

# Kajeet's Aether Journey

## Developing A Commercial Private 5G Platform

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# Kajeet Private Wireless Overview

Derrick Frost  
SVP & GM Private Wireless

# kajeet. AT A GLANCE

- A Leading Wireless Managed Service Provider
- Nearly two decades of experience
- Leading US provider of off-campus wireless internet for students
- Over 3,000 Customers
- Service 7 Large High Growth Verticals
- 5.5M+ Lines Connected
- Award-Winning Sentinel/Excalibur Platform
- 40 U.S. Wireless Patents
- Launch MSP for Charter/Comcast MVNOs
- 40+ Private Wireless Deployments

## MARKETS SERVED



EDUCATION



ENTERPRISE  
FIELD SERVICE



HEALTHCARE



MONITORING



TELECOM  
& CABLE



TRANSPORTATION



PRIVATE  
NETWORKS

## SELECTED CUSTOMERS

EDUCATION



FIELD SERVICES



HEALTHCARE



TRANSPORTATION



MONITORING



TELCO & CABLE



## PARTNERS



# THE START OF OUR JOURNEY



[ABOUT](#) [BROADBAND](#) [PRIVATE 5G & EDGE](#) [OPEN RAN](#) [PROGRAMMABLE N](#)

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## ONF's Aether Private 5G Open Source Platform Selected by Kajeet to Build an Enterprise Private 5G Network Offering

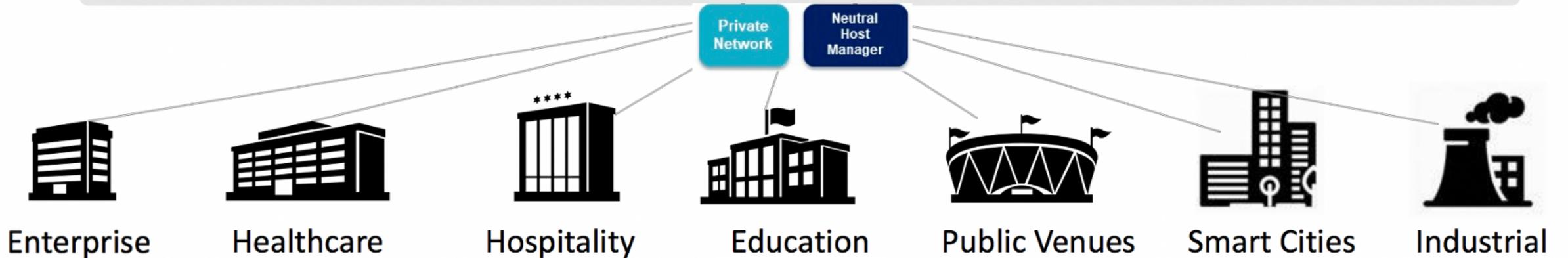
MENLO PARK, Calif., June 1, 2022 –The Open Networking Foundation (ONF) today announced continued momentum for its open source Aether™ private 5G platform, with Kajeet announcing it will leverage Aether to build their own private 5G Networks-as-a-Service offering. The Kajeet solution provides a cloud-based platform providing enterprises Private LTE and 5G, both indoor and outdoor, with seamless mobility between public and private cellular networks, as a turnkey cloud-managed Network-as-a-Service.



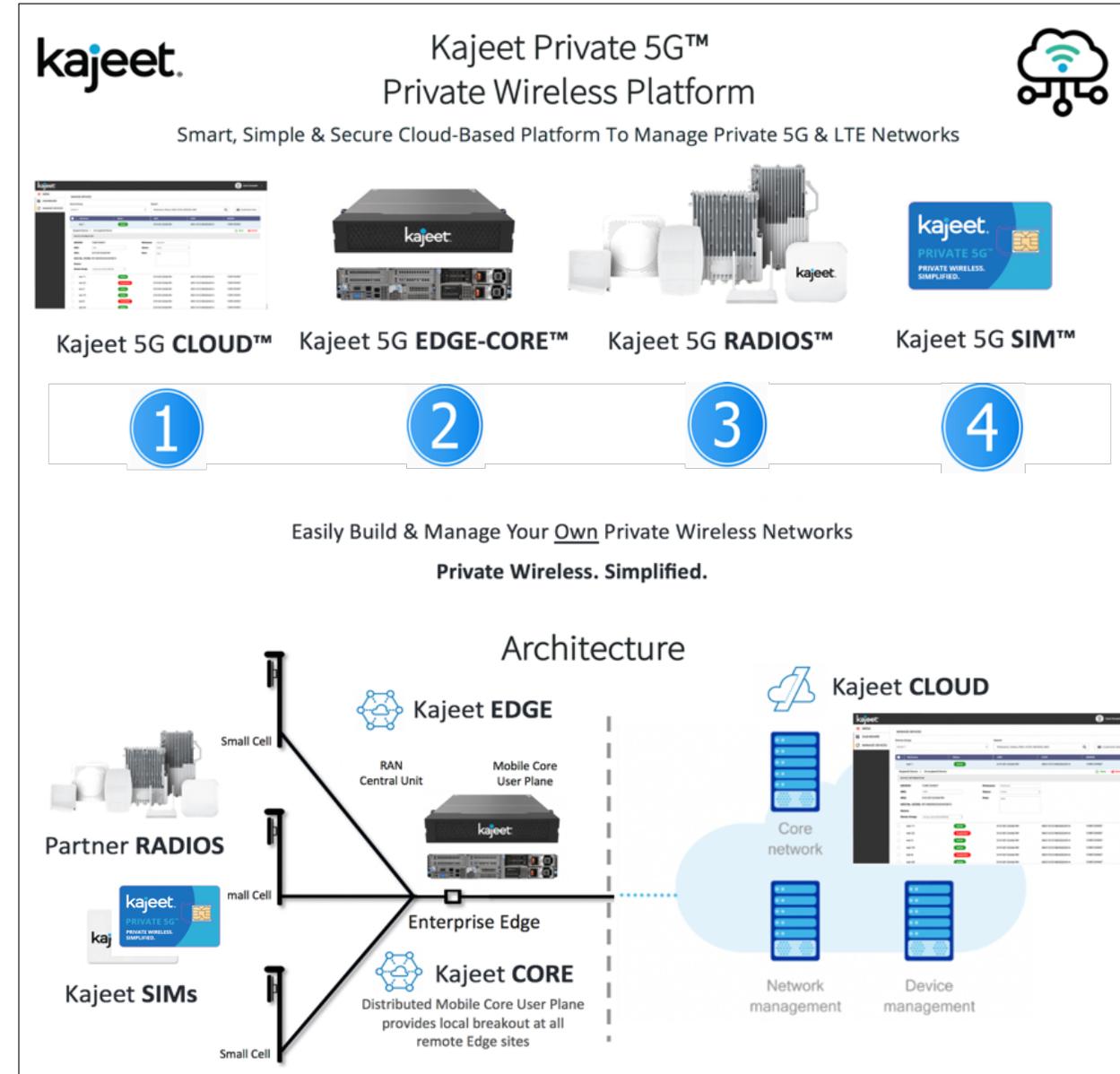
Open, Smart, Simple & Secure Cloud-based Platform To Manage Private 5G & LTE Networks



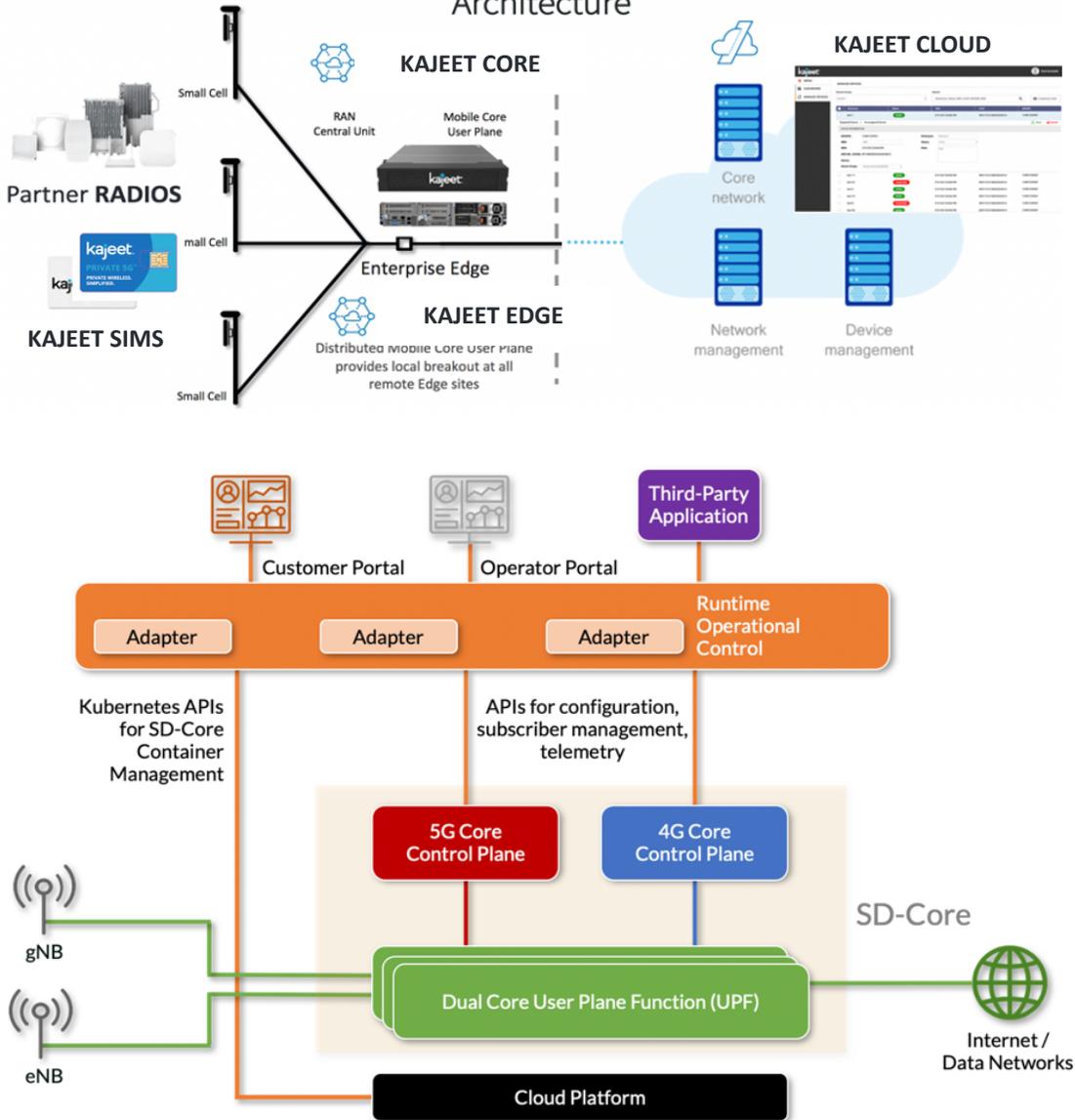
## PRIVATE 5G & LTE SOLUTIONS



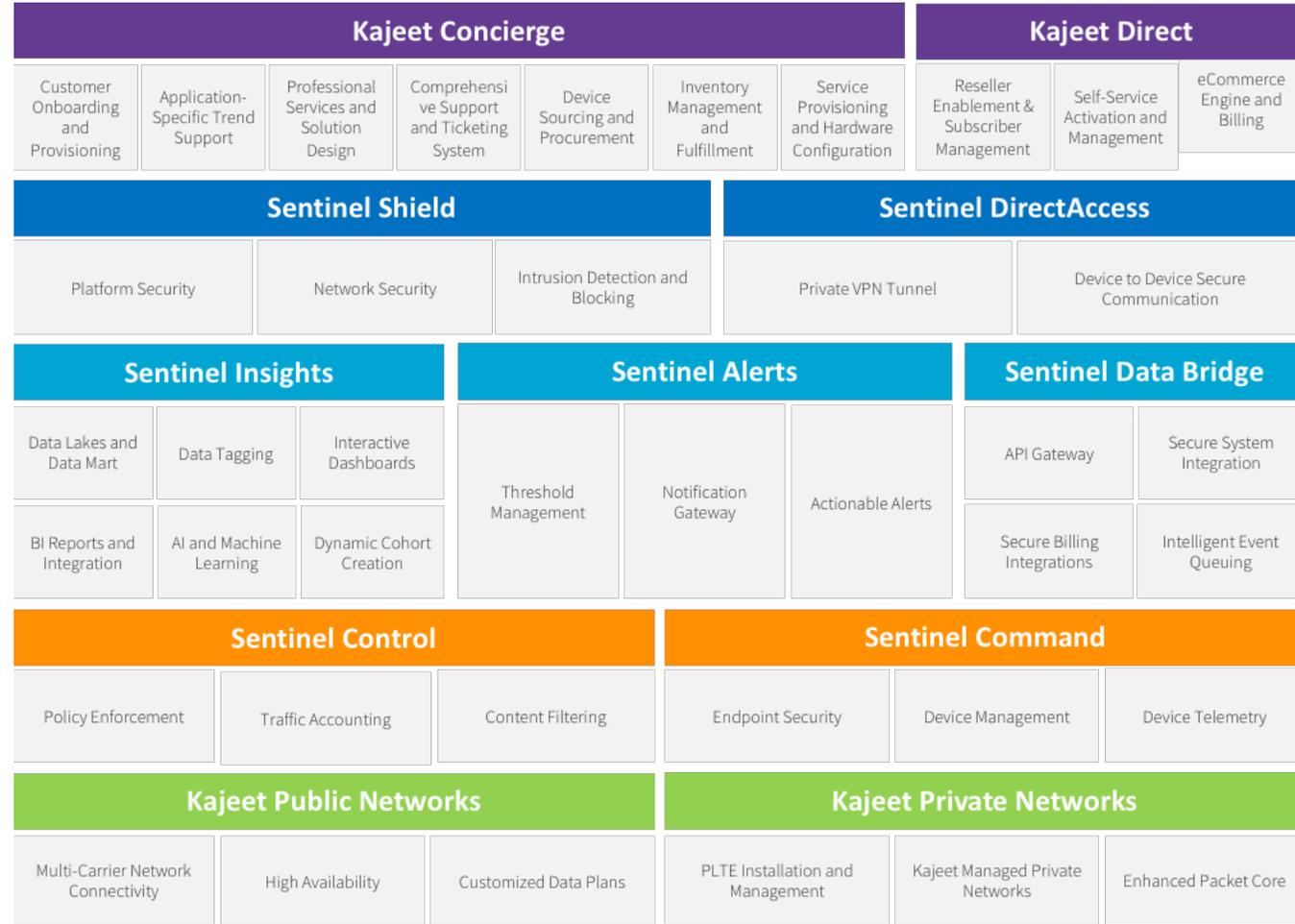
- **Simple & Flexible** – Plug & Play Setup & Management To Quickly & Easily Deploy & Manage Your Own Private 5G & LTE Networks
- **End-To-End Platform** - Complete Private Wireless Solution – Radio, Core, Edge, Cloud, SIMs & Devices
- **Cloud Management & Control** - Cloud-Based SIM, Device & Network Management. End-To-End Smart Slicing with QOS SLA Assurance for mission critical applications.
- **Mobile Edge Cloud** - On Premise CORE User Plane
- **Smart** – Leverages Analytics, AI and ML to proactively manage network and optimize performance
- **Open Ecosystem** - Supports Multiple RAN Vendors with Open APIs, For Full Flexibility & No Lock-in
- **Managed Service** – Delivered “as-a-Service”
- **Cost-Efficient** - Carrier-grade Technology & Services with Cost-effective Pricing



## Architecture



## Cloud-Native, Smart, Open, Flexible, End-to-End, Managed Service



## SENTINEL SIM & SUBSCRIBER MANAGEMENT

## AETHER CORE & EDGE MANAGEMENT



Cloud SIM & Device Management	Hybrid Network Connectivity	Security & Threat Protection	Content Filtering	Analytics & Dashboards	Open APIs & Integration
Real-time secure activate/deactivate, configuration, policy management for devices by group or individual	Shared data across devices, multiple networks and technologies (PLTE, Hybrid, LTE: 4G, NB-IoT, CAT-M) on one interface	Enterprise-class security firewall to stay ahead of unknown threats, protect users, applications and data	CIPA compliant filtering allows for adding of "white-listing" and "black-listing" of specific URLs, multiple filter groups & deny pages	Real-time actionable insight into usage patterns and behavioral activity. Reports and dashboards provide valuable insights	All Sentinel features and functions are available via APIs for integration and process automation

SIM & Device Management	Site & Slice Management	QoS Management	Open RAN Controller	Alerts & Dashboards	Open APIs & Enterprise Apps
Set up and configure SIMs, Devices and Device groups. API integration of third-party Subscriber management systems	Set up and configure Sites and associate Devices and Slices to each location	Set up and configure QoS attributes and for Sites and associated Devices and Slices for each location	A near real-time RIC, xApp/development environment and set of xApps for controlling open RAN (RU/DU/CU)	Alerts, reports and dashboards provide efficient and effective ways to report out valuable insights across the Enterprise	Enterprise Apps & Network Aware Apps can be integrated via APIs for process automation and closed loop network control





Aether Journey

Dan Rittenhouse  
Sr. Director Technical Operations

# Aether Journey to date

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## SCALING ABILITIES & REDUNDANCY

- To scale the system to support 400 attached eNBs and 10k attached UEs, we have:
  - Deployed the SR-IOV UPF
  - Validated a 4 UPF configuration
  - Enabled configs on the SR-IOV NICs to support HA on the MME
  - Demonstrated an F5 SCTP Load Balancer to work around the GKE limitation encountered to support HA.
- Demonstrated large clients can be onboarded and managed on the Aether platform.
- These loads are also able to be managed and monitored via Grafana dashboards.

## PROVISIONING SUBSCRIBERS AND SIMS

- New HSS subscriber APIs allow support reps to search and locate existing subscribers in the ROC dashboard / third party system consuming ROC APIs.
- Support reps can update subscriber information, including APN values, as needed via these same methods.
- SIMs can be provisioned via the ROC dashboard as well.

## OPERATIONAL CAPABILITIES

- SNMP MIBs developed and being consumed by Datadog, Kajeet's monitoring tool, for Baicells eNBs.
- Operational monitoring data is integrated into Datadog.
- Grafana dashboards display key system metrics as well as more detailed views of system components.



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# Functionality Enhancements to the Aether Platform

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## **MULTI-TENANCY AND IP ALLOCATION**

- Virtual APNs can be allocated, allowing for multi-tenancy and the ability to define gateway-specific APNs (multiple PGW with single APNs).
- Static IP allocation is also allowed, providing the ability to configure IP pools for different APNs.

## **ANTHOS HYBRID CLOUD DEVELOPMENT & MANAGEMENT**

- Centralized management of application deployment.

## **SECURITY FEATURES**

- An audit trail tracks configuration and other changes made by users.



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# Resolution of Aether Platform Bugs

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## PERFORMANCE ISSUES

- 30% packet loss in UPF when running multiple UPFs (multiple UPFs compete for CPU resources).
- Cannot attach users to more than one UPF.
- Inability to delete a UPF.

## API LAYER

- Database not receiving SIM and device value updates (POST API context deadline exceeded error).

# Performance Testing Summary

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Scenario 4 UPFs and 4, 8, 12 UEs

- Small packets we were able to attain a throughput of 250Mbps
- Medium packets we were able to attain a throughput of 3.6Gbps
- Large Packets we were able to attain a throughput of 8.9Gbps

From information and full testing results <https://arterra.atlassian.net/browse/KPW-361>

# Next Steps

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## Bugs to Resolve

- In Progress – Unable to provision at scale via ROC UI (maximum message size in gRPC).
- Keycloak user admin UI does not save changes into the database. Must use backend file upload process.
- Unable to delete SIM via ROC UI.

## OPERATIONAL ENHANCEMENTS

- Database not receiving SIM and device value updates (POST API context deadline exceeded error).
- In Progress – Unable to provision at scale via ROC UI (maximum message size in gRPC).
- Automate SIM provisioning.

## PERFORMANCE ENHANCEMENTS

- Validate 30k UE load.
- Achieve redundancy at every system component.

## SECURITY ENHANCEMENTS

- Integrate with our IDP platforms Azure AD / Okta.
- Further analysis is required to establish all the security tenants needed in production.



# Next Steps

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## **SOLUTION ENHANCEMENTS**

- Finish certification of Ruckus and Airspan RAN integrations.
- Implement a version that does not have all the overhead and limitations we encountered with Google Anthos. (Small single tenant)
- Create and validate fully multi-tenant solution.
- Build out MEC app developer platform.
- Implement a fully-cloud hosted solution (small customer implementation solution) if customers have a need.
- Maturity around caring and feeding for this open-source platform. This will require a significant amount of investment to keep the public code base and our code base in sync, tested and stable.
- Engage the TST at ONF to adopt current OS platforms and automated test frameworks.
- Re-visit static IP solution so that a UPF is not consumed by a static pool.

## **Utilizing Aehter in new interesting ways**

- As the core for a MOCN gateway solution to support higher ED
- To provide core for large public library systems allowing them to leverage the Core capabilities and our Sentinel filtering and reporting capabilities.



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# Contributing Back to the Community

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- Identified and resolved 15 bugs that we will check back in to the mainline code
- Still working through how to contribute back new features/enhancements