View from the Pacific

David Lassner, University of Hawai'i

APAN Meeting

August 2018 – Auckland, NZ

HŌKŪLE'A IMAGE ® POLYNESIAN VOYAGING SOCIETY
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HŌKŪLE'A
MĀLAMA HONUA
WORLDWIDE VOYAGE

Voyage of the Hōkūle‘a

Hawai‘i’s Proud Networking History

- The Aloha protocols were developed and deployed at the University of Hawai‘i to connect UH campuses on different islands via radio
- PACCOM project based at the University of Hawaii was the vehicle for first international IP connections to academic institutions and networks beginning in 1989 with New Zealand, Australia, Japan, Korea…
- The University of Hawai‘i was the first U.S. R&E entity to acquire submarine fiber IRUs: JUSCN, SCCN, AAG, SEA-US
- Hawai‘i was the first US state to deploy self-managed fiber to every public school, every public library and every public college/university – and interconnect them on every island

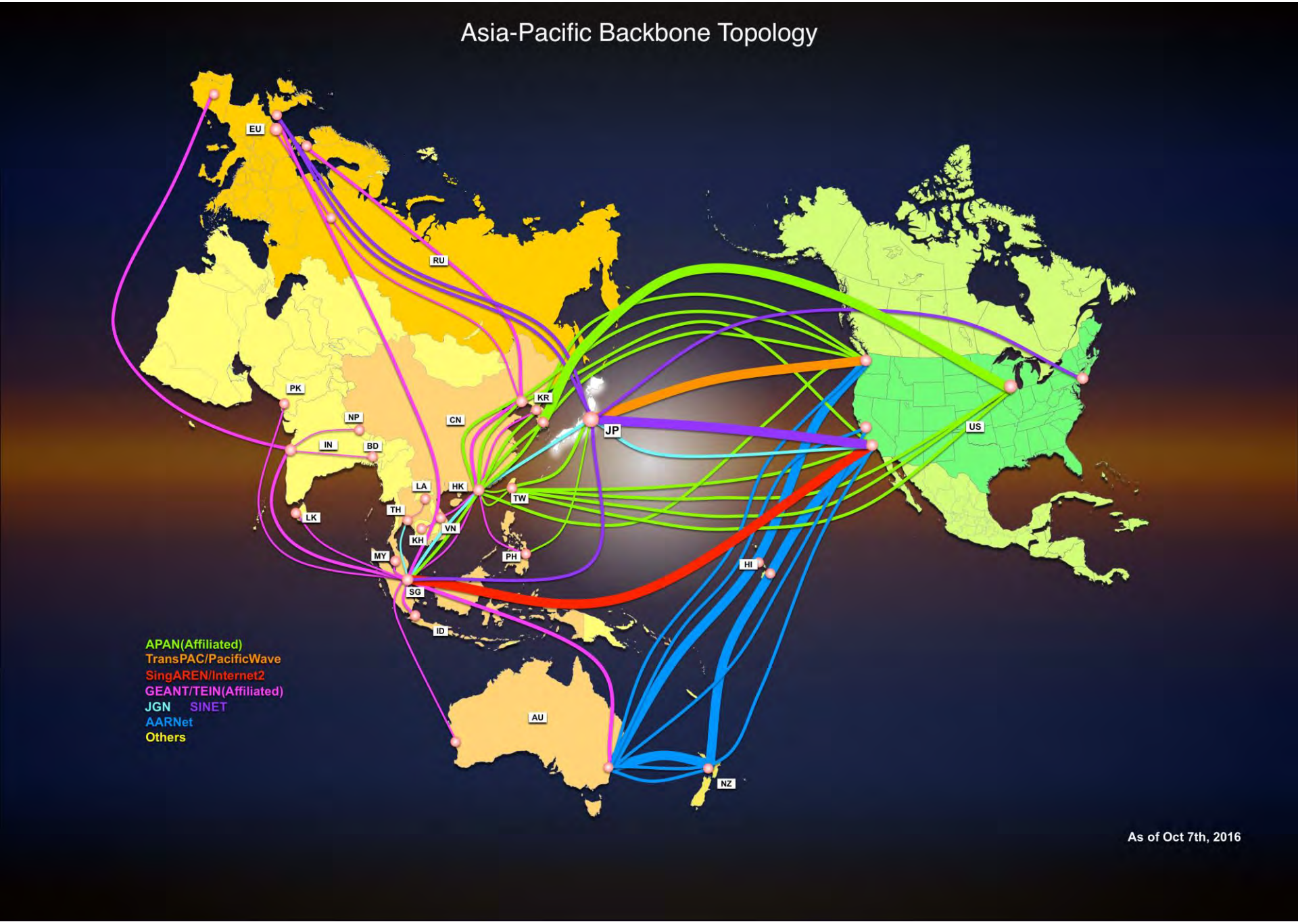
The Early Cycle of Academic Networks

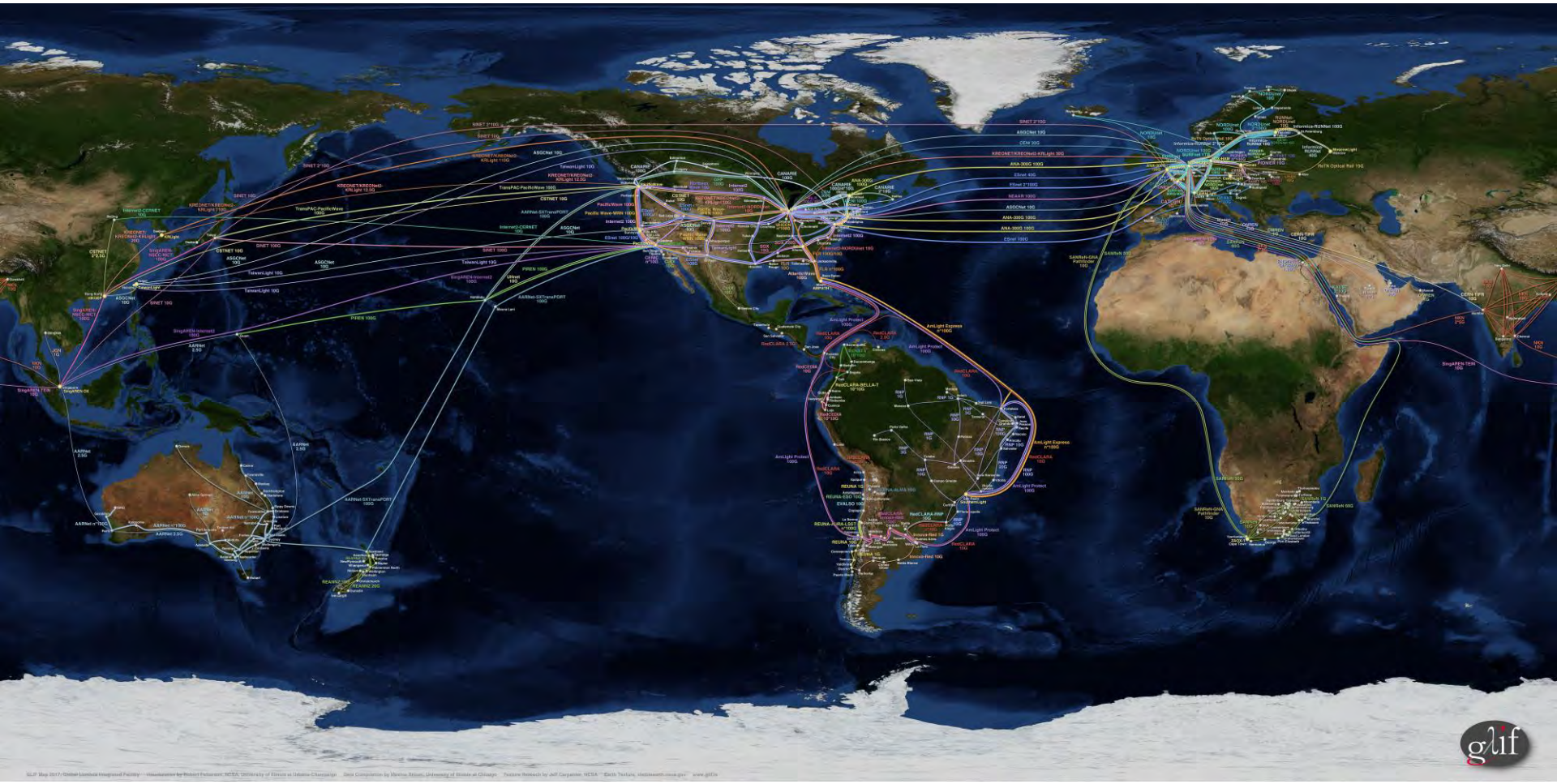
- Universities actively pioneered the deployment of IP networks around the world
- The world noticed, and the commercial Internet emerged
  - Many R&E networks sold and/or replaced by commercial services
- By the mid-1990s U.S. universities realized something was missing
  - Costs spiraling out of control
  - Limited development and deployment of new IP technologies
  - Connectivity via commercial ISPs hindered high-bandwidth academic applications and innovations
- We brought forward the next generation of R&E networking (Internet2)
- And now national and regional R&E organizations collaborate through our extensive interconnected global R&E network fabric

INTERNET2®

INTERNATIONAL PARTNERSHIPS

Asia-Pacific Backbone Topology

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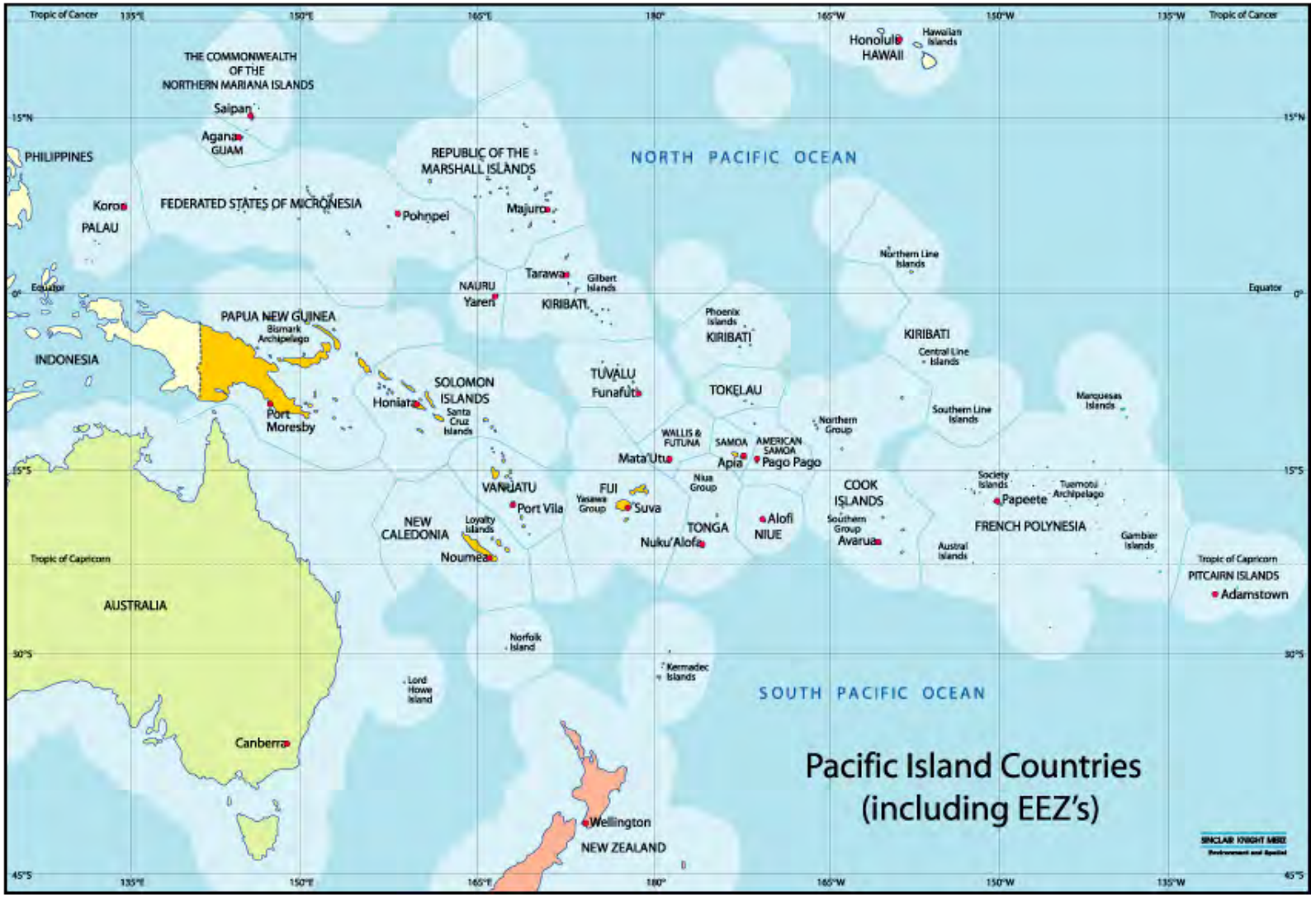
The Missing Link

- We have seen substantial R&E networking progress in:
  - Southeast Asia
  - South Asia
  - Central Asia
  - Africa
  - Caribbean

The Pacific Islands have been the last major part of the world to develop Research & Education network capacity


Tropic of Cancer
135°E
150°E
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Tropic of Cancer
THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS
Saipan
Agana
GUAM
Honolulu
HAWAII
Hawaiian Islands
15°N
PHILIPPINES
REPUBLIC OF THE MARSHALL ISLANDS
NORTH PACIFIC OCEAN
Koror
PALAU
FEDERATED STATES OF MICRONESIA
Pohnpei
Majuro
Northern Line Islands
Equator
Tarawa
Gilbert Islands
NAURU
Yaren
KIRIBATI
PAPUA NEW GUINEA
Bismark Archipelago
Phoenix Islands
KIRIBATI
KIRIBATI
Central Line Islands
INDONESIA
TUVALU
Funafuti
SOLOMON ISLANDS
Honiara
Santa Cruz Islands
TOKELAU
Port Moresby
Southern Line Islands
Marquesas Islands
Northern Group
WALLIS & FUTUNA
SAMOA
AMERICAN SAMOA
Mata'Utu
Apia
Pago Pago
15°S
Niua Group
Society Islands
Tuamotu Archipelago
VANUATU
FIJI
Yasawa Group
Port Vila
Suva
COOK ISLANDS
Papeete
Southern Group
Alofi
NEW CALEDONIA
Loyalty Islands
TONGA
NIUE
FRENCH POLYNESIA
Avarua
Gambier Islands
Nouméa
Nuku'Alofa
Austral Islands
Tropic of Capricorn
Tropic of Capricorn
PITCAIRN ISLANDS
Adamstown
AUSTRALIA
Norfolk Island
50°S
Kermadec Islands
Lord Howe Island
SOUTH PACIFIC OCEAN
Canberra
Wellington
NEW ZEALAND
45°S
135°E
150°E
165°E
180°
165°W
150°W
135°W
45°S
Pacific Island Countries
(including EEZ's)

In a Nutshell

- Only Papua New Guinea has a population over a million (>6m)
  - Next is Fiji at <900,000
  - Some with populations under 10,000
- Mostly weak economies with low GDP
- Limited educational attainment and opportunity
- High incidence of NCDs
- Limited telecom infrastructure – internal and external
  - Developing and variable telecom regulatory environments
- Multiple political affiliations and limited regional "glue"

- **Connectivity is most critical to the most isolated communities; Unfortunately, they generally have the most limited capacity.**

Typical R&E Network Goals

- Connect education & research communities domestically and globally
  - Enable cyberinfrastructure-empowered research
  - Enable distance learning, training, access to content and academic collaborations
  - Support academic cloud services
- Develop, deploy and transfer advanced network applications and technologies
  - Enable new generation of R&E applications
  - Transfer technology, knowledge and experience for broad commercial use

Benefits of R&E Networking for the Pacific – Education & Health

- Expand distance learning opportunities and improve educational capacity
  - Education, Public Health, Health Care, Social Work, STEM, Marine Sciences, Environmental Studies, Business…
  - Connect indigenous and native communities to share language, culture, practices and wisdom
- Access to global digital libraries and educational content repositories
- Enable collaboration among schools, colleges, universities, NGOs and others throughout the world
- Telemedicine & Public Health outreach and research

Benefits of R&E Networking for the Pacific – Addressing National & Regional Problems

- Enable strategic research using modern cyberinfrastructure and eScience approaches:
  - Climate Change & Sea Level Rise, Ocean Acidification, Coral Reef Survival, Fisheries, Island Sustainability, Indigenous Culture Preservation, Sustainable Agriculture, Public Health, Bioinformatics applications to people and the environment, Earthquake & Tsunami Modeling, Disaster Resilience, Environmental Studies…
- **WITH, not just FOR Pacific Islanders**

Benefits of R&E Networking for the Pacific – Economic

- Develop a workforce skilled with emerging technologies for local telecommunications and ICT industries
- Enable economic development for information economies through new ICT-based innovations and initiatives
- Build appreciation for higher speed broadband and demand for higher capacity services and infrastructure

Explosion of Fiber Infrastructure in the Pacific

Projects

- SCCN – AU, NZ, HI, US (+ SC NEXT)
- PPC-1 – AU, Guam + PNG
- AJC – AU, Guam, JP
- AAG – US, HI, Guam, HK, SG, VN, Brunei, MY, PI, TH
- SEA-US – UH, HI, Guam, PI, IN + Palau, Yap
- Honotua – Tahiti, HI
- ASH - American Samoa – Hawaii
- Hantru-1 – Micronesia, Marshalls, Guam
- ATISA - Northern Marianas, Guam
- Gondwana-1 - New Caledonia, AU
- PNG – AU & Guam
- Tonga – Fiji
- Vanuatu – Fiji
- Tui Samoa – Samoa, Fiji, Wallis, Futuna

Pending

Manatua – Samoa, Tahiti, Cooks, Niue
Coral Sea – AU, PNG, Solomons
+ multiple internal/regional systems

Gamechanger

Deployment of strategic branching units - whether initially utilized or not

Plus Satellite Projects

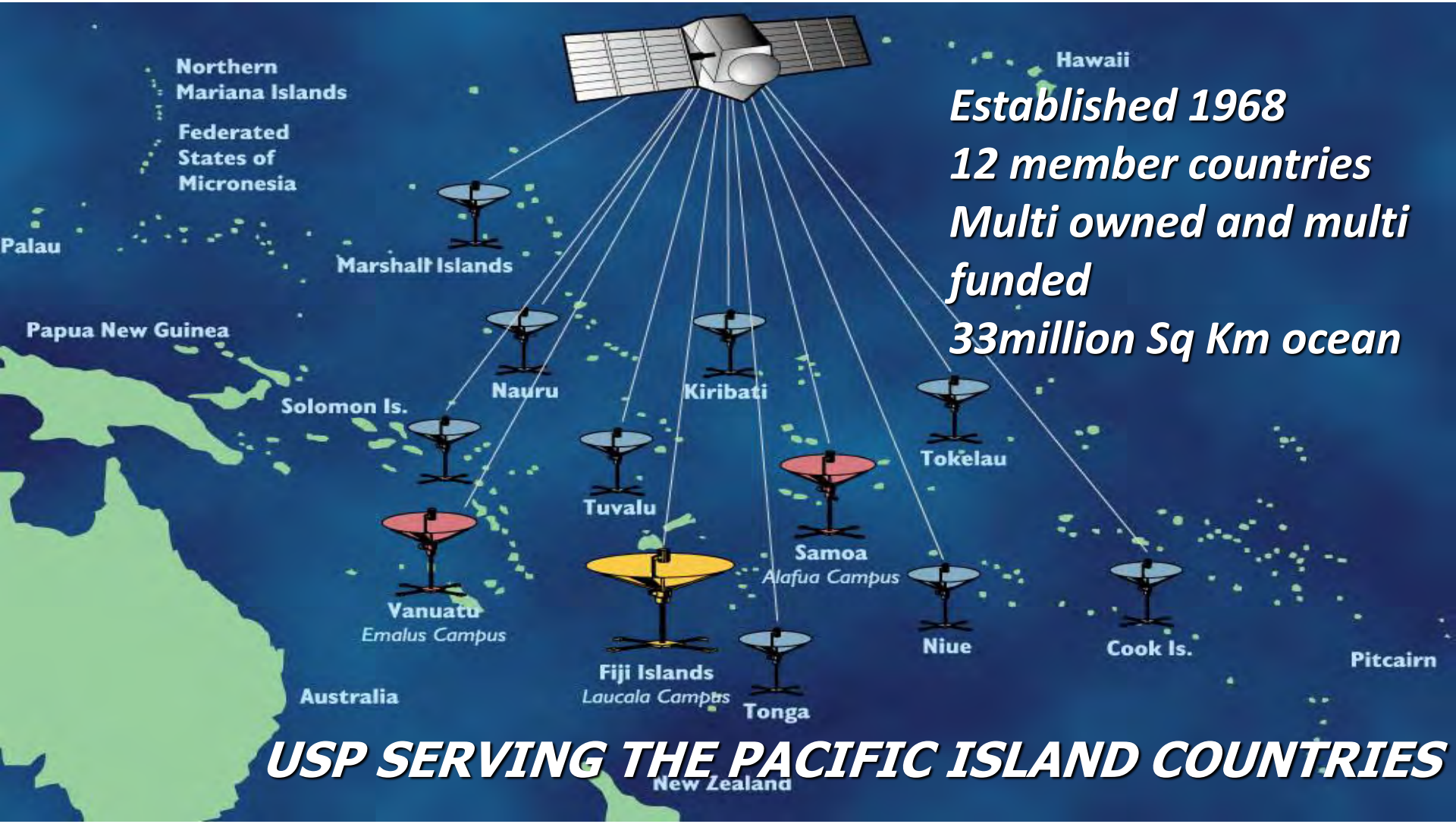
- O3B in Production
  - MEO – Low Latency (120 ms)
  - Ka Band – Gigabit speeds
- Kacific (pending)
  - “affordable” Geostationary Ka Band for end users

Hawaiki – NZ, AU, HI, US +
AmSamoa, Fiji, Tonga, New Caledonia

Pacific R&E network initiatives

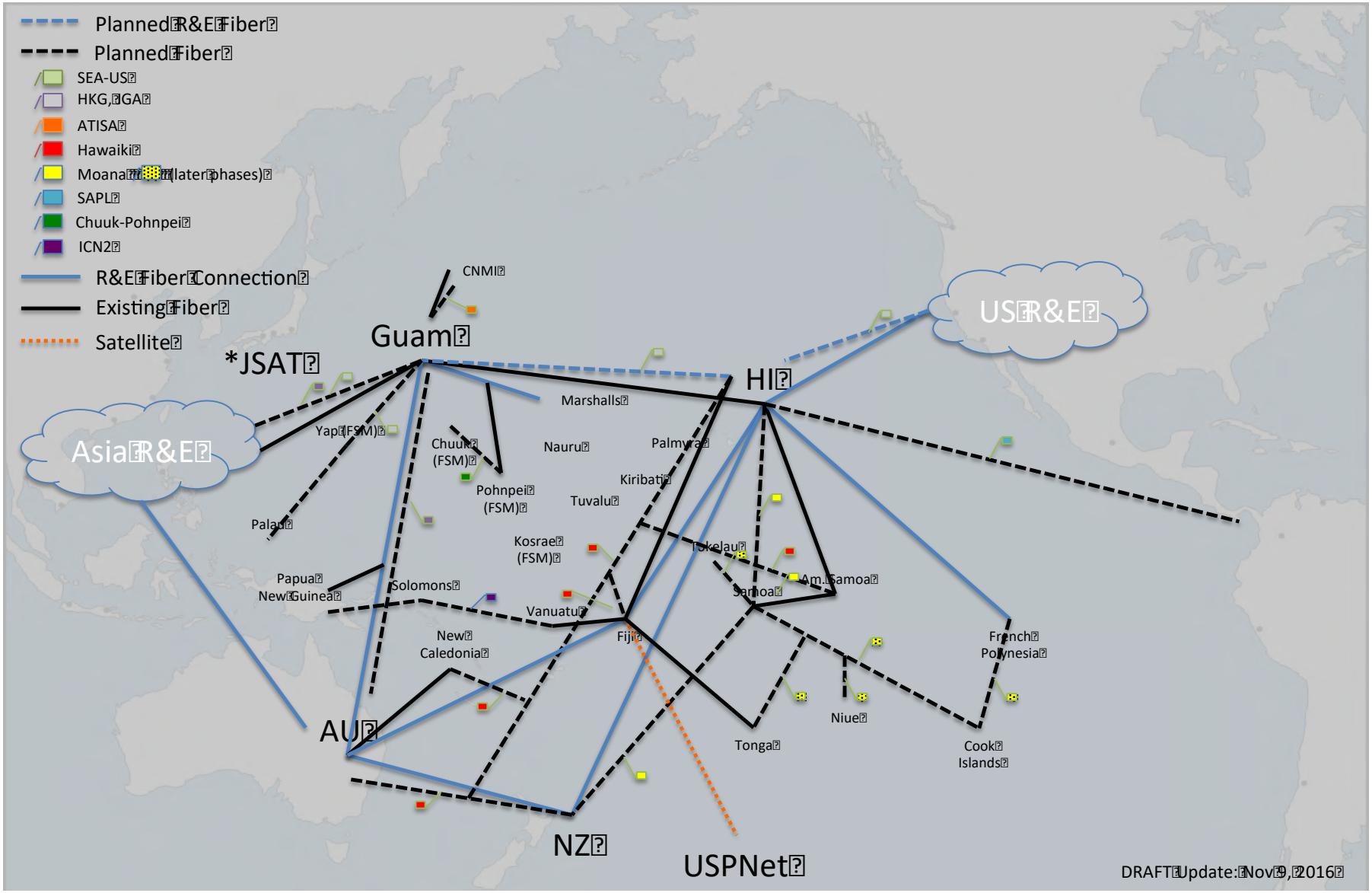
- USPNet
- U.S. NSF-funded exploratory project (UH & NSRC)
- EC's ACP Connect Study
- Australia's support for USP through AARNet
- PIREN and partners

Current approach: opportunistic and incremental


Northern Mariana Islands
Federated States of Micronesia
Palau
Marshall Islands
Papua New Guinea
Nauru
Kiribati
Hawaii
Solomon Is.
Tokelau
Tuvalu
Samoa
Alafua Campus
Vanuatu
Emalus Campus
Niue
Cook Is.
Pitcairn
Fiji Islands
Laucala Campus
Tonga
Australia
New Zealand
Established 1968
12 member countries
Multi owned and multi funded
33million Sq Km ocean
USP SERVING THE PACIFIC ISLAND COUNTRIES

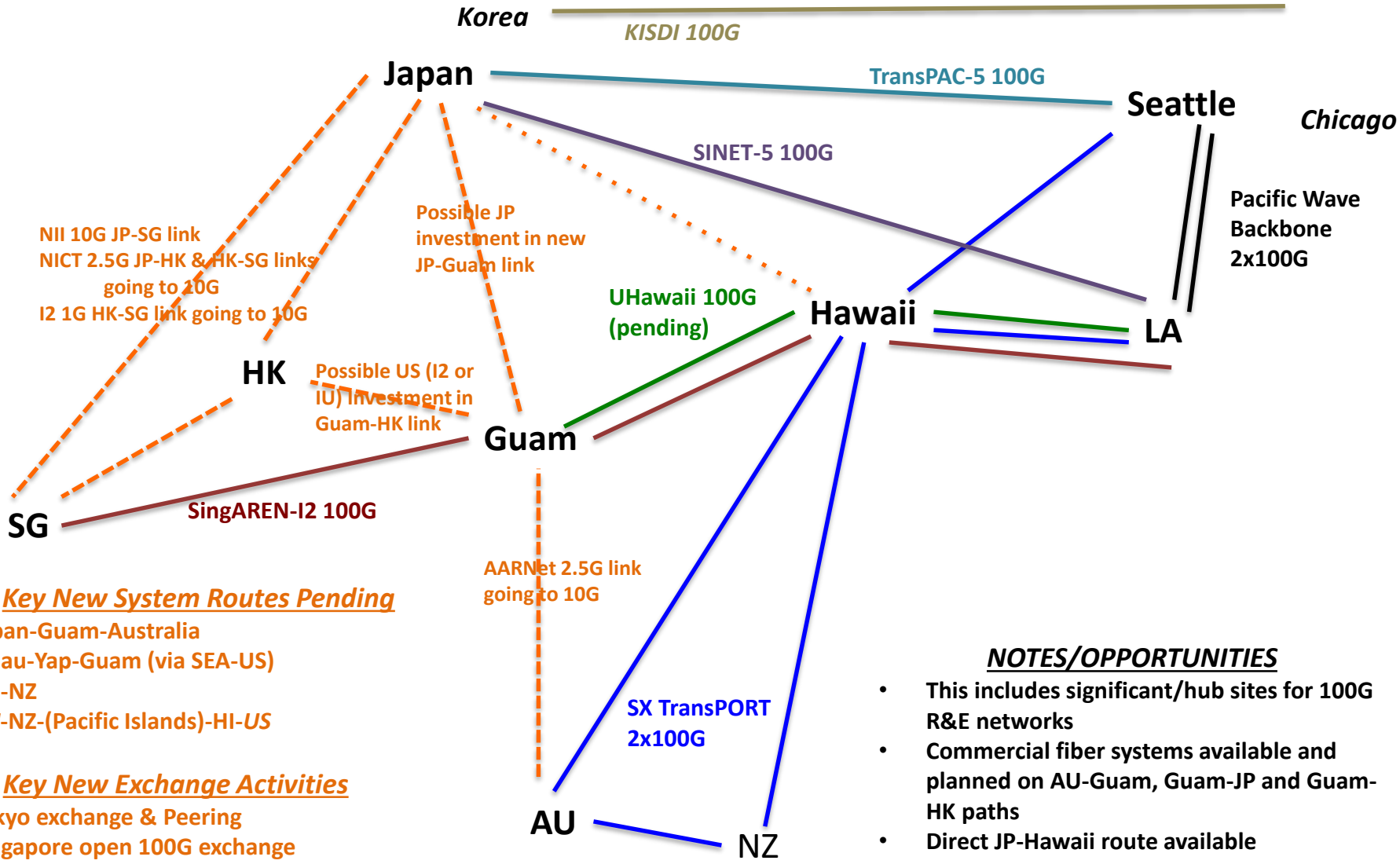
- Provide full domestic support for AARNET's current 2x40Gbps R&E circuits from Australia and New Zealand to the U.S., via Hawaii (including Mauna Kea) with upgrade to 2x100Gbps in 2016
- Continue to foster research and education (R&E) network capacity to interconnect Pacific Islands with each other and the global R&E network fabric by building on previous projects and relationships.
- Opportunistically connect Mauna Kea and Haleakala, sites of major international astronomy observatories
- Collaborate and cooperate with IRNC measurement, NOC, Engagement, and Open Exchange awardees
- Partner with AARNet, REANNZ, Pacific Wave and NSRC

National Pacific Islands Research & Education Network (PIREN)



Toward Rationalizing the High Speed Trans-Pacific R&E Infrastructure

Notional Architecture



Key New System Routes Pending

- Japan-Guam-Australia
- Palau-Yap-Guam (via SEA-US)
- AU-NZ
- *AU*-NZ-(Pacific Islands)-HI-*US*

Key New Exchange Activities

- Tokyo exchange & Peering
- Singapore open 100G exchange
- Hong Kong exchange

NOTES/OPPORTUNITIES

- This includes significant/hub sites for 100G R&E networks
- Commercial fiber systems available and planned on AU-Guam, Guam-JP and Guam-HK paths
- Direct JP-Hawaii route available

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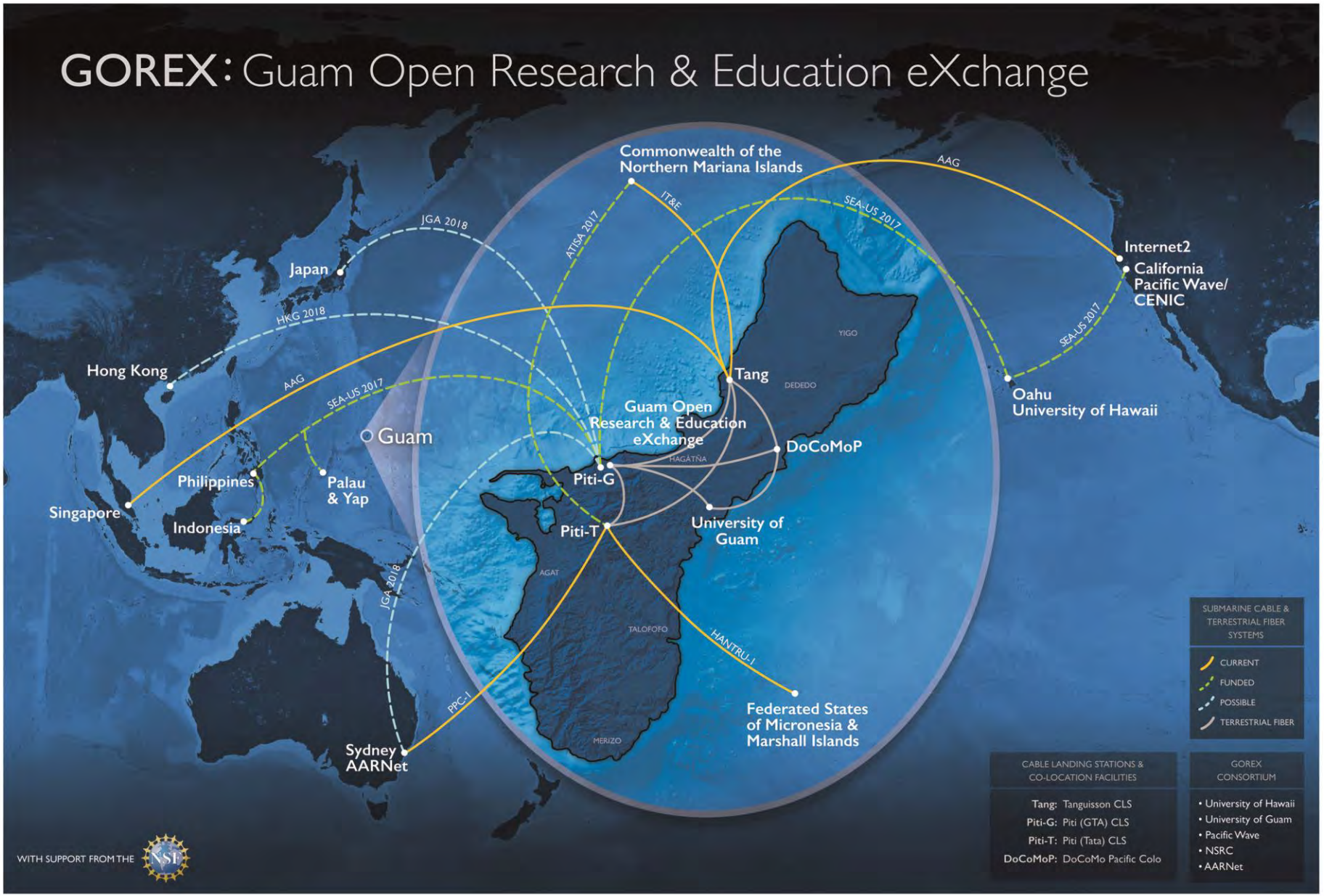
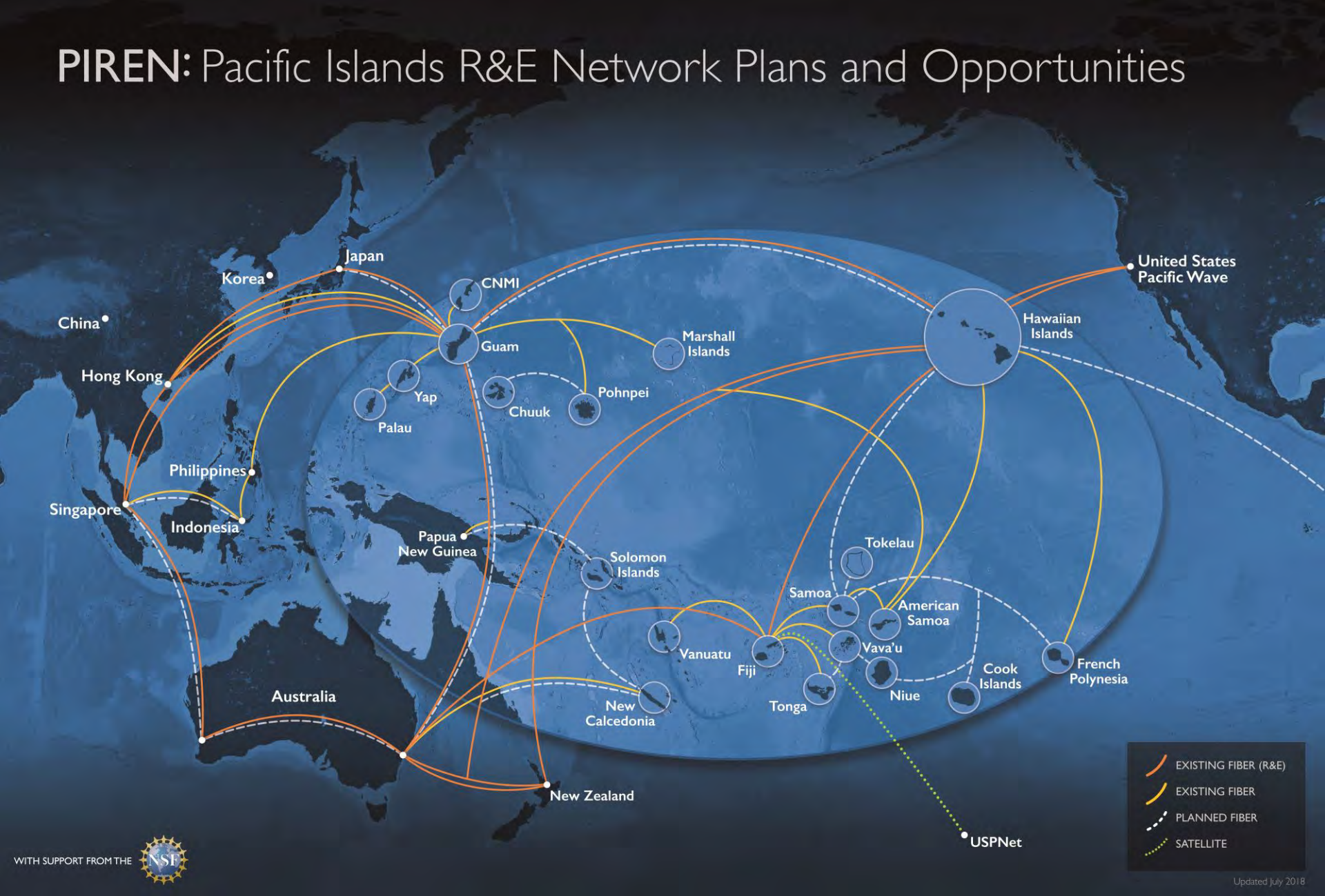

GOREX: Guam Open Research & Education eXchange
Commonwealth of the Northern Mariana Islands
AAG
IT&E
ATISA 2017
SEA-US 2017
JGA 2018
Japan
Internet2
California Pacific Wave/ CENIC
HKG 2018
Hong Kong
YIGO
Tang
DEDEDO
SEA-US 2017
Oahu University of Hawaii
AAG
SEA-US 2017
Guam Open Research & Education eXchange
Guam
DoCoMoP
HAGÅTÑA
Philippines
Palau & Yap
Piti-G
Singapore
Indonesia
Piti-T
University of Guam
AGAT
JGA 2018
TALOFOFO
HANTRU-1
PPC-1
Federated States of Micronesia & Marshall Islands
Sydney AARNet
MERIZO
SUBMARINE CABLE & TERRESTRIAL FIBER SYSTEMS
CURRENT
FUNDED
POSSIBLE
TERRESTRIAL FIBER
CABLE LANDING STATIONS & CO-LOCATION FACILITIES
Tang: Tanguisson CLS
Piti-G: Piti (GTA) CLS
Piti-T: Piti (Tata) CLS
DoCoMoP: DoCoMo Pacific Colo
GOREX CONSORTIUM
• University of Hawaii
• University of Guam
• Pacific Wave
• NSRC
• AARNet
WITH SUPPORT FROM THE NSF

PIREN: Pacific Islands R&E Network Plans and Opportunities



WITH SUPPORT FROM THE NSF

NRSC Workshop UoG 2016

30 participants from Guam, Micronesia, Marshall Islands, Northern Marianas and Palau

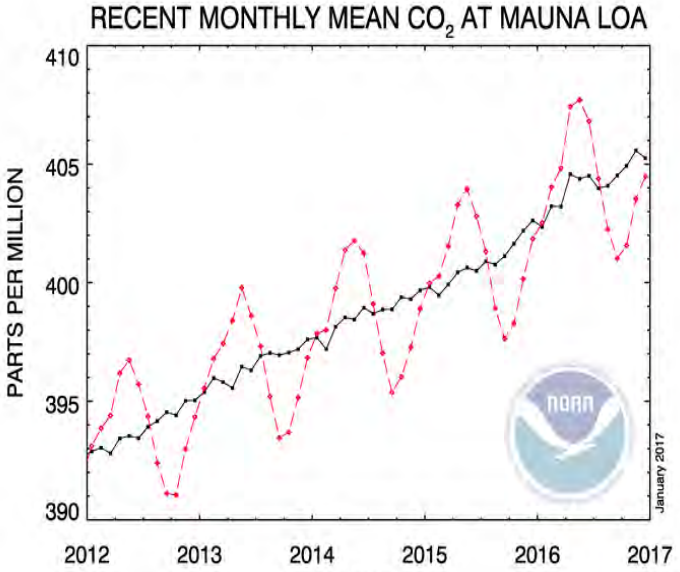
President Robert Underwood welcomes the workshop participants.

What do we do with it / What do we want to do?

Haleakalā Observatory

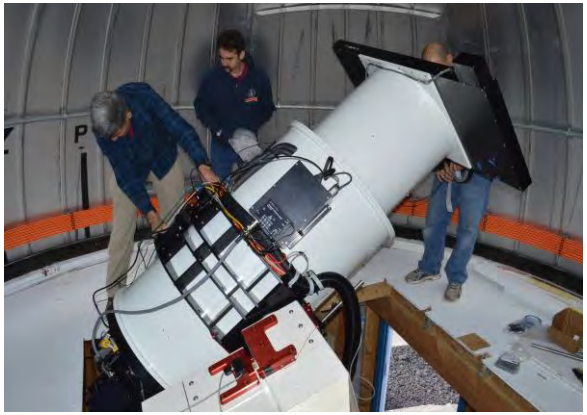
Daniel K Inouye Solar Telescope and PanSTARRS PS1 and PS2

Mauna Loa Net NSF CC*



ATLAS (center) and VYSOS (right) telescopes

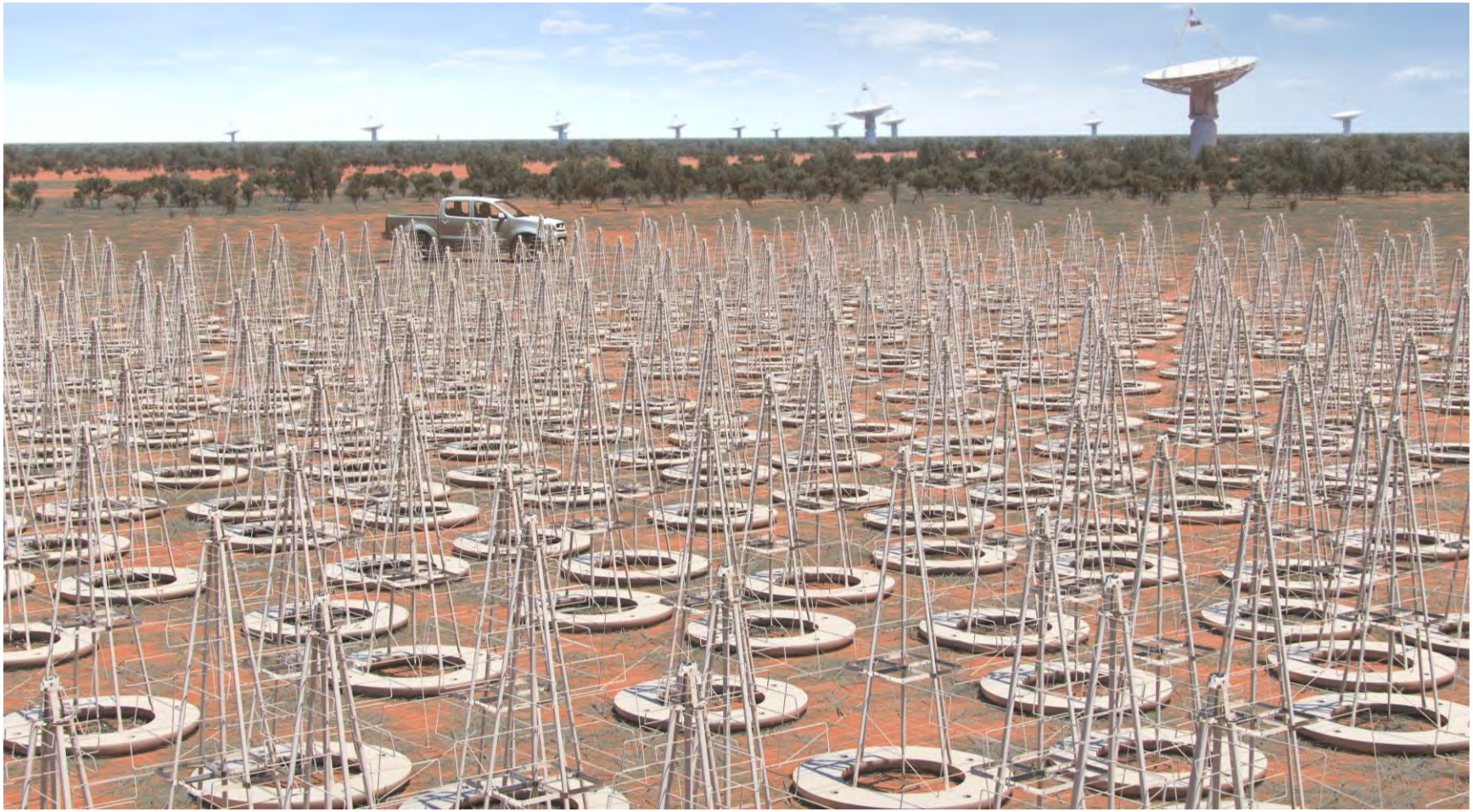
Mauna Loa Solar Observatory



The ATLAS telescope

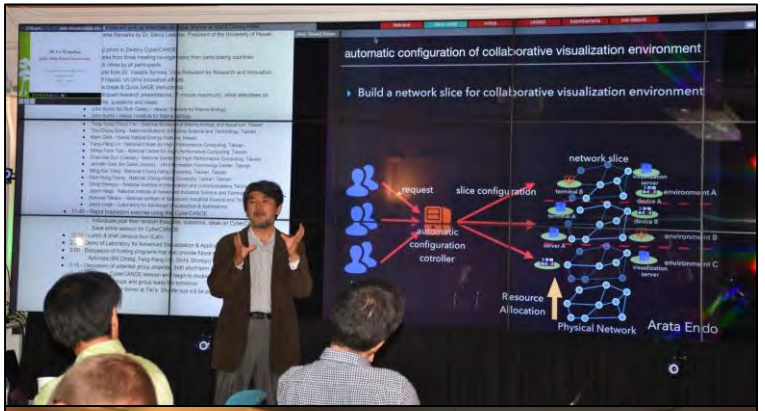
Hawai‘i Astroflows

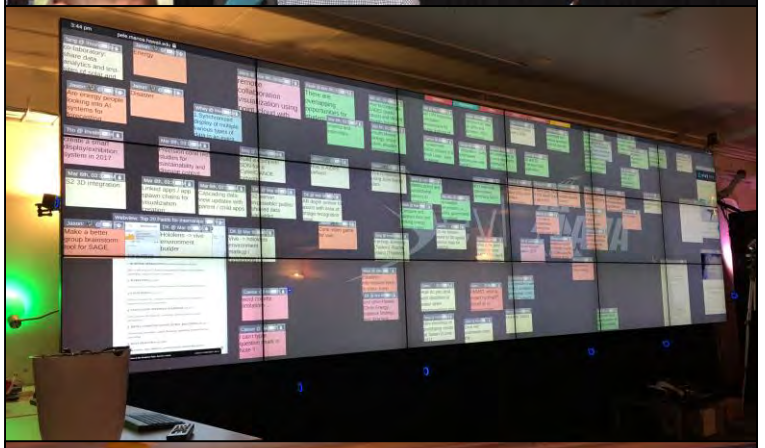
Square Kilometre Array (SKA)

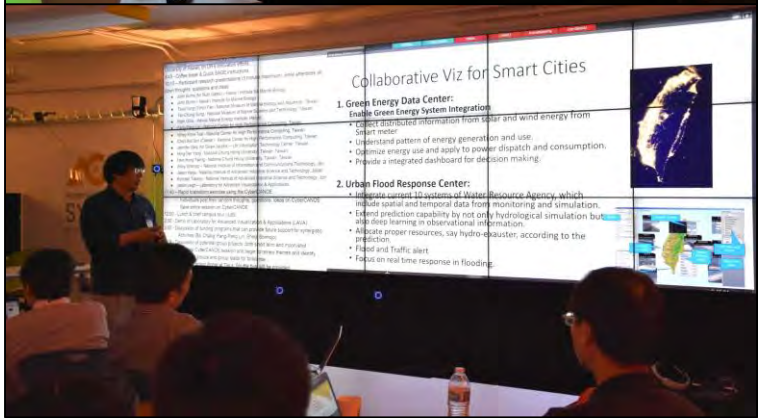


CyberCANOE: Cyber-enabled Collaboration Analysis Navigation & Observation Environment

HI-Vision: Hawai‘i Workshop on Establishing Trans-Pacific Visualization Research & Education Collaboration Networks







- Attendees from Taiwan & Japan
- Topics of Discussion centered on cyber-infrastructure for:
  - Coral Reef Ecology and Restoration
  - Renewable Energy Research
  - Disaster Management
  - Water Resource Sustainability

Possible PolyREN Approach in French Polynesia

UPF (Tahiti) - FP R&E Hub

DR Fortress (HI) via Honotua

Commercial Internet & local peering (FP)

Univ of Hawaii

AARNet (AU) & REANNZ (NZ)

Pacific Wave (US)

Renater (France)

FP Schools

French Research Centers

UH researchers study survival traits of coral worldwide

Josh Madin, HIMB

Assisted Evolution in coral reefs to support adaptation to climate change

Assisted Evolution (AE) accelerates naturally occurring evolutionary processes to enhance stress tolerance by:

Selectively breeding

Modifying partnerships/symbioses

Manipulating environmental experience

Use these "assisted" corals to:

- Restore damaged reefs
- Re-connect fragmented reefs
- Increase resilience on vulnerable reefs
- Green grey structures

Supported by Paul Allen Ocean Challenge

SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY
UNIVERSITY OF HAWAI'I AT MĀNOA

UNIVERSITY of HAWAI'I® MĀNOA

PACIFIC BIOSCIENCES RESEARCH CENTER • PBRC •

Paepae o He'eia
He'eia Fishpond, He'eia O'ahu

HAWAI'I

MONITORING RESEARCH

(Microbial/Geochem/Physical)

SUSTAINABLE FISHERIES MODELS

RESTORATION MODELS

WHAKAPAPA (*Genealogy*)

MĀTAURANGA (*Indigenous Framework*)

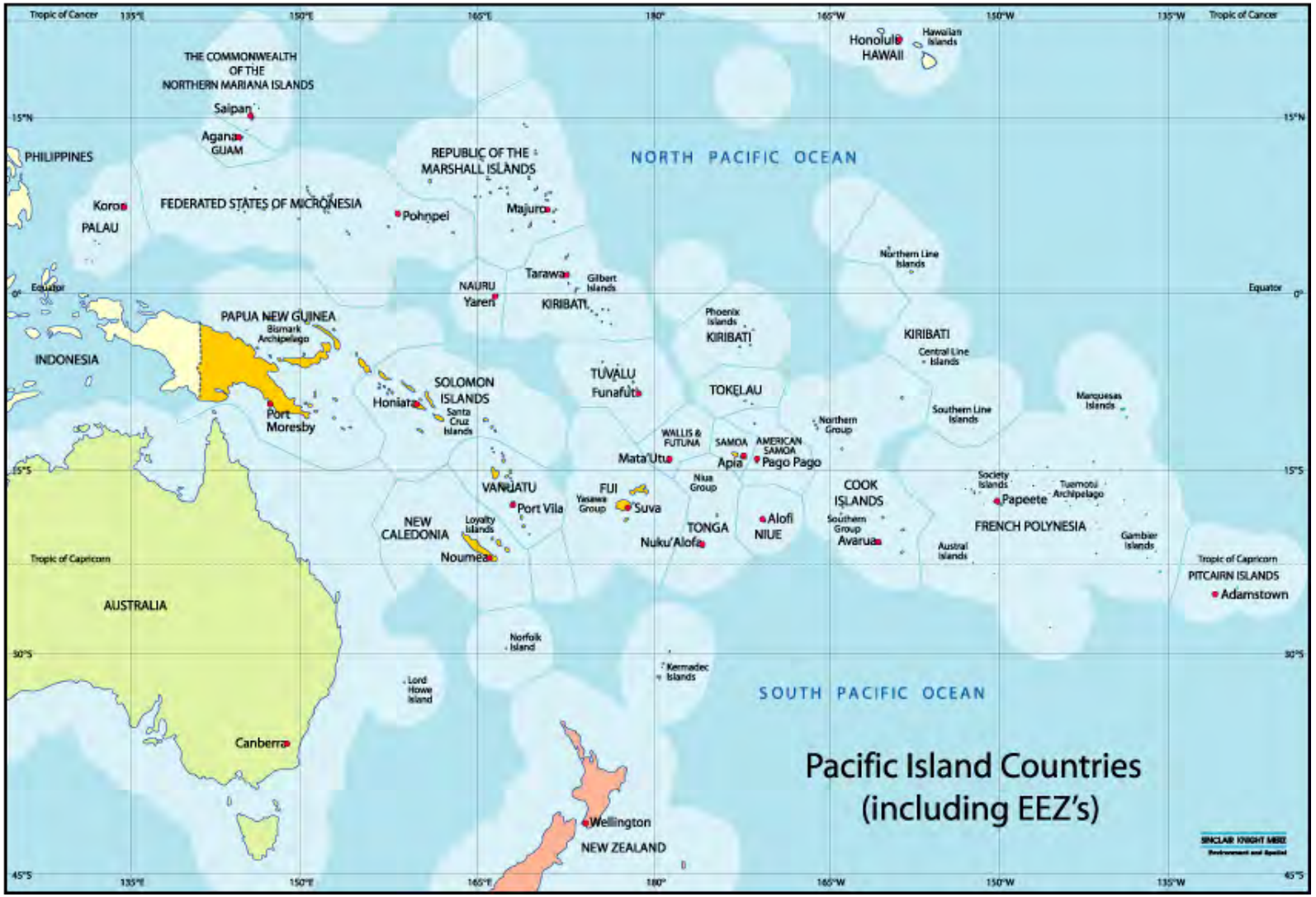
$$

NEW ZEALAND

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Te Runanga o NGAI TAHU

Te Kōhaka o Tūhaitara Trust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Pacific Island Countries
(including EEZ's)

In a difficult telecom environment with challenging geography, inadequate infrastructure, emerging regulatory regimes, limited competition, traditions of isolation and highly limited resources – meaningful progress will requires multi-sectoral and global collaboration.

Mahalo


Hokule'a
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