

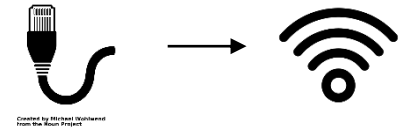
# A Regulators Perspective on Digital Twinning for Mobile Communications

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- Introduction
- Developing a Digital Twin for 5G mobile network
- Relevance of the Digital Twin for 5G and promising technologies
- Regulatory aspects
- Asset Administration Shell for 5G
- 5G Digital Twin submodule for regulatory purposes
- Summary & future work

## Motivation:

- Digitalization continues to spread in industry
- The I4.0 context requires more flexibility in communication



## Challenge:

- Design of a complete digital Asset Administration Shell (AAS)-based replica for 5G communication system.

## Why integrate the 5G-network into AAS?

- Radio-based communication requires detailed network planning to minimize interference
- Automation of regulatory processes provides more planning flexibility

## Standards in development:

- ETSI -> “Zero touch network & Service Management (ZSM)”
- IRTF NMRG -> “Concepts of Digital Twin Network”; “Digital Twin Network: Concepts and Reference Architecture”
- ITU-T SG13 -> “Digital Twin network- Requirements and architecture”

## Proof-of-concept:

- The Industry Specification Group (IDTA) -> AAS submodel template for “Wireless Communication”
- 5G-ACIA -> white paper “Digital Twin and AAS to integrate 5G into Production Networks”
- TM-Forum -> Digital Twin Network (DTN)
- NetBrains -> product “NetBrain Problem Diagnosis Automation System”

# Relevance of the Digital Twin for 5G and promising technologies

With URLLC, eMBB, and mMTC the focus of 5G is on highly reliable communication systems.

How to ensure reliability of the communication system?

- Redundancy → Too expensive
- Resilience

Potential use cases for 5G DTs:

- Network Planning and Optimization
- Traffic Management
- Predictive Maintenance
- Autonomous Network Management
- Nomadic Network Management
- Automated regulation

Enabling technologies:

- Virtual services of the 5G core
- Software defined radio (SDR) for functions closer to the physical layer
- Simulating channel models with ns-3 and Omnet++
- Simulation via ray tracers with Omniverse from Nvidia

Currently:

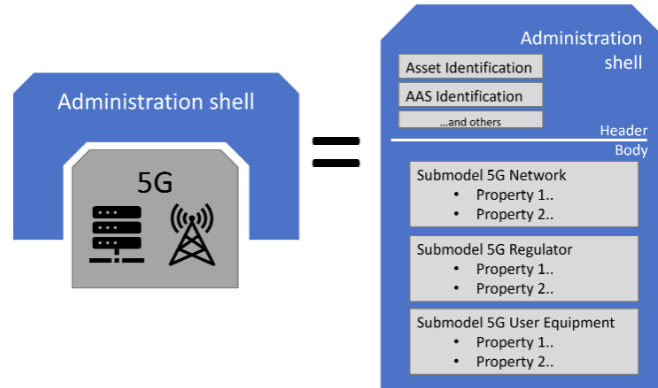
- Allocation of frequency range by means of an application procedure
- Specified application forms depending on the type of use and with regard to the information required
- Additionally: certificates in certain use cases (e.g., “Standortbescheinigung”)

5G network DT -> Automation of regulatory processes:

- Allocation of a dedicated frequency range (spatial, temporal allocation)
- Automation of application procedures

5G-DT enables early involvement of the regulator (e.g., in the planning stage to minimize future interferences)

-> Partial regulator model needed



Asset Administration shell for 5G

How to define an AAS submodel for the 5G regulator?

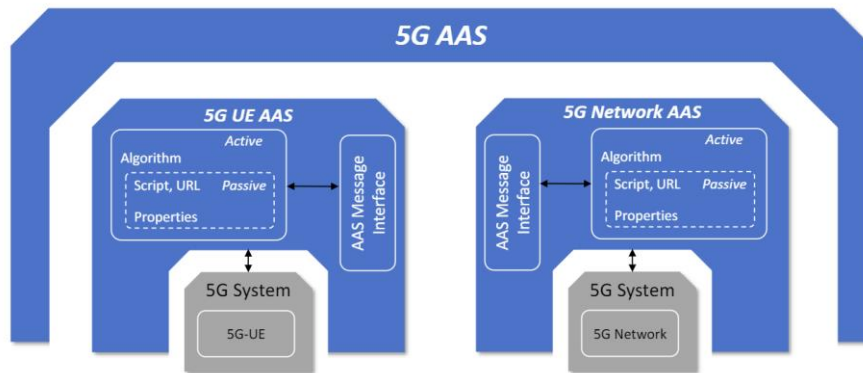


Problem: Lack of explicit 5G AAS submodel

Processing and storage of information:

- Part of application-required information can be stored in a digital nameplate
- Parameters which vary during operation can be mapped in a digital product passport

# 5G Digital Twin submodule for regulatory purposes



5G-ACIA concept for a 5G AAS Sumodel

[SME type]	[Value Type] Example
NCGI	[string] 70368744177663
Owner	[string] Example Company
Operator	[string] Example Company
License	[string] time restricted
Timestamp	[xsd:dateTim] 2023-05-30T09:00:00
Location	[string] u0v92bg47eh
Orientation	[float] 45.0
Nomadic	[string] true
Trajectory	[]
Speed	[float] 15km/h
Transmit Power	20 dBm
Antenna	AirVelocity 2700 by Airspan
Antenna Gain	22 dBi
Center Frequency	3750 MHz
Bandwidth	100 MHz

AAS Submodel for regulatory purposes



## Conclusion:

- The topic of Digital Twins has been motivated and analyzed
- Exemplary submodel in the format of the AAS was presented

## Future Work:

- The 5G\_Regulator submodel will be adapted according to emerging 5G AAS submodels
- The content of the 5G\_Regulator submodel will be further investigated
- Use cases for the specified model will be developed from the regulator's perspective
- Aspects of intelligent spectrum management will be further investigated

# Thank You for your attention!

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