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Network Exposure Function simulator: Opening Up 5G network to Verticals

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Introduction - 5G Programmability (Rel.17/3GPP SA6)

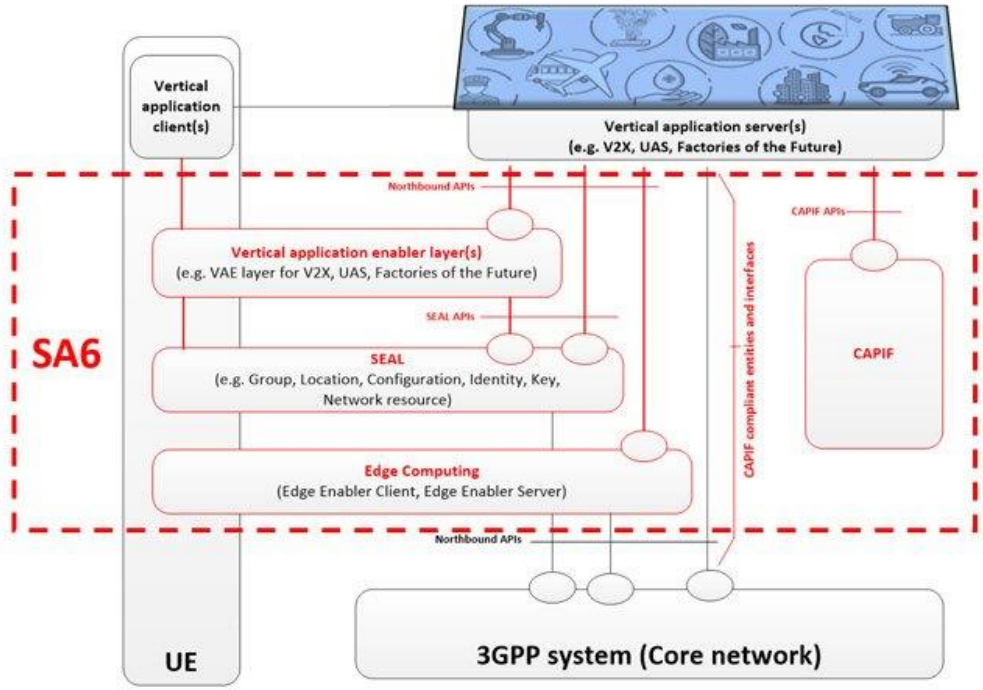
5G programmability promises new generation applications that deliver an unprecedented user experience

5G Core network is realizing the “openness” feature by securely exposing standard APIs

3GPP decided that the service exposure should be delivered through RESTful APIs (i.e., SCEF, NEF)

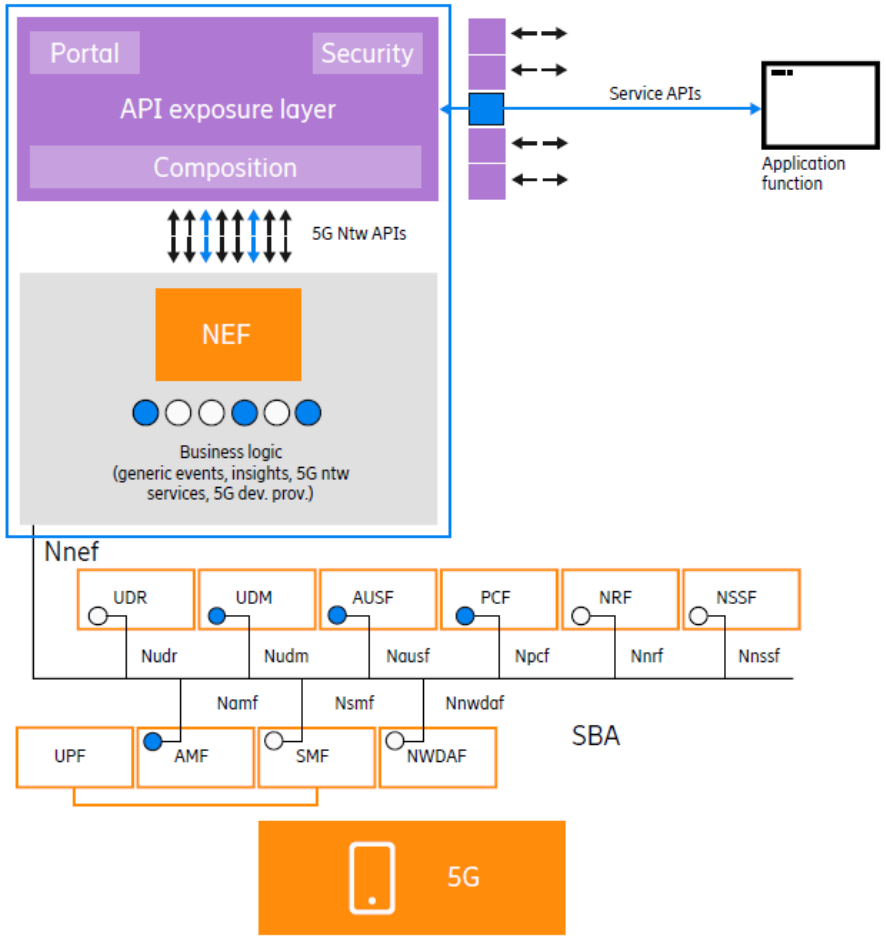
Service Based Architecture enables the internal communication of 5GC’s network functions through APIs.

Bi-directional communication between vertical apps and the 5GC



Enabling a new programmable ecosystem for 3rd parties

3GPP Network Exposure Function



NEF creates and exposes standard APIs (i.e., OpenAPI 3.0.0) to the internal and/or external developer ecosystem, which will result in new use cases.

Exposure enables:

- hiding the complexity of the underlying network
- secure/controlled access of the network to external AFs
- monetization of the network capabilities
- For example, NEFs provide the capability to convert technical features from PCF and AMF into business use cases. The NEF can expose network APIs required by specific AFs.

NEFSim - Architecture

Realization / The need

Key features

Exposure Layer (NEF APIs)

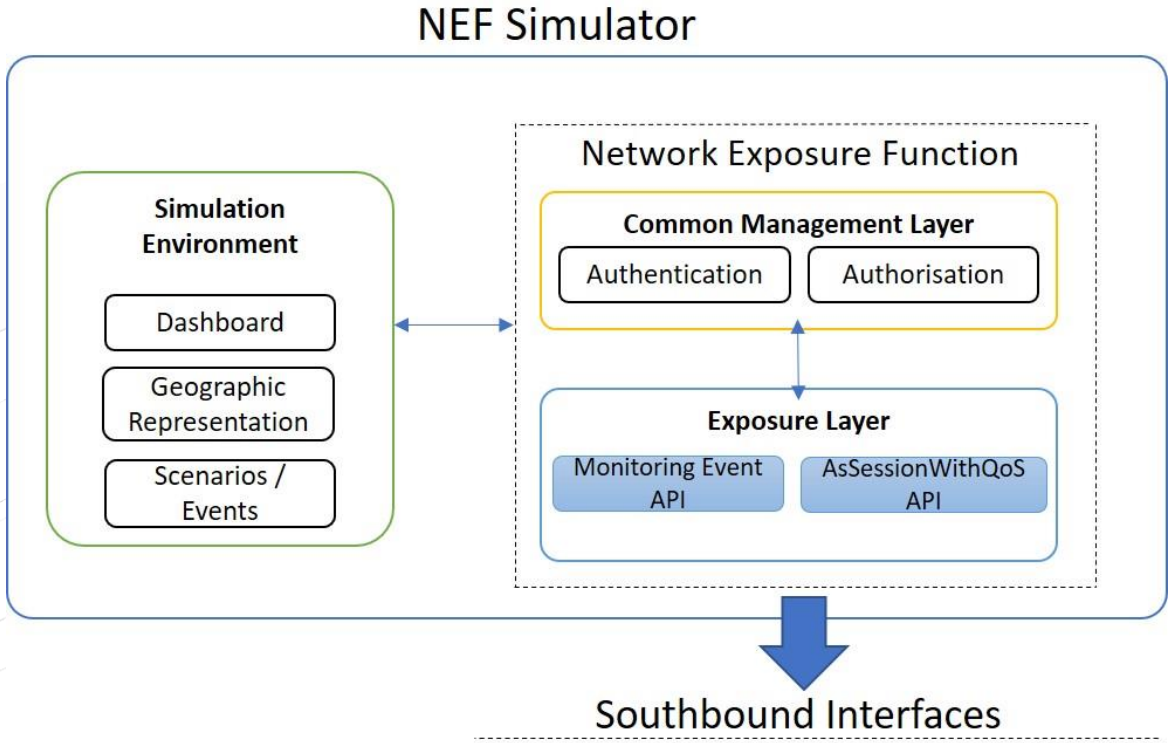
- Monitoring Event API
- AsSessionWithQoS API

Simulation Environment

- Creation of simulated evets to tackle the challenge of communicating with the southbound interfaces / APIs
- Developers are able to define their own scenarios

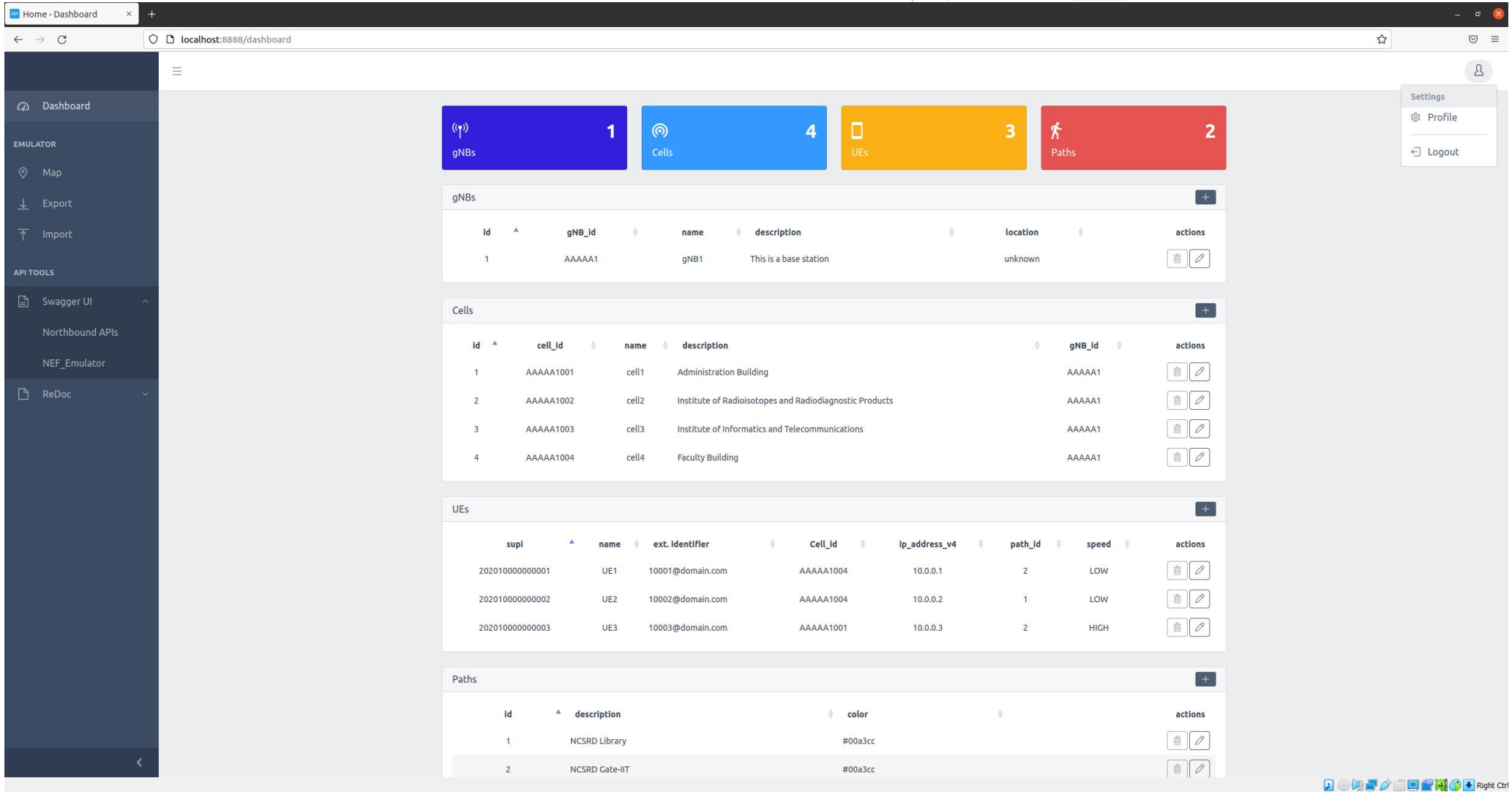
Common Management Layer

- Token-based user authentication / authorization
- Create an account
- Authorization step based on OAuth2.0



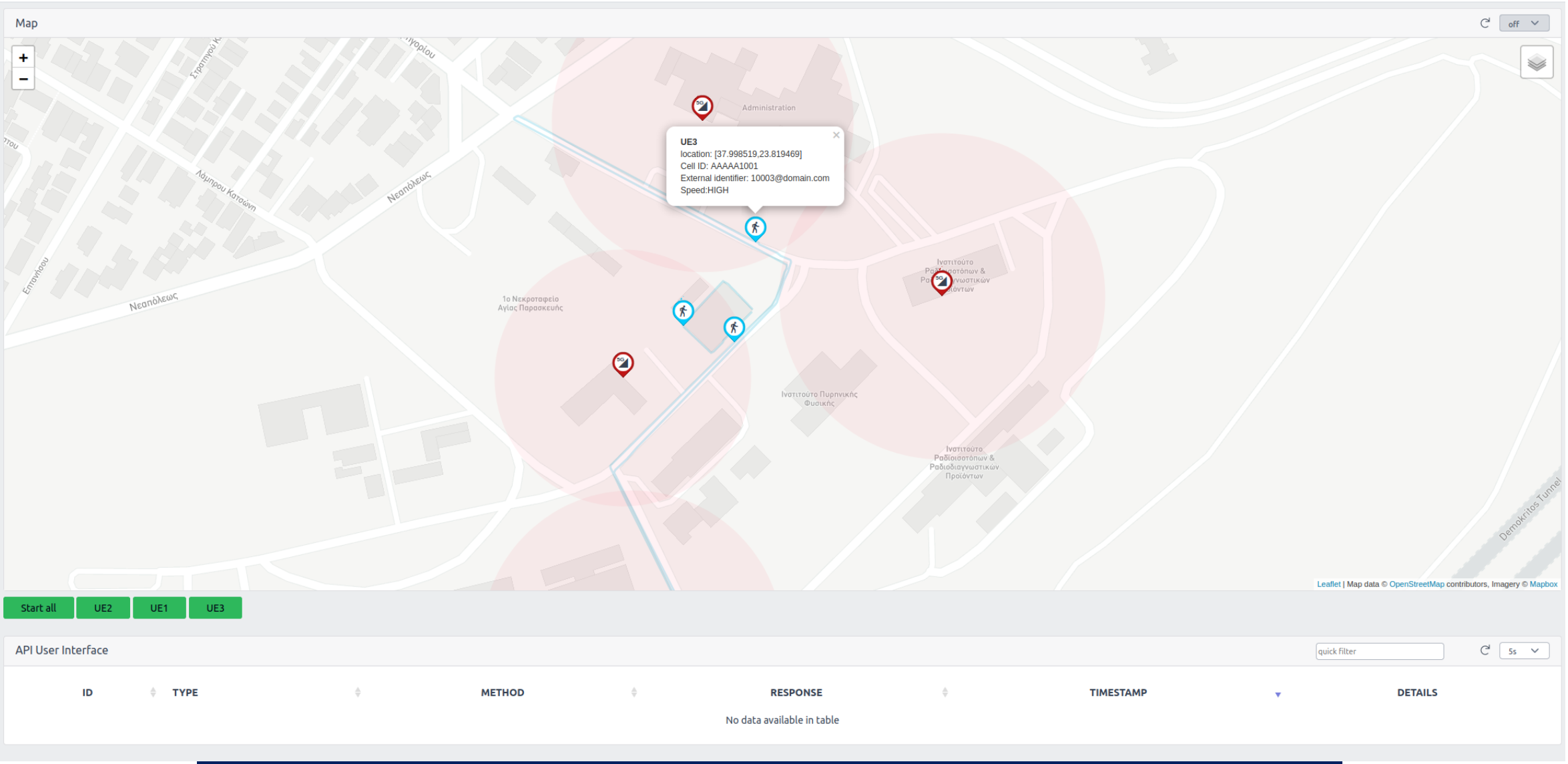
GitHub Link: https://github.com/EVOLVED-5G/NEF_emulator

NEFSim - Architecture



Dashboard

NEFSim - Architecture



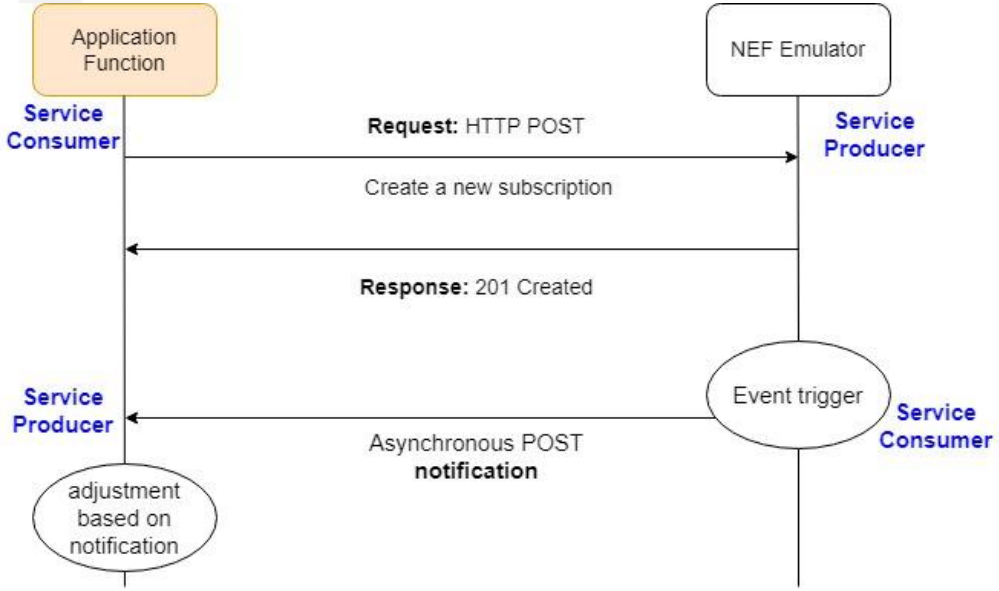
Map – Geographic Representation

Security Aspects of NEF

Requirements	Provisioning	Supported (NEF Emulator)
Integrity protection, **replay protection** and **confidentiality protection** for communication between the NEF and Application Function shall be supported	**TLS** shall be used to provide integrity protection, replay protection and confidentiality protection for the interface between the NEF and the Application Function. The support of TLS is mandatory (Protection of the NEF – AF interface)	✓
Mutual authentication between the NEF and Application Function shall be supported.	Mutual authentication based on **client** and **server certificates** shall be performed between the NEF and AF using **TLS**	✓
The NEF shall be able to determine whether the Application Function is **authorized** to interact with the relevant Network Functions	The NEF shall authorize the requests from Application Function using **OAuth-based authorization** mechanism, the specific authorization mechanisms shall follow the provisions given in RFC 6749	✓
SUPI shall not be sent outside the 3GPP operator domain by NEF.	The 3GPP system stores within the subscription data the association between the GPSI and the corresponding SUPI. The GPSI is either an MSISDN or an **External Identifier**	✓
Internal 5G Core information such as DNN, S-NSSAI etc., shall not be sent outside the 3GPP operator domain.	Out of scope	Out of scope

NEFSim – Adaptation of 3GPP's Northbound APIs

- Service consumer and service producer as client and server
- Subscribe/Notify: besides direct HTTP request – response, callback notifications are supported
- MonitoringEvent API supports location reporting, loss of connectivity and UE reachability events
- AsSessionWithQoS API to ensure better service experience and avoid service interruption



NEFSim – AsSessionWithQoS API Example

- Applications can request QoS from a set of standardized values (i.e., 5QI) for better service experience
- Applications can use the results (notifications) to adjust the application's behavior
- In order to receive notifications from the NEF the 5QI needs to be a GBR value
- The notification can be either periodic (e.g., every 2 sec) or event trigger
- The event that triggers the notification occurs on handover

5QI	Resource Type	Default Priority Level	Packet delay Budget	Packet Error Rate	Default Maximum Data Burst Volume	Default Averaging Window	Example Service
1	GBR	20	100ms	10e-2	N/A	2000ms	Conversational Voice
2	GBR	40	150ms	10e-3	N/A	2000ms	Conversational Video (Live Streaming)
8	Non-GBR	80	300ms	10e-6	N/A	N/A	TCP-Based (best efford) *Usually the default value
9	Non-GBR	90	300ms	10e-6	N/A	N/A	TCP-Based (best efford)
82	Delay-Critical-GBR	19	10ms	10e-4	255bytes	2000ms	Discrete Automation

NEFSim – AsSessionWithQoS API Example

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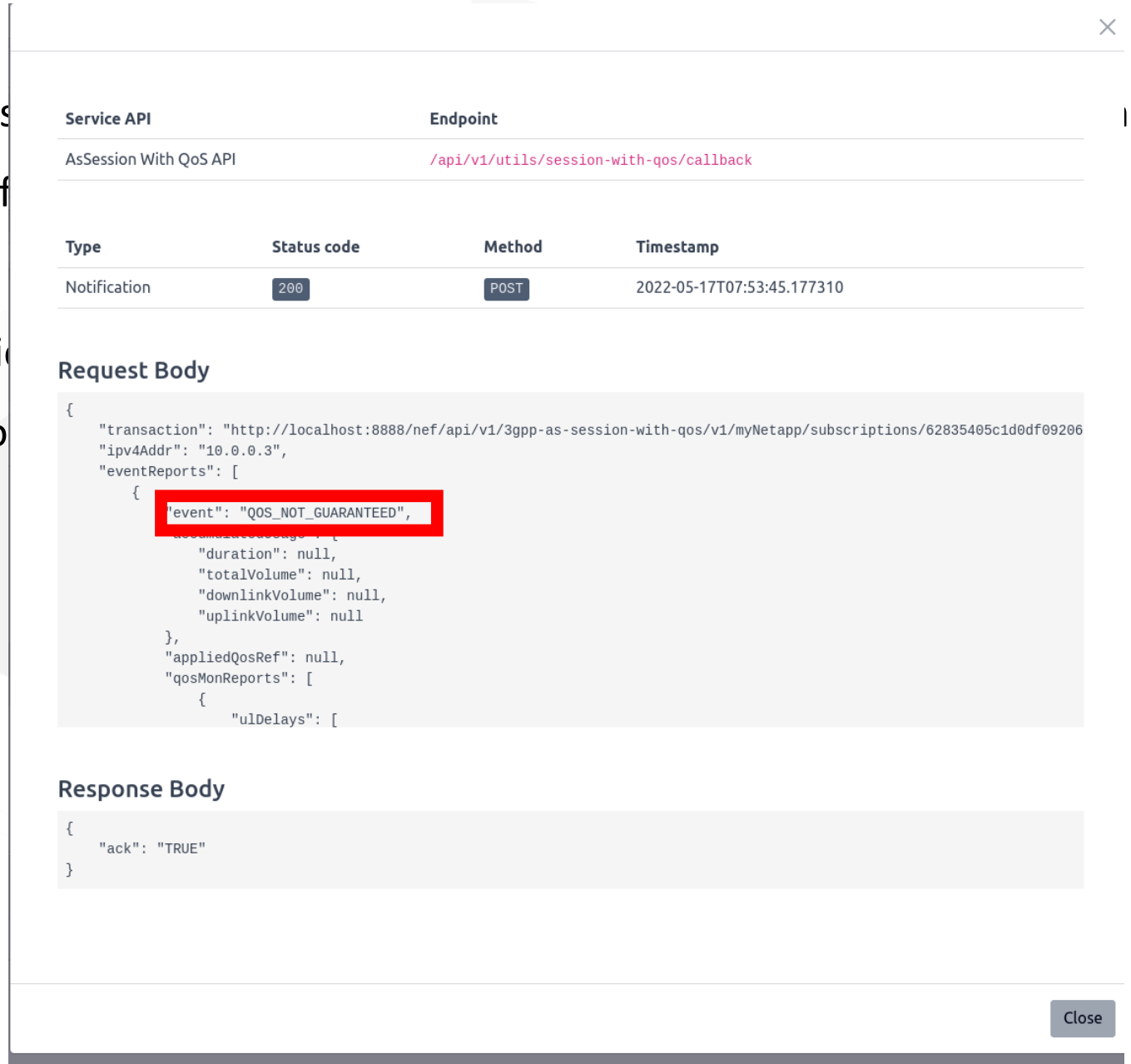

Service API	Endpoint
AsSession With QoS API	/api/v1/utils/session-with-qos/callback

Type	Status code	Method	Timestamp
Notification	200	POST	2022-05-17T07:53:45.177310

Request Body


```
{
    "transaction": "http://localhost:8888/nef/api/v1/3gpp-as-session-with-qos/v1/myNetapp/subscriptions/62835405c1d0df09206
    "ipv4Addr": "10.0.0.3",
    "eventReports": [
        {
            "event": "QOS_NOT_GUARANTEED",
            "duration": null,
            "totalVolume": null,
            "downlinkVolume": null,
            "uplinkVolume": null
        },
        "appliedQosRef": null,
        "qosMonReports": [
            {
                "ulDelays": [
```


Response Body


```
{
    "ack": "TRUE"
}
```


Close

Conclusion – Future Steps

- NEFSim – configurable, simulated environment which provided 3GPP's Northbound NEF APIs
- Architecture, implementation aspects
- GitHub page: https://github.com/EVOLVED-5G/NEF_emulator

- Future Steps:
  - Implementation of additional NEF APIs
  - Integration of NEF with commonly used frameworks (i.e., Open5GS)
  - NWDAF

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evolved 5G

Thank you!

Questions?

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