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RADIUS Extensions for Dual-Stack Lite

Abstract

Dual-Stack Lite is a solution to offer both IPv4 and IPv6 connectivity to customers that are addressed only with an IPv6 prefix. Dual-Stack Lite requires pre-configuration of the Dual-Stack Lite Address Family Transition Router (AFTR) tunnel information on the Basic Bridging BroadBand (B4) element. In many networks, the customer profile information may be stored in Authentication, Authorization, and Accounting (AAA) servers, while client configurations are mainly provided through the Dynamic Host Configuration Protocol (DHCP). This document specifies a new Remote Authentication Dial-In User Service (RADIUS) attribute to carry the Dual-Stack Lite AFTR tunnel name; the RADIUS attribute is defined based on the equivalent DHCPv6 OPTION_AFTR_NAME option. This RADIUS attribute is meant to be used between the RADIUS server and the Network Access Server (NAS); it is not intended to be used directly between the B4 element and the RADIUS server.

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1. Introduction

Dual-Stack Lite [RFC6333] is a solution to offer both IPv4 and IPv6 connectivity to customers that are addressed only with an IPv6 prefix (no IPv4 address is assigned to the attachment device). One of its key components is an IPv4-over-IPv6 tunnel, but a Dual-Stack-Lite Basic Bridging BroadBand (B4) element will not know if the network to which it is attached offers Dual-Stack Lite support. Even if the B4 did know, it would not know the remote end of the tunnel to which it could establish a connection.

To inform the B4 element of the location of the Address Family Transition Router (AFTR), a Fully Qualified Domain Name (FQDN) may be used. Once this information is conveyed, the presence of the configuration indicating the AFTR's location also informs a host to initiate Dual-Stack Lite (DS-Lite) service and become a Softwire Initiator.

[RFC6334] specifies a DHCPv6 option that is meant to be used by a DS-Lite client (B4 element) to discover its AFTR name. In order to be able to populate such an option, the DHCPv6 server must be pre-provisioned with the AFTR name.

In broadband environments, a customer profile may be managed by Authentication, Authorization, and Accounting (AAA) servers, together with AAA for users. The Remote Authentication Dial-In User Service (RADIUS) protocol [RFC2865] is usually used by AAA servers to communicate with network elements. [RADIUS-IPv6] describes a typical broadband network scenario in which the Network Access Server (NAS) acts as the access gateway for the users (hosts or Customer Premises Equipment (CPE) devices) and also embeds a DHCPv6 server function that allows it to locally handle any DHCPv6 requests issued by the clients.

Since the DS-Lite AFTR information can be stored in AAA servers and the client configuration is mainly provided through DHCP running between the NAS and the requesting clients, a new RADIUS attribute is needed to send AFTR information from the AAA server to the NAS.

This document defines a new RADIUS attribute to be used for carrying the DS-Lite Tunnel Name, based on the equivalent DHCPv6 option already specified in [RFC6334].

2. Terminology

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 [RFC2119].

The terms DS-Lite Basic Bridging BroadBand element (B4) and the DS-Lite Address Family Transition Router element (AFTR) are defined in [RFC6333].

3. DS-Lite Configuration with RADIUS and DHCPv6

Figure 1 illustrates how the RADIUS protocol and DHCPv6 work together to accomplish DS-Lite configuration on the B4 element when a PPP session is used to provide connectivity to the user.

The NAS operates as a client of RADIUS and as a DHCP Server. The NAS initially sends a RADIUS Access-Request message to the RADIUS server, requesting authentication. Once the RADIUS server receives the request, it validates the sending client, and if the request is approved, the AAA server replies with an Access-Accept message including a list of attribute-value pairs that describe the parameters to be used for this session. This list MAY also contain the AFTR tunnel name. When the NAS receives a DHCPv6 client request containing the DS-Lite tunnel option, the NAS SHALL use the name returned in the RADIUS DS-Lite-Tunnel-Name attribute to populate the DHCPv6 OPTION_AFTR_NAME option in the DHCPv6 reply message.

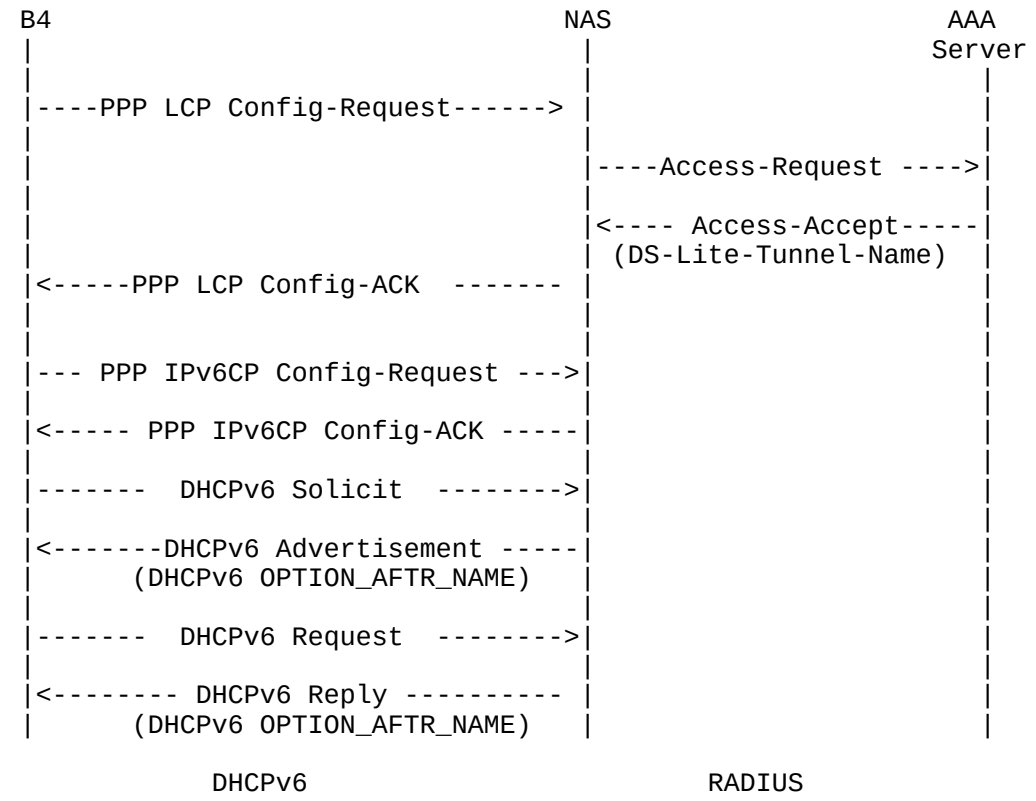


Figure 1: RADIUS and DHCPv6 Message Flow for a PPP Session

Figure 2 illustrates how the RADIUS protocol and DHCPv6 work together to accomplish DS-Lite configuration on the B4 element when an IP session is used to provide connectivity to the user.

The only difference between this message flow and the previous one is that in this scenario, the interaction between the NAS and the AAA/ RADIUS server is triggered by the DHCPv6 Solicit message received by the NAS from the B4 acting as a DHCPv6 client, while in the case of a PPP session, the trigger is the PPP Link Control Protocol (LCP) Config-Request message received by the NAS.

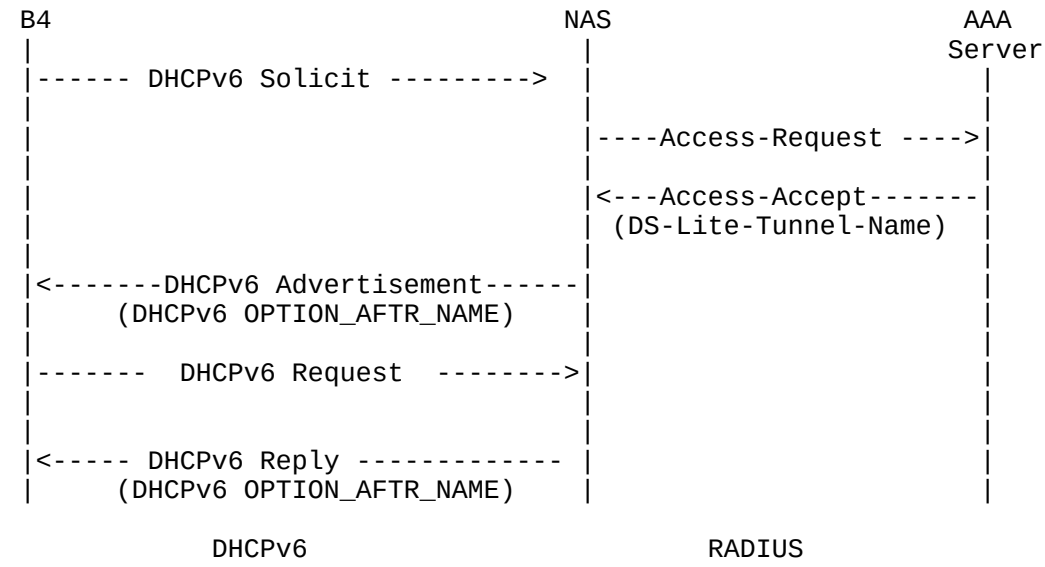


Figure 2: RADIUS and DHCPv6 Message Flow for an IP Session

In the scenario depicted in Figure 2, the Access-Request packet contains a Service-Type attribute with the value Authorize Only (17); thus, according to [RFC5080], the Access-Request packet MUST contain a State attribute.

After receiving the DS-Lite-Tunnel-Name attribute in the initial Access-Accept packet, the NAS MUST store the received AFTR tunnel name locally. When the B4 sends a DHCPv6 Renew message to request an extension of the lifetimes for the assigned address or prefix, the NAS does not have to initiate a new Access-Request packet towards the AAA server to request the AFTR tunnel name. The NAS retrieves the previously stored AFTR tunnel name and uses it in its reply.

According to [RFC3315], if the DHCPv6 server to which the DHCPv6 Renew message was sent at time T1 has not responded, the DHCPv6 client initiates a Rebind/Reply message exchange with any available server. In this scenario, the NAS receiving the DHCPv6 Rebind message MUST initiate a new Access-Request message towards the AAA server. The NAS MAY include the DS-Lite-Tunnel-Name attribute in its Access-Request message.

If the NAS does not receive the DS-Lite-Tunnel-Name attribute in the Access-Accept message, it MAY fall back to a pre-configured default tunnel name, if any. If the NAS does not have any pre-configured

default tunnel name or if the NAS receives an Access-Reject message, the IPv4-over-IPv6 tunnel cannot be established; thus, the B4 element has only IPv6 connectivity.

4. RADIUS Attribute

This section specifies the format of the new RADIUS attribute.

4.1. DS-Lite-Tunnel-Name

The DS-Lite-Tunnel-Name RADIUS attribute contains an FQDN that refers to the AFTR to which the client is requested to establish a connection. The NAS SHALL use the name returned in the RADIUS DS-Lite-Tunnel-Name attribute to populate the DHCPv6 OPTION_AFTR_NAME option [RFC6334].

This attribute MAY be used in Access-Request packets as a hint to the RADIUS server; for example, if the NAS is pre-configured with a default tunnel name, this name MAY be inserted in the attribute. The RADIUS server MAY ignore the hint sent by the NAS, and it MAY assign a different AFTR tunnel name.

If the NAS includes the DS-Lite-Tunnel-Name attribute, but the AAA server does not recognize it, this attribute MUST be ignored by the AAA server.

If the NAS does not receive the DS-Lite-Tunnel-Name attribute in the Access-Accept message, it MAY fall back to a pre-configured default tunnel name, if any. If the NAS does not have any pre-configured default tunnel name, the tunnel cannot be established.

If the NAS is pre-provisioned with a default AFTR tunnel name and the AFTR tunnel name received in the Access-Accept message is different from the configured default, then the AFTR tunnel name received in the Access-Accept message MUST be used for the session.

If the NAS cannot support the received AFTR tunnel name for any reason, the tunnel SHOULD NOT be established.

When the Access-Request message is triggered by a DHCPv6 Rebind message, if the AFTR tunnel name received in the Access-Accept message is different from the currently used one for that session, the NAS MUST force the B4 to re-establish the tunnel using the new AFTR name received in the Access-Accept message.

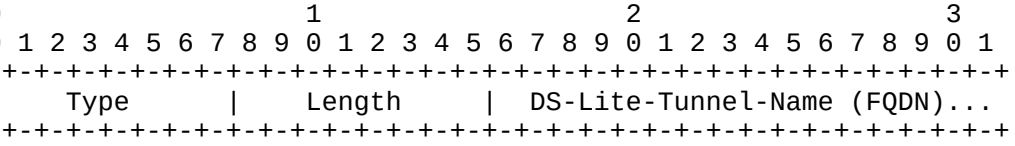
If an implementation includes Change-of-Authorization (CoA) messages [RFC5176], they could be used to modify the current established DS-Lite tunnel. When the NAS receives a CoA Request message

containing the DS-Lite-Tunnel-Name attribute, the NAS MUST send a Reconfigure message to a B4 to inform the B4 that the NAS has new or updated configuration parameters and that the B4 is to initiate a Renew/Reply or Information-Request/Reply transaction with the NAS in order to receive the updated information.

Upon receiving an AFTR tunnel name different from the currently used one, the B4 MUST terminate the current DS-Lite tunnel, and the B4 MUST establish a new DS-Lite tunnel with the specified AFTR.

The DS-Lite-Tunnel-Name RADIUS attribute MAY be present in Accounting-Request records where the Acct-Status-Type is set to Start, Stop, or Interim-Update. The DS-Lite-Tunnel-Name RADIUS attribute MUST NOT appear more than once in a message.

A summary of the DS-Lite-Tunnel-Name RADIUS attribute format is shown below. The fields are transmitted from left to right.



Type:

144 for DS-Lite-Tunnel-Name.

Length:

This field indicates the total length in octets of this attribute including the Type and Length fields, and the length in octets of the DS-Lite-Tunnel-Name field.

DS-Lite-Tunnel-Name:

This field contains a single FQDN of the remote tunnel endpoint, located at the DS-Lite AFTR.

As the DS-Lite-Tunnel-Name attribute is used to populate the DHCPv6 OPTION_AFTR_NAME option, the DS-Lite-Tunnel-Name field is formatted as required in DHCPv6 (Section 8 of [RFC3315] -- "Representation and Use of Domain Names"). Briefly, the format described is using a single octet noting the length of one DNS label (limited to at most 63 octets), followed by the label contents. This repeats until all labels in the FQDN are exhausted, including a terminating zero-length label. Any updates to Section 8 of [RFC3315] also apply to the encoding of this field.

The data type of the DS-Lite-Tunnel-Name RADIUS attribute is a string with opaque encapsulation, according to Section 5 of [RFC2865].

5. Table of Attributes

The following tables provide a guide to which attributes may be found in which kinds of packets, and in what quantity.

Access-Request	Access-Accept	Access-Reject	Challenge	Accounting-Request	#	Attribute
0-1	0-1	0	0	0-1	144	DS-Lite-Tunnel-Name

CoA-Request	CoA-ACK	CoA-NACK	#	Attribute
0-1	0	0	144	DS-Lite-Tunnel-Name

The following table defines the meaning of the above table entries.

0	This attribute MUST NOT be present in the packet.
0+	Zero or more instances of this attribute MAY be present in the packet.
0-1	Zero or one instance of this attribute MAY be present in the packet.

6. Security Considerations

This document has no additional security considerations beyond those already identified in [RFC2865] for the RADIUS protocol and in [RFC5176] for CoA messages.

[RFC6333] discusses security issues related to Dual-Stack Lite.

7. IANA Considerations

Per this document, IANA has allocated a new RADIUS attribute type from the IANA registry "Radius Attribute Types" located at http://www.iana.org/assignments/radius-types.

DS-Lite-Tunnel-Name - 144

8. References

8.1. Normative References

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[RFC2865] Rigney, C., Willens, S., Rubens, A., and W. Simpson, "Remote Authentication Dial In User Service (RADIUS)", RFC 2865, June 2000.

[RFC3315] Droms, R., Ed., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", RFC 3315, July 2003.

[RFC5080] Nelson, D. and A. DeKok, "Common Remote Authentication Dial In User Service (RADIUS) Implementation Issues and Suggested Fixes", RFC 5080, December 2007.

[RFC6333] Durand, A., Droms, R., Woodyatt, J., and Y. Lee, "Dual-Stack Lite Broadband Deployments Following IPv4 Exhaustion", RFC 6333, August 2011.

[RFC6334] Hankins, D. and T. Mrugalski, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Option for Dual-Stack Lite", RFC 6334, August 2011.

8.2. Informative References

[RADIUS-IPv6] Lourdelet, B., Dec, W., Ed., Sarikaya, B., Zorn, G., and D. Miles, "RADIUS attributes for IPv6 Access Networks", Work in Progress, November 2011.

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