N-Wave:
NOAA's Enterprise Network

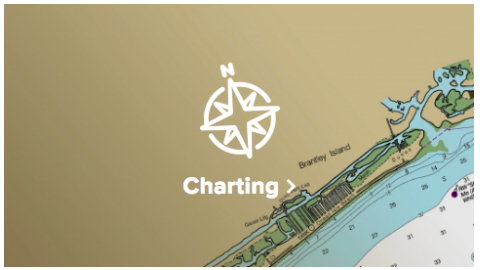
Robert Sears, Branch Chief for N-Wave
MAX Participants Meeting
April 11, 2019

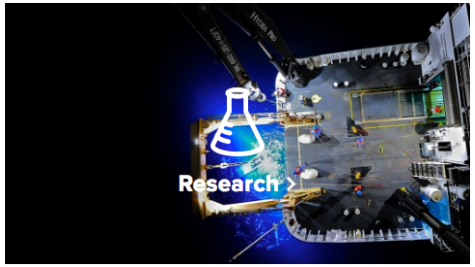
NOAA ENTERPRISE NETWORK

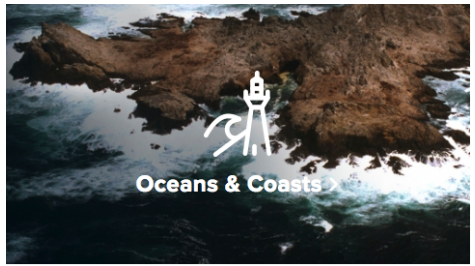
Photo credit: NOAA

NOAA is an agency that enriches life through science. Our reach goes from the surface of the sun to the depths of the ocean floor as we work to keep citizens informed of the changing environment around them.

NOAA Line Offices: 9 Key Focus Areas







N-Wave provides reliable,
secure and sustainable enterprise
network services
to enable NOAA’s mission of
science, service and stewardship.

N-Wave is built on partnerships

Enterprise Transport

- National Fiber Optic Backbone
- Multiple 10 Gbps
- Multi-Protocol Label Switching
- Wavelength-Division Multiplexing (WDM)
- 100+ Gbps Ring in Washington, D.C. Metro

Enterprise Services

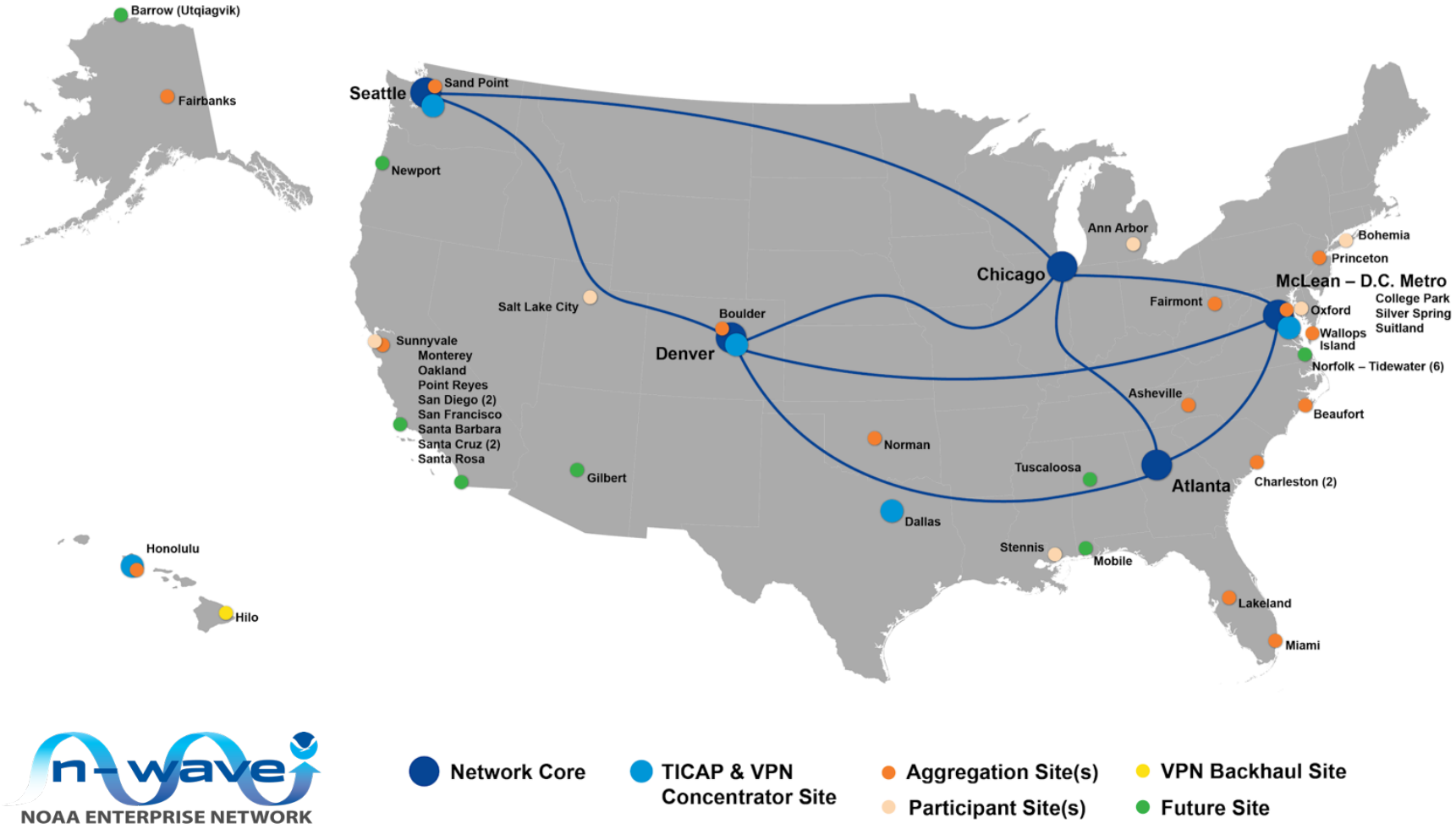
- Cloud Transport
- Enterprise Wireless
- Remote Access VPN
- Security as a Service
- 24x7 Network Operations

Campus Services

- Local Area Networking
- Cable Plant Management
- Engineering Assessments, Architecture, Design and Consulting

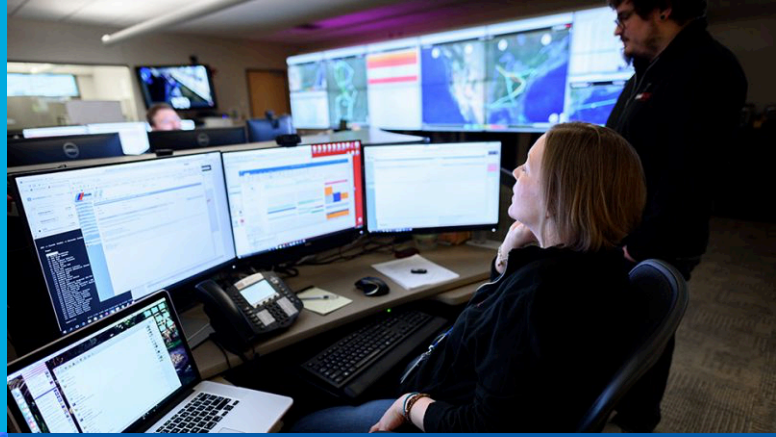
SLA= Service level actual, based on historical data collection

Service Type	Service Element	SLA or SLO	Service Response
Transport services - Single path site	N-Wave Transport/ Backbone	SLA= 99.9%	Tier 1-3 24x7x365 (refer to Appx B response time agreement)
Transport services - Diverse Connected Sites	N-Wave Transport/ Backbone	SLA= 99.99%	Tier 1-3 24x7x365 (refer to Appx B response time agreement)
Transport services	N-Wave Backbone	SLA= 99.999%	Tier 1-3 24x7x365 (refer to Appx B response time agreement)
Transport services	TICAP Services*	SLA= 99.999%	Tier 1-3 24x7x365 (refer to response time agreement)
Campus	Wireless	SLA= 99.9%	Tier 1, 24x7x365, Tier 2-3. 8x5xNBD (escalation per appx B, response time agreement)


Barrow (Utqiagvik)
Fairbanks
Seattle
Sand Point
Newport
Salt Lake City
Boulder
Denver
Sunnyvale
Monterey
Oakland
Point Reyes
San Diego (2)
San Francisco
Santa Barbara
Santa Cruz (2)
Santa Rosa
Gilbert
Norman
Dallas
Tuscaloosa
Atlanta
Stennis
Mobile
Chicago
Ann Arbor
Fairmont
McLean – D.C. Metro
College Park
Silver Spring
Suitland
Oxford
Wallops Island
Norfolk – Tidewater (6)
Asheville
Beaufort
Charleston (2)
Lakeland
Miami
Bohemia
Princeton
Honolulu
Hilo
n-wave
NOAA ENTERPRISE NETWORK
Network Core
TICAP & VPN Concentrator Site
Aggregation Site(s)
Participant Site(s)
VPN Backhaul Site
Future Site

World-Class Network Operations

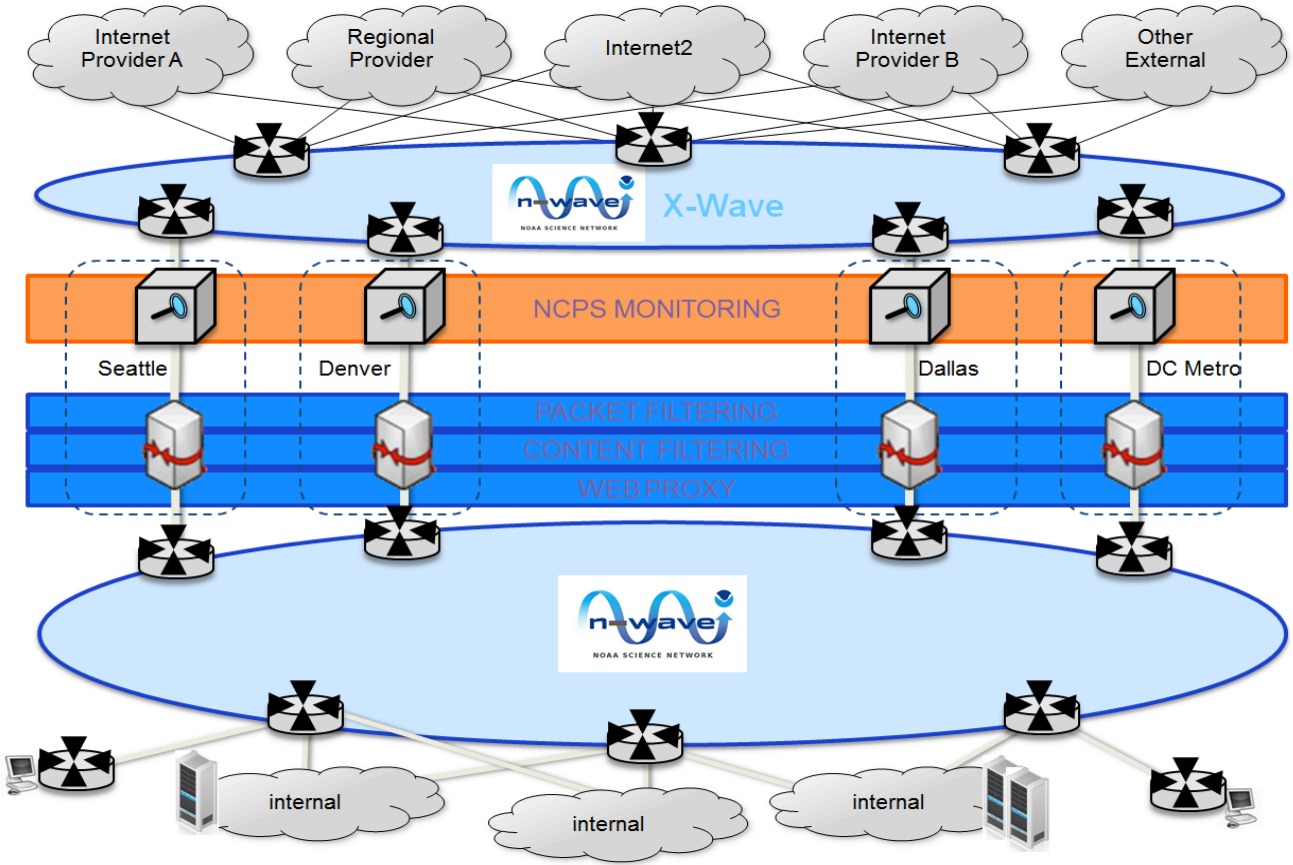
Provided in partnership with GlobalNOC at Indiana University



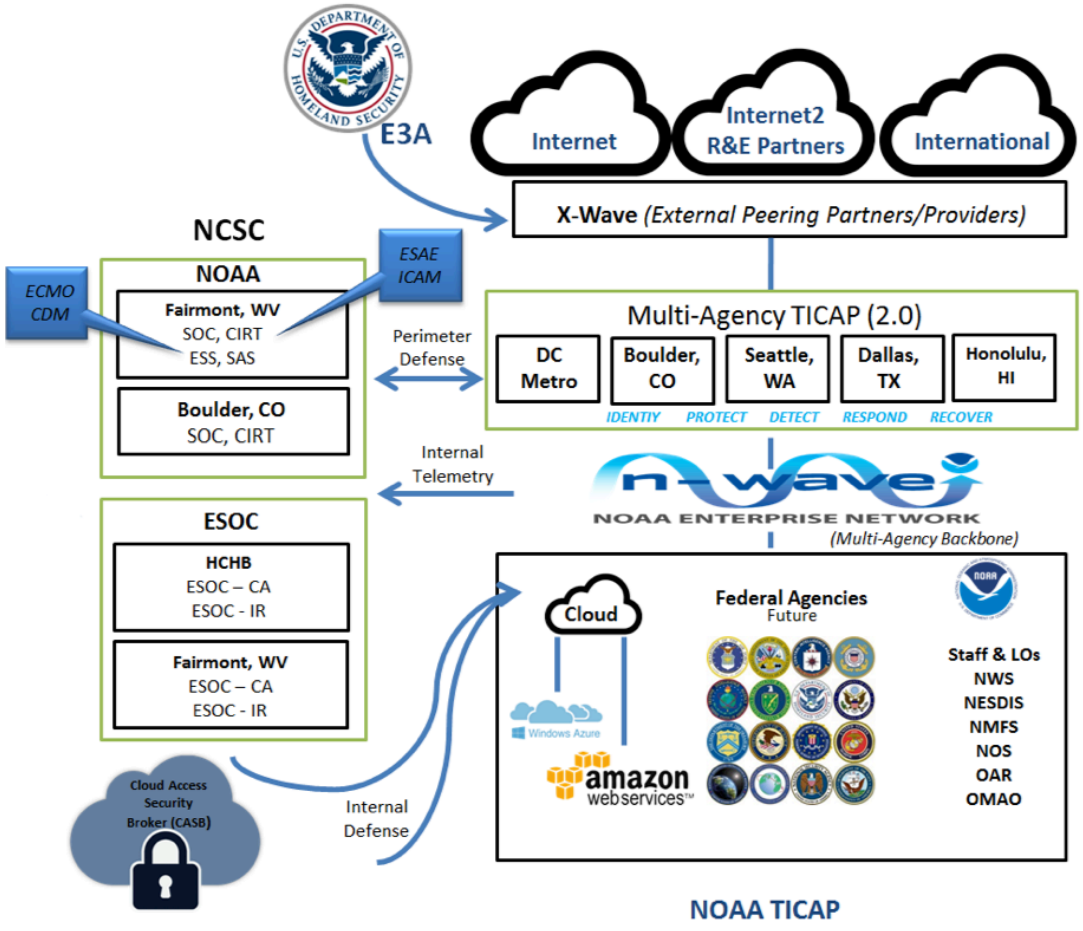
- 24x7 support
- Tier I, II and III engineering
- Advanced monitoring, measurement and analysis
- Primary, secondary and tertiary ops sites

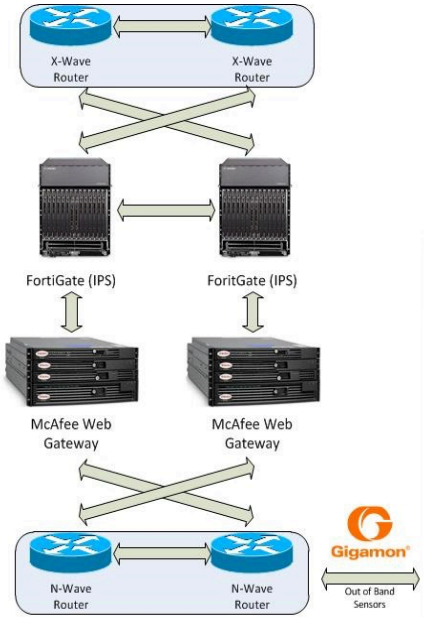
Photo credit: GlobalNOC at Indiana University

NOAA TICAP Service

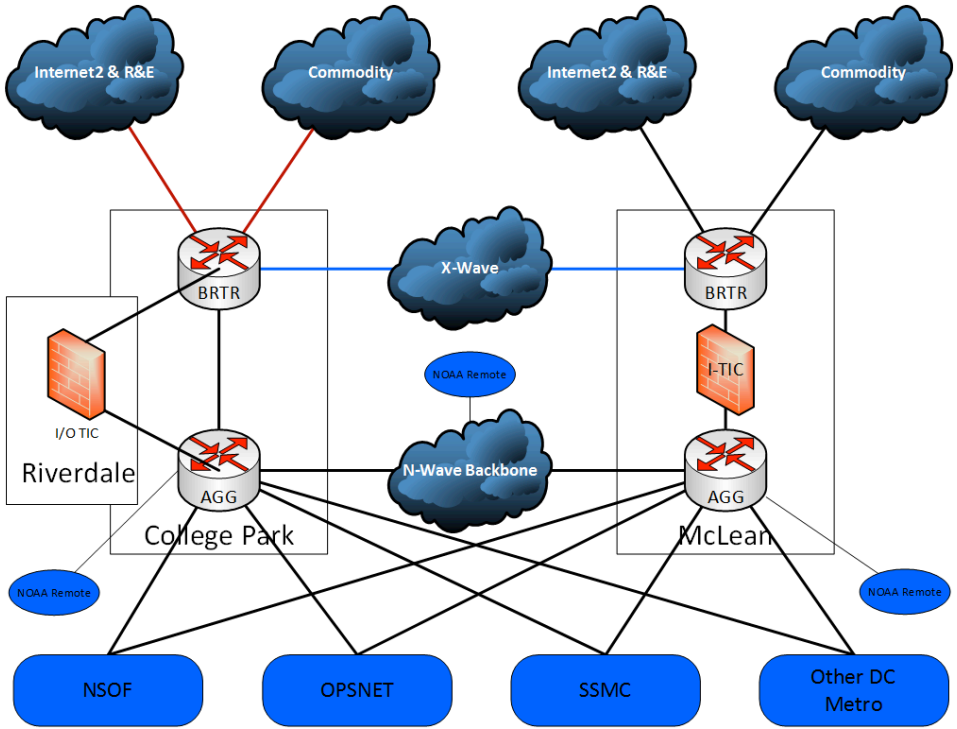


TICAP Operations

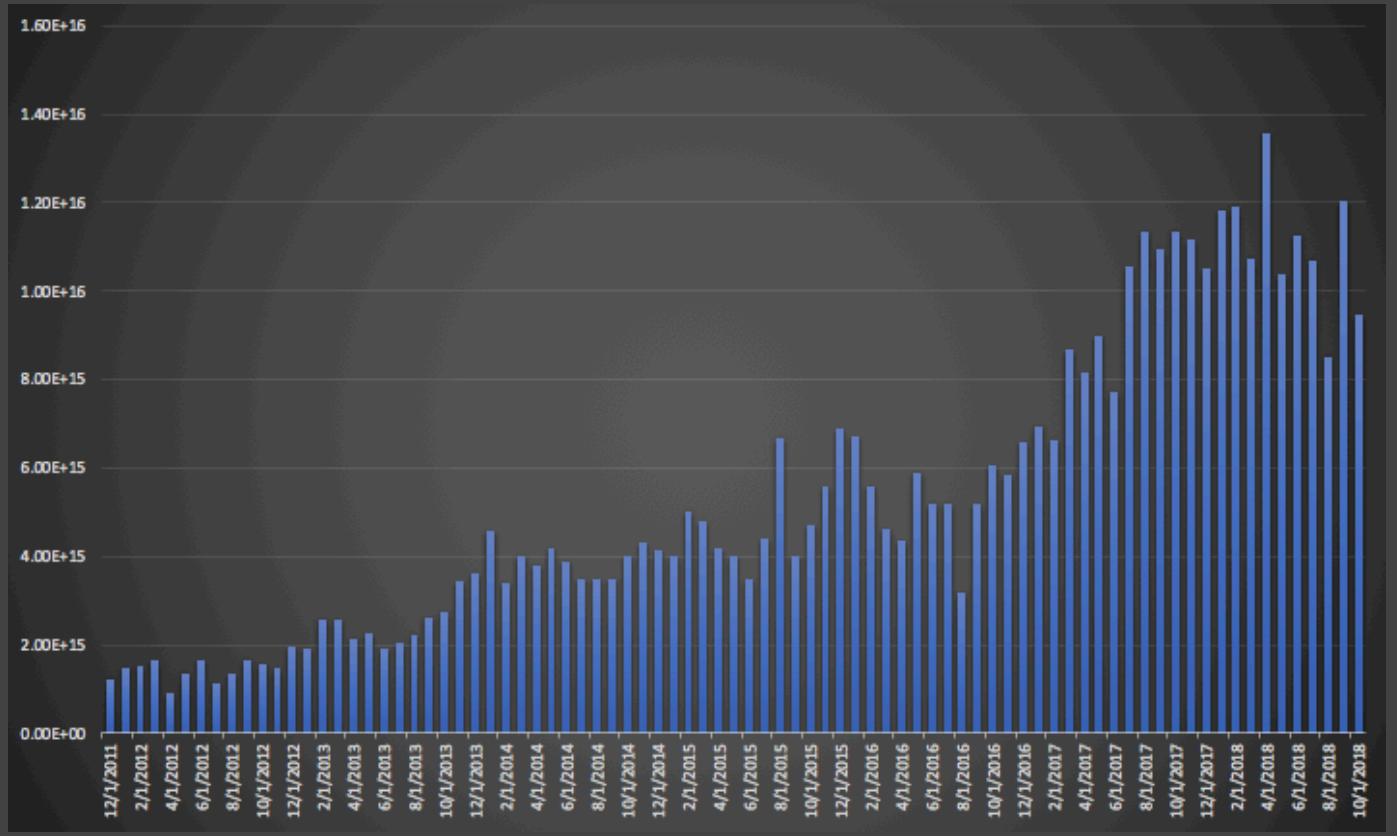




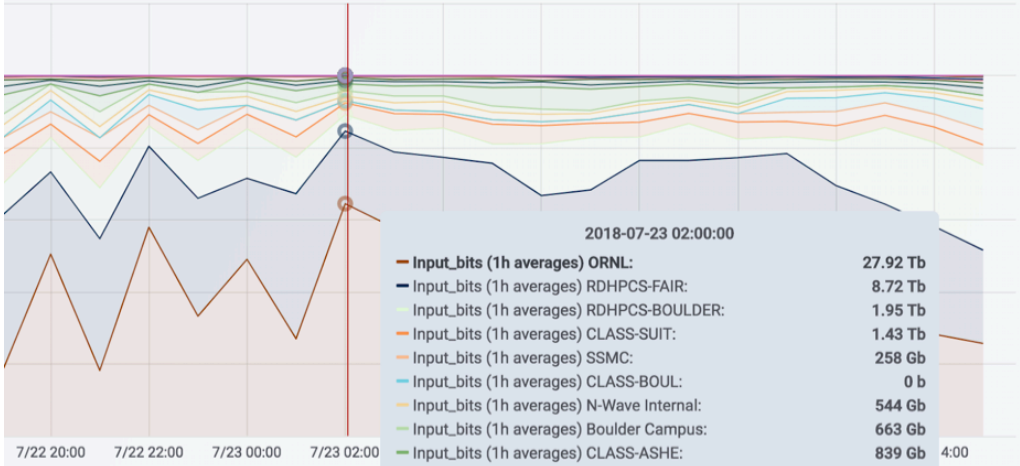
Engineering Resilient TIC – DC Metro



N-Wave Network Traffic



Input Bits By Program



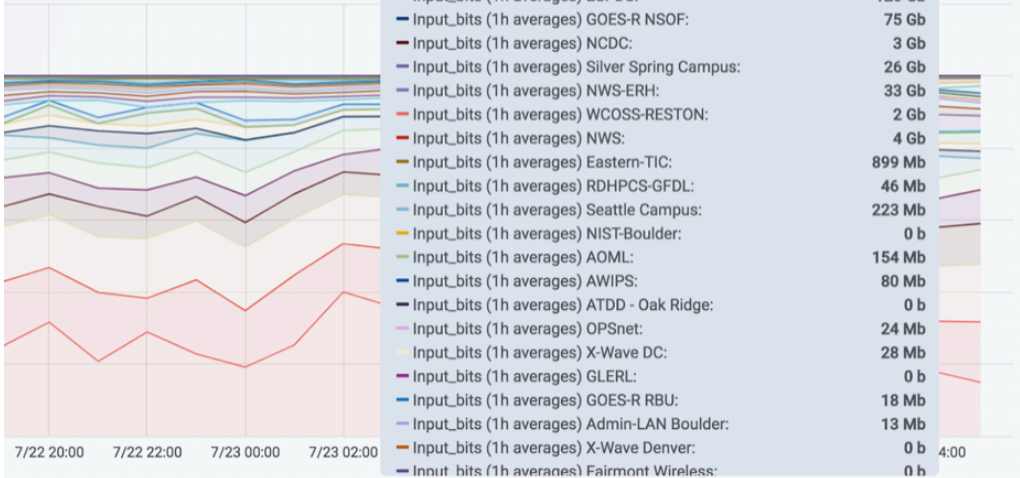
2018-07-23 02:00:00

Input_bits (1h averages) ORNL:	**27.92 Tb**
Input_bits (1h averages) RDHPCS-FAIR:	8.72 Tb
Input_bits (1h averages) RDHPCS-BOULDER:	1.95 Tb
Input_bits (1h averages) CLASS-SUIT:	1.43 Tb
Input_bits (1h averages) SSMC:	258 Gb
Input_bits (1h averages) CLASS-BOUL:	0 b
Input_bits (1h averages) N-Wave Internal:	544 Gb
Input_bits (1h averages) Boulder Campus:	663 Gb
Input_bits (1h averages) CLASS-ASHE:	839 Gb
Input_bits (1h averages) GOES-R WCDAS:	408 Gb
Input_bits (1h averages) RDHPCS-CLPK:	335 Gb
Input_bits (1h averages) ESPDS:	120 Gb
Input_bits (1h averages) GOES-R NSOF:	75 Gb
Input_bits (1h averages) NCDC:	3 Gb
Input_bits (1h averages) Silver Spring Campus:	26 Gb
Input_bits (1h averages) NWS-ERH:	33 Gb
Input_bits (1h averages) WCOSS-RESTON:	2 Gb
Input_bits (1h averages) NWS:	4 Gb
Input_bits (1h averages) Eastern-TIC:	899 Mb
Input_bits (1h averages) RDHPCS-GFDL:	46 Mb
Input_bits (1h averages) Seattle Campus:	223 Mb
Input_bits (1h averages) NIST-Boulder:	0 b
Input_bits (1h averages) AOML:	154 Mb
Input_bits (1h averages) AWIPS:	80 Mb
Input_bits (1h averages) ATDD - Oak Ridge:	0 b
Input_bits (1h averages) OPSnet:	24 Mb
Input_bits (1h averages) X-Wave DC:	28 Mb
Input_bits (1h averages) GLERL:	0 b
Input_bits (1h averages) GOES-R RBU:	18 Mb
Input_bits (1h averages) Admin-LAN Boulder:	13 Mb
Input_bits (1h averages) X-Wave Denver:	0 b
Input_bits (1h averages) Fairmont Wireless:	0 b

timeshift -1h

	max	avg
Input_bits (1h averages) ORNL	40.44 Tb	16.26 Tb
Input_bits (1h averages) RDHPCS-FAIR	17.93 Tb	11.19 Tb
Input_bits (1h averages) RDHPCS-BOULDER	10.86 Tb	3.16 Tb
Input_bits (1h averages) CLASS-SUIT	1.83 Tb	1.55 Tb
Input_bits (1h averages) SSMC	1.77 Tb	1.07 Tb
Input_bits (1h averages) CLASS-BOUL	1.80 Tb	868 Gb
Input_bits (1h averages) N-Wave Internal	1.18 Tb	711 Gb
Input_bits (1h averages) Boulder Campus	813 Gb	523 Gb
Input_bits (1h averages) CLASS-ASHE	2.32 Tb	479 Gb
Input_bits (1h averages) GOES-R WCDAS	654 Gb	432 Gb
Input_bits (1h averages) RDHPCS-CLPK	676 Gb	338 Gb
Input_bits (1h averages) ESPDS	314 Gb	198 Gb
Input_bits (1h averages) GOES-R NSOF	87 Gb	72 Gb
Input_bits (1h averages) NCDC	210 Gb	34 Gb
Input_bits (1h averages) Silver Spring Campus	35 Gb	22 Gb
Input_bits (1h averages) NWS-ERH	34 Gb	18 Gb
Input_bits (1h averages) WCOSS-RESTON	31 Gb	7 Gb

Output Bits By Program

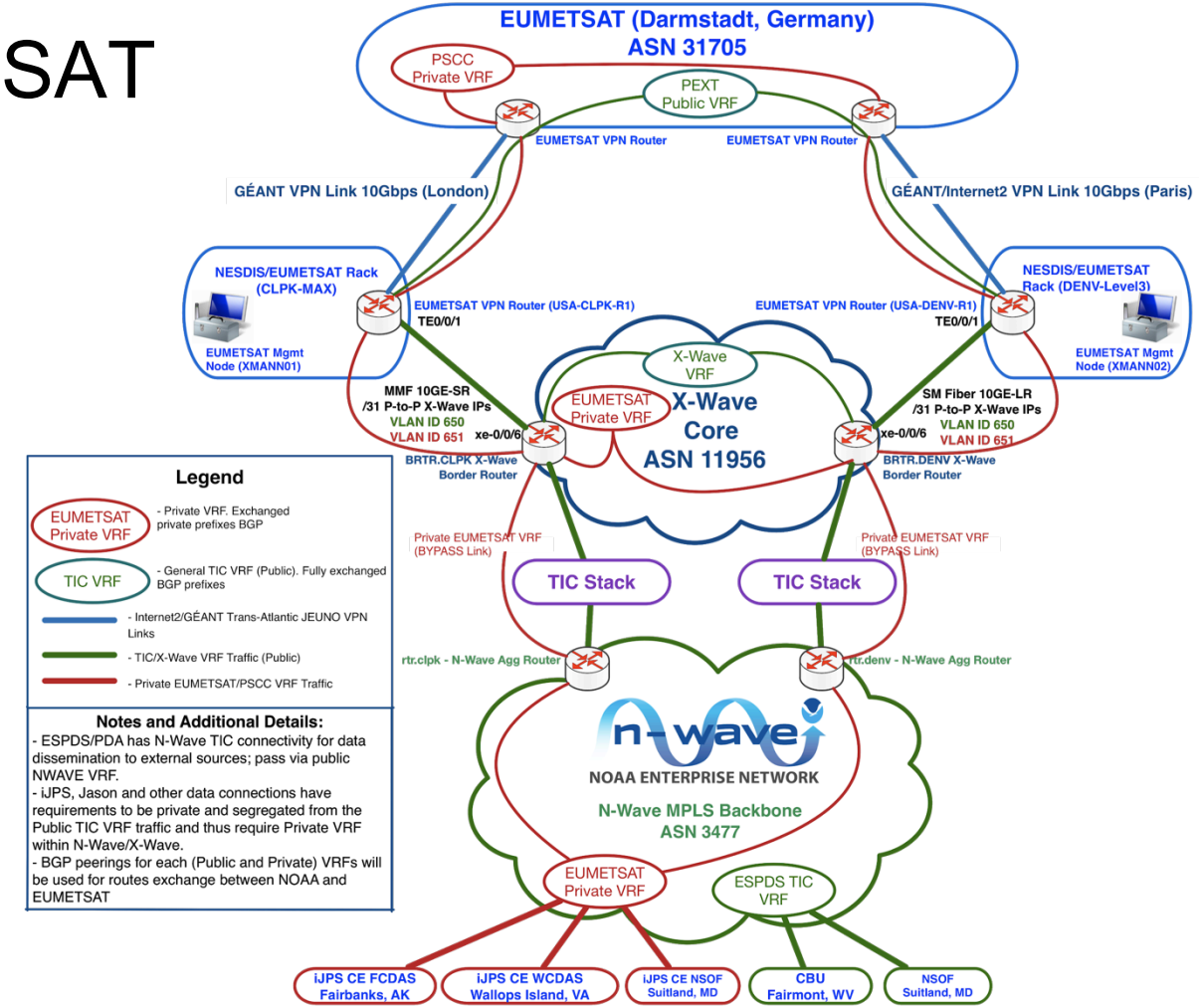


timeshift -1h

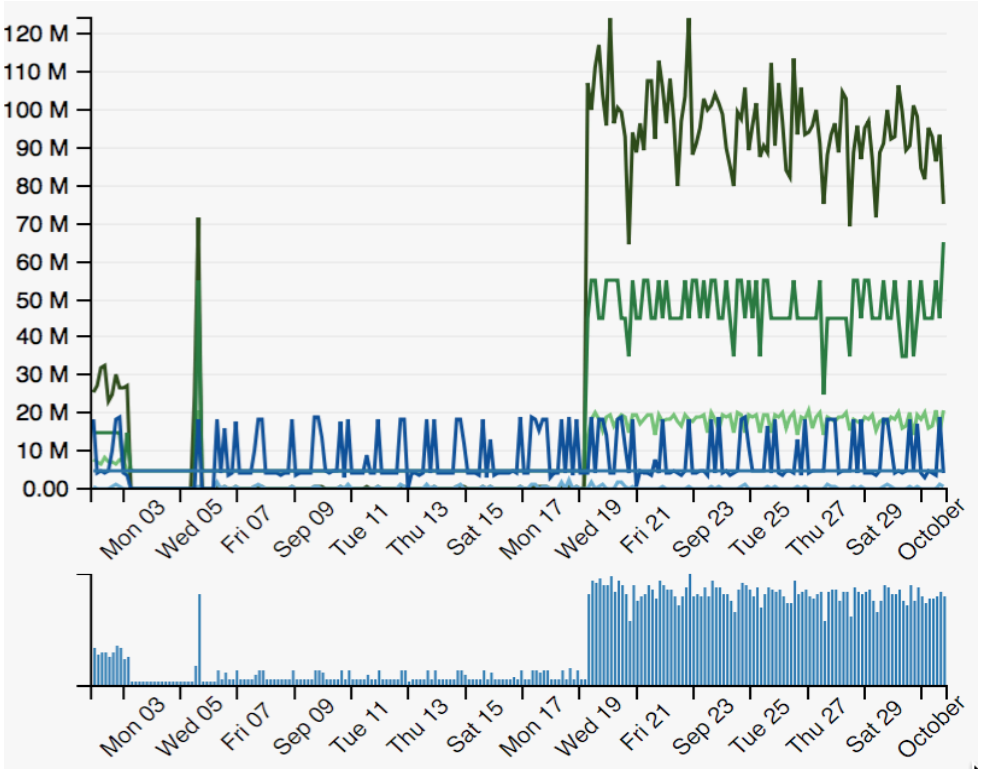
	max	avg
Output_bits (1h averages) WCOSS-RESTON	15.38 Tb	7.26 Tb
Output_bits (1h averages) WCOSS-ORLANDO	9.25 Tb	6.10 Tb
Output_bits (1h averages) SSMC	6.23 Tb	5.06 Tb
Output_bits (1h averages) RDHPCS-BOULDER	10.40 Tb	3.41 Tb
Output_bits (1h averages) NCDC	4.05 Tb	2.18 Tb
Output_bits (1h averages) STAR CLPK	3.47 Tb	2.13 Tb
Output_bits (1h averages) Boulder Campus	2.11 Tb	1.71 Tb
Output_bits (1h averages) RDHPCS-GFDL	2.29 Tb	1.51 Tb
Output_bits (1h averages) RDHPCS-FAIR	1.88 Tb	737 Gb
Output_bits (1h averages) N-Wave Internal	1.19 Tb	716 Gb
Output_bits (1h averages) CLASS-ASHE	1.25 Tb	602 Gb
Output_bits (1h averages) GOES-R RBU	649 Gb	475 Gb
Output_bits (1h averages) CLASS-BOUL	1.72 Tb	442 Gb
Output_bits (1h averages) Silver Spring Campus	1.55 Tb	424 Gb
Output_bits (1h averages) ORNL	767 Gb	357 Gb
Output_bits (1h averages) Seattle Campus	737 Gb	350 Gb
Output_bits (1h averages) ESPDS	416 Gb	279 Gb


PACIFIC WAVE
INTERNATIONAL PEERING EXCHANGE
NORDUNet
Nordic Countries
JANET
United Kingdom
SURFnet
Netherlands
GEANT
Europe
USLHCNet
CERN
KISTI
KREONET
Korea
GEMNet2
JGN-X
NII/SINET
TransPAC
Japan
TransPAC/
Pacific Wave
100Gbps
CERNET
China
QATAR
FOUNDATION
Qatar
CSTNET
GLORIAD
Hong Kong
TWAREN
TANET
Taiwan
CANARIE
100gbps
PNWGP
Vancouver
ESnet
Seattle
DREN
Internet2
PACIFIC WAVE
BACKBONE
StarLight
Chicago
CENIC
NREN
(NASA Ames)
Denver
FRGP
ESnet
San Francisco
Bay Area
Los
Nettos
CENIC
UltraLight
(UltraNet)
Internet2
Albuquerque
ABQG
NUS-GIGAPOP
Singapore
UH
Oahu
Los
Angeles
Tijuana
El Paso
DREN
UH
Hawaii
AARNET
Australia
CUDI
Mexico
REANNZ
New Zealand
SPEEDS/POPS
1 Gbps
2.5 Gbps
10 Gbps
40 Gbps
100 Gbps
Pacific Wave POPs
Pacific Research Platform (PRP)
PRP Science DMZ Fabric
Software Defined Network
Commercial Peering Points
(Amazon, Google, & Microsoft)
WESTERN REGIONAL NETWORK
States served by WRN members:
• PNWGP: Washington, Montana, Alaska, Oregon & Idaho
• FRGP: Colorado and Wyoming
• ABQG: Albuquerque GigaPoP
• UH: Hawaii
• CENIC: California
CEV: 102215

NOAA - EUMETSAT Future Network (JEUNO)



50mbps
with peaks of over 120mbps

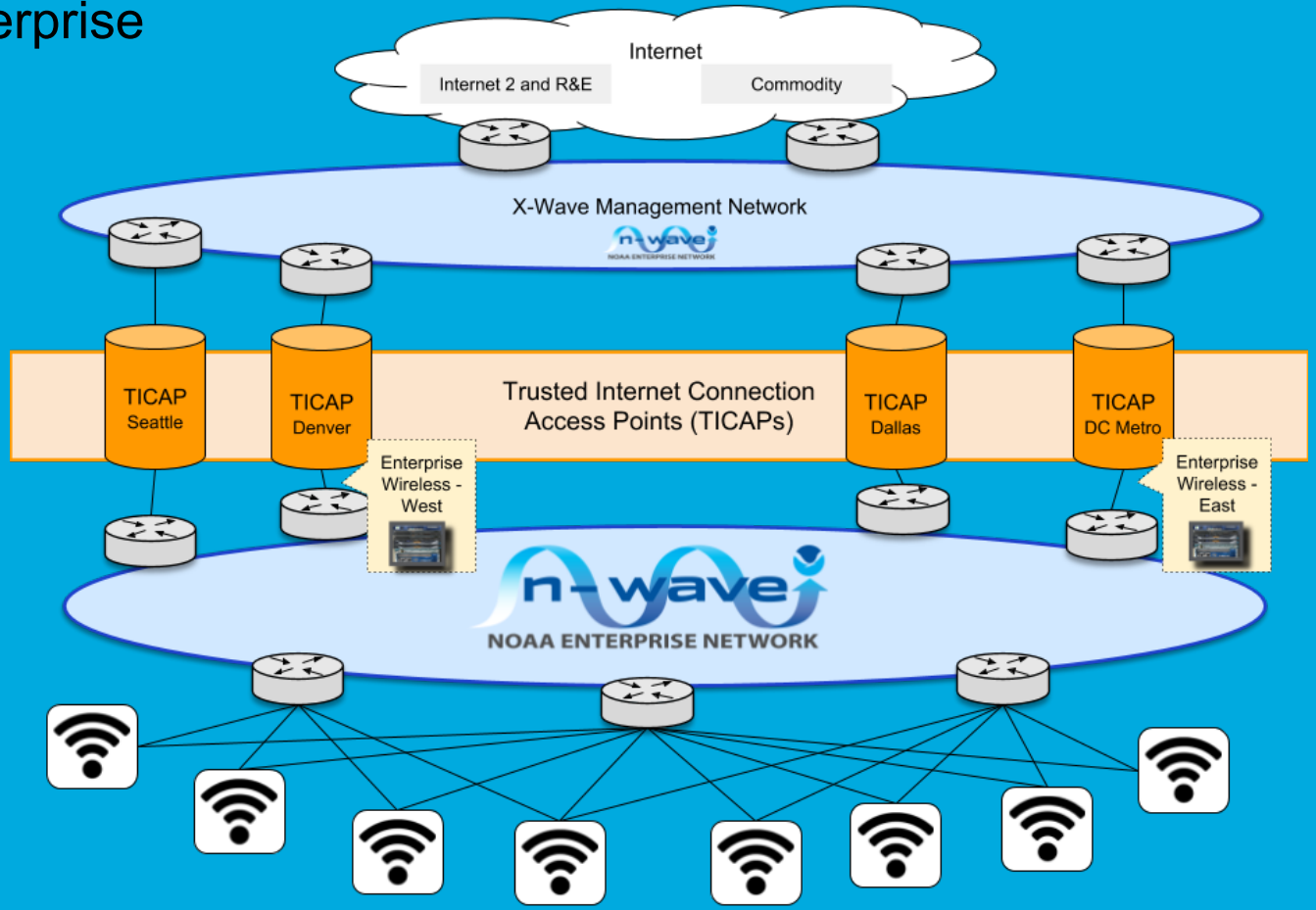


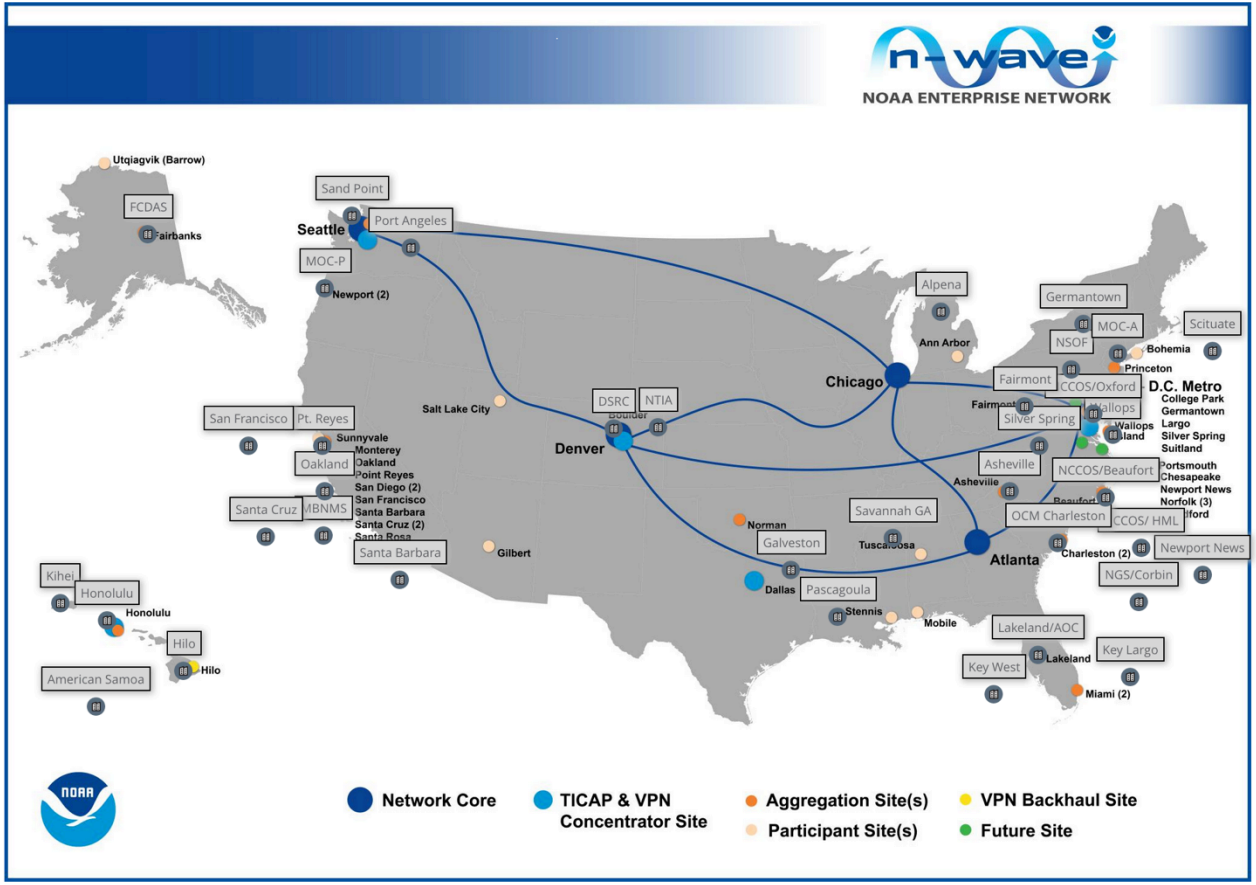
since the cutover from the DS-3 circuits to JEUNO on 9/19/2018

Latency for key EUMETSAT MetOp satellite products has decreased by

8-15 minutes

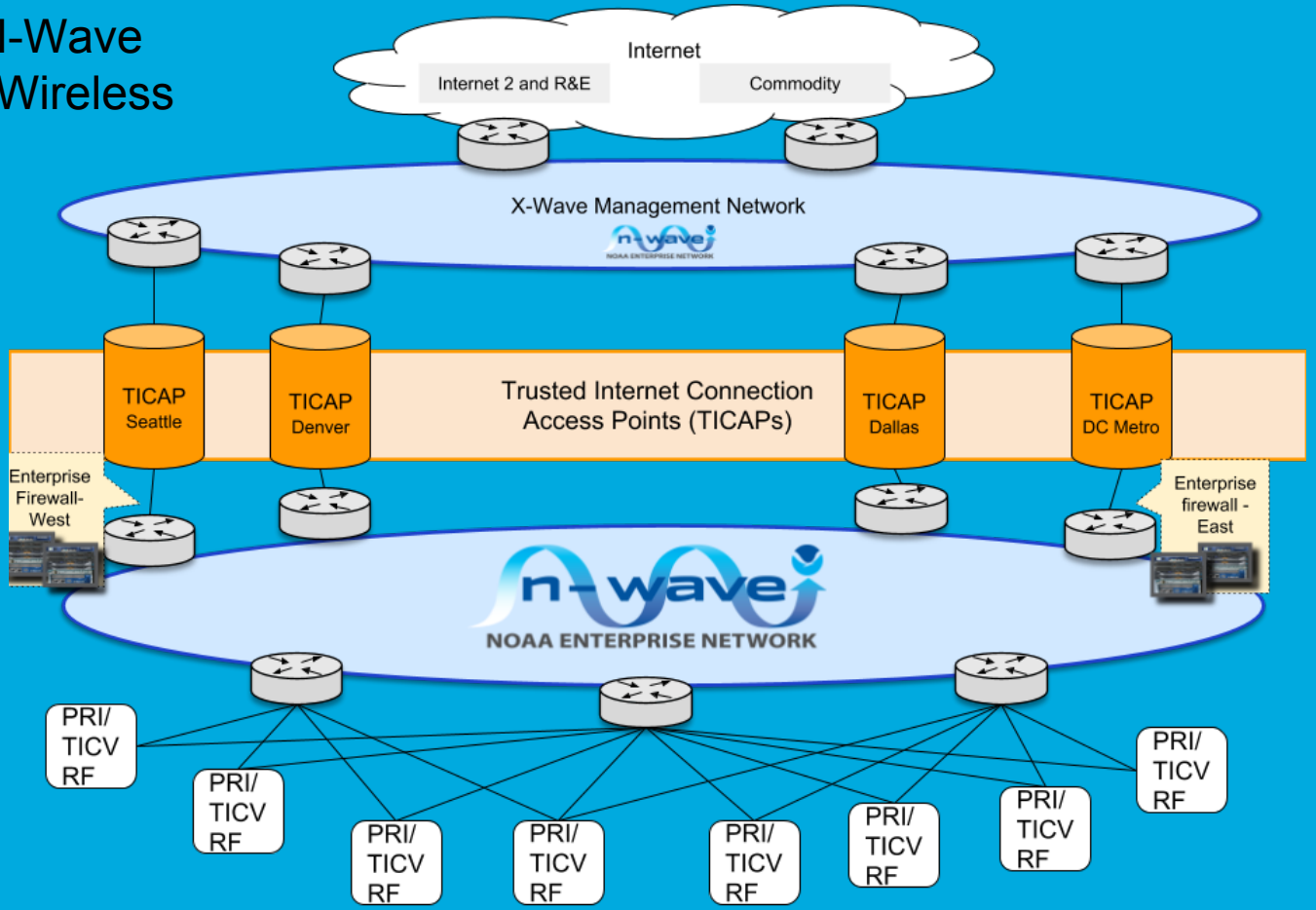
TICAP Adjacent Services: N-Wave Enterprise Wireless

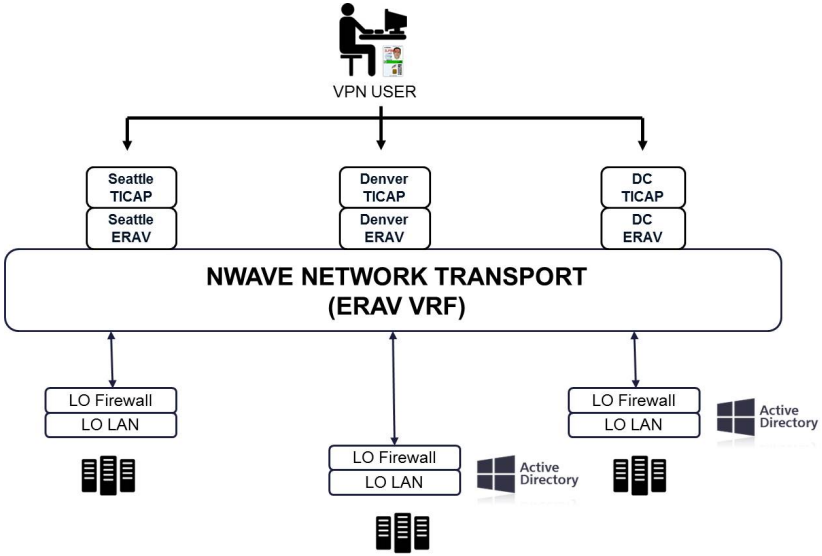




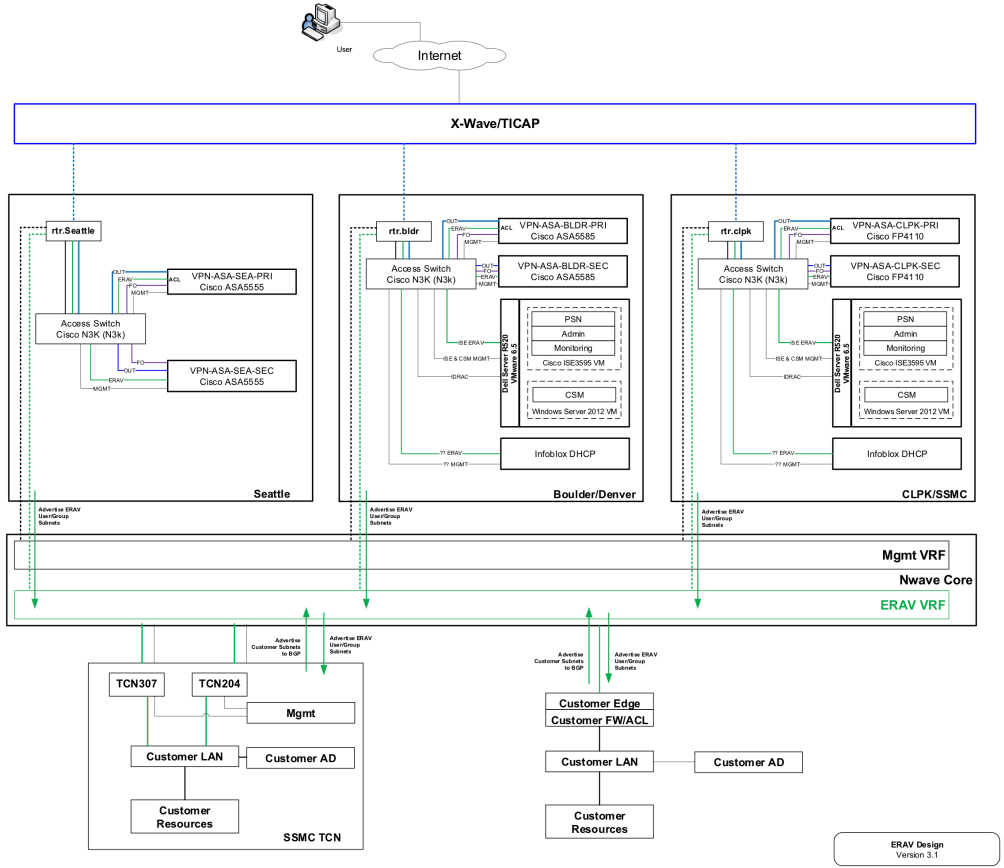
Active: Silver Spring SSMC4, Oakland, Germantown, Lakeland, Beaufort, HML, OCM Charleston, Fairmont, Oxford, Wallops, ITC, DSRC (NOAA,NTIA) and WRC

TICAP Adjacent Services: N-Wave Enterprise Wireless

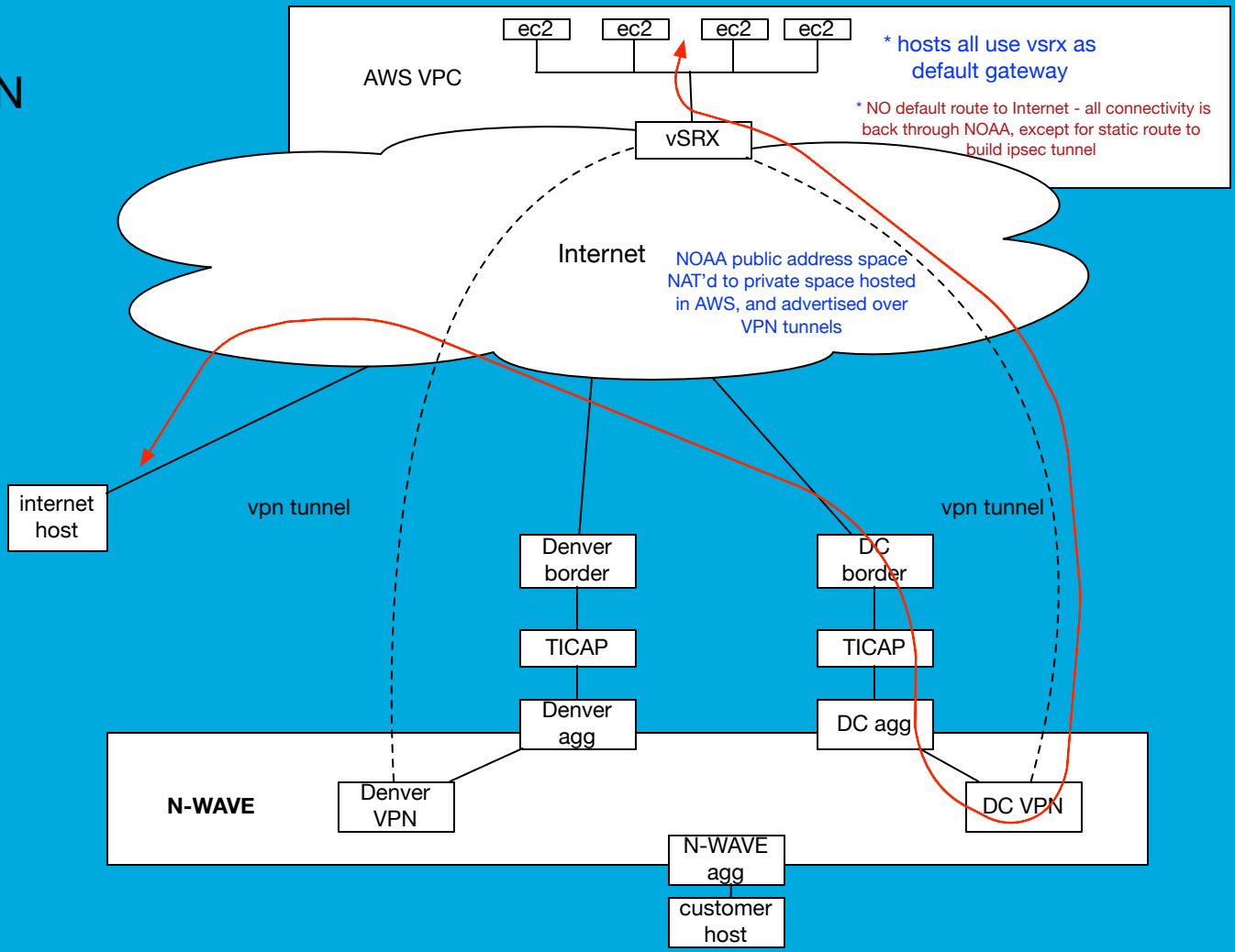




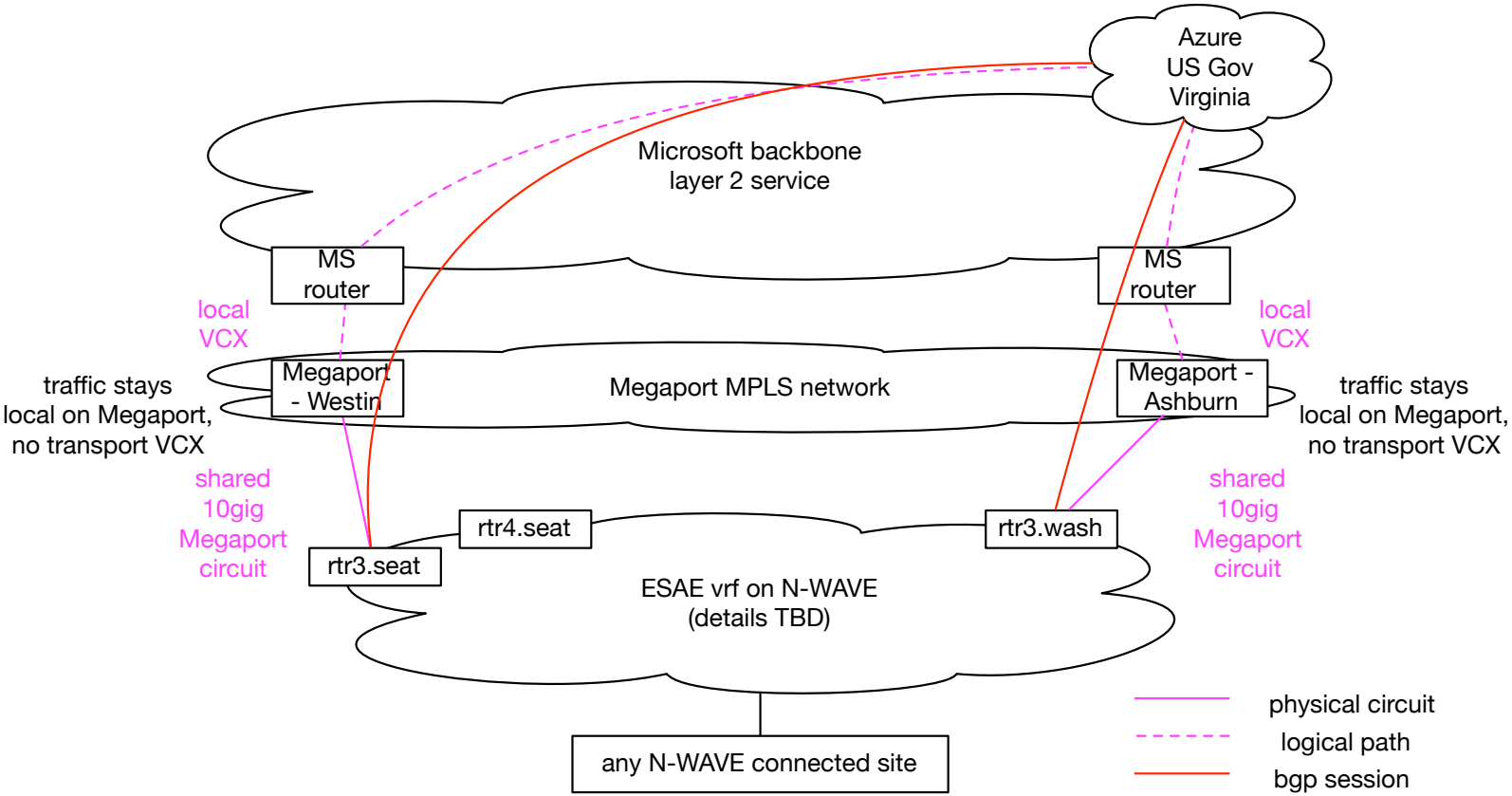
N-Wave
Enterprise Remote Access VPN Service



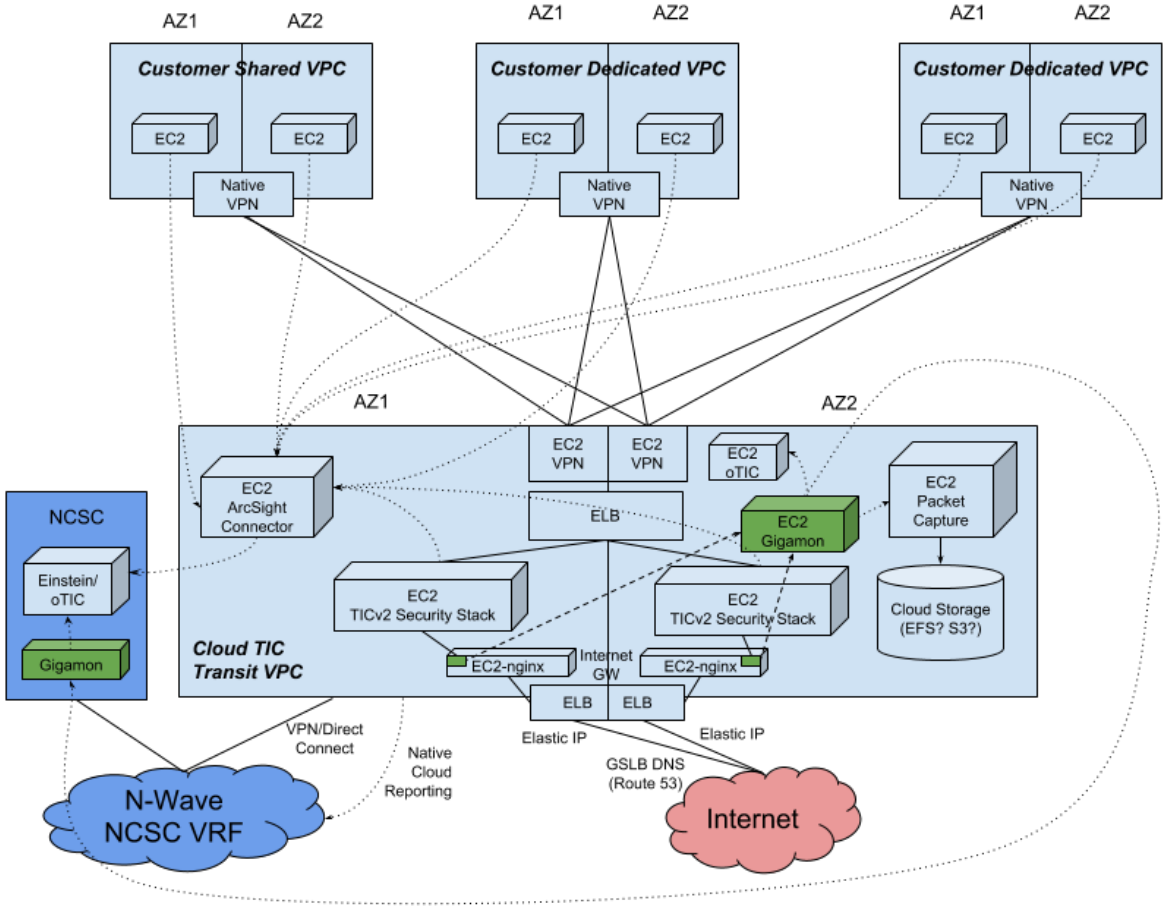
N-Wave Cloud Connectivity - VPN



N-Wave Cloud Direct Connect - Broker



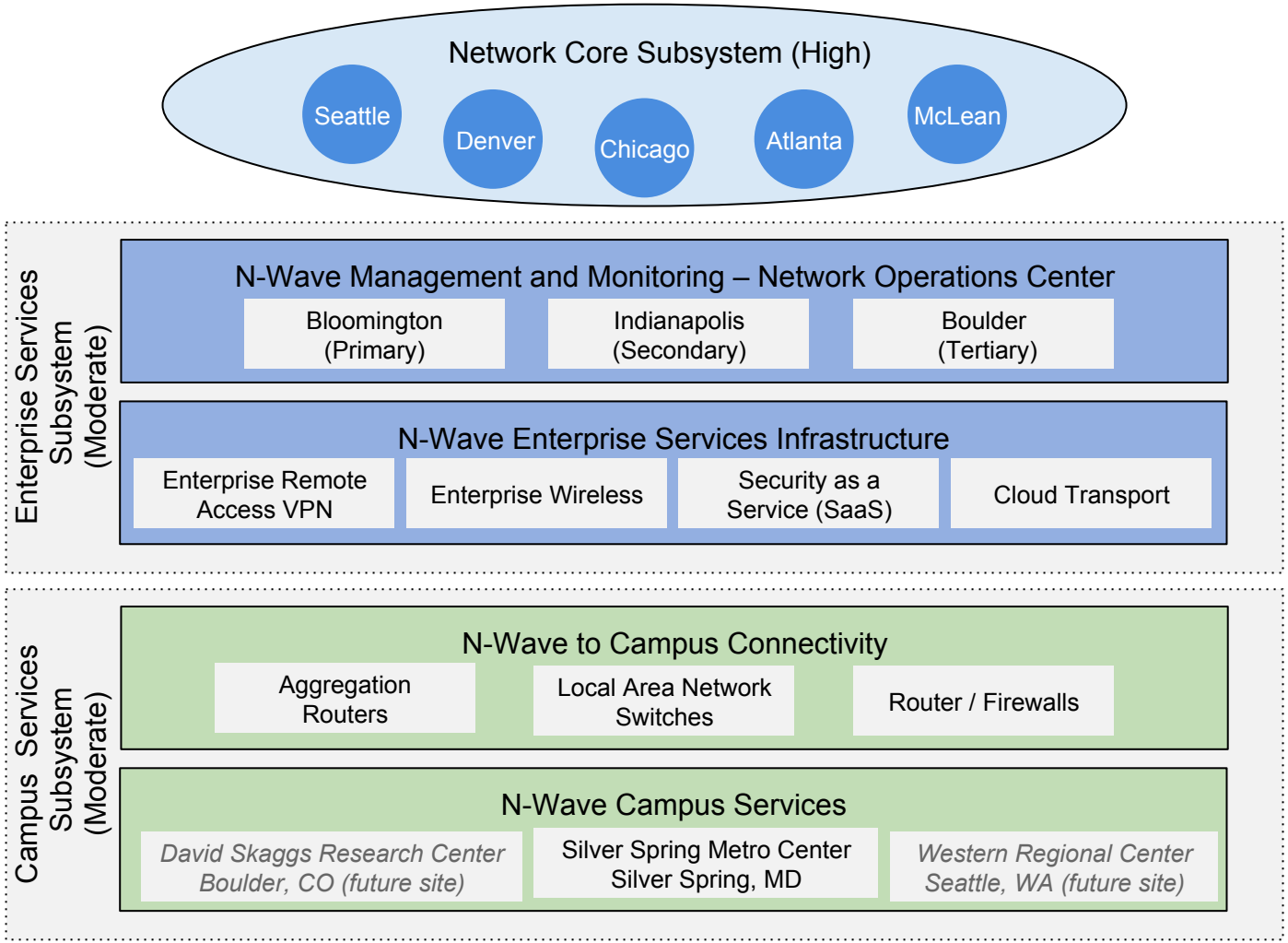
AWS Cloud TIC



Alex.Hsia@noaa.gov
20180821

Information Security Classification

High-Criticality System With Moderate Enclaves



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