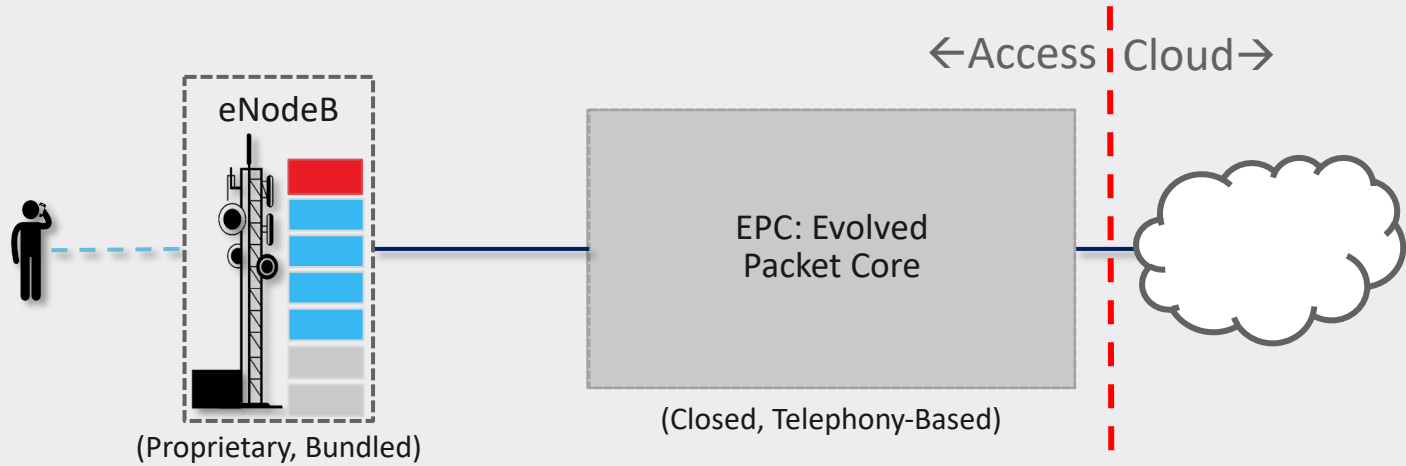


*AETHER: OPEN 5G-CONNECTED  
EDGE CLOUD*

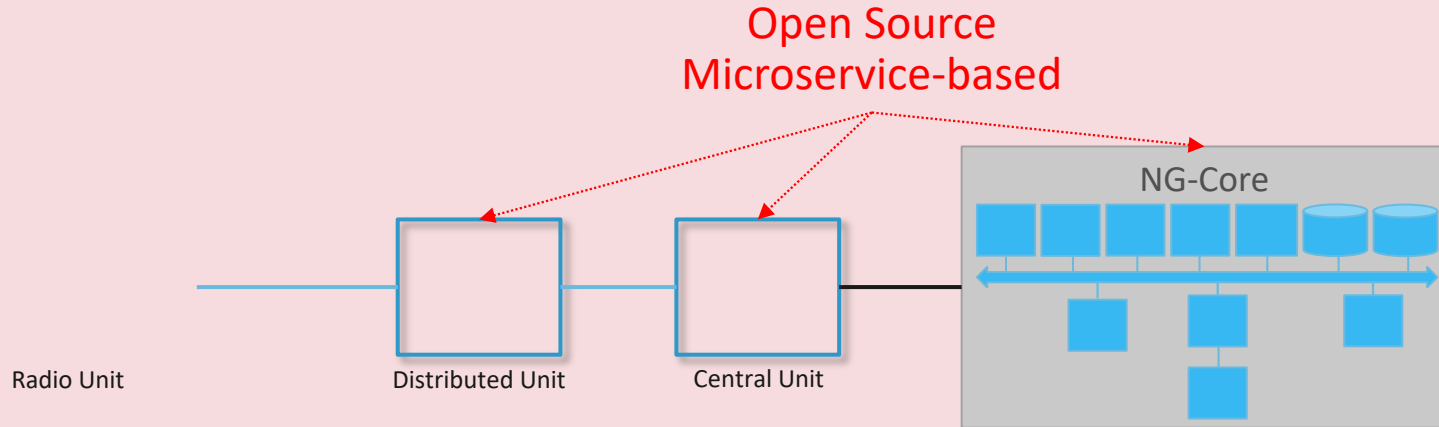
*Larry Peterson  
Open Networking Foundation  
Princeton University*

# 5G TRANSFORMATION

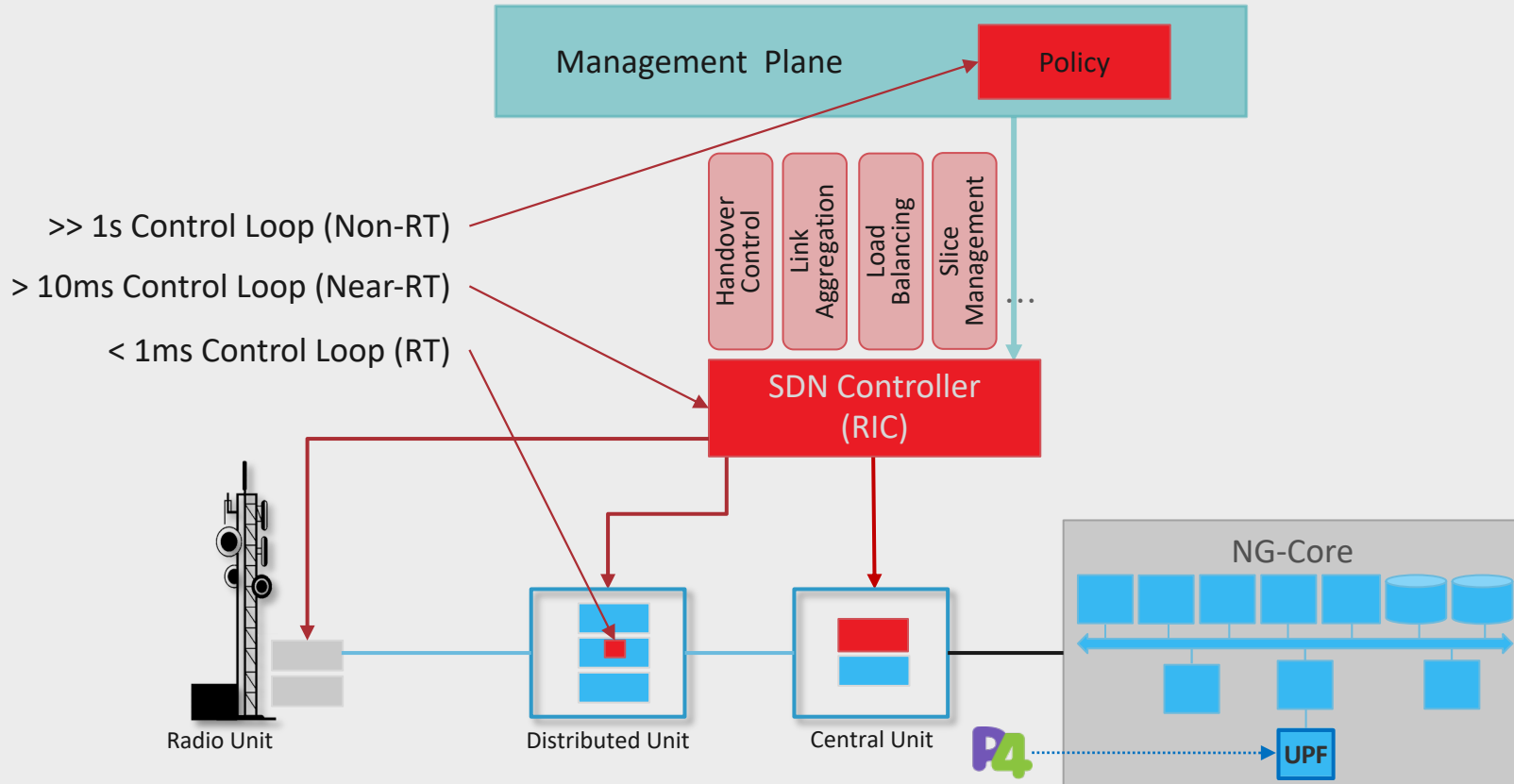
4G



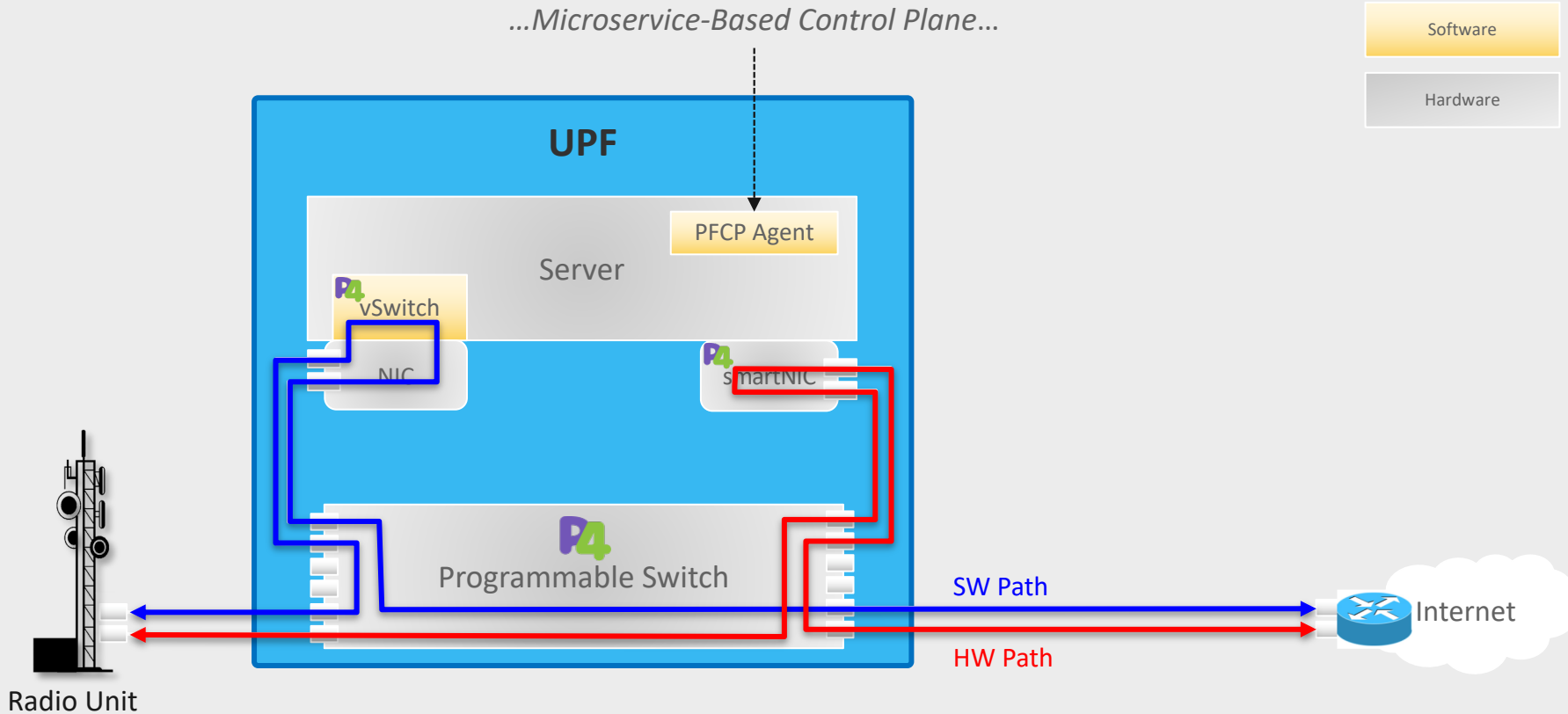
5G



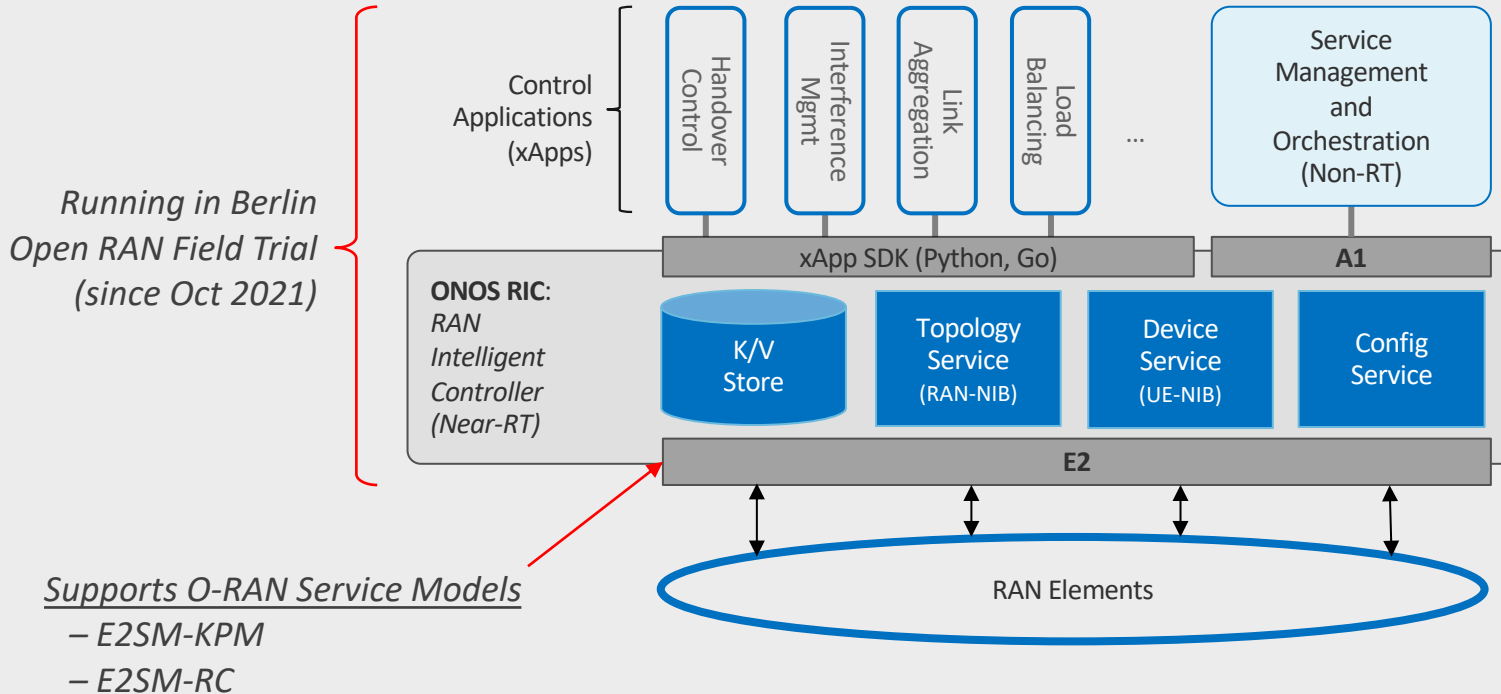
# PROGRAMMABLE END-TO-END & TOP-TO-BOTTOM



# SD-CORE: P4-BASED UPF



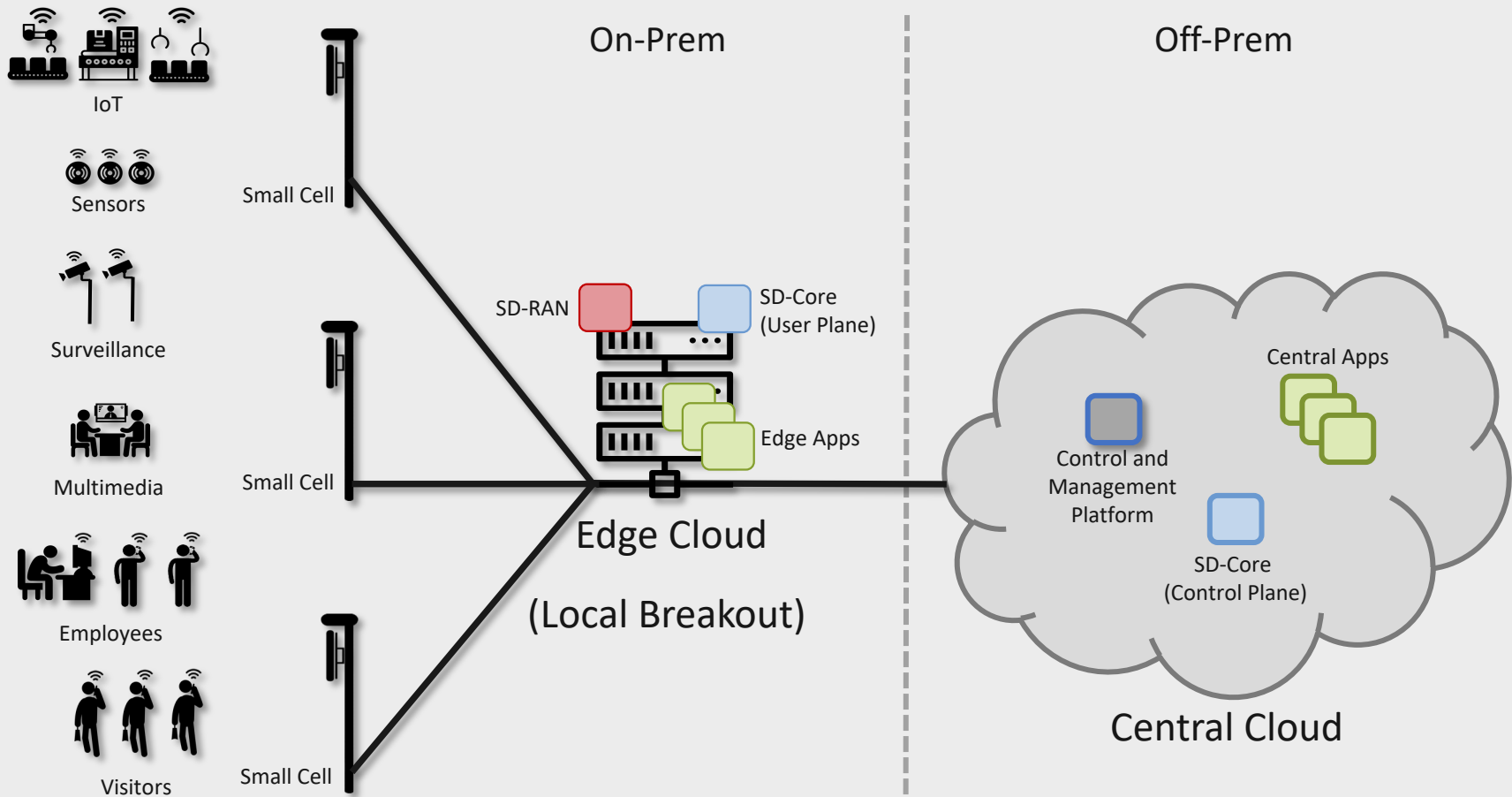
# SD-RAN: ONOS-BASED RIC



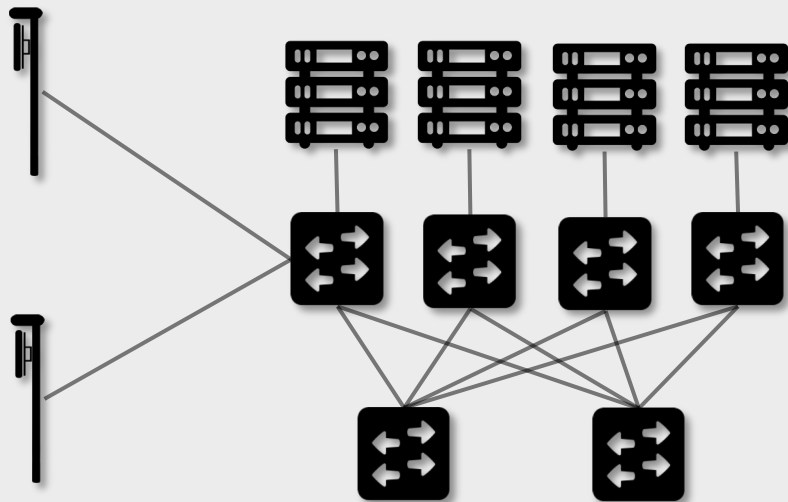


Private 5G as a Cloud-Managed Service  
(An Open Source Project at ONF)

# AETHER OVERVIEW

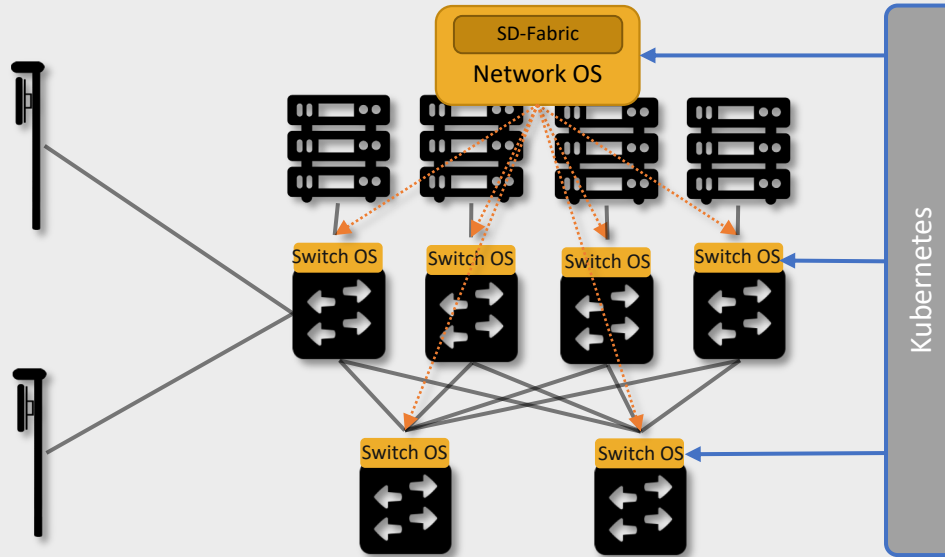


# AETHER HARDWARE

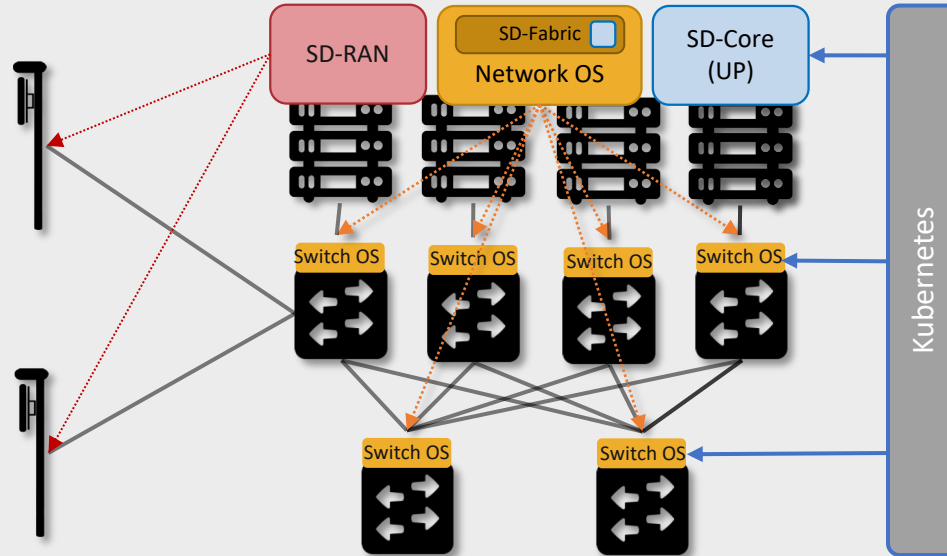




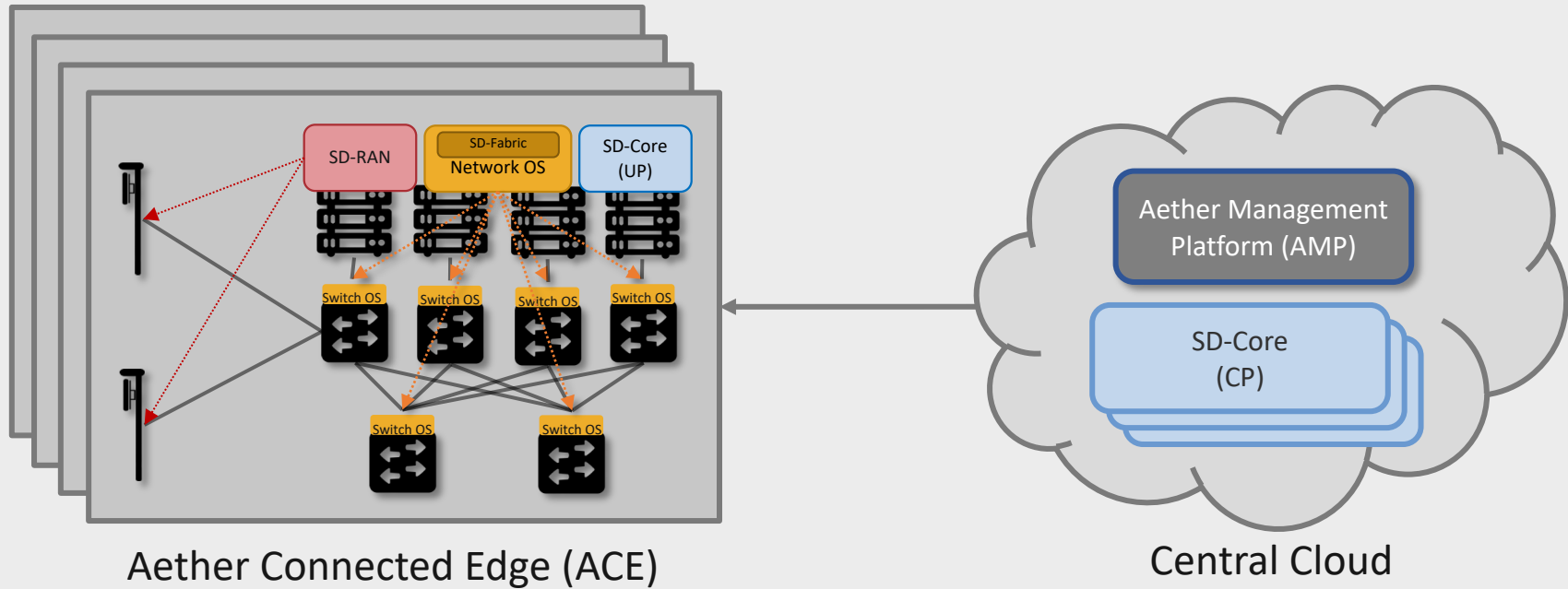
# AETHER PLATFORM



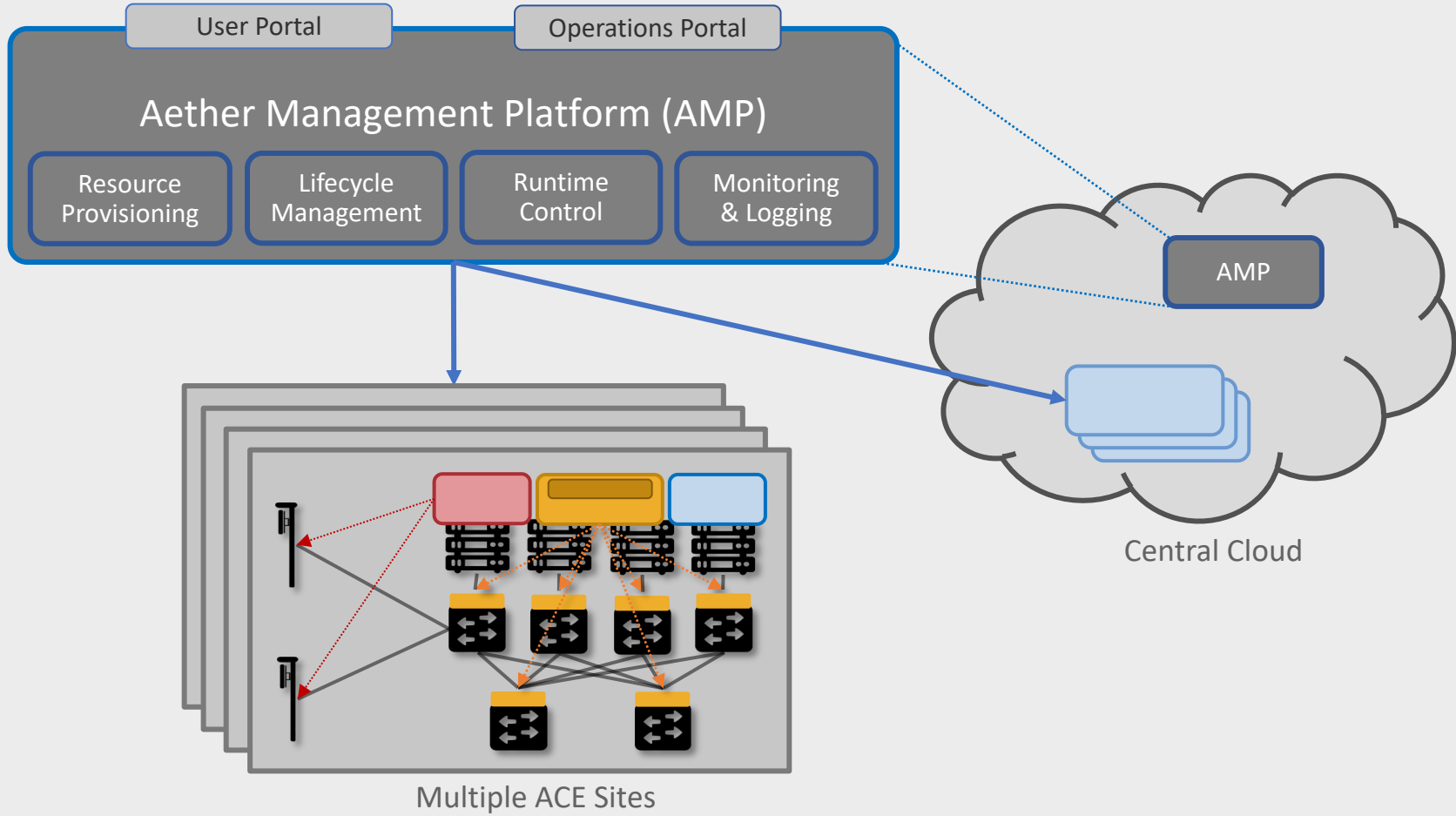
# AETHER CONNECTIVITY SERVICE



# AETHER AS A MANAGED SERVICE

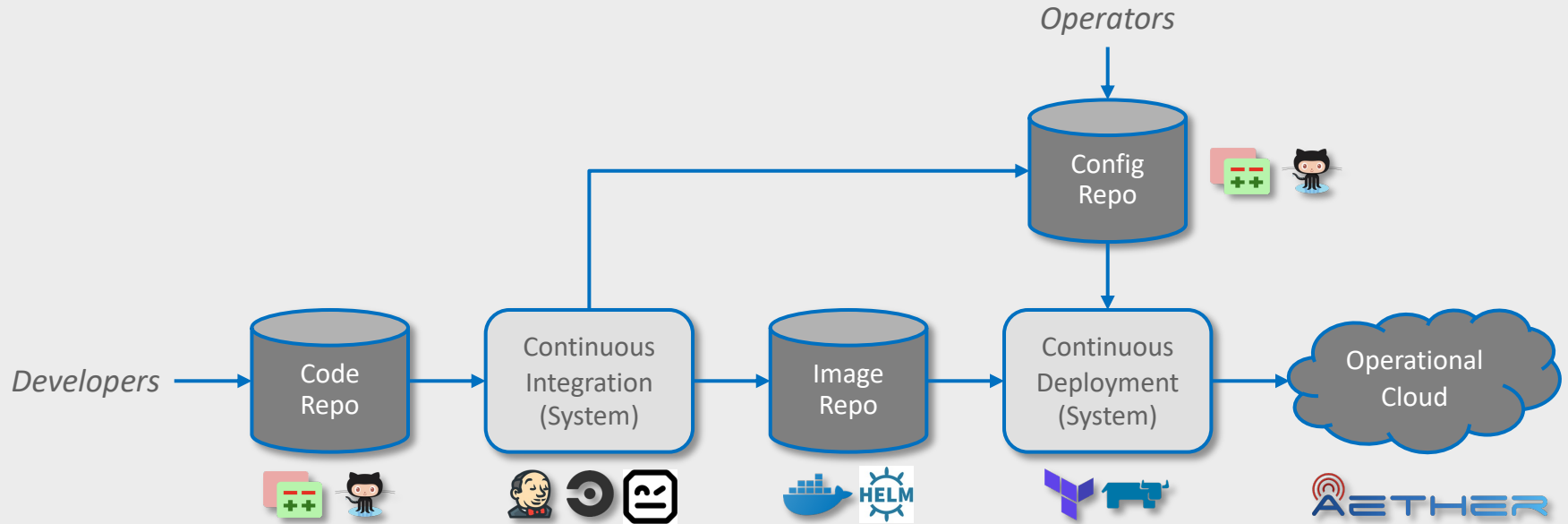


# AETHER MANAGEMENT PLATFORM



# LIFECYCLE MANAGEMENT

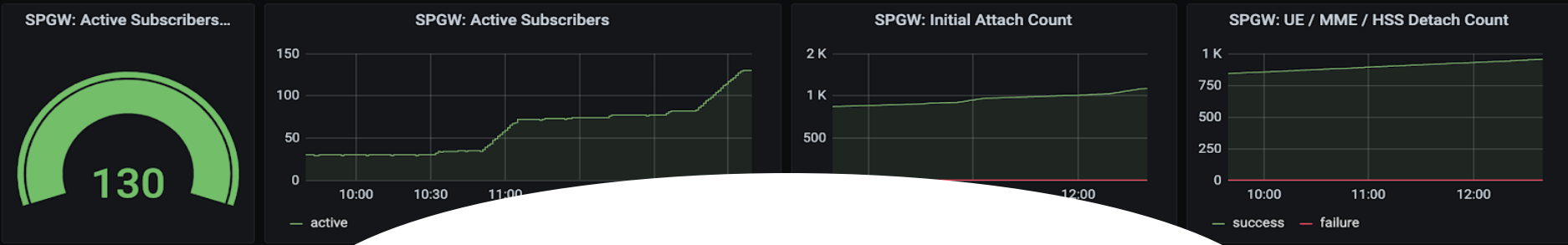
(Continuous Integration / Continuous Deployment)



# MONITORING & LOGGING

SD-CORE Metrics ☆ 🔗

📊 📄 ⚙️ 🖨️ 🕒 Last 3 hours 🔍 🔄 1m



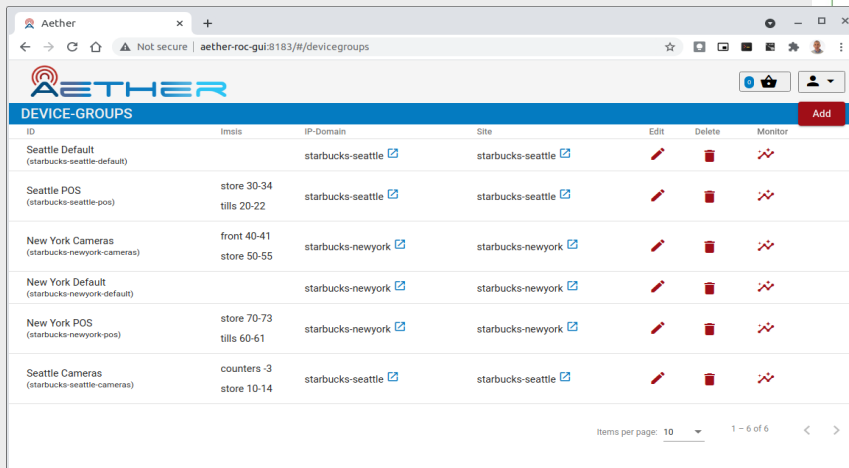
Prometheus Grafana Elasticsearch Kibana Fluentd



# RUNTIME CONTROL API

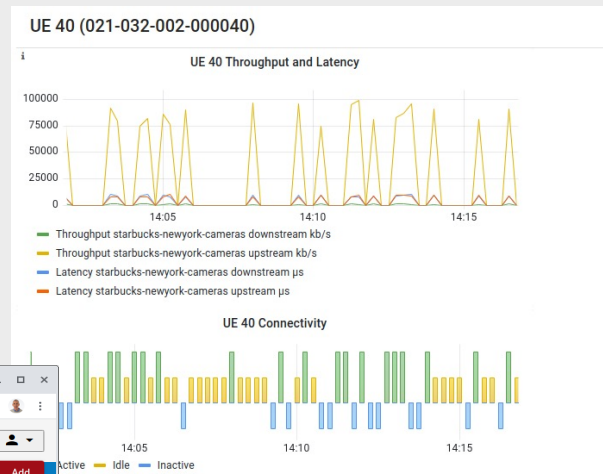
## Programmatic API and Enterprise Portal to...

- *Manage Devices and Device Groups*
- *Define Slices to Isolate Traffic*
- *Set QoS Parameters for Slices*
- *Assign Device Groups & Applications to Slices*
- ...

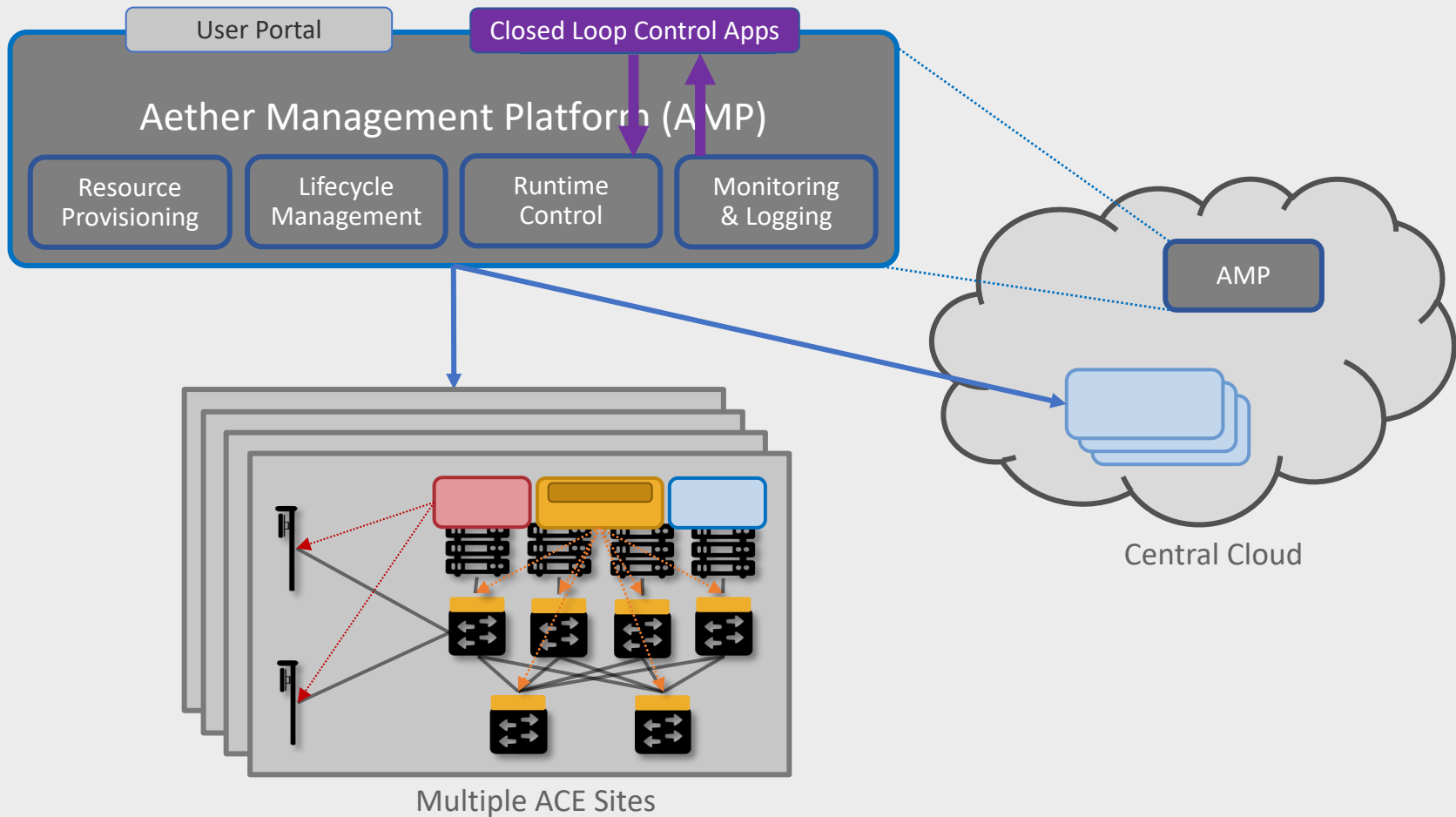


The screenshot shows the Aether Enterprise Portal interface. The browser address bar displays "aether-roc-gui:8183/#/devicegroups". The page title is "DEVICE-GROUPS" and includes an "Add" button. The table below lists various device groups with columns for ID, IMSI, IP-Domain, Site, and actions (Edit, Delete, Monitor).

ID	Imsis	IP-Domain	Site	Edit	Delete	Monitor
Seattle Default (starbucks-seattle-default)		starbucks-seattle	starbucks-seattle			
Seattle POS (starbucks-seattle-pos)	store 30-34 tills 20-22	starbucks-seattle	starbucks-seattle			
New York Cameras (starbucks-newyork-cameras)	front 40-41 store 50-55	starbucks-newyork	starbucks-newyork			
New York Default (starbucks-newyork-default)		starbucks-newyork	starbucks-newyork			
New York POS (starbucks-newyork-pos)	store 70-73 tills 60-61	starbucks-newyork	starbucks-newyork			
Seattle Cameras (starbucks-seattle-cameras)	counters -3 store 10-14	starbucks-seattle	starbucks-seattle			

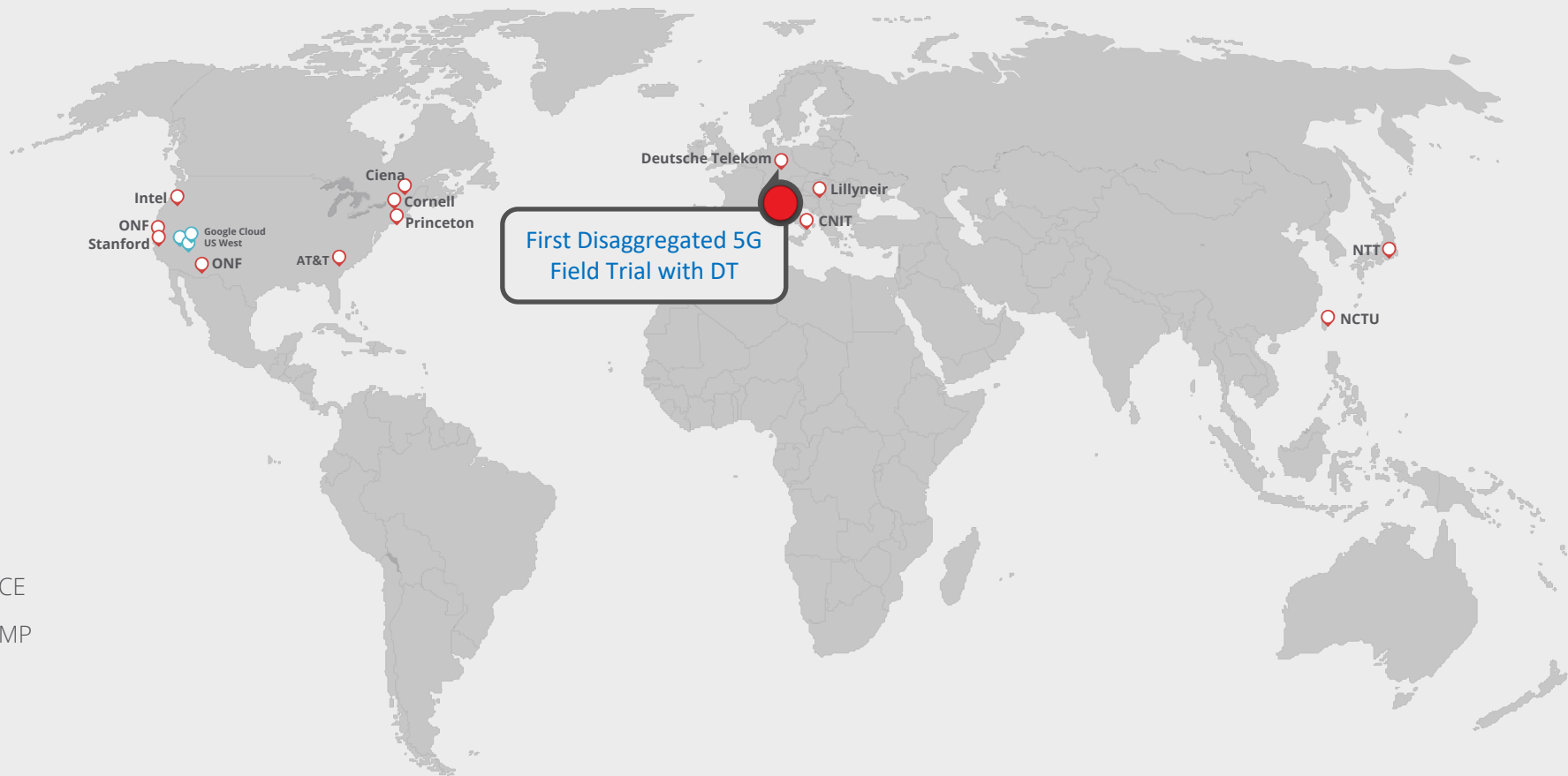


# CLOSED-LOOP CONTROL



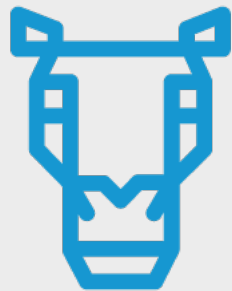


# AETHER HAS BEEN OPERATIONAL SINCE DECEMBER '19



ACE

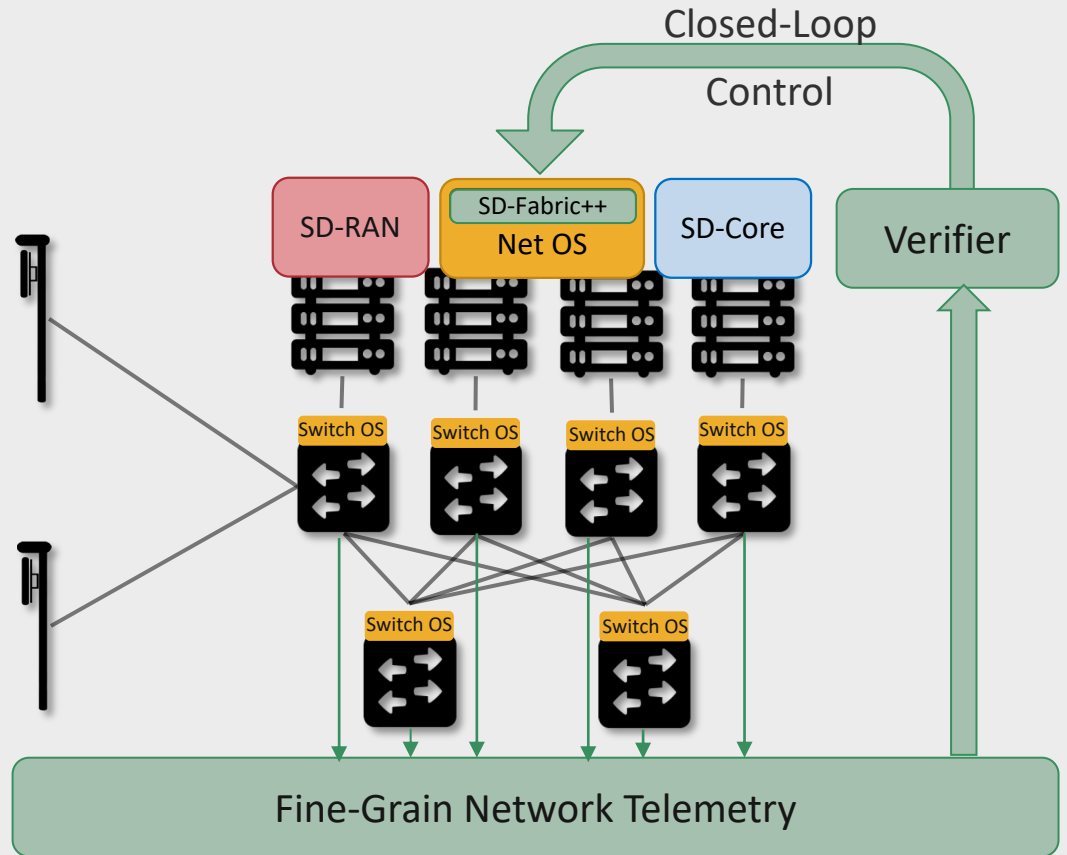
AMP



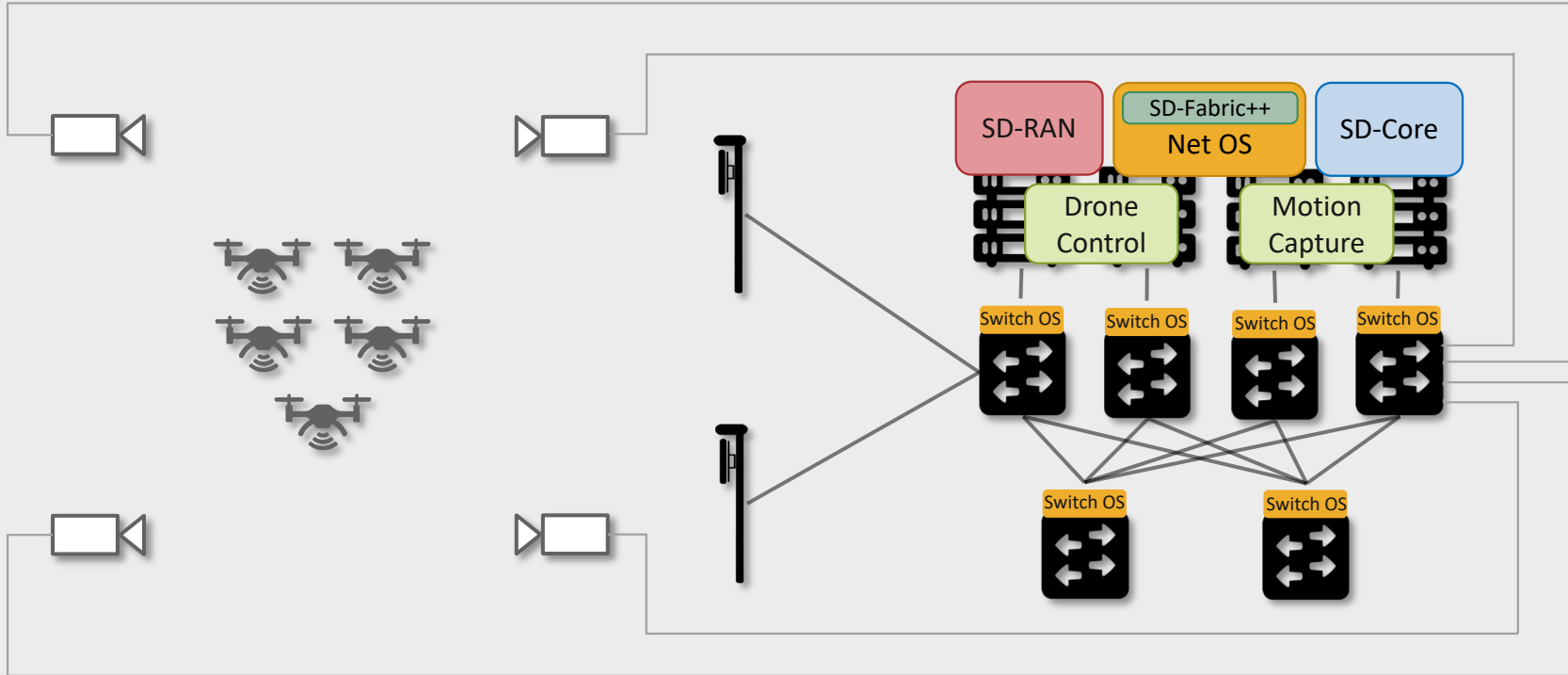
# PRONTO

Securing the Internet Using Verifiable Closed-Loop Control  
*(A DARPA Research Project at Stanford, Cornell, Princeton, ONF)*

# VERIFIABLE CLOSED-LOOP CONTROL



# DEMONSTRATION



# MORE INFORMATION

## Research Position Papers

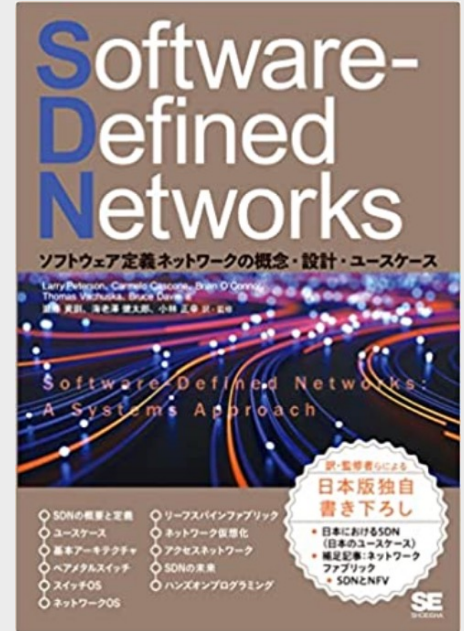
- *Deep Programmability: SIGCOMM CCR, Oct 2020.*
- *Formal Foundations for P4 Data Planes, ACM POPL, Jan 2021.*

## Project Web Sites

- PRONTO: <https://prontoproject.org>
  - Includes links to *demo videos*
- AETHER: <https://opennetworking.org/aether>
  - Includes links to *SD-Fabric, SD-RAN, and SD-Core projects*

## Background Reading

- <https://5g.systemsapproach.org>
- <https://sdn.systemsapproach.org>
- <https://ops.systemsapproach.org>



Bruce Davie, Motonori Shindo, and Kentaro Ebisawa  
*SDN Experience from the Asia-Pacific Region*  
ACM SIGCOMM's Network Channel on Nov 9<sup>th</sup>

<https://networkingchannel.eu/>