Remote Area Networks
- The Last Frontier for Universal Access

Yaning Zou, Technische Universität Dresden, Germany
Luciano Leonel Mendes, Inatel, Brazil
4th ITU workshop on Network 2030, May 21-22, 2019
Motivations and Applications
Motivations for Remote Areas

- Connectivity gap in rural areas
- New markets for operators
- IoT in Remote Areas
- Road coverage
Connectivity in remote areas

- Last frontier for universal access.
- 3.9 billion people unconnected.
- High social impact:
  - e-gov
  - e-health
  - remote education
New Market for Operators

- New customers.

- Micro-operators partnership.

- New services to be offered.
IoT in Remote Areas

- Smart Farm application
  
  Field information: soil, water, air.
  Remote activation: watering system.
  Cattle monitoring.
  Machinery control: platooning.
IoT in Remote Areas

Use of Drones for pesticide and fertilizer.
Road Coverage

- Entertainment
- V2X connectivity
- Safety
5G-based Solution
5G-RANGE Project

• Funded by ICT EU-BR JOINT CALL
  o Call topic: 5G Networks
  o H2020-EUB-2017 on the EU side
  o 4ª Chamada Coordenada BR-UE em Tecnologias da Informação e Comunicação

• Project duration: 30 months

• Starting date: 1st November 2017

• Budget:
  o EU funding: EUR 999,906,25  BR funding: R$ 3,248,121,34
5G-RANGE Consortium
5G-RANGE Goals

Provide mobile broadband in remote areas.

Overcome the current limitations in range in 4G and 5G standards.

Reduce the operational cost by exploiting TVWS in remote areas.

Increase the data rate at the cell edge.

Bring 5G services to rural and remote areas.
5G-RANGE Requirements

Cell radius: 50 km
Data rate: 100 Mbps
Mobility: 120 km/h
5G services: MBB & IoT
5G-RANGE Features

Robustness: MIMO diversity and Polar Codes

Smartness: Cognitive Radio & Dynamic Spectrum

Coexistence: Low Out-of-Band emissions

Flexibility: covers multiples scenarios

Evolution: Software Defined Radio approach
5G-RANGE Features

Exploit the advances proposed for 5G.

But tailored for the new scenario.

Flexible PHY

Cognitive MAC

Network Layer
5G-RANGE Features

- Development of a Long-range Network based on SDR.
- Combination of FPGA and CPU/GPU processing for higher throughput and flexibility.
- Fast prototyping environments. Build RF front-end for sub 1GHz white space exploitation.
5G-RANGE Field Test

- System parameters:
  - MIMO: 2+2
  - TX1 power (EIRP): 50.5 dBm
  - TX2 power (EIRP): 48.5 dBm
  - Transmit antenna gain: 9 dBi
  - Receive antenna gain: 9 dBi
  - BW: 6 MHz or 12 MHz
  - Frequency: 700 MHz band
Remote Area Networks in 2030 Framework
Remote Area Networks in 2030

- **Broadband access date rate ~ 1Gbps**
  - Immersive experiences for e.g. entertainment, education, agriculture and health-care applications
  - Better coverage & mobility trade-off

- **Low latency especially while using satellite backhaul**
  - Mobile edge computing at local network

- **Connecting diverse ranges of devices**
  - Heterogeneous and flexible network topologies
  - Ultra-fast information processing/fusion
Remote Area Networks in 2030

• **Reliable and resilient network for 24/7 operation**
  - Example: autonomous machinery for seeding and harvest
  - Always available and robust network
  - Reliable coverage

• **Shared infrastructures for the shared economy**
  - Multiple operators/applications using the shared infrastructure
  - Virtualization of infrastructures
  - Data handling, security and privacy!!!
Major Challenges and Opportunities

**Technology**
- Cost, cost and cost!
- Standardization
- New products

**Regulation**
- TVWS access
- Higher power limits for long range coverage
- New licensing model

**Economy**
- Shared values and economy
- Sustainable and scalable business models
- Public-Private Partnership

**Society**
- Value (co-)creation
- Sustainable development
- Reduction of negative impact on environment

Remote Area Networks
Connecting the Last Billions
Thanks for your attention!

yaning.zou@ifn.et.tu-dresden.de
luciano@inatel.br

http://5g-range.eu/