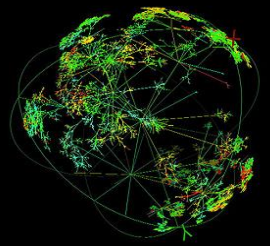
Global Research Platform And SC22 Network Research Exhibitions

Joe Mambretti, Director, (j-mambretti@northwestern.edu)
International Center for Advanced Internet Research (www.icair.org)
Northwestern University
Director, Metropolitan Research and Education Network (www.mren.org)
Director, StarLight International/National Communications Exchange Facility (www.startap.net/starlight),
PI: StarLight SDX, Co-PI Chameleon, PI-iGENI, PI-OMNINet

IEEE/ACM International Conference On High Performance Computing, Networking, Storage, and Analytics
Dallas, Texas
November 13-17, 2022





iCAIR

STARLIGHT SDX

The GRP: A Platform For Global Science



A Next Generation, Software Defined, Globally Distributed, Multi-Domain Computational Science Environment

STARLIGHT℠

Global Research Platform: Global Lambda Integrated Facility Available Advanced Network Resources



Visualization courtesy of Bob Patterson, NCSA; data compilation by Maxine Brown, UIC.

Selected Applications



GENI
www.geni.net



Open Storage Network
www.openstorage network.org



OSG
www.openscience grid.org



Polar Geospatial Center
www.pgc.umn.edu



LSST
www.lsst.org



ISS
www.nasa.gov/ station



Virgo
www.virgo-gw.eu



LHC
home.cern/science/ accelerators/large-hadron-collider



GLEON
www.gleon.org



GRP
theglobalresearch platform.net/



IceCube
icecube.wisc.edu



Pierre Auger Observatory
www.auger.org



SKA
www.skatelescope. org



LIGO
www.ligo.caltech. edu





LHCONE
twiki.cern.ch/twiki/bin /view/LHCONE/ WebHome



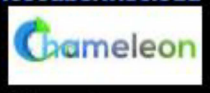
USGS EROS
www.usgs.gov/ centers/eros



Blue Waters
bluewaters.ncsa. illinois.edu



PRP
pacificresearch platform.org



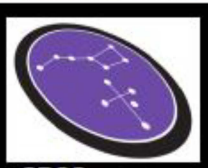
Chameleon
www.chameleon cloud.org



Belle II
www.belle2.org



XENON
xenon.astro. columbia.edu



SDSS
www.sdss.org



NEON
www.neonscience. org



PRAGMA
www.pragma-grid.net



CHASE-CI
www.calit2.net/ newsroom/article.php?id=2910



Genomic Science Program
genomicscience. energy.gov



LBNF/DUNE/ ProtoDUNE
lbnf.fnal.gov



NOvA
novaexperiment. fnal.gov



ALMA
www.alma observatory.org



IVOA
www.ivoa.net



CENTRA
www.global centra.org



SAGE2
sage2.sagecommons. org



LHCOPN
twiki.cern.ch/twiki/bin /view/LHCOPN/ WebHome

Compilation by Maxine Brown and Joe Mambretti

STARLIGHT℠

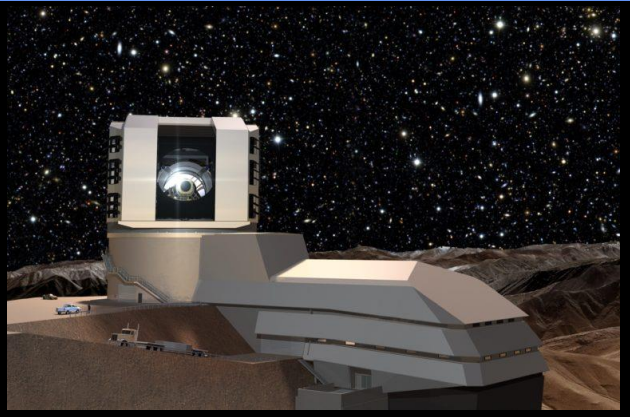
Instruments: Exebytes Of Data



High Luminosity LHC



SKA Australia Telescope Facility



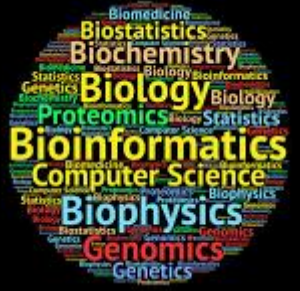
Vera Rubin Observatory



KSTAR Korea Superconducting Tokamak



Next Gen Advanced Photon Source



Bioinformatics/Genomics

NSF's Cyberinfrastructure Framework for the 21st Century (CIF21)

- ***"Across the full range of NSF---supported fields increasingly sophisticated instrumentation and expanded computational resources are opening new windows onto phenomena from the universe to the human brain, from the largest scales to the smallest. Across all domains, data play the key role in a profound transformation of the culture and conduct of science and society.***
- ***This Revolution Will Transform Research, Practice, And Education In Science and Engineering As Well As Advance Innovation In Society***
- ***This vision of the near future shows clearly the urgent need for a comprehensive, scalable, cyberinfrastructure that bridges diverse scientific communities and integrates high---performance computing, data, software, and facilities in a manner that brings theoretical, computational, experimental, and observational approaches together to advance the frontier."***

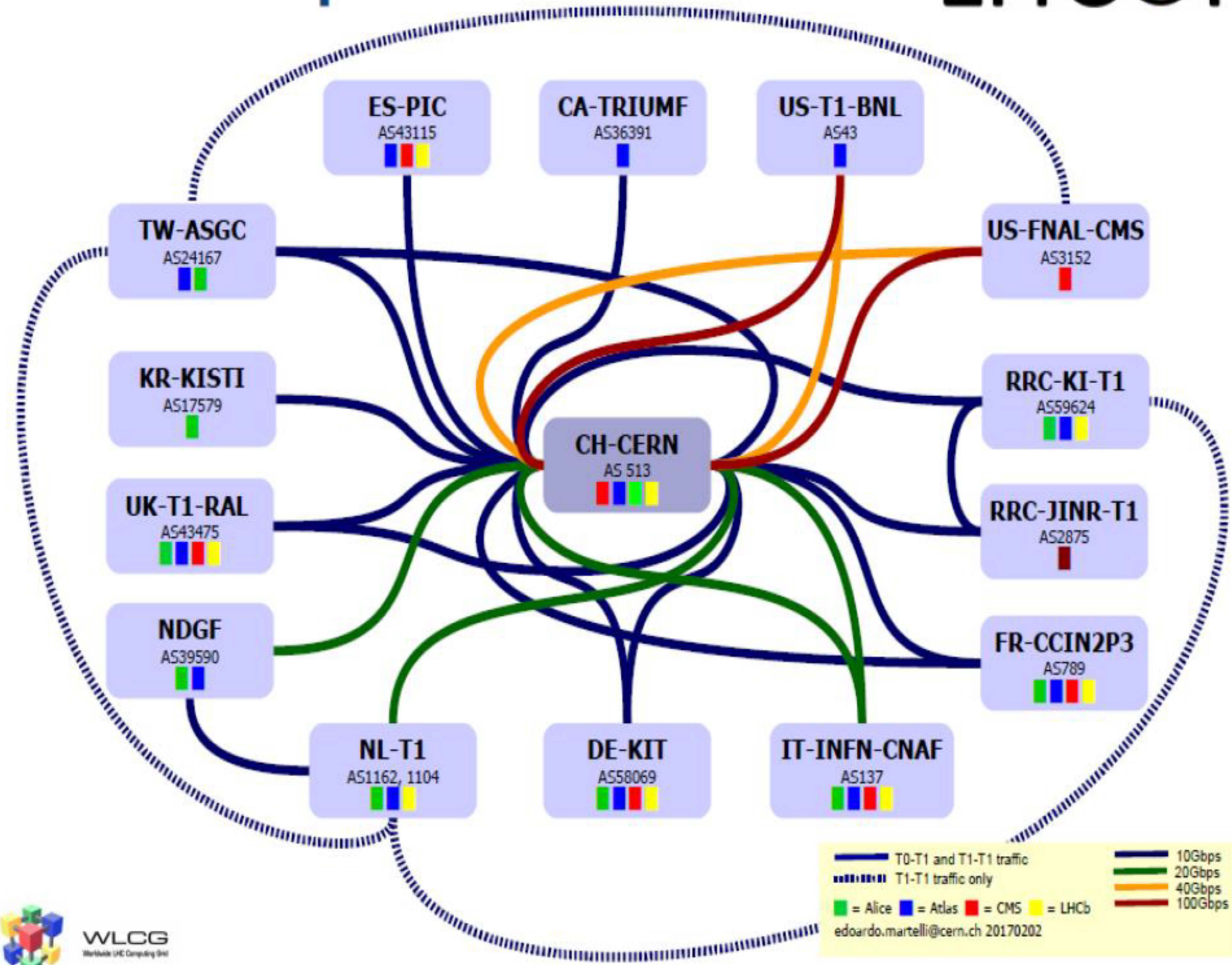


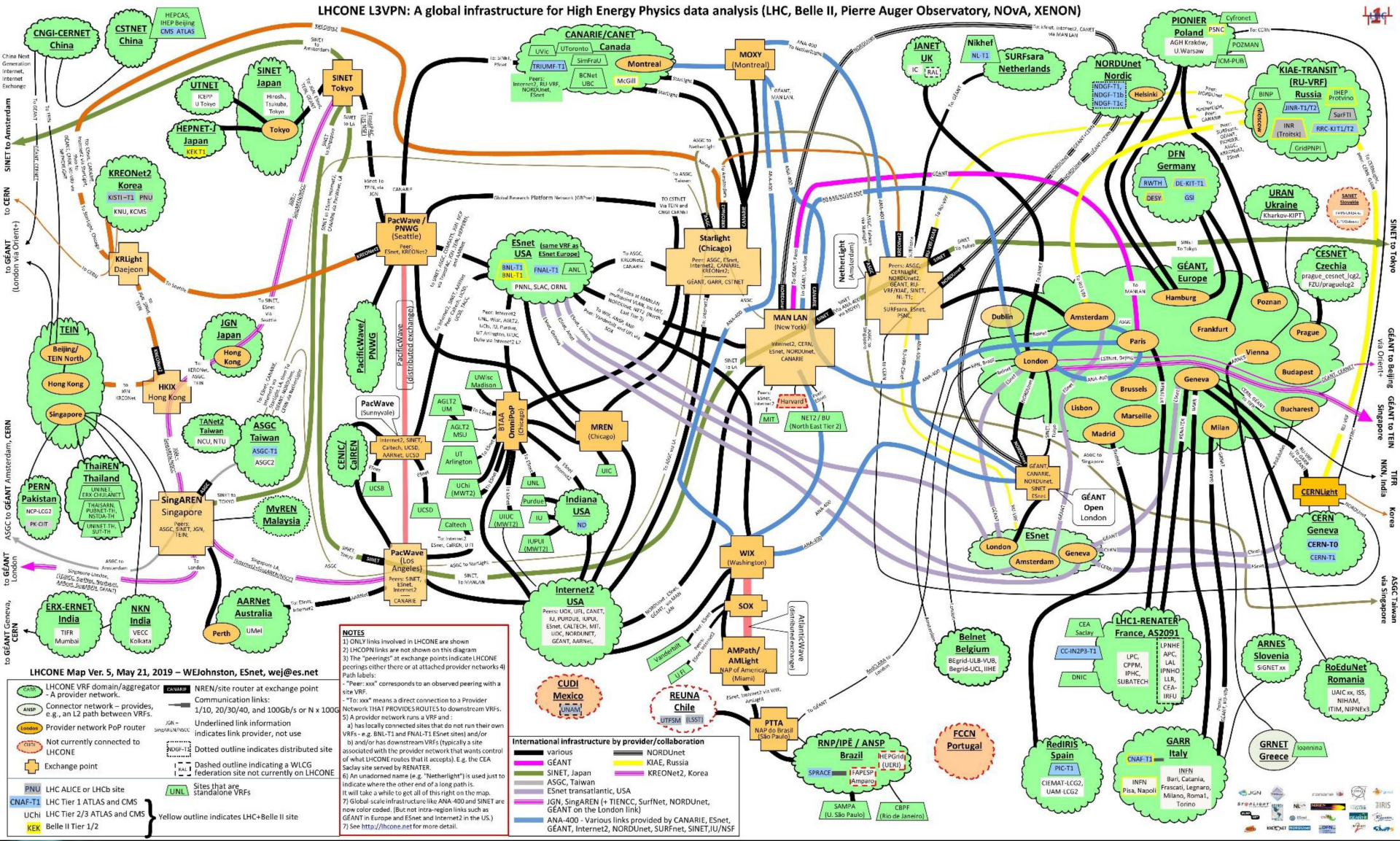
Theme 1: Large Scale Global Science

- Science Domains Create Cyberinfrastructure Ecosystems, Some Distributed World Wide, Some Devoted To Domains, Some Shared Among Domains
- Minimal Opportunities For Information Sharing On Cyberinfrastructure Architecture, Implementation, Technologies and Operations Among Projects
- Such Opportunities Are Especially Useful For Cross Disciplinary Research
- Example Ecosystem: HEP - LHC



LHCOPN map


ES-PIC
AS43115
CA-TRIUMF
AS36391
US-T1-BNL
AS43
TW-ASGC
AS24167
US-FNAL-CMS
AS3152
KR-KISTI
AS17579
RRC-KI-T1
AS59624
CH-CERN
AS 513
UK-T1-RAL
AS43475
RRC-JINR-T1
AS2875
NDGF
AS39590
FR-CCIN2P3
AS789
NL-T1
AS1162, 1104
DE-KIT
AS58069
IT-INFN-CNAF
AS137
T0-T1 and T1-T1 traffic
T1-T1 traffic only
= Alice = Atlas = CMS = LHCb
edoardo.martelli@cern.ch 20170202
10Gbps
20Gbps
40Gbps
100Gbps



STARLIGHT SM

New Science Communities Using LHCONE

- Belle II Experiment, Particle Physics Experiment Designed To Study Properties of B Mesons (Heavy Particles Containing a Bottom Quark).
- Pierre Auger Observatory, Studying Ultra-High Energy Cosmic Rays, the Most Energetic and Rarest of Particles In the Universe.
- In August 2017 the PAO, LIGO and Virgo Collaboration Measured a Gravitational Wave Originating From a Binary Neutron Star Merger.
- The NOvA Experiment Is Designed To Answer Fundamental questions in neutrino Physics.
- The XENON Dark Matter Project Is a Global Collaboration Investing Fundamental Properties of Dark Matter, Largest Component Of The Universe.

Recent=> DUNE/ProtoDUNE – Deep Underground Nutrino Experiment

Theme2 : Next Generation Research Platforms

- *“a comprehensive, scalable, cyberinfrastructure that bridges diverse scientific communities and integrates high--performance computing, data, software, and facilities in a manner that brings theoretical, computational, experimental, and observational approaches together to advance the frontier”*
- **Large Scale Science DMZs**
- **Super Facilities**
- **National Research Platforms**
- **Continental Research Platforms**



Theme 3: Orchestration Among Multiple Domains

- Instrumentation and Analytic, Storage Resources Are Highly Distributed Among Multiple Domains Interconnected With High Performance Networks
- A Key Issues Is Discovering Resources, Claiming Them, Integrating Them, Utilizing Them and Releasing Them
- Increasingly, New Software Defined Infrastructure Architecture, Services, Techniques And Technologies Are Addressing These Issues, Especially Network Programmability (e.g., Software Defined Networking)



Theme 4: Large-Scale High Capacity Data WAN Transport

- Large-Scale High Capacity Data WAN Transport Has Always Been And Remains A Major Challenge, Especially Over Global Paths
- This Issue Is Emphasized By A Next Generation Of Instrumentation That Will Generate Exponentially Large Volumes Of Data That Has To Be Distributed Across the Globe
- Often, This Issue Is Considered Reductively Only In Terms Of Network Capacity
- However, Actually It Is More An E2E Issue, Especially Given Advances In Core Optical Networking Technologies



Theme 5: High-Fidelity Data Flow Monitoring, Visualization, Analytics, Diagnostic Algorithms, Event Correlation AI/ML/DL

- A Major Opportunity For Data Transport Optimization Is Being Provided By New Methods For Directly Detecting And Analyzing All Data Flows And Their Characteristics
- Because These Techniques Enable High-Fidelity Views Of All Flows, Real Time, Dynamic Traffic Engineering Is Possible With Much More Sophistication Than Traditional Approaches
- These Techniques Can Be Significant Enhanced Using AI/ML/DL, Which (Although Still Emerging) Are Becoming Critically Important Tools



Theme 6: International Testbeds for Data-Intensive Science

- Given Challenges Of Anticipated Large Scale Science Projects Along With Accelerated Rates Of Ongoing Innovation, International Testbeds Are Required for Pre-Production Investigations And Prototyping Of New Technologies And Techniques Specifically Related To Data Intensive Science
- Such Global Experimental Research Testbeds Exist Today, And They Are Being Developed With Enhanced Capacities, Sites, And Capabilities



StarLight – "By Researchers For Researchers"

StarLight: Experimental Optical Infrastructure/Proving Ground For Next Gen Network Services

Optimized for High Performance Data Intensive Science

Multiple 100 Gbps (110+ Paths)

StarWave

100 G Exchange

World's Most Advanced Exchange

Multiple First of a Kind Services and Capabilities



View from StarLight



Abbott Hall, Northwestern University's Chicago Campus

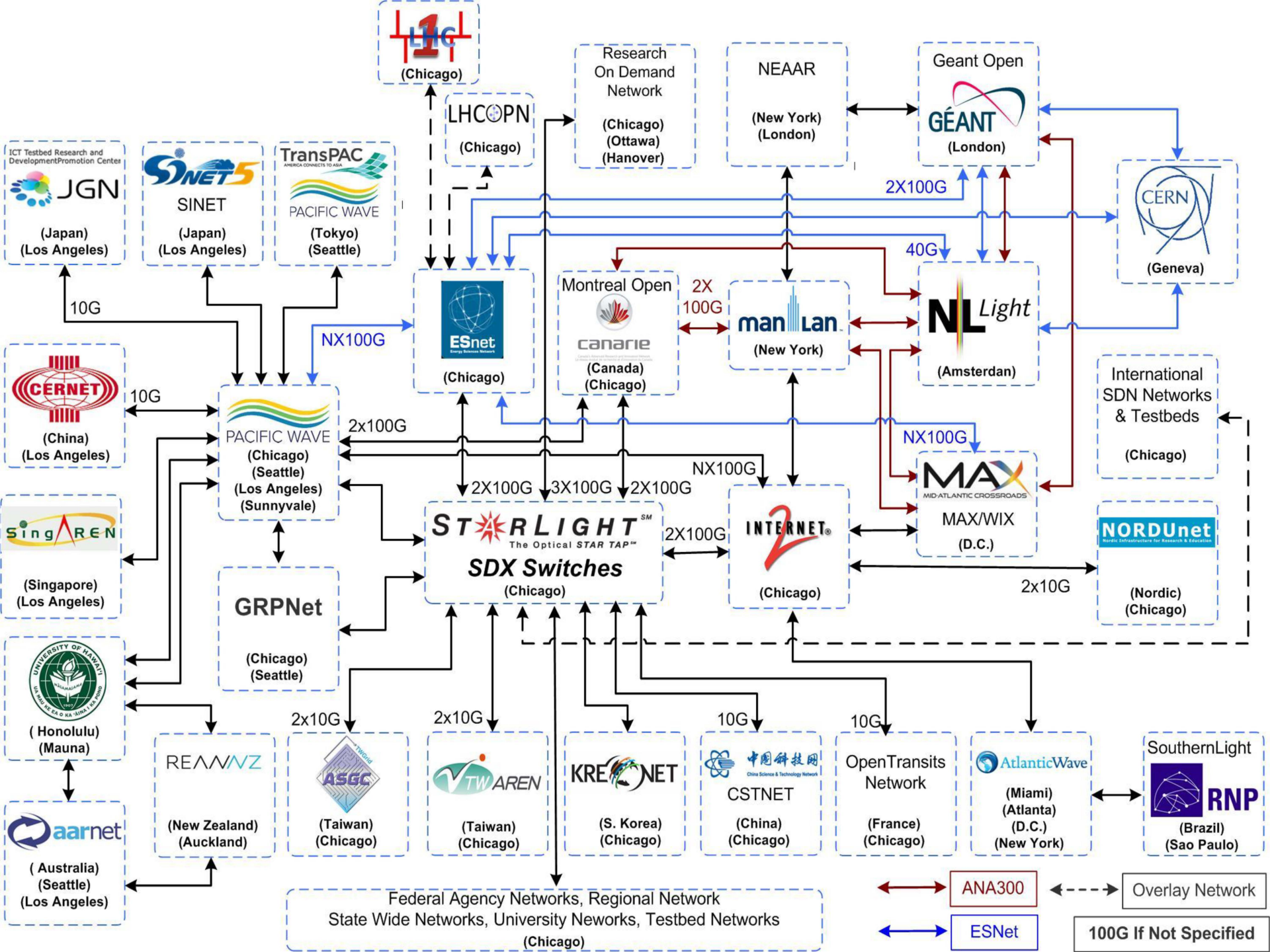
Currently: Multiple 400 Gbps Paths Planning for 800 Gbps Tbps

STARLIGHT℠

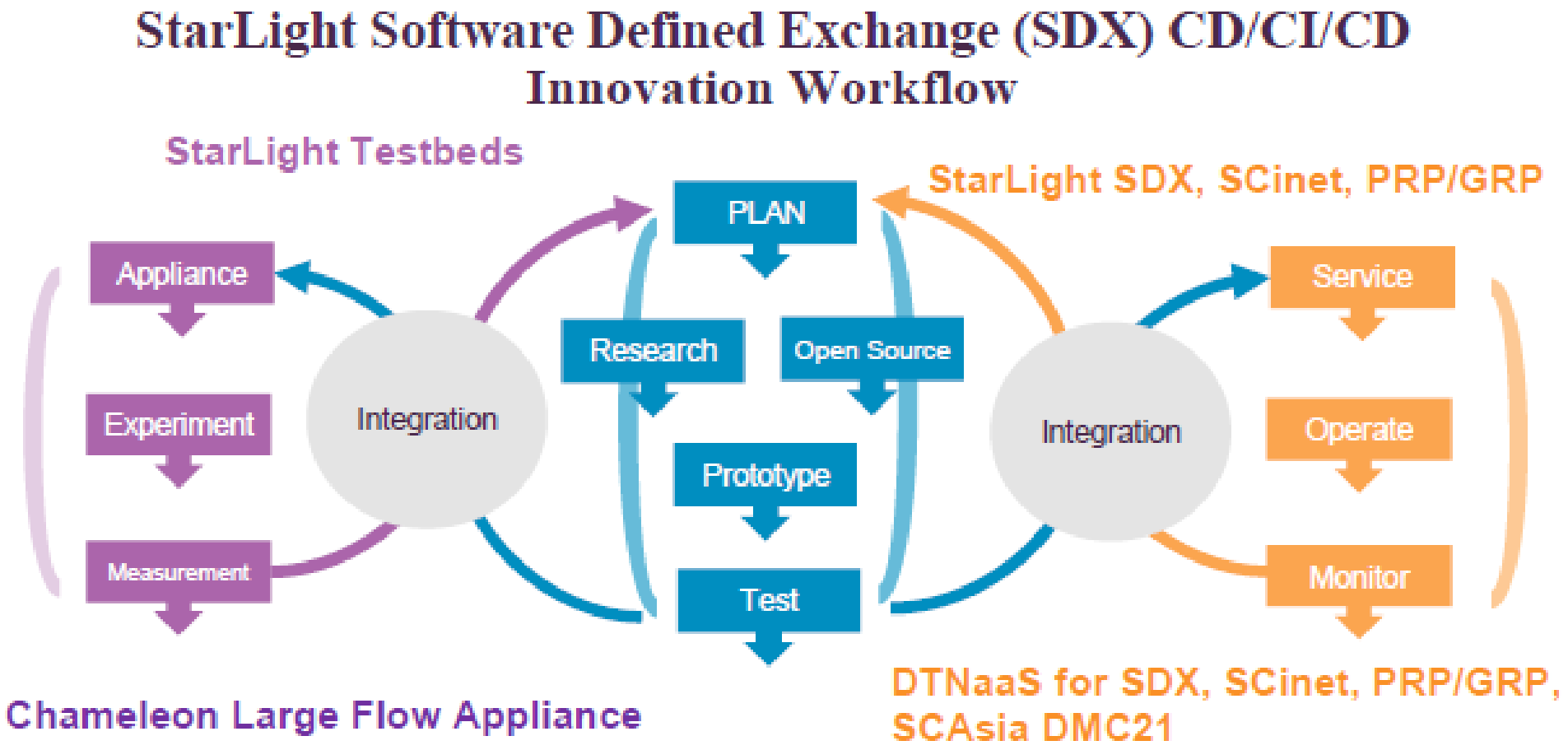
International Federated Testbeds As Instruments for Computer Science/Network Science

- The StarLight Communications Exchange Facility Supports ~ 25 Network Research Testbeds (Instruments For Computer Science/Networking Research)
- StarLight Supports Two Software Defined Exchanges (SDXs), An NSF IRNC SDX & A Network Research GENI SDX (Global Environment for Network Innovations)
- The GENI SDX Supports National and International Federated Testbeds




LHC
(Chicago)
LHCOPN
(Chicago)
Research On Demand Network
(Chicago)
(Ottawa)
(Hanover)
NEAAR
(New York)
(London)
Geant Open
GÉANT
(London)
CERN
(Geneva)
2X100G
40G
ICT Testbed Research and DevelopmentPromotion Center
JGN
(Japan)
(Los Angeles)
SINET
(Japan)
(Los Angeles)
TransPAC
PACIFIC WAVE
(Tokyo)
(Seattle)
10G
NX100G
ESnet
(Chicago)
Montreal Open
canarie
(Canada)
(Chicago)
2X 100G
manLan
(New York)
NL Light
(Amsterdan)
CERNET
(China)
(Los Angeles)
10G
PACIFIC WAVE
(Chicago)
(Seattle)
(Los Angeles)
(Sunnyvale)
2x100G
International SDN Networks & Testbeds
(Chicago)
NX100G
MAX
MID-ATLANTIC CROSSROADS
MAX/WIX
(D.C.)
2X100G
3X100G
2X100G
NX100G
SingAREN
(Singapore)
(Los Angeles)
STARLIGHT
The Optical STAR TAP
SDX Switches
(Chicago)
2X100G
INTERNET2
(Chicago)
2x10G
NORDUnet
(Nordic)
(Chicago)
GRPNet
(Chicago)
(Seattle)
(Honolulu)
(Mauna)
2x10G
2x10G
10G
10G
REANNZ
(New Zealand)
(Auckland)
ASGC
(Taiwan)
(Chicago)
TWAREN
(Taiwan)
(Chicago)
KREONET
(S. Korea)
(Chicago)
CSTNET
(China)
(Chicago)
OpenTransits Network
(France)
(Chicago)
AtlanticWave
(Miami)
(Atlanta)
(D.C.)
(New York)
SouthernLight
RNP
(Brazil)
(Sao Paulo)
aarnet
(Australia)
(Seattle)
(Los Angeles)
Federal Agency Networks, Regional Network
State Wide Networks, University Neworks, Testbed Networks
(Chicago)
ANA300
Overlay Network
ESnet
100G If Not Specified

StarLight Software Defined Exchange



iCAIR

STARLIGHT SDX

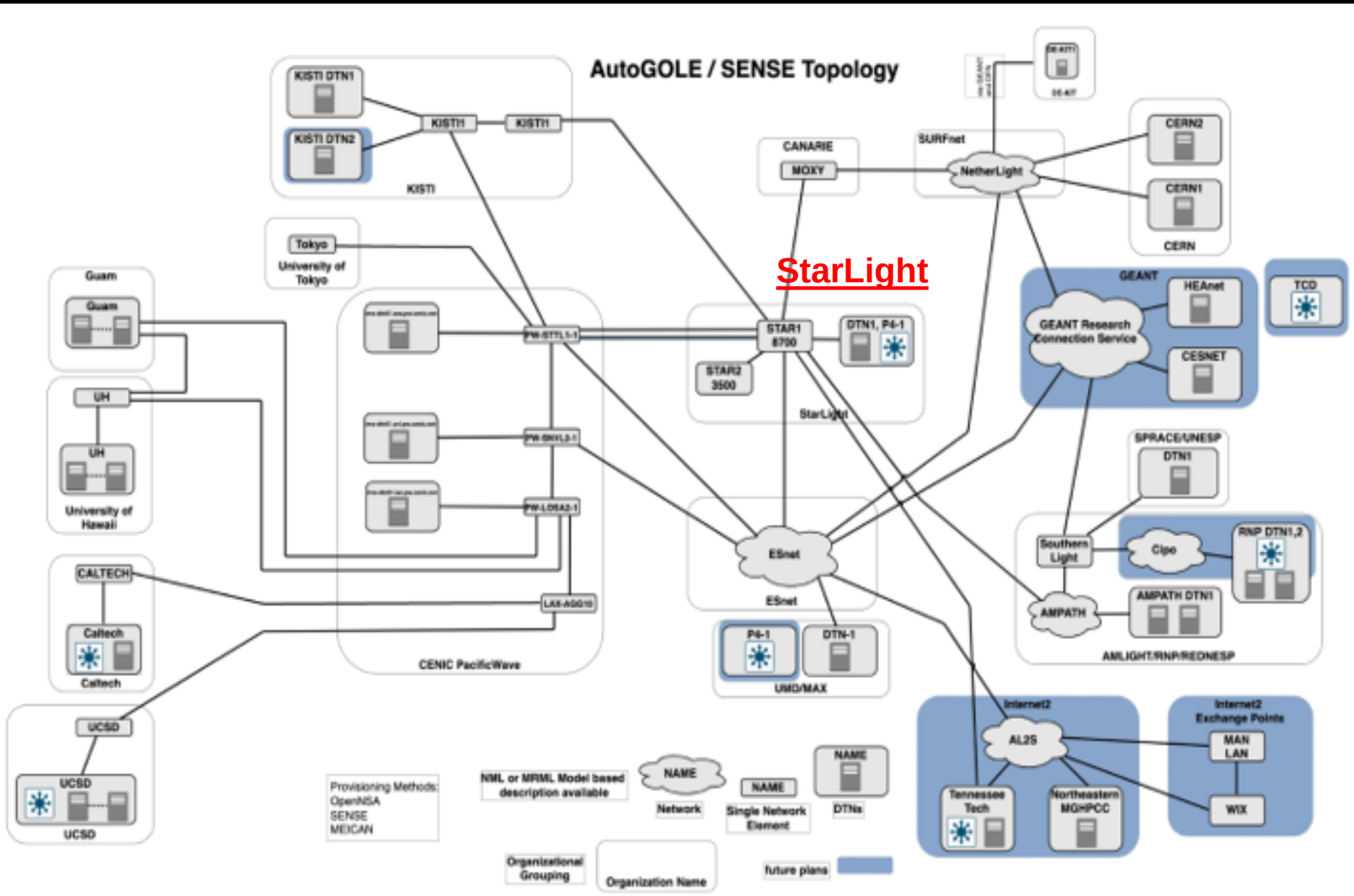
Source: Jim Chen

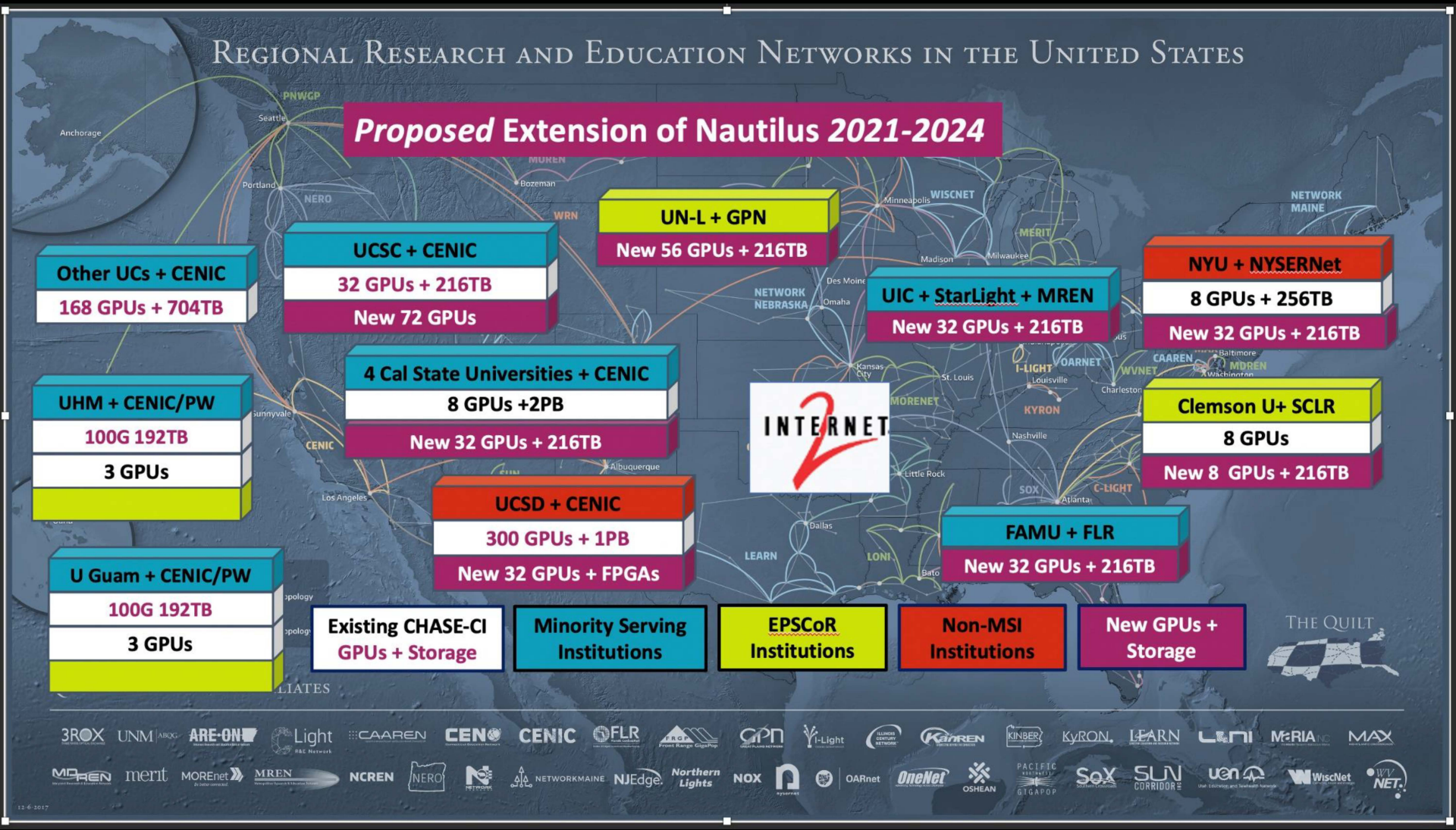
STARLIGHT SM



AutoGOLE Open R&E Exchanges

STARLIGHT℠


AutoGOLE / SENSE Topology
StarLight
KISTI DTN1
KISTI DTN2
KISTI1
KISTI1
KISTI
Tokyo
University of Tokyo
Guam
Guam
UH
UH
University of Hawaii
CALTECH
Caltech
Caltech
UCSD
UCSD
UCSD
CENIC PacificWave
FW-STTL1-1
FW-SNVL2-1
FW-LOSA2-1
LAX-AGG10
CANARIE
MOXY
SURFnet
NetherLight
CERN2
CERN1
CERN
STAR1 8700
STAR2 3500
DTN1, P4-1
StarLight
GEANT
GEANT Research Connection Service
HEAnet
CESNET
TCD
SPRACE/UNESP
DTN1
ESnet
ESnet
P4-1
DTN-1
UMD/MAX
Southern Light
Cipo
RNP DTN1,2
AMPATH
AMPATH DTN1
AMLIGHT/RNP/REDNESP
Internet2
AL2S
Tennessee Tech
Northeastern MGHPCC
Internet2 Exchange Points
MAN LAN
WIX
Provisioning Methods:
OpenNSA
SENSE
MEICAN
NML or MRML Model based description available
NAME
Network
NAME
Single Network Element
NAME
DTNs
Organizational Grouping
Organization Name
future plans



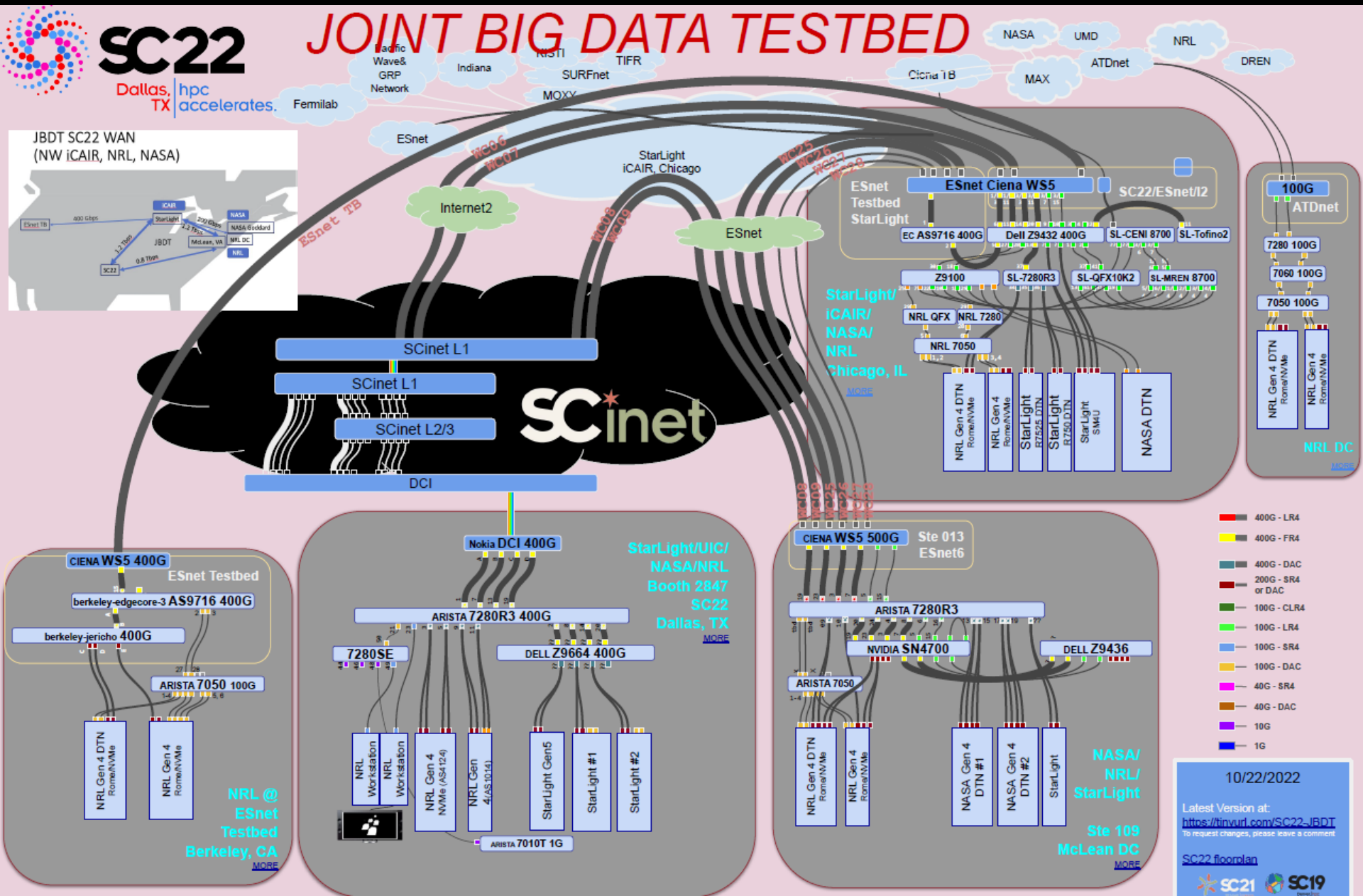
STARLIGHT SM

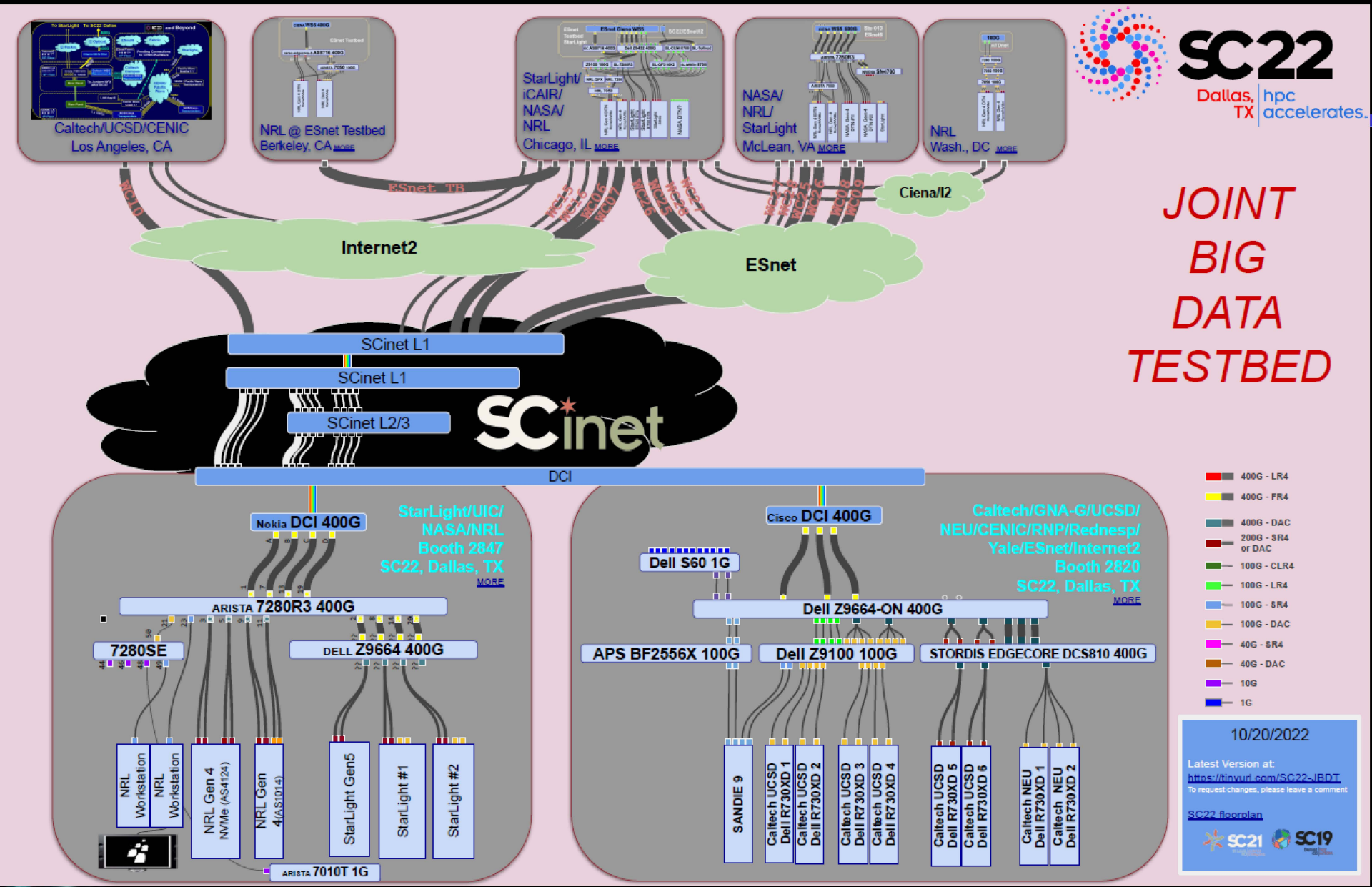
SC22 SCinet National WAN Testbed

- As In Previous Years, iCAIR Supports SCinet In Designing and Implementing a National WAN Testbed
- A Key Focus Is 400, 800, and 1.2 Tbps Path Services and Interconnections, Including Direct Connections To Edge Nodes, Primarily High Performance DTNs
- The SC22 National WAN Testbed Was Designed and Implemented To Support Demonstrations and Experiments Of Innovations Related To Data Intensive Science



Persistent Communication Services For Petascale Sciences: Demonstrations At IEEE/ACM Supercomputing Conference – SC22, Dallas Texas

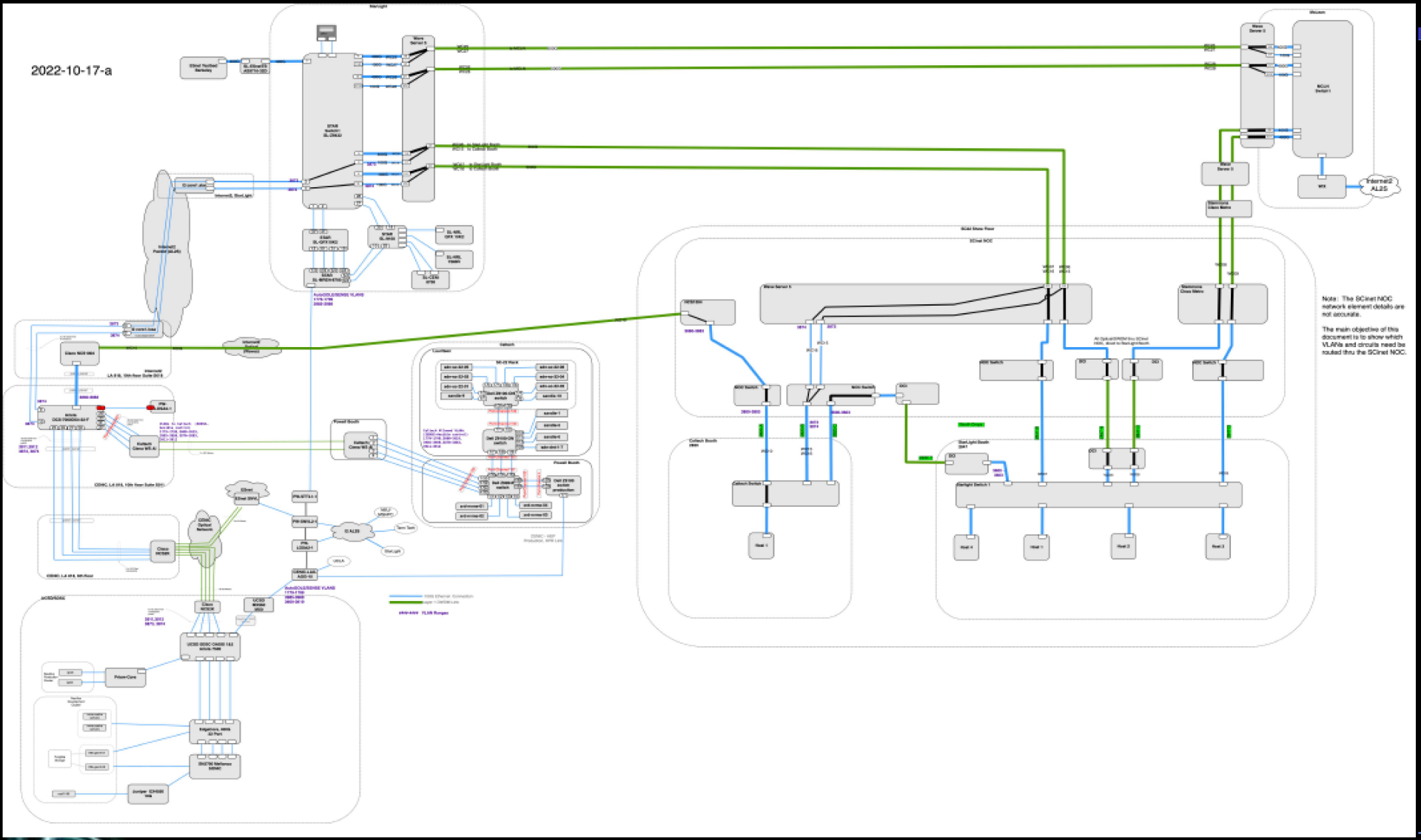




JOINT BIG DATA TESTBED

SC22 Dallas, TX hpc accelerates.

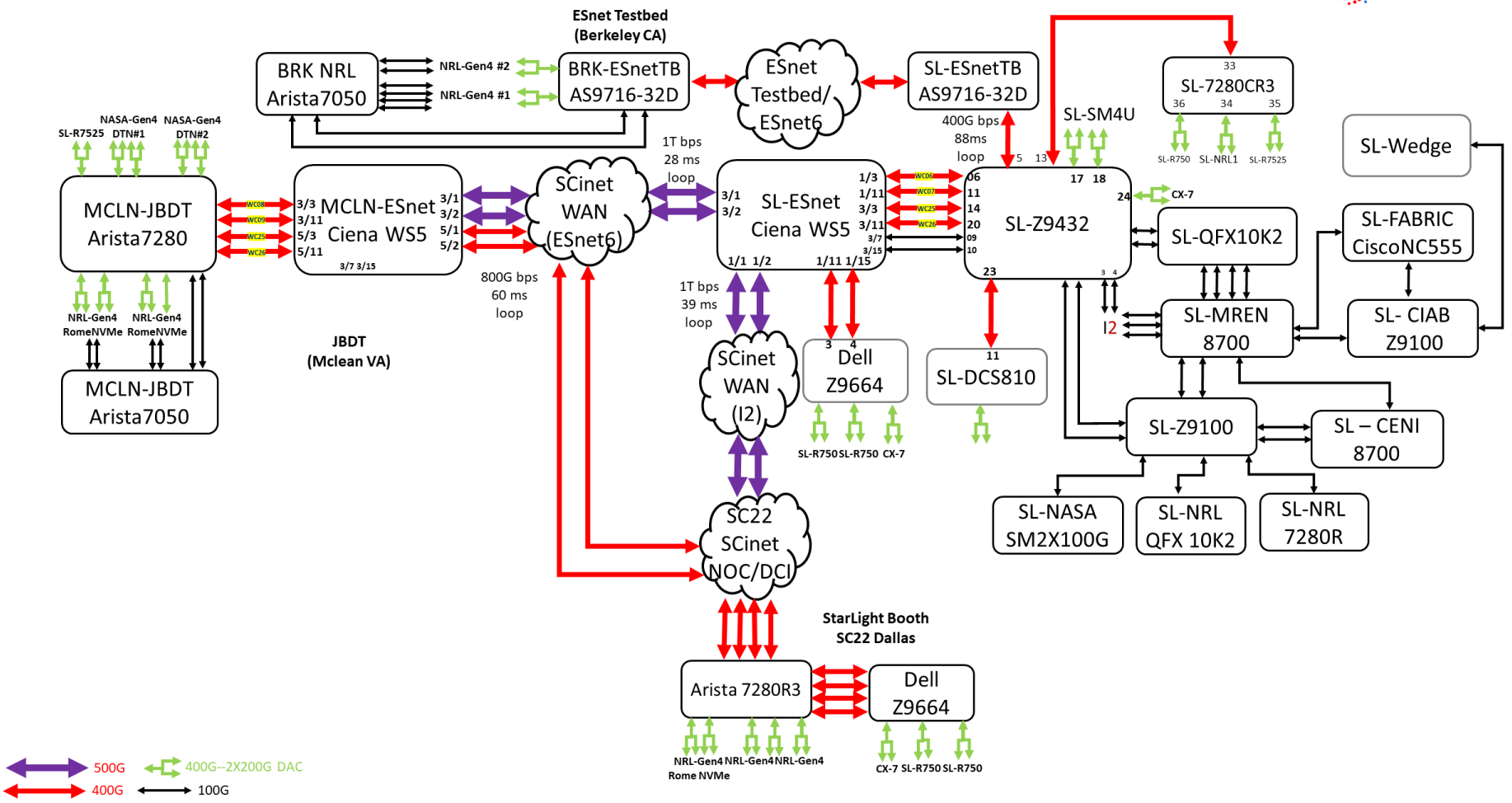
STARLIGHT SM

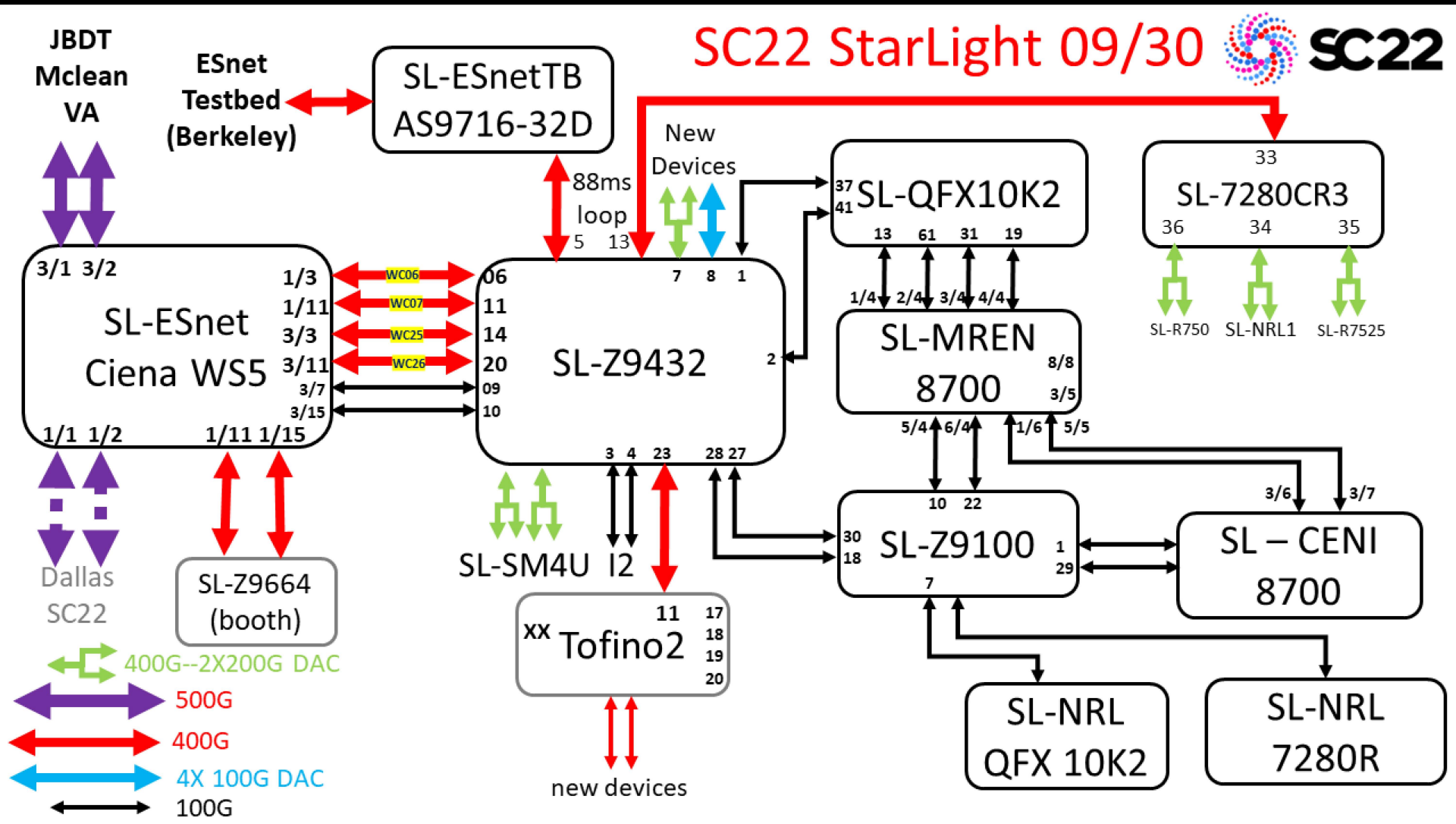


STARLIGHT SM

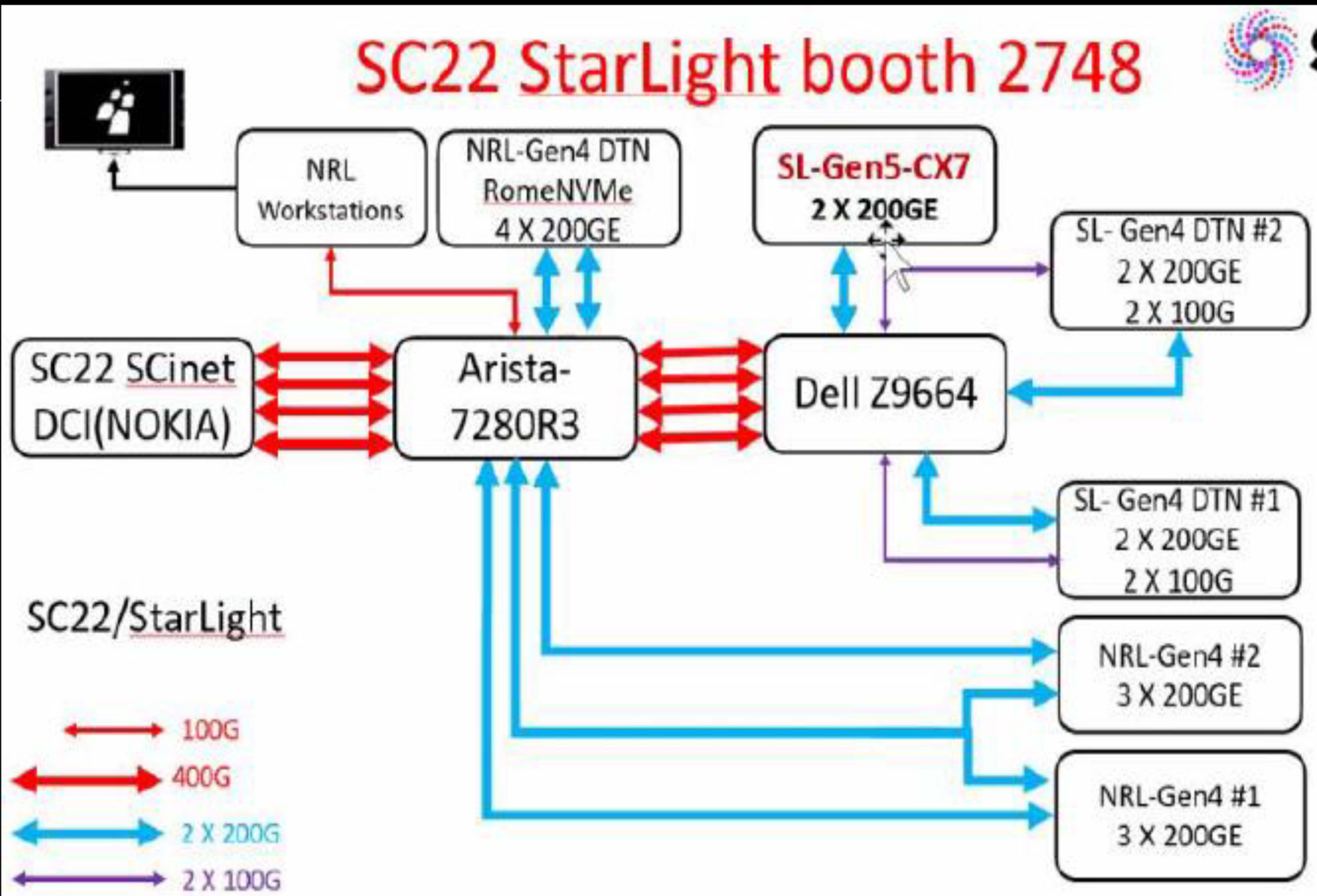
SC22 SCinet WAN Testbed

1T/800G/400G WAN Testbed by ESnet Testbed-I2-SCinet-StarLight-JBDT 11/14/2022




SC22 StarLight 09/30
SC22
JBDT
Mclean
VA
ESnet
Testbed
(Berkeley)
SL-ESnetTB
AS9716-32D
88ms
loop
5 13
New
Devices
37
41
SL-QFX10K2
13 61 31 19
33
SL-7280CR3
36 34 35
SL-R750
SL-NRL1
SL-R7525
3/1 3/2
SL-ESnet
Ciena WS5
1/3
1/11
3/3
3/11
3/7
3/15
1/1 1/2
1/11 1/15
WC06
WC07
WC25
WC26
06
11
14
20
09
10
SL-Z9432
7 8 1
2
1/4 2/4 3/4 4/4
SL-MREN
8700
8/8
3/5
5/4 6/4
1/6 5/5
3/6
3/7
3 4 23 28 27
10 22
30
18
SL-Z9100
1
29
7
SL – CENI
8700
Dallas
SC22
SL-Z9664
(booth)
SL-SM4U I2
XX Tofino2
11
17
18
19
20
new devices
SL-NRL
QFX 10K2
SL-NRL
7280R
400G--2X200G DAC
500G
400G
4X 100G DAC
100G

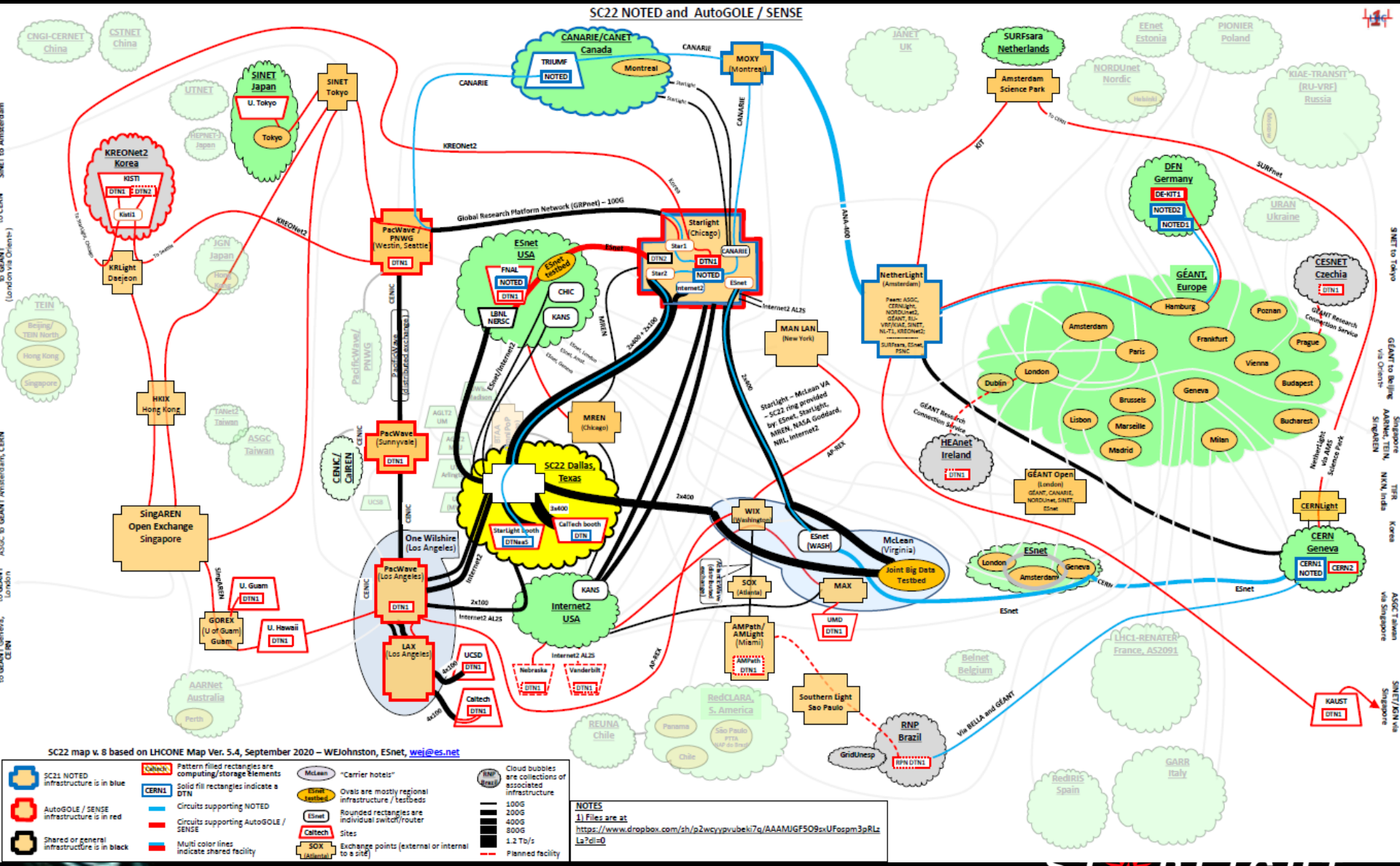
SC22 StarLight booth 2748



Example SC22 SCinet Network Research Exhibitions

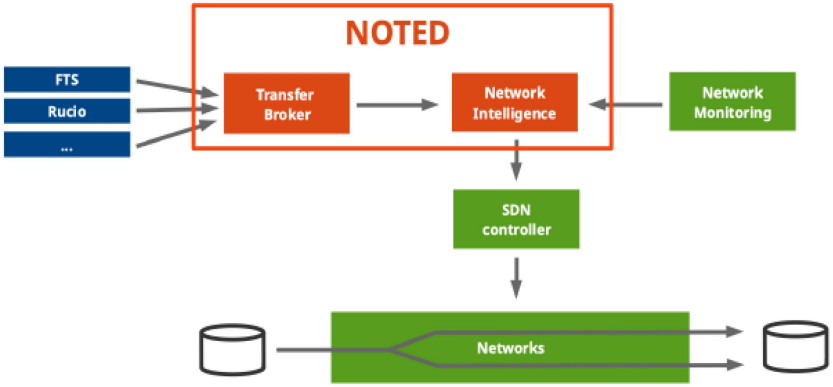
- Global Research Platform (GRP)
- SDX 1.2 Tbps WAN Services
- SDX E2E 400 Gbps WAN Services
- 400 Gbps DTNs & Smart NICs
- Network Optimized Transport for Experimental Data (NOTED) – With AI/ML Driven WAN Network Orchestration
- SDX International Testbed Integration
- StarLight SDX for Petascale Science
- DTN-as-a-Service For Data Intensive Science
- P4 Integration With Kubernetes
- PetaTrans Services Based on NVMe-Over-Fabric
- NASA Goddard Space Flight Center HP WAN Transport Services
- Resilient Distributed Processing & Rapid Data Transfer
- PRP/NRP Demonstrations
- Open Science Grid Demonstrations
- N-DISE Named Data Networking for Data Intensive Science
- Orchestration With Packet Marking (SciTags)
- Smart Amplified Group Environment Enhanced with Artificial Intelligence for Global Collaboration (SAGE3)
- JANUS Container Orchestration

Network Optimized Transport for Experimental Data (NOTED) – AI/ML Driven WAN Network Orchestration



STARLIGHT

SKELETON AND ELEMENTS OF NOTED



FTS (File Transfer Service):

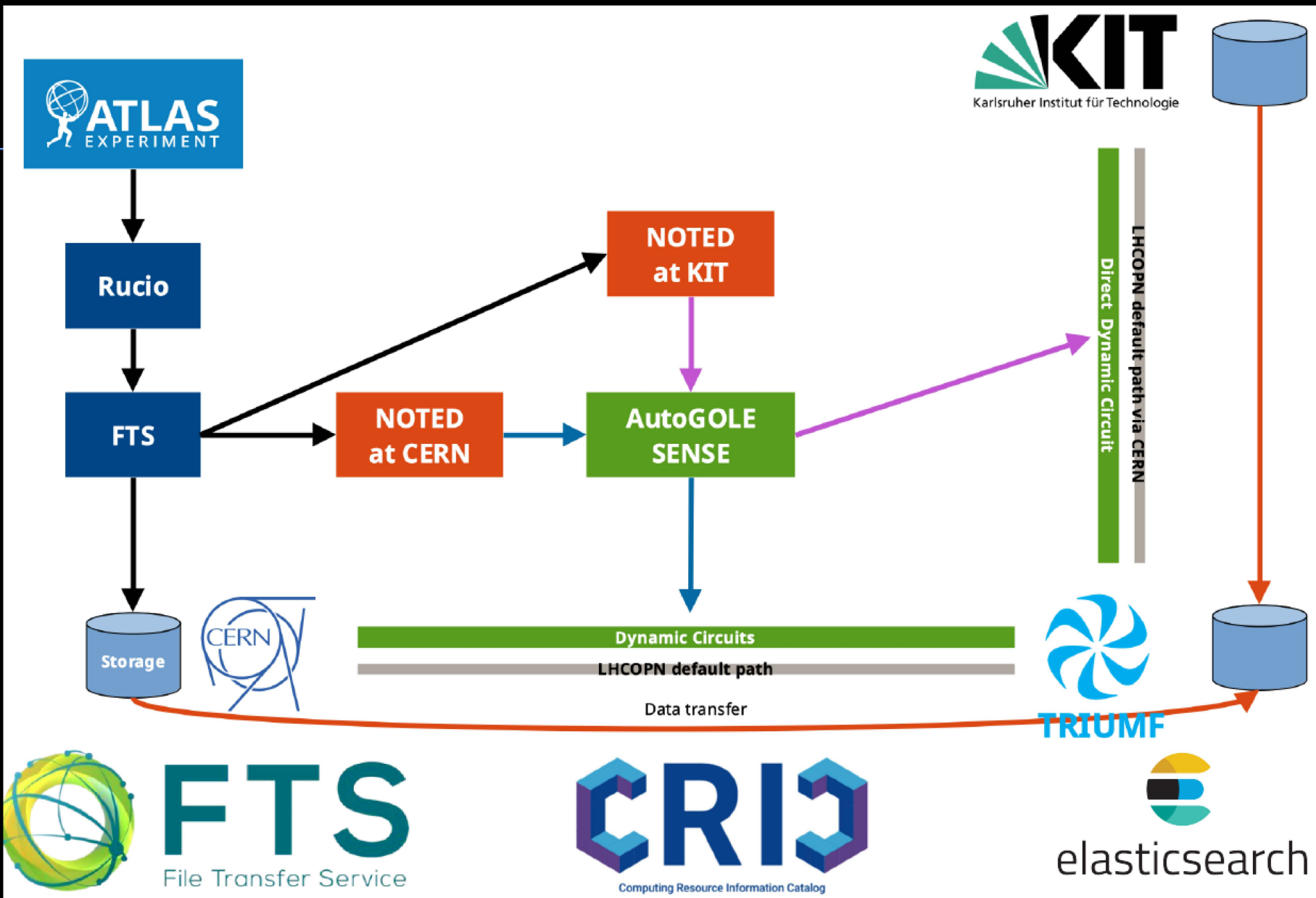
- Inspect and analyse data transfers to estimate if an action can be applied to optimise the network utilization → get on-going and queued transfers.

CRIC (Computing Resource Information Catalog):

- Enrichment to get an overview and knowledge of the network topology → get IPv4/IPv6 addresses, endpoints, rcsite and federation.

FLOWCHART AND DATASET STRUCTURE

- Input parameters: configuration given by the user
  - In noted/config/config.yaml → define a list of {src_rcsite, dst_rcsite}, maximum and minimum throughput threshold, SENSE/AutoGOLE VLANs UUID and user-defined email notification among others.
- Enrich NOTED with the topology of the network:
  - Query CRIC database → get endpoints that could be involved in the data transfers for the given {src_rcsite, dst_rcsite} pairs.
- Analyse on-going and upcoming data transfers:
  - Query FTS recursively → get on-going data transfers for each set of source and destination endpoints.
  - The total utilization of the network is the sum of on-going and upcoming individual data transfers for each source and destination endpoints for the given {src_rcsite, dst_rcsite} pairs.
- Network decision:
  - If NOTED interprets that the link will be congested → provides a dynamic circuit via SENSE/AutoGOLE.
  - If NOTED interprets that the link will not be be congested anymore → cancel the dynamic circuit and the traffic is routed back.


ATLAS EXPERIMENT
Rucio
FTS
NOTED at KIT
NOTED at CERN
AutoGOLE SENSE
Direct Dynamic Circuit
LHCOPN default path via CERN
Storage
CERN
Dynamic Circuits
LHCOPN default path
Data transfer
KIT
Karlsruher Institut für Technologie
TRIUMF
FTS
File Transfer Service
CRIC
Computing Resource Information Catalog
elasticsearch

SC22 Dallas, TX | hpc accelerates.

scitags.org

Flow and Packet Marking for Global Scientific Computing

DTN-KIT-100g

KIT Karlsruher Institut für Technologie

DFN

DTN-UVIC-100g

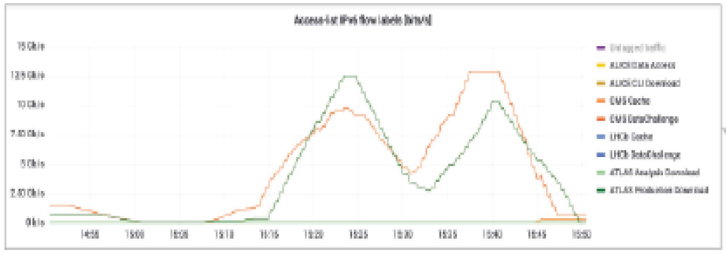
University of Victoria

1.Clients requesting data transfers from/to DTN-SC22-400g while passing science domain and activity fields via transfer protocols.

ESnet

canarie

4.High performance tests using eBPF-TC filters to test encoding of the science domains and activity fields in the IPv6 flow label at scale.



3. P4 programmable switch at CERN collecting the science domains and activity bits encoded in the packets.

CERN-LHCONE

P4 EdgeCore Wedge

CERN

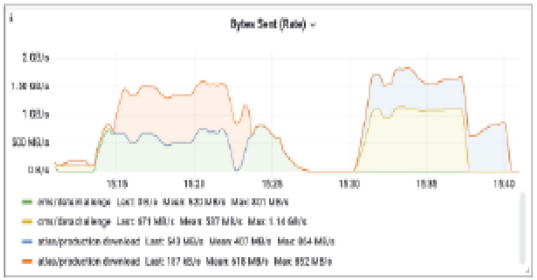
DTN-CERN-100g
2.6GHz/32 cores
SSD, 100Gbps

DTN-SC22-400g
R7503 2.6 GHz
NVMe 2.0
2x200 Gbps

XRootD

SC22 Dallas, TX | hpc accelerates.

STARLIGHT



2. XRootD storage responds to the client requests and marks the data transfer packets with the corresponding science domain and activity.

CERN

5.Sampling of the low level TCP/IP metrics, which can be used by sites and R&Es to better understand the scientific flows.

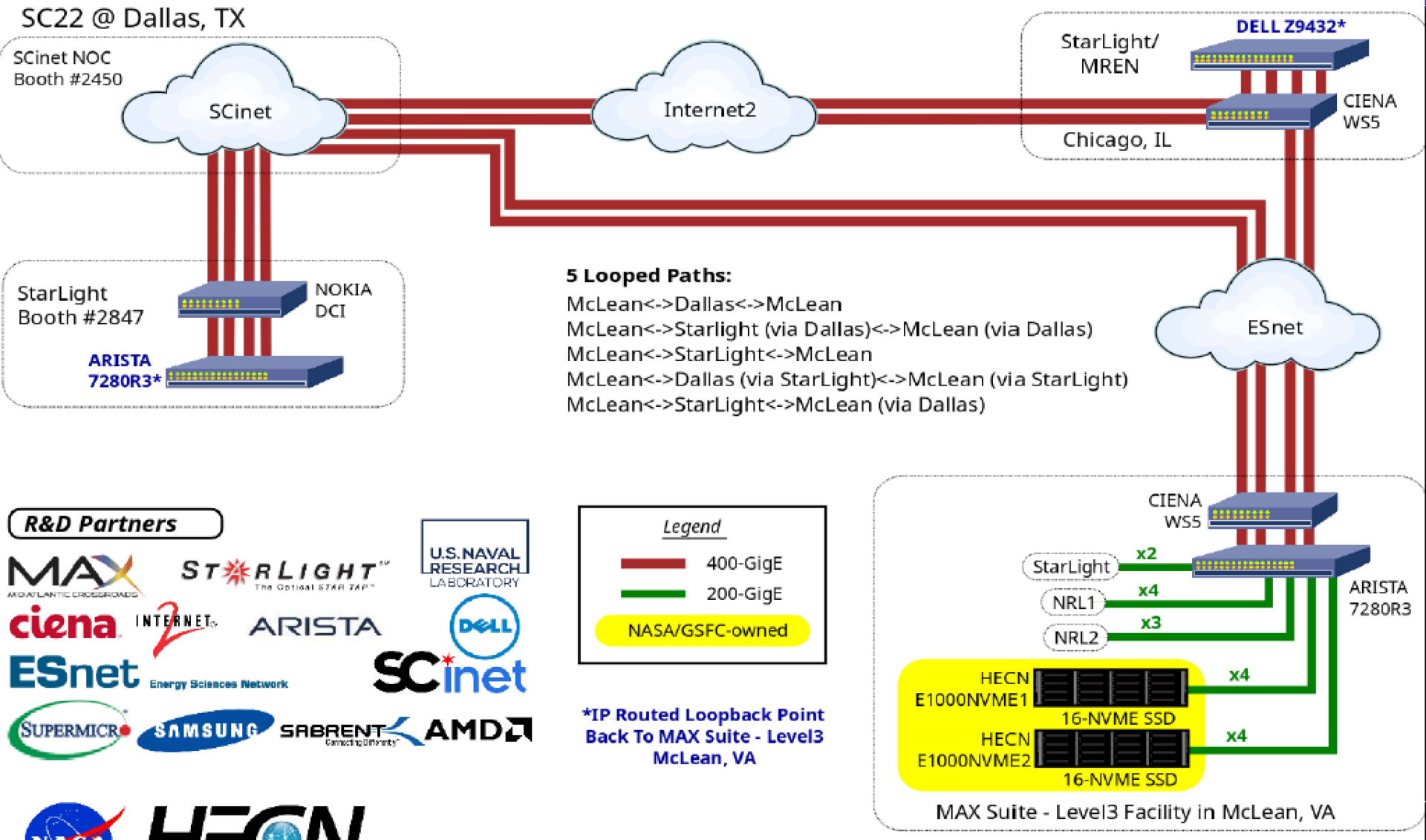
200 Gbps
100 Gbps
50 Gbps

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SC22
Joint Big Data Testbed

Demonstrations of 400 Gbps Disk-to-Disk WAN File Transfers using NVMe-oF/TCP

An SC22 Collaborative Initiative Among NASA and Several Partners



R&D Partners

MAX MID-ATLANTIC CROSSROADS · STARLIGHT The Optical STAR TAP · U.S. NAVAL RESEARCH LABORATORY · ciena · INTERNET2 · ARISTA · DELL · ESnet Energy Sciences Network · SCinet · SUPERMICRO · SAMSUNG · SABRENT · AMD

Legend

400-GigE

200-GigE

NASA/GSFC-owned

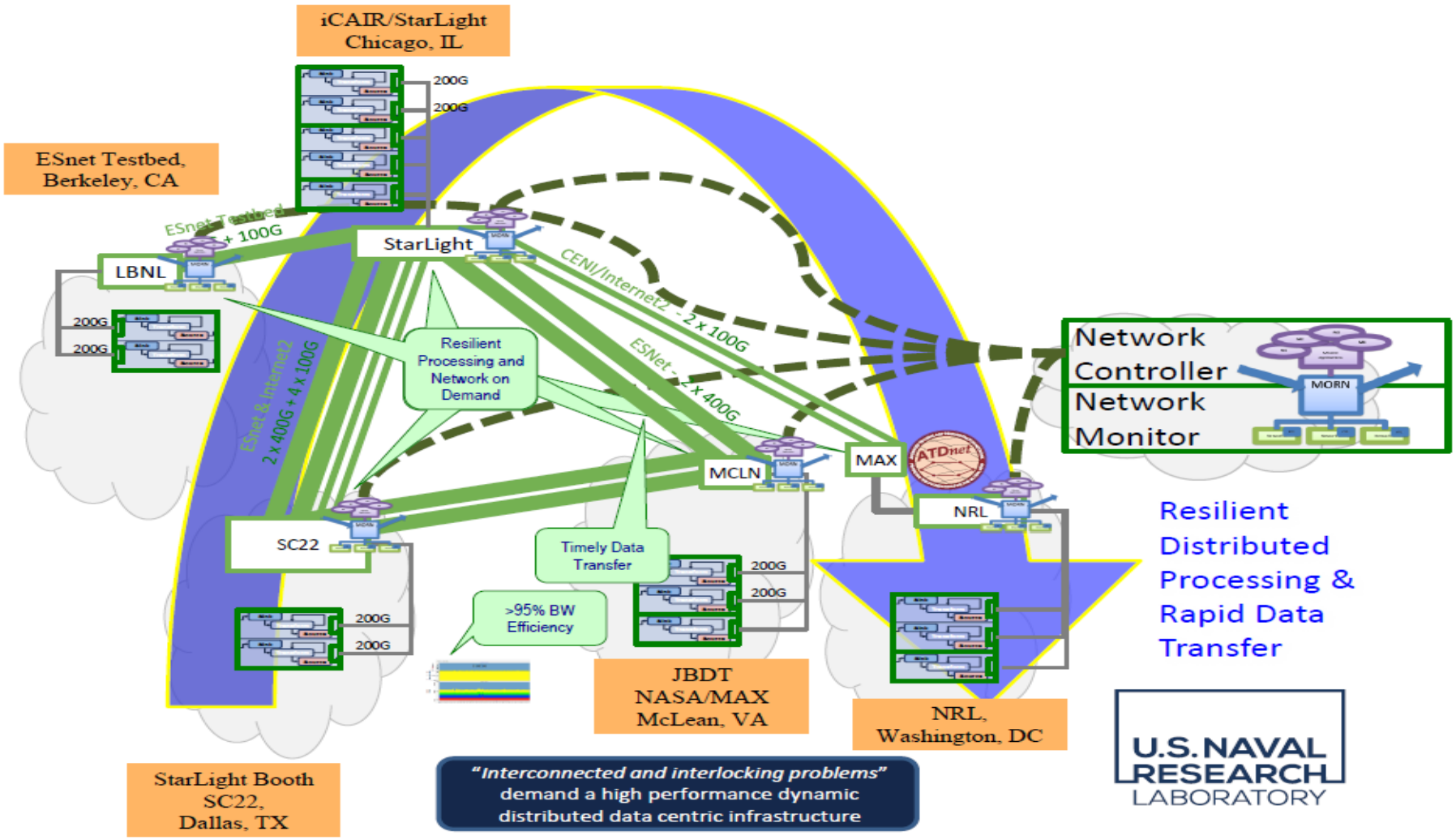
***IP Routed Loopback Point Back To MAX Suite - Level3 McLean, VA**

NASA · HECN High End Computer Networking

In memory of Paul Lang and Pat Gary

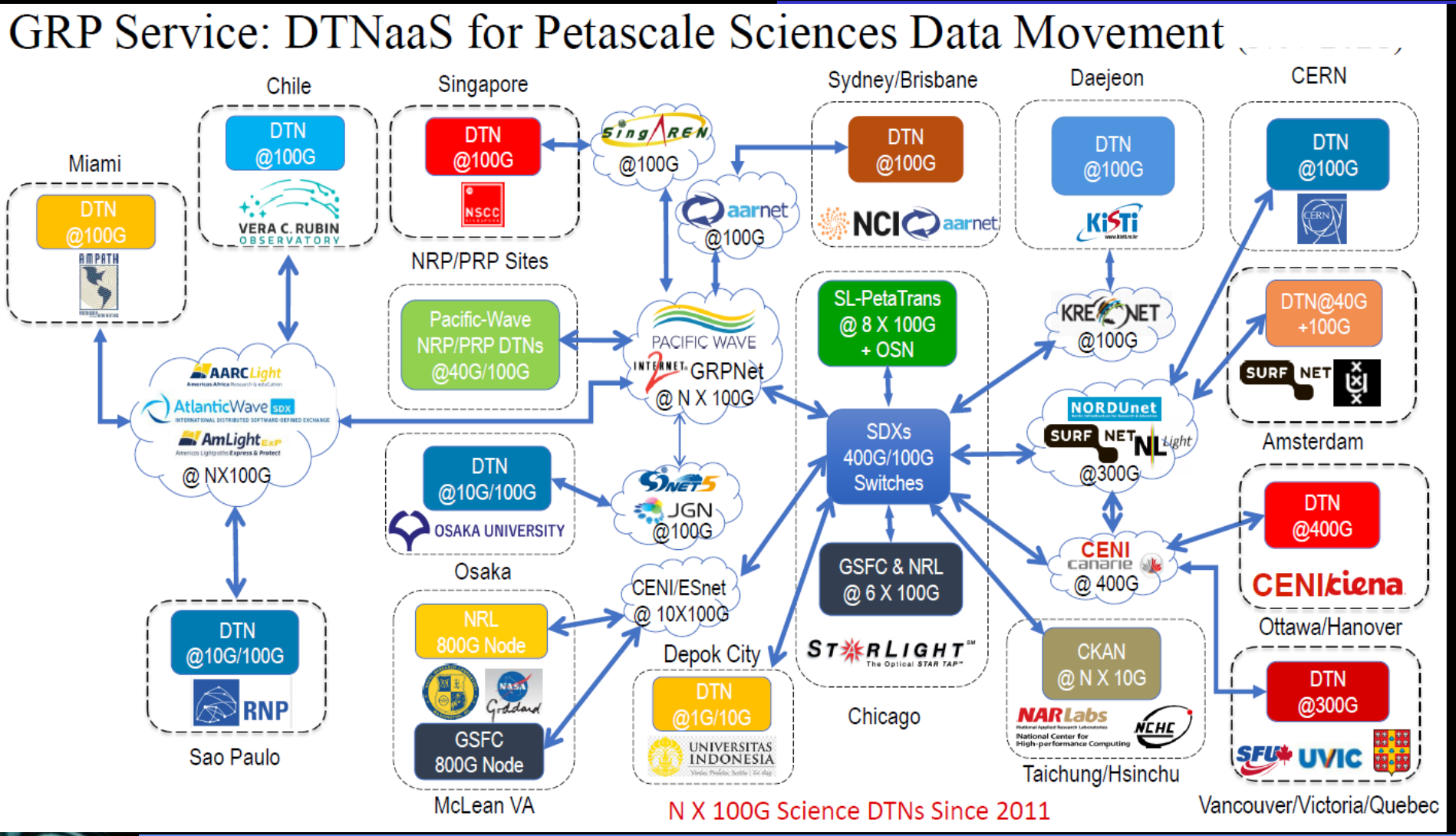
NASA/GSFC High End Computer Networking (HECN) Team
Diagram by Bill Fink - 10/20/2022

Resilient Disributed Processing & Rapid Data Transfer



DISTRIBUTION A: Approved for Public Release

GRP DTNaaS For Petascale Science



DTN-as-a-Service – Demonstrated At SC22

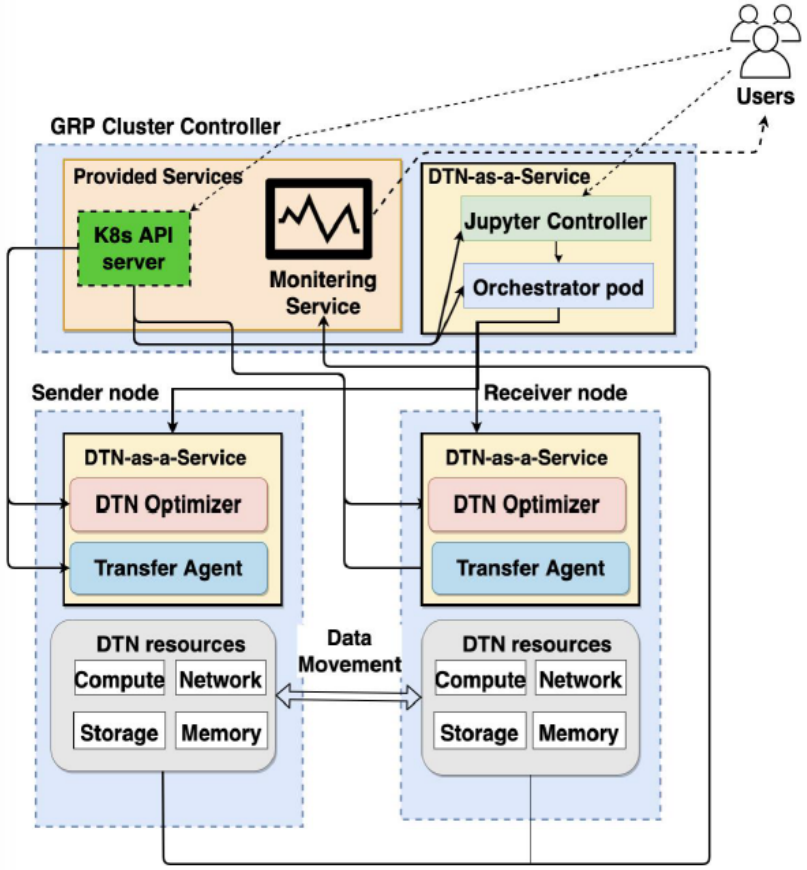
GRP Cluster with DTN-as-a-Service

DTN-as-a-Service(DTNaaS) provides a data movement workflow in GRP k8s cluster:

1. Deploy DTNaaS workloads via k8s API server
2. Use Jupyter to optimize and run transfers
3. Observe performance from monitoring service

GRP DTNaaS Components:

- Orchestrator: controller of DTNaaS to manage agent and optimizer pods via REST API.
- Transfer Agent: run transfer jobs
- DTN Optimizer: optimize the DTN resources for workflow
- Jupyter: web interface to run DTNaaS interactively



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STARLIGHT SDX

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Janus Container Orchestration

Overview

Janus is a container management framework with a focus on advanced networking configurations. Our approach minimizes external dependencies and provides tooling to support data mover tuning and lifecycle management. A goal of Janus is to provide a Data Transfer Node *as-a-Service* (DTNaaS) capability. Janus has also found use within the ESnet Advanced Network Testbed and enables the ESnet in-network Data Caching pilots.

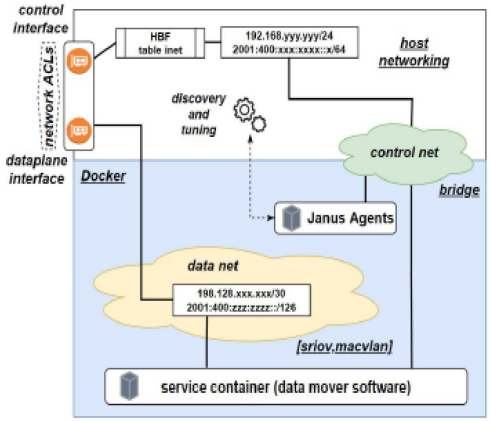
Networking

Janus manages a Data Transfer Node's container networking attachments

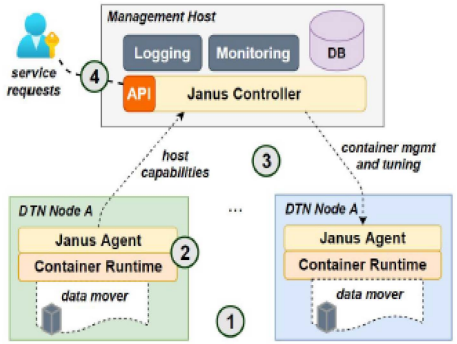
- Multi-homing of control and data networks
- Dual-stack configurations (IPv4/IPv6)
- Selection of container networks (host, macvlan, sriov, ...)

Janus service profiles provide external network configuration hooks

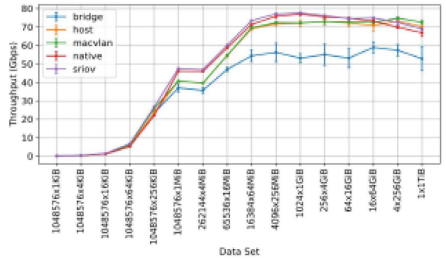
- Ansible playbooks
- Host-based QoS



Architecture



1) Data mover software in managed containers
2) Container network and storage optimization
3) Host discovery and tuning
4) Lightweight service orchestration through APIs



Comparing performance of various container networks, disk-to-disk on 100G network

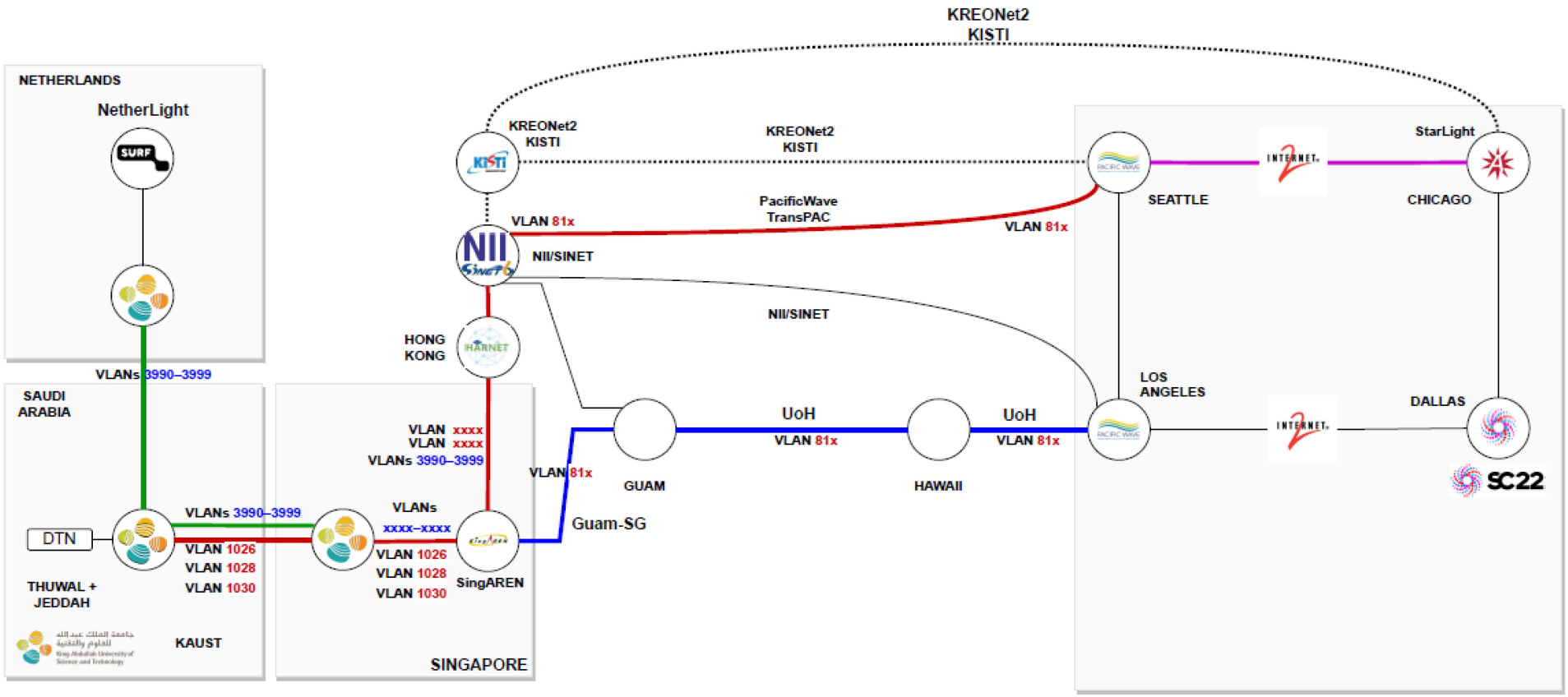
data mover: **EScp**
https://github.com/esnet/EScp

Thank you to Md Arifuzzaman and Charles Shiftlett for their many contributions.

Contact: Ezra Kissel
kissel@es.net

U.S. DEPARTMENT OF ENERGY
Office of Science
BERKELEY LAB
ESnet
ENERGY SCIENCES NETWORK

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KAUST-US NEW PERMANENT CIRCUITS (PNWGP Proposal: use VLANs 811, 812, 813)

1) StarLight (VLAN 81x - TBD)
Amsterdam > Jeddah > Singapore > Hong Kong > Daejeon > Chicago
NetherLight > KAUST > SingAREN > NICT/NSCC > KREONet2/KISTI > STARLIGHT

2) PNWGP / TransPAC (VLAN 81x - TBD)
Amsterdam > Jeddah > Singapore > Tokyo > Seattle
NetherLight > KAUST > SingAREN > TransPAC/PacWave

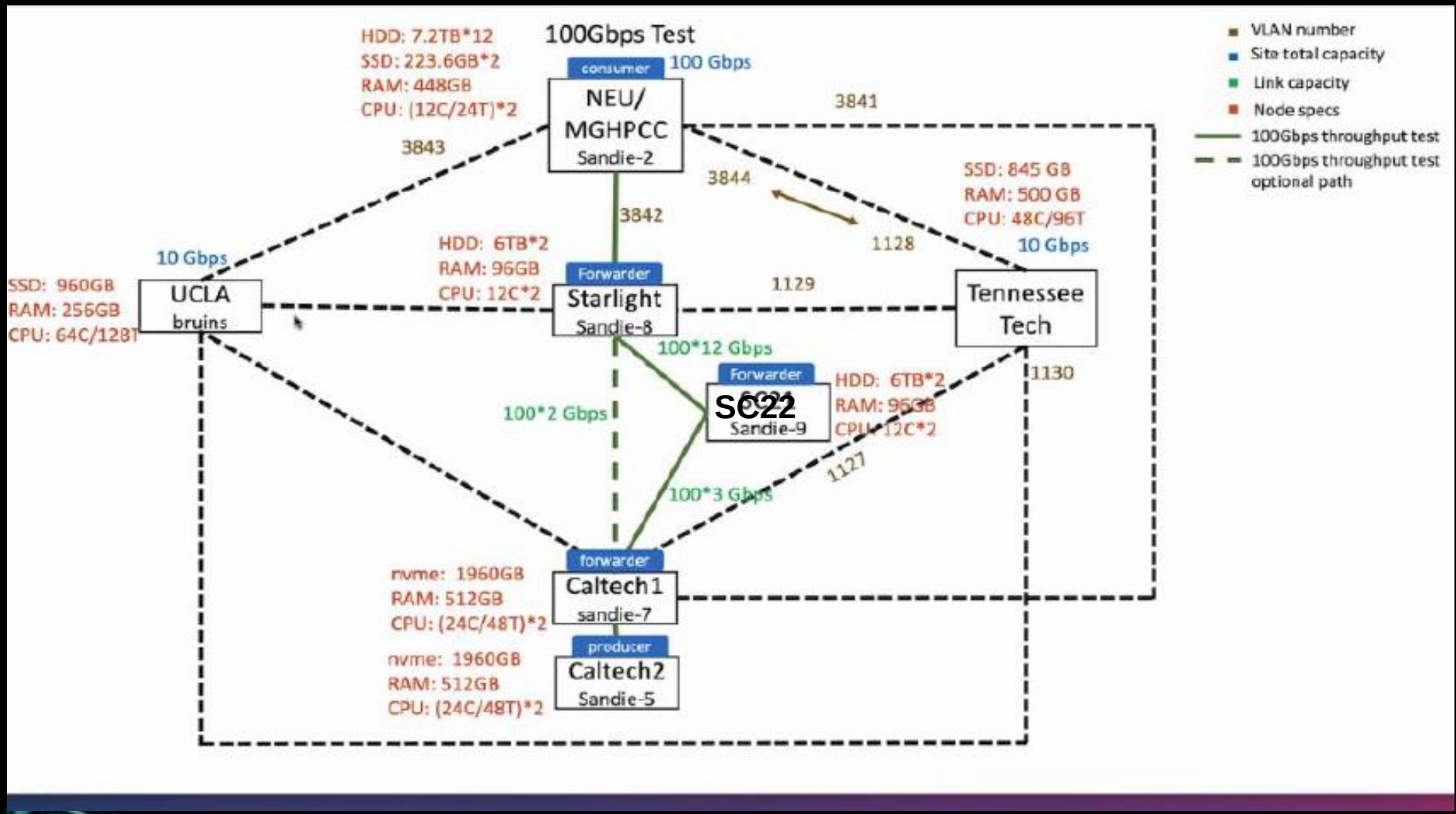
3) CENIC (VLAN 81x - TBD)
Amsterdam > Jeddah > Singapore > Guam > Hawaii > Los Angeles
NetherLight > KAUST > SingAREN > Guam-SG > UoH > Pacific Wave

KAUST has deployed 3 circuits - VLANs 1026, 1028, and 1030 – to peer with PacificWave/Cenic, StarLight and SC22

The range 3990-3999 is also available between KAUST Routers in NetherLight PoP and in SingAREN PoP.
The AutoGOLE / SENSE can be used to stitch circuits to each end in NetherLight and in SingAREN, and pass traffic through between Europe and Singapore.

Mike: -> I'm responsible specifically for the path between 'Tokyo > Seattle', our suggestion is to use the following VLANs for the permanent VLAN assigments: 811, 812, 813. I can configure the Tokyo side of device interfaces facing NII/SINET & TransPAC towards Seattle.
Please contact StartLight NOC for the circuit 1, and CENIC NOC for circuit 3

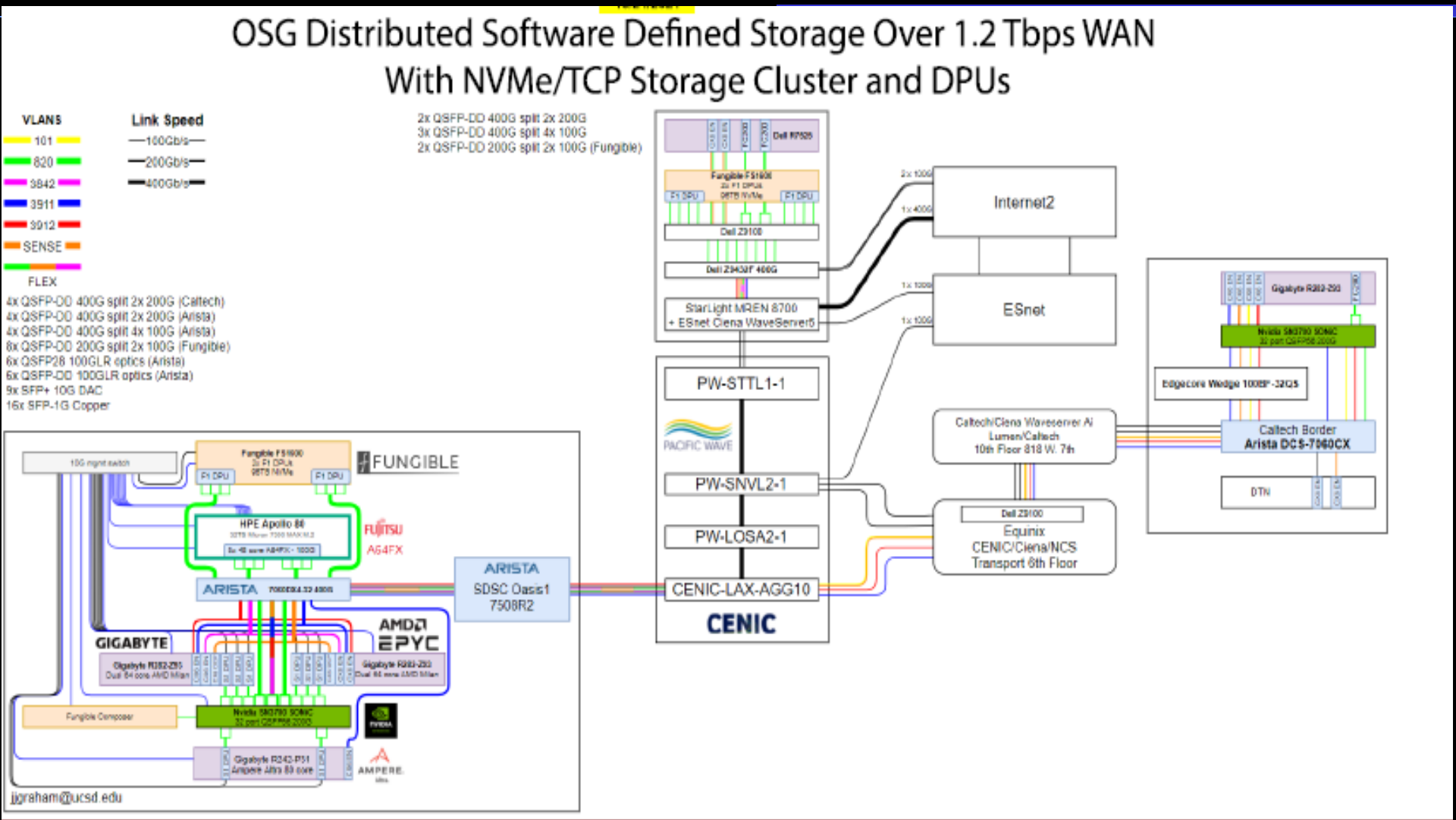
Named Data Networking (NDN) for Data Intensive Science Experiments (N-DISE)



Source Edmund Yeh

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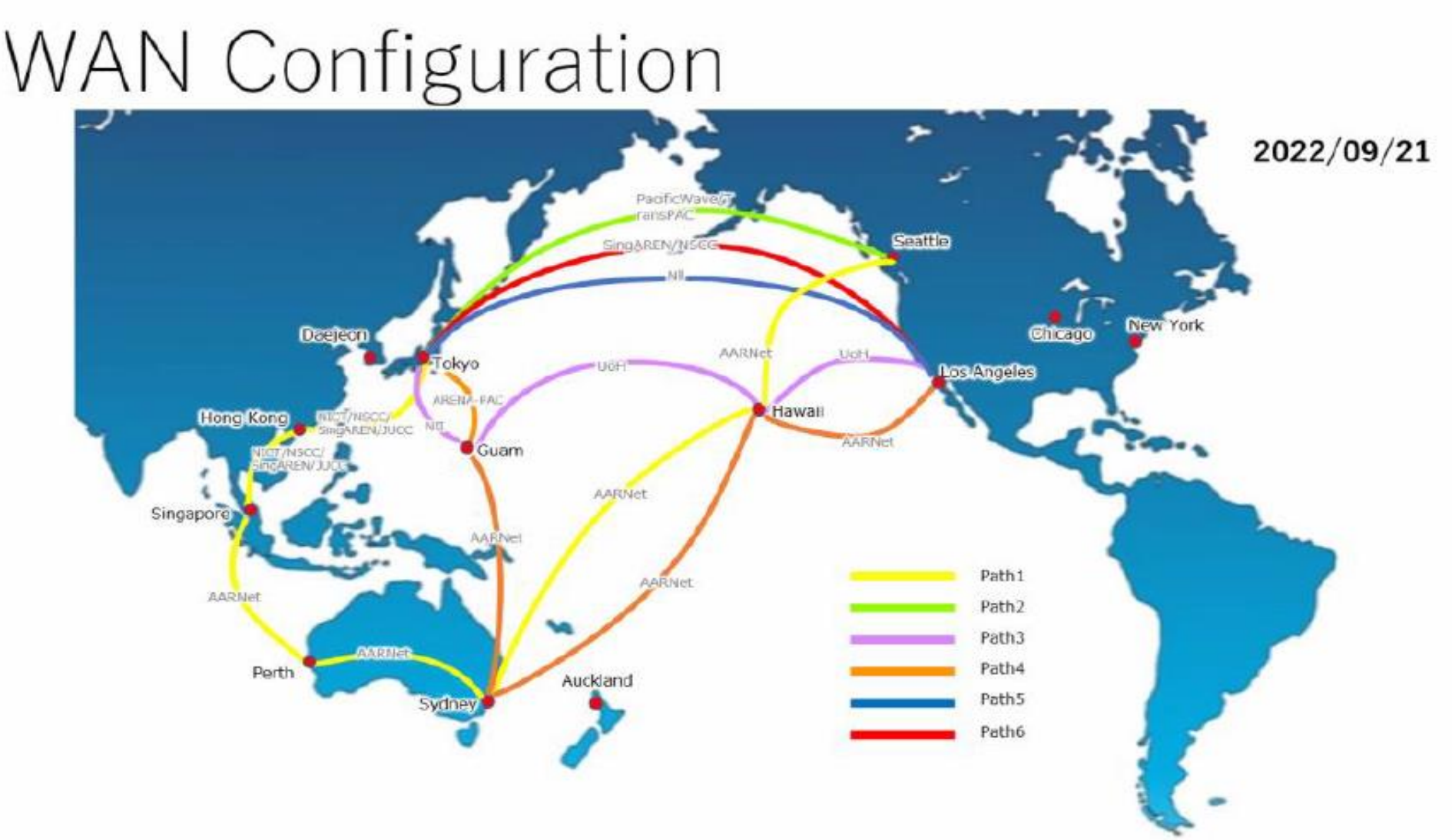
Open Science Grid SD Distributed Storage



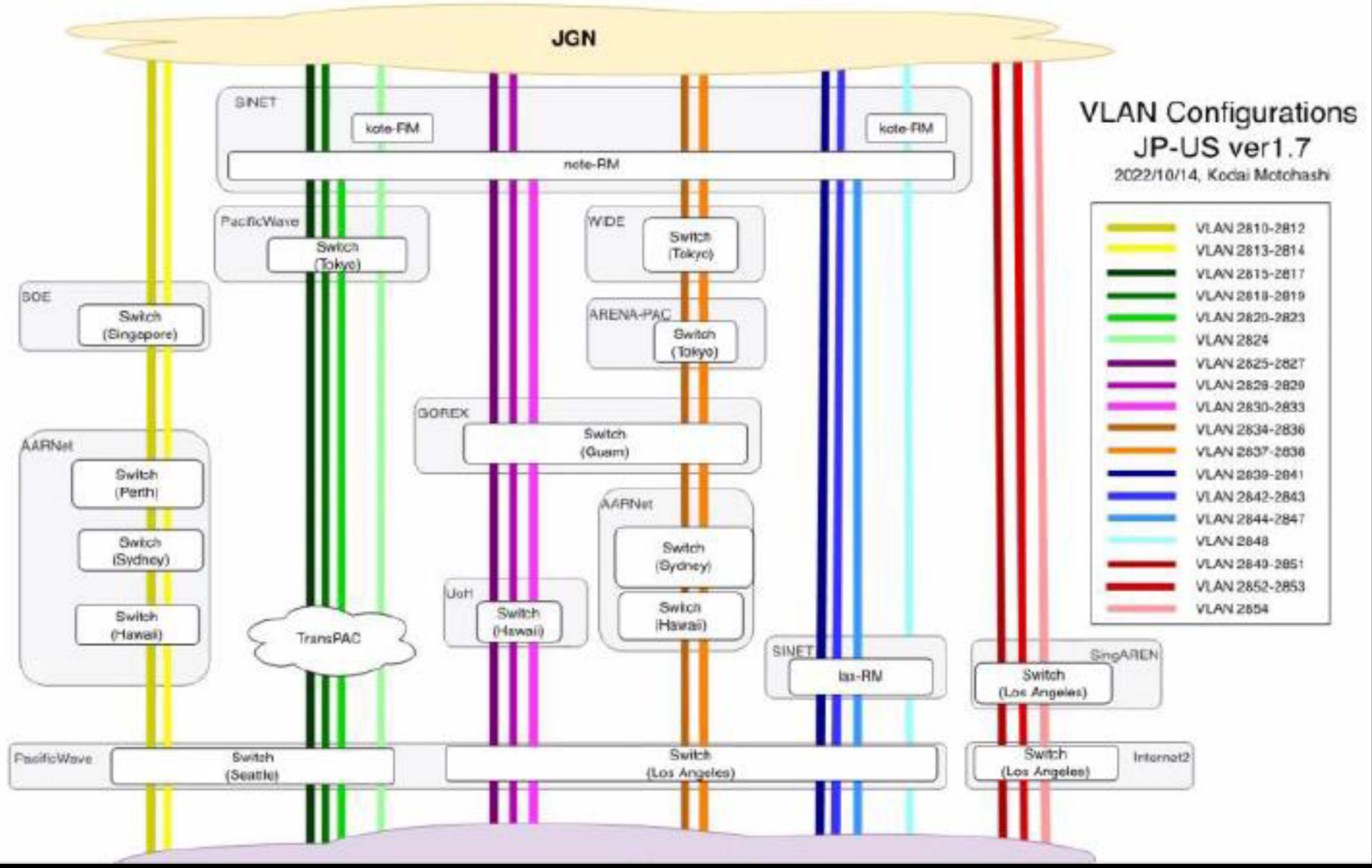
Source: John Graham

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NICT-JPG NREs @ SC22

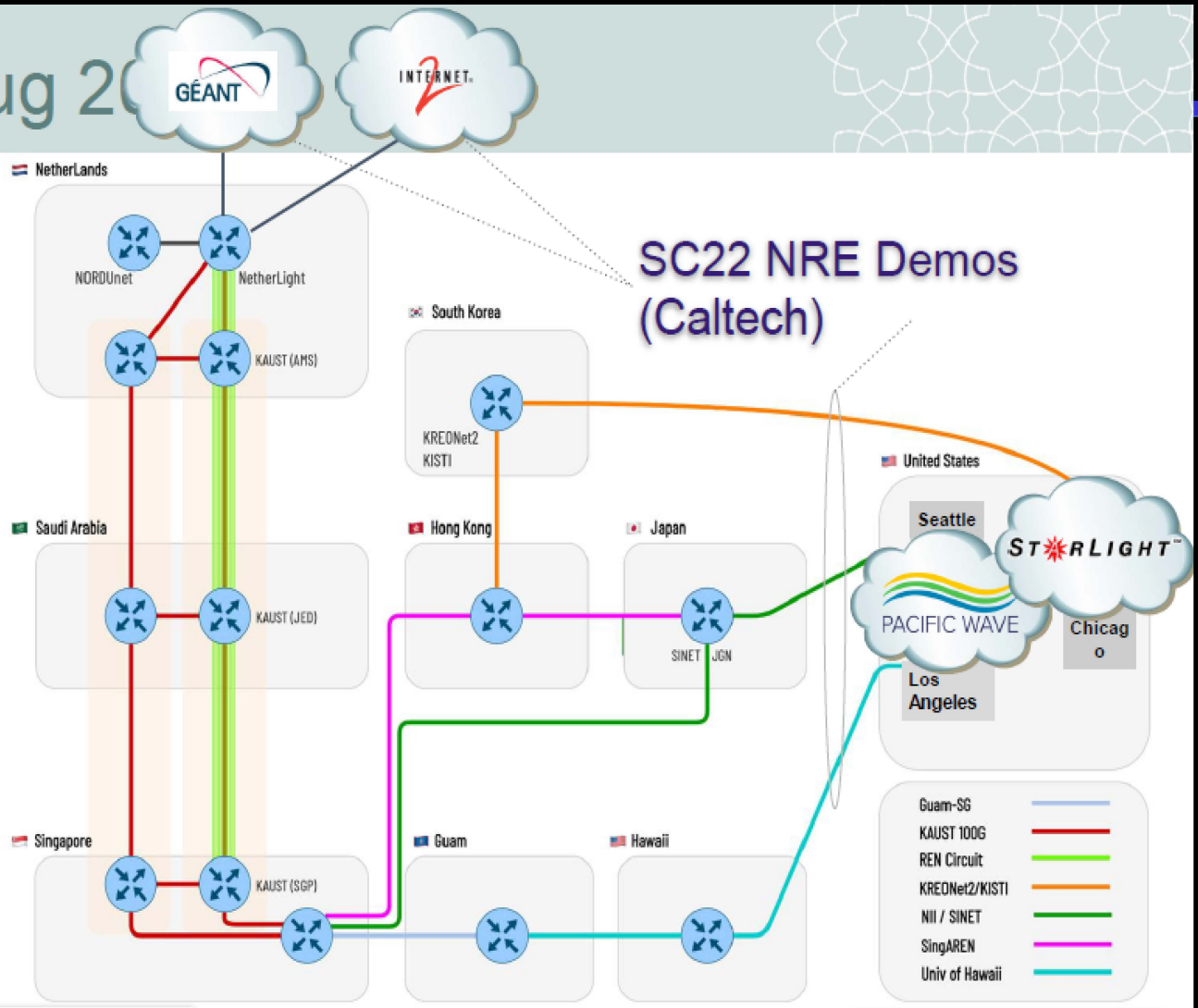


VLAN Configurations(Japan-SCinet)



AER Update - Aug 2

- Since the AER MoU, KAUST is coordinating with REN partners deployment of sharing spare capacity
- KAUST is supporting the following partners by offering point-to-point circuits for submarine cable backup paths:
  - AARnet
  - GÉANT
  - NetherLight
  - NII/SINET
  - SingAREN
- The SC22 NRE Demonstrations will also be supported by KAUST closing the ring from Amsterdam to Singapore and back to the US
  - SC22 NRE

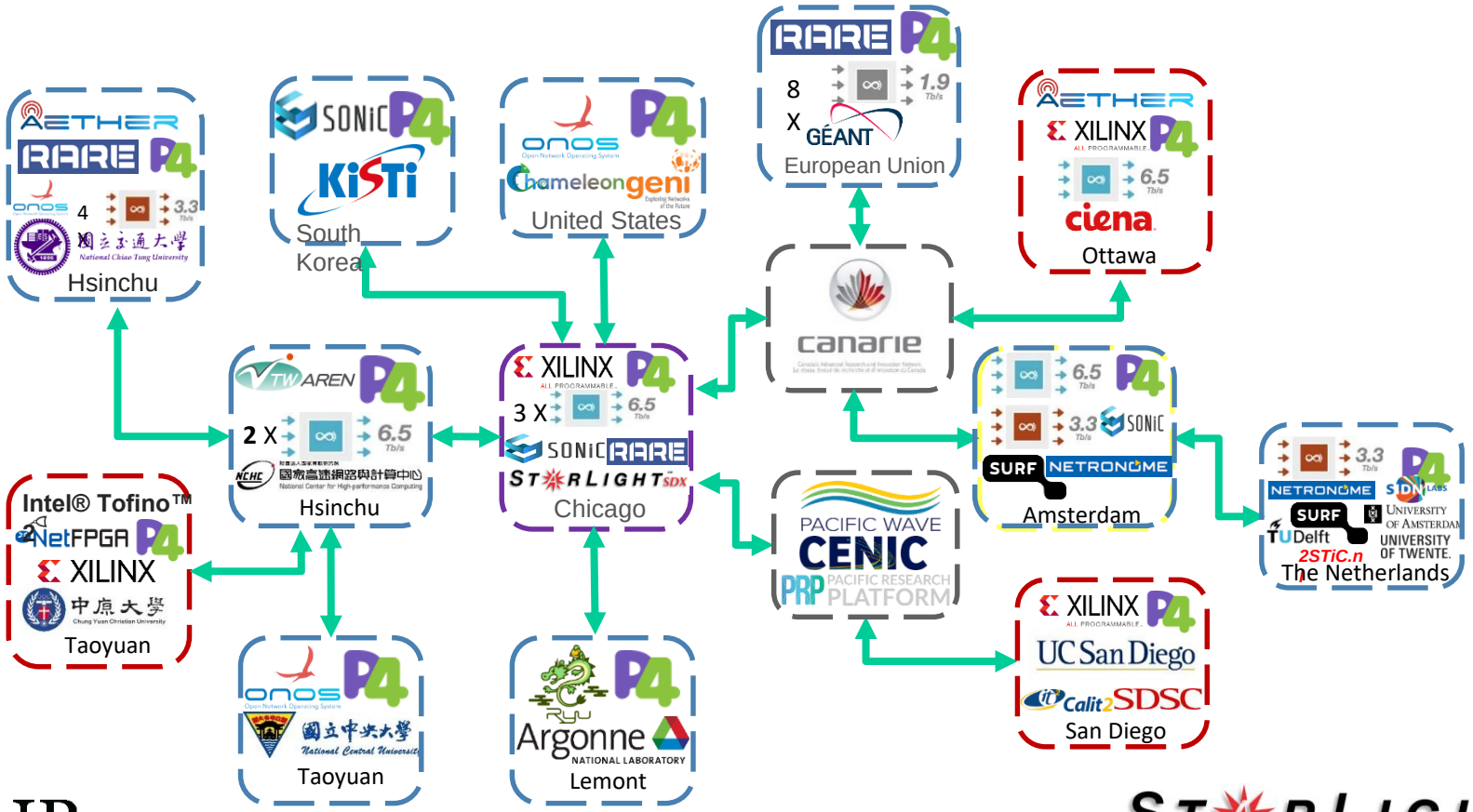


INTERNET2 · GÉANT Networks · Services · People · NL Light · Asi@Connect · APAN · aponet · TransPAC America Connects to Asia · International Networks at Indiana University

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International P4 Testbed Showcase at SC22

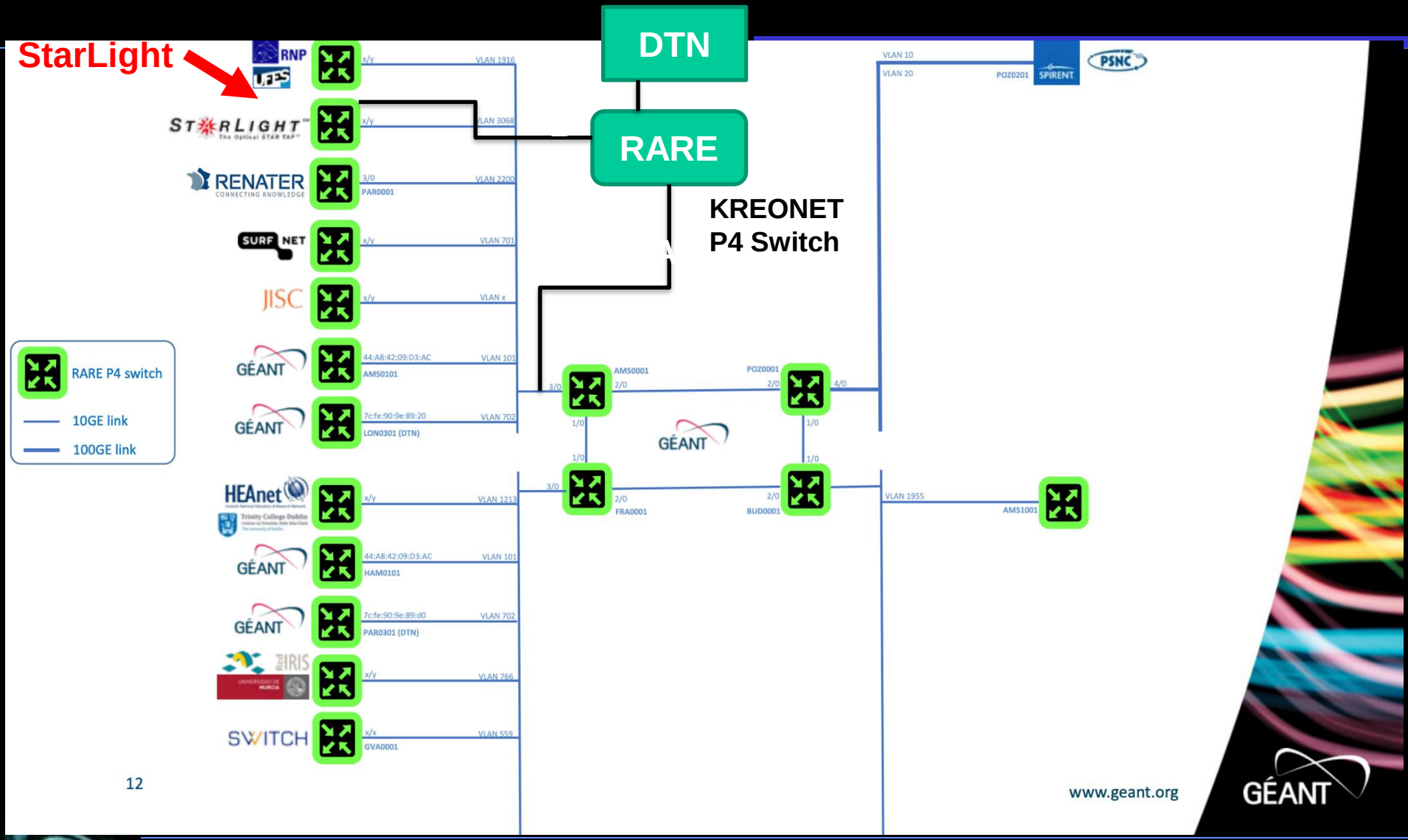
GRP Service: International P4 Experimental Networks (iP4EN)



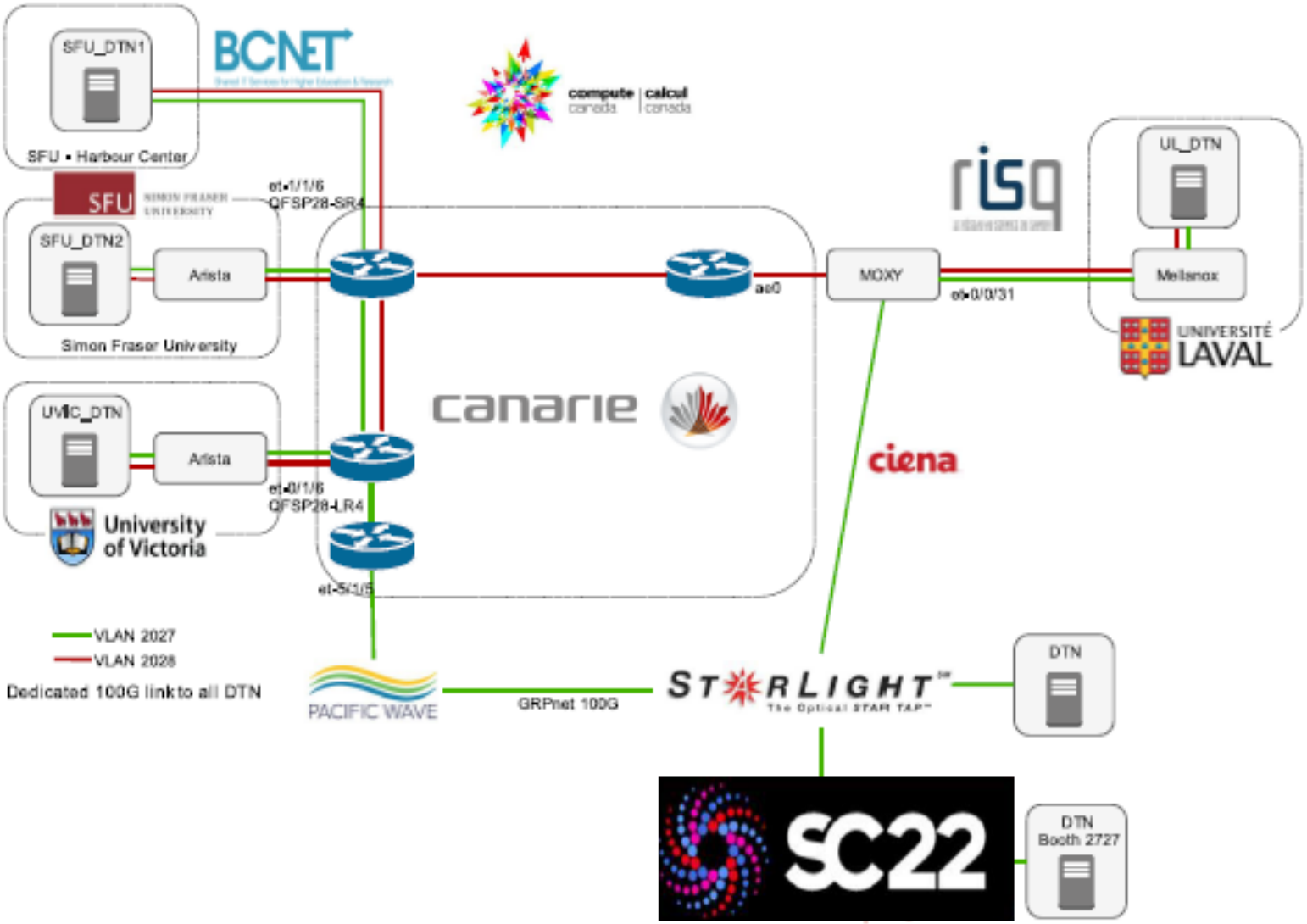
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Integration With GEANT P4 Testbed



Digital Alliance Demonstrations
Of Data Intensive Science WAN Transport



Chameleon

www.chameleoncloud.org

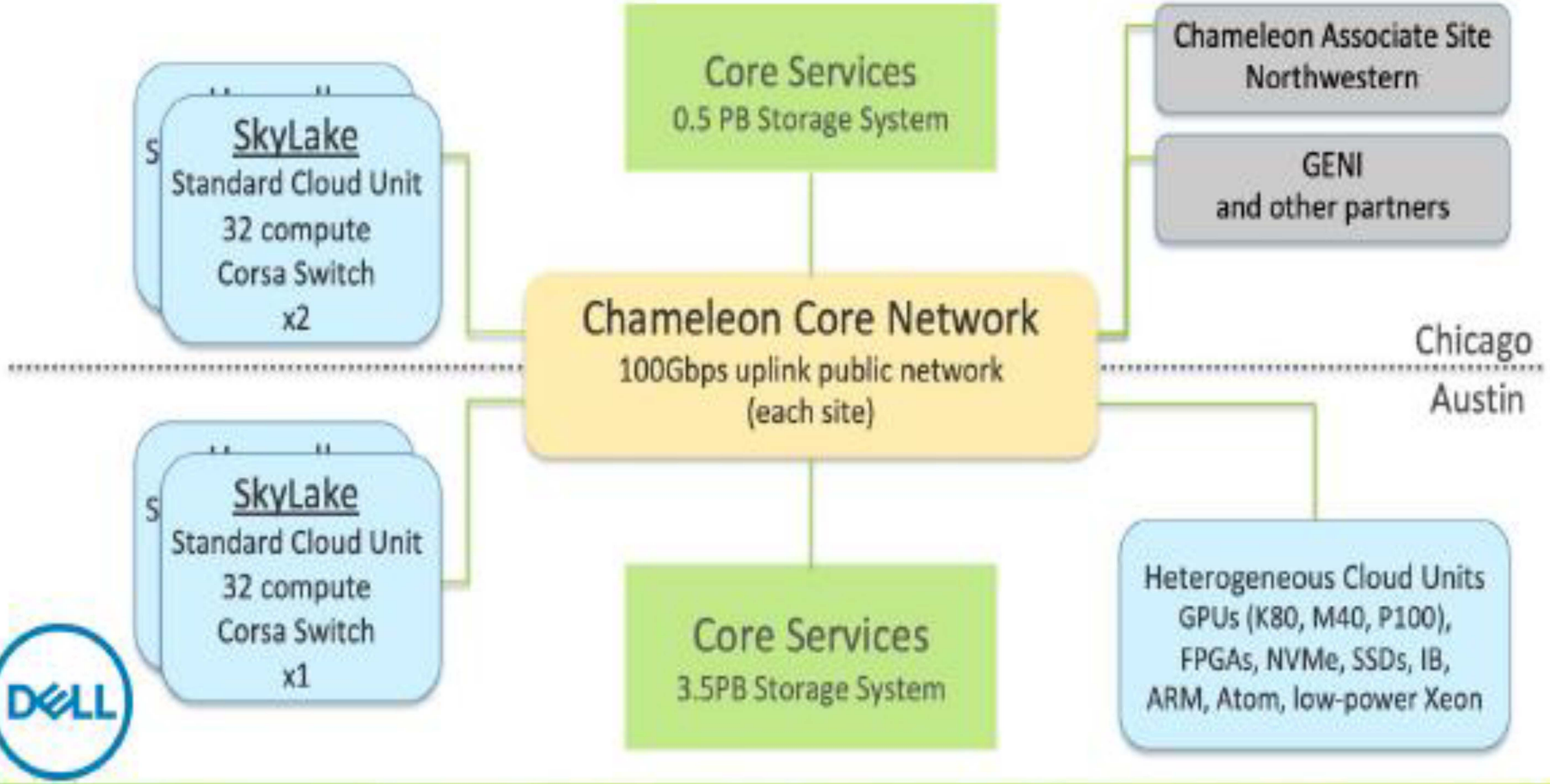
CHAMELEON: A LARGE SCALE, RECONFIGURABLE EXPERIMENTAL INSTRUMENT FOR COMPUTER SCIENCE

Kate Keahey

Joe Mambretti, Pierre Riteau, Paul Ruth, Dan Stanzione

THE UNIVERSITY OF CHICAGO TACC renci NORTHWESTERN UNIVERSITY NSF

Chameleon CHI In A Box(CIAB) at StarLight

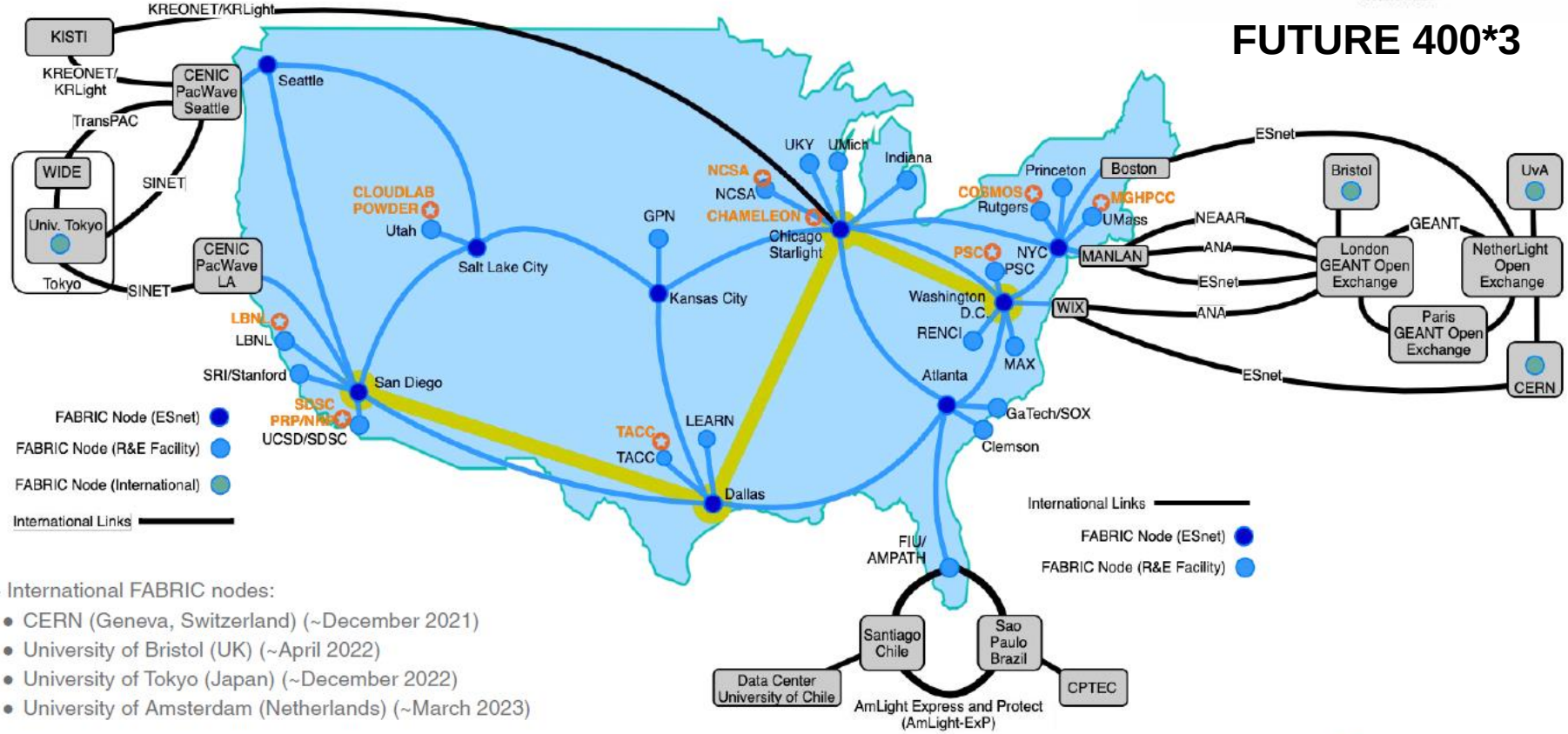


FABRIC And FAB



FUTURE 400*3

FAB (FABRIC Across Borders)



4 International FABRIC nodes:

- CERN (Geneva, Switzerland) (~December 2021)
- University of Bristol (UK) (~April 2022)
- University of Tokyo (Japan) (~December 2022)
- University of Amsterdam (Netherlands) (~March 2023)

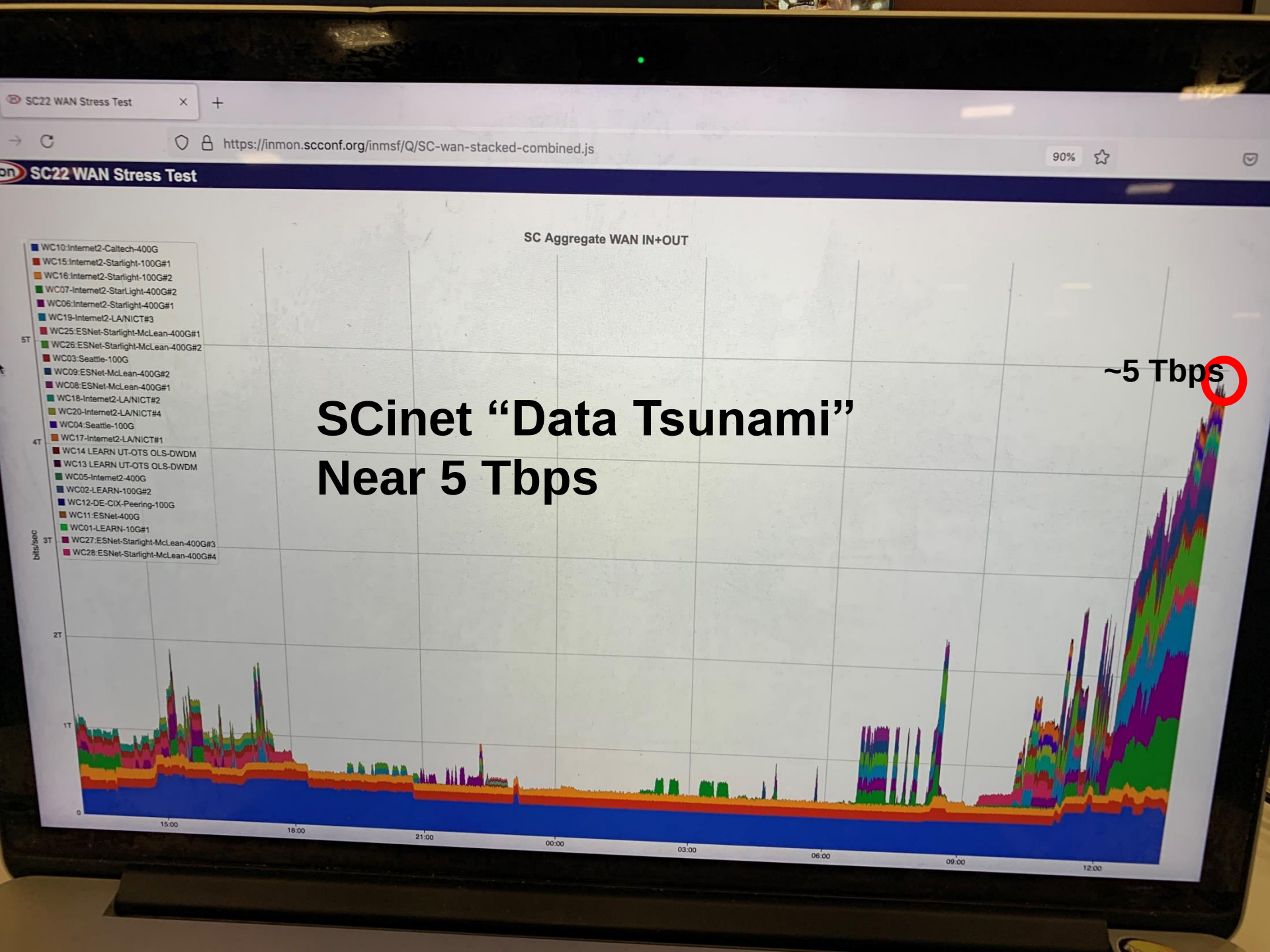
ESnet

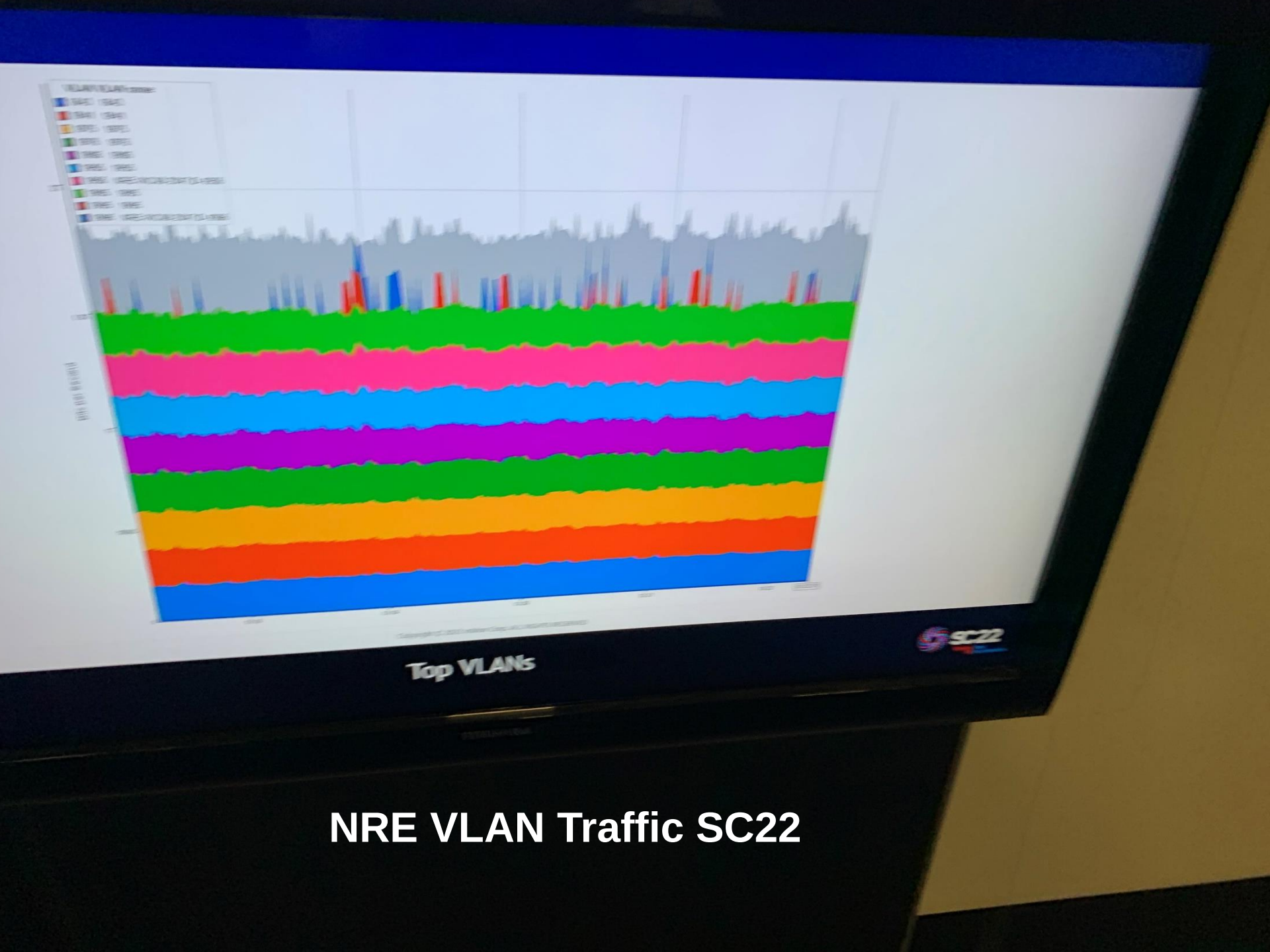
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Chameleon & FABRIC

- Currently, Two NSF Testbeds Are Investigating Methods For Optimizing Cross Platform Research: Chameleon, A Large-Scale, Deeply Reconfigurable Experimental Platform for Computer Sciences Systems Research, and FABRIC, Which Enables Edge And Exploratory Research At-Scale in Networking, Cybersecurity, Distributed Computing And Storage Systems, Machine Learning, and Science Applications.
- As A First step, These Projects Plan Demonstrations At SC22
- Demonstrations Will Use Jupyter Notebooks (Which Can Be Shared By Publishing via Trovi) to Integrate Chameleon and FABRIC Resources.
- One Demonstration Will Implement An L2 Stitched Network Between Chameleon and FABRIC That Can Be Used With Slices Deployed With a Jupyter Notebook




SC22 WAN Stress Test
https://inmon.scconf.org/inmsf/Q/SC-wan-stacked-combined.js
90%
SC22 WAN Stress Test
SC Aggregate WAN IN+OUT
WC10:Internet2-Caltech-400G
WC15:Internet2-Starlight-100G#1
WC16:Internet2-Starlight-100G#2
WC07-Internet2-StarLight-400G#2
WC06:Internet2-Starlight-400G#1
WC19-Internet2-LA/NICT#3
WC25:ESNet-Starlight-McLean-400G#1
WC26:ESNet-Starlight-McLean-400G#2
WC03:Seattle-100G
WC09:ESNet-McLean-400G#2
WC08:ESNet-McLean-400G#1
WC18-Internet2-LA/NICT#2
WC20-Internet2-LA/NICT#4
WC04:Seattle-100G
WC17-Internet2-LA/NICT#1
WC14 LEARN UT-OTS OLS-DWDM
WC13 LEARN UT-OTS OLS-DWDM
WC05-Internet2-400G
WC02-LEARN-100G#2
WC12-DE-CIX-Peering-100G
WC11:ESNet-400G
WC01-LEARN-10G#1
WC27:ESNet-Starlight-McLean-400G#3
WC28:ESNet-Starlight-McLean-400G#4
5T
4T
3T
2T
1T
0
bits/sec
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
SCinet “Data Tsunami”
Near 5 Tbps
~5 Tbps

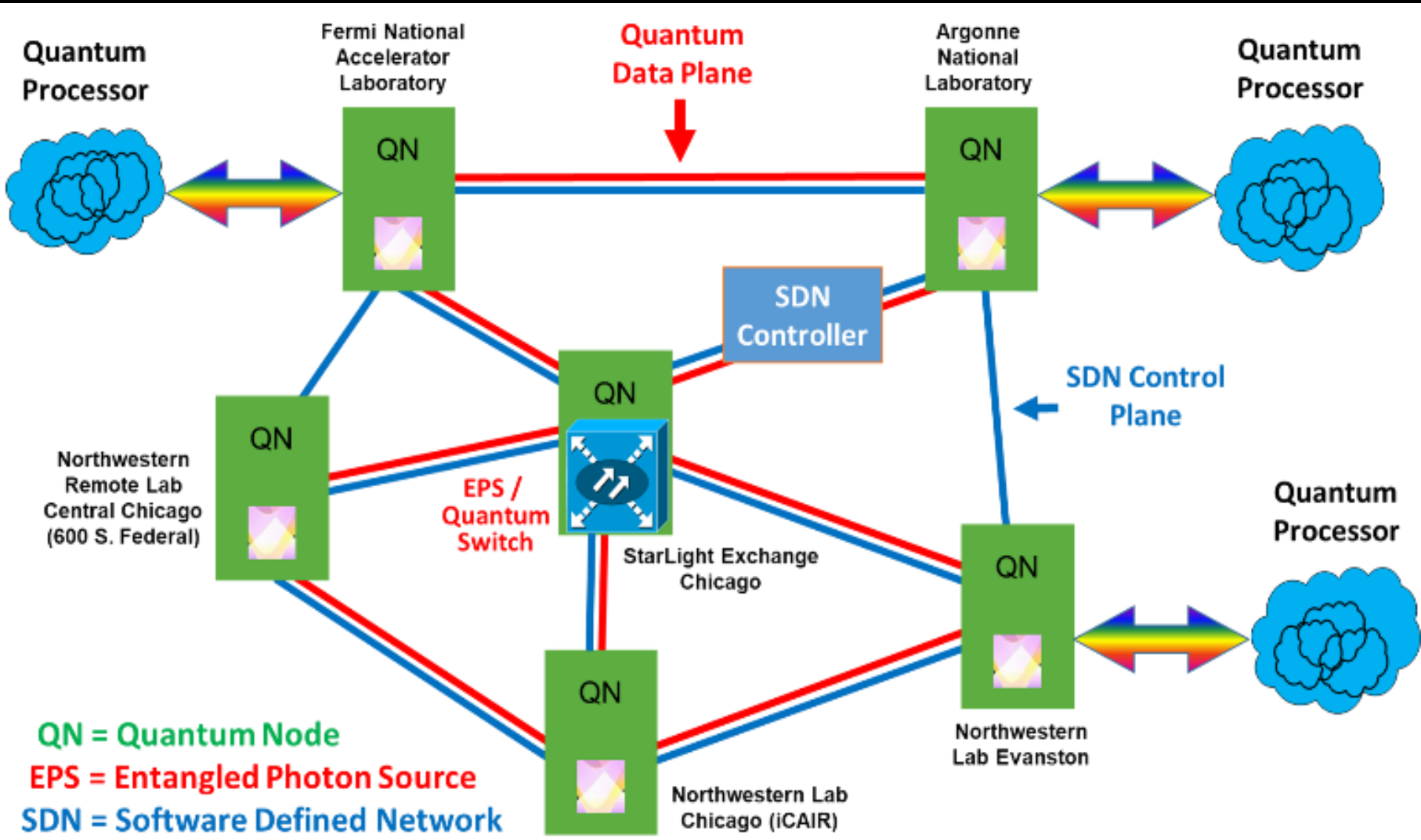


NRE VLAN Traffic SC22

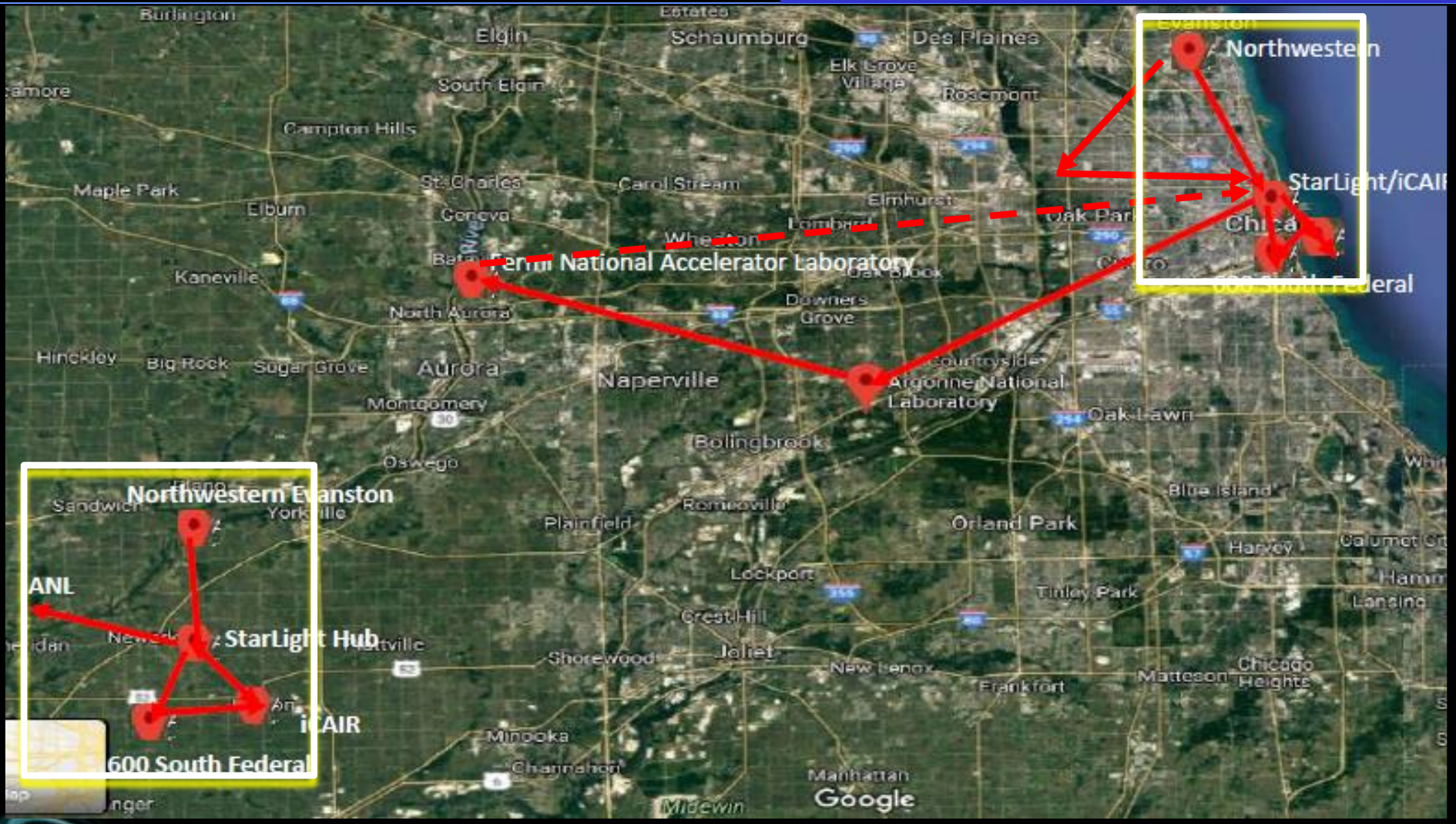
StarLight: Founding Partner Of Supercomputing Asia DMC International Testbed



Emerging Chicago Quantum Exchange Testbed



Energing IEQnet Testbed Topology



Illinois Express Quantum Network

STARLIGHT℠

www.startap.net/starlight



**Thanks to the NSF, DOE, NASA, NIH, DARPA
Universities, National Labs, International & Industrial Partners,
and Other Supporters**

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