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Problem Statement and Requirement for Inband Flow Learning
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Abstract

Alternate-Marking (coloring) provides a method to perform packet loss, delay, and jitter measurements on live traffic. At the same time, on-path telemetry techniques are used to enable the collection and correlation of performance information to further support autonomous network operations. However, network operators still face the challenge of inband flow identification in large scale deployment. This document addresses the problems by introducing the real network scenarios, and proposes the requirements of supporting inband flow learning of flow information telemetry.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

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[1.](#) Introduction

Alternate-Marking (coloring) [[RFC8321](#)] provides a method to perform packet loss, delay, and jitter measurements on live traffic. [[I-D.ietf-mpls-inband-pm-encapsulation](#)] and [[I-D.ietf-6man-ipv6-alt-mark](#)] introduce the MPLS and IPv6 performance measurement applications of alternate marking method respectively, and specifies the encapsulations for MPLS and IPv6. On-path telemetry techniques are used to enable the collection and correlation of performance information from the network. By coloring

the real service flow and telemetry flow statistics, per-flow SLA compliance monitoring becomes available and scalable for network operators. When deployed in network, per-flow monitoring can be applied based on CLI configuration or via Netconf YANG.

However, even though Netconf YANG can provide feasibility to network administration, the characteristic of a flow (e.g. IP 5-tuple) can vary dynamically and mislead the service flow identification. Inband flow learning becomes a challenge in large scale deployment to network operators. This document addresses the problems by introducing the real network scenarios, and proposes the requirements of supporting inband flow learning of flow information telemetry.

2. Terminology

OAM: Operations, Administration, and Maintenance

SLA: Service Level Agreement

NFV: Network Function Virtualization

UNI: User-Network-Interface

CN: Core Network

3. Problem Statement

In an alternate marking application, it is usually to utilize the characteristic fields of packet to identify a service flow. For example, IP 5-tuple is usually to be used as the identifier of a service flow at source node. A concept of flow identifier, such as Flow-ID Label Indicator [[I-D.ietf-mpls-inband-pm-encapsulation](#)] or FlowMonID [[I-D.ietf-6man-ipv6-alt-mark](#)] is used to identify service flow at transit or egress nodes. The change of packet data fields would mislead the flow identification for flow monitoring and statistics telemetry in large scale.

3.1. Frequent and Dynamic Change of Flows

In 4G/5G mobile backhaul networks, IP address of one service can be changed based on location, time or even with business growth. The following scenarios describes the challenges which 4G/5G mobile service encounters.

3.1.1. Tidal Effect

A Tidal Effect phenomenon has been recognized as traffics between base station and Core Network (CN) show repetitive patterns with spatio-temporal variations. A typical example of Tidal phenomenon is the traffic difference happened in day and night time of a commercial and business area. In day time, eNodeB allocates more core network resources when a large number of user equipment accesses eNodeB, and less resources at night accordingly. The change of the number of UEs and the core network resources may affect the change on source and destination IP address of service flows.

Moreover, NFV used in core network makes the traffic change even worse as the IP address at CN cannot be manually configured or even predicted. In this case, it is impossible for operators to statically deploy flow monitoring and statistics telemetry.

3.1.2. UPF Expansion

In 5G deployment, the increase of number of subscribers triggers the expansion of UPF resources on data plane of 5G core network. After new UPF resource is added, eNodeB sets up a connection to the new UPF. Correspondingly, a new IP flow is created in mobile bearer network. In this scenario, if flow monitoring and statistics telemetry is deployed in a static mode, operators would need to manually add related configurations to mobile bearer network after the core network capacity is expanded, which is very difficult to deploy in practice.

3.2. Enterprise Service Demand

The enterprise services usually connect different private networks between Headquarter and Branches, Branches and Branches. Network operator has very limited or even no information about end users. Besides, information from one site could be changed from time to time. Unpredictable information on enterprise customer side makes impossible for network operators to set up real time flow monitoring, and to avoid the omission of flow monitoring.

3.3. Large Scale Network Monitor Deployment and Maintenance

In a large-scale mobile bearer network, a large number of base stations and corresponding access points may lead to a large number of IP addresses in core network. From network maintenance perspective, when flow monitoring and statistics telemetry is deployed in a static mode, network operator had to manually set up each monitoring instance between base station and core network, then separately delegate configurations to a large number of network

entities. It is difficult for network operators to find an effective way of monitoring creation and maintenance.

Note that traffic monitoring is comprised of uplink and downlink directions, which makes twice of workload on configurations.

3.4. Service Flow Path Change

When a hop-by-hop flow monitoring is required by critical traffic for deep SLA investigation, the actual forwarding path of service flow and the every forwarding nodes along the path are obtained. Network operator delegates different configurations to each node including ingress, transit, and egress nodes on the path.

Once the traffic forwarding path is changed because of service flow switching or route convergence, the monitoring instance on each node needs to be re-deployed on the new path. In this situation, a flexible and efficient deployment approach is required by network operators.

4. Requirement

To face the flow deployment challenges mentioned in preceding section, an approach of inband flow learning is required. It should simplify the deployment of flow monitoring and achieve an automatic mode of telemetry in large scale networks.

4.1. Ingress Flow Learning

On the UNI side of network node, ingress flow learning can help to capture the characteristic data fields of packet and create the monitoring instance when the flow is created from base station. Flexible policy based on access control list (ACL) can facilitate the identification of flow characteristic. For example, IP 2-tuple (DIP+SIP), DSCP value, etc.

4.2. Egress Flow Learning

Similar to the requirement on ingress node, traffic egress node should support the same capability of inband flow learning to create traffic monitoring instance for completing a monitor. When the egress node or egress port of a service flow is changed, the egress node or egress port of service flow can be triggered to re-learn and re-monitor the service flow.

4.3. Hop-by-Hop Path Learning

When hop-by-hop flow monitoring and telemetry is required, the flow learning and monitor deployment should be created on all the ingress, transit, and egress nodes that service flows pass through. When the path of a service flow changes due to the service switching or network convergence, the service flow re-triggers the flow learning on the new path and starts the new monitoring of service flow.

4.4. Auto Flow Aging

In all the inband flow learning scenarios described above, when the path of a service flow changes, the flow learning on new path is triggered and new monitoring instances are created on devices. Regarding the monitoring instances that have been created before the path change, if there is no traffic detected within a certain period of time, automatic aging and resource recycle should be supported.

5. IANA Considerations

This document has no request to IANA

6. Security Considerations

TBD

7. References

7.1. Normative References

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