Electromagnetic Energy (EME) Exposure assessment of Telstra's 5G trial network on the Gold Coast, Australia

WHO International Advisory Council – 22nd June 2018

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Telstra Corporation Limited

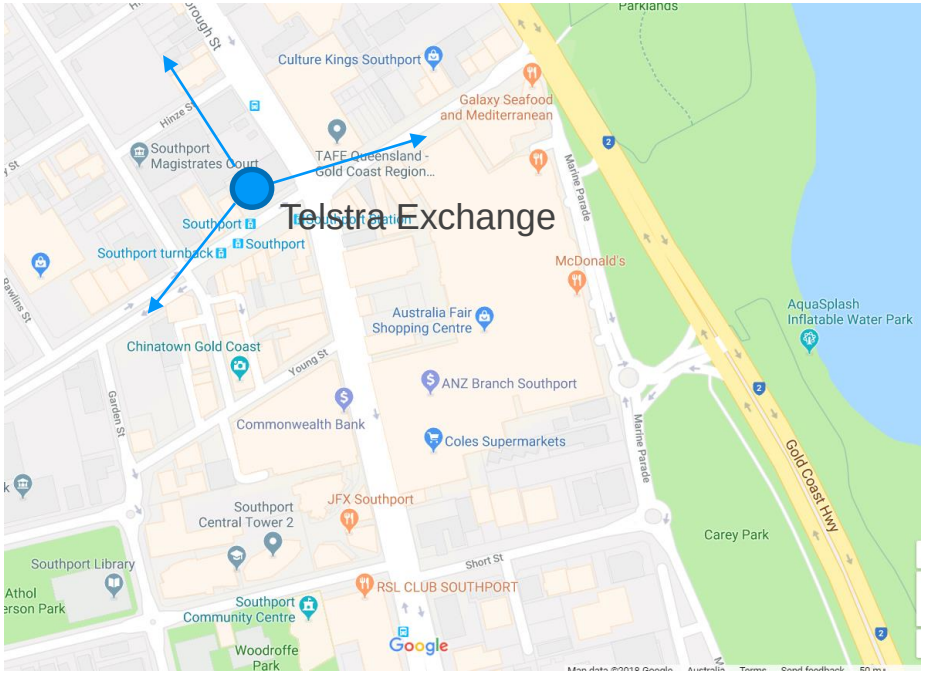
Background

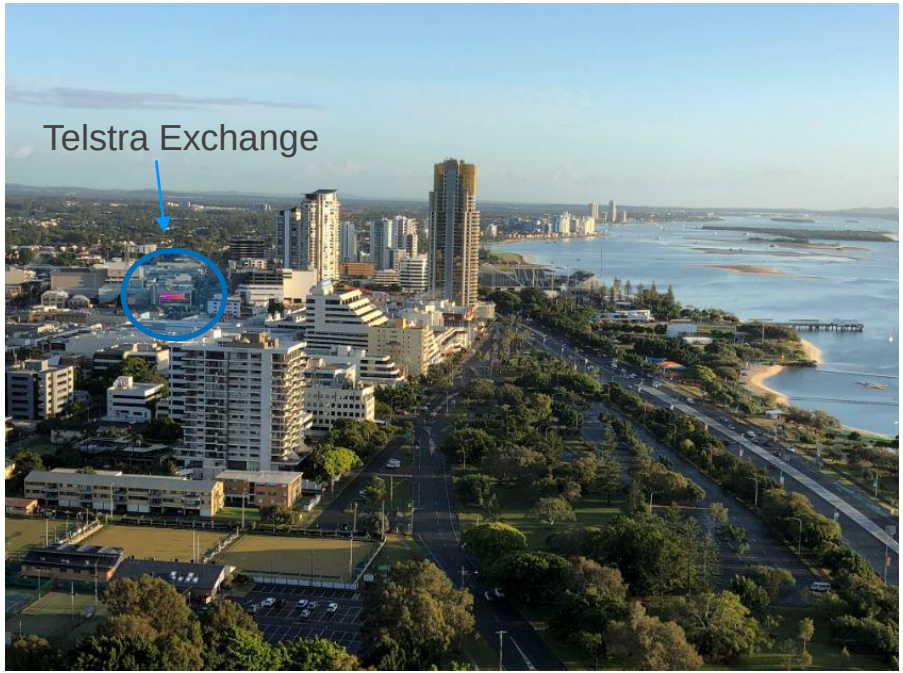
Telstra recently opened a new 5G Innovation Centre at our Southport Exchange on the Gold Coast. The centre will be the home for testing the next generation of mobile technologies in local conditions to support the early commercial deployment of 5G in Australia.

The innovation centre has a

- **27GHz indoor 5G network** operating at similar power to the current indoor mobile technology
- **27GHz outdoor base station** on a tower operating at similar power to a medium range small cell (E100) (63Watts EIRP)

Location


Culture Kings Southport
Galaxy Seafood and Mediterranean
Southport Magistrates Court
TAFE Queensland - Gold Coast Region...
Telstra Exchange
Southport
Southport turnback
Southport
McDonald's
Australia Fair Shopping Centre
AquaSplash Inflatable Water Park
Chinatown Gold Coast
ANZ Branch Southport
Commonwealth Bank
Coles Supermarkets
Marine Parade
Gold Coast Hwy
Carey Park
Southport Central Tower 2
JFX Southport
Southport Library
RSL CLUB SOUTHPORT
Southport Community Centre
Woodroffe Park
Google


Telstra Exchange

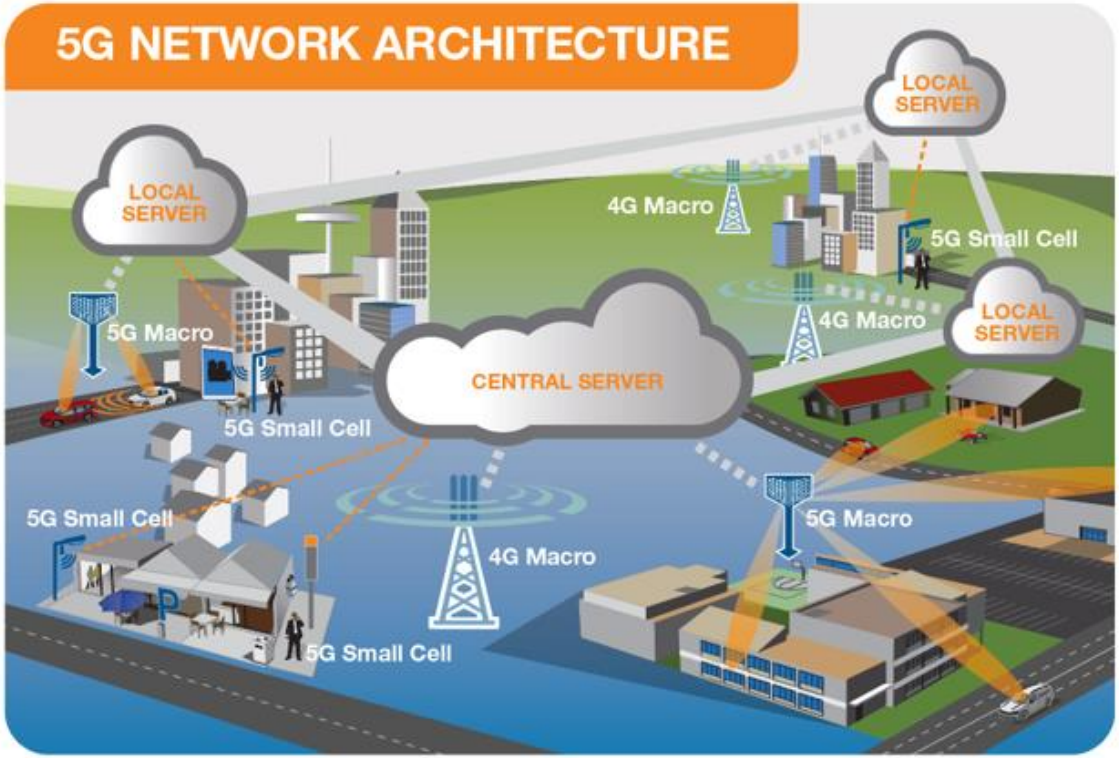
Purpose & Objectives

The purpose of the measurements was to ascertain the electromagnetic field (EMF) or electromagnetic energy (EME) levels associated with this new technology

Objectives

- ❑ Compare actual measured EMF levels with theoretical predictions of EMF levels from a 5G antenna to assess confidence in the computation of exclusion zones
- ❑ Assess environmental EMF levels from 5G and other radio sources at both indoor and outdoor areas in the vicinity of the base station
- ❑ Assess suitability of test equipment for mmWave measurements
- ❑ Determine next steps and ongoing EMF learning & assessment requirements

How Does 5G Work?



Radio Access Network

- Small Cells
- Macro cells
- in-building and home systems

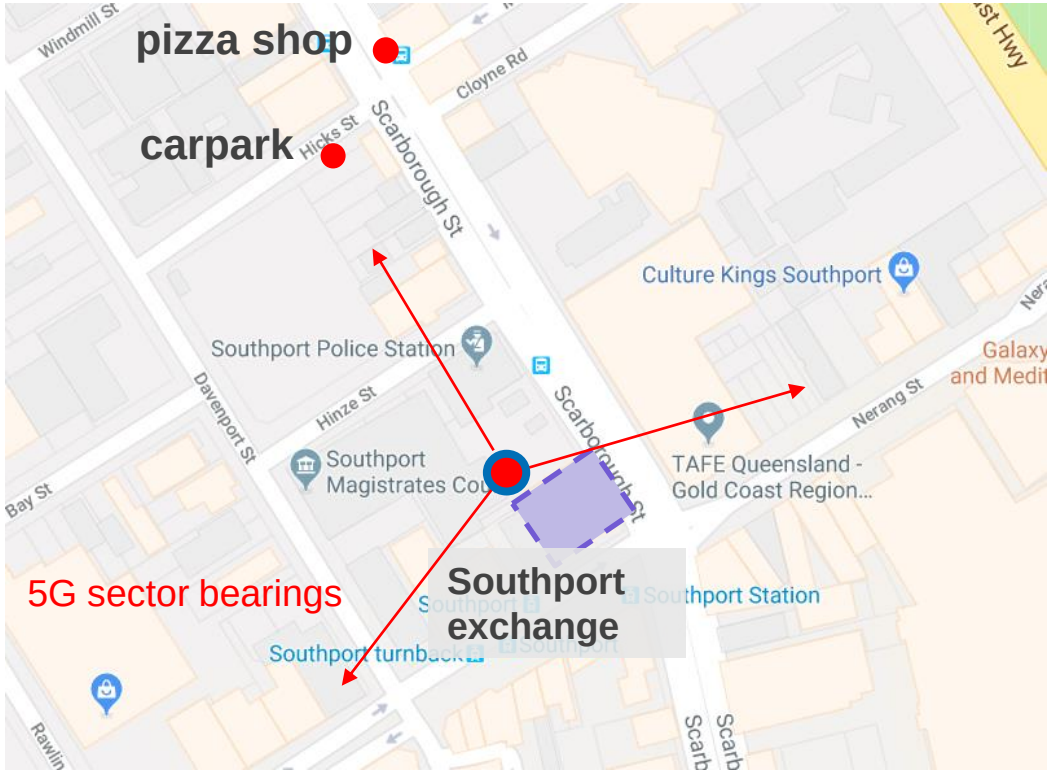
Core Network
mobile exchange and data network, manages voice, data & internet connection.

Early Deployment
4G acts as control plane
5G acts as data/user plane

Later Releases
5G will operate stand alone in later releases

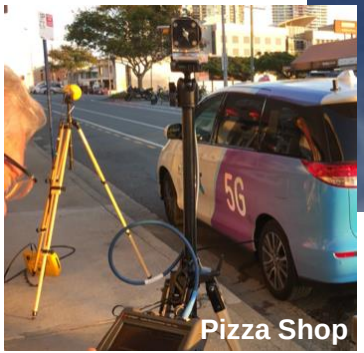
5G and 4G working together, with central and local servers providing faster content to users and low latency applications

Outdoor measurements

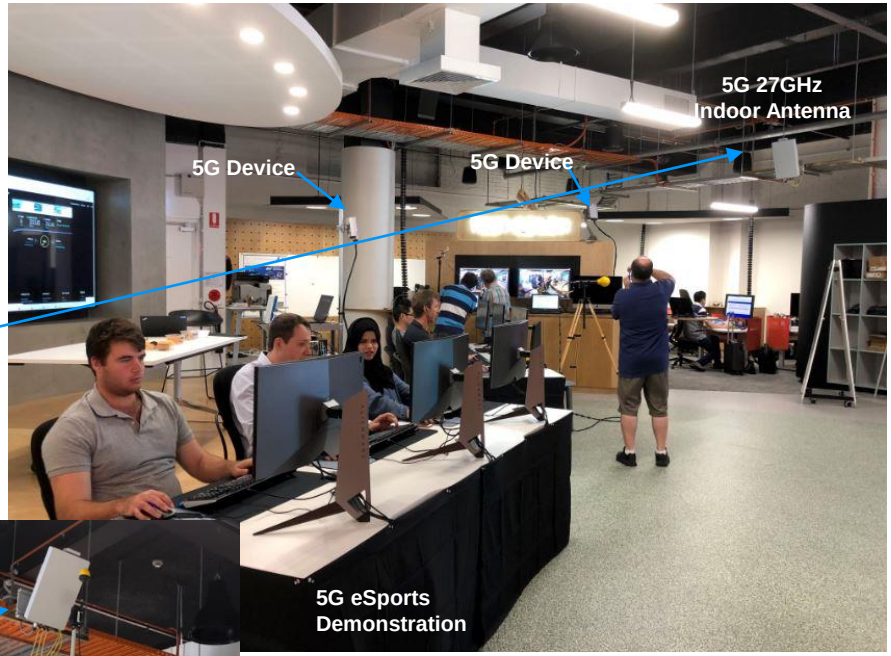


https://www.google.com.au/maps/@-27.974846,153.3818768,14z

44 m radio tower



Indoor measurements



EMF measurements from 5G base station antenna

Transmitter configuration

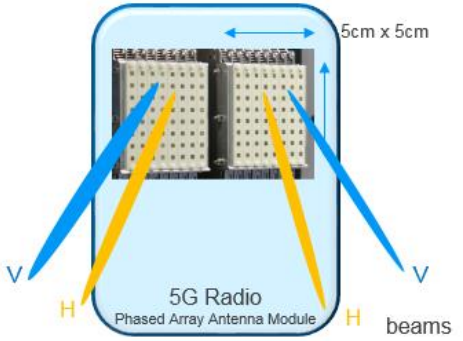
Line of sight along the boresight beam

- **Indoor**:
  single antenna array under program control
  single constant boresight beam, single polarisation, 800 MHz, 42 dBmW (15.8 W) EIRP

- **Outdoor**:
  base station antenna 2x2 MIMO, 400 MHz, 45 dBmW (31.5 W) EIRP,
  vehicle mounted *user equipment* (UE) antenna connected to base station to 'attract' the beam

- Broadband probe (< 1m from antenna), spectrum analyser and horn antenna (≥ 1m)

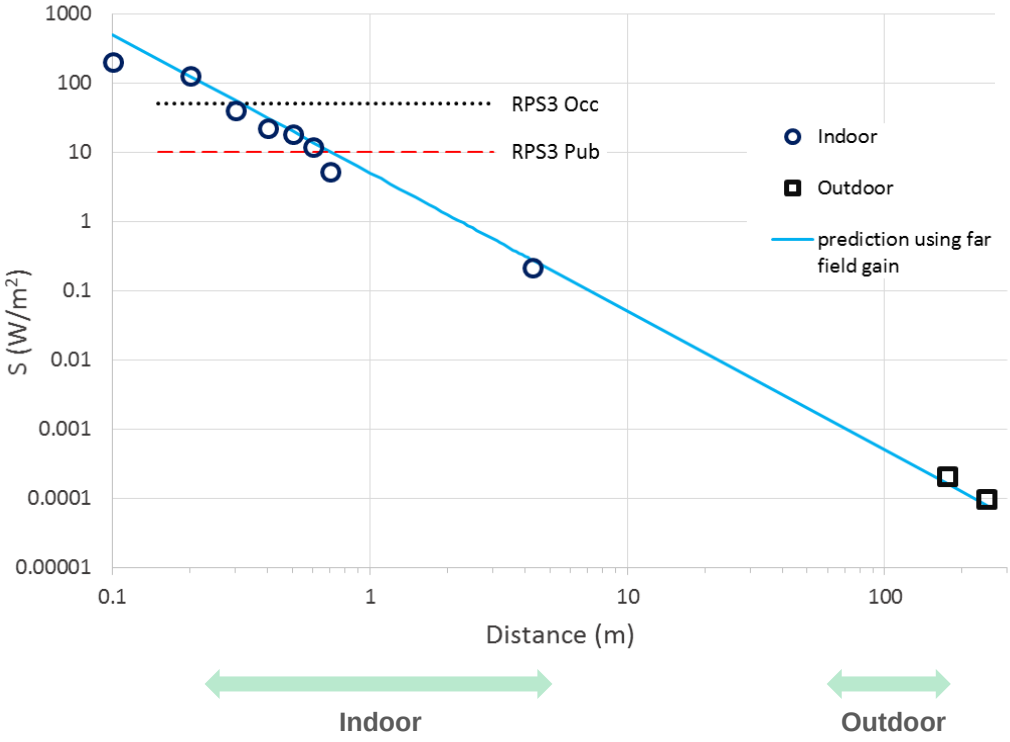
- TDD downlink/uplink ratio 23:1, high downlink (dummy) traffic generating 1-2 Gbps



Massive MIMO antenna

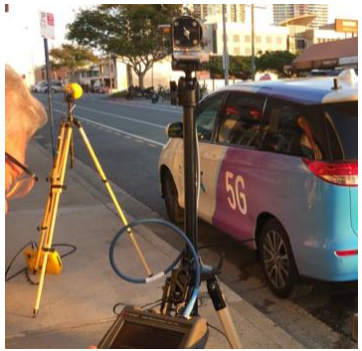
EMF measurements along boresight beam

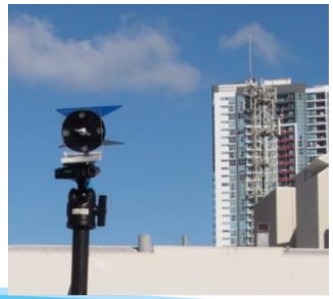
Compare actual measured EMF levels with theoretical predictions



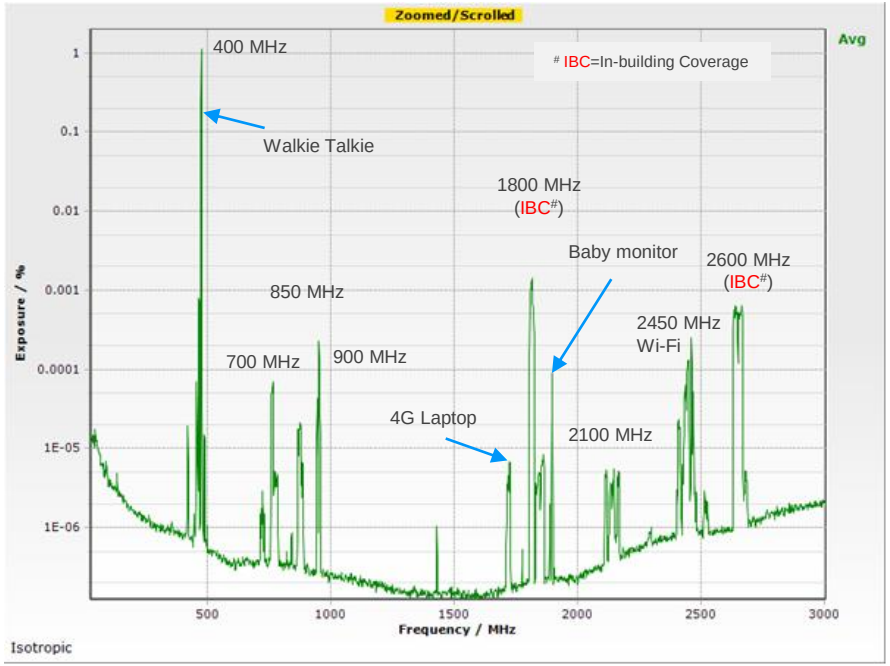
Notes

- Measurements scaled to 63 W total EIRP
- Uncertainties: precise measurement location with respect to boresight, field scattering, calibration.

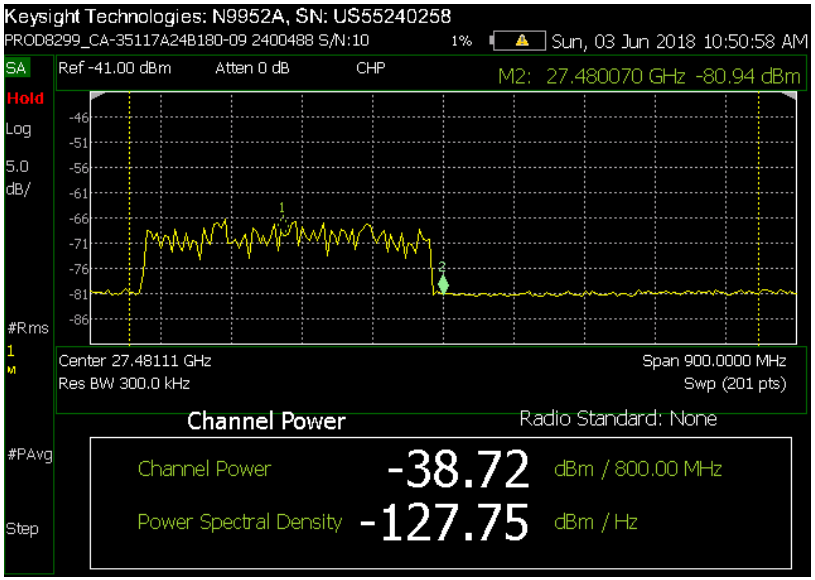




Environmental EMF - indoor spectrum



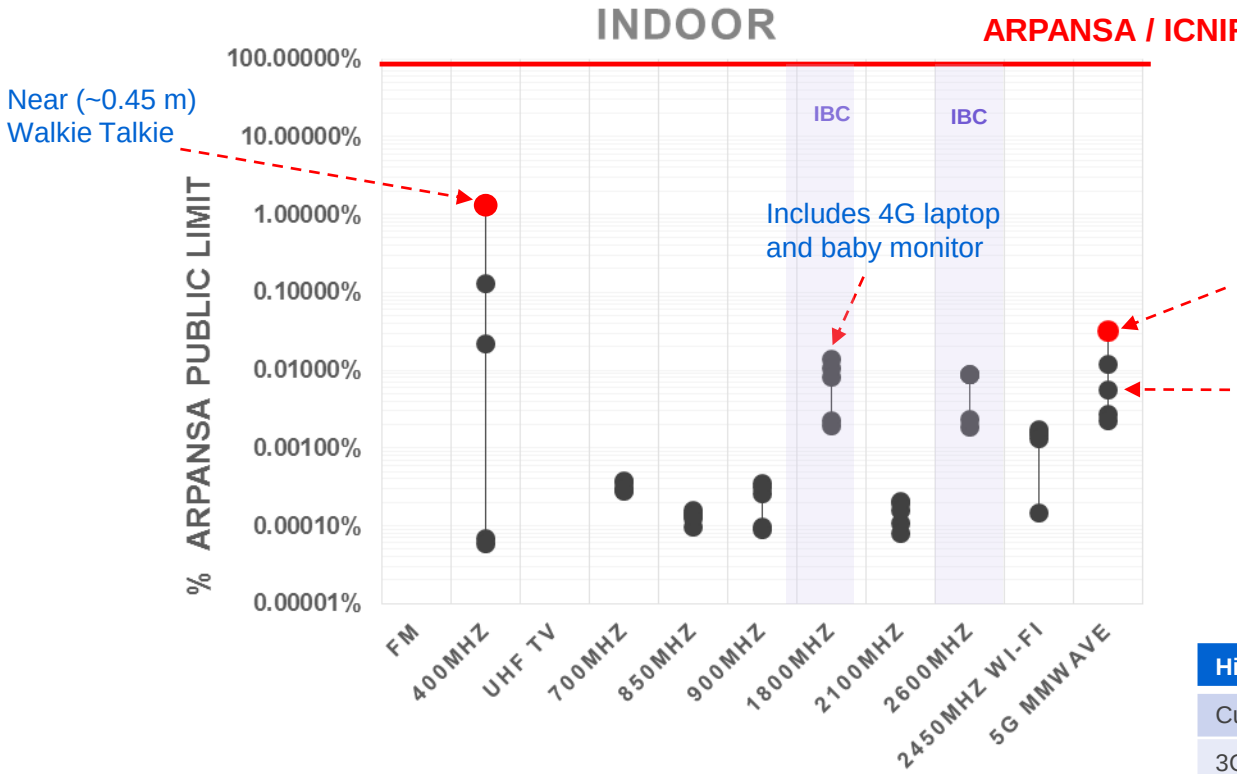
27 MHz – 3 GHz (1 min average)

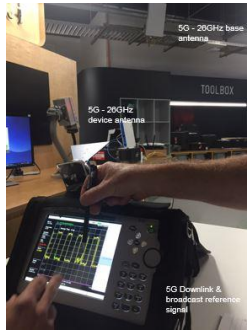


5G - 27 GHz

Channel power measurement with spectrum analyser and horn antenna

Environmental EMF levels - indoor

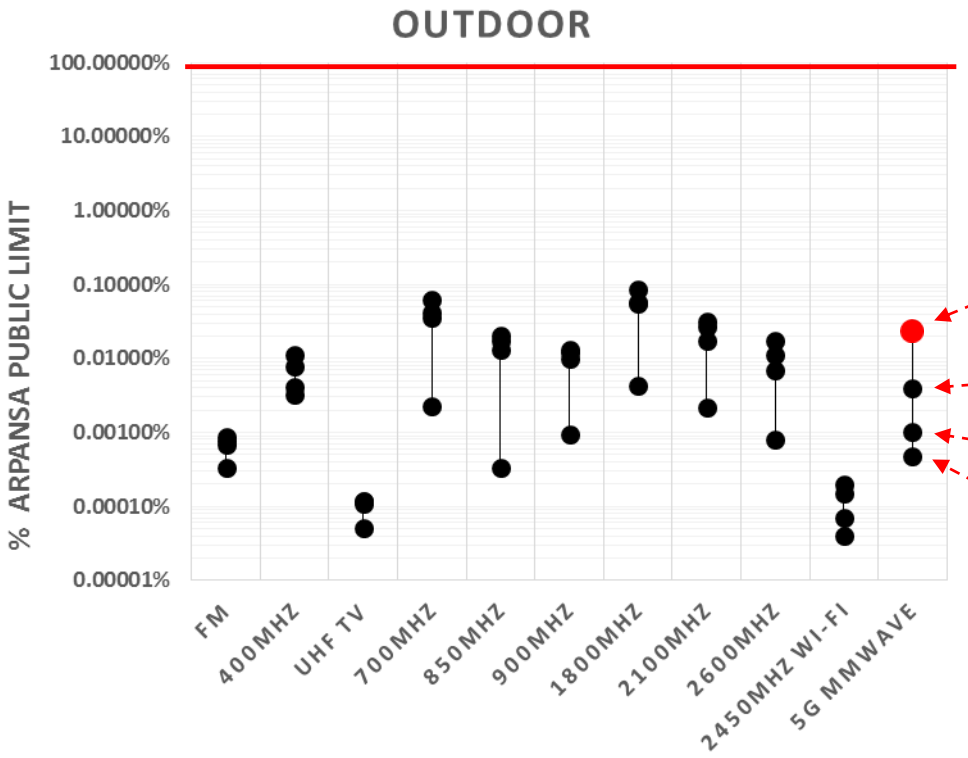




Highest exposure	
Cumulative: 27MHz to 3GHz	1.34%
3G, 4G, Wi-Fi	0.025%
5G (near UE antenna)	0.032%
5G (general environment)	0.012%

- Measurements at different positions

Environmental EMF levels - outdoor



Sum of car mounted 5G UE + BS @ 0.3 m from car, carpark

Sum of car mounted 5G UE + BS @ 1.5 m from car, carpark

Towards BS, carpark

Towards BS, pizza shop

Highest exposure	
Cumulative: 27MHz to 3GHz	0.19%
5G	0.025%

- Measurements at different positions

Observations

- **Overall EMF Levels** – all mobile technologies including 5G significantly below ARPANSA RPS3 / ICNIRP

- **What does 5G add?**

  Indoor & Small cells – similar EMF to current technology (more data/ more users)
  Outdoors Macro cells – predict similar EMF to current macro technology (more data/ more users)

  5G is more efficient – more data/users for same power. (will replace older less efficient technologies)

- **Many more devices** – no significant increase in environmental/background EMF
  - devices will have increased efficiency
  - devices will comply with EMF limits
  - EMF levels from devices decrease very rapidly with distance
  - many devices have intermittent transmission (low EMF)

Findings

- Good alignment between predicted 5G levels and measured 5G levels under test conditions - provides confidence in calculating 5G EMF levels
- Measurements show 5G signals comparable to other radio signals in the environment and significantly lower than the ARPANSA public limit
- Indoor measurements with a multitude of radio technologies and devices inc 5G were well below the ARPANSA public limit
- Massive MIMO systems increase measurement complexity in a live network environment (e.g. dynamic beam steering). IEC is working on standards to assess Massive MIMO systems
- Measurement instruments found to be suitable for the trial – further development needed
- Requires a good understanding of measurement practices and the mobile technology

Team effort

John Parker

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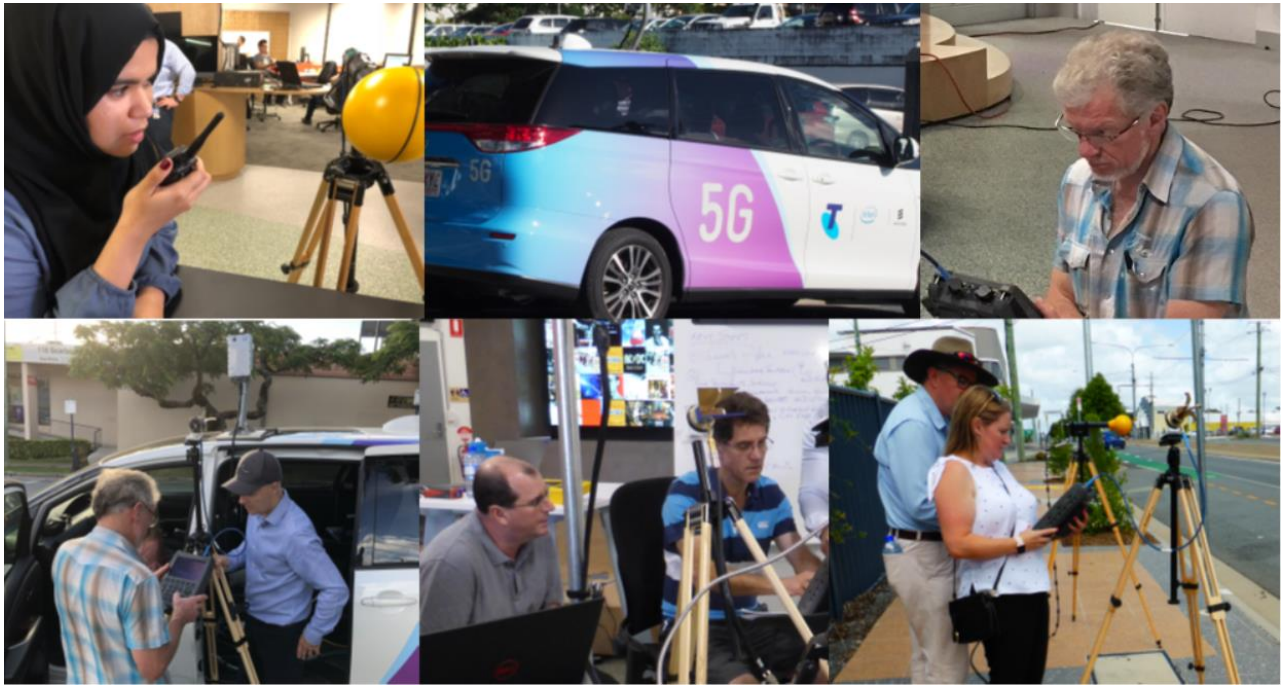
Debbie Wills

Steve Iskra

Mike Wood

Telstra staff at Southport exchange

Ericsson staff



Thank you

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