



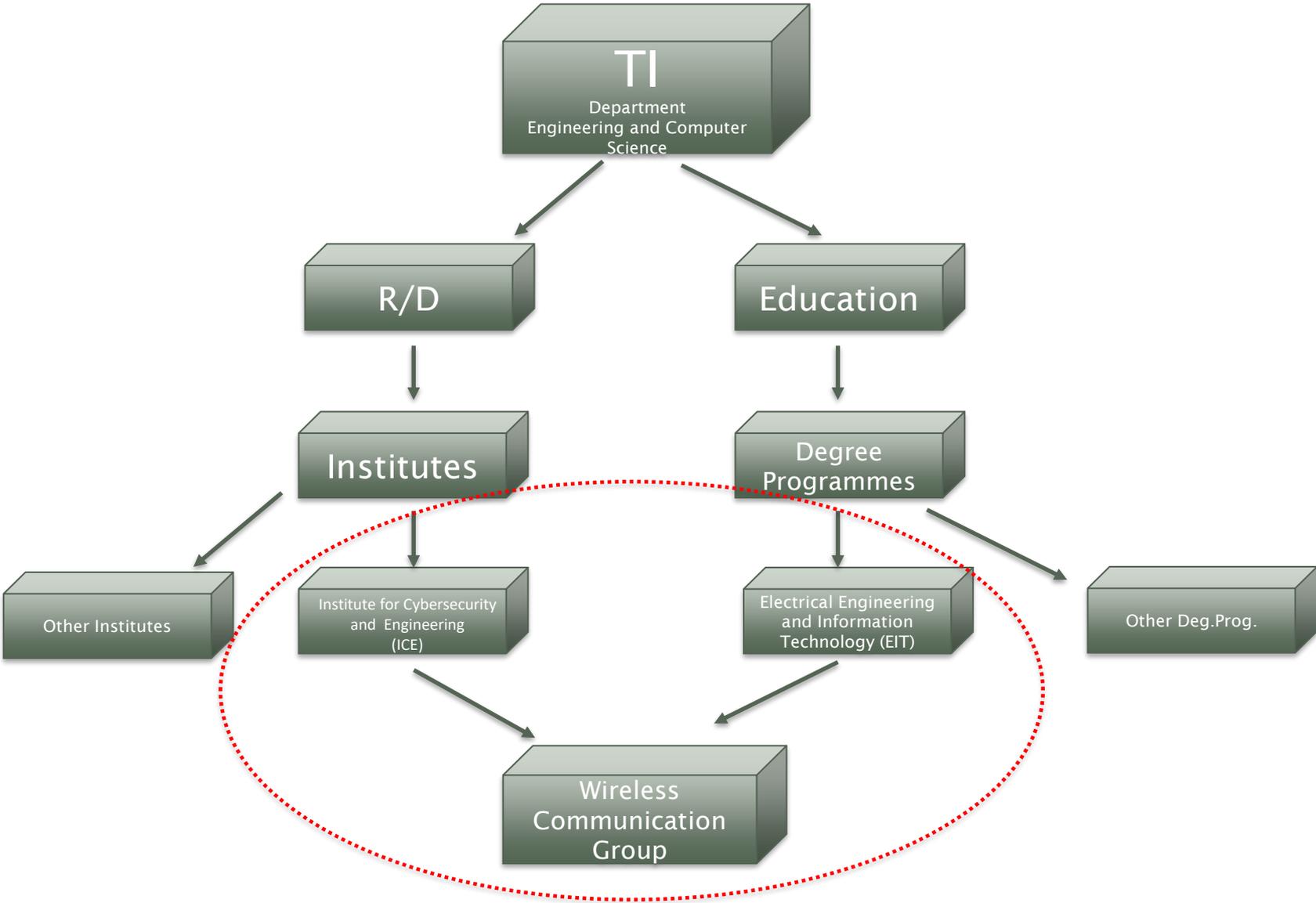
Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

Research Activities @ BFH Lab for Wireless Communications

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Frequency Engineering

Who are we ?

Bern University of Applied Sciences



Wireless Communications Group

R/D- Team consisting of

- ▶ 2 Professors
- ▶ 4 Scientific collaborators
- ▶ 1 Lab Technician



What are our activities?

Main activities

Teaching

- ▶ Courses at both Bachelor and Master level
- ▶ Supervision of undergraduate and graduate students for bachelor and master studies
- ▶ Internships in the field of Radio Frequency Engineering/Software Defined Radio

R/D

- ▶ All but one 40% of FTE financed externally
- ▶ **Innosuisse projects with SMEs (up to three-year projects)**
- ▶ **Directly financed projects**
- ▶ Cost-effective services in the context of bachelor theses and diploma theses
- ▶ Measurement services in the field of high frequency technology

What are our core competences?

Core Competences

- ▶ Radio Frequency Engineering, currently up to 26GHz
 - ▶ fast mixed analog/digital/mixed circuits
 - ▶ Antenna design
- ▶ „Business Idea“:
Combining of RF Engineering by Software Defined Radio
 - ▶ Using commercially available SDRs
 - ▶ Development of dedicated SDRs, if needed
 - ▶ Leading Etch RFSoc (4GHz BW)
- ▶ Fast digital and analog signal processing
 - ▶ FPGA, Embedded PCs

Focus Topic : RF Design & Software Defined Radio

- ▶ Capture of larger bandwidths from the RF spectrum
- ▶ Direct digitization (e.g. by subsampling) and conversion to (complex) baseband
- ▶ Further processing of the signals in the baseband using
 - ▶ FPGA
 - ▶ Embedded PCs
- ▶ Advantage:
 - ▶ development of **reconfigurable systems**,
 - ▶ great flexibility. These
 - ▶ can then be **adapted relatively quickly** to the most diverse **needs of our (SME) customers**.

Selected project examples

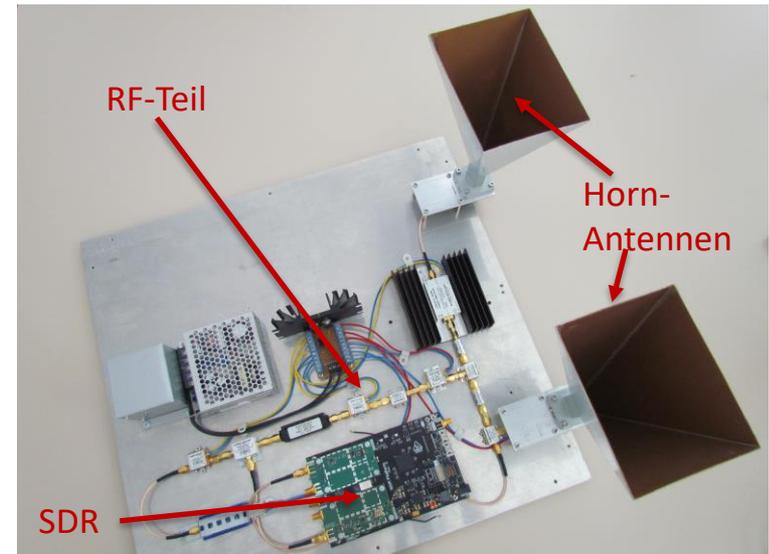
Project 1: SDR based *active RADAR* (cont.)

- ▶ Active radar with the **most flexible generation of the waveforms**
- ▶ Signal generation via SDR
- ▶ Up-/Downconversion 300 MHz 9 GHz with classical microwave technology
- ▶ Attachable expansion board
- ▶ Application for bird detection

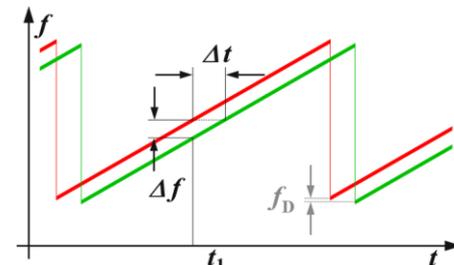


SDR based *active* RADAR (cont.)

- ▶ Bird detection
 - ▶ Study purposes (biologists)
 - ▶ Protection from wind turbines
- ▶ Conventional solution:
 - ▶ Pulse radar, several kW
 - ▶ Large, high maintenance (tubes)
- ▶ Our solution:
 - ▶ FMCW radar, only 4 watts (!), compact
 - ▶ Signal conditioning: DC..300MHz RF part 9GHz
 - ▶ Measurement signal shape can be adapted to any specific measurement scenario
 - ▶ Detection radius 1.2km (practice)



SDR-based 9GHz-FMCW Radar



Basic FMCW Radar
Working Principle

Projekt 2 : Through Wall Sensing

- ▶ Detection of movements behind one ... two walls
- ▶ Signal generation by SDR
- ▶ Up-/Downconversion 300 MHz 2.4 GHz with classical microwave technology
- ▶ New signal processing method
- ▶ No calibration required during operation, only 2 antennas needed
- ▶ Youtube demonstration video:
<https://www.youtube.com/watch?v=EcVynxZvHcE&t=24s>



More projects

- ▶ On board Radio Direction Finder (Interferometer) upon Drones
 - ▶ GPS/Orientation Sensor
 - ▶ LimeSDR / Udoe Bolt
- ▶ Multi-view three-dimensional radar imaging to derive accurate digital Earth surface models



Thank you very much