

# ANDREWSEYBOLD

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## **FirstNet Coverage: Making Sure There Is Common Ground**

Recently I was sent an article dated July 18, 2017, apparently written by someone with access to the FirstNet Portal for Pennsylvania. The paper was attached to the testimony for the U.S. House Subcommittee on Communications and Technology authored by LeRoy T. Carlson, Jr., Chairman of U.S. Cellular Corporation. I was asked to review this paper because there were questions about points made by the author and what the author believes public safety was promised.

I have reviewed the paper and discussed it with Mario De Rango, Principal and Founder of Intechigence, LLC, an advanced technology consulting company. I contacted Mr. De Rango (an acknowledged expert in LTE coverage) to verify and better understand what was presented as fact in the paper, as well as the U.S. Cellular testimony used by the author to validate the points he was making. I also reached out to other acknowledged LTE network experts and had similar discussions with them as well. The result of these discussions and my own research has led me to the point where I can explain why this paper improperly denigrates the FirstNet/AT&T coverage maps.

To understand exactly why this paper is misleading, it is important to understand the basic fundamentals of LTE cell sector coverage and data rates. All LTE cell sites have varying data speeds. These speed differences are dependent on several factors:

- 1) Link Adaptation: LTE adapts the data rate between the user and the cell site based on the signal to interference and noise ratio (SINR) at the receiver, using lower-speed data modulations that are more robust as the interference and path loss increases, and using higher-speed data modulations when the path loss and interference is lower. Since path loss is generally related to the distance between the user and cell site, typically, the closer a user is to the cell site the better and higher the data rate will be in both the outbound and inbound directions.
- 2) Network Loading: A single active user within a cell will enjoy all its resources, but as additional users within that cell simultaneously make use of broadband data services, the data service must be shared. Thus, data rates will fluctuate anywhere within the coverage area, with each actively-sharing user within that cell experiencing lower data speeds. Another type of loading that significantly impacts user data speed comes from user activity in adjacent cell sites, which can raise the level of interference at the receiver and cause the link adaptation to further lower its data rate to improve the reliability of the transmission.
- 3) Data Rate Specifications: Since data rates can differ dramatically based on the considerations described above, it should not be surprising that network data rates can be difficult to specify. One

specification that may appear significantly different from another can actually be similar in overall performance. A good data rate specification should provide a data rate either as a median sample value or a minimum value together with a stated statistical confidence level, and the applicable loading level under which that specification would be achieved. A “median” specification means the middle value of a set of samples made randomly throughout the coverage area of the cell. Statistically speaking, the middle or median value would likely occur toward the middle location of the distance between the cell site and the edge of the cell coverage. A minimum threshold data rate specification, on the other hand, would specify the value at the far edge of the cell coverage where minimum data rates would most likely be seen. The key point to remember is that in any given LTE cell, a minimum specified data rate and a median specified data rate can typically vary by more than a magnitude. This dramatic difference in specification value can lead to confusion or misinterpretation with regard to the overall performance of the network.

### The Paper

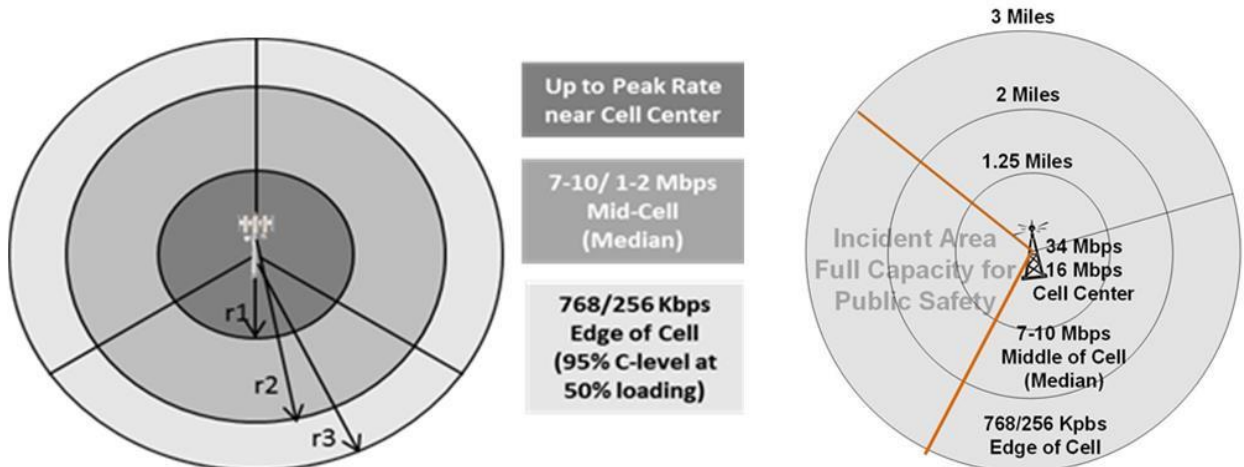
The paper states, “In 2016, FirstNet published its RFP and asked bidders to provide coverage maps for **narrowband** communications: 768 Kbps downloads and 256 Kbps uploads. (Solicitation No. D15PS00295 – Section J, Attachment J-1, Coverage and Capacity Definitions).” The word “narrowband” was added by the author because he contends that 768-Kbps downloads and 256-Kbps uploads cannot be classified as broadband. He comments on this just before stating that “between 2012 and 2016, cellphones evolved into smartphones, and “broadband” was firmly established in the telecommunications vernacular as meaning data rates in multiples of 10 Mbps.”

What the author is missing is that while the RFP does, in fact, state the download speed of 768 Kbps and the upload speed of 256 Kbps, these data rates are specified for EDGE-of-cell, that is, at the maximum distance you can be from the cell site and still have some data capability. In this, case FirstNet used a minimum threshold specification that included 95% confidence (which is extremely high), and 50% network loading. Next, he shows a coverage map and then references the statement of LeRoy Carson, chairman of U.S. Cellular, which is attached to the author’s paper.

Here is where the author goes off the track. The U.S. Cellular discussion is based on the MEDIAN data rate, not the cell-edge data rate. In reality, according to the experts I have consulted including Mario De Rango, all agree that if the FirstNet RFP has stated a median data rate based on the cell-edge data rate of 768/256 Mbps, the median, that is, the data speeds available at the mid-cell point or the median, would have been stated as 7-10 Mbps as the downlink speed and at least 1 Mbps as the uplink speed.<sup>1</sup>

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<sup>1</sup> For Further information on cell sector data speeds see the Cornerstone Capacity testing document submitted to the FCC on September 12, 2012 (<https://ecfsapi.fcc.gov/file/7021709918.pdf>)



Notes: Cell coverage radii (r1-r3) per sector will vary depending on transmit power, antenna gains, antenna heights, and the coverage topology (urban, suburban, rural). Data speeds will vary based on number of simultaneous users, and the priority of the users, with public safety having higher priority to ensure these optimal data speeds and latencies are provided.

Notes: Cell distances (coverage area) will vary depending upon Urban, Suburban, Rural areas  
Data Speeds will vary depending upon the number of users per cell sector

Further, the FCC in its rules for the Connect American Mobility Fund specified that in rural areas it expects 10 Mbps down and 1 Mbps up. T-Mobile took exception to these rural numbers in a filing with the FCC. In its comments to the FCC, T-Mobile stated that if carriers were required to meet 10/1 in rural America the cost of implementing wireless broadband would remain out of reach of the typical network operator and suggested a data rate of 5 Mbps down and 1 Mbps up, which it stated could be met within the level of funding being made available by the FCC in the funding order. More important to this discussion, T-Mobile recognized that minimum threshold data rates of 500-Kbps downlink and 150-Kbps uplink would be a better specification to achieve the median 5 Mbps/1 Mbps value, confirming the magnitude difference in minimum to median data speed values in LTE networks.<sup>2</sup>

**The Issue**

The issue brought forth by the author of the Pennsylvania paper (which is attached for reference) is comparing edge-of-cell data speed requirements with median or middle-of-the cell data speed averages. There is no doubt these two numbers will be vastly different from each other and can confuse people without the appropriate technical background. I would like to believe that in this case the author of the paper was not deliberately trying to mix his metaphors, but perhaps he had not been aware of the differences between edge-of-cell and middle-of-cell or median data speeds.

The author’s closing two paragraphs are aimed at the SPOCs and recommend they should, “include in their advice to their governor a forceful explanation of the discrepancy between FirstNet's claims of coverage and the reality of what broadband coverage will actually look like for first responders. To do otherwise would be to be irresponsible.”

<sup>2</sup> T-Mobile: In the Matter of Connect America Fund, Universal Service Reform Mobility Fund. WC-docket No. 10-90, WT Docket 1-208

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The bottom line is that AT&T and FirstNet have provided coverage maps that more than meet the edge-of-cell data speed requirements and, in fact, accurately represent the data rates that will be delivered at median or mid-cell data speeds. There is no doubt that each public safety agency should verify the FirstNet/AT&T coverage within their area of operation today, but these agencies should also remember that the FirstNet contract with AT&T is for a five-year build-out of the network. Will the coverage be perfect at first? No, it won't. Will it provide data speeds acceptable to public safety to meet its data and video needs? Yes, it will.

Respectfully submitted,  
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