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Explicit Congestion Notification (ECN) Deployment Observations

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 initiated ECN, across 45% of member IPs.

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

- *24% of member IPs that negotiated TCP ECN flows saw apparent AQM marking via CE or ECE, with more congestion observed on the downstream.

- *42% of the member IPs that saw CE or ECE were from subnets that have known AQM instances in the ISP's backhaul, and the remainder appear to be from unknown AQMs.

- *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 evidence of [\[RFC3168\]](#) marking AQMs. Of 861 active member IP addresses:

- *382 member IPs, or 44%, successfully negotiated any TCP ECN flows

- *90 member IPs, or 24% of those that negotiated ECN, saw any CE or ECE marks on negotiated TCP ECN flows

Two backhaul links have fq_codel [\[RFC8290\]](#) deployed, serving the 10.45.64.0/24 and 10.45.235.0/24 subnets. This accounts for 38 of the 90 member IP addresses that saw CE or ECE, with the source of the remaining CE and ECE marks unknown. These are presumed to be from other [\[RFC3168\]](#) marking AQM instances.

Note that depending on the position of the marking AQM relative to the gateway, CE marks may not be seen on some packets, while TCP ECE flags are seen in the opposite direction. For a number of member IP addresses, we saw 0 CE marks downstream, but ECE flags set upstream, suggesting an AQM downstream from the gateway marking downstream traffic.

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

We note the following:

- *TCP accounted for 97.7% of the 536 million ECT(0) marks
- *0.68% of all TCP packets were marked with a nonzero ECN codepoint
- *0.053% of all non-TCP packets were marked with a nonzero ECN codepoint
- *Non-TCP accounted for 99.8% of the 4.2 million CE marks
- *Non-TCP accounted for virtually all of the ECT(1) marks

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

3.3.1. Tunneled 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 [[WIREFGUARD](#)] 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. 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).

3.3.3. 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.

3.3.4. 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

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](#)].

4.2. 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.

4.3. 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](#)].

4.4. 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.

4.5. 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

[*] Conntrack protocols: UDP, ICMP, DCCP, SCTP, GRE
 Conntrack total Bytes and Packets included in Other

5.2. TCP initiated from LAN to WAN

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, 10.5% of all)
 Saw ECT(1) on ECN flow: 5

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

ECN congestion signals by active IP:

IP	CE from WAN	ECE from LAN	CE from LAN	ECE from WAN
--	-----	-----	-----	-----
10.45.9.88	0	0	0	431
10.45.64.3	36	13348	0	45
10.45.64.4	0	2192	0	0
10.45.64.7	28	4610	0	35
10.45.64.11	0	335	0	0
10.45.64.12	0	14955	3	0
10.45.64.13	0	223	0	0
10.45.64.14	13	20863	0	23
10.45.64.15	0	9	0	0
10.45.64.16	0	1396	0	0
10.45.64.17	0	464	0	0
10.45.64.31	0	46740	12	0
10.45.64.39	0	11019	0	0
10.45.64.45	0	363	0	0
10.45.64.47	0	15731	321	6041
10.45.64.59	0	44	0	0
10.45.64.85	0	57	0	0
10.45.64.93	0	16530	0	0
10.45.64.103	0	10649	0	0
10.45.64.105	0	2046	0	0
10.45.64.112	0	1135	1	1
10.45.64.116	0	1042	0	0
10.45.64.118	163	710	0	170
10.45.64.123	0	3118	0	0

10.45.64.125	0	52960	49	0
10.45.64.126	0	12579	122	0
10.45.65.7	0	176	0	0
10.45.65.16	0	4483	0	0
10.45.65.110	0	1530	0	0
10.45.65.112	0	2313	0	0
10.45.65.124	5	6	0	9
10.45.86.39	1	13	0	0
10.45.86.41	72	3228	0	0
10.45.87.32	0	64	0	0
10.45.87.45	1	0	0	0
10.45.87.50	3	3	0	0
10.45.87.127	17	22	0	39
10.45.101.96	155	156	0	151
10.45.104.24	55	63	0	77
10.45.107.73	400	416	0	430
10.45.108.24	0	0	0	36
10.45.113.6	168	191	0	174
10.45.113.106	34	37	0	40
10.45.114.98	1619	1792	0	1739
10.45.138.66	43	56	0	47
10.45.140.73	510	551	0	520
10.45.140.74	39	46	0	38
10.45.141.85	39	50	0	85
10.45.145.2	10	15	0	25
10.45.145.73	1	0	0	0
10.45.153.10	6	11	0	0
10.45.154.82	22	25	0	44
10.45.155.68	1	1	0	0
10.45.155.71	144	143	1	152
10.45.158.197	493	53	0	0
10.45.158.198	13	13	0	25
10.45.176.114	32	46	0	62
10.45.176.119	38	47	0	68
10.45.177.68	22	24	0	27
10.45.182.75	6	7	0	13
10.45.183.117	131	145	6	152
10.45.183.204	8	10	0	0
10.45.212.82	18	23	0	48
10.45.229.81	268	2104	1	0
10.45.230.25	3132	18481	0	0
10.45.230.204	1	1	0	0
10.45.231.31	16	9	0	30
10.45.234.197	188	225	0	153
10.45.235.6	0	217	0	0
10.45.235.24	0	388	0	0
10.45.235.59	16	897	0	30
10.45.235.89	56	31899	176	5630
10.45.235.90	727	4278	0	709

10.45.235.92	151	169965	41	1784
10.45.235.94	0	1394	0	0
10.45.235.196	0	157	0	0
10.45.235.199	0	56	0	0
10.45.235.200	0	220	0	0
10.45.235.203	0	234	0	0
10.45.235.206	0	3484	0	0
10.45.235.208	0	378	0	0
10.45.238.75	196	262	0	229
10.45.241.101	0	740	0	0
10.45.242.72	5	5	0	11
10.45.242.146	21	25	0	44
10.45.243.69	2	3	0	0
10.45.249.6	0	2461	0	0
10.45.249.34	0	2260	0	0
10.45.251.37	39	171	0	0
10.45.251.114	134	13794	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 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 LAN	CE from LAN	ECT(1) from LAN	ECT(0) from WAN	CE from WAN	ECT(1) from WAN
10.45.10.0	201	0	0	0	0	0
10.45.10.4	14	0	0	0	0	0
10.45.10.5	20	0	0	0	0	0
10.45.10.6	9	0	0	0	0	0
10.45.10.7	8	0	0	0	0	0
10.45.10.8	39	0	0	0	0	0
10.45.10.11	8	0	0	0	0	0
10.45.10.12	2	0	0	0	0	0
10.45.10.42	6	0	0	0	0	0
10.45.10.61	2	0	0	0	0	0
10.45.10.70	44	0	0	0	0	0
10.45.10.71	5	0	0	0	0	0
10.45.10.73	7	0	0	0	0	0
10.45.10.77	13	0	0	0	0	0
10.45.10.81	10	0	0	0	0	0
10.45.10.82	8	0	0	0	0	0
10.45.10.83	3	0	0	0	0	0
10.45.10.95	59	0	0	0	0	0
10.45.10.96	39	0	0	0	0	0
10.45.10.129	0	0	0	0	403	1
10.45.10.196	80	0	0	0	0	0
10.45.10.197	63	0	0	0	0	0
10.45.10.201	3	0	0	0	0	0
10.45.10.204	25	0	0	0	0	0
10.45.10.227	40	0	0	0	0	0
10.45.10.228	7	0	0	0	0	0

10.45.10.244	14	0	0	0	0	0
10.45.10.245	7	0	0	0	0	0
10.45.64.3	100	0	0	0	0	0
10.45.64.4	31	0	0	0	0	0
10.45.64.6	2	0	0	0	0	0
10.45.64.7	8	0	0	12	126	20
10.45.64.10	29	0	0	0	0	0
10.45.64.11	67	0	0	0	0	0
10.45.64.12	6	0	0	0	0	0
10.45.64.13	35	0	0	0	0	0
10.45.64.14	121	0	0	0	0	0
10.45.64.15	52	0	0	0	0	0
10.45.64.16	18	0	0	0	0	0
10.45.64.19	0	0	0	16	0	0
udp:4500 (ipsec-na..	0	0	0	11	0	0
10.45.64.31	27	0	0	34129	2468	58304
udp:37658	0	0	0	0	0	4346
* udp:38129	0	0	0	24957	2468	15281
udp:38884	0	0	0	0	0	10409
* udp:40871	0	0	0	288	0	2269
* udp:41621	0	0	0	3057	0	14609
* udp:41744	0	0	0	171	0	61
udp:43588	0	0	0	0	0	6746
udp:45444	0	0	0	0	0	1292
* udp:45465	0	0	0	866	0	0
udp:45483	0	0	0	0	0	1838
* udp:45522	0	0	0	4764	0	708
10.45.64.39	75	0	0	0	0	0
10.45.64.45	50	0	0	0	0	0
10.45.64.47	11	0	0	0	0	0
10.45.64.51	2	0	0	0	0	0
10.45.64.59	593	0	0	56	1624	10
udp:3478 (stun)	0	0	0	56	1624	10
10.45.64.85	4	0	0	0	0	0
10.45.64.86	9	0	0	7	434404	3
udp:4400 (ds-srv)	0	0	0	0	29065	0
udp:14757	0	0	0	0	97175	0
udp:24173	0	0	0	0	35437	0
udp:29493	0	0	0	0	120959	0
udp:44495	0	0	0	0	41547	0
udp:53678	0	0	0	0	109978	0
10.45.64.89	4	0	0	7	50	0
10.45.64.93	75	0	0	598	2971	341
* udp:3478 (stun)	0	0	0	598	2971	341
10.45.64.98	0	0	0	0	0	32780
udp:6008	0	0	0	0	0	9234
udp:7008 (afs3-upd..	0	0	0	0	0	23546
10.45.64.99	0	0	0	132	2094	73
udp:3478 (stun)	0	0	0	0	3	0

10.45.64.103	47	0	0	0	0	0
10.45.64.104	1	0	0	70	293	31
10.45.64.105	7	0	0	213	33440	0
* udp:443 (https)	0	0	0	213	33440	0
10.45.64.107	2	0	0	0	0	0
10.45.64.108	1	0	0	0	0	0
10.45.64.111	0	0	0	1	1	0
10.45.64.112	48	0	0	0	421	0
10.45.64.116	64	0	8	4	143	8
10.45.64.118	77	0	0	0	0	0
10.45.64.121	0	0	0	0	2107	0
udp:38603	0	0	0	0	2100	0
10.45.64.123	13	0	0	0	0	0
10.45.64.124	0	0	0	6	0	0
udp:443 (https)	0	0	0	6	0	0
10.45.64.125	22	0	0	0	0	0
10.45.64.126	37	0	0	1	10	0
10.45.65.0	42	0	0	0	0	0
10.45.65.1	45	0	0	0	0	0
10.45.65.5	17	0	0	0	0	0
10.45.65.7	30	0	0	0	0	0
10.45.65.11	6	0	0	0	0	0
10.45.65.16	505	0	0	1686	40141	36888
* udp:3478 (stun)	0	0	0	1595	22049	4
udp:26808	0	0	0	0	0	36805
udp:62348	0	0	0	0	15738	0
10.45.65.17	0	0	0	0	4	0
10.45.65.66	94	0	0	0	17	0
udp:3478 (stun)	0	0	0	0	17	0
10.45.65.94	25	0	0	319	0	1
udp:3478 (stun)	0	0	0	0	0	1
10.45.65.95	8	0	0	0	0	0
10.45.65.104	41	0	0	0	0	0
10.45.65.107	5	0	0	12	77	2
10.45.65.110	38	0	0	0	0	0
10.45.65.112	75	0	0	39	1168	18
10.45.65.122	0	0	0	2	5	0
10.45.65.123	1	0	0	0	0	0
10.45.65.124	11	0	0	0	0	0
10.45.65.127	5	0	0	0	0	0
10.45.75.90	1	0	0	0	0	0
10.45.80.28	0	0	0	2	8	1
10.45.80.79	2	0	0	4	7	0
10.45.80.85	10	0	0	0	0	0
10.45.80.99	11	0	0	0	0	0
10.45.83.76	3	0	0	0	0	0
10.45.83.80	0	0	0	28	51	11
10.45.85.127	68	0	0	301	174	30747
* udp:599 (acp)	0	0	0	222	174	45

udp:6008	0	0	0	0	0	30702
* udp:60001	65	0	0	49	0	0
10.45.86.16	2	0	0	13	0	0
udp:4500 (ipsec-na..	0	0	0	8	0	0
udp:51820 (wiregua..	0	0	0	5	0	0
10.45.86.36	4	0	0	0	0	0
10.45.86.39	50	0	0	205	37619	107
udp:29492	0	0	0	0	2512	0
udp:64733	0	0	0	0	30711	0
10.45.86.40	0	0	0	2	0	0
udp:443 (https)	0	0	0	2	0	0
10.45.86.43	532	0	0	0	11	0
10.45.86.68	325	0	0	760	3528	614
udp:80 (http)	0	0	0	0	2	0
10.45.87.32	14	0	0	12	0	0
10.45.87.44	0	0	0	709	4963	623
udp:80 (http)	0	0	0	0	1	0
udp:6881	0	0	0	3	1313	43
10.45.87.45	185	0	0	0	0	0
10.45.87.48	82	0	0	0	0	0
10.45.87.50	68	0	0	3	0	9
udp:4500 (ipsec-na..	0	0	0	3	0	9
10.45.87.103	2	0	0	0	0	0
10.45.87.112	0	0	0	0	1	0
10.45.87.113	33	0	0	0	0	0
10.45.87.127	44	0	0	0	0	0
10.45.92.74	2	0	0	31	0	1
10.45.93.69	0	0	0	15	122	6
10.45.93.75	4	0	0	361	2945	278
10.45.93.79	8	0	0	0	0	0
10.45.98.71	0	0	0	2	8	0
10.45.98.72	40	0	0	0	1	0
udp:3478 (stun)	0	0	0	0	1	0
10.45.101.96	140	0	0	0	0	0
10.45.101.100	12	0	0	0	0	0
10.45.101.101	0	0	0	2	10	7
10.45.101.103	0	0	0	21	21899	15
udp:58479	0	0	0	0	21372	0
10.45.101.104	33	0	0	0	0	10
10.45.104.24	324	0	0	0	0	0
10.45.104.104	60	0	0	16	72	2
10.45.107.73	58	0	0	32	0	1
udp:4500 (ipsec-na..	0	0	0	32	0	1
10.45.107.79	70	0	0	34	0	0
udp:443 (https)	0	0	0	34	0	0
10.45.107.81	3	0	0	0	4421	0
udp:61094	0	0	0	0	4421	0
10.45.108.3	1	0	0	0	0	0
10.45.108.4	1	0	0	33	5079	90

udp:33027	0	0	0	0	2978	0
10.45.108.13	14	0	0	0	0	0
10.45.108.24	117	0	0	799	5543	1059
* udp:40211	0	0	0	107	0	0
10.45.108.25	799	0	0	1	2	1
10.45.108.66	0	0	1	0	0	0
10.45.108.69	2	0	0	0	0	0
10.45.108.71	0	0	0	28	12830	0
udp:34665	0	0	0	0	12462	0
10.45.108.75	38	0	0	0	0	6395176
udp:6008	0	0	0	0	0	1755476
udp:7008 (afs3-upd..	0	0	0	0	0	1827173
udp:8008 (http-alt)	0	0	0	0	0	740987
udp:9008	0	0	0	0	0	809024
udp:10008 (octopus)	0	0	0	0	0	380001
udp:11008	0	0	0	0	0	578400
udp:12008 (accurac..	0	0	0	0	0	231619
udp:13008	0	0	0	0	0	72496
10.45.108.76	2	0	0	0	0	0
10.45.108.77	31	0	0	0	0	0
10.45.108.80	10	0	0	337	1566	173
10.45.108.95	283	0	0	1	5	0
10.45.108.126	12	0	0	0	0	0
10.45.112.74	371	0	0	9	95	4
10.45.112.102	29	0	0	0	0	0
10.45.112.139	5	0	0	0	0	0
10.45.112.154	4	0	0	0	0	0
10.45.112.165	24	0	0	0	0	0
10.45.112.172	0	0	0	6333	0	0
* udp:443 (https)	0	0	0	6333	0	0
10.45.112.216	2	0	0	0	0	0
10.45.113.6	136	0	0	147184	0	0
* udp:4500 (ipsec-na..	0	0	0	147184	0	0
10.45.113.7	52	0	0	453	0	10
* udp:443 (https)	0	0	0	309	0	0
* udp:4500 (ipsec-na..	0	0	0	144	0	10
10.45.113.9	60	0	0	0	0	0
10.45.113.11	187	0	0	0	0	0
10.45.113.27	1	0	0	0	0	0
10.45.113.30	4	0	0	0	0	0
10.45.113.33	2	0	0	0	0	0
10.45.113.34	58	0	0	0	0	0
10.45.113.35	6	0	0	0	0	0
10.45.113.36	2	0	0	0	0	0
10.45.113.66	0	0	0	1	11	0
10.45.113.90	163	0	0	0	0	0
10.45.113.94	0	0	0	17	62	2
10.45.113.97	19	0	0	0	0	0
10.45.113.99	15	0	0	11	76	12

10.45.113.104	0	0	0	818	0	0
* udp:4500 (ipsec-na..	0	0	0	818	0	0
10.45.113.106	10	0	0	0	0	0
10.45.113.119	313	0	0	0	178	0
udp:3478 (stun)	0	0	0	0	178	0
10.45.113.122	0	0	0	36	0	0
udp:4500 (ipsec-na..	0	0	0	36	0	0
10.45.113.124	201	0	0	0	0	0
10.45.114.8	0	0	0	0	3	0
10.45.114.10	3	0	0	0	0	0
10.45.114.42	3	0	0	286	12	67
* udp:51820 (wiregua..	0	0	0	286	0	66
10.45.114.98	10	0	0	0	0	0
10.45.120.25	53	0	0	0	0	0
10.45.120.34	12	0	0	0	0	0
10.45.120.78	715	0	0	0	0	0
10.45.122.51	66	0	0	686	28190	122
udp:45622	0	0	0	0	5782	0
udp:59437	0	0	0	0	17791	0
10.45.124.31	105	0	0	1720	5946	16897
udp:3478 (stun)	0	0	0	0	6	0
* udp:50451	0	0	0	1720	0	15875
udp:50919	0	0	0	0	2428	0
udp:50996	0	0	0	0	0	1016
udp:57403	0	0	0	0	1944	0
10.45.124.43	12	0	0	0	0	0
10.45.124.73	0	0	0	37	0	0
udp:4500 (ipsec-na..	0	0	0	37	0	0
10.45.124.74	1	0	0	0	0	0
10.45.124.89	2	0	0	0	0	0
10.45.124.107	0	0	0	142	626895	83
udp:24616	0	0	0	0	501142	0
udp:51123	0	0	0	0	124060	0
10.45.124.111	0	0	0	0	1538	166
udp:4748	0	0	0	0	1491	166
10.45.124.117	248	0	0	0	0	0
10.45.125.97	2	0	0	0	0	0
10.45.125.99	1	0	0	130	6235	29
udp:8609 (canon-cp..	0	0	0	0	3002	0
10.45.125.104	3	0	0	0	0	0
10.45.125.105	7	0	0	0	0	0
10.45.136.82	1	0	0	0	0	0
10.45.136.198	8	0	0	0	0	0
10.45.136.199	0	0	0	68	3210	7
udp:22312	0	0	0	0	2452	0
10.45.136.200	0	0	0	0	44	1
10.45.137.4	1882	0	0	4603	0	0
* udp:443 (https)	1882	0	0	4603	0	0
10.45.137.21	118	0	0	0	0	0

10.45.137.27	63	0	0	4	0	0
10.45.137.29	0	0	1	0	0	0
10.45.137.46	6	0	0	9	154	0
udp:443 (https)	0	0	0	9	0	0
10.45.137.53	7	0	0	0	0	0
10.45.137.55	37	0	0	0	0	1
10.45.137.62	14	0	0	5	29	1
udp:443 (https)	0	0	0	2	0	0
10.45.137.119	4	0	0	16	203825	12
udp:16772	0	0	0	0	55846	0
udp:25135	0	0	0	0	24694	0
udp:25476	0	0	0	0	66965	0
udp:51123	0	0	0	0	54265	0
udp:55430	0	0	0	0	1138	0
10.45.137.123	1	0	0	2	4190	1
udp:29363	0	0	0	0	3283	0
10.45.138.52	0	0	0	3093	18938	0
* udp:42420	0	0	0	3087	18871	0
10.45.138.66	249	0	0	0	0	0
10.45.138.88	0	0	0	43	107	10
10.45.138.95	20	0	0	0	0	0
10.45.140.0	84	0	0	0	0	0
10.45.140.5	2	0	0	0	0	0
10.45.140.28	1	0	0	0	0	0
10.45.140.74	12	0	0	0	0	0
10.45.140.81	26	0	0	0	0	0
10.45.140.100	0	0	0	143	465	37
10.45.140.103	16	0	0	0	0	0
10.45.140.104	4	0	0	0	0	0
10.45.140.109	2	0	0	0	0	0
10.45.140.118	27	0	0	0	0	0
10.45.140.121	17	0	0	0	7032	0
udp:49710	0	0	0	0	1160	0
udp:53984	0	0	0	0	2694	0
udp:58704	0	0	0	0	1597	0
10.45.140.122	0	0	0	0	3	0
10.45.140.123	0	0	0	0	0	4
10.45.140.127	15	0	0	0	0	0
10.45.140.133	0	1	0	0	0	0
10.45.140.169	59	0	0	0	0	0
10.45.140.171	14	0	0	0	0	0
10.45.141.2	12	0	0	91	0	0
udp:443 (https)	0	0	0	91	0	0
10.45.141.6	24	0	0	0	0	0
10.45.141.14	2	0	0	0	0	0
10.45.141.17	17	0	0	2	37	1
10.45.141.19	2	0	0	0	0	0
10.45.141.82	21	0	0	579	0	0
* udp:443 (https)	0	0	0	579	0	0

10.45.141.83	14	0	0	0	0	0
10.45.141.84	90	0	0	0	0	0
10.45.141.85	518	0	0	0	0	0
10.45.141.86	6	0	0	0	0	0
10.45.141.87	2	0	0	0	0	0
10.45.141.103	57	0	0	0	0	0
10.45.141.106	1079	0	0	7	190	3947
udp:3478 (stun)	0	0	0	0	24	12
* udp:5001 (complex..	1072	0	0	0	0	0
udp:40208	0	0	0	0	0	3932
10.45.141.125	2	0	0	0	0	0
10.45.144.20	1	0	0	2	6	2
10.45.144.43	3	0	0	0	0	0
10.45.144.55	2	0	0	0	0	0
10.45.144.68	363	0	0	0	0	0
10.45.144.73	14	0	0	0	0	0
10.45.144.75	51	0	0	0	0	3
10.45.144.77	24	0	0	51	289	35
10.45.144.105	1	0	0	413	0	11
* udp:4500 (ipsec-na..	0	0	0	413	0	11
10.45.144.139	0	0	0	1496	0	0
* udp:443 (https)	0	0	0	1496	0	0
10.45.144.197	102	0	0	0	0	0
10.45.145.2	15	0	0	0	0	0
10.45.145.26	44	0	0	0	0	0
10.45.145.39	11	0	0	2503039	0	0
udp:443 (https)	0	0	0	4	0	0
* udp:4500 (ipsec-na..	0	0	0	2503035	0	0
10.45.145.56	3	0	0	0	0	0
10.45.145.72	32	0	0	0	0	0
10.45.145.75	0	0	0	3024	0	0
* udp:443 (https)	0	0	0	3024	0	0
10.45.145.81	292	0	0	8691	107114	8245
udp:80 (http)	0	0	0	0	2	0
* udp:6881	0	0	0	355	8092	672
udp:19517	0	0	0	0	1097	0
udp:22784	0	0	0	0	3441	0
* udp:25223	0	0	0	110	0	0
* udp:37526	0	0	0	139	0	0
* udp:40631	0	0	0	191	0	0
udp:40990	0	0	0	0	33415	0
udp:51820 (wiregua..	0	0	0	0	3	0
10.45.145.96	7	0	0	0	0	0
10.45.145.98	3	0	0	0	0	0
10.45.145.107	0	0	0	0	9	0
10.45.145.109	9	35	0	0	0	0
10.45.145.115	11	0	0	0	0	0
10.45.146.66	26	0	0	52	88	7
10.45.146.195	2	0	0	0	0	0

10.45.146.200	49	0	0	1471	0	0
* udp:4500 (ipsec-na..	0	0	0	1471	0	0
10.45.146.201	9	0	0	0	0	0
10.45.153.10	33	0	0	0	0	0
10.45.153.194	0	0	0	2	86	2
10.45.154.6	9	0	0	0	0	0
10.45.154.81	4	0	0	0	0	0
10.45.154.82	140	0	0	0	0	0
10.45.154.100	14	0	0	0	0	0
10.45.154.105	17	0	0	0	0	0
10.45.154.112	5	0	0	0	0	0
10.45.154.113	3	0	0	1	88	2
10.45.154.115	224	0	0	0	0	0
10.45.155.12	11	0	0	0	0	0
10.45.155.67	1	0	0	0	0	0
10.45.155.68	237	0	0	0	0	0
10.45.155.69	1	0	0	0	0	0
10.45.155.71	246	0	0	0	0	0
10.45.155.73	72	0	0	0	0	0
10.45.155.74	0	0	0	0	1	0
udp:3478 (stun)	0	0	0	0	1	0
10.45.155.75	0	0	0	0	4	0
10.45.155.76	0	0	0	0	1	0
10.45.155.217	15	0	0	0	0	0
10.45.155.229	48	0	0	4	42	6
10.45.156.94	0	0	0	25	152	8
10.45.156.105	19	0	0	0	5362	0
udp:58796	0	0	0	0	5362	0
10.45.156.127	22	0	0	0	0	0
10.45.158.115	402	0	0	0	0	0
10.45.158.124	4	0	0	0	0	0
10.45.158.127	3	0	0	0	0	0
10.45.158.195	25	0	0	0	1630	3
udp:6881	0	0	0	0	1610	0
10.45.158.197	82	0	0	0	0	0
10.45.158.198	204	0	0	0	0	0
10.45.158.204	118	0	0	0	0	0
10.45.158.206	0	0	0	9	32	2
10.45.176.114	68	0	0	0	0	0
10.45.176.116	1	0	0	188	1702	191
10.45.176.117	35	0	0	0	0	0
10.45.176.119	218	0	0	9320	1028270	11302
udp:6881	0	0	0	0	91498	83
* udp:6900	0	0	0	322	0	0
udp:8999 (bctp)	0	0	0	0	405853	3
* udp:10556	0	0	0	741	0	0
udp:11778	0	0	0	0	311705	0
* udp:12111	0	0	0	274	0	0
udp:21606	0	0	0	0	5678	0

udp:23578	0	0	0	0	4281	0
udp:24488	0	0	0	0	2140	0
udp:35849	0	0	0	0	2632	0
* udp:37758	0	0	0	212	721	0
udp:40954	0	0	0	0	27113	0
* udp:42012	0	0	0	380	26	101
udp:48235	0	0	0	0	3182	0
* udp:50321	0	0	0	2066	14226	5982
* udp:50838	0	0	0	389	0	0
udp:50884	0	0	0	0	0	2743
udp:51413	0	0	0	39	1712	0
udp:54457	0	0	0	0	3504	0
udp:56769	0	0	0	0	23761	0
udp:59025	0	0	0	0	3034	0
* udp:60050	0	0	0	3000	3961	1478
udp:60062	0	0	0	0	13672	0
udp:64329	0	0	0	0	75590	0
10.45.176.120	73	21	18	0	0	0
10.45.176.206	34	0	0	37	689	3
udp:3478 (stun)	0	0	0	37	685	3
10.45.176.207	5	0	0	8	143	0
10.45.176.209	11	0	0	12	88	1
10.45.176.210	1	0	0	10	32	4
10.45.176.214	18	0	0	25	8900	0
udp:6672 (vision-s..	0	0	0	23	8900	0
10.45.176.224	114	0	0	1	0	0
10.45.176.225	1	0	0	120	786	137
10.45.176.226	4	0	0	0	0	0
10.45.176.237	0	0	0	4	0	0
udp:443 (https)	0	0	0	4	0	0
10.45.177.66	0	0	0	9	213	8349
udp:6672 (vision-s..	0	0	0	0	0	8334
10.45.177.68	124	0	0	12	64	8
10.45.177.75	66	0	0	0	2	0
10.45.177.197	0	0	0	0	2	1
10.45.182.75	25	0	0	44	71	17
10.45.182.85	0	0	0	41	2612	5024
udp:45864	0	0	0	0	0	4985
10.45.182.136	8	0	0	0	0	0
10.45.183.117	15	0	0	0	0	0
10.45.183.199	8	0	0	45	1579	0
udp:3478 (stun)	0	0	0	45	1578	0
10.45.183.204	731	0	0	0	9478	0
* udp:4500 (ipsec-na..	237	0	0	0	0	0
udp:22885	0	0	0	0	9404	0
10.45.183.205	3	0	0	0	0	1
udp:4500 (ipsec-na..	0	0	0	0	0	1
10.45.183.209	280	0	0	3	1	0
10.45.183.219	61	0	0	0	0	0

10.45.203.6	2	0	0	0	0	0
10.45.212.17	0	0	0	10472	25127	16430
* udp:62503	0	0	0	10452	23528	16423
10.45.212.27	1	0	0	0	0	0
10.45.212.29	30	0	0	0	0	0
10.45.212.51	2	0	0	0	0	0
10.45.212.82	28	0	0	0	1	1
10.45.212.84	2	0	0	0	0	0
10.45.212.199	1	0	0	0	0	0
10.45.212.202	4	0	0	0	0	0
10.45.212.205	299	0	0	0	0	0
10.45.212.207	85	0	0	0	0	0
10.45.229.75	0	0	0	3	0	0
udp:443 (https)	0	0	0	3	0	0
10.45.229.78	113	0	0	6694314	0	0
* udp:4500 (ipsec-na..	0	0	0	6694314	0	0
10.45.229.79	27	0	0	0	0	0
10.45.229.81	3	0	0	0	0	0
10.45.229.101	69	0	0	0	0	0
10.45.229.104	0	0	0	128	525	128
10.45.229.119	20	0	0	0	0	0
10.45.230.20	1	0	0	0	0	0
10.45.230.25	32	0	0	10	0	72
udp:4500 (ipsec-na..	0	0	0	10	0	72
10.45.230.89	4	0	0	495	3537	296
10.45.230.99	2	0	0	7	0	5
udp:4500 (ipsec-na..	0	0	0	7	0	5
10.45.230.204	110	0	0	9	57	18
10.45.230.207	1	0	0	18	33	1
10.45.230.212	2	0	0	0	0	0
10.45.230.223	3	0	0	0	0	0
10.45.230.224	0	0	0	27927	93	13
* udp:50323	0	0	0	322	0	0
* udp:50361	0	0	0	128	0	0
* udp:52065	0	0	0	409	0	0
* udp:55236	0	0	0	257	0	0
* udp:57072	0	0	0	142	0	0
* udp:58494	0	0	0	170	0	0
* udp:59465	0	0	0	160	0	0
* udp:59659	0	0	0	445	0	0
* udp:60874	0	0	0	129	0	0
* udp:60898	0	0	0	102	0	0
* udp:61122	0	0	0	302	0	0
* udp:61312	0	0	0	137	0	0
* udp:61669	0	0	0	124	0	0
* udp:62889	0	0	0	24738	0	0
* udp:63354	0	0	0	122	0	0
* udp:63474	0	0	0	107	0	0
10.45.230.226	3	0	0	0	0	0

10.45.230.228	0	1	0	0	45	0
10.45.230.229	0	0	0	682	21	3
* udp:4500 (ipsec-na..	0	0	0	682	0	0
10.45.231.16	24	0	0	433	0	0
* udp:4500 (ipsec-na..	0	0	0	433	0	0
10.45.231.21	0	0	0	40	256	81
10.45.231.31	32	0	0	0	0	0
10.45.231.53	0	0	0	2	46	0
10.45.231.61	13	0	0	4151	0	1
* udp:4500 (ipsec-na..	0	0	0	4151	0	1
10.45.231.80	6	0	0	0	0	0
10.45.231.99	40	0	0	0	0	0
10.45.231.102	11	0	0	0	0	0
10.45.231.114	47	0	0	0	0	0
10.45.233.16	55	0	0	0	0	0
10.45.233.39	1	0	0	1	13	2
10.45.233.41	4	0	0	0	0	3
10.45.233.42	115	0	0	0	0	0
10.45.233.47	1	0	0	0	0	0
10.45.233.55	3	0	0	0	0	0
10.45.234.197	2	0	0	320	0	11
* udp:4500 (ipsec-na..	0	0	0	320	0	11
10.45.235.6	6	0	0	107	454	62
10.45.235.11	0	0	0	250	0	0
* udp:443 (https)	0	0	0	249	0	0
10.45.235.13	4	0	0	0	0	0
10.45.235.16	0	0	0	24	56	3
10.45.235.19	3	0	0	0	0	0
10.45.235.24	33	0	0	0	2	0
10.45.235.25	17	0	0	2310	28152	68
* udp:443 (https)	0	0	0	2214	0	0
udp:6881	0	0	0	0	13339	0
udp:31708	0	0	0	0	4595	0
udp:51413	0	0	0	0	5367	0
udp:52372	0	0	0	0	3975	0
10.45.235.49	0	0	0	672	3165	14
* udp:443 (https)	0	0	0	672	79	0
udp:59418	0	0	0	0	3078	0
10.45.235.52	0	0	0	23	0	0
udp:4500 (ipsec-na..	0	0	0	23	0	0
10.45.235.59	58	0	0	0	0	0
10.45.235.66	4	0	0	0	0	0
10.45.235.89	582	0	0	165	2580	23
* udp:3478 (stun)	0	0	0	165	2580	23
10.45.235.90	332	0	0	0	0	0
10.45.235.92	1007	0	0	0	0	0
10.45.235.93	13	0	0	229	3272	306
10.45.235.94	10	0	0	0	0	0
10.45.238.75	1744	0	0	0	0	0

10.45.238.104	7	0	0	0	2576	0
udp:443 (https)	0	0	0	0	2576	0
10.45.239.66	0	0	0	40	0	5
udp:4500 (ipsec-na..	0	0	0	40	0	5
10.45.239.219	18	0	0	1	0	0
udp:443 (https)	0	0	0	1	0	0
10.45.240.86	5	0	0	0	0	0
10.45.241.57	0	0	0	216	66079	437
udp:4500 (ipsec-na..	0	0	0	0	0	21
udp:33522	0	0	0	0	37844	0
udp:37859	0	0	0	0	27536	0
10.45.241.94	44	0	0	0	0	0
10.45.241.98	4	0	0	0	0	0
10.45.241.101	120	0	0	68946	10	2
* udp:4500 (ipsec-na..	0	0	0	68942	0	0
10.45.241.121	2	0	0	0	0	0
10.45.242.72	4	0	0	0	0	0
10.45.242.81	14	1	0	0	0	0
10.45.242.144	5	0	0	0	0	0
10.45.242.146	30	0	0	0	0	0
10.45.242.161	139	0	0	143	134	2297
* udp:4500 (ipsec-na..	0	0	0	115	0	4
udp:27032	0	0	0	0	78	2293
10.45.243.13	0	0	0	13877	63	1
* udp:20911	0	0	0	13853	0	0
10.45.243.41	14	0	0	12	0	0
udp:443 (https)	0	0	0	12	0	0
10.45.243.69	66	0	0	0	0	0
10.45.243.71	2	0	0	0	28	0
udp:80 (http)	0	0	0	0	28	0
10.45.243.109	7	0	0	0	2008	0
udp:41697	0	0	0	0	2002	0
10.45.248.33	10	0	0	2	8	0
udp:3478 (stun)	0	0	0	2	8	0
10.45.248.94	11	0	0	0	0	0
10.45.248.118	2	0	0	0	0	0
10.45.249.6	1502	0	0	0	0	0
10.45.249.34	154	0	0	25	0	0
udp:443 (https)	0	0	0	25	0	0
10.45.249.99	0	0	0	68	558	88
10.45.249.104	7	0	0	0	0	0
udp:4500 (ipsec-na..	6	0	0	0	0	0
10.45.250.89	5	0	0	0	0	0
10.45.251.37	19	0	0	0	0	0
10.45.251.110	0	0	0	9	72	1
10.45.251.119	23	0	0	0	0	0
10.45.253.59	1	0	0	0	0	0
udp:4500 (ipsec-na..	1	0	0	0	0	0
10.45.253.61	53	0	0	0	0	0

10.45.253.84	16	0	0	121	0	0
* udp:443 (https)	0	0	0	121	0	0
10.45.253.93	4	0	0	0	0	0
10.45.253.100	142	0	0	0	0	0
10.45.253.121	2	0	0	0	0	0
10.45.254.94	12	0	0	0	0	0
10.45.255.90	0	0	0	1	125	0
10.45.255.97	36	0	0	0	0	0

ECN codepoint packet counts for selected ports:

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

6. IANA Considerations

This document has no IANA actions.

7. Security Considerations

There are no known security considerations introduced by this note.

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9. Informative References

[IPTABLES-ECN] Heist, P.G., "iptables-ecn GitHub Repository",
<<https://github.com/heistp/iptables-ecn/>>.

[RFC1349] Almquist, P., "Type of Service in the Internet Protocol Suite", RFC 1349, DOI 10.17487/RFC1349, July 1992,
<<https://www.rfc-editor.org/info/rfc1349>>.

[RFC2481] Ramakrishnan, K. and S. Floyd, "A Proposal to add Explicit Congestion Notification (ECN) to IP", RFC 2481, DOI 10.17487/RFC2481, January 1999, <<https://www.rfc-editor.org/info/rfc2481>>.

[RFC3168] Ramakrishnan, K., Floyd, S., and D. Black, "The Addition of Explicit Congestion Notification (ECN) to IP", RFC 3168, DOI 10.17487/RFC3168, September 2001, <<https://www.rfc-editor.org/info/rfc3168>>.

[RFC3540] Spring, N., Wetherall, D., and D. Ely, "Robust Explicit Congestion Notification (ECN) Signaling with Nonces", RFC 3540, DOI 10.17487/RFC3540, June 2003, <<https://www.rfc-editor.org/info/rfc3540>>.

[RFC3948] Huttunen, A., Swander, B., Volpe, V., DiBurro, L., and M. Stenberg, "UDP Encapsulation of IPsec ESP Packets", RFC

3948, DOI 10.17487/RFC3948, January 2005, <<https://www.rfc-editor.org/info/rfc3948>>.

[RFC6040] Briscoe, B., "Tunnelling of Explicit Congestion Notification", RFC 6040, DOI 10.17487/RFC6040, November 2010, <<https://www.rfc-editor.org/info/rfc6040>>.

[RFC8290] Hoeiland-Joergensen, T., McKenney, P., Taht, D., Gettys, J., and E. Dumazet, "The Flow Queue CoDel Packet Scheduler and Active Queue Management Algorithm", RFC 8290, DOI 10.17487/RFC8290, January 2018, <<https://www.rfc-editor.org/info/rfc8290>>.

[RFC8311] Black, D., "Relaxing Restrictions on Explicit Congestion Notification (ECN) Experimentation", RFC 8311, DOI 10.17487/RFC8311, January 2018, <<https://www.rfc-editor.org/info/rfc8311>>.

[WIREGUARD] "WireGuard web site", <<https://www.wireguard.com>>.

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