Calibration of Measured Time Values between Network Elements

draft-contreras-bmwg-calibration-03

Luis M. Contreras (Telefónica)

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Motivation (reminder)

- Timestamps in packets are used for calculating the measured delay between origin and destination in a path
  - It can be used for traffic engineering purposes composing the path latency summing up the hop-by-hop delay
  - This is the base of other efforts in IETF, such as Flex Algo algorithms [RFC9502] [RFC9351] for latency, deterministic services [RFC8557], or PCE path calculations [RFC5440]
- Network devices (routers) incorporate capabilities for time stamping packets
- The aim of this document is to propose a methodology for calibrating the measurements from different network element implementations
  - Common measurement scenario
- Document already presented at IETF 121

Measurement scenario

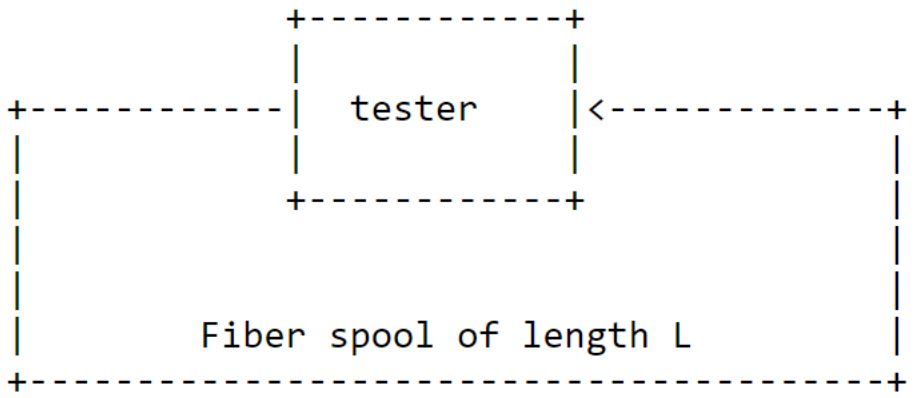

Figure 1: Baseline measurement scenario

Baseline = *T_baseline*

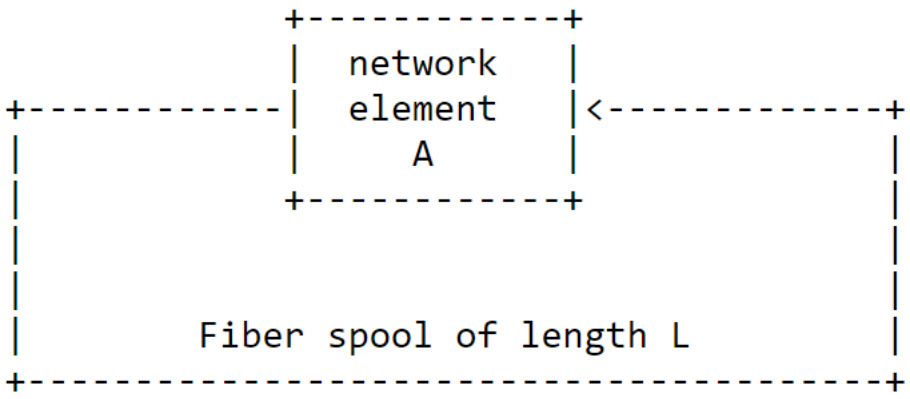

Figure 2: Single network element test

Bias = comparison between *T_baseline* and *T_ne*

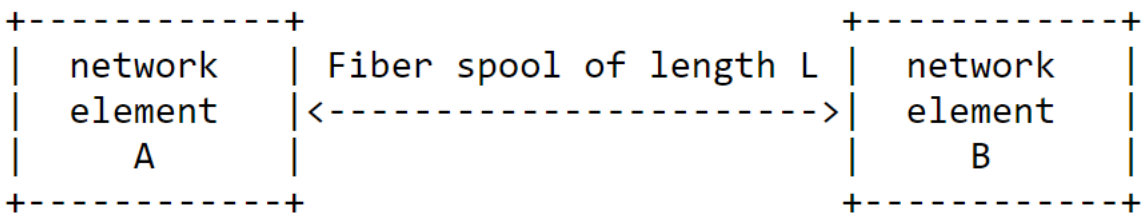

Figure 3: Paired network elements test

Bias = comparison between *T_baseline* and *T_ne_ab* (or *T_ne_ba*)

Measurement conditions

- Network device model, hardware and software description.
- Length of the fiber spool used as reference for the measurement.
- Description of the ports / line card where the fiber spool is connected.
- Protocol used in the measurement (e.g., TWAMP-light, STAMP, …).
- Duration of the test for statistical consistency (e.g., period for average, min, max calculations).
- Network tester used for generating the baseline values.

Progress in versión -03

- Further clarification on the scope
- Clarification on the resolution needed
  - E.g., for usage in FlexAlgo, the measured delay collected by means of TWAMP, TWAMP Light, and STAMP protocols SHOULD be adjusted using a ceiling function, i.e., rounding up to the nearest integer value in µs.

devices. Furthermore, services sensitive to latency, such as the deterministic ones [RFC8557] or those following the network slicing paradigm [RFC9543], require from accurate information in order to place flows in the network.

The measurements here considered are those performed between neighbor nodes in a network, so that an end-to-end delay metric can be composed by aggregating partial measurements. To ensure consistency and accuracy across different network element implementations, a benchmarking procedure is necessary to calibrate the timestamps. This allows correction of observed measurements and improves the reliability of latency-based traffic engineering decisions.

The timestamp format used in TWAMP, TWAMP Light, and STAMP protocols is based on the NTP format, as defined in [RFC8877]. These protocols employ a 64-bit timestamp, where:

* The first 32 bits represent the number of seconds since the NTP epoch (January 1, 1900)

* The remaining 32 bits represent fractional seconds.

This structure provides a theoretical resolution of approximately 233 picoseconds.

For instance, with this in mind, if the purpose is the generation of FlexAlgo topologies based on delay, it should be taken into account that the delay field advertised when using IS-IS [RFC8570] or OSPF [RFC7471] is expressed in microseconds. Thus, differences below a microsecond are not relevant. OSPF or IS-IS with traffic engineering extensions encode the "delay" value in microseconds using 24-bit fields. This naturally results in lower precision compared to the timestamp format used in active measurement protocols.

When calibrating measurements for use in network operations or control plane mechanisms, it is crucial to consider the specific use case of the timestamp to ensure appropriate granularity and accuracy. For example, in the case of constructing low-latency FlexAlgo topologies, it is necessary to align the measurement resolution to microseconds, as this is the resolution that the IGP protocol can propagate towards the control plane generating the low-latency topology. To achieve this, the measured delay collected by means of TWAMP, TWAMP Light, and STAMP protocols SHOULD be adjusted using a ceiling function, i.e., rounding up to the nearest integer value in microseconds.

Other use cases, however, may require different resolution levels, rounding techniques, or adjustments depending on operational goals.

Next steps

- Take profit of this joint session of both BMWG and IPPM for collecting feedback and interest from IPPM WG

- Complete the draft with the open points already identified
  - Address additional points raised during presentation or from comments received
  - Work on some lab experiments to address ome of the open points (e.g., behavior in different link loads, etc)

- Prepare new version for IETF 124
  - Ask for adoption at that time