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Ericsson submission

Inquiry into the deployment, adoption and application of 5G in Australia

House of Representatives Standing Committee on Communications and the Arts

November 2019

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Executive Summary

- Ericsson welcomes the opportunity to contribute to the House of Representatives Standing Committee on Communications and the Arts inquiry on the deployment, adoption and application of 5G in Australia.

- Ericsson is a 5G technology leader and as at October 2019, had 70 commercial 5G agreements and contracts with unique operators, of which 21 are live in 14 Countries.

- Ericsson is an integral part of the Australian telecommunications landscape and is at the forefront of Australia's and the global transition to 5G.

- 5G will deliver significantly greater speed and capacity to meet rising demand for mobile data - that is doubling every 18 months - and provide more efficient, stable and secure networks with significantly reduced latency.

- The transition to 5G will occur in stages and involve new radio technologies, a virtualised cloud-based core and end-to-end management and orchestration to facilitate both network slicing and automation.

- 5G should be viewed as one network that will deliver a diverse set of use cases. From enhanced mobile broadband (**eMBB**), fixed wireless access (**FWA**) and massive and critical IoT.

- 5G will be the fastest generation of mobile technology to be rolled out on a global scale.

- By 2024 global 5G subscriptions are expected to reach 1.9 billion (or 20% of all subscriptions), with 35% of mobile data traffic carried by 5G networks and 65% of the world's population covered by 5G networks.

- For 5G to achieve what it is designed to do, each operator requires 100MHz of mid-band and 1GHz of high band or mmWave spectrum.

- As a technology taker not maker, it is critical that Australia has a globally aligned pipeline of new and in-market spectrum that is 'fit for 5G'. This will enable Australia to take advantage of economies of scale from global suppliers of equipment and reduce the need and cost of be-spoke solutions.

- 5G is forecast to add between $1300-2000 per capita benefit to GDP after the first decade of a 5G roll-out in Australia.

- The Australian Radiation Protection and Nuclear Safety Agency (**ARPANSA**) and the World Health Organisation (**WHO**) have stated there are no established health effects from the radio waves that the 5G networks will use.

- Australia has the potential to benefit from the adoption of enterprise and government 5G use cases in for example: ports; mining; financial services; the internet of skills; health service delivery and emergency services.

- There is a significant opportunity for government to work with industry to identify regulatory enablers and remove regulatory barriers to 5G so that Australia's position at the forefront of the global transition to 5G can be leveraged to deliver real economic benefits.

Section A: Ericsson

Australia

- Ericsson is an integral part of the Australian telecommunications landscape.

- From the sale of the first Ericsson telephone in Australia in 1890 to being at the forefront of the transition to 5G, today Ericsson supplies the Australian telecommunications market with:

    - Radio Access Network (**RAN**) equipment;

    - Mobile core equipment;

    - Operations Support System (**OSS**) systems;

    - Equipment for transmission networks, delivery, support and maintenance services for these types of equipment; and

    - Managed Network Services

- Ericsson proudly employs over 1,300 people in Australia and is focused on building a future workforce via a 'disruption ready' lens.

- Ericsson has partnerships with six Australian Universities, provides scholarships for women in engineering and IT, supports a field services TAFE trainee program and under gradate and post graduate student mentoring and co-creation events like hackathons and software studios.

Global presence

- Established in 1876 in Stockholm, today Ericsson operates in 188 countries and territories with over 95,000 employees, 24,800 dedicated to research and development and 49,000 patents.

- The company's portfolio spans networks, digital services, managed services, and emerging business.

- Ericsson has made the world a smaller place by connecting people through communications technology - from telegraphy to fixed telephony to mobile.

- As a 5G technology leader[1] Ericsson is making the world even smaller as we move from connecting every 'one' to connecting every 'thing'.

- As at October 2019, Ericsson has 70 commercial 5G agreements and contracts with unique operators, of which 21 are live networks in 14 Countries. [2]

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[1] https://www.youtube.com/watch?v=V-ZGfzbMyBg

[2] https://www.ericsson.com/en/5g

Section B: The capability, capacity and deployment of 5G

What is 5G?

- 5G goes beyond connecting people and by design, will also be about connecting things.

- Previous generations of mobile networks were about connecting consumers predominantly for voice and SMS in 2G, web-browsing in 3G and higher-speed data and video streaming in 4G.

- 5G will deliver significantly greater speed and capacity to meet rising demand for mobile data that is doubling every 18 months. Between Q1 2018 and Q2 2019, global mobile data traffic grew 82 percent.[3]

- 5G is not just about speed and capacity. 5G will provide more efficient, stable and secure networks with significantly reduced latency. It will deliver features like network slicing to enable dedicated virtual network 'slices' with functionality specific to the service or customer. It will also grow the internet of things to an industrial scale.

- Equipped with these capabilities, 5G will support the transition to industry 4.0 delivering benefits and opportunities to enterprise, government and consumers.
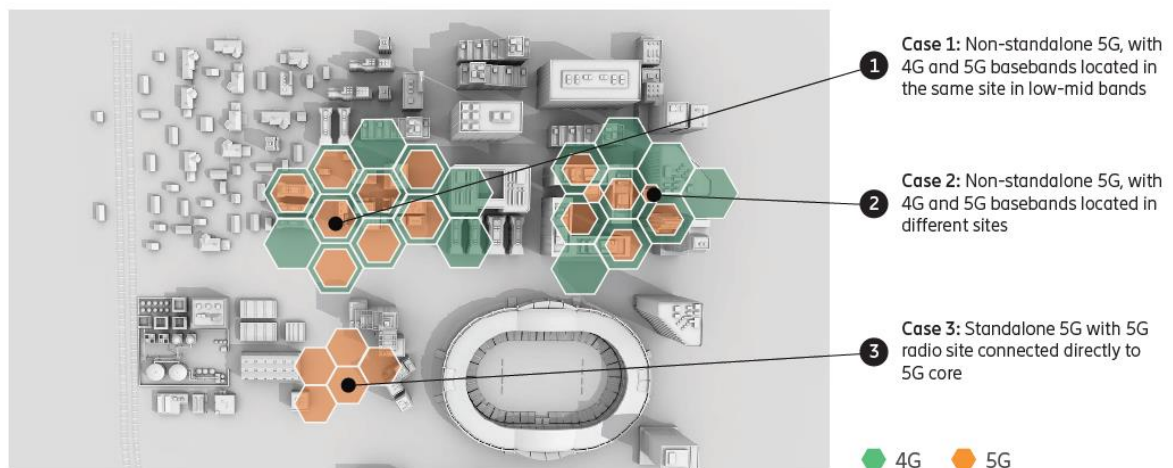
A 5G mobile network

- Mobile telecommunications networks are built upon 3GPP (3rd Generation Partnership Project) standards using three main parts, the **RAN**, the core and backhaul.

- Establishing a mobile telecommunications network requires:

  - spectrum;

  - sites to place radio transmission equipment;

  - RAN equipment;

  - core network equipment;

  - customer provisioning and billing systems; and

  - interconnection (i.e. transmission) equipment.

- An operator may increase capacity on a network by purchasing additional spectrum licences, building more sites or using more efficient radio technology, like 5G.

- The transition to 5G will:

  - occur in stages. From 5G non stand-alone (**NSA**) where a 5G network requires a 4G network to operate, to 5G stand-alone (**SA**) that is not linked to a 4G network and will require a 5G core to support a wider set of use cases.

  - involve new radio technologies, a virtualised cloud-based core, and end-to-end management and orchestration to facilitate both network slicing and automation.

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[3] https://www.ericsson.com/en/mobility-report/reports/june-2019

     –   unlock the ability to critical services and infrastructure.

- Decisions on where, when and how mobile operators will deploy 5G are influenced by a range of factors, from the availability and price of spectrum, network equipment and devices and other commercial considerations.

- **Figure** 1 below shows three main 5G deployment scenarios.

Case 1: Non-standalone 5G, with 4G and 5G basebands located in the same site in low-mid bands

Case 2: Non-standalone 5G, with 4G and 5G basebands located in different sites

Case 3: Standalone 5G with 5G radio site connected directly to 5G core

⬢ 4G   ⬢ 5G

Figure 1: Three main 5G deployment scenarios

- Infrastructure to support 5G will be deployed via 'macro sites' and 'small cells'. That is, 5G:
  - macro sites will use **MIMO** (multiple input, multiple output) antennas that have many elements or connections to send and receive more data simultaneously. This will increase the number of users who can simultaneously connect to the network while maintaining high throughput. Where **MIMO** antennas use very large numbers of antenna elements they are referred to as '**massive MIMO'** although their actual physical size is similar, or smaller, to existing 3G and 4G base station antennas.
  - small cells will provide additional capacity and coverage over a smaller geographic area, are smaller in size and use less power than a macro site. There are a wide range of types of small cells[4] for both indoor and outdoor use. **Figure 2** is Ericsson's Radio Dot System [5]- an indoor small cell 5G solution.

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[4] See for example https://www.ericsson.com/en/networks/offerings/urban-wireless/outdoor-small-cells;
https://www.ericsson.com/en/networks/offerings/urban-wireless/indoor-small-cells

[5] https://www.ericsson.com/en/networks/offerings/5g/5g-supreme-indoor-coverage

Figure 2: Ericsson's Radio Dot

- The use of 5G for critical use cases will increase the need for secure, stable and resilient networks as applications move to the edge[6] of the network. This means 5G will require a higher security focus at every part of the eco system - from standards, products, and network deployments to network management - to deliver secure end user services.

5G Capabilities

- The commonly referred to '5G use case categories' provide a framework to understand 5G's capabilities. That is:

  - **Enhanced Mobile Broadband(eMBB):** is a cost-efficient addition of capacity to meet actual and forecast growth in mobile data. It will enable high quality video streaming, including virtual reality and boost live sharing on social media at main sporting and entertainment attractions. For example, Telstra's 5G at the G[7] and Verizon's launch of 5G at 13 NFL stadiums across the United States.[8]

  - **Fixed Wireless Access (FWA):** provides enhanced mobile broadband wirelessly at a fixed location. For example, Optus' 5G **FWA** service[9] and Verizon's **FWA** 'ultra-wideband mobility service.'[10]

  - **Massive IoT:** is a broad range of enterprise and consumer device types, with device and service bundles offered 'as a service'. In these applications latency and data rates are not as important as things like battery life and the ability to handle 'a million or more' devices.

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[6] Edge computing pushes applications, data and computing power away from centralised points to locations closer to the user, bringing memory and computing power closer to the location where it is needed. Edge application services significantly decrease the volumes of data that must be moved, the consequent traffic, and the distance the data must travel, thereby reducing transmission costs, shrinking latency, and improving quality of service.

[7] https://exchange.telstra.com.au/5g-arrives-at-the-mcg-just-in-time-for-the-afl-grand-final/

[8] https://www.cnet.com/news/verizon-launches-5g-in-nfl-stadiums-across-the-us/

[9] https://www.optus.com.au/content/dam/optus/documents/about-us/media-centre/speeches-and-reports/2019/03/19.04.08_CommsDay_AL_speakingnotes_Final.pdf

[10] https://www.verizon.com/about/news/speed-september-19-2019

- Critical IoT: 5G's low latency capability will deliver quick reaction time to enable new secure mission critical applications with highly specific, sensitive demands in complex environments. Examples include wide or local area applications in intelligent transportation systems, smart utilities, remote healthcare, smart manufacturing and fully immersive Augmented and virtual reality. (**AR/VR**).
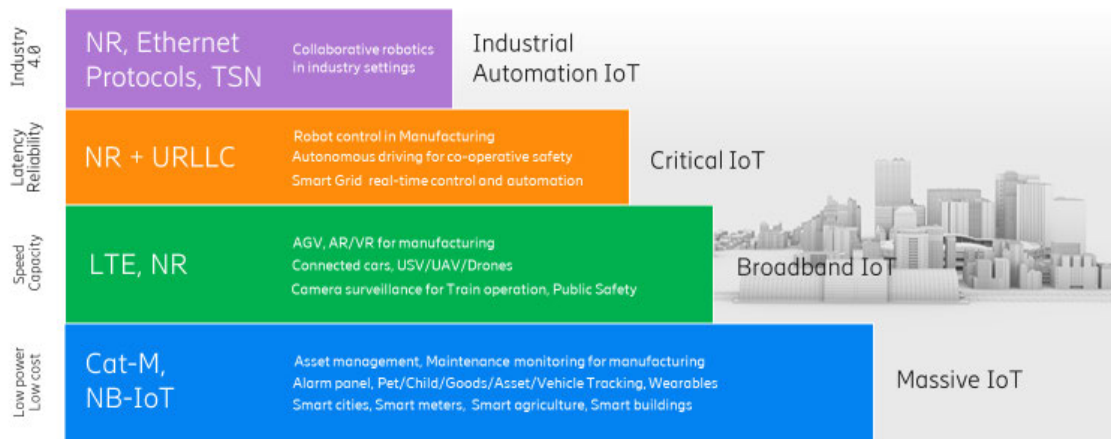- **Figure 3** below links 5G use cases with 5G network characteristics.

Figure 3: 5G's capabilities linked to use case categories

Section C: 5G State of Play, Forecast and Economic Contribution

State of Play

Australia

- Australia is leading the global transition to 5G. For example:
  - Telstra launched its 5G network[11] on 22 May 2019 recently advising that they expect their 5G coverage "to increase almost five-fold in area and reach into at least 35 Australian cities over the next twelve months." [12]
  - Early insights from Telstra's 5G rollout are:
    - "*the rollout of 5G coverage is in its early stages with the current footprint being in CBD locations and selected regional centres where more than four million people live, work or visit every day.*"[13]
    - "*customers with 5G devices are spending around 26% of their time and 61% of their data on 5G and their 5G devices can let them experience twice the speed of 4G.*" [14]
  - Optus has announced they will deliver fifty 5G sites across Sydney and Melbourne stating:[15]
    - "*We are proud to be first in market with a 5G home broadband service. Our customers can continue to expect more innovation, entertainment services, value added solutions including cyber security and game changing customer experiences in the future.*"[16] [17]

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[11]Telstra is using 3.6 GHz (3575 -3700MHz) acquired at auction in Dec 2018.

[12] https://www.telstra.com.au/content/dam/tcom/about-us/investors/pdf%20F/2019-Annual-Report.PDF

[13] https://www.telstra.com.au/content/dam/tcom/about-us/investors/pdf%20F/2019-Annual-Report.PDF

[14] https://www.telstra.com.au/content/dam/tcom/about-us/investors/pdf%20F/2019-Annual-Report.PDF

[15] https://www.optus.com.au/about/media-centre/media-releases/2019/02/Optus-switches-on-new-5G-site-in-Kellyville-NSW

[16] https://www.optus.com.au/about/media-centre/media-releases/2019/02/Optus-delivers-continuing-customer-growth-and-leads-in-5G

[17]https://www.optus.com.au/content/dam/optus/documents/about-us/media-centre/speeches-and-reports/2019/03/19.04.08_CommsDay_AL_speakingnotes_Final.pdf

- Initial 5G deployment strategies are focused on major cities and key population and commuter locations. For example:

  - South Korea, the leading global adopter of 5G had connected 1 million 5G subscribers in 69 days post launch, which is faster than the 80 days it took to get the country's first 1 million 4G subscribers in 2011.[18] As of 9 September 2019, South Korea had:

    - surpassed 3 million 5G subscribers, with coverage expected to reach 93 per cent of the population by the end of the year.[19]

    - deployed 90,000 5G base stations deployed, nearly double the number installed at launch with a choice of two 5G smartphone models from Samsung and LG. [20]

  - Swisscom's accelerated 5G roll out, supported by Ericsson, is unique with the intention to cover 90% of the population by the end of 2019. Ericsson's capabilities in relation to dynamic spectrum sharing[21] has played a key role in enabling Swisscom to execute this strategy.

  - In the United States, Verizon has launched in 11 cities with both mobility and **FWA** offerings with plans for continued expansion to 20 more markets by the end of 2019 and new 5G stadium experiences in partnership with the NFL.[22]

Forecast

- 10 million 5G subscriptions are projected worldwide by the end of 2019 as 5G devices, which numbered 129 as at September 2019[23] become more available and more operators launch services.[24]

- 5G will be the fastest generation of mobile technology to be rolled out on a global scale.

- By 2024 it is forecast that:

  - global 5G subscriptions will reach 1.9 billion (or 20% of all subscriptions);

  - 35% of mobile data traffic will be carried by 5G networks;[25] and

  - 65% of the world's population will be covered by 5G.

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[18] Venture Beat 2019, South Korea hits 1 million 5G subscribers in 69 days

[19] Mobile World Live, 24 Sept 2019, South Korea hits 3m 5G subs as base stations double

[20] Mobile World Live, 24 Sept 2019, South Korea hits 3m 5G subs as base stations double

[21] Ericsson spectrum sharing allows an existing 4G network to operate 5G and 4G using the same spectrum simultaneously via a simple software upgrade. The solution is based on innovative intelligent scheduler algorithms that enable optimal performance as the mix of 4G and 5G devices in the network changes over time. https://www.ericsson.com/en/news/2019/9/ericsson-spectrum-sharing

[22] https://www.cnet.com/news/verizon-launches-5g-in-nfl-stadiums-across-the-us/ https://www.verizon.com/about/news/speed-september-19-2019

[23] 5G Device Ecosystem, GSA, September 2019

[24] https://www.ericsson.com/en/mobility-report/reports/june-2019

[25] Note 5G traffic forecast do not include traffic generated by fixed wireless access (**FWA**) services, as it is not yet possible to estimate this traffic. However, as **FWA** is one of the early use cases planned for 5G in some regions, it could significantly impact the overall traffic, depending on market uptake**.**

- mobile traffic growth in South East Asia and Oceania (including Australia) will grow 7-fold, with Long Term Evolution (i.e. 4G) subscriptions expected to account for 63% of mobile subscriptions.

- An illustration of the actual and forecast take up of mobile subscriptions by technology type from 2014 to 2024 is depicted at **Figure 4** below.
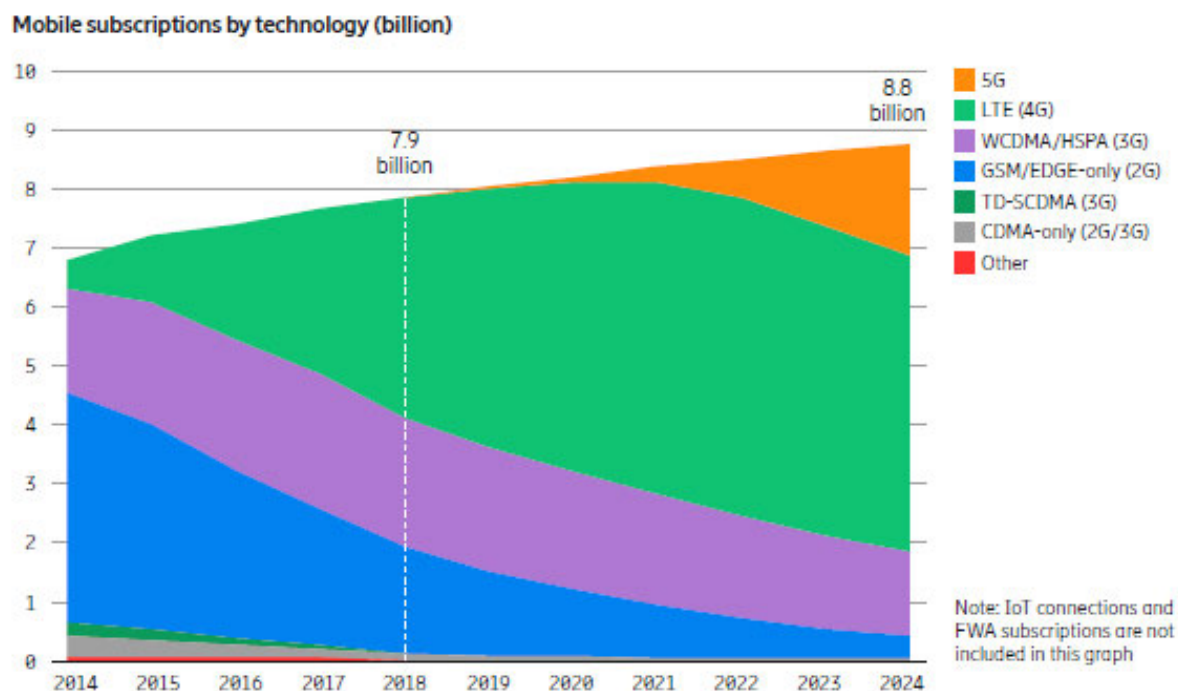
Mobile subscriptions by technology (billion)

Figure 4: Mobile Subscriptions by Technology, Ericsson Mobility Report, June 2019

- During the 4-5G transition phase, there will be overlap between LTE and 5G. That is:

    - LTE will remain the dominant mobile access technology by subscription for the foreseeable future and is projected to have nearly 5 billion subscriptions at the end of 2024.

    - Globally, the peak of **LTE** subscriptions is projected for 2022, at around 5.3 billion subscriptions, with the number declining slowly thereafter. [26]

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[26] https://www.ericsson.com/en/mobility-report/reports/june-2019

Economic Contribution

- The contribution of the mobile industry to Australia's current and future productivity growth is significant. For example, Deloitte Access Economics research commissioned by the Australian Mobile Telecommunications Association (**AMTA**) found:

  - The mobile industry directly contributed $8.2 billion to the Australian economy in 2017-18 and directly employed almost 25,000 Full Time Equivalent (**FTE**) people. [27]

  - For every FTE role employed by the mobile industry there are 3.7 people employed in flow-on industries. [28]

  - By 2023, the productivity impact of mobile will be equivalent to $2,500 for every Australian. This amounts to a total of $65 billion of additional GDP by 2023, or a 3.1% increase in GDP.[29]

- Research undertaken by the Bureau of Communications and Arts on the impact of 5G on productivity and economic growth forecast a $1,300-2,000 per capita benefit to GDP after the first decade of a 5G roll-out in Australia, noting that this is a conservative estimate that did not fully consider consumer and indirect benefits. [30] They also observed:

  - "*Digital transformation has long held the promise of improving productivity outcomes, and the planned rollout of 5G internationally has been viewed as the next development continuing the critical enabling capacity of communications services across the economy.*"[31]

  - 5G has the potential to transform the economy by "*supporting and even accelerating, Australia's digital transformation.*"[32]

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[27] https://amta.org.au/new-mobile-nation-report-the-5g-future/

[28] https://amta.org.au/new-mobile-nation-report-the-5g-future/

[29] https://amta.org.au/new-mobile-nation-report-the-5g-future/

[30] Bureau of Communications and Arts Research, Impacts of 5G on productivity and economic growth, April 2018

[31] Bureau of Communications and Arts Research, Impacts of 5G on productivity and economic growth, April 2018

[32] Bureau of Communications and Arts Research, Impacts of 5G on productivity and economic growth, April 2018

Section D: Spectrum for 5G and Radio Waves and Health

Spectrum for 5G

- 5G can be deployed in low, mid or high band frequencies. That is, 5G will leverage both in-market and new, yet to be allocated spectrum.

- **Figure 5** below illustrates the technology and deployment drivers per frequency band.
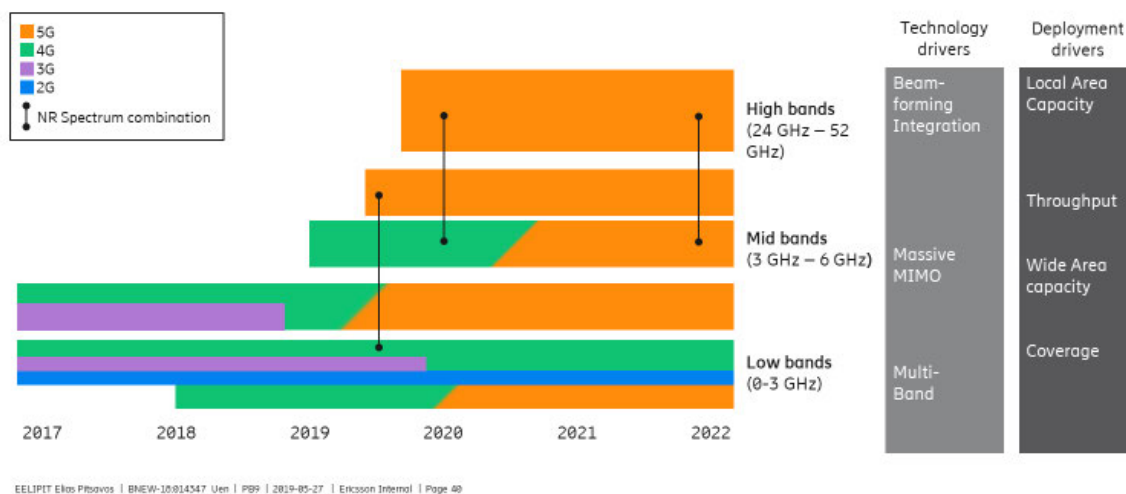
Figure 5: 5G Technology and Deployment Drivers for Low, Mid and High spectrum bands

- **Figure 5** above also suggests that each spectrum band has unique properties, meaning there are diverse opportunities to balance throughput, coverage, quality and latency, as well as reliability and spectral efficiency.

- For 5G to achieve what it is designed to do, the Global Suppliers Association (**GSA**)[33] and **AMTA** consider that each operator requires 100MHz of mid-band and 1GHz of mmWave spectrum for the initial phase of 5G networks to reach their full potential.

- Globally, early 5G network launches are being deployed in either mid-band or high band, referred to as **mmWave**.

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[33] www.gsacom.com

- In Australia:

  - **Low-band spectrum** is currently being used for 3G and 4G services for voice, mobile broadband (**MBB**) services and Internet of Things (**IoT**) applications. For example, allocations in the 850, 900 and 700MHz bands are ideal for wide-area and outside-in coverage as well as for deep indoor coverage typically required for (**eMBB**) and voice services.

  - **Mid-band spectrum** is currently used for 3G, 4G and pioneer 5G services in the $3.4 - 3.7$GHz bands (commonly referred to as the 3.5 and 3.6GHz bands). Allocations of between 50 to 100 MHz per network operator will enable high-capacity and low-latency networks ideal for 5G use cases such as (**eMBB**) and massive and critical IoT applications. With better wide area and indoor coverage than high-band spectrum, mid-band spectrum is an optimal compromise between coverage, quality, throughput, capacity and latency. Combining mid-band spectrum with low-band spectrum leads to significant network improvements in terms of capacity and efficiency. 125 MHz of mid band spectrum has recently been allocated in Australia in the 3.6 GHz bands in metro regional markets.[34]

  - **High-band spectrum** provides the leap in data speed, capacity, quality and low latency promised by 5G. High-band spectrum provides a significant opportunity for very high throughput services for **eMBB**, localised deployments and low latency use cases. New high band spectrum being considered for 5G are in the range 24 GHz to 50 GHz, with contiguous bandwidths of more than 100 MHz per operator. The initial high-bands that are of global interest are 26GHz ($24.25 - 27.5$GHz) and 28GHz ($27.5 - 29.5$GHz). For example, industrial IoT, sporting venues, for both indoor and outdoor deployments. **FWA** will also benefit from high band spectrum in terms of capacity. For wider-area coverage, combinations of low-band and mid-band are essential. 2.4GHz will be allocated for 5G in the 26GHz band in Australia with an auction expected in Q1, 2021.[35]

- As a technology taker not maker, it is critical that Australia has a globally aligned pipeline of new and in-market spectrum that is fit for 5G. This will enable Australia to take advantage of economies of scale from global suppliers of equipment and reduce the need and cost of be-spoke solutions.

- Spectrum pricing is also a key consideration for operators. As the Minister for Communications, Cyber Security and the Arts, the Hon Paul Fletcher MP recently noted:

  - "*the (Radiocommunications) Act is clear that the purpose is to allocate spectrum to its highest value use, not to maximise revenue for the Commonwealth*."[36]

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[34] https://www.acma.gov.au/auction-summary-36-ghz-band-2018

[35] https://www.legislation.gov.au/Details/F2019L01374

[36] https://www.afr.com/companies/telecommunications/ultra-fast-5g-spectrum-to-go-under-the-hammer-in-2021-20191024-p533si

- Research by Ericsson[37] and GSMA support this view and assess the economic impact of high spectrum prices in terms of rollout timing, coverage quality and consumer prices.[38]

- Ericsson considers Australia is well placed in its planned spectrum allocations for 5G. This includes the ability to act quickly to implement the outcomes from the World Radio Conference 2019[39] to ensure Australia's pipeline of new 5G spectrum is regionally and globally aligned.

- The current spectrum planning and policy challenge is to de-fragment or make contiguous in-market 5G spectrum allocations to improve efficiencies in network rollout for operators. That is:

  - in-market 5G spectrum allocations, particularly in the 3.5GHz and 3.6GHz bands, are not contiguous, not configured for 5G and operate under different and outdated technical frameworks.

Radio waves and health

- 5G equipment, whether it be mobile devices or base stations, meet the same safety standards as the equipment used in current mobile networks.

- Like previous generations of mobile networks, 5G devices will communicate with base stations by transmitting and receiving radio waves, or radio frequency (**RF**) electromagnetic fields (**EMF**), sometimes also referred to as electromagnetic energy (**EME**).

Key facts about 5G and EMF/EME

- **5G will use new radio technology and new frequency bands as illustrated at Figure 5**.

  - New radio technology is introduced to meet all the extended capacity and capability demands of 5G. To increase the capacity and support very high data rates, 5G will extend the range of frequencies used for mobile communication. This includes new spectrum below 6 GHz, as well as spectrum in higher frequency bands up to 100 GHz.

- **5G equipment will use beamforming to improve performance**

  - To address the demands of increased performance, 5G base stations and devices will use more antennas. Arrays of up to hundreds of small antennas at the base station will make it possible to focus the transmission of radio waves to maximize the signals that the connected devices receive. This is called beamforming or massive **MIMO**. This technology's transmitted power can be kept low resulting in radio wave exposure at similar levels as in previous networks, even though the performance is significantly improved.

- **Exposure levels will be below international safety limits**

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[37] https://www.ericsson.com/en/blog/2019/10/auctions-and-5g-spectrum-be-careful-what-you-wish-for

[38] https://www.gsma.com/spectrum/resources/spectrum-auctions/

[39] https://www.itu.int/en/ITU-R/conferences/wrc/2019/Pages/default.aspx

– The power levels of the radio signals transmitted by 5G radio equipment will be of similar or lower magnitude as those used in previous networks. 5G devices are being designed and tested to comply with established radio wave exposure limits.

- **Public access will be restricted where needed**

    – As for existing networks, exposure limits may be reached near a base station antenna. The antennas are installed in such a way that unauthorised people do not have access to this area, which varies in size from a few centimetres for small indoor antennas up to several meters for antennas mounted on masts or on rooftops. The intensity of the exposure drops quickly when moving away from the antenna, and the exposure levels are well below the limits in places where people normally reside.

- **Exposure limits are set by independent organisations**

    – Independent expert organisations have established the exposure limits for radio waves based on many years of research. The limits are recommended by the World Health Organization (**WHO**), among others, and include large safety margins. 5G equipment, whether it be mobile devices or base stations, will meet the same safety standards as the equipment used in previous mobile communication networks. This includes the use of mmWave spectrum for 5G.[40]

- **No adverse health effects from mobile communications**

    – The **WHO** states:

    "From all evidence accumulated so far, no adverse short- or long-term health effects have been shown to occur from the RF signals produced by base stations and a large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use." [41]

- Ericsson's assessment of 5G and **EMF/EME** is also aligned with the Australian Radiation Protection and Nuclear Safety Agency (**ARPANSA**) – responsible for setting Australian safety standards around radiation and **EMF/EME** emissions. ARPANSA advised:

    – "*Although the 5G mobile phone network is new, limits set in safety standards, our understanding of the evidence of health effects and the need for more research have not changed. At exposure levels below the limits set within the ARPANSA safety standard, it is the assessment of ARPANSA and international organisations such as the* [World Health Organisation](#) *(WHO) and the* [International Commission on Non-Ionising Radiation (ICNIRP)](#) *that there is no established scientific evidence to support any adverse health effects from very low RF EME exposures to populations or individuals.*"[42]

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[40] Further evidence is at the EMF-Portal (an open-access extensive database of scientific research) details more than 25,000 published scientific articles on the biological and health effects of EMF/EME including approximately 350 studies on mmWave frequencies relevant for 5G. https://www.who.int/peh-emf/research/database/en/

[41] WHO fact sheets No 304 and No 193

[42] https://www.arpansa.gov.au/news/5g-new-generation-mobile-phone-network-and-health

- ARPANSA also issued a further statement[43] to dispel misinformation about 5G networks concluding that:

  – "*Contrary to some claims, there are no established health effects from the radio waves that the 5G network uses. ARPANSA and the World Health Organization (WHO) are not aware of any well-conducted scientific where health symptoms were confirmed as a result of radio wave exposure in the everyday environment.*"[44]

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[43] https://www.arpansa.gov.au/news/misinformation-about-australias-5g-network

[44] https://www.arpansa.gov.au/news/misinformation-about-australias-5g-network

Section E: 5G Use Cases for Enterprise and Government

Enterprise

- Recent Ericsson research on 5G for enterprise[45] assessed over 200 use cases from ten industries and 'nine use case clusters' for their characteristics of being 5G enabled, meaning they are either significantly enhanced, or made possible by the introduction of 5G 3GPP technology.

- The research found:

  - The digitisation of the ICT industry is forecast to generate USD 3.8 trillion in revenue by 2030, with USD 700 billion addressable by mobile service providers.[46]

  - For South-East Asia, that includes Australia, the addressable market for mobile service providers is USD 41 billion.

  - Healthcare now represents the largest addressable market, followed by manufacturing, energy, utilities and automotive.

  - All of the 10 industries assessed have significant value, but all present different barriers to entry.

  - The service provider industry opportunity is confirmed to be significant but is expected to be later and to be somewhat differently distributed across industries.

- These research findings are a further marker of the global transition to Industry 4.0. This transition is which is about leveraging technology and digitalisation to improve product quality, boost efficiency, stay competitive, enhance safety, security and sustainability and remain profitable.

- **Figure 4** illustrates a 'maturity model' on connectivity's role in the transition to Industry 4.0 – from digitisation to optimisation.

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[45] https://www.ericsson.com/en/news/2019/10/ericsson-5g-for-business-a-2030-market-compass
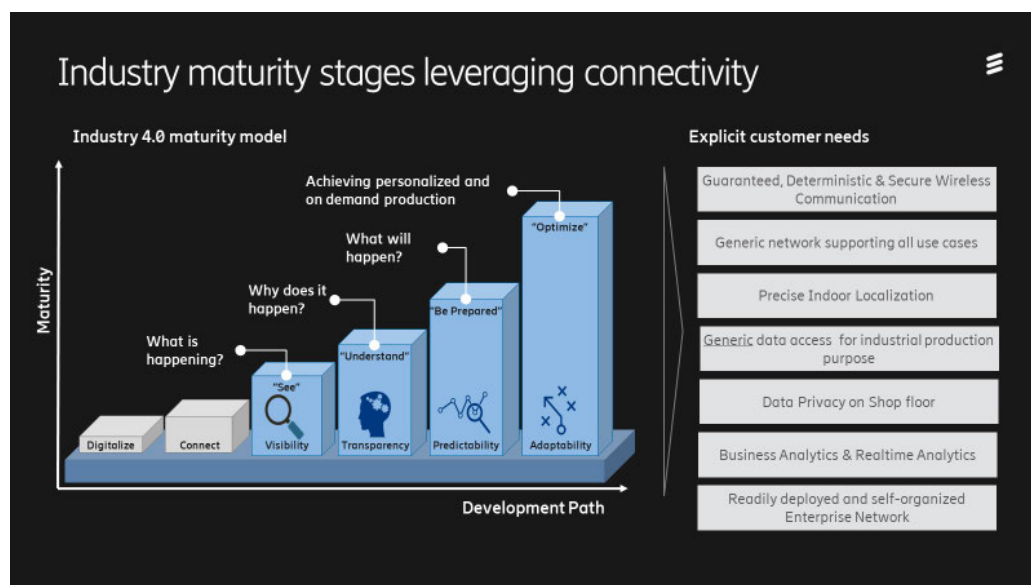
[46] ibid

Figure 6: Transition to Industry 4.0 maturity model

- A sample of global and Australian examples of how 5G is being used as an innovation platform to drive the transition to Industry 4.0 for enterprise and government are provided below.

Ports

- Ericsson and China Unicom are developing a 5G smart harbor at the Port of Qingdao in China.[47]

- Qingdao Harbor is the 4th largest harbor in China. It has fifteen ports, including the first autonomous port in operation in Asia and a new autonomous port under construction.

- A 5G network has been installed to connect data traffic from over 30 high-definition cameras and control data for a programmable logic controller (**PLC**).

- These operations require millisecond-level latency control signals, as well as stable, remote and real-time control, requirements which only 5G technologies can deliver.

- In an autonomous port, there are tens of cranes and automated guided vehicle (**AGV**) trucks that operate with very little worker assistance. Automatic and remote operations are key to efficiency.

- In terms of technology choice:

  - fibre was not flexible enough for moving cranes, with high operational and maintenance costs and high-power consumption.

  - Wi-Fi and 4G could not provide the needed bandwidth and latency features of 5G.

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[47] https://www.ericsson.com/en/press-releases/2019/2/ericsson-and-china-unicom-announce-5g-smart-harbor-at-the-port-of-qingdao

- The 5G solution:

    - enables the remote control of cranes with a dedicated private network, with 5G **NR** and core on premises.

    - provides low latency for **PLC** control and high bandwidth for video transmission from 30 plus cameras on each crane.

    - saved 70 % in labour costs when a port used the 5G automation upgrade, compared to a traditional port.

- This is an example of how 5G can transform traditional port operations to industry 4.0 by replacing fibre with 5G to upgrade to autonomous operations.

Mining

- Mining requires the movement of millions of metric tons of rock by giant pieces of equipment with precision. Any disturbance to the finely tuned flow of materials can have major consequences and cost for a mine's operations.

- Mines also represent challenging environments with numerous potential safety risks such as falling rock, blasting, dangerous gases and limited visibility.

- 5G has the potential to deliver specialised technical solutions to meet emerging requirements for connectivity and automation.

- Improving profitability in the mining industry requires working relentlessly on efficiency, transport and metal extraction. However, incremental improvements are facing diminishing returns, and the industry is turning its attention to automation as the next area of opportunity.

- Ericsson is working closely with a number of partners to deliver industrialised connectivity and automation mining solutions via 5G. For example:

    - Boliden[48] is working with a number of partners, including Ericsson, to create the 'mine of the future' at Aitik the largest open pit mine in Europe in the north of Sweden. The trial explored the role of automation and what business value 4G and 5G technology could deliver in the mine in terms of economics and sustainability.

    - The key outcomes of the trial were:

        - Automation to enable the remote operation of diggers;

        - Productivity improvements by being able to continue to work on the mine remotely soon after blasts;

        - Better safety outcomes with 'smart ventilation' improving air quality;

        - The delivery of versatile wireless industrial mining connectivity, enabling greater safety as well as productivity; and

        - A 20% increase in drill rig productivity in the Boliden Aitik mine.

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[48] https://www.ericsson.com/en/trends-and-insights/consumerlab/consumer-insights/reports/a-case-study-on-automation-in-mining

- In Australia, the use of 4G technology, also known as Long Term Evolution or LTE, in mining is also evolving. For example:
  - Ericsson is Telstra's Mining for Private LTE networks partner.
  - In September 2019, Telstra Mining Services and South32 launched the development of one of the largest underground mining LTE networks in the world in North West Queensland.[49]
  - South32's Cannington Mine represents a significant industry milestone in moving closer to automated mining processes and improved connectivity.

Cellular Vehicle-to-Everything (V2X)

- Telstra, supported by Ericsson has recently trialled Vehicle-to-Everything (**V2X**) technology over Telstra's 4G network in Victoria.

- V2X technology lets cars talk to the environment around them using both short range communications and Telstra's 4G network. The environment around the car could be other cars and trucks, traffic lights, roadworks or even pedestrians and cyclists.

- The use and development of V2X, over 4G and 5G networks will help create clever transport systems to support more efficient use of roads, better traffic management (i.e. reduced congestion) and, in the future, coordinated and safer driverless vehicle operation.

- Ericsson is also collaborating with Toyota[50] and the Automotive Edge Computing Consortium[51] to investigate how to place applications close to the edge in order to provide fast transactions and smart filtering of data.

- Edge computing is particularly relevant for the auto industry as it requires the uplink of large volumes of data for cloud processing. The use of edge computing will allow the right data to be collected and used to improve for example congestion in city road networks and increase fuel efficiency.

Manufacturing

- The manufacturing industry presents a significant addressable 5G-enabled market for service providers globally, estimated to be USD 132 billion in 2030.[52]

- The industry needs to meet the demand from a globally volatile, diverse, complex and demanding market place which is driving the need to run flexible production via smart factories.

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[49] https://www.zdnet.com/article/telstra-mining-services-to-deploy-underground-lte-network-in-queensland/

[50] https://www.ericsson.com/en/blog/2019/10/cellular-v2x-the-road-ahead-c-its-adas

[51] https://aecc.org/

[52] https://www.ericsson.com/en/5g/forms/5gforbusiness-2019-report

- 5G offers reliable connectivity without cumbersome and costly cabling enabling factory set-ups with two-way communication between machines and workers in a modular and flexible setting. For example:

    - Ericson's partnership with Telefioncia and Mercedes Benz to enable 5G car production 'Factory 56' via a private 5G network at the company's Sindelfingen plant in southern Germany.[53]

    - Ericsson new smart manufacturing factory in the United States in Lewisville, Texas.[54] The 28,000sq m state-of-the-art factory will produce 5G and advanced antenna system radios using fast and secure 5G connectivity to enable agile operations and flexible production. Ericsson's 5G industrial solutions include: automated warehouses; connected logistics; automated assembly; packing and product handling and the use of autonomous carts.

- There are significant opportunities for the Australian manufacturing sector from the wide spread deployment of 5G. The Australian Industry Group's 'Australian Manufacturing in 2019 Local and Global Opportunities'[55] recognises this potential:

    - "*Industry 4.0 is the integration of digital technology, manufacturing and consumer life. It is the latest of many Australian industry responses to the global opportunities arising from digital technologies and the 'Fourth Industrial Revolution'.* "

    - *According the World Economic Forum's Readiness for the Future of Production Report, Australia is a "high potential" country for this type of future production. Key opportunities and advantages are arising for Australian manufacturing from increasing amounts of investment in digital technologies but also from the integration of these new technologies into an increasing range of the manufacturing processes and supply chains.*"

Financial Services

- Ericsson is partnering with Telstra and the Commonwealth Bank of Australia to trial 5G edge computing technologies for the financial services sector.[56]

- The trial will consider what the bank branch of the future might look like and how 5G edge compute can help reduce the network infrastructure currently required at individual bank branches.

- The learnings on 5G and edge computing intend to be used across a broad range of industries.

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[53] https://www.youtube.com/watch?v=UdDvDKC8FVM

[54] https://www.ericsson.com/en/news/2019/9/ericsson-us-5g-factory-in-lewisville-texas

[55] https://cdn.aigroup.com.au/Economic_Indicators/Economic_Outlook/Australian_Manufacturing_in_2019.pdf

[56] https://www.telstra.com.au/aboutus/media/media-releases/Telstra_CBA_Ericsson_trial_5G_banking_sector

Climate Change

- The Ericsson Innovation Awards[57] support the next generation of innovators, including Australian-made 5G use cases. For example:

    - University of Adelaide students are semi-finalists in this year's awards for their cuttlefish inspired autonomous underwater vehicle.

    - The Bio-AUV's [58] unique propulsion system will enable access to otherwise untraversable underwater exploration.

    - Once commercialised the Bio-AUV will use 5G capabilities to assist scientists in crucial data gathering from complex reef systems which will help reduce the effects of climate change in underwater ecosystems globally.[59]

Government

5G and Health Services

- Recent research estimates that the healthcare industry is the largest addressable market for service provides from digitisation.[60] Provided below are two 5G use cases for the health sector.

Connected Ambulance

- In a collaboration between Ericsson, Kings College and British Telecom, the connected ambulance demonstration[61] shows how a doctor, paramedic and patient can interact in real time via 5G to expedite diagnosis.[62]

- With 4G, near real time communication was via voice and video. 5G brings the capability to touch and move in real time over the network.

- In this demonstration a patient is in an ambulance with a suspected blood clot on their way to hospital.

- The paramedic adds a 5G data channel to the 4G **VoLTE** (Voice over Long-Term Evolution) call to connect to the doctor at the hospital's emergency room.

- Acting as a surrogate arm for the doctor, the paramedic uses a haptic glove, controlled in real-time by the doctor, to undertake an ultrasound examination, while travelling to the hospital.

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[57] https://www.ericsson.com/en/events/eia

[58] https://www.ericsson.com/en/events/eia/adelaide-bio-auv-the-university-of-adelaide-australia

[59] ibid

[60] https://www.ericsson.com/en/news/2019/10/ericsson-5g-for-business-a-2030-market-compass

[61] https://www.youtube.com/watch?v=qgYIUffnqlI

[62] https://www.ericsson.com/4a44a9/assets/local/digital-services/doc/health-care-case-real-time-interaction-in-5g-with-ims-data-channel.pdf

- By the time the patient arrives at the hospital the diagnosis is complete and next steps for treatment are clear.

- The connected ambulance:

  - has the potential to save lives and improve both the efficiency and cost of healthcare diagnosis protocol.

  - uses haptic communications, which are enabled by 5G as they require latencies below 10ms in the most demanding scenarios.

  - relies on security and privacy features of 5G since the devices may capture sensitive visual, audio and haptic information.

Remote Medicine

- 5G's speed, capacity, low latency and edge compute capabilities will also enable the delivery of more complex remote healthcare services.

- For example:

  - Imaginalis, an Epica International Group company that researches, develops and produces robotic imaging medical devices, is working with Ericsson to investigate how 5G can improve treatment options with their state-of-the-art laser equipment.[63]

  - Imaginalis is using 5G to advance remote diagnosis by improving mobile uplink connectivity and data compression to transfer images and perform remote analysis. As Damiano Fortuna, CEO and President of Imaginalis, explains:

    - "*With 5G wireless connection, the entire workflow could become very easy and intuitive. That could make it possible to perform a pre-planned surgery by an expert surgeon in Cambridge or Boston, when the system (and patient) is located in another part of the world.*"[64]

  - In February 2019, the first tele-mentored surgery over a 5G connection was performed between the Fira Gran Via and Hospital Clinic de Barcelona, with a medical expert advising an in-theatre surgeon on a live operation in near real time. As Vodafone Spain Head of Network deployment and optimisation Julia Velasco explained:

    - "*5G allows low latency but also a high-quality image on screen at high speed. Using network slicing we can dedicate the services to the e-health service independent of the rest of the network.*"[65]

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[63] https://www.ericsson.com/en/cases/2016/5gtuscany/transforming-healthcare-with-5g

[64] https://www.ericsson.com/en/cases/2016/5gtuscany/transforming-healthcare-with-5g

[65] https://www.mobileworldlive.com/featured-content/home-banner/mwc19-hosts-5g-surgery-breakthrough/

5G and Emergency Services

- The ability of 5G to optimise and coordinate emergency service responses in the critical minutes following accidents has been highlighted in a demonstration led by Ericsson and Portuguese operator Altice.

- Ericsson configured a non-standalone end-to-end 5G network, with 5G Evolved Packet Core, for the demo.

- The demonstration was conducted in partnership with local first responders.[66]

- Professionals from multiple Portuguese response agencies - police, ambulance service, fire brigade, and the civil protection authority - were equipped with body kit comprising cameras and sensors. There were then connected via a 5G test network to a command centre as they responded to a staged traffic accident, where the driver was trapped inside. Connected drones captured overhead views.

- The almost latency-free high-quality video stream and sensor feedback provided instant feedback from the scene, including real-time relative positions of all emergency personnel, allowing command center coordinators to act instantly to optimise operations.

- Real time monitoring of on-site environmental conditions - such as air quality, gasses and fumes - also improved the operational efficiency of on-site responses and actions. The first responders' own vital signs were also constantly monitored with all data coordinated in the command centre.

Internet of Skills

- The use of internet as a learning tool will also evolve with 5G's capabilities. For example:

    - Ericsson is collaborating with Kings College London to test the transference of human skills remotely, combing haptics, tactile and augmented reality.

    - The high reliability and very low delay of 5G is powering the collection, availability and processing of data analytics will facilitate countless education and skills enhancement use cases.

    - One use case is piano teaching: using an exoskeleton on people's hands, piano teachers will be able to train learners' muscle memory to play the piano in the optimum way. Through the exchange of touch, sight and hearing in what is termed by many as the Internet of Skills, teachers can monitor performance in almost real time. [67]

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[66] https://www.ericsson.com/en/news/2019/9/5g-tested-for-emergency-response

[67] https://www.ericsson.com/en/cases/2017/kings-college/education

Section F: Role of government to fast track Australia's transition to 5G

- Ericsson welcomes the Minister for Communications, Cyber Safety and the Arts, the Hon Paul Fletcher MP's recognition of 5G's role as a significant economy wide economic enabler [68] .

- The commitment to auction the 26 GHz band in early 2021 is a key example of what targeted role Government has in fast tracking Australia's transition to 5G as it evolves . As the Minister recognised:

    - "*making this spectrum available means that the Australian telecommunications industry can do what it does best – provide world-class telecommunications services for consumers, small businesses and enterprises. 5G will deliver speeds significantly faster than 4G and at much lower latency*".[69]

- Key examples of other public policy levers all levels of government could consider to fast track Australia's transition to 5G as it evolves include:

    - Supporting 5G by design, where policy approaches to procurement and tender design for government services or infrastructure builds include an assessment of what role 5G could play and how could the deployment of 5G be supported.

    - Assessing opportunities in government service delivery for the early adoption of 5G in for example, health service delivery, education or skills delivery.

    - Options for the use of government owned infrastructure or infrastructure corridors to support 5G deployment so forecast economy wide benefits can be realised sooner.

    - Ensuring new spectrum for 5G is allocated in a timely manner at a price that doesn't deter investment, with in-market spectrum reconfigured to support efficient deployment.

    - Working with industry to build trust in the security and safety of 5G networks as they evolve to ensure 5G's success as an economy wide enabler.

- There is a significant opportunity for government to work with industry to identify regulatory enablers and remove regulatory barriers to 5G so that Australia's position at the forefront of the global transition to 5G can be leveraged to deliver real economic benefits.

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[68] https://www.afr.com/business/telecommunications/new-comms-minister-eyes-5g-industry-opportunities-20190527-p51rgu.

[69] https://www.minister.communications.gov.au/minister/paul-fletcher/news/opening-more-5g-spectrum