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RADIUS Attribute for 6rd

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Status of this Memo

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Abstract

IPv6 Rapid Deployment (6rd) is one of the most popular methods to provide both IPv4 and IPv6 connectivity services simultaneously during the IPv4/IPv6 co-existing period. The Dynamic Host Configuration Protocol (DHCP) 6rd option has been defined to configure 6rd Customer Edge (CE). However, in many networks, the configuration information may be stored in Authentication Authorization and Accounting (AAA) servers while user configuration is mainly from Broadband Network Gateway (BNG) through DHC protocol. This document defines a Remote Authentication Dial In User Service (RADIUS) attribute that carries 6rd configuration information from AAA server to BNG.

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1. Introduction

Recently providers start to deploy IPv6 and consider how to transit to IPv6. IPv6 Rapid Deployment (6rd) [RFC5969] is one of the most popular methods to provide both IPv4 and IPv6 connectivity services simultaneously during the IPv4/IPv6 co-existing period. 6rd is used to provide IPv6 connectivity service through legacy IPv4-only infrastructure. 6rd adopts Dynamic Host Configuration Protocol (DHCP) as auto-configuring protocol. The 6rd Customer Edge (CE) uses the DHCP extension option to discover 6rd border relay and to configure IPv6 prefix and address.

In many networks, user configuration information may be managed by AAA (Authentication, Authorization, and Accounting) servers. Current AAA servers communicate using the Remote Authentication Dial In User Service (RADIUS) [RFC2865] protocol. In a fixed line broadband network, the Broadband Network Gateways (BNGs) act as the access gateway of users. The BNGs are assumed to embed a DHCP server function that allows them to locally handle any DHCP requests issued by hosts.

Since the 6rd configuration information is stored in AAA servers and user configuration is mainly through DHC protocol between BNGs and hosts/CEs, new RADIUS attributes are needed to propagate the information from AAA servers to BNGs.

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 6rd CE and 6rd Border Relay are defined in [RFC5969].

3. IPv6 6rd Configuration with RADIUS

The below Figure 1 illustrates how the RADIUS protocol and DHCP cooperate to provide 6rd CE with 6rd configuration information.

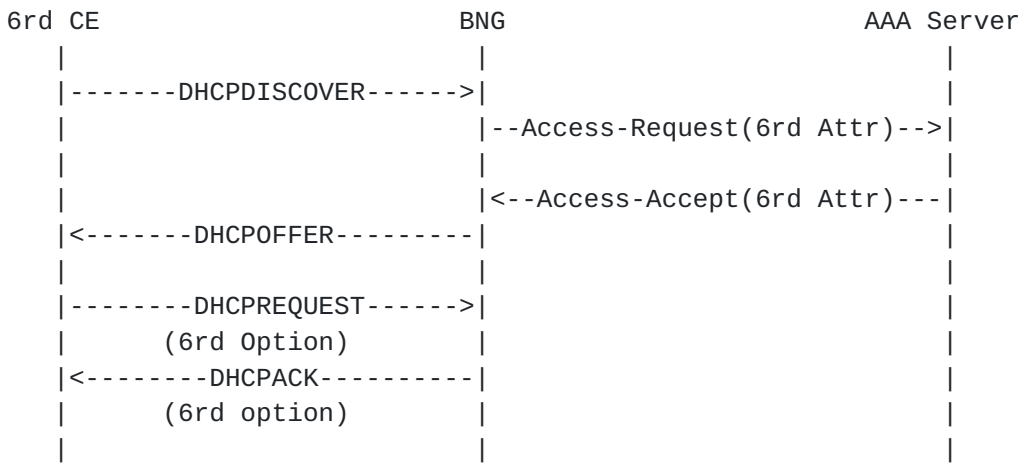


Figure 1: the cooperation between DHCP and RADIUS

BNGs act as a client of RADIUS and as a DHCP server for DHC protocol. First, a BNG receives a DHCPDISCOVER from the 6rd CE. It initiates the BNG to request correspondent user authentication relevant from an AAA server using RADIUS protocol. A 6rd configuration request may also be sent in the same message. If the user authentication is approved by the AAA server, an Access-Accept message is acknowledged with the IPv6-6rd-Configuration Attribute, defined in the next Section. After the BNG responds to the user with an Advertise message, the user requests for a 6rd Option. Then, the BNG can reply the user using the DHC protocol.

In the abovementioned scenario, 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.

Figure 2 describes another scenario, in which the authentication operation is not coupled with DHCP. In the authentication stage, the BNG obtains the 6rd configuration information from the AAA server through the RADIUS protocol. When the user requests the 6rd Option, the BNG replies with a 6rd option in DHCPACK.

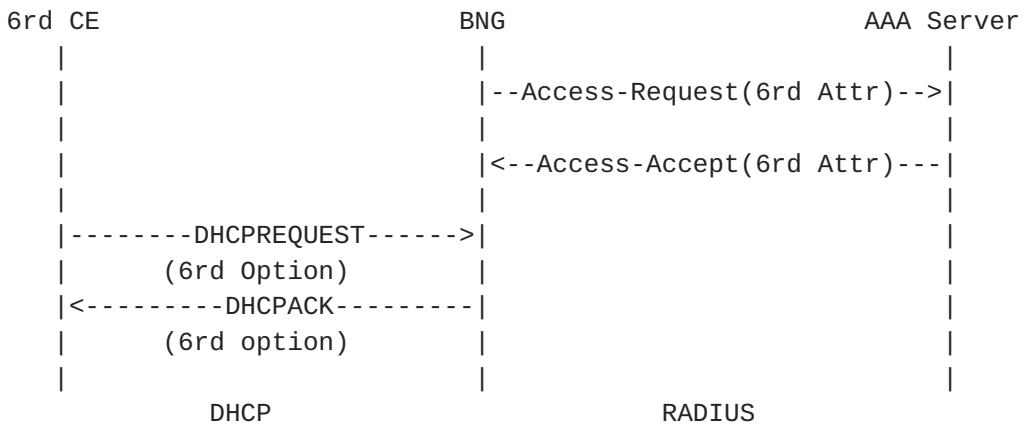


Figure 2: the cooperation between DHCP and RADIUS

After receiving the IPv6-6rd-Configuration Attribute in the initial Access-Accept, the BNG MUST store the received 6rd configuration parameters locally. When the 6rd CE sends a DHCP Request message to request an extension of the lifetime for the assigned address, the BNG does not have to initiate a new Access-Request towards the AAA server to request the 6rd configuration parameters. The BNG retrieves the previously stored 6rd configuration parameters and use them in its reply.

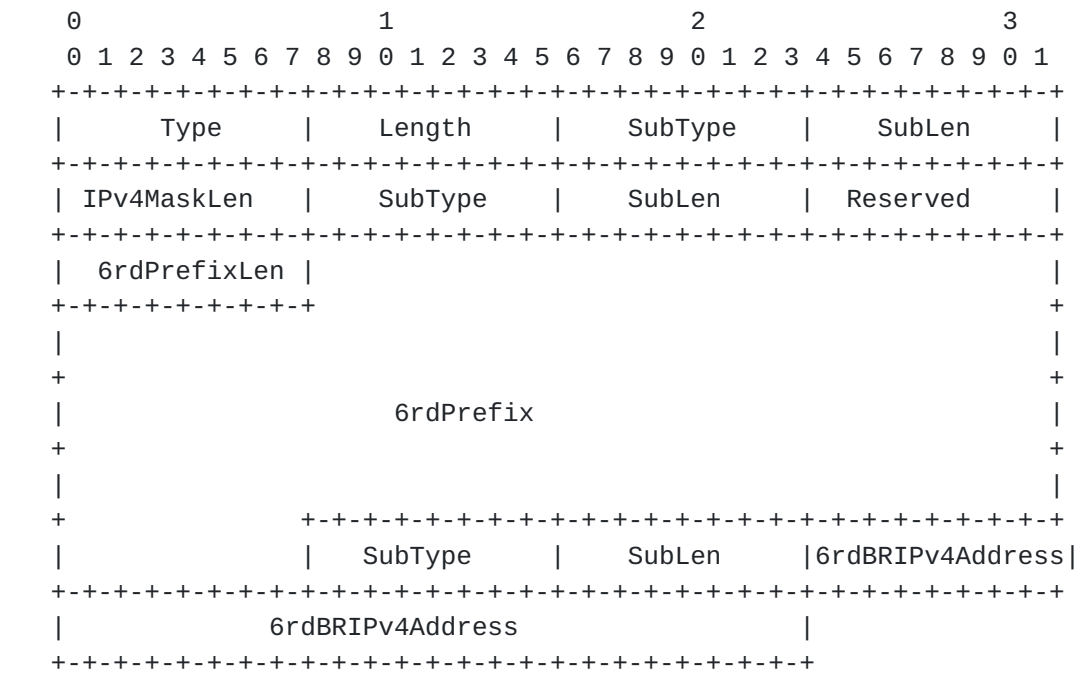
If the DHCP server to which the DHCP Request message was sent at time T1 has not responded, the DHCP client enters the REBINDING state and attempts to contact any server. In this scenario the BNG receiving the DHCP message MUST initiate a new Access-Request towards the AAA server. The BNG MAY include the IPv6-6rd-Configuration Attribute in its Access-Request. If the BNG does not receive the IPv6-6rd-Configuration Attribute in the Access-Accept it MAY fallback to a pre-configured default 6rd configuration, if any. If the BNG does not have any pre-configured default 6rd configuration or if the BNG receives an Access-Reject, the tunnel cannot be established.

4. Attributes

This section defines IPv6-6rd-Configuration Attribute which is used in the 6rd scenario. The attribute design follows [RFC6158].

4.1. IPv6-6rd-Configuration Attribute

The IPv6-6rd-Configuration Attribute is structured as follows (The specification requires that multiple IPv4 addresses are associated strongly with one IPv6 prefix. Given that RADIUS currently has no recommended way of grouping multiple attributes, the below design appears to be a reasonable compromise.):



Type

TBD

Length

25 + n*6 (the length of the entire attribute in octets; n stands the number of BR IPv4 addresses, minimum n is 1).

SubType

1 (SubType number, for the IPv4 Mask Length suboption)

SubLen

3 (the length of the IPv4 Mask Length suboption)

IPv4MaskLen

The number of high-order bits that are identical across all CE IPv4 addresses within a given 6rd domain. This may be any value between 0 and 32. Any value greater than 32 is invalid.

SubType

2 (SubType number, for the 6rd prefix suboption)

SubLen

20 (the length of the 6rd prefix suboption)

Reserved

Set to be all 0 for now. Reserved for the future use. To be compatible with other IPv6 prefix attributes in the RADIUS Protocol.

6rdPrefixLen

The IPv6 Prefix length of the Service Provider's 6rd IPv6 prefix in number of bits. The 6rdPrefixLen MUST be less than or equal to 128.

6rdPrefix

The Service Provider's 6rd IPv6 prefix represented as a 16 octet IPv6 address. The bits after the 6rdPrefixlen number of bits in the prefix SHOULD be set to zero.

SubType

3 (SubType number, for the 6rd Border Relay IPv4 address suboption)

SubLen

6 (the length of the 6rd Border Relay IPv4 address suboption)

6rdBRIPv4Address

One or more IPv4 addresses of the 6rd Border Relay(s) for a given 6rd domain. The maximum RADIUS Attribute length of 255 octets results in a limit of 58 IPv4 addresses.

The IPv6-6rd-Configuration Attribute MAY be used in Access-Request packets as a hint to the RADIUS server; for example if the BNG is pre-configured with a default 6rd configuration, these parameters MAY be inserted in the attribute. The RADIUS server MAY ignore the hint sent by the BNG and it MAY assign different 6rd parameters.

If the BNG includes the IPv6-6rd-Configuration Attribute, but the AAA server does not recognize it, this attribute MUST be ignored by the AAA Server.

If the BNG does not receive IPv6-6rd-Configuration Attribute in the Access-Accept it MAY fallback to a pre-configured default 6rd configuration, if any. If the BNG does not have any pre-configured default 6rd configuration, the 6rd tunnel cannot be established.

If the BNG is pre-provisioned with a default 6rd configuration and the 6rd configuration received in Access-Accept is different from the configured default, then the 6rd configuration received in the Access-Accept message MUST be used for the session.

If the BNG cannot support the received 6rd configuration for any reason, the tunnel SHOULD NOT be established.

4.2. Table of attributes

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

Request	Accept	Reject	Challenge	Accounting Request	#	Attribute
0-1	0-1	0	0	0-1	TBD	IPv6-6rd-Configuration

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

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

5. Diameter Considerations

This attribute is usable within either RADIUS or Diameter [RFC3588]. Since the Attributes defined in this document will be allocated from the standard RADIUS type space, no special handling is required by Diameter entities.

6. Security Considerations

In 6rd scenarios, the RADIUS protocol is run over IPv4. Known security vulnerabilities of the RADIUS protocol are discussed in [RFC2607], [RFC2865], and [RFC2869]. Use of IPsec [RFC4301] for providing security when RADIUS is carried in IPv6 is discussed in [RFC3162].

Security considerations for the Diameter protocol are discussed in [RFC3588].

7. IANA Considerations

This document requires the assignment of one new RADIUS Attribute Types in the "Radius Types" registry (currently located at http://www.iana.org/assignments/radius-types for the following attributes:

- IPv6-6rd-Configuration

IANA should allocate the number from the standard RADIUS Attributes space using the "IETF Review" policy [RFC5226].

8. Acknowledgments

The authors would like to thank Alan DeKok, Yong Cui and other members of Softwire WG for valuable comments.

9. References

9.1. Normative References

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[RFC6158] DeKok, A. and G. Weber, "RADIUS Design Guidelines", RFC 6158, March 2011.

9.2. Informative References

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