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Hierarchical SFC for DC Interconnection
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Abstract

Sometimes some SFs of a SFC are provided by several DC networks. That means a SFC may cross several SFs in different DC network. How to establish such SFC that is across several DCs is what we want to state. In this document, a hierarchical SFC method is proposed. It will cover data plane, control plane for such hierarchical SFC. And it includes requirements of the SFC Gateway for every DC network that provide SF for SFC.

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[1.](#) Introduction

Service Function Chain (SFC) is the chain with a series of ordered Service Functions(SF). These SFs are distributed in a DC network or some DC networks. So it's common that a SFC is across several DC networks, which incurs the problem of DC network interconnection. Every part of the SFC in one DC network is a SFC within DC network. We call such SFC to be hierarchical SFC. And the part of such SFC within a DC network is called to be Inter-SF. Inter-SF may contain one or more SFs that are within one DC network, but is a logical SF from the view of the hierarchical SFC.

This document is going to describe the architecture for such scenario. And data plane and control plane will be provided to specify how the hierarchical SFC works. Meantime, some concepts are proposed.

[2.](#) Terminology

SFC(Service Function Chain): An ordered set of some abstract SFs.

H-SFC(Hierarchical SFC): A SFC that transfers one or more Data center networks. Every Datacenter network provide a inter-SF for H-SFC.

Inter-SF: A logical SF that is provided by a SFC in Datacenter network. For H-SFC, the Inter-SF in one Datacenter network is regarded as a SF on the path of this H-SFC.

I-SFC(Internal-SFC): A Service Function Chain within the Datacenter network which is corresponding to the Inter-SF in H-SFC.

SFC-GW: A gateway for SFC in Datacenter network which is used to interconnect with H-SFC.

3. Architecture of Hierarchical SFC

Hierarchical SFC is composed of an ordered of SFs or Inter-SFs. Inter-SF is a logic SF that is composed of an ordered of SFs which form a SFC in DC network. We can connect every SFC of every Datacenter network as a whole H-SFC.

For more details about H-SFC, please see Figure 1. To setup such H-SFC, we need to:

- 1) To determine what kind of service the Inter-SF should provide has been determined by the Orchestration;
- 2) To establish the corresponding SFC in the Datacenter network of the Inter-SF has been established by the controller of the Datacenter network;
- 3) Inter-SF also has its SFID in H-SFC;
- 4) Inter-SF as next hop of the H-SFC also has its locator, which may be the address of the SFC-GW. This locator information has been exchanged with Controller1.

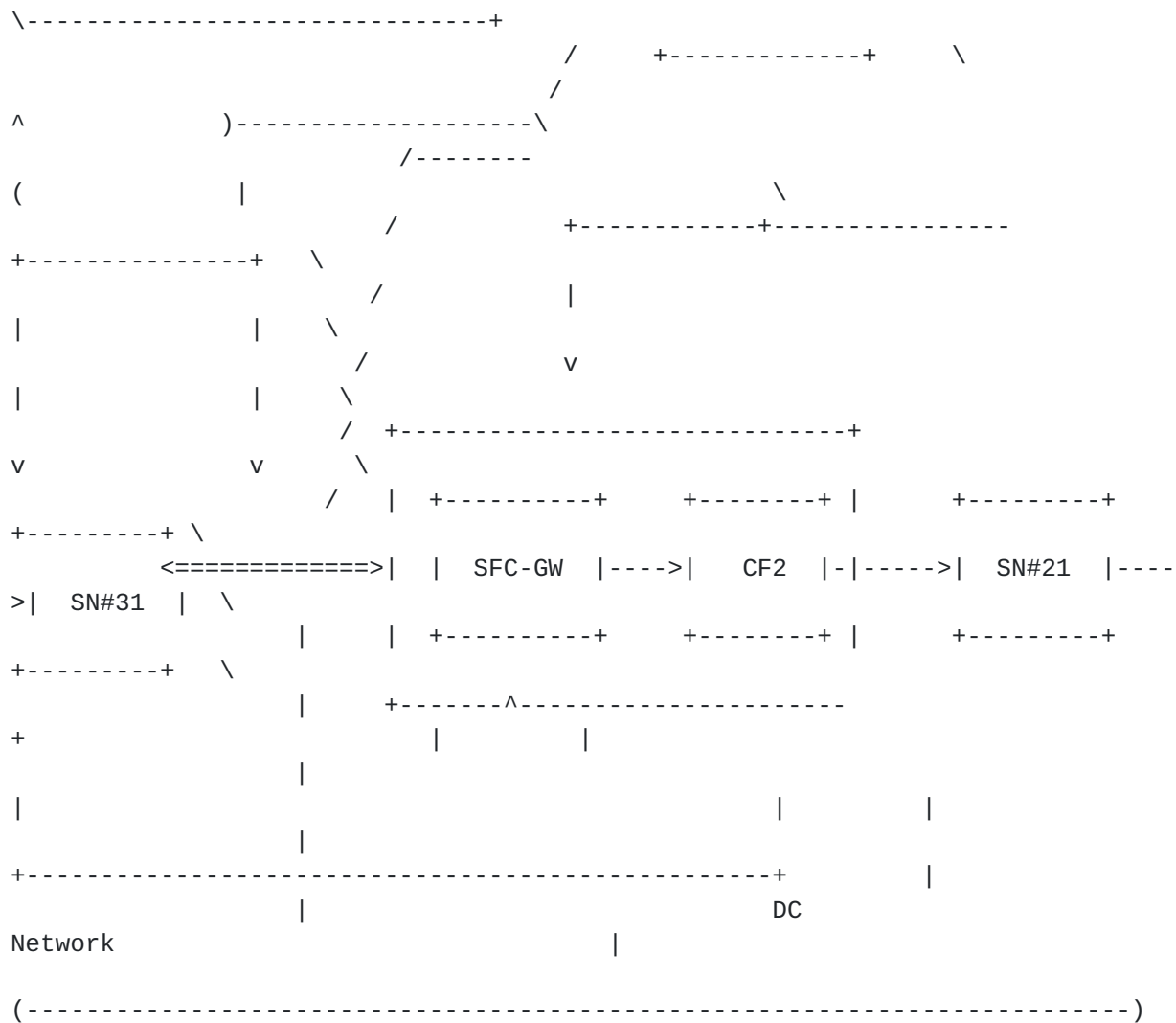


Figure 1 H-SFC architecture

In the Figure 1, the Inter-SF#1, Inter-SF#2, Inter-SF#3 which is provided by a separate Datacenter network are an ordered set of a Hierarchical SFC. For this H-SFC, it's a logical SF. But for this datacenter network, it actually is a SFC within the datacenter network.

CF1 classifies the traffic and assign it a H-SFC. The traffic traverses along the path according to this H-SFC. Whenever the traffic enters into Inter-SF#n, it actually enters into the corresponding Datacenter network through SFC-GW to begin its SFC. The setup of this SFC in the datacenter is invisible to H-SFC. The path of the SFC in the datacenter network is also invisible to H-SFC.

3.1. SFC-GW

SFC-GW is the component through which Inter-SF#n communicate with H-SFC. For H-SFC, the SFC-GW can be considered as a SFF for the corresponding Inter-SF#n, see Figure 2. And the SFC-GW's locator is regard as the next hope address of the HSFC. Traffic enters into Inter-SF#n arrives the SFC-GW firstly. And then the SFC-GW forwards the traffic to the Classifier in Datacenter network.

When the traffic finishes this SFC in the Datacenter network, it should be forwarded back to SFC-GW, and then be forwarded to next SF or Inter-SF by the SFC-GW.

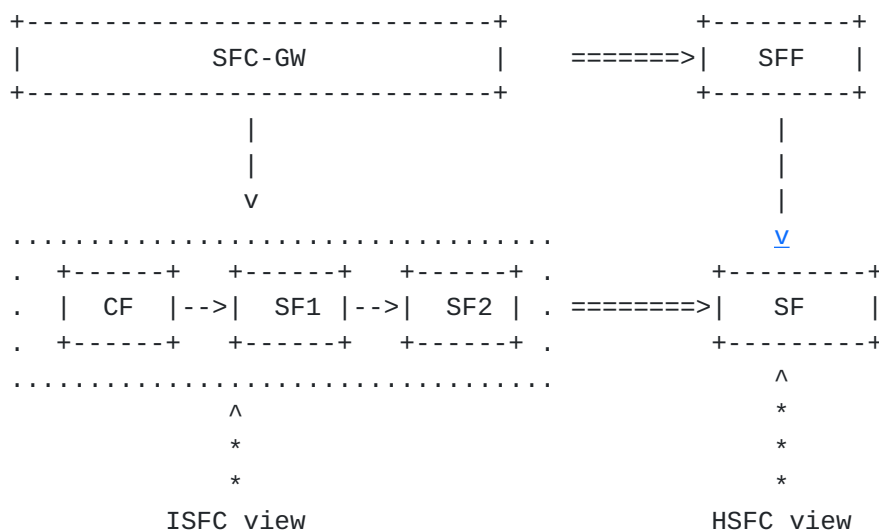


Figure 2 View of the SFC-GW

3.2. Classifier for Inter-SF

Classifier for Inter-SF receives the traffic from SFC-GW. For the traffic, the Classifier classifies the traffic and maps the traffic into corresponding SFC in the Datacenter network according to the H-SFC header information. The Classifier assigns the traffic the SFC header and the traffic is forwarded along the SFP specified by the SFC header.

4. Encapsulation

As description in [section 3](#), SFC in Datacenter network is invisible to H-SFC. So it's not feasible to use the forwarding method of SFC that is in one Datacenter network. We need to assign a new SFC header for the specific SFC in the Datacenter network.

Here is the analysis for the methods to handle the SFC in the Datacenter network.

4.1. Overlap SFC encapsulation

When the packets with H-SFC header arrives the Classifier in the Datacenter network, this Classifier would assign a new I-SFC header based on the H-SFC header. An example is showed like the following format, Figure 3.

```

+-----+
| Overlay Header |
+-----+
| I-SFC Header   |
+-----+
| H-SFC Header   |
+-----+
| Original Packet |
+-----+

```

Figure 3 View of the SFC-GW

The traffic with the above 2 layer-SFC header would be forwarded according to the I-SFC header in the Datacenter network. H-SFC header is just preserved in the packets. At the last SFF of the Service Function Chain of the network, the I-SFC header is removed from the packet and then the packet is forwarded to the SFC-GW of the Datacenter network for further forwarding based on the H-SFC header.

With such encapsulation, H-SFC information is carried along the the whole H-SFC life, so that the last SFF in the Datacenter center of the I-SFC is not required to be aware of the H-SFC. This forwarding method eliminates the last SFF's awareness of the H-SFC.

4.2. Metadata SFC encapsulation

In this method, H-SFC header is transferred as a metadata that is stored in the I-SFC header. And at the last SFF of the I-SFC, the SFF need to restore metadata information into H-SFC header, then pass such traffic to SFC-GW.

This method requires that the last SFF must transfer I-SFC header to H-SFC header before forward the traffic to SFC-GW.

4.3. Exchange SFC encapsulation

In this kind of encapsulation, there is 1 layer SFC header with the packet all the time. The Classifier in the Datacenter network maps the H-SFC header to the I-SFC header. And the last SFF of the I-SFC maps the I-SFC header back to H-SFC header.

This method requires the last SFF in Datacenter network not only map the I-SFC header back to H-SFC, but also must learn the mapping information from controller.

5. Coordination

To be added later.

6. Summary

As we discuss above, H-SFC is very useful in the Service Function Chain across several Datacenter networks so that the SFC is more scalability. With the overlap SFC encapsulation, we keep the principle that the two level SFC decouple as possible as it can. And we can use the existing SFC in Datacenter to be a Inter-SF without modification and with no new requirement for SFF.

7. Security Considerations

To be added later

8. IANA Considerations

N/A

9. Information References

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