HITTING THE RIGHT TARGET

Governments are pursuing the wrong types of connectivity target in their digital policies, argues **BRIAN WILLIAMSON**. What is needed is flexibility to embrace technological change

In several regions around the world, governments' aspiration for the digital economy with universal broadband has run ahead of what markets and independent regulation can deliver. This is a threat to regulatory and market independence. At the same time, advances in computing and software do offer the tantalising prospect of delivering high capacity connectivity at lower cost, but only if we allow market participants to choose paths less trodden and let rewards reflect risk. What I call 'ambitious incrementalism' will not get us from here to there – let me explain.

Aspirational targets for fixed and mobile broadband access – including access speed, coverage and technology specific aspirations for fibre – have been widely adopted. In Australasia, there are targets for fibre to the premises; in Europe the digital single market targets include universal 30 Mbps provision by 2020; but the US has been less target driven and consistently focused on mobile rather than fibre per se.[1] Mobile coverage obligations, typically attached to spectrum licences, are also commonplace.

Where targets are adopted, there is a desire not

only to reap the productivity benefits of connectivity, but to outperform other nations. Like the Red Queen's race in Lewis Carroll's *Through the Looking-Glass*, nations feel they need to run to stand still.

"A slow sort of country!" said the Queen. "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

But what matters is investing wisely in the right areas at the right time – not investing more than others in a given area. Sufficient connectivity is crucial, but is not the only ingredient for success.

Investing too much, too early or in the wrong form of connectivity are all risks, but perhaps a greater risk for policymakers is that a single form of connectivity comes to dominate digital policy, while technology and market inflexion points may be missed.

NETWORK TARGETS MAY DOMINATE DIGITAL POLICY

There is a danger that everything is seen through the lens of network investment, given the commitment of political capital involved. Malcolm Turnbull, Australia's prime minister, has pointed to the all-consuming nature of the previous government's commitment to build a national broadband network (NBN):[2]

"Everything that was said about the digital space was said in a way that sought to justify the NBN."

The Australian government had originally committed itself to roll out fibre to the premises to 93% of households. Progress was poor, costs overran and the policy was eventually changed to a mixed strategy involving predominantly investment in fibre to the cabinet, cable upgrades and wireless.

However, under the original policy the role of the market was diminished, and regulatory independence and legitimacy undermined.[3] Infrastructure competition was sidelined and points of interconnection limited to support the NBN – resulting in underprovision and poor performance at peak times.[4] Even where fibre to the premises has been deployed, it is not fulfilling its promise.

New Zealand has had more success delivering fibre, but was more realistic regarding initial fibre to premises coverage targets, and worked with providers via a competitive procurement programme rather than establishing a new national provider. In New Zealand responsibility for fibre pricing rested with the government via contracts, and not the regulator. Acting independently, and with responsibility for copper but not fibre, the Commerce Commission proposed a significant reduction in the price of copper in 2012, undermining the fibre business case. In response:[5]

"Prime Minister John Key indicated the government would change the law rather than see its ultra-fast broadband network compromised by a Commerce Commission decision."

The New Zealand experience illustrates the risk to regulatory stability and independence that can arise with ambitious national fibre plans:[6]

"It appears that the government's 'grand strategy' for a fibre network was implemented as if it was a stand-alone project independent of any need to coordinate the integration of either the network or the requisite regulatory framework governing it into the existing industry. Meanwhile, the custodians of the regulatory framework governing the pre-fibre industry appear to have failed to appreciate the revolutionary effect of the government's strategy on their sector."

> **"There is a danger that everything is seen through the lens of network investment."**

Given pressure to deliver outcomes that markets alone may not deliver, the role of governments and independent regulators, and the way in which they relate, need to be rethought and reset. The problem is not necessarily that governments are re-engaging with telecoms, but that there are not established channels and norms for doing so after a sustained period of independent regulation in which the introduction of competition was the primary goal.

INFLEXION POINTS MAY BE MISSED

As Kenji Kushida noted in relation to experience in Japan:[7]

"Japan quickly discovered that taking advantage of the broadband environment to produce innovation, productivity growth, and economic dynamism, was far more difficult than facilitating its creation... Like Europe, Japan was not home to the ICT lead-user enterprises and industries that drove the ICT revolution, producing innovation and productivity gains. Moreover, the advent of US-centred cloud computing services potentially decreases the minimum bandwidth requirement to access global-scale computing power. The development of wireless technologies far cheaper than Japan's nationwide FTTH also merits serious consideration for European policy discussions."

Once targets for, say, fixed broadband access are adopted there is a tendency to double-down on them – irrespective of how the market may be changing.

Discussion of communications markets and policy may take comfort in certain shared beliefs regarding 'inevitable' trends. Demand for bandwidth will inevitably increase, fibre is the 'futureproof' technology, and convergence – whatever that may mean precisely – is a given. On closer examination, these beliefs are not obviously shared by market participants that are pursuing diverse strategies in the face of technological change and uncertainty. Some have pursued incremental network upgrades, while others are placing bold bets on future demand – either investing in fibre to the premises or in high-capacity wireless.

Others, from outside the traditional telecoms space, have developed internet-based communications applications that improve on, and bypass, legacy services integrated with networks. Developments in relation to network virtualisation may also see network service provision separated from network infrastructure.

Advances in software and computing are facilitating these changes, and may also allow

new forms of network to succeed commercially, including high-capacity 'wireless fibre' and 'over-the-top networks' using balloons, drones and low-earth-orbit satellites.

WIRELESS FIBRE

"In the longer-term, we will forget this stupid debate about rolling out fibre cables... My sense is that there's a more forward-looking context for the delivery of regulation and policy there [in the US], which is adopting the notion of a digitally led mobile first," said Ronan Dunne, then at the UK's O2, now at Verizon Wireless.[8]

Wireless fibre refers to wireless links with high capacity and near gigabit speeds. The possibility raises the question of whether fibre, in the access network, really is 'futureproof'. Extensive trials underway in the US and elsewhere suggest the possibility of using wireless instead of fibre for the final drop is more than speculative:

- *"Fixed-wireless millimetre wave technology gives us the ability to make ultra-fast internet speeds available to additional locations in less time and with less disruption."* AT&T, 6 October 2016[9]
- *"With wireless fibre, the so-called last mile can be a virtual connection, dramatically changing our cost structure."* Verizon, 26 July 2016.[10]

Wireless has, of course, been tried before as a residential fixed access technology – with limited success (fixed wireless is though used in mobile backhaul). While we don't know yet how successful the new fixed wireless business models will prove, we do know that the market and the underlying technology are different.

A decade ago wireless was competing with basic broadband which could be delivered to many via relatively low cost upgrades to copper. Today, delivering higher speed access can involve costly civil works to bring fibre closer to premises. The fixed competitor has higher costs. The capability and cost of wireless have also improved, driven in part by advances in computing. Answering an analysts question Lowell McAdam, Verizon's CEO, put it as follows:[11]

"The thing that I see in our industry is you tend to lock in on the design principles from the 2000s. Because that's when wireless was sort of exploding. And back then, you didn't have MIMO, massive-in massive-out antenna structures, you didn't have the computing power that you had to do signal processing that you can do today... Small cells are a fraction of what they were cost-wise even 5 years ago. I'll give you an example: we were at 2,000 feet from the receiver in Samsung's technology park, and delivering 1.8 gigs. We said, okay, take that truck, drive it around the back side of the building so there is no possible way you will have a direct line of sight, and 2,000 feet away it delivered 1.4 gigs. And the reason was that it took all the different reflections and the computers were able to process it and get that signal back up. So in the field today, we're doing heavy foliage. We're doing downtown urban areas. We're doing residential. We're doing long haul – you're out in a rural area and you don't have anything for 5 miles before you get to the next house, we're going to shake all of that out. But I think people when they say, oh, it's just line of sight, they've forgotten the computer technology that you see in the antenna systems today that you didn't have even 5 years ago."

A SpaceX rocket blasts off – and over the top takes on a new meaning

Fibre will be used in backhaul and core networks, but it need not necessarily be fibre to the premises, and may involve different types of fibre and topology. Verizon has pointed to this possibility:

"When you think about FiOS [fibre to the premises], it was a very purpose-built set of fibres. It went into the neighbourhood. We delivered a fibre or two to each resident and you aggregated up to maybe 144 fibres in a cable by the time you got back to the central office. We had parallel networks for wholesale. So if we were selling dark fibre to AT&T for a cell tower or Verizon Wireless was buying their fibre, it was much more point-to-point because that's where the cell towers were. The architecture that we're building in Boston, and now in other cities around, is multiuse... building to the fibre requirements for wireless and 4G with a dense small-cell deployment is actually the best architecture for everything, because you're going to run right by the enterprise. You're going to run right by the small business. In many cases, you're out in the neighbourhoods, and it sets you up for delivering things like smart cities, and when you deliver smart cities, you're starting to put fibre to every light post. And then every light post becomes a potential small cell for 5G. So this multiuse architecture is far more cost effective than the old purpose-built fibre. And if you look at the manufacturing capabilities of a company like Corning – from our perspective the constructor of the network – the number of fibres that you put in the cable are a matter of pennies per foot. So you're far better off today doing what we're doing in Boston, and that's putting 1700-strand cables in the main feeder routes so that you can serve these networks as we go forward."

> **Using wireless instead of fibre for the final drop is more than speculative.**

The fibre required for a multi-purpose network may differ from the fibre required for a fibre to the premises network; and fibre all the way to the premises may not be required. We don't know if this is the direction technology and consumer preferences will take us, but it is a plausible future (a low demand scenario is also plausible).[12]

> **Attempting to do both fibre to the premises and 5G may be too slow and costly.**

Neither current national broadband plans and regulation, nor ambitious policy incrementalism, will take us down a high-capacity wireless path. Attempting to do both fibre to the premises and 5G may be too slow and costly, while failing to lay the foundations for dense high-capacity wireless.[13] Further, current access regulation may be incompatible with efficient fixed-mobile convergence, since turning upfront investment in access into a recurring access charge encourages potentially socially inefficient substitution of higher incremental cost mobile for low incremental cost fixed (once fibre investment has been made). This, combined with structural separation (which frees the retail arm to consider alternatives to utilising wholesale fibre during copper to fibre transition) has triggered growing substitution of mobile for fibre in New Zealand.[14]

'OVER THE TOP' NETWORKS

One way to build an over the top network – with free-space optical links rather than optical fibre – is with re-usable rockets to launch a space-based network. Fibre is, for the most part, dispensed with since it is redundant for 'free-space' laser communications between satellites. Wireless can be used for direct links between ground receivers and satellites, or to provide backhaul for conventional cellular infrastructure on the ground.

The combination of space and terrestrial systems can offer ubiquitous coverage, which may be unfeasible economically for terrestrial systems alone. Genuine ubiquity would allow everyone to use connected applications, and would allow new mobile applications which require continuous connectivity to be developed. Computing and software are making this possible, at much lower cost:

- Google has developed balloon-based internet access, and utilising machine learning has substantially reduced the number of balloons required to cover a given area[15]
- SpaceX has demonstrated launch, recovery and re-use of rockets – exploiting computing software to land the first stage after launch. Re-use will lower costs.

SpaceX has submitted plans with the FCC for a constellation of 4,425 satellites to deliver high speed broadband and plans to launch the first test satellite in 2017.[16] OneWeb has a key approval for a constellation of 720 low earth orbit satellites.[17]

Since these satellites would be in low-earth orbit (around 1,000 km versus around 36,000 km for a geostationary orbit), and since light travels faster in a vacuum or air than in glass, the system would offer latency comparable to terrestrial broadband. Indeed, for distances over 5,000 km, sending information via low-earth orbit satellite would

A 'FIBRE TO 5G' VISION – IN PLACE OF THE 'GIGABIT SOCIETY'

Are 'gigabit society' visions – such as that of the European Commission – on the right track in a mobile world? Mobile devices, coupled with apps stores, have seen rapid adoption. Mobile device sales dominate PC sales globally, and more than half of our online time is now spent on mobile devices. Applications providers have adopted global mobile first strategies and developed apps that are bandwidth efficient. Mobile devices also connect via cellular and/or Wi-Fi, so the last leg of a connection is wireless and wireless may constrain connectivity, regardless of how far fibre is extended.

The individual user – with their devices and applications – is the underlying driver of demand for access. In assessing connectivity requirements, we should therefore focus on the individual and app, and work back via points in the network where traffic is aggregated, rather than focus on the premises and fixed connectivity per se. Our current approach to assessing connectivity requirements, which focuses on the premises and fibre to the premises (FTTP) in particular, is backward looking. The focus should be on ubiquitous wireless connectivity indoors and outdoors, and on fibre as required to support this vision. More fibre will be required, but not necessarily to the premises.

I refer to this as fibre to 5G or 'FT5G', where 5G encompasses mobile and Wi-Fi using millimetre and other spectrum bands, and tailored connectivity matching different consumer and business requirements. In assessing demand, it is important to distinguish demand for peak bandwidth from overall traffic. The latter may grow even though the former does not. For example, if users spend more time watching online video their data consumption would grow but not the required size of the final pipe, or 'on-ramp' to the core network.

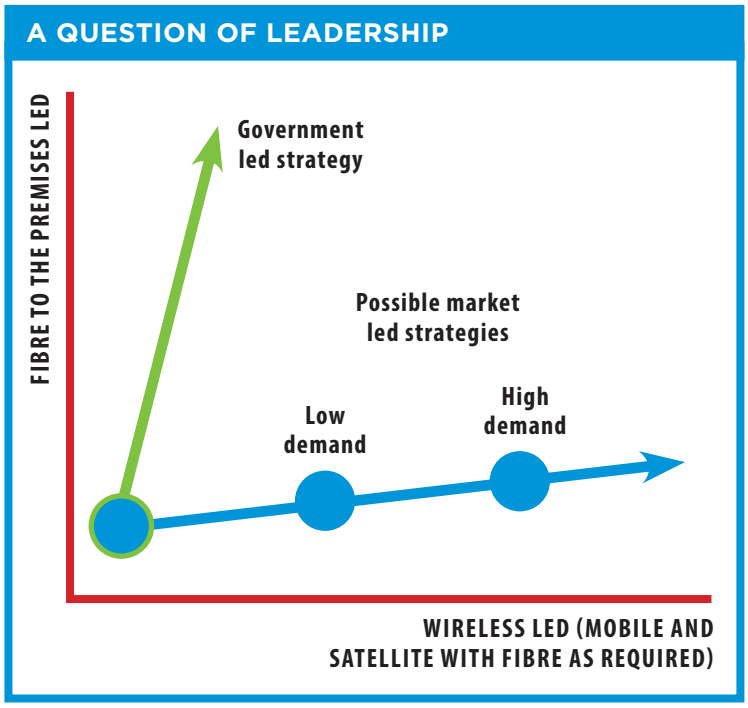
A growing fraction of traffic is aggregated directly at cellular sites, with aggregate demand at such sites projected to range from a few 100 Mbps to over 10 Gbps per site by 2025 – depending on the cell location and size.

Those households that are not smartphone only will also see wireless demand aggregated, via indoor Wi-Fi, with wireless or wired connectivity back to the core network. For a larger household, assuming per device-app demand of 10 Mbps, aggregate peak demand might be around 50 Mbps. Institutions such as schools, hospitals and larger businesses would have higher demand, depending on their size. The internet of things (IoT) will also be a growing source of demand, though predominantly in terms of the number of connections rather than speed or capacity requirements.

Aggregated demand will therefore cover an enormous range – there is no one-size-fits-all. A gigabit per second may greatly exceed residential requirements and the capability of in-home Wi-Fi, while falling short of the requirements from larger mobile sites by 2025. More fibre will be required for mobile, but not necessarily FTTP, while the requirement for mobile will evolve over time and is not amenable to a plan or targets. The extent of fibre required to meet residential demand will vary, with intermediate copper (cable DOCSIS, VDSL and G.fast) and wireless links. Wireless links to the premises may offer an alternative to fibre and copper, particularly with the advent of 5G.

Prioritising rapid deployment and upgrades utilising a mix of technologies will also stimulate near-term applications development and adoption, improving the prospects for further investment.

We can be reasonably sure that the pivot to mobile will continue, and that the performance-cost ratio of wireless will improve rapidly. Wireless fibre may help overcome the cost and logistics constraints involved with the civil works typically required for FTTP. It is also unlikely that we have the time and money to build both a dense 5G network and widely deploy FTTP in the medium term. It is therefore prudent to focus investment on the most likely bandwidth bottlenecks as well as other priorities, including delivering universal access.



offer lower latency than via terrestrial fibre.

The possibility that, within as little as five years' time satellite might provide a ubiquitous low-latency high capacity network, is not factored into national plans nor currently considered in deciding targets and the feasibility of extending coverage.

If even a small number of nations entertained the possibility, as a means of meeting their own unmet needs and offering development assistance to other countries, then collectively their demand might be sufficient to tip the balance towards rapid deployment of low earth orbit satellite systems. A different approach to procurement, which today is national or sub-national, may be called for.

BEYOND AMBITIOUS INCREMENTALISM

Existing businesses find pronounced change difficult, as it may require them to abandon existing assets, services and ways of doing things. Change in more than one area at once may require strategic direction, rather than emerging organically from an incremental response to profit opportunities.[18]

Regulatory institutions find it even harder to adapt, since they do not face competition and have power which is not (initially) disrupted by technology change. Regulation also tends to become more incremental in approach over time, reflecting the accumulation of decisions involving competing interests. Conscious, and aligned, strategic and policy shifts are required to get beyond ambitious incrementalism and accommodate fundamental change.

Governments, driven by past trends and the apparent simplicity of easy to define (but hard to deliver) targets – tend to bet on fibre to premises, as illustrated in the diagram above.

The market, however, is continuing a decade long pivot towards mobile, and some – including Verizon – are now betting on wireless-led, fibre-rich networks – but not necessarily with fibre to the premises. Lower demand wireless scenarios are also plausible, depending on consumer willingness to pay for high-capacity networks. The shift towards network independent applications coupled with network service virtualisation can also be expected to continue, achieving network–service separation via the market rather than via regulation.

These changes present several policy challenges:

- First, existing broadband targets focused on ever more ambitious fixed connectivity to the premises, and particularly fibre per se, should be modified or abandoned. They are out of step with the pivot towards wireless, both in terms of its impact on the demand side and on the supply side.
- Second, the relationship between government and independent regulators should be clarified. Separating policy development into two phases – establishing the facts first and then moving to policy development – may help. The purpose of independent regulation should also be revisited and refreshed, with transparent channels for communication between the regulator and the government established (analogous in some respects to the relationship between governments and central banks regarding inflation targets and the conduct of monetary policy).
- Third, the policy and regulatory environment in relation to radio spectrum and network access should facilitate a pivot to networks that look rather different to those in place today, by allowing investors to take strategic bets without fear of appropriation (either via spectrum fees or revised regulated access terms that remove any upside). Less hubris is also required, as nobody knows which path will prove the correct one.
- Finally – and mirroring the separation of applications, network services and network infrastructure by the market – the responsibility of regulatory institutions should be redefined. Sector specific regulation should be focused on network access bottlenecks alone,[19] with services and applications subject to general competition and consumer protection law.

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REFERENCES **1** FCC (2010). National Broadband Plan. bit.ly/2h3HuJe / FCC (2017). Inquiry concerning deployment of advanced telecommunications capability to all Americans in a reasonable and timely fashion. GN Docket No. 17-199. bit.ly/2eXJIFH **2** Malcolm Turnbull: I'm a smartphone tragic. Gizmodo, 16 October 2013. bit.ly/2wcHDkh **3** Ian Martin. Letter to the Australian Competition and Consumer Commission, October 2014. bit.ly/2x3PgIJ **4** NBN costs put brake on internet speeds. The Australian, 18 July 2017. bit.ly/2vWhd1Z **5** PM not ruling out legislation over broadband. RNZ, 4 December 2012. bit.ly/2x1xxzS **6** Howell B (2013). Broadband regulation and government investment in nationwide ultrafast fibre broadband networks: evidence from New Zealand. September 2013. bit.ly/2ws8i86 **7** Kushida K (2013). Public private interplay for next generation access networks: lessons and warnings from Japan's broadband success. Communications and Strategies 91:13–34. bit.ly/2wrYmvI **8** UK must switch off 'analogue' thinking or lose 5G race, says outgoing O2 chief. Financial Times, 18 September 2016. on.ft.com/2cCbN8h **9** AT&T trialing fixed-wireless millimeter wave to deliver high-speed internet outside of its traditional wireline service area. ATT, 6 October 2016. soc.att.com/2h3PU3I **10** 2Q 2016 quarter earnings conference call webcast – transcript. Verizon, 26 July 2016. vz.to/2vW67KG **11** JP Morgan Global Technology, Media And Telecom Conference 2017 – transcript. Verizon, 22 May 2017. vz.to/2wc8kph **12** Webb W (2016). The 5G myth – and why consistent connectivity is a better future. webbsearch.co.uk/the-5g-myth **13** Williamson B (2017). Mobile first, fibre as required – The case for 'fibre to 5G' (FT5G). Communications Chambers. commcham.com/ft5g **14** Spark New Zealand FY2017 results summary. bit.ly/2x1yFU8 **15** How Project Loon's smart software learned to sail the winds. Google, 16 February 2016. bit.ly/2IT6CAz **16** SpaceX plans to launch first internet-providing satellites in 2019. The Verge, 4 May 2017. bit.ly/2oZJQMp **17** Low-latency satellite broadband gets approval to serve US residents. Ars Technica, 23 June 2017. bit.ly/2syvXEZ **18** Roberts J (2004). The Modern Firm. Oxford University Press. **19** Williamson B (2017). Deconstructing the 'level playing field' argument – an application to online communications. Communications Chambers. bit.ly/2h4JixY