



Advisory Report

LTE Chips: A Leading Indicator of Mainstream Adoption

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Issue

Long Term Evolution (LTE) is a mobile broadband system designed to deliver multimedia services and is already creating significant mobile industry hype. Technically, LTE is a 3.9G technology that is marketed as 4G as defined by the 3rd Generation Partnership Project (3GPP). As a result, 4G operates under a name trademarked by one of the associations within the 3GPP partnership, the European Telecommunications Standards Institute (ETSI). Akin to LTE, Mobile WiMAX is also branded as 4G technology today and both are on the path toward fulfilling ITU-sanctioned IMT Advanced requirements that define pure 4G capabilities such as multi-carrier transmission support and all-IP network switching. Currently LTE is designed to theoretically provide downlink peak data rates of up to 100 Mbps, uplink data peaks of up to 50 Mbps, and radio access network (RAN) round-trip times of less than 10 ms. The need for these levels of bandwidth within mobile networks is driven by a multitude of factors including burgeoning adoption of smart consumer devices (beyond the usual USB modems/aircards), such as smartphones and tablets, which are becoming widely available and support an expanding range of multimedia applications.

Like most emerging technologies that are evolving, LTE itself will continue to be driven by standards and specifications that are also evolving. Modifications and revisions - typically on a year's time horizon or longer - are ironed out in an iterative process of releases that each generally carries new functionality to support new applications, services and fixes. At some stage in a successful standards process, a critical mass of vendors can jump in to begin their product development cycles.

For LTE this came to fruition with 3GPP Release 8 in January 2009, when the specification was considered stable enough for vendors and the development community to begin implementations in silicon that in turn allowed OEMs/ODMs, such as mobile phone and mobile Internet device (MID) manufacturers, to produce LTE-enabled handsets, to connect to wireless networks supporting LTE and begin trialing and launching commercial services. The latest iteration, Advanced LTE, is currently being standardized on 3GPP Release 10, targeted to be released in March 2011, but again LTE advanced retail products will likely take a couple more years to materialize in earnest. The availability of the LTE silicon devices is a key step in this process and by examining the competing vendor's offerings and product roadmaps in this area, some insight into future LTE/LTE Advanced capabilities can be gained.

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Current Perspective

As the industry moves from 3G to 4G technologies, LTE is coming into its own. In the U.S., Verizon Wireless has already targeted at least 25 markets for coverage by the end of 2010. MetroPCS is also launching in 2010 and AT&T has trial plans for 2010 with deployment targeted for 2011. These LTE service launches are motivated in part to counter WiMAX service offerings from Sprint and Clearwire, in part to fulfill promises made during recent spectrum auctions, and in part due to improved efficiencies offered by the technology. On a related note, as of May 2010, wireless infrastructure vendors have claimed a total of 39 commercial references for LTE services worldwide. With major U.S. carriers committed to LTE technology, a major determinant in the long-term success of LTE service offerings is the timely availability of LTE silicon.

While LTE will continue to be driven by evolving standards and specifications, it is important to note which LTE silicon vendors have gained time to market advantages by supporting key elements of the standard early on. The 3GPP Release 8 standard was frozen in January 2009, and established LTE characteristics such as support of up to 100 Mbps downstream (d/s) and 50 Mbps upstream (u/s) speeds (under optimal conditions), and the dual support of frequency division duplexing (FDD) and time division duplexing (TDD). However, there are a wide range of mobile silicon vendors with differing approaches to implementing those standards. The unencumbered start-ups and independent mobile silicon vendors targeting the LTE silicon space are leveraging their WiMAX silicon roots in order to address LTE opportunities. These include vendors such as Beceem, Sequans and Wavesat who position themselves as on the leading edge of LTE silicon deployment.

On the other hand, the established and mature mobile silicon vendors such as Qualcomm, Infineon, Fujitsu and ST-Ericsson can leverage various portfolio assets to create highly integrated LTE silicon platform solutions. For example, Qualcomm and Fujitsu have crafted LTE silicon solutions that leverage their existing legacy support for 3G devices to create multimode, multichannel RF transceivers to support legacy radio, dual band radio and network roaming in a single package. They are leveraging their product architectures from already established 3G HSPA+ assets in order to add LTE support quickly, and create a multiband receiver. ST-Ericsson is taking a more targeted approach, betting on specific market segments and has already launched a LTE-only platform solution.

Infineon emphasizes the Software Defined Radio (SDR) aspect of its LTE silicon solution and so far Infineon is the only one to include a SDR approach to LTE. The approach as implemented by Infineon is a good means to hedge your bet on radio technology flexibility in terms of using software (and not a hardware-centric approach that requires time consuming production cycles) to adopt and evolve radio combinations according to customer needs. Within the design parameters it also allows for changes and upgrades in support of evolving standards through software upgrades. The table below shows some of the key mobile silicon vendors in the mobile device silicon market that are at least in the sampling stage for LTE mobile devices. Sampling comes first, which a preproduction run in small quantities used to determine yields and provide the first samples to the vendor's key customers and development partners. They are used to get design wins before becoming adopted into end devices ready for retail. Production follows, typically within a six month window, and includes changes and fixes discovered during the sampling and prototyping phase. Vendors will generally not deploy equipment or services based on sample silicon, but will wait for the production silicon.

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| Vendor | Beceem | Sequans | ST-Ericsson | Qualcomm | Fujitsu |
|------------|--------------|----------|--------------|--------------|-----------|
| Product | 4G LTE/WiMAX | LTE | LTE Platform | HSPA+ 3G/LTE | 2G/3G/LTE |
| Model | BCS500 | SQN 3010 | M700 | MDM9600 | MB86L 10A |
| Support | TDD/FDD | TDD/FDD | FDD | TDD/FDD | TDD/FDD |
| Sample | Q4 2010 | Q1 2010 | 2009 | Q4 2009 | Q2 2010 |
| Production | Q2 2011 | NA | NA | Q2 2010 | NA |

NA = not announced

Beceem is a start-up that has leveraged its WiMAX experience to create a dual mode LTE/WiMAX device for roaming or back-up and is shipping sample product in substantial volumes in the support of early field trials. Sequans, another start-up, is fielding an LTE-only solution, although the company has experience in WiMAX, it made a decision to go to market with LTE-only silicon. The M700 LTE platform from ST-Ericsson is unique in that it's limited to the single access technology of FDD-LTE. While this is ideal for fixed terminal applications and in-country networks where external roaming is not supported, it's not viable for a majority of smartphone devices and network services requiring alternative access for roaming and back-up. LTE-only devices are optimal for a greenfield deployment where legacy support is not required. On the other hand, legacy providers such as Qualcomm and Fujitsu have integrated multimode 3G/LTE support into their overall LTE solution mix, which enables vendors to participate in design competition quicker, leveraging previous development work. Qualcomm also promotes its early to market support of LTE standards and touts itself as first to market with multimode 3G/LTE solutions (e.g., MDM9x00). Again this fits better the support model for major wireless carriers with large legacy installed bases planning to migrate their pre-4G networks to 4G-based network and services.

While it might seem as if there are enough device types available, the actual number is small and vendors are targeting specific market niches as shown from the differences in implementation and approaches. This is typical for an emerging market and new technology. The overall timeframe for widespread network deployment of devices and services based upon LTE is probably going to take longer than the service providers, equipment vendors and market hype is projecting. The chips currently available represent first generation solutions and are only beginning to be produced in large quantities for the mass market. There are always the lessons learned from the active field trials with a new technology and this provides feedback to the developers and equipment manufacturers to improve or modify the equipment. Battery life optimization, needed for mainstream adoption, usually does not occur until second or third generation silicon. There is also the LTE standards process that is developing future 3GPP Release 10 (i.e., Advanced LTE), targeted for release in March 2011, as the final version which will need to be incorporated into the chipsets themselves to maintain compliance over the long-term while maintaining backwards compatibility.

While there will be LTE-enabled smartphone devices available at the end of 2010 and more service provider networks supporting LTE, it will not become a mainstream technology in the U.S. over the next 12 months. The LTE silicon chip vendors will need to go through another engineering sample-to-production cycle based upon the results of field trials. The device manufacturers will need to complete another product design cycle based upon this next generation offering of LTE silicon. Although both design cycles will be faster than the original, each iteration still takes time. With all these factors taken into consideration the timeframe for mainstream adoption of LTE seems to fit a more mid-2012 to early 2013 time horizon.

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Recommended Actions

Recommended Vendor Actions

- Intel needs to develop and announce its plans for LTE support. Intel continues to operate as a proponent of WiMAX, but needs to hedge its bet by having a LTE option for mobile wireless broadband connectivity or risk losing potential opportunities, especially among incumbent mobile carriers with extensive investment in 2G/3G technologies.
- ST-Ericsson should add or acquire WiMAX silicon to its platforms series of products. Its current M700 platform only supports FDD-LTE and that limits its application to wireless terminals and a single network type interface. The addition of WiMAX will diversify its addressable market as well as demonstrate its market independence from Ericsson in this area.
- Infineon needs to improve its marketing and the level of technical details it provides for its SDR technology. The trade-offs of a SDR approach versus a ground up implementation should be highlighted with cost trade-offs versus time to market implementation issues.

Recommended OEM Actions

- Smartphone and tablet OEMs looking to build a best of breed product through the use of discrete LTE RF transceivers, baseband modems and core processors should consider the RF transceiver solution from Beceem. In addition to being standards compliant, it offers some enhanced capabilities in its dual antenna system that provides for better reception and improved signal to noise ratio. The support of WiMAX also increases deployment flexibility in dual mode or network transition situations.
- Smartphone and tablet OEMs that require LTE multiband receivers with legacy 2G/3G network support should consider the product offerings from Qualcomm and Fujitsu. They both offer multimode multiband silicon that typically supports an open standard digital interface like DigRF/MIPI allowing for a broad range of industry basebands and backwards compatibility with pre-LTE designs.
- Smartphone and tablet OEMs looking for a high level of LTE silicon integration in order to achieve the best possible price points should wait until the first part of 2011 to make their selection. Many of the vendors will have announced their next generation products by then and new platforms offering a higher level of integration within the silicon level should be available