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July 7, 2015

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

Re: *Ex Parte* Submission of Laser, Inc., WT Docket No. 14-17

Dear Ms. Dortch:

This supplemental submission filed on behalf of Laser Inc. ("Laser") expands on the analysis in its recent field test report filed in the above-referenced docket on June 19, 2015 ("Technical Report") and its discussion with the FCC's Office of Engineering and Technology ("OET") on June 23, 2015.

The following discussion provides further support for Laser's conclusions set forth in the record that LTE user equipment ("UE") transmissions in the 700 MHz A-Block spectrum in Chicago would cause only a *de minimis* level of interference to the reception of the DTV station WPWR-TV signal. Further, Laser is committing to mitigate any interference that may occur. Hence, the only impact to WPWR-TV would be the very short time between when a location requiring mitigation is identified and the installation of a mitigation. The very small number of locations that may require mitigation makes this impact negligible.

As previously discussed in the cover letter which accompanied the Technical Report filing in this docket on June 19, 2015, Laser is willing to share with the Commission the testing data and detailed results underlying the Technical Report.

Overview of Technical Analysis

In the OET meeting, Laser presented field testing data that demonstrate that DTV receivers tolerate D/U ratios between -35 dB and -45 dB in the WPWR-TV service area before experiencing adjacent-channel interference from an A-Block LTE signal. Laser's testing utilized a 1 MHz offset between the Channel 51 signal and the LTE UE transmission. However, other researchers, notably the FCC OET, report similar results without a guard band.

Laser's results generally are consistent with recent Commission analysis that used a -33 dB D/U ratio to define adjacent-channel interference to DTV receivers.[1] That ratio is an order of magnitude (10 dB) less stringent than the -23 dB D/U ratio utilized in Section 27.60 of the FCC rules. This -33 dB D/U ratio is consistent with the recommendation of the television industry for receiver performance standards in ATSC A/74:2010. Based on the FCC's -33 dB D/U ratio, which is somewhat more conservative than the -35 dB to -45 dB tolerance results of Laser's field testing,[2] the potential for UE-to-DTV interference would be largely the same as demonstrated in Laser's field testing and analysis — only about 122 WPWR-TV viewers (or ~46 households) may experience any disruption to their over-the-air DTV signal from LTE UE operating on the 700 MHz A-Block channel in Chicago.[3]

The data that Laser presented demonstrated that 90 percent of the population served by WPWR-TV are excluded from even the potential for interference, because Laser's testing showed that WPWR-TV's signal strength is sufficient to prevent interference from an LTE UE within the station's 62.1 dBu contour.[4] Laser's analysis also accounted for "corner cases" where people may be viewing over-the-air DTV signals in weak reception areas, such as basements or in areas that have shadowing effects from large buildings downtown. Laser noted the potential of such "corner cases" in the Technical Report, and explained that its field testing had examined the potential for interference within WPWR-TV's 62.1 dBu contour to account for viewers with weak DTV signal strength. In addition, Laser conducted its field testing in a variety of indoor

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[1] *See Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Second Report and Order and Further Notice of Proposed Rulemaking, 29 FCC Rcd 13071, Appendix A (2014).

[2] In most cases, a D/U ratio is calculated for similar signals operating in adjacent channels. However, when dealing with signals of dissimilar bandwidths, the D/U ratio should be adjusted because it is the relative signal amplitude and frequency separation that are most correlated to interference. Hence, a D/U ratio of -33 dB between two adjacent 6 MHz ATSC signals would be -33.8 dB between an ATSC signal with a 5 MHz LTE signal in the adjacent channel. This adjustment brings the ATSC recommended receiver performance of -33.8 dB D/U closer to the measured -35 dB to -45 dB D/U.

[3] These estimates exclude persons using wireless handsets at very close distances of under about two meters to a DTV over-the-air antenna.

[4] The 62.1 dB contour was calculated to be there area where the WPWR-TV signal is 20 dB above the noise limited contour, defined by the WPWR-TV signal being 42.1 dBu, the dipole adjusted value of the 41 dBu specified in the FCC rules as defining the noise limited contour. In this central part of the viewing area, the strength of the WPWR-TV signal is sufficient to eliminate any material probability of interference.

locations throughout the WPWR-TV service area, including at the edges of, and just beyond, the station's protected contour, as discussed in greater detail in Section 5 of the Technical Report.[5]

Laser also used sensitivity analysis to evaluate the impact that wireless operations on the 700 MHz A-Block could have on areas with weak DTV signals. The analysis demonstrated that "corner case" areas with weak reception within the 62.1 dBu contour do not affect the study's conclusion.

- If 10 percent of TV viewers within the 62.1 dBu contour experienced weak reception because they viewed TV in locations such as basements or areas with deep building shadows (an unlikely percentage of viewers), the estimated number of potentially impacted people would increase to 223 and the number of locations to 83.
- In an even more unlikely situation, if 20% of TV viewers within the 62.1 dBu boundary (i.e., one out of every 5 of the ~9 million people living in such area) viewed the DTV signal in a location with weak reception, the estimated number of potentially impacted people would increase to 446 and locations to 166.

The *De Minimis* Interference Impact Can Be Mitigated

When compared to the 10 million people living within the greater Chicago BEA and served by WPWR-TV, and the up to 3.4 million people who could enjoy improved LTE service if the spectrum were to be deployed by a major carrier in Chicago, the 223 or 446 people described above who may potentially experience interference represent a *de minimis* portion of the Chicago TV viewing population.

Significantly, Laser has committed to pay to mitigate any interference that may occur as a result of increasing data services in the greater Chicago area by deploying the 700 MHz A-Block in Chicago.

There are two additional factors that should be considered when analyzing potential interference. First, if a person views the DTV signal in a weak reception area, his or her reception will likely be weak for many stations besides WPWR-TV because multiple stations broadcast from the Willis Tower and other tall buildings in the downtown Chicago area. Since viewers generally desire good DTV reception, people with weak reception will likely have already found methods to improve their reception by utilizing a better indoor TV antenna,

[5] During the field testing, Laser made significant efforts to ensure that the data that was collected was representative of actual viewer conditions and carefully documented the field test measurement conditions so that their significance could be extended to other locations. The DTV signal strength and signal quality measured by Laser were recorded on a calibrated meter and the 20 measurement locations in the inner part of the WPWR-TV viewing area were made either in private homes or at businesses. The measurements made in homes used indoor antennas purchased at major retail outlets like Wal-Mart or Best Buy. The received signal strength was recorded at the input to the DTV receiver.

The measurements made in the Southern Wisconsin area were made both indoors and outdoors. The indoor measurements were made at a motel, while the outdoor measurements were made from a vehicle with a power converter powering the DTV receiver. The WPWR-TV signal strength was measured at the input of the DTV receiver to document the conditions at the measurement location.

moving TV viewing locations, or installing an outdoor antenna. Second, if interference does occur, Laser has committed to mitigate the interference, and the viewer at issue will end up with better overall DTV reception than they currently receive in their weak-reception location.

As Laser explained in its OET meeting, and as explained in detail in the Technical Report, multiple factors must be considered to accurately estimate the number of persons who may be impacted by the deployment of the greater Chicago 700 A-Block spectrum. Laser outlined at least eleven factors that had to occur simultaneously for a viewer to experience interference. The likelihood that all of these the factors will come into play is extremely unlikely – in fact, *de minimis*. And even if interference were to occur, Laser's testing demonstrated that in most circumstances, the interference will be limited and result in the loss of only a few pixels for a short period of time. Moreover, a viewer who experiences interference can self-correct the interference in almost all cases. Laser's testing and analysis show that the distances at which interference could occur almost always fall within a viewer's personal space. In an estimated 96 percent of cases, the LTE handset must be closer than 2 meters from the DTV antenna for interference to even be possible, and in all or virtually all cases, the interference distance must be within 10 meters. Thus, viewers who experiences interference can self-correct the interference in almost all cases by changing their body position, changing the orientation of their LTE device, or moving away from the DTV. In the rare instance where interference is more severe or persistent, it can be mitigated by a better indoor antenna, an outdoor antenna, or a low-pass filter.

The Technical Report presents a detailed analysis of the very small number of viewers who may be affected by interference from the deployment of wireless operations on the 700 MHz A-Block in Chicago. The results of that analysis could change if different estimates were to be made regarding the frequency of the multiple factors that must occur simultaneously for even the possibility of interference to occur. Any reasonable change in such estimates, however, would still result in only a *de minimis* number of viewers who may be impacted by wireless operation of 700 MHz A-Block in the greater Chicago area. And, in any such case, there are multiple paths to eliminate or mitigate any interference that occurs and Laser has agreed to bear the expense of such mitigation.

<u>Laser's Analysis Considered Factors That Could Reduce or Increase the Impacted Viewers</u>

The following factors and considerations would tend to reduce the number of people/households that may be impacted by interference below the estimates presented by Laser in its Technical Report:

- a wireless device is not likely to be constantly operating in every household in the greater Chicago area in which TV is viewed over-the-air,
- all of the wireless devices operating in such households will not be operating in the <u>transmission</u> mode, (and instead will be frequently inactive or will be downloading data, or receiving voice communications in the downlink mode),
- all of the wireless devices operating in such households are not likely to be operating solely on the 700 MHz A-Block and instead will frequently be operating on one of the other multiple bands that are available on virtually every wireless device sold today,

- every wireless device that is operating in a household with over-the-air reception will not be not located in close proximity to an indoor DTV receiving antenna,
- many wireless devices will be up-loading data through a Wi-Fi connection, which is used approximately 80 percent of the time, and
- wireless device antennas will not always be oriented toward the DTV receiver antenna, and the device user's body, walls and furniture will often attenuate the signal from the device to the DTV receiving antenna.

The following factors and considerations would tend to increase the number of people/households that may be impacted by interference above the estimates presented by Laser in its field study but, as noted above, any reasonable change in such estimates would still result in a *de minimis* number of viewers that may be impacted by wireless operation on the 700 MHz A-Block in greater Chicago:

- Some viewers within the WPWR-TV 62.1 dBu transmission contour may view over-the-air TV in a weak reception area (but as noted in Laser's study, its results adjust for these "corner case" viewers because the analysis was conducted at the 62.1 dBu contour rather than the 42.1 dBu noise limited contour),
- the percentage of viewers using over-the-air reception, an aggregate of 7 percent for indoor and outdoor antennas, could increase, but it is likely that any such increase would be a small amount through 2020 when the interference issue disappears as a result of the 600 MHz auction, and
- WPWR-TV may increase its market share from the current 1.3 percent viewership peak (0.65 percent viewership average), although any such increase is likely to be gradual over the next five years.

<u>Laser's Analysis Considered Multiple Handsets</u>

Laser's Technical Report did not specifically address the potential impact of multiple LTE handsets on adjacent channel DTV reception. However, as discussed below, the field testing conducted by Laser provides a good estimation of the impact that is likely to be experienced from the operation of one or more LTE handsets in a single household or in the general proximity of the same TV.

As discussed above, Laser's field testing and analysis demonstrated that LTE handset transmissions will only impact DTV reception — if at all — at distances of approximately two meters or less from a DTV antenna in the vast majority of cases. It is unlikely that multiple LTE handsets will be operating within such proximity to an indoor DTV receiving antenna. And, while one could envision scenarios in which multiple handsets will be in use at the same time and in the same general location (e.g. a party, a family gathering, etc.), it is highly unlikely that all handsets would transmit on the A-Block as opposed to the multiple other uplink channels available on virtually every wireless device sold today.

Even if multiple handsets were operating in close proximity and all were operating on the 700 MHz A-Block, the calls would all be under the control of a single network operator since there is only a single 700 MHz A-Block license in each geographic area. As a result, all of such

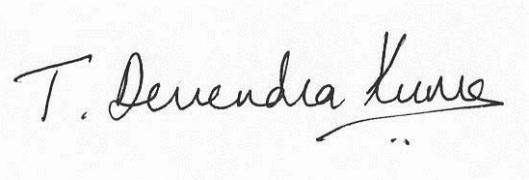
calls would be controlled by the network operator's base station which regulates the cell serving that area.

Having a single base station controlling A Block calls within a geographic area means that if multiple handsets are assigned to the A-Block, their activity will be separated in time and/or frequency since only one LTE handset can operate at a time on a given frequency. The field testing performed by Laser operated the test handsets at very close distances to the DTV receiver and forced the handsets to transmit continuously at a very high data rate of 3 Mbps, which effectively presents a worst case or near worst case scenario because such a high data rate signal exceeds what is required for virtually all LTE UE uplink transmissions.[6] Thus, Laser's field testing of a single handset transmitting continuously within very close distances to a DTV antenna created a higher potential for interference to DTV reception than would be presented by multiple handsets operating close to a DTV receiver, each transmitting at different times or on different frequencies.

As a result of the foregoing, Laser submits that the cumulative impact of multiple LTE handsets operating at the same time in close proximity to the same DTV receiver will create a smaller potential for interference than the impact of one continuously transmitting LTE handset that is transmitting a very high data rate signal in close proximity to a DTV, as tested by Laser.

Please direct any questions regarding this matter to the undersigned.

Respectfully submitted,



Devendra T. Kumar
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[6] Indeed, in the earlier testing performed by Intertek, the impact of a fully-loaded LTE handset signal occupying every available frame and resources block was tested, and the results were found to be essentially the same as in the recent field testing. *Intertek, Evaluation of The RF Coexistence LTE Operation on 700 MHz A Block (formerly channels 52 / 57) and TV Channel 51 Reception*, Report G1002WX445LEX-02 (Jan. 14, 2013), filed as Exhibit B to Petition of Cricket License Company, LLC for a Waiver of DTV Protection Criteria, ULS File No. 0006046277 (filed Dec. 6, 2013).