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**The Big Data Approach for Multipoint Alternate Marking method  
draft-c2f-ippm-big-data-alt-mark-00**

Abstract

This document introduces a new approach for the Alternate Marking method. It is called Big Data Multipoint Alternate Marking method and, starting from the methodology described in [RFC 8321](#) and [draft-ietf-ippm-multipoint-alt-mark](#), it explains how to implement performance measurement analytics on the Network Management System by analysing the raw data of the network nodes.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

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## Table of Contents

<a href="#">1.</a>	Introduction . . . . .	<a href="#">2</a>
<a href="#">2.</a>	Scenario and Background . . . . .	<a href="#">3</a>
<a href="#">3.</a>	Methodology . . . . .	<a href="#">5</a>
<a href="#">3.1.</a>	Data collecting . . . . .	<a href="#">5</a>
<a href="#">3.2.</a>	Sending data . . . . .	<a href="#">7</a>
<a href="#">3.3.</a>	Preprocessing . . . . .	<a href="#">7</a>
<a href="#">3.4.</a>	Results . . . . .	<a href="#">7</a>
<a href="#">4.</a>	Security Considerations . . . . .	<a href="#">9</a>
<a href="#">5.</a>	Acknowledgements . . . . .	<a href="#">9</a>
<a href="#">6.</a>	IANA Considerations . . . . .	<a href="#">9</a>
<a href="#">7.</a>	References . . . . .	<a href="#">9</a>
<a href="#">7.1.</a>	Normative References . . . . .	<a href="#">9</a>
<a href="#">7.2.</a>	Informative References . . . . .	<a href="#">9</a>
	Authors' Addresses . . . . .	<a href="#">10</a>

## [1.](#) Introduction

This document describes a scenario and a methodology that can be used to get performance details from a monitored network. The approach is inspired by the concepts illustrated in the Alternate Marking Method ([RFC 8321](#) [[RFC8321](#)]), Multipoint Alternate Marking Method ([\[I-D.ietf-ippm-multipoint-alt-mark\]](#)), and Hash Sampling ([RFC 5474](#) [[RFC5474](#)] and [RFC 5475](#) [[RFC5475](#)]).

In general the performance measurement results are based on a posteriori calculation and the method is called Big Data Multipoint Alternate Marking performance measurement.

The kinds of measurements are specified on the Network Management System (NMS) and they can be split into two main categories: per cluster and end-to-end.



- o The per cluster approach includes all the details that refer to each single cluster and provides a list of parameters that characterize it (packet loss, mean delay).
- o The end-to-end approach provides more general information about the entire path (packet loss, mean delay).

The results can be provided on demand, in a non real-time processing environment, and each one of them refers to a single monitoring period, even if it is possible to broaden the search to more periods.

The basic mechanism of the Big data approach here introduced is the Packet sampling. Packet sampling, which is performed through Hashing Sampling technique ([RFC 5474](#) [[RFC5474](#)] and [RFC 5475](#) [[RFC5475](#)]) applied on all incoming traffic, without any flow distinction. Nevertheless, thanks to data postprocessing, results are split by flow afterwards, since the storage system memorizes the fields of the packet headers that identify flows. The NMS, in fact, requires, as input parameters, the flow identification fields as well as the timestamp.

The use of hash sampling improves packet tracking performance and thus overall performance. It allows to track the path followed by each packet without further efforts by the NMS.

## **2. Scenario and Background**

The service provider's network is made up of a main backbone network surrounded by routers that handle customers traffic input and output. The proposed methodology requires that the traffic is marked before entering the backbone network, by means of the Alternate Marking technique. The marking process can be made by the edge routers or by the customers itself, keeping in mind that it requires that the markers are synchronized.



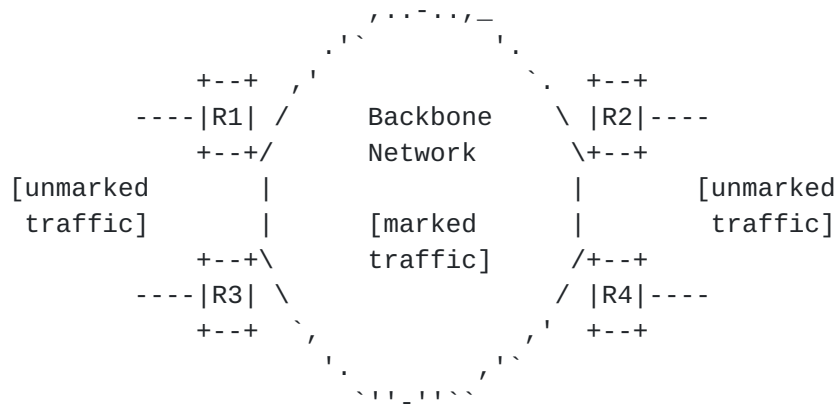


Figure 1: Backbone Network

Only the marked traffic can be monitored. It is possible to mark traffic partially; the results will not be affected by unmarked packets and will refer only to the marked ones. In order to do that a time reference period and a marking method must be fixed at the beginning. The time reference period must consider the misalignment between the marking source routers, clock error between network devices and the interval we need to wait to avoid packets being out of order because of network delay, as described in [RFC 8321](#) [[RFC8321](#)] and [[I-D.ietf-ippm-multipoint-alt-mark](#)].

A possible marking method could use two bits of the header and set them to 0x01, to identify a period, and to 0x10 to identify the next one. This allows to distinguish between marked traffic and unmarked traffic, instead of using just one bit, which can generate misunderstanding between the unmarked traffic (that has the marked bit set to 0 by default) and the marked traffic (that alternates between 0x0 and 0x1, with 0x0 as marker value and not as default). As an alternative, it is possible to use just one bit to mark, and use a filter based on IP address to distinguish the flow to be monitored from the others.

To enable the Big Data approach for monitoring, the network nodes require a packet collector, that is the agent installed on board of the network node that collects measurements, based on the configured Packet sampling criteria.

The portion of network to be monitored must be delimited by routers with packet collector installed on. The rest of the network cannot be monitored even if the traffic is marked. So, the size of the monitored network depends on the network devices placement. However, the size of the network surrounded by packet collectors must be less than or equal to the size of the network with marked traffic.



### 3. Methodology

The method described here consists of the following steps:

1. Data collecting;
2. Sending data;
3. Preprocessing;
4. Results.

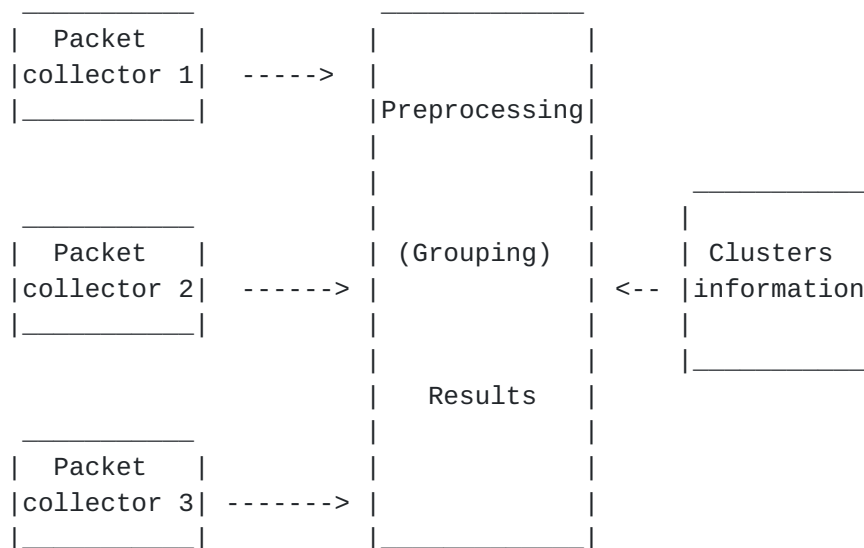


Figure 2: Outline of the Methodology

#### 3.1. Data collecting

The Data collecting phase implies that, on board of the network nodes, the packet collector analyses data passing through a network interface. A packet collector needs to be placed into each router interface we want to monitor.

The agent is configured by setting:

- o the reference hash,
- o the maximum number of packets to store,
- o the alternate marking period duration,
- o the two alternate marking values that identify the marked flow,





- o the interface to monitor,
- o the flow to monitor (i.e identified by header IP fields).

We can select to monitor either a subset (e.g. filter on a particular IP source or destination address range) or all the flows (filter off). After that, the packet collector will only take care to verify consistency between filter and identification fields and no more information about flow will be carried out.

The Data collection is based on Hashing sampling described in [RFC 5474](#) [[RFC5474](#)] and [RFC 5475](#) [[RFC5475](#)].

The process is recursive. Each incoming packet is hashed, compared with the reference hash, and recorded if the number of bits that are matching are the same of those required by the packet collector . When the number of matched packets exceed the maximum number requested in configuration, the number of bits to match is increased by one. At this point all the previous stored packets could be potentially discarded and must be rechecked. So data are stored temporally and are subject to changes, discards and additions. After the period ends, previous data are still subject to change, but after a guard band (reasonably  $L/2$  if  $L$  is the period duration) data are stored permanently and ready to be sent.

Note that the packet collector (carried out with probe) selects the packets based on the configured parameters, so it works with every incoming packet, without distinction. This greatly increases the probe configuration easiness. Otherwise the probe should save all possible flows (potentially too many), which would be too expensive for the device, and need to be reconfigured if a new flow is available for performance monitoring. On the other hand, this increases the amount of data collected.

Stored data include two kind of details: one refers to each single packet and the other one is about aggregate measures.

The first set of data includes the fields that identify the flow (IP header fields), packet hash, timestamp when the packets come in, period to which data refer.

The second set of data reports network interface identification, total counted packets, total hashed packets, mean timestamp based on all the timestamp of all packets that passed through the interface, period.



### **3.2. Sending data**

The Sending data phase is separated from the previous one. Once the data has been stored and collected as logs by the network device following the provisions of the theoretical model, the sending system has only the task of carrying data safely and reliably. It is possible to use a synchronous mechanism, in which the sending system periodically checks the availability of new data, or an asynchronous mechanism. In the last case when a new batch of data is ready, an alert wakes up the sending system that carries them to the destination.

### **3.3. Preprocessing**

The Preprocessing phase has two main goals:

- o aggregate input data to produce a new record that is ready to be postprocessed and that makes it easier to obtain performance parameters;
- o decrease the total amount of data to store.

Although this step is not mandatory, it is recommended to speed up subsequent operations and to give a better shape to the stored data in order to fit well with the last queries.

Preprocessing can be done after data has been stored into the NMS in an iterative loop that parses that periodically or just before to be sent to NMS, through a consolidator, that collects data that comes from all network devices, parses them and then sends them to the NMS.

However, in this phase it is possible to group incoming data from all devices and determine the path followed by each sampled packet. In order to do that, if the data are grouped by hash and ordered them by timestamp, it is possible to outline the path.

After providing to the NMS the topology information and Clusters partition of the monitored network, it is also possible to track the crossed cluster for each couple of sorted data, by analyzing the interface ID available in the stored record and comparing them with the edge that characterizes the clusters available in the monitored network.

### **3.4. Results**

The Results phase involves the preprocessed records lay into database. When necessary the storage system can be queried, in a



deferred time. The records are organized to fit well with the queries that care about timing and loss aspects.

Results are achieved by querying the storage system properly. Certainly, input parameters that identify which flow we are addressing are required. Additionally, time reference is needed to select only the packets of interest. The Big data system is aware of flow identification fields and performs packet flow grouping on the fly. The results described below can refer to different flows, depending on which parameters have been specified for the query.

It is possible to deduce the cluster mean delay  $D_i$  (mean delay referred to cluster  $i$ ), by analyzing each record, computing delay  $d_j$  (delay referred to record  $j$ ) as difference between the two available timestamps, that correspond to the input timestamp (when the packet has gone into the cluster) and the output timestamp (when the packet has gone out of that cluster), and summing it with all other delays; then the result is divided by the number of records that refer to the same cluster:

$$D_i = [d_0 + d_1 + \dots + d_{(N_i-1)}] / N_i$$

Where  $D_i$  is the mean delay related to cluster  $i$ ,  $d_j$  the delay related to record  $j$ ,  $N_i$  the total number of records belonging to cluster  $i$ .

It could also be computed the end-to-end mean delay  $AD$  as the sum of all delays available in our database, and dividing it by all the records:

$$AD = [ad_0 + ad_1 + \dots + ad_{(M-1)}] / M$$

Where  $AD$  is the end-to-end mean delay,  $ad_j$  the delay related to records  $j$ , and  $M$  the total number of records.

If necessary, after observing an unusual cluster delay, it could be possible to compute also max/avg/min link delay, by analyzing records again, and exploiting the difference between the two timestamps.

Additionally, also details about loss are available. Since the total packets are counted by each node, the sum of the input packets must be equal to the sum of the output packets inside each cluster. If their difference is greater than 0, then a loss has occurred, and the result is the total loss. The total packet loss per cluster:

$$PL_i = [p_{(i,0)} + p_{(i,1)} + \dots + p_{(i,K-1)}] - [p_{(o,0)} + p_{(o,1)} + \dots + p_{(o,L-1)}]$$



Considering cluster  $i$  with  $K$  input nodes and  $L$  output nodes, the calculation follows [[I-D.ietf-ippm-multipoint-alt-mark](#)].

In the same way it is possible to get the entire packet loss, as the sum of all the packet loss per cluster. The same measure can be obtained by using only the hashed packets, but in this case, we get an approximate measurement that might reflect or not the real one.

Notice that all these measurements refers to the flow we specify as input of the query and that the specified flow can include or not all the sampled packets (e.g. filter on `ip_src=0.0.0.0/0`, `ip_dst=0.0.0.0/0`, `port_src=/`, `port_dst=/`, `type=tcp`, outlines a flow that includes all the TCP packets in an IP network).

#### **4. Security Considerations**

tbc

#### **5. Acknowledgements**

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#### **6. IANA Considerations**

tbc

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