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

Prepared for 61st IETF NEMO WG

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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

I am LFN.
My CoA = MR1.CoA.

Tunnel all packets for this prefix to my CoA

• 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 (e.g., HA) must be available.
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?