











Atmpt	no ECN	%	50% ECN	%	only ECN	%
1	17928	89.64	17535	87.67	16924	84.62
2	1876	9.38	2135	10.68	2629	13.14
3	176	0.88	282	1.41	383	1.92
4	17	0.09	46	0.23	56	0.28
5	3	0.01	2	0.01	8	0.04
Total	20000	100%	20000	100%	20000	100%

Table II: Efficiency of DNS for 300ms link delay

	Queries	Replies	Success %	Mean %	StdDev of %	Confidence Interval	Range with 99% confidence
No ECN	20000	17928	89.64	89.91	0.28618	±0.43	89.48 - 90.34
50% ECN	20000	17535	87.67	87.95	0.30139	±0.45	87.50 - 88.40
Only ECN	20000	16924	84.62	85.00	0.42665	±0.63	84.37 - 85.63

Table III: Confidence intervals with 99% confidence level from 3 samples for 300ms link delay

Targeted Link Delay	Internet Delay/Jitter	FIFO queue		RED queue					
		#	%	no ECN	%	50% ECN	%	only ECN	%
200ms	20ms ±5ms	18285	91.42	16129	80.64	13606	68.03	8278	41.39
200ms	50ms ±5ms	18513	92.56	16819	84.09	15073	75.36	9156	45.78
300ms	100ms ±25ms	19474	97.37	17928	89.64	17535	87.67	16924	84.62

Table IV: Comparison of 1st attempt success rate of DNS queries under varying parameters with FIFO and RED

## VII. CONCLUSIONS

AQM and ECN are two related promising improvements for the Internet. However, as shown in this paper, the transition to AQM and ECN highly degrades the efficiency of the DNS protocol. Since UDP-based DNS queries and replies are one-packet per-direction data transfers, they cannot be congestion controlled. This results in significant DNS packet loss and has high impact on user-experience (i.e. multi-second, user-observable delays).

The paper presented a subset of a quite larger set of experimental results regarding the effects of congestion on intermediate FIFO and RED queues on the DNS protocol. Under the selected network parameters, when the congested link switched from FIFO to RED, the DNS protocol efficiency dropped from at least 8 and up to 11 percentage points. When the background TCP traffic took advantage of ECN, the DNS's efficiency further dropped from 12 up to 50 percentage points. Since the DNS protocol is a core Internet protocol with very high impact on user experience, this degradation can be considered very harmful and perhaps unacceptable especially when targeting lower maximum delays. It seems thus that the disadvantages of AQM and ECN may outweigh the advantages under certain conditions.

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