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Network Slicing for 5G: Hype and Hypothesis

WSTS, March 2019

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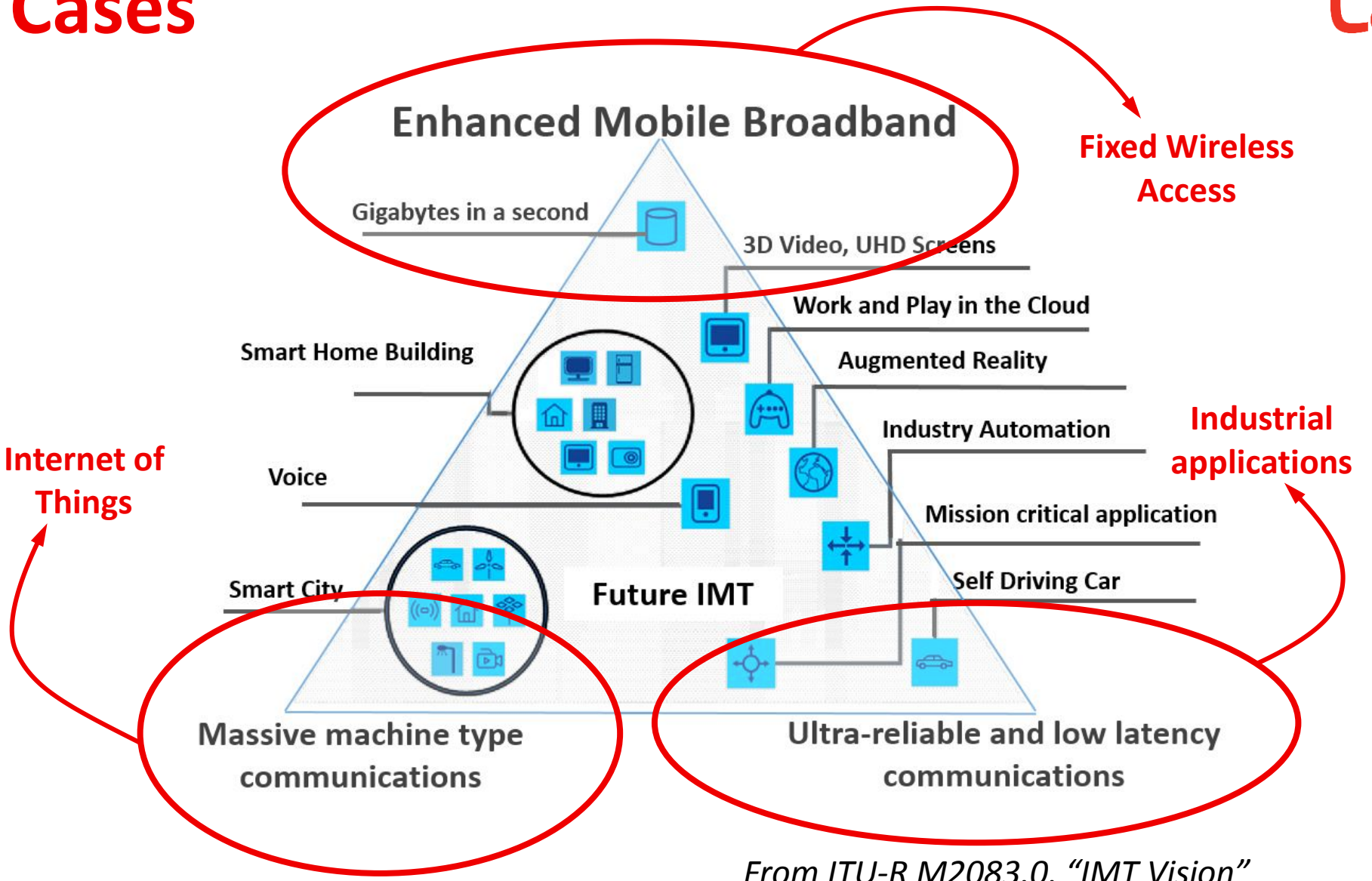
The hype?

The hype?

- ***"5G is a wireless infrastructure to connect the world" ****
  - Enhanced mobile broadband
  - Ultra-reliable and low latency communication (URLLC)
  - Massive machine-to-machine type communications (i.e. the "internet of things")
- It's going to solve everything from glitchless 8K video streaming to world poverty…
- Goals for 5G*:
  - Promote a new ICT market to help drive economies around the globe
  - Bridge the digital divide by providing affordable, sustainable mobile and wireless communications
  - Enable new ways of communication, sharing content anytime, anywhere through any device
  - Enable new forms of education, boosting e-learning, e-health and e-commerce
  - Promote energy efficiency by supporting smart gird, smart logistics and teleconferencing
  - Social changes through shared opinions and information
  - New art and culture; virtual group performances, art and activities

** From ITU-R M2083.0, "IMT Vision"*

5G Use Cases



From ITU-R M2083.0, "IMT Vision"

Example: Smart Cities

- Intelligent Traffic Management
- Smart Public Transport
- Smart Energy Management
- Smart Communications and Information
- Security Systems
- Waste Management
- Crowd Management

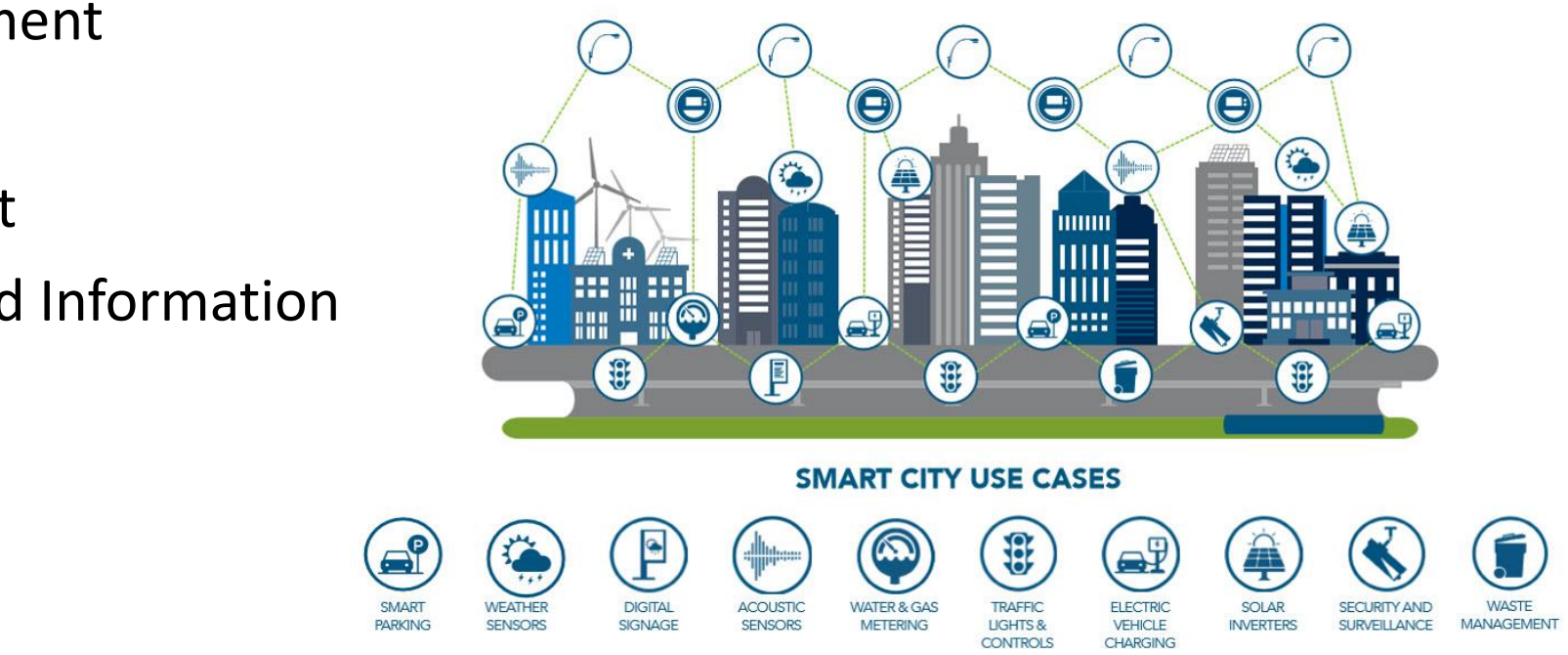
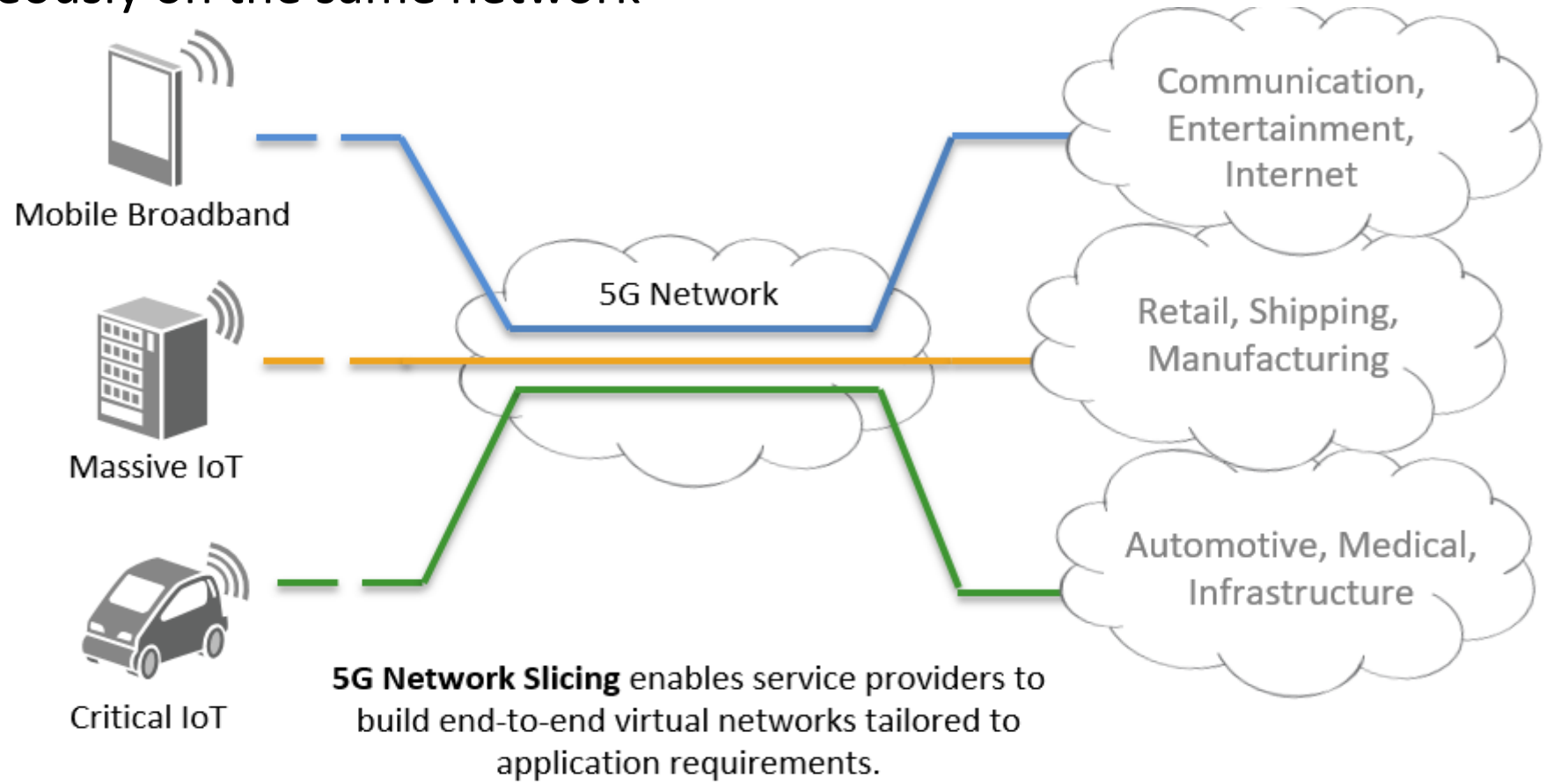


Image: Amaresco

The hypothesis?

The Hypothesis?

- Network slicing is the way to deliver the disparate requirements of all these applications simultaneously on the same network



https://www.vanillaplus.com/2017/01/31/24983-network-slicing-unleashes-5g-opportunities-service-quality-can-assured-part-2/

Network Slicing

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- Virtualizing the network to provide dedicated functions specific to a service or customer
  - Unique quality and class-of-service
  - Dedicated, guaranteed bandwidth allocation
  - Service-specific latency targets
  - Reliability and guaranteed delivery targets
  - Mass connectivity and ease of deployment
  - Isolation and security of slices
- Initially provided in the core networks to support 4G services, but moving into the RAN
  - More distributed architectures required to support the mass connectivity, reliability and latency goals

Let your dreams run wild…

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- Network slices can separate traffic not just by type, but by customer or source
  - Critical infrastructure – emergency services, power and utilities, law enforcement, healthcare – could all have their own slices
  - Mobile Virtual Network Operators (MVNOs) could operate in separate slices across their leased wireline networks
  - Data centers and large enterprises could have a separate slice, with customisable service quality – the logical extension of virtual private networks
  - Logistics companies could have a slice for trucks, containers, warehousing etc.
  - Public transport could operate their own slice for vehicles and street infrastructure
- Once you have the ability to orchestrate and establish the parameters of a new slice, you can set up slices for almost anything
- Becomes a big new revenue opportunity for mobile operators: the ability to tailor a virtual network for any customer or industry

How does it work?

Network Slicing in the Core

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- A way of segmenting the network into a set of virtual independent networks or “slices”
- Each slice is a set of logical functions supporting the requirements of the user or service
- Differs from QoS, because it can be applied end-to-end and optimized for a given user (e.g. an MVNO), not just on a traffic type
  - QoS tends to work on a class of traffic, rather than a user or tenant
  - Network slicing uses QoS (e.g. DiffServ) as a building block for creating a slice
- Technologies involved
  - Service Orchestration
  - Network Function Virtualization (NFV)
  - Software Defined Networking (SDN)
  - Segment Routing (SR)
  - Quality of Service (e.g. DiffServ)

Network Slicing in the RAN

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- Based on a more hardware-oriented approach at layer 2
- Competing technologies to provide traffic isolation and performance guarantees
  - ***Slicing Packet Network***, using FlexE technology
  - ***Mobile OTN***, using Optical Transport Network (OTN) technology

- Both of these create dedicated bandwidth channels, enabling latency and throughout guarantees to be provided
- Similar in concept to ATM, with small data blocks multiplexed across high-capacity networks

FlexE

- Enables channelization and bonding of Ethernet links to provide guaranteed bandwidth to a number of different services

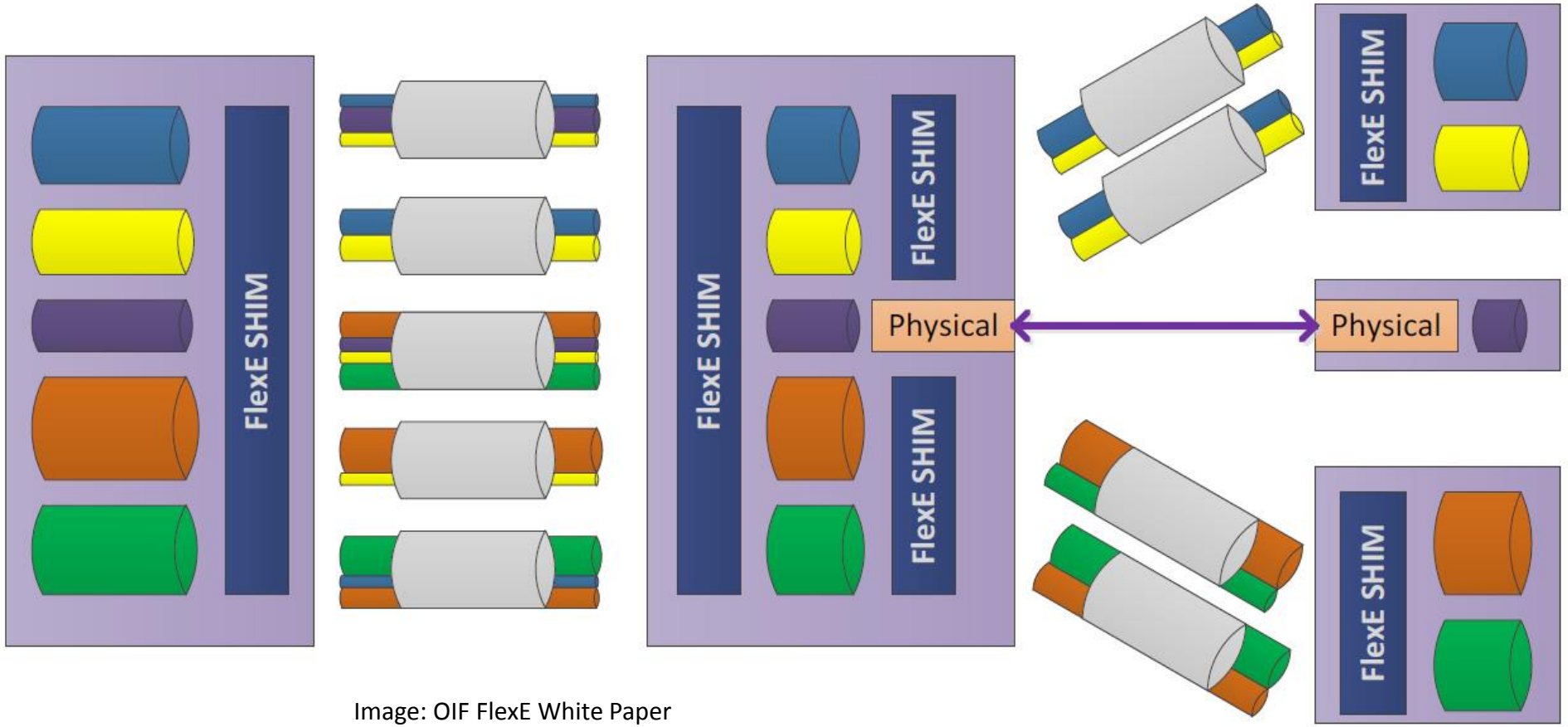

Image: OIF FlexE White Paper

Network Slicing in the Air

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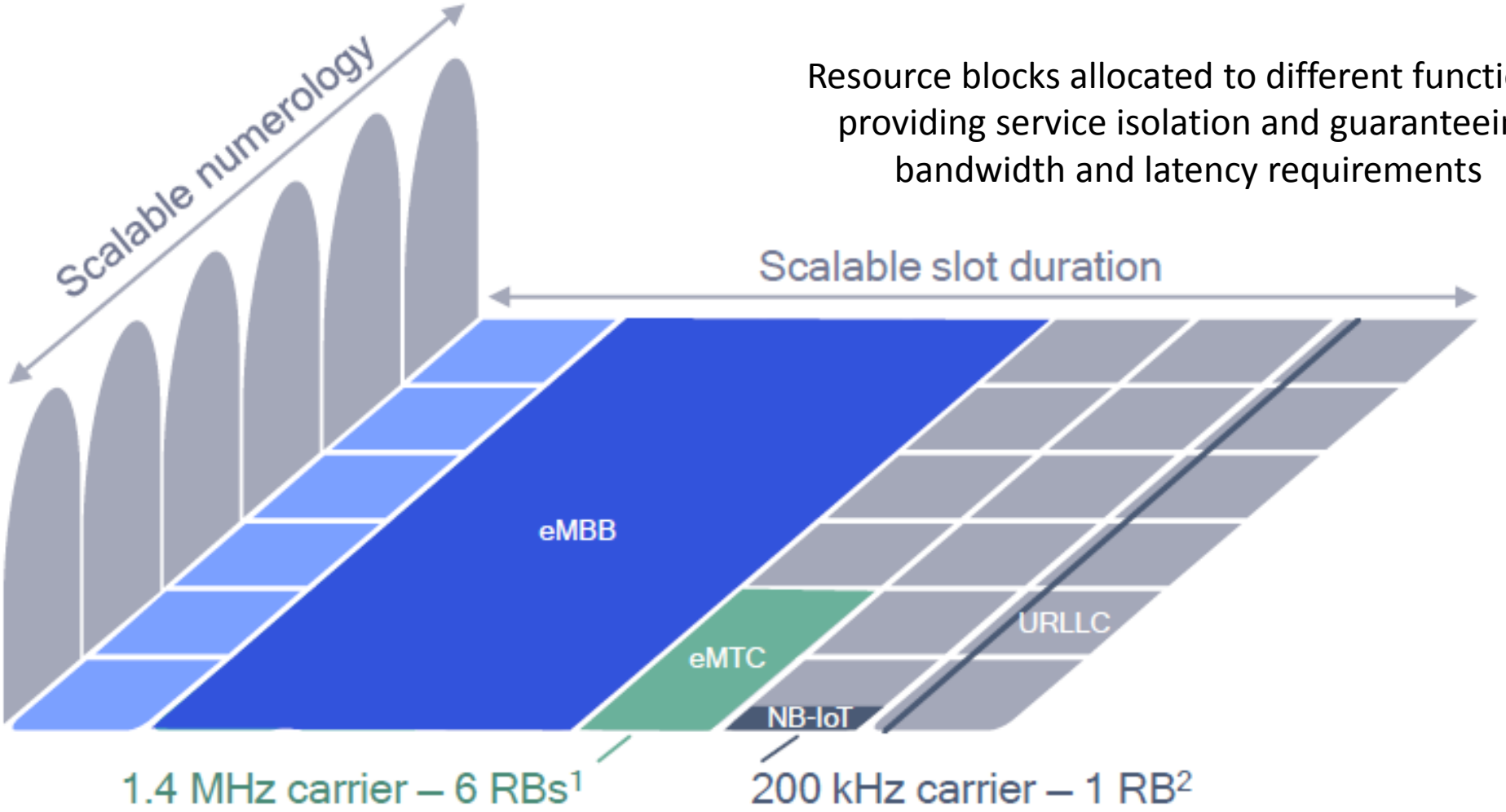

Resource blocks allocated to different functions, providing service isolation and guaranteeing bandwidth and latency requirements

Source: Qualcomm, “Expanding the 5G NR Ecosystem”

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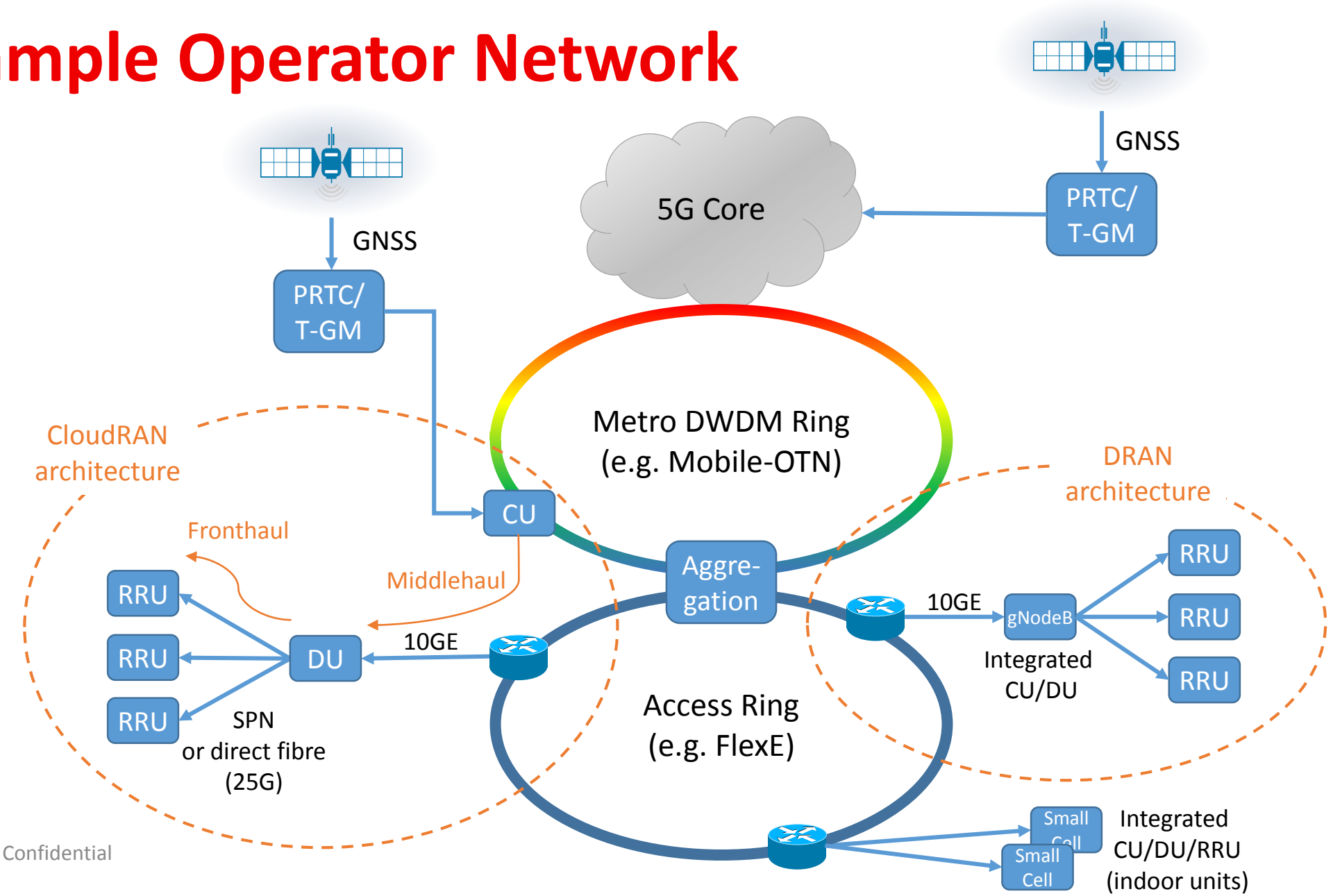
What about Sync?

Example Operator Network



Can we create a network slice for Sync?

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- Create a low-latency, guaranteed delivery and bandwidth channel for sync messages
- But remember:
  - Sync is a physical rather than virtual commodity
  - Latency guarantees are one thing, but symmetrical delays are outside software control since they are affected by wavelengths used, physical fiber distances, temperature variation
- Technologies such as OTN and FlexE are not kind to sync distribution
  - Framing structures can cause latency changes each time the link is established
  - Leads to asymmetry between forward and reverse

Special Treatment for Sync

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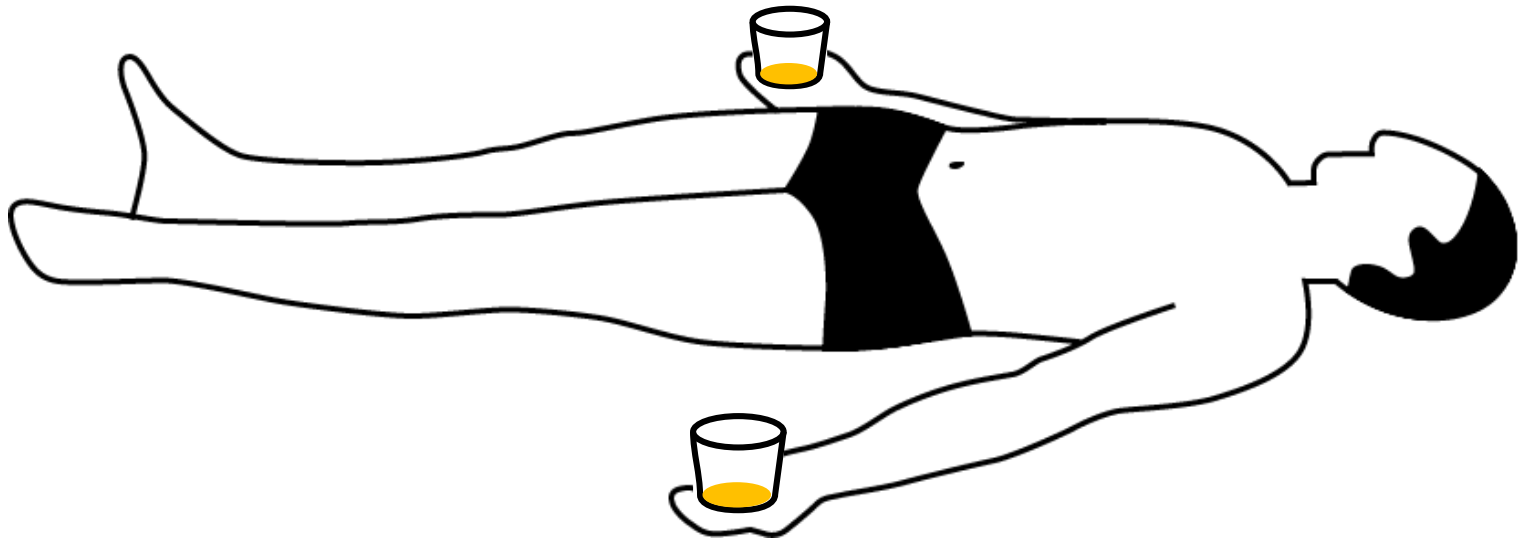
- FlexE
  - Sync can’t be carried in FlexE clients, because framing structure causes variable asymmetry
  - No need for each client to have its own synchronization
  - PTP and ESMC (SyncE quality levels) carried in overhead channel
  - Overhead channel is always on first FlexE instance of the group (easy to find)
  - Message timestamp point is the start of the overhead multiframe (easy location)
- Mobile OTN
  - Similar issue: framing structure causes variable asymmetry
  - Again, no need for each client to have it’s own synchronization
  - PTP and ESMC carried in OSMC (OTN Synchronization Messaging Channel) (part of the OTU overhead)
  - Message timestamp point is the start of the overhead multiframe (easy location)

Conclusions

Hype or Hypothesis?

- Can network slicing deliver the hype?
  - Possibly, but the hypothesis is not proven yet…
- Will it affect sync?
  - Sync and virtualization don’t go well together
  - Channelization at the lower layers (such as FlexE or OTN) destroys sync unless special treatment is applied
  - Sync is best running at the lower layers (e.g. Ethernet point-to-point, or FlexE/OTN overhead channels)
- And finally…

The one yoga pose you'll be able to do after Calnex's famous conference dinner and whisky tasting experience ...



Reception and Dinner: Siskiyou Ballroom, DoubleTree I Wednesday 7:00 - 9:30 p.m

Insight and Innovation

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