Fixed–mobile Convergence: Architecture and Functionality

Summary and Conclusion
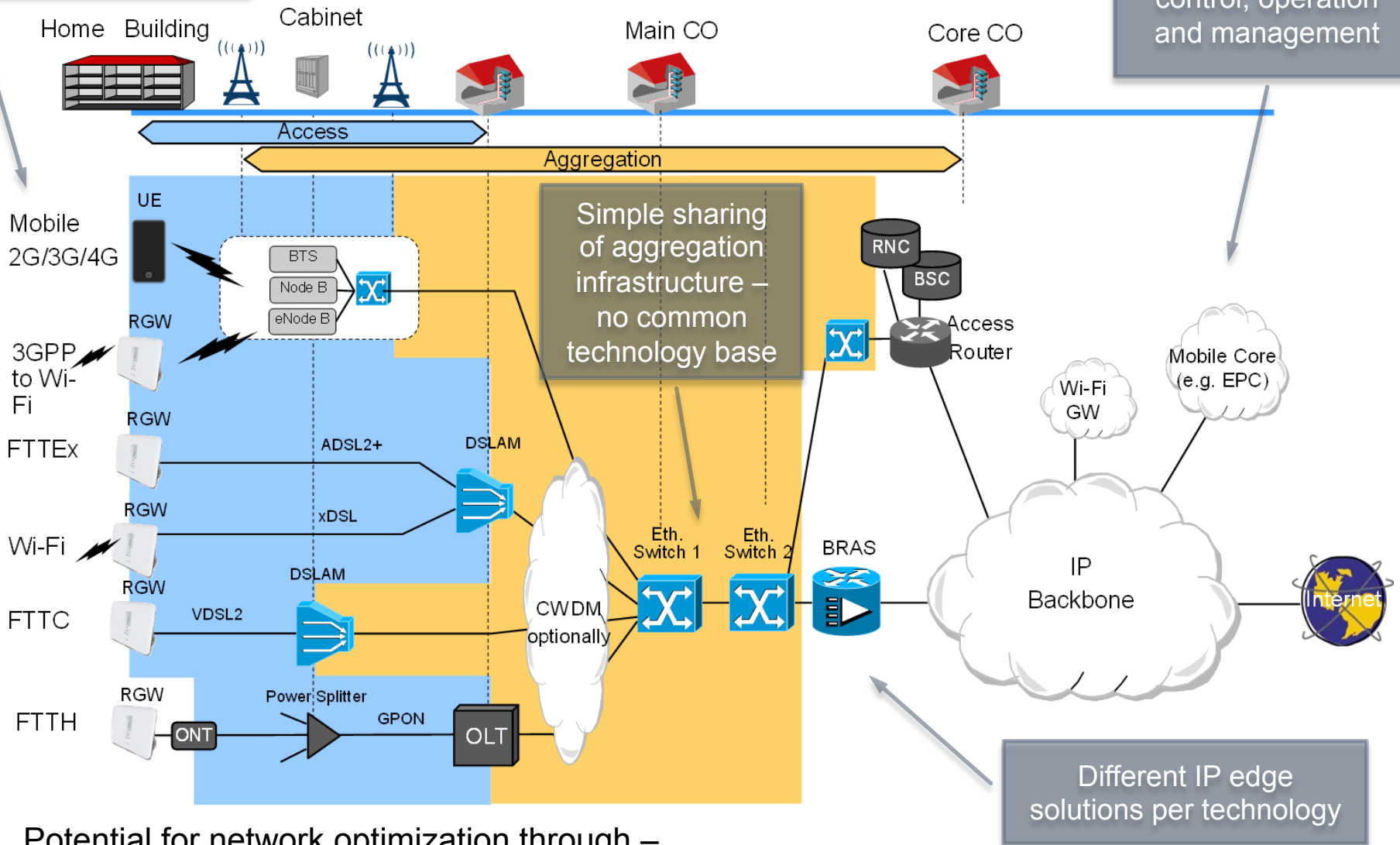
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Today's segmented networks

Huge variation in terminal equipment and technologies

Fixed and wireless have separated control, operation and management

Simple sharing of aggregation infrastructure – no common technology base

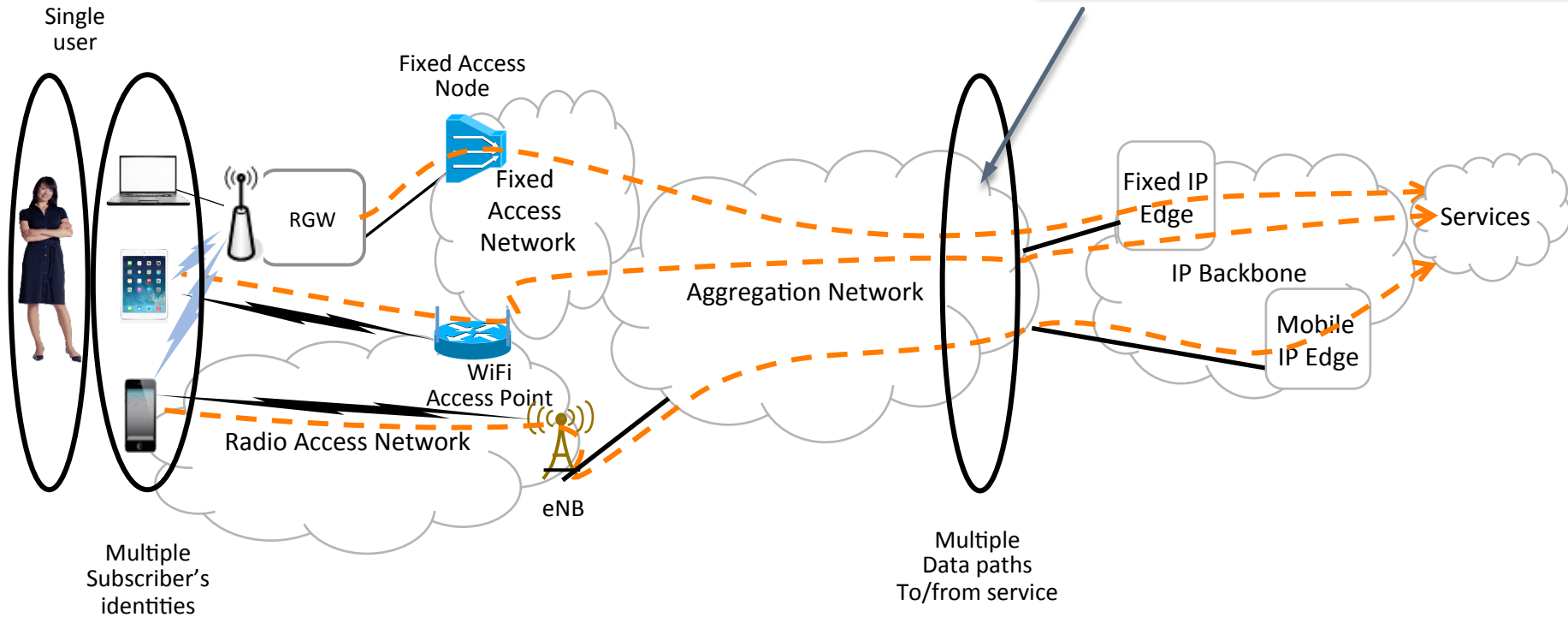**Different IP edge solutions per technology**

Potential for network optimization through –
- Converged network control and operation → functional convergence
- Converged transport for mobile and fixed network → structural convergence

Multi-technology seamless access

The Universal Data Path Manager controls user traffic flow over all available data paths

Single user

Fixed Access Node

Fixed Access Network

Aggregation Network

IP Backbone

Fixed IP Edge

Services

RGW

WiFi Access Point

Mobile IP Edge

Radio Access Network

eNB

Multiple Subscriber's identities

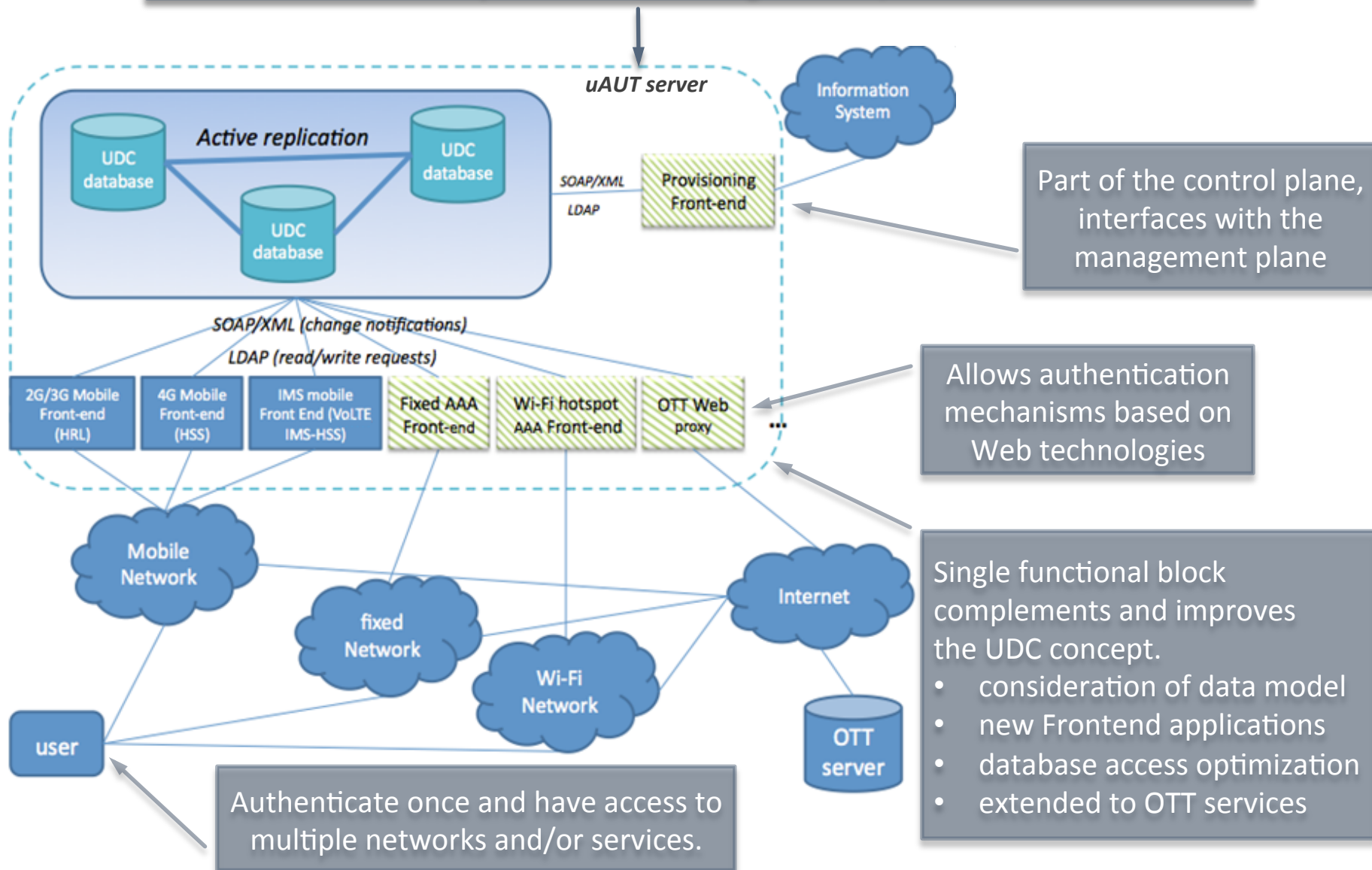Multiple Data paths To/from service

Beyond user controlled "Wi-Fi offload" :

- Network controlled offload
- Load balancing on multiple paths
- Smooth handover (horizontal/vertical)
- Take advantage of content replication

uAUT: Universal Subscriber and User Authentication

uAUT server binds multiple traffic flows to a given user, over all available accesses

uAUT server

Active replication

UDC database — UDC database — UDC database

SOAP/XML
LDAP

Provisioning Front-end

Information System

Part of the control plane, interfaces with the management plane

SOAP/XML (change notifications)
LDAP (read/write requests)

2G/3G Mobile Front-end (HRL) | 4G Mobile Front-end (HSS) | IMS mobile Front End (VoLTE IMS-HSS) | Fixed AAA Front-end | Wi-Fi hotspot AAA Front-end | OTT Web proxy ...

Allows authentication mechanisms based on Web technologies

Mobile Network

fixed Network

Wi-Fi Network

Internet

OTT server

user

Single functional block complements and improves the UDC concept.
- consideration of data model
- new Frontend applications
- database access optimization
- extended to OTT services

Authenticate once and have access to multiple networks and/or services.

The Universal Access Gateway

UAG interfaces

——— (blue)	Control interfaces
——— (black)	Network interfaces
——— (red)	Subscriber interfaces

UAG Universal Access Gateway
AN Access Node
AAA Authentication Authorization Accouting
CPE Customer Premises Equipment
UE User Equipment
uAUT Universal Authentication
uDPM Universal Data Path Management

Implements
Universal Path Management
and Universal Authentication

- Can be realised as Standalone equipment vs. split data/control plane (SDN)
- Can be distributed or centralised

Structural convergence

Pooling/sharing of network infrastructure allows true integration of fixed and mobile networks

Mobile

"5G"

4G
(LTE/LTE-Advanced)

Macro Pico

2G/3G

Wi-Fi

Wireless

Fixed

Converged Broadband Fixed and Mobile Access/Aggregation Network

$\lambda_1 \dots \lambda_N$

BBU-H
OLT

Edge Router

BBU-H
OLT

$\lambda_1 \dots \lambda_N$

Mobile Core Components

4G MME
S-GW P-GW

2G/3G MSC
SGSN GGSN

Fixed Core Components

BB-RAR LER

IPTV Web ...

Service Control Layer
IMS/TISPAN

IP/MPLS Backbone

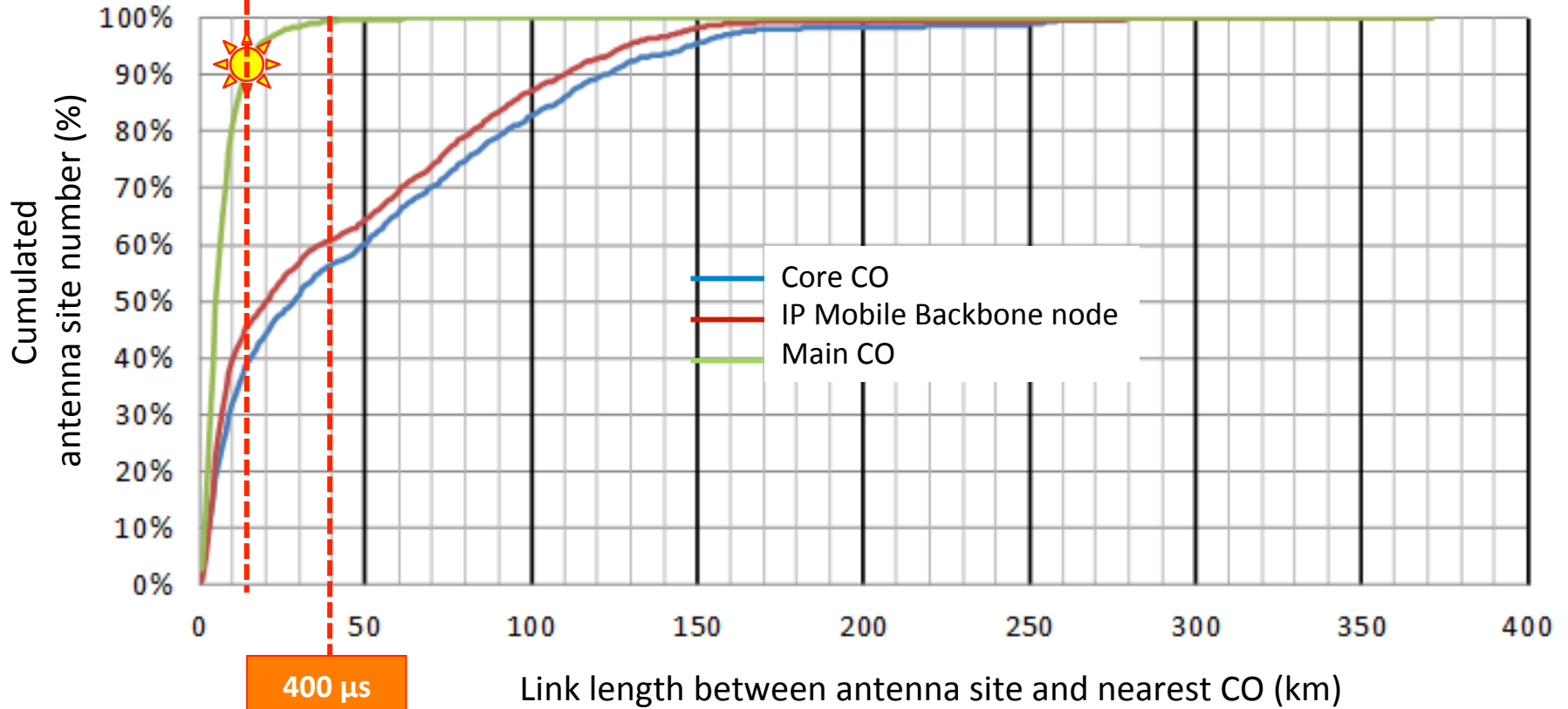Network Control Layer
OSS, Synchronization, Platform Control

Structural convergence triggered by:
- Heterogeneous radio access networks
- Mobile fronthaul and Cloud RAN
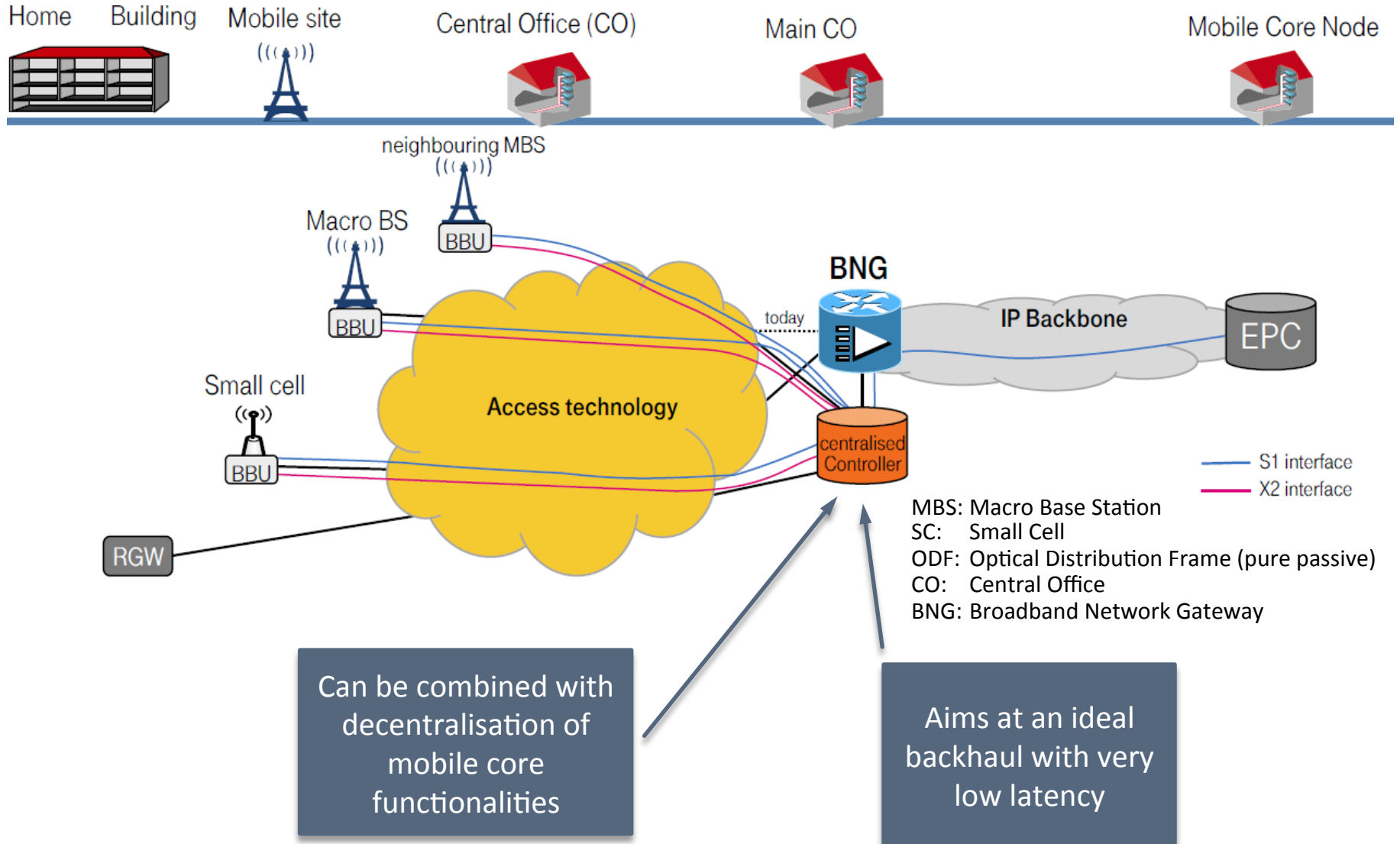
Where is the optimal BBU hotel location?

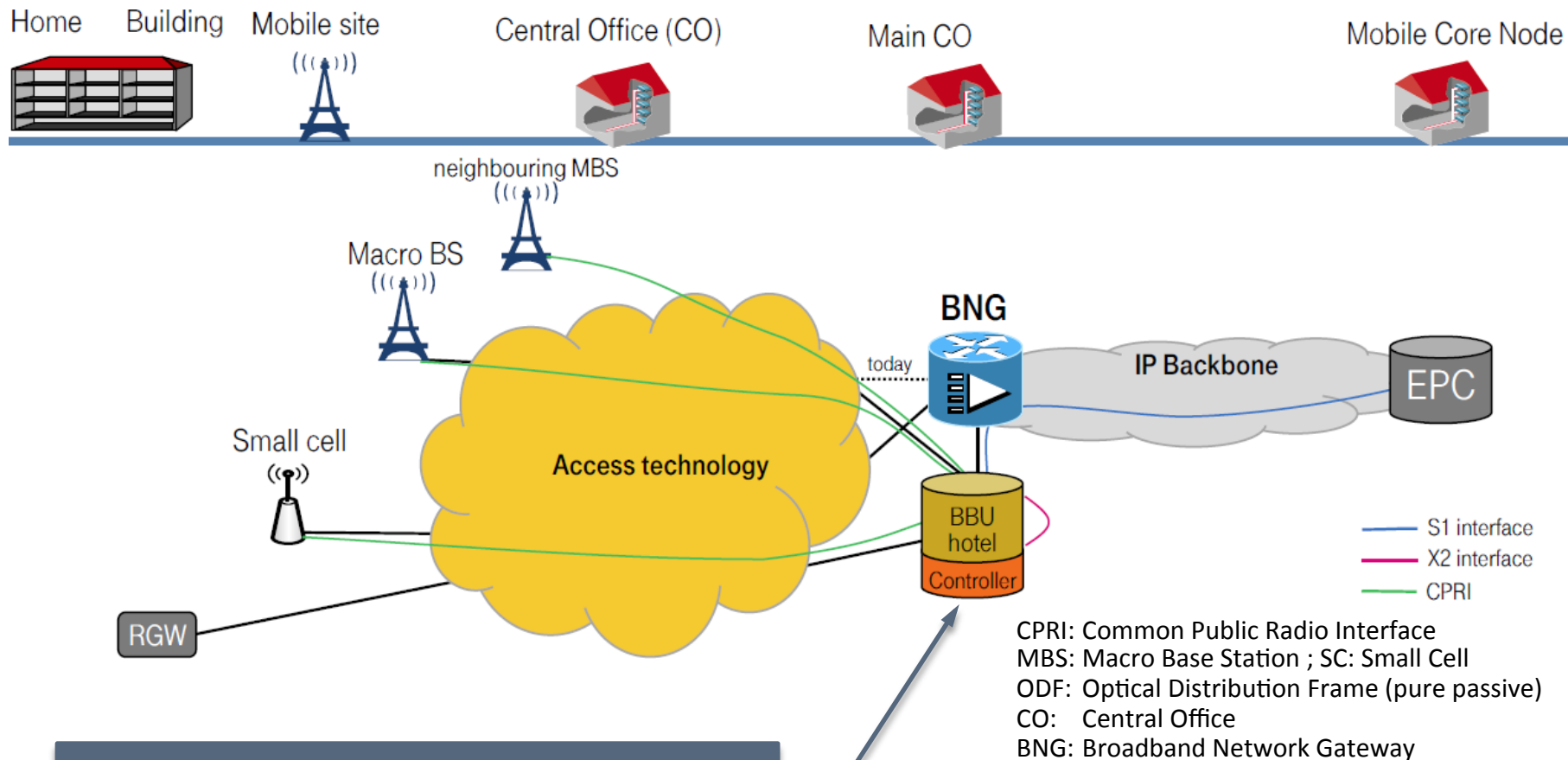150 µs RTT limit as rule of thumb from RAN vendors

400 µs RTT limit

Cumulated antenna site number (%)

Link length between antenna site and nearest CO (km)

Core CO
IP Mobile Backbone node
Main CO

RAN delay requirement limits BBU placement:
< 400 µs (~40 km) is expected

Backhaul architecture scenario: Controller at the Main Central Office

Home Building Mobile site Central Office (CO) Main CO Mobile Core Node

neighbouring MBS

Macro BS

BBU

Small cell

BBU

RGW

Access technology

BNG

today

IP Backbone

EPC

centralised Controller

S1 interface
X2 interface

MBS: Macro Base Station
SC: Small Cell
ODF: Optical Distribution Frame (pure passive)
CO: Central Office
BNG: Broadband Network Gateway

Can be combined with decentralisation of mobile core functionalities

Aims at an ideal backhaul with very low latency

Fronthaul architecture scenario:
BBU hotel & controller at the Main CO

CPRI: Common Public Radio Interface
MBS: Macro Base Station ; SC: Small Cell
ODF: Optical Distribution Frame (pure passive)
CO: Central Office
BNG: Broadband Network Gateway

Very low latency < 400 µs (RTT) and high CPRI data rate allow inherent Coordinated Multipoint scheme support

Concluding remarks for structural convergence

Two main approaches can be considered for structural convergence

- Access pushed into aggregation, based e.g. on NG-PON2 including WDM, or
- Aggregation pushed into access, based e.g. on programmable DWDM technologies

Network FMC is fundamental for future 5G infrastructure

- To achieve end-to-end management and orchestration capabilities

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