Kajeet’s Aether Journey

Developing A Commercial Private 5G Platform

October 27th, 2022
Kajeet Private Wireless Overview

Derrick Frost
SVP & GM Private Wireless
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
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.
KAJEET PRIVATE WIRELESS

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

PRIVATE 5G & LTE SOLUTIONS

- Network Design & Installation
- SIM & Device Management & Logistics
- Network Slicing & Management
- Open APIs Application & Developer Platform
- Neutral Host & Carrier Connectivity
- Private 5G/LTE as a Service

Private Network
Neutral Host Manager

Enterprise
Healthcare
Hospitality
Education
Public Venues
Smart Cities
Industrial
KAJEET PRIVATE WIRELESS

- **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
PRIVATE 5G PLATFORM

Cloud-Native, Smart, Open, Flexible, End-to-End, Managed Service
PRIVATE 5G PLATFORM

SENTELIN SIM & SUBSCRIBER 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 or "whitelist" and "blacklisting" 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.

AETHER CORE & EDGE MANAGEMENT

SIM & Device Management
Site & Slice Management
QoS Management
Open RAN Controller
Alerts & Dashboards
Open APIs & Enterprise Apps

Set up and configure SIM, 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, app development environment and set of APIs for controlling open RAN (RIO/RIU).
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

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.
Functionality Enhancements to the Aether Platform

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.
Resolution of Aether Platform Bugs

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

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

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

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.
Contributing Back to the Community

- 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