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SHIM - MIPv6 Interaction
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Abstract

In this note, we explore the interaction between the SHIM protocol and MIPv6 protocol, identifying potential benefits and difficulties. The analysis will consider the two modes of operation of MIPv6: the Bidirectional Tunnel (BT) mode where the communication is routed through the Home Agent and the Route Optimization (RO) mode, where the communication flows directly between the Correspondent node and the mobile node.

Table of Contents

1. Introduction 3
2. Bidirectional Tunnel (BT) Mode 4
2.1 Communication between the MN and the CN 4
3. RO mode 5
4. Security considerations 7
5. Normative References 7
Authors' Addresses 7
Intellectual Property and Copyright Statements 8

1. Introduction

SHIM [1] is a host-based mechanism to provide site-multihoming support. In this note, we explore the interaction between the SHIM protocol and MIPv6 protocol, identifying potential benefits and difficulties.

The analysis contained in this document considers the most general case of shim and MIPv6 interaction, where the mobile node has both multiple Care-of-Addresses as well as multiple Home Addresses. The MN can have multiple addresses for any number of reasons. For example, the MN can have multiple CoAs due to the MN having multiple interfaces (connecting to different providers), or the MN visiting a link which has multiple address prefixes due to the visited site being multihomed. Also, the MN can have multiple HoAs for different reasons, including having a home link which has multiple address prefixes due to being in a multihomed site, to having multiple, independent Home Agents that each provide it with a Home Address.

Without loss of generality the analysis uses a single IP address for the correspondent node.

The analysis will consider the two modes of operation of MIPv6: the Bidirectional Tunnel (BT) mode where the communication is routed through the Home Agent and the Route Optimization (RO) mode, where the communication flows directly between the Correspondent Node and the Mobile Node.

2. Bidirectional Tunnel (BT) Mode

2.1 Communication between the MN and the CN

In this case, we have a MN with multiple CoAs (CoA1,..., CoAj) and multiple HoAs (HoA1,..., HoAm) communicating with a Cn with address IPCN.

We assume that the SHIM is layered above MIPv6.

In this scenario, suppose that an application located above the SHIM layer, establishes a communication using one of the available HoAs, e.g. HoAl and the address of the CN, IPCN, as ULIDs. Because the SHIM is located above MIPv6, packets will be tunneled through the HA, i.e. packets will be encapsulated with an additional header that will contain IPHA and CoAj as addresses.

At some point during the lifetime of the communication, a SHIM context is established. Such context will contain:

- HoAl and IPCN as ULIDs
- HoA1,..., HoAm, as locator set for the MN. (Optionally, the MN could choose not to provide the CoAs to the CN in the shim6 signaling.)
- IPCN as locator set for the CN

We will next consider the response in case of an outage:

Suppose that an outage occurs and the communication path becomes unavailable. If there is an outage affecting the path between the CN and the MN, then the SHIM layer will detect it, and will retry with an alternative locator.

When an alternative HoA is used as alternative locator, packets will be tunneled through the HA associated with the new HoA, and will be received through the CoA associated with the new HoA. In case that there is at least one HA and one CoA that are not affected by the outage, the communication will be preserved. In this case, the communication will still flow in BT mode, but it will be routed through an alternative tunnel associated with the new HoA.

If an alternative CoA is used as alternative locator, then the communication will run directly between the MN and the CN in a kind of SHIM based RO mode, recovering from the outage. However, in this case, care must be taken because the alternative CoA may become unavailable after movement.

3. RO mode

We assume that the SHIM is layered above MIPv6.

In this case, we have a MN with multiple CoAs (CoA1,..., CoAj) and multiple HoAs (HoA1,..., HoAm) communicating with a CN with address IPCN.

Suppose that a communication is established between the MN and the CN using HoAl and IPCN. In addition, through MIPv6 protocol, a Binding Cache Entry (BCE) is created in the CN associating the HoAl with one of the CoAs, CoAp. So, packets associated with the communication are flowing directly between the CN and the MN carrying CoAp and IPCN in the source and destination address fields.

Later on, at some point in time, a SHIM context is established between the MN and the CN. In this case the SHIM context established contain the following information:

- ULIDs: HoAl and IPCN
- Locator set for MN: HoA1,...,HoAm, CoA1,..., CoAj. (Optionally,

the MN could choose not to provide the CoAs to the CN in the shim6 signaling.)

- IPCN as locator set for the CN

We will next analyze how this configuration reacts to different failure modes:

- The path between IPCN and CoAp fails. The SHIM will detect the outage and will try with alternative locators available for the ULIDs of the session. If an alternative HoA is used by the SHIM as alternative locator, when the SHIM passes the packet with an alternative HoA to the MIP layer, the MIP layer will route through the corresponding CoA available in the BCE associated with the new HoA, possibly falling back to BT mode but potentially recovering the failure. If an alternative CoA is used by the SHIM as alternative locator, the MIP layer wonOt affect the packet carrying the alternative CoA, and packets will be routed directly between the MN and the CN, in a kind of SHIM-based RO mode.

- The path between the MN and the CN through the HA fails. While data traffic is not routed through the HA, HoTI/HoT packets are exchanged through the HA. If the path between the MN and the CN through the Ha fails, then HoTI/HoT exchange will fail. A few minutes later, the corresponding BCE will expire, and the communication will fallback to the BT mode through the HA.

However, because we are considering the case where the path through the HA is down, the communication will fail. At this point, the SHIM will detect the outage and use an alternative locator pair. Analogously to the previous case, the SHIM can try with an alternative CoA or an alternative HoA as alternative locators for the communication. In any case, similar considerations to the ones described above apply and the communications will be restored, whether in BT mode (alternative HoA) or in a SHIM-based RO mode (alternative CoA used).

In any case, the presented setup seems to allow the preservation of the established communication through different failure modes. It should be noted, that if CoAs are included as alternative locators for the SHIM, those will be short lived locators, and they may become unavailable sooner than the HoAs.

4. Security considerations

TBD

5. Normative References

[1] Nordmark, E. and M. Bagnulo, "Multihoming L3 Shim Approach", draft-ietf-shim6-l3shim-00 (work in progress), October 2004.

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