Improving Multihoming in Wireless Personal Area Network

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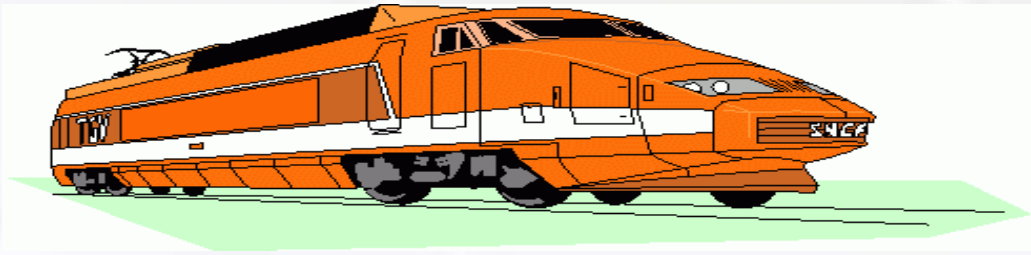
Introduction

- Mobile Network (MoNet):
  - ✓a set of devices moving together and viewed as a single unit.
  - ✓Access to the Internet for Mobile Network Nodes (MNNs) is provided by Mobile Routers (MRs).
  - ✓Mobility management is conducted by the NEMO protocol [1] implemented at MR. (a Home Agent (HA) will store the current MoNet location)

Examples

Personal Area Network (PAN)

Sensors Network inside a vehicle



Passengers devices inside a train

Multihoming

- Definition:
  - more than one access path to the Internet
- Benefits
  - Ubiquitous Access (different radio interfaces => possibility to connect to different Radio Access Technologies)
  - Load balancing (distributing traffic between different points of attachment)
  - Fault Recovery

Example

- **A PAN with two gateways (MRs):**
- **A PDA with WiFi egress interface & a cellular phone with UMTS connection**
- **A local Bluetooth Network is formed by the four devices**

Multihoming aspects (1)

- Connectivity aspect : When a MNN switches between two MRs inside the MoNet, there are 2 possibilities:
  - Keeping or changing the MNN IP address?
    - If changed

      => Session Interruption: TCP sessions are identified by the source/destination IP address
    - If kept

      =>Ingress Filtering: Routers accept only packets with a source address configured based on their prefix (es)

      => NEMO security policy problem: HAs accept only packets from nodes already registered (home@ / CoA)

Multihoming aspects (2)

- MR discovery and selection:
  - How MNNs can discover an egress link failure?
  - How MNNs can select the best egress interface?
  - How MNNs can route their packet to the selected MR?

Proposed architecture

- Connectivity :
  - MNNs keep the same address.
  - Each MR has to register all other MRs CoAs with its HA.
- MR selection and discovery

  - a new virtual interface in each MNN, responsible for collecting information from MRs and selecting the best one, is used

New tasks for MRs

- New tasks introduced:
  - Step 1: Exchanging Information between MRs
  - Step 2: Registration with HAs
  - Step 3: Integrate a Distributed Virtual Network Interface (DVNI) scheme in each MNN needed to achieve MR interfaces discovery and selection

Step 1: Information exchange

- MRs inside the MoNet exchange the following information:
  - CoAs, prefixes, HA' address, Security Parameter Index.
- This information is stored in each MR and used to avoid Ingress Filtering and tunnelling packets to the right HA; the MNN HA.

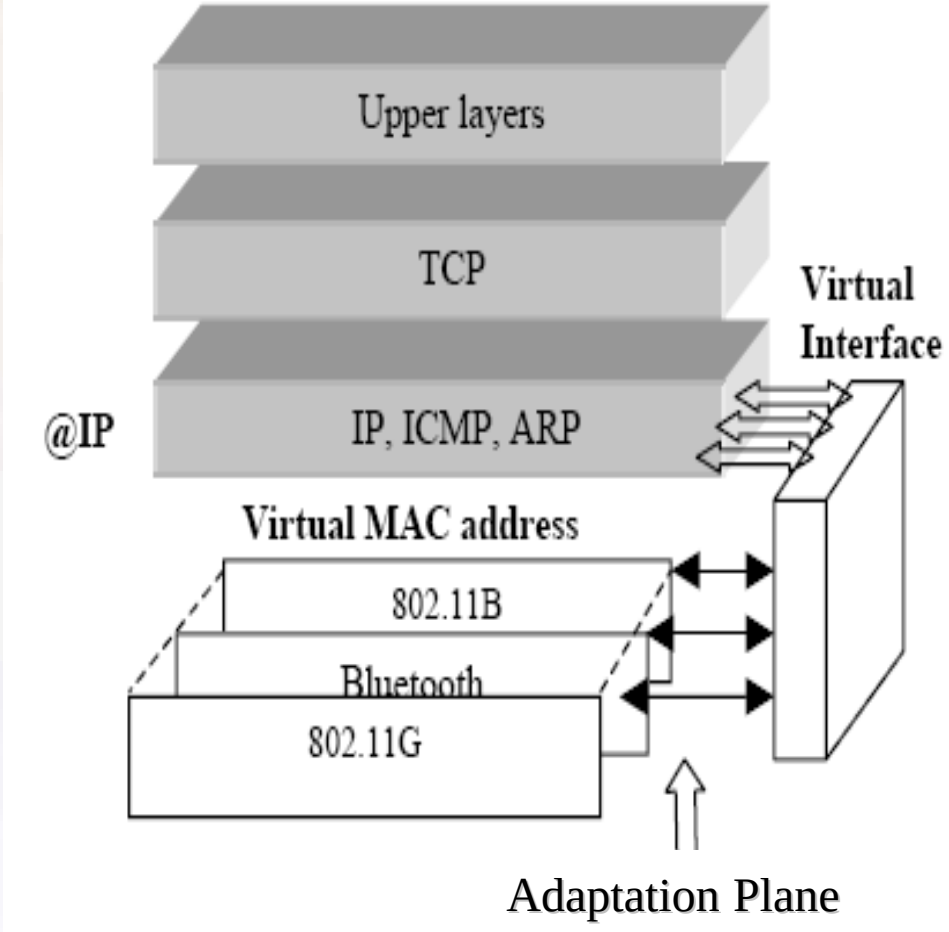
Step 2: Registration

- In addition to registering its CoA, each MR has to register the other MRs' CoA bound to its prefix.
- Example: Binding cache for MR_1's HA

MR' prefix	**MR' CoA**	**BID (Binding Unique Identification)**
MR_1 prefix	MR_1' CoA	BID1
MR_1 prefix	MR_2' CoA	BID2
…	…	…

DVNI solution

- Based on the VNI solution [2] proposed for enhancing the multihomed host operation.
- VNI assigns a unique virtual MAC address to all the radio interfaces available on one terminal.



DVNI solution

- Unique virtual MAC @=>unique IP@=>avoid session interruption
- The idea of DVNI is to extend the VNI concept by pooling all the MoNet egress interfaces together in all the MNN. (as if they are available locally)

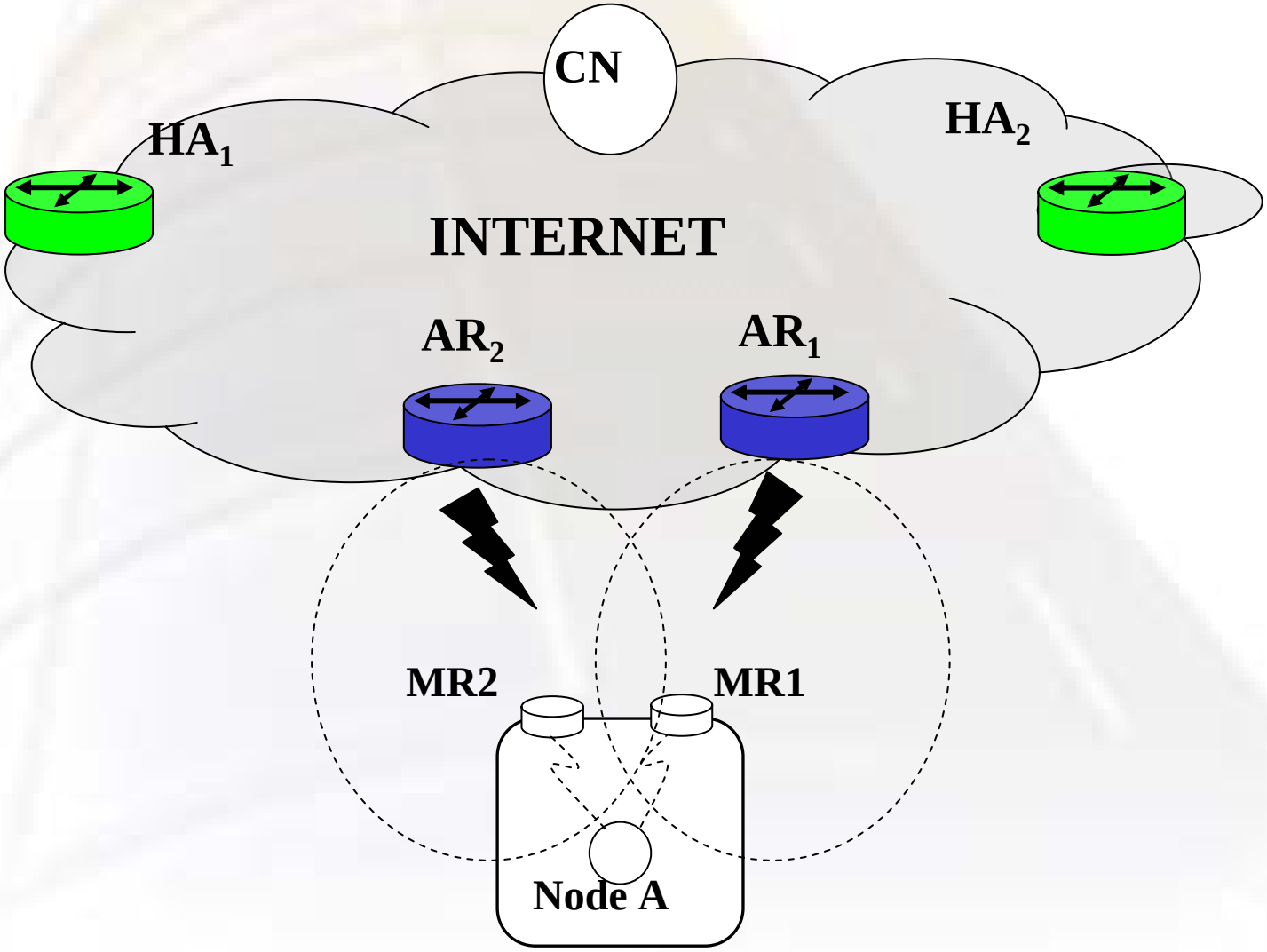
DVNI solution

- Each MR broadcast a “Hello” message containing information (MAC@, lifetime, technology used and route metric) about each of its egress interface.
- The “Hello” message is broadcast periodically and each time one of the egress interface state changes
- MNNs will store this information in their VNI table
- The DVNI will select the best egress interface based on “Hello” message details & applications requirements.

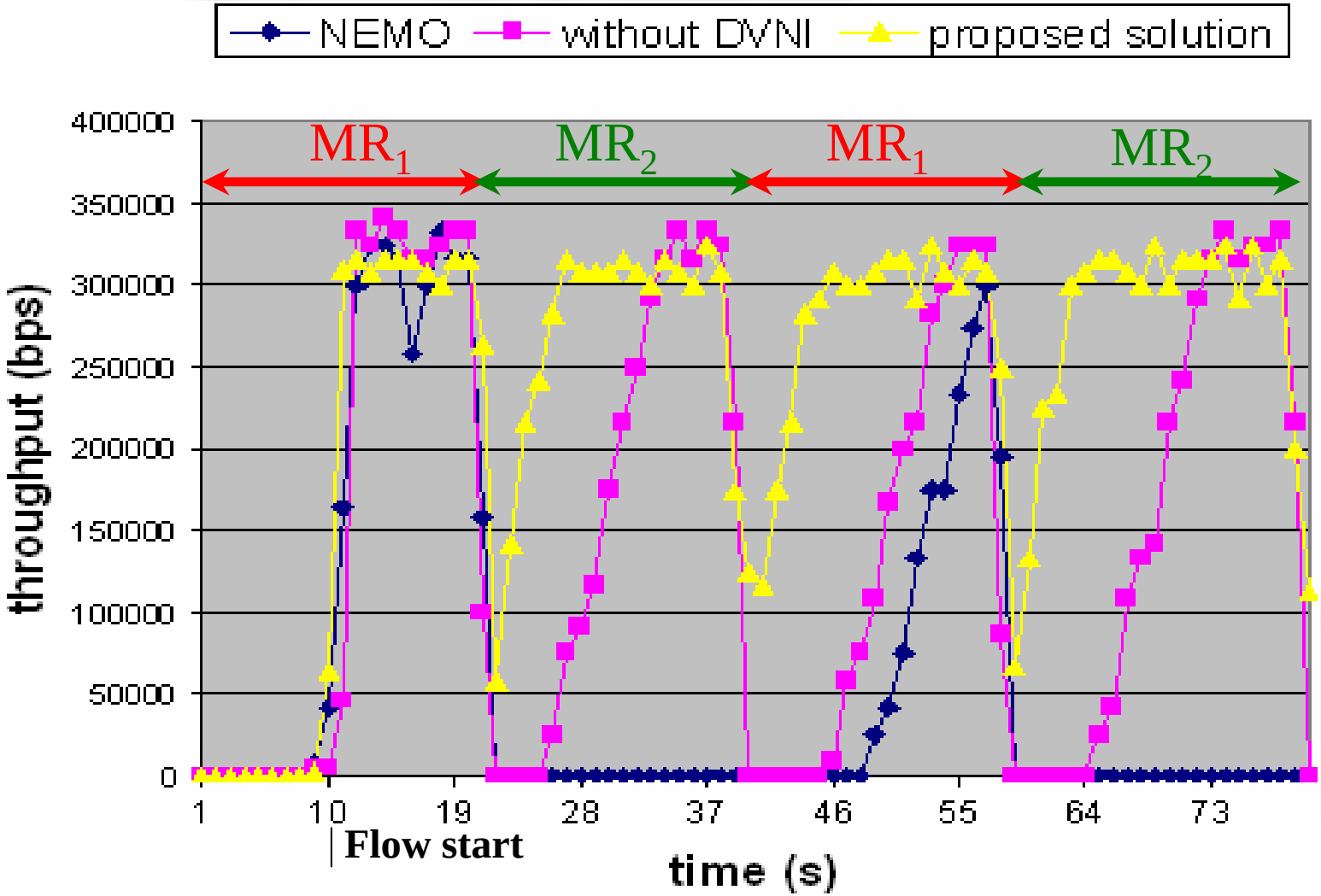
Simulation Study

- Using Network Simulator NS2.28 [3] with Mobiwan extension [4].
- A MoNet with two MRs providing 802.11 access connection.
- MRs are deliberately but successively shut down every 20s to force a switch to the available MR.
- 3 solutions are studied: NEMO basic support, the proposed solution with and without DVNI

Network Model



Simulations Results



Simulation Results

- As said before, NEMO basic support does not enable multihoming operations. (No traffic received when MR2 is used)
- Our proposal resolves this issue (packets forwarded via MR2 are not dropped)
- The DVNI solution enhances multihoming operation in terms of switching latency (no need to wait for Router Advertisements)

Conclusion & Future Work

- We present a new solution for supporting multihoming with mobile networks
- the solution is divided into two parts:
  - New tasks to enable multihoming operations (connectivity aspect)
  - The DVNI mechanism for MR discovery & selection.
- A mechanism for MR authentication will be proposed to avoid attacks.

References

- [1] Vijay Devarapalli et al. “Network Mobility (NEMO) Basic Support Protocol”, RFC 3963 January 2005.
- [2] K. Sethom, M. Sabeur, B. Jouaber, H. Afifi, and D. Zeghlache "Distributed Virtual Network Interfaces to support intra-PAN and PAN-to-infrastructure connectivity", GLOBECOM 2005.
- [3] Network Simulator 2 (NS2), http://www.isi.edu/nsnam/ns/.
- [4] T. Ernst. MobiWan: NS-2 extensions to study mobility inWide-Area IPv6 networks http://www.inrialpes.fr/planete/pub/mobiwan/

Questions