CN-SIM: Discussion About Metrics

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Agenda

- Clarifications on previous presentation
- Classification of metrics
- Acceptance criteria
Introduction

- At the last Interim Meeting in Monterey we agreed to gather the following metrics in our simulations (see au-thaler-CN-metrics-070124.pdf):
  - Queue depth (Max, Avg, StdDev)
  - Time above highly congested point (TBD, time above Qsc, n * equilibrium point)
  - Packets dropped in network
  - % time paused
  - Aggregate throughput for congested flows
  - Aggregate throughput for innocent flows
  - Signaling overhead
  - Fairness
  - Completion time for innocent flows
  - Completion time for congested flows
  - Convergence time
  - Reaction to short flows, flow length boundaries for benefit, flow length boundaries that cause harm?
Flow Completion Time

- Definition of Flow:
  - Ordered sequence of frames originated by a source node and addressed to a destination node

- Definition of Flow Completion Time (FCT):
  - **Ideal**: Difference between the arrival time of the last BIT and the departure time of the first BIT of a flow.
  - **Approximate**: Difference between the arrival time of the last FRAME and the departure time of the first FRAME of a flow.

- The FCT can be computed if all the frames of flow are received by the destination node.

- When Port Scavenging is used, frames may be dropped, effectively compromising flows and FCT computation.

- Proposal:
  - Compute FCT only for uncompromised flows (“good flows”)
  - Count number of compromised flows (“bad flows”)

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Flow Completion Time

- When PAUSE is used, frames cannot be dropped. Hence FTC can be computed for all flows.
- However, FCT may be compromised because of blocking inside NICs.
Flow Completion Time

- Proposal
  - For external flow control (i.e., PAUSE triggered), nothing can be done, so just live with it
  - For internal flow control, block only if a flow is mapped to a RL whose queue exceeds a certain threshold (i.e., selective flow control)
  - This complicates the packet architecture because multiple traffic generators (or a “multi-threaded” traffic generator) are required within an aggregate node
Convergence Time

- In Monterey, Bruce Kwan presented some very good material regarding the estimation of transient duration (au-sim-kwan-transient-duration-012407.pdf)

- The “Initial Data Deletion” methodology was used to determine when the initial transient was over

- Although extremely accurate, such methodology is quite labor-intensive and time-consuming

Proposal

- Use a far less accurate but simpler transient estimation technique commonly used in electronics and control theory to conduct quick assessments

- Use the Initial Data Deletion methodology to “dig deeper”, if needed
Convergence Time

Queue Settling Time $t_s$

$t_s \in [0, T]$ such that

$|Q_{\text{len}}(t) - Q_{\text{eq}}| < \alpha Q_{\text{eq}}$

for any $t > t_s$

Where $\alpha \in [0, \frac{1}{2}]$
Convergence Time

Queue Settling Time $t_s$

$t_s \in [0, T]$ such that

$Q_{len}(t) < Q_{sc} \land \land$

$Q_{len}(t) > 1$ MTU

for any $t > t_s$
Metrics Classification

- Tier 1
  - Used to assess conformance with PAR objectives
  - Performance Related
    - Measurable with simulations
  - Implementation Related
    - Some measurable, others require judgment calls
- Tier 2
  - Used to achieve a better understanding of a proposal
  - Differentiate further in case of a tie based on Tier 1 metrics
Tier 1 Metrics

- **Performance Metrics**
  - Aggregate throughput
  - Flow completion time (Max, Avg, Min, Stddev)
  - Packets dropped / % time paused
  - Signaling overhead
  - Queue depth (Max, Avg, Stddev)
  - Bottleneck link utilization

- **Implementation Metrics**
  - Implementation complexity
  - Processing costs
  - IP cost
  - Support costs
    - Amount of tuning
    - Sensitivity to tuning
    - Effects of wrong tuning
  - Sensitivity to loss of signal
  - Envelope bytes (max frame size implications)
Tier 2 Metrics

- Additional Performance Metrics
  - Convergence time
  - Time above severe congestion watermark
  - Fairness
  - Throughput of congested flows
  - Throughput of innocent flows
  - Completion time of congested flows
  - Completion time of innocent flows
Acceptance Criteria

- Metrics alone allow us to merely compare proposals
- Our goal is different. Chose the proposal which:
  - Does a “good enough” job at controlling congestion as per the PAR objectives
  - With the lowest
    - Implementation costs
    - Deployment costs
- Acceptance Criteria is the tool that should tell us if the job is “good enough”
Acceptance Criteria

- For some metrics, acceptance criteria are trivial:
  - Bottleneck link throughput > 85%
  - Queue length bounded within a certain band

- For others, it’s not so trivial:
  - Flow completion time ???
  - Aggregate throughput ???

- Shall we have a brainstorming on this?