



Why spectrum sharing is needed for 5G (and beyond)

Dr. Oliver Holland

Director of Standards and Systems Integration

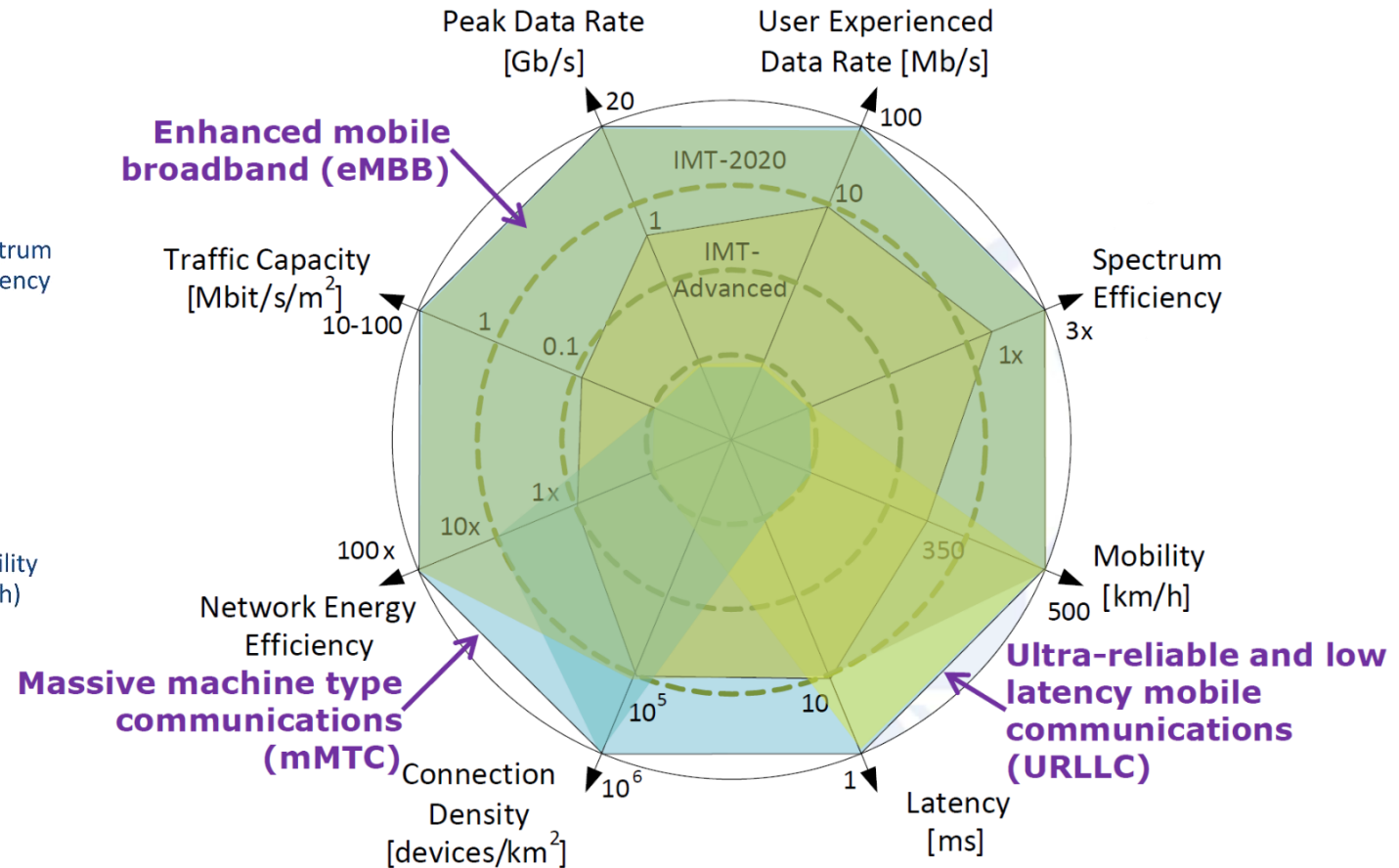
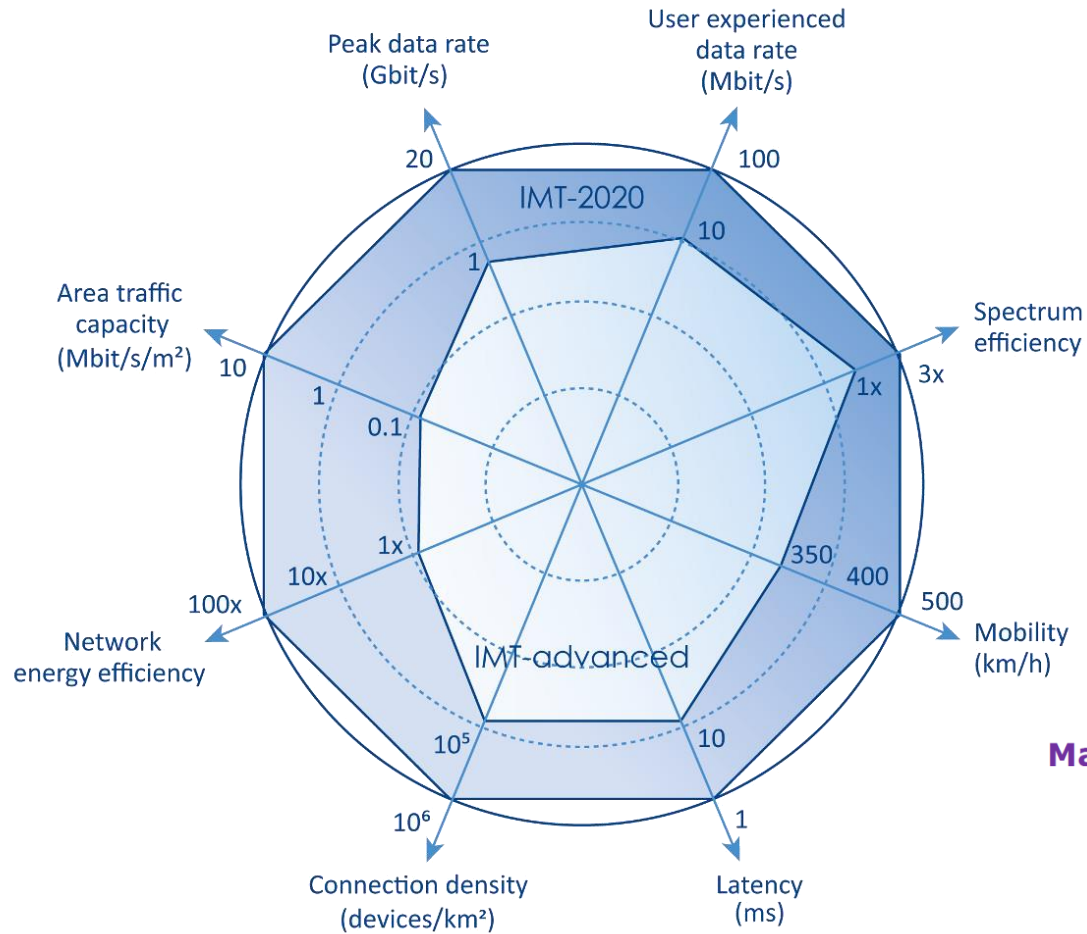
2021 Joint EuCNC & 6G Summit -

Workshop on Spectrum Sharing for the Digital Ecosystem Towards 6G

8 June 2021



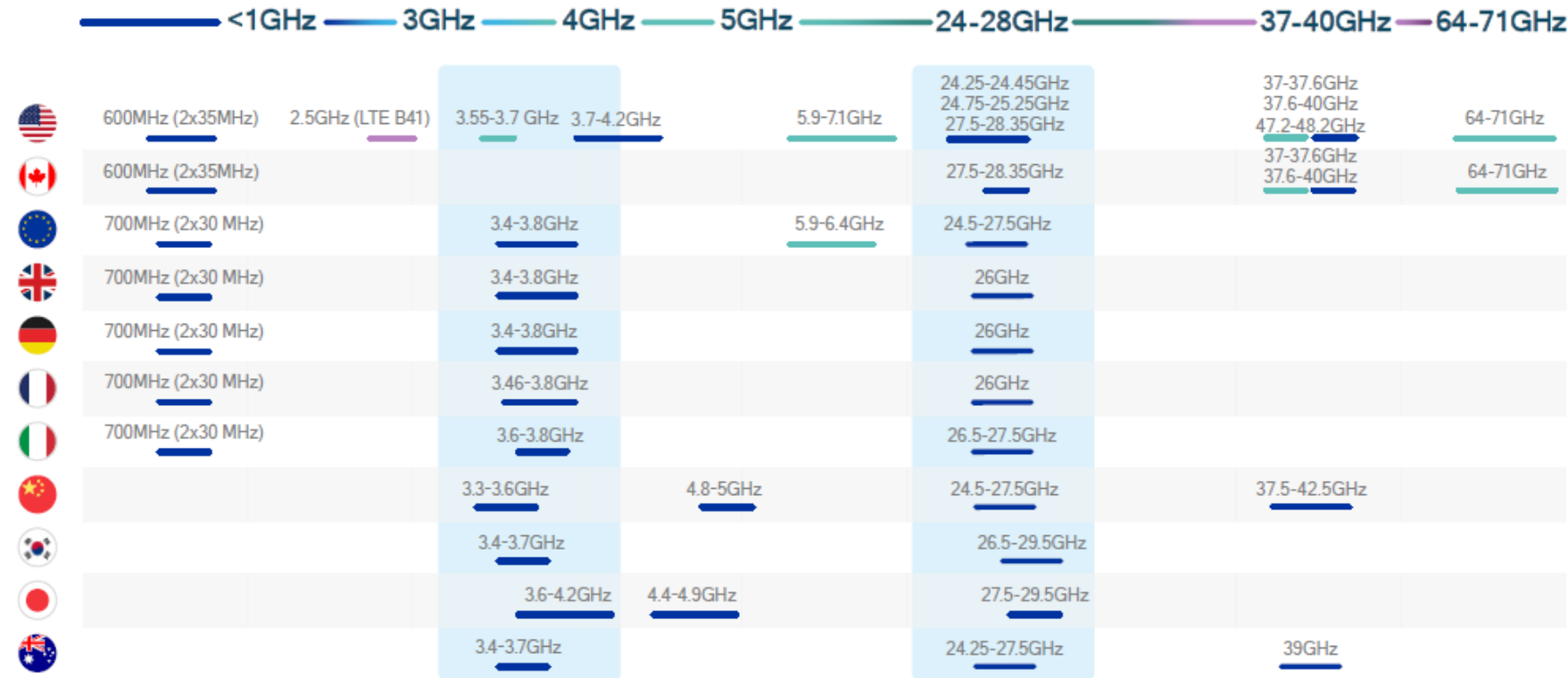
IMT-2020 (5G) Requirements



NB: Downlink metrics shown

Bandwidths and Bands

- Some of the biggest gains of 5G are through the vast bandwidths opened up at higher frequencies



Global snapshot of 5G spectrum

Around the world, these bands have been allocated or targeted

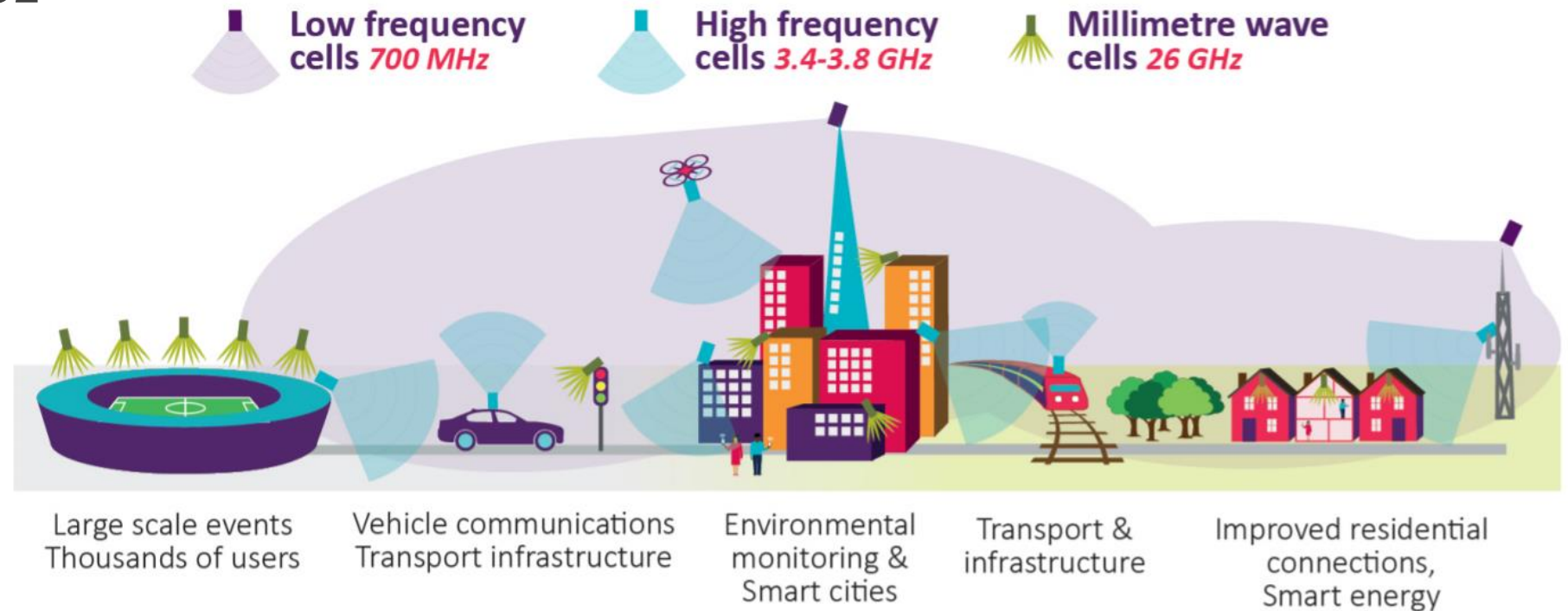
New 5G band

- Licensed
- Unlicensed/shared
- Existing band

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Bandwidths and Bands - UK Situation Example

- O2, BT/EE and Three UK have 10 MHz paired each of 700 MHz (n28); BT/EE also an additional 20 MHz SDL
 - Vodafone appears to be using 2.1 GHz n1 band, 15 MHz paired, as coverage layer
- In 3.4-3.8 GHz (n78 subset), only Three UK has contiguous 100 MHz; others still fragmented. These full bandwidths are 90 MHz (50 MHz + 40 MHz) for Vodafone, and 80 MHz (40 MHz + 40 MHz) each for EE and O2
- Mm-wave 24.25-27.5 GHz (n258) is currently not considered as “usable” by Ofcom), aside from 24.25-26.5 GHz permitted for indoor-only shared access case



Implications

- 3.4-3.8 GHz (n78 band subset) doesn't propagate
 - Depends on scenario, but commonly a few hundred metres
 - Although neutral host and rural network sharing might assist, level of implied densification not sustainable especially for rural
- 700 MHz “coverage layer” extremely low bandwidth

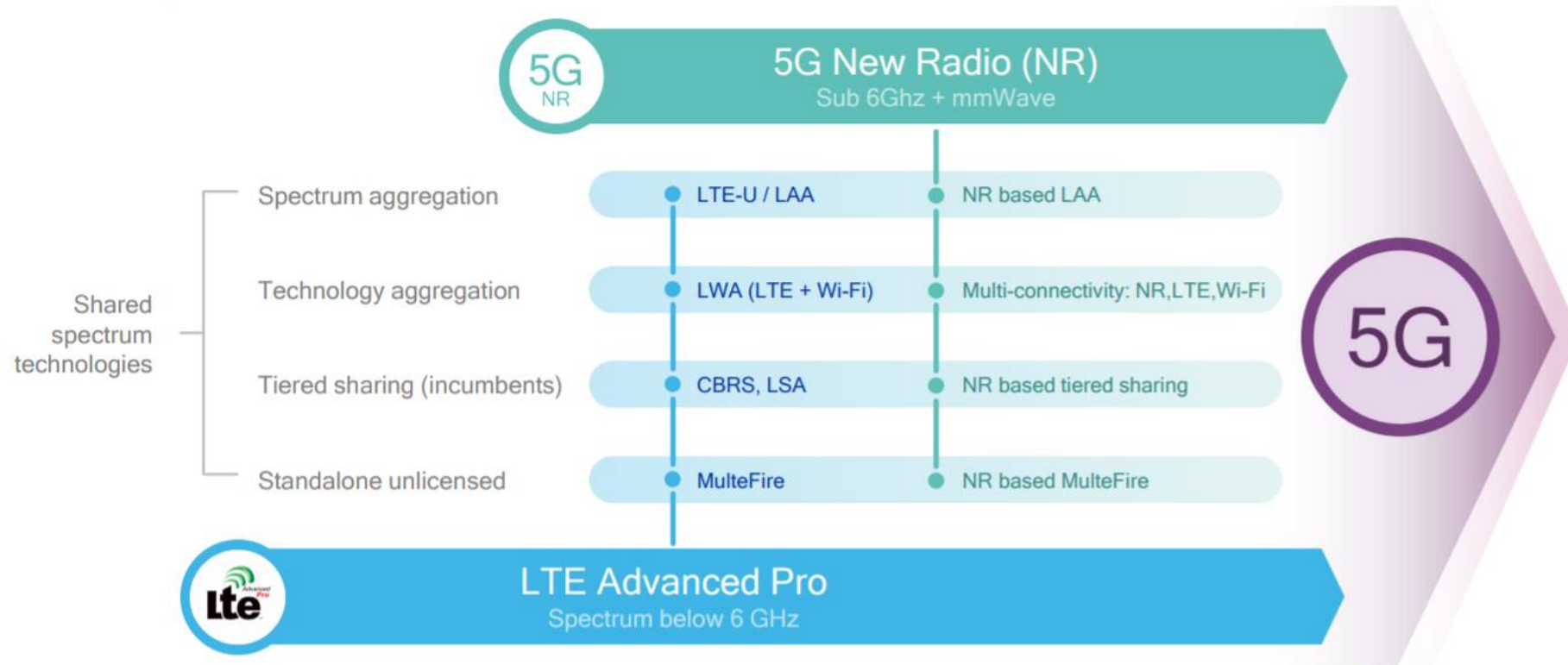
Test environment	Downlink (bit/s/Hz/TRxP)	Uplink (bit/s/Hz/TRxP)
Indoor Hotspot – eMBB	9	6.75
Dense Urban – eMBB (Note 1)	7.8	5.4
Rural – eMBB	3.3	1.6

NOTE 1 – This requirement applies to Macro TRxP layer of the Dense Urban – eMBB test environment as described in Report ITU-R M.2412-0.

- For dense urban average spectral efficiency requirement for 5G of 7.8 b/s/Hz for example, this would achieve 78 Mbps on average per cell/sector
- Perhaps more pertinently, given the rural average spectral efficiency requirement of 3.3 b/s/Hz, this would achieve 33 Mbps on average per cell/sector
- Clearly way short of 100 Mbps “user experienced data rate” for rural scenarios
- High-reliability/availability use cases for 5G? Large numbers of connected devices...?

Need for Spectrum Sharing

- Spectrum sharing vital for 5G → open as much as possible at lower frequencies through sharing. Includes unlicensed spectrum



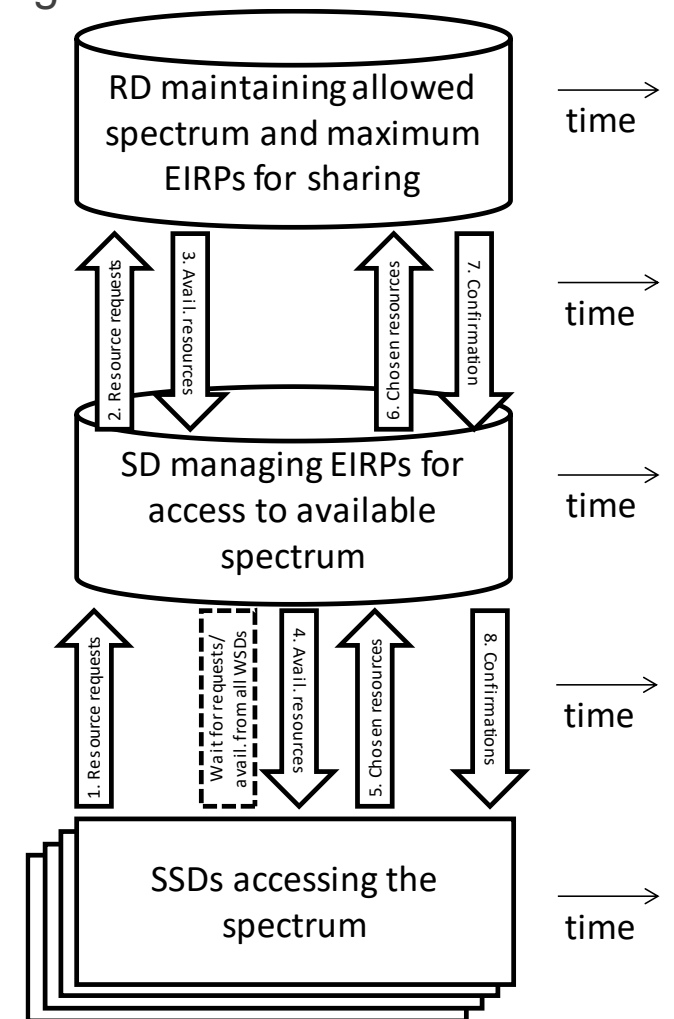
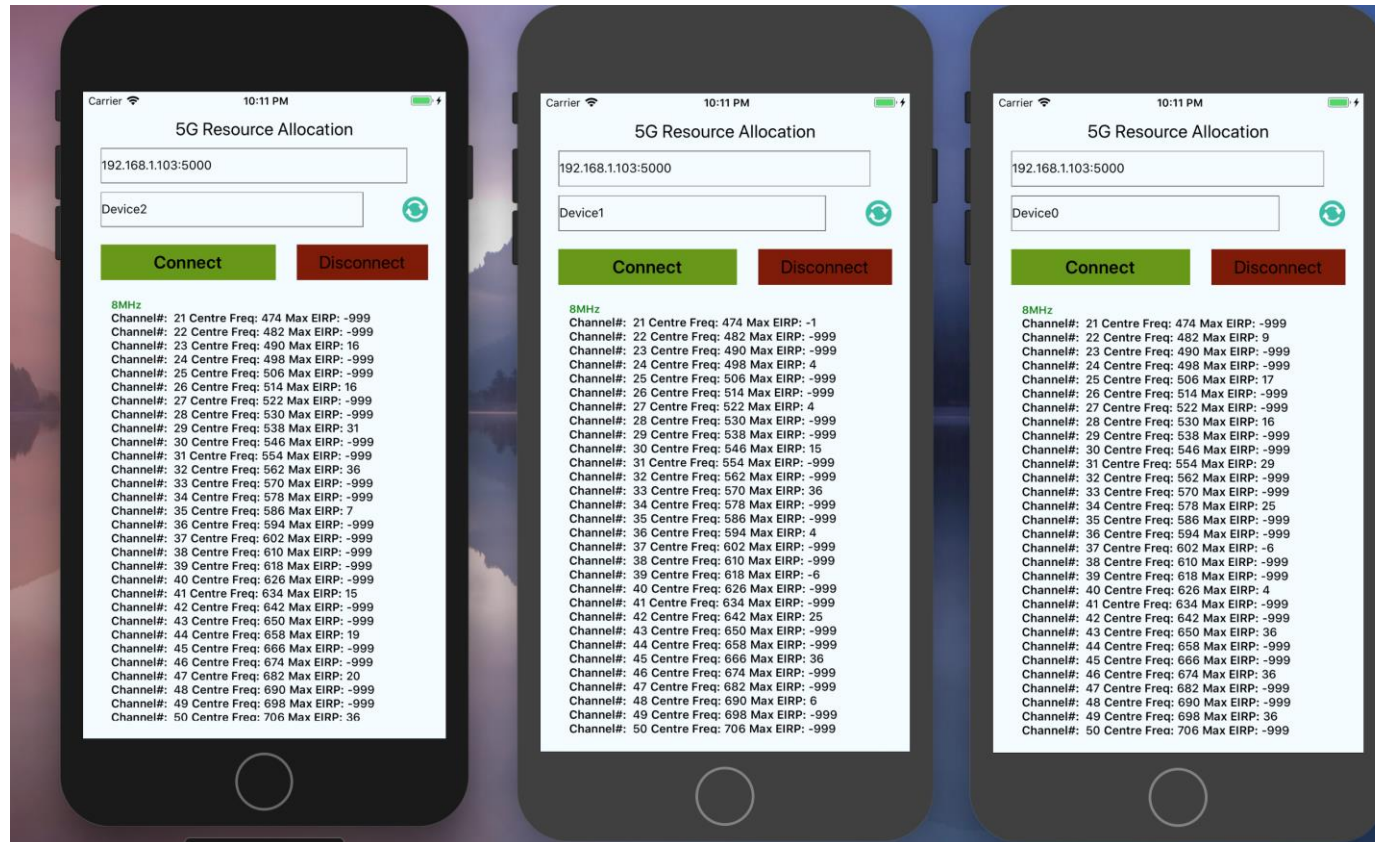
- Beyond 5G: Even higher frequencies being discussed (e.g., sub-Terahertz); satellite/airbourne solutions
 - Help for outdoor at such frequencies, but in tunnels, indoors, etc...?

Spectrum Sharing for 5G

- Shared Access Licenses / Local Access Licenses / Private 5G licenses
- Database-driven approaches
 - Citizens Broadband Radio Service (CBRS) Spectrum Access System (SAS)
 - TV White Space
 - Licensed Shared Access (LSA)
- Sensing-driven approaches
- Sharing needs to be between operators in mobile bands
 - UK 700 MHz example: doubling bandwidth
- Needs to allow access to other non-mobile spectrum in the locality
 - Challenging due to frequency flexibility requirement in radio equipment, but there are some opportunities based on supported 5G NR bands
- Needs to be focus on frequencies below the ~2 GHz range

Spectrum Sharing – Management Intermediary

- The issue quickly becomes how resources are apportioned in spectrum sharing
- AWTG management intermediary for spectrum sharing (example compliant with UK TV white space databases)



Thank you!



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