The error performance metric in a packet-switched network

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So often, in documents and discussions, we refer to the availability concerning, for example, a network service. But, so far, there's no commonly accepted definition of availability as a quantitative characteristic of a packet-switched network.

Operations, Administration, and Maintenance (OAM) is a collection of methods to detect, characterize, localize failures in a network, and monitor the network's performance using various measurement methods. Traditionally, the former set of OAM tools is identified as Fault Management OAM. The latter - Performance Monitoring OAM. Some OAM protocols can be used for both groups of tasks, while some serve one particular group. But regardless of how many OAM protocols are in use, network operators and network users are faced with multiple metrics that characterize the network conditions.

Error performance measurement (EPM) is a part of an OAM toolset that provides an operator with information related to network measurements for a uni-directional or a bidirectional connection between two systems. In EPM OAM, we combine performance metrics like packet loss, packet delay, and the detected state of a network connection, e.g., the Loss of Path Continuity, to conclude the state of the network characterized through periods of availability or unavailability.

In the current technology, EPM has been defined in [1] only for data communication methods that have a constant bit-rate transmission and not for a packet-switched network (PSN), where transmissions are statistically random. As a statistically multiplexed network in a PSN, a receiver node does not expect a packet to arrive from a sender node at a specific moment, less from a particular sender. That is what differentiates PSN from networks built on a constant bit-rate transmission, where a stream of bits between two nodes is always present, whether it represents data or not. That provides the receiver with a predictable number of measurements in a series of measurement intervals. In PSN, on-path OAM methods, i.e., measurement methods that use data flow, cannot provide such predictability and thus be used for EPM. In PSN, EPM needs to use active OAM methods, per definition in [2].

In [3], a set of EPM metrics is described, requirements for an active OAM protocol to support EPM in PSN are provided, and the analysis of candidate OAM protocols. Further in [3], we use Errored, Severely Errored, and Error-Free time intervals, e.g., second. The determination of each time interval reflects the combination of Service Level Objectives set forth for the monitored service. In addition to determining the state of the monitored service (available or unavailable) two EPM metrics can be calculated – Errored Second ratio and Severely Errored Second ratio. Further, [4] is considered as a protocol to support EPM.

References

1.	Recommendation G.826	End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections	ITU-T	December 2002
2.	RFC 7799	Active and Passive Metrics and Methods (with Hybrid Types In-Between)	IETF	May 2016
3.	draft-mirsky-ippm-epm	Error Performance Measurement in Packet-switched Networks	IETF	March 2021
4.	draft-mmm-rtgwg-integrated-oam	Integrated Operation, Administration, and Maintenance	IETF	March 2021