Path Computation Based on Precision Availability Metrics

draft-contreras-pce-pam-05

Luis M. Contreras (*Telefónica*), Fernando Agraz (*UPC*),
Salvatore Spadaro (*UPC*), Quan Xiong (ZTE)

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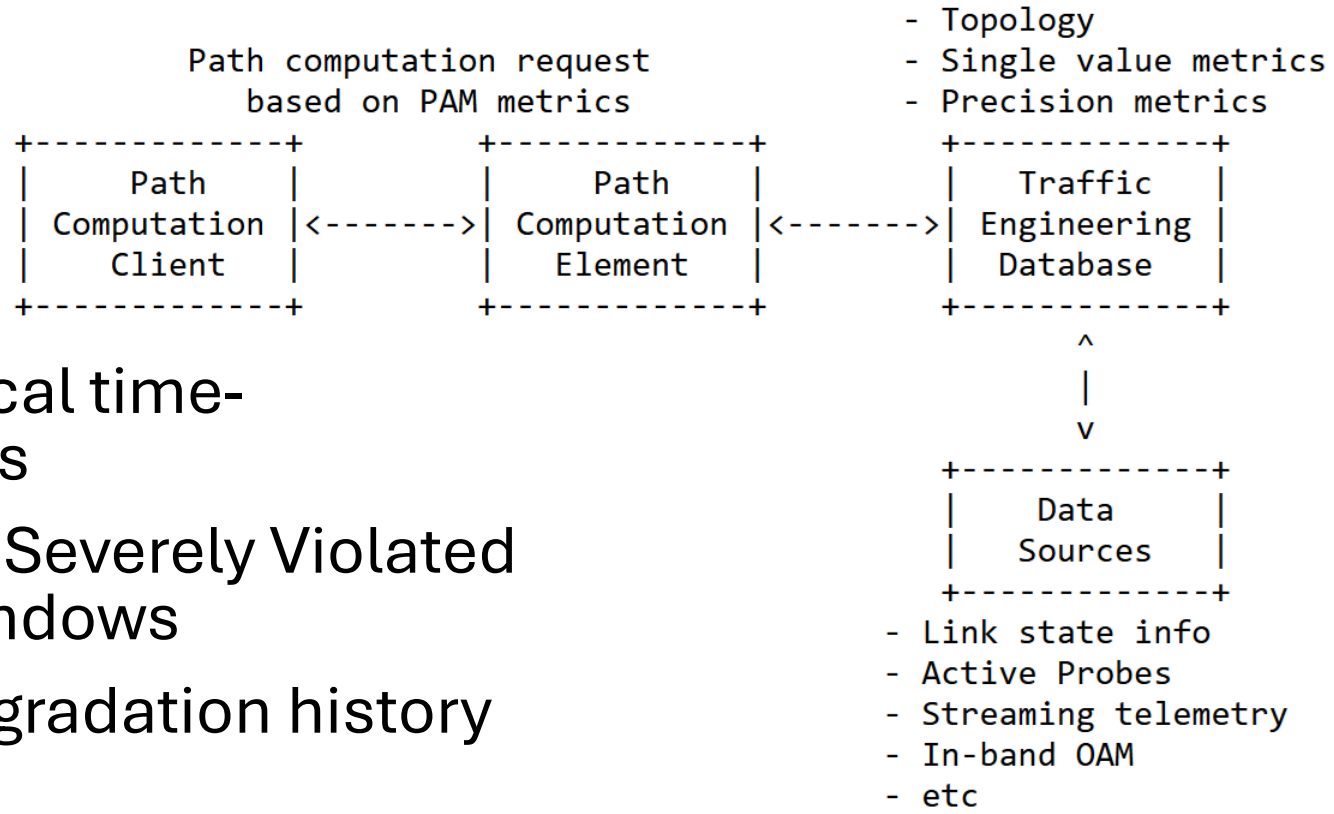
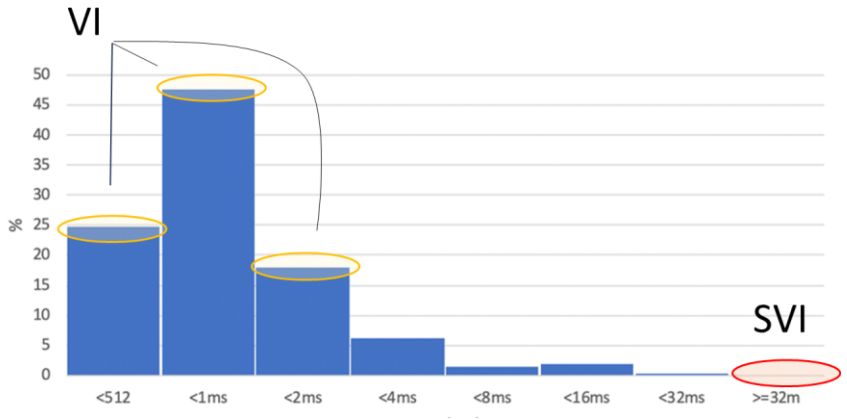
Introduction to PCE and PAM

- Path Computation Element (PCE) [RFC4655] computes network paths based on metrics
- Existing METRIC object handles bounds on instantaneous metric values
- Some services (e.g., Network Slices [RFC9543], Deterministic Networking [RFC8655]) require service-level objectives (SLOs) with historical performance stability
- Precision Availability Metrics (PAM) [RFC9544] provide a measure of path stability over time for SLOs
- This document defines a new PRECISION METRIC object for PCE path calculations using PAM

Rationale and Applicability of PAM

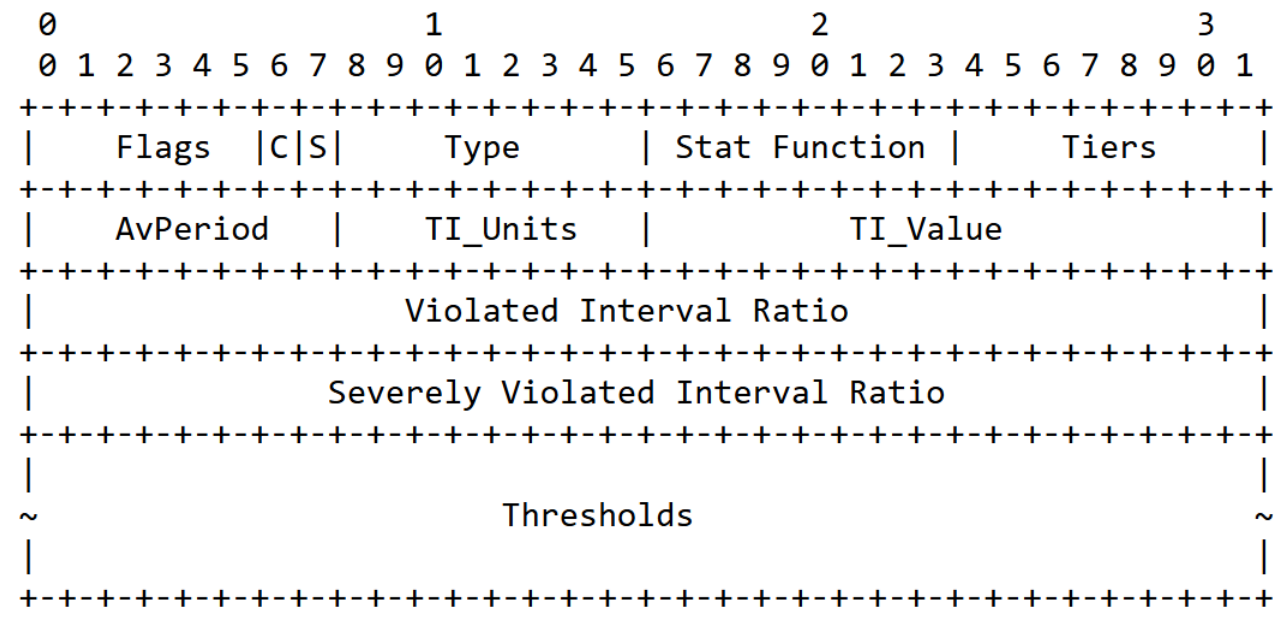


- PAMs consider dynamic, historical time-windowed performance intervals
- Define Violated Interval (VI) and Severely Violated Interval (SVI) ratios over time windows
- These ratios quantify service degradation history (VIR and SVIR)
- PAM useful for:
  - Selecting paths with proven stable behavior
  - Real-time path provision with prior monitoring
  - Triggering corrective actions for degradation
- TED (Traffic Engineering Database) can store and provide PAM data for PCE



Definition and Structure of the PRECISION METRIC Object

- New object distinct from METRIC object to avoid complexity and inconsistency
- Flags for Statistical (S) and Computed (C) metrics
- Type field matches existing IANA metric types
- Statistical Function field for histogram or cumulative distributions



- Tiers define number of statistical thresholds
- Fields define availability period, time interval units and value
- VIR and SVIR encoded as IEEE floating-point
- Thresholds provided for multiple tiers or simple optimal and critical thresholds

Examples of PRECISION METRIC Usage

- Example 1: Two-tier delay SLO
  - 20ms threshold for 99.9% packets
  - 25ms critical threshold
  - VIR 5%, SVIR 0.2%, 1-day availability period, 1-hour interval
- Example 2: Multi-tier statistical distribution
  - 20ms for 99%, 25ms for 99.999%, 30ms critical
  - Same VIR/SVIR and time parameters
- PCE uses these objects to calculate and verify candidate path's VIR and SVIR
- Errors returned if duplicate metric types in METRIC and PRECISION METRIC objects

PCEP Protocol Extensions and Key Considerations

- New optional PRECISION METRIC object added to PCReq, PCRep, and PCRpt messages
- PCReq can include precision metric constraints
- PCRep returns computed metrics or failure reasons referencing precision metrics
- PCRpt can carry precision metric updates
- Security: PCE rejects requests with conflicting metric types, mitigates denial of service
- Operational: external TED systems handle metric collection and processing
- IANA allocation needed for new PRECISION METRIC object and related error codes

History and Next Steps

- Presented in PCE at IETF 118, 119, 120, 122 and 123
- Presented in IPPM at IETF 122

- Collect comments / feedback from DetNet to ensure alignment
- Prepare new version for IETF 124
  - After that, ask for adoption in PCE WG if no major concerns exist