S-38.180 Exercise VI: TCP with ECN and applications

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Abstract

In this work it is studied how use of ECN will have an effect on network throughput and performance
(or does it) in cases when all TCP clients use it and in case when it is supported only by part of clients.
Other study compares packet loss ratio and frame error ratio with MPEG stream.

1 Introduction

For this work ns2 simulator is used. The simulation model is hevily based on one used in "Exercise II:
Mechanisms" and only differences between these two models are listed here.

2 ECN and ns2

ECN functionality is supported by ns2 both by `Agent/TCP` and `Queue/RED`. To activate ECN in ns2,
one must set `ecn_` property for `Agent/TCP` objects it is needed and also queues must have `setbit_`
true.

2.1 Model differences compared to Exercise II

The main change is removing all policy-related settings so system is pure RED with default values. The
other change is increased link delays for links s4-e1 (50 ms) and s8-e1 (100 ms).

For easy modifying, all ECN settings are collected to one location (around line 200).

```
# Modify HERE
$tcp3 set ecn_ 0
$tcp4 set ecn_ 0
$tcp5 set ecn_ 0
$tcp6 set ecn_ 0
$tcp7 set ecn_ 0
$tcp8 set ecn_ 0
$tcp9 set ecn_ 0
$tcp10 set ecn_ 0
$qE1E2 set setbit_ 0
$qE2E1 set setbit_ 0
```

Yet another change is a modification of the final awk reporting script. It prints to file `out.stat` for
each source (1=udp1, 5=tcp5, etc.) number of packets successfully received by sink, number of packets
dropped and packet loss ratio.

3 MPEG performance

In MPEG video there are three types of frames

I-frames are basicly JPEG-type still images and do not depend on anything but themselves.

P-frames are predictive frames and depend on earlier reference frame (I- or P-frame).

B-frames are bi-directional frames that depend on earlier, following or both reference frame.

Frames are groupend into GOPs (group of pictures) and typically the sequence is fixed one, like 15-frame IBBPBBPBBPBBPBB. If there is transmission error in B-frame, it will affect only that frame. If error is in P-frame it will affect on that frame and all of following frames in that GOP and also just preceding B-frames. Error in I-frame affects on whole GOP. Note, that last B-frames depend only preceeding reference frame.

In this work we will use GOP above to simulate MPEG transmission (with VoIP souces). Frame sizes are following: I: 10 packets, P: 2 packets, B: 1 packet. A GOP size is thus 1*10+4*2+10*1 = 28 packets. B-frames depend on both preceding and following frames.

To calculate frame loss ratio, you must divide packet stream into 28-packet sequences. To print out sequence numbers for udp2 you can use following command:

```
awk '$1=="r"&&$9=="1.0"&&$4==12{print $11}' out.all
```

If the 3rd packet of 28-packet sequence is lost, then the error is in I-frame and whole GOP (15 frames) has erros; thus all frames are lost. If the error is in 12th packet, then only one frame has an error. If error is in 26th packet (the last P frame), then there are errors in last 5 frames (BBPBB).

4 Task

Your task is run simulation and compare results for following cases:

1. ECN not supported by network

2. ECN supported by network but only tcp4 and tcp8 (the long-delay ones) support ECN.

3. ECN supported by network but only tcp4, tcp6, tcp8, and tcp10 support ECN.

4. ECN supported by network and by all tcp sources.

You should compare cases by considering individual source throuhput, total network throuhput, packet loss ratio and total number of packets lost in network. Simulation time is by default 60 seconds, you should increase it. Script can be found from course pages.

Compare also for at least two cases (first and last one) packet loss rate and frame error rate with MPEG specification described above. When you calculate frame error rates, make sure that you calculate errors only once; i.e. if there is a packet loss in I-frame resulting 15 frame errors, then you do should not to calculate any more errors for that GOP.

4.1 Grading

This excersice is graded with 4-level grading: fail / statisfactory / good / excellent.

References