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Essays & Reportage

5G’s new frontier

Jock Given

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From the archive | Backers of 5G promise breathtaking speed and ultra-reliability. But does Australia need its own vision for the new wireless networks?

If you think it isn’t long since your smartphone started using 4G, you’re right. Telstra, Optus and Vodafone switched on their networks between 2011 and 2013. Adoption was rapid. By the end of 2014, 40 per cent of Australia’s mobile customers were using 4G, although Optus has only recently shut down its 2G network and Vodafone’s is scheduled to close in a few weeks.

So what is 5G, why might we need it, and why is it suddenly dominating the telecommunications policy agenda in Australia? Communications minister Mitch Fifield told a conference in Sydney in late July that 5G would be “a truly revolutionary event, an inflection point not just for the telecommunications sector but for the whole Australian economy.” Chris Althaus, long-time CEO of the Australian Mobile Telecommunications Association, which represents Telstra, Optus and Vodafone, talked of a “Fourth Industrial Revolution” and “a fundamental change in the nature of the mobile experience.”

Australian Competition and Consumer Commission chair Rod Sims agreed that “we are at another turning point.” As a participant in communications policy for nearly thirty years, Sims has seen a few turning points: the introduction of the first cellular mobile services in 1987, the transition from monopoly to competition in the 1990s, Telstra’s staged privatisation from the mid 1990s, major auctions of radiofrequency spectrum especially for 3G services in 2001, and the creation of the National Broadband Network after 2009. The ACCC has been a central player in the NBN debate and implementation, attracting both
praise and criticism for its endorsement of the whole plan and for detailed decisions about the NBN's technical architecture and the prices retail service providers pay to use it.

Old telecommunications equipment gets turned over, but familiar issues live on in the debates about 5G: the roles of fixed and mobile communications in the overall telecommunications market; the strength and sustainability of competition; the power and vulnerability of the original incumbent, Telstra; how governments allocate spectrum resources for uncertain new wireless services; and the progress of the fixed-line NBN.

No one is quite sure what 5G is yet because international technical standards are not expected to be finalised until next year. The goals are dazzling: 1000 times increase in mobile data volumes, ten to one hundred times increase in peak data rates and the number of connected devices, ten times the battery life for low-power devices, and five times lower “latency” (response times, or “end-to-end transmission delays”), all while using energy and spectrum much more efficiently.

These technical aims cater to three main kinds of use. The most obvious are the mobile broadband networks that are already so popular with smartphone and tablet users. Mobile operators, service providers and device manufacturers want to be able to offer much faster speeds and more data. Specific applications — such as consistent high-speed broadband on fast-moving trains — matter a lot to customers in some parts of the world but at the moment are technically difficult to deliver.

Second, 5G will connect machines. Existing 3G and 4G mobile networks have been built mainly to serve human customers operating handheld devices. Initially, they made voice calls, then they exchanged data among themselves or with machines. Increasingly, these networks are connecting self-operating machines — meters in energy networks; sensors monitoring rainfall, pollution, pollen and noise levels or the performance and wear-and-tear of components in manufactured products; surveillance cameras and back-to-base security systems; signalling in vehicles and transport networks. These machines regularly exchange “bursty” amounts of data, tiny or large, intermittently or on-demand. 5G aims to make these kinds of devices much cheaper to supply and maintain, and therefore more pervasive. This expanding universe of machines communicating and trading data with other machines is dubbed the Internet of Things, “massive machine-type communications,” or sometimes the Internet of Everything.

Third, ultra-reliable and low-latency communications make it possible to do new things over communications networks, or for many people to do things that could previously only be done by specialists over expensive, bespoke networks. Automated traffic control and driving, public safety, and health-monitoring applications are some of the things that require ultra-reliable networks. Low latency can make it possible to simulate the experience of human touch, essential for remote surgery, or playing music together in sync from distant locations.

Together, these goals and potential uses will require many more devices transmitting and receiving wireless signals and much more radiofrequency spectrum. Some of this spectrum is likely to be made available within frequency bands already used for
communication. This will require some existing users to shift to other frequencies.

The big, largely new demand is for “millimetre wave,” or mmW, frequencies, which lie in the Extremely High Frequency band. Little human use is currently made of this band. Signals can carry large amounts of data, but they don’t travel far without significant propagation losses and they can’t get around obstacles. A new version of wi-fi uses frequencies in this band, which makes it good for fast data transfers, but only within a single room, not a whole apartment, house or office.

Last year, the spectrum regulator in the United States, the Federal Communications Commission, or FCC, was persuaded of the possibility of “a new and radically more capable generation of wireless mobile service” that could be deployed by 2020 using these frequencies. This decision followed trials funded by an unusual coalition of the US army and Samsung. These “appeared to demonstrate that non-line-of-sight services can be provided in the mmW bands by capturing reflections of signals that would otherwise be blocked by intervening obstructions.” In its “Spectrum Frontiers” proceeding, the FCC authorised various forms of exclusive, shared and unlicensed use of spectrum in and just below the mmW bands, declaring it had “created a runway for US companies to launch the technologies that will harness 5G’s fibre-fast capabilities.”

But there is a problem. According to William Webb, “the vision of 5G as currently promulgated by major players is a myth.” Webb, a former executive at Motorola and director at the UK spectrum regulator Ofcom, is now CEO of Weightless SIG, the standards body developing a new global machine-to-machine technology. His view is that the 5G vision is an “ill-defined utopia,” “so badly flawed it is highly unlikely to be widely implemented.”

Webb lays out his case in a short book, *The 5G Myth*. As currently envisaged, he argues, 5G is not required, not achievable and not economical. A fifth wireless generation is only being developed, he says, “because there have been four prior successful generations.” They have arrived roughly every decade since the early 1980s, and each has delivered, even more roughly, about a tenfold increase in data rates.

New generations responded to specific shortcomings in the previous generation. Most recently, mobile operators caught out by the “iPhone moment” needed 4G to deal with the surge in mobile data consumption that followed the 2007 launch of Apple’s device. The iPhone and other smartphones that followed it made mobile internet and video use a reality but stretched 3G networks supposedly purpose-built for just that moment.

Webb thinks it is wrong to assume the demand for mobile data will keep increasing along its historical trajectory. He is not sure what consumers are going to need now that they are already watching lots of video on their mobile devices. He thinks the Internet of Things will be important but “very unlikely to materially add to data traffic volumes.” Latency, too, is important, but he believes it will be difficult for 5G to do better on this score than 4G, especially because latency in other parts of telecommunications networks will remain and dominate.

Surveying the engineering approaches available to deliver the ambitious technical goals for
5G, Webb sees some potential gains but thinks they will be "hard won." Moving to the economics of deployment, he thinks that, without a new "killer application," it will be difficult to extract from consumers already well-served by 4G the extra revenue needed to earn a return on investments in 5G. Mobile operators were highly profitable in the 2G era; today, they are not. "This is a moribund industry in increasing need of change."

Webb is not pessimistic about the possibilities of a "huge array of new applications" using mobile networks. He just thinks they "can all be achieved today with the technology and networks already at our disposal." Very fast speeds are being delivered now to customers on 4G networks, and speed and capacity improvements will occur anyway as operators move more customers onto them from 3G networks. As they do this, they will also "re-farm" spectrum from older networks to the newer, more efficient ones, deploy additional spectrum that governments around the world are making available, and offload more traffic to wi-fi networks.

By focusing on higher speeds and the ability to deliver substantially improved data capabilities to people already well-served by 4G, Webb worries that 5G "may not be targeting the right areas." He thinks there is a better, more socially and economically important goal. He calls it "consistent connectivity" or "broadband everywhere." It requires lower-cost solutions, whereas the mainstream proposals for 5G "all appear higher cost."

Back in April 2009, Kevin Rudd’s Labor government announced a plan to deliver a different kind of "consistent connectivity." The “fibre-to-the-premises" National Broadband Network was going to bring download speeds of 100 megabits per second to 90 per cent of Australian homes and workplaces by wholly replacing with optical fibre the copper lines that connected telephone exchanges to most Australian households and business premises. It would take eight years. Had the plan been implemented on time, it would be done by now.

Of course, it wasn’t and it’s not. The government changed, the plan changed, and the NBN is still a long way from finished. Depending on whom you speak to, it is also not working very well. A parliamentary committee is currently touring the country listening to the evidence. It is hearing from people and businesses who have the NBN and are happy with it, others who have it and are disappointed with its performance and price, and those who do not have the NBN yet and are frustrated about how long they are having to wait. Many Australian households don’t have a fixed-line service at all any more, and others don’t know or care about the NBN. If they switch to it at all, it will probably only be if and when there is no alternative.

In and around the industry, there is a lively argument about how badly the NBN is not working, who is to blame and what to do. Rusted-on critics, always convinced it was just a Big Labor initiative that would cost too much and take too long, feel vindicated. Critics of Labor’s fibre-to-the-premises NBN who liked the Coalition’s fibre-to-the-node model point out that the network is now half-built, with thousands of premises connected each week. Some customers are complaining but most are not, and network performance will get better as services in each area are fully migrated to the NBN and transmission power is increased.
Supporters of Labor’s all-fibre NBN, in despair at the compromising of the original vision, are experiencing schadenfreude as the Coalition’s NBN struggles. Lukewarm supporters of the original vision, attracted to the bold idea but worried about the details, are unsurprised by the broad nature of some of the problems encountered — the cost, the persistence of the originally proposed monopoly, the complexity and blame game for consumers dealing with separate service and network providers, and the same lack of priority for the worst-served areas.

Retail service providers who hailed the original plan for taxpayers to fund an NBN now rail at the cost of using it. The state-owned NBN Co, charged with building a network that reaches every Australian and earning a modest return on the investment, thinks that “over competitive” retail service providers are indulging in “a temporary ‘land grab.’” They are not buying the level of wholesale capacity from NBN Co that they need to satisfy their retail customers’ expectations, and then blaming the NBN for the disappointing service.

The ACCC has stepped in to formally monitor broadband performance; the Australian Communications and Media Authority will now try to get to the bottom of it all by conducting research and collecting data “to ensure customers have a positive experience on the NBN.”

Whether it was Labor’s plan, the Coalition’s changes to the plan, the NBN’s implementation, or retail service providers’ over-promiseing really doesn’t matter now. Most commentators seem to think the access pricing model will need to be further tweaked. Even if it is, the government has an NBN on its books that is worth a lot less than it is costing. Some government is going to have to acknowledge that. Will it be left to a future Labor administration to take the hit for starting it all? Or will it be the Coalition, which changed the plan and is into a second term, and therefore owns the problem now?

While this fixed-line debate treads water, mobile communications marches on. The same OECD data that shows Australia stuck below the middle of fixed broadband rankings finds it surpassed only by Finland and Japan in mobile broadband penetration. According to tech company Akamai, in the first quarter of 2017 Australians got faster average access speeds on mobile networks (15.7 megabits per second) than they did on fixed networks (11.1 megabits per second).

The architects of Labor’s all-fibre NBN insisted wireless would be complementary, not a substitute for the NBN. It was always a claim based on the raw speed and capacity of fibre rather than the price that typical households and businesses might be prepared to pay for it. A small but politically significant proportion of customers was only ever going to get fixed wireless or satellite connections even from Labor’s original NBN. When the NBN was announced in 2009, wireless was already the fastest-growing broadband access technology.

Most importantly, because retail fixed-line service providers would have had to use the NBN under the original monopoly model, those who controlled mobile networks were always likely to shift even more of their attention to them. That is exactly what has happened. Mobile retail prices have come down, data limits have increased and some mobile plans have got closer to being effective substitutes for light fixed-line users. The three incumbent
Mobile operators have all announced big plans to make the investment in their 4G networks and in other parts of their networks that will set them up for 5G’s heavier data loads and more densely deployed transmission infrastructure. Another operator has acquired spectrum for a fourth mobile network.

It was a thought experiment in 2010. It is reality in 2017, though not a simple reality in which mobile vanquishes fixed, because most customers will probably still use both — indeed “fixed–mobile convergence” has been a staple topic for industry conferences for years. Wireless doesn’t need to be the only thing; it just needs to be a Big Thing.

5G plays perfectly to this moment. The technology is expected to be capable of delivering much, including the higher-speed broadband and increased data, that the NBN was supposed to bring. The vision for services beyond better retail broadband — the Internet of Things and ultra-reliable, low-latency services — is the kind of big promise that galvanises governments to do the things the visionaries want from them.

Thomas Winslow Hazlett doesn’t have much time for wireless visions. Or at least he doesn’t have much time for visions articulated by governments and regulators about what radiofrequency spectrum should be used for. In his new book, The Political Spectrum, he talks a little about 5G and is interested in what it might be, but he thinks the best approach is for governments and regulators simply to make as much spectrum available as possible, to as many people as possible, to do as many things as possible, then get out of the way. The “right” visions for 5G and everything else will be decided by customers.

Hazlett’s contemporary vision comes out of his analysis of history. The Political Spectrum tracks “the tumultuous liberation of wireless technology from Herbert Hoover to the smartphone” in the United States. Essentially, it is a journey from bureaucratic control to markets. The journey is far from complete, but Hazlett cheers it all the way.

The book brings together the author’s lifetime of passion for the technology, law and economics of wireless and his longstanding hostility to the ways that government agencies, especially the FCC, have managed radiofrequency spectrum. A disciple of Nobel Prize–winning economist Ronald Coase, who started to question the global fashion for governments to micromanage spectrum in the 1950s, Hazlett doesn’t think markets are perfect, just that they work better than any other way of managing spectrum.

“The wireless entrepreneur searches for those [options] that work best,” he says, “comparing input costs... with output price... and so calculates profit. That is her quest. It is also her risk, motivating her to seek and exploit every little efficiency.”

Hazlett writes:
Spectrum is a key variable in the efficiency equation, yet the [government] Spectrum Store keeps dreadfully short hours and stocks laughably sparse inventories. In a different world, the marketplace would allow entrepreneurs to sample frequencies, gauge their performance, and see their prices. Airwaves used one way would be available to accommodate more pressing needs. With competing entrepreneurs seeking to buy low and sell high, underutilized bands would turn into busier and more productive frequencies. But the task is subtle, incorporating guesses as to future consumer behavior, technology trends, and evolving market rivalry. These baffle the best of experts.

According to this story, the experts inside governments and spectrum regulators guess wrong, entrepreneurs are thwarted, and consumers pay through higher prices, less innovation, and delays in the delivery of new services. In the past, those delays have affected FM radio and cellular mobile phones. In the future, who knows what may be denied.

But over time, Hazlett thinks, regulators did get better. From the 1990s, by “embracing their ignorance” and handing out spectrum without defining what it had to be used for, regulators delegated decisions to “entrepreneurs possessing superior incentives, information, and the financial wherewithal to innovate.” The steps were incremental but they added up to “deep policy reform” that “ignited the ‘wireless explosion.’” “Relatively liberal licenses” inspired “massive investments in networks” and “huge gains in consumer welfare.”

The contrasting experiences from this ancient and recent history bring Hazlett to three crucial policy prescriptions that are directly relevant to debates about 5G. First, he thinks governments should continue to allocate access to particular spectrum bands via these kinds of liberal licences. They should be awarded either to primary licensees, or to “overlay” licensees who would enter into commercial agreements with the primary licensees enabling them to operate at times or in places or ways that the primary licensee can live with.

Hazlett has not been converted to the “counter-revolution” of so-called unlicensed spectrum, where regulators allow anyone to operate equipment in designated bands provided they obey certain rules set by the regulator, such as low-power operation. This is how wi-fi works. While acknowledging the vital role that unlicensed spectrum has played, Hazlett thinks that “the system defect is that regulators are making the fundamental spectrum use choices.” This becomes especially costly when better uses for the unlicensed bands emerge. “Without effective owners, the market cannot coordinate new and better arrangements,” Hazlett argues. “Many unlicensed bands, with their widely dispersed, nonexclusive use rights, have thwarted an efficient migration to advanced services.”

Second, he thinks regulators should get much busier making more spectrum available. Underutilised bands, particularly those occupied by spectrum-guzzling government users, should be cleared or shared. “Spectrum,” he argues, “is a force multiplier, but needlessly withheld spectrum is a party killer... The point is not that more mobile spectrum is the answer to all wireless policy questions. It is that there is no good reason to keep airwaves locked up in government inventory.”
Third, Hazlett wants the politics taken out of spectrum, preferring “markets over ideology.”

What should Australians do? Get a 5G vision? And if so, which one?

The recent record of government visions for communications in Australia is mixed. High-speed fixed-line broadband inspired massive public intervention, massive political conflict, but so far only modest improvements in service via the NBN. The Australian Digital Inclusion Index for 2017 shows steady improvement in access since 2014 but a decline in affordability (the cost of data has fallen but people are spending more money on services) and stubborn gaps between the online experiences of people based on income, age, education and geography. This is a very old story. The NBN was going to make Tasmania “the most connected place on the planet” by 2013; it was still the worst-performing state or territory in 2016–17, according to the Index.

Another long-term vision was the government-mandated switchover from analogue to digital TV, conducted in Australia from 2001 to 2013. Despite vigorously contested and shifting ideas about the purpose of the whole project from its beginnings in the mid 1990s, this large spectrum “re-farming” project achieved its goals. TV was transformed, valuable spectrum was liberated for other purposes, and the total, inflation-adjusted financial return to the federal budget eventually exceeded even the generous public expenditure on new transmission infrastructure, public information campaigns and consumer subsidies. Perhaps we could have done even better, allowing a wider range of new services, making the switch faster, recovering more spectrum, but that would have brought extra costs too.

A further, related case study comes from the longer history of spectrum allocation for TV broadcasting. This reminds us how spectrum innovators become spectrum incumbents who can be very hard to shift. We are still living with the consequences of effectively giving TV broadcasters perpetual licences to use large amounts of spectrum decades before the switch to digital. Had we changed that approach as part of the switch, and awarded digital licences only for fifteen-year terms, as for mobile phone and broadband spectrum, the spectrum regulator would have had a recent opportunity to reconsider the best use of all that TV spectrum. Instead, governments have been making ad hoc adjustments to the amounts broadcasters pay for their continuing licences and the obligations that attach to them.

Governments and spectrum regulators do not necessarily need a vision for 5G but they do need views — they have some already — about the direction change. They are being asked to do things that have real costs, like clearing existing users from bands that might be reallocated, setting limits on the amount of spectrum that can be acquired by a single operator, and changing the processes for approving new wireless facilities so it is easier to build them and harder for local councils and residents to object.

Governments and regulators with public missions may be well-placed — though not always perfectly placed — to consider the full range of issues that affect all Australians, especially the range and distribution of non-economic as well as economic benefits. These are the things that show up in the Digital Inclusion Index and the voting patterns of excluded Australians.
Whatever assurances are given about the complementarity of 5G wireless and fixed-line NBN services, this new vision is partly a product of the problems with the last one. That is, 5G in Australia is attractive to mobile operators precisely because of the capacity it may offer to work around the NBN. It will be truly remarkable if the 5G vision that comes to dominate Australian telecommunications rushes past the persistent equity issues highlighted in the Digital Inclusion Index, repeating the high-cost, bigger/faster rhetoric of the NBN, rather than its aspiration to “connect all Australians.”

When it is time to draw the lessons from the NBN, this may be one of them: in our laudable ambition to spend whatever it took to lead the world in broadband, we chose a high-cost solution that would not solve all the problems and take too long to address some of those it did. That meant it could not garner the steady, multi-party, multi-year political support needed to get a multi-parliamentary-term project finished. An increasingly toxic political environment turbo-charged the challenges.

The mainstream 5G vision — sizzling with imaginative Internet of Things applications but troublingly dependent on retail broadband to turn a buck — looks just a little like those early NBN promises. Setting our sights on the stars for a new generation of communications technology, we should not overlook some familiar challenges at our feet. •

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Jock Given

Jock Given is Professor of Media and Communications at Swinburne University of Technology and co-editor of a recent issue of Telecommunications Policy on “Optimising Spectrum Use.”

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