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SFC Long-lived Flow Use Cases

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Abstract

Long-lived flows such as file transfers, video streams are common in today's networks. In the context of service function chaining, this draft suggests use cases for dynamic bypass of certain service nodes for such flows. The benefit of this approach would be to avoid expensive Layer 7 service node processing for such flows based on dynamic decisions and improve overall performance.

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Conventions used in this document

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 [RFC 2119].

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1. Introduction

In the context of service function chaining, this draft suggests use cases for dynamic bypass of certain service nodes for long-lived flows such as file transfers, video streams. The benefit of this approach would be to avoid expensive Layer 4-7 service node processing for such flows and improve overall performance. The focus would be only on long-lived flows which are observable and controllable from a control plane perspective; attempting dynamic bypass for short-lived flows would cause excessive control plane chattiness without any significant performance benefit.

For long-lived flows, in order to dynamically bypass certain service nodes in the service function chain, the key is to make sure that the Layer 7 flow can be identified using Layer 2/3/4 fields in the packet. Examples of such flows are file transfers (FTP) and video streams (typically use HTTP) which can be mapped to a unique IP 5 tuple (IP source address, IP destination address, IP protocol, TCP/UDP source port, TCP/UDP destination port). We note that it may not always be possible to identify a Layer 7 flow based on L2/L3/L4 fields in the packet header. An example of this could be file transfers under persistent HTTP sessions where multiple files would be transferred using the same fields in the packet headers.

The definition of long-lived flow in this context can re-use the definition in [I2RS-large-flow] and [OPSAWG-large-flow], where flows are categorized into 4 types - short-lived small flows, short-lived large flows, long-lived small flows and long-lived large flows. In this draft we are concerned with the last 2 types -- long-lived small flows and long-lived large flows - and we refer to these as long-lived flows. This identification of long-lived flows is based on L2/L3/L4 fields in the packet header that is consistent with that the definition of a flow in IPFIX [RFC 7011].

The criteria used by the service node for identifying a long-lived Layer 4-7 flow can use similar criteria, with appropriate modification to account for long-lived small flows, as the techniques described in [OPSAWG-large-flow] for large flow identification. The mechanics of dynamic bypass are quite different for different service functions and are described in the following sections.

For the mechanisms in this draft, our focus is on the following SFC components:

- An SFC Control Plane Application which is responsible for implementing the control plane functionality and programming the data plane for SFC.

- An SFC edge, which is a switch/router responsible for adding/removing the service chain header to the packets.

1.1. Acronyms

COTS: Commercial Off-the-shelf

DOS: Denial of Service

DDoS: Distributed Denial of Service

ECMP: Equal Cost Multi-path

GRE: Generic Routing Encapsulation

LAG: Link Aggregation Group

LSR: Label Switch Router

MPLS: Multiprotocol Label Switching

NVGRE: Network Virtualization using Generic Routing Encapsulation

PBR: Policy Based Routing

QoS: Quality of Service

STT: Stateless Transport Tunneling

TCAM: Ternary Content Addressable Memory

VXLAN: Virtual Extensible LAN

2. Transparent Firewall Use Case

A transparent firewall determines that a long-lived flow (e.g. video stream, file transfer) has no security issues. This long-lived flow is made to dynamically bypass the firewall service function but continue to execute the other service functions in the chain (e.g. NAPT). The key benefit is overall performance improvement. The event sequence for this use case is detailed below. Another point to note is that the firewall is transparent and does not perform packet modification.

2.1. Event Sequence

1. The firewall examines packets of a flow and deems that it is benign. This can be based on many factors such as

    a. The packets are encrypted packets which cannot be decrypted and examined further

    b. The packets are from a trusted source

    c. The packets are from a trusted application

2. The firewall determines that the flow can be identified using a Layer 2/3/4 rule in the fast path. The firewall moves the flow from the internal slow path (which inspects every packet) to the fast path (which does only switching and skips the detailed inspection of every packet).

3. Based on the above criteria and also having identified the flow as a long-lived flow, the firewall determines that the flow is a benign one and does not need to be processed by the firewall any more.

4. The firewall signals this information to the SFC Control Plane Application.

5. The SFC Control Plane Application assigns the flow to a different service function chain that excludes the firewall.

6. The flow continues to be monitored by the SFC edge switch/router for activity.

7. Once the flow is detected as having become inactive, the flow is aged out by the SFC edge switch/router.

8. The SFC edge switch/router signals a flow age event to the SFC Control Plane Application.

9. The SFC Control Plane Application removes the dynamic service chain association created for the flow.

3. Long-tail content CDN Use Case

Most popular content is of interest to a number of users; typical examples are newly released movies, latest television episodes, etc. Such content is very amenable to caching. A single copy of the

content is delivered to the cache; the content is delivered to multiple users from the cache.

Long-tail personalized content is of interest to only a few users; typical examples are documentaries, older movies etc. Long-tail personalized content is typically not shared by many users and is not amenable to caching [CDNI-long-tail]. Caching of such content, could cause excessive thrashing of the cache.

The idea is to improve performance by identifying such long-tail content and bypassing the CDN cache in the service chain for such content. This would be dynamic in nature, since content which is not so popular can become popular and vice versa. The focus will be on long-lived content such as movies, catch up episodes which generate long-lived flows. The key benefit is overall performance improvement. The event sequence for this use case is detailed below.

For the purpose of this draft, our focus is on the following components in the CDN:

. CDN Monitoring System: The CDN Monitoring System monitors various aspects of the content such as

  o Dynamic Content Usage: Number of users simultaneously viewing the same content.

  o Content Life: If the content is long-lived or short-lived. Examples of long-lived content are movies, catch up episodes, etc., while examples of short-lived content are video clips, advertisements, etc.

. CDN Cache: This is the node in the network where the content is cached.

For a general overview of CDNs, see [CDN-overview].

3.1. Event Sequence

1. The CDN Monitoring System monitors the numbers of users and type of content being accessed. By default, we assume the CDN Cache is bypassed.

2. If the number of users viewing the same content exceeds a pre-programmed threshold and the content is long-lived, the CDN Monitoring System instructs the SFC Control Plane Application to dynamically add a CDN Cache to the service chain for that content.

This is done by installing a rule for that flow in the SFC edge switch/router.

3. If the number of users viewing the same content falls below a pre-programmed threshold and the content is long-lived, the monitoring server instructs the SFC Control Plane Application to a dynamically remove a CDN Cache from the service chain for the content. This is done by removing the rule for that flow from the SFC edge switch/router.

4. IPsec Management in Mobile Environments

Existing security procedures for flow protection in LTE are based on the use of IPsec tunnels between the radio base stations (eNodeBs) and some central node in the core, where a security gateway (SecGW) is deployed. The eNodeB device located on the cell site initiates the IPSec tunnel through the backhaul network to the SecGW, where the tunnel is terminated and the traffic is forwarded towards its final destination. IPsec ESP is the method that LTE standards use for achieving the required levels of security [TS33.401].

To avoid traffic bottlenecks and in order to guarantee a high level of service availability, a recommended practice is the concurrent use of several SecGW devices. The one that is to be used for a given traffic flow may be determined by several criteria such as the origin of the traffic (user traffic vs network control), flows with well-known characteristics, e.g. security properties (HTTPS, secure VPNs), etc. In this way, more critical traffic can be prioritized, and different levels of security can be applied depending of payload characteristics.

Such an optimization could be applied as well to long-lived flows in a dynamic way, relaxing security procedures for non-sensitive ones, e.g. it may not be necessary to secure a well-known video stream that is openly available, applying differentiated policies to avoid congestion, or even hardening the security procedures according to the user’s data profile.

4.1. Event Sequence

1. A monitoring element such as a DPI appliance analyzes the new flows arriving at the default SecGW device used by a given eNodeB device according to criteria such as:

   . Security payload protection;

   . Application and transport protocol(s) in use;

. Relevant parameters in those protocols (URL, content-transfer declarations, etc.).

2. If the monitoring element identifies a long-lived flow that matches its differentiating criteria, it signals the flow to the SFC Control Plane Application.

3. The SFC Control Plane Application assigns the flow to a different service function chain that makes the eNodeB device use a different SecGW device.

4. Once the flow is becomes inactive, it is aged out by the eNodeB device and signaled as such to the SFC Control Plane Application.

5. The SFC Control Plane Application removes the dynamic service chain association that was created for the flow.

5. Operational Considerations

Any modification to the SFC path (due to insertion or removal of a service function) could result in temporary mis-ordering in the delivery of packets.

6. IANA Considerations

None.

7. Security Considerations

This draft specifies a use case for SFC and does not introduce any new security requirements beyond those already under consideration for SFC.

8. Acknowledgements

9. References

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