# RTT TECHNOLOGY TOPIC
# January 2017

# GAFASAT

We start the New Year with some thoughts on the future of the telecommunications industry and the shifting dynamics of the 5G and satellite supply chain.

5G is poised to be the next big enabler of telecommunications industry growth both in developed and emerging economies. However, this growth will only be achieved if the satellite industry can be motivated to share its spectral and space assets.

To move the industry forward toward 5G, we are conducting a research study to produce a definitive economic and technical analysis of the 5G and satellite industry supply chain with an associated forward forecast to future asset and business value and relative competitive positioning.

We're inviting you to become a co-sponsor of this critical study, which RTT Programmes are conducting in partnership with The Mobile World and Policy Tracker.

To learn more about the study, which is offered on the research crowdfunding site Collaborata, click here.

COLLABORATA™

You're also invited to join us for a Webinar hosted by Collaborata on January 18 during which we will present the opportunity and answer all of your questions. To register for the webinar, please click here.

In the meantime, read on

**The impact of innovation on satellite and 5G operators and the 5G and satellite supply chain**

Technology innovations in the satellite sector including launch innovation and space hardware and software and system innovation are together reducing satellite capex and opex and will therefore deliver future gains in net margin.

Examples of launch innovation include reusable rockets; examples of space hardware innovation include electric satellites (TESLA SATS?) and fractional beam width antennas. Examples of system innovation include frequency re use achieved through hybrid MEO and GSO satellite constellations (angular power separation).

The result is more cost efficient and power efficient throughput delivered over ultra-sparse spectrally efficient satellite network topologies. Companies such as OneWeb also base their business modelling on the assumption that satellite production costs can be reduced by mass producing micro satellites, first attempted by Teledesic 15 years ago but now more realisable.

Technology innovation in the mobile broadband industry by contrast is predicated on the assumption that 5G networks will be ultra-dense. The end result is an increase in capex and opex and reduced power efficiency.

Company valuations in both sectors are based on turnover and profitability, competitive market positioning, asset value and debt ratios. The top four mobile broadband operators have one million employees and a combined turnover of $440 billion dollars (including other revenues). The top four satellite operators have seven thousand employees and a combined turnover of $8 billion dollars - a difference of David and Goliath proportions. Both sectors are highly geared. Intelsat debt servicing costs are equivalent to buying three new satellites per year.

Mobile broadband assets include spectrum and sites, either owned or leased. A mobile broadband operator will typically have access to several hundred MHz of licensed spectrum in the UHF band, L band, S band and occasionally C band and several thousand or tens of thousands of base station sites. China Mobile has over one million LTE base stations.

Satellite operator assets include ground stations and space assets (satellites) placed in GSO orbital slots or in MEO, LEO or occasionally HEO orbits. A satellite operator will typically have access to **several GHz of spectrum** including potentially some combination of UHF (Orbcomm for IOT being one example), L band (including GNSS), S band, C band, X band, Ku-Band and Ka-band (High Throughput Satellites). Spectral values are dependent on landing rights negotiated with countries covered by the satellite footprint, a substantially political process.

Mobile operators and satellite operators are both financially sensitive to network underutilisation (described as low fill rates in the satellite sector). Some industry commentators are suggesting that if a significant percentage of present constellation investment plans are realized then the result could be significant over capacity in the satellite sector. While this is a risk, the bigger problem is likely to be user device and IOT device cost and performance.

Companies such as OneWeb and Facebook/Eutelsat (internet.org) identify developing markets including developing rural markets in Latin America Africa and Asia as target markets (the yet to be connected two and a half billion). Adding in these new users would improve fill rates but would require present delivery cost models to reduce by several orders of magnitude. Premium connectivity services in the satellite sector cost $3000 to $5000 dollars per month and more basic services cost $300 to $500 dollars per month. In the mobile broadband industry we are more familiar with rates of the order of $30 to $40 dollars per month but to enable mass deployment in developing markets implies a need to reduce this to $3 to $5 dollars per month.

Similarly a terminal costing $1000 dollars is transparently inappropriate for markets where individual earning power is of the order of a dollar per day. Even $100 dollars is too expensive. Ideally the price point needs to be similar to a transistor radio at $3 to $5 dollars.

The solution suggested by OneWeb and Facebook is to deliver two way connectivity from the satellite to a base station costing a few hundred dollars with local access provided by Wi-Fi. But Wi-Fi does not have sufficient range and though lower cost than present LTE is still too expensive. The cost includes patent costs which do not necessarily reduce with volume.

The alternative would be to develop a purpose made transceiver that provided wide area coverage suggesting a need for at least a one watt or two watt device deployed into FDD spectrum to maximise receive sensitivity. Ideally this device would have no associated patent costs.The device would however need to globally standardised in order to realise sufficient scale to be cost economic. This would need to include global agreement on terrestrial spectral allocation, band plans and guard bands and technology and it would be unlikely that auction costs could be supported. This would have to be no cost rather than low cost spectrum.

It is hard to see either the mobile broadband industry or traditional satellite industry either being able or wanting to do this. The mobile broadband industry has so much asset value and more importantly balance sheet value invested in expensive licensed spectrum that it would be hard and probably impossible for them to adopt a model with no auction protection, particularly in markets

where the auction process has been used to consolidate incumbent advantage. Similarly their supply chain is critically dependent on realizing revenues from standards based patent income.

The satellite industry by contrast does not have an effective standards process. Value in the traditional satellite industry is realized from terrestrial and space assets largely subsidized by military dual payloads and military R and D.

Web scale companies including the GAFA quartet, Google, Amazon, Apple and Facebook, are beginning to engage with the 5G and satellite industry but are starting from a different market position.

Apple over the last ten years (the iPhone was launched in 2007) has demonstrated that it is possible to capture a dominant share of the added value of mobile broadband connectivity without investing in that connectivity.

It is the device and the applications on the device that confers value not the network (the OTT opportunity). A decision to address developing market requirements would however have significant device form factor implications. Approximately 800 million people cannot read or write or have limited numeracy skills. While Apple has not explicitly addressed this market, the company would undoubtedly have the requisite capability and resources.

There is also an associated capitalization issue. We have referenced the high gearing and debt ratios that are a fact of life in the mobile broadband and satellite industry. In the mobile broadband industry, this is a consequence of over regulation and aggressive competition policy coupled with an auction process deliberately contrived to elevate bid value for any available spectrum (driven by the myth that the industry is short of spectrum). In the satellite industry it is a consequence of unfortunate timing with a deregulation and privatisation process that coincided with the dot.com melt down in 2000 and the telecoms meltdown two years later, the related fibre over capacity issue (dark fibre everywhere) and the competitive stampede to invest in new Ku-band and Ka-band constellations

In the 15 years since 2002, the debt ratios and gearing of the mobile broadband operators and satellite operators have increased relentlessly. During the same period the cash reserves of the GAFA quartet have grown exponentially and are now close to half a trillion dollars. The combined enterprise value of EchoStar, Eutelsat, Inmarsat, Intelsat, SES and Viasat is $49 billion. Apple has $67 billion in net cash, Google $79 billion; Facebook has a comparatively modest $6 billion. Amazon has $1 billion of net debt but remarkable customer reach. This means that at least three of the GAFA quartet (Google, Apple, Facebook, and Amazon) could afford to buy some and potentially all of the satellite operators.

And the GAFA quartet cannot afford to stand still.

So we propose the following scenarios.

**GAFASAT**

Disappointed by their experiments with balloons (the Google Loon project) and drones (Facebook), the GAFA quartet realizes that they can buy satellite operators at a discounted price to the extent that their prior reluctance to invest in network access no longer applies. If the satellite operators fail to match constellation investment fill rate expectations they will be even more vulnerable.

Connecting the two and a half billion disconnected has a global strategic value probably significantly higher than the present US defence budget (about six hundred billion dollars) and could probably make a bigger impact on future global prosperity and stability than the combined efforts of the US DOD.

The Republican sponsored Space Renaissance Act highlights the US position but does not explicitly address the disconnected or under connected world. The GAFA quartet by contrast has access to ROW (rest of the world) customers that can deliver the fill rates that are needed to make the delivery economics make sense.

Google and Apple and Facebook and Amazon all have experience in developing user interfaces and devices that could potentially be repurposed for sale into emerging markets. Amazon has a project donating Kindles to developing countries.

**GOOGLESAT**

Competition policy might of course get in the way in which case each company within the GAFA Group would do their own thing but of course there are other options.

**AUTOSAT**

Automotive manufacturers in some markets already deliver services to cars and lorries and buses via satellite. Sirius XM Radio in the US is one example. http://www.siriusxm.com/whatissiriusxm.

The four largest car manufacturers have a combined turnover of $800 billion dollars, employ 1.4 million people and have a combined R and D budget of over $50 billion dollars though do not have a great record of mutual collaboration.

**OTHERSATS**

OTHERSATS could develop for discrete vertical markets, farming and agrarian applications (Botswana farmers on their TESLA tractors), medical (the Trump Care initiative?), Energy and the Environment to name a few – in many ways vertical market segmentation makes more commercial sense that legacy sovereign market segmentation.

The common touch point is that the telecommunications industry remains over focussed on developed economy markets.

There are exceptions. Developing economies between the 48$^{th}$ to 48$^{th}$ parallel now make up 70% of Vodafone's subscriber base. China Mobile and the China based LTE supply chain have successfully reduced terrestrial delivery and device costs to support market penetration into lower ARPU markets.

The satellite industry to date has had less success and less motivation in reducing delivery and device costs.

Partly this is due to having a supply chain still heavily geared to meeting military space requirements. Companies such as Lockheed Martin, Boeing, Northrop Grumman, Raytheon and Harris are significantly different to Ericsson, Nokia and Huawei or Samsung and Qualcomm.

The satellite supply chain has not had the scale or motivation to be able or willing to invest in truly low cost user and IOT devices and has not to date had the agreed standards required for this to be achieved. OneWeb and similar new constellation enterprises may be able to change this model though by definition start with zero market scale. Similarly the prospect of reducing monthly revenues from $3000 dollars to $3 dollars may not be immediately appealing.

There is also a critical need for investment in fundamental component technology, for example high Q low loss filters and power efficient low noise highly linear amplifiers for centimetre band and millimetre band user devices. Companies such as Avago/Broadcom, Skyworks, Qorvo, Analog Devices, Fujitsu, Infineon, NXP (now Qualcomm), Infineon and TI all have to be motivated to invest

in these technologies. This is high risk material and manufacturing innovation with long rather than short term return.

Part of the motivation is that parallel markets such as automotive radar at 77 GHz are delivering substantial added value both in terms of RF front end component value and signal processing IP.

But these companies will only invest in low cost satellite end user and IOT products and or low cost 5G end user and IOT end user products once they are convinced that global scale opportunities are a potential reality.

This would require the satellite industry and 5G industry (including fixed point to point backhaul vendors) to collaborate on spectrum and standards and for regulatory and competition policy to be more or less perfectly aligned.

But as Mr Farage has said, anything is possible.

And apparently and disturbingly…… it is.

http://www.silverdoctors.com/headlines/world-news/brexit-nigel-farage-donald-trump-speech-can-beat-hillary-clinton-establishment/

**Learn more about these topics**

## Resources for 5G engineering, marketing and policy teams

New in depth syndicated research from RTT, Policy Tracker and The Mobile World.

### A timely and critical investigation into 5G and satellite industry supply chain economics and spectral and space asset value

Telecommunications is a trillion-dollar industry with 5G promoted as the next big enabler of growth both in developed and developing economies**.** However, this growth will only be achieved if the satellite industry is motivated to share its spectral and space assets including C band and Ku and Ka- band spectrum.

Mobile and satellite operators are highly leveraged and are reliant on vendor supply-chain support. “Over-the-top players,” such as Google and Facebook, are starting to invest in access infrastructure and are cash rich. Additionally, the military and the automotive industry are increasingly important stakeholders.

So, the question is: Who will own added value in next- generation mobile broadband?

This study is being developed as a syndicated research opportunity in association with Collaborata

COLLABORATA™

The satellite industry is engaged in a transformation of its Ka-band spectral and space assets. Ka-band spectral assets, particularly the 28 GHz and 38 GHz bands, are emerging as the sweet spot for 5G terrestrial network deployment with AT&T and Echostar and Verizon and Viasat as examples of potential 5G technical and commercial partnerships.

**'A timely and critical investigation into 5G and satellite industry supply chain economics and spectral and space asset value'** analyses the implications of the growing inter dependency of these two industries and will make extensive use of presentation graphics to highlight present

value and risk distribution in the industry with modelling of three future industry scenarios assigning different weightings on terrestrial and satellite spectral and network value and the relative market reach value and technology value of each supply chain and the major players in each supply chain. The value modelling will use inputs from industry interviews correlated with our own research and in house data sets and the in house research and data bases of our project partners, Policy Tracker and The Mobile World.

This is a unique opportunity to join us in a syndicated research project in which costs are shared between two or more sponsoring agencies providing the opportunity to precisely dimension the technical and commercial risks and opportunities of Ka-band spectral asset and space asset and terrestrial asset integration.

**Follow this link for more details**
http://www.collaborata.com/projects/186

Join our live webinar Wednesday January 18 4.00 pm GMT

---

**5G BOOK – 5G Spectrum and Standards – Geoff Varrall**
Published by Artech House

The spectrum, band plan and standards choices for 5G radio systems and the relative technology and economic impact of these choices on the industry supply chain, operator community and end users.

£117.00 available to pre-order at a discounted price of £87.00
**Order a copy here**

**About RTT Technology Topics**
RTT Technology Topics reflect areas of research that we are presently working on. We aim to introduce new terminology and new ideas to help inform present and future technology, engineering, market and business decisions. The first technology topic (on GPRS design) was produced in August 1998. 18 years on there are over 200 technology topics **archived on the RTT web site.**

Do pass these Technology Topics and related links on to your colleagues, encourage them to join our **Subscriber List** and respond with comments.

**RTT and 5GIC**

We are pleased to announce that as of January 2017, **RTT is an affiliate SME partner of the 5G Innovation Centre (5GIC)**. Based on the University of Surrey Stag Hill Campus, 5GIC is one of the principal centres of excellence for 5G related research and we look forward to working with the 5GIC team on 5G and satellite spectrum and standards issues and related supply chain implications.

---

**Contact RTT**
**RTT**, **Policy Tracker** and **The Mobile World** are presently working on a number of research and forecasting projects in the mobile broadband, two way radio, satellite and broadcasting industry.

If you would like more information on this work then please contact **geoff@rttonline.com**
**00 44 208 744 3163**