



THE 5G EDGE CLOUD:

*KEY DEVELOPMENT FOR 5G VISION SERVICES, RAN VIRTUALIZATION &
SECURING IOT IN THE MOBILE MULTI-CLOUD*

Ian Goetz, Chief Architect – Mobile Solutions
September 2020

Legal Disclaimer





This product roadmap sets forth Juniper Networks' current intention and is subject to change at any time without notice.

No purchases are contingent upon Juniper Networks delivering any feature or functionality depicted on this roadmap.

JUNIPER
NETWORKS

Engineering
Simplicity

WHERE'S THE MONEY COMING FROM? - Revenue Growth in 5G Mobile

CONSUMER 		ENTERPRISE 		IoT 		AUTOMOTIVE 					
											
Trusted Reliability		Pervasive Coverage		Seamlessly Converged		Ubiquitous-Coverage		Low-Latency		Security	

SP:

- Mobile Carriers and Wholesale Carriers
- Cloud Providers looking at the Edge

eMBB

REDUCE COST
 (Open RAN, Fixed-Mobile Node Usage, Automation)

SP & ENTERPRISE:

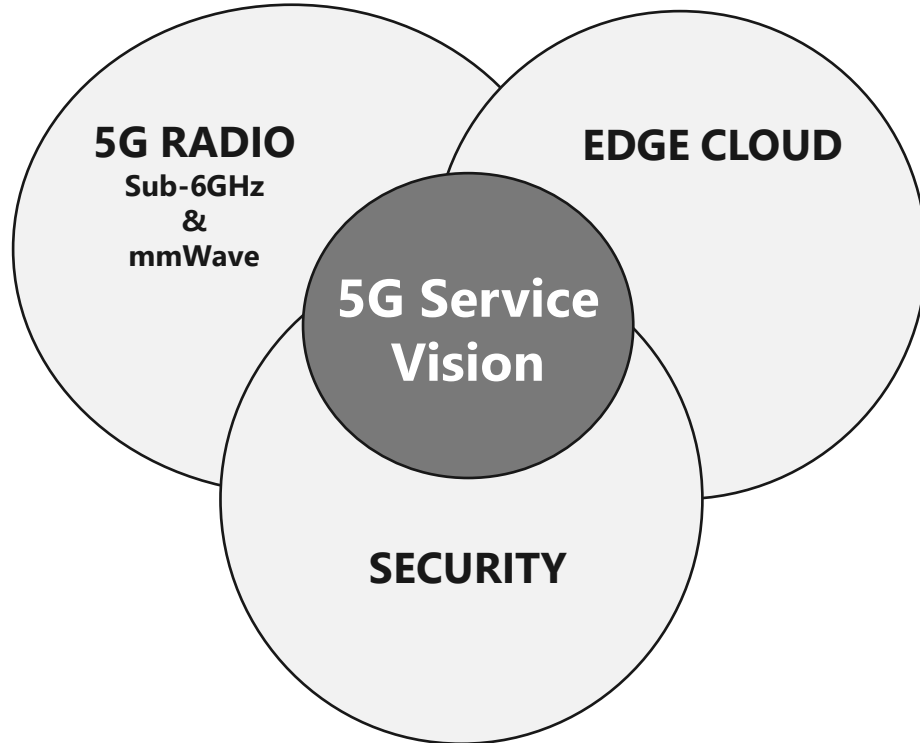
- Mobile Carriers and Wholesale Carriers
- Cloud Providers looking at the Edge
- Cities, Industrial SI's, Railways, Government, etc

Low Latency & Massive IoT

EDGE CLOUD INVESTMENT

THE 5G SERVICE VISION IS BUILT FOR AND BY MANY AREAS

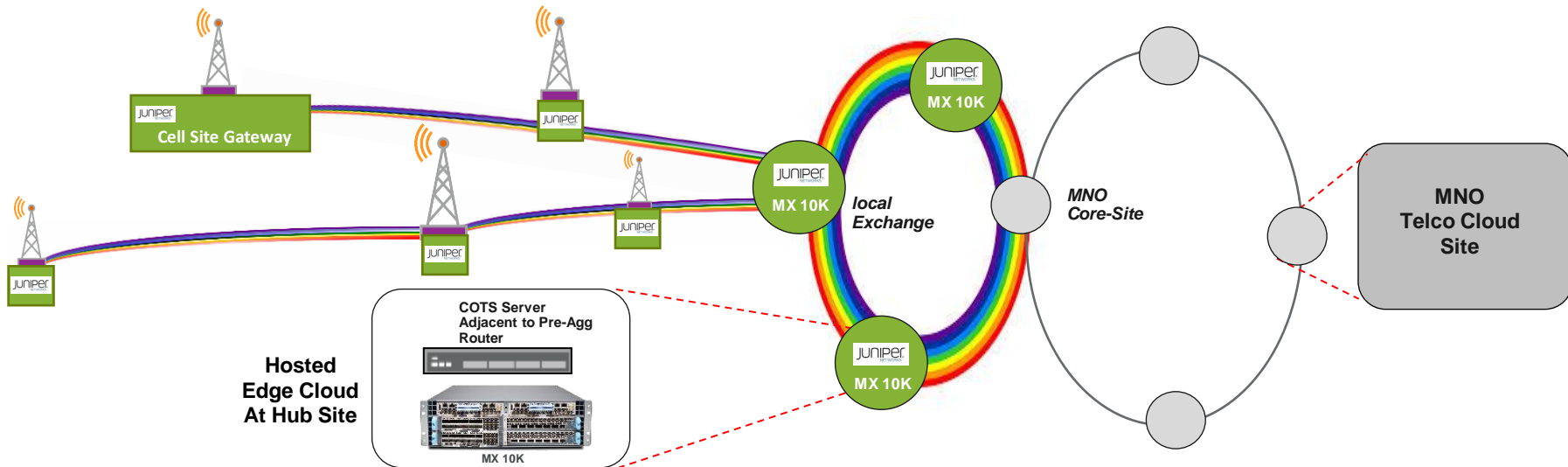
5G Radio, IoT, Security, Automotive, Industry 4.0, IIoT, Edge Cloud, ORANacross Enterprise & SP



5G OPEN RAN DRIVES A NEW “EVERY” HAUL MODEL: WHOLESALE TRANSPORT EXAMPLE

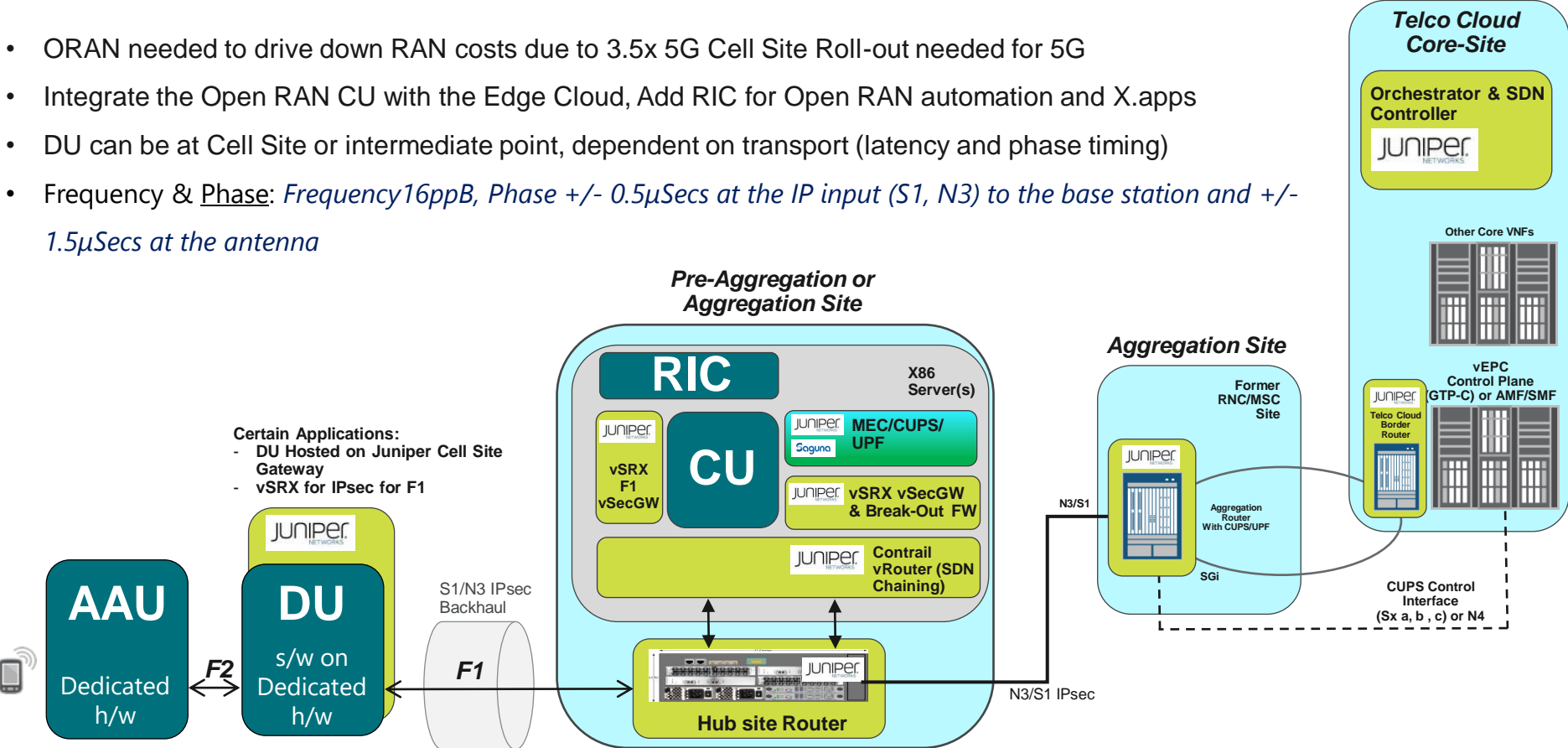
DENSE 10G/25G/100G, PHASE TIMING & LOW LATENCY

- MNO 5G NR Upgrade to existing SRAN Base stations with current 4G Core as initial deployment model, then adding Open RAN
- Phase & Freq timing in IP Network is key: *Frequency 16ppB, Phase +/- 0.5µSecs, LTE-A pro needs a Phase accuracy of +/- 1.5µSecs, or better for CoMP*
- **Edge Cloud Add On: Distributed Security:** X2 Handover Interface requires a latency of $\leq 3-5\text{ms}$ – vSRX for X2 SecGW
- In 5G - Network moves from 1G (S1 - eNB to Pre-agg) and 10G (Pre-agg to Core) to 10G/100G+
- EDGE CLOUD: Adds SDN Gateway requirements to the aggregation router
- Aggregation Router needs to drive the Fibre from the Local Exchange to the CSGs – 400 or 800 core fibre over 5km – 15km
- Then CSG and aggregation router need to address Open RAN interfaces and Timing: F1, F2 – Optical, 25G and nanosecond Phase timing



OPEN RAN: EDGE CLOUD AND ROUTING

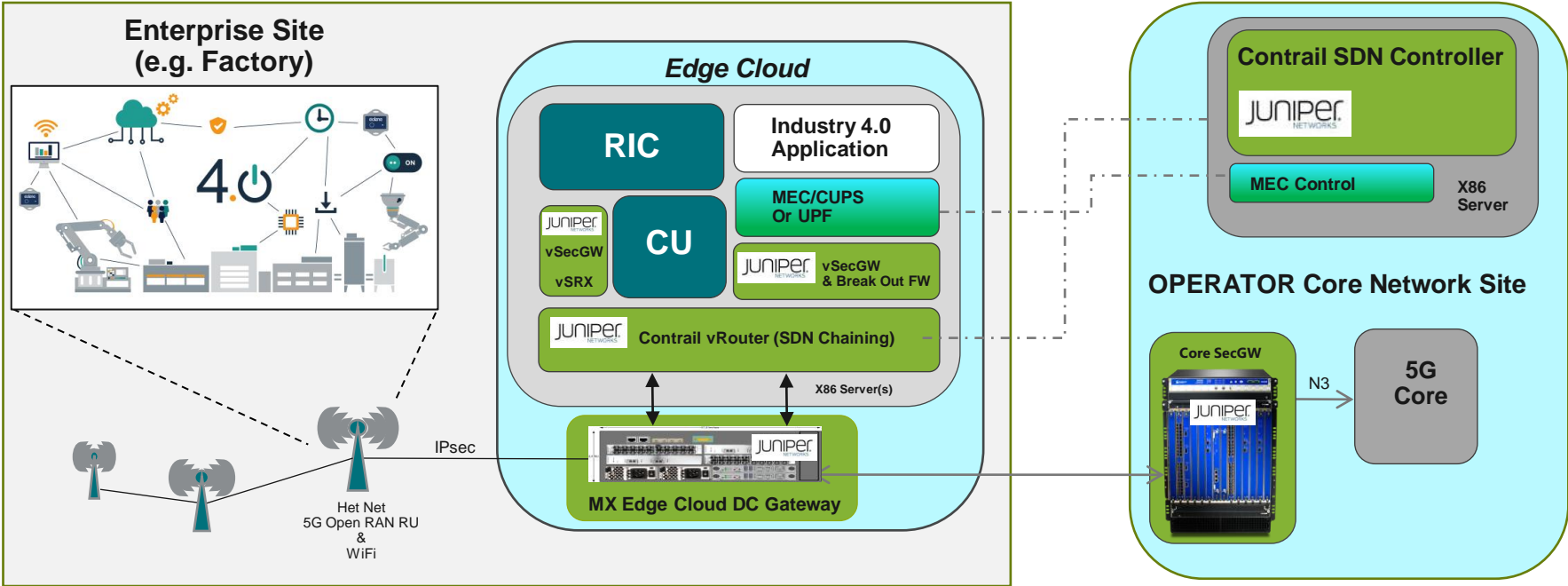
- ORAN needed to drive down RAN costs due to 3.5x 5G Cell Site Roll-out needed for 5G
- Integrate the Open RAN CU with the Edge Cloud, Add RIC for Open RAN automation and X.apps
- DU can be at Cell Site or intermediate point, dependent on transport (latency and phase timing)
- Frequency & Phase: *Frequency 16ppB, Phase +/- 0.5μSecs at the IP input (S1, N3) to the base station and +/- 1.5μSecs at the antenna*



Open RAN Private 5G: Industry 4.0, Healthcare etc

Private Network applications for Industrial control: Factory Machinery, Construction sites, Production Plants, Ports, Hospitals, Oil rigs etc

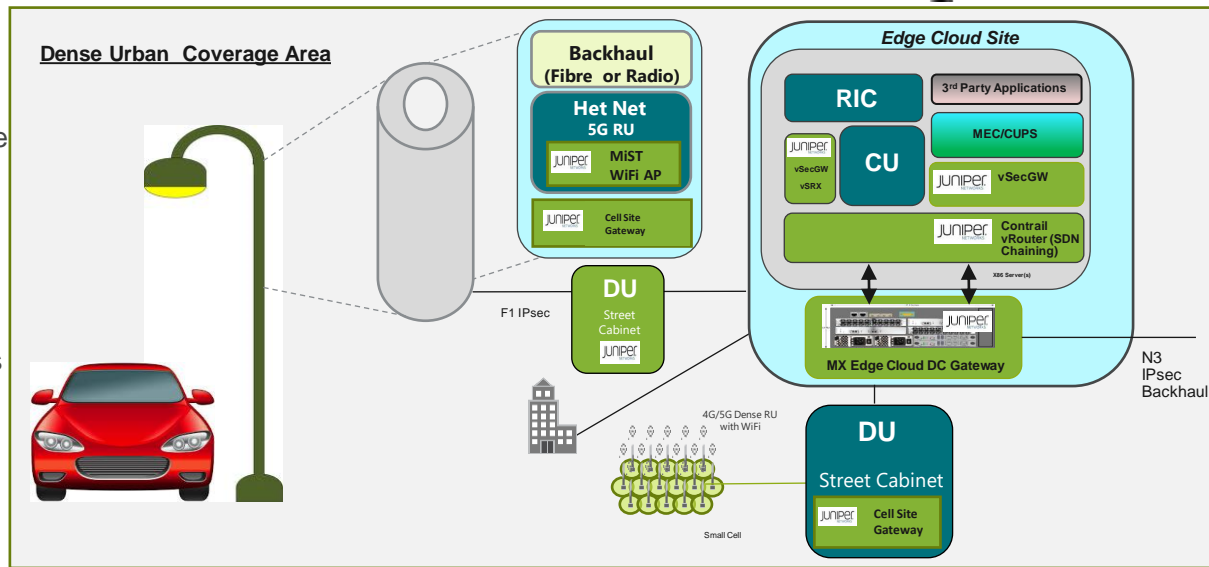
- Requires low latency with applications running on site
- Specific 5G coverage deployed – small cells, using licensed spectrum to avoid open band interference issues
- Uses Edge Cloud with MEC, CUPS or UPF and the core in the MNO Telco Cloud or a full Distributed mobile core (EPC or 5G SA)



Network Densification & Smart City: Public WiFi and Open RAN

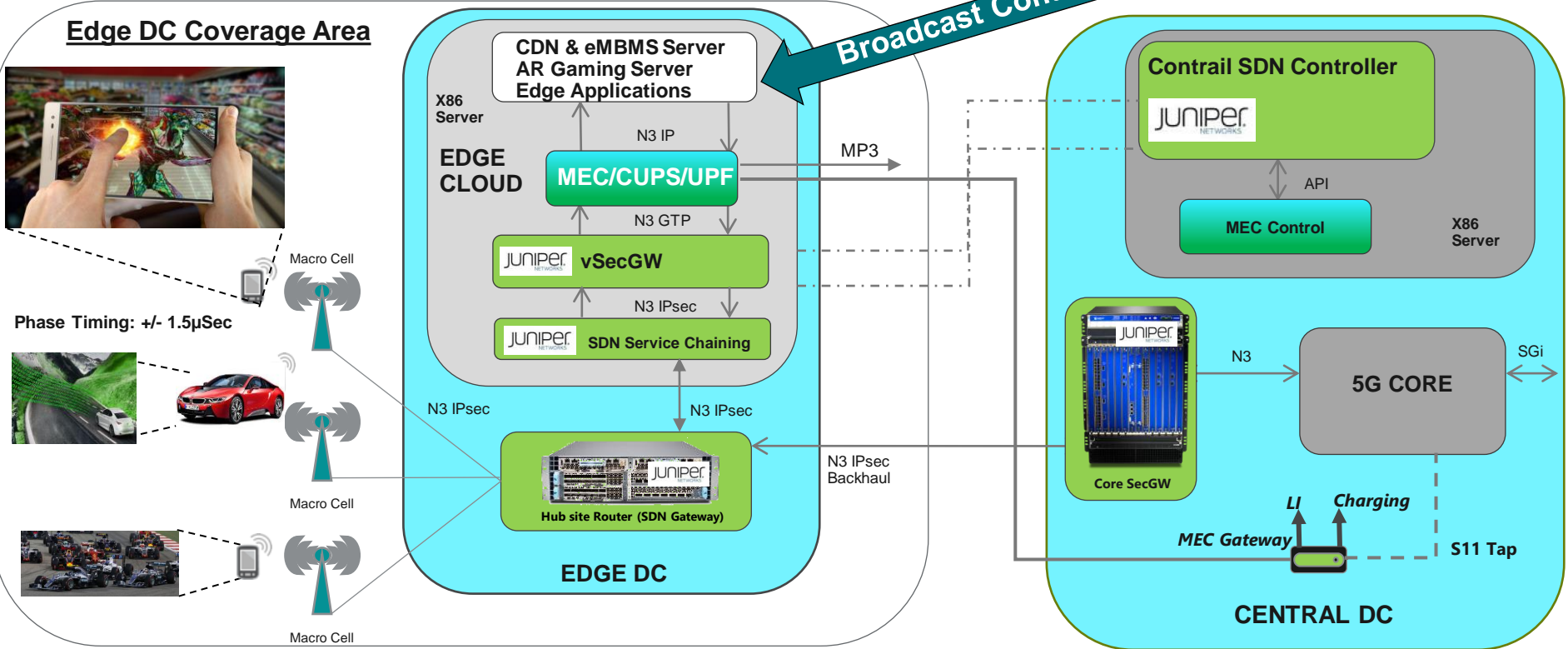
Smart City needs Edge Cloud and both 5G Open RAN and WiFi to mix public and Smart City services

- Augmented & Fully Autonomous Vehicles:** Network information & low latency for automotive systems
 - Vehicle lifetime is 20 years – on-board compute insufficient through vehicle lifecycle so network assistance needed
- Coverage & Capacity:** Depth of capacity needed to address density of devices (Vehicles, Sensors etc)
- Business Case:** Transport Efficiency, Reduced emissions, Reliable journeys for people and goods, Reduced congestion etc
- 5GAA:** Bringing together telecoms vendors and operators with automotive manufacturers, needs ITS involvement
- Security:** Essential that security is designed into the solution
- Low Latency:** Generally accepted that <25ms (Round Trip) required to allow semi/fully autonomous vehicles
- Sites:** City owned street furniture ideal for network densification and hence neutral hosts for MNOs as well as Smart City
- Dense Radio:** Cell radius is 80m – 100m



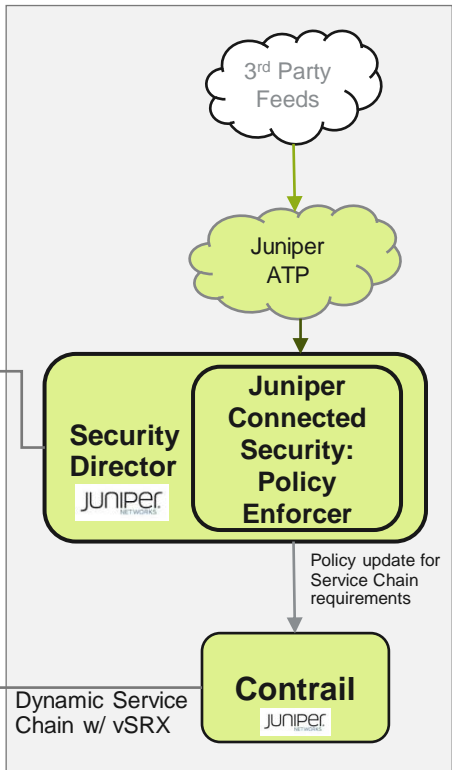
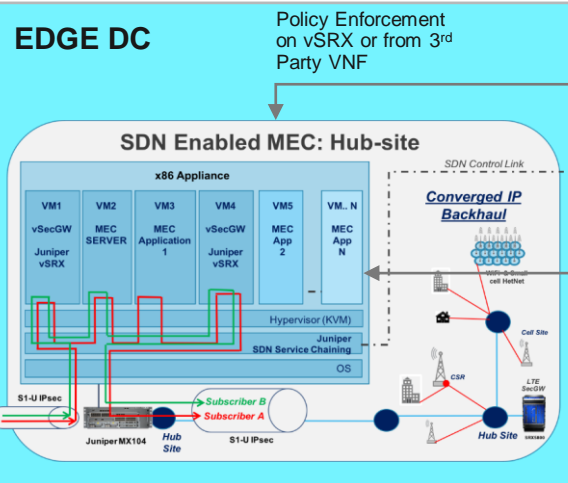
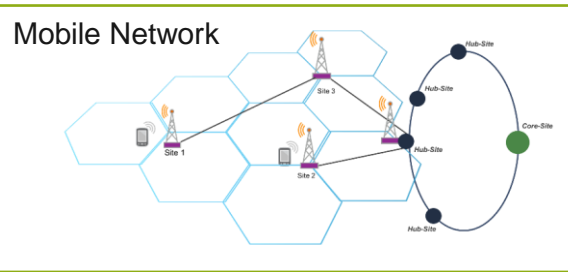
Consumer Services & IoT Updates – CDN & eMBMS, AR Gaming

- Edge Cloud Allows high bandwidth content (Streaming, Broadcast, Device s/w etc) to be distributed into the RAN to improve scalability and user experience
- Augmented Reality (AR) Gaming involves device-based gaming that superimposes the game on the image the device captures of it's immediate surroundings – Low Latency
- AR "Assisted Maintenance" services allow faster field repairs



EDGE SECURITY USE CASE: CONNECTED SECURITY

NOTE: For CUPS/Dis EPC/UPF – Compromised Device attacks reach the core network first, with MEC, Detection & Enforcement is possible before the core network functions



Policy

- Policy defined in Policy Engine
 - “Attacks from infected mobile devices should be blocked in the Mobile Pre-aggregation site”

Detection

- Sky Infected Host feed
 - 3rd party feeds
 - vSRX data to Sky

Enforcement

- Contrail provisions vSRX in the Service Chain
- Traffic from infected Devices dropped by vSRX

EDGE CLOUD: CUPS, MEC and the 5G UPF – Handling GTP At The Edge

Edge Cloud Infrastructure build should be the focus as CUPS, MEC and 5G UPF is mainly a single VNF change in an edge cloud service chain



CONTRAIL EDGE & MULTI CLOUD & vSRX



CUPS & R15 UPF

(& Distributed EPC)

*No Application h/o
No Access to Real Time Radio data
Edge Security NOT Possible*

2019

ETSI MEC

*Application h/o
Access to Real Time Radio
(RNIS API)
Edge Security Possible*

2019

5G R16 UPF/N4

*Application h/o
Access to Real Time Radio data?
Edge Security NOT Possible*

2022+

Private Network

**Defined Coverage Area
Match to Core Vendor**

Private Network

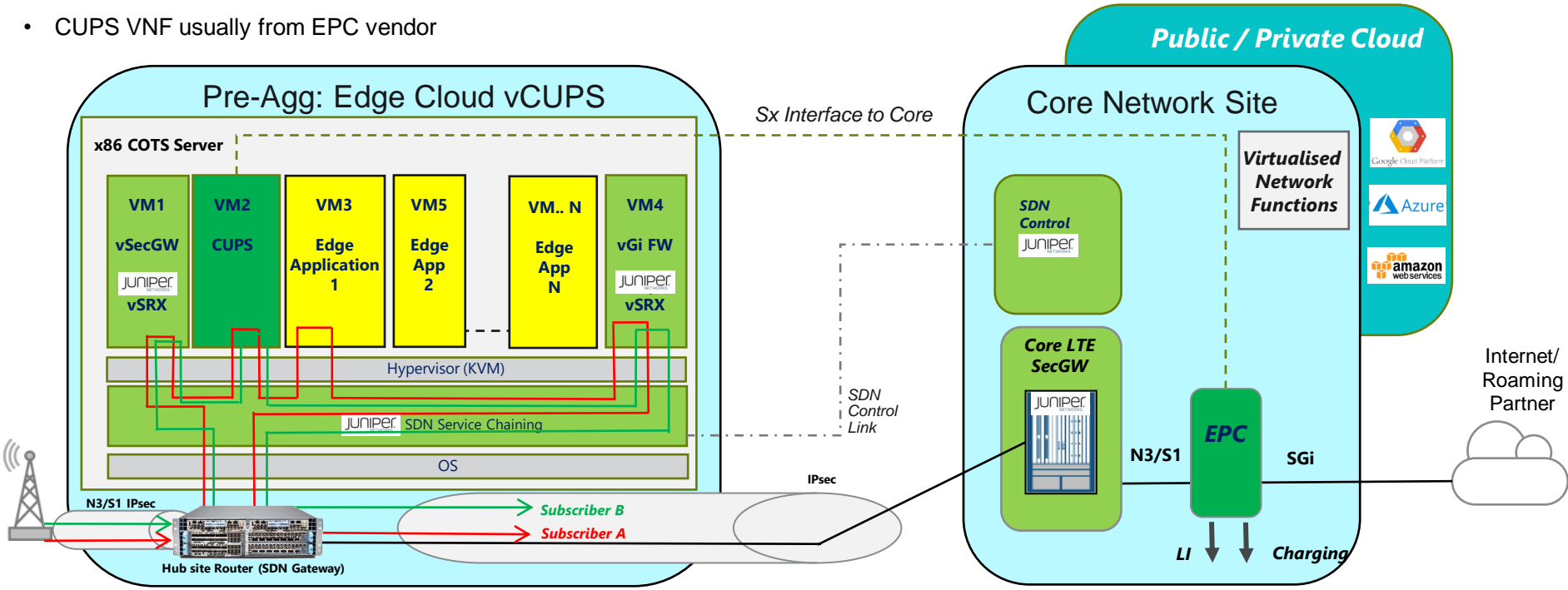
**Defined Coverage Area
&
Wide Area**

Private Network

**Defined Coverage Area
&
Wide Area
Match to Core Vendor**

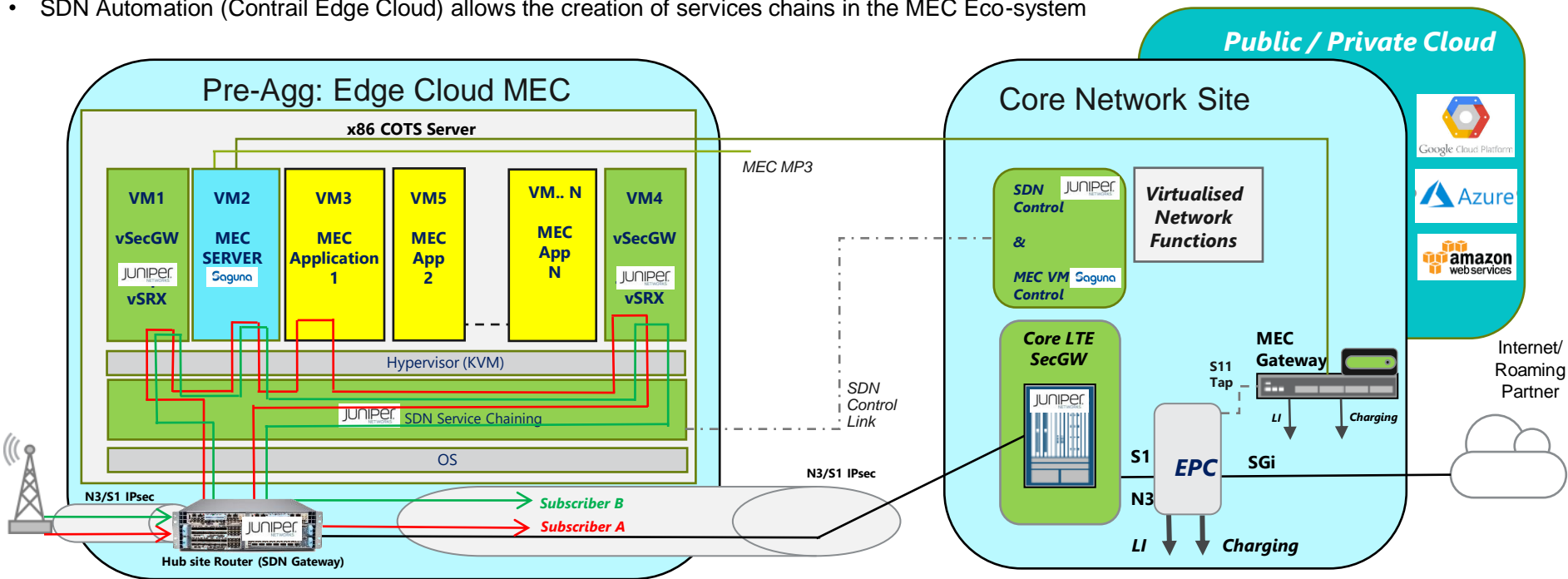
MOBILE EDGE CLOUD: THE SOFTWARE – CUPS/Dist EPC (2019)

- 3GPP CUPS Enables applications to be deployed at the mobile network edge for **Private Network / Defined Coverage Area ONLY**
- No APN handover defined on SGi interface – sessions are lost as devices leave the coverage area
- Application State h/o not possible as no h/o, Edge Security not possible as access to IP is after “core” network function. No access to radio data
- Charging & LI via EPC in Telco Cloud
- CUPS VNF usually from EPC vendor



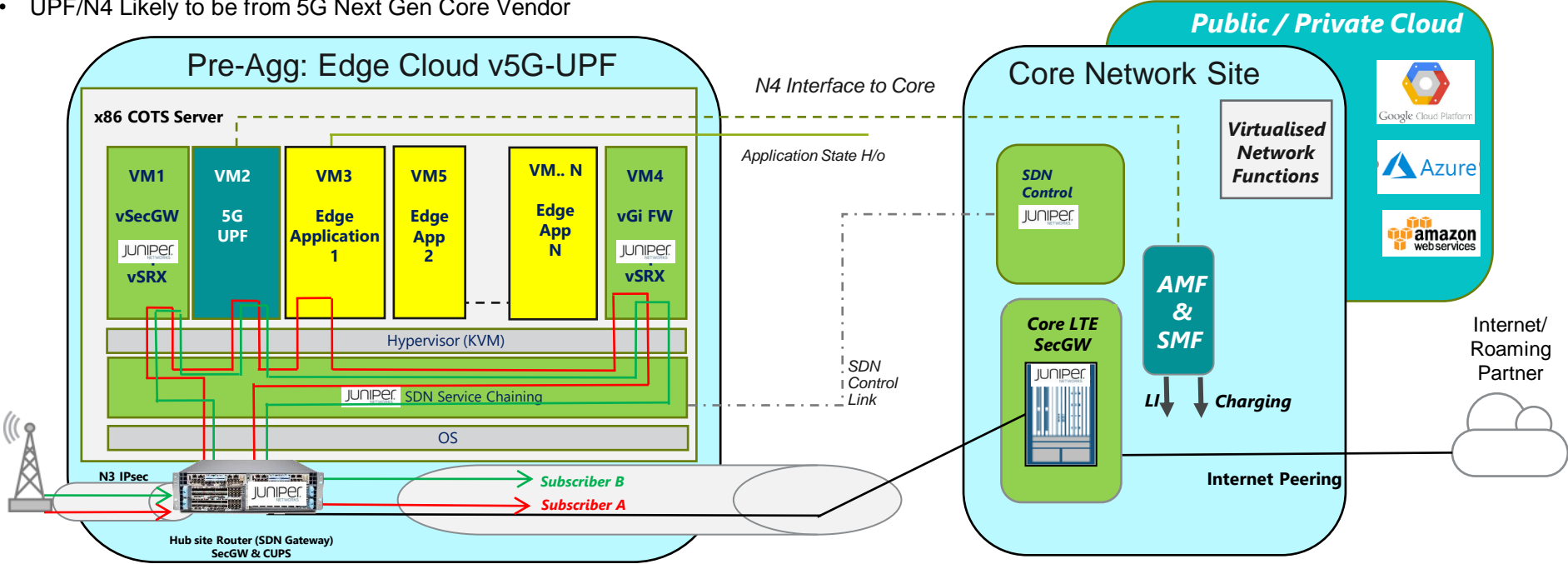
MOBILE EDGE CLOUD: THE SOFTWARE – MEC (2019)

- MEC Enables applications to be deployed at the mobile network edge for **Private Network / Defined Coverage Area and Wide Area Use Cases**
- Application State h/o via MEC MP3 API, Edge Security possible as access to IP is before “core” network function. Access to radio data (RNIS)
- Charging & LI via MEC Gateway in Telco Cloud
- SDN Enables the chaining of MEC Applications and the Life-cycle Management of MEC Application VNFs using automation
- SDN Automation (Contrail Edge Cloud) allows the creation of services chains in the MEC Eco-system



MOBILE EDGE CLOUD: THE SOFTWARE – 5G NEXT GEN CORE (2022+)

- 3GPP are standardising the 5G Next Generation Core:
 - Application Management Function (AMF), Session Management Function (SMF) & User Plane Function (UPF)
- Standardising UPF h/o during a session for 3GPP R16 – Once available, covers Private Network / Defined Coverage Area and Wide Area Use Case
- Edge Security not possible as access to IP is after “core” network function. Access to radio data requires additional standards work
- 3GPP R16 Not expected in deployed networks until 2022+ , especially post COVID19. 5G R15 SA going live 2020+ - no APN h/o
- UPF/N4 Likely to be from 5G Next Gen Core Vendor

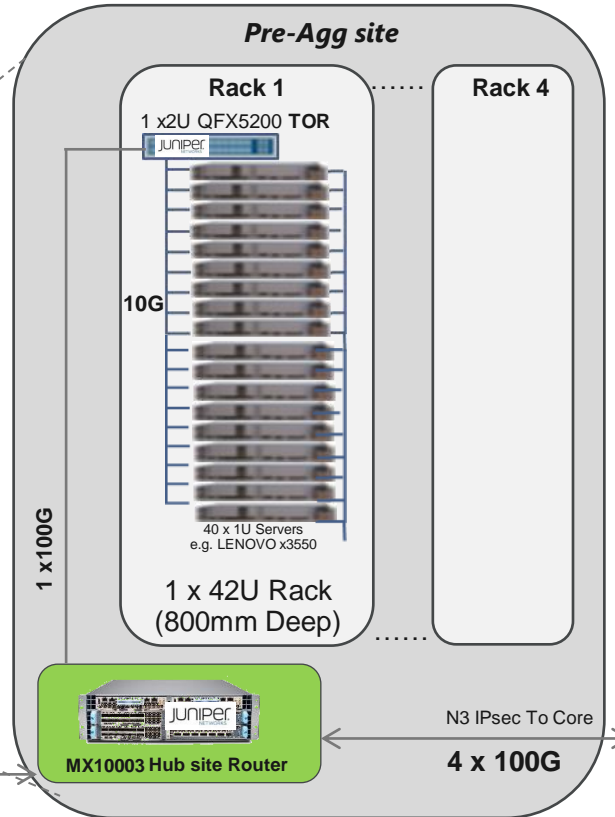


MOBILE EDGE CLOUD: – Micro Data Centre

- To Deliver Low Latency Services an Edge Micro DC is needed
- Classic DC architecture ... but smaller:
 - 40 x 2U 24 Core servers/rack, 2U TOR
 - Pre-agg Router “DC Gateway” (timing etc)
 - SDN Service Chaining, Supporting MEC/CUPS/UPF
- Industrial verticals already deploying Edge DC’s and Private 5G
- **As an example:** Juniper Elite Partners, Axians with sister company, Actemium build Edge DCs for private networks & deliver to site, pre-equipped:
 - Racks, Compute, routing, switching
 - Software installed on site
- Also Elite Partners (e.g. NEC XON, Telent & Xantaro)
 - With Private 5G this extends to RAN & Core:
 - Open RAN, vEPC and/or MEC/CUPS

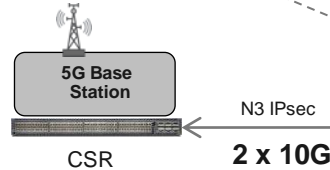


**Local Exchange
Or
BNG Site**



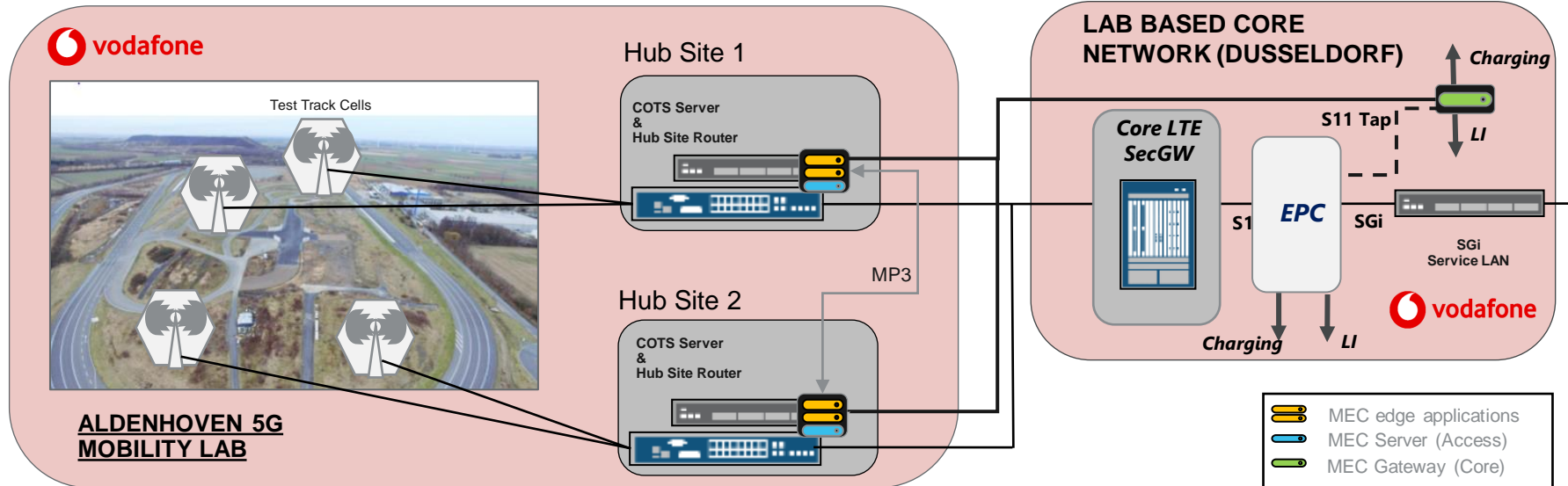
<https://www.youtube.com/watch?v=g9DQ4z0dQJc>

https://www.youtube.com/watch?v=52_NM6ICVlk

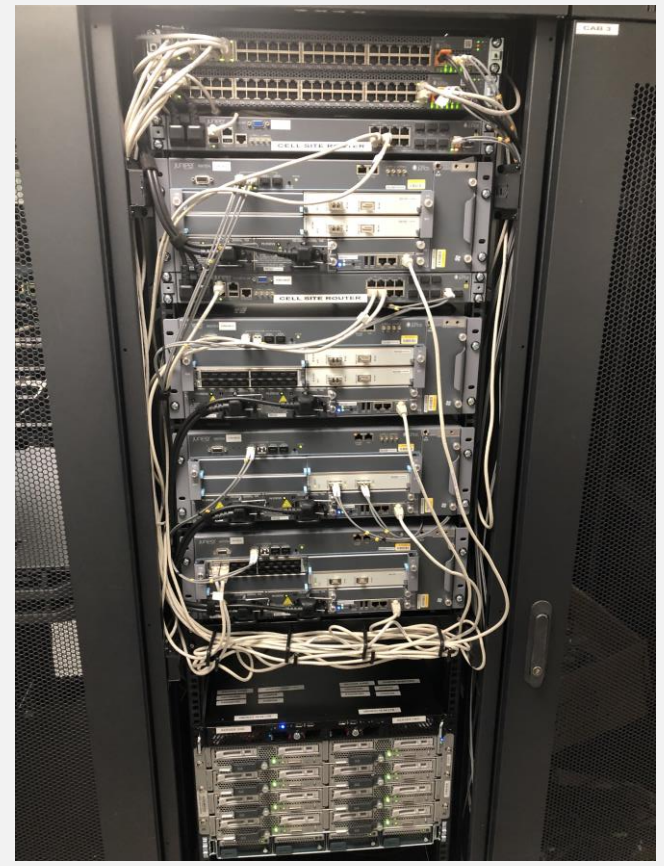


VODAFONE GERMANY 5G MOBILITY LAB

- Juniper SDN allows the automated creation of MEC systems and service chains – MEC, vSecGW, Break-Out Firewall etc
- The use of the Saguna vEDGE MEC server on the Hub site addresses low latency whilst addressing handover
- Application handover between MEC servers (MP3) can be tested
- Since the S1 connections are protected with IPsec, the MEC hubs require a vSecGW in the service chains
- See: <https://www.vodafone.com/perspectives/blog/multi-access-edge-computing-to-power-artificial-intelligence-for-automotive>



United Kingdom 5G TEST BED: JUNIPER UNDERPINS UK 5G Test Bed



THANK YOU!