                   A Distributed NHRP Service Using SCSP

Status of this Memo

   This document specifies an Internet standards track protocol for the
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   Official Protocol Standards" (STD 1) for the standardization state
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Abstract

   This document describes a method for distributing an NHRP service
   within a LIS [1]. This method uses the Server Cache Synchronization
   Protocol (SCSP) [2] to synchronize the client information databases
   held by NHRP Servers (NHSs) within a LIS.

1. Introduction

   The keywords MUST, MUST NOT, REQUIRED, SHALL, SHALL NOT, SHOULD,
   SHOULD NOT, RECOMMENDED, MAY, and OPTIONAL, when they appear in this
   document, are to be interpreted as described in [4].

   NHRP Clients (NHCs) register their existence and reachability
   information with NHRP Servers (NHSs). There may be multiple NHSs in
   a given Logical IP Subnet (LIS). NHCs do not necessarily register
   with all NHSs in a LIS; however, all NHCs need to be able to query at
   least one NHS about any NHC within the LIS. Thus, the contents of
   the NHS databases in a LIS need to be synchronized across the LIS.
   The Server Cache Synchronization Protocol (SCSP) solves the
   generalized server synchronization/cache-replication problem for
   distributed databases and thus SCSP may be applied to the NHS
   database synchronization problem within the LIS.

SCSP is defined in two parts: the protocol independent part and the
client/server protocol specific part. The protocol independent part
is defined in [2] whereas this document will specify the
client/server protocol specific part where NHRP is the client/server
protocol.

This document is separate from [2] because it was felt that it was
desirable to allow the client/server protocol specific part
specification for NHRP to progress independently from the protocol
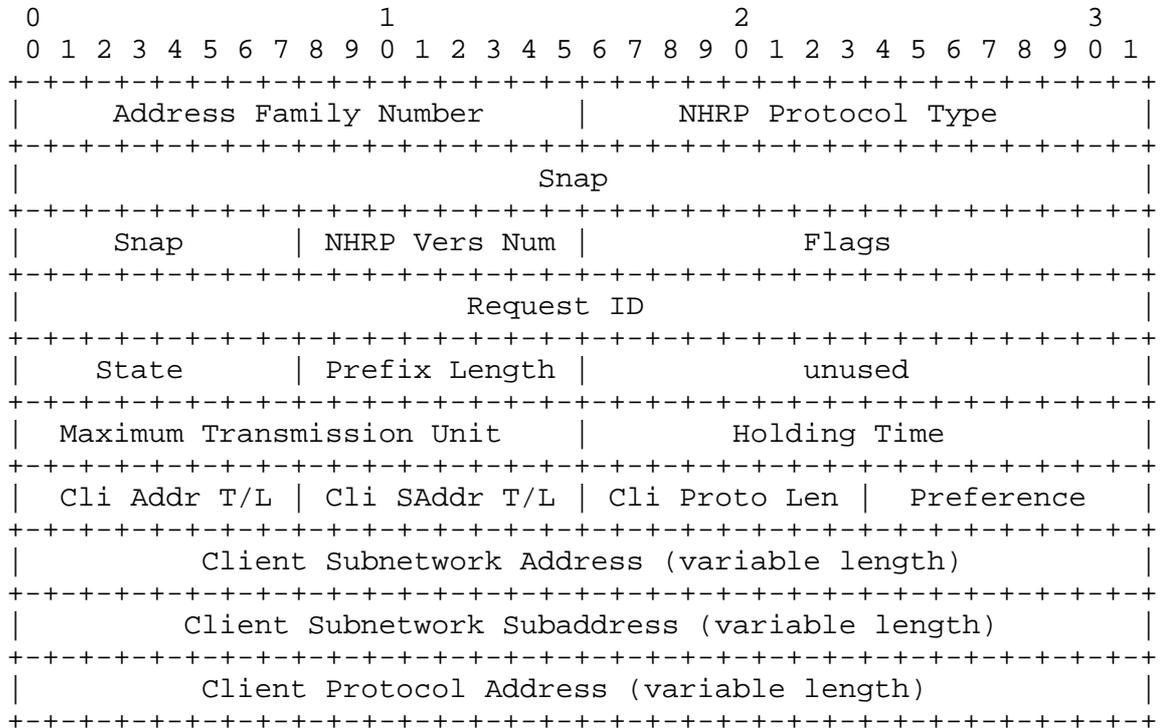independent specification.

2. Overview

All NHSs belonging to a Logical IP Subnet (LIS) [1] are said to
belong to a Server Group (SG). An SG is identified by, not
surprisingly, its SGID which is contained in a field in all SCSP
packets. All SCSP packets contain a Protocol ID (PID) field as well.
This PID field is set to 0x0002 to signify that SCSP synchronizing
NHS databases as opposed to synchronizing some other protocol's
databases (see Section B.2.0.1 of [2] for more details). In general,
PIDs for SCSP will be assigned by IANA as described in Section C of
[2]. In the case of NHRP, the client/server protocol specific
specification was initially written at the same time as SCSP, and
thus a PID=0x0002 was assigned by the author.

SCSP places no topological requirements upon an NHRP SG. Obviously,
however, the resultant graph of NHSs must span the set of NHSs to be
synchronized. For more information about the client/server protocol
independent part of SCSP, the reader is encouraged to see [2].

When a SG is using SCSP for synchronization, an NHC will register
with only one NHS, but the NHC MAY use any NHS in the SG. When an
NHC wishes to leave a SG, the NHC MUST do one of the following: 1)
the NHC MUST send an NHRP Purge Request for itself requesting a
reply, and it MUST wait for an NHRP Purge Reply, 2) the NHC MUST keep
the Request ID it used when registering itself in non-volatile RAM
and use a Request ID larger than the one saved when re-registering,
or 3) the NHC MUST not re-register for a time equal to the Holding
Time specified in the previous registration. It is necessary to do
one of the previous in order to prevent the unlikely case of race
conditions from occurring during updated. In the case where method 2
is used, the NHS with which the NHC registered uses its ID as the OID
and the Request ID from the NHC as the CSA Sequence Number in the
CSA(S) Record.

3. Format of the CSA Record NHRP Specific Part

   CSA Records in SCSP contain a "Client/Server Protocol Specific Part"
   which contains the non-protocol independent information for a given
   server's cache entry.

```
       0                   1                   2                   3
       0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |      Address Family Number      |     NHRP Protocol Type      |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                              Snap                             |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |     Snap        | NHRP Vers Num |            Flags            |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |                           Request ID                         |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |     State       | Prefix Length |            unused           |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |   Maximum Transmission Unit     |         Holding Time        |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      | Cli Addr T/L | Cli SAddr T/L | Cli Proto Len |   Preference   |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |         Client Subnetwork Address (variable length)          |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |        Client Subnetwork Subaddress (variable length)        |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |          Client Protocol Address (variable length)          |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The following six fields contain values specified in the common
   header of the mandatory part of an NHRP Registration Request or NHRP
   Purge Request packet which caused the
   creation/deletion/modification/update/etc. of an NHS's cache entry.

   Address Family Number
      Defines the type of "link layer" addresses being carried. This
      number is taken from the 'address family number' list specified in
      [3]. This field is the same field which would be supplied in an
      NHRP packet in the ar$afn field.

   NHRP Protocol Type
      This field is the same field which would be supplied in an NHRP
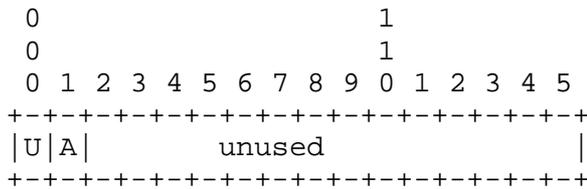   packet in the ar$pro.type field.

   Snap
      This field is the same field which would be supplied in an NHRP
      packet in the ar$pro.snap field.

NHRP Vers Num
   This field indicates what version of generic address mapping and
   management protocol that is represented by this message. This
   field contains 0x01 for the NHRP protocol version 1. This field is
   the same field which would be supplied in an NHRP packet in the
   ar$op.version field.

Flags
   Defined flags are as follows:

```
    0                   1
    0                   1
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |U|A|        unused             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   U
     This is the Uniqueness bit.

   A
     When set, this bit specifies that the cache entry was created
     as a result of ATMARP client interaction with the NHS.

Request ID
   This field contains the Request ID value placed in the cache entry
   of the NHS as a result of an NHRP Registration Request. This NHS
   is the NHS causing a synchronization event.

State
   This field contains a value which represents the new state of the
   client.

      0 - Client is registered and available.
      1 - Client reregistered.
      2 - Client has been purged.
      3 - No such client data in server cache

   Note that a time-out of a cache entry does not cause a CSA Record
   to be sent because, if everything is working properly then all NHSs
   have the cache entry timing out at the same time. Thus, the
   individual NHSs would take the appropriate actions necessary.

The following ten fields contain values specified in or derived from
the CIE of an NHRP Registration Request or NHRP Purge Request packet
which caused the creation/deletion/modification/update/etc. of an
NHS's cache entry.

   Prefix Length
     This field contains the internetwork layer address prefix length
     value covered by the cache entry being synchronized.

   Maximum Transmission Unit
     This field contains a value supplied by or derived from information
     in the CIE of the NHRP Registration Request packet.

   Holding Time
     The Holding Time field specifies the number of seconds remaining
     for which the Next Hop NBMA information specified in the CIE of the
     NHRP Registration Request is considered to be valid by the NHS
     initiating the synchronization event.

   Cli Addr T/L
     Type & length of next hop NBMA address (see [1]).

   Cli SAddr T/L
     Type & length of next hop NBMA subaddress (see [1]).

   Cli Proto Len
     This field holds the length in octets of the Client Protocol
     Address.

   Preference
     This field specifies the preference value for use of the next hop
     NBMA information specified.

   Client NBMA Address
     This is the client's NBMA address.

   Client NBMA SubAddress
     This is the client's NBMA subaddress.

   Client Protocol Address
     This is the client's internetworking layer address.

4. Values for SCSP Protocol Independent Part

   The following sections give values for fields of the SCSP Protocol
   Independent Part of the various SCSP messages.

4.1 Values for the SCSP "Mandatory Common Part"

   Protocol ID = 0x0002
   Sender ID Len = 0x04
   Recvr ID Len = 0x04

   See Section B.2.0.1 of [2] for a detailed description of these
   fields.

4.2 Values for the SCSP "CSAS Record"

   Cache Key Len = 0x04
   Orig ID Len = 0x04

   See Section B.2.0.2 of [2] for a detailed description of these
   fields.

5. Security Considerations

   Relevant security considerations are documented in [1] and [2].

References

   [1] Luciani, J., Katz, D., Piscitello, D., Cole, B., and N.
   Doraswamy, "NMBA Next Hop Resolution Protocol (NHRP)", RFC 2332,
   April 1998.

   [2] Luciani, J., Armitage, G., Halpern, J., and N. Doraswamy, "Server
   Cache Synchronization Protocol (SCSP)", RFC 2334, April 1998.

   [3] Reynolds, J., and J. Postel, "Assigned Numbers", STD 2, RFC 1700,
   October 1994.

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

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