Internet Traffic Trends

A View from 67 ISPs

AUSNOG
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State of Internet Statistics

- Lack of global, quantitative Internet traffic studies
  - Some single ISP traffic research and commercial datasets (e.g. Akamai, Google, etc.)
  - Lots of BGP data and many analyst reports
  - But last global traffic data from 1995 ARTS report
- Significant open engineering / research questions
  - How is the Internet traffic evolving?
  - Am I the only ISP seeing this attack?
  - Is growth of application X local or Internet wide?

Internet Traffic Project

- **Goal**: Provide first global view of Internet traffic and attack trends

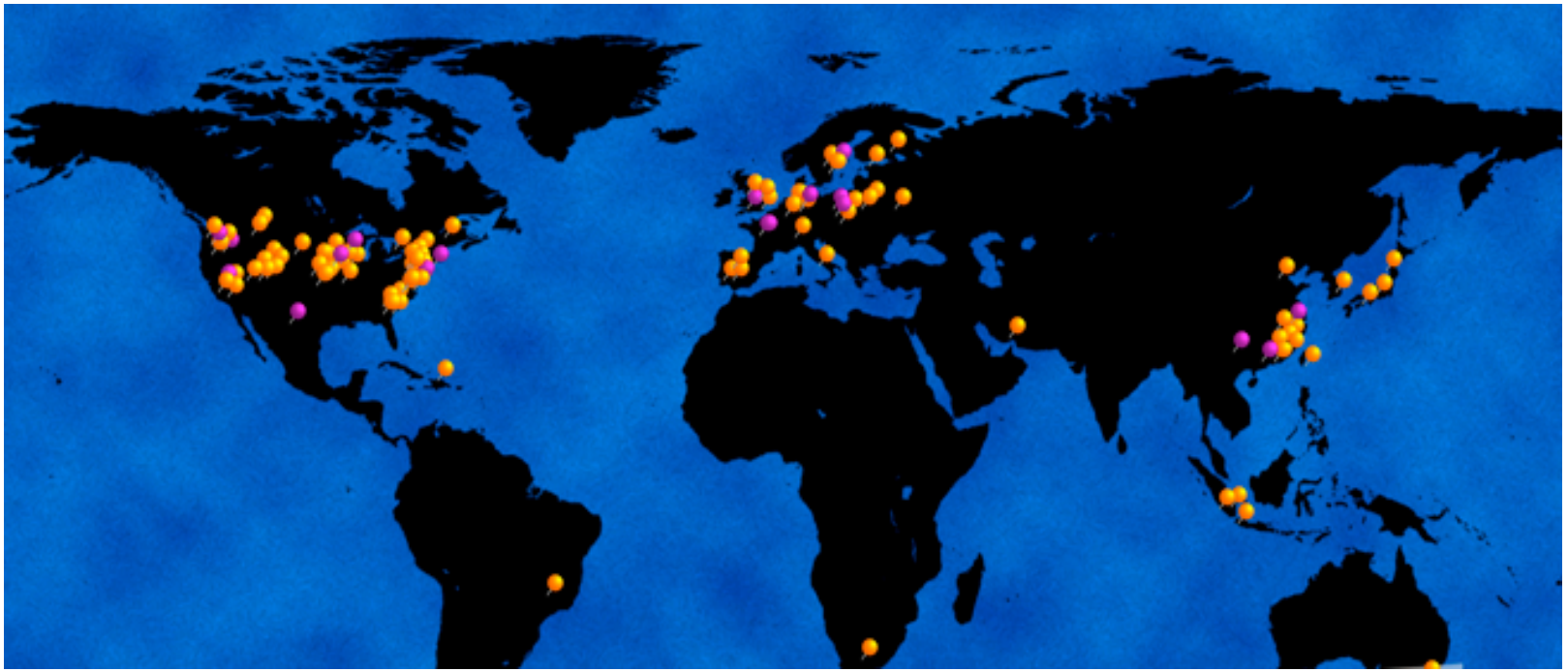
- Leverage commercial probe deployments
  - Pool of 2,500+ Flow / DPI collectors
  - Across 250 ISPs / Content Provider / Higher Ed

- Internet scale data collection
  - Traffic, DPI, Mitigation and Security datasets
  - Geographically and topologically diverse

Internet Traffic Project

- Service operational and research interests
- Outgrowth Fingerprint Sharing Initiative (45 publicly disclosed participants) and Security Survey
- Data from explicit voluntary anonymous data sharing agreement with ISPs
- Research Partners
  - Arbor, University of Michigan, Princeton (Intern)
  - And 78 customers (and growing)
- Initial / preliminary presentation of data

Internet Traffic Deployment



- 67 long-term participants (2 years)
- 17 unique countries
- 27 in US, though many have global footprint

Current Traffic Project Deployment

- 67 long-term ISPs (now 78)
  - 5 MSO, 4 Tier1, 15 Tier2, 4 Content, 1 R&E
  - Remainder not self-catagorized

- 1,270 routers
- 141,629 interfaces
- > 1.8 Tbps of inter-domain traffic
- 638 days and counting (began SEP 2006)

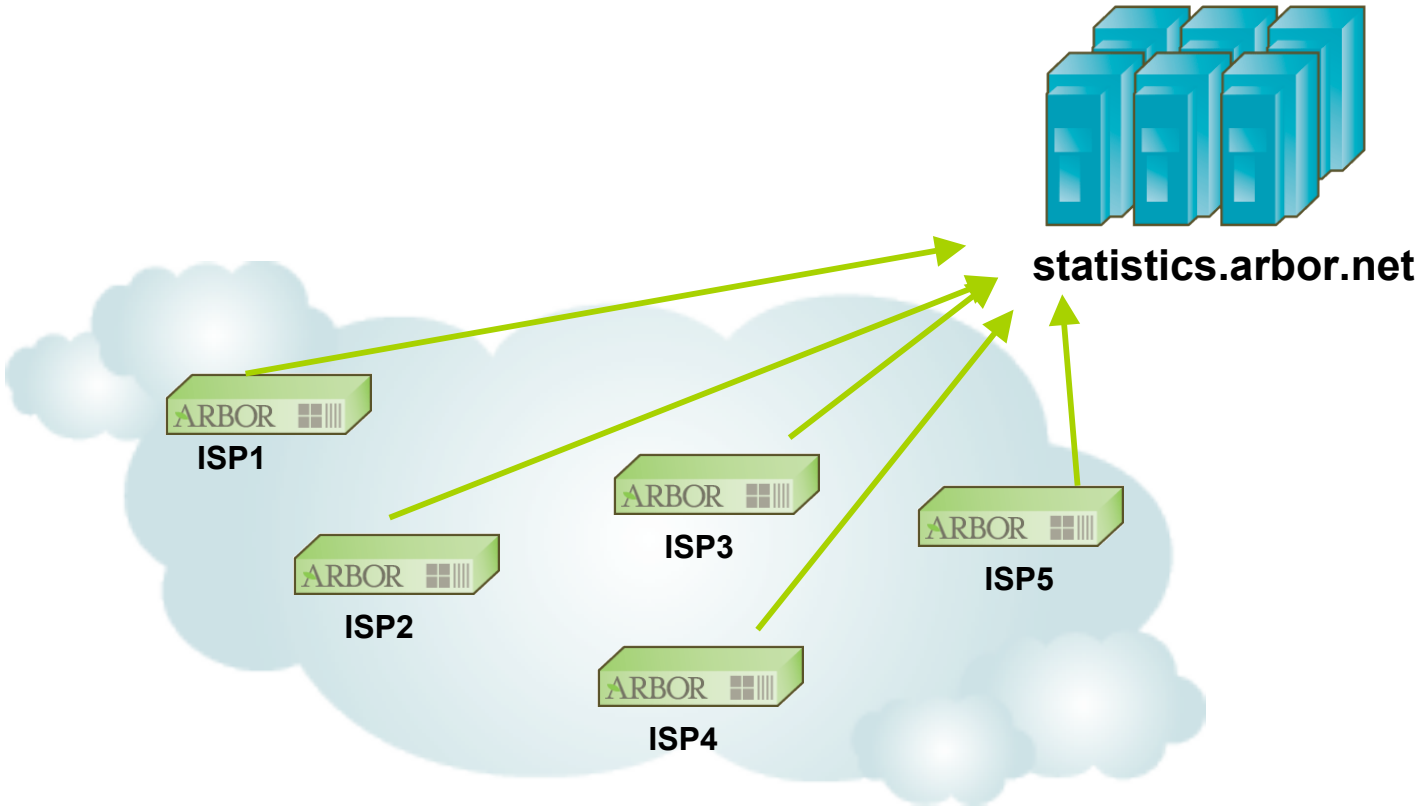
Typical ISP Deployment

- Flow (NetFlow / JFlow/ / etc) from all peering edge routers
- DPI from gigabit inline / portspan in front of customers or server clouds
- Exported to commercial probes
  - Usually 1/100 - 1/000 sampling
  - Regexp or BGP based classification of border interfaces to avoid double counting
  - Data validated against interface SNMP counters

Probe Data Sources

- Five minute traffic samples
  - Traffic In/out of network (subset of backbone traffic)
  - Cross-products based on top N protocols, ASNs, ports, applications, etc.
- Traffic anomaly data
  - Combination protocol signatures, behavior and statistical variance from baselines
  - Distinguish Attack versus Flash Crowd
    - Annotations and mitigation status
- Self-Categorization
  - Tier1/2/3, Content, High Ed, etc
  - Predominant geographic coverage area

Internet Traffic Project

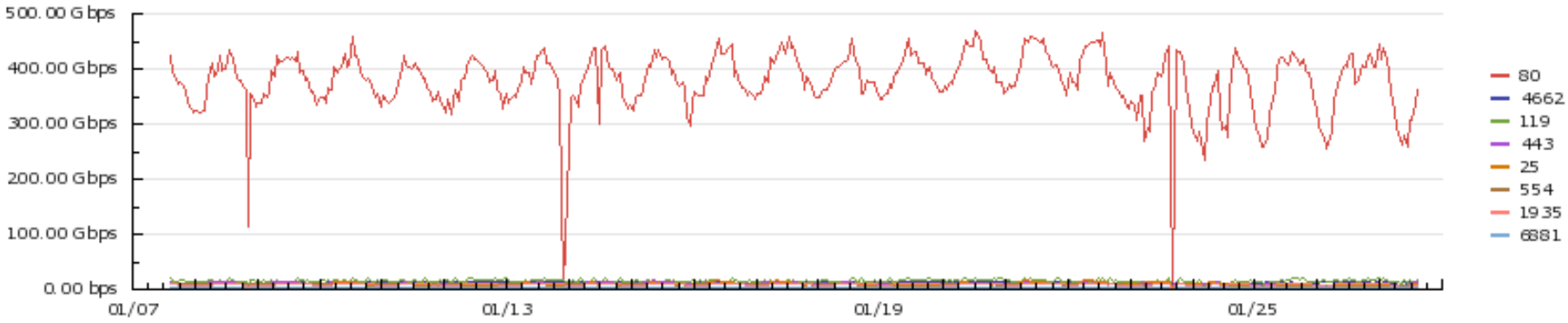


- Each participating ISP deployment submits XML
- Anonymous XML over SSL every hour
- Arbor managed servers collect/process

90 Day Protocol Distribution Trends

- No real surprises: TCP dominates followed by UDP
- Possible North America / Europe bias to dataset given diurnal patterns
- Wither IPv6?

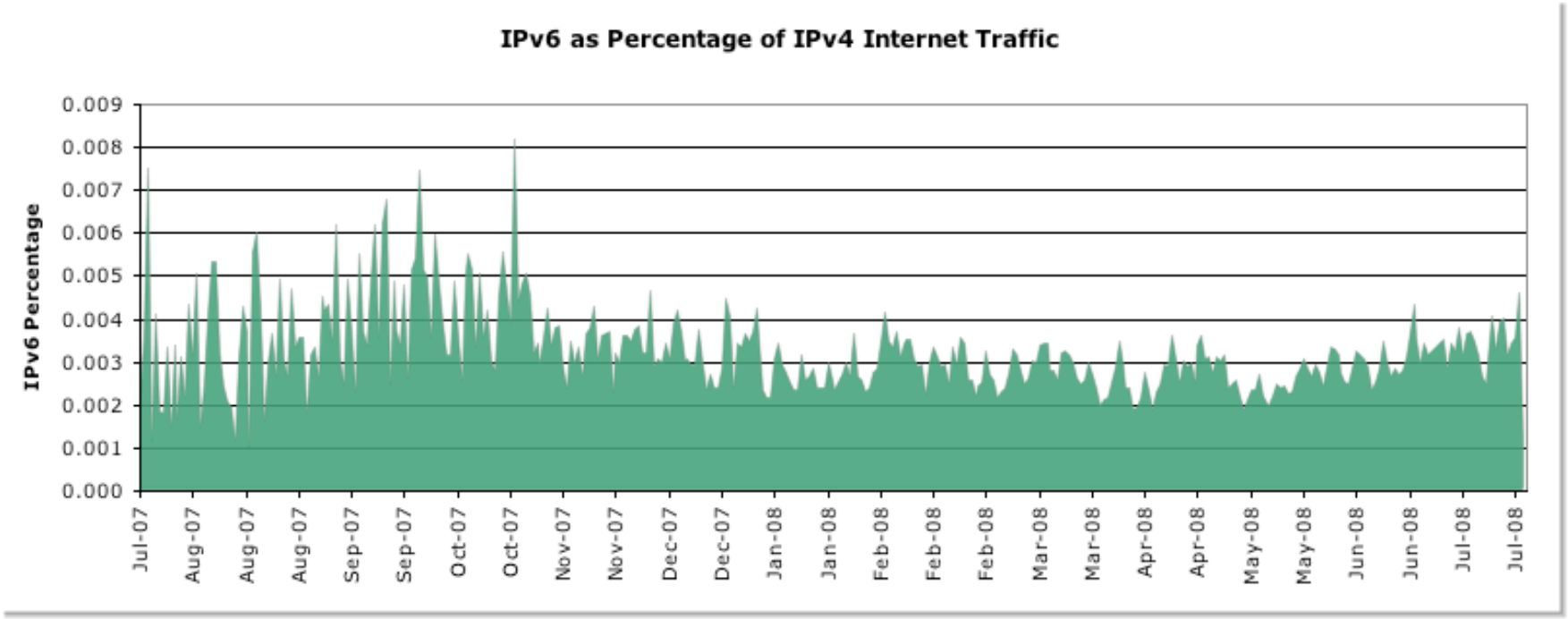
60 Day TCP Port Trends



- Again, no surprises: http/80 by far most prominent TCP port
- In second place, Tcp/4662 (edonkey) most prominent inter-domain peer-2-peer file sharing protocol
- Rises of NNTP (ranks 3rd) as file sharing alternative (alt.binaries!)

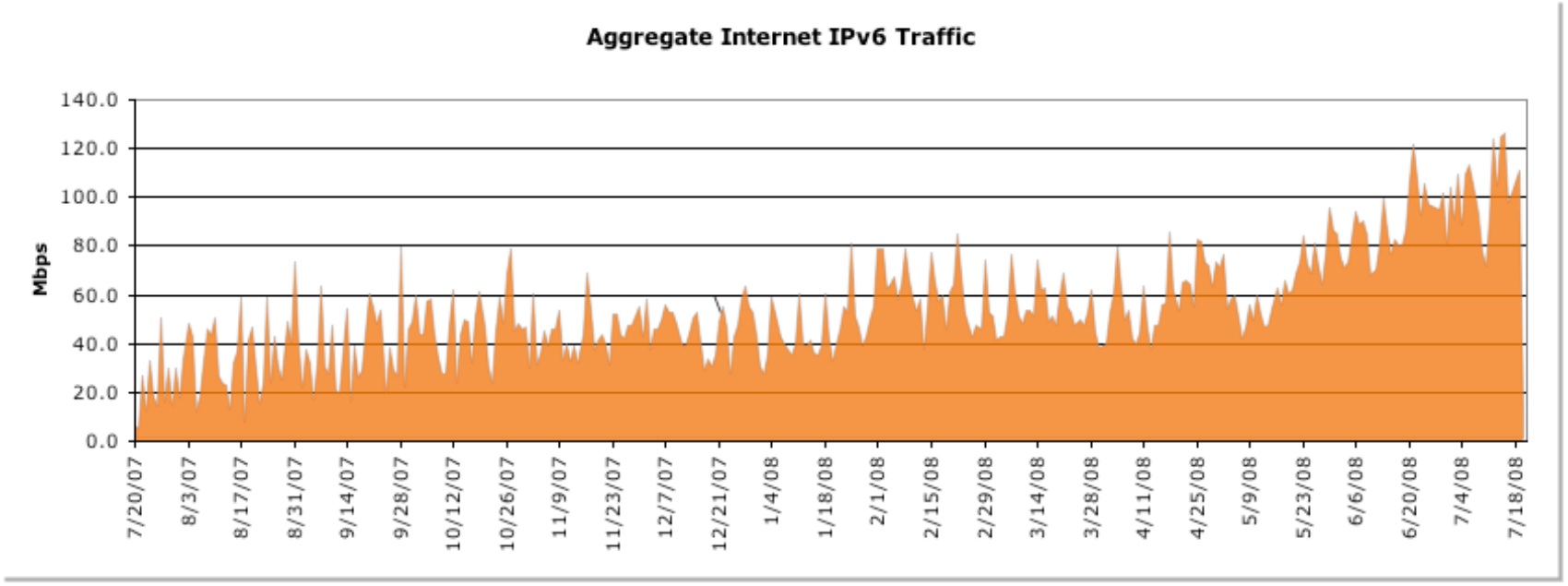
IPv6 Traffic Distribution

- ASNs with IPv6 BGP Announcements: 3%
- Internet2 sites with passing IPv6 Grade: 1%
- Alexa Top 500 websites IPv6-enabled: 0.4%
- IPv6 DNS queries as % of total: 0.2%
- **IPv6 percentage of all Internet traffic: 0.0026%**



Aggregate IPv6 Traffic

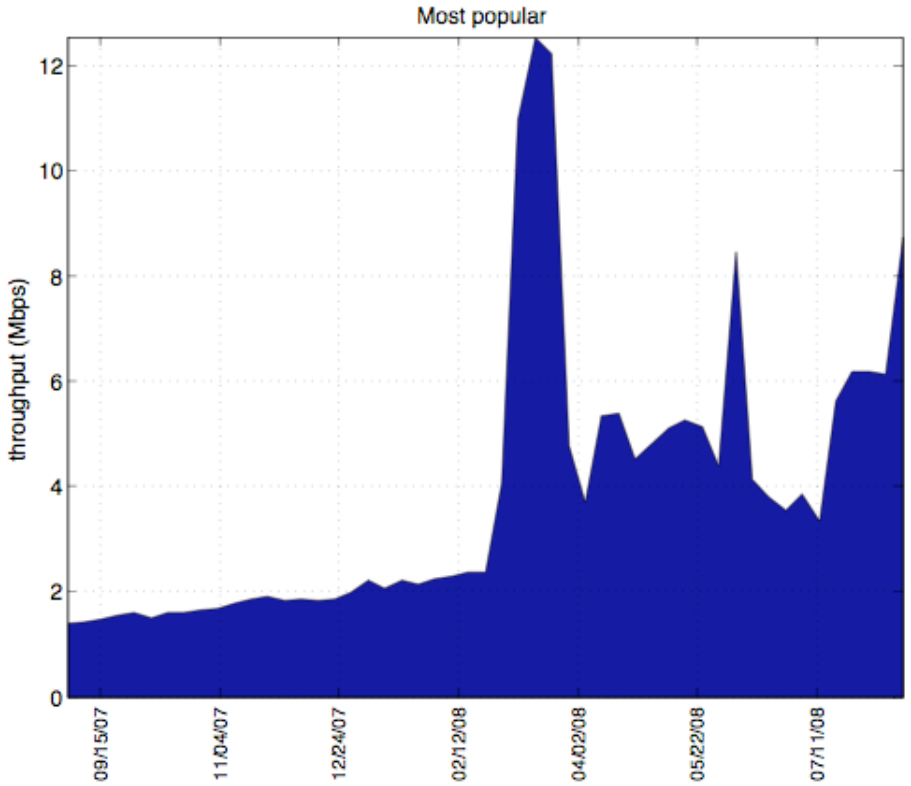
- Since July 2007, IPv6 traffic has grown by nearly a factor of 5 to an average of 100 Mbps per day.
- BGP tables show an even larger proportional growth. Though not a landslide of adoption, it is still something.



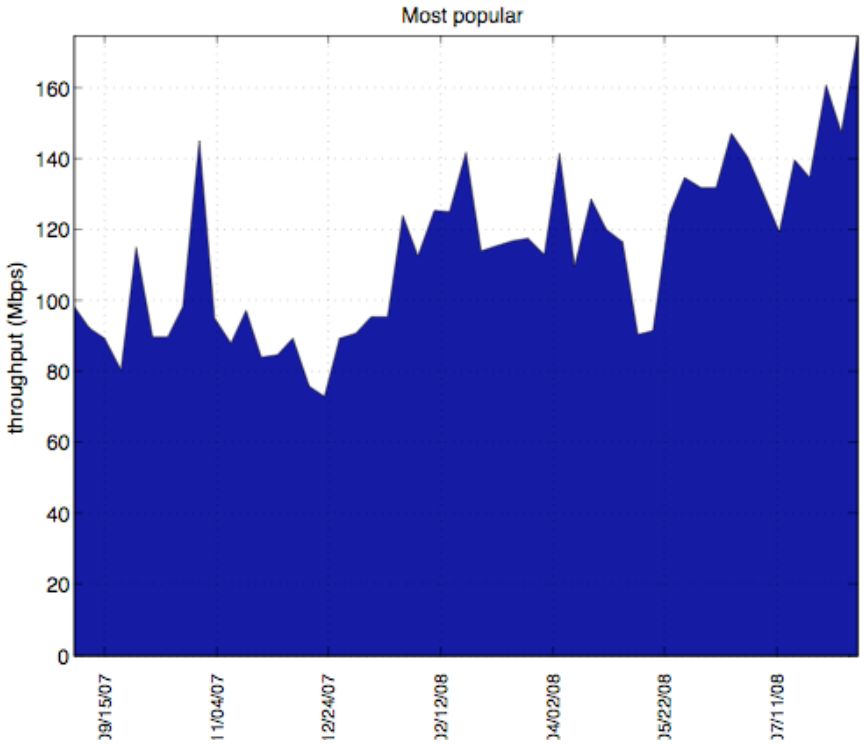
Teredo, Port Obfuscation, etc..

- If port obfuscation or related techniques are employed we're held captive to that, as our observations *here* are based solely on Network and Transport layer data
- Teredo traffic upticks have been observed, new chart as of yesterday below. If not using well-known ports - well, yes, we realize that's not reported
- Only 14 deployments have observed any port 3544 control traffic, and of those only two saw a significant amount. The rest saw only kbps, and had weeks of none subsequently
- Some observable upticks as a result of new software releases, industry events, etc.. (e.g., uTorrent, IETF)
- IPv6 here still miniscule compared to aggregate

Aggregate IPv6 Teredo (port 3544)



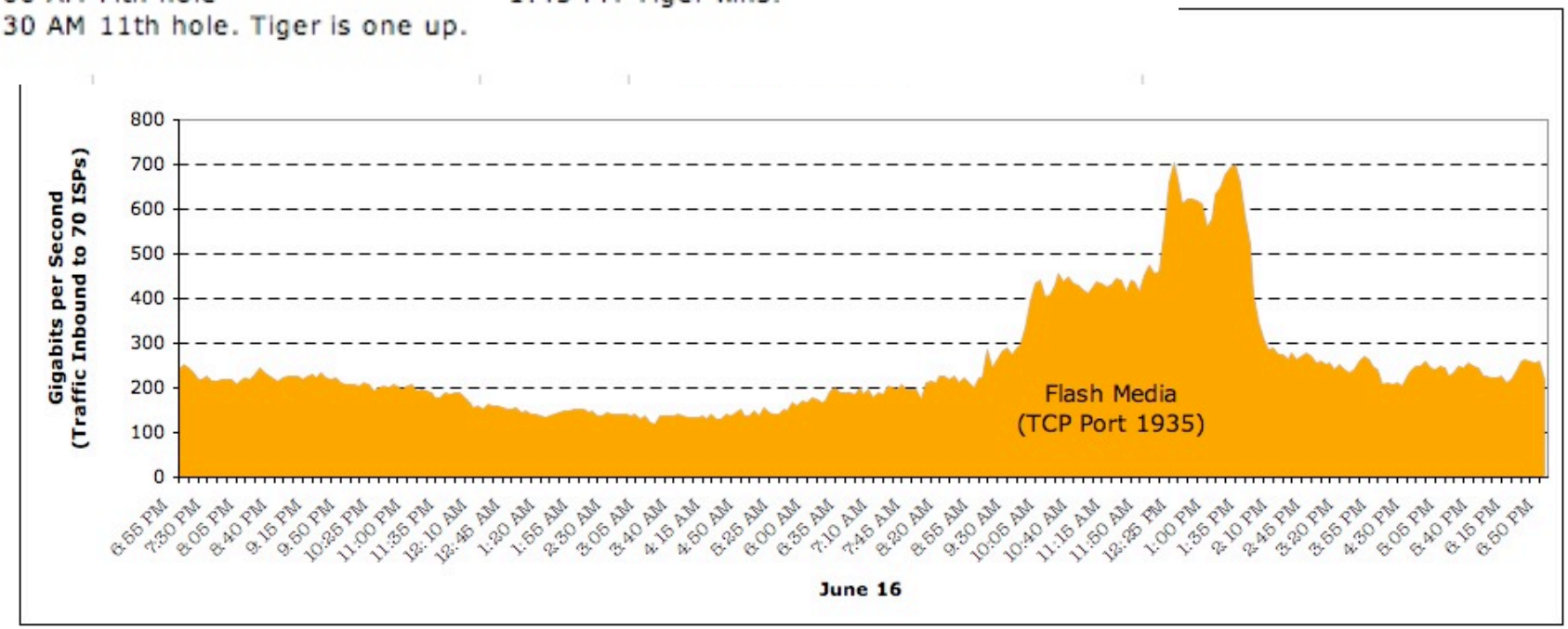
Teredo



IPv6 (native & tunneled)

The Tiger Effect

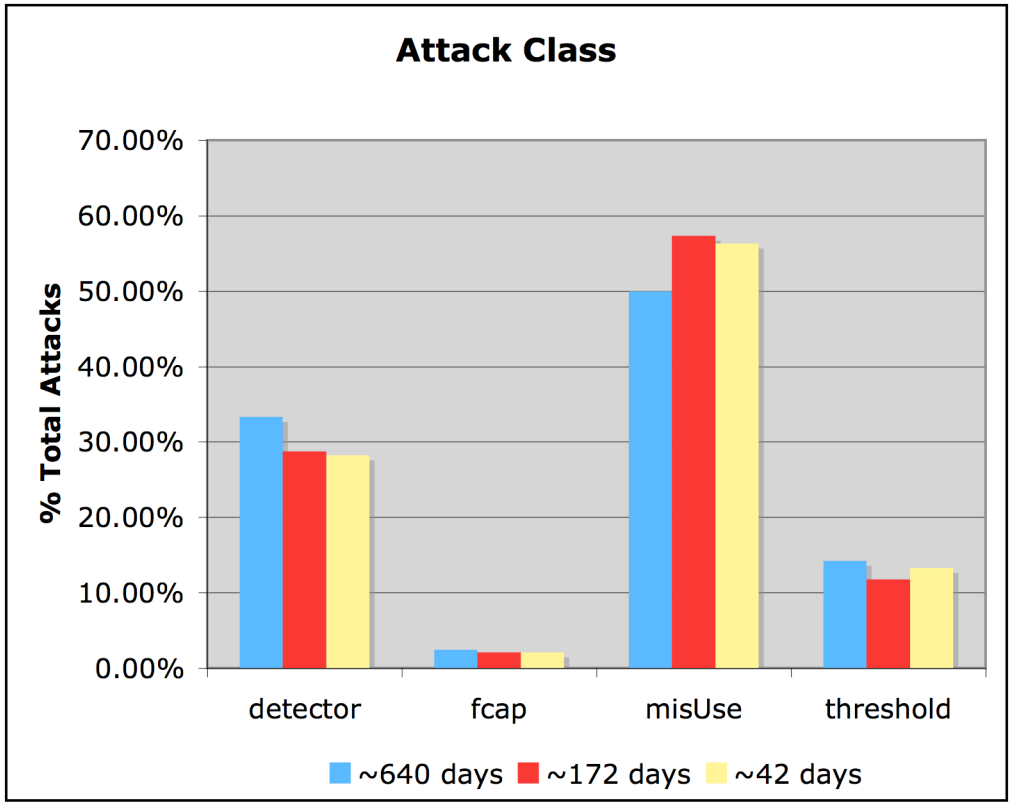
9:15 AM Tiger Tees Off
9:30 AM Third hole
10:00 AM Fith hole
11:30 AM 11th hole. Tiger is one up.
12:30 PM Tiger misses. Rocco is now one up.
1:15 PM First Sudden Death
1:45 PM Tiger wins!



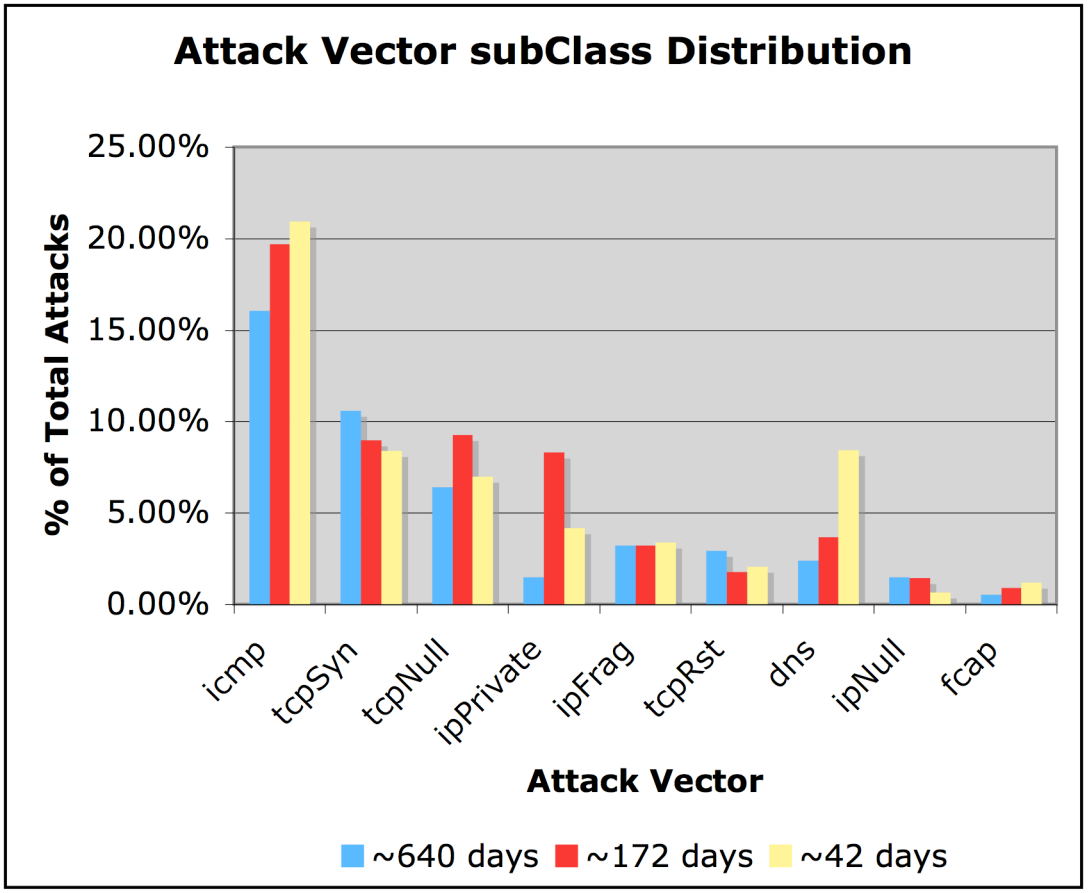
- June 16 spillover from U.S. Open at Torrey Pines, sudden-death playoff
- Largest sources of traffic were CDN network
- Tiger beat Rocco Mediate

Anomaly Summary

- Attacks based on statistical anomaly detection
- Primarily rate-based DDoS attacks
- We'll focus mostly on misUse attacks
- Total Attacks
  - 640 days: 1,166,282
  - 172 days: 582,412
  - 42 days: 200,782

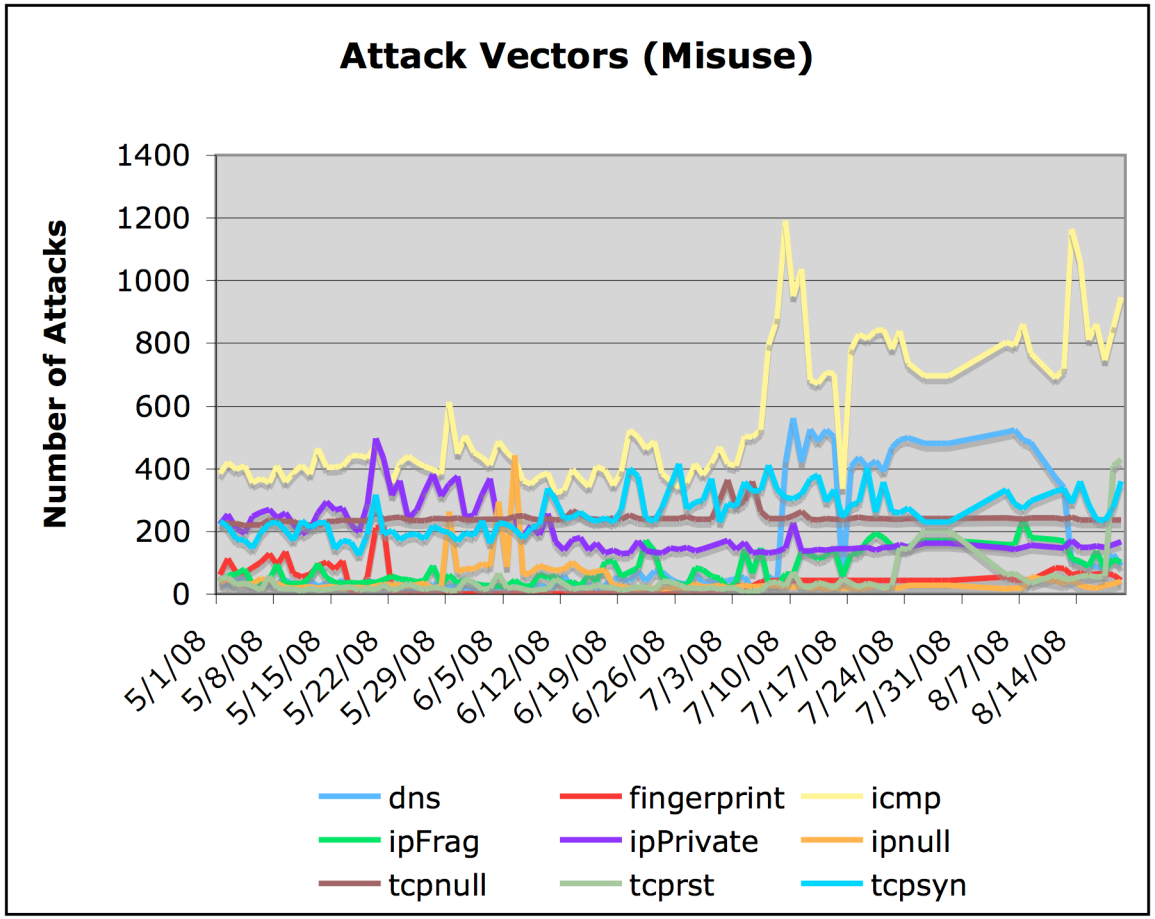


Attack Class Distribution



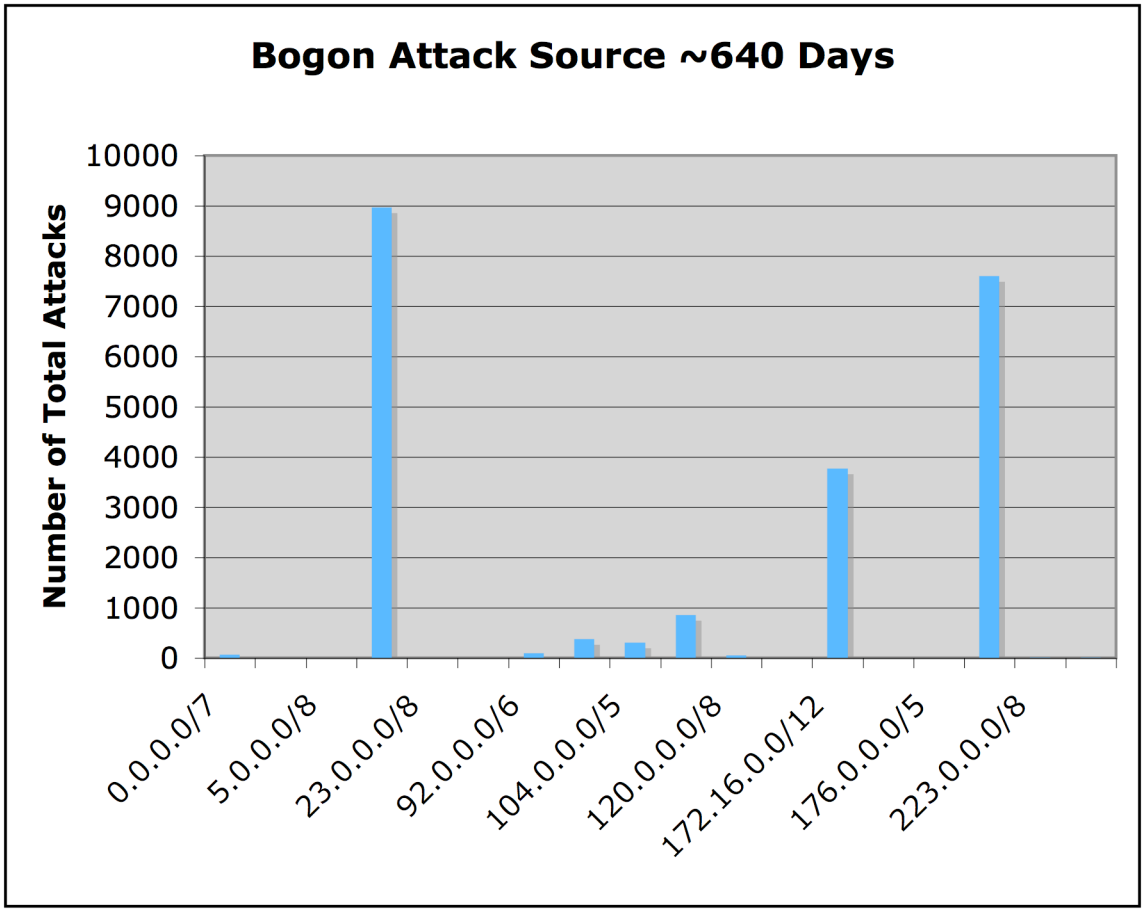
- Fairly consistent over past ~2 years
- Not surprisingly, TCP SYN and ICMP attacks remain most common attack vector
- Recent surge in DNS and ICMP rate-based anomalies

Attack Miuse subClass



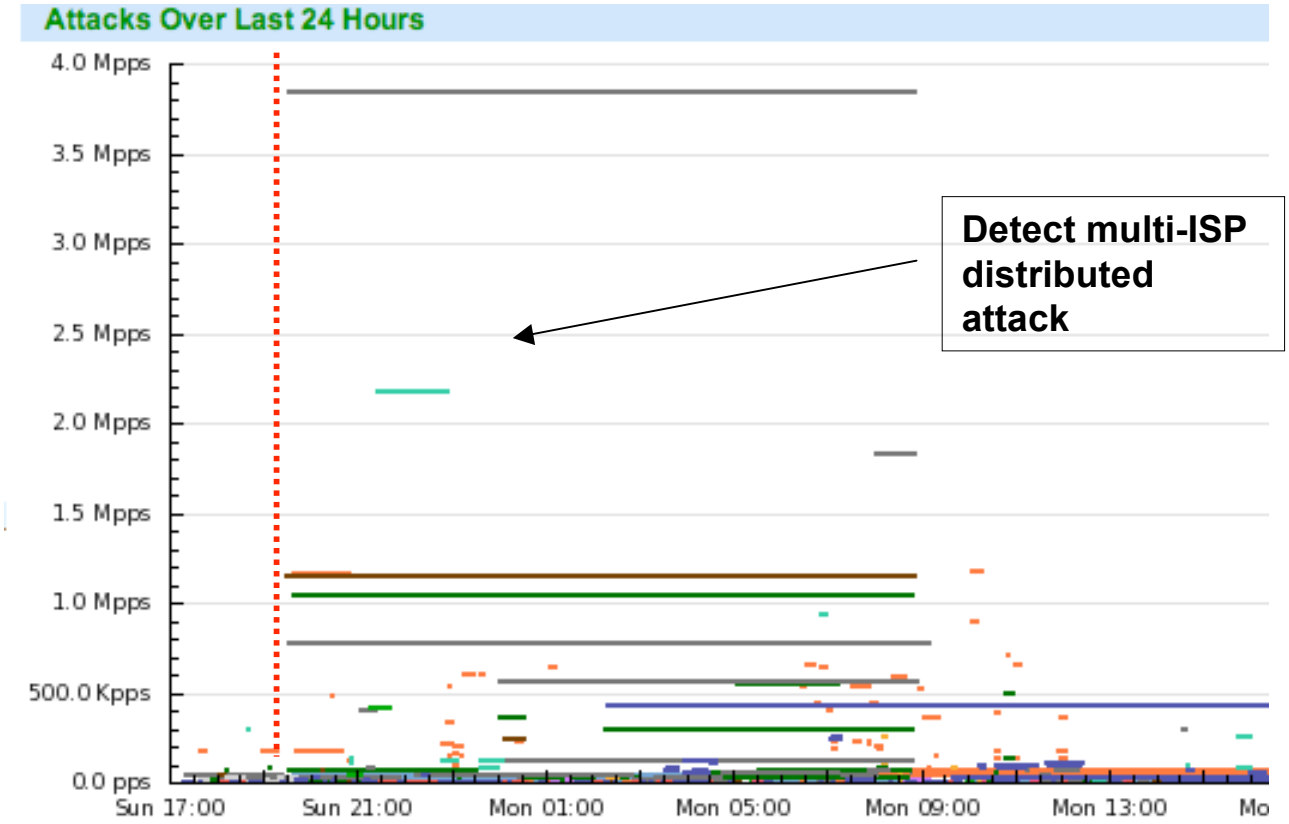
- 10x uptick in DNS attack activity, likely result of much testing (and actual attacks) from DNS cache poisoning vulnerability
- ICMP is backscatter from attacks
- DNS activity back down to ~2x pre-disclosure rates

Bogon Summary

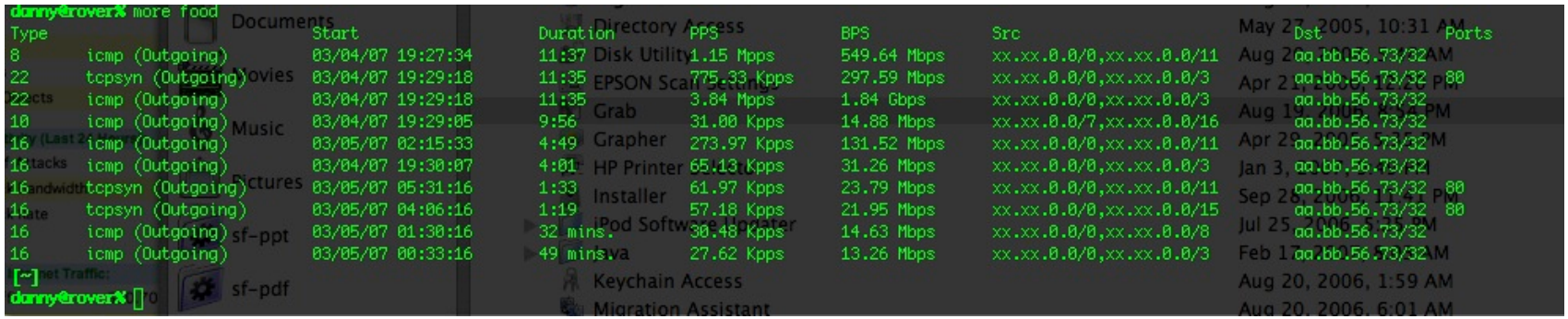


- 2.95% (22,153) of 749,672 misUse attacks employed at least one bogon attack source
- ~92% of that from 3 prefixes

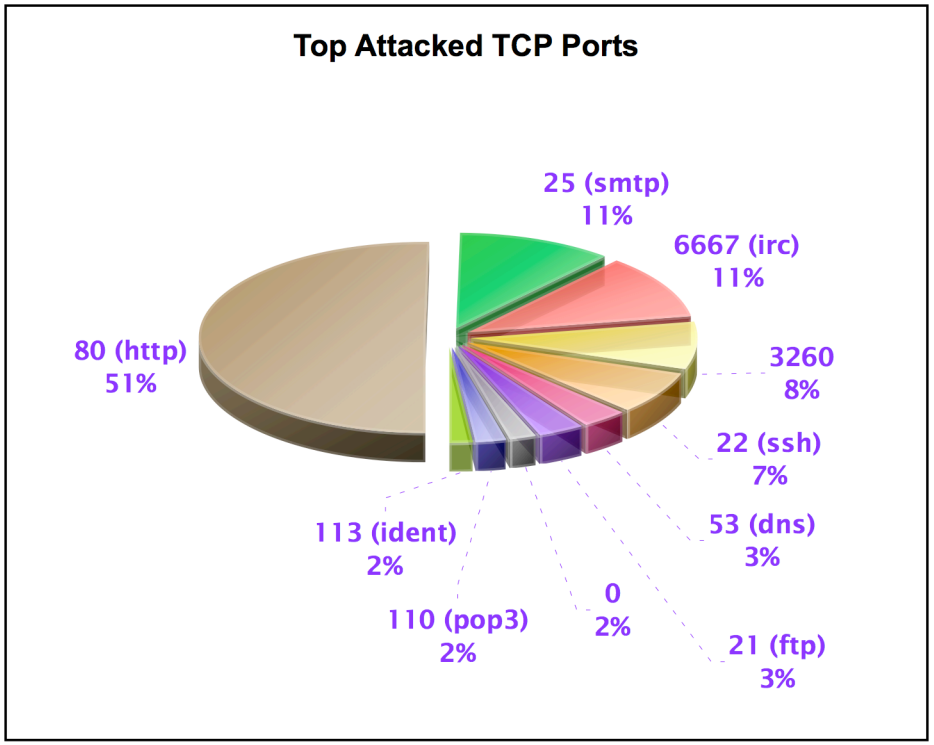
Internet Attack Propagation

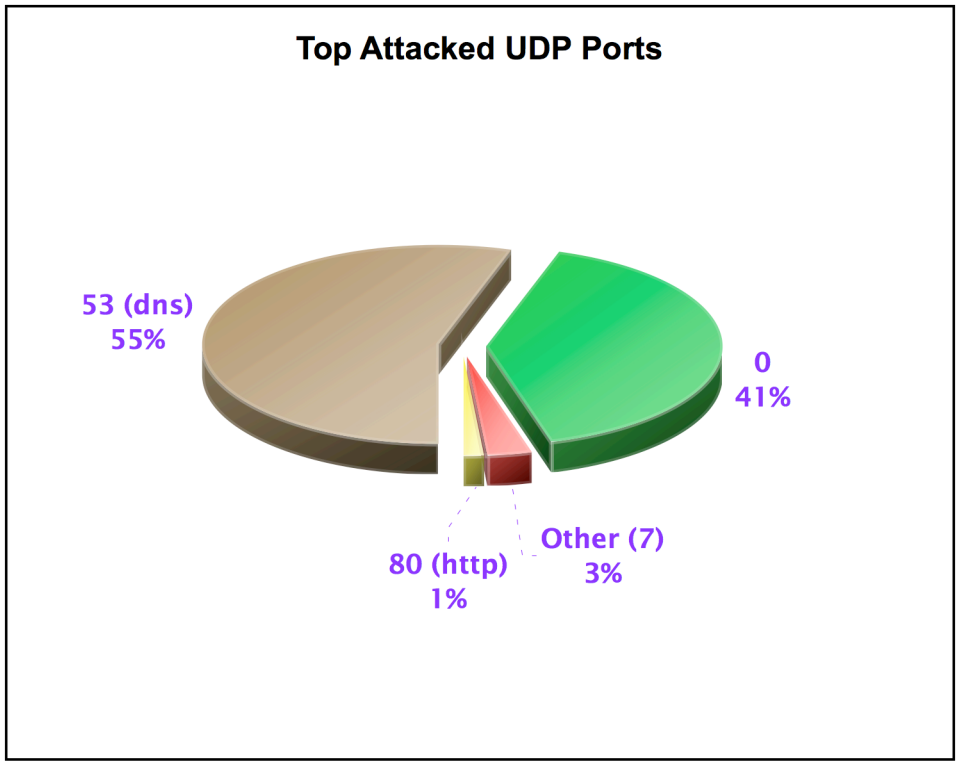


- Each color represents different anonymous ISP (30 represented)
- Each line represents different attack
- 7 Outbound ISPs, 10 attack streams (7 tcpsyn, 3 icmp) generating 6.312 Mpps, one Russian AV Vendor



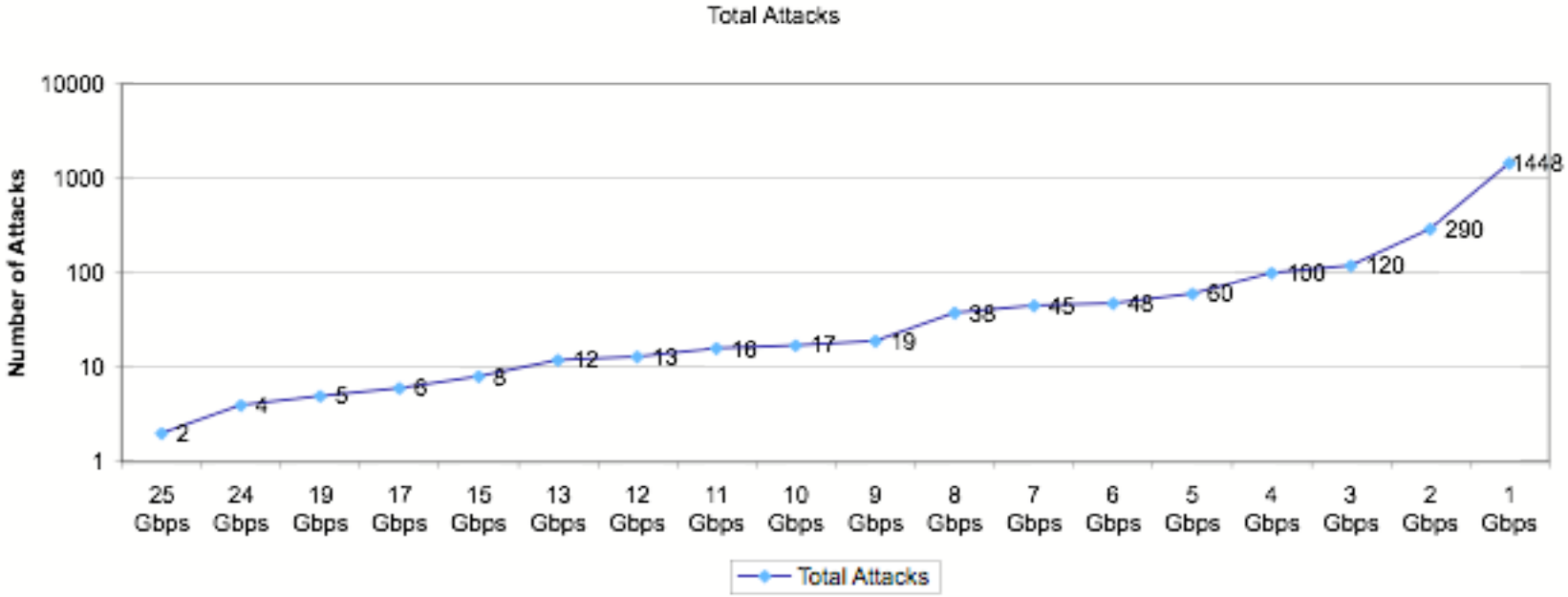
Most Frequently Attacked Ports





- 640 days
- HTTP ports account for bulk of TCP-based attacks
- Fragmentation attacks lead the pack on the UDP front

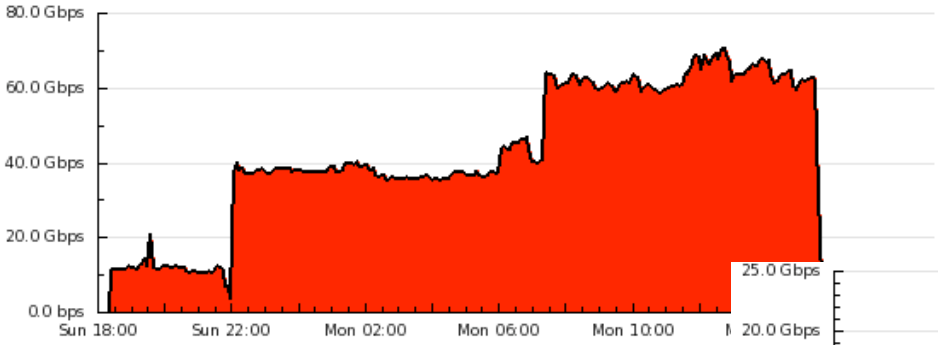
Internet Attack Scale



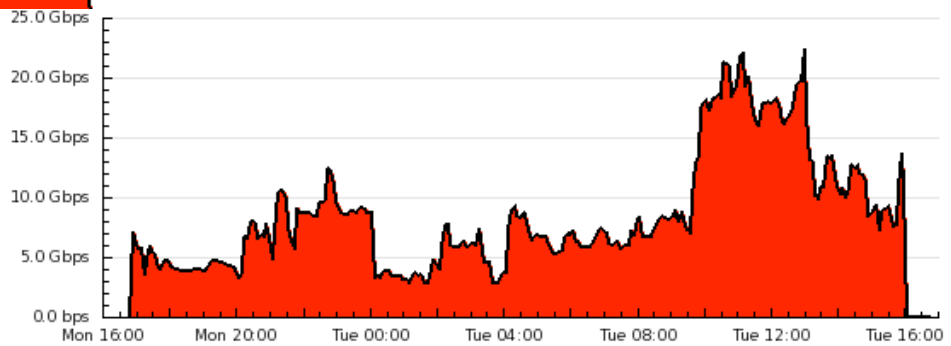
- Unique attacks exceeding indicated BPS threshold for single ISP
- Average of three 1-Gbps or larger attacks per day over 485 days of collection
- Two ~25 Gbps attacks reported by a single ISP (on same day, about one hour apart, duration of ~35 minutes)

Interesting Finding…

- Typical aggregate Internet traffic::attack_traffic ratio over past year is around 2%, although spikes like that illustrated below are common
- Two specific long-duration attacks (32.86 Gbps/17h30m & 22.36 Gbps/8h16m) contributing to most of the uplift below in January 28 chart

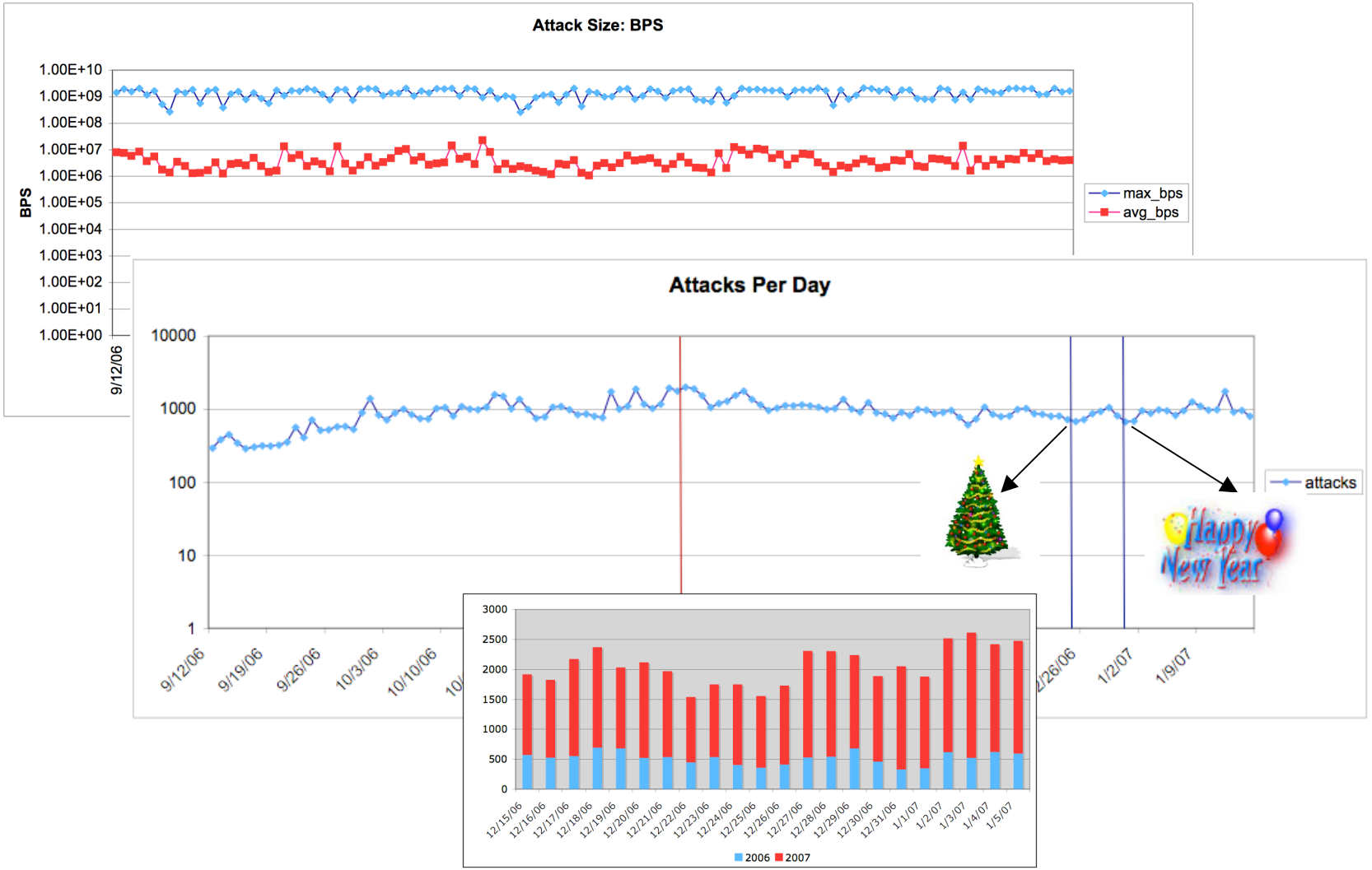


ATLAS: January 28, 2007

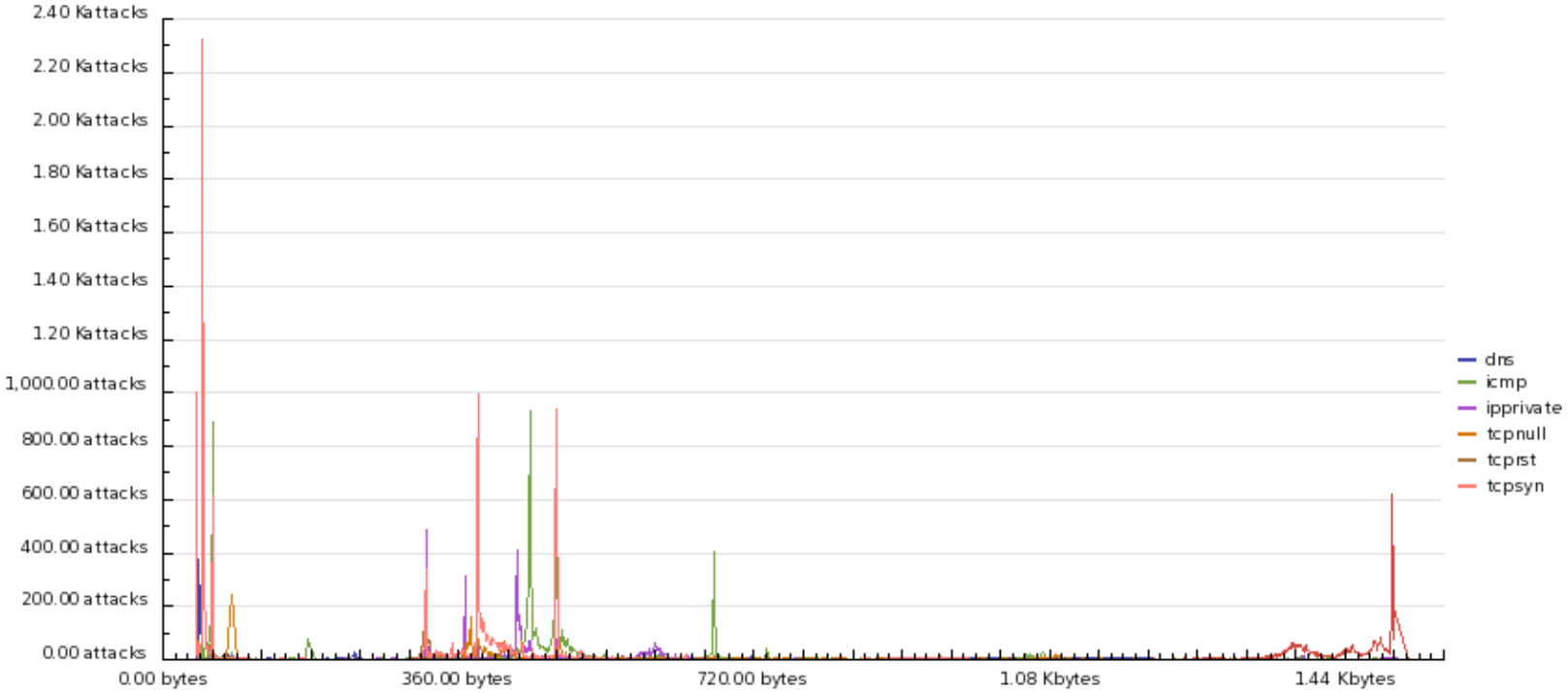


ATLAS: January 29, 2007

Attack Trending



Attack Packet Size Distribution



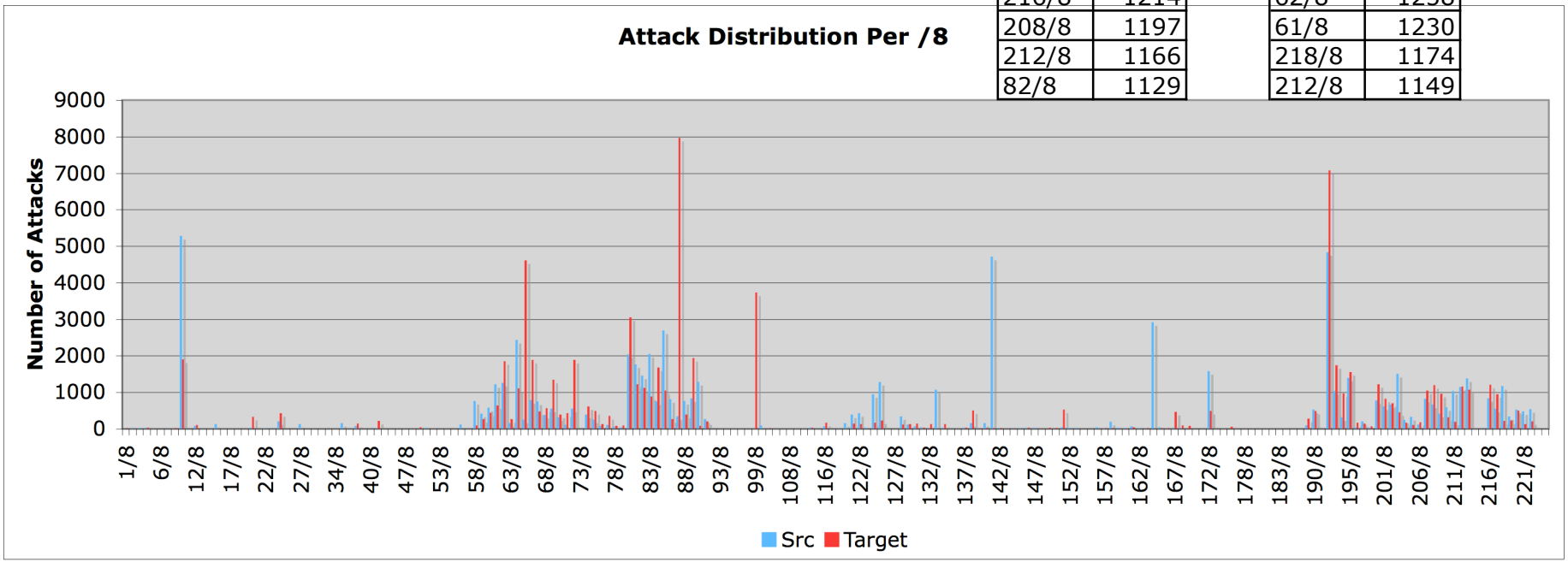
- Small packets predominate (pps attacks)
- Spectral analysis-like fingerprints of other attack types and tools
- Some issues with data collection methodology

Most Active IP Prefixes

- High user-density prefixes see high activity rates
- Swamp space sees high activity rates as well
- Rolled-up here only to /8s for presentation purposes, underlying advertising prefixes more telling

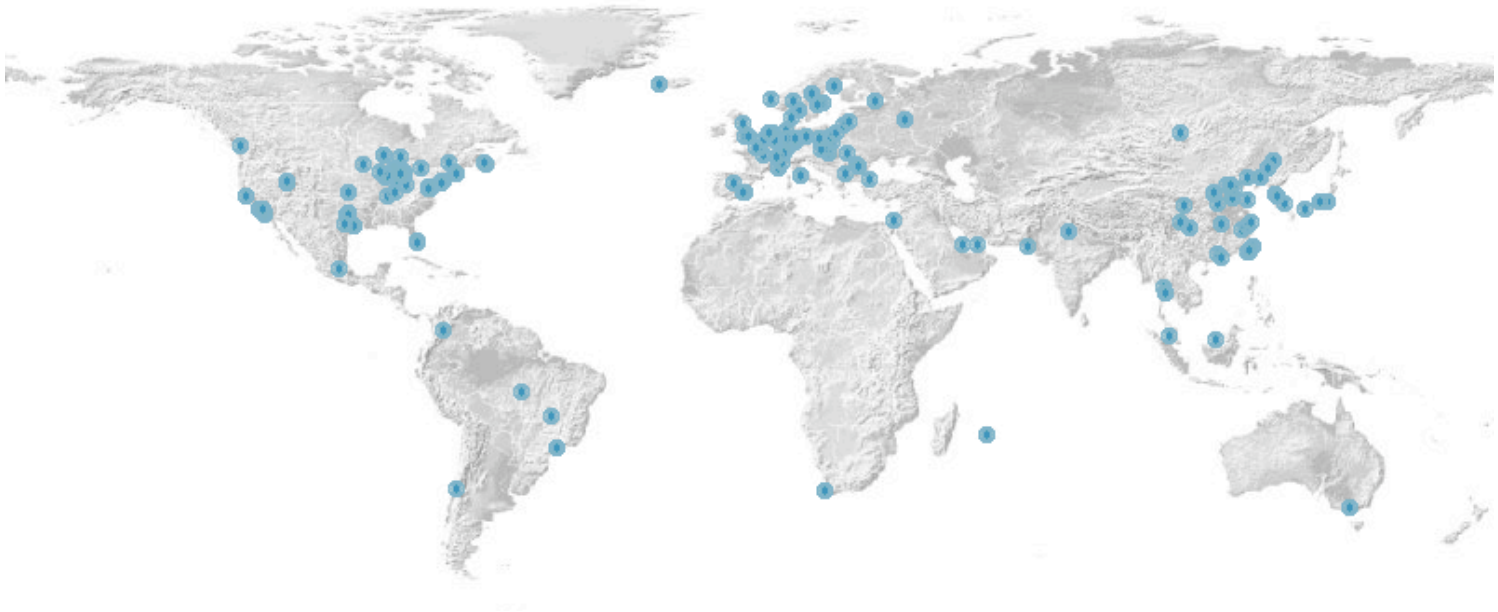
Prefix	Target
87/8	7978
192/8	7087
65/8	4614
99/8	3742
80/8	3061
89/8	1946
10/8	1906
72/8	1896
66/8	1894
62/8	1859
193/8	1744
84/8	1681
195/8	1555
69/8	1350
200/8	1230
81/8	1228
216/8	1214
208/8	1197
212/8	1166
82/8	1129

Prefix	Src
10/8	5289
192/8	4844
141/8	4715
164/8	2924
85/8	2700
64/8	2439
83/8	2057
80/8	2047
81/8	1769
172/8	1587
203/8	1510
82/8	1464
195/8	1395
213/8	1391
125/8	1289
90/8	1282
62/8	1258
61/8	1230
218/8	1174
212/8	1149



Multi-ISP Attack Source Countries

- 416 attack sources were reported across multiple ISPs, contributing to 5,078 total attacks
- Top attack source countries (ordered): US, CN, SE, JP, KR, RO, DE
- Attacking source PTRs in table below.



3(NXDOMAIN)	178
2(SERVFAIL)	11
com	73
net	37
edu	22
jp	16
de	10
ro	9
tw	6
se	6
br	6
ru	5
fr	5
pl	4
cz	3
ch	3
arpa	3
nl	2
mu	2
is	2
hu	2
cn	2
ca	2

Mutli-ISP Targets

- Top 13 Targets
- Most common IRC targets
- Interesting targets not listed?

Target	Attacks	ISPs	PTR
194.109.20.90/32	24	7	undernet.xs4all.nl
195.149.115.2/32	70	7	box1.freakshells.com
207.162.194.151/32	60	7	us.ircnet.org
129.143.67.242/32	29	6	irc.belwue.de
161.53.178.240/32	27	6	zagreb.hr.eu.undernet.org
195.144.12.5/32	11	6	undernet.it-ss.be
198.3.160.3/32	11	6	NXDOMAIN/Bandwidth.com
208.98.12.133/32	33	6	ip1064.prodhosting.com
62.94.0.22/32	10	6	irc.eutelia.it
64.157.15.117/32	14	6	yul.desync.com
64.18.151.101/32	10	6	i.hate.Dd0s.co.uk
69.16.172.40/32	25	6	irc3.easynews.com
80.244.168.23/32	31	6	mail.iparser.net

- Top 20 Sources
- Only 3 PTRs Exist - SPAM PTR map correlation?
- 3 RFC 1918

Attack Source	Attack	ISPs	AS NAME (*PTR Exists)
202.196.225.134/32	72	8	ERX-CERNET-BKB
192.168.0.1/32	143	7	NA
89.160.52.135/32	64	7	SKYCOM-AS SkyCom Sweden
89.160.52.112/32	36	7	SKYCOM-AS SkyCom Sweden
82.183.102.167/32	88	6	TELENOR-NEXTEL T.net
82.183.102.89/32	55	6	TELENOR-NEXTEL T.net
192.168.1.2/32	104	5	NA
218.25.40.238/32	60	5	CNCGROUP China169
82.183.102.134/32	51	5	TELENOR-NEXTEL T.net
89.160.52.97/32	48	5	SKYCOM-AS SkyCom Sweden
200.213.204.6/32	44	5	*Embratel
195.67.217.233/32	30	5	*TELIANET-SWEDEN
60.217.20.234/32	28	5	CNCGROUP China169
210.251.205.234/32	26	5	*TDNC TOKAI DIGITAL
192.168.1.6/32	25	5	NA
60.21.215.165/32	23	5	CNCGROUP China169
66.180.202.39/32	17	5	CYBERVERSE - Cyberverse Online
202.139.8.110/32	14	5	OPTUSCOM-AS01-AU SingTel Optus Pty Ltd
60.0.38.176/32	10	5	CNCGROUP China169

Internet Traffic Challenges

- Balance commercial privacy with research and greater Internet interests
- Data normalization / extrapolation
  - Differing notions tier1
  - Many business units within an ISP
- Data availability to other researchers

Questions?

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