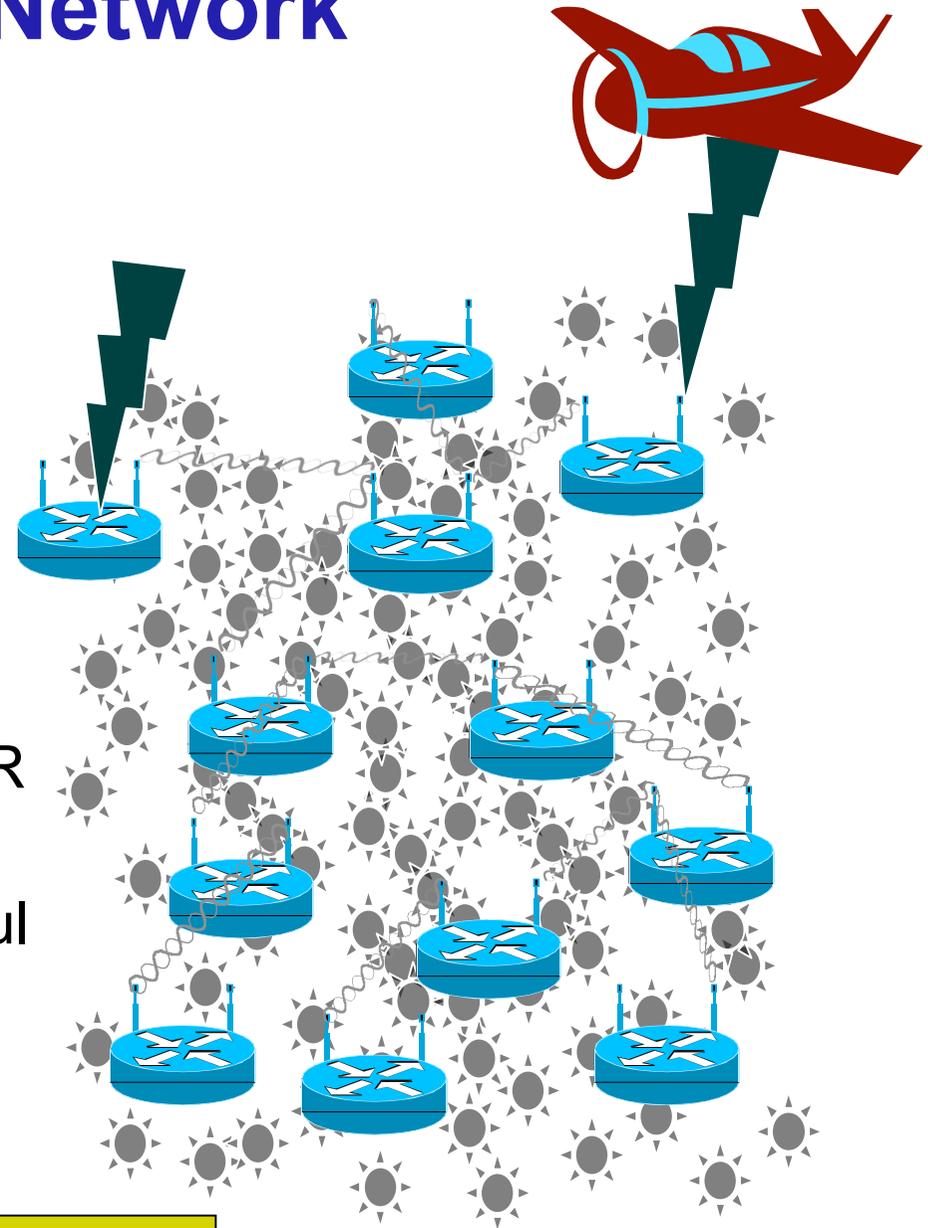


MANEMO GOALS

Scenarios and Requirements

Sensors Network

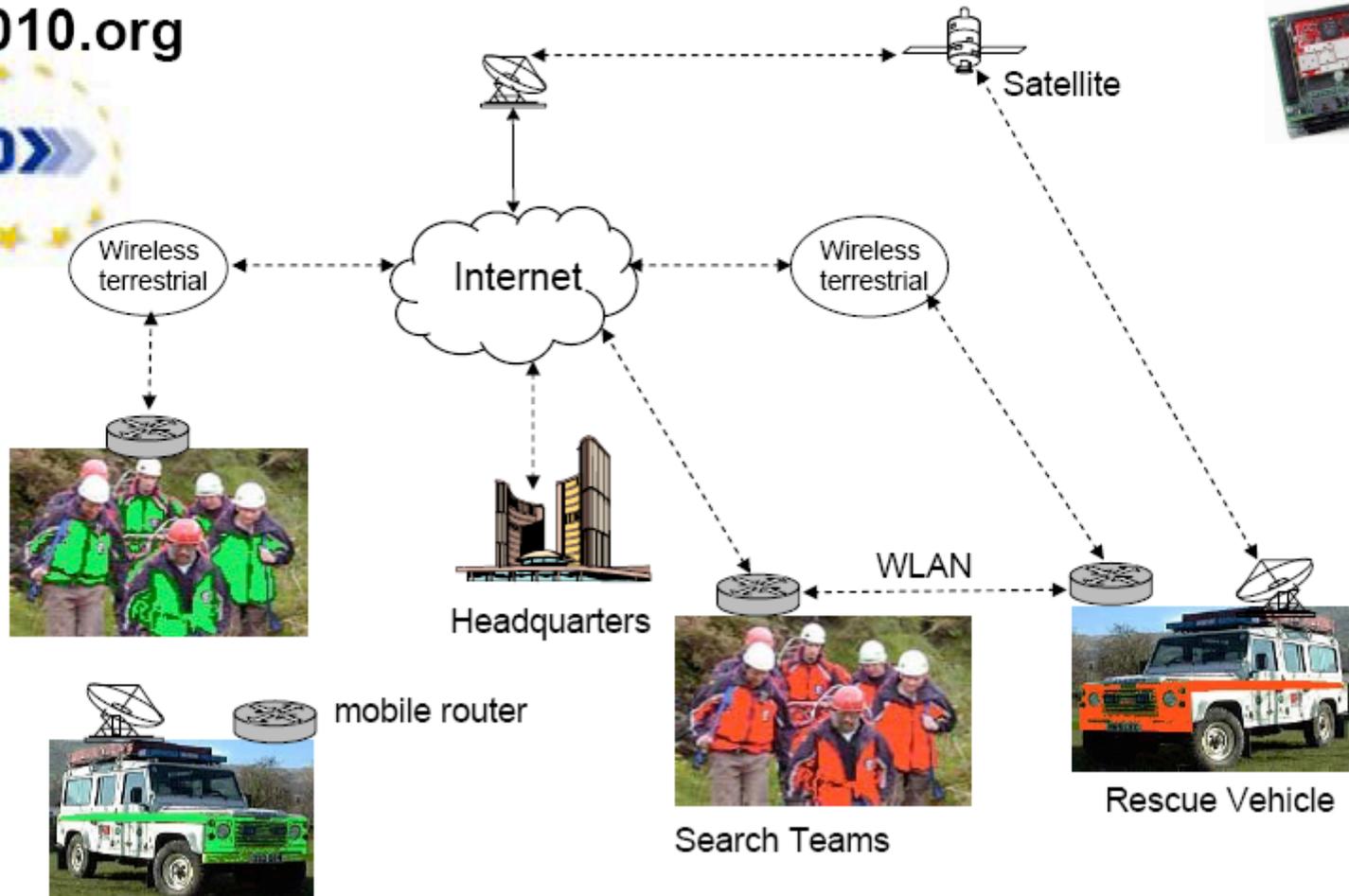
- “Sensor dust” spread over a territory
- Sensors assume a fixed arbitrary geographical distribution
- numerous sensors with limited capabilities (LFN == RFD*)
- A limited number of relays (MR == FFD*)
- Few uplinks (MR with backhaul capability)
- Mobile Sensors, mobile Sinks



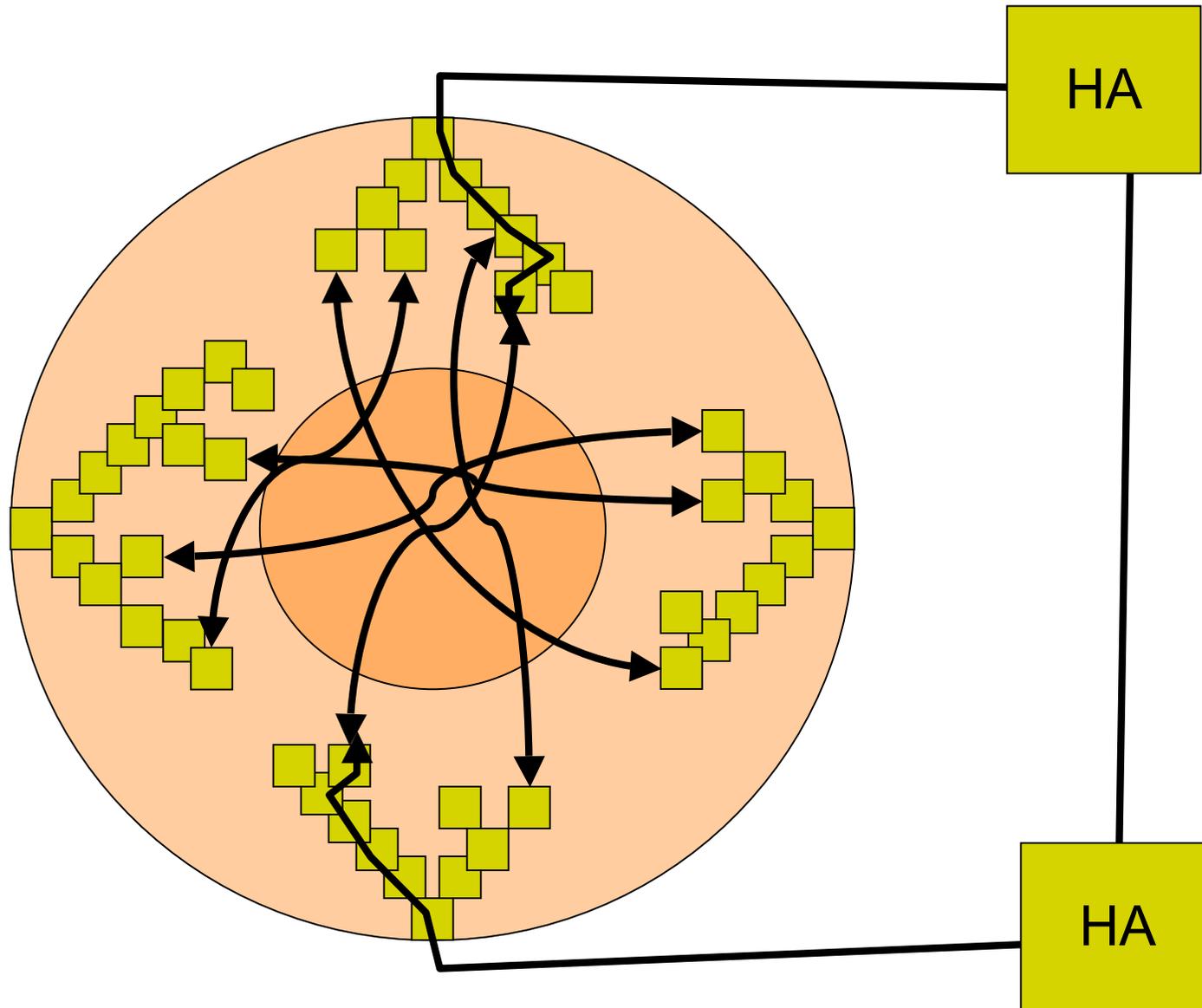
* Reduced and Full Functions Devices

U-2010 (2006 – 2008)

www.u2010.org

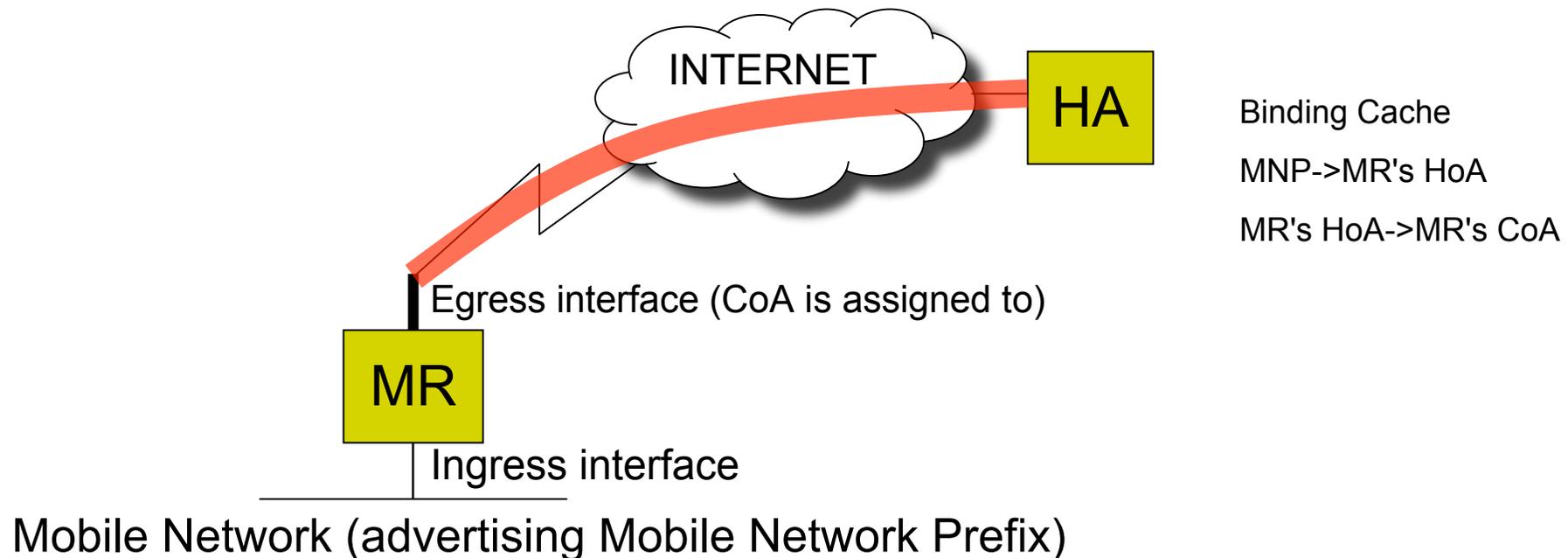


Disaster area



What is NEMO?

- Mobile Router has
 - two interfaces: egress is for Internet connectivity, and ingress interfaces is for a mobile network.
 - an permanent prefix called mobile network prefix assigned to the ingress interface
- Mobile Router sends a Binding Update for its mobile network prefix to its Home Agent and creates bi-directional tunnel with the HA for the mobile network prefix.
- Mobile Network is seen as normal IPv6 link so that mobile network nodes attached to the mobile network is not aware of mobility at all.



What is MANEMO?

MANEMO provides the necessary additions to existing protocols (IPv6, ND, NEMO), for nested Mobile Routers to find the most suited exit towards the infrastructure. MANEMO enables some internal connectivity within the nested NEMO whether the infrastructure is reachable or not.*

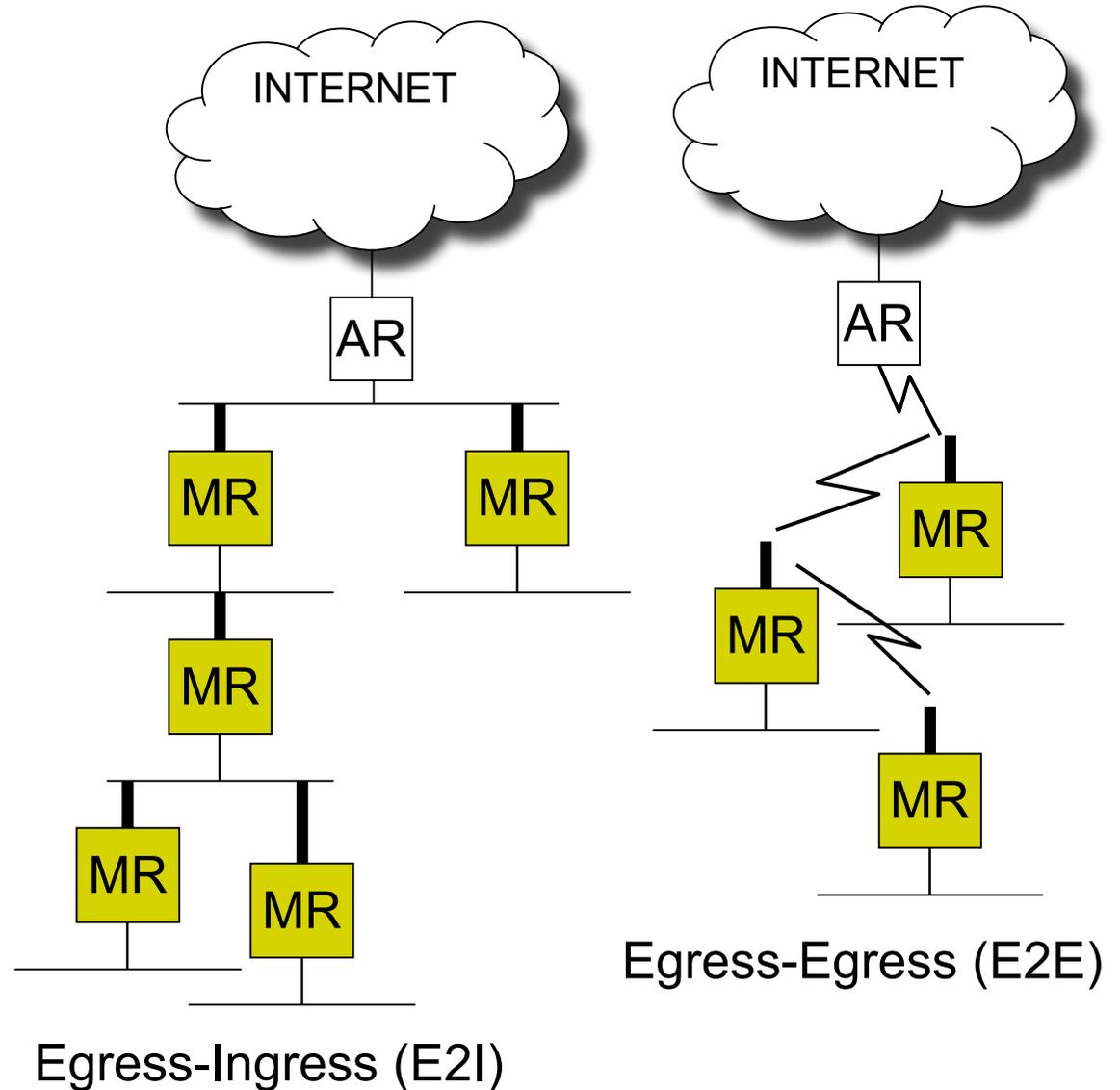
* **draft-wakikawa-manemo-problem-statement-00.txt**

MANEMO requires

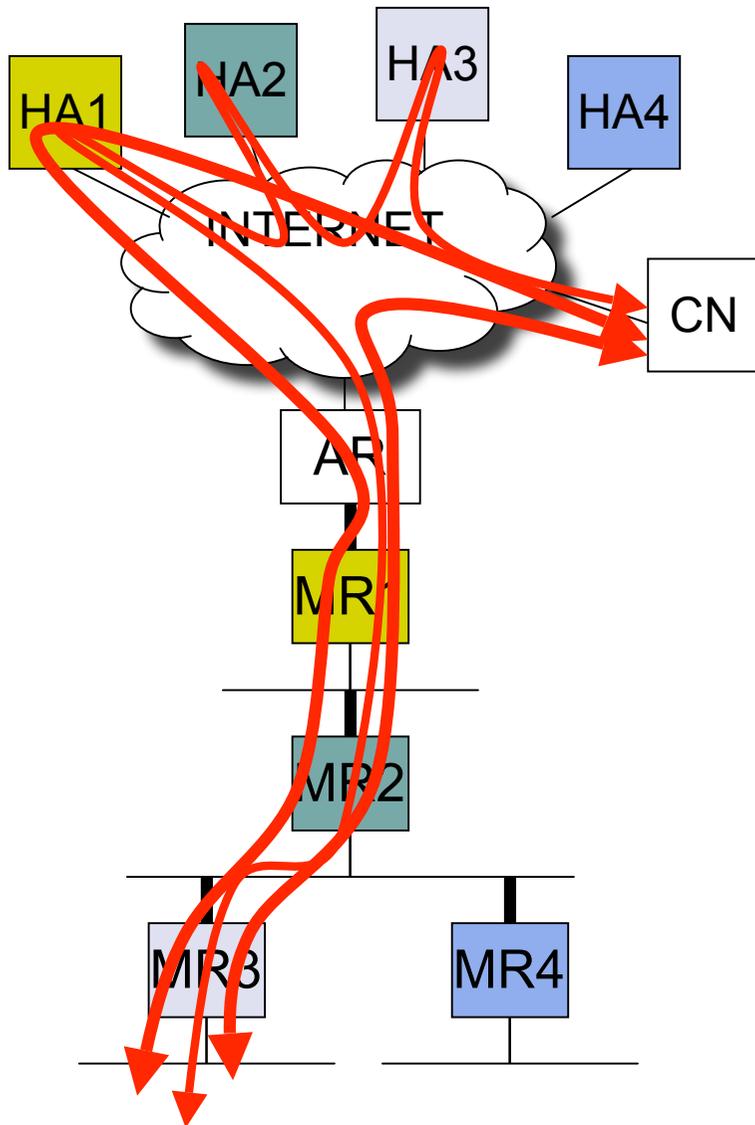
- Formatting the nested NEMO
 - Into a Loopless Logical Topology
 - Oriented towards the “nearest” Exit Router
- Internal routing in nested NEMO
 - Routing Scope depends on bandwidth and stability
 - Routing decision via the infrastructure vs. within MANET
- Managing multicast within nested NEMO
 - Seamless support of inner movement
 - MLD proxy type of interaction with the infrastructure
 - Inner default rendezvous point when not connected to infrastructure

Nested NEMO operations

- Exit router discovery
- Loopless attachment router selection
- E2I routing
 - Along the loopless topology
- E2E routing
 - Line of sight
 - One hop away
 - Routed (MANET)

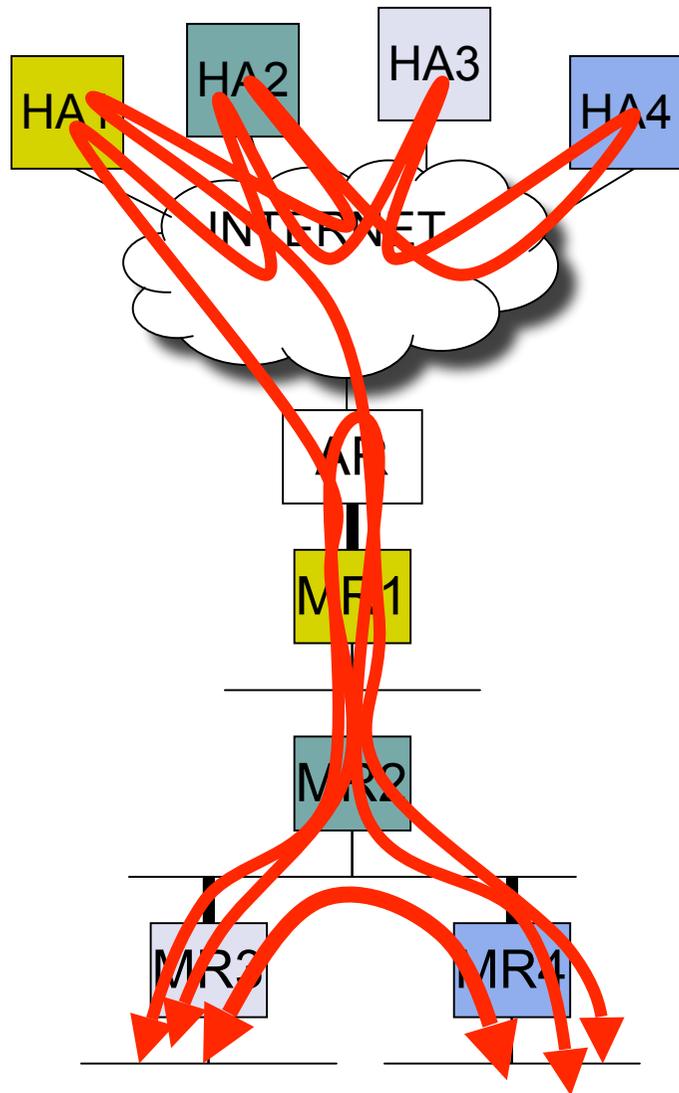


Optimized Path from Nested NEMO to the Internet (vice versa)



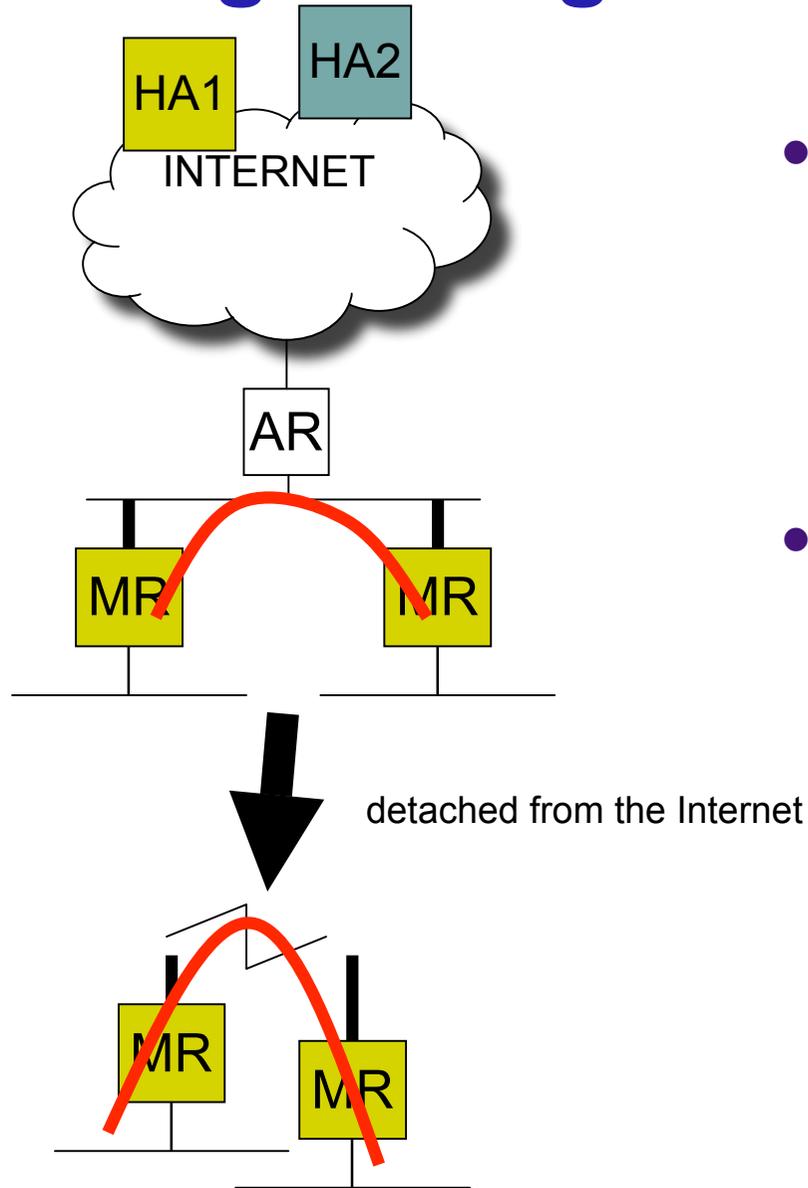
- **This should be addressed in NEMO WG**
- *A mechanism to route packets over nested NEMO without multiple IP encapsulations and ping-pong routing among HAs.*

Optimized Path inside Nested NEMO



- The Path From MR1 to MR4
 - MR1->AR->HA1->HA4->HA2->HA1->AR->MR1->MR2->MR4
- The Path from MR3 to MR4
 - MR3->MR2->MR1->AR->HA1->HA2->HA3->HA4->HA2->HA1->AR->MR1->MR2->MR4
- **This may be out of scope in NEMO WG**
 - *A mechanism to exchange "Mobile Network Prefix" inside a nested NEMO and to provide certain optimized path.*

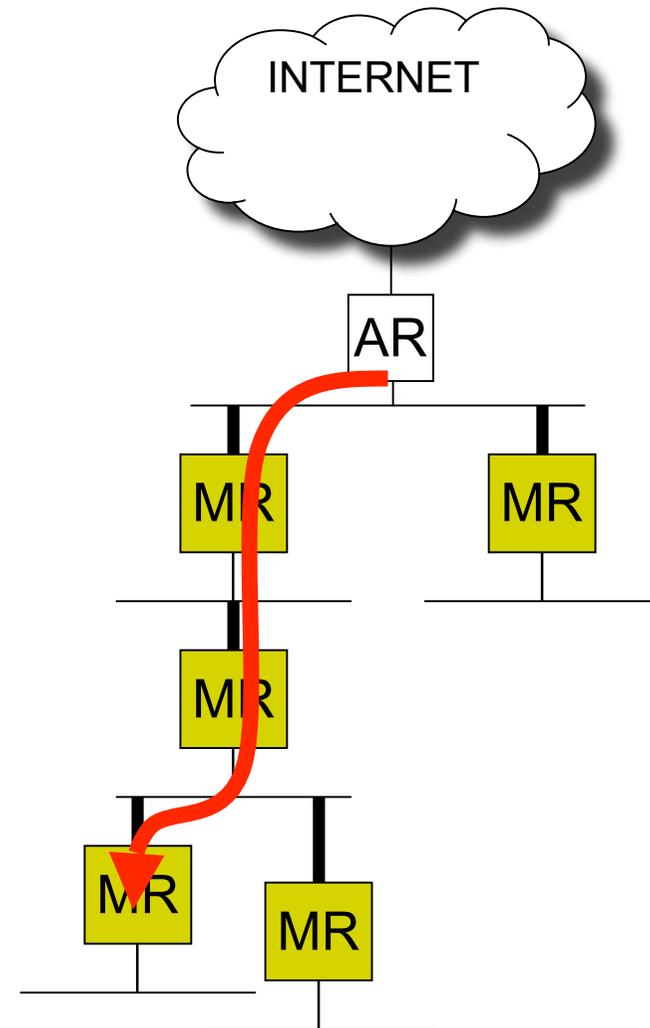
Egress-Egress connection



- Communication capability between nearby MRs
 - without Internet reachability
 - without HA involvement
- NEMO scope or maybe not
 - depending on topology of MRs
 - multi-hop?
 - one hop?

Exit Router Discovery

- Attaching node is unaware of mobility and reachability to the Internet.
 - Mobile Network is seen as an IPv6 link.
 - Since this is NEMO, a mobile network is not always reachable to the Internet due to movements.
- Clarification
 - NEMO scope.
 - Need an mechanism to know the reachability and an exit router(s) to the Internet.
 - Not NEMO scope.
 - forming a nested NEMO without loop in logical fashion
 - maintaining a route between an exit router and each MR



Relationship with MANET

- In NEMO perspective,
 - Internet reachability is the highest requirement
 - as opposed to the routing inside the nested NEMO
 - Each Mobile Router has own prefix
 - assigned by NEMO
 - Nodes form temporary addresses from MNP
 - => no renumbering due to movements
 - Radio resources are scarce
 - Infrastructure has relatively huge bandwidth
 - using infrastructure unless close neighborhood
- MANET applicability
 - forming loop free topology
 - with minimum (0) overhead
 - internal routing in nested NEMO
 - within constraint

Solution Requirements

- R1: The MANEMO protocol must enable the discovery of multihop topologies at layer 3 from mere reachability and elaborate links for IPv6 usage, regardless of the wired or wireless media.
- R2: The MANEMO protocol must enable packets transmitted from Mobile Routers visiting the MFS to reach the Internet via an optimized path towards the nearest Exit Router, and back.
- R3: MANEMO must enable IP connectivity within the nested NEMO whether the infrastructure is reachable or not.
- R4: The MANEMO protocol must enable packets transmitted from Mobile Routers visiting the MFS to reach the Internet with a topologically correct address.
- R5: The MANEMO protocol should aim at minimizing radio interference with itself as the control messages get propagated in the MFS.
- R6: MANEMO protocol must enable inner movements within MFS to occur, and ensure details of this movement are not propagated beyond the MFS.
- R7: An MFS may split to become two separate MFSs, in this case MANEMO will continue to maintain local connectivity within the separate MFSs and connectivity between the MFSs will be restored once a NEMO connection becomes available.
- R8: The MANEMO protocol should enable and optimize the trade-off between ensuring some reciprocity between MFS peers and maintaining a safe degree of CIA (see Paragraph 3 in the terminology section (Section 2)) properties between the peer Mobile Routers.
- R9: The MANEMO protocol should enable that Mobile Routers be deployed to restore connectivity in parts of an MFS went isolated, or extend the connectivity in the areas that are not covered.
- R10: The solution MUST not require modifications to any node other than nodes that participates to the MFS. It must support fixed nodes, mobile hosts and mobile routers in the NEMOs that form the MFS, and ensure backward compatibility with other standards defined by the IETF.
- R11: The MANEMO protocol shall enable multicast communication, for nodes within the MFS and on the Internet. Translation of MANEMO multicast signaling and multicast signaling on the Internet shall take place on the Exit Router.
- R12: The MANEMO protocol shall optimize the path to the Internet using cross-layer metrics.

More info

- MANEMO Web
 - document lists, agenda for pre-BOFs, ML information

<http://www.mobileip.jp/MANEMO/>

- ***Pre BOF Thursday 19:30- 21:00 in Tyrolka.***
- Contact address:
 - Ryuji ryuji@sfc.wide.ad.jp
 - Pascal pascal.thubert@gmail.com
 - Teco teco@inf-net.nl

Related drafts

- ✓ **draft-wakikawa-manemo-problem-statement-00.txt**
- ✓ **draft-clausen-nemo-ro-problem-statement-01.txt**
- ✓ **draft-boot-manet-nemo-analysis-00.txt**
- ✓ **draft-baldessari-c2ccc-nemo-req-00.txt**
- ✓ **draft-chakrabarti-mobopts-lowpan-req-01.txt**
- ✓ **draft-ietf-nemo-ro-space-analysis-03.txt**
- ✓ **draft-ietf-nemo-ro-problem-statement-03.txt**
- ✓ **draft-ietf-autoconf-manetarch-01**
- ✓ **draft-thubert-tree-discovery-04.txt**
- ✓ **draft-thubert-nina-00.txt**
- ✓ **draft-petrescu-manemo-nano-00.txt**
- ✓ **draft-thubert-nemo-reverse-routing-header-07.txt**
- ✓ **draft-templin-autoconf-dhcp-05.txt**