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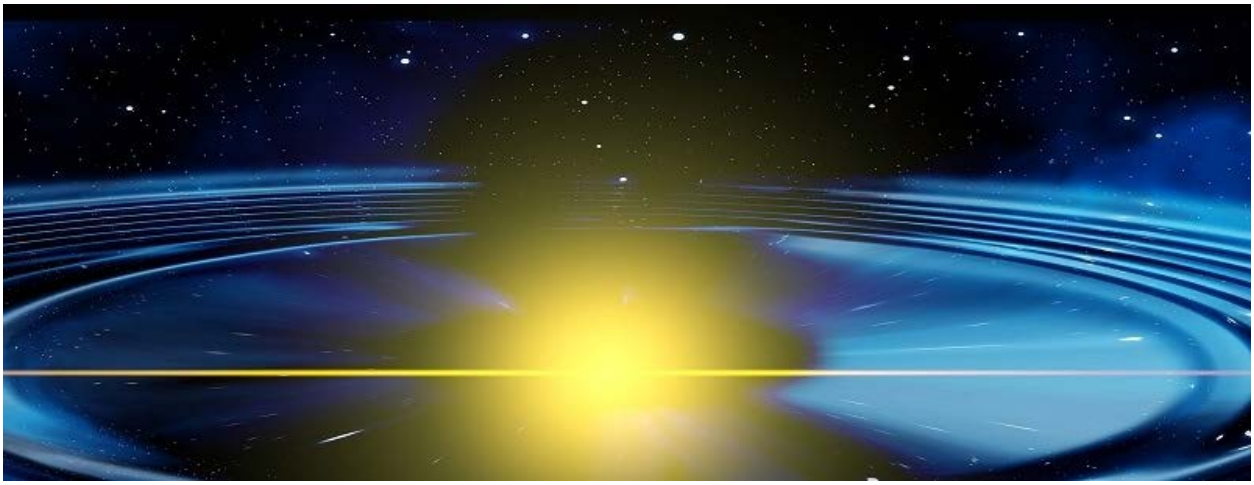
# Industry Voices—Rysavy: Mid-band spectrum for 5G needed now

by *Peter Rysavy* | Aug 13, 2018

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Is the United States about to lose the race to widespread 5G availability? While the United States has been conducting the most complicated spectrum experiment in human history, namely Citizens Broadband Radio Service (CBRS), with its three tiers of users and various other complications, other countries are taking a simpler, more traditional view of mid-band spectrum. China, Korea, Japan, and European Union countries have already licensed, or about to begin licensing hundreds of megahertz of spectrum to operators for 5G service. The FCC is responding to the need but has only now issued a notice of proposed new rules.

In the recent past, an operator's spectrum strategy consisted of two layers: a coverage layer and a capacity layer. When the **FCC auctioned AWS spectrum in 2015 for $45B**, 2 GHz was ideal for capacity and 700 MHz for coverage. The emerging 5G model, however, is a three-layer model: low-band for coverage, mid-band for a blend of coverage and capacity, and high-band for augmented capacity. Not all operators will

deploy 5G in every band, but because each layer plays a crucial role, access to all the bands is paramount.

The core tenet of 5G architecture is flexibility, enabling different operator business strategies. First, 5G can operate in far more frequencies than 4G. As of June 2018, 3GPP had specified 34 bands in which 5G can operate, ranging from 600 MHz to 40 GHz, with higher frequencies on the way. Second, 5G integrates tightly with LTE based on different architecture options, enabling the 5G radio network to be based on either an LTE core network or on a 5G core network.

Some operators may deploy 5G in the low-band, coverage lager. For example, T-Mobile has stated it will deploy 5G in 600 MHz, enabled by its acquisition of spectrum during the recent **600 MHz incentive auctions**. Other operators, however, have the option of using their existing LTE network, such as at 700 MHz, for the coverage layer.

Jumping to the high-band frequencies, including 28 MHz mmWave, the limited propagation of radio signals requires a dense deployment of small cells. Modeling shows that for good performance in an environment of low foliage, intersite distances need to be about 300 meters, resulting in a dense network of 15 sites per square kilometer. High foliage environments will require even denser networks. As **my 2017 report quantifies**, a mmWave network built out at this density can compete directly against cable wireline broadband. This density, however, translates to many hundreds of thousands of small cells to reach large segments of the population, something that will happen over time, but not without **hundreds of billions of dollars of investment in small cells and fiber**.

In contrast, an operator can deploy a mid-band network at a far lower cost. Because the lower-frequency signal propagates farther than mmWave and penetrates obstructions better, cells can be larger, with ISDs as large as perhaps 1 km. Compared to an ISD of 300 meters, an operator only needs to deploy one tenth as many cells. The better in-building penetration also means more users will be able to access the signal indoors without needing a fixed antenna on the outside of the building, as will be typical of mmWave access.

The relatively large amount of spectrum in mid-band frequencies also provides significant capacity gains compared to current cellular bands. Mid-band licenses overseas have been for **radio channels as wide as 100 MHz**, much greater than previous cellular licenses that have typically been 5 MHz or 10 MHz. 5G in mid-band has advantages beyond just lower cost and faster deployment: it is likely to become the global roaming band for 5G, and it will be effective at delivering broadband to rural areas.

The euphoria of this quick-to-market 5G solution might suggest that the FCC is wasting its time with mmWave auctions and should be focusing on just mid-band, but an operator gets what it pays for. A mmWave network using a 400 MHz radio channel at ten times the site density compared to mid-band using a 100 MHz radio channel has 40

times the capacity, and even at the same site density, has 4 times the capacity. From a use-case perspective, mid-band will provide an alternative to wireline broadband in rural areas, but for dense urban areas, mmWave will be more effective.

Thus, the FCC plans for mmWave band licensing, which are extensive at this time, combined with its July 12 **Notice of Proposed Rulemaking for 3.7 to 4.2 GHz**, is the appropriate strategy, and both mid-band and high band deserve equal emphasis. Unfortunately, the U.S. mid-band frequencies are more encumbered than in other countries, both with satellite incumbents and the CBRS sharing complexity. Working quickly through these complexities to bring mid-band to market will be crucial for the success of 5G in the United States.

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