Suitability studies of mmWave spectrum for 5G access networks

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Outline

› Frequency bands for 5G
› 5G use cases and spectrum requirements
› Coverage aspects
› Spectrum demand aspects
› Key Messages
Frequency bands for 5G

Main frequency bands under consideration/discussion for 5G deployment

- 600/700 MHz bands (e.g. in US, Europe)
- 3.3-3.8 GHz range (e.g. in Europe, China, Japan, South Korea)
- 24.25-29.5 GHz range (e.g. in Europe, China, Japan, South Korea, US)

Frequency bands to be studied in ITU-R for 5G/IMT-2020 for WRC-19
Use cases and spectrum requirement

› **Capacity** to cope with high traffic per cell / area, including large contiguous spectrum → high bandwidth.

› **Coverage** to ensure the availability of 5G everywhere → lower frequencies.

› **Reliability** to fulfil the demands of critical services, requiring stable and predictable operation conditions → dedicated spectrum.
Coverage over frequencies

Feasible frequency range depends on a deployment scenario and lower frequency is better to ensure more diverse scenarios feasible. Higher frequency is also useful in some scenarios.

*Indicative coverage feasibility of different deployment scenarios in different frequency ranges.

*frequency dependent beamforming gain is included
Spectrum bandwidth demand analysis: Example results for xMBB use cases

- Spectrum demand varies a lot in different xMBB use cases
- Some use cases have very high spectrum demand*

### Table 1: Spectrum needs for different frequency ranges between 24.25 and 86 GHz [ITU17-WP5D].

<table>
<thead>
<tr>
<th>Examples</th>
<th>Associated conditions (details in Annex A of [ITU17-WP5D])</th>
<th>Spectrum needs in total (GHz)</th>
<th>Spectrum needs (GHz) per range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overcrowded, Dense urban and Urban areas</td>
<td>18.7</td>
<td>3.2 (24.25-33.4 GHz range)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.4 (37-52.6 GHz range)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>9.3 (66-86 GHz range)</td>
</tr>
<tr>
<td>2</td>
<td>Highly crowded area</td>
<td>9.7</td>
<td>0.14 (24.25-33.4 GHz range)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.56 (37-52.6 GHz range)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.34 (66-86 GHz range)</td>
</tr>
<tr>
<td>3</td>
<td>Indoor hotspot</td>
<td>1.8</td>
<td>0.3 (24.25-33.4 GHz range)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.56 (37-52.6 GHz range)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.77 (66-86 GHz range)</td>
</tr>
</tbody>
</table>

* Exact estimate may be under specific assumptions in D3.2
Example results for UC5 – Traffic efficiency and safety

› Spectrum demand example based on a theoretical contention based system
› The level of contention (left) and QoS requirement (right) gives significant impact on spectrum needs
Key Messages

› Success of 5G depends on the access to sufficient amount of contiguous, wide and globally or regionally harmonized new frequency bands

› Availability of sufficient and adequate spectrum for 5G requires quantity assessment (coverage/propagation conditions, spectrum bandwidth demand) and quality assessment (e.g. authorization schemes).

› Sufficient exclusive licensed spectrum is essential for providing the expected QoS and for securing investments, shared spectrum usage (e.g. by LSA scheme) is a suitable supplementary option.

› Spectrum at lower frequencies is a baseline for the 5G coverage of diverse deployment scenarios. mmWave spectrum could be used for specific use cases, e.g. high capacity demand in local areas.