Internet Draft
draft-irtf-rrg-ilnp-icmpv6-06.txt
Category: Experimental
Expires: 10 JAN 2013

RJ Atkinson
Consultant
SN Bhatti
U. St Andrews

10 July 2012

ICMP Locator Update message for ILNPv6
draft-irtf-rrg-ilnp-icmpv6-06.txt

Status of this Memo

Abstract

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

Table of Contents

1. INTRODUCTION

At present, the Internet research and development community are exploring various approaches to evolving the Internet Architecture to solve a variety of issues including, but not limited to, scalability of inter-domain routing [RFC4984]. A wide range of other issues (e.g. site multi-homing, node multi-homing, site/subnet mobility, node mobility) are also active concerns at present. Several different classes of evolution are being considered by the Internet research & development community. 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.

1.1 Document Roadmap

This document describes a new IPv6 Nonce Destination Option used by ILNPv6 nodes (1) to indicate to ILNP correspondent nodes (by inclusion within the initial packets of an ILNP session) that the node is operating in the ILNP mode and (2) to prevent off-path attacks against ILNP ICMP messages. This Nonce is used, for example, with all ILNP ICMPv6 Locator Update messages that are exchanged among ILNP correspondent nodes.

The ILNP architecture can have more than one engineering instantiation. For example, one can imagine a "clean-slate" engineering design based on the ILNP architecture. In separate documents, we describe two specific engineering instances of ILNP. The term ILNPv6 refers precisely to an instance of ILNP that is based upon, and backwards compatible with, IPv6. The term ILNPv4 refers precisely to an instance of ILNP that is based upon, and backwards compatible with, IPv4.

Many engineering aspects common to both ILNPv4 and ILNPv6 are described in [ILNP-ENG]. A full engineering specification for either ILNPv6 or ILNPv4 is beyond the scope of this document.

Readers are referred to other related ILNP documents for details not described here:

a) [ILNP-ARCH] is the main architectural description of ILNP,

including the concept of operations.

b) [ILNP-ENG] describes engineering and implementation considerations that are common to both ILNPv4 and ILNPv6.

c) [ILNP-DNS] defines additional DNS resource records that support ILNP.

d) [ILNP-ICMPv6] defines a new ICMPv6 Locator Update message used by an ILNP node to inform its correspondent nodes of any changes to its set of valid Locators.

e) [ILNP-ICMPv4] defines a new ICMPv4 Locator Update message used by an ILNP node to inform its correspondent nodes of any changes to its set of valid Locators.

f) [ILNP-v4OPTS] defines a new IPv4 Nonce Option used by ILNPv4 nodes to carry a security nonce to prevent off-path attacks against ILNP ICMP messages and also defines a new IPv4 Identifier Option used by ILNPv4 nodes.

g) [ILNP-ARP] describes extensions to ARP for use with ILNPv4.

h) [ILNP-ADV] describes optional engineering and deployment functions for ILNP. These are not required for the operation or use of ILNP and are provided as additional options.

1.2 ICMPv6 Locator Update

As described in [ILNP-ARCH] and [ILNP-ENG], an ILNP for IPv6 (ILNPv6) node might need to inform correspondent ILNPv6 nodes of changes to the set of valid Locator values. 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 [RFC2460] [RFC4443].

This new ICMPv6 message MUST ONLY be used for ILNPv6 sessions. 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, on grounds that this is a control message, there is no architectural difference between using ICMP and using some different framing, for example UDP.

1.3 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 [RFC2119].

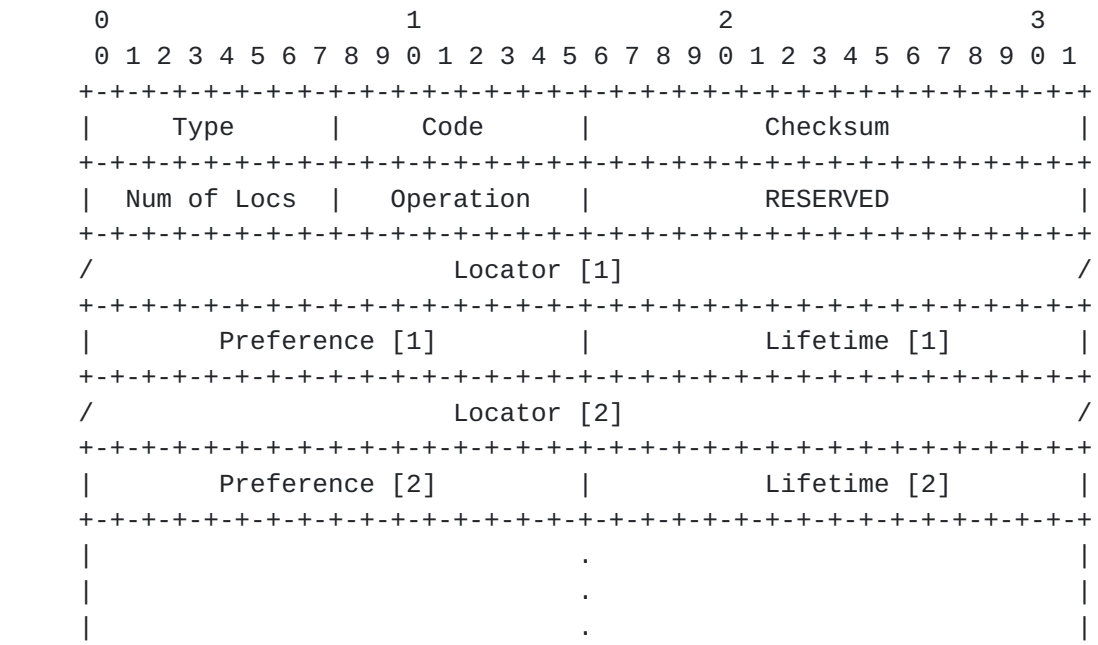
2. Syntax

The ICMP for IPv6 message described in this section has ICMP Type XXX and is used ONLY with a current ILNPv6 session. This message enables an ILNPv6 node to inform ILNPv6 correspondent nodes of changes to the active Locator set for the ILNPv6 node that originates this message. This particular ICMP for IPv6 message MUST ONLY be used with ILNPv6 sessions.

The ICMP for IPv6 message described in this section has ICMP Type XXX and is used ONLY with a current ILNPv4 session. This message enables an ILNPv6 node to advertise changes to the active Locator set for the ILNPv6 node that originates this message to its unicast ILNP correspondent nodes. It also enables those correspondents to acknowledge receipt of the advertisement.

This particular ICMP for IPv6 message MUST ONLY be used with ILNPv6 sessions. The Checksum field for this message is calculated identically as for any other IPv6 ICMP message.

ICMPv6 Locator Update message



ICMPv6 Locator Update fields:

Type	XXX
Code	0
Checksum	The 16-bit one's complement of the one's complement sum of the ICMP message, starting with the ICMP Type. For computing the checksum, the Checksum field is set to 0.
Num of Locs	The number of 64-bit Locator values that are advertised in this message. This field MUST NOT be zero.
Locator[i], i = 1..Num of Locs	The 64-bit Locator values currently valid for the sending ILNPv6 node.
Preference[i], i = 1..Num of Locs	The preferability of each Locator[i], relative to other valid Locator[i] values. The Preference numbers here are identical, both in syntax and semantics, to the Preference values for L64 records as specified by [ILNP-DNS].
Lifetime[i] i = 1..Num of Locs	The maximum number of seconds that this particular Locator may be considered valid. Normally, this is identical to the DNS lifetime of the corresponding L64 record, if one exists.
Operation	The value in this field indicates whether this is a Locator Update Advertisement (0x01) or a Locator Update Acknowledgement (0x02).
RESERVED	A field reserved for possible future use. At present, the sender MUST initialise this field to zero. Receivers should ignore this field at present. The field might be used for some protocol function in future.

The Operation field has value 1 (hexadecimal 0x01) for a Locator Update Advertisement. The Operation field has value 2 (hexadecimal

0x02) for a Locator Update Acknowledgement. All other values of the Operation field are reserved for future use by future revisions of this specification.

A node whose set of valid Locators has changed MUST send Locator Update Advertisement messages to each correspondent node for each active unicast ILNP session. For unicast ILNP sessions, the receiver of a valid (e.g. authentication checks all passed, advertisement is received from a current correspondent node) Locator Update Advertisement addressed to the receiver MUST send a Locator Update Acknowledgement back to the sender of the Locator Update Advertisement. The Acknowledgement message body is identical to the received Advertisement message body, except for the Operation value.

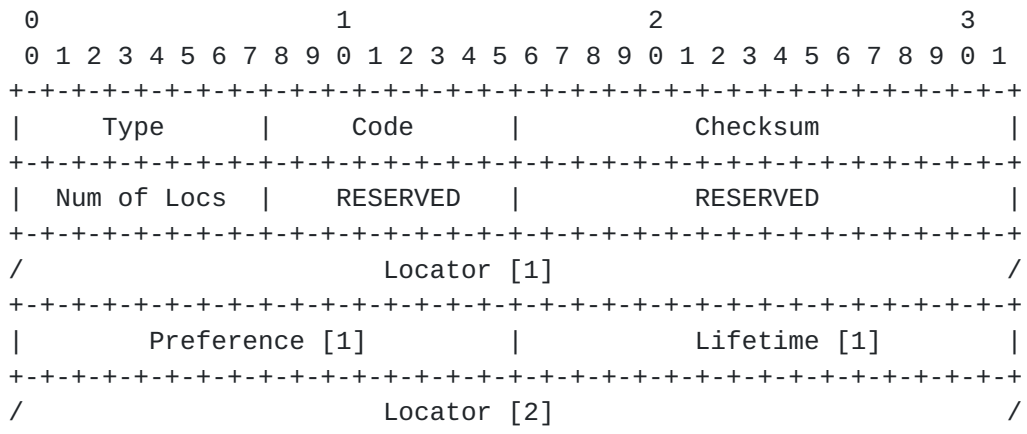
All ILNPv6 ICMP Locator Update messages MUST contain a valid ILNPv6 Identifier option and MUST contain an ILNPv6 Nonce Option.

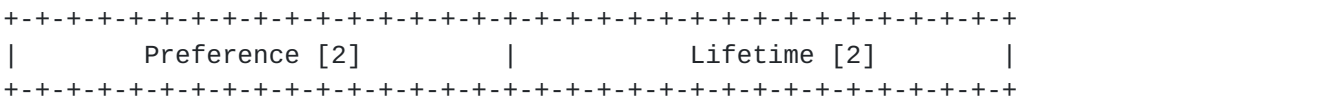
ILNPv6 ICMP Locator Update messages also MAY be protected using IP Security for ILNP [ILNP-ENG] [RFC4301]. Deployments in high-threat environments SHOULD also protect ILNPv6 ICMP Locator Update messages using IP Security. While IPsec ESP can protect a payload, no form of IPsec ESP is able to protect an IPv6 option that appears prior to the ESP header.

Note that even when IP Security for ILNP is in use, the ILNP Nonce Option still MUST be present. This simplifies protocol processing, and it also means that a receiver can perform the inexpensive check of the Nonce value before performing any (potentially expensive) cryptographic calculation.

2.1 Example ICMPv6 Locator Update message

This example shows the ICMPv6 syntax for the case where 2 Locator values are being indicated.





3. Transport Protocol Effects

This message has no impact on any transport protocol.

The message may affect where packets for a given transport-layer session are sent, but an ILNP design objective is to decouple transport-layer protocols and transport-layer session information 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 ILNPv6, and to 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 supporting ILNPv4, nodes will need to support an Identifier Locator Communication Cache (ILCC) in the network layer as described in [ILNP-ENG].

A node sending an ICMP Locator Update message MUST 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 its own ILCC 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

This IPv6 ICMP message uses the same checksum calculations as any other IPv6 ICMP message.

When ILNPv6 is not in use, the receiving IPv6 mode MUST discard the ICMP Locator Update packet without processing the packet. This is standard behaviour for a non-ILNPv6 node when receiving an ICMPv6 message with an unknown header field value.

6. Security Considerations

Security considerations for the overall ILNP Architecture are described in [ILNP-ARCH]. Additional common security considerations are described in [ILNP-ENG]. This section describes security considerations specific to ILNPv6 topics discussed in this document.

The ICMPv6 Locator Update message MUST ONLY be used for ILNPv6 sessions.

The ILNP Nonce Destination Option [ILNP-NONCEv6] MUST be 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 a forgery, and a security event SHOULD be logged by the system receiving the non-authentic packet.

ILNP sessions operating in higher risk environments SHOULD use IP Security for ILNP [ILNP-ENG] [RFC4301] *in addition* to the ILNPv6 Nonce Destination Option. Use of IP Security for ILNP to protect a packet does NOT permit the packet to be sent without the Nonce Destination Option.

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.

If the ILNP Nonce value is predictable, then an off-path attacker might be able to forge data or control packets. This risk also is mitigated by the existing common practice of IP Source Address filtering [RFC2827] [RFC3704].

7. IANA Considerations

Subject to IESG Approval, consistent with the procedures of [RFC4443], IANA is requested to assign a value, replacing the XXX, to the ICMP Type listed in Section 2.

There are no other IANA actions for this document.

8. References

This document contains both normative and informative references.

8.1. Normative References

[ILNP-ARCH] R.J. Atkinson & S.N. Bhatti, "ILNP Architecture", draft-irtf-rrg-ilnp-arch, May 2012.

[ILNP-DNS] R.J. Atkinson & S.N. Bhatti, "DNS Resource Records for ILNP", draft-irtf-rrg-ilnp-dns, May 2012.

[ILNP-ENG] R.J. Atkinson & S.N. Bhatti, "ILNP Engineering Considerations", draft-irtf-rrg-ilnp-eng, May 2012.

[ILNP-NONCEv6] R.J. Atkinson & S.N. Bhatti, "Nonce Destination Option", draft-irtf-rrg-ilnp-noncev6, May 2012.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2460] S. Deering & R. Hinden, "Internet Protocol Version 6 Specification", RFC 2460, December 1998.

[RFC3704] F. Baker, P. Savola, "Ingress Filtering for Multihomed Networks", RFC 3704, March 2004.

[RFC4301] S. Kent & K. Seo, "Security Architecture for the Internet Protocol", RFC 4301, December 2005.

[RFC4443] A. Conta, S. Deering, and M. Gupta (Ed.), "Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification", RFC 4443, March 2006.

[ILNP-ARCH] R.J. Atkinson & S.N. Bhatti, "ILNP Architectural Description", draft-irtf-rrg-ilnp-arch, 10 July 2012.

[ILNP-ENG] R.J. Atkinson & S.N. Bhatti, "ILNP Engineering and Implementation Considerations", draft-irtf-rrg-ilnp-eng, 10 July 2012.

[ILNP-ICMPv6] R.J. Atkinson & S.N. Bhatti,
"ICMPv6 Locator Update message"
draft-irtf-rrg-ilnp-icmpv6, 10 July 2012.

[ILNP-NONCEv6] R.J. Atkinson & S.N. Bhatti,
"IPv6 Nonce Destination Option for ILNPv6",
draft-irtf-rrg-ilnp-noncev6, 10 July 2012.

8.2. Informative References

[RFC2827] P. Ferguson and D. Senie, "Network Ingress
Filtering: Defeating Denial of Service Attacks
which employ IP Source Address Spoofing",
RFC 2827, May 2000.

[ILNP-ADV] R.J. Atkinson & S.N. Bhatti,
"Optional Advanced Deployment Scenarios for ILNP",
draft-irtf-rrg-ilnp-adv, 10 July 2012.

[ILNP-ARP] R.J. Atkinson & S.N. Bhatti, "ARP Extension for
ILNPv4", draft-irtf-rrg-ilnp-arp, 10 July 2012.

[ILNP-DNS] R.J. Atkinson, S.N. Bhatti, & S Rose,
"DNS Resource Records for ILNP",
draft-irtf-rrg-ilnp-dns, 10 July 2012.

[ILNP-ICMPv4] R.J. Atkinson & S.N. Bhatti,
"ICMPv4 Locator Update message"
draft-irtf-rrg-ilnp-icmpv4, 10 July 2012.

[ILNP-v4OPTS] R.J. Atkinson & S.N. Bhatti,
"IPv4 Options for ILNP",
draft-irtf-rrg-ilnp-v4opts, 10 July 2012.

ACKNOWLEDGEMENTS

Steve Blake, Stephane Bortzmeyer, Mohamed Boucadair, Noel Chiappa, Wes George, Steve Hailes, Joel Halpern, Mark Handley, Volker Hilt, Paul Jakma, Dae-Young Kim, Tony Li, Yakov Rehkter, Bruce Simpson, Robin Whittle and John Wroclawski (in alphabetical order) provided review and feedback on earlier versions of this document. Steve Blake provided an especially thorough review of an early version of the entire ILNP document set, which was extremely helpful. We also wish to thank the anonymous reviewers of the various ILNP papers for their feedback.

Roy Arends provided expert guidance on technical and procedural

aspects of DNS issues.

RFC EDITOR NOTE

This section is to be removed prior to publication.

Please note that this document is written in British English, so British English spelling is used throughout. This is consistent with existing practice in several other RFCs, for example RFC-5887.

This document tries to be very careful with history, in the interest of correctly crediting ideas to their earliest identifiable author(s). So in several places the first published RFC about a topic is cited rather than the most recent published RFC about that topic.

Author's Address

RJ Atkinson
Consultant
San Jose, CA
95125 USA

Email: rja.lists@gmail.com

SN Bhatti
School of Computer Science
University of St Andrews
North Haugh, St Andrews,
Fife, Scotland, UK
KY16 9SX

Email: saleem@cs.st-andrews.ac.uk

Expires: 10 JAN 2013