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Author: M. Boucadair
Orange

RFC 8983
Internet Key Exchange Protocol Version 2 (IKEv2) Notification Status Types for IPv4/IPv6 Coexistence

Abstract

This document specifies new Internet Key Exchange Protocol Version 2 (IKEv2) notification status types to better manage IPv4 and IPv6 coexistence by allowing the responder to signal to the initiator which address families are allowed.

This document updates RFC 7296.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc8983.

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1. Introduction

As described in [RFC7849], if the subscription data or network configuration allows only one IP address family (IPv4 or IPv6), the cellular host must not request a second PDP-Context (Section 3.2 of [RFC6459]) to the same Access Point Name (APN) for the other IP address family (AF). The Third Generation Partnership Project (3GPP) network informs the cellular host about allowed Packet Data Protocol (PDP) types by means of Session Management (SM) cause codes. In particular, the following cause codes can be returned:

cause #50 "PDP type IPv4 only allowed": This cause code is used by the network to indicate that only PDP type IPv4 is allowed for the requested Public Data Network (PDN) connectivity.

cause #51 "PDP type IPv6 only allowed": This cause code is used by the network to indicate that only PDP type IPv6 is allowed for the requested PDN connectivity.

cause #52 "single address bearers only allowed": This cause code is used by the network to indicate that the requested PDN connectivity is accepted with the restriction that only single IP version bearers are allowed.

If the requested IPv4v6 PDP-Context is not supported by the network but IPv4 and IPv6 PDP types are allowed, then the cellular host will be configured with an IPv4 address or an IPv6 prefix by the network. It must initiate another PDP-Context activation of the other address family in addition to the one already activated for a given APN. The purpose of initiating a second PDP-Context is to achieve dual-stack connectivity (that is, IPv4 and IPv6 connectivity) by means of two PDP-Contexts.

When the User Equipment (UE) attaches to the 3GPP network using a non-3GPP access network (e.g., Wireless Local Area Network (WLAN)), there are no equivalent IKEv2 capabilities [RFC7296] notification codes for the 3GPP network to inform the UE why an IP address family is not assigned or whether that UE should retry with another address family.

This document fills that void by introducing new IKEv2 notification status types for the sake of deterministic UE behaviors (Section 4).

These notification status types are not specific to 3GPP architectures but can be used in other deployment contexts. Cellular networks are provided as an illustration example.

2. Terminology

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.

This document makes use of the terms defined in [RFC7296]. In particular, readers should be familiar with "initiator" and "responder" terms used in that document.

3. Why Not INTERNAL_ADDRESS_FAILURE?

The following address assignment failures may be encountered when an initiator requests assignment of IP addresses/prefixes:

- An initiator asks for IPvx, but IPvx address assignment is not supported by the responder.
- An initiator requests both IPv4 and IPv6 addresses, but only IPv4 address assignment is supported by the responder.
- An initiator requests both IPv4 and IPv6 addresses, but only IPv6 prefix assignment is supported by the responder.
- An initiator asks for both IPv4 and IPv6 addresses, but only one address family can be assigned by the responder for policy reasons.

Section 3.15.4 of [RFC7296] defines a generic notification error type (INTERNAL_ADDRESS_FAILURE) that is related to a failure to handle an address assignment request. The responder sends INTERNAL_ADDRESS_FAILURE only if no addresses can be assigned. This behavior does not explicitly allow an initiator to determine why a given address

family is not assigned, nor whether it should try using another address family. INTERNAL_ADDRESS_FAILURE is a catch-all error type when an address-related issue is encountered by an IKEv2 responder.

INTERNAL_ADDRESS_FAILURE does not provide sufficient hints to the IKEv2 initiator to adjust its behavior.

4. IP6_ALLOWED and IP4_ALLOWED Status Types

IP6_ALLOWED and IP4_ALLOWED notification status types (see Section 7) are defined to inform the initiator about the responder's address family assignment support capabilities and to report to the initiator the reason why an address assignment failed. These notification status types are used by the initiator to adjust its behavior accordingly (Section 5).

No data is associated with these notifications.

5. Update to RFC 7296

If the initiator is dual stack (i.e., supports both IPv4 and IPv6), it **MUST** include configuration attributes for both address families in its configuration request (absent explicit policy/configuration otherwise). More details about IPv4 and IPv6 configuration attributes are provided in Section 3.15 of [RFC7296]. These attributes are used to infer the requested/assigned AFs listed in Table 1.

The responder **MUST** include the IP6_ALLOWED and/or IP4_ALLOWED notification status type in a response to an address assignment request as indicated in Table 1.

Requested AF(s) (Initiator)	Supported AF(s) (Responder)	Assigned AF(s) (Responder)	Returned Notification Status Type(s) (Responder)
IPv4	IPv6	None	IP6_ALLOWED
IPv4	IPv4	IPv4	IP4_ALLOWED
IPv4	IPv4 and IPv6	IPv4	IP4_ALLOWED, IP6_ALLOWED
IPv6	IPv6	IPv6	IP6_ALLOWED
IPv6	IPv4	None	IP4_ALLOWED
IPv6	IPv4 and IPv6	IPv6	IP4_ALLOWED, IP6_ALLOWED
IPv4 and IPv6	IPv4	IPv4	IP4_ALLOWED
IPv4 and IPv6	IPv6	IPv6	IP6_ALLOWED

Requested AF(s) (Initiator)	Supported AF(s) (Responder)	Assigned AF(s) (Responder)	Returned Notification Status Type(s) (Responder)
IPv4 and IPv6	IPv4 and IPv6	IPv4 and IPv6	IP4_ALLOWED, IP6_ALLOWED
IPv4 and IPv6	IPv4 or IPv6 (policy based)	IPv4 or IPv6	IP4_ALLOWED, IP6_ALLOWED

Table 1: Returned Notification Status Types

If the initiator only receives one single IP4_ALLOWED or IP6_ALLOWED notification from the responder, the initiator **MUST NOT** send a subsequent request for an alternate address family not supported by the responder.

If a dual-stack initiator requests only an IPv6 prefix (or an IPv4 address) but only receives an IP4_ALLOWED (or IP6_ALLOWED) notification status type from the responder, the initiator **MUST** send a request for IPv4 address(es) (or IPv6 prefix(es)).

If a dual-stack initiator requests both an IPv6 prefix and an IPv4 address but receives an IPv6 prefix (or an IPv4 address) only with both IP4_ALLOWED and IP6_ALLOWED notification status types from the responder, the initiator **MAY** send a request for the other AF (i.e., IPv4 address (or IPv6 prefix)). In such case, the initiator **MUST** create a new IKE Security Association (SA) and request another address family using the new IKE SA.

For other address-related error cases that have not been covered by the aforementioned notification status types, the responder/initiator **MUST** follow the procedure defined in Section 3.15.4 of [RFC7296].

6. Security Considerations

Since the IPv4/IPv6 capabilities of a node are readily determined from the traffic it generates, this document does not introduce any new security considerations compared to the ones described in [RFC7296], which continue to apply.

7. IANA Considerations

IANA has updated the "IKEv2 Notify Message Types - Status Types" registry (available at <https://www.iana.org/assignments/ikev2-parameters/>) with the following status types:

Value	NOTIFY MESSAGES - STATUS TYPES	Reference
16439	IP4_ALLOWED	RFC 8983

Value	NOTIFY MESSAGES - STATUS TYPES	Reference
16440	IP6_ALLOWED	RFC 8983

Table 2: Updates to "IKEv2 Notify Message Types - Status Types" Registry

8. References

8.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

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[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

8.2. Informative References

[RFC6459] Korhonen, J., Ed., Soininen, J., Patil, B., Savolainen, T., Bajko, G., and K. Iisakkila, "IPv6 in 3rd Generation Partnership Project (3GPP) Evolved Packet System (EPS)", RFC 6459, DOI 10.17487/RFC6459, January 2012, <https://www.rfc-editor.org/info/rfc6459>.

[RFC7849] Binet, D., Boucadair, M., Vizdal, A., Chen, G., Heatley, N., Chandler, R., Michaud, D., Lopez, D., and W. Haeffner, "An IPv6 Profile for 3GPP Mobile Devices", RFC 7849, DOI 10.17487/RFC7849, May 2016, <https://www.rfc-editor.org/info/rfc7849>.

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Author's Address

Mohamed Boucadair
Orange
35000 Rennes
France
Email: mohamed.boucadair@orange.com