A Mobility Protocol Framework to Support Multiple Namespaces

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Mobile access devices are increasingly popular
  - laptops, PDAs
Demands for mobile protocols are emerging
  - Mobile IPv6
  - LIN6
Issues of Mobility Protocols

• Mobility protocols need an identifier defined in the protocol
  • Mobile IP: Home Address, LIN6: LIN6 ID
• Cannot ignore the demand for defining an identifier of a node independent of the protocol
  • e.g. Auto-ID center
• Complexity in maintaining integrity of such identifiers
  • Namespaces are expected to become more diversified
• Hard to provide anonymity
  • Must disclosure its identifier, e.g. Home Address
Proposed Framework

- L3 Transparent Mobility
  - based on LINA
- Supports Multiple namespaces
  - L3 identifiers NOT needed
- Coexists with current IPv6 infrastructure
- No modification is needed for IPv6 applications
- Anonymity
Concept (1/2)

- **Virtual IPv6 Node Space**
  - Identified by (Namespace ID, Name)
  - Virtual IPv6 address (NID)
  - IPv6 address

- **IPv6 Network**
  - Exchange of packets

- **Communication**
  - Logical communication between Namespace A, Namespace B, and Namespace C.
A node specifies a target node by "name"

- Binding a name with a dynamically determined ID (NID)
  - conforms to the format of the IPv6 address
- The association of NID with the current interface address (Maddr) is maintained in each node
  - used for packet delivery
Immediate path: identification layer is bypassed
- no address conversion
Mapping Agent: Resolving interface address from node name

- Mapping: association of the node name with current interface address
- Mapping Agent:
  - Maintains mappings
  - Replies with a mapping when requested
- A node registers a new mapping with its MA
- Each namespace needs a mechanism to discover a MA
  - This mechanism is dependent on each namespace
  - Out of the scope of this paper
Negotiated endpoint ID (NID) (1/2)

- NID: a dynamically determined "temporary" IPv6 address
  - Each name in any namespace is mapped to NID
  - Used in upper layers
  - Not interface address

AGUA:
- Network Prefix
- Interface ID (EUI-64)

NID:
- Dedicated Prefix
- Negotiated Endpoint Number (NEN)

initiator bit
Negotiated endpoint ID (NID) (2/2)

- NEN: determines the endpoint of a communication
  - Unique in the communicating nodes
  - Determined by negotiation
- Dedicated Prefix: predefined well-known fixed value
  - Does not determine any physical point of the network
Mobility address: Maddr

- Maddr: enables mutual conversion between NID and Locator
  - Conforms to the IPv6 address format

- LUN: Randomly chosen value by the node
  - Embedded in the interface address
  - Immediate bit: goes to immediate path
    - no address conversion

- Mapping Entry:
  - Table for mutual conversion
  (Namespace-ID, Name, NEN, ILUN, tLUN, tMaddr, ...)
Communication model

Upper Layer

Network Layer

Identification Sublayer

Delivery Sublayer

Maddr

NID

DP

NEN

NEN

mapping

Maddr

Prefix

LUN

Dedicated Prefix (DP) (Fixed Value)
Communication Procedure (1/2)

- Determining LUN
  - Each node determines at least one LUN on bootstrap
- Assigns Maddr to its interface
- Resolving Target Maddr
  - queries for the mapping to one of Na’s MAs.
• Determination of NEN: NEN negotiation
  • Notify each other of (Namespace-ID, name, LUN)
  • Negotiate unique NEN in the two nodes
  • Generate mapping entry:
    • (NSb, Nb, nab, ia, ib, Pcb::ib)

\[
\begin{align*}
\text{NSa, Na} \quad \text{NSb, Nb} \quad \text{Pcb::ib}
\end{align*}
\]

\[
\begin{align*}
\text{NSa, Na, ia} \quad \text{NSb, Nb, ib} \quad \text{Pca::ia}
\end{align*}
\]

\[
\begin{align*}
\text{DP::nab(1)} \quad \text{IGID:} \quad \text{NEN = nab} \quad \text{DP::nab(0)}
\end{align*}
\]
Sending a packet

- Obtains NEN from specified NID
- Search for mapping entry, get target Maddr

| src: DP::nab(1) | dst: DP::nab(0) |

| nab |

Mapping Table

<table>
<thead>
<tr>
<th>NS</th>
<th>Name</th>
<th>NEN</th>
<th>lLUN</th>
<th>tLUN</th>
<th>tMaddr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Na</td>
<td>nab(0)</td>
<td>ib</td>
<td>ia</td>
<td>Pca::ia(0)</td>
</tr>
</tbody>
</table>

| (ib, Pca::ia) |

Identification Sublayer

Delivery Sublayer

src: Pcb::ib
dst: Pca::ia

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Receiving a packet

- Obtains (local LUN, target LUN) pair from addresses in the packet
- Search for Mapping entry, get NEN

```
<table>
<thead>
<tr>
<th>NS</th>
<th>Name</th>
<th>NEN</th>
<th>lLUN</th>
<th>tLUN</th>
<th>tMaddr</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSa</td>
<td>Na</td>
<td>nab(0)</td>
<td>ib</td>
<td>ia</td>
<td>Pca::ia(0)</td>
</tr>
</tbody>
</table>
```

```
src: DP::nab(0)
dst: DP::nab(1)
```

**Diagram:**
- DP
- nab
- Identification Sublayer
- Delivery Sublayer
- src: Pca::ia
dst: Pcb::ib
- nab
- (ib, ia)

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Hand-off of a Node

- Assigns a new Maddr to the interface
- Notifies its MA of the new mapping
- May send the new mapping to correspondent nodes
  - Or wait until the correspondent node refreshes the mapping
Anonymity (1/2)

- Supports the two types of anonymity:
  - Eavesdropping
    - Addresses used in packets are based on LUN
    - Generated autonomously and are random numbers
    - Difficult to derive names of nodes from addresses of packets
  - Difficult to determine the name of a node by eavesdropping on communication packets
Hiding Caller-ID
- "Name" is needed to find designated MAs and to query for a mapping
  - Initiator can declare a temporary name
    - random number, hash...
  - Declare address list of its designated MA on NEN negotiation
- No need to disclose its real name to the correspondent node
Conclusion

- Proposed a new mobility protocol framework
  - Supports Multiple Namespaces
  - Allows to specify a correspondent node by a name
    - Defined in any namespace
  - Adapted to a new namespace with ease
  - Can support two types of anonymity
- Future work
  - Prototype implementation of this framework
  - Evaluation on real IPv6 networks