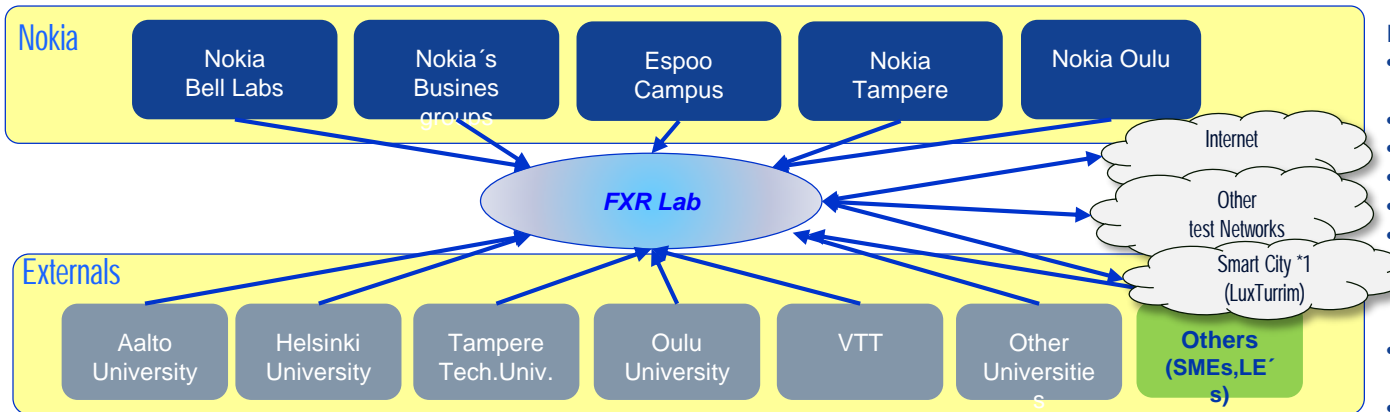


5G Platform project – 5G-FORCE of 5GTNF Phase 3 2019-2020

Future X Research Lab. (FXR Lab.)

- The success of the project based on the smart and flexible FXR Lab – test network
- The forthcoming FXR Lab is an evolution from the NetLeap network used in LTE so usable also for 4G evolution
- The FXR Lab offers an environment to test all kind of Future generation use cases
- The Architecture options 3x (Non Standalone) will be supported in the first phase and 2 (Standalone) a bit later
- Used Radio Network will use the bands allocated by LVM (Ministry of Transport and Communications) for Test, Development and Education purposes in Finland. In addition the radio room makes possible to use other frequencies
- The rules to use the FXR Lab in rough level included to doc. "5G-FORCE Testbed User Agreements"

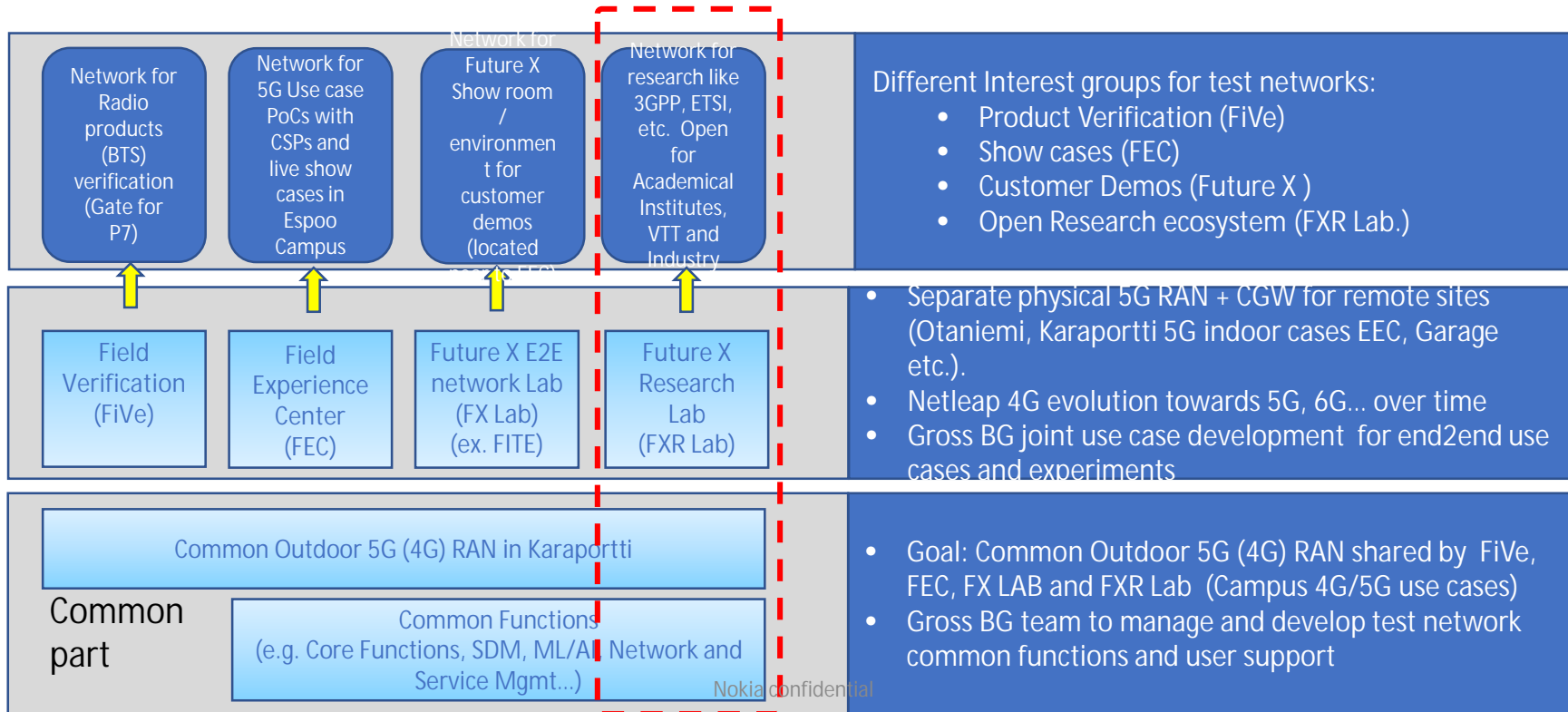


Features (for example):

- Radio access for: 4G/5G/ mm and cm waves.
- WiFi and Fixed access
- Cellular and fixed IoT
- Cloud RAN, ORAN
- Network Slicing
- DevOps mechanism with SAFE Data Collection and Analytic (ML/AI – DCAP & AVA) for Internal and External data
- URLLC/MEC for Games, Health Care, Robotic...etc....
- Cloud Core (Voice & Data)

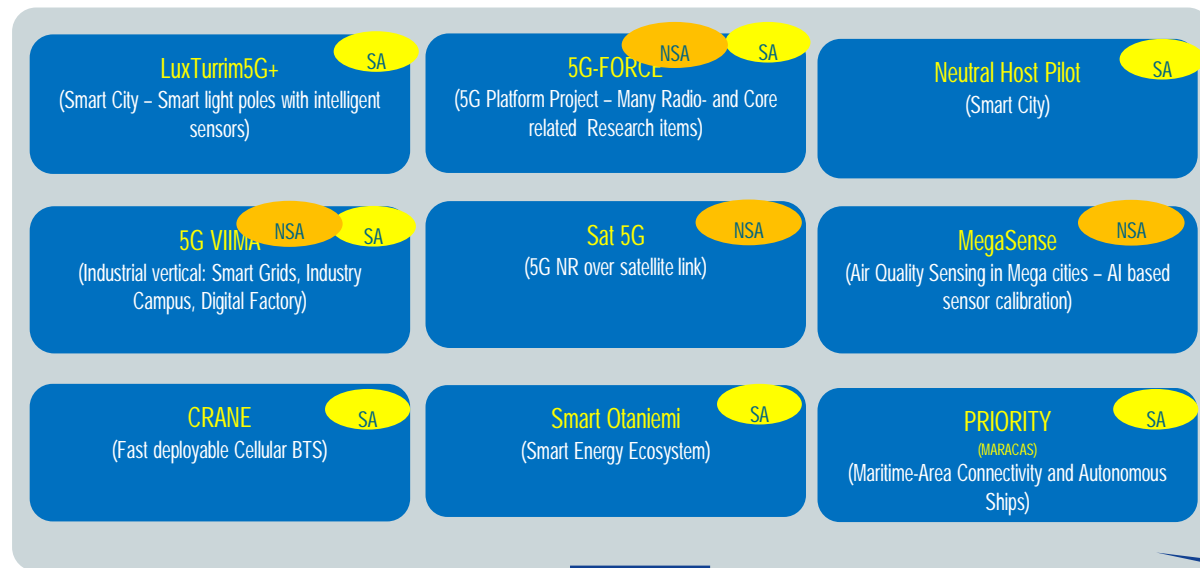
Nokia Test Networks in Finland – general view

Note: Finnish Ministry of Transport and Communications allocates Radio Frequencies (indoor/outdoor) for test use giving excellent possibility to build test networks in Finland



University co-operation projects: 5GTNF Phase 3 (2019-2020) – FXR Lab

Research verticals and co-operation Universities and Industry-/Public Partners



Research Vertical project	Co-operation with		
	Research Institutes	Industry Partners	Public Partners
5G FORCE	7	11	0
Lux Turrim5G	3	11+	1
Neutral Host Pilot	3	11	2
5G VIIMA	2	22	0
Sat 5G	3	2	0
Mega Sense	2	9	7
CRANE	4	11	3
Otaniemi Smart Energy	3	tbd	tbd
MARACAS	2	8	1

NSA =Non Stand alone Arch Option 3x

SA= Stand alone Arch Option 2

Future X Research Lab.
(FXR Lab.)

Note: In addition of these ones we have lot of other co-opration projects / events with universities

WP6 Nokia contribution

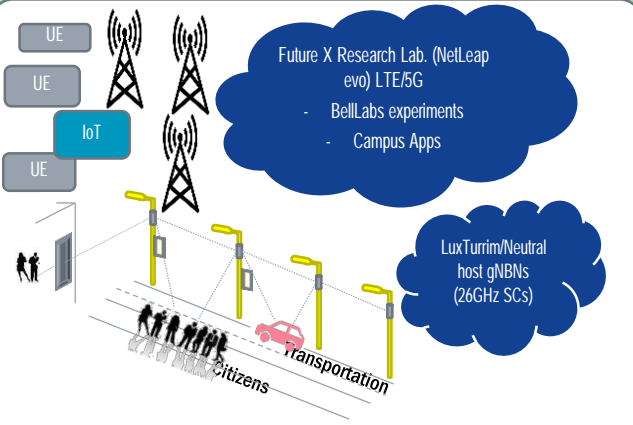
- Make/document transport plan so that Nokia centralized part of test network will be connected to remote sites (M5)
- Update LTE based NetLeap (EPC) to Cloud (Datacenter in Karaportti 8) (Ready)
- Update Registers to support 5G NSA profiles (Registers in DC Tampere) (Ready)
- Update old routers and switches in Karaportti campus (old ones are not capable to handle all needed connections) (M5)
- Update EPC to support 5G Non Standalone architecture option 3x (Ready)
- Update Karaportti eNB's to support 5G IW functionality (M5)
- Make a solid plan for SIM management (M6)
- Create Nokia internal information sharing portal about the test network (documentation, contact information, network status etc.). Public information of that will be loaded to 5GTNF/5GFORCE information portal. (M6)
- Install gNBs to Karaportti (Discussion needed with Nokia Field Verification people) (M6)

WP6 Nokia contribution

- Update NB-IoT functionality to Karaportti eNB's (M8)
- Update IoT device management ("IMPACT") (M8)
- Install DCAP to collect element data (M9)
- Update ML/AI platform to system (Nokia AVA Cognitive Service Platform) (M9)
- Make possible to install remote Packet WG to remote sites to support local break out (URLLC connections) (M10)
- Make possible to install Multi Access Edge Computing (MEC) to remote sites (M10)
- Update registers to support Standalone 5G subscriber profiles (M10)
- Install 5G capable new Standalone Core (Note: NSA will stay parallel with this SA model) (M10)
- Update or install new 5G SA capable gNB's to Karaportti / Otaniemi (M10)
- Make plan to prepare Network Slicing (M10-M11)
- Probably to update SA architecture to support slicing (5G Core + registers) (M12)

Future X Research Lab. - Rough Technical View

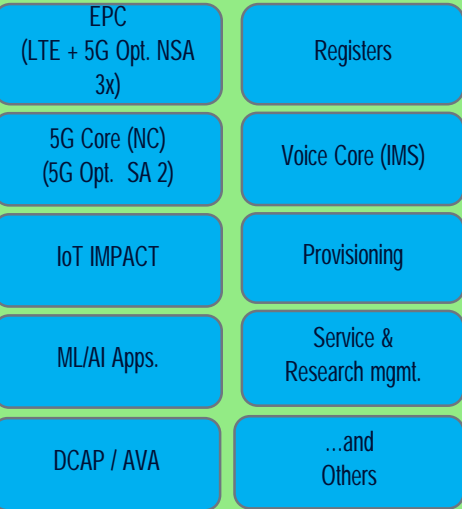
Nokia Espoo Campus Research Network Users



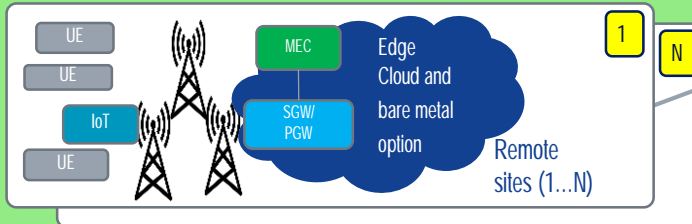
Backhaul /transport

- Routers
- Optical

Common Functions in Karaportti 8 and Tampere Data Centers



Nokia and External Research Network Users



LuxTurrim5G smart light pole (2nd generation)



LuxTurrim5G

Building key enablers for a Digital Smart City

NOKIA

NOKIA

LuxTurrim5G - Solution

LuxTurrim5G develops and pilots concrete technology enablers and service concepts for open Smart City Digital Ecosystem

Indoor/Outdoor connections

Signal propagation through construction materials

- RF permeable windows: **Lammin Windows**

5G network

High capacity, low latency

Small cells -> many sites

5G network: **Nokia Bell Labs**

Light pole: **Exel Composites**

Operators

Business models for:

- Existing ones
- **New ones?**

Smart city services on top of a common platform

Examples:

- Video surveillance, public safety, infotainment screens: **Teleste**
- Air quality, weather: **Valsala**
- Location, navigation: **Indagon**
- Lighting/charging: **Ensto**
- Drones: **Rumble Tools**

City Infrastructure

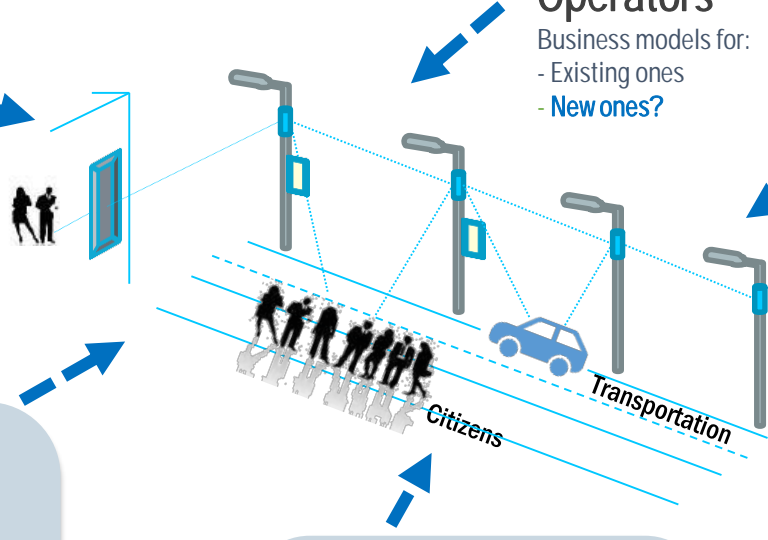
Light pole infra, power, data transport

Infra planning: **Sitowise**

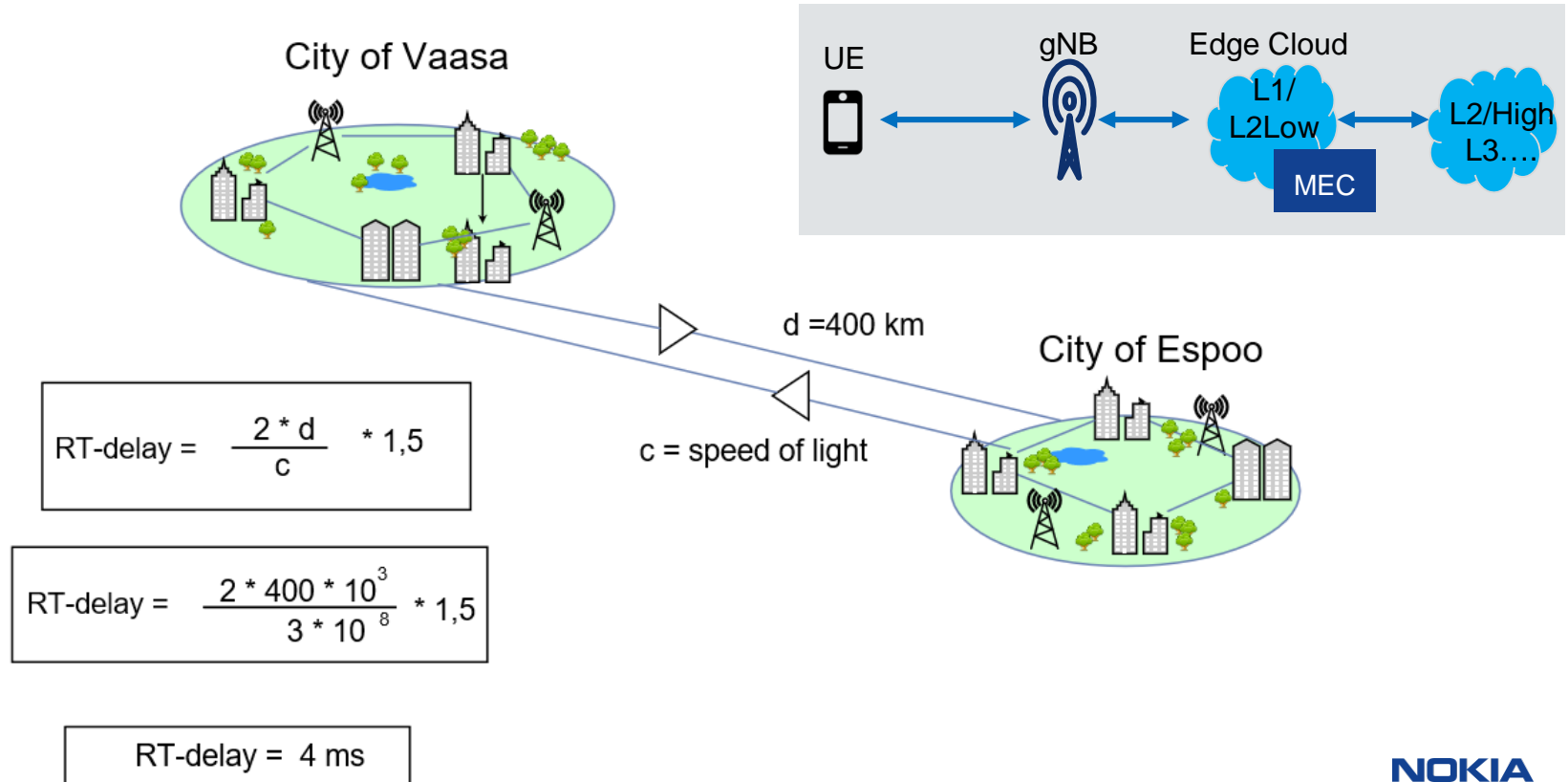
Infra owner: **Espoo,...**

Public partners contributing in each research area:
VTT, Aalto

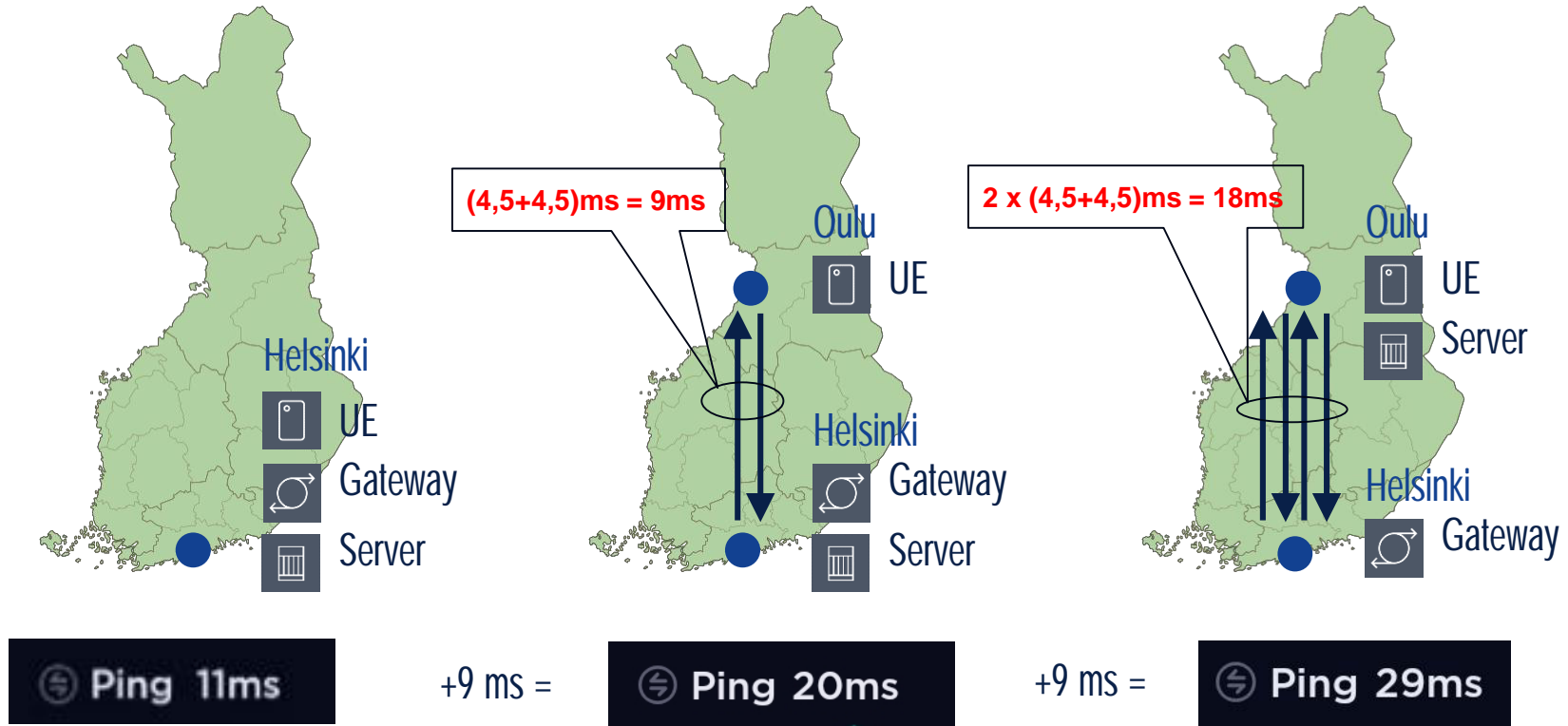
NOKIA



Real time application – Latency between Vaasa – Espoo



Distributed Core Network Needed for Low Latency Services



MEC

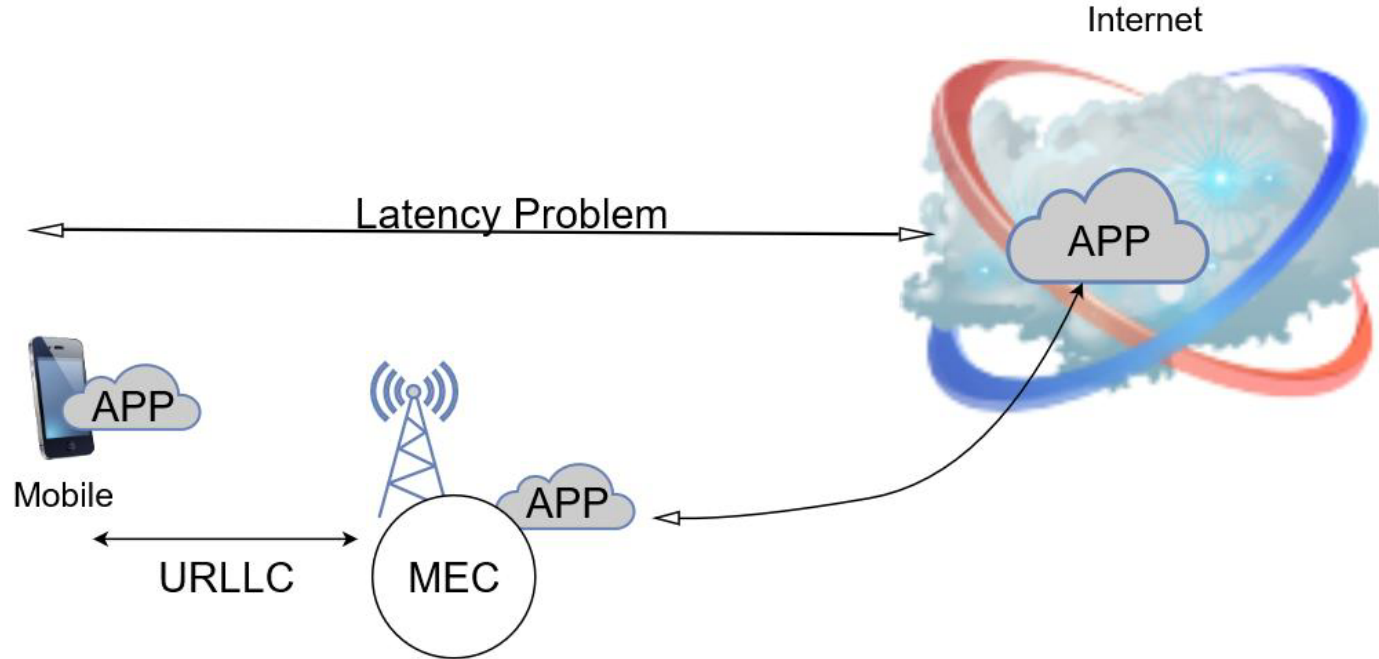
URLLC

5G

ML / DL / AI

IoT

- 5G target is 1 ms round trip time
- 100 km two-way propagation delay in optical fiber is to 1 ms
- 10 km propagation delay to 0.1 ms



Open questions to discussion:

What are your requirement for Vaasa 5G test network?

What frequency's are you planning to use?

Test terminal expectations?

Plans to join to 5GTNF consortium?

Do you have any 4G test network already available?

MEC

URLLC

5G

IoT

ML / DL / AI

Slicing

Open questions to discussion:

Reflections of the day

Next steps...

MEC

5G

ML / DL / AI

URLLC

IoT

slicing