WSC

5G & 6G
E2E Massive MIMO

testbeds & trials systems

Sten Wallin

ERICSSON
Outline

Testbed program overview

5G testbed
  • Overview
  • Different trials
  • 5G proprietary specifications

6G
  • Capabilities
  • Spectrum & testbeds

Summary
Testbed program in Ericsson

- Explore new concepts and technologies
- Evaluate in small-scale test networks
- Testbeds successfully developed for 3G, 4G & 5G paving the way for commercialization

- Research, standardization & studies
- Testbeds & field trials
- Commercial product development
Ericsson 5G testbeds

Phase 1: New bands & wider bandwidths
- 15 GHz band | 5 Gbit/s

Phase 2: Massive MIMO using analogue BF
- 15 and 28 GHz | 27.5 Gbit/s

Phase 3: Pre-commercial E2E with 3rd party device
- 3.5, 4.7 and 28 GHz | E2E | Mobility | Interoperability with one terminal vendor

Phase 4: Early commercial
- Many bands | NSA | SA | Interoperability with multiple terminal vendors

BBC reporter in 2014: Worlds first 5G mobile device
Selected 5G testbed trials 2014-2019
5G testbed system overview

Complete E2E systems with support for

- mmW + midband
- Stand-Alone and Non-Stand-Alone
- Grid-of-Beams & Reciprocity-based BF
- Integrated-Access-Backhaul (IAB)
- High-speed mobility
- URLLC
- Time-Sensitive-Networking (TSN)
High-speed beam-tracking @28GHz

Demonstrate 5G potential for high-speed users in e.g. highways, trains, etc.

Challenges
- High speed
- High angular speed for beam tracking
- Large and rapidly shifting Doppler
High-speed beam-tracking @28GHz

**Outcome**
- Beam tracking demonstrated at 170 km/h with 3-3.5 Gbps
- Transmission Point switch demonstrated at 160 km/h with ~1 Gbps
- Over 8 kHz changes in Doppler shift between TPs
- Seamless mobility with Gigabit performance in a realistic use case

**ACHIEVING UNINTERRUPTED CONNECTIVITY**
JARI racetrack @4.8 GHz

HO at 275Km/h (L1 and L2)

• UL = 24Mbps
• DL = 444Mbps
VR trial 2
Low-latency remote driving

Electrical vehicles from Royal Institute of Technology (KTH) in Stockholm equipped with 5G devices and used to demonstrate low-latency remote driving.
Reciprocity based testing @ 4.8 GHz
Proprietary 5G “standards”

- VZ-TF
- KT-SIG
- Ericsson JTS 3
- 5G Open TSA

FWA systems in a few markets in US

2015 - 2019
Many challenges during field testing

Raccoon attacks !!!
6G – Capabilities

• “Classical” capabilities still important

• New capabilities expanding into new dimension
6G – Capabilities

• “Classical” capabilities
  - Much higher achievable data rates in all relevant scenarios
  - Extremely high achievable data rates in specific scenarios
  - Sub-ms latency in specific scenarios
  - Predictable end-to-end latency (incl. reliability)
  - Much more traffic per area for same overall cost
  - Detailed sensing of the surrounding
  - Dynamic network deployment
  - Spectrum flexibility

• New capabilities expanding into new dimension
  - Extremely high achievable data rates in specific scenarios
  - Much more traffic per area for same overall cost
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Key aspects:
- Data rates
- Service availability
- Latency and reliability
- Total cost of operation
- Security and privacy
- Network energy efficiency
- Coverage
- Hosting distributed applications
- Service versatility
- Positioning
- Traffic capacity
- Sensing
- Deployment flexibility
- Network energy efficiency
- Latency and reliability
- Coverage
- Predictable end-to-end latency (incl. reliability)
6G – spectrum

Wide range of spectrum including possible/likely extension into sub-THz

- Extreme coverage
- Licensed spectrum complemented by unlicensed spectrum
- Extreme data rates in specific scenarios

Co-existence with legacy technology

Enable smooth 6G introduction, especially at lower bands
Compare NR/LTE spectrum compatibility of today

Supporting new ways of deployment
For example, local areas
To enable new use scenarios
6G – spectrum

Wide range of spectrum including possible/likely extension into sub-THz

1 GHz  3 GHz  10 GHz  30 GHz  100 GHz  300 GHz

Extreme coverage
Licensed spectrum complemented by unlicensed spectrum

Extreme data rates in specific scenarios

Co-located MIMO
Distributed MIMO
multi-site/multi-RAT connectivity
Massive Distributed MIMO
E2E testbed summary

• Exploring new concepts and technologies
  – Serves as a research platform for algorithm development, field trials and learnings
  – Serves as the basis for new products or product decisions
  – Serves as input to 3GPP standardization

• Demonstrating new features to customers, and the performance of them

• Pushing the technology and building ECO-system with selected partners
Thank you