SD-Core and Aether Techinar

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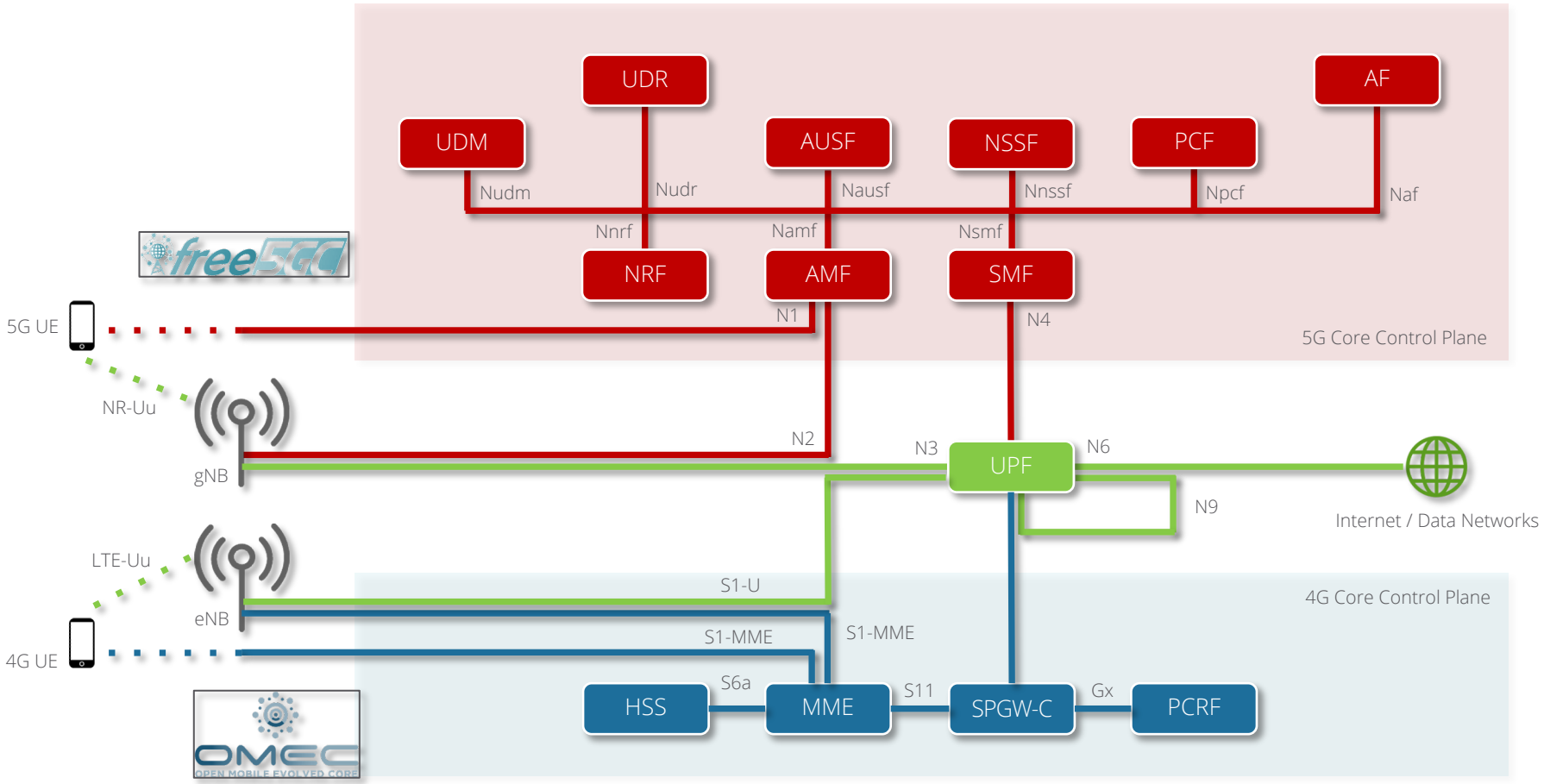
January 25, 2022

SD-Core supports 5G SA, 5G NSA (option 3x) and LTE

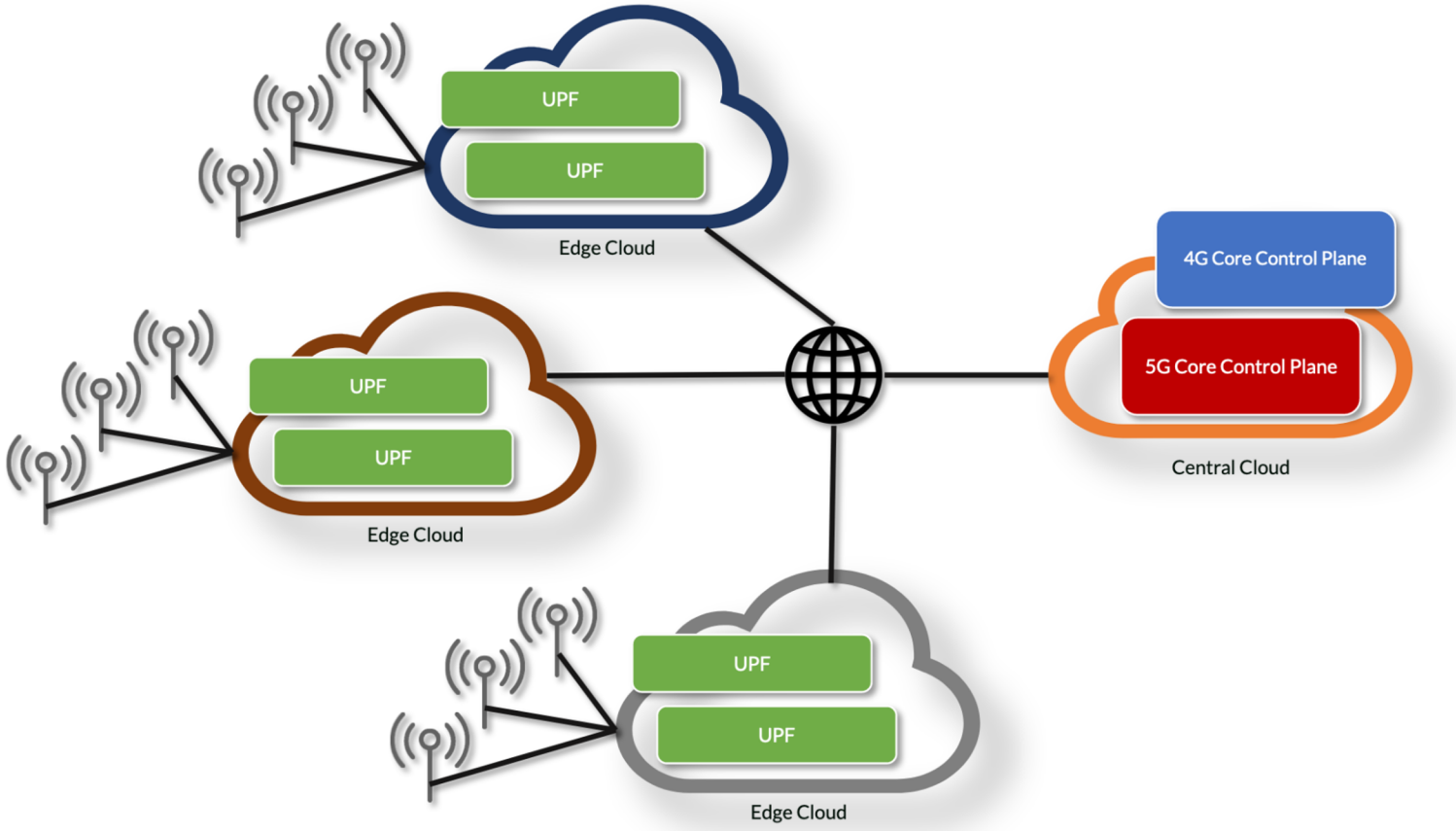


- SD-Core Supports 4G, 5G, 5G-NSA
- 4G - Release 13 compliant and selective features from further releases
- 5G - Release 15 compliant and selective features from further releases
- Containerized network functions deployed on K8s using helm charts.

SD-Core Release 1.0

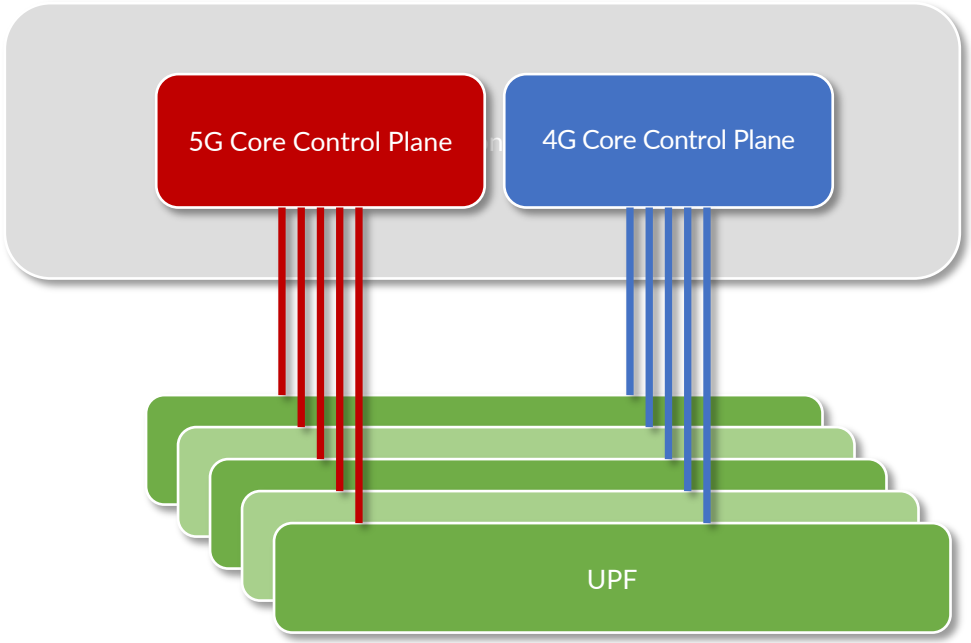
- First SD-Core Release - 1.0
  - SD-Core 1.0 was released December 17, 2021 and is currently running on Production
  - New documentation site with comprehensive details about SD-Core project - Link
    - Configuration guide
    - Helm Chart versions for releases
    - Developer Guide
    - 3gpp Compliance
    - Release notes
  - Detailed release notes - Link
  - SD-Core Configuration APIs (4G & 5G)
  - Delivering solutions like Application filtering & multi-level QoS metering
  - 5G stable version available on Aether Network.
  - gNB Simulator available for 5G testing

Typical SD-Core Deployment



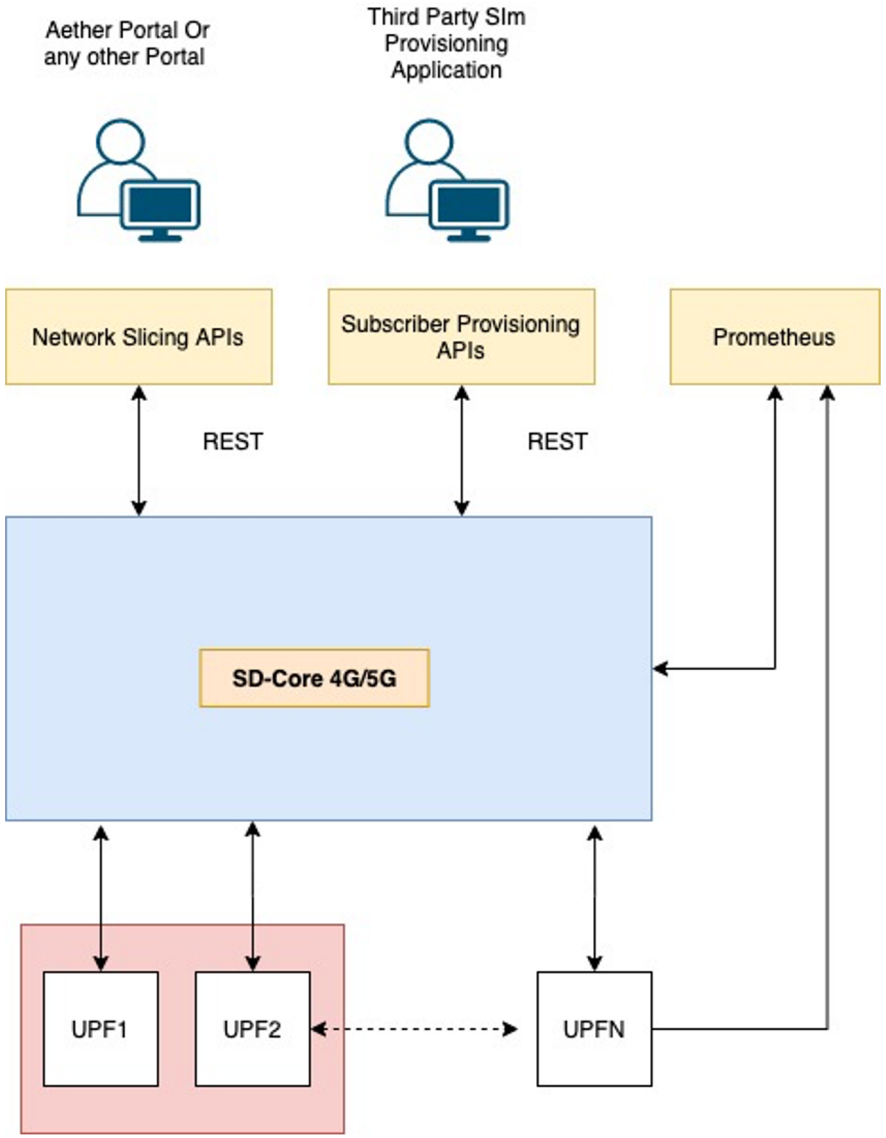
- Control Plane can be deployed on any Public Cloud or at edge
- Each Site has one or more UPFs dedicated for use case.
- CUPS compliant implementation.
- Control Plane & User plane communicate over PFCP protocol.
- Error handling - timeout, retransmission support
- UPFs can be added during runtime and UP/CP form PFCP association
- Edges can go away at any time and appropriate error handling available at control plane
- Edges can run on different versions of UPF. Changes are always backward compatible
- Option to Install only 4G or 5G or both

Multiple Optimized UPFs



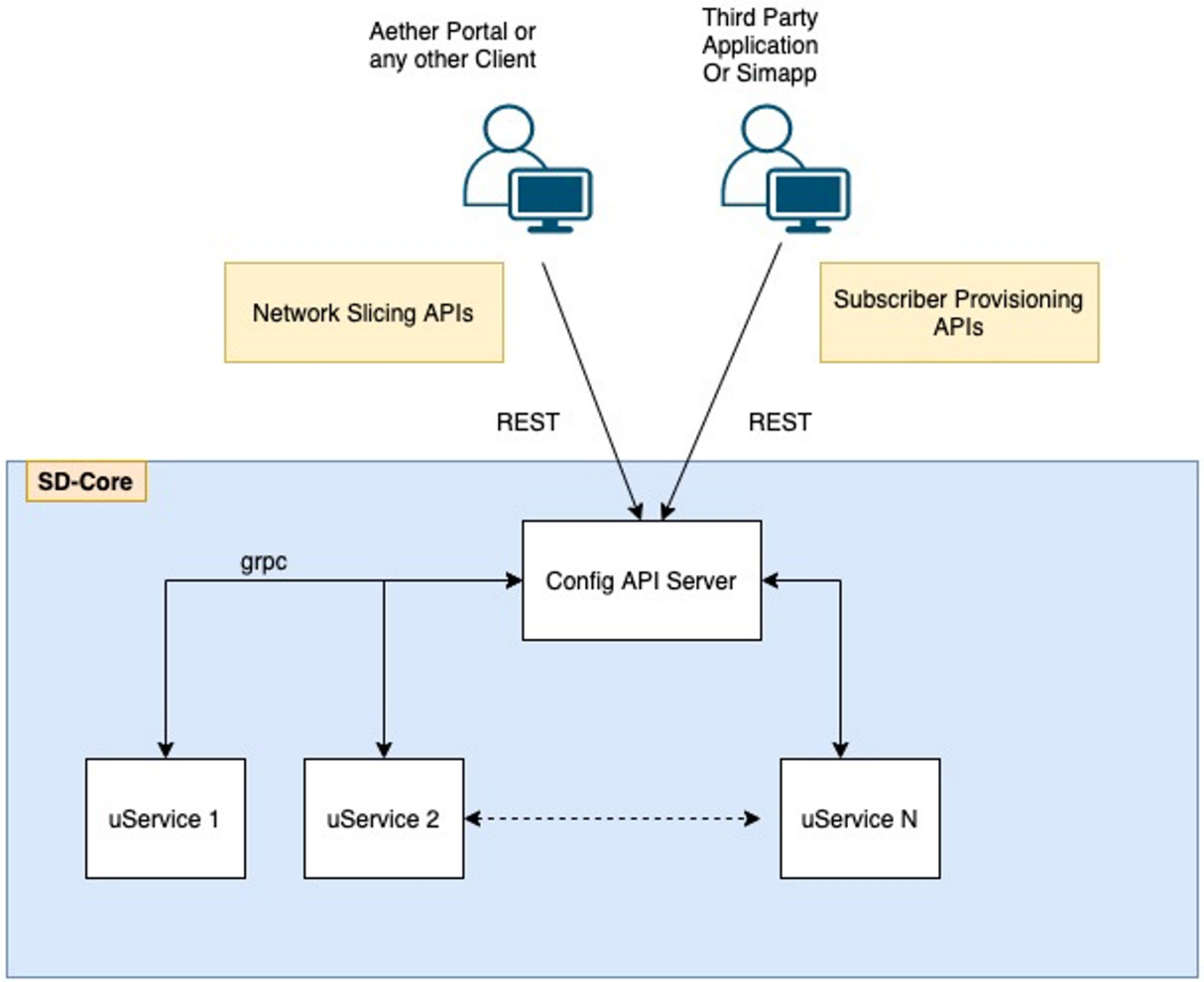
- Multiple UPF (user plane function) options available to meet the needs of different applications
  - BESS-UPF, P4-UPF
- BESS UPF can be deployed at the Public Cloud if latency is not the concern or remotely located at edge site. Throughput in 100+ Gbps
- P4 UPF has very high throughput in Tbps
- Many UPFs can connect to same control plane. Control Plane selects UPF based on various criteria - DNN/Slice (5G), Apn, IMSI, Uli(4G), Slice IDs
- IP address allocation supported at Control plane and also at UPF
- UPF initiated association, PFCP Echo, Session Report
- UPF project is part of ONF's SD-Fabric project. You can see lot more details about SD-Fabric project at link

SD-Core Block diagram



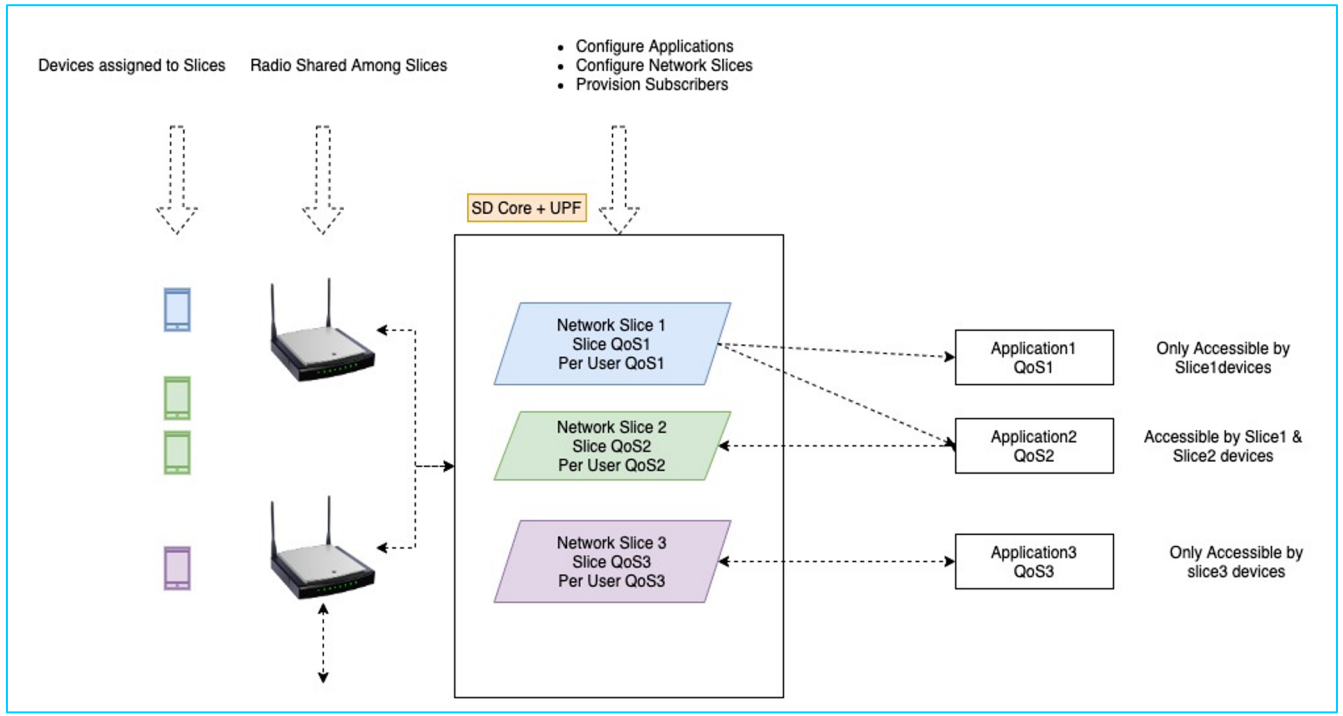
- Subscriber Config API - Add/Remove/Modify subscription
- N/W slice Configuration APIs
  - Add/Update/Delete Slice
  - APIs same for 4G & 5G.
- UPF Attach/detach to SD-Core. UPF Pools created based on enterprise need. We are working on adding/remove UPF PODs while we add/remove slice.
- Slice selection to select one of the UPF
- Telemetry KPIs

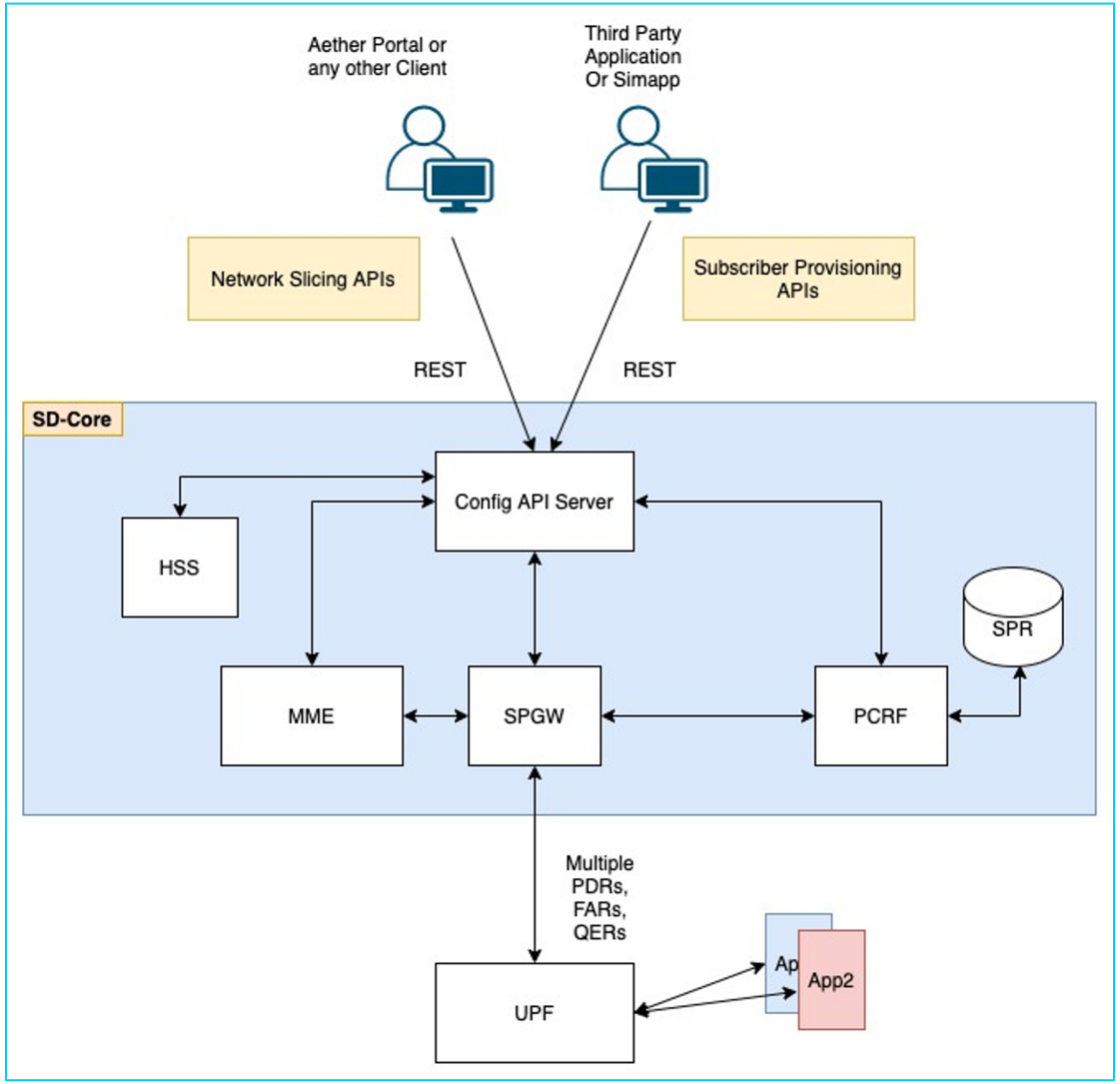
Network Slice Provisioning & Subscriber Provisioning



- SD-Core config server to handle configuration APIs from ROC (Run time Operation Control)
- Configuration APIs same for 4G/5G network functions.
- Config-server distributes configuration to all SD-Core components (4G/5G)
- Support for slice deletion - release PFCP association with UPF when slice deleted, also release subscriber sessions
- Simapp is developed for subscriber provisioning in SD-Core
- Simapp uses SD-Core config APIs to configure subscribers

Application Filtering Support & QoS



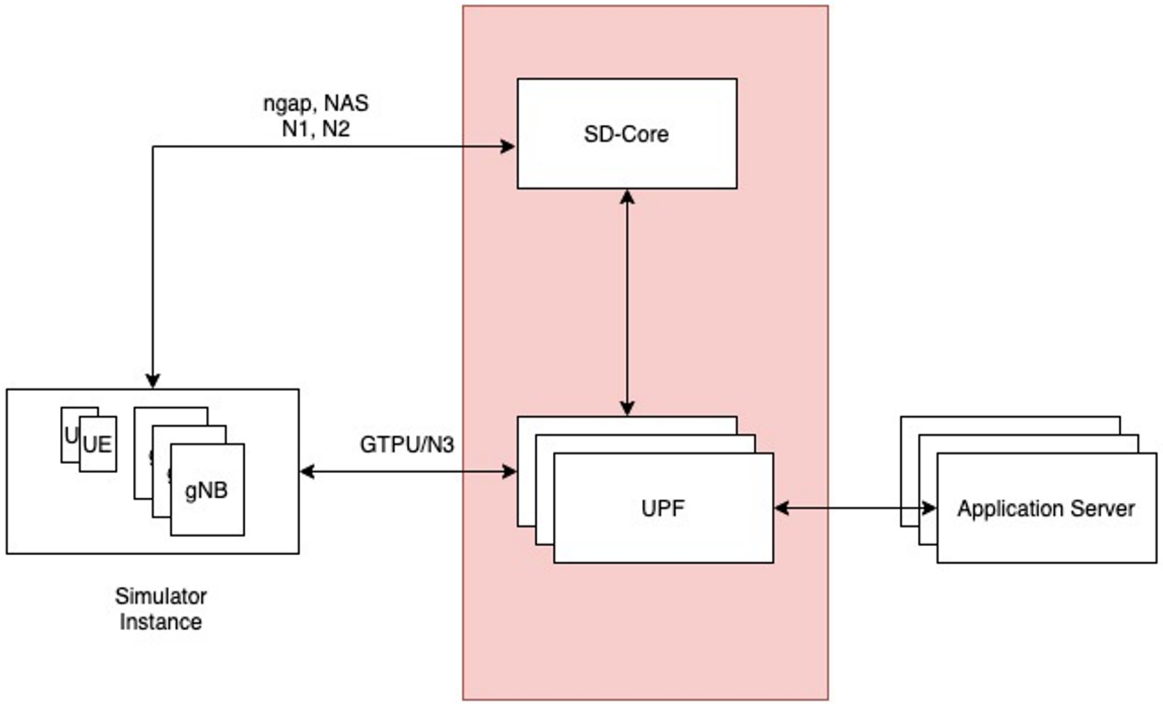


- Each slice has access to only configured applications
- PCRF generates policies to close flow gates based on configuration
- Slice Level QoS
- SD-Core integrates ROC configuration APIs to generate PCRF Policies
- PCRF policies pushed to SPGW and Policies installed in UPF through PFCP
- Each user has multiple application rules support and each rule can have its own qos limits
- Collective QoS limit per subscriber

5G Available on Aether !

- Seed Code - free5gc 3.0.5 Version
- Additions by SD-Core
  - Configuration APIs to configure all network functions
  - 5000 subscribers with 10 calls per second stability achieved (Single Instance)
  - Error cases with UPF connectivity fixed
  - Error cases with Network functions restarts fixed
  - Stability issues on NGAP interfaces and N1 interfaces fixed
  - 100+ code commits to achieve code stability
  - 3gpp compliance of 5G core is added in SD core documentation
- Deployment
  - 5G core now available in Aether Network
    - Two edge networks connected to 5G core (FET and NTT)
  - 5G Deployed in SD-RAN trial with 2 Network Slices
    - ORAN compliant RAN + 5G Core

gNodeB Simulator



- Simulates - UE + gNodeB
- Containerized
- Easy to run multiple instances
- Designed for automation
- Inbuilt sanity traffic test
- Simulates following 3gpp procedures
  - Registration
  - UE initiated PDU Session Establishment
  - UE Initiated De-registration.
  - AN Release
  - Service Request
  - ICMP Data flow Testing
- Complete documentation available on SD-Core documentation website

Roadmap

Upcoming Release

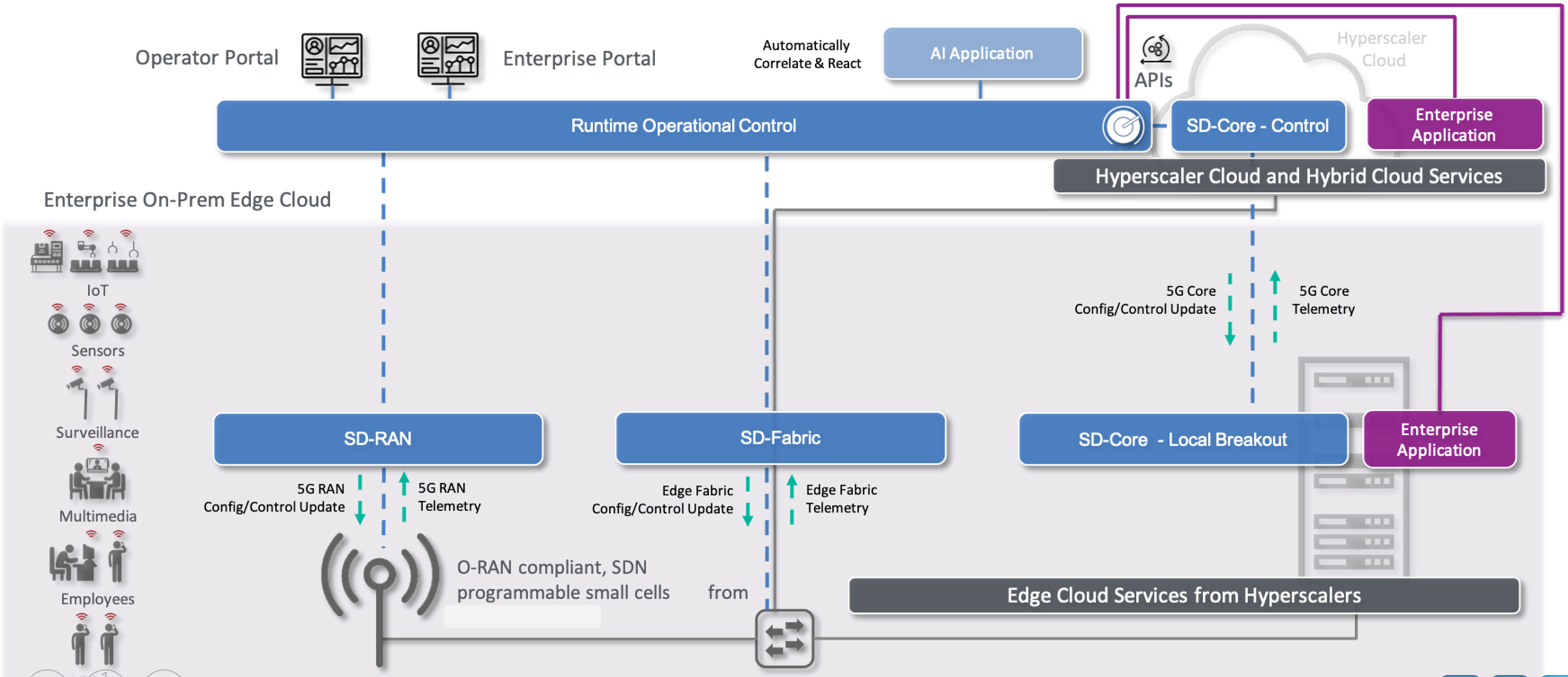
- Next Release SD-Core - 1.1 - Q1 2022
- 5G QoS Call flows
- O & M - Gracefully delete connected subscriber sessions
- 5G Cloud Native Architecture and Prototype
- gNodeB simulator enhancements - Support new call flows
- Configuration APIs design for create dedicated flows for user
- Enhanced Metrics design and prototypes

Joining SD-Core Project

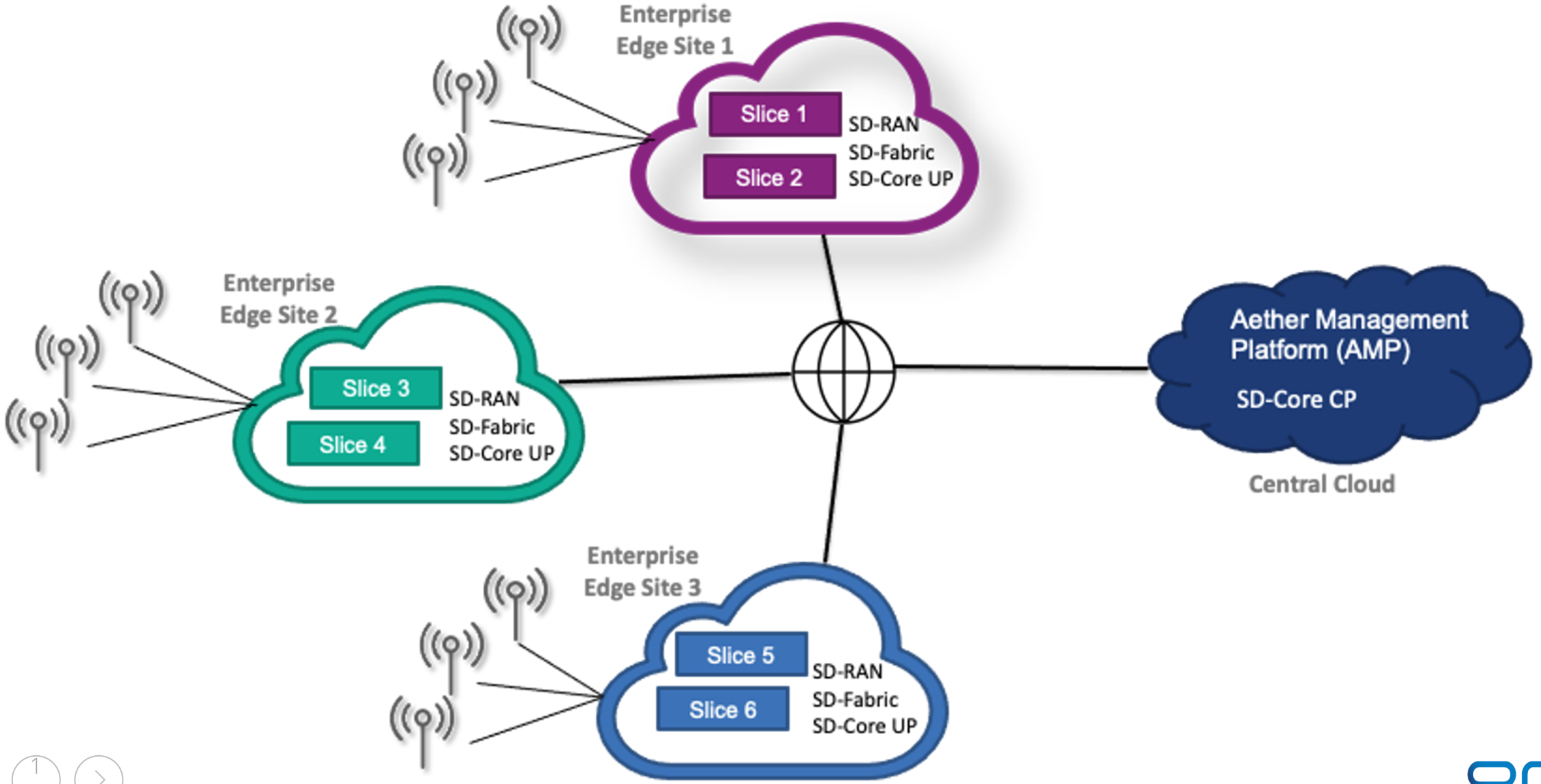
- Find various SD-Core resources
  - SD-Core Home Page
  - SD-Core Whitepaper
  - SD-Core Wiki
  - SD-Core 1.0 Release Blog
  - SD-Core 2021 Review
  - #sdcore-dev channel in ONF Community Slack

Thanks

Aether Architecture



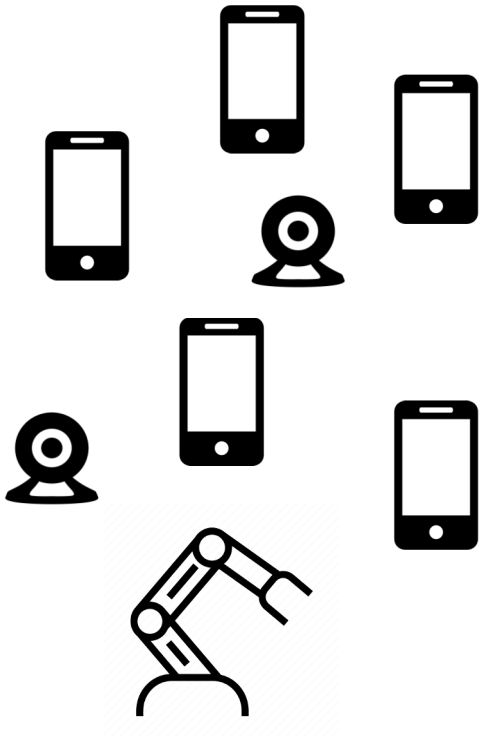
Aether: Single Cloud, Multiple Enterprise Sites



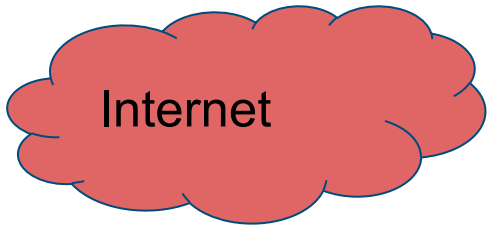
Live Demo - Aether Production Grafana Dashboard

Show Aether Production Grafana

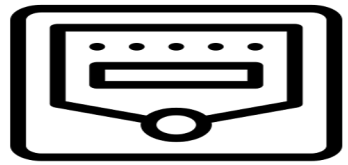
Aether Service Abstraction



Connectivity



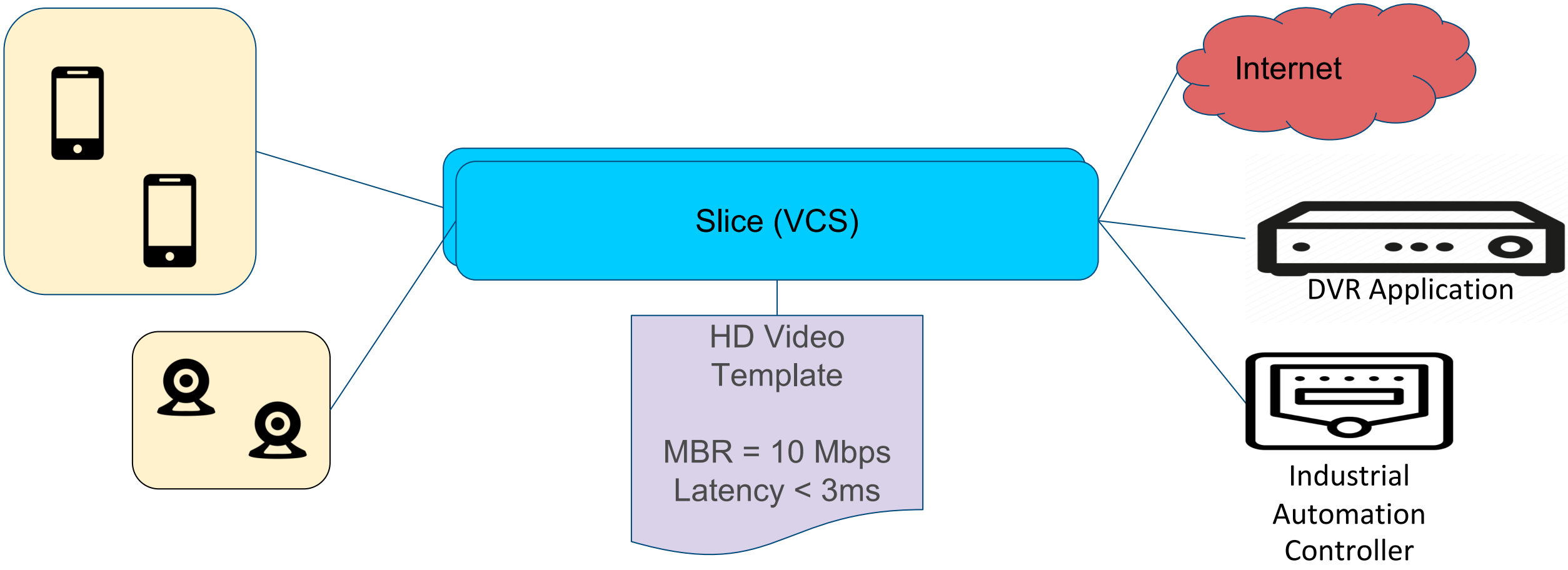
DVR Application



Industrial Automation Controller

Goal of Aether is to connect devices to applications.

Control



Administrator can group the devices for convenience.
Administrator can associate devices with applications via a Slice.
ONF gives the user templates to abstract out 4G/5G details.

Analytics

Internet

DVR Application

Slice (VCS)

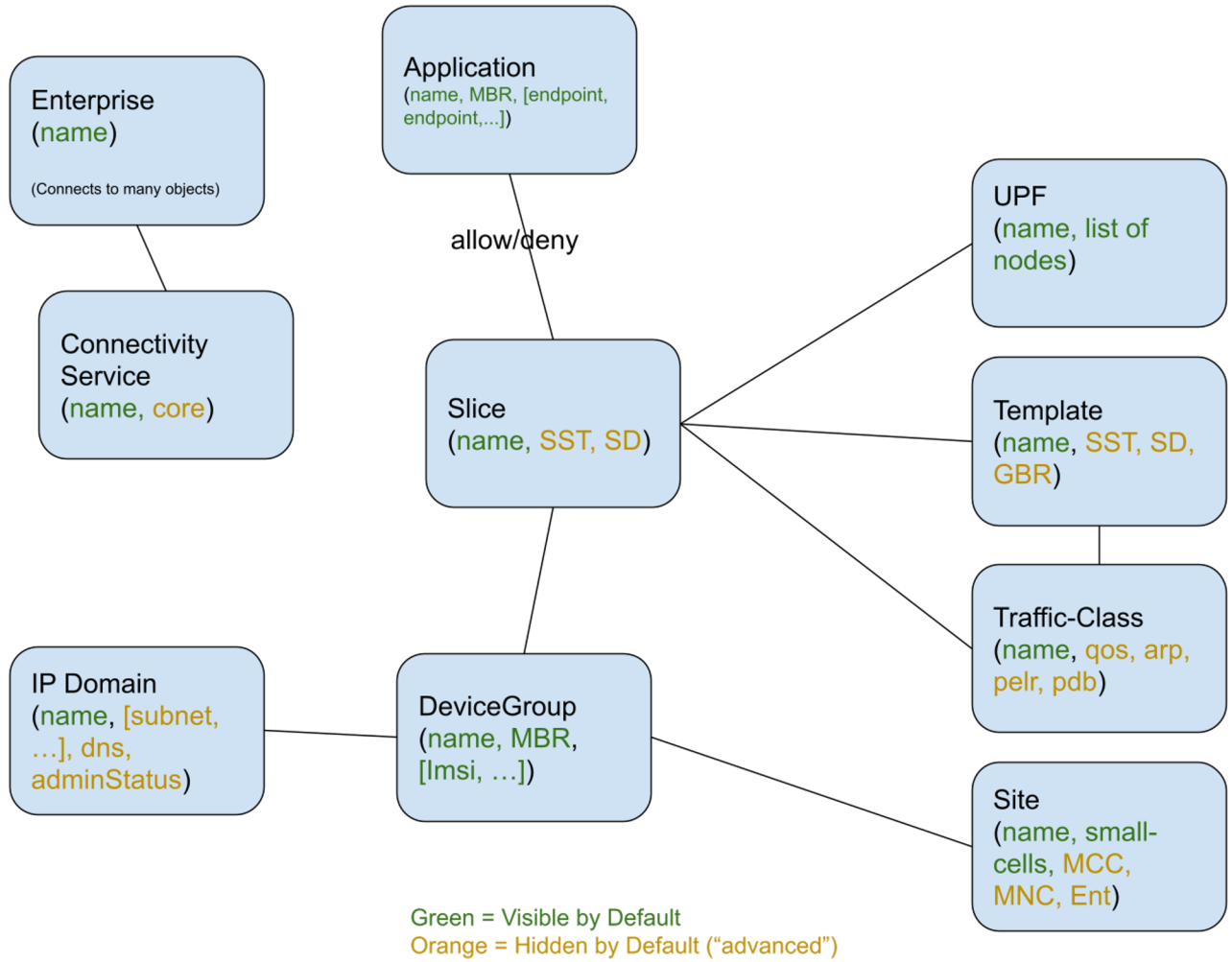
Industrial Automation Controller

Analytics are as important, if not more important than control.
Aether includes a robust analytics solution based on Grafana, Prometheus, and Elastic.

Service Abstraction is a set of models

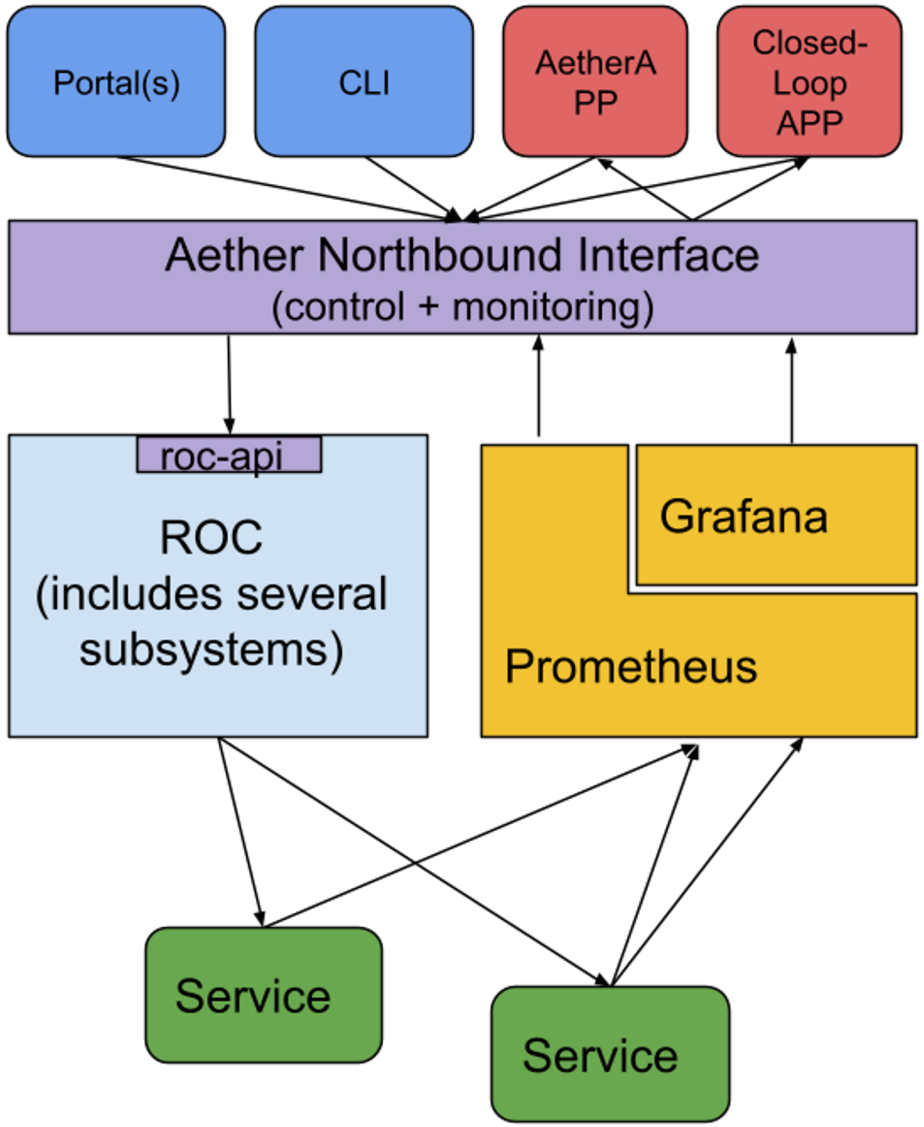
The Aether Service Abstraction is a set of models, some of which are managed by Aether Operations, and some are managed by the enterprise administrator.

We will see these models in use in the GUI shortly.



The models are available via a Portal

- Portal supports both control and analytics, side-by-side.
- RBAC to isolate Enterprise users from one another.

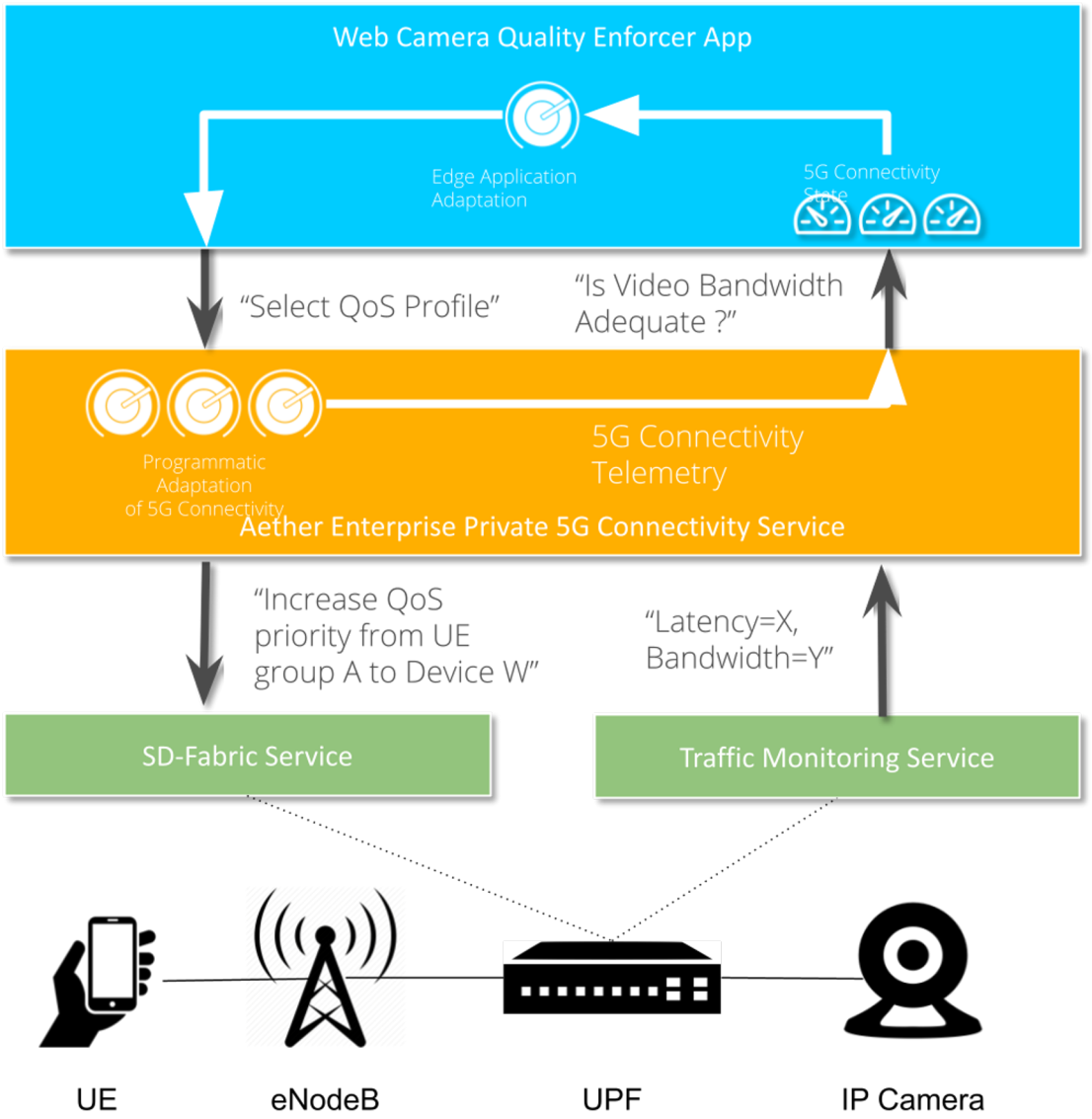


Live Demo - Aether Production Operations GUI

Interactive walkthrough of Production GUI

API

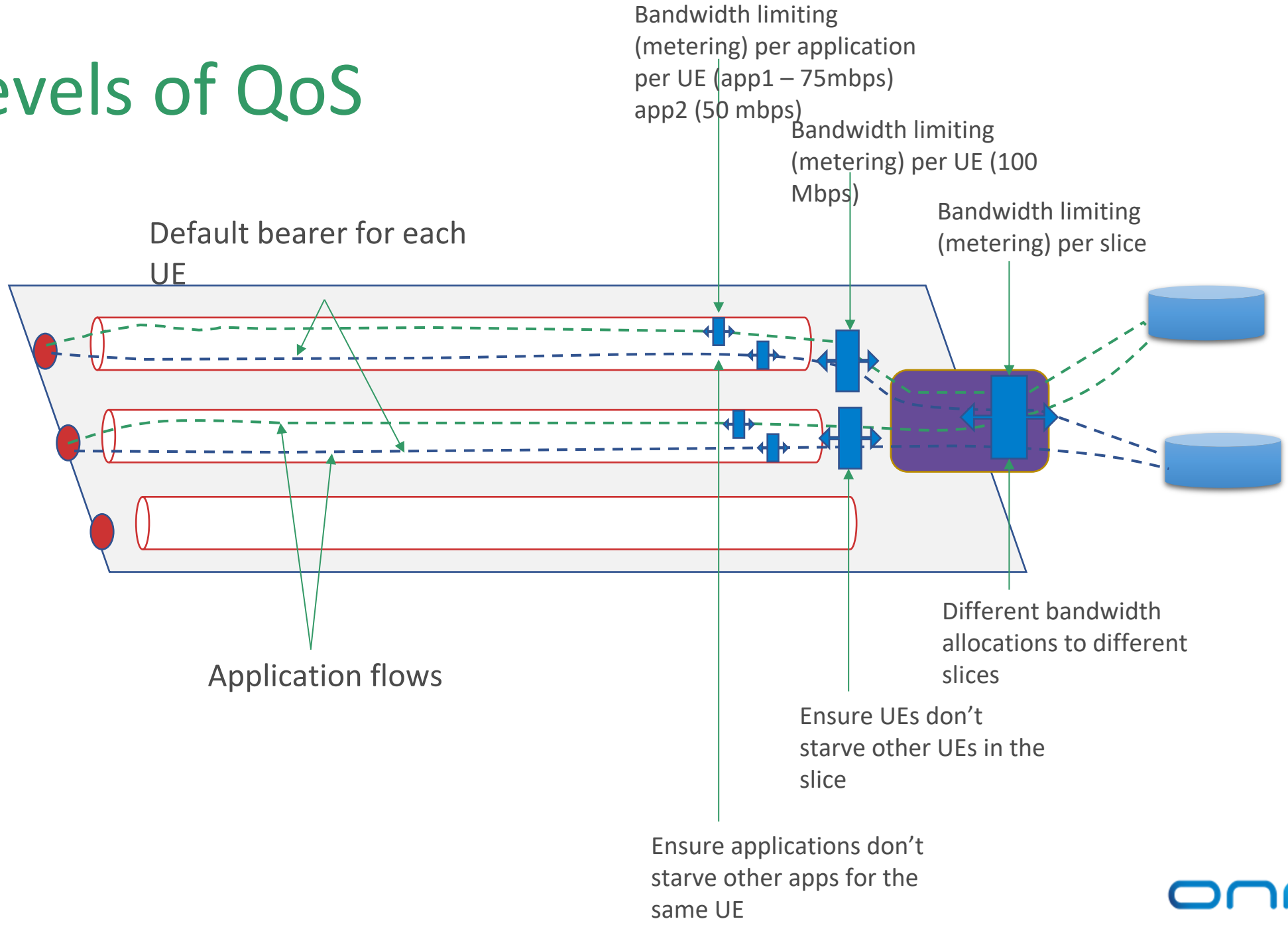
- The portal sits atop a pair of APIs.
- Those same APIs can be used for other applications.
- This is how we “5g Enable” / add Aether value.
- The control API is protected by RBAC and authentication.
- The monitoring API is not yet protected.



Aether Release

- Aether 1.6
  - 1.6 was released December 17, 2021 and is currently running at ONF's Menlo Lab.
  - Supports three levels of QoS (per-Slice, per-UE, per-UE-per-App)
  - Supports application filtering
  - User Plane Functions (UPFs) are created at customer onboarding time, and assigned to a slice by the customer at runtime.
  - Single Sign-On using Keycloak and LDAP

Three Levels of QoS



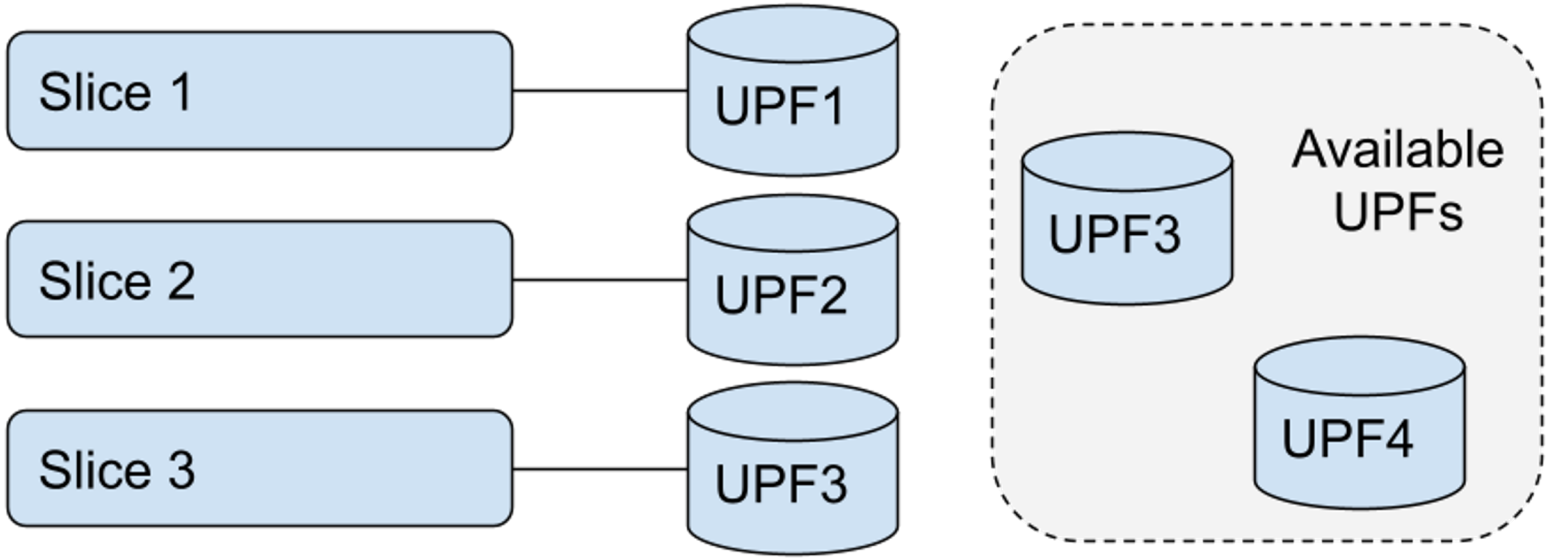
Application Filtering

- Each slice has a default behavior
  - “Allow All”
  - “Deny All”
- Each slice also has up to five filtering rules, each rule specifies:
  - Priority, used to order the rules
  - Application IP Address
  - Allow or Deny
  - per-UE-per-Application MBR
- First match determines action. Traffic that matches an Allow is permitted whereas traffic that matches a Deny is dropped

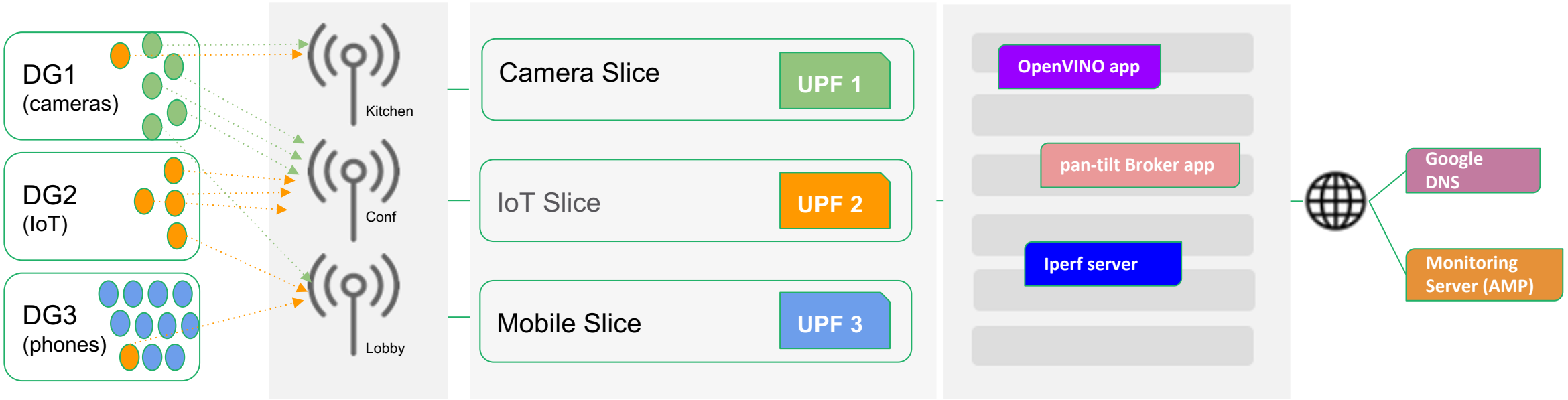
UPF Pools

UPFs are created at onboarding time, assignable by the customer at runtime.

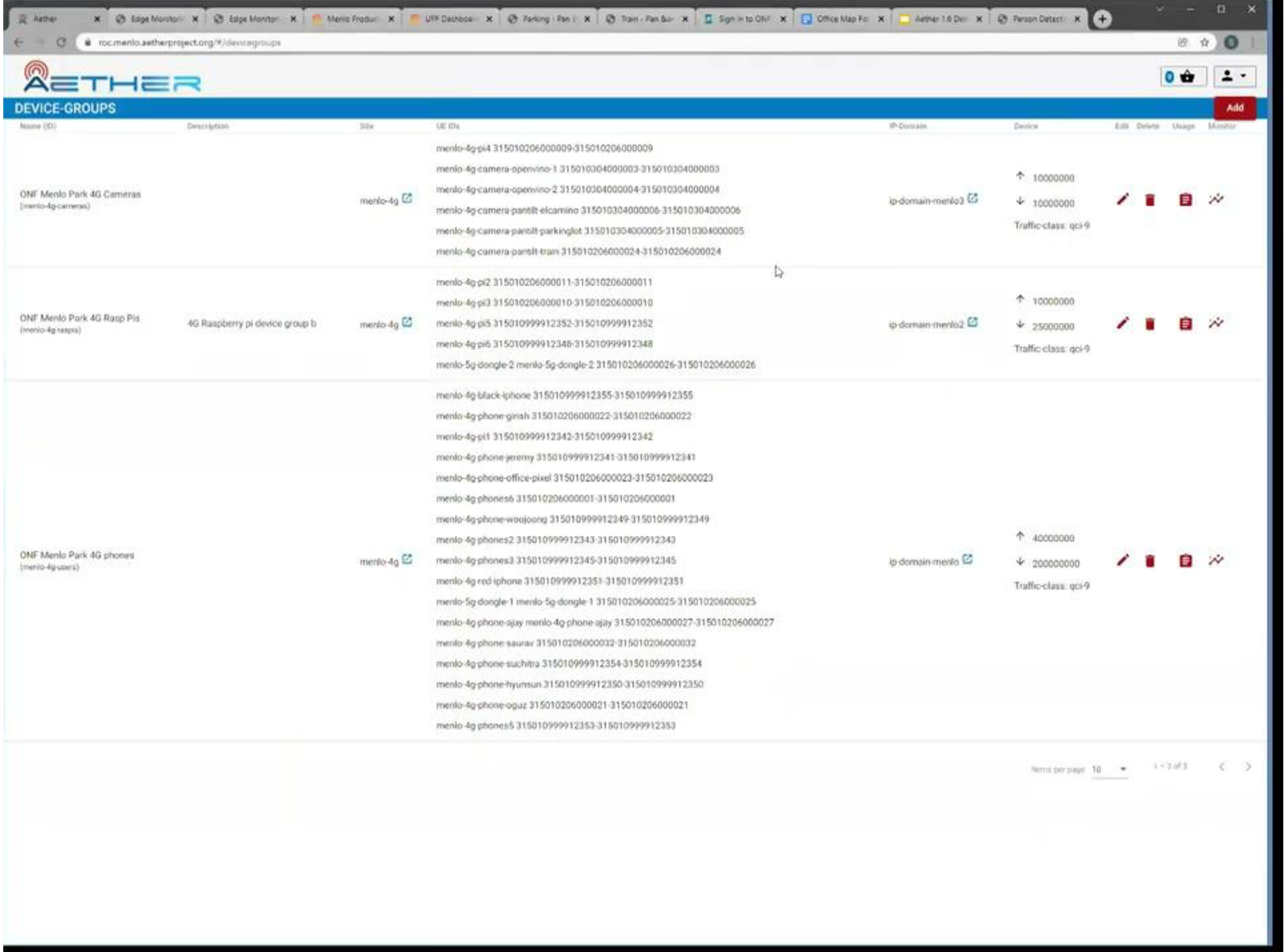
Additional UPFs may be added to pool by OPs by customer demand.



Sample Enterprise Network



Sample Enterprise Network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DEVICE-GROUPS
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Roadmap

Aether Roadmap

- 5G Support
  - Guaranteed Bitrate / Dedicated Bearer by application demand
- Application Gateway API
- Analytics Engine
- Modeling Improvements
  - Device and SIM Card modeling
  - Subscriber proxy / SIM management integration
  - Configuration subsystem (onos-config) refactoring

Thanks