

5G update: Big 5G conference highlights and XLNX analyst day review

Industry Overview



Equity | 15 May 2019

Big 5G/XLNX: focus on timing, architecture, monetization

Last week we attended the Big 5G Event in Denver which attracted 1,500-2,000 people. There we interacted with industry contacts from semi cos Intel/Xilinx and telecom operators investing in 5G. We also attended [XLNX analyst day](#) on Tuesday in NYC where the company outlined drivers for 5G infrastructure investment. Key areas of focus incl: 1) 5G ramp progress; 2) monetization opptys for 5G; 3) importance of edge computing.

20 operations have deployed 5G worldwide so far in 2019

So far in 2019, 20 operators worldwide have deployed 5G in 294 locations and 500k 5G base stations (BTS) have shipped. Samsung is off to a strong start (driven by Korea/US) following a strong 2018 (+33% YoY). We believe [MRVL stands to benefit from Samsung share gains](#) as the provider of a full-suite of chips for Samsung. Heavy Reading forecasts operators will spend \$8.6bn on 5G capex in 2019 (vs. \$600mn in 2018) and they see this growing to over \$85bn by 2023E. Per XLNX, the 5G BTS ramp is expected to be larger and longer compared to 4G. XLNX forecasts 50% more 5G BTS will ramp over a 10 year timeframe vs. 4G. In year 10 of the 5G ramp, BTS deployments will still be growing YoY while in 4G, by year 8, BTS deployments peaked (per Mobile Experts).

Cost savings, spectrum complexity, and enterprise apps drive 5G infra ramp

As we stated in our [5G Primer](#), operators did not profit much from 3G/4G, so their motivation to invest in 5G will be driven by the ability to monetize the network. Key drivers of 5G infrastructure investment include: (1) **cost benefits**: at XLNX analyst day, the company illustrated the cost advantages for operators as they move from LTE to 5G mid-band and high-band. With macro cell LTE, each Gb of data costs \$2.13, per XLNX. This falls to just 45c per Gb with 5G at 4GHz, 4T and even lower (6c) at 28GHz 5G; (2) **spectrum complexity**: to realize these cost per Gb savings, operators will need to utilize higher frequencies (which limit range) leading to a need for more base stations; and (3) **enterprise applications**: industry executives at the Big 5G event, incl reps from Verizon and AT&T, agreed the driver for 5G profitability will be enterprise applications (which may have very demanding latency/throughput requirements), not increasing speeds/performance for consumer devices. To unlock these enterprise apps and cost savings, operators will need to invest in a complete re-architecture of the 5G network driving revenues for semis exposed to 5G infrastructure (ADI, XLNX, MRVL, INTC) more than semis exposed to 5G mobile devices (like smartphone vendors QVVO and SWKS).

5G needs edge computing to reach “real 5G” latency

One of the largest themes at the Big 5G event was the need for edge computing to reach “true 5G” sub-1ms latency. Verizon said it will be able to cut latency by 80%+ vs. 4G through investments in edge architectures. Each edge computing site needs its own servers, networking and storage capabilities. While edge sites will have less content than a normal data center, the number of edge sites will be much greater, creating new opportunities for semis like NVDA, INTC, AMD, XLNX, MRVL, and AVGO.

Recent 5G developments around the world

(1) Vodafone is first UK network to announce date (July 3rd) for launch of its 5G services in 7 cities; (2) WSJ article Wed. highlighted worries of 5G expansion to new frequencies impacting weather forecasts used to predict hurricanes; (3) US needs more access to mid-band spectrum to succeed in 5G, per Chris Pearson from 5G Americas at Big 5G.

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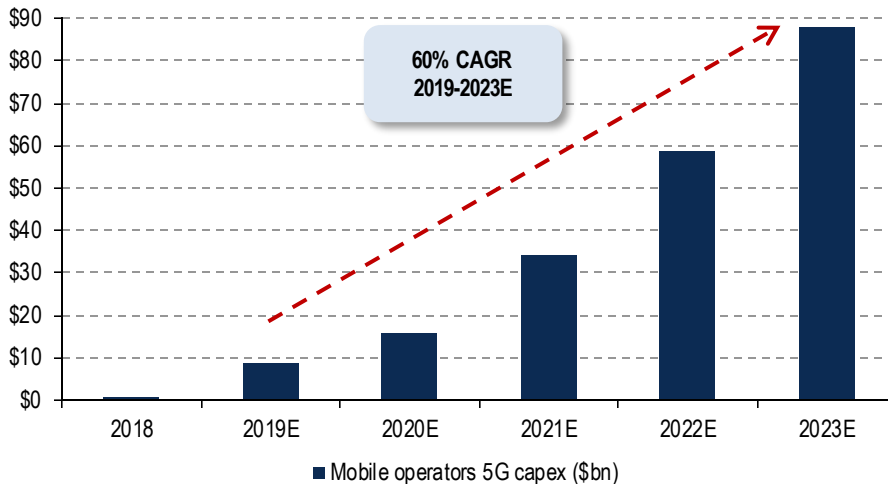
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Mobile operators annual global 5G capex

Per Heavy Reading, mobile operators 5G capex spend is expected to grow 14x YoY in 2019 to \$8.6bn (vs. \$600mn in 2018). Over the next 4 years, Heavy Reading forecasts 5G capex will grow at a 60% CAGR through 2023E. Recall, capex spend from operators becomes revenue for semis vendors tied to 5G infrastructure (ADI, XLNX, MRVL, INTC).

Chart 1: Mobile operator 5G capex spend to grow at a 60% CAGR through 2023E

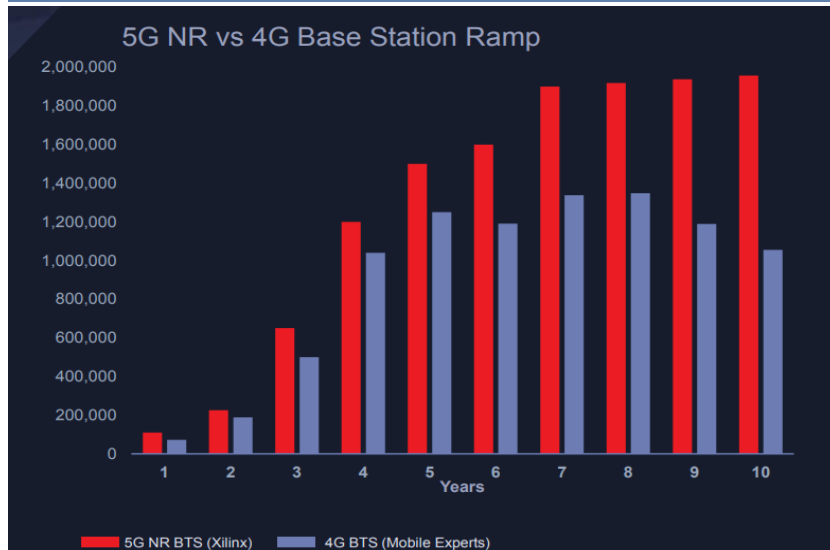


Source: Heavy Reading

Base station deployments in 5G vs. 4G

Exhibit 1 shows 5G NR base station (BTS) deployments compared with 4G base station deployments. The Year 1 for 4G BTS (blue bars) deployments represents 2011 with Year 10 representing year 2020. For 5G BTS (red bars) year 1 represents 2018 and Year 2-10 are Xilinx's forecasts for base station deployments from 2019E-2027E. The two main takeaways from this chart are: (1) 5G NR total base station deployments will be **50% larger** than the number of 4G deployments over the same amount of time; and (2) deployments will be **longer in 5G** compared with 4G. XLNX expects in year 10 of the 5G ramp, base station deployments will still be growing YoY (albeit at a slower rate than earlier years) while in 4G, by year 8, base station deployments peaked and began to decline in years 9 and 10 (per Mobile Experts).

Exhibit 1: 5G NR ramp expected to be larger and longer compared to 4G ramp

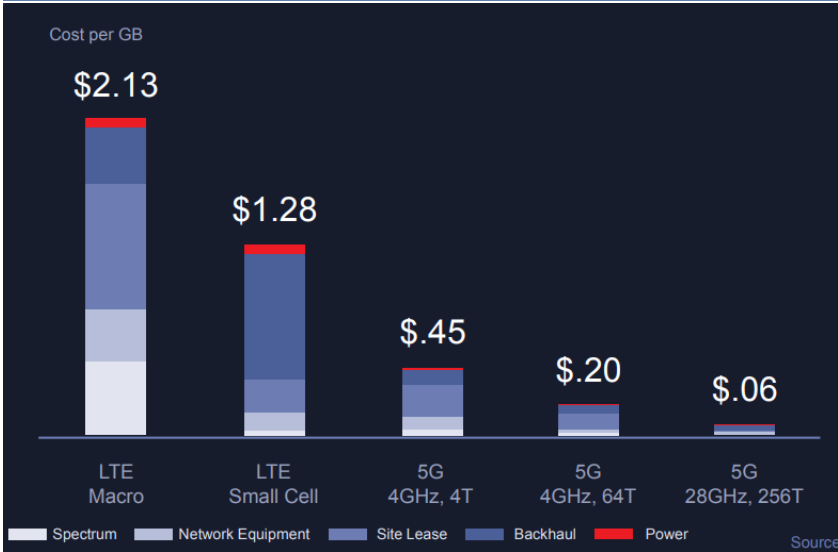


Source: Xilinx, Mobile Experts

4G vs. 5G cost per gigabit

In Exhibit 2, XLNX illustrates the cost advantages for operators as they move from LTE to 5G mid-band and high-band. With macro cell LTE, each gigabit of data cost \$2.13. With LTE small cells, this cost is nearly halved to \$1.28 per gigabit. However, the real cost savings are seen when operators move to 5G mid-band and high-band. With 5G at 4GHz, 4T cost per gigabit falls to just 45c. At 5G 4GHz, 64T, this cost falls even lower to just 20c. Finally when the industry moves to mmWave spectrum in 5G (28GHz) the cost per gigabit falls to just 6c, a 35x cost savings compared with LTE macro cell.

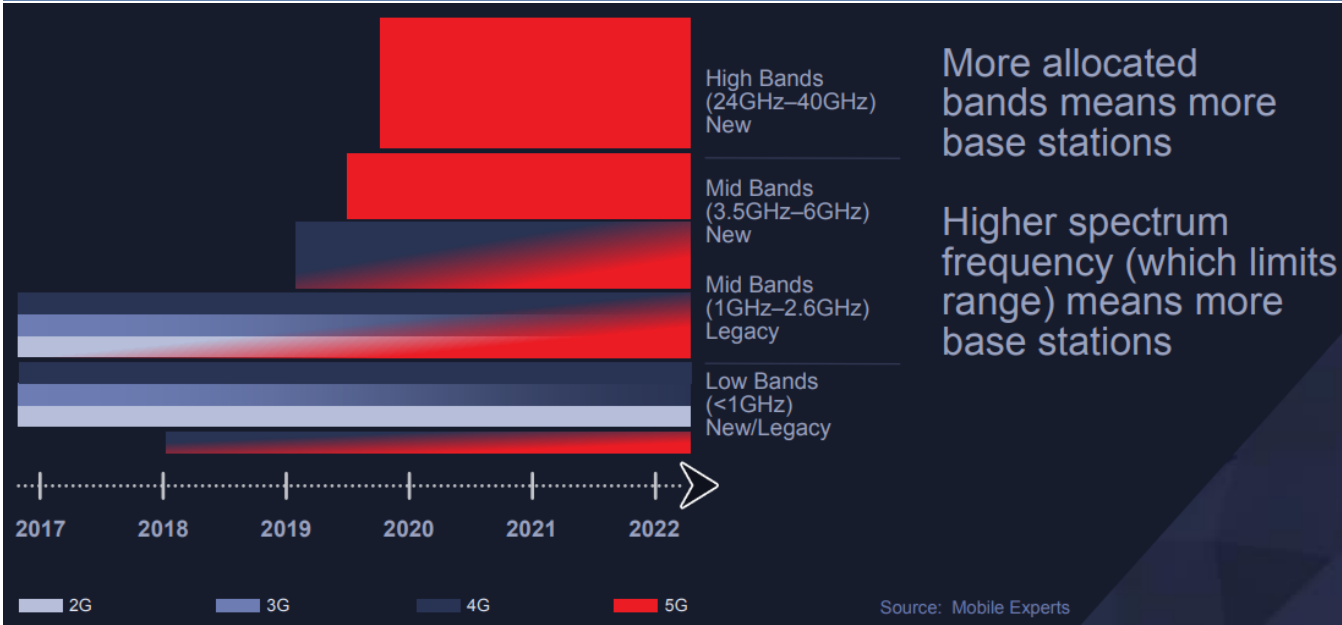
Exhibit 2: Lower cost per Gb driving operator deployment of 5G



Source: Xilinx, Mobile Experts

As operators look to take advantage of cost per Gb savings with 5G, spectrum complexity will increase. At higher frequencies (especially high-band frequencies) the range the signal can travel is limited. This means operators need to deploy more base stations in order to cover the same amount of distance as lower band spectrum driving further investment in infrastructure and revenue for semis exposed to 5G infrastructure.

Exhibit 3: Increased spectrum complexity driving need for more base station deployments



Source: Xilinx, Mobile Experts

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