Research Challenges for Reliable 5G Systems

TUHH, ComNets

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Retrospektive: 4G & IMT-Advanced

- Methods to increase reliability are well researched: ARQ, MIMO, Adaptive Modulation & Coding, multi-homing, multi-path routing, …
- Deviating LTE-Advanced performance results although simulation methodology was well described and simulators were calibrated
- Only few groups were able to deliver VoIP capacity results (**98-percentile**)
- No severe consequences expected if result off by e.g. ±10%
- **Insufficient result accuracy for safety critical systems**
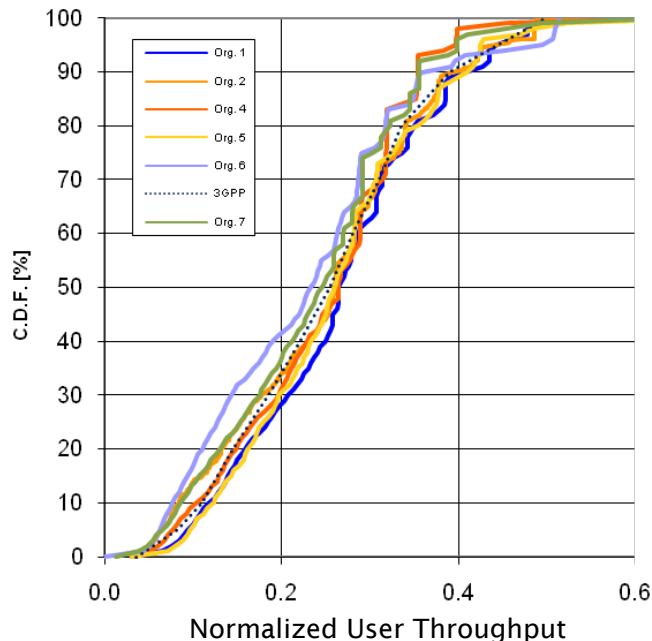
Source: ITU-R, "Evaluation of IMT-Advanced candidate technology submissions by WINNER+ Evaluation Group," Tech. Rep. ITU-R IMT-ADV/22, 2010.
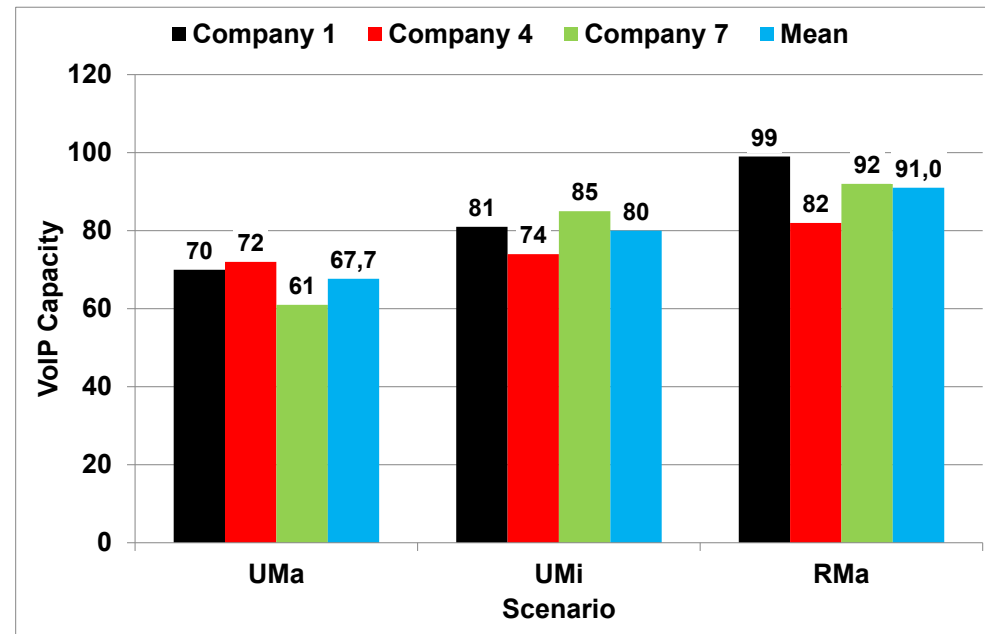
Source: NTT DOCOMO (Rapporteur), "TR36.912 Annex A3: Self evaluation results," Tech. Rep. RP-090738, 3GPP, 2009.
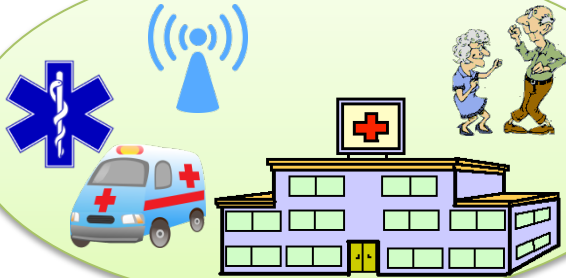
Verticals & Models

Transportation

Testbeds, Simulators, Result Evaluation

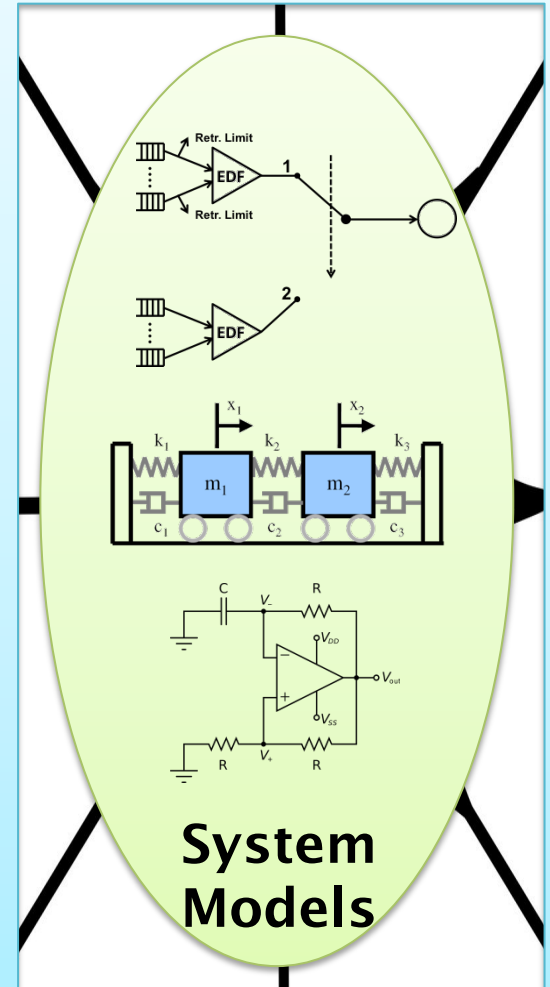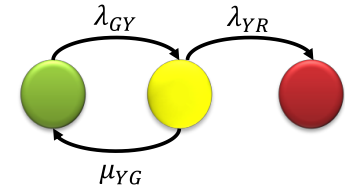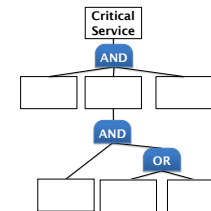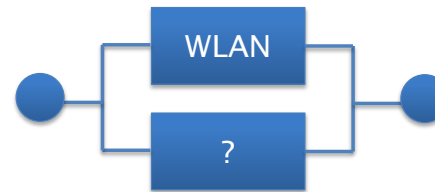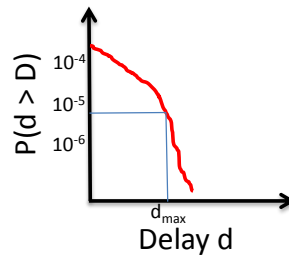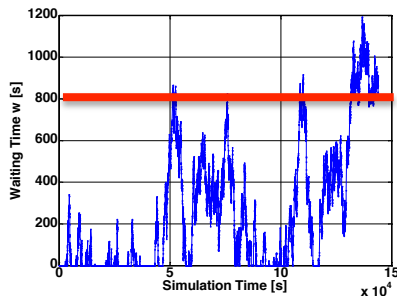**Environment Models**

Healthcare

Energy

99.9…%

1 - 99.9…%

Modelling Inaccuracy

**System Models**

- Evaluate existing models, extend them and develop new ones
- Joint network and reliability modelling and evaluation
  - **Reliability ≠ (1 – Packet Loss)**
  - **Solvable mathematical models for evaluation and optimization**
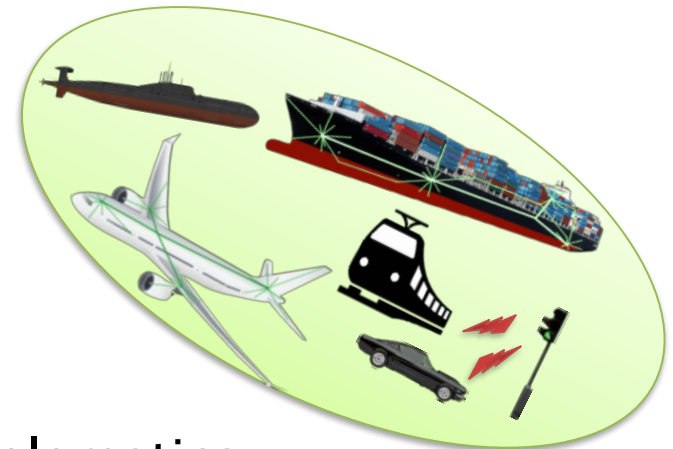- Result analysis beyond standard error confidence intervals

- Novel/advanced testbeds and simulators
  - **Importance sampling & rare event simulation**
  - **"Climate chambers" & "shaker tables"**

- Crosscutting topic analog to "security"
- Targeting Action (TA) 13 "Security, Privacy, Resilience, and High Availability"

Project Goal & Overview
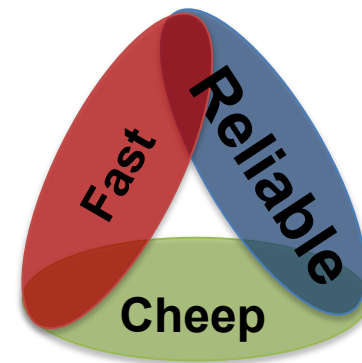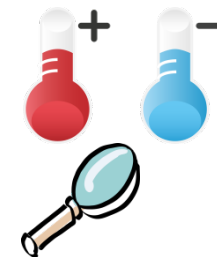
Design Principles and Performance Evaluation of Highly-Available and Ultra-Reliable Vehicular Communication Systems

- Project goal: define methods to systematically **design, model, evaluate, certify and deploy safety critical vehicular communication systems**

- Domains: automotive, aviation, railway, (sub)maritime

- Use-Cases (least to most challenging):
  - 1) Operations (e.g. control center) & telematics
  - 2) Cooperation & swarm
  - 3) Remote control (Tactile Internet)

Thank you! Questions?

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