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**ICMP Locator Update message
draft-rja-ilnp-icmp-11.txt**

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This document has had extensive review within the IRTF Routing Research Group, and is part of the ILNP document set. ILNP is one of the recommendations made by the RG Chairs. Separately, various refereed research papers on ILNP have also been published during this decade. So the ideas contained herein have had much broader review than the IRTF Routing RG. The views in this document were considered controversial by the Routing RG, but the RG reached a consensus that the document still should be published. The Routing RG has had remarkably little consensus on anything, so virtually all Routing RG outputs are considered controversial.

Abstract

This note specifies an experimental ICMPv6 message type used with the Identifier-Locator Network Protocol (ILNP). This message is used to dynamically update Identifier/Locator bindings for an existing ILNP session. This is a product of the IRTF Routing RG.

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1. Introduction

At present, the research and development community are examining various alternatives for evolving the Internet Architecture. Several different classes of evolution are being considered. One class is often called "Map and Encapsulate", where traffic would be mapped and then tunnelled through the inter-domain core of the Internet.

Another class being considered is sometimes known as "Identifier/Locator Split". This document relates to a proposal that is in the latter class of evolutionary approaches. In particular, the Identifier-Locator Network Protocol being described in this document and related Internet-Drafts is an evolution of IPv6. [ILNP-Intro] [[ILNP-Nonce](#)] [[ILNP-DNS](#)] [[RFC 2460](#)]

The new ICMPv6 Locator Update message described in this document enables an ILNP-capable node to update its correspondents about the currently valid set of Locators valid to use in reaching the node sending this message.

This new ICMPv6 message MUST NOT be used for IP sessions operating in classic IPv6 mode. This ICMPv6 message MUST ONLY be used for IP sessions that are operating in Identifier/Locator Split mode. Authentication is always required, as described in the Security Considerations section later in this note.

Some might consider any and all use of ICMP to be undesirable. In that context, please note that while this specification uses ICMP, there is no architectural difference between using ICMP and using some different framing, for example UDP.

1.1 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 [RFC 2119](#). [[RFC 2119](#)]

2. Syntax

Example ICMP message body for case where only 1 Locator value is being indicated:

```

-----
| ICMP Type | ICMP Code | Checksum |
+-----+-----+-----+
| Num of Locs | RESERVED | Preference |
+-----+-----+-----+
/                               /
+-----+-----+-----+

```

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Example ICMP message body for case where 2 Locator values are being indicated:

```

-----
|  ICMP Type  |  ICMP Code   |          Checksum          |
+-----+-----+-----+-----+
| Num of Locs |   RESERVED   |      Preference            |
+-----+-----+-----+-----+
/                               /
+-----+-----+-----+-----+
|   RESERVED   |      Preference            |
+-----+-----+-----+-----+
/                               /
+-----+-----+-----+-----+

```

For cases where more than 2 Locator values are being indicated, the "RESERVED", "Preference", and "Locator" fields are appended as appropriate to carry the intended number of Locator fields.

- ICMP Type: This 8-bit field is set to the value XXX to indicate that this is a Locator Update message.
- ICMP Code: This 8-bit field indicates which kind of ICMP Locator Update this is. At present, the only valid value is 0, which means that this message contains all currently valid Locator values for the sending node.
- Checksum: This contains the ICMPv6 Checksum value for this packet.
- Num of Locs: This field contains the number of 64-bit Locators that follow the RESERVED field. This field must not contain the number zero, as each ILNP node needs to be reachable via at least 1 Locator value. Multi-homed nodes will have at least 2 Locator values.
- Reserved: These fields MUST be sent as zero. At this time, recipients should ignore the contents of these field, as these bits are reserved for future use. (Implementers should understand that these fields might be used in the future.)
- Locator: This 64-bit field contains a valid Locator

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that can be used to reach the sending node. A variable number of Locator fields are concatenated one after another. These are listed in priority order, with the first Locator field containing the most preferred Locator value.

Preference: A 16-bit unsigned integer which specifies the preference given to this Locator among other Locators in the same ICMP message. Lower Preference values are preferred over higher Preference values.

NOTE: In order to prevent session stealing by an off-path adversary, all ICMP Locator Update packets MUST also contain an ILNP Nonce Destination Option with valid authentication information for the session associated with the ICMP Locator Update packet. The ILNP Nonce Destination Option is required in all cases, even if some other authentication mechanism (e.g. IP Authentication Header) is also in use.[\[RFC 4302\]](#)

3. Transport Protocol Effects

This message has no impact on any transport protocol.

The message may affect where packets for a given transport session are sent, but one of the design objectives for the I/L Split Mode (i.e. ILNP) is to decouple transport-protocols from network-layer changes.

4. Implementation Considerations

Implementers may use any internal implementation they wish, provided that the external appearance is the same as this implementation approach.

To support the Identifier/Locator Split operating mode, and retain the incremental deployability and backwards compatibility needed, the network layer needs a mode bit in the Transport Control Block (or its equivalent) to track which IP sessions are using the classic IPv6 mode and which IP sessions are using the Identifier/Locator Split mode.

Further, when in the Identifier/Locator Split mode, nodes will need to retain a Correspondent Cache in the network layer that contains for each correspondent node:

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- Source Identifier(s) in use
- Source Locator(s) in use
- Destination Identifier(s) in use
- Destination Locator(s) in use
- Session Nonce value from Local Node to Correspondent Node
- Session Nonce value from Correspondent Node to Local Node

Please also read the discussion of this Correspondent Cache in the companion document [[ILNP-Intro](#)].

A node sending an ICMP Locator Update message will include all currently valid Locator values in that message. A node receiving a valid ICMP Locator Update message MUST replace the previously current set of Locator values for that correspondent node in the ILNP Correspondent Cache with the newly received set of Locator values.

Every implementation needs to support a large number of Locator values being sent or received in a single ICMP Locator Update message, because a multi-homed node or multi-homed site might have a large number of upstream links to different service providers, each with its own Locator value.

5. Backwards Compatibility

For all sessions operating in Identifier/Locator Split mode, inside each node the high-order 64-bits ("Locator") are always set to zero before the packet is sent upwards to the transport protocol. So any changes in Locator values used on the wire will be invisible to the transport protocol. In this mode, transport-layer checksums (e.g. TCP pseudo-header checksum) will be calculated with both Source Locator and Destination Locator fields set to all zero.

For recipient nodes or sessions operating in the classic IPv6 mode or otherwise not in the Identifier/Locator Split mode, the ICMP Locator Update packet MUST be discarded by the recipient without being processed.

6. Security Considerations

The ICMP Locator Update message MUST ONLY be used for IP sessions operating in the Identifier/Locator Split mode.

The experimental Nonce Destination Option [[ILNP-Nonce](#)] MUST be

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present in packets containing an ICMPv6 Locator Update message. Further, the received Nonce Destination Option must contain the correct nonce value for the packet to be accepted by the recipient and then passed to the ICMPv6 protocol for processing. If either of these requirements are not met, the received packet MUST be discarded as not authentic, and a security event SHOULD be logged by the system receiving the non-authentic packet.

For sessions operating in higher risk environments, the use of the IP Authentication Header *in addition* to the experimental Nonce Destination Option is recommended. Use of the IP Authentication Header to protect a packet does NOT permit the packet to be sent without the Nonce Destination Option.

A broader discussion of ILNP Security Considerations is found in [[ILNP-Intro](#)], and is incorporated here by reference.

Implementations need to support the case where a single ICMP Locator Update message contains a large number of Locator and Preference values and ought not develop a security fault (e.g. stack overflow) due to a received message containing more Locator values than expected.

7. IANA Considerations

IANA is requested to assign a value, replacing the XXX, to the ICMP Type listed in [Section 2](#), following the procedures in [[RFC 4443](#)].

There are no other IANA actions for this document.

8. References

8.1. Normative References

- [RFC 2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC 2460] S. Deering & R. Hinden, "Internet Protocol Version 6 Specification", [RFC-2460](#), December 1998.
- [RFC 4302] S. Kent, "IP Authentication Header", [RFC 4302](#), December 2005.

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- [RFC 4443] A. Conta, S. Deering, and M. Gupta (Ed.),
"Internet Control Message Protocol (ICMPv6)
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Specification", [RFC 4443](#), March 2006.

8.2. Informative References

- [ILNP-Intro] Atkinson, R, "ILNP Concept of Operations",
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- [ILNP-DNS] Atkinson, R, "DNS Resource Records for ILNP",
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- [ILNP-Nonce] Atkinson, R, "Nonce Destination Option",
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