How to lead the evolution and expansion of the 3GPP ecosystem

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So far in this series of blogs, we've introduced the 3GPP organization, reviewed the basics on how 3GPP operates, and explored the drawbacks of simplistic approaches to assessing 3GPP leadership — specifically contribution counting. In this final blog post, I will propose an alternative approach to assessing and thinking about 3GPP leadership that we believe more accurately reflects how work gets done in 3GPP and which members are really driving the ecosystem forward.

To help exemplify this approach, as well as showcase the essential leadership role Qualcomm has played in driving the evolution and expansion of the cellular ecosystem, we will provide an in-depth example of one recent, important feature added to the cellular ecosystem: LAA (Licensed Assisted Access), which expands LTE access into unlicensed spectrum with a licensed spectrum anchor. This is one of many examples of how Qualcomm has led the 3GPP ecosystem in new directions that not only enhance existing cellular services, but also expand cellular networks to new services/industries. This leadership is becoming increasingly important as we approach the 5G era.

So, what defines 3GPP leadership?

We believe this really boils down to two key leadership traits:

#1: The proven desire and ability to build broad consensus across the ecosystem and drive it in new directions

This goes back to one of our fundamental 3GPP basics — there is no "Mr. or Mrs. 3GPP" driving the direction of cellular networks. Therefore, fueling progress, and especially progress in fundamental new directions (as opposed to smaller, more evolutionary advancements of existing technology), is one key characteristic of 3GPP leadership. This starts with having the vision and foresight to identify the compelling challenges and problems that cellular networks will encounter in the future. But it doesn't end there—to really drive the industry in new directions requires much more than just a vision or idea. It requires end-to-end technology and R&D leadership to develop early designs, including the underlying system-level technology inventions, to define the problem more clearly, specify requirements, and introduce potential solutions. It also requires developing end-to-end prototypes to serve as testbeds for these potential solutions.

This work is critical to not only defining the problem and potential solutions more clearly, it is also essential to garnering the industry support needed to initiate new features into 3GPP. This work often occurs before any 3GPP meeting on the topic, and drives the concept proposal into 3GPP to initiate work. If you were counting contributions, this initial concept proposal would count as a single contribution (the same level as a Change Request to fix a bug), but is fundamental to all future work that gets completed on this new feature and usually results from significant upfront investment and risk by the company or companies initiating it.

Invention
Invent new technologies and
e2e system architecture

Proof-of-concept
Deliver end-to-end prototypes and
impactful demonstrations

Vision
Identify a problem or need;
establish requirements

Standardization
Drive e2e design with ecosystem
and through standards process

Figure 1: Early R&D and technology inventions essential to moving ecosystem to new areas.

#2: The expertise and ability to drive an end-to-end design through 3GPP across multiple Working Groups

Initiating the work on new directions in 3GPP is an important first step, but it certainly does not end there. The standardization process, especially for key features/technologies that push the cellular ecosystem in new directions, often takes well over a year and will inevitably take numerous twists-and-turns along the way. This presents another opportunity for 3GPP leadership — to drive an end-to-end design through 3GPP from start to finish.

As we discussed in 3GPP basics, 3GPP defines end-to-end cellular systems. When completely new areas, such as LAA, are proposed to be added into the 3GPP ecosystem, these new areas must create a new cellular sub-system that builds on top of the existing baseline mobile broadband design that we have today. As shown in Figure 2 below, this requires adjusting, optimizing, and redesigning procedures across all the cellular communications layers to address these new requirements. This adds complexity in driving new directions through the 3GPP standardization process. System design in 3GPP is done in a piecemeal fashion, with a block-by-block decision process across numerous (16 at the time of writing this post) specialized Working Groups with very limited end-to-end supervision. The success of driving successful standardization of these new directions relies heavily on leading 3GPP members to drive end-to-end design through the complex 3GPP process. This requires a unique combination of system-level expertise, scale, and design flexibility that very few have consistently showcased the ability to deliver.
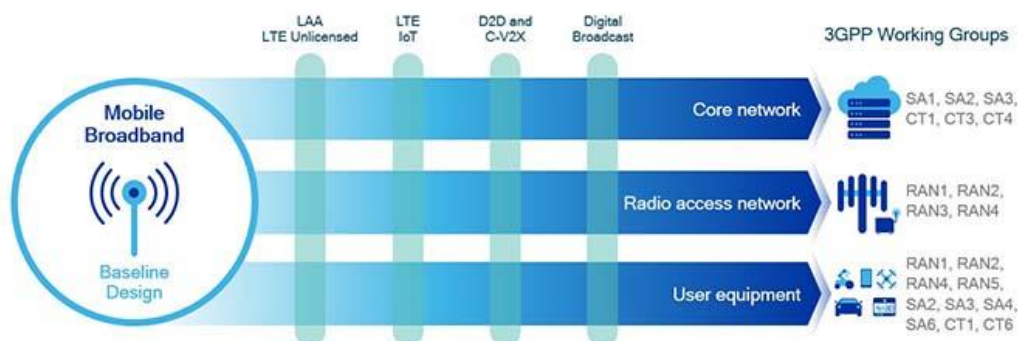
Figure 2: End-to-end system design in 3GPP.

A Qualcomm 3GPP leadership example: LAA

To help showcase these 3GPP leadership traits, let's use a recent key example of driving the cellular ecosystem in a new direction: Licensed Assisted Access, or LAA. LAA introduced the use of cellular technologies, specifically LTE, into unlicensed spectrum for the first time. Work in 3GPP first begun on LAA in 2014 and is now beginning to see commercial success as a key underlying technology to globally delivering Gigabit LTE and helping mobile operators continue to address the ever-increasing global demand for mobile data. In addition, as is often the case with introducing new directions or areas, the initial work on LAA has now begun to broaden to new, related technology areas on the path to 5G. In fact, 3GPP recently approved a proposal, led by Qualcomm, to begin work on studying 5G NR in unlicensed spectrum.

We believe truly assessing 3GPP leadership requires dissecting these new technology directions that 3GPP is taking (or has taken in the past) and looking at the entire history to assess which 3GPP members have had the most impact in both initiating the effort and driving the end-to-end design through 3GPP. Figure 3 below shows a timeline of the three high-level 3GPP steps — Project Proposal, Study Item, Work Item — for LAA and a summary of the key examples of Qualcomm's leadership throughout this process. Although we are not sure if Qualcomm had the highest number of 3GPP contributions submitted with respect to LAA, we are very

confident that no other 3GPP member could provide as many compelling proof-points for leading this new direction into 3GPP.

To start with, Qualcomm led the project proposal phase for LAA into the 3GPP RAN Technical Specification Group (or RAN TSG). This started with early R&D work on extending LTE technology into unlicensed spectrum, which Qualcomm started over five years ago. Then, in collaboration with Ericsson, we first introduced the concept into 3GPP at the RAN#62 plenary meeting in December of 2013 (Concept Contribution RP-131635). As can be the case with introducing new directions, the project phase required multiple 3GPP meetings with iteration and negotiation happening both inside and outside 3GPP meetings. This led to a RAN Workshop held on the topic in June of 2014, in which 20+ companies including Qualcomm, provided technical inputs on the topic, showcasing an expanding interest from the ecosystem on this new direction. This ultimately led to an approved Study Item in September 2014 on Licensed Assisted Access or LAA. This represents an excellent example of Qualcomm demonstrating 3GPP leadership trait #1 — the proven desire and ability to build broad consensus across the ecosystem and driving it in new directions.

Figure 3: LAA project proposal phase in RAN TSG.

Qualcomm's leadership on driving LAA 3GPP standardization certainly did not stop at the project proposal. Leveraging the

extensive R&D work we did leading up and throughout the project proposal phase, Qualcomm delivered numerous seminal contributions during the Study Item phase in the 3GPP RAN1 Working Group. These contributions were fueled by the underlying technology inventions that we contributed into 3GPP, and exemplify the foundational system-level R&D and technology leadership that we bring into 3GPP. This R&D leadership was demonstrated by the first live LAA demo delivered at MWC Barcelona 2015.
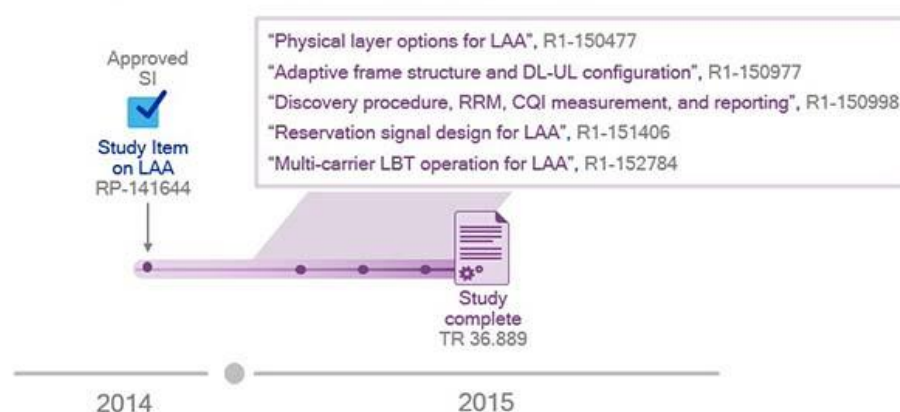

Figure 4: LAA Study Item phase.

The 3GPP Study Item covered above ultimately led to a Release-13 Work Item on LAA. During the Work Item phase, as shown below in Figure 5, Qualcomm drove the essential Wi-Fi coexistence testing and band definition in the RAN4 Working Group, building on top of the previous seminal contributions in RAN1 made during the Study Item phase. In addition, Qualcomm led continued work in the SA1 and SA2 Working Groups on Unlicensed Spectrum Offloading System-enhancements (or USOS) — design work related to identification of traffic carried over unlicensed spectrum (reporting from RAN to CN) to be used for charging, as well as for regulatory reasons. We also continued our work in RAN4 to introduce the ability to have coexistence tests among LTE base stations and Wi-Fi Access Points for LAA. In addition, beyond all this leading work inside 3GPP, Qualcomm also

led many liaisons between 3GPP and IEEE/WFA on the important topic of LAA and Wi-Fi coexistence. Our leadership throughout the LAA Work Item phase (and beyond) is an excellent example of 3GPP leadership trait #2 —Qualcomm's unique ability and expertise in driving end-to-end designs in 3GPP (across RAN1, RAN2, RAN4, SA1, and SA2 Working Groups in this example).
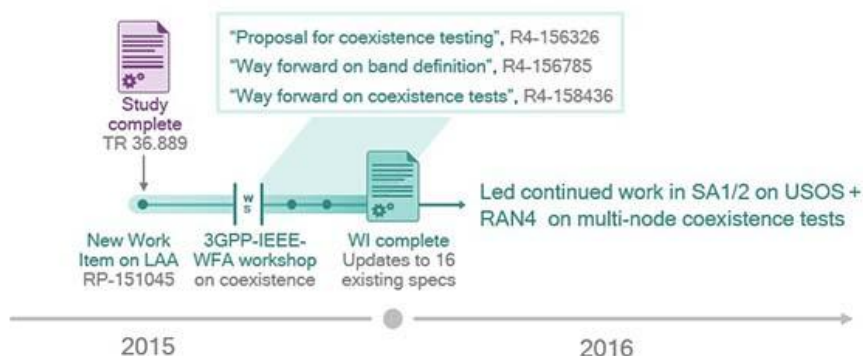

Figure 5: LAA Work Item phase.

Finally, our leadership in LAA has continued beyond R&D and standardization. In collaboration with Deutsche Telekom, we completed the world's first LAA over-the-air trial in February 2016. We also delivered the first commercially announced modem to support LAA, the Qualcomm Snapdragon X16 LTE modem, which has since gone on to power commercial Gigabit LTE smartphones.

The essential role of Qualcomm in driving the evolution and expansion of the 3GPP/cellular ecosystem

Of course, 3GPP leadership cannot be defined by one specific example. It is defined with a proven track-record of demonstrating these essential 3GPP leadership traits repeatedly and consistently. At Qualcomm, solving system-level problems is in our DNA. In fact, Dr. Irwin Mark Jacobs and Dr. Andrew J. Viterbi wrote in Qualcomm's Mission Statement from July 1985, "Qualcomm's objective is to apply our experience to systems problems that arise in the design, analysis, implementation and testing of digital

communication processing systems and networks to bring reliable, functionally effective, user-friendly products to the marketplace."

Over the last 30+ years, we have spent more than $46 Billon in R&D, delivering system-level inventions that have fueled the mobile industry. We have done this by not only taking significant risks to start early with an end-to-end design, but also in our leadership in well over 160 standard setting bodies and associations — most notably in 3GPP. From our early work in pioneering CDMA which became the foundation to 3G technologies (both in 3GPP and 3GPP2) to our leadership in driving the evolution and expansion of LTE the last ~10 years, Qualcomm has been leading the way in driving the evolution and expansion of the 3GPP/cellular ecosystem. And now, as we approach 5G, Qualcomm is once again leading the industry in designing and standardizing the next generation of wireless technologies (5G NR) that will expand the 3GPP/cellular ecosystem to an array of world-changing use cases.

I hope you have found this series of blog posts on 3GPP informative. Stay tuned to OnQ Blog where I will dive into additional proof-points of our 3GPP and technology leadership utilizing this same approach — including past examples such as LTE Carrier Aggregation, present examples like LTE IoT technologies (eMTC, NB-IoT), and of course 5G. In the meantime, you can get a preview of these additional proof-points, as well as a recap on 3GPP fundamentals, by joining our upcoming FierceWireless webinar "How do Global 4G and 5G Standards get Created? Demystifying 3GPP."