

PACIFIC



WAVE

Pacific Wave: Introduction and Update

APAN 30, Hanoi, Vietnam



What is Pacific Wave?

- It is a state-of-the-art international peering exchange facility designed to serve research and education networks throughout the Pacific Rim and the world.
- It is a distributed exchange allowing participants at any of its connection points to interconnect in a transparent way.
- It is flexible, adaptable, and able to leverage rapidly changing technologies to meet the diverse needs of different networks.
- Pacific Wave is a joint project between the Corporation for Education Network Initiatives in California (CENIC) and the Pacific Northwest Gigapop (PNWGP) and is operated in collaboration with the University of Southern California and the University of Washington.

Pacific Wave: A brief overview

- In 2004, Seattle and Los Angeles exchanges were connected to form Pacific Wave using waves from National Lambda Rail (NLR), CENIC, and PNWGP.
- Taking advantage of submarine cabling landings along the Pacific coast, Pacific Wave is available in:
 - Seattle , Washington (1 site), Los Angeles, California (3 sites), and Sunnyvale/Palo Alto, California (2 sites)
- It is the longest operating distributed internet exchange.
- Currently 26 networks exchange traffic on Pacific Wave, including R&E Networks from Asia, Oceania, the Middle East, South America, and North America.

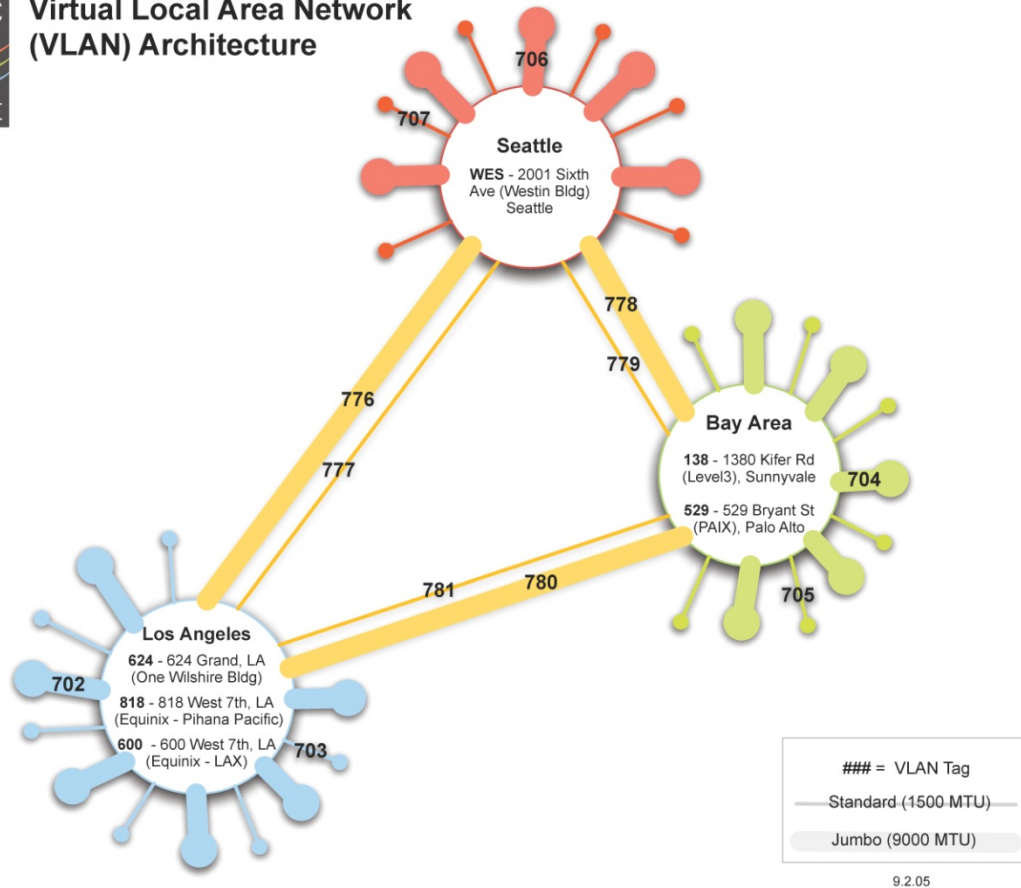
More than just a Layer 2 exchange

- Pacific Wave supports:
 - Network-to-network Layer 3 peering across regional and inter-regional public VLANS.
 - Dedicated VLANs between participants for traffic exchange at Layer 2.
 - Access to Dynamic Circuit Networks (Internet2 ION, NLR Framenet).
 - Lightpath and VLAN provisioning via GLIF.

VLANS

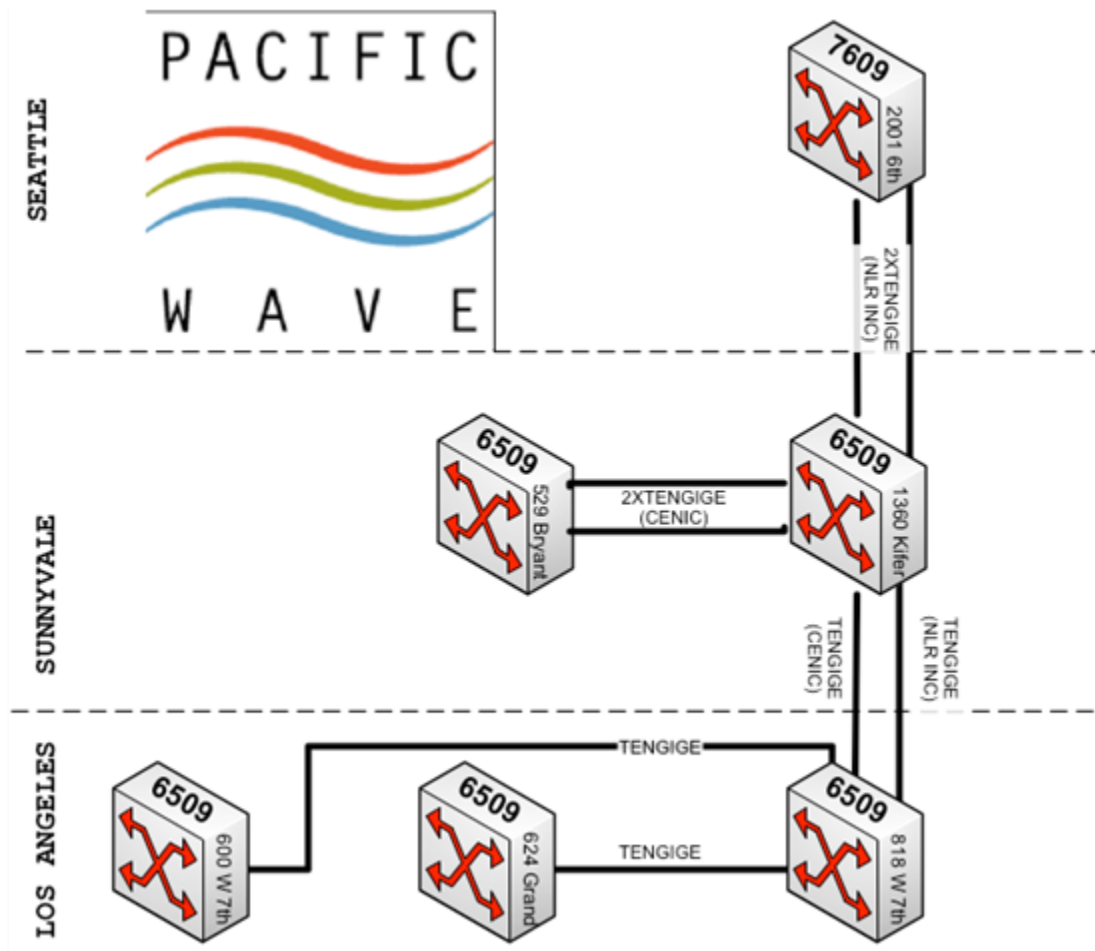


Virtual Local Area Network (VLAN) Architecture



9.2.05

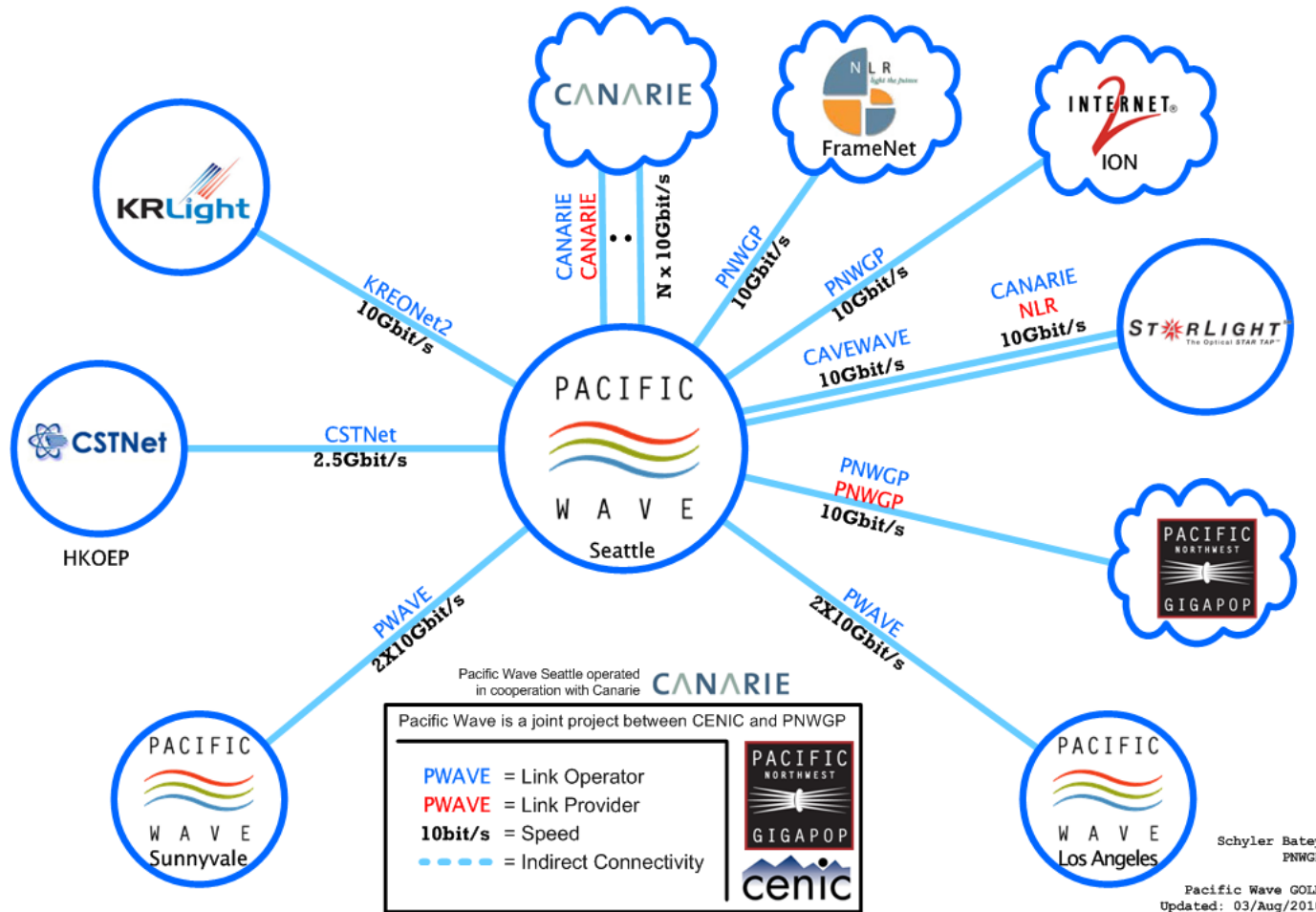
Pacific Wave Exchange Switches



GLIF Map Acknowledgements

- **Acknowledgements** - The Global Lambda Integrated Facility (GLIF) Map 2008 visualization was created by Robert Patterson of the [Advanced Visualization Laboratory \(AVL\)](#) at the [National Center for Supercomputing Applications \(NCSA\)](#) at the [University of Illinois at Urbana-Champaign \(UIUC\)](#), using an Earth image provided by [NASA](#). Data was compiled by Maxine D. Brown of the [Electronic Visualization Laboratory \(EVL\)](#) at the [University of Illinois at Chicago \(UIC\)](#). Funding was provided by GLIF and US National Science Foundation grants # SCI-04-38712 to NCSA/UIUC and # OCI-0441094 to EVL/UIC. For more information on GLIF, see <http://www.glif.is/>.
- **Additional Information** - The GLIF map *does not* represent all the world's Research and Education optical networks, and *does not* show international capacity that is dedicated to production usage. The GLIF map only illustrates *excess* capacity that its participants are willing to share with international research teams for applications-driven and computer-system experiments, in full or in part, all or some of the time. GLIF does not provide any network services itself, and researchers should approach individual GLIF network resource providers to obtain lightpath services.

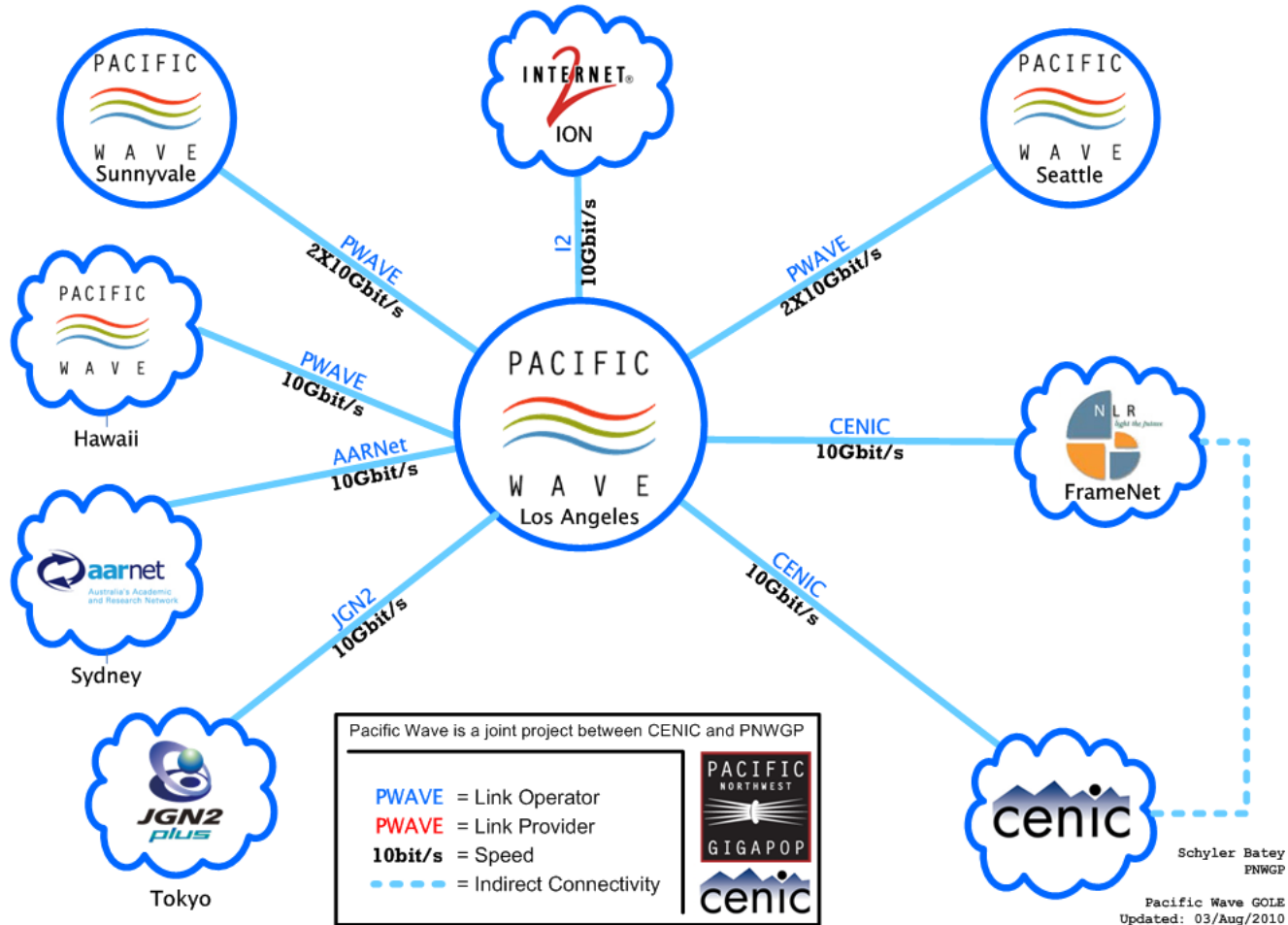
Seattle GOLE



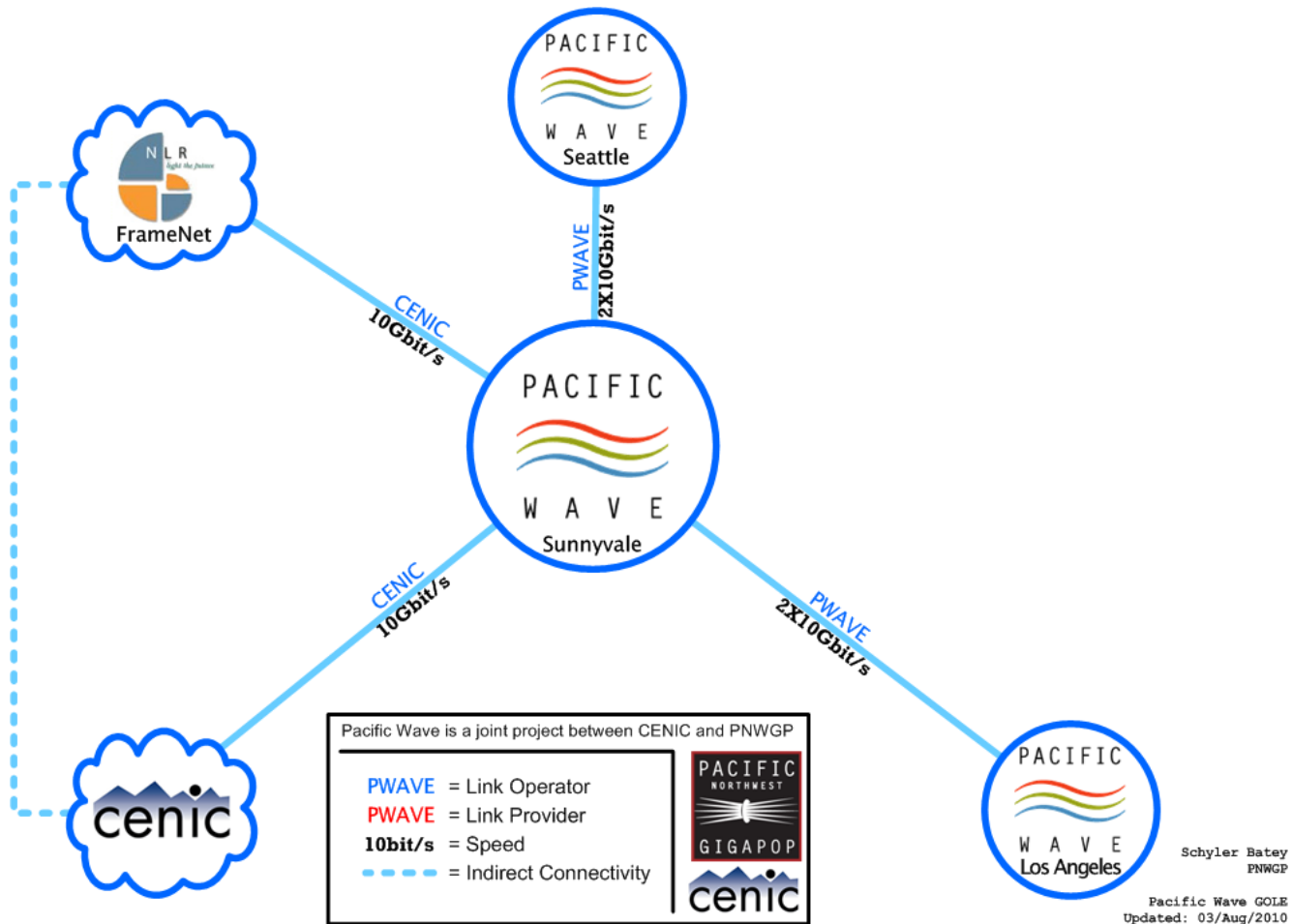
Schyler Batey
PNWGP

Pacific Wave GOLE
Updated: 03/Aug/2010

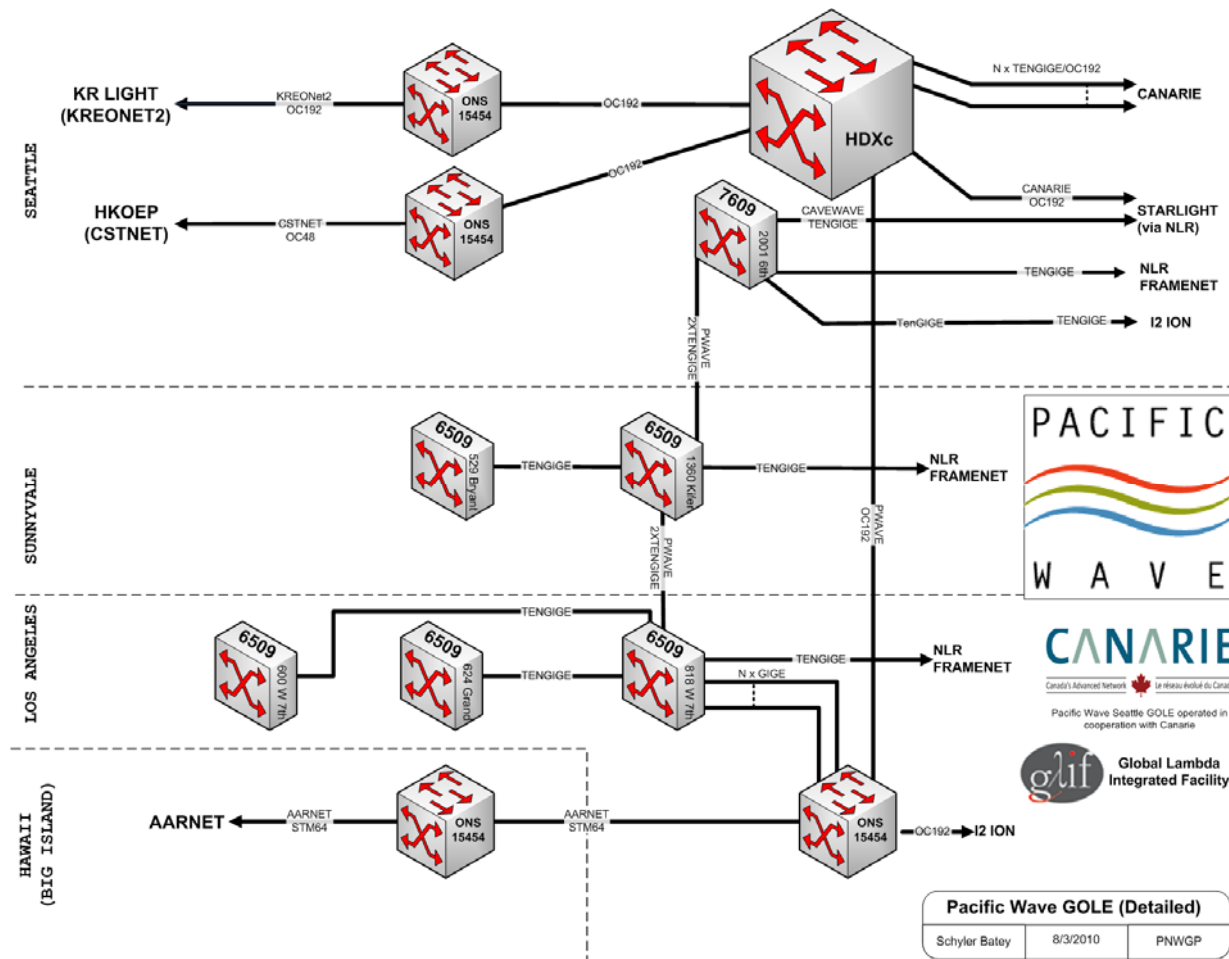
Los Angeles GOLE



Sunnyvale (Palo Alto) GOLE



Pacific Wave GOLE (Detailed View)



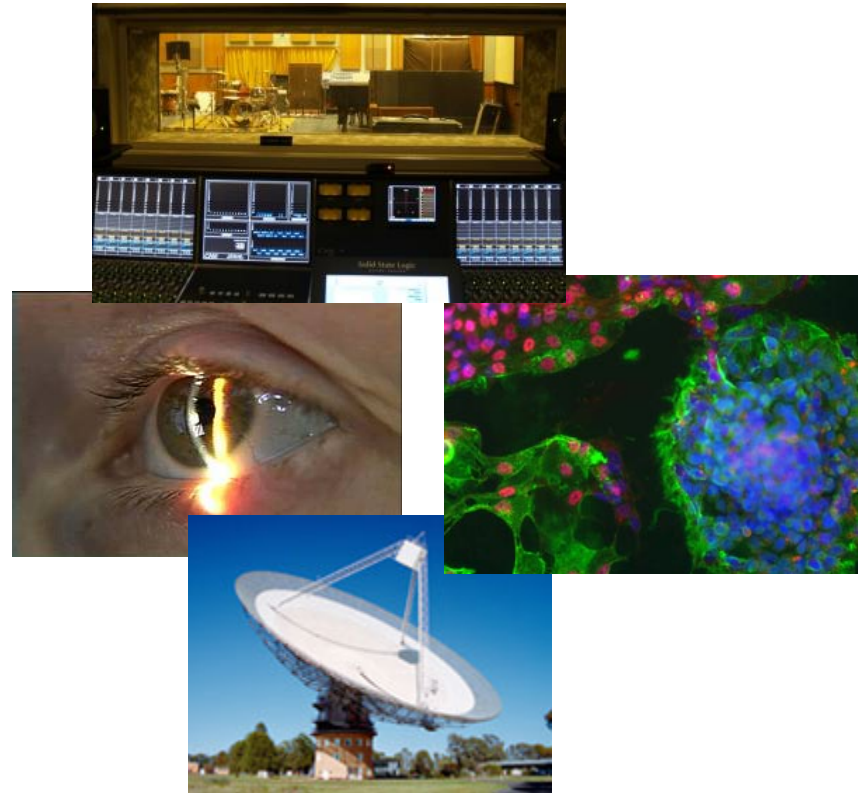
Pacific Wave supports research and education.

- Telemedicine
- Remote collaborations
- Collaborative arts
- Global visualcasting
- Student exchange (MURPA/UCSD Prime)
- Large volume data transfer over networks
- Remote instrumentation & data visualization
- Digital archives



Without borders

- Music
- Arts
- Education/Teaching
- Medicine
- Astronomy
- Ocean Sciences



Astronomy: eVLBI, eVLBA

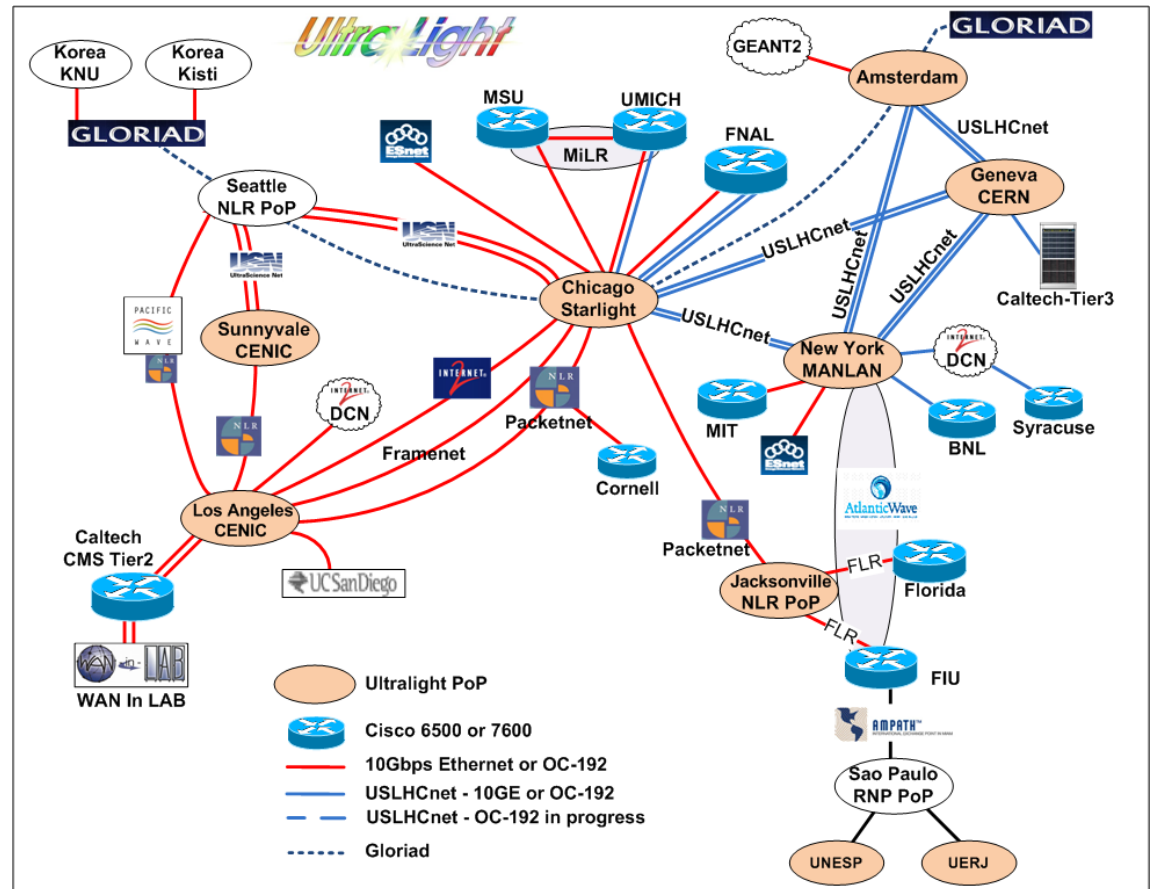
Pacific Wave supports e-Very Long Baseline Interferometry (eVLBI) and e-Very Long Baseline Array applications (eVLBA)



Networks and telescopes used for IYA2009 24hr e-VLBI. Image by Paul Boven <boven@jive.nl>. Satellite image: Blue Marble Next Generation, courtesy of Nasa Visible Earth (visibleearth.nasa.gov).

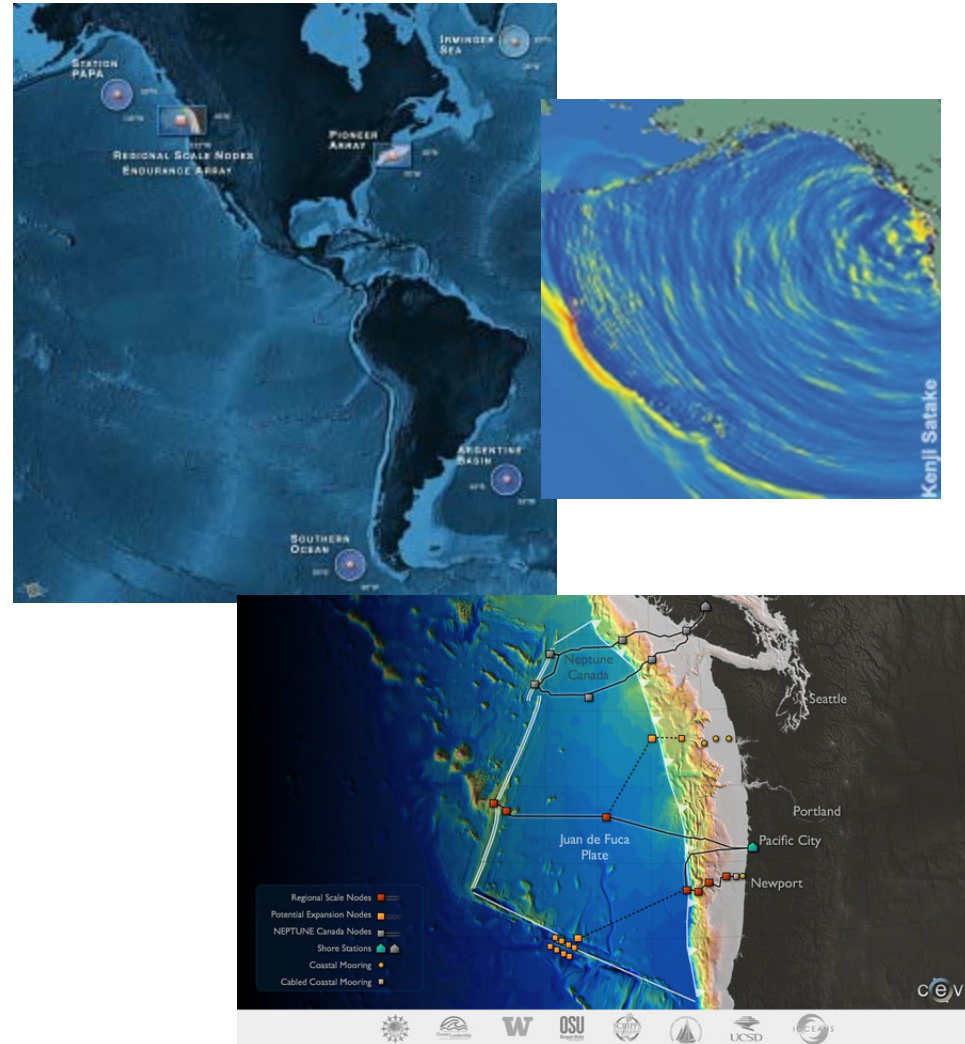
High Energy Physics

- HEP
 - Atlas
 - Belle
 - Alice
 - CMS
 - Ultralight



Ocean Observatories Initiative

The Ocean Observatories Initiative (OOI) will construct a networked infrastructure of science-driven sensor systems to measure the physical, chemical, geological, and biological variables in the ocean and seafloor. Greater knowledge of these variables is vital for improved detection and forecasting of environmental changes and their effects on biodiversity, coastal ecosystems, and climate.



Future Directions:

- Additional backbone capacity.
- PerfSONAR and other network/performance measurements.
- 40 Gigabit, 100 Gigabit.
- Dynamic VLAN provisioning.
- Support of Future Internet activities.

For more information

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