IP CREW

Cognitive Radio Experimentation World

The LTE Advanced Testbed in Dresden

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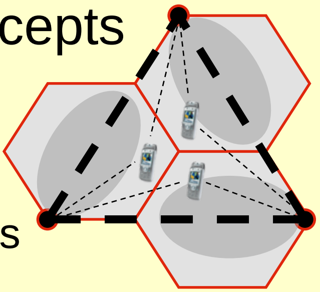
Motivation for an LTE-Advanced Testbed

Requirements, Metrics

- Latency
- Fairness
- Spectral Efficiency
- …

Advanced Concepts

- CoMP
- Relaying
- Advanced MIMO
- Antenna concepts
- Scheduling



Key Questions:

- Do concepts work?
- How often do they yield which gain?
- What is the price?
- Which steps in standardization need to be taken?

Simulations

Field Test Measurements

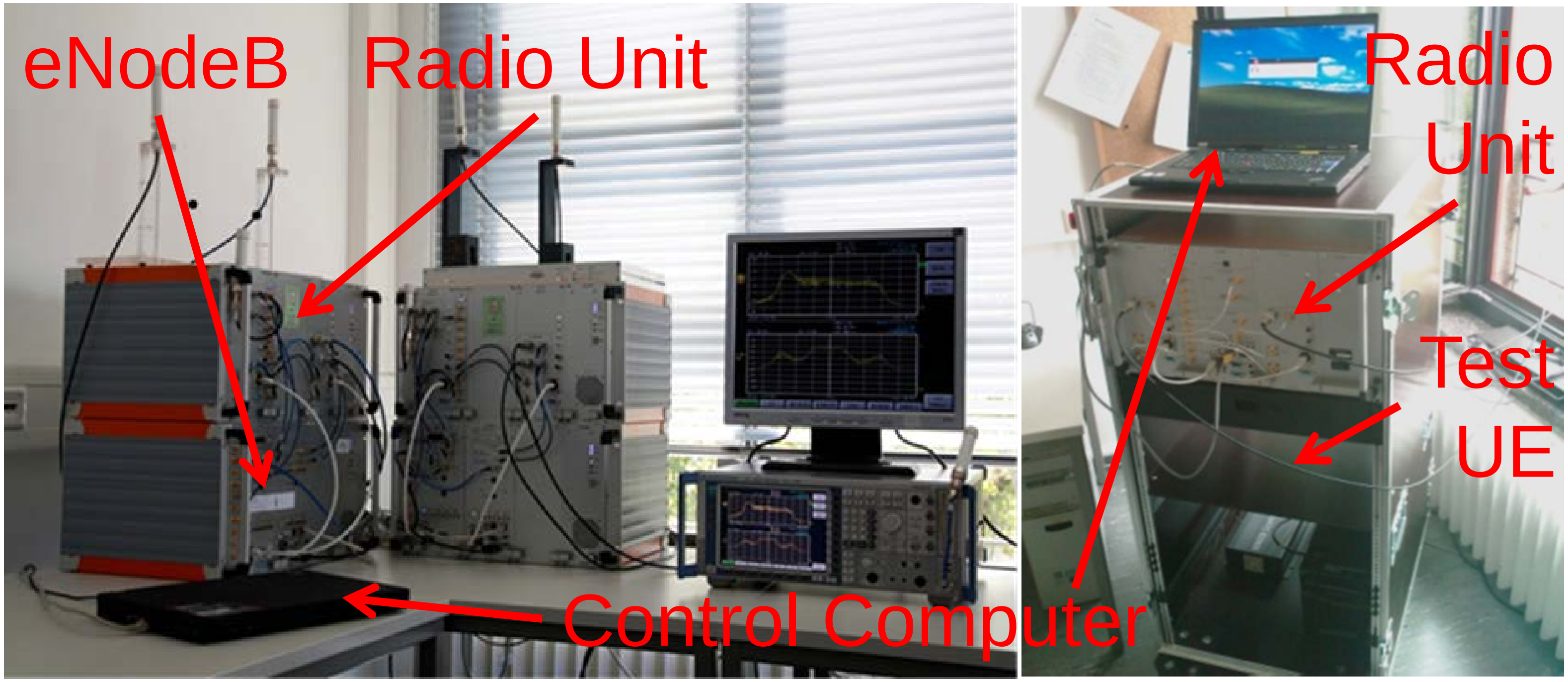
Available Hardware

- **Signal Processing Hardware by Signalion**
  - eNB - Sorbas602 eNodeB Simulator
  - UE – Sorbas202 Test UE
  - Sorbas472 Radio Unit
    - EUTRAN band VII (2.6 GHz)
    - 20MHz bandwidth
    - Supports 2 Tx and 2 Rx channels
  - Dimensions: 19” rack, 7 HU
- **Other**
  - Batteries
    - 6; each can supply an UE for around 2-4 hours
  - Antennas
    - For UEs and indoor eNBs → omnidirectional Kathrein 800 10431
    - For outdoor eNBs → sectorized Kathrein 800 10551
  - GPS receiver
    - For time synchronization of eNBs
    - For position tracking of UEs
  - Various coaxial cables, attenuators, splitters
  - Measurement equipment
    - R&S FSH4
    - R&S FSQ8

Available Hardware: Indoor

Flexible setup: Tx and Rx antennas can be moved within the lab room

- Tx power: ~15dBm
- 5 eNBs stationary on the desks
- 4 stationary UEs, 2 on studio racks, 2 on carts

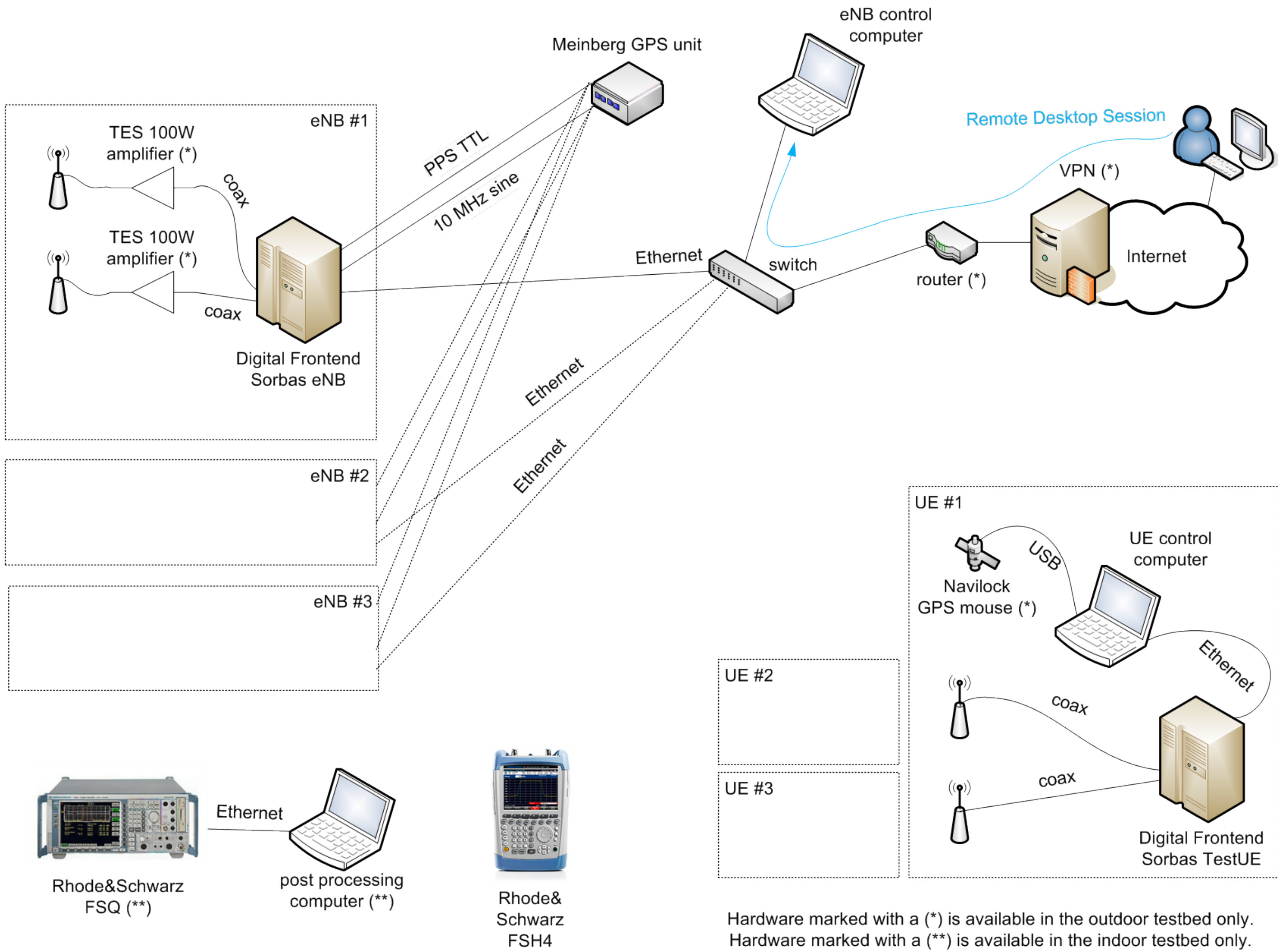


Available Hardware: Outdoor

Realistic setup: Two sectors on roof of our institute's building; UEs can roam around indoor and outdoor

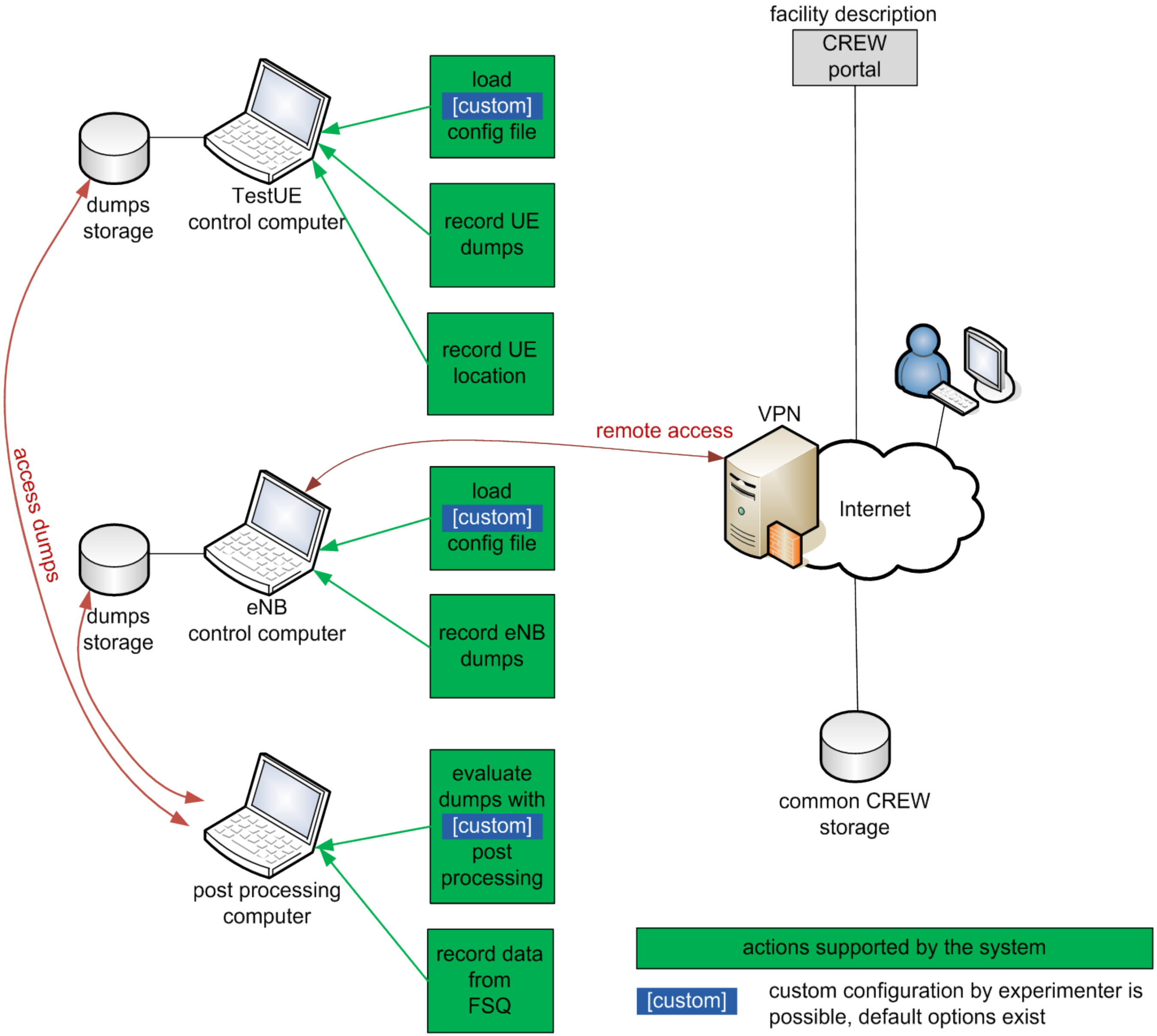
- Tx power: ~30dBm
- 2 eNBs on the roof
- 3 UEs on studio racks / rickshaws

Testbed Setup



Hardware marked with a (*) is available in the outdoor testbed only.
Hardware marked with a (**) is available in the indoor testbed only.

Testbed Usage



Performance Evaluation

- **Real-time – directly from receiver**
  - Received Signal Strength Indicator (RSSI)
  - Reference Signal Receive Power (RSRP)
  - Path loss
  - Channel Quality Indicator (derived from SINR)

- **Non-real-time – signal dump and offline MATLAB post processing of baseband-I/Q data**
  - QAM constellations
  - Block error rate (BLER)
  - …

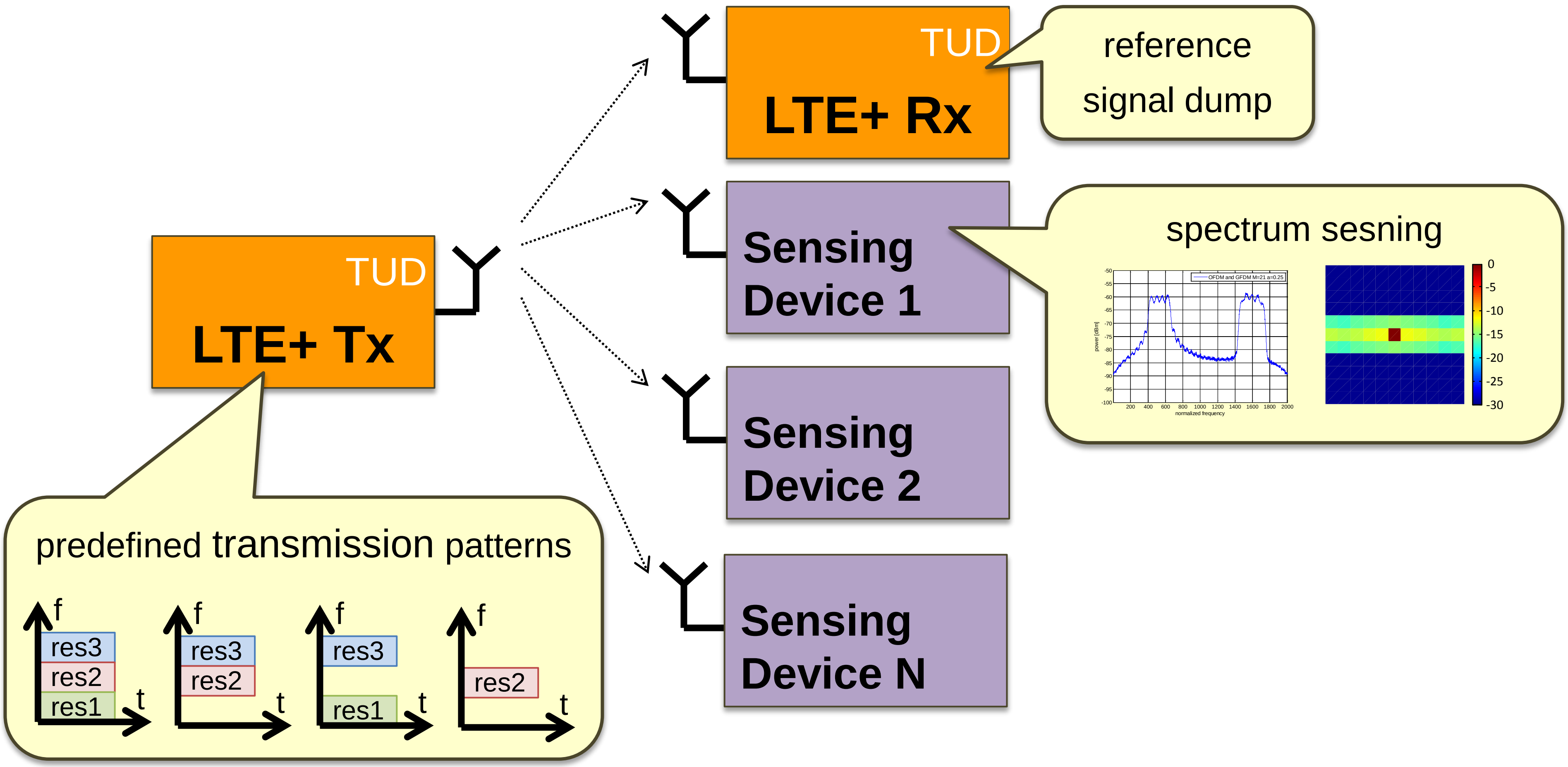
Deviations from Standard

- **Testbed supports most of LTE Rel. 8**
- **However:**
  - DL frame structure and control channels slightly different
    - PDCCH is always on 2. OFDM-symbol (variable position according to Rel. 8)
    - PHICH (HARQ indicator channel) is not in the first OFDM symbol and has a different structure / content
    - PCFICH (control format indicator channel) not supported
    - PBCH not supported
  - UL scheme is OFDM instead of SC-FDMA
    - other deviations

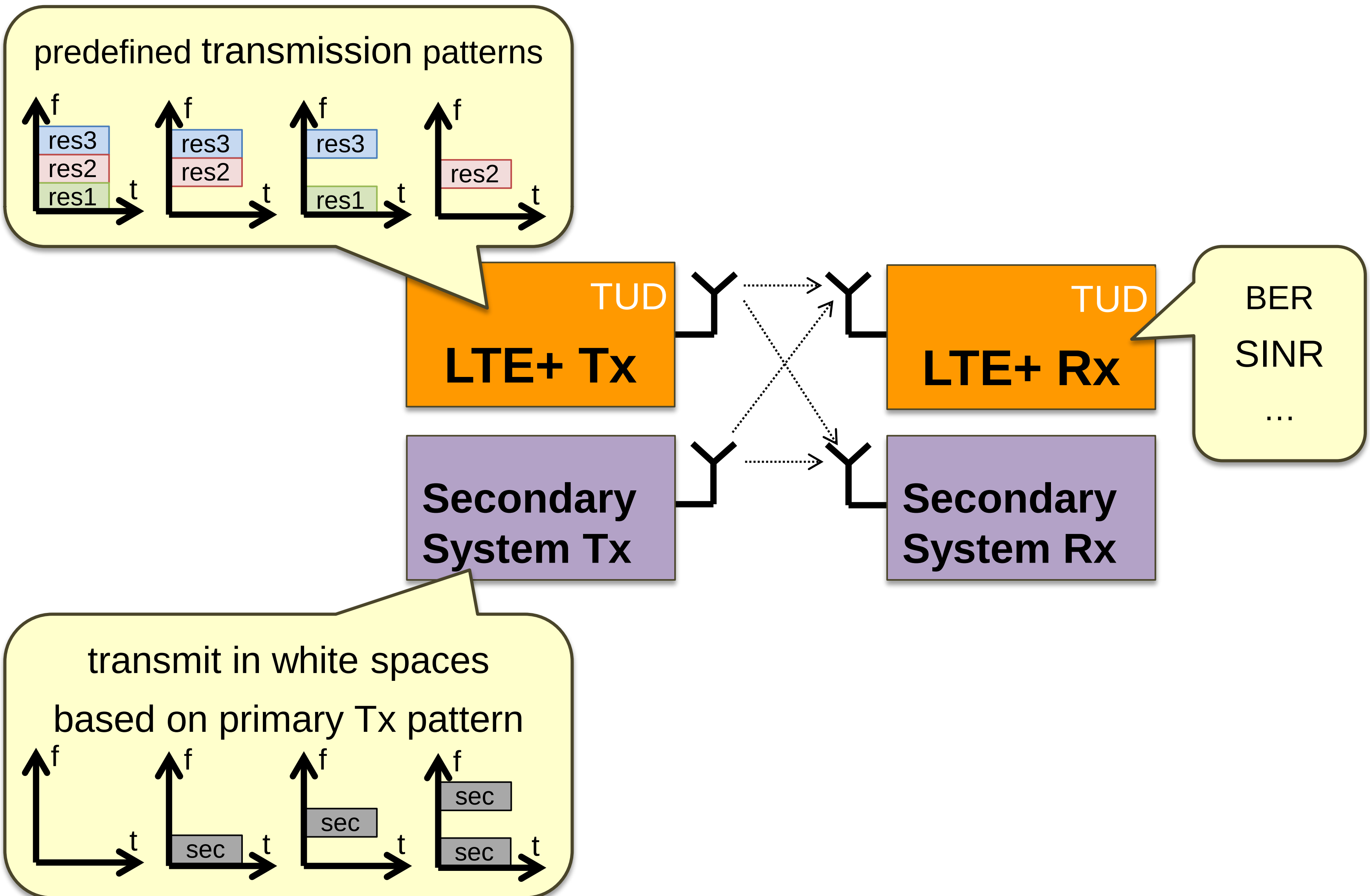
Envisioned Usage in CREW

- **Setup 1: White Space Detection**
  - Validate spectrum sensing algorithms for LTE signals in a realistic environment
- **Setup 2: White Space Transmission**
  - Measure impact of secondary system transmission schemes on the performance of the primary system
- **Setup 3: Detection and Transmission**
  - Closed loop: Primary transmission → Spectrum sensing → Secondary transmission

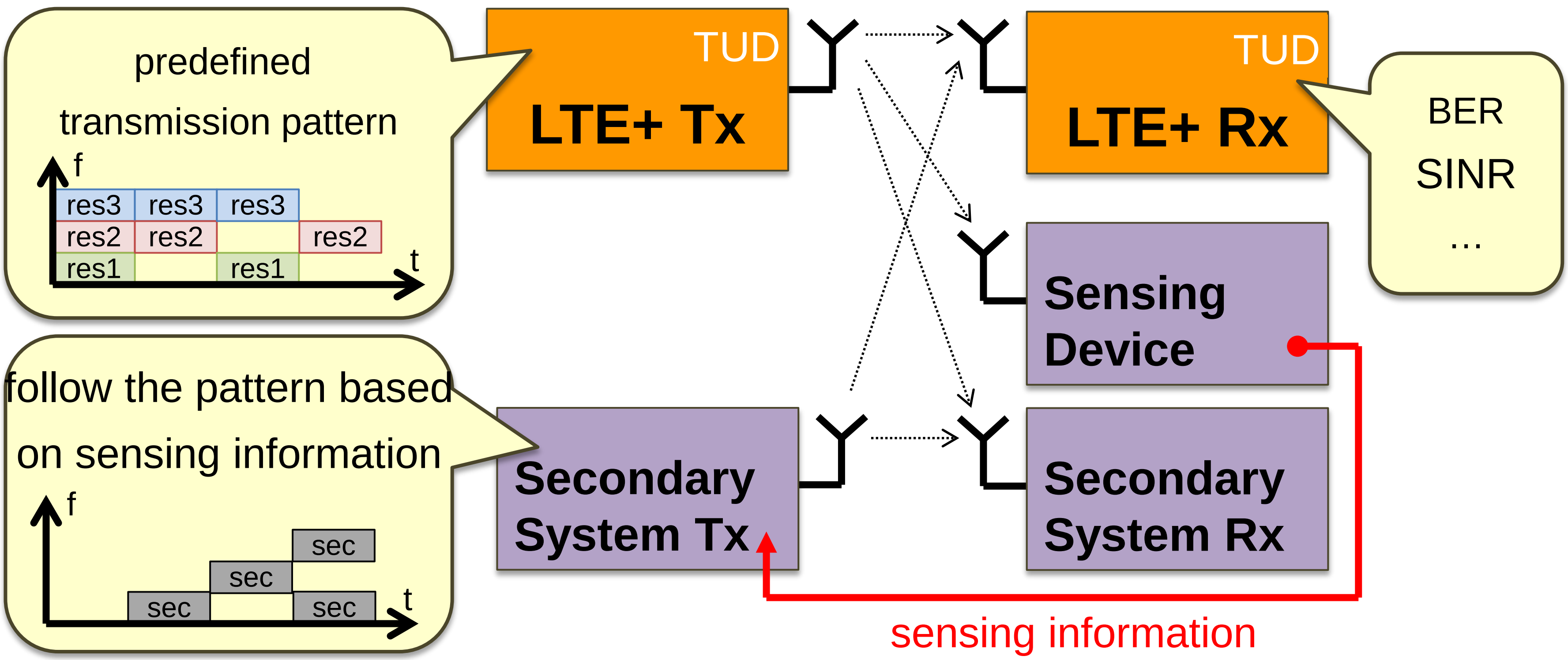
White Space Detection



White Space Transmission



Detection and Transmission



CREW

SEVENTH FRAMEWORK PROGRAMME

Thank you!

Testbed UL and DL Chain