Fixed and Mobile Convergence: Needs and Solutions

S. Gosselin¹, J. De Biasio¹, M. Feknous¹, T. Mamouni¹, J. Torrijos², L. Cucala², D. Breuer³, E. Weis³, F. Geilhardt³, D. v. Hugo¹, E. Bogenfeld¹, A. Hamidian⁴, N. Fonseca⁴, Y. Liu⁴, S. Kuehrer⁴, A. Gravez⁴, A. Mitcesenkov⁷, J.V. Galán⁵, E. Masgrau⁵, L. Gómez⁵, L. Alonso⁶, S. Höst⁶, A. Magee⁷

¹: Orange Labs Networks, France, (stephane.gosselin@orange.com), 2: Telefónica I+D, Spain (jgijon@tid.es), 3: Deutsche Telekom AG, Germany, 4: Ericsson AB, Sweden, 5: JCP-Connect SAS, France, 6: Telecom Bretagne, France, 7: Budapest University of Technology and Economics (BME), Hungary, 8: Telefónica I+D, Spain, 9: FON Wireless Ltd, United Kingdom, 10: Lund University, Sweden, 11: ADVA Optical Networking Ltd, United Kingdom.

Abstract—The drivers of Fixed and Mobile Convergence (FMC) are discussed. A reference framework for FMC proposed by European project COMBO is then presented. Some use cases of FMC are described, showing the needs for mutualization and convergence of fixed and mobile broadband networks. Five network scenarios providing technical solutions to FMC use cases are proposed. They target an optimal and seamless quality of experience for the end user together with an optimized network infrastructure ensuring increased performance, flexibility, reduced cost and reduced energy consumption.

Keywords—FMC; convergence; fixed; mobile; Wi-Fi; use case; network scenario

I. INTRODUCTION

Today, telecom operators are facing great challenges in order to provide the best broadband services at the lowest cost. They continue investing to upgrade their networks even in the current macroeconomic downturn situation. On top of that, the Average Revenue Per User (ARPU) remains roughly static or is even declining and many of their Operational Expenses (OpEx) are fixed and difficult to reduce. In this context, telecom operators need to evolve their networks to be more efficient, open and flexible, providing the best Quality of Experience (QoE) to their customers with the minimum cost.

As part of making the networks more efficient, it is essential for the fixed and mobile networks to be viewed in a converged manner. A low level of convergence is present already today in access and aggregation networks for fixed, mobile, and Wi-Fi services, see Fig. 1. Mobile base stations and business customer premises, as well as the first hop node as seen from most residential customers, are already connected via fibre and the aggregated traffic is transported via Ethernet infrastructure. Furthermore, the common IP backbone for all networks is often using Multiprotocol Label Switching (MPLS). For Wi-Fi, the feeder link is often identical to the residential/business fixed access line. The access control functionality to grant connectivity to Internet or dedicated services, may be shared with mobile core control, e.g. in providing Authentication, Authorization and Accounting (AAA) information.

This paper proposes a joint design and optimization of fixed and mobile networks through a new access and aggregation network¹. The target architecture combines both structural convergence, defined as sharing and mutualization of equipment and infrastructures for several network types (fixed, mobile, Wi-Fi), and functional convergence, aiming at generic networking functionalities for all network types, which includes in particular a unified control plane. Section II introduces the current traffic and economical drivers for Fixed and Mobile Convergence (FMC) and Section III defines a reference framework. In Section IV, this framework is used to specify the network use cases as the current needs of telecom operators and users. These use cases lead, in turn, to different solutions as FMC network scenarios in Section V. Finally, Section VI provides the main conclusions and future work directions.

II. MAIN TRAFFIC AND ECONOMICAL DRIVERS FOR FIXED AND MOBILE CONVERGENCE

As unanimously stated in various studies and publications of public authorities [1][2][3] as well as global consultancy companies [4][5][6][7][8] or network vendors [7][9][10] the global telecommunications market will change dramatically in the upcoming years, even more than in the past 10 years.

One of the main market drivers is the need for more capacity in Internet access deriving from following factors: (1) continuously increasing number of subscribers as well as Internet users worldwide (estimation of 4 – 5 billion in 2020), (2) mobility of users and their need to access Internet every
time and everywhere with each device and (3) growing number of connected devices (including M2M), boosted through new developed technologies. Another market driver, the increasing number of Over-The-Top (OTT) service offerings with need of more bandwidth but no contribution to telecom operators’ revenues, shows the need for new business models, which can be facilitated by FMC and, by that, improve the operators’ position in the market.

A. Traffic Drivers for FMC

Currently, there are evident facts that fixed and mobile traffic is growing and there exist many references showing that this trend will continue in the following years [10][11][12]. The main drivers for traffic growth are the increasing number of connected devices, higher speed connections and bandwidth hungry applications and services as commented before. FMC will help to manage traffic more efficiently, providing more capacity to end-users through a single access-aggregation network with seamless multiple accesses, providing the best connection in each situation.

An analysis of real traffic data provided by operators (Telefónica and Orange) in 2013 [13] shows that, in the downstream direction, usage characteristics of fixed and mobile customers are strongly similar. Video streaming is the service that generates most of the traffic and also contributes with the same proportion (between 30% and 40%) to the total volume generated by fixed and mobile customers. In the case of mobile customers using Wi-Fi access, video streaming even contributes to between 40% and 70% of the total volume. Web browsing (including web video) is the second most used service by fixed and mobile customers and represents more than 20% of the total volume. Wi-Fi traffic coming from mobile terminals is also growing every year. In France, the Compound Annual Growth Rate (CAGR) of average volume generated by Orange’s mobile customers using Wi-Fi at home between 2011 and 2013 represents 56% and the number of mobile customers using Wi-Fi is also growing (CAGR of 38%).

B. Economical Drivers for FMC

The continuous traffic growth, as described in the previous section, poses a constant challenge to telecom operators. Add to that an increase in revenues significantly slower than the traffic growth; the result is a tight price pressure on telecom operators.

The market is hardly accepting a steep increase of subscription fees; even flat rate models are widely spread. Hence, to overcome the economical challenge, cost reduction has key importance, which is one of the most important driving forces behind FMC. FMC not only fosters a better exploitation of network capacity, but also provides cost savings both for deployment (CapEx) and operation (OpEx) costs. Sharing the fixed access network infrastructure with the mobile backhaul results in lower deployment costs, i.e. CapEx savings. The Wi-Fi network attached to the wired fixed access provides low-cost complementary bandwidth for mobile customers, as Wi-Fi operates in the freely available Industrial, Scientific and Medical (ISM) frequency bands. Convergence of fixed and mobile networks leads to unified control and simplified network management. Besides Operations, Administration and Maintenance (OAM) cost savings, FMC also supports reduction of power consumption, which is a significant component of OpEx in both current and future access networks.

III. REFERENCE FRAMEWORK

This section presents a high-level view of the architecture of today’s fixed and mobile networks [14]. As illustrated in Fig. 2, the network is divided in four segments: the customer premises network, the access network, the aggregation network, and the core network, which is connected to the Internet and other data networks. This framework provides the reference network for the following sections.

![Reference framework of COMBO project.](image)

1) Customer Premises Network:

The customer premises network consists of the devices that end-users use to access the fixed, wireless, and/or mobile networks and the elements that interconnect them. These devices may be smartphones, tablets, laptops, desktop Personal Computers (PCs), Wi-Fi Access Points (APs), Set Top Boxes (STBs), Residential Gateways (RGWs), smart TVs, digital media players, etc. Among these, STBs and RGWs can be managed by operators in order to control network access and provide the required level of Quality of Service (QoS).

2) Access Network:

The mobile network elements in the access segment are the radio Base Stations (BSs). In commercial networks, it is common that one BS site can support 2G, 3G and LTE (Long Term Evolution) simultaneously. Today, copper, fibre and microwave links are used for the backhaul of the BSs.

Regarding Wi-Fi, private and community APs are typically located in the customer premises but public APs may be considered as part of the access network.

The dominating technique to deliver Internet to the home is based on copper access technologies, i.e. Digital Subscriber Line (DSL). The distribution network may be fed by fibre down to the CO (Central Office) or cabinet (above access network clouds in Fig. 2). Steadily, fibre to the home/building (third cloud from above in Fig. 2) and other technologies, such as cable, emerge in the broadband access market.
In the case of business service delivery, fibre access to the premises is more common. In this service, a demarcation device is typically deployed close to the customer premises. Carrier class protection and equipment redundancy are key requirements and a managed service ensures Service Level Agreement (SLA) guarantees are monitored, recorded and delivered.

3) Aggregation Network:
The main function of the aggregation network for fixed, mobile and wireless connectivity is transport and aggregation of the subscriber traffic between access and core network via several aggregation levels. Transport technology is generally independent from access type and the protocols used may comprise, e.g., Ethernet, MPLS and IP. Fixed and mobile networks may share the same aggregation physical resources.

4) Core Network:
Although still being separated for different access types, the core network nodes perform control functions such as authentication, billing, and user and network management. Connectivity between the nodes and gateways towards other networks is operated via a high speed IP backbone.

IV. NETWORK USE CASES FOR FIXED AND MOBILE CONVERGENCE

Several use cases for FMC are proposed in this section, grouped in four basic areas of convergence spanning from the sharing of technologies in access and aggregation domains up to the end-to-end control and management of the whole network [14].

A. Unified Wireless Access Networks
The first group describes three FMC use cases looking for a smart use of mobile infrastructure in combination with other fixed network elements, mainly wireless.

1) UC01 – FMC access for mobile devices:
Today, mobile network access is used for data and voice. Nevertheless, mobile devices have more than one communication interface available, and users generally prefer to use Wi-Fi access for mobile data since it is fast and independent of the mobile data plane. This use case proposes to connect automatically a mobile user to Wi-Fi networks. Authentication process is seamless (e.g. through Extensible Authentication Protocol – Subscriber Identity Module i.e., EAP-SIM [15]) so that the user does not need to take any action after the initial configuration has been performed. With this solution, the operator obtains an overall data traffic decrease in its mobile network thanks to the traffic offload to fixed networks and the user will increase its QoE thanks to the transparent configuration and higher service availability.

2) UC02 – Enhanced FMC access for mobile devices:
This use case extends the previous use case by enabling mobile devices to simultaneously use both Wi-Fi and mobile access networks and seamlessly move all or part of their traffic from one access to another. The solution relies on network assistance for selecting and using the most suitable access networks according to application needs, operator policies, customer profile parameters, access network load, or even data plane rate optimization. Such smart and optimized network utilization requires end-user devices to operate two network interfaces simultaneously and to balance the user traffic on different accesses; however, it will provide users a higher availability and capacity.

3) UC03 – Converged CDN for unified service delivery:
Content Delivery Networks (CDNs) have been successfully deployed in fixed networks. In 2012, about one third of the Internet traffic was carried by CDNs, and by 2017, the traffic crossing CDNs will grow by 51% [16]. Mobile Internet is expanding dramatically [17] and to meet the growing data demands, mobile network caching has been investigated and deployed to improve service latency and reduce mobile backhaul traffic by replicating popular and frequently demanded content in the 3G/4G network elements closer to mobile users. This use case focuses on the possible methods for a converged CDN solution by proposing new infrastructures, cache framework and cache algorithms. The proposed solution will allow network operators to enable a better QoS and user experience, reduce internal costs, traffic and latency and offer unified content services.

B. Access Resource Sharing
This section describes three FMC use cases with focus on efficient utilization of access resources.

1) UC04 – Reuse of infrastructure for indoor small cell deployment:
Today, there is a need for wide deployment of indoor small cells to improve the coverage and capacity for indoor end-users. In order to enable low cost deployment, this use case captures the operators’ needs to reuse existing copper and fiber infrastructure in buildings for indoor small cell deployments. The small cells can be of different types: pico BSs with integrated Base Band Units (BBUs), Remote Radio Units (RRUs) with centralized BBUs, or Radio Heads (RHs) connected to a Radio Unit (RU). An indoor small cell gateway provides baseband functionality for the RRUs and aggregates the traffic from all small cells in the building.

2) UC05 – Effective wireless backhaul deployment for outdoor small cells:
In order to increase capacity and coverage, operators are considering deploying outdoor small cells as a complement to existing macro cells. One of the key challenges for outdoor small cell deployment is backhaul connectivity. This use case captures this operator need and highlights the importance of quick and easy backhaul deployment for outdoor small cells, by reusing as much as possible wired links to transport this additional capacity, or deploying different wireless backhaul technologies when there are no copper or fibre connections available. These technologies have key characteristics that can suit specific wireless transmission requirements regarding the constraint of outdoor deployments. These key characteristics are carrier frequency (600 MHz to 80 GHz), latency, Line of Sight (LoS) or Non LoS (NLoS) propagation (reflection, diffraction or penetration), spectrum licensing policy, point-to-point or point-to-multipoint, and topology (tree, daisy chain, ring, or mesh).

Small cells deployed at street level in dense urban environments cannot always count on wired nor wireless LoS
backhaul connectivity. The link between the endpoints (e.g., the small cell and the macro cell) may very well be obstructed. This is where an NLoS solution gives operators the flexibility to deploy the small cells where there is a need for more capacity and coverage without being restricted by the available wired or LoS backhaul connections.

3) UC06 – Common fixed and mobile access termination in hybrid connectivity for fixed and mobile integrated customer services:

The aim of a hybrid access approach is to provide the residential customer with optimum bandwidth resource dynamically assigned via available fixed, mobile, and wireless technologies. Especially addressed areas are those where optical broadband access cannot be deployed economically such as in rural areas. In this use case, a household is connected via the RGW to DSL access with constant but potentially too low bandwidth while a high speed transmission via the mobile network and/or a public or community Wi-Fi hotspot can be added on demand. Bundling of the multiple paths towards unified service experience requires proper configuration of the RGW and a dedicated aggregation server within the network operator.

C. Aggregation Resource Sharing

This section addresses FMC aspects related to the aggregation segment of the network.

1) UC07 – Support for large traffic variations between residential and business areas:

The focus of this use case is network infrastructure convergence by sharing the resources of a common (based on Common Public Radio Interface - CPRI fronthaul and IP backhaul) aggregation network for mobile, residential and business services in metropolitan areas. It highlights the need to handle large variations in traffic demand at different times of the day and week. Considering the dynamic behavior of traffic demand, today’s static RRU-BBU association can result in over-provisioning and low utilization of resources and, thus, cost inefficiency. To overcome this problem, one BBU can be shared over time by several RRUs, reducing the number of BBUs needed to support the same number of subscribers. Thus, instead of statically allocating a dedicated BBU for each RRU, one and the same BBU can, for example, serve RRUs in a business area during business hours and RRUs in a residential area during evenings and weekends. As a consequence, RRUs in areas with low utilization can go into sleep mode and save power when not used. Other examples are stadium areas with high traffic volume during football matches and city centers with lots of mobile traffic during shopping hours on Saturday afternoons. These types of scenarios have been identified in the FP7 project METIS that is focused on 5G solutions beyond 2020 [16].

2) UC08 – Universal Access Gateway for fixed and mobile aggregation network:

This use case aims at the integration of key fixed and mobile gateway functionalities (also called IP edges) in the same network entity, called Universal Access Gateway (UAG). This requires moving down some Evolved Packet Core (EPC) data plane functions to UAGs. Such an approach promises to realize a more efficient operation of gateway functionalities within the aggregation network and to optimize costs by reducing the number of network elements. In case of availability of corresponding access capacity, a more advanced transport of mobile traffic from UAG towards the BS can also be implemented with Medium Access Control (MAC) layer instead of IP layer, or using radio transmission ready CPRI signals. In such a centralized Radio Access Network (RAN) scenario with BBU hoteling, additional gain in flexibility and performance and saving in terms of infrastructure equipment will be possible.

3) UC09 – Convergent access and aggregation technology supporting fixed and mobile broadband services:

The focus of this use case is to employ a common technology universally serving fixed, wireless and mobile access and aggregation for all types of customers and services. This use case targets an optimized usage of L1 and L2 access and aggregation network resources (fiber infrastructure and systems). Such a single network approach aims at CapEx and OpEx savings.

D. Operator Cooperation

This section addresses FMC aspects related to operator cooperation.

1) UC10 – Network sharing:

This use case highlights the need to provide multi-operator network capabilities in a future FMC scenario. Network sharing in an FMC scenario may facilitate mobile-only operators to enter the fixed market or vice versa, resulting in new cooperation possibilities. For example, in order to share the investment costs, a mobile-only operator may decide to roll out an LTE-Advanced network together with a fixed-only operator that is interested in entering the mobile market. Besides investment cost savings, other drivers for network sharing are access to limited radio spectrum, fast network roll-out and quick start of new services, cost-effective coverage in rural areas, and increased resource utilization. The shared resources can be infrastructure (e.g. sites, towers, power, RAN, backhaul network, etc.) or spectrum.

E. Overall Analysis of Network Use Cases

The network use cases described above identify needs towards future network design taking into account more efficient resource usage and provisioning in the area of access and aggregation, both from a single operator and operator cooperation point of view. The resulting requirements target, on the one hand, functional convergence, which includes new generic control plane approaches serving all types of networks concurrently, thus allowing for better user data traffic manipulation. On the other hand, the mutualization and sharing of fixed and mobile network infrastructures (structural convergence) will enable a unification of hardware resources (equipment, cables, sites, etc.) for both fixed and mobile services with expected savings in infrastructure investment of a converged operator.

V. FROM FMC USE CASES TO FMC NETWORK SCENARIOS

The difference between use cases and network scenarios should be clarified first of all:
• Use cases define needs, i.e., detailed expectations from the network. These expectations will in particular help defining detailed requirements quantifying the expectations;
• Network scenarios define technical solutions, i.e., candidate network architectures. These candidate network architectures have to satisfy the expectations defined in the use cases, should have positive impacts on user experience, or reduce costs and/or energy consumption. They can target structural and/or functional convergence of fixed and mobile networks.

As expected, a single network scenario may support multiple use cases. The five network scenarios proposed by COMBO project are described in the following sub-sections.

1) Unified access / aggregation network (Layers 1 and 2):
Several challenges arise in the access/aggregation networks when tackling an FMC network down to the structural level. The proposed network scenario aims at a unified access/aggregation network, focusing on the investigation of new transport architecture solutions and assuming both L1 and L2 aspects. It answers to several use cases described in Section IV, as UC04, 05, 07, 08, 09 and 10.

This network scenario takes into account the variation and complexity of access techniques (e.g. small cells indoor/outdoor deployment, wireless and wireline technologies, fronthaul technologies). Various options are considered for the structural convergence between Customer Premises Equipment (CPE) and first CO, considering different topologies and optical technologies. From first CO to Core CO, the convergence is performed via WDM rings, possibly complemented by L1 (TDM) / L2 (packet) switching technologies. The outcome of such architecture solution for a unified access/aggregation network focuses on providing:

• Seamless interoperability between fixed/mobile network elements and the aggregation edge node;
• Network adaptability and scalability to deal with continuously increasing end-user data rates and demanding QoS and QoE, also considering traffic variation in time and between geographical areas;
• Networking granularity and type, in order to achieve an effective usage of transport means;
• Enablers for “carrier grade” operations, including OAM, resilience, synchronization, preferably in end-to-end extent (i.e. from CPE to CO);
• Control of latency and delay variation for the transport of sensitive services (e.g. for CPRI based fronthauling deployments).

2) IP edge convergence:
This second network scenario is characterized by a common IP edge for fixed, mobile and Wi-Fi, namely the Universal Access Gateway (UAG), typically located at a main CO. The converged gateway encompasses functions for mobile aggregation routers and data plane EPC gateways, Broadband Network Gateway (BNG) and security gateways. The BBU for the radio processing units may also be part of it, depending on the location of the main CO.

The motivation for this network scenario is to simplify the network by reducing the technology variety so as to reduce CapEx and OpEx and to improve latency and reliability. It aims at a high utilization of the network infrastructure and systems in order to cope with the anticipated traffic increase. It answers in particular to use cases UC06, 08 and 09.

The UAG innovative concept takes advantage of Software Defined Networking (SDN), which uses a single control protocol for multiple simple network devices. Furthermore, Network Function Virtualization (NFV) brings the required flexibility to encompass the various functions in an effective way into such a node. This concept targets structural convergence on infrastructure and system level; it can also lead ultimately to IP edge functional convergence with the definition of a generic IP edge functional entity used by any types of networks.

3) Converged cloud-based network control:
In today’s networks, the network elements are typically based on dedicated network nodes with specific hardware for determined (network) functions. New network features often require new hardware and software. The operator’s innovation cycle and time to market is depending on the vendor’s product roadmap and therefore highly constrained by vendor implementations, planning and support. Furthermore, the roll-out of new network elements causes high installation effort and OpEx. SDN and NFV based on a data center infrastructure enable increased cost-efficiency (OpEx and CapEx), programmability and rapid innovation, higher flexibility, openness, vendor agnosticism and improved scalability.

This third network scenario is characterized by the separation of control plane and data plane. In the control plane, network applications and service creation are moved into the cloud (data centers) where SDN/NFV concepts are applied (gaining from distributed processing and shared resource usage). This network scenario provides answers to use cases UC03, 06, 07, 08, 09 and 10.

Mobile and fixed network functions (e.g. AAA, Deep Packet Inspection, Network Address Translation, etc.) are abstracted, merged and implemented as converged functions. Therefore, this scenario focuses on functional convergence. In this concept, routers provide only forwarding function, which is controlled via open interfaces by the network cloud. Some routers are co-located with a data center, which hosts network, service and operation functions.

4) Converged subscriber and session management:
This fourth network scenario addresses converged subscriber and session management, as opposed to the current situation where users hold different subscriptions and identities to be allowed to use fixed and mobile telecommunication services. At the network level, a universal AAA infrastructure is required as a common control entity for any kind of access network used. Such a converged AAA server is also in charge of providing service level adaptation information based on access network capabilities and type, resulting in better end-user QoE.
In a first step, each access network can still use its own authentication methods while an additional common subscriber session management will keep track of the access network used. This allows for further service adaptation, common subscriber session management, common charging, whatever the access network is in use, thus leading to AAA functional convergence. A second step could be defined as fully converged with the introduction of a single universal user identity, managed by a single AAA/HSS (Home Subscriber Server) database, allowing also for structural convergence. The HSS is just a particular AAA server based on the Diameter protocol. This network scenario is an enabler for use cases UC01, 02, 06, 08 and 10.

As for the IP edge convergence network scenario, NFV technologies are a major driver to build such a universal AAA entity, which could be placed at the same level as the UAG within the network. Even if there is a single logic subscriber database, there should be, for redundancy reasons, different pieces of physical equipment that host synchronized copies of the database and that can take over the traffic in case the main node faces an outage.

5) Advanced interface selection and route control:

The classical LTE routing is based on tunnelling the traffic, first from the User Equipment (UE) to the eNodeB, then from the eNodeB to a Serving Gateway (SGW), then from the SGW to a Packet Data Network Gateway (PGW). The motivation of the present network scenario is to provide the network operator (in charge of both mobile and fixed access networks) with means to dynamically control mobile traffic routes, when several routes are available. Such route control implements traffic offload, and can be implemented either on all three legs.

- Traffic offload on the first leg (UE-eNodeB) is based on the network triggering the UE to use Wi-Fi access instead of the 3G network. It allows alleviating the load on eNodeBs; this differs from user-initiated offload, when a user selects its Wi-Fi interface instead of selecting its mobile interface, without network operator’s intervention;
- Traffic offload on the other legs allows to alleviate the loads on SGW and PGW, or to balance load between gateways. This is done thanks to multiple small-scale core network nodes SGW and PGW within “Local Gateways” (LGW) that are deployed to serve local communities. The control may be implemented within the LGW, thanks to procedures such as LIPA (Local IP Access) and SIPTO (Selected IP Traffic Offload)[18].

Traffic offload is intended to improve user experience by decreasing latency, whenever the selected route is shorter than the classical route. However, traffic offload scenarios imply finding alternatives for the current implementations of the following functions: AAA, handover and mobility support, charging and route control. One of the major tools for realizing traffic offload scenarios lies in distributing SGW and PGW functions in small local gateways (LGW) which could be located either within RGW or in COs. New functions are requested for realizing mobility and interface selection, so that this network scenario mainly addresses functional convergence. It answers in particular to use cases UC01, 02, 03, 06 and 09.

VI. CONCLUSION AND FUTURE WORK

Fixed and mobile network operators need to evolve their network to deal with the expected high traffic growth, and they need to deploy the most efficient and flexible network.

This paper introduces new FMC network designs in the access and aggregation segments, as the solution to the current and future needs that network operators will have. These needs are presented as network use cases in which network operators are interested in, considering different areas, such as, unified wireless access, access resource sharing, aggregation resource sharing and operator cooperation.

The resulting requirements aim at functional convergence in terms of a single control plane approach and structural convergence with a unified usage of the same hardware resources. Several FMC network scenarios are proposed as solution to the previous needs including a unified access/aggregation network, a converged IP edge node, a converged cloud-based network control, a converged subscriber and session management and an advanced interface selection and route control as the most interesting.

A deep analysis and assessment of the previous FMC network scenarios will be performed in the European FP7 COMBO project to obtain the most appropriate level of convergence.

REFERENCES

[16] Scenarios, requirements and KPIs for 5G mobile and wireless system, METIS D1.1, April 2013.