Multipoint Alternate Marking method for passive and hybrid performance monitoring

draft-ietf-ippm-multipoint-alt-mark-00

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Introduction: What's next after RFC8321

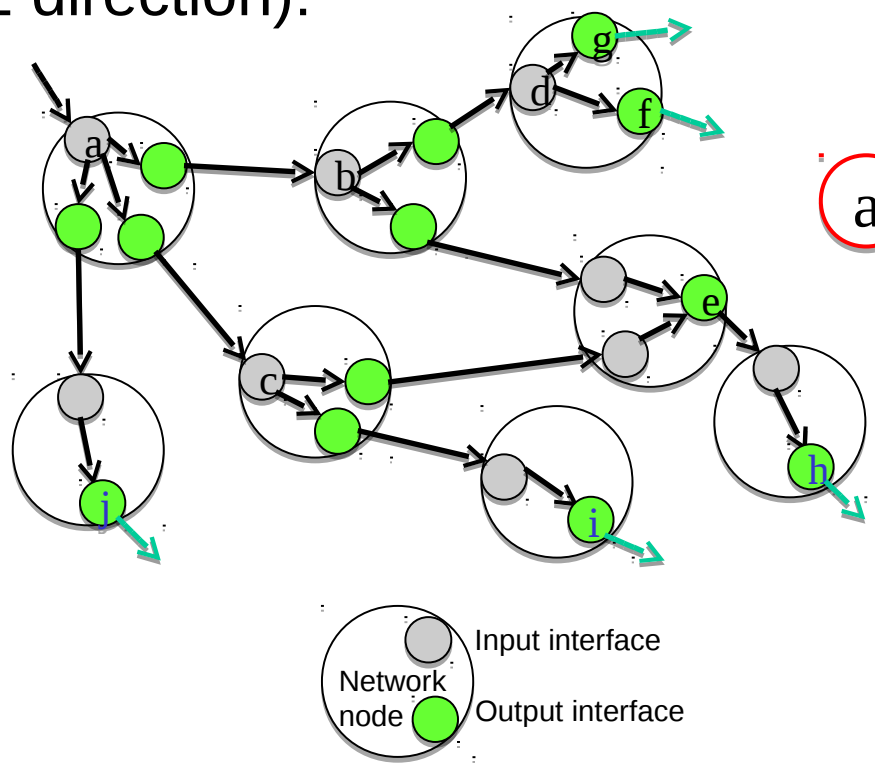
- ✓ There are some performance measurements applications where a lot of flows and nodes have to be monitored.
- ✓ The idea is to generalize and expand AM/PM (Alternate Marking Performance Monitoring) methodologies to measure any kind of unicast flows (not to multicast): in general multipoint-to-multipoint.
- ✓ These unicast multipoint flows are “created” for monitoring purposes joining several point-to-point flows (using appropriate packet selection rules in the monitoring points).
- ✓ A new framework can be introduced: **Multipoint Alternate Marking**
  - It adds flexibility to PM because it can reduce the order of magnitude of the packet counters for large networks.
  - It permits to “localize” performance by splitting the network in “clusters”.
  - It allows an SDN Orchestrator to supervise, control and manage PM in large networks.
  - It enables dynamic performance monitoring and the possibility to set the desired performance measurement depending on the needs.

The monitoring network

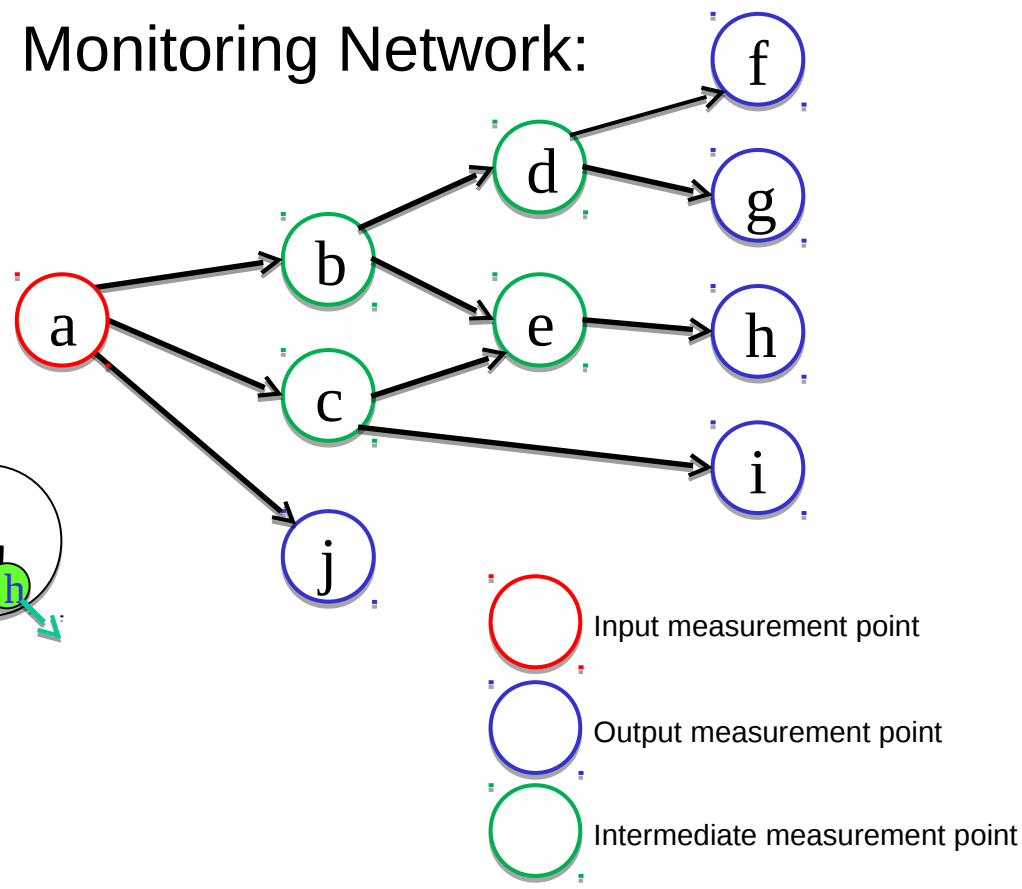
The nodes of the graph (the monitored network), representing a «monitored flow», are the measurement points and the links are virtual connections between measurement points.

This method work if all the input and output points of the network domain to be monitored are measurement points. The intermediate measurement points have only the task to split the measurement in order to locate faults or performance (e.g. packet losses).

Production Network (1 direction):



Monitoring Network:



Examples of application

- **VPN**: The IP traffic is selected on IP source basis in both directions. At the end point WAN interface all the output traffic is counted in a single flow. The input traffic is composed by all the other flows aggregated for source address. So, by considering n end-points, the monitored flows are n (each flow with 1 ingress point and (n-1) egress points) instead of n*(n-1) flows (each flow, with 1 ingress point and 1 egress point);

- **Mobile Backhaul**: LTE traffic is selected, in the Up direction, by the EnodeB source address and, in Down direction, by the EnodeB destination address because the packets are sent from the Mobile Packet Core to the EnodeB. So the monitored flow is only one per EnodeB in both directions;

- **OTT (Over The Top) services**: The traffic is selected, in the Down direction by the source addresses of the packets sent by OTT Servers. In the opposite direction (Up) by the destination IP addresses of the same Servers. So the monitoring is based on a single flow per OTT Servers in both directions.

Multipoint Alternate Marking: Cluster Packet Loss

“Packet loss property”:

In a packet network, the number of lost packets is the number of input packets minus the number of output packets.

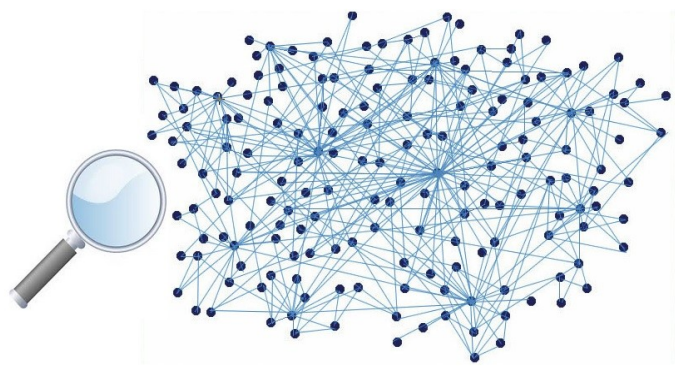
The monitoring network can be considered as a whole or can be split in Clusters

Clusters are the smallest subnetworks (in general group-to-group segments), maintaining the “packet loss property” for each subnetwork

They can also be combined in new connected subnetworks at different levels depending on the detail we want to achieve.

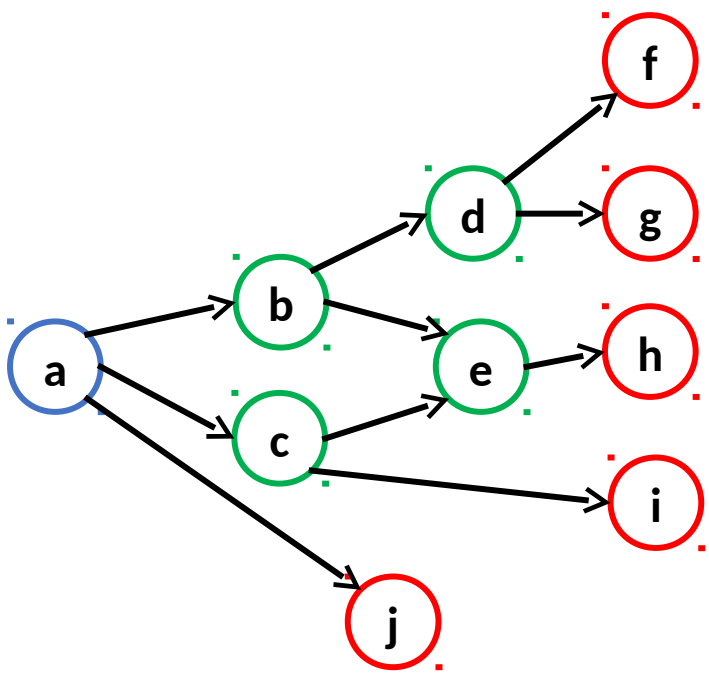
•***Without network clustering***, it is possible to apply alternate marking only for all the network or per single flow.

•***With network clustering***, it is possible to use the network clusters partition at different levels to perform the needed degree of detail.



A simple Algorithm for Cluster partition

A possible algorithm for Cluster partition is a two-step algorithm:
1.Group the links where there is the same starting node;
2.Join the grouped links with at least one ending node in common.



First step:

(a,b)
(a,c)
(a,j)

(b,d)
(b,e)

(c,e)
(c,i)

(d,f)
(d,g)

(e,h)

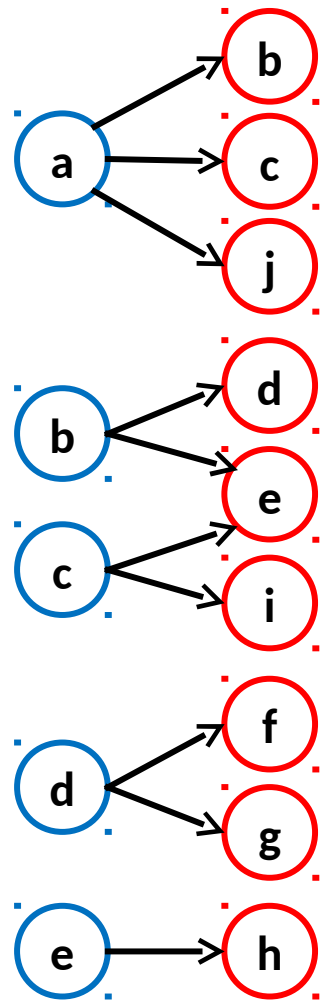
Second step:

Cluster 1: (a,b)
(a,c)
(a,j)

Cluster 2: (b,d)
(b,e)
(c,e)
(c,i)

Cluster 3: (d,f)
(d,g)

Cluster 4: (e,h)



Delay Measurement: multipoint paths basis and single packet basis

This classification has been introduced to distinguish between the two possible ways of measurement

-**multipoint path basis measurement**: the delay value is representative of an entire multipoint path (e.g. whole multipoint network, a cluster or a combination of clusters).

- mean delay: The average latency can be measured as the difference between the mean timestamps of the sets of output and input nodes

-**single packet basis measurement**: the multipoint path is used just to easily couple packets between inputs and output nodes of a multipoint path:

- single marking based on the first/last packet of the interval would not work,
- double marking/multiplexed marking works only for point-to-multipoint flows with limitations,
- hashing is a more general solution (clusters simplify the coupling of the samples from a topological point of view, as well as marking method anchor the samples to a specific period and facilitates their correlation)

Delay measurement with RFC 5475 + RFC 8321

Single packet basis delay and delay variation measurement can be done with Hash Selection described in RFC 5475: it gives a way to select the same packets in every monitoring point of a network

There are two possible alternatives:

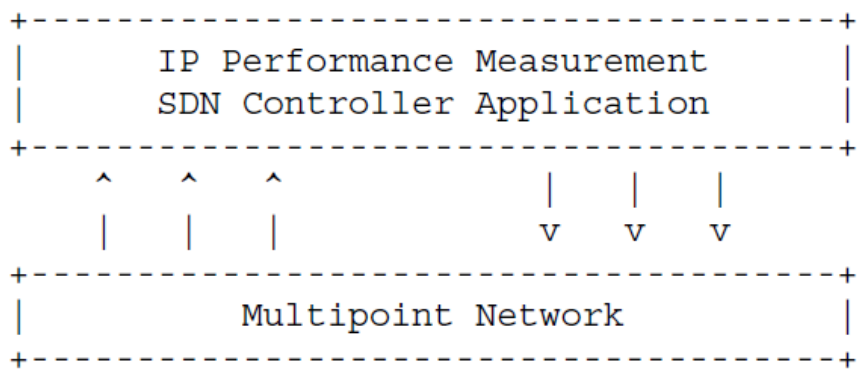
•Basic Hash: Alternate Marking splits the continuous flow in batches of packets and anchor the samples so this simplifies the correlation of the hashing packets along the path. But using Basic Hash, the number of samples depends on packet rate

- Dynamic Hash: In a marking period it is possible to select a number of samples «almost» constant with an iterative algorithm that statistically converges at the end of a marking period.

See also: draft-mizrahi-ippm-compact-alternate-marking

Use Case: Multipoint Alternate Marking in an SDN scenario

- The IP Performance Measurement SDN Controller Application can orchestrate and calibrate the level of detail in network monitoring data by configuring measurement points roughly or meticulously to allow an optimized monitoring.
- Two ways to calibrate: Flow Filtering and Cluster Zooming
- Using Network Clustering approach it is possible to monitor a Multipoint Network. We can start without examining in depth, and in case there is packet loss or the delay is too high, the filtering criteria and clusters partition can be specified in different ways to perform a more detailed analysis.
- A FSM (Finite State Machine) can be programmed such that each state represents a composition of clusters (see draft-sambo-netmod-yang-fsm).



Summary and next steps

A new point of view to the alternate marking method:

- A Controller can calibrate Performance Measurements.
- Dynamic Performance Measurement is introduced.
- Alternate Marking, Hashing technique and Clusters help to perform a “optimized” single packets performance analysis.

Working group just adopted.

Beginning the path to became RFC.

Inputs and Comments always welcome