioned channel bandwidths, it is possible that the spectrum overlap is only partial either within the channel or at the edges only, and as consequence the impact and mitigation techniques could vary significantly. Likewise the large bandwidths will also impact OOBE and adjacent bands.

c) New duplexing schemes: Currently 2G, 3G, and 4G technologies either operate on an FDD, TDD or downlink only mode. For 5G it is envisioned that new duplexing schemes will be introduced, such as dynamic duplexing, simultaneous transmission and reception on same frequency.

# Recommendations – 5G Unique Attributes

***Recommendation 1:*** *NTIA should facilitate coexistence evaluation for three broad categories of 5G use cases, as opposed to previous technologies where there was only one case for evaluation (broadband). The three broad categories are broadband, machine-type communications (IoT), and critical communications (e.g. low-latency). As a first step, include lessons learned from the AWS-3 and 3.5 GHz coordination process.*

***Recommendation 2:*** *As the channel bandwidth size in 5G can be large (100 MHz and above), the chance of overlaps with different types of federal systems will increase. NTIA should facilitate a collaborative government-industry study of large bandwidth sharing scenarios that potentially involve multiple incumbents, waveforms and applications for future higher frequency bands.*

***Recommendation 3:*** *5G will introduce new duplexing schemes besides FDD and TDD, such as dynamic duplexing and simultaneous transmission and reception on the same frequency. NTIA should facilitate a collaborative government-industry study of the impact of these new duplexing schemes.*

# Recommendation - 4

**4. Baseline Assumptions**

Traffic characteristics are going to vary widely depending on what kind of services the spectrum is utilized for. For example, spectrum utilized for low powered IoT type use cases with sparse but delay tolerant traffic may require a different coordination approach than mobile broadband use cases. The sharing studies in general should consider the traffic characteristics of the services deployed in a spectrum band and the probability of interference, specifically when one calculates cumulative interference, and the impact of that interference from the perspective of what harm it could cause. This becomes more relevant to 5G due to advanced techniques such as MU-BF and 3D-MIMO that steer signal only in the wanted region instead of wide area coverage. Also in practice many system deployments are over-designed to support high reliability metrics and should be able to able to handle both short term and long term interference at different thresholds.

In the past, the sharing analysis was mostly based on a "worst-case" scenario. A more probabilistic approach that can still provide a strong level of protection to incumbent systems should be investigated (e.g., exceeding an interference level of X for less than Y% of the time at Z locations where X, Y and Z could vary from system to system).

***Recommendations:***

- *NTIA should facilitate a multi-stakeholder collaboration to agree on future baseline criteria (such as probability aspects), detection and mitigation techniques that can empower technology innovation for ensuring effective sharing of the spectrum between federal and non-federal 5G systems*

# Recommendation - 5

**5. Phased approach with upgrades**

As has been the case with 4G (LTE) and how it progressed from LTE to LTE-A to LTE-A Pro, it is expected that 5G will also be developed and be deployed in phases. Newer technologies will be incorporated into the initial 5G standards over several evolutions of the specifications and some of the technologies that may not be currently available for effective sharing could become available during the latter part of the evolutionary cycle of 5G. Similarly it may be reasonable to assume that the other incumbent technologies would also migrate to advanced versions. With each upgrade cycle, it would be very helpful if it is encouraged to incorporate sharing technologies within new versions. Another consideration could be to use similar physical layer characteristics to improve compatibility and sharing.

***Recommendations:***

- *The NTIA working with the FCC and through the existing Department of Commerce 3GPP membership, should facilitate the introduction of a work item that requests 3GPP to evaluate sharing technologies. The CSMAC can help with the drafting of the documents necessary.*

# Recommendation - 6

**6. Propagation Modeling for sharing/co-existence studies**

Historically, models like ITM and TIREM have been the main stay during the coordination analysis and determination of protection zones. However, these models may not have the same level of predictability at higher frequencies (20 GHz and above) to estimate the interference from 5G systems. In absence of such models very conservative assumptions may be used which may lead to unnecessary constraints when evaluating capability between systems.

***Recommendation:*** *NTIA should allocate the resources necessary to investigate revision of propagation models, and if needed undertake measurements, for the higher frequencies so that accurate/appropriate models can be utilized for estimating interference from 5G systems in a varied set of environments and distances. New models should be promoted in ITU-R Study Group 3 for global harmonization at WRC-19.*