Architectural Considerations and Relationship within the IETF

Ryuji Wakikawa (ryuji@sfc.wide.ad.jp)
Thomas Clausen (T.Clausen@computer.org)
MANEMO Problems
Issue 1: Sub-optimal path
Communication in Nested NEMO
Optimal Path for internal communication
MANET/AUTOCONF Applicability

- **Required functions**
  - *Prefix Route Exchange* for neighboring MRs (MNP)
  - *Address assignment* for local communication in nested NEMO

- **NEMO MR**
  - exchanges prefix route of own MNP
  - routes the packets to the destination according to the prefix route if available
  - bypass the HA (no tunnel)
Considerations

- Routing Scope?
  - 1-hop? (NDP)
  - 2-hop? (NHDP)
  - n-hop? (MANET)

- Who should participate in the MANET?
  - mobile router (MR)
  - fixed router (FR)
  - mobile network node (MNN)
  - mobile host (MH)
  - access router/Internet Gateway

- Which address is used?
  - link local?
  - unique site-local?
  - global address
    - owned by each MR, HoA? (unique, topology incorrect)
    - obtained from upper MR? (topology incorrect)
    - obtained from AR? (topology correct)

- Is Tunnel required?
  - NO
  - HA independent
# MANET/AUTOCONF applicability

<table>
<thead>
<tr>
<th>Solutions</th>
<th>What NEMO MR can get</th>
</tr>
</thead>
</table>
| AUTOCONF  | - local address for internal communication in nested NEMO  
            - global topologically correct address to reach the Internet over nested NEMO |
| NHDP      | - neighbor's information of 2-hop mobile routers  
            - MR's HoA and MNP  
            - MR's address (local address and global address)  
            - Link information |
| OLSR      | - n-hop mobile routers  
            - route to the Internet (IGW) |
| DYMO      | - discovering n-hop mobile routers  
            - discovering IGW |
NHDP vs NDP

- NDP
  - Mobile IPv6 based protocols rely on NDP for
    - movement detection (DNA)
    - network reachable detection (Router reachability)
    - address configuration (including DAD)
    - Neighbor Unreachability Detection
    - returning home operation
  - 1-hop neighboring information

- NHDP offers similar functionalities of NDP
  - 2-hop neighbors information
  - link information

- How can mobile router interact with NDP and NHDP simultaneously?!
  - conflicting reachability information
  - conflicting routing table information
Issue 2: Sub-optimal Path from Nested NEMO to the Internet
Optimal Path from nested NEMO to the Internet
MANET/AUTOCONF Applicability

- Required functions
  - Global topology correct address assignment from AR
  - Route setup to AR (Internet)
  - Sending BU and Creating tunnel

- NEMO MR
  - Sends BU for the global address to its HA
  - Tunnel setup
  - Routes the packets of other MRs

- AR/IGW
  - MUST NOT leak the prefix routes to the Internet
Considerations

- Routing Scope?
  - 1-hop? (NDP)
  - 2-hop? (NHDP)
  - n-hop? (MANET)

- Who should participate in the manet?
  - mobile router (MR)
  - fixed router (FR)?
  - Access Router/Internet Gateway?
    - mobile network node (MNN)
    - mobile host (MH)

- Which address is used?
  - link local?
  - unique site-local?
  - global address
    - owned by each MR, HoA? (topology incorrect)
    - obtained from upper MR? (topology incorrect)
    - obtained from AR? (topology correct)

- Is Tunnel required?
  - YES
## MANET/AUTOCONF applicability

<table>
<thead>
<tr>
<th>Solutions</th>
<th>What NEMO MR can get</th>
</tr>
</thead>
</table>
| **AUTOCONF** | - local address for internal communication in nested NEMO  
- *global topologically correct address to reach the Internet over nested NEMO* |
| **NHDP** | - *neighbor's information of 2-hop mobile routers*  
- MR's HoA and MNP  
- MR's address (local address and global address)  
- Link information |
| **OLSR** | - *n-hop* mobile routers  
- *route to the Internet (IGW)* |
| **DYMO** | - discovering *n-hop* mobile routers  
- *discovering IGW* |
- The problem of Nested NEMO
- AR/IGW is nested NEMO aware
- AR/IGW is NOT Nested NEMO aware
  - Prefix Delegation to MR1
    - MR1 advertises Topologically Correct Prefix
  - MR1 takes roles of IGW/AR
    - MR1 advertises its Mobile Network Prefix
    - a bit optimization
Possible Issue: divide a Nested NEMO

An IPv6 router in a mobile network, named Fixed Router, may divide a nested NEMO

If FR is MANET aware, full optimization
If FR is NOT MANET aware, it is still better than the basic nested NEMO
Impact of MR movement
A MR movement causes address changes on all the other MRs.
- MR MUST update CoA
- MR MUST send BU
- MR MAY re-calculate routes

This is orthogonal to the NEMO basic functionality, movement transparency.
The NEMO Addressing: Movement Transparency
Multihoming Capability

A MR may obtain multiple addresses in Nested NEMO,
1) NEMO topologically incorrect address
2) AUTOCONF topologically correct address.

Which is CoA?
ANP:2::MR2 (from AR)
MNP1::MR2 (from MR1)
MR's HoA (from HA)
Monami6 Applicability??

MR can register both addresses as CoA with Monami6 solution, although it may not help anything for the nested NEMO.

- Tunnel Selection?
- HoA/CoA Selection?
- Path Selection?
  (i.e. tunnel or MANET direct)
Some Overall Observations

- Integration of NEMO, AUTOCONF, OLSR/DYMO, NHDP, NDP,….
  - MR obtains IPv6 address through NDP or AUTOCONF
  - MR updates routes by OLSR/DYMO, NHDP, NEMO(tunnel), NDP
  - MR checks reachability by NDP and NHDP

- Interoperability & backward compatibility
  - MR is not always participating in MANET, but attaches to the legacy v6 link