Architecture design of satellite integration with 5G network

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Outline

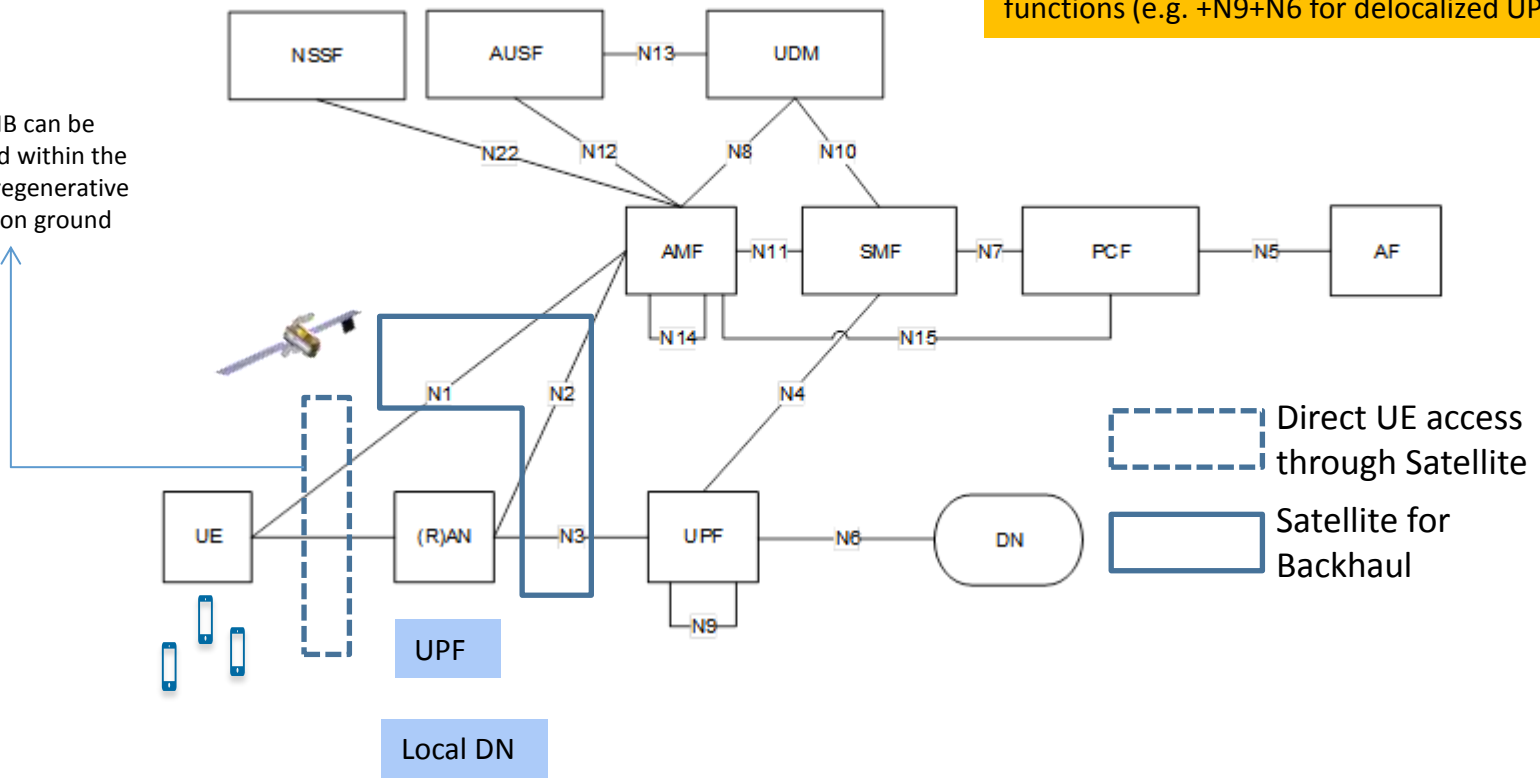
- Generic Satellite positioning in 5G network architecture
- Integrated Satellite and Terrestrial 5G Architecture: Implementation options
- SaT5G Reference Architecture
- Implementation approaches and related Network Management concepts
- Satellite and Terrestrial integration challenges
- Architecture and testbeds
- Architecture and standardisation

Satellite positioning in 5G network architecture

Direct and Indirect 5G UE Access
Several Implementations options identified, based on 3GPP or not

NF can be delocalized to the edge of the network (e.g. UPF).
Therefore, Interfaces transported through the backhauling satellite link will depend on delocalized functions (e.g. +N9+N6 for delocalized UPF)

The gNB can be embedded within the satellite (regenerative case) or on ground



Integrated Satellite – 5G Architecture: implementation options and functions

« Backhaul services »

Positioning

- **Direct** 5G UE Access
- **Indirect** 5G UE Access

Implementation

- Non 3GPP Access
  - Trusted
  - Untrusted
- 3GPP Access
- Relay UE
  - Non 3GPP Access
    - Trusted
    - Untrusted
  - 3GPP Access
- Transport Network
  - Based on 3GPP System
  - Based on Non 3GPP System

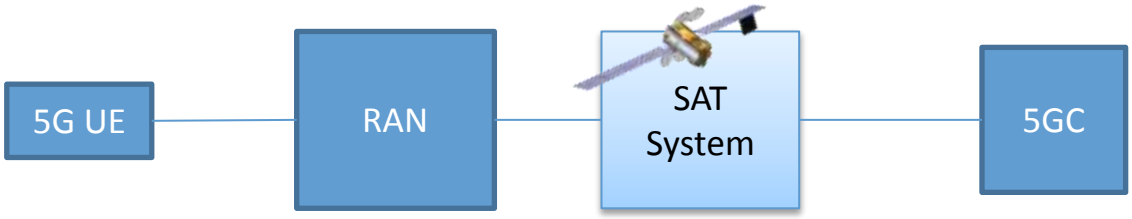
MEC Support

- Network Functions Delocalisation
  - Edge caching
  - No Edge caching
- No Network Functions Delocalisation

Multilink Support

- Satellite Link only
- Satellite and Non Satellite Links

Backhaul Implementation options

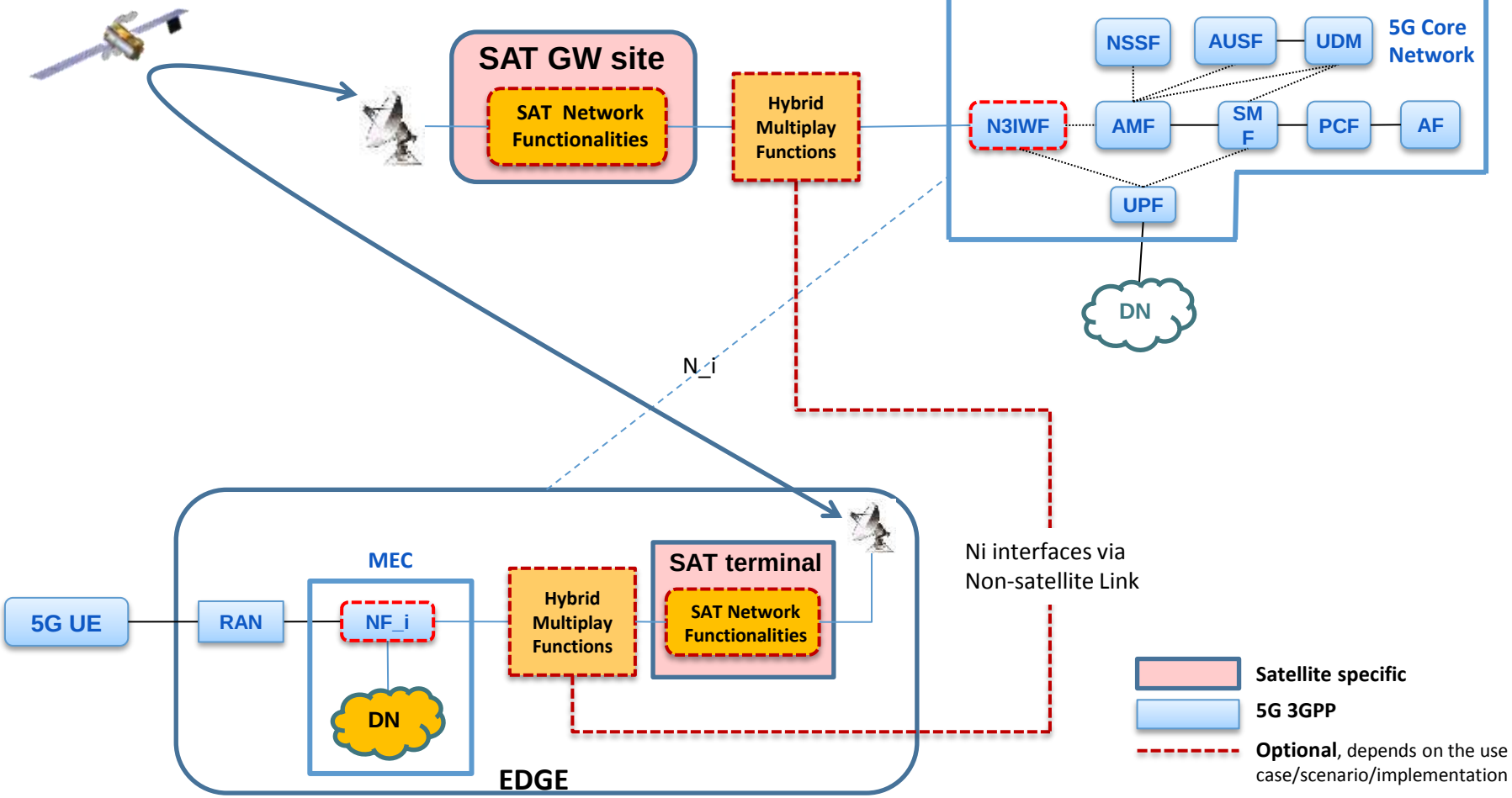


- Backhaul via Transport Network 5G
  - (1) **Based on 3GPP system specifications:** the TN is 5G ready as it is built taking into consideration the 5G system requirements
  - (2) **Non based on non-3GPP system specifications:** the TN is adapted to meet as much as possible 5G system requirements

- Backhaul via Relay UE

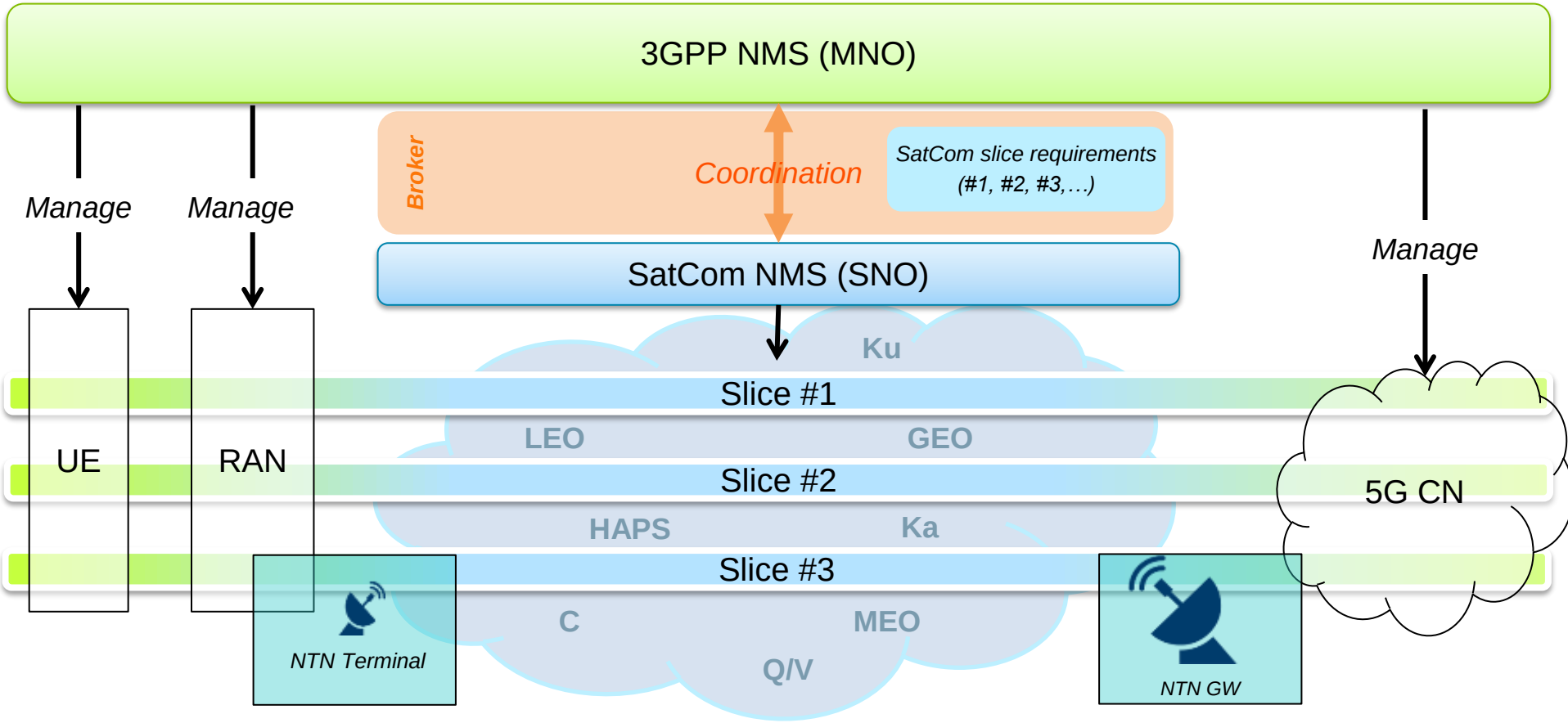
  The relay UE is managed by the 5G core and aggregates the traffic of several 5G UE via a 3GPP or non-3GPP access.
  - (3) **3GPP access:** backhauling implementation via relay UE with 3GPP access. Inherently, via the full adoption of 3GPP layers, a trusted access is established.
  - (4) **Trusted non-3GPP access:** backhauling implementation via relay UE with trusted non-3GPP access. The adoption of 3GPP higher layers enables a trusted access.
  - (5) **Untrusted non-3GPP access:** backhauling implementation via relay UE with untrusted non-3GPP access. Being untrusted access, N3IWF interface is required.

SaT5G reference architecture



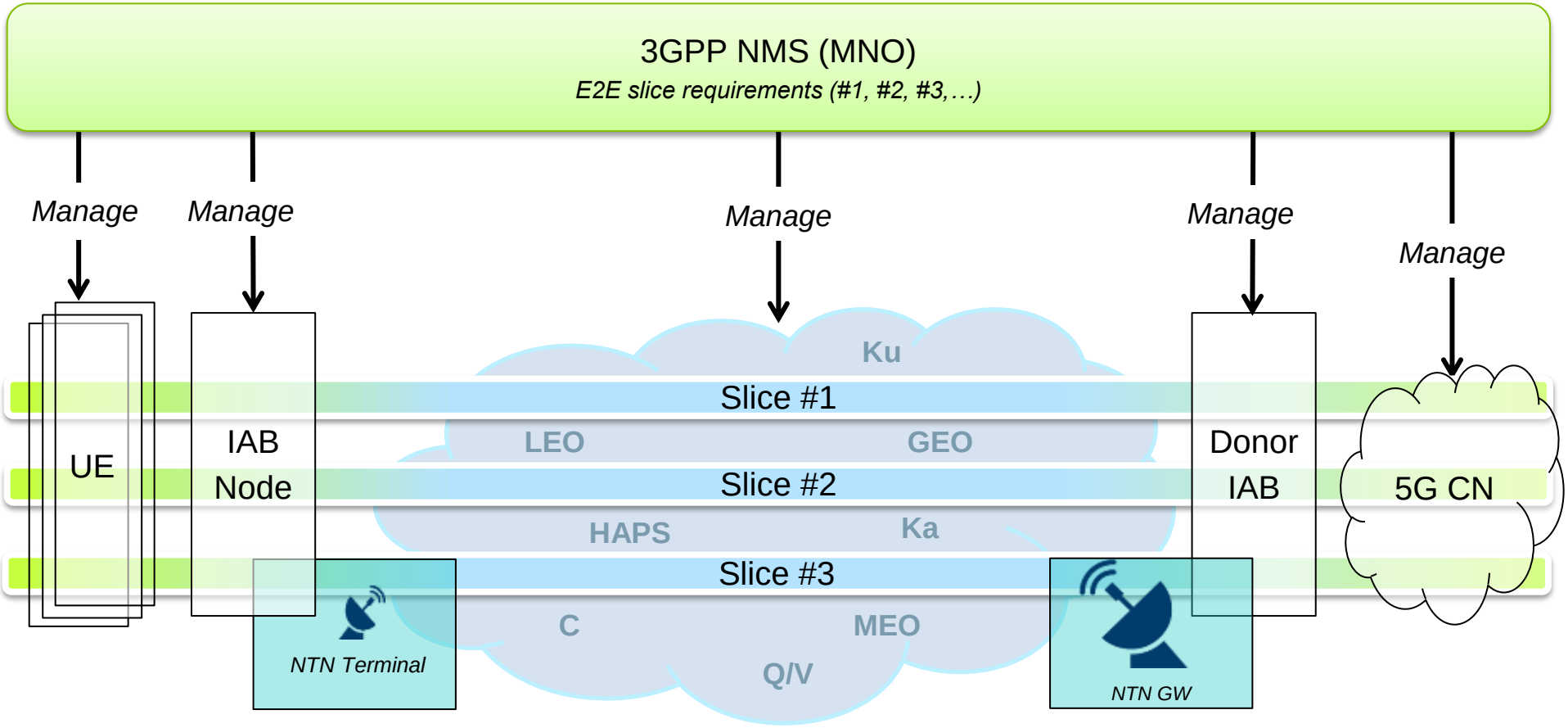
Advanced SatCom Transport Network in 5G networks

New concept being studied in 3GPP to make 3GPP NMS aware of transport network and establish coordination between SatCom and 3GPP NMS to better support network slicing



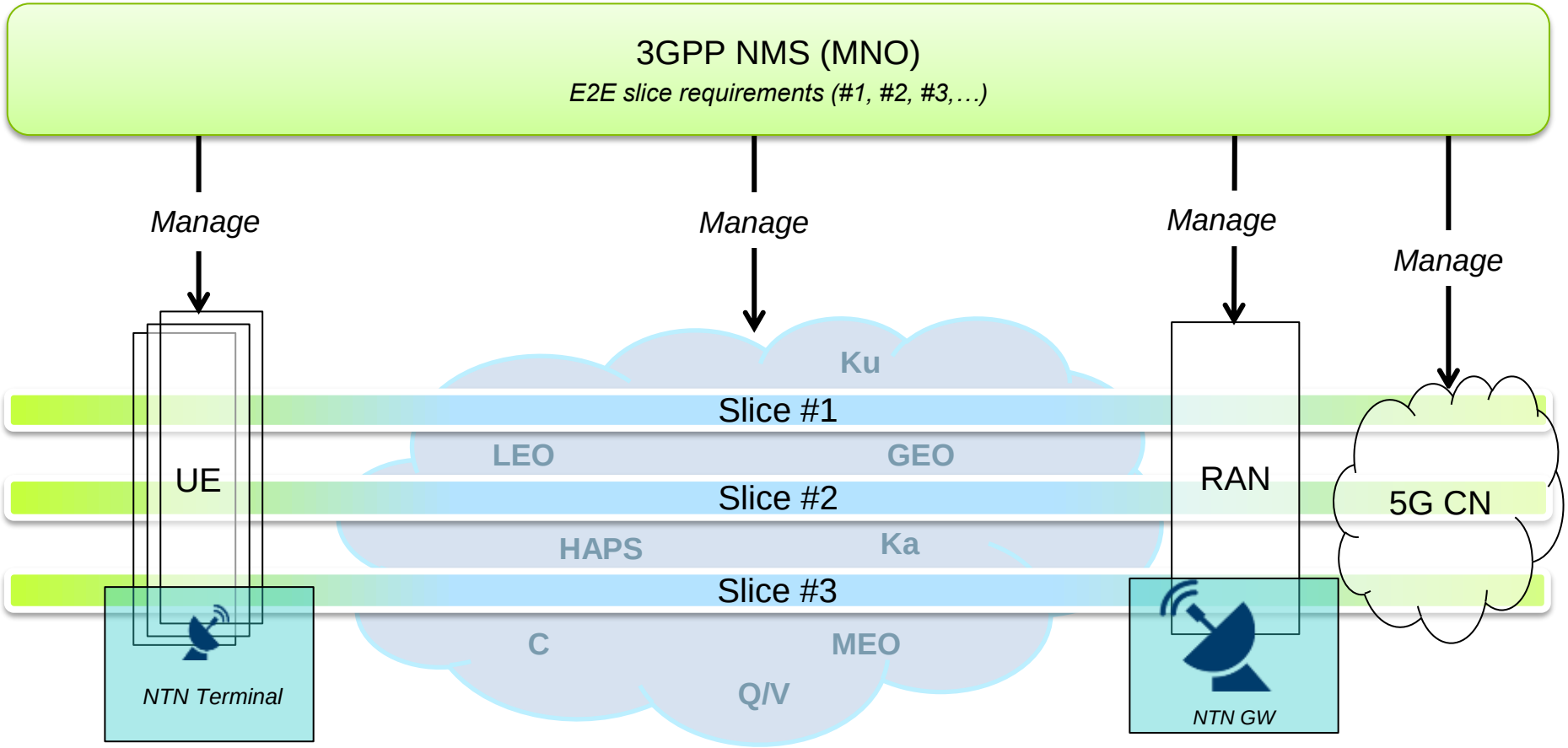
Satcom Relay Node (IAB) in 5G networks

New concept being studied in 3GPP to make 3GPP NMS aware of transport network and establish coordination between SatCom and 3GPP NMS to better support network slicing



Satellite access in 5G networks

New concept being studied in 3GPP to make 3GPP NMS aware of transport network and establish coordination between SatCom and 3GPP NMS to better support network slicing

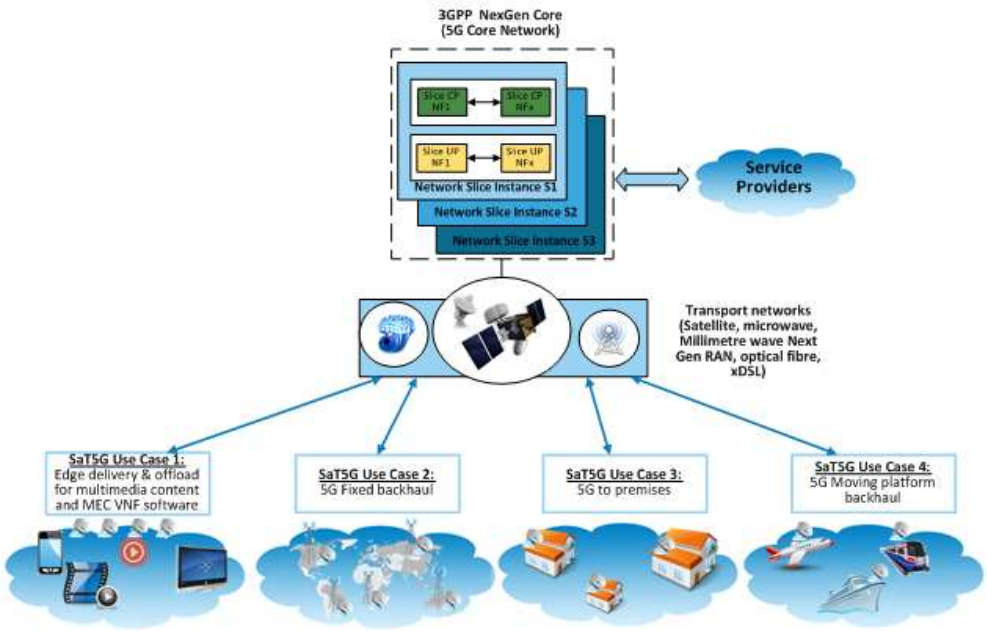


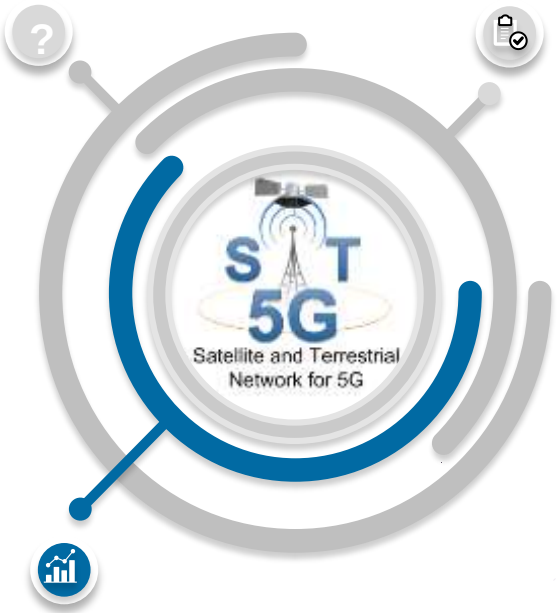
Satellite and terrestrial 5G integration challenges

Several technical and functional challenges need to be addressed to achieve full SatCom integration into 5G networks.

- **Highly flexible and reconfigurable space segment** integrating digital payloads, active antennas, beam hopping, etc.
- **Ground segment based on SDN/NFV paradigms** allowing enhanced exploitation and flexible control of space segment infrastructure
- **3GPP standardisation:** inclusion of SatCom networks in 5G architecture, protocol and management specifications
- **SatCom 5G-enabled Management & Orchestration interfaces** exposing key SatCom functionalities to terrestrial Network Management System (NMS)

Architectures and Testbeds





Demonstrations live 5G Testbeds – SaT5G Industry day

Following architecture aspects are demonstrated :

- Relay UE
- Network Function delocalization
- Edge delivery support
- Multilink support
- Advanced functions for mobility management

Architecture and standardisation

The Architecture work has led to several contributions in SDOs:

- ETSI SES SCN, TR 103 611: “Integration of satellite and/or HAPS (High Altitude Platform Station) systems into 5G and related architecture options”
- ETSI SES SCN, contribution: ”Enhanced Interfaces for Advanced Satellite Transport Network”
- 3GPP CT4, contribution “Satellite Specific technical issues to be considered in 5G Core specification”
- 3GPP SA2, FS_5GSAT_ARCH: Several contribution of different topics (Multilink, Edge delivery, QoS, …)

Thank you for your attention

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