Aether™

An Open Source Platform for Private 5G Connected Edge Cloud as a Service

To Accelerate Smart Enterprise Transformation

Guru Parulkar

December 2020
Smart Enterprise Transformation
Adopters see big gains

Harley-Davidson York Factory: Building customized motorcycles

Deployed an IoT network for operations automation

Productivity
Production time for each motorcycle was 21 days

Efficiency
Production costs

Safety & Security
Worker Injuries

Flexibility
Bike variations on a single production line

6 hours
70%
91%
1,700
Adopters see big gains

Nokia Oulu factory: Manufacturing base station parts

Deployed an LTE-powered mobile private IoT network with edge-cloud for operation automation

- **Productivity**
  - Effective use of machinery: \(\uparrow 40\%\)
  - System maintenance frequency: \(\downarrow 98\%\)

- **Efficiency**
  - Operations: \(\uparrow 30\%\)
Adopters see big gains

Bosch Rexford, Homburg: Factory manufacturing hydraulic valves
Deployed an IoT network with edge cloud for operation automation

- **Productivity**
  - Output
  - Increase by 10%

- **Efficiency**
  - Stock reduction
  - Decrease by 30%

- **Efficiency**
  - Savings
  - Increase by 500,000€

- **Flexibility**
  - Setup time for producing the 250 variants was reduced from 450 to 0 secs
  - Decrease by 0 sec
Smart Enterprise Transformation is the next big infrastructure build out.

5G & edge cloud with IoT, AI/ML & AR/VR will enable transformation.

Every enterprise will be impacted, making this a transformational market opportunity.

The US$517bn 5G+Edge ecosystem across just five industries:

- **Industrial manufacturing**: $206.4bn
- **Connected healthcare**: $45.3bn
- **Intelligent transportation**: $24.3bn
- **Environmental monitoring**: $5.0bn
- **Gaming**: $236.0bn

Source: KPMG - https://assets.kpmg/content/dam/kpmg/pe/pdf/5g-edge-computing-value-opportunity.pdf
Current Solutions

Purpose Built
Closed & Proprietary

Proposed Solution
Aether

Open Source
General Purpose
Easy to Use
Economical

To create an Android Effect
Open Source Platform for Private 4G/5G Connected Edge Cloud as a Service

with
Fine-Grained Measurement, Closed Loop Control and Network Verification
Connected Edge

Aether Connected Edge (ACE)

Distributed Mobile Core User Plane provides local breakout at all remote Aether Edge sites

RAN + Core + Edge Stack

SDN Substrate

Edge Apps

IoT AI/ML Platform(s)

Central Cloud

Aether Connectivity Control (ACC)

Aether Management Platform (AMP)

Central IoT AI/ML Apps

Shared Mobile Core Control Plane in central cloud supports all Aether Edge sites

Small Cell

Sensors

Surveillance

Multimedia

Employees

Visitors

IoT

CBRS or Licensed Band
Aether Essential Services for Enabling 5G-Driven Smart Enterprise Initiatives

Connectivity Service

Connected Edge Cloud Service

End-to-End Slicing

Private 4G/5G/CBRS connectivity, for mission critical applications

Designed to natively support edge applications and AI/ML for digital transformation projects

Manage precise interlinked assembly of connectivity and cloud compute for each application

All offered as cloud-managed services
Aether “Essential” Services: Key Attributes

- Connectivity Service
- Connected Edge Cloud Service
- End-to-End Slicing

Qos and Security Guarantees
Programmable and Customizable
Fine-grained visibility
Closed loop control for resource optimization, trouble shooting, security
Verifiability
SD-Core: Disaggregated Virtualized Cloud Native Mobile Core
SD-RAN: O-RAN Based Software Defined Cloud Native
Containerized and Cloud Native
SDN with Programmable Forwarding
Aether Enables End-to-end Solutions for Enterprises

Enterprise Devices

IoT
- Sensors
- Surveillance
- Multimedia
- Employees

COTS Edge Optimized Hardware

Edge Apps

AI/ML Platforms

IoT Platforms

Vision Platforms

White box Compute, Networking, NICs & Small Cell Radios with x86/ARM CPUs, GPUs, DPUs, TPUs, P4 silicon

Aether Enables End-to-end Solutions for Enterprises
So what is real?
Aether has been operational in pilot deployment since December’19
Upcoming ACE Sites: Cornell, Princeton and Stanford
Object Identification App Running on Azure IoT Edge Platform Integrated with ACE

Edge Platforms and Applications Demonstrated

Dual MNO-Aether Connectivity

Smart Spaces – Space Occupancy Detection App

CDN App
Person Detection App Running on Google Anthos Platform
Aether Operator Dashboards (Pilot Network)
### Enterprise Dashboard: Aether Health Monitoring (Coming)

**Aether at XYZ Corp**

**Overall Health:** Impaired  
**Last Update:** Oct 25, 2020 14:45 PST

**Enterprise Summary:**  
- **Deployed Sites:** 4  
- **Devices:** 1,148  
- **Radios:** 9  
- **Edge Compute Clusters:** 42

### Los Angeles
- Healthy

### New York
- Critical

### Miami
- Impaired

### Atlanta
- In Maintenance

**Time Selection:** Last 4 hours

#### Health of New York

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<thead>
<tr>
<th>Metric</th>
<th>Measure 1: value</th>
<th>Measure 2: value</th>
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<td>Metric 1</td>
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<td>Metric 3</td>
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**Edge Compute**

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**QoS & Slicing**

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### Notifications

**Active Filters:** New York, Connectivity Service

**Time Selection:** Last 4 hours

<table>
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<tr>
<th>Time Stamp</th>
<th>Importance</th>
<th>Source</th>
<th>Description</th>
<th>Suggested Remedial Action</th>
</tr>
</thead>
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**Filtered event log sorted by time**

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**Portal Navigation Menu**

**Get Help**

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**Welcome:** A. Joe (Operator) | Log Out
DARPA Funded: Project “Pronto”

$30M funding for three years to build, deploy, and operate a production-ready Aether with fine-grained measurement, closed loop control, and network verification.

- Fine-grained measurement
- Network Verifiability: forwarding/sw stack
- Closed-Loop Control

- Software-Defined Edge Cloud Infrastructure
- Software-Defined Disaggregated RAN
- Software-Defined Disaggregated Core
- Edge Cloud Platform Operationalization
- Edge Services
  - Towards Pre-Production
Learn More from Experts: Pronto Research

Nick McKeown,
Stanford
December 9th 8:00am
Pacific

Jen Rexford,
Princeton

On-Demand on
Web

Nate Foster,
Cornell
Learn More from Experts: Aether Platform

Oguz Sunay, ONF
December 9th 8:00am Pacific

Larry Peterson, ONF
December 10th 8:00am Pacific

https://aetherproject.org
Aether Ecosystem
In conclusion ...
Smart Enterprise Transformation
Aether: Private 4G/5G Connected Edge-Cloud-as-a-Service

Innovations
- Private 4G/5G enabled edge cloud
- Local breakout
- Cloud-native connected edge platform with support of multi-cloud
- Cloud-based managed service
- End-to-end network slicing
- SDN with programmable forwarding
- Top down network programming and control
- Fine-grained measurement, closed-loop control
- Network verification
- Open source software & COTS hardware

Benefits
- Compelling Economics
  - Open Source + COTS
  - Managed Service
  - Minimize WAN BW
  - Monetization via reverse MVNO
- Highly Secure
  - Mobile cellular like
  - Programmable access control
  - Detect and prevent DDOS
- Right for Mission Critical Use
  - Predictable performance
  - Low latency
  - Secure
- Control of Your Destiny
  - Top-down programmable control
  - Fine-grained real time visibility
  - Innovation in production
  - Own your data
- Platform for Diverse Applications
  - connectivity + computing
  - on edge + public/central cloud

Enterprise Value Prop
Aether: ONF Flagship Project Primed for Big Impact

- **Funding from DARPA + Companies**
  - Funding committed over 3 years, starting June 2020.

- **Compelling Mission**
  - Private 4G/5G Connected EdgeCloud-as-a-Service with Fine-grained Measurement, Closed-Loop Control & Verification
  - Builds on ONF's in-production platforms and latest cloud technologies and augmented by Research

- **Dream Team**
  - ONF: Software Team, Ecosystem
  - Cornell, Princeton, Stanford: Profs, Post-Docs, Students
  - Campus IT as users/customers

- **Solid Technical Chops**
Let us Join Forces to Realize Full Potential of Smart Enterprises

• **Enterprises** interested in “smart enterprise” transformation
  – Happy to explore Aether Connected Edge deployment for a POC or trial leading to a production deployment

• **Ecosystem partners** wanting to enable and accelerate “smart enterprise” transformation
  – Happy to integrate your IoT, ML/AI, ... platform and applications in Aether
  – Happy to port Aether to your hardware or software platform

• **University campuses**
  – Happy to support Aether Connected Edge deployment for your research and campus automation
    Replicate and build on what Stanford, Princeton, and Cornell doing

• **Open source developers**
  – Love to get your help and help you make significant contributions to a significant project
Thank You!

https://aetherproject.org