iJOIN Winter School

5G Cloud Technologies: Benefits and Challenges

University of Bremen, Bremen, Germany,

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Department of Communications Engineering

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University of Bremen, Department of Communications Engineering
February 2015
University of Bremen

- Founded in 1971, center of Bremen Technology Park
- Research oriented university (DFG: Top2 ranked for DFG-funding per professor in engineering)
- ca. 3,500 employees
- Excellence University
- 4 Collaborative Research Centers (CRC)
- Studies:
  - ca. 20,000 students
  - ca. 3,600 graduates per year
  - ca. 330 PhDs per year
- 44 bachelor studies
- 50 master studies
Research branches

5G

Industry 4.0

Medical Recording
Balanced project scheme from fundamental research to industry oriented pre-standardization research

<table>
<thead>
<tr>
<th>Fundamental research</th>
<th>Applied research</th>
<th>Contract research</th>
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<tr>
<td>DFG/ZF – projects single and/or cooperative</td>
<td>BMBF/EU-Projekte cooperative projects w/ industry</td>
<td>industrial cooperations bilateral</td>
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- **Fundamental research**
  - DFG/ZF – projects single and/or cooperative
- **Applied research**
  - BMBF/EU-Projekte cooperative projects w/ industry
- **Contract research**
  - industrial cooperations bilateral

- **Time to market**
  - 10 years
  - 5 years
  - < 5 years

- Project schemes: NiCoM, CoSem, INNS, INDA, Universität Bremen, BZKI, HiFlecs, METIS, iJOIN, Alcatel-Lucent, dōcomo

Diagram: Project scheme slide with arrows pointing from fundamental research to contract research, illustrating the time to market (10 years, 5 years, < 5 years) and project schemes.
Research in a nutshell

Cooperative Communications  
Dr. Dirk Wübben
- Network coding
- Two-way-relaying, multi-hop-relaying (IDMA)
- Waveform design
- mmWave technologies
- Projects:
  - DFG: COIN
  - EU: METIS, iJOIN
  - Industry
- Applications:
  5G: D2D, relaying networks, ultra-dense networks
- Publications (since 2012):
  1 book chapter, 3 journals, 18 conferences

In-Network-Processing  
Dr. Henning Paul
- Distributed linear and non-linear estimation
- Consensus-based estimation and detection
- Projects:
  - DFG
  - EU: iJOIN
- Applications:
  Environmental monitoring, 5G - ultra dense networks (small cells)
- Publications (since 2012):
  3 journals/letters, 10 conferences

Compressed Sensing  
Dr. Carsten Bockelmann
- CS-Multi-User-Detection
- CS vs. channel coding
- Compressive sampling and signal acquisition
- Projects:
  - DFG
  - EU
  - BMBF: HiFlecs, BZKI
- Applications:
  Massive M2M communication, invasive neuronal signal recording
- Publications (since 2012):
  4 journals/letters, 14 conferences
ANT Nutaq Hardware Platform

**Hardware Properties**
- 4x4 MIMO at 20Mhz Bandwidth
- 2.4 GHz and 5 GHz Band
- Half-Duplex
- 14 bit @ 104 MSPS A/D & D/A
- Real-Time (DSPs & FPGAs)

**Offline Processing**
- VDL Synthesis
  - Real-Time Applications

**Real-Time Applications**

**Lte**

**Co-Simulation**
- Matlab
- Simulink
- Co-Simulation („Live“ Evaluation)
- Real-Time and offline processing combined

**Over Air Testing of PHY/MAC concepts/algorithms**
Thank you for your attention!