NSF Research Coordination Network on Millimeter-Wave Wireless

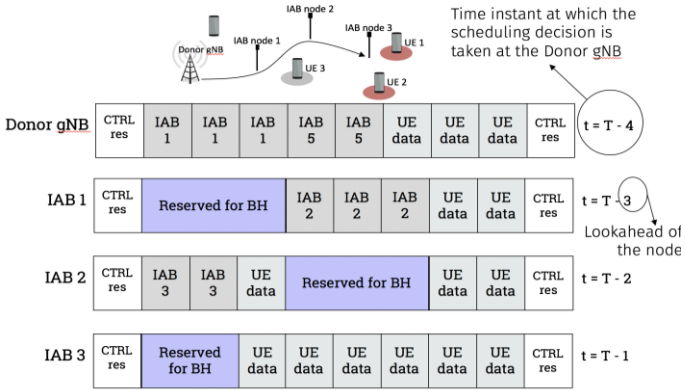
Readout from Breakout Session

CSP-NET Interface

Communication and Signal Processing & Networking

End-to-end simulation of mmWave networks
NEW FEATURES

- **IMPLEMENTED**
  - Integrated Access and Backhaul



M. Polese et al, End-to-End Performance of Integrated Access and Backhaul at Millimeter Waves

End-to-end simulation of mmWave networks
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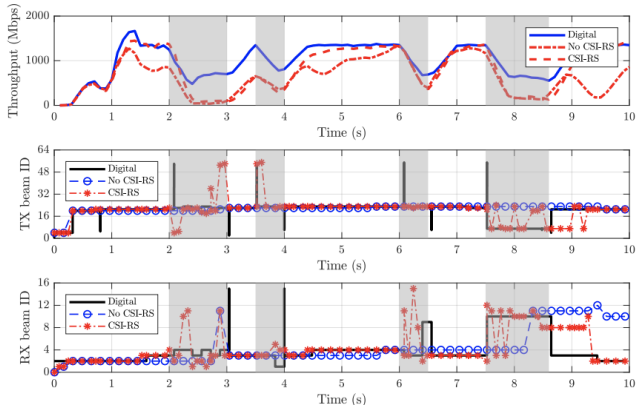
  - 3GPP CSI-RS signaling



C. H. Claveras et al, Achieving mmWave Beam Tracking Within 3GPP New Radio Release 15

End-to-end simulation of mmWave networks
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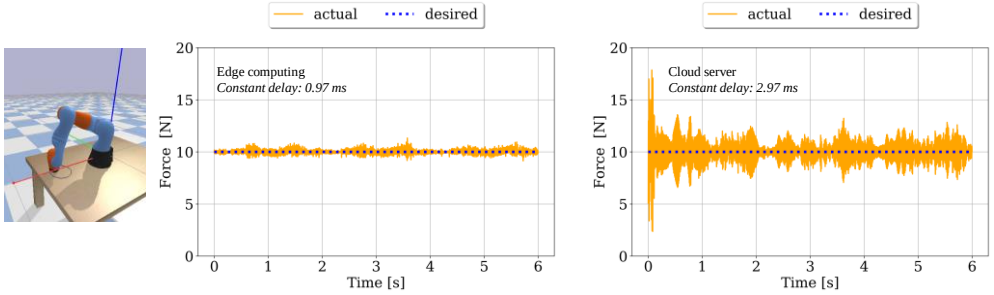
  - Robotic control



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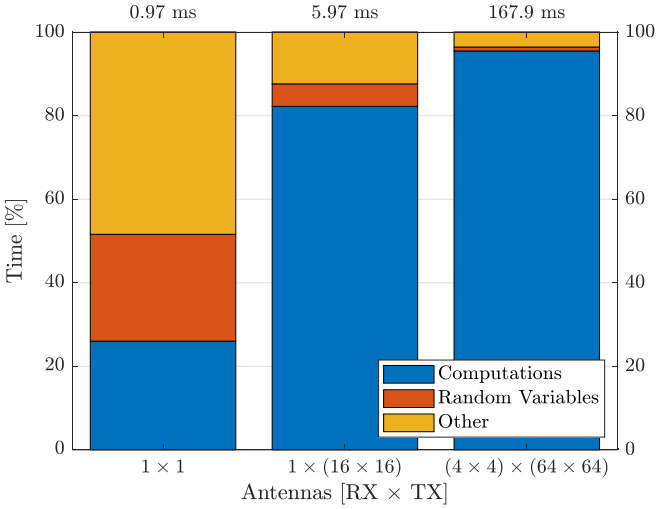
  - Aerial communications
    - Integration of drone traces
  - Vehicular communications
    - Integration of 3GPP vehicular channel
    - 802.11p like access
  - More scalable simulations
  - NIST: QD models + 802.11ay extensions



M. Polese et al, Scalable and Accurate Channel Models for Analysis and Large-Scale Simulations at mmWaves

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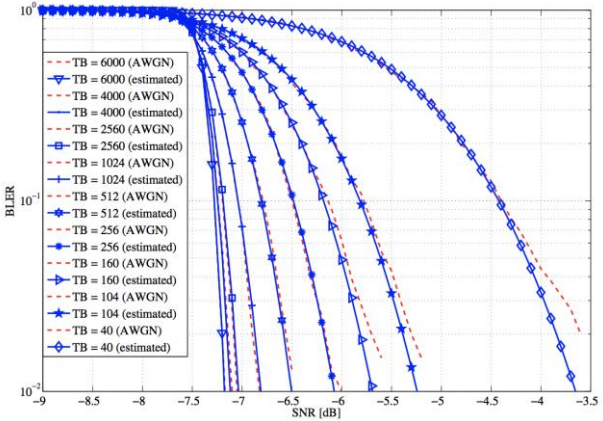
- **FUTURE**
  - LDPC-based error model



Interdigital to provide LL curves by Q2 to improve current turbo-codes based error model

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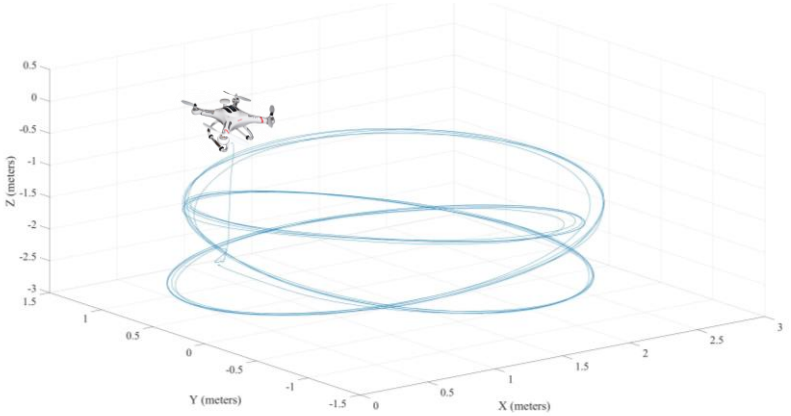
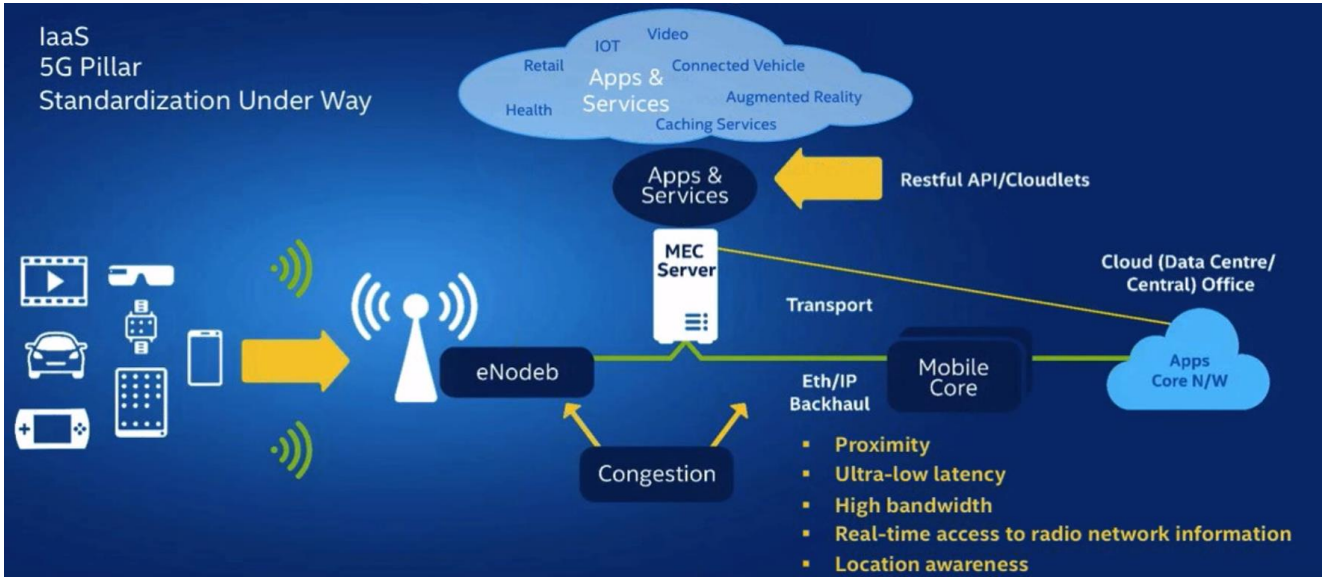
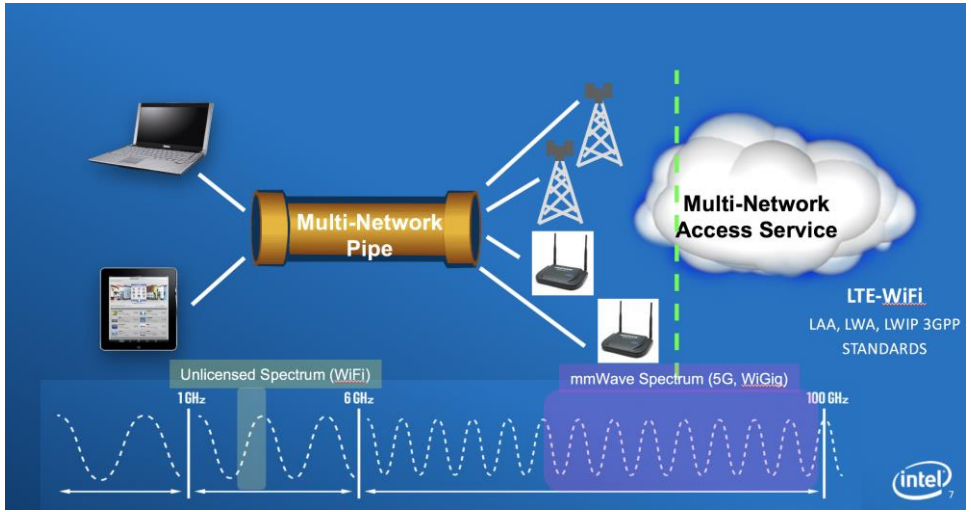


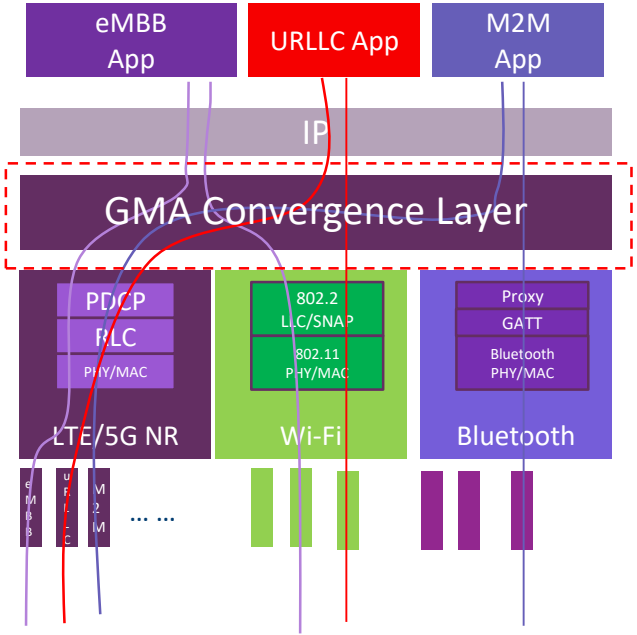
Multi-Access Edge computing (MEC)



Ref: http://www.etsi.org/deliver/etsi_gs/MEC/001_099/003/01.01.01_60/gs_MEC003v010101p.pdf

Generic Multi-Access/Radio Convergence (GMA)





Ref: https://tools.ietf.org/html/draft-kanugovi-intarea-mams-framework-00

ITU: Machine-learning for future networks

Working Group Activities

- ❑ Working Group 1: Use, cases, services and requirements
- ❑ Working Group 2: Data formats and ML technology
- ❑ Working Group 3: ML-aware network architecture

Categorization of Use Cases

- ML objective:
  - ❑ Classification
  - ❑ Clustering
  - ❑ Prediction
  - ❑ Inference
- Cost associated with architectural changes
- Cost associated with ML data

Network domain

- Application/Service Domain
- Core Network Domain
- Transport Network Domain
- Access Network Domain
- End-to-End Network

Network phase

- Planning and Design
- Deployment
- Provisioning
- Operation and Management
- Maintenance

Among active members are: China Unicom, China Mobile, ETRI, Fraunhofer HHI, Intel Corp., KT Corp., Tsinghua University, Turkcell, Vodafone, ZTE.
The group collected so far more than 120 input contributions, with 23 related use cases and numerous proposals for future network architecture enhancements.

Wrapping-up

- Increasing collaborative effort to improve the mmWave simulation capabilities of ns-3
  - NYU, University of Padova, Polytechnic of Valencia, University of Washington, Interdigital, NIST, Intel, Nokia, and many more..
- Open challenges
  - Trade-off: simulation scalability vs. accuracy
  - Integration of new use cases and scenarios
    - Drones, robotics, automotive, ..? We are open to inputs/suggestions
  - Validate/match simulated performance trends (e.g., TCP) with industrial trials
- New technologies
  - MEC and GMA
  - Machine learning (for mmWave channel modeling and higher layer protocols improvements)
- The networking community will gather offline inputs for the NSF Mid-Scale Research Infrastructure Solicitations