Enhanced TeraHertz communications for beyond 5G

Mots clés : Array

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Résumé du projet de recherche (Langue 1)
To respond to the severe spectrum shortage under 6 GHz and the huge wireless traffic demand, there is a growing research interest in utilizing higher frequency bands for beyond 5G wireless communication systems. In fact, millimeter-wave (mm-wave) technology has received a lot of attention in the recent years. Despite gains provided by such a technology, the total consecutive free bandwidth in mm-wave does not exceed 10 GHz. Therefore, in order to support data rates of Terabit-per-second (Tbps) as expected in future communication systems, a spectral efficiency of 100 bit/s/Hz is required which is not feasible by the existing communication technologies. Such a result means that enormous bandwidth is required to make feasible Tbps wireless links.

Major progress in electronic and photonic technologies has opened up practical use of Terahertz (THz) band. In this direction, THz communication could be considered as a key enabling technology for Tbps wireless links by offering free ultra-broad bands. However, THz communication is drastically impacted by a very high propagation loss and power limitations of THz transceivers leading thus to very short-range communications. Moreover, a frequency selective attenuation is caused by molecules absorption leading to a total loss of more than 200 dB for some frequencies at very short distances. Such a phenomenon splits the THz band into multiple sub-regions called transmission windows. The latter shrink when increasing the transmission distance.

Objectives:

In this thesis, we aim to identify what improvements should be made to enhance the quality of THz communication. What is the most suitable waveform for PHY-layer of THz? Is it a single carrier or a multicarrier technique? What is the gain that can be achieved when combining Massive MIMO/ultra-massive MIMO and THz communication? The purpose of this thesis is to provide new insight on these issues by analyzing the characteristics of the THz-band channel, the energy efficiency and hardware constraints of THz wireless transceivers.

The PhD student will consider the following tasks:

- Develop extensive knowledge of state-of-the-art of THz-band channel models (line-of-sight (LOS), non-LOS and multipath propagation), state of the art of the waveforms used in THz-band.
- Design the waveform the most suitable to THz communications.
- Develop a good understanding of massive-MIMO.
- Propose his solution of THz/massive-MIMO combination taking into account impact of very large arrays in the transceivers as well as the THz-band channel effects.

References: