RouteViews & NSRC operational update

APstar Retreat
Monday 11th September 2023
Kyoto International Convention Centre

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Network Startup Resource Center

RouteViews

A collaborative router looking glass to share BGP views among network operators and researchers.

- RouteViews was founded at the University of Oregon's Advanced Network Technology Center (ANTC) in 1995. Data archives began in 1997 and amount to 50TBs (compressed) today.
- RouteViews is currently led by the Network Startup Resource Center (NSRC) engineering team at the University of Oregon

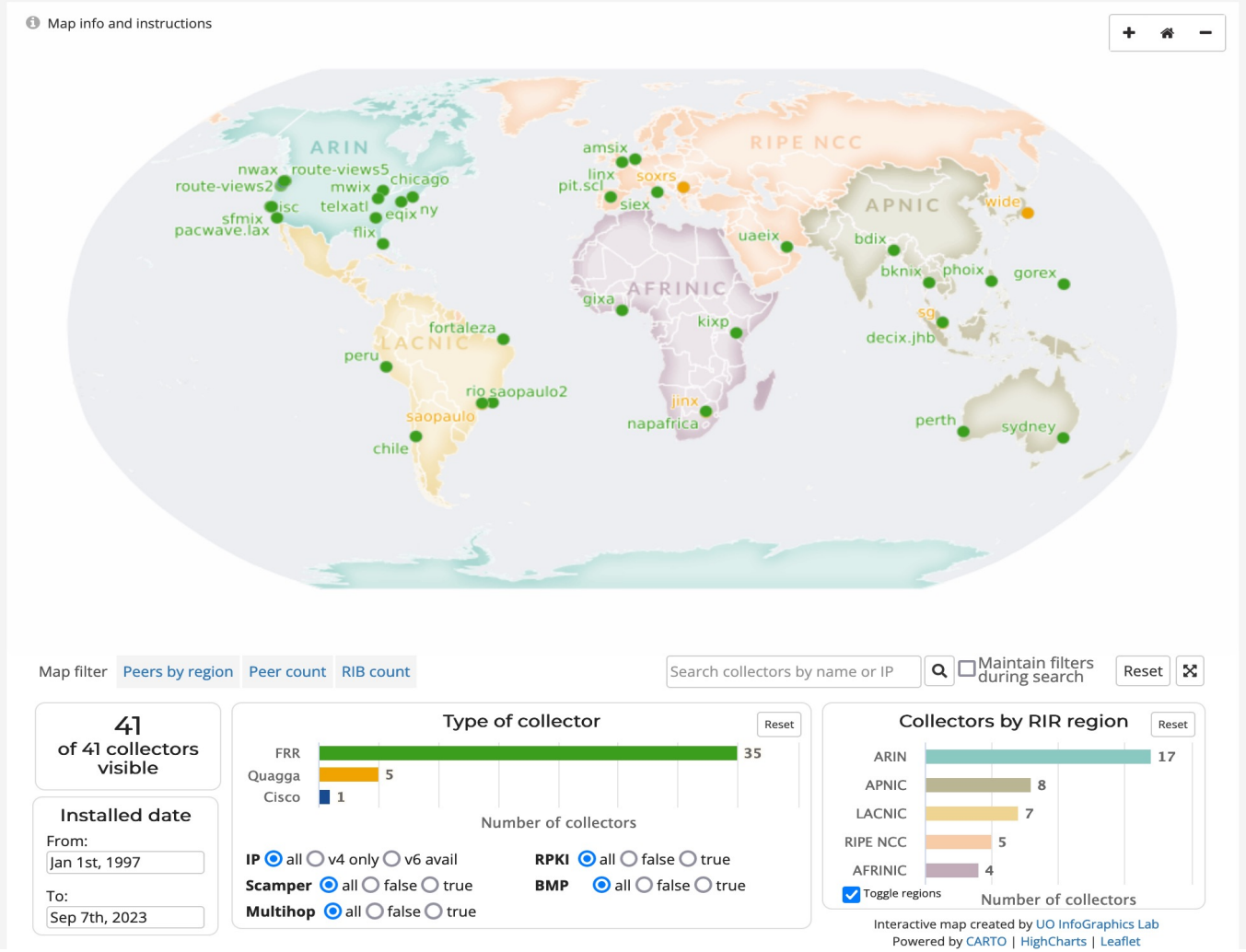
- NSRC
  - NSRC supports the growth of global Internet infrastructure by providing engineering assistance, collaborative technical workshops, training, and other resources to university, research & education networks worldwide.
- University of Oregon
  - The University of Oregon is a public research institution in Eugene, Oregon, USA founded in 1876. UO is renowned for its research prowess and commitment to teaching. Both NSRC and RouteViews are based at the UO.

Why RouteViews?

- Originally conceived in 1995 as a tool for Internet operators to look at the BGP table from different backbones and locations around the world to troubleshoot and to assess:
  - reachability, hijacks, peer visibility, mass withdrawals, and RPKI status
- Operators who find it a valuable tool also peer to contribute to the value

- The 26-year data-set of BGP information archived by RouteViews since 1997 has become an invaluable research resource
  - RouteViews data has been used in over 1000 research papers.
  - http://www.routeviews.org/routeviews/index.php/papers/

RouteViews Collector Map



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http://www.routeviews.org/routeviews/index.php/map/

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Collector Deployment

- Physical
  - Commodity hardware shipped to the IX
  - Last resort option only.

8-16 Cores, 32G RAM, 1T SSD, 2x10 Gbps ethernet

- Virtual
  - VM hosted by the IX – the preferred option
  - Much quicker deployment time.
  - Easier to maintain and to upgrade

4 Cores, 32G RAM, 100G disk

- Software
  - Collector OS: Ubuntu 22.04
  - BGP daemon: FRR (https://frrouting.org/)

Collector Deployment

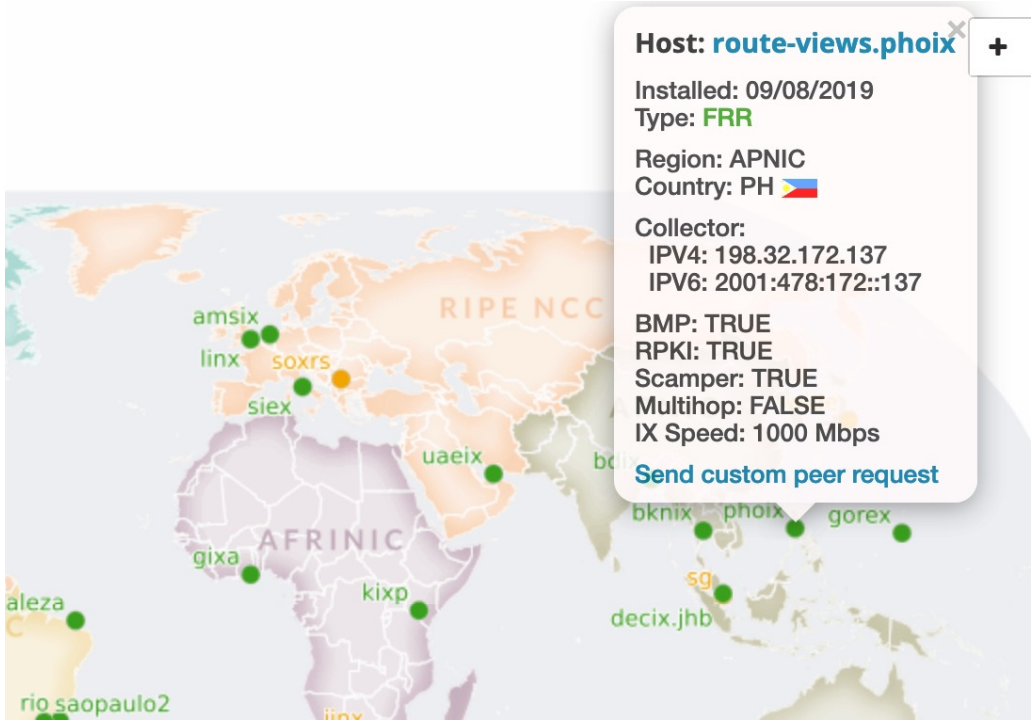
- Multi-Hop Collectors hosted at the University of Oregon
  - Advantage: If you can reach the collector, you can peer.
  - Disadvantage: Multi-hop peerings are subject to the routing anomalies RouteViews seeks to observe and archive.

- IX Hosted Collectors (most of them)
  - Advantages:
    - Better positioned to address multi-hop issues.
    - Geographic & Peering diversity.
    - Scalable.
  - Disadvantage:
    - More infrastructure to manage.

Collector Data

- Multi-Threaded Routing Toolkit (MRT)
  - https://tools.ietf.org/html/rfc6396
    - MRT provides a standard for parsing or dumping routing information to a binary file.
  - RouteViews dumps consist of BGP RIBs and Updates
    - RIBs are archived every 2 hours
    - Updates are archived every 15 minutes
- Data Access
  - MRT files are bzipped and rsynced back to http://archive.routeviews.org/ on the above schedule
  - They can be accessed via http, ftp and rsync
  - Map view tool is interactive
- Direct BGP Monitoring Protocol (BMP) feed
  - New Model, in testing right now
  - BMP upstream from collectors, **not** from peers

Collector Data



Index of /route-views.phoix/bgpdata

Name	Last modified	Size	Description
Parent Directory		-	
2019.08/	2019-08-08 22:58	-	
2019.09/	2019-08-28 23:01	-	
2019.10/	2019-09-28 23:01	-	
2019.11/	2019-10-28 23:01	-	
2019.12/	2019-11-28 23:01	-	
2020.01/	2019-12-28 23:01	-	
2020.02/	2020-01-28 23:01	-	
2020.03/	2020-02-28 23:01	-	
2020.04/	2020-03-28 23:01	-	
2020.05/	2020-04-28 23:01	-	

http://archive.routeviews.org/route-views.phoix/bgpdata/

Peering How-to

- BGP Configuration:
  - Send full-table (IPv4 & IPv6) if you can
  - Remove default route
  - Remove NULL routes
  - Remove RFC1918 addresses
  - We don’t accept/want ADD-PATH TX/RX
  - We don’t send any routes to you
  - When peering with multi-hop collectors, set ebgp-multihop

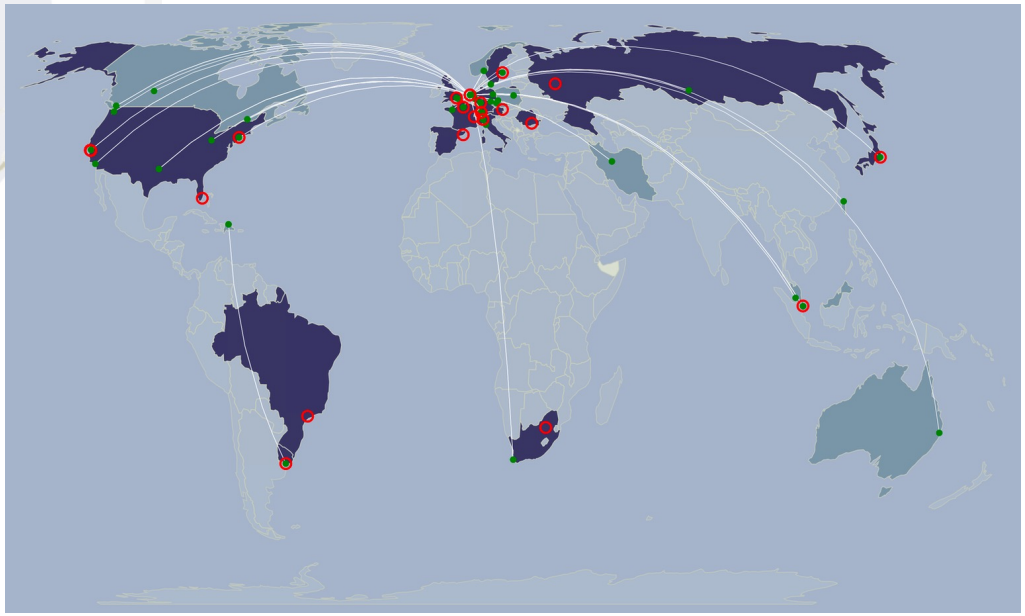
MRT Tools

- BGPkit, RIPE libbgpdump, NTT bgpdump2, etc
  - https://bgpkit.com/ (BGP toolkit written in Rust)
    - https://bgpkit.com/parser
  - https://github.com/bgpkit
    - https://github.com/bgpkit/bgpkit-parser
    - https://github.com/bgpkit/peer-stats
    - https://github.com/bgpkit/pybgpkit
  - https://github.com/RIPE-NCC/bgpdump (Last updated 2020)
  - https://github.com/cawka/bgpparser (Last updated 2015 ☹)
  - https://github.com/yasuhiro-ohara-ntt/bgpdump2
  - https://github.com/t2mune/mrtparse (python)
  - https://github.com/rfc1036/zebra-dump-parser (perl) (Last updated 2014 ☹)

Route Collection: Global Community Cooperation

RouteViews Collector Map

RIPE RIS Collector Map



Extends coverage
Provides Redundancy
Complimentary Services
Common files/tools

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Use Cases: Operations

- BGP is the backbone of the Global Routing Infrastructure.
- To ensure its stability, the community needs to monitor what is happening.
- RouteViews provides:
  - Command-Line / Looking Glass
  - Prefix Visibility, Verify Convergence, Path Stability
  - Comparing Local/Regional/Global Views
  - Troubleshooting Reachability
  - Access to historical BGP data, i.e. “When did this happen??”

Use Cases: Access

- `telnet://route-views*.routeviews.org`
  - No username necessary.
  - Users are able to run show commands, e.g. `show ip bgp x.x.x.x`
  - Telnet access is rate-limited to prevent automation overuse.
  - Likely will be replaced by a LookingGlass front-end in due course.
  - An API (http://api.routeviews.org) is also being finalised.

- Why not SSH?!
  - RouteViews data are publicly available. We've got nothing to hide.

- `show ip route x.x.x.x next-hop` is incorrect!
  - This is a collector; it has no data-plane, thus no true FIB.
  - Kernel default-route points to transit provider next-hop.

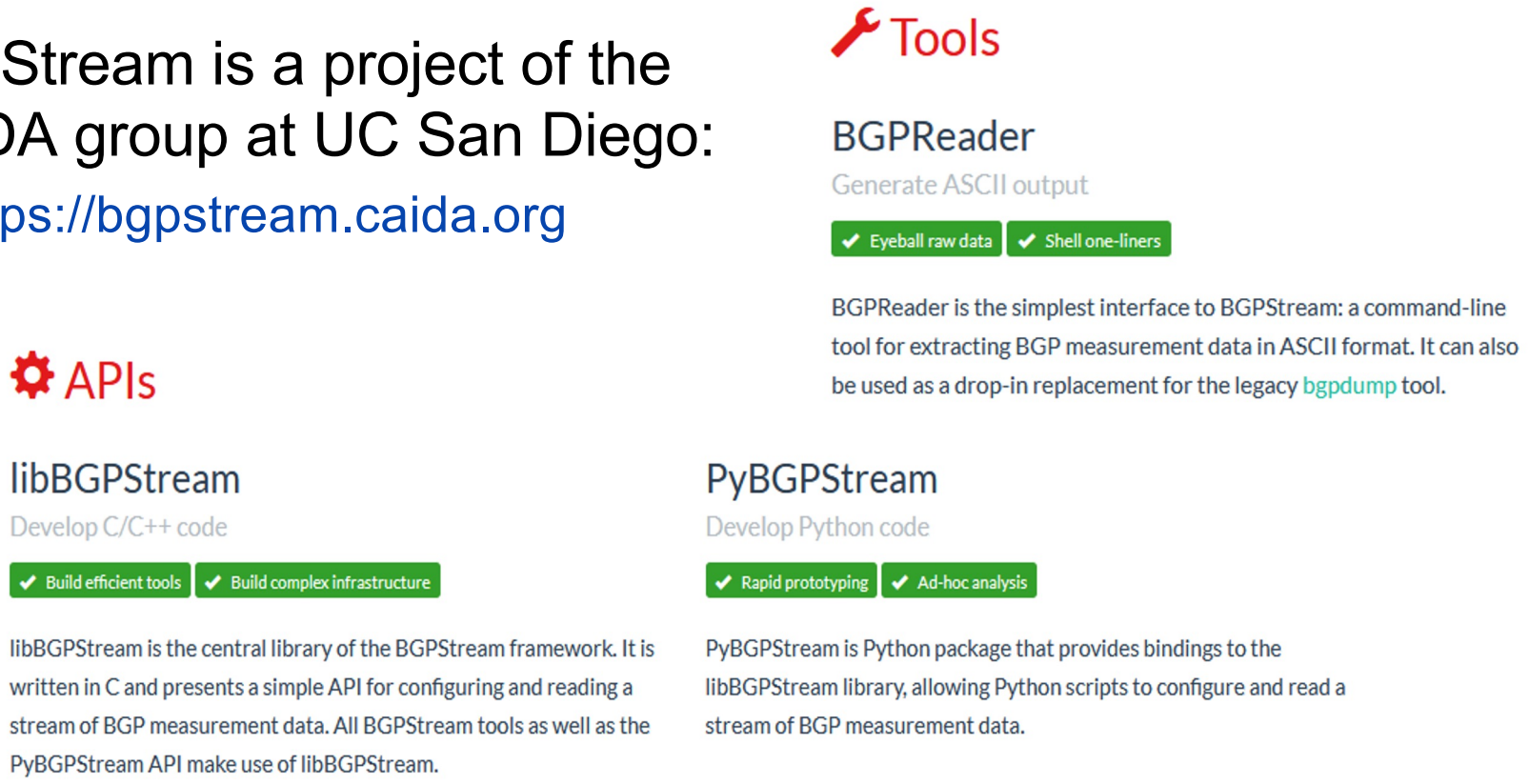
Use Cases: Tools

- BMP
  - BMP data will feed tools like BGPStream and ARTEMIS.
  - Or write your own Kafka consumer for raw BMP data.
  - Limited access for now (in trials).
  - Wider availability to follow.

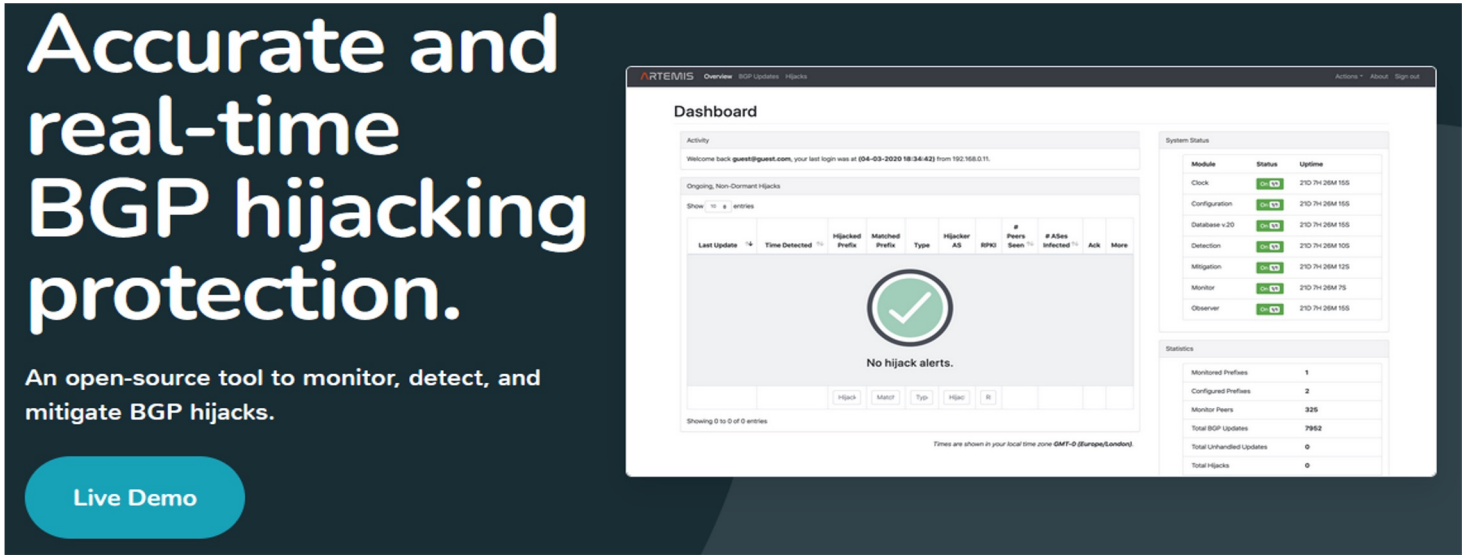
- RPKI
  - RPKI data is accessible directly on most of the collectors.
  - We also are establishing an archive of RPKI ROA data.

Use Cases: BGPSTREAM

- BGPStream is a project of the CAIDA group at UC San Diego:
  - https://bgpstream.caida.org



Use Cases: ARTEMIS



- An open-source tool to monitor, detect, and mitigate BGP hijacks
- Real-time detection and notifications of BGP prefix hijacking attacks/events
- https://bgpartemis.org and https://bgpartemis.readthedocs.io/en/latest/

Use Cases: BGPKIT

- bgpkit-parser
  - Rust-based MRT/BGP Data Parser
- bgpkit broker
  - REST API for searching archive files across public data collection projects. Data updated in real-time.
- monocle
  - A command-line application to search, parse, and process BGP information in public sources
- https://bgpkit.com/

Use Cases: Operations

```
route-views2.routeviews.org> show ip bgp sum

IPv4 Unicast Summary (VRF default):
BGP router identifier 128.223.51.102, local AS number 6447 vrf-id 0
BGP table version 14375055
RIB entries 1786807, using 327 MiB of memory
Peers 77, using 54 MiB of memory

Neighbor        V         AS   MsgRcvd   MsgSent   TblVer  InQ OutQ  Up/Down State/PfxRcd  PfxSnt Desc
4.68.4.46       4       3356         0     15732        0    0    0    never       Active        0 Level3
5.101.110.2     4      14061         0         0        0    0    0    never      Connect        0 DIGITALOCEAN
12.0.1.63       4       7018   9318817     31942        0    0    0 03w1d04h       909294        0 ATT
37.139.139.17   4      57866   9727660     63869        0    0    0 03w1d04h       911576        0 Fusix
43.226.4.1      4      63927         0         0        0    0    0    never      Connect        0 Rise
45.61.0.85      4      22652   8018158     63869        0    0    0 03w1d04h       913095        0 FIBRENOIRE
62.115.128.137  4       1299  31136526     31866        0    0    0 01w3d16h       892007        0 Telia
64.71.137.241   4       6939   7260005     31935        0    0    0 03w1d04h       936399        0 Hurricane Electric
64.71.255.61    4        812         0         0        0    0    0    never      Connect        0 Sprint
66.185.128.1    4       1668         0         0        0    0    0    never      Connect        0 AOL
67.219.192.18   4      19653         0         0        0    0    0    never       Active        0 CTSTelecom
68.67.63.245    4      22652         0         0        0    0    0    never       Active        0 FIBRENOIRE
80.241.176.31   4      20771         0         0        0    0    0    never      Connect        0 CAUCASUS
85.114.0.217    4       8492  13486557     63875        0    0    0 01w4d01h       924556        0 OBITRU
87.121.64.4     4      57463  13008288     32486        0    0    0 01w3d12h       413863        0 NETIXLTD
89.149.178.10   4       3257   8721640     31936        0    0    0 03w1d04h       909050        0 Tiscali
91.209.102.1    4      39756         0         0        0    0    0    never      Connect        0 HOSTWAY-RO
91.218.184.60   4      49788  17361887     31939        0    0    0 01w3d15h       915046        0 NEXTHOPNO
...

Total number of neighbors 77
```

77 peers, multi-hop

Not all peers are up..

Lots of full tables

Use Cases: Operations

```
route-views2.routeviews.org> sh ip bgp  45.235.208.0/22
BGP routing table entry for 45.235.208.0/22, version 1474520
Paths: (30 available, best #25, table default)
  Not advertised to any peer
  11686 52320 22381 22381 22381 22381 11432 11432 11432 11432 11432 11432 11432 11432 11432 11432 11432
11432 11432 11432 11432 11432 11432 11432 11432 11432 11432 11432 11432 11432 268214
        96.4.0.55 from 96.4.0.55 (96.4.0.55)
        Origin IGP, valid, external, rpki validation-state: not found
        Community: 11686:294
        Last update: Tue May  9 04:34:01 2023
  22652 4230 11432 268214
        45.61.0.85 from 45.61.0.85 (184.95.245.30)
        Origin IGP, valid, external, rpki validation-state: not found
        Community: 4230:11 4230:30 4230:511 4230:5101
        Last update: Sat May  6 08:05:45 2023
  8492 31133 3356 268214 268214
        85.114.0.217 from 85.114.0.217 (85.114.0.104)
        Origin IGP, valid, external, rpki validation-state: not found
        Community: 8492:1104 8492:1601
        Last update: Thu May  4 05:57:42 2023
...
```

What is AS11432 trying to achieve by prepending 23 times??

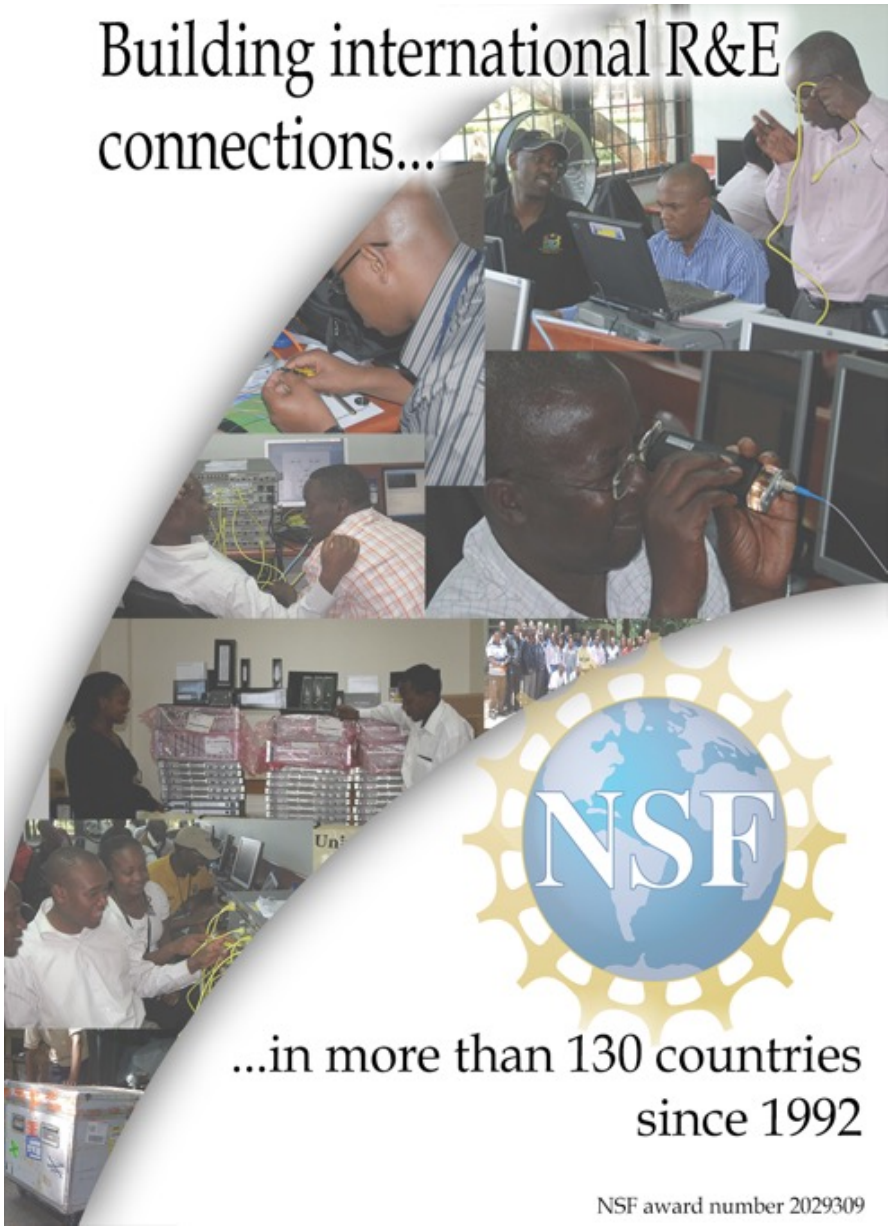
RouteViews in the Asia Pacific region

- Currently there are nodes in:
  - Bangkok (BKNIX)
  - Dhaka (BDIX)
  - Guam (GOREX)
  - Johor Bahru (DE-CIX Asia)
  - Manila (PhOpenIX)
  - Perth (WAIX)
  - Singapore (Equinix)
  - Sydney (Equinix)
  - Tokyo (DIX-IE)
- Future nodes?
- In places which:
  - Can add richness to the global BGP view
  - Have IXes willing to provide a VM to host the node
- We want to avoid duplication in the same location

NSRC activities in Asia Pacific

The NSRC cultivates collaboration among a community of peers to build and improve a global Internet that benefits all parties. We facilitate the growth of sustainable Internet infrastructure via technical training and engineering assistance to enrich the network of networks.

Our goal is to connect people.



NSF IRNC: ENgage:

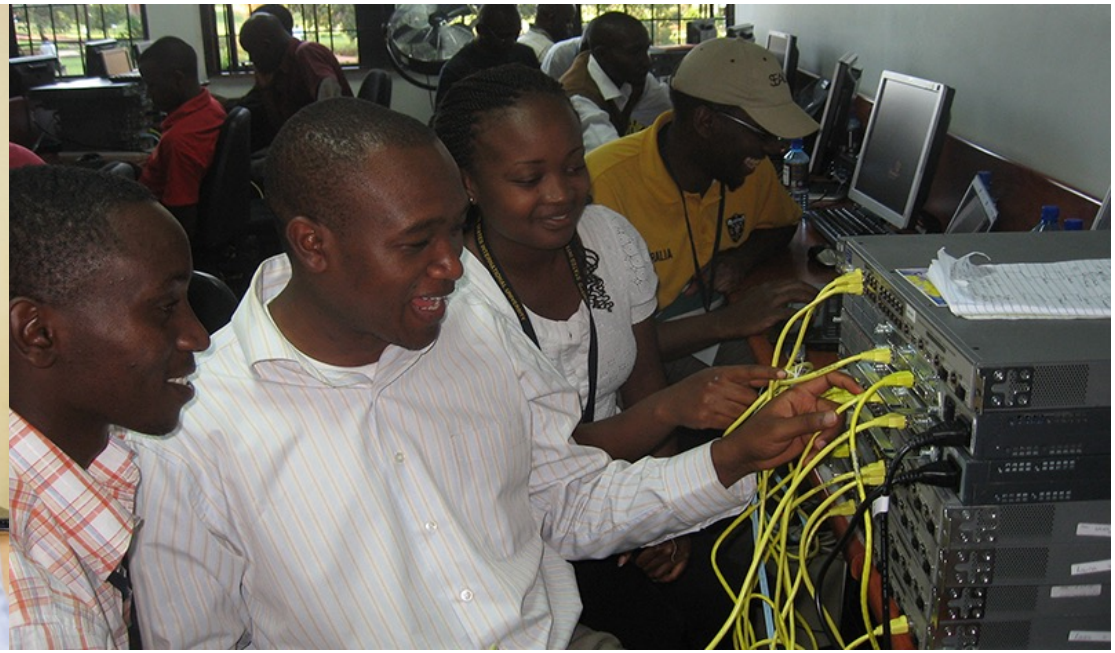
Strengthening Global Cyberinfrastructure Ecosystems to Advance International Science Collaboration

Award #: 2029309

https://www.nsf.gov/awardsearch/showAward?AWD_ID=2029309

The NSRC Model

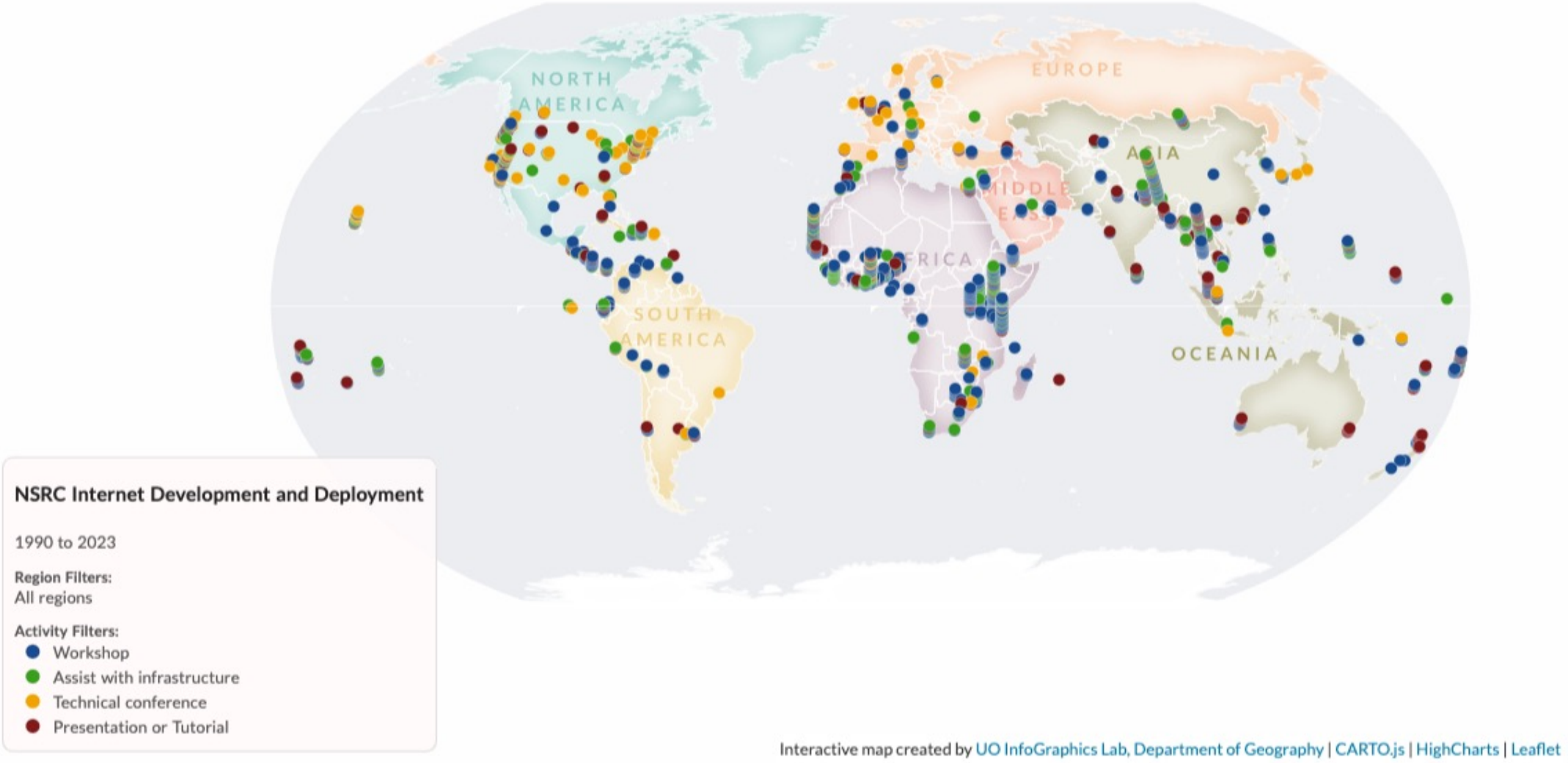
- Technical training and human resource development activities
- Direct engineering assistance (DEA) to build operational infrastructure
- Participatory development (request-driven)
- Local hands cultivating local expertise (scaling workforce impacts)



What the NSRC Does

- Works with numerous orgs worldwide to enhance network operations, affordable Internet access and human resource development of network engineers
- Leverages long-term built relationships with government, academia, industry, and private investments to facilitate building shared Internet infrastructure

1060+ Field Activities & 58,000+ Trained



Asia Pacific Region activities

NSRC Internet Development and Deployment

1990 to 2023

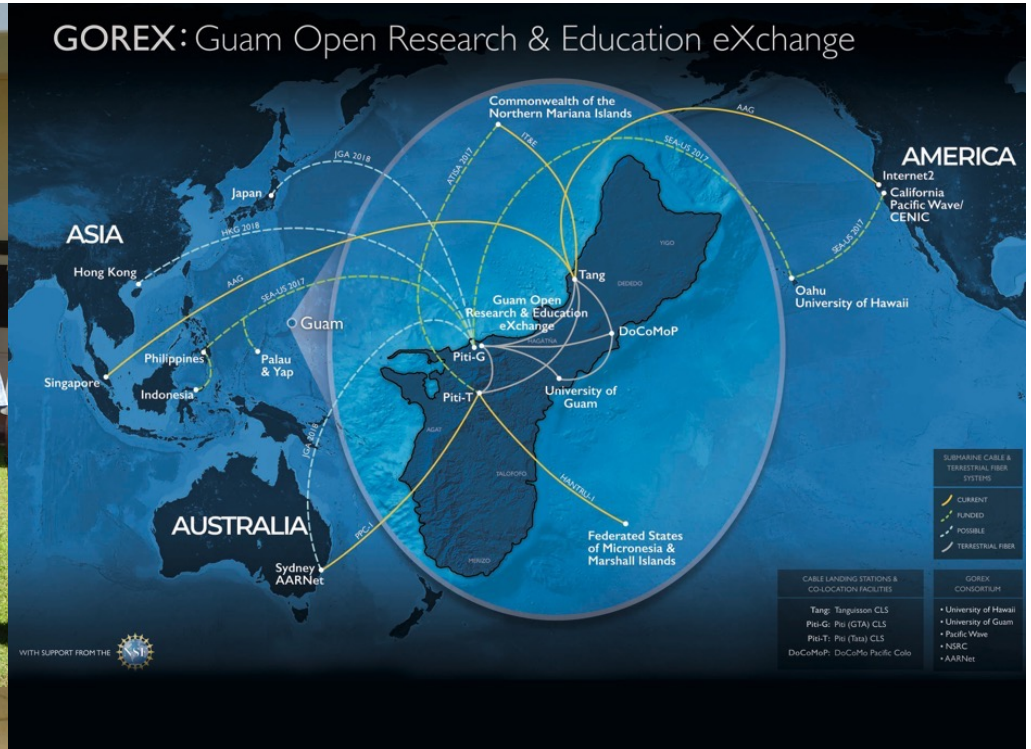
Region Filters:
Asia/Australia/Pacific

Activity Filters:
- Workshop
- Assist with infrastructure
- Technical conference
- Presentation or Tutorial

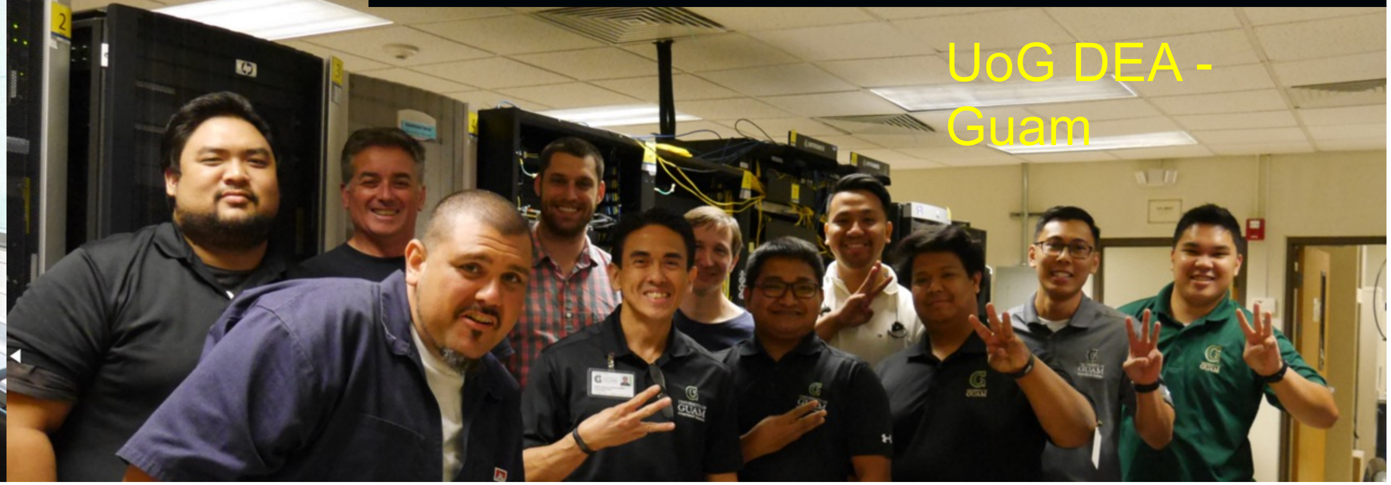
11,000+ trained
420+ in-the-field activities

Interactive map created by UO InfoGraphics Lab, Department of Geography | CARTO.js | HighCharts | Leaflet


CNDO Workshop
Guam - UoG
Lecture Hall


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


DEA – USP - Fiji


UoG DEA -
Guam

2023 in Asia Pacific…

- APRICOT 2023 in Manila
  - Campus Network Design & Routing Security Workshops (February)
- University of South Pacific Direct Engineering Assistance (April)
- BKNIX Peering Forum in Bangkok
  - BGP Deployment Workshop (May)
- Mongolia Network Operators Group
  - Routing & Infrastructure Security Workshop (September)
- South Asia Network Operators Group
  - Campus Network Design Workshop in Colombo (October)
- Pacific Network Operators Group
  - Routing & Infrastructure Security Workshop in Nuku'alofa (November)

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