TCP Evaluation Suite for ns-3

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Outline of the presentation

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- Existing implementations
- Design and implementation of tcp-eval in ns-3
- User interaction with ns-3 tcp-eval
- Comparing TCP extensions in ns-3
- Results and discussions
- Validation issues
- Conclusions and the next goals
Motivation

- Congestion control algorithms continue to evolve . . .
- . . . and so do TCP extensions!
- Problem: not feasible to evaluate every TCP extension exhaustively
- Potential solution:
  - derive some initial results and study the behaviour
  - consider the promising ones for thorough evaluation

What is TCP Evaluation Suite?

- a set of well-defined, standard test cases to compare TCP extensions
- initially proposed by Transport Modeling Research Group (TMRG)
- modified by Internet Congestion Control Research Group (ICCRG)
- widely used today for evaluating new TCP extensions
Existing implementations

  - Two versions of code.
  - Version 2 source: https://sourceforge.net/projects/tcpeval

  - designed for evaluating High-speed TCP extensions using ns-2
  - Source: http://nrlweb.cs.ucla.edu/tcpsuite/index.html
Existing implementations

  - designed for evaluating High-speed TCP extensions using ns-2

  - The latest draft on TCP Evaluation Suite
  - Source: https://bitbucket.org/hayesd/tcp-evaluation-suite-public
Design and implementation of ns-3 tcp-eval

- Implemented as a separate model called \texttt{tcp-eval} in ns-3 (~5500 lines)

- Topologies:
  - Dumbbell (single bottleneck topology)
  - Parking lot (multiple bottlenecks topology)

- Traffic types:
  - Long lived FTP
  - Streaming video
  - Interactive voice

- Performance metrics:
  - Aggregate link utilization
  - Mean queue length, and Packet drop rate
Design and implementation of ns-3 tcp-eval

Figure: Class diagram of tcp-eval in ns-3
Figure: User interaction diagram of tcp-eval for dumbbell scenario
Figure: User interaction diagram of tcp-eval for parking-lot scenario
Comparing TCP extensions in ns-3

- Five TCP extensions: Tahoe, Reno, NewReno, Westwood, Westwood+
- Three scenarios:
  - Varying bottleneck bandwidth
  - Varying RTT
  - Varying the number of FTP flows
- Three Performance metrics:
  - Link utilization
  - Mean queue length
  - Packet drop rate
- Output:
  - PDF containing graphs (LaTex must be installed!)
Results and discussions: varying bottleneck bandwidth

Dumbbell topology

Parking lot topology
Results and discussions: varying bottleneck bandwidth

Dumbbell topology

Parking lot topology
Results and discussions: varying bottleneck bandwidth

Dumbbell topology

Parking lot topology
Results and discussions: varying RTT

Dumbbell topology

Parking lot topology
Results and discussions: varying RTT

Dumbbell topology

Parking lot topology
Results and discussions: varying RTT

- **Dumbbell topology**
- **Parking lot topology**
Results and discussions: varying number of FTP flows

Dumbbell topology

Parking lot topology
Results and discussions: varying number of FTP flows

Dumbbell topology

Parking lot topology
Results and discussions: varying number of FTP flows

Dumbbell topology

Parking lot topology
Validation issues

- Original tcp-eval is implemented in older version of ns-2 (ns-2.31!)
- ns-2.31 did not have many new TCPs
- Hence, tcp-eval contained custom implementations of new TCPs
- Latest tcp-eval implementation in ns-2 is on ns-2.35
- But there are several bugs identified, and its development has stopped
- Started aligning our implementation with that of tcp-eval for ns-2.35
Conclusions and the next goals

- A ns-3 model for tcp-eval has been implemented, but not validated.
- Automates the cycle from setting parameters to collecting results
- Steps to reproduce the results have been provided.

Next goals:

- Align the model to latest version of tcp-eval (2016 summer project!)
- Evaluate the model by comparing its results to those obtained from ns-2
- Include support for more topologies (wireless) and AQM algorithms
- Provide per-flow analysis to the user.
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