

Network Working Group
Internet-Draft
Updates: [7296](#) (if approved)
Intended status: Standards Track
Expires: April 24, 2019

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October 21, 2018

IKEv2 Notification Codes for IPv4/IPv6 Coexistence
draft-ietf-ipsecme-ipv6-ipv4-codes-00

Abstract

This document specifies new IKEv2 notification codes to better manage IPv4 and IPv6 co-existence.

This document updates [RFC7296](#).

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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 to the same APN for the other IP address family. 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:

- o 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.
- o 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.
- o 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 Access Point Name (APN). The purpose of initiating a second PDP-Context is to achieve dual-stack connectivity by means of two PDP-Contexts.

According to 3GPP specifications (TS.24302), when the UE attaches the network using a WLAN access by means of IKEv2 capabilities [[RFC7296](#)], there are no equivalent notification codes to inform the User

Equipment (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 codes for the sake of deterministic UE behaviors.

These notification codes 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?

[Section 3.15.4 of \[RFC7296\]](#) defines a generic notification code that is related to a failure to handle an internal address failure. That code 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 code 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. An Update to [RFC7296](#)

The following notification codes are defined:

- o UNSUPPORTED_AF: This code indicates that the requested address family (IPv4 or IPv6) is not supported. Subsequent exchanges with the remote peer MUST NOT include any object of that address family.
- o IP6_ONLY_SUPPORTED: This code indicates that only IPv6 is supported. Subsequent exchanges with the remote peer MUST NOT include any IPv4-related object.

Concretely, if the initiator requests both IPv4 and IPv6 addresses/prefixes, the responder replies with IPv6 address(es)/prefix(es) and the IP6_ONLY_SUPPORTED notification code. If the initiator requests only IPv4 address(es) but gets the IP6_ONLY_SUPPORTED notification code from the responder, the IPv6-capable initiator should request IPv6 address(es) only in subsequent requests.

- o IP4_ONLY_SUPPORTED: This code indicates that only IPv4 is supported. Subsequent exchanges with the remote peer MUST NOT include any IPv6-related object.

Concretely, if the initiator requests both IPv4 and IPv6 addresses/prefixes, the responder replies with IPv4 address(es) and the IP4_ONLY_SUPPORTED notification code. If the initiator requests only IPv6 address(es) and gets the IP4_ONLY_SUPPORTED notification code from the responder, the IPv4-capable initiator should request IPv4 address(es) only in subsequent requests.

- o SINGLE_AF_SUPPORTED: This code indicates that only a single address family can be assigned per request, not both. This code is returned when an initiator requested both IPv4 and IPv6 addresses/prefixes in the same request, but only a single address family can be assigned per request by the responder.

The address family preference is defined by a policy that is local to the responder.

If a responder receives a request for both IPv4 and IPv6 address families, it replies with the preferred address family and includes SINGLE_AF_SUPPORTED notification code. Upon receipt of this code, the initiator MAY re-issue another configuration request to ask for an additional address family.

For other address-related error cases that have not been covered by the aforementioned notification codes, the repsonder/initiator MUST follow the procedure defined in [Section 3.15.4 of \[RFC7849\]](#).

5. Security Considerations

This document adheres to the security considerations defined in [\[RFC7849\]](#) and [\[RFC7296\]](#).

6. IANA Considerations

This document requests IANA to update the "IKEv2 Notify Message Types - Error Types" registry available at:

<https://www.iana.org/assignments/ikev2-parameters/ikev2-parameters.xhtml> with the following codes:

Value	NOTIFY MESSAGES - ERROR TYPES	Reference
TBD	UNSUPPORTED_AF	[This-Document]
TBD	IP6_ONLY_SUPPORTED	[This-Document]
TBD	IP4_ONLY_SUPPORTED	[This-Document]
TBD	SINGLE_AF_SUPPORTED	[This-Document]

7. Acknowledgements

Many thanks to Christian Jacquenet for the review.

Thanks to Paul Wouters and Yaov Nir for the comments.

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>>.
- [RFC7296] Kaufman, C., Hoffman, P., Nir, Y., Eronen, P., and T. Kivinen, "Internet Key Exchange Protocol Version 2 (IKEv2)", STD 79, [RFC 7296](#), DOI 10.17487/RFC7296, October 2014, <<https://www.rfc-editor.org/info/rfc7296>>.
- [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

- [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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