5G SBP 5G and 5G Advanced Capabilities

Ike Alisson This section includes some of Ike Alisson's questions and remarks expressed during his presentation on 3GPP 5G and 5G Advanced releases selected Capabilities on June 7th, 2022 to the LFN 5G Super Blueprint Project meeting (Ref.: 06-07-22 - 5G SBP Off-Week Working Group Meeting).

The remarks made during the presentation were expressed in form of "questions" to enable the recipients to judge the relevance to and/or importance for the 5G Super Blueprint and therein determine whether to consider to further pursue to find an answer or have a discussion to determine whether the raised questions and remark are worthwhile to be pursued.

Question/Remark 1: With respect to Project Magma and its support to EPC, which 5G Option definition (as defined by 3GPP and GSM attached below) the 5G Super Blueprint follows/implements so that the "Super Blueprint Project" derives its reference to be denoted as "5G"?

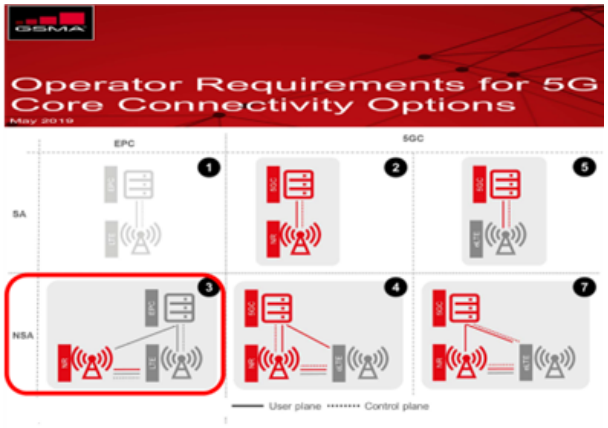


Figure 1: 3GPP defined options for 5G deployment

It is widely expected that Mobile Operators will initially deploy 5G using **Option 3** allowing the re-use of existing EPC Core functionality. **Option 3 has been fully specified in an early drop of 3GPP Release 15.**

In case that there is any member Project that can supply NR Solution to 5G Super Blueprint Project (as specified by 3GPP and O-RAN Alliance utilizing the IAB (Integrated and Access Backhaul solution)), with reference to current Member Magma project involvement for supply of CN functionality and recent media press release on MNOs launch of voice over NR (with indications a year ago that voice over NR would have a fall back to EPC), could the 5G Super Blueprint Project consider as an option to utilize/explore within 5G Super Blueprint the Solution "Voice over NR" as an UC?

Please see below some reference information related to the remark's content above:

The IAB-node can access the network using either SA mode or EN-DC. In EN-DC, the IAB-node connects via E-UTRA to a MeNB, and the IAB-donor terminates X2-C as SgNB

Figure : IAB architecture; a) IAB-node using SA mode with NGC; b) IAB-node using EN-DC

T-Mobile Launches Voice Over 5G NR using 5G SA Core Network

Posted on June 4, 2022 by Alan Weissberger

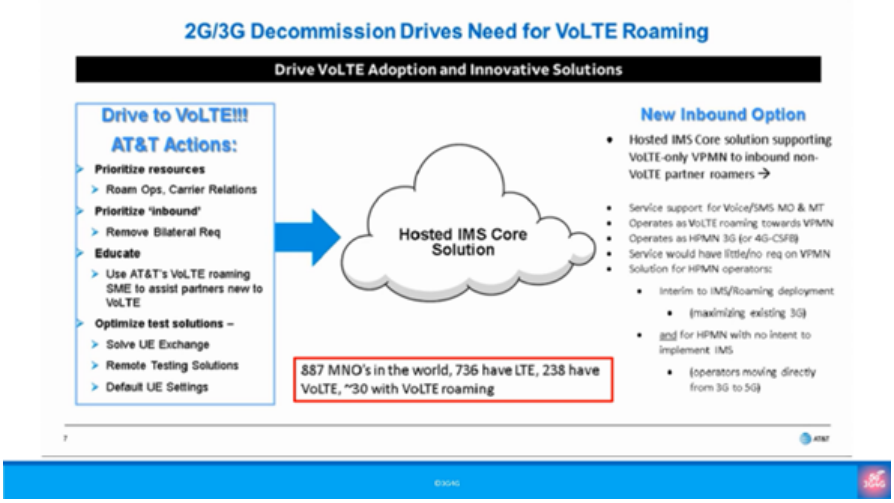
T-Mobile has deployed commercial **Voice over 5G (VoNR, or Voice Over (5G) New Radio)** service in limited areas of **Portland, Oregon and Salt Lake City, Utah.** The Un-carrier plans to expand VoNR to many more areas this year. Now that Standalone 5G (5G SA) is beginning to carry voice traffic with the launch of VoNR, other real 5G services, such as network slicing and security are likely to be deployed. T-Mobile customers with Samsung Galaxy S21 5G smartphones can take advantage of VoNR today in select areas.

"We don't just have the leading 5G network in the country. T-Mobile is setting the pace for providers around the globe as we push the industry forward – now starting to roll out another critical service over 5G," said Neville Ray, President of Technology at T-Mobile. "5G is already driving new levels of engagement, transforming how our customers use their smartphones and bringing unprecedented connectivity to areas that desperately need it. And it's just going to get better thanks to the incredible T-Mobile team and our partners who are tirelessly innovating and advancing the capabilities of 5G every day."

Standalone 5G removes the need for an underlying 4G LTE network and 4G core, so 5G can reach its true potential. In other words, it's "pure 5G", and T-Mobile was the first in the world to deliver it nationwide nearly two years ago.

The addition of VoNR takes T-Mobile's standalone 5G network to the next level by enabling it to carry voice calls, keeping customers seamlessly connected to 5G. In the near-term, customers connected to VoNR will notice slightly faster call set-up times, meaning less delay between the time they dial a number and when the phone starts ringing. But VoNR is not just about a better calling experience. Most importantly, VoNR brings T-Mobile one step closer to truly unleashing its standalone 5G network because it enables advanced capabilities like network slicing that rely on a continuous connection to a 5G core.

Is it worthwhile to check with LF ONAP Enterprise Task Force about AT&T's current plans, interest and/or availability of resources of VoLTE to be involved with Voice over NR?

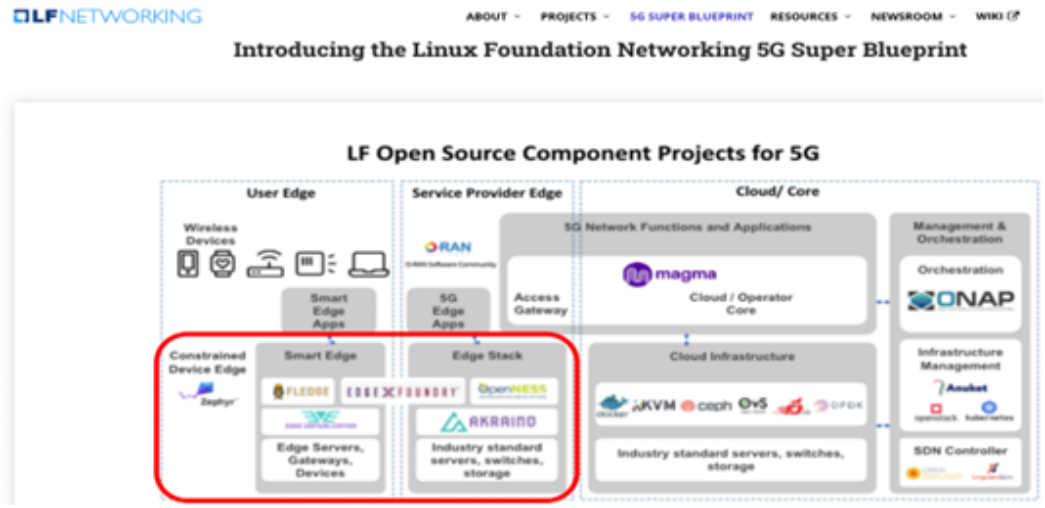


Question-Remark 2: Is there available a ***written input from*** the circled in red circle in the below LFN 5G Super Blueprint infographic participating LF Mmeber Projects:

1. *How are the respective Projects "related"/connected" to "5G" in terms of providing information about the respective 3GPP Releases, Architecture /Applications/ Services Requirements/Security/Management etc, that they support/implement?*

The **Purpose** with this "inventory requirement" and outcome, could be twofold:

First, to verify the respective project relevance with 3GPP Specifications for 5G and therein prevent/avoid ground for undermining not only credibility of the 5G Super Blueprint as a Project pursuing 5G evolvement within LFN, but also, in case that the respective Projects are not involved with 5G, to contain and prevent the risk from that "disconnection/lack of relevance" to cause any mistrust and doubt to be spread/shift/spill over to the rest of the Member Projects participating at the 5G Super Blueprint Project as shown on the infographic below.



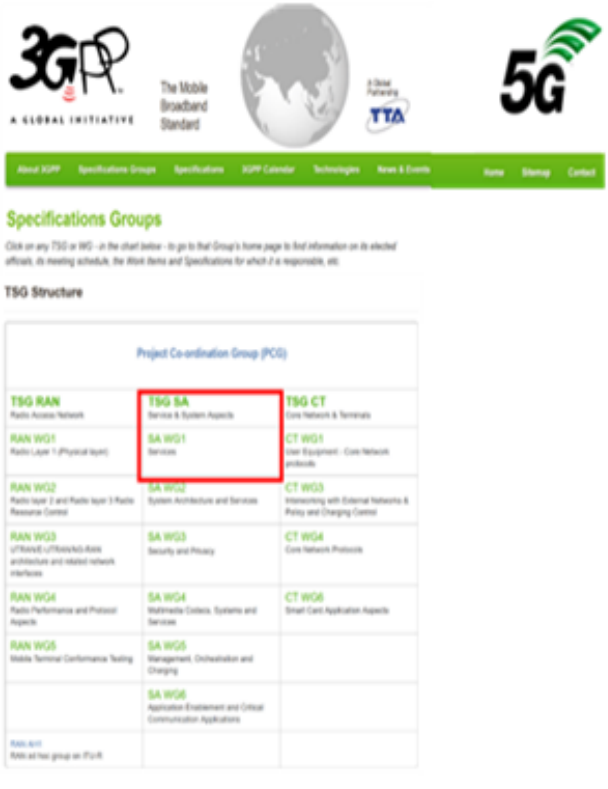
Second, when being able to identify with which 3GPP Release Specifications, related to 5G and/or 5G Advanced (TRs), the respective LF Member Project (s) is/are involved with, the LFN 5G Super Blueprint prepare a plan about assist with providing information about the relevant specifications evolvement within 3GPP (as e.g. related to 3GPP "5G Advanced" Release) and in this way assist and contribute to the respective Member project Roadmap evolvement related to 5G & 5G Advanced.

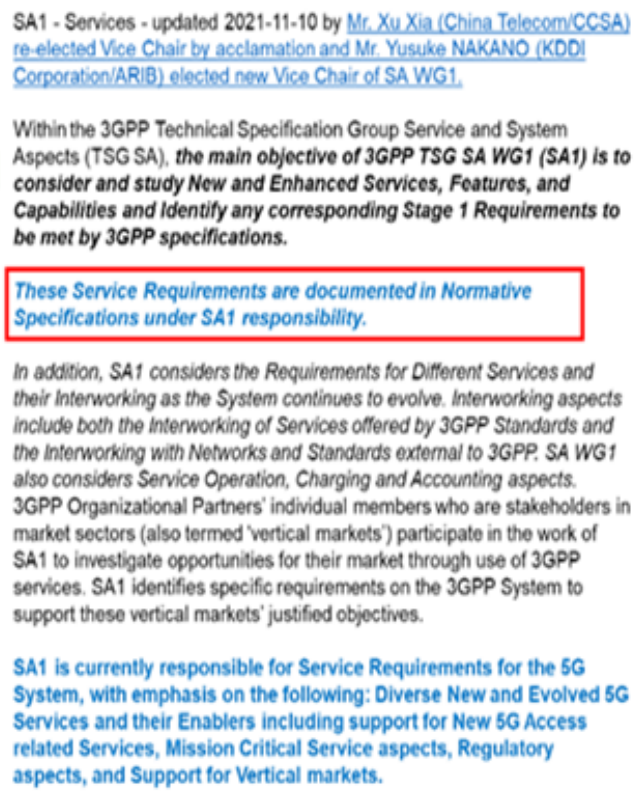
Example info attached below on 3GPP decision in 2019 for "full wired Ethernet replacement (with Wireless connections) in factories and latest evolvement by 2021 related to that (as part of the 3GPP Specifications for Verticals and FoF (Factory of the Future).

Question - Remark 3 on the 5G Super Blueprint intended discission on identifying "relevant" UCs for 5G".

The 5G Super Blueprint Project had initiated discussion on "identifying the relevant UCs for 5G.

Question 1: Is the purpose/objective of the 5G Super Blueprint Project to identify, then outline, categorize and group the Member Projects selection of specified by 3GPP WG SA1 Service Requirements and afterwards to assist with information on the specifications from the rest of the 3GPP WGs (SA2-SA6) as well as 3GPP Specifications for TN and RAN specifications? (please see attached below info on 3GPP WGs SA1- SA6)? or





Question 2: Is the 5G Super Blueprint intends to discuss the "preliminary/tentative" interest in potential 5G Use Cases (UCs) and once the respective UCs are identified to undertake within the 5G Super Blueprint build-up of small groups that can undertake the Functional role, similar to 3GPP WGs SA1-to-SA6 to identify e.g. Requirements, Architecture, Security, Multimedia, Management, Applications and apply the Open Source SW Dev Ops Business Model (please see below) to promote the use of Cloud-native Mechanisms? (please see further below on the difference between use of SW Telco Business Model ("aaP") and Open Source DevOps Business Model "SaaS" (SW as a Service")):

With respect to the above, it might be worthwhile to take into account the following:

Difference in Business Models between Telcos in terms of "aaP" (as a Product implementing 3GPP specifications) and Open Source SW DevOps Business Model "SaaS" (SW as a Service). Below attached an infographic on that:

5G Architecture for Hybrid and Multi-Cloud Environments

A Unified Approach to Developing, Deploying & Operating 5G Services - including 5G RAN, Core, OSS & BSS Applications – in Public & Private Cloud Environments is a Key Enabler for Communication Service Providers (CSPs) to successfully adopt a Hybrid & Multi-Cloud Strategy. The "main benefits" are "Faster Time to Market" (TTM) & "Lower Total Cost of Ownership" (TCO).

As *Figure 2* illustrates, this approach could *lead to a lot of Diversity & Heterogeneity in the Deployment Targets for Network SW* Vendors. Designing & Operating an application that is capable of utilizing such a Diverse Set of HCP Managed Services also creates *Several Challenges for Network SW* Vendors & CSPs alike.

The Main Challenges to overcome in a Hybrid & Multi-Cloud Strategy are:

1. *Maintaining Portability;*
2. *Controlling the Total Cost of Ownership (TCO);*
3. *Optimizing Productivity & Time to Market (TTM).*

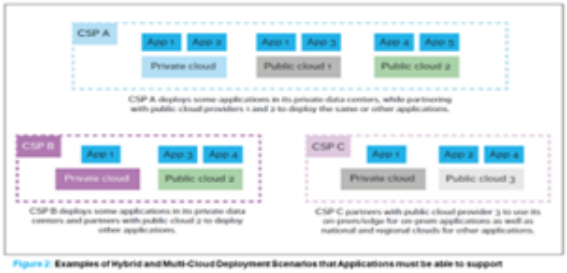
DevOps – *a Set of Practices* that brings together *SW Development & IT operations* with the **Goal of Shortening the Development & Delivery Cycle & increasing SW Quality - is often thought of and discussed in the Context of a Single Company or Organization.** The Company usually Develops the SW, Operates it & Provides it as a Service to Customers, according to the SW-as-a-Service (SaaS) Model.

Within this context, it is easier to have **Full Control over the Entire Flow**, including **Full Knowledge of the Target Deployment Environment.** In the **Telecom Space**, by contrast, we typically follow the **"as-a-Product (aaP) Business model**, in which **SW is developed by Network SW Vendors** such as Ericsson (Nokia, Huawei, ZTE) & provided to Communication Service Providers (CSPs) that Deploy & Operate it within their Network. This **Business Model requires the consideration of additional aspects**.

As shown in *Figure 1*, **the most important contrasts between the Standard DevOps SaaS Model & the Telecom aaP Model** are the **Multiplicity of Deployment Environments & the fact the Network SW Vendor Development Teams cannot know upfront exactly what the Target Environment looks like**.

Although a SaaS Company is likely to Deploy & Manage its SW on two (2) or more different Cloud Environments, this is inevitable within Telco, as each CSP creates &/or selects its own Cloud infrastructure.

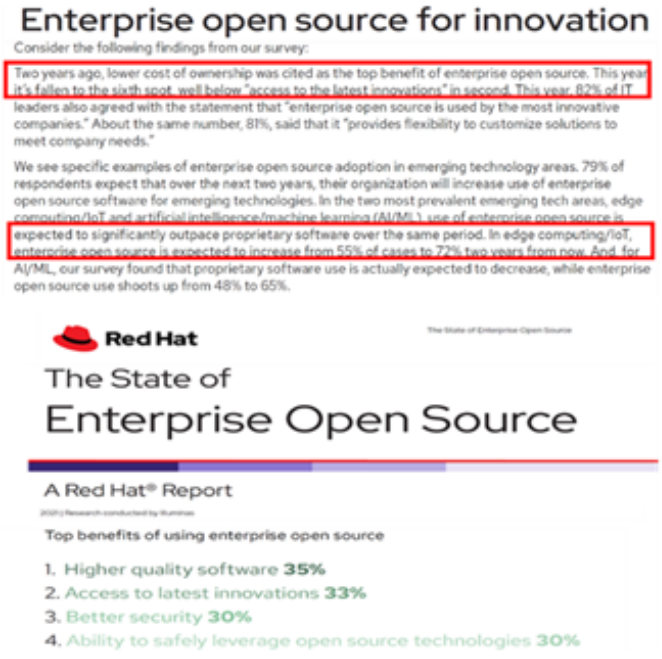
Figure 1: The DevOps and (Telecom) aaP Business



Diminishing importance of using Open Source SW as a mean to lower TCO (Total Cost of Ownership).

The above made remark about the use of Open Source SW use as a mean to lower TCO needs to be updated. It might be worthwhile to get aware about the change and shift in the priority related to use of Open Source SW in this context.

Please see below from Red Hat's reports from 2021 and 2022 about the outcome related to use of Open Source SW as a mean to lower TCO.



Question – Remark: With respect to the 3GPP EDGEAPP Architecture (evolvement) related to enabling Applications on "the Edge", aligned evolvement with ETSI MEC Architecture for supply and commissioning of E2E Applications, as foreseen by GSMA OPG (please see further information on that below), would 5G Super Blueprint undertake any activity?

Please see below some general information on the subject:

The OPG believes that, for Operators to develop a Federated Edge Computing Platform such as the OP, *Requirements must be enforceable in Contracts by a Published Set of Standards.*

To this end, the OPG proposes selecting ETSI ISG MEC and 3GPP to provide a Standard Reference for an Edge Service End to End (E2E) definition.

We note that 3GPP EDGEAPP Architecture and ETSI ISG MEC Architecture could complement each other in a way that is acceptable to OPG.

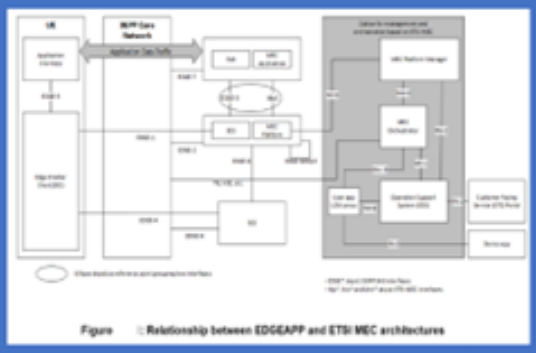


Figure : Relationship between EDGEAPP and ETSI MEC architectures

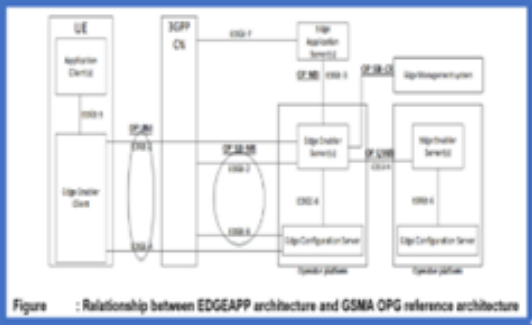


Figure : Relationship between EDGEAPP architecture and GSMA OPG reference architecture

43

Enhanced EDGEAPP Architecture for enabling Edge Applications E2E

As illustrated in the Figs 1 & 2 below related to Edge Services in e.g. V2X and AR/VR Use Cases (as part of the ongoing discussions for enhancements in EDGEAPP Architecture foreseen in "5G Advanced" release (Ref. 3GPP, 5G Advanced, March 2022), an **Edge Service or an EAS** *(Edge Application Server, e.g. V2X Server)* can be provided via different **EDNs** (*Edge Data Networks*) deployed by different **EES** (*Edge Enabling Server*) **ECSPs** (*Edge Computing Service Providers*).

Each ECSP may not have the required Infrastructure to install the EAS in every EDN due to Financial, Regulatory and Operation constraints.

A User can access the same Edge Service served by different **EASs,** which are registered to different **EESs** (*Edge Enabling Servers*) and deployed by different **ECSPs**, which have a Service Level Agreement (**SLA**) to share Edge Services.

These **ECSPs** can deploy **EESs** to serve different Mobile Networks (**PLMNs**) or different Coverages of the same **Mobile Network (PLMN)**.

Furthermore, the Target EDN (T-EDN) and Source EDN (S-EDN) are operated by different **ECSP** which may not have **SLA** with each other, then the **S-EES** may not be able to communicate with a **T-EES** (discovered from **ECS**) due to lack of **SLA**.

Unfortunately, in **Rel.17** this failure may only be detect upon **EDGE-9** interaction.

Fig 1.: EAS (Edge Application Server) deployed by different ECSPs (Edge Computing Service Providers)

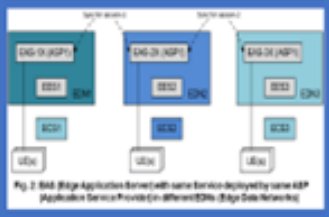


Fig. 2: EAS (Edge Application Server) with same Service deployed by same ASP (Application Service Provider) in different EDNs (Edge Data Networks)

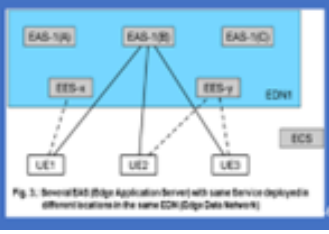


Fig. 3.: Several EAS (Edge Application Server) with same Service deployed in different locations in the same EDN (Edge Data Network)

6

Enablement of Service APIs exposed by EAS

EAS Service API enablement in the EDGEAPP Architecture for KI#2 specific requirements in this clause, the Solution #X: *"EAS Service API enablement using CAPIF" is further specified.*

This solution is based on Architectural requirements to support ***EAS Service APIs*** in the **EDGEAPP Rel. 18 (5G Advanced) Architecture.**

1) EAS Capability Exposure

- ***The Application Layer Architecture shall support Exposure of EAS's Capabilities to the other EASs.***

2) EAS Service API publication

- The Application Layer Architecture shall support EAS to publish its exposing Service API information to EES
- The application layer architecture shall support EAS to update the published EAS Service API information on the EES.

3) EAS Service API discovery

- ***The Application Layer Architecture shall provide Mechanisms for an EAS to discover Available EAS Service APIs.***

4) Subscription service

- The Application Layer Architecture shall provide Subscription and Notification Mechanisms enabling an EAS to receive changes in dynamic information of EAS Service APIs from an EES.
- The application layer architecture shall provide subscription and notification mechanisms enabling an EAS to receive changes in availability of EAS Service APIs from an EES.

Deployment and Evolution options of EDGEAPP and ETSI MEC Platforms (Informative):

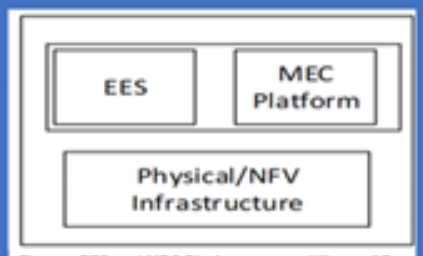


Figure.: EES and MEC Platform as two different AFs on a single Physical/NFV Infrastructure

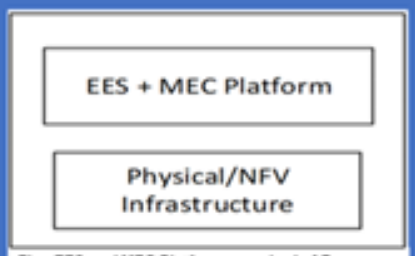


Fig.: EES and MEC Platform as a single AF on a single NFV Infrastructure

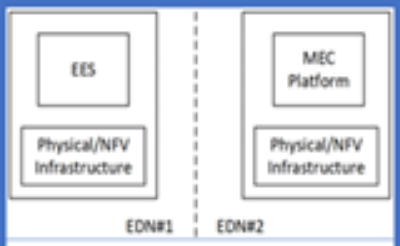


Fig.: EES and MEC Platform as two different AFs on two different EDNs

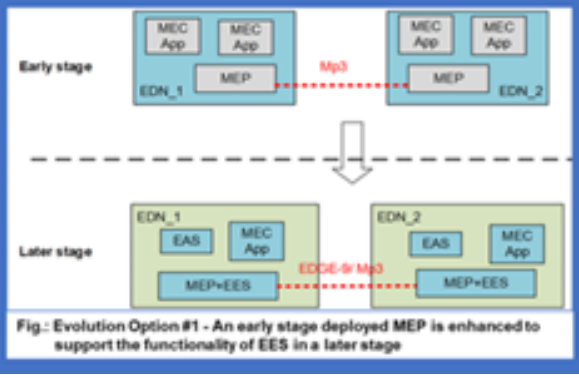


Fig.: Evolution Option #1 - An early stage deployed MEP is enhanced to support the functionality of EES in a later stage

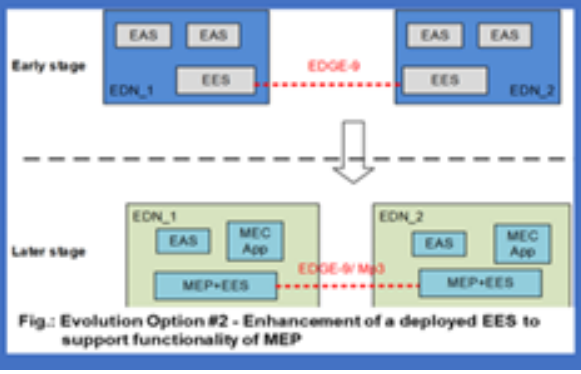


Fig.: Evolution Option #2 - Enhancement of a deployed EES to support functionality of MEP

Dependent on the Use Case (UC), the **EEL** (*Edge Enabling Layer*) may apply different additional criteria to determine this **common EAS.**

E.g., it could be desirable to determine the **EAS** so that the **Latency** for all the **ACs** in the session is approximately the same or that the **Latency** for a specific **AC** is minimized.

There is further utilization of Capabilities related to **EEL** (*Edge Enabling Layer*) and **AEF** (*API Exposing Function*) and **5G NDL** (*Network Data Layer*) specified and stored **NF's Application Context** (*ACR/ACT, Application Context Relocation/Application Context Transfer*) for assuring Service Continuity between **S-EAS** and **T-EAS**) as well as *Data Traffic split rendering* between **EASs** and **CAS** (*Cloud Application Server*).

Table: KPI Table for Additional High Data Rate and Low Latency Service

Use Cases	Characteristic parameter (KPI)			Influence quantity		
	Max allowed end-to-end latency	Service bit rate: user-experienced data rate	Reliability	# of UEs	UE Speed	Service Area (note 2)
Cloud/Edge/Split Rendering (note 1)	5 ms (i.e. UL+DL between UE and the interface to data network) (note 4)	0,1 to [1] Gbit/s supporting visual content (e.g. VR based or high definition video) with 4K, 8K resolution and up to120 frames per second content	99,99 % in uplink and 99,9 % in downlink (note 4)	-	Stationary or Pedestrian	Countrywide
Gaming or Interactive Data Exchanging (note 3)	10ms (note 4)	0,1 to [1] Gbit/s supporting visual content (e.g. VR based or high definition video) with 4K, 8K resolution and up to120 frames per second content	99,99 % (note 4)	s [10]	Stationary or Pedestrian	20 m x 10 m in one vehicle (up to 120 km/h) and in one train (up to 500 km/h)
Consumption of VR content via tethered VR headset (note 6)	[5 to 10] ms (note 5)	0,1 to [10] Gbit/s (note 5)	[99,99 %]	-	Stationary or Pedestrian	-

NOTE 1: Unless otherwise specified, all communication via wireless link is between UEs and network node (UE to network node and/or network node to UE) rather than direct wireless links (UE to UE).
NOTE 2: Length x width (x height).
NOTE 3: Communication includes direct wireless links (UE to UE).
NOTE 4: Latency and reliability KPIs can vary based on specific use case/architecture, e.g. for cloud/edge/split rendering, and may be represented by a range of values.
NOTE 5: The decoding capability in the VR headset and the encoding/decoding complexity/time of the stream will set the required bit rate and latency over the direct wireless link between the tethered VR headset and its connected UE, bit rate from 100 Mbit/s to [10] Gbit/s and latency from 5 ms to 10 ms.
NOTE 6: The performance requirement is valid for the direct wireless link between the tethered VR headset and its connected UE.

EASDF - Edge Application Server Discovery Function

Functional Description

The Edge Application Server Discovery Function (EASDF) includes one (1) or more of the following Functionalities:

- Registering to NRF for EASDF Discovery and Selection.
- Handling the **DNS messages** according to the **instruction from the SMF**, including:
  - Receiving DNS message handling Rules and/or **BaselineDNSPattern from the SMF.**
  - Exchanging **DNS messages from the UE**.
  - **Forwarding DNS messages to C-DNS or L-DNS for DNS Query.**
  - Adding **EDNS Client Subnet (ECS) option into DNS Query for an FQDN**
  - Reporting to the SMF the information related to the received DNS messages.
  - Buffering/Discarding **DNS response messages from the UE or DNS Server**.
- Terminates the **DNS security**, if used.

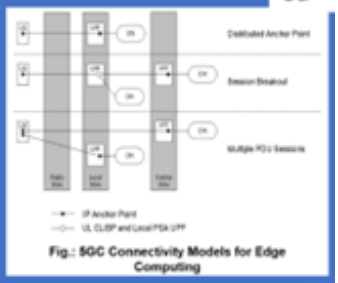


Fig.: 5GC Connectivity Models for Edge Computing

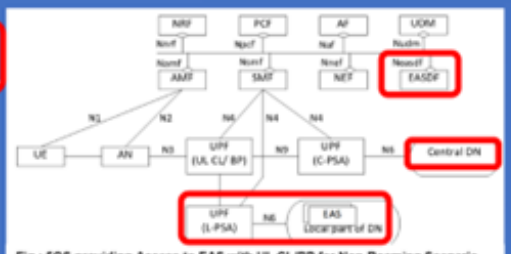


Fig.: 5GS providing Access to EAS with UL CL/BP for Non-Roaming Scenario

The **EASDF has direct User Plane Connectivity** (i.e. without any NAT) with the **PSA UPF over N6** for the transmission of **DNS signalling** exchanged with the UE. **The deployment of a NAT between EASDF and PSA UPF is not supported**.

Multiple EASDF instances may be deployed within a PLMN.

The interactions between 5GC NF(s) and the EASDF take place within a PLMN.

5G ACT & ACR (Application Context Transfer & Application Context relocation

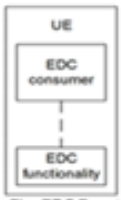


Fig. EDC Funct. in the UE

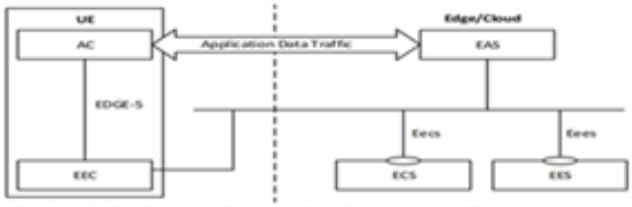


Fig. Archit. For Enabling Edge Applic. - Service-based Represent

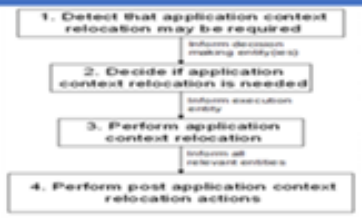


Fig. High level overview of ACR (Application Context Relocation)

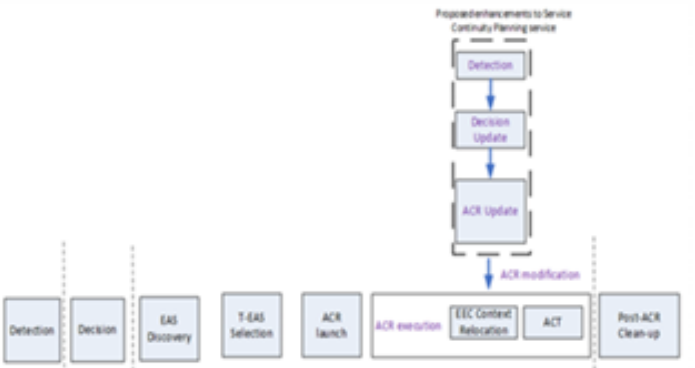


Fig. High-level of proposed ACR update in Service Continuity Planning Enhancement

Fig. ACR initiated by the EEC & AC

Table : ACR request

Information element	Status	Description
Requestor Identifier	M	Unique identifier of the requestor (i.e. EECID or EASID).
Security credentials	M	Security credentials resulting from a successful authorization for the edge computing service.
UE identifier (NOTE 4)	O	The identifier of the UE (i.e. GPSI).
ACR type	M	Indicates whether the ACR is for normal ACR or service continuity planning
Predicted/Expected UE location or EAS service area (NOTE 5)	O	The predicted/expected location information of the UE. The UE location is described in clause 7.3.2 or the predicted/expected EAS service area as described in clause 7.3.3.3
ACR action (NOTE 3)	M	Indicates the ACR action (ACR initiation or ACR determination)
ACR initiation data (NOTE 2)	O	ACR initiation IEs to be included in an ACR request message when ACR action indicates it is ACR initiation request.
> T-EAS Endpoint	M	Endpoint information (e.g. URI, FQDN, IP 3-tuple) of the T-EAS.
> DNAI of the T-EAS	O	DNAI information associated with the T-EAS.
> N6 Traffic Routing requirements	O	The N6 traffic routing information and/or routing profile ID corresponding to the T-EAS DNAI.
> EAS notification indication	M	Indicates whether to notify the EAS about the need of ACR.
> S-EAS endpoint (NOTE 1)	O	Endpoint information of the S-EAS
ACR determination data (NOTE 2)	O	ACR determination IEs to be included in an ACR request message when ACR action indicates it is ACR determination request.
> S-EAS endpoint	M	Endpoint information of the S-EAS

NOTE 1: This IE shall be present if the EAS notification indication indicates that the EAS needs to be informed.
NOTE 2: Either ACR initiation or ACR determination shall be included corresponding to the ACR action.
NOTE 3: This IE shall indicate ACR determination if the request originates from the S-EAS.
NOTE 4: This IE shall be present if the request originates from the EEC.
NOTE 5: This IE shall be present if the ACR type indicates the ACR procedure is for service continuity planning.

Table : Session with QoS create request

Information element	Status	Description
EASID	M	The identifier of the EAS
Security credentials	M	Security credentials of the EAS
UE IP address (NOTE 1)	O	The UE IP address.
UE ID (NOTE 1)	O	The identifier of the UE (i.e. GPSI)
UE Group ID (NOTE 1)	O	Identifies a group of UEs (i.e. internal group ID or external group ID)
IP flow description	M	The IP flow description for the application traffic.
Requested QoS reference (NOTE 2)	O	Refers to pre-defined QoS information for the data session between AC and EAS (NOTE 3).
...	...	...

Table : Mapping of solutions to key issues

	KI # 1	KI # 2	KI # 3	KI # 4	KI # 5	KI # 6	KI # 7	KI # 8	KI # 9	KI # 10	KI # 11	KI # 12	KI # 13	KI # 14	KI # 15	KI # 16	KI # 17	KI # 18	KI # 19	KI # 20
Sol #1	x																			
Sol #2							x													
Sol #4						x				x										
Sol #5						x				x										
Sol #6			x																	
Sol #7			x																	
Sol #8		x																		
Sol #9														x						
Sol #10															x					
Sol #11		x			x															
Sol #12			x									x								
Sol #13						x				x										
Sol #14										x										
Sol #15								x						x						
Sol #16												x								
Sol #17														x						
Sol #18															x					
Sol #19																			x	
Sol #20	x																			
...																				