TELECOM INFRA PROJECT

Open Core Network Project Group

Fixed Wireless Access

Use Case and Technical Requirements Document (TRD) v1.0

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Change Tracking

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7/21/2021	v.0.1	Authors: - Xinli Hou - Mahmoud Habhab	Initial draft based on TIP OCN Application and Service Technical Requirement v.1.1 with input from VTS
8/3/2021	v.0.6	Veronica Quintuna	Minor and editorial changes. Adding CPE in the glossary
10/6/2021	v.0.7	Xinli Hou	Updated based on comments from MTN (assumption 9], Telecom Argentina (assumption 10, REQ-OCN 07 & 16) and Facebook. All comments are here.
10/19/2021	v.0.8	Xinli Hou	Further updated based on comments from OCN leads (added assumption 11); Added Contributors.
11/3/2021	v0.9	Kelly Rush	Document Formatting and TIP Branding
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1. Introduction

Today's 4G/5G mobile core network has evolved from the legacy cellular systems aimed at providing mobile broadband for millions of consumers in a wide area and to support IoT use cases with various device types. As such, the core network has become complex, with a wide range of features and functionalities. On the other hand, 4G/LTE and 5G enable new use cases creating business opportunities for MNOs (Mobile Network Operators), Cloud providers, SI, NEV (network equipment vendors), and enterprises. Fixed Wireless Access (FWA) use cases have become an attractive alternative to providing internet connectivity to a wide range of consumers in place of fiber or copper access.

Service providers require simple, cost-efficient solutions optimized for targeted use cases.

- Simplicity is introduced in vendor selection, procurement, deployment and operations and maintenance
- Cost efficiency in the total cost for CAPEX and OPEX

The term solution is meant for a set of products, supplied by one or more vendors, that are integrated, deployed, operated, and managed as a whole in order to meet a specific set of business and technology requirements of a service provider. The size and complexity of solutions varies as the requirements change. For example, a 5G OCN solution could consist of functions provided by different vendors.

The TIP OCN project group responds to this request by driving pre-verified, pre-packaged ready-to-deploy OCN blueprints that can be adopted by MNOs and service providers with minimum effort in OCN product test & validation in their labs & staging environment. A blueprint consists of documents that describe the supported use cases and requirements, OCN solution architecture and configuration, test plan and test report summary. The blueprints shall also provide experience and lessons learned, in addition to white paper and Playbook produced during the Lab Test and Field Trials with regards to OCN deployment as well as Operations and Maintenance (O&M).

This document describes the FWA use case and requirements on OCN to support the use case. It can be easily converted to a FWA solution RFP to facilitate the vendor selection and procurement process.

OCN PARTICIPANT CONTRIBUTION - *Full Tier Membership required*

Vendors may provide product compliance readiness against the requirements herein. Download the supplemental detailed Technical Requirements doc here. Product readiness is

evaluated and eligible for the TIP Requirements Compliance ribbon and listing on TIP Exchange.

2. Document Structure

This document is structured as follows:

Chapter 3 describes the FWA use case and its most important characteristics, followed by an end-to-end solution reference architecture in Chapter 4. Although the long-term vision of FWA reference architecture is to support multi-access with a converged open core network, this document shall focus on assumptions about CPE (customer-premises equipment) and RAN (radio access network) in Chapter 5, and requirements on core network that supports either 4G/LTE or 5G NR in Stand-Alone (SA) architecture. These functional, architectural, implementation and non-functional requirements are detailed in Chapter 6.

This document is an input document to the TIP test and validation process, through which vendors can have products and solutions rewarded with TIP ribbon and badges. Chapter 7 describes criteria for a vendor's product to receive "Requirement Compliance" ribbon and "TIP Validated" Product badge.

Chapter 8 outlines the document glossary.

3. FWA Use Case Description

The FWA use cases support users in gaining access to the Internet by using CPE as a gateway to the 4G/5G network as an ISP-like access method. User devices gain access via WiFi, wired, or another form of local area network methods with the following characteristics:

- Support of limited mobility, i.e., once a CPE is attached/registered to the 4G/5G network, it typically does not move. If a session is dropped or a mobility event is detected (due to access network fault or change in RF conditions or the CPE is moved from one location to another) the CPE can simply re-attach
- CPE can only attach to the network from locations predefined in the CPE profile
- CPE shall be served with QoS as defined in the associated profile. QoS can be defined simply as the CPE experienced peak throughput.
- It should be possible to remotely monitor the CPE status (on/off) and software update following Broadband Forum Technical Report 069 (TR-069) or equivalent
- It should be possible to remotely monitor the radio conditions in order to understand if the CPE location is optimal for radio propagation or if it can be improved by changing its location slightly.
- Authentication and Authorization functions can be simplified. May use standard Universal Integrated Circuit Card (UICC) as defined in 3GPP, however because the CPE is confined to predefined locations, other non-3GPP authentication methods can be considered to simplify the development
- FWA service can be prepaid or postpaid.

4. Reference Architecture

The long-term vision for the use case is to develop a cloud-native converged open core network interworking with multiple wireless access technologies to support the targeted use cases such as FWA services, as illustrated in Figure 1.

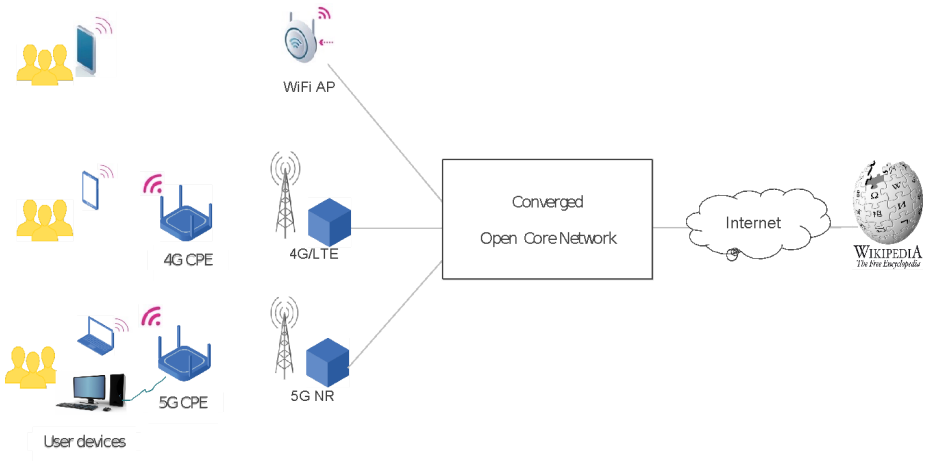

Figure 1. Long-term vision for FWA reference architecture

A core network is open if it complies with standards supporting open interfaces and APIs and enabling multi-vendor implementation. Multi-vendorship can be supported at different levels: in minimum an open network must be able to interwork with Radio Access Networks (RANs) from different vendors. An open core can, but not necessarily, consist of network functions as defined by 3GPP and a service provider can pick and choose a different vendor for each function. A more likely scenarios is a core network consisting of multiple clusters of network functions, each cluster of network functions are provided by a different vendor.

An open core network is considered a converged open core network if it supports two or more access technologies simultaneously. Even though not in the scope of this document, 5G enabled EPC supporting 5G NSA can be considered a converged core because it supports both 4G/LTE and 5G NR. In long run, the converged OCN shall support 4G, 5G and WiFi access, that is TWAG/ePDG & AAA or N3IWF or equivalent is considered part of OCN.

FWA use case and requirement release 1 shall focus on developing minimum viable OCN products that are cloud native capable for supporting 4G/LTE or 5G SA based FWA. At the heart of a 4G/5G-based FWA solution is the 4G/5G CPE, i.e., User Equipment (UE) in 3GPP terminology, a dedicated gateway device that uses the 4G/5G network as an ISP-like access method and provides in-home or in-office services by bridging to WiFi, wired or other local area network methods. It may include specialized advanced services in the gateway, e.g., VoIP, Video, or personal assistant.

5. Assumptions

Following assumptions are made:

No.	Description	Notes
1	The wireless access technology complies to the applicable standards from 3GPP for 4G/LTE or 5G NR	
2	Interfaces between user devices and 4G/5G CPE comply with relevant IEEE WiFi specifications	
3	Interfaces between 4G/5G CPE and eNodeB/gNodeB comply with relevant 3GPP LTE/NR Uu interface specifications	
4	4G/LTE eNodeB complies with relevant 3GPP S1 interface specifications	
5	5G NR gNodeB complies with relevant 3GPP N2 and N3 interface specifications	
6	4G/5G CPE is, in 3GPP terminology, a User Equipment (UE) and it complies with 3GPP specifications relevant to UE	
7	4G CPE supports 3GPP NAS specifications	
8	5G CPE supports 3GPP N1 interface specifications	
9	CPE supports TR-069 for remote status monitoring and software update	
10	CPE may support XMPP protocol for CPE management in case for example where the auto configuration server (ACS) is behind CGNAT/FW	
11	It should be possible to remotely monitor the radio conditions in order to understand if the CPE location is optimal for radio propagation or if it can be improved by changing its location slightly.	

6. Requirements on OCN Supporting FWA

6.1 Architectural requirements

The following table outlines a total of 15 Architectural Requirements:

Req #	Description	Notes
REQ-ARC-01	The OCN shall conform the 3GPP release 15.08 or later releases	
REQ-ARC-02	OCN shall be cloud native microservice based. One or more OCN microservices constitute network functions of 4G EPC and 5G Core as defined in 3GPP TS 23.002/TS23.501	
REQ-ARC-03	Several 3GPP network functions may optionally be combined into an integrated OCN network function.	
REQ-ARC-04	When several network functions are combined and implemented as a combined OCN network function, the interfaces between network functions may be simplified/modified by the implementation. However, any interfaces outside the combined OCN network function must remain compliant with the relevant 3GPP and/or OCN specifications.	
REQ-ARC-05	Each Network Function of OCN shall be able to stand alone and operate as an independent Network Function	
REQ-ARC-06	Each Network Function of OCN shall be able to interoperate with Network Functions provided by other vendor's Network Functions using standard 3GPP reference point interfaces.	
REQ-ARC-07	OCN shall comply with 3GPP NAS and S1 interface specifications to interwork with 4G CPE and Radio Access Network to the extent necessary to support the OCN functional requirements as specified in Section 6.1	
REQ-ARC-08	OCN shall comply with 3GPP N1, N2, and N3 interface specifications to interwork with 5G CPE and Radio Access Network to the extent necessary to support the OCN functional requirements as specified in Section 6.1	
REQ-ARC-09	OCN shall not, to the extent reasonably possible, depend upon specific hardware selections or specialized equipment configuration	
REQ-ARC-10	OCN shall be designed for flexible deployment in a different operating environment, such as public and private cloud environments, standalone deployments or integrated into other projects	

REQ-ARC-11	OCN shall offer simple, templated onboarding with a bundled baseline schema	
REQ-ARC-12	OCN shall be managed using automation and orchestration tools	
REQ-ARC-13	It shall be possible to deploy OCN in a variety of configurations supporting differing user needs for capacity, reliability, scalability, and performance	
REQ-ARC-14	Tools for monitoring and visibility shall be available	
REQ-ARC-15	OCN shall support capabilities mandated by appropriate legal and regulatory agencies.	

6.2 OCN software implementation requirements

Req #	Description	Notes
REQ-SW-01	Software components of OCN shall be constructed of micro-services	
REQ-SW-02	Software components of OCN shall be constructed to scale horizontally (duplicating network functions)	
REQ-SW-03	Software components of OCN shall be built to deploy on any platform that is compliant with the Cloud Native Telco Task Force (CNTT) specification	
REQ-SW-04	Software components of OCN shall be designed to allow deployment on Public Cloud, Private Cloud, Hybrid Cloud or Bare Metal deployments	
REQ-SW-05	Software components of OCN shall not depend on any Cloud Service Provider proprietary services	
REQ-SW-06	Software components of OCN may support IO acceleration technologies	
REQ-SW-07	Software components of OCN shall comply with Cloud Native design best practices as defined by CNTT	
REQ-SW-08	Software components of OCN shall provide open metrics and monitoring capabilities	
REQ-SW-09	Software components of OCN shall publish metrics on a standard exporter endpoint(s) compliant with CNTT specifications	
REQ-SW-10	Software components of OCN may publish metrics by other APIs or methods (event streams, SNMP, etc.)	

6.3 Functional requirements

The following table outlines a total of 17 Functional Requirements.

Req#	Description	Notes
REQ-OCN-01	OCN shall support basic CPE attach/detach, and PDP session establishment and maintenance procedures	
REQ-OCN-02	OCN shall support basic firewall functionality. If FW rules are global (not user specific) then may be handled outside UPF by FW appliance	

REQ-OCN-03	OCN shall support performance to handle typical fixed ISP bandwidth (speeds/feeds to be specified)	
REQ-OCN-04	Support of IPv4 user sessions is required, IPv6 support is highly desirable	
REQ-OCN-05	CPE may move from one location to another. However, during the transition, no service is provided.	
REQ-OCN-06	CPE can only attach to the network from a predefined list of locations.	
REQ-OCN-07	Whether the CPE can be moved from one location to another, there should be a mechanism to inform the Operator about it. This allows the Operator to check the service feasibility in the new place and/or to check if existing FWA users (in the new place) quality of experience would be affected	
REQ-OCN-08	OCN shall support basic authentication and authorization procedures only	
REQ-OCN-09	OCN shall support simple subscriber & subscription management functions only	
REQ-OCN-10	OCN shall support basic policy control functions	
REQ-OCN-11	It is mandatory to support CDR (charging data records) creation, where CDR contains network usage information	
REQ-OCN-12	It is desirable to support on-line charging based on duration, data volume or a combination of both	
REQ-OCN-13	It is desirable to support open API to integrate OCN on-line charging with service provider's customer care or billing system	
REQ-OCN-14	It may be required to support CG-NAT (carrier grade NAT) as a large inventory of public IP is likely unavailable.	
REQ-OCN-15	It is desirable to support different tiers of services with different peak bit rate, total volume of data per month with option to downgrade service to lower speed or cut connections	
REQ-OCN-16	It is desirable to support QCI or similar mechanism in order to preserve FWA users' quality of experience	
REQ-OCN-17	It may be required to support LI (Lawful Intercept) functions, depending on regulatory requirements in the market/country of deployment	
REQ-OCN-18	It may be required to support simple DPI (deep packet inspection)/App Detection	
REQ-OCN-19	Application Function support for private services provided to customers (i.e., video services) is an option.	

6.4 Non-functional requirements

Req #	Description	Notes
REQ-NFUN-01	OCN shall target service availability of 99.999%	
REQ-NFUN-02	Network Functions shall support horizontal scaling (i.e., scaling by adding replicas)	
REQ-NFUN-03	Each Network Function shall scale independently from other functions (i.e., scaling one network function does not lead to or require scaling of	

	any other network functions)	
REQ-NFUN-04	Network Functions may be vertically scalable (e.g., increasing CPU, RAM resources.) Note: vertical scale may be increased by horizontal scaling of the microservices that make up the Network Function	
REQ-NFUN-05	Number of UEs supported by OCN shall be for further study and is likely operator specific	
REQ-NFUN-06	Number of simultaneously attached PDP sessions supported by OCN shall be for further study and is likely operator specific	
REQ-NFUN-07	The user data throughput supported by OCN shall be for further study and is likely operator specific	
REQ-NFUN-08	Network Functions shall be independently re-startable without impact to other functions	
REQ-NFUN-09	Network Functions shall be upgradeable independently	
REQ-NFUN-10	OCN interfaces shall be versioned allowing forward and backward compatibility	

7. OCN Ribbon and Badging Criteria

7.1 Requirement compliance ribbon Criteria

A OCN vendor may apply for a "requirement compliance" ribbon by submitting a statement of compliance to this requirement document, along with product description. In the "Notes" column of the requirement tables, vendor will state:

- C: Comply with, now or with a future date (QQ/YYYY)
- PC: Partially comply, now or a future date (QQ/YYY) with explanation
- NC: Does not comply

The product will receive the "Requirement Compliance" ribbon if the product complies, now or in the future, with all mandatory requirements in Chapter 6

7.2 TIP validated badge Criteria

An OCN vendor may apply for a "TIP Validated" product badge by performing a TIP lab test or field trial. The product will receive the "TIP Validated" product badge if

- the product has received "Requirement Compliance" ribbon
- the product passed test cases and demonstrates support of all mandatory functional requirements in Section 6.1
- TIP lab test/field trial may in the future add test cases for non-functional requirements

8. Glossary

3GPP

The 3rd Generation Partnership Project (3GPP) is an umbrella for a number of standards organizations which develops protocols for mobile telecommunications. Its best-known work is the development and maintenance of GSM, UMTS, LTE, 5G, IP Multimedia Subsystem (IMS) and other related standards. 3GPP is a consortium with seven national or regional telecommunication standards organizations as primary members ("organizational partners") and a variety of other organizations as associate members ("market representation partners").

3G, 4G, 5G

The 3rd, 4th, and 5th generation cellular data technologies. 3G generally represents cellular data networks that enabled the introduction of the smartphone and mobile web browsers; 4G represents true broadband internet access to mobile devices; 5G cellular technologies deliver massive bandwidth and reduced latency to cellular systems, supporting a range of devices from smartphones to autonomous vehicles and large-scale IoT. For completeness, 1G represents analog cellular voice systems and 2G represents early digital cellular voice systems with limited data capabilities.

Access Network

A network that enables user devices access to network services. It is contrasted with the core network which connects service providers to one another.

Application Function (AF)

A primary Network Function in the 3GPP 5G Core.

Base Station

A network function in the RAN which is responsible for the transmission and reception of radio signals in one or more cells to or from user equipment. A base station can have an integrated antenna or may be connected to an antenna array by feeder cables. Uses specialized digital signal processing and network function hardware. In modern RAN architectures, the base station may be split into multiple functional blocks operating in software for flexibility, cost

and performance. A base station in 4g/LTE is also called eNode B; while a 5G base station is called gNode B.

Centralized Data Center

A large, often hyperscale physical structure and logical entity which houses large compute, data storage and network resources which are typically used by many tenants concurrently due to their scale. Located a significant geographical distance from most of their users and often used for cloud computing.

Cloud Computing

A system to provide on-demand access to a shared pool of computing resources, including network, storage, and computation services. Typically utilizes a small number of large, centralized data centers and regional data centers today.

Cloud Native Technologies

Cloud native technologies empower organizations to build and run scalable applications in modern, dynamic environments such as public, private, and hybrid clouds. Containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach. These techniques enable loosely coupled systems that are resilient, manageable, and observable. Combined with robust automation, they allow engineers to make high-impact changes frequently and predictably with minimal toil.

Cloud-native Network Function (CNF)

A Virtualized Network Function (VNF) built and deployed using cloud native technologies. These technologies include containers, service meshes, microservices, immutable infrastructure and declarative APIs that allow deployment in public, private and hybrid cloud environments through loosely coupled and automated systems.

Cloud Service Provider (CSP)

An organization which operates typically large-scale cloud resources comprising centralized and regional data centers. Most frequently used in the context of the public cloud. May also be referred to as a Cloud Service Operator (CSO).

Core Network

The layer of the service provider network which connects the access network and the devices connected to it to other network operators and service providers, such that data can be transmitted to and from the internet or to and from other networks.

Customer Premise Equipment (CPE)

A customer-premises equipment (also referred to as customer-provided equipment) is any device that can be connected to a communication network. In FWA scenarios, the CPE works as an internet access gateway and enables users to access communication services within a local network (e.g., home, enterprise).

Jitter

The variation in network data transmission latency observed over a period of time. Typically measured in milliseconds as a range from the lowest to highest observed latency values which are recorded over the measurement period.

Latency

The time taken by a unit of data (typically a frame or packet) to travel from its originating device to its intended destination. Typically measured in milliseconds. Latency generally refers to one-way delays between two devices. Trip Time (RTT).

Latency Critical Application

An application that will fail to function or will function destructively if latency exceeds certain thresholds. Latency critical applications are typically responsible for real-time tasks such as supporting an autonomous vehicle or controlling a machine-to-machine process. Unlike Latency Sensitive Applications, exceeding latency requirements will often result in application failure.

Latency Sensitive Application

An application in which reduced latency improves performance, but which can still function if latency is higher than desired. Unlike a Latency Critical

Application, exceeding latency targets will typically not result in application failure, though may result in a diminished user experience. Examples include image processing and bulk data transfers.

Lawful Intercept (LI)

As per 3GPP standards, Lawful Intercept (LI) is defined as: "Laws of individual nations and regional institutions, and sometimes licensing and operating conditions, define a need to intercept targeted communications traffic and related information in communication systems

Mobile Network Operator (MNO)

The operator of a mobile network, who is typically responsible for the physical assets such as RAN equipment and network sites required for the network to be deployed and operate effectively. Distinct from MVNO as the MNO is responsible for physical network assets. May include those edge data centers deployed at the infrastructure edge positioned at or connected to their cell sites under these assets. Typically, also a service provider providing access to other networks and the internet.

Network Function

A functional building block within a network infrastructure which has a well-defined functional behaviour and well-defined interfaces. A network function may be implemented as a Physical entity (PNF) or software entities (VNF or CNF)

Network Function Virtualization (NFV)

The migration of network functions from physical network elements using embedded software running on proprietary hardware appliances to software based VNFs running on standard servers using industry standard virtualization and cloud computing technologies. In many cases NFV processing and data storage will occur at the edge data centers that are connected directly to the local cellular site, within the infrastructure edge.

Open Core Network (OCN)

Telecom Infra Project (TIP) sub-group addressing applications and services, orchestration and automation issues.

Policy Control Function (PCF)

A primary Network Function in the 3GPP 5G Core. The PCF provides:

- policy rules for control plane functions, including network slicing, roaming and mobility management.
- Accesses subscription information for policy decisions taken by the UDR.
- Supports the new 5G QoS policy and charging control functions.

Quality of Service (QoS)

A measure of how well the network and data center infrastructure is serving a particular application, often to a specific user. Throughput, latency and jitter are all key QoS measurement metrics which edge computing seeks to improve for many different types of application, from real-time to bulk data transfer use cases.

QoS Class Identifier (QCI)

QCI is a mechanism used in LTE networks to ensure carrier traffic is allocated appropriate Quality of Service (QoS). Different carrier traffic requires different QoS and therefore different QCI values.

Radio Access Network (RAN)

A wireless variant of the access network, typically referring to a cellular network such as 3G, 4G or 5G. The 5G RAN will be supported by compute, data storage and network resources at the infrastructure edge as it utilizes NFV and C-RAN.

Service Based Architecture (SBA)

A software development paradigm which improves the modularity of products by breaking down them into interconnected microservices. The 3GPP defines an SBA as a set of Network Functions (NFs) that communicate with each other to provide/request services.

Service Provider

An organization which provides customers with access to its network, typically with the goal of providing that customer access to the internet. A customer will usually connect to the access network of the service provider from their side of the last mile.

Throughput

In the context of network data transmission, the amount of data per second that is able to be transmitted between two or more endpoints. Measured in terms of bits per second typically at megabit or gigabit scales as required. Although a minimum level of throughput is often required for applications to function, after this latency typically becomes the application-limiting and user experience-damaging factor.

Traffic Offloading

The process of re-routing data that would normally be delivered inefficiently, such as over long distance, congested, or high-cost networks, to an alternative, more local destination (e.g., a CDN cache) or on to a lower-cost or more efficient network. Local Breakout is an example of using edge computing for traffic offloading.

XMPP

Extensible Messaging and Presence Protocol (XMPP) is an open communication protocol designed for instant messaging (IM), presence information, and contact list maintenance. Based on XML (Extensible Markup Language), it enables the near-real-time exchange of structured data between two or more network entities.