Managing and Exploiting Mobility for Elastic Traffic

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What and Why?

Seamless connectivity
across heterogeneous networks

- Heterogeneous Networks
  - Infrastructure
  - Multiaccess scheme
  - QoS and Pricing
  - …
- Connectivity: *Vertical* and *horizontal* handoffs

What and Why? (2)

- Managing mobility in
  - Traditional structured networks
  - Quasi-structured networks
- Exploiting mobility in
  - Ad hoc networks
- Vertical handoffs
- Stream traffic
  - SIP-MIP interworking

Managing Mobility in Traditionally Structured Networks

- Mobile Internet Protocol version 6 (MIPv6)
  - Pros
    - Expanded address space
    - Limitations on mobility (due to the need for a Foreign Agent (FA)) are eliminated

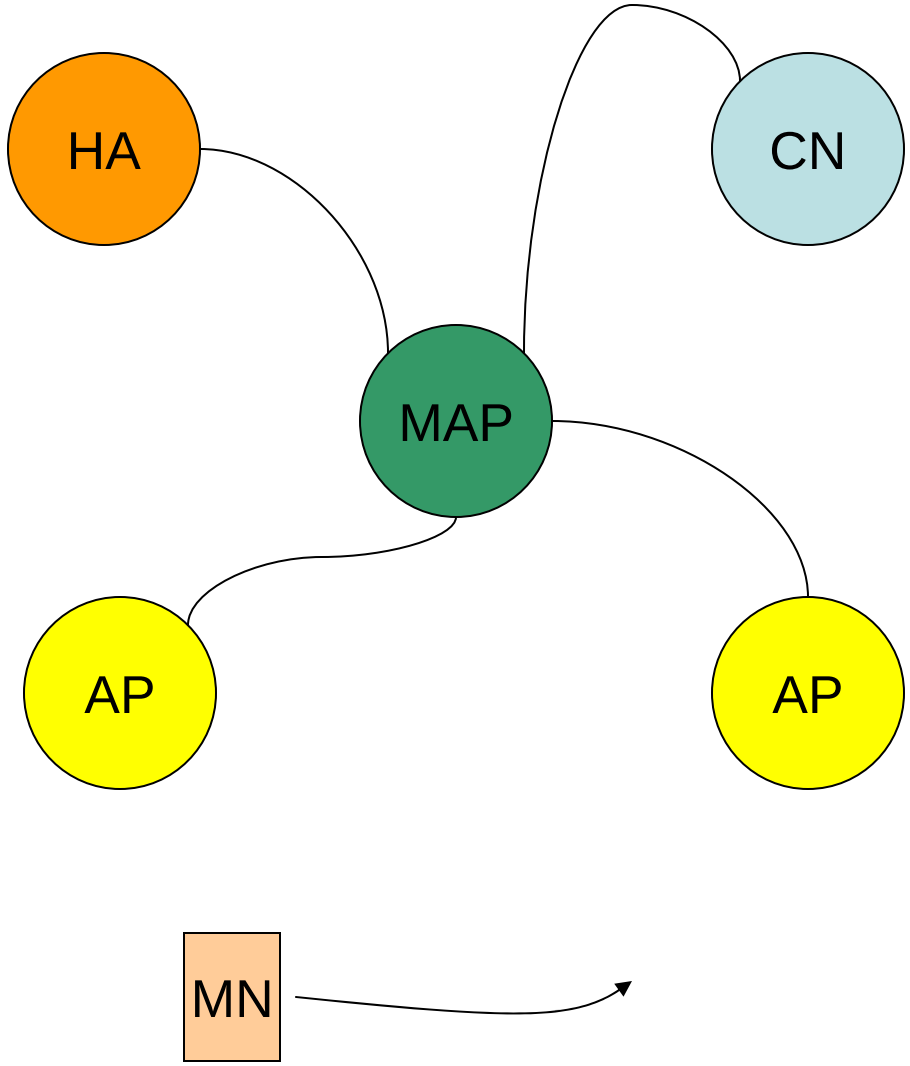
      Stateless Address Configuration
    - Route optimization
  - Cons
    - Poor micromobility support

      Excessively many binding updates (BUs) to Home Agent (HA) and Correspondent Nodes (CNs)

Hierarchical Mobile IPv6 (HMIPv6)

Introduce a local home agent called a Mobility Anchor Point (MAP)

A node that can be located at any level in a hierarchical network of routers



Hierarchical Mobile IPv6

- Principle of HMIPv6's operation
  - MN sends BUs to the local MAP only
  - A single BU suffices for traffic from the HA and all CNs to be routed to MNs new binding access point
- Limits signaling outside MNs local domain
- A MAP is not an FA in disguise since a MAP is not *required* on each subnet.

Comparisons and Inferences

- Clearly the HMIPv6 enhancement lends increased efficiency under micromobility
- Comparison of update costs and delivery costs using HMIPv6
  - Random walk mobility model (Pack, Choi ’04)
  - QoS-controlled handovers
    - Dependence of update costs on QoS parameters (e.g. SIR) relative to dependence on geographical location

Quasi-Structured Networks

What if we allow mobile nodes to

- be served concurrently by multiple access points?
- cooperate with each other?

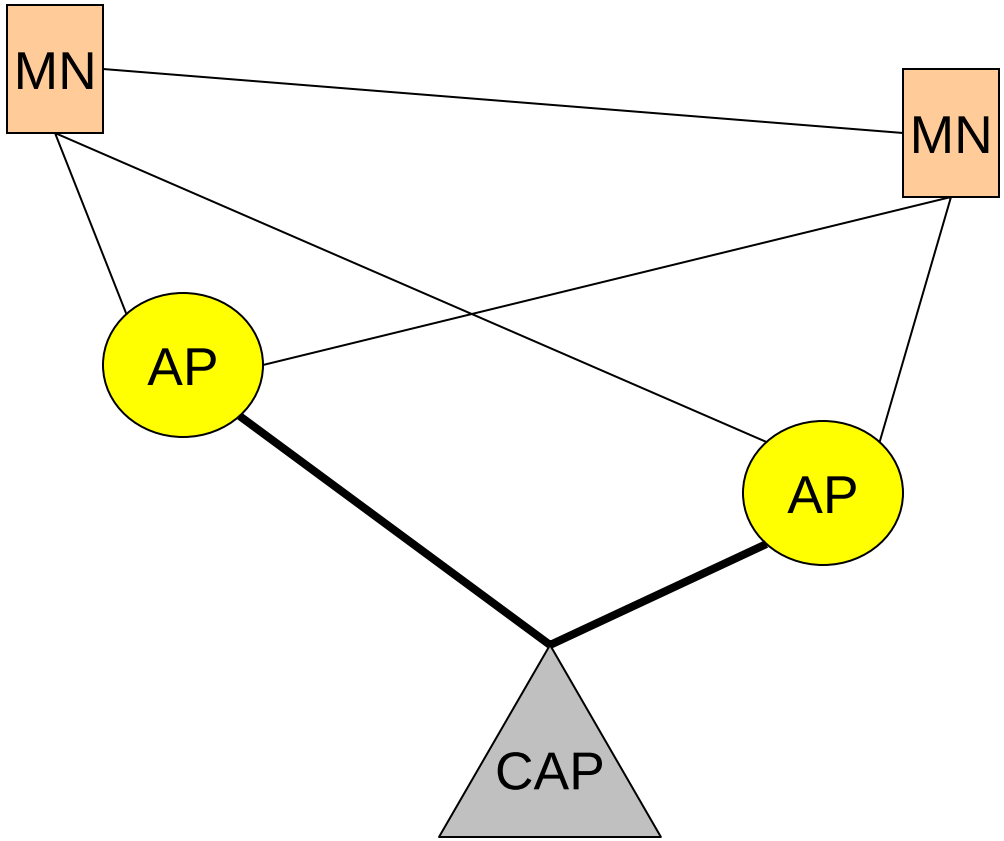
Distributed-spatial-diversity and -multiplexing gains at link layer

References:

[1] J. Thomas, “Distributed multiplexing in multicarrier wireless networks,” in *Multicarrier Spread Spectrum,* eds. S. Kaiser and K. Fazel, Kluwer, 2003

[2] J. Thomas, “Efficient distributed signaling schemes for cooperative wireless networks,” to appear in *Proc. IEEE Vehicular Tech. Conf.,* Los Angeles, CA, September 2004

Quasi-Structured Networks



Generalized notion of QoS-controlled handoff

HMIPv6 in QSNs

- QSNs are likely to be seen in WLANs
- The centralized access point of the MN's current domain is its MAP

  Regional care-of-address = address of MAP
- An MN's MAP and HA are essentially peers with symmetric capabilities
- CNs communicate with the MN's MAP
- An MN needs to communicate only BUs for regional care-of-address changes to its HA
- BUs for local care-of-address changes are communicated to an MN's HA by its MAP

Exploiting Mobility for Elastic Traffic

- Mobility can be exploited in increase the capacity of an ad hoc network for highly elastic traffic (Tse, Grossglauser, ’03)

  Use only a single-hop from source to destination

- Impact of
  - Restricted mobility patterns (Diggavi *et al*, ’03)
  - Relaxing the single hop-count constraint?

Load-Balancing

- Load balancing: A much-studied problem!
- Cross-layer load balancing algorithms
- Ad-hoc extensions to augment coverage area of a structured network
  - Low-bandwidth load-balancing algorithms for gateways to such ad-hoc extensions
  - Address allocation for nodes on ad hoc extension

Vertical Handoffs

Multiple protocol stacks for vertical handoffs

- Natural approach for handoffs across heterogeneous access technologies
- How about for different protocol versions?

MIPv4 - MIPv6 translations

- Use MIPv6 only for dual stack nodes
  - Each MN uses both v4 and v6 care-of-addresses to update its HA
  - Each MN knows both v4 and v6 address of its HA

SIP-MIPv6 Interworking

- SIP = Session Initiation Protocol

  Provides a mechanism for call establishment and management (determine source address, add new streams, add new participants, transfer call…)

- The IP address in a SIP message from an MN must be the source address of the MN

SIP-MIPv6 Interworking (2)

- What address should an MN use for SIP communication
  - its home address or its care-of address?
    1. Home address: Back to *tunneling*!
    2. Care-of Address: *Reinvite* destination nodes upon changing Care-of Address?

- Solutions:
    1. Is the SIP proxy an IPv6 node?
    2. HMIPv6?