HWG | HARRIS, WILTSHIRE & GRANNIS LLP

November 23, 2015

Ex Parte

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street SW
Washington, DC 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 November 19, 2015, Rob Alderfer and Bernard McKibben of CableLabs as well as Paul Caritj and I of Harris, Wiltshire and Grannis, on behalf of the National Cable & Telecommunications Association, met with Julius Knapp, Chief of the Office of Engineering and Technology ("OET"); Ira Keltz, Deputy Chief, OET; and Walter Johnston, Chief, OET Electromagnetic Compatibility Division. At this meeting, we discussed the attached presentation.

Pursuant to the FCC's rules, I have filed a copy of this notice electronically in the above-referenced proceeding. If you require any additional information, please contact the undersigned.

Sincerely,

Paul Margie
Counsel for NCTA

Encl.

cc: meeting participants

LTE-U Update

November 2015

State of LTE-U Research

- Wi-Fi stakeholders are working hard, attempting to find technical solutions
- Research has demonstrated that LTE-U can cause consumer disruption
- Wi-Fi Alliance (“WFA”) workshop demonstrated significant ongoing concern with LTE-U
- Qualcomm’s mischaracterization of recent joint work with CableLabs is disappointing
- IEEE considering building its own testing program

Wi-Fi Alliance Workshop Readout

- New LTE-U Forum coexistence spec released on the eve of the workshop, again without collaboration
- Ongoing significant concerns with LTE-U spec and vendor concepts were quite apparent
- Some agreement to further define LTE-U testing, but unclear where this leads
- Truly collaborative work, rather than half-efforts designed to obscure, are still required to get to broadly supported solutions
- These ongoing problems show the danger of foregoing the standards process

Research Roadmap

- At WFA workshop, CableLabs and WFA task group presented a research roadmap that may ultimately lead to agreement on coexistence, if it leads to broadly supported technical standards
- This covers:

a) Efficacy of specification concepts relied upon by vendors
   - Sensing, ability to set and adjust duty cycle fairly, etc.

b) Considering technical issues not yet addressed at all by vendors
   - E.G., in-device coexistence

c) Accounting for real-world deployment situations not yet addressed at all by vendors or operators
   - E.g., coordination/synchronization of duty cycle across operators when operating in the same area

CableLabs/Qualcomm Joint Work

- CableLabs visited Qualcomm's campus in a good-faith effort
  - Scope of technical work was much narrower than CableLabs requested
- Most of the time on site was spent fixing problems with the research environment as a prelude to actual testing
- Disappointingly, Qualcomm is now attempting to characterize this work as somehow definitive—but even a cursory examination shows that this is a PR, and not an engineering, claim

Key Takeaways from CableLabs/Qualcomm Work

- There is no basis for claims that LTE-U is proven to coexist well with Wi-Fi
  - LTE-U equipment is in the prototype stage and does not posses coexistence features that its proponents have said are important and thoroughly tested
  - LTE-U equipment at Qualcomm did not comply with the LTE-U Forum spec
- Wi-Fi sharing measurements at Qualcomm facility were faulty, calling into question research results
  - Engineers on site were focused almost entirely on diagnosing problems with the research environment
  - As a result, no definitive results were obtained
- “State of the art” LTE-U plainly is not ready for the real world

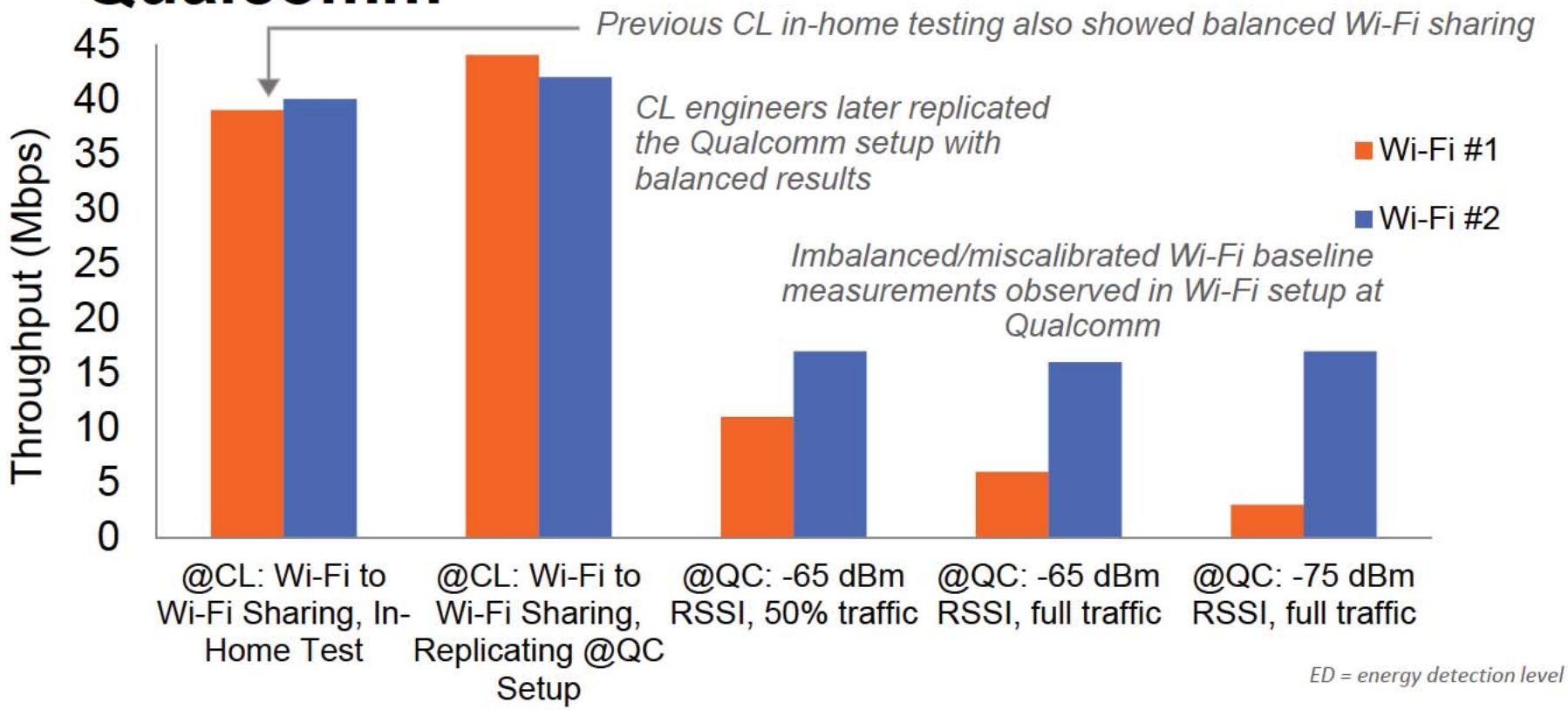
LTE-U State of the Art

- LTE-U is in a prototype stage of development
- Cannot perform coexistence functions that its proponents have said are important and tested
  - Example: LTE-U duty cycle needs to be manually programmed, whereas vendor statements have indicated that it will automatically adapt to changing conditions

LTE-U base station prototype

LTE-U user device prototype

Uneven/Faulty Baseline Measurements at Qualcomm

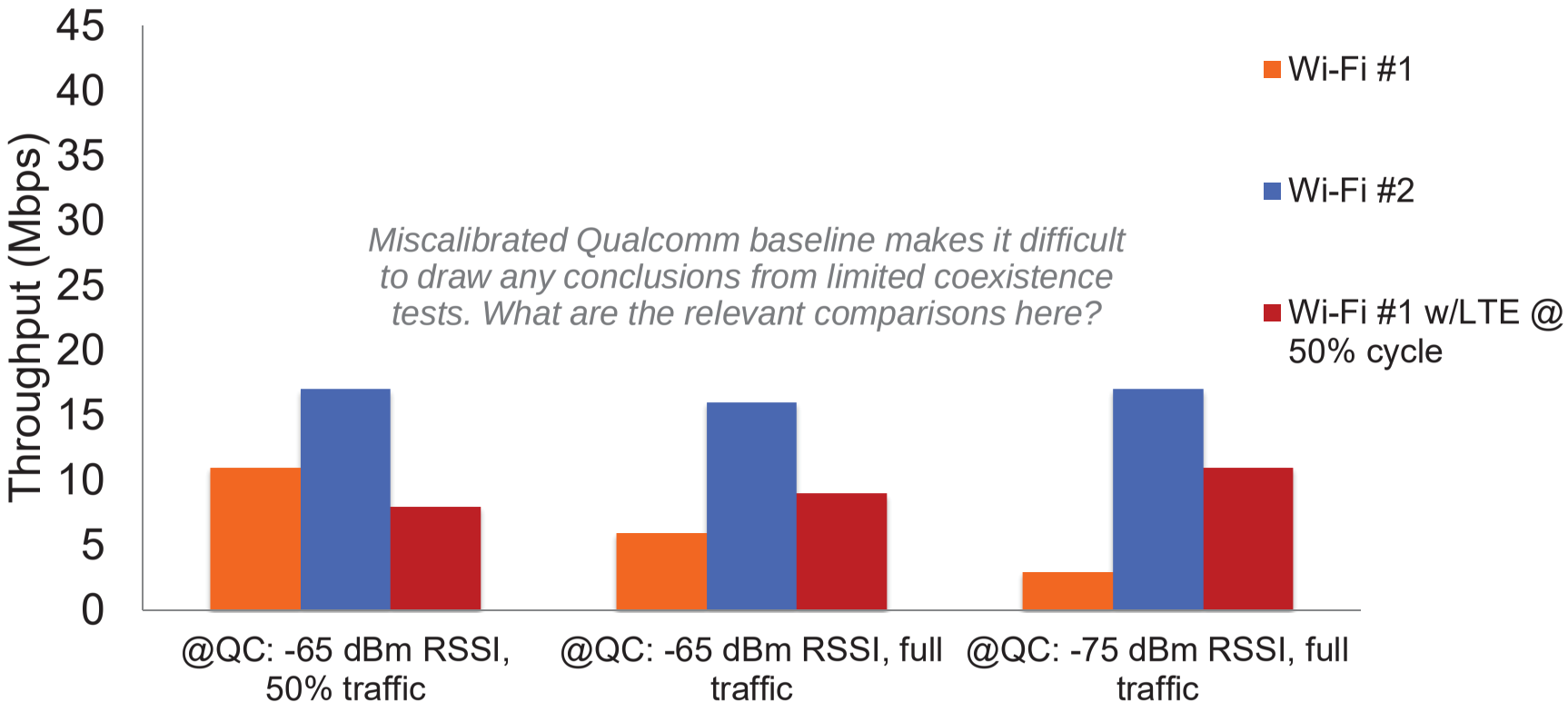


ED = energy detection level

CL measurements taken above ED with full traffic.

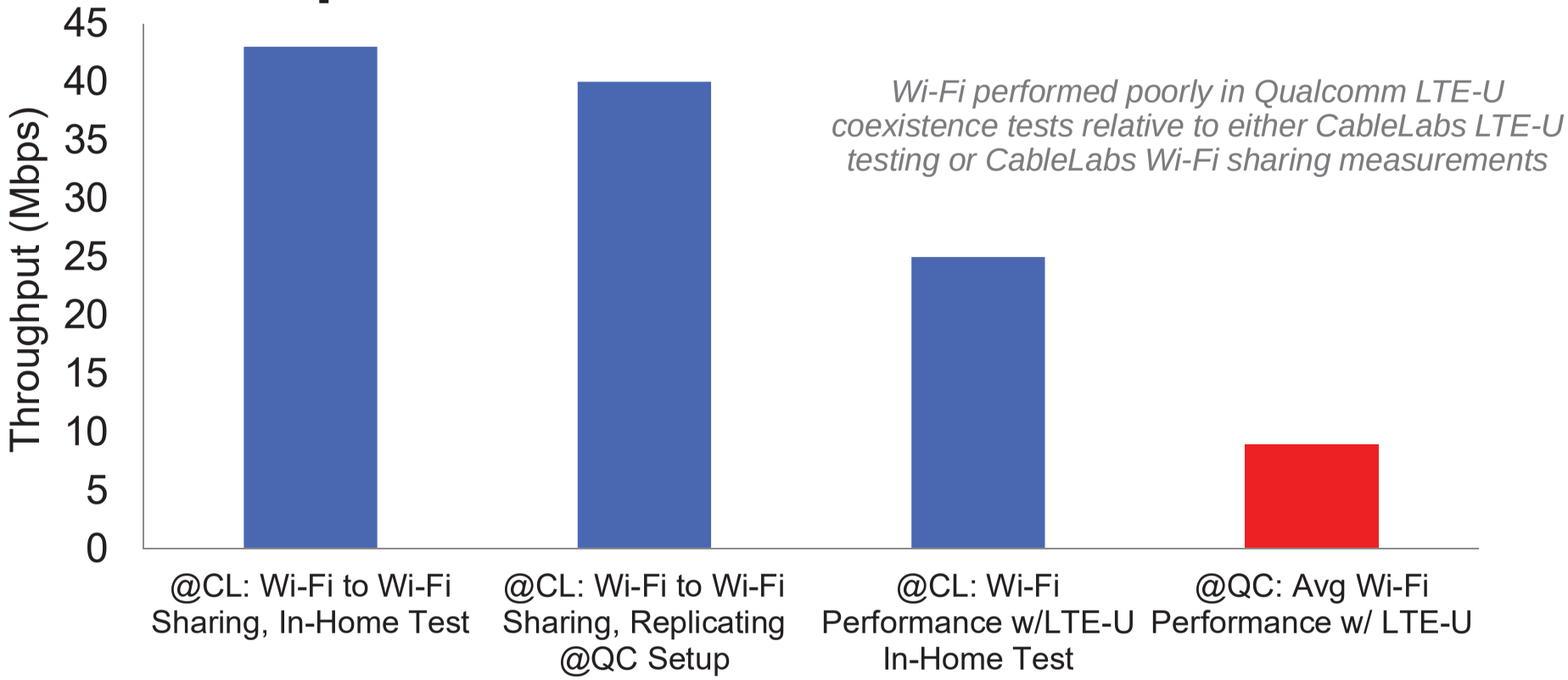
Representative sample of measurements taken at Qualcomm.

Unreliable Coexistence Tests at Qualcomm



Representative sample of measurements taken at Qualcomm.

Qualcomm LTE-U Coexisted Poorly Relative to Comparison Points



Wi-Fi performed poorly in Qualcomm LTE-U coexistence tests relative to either CableLabs LTE-U testing or CableLabs Wi-Fi sharing measurements

Real Collaboration Remains Critical to Progress

- Unlicensed innovation has historically been a product of collaborative development, and the success of this system has meant that regulation is unnecessary
- The LTE-U Forum continues to work outside the long-successful standards process
  - LAA, in contrast, appears to be on a much better path in 3GPP standards process
- Wi-Fi stakeholders remain committed to rectifying shortcomings in LTE-U coexistence
- Remains to be seen if WFA, IEEE, or other Wi-Fi industry work will lead to reliable and fair coexistence for LTE-U

Appendix:

Recent CableLabs Testing of Wi-Fi–LTE-U Coexistence

Context: Continuing to Drive LTE-U Research

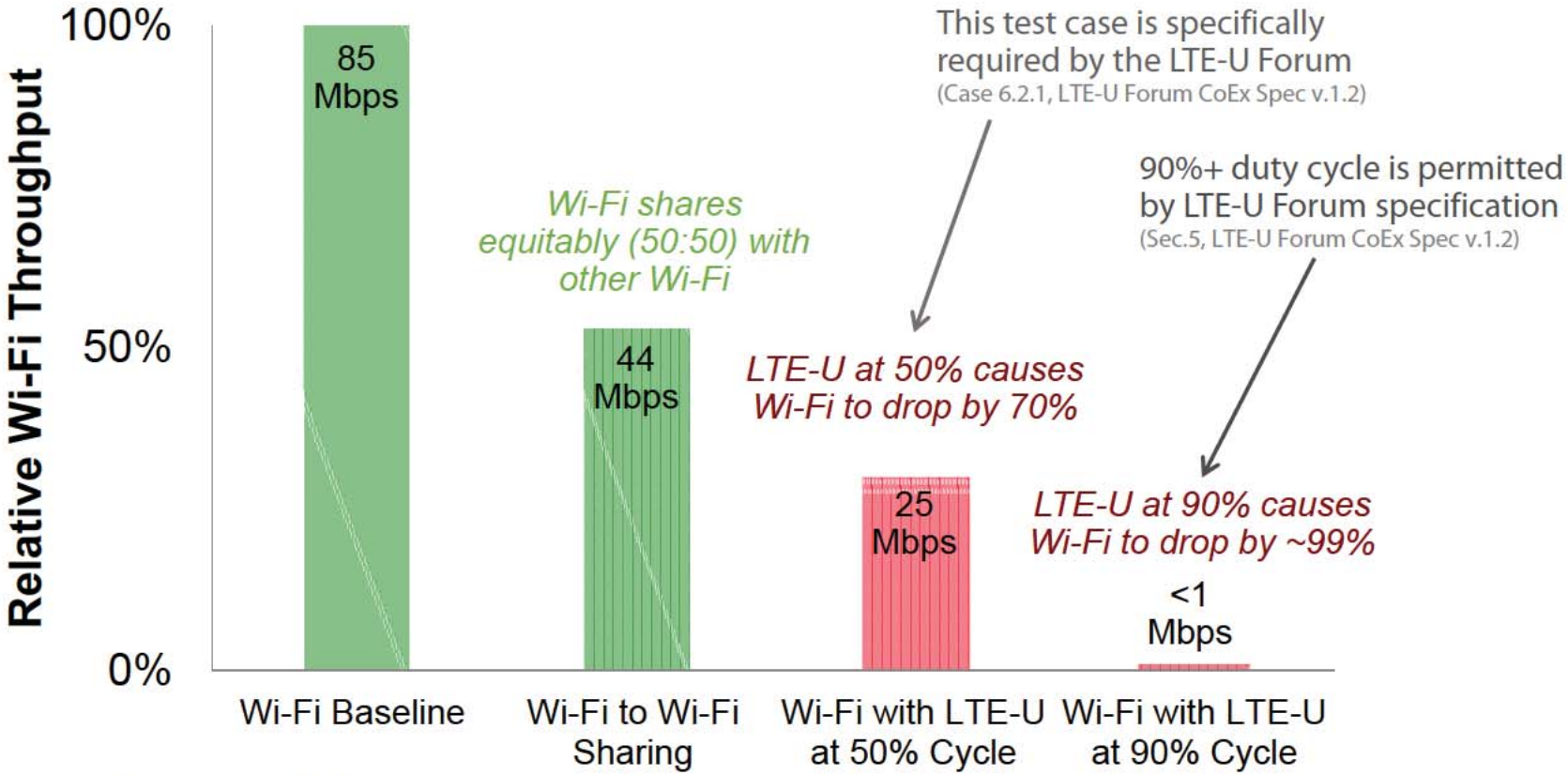
- We have tested LTE-U in our lab, our office environment, and, most recently, in a residential environment (test house) to research how consumers experience technologies
- Our research to date has raised significant concerns about the impact LTE-U will have on Wi-Fi services
- Today we will review our most recent research, which was conducted in our test house
- This work was reviewed at the recent WFA LTE-U coexistence workshop

Summary of Conclusions

Moving our testing from the lab to a home environment, we found that:

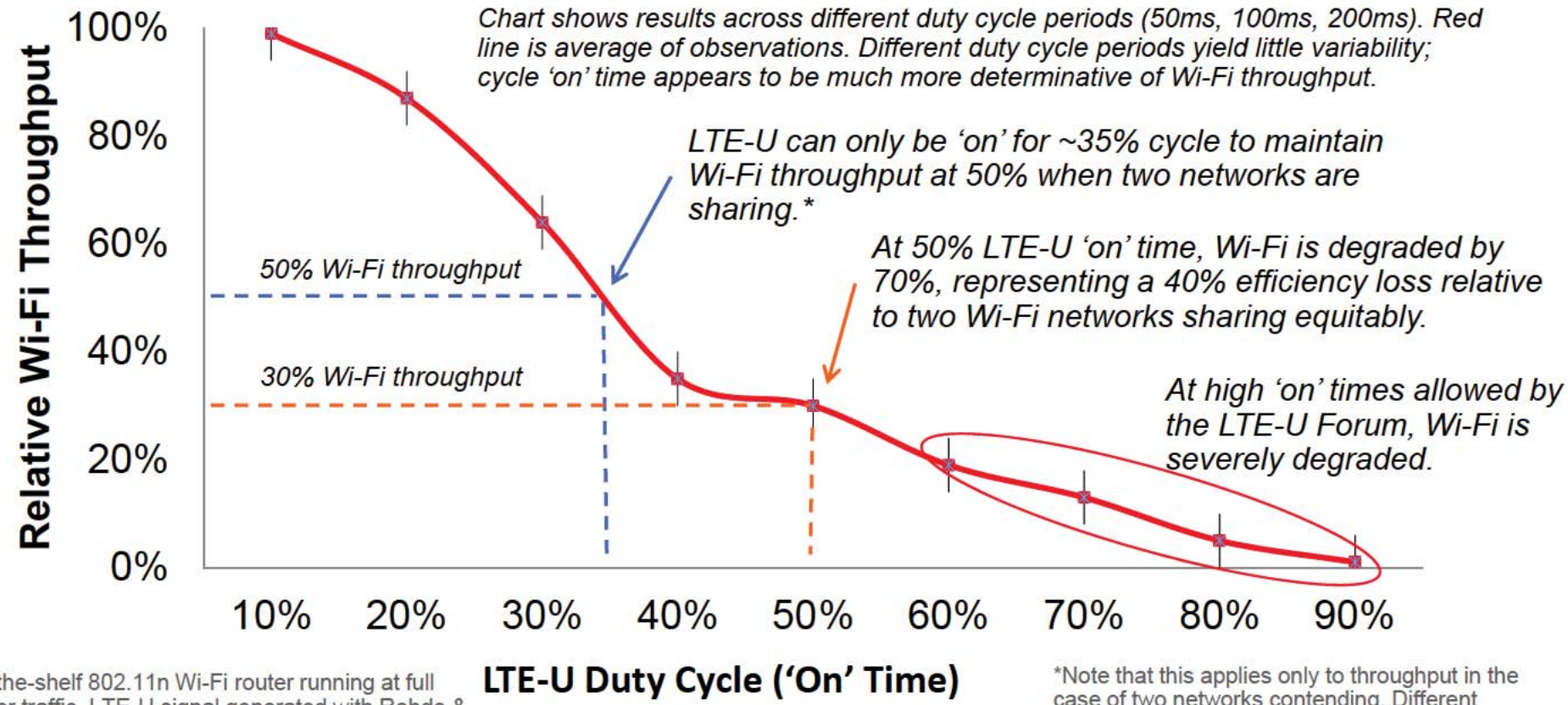
1. Off-the-shelf Wi-Fi access points we tested share fairly with each other (~50:50)
2. “Fairness” as conceived by the LTE-U Forum—proportionate airtime—has a disproportionately negative impact on Wi-Fi performance
3. More aggressive LTE-U configurations will significantly degrade Wi-Fi performance (throughput, latency, and packet loss) even more
4. Therefore, it is clear that LTE-U coexistence concepts need to be reconsidered and thoroughly researched/tested

LTE-U Causes Wi-Fi Throughput Degradation



Off-the-shelf 802.11n Wi-Fi router running at full buffer traffic. LTE-U signal generated with Rohde & Schwarz SMBV100A.

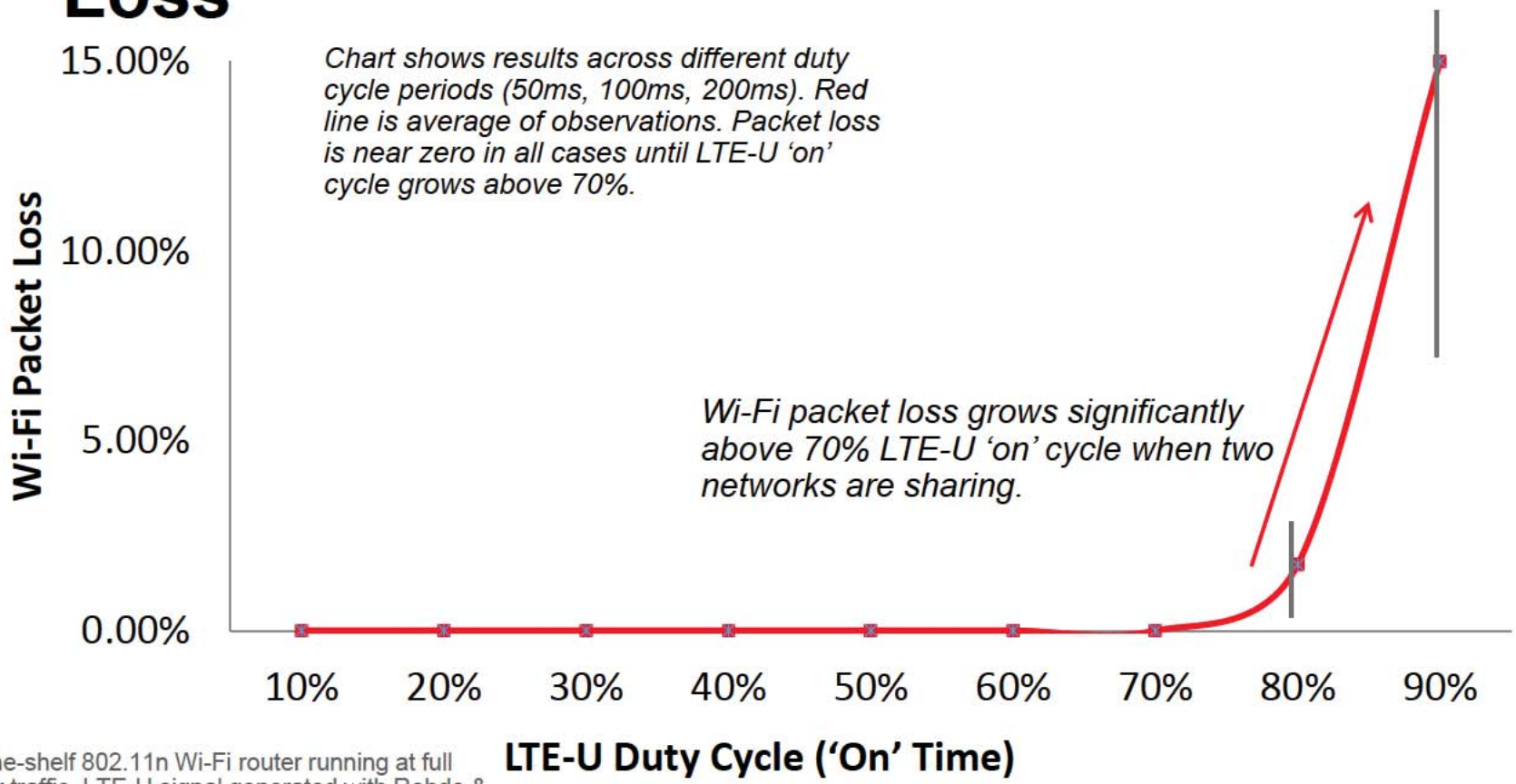
Detailed Throughput Results



Off-the-shelf 802.11n Wi-Fi router running at full buffer traffic. LTE-U signal generated with Rohde & Schwarz SMBV100A.

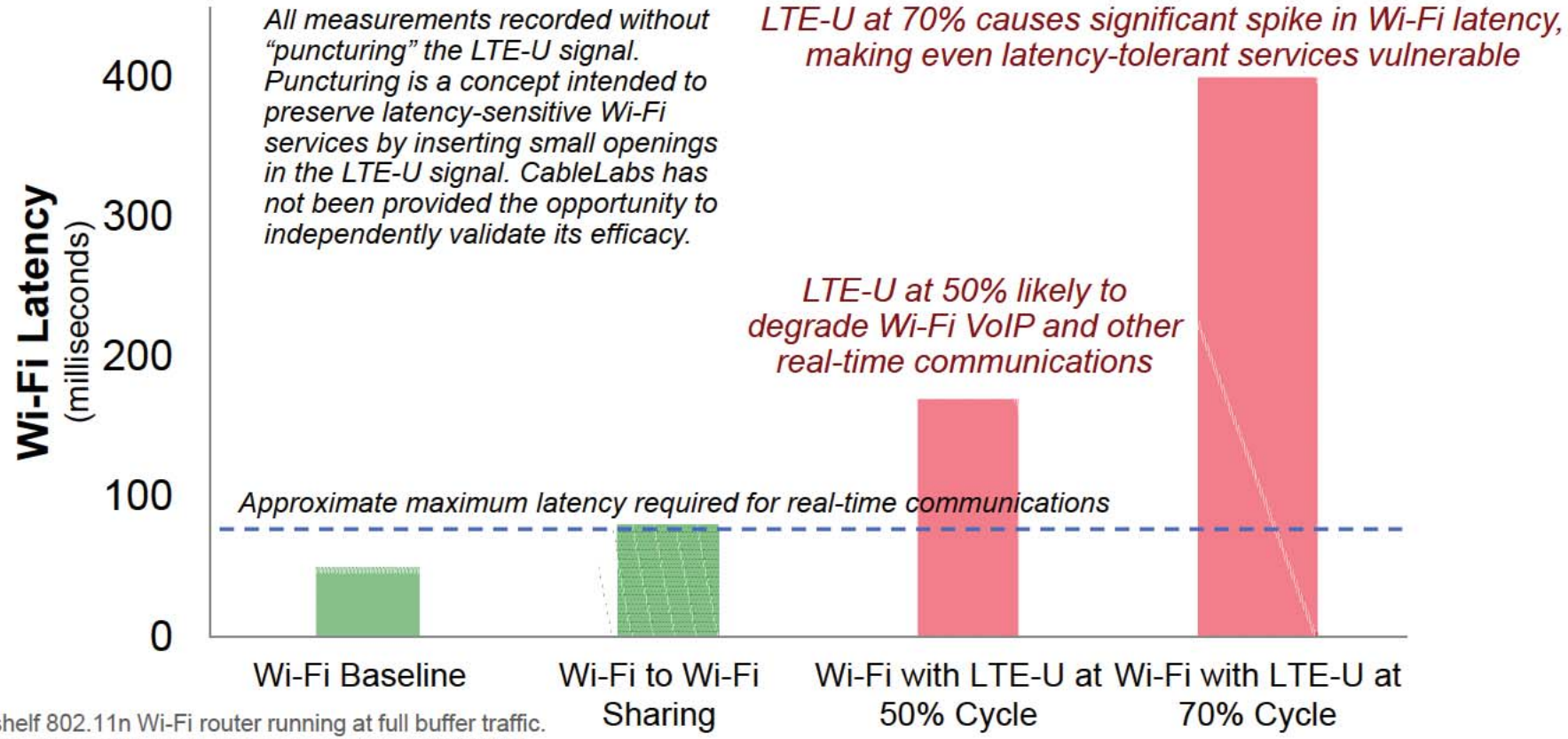
*Note that this applies only to throughput in the case of two networks contending. Different configurations and metrics yield different results.

Aggressive LTE-U Can Cause Severe Loss



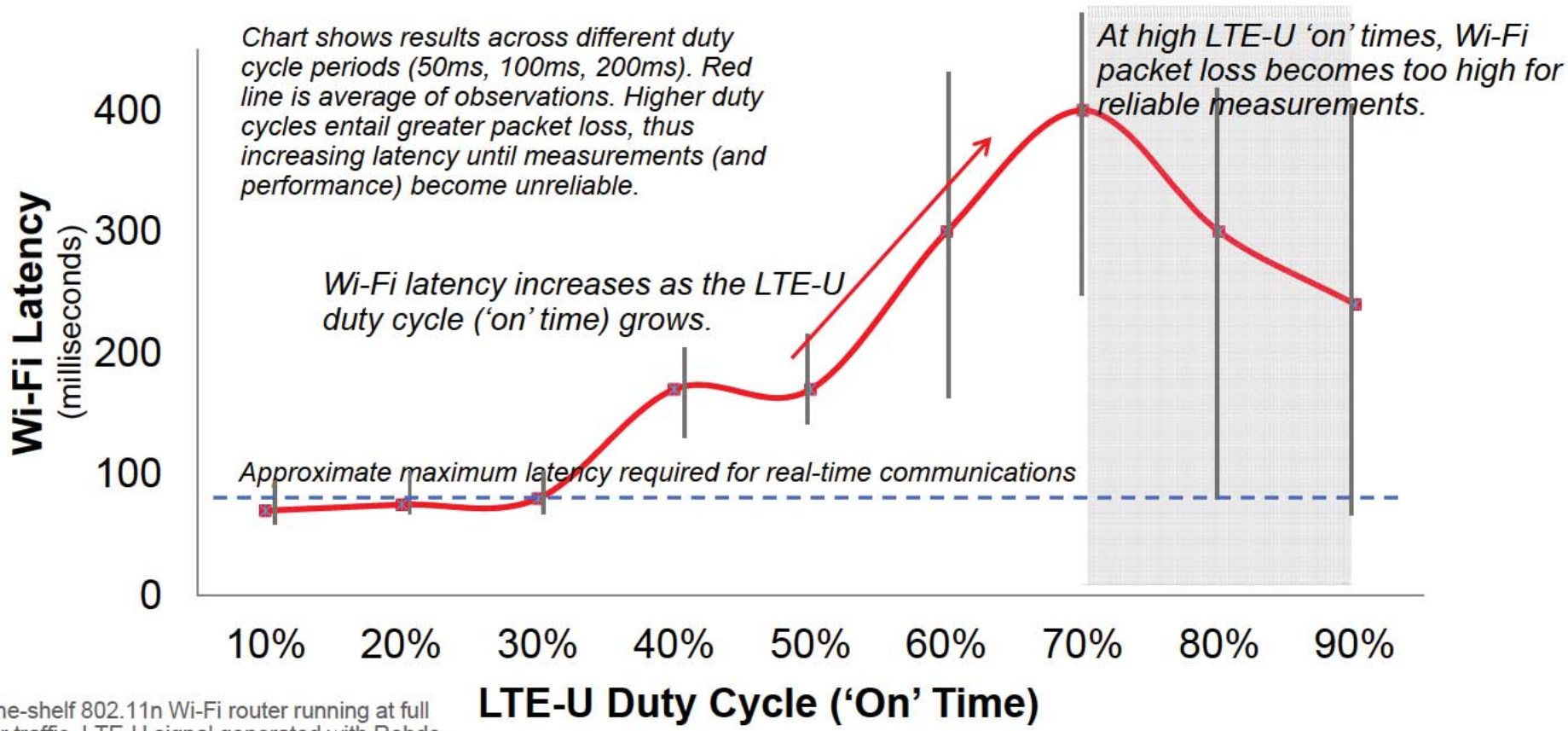
Off-the-shelf 802.11n Wi-Fi router running at full buffer traffic. LTE-U signal generated with Rohde & Schwarz SMBV100A.

LTE-U Causes Intolerable Latency



Off-the-shelf 802.11n Wi-Fi router running at full buffer traffic.
LTE-U signal generated with Rohde & Schwarz SMBV100A.

Detailed Latency Results



Off-the-shelf 802.11n Wi-Fi router running at full buffer traffic. LTE-U signal generated with Rohde & Schwarz SMBV100A.

Test Methodology

Objective

- Test Wi-Fi performance metrics including throughput and latency when the channel is shared between LTE-U and a full buffer Wi-Fi link

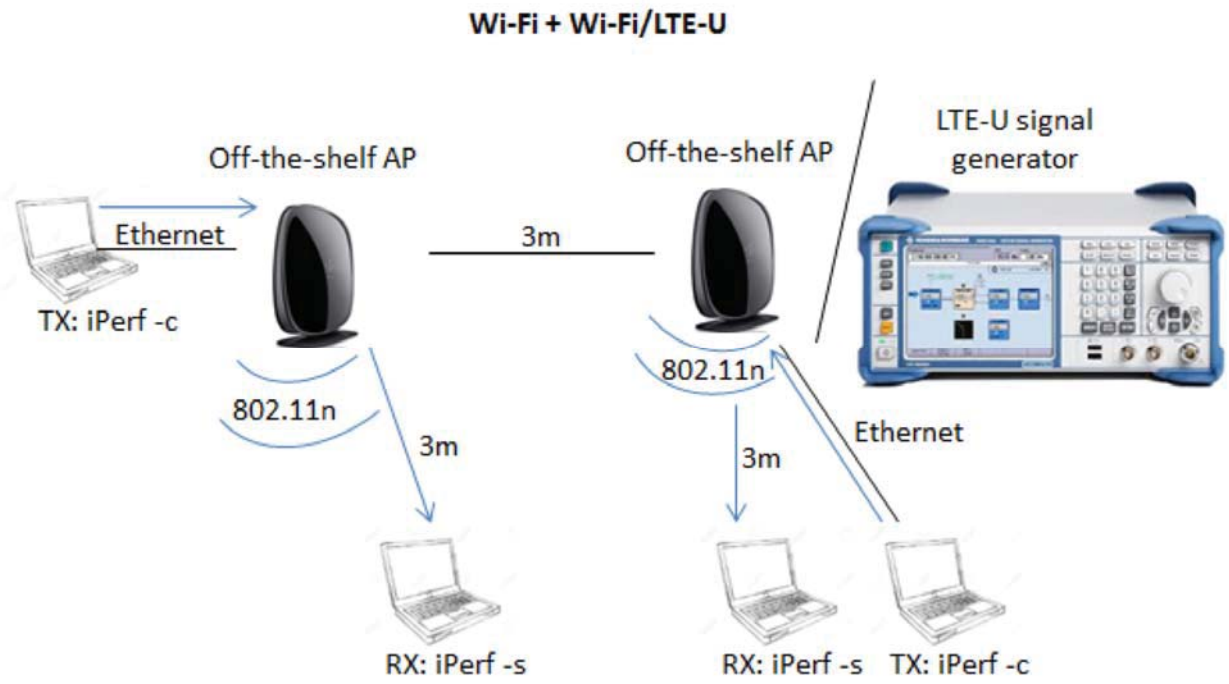
Methodology

1. Baseline: Two Wi-Fi APs are configured to send full buffer DL traffic. The first AP's TCP throughput, latency, and packet loss are measured
2. Replace the second AP with LTE-U, with the following configurations, and record performance metrics of the first AP as in Step 1:
   - Duty cycle period of 50ms, 100ms, 200ms
   - For each duty cycle period, vary duty cycle percentage from 10-90%

Equipment List

- LTE-U signal generator: Rohde & Schwarz SMBV100A
- Antenna for LTE: Maximus FXUB66 ultra wideband antenna 700-6 GHz
- 2x Wi-Fi APs: Off-the-shelf Belkin N600, Wi-Fi dual-band 802.11n router (no MIMO capability)
- 4x Apple MacBook laptops: 1 transmitter and 1 receiver for the network of interest and the same number for the interferer Wi-Fi network

Test Setup



The two Wi-Fi APs are within CCA range; Wi-Fi AP Under Test (left) and LTE-U are within CCA range.

Setup at the CableLabs Test House