

# Advanced Signal Processing Seminar 2, SS 2016 – Signal Processing for 5G Wireless Networks

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April 26, 2017

## 1 5G Vision [1, 2, 3]

5G summarizes the challenges ahead for future wireless networks: higher data rates; lower latencies; higher network densities; wireless for mission-critical services. These challenges create a heterogenous picture for future wireless. A number of new technologies are being considered to face these challenges.

## 2 Massive MIMO

A selection of important papers on Massive-MIMO can be found on a website hosted by the IEEE Communications Society:

<http://www.comsoc.org/best-readings/massive-mimo>

### Foundations [4, 5, 6]

Massive MIMO considers—at one side of the wireless link—a smart antenna (array antenna with complete signal processing chains behind each antenna element) with “very many” elements, e.g.  $> 100$ . The resulting wireless link is capable of removing multipath fading and capable of supporting multiple spatial streams simultaneously.

### System Architecture [see <http://www.comsoc.org/best-readings/massive-mimo>]

How many antennas are actually needed? What is the advantage of TDD operation?

### Analysis of Energy and Spectral Efficiencies [see <http://www.comsoc.org/best-readings/massive-mimo>]

The analysis of capacity bounds for massive MIMO system demonstrates the potential gain.

### Channel Estimation [see <http://www.comsoc.org/best-readings/massive-mimo>]

A fundamental problem of massive MIMO is the estimation of a massive number of wireless channel gains.

### 3 mm-Wave Systems

#### Hybrid Analog and Digital Beamforming [7, 8, 9]

Directional antennas are needed in mm-wave systems (carrier frequency  $\geq 28$  GHz) to overcome the high path loss. Hybrid analog/digital beamformers allow for many antenna elements while keeping the complexity limited.

#### mm-Wave Radio Channels [10, 11, 12]

Modeling of the radio propagation characteristics is a pre-requisite for using new frequency bands for wireless networks.

### 4 Waveform Design [13]

New waveforms are proposed to overcome the challenges posed by 5G systems.

### 5 Location Awareness

#### Location Awareness [14]

Location information can support various performance indicators of a wireless network.

#### MINT—Multipath-Assisted Indoor Navigation and Tracking [15, 16, 17]

The TU Graz approach: location-awareness for robust positioning – exploiting multipath propagation

#### Localization and Location-Awareness in Ultra-Dense Networks [18, 19, 20]

Ultra-dense networks are part of the envisioned evolution to become a reality in 5G networks. These works discuss the potential for 3D localization and location-aware communications arising thereof.

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