RTT TECHNOLOGY TOPIC
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Satellite Scale

Last month we talked about the combined scale economies of the connected car with Space X and its fellow travellers as an integrated part of the connected car added value product offer.

The viability of providing car connectivity from space is implicitly depended on space delivery economics, a topic addressed in some detail in previous technology topics.

In this month's technology topic we look at satellite scale economics.

Today there are several orders of scale difference between satellite and terrestrial mobile.
The terrestrial mobile market is dominated by device volume, a market that absorbs one billion devices per year.

This supports optimised baseband modems which take advantage of the latest silicon scaling iteration, currently 7nm for 5G smart phones. Apart from some problematic capacitance effects, Moore's Law still applies.

RF devices, specifically analogue RF devices, do not follow Moore's Law but still benefit from high volume manufacturing, yielding cost reduction and performance improvement. Pick and place machines today can handle 100,000 components per hour (a 3G production line would typically be using machines placing 7000 components per hour) but in parallel component tolerances can be tightened and component vendors can invest in product optimisation. Devices such as SAW and FBAR filters for example have delivered year on year improvements – better selectivity, lower insertion loss across wider bandwidths over wider temperature ranges.

The ability to build nanoscale devices becomes increasingly useful as RF front ends move into the millimetre bands where materials and manufacturing innovation are not just desirable but essential to deliver cost efficient gain and low noise receiver performance.

But expensive – 5G infrastructure and device vendors typically spend 12-14% of their turnover on research and development and manufacturing investment. This is supported by a weaponised standards system which makes market entry problematic for new players which means that a small number of companies can maintain a relative scale advantage. This might not be fair but is fairly efficient.

The satellite vendor chain is different. Companies such as Lockheed Martin are dominated by defence contracts with R and D amortized across DOD budgets.

These companies do not have a track record of servicing consumer markets.

There are examples of mass production. First and second generation Iridium satellites were built on a production line rather than craft assembled and Airbus have invested heavily in automated manufacturing for OneWeb but the scale is counted in hundreds not hundreds of millions.
The bigger change happening in space is constellation scaling.

SpaceX recently launched the fifth batch of sixty Starlink satellites into a preliminary orbit of 174 miles (280 kilometres). Each of the 60 satellites is equipped with an ion engine to raise their orbit to an altitude of 217 miles (350 km). There are now three hundred Starlink satellites in space.

SpaceX plans to launch 12,000 Starlink satellites for the initial mega constellation with another 30,000 satellites as a longer term option. Other companies such as Amazon (Project Kuiper), OneWeb and Telesat have similar stated ambitions with OneWeb successfully launching 34 satellites last month on a Soyuz rocket from the Baikonur Cosmodrome in Kazakhstan.

Compared to existing constellation counts, tens of thousands of satellites is a big number but modest when compared to terrestrial base station numbers – Huawei plans to ship two million 5G base stations this year. It does however imply a sea change in space.

The question is whether constellation scale can translate to consumer scale.

The web scale majors have the great asset of customers and cash and so far are investing in satellite rather than 5G terrestrial infrastructure.

Space investment however will only realise a return if consumers can be connected via low cost mobile devices which are at least as good as and preferably better than their existing smart phones. Similarly, fixed devices will need to be low cost.

Apple is the exemplar of a company that has successfully bridged the two worlds of hardware production (the iPhone produced in vast numbers by Foxconn in Taiwan) and service delivery. Apple Siri is part of that service offer and has been successfully scaled across Apple's hardware offer with 4G, 5G (the iPhone11) and Wi-Fi as the default connectivity option.

It would be remarkably hard, one might say foolhardy for other Web Majors to attempt to replicate the success of the iPhone but this assumes that the smart phone remains as the common denominator of the connected world for the foreseeable future.

Counter intuitively, the success of Siri may be an early sign of change to come with Amazon's Alexa as the first move into a new mobile era, essentially a house pet allowed into the world outdoors.

As Alexa becomes more portable, Siri is becoming more house friendly. Both products are arguably first generation examples of a new generation of mass market voice controlled local area and wide area fixed and mobile consumer connectivity.

Both products obey the underlying telecoms rule of building addiction and dependency – a low cost easy to use product that makes life easier and more entertaining that can scale across cultures and multiple languages.

This means they need to obey the other underlying telecoms rule of providing universal connectivity.

Wi-Fi and 5G incur the inescapable opex and capex cost multipliers of terrestrial infrastructure.

The latest Space X launches show that sixty satellites can be launched at a time with no truck roll, no installation costs, no coffee and tea breaks and potentially a 25 year life span.

The implication is that at some stage the through life cost of sending sixty base stations into space will be less than installing the equivalent number of terrestrial base stations, there are no rental costs in space and electricity comes for free. Satellites can also take pictures and measure things.

Additionally terrestrial mobile regulation over the past thirty years has meant that four or five operators service each country. This is neither technically or commercially efficient particularly when multiple fibre routing is added into the equation. Six satellite operators could replace 600 terrestrial operators, 590 of whom are sub scale. Capex and opex costs would be reduced and long distance latency would be lower and more closely controlled.

On the ground, low cost terminals with fixed high gain narrow beam antennas, for example a simple passive dish looking directly upwards will be possible as soon as there are sufficient satellites in space to provide almost always almost overhead connectivity, achieved as soon as a LEO constellations scale to 20,000 or more satellites in space.

But the real value of universal connectivity including universal **global** connectivity from space comes from the ability to bridge language and culture, the ability for Siri to understand Swahili, for Alexa to understand Afrikaans, an end to the Tower of Babel.

Siri is a Scandinavian girl's name meaning beautiful victory.

Alexa is a diminutive of Alexandra, a defender or helper of mankind.

The two together could transform the telecoms world.

5G and Satellite Spectrum, Standards and Scale

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