December 13, 2018

Mr. Julius P. Knapp
Chief Engineer
Office of Engineering and Technology
Federal Communication Commission
445 12th Street, S.W.
Washington, D.C. 20554

RE: **Office of Engineering and Technology Requests for Comments on Phase I Testing of Prototype U-NII-4 Devices (ET Docket No. 13-49)**

Mr. Knapp,

Continental welcomes the opportunity to comment on the Federal Communications Commission's (FCC) Office of Engineering and Technology (OET) Request for Comments on Phase I Testing of Prototype U-NII-4 Devices noticed on October 29, 2018 (ET Docket No. 13-49). We offer these comments in reference to the submission by the Motor Equipment Manufacturing Association (MEMA) to provide further background material to the docket for consideration.

Continental is a leading Tier 1 supplier that develops intelligent technologies for transporting people and their goods. We provide our automotive customers with sustainable, safe and affordable solutions that enhance automotive safety. In 2017, we generated more than $50 billion in sales within our six divisions, Chassis & Safety, Interior, Powertrain, Tires, and ContiTech. Continental employs more than 23,000 employees in the U.S, at more than 90 facilities located in 29 states. We have more than 230,000 employees worldwide in 55 countries.

Continental plays an integral role in the development of innovative active and passive safety, driver assistance, and automated driving technologies. For more than a decade, we have been actively involved in developing the technology that vehicle manufacturers will use to transmit the Basic Safety Messages (BSMs) that comprise the foundation of Vehicle-to-Vehicle (V2V) communications.

The published preliminary results demonstrate potential sharing solutions between the proposed Unlicensed National Information Infrastructure (U-NII) devices and licensed Dedicated Short-Range Communications (DSRC) operations in the 5.9 GHz frequency band. As stated in the executive summary, the laboratory test results provide the baseline data to perform the analysis of additional operational scenarios and "real-world" empirical tests as part of the future phases of the coexistence test effort.

Executive Summary

In the view of Continental, all three phases of the test plan need to be completed before the Commission concludes on the potential additional authorizations of the 5.9 GHz band, particularly for field testing in real-world environments, to ensure there would be no harmful interference. For

example, tests should include the transmit power implemented in actual DSRC devices in cars, which is just 20 dBm, instead of the maximum permissible EIRP level of 33 dBm. Furthermore, different environmental scenarios, such as intersections, should be addressed in detail.

In our view, the presented results mark a good starting point, and we support the call for additional tests to complement the ones provided in this document.

From a spectrum view, 75 MHz of bandwidth is required for V2X, regardless of the communication technology, to be able to achieve the known application roadmap leading to automated driving. Any re-channelization for U-NII or sharing with U-NII devices would hinder the full potential of this life-saving communication technology. Re-channelization for U-NII or sharing with U-NII devices would also inhibit the evolution of V2X applications towards automated driving (as explained below with V2X messages like Platooning Control Message (PCM), Maneuver Cooperation Message (MCM), and Collective Perception Message (CPM)).[1]

In Detail

We note that examples of the FCC test results indicate harmful interference.

Referencing the FCC document DA-18-1111A2, Figure 11 shows the impact on the packet completion rate for DSRC communication in the 10 MHz channel 174 (or equivalently channel 180), channel 172 (or equivalently channel 182), and channel 184 when simultaneously operating a U-NII device at the 20 MHz channel 177.

Measured interference starts in the first adjacent channel 174 once the U-NII device's signal power reaches -60 dBm until there is a 0% packet completion rate by -48 dBm. This means that the impact of a U-NII device at the proposed maximum transmit power (+36 dBm EIRP) on DSRC communication is a drop of 96 dB of power density. This determines an interference range of approximately 250 meters, assuming a free-space propagation model. In conclusion, if a re-channelization sharing concept is approved, U-NII devices will impact DSRC communication up to 250 meters in any direction (e.g. when used as a WLAN hotspot at an intersection).

The same observation is valid for the second and third adjacent channel (172 and 184) once the U-NII device's signal power reaches -52 dBm in the second adjacent channel and -48 dBm in the

[1] Platooning Control Message, currently being drafted in the European H2020 project ENSEMBLE (multi-brand truck platooning). https://platooningensemble.eu/

Maneuver Cooperation Message, according to ETSI TR 103 578 (draft) "Intelligent Transport Systems (ITS); Vehicular Communications; Informative report for the Maneuver Coordination Service," and TS 103 561 (draft).

"Maneuver Coordination Service" is in development in project IMAGINE; https://imagine-online.de/en/home/
Collective Perception Message (CPM) specified in ETSI TS 103 324 (draft) to specify the Cooperative Observation Service (COS) in support of ITS applications, and;

ETSI TR 103 562 (draft) "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Analysis of the Collective Perception Service (CPS); Informative Report for the Collective Perception Service."

See also H. Gunther, O. Trauer and L. Wolf, "The potential of collective perception in vehicular ad-hoc networks," 2015 14th International Conference on ITS Telecommunications (ITST), Copenhagen, 2015, pp. 1-5. doi: 10.1109/ITST.2015.7377190;

third adjacent channel. The interference from the UN-II devices reaches ~100 meters in the second adjacent channel to 62 meters in the third adjacent channel, respectively, resulting in unreliable operation of the DSRC safety applications. A single U-NII-4 device transmitting in Channel 177 would impact DSRC transmissions within 62 meters in all three adjacent channels (meaning channels 180, 182, and 184 in the future).

We encourage the focus on a wide mid-band spectrum of 1200 MHz, which is the subject of the FCC NPRM (FCC-18-147A1) for U-NII use in the 5925-7125 MHz range. We support this range for U-NII devices, as long as the V2X spectrum is protected from spillover. We also would like to note that the proposed sharing bandwidth of 45 MHz in the 5.9 GHz spectrum is very small in comparison. The parallel use of the 5850-5895 MHz frequency band for U-NII, taking into account the indicated interference, will be a barrier for life-saving V2X technology.

The full V2X spectrum of 75 MHz is, and will be, needed to roll out the foreseen safety benefits of V2X communication regardless of technology choice. The application roadmap up to cooperative and connected automated mobility (CCAM) includes newer messages like Collective Perception Message (CPM, 700 Byte) and Maneuver Cooperation Message (MCM, 400 Byte), which are important to support future automated driving, and which would occupy 30 MHz of the available V2X spectrum.

We would like to explain this with the following future messaging roadmap examples for calculating realistic spectrum needs depending on the safety-related communication range[2,3] in loaded circumstances:

The spectrum requirements should be related to different scenarios/environments.

An urban environment would load one channel for BSM, one for pedestrian protection with Personal Safety Message (PSM),[4] one for PCM, and two channels for CPM and MCM. This leaves some space for challenging situations which could come in addition.

One challenging situation would be an intersection in an urban square full of people. In this case, pedestrian protection would fill three channels instead of one channel, assuming 3500 pedestrians in the reception area of the vehicles with each sending one message per second. This would require more than 30 MHz bandwidth. Additionally, if there is slow moving traffic, the BSM needs to be received within a safety range of at least 100m in the city where about 320 stations transmit with 3 Hz (as the channel is already in a congested mode). In total, such an urban scenario with slow moving, but dense traffic, would require the full 75 MHz of spectrum for BSM, PSM, PCM, CPM, and MCM.

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[2] Spectrum needs = $\frac{packet\ size \times periodicity \times ITS\ stations\ in\ comm\ range}{spectrum\ efficiency \times max\ channel\ load}$

[3] Note communication ranges can be much larger than the required safety related communication range, which derives from the use case requirements in certain environments.

[4] Pedestrian protection with Personal Safety Messages (PSM) according to SAE J2735, SAE J2945/9_201703 https://www.sae.org/standards/content/j2945/9_201703/

The other extreme is a highway scenario with a relevant safety range of at least 500m, where around 100 fast-moving vehicles would be receiving messages. Such traffic will fill one channel for BSM and one channel for truck platooning (assuming 400 Byte messages sent with a periodicity of 50 Hz[5]), while another three channels could be loaded with CPM and MCM with a periodicity of 10 Hz. Furthermore, extraordinary situations such as tolling stations or truck parking spaces where many truck platoons can be located within reception range of each other should be taken into consideration and can count for an additional channel. If one imagines another highway is going over a bridge or other types of roads being close to the highway, it is justified to reserve a channel for such occasions, resulting in 75 MHz being needed for highways, as well.

Our calculations are in line with those done by other sources[5,6] and are based on the currently known messages (BSM, PSM, PCM, SPAT, MAP[7], CPM, and MCM). Additional messages for additional applications would potentially lead to additional spectrum requirements in the future.

Please also note that we calculated spectrum needs only based on relevant safety distances. For a vehicle in an urban intersection, 100 m of safety range is probably enough from a safety use case perspective to be able to react in time, while receiving, for example, BSMs from about 320 nearby vehicles, while 150m in a suburban and 500m on a highway are seen as relevant safety distances. Realistic communication ranges are, in general, much above these distances which would lead to even more vehicles in communication range. While not significantly relevant for safety benefits, this would lead to additional communication needs for frequency spectrum.

During the Commission's review of the comments being submitted, we would like to reference the protocol of a European spectrum regulation meeting (CEPT CPG)[8] earlier this year for consideration. At the meeting, regulators from 48 countries throughout Europe concluded that ITS (DSRC) communications cannot be adequately protected from harmful interference using sharing mechanisms currently under consideration. This decision was based on a technical report[9] prepared at CEPT's request by many global DSRC and WLAN stakeholders, including QUALCOMM who

[5] C2C-CC White Paper, "Road Safety and Road Efficiency Spectrum Needs in the 5.9 GHz for C-ITS and Automation Applications CAR 2 CAR Communication Consortium", assumptions for V2X messages aligned with passenger vehicle and truck OEM. https://www.car-2-car.org/fileadmin/documents/General_Documents/C2CCC_TR_2050_Spectrum_Needs.pdf

[6] Qualcomm paper L. Gao, Y. Li, J. Misener and S. Patil, "C-V2X Based Basic Safety Related ITS Spectrum Requirement Analysis," 2017 IEEE 86th Vehicular Technology Conference (VTC-Fall), Toronto, ON, 2017, pg. 1-5. doi: 10.1109/VTCFall.2017.8288393.

[7] Signal, Phase, and Timing (SPAT), ISO/TS 19091:2017; and MAP, ISO/TS 19091:2017

[8] CPG(18)017 (Jan. 2018); Minutes of CEPT CPG19-5, see page 13 regarding WRC19 agenda item 1.16 "As far as the band 5850-5925 MHz is concerned,… that studies so far had indicated there were difficulties in providing appropriate protection to all of the safety related ITS functionalities from RLAN interference" https://www.cept.org/Documents/cpg/40925/cpg-18-017_minutes-of-cpg19-5

CPG(18)014 (Jan. 2018); contribution towards CEPT CPG: "In the attached document (B. Cheng, H. Lu, A. Rostami, M. Gruteser, J. Kenney: "Impact of 5.9 GHz Spectrum Sharing on DSRC Performance", IEEE VNC 2017, Turin) simulation results covering the effects of Detect&Mitigate and Detect&Vacate onto a co-operative ITS system (in that document called DSRC) based on IEEE802.11p are presented. Figure 4 and figure 5 show a significant performance impact onto the ITS system in the sense of communication distance for both mitigation techniques prior to detection of ITS traffic. E.g. from Fig. 5a, it can be observed that without Wi-Fi traffic, the two ITS devices can communicate with each other before they are 65 m from the intersection center. However, with Wi-Fi traffic, it is possible that the first contact between ITS devices does not occur until they are 30m from the intersection center. Furthermore, Figure 8 shows that Detect & Mitigate interferes with ITS communication even after detection of ITS traffic, e.g. from Fig. 8a it can be observed that Wi-Fi adds more than 30% to the ITS Packet Error Ratio at a distance 50 - 60m from the intersection center. These are significant reductions of performance in an intersection scenario, which can clearly be interpreted as harmful interference. The intersection collision warning of ITS is known to be one of the most important use cases to prevent fatal accidents in cities"https://www.cept.org/Documents/cpg/40428/cpg-18-014_d-cept-brief-ai116-support-on-5850-5925

[9] ETSI TR 103 319 (Aug. 2017); "Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Mitigation techniques to enable sharing between RLANs and Road Tolling and Intelligent Transport Systems in the 5725 MHz to 5925 MHz band." https://www.etsi.org/deliver/etsi_tr/103300_103399/103319/01.01.01_60/tr_103319v010101p.pdf

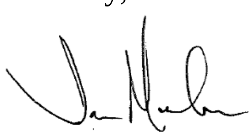
previously advocated for sharing. QUALCOMM submitted a contribution supporting this conclusion explicitly expressing that "spectrum sharing for RLAN (Radio LAN) and ITS considering safety-related applications in the 5.9 GHz band should not be recommended."[10]

In a later European meeting (CEPT CPG) in January 2018, European spectrum regulators confirmed that WLAN should not share 5.9 GHz with DSRC based on considerations of realistic interference scenarios.[11]

Conclusion

Continental supports the continued efforts of the Federal Communications Commission to aid in the development of advanced automotive safety technologies under the 5.9GHz spectrum for intelligent transportation services. We would like to thank the Office of Engineering and Technology for the opportunity to provide input at the Commission's request for comments and welcome the opportunity to provide direct feedback during the review process. Should you have questions or wish to discuss to discuss this further, I can be reached by telephone at (202) 657-2931 or by email at Ian.Musselman@Continental.com.

Sincerely,



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[10] CEPT DOC PTD(17)108 (Sept. 2017): Contribution towards CEPT PTD. https://www.cept.org/Documents/cpg-pt-d/38080/ptd-17-108_etsi-tr-103-319-discussions-on-coexistence-study-of-rlan-with-its-at-59-ghz

[11] CPG(18)017 ANNEX IV-16 (Jan. 2018): Annex to minutes of CEPT CPG19-5, draft CEPT brief for agenda item 1.16 for WRC19: with the preliminary CEPT position regarding RLAN sharing in 5850 – 5925 MHz: "In the 5850-5925 MHz band, CEPT notes that the current studies have shown difficulties in achieving co-existence with other incumbent services without imposing any additional constraints on existing services such as FSS (space station receivers) and existing applications under the mobile service such as ITS (including urban rail)." https://www.cept.org/Documents/cpg/40842/cpg-18-017-annex-iv-16_draft-cept-brief-on-ai-116