



# 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

↓ 6 hours



## Efficiency

Production costs

↓ 70%



## Safety & Security

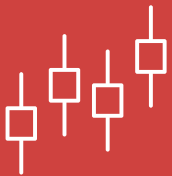
Worker Injuries

↓ 91%

## Flexibility

Bike variations on a single production line

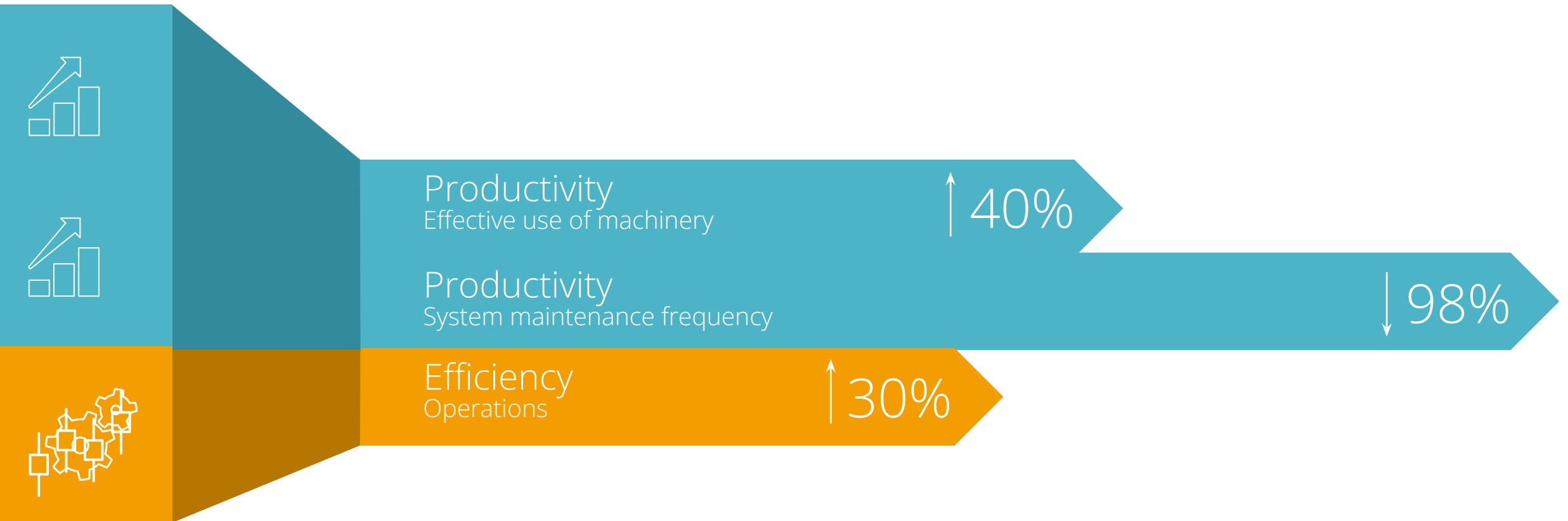
↑ 1,700



# 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



# Adopters see big gains

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



Productivity  
Output ↑ 10%



Efficiency  
Stock reduction ↓ 30%



Efficiency  
Savings ↑ 500,000€

Flexibility  
Setup time for producing the 250 variants was reduced from 450 to 0 secs ↓ 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





A person with a backpack is shown in mid-air, jumping from one rock pillar to another. The background is a vast, blue sky filled with white clouds. The scene is framed by a blue, geometric pattern of lines and shapes, giving it a futuristic or technological feel.

**Current Solutions**

**Purpose Built  
Closed & Proprietary**

**What Market Needs**

**General Purpose  
Easy to Use  
Economical**



**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



IoT



Sensors



Surveillance



Multimedia

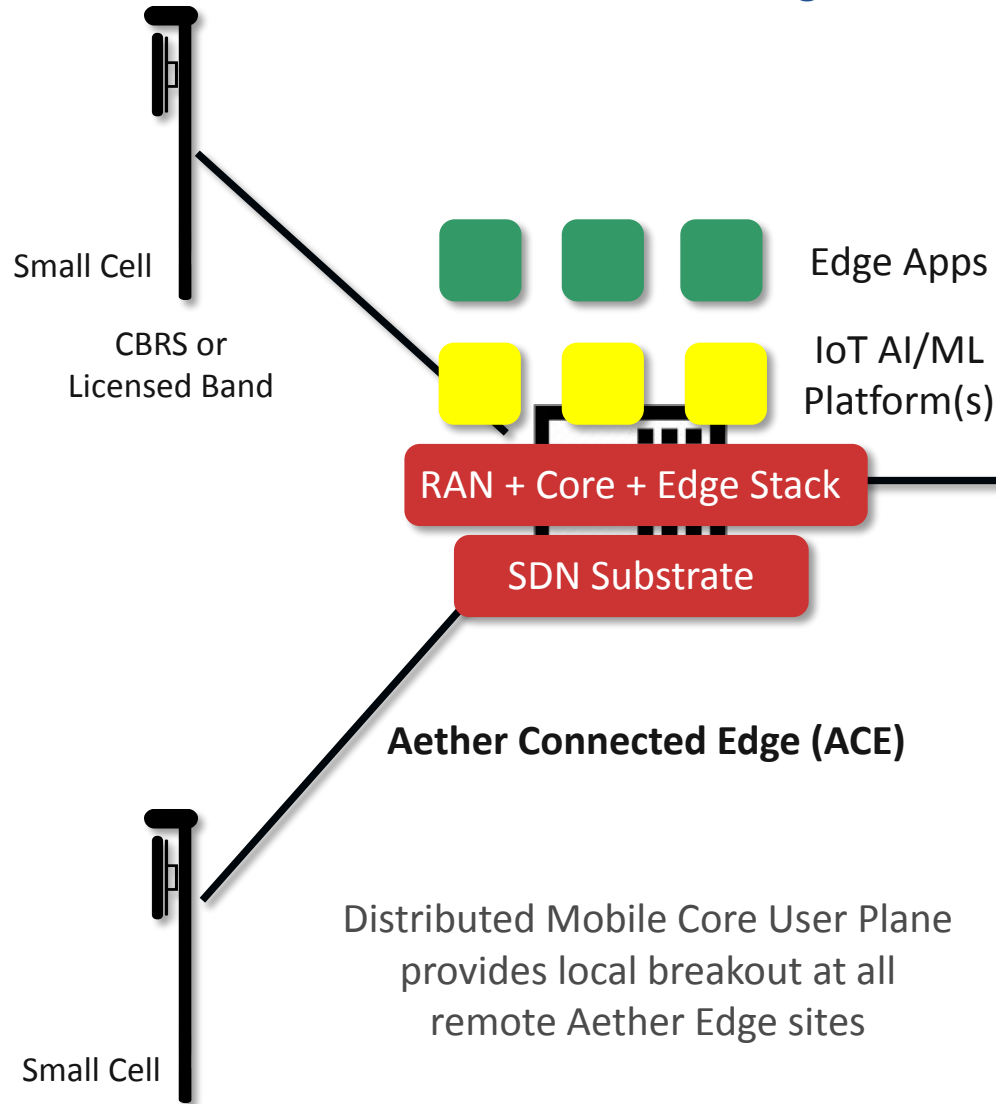


Employees

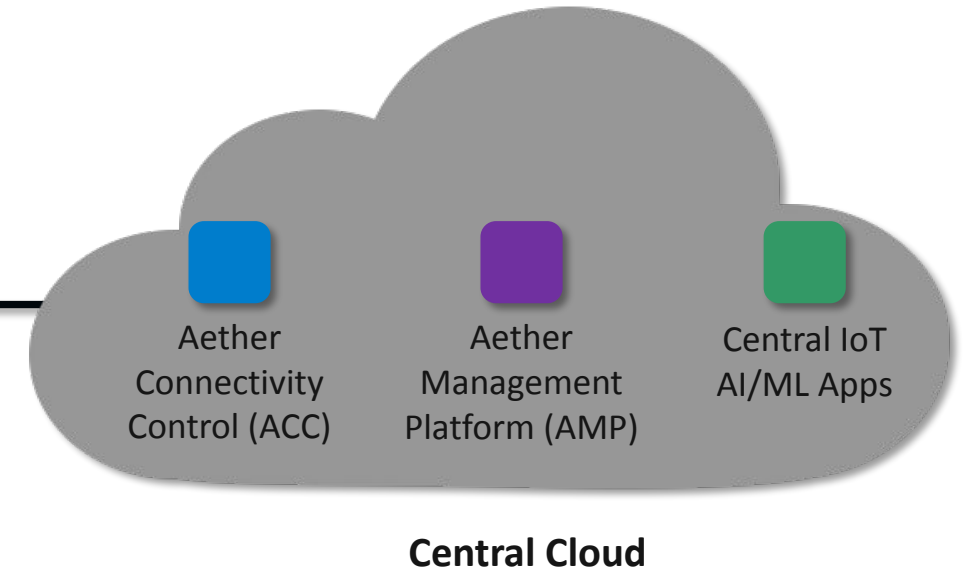


Visitors

## AETHER Connected Edge



## AETHER Central



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

# Aether Essential Services

## for Enabling 5G-Driven Smart Enterprise Initiatives

### Connectivity Service



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

### Connected Edge Cloud Service



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

### End-to-End Slicing



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



# Aether Foundational Technologies

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



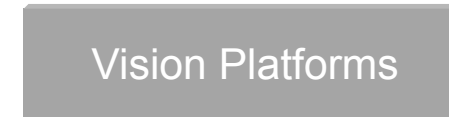
Surveillance



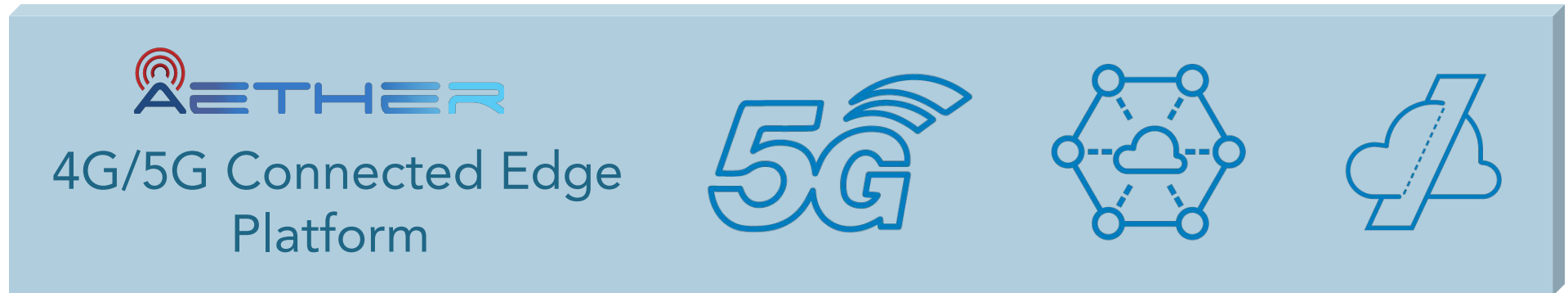
Multimedia



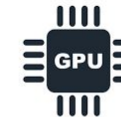
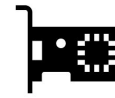
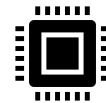
Employees



Enterprise Apps &  
Third-Party Platforms



COTS Edge  
Optimized  
Hardware



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

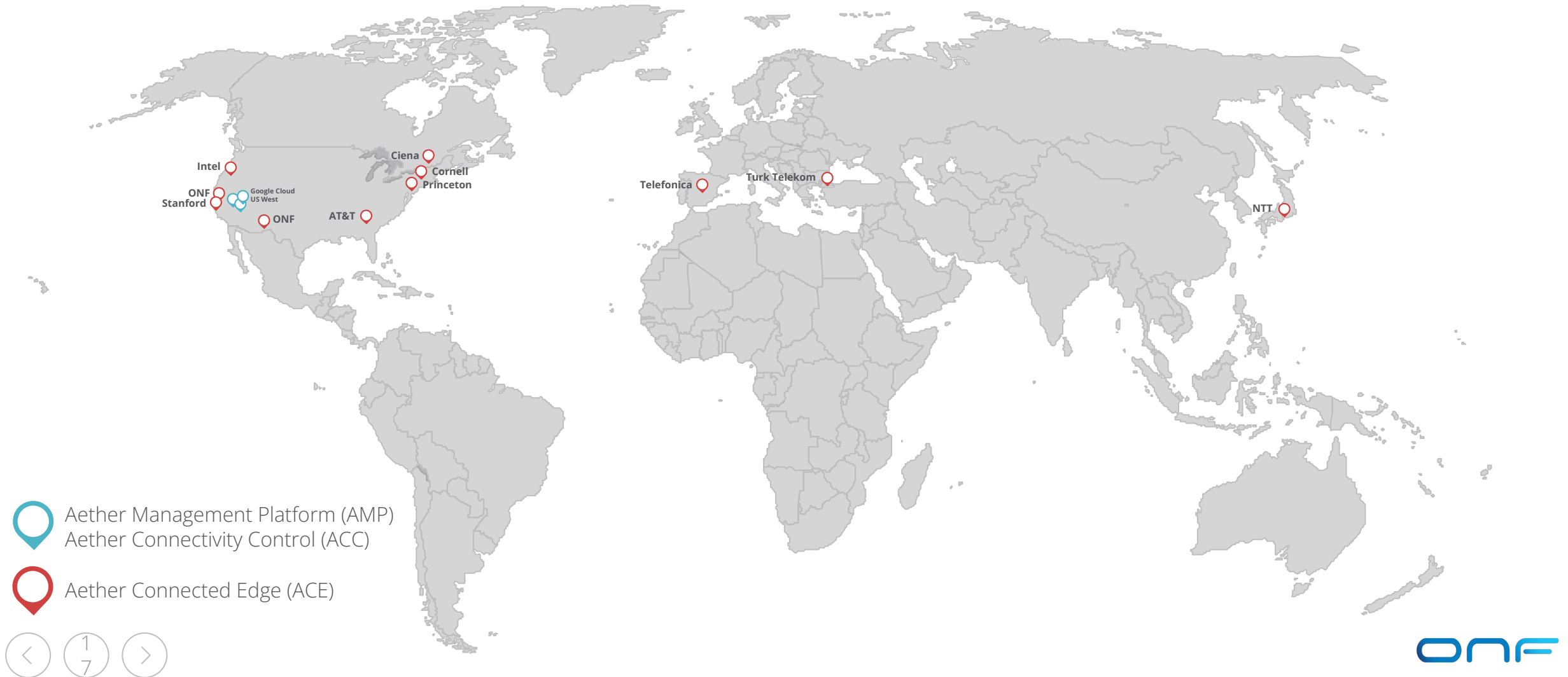
So what is real?

# Aether has been operational in pilot deployment since December'19

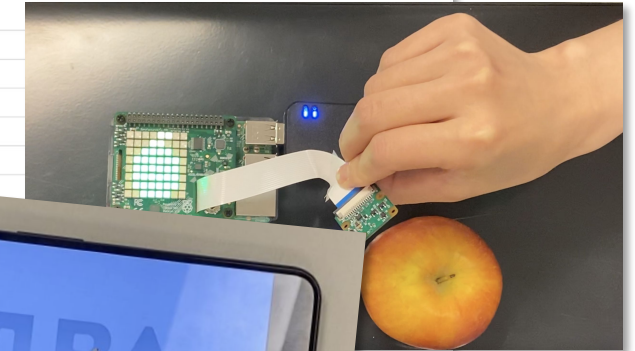
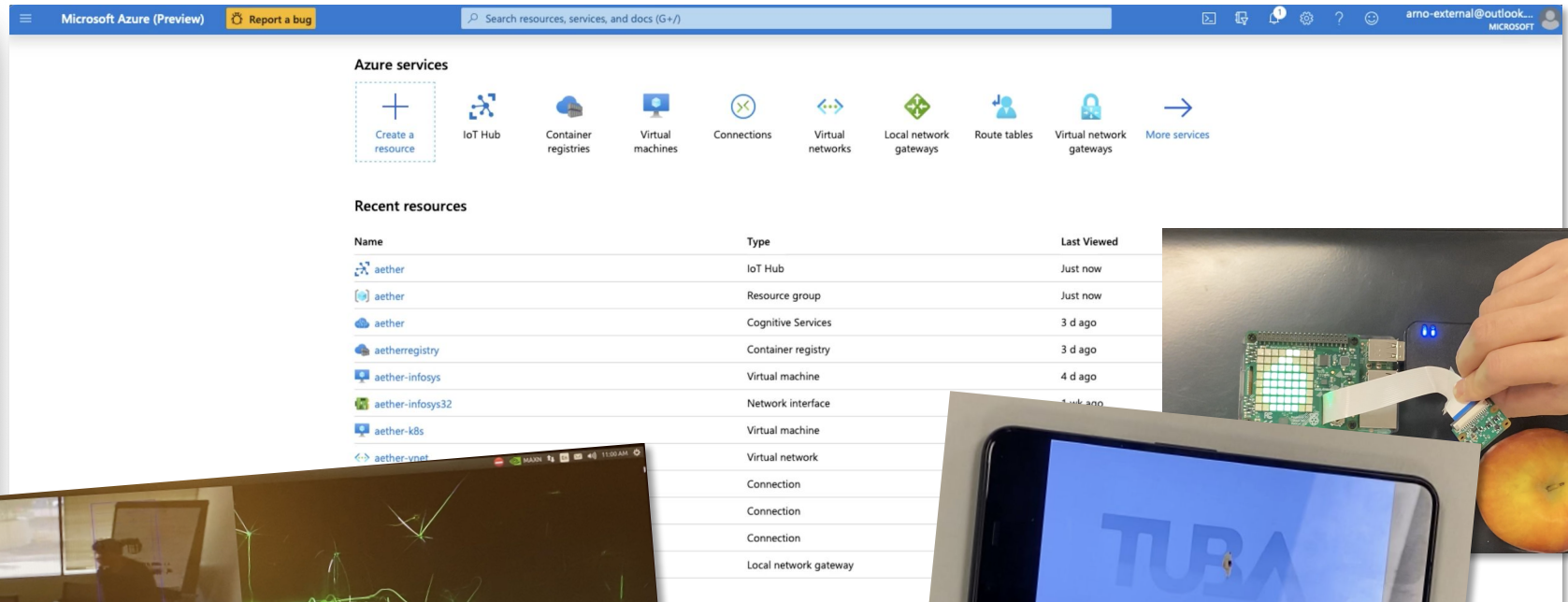




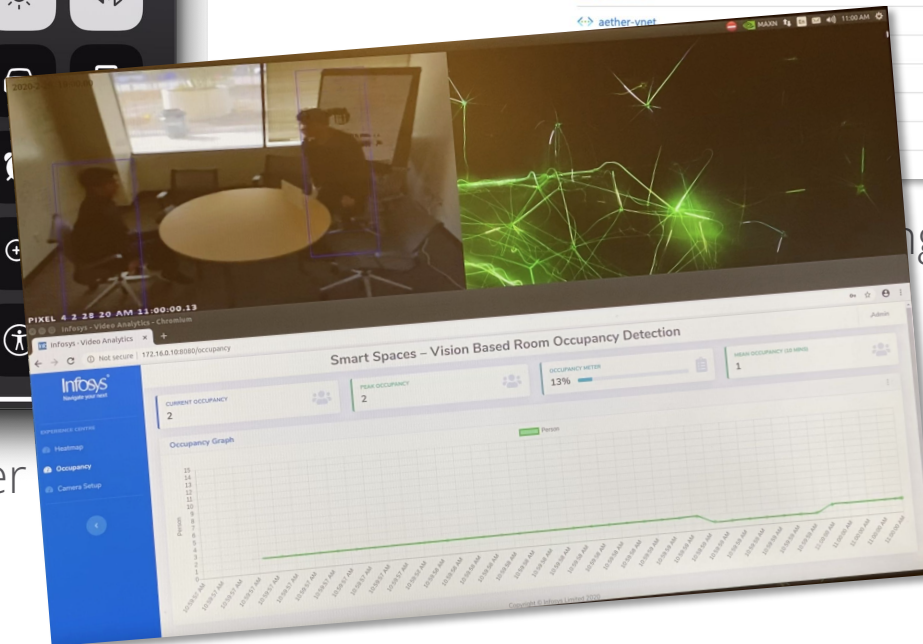
# Upcoming ACE Sites: Cornell, Princeton and Stanford



# Edge Platforms and Applications Demonstrated



Dual MNO-Aether



Smart Spaces – Space Occupancy Detection App



CDN App

# Person Detection App Running on Google Anthos Platform

Google Cloud Platform gcp-demo Search products and resources

Anthos

Clusters **BETA** CREATE CLUSTER REGISTER EXISTING CLUSTER onf-demo

**Status**

✓ All clusters healthy

1 cluster total

**Anthos managed clusters**

Filter table

Name	Location	Type	Labels
onf-demo	registered	Anthos	

**Details**

Type	Anthos
Master version	v1.18.6-gke.6600
Location	registered
Cluster Size	2
Total cores	80 CPU
Total memory	134.11 GB

**Cluster features**

Feature Authorizer ✓ Enabled

Google Cloud Platform gcp-demo Search products and resources

Kubernetes Engine

Workloads REFRESH DEPLOY DELETE

Cluster Namespace 21 options selected RESET SAVE **BETA**

cluster.

Is system object: False Filter workloads

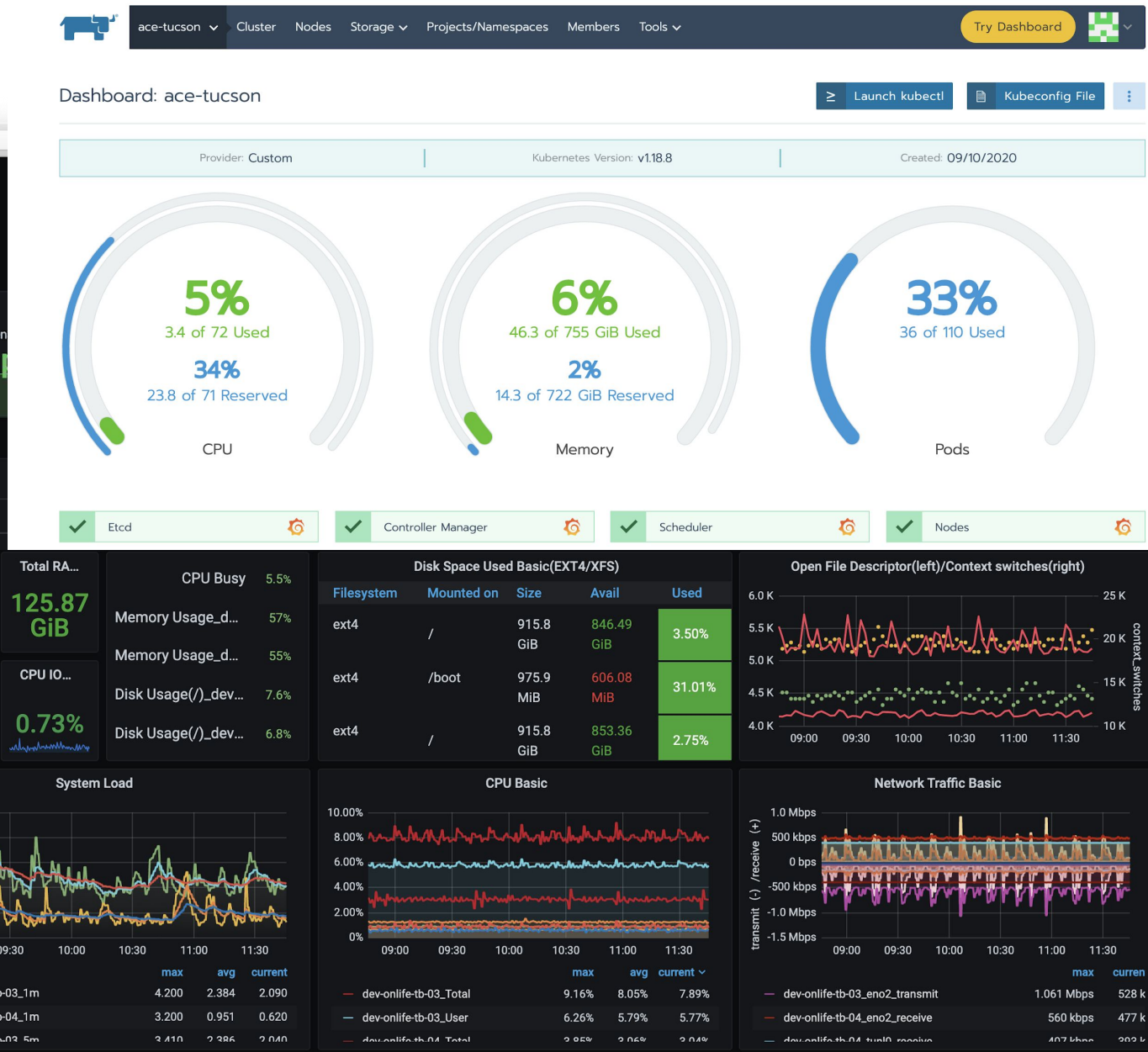
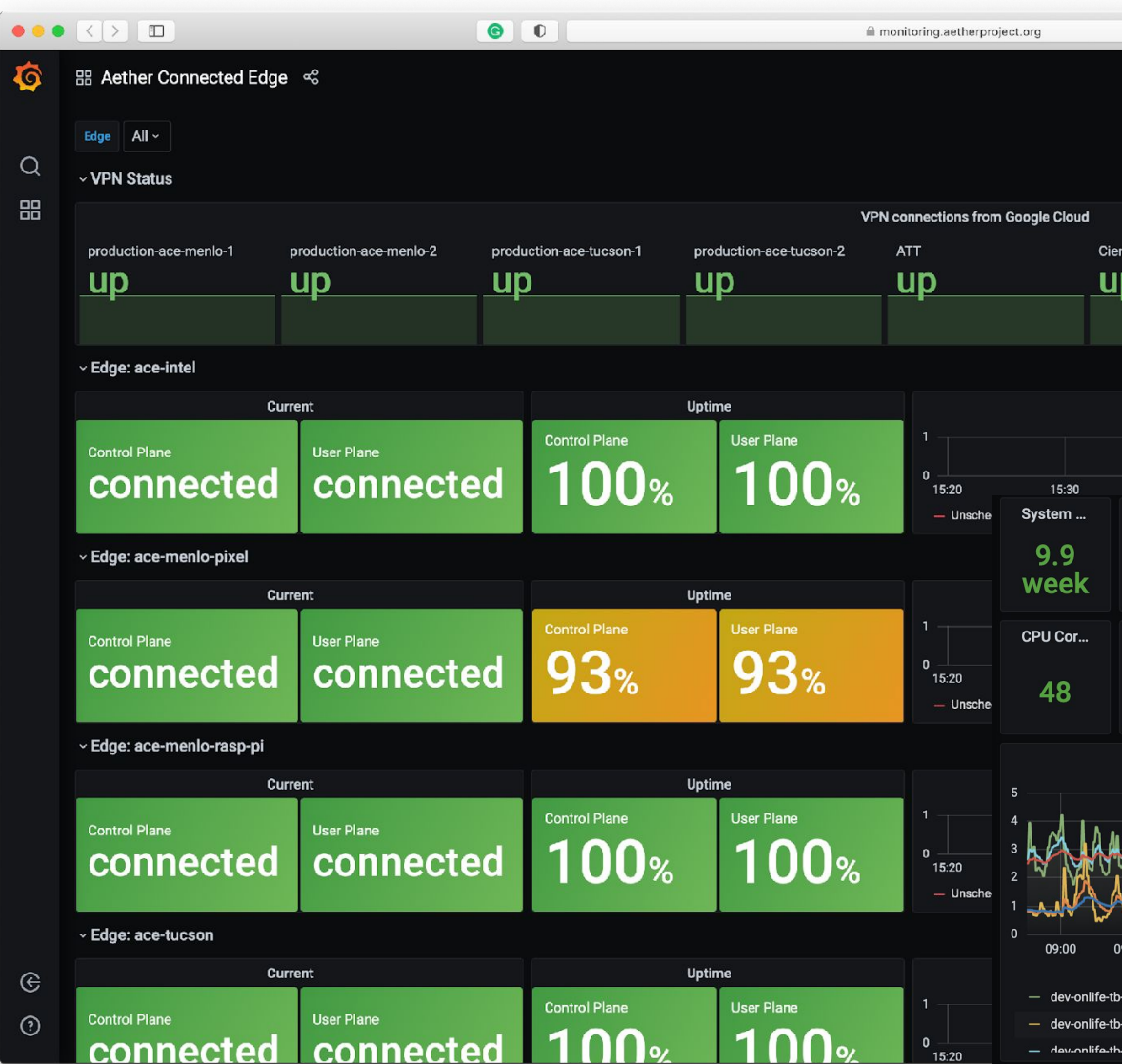
Name	Status	Type	Pods	Namespace	Cluster
10.92.1.43-machine-update-da40298f-892f-4e92-8ab2-d8a19de497b7	✓ OK	Job	0/1	cluster-onf-demo	onf-demo
10.92.1.44-machine-update-ff8162f1-27aa-4b60-950f-1de021b89f61	✓ OK	Job	0/1	cluster-onf-demo	onf-demo
ais	✓ OK	Deployment	1/1	anthos-identity-service	onf-demo
capi-controller-manager	✓ OK	Deployment	1/1	capi-system	onf-demo
capi-controller-manager	✓ OK	Deployment	1/1	capi-webhook-system	onf-demo
capi-kubeadm-bootstrap-controller-manager	✓ OK	Deployment	1/1	capi-webhook-system	onf-demo
capi-kubeadm-bootstrap-controller-manager	✓ OK	Deployment	1/1	capi-kubeadm-bootstrap-system	onf-demo
cert-manager	✓ OK	Deployment	1/1	cert-manager	onf-demo
cert-manager-cainjector	✓ OK	Deployment	1/1	cert-manager	onf-demo
cert-manager-webhook	✓ OK	Deployment	1/1	cert-manager	onf-demo
danm-test-deployment	✓ OK	Deployment	1/1	apps	onf-demo
git-importer	✓ OK	Deployment	1/1	config-management-system	onf-demo
gke-connect-agent-20201113-01-00	✓ OK	Deployment	1/1	gke-connect	onf-demo
istio-ingress	✓ OK	Deployment	2/2	gke-system	onf-demo
istio-ingressgateway	✓ OK	Deployment	1/1	istio-system	onf-demo
istio-operator	✓ OK	Deployment	1/1	istio-operator	onf-demo
istiod	✓ OK	Deployment	1/1	istio-system	onf-demo
istiod	✓ OK	Deployment	2/2	gke-system	onf-demo
monitor	✓ OK	Deployment	1/1	config-management-system	onf-demo
onf-demo-network-health-9e7069d7e2a19eb24c8cd03ecbccd9b7	✓ OK	Job	0/1	cluster-onf-demo	onf-demo
phylo-mystream	✓ OK	Deployment	1/1	apps	onf-demo
stream-server	✓ OK	Deployment	1/1	output-1	onf-demo
stream-server	✓ OK	Deployment	1/1	output-2	onf-demo
stream-server	✓ OK	Deployment	1/1	input-1	onf-demo
wowza	✓ OK	Deployment	1/1	apps	onf-demo

Rows per page: 50 1 - 25 of 25 Show debug panel





# 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  Welcome: A. Joe (Operator) | Log Out

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**

## Health of New York

**Connectivity**

Devices Count: 454  
Operational: 390  
Impaired: 64

Radios Count: 4  
Operational: 3  
Impaired: 1

Aether Central  
Up/Downlink: 75/34 Mbps  
Latency: 35 ms

**Edge Compute**

Metric 1 Measure 1: value Measure 2: value

Metric 2 Measure 1: value Measure 2: value

Metric 3 Measure 1: value Measure 2: value

**QoS & Slicing**

Metric 1 Measure 1: value Measure 2: value

Metric 2 Measure 1: value Measure 2: value

Metric 3 Measure 1: value Measure 2: value

## Notifications

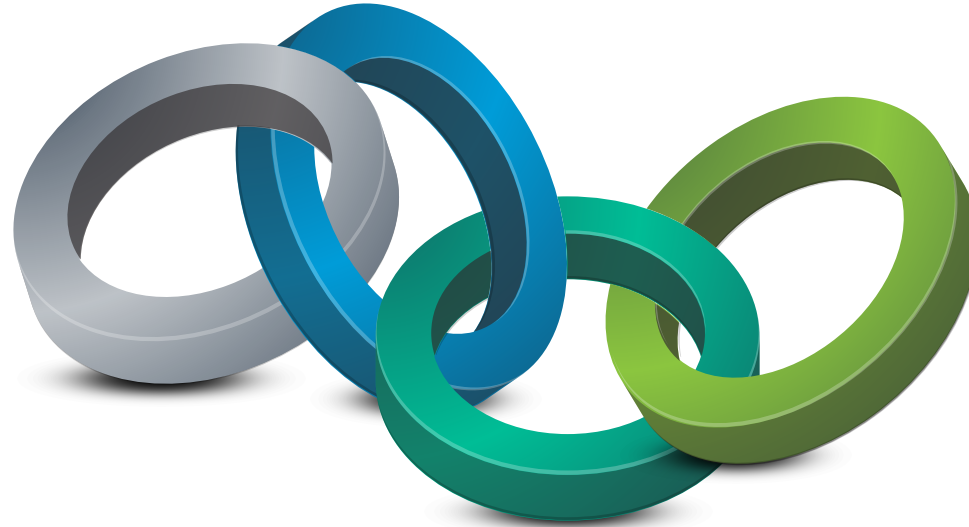
Active Filters: New York, Connectivity Service

Time Selection: Last 4 hours

Time Stamp ▼	Importance	Source	Description	Suggested Remedial Action
Filtered event log sorted by time				

# 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 9<sup>th</sup> 8:00am  
Pacific



Jen Rexford,  
Princeton



Nate Foster,  
Cornell

On-Demand on  
Web

# Learn More from Experts: Aether Platform



Oguz Sunay,  
ONF  
December 9<sup>th</sup> 8:00am  
Pacific



Larry Peterson,  
ONF  
December 10<sup>th</sup> 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

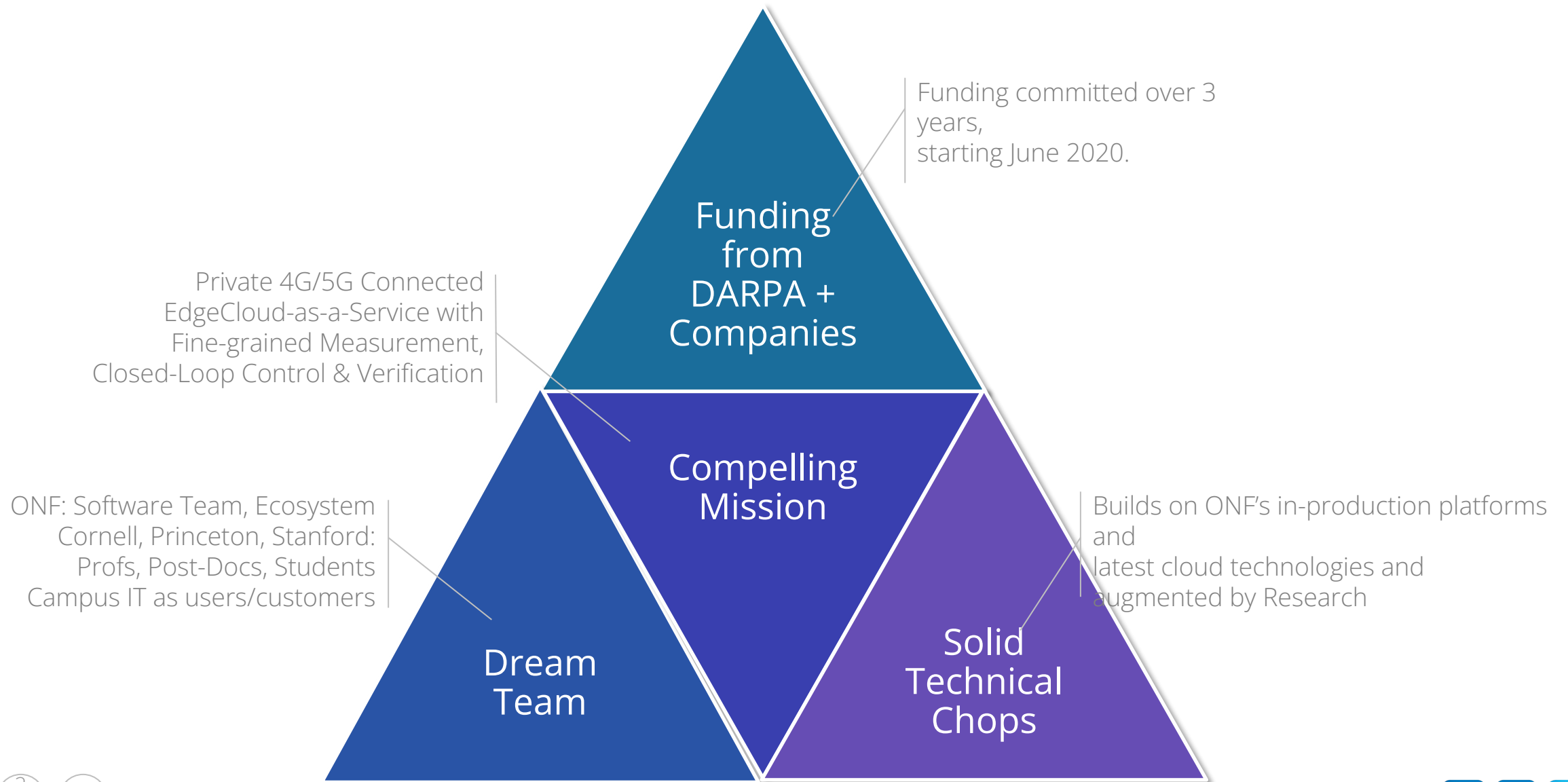
Top-down programmable control  
Fine-grained real time visibility  
Innovation in production  
Own your data

#### Enterprise Value Prop

#### Platform for Diverse Applications

connectivity + computing  
on edge + public/central cloud

# Aether: ONF Flagship Project Primed for Big Impact



# 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>