

SPRING Working Group
Internet-Draft
Intended status: Standards Track
Expires: January 13, 2022

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July 12, 2021

ACH6 in Segment Routing
draft-yang-spring-ach6-sr-00

Abstract

Associated Channel over IPv6 (ACH6) provides a control channel to one specific IPv6 forwarding path for control and management purpose. When ACH6 is used in a Segment Routing network, it provides a control channel to an SRv6 path. This document specifies an SRv6 ACH6 mechanism and describes how ACH6 is applied in a Segment Routing network.

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

Segment Routing [[RFC8402](#)] leverages the source routing paradigm. By leveraging SR into IPv6 network, an ordered list of SRv6 SIDs provides the certainty of a packet forwarding path as restricted to a specific topological path. The Function part in SRv6 SIDs indicates instructions to be executed on network nodes to achieve network programming to an IPv6 forwarding path.

[I-D.yang-rtgwg-ipv6-associated-channel] proposes an Associated Channel over IPv6 (ACH6) to provide a control channel to one specific IPv6 forwarding path for control and management purpose. When ACH6 is used in a Segment Routing network, it provides a control channel

to an SRv6 path. This document specifies an SRv6 ACH6 mechanism and describes how ACH6 is applied in a Segment Routing network.

2. ACH6 in Segment Routing

SRv6 ACH6 provides a control channel to carry control and management messages to an SRv6 path separately from data forwarding. It is a method to provide distributed control and management capabilities to an SRv6 path, which complements the SDN centralized control plane. In SRv6 ACH6 control channel, different types of control and management messages to an SRv6 path are carried.

2.1. ACH6 Network Reference Model in Segment Routing

In SRv6 network, IPv6 packet is generated and transported from one SRv6 endpoint to another with an ordered list of SRv6 SIDs in Segment Routing Header (SRH) [RFC8754]. SRv6 ACH6 is an inband path-based control channel from one SRv6 endpoint to another. SRv6 ACH6 packet is also encapsulated with an Segment Routing Header. To guarantee ACH6 control packet is transported in the same path as data packets forward, ACH6 packet uses the same SRv6 SID list with the one in SRH of data packets associated with.

Figure 1 shows an ACH6 network reference model used in an SRv6 network.

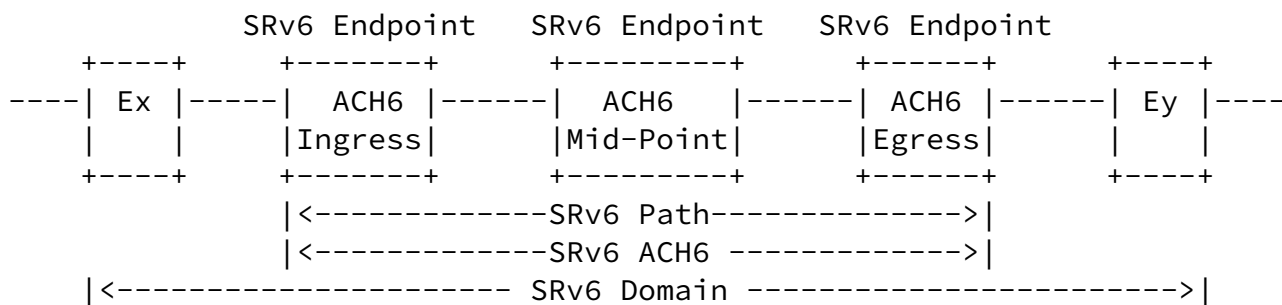


Figure 1 ACH6 Network Reference Model in SRv6

Ex/Ey: SRv6 endpoint

ACH6 Ingress Node: is the node indicates the entering of control and management channel over an SRv6 path, where control and management messages are generated and encapsulated. ACH6 ingress node sets its local IPv6 address as source address of ACH6 packet.

ACH6 Mid-Point Node: the SRv6 endpoints on SRv6 SID list of ACH6 control packet are ACH6 Mid-Point Node, which would process ACH6 packet when hop-by-hop processing on SRv6 endpoints is required by ACH6 control channel.

ACH6 Egress Node: indicates the exiting of control and management channel over an SRv6 path, where the control and management messages

are extracted and delivered to control or management plane for further process. ACH6 egress node sets its local IPv6 address as destination address of ACH6 packet.

2.2. Identification of ACH6 in Segment Routing

The Associated Channel ID is the identifier of ACH6 control channel, and indicates the path which control channel is associated with. In SRv6, Path Segment [[I-D.ietf-spring-srv6-path-segment](#)] is used to identify a specific SRv6 path. It can also be used as Associated Channel ID to identify the control channel of an SRv6 path. The encoding of Path Segment and how Path Segment is allocated keeps same specifications defined in [[I-D.ietf-spring-srv6-path-segment](#)].

2.3. ACH6 TLV Format in Segment Routing

ACH6 TLV in Segment Routing is defined as:

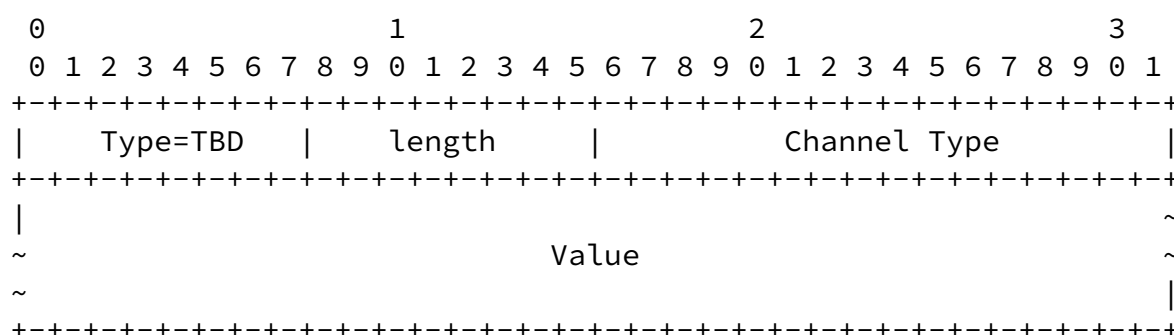


Figure 2 ACH6 TLV Format in SR

Type: 8 bits, indicates it is an ACH6 TLV.

Length: 8 bits, defines the length of Value field in bytes.

Channel Type: is a 16-bit-length fixed portion as a part of Value field. It indicates the specific type of messages carried in SRv6 ACH6 control channel. Note that a new ACH TLV Channel Type Registry would be requested to IANA. In later documents which specify application protocols of associated channel, MUST also specify the applicable Channel Type field value assigned by IANA.

Value: is a variable portion of Value field. It specifies the messages indicated by Channel Type and carried in associated channel. Note that the Value field of ACH6 TLV MAY contain sub-TLVs to provide additional context information to ACH6 TLV.

[2.4.](#) Encapsulation of ACH6 TLV in Segment Routing

In SRv6, ACH6 control channel is used in either an end-to-end or a hop-by-hop approach.

Regarding an end-to-end case, messages in ACH6 is encapsulated at ACH6 ingress node and decapsulated at ACH6 egress node. ACH6 TLV is recommended to be encapsulated in IPv6 Destination Options Header places after the Segment Routing Header. An alternative way to carry ACH6 TLV is using IPv6 payload. When ACH6 TLV format is encapsulated in payload, TLV Type and Length can be omitted. The method of taking advantage of SRH Flag field to indicate active probing packet [[I-D.song-spring-siam](#)] can be used for ACH6 too.

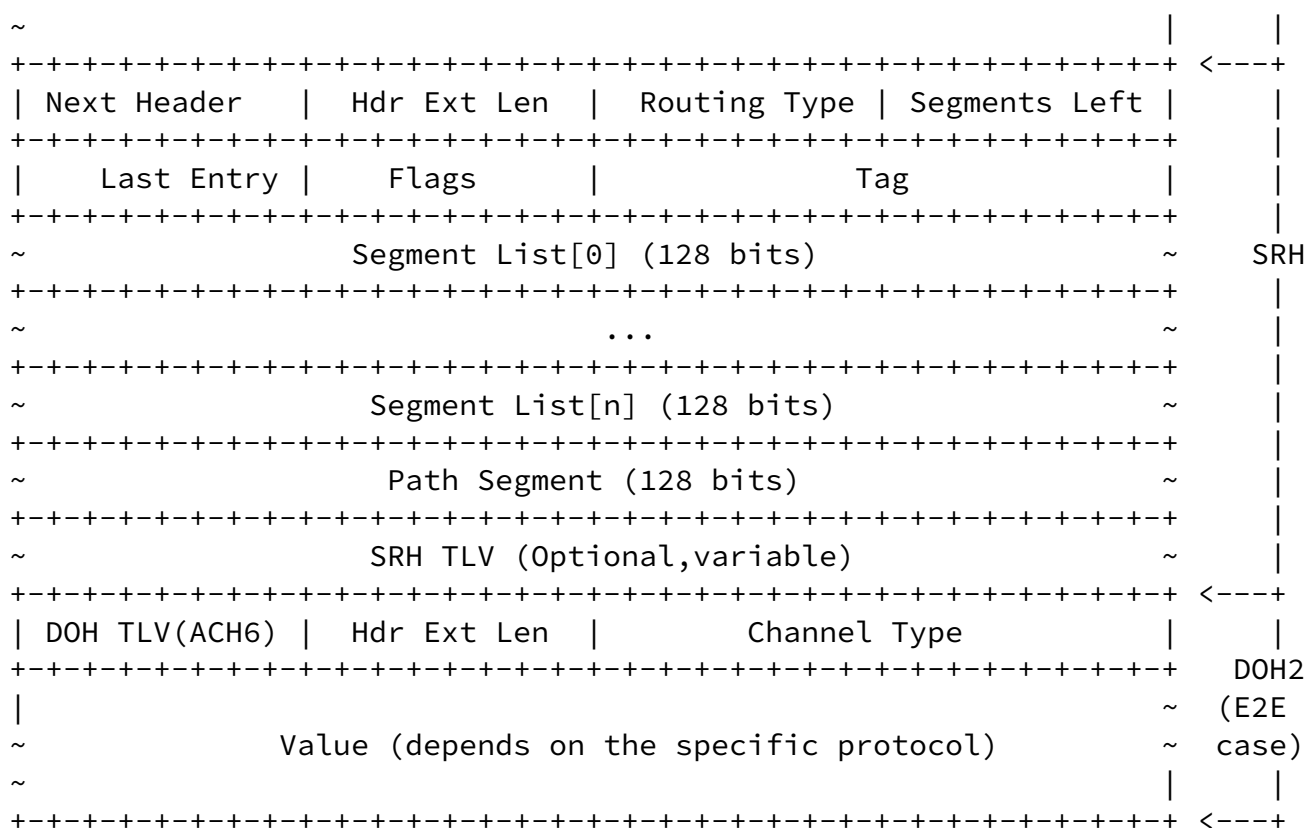
Regarding a hop-by-hop case, messages in ACH6 is encapsulated at ACH6 ingress node. ACH6 mid-points decapsulate and re-encapsulate every ACH6 packet. At last, ACH6 egress node decapsulates ACH6 packet and delivers control and management messages for further process. In this case, ACH6 TLV is recommended to be encapsulated in IPv6 Destination Options Header preceding the Segment Routing Header.

The encapsulation of ACH6 in IPv6 Destination Options Header is

defined as:

```

0                               1                               2                               3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version| Traffic Class |                               Flow Label |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Payload Length          | Next Header | Hop Limit |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                               Source Address                               //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                               Destination Address                               //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ <----+
| DOH TLV(ACH6) | Hdr Ext Len |          Channel Type          | |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+ DOH1
|                                                              | (HbH
~                               Value (depends on the specific protocol) ~ case)
```



3. Use Case of ACH6 in Segment Routing

In SRv6, several works are carrying on to establish an SRv6 OAM toolset. [[I-D.ietf-6man-spring-srv6-oam](#)] provides the mechanisms of continuity check, path discovery by reusing Ping and Traceroute, and defines a sampling flag for flow information telemetry. Simple Two-

request/reply, proactive continuity check, and performance measurement. By using ACH6 to carry OAM messages, continuity check and performance management can be monitored either hop-by-hop on every SR endpoint or end-to-end from the first endpoint to the last. Leveraging IPv6 extension headers to carry OAM messages can facilitate data plane processing on OAM messages, and further improve processing efficiency and accuracy. At last, by leveraging the native semantics of IPv6 extension headers, this method can naturally reduce OAM configuration and session management on SRv6 endpoints.

Figure 4 gives the example format of ACH6 OAM TLV.

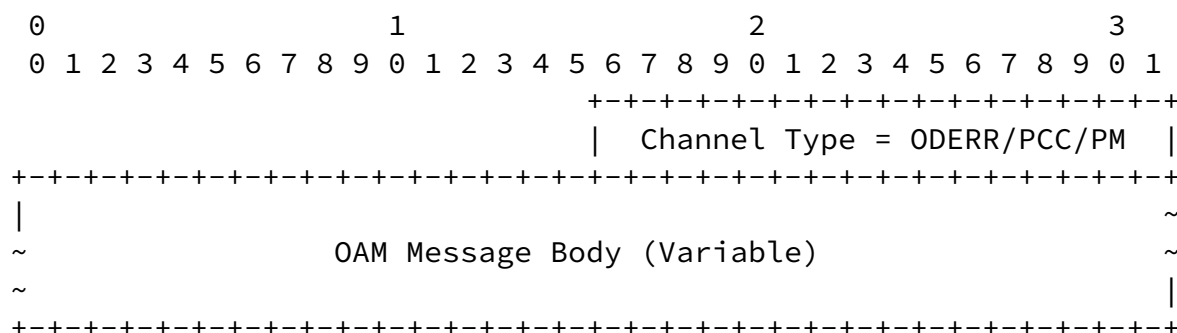


Figure 4 ACH6 OAM TLV

ACH6 Channel Type to indicate which type of OAM message is encapsulated in the following OAM message body, for example on demand echo request/reply. OAM message can also re-utilize the format of existing protocols. For example, BFD or STAMP protocol formats can be encapsulated in IPv6 payload field after UDP header.

3.2. Protection to an SRv6 Path

Protection State Coordination (PSC) Protocol [[RFC6378](#)] provides a single-phased coordination mechanism used for linear protection between two endpoints. This coordination mechanism is useful when there is a need of traffic to be transported on two co-routed paths. In SRv6, active and backup candidate paths in SR policy can provide an end-to-end protection to a specific SRv6 path. However, without a coordination mechanism like PSC, SR policy cannot guarantee the bidirectional traffics are transported on co-routed paths.

messages between SRv6 endpoints. An ordered segment list of working path and an ordered segment list of backup path are separately pre-created at the source and destination of an SRv6 path. Working paths on two SRv6 endpoints are co-routed, so does backup paths. When there is failure to indicate protection switchover on working path, ACH6 exchanges protection state coordination messages between SRv6 endpoints to indicate synchronized switchover. When two SRv6 endpoints accomplish the switchover, the protection paths are co-routed for bidirectional traffics.

Figure 5 gives the example format of ACH6 protection state coordination TLV.

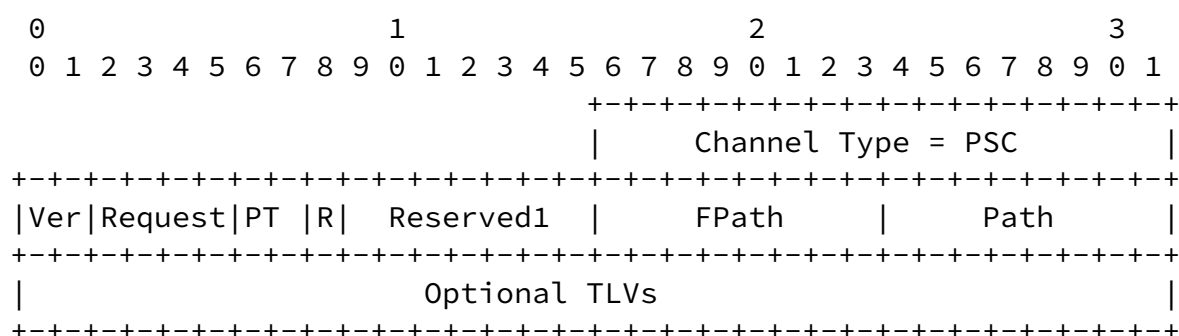


Figure 5 ACH6 PSC TLV

The definition and usage of Request, PT, R, FPath and Path fields are referenced to [\[RFC6378\]](#).

3.3. Resource Reservation to an SRv6 Path

In current practice of SRv6, a distributed resource reservation protocol like RSVP-TE is not used. SDN controller plays the role of calculating forwarding path and reserving relevant resources to the path. It is feasible for controller to calculate bandwidth and send path setup information to headend via PCEP. But for the other metrics e.g. queues, same parameter may have different formats and values on each node. It is not effective for controller to separately establish PCE session with each node to provision the metrics.

The second reason to use a distributed messages exchange mechanism among SRv6 endpoints is that modifications of path-based resource reservation are required to be accomplished fast enough to guarantee service's SLA when network failures happen, especially in the case when thousands of services with independent resource reservations are affected by the same failure on physical path.

A proposed hybrid structure of resource reservation in SRv6 network is comprised of distributed ACH6 resource reservation mechanism and a centralized stateful PCE [[RFC8231](#)].

[4.](#) IANA Considerations

- o This document requests IANA to assign a codepoint of Destination Options Header TLVs to indicate ACH6 TLV.
- o This document request IANA to create a new registry of ACH6 Channel Types to identify the usage of associated channel.

[5.](#) Security Considerations

TBD

[6.](#) Acknowledgements

TBD

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Expires January 13, 2022

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