



Pacific Wave Distributed Environments

Sana Bellamine

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Agenda

- Overview of the Pacific Wave International Exchange.
- Pacific Wave at the core of the National Research Platform (NRP) and the Global Research Platform (GRP).
- Why Multi-domain orchestration is needed.
- Pacific Wave and multi-domain orchestration:
 - The Pacific Wave infrastructure in support of multi-domain orchestration.
 - Pacific Wave/CENIC and multi-domain orchestration.
 - Multi-domain paths provisioned successfully so far.
- Next steps:
 - Encourage additional institutions connected to CENIC to join.
 - Leverage multi-domain orchestration for international provisioning.
 - End to end performance monitoring.

Overview

- Initially funded by the NSF in 2005, Pacific Wave is an open international R&E peering and exchange fabric operated by CENIC and the PNWGP.
- The exchange's primary large-scale backbone nodes are in Los Angeles, San Francisco and Seattle.
- The exchange's core infrastructure extends domestically to Hawaii (UH), Chicago (StarLight), El Paso, Albuquerque and Denver, and internationally to Tokyo via International collaborations.
- Exchange participants:
 - CENIC, PNWGP, Ultralight, Los Nettos, Internet2, ESnet, NOAA N-Wave, DREN, NASA, AARNET, CANARIE, CERNET, CUDI, GEMNET, JGN, KISTI, REANNZ, SINET, TRANSPAC, Transtelco, TWAREN
- Multiple cloud providers of relevance to the R&E communities.

Pacific Wave, the NRP and the GRP

Gateways to
NRP/GRP Partners

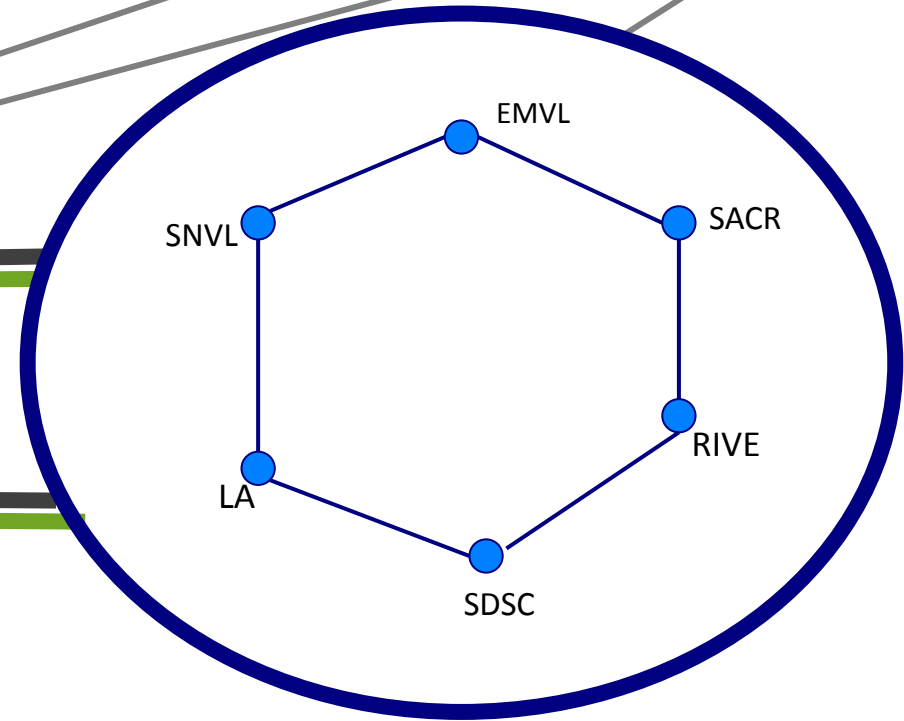
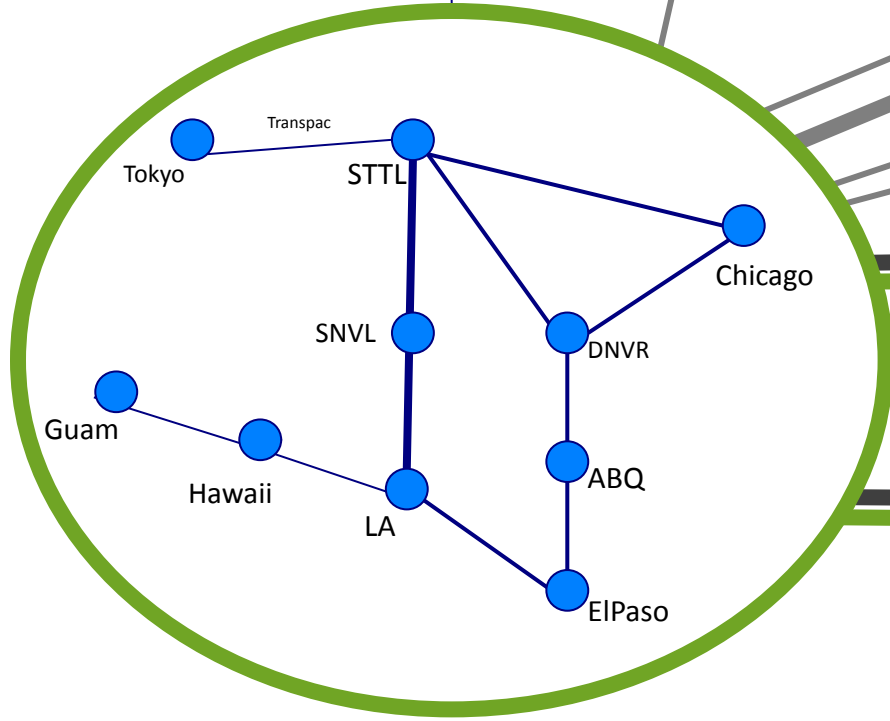
FABRIC

ESNET

StarLight

Canarie

Internet2



Pacific Wave: 300G-->500G (09/14/2021): LA-SNVL;
300G: SNVL-STTL

CENIC High Performance Research Network
over CENIC's optical backbone



-  Partner Exchange Links
-  Participant Links
-  Prospective Links
-  AP-REX Links
-  Pacific Wave Backbone

-  Pacific Wave POP
-  AP-REX POP
-  Pacific Research Platform (PRP)
-  PRP Science DMZ Fabric
-  Software Defined Network
-  Commercial Peering Points (Amazon, Google, & Microsoft)

- WESTERN REGIONAL NETWORKS**
States served by WRN members:
- ABQG: New Mexico GigaPoP
 - CENIC: California
 - FRGP: Colorado & Wyoming
 - PNWGP: Washington, Montana, Alaska, Oregon & Idaho
 - UH: Hawaii

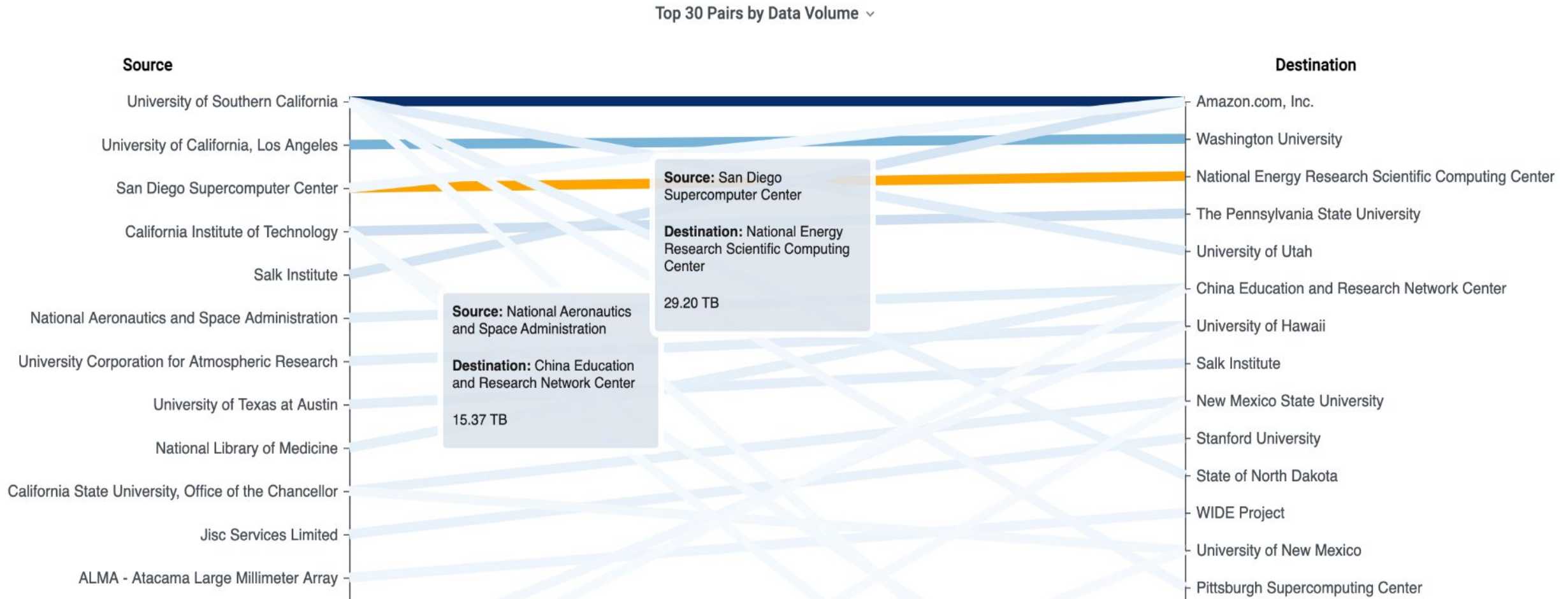
With support from the National Science Foundation



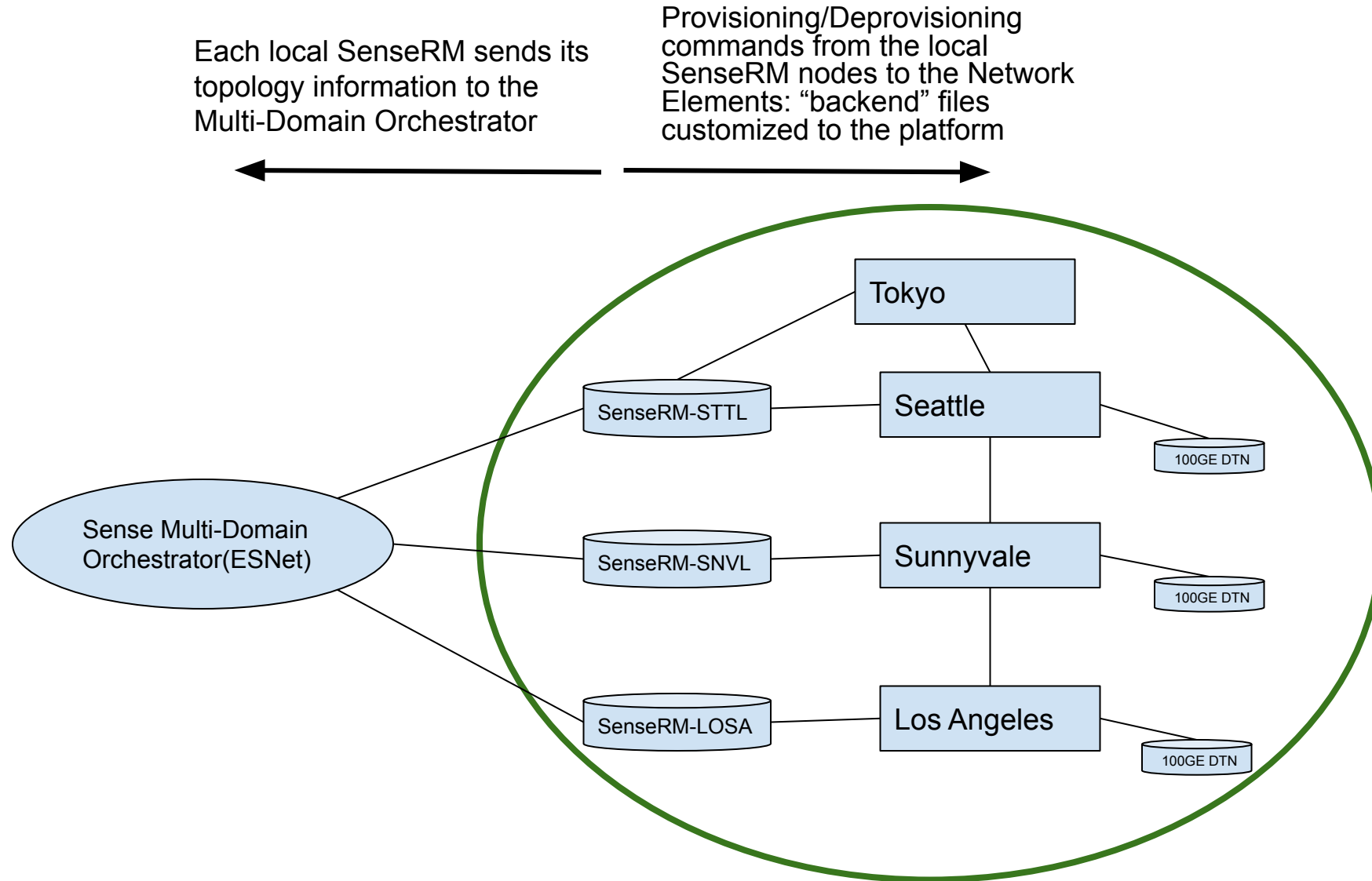
Pacific Wave/CENIC and Multi-domain Orchestration via AutoGOLE/SENSE

Why Multi-Domain Orchestration is Needed

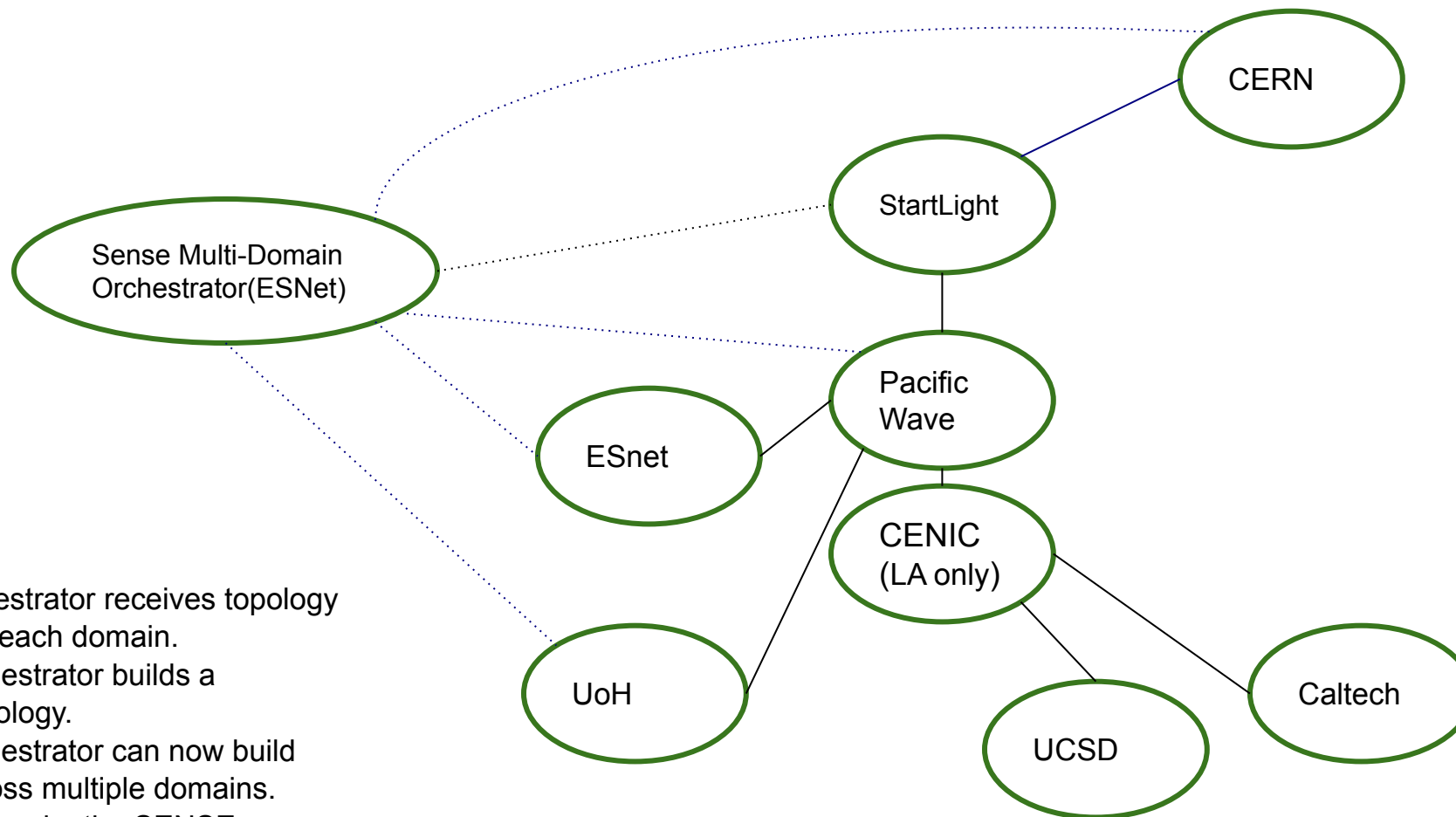
- Big Science is multi-domain.
- How challenging it is to provision paths across multiple domains.



The Pacific Wave Infrastructure in Support of Multi-Domain Orchestration

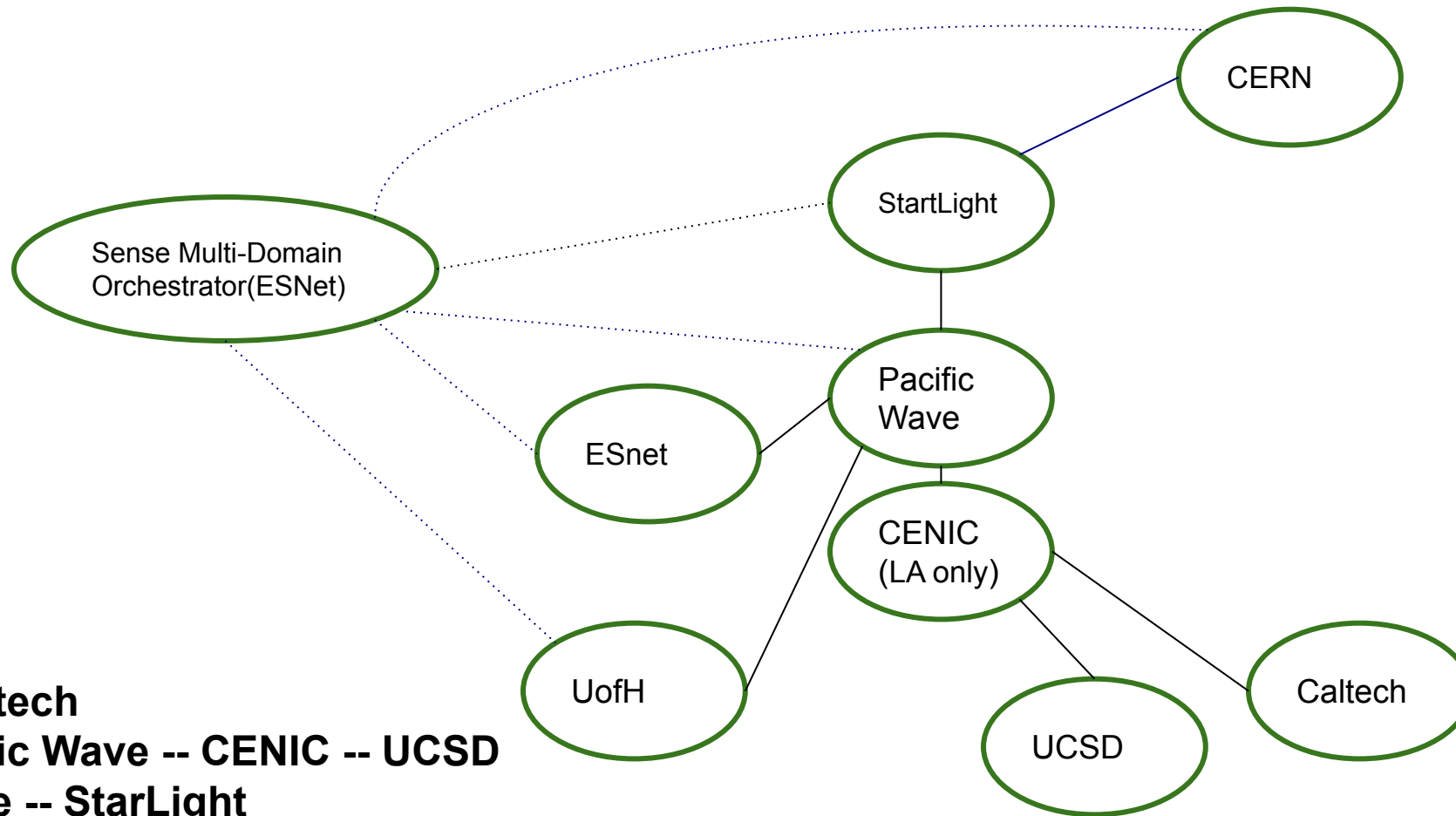


Pacific Wave/CENIC and Multi-Domain Orchestration



- The SENSE orchestrator receives topology information from each domain.
- The SENSE orchestrator builds a multi-domain topology.
- The SENSE orchestrator can now build layer2 paths across multiple domains.
---Within each domain, the SENSE orchestrator reaches out to the local orchestrator to have the path provisioned.

Paths Successfully Provisioned Dynamically and on Demand



- UCSD -- Caltech
- UoH -- Pacific Wave -- CENIC -- UCSD
- Pacific Wave -- StarLight

In few Seconds!

Next Steps

- Add more California-based institutions to multi-domain orchestration.
 - UCSD and Caltech have been pilot participants.
- Global testing:
 - [California-based institutions] -- Pacific Wave -- ESnet -- SURFnet -- CERN
 - Future International testing including through StarLight.
- Use the DTNs in the domains as a resource for end to end performance testing prior to putting production traffic. This work being done within the framework of the AutoGOLE/SENSE working group.
- Migration of the SenseRM application to Kubernetes.
- **We look forward to working with you on these initiatives.**