Several Framework Issues Regarding NSIS and Mobility
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STATUS OF THIS MEMO

1 Abstract

This memo discusses several framework issues related to Next Step In
Signaling (NSIS) and mobility interaction. The first issue is related
to handoff impact on NSIS operation. We present several general
requirements for NSIS and mobility, followed by evaluation of how
specific approaches using Mobile IP or other mechanisms might fit
into the picture. Other issues covered include NSIS and mobility
signaling layering and soft-state management.

2 Introduction

The IETF Next Step In Signaling (NSIS) WG is currently looking at
requirements and framework issues for a general resource signaling
protocol. It is expected that the interaction between such a protocol
(or protocol suite) and general mobility mechanisms is an important
part of the overall framework.

This memo presents our view on several framework issues concerning
NSIS and Mobility interaction. The discussions here are largely

driven by our experience in designing and prototyping an RSVP-Mobile
IPv6 interoperation framework [1,2] as well as by some good coverage
on the same topic in existing NSIS framework proposals such as [3].

The first issue is related to impact of handoff on NSIS operation.
Since NSIS is expected to be interacting with general mobility
mechanisms, we take the approach of analyzing some general
requirements concerning NSIS and general mobility problem first.
Then
we use Mobile IPv6 and other mobility mechanisms as examples, to
show
how they may fit into these requirements when applied. The important
point is to show how distinct features of specific mobility
mechanisms make them distinct in their ability to meet the given
requirements. After the handoff issue, we also talked about issues
such as Signaling Layering and Soft-State management.

Our basic assumption in this memo is in-band signaling with a one-
sender and one-receiver scenario.

3 Issues about Handoff Impact on NSIS Protocol Operation

3.1 The Need for a Separate View on Data and Control Plane Identifiers

In exsiting signaling protocol such as RSVP, resource reservation is
usually done for a flow from a Sender to a Receiver. Typically a
flow
is identified by the IP 5-tuple (Src, Dst address, protocol id and
port number) or in IPv6 by the IP 3-tuple (Src, Dst address and Flow
Label). This flow identifier basically serves two purposes in two
planes:

   o Data Plane: it is used by packet classification mechanism for
     filtering the data packets that are entitled to the reserved
     resources.

   o Control Plane: it is used by the state management entity in
     locating the specific state maintained for the specific flow.
     The flow identifier can actually be seen as a reservation
     identifier in this sense.

Although it is fine to have a single identifier used in both Data
and
Control plane as in the traditional case, problems arises due to
mobility may require two different identifiers to be used in
respective planes, although they should still keep associated with
each other.

3.2 Handoff Problem Statement and Basic Requirements

Handoff is the major cause for the complexity in NSIS and mobility
interaction. Handoff basically results in the original flow path

between a sender and a receiver being split into three portions, all
of which intersects at a cross-over router: The unchanged (common to
old and new) portion, the newly added portion and the obsoleted
portion. To simplify, we will denote the three as: Common path, new
path, obsoleted path respectively.

The ideal requirements for NSIS and mobility interaction, looking
from two different planes respectively, could be:

    o Control Plane: During handoff signaling phase, routers within
      the common path should be kept transparent to mobility;
      routers within the new path should establish corresponding
      states as soon as possible, and routers within the old path
      should delete corresponding states as soon as possible.

    o Data Plane: The Data Plane should be transparent to mobility
      if possible.

Fulfillment of the Control Plane requirement ensures minimized
impact
caused by handoff on state management. Otherwise, it is likely that
handoff signaling will have to be propagated along the common path
to
update state information in routers there and additional mechanism
is
also required to ensure no duplication of states/reservations is
created for the same flow due to handoff.

Fulfillment of the Data Plane requirement ensures a seamless service
for data packets belong to the flow. Otherwise it is likely that
service disruption will be perceived due to handoff. Note that
unable
to fulfill the Data Plane requirement potentially excludes the
possibility of complete fulfillment of Control Plane requirement, as
will be shown below.

3.3 **Evaluation of Existing Framework Proposals using Mobile IP Against
    Requirements**

Mobile IP is likely to be one of the pre-dominant mechanism used for
IP mobility. With Mobile IP, MN is assigned HA and CoAs. The former
keeps constant while the latter changes during handoff. So whether
and how these addresses are used to form Data Plane/ Control Plane
identifier will have important impact on how the proposal will meet
the above stated requirements.

3.3.1 **Approach I**

Approach I: In [1], it is proposed that MNs' HAs instead of CoAs are
used in the 3-tuple Data Plane flow identifier for packet
classification. Furthermore HAs are also used to identify
corresponding reservation states, thus it is used as Control Plane

   reservation identifier as well.

   It can be seen that in this approach, Data Plane identifier and
   Control Plane identifier share the same information, which is HA.
   Both of them are kept constant as well. Thus both Data Plane and
   Control Plane requirements are met.

   However, it is understood that an additional issue with this
approach
   is: the placement of MNs' HA in IP header as specified in current
   Mobile IPv6 makes it necessary to complicate the packet
   classification engine if HAs are used as Data Plane flow identifier.

3.3.2 Approach II

   Approach II: The alternative to using MN's HA as Data Plane flow
   identifier is naturally the use of MN's CoA, such as in [4].

   It can be seen that with this approach, the Data Plane requirement
   can not be met because the flow identifier changes during handoff.
   The changed flow identifier will have to be propagated along the
   common path, in addition to the new path. Thus the first part of
   Control Plane requirement, which states routers in common path be
   kept transparent to handoff, can not be met as well. The rest part
of
   the Control Plane requirement however, can be met by using separate
   reservation identifiers. Example could be the session identifier as
   in [4]. By comparing the previous QoS session identifiers and new
QoS
   session identifiers in the signaling packet and state information,
   the cross-over router could be identified and duplication of
   reservation for the same flow may be avoided.

3.3.3 Approach III

   Approach III: Based on the above analysis, a third approach is also
   possible: to combine the above approach II for Data Plane and
   approach I for Control Plane. That is, use CoAs for flow identifier
   thus relieves the concern on packet classification, while use HAs to
   form a unique identifier in the Control Plane. The use of HAs for
   unique identifier in Control planes seems to be natural for a
   protocol like Mobile IP. This is also in line with what is mentioned
   in [5], flow state establishment methods SHOULD include the Mobile
IP
   HAs if available, to avoid state duplication on fixed portions of
the
   path when either end changes its Care-of Address. This approach can
   be seen as one step further from [1,2] and is currently under study.

3.3.4 Summary Notes

   In summary, the following are the possibilities that can happen when

matching an existing solution with the two requirements:

o Both requirements are met, such as approach I. (Although
  additional concern with Packet Classification could present.)

o The Data Plane requirement is not met, then the Control Plane
  requirement can at most be partially met, such as approach II
  and III.

o The Control Plane requirement is not met. It is still
possible
  to meet the Data Plane requirement although this kind of
  approaches seem less attractive. The reason is when Data
Plain
  requirement can be fulfilled, it is usually not difficult to
  meet the Control Plane requirement at the same time.

o Neither of the requirements are met. This is likely when the
  resource signaling and mobility mechanism are completely
  unaware of each other.

3.4 Evaluation with Other Possible Mobility Mechanisms Against Requirements

According to the above analysis, how a given mobility mechanism can
fulfill the requirements when interact with NSIS is largely
dependent
on the mechanism feature itself. In the case of Mobile IPv6, it
seems
difficult to achieve the Data plane requirement without complicating
the packet classification engine. Other mobility mechanisms, or
optimization schemes to Mobile IPv6, however, might make it possible
in certain situations, for example in the case of Local mobility
management [6].

As in local mobility management, when the mobile node is moving
within a Local Coverage Area (LCA), its change of IP address is not
seen by nodes beyond that area. It may be preferable to look at the
flow path in two segments, one from the border of LCA to CN and the
other within LCA. For the first segment, the Data Plane requirement
can be easily fulfilled as long as MN is within the LCA, hence it is
also not difficult to meet the Control Plane requirement for that
part. A both-requirement-met approach can be applied in this
situation.

It should be noted that within LCA or when the MN moves out of LCA,
the situation is quite different since there are IP address changes.
Approaches similar to what has been discussed above for Mobile IPv6
may be applied. This example implies that there might be a
requirement for NSIS to interact with LMM, similar to the
requirement
for it to interact with Fast handoff and Context Transfer, if
applicable.

[4](#) Issues on Signaling Layering Between NSIS and Mobility

It is expected that NSIS would use a multi-level architecture. In
most of existing NSIS framework proposals (e.g., [7,3]) it is
assumed
that there exists a NSIS protocol transport level. This raises a
possible problem of additional signaling layering issue as far as
mobility is concerned. Specifically, NSIS's general protocol
transport should be properly and efficiently layered with the
mobility signaling transport, if such a need for a mixed resource
and
mobility signaling is present (similar to what is mentioned in [3]
as
tight integration). Some existing work has already lead to the
question of whether resource signaling should be layered on top of
mobility signaling or should it be the other way around. The first
approach is taken by [8,9,10]. And as stated in [3], this is
considered as a special case of NSIS layering, with the mobility
protocol playing the role of the signaling transport. The second
approach is taken by [1] which puts mobility related information
into
resource signaling messages transported by resource signaling
protocols' own mechanism.

It in fact seems pre-mature to answer the question of which is
better
at this time, when the exact nature of a generic transport layer for
NSIS has not even been clearly defined. However, considering the
general purpose of NSIS and the requirement that NSIS - mobility
should be considered without assuming any specific mobility, it
seems
more appropriate at least initially, not to layer resource signaling
messages on any particular mobility mechanism. Rather we suggest
that it may be preferable to define some common interface between
NSIS and (any) mobility mechanisms, probably by putting a mobility
adaptation level(layer) in the overall NSIS framework. Specific
parameters passed into the adaptation layer can be mobility
mechanism
dependent if required. Ultimately these signaling could still be
supported by the NSIS signaling transport itself. For this kind of
framework, [2] might serve as one possible starting point.

5 Issue on Soft-State Management in NSIS and Mobility Interaction

When soft-state mechanism is used for the NSIS protocol, how the
refresh is done could have important implications when NSIS and
mobility is concerned. If the NSIS refresh message is issued end to
end and processed and forwarded by each intermediate routers similar
to, e.g the RSVP Path refresh case, this implies: First, in order to
route the refresh message correctly, the sender may have to know the
receiver's new location. Second, intermediate routers also need to
maintain its own copy of the receiver's new loaction before it can
forward the refresh to the next hop, this is required if the
signaling mechanism in the router do not want to rely on IP header

of
   the received Refresh message to construct the Refresh message that
is
   sent out to next hop (to maintain a clear interface between the
   signaling protocol and IP layer). This means the handoff signaling

message will always have to go beyond the cross-over router even though a unique reservation identifier may be used. This has been shown in [1,2]. Note that this problem is present for all three approaches mentioned in the first section of this memo. The problem might be partially relieved if a direct neighbor to neighbor refresh mechanism were used.

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