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         Survey Report on PIM-SM Implementations and Deployments
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Abstract

   This document provides supporting documentation to advance the
   Protocol Independent Multicast - Sparse Mode (PIM-SM)
   protocol from IETF Proposed Standard to Internet Standard.

Status of this Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

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   Task Force (IETF). Note that other groups may also distribute
   working documents as Internet-Drafts. The list of current Internet-
   Drafts is at http://datatracker.ietf.org/drafts/current/.

   Internet-Drafts are draft documents valid for a maximum of six months
   and may be updated, replaced, or obsoleted by other documents at any
   time. It is inappropriate to use Internet-Drafts as reference
   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on October 23, 2013.

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1. Motivation

1.1. Overview of PIM-SM

   PIM-SM was first published as [RFC2117] in 1997 and then again as
   [RFC2362] in 1998. The protocol was classified as Experimental in
   both of these documents. The PIM-SM protocol specification was then
   rewritten in whole and advanced to Proposed Standard as [RFC4601] in
   2006. Considering its multiple independent implementations developed
   and sufficient successful operational experience gained, the IETF has
   decided to advance the PIM-SM protocol to Internet Standard.

1.2.   RFC2026 and RFC6410 Requirements

   [RFC2026] defines the stages in the standardization process, the
   requirements for moving a document between stages and the types of
   documents used during this process. Section 4.1.2 of [RFC2026]
   states that:"The requirement for at least two independent and
   interoperable implementations applies to all of the options and
   features of the specification. In cases in which one or more options
   or features have not been demonstrated in at least two interoperable
   implementations, the specification may advance to the Draft Standard
   level only if those options or features are removed."

   [RFC6410] updates the Internet Engineering Task Force (IETF)
   Standards Process defined in [RFC2026]. Primarily, it reduces the
   Standards Process from three Standards Track maturity levels to two.
   The second maturity level is a merger of Draft Standard and Standard
   as specified in [RFC2026]. Section 2.2 of [RFC6410] states that:"(1)
   There are at least two independent interoperating implementations
   with widespread deployment and successful operational experience. (3)
   There are no unused features in the specification that greatly
   increase implementation complexity."

   Optional features which do not meet the foresaid criteria has been
   identified by the PIM Working Group and will be removed. This
   document intends to provide supporting documentation to advance the
   Protocol Independent Multicast - Sparse Mode (PIM-SM)
   protocol from IETF Proposed Standard to Draft Standard.

2. Survey on Implementations and Deployments

2.1. Methodology

   A questionnaire had been issued by the PIM WG co-chairs and announced
   widely to the vendors and operational community to obtain information
   on PIM-SM implementations and deployments. The Survey concluded on
   22nd Oct 2012. The responses will be kept strictly confidential and
   only combined results will be published. The raw questionnaire will
   be shown in Appendix A, and a detailed summary of the responses will
   be included in the following section.

2.2. Operator Responses

   Nine operators responded to the survey. They are SWITCH, National
   Research Council Canada, South Dakota School of Mines and Technology,
   Motorola Solutions and five other anonymous operators.

2.2.1. Description of PIM Sparse-Mode deployments

   In the last fourteen years, PIM-SM has been deployed for a wide
   variety of applications: Campus, Enterprise, Research and WAN
   networks, Broadband ISP and Digital TV. There are five deployments
   based on [RFC4601]implementation and two on [RFC2362]
   implementations. PIM-SM for IPv6 has been deployed by three
   operators. Out of the nine operators, six have deployed PIM-SM
   implementations from multiple vendors.

   Operators reported minor inter-operability issues and these were
   addressed by the vendors. There was no major inter-operability
   concern reported by the operators.

2.2.2. PIM Sparse-Mode deployment with other multicast technologies

   Except for one deployment of PIM Sparse-Mode with Multicast OSPF
   (MOSPF), all other operators have deployed PIM-SM exclusively. No
   operators acknowledged deployments of either (*,*,RP) or PIM Multicast
   Border Route (PMBR) for inter-connection between PIM Sparse-Mode and
   other multicast domains.

2.2.3. PIM Sparse-Mode RPs and RP Discovery mechanisms

   The number of Sparse-Mode RPs deployed by operators range from a few
   (up to sixteen) to a massively scaled number (four hundred). Both
   static configuration and Bootstrap Router (BSR) have been deployed as
   RP discovery mechanisms.

   Anycast-RP has been deployed for RP redundancy. Two operator have

deployed Anycast-RP using MSDP ([RFC 3446](#)). Three operators have deployed Anycast-RP using both MSDP ([RFC 3446](#)) and PIM ([RFC 4610](#)) for different scenarios. The best common practice seems to be to use static-RP configuration with Anycast-RP for redundancy.

2.3. Vendor Responses

Eight vendors have reported PIM Sparse-Mode implementations. They are XORP, Huawei Technologies, Cisco Systems, Motorola Solutions, Juniper Networks and three other anonymous vendors.

2.3.1. RFC4601 and RFC2362 implementations

Four vendors have reported PIM Sparse-Mode implementations based on [RFC 4601](#) and two have reported PIM Sparse-Mode implementations based on [RFC 2362](#). Two other reported implementations are hybrid.

Minor inter-operability issues have been addressed by the vendors over the years and no concern was reported by any vendor.

2.3.2. Lack of (*,*,RP) and PMBR implementations

Most vendors have not implemented (*,*,RP) state as specified in [RFC4601] either due to lack of deployment requirements or due to security concerns. Similarly, most vendors have also not implemented PMBR due to lack of deployment requirements or because it was considered to be too complex and non-scalable.

Only one vendor, XORP, reported (*,*,RP) and PMBR implementation and they were implemented just because these were part of the [RFC4601] specification.

2.3.3. Implementations of other features of RFC4601

Most vendors have implemented all of the following from [RFC4601] specifications:

- SSM

- Join Suppression

- Explicit tracking

- Register mechanism

- SPT switchover at last-hop router

- Assert mechanism

   - Hashing of group to RP mappings

   Some vendors do not implement explicit tracking and SSM.

2.4. Key Findings

   1. PIM Sparse-Mode has been widely implemented and deployed for
   different applications. The PIM Sparse-Mode protocol is sufficiently
   well specified in RFC 4601 resulting in inter-operable implementation
   deployed by operators.

   2. There are no deployments and only one known implementation of
   (*,*,RP) and PMBR as specified in RFC 4601. Hence, it is necessary
   to remove these features from the specification as required by
   [RFC2026] and [RFC6410]

3. Security Considerations

   This document does not directly affect the security of the Internet.

4. **IANA Considerations**

   This document makes no request of the IANA.

5. Acknowledgements

The authors would like to thanks Tim Chown and Bill Atwood who had
helped to collect and anonymize the responses as the neutral third-
party. Special thanks are also given to Alexander Gall, William F
Maton Sotomayor, Steve Bauer, Sonum Mathur, Pavlin Radoslavov, Shuxue
Fan, Sameer Gulrajani and to the anonymous responders.

6. **Appendix A**. Questionnaire

   This appendix reproduces a questionnaire that was made available for
   operators and vendors to express their experience and considerations.

6.1. **Appendix A.1** PIM Survey for Operators

   Introduction:

   PIM-SM was first published as RFC2117 in 1997 and then again as
   RFC2362 in 1998. The protocol was classified as Experimental in both
   of these documents. The PIM-SM protocol specification was then
   rewritten in whole and advanced to Proposed Standard as RFC4601 in
   2006. Considering the multiple independent implementations developed
   and the successful operational experience gained, the IETF has
   decided to advance the PIM-SM routing protocol to Draft Standard.
   This survey intends to provide supporting documentation to advance
   the Protocol Independent Multicast - Sparse Mode (PIM-SM) routing
   protocol from IETF Proposed Standard to Draft Standard. (Due to
   RFC6410, now the intention is to progress it to Internet Standard.
   Draft Standard is no longer used.)

   This survey is issued on behalf of the IETF PIM Working Group.

   The responses will be collected by a neutral third-party and kept
   strictly confidential if requested in the response; only the final
   combined results will be published. Tim Chown and Bill Atwood have
   agreed to anonymize the response to this Questionnaire. They have a
   long experience with multicast but have no direct financial interest
   in this matter, nor ties to any of the vendors involved. Tim is
   working at University of Southampton, UK, and he has been active in
   the IETF for many years, including the mboned working group, and he
   is a co-chair of the 6renum working group. Bill is at Concordia
   University, Montreal, Canada, and he has been an active participant
   in the IETF pim working group for over ten years, especially in the
   area of security.

   Please send questionnaire responses addressed to them both. The
   addresses are tjc@ecs.soton.ac.uk and william.atwood@concordia.ca.
   Please include the string "RFC4601 bis Questionnaire" in the subject
   field.

   Before answering the questions, please complete the following
   background information.

   Name of the Respondent:

   Affiliation/Organization:

Contact Email:

Provide description of PIM deployment:

Do you wish to keep the information provided confidential:

Questions:

1 Have you deployed PIM-SM in your network?

2 How long have you had PIM-SM deployed in your network? Do you know
if your deployment is based on the most recent RFC4601?

3 Have you deployed PIM-SM for IPv6 in your network?

4 Are you using equipment with different (multi-vendor) PIM-SM
implementations for your deployment?

5 Have you encountered any inter-operability or backward-
compatibility issues amongst differing implementations? If yes, what
are your concerns about these issues?

6 Have you deployed both dense mode and sparse mode in your network?
If yes, do you route between these modes using features such as
,,RP or PMBR?

7 To what extent have you deployed PIM functionality, like BSR, SSM,
and Explicit Tracking?

8 Which RP mapping mechanism do you use: Static, AutoRP, or BSR?

9 How many RPs have you deployed in your network?

10 If you use Anycast-RP, is it Anycast-RP using MSDP (RFC 3446) or
Anycast-RP using PIM (RFC4610)?

11 Do you have any other comments on PIM-SM deployment in your
network?

6.2. Appendix A.2 PIM Survey for Implementors

Introduction:

PIM-SM was first published as RFC2117 in 1997 and then again as
RFC2362 in 1998. The protocol was classified as Experimental in both
of these documents. The PIM-SM protocol specification was then
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area of security.

Please send questionnaire responses addressed to them both. The
addresses are tjc@ecs.soton.ac.uk and william.atwood@concordia.ca.
Please include the string "RFC 4601 bis Questionnaire" in the subject
field.

Before answering the questions, please complete the following
background information.

Name of the Respondent:

Affiliation/Organization:

Contact Email:

Provide description of PIM implementation:

Do you wish to keep the information provided confidential:

Questions:

1 Have you implemented PIM-SM?

2 Is the PIM-SM implementation based on RFC2362 or RFC4601?

3 Have you implemented (*,*, RP) state of RFC4601? What is the

rationale behind implementing or omitting (*,*,RP)?

4 Have you implemented the PMBR as specified in RFC4601 and RFC2715? What is the rationale behind implementing or omitting PMBR?

5 Have you implemented other features and functions of RFC4601:

- SSM

- Join Suppression

- Explicit tracking

- Register mechanism

- SPT switchover at last-hop router

- Assert mechanism

- Hashing of group to RP mappings

6 Does your PIM-SM implementation support IPv6?

7 Have you encountered any inter-operability issues with other PIM implementations in trials or in the field?

8 Do you have any other comments or concerns about PIM-SM as specified in RFC4601?

7. References

7.1. Normative References

[RFC4601] Fenner, B., Handley, M., Holbrook, H., and I. Kouvelas,
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7.2. Informative References

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           October 2011.

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