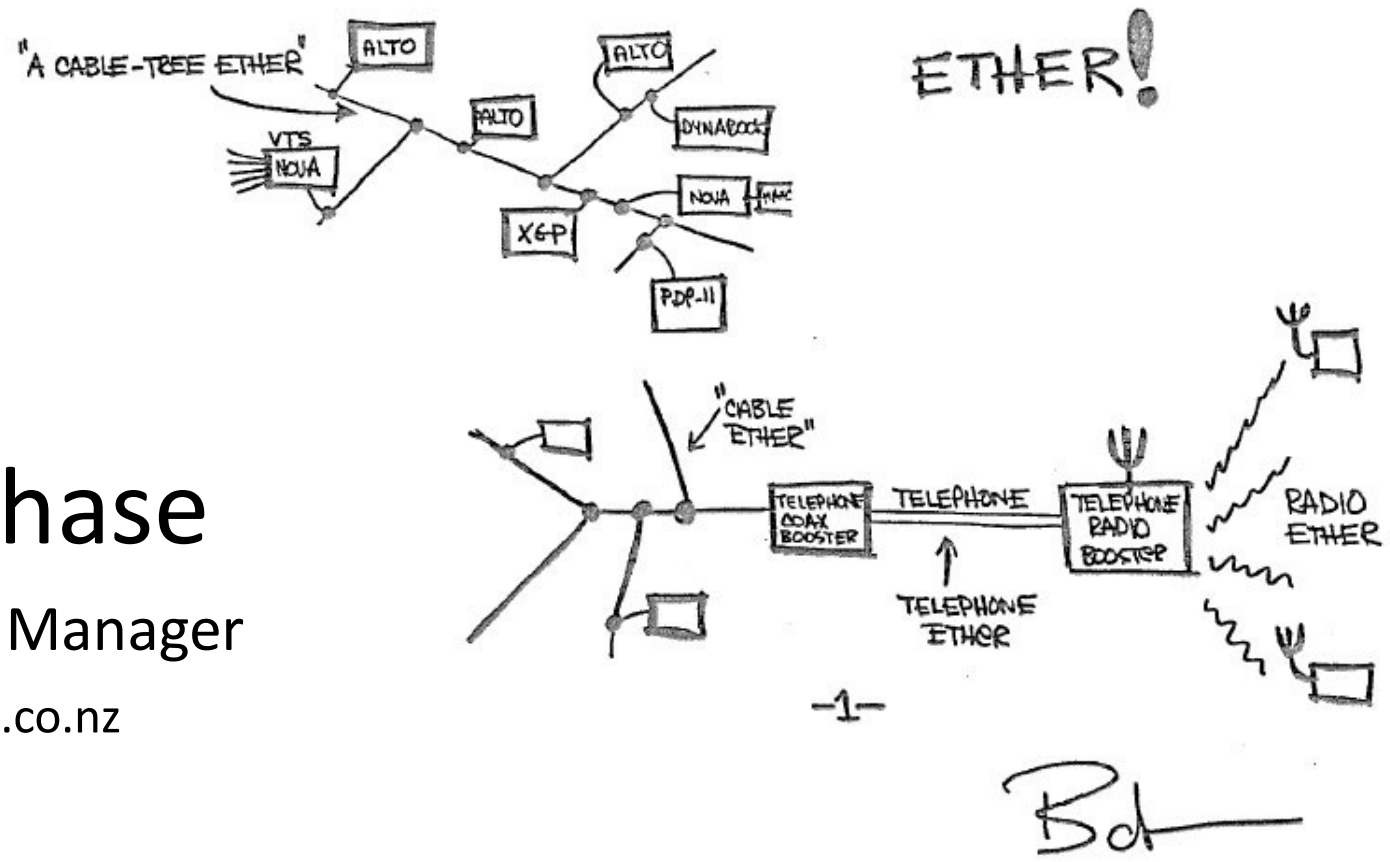
REAWNZ

Wallace A. Chase

Technical Engagement Manager

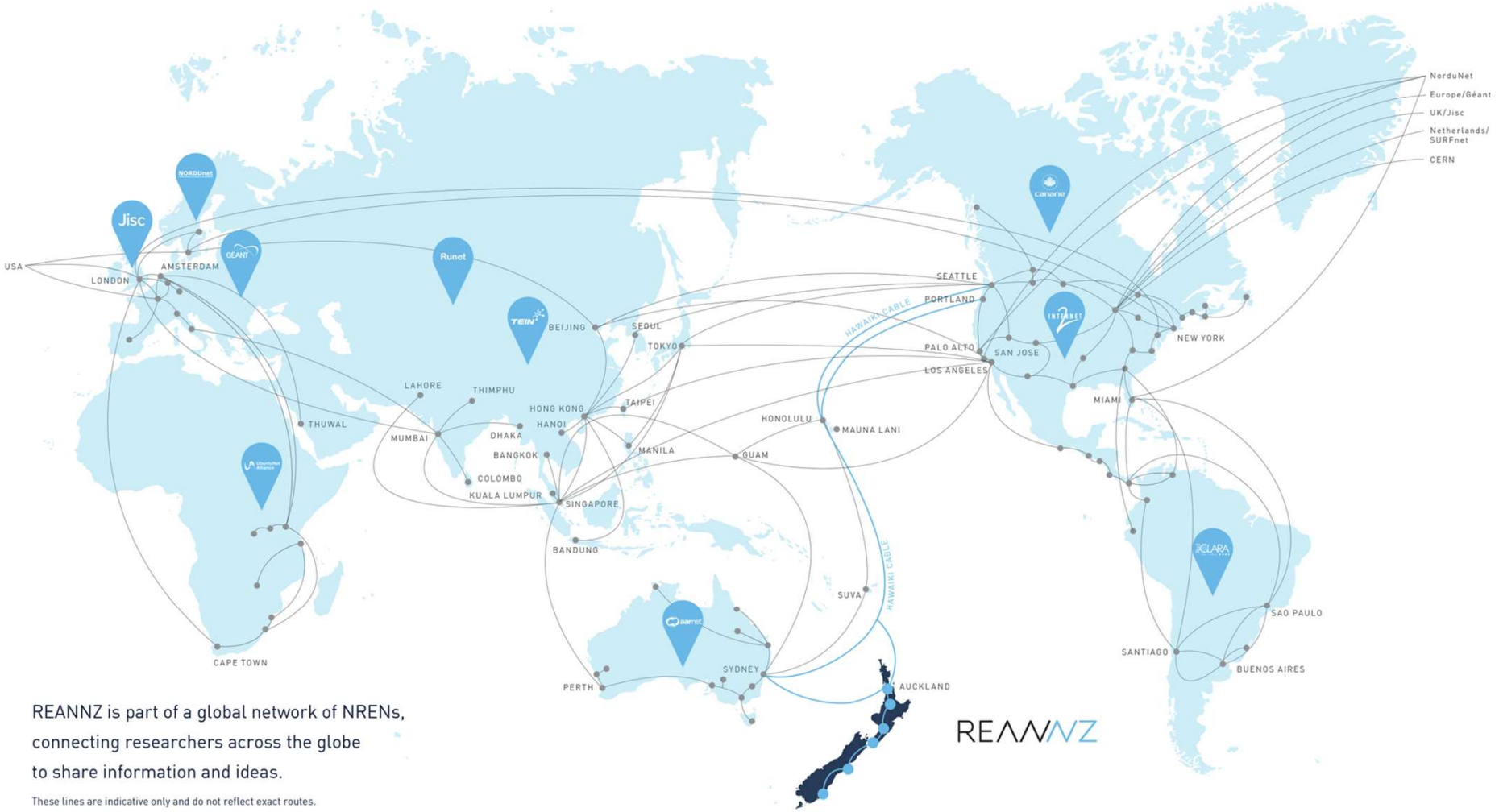
wallace.chase@reannz.co.nz

@bmtfr



REANNZ

GLOBAL RESEARCH AND EDUCATION COMMUNITY /



REANNZ is part of a global network of NRENs, connecting researchers across the globe to share information and ideas.

These lines are indicative only and do not reflect exact routes.

REANNZ

Participants

48 total

UNIVERSITIES

Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND
New Zealand's specialist land-based university

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

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

AUT UNIVERSITY

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

VICTORIA
UNIVERSITY OF WELLINGTON
TE WHARE WĀNANGA
O TE ŪPOKO O TE IKA A MĀUI

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

CROWN RESEARCH INSTITUTES

GNS SCIENCE
TE PŪ AO

LANDCARE RESEARCH
MANAAKI WHENUA

ESR

Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI

agresearch

NIWA
Taihoro Nukurangi

SCION
FORESTS ▪ PRODUCTS ▪ INNOVATION

INSTITUTES OF TECHNOLOGY, POLYTECHNICS AND WĀNANGA

Te Whare Wānanga o Awanuiārangi

Otago Polytechnic – Te Kura Matatini ki Otago

Whitireia New Zealand

Southern Institute of Technology – Te Whare Wānanga o Murihiku

Unitec Institute of Technology – Te Whare Wānanga o Wairaka

WelTec – Wellington Institute of Technology – Te Whare Wānanga o te Awakairangi

WITT – Western Institute of Technology at Taranaki – Te Kura Matatini o Taranaki

EIT – Eastern Institute of Technology

OTHER MEMBERS

Kristin – Kindergarten - Senior School – Building Greatness

Cawthron Institute

CallaghanInnovation

Diocesan School for Girls

Education Payroll Limited

Ministry of Education – Te Tāhuhu o te Mātauranga

Malaghan Institute of Medical Research

compac

AM – Tāmaki Paenga Hira – Auckland War Memorial Museum

NZCER – Rangahau Mātauranga o Aotearoa

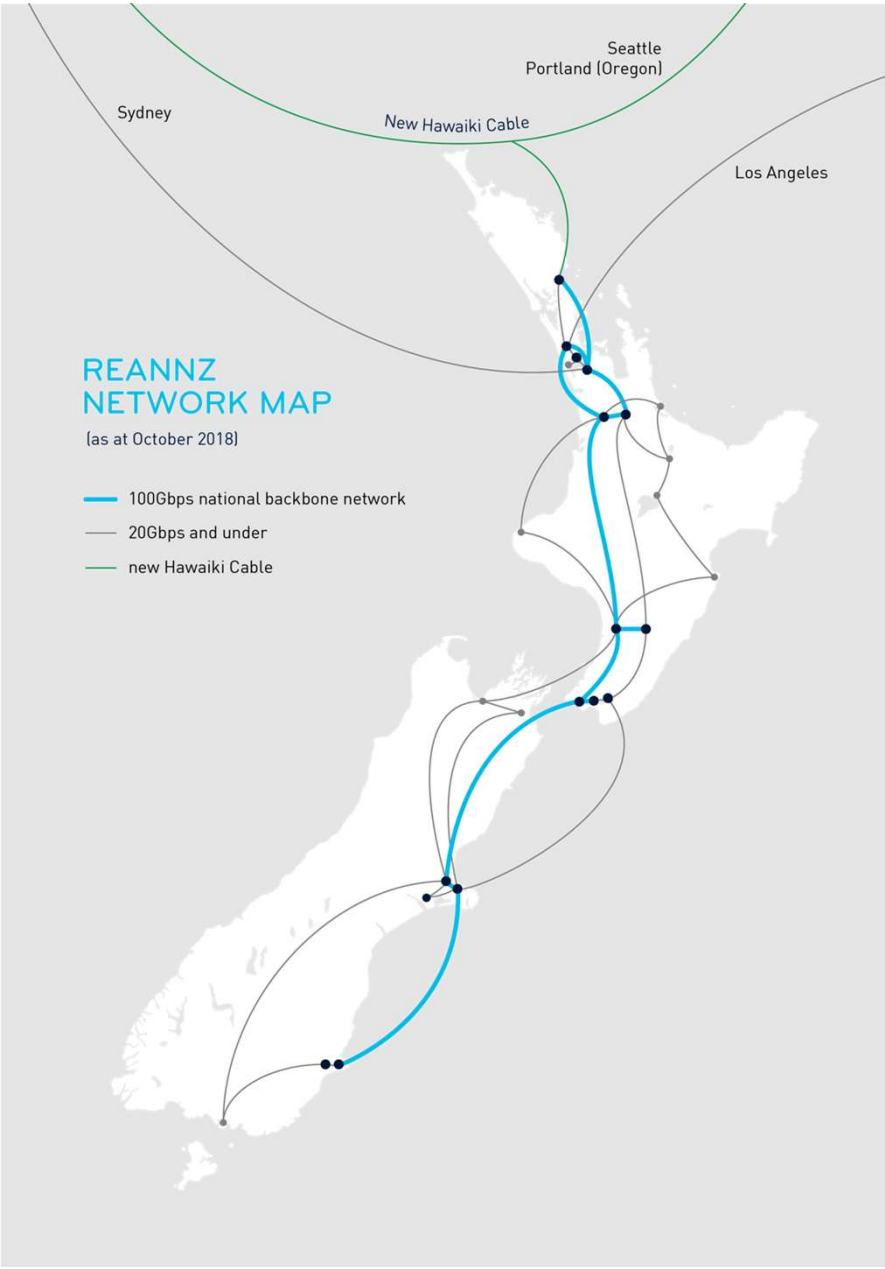
Pacific Edge Ltd – Cancer Diagnostics Company

New participants

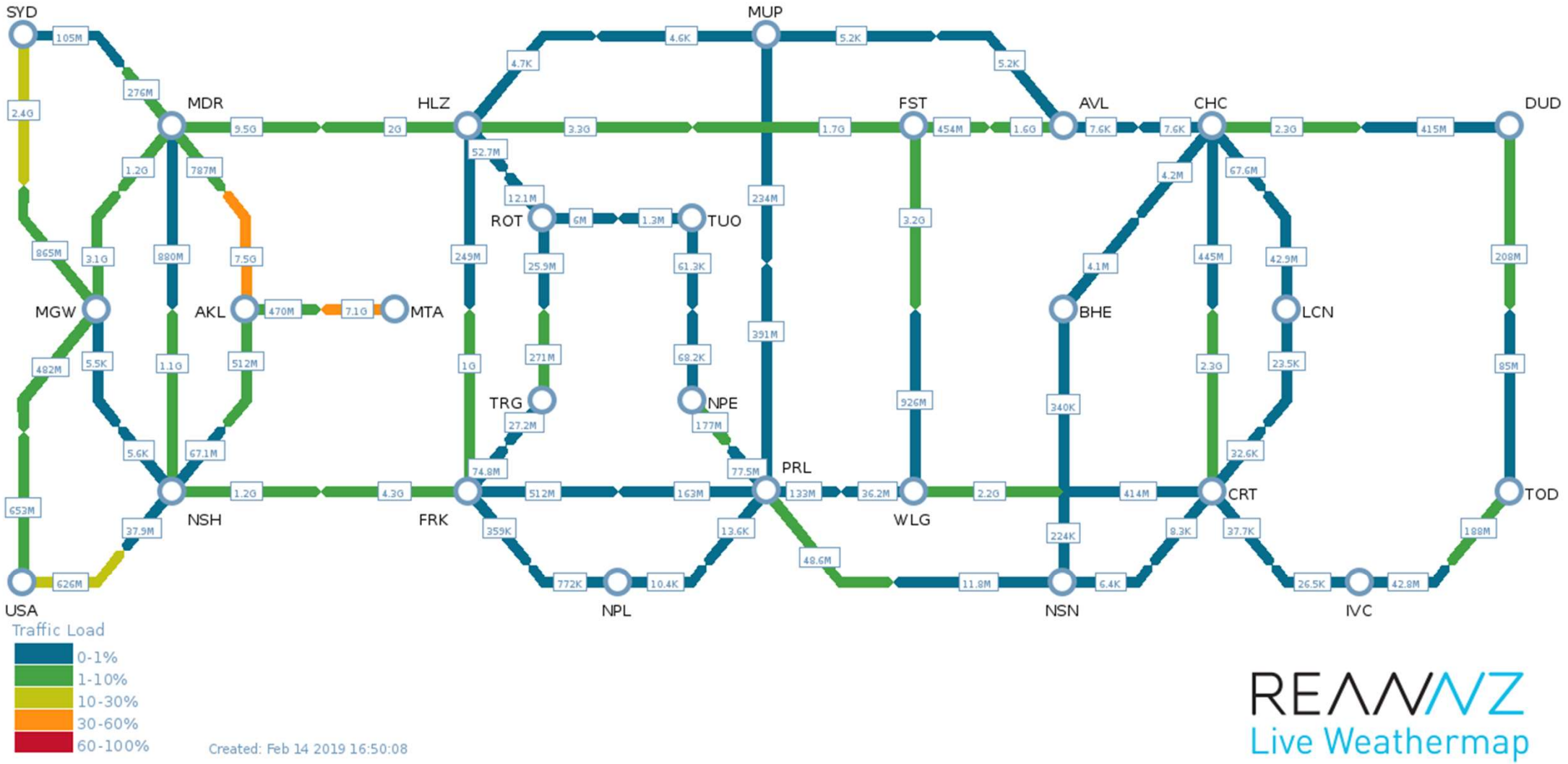
Domestic network

- Upgraded core links supporting 100G on backbone links
- Consolidated some underutilized PoP locations
- Caching upgrades
  - 2x Akamai
  - 1x Facebook
  - 1x Google
  - 1x Netflix
- Monitoring upgrades
- Over 350 connections to participating originations!

Achieved zero packet loss across our network, ie, <0.0000001% loss over 58 trillion packets.

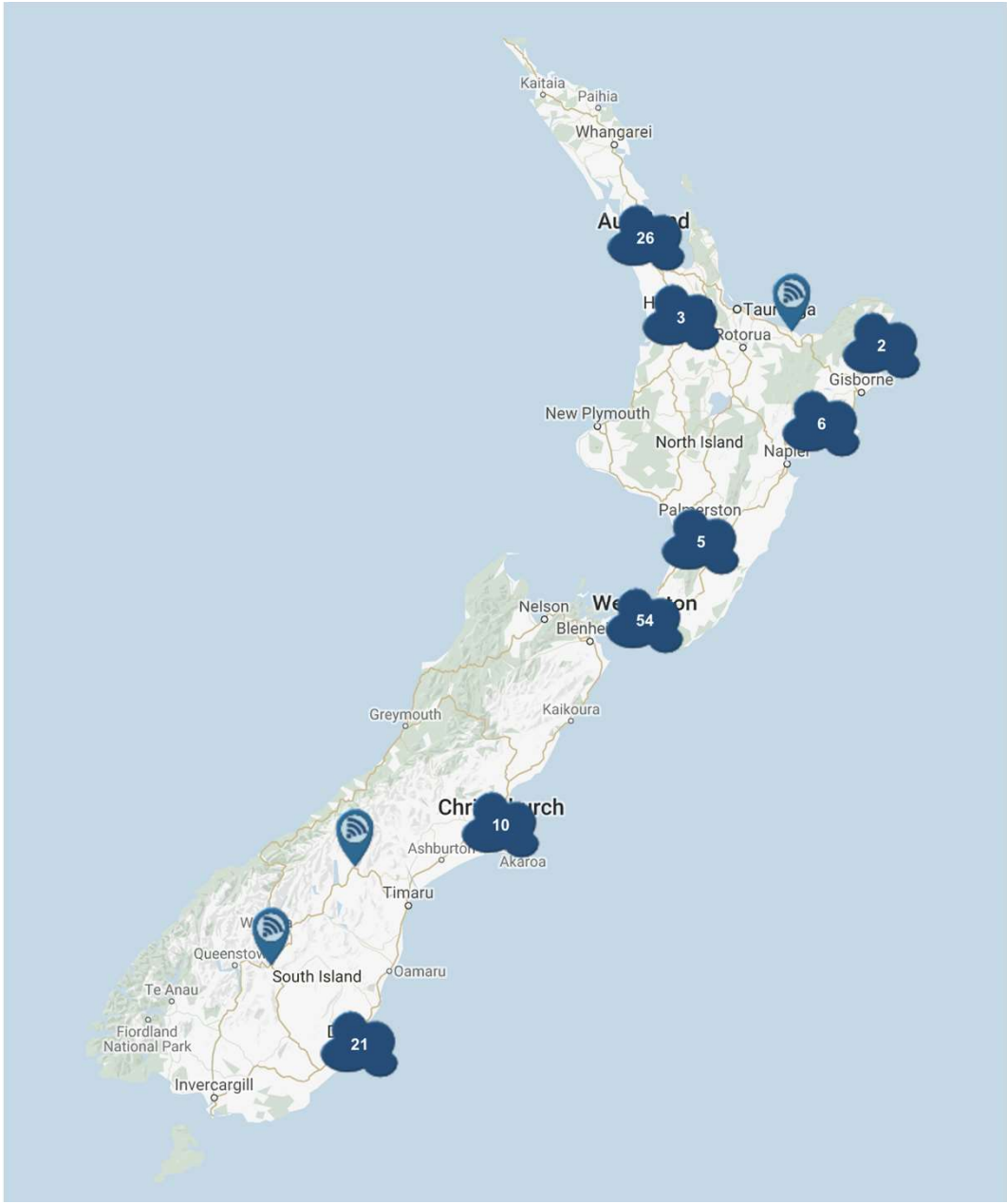


https://weathermap.reannz.co.nz



eduroam

- 100+ countries
- Tens of thousands of hotspots around the world
- More NZ locations are added each month
- Please reach out if you have suggestions



REANZ
TUAKIRI

Faucet

Open source SDN Controller for production networks

Faucet is a compact open source OpenFlow controller, which enables network operators to run their networks the same way they do server clusters. Faucet moves network control functions (like routing protocols, neighbor discovery, and switching algorithms) to vendor independent server-based software, versus traditional router or switch embedded firmware, where those functions are easy to manage, test, and extend with modern systems management best practices and tools. Faucet controls OpenFlow 1.3 hardware which delivers high forwarding performance.

REANNZ

https://faucet.nz/

@faucetsdn

SC18

Dallas, TX | hpc inspires.

UNIVERSITY of OTAGO

1st REANNZ participant to flow in excess 10G of traffic internationally

15G+ disk to disk sustained to Energy Sciences Network (ESNet) in the USA

1st university with a 100G connection in New Zealand!

New 10G capable DTN coming online now

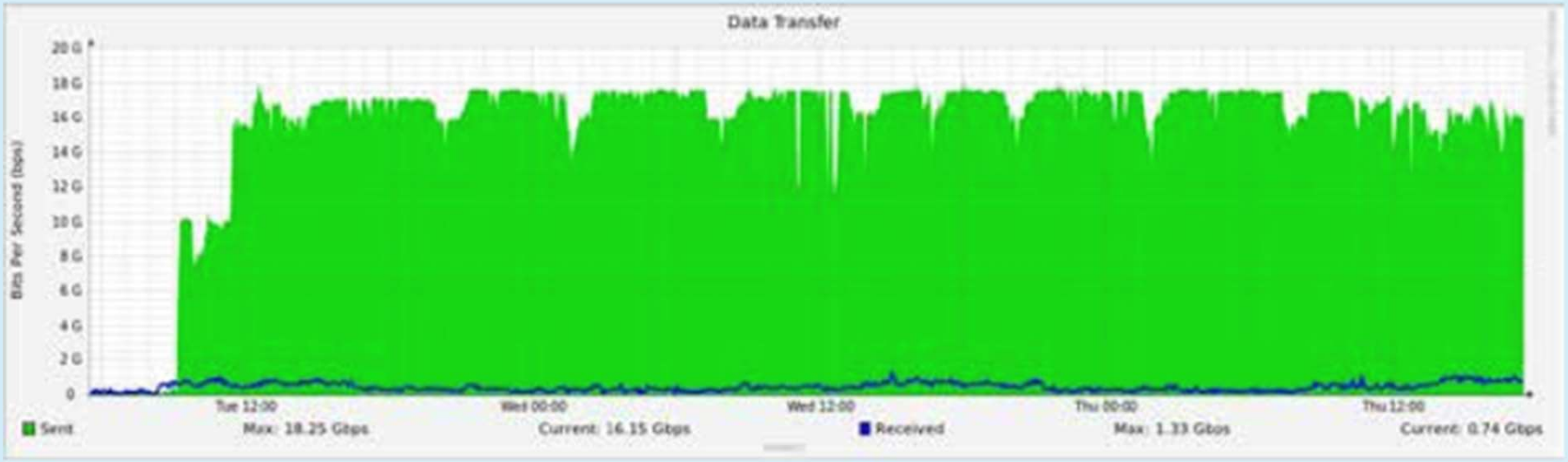
Direct 10G “Science DMZ” connection for nectarcloud directly to REANNZ

When the NeSI/NIWA supercomputers were replaced in early 2018, REANNZ engineers were on hand to make sure the research and education advanced network smoothly handled the transfer of an estimated 900 TB (terabytes) of user data.

NeSI New Zealand eScience Infrastructure

NIWA Taihoro Nukurangi

With peak transfer speeds topping 19 Gbps it was the largest one-off transfer of data undertaken on the REANNZ network

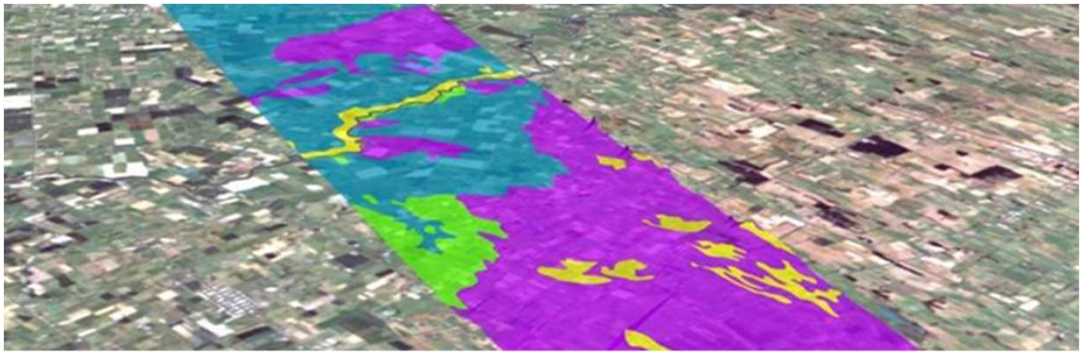


Manaaki Whenua
Landcare Research

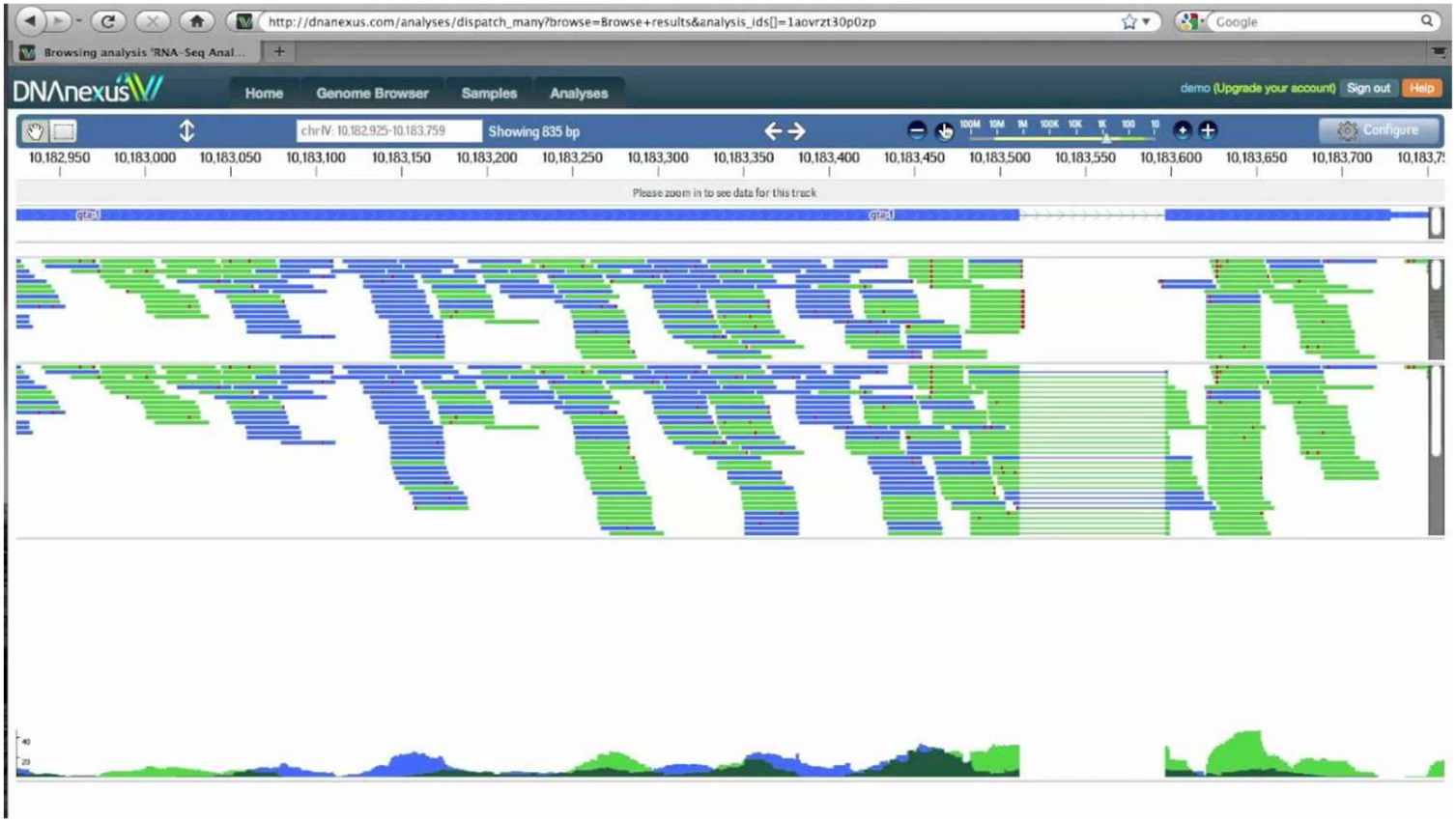
re3data.org
REGISTRY OF RESEARCH DATA REPOSITORIES

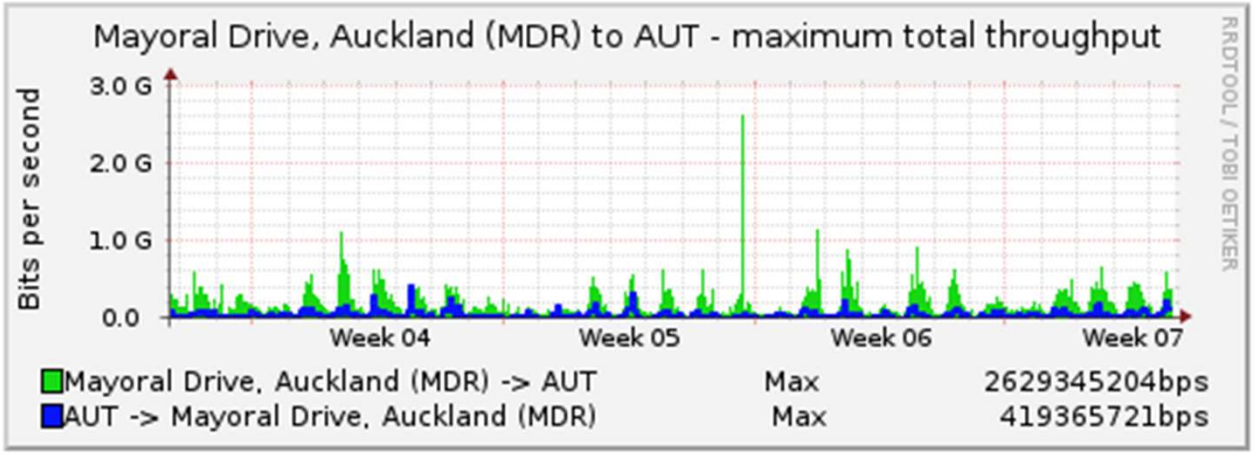
http://doi.org/10.17616/R3092N

Landcare Research Data Repository



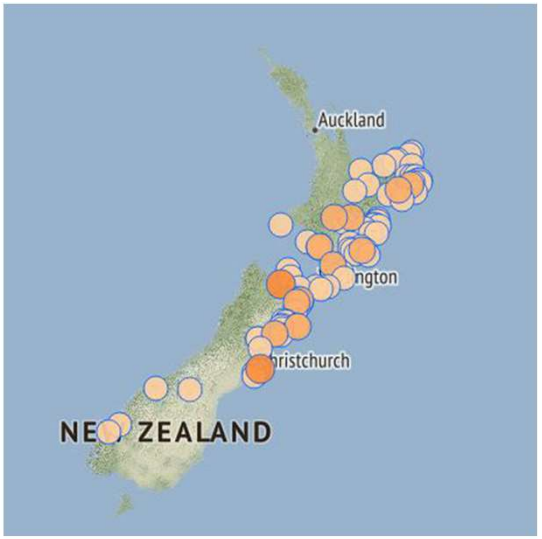
- **Bioinformatics**, dealing with the development and maintenance of databases to store biological information
- **Geoinformatics**, concentrating on spatial information of various types including images, maps, and surveyed points
- **Ecoinformatics**, concerned with information in ecology and environmental sciences

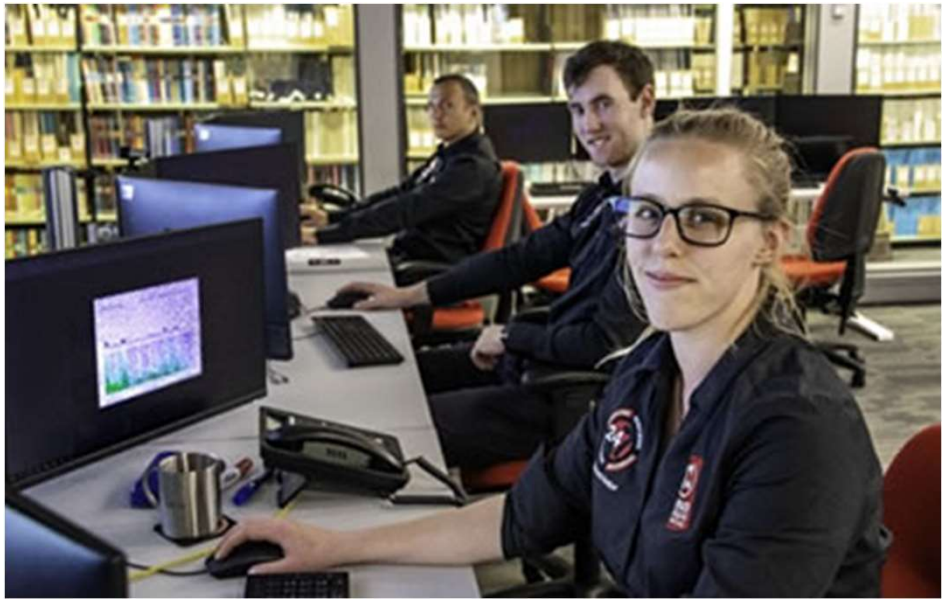

http://dnanexus.com/analyses/dispatch_many?browse=Browse+results&analysis_ids[]=1aovrzt30p0zp
Google
Browsing analysis 'RNA-Seq Anal...
DNAnexus
Home
Genome Browser
Samples
Analyses
demo (Upgrade your account)
Sign out
Help
chrIV: 10,182,925-10,183,759
Showing 835 bp
Configure
10,182,950
10,183,000
10,183,050
10,183,100
10,183,150
10,183,200
10,183,250
10,183,300
10,183,350
10,183,400
10,183,450
10,183,500
10,183,550
10,183,600
10,183,650
10,183,700
Please zoom in to see data for this track
gtaf
gtaf



AUT
UNIVERSITY
TE WĀNANGA ARONUI O TAMAKI MAKAU RAU

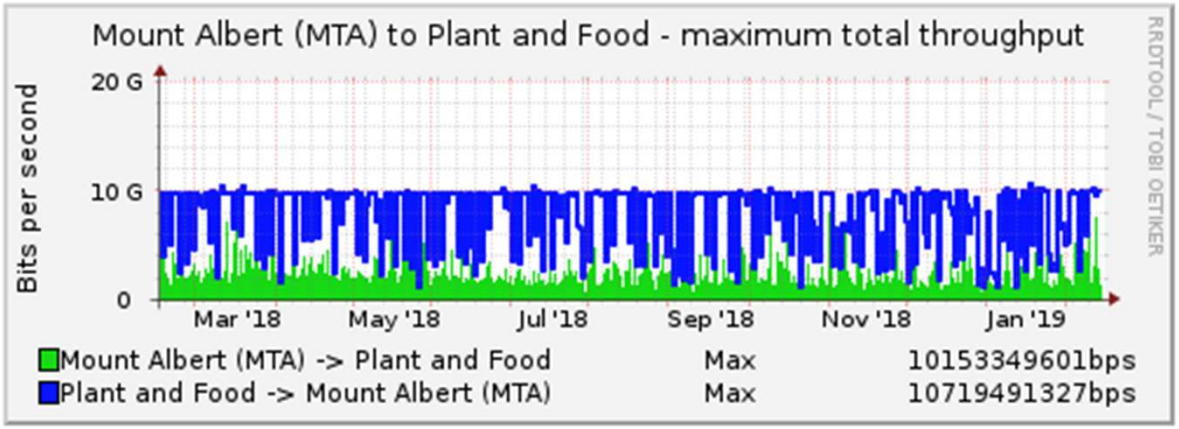
National Geohazards Monitoring Centre



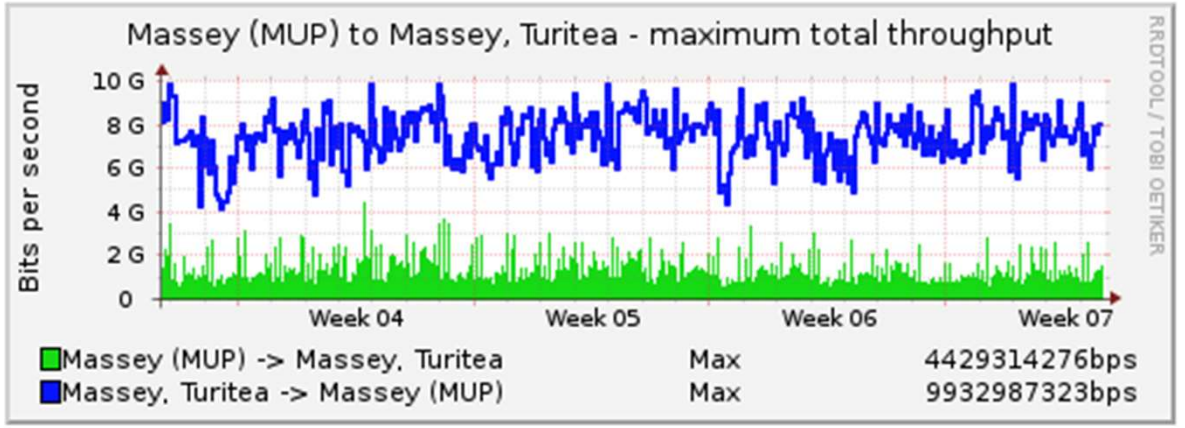


Plant & Food
RESEARCH

RANGAHAU AHUMARA KAI

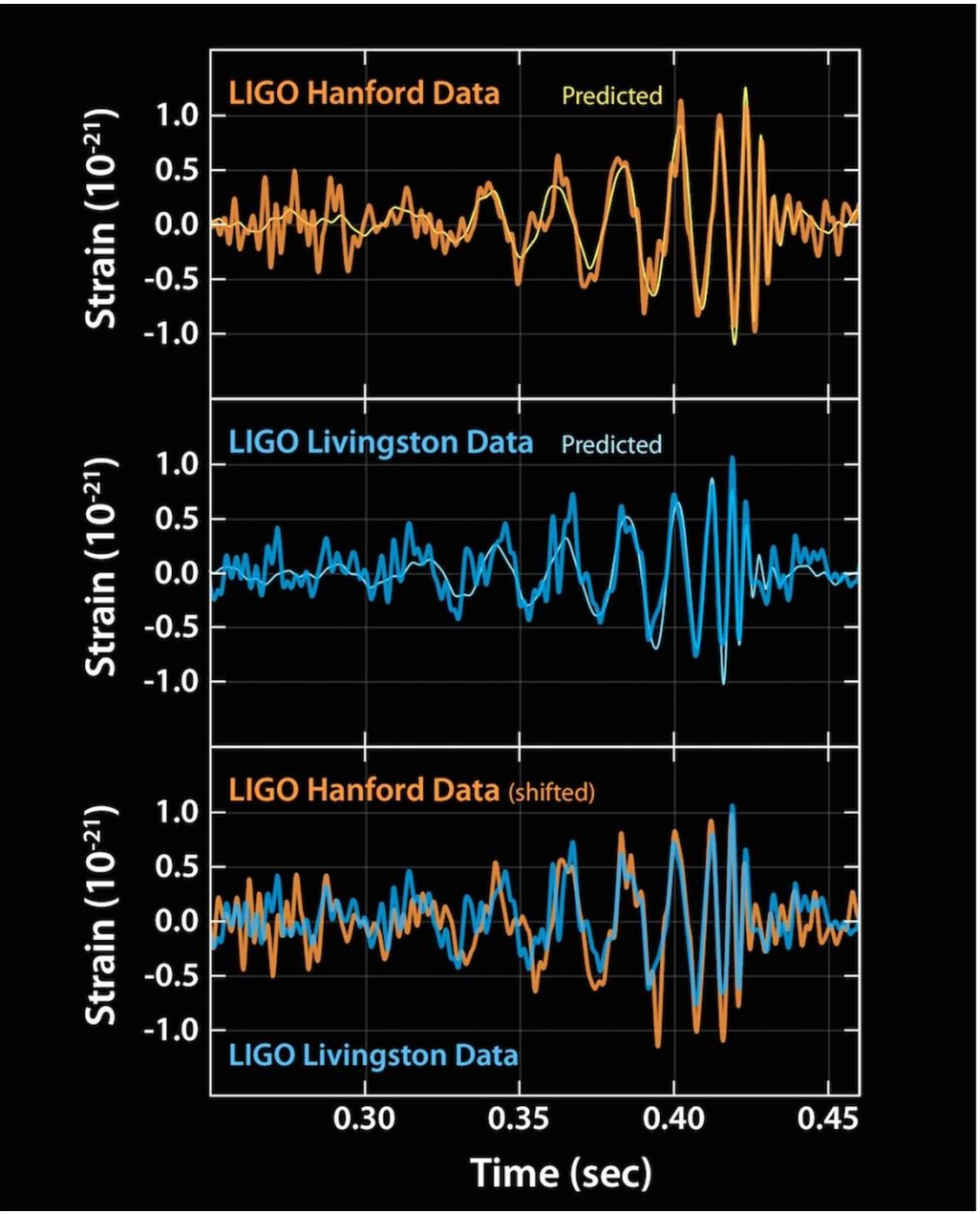


MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

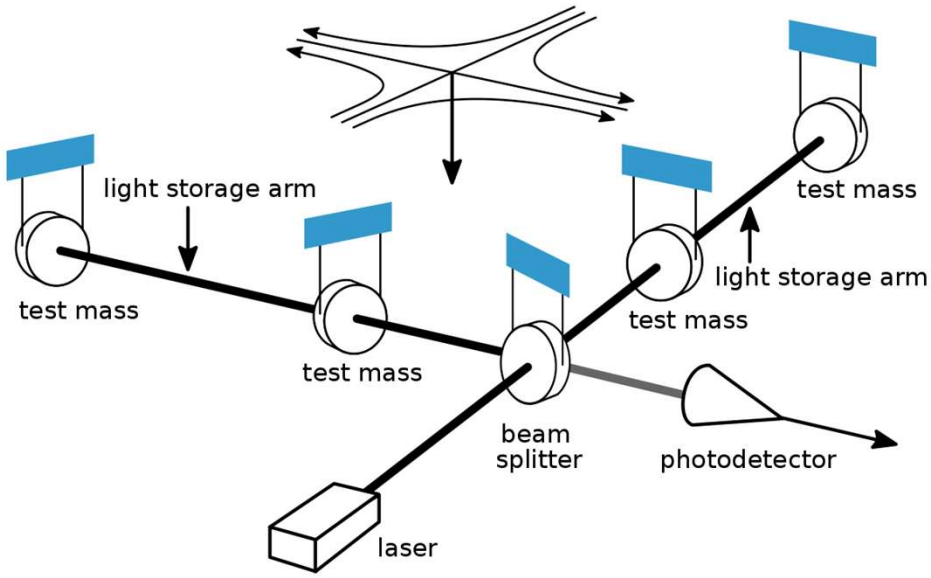


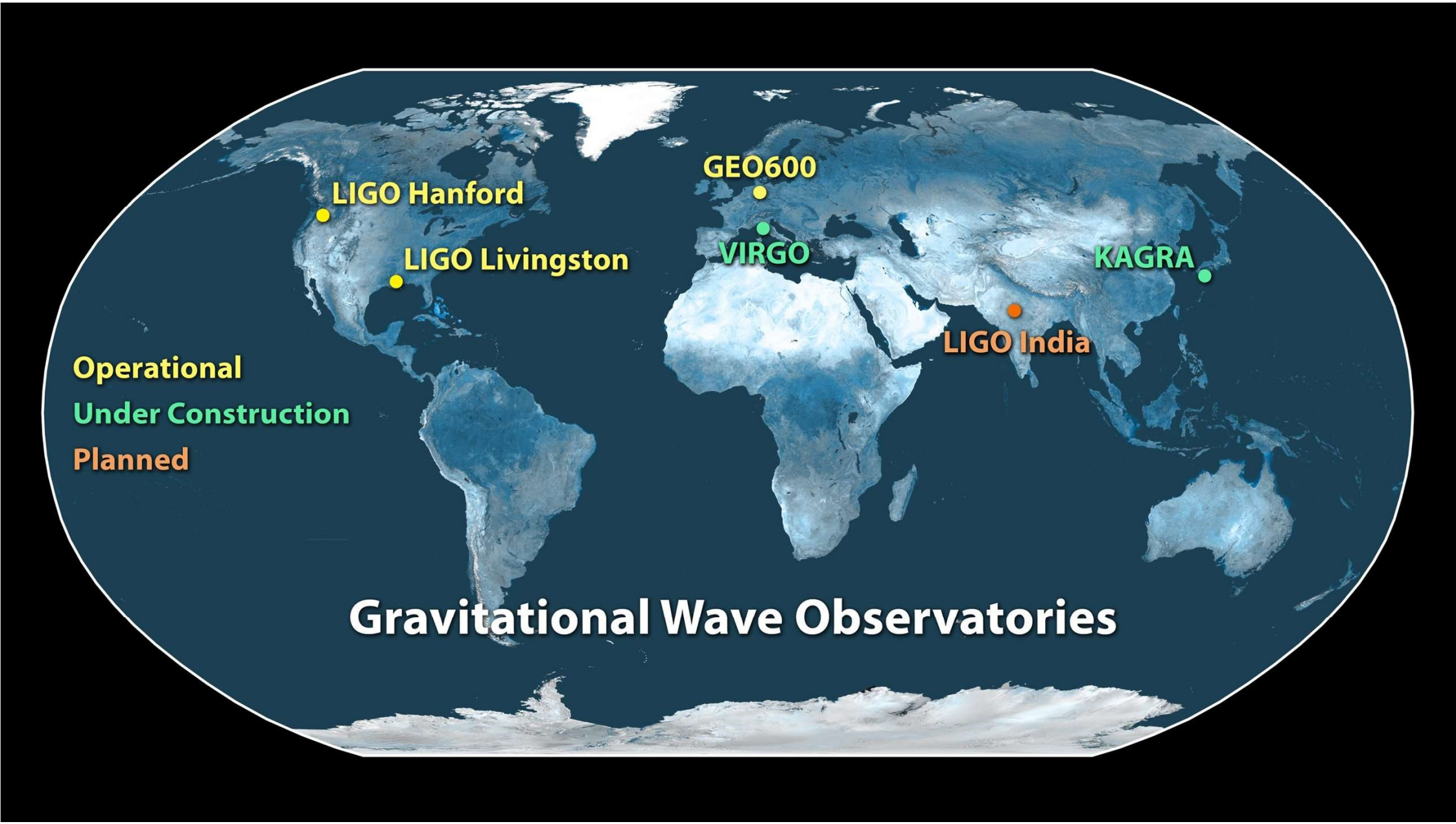
Bioinformatics
Comparative genomics
Conservation and ecological genetics
Developmental genetics
Genetic disease in animals
Molecular and evolutionary ecology
Plant evolutionary genetics, systematics and taxonomy

Collaborations


LIGO Hanford Data
Predicted
LIGO Livingston Data
Predicted
LIGO Hanford Data (shifted)
LIGO Livingston Data
Strain (10-21)
1.0
0.5
0.0
-0.5
-1.0
0.30
0.35
0.40
0.45
Time (sec)

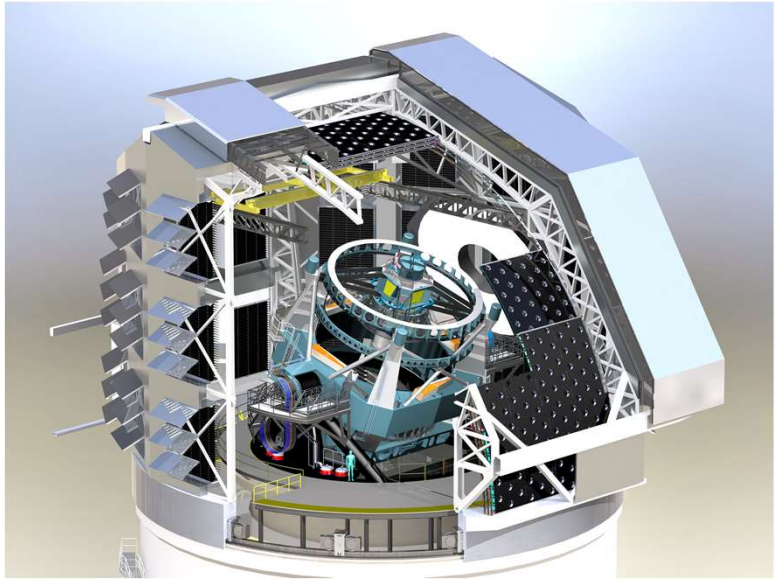
LIGO

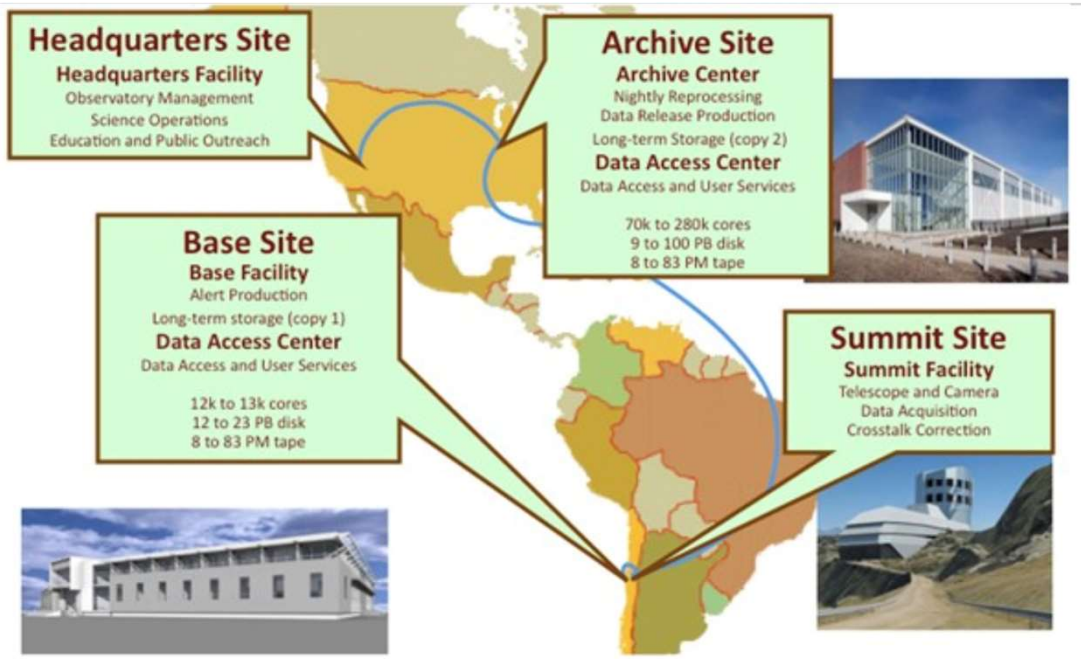

light storage arm
test mass
test mass
test mass
light storage arm
test mass
beam
splitter
photodetector
laser


LIGO Hanford
LIGO Livingston
GEO600
VIRGO
KAGRA
LIGO India
Operational
Under Construction
Planned
Gravitational Wave Observatories

LSST

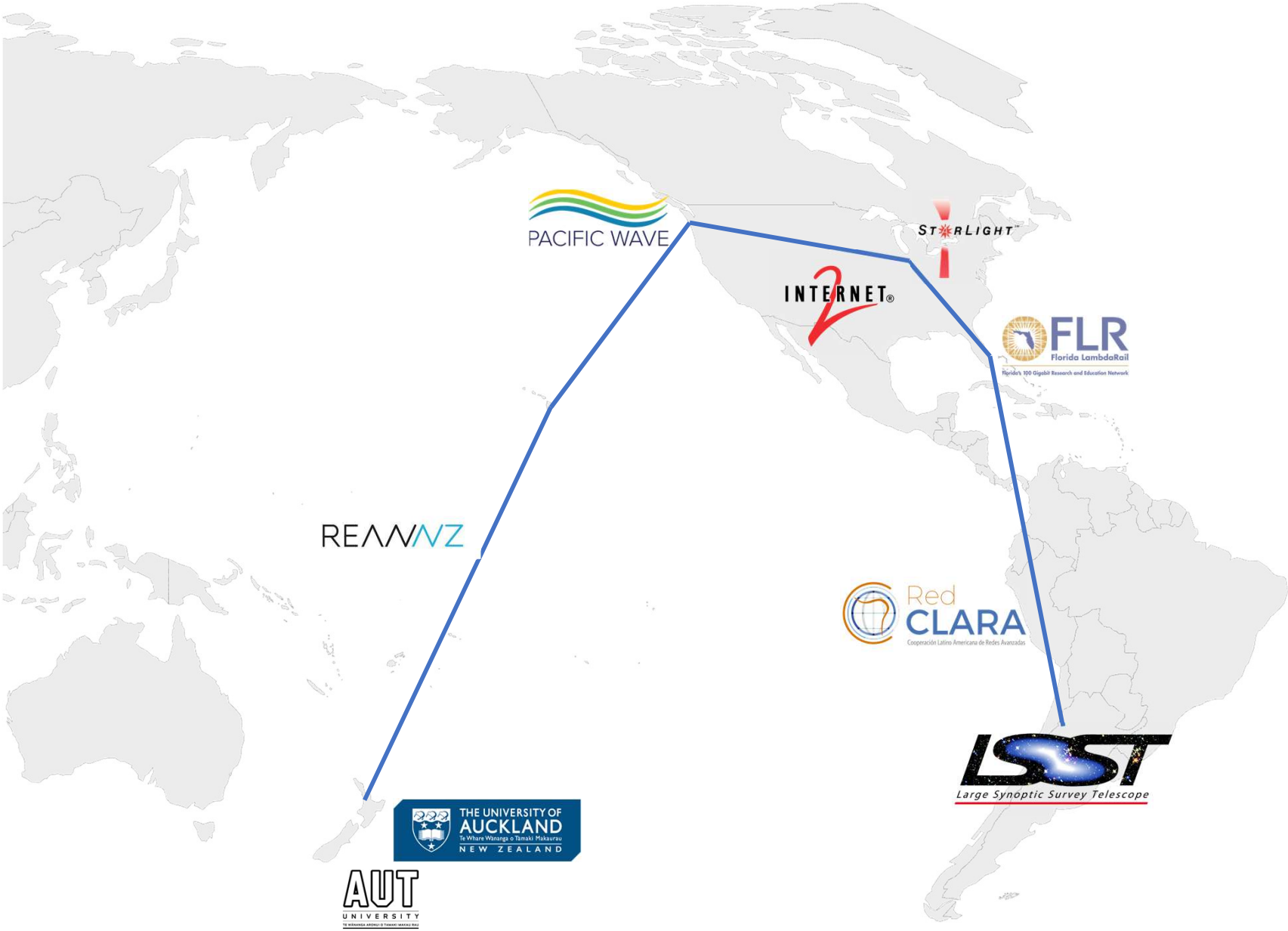
Large Synoptic Survey Telescope

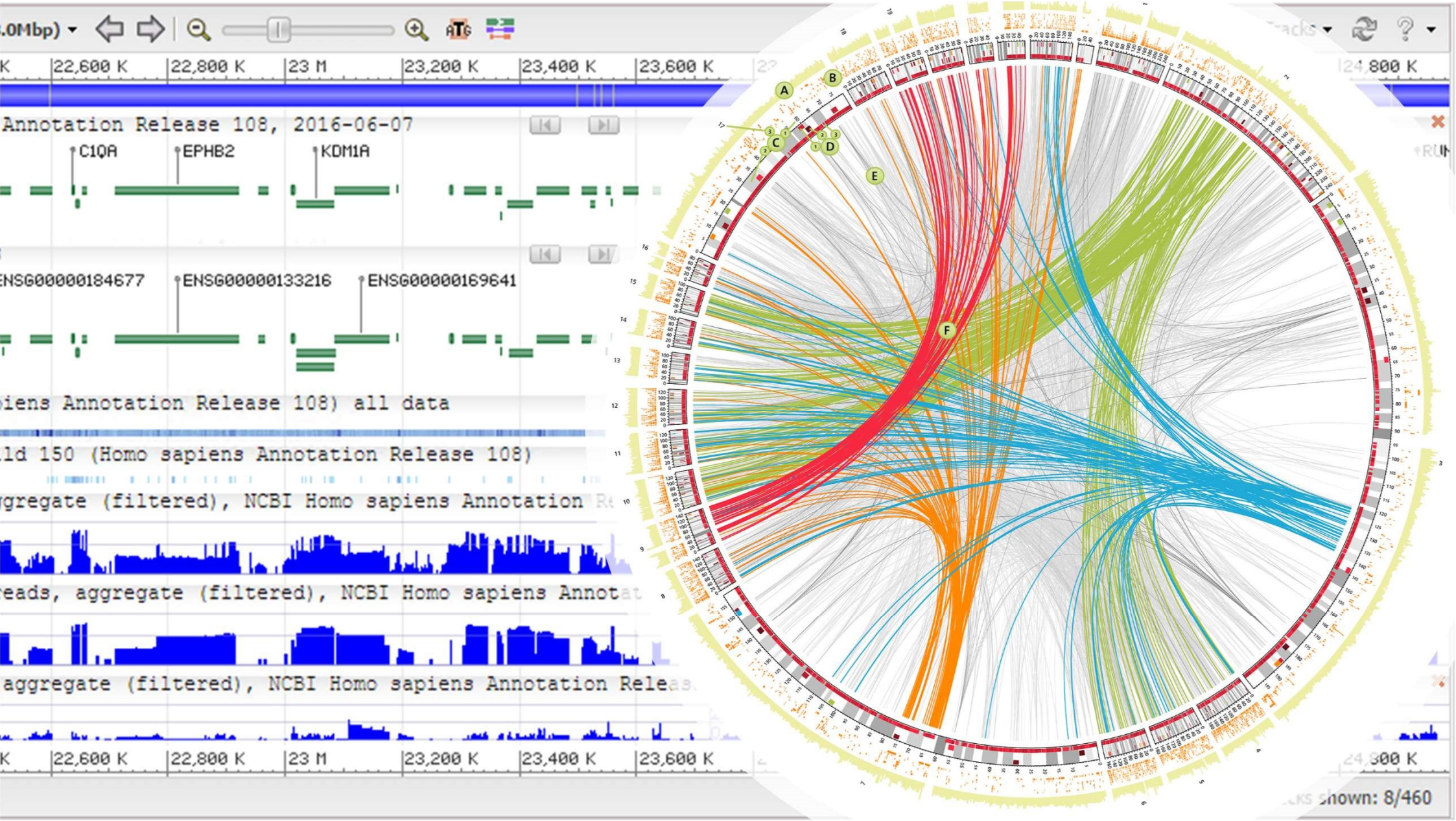


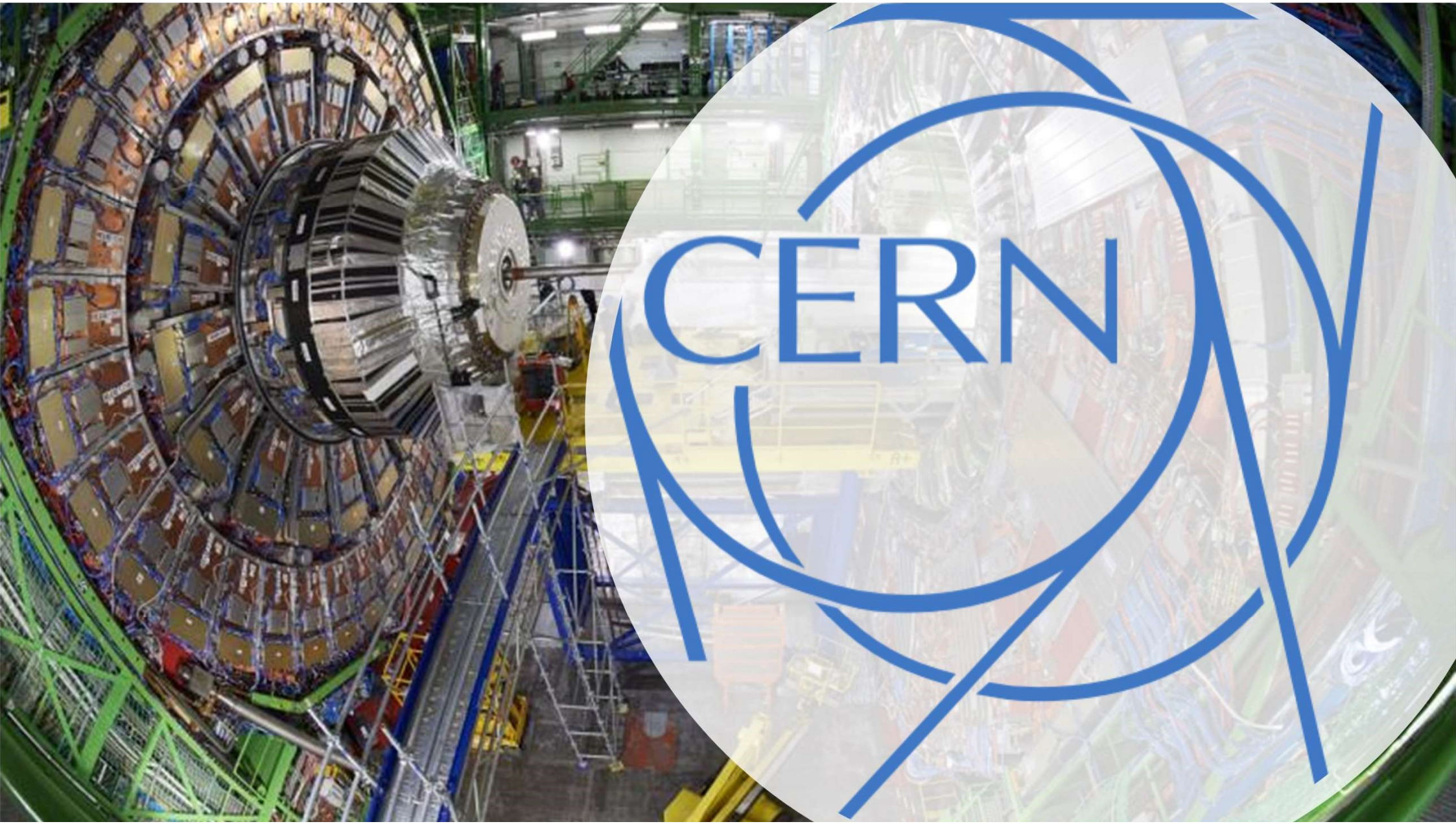


LSST Data Management system must deal with an unprecedented data volume.

- one 6-gigabyte image every 17 seconds
- 15 terabytes of raw scientific image data / night
- 100-petabyte final image data archive
- 20-petabyte final database catalog
- 2 million real time events per night every night for 10 years


PACIFIC WAVE
STARLIGHT
INTERNET2
FLR
Florida LambdaRail
Florida's 100 Gigabit Research and Education Network
REANNZ
Red CLARA
Cooperación Latino Americana de Redes Avanzadas
LSST
Large Synoptic Survey Telescope
THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND
AUT
UNIVERSITY


.0Mbp)
22,600 K
22,800 K
23 M
23,200 K
23,400 K
23,600 K
24,800 K
Annotation Release 108, 2016-06-07
C1QA
EPHB2
KDM1A
ENSG00000184677
ENSG00000133216
ENSG00000169641
iens Annotation Release 108) all data
ld 150 (Homo sapiens Annotation Release 108)
ggregate (filtered), NCBI Homo sapiens Annotation
eads, aggregate (filtered), NCBI Homo sapiens Annot
aggregate (filtered), NCBI Homo sapiens Annotation Relea
A
B
C
D
E
F
shown: 8/460


CERN

THE LARGE HADRON COLLIDER BY THE NUMBERS

27KM (16 MILES)
IN CIRCUMFERENCE

1 PETABYTE-PER-SECOND
IN RAW DATA GENERATED BY LHC EXPERIMENTS

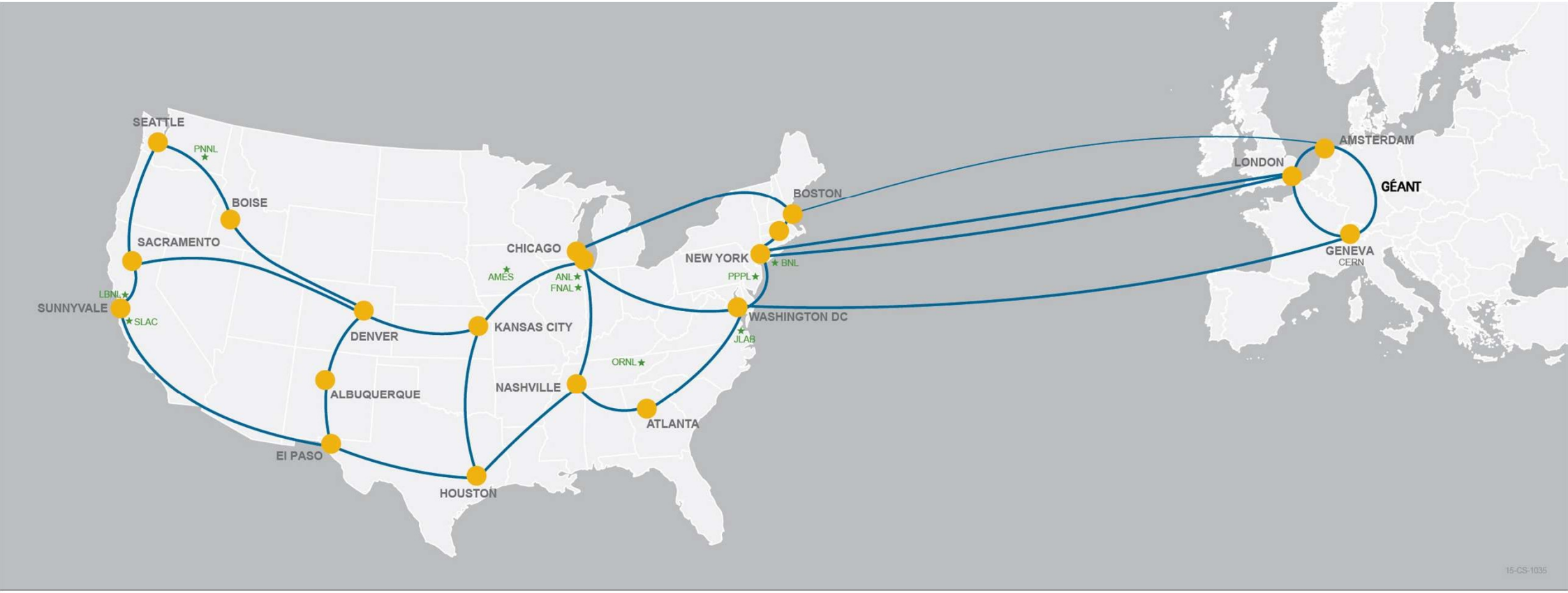
1 BILLION COLLISIONS
OCCUR PER SECOND

100K
TIMES HOTTER THAN THE SUN'S CORE,
HEAT GENERATED BY COLLISIONS

99.99999999%
SPEED OF LIGHT
ACHIEVED BY PARTICLES

1.9 KELVIN (-271.3 DEGREES CELSIUS)
INTERNAL OPERATING TEMPERATURE

120,000
CORES RUNNING
CERN'S OPENSTACK CLOUD ACROSS TWO DATA CENTERS



ESnet
ENERGY SCIENCES NETWORK

★ Department of Energy Office of Science National Labs

Ames	Ames Laboratory (Ames, IA)
ANL	Argonne National Laboratory (Argonne, IL)
BNL	Brookhaven National Laboratory (Upton, NY)
FNAL	Fermi National Accelerator Laboratory (Batavia, IL)
JLAB	Thomas Jefferson National Accelerator Facility (Newport News, VA)
LBNL	Lawrence Berkeley National Laboratory (Berkeley, CA)
ORNL	Oak Ridge National Laboratory (Oak Ridge, TN)
PNNL	Pacific Northwest National Laboratory (Richland, WA)
PPPL	Princeton Plasma Physics Laboratory (Princeton, NJ)
SLAC	SLAC National Accelerator Laboratory (Menlo Park, CA)

The SKA array has the potential of 2 Terabytes per second

Or over 62 exabytes per year

Assuming that the average size photo is 500K, then 2TB is approximately equivalent to 4 million photos.

Per second.

SKA

SQUARE KILOMETRE ARRAY

SKA1-LOW

~ 2 Pb/s

LOW-FREQUENCY APERTURE ARRAY

~ 7 Tb/s

CENTRAL SIGNAL PROCESSOR

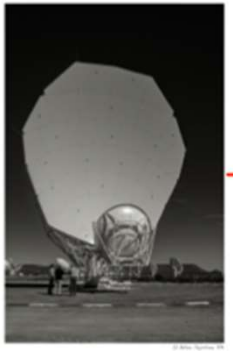
300 PB/yr

~ 130 PFlops

SCIENCE DATA PROCESSOR

SKA

Regional Centres



~ 9 Tb/s

CENTRAL SIGNAL PROCESSOR

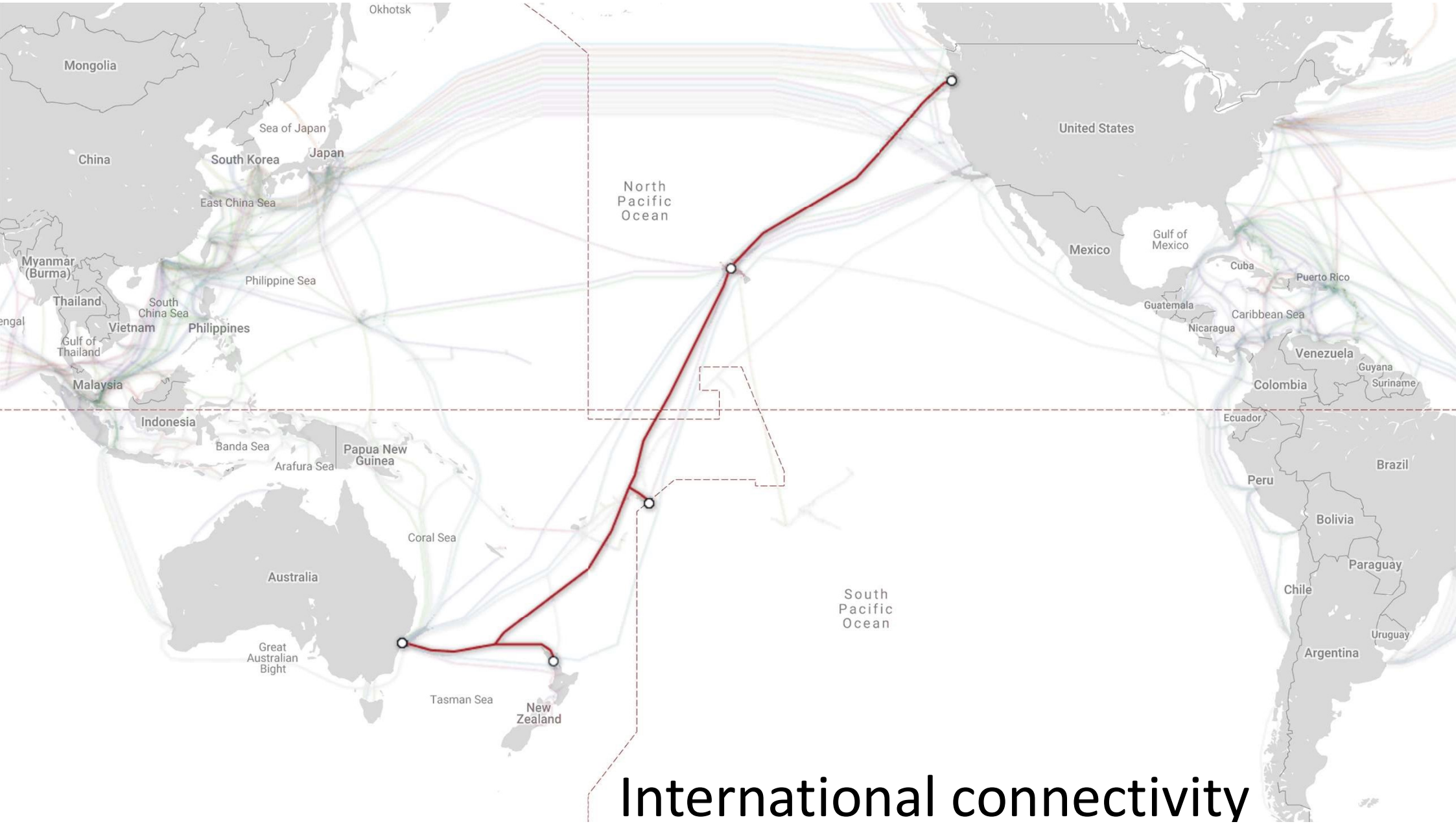
~ 5 Tb/s

SCIENCE DATA PROCESSOR

~ 130 PFlops

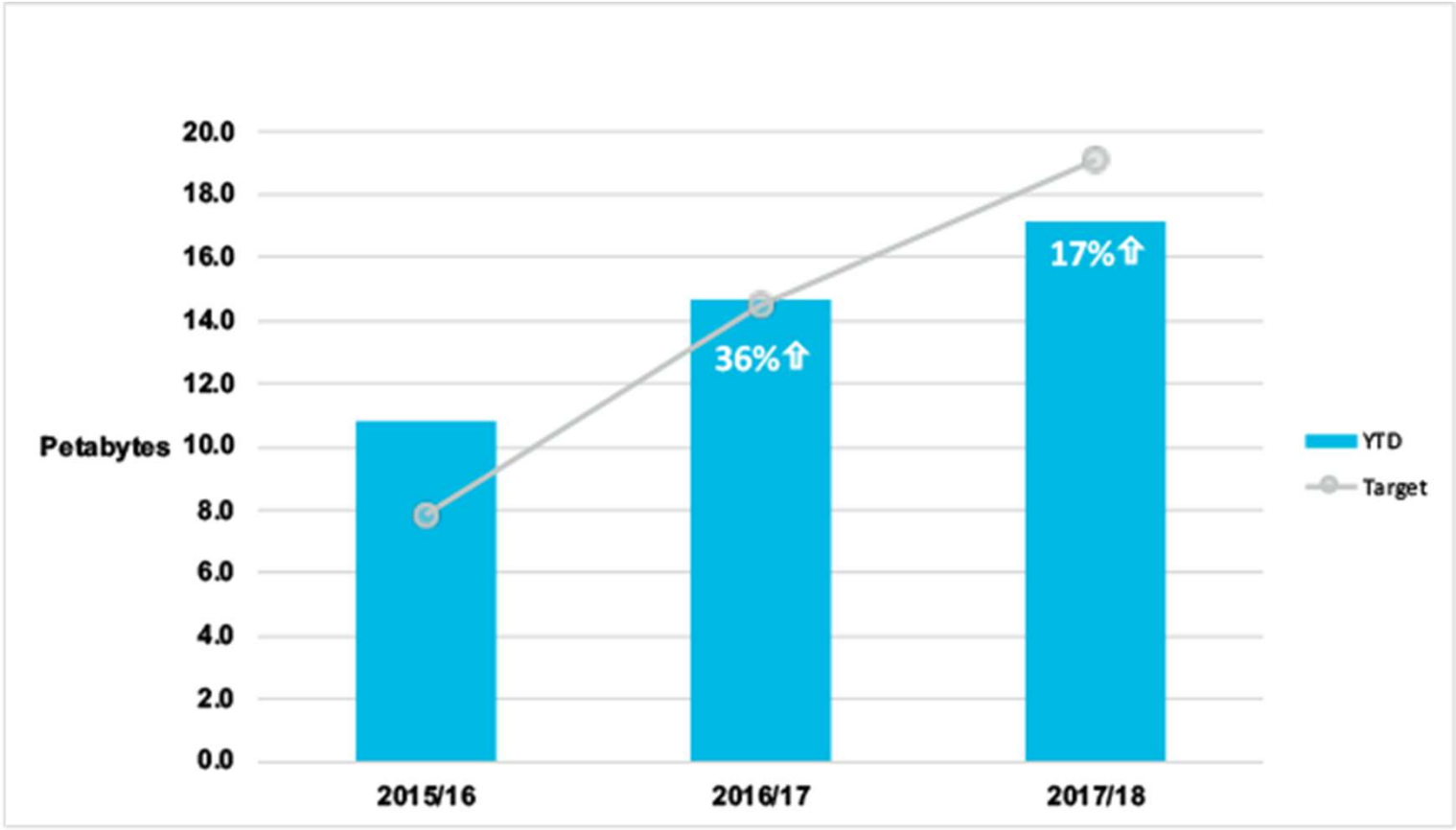
300 PB/yr

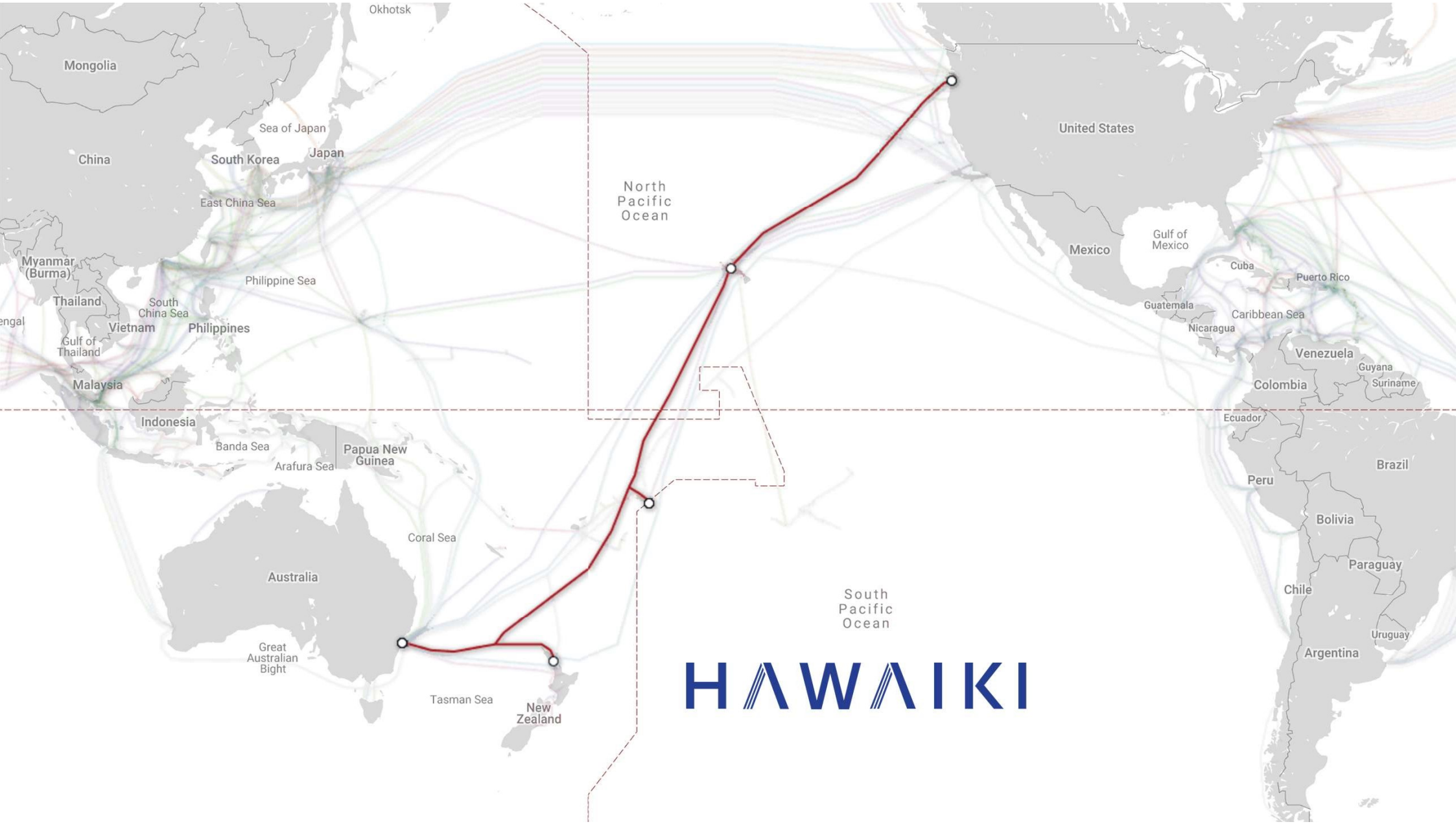
SKA1-MID



International connectivity

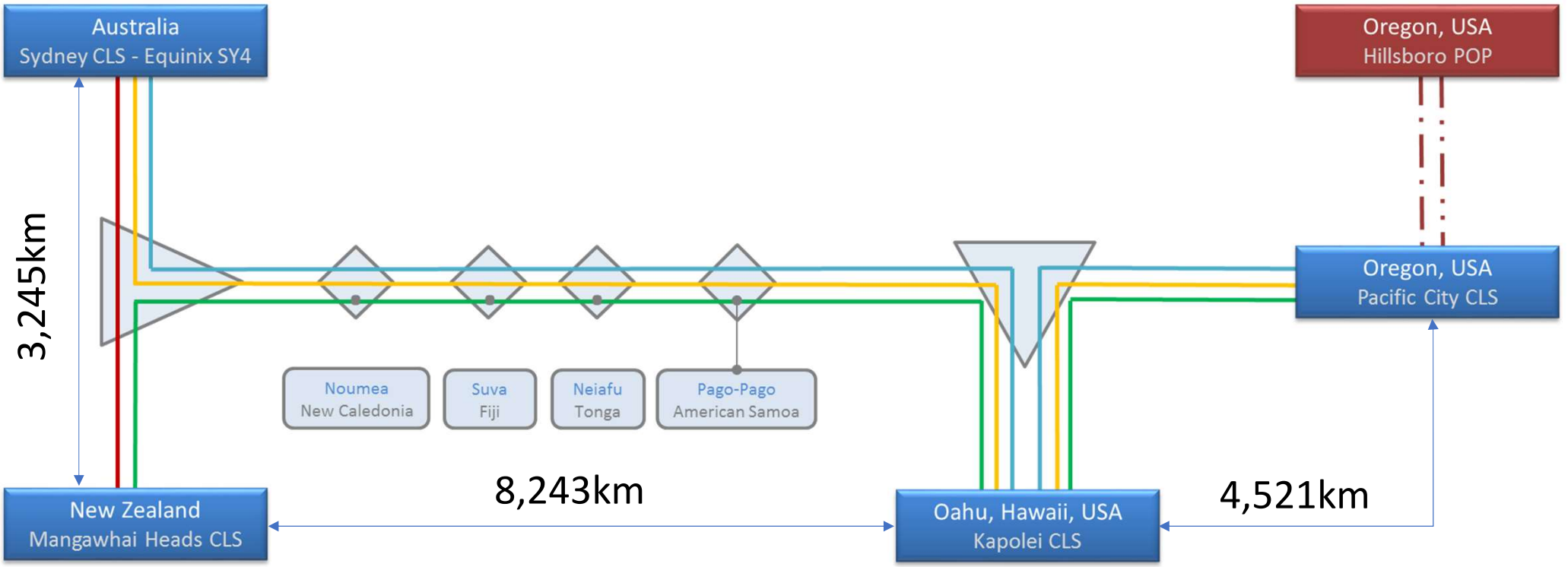
This year REANNZ saw a 61% year-on-year increase in international research data traffic.




Okhotsk
Mongolia
Sea of Japan
China
South Korea
Japan
East China Sea
North
Pacific
Ocean
United States
Gulf of
Mexico
Mexico
Cuba
Puerto Rico
Myanmar
(Burma)
Philippine Sea
Thailand
South
China Sea
Guatemala
Caribbean Sea
Nicaragua
Vietnam
Philippines
Gulf of
Thailand
Venezuela
Guyana
Malaysia
Colombia
Suriname
Indonesia
Ecuador
Banda Sea
Papua New
Guinea
Arafura Sea
Brazil
Peru
Coral Sea
Bolivia
Australia
Paraguay
Chile
South
Pacific
Ocean
Uruguay
Great
Australian
Bight
Argentina
Tasman Sea
New
Zealand
HAWAIKI

HAWAIKI

NETWORK DESIGN



YOUR NEW INTERNATIONAL NETWORK

- New PoP's
  - Flexential Brookwood - Hillsboro, Oregon, US
  - PNWGP – Seattle, Washington, US
  - Equinix SY4 – Sydney, Australia
  - Hawaiki Cable Landing Station – Mangawhai Heads, NZ
- Pacific Wave peering in Seattle, AARNet peering in Sydney
- Direct peering with providers and with other NRENs
- Continued partnership with AARNet
- New options to extend to Guam in partnership with University of Hawaii

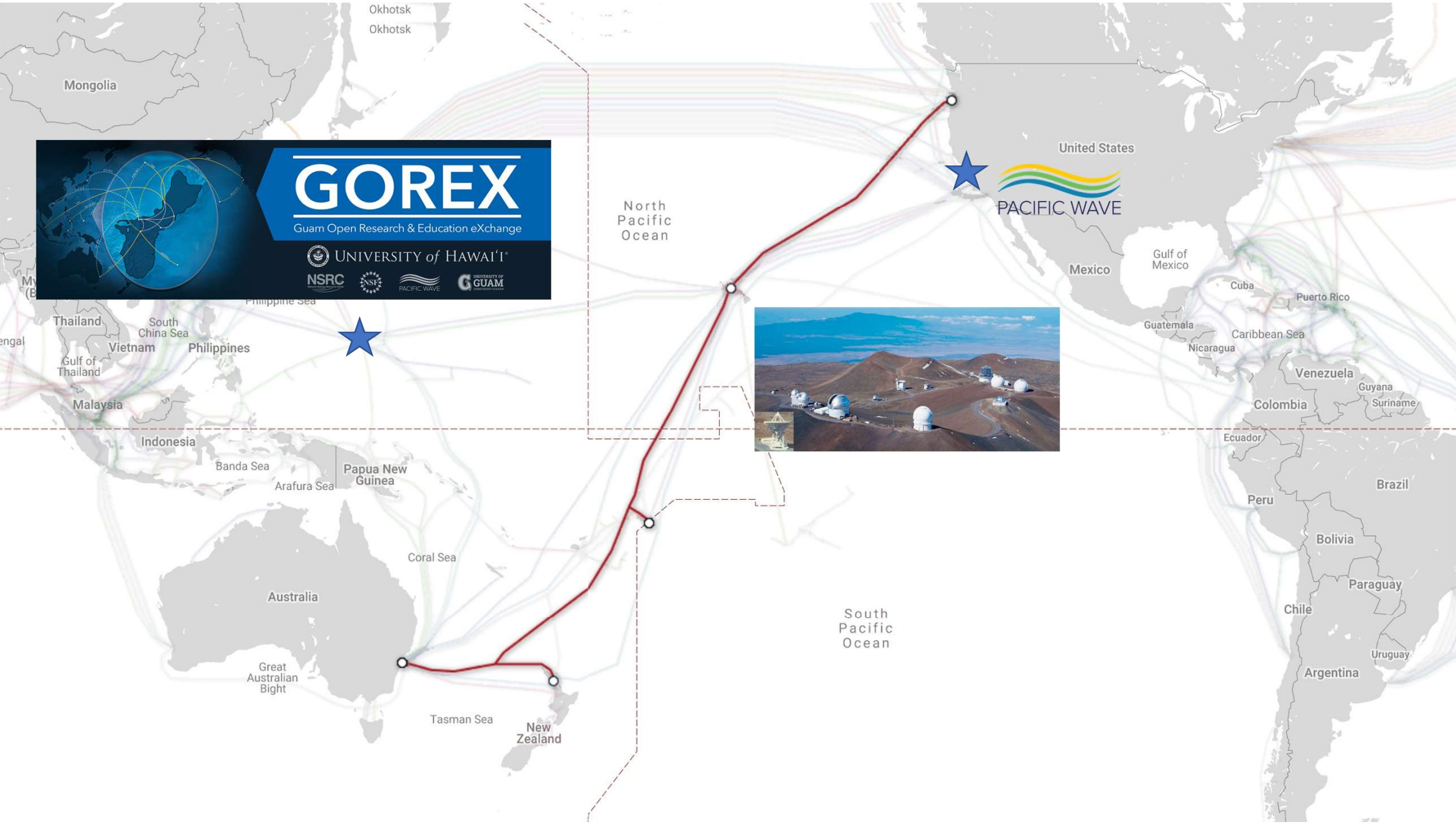
HAWAIKI

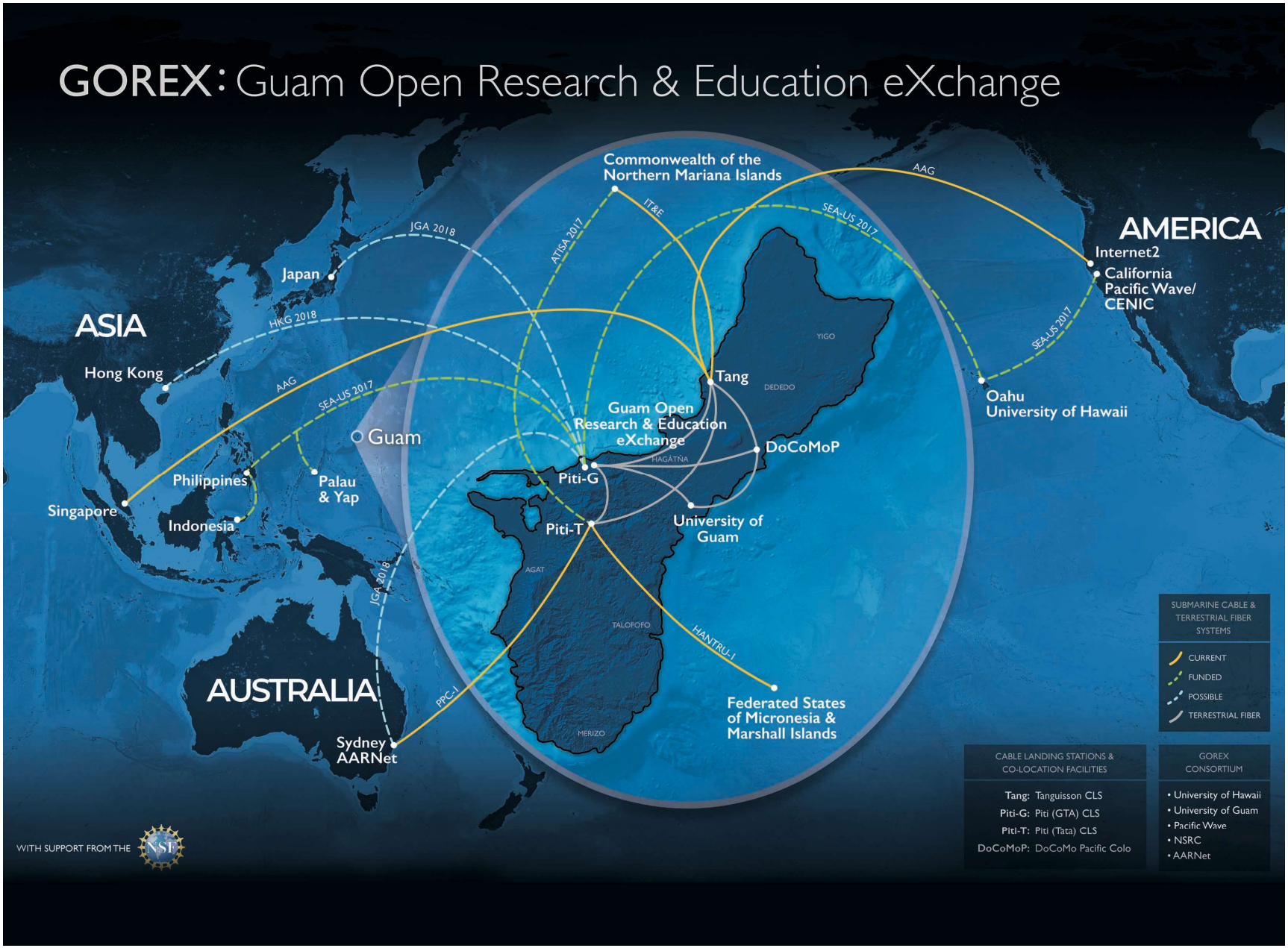
SPECIFICATIONS

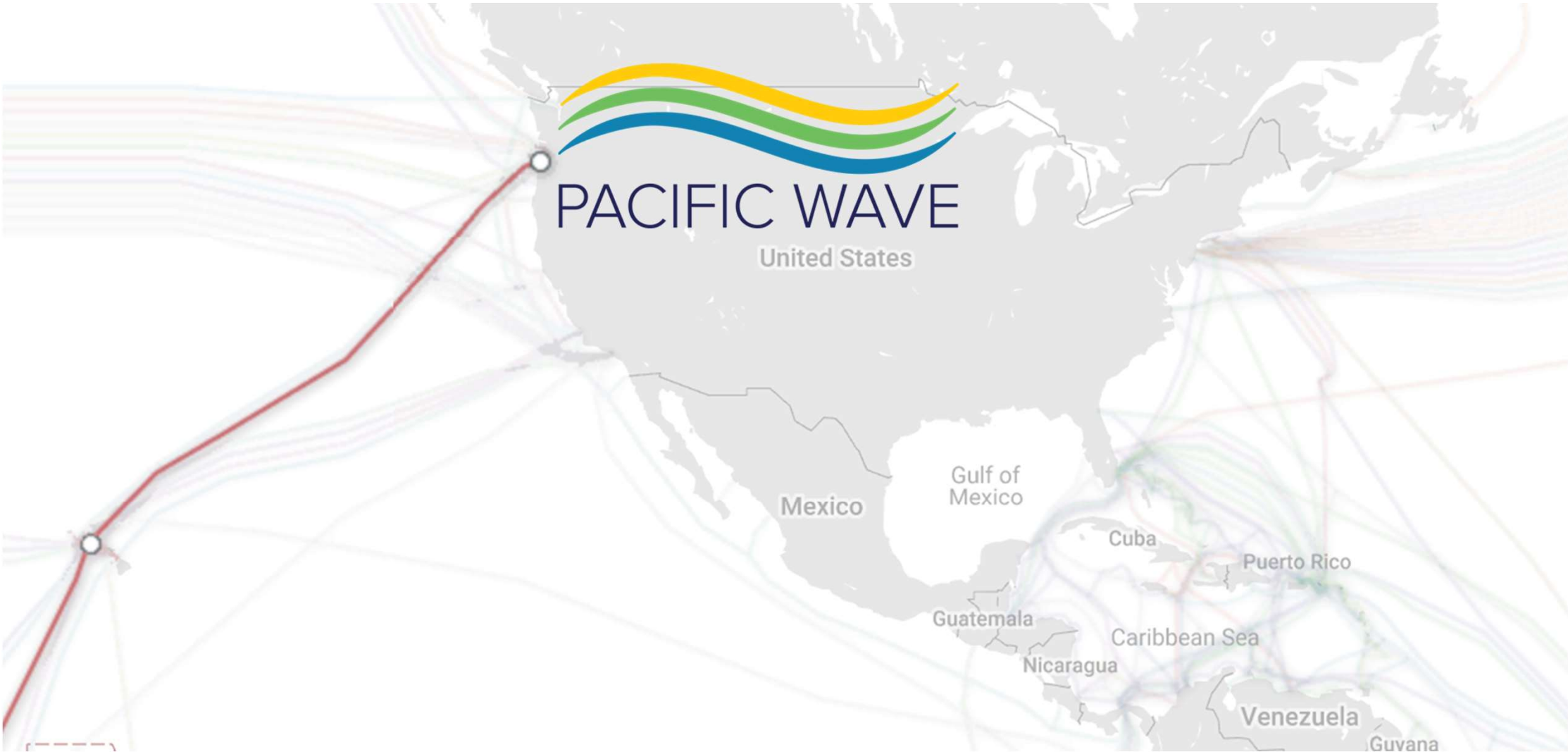
- Design capacity of 43.8 Tbps:
  - Over 100 individual 100Gbps wavelengths carried over each fibre pair
- 33ms latency from New Zealand to Sydney
  - 3,245km
- 127ms latency from New Zealand to Oregon
  - 12,764km
  - via Hawaii (82ms, 8,243km)
- Total of more than 14,600km of cable
- 25 year Service Contract between REANNZ & Hawaiki
  - 20Gbps in both directions through to 2Tbps

PIREN Pacific Islands Research and Education Network

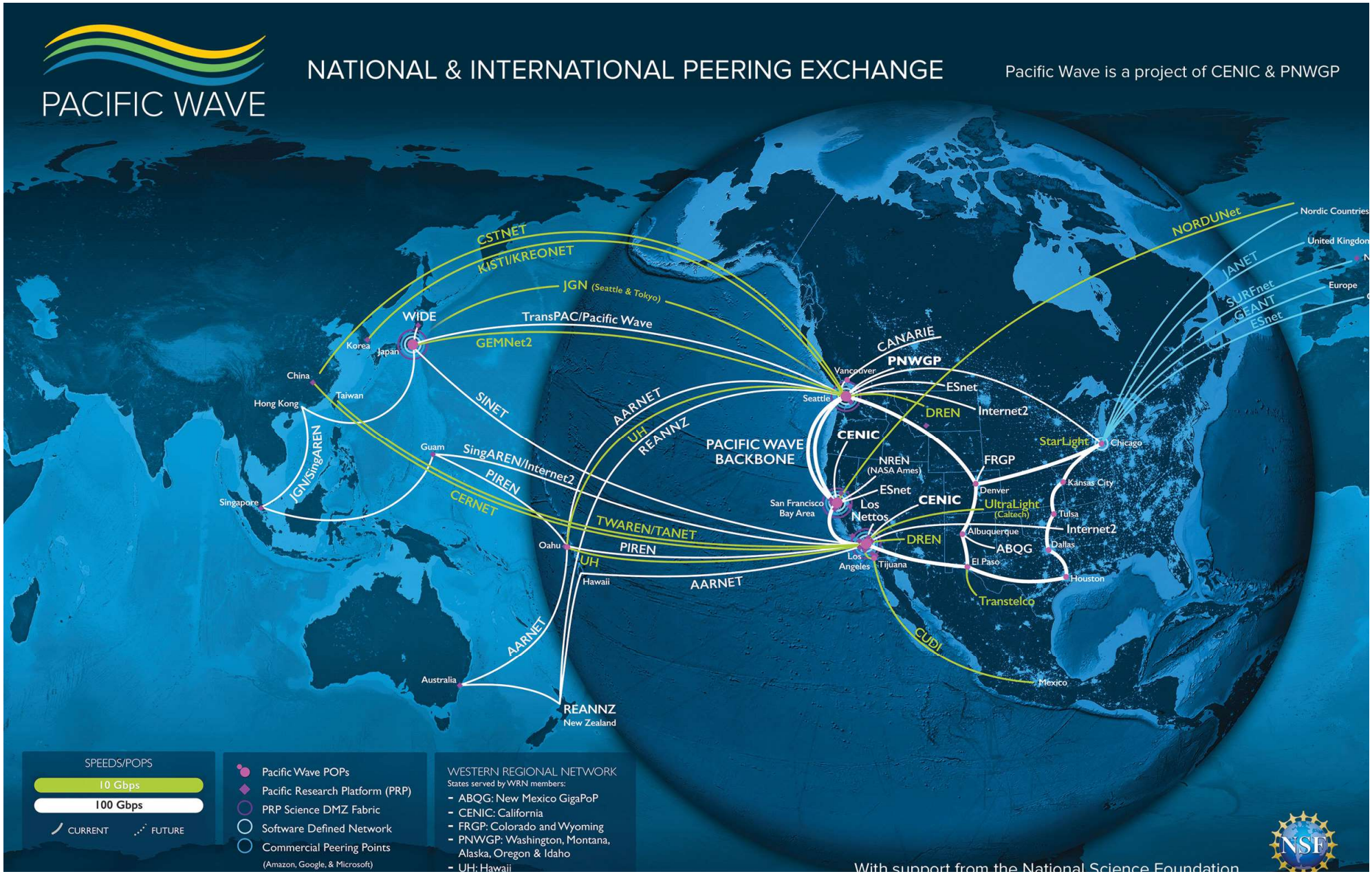
The memorandum outlines assistance UH will provide in connecting REANNZ to Asian research and education networks via Hawai‘i and Guam. It also articulates a shared interest in bringing research and education networks to the Pacific islands, which have been historically unserved and unconnected.

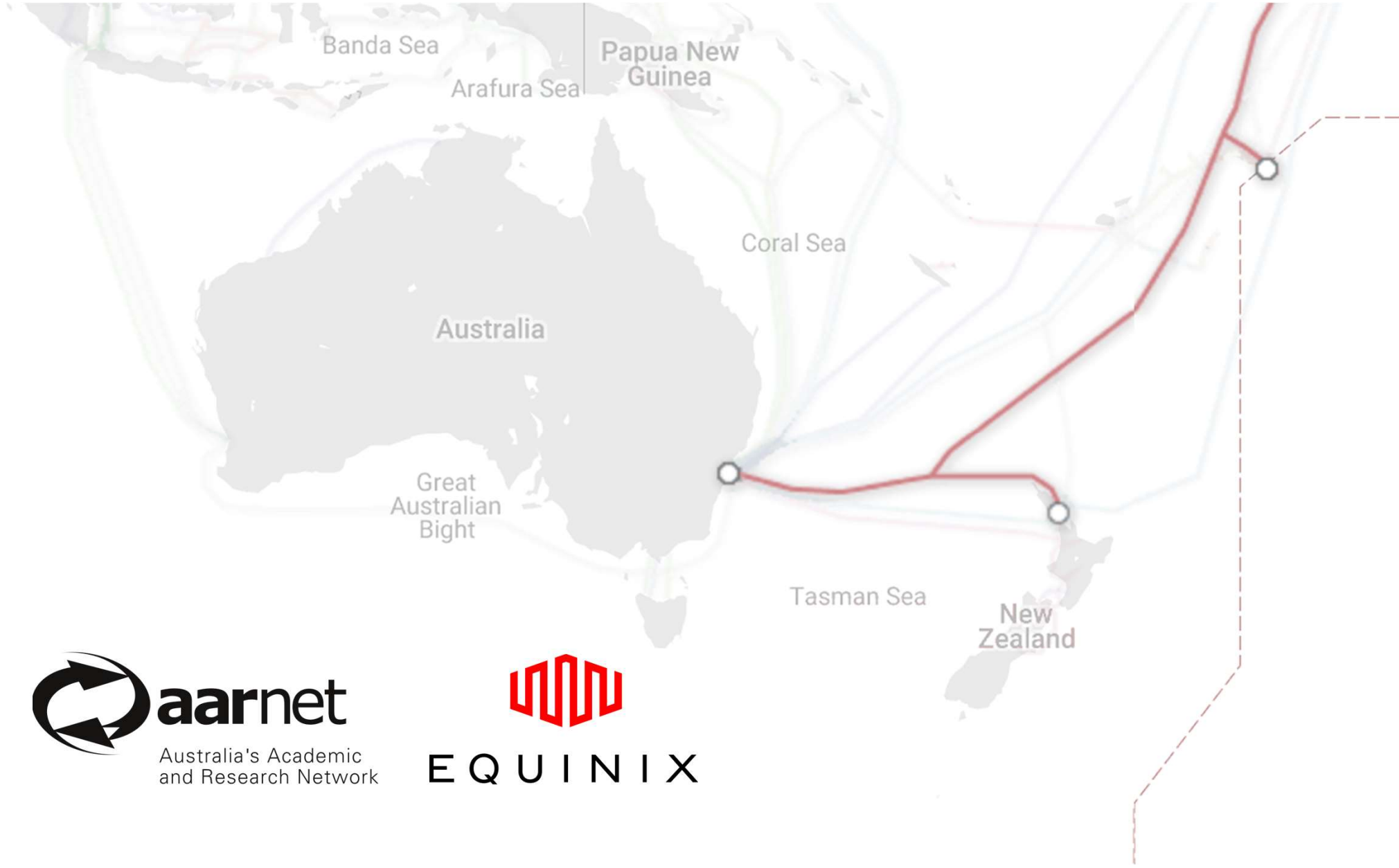

GOREX
Guam Open Research & Education eXchange
UNIVERSITY of HAWAI'I
NSRC
NSF
PACIFIC WAVE
UNIVERSITY OF GUAM
PACIFIC WAVE
Okhotsk
Okhotsk
Mongolia
North Pacific Ocean
United States
Mexico
Gulf of Mexico
Cuba
Puerto Rico
Guatemala
Caribbean Sea
Nicaragua
Venezuela
Guyana
Suriname
Colombia
Ecuador
Brazil
Peru
Bolivia
Paraguay
Chile
Uruguay
Argentina
Philippine Sea
Thailand
South China Sea
Vietnam
Philippines
Gulf of Thailand
Malaysia
Indonesia
Banda Sea
Arafura Sea
Papua New Guinea
Coral Sea
Australia
Great Australian Bight
Tasman Sea
New Zealand
South Pacific Ocean


GOREX: Guam Open Research & Education eXchange
Commonwealth of the Northern Mariana Islands
AMERICA
Internet2
California Pacific Wave/ CENIC
Oahu University of Hawaii
ASIA
Japan
Hong Kong
Singapore
Philippines
Indonesia
Palau & Yap
Guam
Tang
Guam Open Research & Education eXchange
DoCoMoP
Piti-G
Piti-T
University of Guam
Federated States of Micronesia & Marshall Islands
AUSTRALIA
Sydney AARNet
JGA 2018
HKG 2018
AAG
SEA-US 2017
ATISA 2017
IT&E
HANTRU-1
PPC-1
YIGO
DEDEDO
HAGÅTÑA
AGAT
TALOFOFO
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



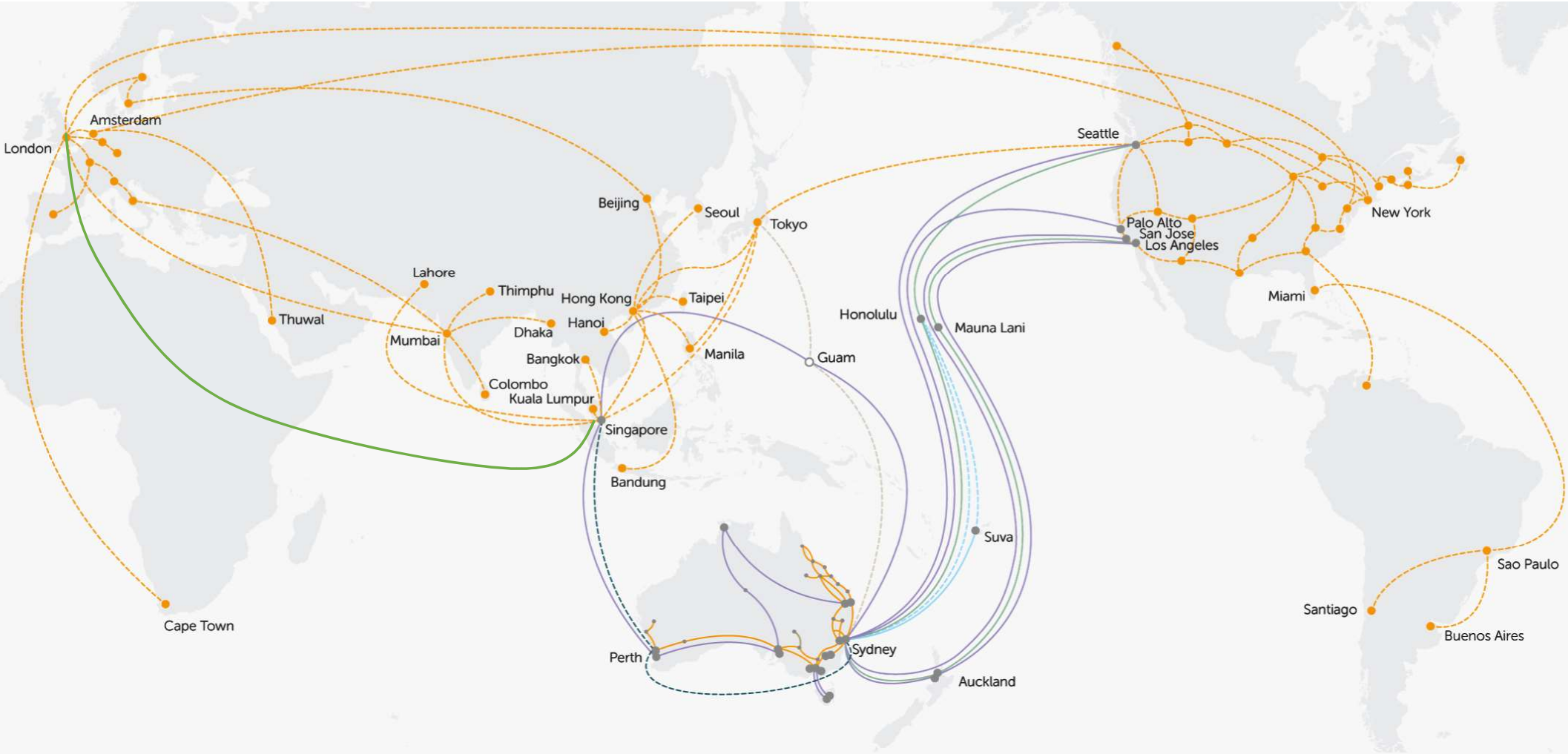
https://pacificwave.net/participants-affiliations

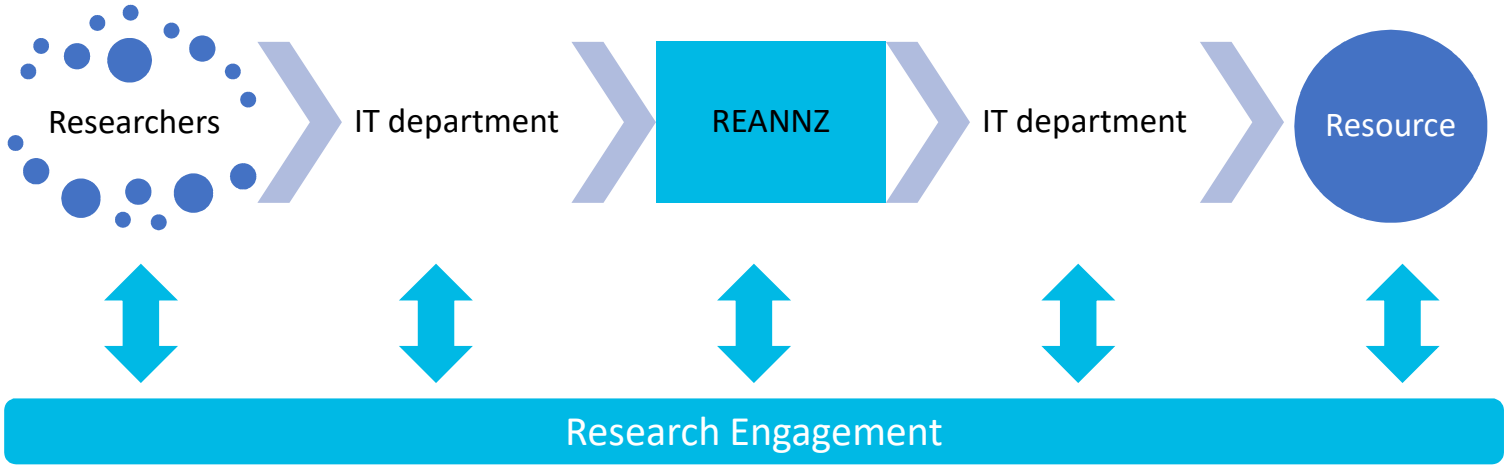

PACIFIC WAVE
NATIONAL & INTERNATIONAL PEERING EXCHANGE
Pacific Wave is a project of CENIC & PNWGP
CSTNET
KISTI/KREONET
JGN (Seattle & Tokyo)
TransPAC/Pacific Wave
GEMNet2
WIDE
Korea
Japan
China
Taiwan
Hong Kong
SINET
JGN/SingAREN
Guam
SingAREN/Internet2
PIREN
CERNET
Singapore
AARNET
UH
REANNZ
PACIFIC WAVE BACKBONE
TWAREN/TANET
PIREN
UH
Oahu
Hawaii
AARNET
AARNET
Australia
REANNZ
New Zealand
CANARIE
PNWGP
Vancouver
Seattle
ESnet
DREN
Internet2
CENIC
NREN (NASA Ames)
ESnet
San Francisco Bay Area
CENIC
Los Nettos
DREN
Los Angeles
Tijuana
FRGP
Denver
UltraLight (Caltech)
Albuquerque
ABQG
El Paso
Kansas City
Tulsa
Internet2
Dallas
Houston
Transtelco
CUDI
Mexico
StarLight
Chicago
NORDUNet
Nordic Countries
United Kingdom
JANET
SURFnet
GEANT
ESnet
Europe
SPEEDS/POPS
10 Gbps
100 Gbps
CURRENT
FUTURE
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:
- ABQG: New Mexico GigaPoP
- CENIC: California
- FRGP: Colorado and Wyoming
- PNWGP: Washington, Montana, Alaska, Oregon & Idaho
- UH: Hawaii
With support from the National Science Foundation
NSF



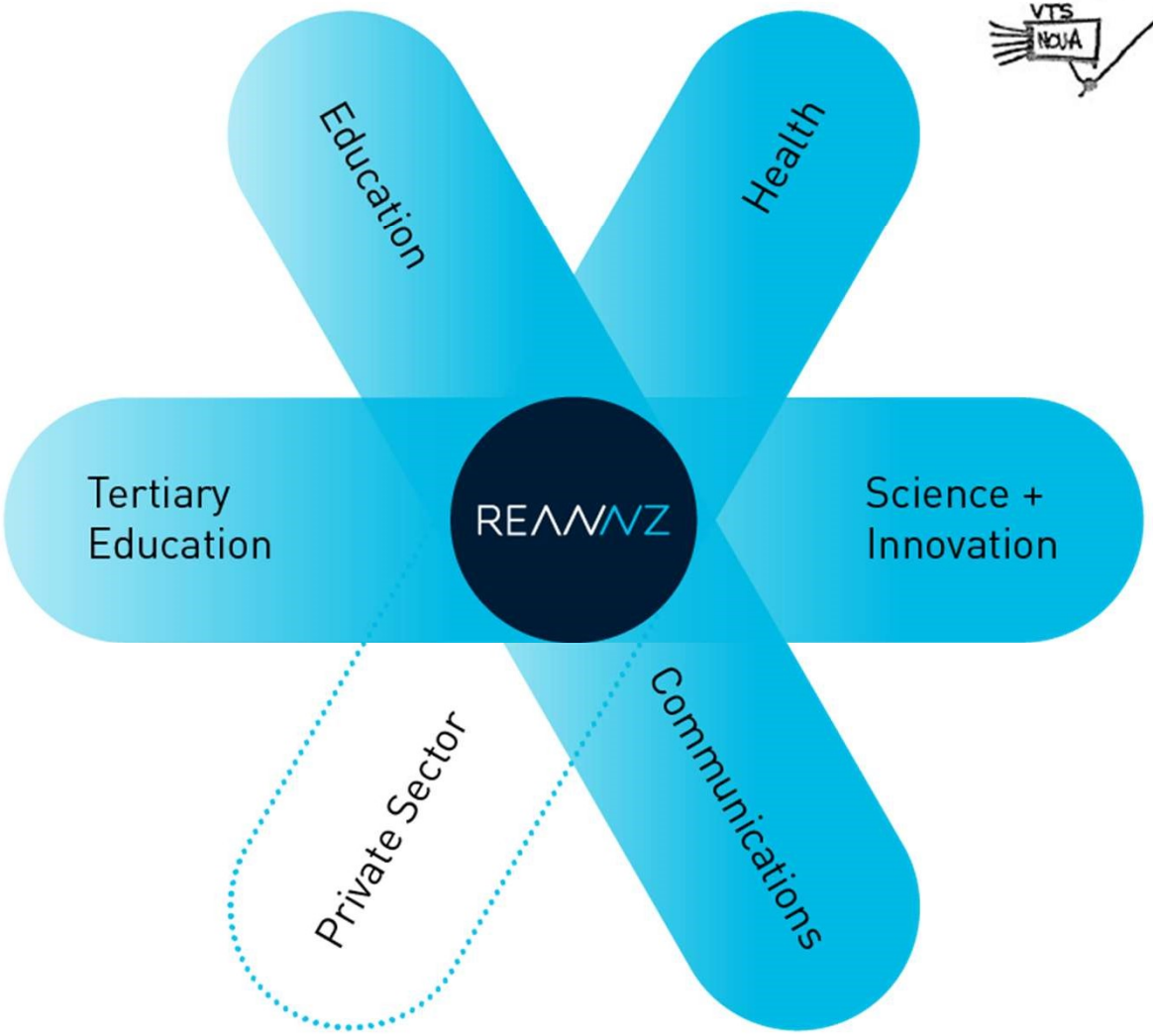
aarnet
Australia's Academic and Research Network

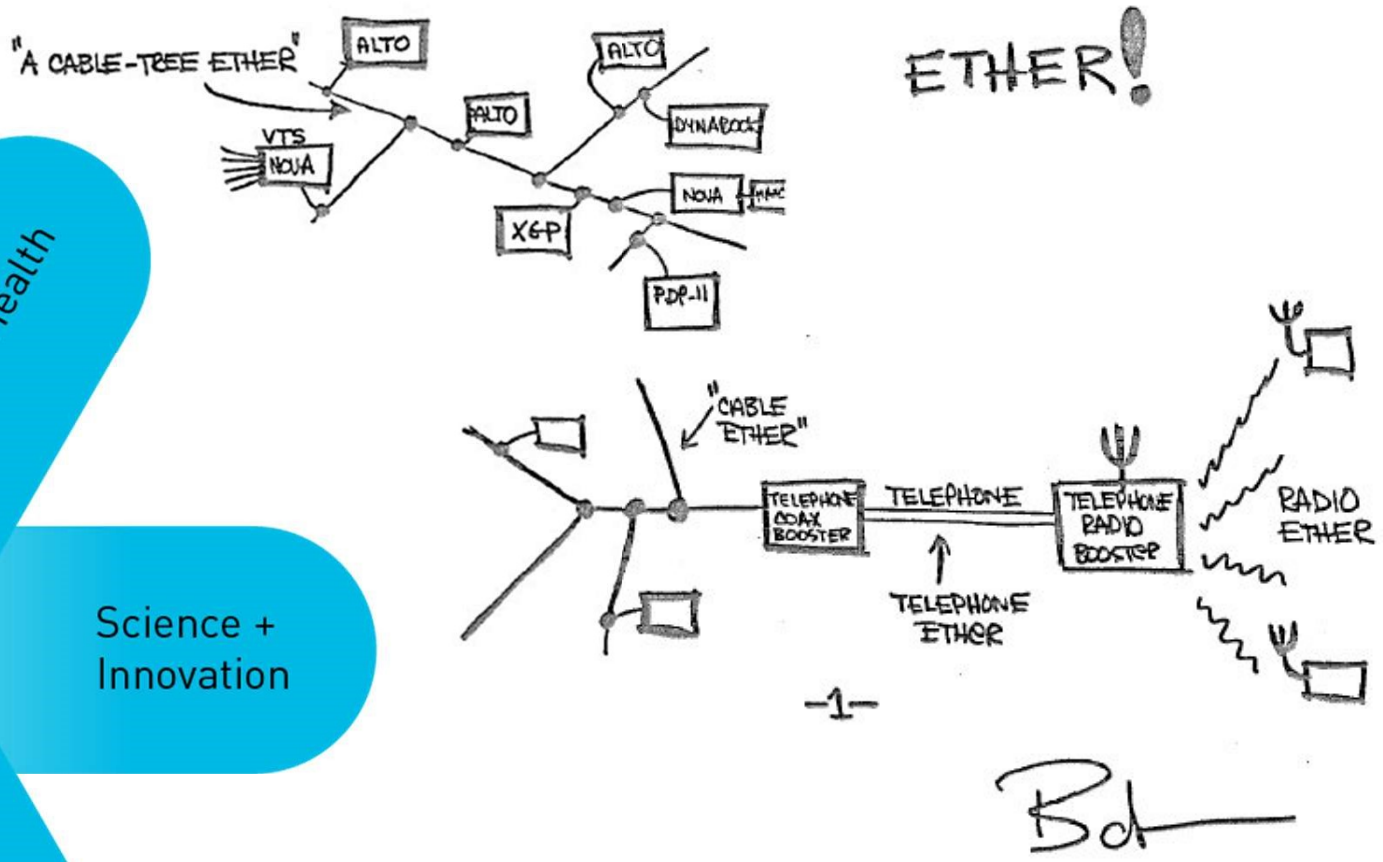
EQUINIX


London
Amsterdam
Cape Town
Thuwal
Lahore
Mumbai
Thimphu
Dhaka
Hanoi
Hong Kong
Bangkok
Colombo
Kuala Lumpur
Singapore
Bandung
Beijing
Seoul
Tokyo
Taipei
Manila
Guam
Perth
Sydney
Auckland
Suva
Honolulu
Mauna Lani
Seattle
Palo Alto
San Jose
Los Angeles
New York
Miami
Santiago
Sao Paulo
Buenos Aires
AARNET POP
OTHER R&E POP
R&E NETWORK
5 GBPS
5 GBPS BACKUP
10 GBPS
100 GBPS
N* 100G WDM
INDIGO PROJECT
JGA PROJECT


Researchers
IT department
REANNZ
IT department
Resource
Research Engagement

Thank you!





Please ask me anything!

wallace.chase@reannz.co.nz
@bmtfr