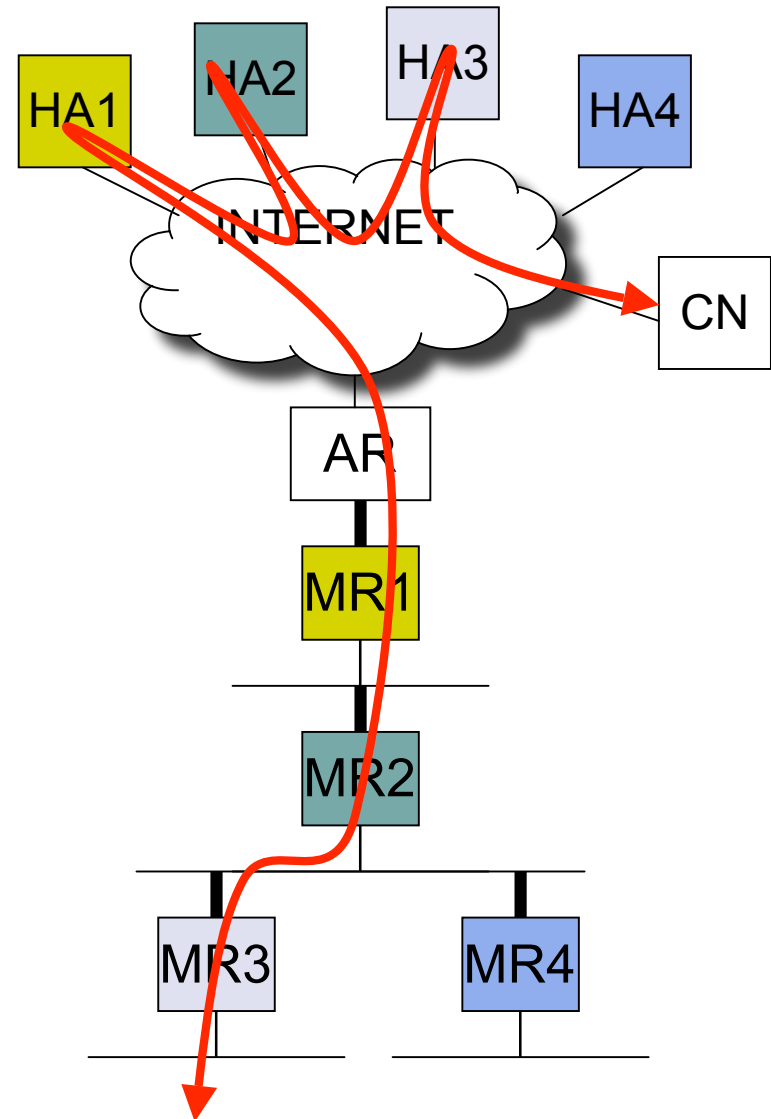
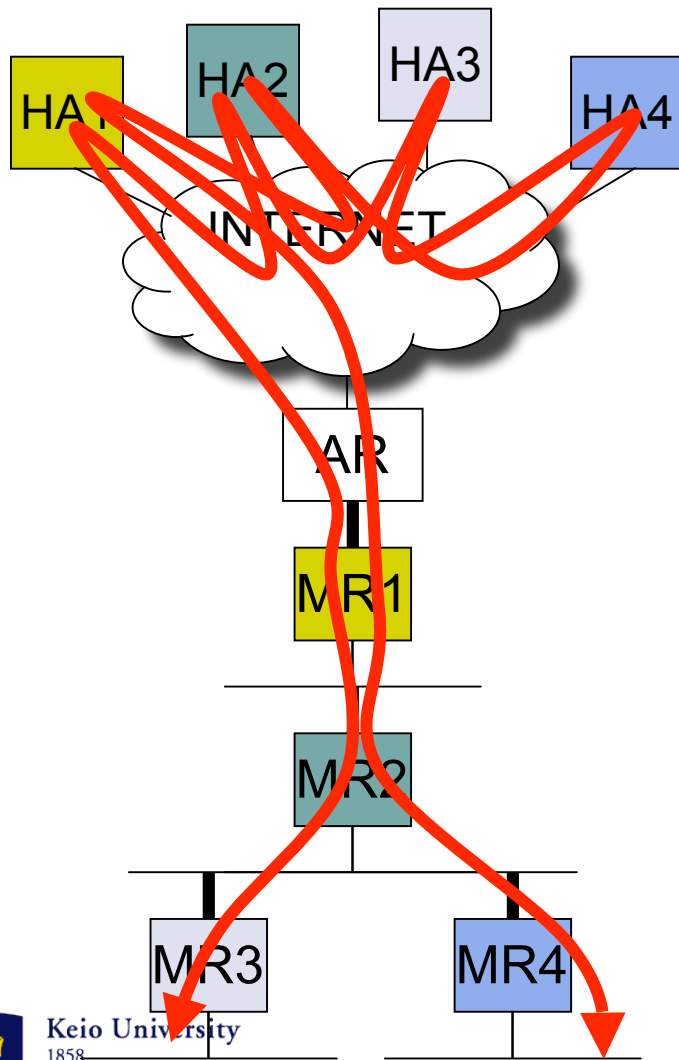


# Architectural Considerations and Relationship within the IETF

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# MANEMO Problems

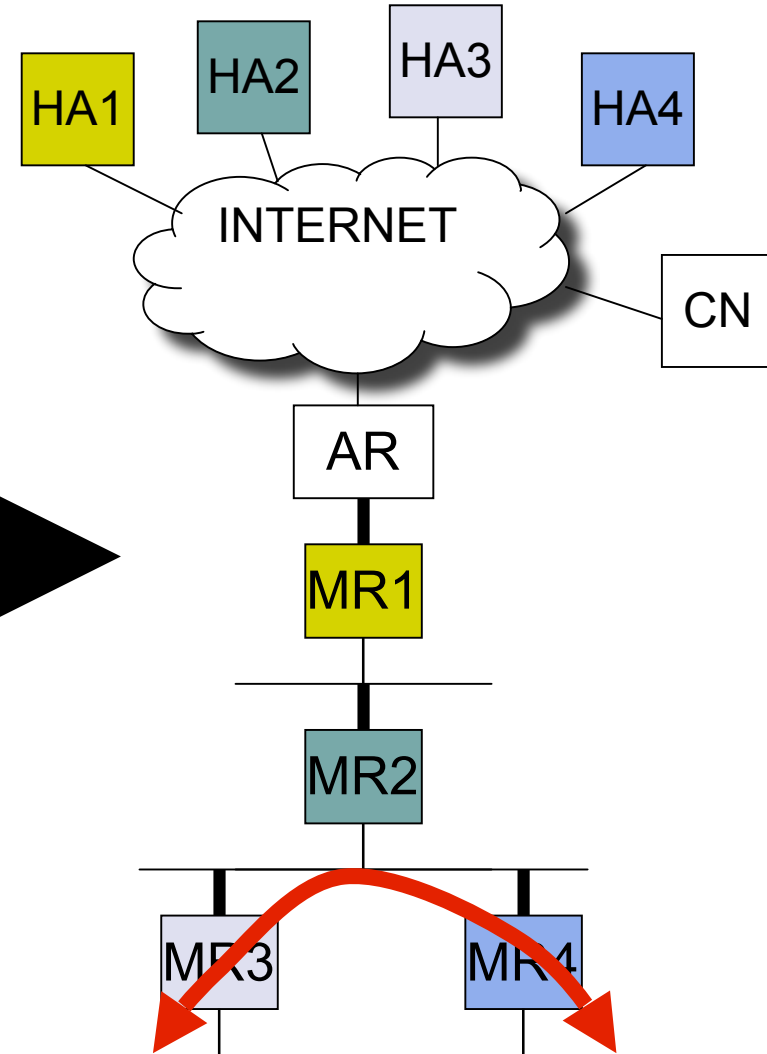
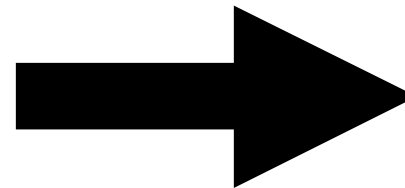
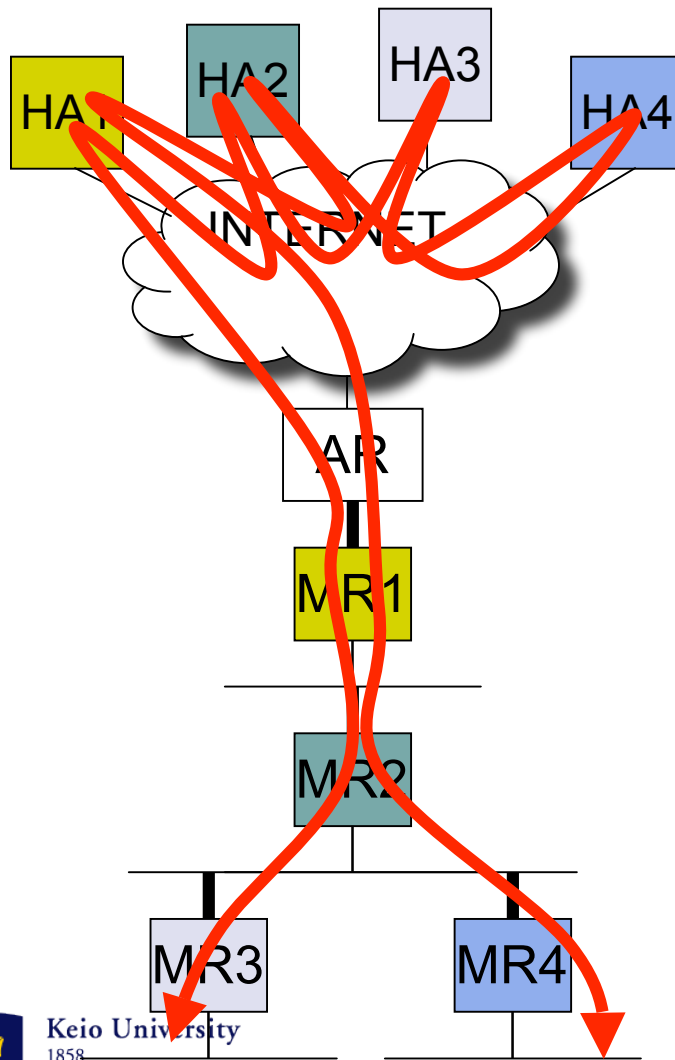


# **Issue 1: Sub-optimal path Communication in Nested NEMO**

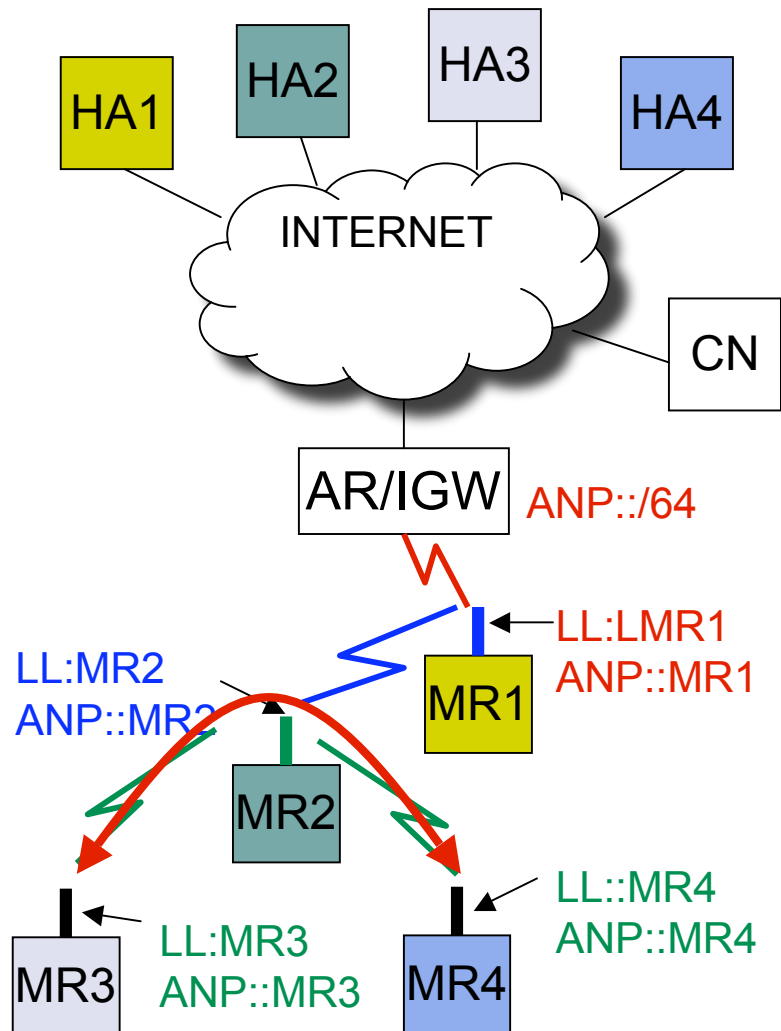


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# Optimal Path for internal communication



# 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

Solutions	What NEMO MR can get
<b>AUTOCONF</b>	<ul style="list-style-type: none"><li>-local address for internal communication in nested NEMO</li><li>-global topologically correct address to reach the Internet over nested NEMO</li></ul>
<b>NHDP</b>	<ul style="list-style-type: none"><li>-neighbor's information of <b>2-hop mobile routers</b><ul style="list-style-type: none"><li>-MR's HoA and MNP</li><li>-MR's address (local address and global address)</li></ul></li><li>-Link information</li></ul>
<b>OLSR</b>	<ul style="list-style-type: none"><li>-<b>n-hop mobile routers</b></li><li>-route to the Internet (IGW)</li></ul>
<b>DYMO</b>	<ul style="list-style-type: none"><li>- <b>discovering n-hop mobile routers</b></li><li>- discovering IGW</li></ul>



# 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





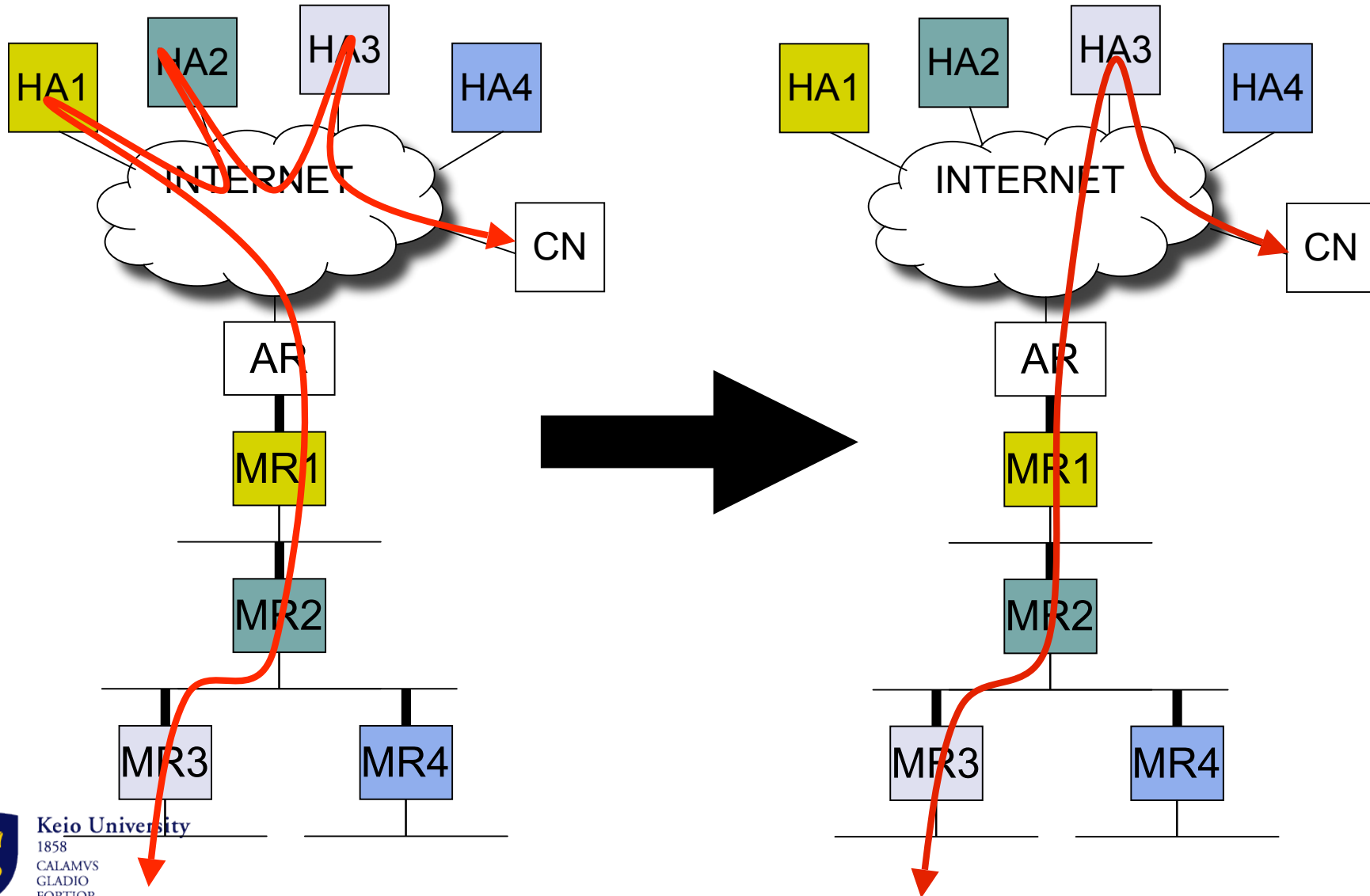
# **Issue 2: Sub-optimal Path from Nested NEMO to the Internet**



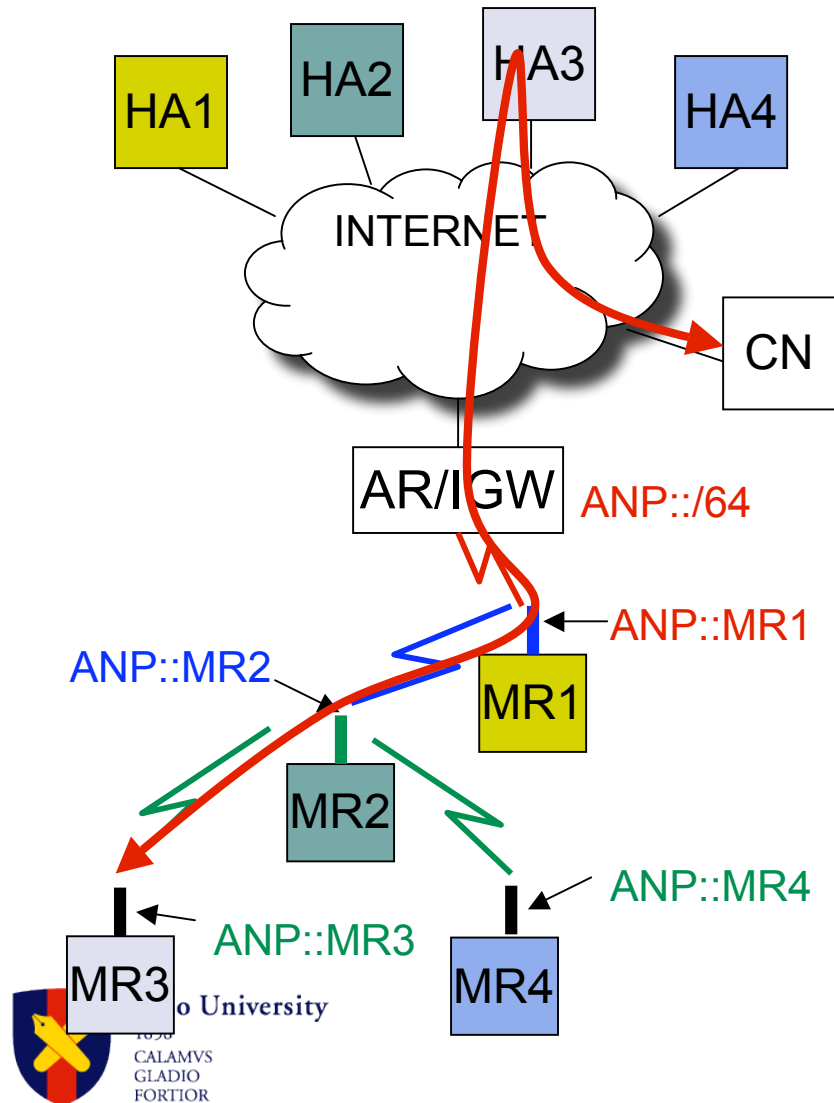
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# Optimal Path from nested NEMO to the Internet



# 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

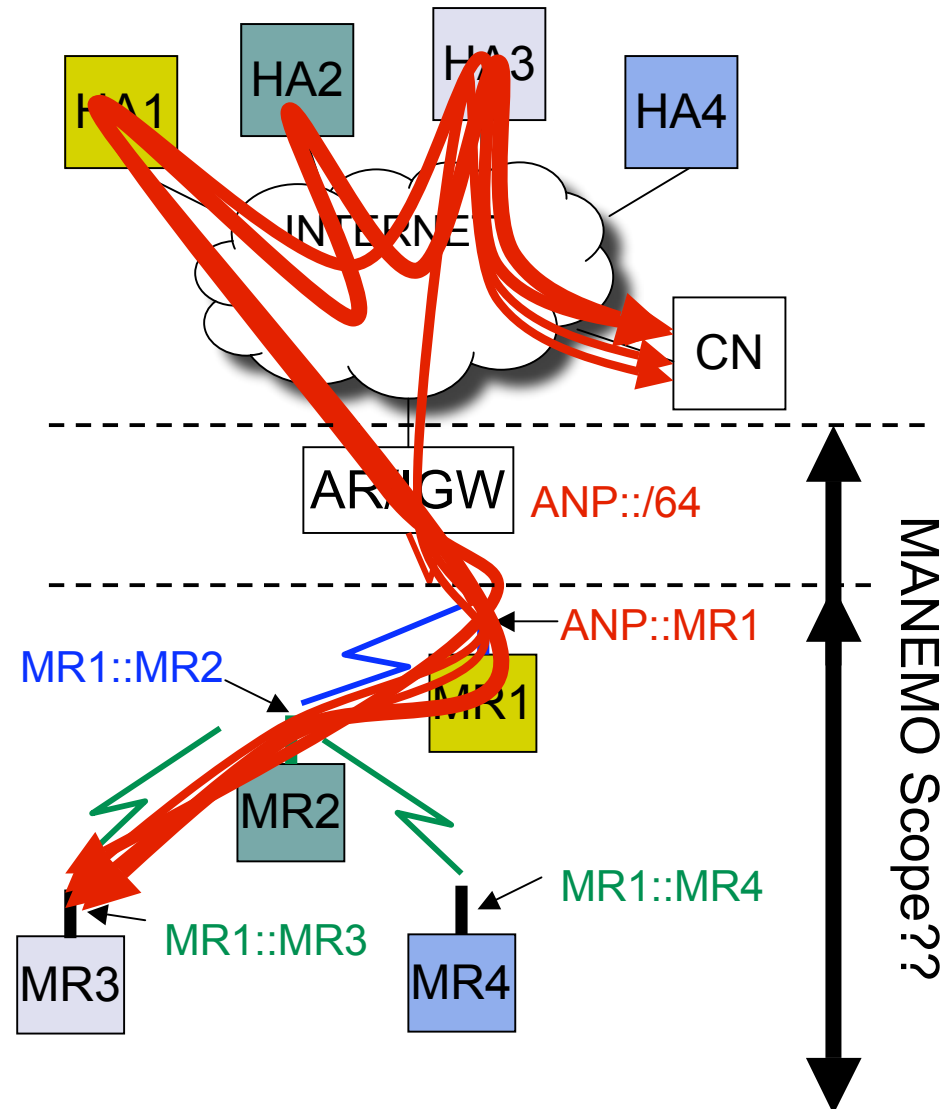


# MANET/AUTOCONF applicability

Solutions	What NEMO MR can get
<b>AUTOCONF</b>	<ul style="list-style-type: none"><li>-local address for internal communication in nested NEMO</li><li>-<i>global topologically correct address to reach the Internet over nested NEMO</i></li></ul>
<b>NHDP</b>	<ul style="list-style-type: none"><li>-neighbor's information of <b>2-hop</b> mobile routers<ul style="list-style-type: none"><li>-MR's HoA and MNP</li><li>-MR's address (local address and global address)</li></ul></li><li>-Link information</li></ul>
<b>OLSR</b>	<ul style="list-style-type: none"><li>-<b>n-hop</b> mobile routers</li><li>-<i>route to the Internet (IGW)</i></li></ul>
<b>DYMO</b>	<ul style="list-style-type: none"><li>- discovering <b>n-hop</b> mobile routers</li><li>- <i>discovering IGW</i></li></ul>

# AR/IGW involvement, deployment consideration

- 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

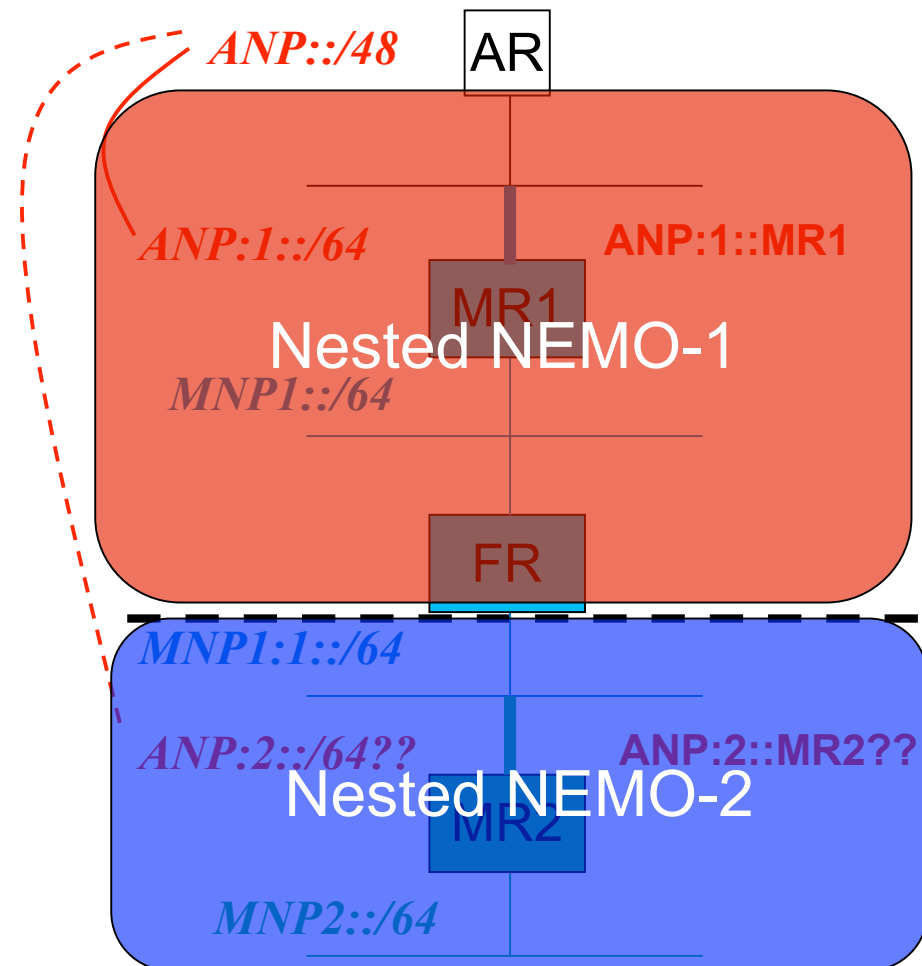
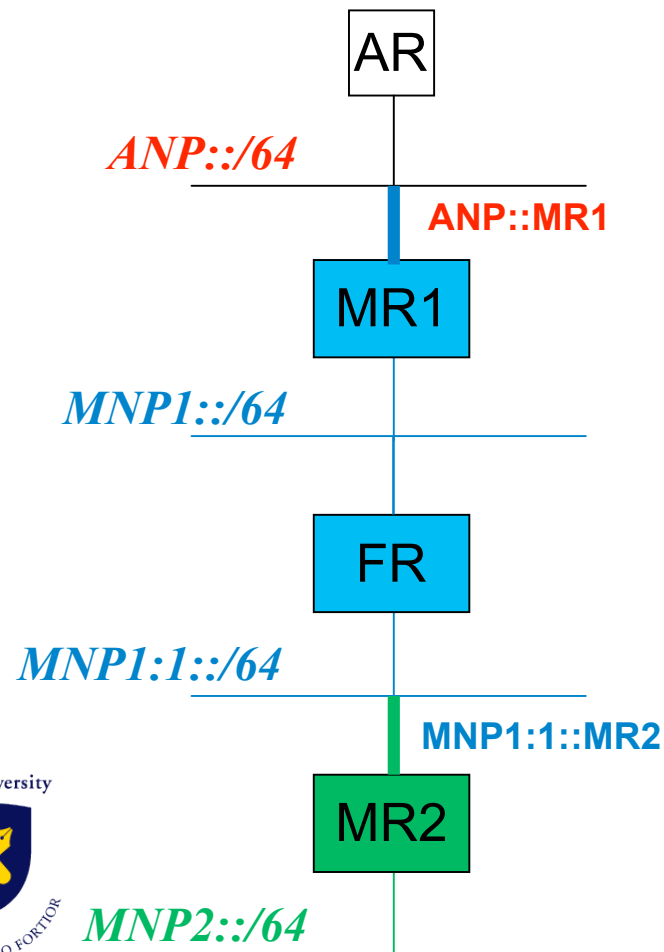


# Possible Issue: divide a Nested NEMO

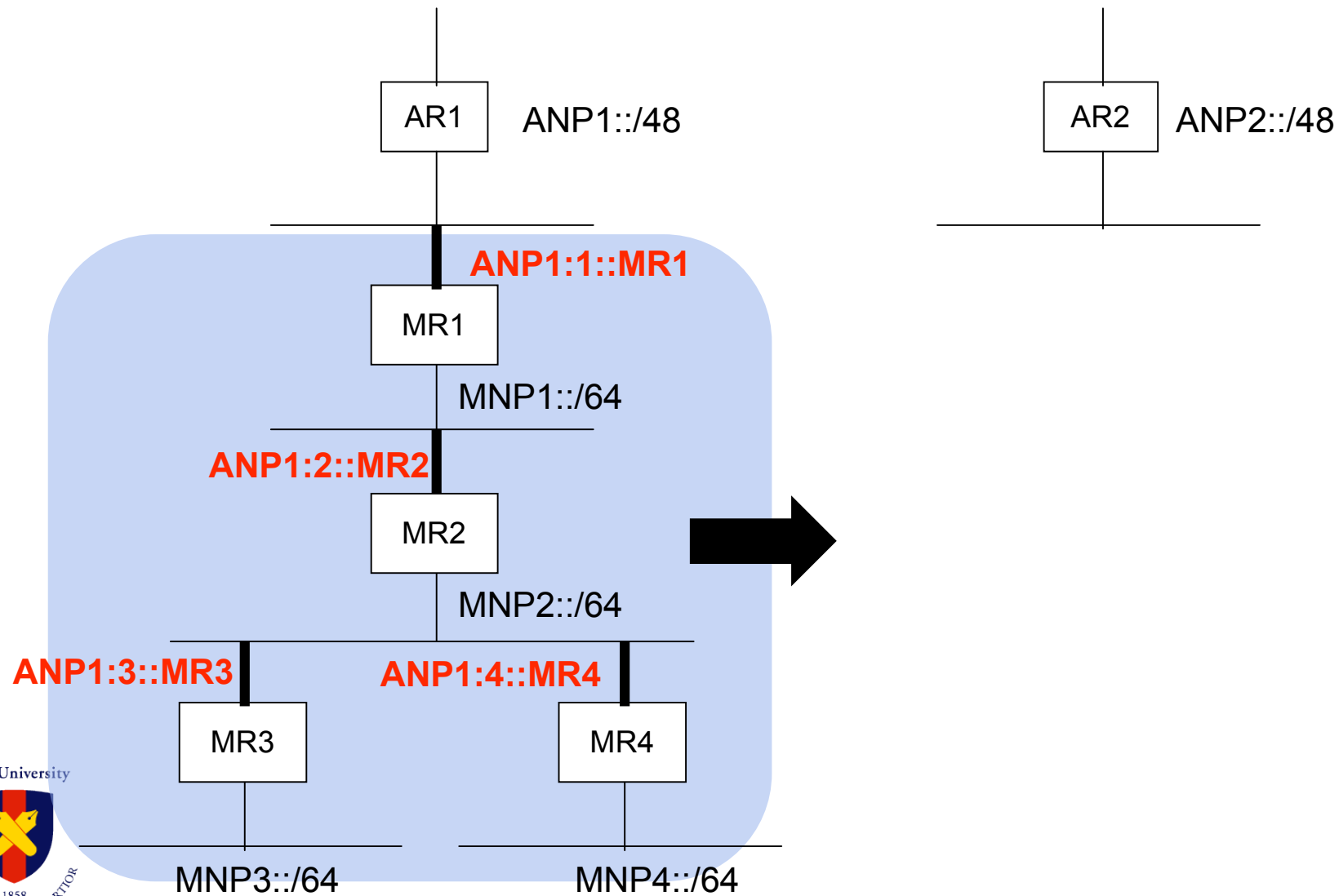
An IPv6 router in a mobile network, named Fixed Router, may divide a nested NEMO

If FR is MANET aware, full optimization

If FR is NOT MANET aware, it is still better than the basic nested NEMO

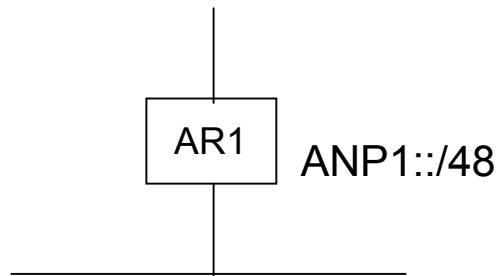


# Impact of MR movement





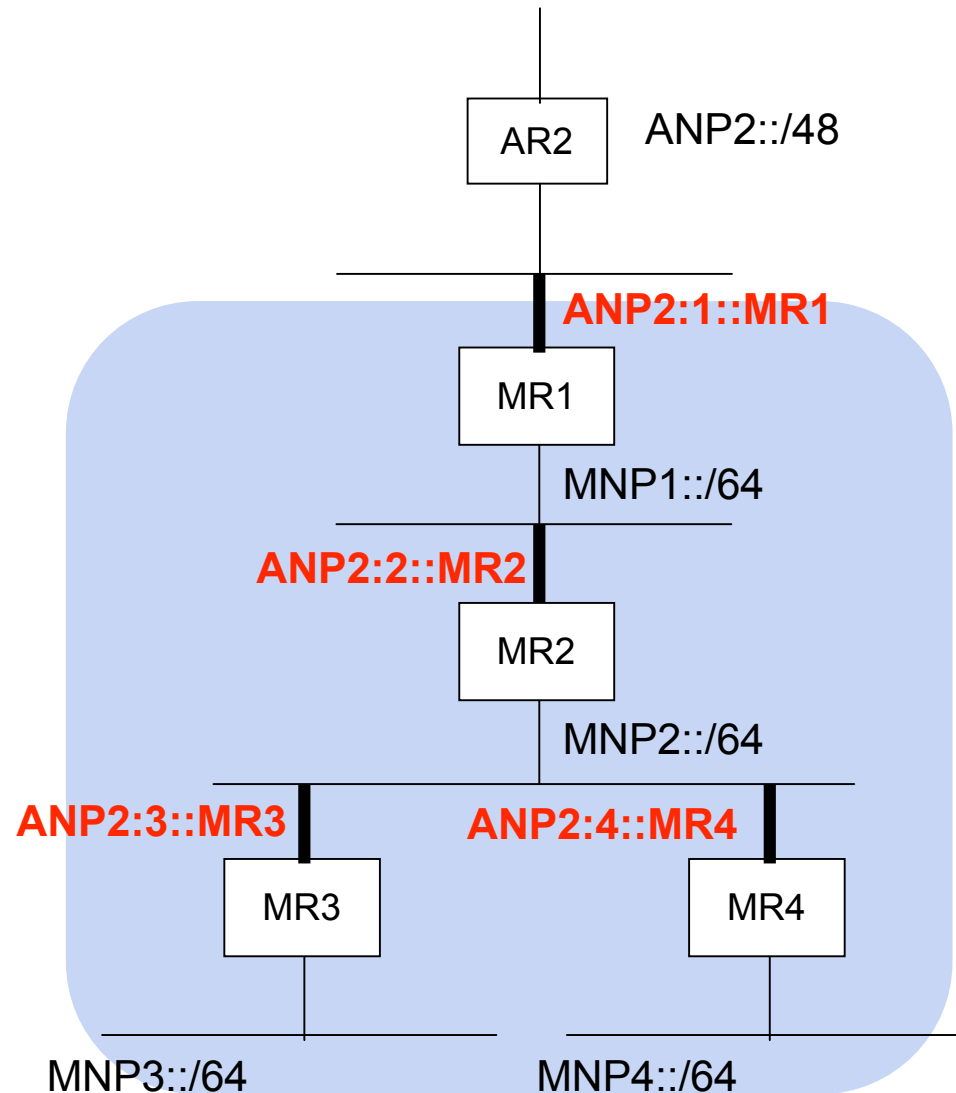
# Impact of MR movement



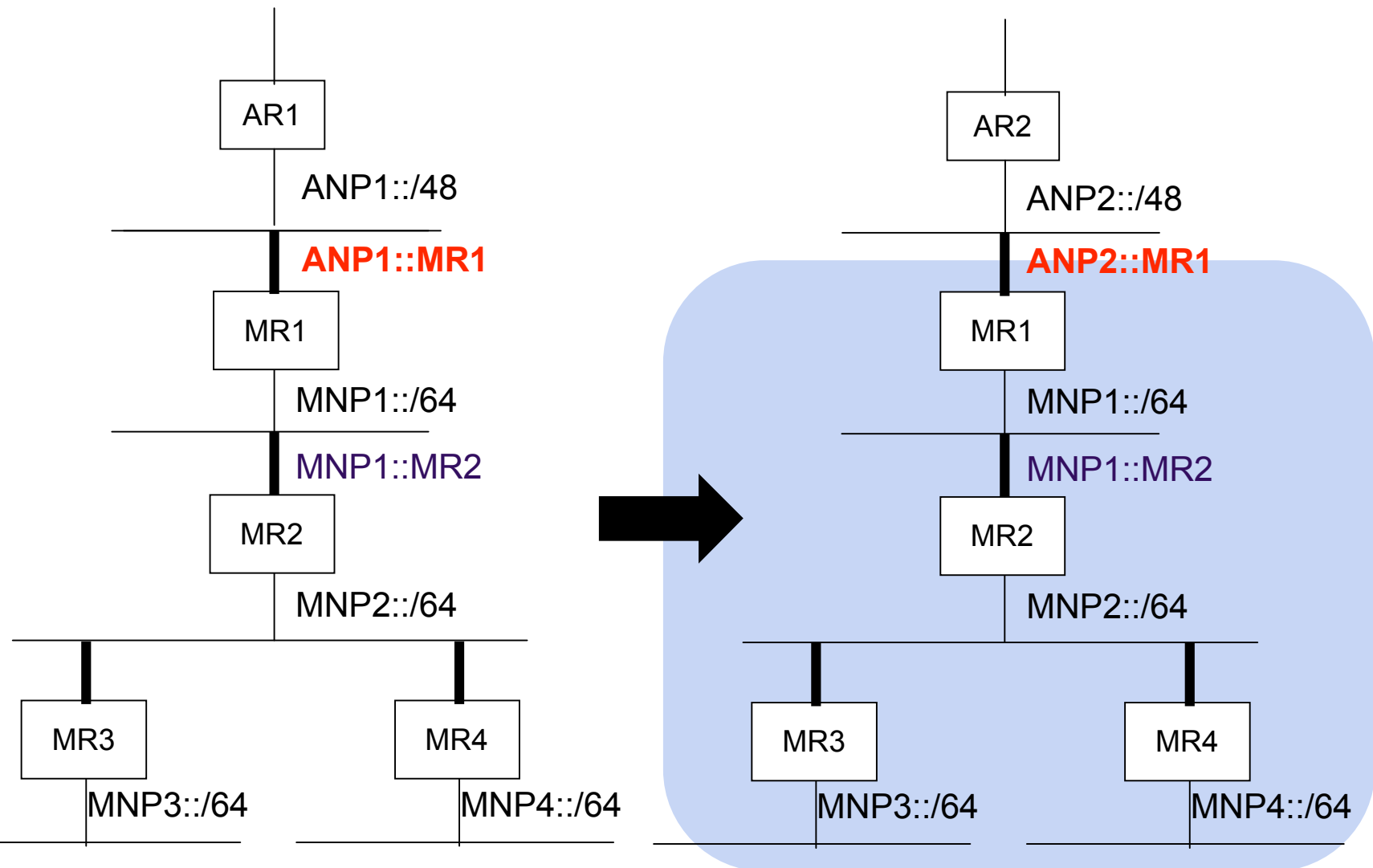
A MR movement causes address changes on all the other MRs.

- > MR MUST update CoA
- > MR MUST send BU
- > MR MAY re-calculate routes

This is orthogonal to the NEMO basic functionality, movement transparency.



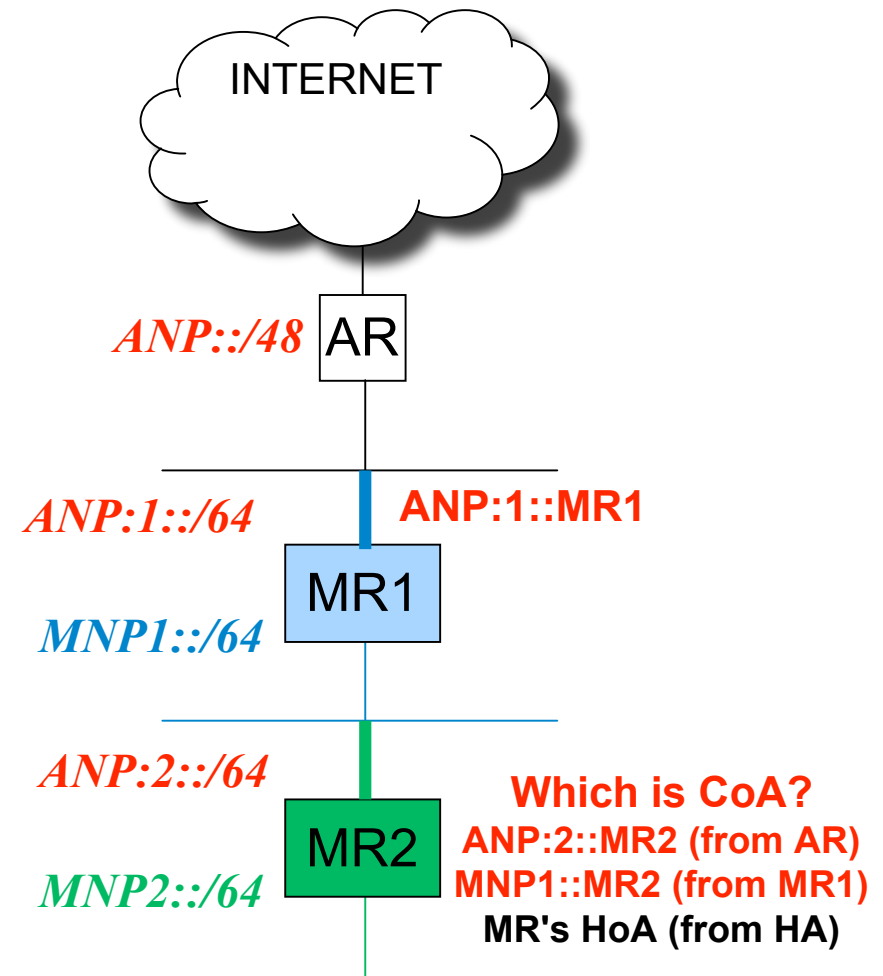
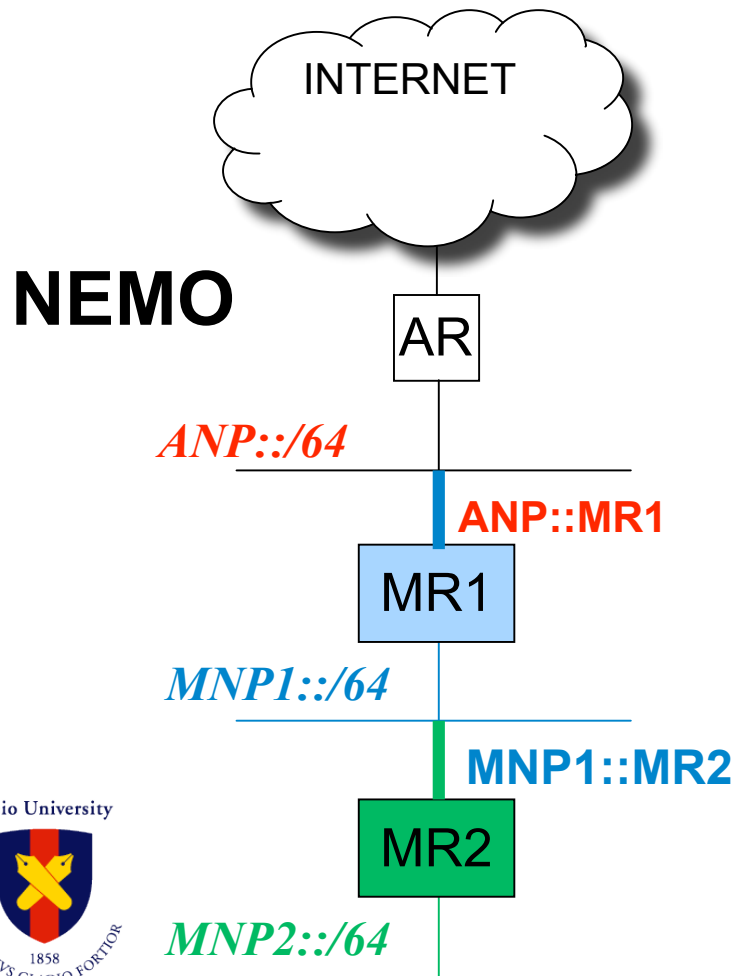
# The NEMO Addressing: Movement Transparency



# Multihoming Capability

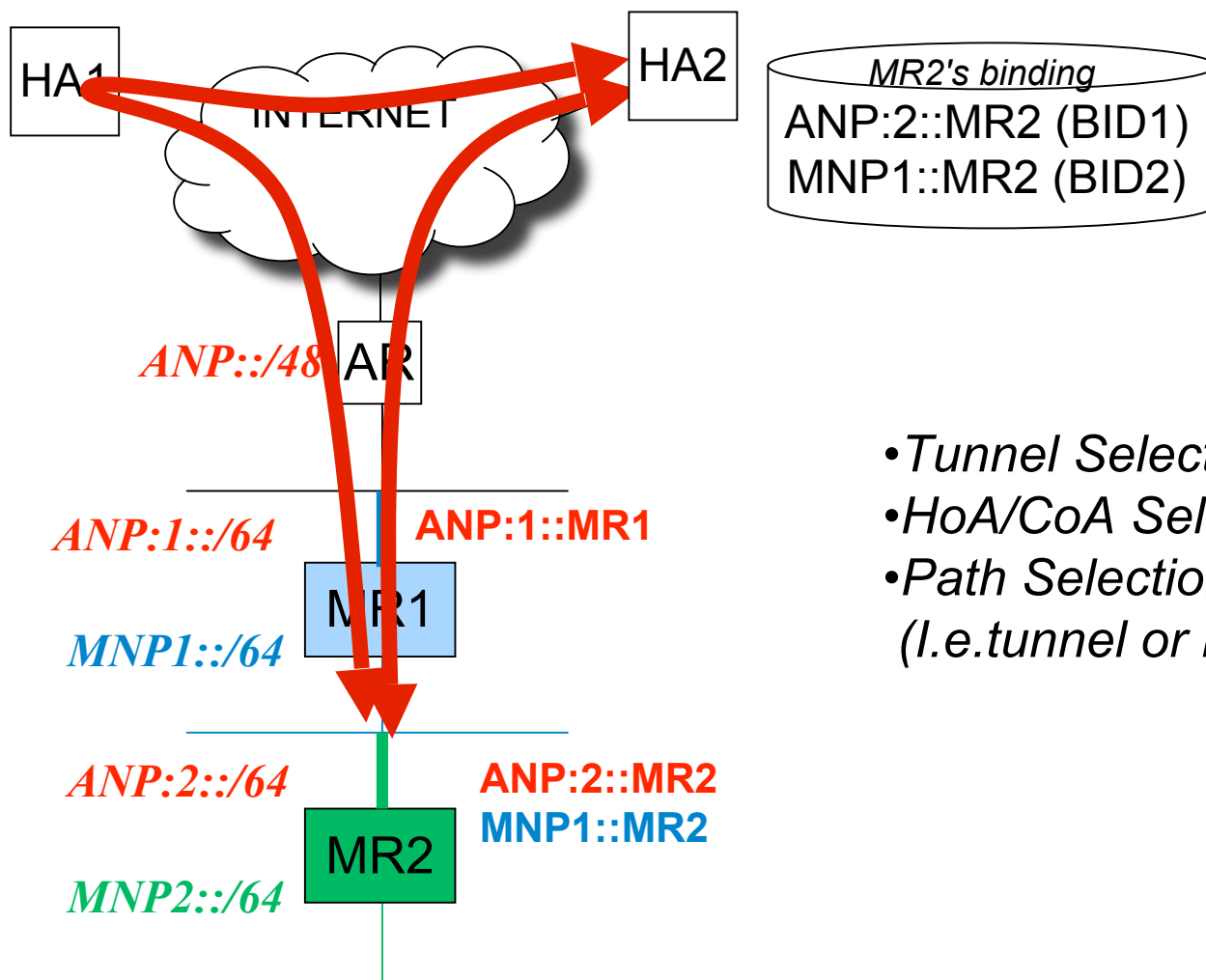
A MR may obtain multiple addresses in Nested NEMO,

- 1) NEMO topologically incorrect address
- 2) AUTOCONF topologically correct address.



# 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