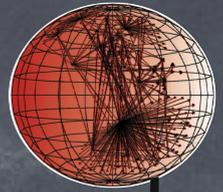
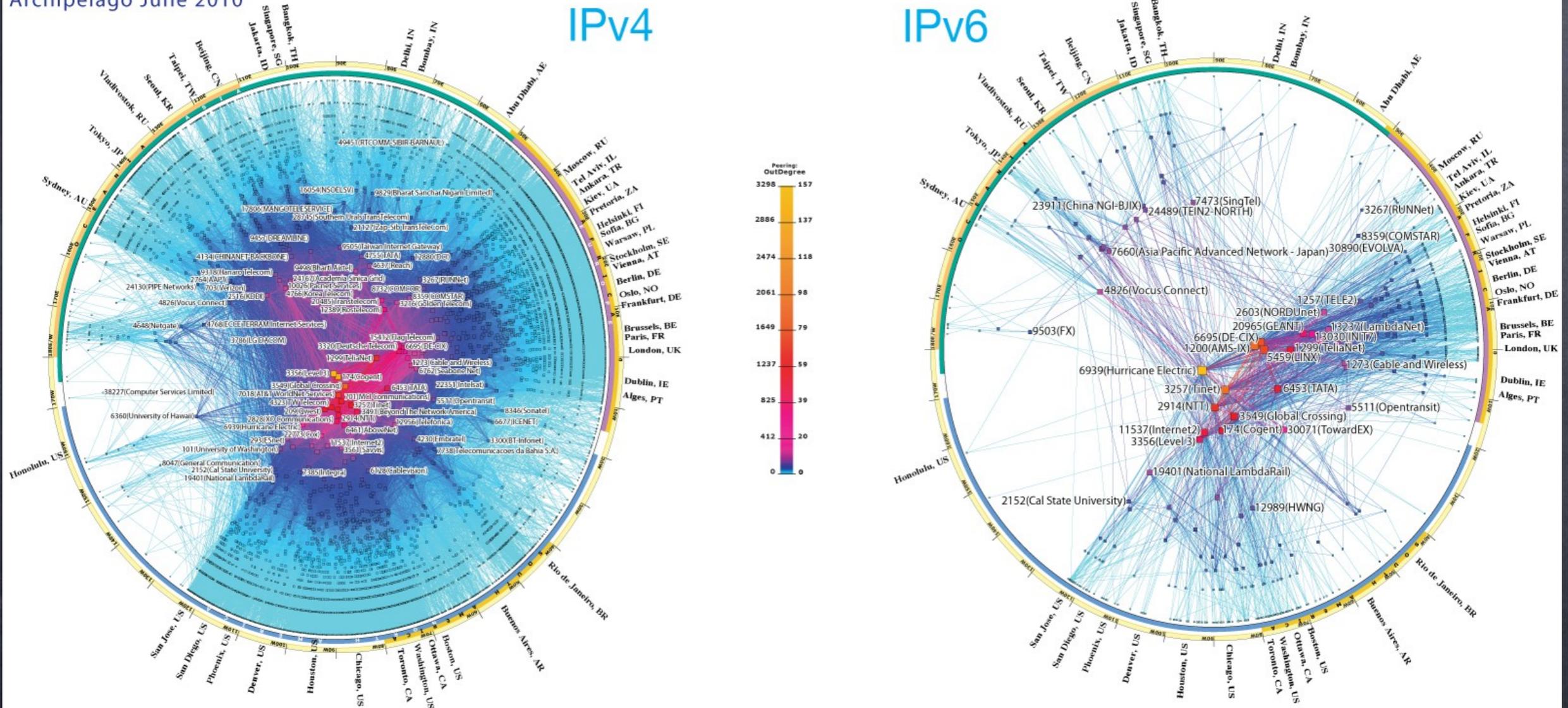


IRNC-SP: Sustainable data-handling and analysis methodologies for the IRNC networks



CAIDA's IPv4 & IPv6 AS Core AS-level INTERNET GRAPH

Archipelago June 2010



copyright © 2010 UC Regents. all rights reserved.

kc claffy
CAIDA/UCSD
NSF – IRNC Workshop
Arlington, VA
6 October 2011

Overview



To help make operational network data available to the research community, we propose three concrete contributions to the IRNC community's measurement efforts:

- (1) to foster and distill discussion of how to best make IRNC data and statistics available,
- (2) to adapt two CAIDA measurement technologies for IRNC community needs, and
- (3) to experiment with two innovations in data-handling procedures applied to existing IRNC measurements.

CAIDA IRNC-SP Plans



We plan to:

(1) Participate in IRNC series of workshops to discuss measurement priorities and to identify how CAIDA and other researchers can support them.

(a) IRNC Kickoff Meeting

(b) IRNC PI Meeting (today)

(c) 2-day annual meetings (e.g., AIMS) dedicated to measurement activities/strategies and how IRNC community can make better use of existing measurement technology, metadata, and other data-handling and data-protection technologies

CAIDA IRNC-SP Plans (cont)



(2) Improve two CAIDA technologies we already know could better serve the community.

(a) Upgrade Coralreef to handle IPv6, DNSSEC, read data formats such as netflow.

(b) Install IPv4/v6 capable Ark monitors at IRNC locations or downstream customers.

CAIDA IRNC-SP Plans (cont)

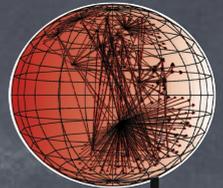


(3) Apply two innovations in data-handling procedures to existing IRNC measurement data:

(a) a recently proposed framework for privacy-sensitive data sharing, to apply to data not appropriate for public posting, but explicitly requested through designated channels to use in clearly defined research, and

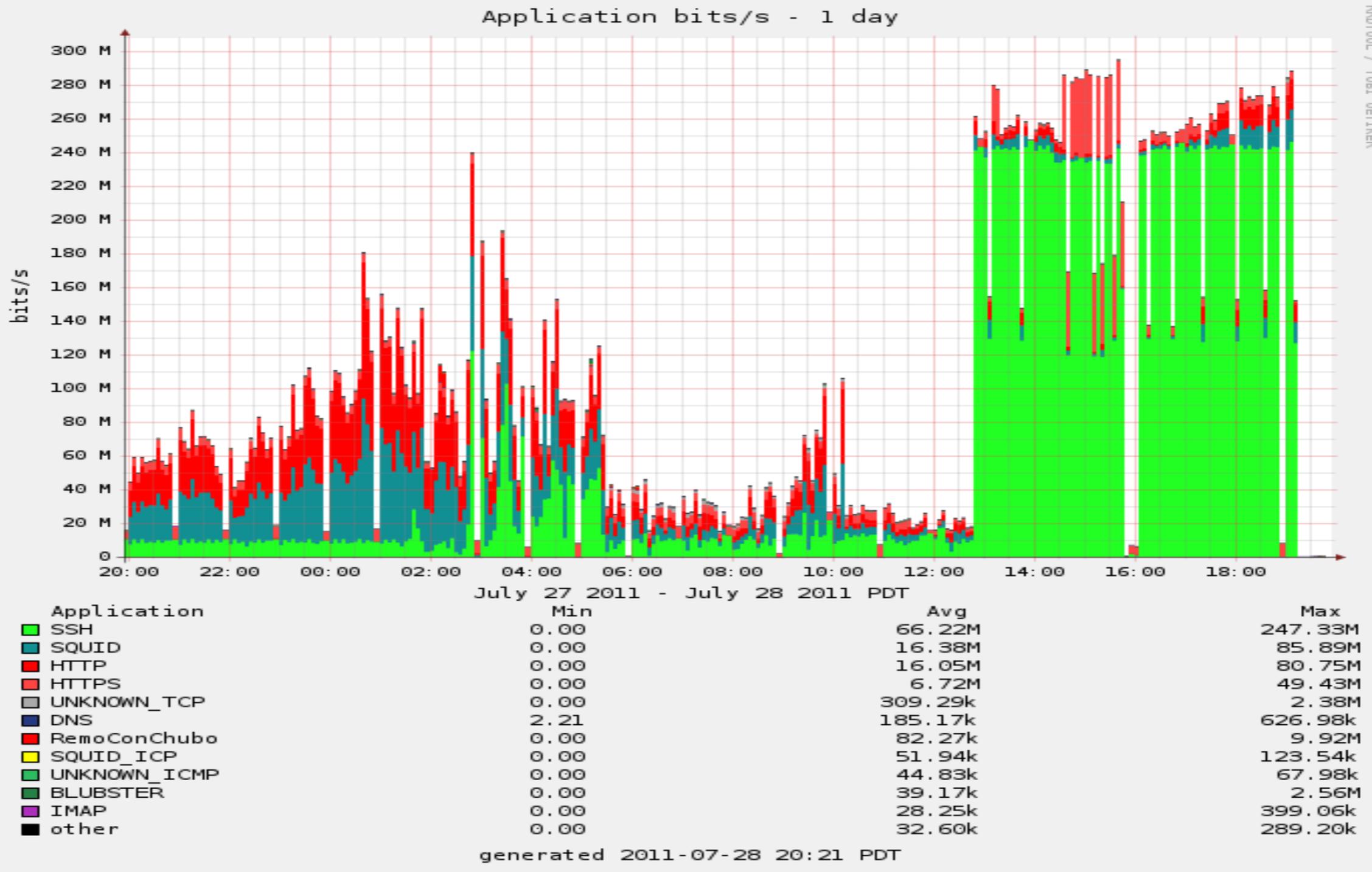
(b) we propose to illustrate our community building effort with a landmark reporting deliverable: a prototype of a "Bureau of Internet Statistics" report, hopefully inspiring other network infrastructure communities to join in this effort.

Coralreef (cont)



Internet Society
isocaida.org

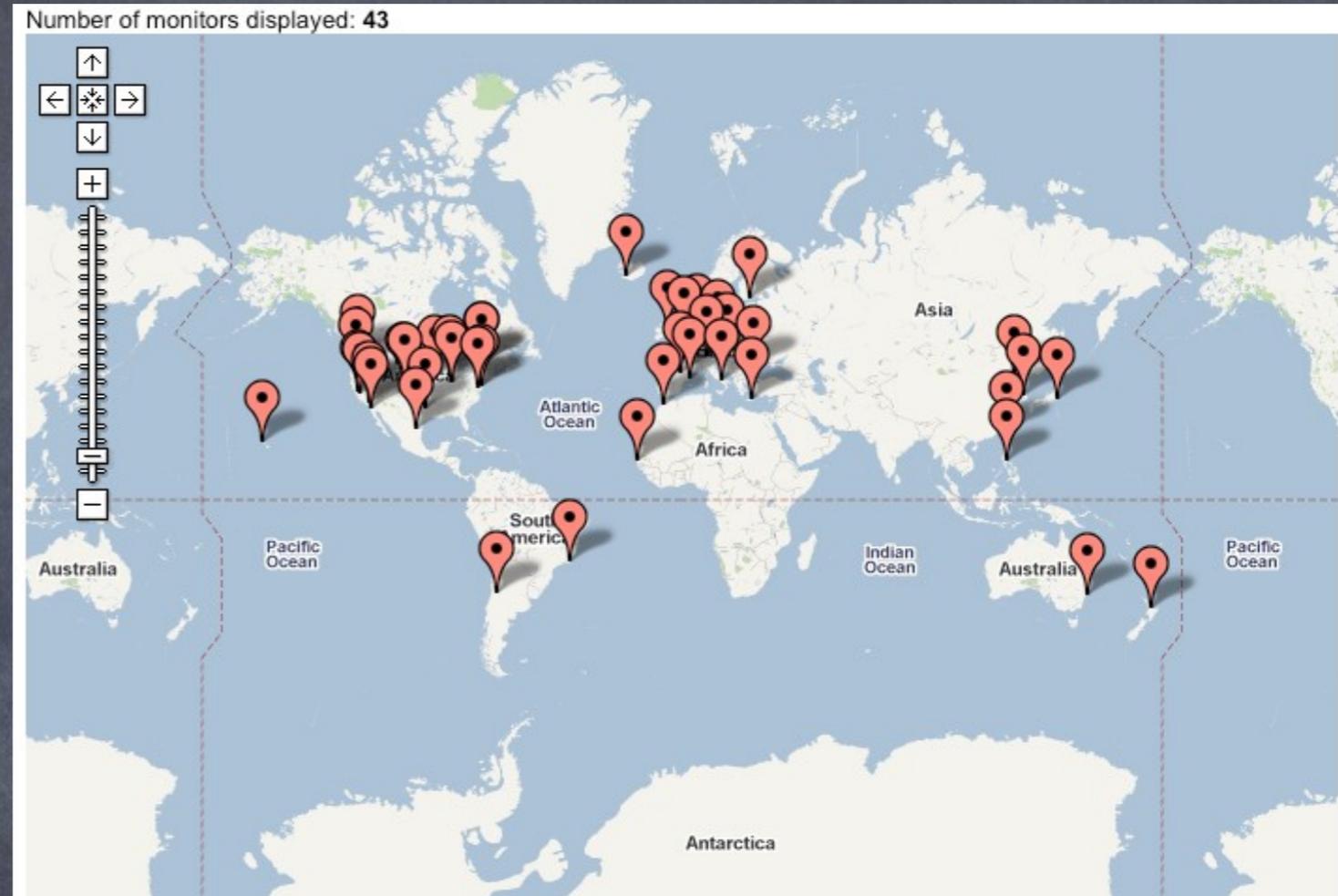
Netflow from pinot (current)



Archipelago (Ark)



- CAIDA's measurement infrastructure
- Built on decade of achievements, from SIGCOMM to MOMA
- Launch 12 Sept 2007
- 56 active IPv4 probers
 - 15 in US
- 28 active IPv6 probers
- collaborators can run vetted measurements on security-hardened platform
- publish analyses of views from individual monitors
- support for meta-data mgt, analysis, and infoviz

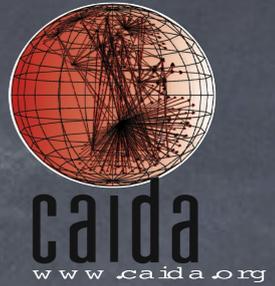


Macroscopic Measurements

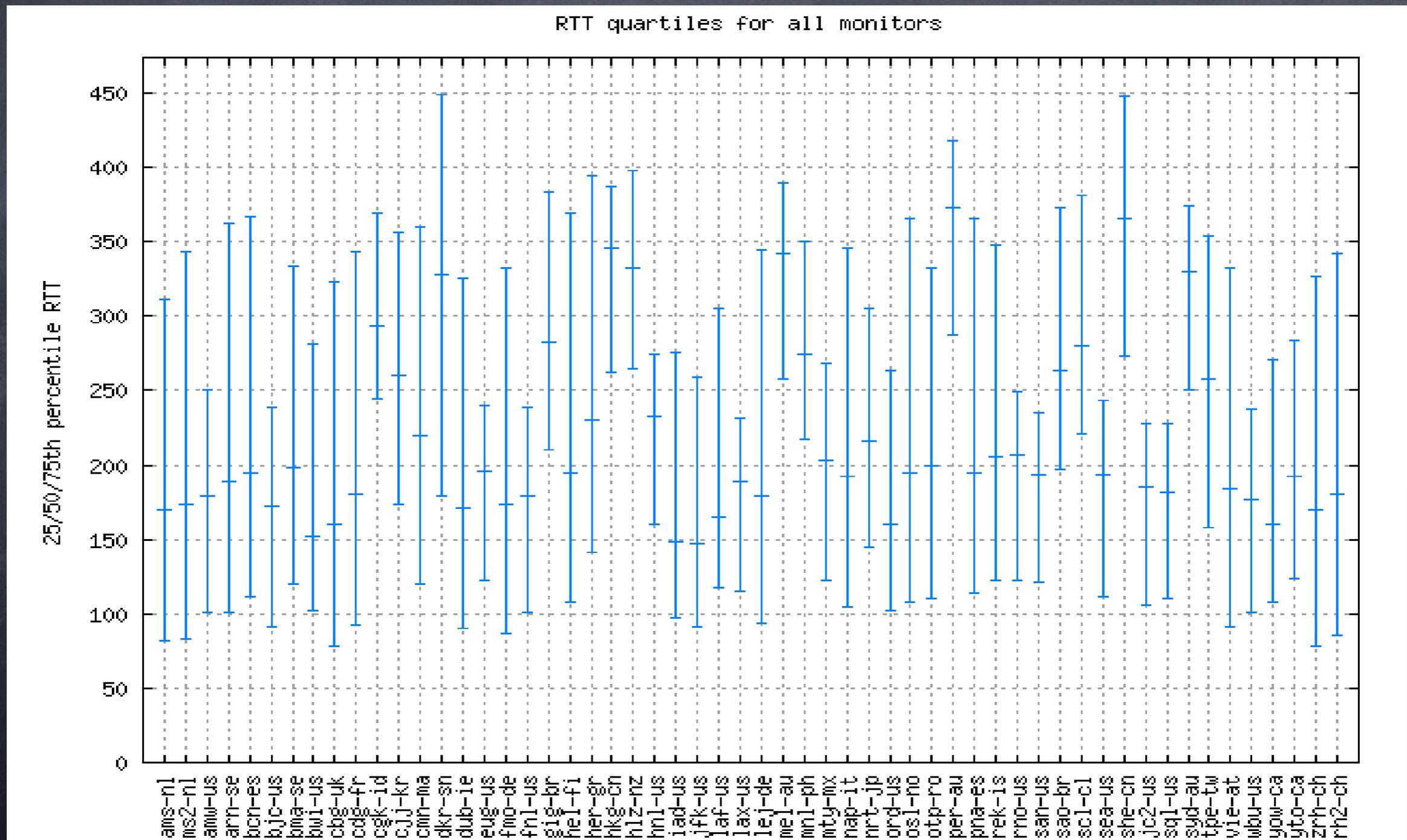


- IPv4 Routed /24 Topology (and per-hop latency)
- IPv6 Topology (and per-hop latency)
- DNS Names & Query/Response Traffic
- Alias Resolution (→ Router-level graph)
- AS-level graph (links, business relationships)

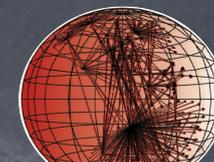
Ark Monitor Statistics Pages



- per-monitor analysis of IPv4 performance data



Monitor hosting site view of Internet



per-au
AARNet
Perth, AU (3)

Time range	2011-09-30 20:08 to 2011-10-02 19:01 UTC (1 day 23 hours)
Total traces	490935
Traces with responding destinations	47610 (9.698%)
ASes with responding destinations	3793 (24.116% out of 15728)
Prefixes with responding destinations	16923 (20.795% out of 81382)

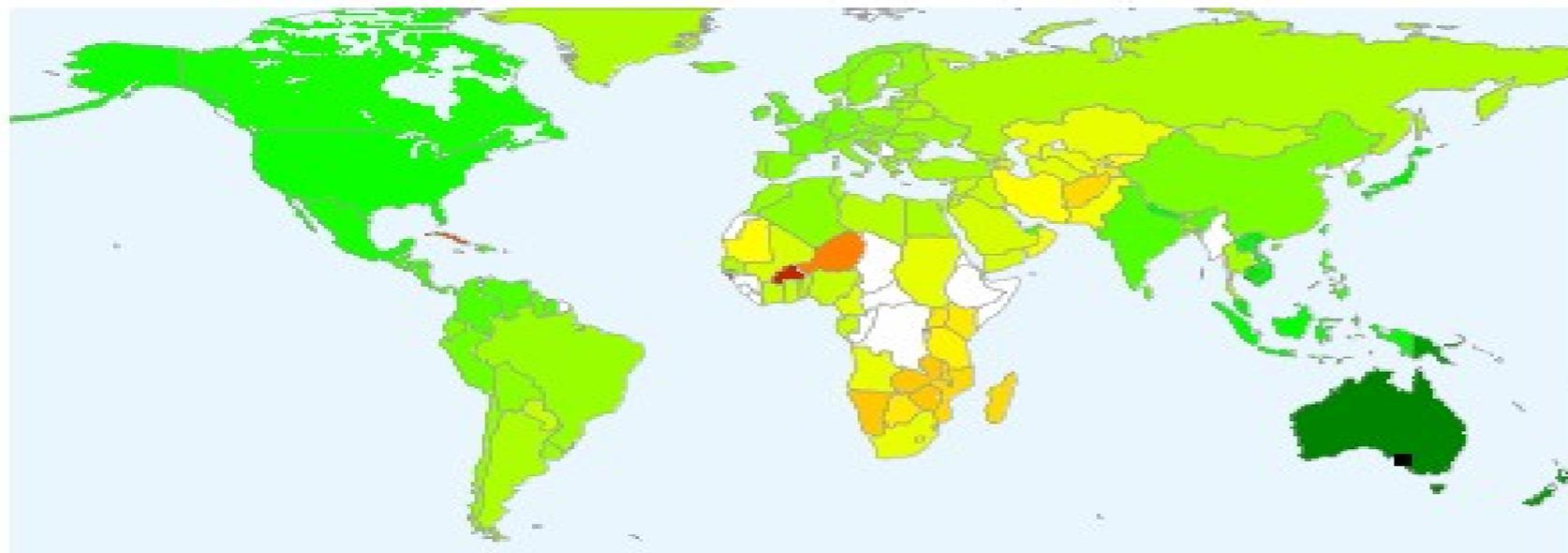
Generated for cycle 1655 on 2011-10-03 14:06 UTC (1 day ago)

All images can be clicked on for more detailed information.



Mapping RTT by political boundaries can reveal where high latency issues are located.

Median RTT per country and US state

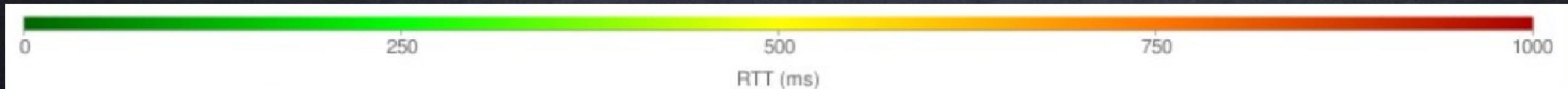
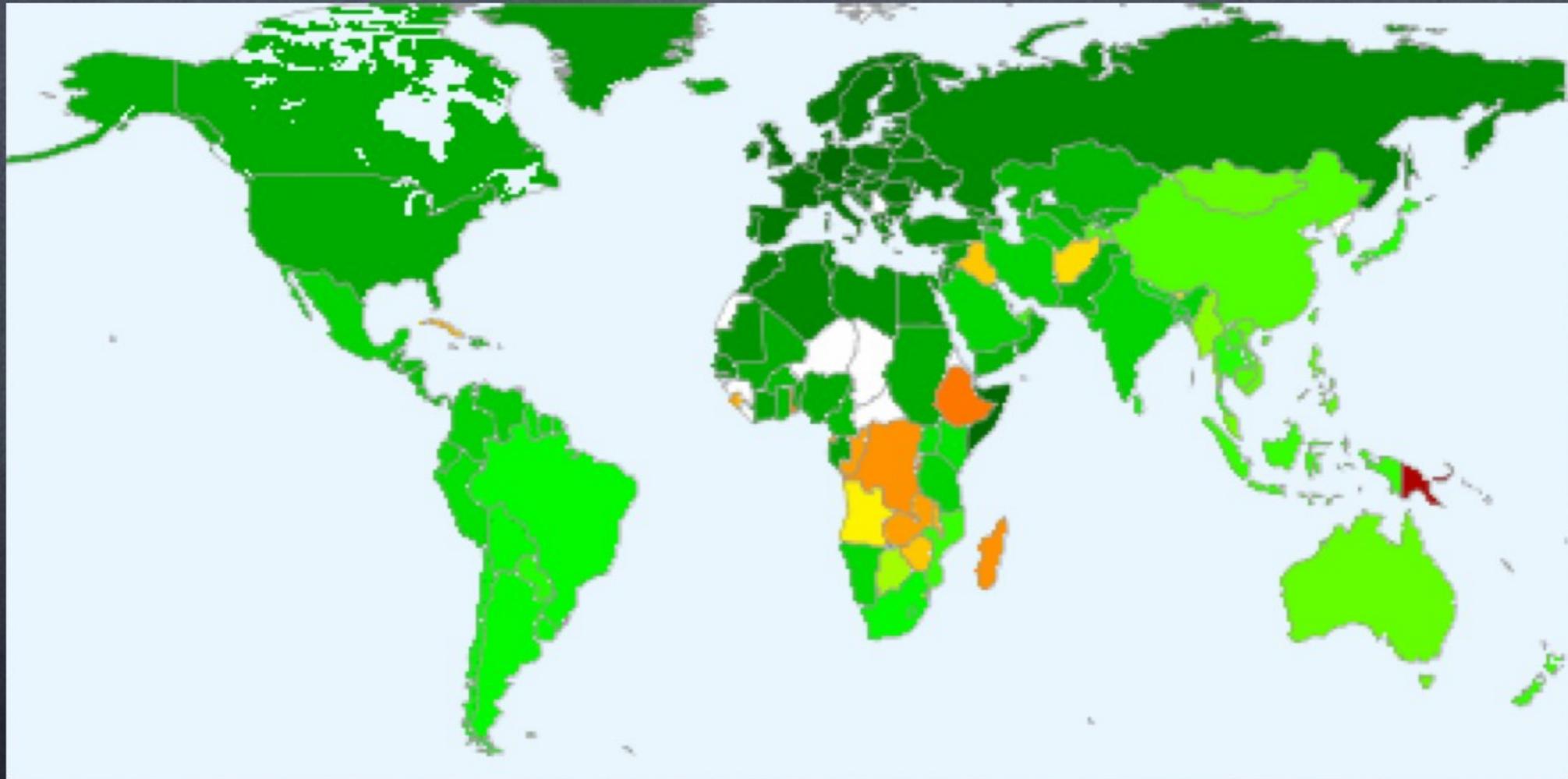


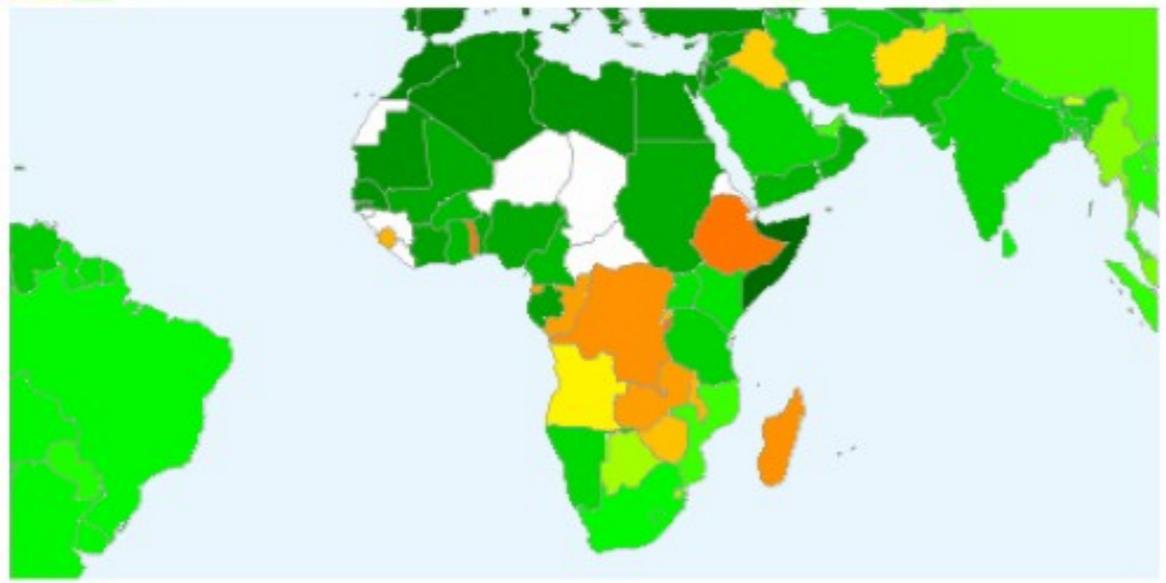
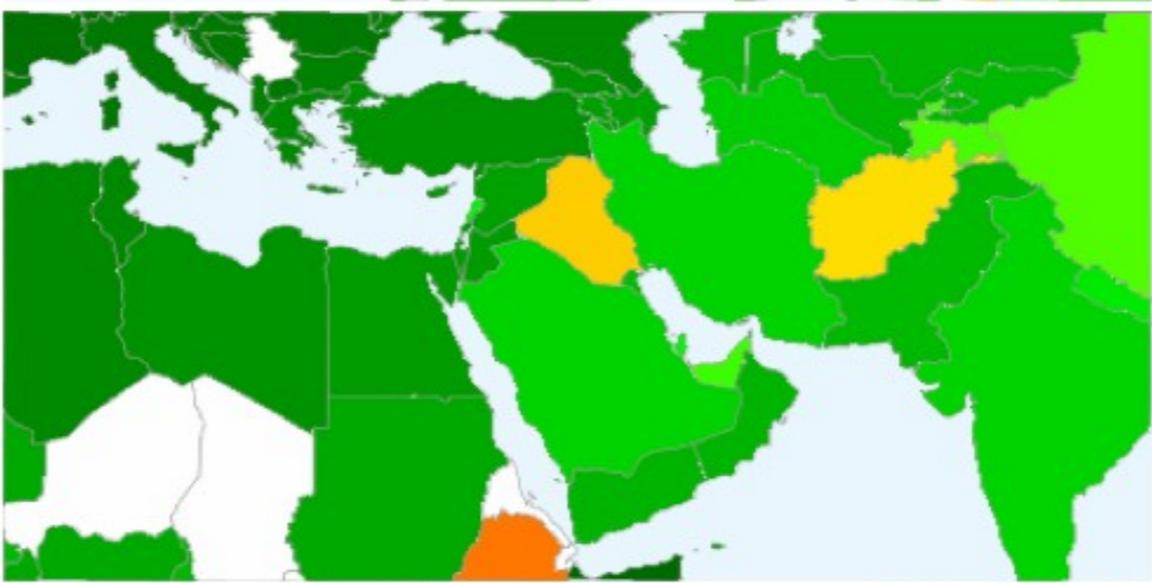
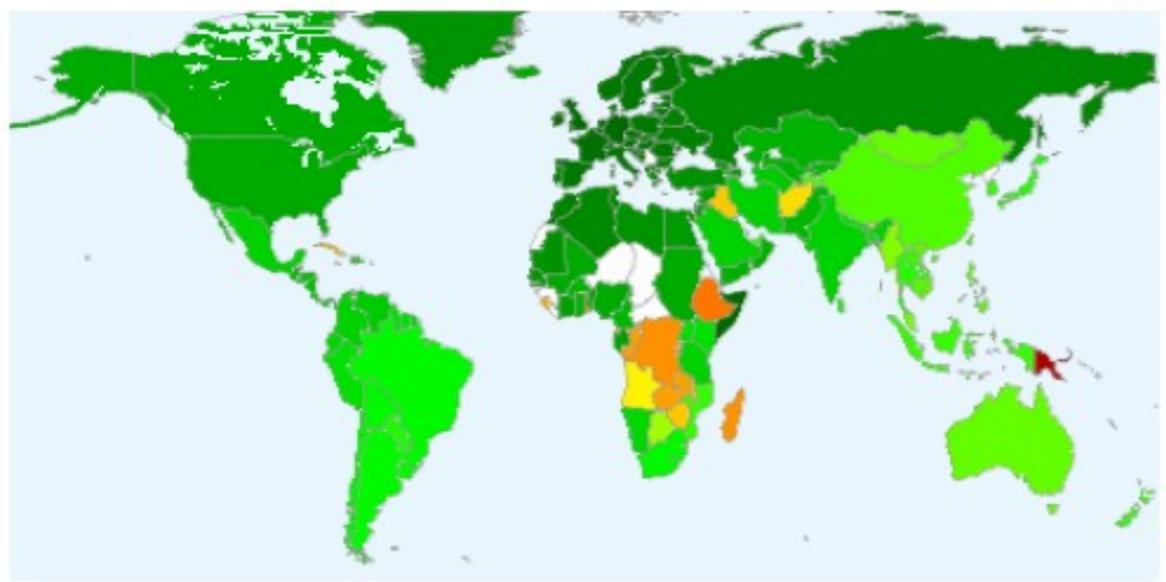
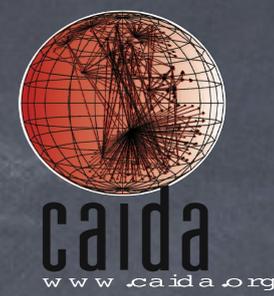
Ark Monitor Statistics Pages



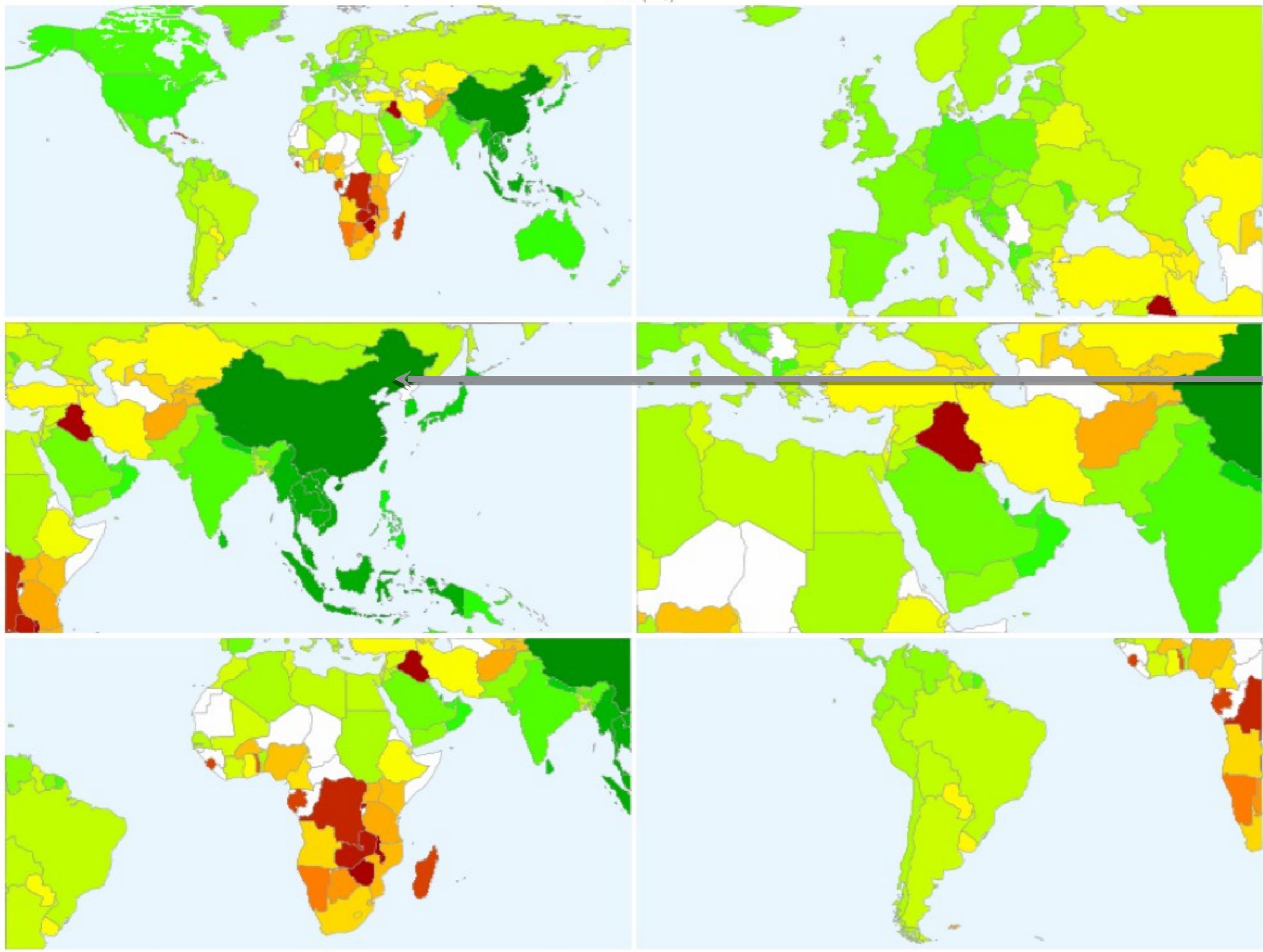
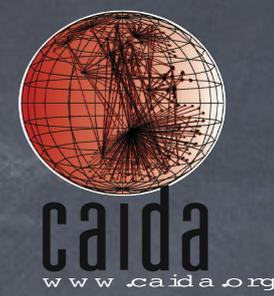
RTT plotted by country

- geolocate destinations with NetAcuity
- color each country by median RTT of destinations

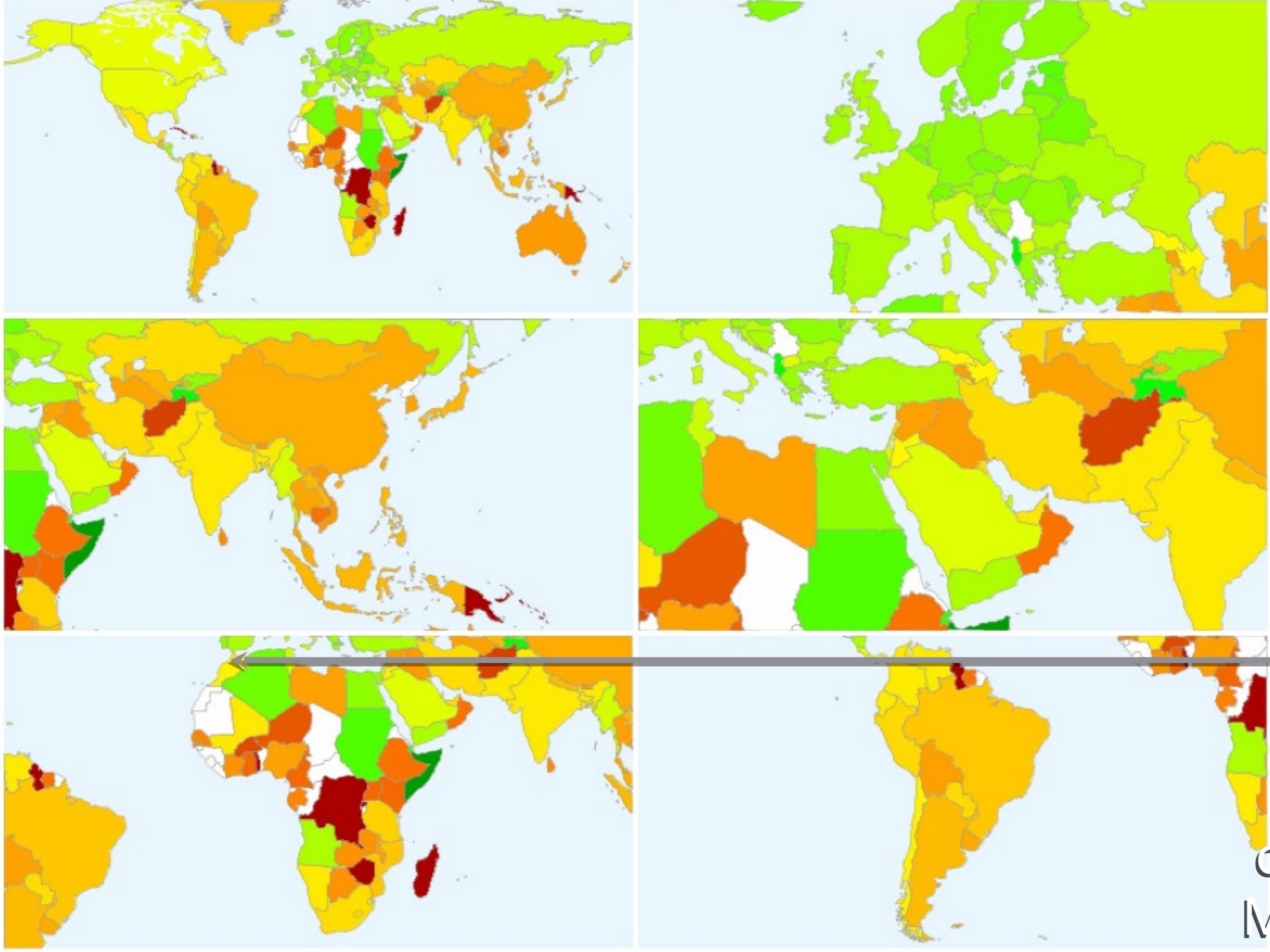
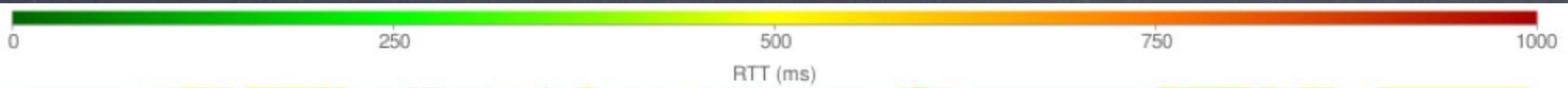




view
from
ams-nl
Netherlands

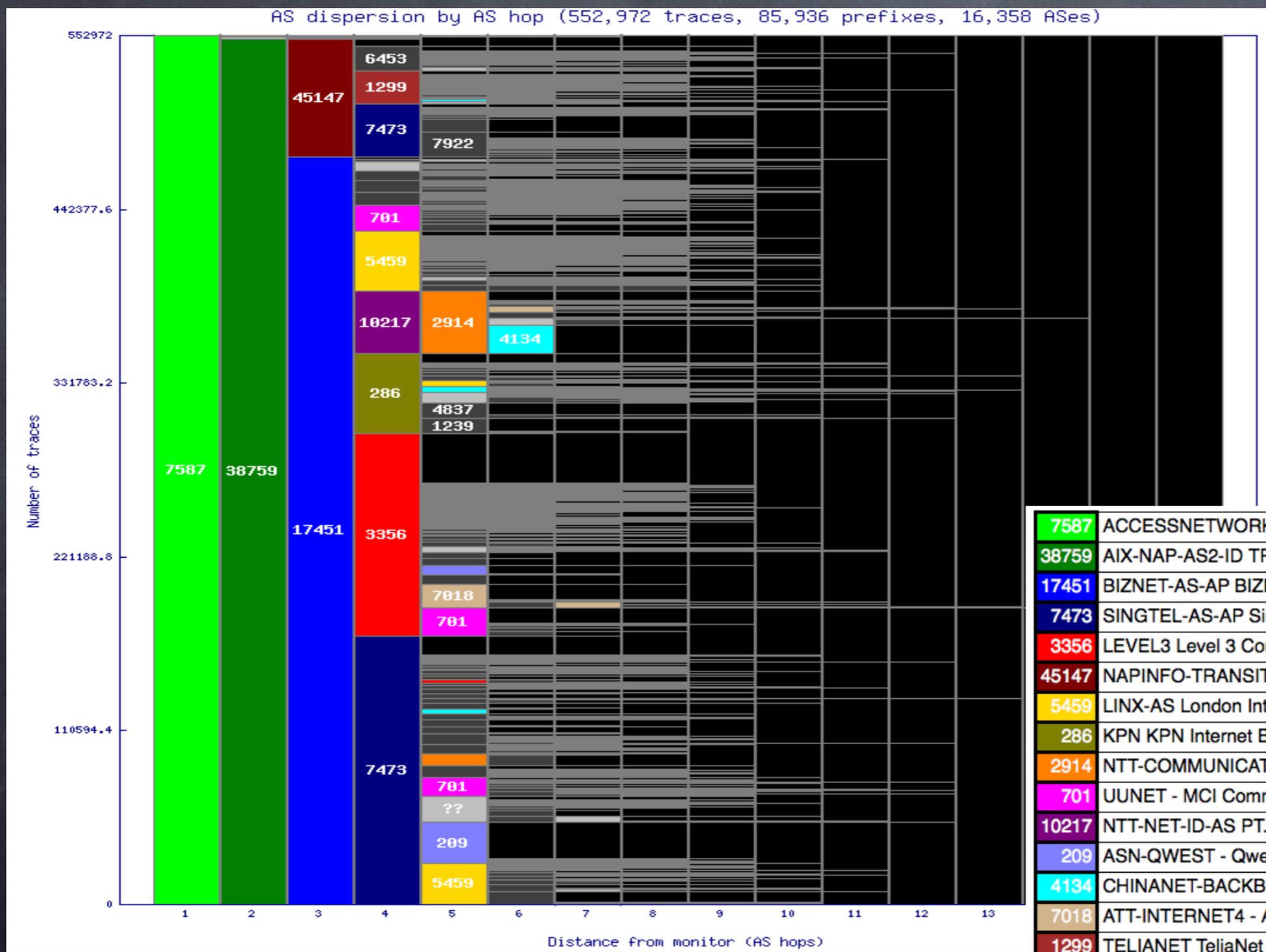
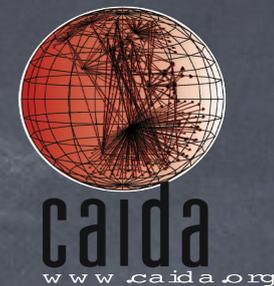


view
from
she-cn
China



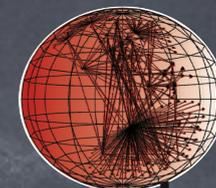
view
from
cmn-ma
Morocco

AS dispersion by AS hop



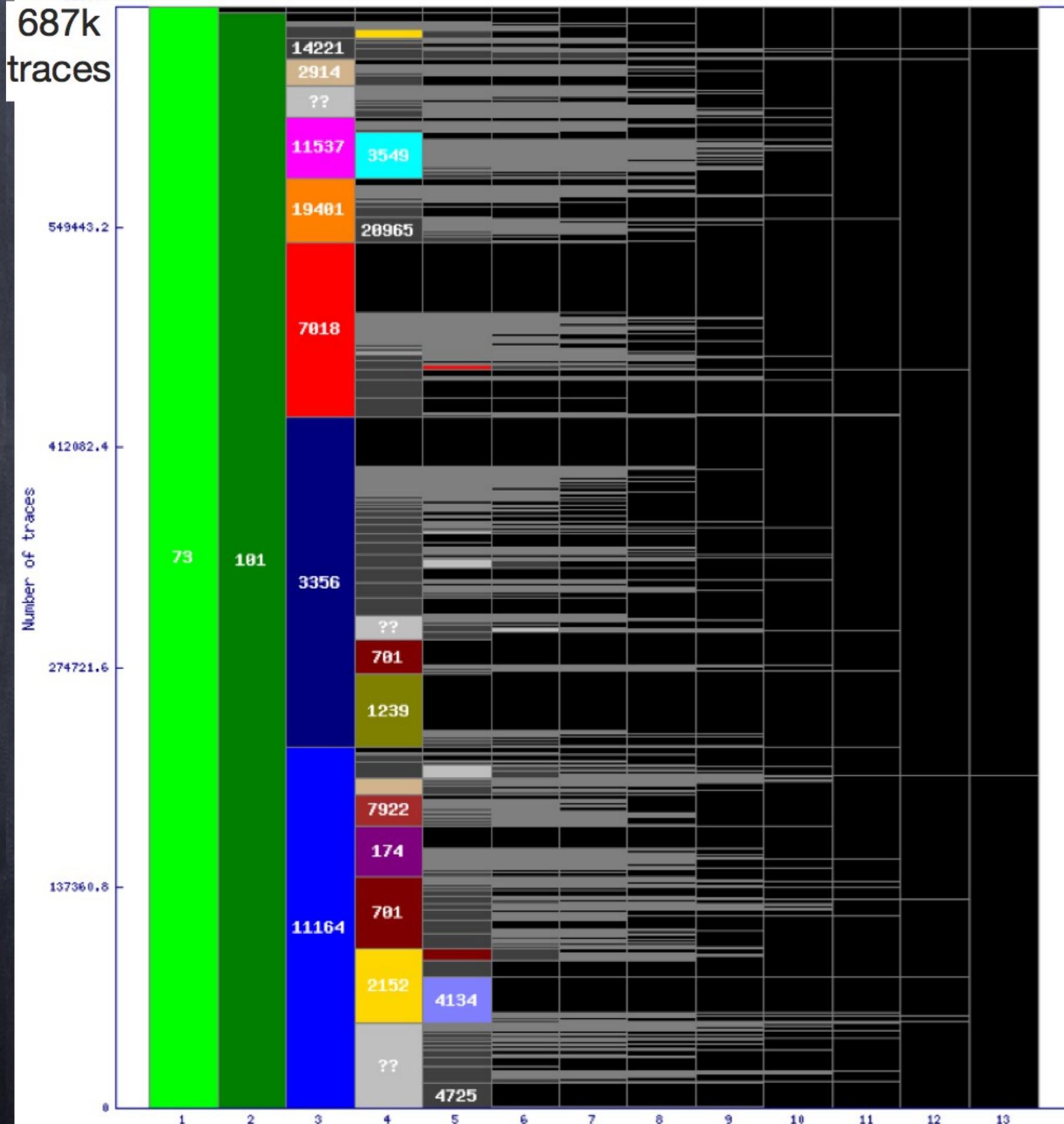
7587	ACCESSNETWORKS DA-NET::Data:Digital:Dialing:ACCESSNET::ID
38759	AIX-NAP-AS2-ID TRANSMEDIA INDONESIA, PT
17451	BIZNET-AS-AP BIZNET ISP
7473	SINGTEL-AS-AP Singapore Telecommunications Ltd
3356	LEVEL3 Level 3 Communications
45147	NAPINFO-TRANSIT-AS-AP PT. NAP Info Lintas Nusa
5459	LINX-AS London Internet Exchange Ltd.
286	KPN KPN Internet Backbone
2914	NTT-COMMUNICATIONS-2914 - NTT America, Inc.
701	UUNET - MCI Communications Services, Inc. d/b/a Verizon Business
10217	NTT-NET-ID-AS PT. NTT Indonesia
209	ASN-QWEST - Qwest Communications Company, LLC
4134	CHINANET-BACKBONE No.31,Jin-rong Street
7018	ATT-INTERNET4 - AT&T Services, Inc.
1299	TELIANET TeliaNet Global Network
7922	COMCAST-7922 - Comcast Cable Communications, Inc.
6453	GLOBEINTERNET TATA Communications
4837	CHINA169-BACKBONE CNCGROUP China169 Backbone
1239	SPRINTLINK - Sprint

AS hop



caida
www.caida.org

AS dispersion by IP hop



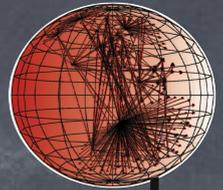
- 73 WASHINGTON-AS - University of Wash
- 101 WASH-NSF-AS - University of Washing
- 11164 TRANSITRAIL - National LambdaRail, L
- 3356 LEVEL3 Level 3 Communications
- 7018 ATT-INTERNET4 - AT&T WorldNet Serv
- 701 UUNET - MCI Communications Service
- 2152 CSUNET-NW - California State Universi
- 1239 SPRINTLINK - Sprint
- 19401 NLR - National LambdaRail
- 11537 ABILENE - Internet2
- 174 COGENT Cogent/PSI
- 4134 CHINANET-BACKBONE No.31,Jin-rong
- 3549 GBLX Global Crossing Ltd.
- 2914 NTT-COMMUNICATIONS-2914 - NTT A
- 7922 COMCAST-7922 - Comcast Cable Com
- 20965 GEANT The GEANT IP Service
- 4725 ODN SOFTBANK TELECOM Corp.
- 14221 WASHINGTON-RD-AS - University of

Data: IPv4 Routed /24 Topology

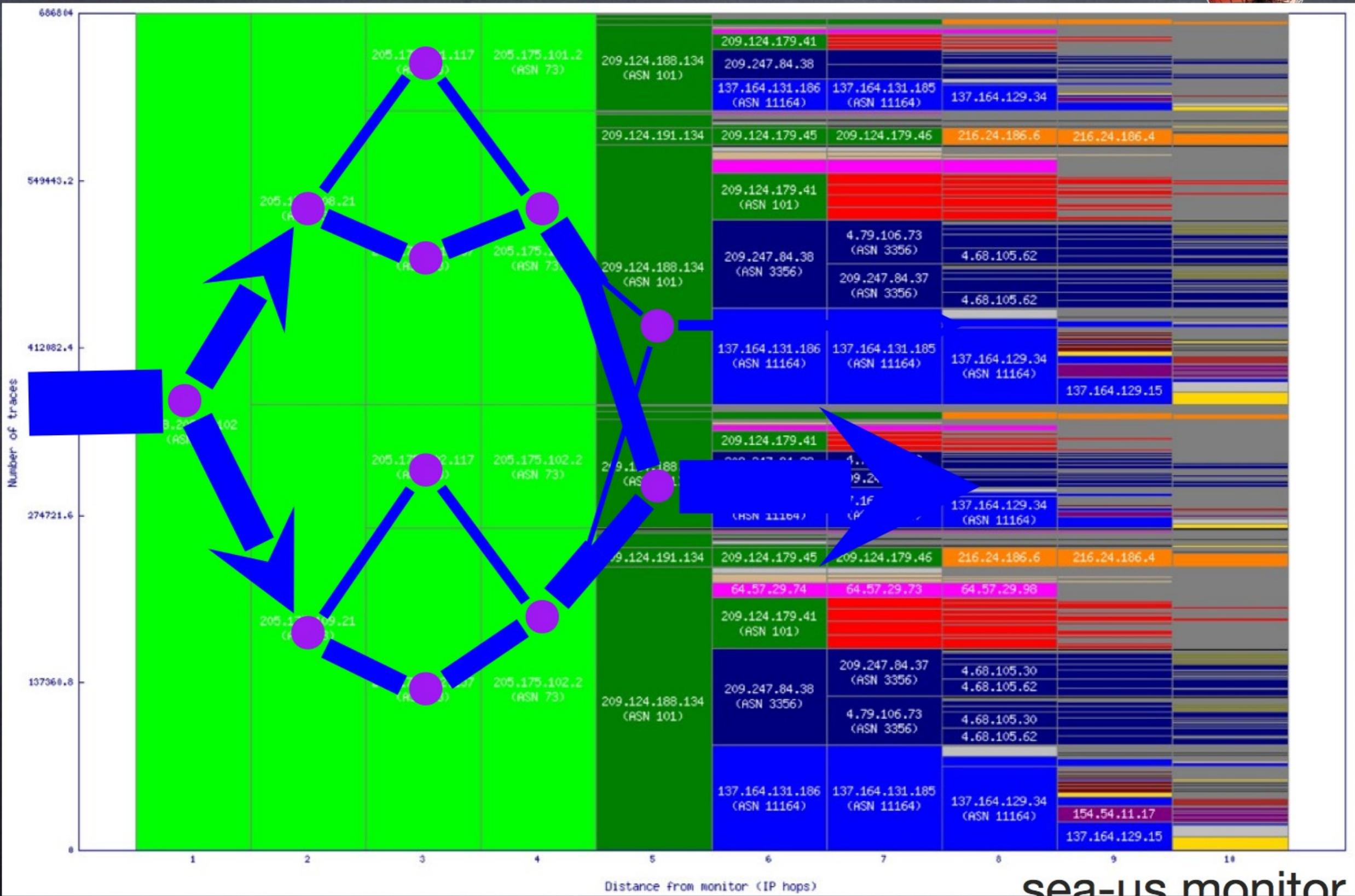


- ongoing large-scale topology measurements
 - ICMP Paris traceroute to every routed /24 (8.25 million)
 - about 126 /8-equivalents of routed space (as of Oct 2009)
 - running *scamper*
 - written by Matthew Luckie of WAND, University of Waikato
- dynamically divide up the measurement work among members of monitor teams
 - 3 teams active
 - 13-member team probes every /24 in 2-3 days at 100pps
 - only one monitor probes each /24 per cycle (=one pass through all /24's)

AS dispersion by IP hop: see load balancing

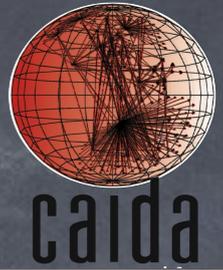


caida
caida.org



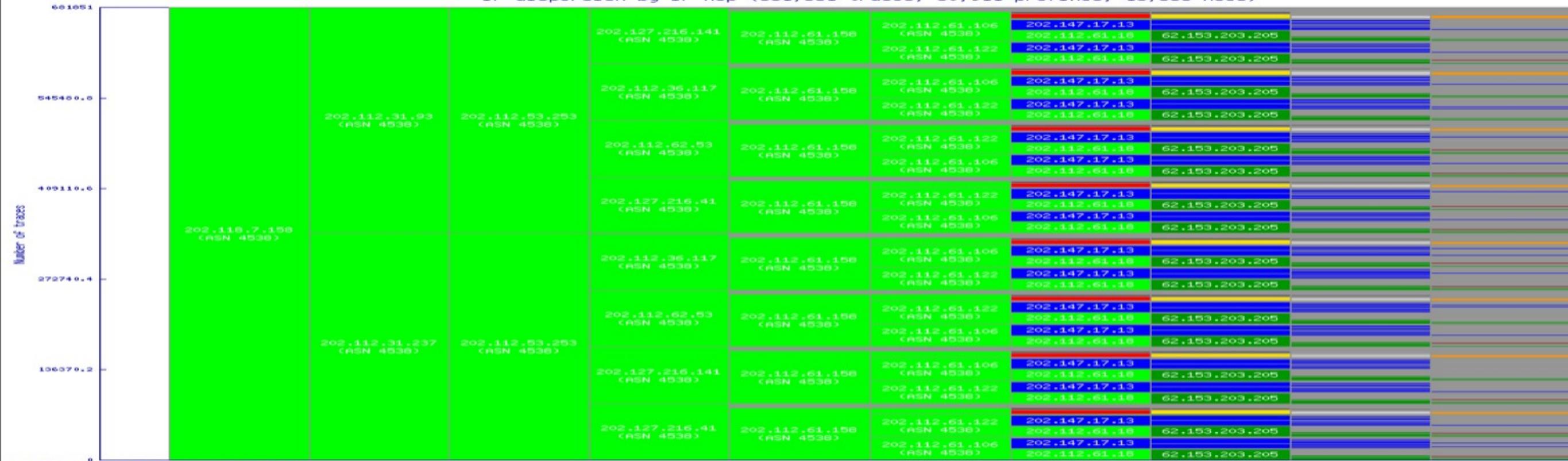
sea-us monitor

Chinese monitor (top) shows IP load balancing over many hops;
 Chilean monitor (bottom) many fewer IP hops to other ASes.



IP Dispersion by IP Hop

IP dispersion by IP hop (681,851 traces, 80,911 prefixes, 15,358 ASes)

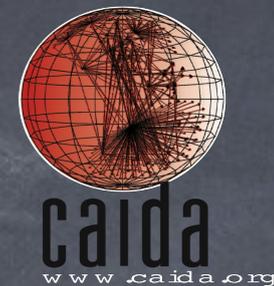


IP Dispersion by IP Hop

IP dispersion by IP hop (721,556 traces, 83,148 prefixes, 15,741 ASes)



Other Links



- IRNC-SP: Sustainable data-handling and analysis methodologies for the IRNC networks

<http://www.caida.org/funding/irnc/>

- Archipelago (Ark) network measurement platform

<http://www.caida.org/projects/ark/>

- Archipelago Monitor Statistics

<http://www.caida.org/projects/ark/statistics/>

- Coralreef

<http://www.caida.org/tools/measurement/coralreef/>