Scalable Traffic management for Emergency Response Operations (STEReO)
Airspace Operations Laboratory (AOL) Unmanned Aircraft Systems (UAS) Traffic Management (UTM) (AOLUSS)

Tabletop Overview
November 2020

George Lawton

Contents

AOLUSS

Buildout

Network

AOLUSS

AOLUSS – UTM USS

- Cloud and Deployable variations
- Standalone USS – isolated USS
- Discovery Grid – provides connectivity with partner USS
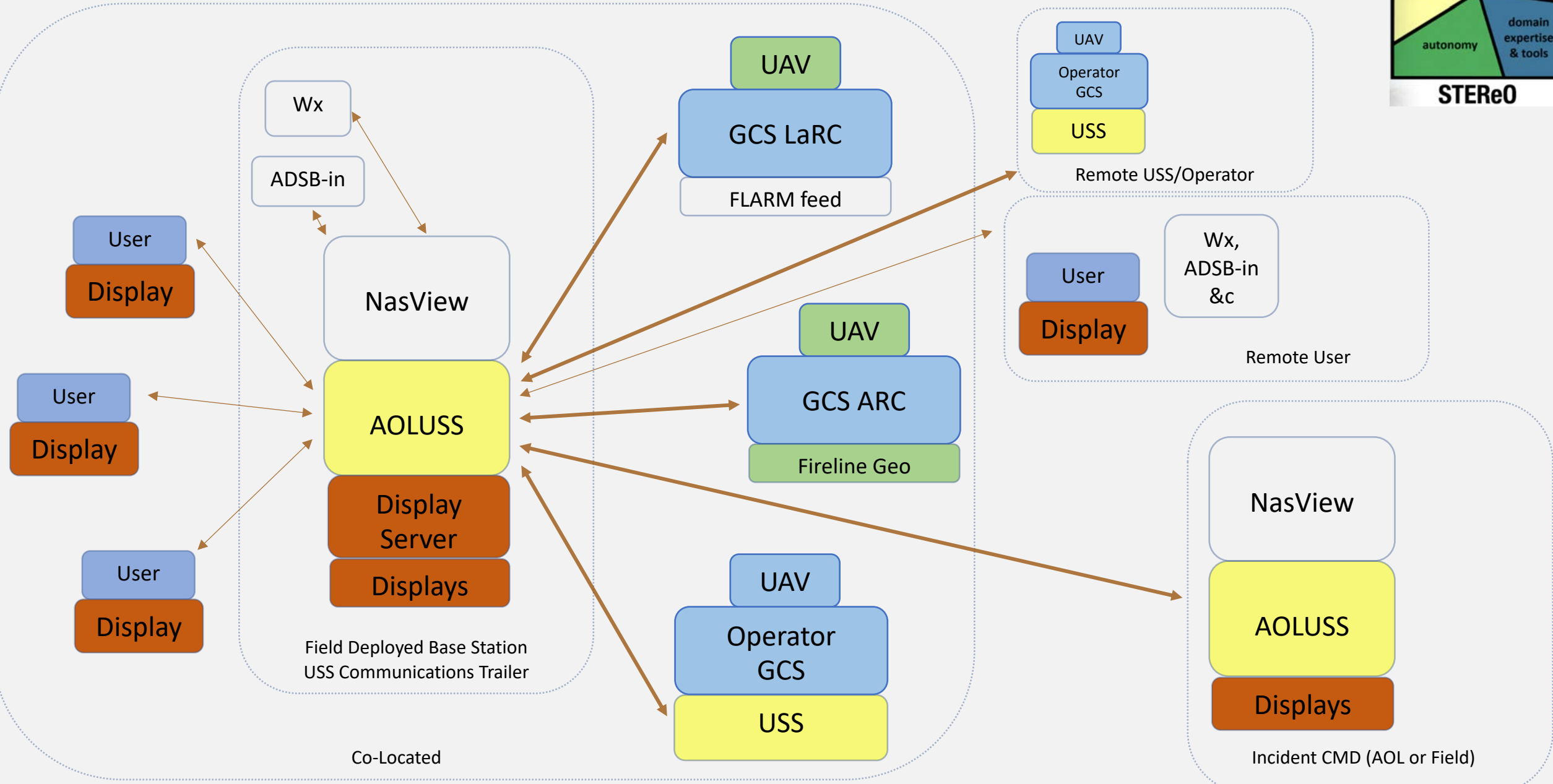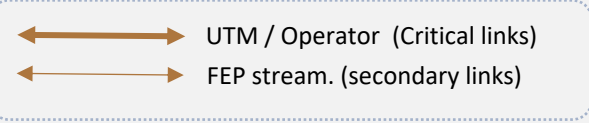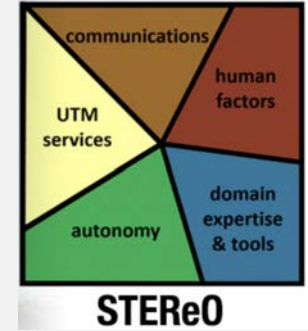
NAS View (FEP)

- APRS-VHF based asset tracking (boots on the ground)
- Local ADSB Surveillance
- TFR, SWIM (Center/TRACon/ASDE-X radar), and WX (backhaul required)
- Surveillance Injection (local sUAS radar and/or vision)
- FTA tracking – digital support for ATGS handoff
- Air Base tracking -- supports reducing radio communications
- Common Lab Display API

Insight-UTM
":[0.710766,1.441566,0.0...BC25-AA84E6E71646" , "

BOOTS023
MACS

"Buckhorn" FIRE
Pressure 29.92
3000 ATGS
2000 Tankers
1000 Heli
100 Elevation
Hazards NONE
Freq: TBD

Redding AirBase
Retardent: 10.0 kgal

center_UAL1286
FDPS_alt_24100

STEReO USS Connectivity*

UTM / Operator (Critical links)

FEP stream. (secondary links)

* does not include sUAS to GCS nor Payload comms

STEReO — communications, human factors, domain expertise & tools, autonomy, UTM services

Wx

ADSB-in

UAV

GCS LaRC

FLARM feed

UAV

Operator GCS

USS

Remote USS/Operator

User

Display

NasView

User

Display

AOLUSS

Display Server

Displays

Field Deployed Base Station
USS Communications Trailer

User

Display

UAV

GCS ARC

Fireline Geo

Wx, ADSB-in &c

User

Display

Remote User

UAV

Operator GCS

USS

NasView

AOLUSS

Displays

Incident CMD (AOL or Field)

Co-Located

Buildout

- Phase I – calendar Q4 2020 - Ames Testing
  - Simple single server
  - Single VHF radio (APRS)
  - Single cellular router (First Net – public static IP)
  - Grafana base metrics: USS, network, and backhaul
  - No: FLARM, VHF audio, displays (KVM only), charge center, cell amps, remote cameras
  - External generator power or battery
- Phase II – calendar Q1 2021 – Field Testing
  - Advanced network security, multiple servers
  - Add Verizon Cell and SATCOM backhauls (public static IP)
  - Add remote camera, FLARM and cellular amps
  - Add additional VHF radios, local weather station, displays, charge center
  - Multi-node Mesh WiFi network with directional links from base to remote GCS location
  - 19" Rack mounted servers/network (installable in trailer, van, or truck)

Phase 1

PHASE I - Device	Description	Power	Rack	Antenna Mount	Cabling
Ground	Ground vehicle to grounding rod in ground		ground	Stake	8-12awg?
Generator	Primary power	120VAC 30A?	N/A	TBD	TBD
UPS	Backup power		4u	N/A	Gen Power
Servers	AOLUSS, javAPRS, NasView, NTP	120VAC 150W	2u-server	N/A	AC Power/Cat6/USB/HDMI
Network Appliance	PoE Switch	TBD	2u-net	N/A	AC Power/Cat6
WiFi	LAN	TBD (<30W in spec)	2u-net	Pole-omni	AC? Power/Cat6/coax
Cellular	Cellular connectivity, (first net)	12VDC – 1-? W	2u-net	Pole-dir	AC?DC Power/Cat6/coax
Satcomm	Low bandwidth	120VAC 224W		TBD	AC Power/Cat6
12VDC power supply	Convert 120VAC to 12VDC	120VAC	rack	N/A	DC distribution bus
VHF: APRS	APRS freq (priority/normal)	12 to 156W	2u-radio	Pole-omni	DC Power/Serial to server-USB-A/coax
ADSB-IN	Local traffic with ADSB-OUT equipage)	500mW (PoE)	N/A	Pole-box	Cat6 PoE
Wx Station/console	Local weather conditions (solar/C batteries)	120VAC 2.5W	2u-drawer	Pole-bulk	AC Power/Serial to server-USB-A
KVM	Monitor server/display	120VAC ??	1u-KVM	N/A	AC Power/USB/HDMI server

Phase I

Gen

Roof or Ground

Ant VHF

sat

Wx | ADSB

Custom Rack

2U Radio/Cell

1U KVM

4U 12VDC bus and distribution

2U Servers

External Side

Gen
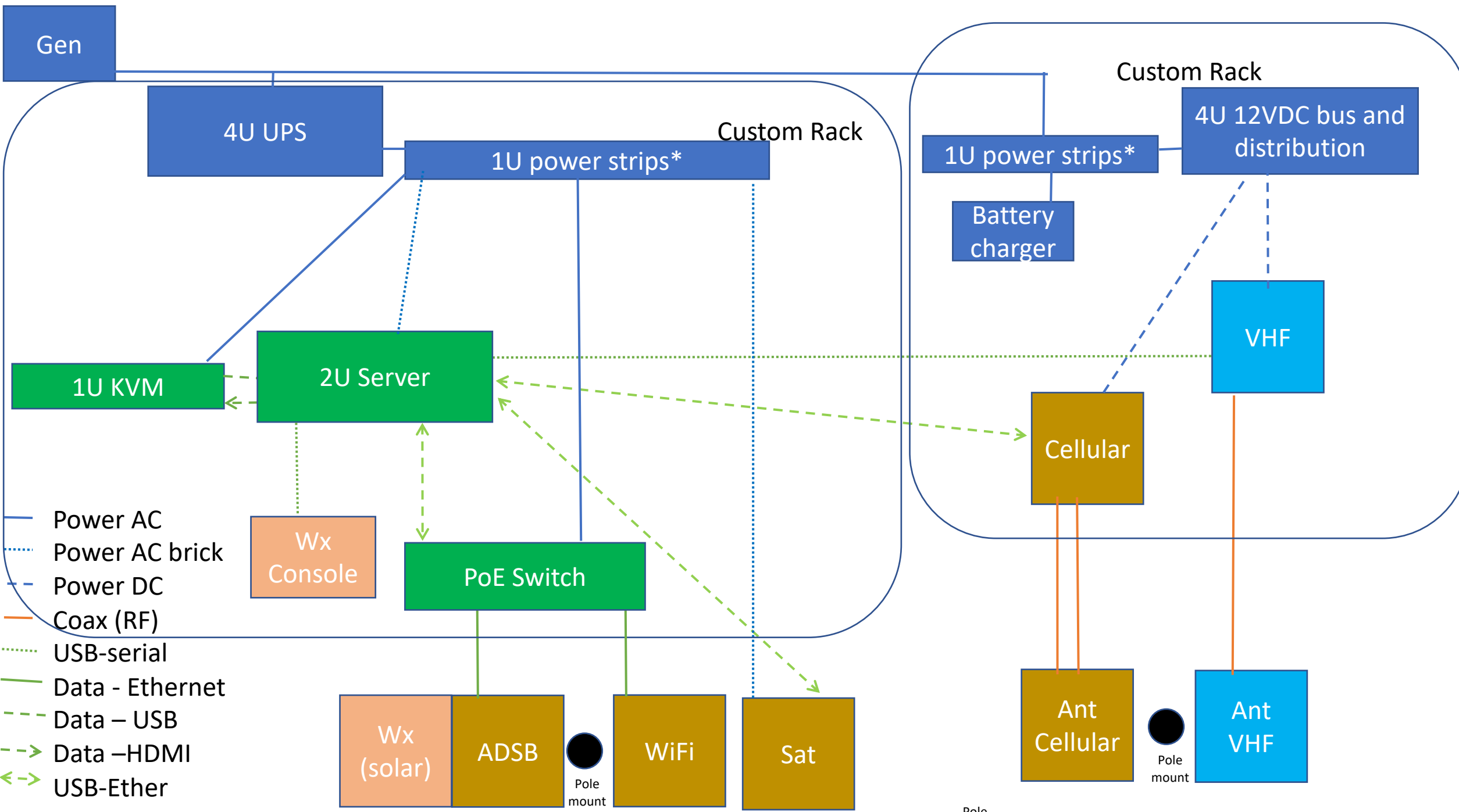
Custom Rack

4U UPS

1U power strips*

4U 12VDC bus and distribution

1U power strips*

Battery charger

VHF

2U Server

1U KVM
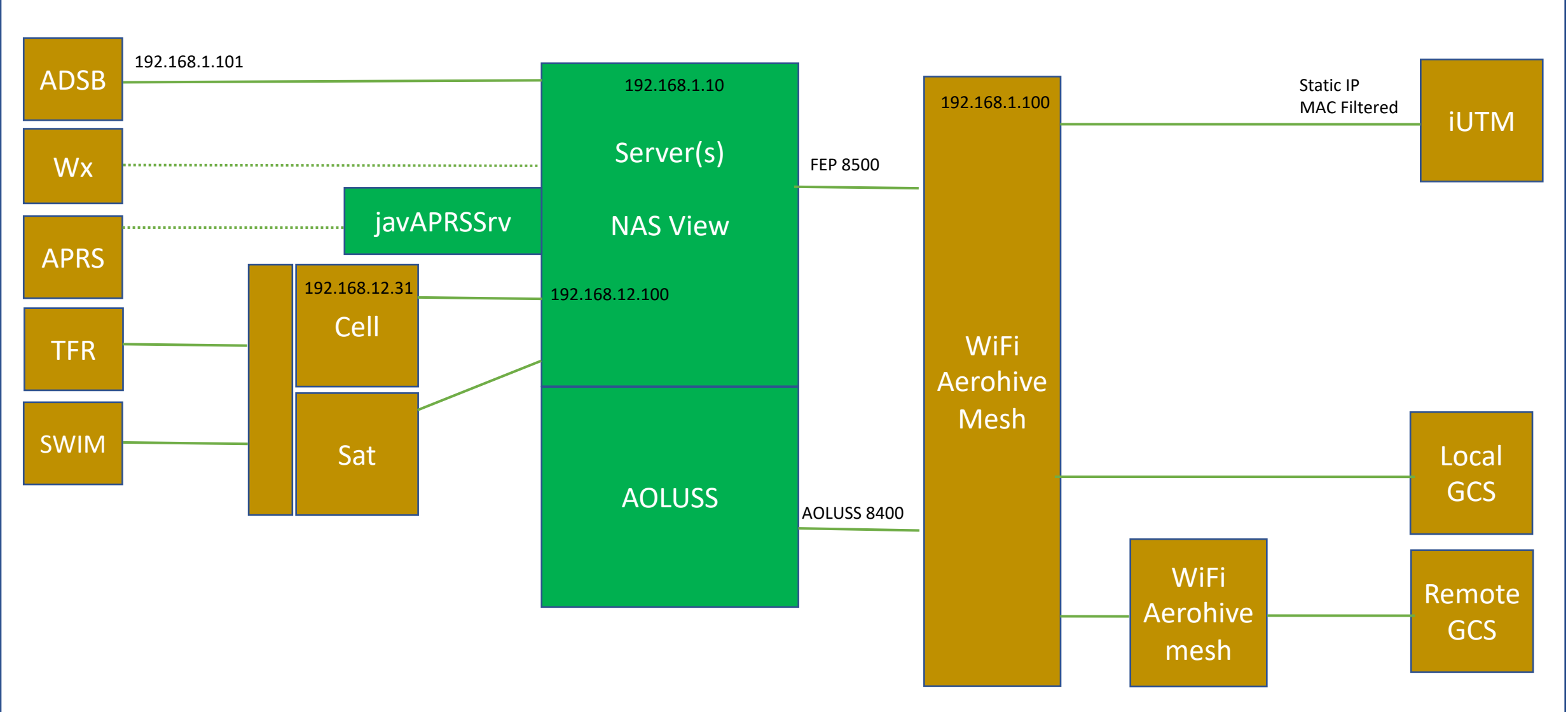
Cellular

Wx Console

PoE Switch

Wx (solar)

ADSB

Pole mount

WiFi

Sat

Ant Cellular

Pole mount

Ant VHF

Pole

Power AC
Power AC brick
Power DC
Coax (RF)
USB-serial
Data - Ethernet
Data – USB
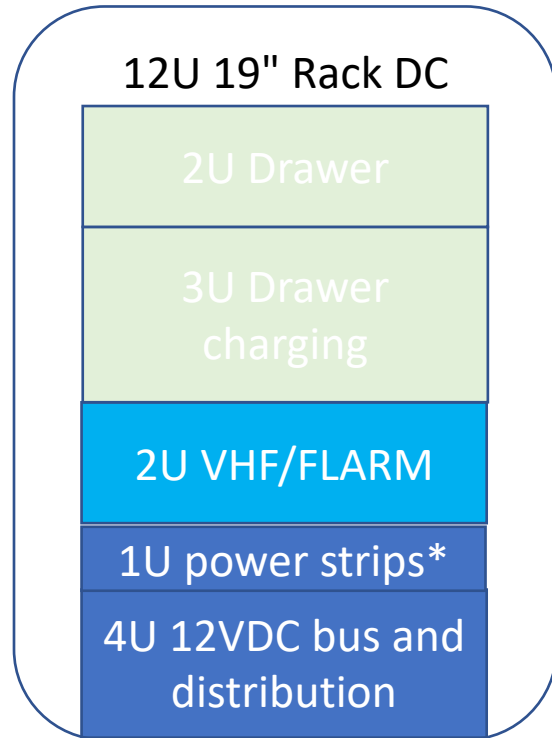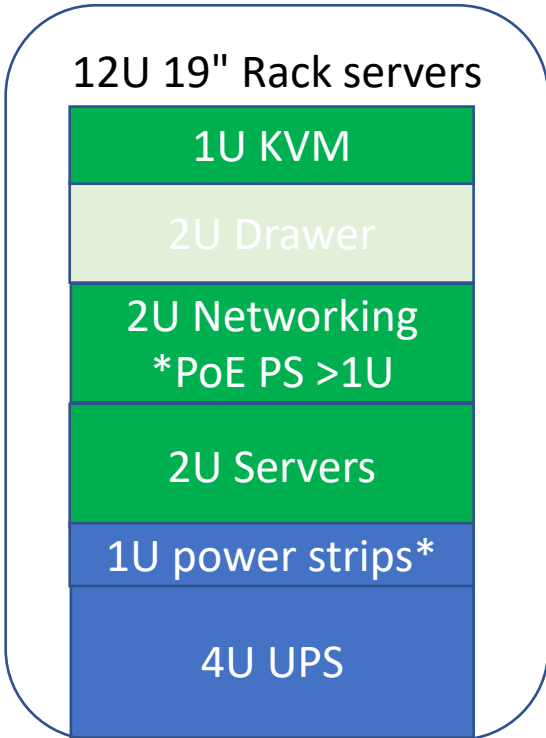Data –HDMI
USB-Ether

Phase I - Network

Phase II

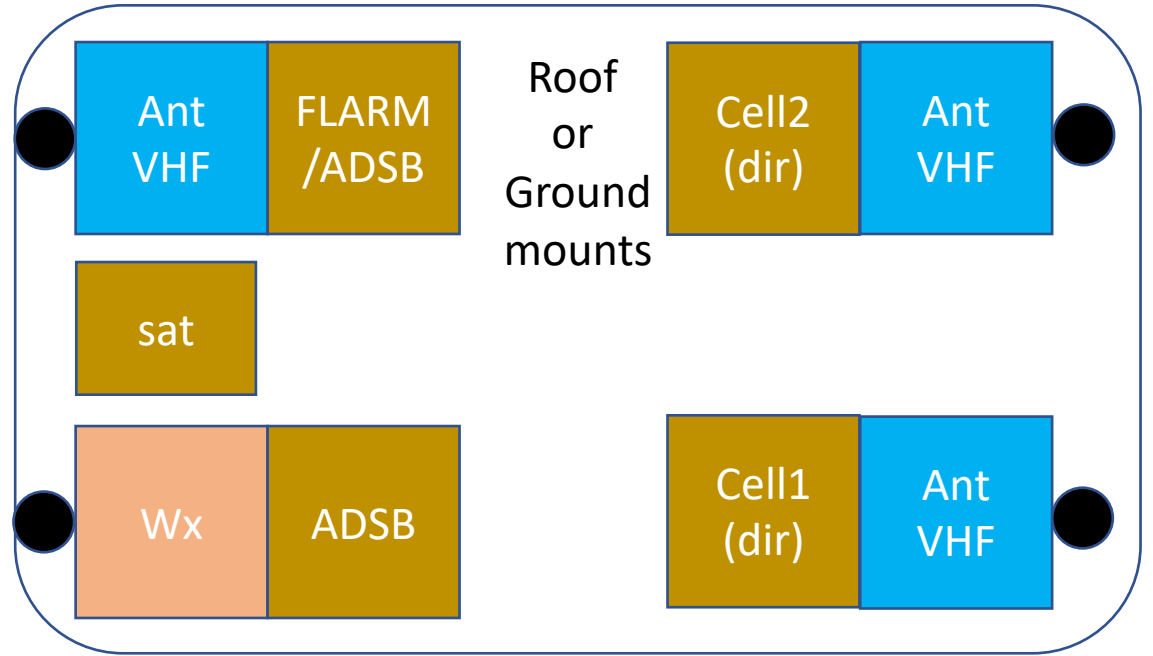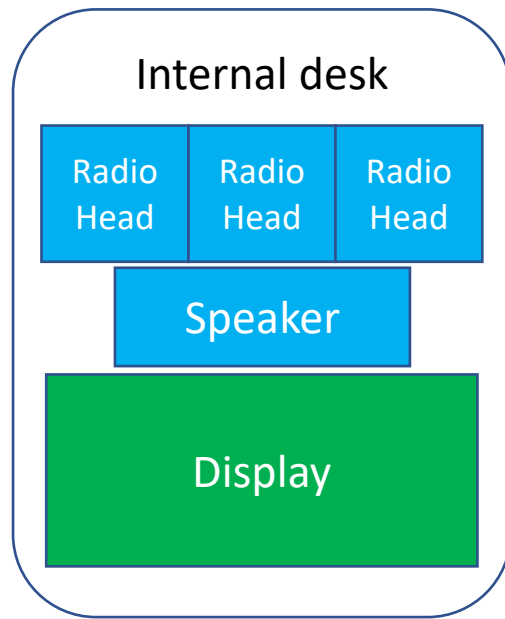

MCD-4800
Auto-Pointing BGAN Terminal
Portable Global WiFi Hotspot

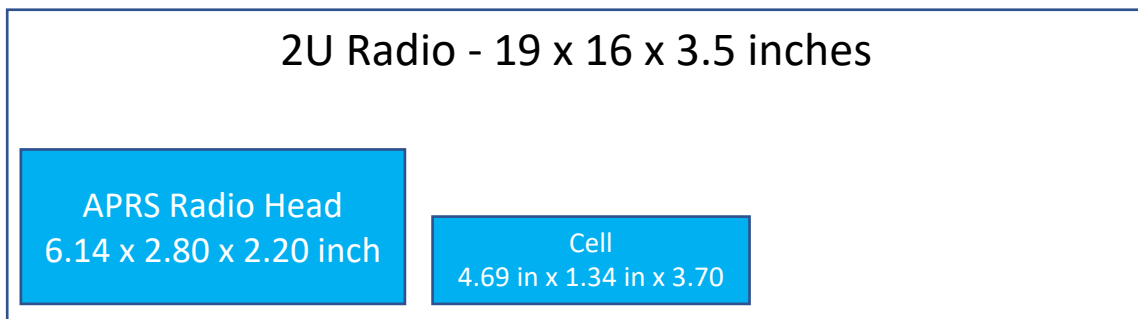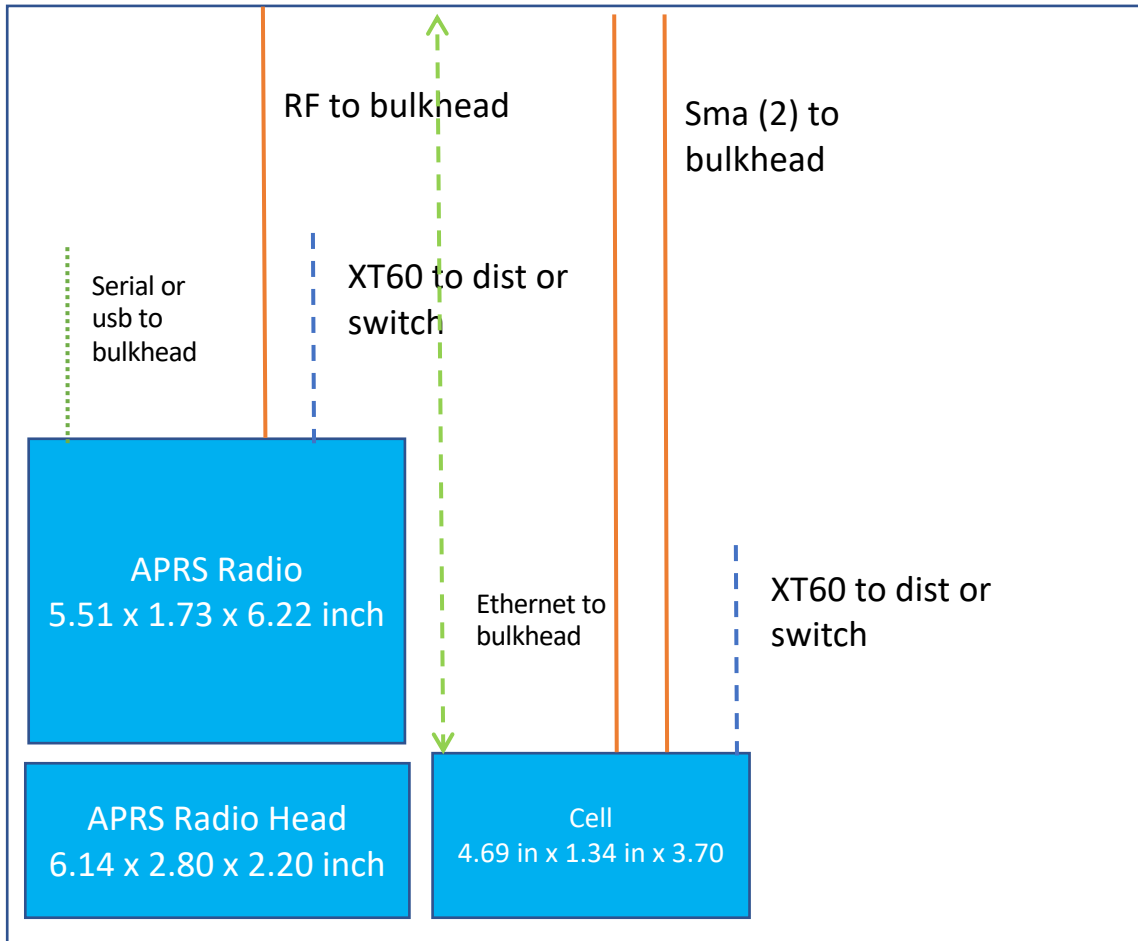| PHASE II - Device	Description	Power	Rack	Antenna Mount	Cabling
Ground	Ground vehicle to grounding rod in ground		ground	Stake	8-12awg?
Generator	Primary power	120VAC 30A?	N/A	TBD	TBD
UPS	Backup power		4u	N/A	Gen Power 30A Extension cable?
Servers (3)	AOLUSS, javAPRC, NasView, Displays	120VAC 150W	2u-server	N/A	AC Power/Cat6/USB/HDMI
Network Appliance	Security Applicance	120VAC ??	2u-net	N/A	AC Power/Cat6
WiFi	LAN	TBD	2u-net	Pole-omni	AC? Power/Cat6/coax
Cellular (2)	Cellular connectivity, if available (v & fn)	12VDC – 1-? W	2u-net	(2) Pole-dir	AC?DC Power/Cat6/coax
Satcomm	Low bandwidth – upgrade to kymeta or fixed hughes ant	120VAC 224W		TBD	AC Power/Cat6
12VDC power supply	Convert 120VAC to 12VDC	120VAC	rack	N/A	DC distribution bus
VHF: APRS	Dual APRS freq (priority/normal) - remote head	12 to 156W	2u-radio	Pole-omni	DC Power/Serial to server-USB-A/coax
VHF: audio	monitor USFS/CalFire - speaker – remote head	12 to 156W	2u-radio	Pole-omni	DC Power / speaker / coax
VHF: audio	monitor USFS/CalFire - speaker – remote head	12 to 156W	2u-radio	Pole-omni	DC Power / speaker / coax
ADSB-IN	Local traffic with ADSB-OUT equipage	500mW (PoE)	N/A	Pole-box	Cat6 PoE
Wx Station/console	Local weather conditions (solar/C batteries)	120VAC 2.5W	2u-drawer	Pole-bulk	AC Power/Serial to server-USB-A
Battery charger	Recharge C for wx station	120VAC ??	2u-drawer	N/A	AC Power
KVM	Monitor server/display	120VAC ??	1u-KVM	N/A	AC Power/USB/HDMI server

Phase II

Internal desk

Radio Head	Radio Head	Radio Head

Speaker

Display

Roof or Ground mounts

Ant VHF	FLARM /ADSB

Cell2 (dir)	Ant VHF

sat

Wx	ADSB

Cell1 (dir)	Ant VHF

Gen

12U 19" Rack servers

- 1U KVM
- 2U Drawer
- 2U Networking *PoE PS >1U
- 2U Servers
- 1U power strips*
- 4U UPS

12U 19" Rack DC

- 2U Drawer
- 3U Drawer charging
- 2U VHF/FLARM
- 1U power strips*
- 4U 12VDC bus and distribution

Side

Speaker

Display

Charge Center

* rear rack mount?

Left Panel (2U Radio / Components)

Serial or usb to bulkhead

RF to bulkhead

Sma (2) to bulkhead

XT60 to dist or switch

APRS Radio
5.51 x 1.73 x 6.22 inch

Ethernet to bulkhead

XT60 to dist or switch

APRS Radio Head
6.14 x 2.80 x 2.20 inch

Cell
4.69 in x 1.34 in x 3.70

2U Radio - 19 x 16 x 3.5 inches

APRS Radio Head
6.14 x 2.80 x 2.20 inch

Cell
4.69 in x 1.34 in x 3.70

2U radio

Right Panel (4U DC power)

(2) XT60 to Radio

Fuse

AC to strip

distribution

DC power supply

Switch panel (opt)

4U 12VDC bus and distribution

Switch panel (opt)

DC power supply

4U DC power

Serial to
bulkhead

Serial
Wx
console

(2)Ethernet to
bulkhead
-Wifi
-ADSB

AC to
strip

USB-A to (4) serial

PoE Switch

USB-A

USB-A &
HDMI to
KVM

(3) USB-C-
Ethernet to
bulkhead
-Sat
-Cell
-MGMT

USB-C-Ethernet
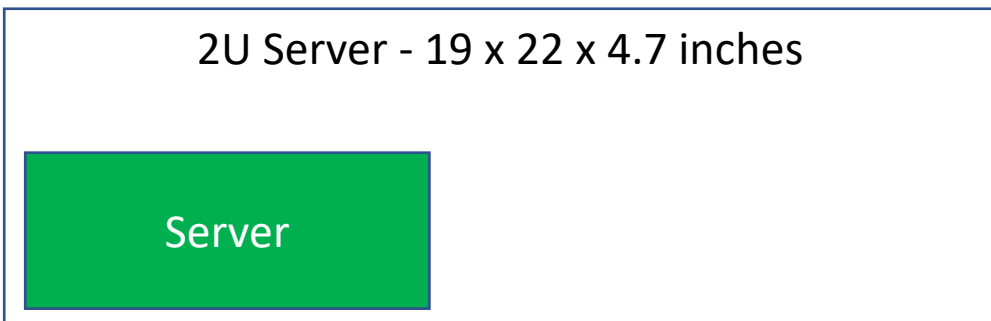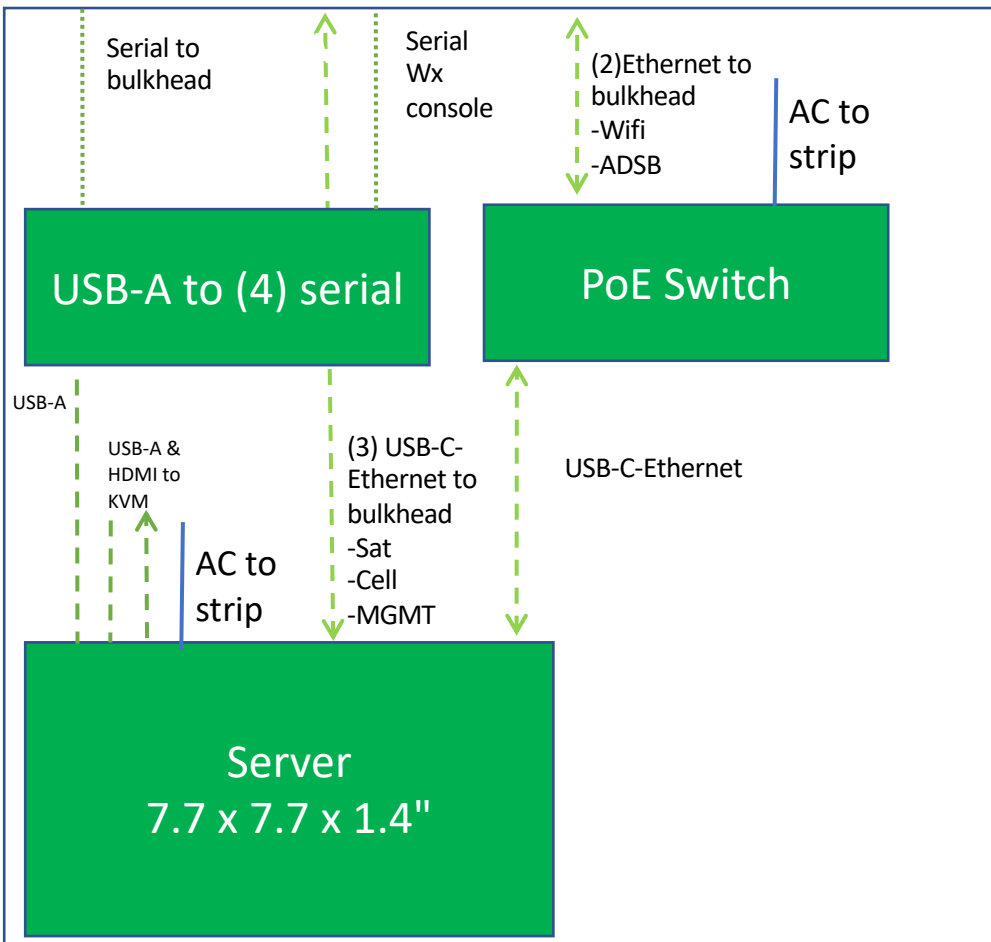
AC to
strip

**Server
7.7 x 7.7 x 1.4"**

2U Server - 19 x 22 x 4.7 inches
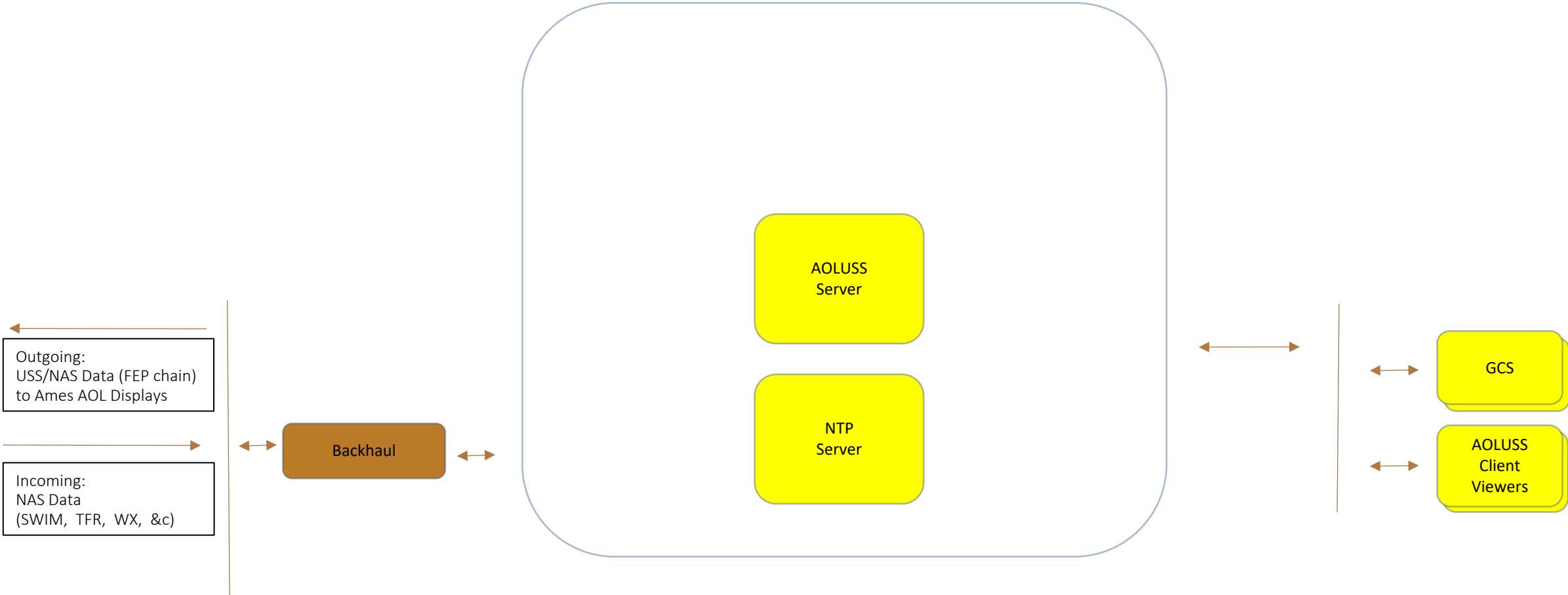
Server

2U server

Network

- The STEReO UTM core network is a field deployed network. It is intended to limit all network traffic to essential UTM traffic. All other traffic will need to be routed over a different network.

- Phase 1 firewalls may be Linux iptables or packet filter (pf) based instead of HW firewalls. The routing table configured in the field will depend on backhaul connectivity.

- WiFi Security:
    - Devices will be configured as static Internet Protocol (IP) address with Media Access Control (MAC) filtering
    - No peer to peer communications (isolated clients- will consider local/non-meshed SSID for Operator-Ground Control Station (GCS)-UAS Service Supplier (USS) connectivity)
    - Only Network Time Protocol (NTP) and UTM specific Transmission Control Protocol (TCP) traffic allowed (e.g. no Dynamic Host Configuration Protocol (DHCP), Dynamic Name Service (DNS), &c)
    - Time sync provided by NTP server
    - Static hosts files

- Only UTM TCP traffic allowed on the core network: Flight Information Management System (FIMS) tokens, Discovery and Synchronization Service (DSS), and USS2USS connections
    - Ability to deploy FIMS/DSS to the field or allow backhaul connections to cloud based FIMS/DSS*
    - USS to GCS communications will need to be handled outside of the core STEReO network (TBD)
    - Internet connectivity in the field is not guaranteed during an event

- Secondary core network that allows for low-bandwidth internet traffic (TBD)

* Backhaul for FIMS/DSS/USS could inject high connectivity latency if using SATCOM

STEReO UTM Network*
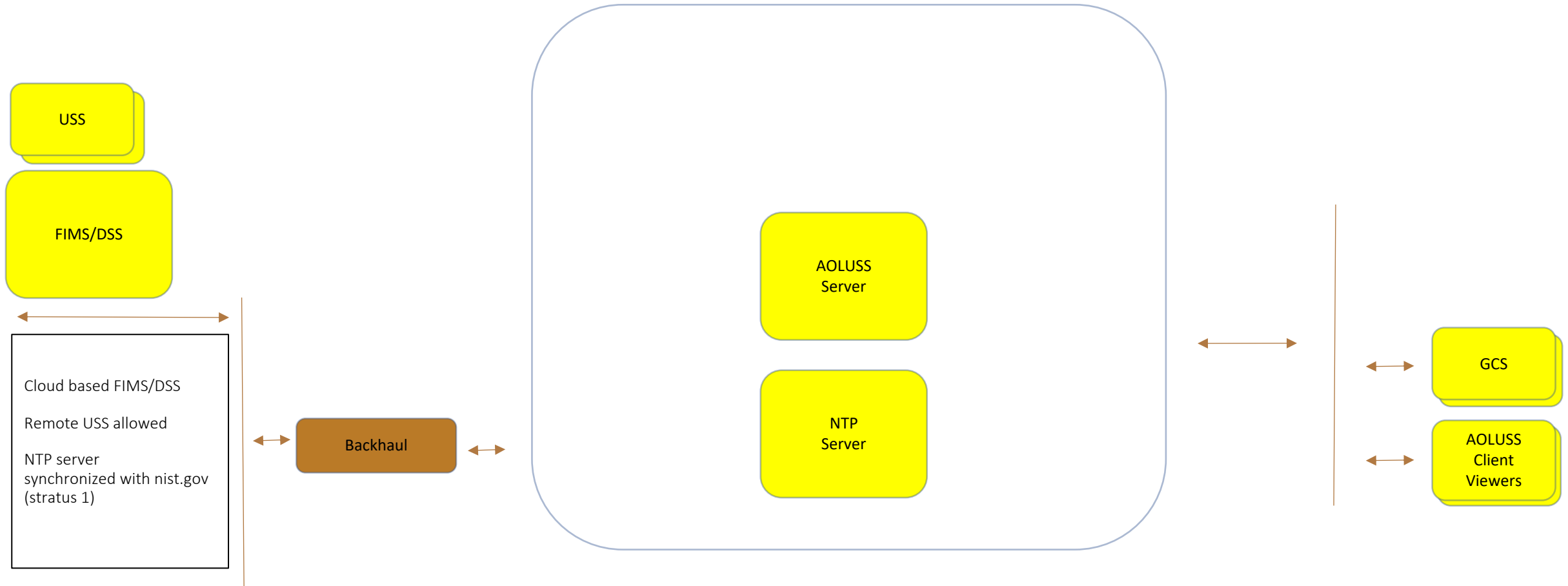# PHASE I - Standalone AOLUSS

- does not include USS-GCS / UAS-GCS / Payload comms

Outgoing:
USS/NAS Data (FEP chain)
to Ames AOL Displays

Incoming:
NAS Data
(SWIM, TFR, WX, &c)

Backhaul

AOLUSS
Server

NTP
Server

GCS

AOLUSS
Client
Viewers

STEReO UTM Network*
PHASE II-A - Cloud Based

- does not include USS-GCS / UAS-GCS / Payload comms

USS

FIMS/DSS

Cloud based FIMS/DSS

Remote USS allowed

NTP server synchronized with nist.gov (stratus 1)

Backhaul

AOLUSS Server

NTP Server

GCS

AOLUSS Client Viewers

STEReO UTM Network*
PHASE II-B - Deployable

- does not include USS-GCS / UAS-GCS / Payload comms

FIMS/DSS

AOLUSS Server

NTP Server

Remote USS allowed

NTP server synchronized with nist.gov (stratus 1)

Backhaul

USS

GCS

AOLUSS Client Viewers
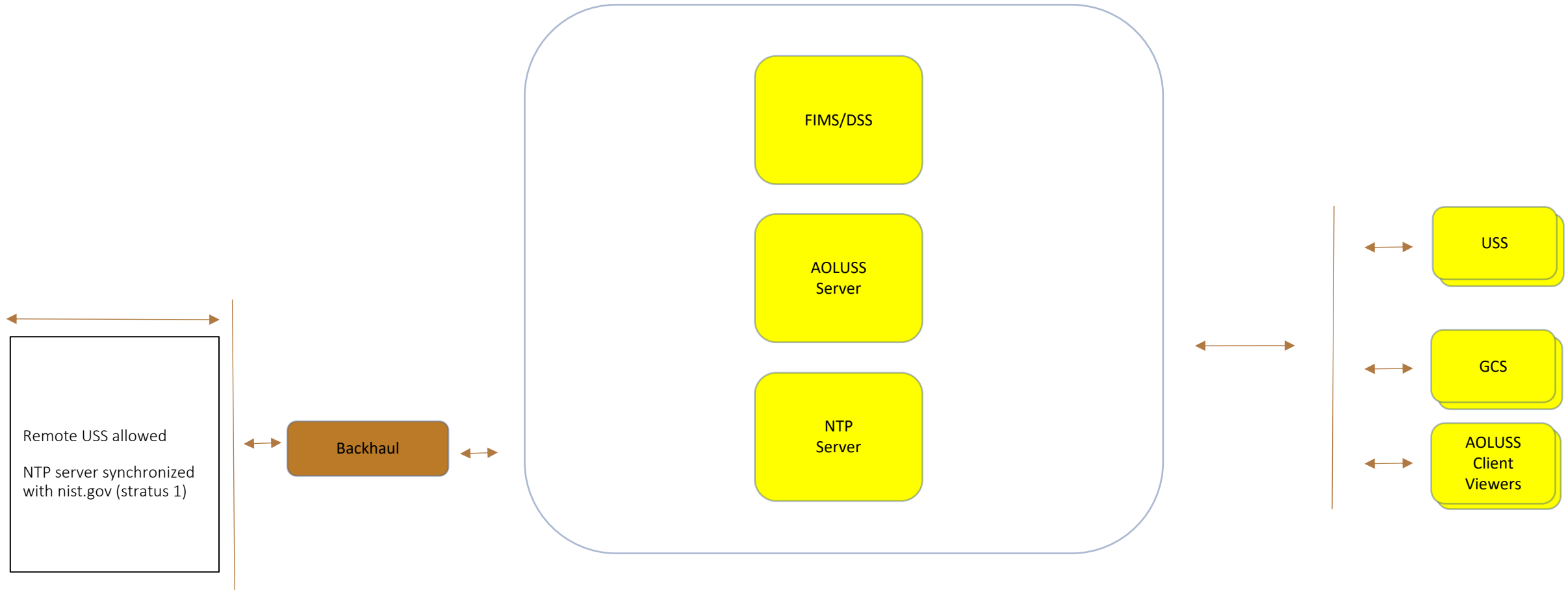
STEReO UTM

```
DHCP     Dynamic Host Configuration Protocol
DNS      Dynamic Name Service
DSS      Discovery and Synchronization Service
FEP      FEP Extensible Proxy
FIMS     Flight Information Management System (FIMS)
FTA      Fire Traffic Area
STEReO   Scalable Traffic Management for Emergency Response Operations
GCS      Ground Control Station
MAC      Media Access Control
NAS      National Airspace System
NTP      Network Time Protocol
SWIM     System Wide Information Management
TCP      Transmission Control Protocol
TFR      Temporary Flight Restriction
UAS      Unmanned Aircraft Systems
UTM      UAS Traffic Management
USS      UAS Service Supplier
Wx       Weather
```