## Radio Technology and Signal Processing - Summary

The beyond 5G/6G system is expected to meet significantly higher and more stringent requirements, such as Tbps data throughput, sub-ms latency, extremely high reliability, everywhere mMTC, extreme energy efficiency, very high security, cm-level accuracy localization, etc.

A straightforward way forward to deal with these challenges is to consider more and higher electromagnetic spectrum such as the sub-THz or THz, infrared and visible light spectrums, and the relevant/specific transmit and receive technologies. The centimetre and millimetre spectrum currently utilised for 5G and other legacy wireless systems need to be re-farmed and more efficiently reused, and co-existence issues, e.g. with short range communications, to be carefully addressed. A scalable architecture will be beneficial to support both low and ultrahigh data rates, esp. for IoT applications. In addition to further enhancing the used technologies (such as waveform, modulation and coding, non-orthogonal multiple access, full-duplex, massive MIMO, etc) to approach the theoretic limits, investigations are needed, e.g. for intelligent reflecting surfaces, integrated positioning, sensing and communications, random access for massive connections, wireless edge caching. Moreover, machine learning (ML) and artificial intelligence (AI) as a tool has been successfully utilized in many applications. For the application in communications and radio interface design, careful study is required.

This chapter aims to address the enabling technologies for the next generation radio interface, including

1. Spectrum re-farming and reutilisation, as well as co-existence;
2. Millimetre wave systems;
3. Optical wireless communications (OWC), especially VLC;
4. Terahertz (THz) communications including new materials (graphene);
5. Massive and ultra-massive MIMO including intelligent reflecting surface;
6. Waveform, non-orthogonal multiple access and full-duplex;
7. Enhanced modulation and coding;
8. Integrated positioning and sensing including radar;
9. Random access for massive connections;
10. Wireless edge caching for further increased spectrum and energy efficiency.
* All these technologies will target fundamental aspects of future wireless communications. They are the physical layer building blocks and ground stones to meet the requirements of next generation wireless system, and should be in place before building such a system. Therefore, they need to be handled in general with high priority.
* Considering the maturity, some less-mature technologies, such as THz transmission, positioning and sensing, may be addressed as soon as possible.
* Due to the inter-dependency, the anticipated new (esp. sub-THz or THz) spectrum bands, the relevant channel measurements and models should be considered first, followed by the transmission technologies (waveform, modulation, massive MIMO, etc, as well as pilot PoC experiments) for these new spectrums, and then by the higher layer networking protocol design.
* Some technologies, which have not widely been employed in wireless communications, such as THz, visible light communications, may be also covered by “other programs or partnerships” that e.g. take care of materials, hardware components, etc.