SA6 – past, present and future

From LTE-Advanced to 5G and from MCPTT to Edge enablement

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(InterDigital Communications)

Chair 3GPP TSG SA WG6 - Application Enablement and Critical Communication Applications

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Outline

- History and Evolution
- Critical Communication Applications
- Service Frameworks
- Enablers for Vertical Applications
- Way Forward

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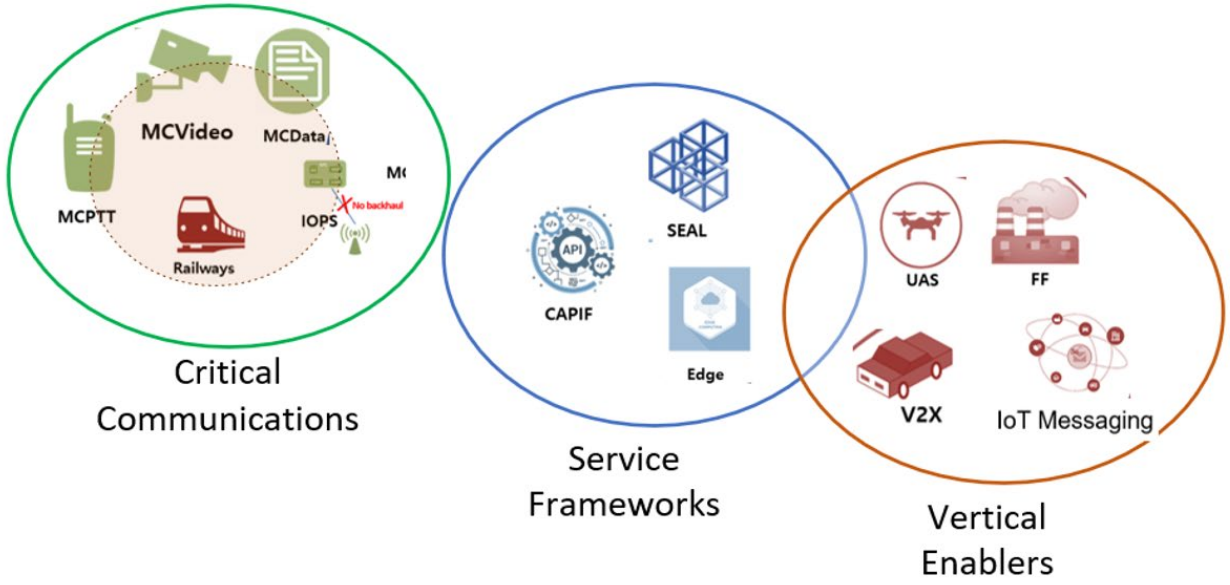
History and Evolution

- 2014 – 3GPP established a Working Group (WG) dedicated to stage 2 requirements for Mission Critical (MC) Applications - WG SA6 is the home for global Mission Critical Services Standards
  - Over 600 user requirements with inputs from TETRA, P25 and mobile broadband industry
- First global MCPTT standard published in 2016 (Rel-13)
- WG SA6 Terms of Reference expanded beyond Mission Critical in 2017

- Current Terms of Reference:
  - Critical communication applications (Mission Critical services for public safety, railways)
  - Service frameworks (Common API Framework, Service Enabler Architecture Layer, Edge Application enablement, Application Data Analytics Enablement, etc.)
  - Enablers for vertical applications (automotive, drones, etc.)



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3GPP SA6 - Industry Involvement

- Below list is not exhaustive

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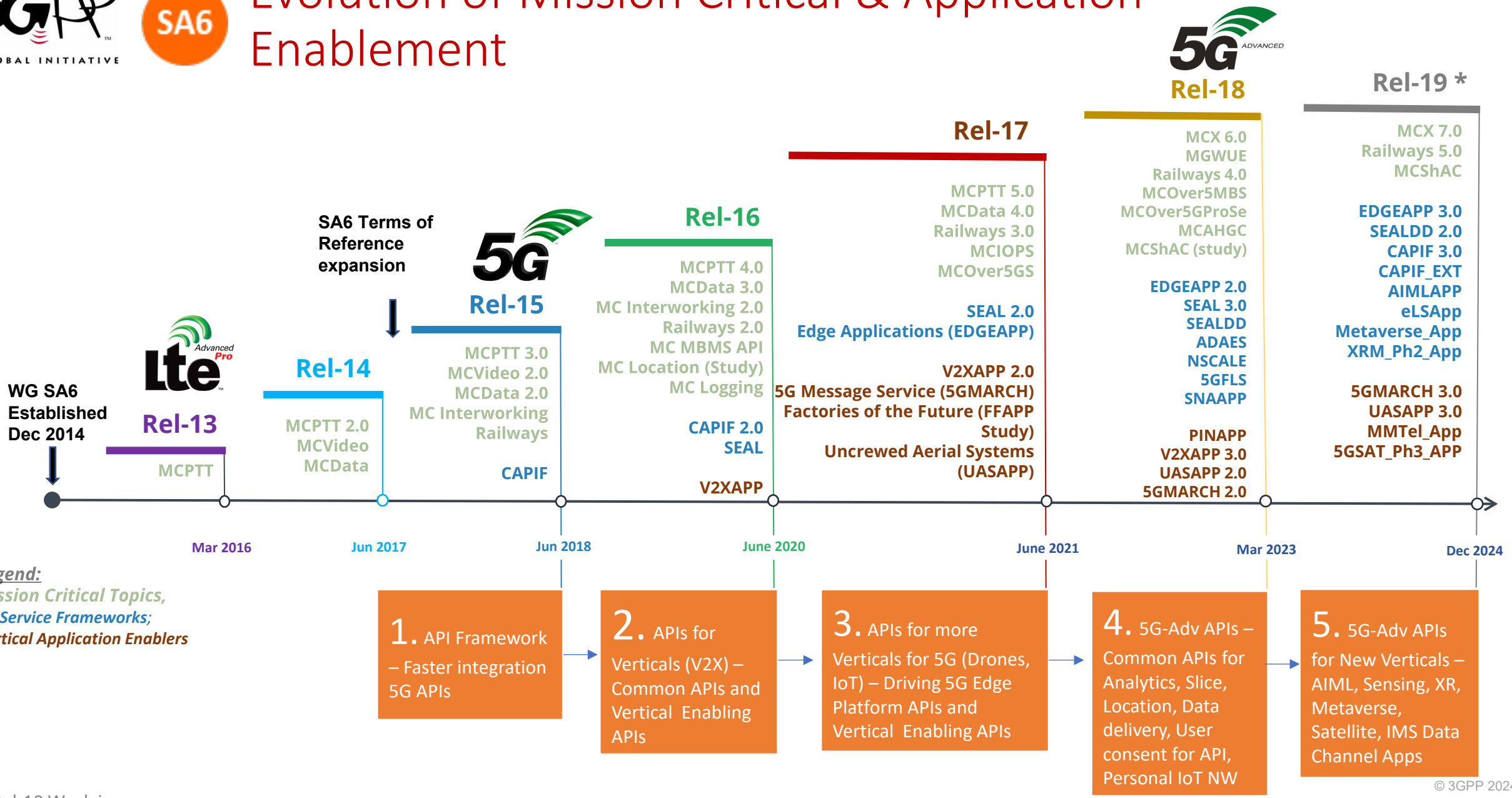
Evolution of Mission Critical & Application Enablement



Legend:
Mission Critical Topics,
5G Service Frameworks;
Vertical Application Enablers

* Rel-19 Work in progress

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Critical Communication Applications 1/3

Rel-12

- **Proximity Services**
- **Group Communication service enablers of LTE**

Proximity Services
Device to Device Communication, UE to network relay
Group Communication
Unicast to efficiently transmit to a group arranged by an application.

Rel-13

- **MC Push to Talk**
- **Proximity Services enh.**

User authentication and service authorization, security; configuration; de-/affiliation; group calls on/off network; simultaneous sessions; dynamic group management; floor control on/off network; resource management; bearer control; location configuration, reporting and triggering;

Rel-14

- **Enhanced MC Push to Talk**
- **MC Video**
- **MC Data**
- **MC Common Architecture**

MC Common Architecture
For all users common authentication and service authorization; security; configuration; de-/affiliation; dynamic group management; identity management;
MC Video: Common and Private & Group Video Call, Transmission control
MC Data: Common & Short Data Service; File Distribution; Transmission control; Disposition Notification.

Rel-15

- **MC Push To Talk/Video/Data enh.**
- **IWF – Interworking with LMR systems**
- **MCCI - MC system migration and interconnection**
- **MBMS for MC communication**
- **Railways** (MONASTERY)

MCCI: migration and Interconnection:
Migration to another MC system. Take part in communications with users in another MC system (interconnection).
Railways enable the support of Functional alias(es) and the use of the multi-talker feature

Enh. = Enhancements

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Critical Communication Applications 2/3

Rel-16

- MCPTT / MC Data enh.
- Interworking with LMR – enh.
- MCCI enh.
- Railways enh.
- MBMS API for MCS
- MC Location (study)
- Discreet listening and logging (study)

MBMS API for MCS:
Definition of ref model where the MBMS APIs are applied to support multicast mission critical services and UE APIs providing the access to MBMS mission critical services for mission critical applications

Rel-17

- MCPTT / MC Data enh.
- Railways enh.
- MCIOPS
- MCOver5GS
- MCOver5MBS (study)
- MC Location (study cont.)

MCIOPS:
For the case of a backhaul failure or a nomadic EPS deployment, MC services shall be supported based on the availability of an Isolated E-UTRAN operations for Public Safety (IOPS) system.

Rel-18

- MCX enh.
- MGWUE
- Railways enh. (IRail)
- MCOver5MBS
- MCOver5GProSe
- MCAHGC
- MCShAC (study)

MC gateway UE :
enables MC service access for MC users using non-3GPP devices (which may or may not have the ability to host MC clients)
MCAHGC:
an ad-hoc group is set up spontaneously based on a list of users or some criteria (e.g. location). An ad-hoc group is 'disposable' i.e. when communications end the ad-hoc group ceases to exist.
Railways:
Interconnection and Migration Aspects

Rel-19 *

- MCX enh.
- Railways enh.
- MCShAC
- Generic IOPS

* Work in progress

Enh. = Enhancements

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Critical Communication Applications 3/3

Rel-19 (work in progress)

- **MCX enhancements**
  - MCX service logging, recording and replay
    - Introduction of a Recording Server (functional entity) that is able to log the metadata and record the media of MCX group communications and private communications and store them into a mass storage. The recording server is also able to retrieve the recordings when requested by an authorized user.
  - MC discreet listening
    - Means for an authorized user to be able to follow the communications (PTT, Data, Video) of a target user or group, without the target(s) being aware
  - Expand (MCData) message storage to MCPTT and MCVideo
  - Several enhancements to existing features
- **Railways enhancements**
  - Interworking with GSM-R (MCPTT, MCData)
  - (Support for) separation of signaling and media paths within an MC system
  - Several enhancements to existing features
- **Sharing of administrative configuration management information (MCShAC)**
  - Examples of sharing of administrative configuration management information is sharing of MC service user profile, group management configuration, system parameters, etc. between interconnected MC systems
- **Generic IOPS (Isolated Operation for Public Safety)**
  - Specify generic support for a mobile system without backhaul – currently only applicable to LTE
- **MC Services over non-terrestrial networks - NTN (as part of 5GSAT study/work item)**
  - How participants of a group communication can be informed about reduced KPIs due to participant(s) being connected via satellite

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Service Frameworks

- Common API Framework (CAPIF)
- Service Enabler Architecture Layer (SEAL)
- Edge Application Enablement
- Application Data Analytics Enablement
- Network Slice Capability Exposure
- AIML Enablement *
- Application support for Metaverse services *
- Application support for XR *

- … See annex for details

* Rel-19, work in progress

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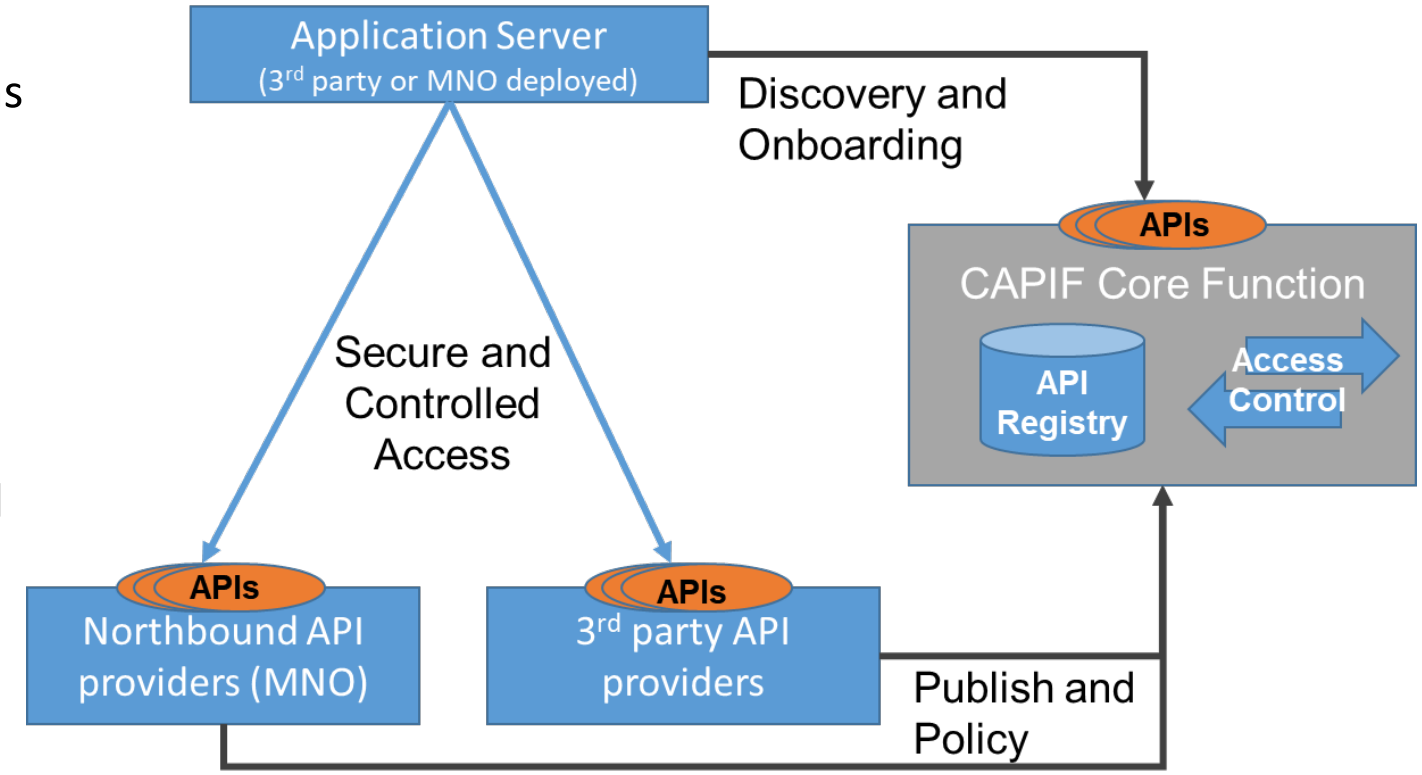
Common API Framework (CAPIF)

- Purpose and Scope
  - Enables a unified Northbound API framework across 3GPP network functions & ensures that there is a single and harmonized approach for API development.
  - CAPIF provides a framework to host network and service APIs of PLMN and from 3rd party domain.
  - Work has been successfully delivered and integrated with Northbound APIs developed by 3GPP SA2 Working Group (SCEF/NEF) and 3GPP SA4 (xMB).
- Key features (see annex)



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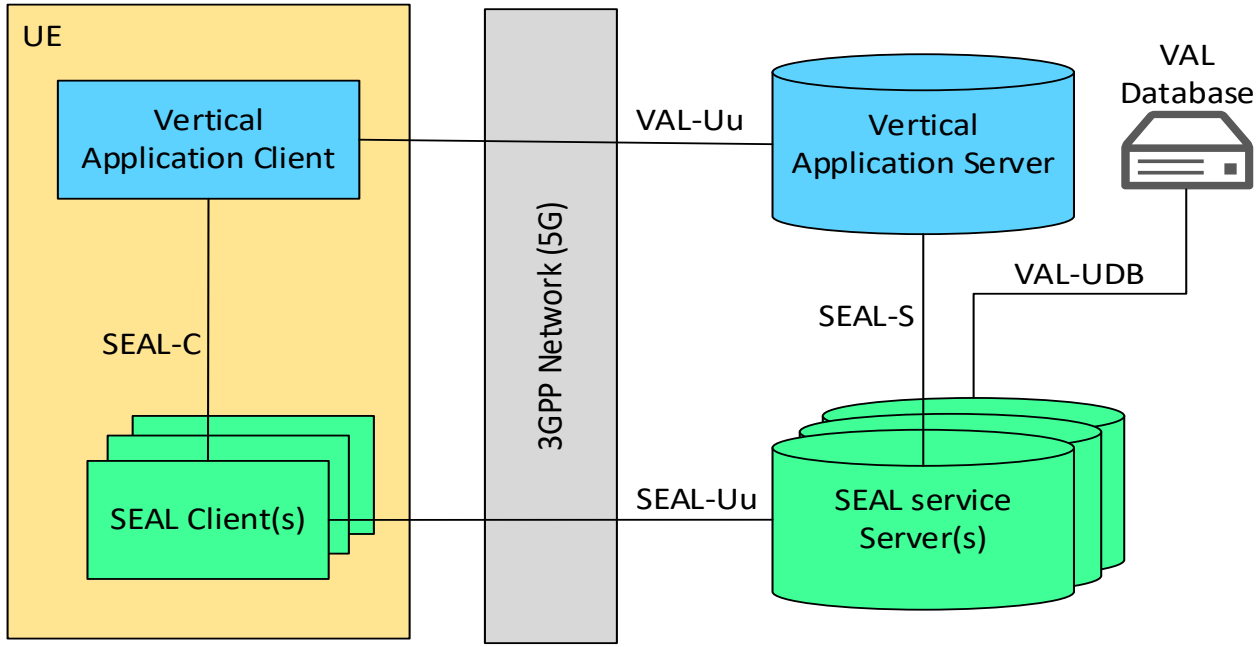
Service Enabler Architecture Layer (SEAL)

- Purpose and Scope
  - 3GPP networks witnessing increasing demand from various vertical industries
  - It is apparent that vertical applications will require similar core capabilities in a timely manner
  - 3GPP specifies application-enabling services that can be reused across vertical applications (e.g. V2X applications)
  - SEAL also specifies the northbound APIs (compliant with CAPIF) - to enable flexible integration with vertical applications.
- Key features (see annex)



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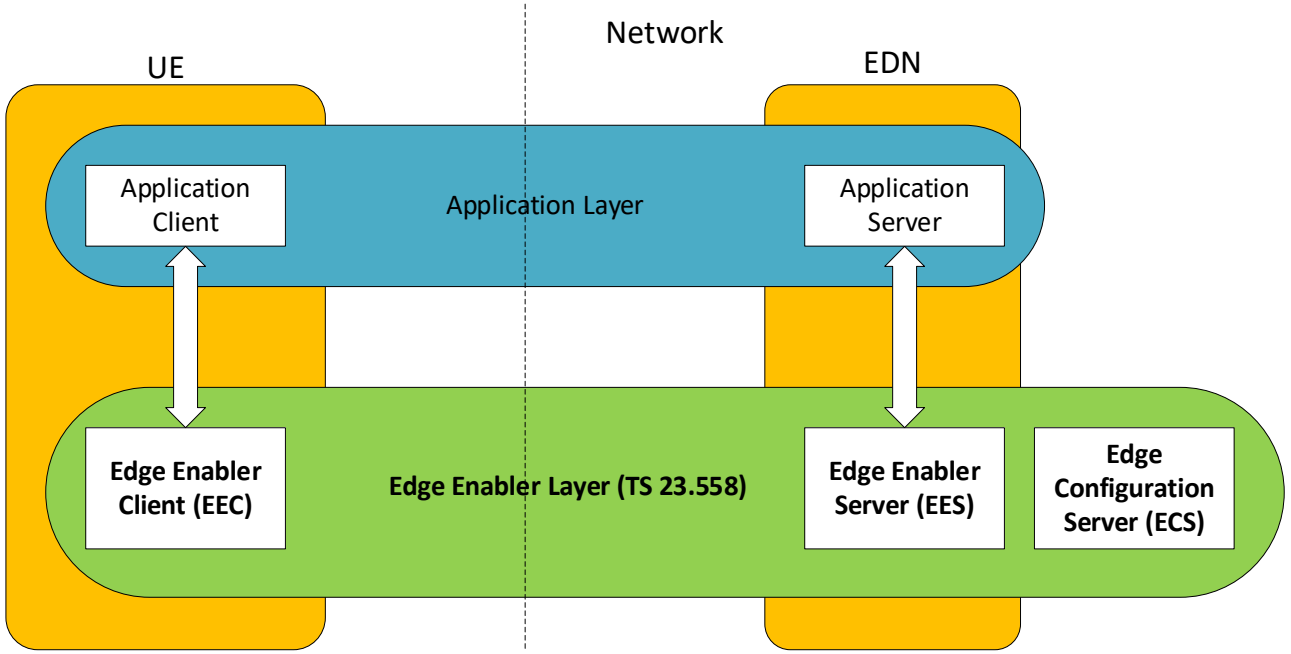
Edge Application Enablement

- Purpose and Scope
  - Edge Application Enablement in 3GPP helps achieve the performance goals of Verticals, providing **low latency and massive broadband**.
  - The feature aims to define a **supporting application layer**, which enables the deployment of applications on the edge of 3GPP networks, with **minimal impacts to edge-based applications** on the UE.
- Key Features (see annex)



EDGEAPP Architecture - Simplified

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Enablers for Vertical Applications

- Application support for Vehicle-to-Everything (V2X) services
  - V2X application enabler layer that is necessary to ensure efficient use and deployment of V2X services over 3GPP systems.
- Application support for Uncrewed Aerial System (UAS)
  - Identify the application aspects to support UAS that are necessary to ensure efficient use and deployment of UAS services and applications over 3GPP systems.
- Application architecture for MSGin5G
  - MSGin5G Service provides messaging communication capability in 5GS especially for Massive Internet of Things (MIoT).
- Application support for Personal IoT Networks
- Application enablement for satellite access enabled 5G services *
- Application enablement for Multimedia Telephony *

- … See annex for more details

* Rel-19, work in progress

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Way Forward

- 3GPP has established a mature set of mission critical standards & New and enhanced mission critical features are still being specified
- Expanded scope of SA6 enabled standardized support for vertical industries
- Support for application development frameworks are in place & specified
- 3GPPs superior connectivity continue to be a major asset for all applications
- Industry feedback is critical to robust standards
- New mechanisms & features take time to deploy
- Participation is essential: **Join 3GPP / SA6!**

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Thank you!

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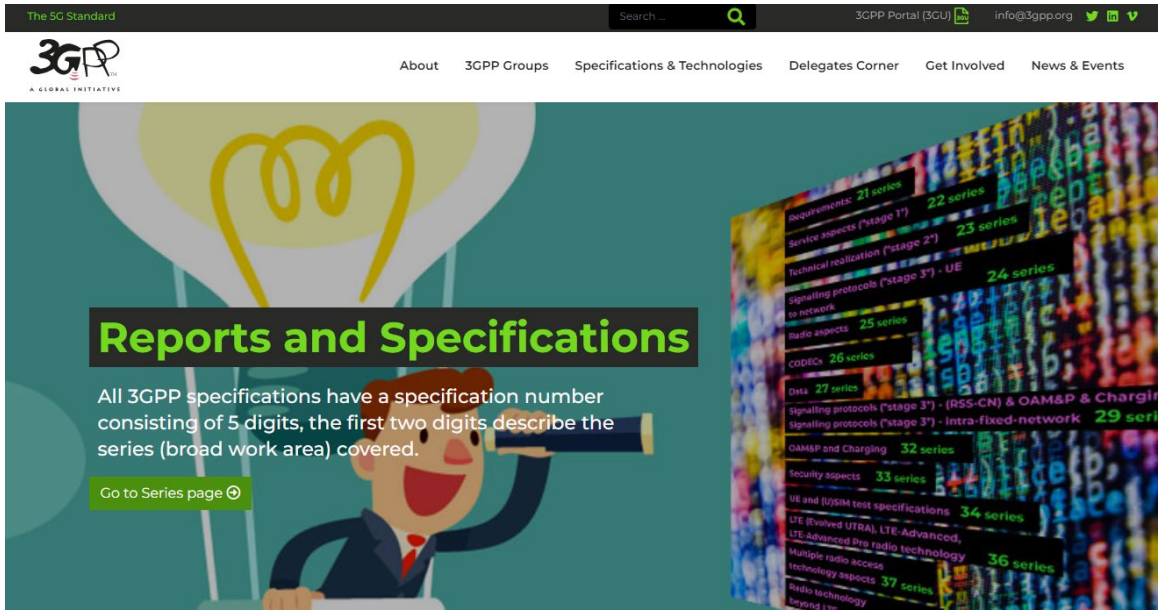

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Annex

Extra slides

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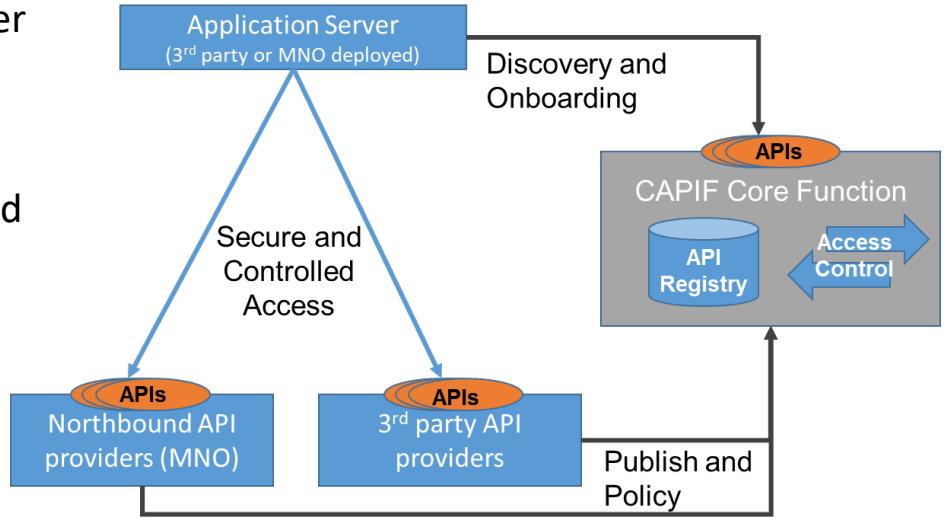
Common API Framework (CAPIF)

Purpose and Scope

- The Common API Framework (CAPIF) was developed to enable a unified Northbound API framework across 3GPP network functions, and to ensure that there is a single and harmonized approach for API development (Refer to 3GPP TS 23.222, TS 33.122 and TS 29.222).
- CAPIF provides a framework to host network and service APIs of PLMN and from 3rd party domain.
- This work has been successfully delivered and integrated with Northbound APIs developed by 3GPP SA2 Working Group (SCEF/NEF) and 3GPP SA4 (xMB).



Key features

- On-boarding/off-boarding API invoker
- Register/de-register APIs and API provider domains
- Discovery of APIs
- CAPIF events Subscription/Notification
- Entity Authentication/Authorization
- Enables secure communication
- API Access control, Auditing, Logging, Charging
- Support for 3rd party domains i.e. to allow 3rd party API providers to leverage the CAPIF framework
- Support for interconnection between two CAPIF providers
- Federation of CAPIF functions to support distributed deployments
- Dynamic routing of service API invocation
- Resource owner-aware northbound API invocation.

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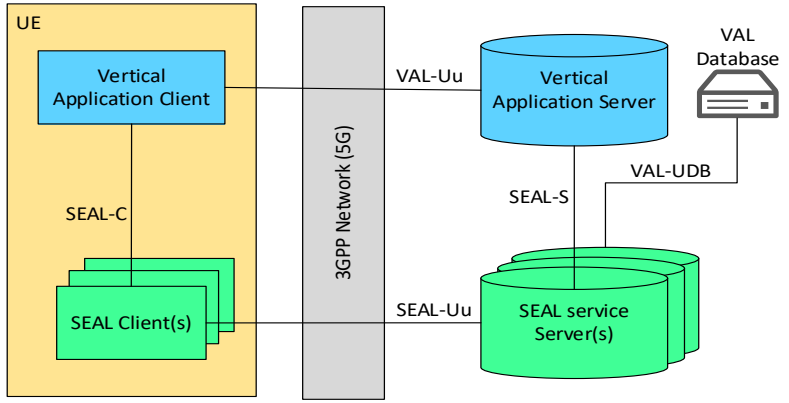
Service Enabler Architecture Layer (SEAL)

- Purpose and Scope
  - 3GPP networks witnessing increasing demand from various vertical industries
  - It is apparent that vertical applications will require similar core capabilities in a timely manner
  - 3GPP TS 23.434 specifies application-enabling services that can be reused across vertical applications (e.g. V2X applications)
  - SEAL also specifies the northbound APIs (compliant with CAPIF) - to enable flexible integration with vertical applications.
- Key features
  - SEAL common core services:
    - Group management
    - Configuration management
    - Location management
    - Identity management
    - Key management
    - Network resource management
    - Notification Management
  - SEAL extension services:
    - Application data analytics
    - Data delivery
    - Network slice capability enablement



  - SEAL services are supported both in on-network and off-network
  - Interconnection between SEAL servers to support distributed SEAL server deployments
  - Inter-service communication between SEAL servers (e.g. location based group management)

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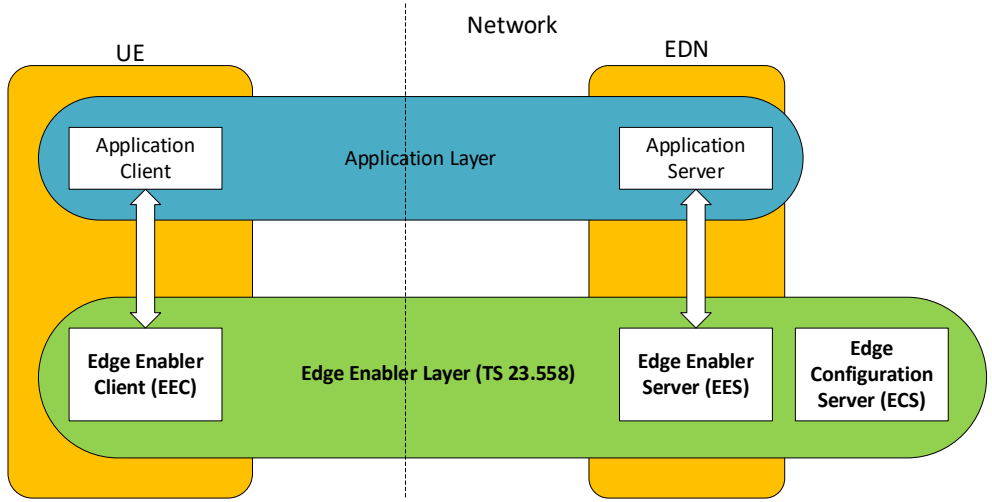
Edge Application Enablement

Purpose and Scope

- Edge Application Enablement in 3GPP helps achieve the performance goals of Verticals, providing **low latency and massive broadband**.
- The feature aims to define a **supporting application layer**, which enables the deployment of applications on the edge of 3GPP networks, with **minimal impacts to edge-based applications** on the UE.



EDGEAPP Architecture (TS 23.558) - Simplified

Key Features

- ECS Discovery and Service Provisioning
  - Enabling a UE with an Edge Enabler Client to find and connect to available Edge Data Networks (EDNs).
- Registration
  - Enabling context initialization and sharing of basic information about the EEC with the EES.
- EAS Discovery
  - Enabling a UE with an EEC to discover Edge AS using filters and policies, including Server capabilities, operation characteristics, service area, schedule, support for service continuity
- Service Continuity
  - To discover EAS in the target area based on the expected new location
  - To trigger application context transfer from source EAS (from where the AC is currently taking service) to target EAS (from where the AC will take service in new location).
- Roaming and Federation
  - To enable roaming UE(s) to access local EASs
  - To enables operators to make their assets and capabilities available across multiple networks.
- Capability exposure
  - Expose capabilities of Edge Enabler Layer and/or 3GPP core network, such as location service, QoS, and AF traffic influence.
- And more… Edge Node Sharing (ENS), Common EAS, Dynamic Instantiation, etc.

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Application Data Analytics Enablement

- Purpose and Scope
  - To provide simplified end to end performance analytics to 3rd party / verticals based on consuming / combining data from the 5G core, OAM, and UE.
  - Such analytics helps identifying or predict edge/cloud server load and performance issues as well as per application session possible performance downgrades, and allows the vertical applications to pro-actively adapt its behaviour or request additional resources from the network to ensure meeting the service KPIs when using the 5GS for the communication.
- Key features
  - Vertical user leveraging the Application layer Analytics capabilities for predicting end to end performance and selecting the optimal VAL server
    - ADAES is a SEAL functionality for providing end to end performance analytics (e.g. VAL server performance)
    - ADAES may consume SEALDD (or A-DCCF) services to retrieve TCP connections statistics for a certain service area and time
    - ADAES locally stores the statistics in A-ADRF
    - ADAES provides the VAL server predictions to the UEs

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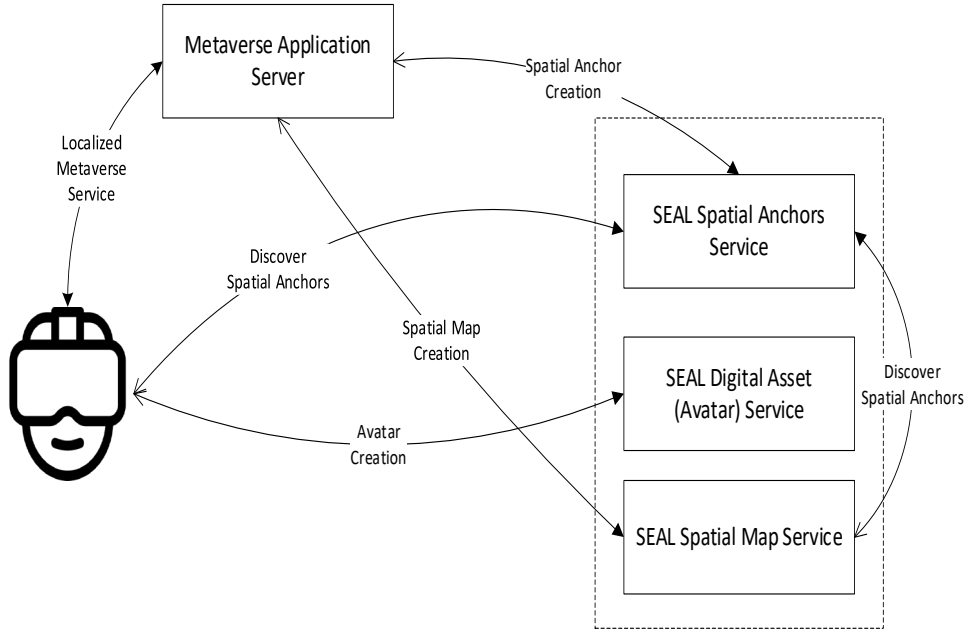
Application support for Metaverse Services

- Purpose and Scope
  - A metaverse is an interactive and immersive system to enhance user experience using XR media, including haptic media.
  - To provide localized metaverse service experience to the user – a user interaction and information provided by a service to a user that is relevant to the physical location in which the user accesses the service.



- Key Features
  - All new services are defined as new SEAL servers.
  - Spatial anchors service
    - It is an association between a location in space (three dimensions) and service information that can be used to identify and access services, e.g., information to access AR media content
  - Spatial mapping and localization service
    - Spatial mapping is constructing or updating a map of an unknown location, localization is tracking an object to identify its location and orientation over time
    - A service offered by a mobile network operator that gathers sensor data in order to create and maintain a Spatial Map that can be used to offer customers Spatial Localization Service.
  - Digital Asset management
    - Digitally stored information that is uniquely identifiable and associated with user
  - Existing PINAPP architecture is enhanced
    - To discovering nearby PIN elements (for the purpose related to application specific task, e.g. to offload the work)

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Application support for Vehicle-to-Everything (V2X) services

- Purpose and Scope
  - V2X application enabler layer that is necessary to ensure efficient use and deployment of V2X services over 3GPP systems.
- Key features
  - V2X service discovery
  - Application level location tracking
  - V2X message delivery
  - File distribution
  - Provisioning 3GPP system info
  - Network monitoring
  - V2X application resource management
  - Dynamic group management (platooning support)
  - V2X service continuity

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Appliction support for Uncrewed Aerial System (UAS)

- Purpose and Scope
  - Identify the application aspects to support UAS that are necessary to ensure efficient use and deployment of UAS services and applications over 3GPP systems.
- Key features
  - UAE layer registration
  - Communications between UAVs within a geographical area
  - Real-Time UAV Connection Status Monitoring and Location reporting
  - C2 Communication mode selection and switching
  - Change of USS during flight
  - UAE layer support for DAA services and applications
  - Support of real time UAV flight path monitoring assistance

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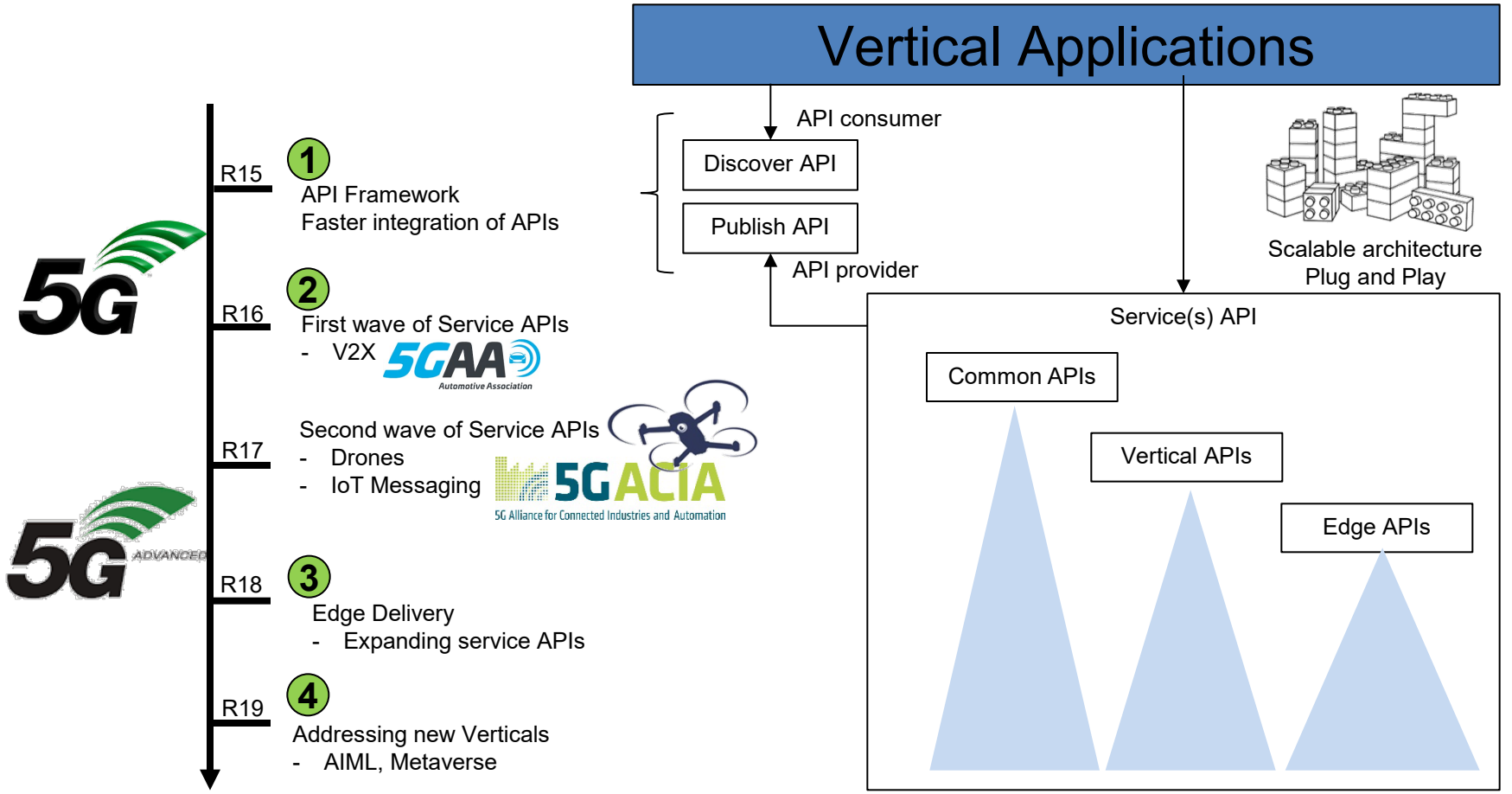
Application Enablement – APIs



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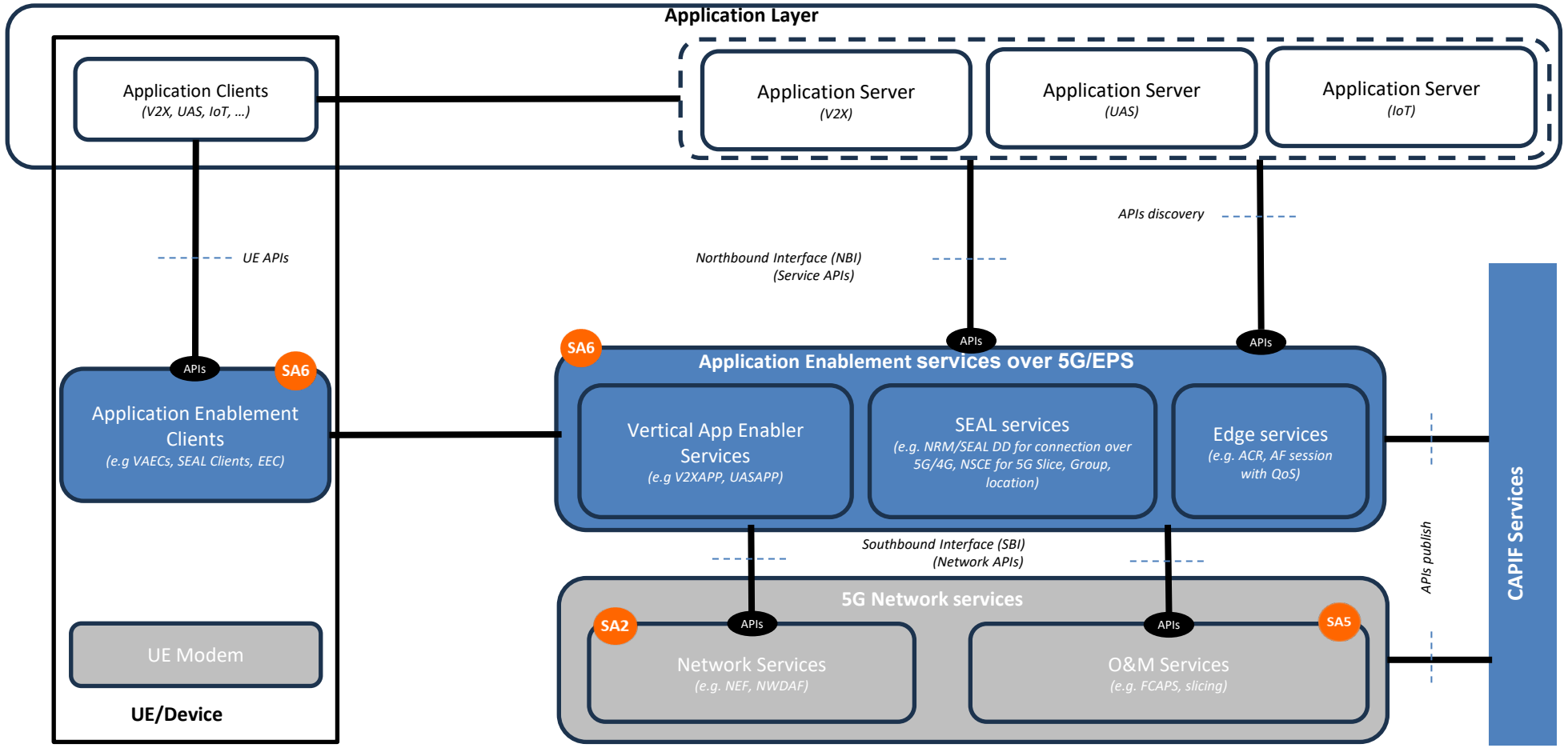
Service Frameworks - Application Enablement Architecture



VAEC – Vertical Application Enabler Client; EEC – Edge Enabler Client; SEAL – Service Enabler Architecture Layer; CAPIF – Common API Framework; NRM – Network Resource Management; DD – Data Delivery; ACR – Application Context Relocation; NSCE – Network Slice Capability Enablement

- **Providing reusable application layer components for 5G vertical applications and Application Platform centric API(s), ensuring good QoE performance by utilizing the underlying 5G network exposed APIs**

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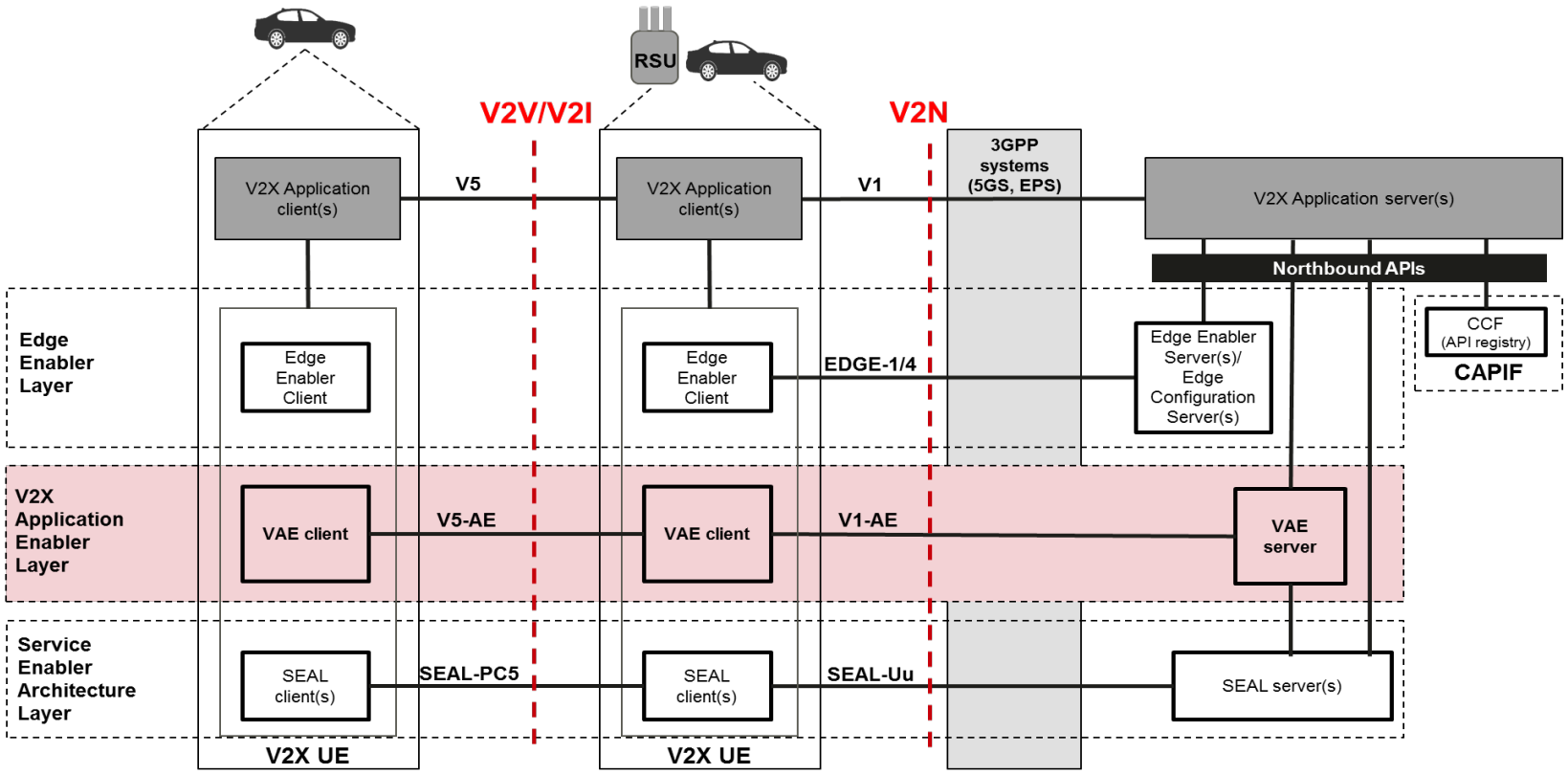
SA6 capabilites and features - example



- Generic Capabilities (Pre-established sessions, Dynamic groups) to support V2X applications e.g. Tele-operated service, Platooning
- V2X messages delivery capabilities (uplink, geo area, group)
- Value added capabilities - Network monitoring, Service requirement (QoS) negotiation, Application resource adaptation, File distribution (MBMS)
- Service Continuity support
- VAE Server APIs
- Multi PLMN and Multi-V2X service provider support

Benefits

- Abstract and Simplify usage of 3GPP network systems (EPS and 5GS)
- Support simplification of V2X application development with value -added capabilities
- API based integration with V2X Application layer

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