

Research Challenges for Reliable 5G Systems

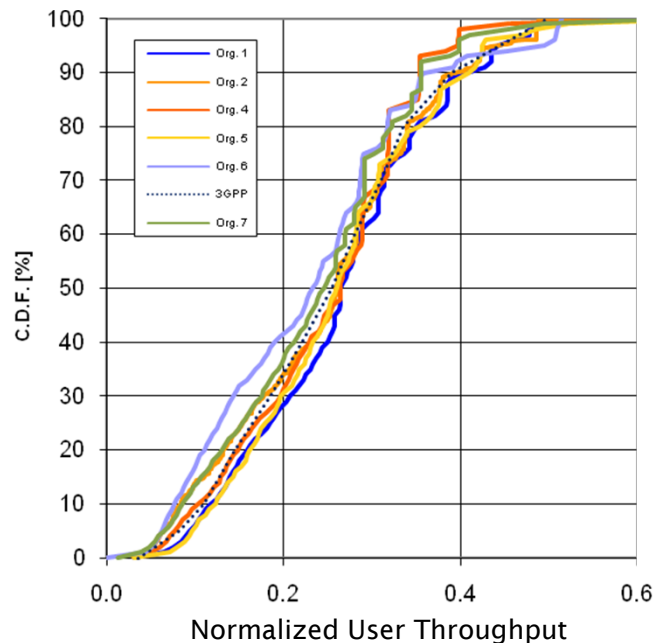
TUHH, ComNets

Maciej Mühleisen, Andreas Timm-Giel

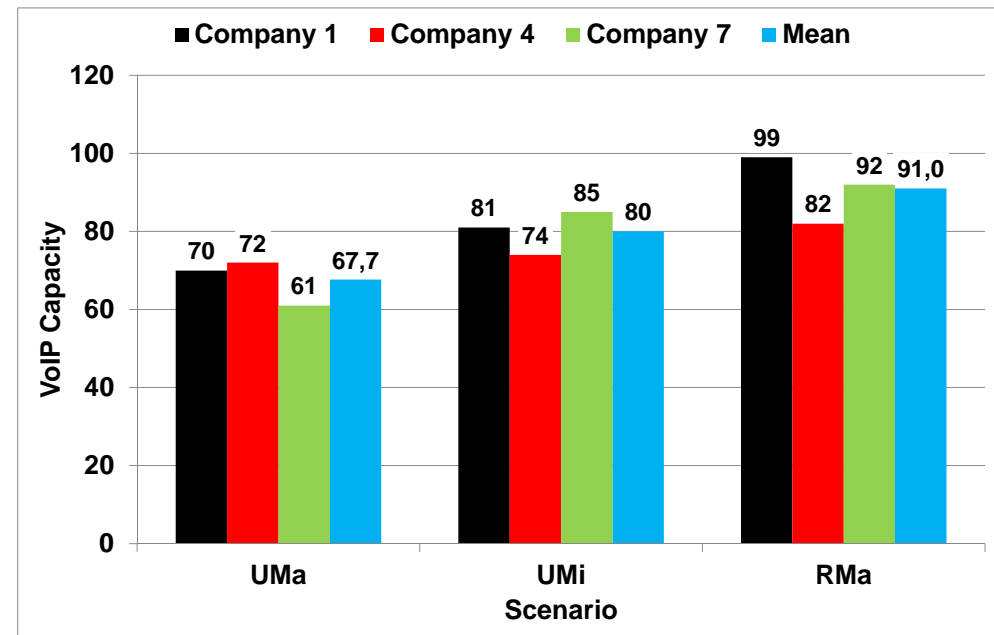
5G PPP Phase 2 Stakeholders Event, 21. Jan. 2016

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. $\pm 10\%$
- Insufficient result accuracy for safety critical systems**

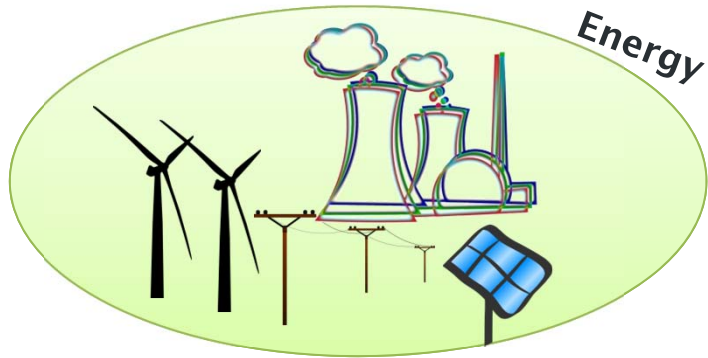
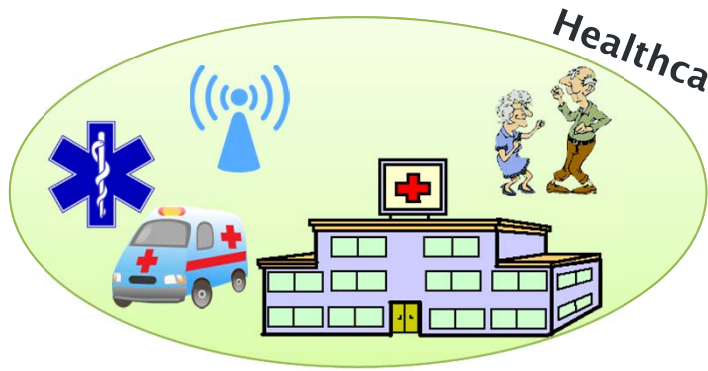


Source: ITU-R, "Evaluation of IMT-Advanced candidate technology submissions by WINNER+ Evaluation Group," Tech. Rep. ITU-R IMT-ADV/22, 2010.



Source: NTT DOCOMO (Rapporteur), "TR36.912 Annex A3: Self evaluation results," Tech. Rep. RP-090738, 3GPP, 2009.

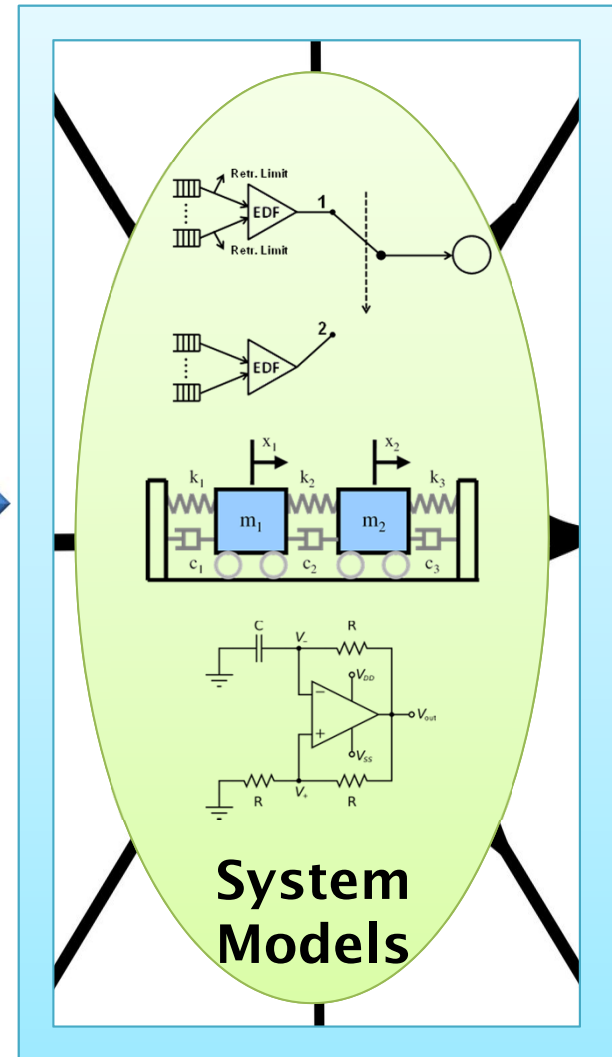
Verticals & Models



Testbeds,
Simulators,
Result
Evaluation



Environment Models



99.9...%

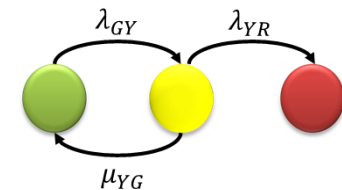
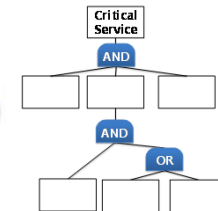
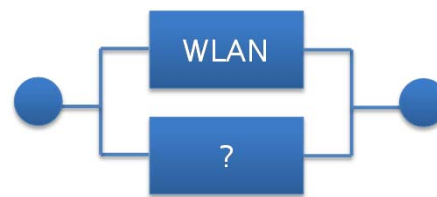
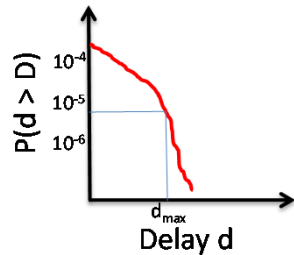
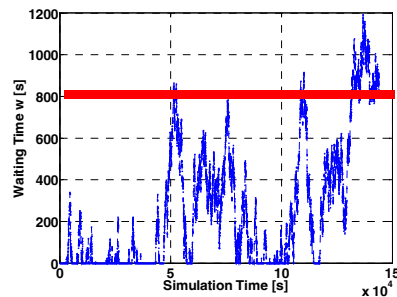


1 - 99.9...%

**Modelling
Inaccuracy**

Research Challenges

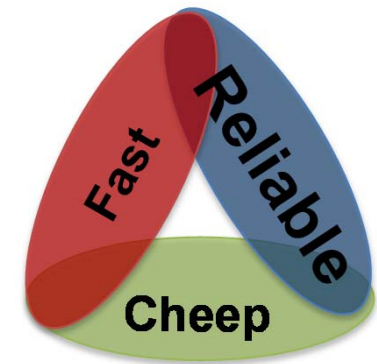
- Evaluate existing models, extend them and develop new ones
- Joint network and reliability modelling and evaluation
 - Reliability \neq (1 - Packet Loss)
 - Solvable mathematical models for evaluation and optimization
- Result analysis beyond standard error confidence intervals



- 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” → Just one TA for all four topics?



Thank you! Questions?

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