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March 24, 2014

VIA EMAIL

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Ex Parte Presentation

GN Docket No. 13-185, ***Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands***

Dear Ms. Dortch:

On March 24, Tom Sugrue, Kathleen Ham, and Steve Sharkey, each of T-Mobile US, Inc. ("T-Mobile"), and the undersigned counsel for T-Mobile met separately with each of the following regarding the above-referenced proceeding: Commissioner Mignon Clyburn, her Legal Advisor Louis Peraertz and Legal Intern Pauline Lee; Commissioner Jessica Rosenworcel and her Senior Legal Advisor David Goldman; Ruth Milkman, Chief of Staff, and Renee Gregory, Legal Advisor to Chairman Tom Wheeler. Christopher Putula of Putula Strategies also attended the meeting with Ms. Milkman and Ms. Gregory. On March 21, 2014, Messrs. Sugrue and Sharkey and Ms. Ham spoke by telephone with Commissioner Ajit Pai and his Legal Advisor Brendan Carr. On March 24, 2014, Ms. Ham also spoke by telephone with Roger Sherman, Chief of the Wireless Telecommunications Bureau.

At each meeting, we noted that the Commission should license AWS-3 spectrum using as many 5x5 megahertz licenses as possible. Smaller spectrum blocks will provide all carriers with maximum flexibility to meet their spectrum requirements in particular markets, rationalizing holdings between AWS-1 and AWS-3 spectrum, and will help carriers more easily conform to whatever spectrum aggregation limits the Commission may adopt in the future. In addition, 5x5 megahertz license blocks will double, over 10x10 megahertz license blocks, the opportunity for competitive carriers to bid on and win AWS-3 licenses, increasing auction revenues.

In their initial comments and reply comments, AT&T and Verizon recognized the benefits of 5x5 megahertz blocks.[1/] However, in a recent blog post, AT&T suggested that the Commission

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[1/] *See* Comments of Verizon Wireless, GN Docket No. 13-185, at 15 (filed Sept. 18, 2013) (suggesting that AWS-3 spectrum should be auctioned "in a combination of 5x5 MHz and 10x10 MHz blocks" and recognizing that "5 MHz pairings could provide small and rural service providers with the opportunity to acquire the spectrum that they need, without forcing them to acquire more than they need"); Reply Comments of AT&T, GN Docket No. 13-185, at 7 (filed Oct. 28, 2013) (noting that "paired 5 x 5 MHz blocks enjoyed broad support").

should use larger 10x10 megahertz spectrum blocks for the AWS-3 auction.[2/] Verizon is also now advocating for multiple 10x10 megahertz blocks.[3/] Larger block sizes will make it easier for both larger carriers to dominate the AWS-3 auction and perpetuate their dominant market positions to the detriment of competition. Smaller carriers uniformly support smaller geographic areas and smaller spectrum blocks.[4/]

In support of its request, AT&T cites the results of the AWS-1 auction in 2006.[5/] AT&T argues that the larger license blocks and license sizes garnered more bidding activity and auction revenues than the smaller spectrum blocks and license sizes. AT&T is wrong for several reasons. With respect to license block size, AT&T fails to note the obvious comparison between identical license areas with different size spectrum blocks. In particular, the AWS-1 B and C Blocks were both licensed as EAs, but with different spectrum block sizes. As T-Mobile has explained, the B Block sold for $.43 per MHz/POP while the C Block sold for $.51 per MHz/POP, a difference of approximately 15 percent.[6/] Moreover, there was a larger number and more diverse group of winners for the C Block licenses than for the B Block licenses.[7/]

There is no material difference in spectrum efficiency between the use of two 5x5 megahertz blocks and a single 10x10 megahertz block as demonstrated in the attached declaration prepared by Karri Kuoppamaki, Senior Director, Technology Development and Policy, at T-Mobile, entitled "An Analysis of Potential LTE Bandwidths Proposed for the AWS-3 Band." He observes that carriers can achieve the same benefits of 10x10 megahertz blocks in the AWS-3 band in one of two ways: by acquiring adjacent 5x5 megahertz blocks or by using well-established carrier aggregation techniques to use non-contiguous spectrum. This means that

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[2/] *See* Joan Marsh, AT&T Public Policy Blog, *Right on in AWS-3* (March 17, 2014), *available at* http://www.attpublicpolicy.com/fcc/right-on-in-aws-3/. *But see* Kathleen Ham, T-Mobile Blog, *Size Matters* (March 19, 2014), *available at* http://multimediacapsule.thomsonone.com/t-mobileusa/blog_size-matters.

[3/] *See, e.g.*, Letter from Tamara Preiss, Vice President, Federal Regulatory Affairs, Verizon, to Ms. Marlene H. Dortch, Secretary, FCC, GN Docket No. 13-185, at 1-2 (filed March 14, 2014).

[4/] *See, e.g.*, Letter from C. Sean Spivey, Assistant General Counsel, Competitive Carriers Association, to Ms. Marlene H. Dortch, Secretary, FCC, GN Docket No. 13-185 and GN Docket No. 12-268, at 1-2 (filed March 6, 2014); Reply Comments of United States Cellular Corporation, GN Docket No. 12-268 and GN Docket No. 13-185, at 5-12 (filed Jan. 23, 2014); *see also* Letter from Competitive Carriers Association, NTCA – The Rural Broadband Association, the Rural Wireless Association, Inc., and Blooston, Mordkofsky, Dickens, Duffy & Prendergast, LLP, to Ms. Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-268 and GN Docket No. 13-185 (filed March 11, 2014).

[5/] *See Auction of Advanced Wireless Service Licenses Scheduled for June 29, 2006*, Public Notice, 21 FCC Rcd 4562, ¶ 11 (2006).

[6/] *See* Letter from Russell H. Fox, Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C., Counsel to T-Mobile US, Inc., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 13-185 and WT Docket No. 12-269, at Attachment at 6 (filed March 11, 2014).

[7/] *See* FCC, *FCC Advanced Wireless Services Auction No. 66, Final* (2006), *available at* http://wireless.fcc.gov/auctions/66/charts/66press_1.pdf.

carriers can provide the same user experience by acquiring whatever AWS-3 spectrum they need in 5x5 megahertz blocks. Because 5x5 megahertz blocks provide other significant public interest benefits – promoting competition, allowing carriers to most efficiently meet their spectrum requirements, and permitting licensees to easily conform to any future spectrum aggregation rules – the Commission should license the AWS-3 spectrum in 5x5 megahertz blocks.

With respect to license area, AT&T inappropriately compares the revenue generated from REAG licenses and CMA licenses to show that larger license sizes should be preferred. *First*, the FCC is not considering the use of REAGs in this auction. A more apt comparison is between the A and B Blocks in the AWS-1 auction – licenses for the same amount of spectrum but licensed on EA and CMA bases – precisely what is under consideration in this auction. Those results show little difference between revenues from EA ($0.43 per MHz/POP) and CMA ($0.39 per MHz/POP) licenses. *Second*, activity level in an auction's initial round may be skewed by a variety of factors, including bidders' desire to retain their activity level and initial bidding strategies; no reasonable conclusions about the level of competition in an auction can be drawn from only one round.

Regardless of the spectrum block and geographic areas through which AWS-3 licenses are auctioned, the Commission should not permit the use of package bidding. In the AWS-3 auction, package bidding will favor the largest carriers and foreclose access to smaller carriers. It will also create opportunities for strategic bidding that could be anti-competitive and induce inefficiency in the auction outcome. The two largest carriers also hold substantial spectrum in the adjacent AWS-1 band, so there is no "exposure risk" for them here that justifies even the consideration of package bidding.

The attached presentation was distributed at the meetings held on March 24, 2014. Pursuant to Section 1.1206(b)(2) of the Commission's rules, an electronic copy of this letter is being filed for inclusion in the above-referenced docket. A copy of this letter is also being provided to all Commission employees who attended the meetings. Please direct any questions regarding this filing to the undersigned.

Respectfully submitted,

/s/ Russell H. Fox

Russell H. Fox

Attachments

cc: (each with attachment)
Hon. Mignon Clyburn
Hon. Jessica Rosenworcel
Hon. Ajit Pai

Louis Peraertz
David Goldman
Brendan Carr
Pauline Lee
Roger Sherman

AWS-3

Topics

AWS-3

- Spectrum Block Sizes
- License Sizes
- Package Bidding

Spectrum Block Sizes

- The Commission should license AWS-3 spectrum using as many 5x5 MHz licenses as possible
  - Maximizes opportunities for competitive carriers to participate at auction by increasing number of licenses – thereby increasing auction revenues
  - Allows existing AWS licenses to fill in additional spectrum based on 5 MHz "building blocks"
  - Secondary markets provide opportunity to rationalize holdings between AWS-1 and AWS-3 markets if necessary
  - Will help carriers conform to future spectrum aggregation limits
- Initial comments and replies supported multiple 5x5 spectrum blocks
  - Verizon called for a "combination of 5x5 MHz and 10x10 MHz blocks" and noted that "5 MHz pairings could provide small and rural service providers with the opportunity to acquire the spectrum that they need, without forcing them to acquire more than they need."
  - AT&T initially agreed with the Commission's proposals to license AWS-3 spectrum in 5 MHz blocks and noted that "paired 5 x 5 MHz blocks enjoyed broad support"

AWS-1 Building Blocks

					Indicative AWS Holdings - Pro Forma								
					A-20MHz (CMA)		B-20MHz (EA)		C (EA)	D (REAG)	E (REAG)	F-20MHz (REAG)	
Pop Rank	Market #		Market Name	Mkt Pops (2010)	A1 10	A2 10	B1 10	B2 10	C 10	D 10	E 10	F1 10	F2 10
3	CMA	3	Chicago, IL	8,507,569	Verizon	Verizon	Verizon	Verizon	AT&T	Leap	T-Mobile	T-Mobile	T-Mobile
17	CMA	14	Baltimore, MD	2,655,604	Leap	Leap	Verizon	Verizon	Verizon	Verizon	T-Mobile	T-Mobile	T-Mobile
24	CMA	13	Pittsburgh, PA	1,959,627	Verizon	Verizon	Verizon	Verizon	AT&T (Aloha)	Leap	T-Mobile	T-Mobile	T-Mobile
37	CMA	46	Nashville-Davidson, TN	1,521,132	Verizon	Verizon	Verizon	Verizon	Leap	C-Spire	T-Mobile	T-Mobile	T-Mobile
38	CMA	61	Charlotte-Gastonia, NC	1,349,794	AT&T	AT&T	Verizon	Verizon	Leap	Verizon	T-Mobile	T-Mobile	T-Mobile
40	CMA	71	Raleigh-Durham, NC	1,333,905	AT&T	AT&T	Verizon	Verizon	Leap	Verizon	T-Mobile	T-Mobile	T-Mobile
42	CMA	47	Greensboro-Winston-Salem-High Point, NC	1,237,144	AT&T	AT&T	Verizon	Verizon	Leap	Verizon	T-Mobile	T-Mobile	T-Mobile
53	CMA	59	Richmond, VA	991,532	Leap	Leap	Verizon	Verizon	Verizon	Verizon	T-Mobile	T-Mobile	T-Mobile
82	CMA	92	Little Rock-North Little Rock, AR	666,956	Leap	Leap	Verizon	Verizon	Verizon	Verizon	T-Mobile	T-Mobile	T-Mobile
98	CMA	102	Des Moines, IA	545,659	US Cellular	US Cellular	Verizon	Verizon	Verizon	Verizon	T-Mobile	T-Mobile	T-Mobile
110	CMA	85	Johnson City-Kingsport-Bristol, TN-VA	505,570	Carolina West	Carolina West	Verizon	Verizon	Verizon	Verizon	T-Mobile	T-Mobile	T-Mobile
119	CMA	116	Lexington-Fayette, KY	477,650	AT&T	AT&T	Verizon	Verizon	Leap	Verizon	T-Mobile	T-Mobile	T-Mobile
120	CMA	109	Spokane, WA	474,961	AT&T	AT&T	Verizon	Verizon	Leap	AT&T	T-Mobile	T-Mobile	T-Mobile
126	CMA	150	Visalia-Tulare-Porterville, CA	437,000	Verizon	Verizon	Verizon	Verizon	AT&T (Aloha)	Leap	T-Mobile	T-Mobile	T-Mobile
128	CMA	716	Wisconsin 9 - Columbia	424,036	Verizon	Verizon	Verizon	Verizon	Leap	Leap	T-Mobile	T-Mobile	T-Mobile
141	CMA	350	Colorado 3 - Garfield	405,681	Verizon	Verizon	Verizon	Verizon	AT&T (Aloha)	AT&T	Leap	T-Mobile	T-Mobile
146	CMA	691	Virginia 11 - Madison	399,867	Leap	Leap	Verizon	Verizon	Verizon	Verizon	T-Mobile	T-Mobile	T-Mobile
157	CMA	101	Beaumont-Port Arthur, TX	379,474	Cameron	Cameron	Verizon	Verizon	Leap	AT&T	Leap	T-Mobile	T-Mobile
182	CMA	394	Illinois 1 - Jo Daviess	341,231	Verizon	Verizon	Verizon	Verizon	AT&T	Leap	T-Mobile	T-Mobile	T-Mobile
195	CMA	662	Texas 11 - Cherokee	316,886	AT&T (Aloha)	AT&T (Aloha)	Verizon	Verizon	Verizon	AT&T	Leap	T-Mobile	T-Mobile

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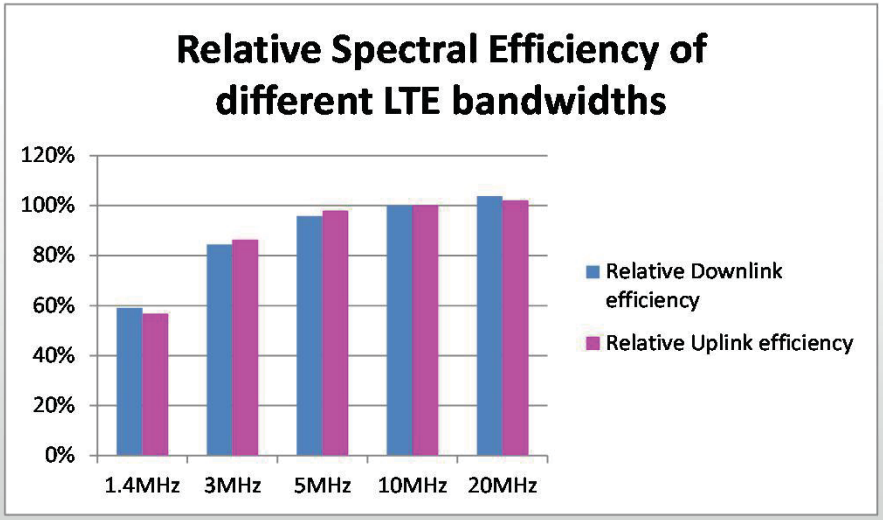
5x5 MHz Blocks Increase Revenues

- Several smaller spectrum blocks can increase competition, participation, and auction revenues, raising revenues for FirstNet
- Competitive carriers will be encouraged to participate in an auction with more licenses and dissuaded from participating in an auction with fewer licenses
- AT&T is wrong when it points to the AWS-1 auction and argues that larger block sizes produce more revenue.
  - The more appropriate comparison is between 5x5 megahertz and 10x10 megahertz licenses for EAs.
  - That's exactly what happened in the AWS-1 auction and the 10x10 megahertz B Block sold for $.43 MHz/Pop while the 5x5 megahertz C Block sold for $.51 MHz/Pop, a difference of approximately 15%

There are Limited Technical Benefits to 10x10 Megahertz Blocks

- The spectral efficiency of various bandwidths depends on many factors, including frequency domain scheduling gains, relative overhead from common and control channels, and relative guardbands
- The efficiency of 5 MHz, 10 MHz and 20 MHz blocks are substantially the same
  - The difference in relative efficiency between 5 MHz blocks and 10 MHz blocks is less than 5%
- Aggregating two non-contiguous 5 MHz carriers on the same band also has practically the same spectral efficiency and peak data rates as with one 10 MHz carrier



Carrier Aggregation Provides Benefits of Wider Channels

- Carriers can create 10x10 contiguous spectrum blocks at auction or in the secondary market.
- However, carrier aggregation virtually eliminates the need for 10x10 megahertz blocks
  - Enables carriers to provide high throughput by combining non-contiguous channels
  - Aggregating two non-contiguous channels has the same peak data rates as one 10x10 megahertz carrier.
  - Two-block carrier aggregation has already been approved by 3GPP; three is under consideration and four will likely be in progress when AWS-3 spectrum is licensed. 3GPP Release 10 contemplates the aggregation of up to **five** carriers.
- Whatever limited technical benefits there are to 10x10 megahertz blocks are more than outweighed by the increase in auction revenues and competition that smaller blocks will produce.

Geographic License Size

- The Commission should license AWS-3 spectrum using a mix of EAs and smaller license areas
  - Smaller licenses will allow licensees to add capacity over the precise area in which they are licensed
  - Encourages auction participation and increases revenues
- The Commission should reject AT&T's calls for larger license areas
  - AT&T cites the prices in the AWS-1 auction for REAGs and CMAs, but REAGs are not at issue in this proceeding
  - AT&T's "activity ratio" comparison is unremarkable considering the different number of licenses available in REAGs and CMAs

Package Bidding

- The Commission should <u>not</u> allow package bidding on AWS-3 spectrum

- AWS-3 adds capacity to AWS-1 networks limiting exposure risk

- Package bidding will:
  - Favor the largest carriers and foreclose access to smaller carriers
  - Create opportunities for strategic bidding that could be anti-competitive and induce inefficiency in the auction outcome

An Analysis of Potential LTE Bandwidths Proposed for the AWS-3 Band

Declaration of Karri Kuoppamaki
Senior Director, Technology Development and Policy
T-Mobile US, Inc.

March 24, 2014

LTE Bandwidth Size for AWS-3*

In the AWS-3 proceeding the Commission has asked for comments on the band plan it should use to license the 1755-1780 MHz/2155-2180 MHz band.[1/] T-Mobile has advocated that the Commission should license the AWS-3 band using 5x5 megahertz, rather than 10x10 megahertz, blocks to promote competition, allow carriers to most efficiently meet their spectrum requirements and to permit licensees to most easily conform to any future spectrum aggregation rules. Others have argued that the Commission should license AWS-3 spectrum in 10x10 megahertz blocks because it permits the spectrum to be used more efficiently. Below, I demonstrate that there is only a slight difference in spectrum efficiency between the use of two 5x5 megahertz blocks, versus a single 10x10 megahertz block and that, through the use of carrier aggregation, two non-contiguous 5x5 megahertz blocks allow the same user experience as a single 10x10 megahertz block. A 10x10 megahertz carrier can also be formed out of two adjacent 5x5 megahertz blocks without carrier aggregation.

Relative Efficiency of Different LTE Bandwidths[2/]

There is only a slight difference in spectrum efficiency between the use of two 5x5 megahertz blocks and a single 10x10 megahertz block. The relative efficiency of different carrier bandwidths is primarily impacted by the following:

1. Guard band overhead – Guard band overhead, the amount of spectrum used for guard band relative to the channel bandwidth, is identical for channel bandwidths of 3 megahertz or greater at 10%, which yields 90% spectrum utilization (e.g. 10MHz having 50 resource blocks at 180 kHz equals 90% utilization) but is higher for a 1.4 MHz carrier bandwidth at 23% yielding 77% utilization (6 resource blocks at 180 KHz equals to 1.08MHz and 77% effective bandwidth utilization).
2. Frequency domain scheduling gains – The larger the bandwidth the more efficiently the scheduler can optimize the transmissions. For 1.4 MHz carrier bandwidths the frequency domain scheduling gain is very low (2.5% on the uplink and 5% on the downlink). For 5, 10 and 20 MHz carrier bandwidths the frequency domain scheduling gains are about 17.5%, 20% and 22.5% respectively on the uplink and 35%, 40% and 45% respectively on the downlink.

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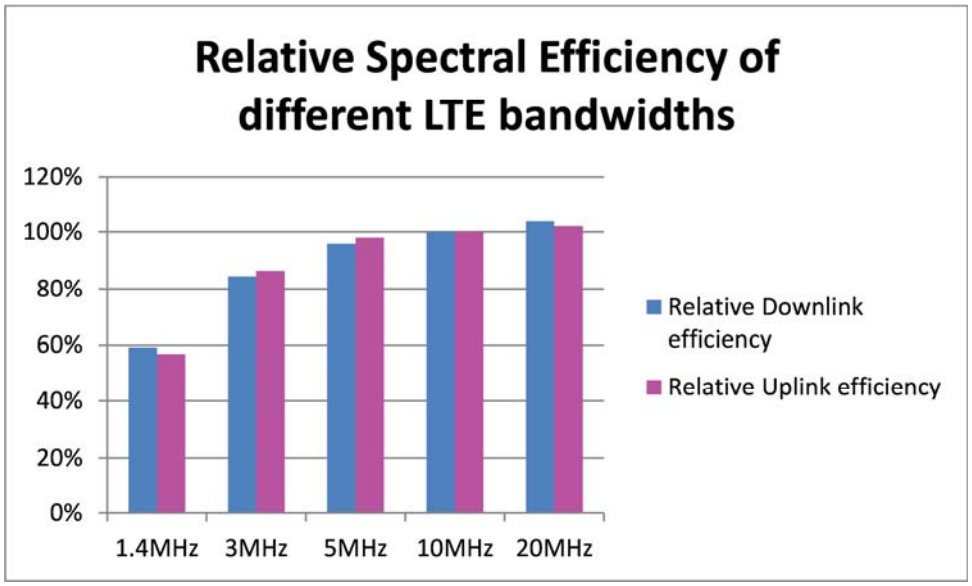
* Prepared by Karri Kuoppamaki, Senior Director, Technology Development and Policy, T-Mobile US, Inc. The following summarizes material found in "LTE for UMTS, OFDMA and SC-FDMA Based Radio Access." *See* Harri Holma, Antti Toskala, *LTE for UMTS, OFDMA and SC-FDMA Based Radio Access* (John Wiley & Sons Ltd. 2009), *available at* http://onlinelibrary.wiley.com/doi/10.1002/9780470745489.fmatter/pdf.

1/ *See Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands, et al.*, Notice of Proposed Rulemaking and Order on Reconsideration, 28 FCC Rcd 11479 (2013).

2/ The following summarizes material found in "LTE for UMTS, OFDMA and SC-FDMA Based Radio Access." *See* Harri Holma, Antti Toskala, *LTE for UMTS, OFDMA and SC-FDMA Based Radio Access* (John Wiley & Sons Ltd. 2009), *available at* http://onlinelibrary.wiley.com/doi/10.1002/9780470745489.fmatter/pdf.

3. Relative overhead from common and control channels – Broadcast Control Channel (PBCH) and Synchronization Channel (PSCH) relative overhead is lower with wider carrier bandwidths. For example on the downlink the common and control channel overhead is roughly 0.6% for 10 MHz carrier bandwidth, ~1.3% for 5MHz carrier bandwidth but ~5.4% for 1.4MHz carrier bandwidth. On the uplink the Physical Uplink Control Channel (PUCCH) relative overhead is identical for channel bandwidths of 5, 10 and 20 megahertz while the overhead is higher for bandwidths less than 5 megahertz.

So, while there are efficiency differences between different LTE bandwidths, those distinctions are only meaningful between carrier bandwidths less than 5 megahertz (1.4 MHz and 3 MHz) and wider carrier bandwidths – not among 5 megahertz, 10 megahertz and 20 megahertz blocks. [3/] Specifically, the efficiency for 5, 10 and 20 megahertz carrier bandwidths is nearly identical with the difference in efficiency between 5 and 10 megahertz carrier bandwidths being less than 5%, while a 3 megahertz carrier bandwidth is about 15% lower than a 10 megahertz carrier bandwidth; and a 1.4 megahertz carrier bandwidth is about 35-40% lower than a 10 megahertz carrier bandwidth.



[3/] AT&T's recent submission demonstrates T-Mobile's point that there is no difference between in efficiency between 5x5 megahertz and 10x10 megahertz blocks, noting that the downlink and uplink capacity of a 5x5 megahertz block is exactly half – not less – of the downlink and uplink capacity of a 10x10 megahertz block. *See,* Letter from Stacey Black, Assistant Vice President, Federal Regulatory, AT&T Services, Inc., to Marlene H. Dortch, Secretary, FCC, GN Docket No 13-185, at Presentation at 3 (filed March 19, 2014). The other graphic associated with its submission merely shows that twice as many users with equivalent performance can be accommodated per cell sector with twice as much spectrum – an unremarkable finding unrelated to block size efficiency.

Carrier Aggregation

While the technical efficiency of deploying a 5 megahertz LTE channel is nearly identical to a 10 megahertz channel; there are customer benefits to the higher data rates that are possible with a wider channel bandwidth. Higher data rates allow consumers to access information faster and enjoy a broader range of services than may be possible at lower data rates. This does not mean however, that it is necessary to auction spectrum in 10x10 MHz blocks. Whatever benefits can be achieved by using 10x10 megahertz blocks can be realized in one of two ways. First, carriers can acquire adjacent 5x5 megahertz blocks, which will result in the same spectrum configuration as a 10x10 megahertz block. Second, carriers can use well-accepted carrier aggregation techniques to use non-contiguous blocks.

Carrier aggregation, as specified by 3GPP, allows for combining compatible carriers with the aim of increasing transmission bandwidth, and thereby enhancing data rates for end-users. It enables operators to provide high throughput by combining *non-contiguous* frequency allocations in the same or different bands, and ensures statistical multiplexing gain by distributing the traffic dynamically over multiple carriers. Aggregating two *non-contiguous* 5x5 megahertz carriers has same spectral efficiency and peak data rates as one 10x10 megahertz carrier.

Several carrier aggregations combinations have already been approved by 3GPP, several others are currently being worked on and more carrier aggregation combinations are expected in the future. A few examples of carrier aggregation combinations including intra-band carrier aggregations are listed below.

Initiated by	Type of Carrier Aggregation		TDD/FDD	Status
Sprint	B41+B41 (intra-band)		TDD	complete
Sprint	B25+B25 (intra-band)		FDD	complete
T-Mobile	B4+B4 (intra-band)		FDD	complete
Sprint	B41+B41+B41 (intra-band and inter-band)		TDD	on-going
T-Mobile	B4+B4+B12 (intra-band and inter-band)		FDD	on-going
T-Mobile	B2+B4+B4 (intra-band)		FDD	on-going
Verizon	B2+B2+B13 (intra-band and inter-band)		FDD	on-going
Verizon	B4+B4+B13 (intra-band and inter-band)		FDD	on-going
AT&T	B2+B12+B12 (intra-band and inter-band)		FDD	on-going
AT&T	B4+B12+B12 (intra-band and inter-band)		FDD	on-going

Source: 3GPP TS 36.101

Verizon has argued that the number of carriers that can be aggregated is limited.[4/] However, LTE 3GPP Release 10 contemplates aggregation of up to **five** carriers. As the above demonstrates there are already three-carrier schemes being worked on by 3GPP and by the time systems with AWS-3 spectrum are expected to be implemented, four or more carrier aggregation configurations will likely be under review. In particular, I expect an inter-band carrier aggregation ecosystem (both network infrastructure as well as devices) to emerge in the US in 2014 followed by intra-band carrier aggregation in 2015. In fact, AT&T is already using inter-band carrier aggregation.[5/]

Because carrier aggregation can be used effectively, the Commission may license AWS-3 spectrum in 5x5 megahertz blocks to promote competition and realize the significant benefits of making more licenses available without diminishing user experience of the spectrum.

I declare, under penalty of perjury, that the foregoing is true and correct to the best of my information and belief.

Karri Kuoppamaki

Karri Kuoppamaki

March 24, 2014

4/ *See* Letter from Tamara Preiss, Vice President, Federal Regulatory Affairs, Verizon, to Ms. Marlene H. Dortch, FCC, GN Docket No. 13-185, at 1 (filed March 14, 2014).

5/ *See* Phil Goldstein, *AT&T Lights Up LTE Advanced Carrier Aggregation in Chicago, Other Markets* (March 7, 2014), *available at* http://www.fiercewireless.com/story/att-lights-lte-advanced-carrier-aggregation-chicago-other-markets/2014-03-07.