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Fraunhofer-Institut für Integrierte Schaltungen IIS

System-Level-Simulationen für 3D-Netze

ITG-Workshop
Antennenkonzepte für 3D Netze der Zukunft

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System Level Simulations for 3D Networks

Overview

System Level Simulation to extract KPIs for different scenarios in 3D networks based on OMNET++

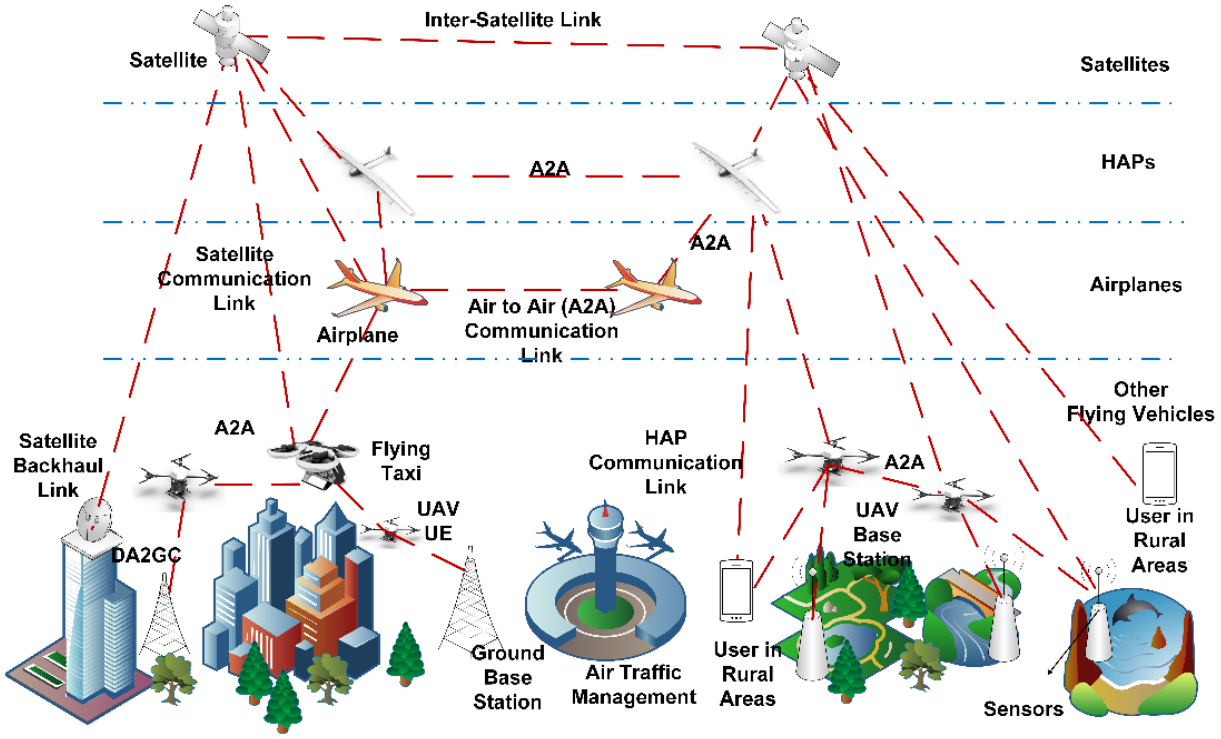
Study of feasibility, benefits and technical challenges for different use cases enabled by 3D-networks

Currently further developed in 2 main projects

Celtic 6G for connected sky
Focus on integration of HAPS as additional network element

DLR 5G-Autosat KI
Focus on connection to AI for automotive use cases

3D-network as adressed in 6G-Sky



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System Level Simulation (SLS)

Architecture

Protocol stack on UE and gNB side

Mobility models to support flying base stations and mobile users

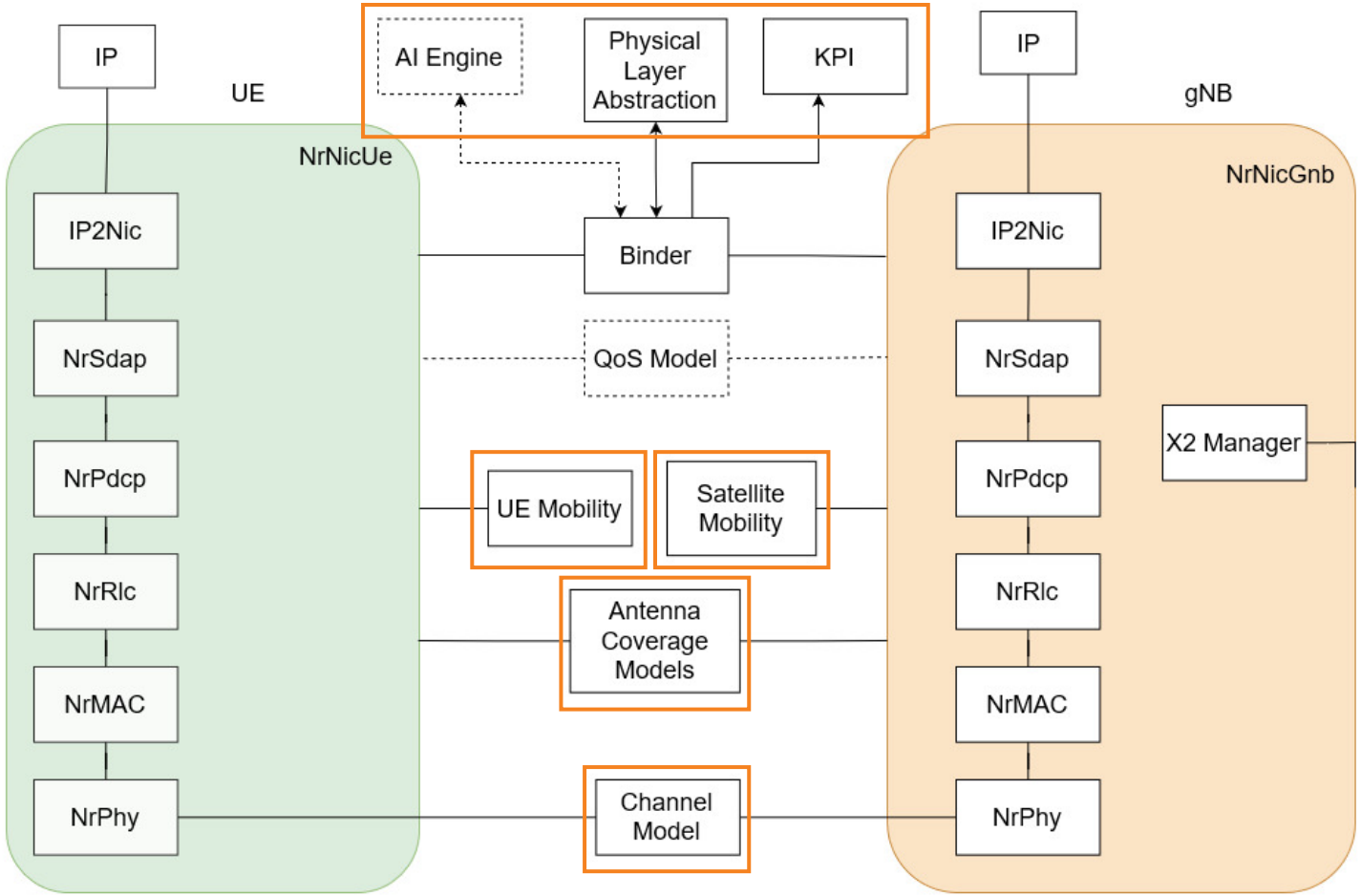
3GPP / ITU defined channel models to represent TN and NTN connections

Interfaces to the physical layer abstraction model for correct mapping between SNR/SINR and throughput

Interface to AI engines for the management of radio resources in development

Integrating QoS model in development

Visualization with OSM



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System Level Simulation

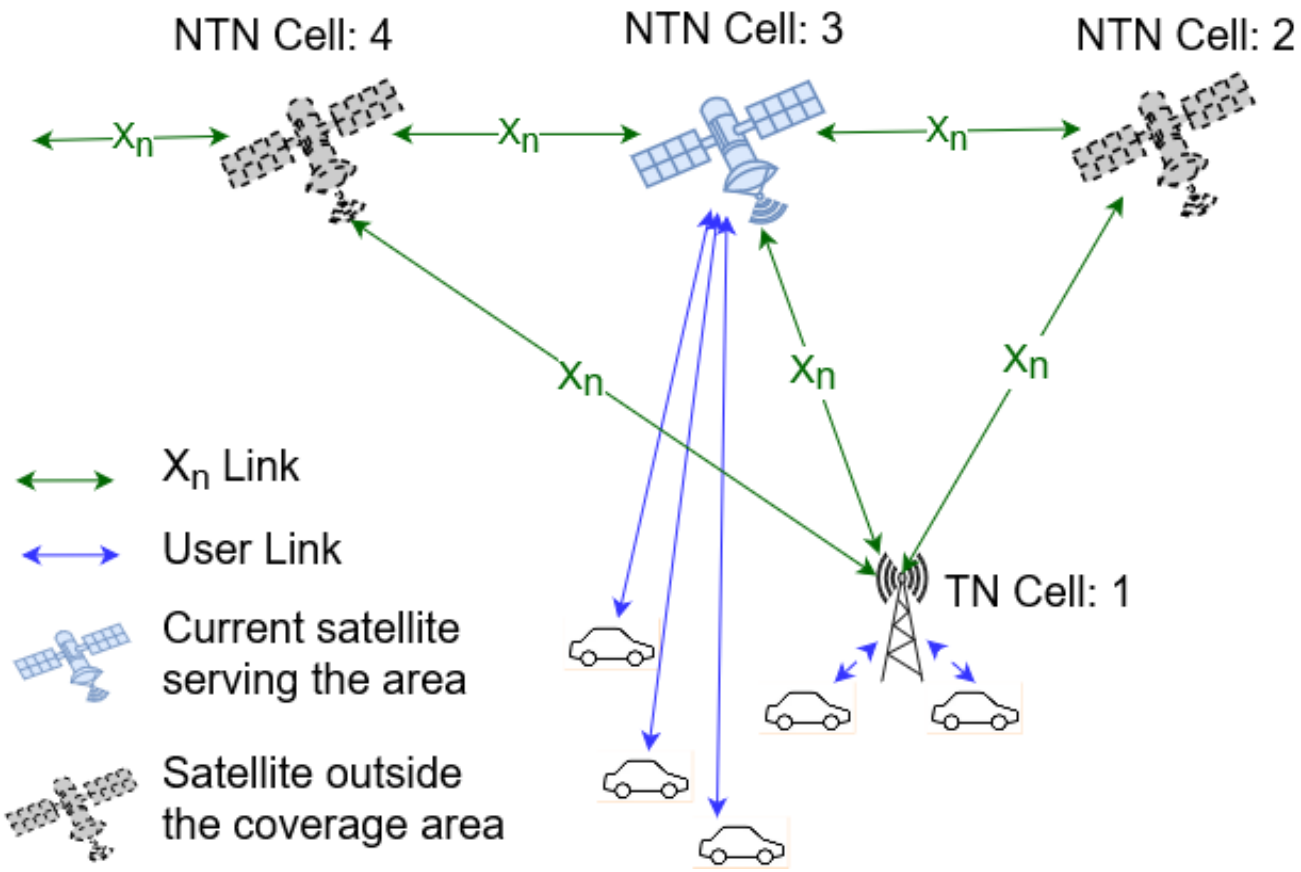
Scenario Generation

Support for multiple base stations at different altitudes (terrestrial, LEO and GEO)

Each base station is connected to another via an Xn interface

Can deploy multiple (car) users in the region of interest

Earth moving beams from the satellites (fixed beam on satellite)



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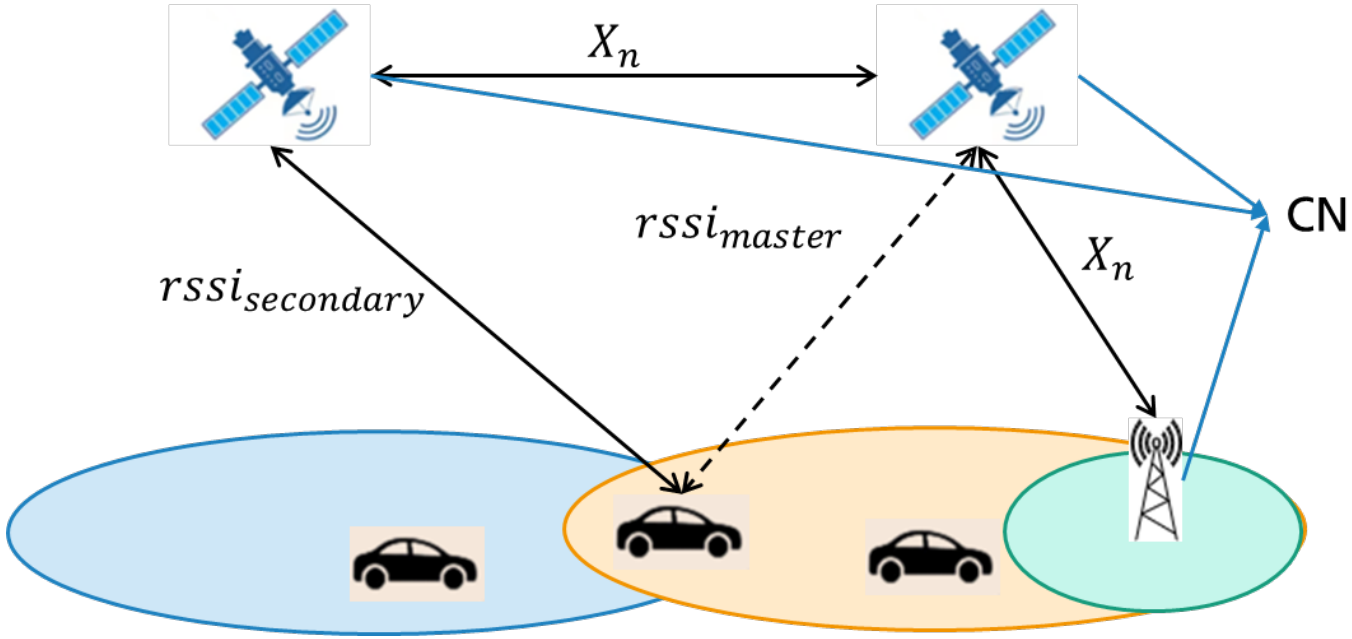
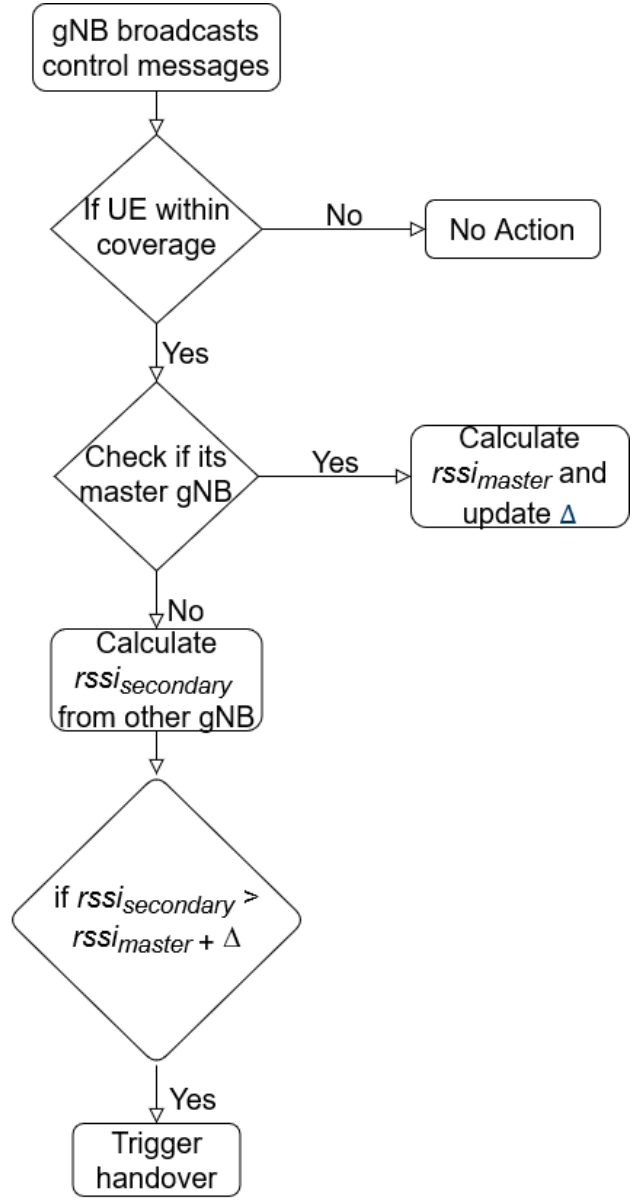
System Level Simulation

Handover Considerations

Handover between base stations is triggered on the basis of the RSSI measurement (Rel-17)





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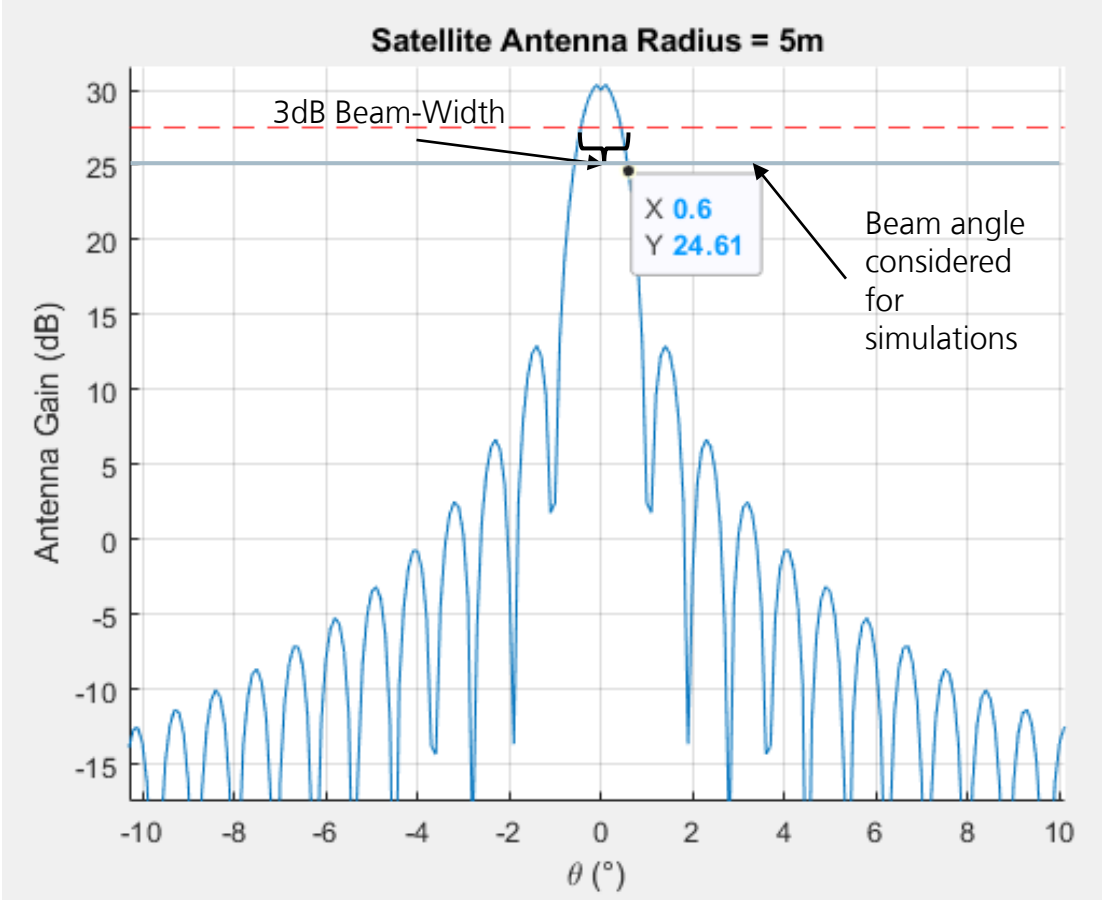
System Level Simulation

Antenna Representation

Satellite orbit	LEO
Satellite altitude (h)	600 km
Satellite antenna pattern	Bessel Type
Payload characteristics for DL transmissions for S Band	
Satellite antenna radius (a)	5 m
Satellite Tx power (P_s)	48.8 dBm
Satellite Tx max Gain (G_s)	30 dBi
Half 3dB beamwidth	0.45 deg
Satellite beam contour (α)	0.6 deg

Mobility	Automotive/Static
Frequency band (f_c)	S band (i.e. 2 GHz)
User antenna type	Omni-directional
Rx Antenna gain (G_u)	0 dBi
G/T	-31.6 dB



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Simulation Scenario

Example

Region of interest : Tennenlohe, Erlangen

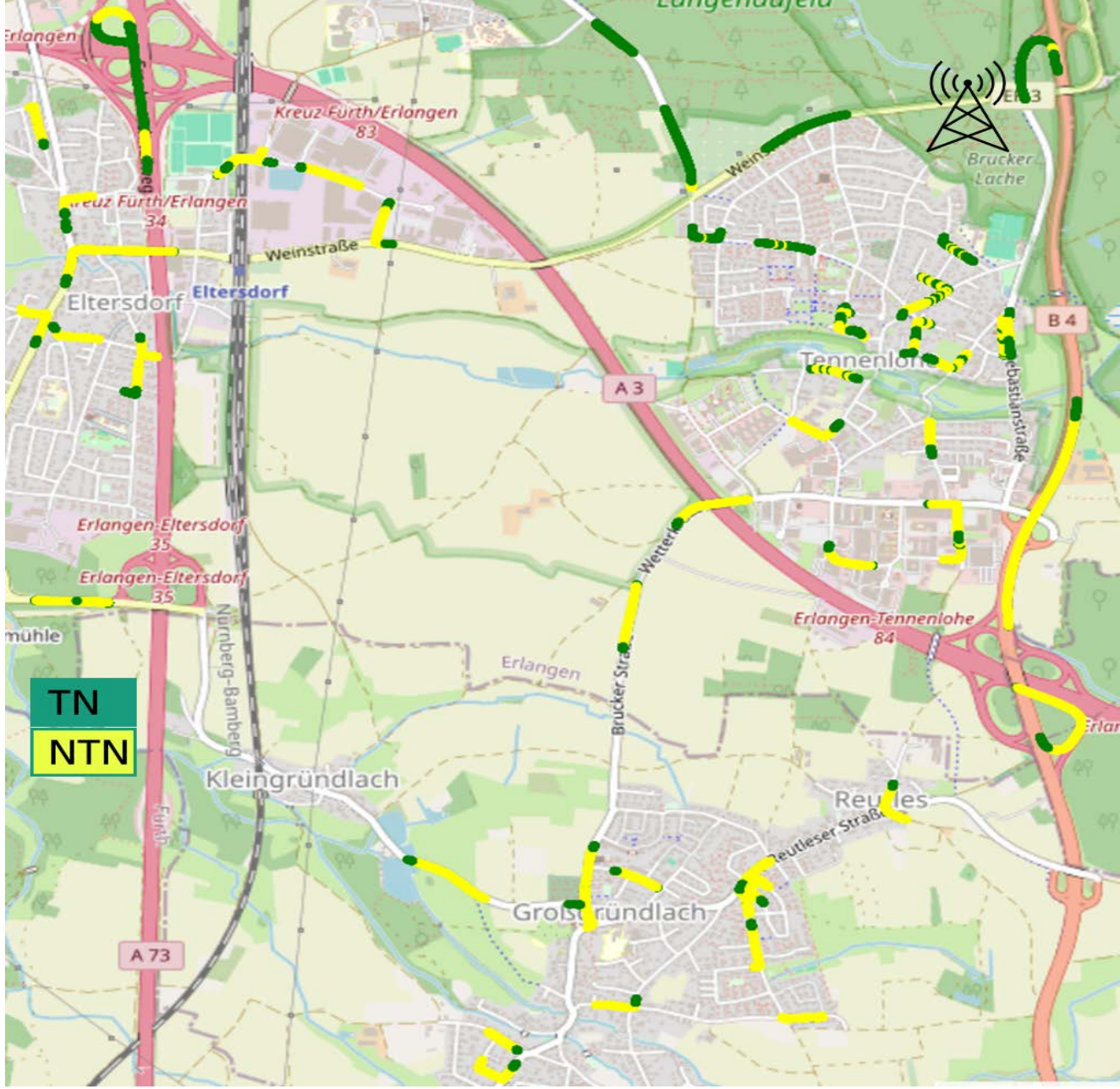
Number of UEs/Cars : 60

Number of gNBs: 1 (TN), 4 (NTN)

Application type:

Uplink
- 400B per 30ms

Downlink
- 500B per 40 ms



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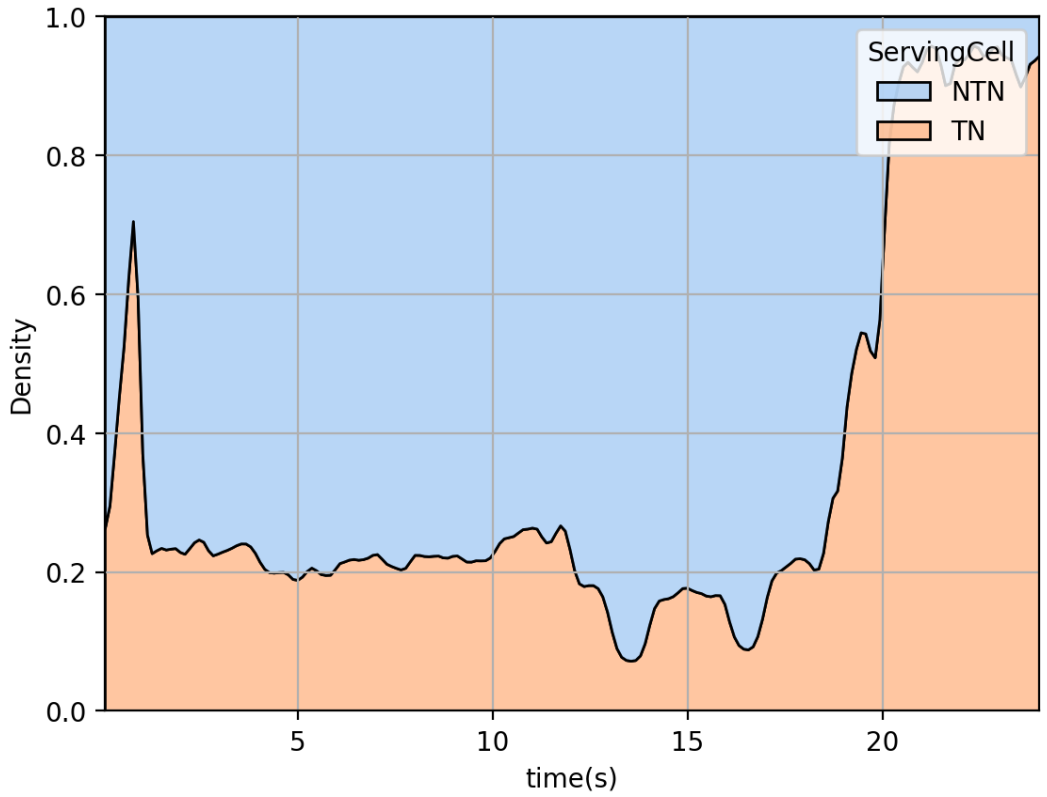
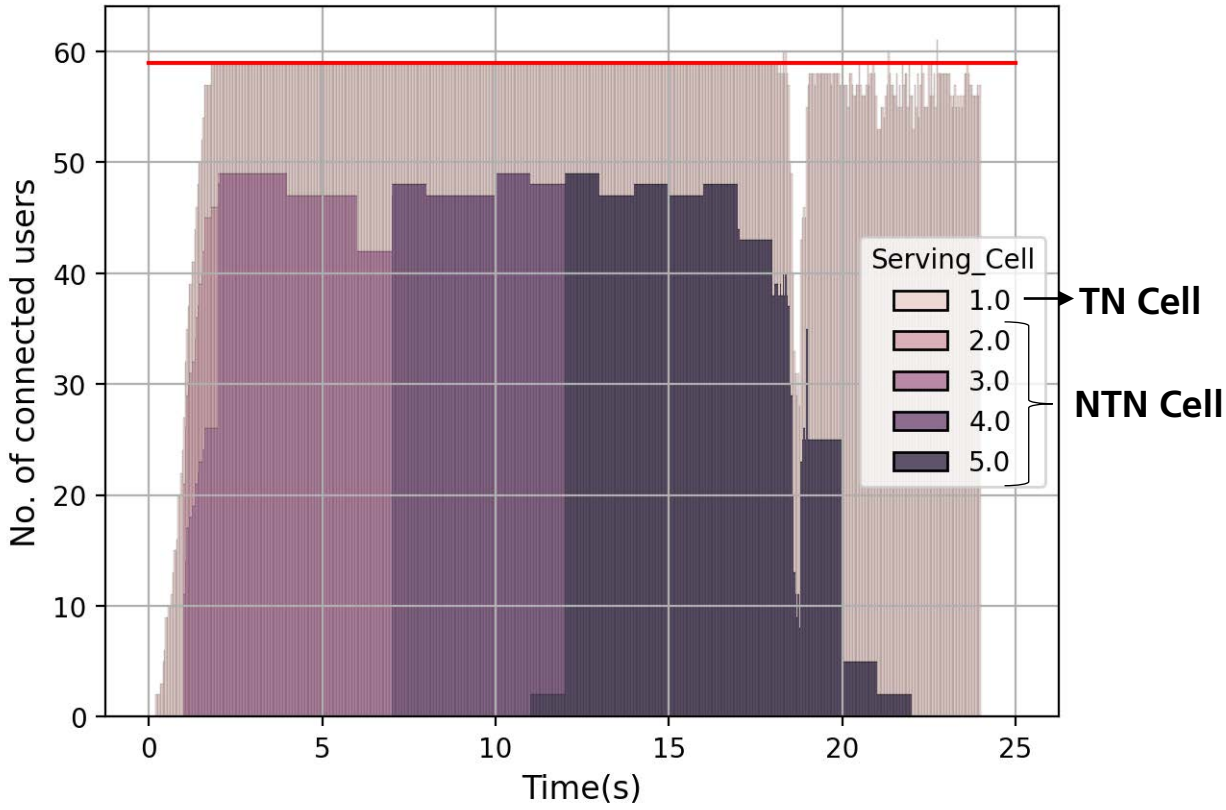
System Level Simulations for Automotive Use Case

Example Results

Probability distribution of user connected to a gNB type



Histogram of users connected to different serving cells / cell IDs



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