Route Optimization Taxonomy:
problem statement, benefits, classification and issues of RO

Prepared for 61st IETF NEMO WG

By

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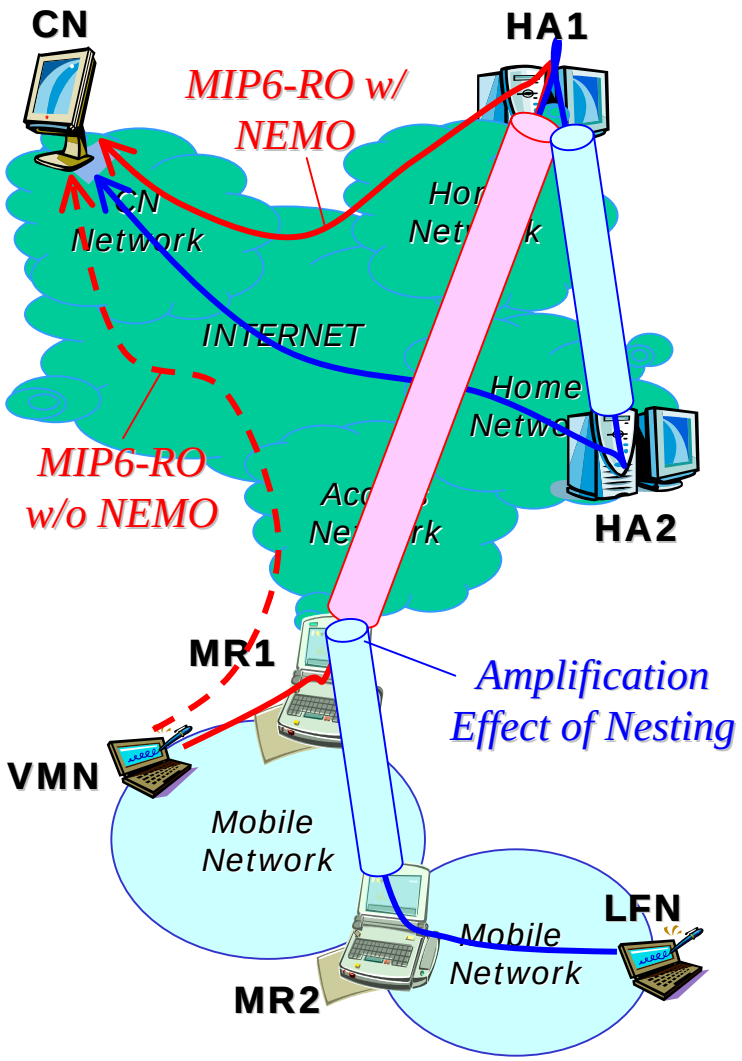
`draft-thubert-nemo-ro-taxonomy-03.txt`

Change-Log

- Changes to `draft-thubert-nemo-ro-taxonomy-03`
  - Added problem statement for route optimization.
  - Discusses benefits of route optimizations
  - Lists a taxonomy for RO Solution Space
    - this is a bit different from previous version
  - Explores into issues route optimization solution might face, including security considerations
  - All solution-specific descriptions are moved to Appendix

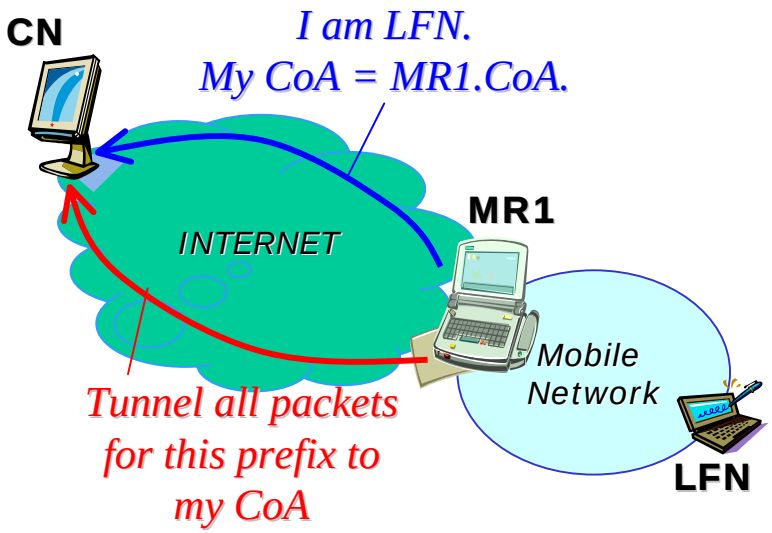
Problems with NEMO Basic

- Sub-optimality of NEMO Basic Support
  - Longer route → increased delay
  - Increased packet overhead
  - Increased processing delay
  - Increased chances of fragmentation
- Nesting of Mobile Network
  - Amplification Effect of Nesting
    - Each level of nesting amplifies the sub-optimality by an order
- MIPv6 Route Optimization
  - Even if MIPv6 RO is used, it will be subjected to the sub-optimality of NEMO basic

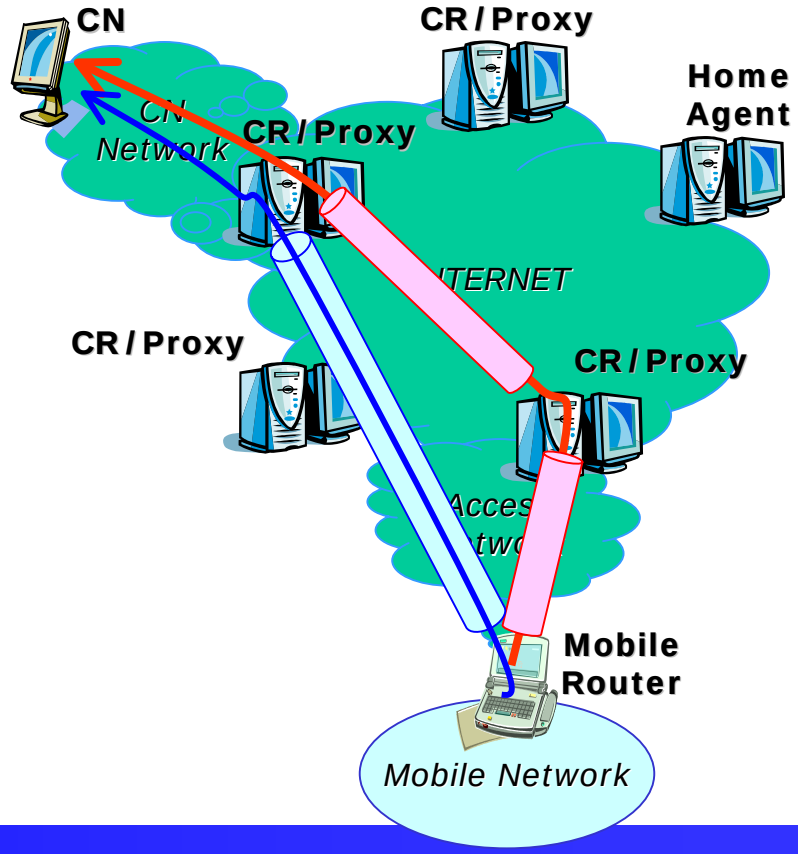


Types of Route Optimization (1)

- MR-to-CN Optimization
  - MR send Prefix-scoped BU to CN
  - MR act as proxy for MNN

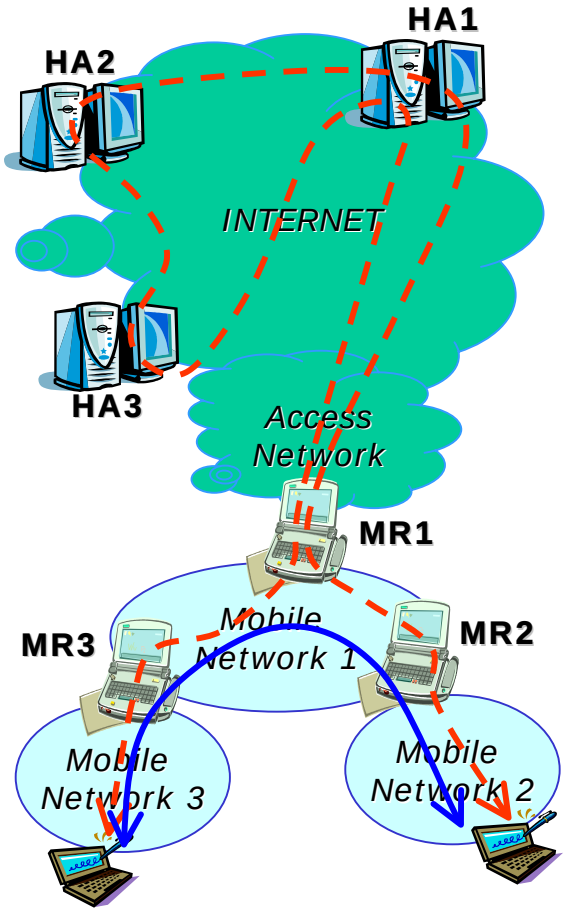


- Infrastructure Optimization
  - Partially: MR tunnels to CR
  - Fully: HA-HA co-operations



Types of Route Optimization (2)

- Nested Tunnels Optimization
  - Eliminates amplification effect of nesting
- MIPv6-over-NEMO Optimization
  - Allows MIPv6 RO to skip the NEMO MRHA tunnel
- Intra-NEMO Optimization
  - Eliminates the need for packet to move out of root-MR when 2 MNNs are talking to each other



Possible Issues with RO: General

- Additional Signaling Overheads
  - BU Storm
- Increased Protocol Complexity
  - May be significant to mobile devices where resources are significant
- Mobility Awareness
  - Tradeoff of location privacy
- New Functionalities
  - Ease of implementing new functionalities in existing entities

Possible Issues with RO: MR-to-CN

- Security Consideration
  - Why should CN 'believe' the Network Prefix?
  - MR as a Proxy may break security protocols
- BU Storm
  - A change in point of attachment may cause MR to send BU to lots of CNs
- Complexity of MR as a Proxy
  - May require MR to scan every packet beyond standard IP header
  - MR needs to maintain states for every MNN-CN flow
  - A hack – new protocols may not work over this hack

Possible Issues with RO: Infrastructure

- Security Consideration
  - Verification of correspondent router
  - Verification of mobile network prefix
- Discovery of Correspondent Router
  - How to find a suitable correspondent router given a CN?

Possible Issues with RO: Nested Tunnels

- Security Consideration
  - Sending of upstream router information needs to be checked
- BU Storm
  - Possible BU storm when root-MR switches its point of attachment, causing every nested MR to send BU
- Complexity
  - May require a recursive complexity at the HA and/or correspondent node

Possible Issues with RO: MIPv6/NEMO

- Extension of other optimizations
  - Most other forms of route optimization can be adapted with minimal modifications to apply to MIPv6-over-NEMO optimization
  - Especially Nested Tunnels Optimization
  - Share similar concerns

Possible Issues with RO: Intra-NEMO

- Extension from other optimization
  - Again, most other forms of optimizations can be applied to Intra-NEMO optimization with little or no modifications
- Reliance on External Infrastructure
  - For Intra-NEMO optimization to work, a connection to an external entity (eg HA) must be available.

Is Content as Expected by WG?

- What we still lack
  - More text on using MANET routing for Nested Tunnels and Intra-NEMO optimizations
    - Will update in next version
  - Missing reference to possible solutions?
    - Please drop us a note!
  - Requirements for RO Solution
    - separate WG draft after WG re-charter?
  - Evaluation Metrics for a RO solution
    - In the requirements draft?