FloodBox: A tool for Measuring the Impact of IP DiffServ Code Point in the Internet

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To measure the impact of DSCP code points on latency

- WebRTC[1] would like to use DSCP code-points to signal QoS expectations, but does it really work?
- We tested three DSCP values: CS1 (low priority data), AF42 (Multimedia conferencing) and EF (Telephony)
- Recent studies[2,3] show DSCP survives in the Internet.

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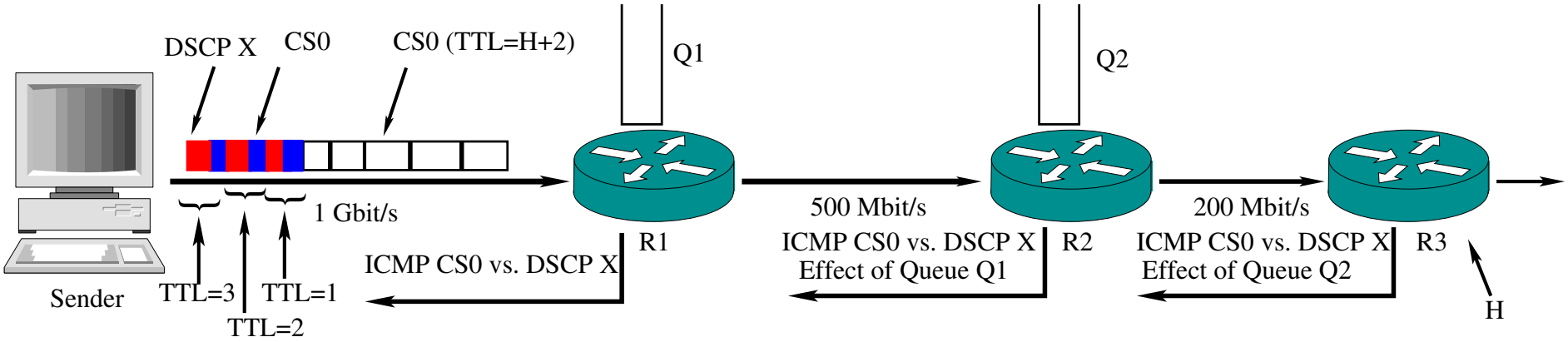
[1] `https://tools.ietf.org/html/draft-ietf-tsvwg-rtcweb-qos-18`

[2] Runa Barik et al. "Can WebRTC QoS Work? A DSCP Measurement Study". In: *Proceedings of the 30th International Teletraffic Congress (ITC)*. Wien/Austria, Sept. 2018, pp. 167–175. ISBN: 978-0-9883045-5-0.

[3] Ana Custura, Raffaello Secchi, and Gorry Fairhurst. "Exploring DSCP Modification Pathologies in the Internet". In: *Computer Communications* 127 (2018), pp. 86–94. ISSN: 0140-3664.

FloodBox



Delay impact at different links

- A probe: a burst of 200 UDP packets of size 1500 bytes with CS0 is followed by 2*(H+1) TTL-limited UDP packets. The probe is repeated 20 times.

Link delay:

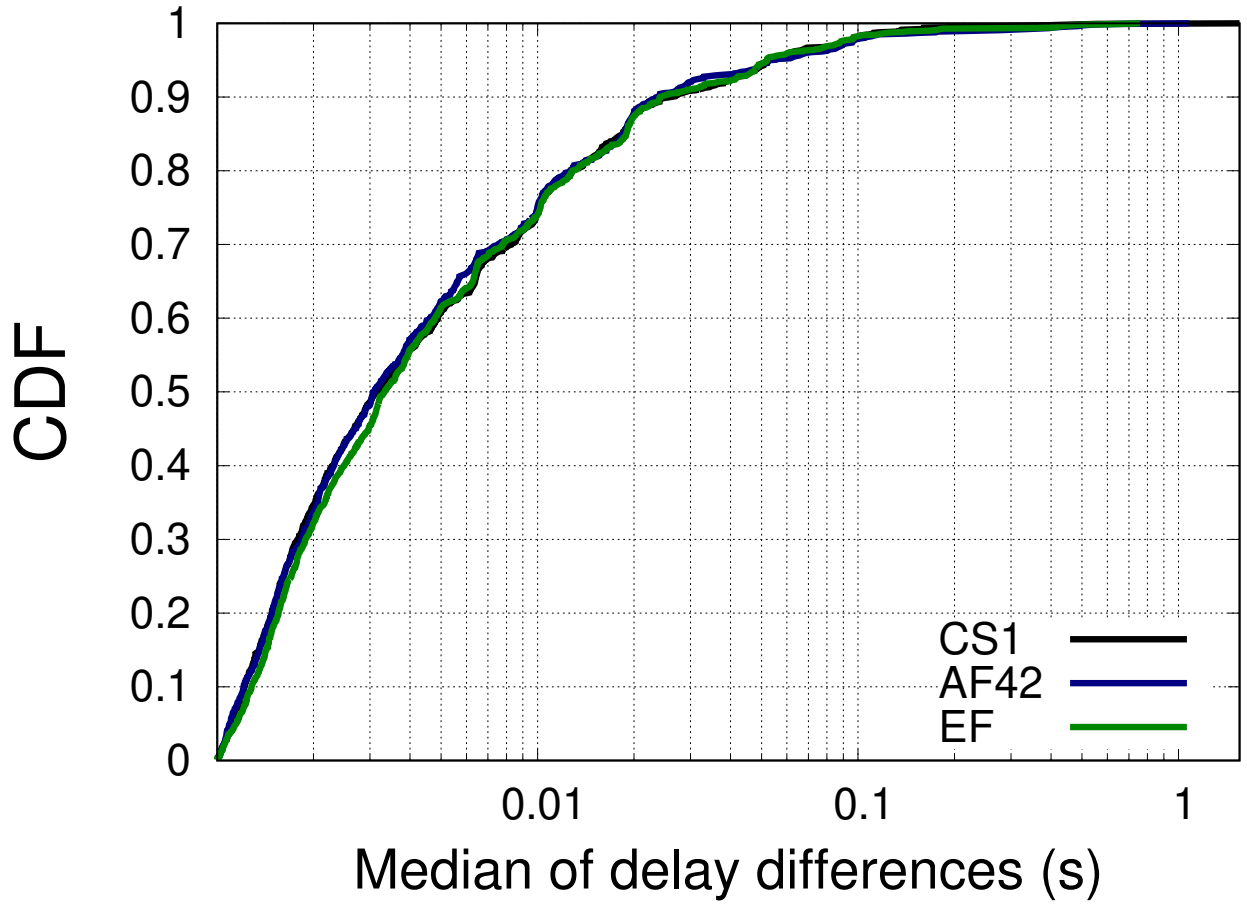
$$\delta_{R1-R2}(X) = RTT_{R2}(CS0) - RTT_{R2}(X) - RTT_{R1}(CS0) + RTT_{R1}(X)$$

Performance Evaluation in the Internet

Country	Number of Nodes	Provider	Type of link	Node type
Norway	9	Uninett	fibre, research	NorNet
Germany	1	DFN	fibre, research	NorNet
	1	Amazon.com	N/A	EC2
USA	1	Amazon.com	N/A	EC2
Canada	1	Amazon.com	N/A	EC2
Brazil	1	Amazon.com	N/A	EC2
India	1	Amazon.com	N/A	EC2
Singapore	1	Amazon.com	N/A	EC2
China	1	CERNET	fibre, research	NorNet
Korea	1	KREONET	fibre, research	NorNet

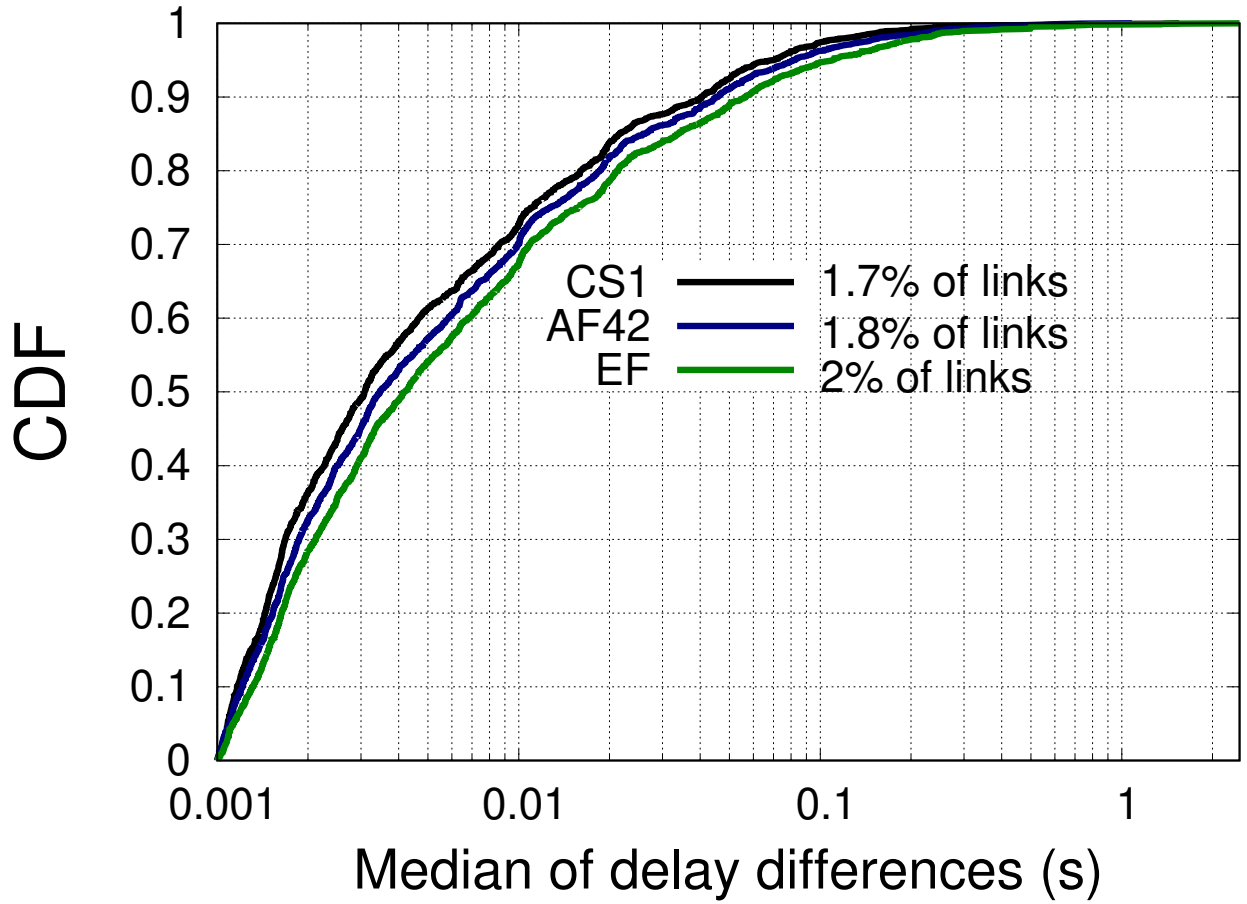
- Each ran FloodBox towards 10k destination IPs (selected randomly from **52k IPs from 52k ASes**).
- Got **111,874** unique links (consecutive TTL) and,
- **50,077** invalid links (non-consecutive TTL) and,
- Traversed **211,928** unique Internet paths.

Latency increment on 1% links



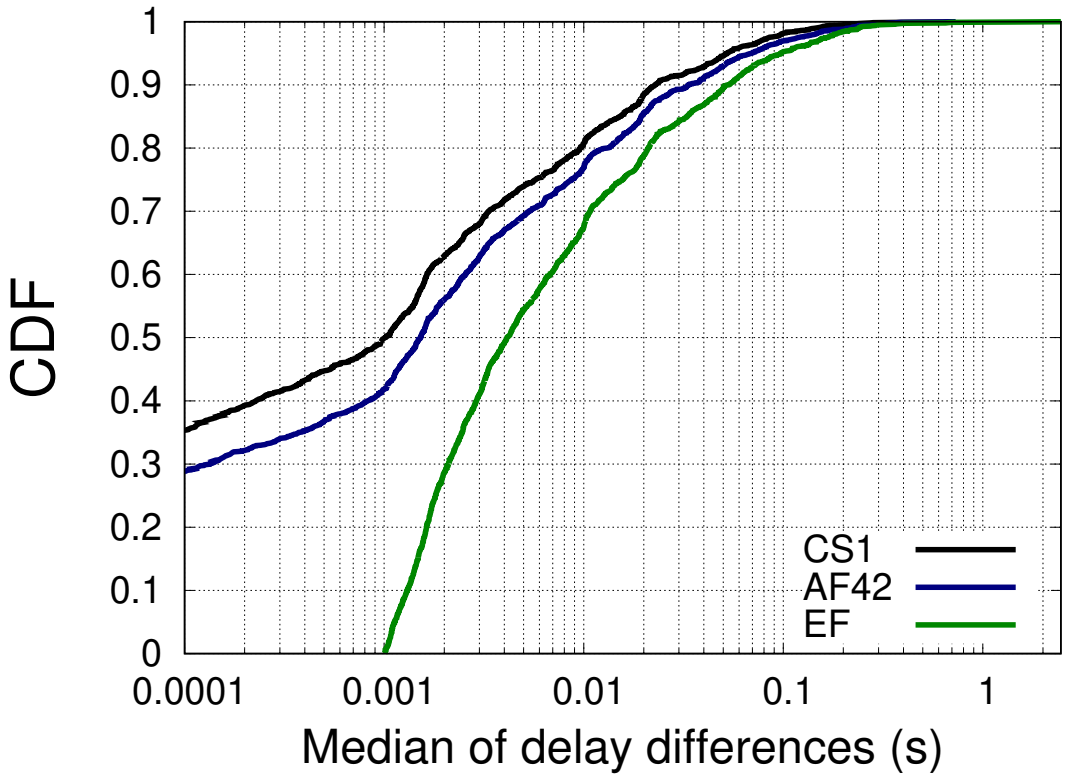
Latency increment for DSCP values CS1, AF42 and EF on links that saw an increase above 1 ms (1% of all links).

Latency reduction on 2% of 100k unique links



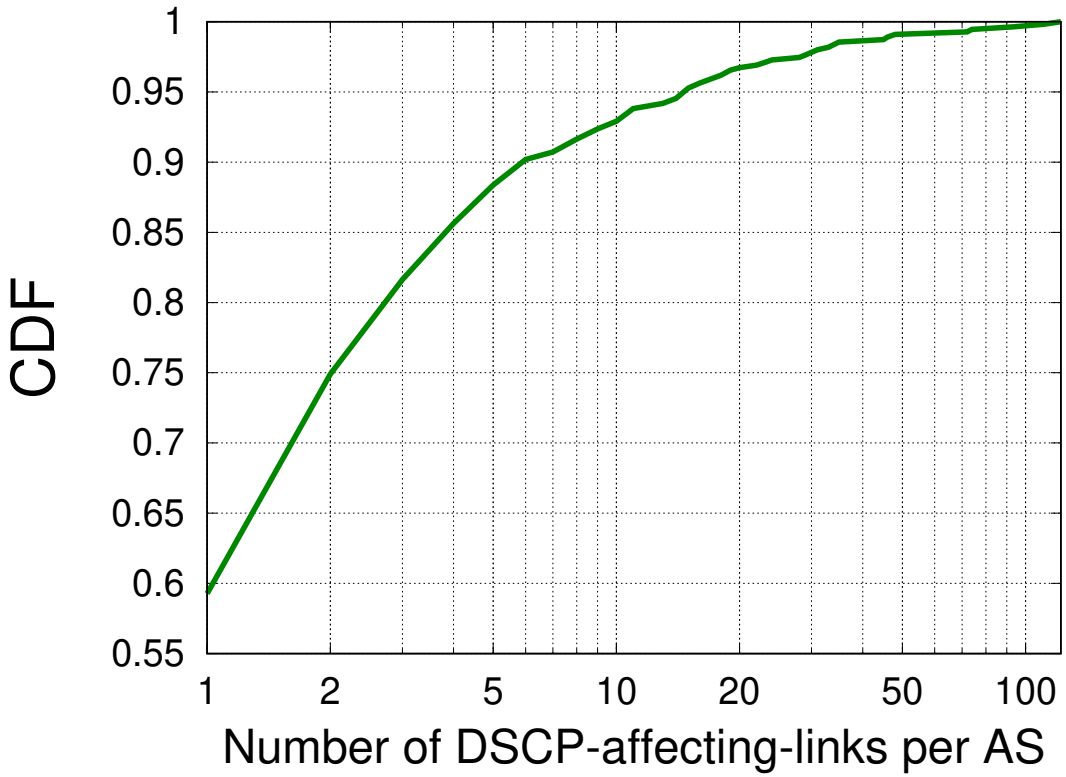
Latency reduction for DSCP values CS1, AF42 and EF on links that saw an improvement above 1 ms.

EF performs better than AF42 and CS1



Latency reduction for DSCP values CS1, AF42 and EF on links that saw an EF improvement above 1 ms.

Latency reduction links per ASes



Distribution of links reducing delay for EF per Ases on links that saw an EF improvement above 1 ms.

Top ASes with EF-reactive links

ASes	Ingress	In-network	Egress
AS4134 (Chinanet-Backbone)	0	1.7ms	2.5ms
AS7018 (ATT-Internet4)	0	23.9ms	1.2ms
AS12389 (Rostelecom)	5.6ms	5.2ms	2.7ms
AS6939 (Hurricane)	20ms	7ms	**11**ms
AS6762 (Seabone-net Telecom italia)	5ms	3ms	1ms
AS1239 (Sprintlink)	0	3.3ms	1.6ms
AS7922 (Comcast)	4.4ms	2.3ms	3.7ms
AS4775 (Globe-Telecom)	**54**ms	**49**ms	0
AS6461 (ZAYO)	10ms	**49**ms	5ms
AS3257 (GTT-Backbone)	2.6ms	4.7ms	3.8ms
AS16509 (Amazon-02)	0	19ms	6ms
AS15412 (Reliance Globalcom)	5ms	5ms	7.5ms

EF impact on link latency: 1.5 years between investigating DSCP remarking and measuring its impact

ASes (% remarking)	Ingress	In-network	Egress
AS3356 (Level-3) ($\approx$ 40)	4.5ms	7.8ms	6ms *
AS1299 (Telia) ($\approx$ 60)	1.5ms *	24ms *	2.6ms *
AS174 (Cogent) ($\approx$ 100)	1.3ms *	0	0
AS2116 (Broadnet) ($<$ 10)	1ms	3.4ms *	0

Table: Behavior of ASes that were encountered in both FloodBox and *fling* measurements. *: DSCP remarking policy.

Summary

- There is a chance WebRTC could get a benefit from using DSCP.
- Core ASes employ a diverse set of re-marking policies.
- FloodBox detects the latency impact due to DSCP code points.

Q&A?

Top ASes with EF-reactive links

ASes	Ingress	In-network	Egress
AS4134 (Chinanet-Backbone)	0	120 (1.7ms)	2 (2.5ms)
AS7018 (ATT-Internet4)	0	104 (23.9ms)	7 (1.2ms)
AS12389 (Rostelecom)*	61 (5.6ms)	38 (5.2ms)	18 (2.7ms)
AS6939 (Hurricane)*	9 (20ms)	47 (7ms)	22 (11ms)
AS6762 (Seabone-net Telecom italia)*	49 (5ms)	15 (3ms)	20 (1ms)
AS1239 (Sprintlink)	0	45 (3.3ms)	3 (1.6ms)
AS7922 (Comcast)	1 (4.4ms)	2 (2.3ms)	32 (3.7ms)
AS4775 (Globe-Telecom)*	9 (54ms)	29 (49ms)	0
AS6461 (ZAYO)	3 (10ms)	15 (49ms)	17 (5ms)
AS3257 (GTT-Backbone)	5 (2.6ms)	9 (4.7ms)	17 (3.8ms)
AS16509 (Amazon-02)	0	29 (19ms)	2 (6ms)
AS15412 (Reliance Globalcom)	9 (5ms)	17 (5ms)	3 (7.5ms)

EF impact on link latency: 1.5 years old studied ASes using *fling* platform

ASes (% remarking)	**Ingress**	**In-network**	**Egress**
AS3356 (Level-3) ($\approx$ 40)	4.5ms	7.8ms	6ms (R1, R2, AF11, AF21, CS0, CS1, CS7)
AS1299 (Telia) ($\approx$ 60)	1.5ms (CS1,R1,R2)	24ms (CS0,2,R1,R2)	2.6ms (CS0,CS1,AF11, AF21,R1,R2)
AS174 (Cogent) ($\approx$ 100)	1.3ms (AF11, AF21)	0	0
AS2116 (Broadnet) ($<$ 10)	1ms	3.4ms (EF unchanged)	0

Table: Behavior of ASes that were encountered in both FloodBox and *fling* measurements.

DSCP Policy	Description
R1	Remark higher 3-bits to 000 (for example, AF42$\rightarrow$4)
R2	Remark higher 3-bits to 001 (AF42$\rightarrow$AF12)

Behavior of previously studied ASes using *fling* platform

ASes	Ingress	In-network	Egress
AS3356 (Level-3)	9 (4.5ms)	4 (7.8ms)	16 (6ms)
AS1299 (Telia)	1 (1.5ms)	2 (24ms)	10 (2.6ms)
AS174 (Cogent)	2 (1.3ms)	0	0
AS2116 (Broadnet)	2 (1ms)	1 (3.4ms)	0

Table: Behavior of ASes that were encountered in both FloodBox and *fling* measurements.