Applicability of Reliable Server Pooling for SCTP-Based Endpoint Mobility
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Abstract

   This document describes a novel mobility concept based on a
   combination of SCTP with Dynamic Address Reconfiguration extension
   and Reliable Server Pooling (RSerPool).

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1. Introduction

An increasing amount of Internet devices is getting mobile.
Therefore, there is a growing demand for software solutions allowing
for a seamless handover of communication sessions between multiple
networks, e.g. to allow for a laptop or PDA to use a fast Ethernet
connection when available, hand over to a WLAN when moving and hand
over again to UMTS when the WLAN becomes unreachable - without
interrupting the running communication sessions.

Mobility handling is a deficiency of the common IP-based networks.
Most of the available solutions are based on the network layer. The
disadvantage of such solutions is that fundamental changes in the
network infrastructure are needed. Therefore, we propose a new
solution based on the upper layers to overcome these disadvantages.
In this document, we present our mobility solution based on the SCTP
protocol with Dynamic Address Reconfiguration extension and Reliable
Server Pooling (RSerPool).

2. Existing Mobility Solutions

2.1. Mobile IP and Mobile IPv6

In the concept of Mobile IP [RFC5944] every node must register to a
Home-Agent (HA) in its own home network. Then, the nodes are
reachable under their home addresses managed by the HA. When a node
leaves its home network, it must also register at a Foreign Agent
(FA) in the new network. After that, a tunnel is established between
the HA and the FA. Any traffic to the mobile node is then tunnelled
by its HA to the FA and forwarded by the FA to the node itself.

Clearly, the detour of all traffic via HA and FA is inefficient and
results in an increased transmission delay.

Mobile IPv6 [RFC6275] is an extension of Mobile IP. In Mobile IPv6,
the FA is not needed. The packets will be tunnelled from the HA to
the Gateway Router in the foreign network, which forwards the packets
to the endpoint. The inefficiency due to the detour of traffic as
described for Mobile IP remains.

2.2. SCTP with Dynamic Address Reconfiguration

Using the SCTP protocol (see [RFC4960] together with its Dynamic
Address Reconfiguration extension (Add-IP, see [RFC5061]), it is
possible for a mobile endpoint to inform its peer on address changes.
That is, when a moving mobile client gets in the vicinity of an
additional radio station, it sends an "ASCONF Add Address Request" to
tell its peer that it is now reachable under an additional network-
layer address. After that, the peer endpoint can use this additional
address for a new SCTP path. When the first radio station becomes
unreachable, the node can send an "ASCONF Delete Address Request" to
the peer endpoint. After that, the peer removes the corresponding
SCTP path to the unusable network-layer address.

The following two cases for handovers are possible:

o Make-before-Break: An additional SCTP path can be used before the
   original path becomes unusable. This case is trivial, since there
   is a continuous connectivity.

o Break-before-Make: The original SCTP path becomes unusable before
   a new SCTP path can be used. For the case that only one endpoint
   performs a handover procedure at the same time, the mobile
   endpoint can always use Add-IP to communicate its new address to
   its peer endpoint. However, when both endpoints perform a
   handover simultaneously, no endpoint is able to tell its
   corresponding peer the new address.

3. Solutions for Simultaneous Handovers

3.1. SCTP with Add-IP and Mobile-IP

Using SCTP with Add-IP and Mobile IP/Mobile IPv6, the ASCONF messages
will be sent to the home address of the peer node. That is, even
when both nodes are mobile, each endpoint is able to reach its peer
endpoint using the corresponding home address. However, this
solution still requires the full Mobile IP/Mobile IPv6
infrastructure.

3.2. SCTP with Add-IP and RSerPool

Using RSerPool (see [RFC3237], [RFC5351], [RFC5352], [RFC5353],
[RFC5354], [RFC5355], [RFC5356]), at least one node registers as a
Pool Element (PE) at an ENRP server under a Pool Handle (PH) known to
both endpoints. Upon handover, it is simply necessary for the PE
endpoint to re-register, i.e. to update its registration with its new
address. The other endpoint can - in the role of a Pool User (PU) -
ask an ENRP server for its peer node's new addresses. After the new
address is known, it is able to create a new SCTP path and continue
the communication.

The usage of RSerPool to provide support for mobile endpoints
provides the following advantages:

o Simplicity: No Mobile IP/Mobile IPv6 infrastructure is needed. In
   particular, it is not necessary that the providers of used
   networks (e.g. public WLAN access points, UMTS providers, etc.)
   provide any support for the mobility solution.

o Efficiency: No tunnelling of traffic is necessary.

o Applicability: All major SCTP implementations already support the
   Dynamic Address Reconfiguration extension. It is only necessary
   to provide support for RSerPool, e.g. in the form of a userspace
   library, which is much easier to deploy than kernel extensions.

o Flexibility: RSerPool provides a complete session layer. That is,
   providing applications on top of RSerPool makes the support for
   high availability simple.

A more detailed description of our approach for endpoint mobility, as
well as a performance analysis using a prototype implementation, can
be found in our paper [LCN2003].

4. Reference Implementation

The RSerPool reference implementation RSPLIB can be found at
[RSerPool-Website]. It supports the functionalities defined by
[RFC5351], [RFC5352], [RFC5353], [RFC5354] and [RFC5356] as well as
the options [I-D.dreibholz-rserpool-asap-hropt],
[I-D.dreibholz-rserpool-enrp-takeover] and
[I-D.dreibholz-rserpool-delay]. An introduction to this
implementation is provided in [Dre2006].

5. Testbed Platform

A large-scale and realistic Internet testbed platform with support
for the multi-homing feature of the underlying SCTP protocol is
NorNet. A description of NorNet is provided in [PAMS2013-NorNet],
some further information can be found on the project website
[NorNet-Website].

6. Security Considerations

Security considerations for RSerPool systems are described by
[RFC5355].

7. IANA Considerations

This document introduces no additional considerations for IANA.

8. References

8.1. Normative References

[RFC3237] Tuexen, M., Xie, Q., Stewart, R., Shore, M., Ong, L.,
           Loughney, J., and M. Stillman, "Requirements for Reliable
           Server Pooling", RFC 3237, January 2002.

[RFC4960] Stewart, R., "Stream Control Transmission Protocol", RFC
           4960, September 2007.

[RFC5061] Stewart, R., Xie, Q., Tuexen, M., Maruyama, S., and M.
           Kozuka, "Stream Control Transmission Protocol (SCTP)
           Dynamic Address Reconfiguration", RFC 5061, September
           2007.

[RFC5944] Perkins, C., "IP Mobility Support for IPv4, Revised", RFC
           5944, November 2010.

[RFC6275] Perkins, C., Johnson, D., and J. Arkko, "Mobility Support
           in IPv6", RFC 6275, July 2011.

[RFC5351] Lei, P., Ong, L., Tuexen, M., and T. Dreibholz, "An
           Overview of Reliable Server Pooling Protocols", RFC 5351,
           September 2008.

[RFC5352] Stewart, R., Xie, Q., Stillman, M., and M. Tuexen,
           "Aggregate Server Access Protocol (ASAP)", RFC 5352,
           September 2008.

   [RFC5353] Xie, Q., Stewart, R., Stillman, M., Tuexen, M., and A.
              Silverton, "Endpoint Handlespace Redundancy Protocol
              (ENRP)", RFC 5353, September 2008.

   [RFC5354] Stewart, R., Xie, Q., Stillman, M., and M. Tuexen,
              "Aggregate Server Access Protocol (ASAP) and Endpoint
              Handlespace Redundancy Protocol (ENRP) Parameters", RFC
              5354, September 2008.

   [RFC5355] Stillman, M., Gopal, R., Guttman, E., Sengodan, S., and M.
              Holdrege, "Threats Introduced by Reliable Server Pooling
              (RSerPool) and Requirements for Security in Response to
              Threats", RFC 5355, September 2008.

   [RFC5356] Dreibholz, T. and M. Tuexen, "Reliable Server Pooling
              Policies", RFC 5356, September 2008.

   [I-D.dreibholz-rserpool-asap-hropt]
              Dreibholz, T., "Handle Resolution Option for ASAP", draft-
              dreibholz-rserpool-asap-hropt-15 (work in progress), July
              2014.

   [I-D.dreibholz-rserpool-delay]
              Dreibholz, T. and X. Zhou, "Definition of a Delay
              Measurement Infrastructure and Delay-Sensitive Least-Used
              Policy for Reliable Server Pooling", draft-dreibholz-
              rserpool-delay-14 (work in progress), July 2014.

   [I-D.dreibholz-rserpool-enrp-takeover]
              Dreibholz, T. and X. Zhou, "Takeover Suggestion Flag for
              the ENRP Handle Update Message", draft-dreibholz-rserpool-
              enrp-takeover-12 (work in progress), July 2014.

8.2. Informative References

   [Dre2006] Dreibholz, T., "Reliable Server Pooling - Evaluation,
              Optimization and Extension of a Novel IETF Architecture",
              March 2007, <http://duepublico.uni-duisburg-
              essen.de/servlets/DerivateServlet/Derivate-16326/
              Dre2006_final.pdf>.

   [LCN2003] Dreibholz, T., Jungmaier, A., and M. Tuexen, "A New Scheme
              for IP-based Internet Mobility", Proceedings of the 28th
              IEEE Local Computer Networks Conference (LCN), Pages
              99-108, ISBN 0-7695-2037-5, DOI 10.1109/LCN.2003.1243117,
              October 2003, <http://www.tdr.wiwi.uni-
              due.de/fileadmin/fileupload/I-
              TDR/ReliableServer/Publications/LCN2003.pdf>.

[PAMS2013-NorNet]
          Dreibholz, T. and E. Gran, "Design and Implementation of
          the NorNet Core Research Testbed for Multi-Homed Systems",
          Proceedings of the 3nd International Workshop on Protocols
          and Applications with Multi-Homing Support (PAMS), Pages
          1094-1100, ISBN 978-0-7695-4952-1, DOI 10.1109/
          WAINA.2013.71, March 2013, <http://simula.no/publications/
          threfereedinproceedingsreference.2012-12-20.7643198512/
          simula_pdf_file>.

[RSerPool-Website]
          Dreibholz, T., "Thomas Dreibholz's RSerPool Page", Online:
          http://www.iem.uni-due.de/~dreibh/rserpool/, 2013,
          <http://www.iem.uni-due.de/~dreibh/rserpool/>.

[NorNet-Website]
          Dreibholz, T., "NorNet -- A Real-World, Large-Scale Multi-
          Homing Testbed", Online: https://www.nntb.no/, 2014,
          <https://www.nntb.no/>.

Authors' Addresses

   Thomas Dreibholz
   Simula Research Laboratory, Network Systems Group
   Martin Linges vei 17
   1364 Fornebu, Akershus
   Norway

   Phone: +47-6782-8200
   Fax: +47-6782-8201
   Email: dreibh@simula.no
   URI: http://www.iem.uni-due.de/~dreibh/

   Jobin Pulinthanath
   University of Duisburg-Essen, Institute for Experimental Mathematics
   Ellernstrasse 29
   45326 Essen, Nordrhein-Westfalen
   Germany

   Phone: +49-201-1837637
   Fax: +49-201-1837673
   Email: jp@iem.uni-due.de.de