Internet Traffic 2009-2019

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Internet Traffic Research

- Large-scale study of Internet traffic around world
 - Anonymized IPFIX, GRPC, DNS responses, BGP, SNMP
 - Collaborating ISPs via commercial software
 - Unique, global view of Internet
- Methodology similar to 2010 APRICOT / SIGCOMM
 - This talk very early preliminary 2019 results
 - Working on a new paper

The New York Times

Scientists Strive to Map the Shape-Shifting Net



C. Labovitz, S. lekel-Johnson, D. McPherson, J. Oberheide, F. Jahanian Internet Inter-Domain Traffic. SIGCOMM 2010

One Big Change from 2009

Crawl 4 Billion IPs Daily

>> 3 16.68 Gb (total: 13.34 Gbps Tags: onnet Sampling: 8192,64000 10.950 Gb (65.65 %) # DDOS Mbps: 8759 694.27 Mb ddos <- 52.23.146.248 14618 16509 636.42 Mb <-3.16.148.229 I ddos 597.61 Mb <-200.119.89.147 19429 I ddos 576.00 Mb <-104.186.116.130 7018 ddos 52.26.13.93 16509 I 561.32 Mb ddos <-154.126.81.205 37054 Т 459.42 Mb <ddos <- 3.19.0.171 16509 427.39 Mb ddos Ι 405.50 Mb <-85.204.96.177 ddos 52.23.146.248 14618 390.40 Mb ddos 1-<- 2.229.44.83 12874 I 356.35 Mb ddos 52.60.57.125 16509 354.82 Mb ddos <-347.14 Mb 52.60.57.125 16509 I ddos 6-307.20 Mb 181.199.76.247 27947 I ddos 104.239.149.127 33070 286.46 Mb ddos <-2.235.240.122 12874 282.62 Mb ddos I <-3.19.0.171 260.35 Mb 16509 I ddos <-2.236.51.65 12874 258.98 Mb I ddos 258.05 Mb 1.179.154.90 Т ddos <-85.204.96.177 I 233.47 Mb ddos 52.26.13.93 16509 I 222.17 Mb ddos <-104.130.135.169 33070 I 192.00 Mb ddos 65.123.159.166 192.00 Mb 209 ddos <-206.124.134.51 18530 I 192.00 Mb ddos <-3.19.0.171 16509 173.57 Mb ddos <-121.90 Mb 192.169.158.75 26496 I ddos e = 103.48.116.22 56301 I 110.59 Mb ddos <-52.23.146.248 108.42 Mb 14618 ddos <-98.30 Mb 86.96.199.44 5384 I ddos <-96.00 Mb 65.123.159.166 209 ddos <-104.186.116.130 7018 96.00 Mb I ddos <-. 11

```
"tagged": {
     "last human": "2019-02-09 22:46",
     "last": 1549752387,
   "tags": [
         "open dnsresolver",
         "ec2.amazonaws.com",
         "cldap"
  },
 "dimensions": {
     "city": "dim:city:Ashburn, VA, US:620.1019",
     "origin asn": "dim:origin asn:Amazon:103.146
     "geoip": "dim:geoip:Ashburn, US:181.1019",
     "region": "dim:region:United States:491.828"
     "hosting": "dim:hosting:ec2.amazonaws.com:13
     "cldap": "dim:cldap:opencldap:623.1",
     "country": "dim:country:United States:490.82
 },
"scan": {
     "open dnsresolver": {
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     },
   π.
     "cldap": {
         "last human": "2019-04-19 02:46",
         "last": 1555641989
```

https://genome.deepfield.net/genome/api/l

Hacker Cloudability Deepfield Nok

C

4 Jenkins

},

"tags":

"ip": "52.23.146.248",

Which CDN

- What hosted applications
- Security threats
- Associated DNS names
- SSL
- Micro services

Four Major Trends

- 1. Internet is getting bigger by
 - traffic volume
 - security threats (including DDoS)
 - number of interconnection points
 - number of connected devices
- 2. Internet is getting smaller by
 - traffic origination sources
 - Topology
- 3. QoE / TE / Security are getting more complicated because
 - Traditional choke points disappearing
 - Far large engineering and security attack surface
- 4. Router silicon and software is finally catching up

Hyper Giants and Traffic Consolidation January 2009 - 2019



Consolidation Applications

Sites	÷	Peak Total	•	Sites		🔷 Peak Total	•
淘	taobao.com	368.1 Gbps		٠	youtube.com	101.3 Gbps	
膨讯视频	video.qq.tencent.com	187.6 Gbps		f	facebook.com	92.2 Gbps	
	kwai.com	125.7 Gbps			microsoft.com	73.2 Gbps	
*	baidu.com	123.7 Gbps		\bigotimes	xboxlive.com	73.1 Gbps	
	video.baidu.com	96.2 Gbps			update.microsoft.com	58.9 Gbps	
HUAWEI	cloud.huawei.com	93.6 Gbps		Ú	apple.com	56.4 Gbps	

Asia (anonymous ISP data)

LATAM (anonymous ISP data)

CDN

CDN Grows from small bandwidth savings to majority of traffic



CDN

Internet is now largely a video and game delivery system

- Globally CDN account for 90% of consumer traffic by 2018
- Definition of CDN blurs as more content providers deploy edge cache and compute
- Nature of traffic changes as adaptive bit rate becomes the norm with automated traffic direction

Average CDN Contribution NA Daily Traffic



4+ Billion IPs on the Internet

But on average day < 5,000 are responsible for most of the traffic!



- True of most networks
- IPs are relatively stationary
- All sorts of implications for how we think about security, TE and QoE

One Quarter of Major Sites Now Multi-CDN





Rapid Growth Edge Devices / IoT

From < 2 Avg Leases per CPE in 2009 to 20+ in 2019



- xboxlive.com - playstation.com - ring.com - nest.com

What's Happening

- Most content shifting to metro
 - Paid video / advertising and gaming highly sensitive to performance
 - Large content building own backbones
 - Growing metro interconnect options
 - Highly competitive CDN market
 - International transit still expensive
- Significant growth subscriber edge
 - FTTH / 5G
- New more flexible proprietary and merchant silicon / routing software

Internet Evolution

2009 most Internet traffic is transit



Internet Evolution

2019 Most Internet traffic is settlement free or on-net cache



Challenges QoE / TE / Security are more challenging



- Expanded DDoS edge
 - Decreasing coverage
- Expanded DPI bandwidth
 - Piracy, Marketing, Security
- Understanding QoE
 - Adaptive Bit Rate

Smaller Traffic Origination -- The Good News Dedicated DDoS Appliances No Longer Required



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- 95%+ of traffic originates from known sites
 - Including CDN, trusted Google, Facebook, SalesForce, Apple, etc.
 - Including stratum-1/2 NTP, public DNS, etc.
- Filter table of 2K CIDRs
 - Can block most DDOS
 - Reduce majority of traffic required sent to DPI

You Can Now Block DDoS Directly on Routers

Internet Small Enough and Filter Tables Large Enough to Block Majority DDoS



Improved Silicon / Router Capabilities Router Telemetry Capabilities



- Improved IPFIX, GRPC / NetConf, Mirroring
- Means you can now track application quality end-to-end across network using
- Only using data from routers

Smaller Traffic Origination -- The Good News

Reduce DPI by 80-90% using FlowSpec and most available routers



- Hourly updated trusted source or destination application and micro-service / CDN
- Trusted traffic bypasses DPI
- 80-90% cost savings

Finally, IPv6

My 2019 Paper Declaring IPv6 a Failure

NEWS

Study Shows Glacial Pace of IPv6 Adoption

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By James Niccolai
Deputy News Editor, IDG News Service | AUG 19, 2008 7:00 AM PST

"At its peak, IPv6 represented less than one hundredth of 1 percent of Internet traffic" over the past year, Arbor Networks' Craig Labovitz wrote in a summary of the findings, adding wryly: "This is somewhat equivalent to the allowed parts of contaminants in drinking water."

Finally IPv6 I was wrong



- IPv6 15-20% inter-domain but growth is flat
- Mostly due to 4 content (Netflix, facebook, google)



Internet Evolution 1995 - 2005



- Hierarchical with global "tier-1" core
- Majority of traffic is over transit
- Traffic comes exchanged between thousands of source ASN
- Well defined peering edge
- Simple economic models



