

**1. How does 5G differ from 4G in terms of any impacts?**

Please see:

- **Attachment 1:** page 1. Particularly, we note the following text on page 1:
  - Under the heading 'Is 5G Safe?':
    - *"The existing safety standards cover 5G, include children and are conservative.*
    - *The frequencies and power levels we are using today for 5G are similar to 3G and 4G."*
  - Under the heading 'What testing has Telstra done in relation to 5G?':
    - *"We have done extensive EME testing on our 5G network at different locations including a school, café, apartment, sports field and in the street.*
    - *We have found the EME levels to be similar to 3G, 4G and WiFi."*
- **Attachment 2:** pages 3 and 4. Particularly, we note the following text on page 3:

*In relation to 5G frequencies, Dr Sarah Loughran, Director of the Australian Centre for Electromagnetic Bioeffects Research at the University of Wollongong states:  
"The higher frequencies [of 5G] actually means that the energy doesn't penetrate as deeply into the body than previous fourth generation and other generation technologies have."*

*"ARPANSA states:*

*This network currently runs on radio waves similar to those used in the current 4G network, and in the future will use radio waves with higher frequencies. It is important to note that higher frequencies does not mean higher or more intense exposure. Higher frequency radio waves are already used in security screening units at airports, police radar guns to check speed, remote sensors and in medicine and these uses have been thoroughly tested and found to have no negative impacts on human health."*

- **Attachment 5:** see questions 18 and 19 (on pages 2 and 5) – extracted below:

*"18. What EME does 5G add?*

*Telstra has conducted extensive EME testing and analysis on the 5G trial network at Southport on the Gold Coast and commenced EME testing on the new 3.5GHz commercial base stations. The test results show EME levels are similar to the existing mobile technologies and well below the EME safety limits.*

*Telstra presented a summary of the results to the Science and Wireless Conference in November 2018 held by the Australian Centre for Electromagnetic Bioeffects Research (ACEBR).*

*The presentation is available online at <https://acebr.uow.edu.au/events/UOW254614>"*

*"19. What testing has Telstra done on 5G to ensure it's safe?*

*Telstra has a dedicated team with responsibility for managing EME compliance and we ensure that all Telstra base stations and devices are designed to meet Australian EME safety standards.*

*Telstra uses EME specialists that are independently accredited by the National Association of Testing Authorities (NATA) for EME compliance assessments.*

*In 2018 Telstra conducted extensive EME testing and analysis on the 5G trial network at Southport on the Gold Coast and commenced EME testing on the new 3.5GHz commercial base stations. The test results show EME levels are similar to the existing mobile technologies and well below the EME safety limits.”*

**2. An explanation (preferably with a simple diagram) which gives a better understanding of the trajectory of radio waves / EME’S relative to the height and location of a tower.**

Please see:

- **Attachment 4:** page 2. Particularly, we note the following text:

*5G networks can use smart antenna technologies (such as multiple input multiple output – MIMO) that deliver radio signals where they are needed. Conventional antennas provide coverage similar to how a floodlight illuminates a wide area. The new antennas are like a flashlight providing coverage where it is needed and reducing unwanted signals. Smart antennas increase capacity and improve efficiency.*

- **Attachment 5:** pages 5 and 6 (question 21):

*“Yes, beam forming antennas are part of the new 5G technology standards and deliver great network efficiencies. Telstra is deploying beam forming antennas as part of the new 5G service. Beam forming antennas for 5G enable the mobile signal to be sent directly to devices in a narrow beam rather than to the broader area where the device is located. The existing 3G and 4G technologies also use beam forming antennas however the beam is quite broad and typically 120 degrees wide.”*

**3. Are there any cumulative impacts of EMEs considering the location of other infrastructure in proximity to the site?**

Please see Page 42 of Telstra’s Rivervale South Development Application which notes the following:

**Maximum cumulative EME level for the proposed configuration**

Location	Height range	Electric field (V/m)	Power density (mW/m <sup>2</sup> )	Percentage of the public exposure limit
Medical centre	0-3 m	6.43	109.79	1.71%
Nearest residential dwelling	0-3 m	3.17	26.64	0.45%

The figures in the last column (Percentage of public exposure limit) are out of 100%.

**4. An explanation of 'demand' and 'need', particularly in relation to traffic volumes on Orrong Road**

As stated in **Attachment 7** (Hourly Volume of Traffic on Orrong Road report), there are now around 4,500 vehicles passing every hour during peak periods, and around 65,000 vehicles per day. **Attachment 6** (The Orrong Road Planning Study FAQs) indicates that this is forecast to increase to around 100,000 vehicles per day by 2030.

In almost every one of those vehicles, there will be at least one device trying to talk to the network, sometimes several devices. We are not just talking about phones and people making phone calls. Many new cars have their own SIM card. Many people have two phones or a phone and a tablet, each with their own SIM card. Every one of those devices is talking to the network regardless of whether a call is being made or not. They are downloading emails, streaming music, operating GPS navigation with maps and live traffic, updating apps, etc., all the time. Passengers in cars and busses are watching videos, reading the news or playing online games. Every device is sending and receiving data. When that peak load hits, the people who are most affected are residents of the 800 or so local houses whose devices can no longer talk to the network from indoors because they have very poor signal quality and the lowest signal strength. Their usual service is simply swamped by the passing road traffic.

**5. A commitment to the revegetation of Streatly Road**

Telstra agrees for a condition to be added that it will provide \$4,935.94 (including GST) (\$2,467.97 (including GST) per tree) for the purchase of 2 *Agonis Flexouosa* for planting on the Streatley Road verge. This price includes tree purchase, contractor charges for planting, fertilising, wetting agent, mulching and watering for three years following planting.

**6. Further details on how cabling any other infrastructure is to be removed from the ROW.**

As you noted during the call this morning, this question was briefly raised at the end of the mediation and Emily Pink from Telstra spoke to this question (very briefly). We understand that Emily is best placed at Telstra to answer this query. Unfortunately, Emily is away this week and next. But we will speak to Emily on her return and then Peter Ward can provide further information on this at the Agenda Briefing Forum on 1 October 2019.

Please let us know if you have any further questions.

Kind regards  
Jaime

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**This communication and any attachments are confidential and may be privileged.**

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See



# 5G and Electromagnetic Energy (EME)

## Fact sheet

### Is 5G Safe?

- At Telstra we take our responsibilities regarding the health and safety of our customers and the community very seriously. We also acknowledge that some people are genuinely concerned about the possible health effects from electromagnetic energy (EME) and we are committed to addressing those concerns responsibly.
- 5G wireless networks are designed to be very efficient and minimise EME. This means that both the network and device power will be low, which means low levels of EME on 5G.
- The advice from the World Health Organisation (WHO) is that "there is no evidence that exposure to low level EME is harmful to human health".
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the agency of the Commonwealth Government tasked with protecting people and the environment from the harmful effects of radiation, says that "there is no established health effects from the radio waves that the 5G network uses".
- We have read the extensive research reviews from international governmental health agencies and standards setting committees, conducted our own assessments and follow the safety standards set by the Australian Health Department.
- The existing safety standards cover 5G, include children and are conservative.
- The frequencies and power levels we are using today for 5G are similar to 3G and 4G.
- Over 50 years of scientific research has already been conducted into the possible health effects of the radio signals used for mobile phones, base stations and other wireless services, including the frequency bands now being redeployed for 5G.

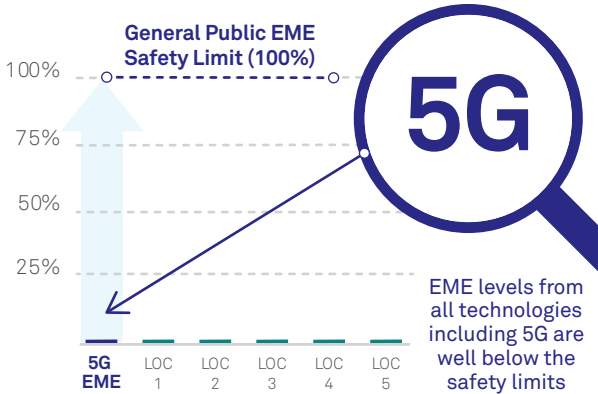
**We are confident that 5G adds no risk compared to existing technologies.**

### What testing has Telstra done in relation to 5G?

- We have done extensive EME testing on our 5G network at different locations including a school, café, apartment, sports field and in the street.
- We have found the EME levels to be similar to 3G, 4G and WiFi.
- The EME levels measured were found to be well below the safety limits, and in many cases over a thousand times lower.
- We continually monitor our network and the ACMA conduct EME compliance audits.



### 5 Surveys of 5G and EME



## 5G and small cells

### Will Telstra be using small cells for 5G?

- Initially we are not using small cells for Telstra's 5G deployment. We are upgrading existing base stations for 5G.
- In the future Telstra will be using a range of different base stations for 5G including small cells.

### Will small cells be built on every street for 5G?

- Currently, Telstra does not plan or need to build small cells on every street for 5G.
- In future years, mmWave small cells with a shorter range may be used extensively in residential & commercial areas where customers need access to quality high speed and high capacity mobile services.

Small cells are not new and have been used for many years to enhance capacity and boost coverage.

### Do small cells have high EME?

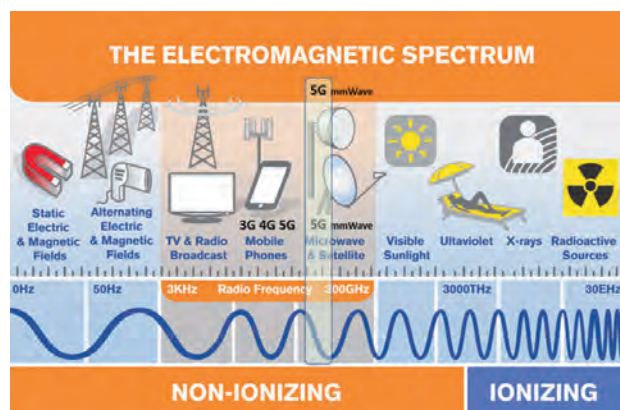
- No, small cells operate at low power and have low EME levels.
- Telstra has tested a range of small cells and found the EME levels around small cells to be very low and well below the EME safety limits.



A typical 4G small cell in a suburban street

## What is mmWave and is it safe?

- Telstra 5G technology does not currently use mmWave frequencies, however we plan to use mmWave in the future when spectrum becomes available.
- mmWave is not new, it's a higher frequency band that is already being used for communications.
- The existing EME safety standards and extensive research to date includes mmWave.
- Telstra's mmWave 5G trials showed EME levels were very low and similar to existing technologies.



## Resources

Source	Website
Telstra.com	<ul style="list-style-type: none"> <li><a href="https://www.telstra.com.au/consumer-advice/eme/5g-and-eme">https://www.telstra.com.au/consumer-advice/eme/5g-and-eme</a></li> </ul>
Telstra Exchange Articles – public information on 5G and EME	<ul style="list-style-type: none"> <li><a href="https://exchange.telstra.com.au/understanding-5g-and-eme/">https://exchange.telstra.com.au/understanding-5g-and-eme/</a></li> <li><a href="https://exchange.telstra.com.au/5-things-you-should-know-about-5g-and-eme/">https://exchange.telstra.com.au/5-things-you-should-know-about-5g-and-eme/</a></li> <li><a href="https://exchange.telstra.com.au/5-surveys-of-5g-show-eme-levels-well-below-safety-limits/">https://exchange.telstra.com.au/5-surveys-of-5g-show-eme-levels-well-below-safety-limits/</a></li> </ul>
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)	<ul style="list-style-type: none"> <li><a href="https://www.arpansa.gov.au/news/misinformation-about-australias-5g-network">https://www.arpansa.gov.au/news/misinformation-about-australias-5g-network</a></li> </ul>
Small cells bringing fast mobile coverage to where it's needed most	<ul style="list-style-type: none"> <li><a href="https://exchange.telstra.com.au/small-cells-bringing-fast-mobile-coverage-needed/">https://exchange.telstra.com.au/small-cells-bringing-fast-mobile-coverage-needed/</a></li> </ul>
Australian Communications and Media Authority (ACMA) - small cells	<ul style="list-style-type: none"> <li><a href="https://www.acma.gov.au/Home/theACMA/a-guide-to-small-cells">https://www.acma.gov.au/Home/theACMA/a-guide-to-small-cells</a></li> </ul>
EMF Explained – how 5G works	<ul style="list-style-type: none"> <li><a href="http://www.emfexplained.info/?ID=25916">http://www.emfexplained.info/?ID=25916</a></li> </ul>
World Health Organisation online (WHO) – EME Q&A	<ul style="list-style-type: none"> <li><a href="https://www.who.int/features/qa/30/en/">https://www.who.int/features/qa/30/en/</a></li> </ul>
International Commission for Non-Ionising Radiation Protection (ICNIRP)	<ul style="list-style-type: none"> <li><a href="https://www.icnirp.org/en/frequencies/high-frequency/index.html">https://www.icnirp.org/en/frequencies/high-frequency/index.html</a></li> </ul>
Science Media Centre – EME Briefing	<ul style="list-style-type: none"> <li><a href="https://www.scimex.org/newsfeed/background-briefing-5g-jitters-how-safe-is-5g-for-our-health">https://www.scimex.org/newsfeed/background-briefing-5g-jitters-how-safe-is-5g-for-our-health</a></li> </ul>
Science & Wireless 2018 EME presentation	<ul style="list-style-type: none"> <li><a href="https://acebr.uow.edu.au/events/UOW254614">https://acebr.uow.edu.au/events/UOW254614</a></li> </ul>
ACMA RadComms 2018 5G and EME	<ul style="list-style-type: none"> <li><a href="https://www.acma.gov.au/-/media/mediacomms/Events/RadComms2018/Presentations/RadComms-2018-Day-1-Mike-wood-pptx.pptx">https://www.acma.gov.au/-/media/mediacomms/Events/RadComms2018/Presentations/RadComms-2018-Day-1-Mike-wood-pptx.pptx</a></li> </ul>

# What is 5G?



**5G is the 5th generation of mobile networks, a significant evolution of today's 4G networks.**

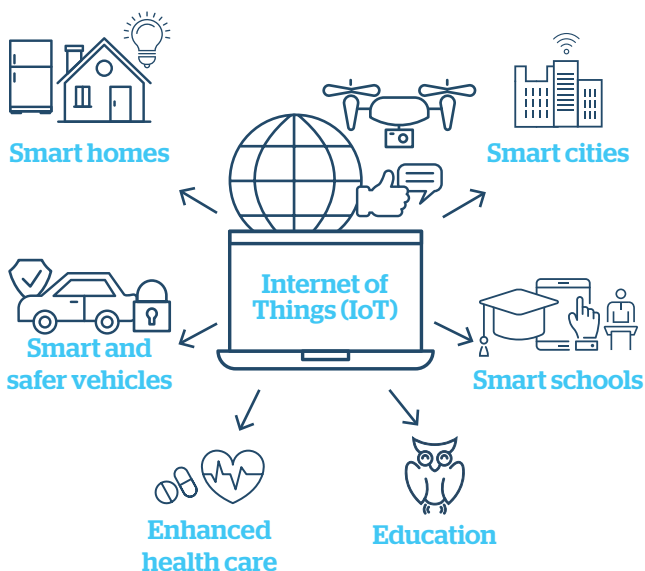
**5G is designed to meet the very large growth in data and connectivity of today's modern society, the internet of things with billions of connected devices, and tomorrow's innovations.**

5G will initially operate in conjunction with existing 4G networks before evolving to fully standalone networks. The rollout of 5G will help meet Australians' growing demand for more data, with the Australian Communications and Media Authority (ACMA) reporting that the volume of data downloaded on mobiles has increased by 41% from June 2017 to June 2018, and this is set to continue.

## What will 5G enable?

5G will enable enhanced mobile broadband, instantaneous connectivity to billions of devices, the Internet of Things (IoT) and a truly connected world.

**For communities, 5G will enable real-time connection of billions of devices to provide a safer and more efficient place to live by enabling things like:**



**For businesses and industry, 5G and IoT will provide a wealth of data allowing them to gain insights into their operations like never before.**

**Business will increasingly operate and make key decisions driven by data (e.g. parcel tracking), and innovate in different application areas including agriculture, smart farms and manufacturing. All of these will pave the way for cost savings, better customer experience and long-term growth.**

**5G enabled mobile technology**  
IS SET TO DELIVER A  
**\$65 billion bigger Australian economy**  
BY 2023

# What is 5G?

## What will be the first applications for 5G?

5G-enabled products such as wireless broadband, mobile devices and IoT will be the first applications using 5G.



## What will 5G devices offer?

The prime benefits of 5G devices will be significantly faster speeds in data access, downloading and streaming content.

In addition, 5G devices will have increased computing power and make use of faster connectivity, meaning that the devices will enjoy virtually instantaneous connections to the network, as well as greater connectivity when on the move. 5G will enable applications such as remote monitoring, automation of production, medical monitoring and even remote surgery.



## How does 5G work?

5G will deliver faster speeds, better response times and greater capacity. 5G networks are designed to work in conjunction with 4G networks using a range of macro cells, small cells and dedicated in-building systems.

Small cells will be a feature of 5G networks and will evolve to include the use of millimetre wave (mmWave) frequencies.

Small cells are mini base stations designed for very localised coverage typically from 10 metres to a few hundred metres providing in-fill for the larger macro network. Small cells will be essential for the 5G networks.



**5G devices will have increased computing power and make use of faster connectivity, meaning that the devices will enjoy virtually instantaneous connections to the network, as well as greater connectivity when on the move.**



# 5G and EME Safety

## Are there safety limits for 5G?

**Yes. Comprehensive international guidelines exist governing exposure to radio waves including the frequencies proposed for 5G.** The limits have been established by independent scientific organisations, such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and include substantial margins of safety to protect all people including children and the elderly at all times.

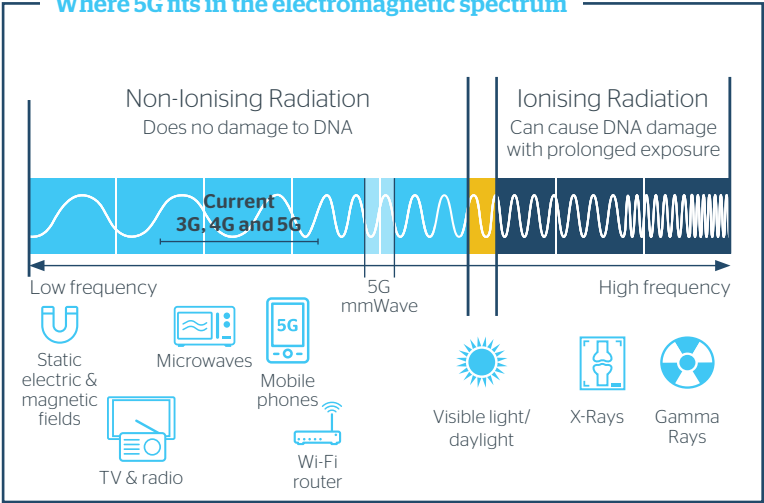
These guidelines have been widely adopted in standards around the world, including in Australia by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and are endorsed by the World Health Organization (WHO).

## What research into health effects has been done on 5G?



**The electromagnetic frequencies used for 5G are part of the radio frequency spectrum which has been extensively researched in terms of health impacts for decades.**

### Where 5G fits in the electromagnetic spectrum



## WHAT DO THE EXPERTS SAY ABOUT 5G AND HEALTH?

In relation to radio frequency exposures and wireless technology and health, including frequencies used for 5G, the World Health Organization (WHO) states:

**“Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health.”**

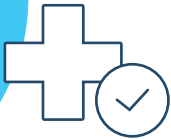
In relation to 5G frequencies, Dr Sarah Loughran, Director of the Australian Centre for Electromagnetic Bioeffects Research at the University of Wollongong states:

**“The higher frequencies [of 5G] actually means that the energy doesn’t penetrate as deeply into the body than previous fourth generation and other generation technologies have.”**

In relation to 5G and health, ARPANSA states:

**“There are no established health effects from the radio waves that the 5G network uses.”**

5G operates at a higher frequency than previous 4G networks so it can carry more data but can’t travel as far. This means it will have less impact on the human body than any previous network.



Over 50 years of scientific research has already been conducted into the possible health effects of the radio signals used for mobile phones, base stations and other wireless services including frequencies planned for 5G and mmWave exposures.

### ARPANSA states:

**“This network currently runs on radio waves similar to those used in the current 4G network, and in the future will use radio waves with higher frequencies. It is important to note that higher frequencies does not mean higher or more intense exposure. Higher frequency radio waves are already used in security screening units at airports, police radar guns to check speed, remote sensors and in medicine and these uses have been thoroughly tested and found to have no negative impacts on human health.”**



# 5G and EME Safety

**Testing on Australian 5G networks with commercial devices in real-world settings shows levels similar to 3G, 4G and Wi-Fi, and in many cases around 1,000 times below the safety limits.**



## Does 5G mean higher power and higher exposure levels?

**No - 5G networks are designed to be more efficient and will use less power than current networks for similar services.**

The Australian Centre for Electromagnetic Bioeffects Research (ACEBR) states:

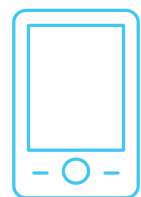
**“In addition, while more antennas may be required to service areas where demand for the new service is high, users are closer to the mobile phone base station and therefore their devices can operate at a reduced power, reducing their exposure from their personal device.”**

Dr Sarah Loughran, Director of the Australian Centre for Electromagnetic Bioeffects Research at the University of Wollongong, states:

**“Based on the improvements in technology, the level of exposure is expected to be lower [with 5G] than what it has been in previous technologies.”**

## How will 5G be regulated?

All base stations including 5G equipment and devices, must comply with standards set by ARPANSA.



## Where can I get more information on 5G?

### Australian Communications and Media Authority (ACMA)

1300 850 115

<https://www.acma.gov.au/theACMA/a-guide-to-small-cells>

### Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

(03) 9433 2211

[www.arpansa.gov.au](http://www.arpansa.gov.au)

### EMF Explained web site

[www.emfexplained.info](http://www.emfexplained.info)

### Mobile Nation 2019 - the 5G future report

<https://amta.org.au/new-mobile-nation-report-the-5g-future/>

### Mobile Carriers Forum

<http://amta.org.au/mcf>



Australian Mobile  
Telecommunications  
Association

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[www.amta.org.au](http://www.amta.org.au)

# EMF Explained Series

March 2018

## 5G and EMF Explained

A graphic featuring the text '5G' in large, white, semi-transparent letters. The background is a dark blue space with a network of glowing nodes and dashed lines, suggesting a 5G network. The bottom part of the image shows a view of Earth from space, with blue oceans and white clouds.

5G

[www.emfexplained.info](http://www.emfexplained.info)

# 5G and EMF Explained

The EMF Explained Series provides information on mobile technology and Electromagnetic Fields (EMF) referencing international health authorities, government, academia and the telecommunications industry.

The EMF Explained Series has been developed by the Australian Mobile Telecommunications Association (AMTA) in association with the GSMA and Mobile and Wireless Forum (MWF).

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# What is 5G?

**5G is the 5th generation of mobile networks, a significant evolution of today's 4G LTE networks.**

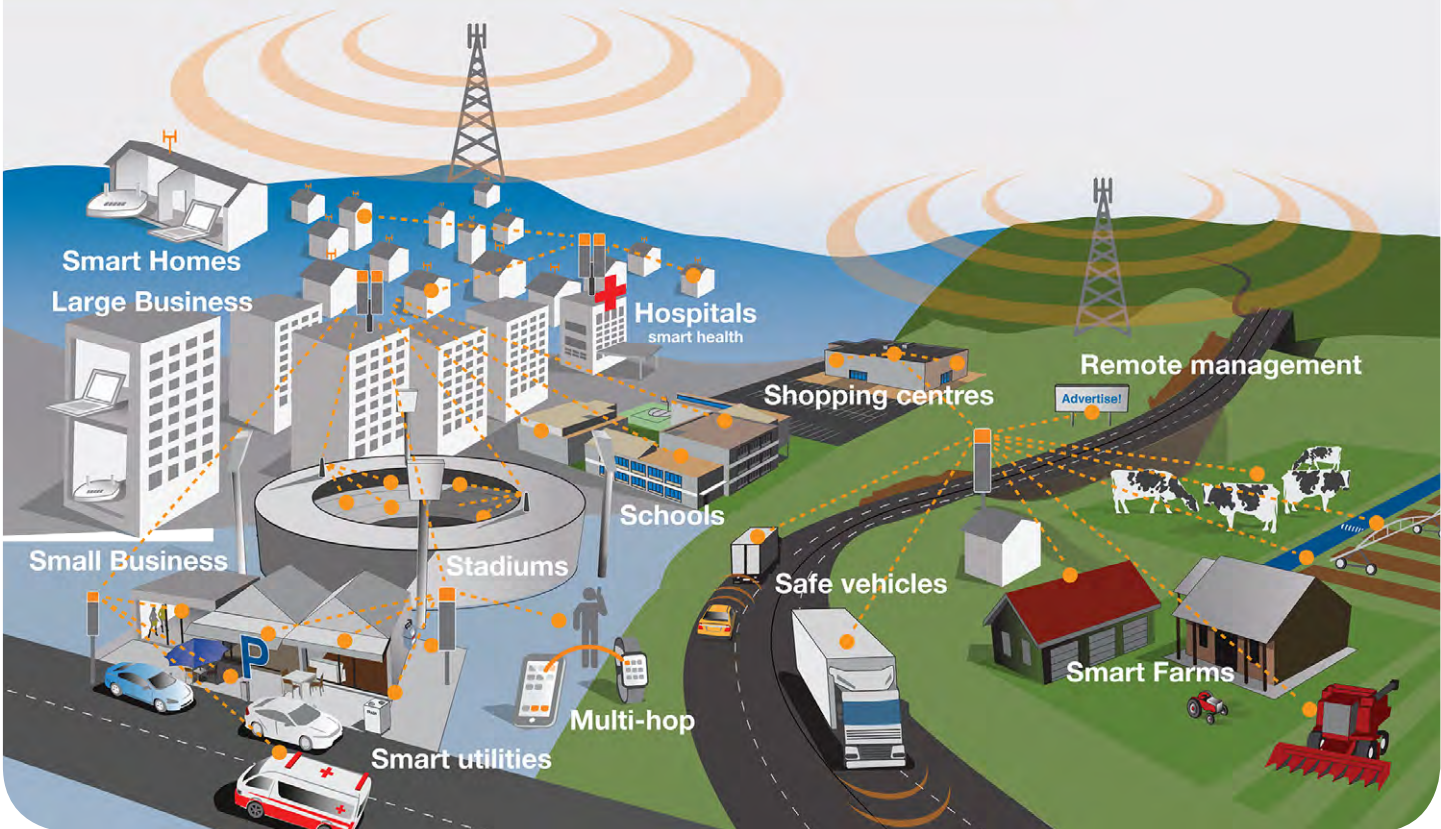
5G is being designed to meet the very large growth in data and connectivity of today's modern society, the internet of things with billions of connected devices, and tomorrow's innovations.

5G will initially operate in conjunction with existing 4G networks before evolving to fully standalone networks in subsequent releases and coverage expansions.

In addition to delivering faster connections and greater capacity, a very important advantage of 5G is the fast response time referred to as latency.

Latency is the time taken for devices to respond to each other over the wireless network. 3G networks had a typical response time of 100 milliseconds, 4G is around 30 milliseconds and 5G will be as low as 1 millisecond. This is virtually instantaneous opening up a new world of connected applications.

# THE CONNECTED COMMUNITY



5G uses radio waves or radio frequency (RF) energy to transmit and receive voice and data connecting our communities.

## What will 5G enable?

**5G will enable instantaneous connectivity to billions of devices, the Internet of Things (IoT) and a truly connected world.**

There are three major categories of use case for 5G:

- **Massive machine to machine communications** – also called the Internet of Things (IoT) that involves connecting billions of devices without human intervention at a scale not seen before. This has the potential to revolutionise modern industrial processes and applications including agriculture, manufacturing and business communications.
- **Ultra-reliable low latency communications** – mission critical including real-time control of devices, industrial robotics, vehicle to vehicle communications and safety systems, autonomous driving and safer transport networks. Low latency communications also opens up a new world where remote medical care, procedures, and treatment are all possible.
- **Enhanced mobile broadband** – providing significantly faster data speeds and greater capacity keeping the world connected. New applications will include fixed wireless internet access for homes, outdoor broadcast applications without the need for broadcast vans, and greater connectivity for people on the move.

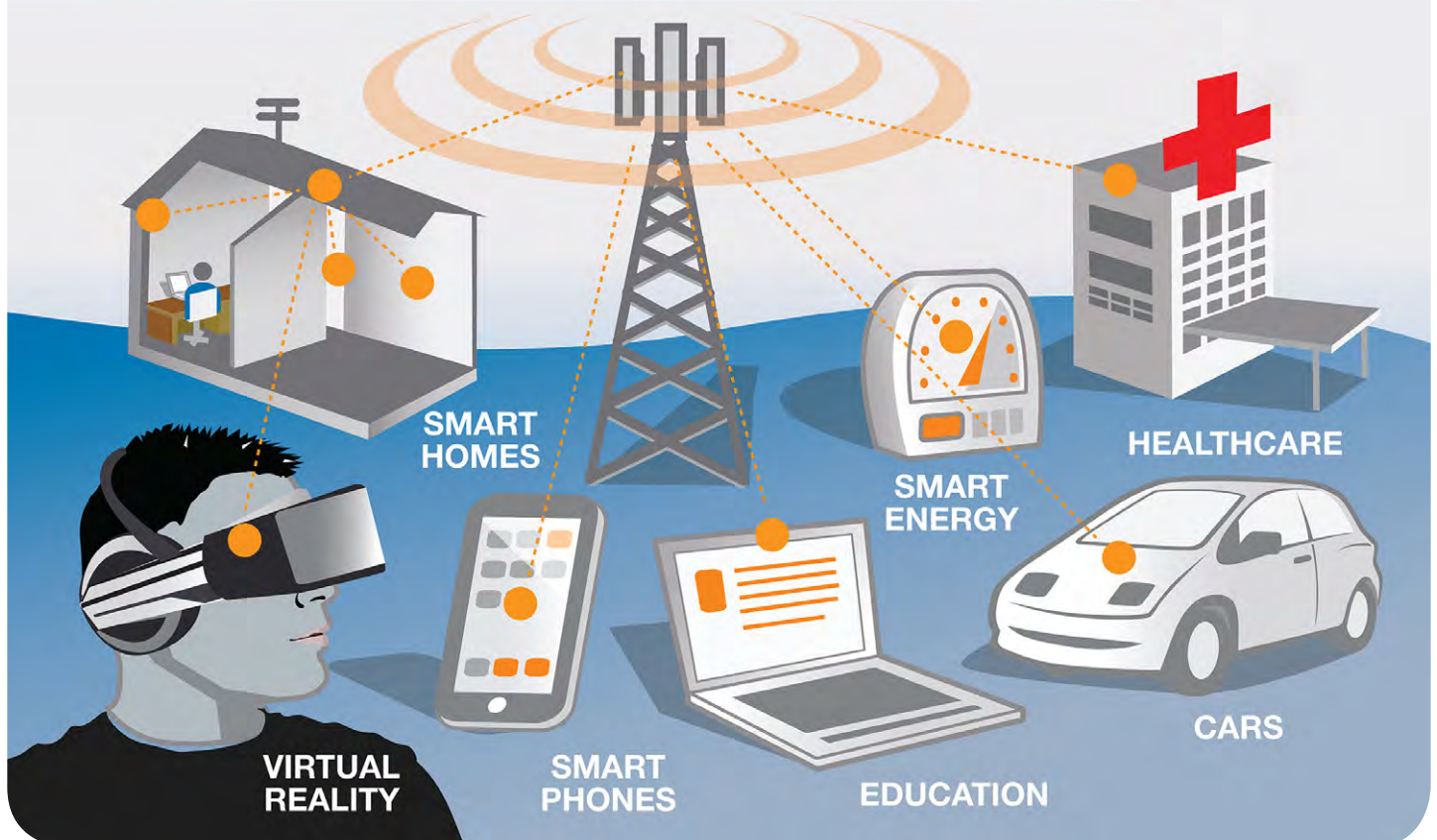
**For communities,** 5G will enable the connection of billions of devices for our smart cities, smart schools and smart homes, smart and safer vehicles, enhance health care and education, and provide a safer and more efficient place to live.

**For businesses and industry,** 5G and IoT will provide a wealth of data allowing them to gain insights into their operations like never before. Businesses will operate and make key decisions driven by data, innovate in agriculture, smart farms and manufacturing, paving the way for cost savings, better customer experience and long term growth.

**New and Emerging technologies** such as virtual and augmented reality will be accessible by everyone. Virtual reality provides connected experiences that were not possible before. With 5G and VR you will be able to travel to your favourite city, watch a live football match with the feeling of being at the ground, or even be able to inspect real estate and walk through a new home all from the comfort of your couch.

**5G will keep us connected in tomorrow's smart cities, smart homes and smart schools, and enable opportunities that we haven't even thought of yet.**

## 5G CONNECTING THE COMMUNITY



5G will provide the speed, low latency and connectivity to enable a new generation of applications, services and business opportunities that have not been seen before.

# When will 5G be ready?

## When will 5G be ready?

5G is currently being developed and trialed ready for commercial launch from 2020. Widespread availability of 5G services is expected by 2025.

## What will be the first applications for 5G?

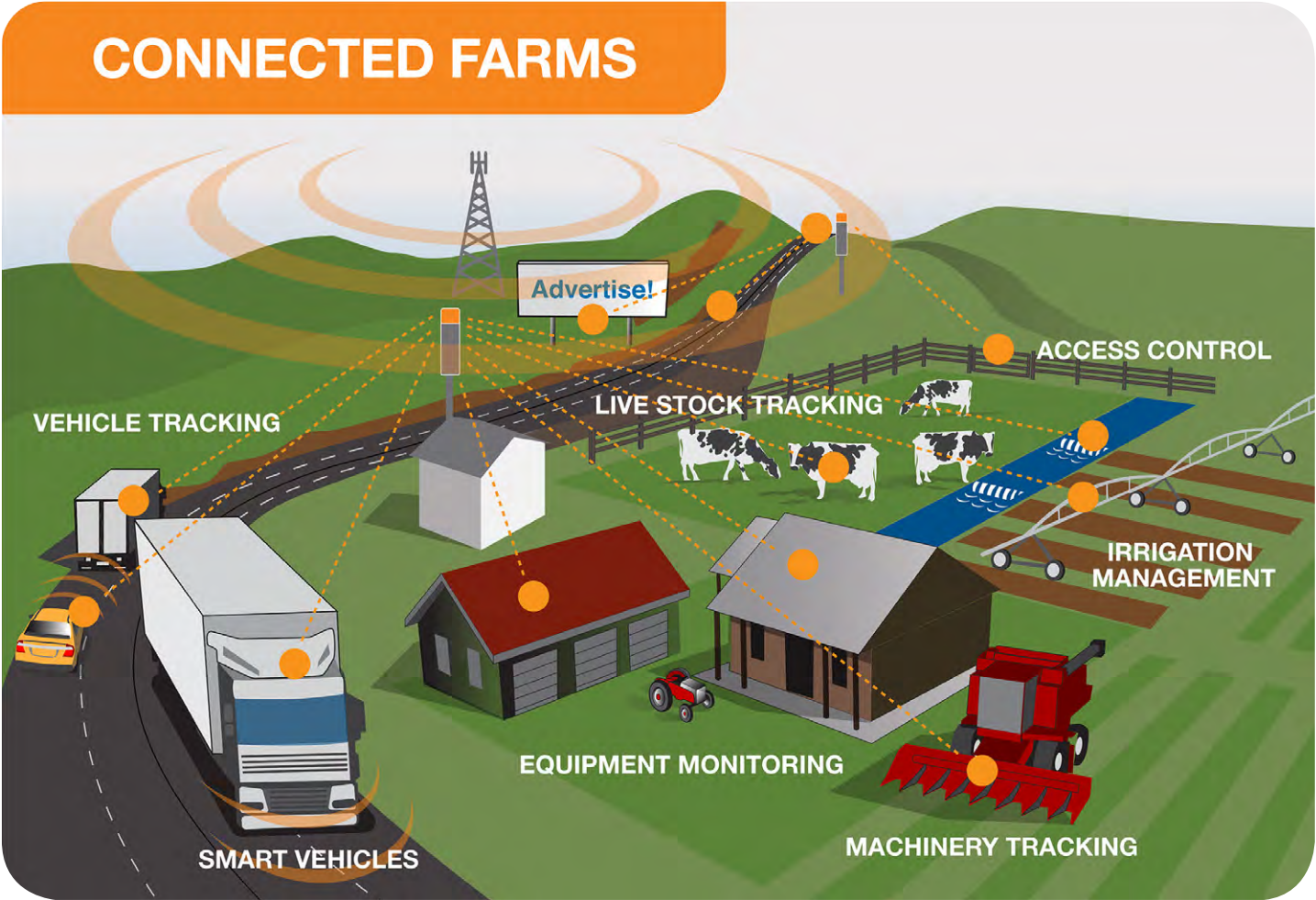
Fixed wireless access for homes and enhanced mobile broadband services are likely to be the first applications using new 5G wireless access modems and hot spots.

## What will 5G devices offer?

The prime benefits of 5G devices will be significantly faster speeds in data access, downloading and streaming content. In addition, 5G devices will have increased computing power and make use of the lower latency, meaning that the devices will enjoy virtually instantaneous connections to the network, as well as greater connectivity when on the move due to the use of advanced antenna beam steering.

## When will 5G devices be available?

Mobile handsets equipped with 3G, 4G and 5G connectivity are expected to become available in the 2020 – 2021 timeframe, and low latency and widespread machine to machine applications using 5G will be developed in the coming years.



5G Enhanced Mobile Broadband and IoT will revolutionise agriculture and farming.

# How does 5G work?

Most operators will initially integrate 5G networks with existing 4G networks to provide a continuous connection. A mobile network has two main components, the 'Radio Access Network' and the 'Core Network'.

**The Radio Access Network** – consists of various types of facilities including small cells, towers, masts and dedicated in-building and home systems that connect mobile users and wireless devices to the main core network.

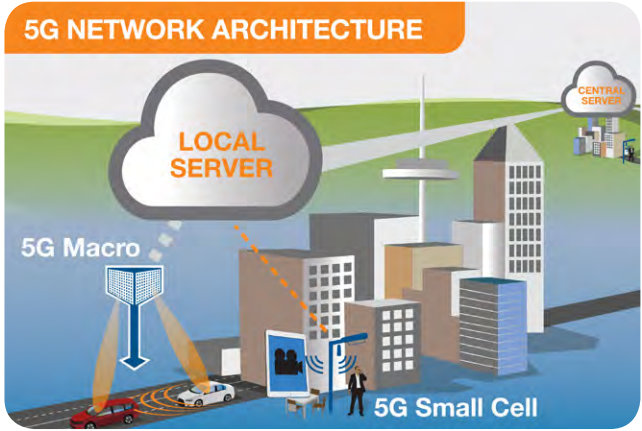
Small cells will be a major feature of 5G networks particularly at the new millimetre wave (mmWave) frequencies where the connection range is very short. To provide a continuous connection, small cells will be distributed in clusters depending on where users require connection which will complement the macro network that provides wide-area coverage.

5G Macro cells will use MIMO (multiple input, multiple output) antennas that have multiple elements or connections to send and receive more data simultaneously. The benefit to users is that more people can simultaneously connect to the network and maintain high throughput. MIMO antennas are often referred to as 'Massive MIMO' due to the large number of multiple antenna elements and connections however the physical size is similar to existing 3G and 4G base station antennas.

**The Core Network** – is the mobile exchange and data network that manages all of the mobile voice, data and internet connections. For 5G, the 'core network' is being redesigned to better integrate with the internet and cloud based services and also includes distributed servers across the network improving response times (reducing latency).

Many of the advanced features of 5G including network function virtualization and network slicing for different applications and services, will be managed in the core.

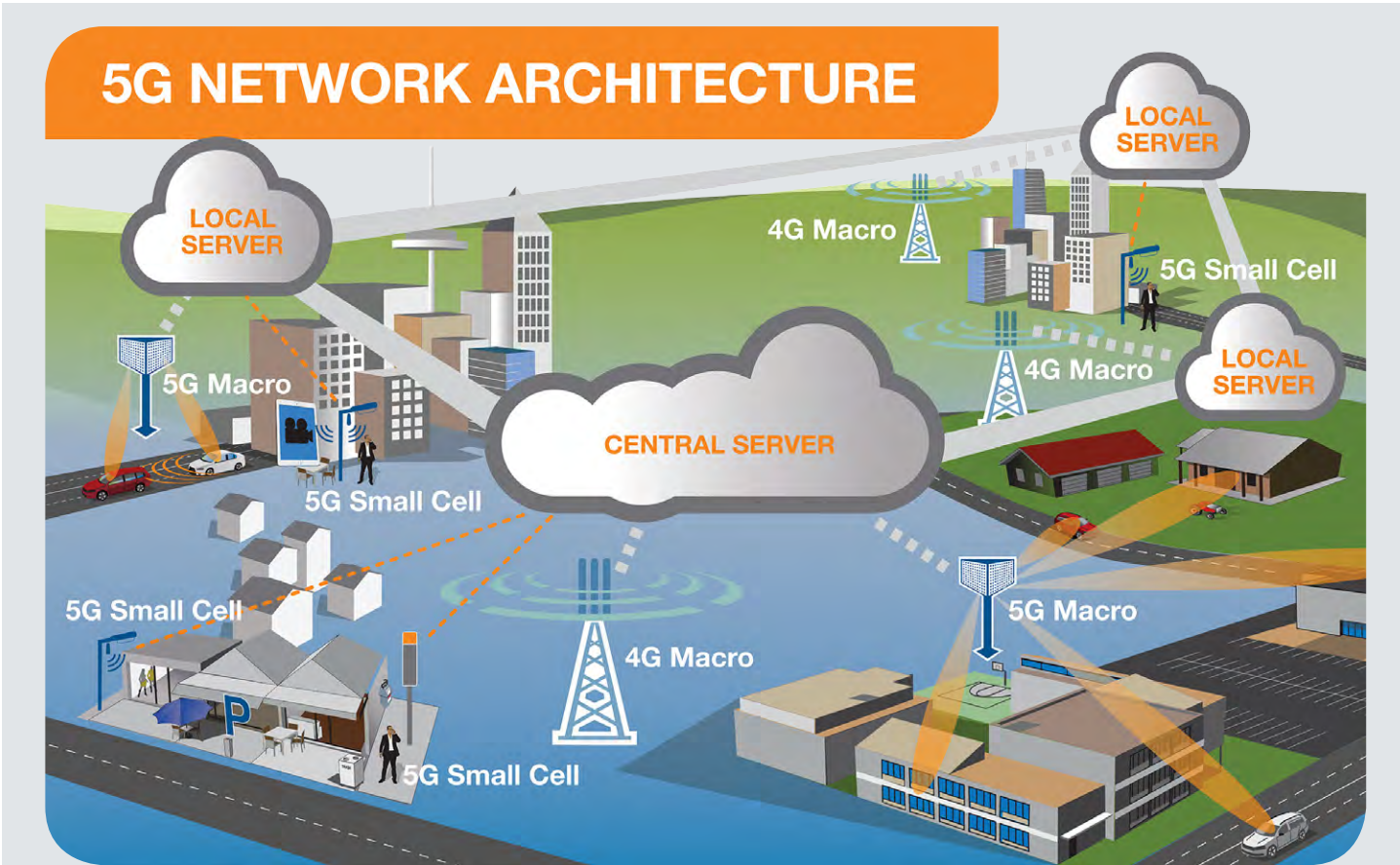
The following illustration shows examples of local cloud servers providing faster content to users (movie streaming) and low latency applications for vehicle collision avoidance systems.



Example of a local server in a 5G network providing faster connection and lower response times.

**Network Slicing** – enables a smart way to segment the network for a particular industry, business or application. For example emergency services could operate on a network slice independently from other users.

**Network Function Virtualization (NFV)** – is the ability to instantiate network functions in real time at any desired location within the operator's cloud platform. Network functions that used to run on dedicated hardware for example a firewall and encryption at business premises can now operate on software on a virtual machine. NFV is crucial to enable the speed efficiency and agility to support new business applications and is an important technology for a 5G ready core.



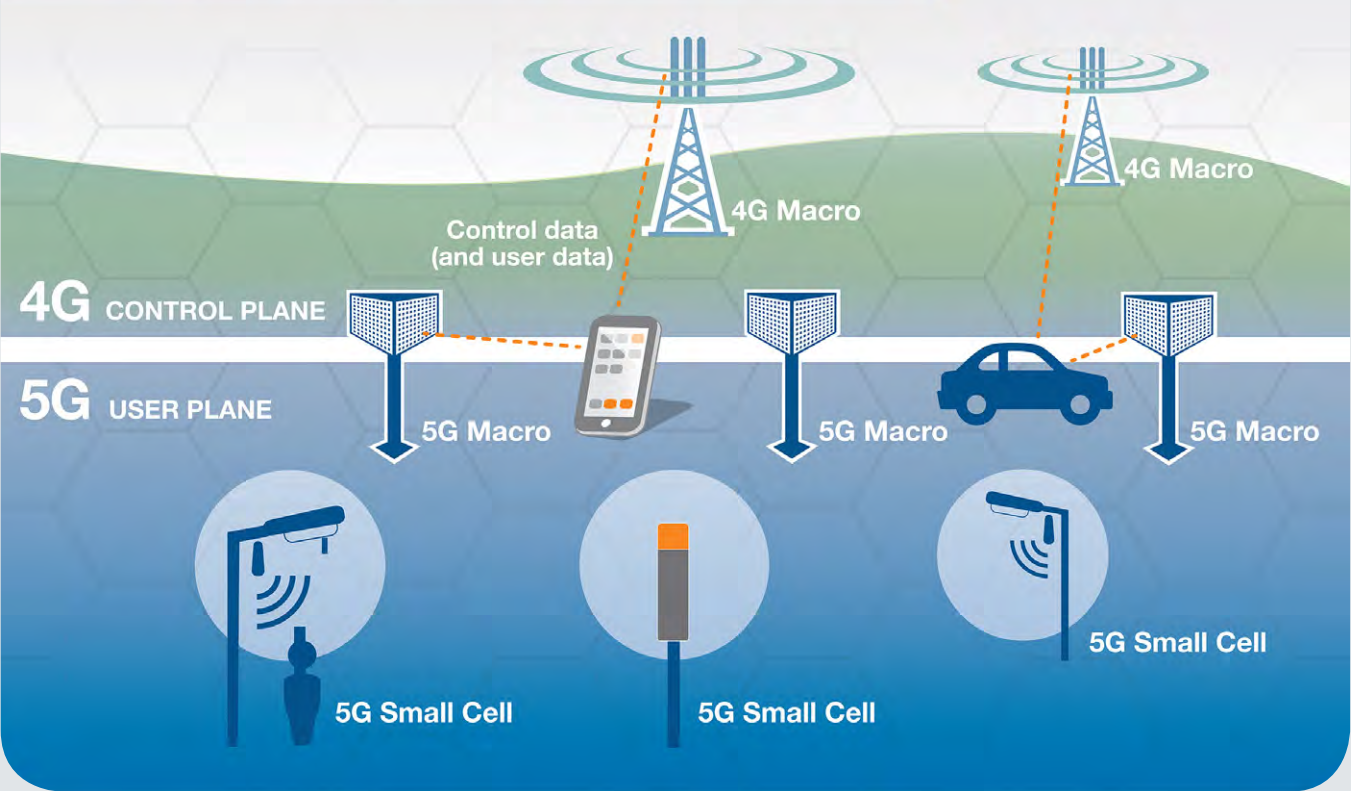
5G network architecture illustrating 5G and 4G working together, with central and local servers providing faster content to users and low latency applications.

# 5G working with 4G

When a 5G connection is established, the User Equipment (or device) will connect to both the 4G network to provide the control signalling and to the 5G network to help provide the fast data connection by adding to the existing 4G capacity.

Where there is limited 5G coverage, the data is carried as it is today on the 4G network providing the continuous connection. Essentially with this design, the 5G network is complementing the existing 4G network.

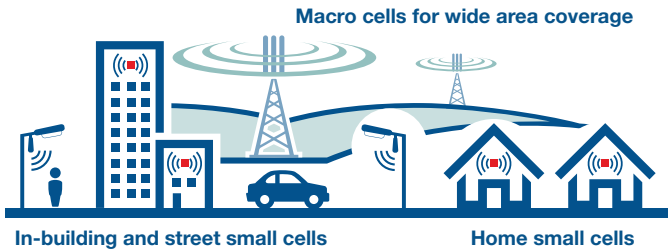
## 5G INTEGRATION WITH 4G



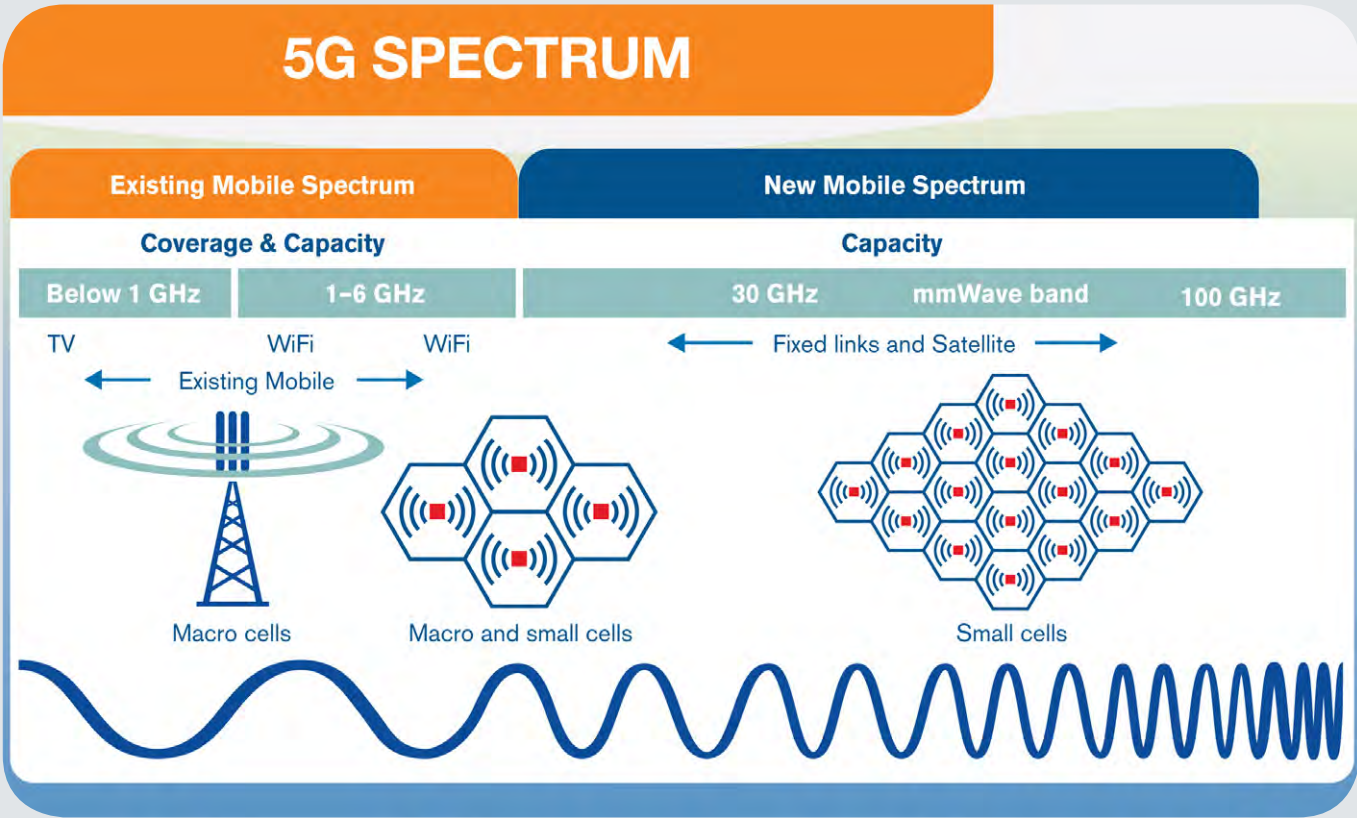
How does 5G deliver continuous connection, greater capacity, and faster speed and response times?

**Better Connection – always connected**

5G networks are designed to work in conjunction with 4G networks using a range of macro cells, small cells and dedicated in-building systems. Small cells are mini base stations designed for very localised coverage typically from 10 metres to a few hundred metres providing in-fill for a larger macro network. Small cells are essential for the 5G networks as the mmWave frequencies have a very short connection range.







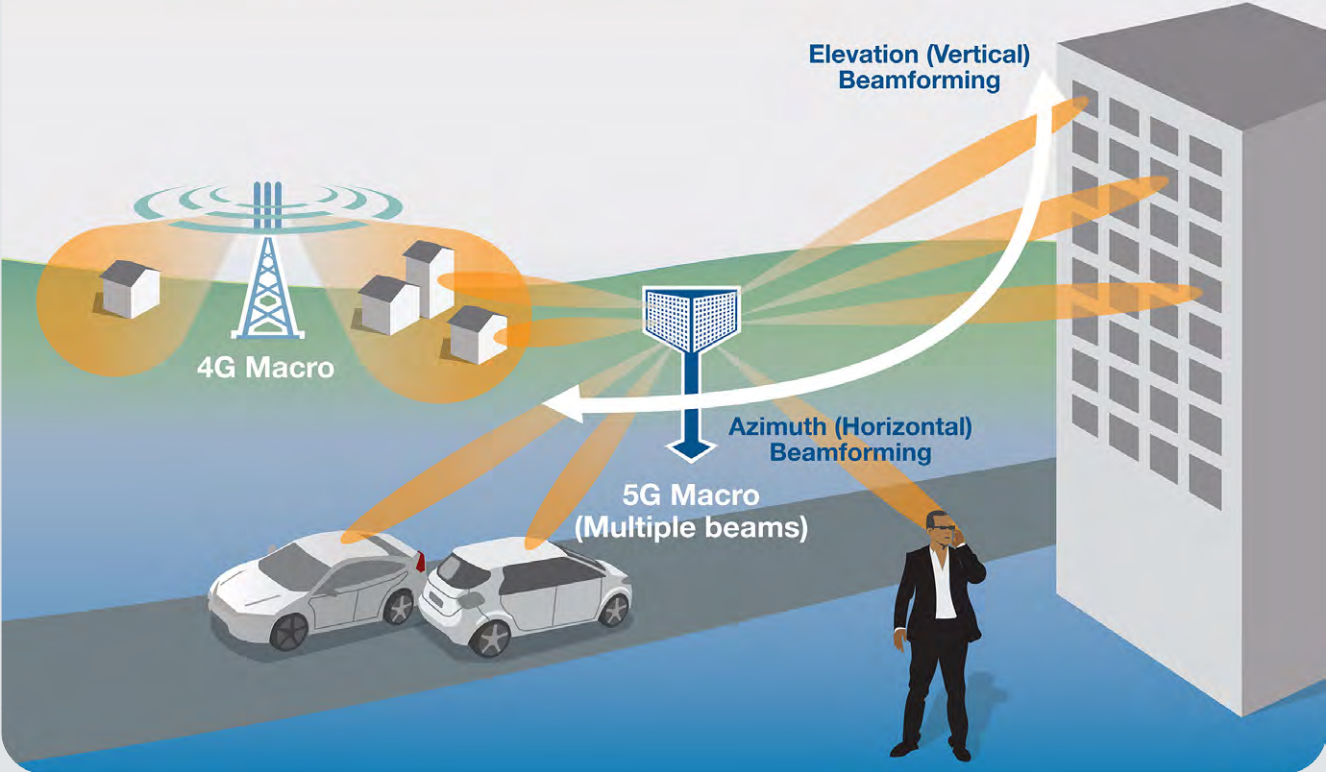
Mobile spectrum showing the radio frequency range from 3-100 GHz with new 5G spectrum above 6GHz. Other radio services (TV, Wi-Fi, Fixed links & Satellite) are shown for reference.

Increased Spectrum – greater capacity, more users and faster speed.

Initial frequency bands for 5G are proposed around 600-700 MHz, 3-4 GHz, 26-28 GHz and 38-42 GHz which will add significantly more capacity compared to the current mobile technologies. The additional spectrum and greater capacity will enable more users, more data and faster connections. It is also expected that there will be future reuse of existing low band spectrum for 5G as legacy networks decline in usage and to support future use cases.

The increased spectrum in the millimetre (mm) Wave band above 30 GHz will provide localised coverage as they only operate over short line of sight distances. Future 5G deployments may use mmWave frequencies in bands up to 86 GHz.

# MIMO BEAMFORMING



Massive MIMO antenna and advanced beam steering optimises EMF and increases efficiency.

### Massive MIMO - multiple element base station - greater capacity, multiple users, faster data

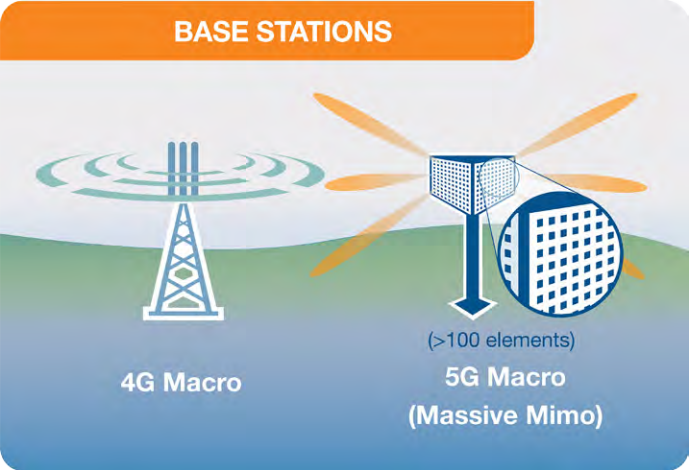
5G will use 'Massive' MIMO (multiple input, multiple output) antennas that have multiple elements or connections to send and receive more data simultaneously. The benefit to users is that more people can simultaneously connect to the network and maintain high throughput.

The overall physical size of the 5G Massive MIMO antennas will be similar to 4G, however with a higher frequency, the individual antenna element size is smaller allowing more elements (in excess of 100) in the same physical case.

5G User Equipment including mobile phones and devices will also have MIMO antenna technology built into the device for the mmWave frequencies.

### MIMO – Beam Steering

Beam steering is a technology that allows the Massive MIMO base station antennas to direct the radio signal to the users and devices rather than in all directions. The beam steering technology uses advanced signal processing algorithms to determine the best path for the radio signal to reach the user. This increases efficiency as it reduces interference (unwanted radio signals).



4G sector base station and 5G base station with a new multi element Massive MIMO antenna array. The overall physical size of the 5G base station antenna is expected to be similar to a 4G base station antenna.

## Lower latency - Faster response times

Lower latency with 5G is achieved through significant advances in mobile device technology and mobile network architecture.

Technology	Response time (milliseconds)
4G - LTE systems	20-30 ms
5G - enhanced mobile broadband	4-5 ms
5G - URLLC (Ultra Reliable Low Latency Communications) systems	1 ms

### 5G Devices (User Equipment)

Improved technology and computing power in the User Equipment and devices is a major contributor to faster response times. As the device chip sets become more advanced, they can process data faster and reduce the response time called latency.

### 5G Network - Mobile Network Architecture

Significant changes in both the Core Network (Core) and Radio Access Network (RAN) are required to deliver low latency.

#### Core Network Changes

With the redesigned core network, signalling and distributed servers, a key feature is to move the content closer to the end user and to shorten the path between devices for critical applications.

Good examples are video on demand streaming services where it is possible to store a copy or 'cache' of popular content in local servers, so the time to access is quicker.

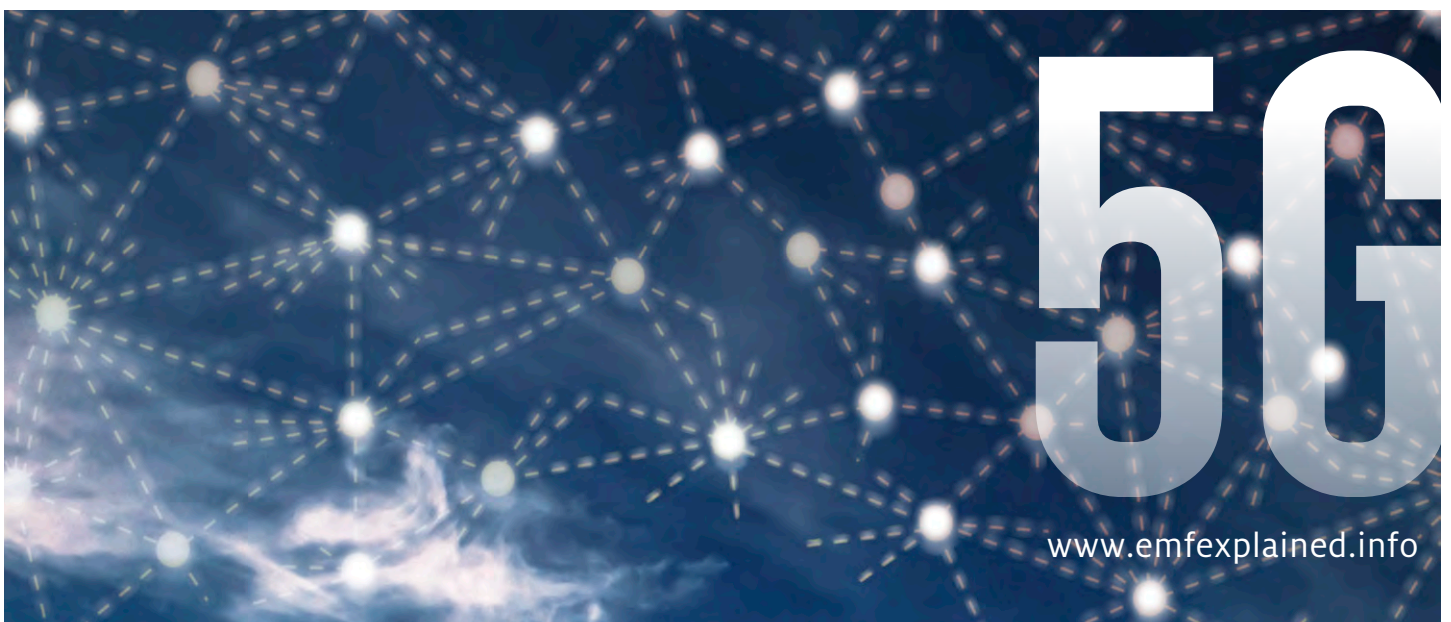
### Radio Access Network Changes

To achieve the low latency, the Radio Access Network (RAN) will need to be re-configured in a manner that is highly flexible and software configurable to support the very different characteristics of the types of services that the 5G system envisages.

Low latency and high reliability over the air interface requires new radio techniques to minimise the time delays through the radio within a few TTIs (time transmit intervals) along with robustness and coding improvements to achieve high degrees of reliability (e.g. one message is delayed or lost in every billion).

Implementing a virtual, dynamic and configurable RAN allows the network to perform at very low latency and high throughput, but it also allows the mobile network to adjust to changes in network traffic, network faults and new topology requirements.

What will be re-configured? The new architecture will exist as a 4G/5G split RAN where the user plane (5G) and the control plane (4G) are separate. This requires the separation of general purpose hardware and specialised network hardware. The functionality of general purpose hardware (nodes) are suitable for network functions virtualisation (NFV), where the specialised hardware in the RAN will become dynamically configurable.



# 5G and EMF Safety

## Are there safety limits for 5G and radio waves?

Yes. Comprehensive international guidelines exist governing exposure to radio waves including the frequencies proposed for 5G. The limits have been established by independent scientific organizations, such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and include substantial margins of safety to protect all people against all established hazards.

These guidelines have been widely adopted in standards around the world, and are endorsed by the World Health Organization (WHO).

## What do the experts say about 5G and health?

**In relation to radio frequency exposures and wireless technology and health, the general conclusion from the World Health Organization (WHO) is:**

*“Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health”*

WHO - About Electromagnetic Fields – Summary of Health Effects  
Key Point 6

**In relation to wireless networks and health, the conclusion from the WHO is:**

*“Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects”*

Source WHO Backgrounder on base stations and wireless technologies

**On mobile phone safety the World Health Organization advises:**

*“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.”*

*“While an increased risk of brain tumors is not established, the increasing use of mobile phones and the lack of data for mobile phone use over time periods longer than 15 years warrant further research of mobile phone use and brain cancer risk. In particular, with the recent popularity of mobile phone use among younger people, and therefore a potentially longer lifetime of exposure, WHO has promoted further research on this group. Several studies investigating potential health effects in children and adolescents are underway.”*

WHO Fact Sheet 193 June 2014 - Electromagnetic fields and public health: mobile phones

## What research into health effects has been done on 5G?

The electromagnetic frequencies used for 5G are part of the radio frequency spectrum which has been extensively researched in terms of health impacts for decades. Over 50 years of scientific research has already been conducted into the possible health effects of the radio signals used for mobile phones, base stations and other wireless services including frequencies planned for 5G and mmWave exposures.

The data from this research has been analysed by many expert review groups. Weighing the whole body of science, there is no evidence to convince experts that exposure below the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) carries any known health risks, for adults or children.

The EMF-Portal ([www.emf-portal.org](http://www.emf-portal.org)) is an open-access extensive database of scientific research into the effects of EMF, including studies on the effects of RF on health. It is managed by the RWTH Aachen University, Germany and linked from the WHO website. EMF-Portal contains more than 25,000 published scientific articles on the biological and health effects of EMF and 2,500 studies on mobile communications.

In terms of research specifically on 5G frequencies, the database lists approximately 350 studies on mmWave EMF health related research. Extensive research on mmWave and health has been conducted on radar, microwave and military applications.

#### ■ Is the research on 5G, mmWave and health continuing?

**Yes** – the current research on mmWave frequencies is focused on the alignment of the human exposure guidelines at frequencies below and above 6 GHz where the measurement parameter changes from Specific Absorption Rate (SAR) below 6 GHz to Power Density above 6 GHz. For more on SAR see <http://www.sartick.com/>.

The research is also focused on the dielectric properties of human skin to ensure that the power density levels and averaging area across the skin align with the temperature values that are the basis of the human exposure guidelines.

For example, a mobile device operating at 5 GHz will be assessed for compliance by measuring the SAR. The SAR levels are set to limit the absorbed power so that the temperature rise in the head or body from the device operating at maximum power is below the equivalent relevant limit. If the same device was operating at 6.5 GHz, a power density measurement would be required, so the measurement parameters would need to ensure the same limit in temperature rise is maintained.

#### ■ Will 5G devices comply with the safety guidelines?

5G technology will be used in a wide range of devices and will be the backbone for the Internet of Things (IoT). All these devices will be evaluated to ensure that they conform to the RF safety limits adopted by agencies around the world.

#### ■ Is 5G safe for children?

**Yes** – The EMF safety limits cover the 5G frequency range and include substantial margins of safety to protect all people including children from all established hazards.

#### ■ What about children wearing RF transmitting devices or wearables for security or entertainment?

The radio transmitters in such devices are generally transmitting with very low power. When tested they are required to comply with national or international exposure limits. When watching a video the device is mostly receiving information and only transmits information for brief periods. Other types of devices such as personal trackers also transmit for short periods of time.

#### ■ Will 5G devices automatically minimise transmitter power?

**Yes** – 5G devices will automatically minimise the transmit power to the lowest level in order to complete a satisfactory communication with the network. Such automatic power control has existed in previous generations of mobile technologies (2G, 3G and 4G) and helps to minimize interference, prolong battery life and also has the effect of limiting the EMF exposure of the user. The transmit power of the device is controlled by the network.

#### ■ Does 5G mean higher power and higher exposure levels?

**No** – 5G networks are designed to be more efficient and will use less power than current networks for similar services.

With the introduction of new technologies, there may be a small increase in the overall level of radio signals due to the fact that new transmitters are active. In some countries deployment of 5G may occur as part of closure of earlier wireless networks. Based on the transition from previous wireless technologies we can expect that the overall exposure levels will remain relatively constant and a small fraction of the international exposure guidelines.

#### ■ What types of base stations are used for 5G?

Base stations used for 5G will consist of various types of facilities including small cells, towers, masts and dedicated in-building and home systems.

Small cells will be a major feature of 5G networks particularly at the new mmWave frequencies where the connection range is very short.

To provide a continuous connection, small cells will be distributed in clusters depending on where users require connection and this will complement the macro network 5G base stations.

5G networks will work in conjunction with 4G networks. In many cases, existing 4G base stations will be used for additional 5G equipment.

#### ■ Do 5G base stations automatically minimise transmitter power?

**Yes** – 5G networks are specifically designed to minimise transmitter power, even more than existing 4G networks. 5G networks use a new advanced radio and core architecture which is very efficient and minimises transmissions consistent with service requirements which results in optimised EMF levels. The network also controls the power level of the device to the lowest level in order to complete a satisfactory communication with the network.

#### ■ What will be the size of compliance zones around 5G network antenna sites?

The technical standards for the 5G networks and devices are still under development however it is expected that the size of the compliance zone for 5G antennas will be similar to that of other mobile technologies using similar transmitter powers.

Mobile network antennas are typically directional. Compliance zones extend in front of the antenna and a small distance above and below.

Mobile networks are designed to use only the power needed to provide quality services. Too much power would cause interference and affect all users. One of the goals of 5G is a substantial increase in network energy efficiency.

Where 5G is added to an existing site with other mobile technologies, the existing compliance zone may increase due to the addition of the 5G technology however this will depend on the site design and network configuration.

#### ■ Is 5G similar to the Active Denial System used by the military?

**No** – Active Denial Systems developed by the military use very high powered mmWave directional signal, sometimes called a 'heat ray' in the 90 GHz band designed to heat the surface of targets such as the skin of a human, and through the heat, control or restrict access.

5G and other mmWave radio communications use different frequencies and a fraction of the power. The human exposure limits for mobile communications technology prevent heating occurring.

Additional information on ADS systems is available here.

<http://jnlp.defense.gov/About/Frequently-Asked-Questions/Active-Denial-System-FAQs/>

[www.emfexplained.info](http://www.emfexplained.info)



# Safety of 5G Mobile Networks

5G is the next generation of mobile technology that will transform the role of mobile connectivity in society, enabling changes in the way we live and do business. The radio signals used for 5G are similar to those used by current technologies and are covered by the same international safety guidelines that protect all members of the public and the environment.

**5G is an evolutionary mobile technology that supports many new capabilities**

5G is the next generation of mobile technology. It is designed to support new applications through Gigabit data rates, low latency and high reliability. It will also provide efficient support for large numbers of connections, enabling the Internet of Things (IoT). 5G will deliver smarter and more convenient living and working. Initial 5G networks launched in 2018 and 5G connections will grow to around 15% of global connections by 2025.

**5G is covered by existing international safety guidelines**

The radio signals used by mobile technologies have been extensively studied for decades. This scientific evidence is the basis for the international safety guidelines for radio signals.<sup>1</sup> These guidelines include all the frequencies under consideration for 5G.

The consistent conclusion of public health agencies and expert groups is that compliance with the international guidelines is protective for all persons (including children) against all established health risks.

**Public health agencies confirm no health risks expected from 5G**



**Australia:**  
*'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.'* (ARPANSA, 2019)



**Europe Union:**  
*'The strict and safe exposure limits for electromagnetic fields recommended at EU level apply for all frequency bands currently envisaged for 5G.'* (European Commission, 2017).



**Norway:**  
*'Measurements show that the total exposure from mobile and radio transmitters that we are exposed to today is weak and is far below the limits for what is harmful to health. We have no reason to believe that the introduction of 5G will change this.'* (DSA, 2019)

Many initial 5G deployments will be at frequencies similar to 3G/4G mobile networks and Wi-Fi. This also means that many existing antennas sites can be reused for 5G.

To achieve higher capacity 5G can also use higher frequencies that are used today by the mobile and satellite industries for other purposes. These frequencies are known as millimetre-waves (mmW or mmWaves) and they are covered by the safety guidelines.

The same limit values that protect people also protect the environment. The responsible German government agency<sup>2</sup> says that there is no scientifically reliable evidence of a risk to animals and plants exposed to radio signals at levels below limits in the international guidelines.

1. World Health Organization: <https://www.who.int/peh-emf/standards/en/>  
2. Bundesamt für Strahlenschutz



**Radio signals will remain well below the safety guidelines**

Based on experience with 3G and 4G networks and the results from 5G trials the overall levels in the community will remain well below the international safety guidelines. International

standards exist for the compliance assessment of 5G network antennas and devices. These standards include new approaches for smart antennas and the use of new frequency ranges.

**SMART ANTENNA TECHNOLOGIES PROVIDE COVERAGE WHERE IT IS NEEDED**



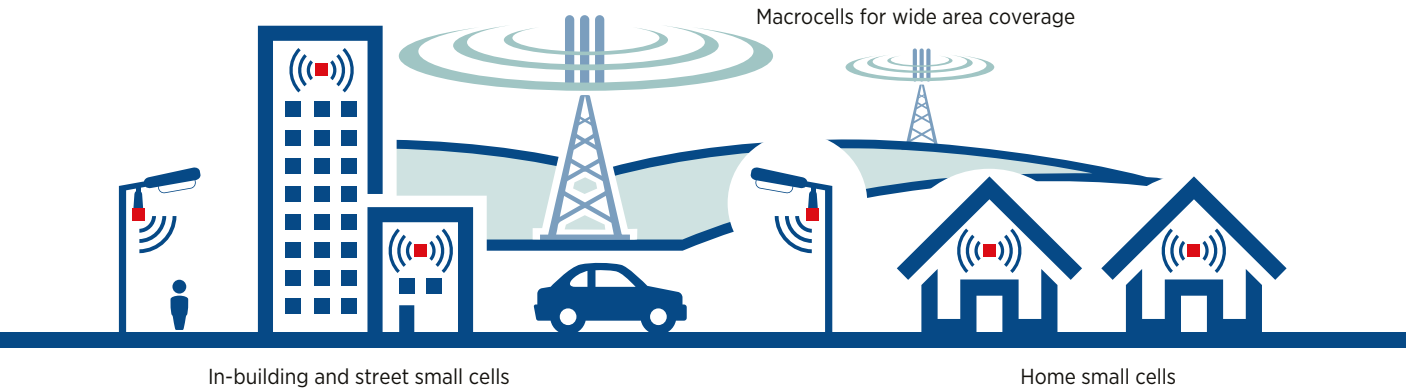
Conventional antenna

Smart antenna

5G networks can use smart antenna technologies (such as multiple input multiple output – MIMO) that deliver radio signals where they are needed. Conventional antennas provide coverage similar to how a floodlight illuminates a wide area. The new antennas are like a flashlight providing coverage where it is needed and reducing unwanted signals. Smart antennas increase capacity and improve efficiency.

Small cells are used by current mobile networks to provide localised coverage or capacity and their use will expand with 5G. They may be mounted on street lights or inside buildings, where over 80% of mobile usage occurs in developed markets. Measurements on 4G small cells by the French spectrum agency found that levels in nearby areas remained well below the international safety guidelines.<sup>3</sup>

**REPRESENTATION OF A 4G/5G MOBILE NETWORK**



**Find Out More**

Learn more by visiting [www.gsma.com/emf](http://www.gsma.com/emf)

<sup>3</sup> Rapport technique sur les déploiements pilotes de petites antennes en France pour favoriser l'accès au très haut débit mobile. L'Agence nationale des fréquences (ANFR). December 2018.

Consumer Advice
Acoustic shrieks and thunderstorms
Customer service
Faulty products
Integrated Public Number Database
Payphone services
Unwelcome calls
Digging and construction
<b>Electromagnetic energy</b>
Understanding EME
Mobile phones and health
Wi-Fi
EME research and science monitoring
Mobile base stations and health
Wireless products - EME fact sheets
Information sources and links
Software and tools
EME and Children
<b>5G and EME</b>
How to access your data

5G and EME

What is 5G?

5G is the 5th generation of mobile technology, a significant evolution of today's 4G LTE technology. 5G has the potential to transform the way we all live and work. It will deliver more capacity and faster speeds but on top of that it will support vastly more connected devices at low latency.

5G will take us from a world of connecting people to each other and the internet to a world of ultra-fast mobile speeds and the Internet of Things on a mass scale. These enhancements will unleash a host of new opportunities – everything from smart cities and smart homes, to drones and driverless cars, to augmented reality in both entertainment and at work.



The 'Connected Community' illustrates how 5G and wireless communications provide essential communications for Australian communities – image courtesy Australian Mobile Telecommunications Association.

**How 5G works** – For more detailed information on how 5G works, visit the [EMF Explained Series](#).

Telstra and 5G

In 2018 Telstra opened our new 5G Innovation Centre at our Southport Exchange on the Gold Coast. The centre is the home for testing the next generation of mobile technology in local conditions to support the early commercial deployment of 5G in Australia.

In 2016, we conducted [Australia's first 5G live field trial](#) and in 2017 the [world-first 5G trial data call](#) over 26GHz 'mmWave' radio frequency spectrum.

From our new 5G Innovation Centre, we completed a number of other 5G firsts and trials in 2018 to ensure Australia remains at the forefront of mobile technology. In August, Telstra announced it had started switching on 5G technology, making Australia's largest and fastest\* mobile network the first in the country to be 5G ready. Since then Telstra has enabled more than 200 5G sites in Melbourne, Sydney, Canberra, Brisbane, Adelaide, Perth, Hobart, Launceston, Toowoomba and the Gold Coast.

*\*based on national average mobile speeds*

In 2019, Telstra will continue to roll out 5G technology including our 5G commercial network at 3.5GHz which is in the same radio frequency band as our existing mobile services.

Telstra has conducted extensive electromagnetic emissions (EME) testing and analysis on the 5G trial network at Southport and commenced EME testing on the new 3.5GHz commercial network base stations. The test results show EME levels are similar to the existing mobile technologies and well below the EME safety limits.

Telstra presented a summary of the results to the Science and Wireless Conference in November 2018 held by the Australian Centre for Electromagnetic Bioeffects Research (ACEBR). The presentation is available online at <https://acebr.uow.edu.au/events/UOW254614>

As Telstra has done with previous generations of mobile technology, Telstra's new 5G service will be designed to comply with all mandatory EME safety requirements. Further information on the EME standards is available at the [ACMA](#) web site.



## 5G and EME Research

5G uses radio waves or radio frequency EME to transmit and receive voice and data – connecting our community.

The frequencies used for 5G are part of the radio frequency spectrum which, for decades, has been extensively researched in terms of health impacts. Over 50 years of scientific research has already been conducted into the possible health effects of the radio signals used for mobile phones, base stations and other wireless services. This research includes the frequencies planned for 5G and mmWave exposures.

The data from this research has been analysed by many expert review groups. Weighing the whole body of science, there is no evidence to convince experts that exposure below the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) carries any known health risks, for adults or children. The safety standard in Australia is based on these guidelines.

There is also an extensive, readily accessible database, EMF-Portal (<https://www.emf-portal.org/en>) of scientific research into the effects of EME, including studies on the effects of radio frequency (RF) on health. It is managed by the RWTH Aachen University, Germany and linked from the World Health Organization (WHO) website.

In terms of research specifically into 5G frequencies, the database lists approximately 350 studies on mmWave EME health related research. Extensive research on mmWave and health has been conducted on radar, microwave and military applications.

## 5G, EME and Health

Telstra relies on the expert advice of a number of national and international health authorities, including the World Health Organisation (WHO), International Commission for Non Ionizing Radiation Protection (ICNIRP) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) for overall assessments relating to health and safety.

### WHO Information on EME and Health

In relation to radio frequency exposures and wireless technology and health, the general conclusion from the World Health Organization (WHO) is:

*“Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health”.*

Source: [WHO About Electromagnetic Fields](#) – Summary of Health Effects Key Point 6

In relation to wireless networks and health, the conclusion from the WHO is:

*“Studies to date provide no indication that environmental exposure to RF fields, such as from base stations, increases the risk of cancer or any other disease.”*

Source: [WHO online Q&A What are the health risks associated with mobile phones and their base stations?](#)

### ARPANSA Information on EME and Health

In relation to radio frequency exposures and wireless technology and health ARPANSA's position is:

*“Based on current research there are no established health effects that can be attributed to the low RF EME exposure from mobile phone base station antennas” Mobile Phone Base Stations and Health”* Fact Sheet August 2016.

### ICNIRP Information on EME and Health

In relation to radio frequency exposures and wireless technology and health, ICNIRP provides scientific advice and guidance on the health and environmental effects of non-ionizing radiation (NIR) to protect people and the environment from detrimental NIR exposure.

ICNIRP publishes [guidelines](#) to provide protection of humans exposed to radiofrequency electromagnetic fields (EMFs) in the range 100 kHz to 300 GHz: The guidelines state:

*The main objective is to establish guidelines for limiting exposure to EMFs that will provide a high level of protection for all people against known adverse health effects from direct, non-medical exposures to both short- and long-term, continuous and discontinuous radiofrequency EMFs.*

The safety standard in Australia is based on these guidelines.

**More information** - Visit [this page](#) for more about 5G and Health. There you'll find three levels of information – L1 Summary, L2 Detailed and L3 Links.

## 5G and EME Safety Standards

In terms of EME safety standards, the current Australian and international EME human exposure guidelines also apply to 5G.

The human exposure guidelines have been established by independent scientific organizations, such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), and include substantial margins of safety to protect all people including children.

The Australian EME safety standard from ARPANSA is called Radiation Protection Series No. 3 and is available [here](#).

The ICNIRP guidelines are available [here](#) and are currently under review.

As part of the [review of the current ICNIRP Guidelines](#), ICNIRP has undertaken an extensive review of the available scientific evidence and research on EME and health. ICNIRP presented the results of their extensive review at a United Nations Workshop in Geneva in October 2018 and concluded:

- The ICNIRP Guidelines are very conservative and include large reduction factors.
- The ICNIRP Guidelines protect all people including children exposed to radiofrequency EME in the frequency range 100 kHz to 300 GHz.
- The ICNIRP Guidelines cover the frequencies used for 5G, including mmWave bands.

A summary from the workshop is available on the UN agency website <https://news.itu.int/5g-electromagnetic-field/>

In Australia, ARPANSA is also reviewing the Australian EME human exposure guidelines and will be using the results of the ICNIRP review to update the Australian standards.

## 5G and EME Q&A

### 1. What EME safety standards apply to 5G?

The current Australian and international EME human exposure guidelines apply to 5G.

The human exposure guidelines have been established by independent scientific organizations, such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), and include substantial margins of safety to protect all people including children.

The Australian EME safety standard from ARPANSA is called Radiation Protection Series No. 3 and is available [here](#).

### 2. Are the EME safety standards current?

Yes. The EME exposure guidelines from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the International Commission for Non Ionizing Radiation Protection (ICNIRP) are still current.

### 3. When do the EME safety standards get reviewed?

Both ARPANSA and ICNIRP continually monitor the scientific literature and update the EME exposure guidelines as required. ARPANSA maintains a [radiation literature survey](#) on their web site that provides updates on published literature including articles in peer-reviewed scientific journals, scientific-body reports, and conference proceedings.

In 2014 ARPANSA published a review of scientific literature and concluded that the exposure limits in the ARPANSA Standard continue to provide a high degree of protection against the known health effects of EME exposure. ARPANSA will update the exposure limits following the ICNIRP review.

Since 2014, the Australian and International EME exposure guidelines have been undergoing an extensive review. As part of the review the International Commission for Non Ionizing Radiation Protection (ICNIRP) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has undertaken an extensive review of the available scientific evidence and research on EME and health.

ICNIRP presented the results of their extensive review at a United Nations Workshop in Geneva in October 2018 and concluded:

- The ICNIRP Guidelines are very conservative and include large reduction factors.
- The ICNIRP Guidelines protect all people including children exposed to radiofrequency EME in the frequency range 100 kHz to 300 GHz.
- The ICNIRP Guidelines cover the frequencies used for 5G, including mmWave bands.

### 4. What frequencies is Telstra using for 5G?

The initial radio frequencies that will be used for 5G in Australia are 3.5GHz and 3.6GHz which are in the existing mobile band. In future years radio frequencies in the mmWave band at 26-28GHz are expected to be used for 5G in Australia.

### 5. What assurance can Telstra provide that 5G is safe for people?

At Telstra we take our responsibilities regarding the health and safety of our customers and the community very seriously. We have a dedicated team with responsibility for managing EME compliance and we ensure that all Telstra base stations and devices are designed to meet Australian EME safety standards.

## 6. What research has been done on 5G and EME?

Research on the possible human health effects of exposure to radio frequencies that will be used for 5G including the millimetre wave frequencies goes back many decades and is continuing.

In terms of research specifically on millimetre wave frequencies, the WHO and EMF Portal database lists approximately 350 studies on mm-wave EMF health related research.

Research on mm-wave and health has been conducted on radar, microwave and military applications.

## 7. What are millimetre waves?

Millimetre waves refer to radio frequencies in the Extremely High Frequency band from 30GHz to 300GHz. The wave length at 30GHz is 10mm and at 300GHz is 1mm. This is the official definition from the International Telecommunications Union.

Frequencies in the 26-28GHz band that will be used for 5G are also referred to as millimetre wave as the wave length is approximately 11mm.

## 8. Are millimetre waves safe?

Safety standards for exposure to radio frequencies including millimetre waves have been established by independent scientific organizations, such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

The EME exposure guidelines include substantial margins of safety to protect all people including children.

## 9. Are millimetre waves absorbed by humans?

Yes. When people are exposed to radio frequencies including millimetre waves in everyday life, a very small amount that is virtually undetectable is absorbed in the body. Radio frequencies in the current mobile, TV and radio broadcast bands are absorbed into the body at extremely low levels. Millimetre waves are also absorbed at extremely low levels into the body but only into the upper layers of the skin due to the very short wave length and typically up to depth of 1-10mm.

## 10. If millimetre waves are absorbed in the skin, how can it be safe?

The EME exposure guidelines cover all frequencies including millimetre waves. The exposure guidelines are set to ensure that absorption of the radio frequency signals in the body and skin is well below the safety threshold.

Radio frequency signals in the environment are part of everyday life. In terms of millimetre waves, the amount of radio frequency signal actually absorbed in the skin from devices, base stations or other radio services is very low, significantly below the threshold that could be detected and well below the safety limits.

## 11. Is Telstra building new base stations for 5G?

Telstra is upgrading existing facilities for the initial deployment of 5G. Telstra will continue to upgrade existing facilities and build new base stations as part of the 5G rollout.

## 12. How many 5G base stations is Telstra proposing?

By the end of 2018 Telstra had enabled more than 200 5G sites in Melbourne, Sydney, Canberra, Brisbane, Adelaide, Perth, Hobart, Launceston, Toowoomba and the Gold Coast. During 2019 and 2020 Telstra plans to continue the deployment of 5G at existing base stations as part of the 5G rollout.

## 13. How will I know when 5G is proposed for my area?

Telstra will be undertaking a range of advertising and community notification activities for the deployment of 5G. For all new base station deployments and existing site upgrades, Telstra follows the community consultation and notification requirements of Industry Code C564:2018 Mobile Phone Base Station Deployment Code.

Information about new and existing mobile base stations including new technologies is available on the National Site Database called the Radio Frequency National Site Archive at [www.rfnsa.com.au](http://www.rfnsa.com.au)

## 14. Will Telstra be using small cells for 5G?

Yes, Telstra will be using a range of different base stations for 5G including small cells. Initially, for Telstra's 5G deployment, existing base stations will be upgraded.

## 15. Will small cells be built on every street for 5G?

No, Telstra does not plan or need to build small cells on every street for 5G. Telstra is upgrading its existing network to provide the initial 5G coverage and will use small cells in future years.

Small cells are typically used to provide localised coverage in small geographic areas where there are coverage limitations due to terrain, buildings or other obstructions, or to provide additional capacity where there is a significant number of people using mobile and data services in the local area. Small cells are not new and have been used for many years to provide mobile services.

## 16. Do small cells have high EME?

No, small cells operate at low power and have low EME levels.

Telstra has tested a range of small cells and found the EME levels close by and immediately around the small cell to be very low and well below the EME safety limits.

## 17. Why is Telstra activating 5G base stations when devices are not yet available?

Telstra is currently testing the new 5G technology across parts of Australia with prototype devices as part of the important integration phase so it's ready for customers when the commercial devices are available. The integration is an important step in the network readiness.

When we activate a 5G base station we also boost the 4G capability at that same location which means our existing 4G customers get an immediate benefit.

## 18. What EME does 5G add?

Telstra has conducted extensive EME testing and analysis on the 5G trial network at Southport on the Gold Coast and commenced EME testing on the new 3.5GHz commercial base stations. The test results show EME levels are similar to the existing mobile technologies and well below the EME safety limits.

Telstra presented a summary of the results to the Science and Wireless Conference in November 2018 held by the Australian Centre for Electromagnetic Bioeffects Research (ACEBR).

The presentation is available online at <https://acebr.uow.edu.au/events/UOW254614>

## 19. What testing has Telstra done on 5G to ensure it's safe?

Telstra has a dedicated team with responsibility for managing EME compliance and we ensure that all Telstra base stations and devices are designed to meet Australian EME safety standards.

Telstra uses EME specialists that are independently accredited by the National Association of Testing Authorities (NATA) for EME compliance assessments.

In 2018 Telstra conducted extensive EME testing and analysis on the 5G trial network at Southport on the Gold Coast and commenced EME testing on the new 3.5GHz commercial base stations. The test results show EME levels are similar to the existing mobile technologies and well below the EME safety limits.

## 20. How can the public find out what EME is coming from nearby base stations?

Information about new and existing mobile base stations including EME levels is available on the National Site Database called the Radio Frequency National Site Archive at [www.rfnsa.com.au](http://www.rfnsa.com.au)

## 21. Is Telstra using beam forming antennas for 5G?

Yes, beam forming antennas are part of the new 5G technology standards and deliver great network efficiencies. Telstra is deploying beam forming antennas as part of the new 5G service. Beam forming antennas for 5G enable the mobile signal to be sent directly to devices in a narrow beam rather than to the broader area where the device is located.

The existing 3G and 4G technologies also use beam forming antennas however the beam is quite broad and typically 120 degrees wide.

22. What happens to 4G when 5G is activated?

5G is designed to work in conjunction with 4G. When we activate a 5G base station we also boost the 4G capability at that same location which means our existing 4G customers get an immediate benefit.

23. Is Telstra proposing to turn off 3G?

Yes, in future years Telstra will turn off 3G as the 4G and 5G services evolve. The frequencies used for 3G will be reused for newer mobile technologies that provide greater efficiency.

24. Do base stations in residential areas impact property prices?

To work effectively, base stations need to be located near the people wishing to access this technology. Property valuation is a complex issue, with fluctuations in price being subject to a number of factors. Many of these are subjective, and may be as diverse as aspect, views, condition of the property, local amenity and access to services, including high quality communications. Since the mid-1990s, thousands of telecommunication facilities have been installed throughout Australian metropolitan and regional areas. During this period, property values have continued to increase, showing no clear signs of deterioration as a result of the location of communications facilities.

Telstra is not aware of any credible evidence that directly links the siting of telecommunications facility to a decrease in property prices

25. Is '5G' displayed on Wi-Fi modems and routers the same as the new 5G mobile technology?

No. '5G' displayed on Wi-Fi modems and routers actually refers to one of the frequency bands used for Wi-Fi of 5GHz. The other Wi-Fi frequency band is 2.4GHz and sometimes displays as 2G on a modem or router.

The 5G mobile technology to be introduced in 2019 is completely new and is the next evolution from 4G and 3G. It's completely understandable that people may be confused by the similar abbreviations and terms so we hope this helps to clarify the meaning.



## Further information

More comprehensive information about 5G and EME is available from the following resources:

[EMF Explained Series](#), which has been developed by the Australian Mobile Telecommunications Association (AMTA) in association with the GSMA and Mobile and Wireless Forum (MWF).

[5G Wireless Technology Fact Sheet](#) – Australian Centre for Electromagnetic Bioeffects Research

[Telstra Exchange](#) – information on wireless technology from Telstra

[Misinformation about Australia's 5G Network](#) – Australian Government - Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

Did you find what you need on our website?

Yes	Too early to tell	No
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Telstra Home > Consumer Advice > Electromagnetic energy > **5G and EME**



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- Privacy
- Your Information

## Orrong Road Planning Study

# An invitation to have your say

Main Roads is seeking community input into a planning study to identify the best solution for upgrading Orrong Road, between Leach Highway in Kewdale and Great Eastern Highway in Rivervale.

## Why does Orrong Road need upgrading?

In its current state, Orrong Road is a deficient link in the state's road network. Orrong Road distributes traffic to Mitchell Freeway and Graham Farmer Freeway to the north-west and Leach Highway, Roe Highway and Tonkin Highway to the south-east.

Traffic studies have confirmed that Orrong Road currently operates at capacity, with up to 65,000 vehicles per day using the road. As Perth's population increases, conditions along Orrong Road will deteriorate further, with traffic volumes likely to increase to 100,000 vehicles per day by 2031.

Historical planning provides for the upgrade of Orrong Road to six lanes at ground level. However, more recent investigations have confirmed that this solution is unviable because it is unable to service the forecast traffic demand, would have a significant impact on land and community amenity and results in no improvements to travel times.

## This planning study

For this planning study, Main Roads has undertaken extensive traffic assessment and considered several options to determine the preferred concept for upgrading Orrong Road. This concept maintains key local road connections along surface roads, with the majority of a full expressway for through traffic to be constructed below ground level. This expressway will deliver a five kilometre section of Orrong Road with no traffic signals for regional traffic.

Importantly, this concept will reduce journey times to approximately five minutes between Leach Highway and Great Eastern Highway. It also has only minor land impacts and improves safety by eliminating conflict between regional and local traffic.

The WA Planning Commission (WAPC) has supported Main Roads' plans to develop this concept further and undertake stakeholder and community consultation. Once this is complete, Main Roads will provide a submission to the WAPC to reserve the required land in the Metropolitan Region Scheme (MRS).

It is important to note this a long-term planning study and there are currently no funds for construction.



Orrong Road is currently a deficient link in the state's road network, with high levels of congestion especially at peak periods



## The planning process



## Benefits of the preferred concept

### ✓ Improves safety

Reduces the chance of crashes due to congested stop-start conditions or turning movements

Separates regional and local traffic

Pedestrians can safely cross the corridor using local surface roads

### ✓ Better traffic efficiency

Traffic forecasts show it will take five minutes to travel the expressway in 2031, compared to approximately 40 minutes on a six-lane highway with signals

Enhances important freight and commuter links

### ✓ Local connectivity

Local road connections are maintained via surface roads

Residential areas are not severed

### ✓ Reduces noise

Reduces noise for local residents by building the majority of the expressway below current ground level

Noise walls to be investigated in detailed planning

### ✓ Improves visual amenity

Regional traffic uses the expressway below ground level

Opportunities for public art and landscaping

### ✓ Preserves property

No homes are affected by the expressway option

Minor land impacts only

## How to have your say

Local communities and stakeholders can participate in this consultation process by:

- Visiting our webpage at [www.mysaytransport.wa.gov.au](http://www.mysaytransport.wa.gov.au), completing our online survey by 22 July 2019 and/or registering for future updates
- Attending our drop-in information session on Wednesday 12 June 2019 at Rivervale Community Centre, corner of Surrey Road and Francisco Street, Rivervale, from 5pm-8pm

## Next steps

All feedback provided by property owners, stakeholders and the community will be used to inform Main Roads' final submission to the WA Planning Commission.

## More information

Web: [www.mainroads.wa.gov.au](http://www.mainroads.wa.gov.au)

Tel: 138 138

Enquiries: [enquiries@mainroads.wa.gov.au](mailto:enquiries@mainroads.wa.gov.au)





# Hourly Volume

Orrong Rd (H027)

2018/19  
Monday to Friday

South of Francisco St (SLK 0.46)

	All Vehicles		
	NB	SB	Both
00:00	186	253	439
01:00	139	153	292
02:00	107	119	226
03:00	124	150	274
04:00	277	383	660
05:00	737	1019	1756
06:00	1895	1533	3428
07:00	2470	2019	4489
08:00	2509	1786	4295
09:00	1972	1666	3638
10:00	1752	1645	3397
11:00	1736	1772	3508
12:00	1794	1810	3604
13:00	1761	1787	3548
14:00	1964	1999	3963
15:00	2111	2126	4237
16:00	2380	2124	4504
17:00	2283	2238	4521
18:00	1699	1768	3467
19:00	1105	1280	2385
20:00	864	1068	1932
21:00	747	1094	1841
22:00	594	856	1450
23:00	405	592	997
<b>TOTAL</b>	<b>31611</b>	<b>31240</b>	<b>62851</b>

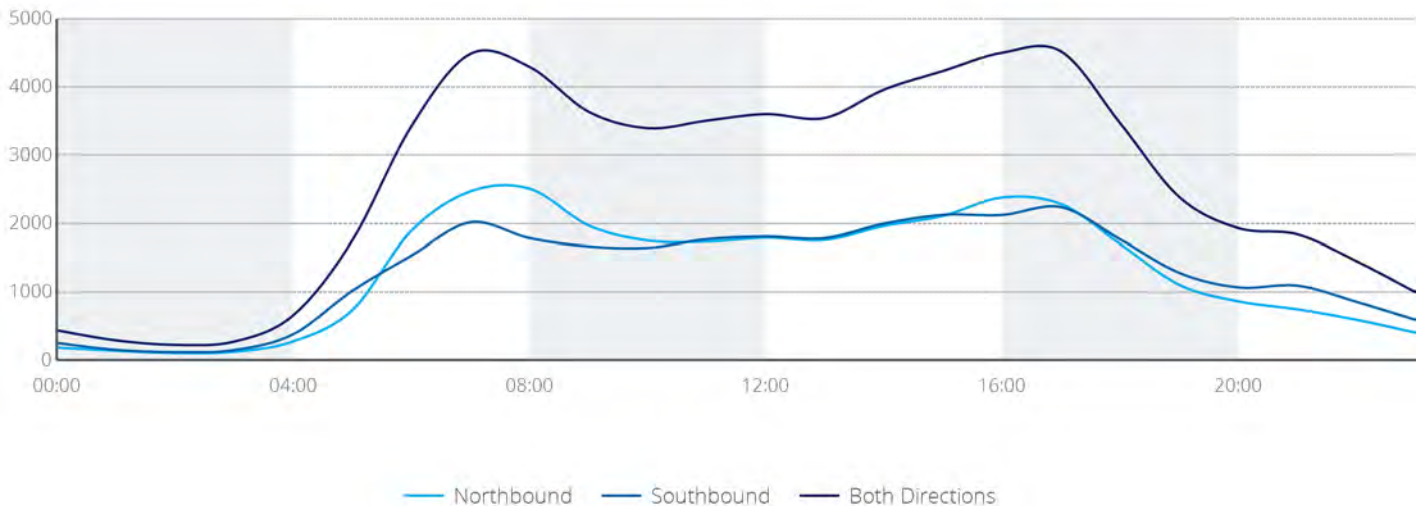
	Heavy Vehicles			
	NB	SB	Both	%
00:00	10	17	27	6.2
01:00	11	10	21	7.2
02:00	13	8	21	9.3
03:00	20	11	31	11.3
04:00	33	34	67	10.2
05:00	72	105	177	10.1
06:00	188	189	377	11.0
07:00	228	193	421	9.4
08:00	240	188	428	10.0
09:00	254	246	500	13.7
10:00	241	278	519	15.3
11:00	220	266	486	13.9
12:00	225	270	495	13.7
13:00	207	239	446	12.6
14:00	188	249	437	11.0
15:00	164	209	373	8.8
16:00	130	181	311	6.9
17:00	94	119	213	4.7
18:00	60	84	144	4.2
19:00	46	53	99	4.2
20:00	30	41	71	3.7
21:00	22	37	59	3.2
22:00	17	35	52	3.6
23:00	13	25	38	3.8
<b>TOTAL</b>	<b>2726</b>	<b>3087</b>	<b>5813</b>	<b>9.2</b>



## Peak Statistics

AM	TIME	07:15	07:15	07:15	08:15	10:30	10:00
	VOL	2569	2053	4622	257	285	519
PM	TIME	16:30	17:00	16:30	12:15	12:15	12:15
	VOL	2431	2238	4650	227	271	498

Volume





# Hourly Volume

Orrong Rd (H027)

2018/19  
Monday to Sunday

South of Francisco St (SLK 0.46)

	All Vehicles		
	NB	SB	Both
00:00	261	394	655
01:00	188	249	437
02:00	138	186	324
03:00	142	198	340
04:00	253	364	617
05:00	608	830	1438
06:00	1525	1204	2729
07:00	1936	1607	3543
08:00	2075	1499	3574
09:00	1802	1512	3314
10:00	1709	1612	3321
11:00	1769	1754	3523
12:00	1773	1792	3565
13:00	1741	1757	3498
14:00	1853	1915	3768
15:00	1929	2014	3943
16:00	2087	1963	4050
17:00	2099	2033	4132
18:00	1570	1657	3227
19:00	1073	1219	2292
20:00	886	1022	1908
21:00	748	1085	1833
22:00	627	862	1489
23:00	418	608	1026
<b>TOTAL</b>	<b>29210</b>	<b>29336</b>	<b>58546</b>

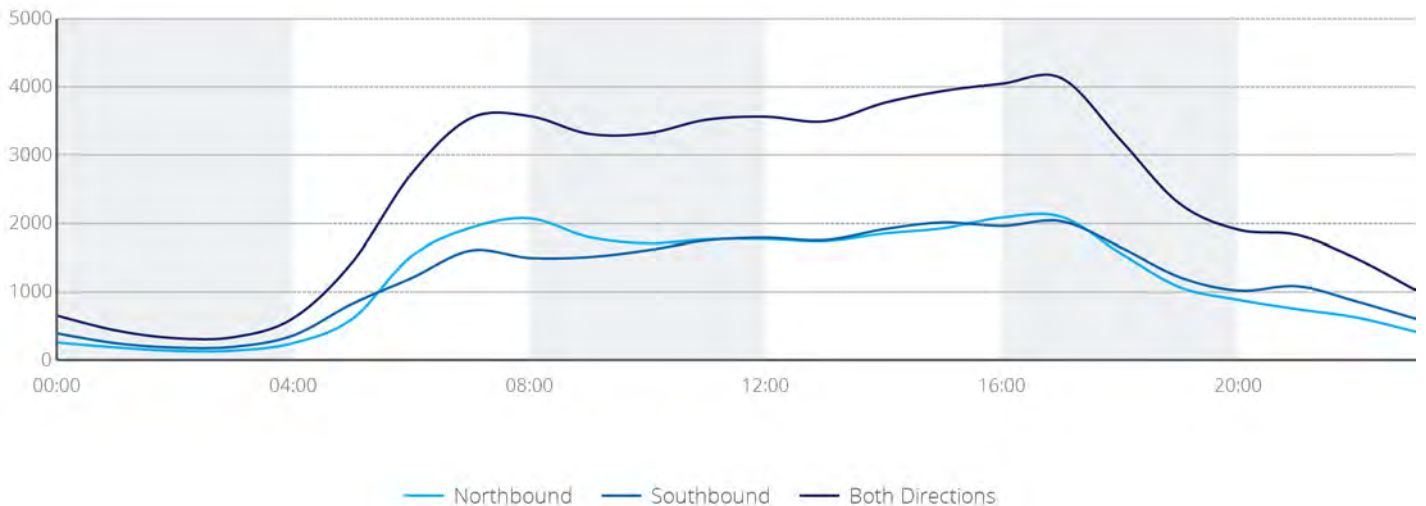
	Heavy Vehicles			%
	NB	SB	Both	
00:00	10	22	32	4.9
01:00	8	11	19	4.3
02:00	11	9	20	6.2
03:00	15	11	26	7.6
04:00	25	24	49	7.9
05:00	53	76	129	9.0
06:00	136	134	270	9.9
07:00	163	142	305	8.6
08:00	177	141	318	8.9
09:00	188	185	373	11.3
10:00	180	207	387	11.7
11:00	169	202	371	10.5
12:00	169	204	373	10.5
13:00	157	179	336	9.6
14:00	137	187	324	8.6
15:00	124	161	285	7.2
16:00	96	142	238	5.9
17:00	73	95	168	4.1
18:00	51	70	121	3.7
19:00	37	47	84	3.7
20:00	27	37	64	3.4
21:00	21	34	55	3.0
22:00	17	28	45	3.0
23:00	12	23	35	3.4
<b>TOTAL</b>	<b>2056</b>	<b>2371</b>	<b>4427</b>	<b>7.6</b>



## Peak Statistics

AM	TIME	08:00	11:45	07:15	09:30	10:30	09:45
	VOL	2075	1781	3666	190	212	390
PM	TIME	16:30	17:00	16:30	12:30	12:15	12:15
	VOL	2159	2033	4175	173	204	375

Volume





# Hourly Volume

Orrong Rd (H027)

South of Francisco St (SLK 0.46)

2018/19  
Weekend

	All Vehicles		
	NB	SB	Both
00:00	410	673	1083
01:00	294	441	735
02:00	204	325	529
03:00	181	294	475
04:00	201	313	514
05:00	334	412	746
06:00	728	490	1218
07:00	792	706	1498
08:00	1133	858	1991
09:00	1426	1154	2580
10:00	1586	1504	3090
11:00	1805	1675	3480
12:00	1692	1712	3404
13:00	1667	1652	3319
14:00	1586	1695	3281
15:00	1510	1720	3230
16:00	1432	1563	2995
17:00	1663	1543	3206
18:00	1261	1371	2632
19:00	984	1051	2035
20:00	908	892	1800
21:00	728	1031	1759
22:00	678	849	1527
23:00	438	619	1057
<b>TOTAL</b>	<b>23641</b>	<b>24543</b>	<b>48184</b>

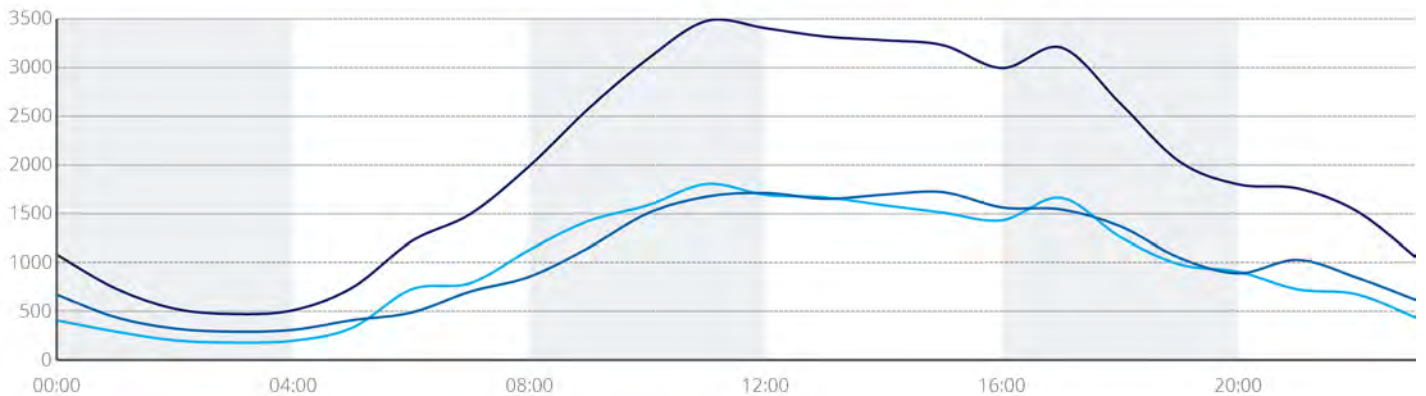
	Heavy Vehicles				%
	NB	SB	Both		
	12	32	44		4.1
	8	16	24		3.3
	12	13	25		4.7
	10	14	24		5.1
	14	7	21		4.1
	23	24	47		6.3
	43	33	76		6.2
	47	51	98		6.5
	60	54	114		5.7
	72	73	145		5.6
	65	75	140		4.5
	77	85	162		4.7
	62	84	146		4.3
	66	73	139		4.2
	45	80	125		3.8
	54	72	126		3.9
	38	68	106		3.5
	36	57	93		2.9
	36	47	83		3.2
	26	39	65		3.2
	22	33	55		3.1
	18	33	51		2.9
	17	19	36		2.4
	14	19	33		3.1
<b>TOTAL</b>	<b>877</b>	<b>1101</b>	<b>1978</b>		<b>4.1</b>



## Peak Statistics

AM	TIME	11:00	11:45	11:30	11:00	11:45	11:00
	VOL	1805	1692	3483	77	90	162
PM	TIME	12:15	14:45	12:15	13:00	12:00	12:00
	VOL	1709	1731	3436	66	84	146

Volume



— Northbound — Southbound — Both Directions