

Q. Could you please touch on the benefits / dis-benefits of 5G vs WiFi 6, which could potentially solve the indoor coverage and QoS concerns raised.

[JB:] Both technologies have their place. Wi-Fi has a strong existing ecosystem, widely included by default in devices and low cost equipment.

The inherent disadvantages of Wi-Fi tend to be:

- *The usage of licence exempt spectrum so it is more at risk of interference than 5G in licenced spectrum (but you can manage the risk of interference in LE spectrum in your own location with careful planning – take for example the very dense Wi-Fi networks deployed in stadiums)*
- *Typically, lower power limits for Wi-Fi than cellular meaning more APs needed*
- *Not designed with mobility in mind so can't cover all the use cases of 5G*

Q. What changes do you expect with the rapid emergence of Wi-Fi6E (in 6GHz) & future Wi-Fi7 around 2023-24 (likely before Rel17 5G). Does that change the calculus?

[JB:] Certainly Wi-Fi is already good enough for many enterprise private networks with lower end networking requirements and/or closed controlled physical environments where interference can be managed. These later releases of Wi-Fi seem targeted at tackling issues like latency but there is only a small subset of use cases that really need this.

I think the more generic pros and cons of Wi-Fi vs. 5G mentioned above will still apply so definitely space for both solutions depending on scenario.

Q. Julie -- how was the licensing done for the Rotterdam example? Was that also done under an existing MNO like the two German examples?

[JB:] In this case 2 of the container terminal operators acquired their own local spectrum licences for band 43 and band 42 (around 3.5GHz) back in 2014. The band 42 licence had to be vacated to make way for the 5G auction though. So no MNO involvement.

Q. You mentioned that ships were coming into port with their own Wi-Fi networks radiating/interfering. Was analysis done about bands, generation, old/new?

[JB:] I don't think – the disruption to the container terminals was such that they quickly needed to find a solution rather than spend a lot of time investigating.

Q. At what point will Private 5G (esp. in unlicensed bands) suffer from problems with multiple overlapping networks in same place? eg landlord vs. tenant owned

[JB:] In the UK checks on the potential to cause interference are part of the application process for the Shared Access and Local Access licences so shouldn't be an issue. Obviously there are limited licences per location though.

For 5G private networks in LE spectrum I think the challenges are the same as Wi-Fi. Cellular does not have any higher priority access than anyone else to LE spectrum and certainly for LAA the listen before talk type access mechanisms applied are very similar to Wi-Fi. So I think, similarly to Wi-Fi, if you have a physical space where you

can control devices deployed 5G private networks in LE spectrum should be OK but will suffer interference in wider outdoor environments just like Wi-Fi.

[SE:] WiFi behaves erratically when a given access point is congested; both from a throughput perspective (speeds, latency and jitter) but also cell edge behaviour (one never knows where the performance drops off a cliff). 5G is predictable and stable under congestion even at the edge of the cell - this is why it is much better suited to critical services (in addition to its security and mobility benefits).

Q. RIs 16 was released in Dec '20, but when will MNOs have this for their MPNs?

[SE:] Release 16 is available now from vendors. Full 5G SA from operators is 12-18 months out. For private networks it can be deployed now.

Q. How are local spectrum licenses going to be managed in a given geographical location to ensure minimal interference with commercial MNO networks?

[JB:] It varies from country to country. In the UK checks on the potential to cause interference are part of the application process for the Shared Access and Local Access licences so shouldn't be an issue. Obviously there are limited licences per location though. Power limits are also much higher than in MNO spectrum.

Q. Do the different types of Ofcom licences for private 5G networks and their frequency bands enable all of the potential use cases?

[JB:] Low power shared access licences seem to be more for indoor use cases

Medium power shared access is better for wider area outdoor private networks – but only permitted in rural areas at the moment – but would work well potentially for city wide private networks if they were allowed in urban areas too

Local access spectrum licences require negotiation with an MNO and identification of unused MNO spectrum – not likely to be applicable in city areas where MNOs will need to use all bands to deliver the capacity needed.

So overall, I would say that the Ofcom licences fail to support non-MNO, standalone smart city style private network deployments and related use cases potentially.

Q. Do you know why major mobile phones e.g. iPhone, Samsung etc. don't work on Private Standalone networks?

[JB:] Consumer targeted devices tend to support the main stream MNO frequency bands. Some have been modified on projects to work with the frequency bands of private networks but these vary between countries and result in end devices on standalone private networks being a bit more bespoke and higher cost.

Q. What about Japan and South Korea regarding private network as they started 5G earlier than other countries?

[SE:] Japan and South Korea both have private networks deployed. No different to Europe.