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September 8, 2015

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, NW
Washington, D.C. 20554

**RE: Office of Engineering and Technology and Wireless
Telecommunications Bureau Seek Information on Current Trends In
LTE-U and LAA Technology, ET Docket No. 15-105**

Dear Ms. Dortch:

On August 29th, 3GPP held a workshop on the form of unlicensed LTE known as Licensed Assisted Access, or LAA. At this session a number of U.S. and international cable operators, as well as IEEE and Wi-Fi Alliance, presented views on the importance of protecting existing unlicensed consumers and how to achieve that outcome. I have attached the presentation made by cable operators for the Commission's consideration.

This presentation notes that collaborative technology development between 3GPP and the unlicensed community – including the cable industry, IEEE, and Wi-Fi Alliance – is critical. Absent a broad technical consensus, millions of Wi-Fi consumers are at risk. Cable operators therefore recommended that 3GPP adopt a number of specific coexistence features that have been proven successful through IEEE 802.11, and that those features be included as a mandatory part of the LAA standard to enable the continued growth of wireless broadband over unlicensed spectrum. These coexistence features fall into three categories:

1. Permitting equitable spectrum access across technologies, including through the “listen before talk” (LBT) configurations that hold the most promise for coexistence;
2. Ensuring that consumers have the ability to access their network of choice; and
3. Enabling robust coexistence testing, measurement, and certification of LAA technology.

3GPP did not make any decisions on including coexistence mechanisms in the LAA standard at the August 29th meeting. And while the Technical Report (TR 36.889) it approved in May noted that a “listen before talk” approach is preferred, important details have yet to be decided about how it will be structured to coexist fairly with Wi-Fi.

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NCTA understands that 3GPP will make its draft LAA standard available for external review in the fourth quarter of 2015. We hope that 3GPP will incorporate the input of outside groups into the final text. However, we understand that 3GPP will close consideration of the final text of the LAA specification in March 2016. This provides only a limited window for 3GPP to incorporate any changes recommended by outside parties before LAA moves to manufacture and deployment, so time is of the essence. We, like the other stakeholders, intend to continue to pursue improvements at 3GPP, and look to the support of the international Wi-Fi stakeholder community to protect the integrity of the unlicensed ecosystem.

Separately, as the Commission is aware, a set of individual companies is developing a different unlicensed LTE technology, called LTE-U, outside of the 3GPP process, specifically for the U.S. market. LTE-U does not meet even the minimal coexistence standards being advanced for LAA. 3GPP, in fact, has decided not to even *explore* a duty-cycle approach for the LAA version of unlicensed LTE, instead focusing on types of LBT. But because carriers plan to deploy LTE-U and not LAA in the United States, American consumers may never benefit from the coexistence mechanisms described above even if 3GPP adopts them for the global LAA standard.

Cable operators and the broader unlicensed community remain eager to engage with proponents of LTE-U and LAA to ensure that these technologies can share spectrum with Wi-Fi without harming consumers. Cable representatives traveled to Beijing to meet with 3GPP on August 29th, and we will attend future discussions whenever and wherever they take place. But the LTE-U Forum, by contrast, has provided no workable procedure for considering the views of unlicensed stakeholders. The specific recommendations for 802.11-like coexistence features that cable companies presented at the August 29th 3GPP meeting should apply equally to all variants of unlicensed LTE.

Thank you for considering this information. If you have any questions, please contact me.

Regards,

/s/ Rick Chessen

Rick Chessen

cc: Julius Knapp via email

CONTRIBUTION TO 3GPP LAA WORKSHOP

29 AUGUST 2015, BEIJING

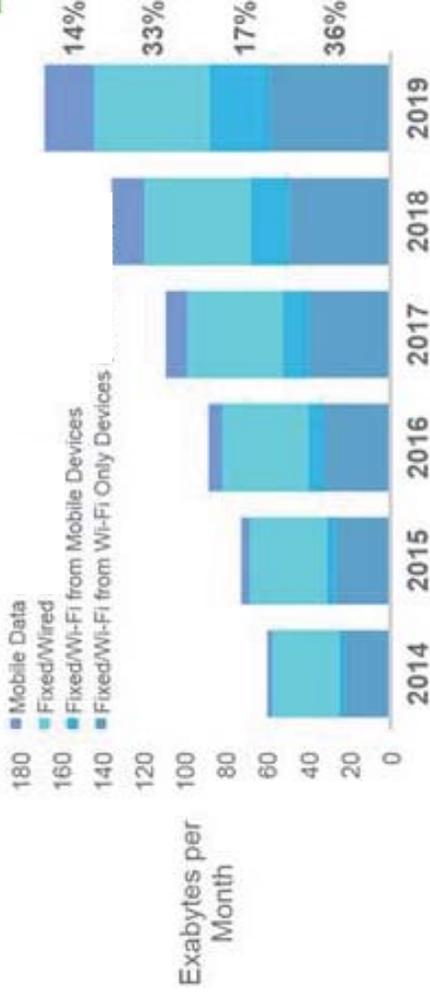
**Cablevision, Suddenlink communications, Tele Columbus,
Charter Communications, Cox Communications, Comcast,
Liberty Global, Cogeco Cable, Atlantic Broadband, Time
Warner Cable***



AGENDA

- 1. Cable industry in unlicensed bands**
- 2. LAA coexistence design considerations**
- 3. Next steps**

WI-FI IS THE BROADBAND WORKHORSE



Mobile and Wi-Fi global traffic distribution trend [1]

By 2019:

- Wi-Fi networks will carry more than 50% of the global IP traffic.
- Wi-Fi networks will carry nearly 80% of all global IP wireless traffic.

Wi-Fi networks are and will remain the most cost effective and popular access technology.

CABLE OPERATORS' INTEREST IN WI-FI DEPLOYMENTS

Sample Cable Wi-Fi networks:

- Comcast: operates 10+ million Wi-Fi hotspots in the US [10]
- Liberty Global: 6 million hotspots in Europe [8]
- Time Warner Cable: 100,000+ Wi-Fi hotspots in US [7]
- Shaw Cable: 60,000+ hotspots across Western Canada [6]
- Cablevision: 1,200,000+ Wi-Fi hotspots in US [13]

Broadband consumers heavily rely on Wi-Fi to connect online.

The Cable Industry has a vested interest in ensuring that unlicensed LTE fairly and reliably coexists with Wi-Fi.

JOINT COLLABORATION ON UNLICENSED BAND

Collaborative technology development through IEEE has led to the success of Wi-Fi and other unlicensed technologies.

3GPP has been developing the standard for LTE in unlicensed spectrum.

Lack of collaboration between 3GPP and the other major Wi-Fi stakeholders (e.g., cable industry, WFA, IEEE) may limit the successful development of new technologies in unlicensed bands.

The development of unlicensed LTE should include input and ensure consensus from the major Wi-Fi stakeholders.

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THE TRAFFIC FAIRNESS CONCEPT

[9] states *“The LAA design should target fair coexistence with existing Wi-Fi networks to not impact Wi-Fi services more than an additional Wi-Fi network on the same carrier, with respect to throughput and latency.”*

While the statement appears to be formally sound, it does not clearly specify a fair spectrum access in terms of time and bandwidth. Suggested fairness criteria should include:

- LAA and Wi-Fi networks must receive equal access to the unlicensed band
 - In air time
 - In spectrum allocations
- When demand exceeds capacity, each network must be able to access an equal share.
- When a particular network’s user plane traffic demand is less than the spectral capacity of an equal share, that network must allow other networks to access the unused capacity.

Proposal: 3GPP should clarify the basic traffic fairness definition with the fair spectrum access in terms of bandwidth and time.

SINGLE GLOBAL SOLUTION WITHOUT CONFIGURABILITY

While regulatory requirements for equipment operating in unlicensed band vary by region, 3GPP agrees that Listen Before Talk is a fundamental requirement for fair coexistence.

- [9] states LBT is a required functionality for an LAA system, and is “vital for fair and friendly coexistence”.

Yet, the same TR also allows for “a single global solution framework...to ensure LAA can be operated according to any regional regulatory requirements... LAA design should provide sufficient configurability to enable efficient operation in different geographical regions”.

Proposal: 3GPP should ensure LBT cannot be switched off by removing the “framework” and configurability requirement from 3GPP specification.

CATEGORY 4 LBT FOR DL LAA, WITH PROPER PARAMETERS

[9] concludes that Cat4 LBT scheme (dynamic or “semi-static” back-off) is the best way to ensure fair coexistence for DL access, but leaves some vital parameters open for further study.

TR shows evidence almost all evaluations are based on (and show good coexistence) :

- Exponential backoff, with $CW_{min} = 16$, $CW_{max} = 1024$
- Defer period = 34-43 μs
- ACK/NACK based feedback
- Slot length = 9 μs

Above set of parameters is consistent with Cat4 LBT and should be set as a minimum requirement.

Proposal: 3GPP should consider the above set of Cat4 parameters without configurability, for DL transmissions, based on fair spectrum access (time and bandwidth) considerations.

CAT4 LBT FOR UL LAA

[9] does not recommend a LBT category for UL.

- LAA UL transmissions share the same channel as Wi-Fi DL + UL transmissions. Therefore, as # of transmitters increases due to scheduled LAA UEs, contention window must adaptively increase to avoid an increase in collision rate.

While 3GPP has argued for non-Cat4 LBT for UL, such as shortened backoff for faster UL access, it is important to also consider the following:

- Exponential backoff starts with a low CW_{min}, and is adaptive to increased collision rate.
- Therefore, there is no need to artificially adjust the parameters.

Proposal: 3GPP should consider the same set of Cat4 LBT parameters and values for both UL as and DL transmissions.

LBT IMPLEMENTED ON ALL SIGNALS TRANSMITTED DURING SCELL OFF

Rel-12 DRS were designed to supported SCell on/off.

LAA does not mandate LBT for control channels/signals (e.g., DRS is allowed to be transmitted as a short control transmission without LBT).

To ensure fair coexistence in unlicensed band, the following should be taken into account :

- DRS duration is ≤ 5 ms, longer than the vast majority of Wi-Fi TxOP in the field (3ms). Transmitting DRS without LBT will adversely impact Wi-Fi transmissions.
- The closest Wi-Fi equivalent of DRS is beacons broadcasted by APs. However, Wi-Fi beacons are subject to LBT.
- Japan regulation does not allow short control transmissions without LBT. Consistent with the requirement for LAA to operate under a single, global solution, non-LBT DRS should not be allowed.
- The aggregated RF RX power of all control channels/signals could exceed Wi-Fi ED thresholds.

Proposal: 3GPP should consider requiring LBT support for all signals/channels.

SETTING LIMITS ON DRS

DRS duration is $\leq 5\text{ms}$, longer than the vast majority of Wi-Fi TxOP in the field (3ms).

DRS is sent during DMTC occasion, which is 6ms.

DRS takes up considerable airtime overhead, particularly when 5ms duration and 40ms periodicity is used.

Even though multiple DRS occasions can be sent in a single DMTC occasion, there are no requirements to do so.

- In the case where multiple LAA operators are present, they may not line up their DMTC occasions, which will incur even more airtime overhead during SCell OFF.

Proposal: 3GPP should consider requiring synchronized DMTC occasions when multiple LAA systems are present. Furthermore, 3GPP should consider limiting the DRS duration and periodicity.

LOWER SENSING THRESHOLDS FOR DL + UL LAA

VoWiFi continues to gain popularity [12, 14, 15]. LBT must be evaluated and designed by using VoIP performance as a least common denominator, not as optional as stated during 3GPP evaluation.

Although optional, a handful of evaluation results were reported in [9]. In particular :

- For DL-only LAA coexisting with Wi-Fi, -62 dBm was shown to impact Wi-Fi; whereas -82 dBm showed no increase in VoIP outage. (§8.3.1.1.1, 8.3.1.3)
- For DL + UL LAA coexisting with Wi-Fi, only -82 dBm was used for VoIP and showed no impact on VoIP outage. (§8.3.2.1)

Proposal: 3GPP should consider lowering the CCA-ED threshold from -62 dBm for LAA DL + UL, to ensure real time traffic is not impacted due to presence of LAA.

IN-DEVICE COEXISTENCE

In order to provide the user with more flexibility in terms of network connectivity, devices operating in LAA mode must be able to detect a list of Wi-Fi SSIDs.

3GPP claims that LAA UE has the ability to do so. However, these capabilities are all optional today:

- When UE identifies an IDC resource conflict, e.g., LTE transmitter causing interference to a WLAN receiver, LAA UEs can use an LTE Rel-11 IDC solution to report and resolve resource conflict.
- However, eNB is not required to help UE resolve resource conflict.
- Furthermore, UE is not required to report resource conflict.

Proposal: In order to allow the user to preferentially select a network, 3GPP should require a UE operating in LAA mode to periodically scan for Wi-Fi SSIDs.

PERFORM COEXISTENCE EVALUATION WITH ADDITIONAL PERFORMANCE METRICS

Airtime occupancy

- LBT leads to fair channel access opportunities.
- Once successfully acquires the channel, no transmitter should be allowed to “hog” the channel for a prolonged period of time.

Wi-Fi frame re-transmission rate at the MAC

Impact of LAA on Wi-Fi control and management frames (e.g. Wi-Fi beacon loss and deferral)

Data rate, measured as MCS on each Wi-Fi frame

Proposal: 3GPP should consider a maximum airtime occupancy to meet the airtime fairness criteria (see slide 8).

EVALUATE COEXISTENCE IN DENSE DEPLOYMENT SCENARIOS

Denser scenarios have more significant impact on the mean contention window.

3GPP has repeatedly rejected IEEE's requests to simulate denser scenarios in LAA SI (50-200 STAs/AP), citing either no reason or dense scenario being unrealistic. [2] [3]

Survey of several major N. American and Asian Wi-Fi operators show that most operator deployments are on the order of :

- Indoor density 20 STAs/AP; urban outdoor density 60-100 STAs/AP.
- Operators routinely see 200-580 Wi-Fi APs at a given urban outdoor location in today's deployment. 20-50 APs on any given 20MHz channel is expected in the near future.
- LAA is likely to be deployed in traffic congestion areas (e.g. high dense urban areas) where multiple operator-deployed LAA-LTE and Wi-Fi systems have been already rolled-out.
- The above real traffic conditions may risk rendering 3GPP LTE LAA simulations as being not realistic.
- 3GPP needs to either increase # of operators with above density, or stay with 2 operators but increase STA density.

Proposal: 3GPP should collaborate with all major Wi-Fi stakeholders to simulate realistic deployment scenarios in the LAA WI.

UPDATE TRAFFIC MODELS TO INCLUDE REAL-TIME TRAFFIC

3GPP did not consider requests [2, 3, 11] to simulate other real-time traffic such as video in LAA SI, despite :

- Global IP video traffic (Internet video, IP, VoD, video-streamed gaming, videoconferencing) will continue to be 80-90% of all IP traffic. [1]
- 3GPP traffic conditions [9] do not reflect the Wi-Fi user traffic scenarios.
- Globally, there will be nearly 341 million public Wi-Fi hotspots by 2018, up from 48 million in 2014. [1]
- IEEE repeatedly recommended 3GPP to simulate coexistence scenarios with video traffic. [2] [3]
- VoIP traffic is not a mandatory traffic model, despite the fact that VoWiFi traffic is expected to exceed VoLTE traffic. [12]

Proposal: 3GPP should work with all major Wi-Fi stakeholders to include video and VoIP traffic model requirements in the LAA WI.

EVALUATE COEXISTENCE IN MULTIPLE CHANNELS

Wi-Fi devices already support multiple channels configuration.

MNOs stated that LAA devices will utilize multiple channels. Indeed, 3GPP Rel-13 CA WI includes support for LAA as a main rationale for increasing # of component carriers to 32. [5]

Wi-Fi treats secondary channels differently from primary channels, and may be unfairly impacted if LAA uses same LBT mechanism on all channels regardless of whether the channel is Wi-Fi's primary or secondary channel.

Proposal: 3GPP should investigate impact on coexistence in multiple channel transmissions as part of the LAA WI.

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DEVELOP PROCESS FOR LAA DEVICE CERTIFICATION

Unlike traditional 3GPP-driven specifications, LAA operations impact other (non-3GPP) controlled networks.

To ensure LAA can coexist fairly with Wi-Fi technologies in unlicensed bands, 3GPP should develop test procedures collaborating with the Wi-Fi certification bodies ensuring LAA devices' successful coexistence certification before deployment.

To ensure tests are done in a fair and open manner, testing may be performed by organizations independent from the cellular and Wi-Fi industries.

Proposal: 3GPP should work with major Wi-Fi stakeholders to develop test plans, and ensure LAA devices pass mandatory coexistence tests, before deployment in the field.

CONCLUSIONS

Cable Operators look forward to the opportunity to collaborate with 3GPP.

- Technical collaborations based on design considerations provided in this deck.
- Processes to ensure LAA devices are certified for fair coexistence.

In the case of LAA, without effective coexistence, access to unlicensed spectrum will be controlled by licensed spectrum holders.

REFERENCES

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- [13] <https://www.optimum.net/internet/hotspots/>
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* Time Warner Cable signed the workshop contribution after the 3GPP deadline for submittal. Time Warner Cable is therefore not listed as a signatory in the version of this presentation recorded by 3GPP, though their support was noted in discussion and recorded in the workshop report.