

5G Smart Apartment EME Testing

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Introduction



Phase 1 - 2019

- Following a survey of 76 Telstra staff we determined that people had an average of 19 connected devices in their homes with one home having 75 devices.
- Typical devices included phones, laptops, security cameras, wireless speakers and Bluetooth devices
- We undertook EME measurements in 5 homes and we found the levels to be well below RPS3 General Public limits

Phase 2 - 2020

- Simulate a smart apartment with many connected devices
- Include 5G into the EME measurements

Phase 2 - 2020



Scope

Show what EME levels are like for families in apartments and homes with multiple devices operating under high usage conditions

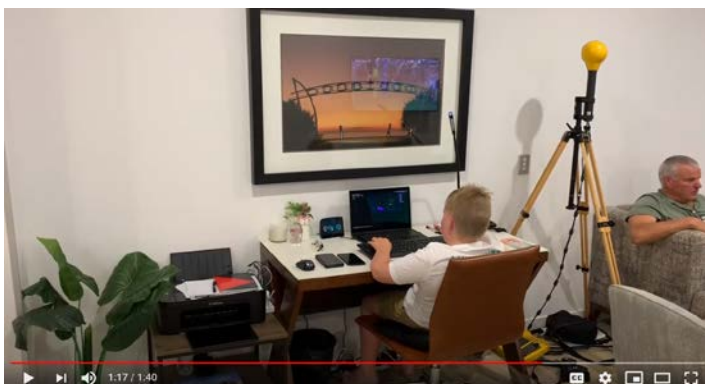
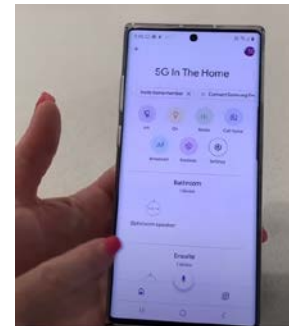
How

- Connect 50+ smart devices over 5G, 4G and 5G Wi-Fi in an apartment
- Challenge the family and kids to 'max out' the Wi-Fi and 5G usage
- Measure the EME levels under various levels of activity over a weekend
- Measure the EME levels from individual devices

Telstra 5G smart apartment



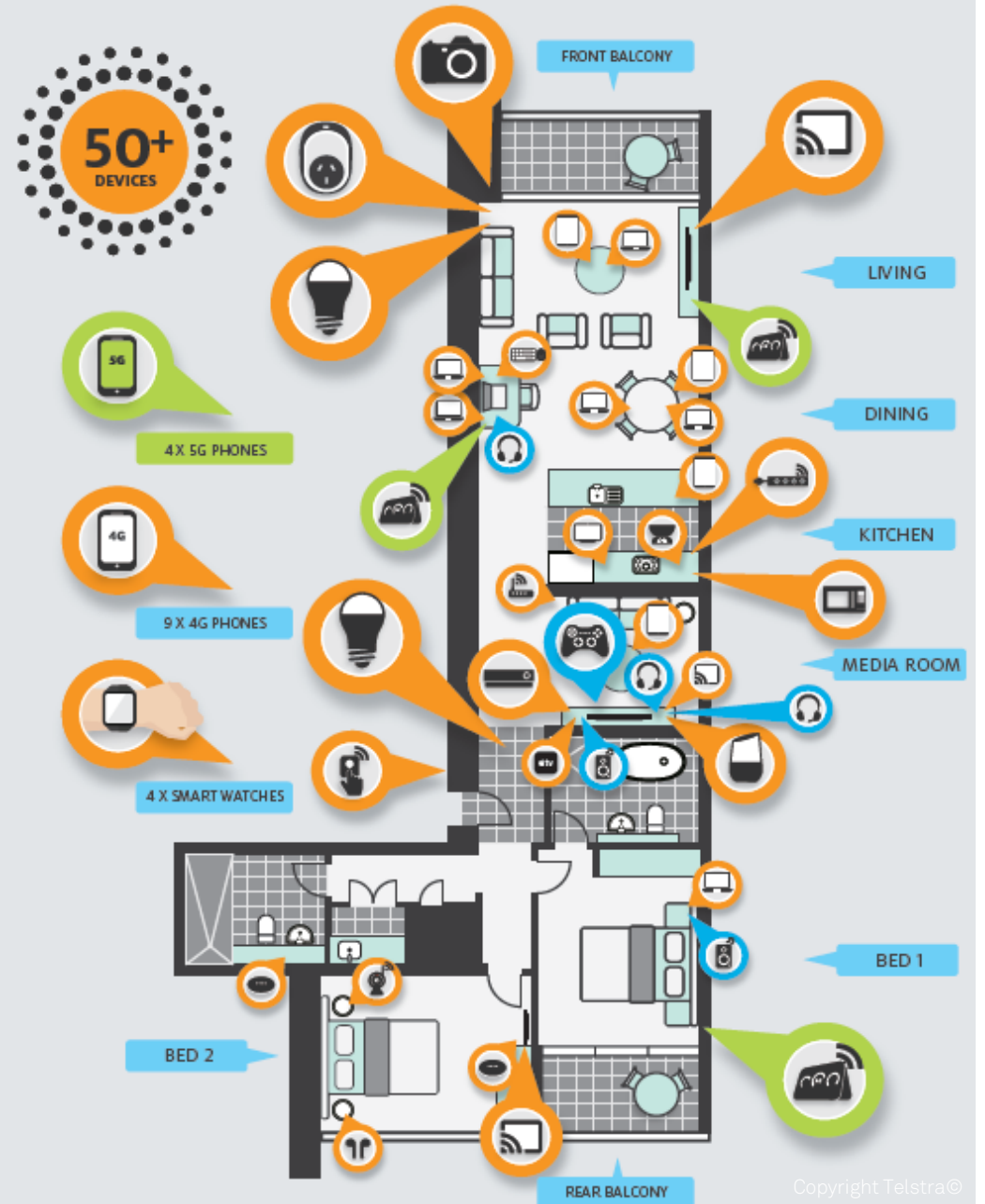
Inside the smart apartment



Smart apartment devices

Device	Quantity	Connectivity	Device	Quantity	Connectivity
Mobile phone	4	5G	Apple TV	1	5G Wi-Fi
5G Wi-Fi router	3	5G	Smart lights	2	5G Wi-Fi
Mobile phone	9	4G	Smart plug	1	5G Wi-Fi
Smart watches	4	4G	Kasa Smart Wi-Fi Power Strip	1	5G Wi-Fi
Laptop	6	5G Wi-Fi	Vitamix Perfect Bake smart scales	1	5G Wi-Fi
Wireless keyboard and mouse	3	Bluetooth	Airpods	1	Bluetooth
Ipad	4	5G Wi-Fi	Chromecast	3	5G Wi-Fi
Google home	1	5G Wi-Fi	Speaker	2	Bluetooth
Google nest hub	1	5G Wi-Fi	Wi-Fi extender	1	5G Wi-Fi
Google mini	3	5G Wi-Fi	Microwave (2.4GHz)	1	
Doorbell	1	5G Wi-Fi	Baby monitor with video	1	5G Wi-Fi
Camera	1	5G Wi-Fi	Additional device		
Gaming console	1	5G Wi-Fi	Smart Fridge	1	At 5GIC
Gaming controller	1	Bluetooth	Measurement Equipment		
Wireless headset	3	Bluetooth	Narda SRM3006	3	Varying locations in living/dining/kitchen

Wi-Fi devices (5G Wi-Fi) were connected to the HTC 5G routers



Results



Environmental EME Levels

Living Room

- Higher EME levels
- Main Wi-Fi routers & 5G hubs
- Highest concentration of users

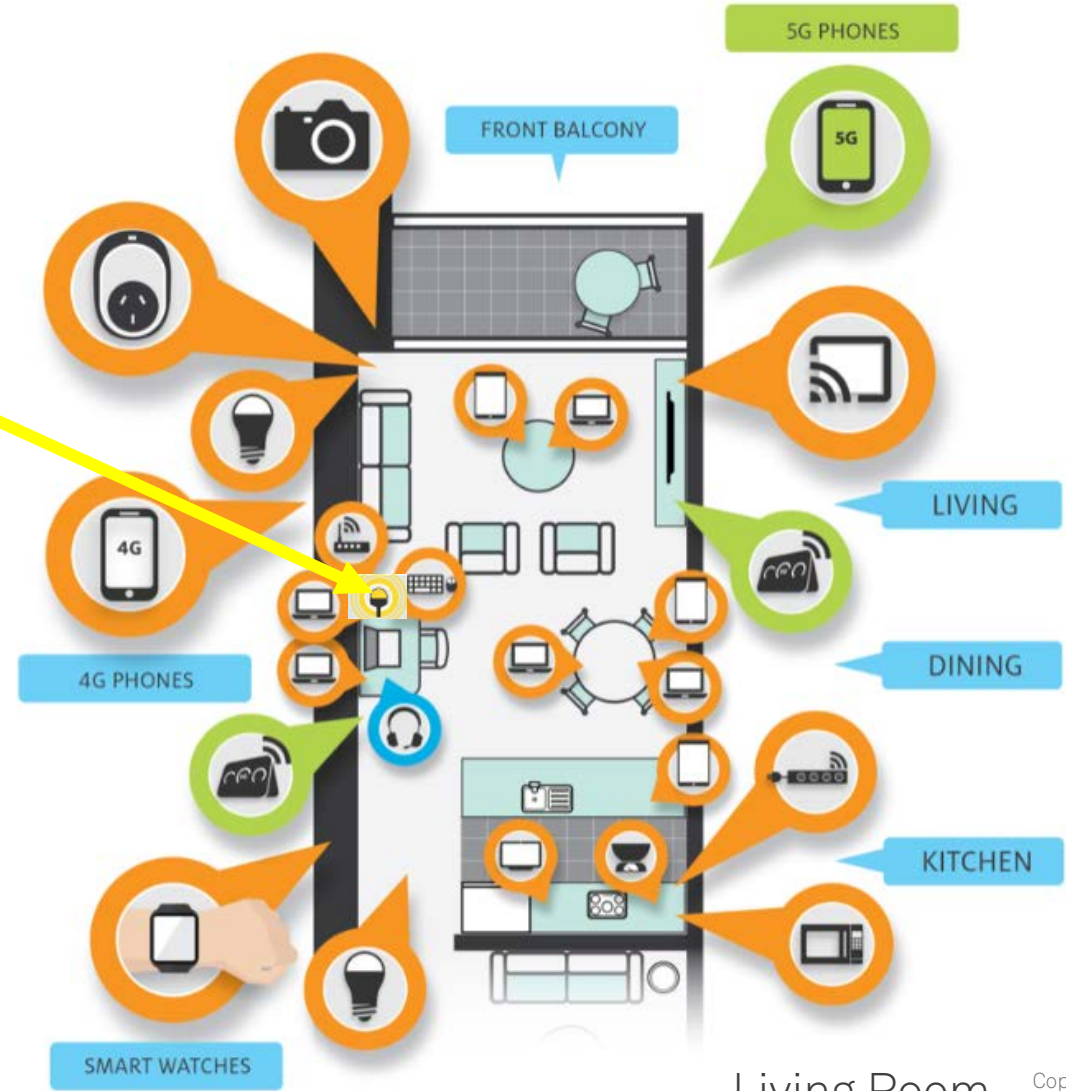
Living Room EME
Spectrum Analyser

Media room

- No Wi-Fi routers
- EME from gaming devices & smart TV
- Lower EME levels - middle of apartment, no windows

Device EME Levels

- Devices measured @ 20cm
- Results feed into AMTA / ACEBR devices project

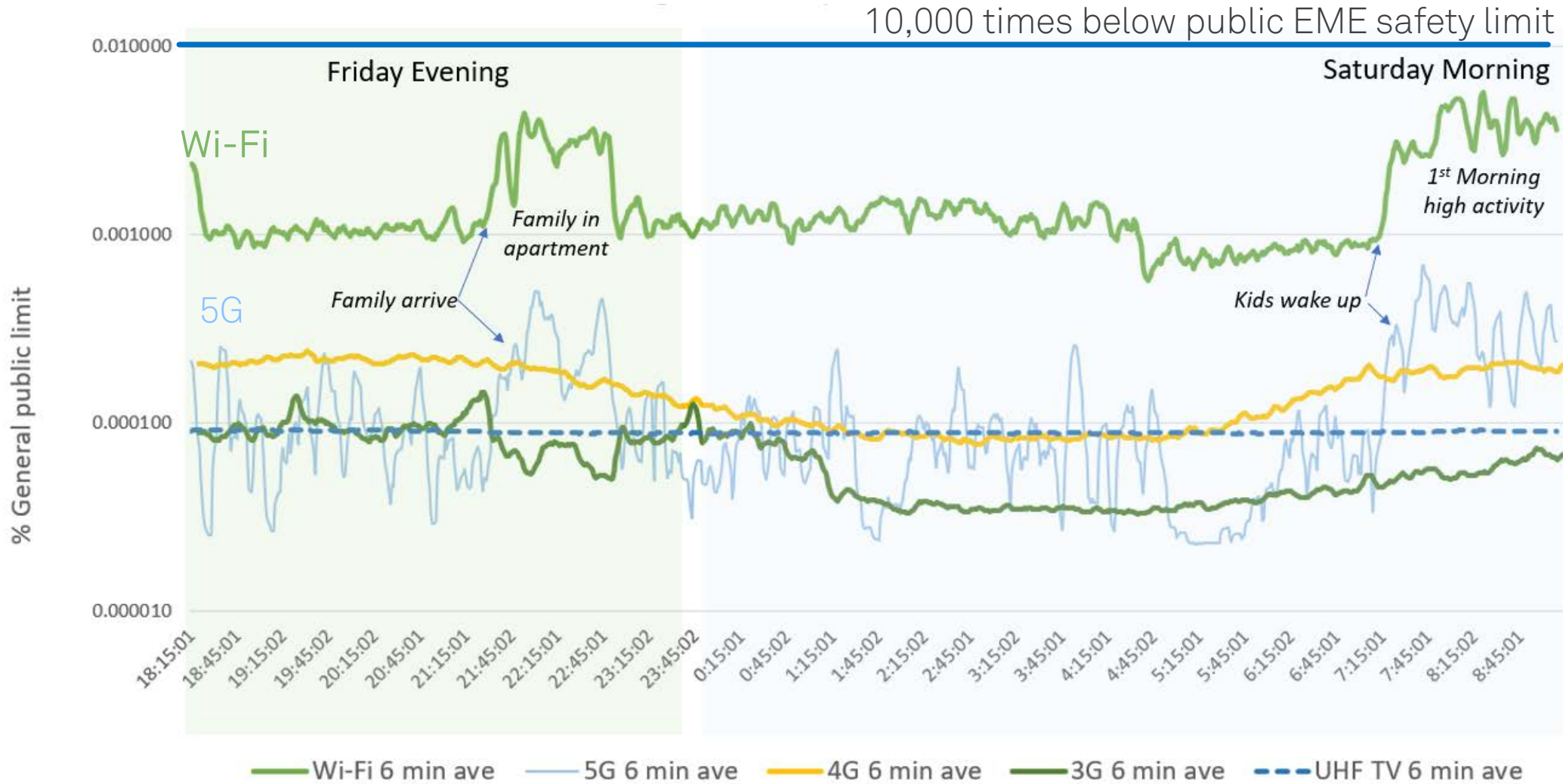


Living Room

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Spectrum Analyser recorded EME level continuously in 1-minute intervals

EME Levels – Living Room (Friday/Saturday)

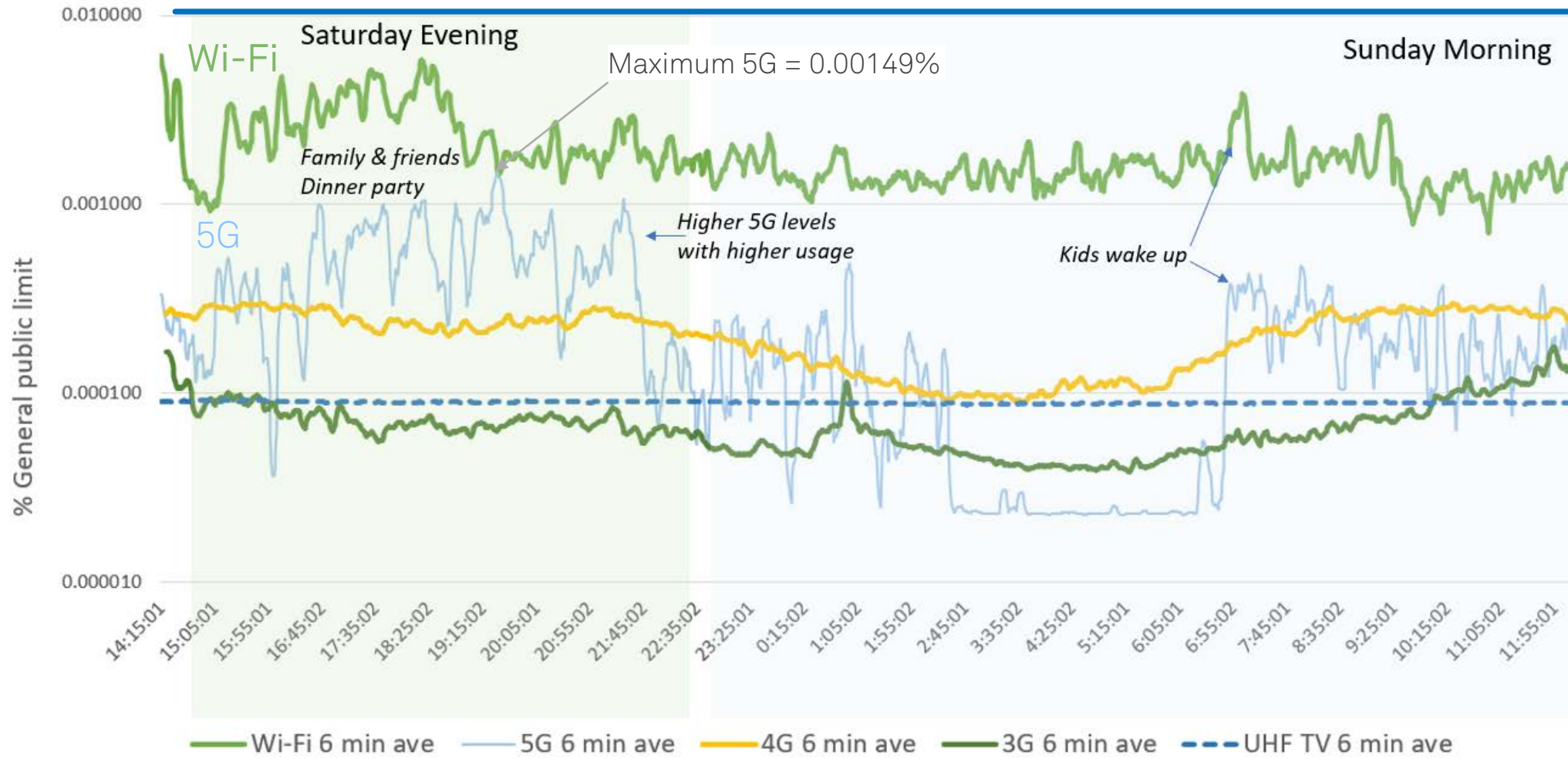


Note: 6 min average EME levels

EME Levels – Living Room (Saturday/Sunday)



10,000 times below public EME safety limit

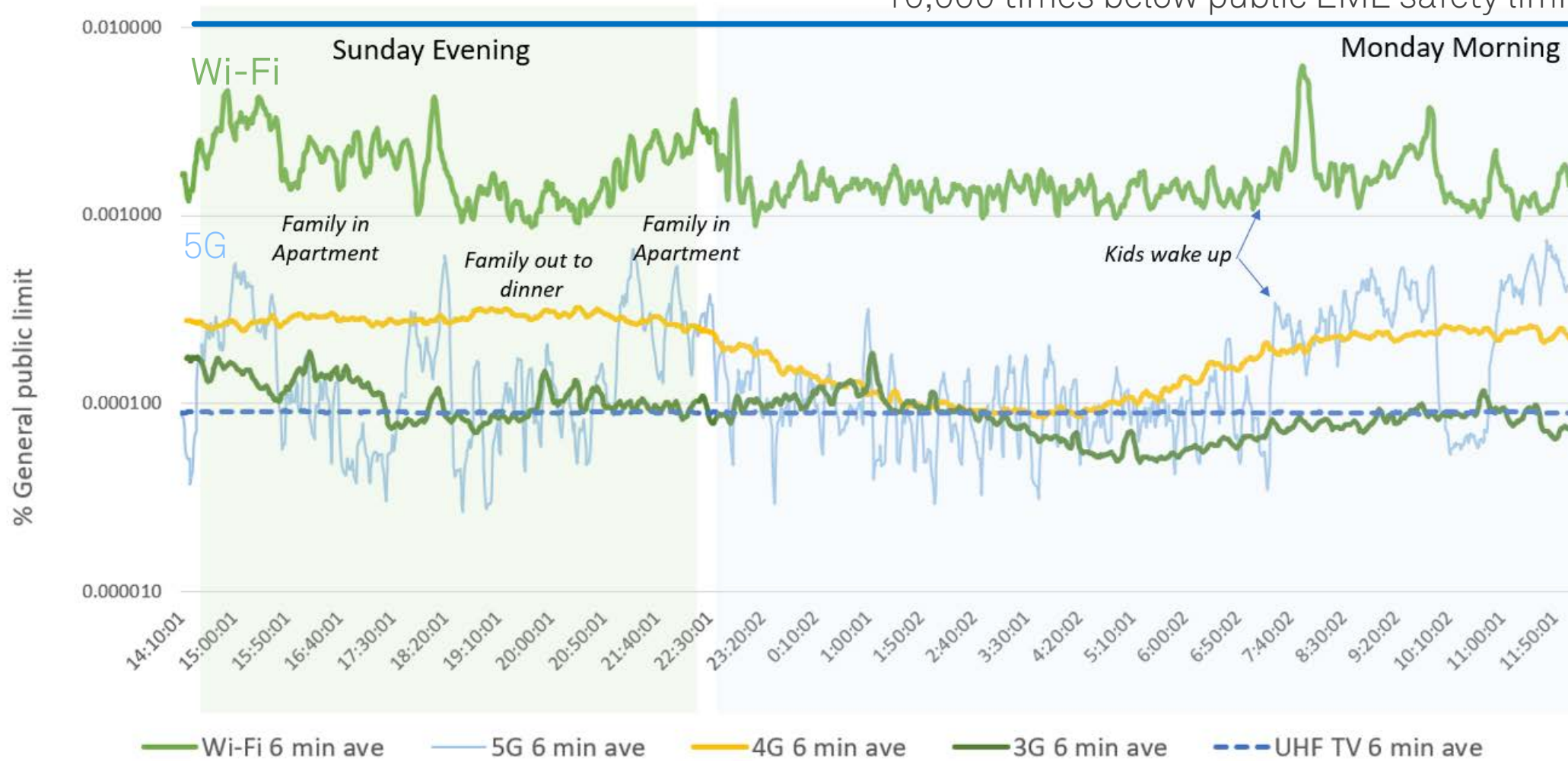


Note: 6 min average EME levels

EME Levels – Living Room (Sunday/Monday)

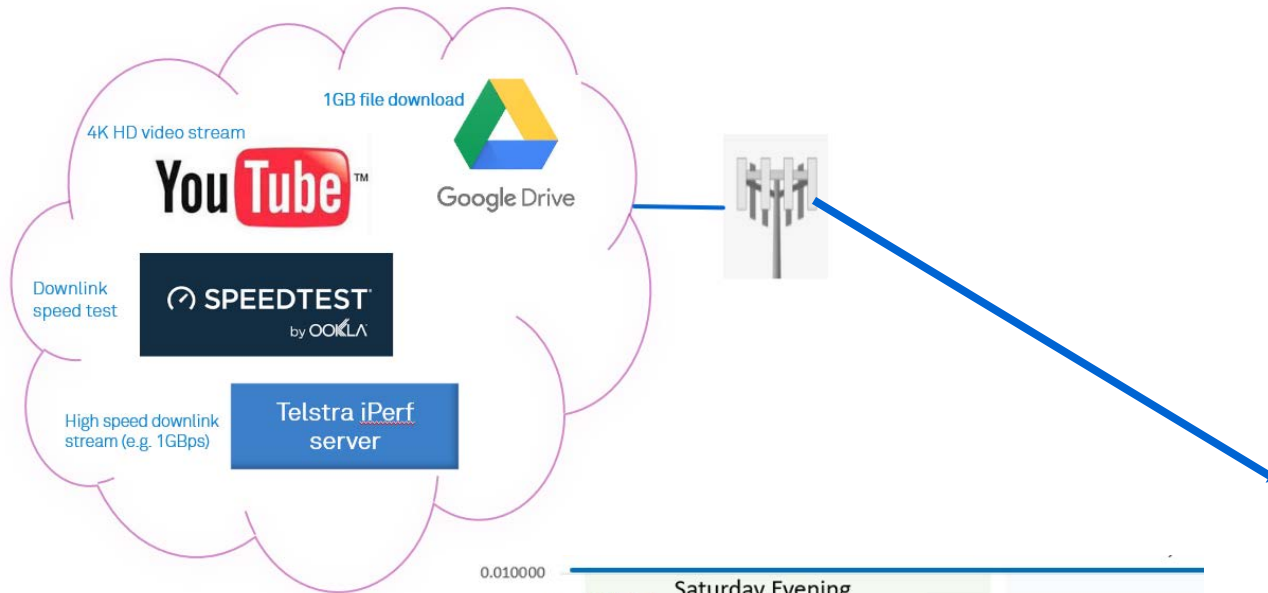


10,000 times below public EME safety limit



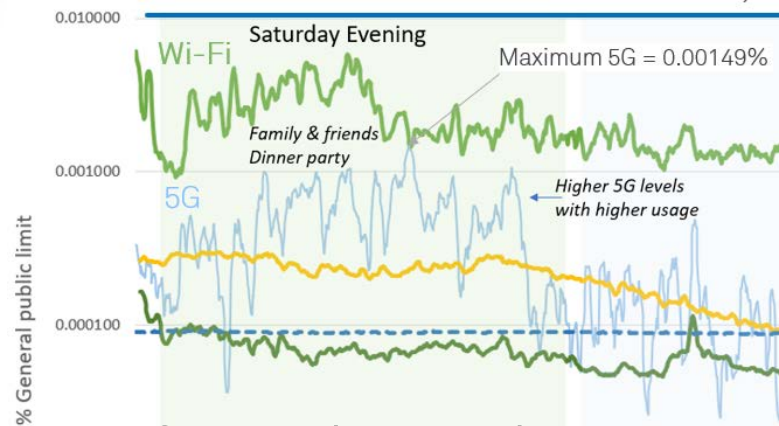
Note: 6 min average EME levels

5G Network – did the dinner party max it out ?



5G network loaded with iPerf (high load)
EME = 0.00143%

5G maxed out at dinner party
EME = 0.00149%



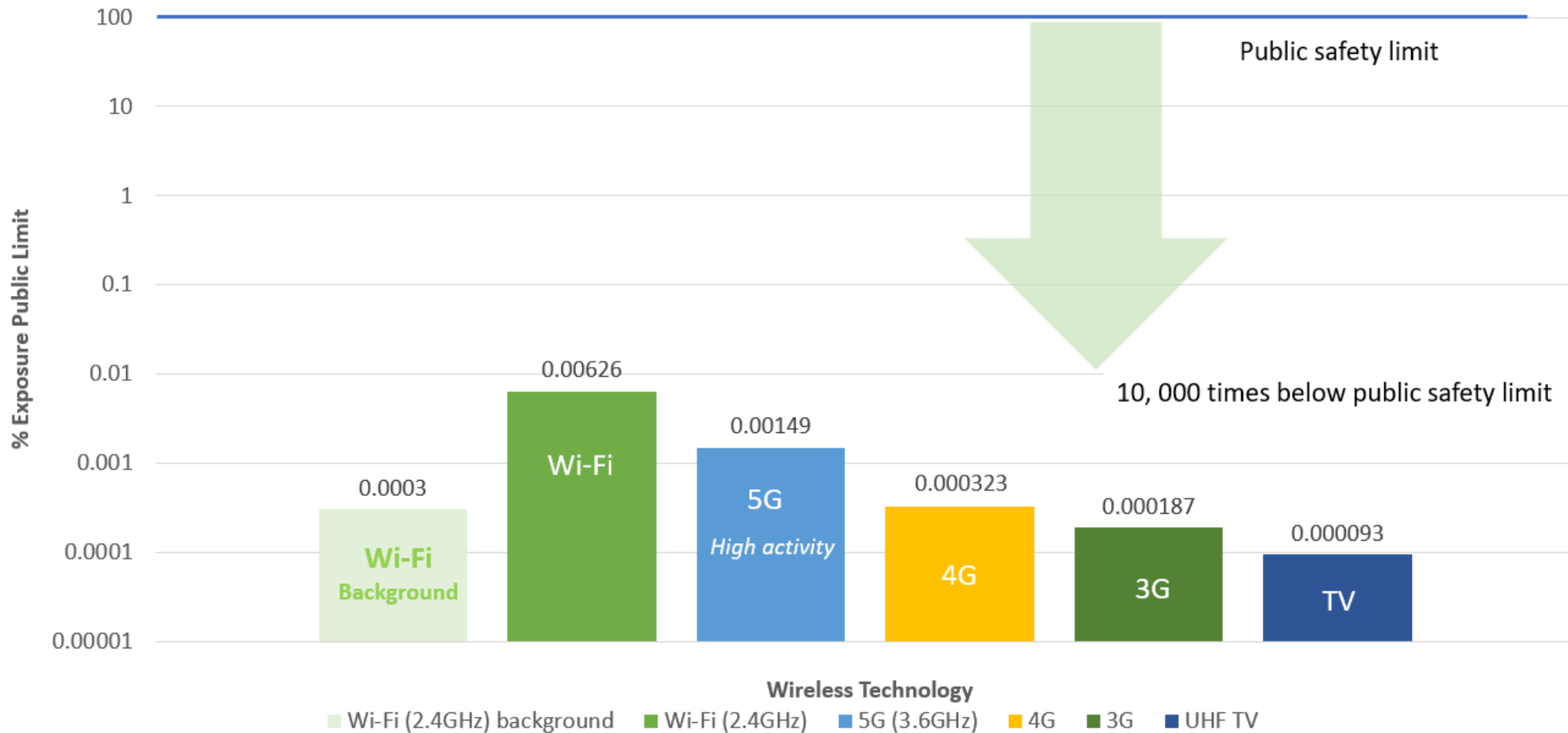
5G maxed out at dinner party



Test Results – Living Room



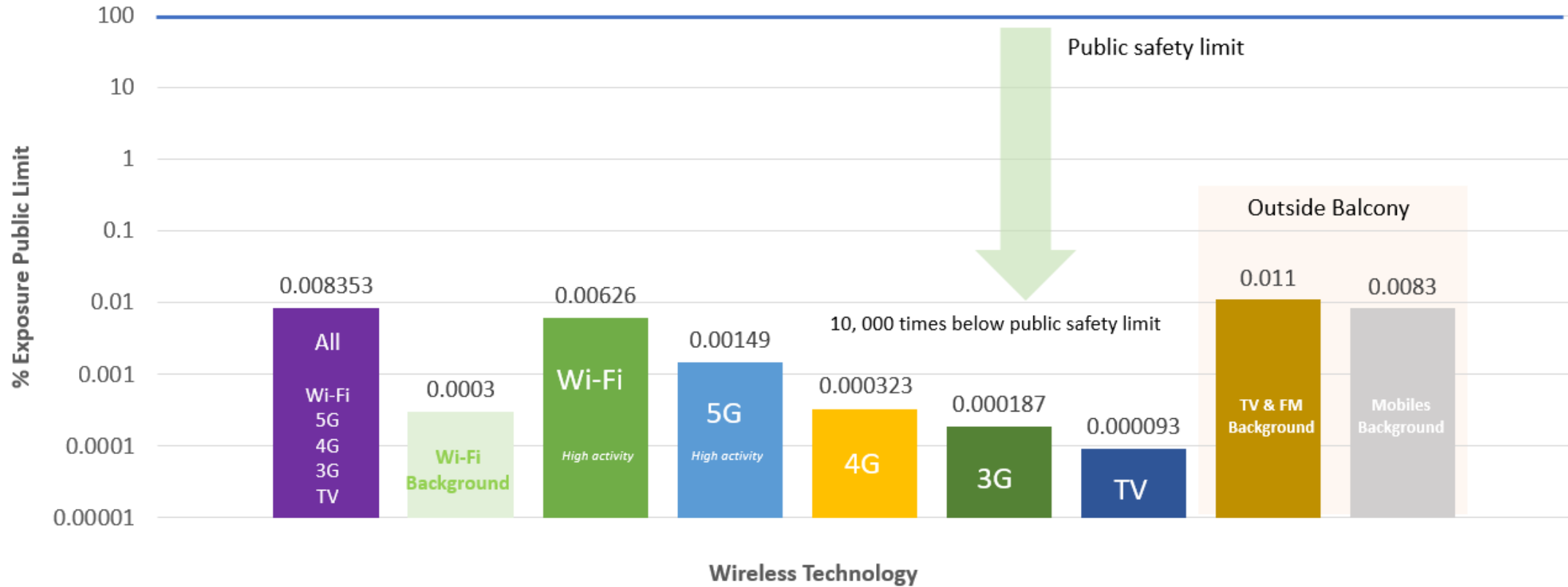
5G Smart Apartment - Highest Measured EME Levels
High Data Usage



Test Results – Living Room



5G Smart Apartment - Highest Measured EME Levels
High Data Usage



■ All
 ■ Wi-Fi (2.4GHz) background
 ■ Wi-Fi (2.4GHz)
 ■ 5G (3.6GHz)
 ■ 4G
 ■ 3G
 ■ UHF TV
 ■ Background TV & FM (Balcony)
 ■ Background Mobiles (Balcony)

All EME = Wi-Fi 2.4GHz + 5G + 4G + 3G + UHF TV in living room

Observations & Conclusions



Smart Apartment

58 devices - (5G, 4G, 5G Wi-Fi, Wi-Fi)

EME Testing

- Continuous EME Monitoring – living & media room
- Normal activity & High Utilization - (maxing out the network)
- Device Testing – individual device measurements

Highest EME Levels – living room

5G level = 0.00149% under high usage

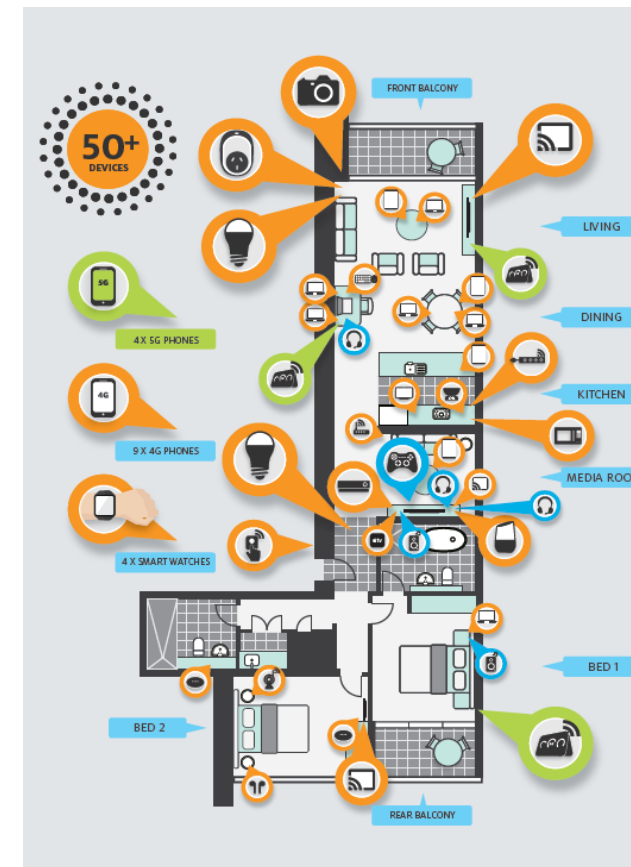
Wi-Fi = 0.00626% under high usage

All = 0.00835% under high usage

Device EME Levels @ 20cm

Baby Monitor = 0.813% (highest)

Smart Power Board = 0.00008% (lowest)



The EME levels from 5G, 4G and Wi-Fi under high utilization in a smart apartment were all very low

Thank you

More Information:

EME.Enquiries@team.telstra.com

Acknowledgments:

The team at the 5GIC

The Fuge Family

The Wills Family

