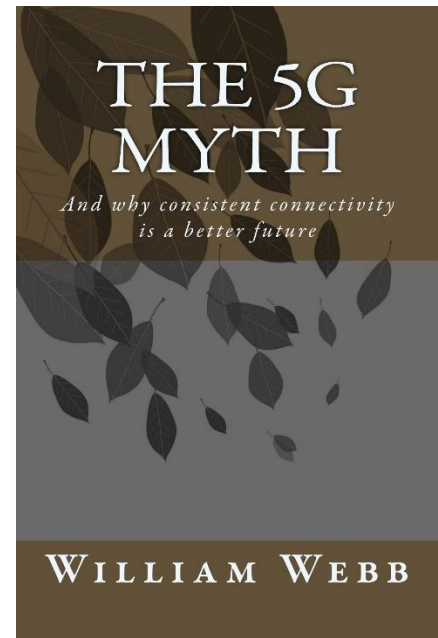


5G Technology is Fantastic: But Can We Afford it?

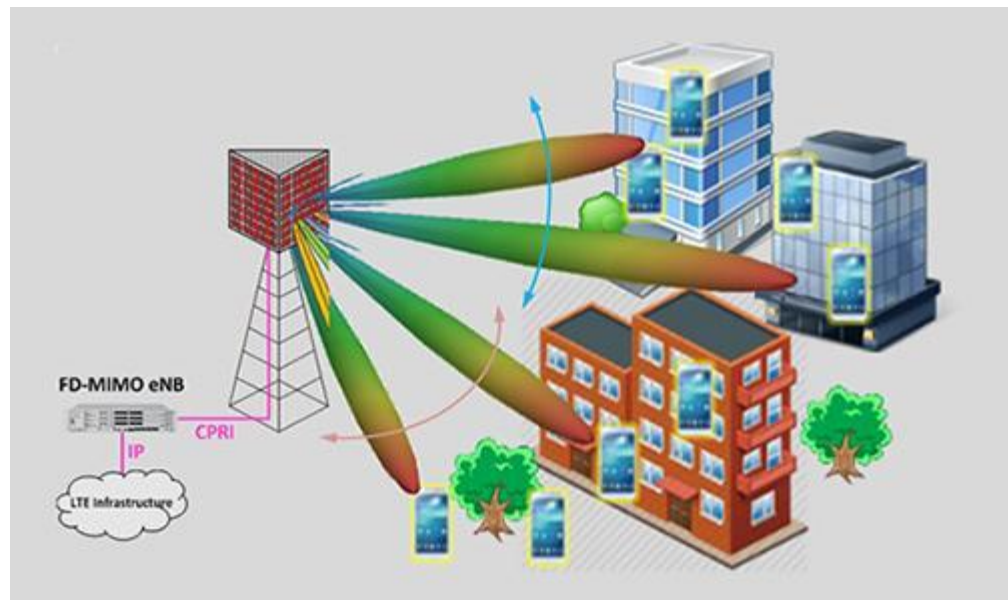
Professor William Webb

November 2017



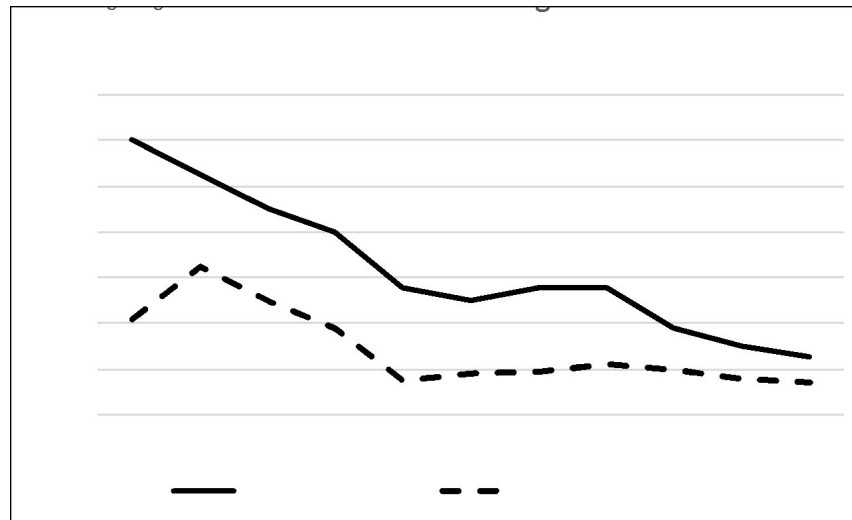
Fantastic, cutting edge technology

- Complex MIMO antennas forming narrow beams
- Use of mmWave bands to provide huge bandwidth and enable FWA
- Virtualised core networks saving costs and enabling new models
- Very high data rate and low-latency systems
- Separation of control and data planes to support hetnets
- And more...

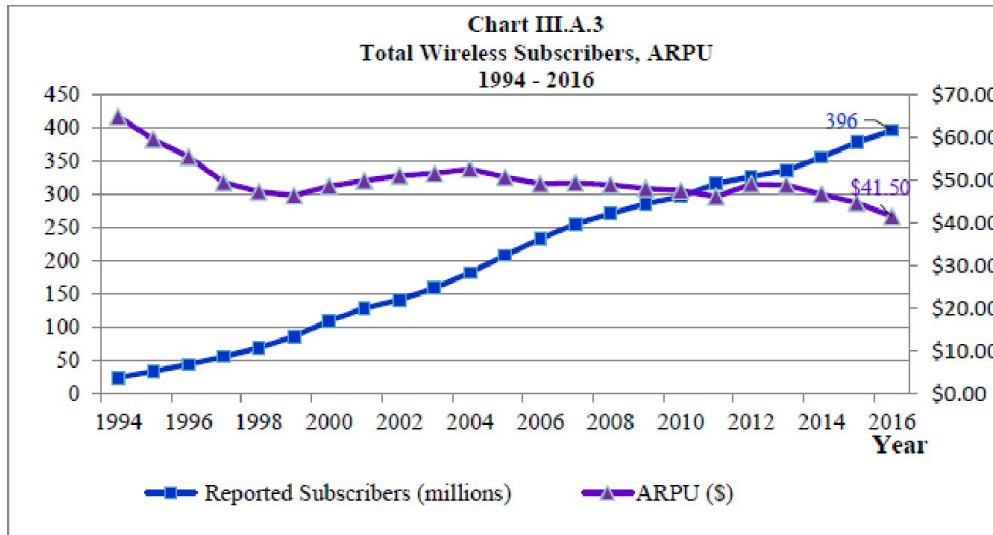


MNOs will be the ones needing to get their wallets out

- MNO revenue in decline in many markets
 - US ARPUs fell 7% last year!
- A bad investment – falling revenue, tight regulation, high capital spend, limited ability to exit
- RAN spending at a historic low



The US market



Appendix II: Table II.F.i
Year-End Cell Site Counts by Service Provider, 2013–2016²⁹⁸

Cell Sites	2013	2014	2015	2016
AT&T	61,800	71,768	66,500	67,000
Sprint	55,000	55,000	55,000	50,000
T-Mobile	63,879	61,079	57,971	59,417
Verizon Wireless	46,655	50,065	54,000	58,300
U.S. Cellular	6,975	6,220	6,297	6,415*
Total by Top Wireless Service Providers	244,753	245,585	240,735	241,091
CTIA Reported Total Industry-wide Cell Sites	304,360	298,055	307,626	308,334

The 5G community has mapped out the next decade for us, hasn't it?

Webb

Search

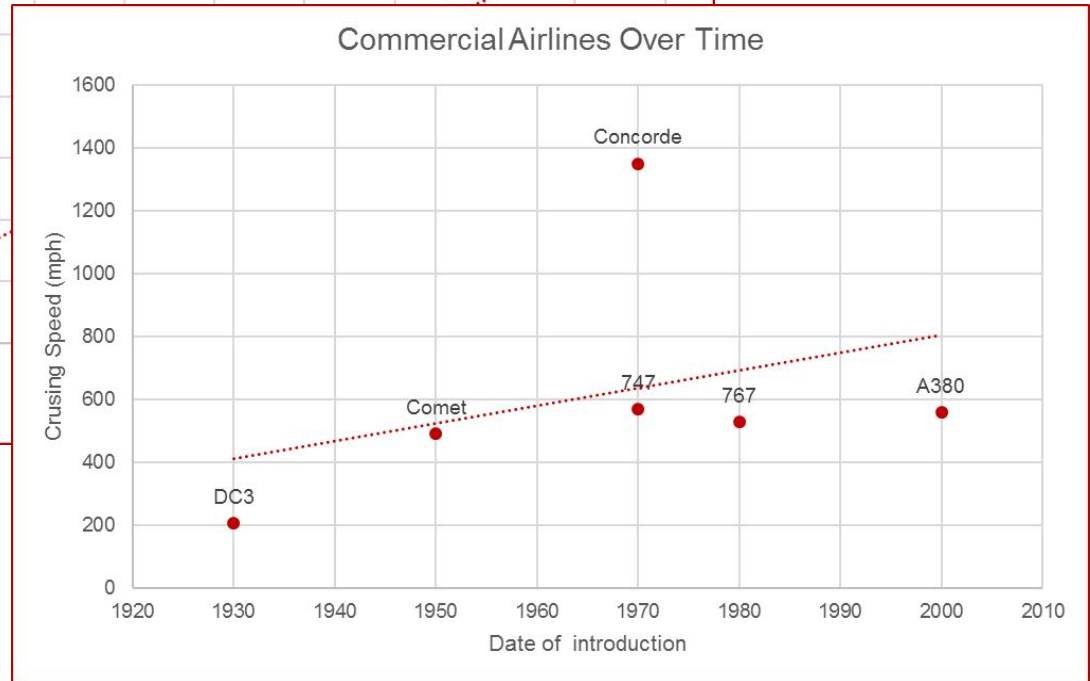
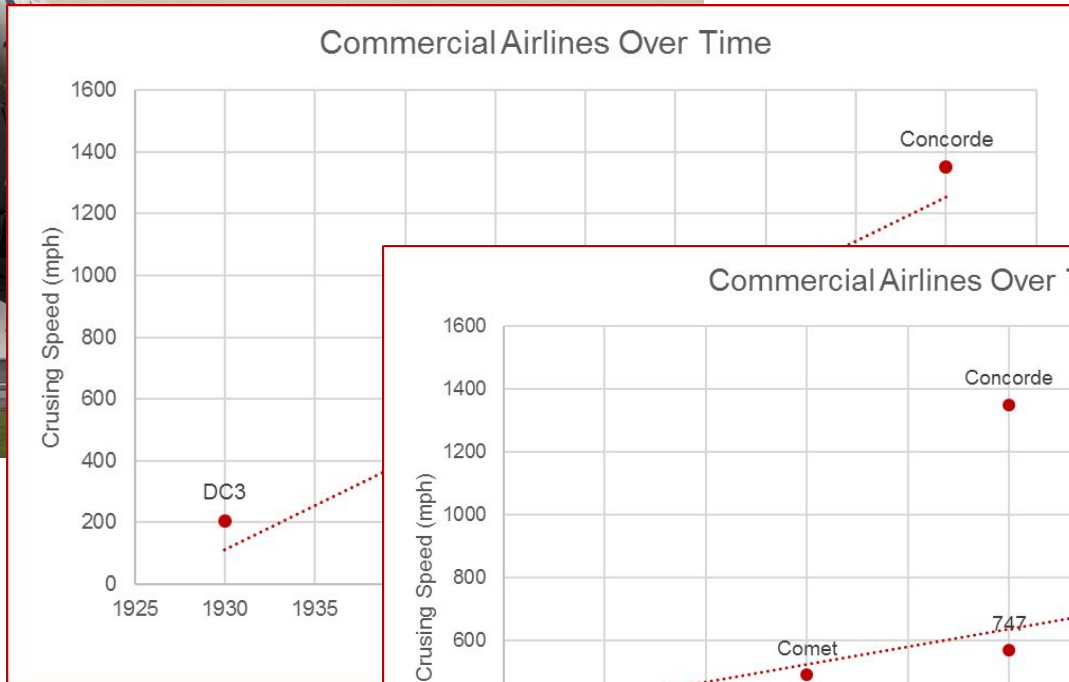
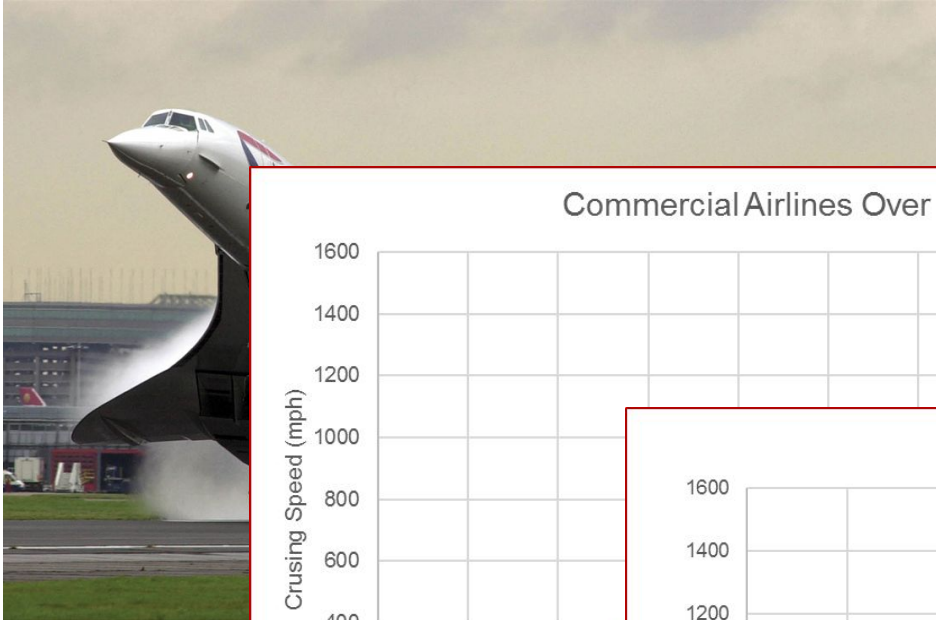
- Incredibly fast – Gbits/s speeds
- Incredible capacity – 1000x current networks
- Broadband everywhere
- Massive machine connectivity
- Ultra-low latency and complete reliability

5G will be instrumental in the next evolution of connected devices, including cars, smart homes, and wearables, due to its superior network speeds (10 times faster than 4G) and capacity (1,000 times the capacity of 4G). [Business Insider]

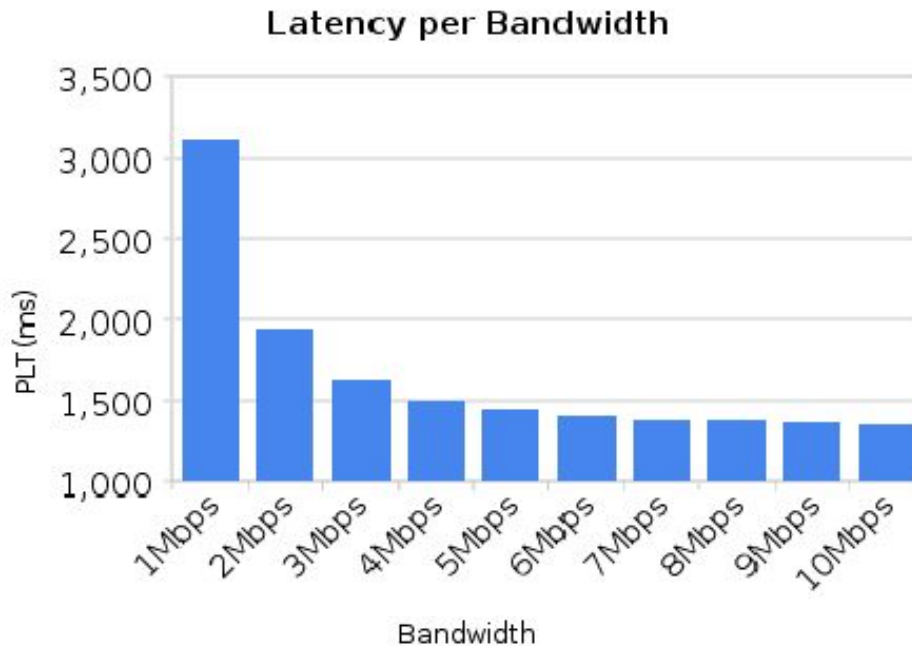
There is a general industry consensus which indicates that traffic volumes will be multiplied 1,000 times; 100 times more devices will require connectivity; some applications will demand data rates 100 times the speeds that average networks currently deliver; some will require near-zero latency [Ericsson]

Optus and Huawei have claimed a single user transmission speed of 35 gigabits per second was achieved over the 73 GHz band in a 5G speed trial just completed in Sydney. [Huawei]

But sometimes more speed isn't the right answer

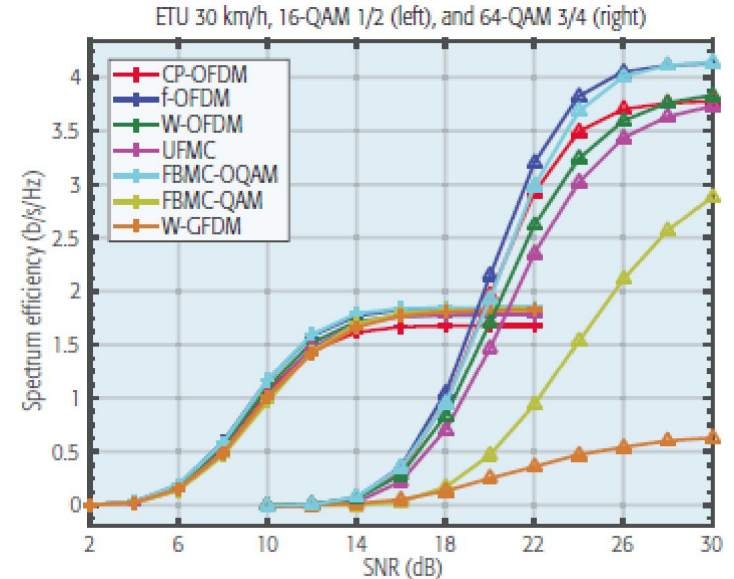
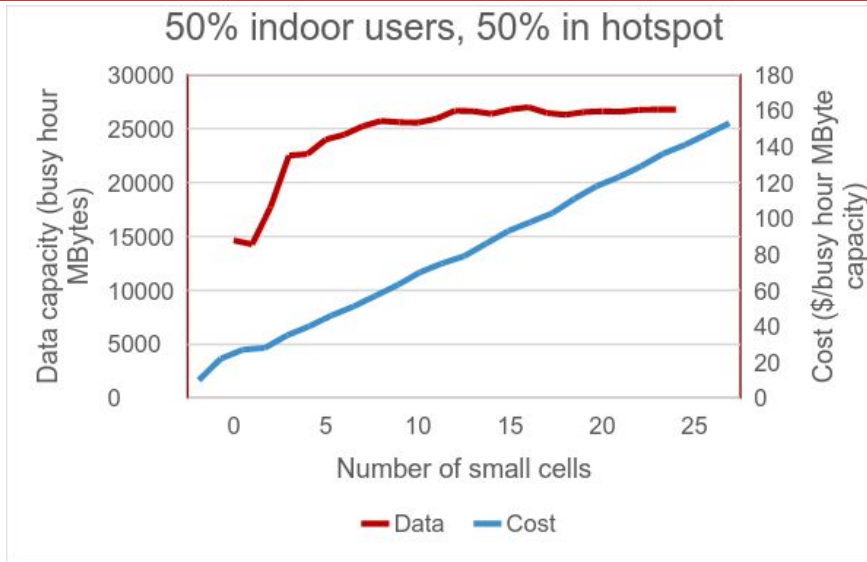


Why higher speed is not valued

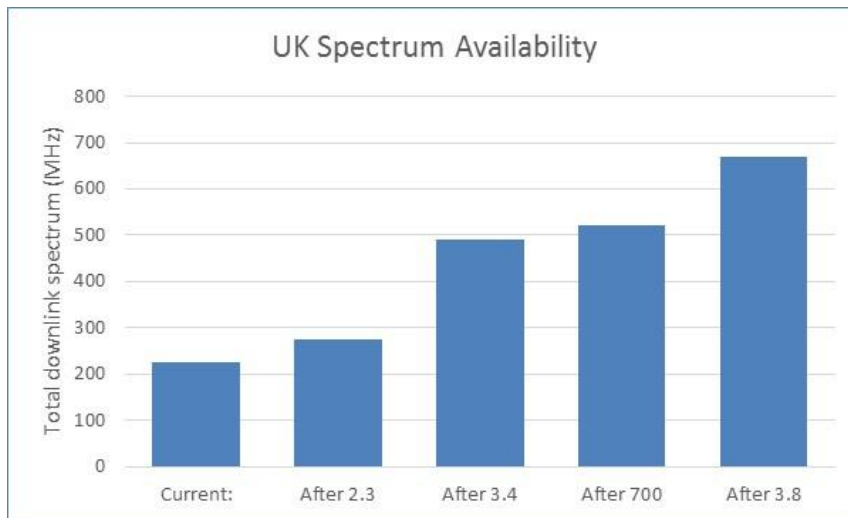


BCG said: “Put simply, telcos have overrated the role that speed plays in customer satisfaction. For video, we saw that once speeds reach 1.5 Mbps, further increases have little or no impact on users’ perception of performance.”

Capacity is expensive and limited to circa 3x outdoors



Capacity gains are tough, even 5G studies have failed to materially improve on LTE (red line)



And perhaps we don't need more?

The screenshot shows a web browser window with several tabs open. The active tab is the BBC News website, specifically the Business section. The main article is titled "Smartphone use falls among young for first time" by Rebecca Marston. Below the article title is a video player showing a woman, June King, with the caption "June King is in almost constant contact with her phone". To the right of the article is a "Top Stories" sidebar with three items: "75,000 jobs 'could be lost' after Brexit", "Fixed-odds maximum bet 'could drop to £2'", and "Fallon 'touched journalist's knee'". Below that is a "Features" sidebar with two items: "This is my country, too" and another partially visible item. The Windows taskbar is visible at the bottom of the browser window.

In some countries growth is slowing

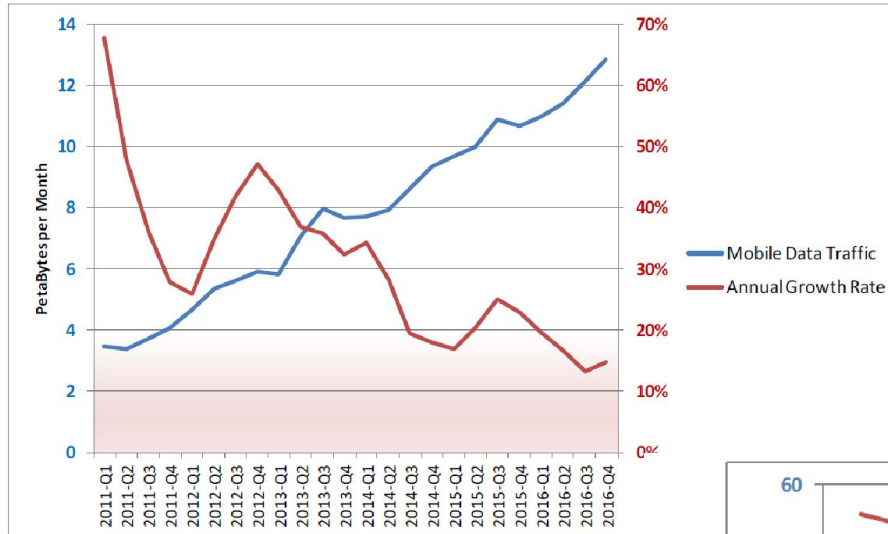


Figure 12: Growth of Mobile Data Traffic in Singapore between 2011 and

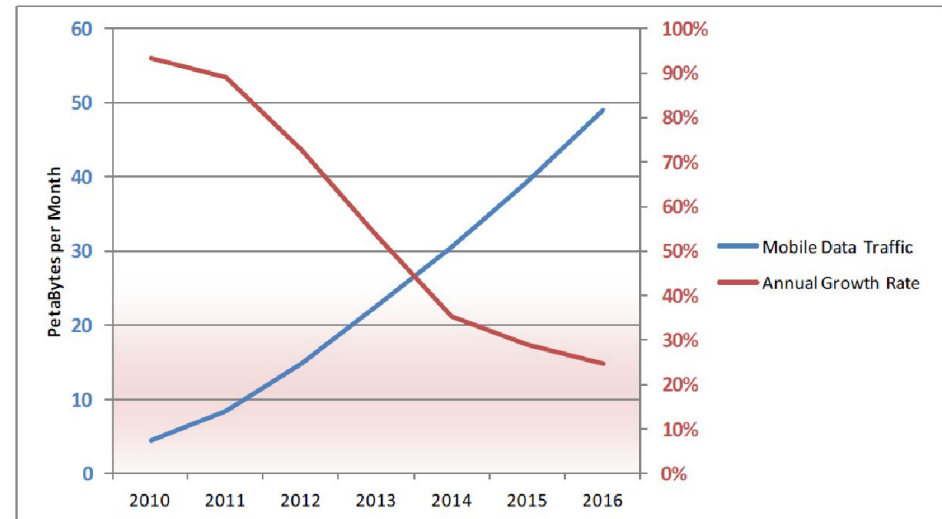


Figure 13: Growth of Mobile Data Traffic in Sweden between 2010 and 2016²⁴

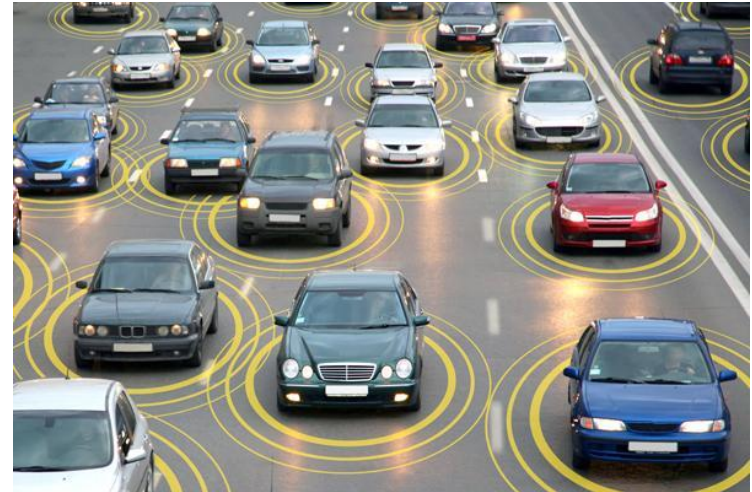
Ultra-low latency requires mmWave

- For what purpose?
 - Applications typically indoors
- Impossible to achieve in many practical situations due to need to reach servers 100's of miles away
- MNOs cannot afford it unless users pay a lot more



Automotive in more detail

- Cars need
 1. Telematics for maintenance, software upgrade, etc
 2. Entertainment for passengers (but most cars are driver-only)
 3. Connectivity related to autonomy
- But autonomous cars need to be....autonomous
 - Cannot rely on connectivity
- V2V useful for signalling to nearby cars
 - but this is not 5G
- Centralised low-latency control looks to have very limited benefits and a very high cost
- In any case, extensive autonomous cars unlikely to be around before 6G



More of a problem is coverage



Broadband everywhere is being achieved with Wi-Fi and LTE

- Trains and planes – Wi-Fi
- Buildings – Wi-Fi (and delivers capacity where needed)
- Rural and third world – 700/800MHz LTE (ideally with long-range mode)
- Integrating Wi-Fi well into 4G is critically important (eg Google Project Fi)



CBRS – a benefit or a block to 5G?

- 5G proponents claim that 3.4-3.8GHz is a key 5G band and having CBRS prevents maximum 5G capacity and bandwidths
- But if 5G is about hetnets (which combine multiple network technologies) then allowing independent indoor deployments of WiFi-like 5G base stations is exactly what is needed
- Indicates that MNOs have a narrower interest than the full 5G vision so Governments and regulators need to have broader view they are prepared to stand up for

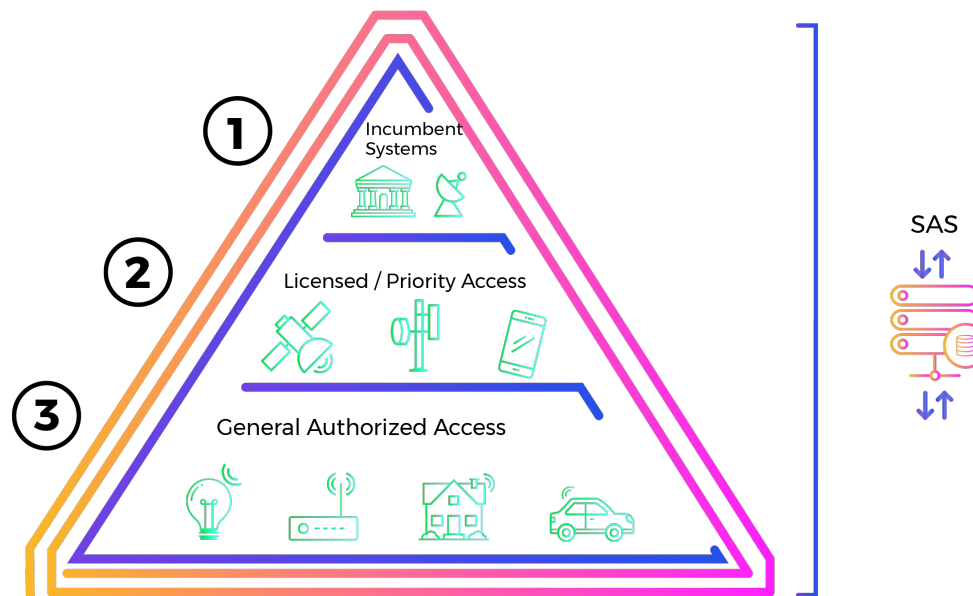


Figure 2

Massive machine connectivity is easy

- Can be achieved today with NB-IoT or LTE-M
- Only adds 0.03% loading to network
- Might also want unlicensed (eg LoRa or Weightless)



The future could be bright

- What we don't need or won't pay for
 - Speeds above 10Mbits/s to handsets
 - Much more outdoor capacity
 - Ultra-low latency solutions
- What we do need and can afford
 - More capacity indoors
 - IoT solutions
 - Coverage improvements in rural areas, in not-spots, on trains, in developing countries...
 - A viable regulatory framework for provision of broadband comms where declining ARPUs still allow for investment



Now accepting questions

