Network slicing impact on transport NW

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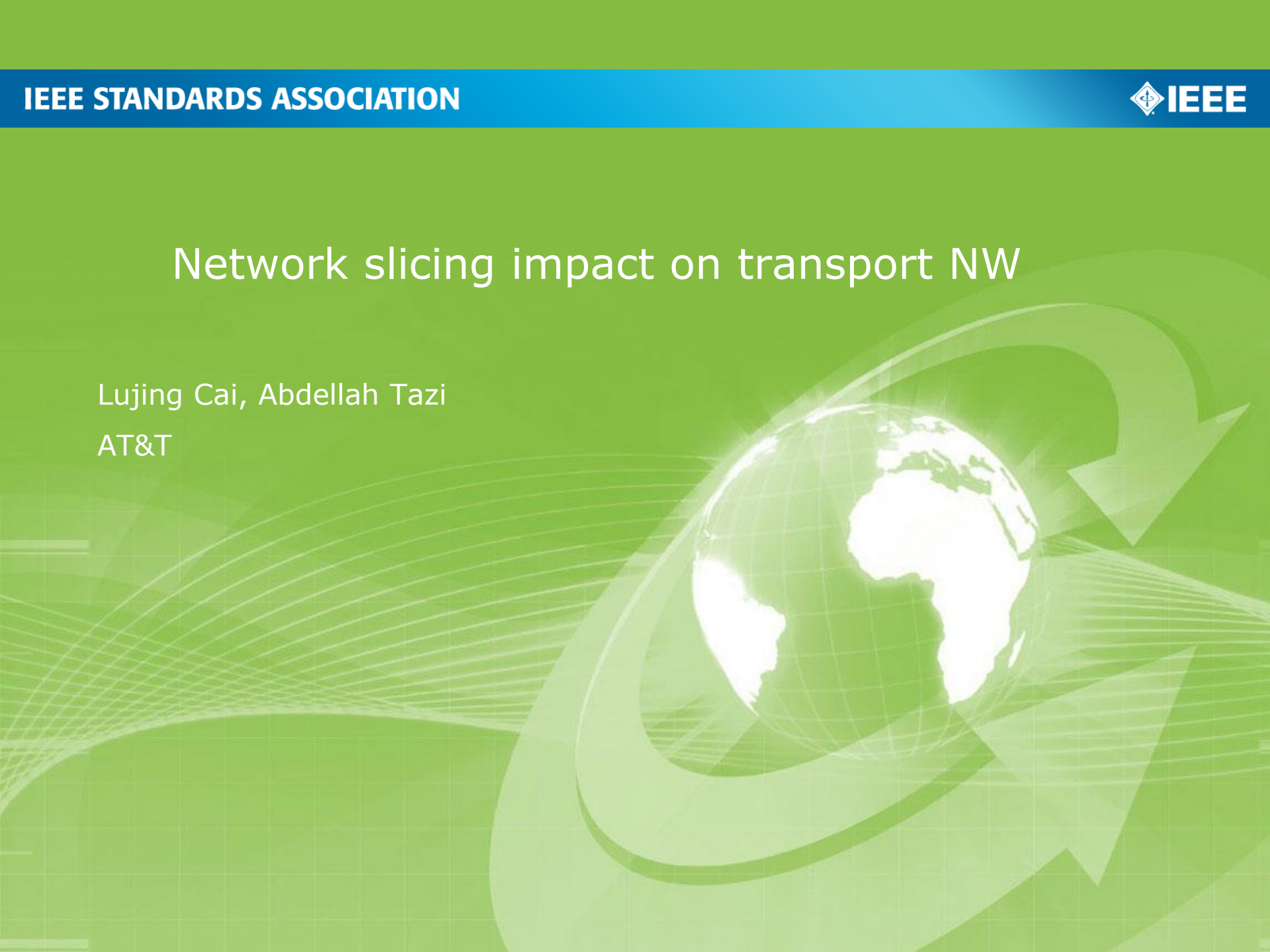

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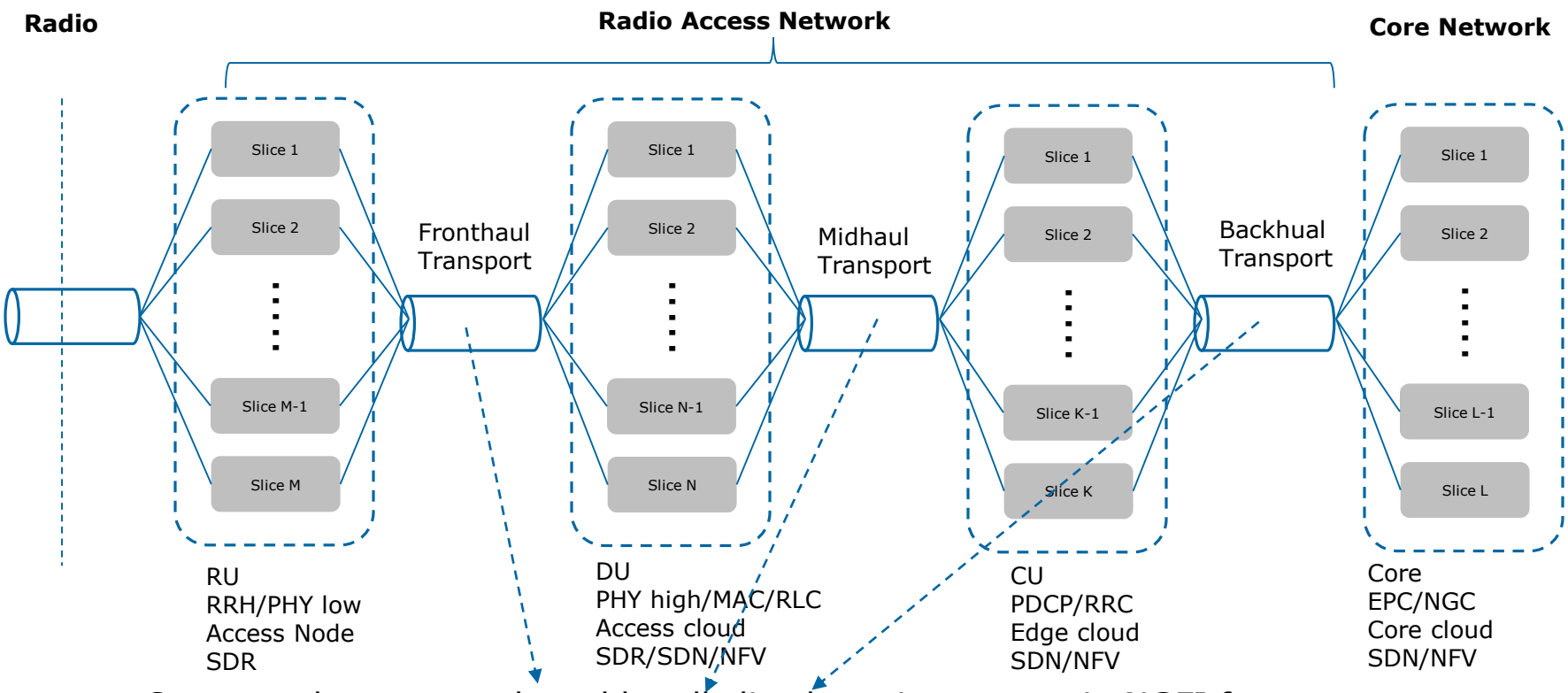
High level requirement for NW slicing on 5G from 3GPP

The 5G system shall*:

- allow the operator to create, modify, and delete a network slice
- allow the operator to define and update the services and capabilities in a network slice
- have no impact from the traffic and services in one network slice to other slices in the same network
- have no or minimal impact from creation, modification and deletion of a network slice to other slices in the same network
- support scaling of a network slice, i.e., adaptation of its capacity
- enable the operator to define a minimum capacity for a network slice
- enable the operator to define a maximum capacity for a network slice
- enable the operator to define a priority order between different network slices
- support means by which the operator can differentiate policy control, functionality and performance provided in different network slices

* Reference: 3GPP TS 22.261 "Service requirement for the 5G system"

Network slicing and transport overview



Converged transport shared by all sliced services, ➔ main NGFI focus

- End-to-end network slicing involves CN slicing, RAN slicing and slicing at user side
- RAN slicing is seen to has major impact on NGFI

RAN slicing use case 1 → transport impact

	Slice A Static Temperature Sensor (mMTC)	Slice B Video Streaming (xMBB)	Slice C Smart Grid (uMTC)	Slice E Other
RRC	HO measurements ommitted	State handling optim. for reduced RAN/CN signaling	State handling optim. for reduced state change latency	default
PDCP	Potential omitting of ciphering and header compression	default	Potential omitting of ciphering and header compression	default
RLC	Unacknowledged mode only	default	Acknowledged mode only	default
MAC	H-ARQ optimized for coverage	default	H-ARQ omitted for low-latency, RACH prioritization	default
PHY	Coding optimized for coverage, energy efficiency	Coding optimized for very large payloads	Coding optimized for short payloads, low latency	default

Midhaul transport

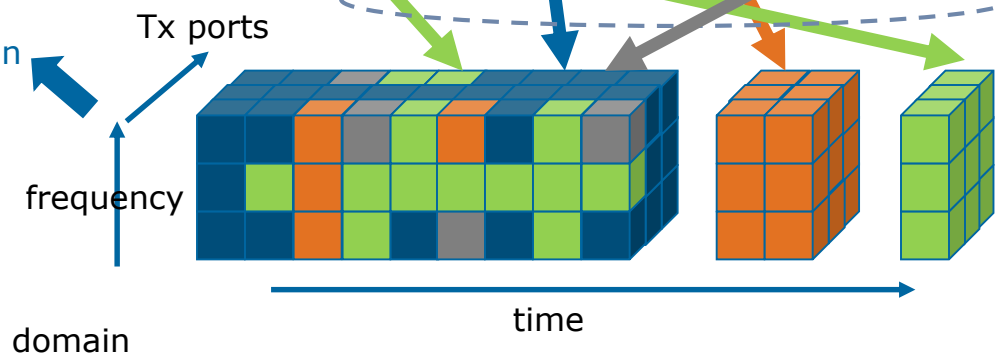
Fronthaul transport

Possible slice-tailored NFs in RAN:

- HARQ
- TTI duration
- Packet size
- Coding
- Signaling
- Scheduler
- …..

Slice aware resource management
- QoS
- Scheduling
- Interference coordination

Mixed transport traffics co-exist in the same access node



Slicing in frequency domain

Slicing in in time domain

Slicing in spatial domain

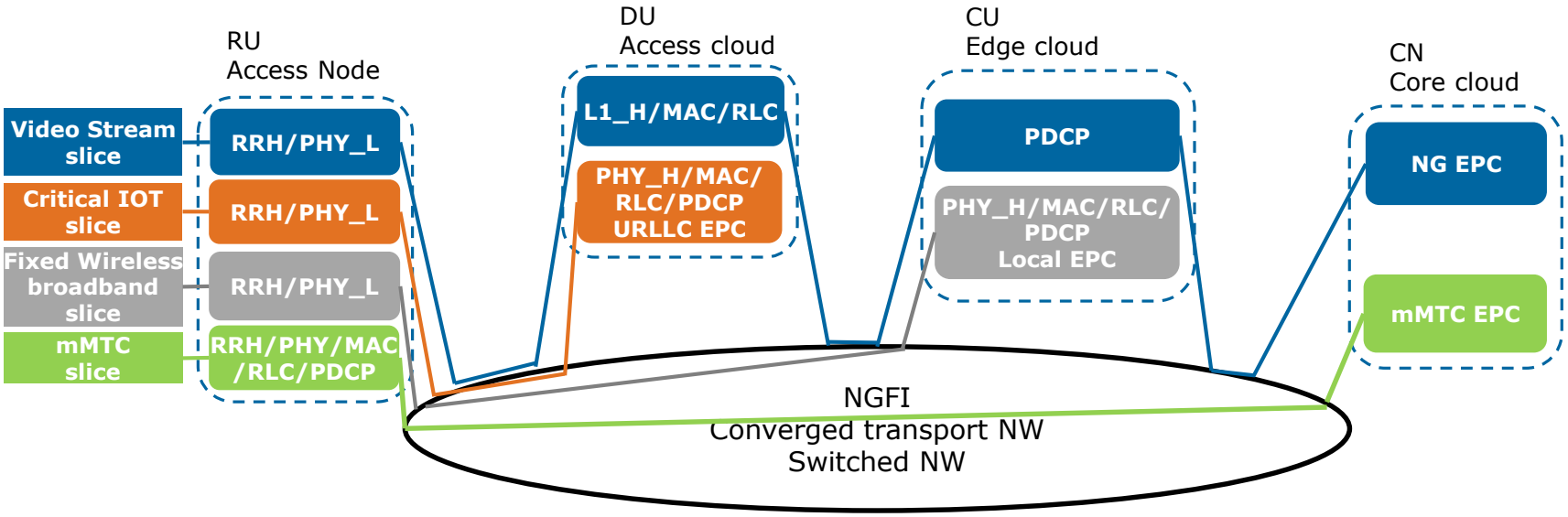
Mixed latency

Tight latency Short TTI

Long latency

Dynamic latency & throughput variation along time

RAN slicing use case 2 ➔ transport impact



- Horizontal NW slicing* concept: resource sharing/pooling with network functions allocated differently for each sliced service among the network nodes
- Allow different function splits among the sliced services
- Allow EPCs at different network nodes to meeting the service requirement: latency, rate, etc.
- Transport traffics taking shortest path to its destination (no need go through each hierarchy node)
- Adding or deleting or reconfiguring the slices cause more dynamic switching of node access points

➔ Key to the transport network:

- Fronthaul/Midhaul/backhaul converged into one network
- Data addressablibilty and switchability to reach various intended destinations

*ref: ETSI workshop on future radio technologies, "An end-to-end network slicing framework for 5G wireless communication systems"

Additional transport requirement due to NW slicing

Current NGFI specification under consideration already addressed:

- Converged transport network for all possible function split options
- Classed of service designed to accommodate all types of transport traffics with priorities
- NGFI reference architecture allows flexible RU/DU/CU access points

Additional requirements for NW slicing:

- Support protection/isolation mechanisms to minimize inter-slice effects (such as specifying minimum capacity to guarantee the service of the low priority slices)
- Allow more dynamic configuration via the transport C&M to efficiently support adding/deleting/reconfiguring slices and services
- Allow finer granularity of COS sub-classes in order to differentiate transport traffic better for different slices and services

Transport options in handling NW slicing

Sliced transport

- A slice-ID is assigned to the transport traffic associated to each of the slices
- The transport is also sliced accordingly by assign separate NW resources to the sliced transport traffics
- Complex and costly solution while optimized for network slicing ➔ more specification work for NGFI if considered

Slice-awareness transport

- The transport NW operation is not slice-specific
- Instead, the transport traffics of different slices with similar QoS requirements are grouped and mapped to the same COS sub-class ➔ treated as a sub-network instance
- The transport NW is optimized according to the requirements of the COSs
- Consider finer granularity of COS sub-classes for better slice differentiation
- Also specify minimum service rules to ensure the network slice protection/isolation
- In line with current NGFI specification framework

Slice-agnostic transport

- The transport traffics from different slices in a physical service node are aggregated without identifying the slices
- The tightest transport requirement among the slices are labeled to the whole aggregated traffic when handling the transport NW
- Simple but require much larger network capacity