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IKEv2 Notification Status Types for IPv4/IPv6 Coexistence
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Abstract

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

This document updates [RFC7296](#).

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Table of Contents

1.	Introduction	2
2.	Terminology	3
3.	Why Not INTERNAL_ADDRESS_FAILURE?	3
4.	IP6_ALLOWED and IP4_ALLOWED Status Types	4
5.	An Update to RFC7296	4
6.	Security Considerations	6
7.	IANA Considerations	6
8.	Acknowledgements	6
9.	References	6
9.1.	Normative References	6
9.2.	Informative References	6
	Author's Address	7

[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 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:

- 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 APN. The purpose of initiating a second PDP-Context is to achieve dual-stack connectivity by means of two PDP-Contexts.

Boucadair

Expires October 31, 2019

[Page 2]

When the User Equipment (UE) attaches the network using a Wireless Local Area Network (WLAN) access by means of Internet Key Exchange Protocol Version 2 (IKEv2) capabilities [[RFC7296](#)], there are no equivalent notification codes 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:

- o An initiator asks for IPvx, but IPvx address assignment is not supported by the responder.
- o An initiator requests both IPv4 and IPv6 addresses, but only IPv4 address assignment is supported by the responder.
- o An initiator requests both IPv4 and IPv6 addresses, but only IPv6 prefix assignment is supported by the responder.
- o 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 that is related to a failure to handle an address assignment request. That error type 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` 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. An Update to [RFC7296](#)

If the initiator is dual-stack, it **MUST** include both address families in its request (absent explicit policy/configuration otherwise).

The responder **MUST** include `IP6_ALLOWED` and/or `IP4_ALLOWED` 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
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 notification IP4_ALLOWED or IP6_ALLOWED from the responder, the initiator MUST NOT send a 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 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 that 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 repsonder/initiator MUST follow the procedure defined in [Section 3.15.4 of \[RFC7296\]](#).

6. Security Considerations

This document adheres to the security considerations defined in [RFC7296].

7. IANA Considerations

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

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

Value	NOTIFY MESSAGES - STATUS TYPES	Reference
TBD	IP4_ALLOWED	[This-Document]
TBD	IP6_ALLOWED	[This-Document]

8. Acknowledgements

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9. References

9.1. Normative References

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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>>.

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

Boucadair

Expires October 31, 2019

[Page 6]

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