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):

Easy

- 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

Not so Easy

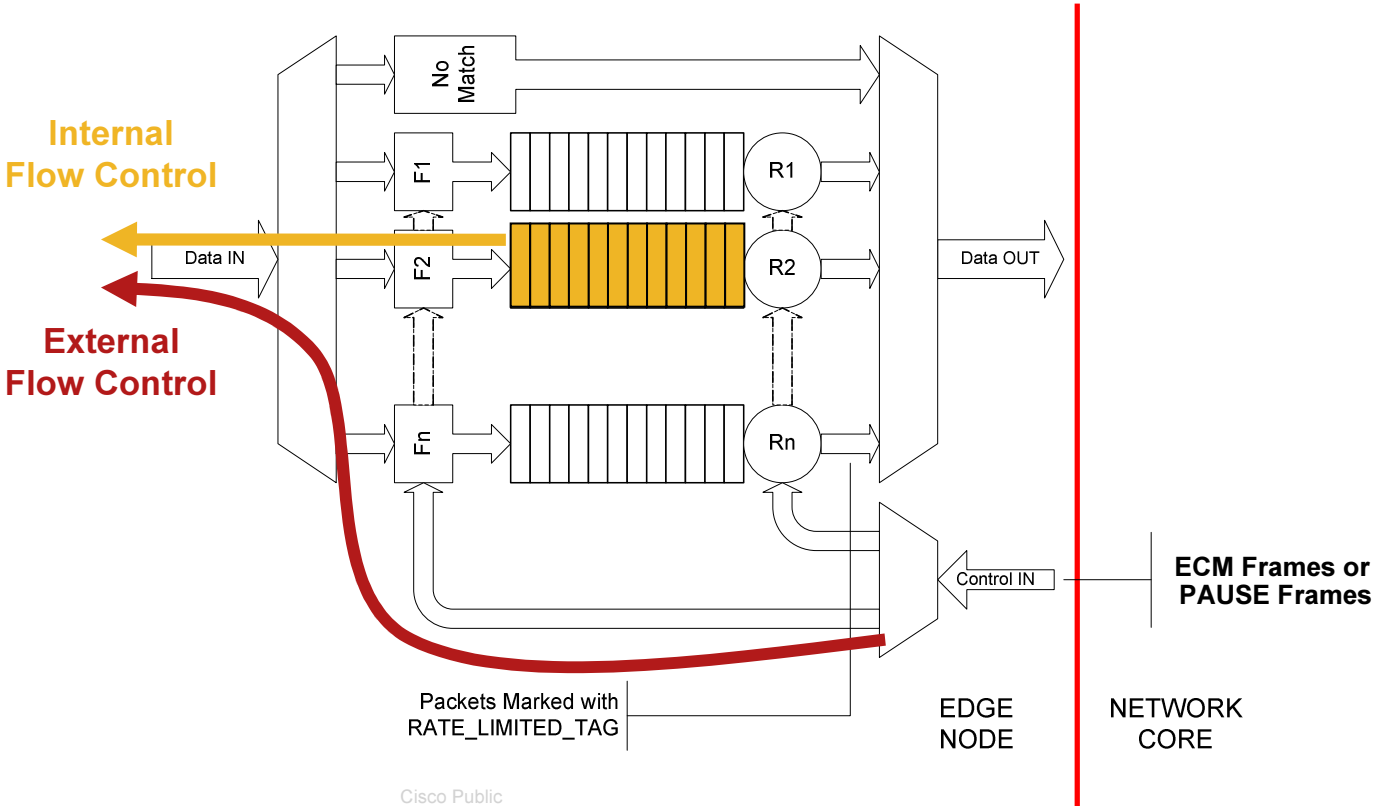
- Completion time for innocent flows
- Completion time for congested flows
- Convergence time
- Reaction to short flows, flow length boundaries for benefit, flow
- length boundaries that cause harm?

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 when all the frames of flow are received by the destination node
- When PACKET SPRAY 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”)

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

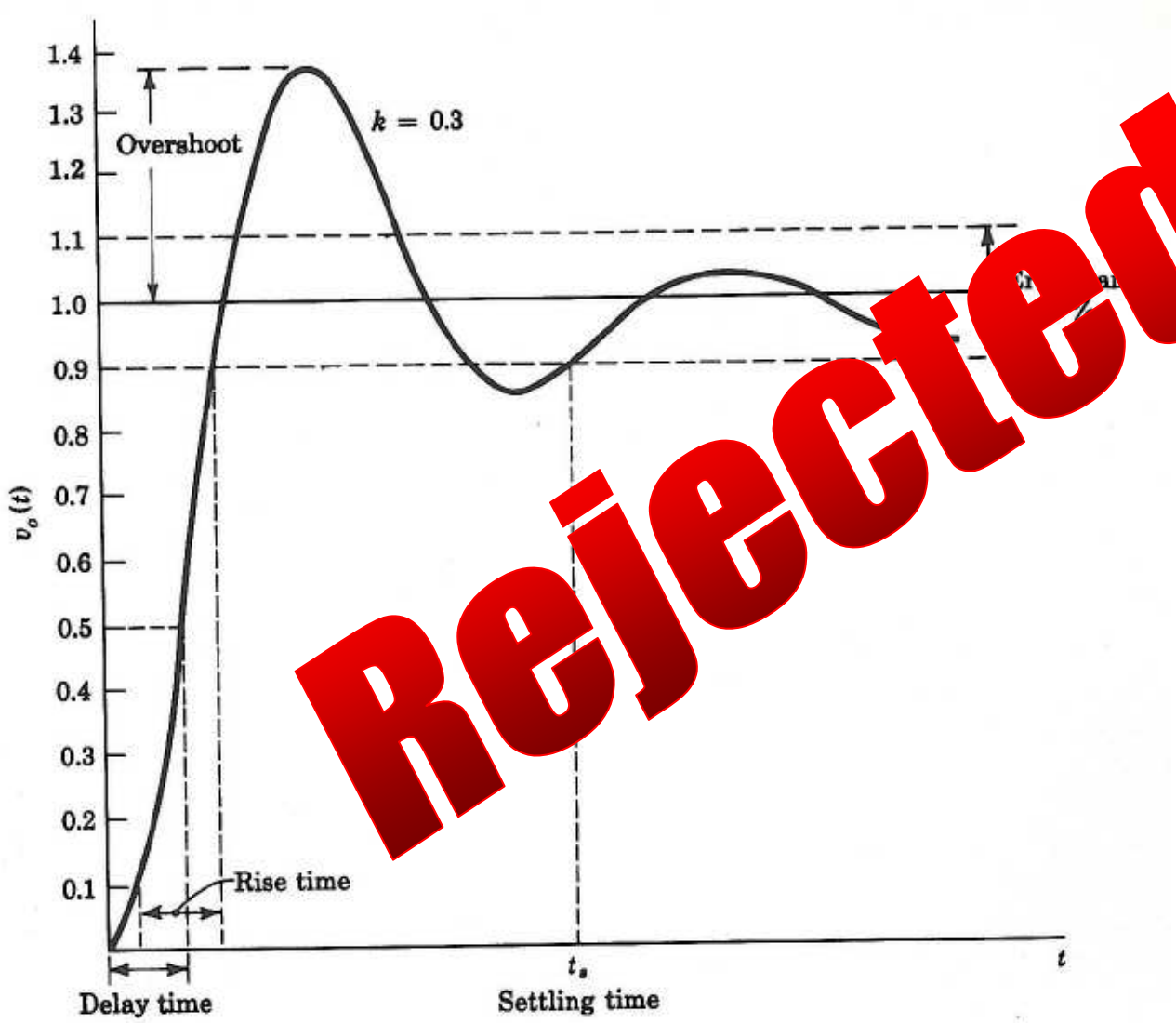
- Proposal
  - For external flow control (i.e., PAUSE triggered), nothing can be done, so just live with it
  - For internal flow control, block only the flows mapped to a RL whose queue exceeds a certain threshold (i.e., selective flow control)
  - This complicates the reference architecture because multiple traffic generators (or a multithreaded" traffic generator) are required within the same node

Accepted

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



Rejected

Queue Settling Time t_s

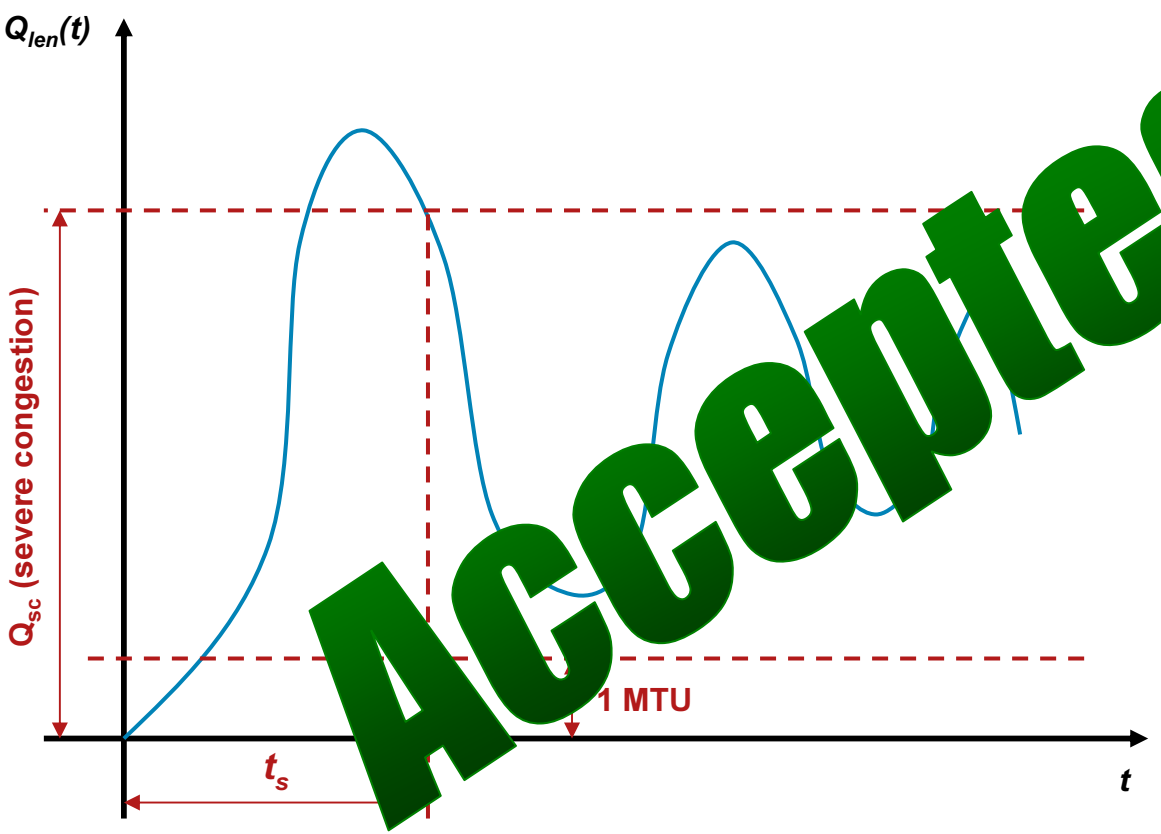
$t_s \in [0, T]$ such that

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

for any $t > t_s$

Where $\alpha \in [0, ½]$

Convergence Time



Queue Settling Time t_s

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

$Q_{len}(t) < Q_{sc}$ &&

$Q_{len}(t) > 1$ 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)
  - Queue depth (Max, Avg, Stddev)
  - Bottleneck link utilization
  - Packets dropped / % time paused
  - Signaling overhead
- 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?