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Explicit Congestion Notification (ECN) Deployment Observations
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Abstract

This note presents data gathered at an Internet Service Provider's gateway on the observed deployment and usage of ECN. Relevant IP counter and flow tracking data was collected and analyzed for TCP and other protocols.

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1. Introduction

To help guide the evolution of ECN, there is a need for more data on current deployment status, and observed usage of the ECN related bits, including:

* the initiation and acceptance of ECN capable TCP flows

* marking via CE, and feedback for TCP via the ECE and CWR flags

* codepoints set on packets for protocols other than TCP

For several weeks, we gathered data on all traffic through an Internet Service Provider's gateway. Though some of the results are informative, we caution that a larger, more widely reviewed and geographically distributed survey would be needed to be authoritative.

2. Collection Details

From December 28, 2020 to January 20, 2021, data was gathered on all traffic into and out of the Internet gateway at FreeNet Liberec, a cooperative WISP in an urban area of the Czech Republic. A total of 122.5 TB of incoming data and 12 TB of outgoing data was seen.

Around 660 members belong to the ISP, and 861 member IP addresses on the LAN were considered active during data collection. Most member IPs are used by a household of users, while others are for individual devices and public locations.

[IPTABLES-ECN] was used to collect and analyze the data. This consists of a script to gather the data using iptables and ipsets in Linux, and an analysis program that produces textual output. An abbreviated version of the output is included in Section 5. See the referred to source repository for more details and full output.

3. Observations

Our key observations are summarized as follows, and further expanded upon in the following sections:

* 1.44% of TCP flows attempted to initiate ECN, across 390 member IPs (45%).

* The acceptance rate for ECN flows was likely >50%.

* 382 member IPs (44%) successfully negotiated any TCP ECN flows, determined by receipt of any ECN SYN/ACKs.

* 71 member IPs (18.6% of ECN negotiating) saw possible AQM marking via CE and ECE, with 38 in one of two subnets with known AQMs, and 33 from other subnets, with unknown, possible AQMs.

* The 33 IPs that saw possible AQM marking from unknown, possible AQMs, were from a population of 319 ECN negotiating IPs not in subnets with known AQMs, leading to a rough estimate of 10.3% of random paths with AQMs present.

* Nonzero ECN codepoints were observed on 0.053% of non-TCP packets, with possible attribution to tunneled ECN and/or misuse of the ECN field.

3.1. ECN Endpoint Activity

3.1.1. Client Initiation

Of 319.5 million TCP SYNs from LAN to WAN, 1.44% indicated ECN capability. Of 861 active member IP addresses, 390 (45.3%) attempted initiation for at least one ECN flow. A large proportion of the ECN flows are thought to come from Apple devices.

3.1.2. Server Acceptance

While 4.6 million ECN TCP SYNs were seen from LAN to WAN, 3.3 million ECN SYN-ACKs were seen in return. While it's not possible to get an exact ECN acceptance rate from this, it appears to be reasonably high, likely due to default acceptance on prevailing server operating systems like Linux, FreeBSD and recent versions of Windows Server.

3.2. RFC3168 AQM Activity

There appears to be some evidence of [RFC3168] marking AQMs. Of 861 active member IP addresses:

* 382 member IPs, or 44%, successfully negotiated any TCP ECN flows
  - 63 of those (16.5%) were from subnets with known AQMs deployed
  - 319 (83.5%) were from subnets without a known AQM
* 90 member IPs saw any CE or ECE marks on negotiated TCP ECN flows
* 71 member IPs (18.6% of ECN negotiating) saw possible AQM activity, of which:
  - 38 are in subnets with known AQMs (60.3% of 63 in total, representing the detection rate)
  - 33 are in subnets with unknown AQMs (10.3% of 319 in total, representing the proportion of possible AQMs on random paths)

Some factors may affect the 10.3% proportion of possible AQMs on random paths:

* There may be false positives and negatives in possible AQM identification.

* We have not attempted to correct for the likelihood of missed AQMs, for example by assuming a detection rate similar to that for the known AQMs.

The following subsections clarify what is known AQM activity, what is considered possible activity, and some of the limitations in identifying AQMs.

3.2.1. Known AQM Activity

Two backhaul links have fq_codel [RFC8290] deployed, serving the 10.45.64.0/24 and 10.45.235.0/24 subnets (also see Section 8). These are the known AQMs that account for the 38/71 member IPs that saw possible AQM activity. It is possible that additional AQMs exist within the known subnets with AQM deployments, however those would be harder to identify. The source of the AQM activity from the remaining subnets is unknown, and could be from CPE, an external network, or both.

3.2.2. Identifying Possible AQM Activity

For detection of [RFC3168] AQM activity, we observe TCP flows. The ECE flag seen on negotiated TCP ECN flows allows for a more accurate confirmation of marking, since CE marks applied after traversal through the gateway will be missed.

To classify a member IP as having seen AQM activity, we use the following criteria:

1. Nonzero ECT(0) counts in both directions

2. AND nonzero ECE in either direction

3. AND for nonzero CE and ECE, ECE:CE ratio >= 2:1, OR subtraction of the ECE marks from the ECE marks in the opposite direction allows the opposite direction to meet the same criteria, as explained in the following section.

3.2.3. AQM False Positives

Some of the member IP addresses showed small and nearly identical counts of CE marks in one direction and ECE flags in both directions, which seems unlikely to be the result of genuine congestion and AQM activity. Our hypothesis is that these are part of a "fingerprinting" routine used by port scanners when they find an open port.

To exclude these, we looked for cases where inbound CE mark counts were within a 2x factor of outbound ECE flags, and discounted these as evidence of inbound AQM activity. In these cases we also applied a more stringent check for outbound AQM activity, by subtracting the outbound ECE flags from the inbound ECE flags, and looking for at least a 2x ratio between any remainder and the number of any outbound CE marks observed.

3.2.4. Limitations in AQM Identification

It is possible that some false-positives and/or false-negatives still remain in our classification method. Additionally, there is no way to know if we have identified all utilized paths with AQMs present. Detection first requires an ECN flow (1.44% of TCP SYNs requested ECN) and for that flow to encounter congestion at a bottleneck with an AQM enabled.

3.3. ECN Codepoints on Non-TCP Protocols

Referring to the packet counts in the _All IP_ / _Both Directions_ table in the stats output in Section 5, where M indicates megapackets and G, gigapackets:

	TCP (X)	Conntrack (XX)	Other	Total
All	76.60 G	->	43.52 G	120.14 G
CE	10031	3.38 M	813951	4.20 M
ECT(0)	523.91 M	9.66 M	2.55 M	536.12 M
ECT(1)	63	6.68 M	182928	6.86 M

Table 1

(X) TCP ECN packet counts only for negotiated ECN flows

(XX) UDP, ICMP, DCCP, SCTP, GRE (Conntrack All packets included in Other)

We note the following, where TCP-ECN refers to TCP flows that have successfully negotiated ECN support:

* TCP-ECN accounted for 97.7% of the 536 million ECT(0) marks

* 0.68% of all TCP packets were from TCP-ECN marked with a nonzero ECN codepoint

* About 0.05% of all non-TCP packets were marked with a nonzero ECN codepoint

* Not-TCP-ECN accounted for 99.8% of the 4.2 million CE marks

* Not-TCP-ECN accounted for virtually all of the ECT(1) marks

* 6.4 of 6.68 million ECT(1) marks were to a single member IP

Possible explanations for ECN marks on non-TCP packets are explored further in this section.

3.3.1. Tunneled ECN Traffic

There are several different encapsulation methods used when handling the ECN field through tunnels, as per [RFC3168] and [RFC6040]:

1. copy the ECN field from the inner to the outer packet

2. reset the ECN field on the outer packet to ECT(0)

3. set Not-ECT on the outer packet

When method 3 is used at both ends of a tunnel, we would not expect to see ECN codepoint usage in either direction.

When methods 1 or 2 are used at both ends of a tunnel, we would expect to see ECT(0) on both incoming and outgoing packets. We would also expect a bias towards incoming packets, since more data is generally downloaded than uploaded, and pure ACKs do not have ECT(0) marks.

When method 3 is used at only one end of the tunnel, we would expect to see ECT(0) on packets in only one direction.

We note the following:

* Bi-directional ECT(0) marks were observed for two member IP / port pairs, on UDP port 443 and 60001.

* Uni-directional ECT(0) marks were observed for:

  - UDP port 4500 (IPSec NAT traversal [RFC3948]) with 23 member IP addresses downstream, and 1 member IP address upstream.

  - UDP port 51820 [WIREGUARD] with 2 member IP addresses downstream.

  - Numerous UDP ports in other ranges, mostly on the downstream.

While it's possible that some of the data observed was from tunneled ECN traffic, this can't be established definitively.

3.3.2. QUIC-ECN

Since a production implementation of QUIC-ECN is known to exist, we could see some of that traffic in the non-TCP data. One member IP / dstport pair to udp:443 saw 4603 ECT(0) marks from the WAN, and 1882 ECT(0) marks from the LAN. This may have been QUIC-ECN, although it can't be established definitively.

3.3.3. Use of the ECN Field for Historical Reasons

Some applications may still use historical definitions of the former TOS byte. Although RFC791 reserved the ECN field for future use, the now obsolete [RFC1349] defined the TOS field as four bits within the Type of Service octet, one of which overlaps with the ECN field. This may account for some of the observed usage of ECT(0), since the value for "minimize monetary cost" was 0001, shifted to the left one bit, coinciding with ECT(0).

3.3.4. Use of the ECN Field Inadvertently

Users of operating system's socket APIs wishing to set a DiffServ codepoint may be confused as to whether or not they need to shift the desired value left two bits before passing it in. Additionally, OS header files have been seen with out-of-date definitions for obsolete values in the former Type of Service octet, and obsolete definitions from [RFC2481].

Another possible source of confusion is the TOS field values listed in the now obsolete [RFC1349], without having been shifted. A casual reader could see the value 0001 for "minimize monetary cost" and think that they should use this value in the TOS byte, conflicting with ECT(1), not realizing that:

* [RFC1349] is obsolete

* even if it weren't obsolete, the TOS values must be shifted to the left *by one bit*

To reduce incorrect usages of the DS field, OS header files should be sanitized, obsolete RFCs more prominently marked as such, and API documentation brought up to date.

3.3.5. Use of the ECN Field Maliciously

It's possible that some software is using the ECN field to gain an advantage in Internet queues or for some other nefarious purpose. Further analysis would be needed to determine if this is the case.

4. Study Limitations and Recommendations for Future Work

The main limitation of this study is that we use counter data at different levels of granularity. In some cases, it would be possible to gain more certainty by taking packet captures and analyzing individual flows, but this can be more difficult to do on production data, both for technical and privacy reasons.

4.1. ECN Acceptance Rate

While we captured the ratio of ECN SYNs to ECN SYN-ACKs, we do not have an exact count of flows that were accepted or rejected. It may be possible to do this more accurately with additional iptables rules in [IPTABLES-ECN]. Additionally, flows are tracked as ECN capable upon receipt of an ECN SYN/ACK, regardless of whether that SYN/ACK was associated with an outgoing ECN SYN. This could be improved with more state tracking.

4.2. Not-ECT Counts by IP

While we captured the nonzero ECN codepoints by IP address, separately for TCP and conntrack-supported protocols, we do not have a count of Not-ECT by IP address. Although it may be possible to obtain this, it would require an ipset lookup for every packet traversing the gateway.

4.3. ECN Marked Packets on Not-ECN-Capable TCP Flows

While we captured counts of ECN marked packets on ECN capable TCP flows, identified upon receipt of an ECN SYN/ACK, we do not have separate counts of TCP packets that were marked with ECN codepoints without having negotiated ECN. This should be possible to obtain with additional iptables rules in [IPTABLES-ECN].

4.4. Tunnels

Tunnel protocols are challenging because of the different encapsulation methods and protocols used. An analysis at the flow level, rather than by IP address and destination port pairs, might be more useful in identifying the usage of ECN over tunnels.

4.5. Non-TCP Protocols

More research is needed into the reasons for ECN codepoints being set on non-TCP traffic. Given the relatively low volume of this traffic, it might be practical to take packet captures of it for further analysis.

Additionally, we are currently not able to differentiate between the total number of packets for conntrack-supported and Other protocols. This could be improved with some changes to [IPTABLES-ECN].

4.6. Other Protocols

While this study looked at signals by IP address for TCP and IP/port for conntrack-supported protocols, it does not break down signals for Other protocols by IP address. Among those protocols is IPSec ESP packets, using IP protocol 50. The [IPTABLES-ECN] script could be modified to create more ipsets of type hash:ip, parallel to what was done for IP traffic as a whole, to further analyze these protocols for tunnel activity.

4.7. CWR Flag

Counting occurrences of TCP's CWR flag could better help distinguish between some of the false positives and negatives in AQM detection.

4.8. NS Flag

Since [RFC8311] declared that the NS (Nonce Sum) flag is again Reserved, after its now historical use by [RFC3540], we could collect any observed usages of this flag, to confirm that it's available for use in practice.

5. Abbreviated Output from ecn-stats

This abbreviated output only includes LAN to WAN flows, and a small subset of the non-TCP conntrack protocols by member IP address. For full output, see the [IPTABLES-ECN] repository.

Note the IP addresses shown here have been anonymized within the 10.0.0.0/8 address space, in a way that retains the subnet structure.

5.1. All IP

Packets, CE, ECT(0) and ECT(1) are packet counts, and use units of M, G or T for mega, giga, or terapackets.

Total (both directions):

	TCP [*]	Conntrack [+]	Other	Total
Bytes	101.22 TB	->	33.22 TB	134.46 TB
Packets	76.60 G	->	43.52 G	120.14 G
|-CE	10031	3.38 M	813951	4.20 M
|-ECT(0)	523.91 M	9.66 M	2.55 M	536.12 M
|-ECT(1)	63	6.68 M	182928	6.86 M

WAN to LAN:

	TCP [*]	Conntrack [+]	Other	Total
Bytes	95.79 TB	->	26.65 TB	122.45 TB
Packets	41.43 G	->	30.29 G	71.72 G
|-CE	9298	3.38 M	721002	4.11 M
|-ECT(0)	480.35 M	9.62 M	1.93 M	491.91 M
|-ECT(1)	62	6.68 M	65111	6.74 M

LAN to WAN:

	TCP [*]	Conntrack [+]	Other	Total
Bytes	5.43 TB	->	6.57 TB	12.00 TB
Packets	35.17 G	->	13.23 G	48.41 G
|-CE	733	60	92949	93742
|-ECT(0)	43.56 M	40366	614623	44.21 M
|-ECT(1)	1	28	117817	117846

[*] TCP ECN packet counts only for negotiated ECN flows
Counts for non-ECN TCP flows in Other
[+] Conntrack protocols: UDP, ICMP, DCCP, SCTP, GRE
Conntrack total Bytes and Packets included in Other

5.2. TCP initiated from LAN to WAN

SYN packet count totals for active IPs:

All SYNs: 319560652
ECN SYNs: 4601118 (1.44% of all)
ECN SYN/ACKs: 3273815 (71.15% of ECN SYNs)

ECN packet count totals for active IPs:

Direction	CE	ECE	ECT(0)	ECT(1)
From LAN	733	502985	42903861	1
From WAN	9298	19367	479756419	62

IP address counts with TCP and ECN activity:

```
Active (sent >= 10 SYNs):  861 (of 1195)
Initiated any ECN flows:   390 (45.3%)
Negotiated any ECN flows:  382 (44.4%)
Saw CE or ECE on ECN flow: 90 (23.6% of ECN negotiating)
Saw ECT(1) on ECN flow:    5
```

IP address counts with possible AQM activity:

```
Negotiated any ECN flows:       382
|- in subnet with known AQM:    63 (16.5% of ECN negotiating)
|- in subnet without known AQM: 319 (83.5% of ECN negotiating)

Criteria for possible AQM activity:
    nonzero ECT(0) in both directions
    AND nonzero ECE in either direction
    AND ECE:CE ratio >= 2:1 OR opposite direction
        ECE difference meets same criteria

IPs with possible AQM activity: 71 (18.6% of ECN negotiating)
|- from known AQMs:             38 (60.3% of 63 /w known AQM)
|- from unknown, possible AQMs: 33 (10.3% of 319 w/o known AQM)
```

ECN flow packet counts by active IP, for nonzero CE or ECE:

Flags column:
- A: possible AQM activity (see Criteria above)
- K: known AQM deployment

IP	Flags	ECT(0) from WAN	CE from WAN	ECE from LAN	ECT(0) from LAN	CE from LAN	ECE from WAN
10.45.9.88		17970	0	0	0	0	431
10.45.64.3	AK	2909975	36	13348	245614	0	45
10.45.64.4	AK	228451	0	2192	60531	0	0
10.45.64.7	AK	1119810	28	4610	15970	0	35
10.45.64.11	AK	158206	0	335	52721	0	0
10.45.64.12	AK	466173	0	14955	28006	3	0
10.45.64.13	AK	287196	0	223	17277	0	0

10.45.64.14	AK	2264292	13	20863	362708	0	23
10.45.64.15	AK	46467	0	9	33894	0	0
10.45.64.16	AK	12238	0	1396	3339	0	0
10.45.64.17	AK	1058702	0	464	10578	0	0
10.45.64.31	AK	1137817	0	46740	114016	12	0
10.45.64.39	AK	519279	0	11019	44094	0	0
10.45.64.45	AK	229911	0	363	297811	0	0
10.45.64.47	AK	1257622	0	15731	410234	321	6041
10.45.64.59	AK	186455	0	44	71189	0	0
10.45.64.85	AK	4958	0	57	1069	0	0
10.45.64.93	AK	604641	0	16530	89847	0	0
10.45.64.103	AK	660575	0	10649	129808	0	0
10.45.64.105	AK	407561	0	2046	28347	0	0
10.45.64.112	AK	2007755	0	1135	58168	1	1
10.45.64.116	AK	427696	0	1042	30081	0	0
10.45.64.118	AK	275449	163	710	94141	0	170
10.45.64.123	AK	461008	0	3118	29852	0	0
10.45.64.125	AK	540511	0	52960	57523	49	0
10.45.64.126	AK	686366	0	12579	57480	122	0
10.45.65.7	A	959608	0	176	94920	0	0
10.45.65.16	A	1392760	0	4483	157057	0	0
10.45.65.110	A	694373	0	1530	44914	0	0
10.45.65.112	A	1140897	0	2313	171205	0	0
10.45.65.124	A	73846	5	6	24228	0	9
10.45.86.39	A	823913	1	13	135427	0	0
10.45.86.41	A	6872888	72	3228	1116750	0	0
10.45.87.32	A	62967	0	64	33255	0	0
10.45.87.45		2052604	1	0	225774	0	0
10.45.87.50		2500669	3	3	134178	0	0
10.45.87.127	A	527732	17	22	58020	0	39
10.45.101.96		1883157	155	156	270789	0	151
10.45.104.24	A	1837837	55	63	416284	0	77
10.45.107.73	A	1851297	400	416	463753	0	430
10.45.108.24	A	230952	0	0	33749	0	36
10.45.113.6		10491356	168	191	253856	0	174
10.45.113.106	A	638565	34	37	173265	0	40
10.45.114.98		1370882	1619	1792	309940	0	1739
10.45.138.66		479880	43	56	95577	0	47
10.45.140.73		6036	510	551	1918	0	520
10.45.140.74		5396418	39	46	336854	0	38
10.45.141.85	A	450018	39	50	157585	0	85
10.45.145.2	A	118843	10	15	19309	0	25
10.45.145.73		3484464	1	0	153147	0	0
10.45.153.10		714256	6	11	80712	0	0
10.45.154.82	A	2355299	22	25	263636	0	44
10.45.155.68		1849086	1	1	349722	0	0
10.45.155.71	A	9089268	144	143	660457	1	152
10.45.158.197		17618743	493	53	369921	0	0

10.45.158.198	A	1019414	13	13	222440	0	25
10.45.176.114	A	736022	32	46	88713	0	62
10.45.176.119	A	2393601	38	47	167329	0	68
10.45.177.68	A	17191899	22	24	201187	0	27
10.45.182.75	A	615134	6	7	100995	0	13
10.45.183.117		199726	131	145	52876	6	152
10.45.183.204		2729641	8	10	851838	0	0
10.45.212.82	A	2497321	18	23	213484	0	48
10.45.229.81	A	1043941	268	2104	36517	1	0
10.45.230.25	A	4560825	3132	18481	290819	0	0
10.45.230.204		28514121	1	1	321299	0	0
10.45.231.31	A	62246	16	9	12782	0	30
10.45.234.197		265034	188	225	98664	0	153
10.45.235.6	AK	140242	0	217	42778	0	0
10.45.235.24	AK	213822	0	388	50485	0	0
10.45.235.59	AK	1017759	16	897	121453	0	30
10.45.235.89	AK	8066090	56	31899	637830	176	5630
10.45.235.90	AK	3878916	727	4278	460048	0	709
10.45.235.92	AK	15410232	151	169965	1030037	41	1784
10.45.235.94	AK	344002	0	1394	3913608	0	0
10.45.235.196	AK	2234	0	157	1323	0	0
10.45.235.199	AK	2166	0	56	676	0	0
10.45.235.200	AK	5279	0	220	2311	0	0
10.45.235.203	AK	2966	0	234	1765	0	0
10.45.235.206	AK	154701	0	3484	333	0	0
10.45.235.208	AK	5076	0	378	3240	0	0
10.45.238.75		4916805	196	262	942367	0	229
10.45.241.101	A	2838055	0	740	303980	0	0
10.45.242.72	A	81526	5	5	36884	0	11
10.45.242.146	A	894737	21	25	85268	0	44
10.45.243.69		1946622	2	3	64838	0	0
10.45.249.6	A	621444	0	2461	75061	0	0
10.45.249.34	A	180747	0	2260	128409	0	0
10.45.251.37	A	455964	39	171	18996	0	0
10.45.251.114	A	14208298	134	13794	946610	0	0

5.3. Non-TCP conntrack-supported protocols initiated from LAN to WAN

Protocols included:

UDP, ICMP, DCCP, SCTP, GRE

Active IPs:

Active IPs with ECN signals: 420
Active IP/dstport pairs with ECN signals: 24972

ECN flow packet count totals for active IPs:

Direction	CE	ECT(0)	ECT(1)
From LAN	59	26692	28
From WAN	2838929	9562002	6632561

ECN codepoint packet counts by client IP, with selected ports:
(ports with '*' had >100 ECT(0) marks)

IP/Port	ECT(0) from WAN	CE from WAN	ECT(1) from WAN	ECT(0) from LAN	CE from LAN	ECT(1) from LAN
10.45.10.0	0	0	0	201	0	0
10.45.10.4	0	0	0	14	0	0
10.45.10.5	0	0	0	20	0	0
10.45.10.6	0	0	0	9	0	0
10.45.10.7	0	0	0	8	0	0
10.45.10.8	0	0	0	39	0	0
10.45.10.11	0	0	0	8	0	0
10.45.10.12	0	0	0	2	0	0
10.45.10.42	0	0	0	6	0	0
10.45.10.61	0	0	0	2	0	0
10.45.10.70	0	0	0	44	0	0
10.45.10.71	0	0	0	5	0	0
10.45.10.73	0	0	0	7	0	0
10.45.10.77	0	0	0	13	0	0
10.45.10.81	0	0	0	10	0	0
10.45.10.82	0	0	0	8	0	0
10.45.10.83	0	0	0	3	0	0
10.45.10.95	0	0	0	59	0	0
10.45.10.96	0	0	0	39	0	0
10.45.10.129	0	403	1	0	0	0
10.45.10.196	0	0	0	80	0	0
10.45.10.197	0	0	0	63	0	0
10.45.10.201	0	0	0	3	0	0
10.45.10.204	0	0	0	25	0	0
10.45.10.227	0	0	0	40	0	0
10.45.10.228	0	0	0	7	0	0
10.45.10.244	0	0	0	14	0	0
10.45.10.245	0	0	0	7	0	0
10.45.64.3	0	0	0	100	0	0
10.45.64.4	0	0	0	31	0	0
10.45.64.6	0	0	0	2	0	0
10.45.64.7	12	126	20	8	0	0
10.45.64.10	0	0	0	29	0	0
10.45.64.11	0	0	0	67	0	0
10.45.64.12	0	0	0	6	0	0
10.45.64.13	0	0	0	35	0	0

```
   10.45.64.14            0       0       0       121     0    0
   10.45.64.15            0       0       0       52      0    0
   10.45.64.16            0       0       0       18      0    0
   10.45.64.19            16      0       0       0       0    0
     udp:4500 (ipsec-na.. 11      0       0       0       0    0
   10.45.64.31            34129   2468    58304   27      0    0
     udp:37658            0       0       4346    0       0    0
   * udp:38129            24957   2468    15281   0       0    0
     udp:38884            0       0       10409   0       0    0
   * udp:40871            288     0       2269    0       0    0
   * udp:41621            3057    0       14609   0       0    0
   * udp:41744            171     0       61      0       0    0
     udp:43588            0       0       6746    0       0    0
     udp:45444            0       0       1292    0       0    0
   * udp:45465            866     0       0       0       0    0
     udp:45483            0       0       1838    0       0    0
   * udp:45522            4764    0       708     0       0    0
   10.45.64.39            0       0       0       75      0    0
   10.45.64.45            0       0       0       50      0    0
   10.45.64.47            0       0       0       11      0    0
   10.45.64.51            0       0       0       2       0    0
   10.45.64.59            56      1624    10      593     0    0
     udp:3478 (stun)      56      1624    10      0       0    0
   10.45.64.85            0       0       0       4       0    0
   10.45.64.86            7       434404  3       9       0    0
     udp:4400 (ds-srv)    0       29065   0       0       0    0
     udp:14757            0       97175   0       0       0    0
     udp:24173            0       35437   0       0       0    0
     udp:29493            0       120959  0       0       0    0
     udp:44495            0       41547   0       0       0    0
     udp:53678            0       109978  0       0       0    0
   10.45.64.89            7       50      0       4       0    0
   10.45.64.93            598     2971    341     75      0    0
   * udp:3478 (stun)      598     2971    341     0       0    0
   10.45.64.98            0       0       32780   0       0    0
     udp:6008             0       0       9234    0       0    0
     udp:7008 (afs3-upd.. 0       0       23546   0       0    0
   10.45.64.99            132     2094    73      0       0    0
     udp:3478 (stun)      0       3       0       0       0    0
   10.45.64.103           0       0       0       47      0    0
   10.45.64.104           70      293     31      1       0    0
   10.45.64.105           213     33440   0       7       0    0
   * udp:443 (https)      213     33440   0       0       0    0
   10.45.64.107           0       0       0       2       0    0
   10.45.64.108           0       0       0       1       0    0
   10.45.64.111           1       1       0       0       0    0
   10.45.64.112           0       421     0       48      0    0
   10.45.64.116           4       143     8       64      0    8
```

10.45.64.118	0	0	0	77	0	0
10.45.64.121	0	2107	0	0	0	0
udp:38603	0	2100	0	0	0	0
10.45.64.123	0	0	0	13	0	0
10.45.64.124	6	0	0	0	0	0
udp:443 (https)	6	0	0	0	0	0
10.45.64.125	0	0	0	22	0	0
10.45.64.126	1	10	0	37	0	0
10.45.65.0	0	0	0	42	0	0
10.45.65.1	0	0	0	45	0	0
10.45.65.5	0	0	0	17	0	0
10.45.65.7	0	0	0	30	0	0
10.45.65.11	0	0	0	6	0	0
10.45.65.16	1686	40141	36888	505	0	0
* udp:3478 (stun)	1595	22049	4	0	0	0
udp:26808	0	0	36805	0	0	0
udp:62348	0	15738	0	0	0	0
10.45.65.17	0	4	0	0	0	0
10.45.65.66	0	17	0	94	0	0
udp:3478 (stun)	0	17	0	0	0	0
10.45.65.94	319	0	1	25	0	0
udp:3478 (stun)	0	0	1	0	0	0
10.45.65.95	0	0	0	8	0	0
10.45.65.104	0	0	0	41	0	0
10.45.65.107	12	77	2	5	0	0
10.45.65.110	0	0	0	38	0	0
10.45.65.112	39	1168	18	75	0	0
10.45.65.122	2	5	0	0	0	0
10.45.65.123	0	0	0	1	0	0
10.45.65.124	0	0	0	11	0	0
10.45.65.127	0	0	0	5	0	0
10.45.75.90	0	0	0	1	0	0
10.45.80.28	2	8	1	0	0	0
10.45.80.79	4	7	0	2	0	0
10.45.80.85	0	0	0	10	0	0
10.45.80.99	0	0	0	11	0	0
10.45.83.76	0	0	0	3	0	0
10.45.83.80	28	51	11	0	0	0
10.45.85.127	301	174	30747	68	0	0
* udp:599 (acp)	222	174	45	0	0	0
udp:6008	0	0	30702	0	0	0
* udp:60001	49	0	0	65	0	0
10.45.86.16	13	0	0	2	0	0
udp:4500 (ipsec-na..	8	0	0	0	0	0
udp:51820 (wiregua..	5	0	0	0	0	0
10.45.86.36	0	0	0	4	0	0
10.45.86.39	205	37619	107	50	0	0
udp:29492	0	2512	0	0	0	0

```
  udp:64733            0       30711   0       0       0    0
10.45.86.40            2       0       0       0       0    0
  udp:443 (https)      2       0       0       0       0    0
10.45.86.43            0       11      0       532     0    0
10.45.86.68            760     3528    614     325     0    0
  udp:80 (http)        0       2       0       0       0    0
10.45.87.32            12      0       0       14      0    0
10.45.87.44            709     4963    623     0       0    0
  udp:80 (http)        0       1       0       0       0    0
  udp:6881             3       1313    43      0       0    0
10.45.87.45            0       0       0       185     0    0
10.45.87.48            0       0       0       82      0    0
10.45.87.50            3       0       9       68      0    0
  udp:4500 (ipsec-na.. 3       0       9       0       0    0
10.45.87.103           0       0       0       2       0    0
10.45.87.112           0       1       0       0       0    0
10.45.87.113           0       0       0       33      0    0
10.45.87.127           0       0       0       44      0    0
10.45.92.74            31      0       1       2       0    0
10.45.93.69            15      122     6       0       0    0
10.45.93.75            361     2945    278     4       0    0
10.45.93.79            0       0       0       8       0    0
10.45.98.71            2       8       0       0       0    0
10.45.98.72            0       1       0       40      0    0
  udp:3478 (stun)      0       1       0       0       0    0
10.45.101.96           0       0       0       140     0    0
10.45.101.100          0       0       0       12      0    0
10.45.101.101          2       10      7       0       0    0
10.45.101.103          21      21899   15      0       0    0
  udp:58479            0       21372   0       0       0    0
10.45.101.104          0       0       10      33      0    0
10.45.104.24           0       0       0       324     0    0
10.45.104.104          16      72      2       60      0    0
10.45.107.73           32      0       1       58      0    0
  udp:4500 (ipsec-na.. 32      0       1       0       0    0
10.45.107.79           34      0       0       70      0    0
  udp:443 (https)      34      0       0       0       0    0
10.45.107.81           0       4421    0       3       0    0
  udp:61094            0       4421    0       0       0    0
10.45.108.3            0       0       0       1       0    0
10.45.108.4            33      5079    90      1       0    0
  udp:33027            0       2978    0       0       0    0
10.45.108.13           0       0       0       14      0    0
10.45.108.24           799     5543    1059    117     0    0
* udp:40211            107     0       0       0       0    0
10.45.108.25           1       2       1       799     0    0
10.45.108.66           0       0       0       0       0    1
10.45.108.69           0       0       0       2       0    0
```

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      10.45.108.71           28      12830   0       0       0    0
        udp:34665            0       12462   0       0       0    0
      10.45.108.75           0       0       6395176 38      0    0
        udp:6008             0       0       1755476 0       0    0
        udp:7008 (afs3-upd.. 0       0       1827173 0       0    0
        udp:8008 (http-alt)  0       0       740987  0       0    0
        udp:9008             0       0       809024  0       0    0
        udp:10008 (octopus)  0       0       380001  0       0    0
        udp:11008            0       0       578400  0       0    0
        udp:12008 (accurac.. 0       0       231619  0       0    0
        udp:13008            0       0       72496   0       0    0
      10.45.108.76           0       0       0       2       0    0
      10.45.108.77           0       0       0       31      0    0
      10.45.108.80           337     1566    173     10      0    0
      10.45.108.95           1       5       0       283     0    0
      10.45.108.126          0       0       0       12      0    0
      10.45.112.74           9       95      4       371     0    0
      10.45.112.102          0       0       0       29      0    0
      10.45.112.139          0       0       0       5       0    0
      10.45.112.154          0       0       0       4       0    0
      10.45.112.165          0       0       0       24      0    0
      10.45.112.172          6333    0       0       0       0    0
      * udp:443 (https)      6333    0       0       0       0    0
      10.45.112.216          0       0       0       2       0    0
      10.45.113.6            147184  0       0       136     0    0
      * udp:4500 (ipsec-na.. 147184  0       0       0       0    0
      10.45.113.7            453     0       10      52      0    0
      * udp:443 (https)      309     0       0       0       0    0
      * udp:4500 (ipsec-na.. 144     0       10      0       0    0
      10.45.113.9            0       0       0       60      0    0
      10.45.113.11           0       0       0       187     0    0
      10.45.113.27           0       0       0       1       0    0
      10.45.113.30           0       0       0       4       0    0
      10.45.113.33           0       0       0       2       0    0
      10.45.113.34           0       0       0       58      0    0
      10.45.113.35           0       0       0       6       0    0
      10.45.113.36           0       0       0       2       0    0
      10.45.113.66           1       11      0       0       0    0
      10.45.113.90           0       0       0       163     0    0
      10.45.113.94           17      62      2       0       0    0
      10.45.113.97           0       0       0       19      0    0
      10.45.113.99           11      76      12      15      0    0
      10.45.113.104          818     0       0       0       0    0
      * udp:4500 (ipsec-na.. 818     0       0       0       0    0
      10.45.113.106          0       0       0       10      0    0
      10.45.113.119          0       178     0       313     0    0
        udp:3478 (stun)      0       178     0       0       0    0
      10.45.113.122          36      0       0       0       0    0
```

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  udp:4500 (ipsec-na.. 36      0       0       0      0    0
10.45.113.124          0       0       0       201    0    0
10.45.114.8            0       3       0       0      0    0
10.45.114.10           0       0       0       3      0    0
10.45.114.42           286     12      67      3      0    0
* udp:51820 (wiregua.. 286     0       66      0      0    0
10.45.114.98           0       0       0       10     0    0
10.45.120.25           0       0       0       53     0    0
10.45.120.34           0       0       0       12     0    0
10.45.120.78           0       0       0       715    0    0
10.45.122.51           686     28190   122     66     0    0
  udp:45622            0       5782    0       0      0    0
  udp:59437            0       17791   0       0      0    0
10.45.124.31           1720    5946    16897   105    0    0
  udp:3478 (stun)      0       6       0       0      0    0
* udp:50451            1720    0       15875   0      0    0
  udp:50919            0       2428    0       0      0    0
  udp:50996            0       0       1016    0      0    0
  udp:57403            0       1944    0       0      0    0
10.45.124.43           0       0       0       12     0    0
10.45.124.73           37      0       0       0      0    0
  udp:4500 (ipsec-na.. 37      0       0       0      0    0
10.45.124.74           0       0       0       1      0    0
10.45.124.89           0       0       0       2      0    0
10.45.124.107          142     626895  83      0      0    0
  udp:24616            0       501142  0       0      0    0
  udp:51123            0       124060  0       0      0    0
10.45.124.111          0       1538    166     0      0    0
  udp:4748             0       1491    166     0      0    0
10.45.124.117          0       0       0       248    0    0
10.45.125.97           0       0       0       2      0    0
10.45.125.99           130     6235    29      1      0    0
  udp:8609 (canon-cp.. 0       3002    0       0      0    0
10.45.125.104          0       0       0       3      0    0
10.45.125.105          0       0       0       7      0    0
10.45.136.82           0       0       0       1      0    0
10.45.136.198          0       0       0       8      0    0
10.45.136.199          68      3210    7       0      0    0
  udp:22312            0       2452    0       0      0    0
10.45.136.200          0       44      1       0      0    0
10.45.137.4            4603    0       0       1882   0    0
* udp:443 (https)      4603    0       0       1882   0    0
10.45.137.21           0       0       0       118    0    0
10.45.137.27           4       0       0       63     0    0
10.45.137.29           0       0       0       0      0    1
10.45.137.46           9       154     0       6      0    0
  udp:443 (https)      9       0       0       0      0    0
10.45.137.53           0       0       0       7      0    0
```

10.45.137.55	0	0	1	37	0	0
10.45.137.62	5	29	1	14	0	0
udp:443 (https)	2	0	0	0	0	0
10.45.137.119	16	203825	12	4	0	0
udp:16772	0	55846	0	0	0	0
udp:25135	0	24694	0	0	0	0
udp:25476	0	66965	0	0	0	0
udp:51123	0	54265	0	0	0	0
udp:55430	0	1138	0	0	0	0
10.45.137.123	2	4190	1	1	0	0
udp:29363	0	3283	0	0	0	0
10.45.138.52	3093	18938	0	0	0	0
* udp:42420	3087	18871	0	0	0	0
10.45.138.66	0	0	0	249	0	0
10.45.138.88	43	107	10	0	0	0
10.45.138.95	0	0	0	20	0	0
10.45.140.0	0	0	0	84	0	0
10.45.140.5	0	0	0	2	0	0
10.45.140.28	0	0	0	1	0	0
10.45.140.74	0	0	0	12	0	0
10.45.140.81	0	0	0	26	0	0
10.45.140.100	143	465	37	0	0	0
10.45.140.103	0	0	0	16	0	0
10.45.140.104	0	0	0	4	0	0
10.45.140.109	0	0	0	2	0	0
10.45.140.118	0	0	0	27	0	0
10.45.140.121	0	7032	0	17	0	0
udp:49710	0	1160	0	0	0	0
udp:53984	0	2694	0	0	0	0
udp:58704	0	1597	0	0	0	0
10.45.140.122	0	3	0	0	0	0
10.45.140.123	0	0	4	0	0	0
10.45.140.127	0	0	0	15	0	0
10.45.140.133	0	0	0	0	1	0
10.45.140.169	0	0	0	59	0	0
10.45.140.171	0	0	0	14	0	0
10.45.141.2	91	0	0	12	0	0
udp:443 (https)	91	0	0	0	0	0
10.45.141.6	0	0	0	24	0	0
10.45.141.14	0	0	0	2	0	0
10.45.141.17	2	37	1	17	0	0
10.45.141.19	0	0	0	2	0	0
10.45.141.82	579	0	0	21	0	0
* udp:443 (https)	579	0	0	0	0	0
10.45.141.83	0	0	0	14	0	0
10.45.141.84	0	0	0	90	0	0
10.45.141.85	0	0	0	518	0	0
10.45.141.86	0	0	0	6	0	0

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10.45.141.87           0       0       0       2       0    0
10.45.141.103          0       0       0       57      0    0
10.45.141.106          7       190     3947    1079    0    0
  udp:3478 (stun)      0       24      12      0       0    0
* udp:5001 (commplex.. 0       0       0       1072    0    0
  udp:40208            0       0       3932    0       0    0
10.45.141.125          0       0       0       2       0    0
10.45.144.20           2       6       2       1       0    0
10.45.144.43           0       0       0       3       0    0
10.45.144.55           0       0       0       2       0    0
10.45.144.68           0       0       0       363     0    0
10.45.144.73           0       0       0       14      0    0
10.45.144.75           0       0       3       51      0    0
10.45.144.77           51      289     35      24      0    0
10.45.144.105          413     0       11      1       0    0
* udp:4500 (ipsec-na.. 413     0       11      0       0    0
10.45.144.139          1496    0       0       0       0    0
* udp:443 (https)      1496    0       0       0       0    0
10.45.144.197          0       0       0       102     0    0
10.45.145.2            0       0       0       15      0    0
10.45.145.26           0       0       0       44      0    0
10.45.145.39           2503039 0       0       11      0    0
  udp:443 (https)      4       0       0       0       0    0
* udp:4500 (ipsec-na.. 2503035 0       0       0       0    0
10.45.145.56           0       0       0       3       0    0
10.45.145.72           0       0       0       32      0    0
10.45.145.75           3024    0       0       0       0    0
* udp:443 (https)      3024    0       0       0       0    0
10.45.145.81           8691    107114  8245    292     0    0
  udp:80 (http)        0       2       0       0       0    0
* udp:6881             355     8092    672     0       0    0
  udp:19517            0       1097    0       0       0    0
  udp:22784            0       3441    0       0       0    0
* udp:25223            110     0       0       0       0    0
* udp:37526            139     0       0       0       0    0
* udp:40631            191     0       0       0       0    0
  udp:40990            0       33415   0       0       0    0
  udp:51820 (wiregua.. 0       3       0       0       0    0
10.45.145.96           0       0       0       7       0    0
10.45.145.98           0       0       0       3       0    0
10.45.145.107          0       9       0       0       0    0
10.45.145.109          0       0       0       9       35   0
10.45.145.115          0       0       0       11      0    0
10.45.146.66           52      88      7       26      0    0
10.45.146.195          0       0       0       2       0    0
10.45.146.200          1471    0       0       49      0    0
* udp:4500 (ipsec-na.. 1471    0       0       0       0    0
10.45.146.201          0       0       0       9       0    0
```

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      10.45.153.10           0       0       0       33      0    0
      10.45.153.194          2       86      2       0       0    0
      10.45.154.6            0       0       0       9       0    0
      10.45.154.81           0       0       0       4       0    0
      10.45.154.82           0       0       0       140     0    0
      10.45.154.100          0       0       0       14      0    0
      10.45.154.105          0       0       0       17      0    0
      10.45.154.112          0       0       0       5       0    0
      10.45.154.113          1       88      2       3       0    0
      10.45.154.115          0       0       0       224     0    0
      10.45.155.12           0       0       0       11      0    0
      10.45.155.67           0       0       0       1       0    0
      10.45.155.68           0       0       0       237     0    0
      10.45.155.69           0       0       0       1       0    0
      10.45.155.71           0       0       0       246     0    0
      10.45.155.73           0       0       0       72      0    0
      10.45.155.74           0       1       0       0       0    0
        udp:3478 (stun)      0       1       0       0       0    0
      10.45.155.75           0       4       0       0       0    0
      10.45.155.76           0       1       0       0       0    0
      10.45.155.217          0       0       0       15      0    0
      10.45.155.229          4       42      6       48      0    0
      10.45.156.94           25      152     8       0       0    0
      10.45.156.105          0       5362    0       19      0    0
        udp:58796            0       5362    0       0       0    0
      10.45.156.127          0       0       0       22      0    0
      10.45.158.115          0       0       0       402     0    0
      10.45.158.124          0       0       0       4       0    0
      10.45.158.127          0       0       0       3       0    0
      10.45.158.195          0       1630    3       25      0    0
        udp:6881             0       1610    0       0       0    0
      10.45.158.197          0       0       0       82      0    0
      10.45.158.198          0       0       0       204     0    0
      10.45.158.204          0       0       0       118     0    0
      10.45.158.206          9       32      2       0       0    0
      10.45.176.114          0       0       0       68      0    0
      10.45.176.116          188     1702    191     1       0    0
      10.45.176.117          0       0       0       35      0    0
      10.45.176.119          9320    1028270 11302   218     0    0
        udp:6881             0       91498   83      0       0    0
      * udp:6900             322     0       0       0       0    0
        udp:8999 (bctp)      0       405853  3       0       0    0
      * udp:10556            741     0       0       0       0    0
        udp:11778            0       311705  0       0       0    0
      * udp:12111            274     0       0       0       0    0
        udp:21606            0       5678    0       0       0    0
        udp:23578            0       4281    0       0       0    0
        udp:24488            0       2140    0       0       0    0
```

```
  udp:35849            0       2632    0       0       0    0
* udp:37758            212     721     0       0       0    0
  udp:40954            0       27113   0       0       0    0
* udp:42012            380     26      101     0       0    0
  udp:48235            0       3182    0       0       0    0
* udp:50321            2066    14226   5982    0       0    0
* udp:50838            389     0       0       0       0    0
  udp:50884            0       0       2743    0       0    0
  udp:51413            39      1712    0       0       0    0
  udp:54457            0       3504    0       0       0    0
  udp:56769            0       23761   0       0       0    0
  udp:59025            0       3034    0       0       0    0
* udp:60050            3000    3961    1478    0       0    0
  udp:60062            0       13672   0       0       0    0
  udp:64329            0       75590   0       0       0    0
10.45.176.120          0       0       0       73      21   18
10.45.176.206          37      689     3       34      0    0
  udp:3478 (stun)      37      685     3       0       0    0
10.45.176.207          8       143     0       5       0    0
10.45.176.209          12      88      1       11      0    0
10.45.176.210          10      32      4       1       0    0
10.45.176.214          25      8900    0       18      0    0
  udp:6672 (vision-s.. 23      8900    0       0       0    0
10.45.176.224          1       0       0       114     0    0
10.45.176.225          120     786     137     1       0    0
10.45.176.226          0       0       0       4       0    0
10.45.176.237          4       0       0       0       0    0
  udp:443 (https)      4       0       0       0       0    0
10.45.177.66           9       213     8349    0       0    0
  udp:6672 (vision-s.. 0       0       8334    0       0    0
10.45.177.68           12      64      8       124     0    0
10.45.177.75           0       2       0       66      0    0
10.45.177.197          0       2       1       0       0    0
10.45.182.75           44      71      17      25      0    0
10.45.182.85           41      2612    5024    0       0    0
  udp:45864            0       0       4985    0       0    0
10.45.182.136          0       0       0       8       0    0
10.45.183.117          0       0       0       15      0    0
10.45.183.199          45      1579    0       8       0    0
  udp:3478 (stun)      45      1578    0       0       0    0
10.45.183.204          0       9478    0       731     0    0
* udp:4500 (ipsec-na.. 0       0       0       237     0    0
  udp:22885            0       9404    0       0       0    0
10.45.183.205          0       0       1       3       0    0
  udp:4500 (ipsec-na.. 0       0       1       0       0    0
10.45.183.209          3       1       0       280     0    0
10.45.183.219          0       0       0       61      0    0
10.45.203.6            0       0       0       2       0    0
```

```
10.45.212.17           10472   25127   16430   0      0    0
* udp:62503            10452   23528   16423   0      0    0
10.45.212.27           0       0       0       1      0    0
10.45.212.29           0       0       0       30     0    0
10.45.212.51           0       0       0       2      0    0
10.45.212.82           0       1       1       28     0    0
10.45.212.84           0       0       0       2      0    0
10.45.212.199          0       0       0       1      0    0
10.45.212.202          0       0       0       4      0    0
10.45.212.205          0       0       0       299    0    0
10.45.212.207          0       0       0       85     0    0
10.45.229.75           3       0       0       0      0    0
  udp:443 (https)      3       0       0       0      0    0
10.45.229.78           6694314 0       0       113    0    0
* udp:4500 (ipsec-na.. 6694314 0       0       0      0    0
10.45.229.79           0       0       0       27     0    0
10.45.229.81           0       0       0       3      0    0
10.45.229.101          0       0       0       69     0    0
10.45.229.104          128     525     128     0      0    0
10.45.229.119          0       0       0       20     0    0
10.45.230.20           0       0       0       1      0    0
10.45.230.25           10      0       72      32     0    0
  udp:4500 (ipsec-na.. 10      0       72      0      0    0
10.45.230.89           495     3537    296     4      0    0
10.45.230.99           7       0       5       2      0    0
  udp:4500 (ipsec-na.. 7       0       5       0      0    0
10.45.230.204          9       57      18      110    0    0
10.45.230.207          18      33      1       1      0    0
10.45.230.212          0       0       0       2      0    0
10.45.230.223          0       0       0       3      0    0
10.45.230.224          27927   93      13      0      0    0
* udp:50323            322     0       0       0      0    0
* udp:50361            128     0       0       0      0    0
* udp:52065            409     0       0       0      0    0
* udp:55236            257     0       0       0      0    0
* udp:57072            142     0       0       0      0    0
* udp:58494            170     0       0       0      0    0
* udp:59465            160     0       0       0      0    0
* udp:59659            445     0       0       0      0    0
* udp:60874            129     0       0       0      0    0
* udp:60898            102     0       0       0      0    0
* udp:61122            302     0       0       0      0    0
* udp:61312            137     0       0       0      0    0
* udp:61669            124     0       0       0      0    0
* udp:62889            24738   0       0       0      0    0
* udp:63354            122     0       0       0      0    0
* udp:63474            107     0       0       0      0    0
10.45.230.226          0       0       0       3      0    0
```

10.45.230.228	0	45	0	0	1	0
10.45.230.229	682	21	3	0	0	0
* udp:4500 (ipsec-na..	682	0	0	0	0	0
10.45.231.16	433	0	0	24	0	0
* udp:4500 (ipsec-na..	433	0	0	0	0	0
10.45.231.21	40	256	81	0	0	0
10.45.231.31	0	0	0	32	0	0
10.45.231.53	2	46	0	0	0	0
10.45.231.61	4151	0	1	13	0	0
* udp:4500 (ipsec-na..	4151	0	1	0	0	0
10.45.231.80	0	0	0	6	0	0
10.45.231.99	0	0	0	40	0	0
10.45.231.102	0	0	0	11	0	0
10.45.231.114	0	0	0	47	0	0
10.45.233.16	0	0	0	55	0	0
10.45.233.39	1	13	2	1	0	0
10.45.233.41	0	0	3	4	0	0
10.45.233.42	0	0	0	115	0	0
10.45.233.47	0	0	0	1	0	0
10.45.233.55	0	0	0	3	0	0
10.45.234.197	320	0	11	2	0	0
* udp:4500 (ipsec-na..	320	0	11	0	0	0
10.45.235.6	107	454	62	6	0	0
10.45.235.11	250	0	0	0	0	0
* udp:443 (https)	249	0	0	0	0	0
10.45.235.13	0	0	0	4	0	0
10.45.235.16	24	56	3	0	0	0
10.45.235.19	0	0	0	3	0	0
10.45.235.24	0	2	0	33	0	0
10.45.235.25	2310	28152	68	17	0	0
* udp:443 (https)	2214	0	0	0	0	0
udp:6881	0	13339	0	0	0	0
udp:31708	0	4595	0	0	0	0
udp:51413	0	5367	0	0	0	0
udp:52372	0	3975	0	0	0	0
10.45.235.49	672	3165	14	0	0	0
* udp:443 (https)	672	79	0	0	0	0
udp:59418	0	3078	0	0	0	0
10.45.235.52	23	0	0	0	0	0
udp:4500 (ipsec-na..	23	0	0	0	0	0
10.45.235.59	0	0	0	58	0	0
10.45.235.66	0	0	0	4	0	0
10.45.235.89	165	2580	23	582	0	0
* udp:3478 (stun)	165	2580	23	0	0	0
10.45.235.90	0	0	0	332	0	0
10.45.235.92	0	0	0	1007	0	0
10.45.235.93	229	3272	306	13	0	0
10.45.235.94	0	0	0	10	0	0

```
10.45.238.75           0       0       0       1744    0    0
10.45.238.104          0       2576    0       7       0    0
  udp:443 (https)      0       2576    0       0       0    0
10.45.239.66           40      0       5       0       0    0
  udp:4500 (ipsec-na.. 40      0       5       0       0    0
10.45.239.219          1       0       0       18      0    0
  udp:443 (https)      1       0       0       0       0    0
10.45.240.86           0       0       0       5       0    0
10.45.241.57           216     66079   437     0       0    0
  udp:4500 (ipsec-na.. 0       0       21      0       0    0
  udp:33522            0       37844   0       0       0    0
  udp:37859            0       27536   0       0       0    0
10.45.241.94           0       0       0       44      0    0
10.45.241.98           0       0       0       4       0    0
10.45.241.101          68946   10      2       120     0    0
* udp:4500 (ipsec-na.. 68942   0       0       0       0    0
10.45.241.121          0       0       0       2       0    0
10.45.242.72           0       0       0       4       0    0
10.45.242.81           0       0       0       14      1    0
10.45.242.144          0       0       0       5       0    0
10.45.242.146          0       0       0       30      0    0
10.45.242.161          143     134     2297    139     0    0
* udp:4500 (ipsec-na.. 115     0       4       0       0    0
  udp:27032            0       78      2293    0       0    0
10.45.243.13           13877   63      1       0       0    0
* udp:20911            13853   0       0       0       0    0
10.45.243.41           12      0       0       14      0    0
  udp:443 (https)      12      0       0       0       0    0
10.45.243.69           0       0       0       66      0    0
10.45.243.71           0       28      0       2       0    0
  udp:80 (http)        0       28      0       0       0    0
10.45.243.109          0       2008    0       7       0    0
  udp:41697            0       2002    0       0       0    0
10.45.248.33           2       8       0       10      0    0
  udp:3478 (stun)      2       8       0       0       0    0
10.45.248.94           0       0       0       11      0    0
10.45.248.118          0       0       0       2       0    0
10.45.249.6            0       0       0       1502    0    0
10.45.249.34           25      0       0       154     0    0
  udp:443 (https)      25      0       0       0       0    0
10.45.249.99           68      558     88      0       0    0
10.45.249.104          0       0       0       7       0    0
  udp:4500 (ipsec-na.. 0       0       0       6       0    0
10.45.250.89           0       0       0       5       0    0
10.45.251.37           0       0       0       19      0    0
10.45.251.110          9       72      1       0       0    0
10.45.251.119          0       0       0       23      0    0
10.45.253.59           0       0       0       1       0    0
```

udp:4500 (ipsec-na..	0	0	0	1	0	0
10.45.253.61	0	0	0	53	0	0
10.45.253.84	121	0	0	16	0	0
* udp:443 (https)	121	0	0	0	0	0
10.45.253.93	0	0	0	4	0	0
10.45.253.100	0	0	0	142	0	0
10.45.253.121	0	0	0	2	0	0
10.45.254.94	0	0	0	12	0	0
10.45.255.90	1	125	0	0	0	0
10.45.255.97	0	0	0	36	0	0

ECN codepoint packet counts for selected ports:

Port	ECT(0) from WAN	CE from WAN	ECT(1) from WAN	ECT(0) from LAN	CE from LAN	ECT(1) from LAN
icmp:port-unreachable	6632	40795	3539	404	0	0
icmp:host-unreachable	1171	2575	43	22990	0	0
icmp:ttl-zero-during..	65	2	66	0	0	0
icmp:network-unreach..	321	4	0	0	0	0
ipencap:0	0	0	0	1	0	0
udp:53 (domain)	0	403	1	0	0	0
udp:80 (http)	0	33	0	0	0	0
udp:443 (https)	20006	36095	0	1882	0	0
udp:599 (acp)	238	261	59	0	0	0
udp:1024-3457 [81]	100	618	9	34	59	28
udp:3478 (stun)	2498	31725	394	0	0	0
udp:3553-4492 [19]	1	29449	0	0	0	0
udp:4500 (ipsec-nat-t)	9422229	0	151	244	0	0
udp:4548-51819 [8177]	62692	2291117	6604184	1072	0	0
udp:51820 (wireguard)	291	3	66	0	0	0
udp:51821-65535 [9371]	45758	405849	24049	65	0	0

6. IANA Considerations

This document has no IANA actions.

7. Security Considerations

There are no known security considerations introduced by this note.

8. Affiliation

The author wrote the script used to deploy fq_codel to the two backhaul subnets mentioned in Section 3.2.

9. Acknowledgements

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* FreeNet Liberec, for allowing access for data collection

10. Informative References

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