Unified Access and Aggregation Network Allowing Fixed and Mobile Networks to Converge:

The COMBO project

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Agenda

- INTRODUCTION
- COMBO TARGET & KEY QUESTIONS
- NETWORK EVOLUTION TRENDS
- CONVERGENCE - NG-POP
  - FUNCTIONAL CONVERGENCE
  - STRUCTURAL CONVERGENCE
- SUMMARY

COMBO project

Key facts

- COnvergence of fixed and Mobile BrOadband access/ aggregation networks

- Work programme topic: ICT-2011.1.1 Future Networks
- Type of project: Large scale integrating project
- Project start: 1st January 2013
- Project duration: 36 months

Partners

ERICSSON
TELECOM Bretagne
TÜRK TELEKOM
AITIA
Telefónica
Telefónica Investigación y Desarrollo
POLITECNICO MILANO
orange
ADVA Optical Networking
TELNET Redes Inteligentes
CTTC Centre Tecnològic de Telecomunicacions de Catalunya
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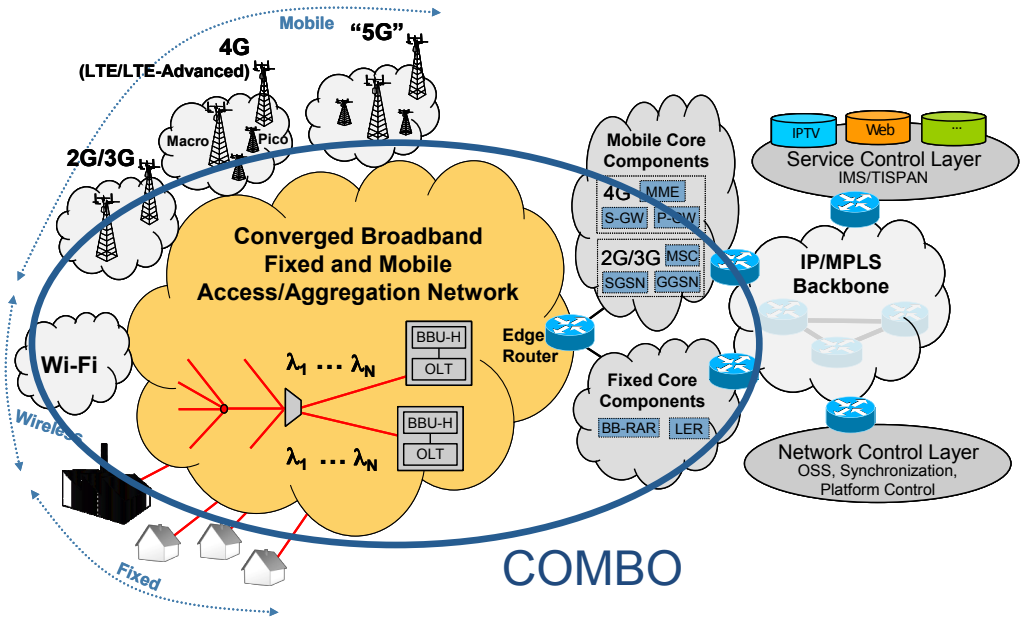
COMBO project motivation

Motivation

- In the past, fixed and mobile access networks have been optimized and evolved independently, with partly contradicting trends
- Access infrastructures represent long term *investments (> 50% of total ICT) and about* 90% of network energy consumption: a sustainable network evolution strategy is required for the next decade

Focus area

- Level of integration and functional distribution needs to be investigated and optimized



Main target and objectives

Main target

COMBO targets a unified access and aggregation network by converging fixed and mobile networks (Fixed / Mobile network convergence), enabling:

- optimal and seamless **quality of experience** for the end-user
- optimized network structure ensuring reduced **cost** and **energy consumption** *while bandwidth is increasing*

Objectives

- Define optimised FMC architectures
- Assess multi-operator FMC scenarios
- Demonstrate experimentally FMC in lab tests and field trials
- Drive standardization bodies with respect to FMC architectures

COMBO key questions and requirements

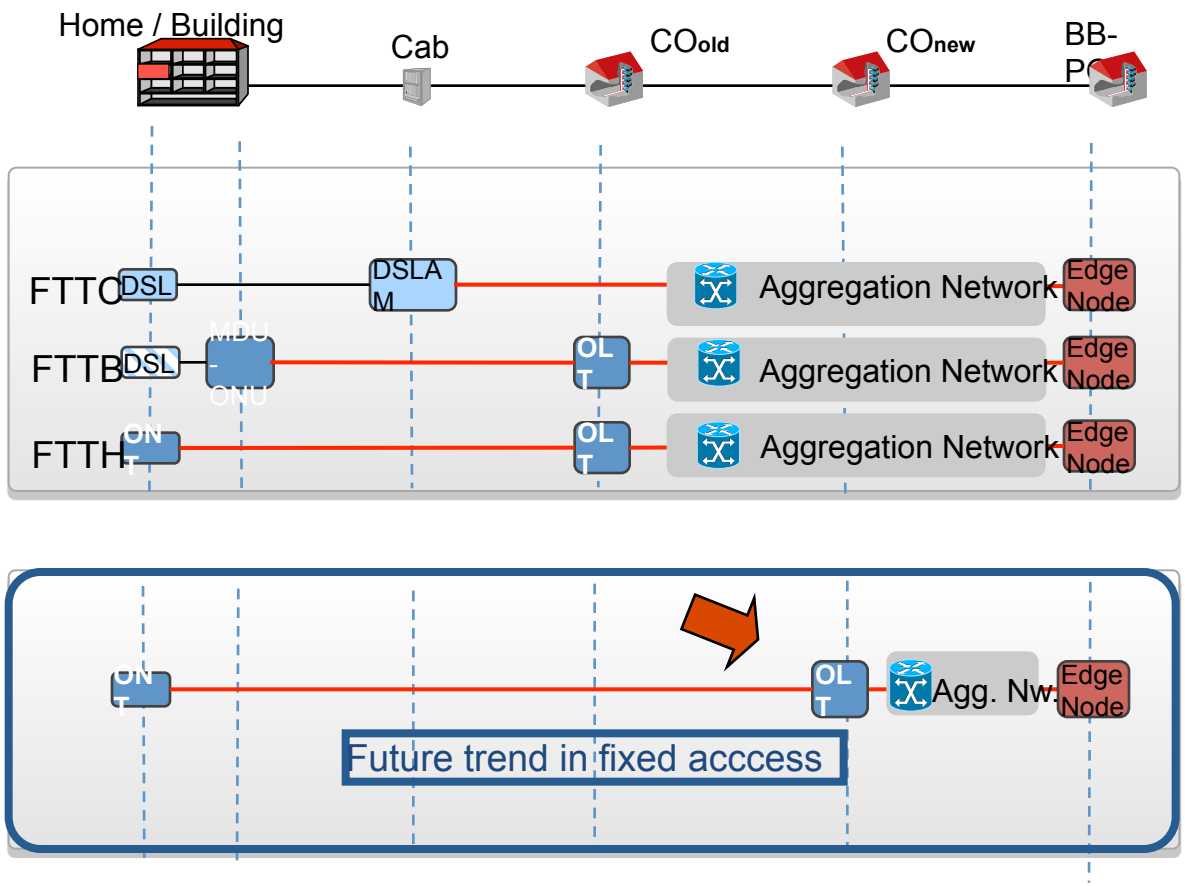
Key questions

- Which are the optimum levels of convergence?
- Which network functions and equipment should be centralized or distributed?
- How will convergence impact handover mechanisms?
- How will convergence impact data traffic?

Key requirements

- Increasing traffic and changing applications
- Reduced network cost and energy
- Openness of network interfaces
- Seamless performance monitoring and management
- Multi service flexible network to cope with future services

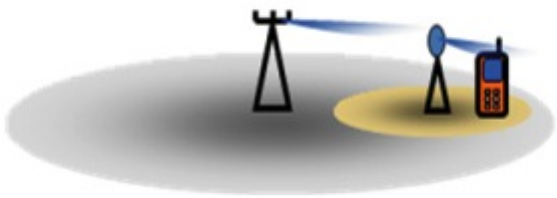
Evolution of fixed access network



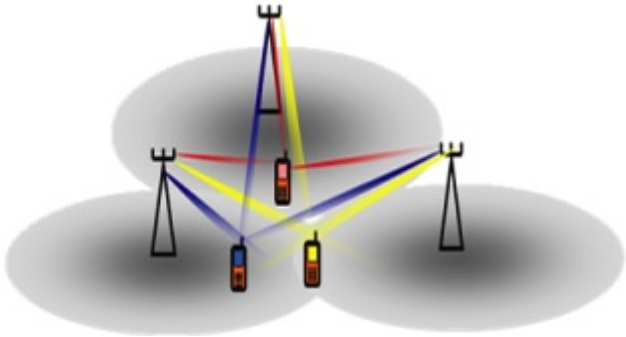
On the way to the Gigabit Society. Replacing of copper network with FTTH enabling real Gigabit access. Total Cost of Ownership optimized access/aggregation network by structural changes (node consolidation).

Evolution of mobile access network (1)

- **Pure packet-based high performance 4G networks**
  - VoIP necessary on 4G networks
  - Bandwidth up to 20 MHz / 100 Mbps typically
  - Reduced latency (~10 ms)
- **Towards more capacity and performance (>4G)**
  - higher bandwidth and spectral efficiency
  - carrier aggregation, generalized MIMO, relaying, Inter-Cell Interference Coordination (ICIC), Coordinated MultiPoint (CoMP)



Relaying

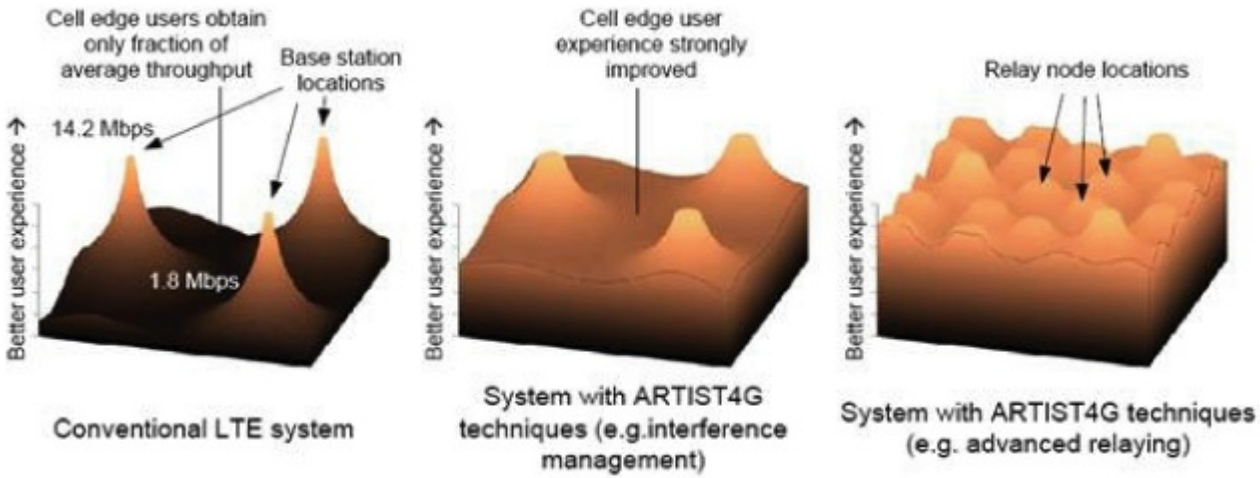


CoMP

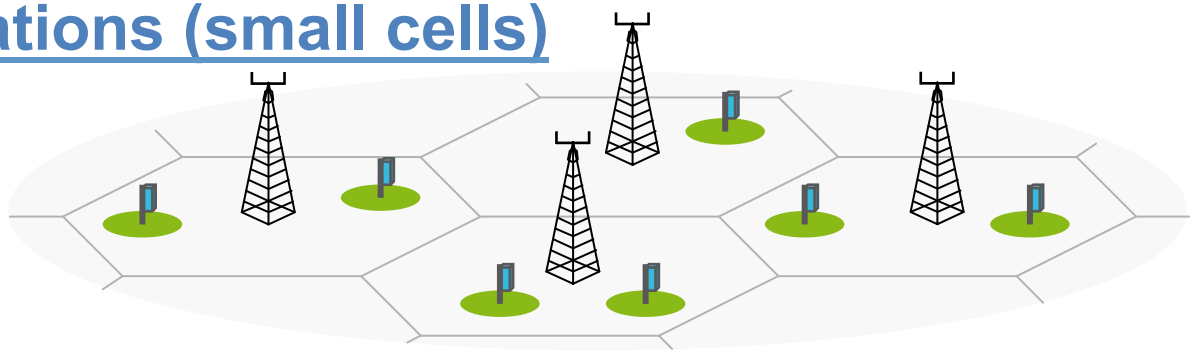
Evolution of mobile access network (2)

❑ A larger data rate uniformity for users

- Cf. ARTIST4G European project results

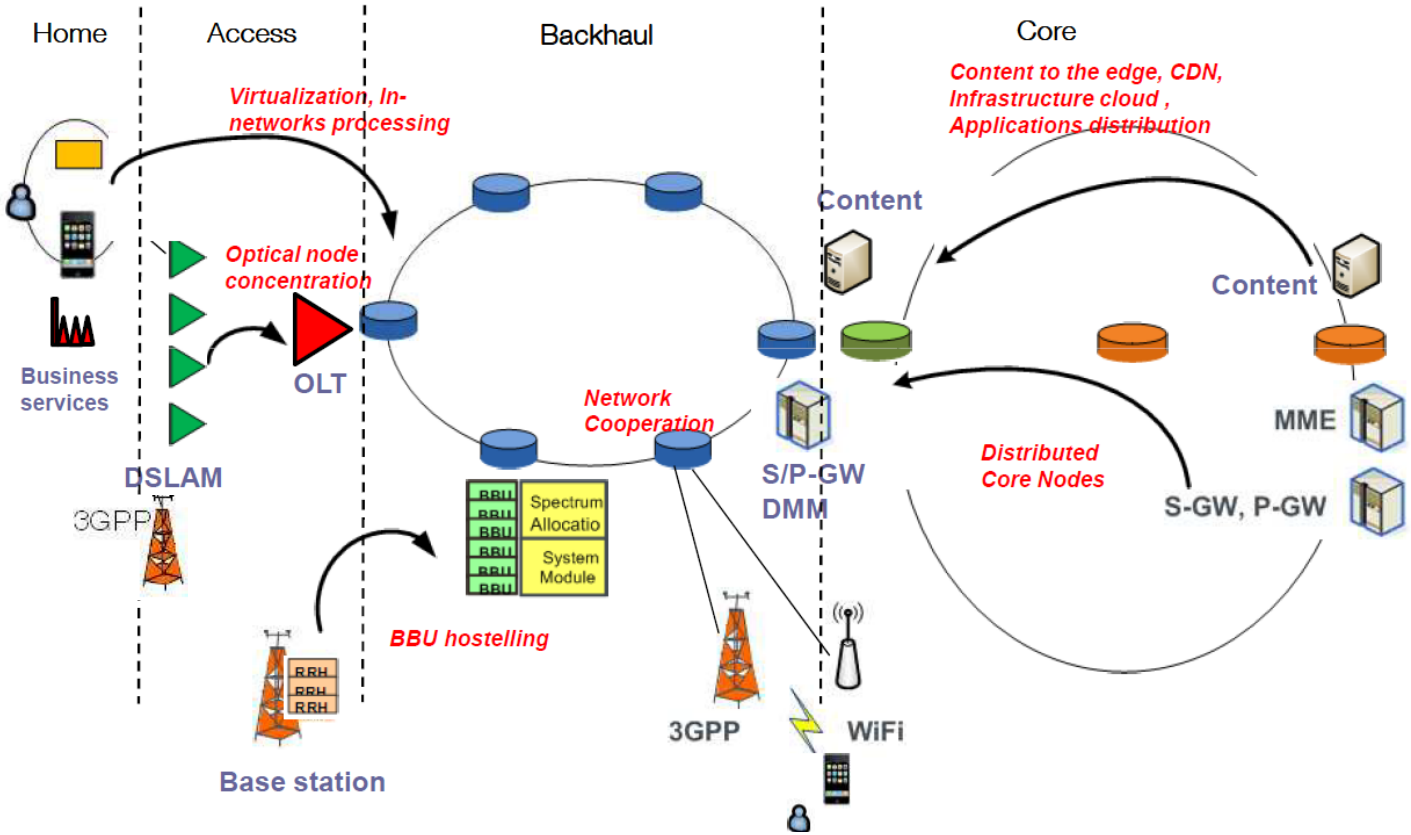


❑ Capacity increase through densification of base stations (small cells)

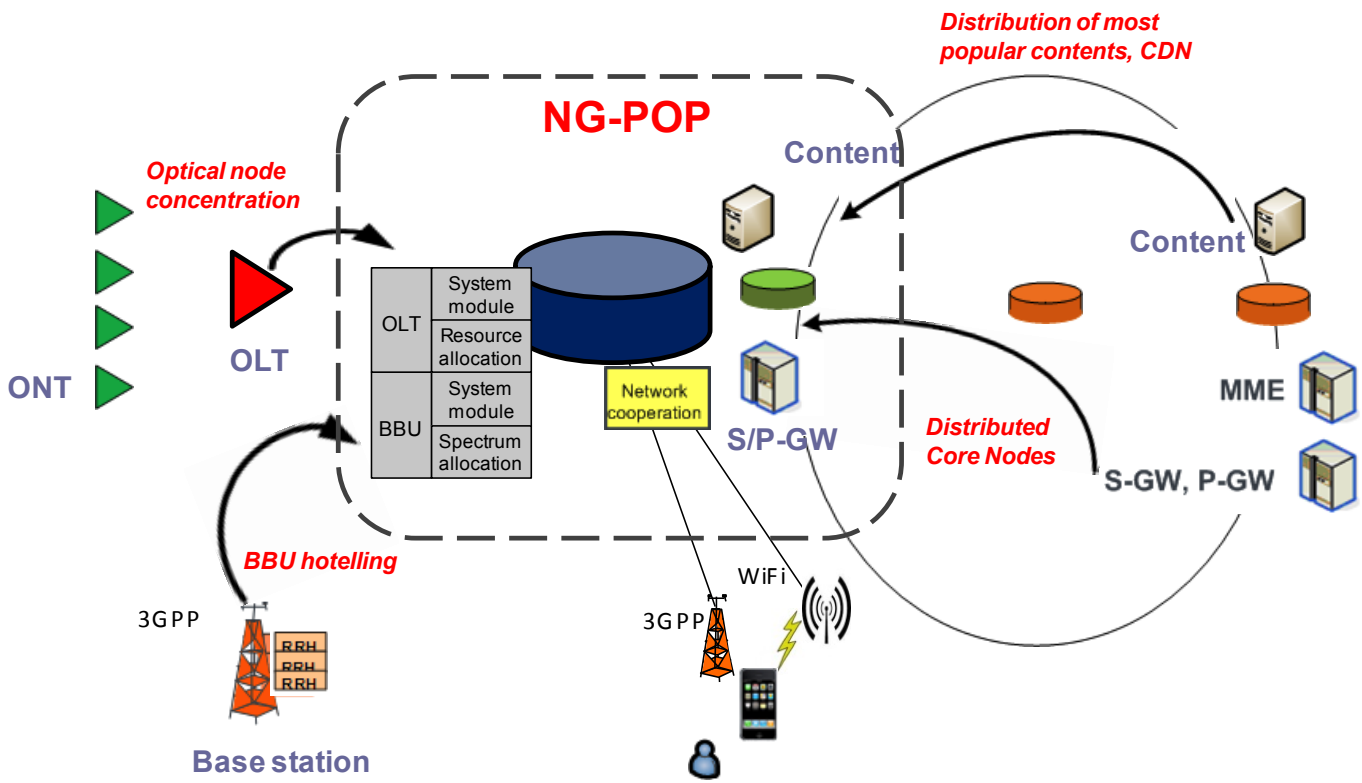


Network evolution trends

Concentration of functionalities in access and distribution of functionalities from core



Potential COMBO architecture

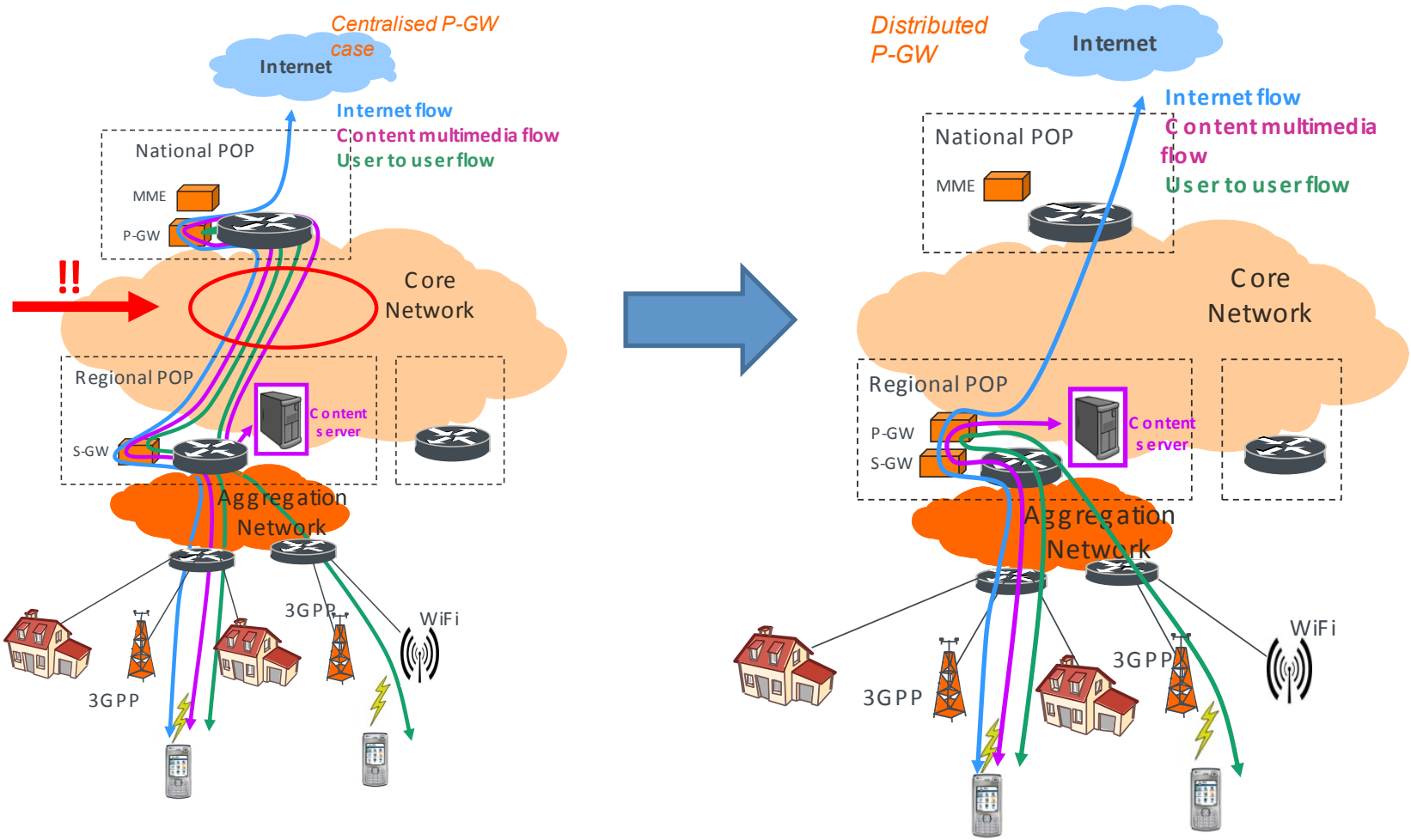


New concept **of Next Generation Point of Presence (NG-POP)**:

- **Functional convergence**, i.e. the convergence of fixed and mobile network functions
- **Structural convergence**, i.e. the convergence of fixed and mobile infrastructures and equipment

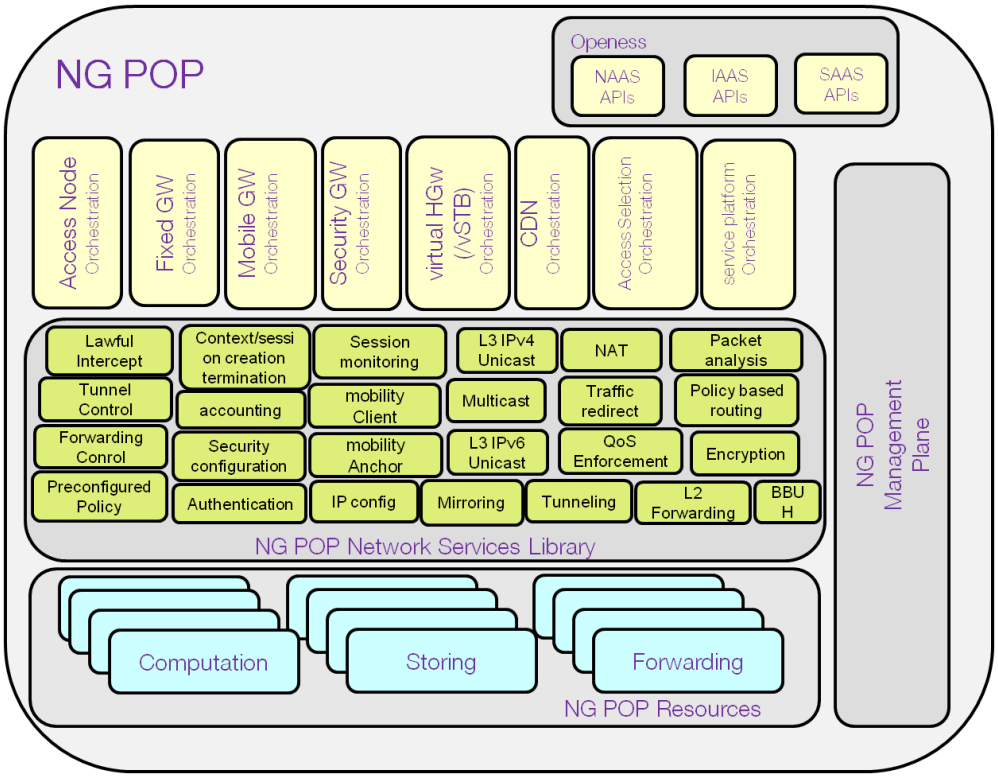
Example of functional convergence

Functional convergence targets a better localization of key network functions



Functional convergence

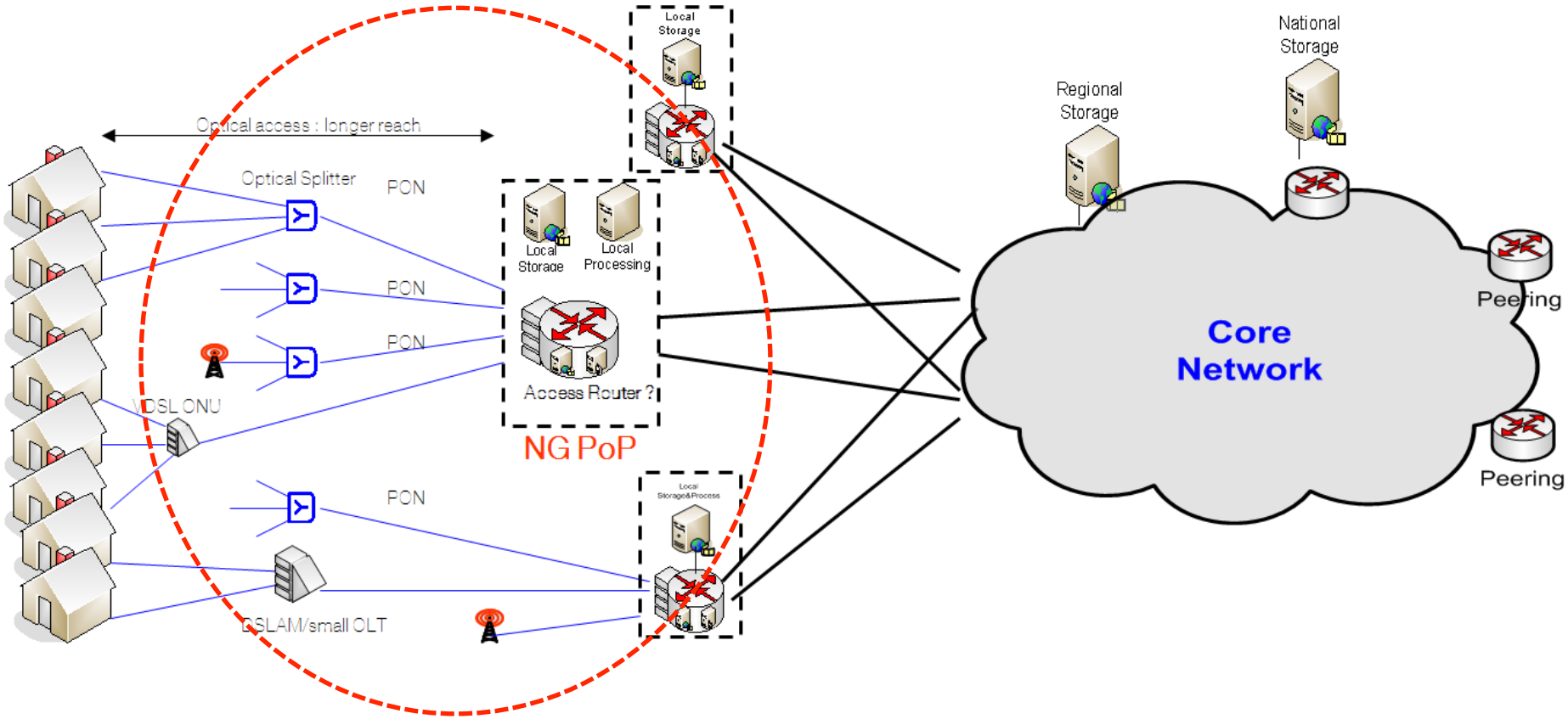
Set of functions which needs to be considered



Enablers

- Virtualization will allow flexible integration of fixed and mobile network functions
- Common handover mechanisms between fixed and mobile networks (e.g. WiFi and 3GPP)
- Common set of CDN functions for fixed and mobile networks
- Unified control of heterogeneous networks and technologies
- Homogenization of authentication and subscriber management
- Openness of infrastructure at NG-POP level
- Convergence on policy mechanisms for seamless fixed and mobile QoS and QoE

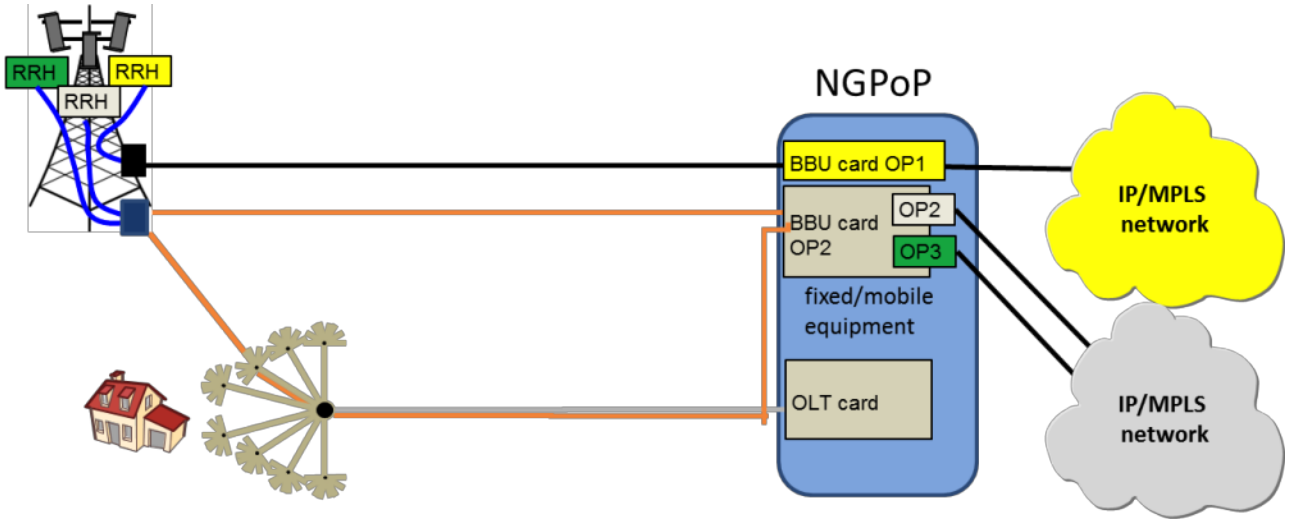
Structural convergence



- Usage of the same location (NG-POP)
- Usage of the same infrastructure/transport
- Usage of the same technologies
- Integration of mobile and fixed access equipment

Structural convergence in a multi-operator environment

Structural convergence targets a mutualization of fiber and equipment through e.g. BBU hostelling and fixed/mobile equipment integration and enabling a multi-operator usage in an **open architecture**



OP1	Mobile operator sharing NG-POP and tower but using its own equipment
OP2	OP2 provides converged network to the other operators and hosts co-location point at NGPOP and tower
OP3	OP3 uses the co-location points of OP1 and also the FMC network resources and functions of OP2

Summary

- **Making fixed and mobile networks converge is a desirable though very complex target for network operators and vendors**
  - Better integration of fixed and mobile networks would result in both
    - an optimal and seamless quality of experience for the end user
    - an optimized network infrastructure ensuring increased performance, reduced cost and also reduced energy consumption

- **COMBO is designing a unified access and aggregation architecture leading to Fixed-Mobile Convergence**
  - Based on Next Generation Point of Presence
  - With a better distribution of all essential functions, equipment and infrastructures of convergent networks and will thus
  - Enable a network with better services at lower operational costs

BACKUP SLIDES

COMBO consortium

Expected COMBO impacts on the delivery model for convergent services

Enhanced quality of experience for access to multimedia contents:

- Adequate distribution of content closer to the user, thanks to network openness, thus lowering network transport cost and making available broader range of contents.
- NGPOP concept will benefit from processing capacity available at the access/ aggregation node level, e.g. to adapt when needed the distributed content to devices and access resource capacity

Improved control of heterogeneous access resources:

- Unified control of heterogeneous access technologies allowed by FMC architectures
- Real-time dynamic resource allocation to service/traffic demand and terminal capacity
- Advanced load balancing and scheduling techniques between access links
- Handover and service continuity schemes over various technologies will be provided in a dynamic way, avoiding un-necessary tunnelling and traffic indirections

Unified user's authentication and access scheme:

- Native homogenization of identification, authentication and reachability of the user over heterogeneous terminals and access technologies
- Easier service provision in multiple operators scenarios, avoiding issues faced today in fixed (generally "access line" based) and mobile ("SIM card" based) networks

Client device scenarios versus COMBO solutions

Client Device Scenario	Network requirements	COMBO solutions
Mobile Client devices and applications with high bandwidth requirements	Increased capacity in both access and metro networks	Very good scalability by adding more wavelengths and capacity per wavelength Easy to manage due to Self Organized Network properties Enable Peer to Peer connections
Programs and data stored in the cloud, Terminals have only I/O functionality	Access capacity need determined by video streams (HD and 3D HD TV)	Centralized concept (e.g. BBU hotels) able to handle the traffic demands from data storage close to end users Scalable, simple and cost effective traffic management for local data storage in the cloud
Increasing number of always connected smart phones, Personal Area Networks and M2M devices	Low data capacity demand per device but very high control traffic	The NG-POPs will be higher in the network than the traditional central offices, thanks to optical node concentration, and will be able to host advanced control functions Unified control mechanisms with a better and possibly dynamic distribution of control functions

Convergence layers

FMC will enable higher energy efficiency both at the level of :

a) Structural convergence
- BBU resource pooling (20%)
- Small cells, decreasing R
  consumption (up to 40%
- Decreased number equipment (50%)
- Optimized location of ontent servers (10-15%)
- Increased utilization of low-power optical technologies for backhauling (up to 50%)

b) Functional convergence
- Energy aware path engineering (multi-hop mobile provides flexibility) (up to 50%)
- Combined idle modes management in the converged fixed-mobile network
- Equipment sharing in multi-operator scenarios (20%)

Overview functional and structural convergence