無線網路多媒體系統
Wireless Multimedia System

Lecture 9 & 10 Ad hoc & Multicast

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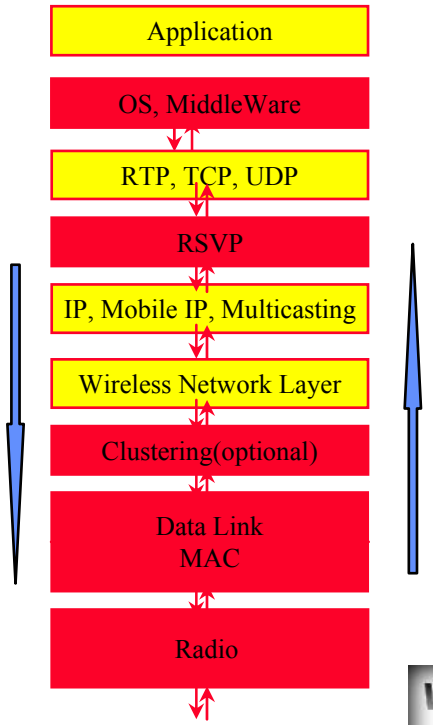
http://inrg.csie.ntu.edu.tw/wms

Two Issues for Collaborative Computing

- Network Layer Collaborative:
  - Ad hoc~ Infrastructure-less ~ support “anytime, anywhere”
  - To support communications between ad hoc nodes
    - To guide the packets effectively to satisfy different requirements
    - To adjust to dynamical topology change (due to Mobility)
- Application Collaborative:
  - Video Conferencing, News Broadcasting
  - Group of users to share the same information
  - Mobility Support



Today's Agenda

- Ad hoc Network Review
- Multicasting for Mobile Network

Observations

Personal Communications have been the dominant paradigm so far, but mobile ad hoc networks open new possibilities, such as the communication between objects

Survey of Ad hoc Researches

Characteristics of Ad hoc

- Fully Distributed
- Complete Wireless
- Forwarding Functions
- Dynamic Topology

Applications of Ad hoc

- Packet Radio (PRNet), 1972
- MANET (1990)
- Sensor Networks
- Glomo Network
- Commercial Applications
- Large Scale Ad hoc Network
- Complementing Cellular System

Maintenance of Ad hoc

- Proactive Protocols
- Reactive Protocols
- Symmetric Links
- Hierarchical Protocol
- Power Budget & Lattency
- Beaconing & Link Status
- QoS Routing
- Application Routing
- GPS Assisting Routing

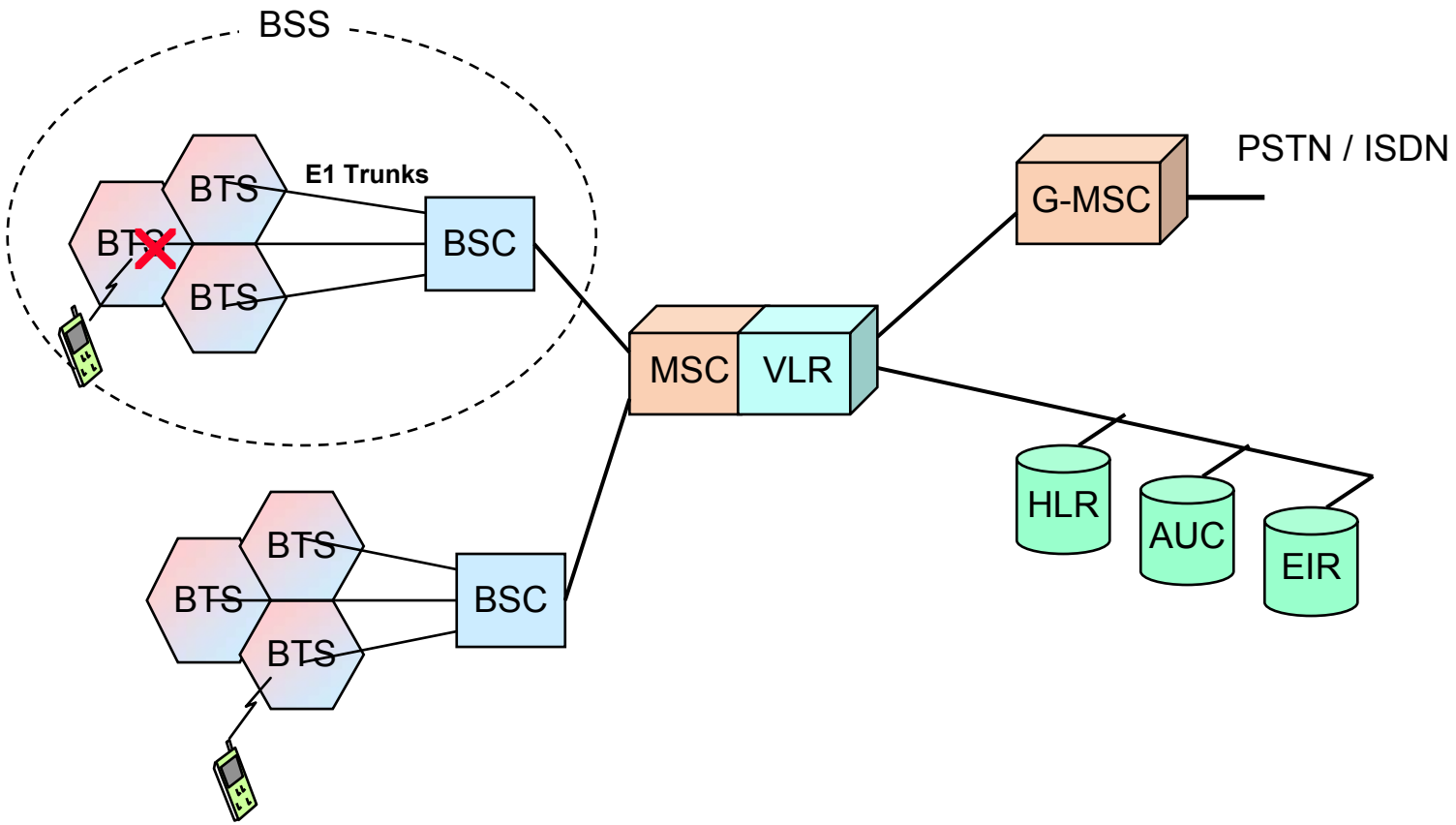
Reading

- [Jean2001] Jean-Pieere Hubaux, Thumas Gross, Jean-Yues Le Boudec, and Martin Vetterli, “Toward Self-Organized Mobile Ad Hoc Networks: The Terminodes Project”

Agenda

- Overview of Mobile Ad Hoc Networks
- Major Technical challenges:
  - Networking
  - Real time services
  - Software
- Long-term Research Project:
  - Terminodes Projects

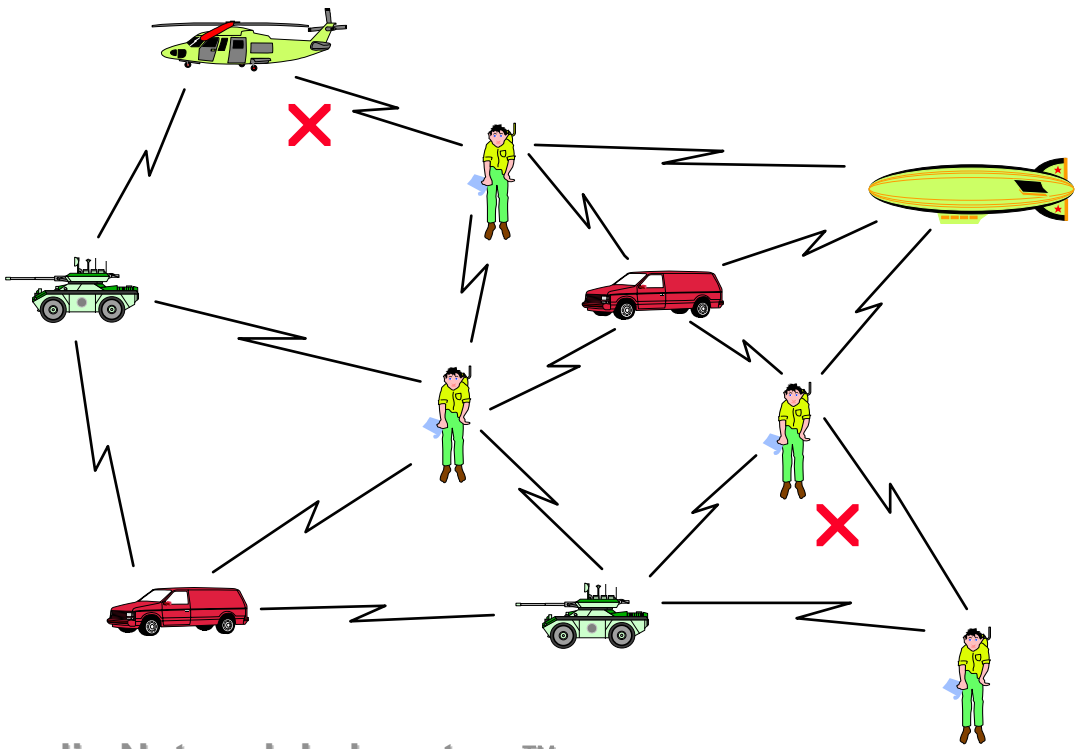
Cellular based

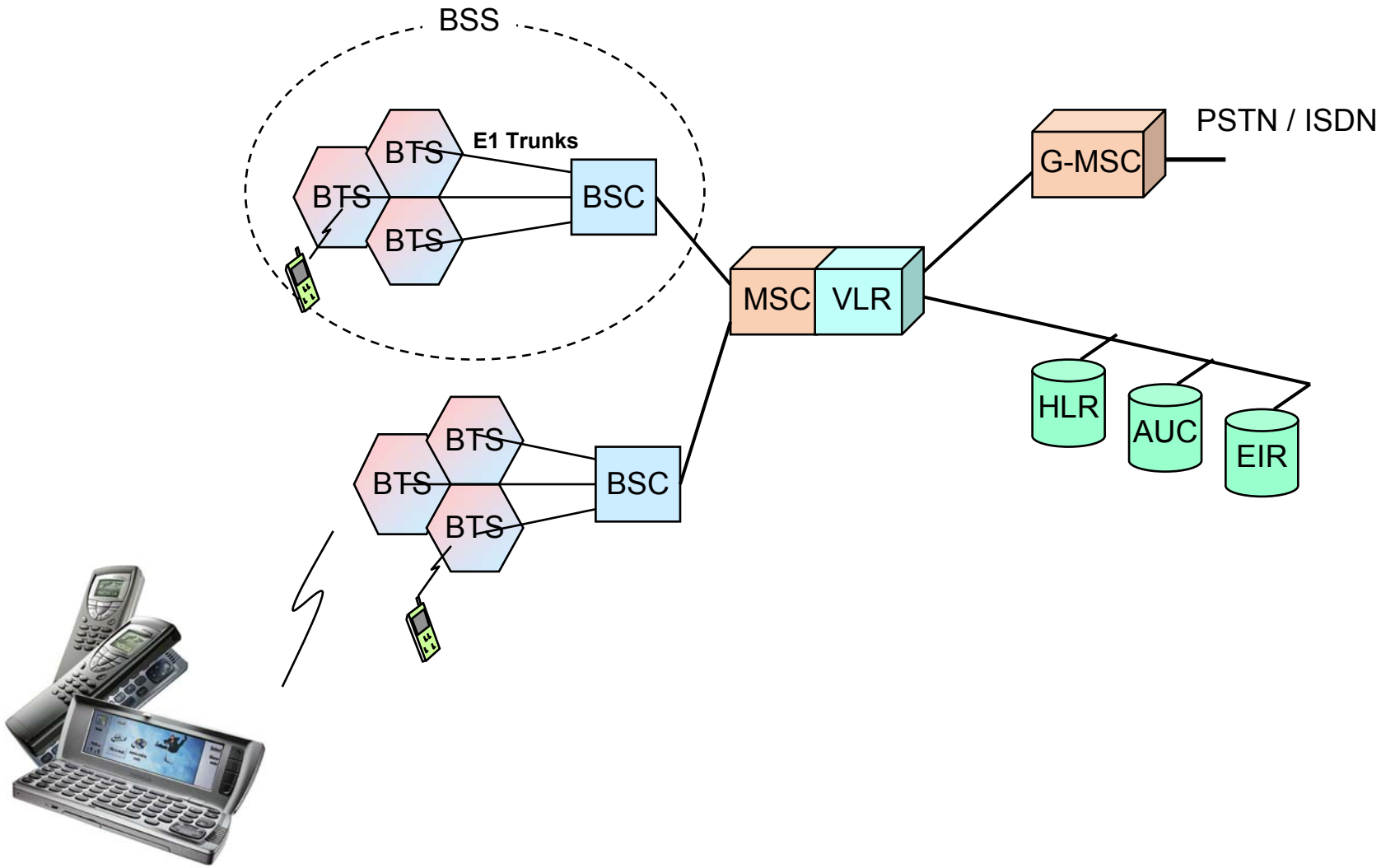


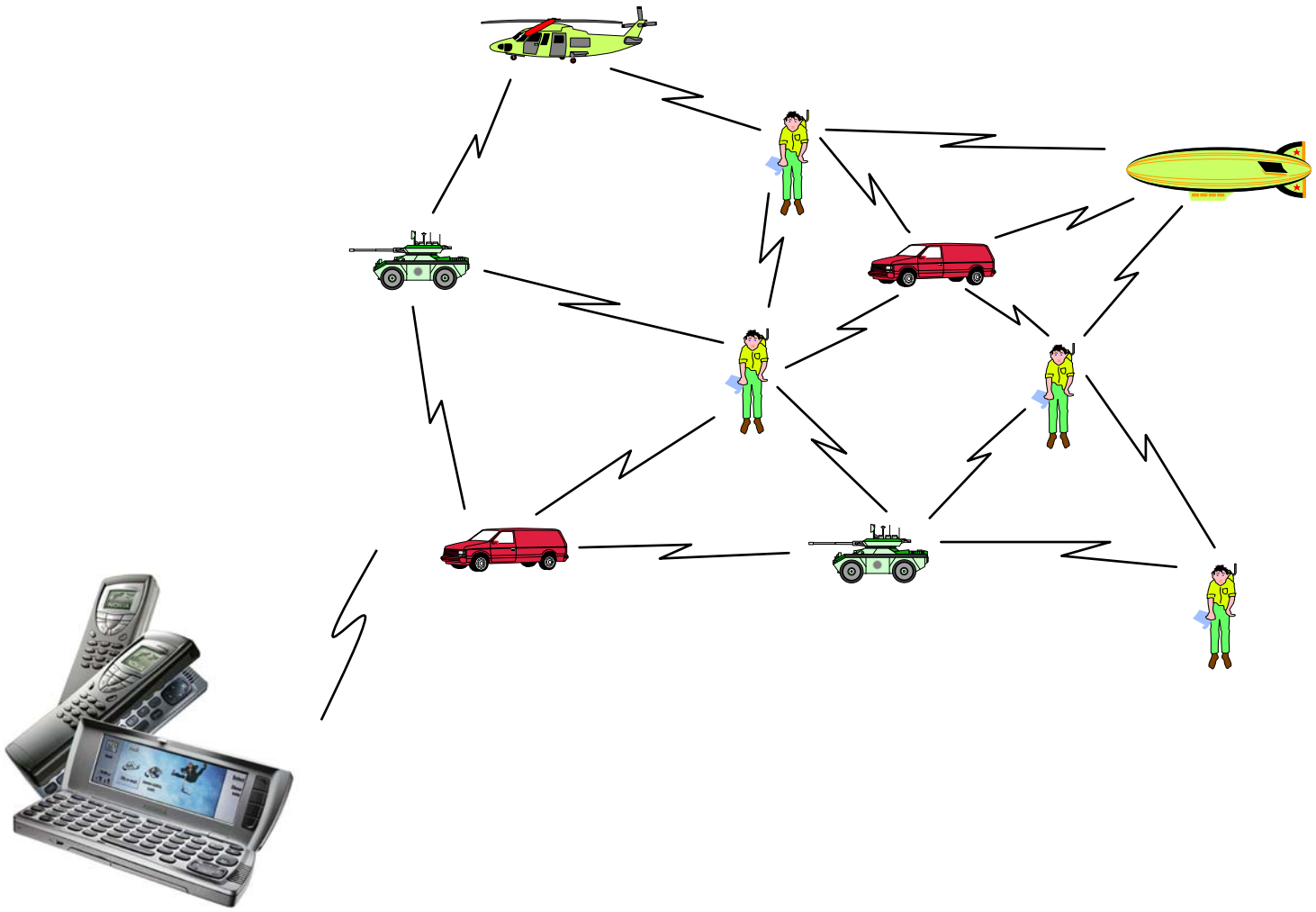
GSM Network Infrastructure

Ad-hoc network

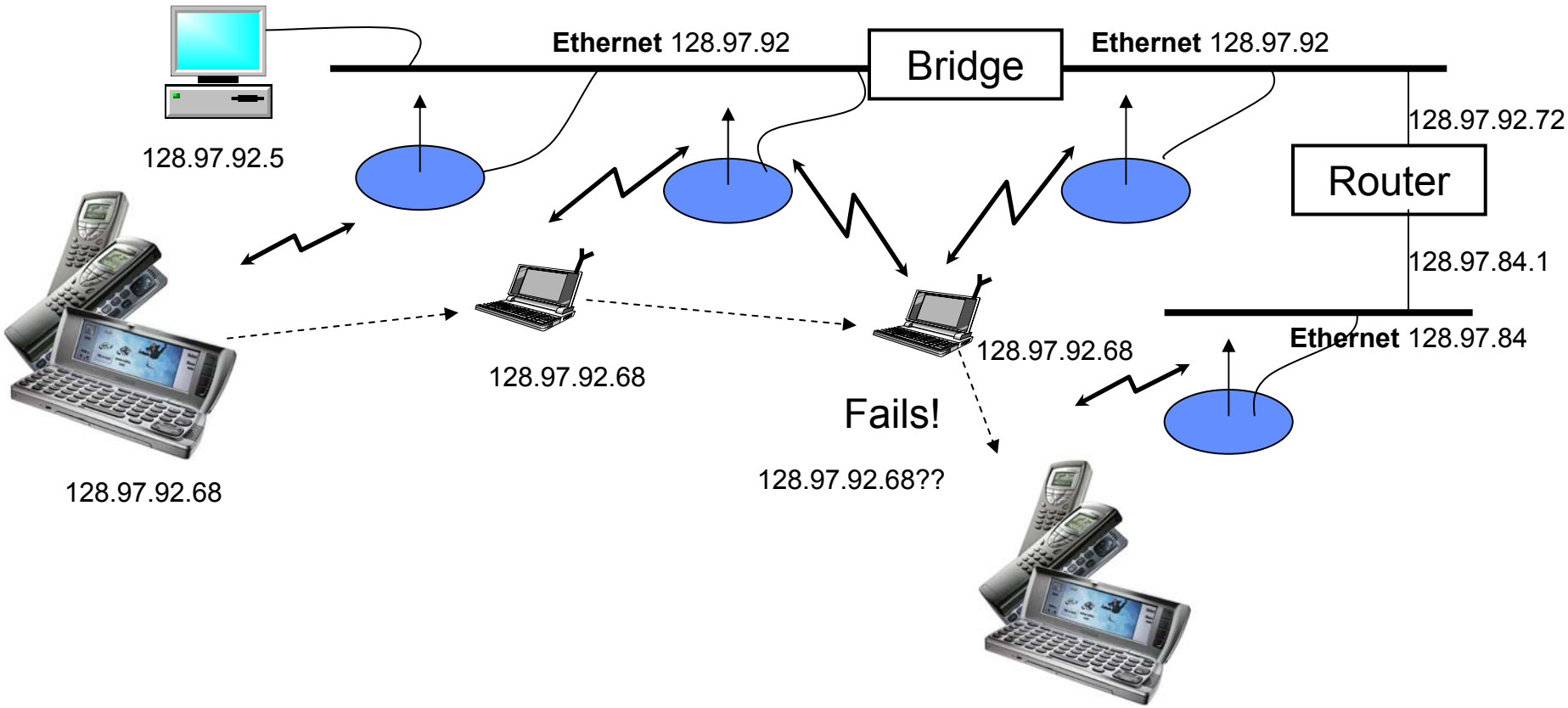
- No centralized controller (base stations)
- No wired inter-connection backbone
- Forwarding function should be provided by mobile nodes




BSS
BTS
BTS
BTS
E1 Trunks
BSC
BTS
BTS
BTS
BSC
MSC
VLR
G-MSC
PSTN / ISDN
HLR
AUC
EIR



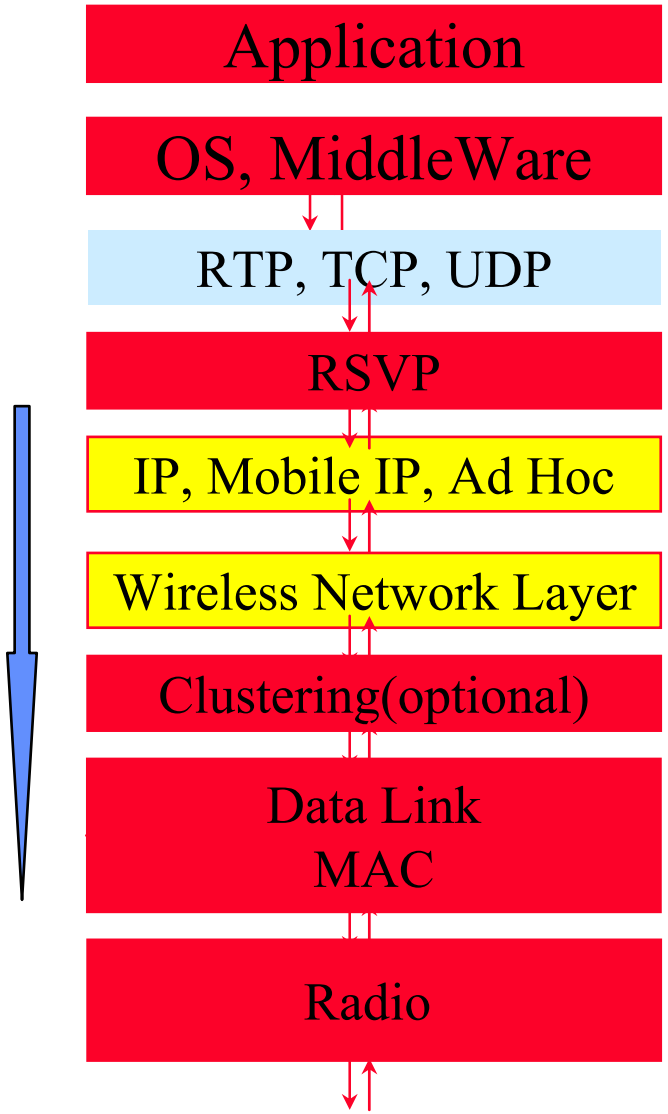
Mobility in Wireless LANs: Mobile IP



QoS and Multimedia Traffic Support

Adaptive Algorithm

by QoS Requirement



Mobility Unpredictable channel

by QoS Information

Introduction

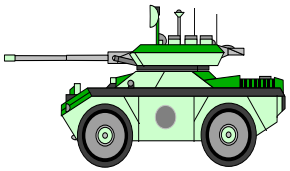
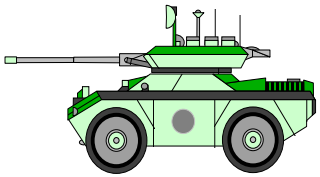
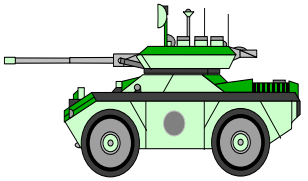
Self-Organized Mobile Ad Hoc Networks

Trend Evolution

- IP success
  - The involvement and level of responsibility of end users have dramatically increased
  - The freedom has fueled creativity
- Infrastructure-less, self-organized networks
  - The network runs solely by operation of end users
  - Progress of electronic integration and wireless communication
  - Complement these infrastructures in cases where cost, constraints, or environment require self-organized solutions
  - Will be interconnected with the Internet and cellular networks

Overview (MANET)

- Packet Radio Networks (’70)
  - Research Results
    - Radio Resource Allocation
    - Network Organization
  - An Individual, handheld device
  - Military application (provide person-to-person communications on the battlefield)

MANET

- Potential Applications:
  - Manmade disasters
  - Relief operation
  - Military applications
  - Car-based networks
  - Sensor networks
  - The Provision of wireless connectivity in remote areas
  - Collaborative Computing, Video Conferences

MANET, Peculiarities

- They can act independent of any provider
- They have to be highly cooperative: The tasks are distributed over the nodes
- Any operation is the result of the collaboration of a group of them
- The nodes rely on batteries for their energy, energy saving
- Power aware: the set of functions offered by a node depends on its available power
- Highly dynamic topology
- Security is difficult to implement

Technical Issues

- Routing
- Mobility Management
- IP Address
- Transport Layer
- Air Interface
- Security
- Power Management
- Standards and Products

Routing

- Ad hoc routing
  - Different from traditional solutions in the Internet or cellular phone networks (relative stable, distributed routing databases)
  - IETF (The Internet Engineering Task Force) MANET address the challenge
  - Distant vector, links state, source routing (table driven, on-demand)
  - Geographic methods: nodes are informed of their own geographic position

Routing Protocol

- Traditional Routing
  - Distance Vector (Bellman Ford)
  - Link State
- Ad Hoc Routing Protocols
  - DSDV
  - DSR
  - AODV
  - TORA

Traditional Routing

- Distance Vector (Table Driven)
  - Each node maintains its own routing table
  - Routing table contains
    - destination node index
    - next hop
    - metric
  - Periodic routing table exchange
- Disadvantage
  - Count-Infinity Problem
  - Convergence Problem

A	B	C
B-A-1	A-B-1 C-B-1	B-C-1
B-B-1 C-B-2	A-B-1 C-B-1	B-B-1 A-B-2
0	1	2
x	1	2
x	3	2
x	3	4
x	5	4
x	∞	∞

Traditional Routing (Cont.)

- Link State Routing
- Procedures
  - Neighbor Discovery
  - Routing Information Broadcast
  - Shortest Path Finding (e.g. Dijkstra's algorithm)
- Disadvantage
  - short-live looping problem

	0	1	2	3	4	5	6	7	8	9	10	11	12
0			X										
1			X										
2	X	X		X									
3			X		X			X			X		
4				X		X	X						
5					X								
6					X								
7				X					X	X			
8								X					
9								X					
10				X								X	X
11											X		
12											X		

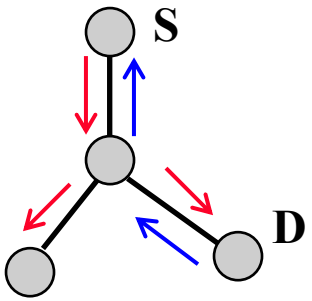
adjacency matrix

Ad Hoc Routing - DSDV

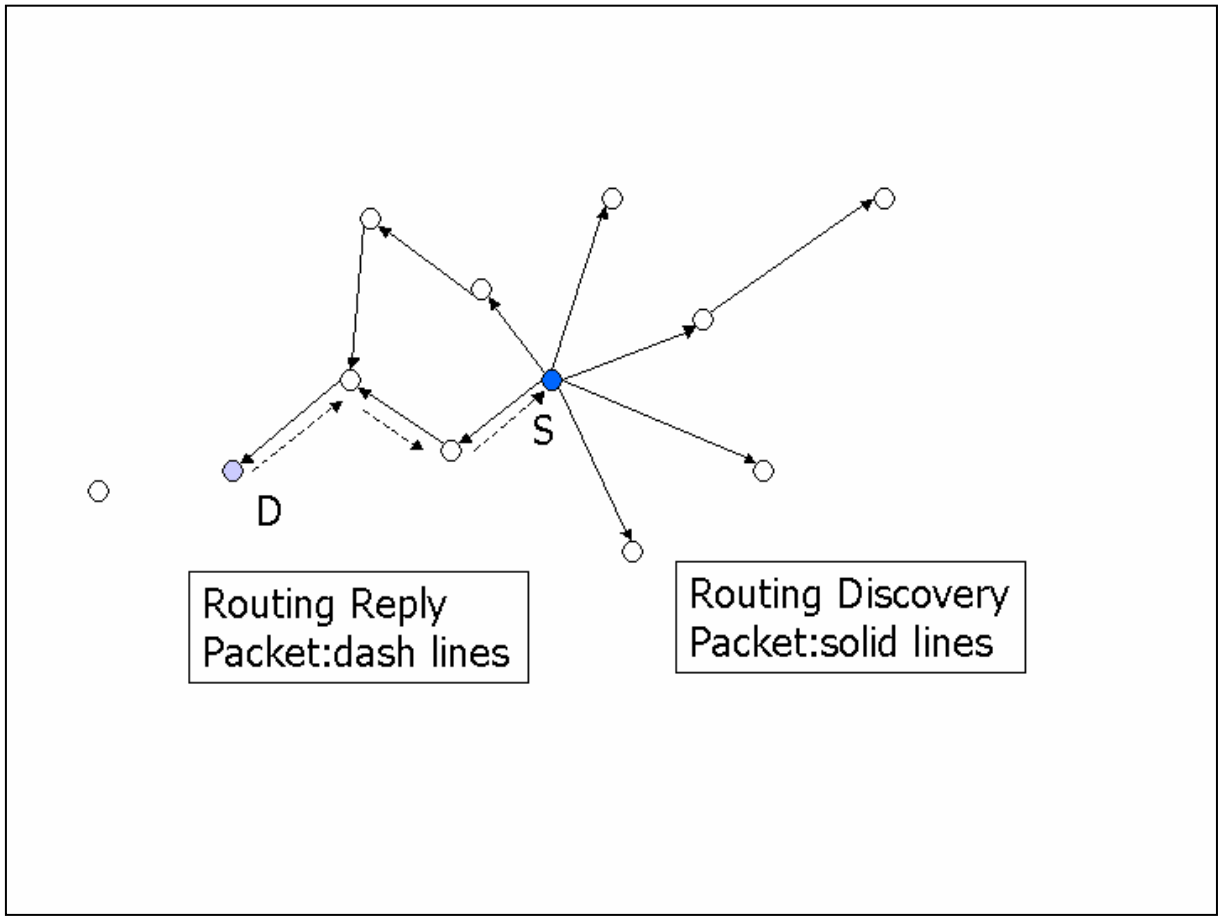
- DSDV
  - Destination Sequence Distance Vector Routing
  - Each route information is labeled with a increasing sequence number
    - Route info. with greatest number will be update
  - Route info. of broken link is broadcast with odd sequence one greater than the original sequence number
- Contribution
  - Main contribution of DSDV is freedom-loop guarantee
- Disadvantage
  - The periodic broadcast adds the overhead into the network

Ad Hoc Routing - DSR

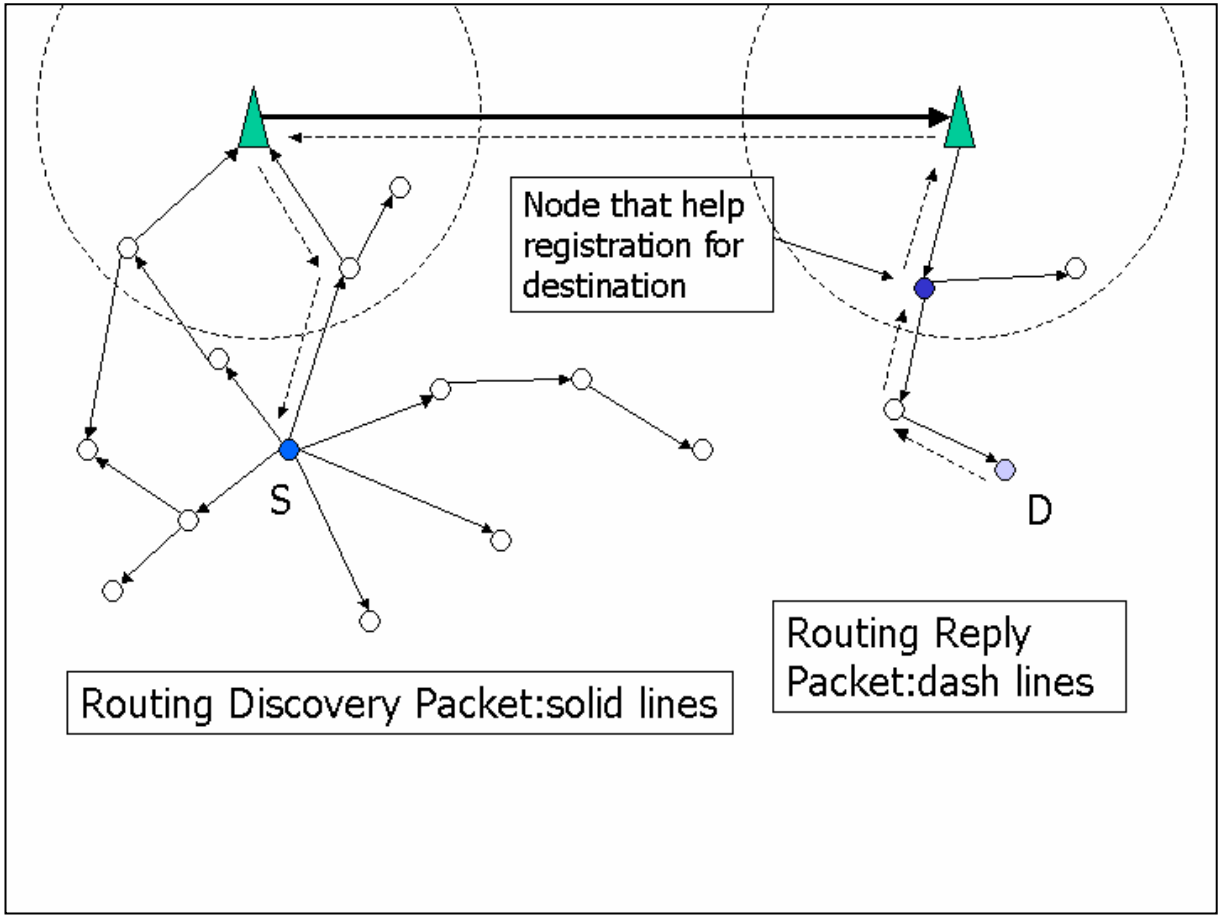
- DSR
  - Dynamic Source Routing
  - Route Discovery
    - Source node flooding routing request (RREQ) packet
    - Destination (inter-node) node reply RREP packet that piggybacks the route info.
    - Source node caches the route info
  - Route Maintenance
    - The route info. will be remove after receiving RERR packet
- Advantage
  - Requires no periodical routing exchange
- Disadvantage
  - packet is larger because of carrying route info.



Routing in ad hoc network environment only

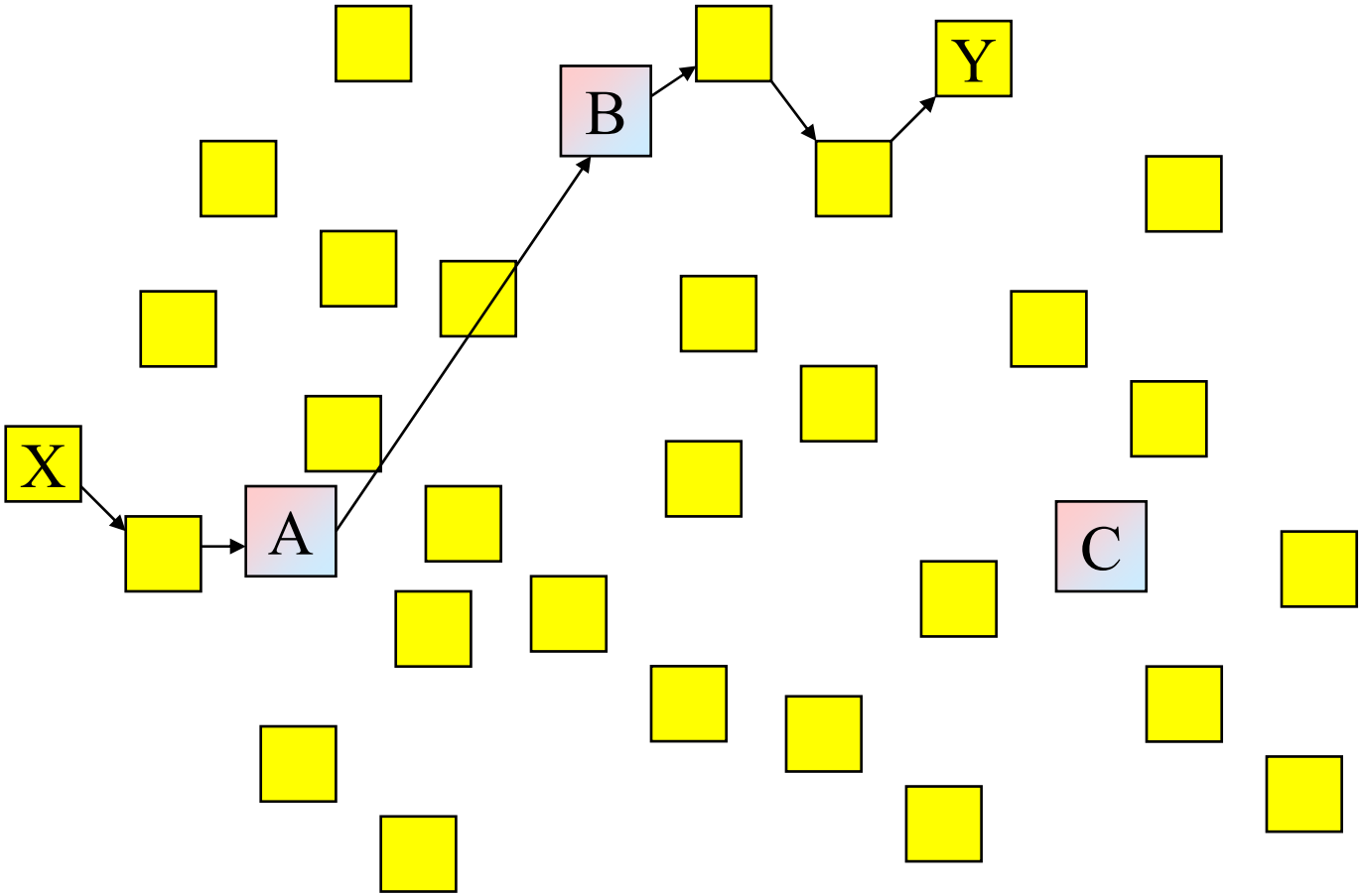


Routing in heterogeneous environment



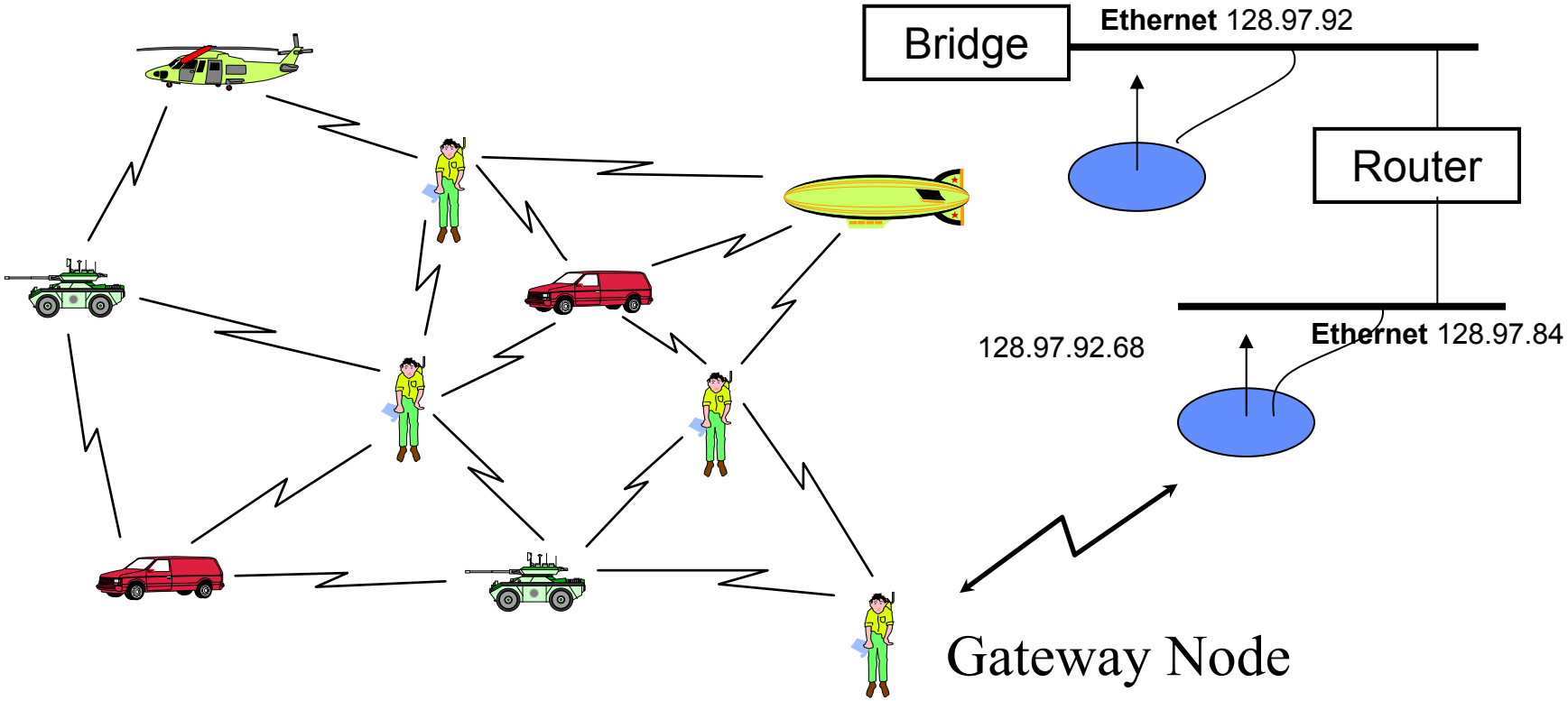
Heterogeneous Network Support

- Use of Interface Indices in DSR

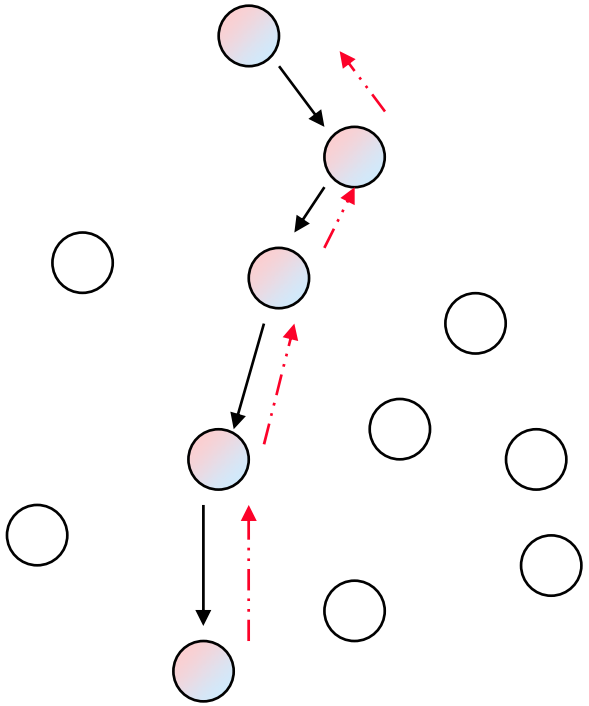


Internet Interconnection and Mobile IP

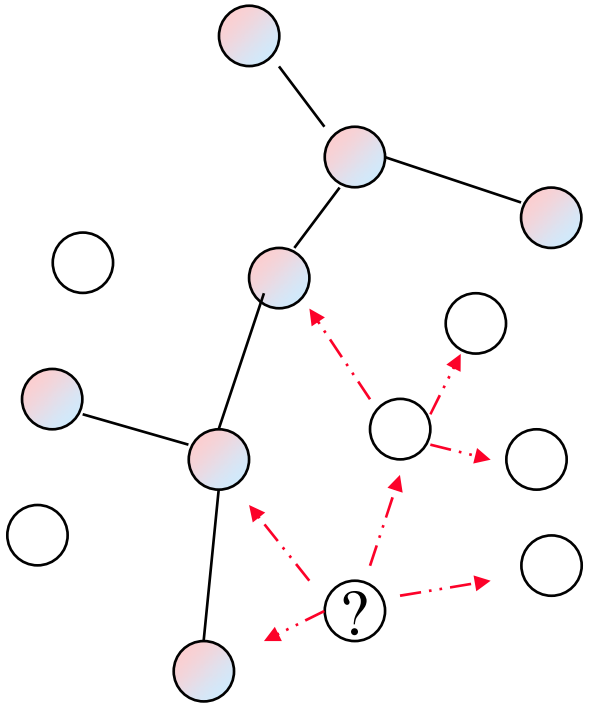
- DSR support the seamless interoperation between an ad hoc network and the Internet



On Demand Support Multicast & QoS



Bandwidth (QoS) Parameters



Multicast Join

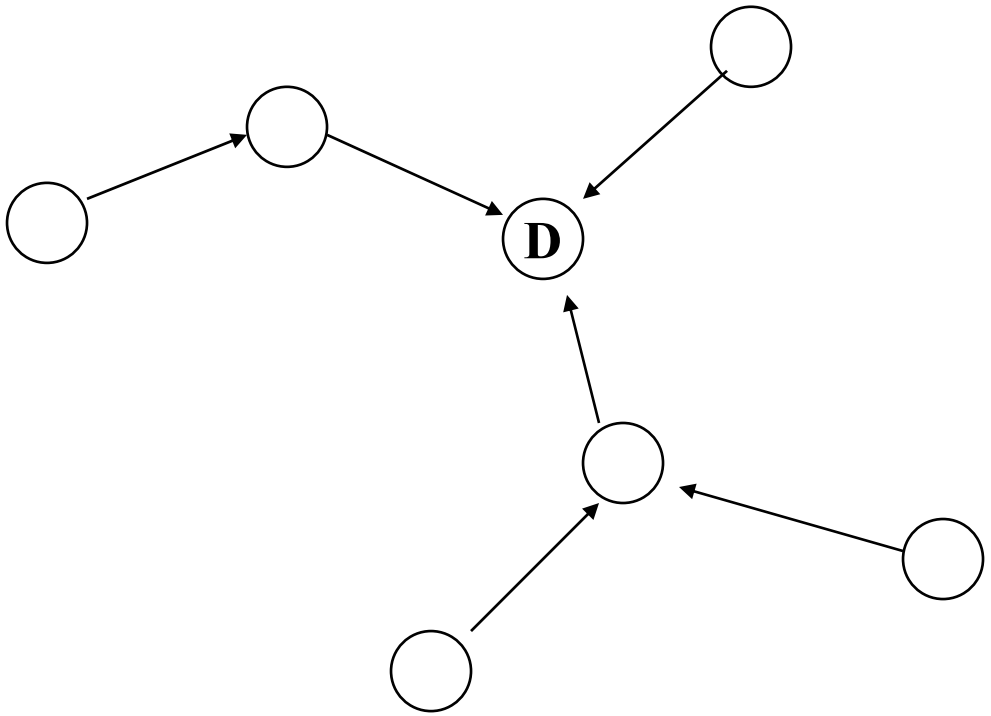
Ad Hoc Routing - AODV

- AODV
  - Ad-hoc On-demand Distance Vector
  - Shares the advantages of DSR and distance vector
  - Route Discovery
    - Similar to DSR
  - Route Maintenance - Table Entry
    - Destination IP, Destination Sequence, Hop Count, Next Hop, Life Time
  - The route info. Is invalid if
    - Life Time is expired
    - Receive RERR packet

Ad Hoc Routing - TORA

- TORA
  - Temporally-Ordered Routing Algorithm
  - Routing procedures
    - Flood QUERY packet
    - UPDATE packet will be broadcast from destination or inter-node
    - HEIGHT info. is appended to UPDATE packet
    - the node receives UPDATE packet set its height and the forwarding UPDATE packet's height to a value one greater than original one
  - Source node send data to the destination via neighbor that have lower height with respect to the destination
- Advantage
  - Minimizes the reaction due to changes of network topology
- Disadvantage
  - Depend on Internet MANET encapsulation Protocol, the overhead is large

Ad Hoc Routing - TORA (Cont.)



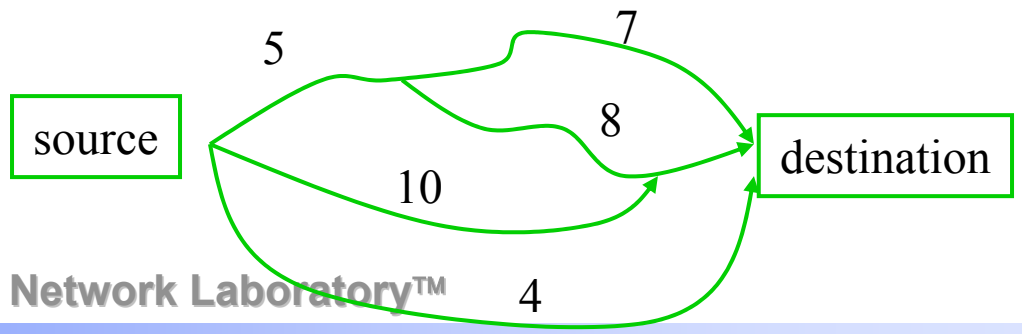
Directed acyclic graph rooted at destination

ABR (Associativity-Based Routing)

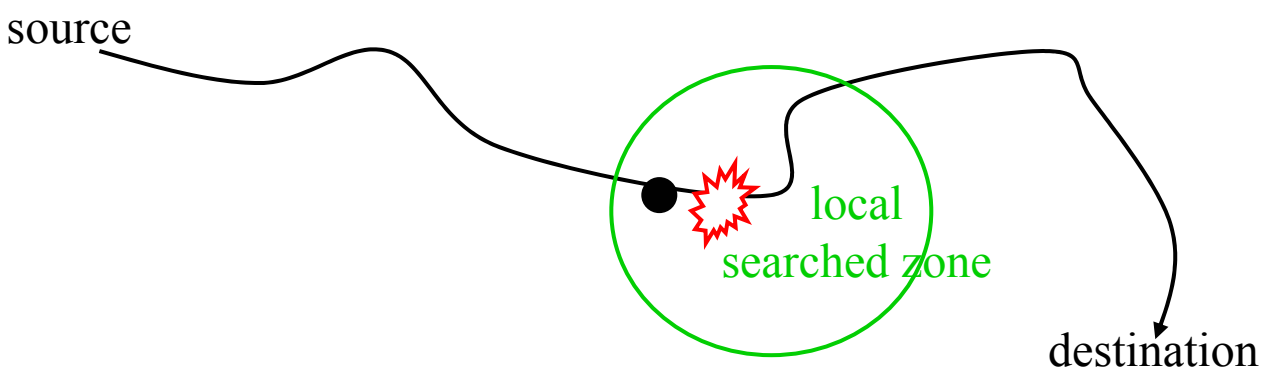
- ABR considers the stability of a link.
  - The metric is called degree of association stability.
- Basic Idea:
  - Each node periodically generates a beacon to signify its existence.
  - On receipt of the beacon, a neighboring node will increase the "tick" of the sender by 1.
    - A higher degree of association stability (i.e., ticks) may indicate a low mobility of that node.
    - A low degree of association stability may indicate a high mobility of that node.
  - When a link becomes broken, the node will set the tick of the other node to 0.

ABR Outline

- Route Discovery:
  - (similar to DSR)
    - On needing a route, a host will broadcast a ROUTE_REQUEST packet.
    - Each receiving host will append its address to the packet.
  - The association stability (represented by “ticks”) is also appended in the ROUTE_REQUEST packet.
  - The destination node will select the best route (in terms of association stability), and then respond a packet to the source.

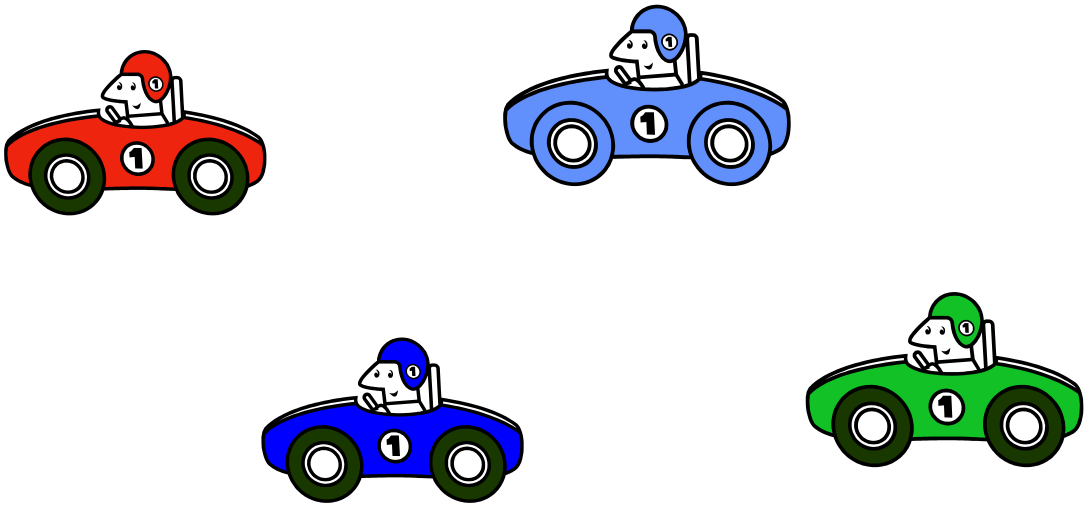


- Route Reconstruction:
  - On route error, a node will perform a local search in hope of rebuild the path.
  - If the local search fails, a ROUTE_ERROR will be reported to the source.



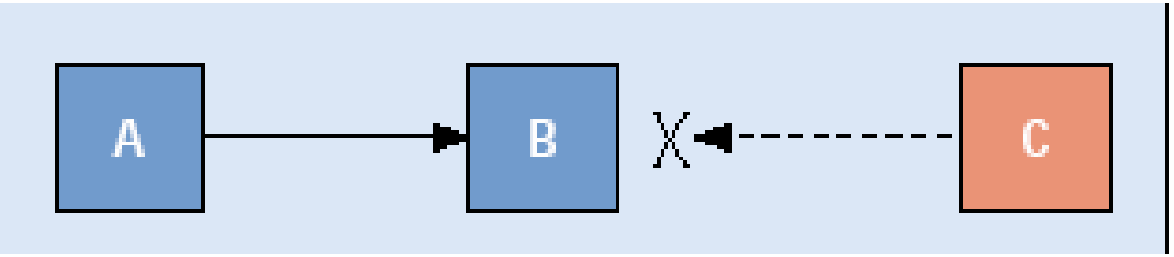
Mobility Management

- Broadcasting a paging message the whole network: won't scale well
- Different from centralized servers (either HLR in GSM), location must be distributed among the nodes
- Prediction of the future locations



Radio Interface

- CSMA/CA: hidden terminal



- Defining master and slaves roles:
  Bluetooth

MACA/PR

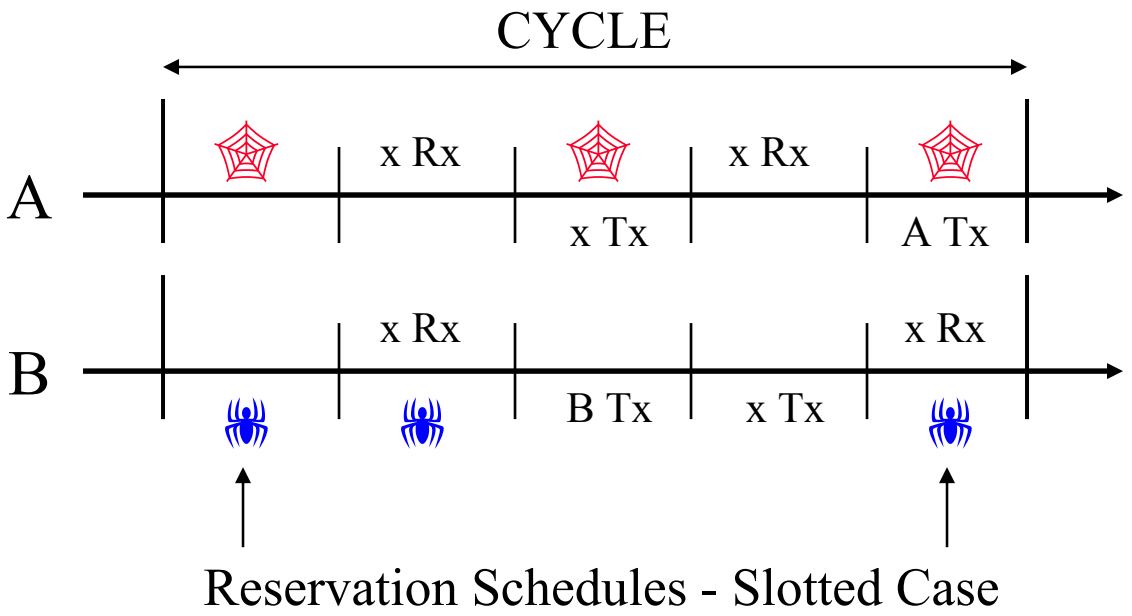
- The key component
  - the MAC protocol for data transmission
  - Reservation scheme for real-time connection setup
  - QoS Routing algorithm

MACA/PR - MAC

- Data-gram Traffic
  - RTS - CTS - PKT - ACK
  - <RTS,CTS> for hidden terminal avoidance, ACK for retransmission
- Real-Time Traffic
  - < RTS - CTS > - PKT - ACK
  - <RTS,CTS> used for first time transmission to set up the reservation
  - ACK for renewing the reservation, not recovery

MACA/PR - Reservation/QoS Routing

- CYCLE is the max. interval allowed between two real-time packets
- Each node maintains its own reservation table
- DSDV routing is employed
- Bandwidth info. can be easily obtained via reservation table



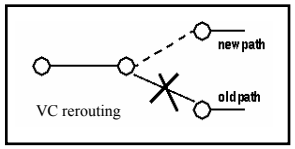
MACA/PR - Properties

- Asynchronous approach
- Low latency, low packet loss rate
  - Hidden Terminal Problem is solve automatically
- Fair bandwidth sharing
- Good mobility handling
  - Maintain secondary routing path
- Low implementation costs

MAISIE Simulation Modules

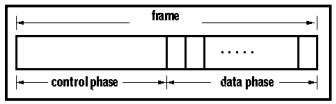
Algorithms/ Protocols

Mobile IP/Nomadic Router

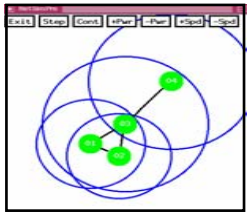


Network Layer: VC support ← "Soft state" fast VC setup

Network Layer: routing ← Loop-free QOS routing (DSDV)



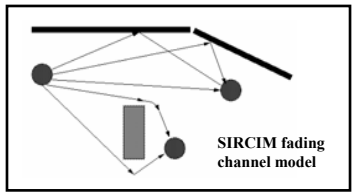
Link Layer ← Acks, backpressure, priority



Mac Layer ← TDMA, CDMA, MACA, TOKEN

Clustering

Connectivity Management ← Adaptive power control
Distributed clusterhead election:

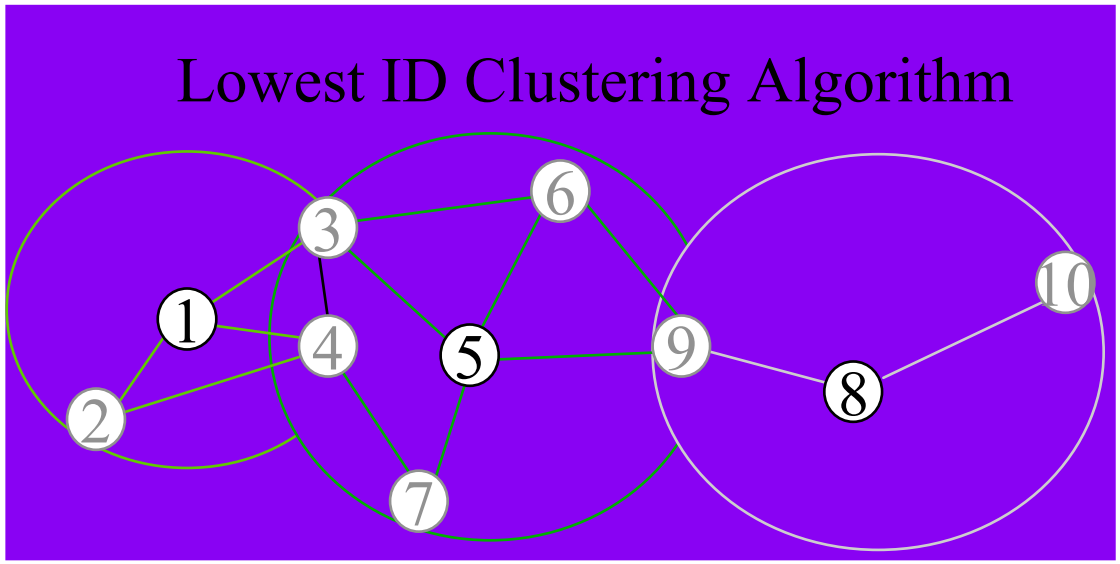


Radio Channel ← DS-SS;channel encoding

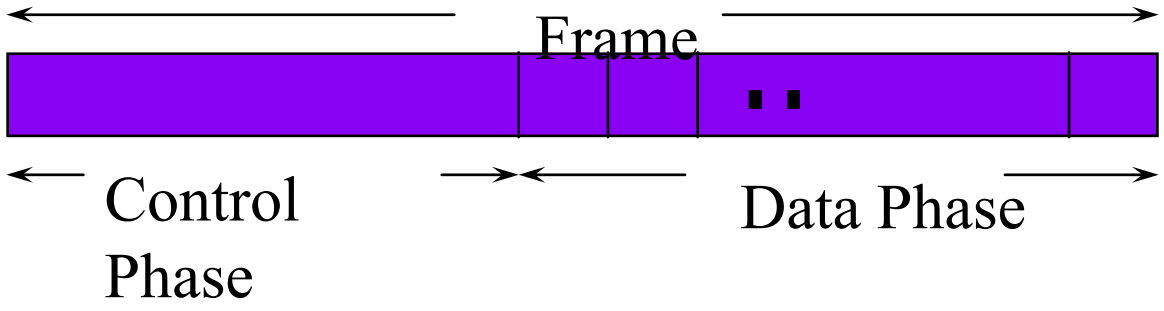
Network Architecture Models

PRNET | Cluster TDMA | MACA/PR | Cluster MACA

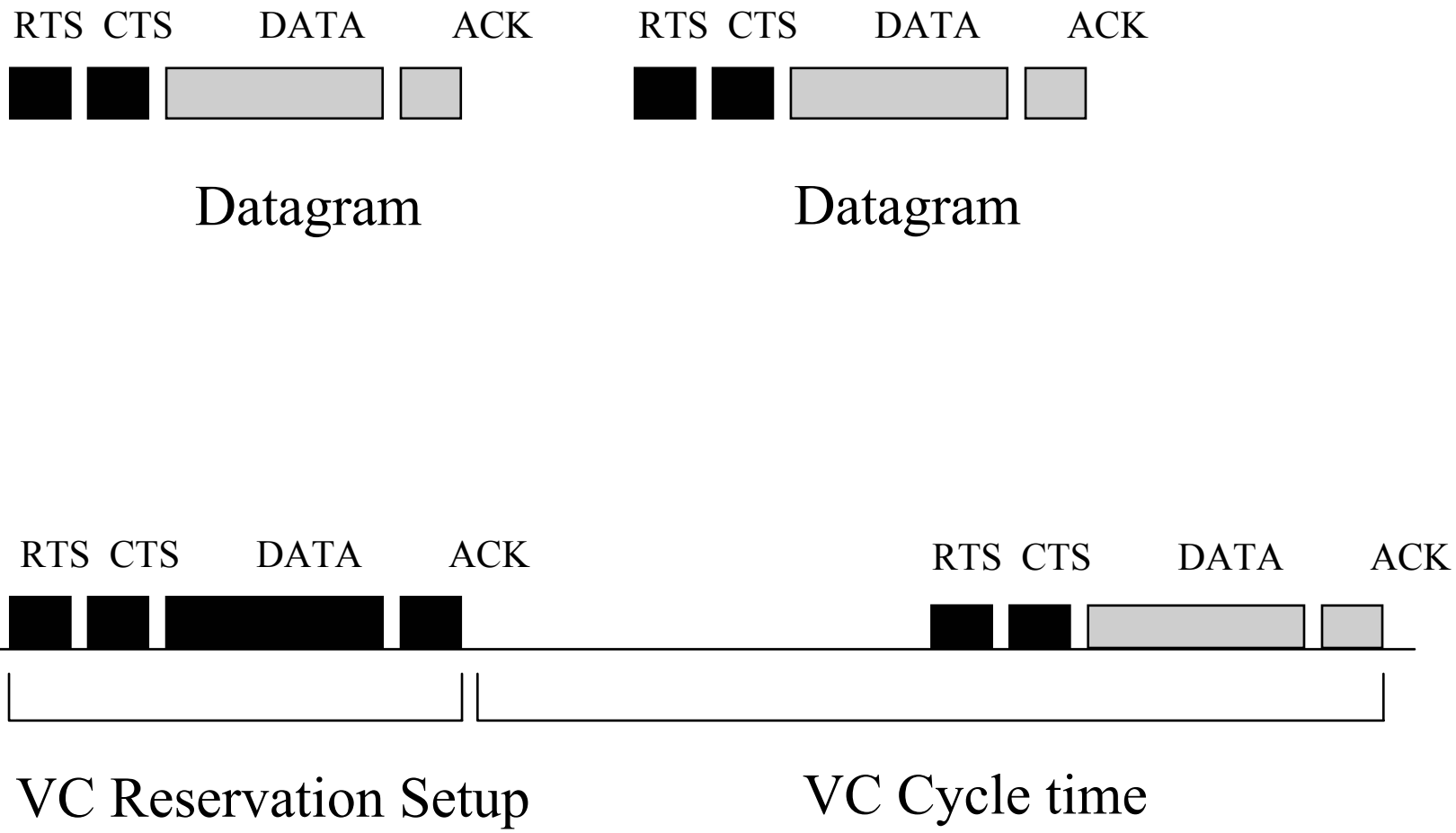
Cluster TDMA



Within each cluster: time-slotted frame



Cluster MACA



The Paradigm Shift and Some Open Research Questions

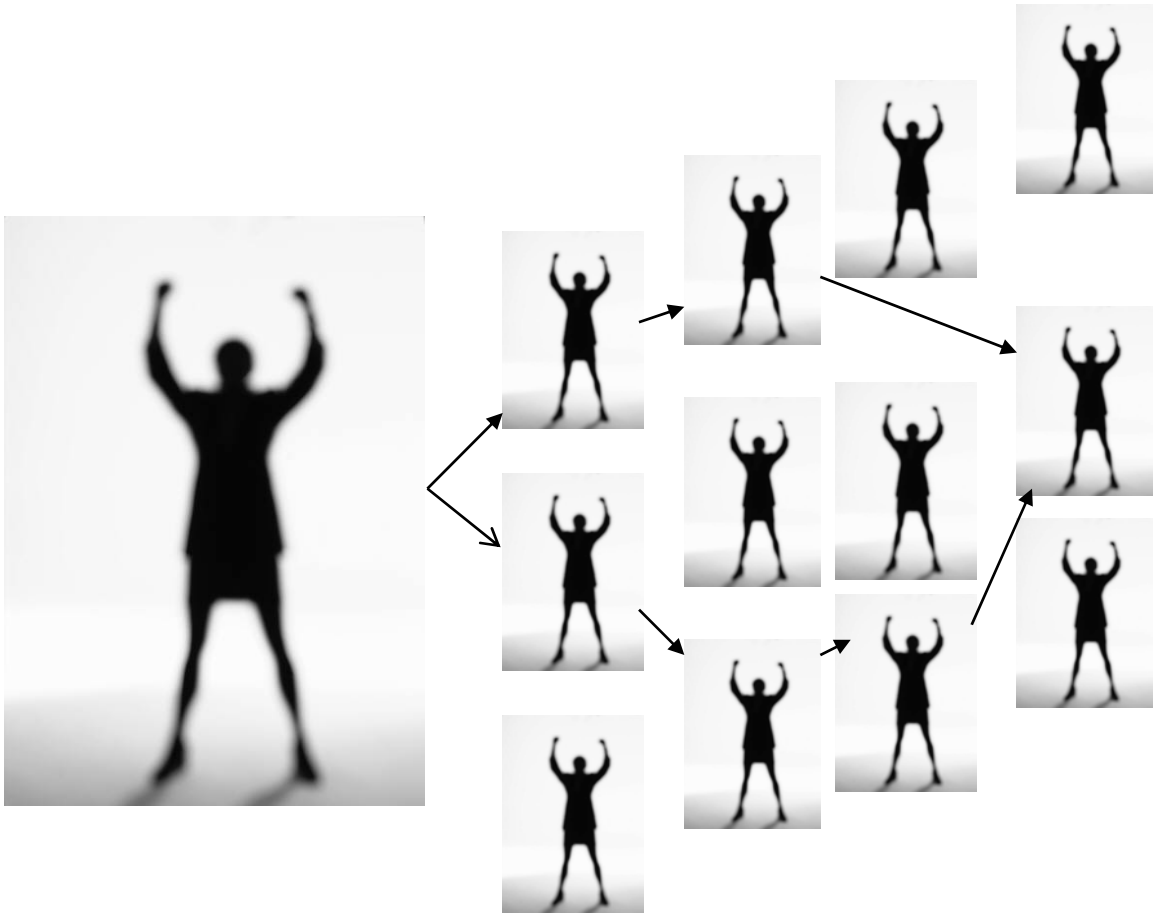
MANET

Terminodes Projects

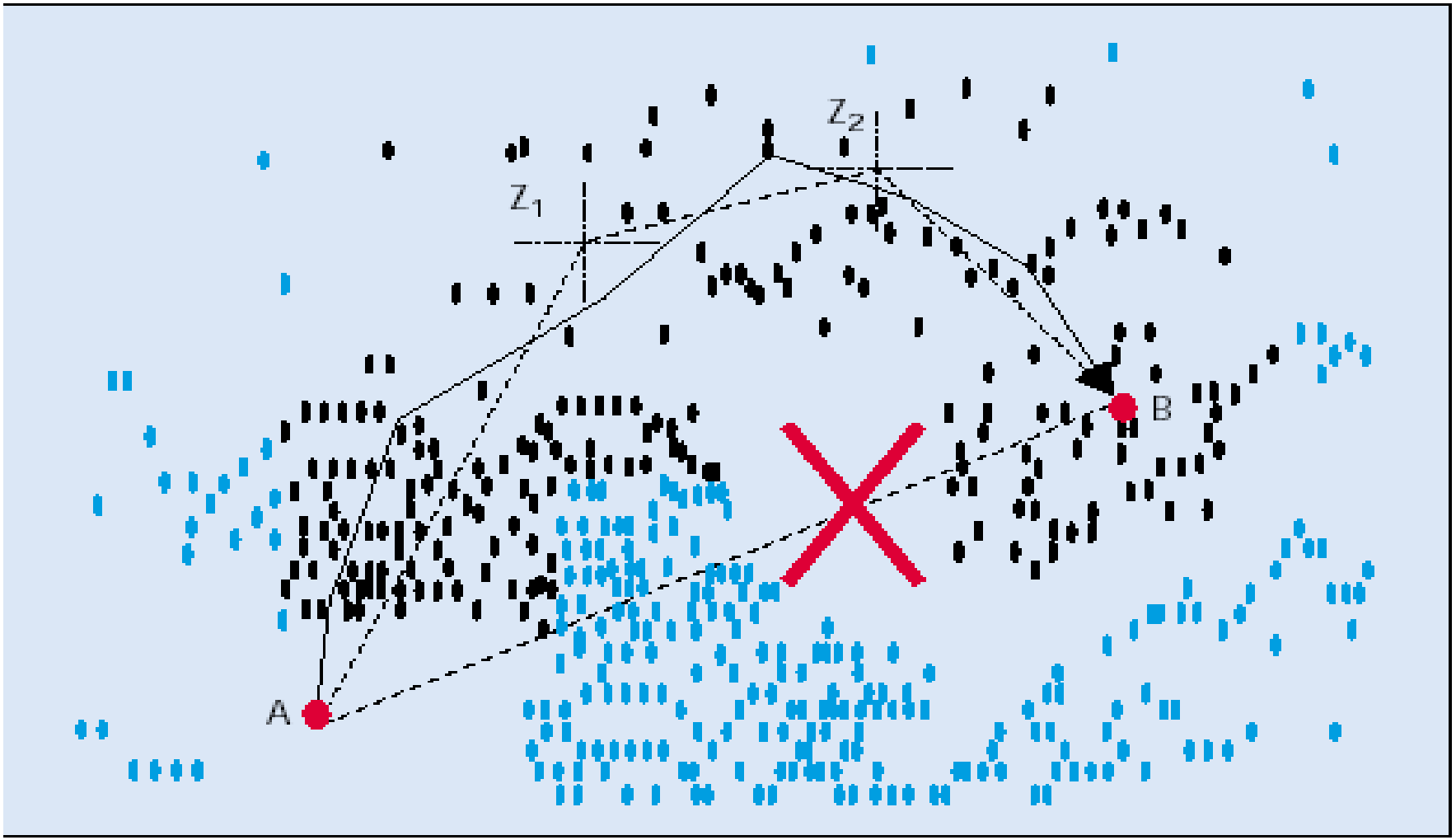
- Large scale self-organized mobile ad hoc networks
- All layers and interlay interactions
  - From physical layer up to software architecture and applications
- Try to capture the business and societal potential
- Three levels:
  - Technical challenges
  - Intellectual fantasy
  - Societal/political vision

Terminodes

- Networking Issues
  - Scalability
- Virtual Currency
  - Obligation
- Real Time Services
  - QoS



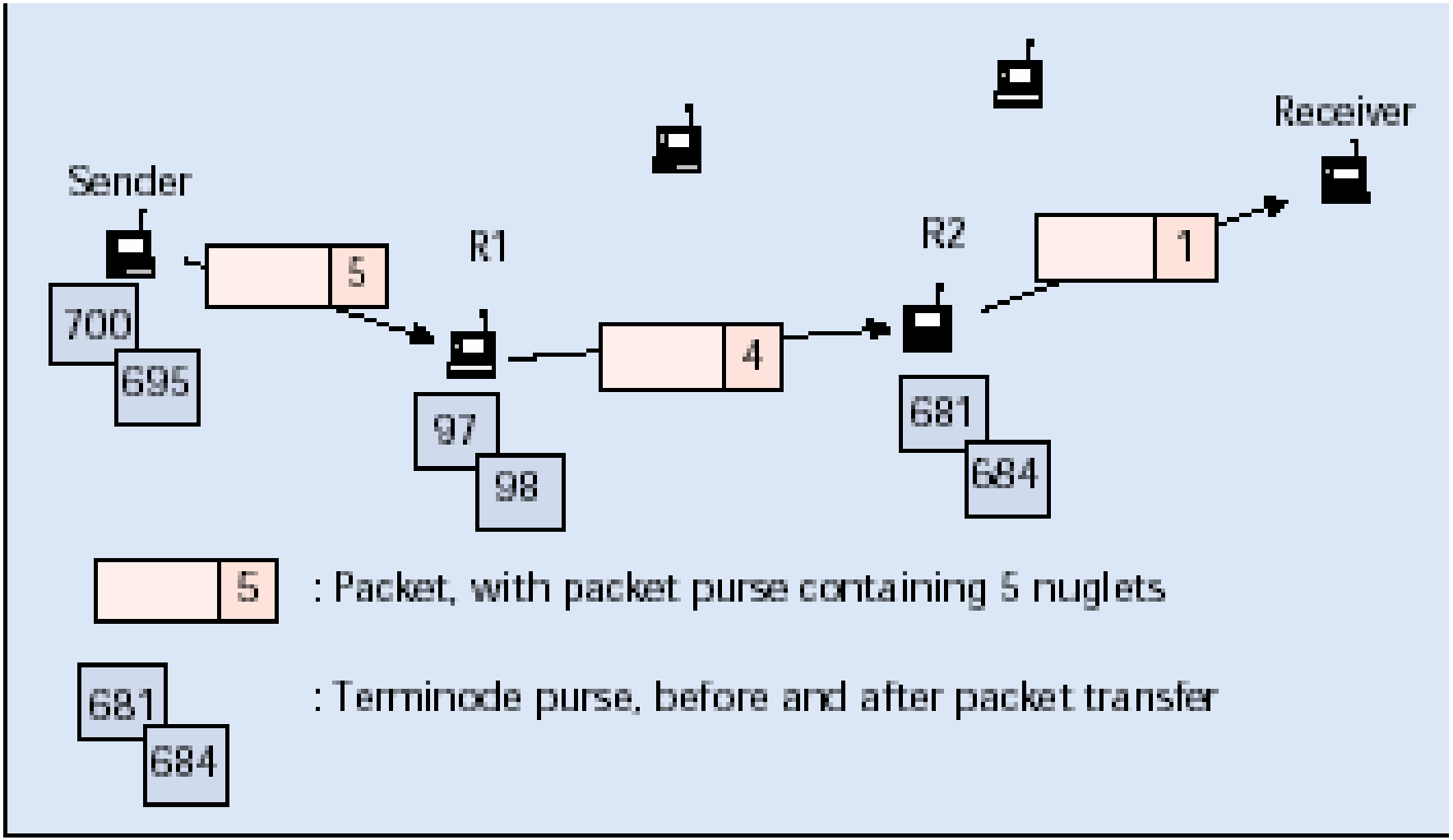
Networking Issues



Routing for Terminode

- Each Terminode has
  - A permanent unique node identier, EUI (End System Unique Identifier)
  - Location-Dependent Address (LDA)
- Geodesic Packet Forwarding:
  - The packet is forwarded to the neighbor closest to the direction in which the destination is located
- Terminode local routing
  - MANET routing (link State, Distance Vector, Source Routing)

Networking Issues



Virtual Currency (Nuglet)

- Service Availability is a major requirement for self-organization
- The End users must be given incentive to cooperate
- They must be encouraged to not overload the network

Multiple description coding

Real-Time Services over Ad hoc Networks

- Real-Time Services
  - Voice or video over ad hoc networks
  - Unreliable <-> stringent delay
  - Large error , node failure
- Redundancy, error correction codes over parallel connections

Software Aspects

- Software implementations:
  - Base software: Routing algorithms, accounting system and security system
  - Application software: Software that makes a collection of terminodes useful for a client
  - Flexible software architectures
- Resource Allocations
  - Contract
  - Loader
  - Dynamic checks

Discussions

- Three Networks:
  - Telecom networks
  - The Internet
  - Self-Organized Mobile Ad Hoc Networks

Network	Infrastructure	Security	Applications
Telecom networks	Telcos	Telcos	Telcos (IN)
Internet	ISPs + telcos	ISPs + users (PGP)	Users
Self-org. ad hoc NW	Users + vendors	Users + vendors	Users

無線網路多媒體系統
Wireless Multimedia System

Lecture 10: Multicast support for Mobile Hosts

吳曉光博士
http://inrg.csie.ntu.edu.tw/wms

Basic Motivations

- Mobile Network~ Mobile IP
- Application Requirements: updates to replicated databases, Inter-process communication among cooperating processes
- Resource Conservations~ Single Copy in…Multicast IP

New Requirements

One to Many Mobile Multicasting Services

Reading

- [Chikamane1998] V. Chikamane, C. L. Williamon, R. B. Bunt, W. L. Mackrell, “Multcast support for mobile hosts using Mobile IP: Design issues and proposed architecture, Mobile Networks and applications (1998)
- [Williamson1998] C.L. Williamson, T.G. Harrison, W.L. Mackrell and R. B. Bunt, “Performance evaluation of the MoM mobile multicast protocol, Mobile Networks and Applications, (1998)
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Agenda

- Fundamental Approaches:
  - Multicast Support for Mobile Host using Mobile IP
- Advanced Approaches:
  - Mobile Multicast Protocol (MoM)
  - Multicast by Multicast Agent (MMA)
  - Mobile Network Gateway (MNG)
  - Synchronization

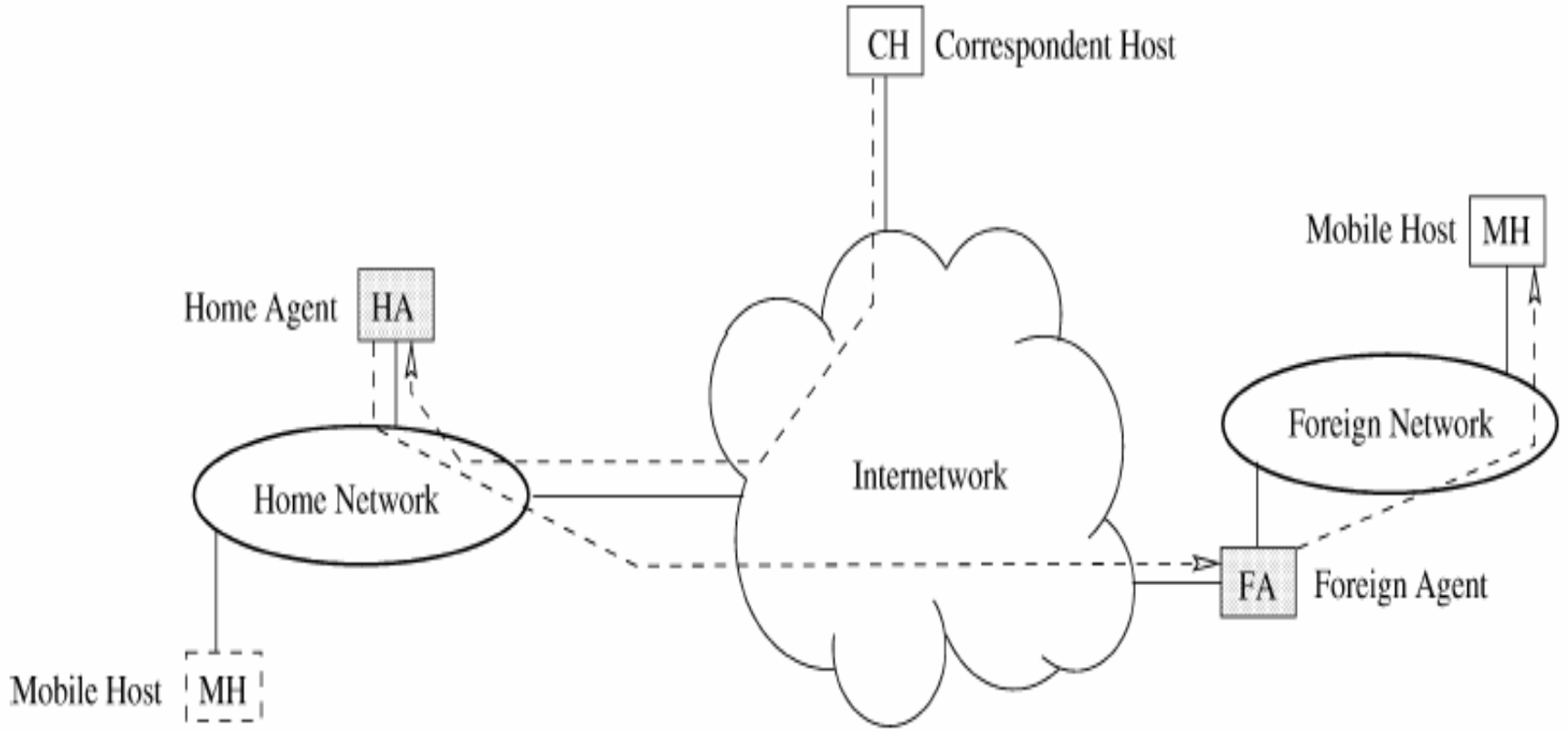
Fundamental Approach: IP Multicast for Mobile Hosts

Mobile IP Approach

Challenges and Solutions

- Providing multicast in an inter-network with mobile hosts is made difficult
  - Many multicast protocols are inefficient when faced with *frequent membership* or *location changes*
- Proposing an architecture to support IP multicast for mobile hosts using Mobile IP
  - The *tunnel convergence problem*, the *duplication problem*, and the *scoping problem*

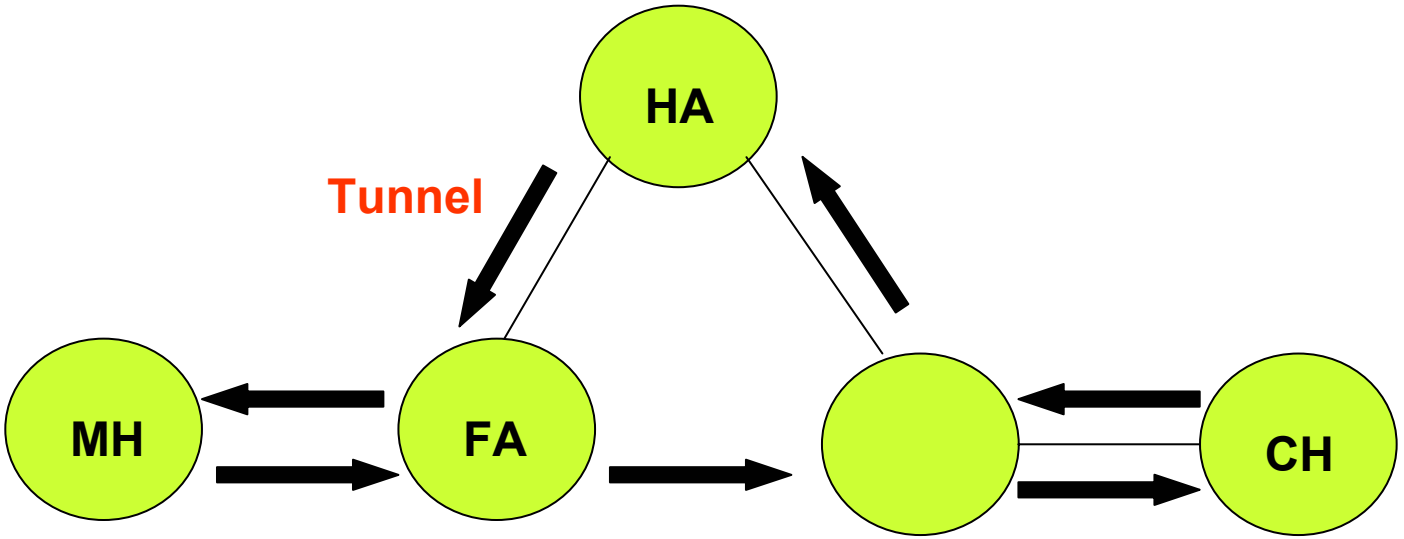
Mobile IP Scenario



Terminology of IP Mobility

- Home address
  - An IP address that is assigned for an extended period of time to a mobile node. It remains unchanged regardless of where the node is attached to the Internet.
- Care-of Address
  - The termination point of a tunnel toward a mobile node, for datagrams forwarded to the mobile node while it is away from home
    - Foreign agent care-of address
    - Co-located care-of address
- Without losing connectivity at the transport layer (assume that a host's address is fixed)

Triangle routing of Mobile IP



- Datagrams from the MH are delivered directly to its correspondent host (CH), but datagrams from the CH to the MH must first go to the HA, which forwards them to the foreign agent (FA).
- Routers: local or remote hosts

Current IETF Mobile IP multicast

- Remote subscription
  - The mobile host is required to re-subscribe to the multicast group on each foreign agent
  - Using a co-located care-of address
  - Advantage
    - Providing the most efficient delivery of multicast datagrams
  - Disadvantage
    - may come at a high price for the networks involved
    - the multicast routers that must manage the multicast tree

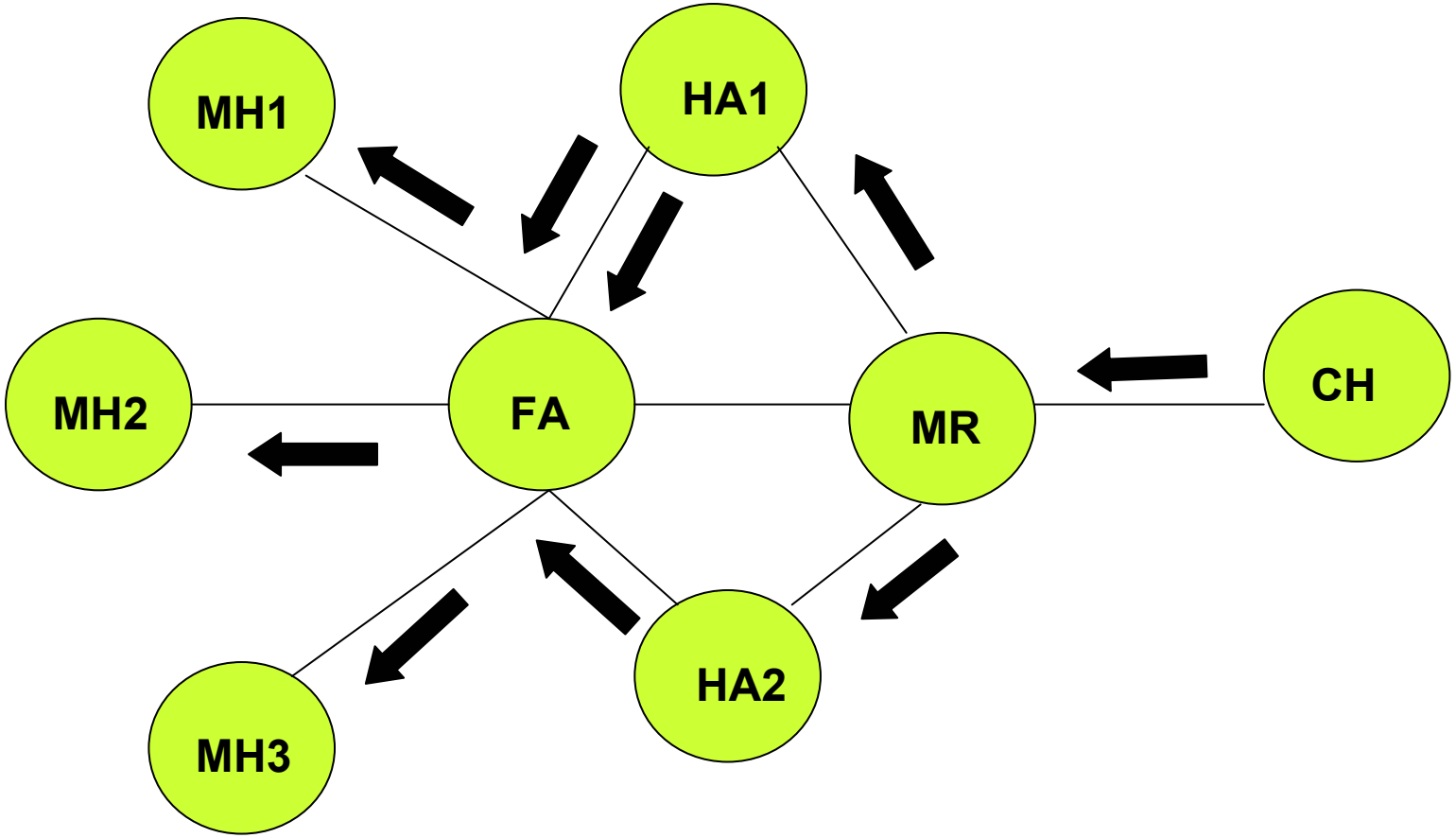
Current IETF Mobile IP multicast (cont.)

- Bi-directional tunneled multicast
  - The home agent must also be a multicast router
  - Subscriptions are done through the home agent
  - Disadvantage
    - If multiple mobile hosts on the same foreign network belong to the same multicast then duplicate copies of the multicast packets will arrive at the foreign network
    - Multiple encapsulation increases the packet size substantially and can cause fragmentation

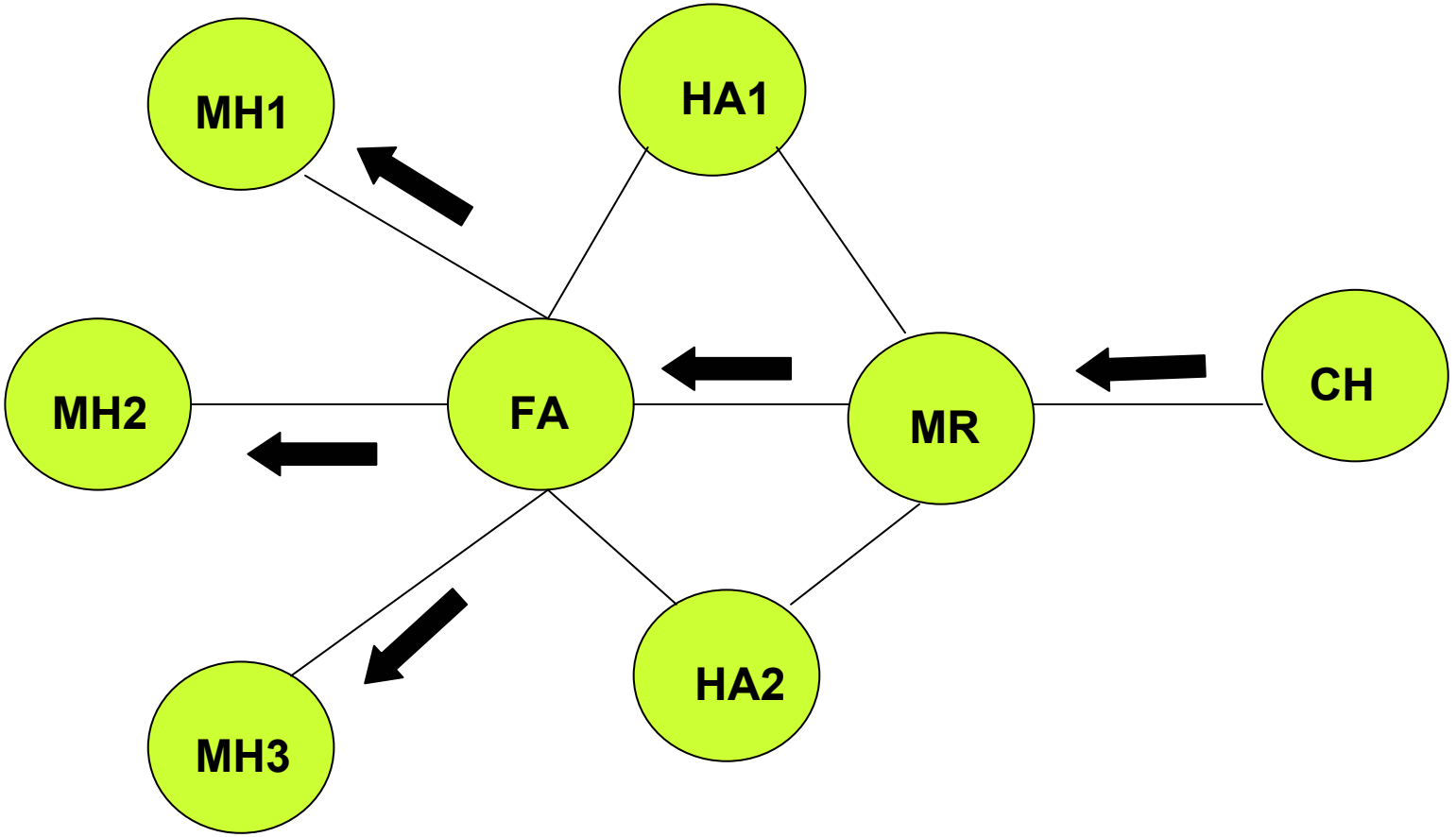
Multicast Reception on Mobile Hosts

- Home Agent Routing
  - HA and MH communication via virtual PtP links
- Foreign Agent Routing
  - FA acting as an MR hides the MH addresses
  - Trade-off
- Combined Routing
  - The FA gathers membership information and arranges for unique or more tunnels to be set up for each group
  - MoM

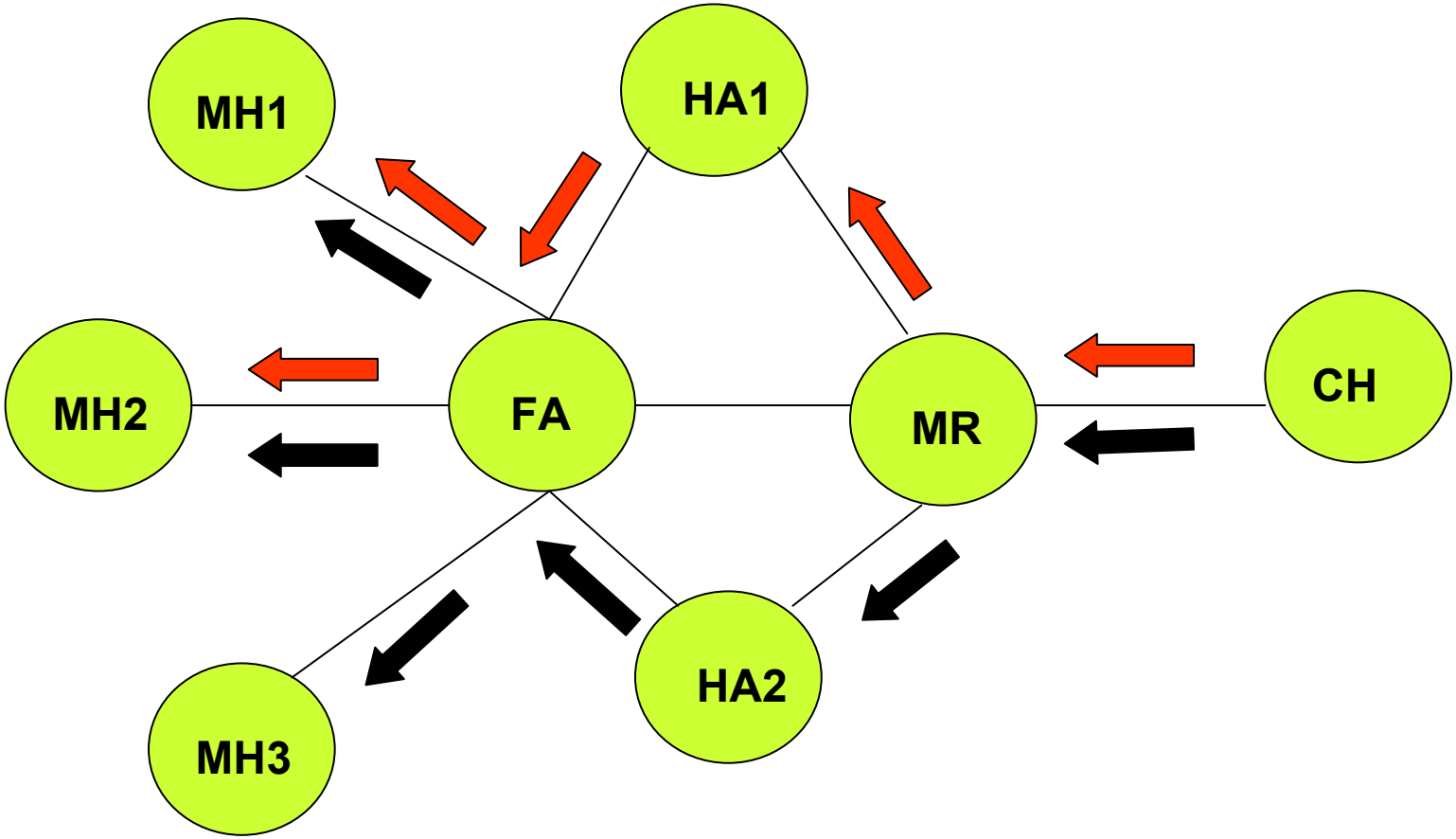
Home Agent Routing



Foreign Agent Routing



Combined Routing



MH3 first reported group membership to the FA

Assumptions of MoM

- The service to be provided is the unreliable, best effort, connectionless delivery of multicast datagrams
- Dynamic group membership is a necessary feature of multicast
- A mobile host that wishes to receive multicast datagrams is capable of receiving them on its home network using existing multicast routing techniques
- The home agent and foreign agent are static hosts
- There is exactly one foreign agent per network visited

Handling multicast source mobility

- On its home network
  - The mobile host uses link-level multicast to send the datagram
  - The home agent propagates the multicast downstream normally
- On a foreign network
  - The mobile host uses a tunnel to deliver the datagram to its home agent
  - The multicast home agent then propagates the multicast datagram downstream via all interface
- In both cases, the source address in the multicast packets is the mobile host's home address

Handling multicast destination mobility

- Home agent is one of many group members
- Foreign agent need not join groups on behalf of mobiles that visiting its network
- Home agent need not forward a separate copy for each mobile host that it serves, but only one copy for each foreign network at which its mobile host group member reside
  - MoM differs from the IETF bi-directional tunneling approach in which multicast packets are delivered as *unicast* packets to each mobile host

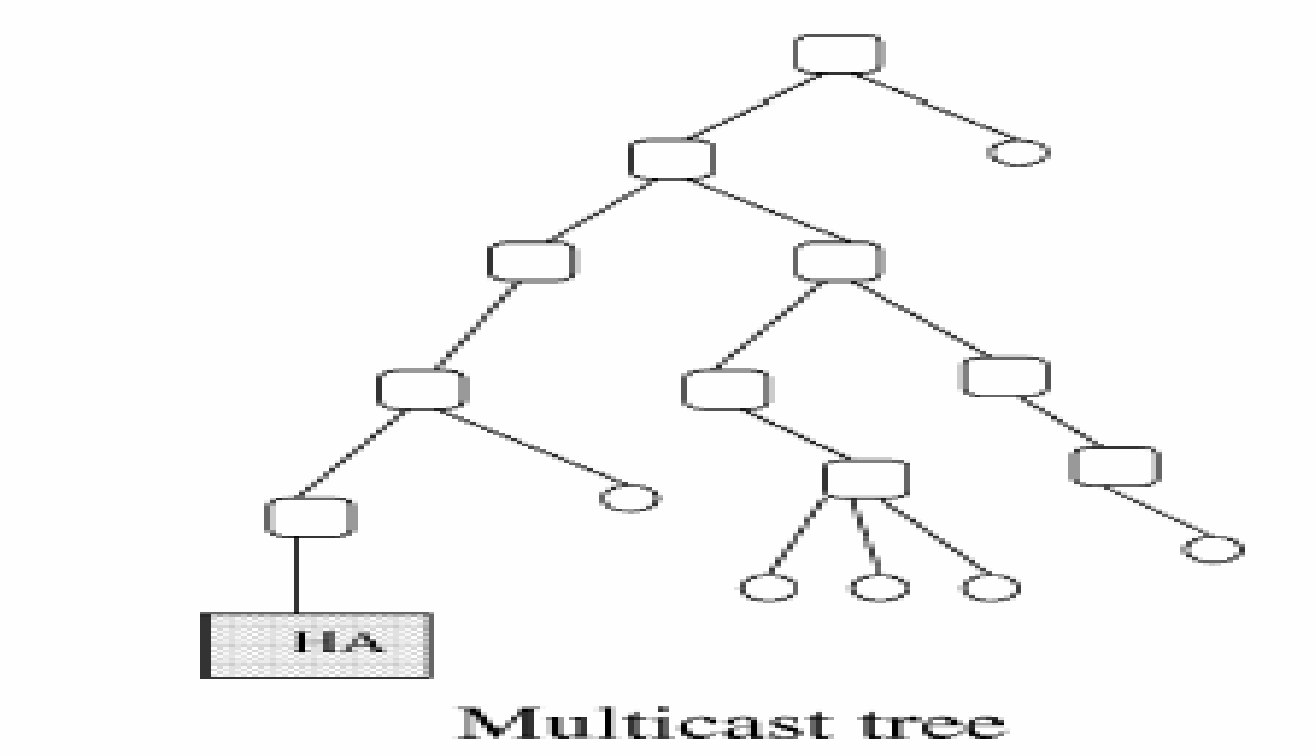
Advanced Approach (I)

MoM

Problems and Issues of MoM

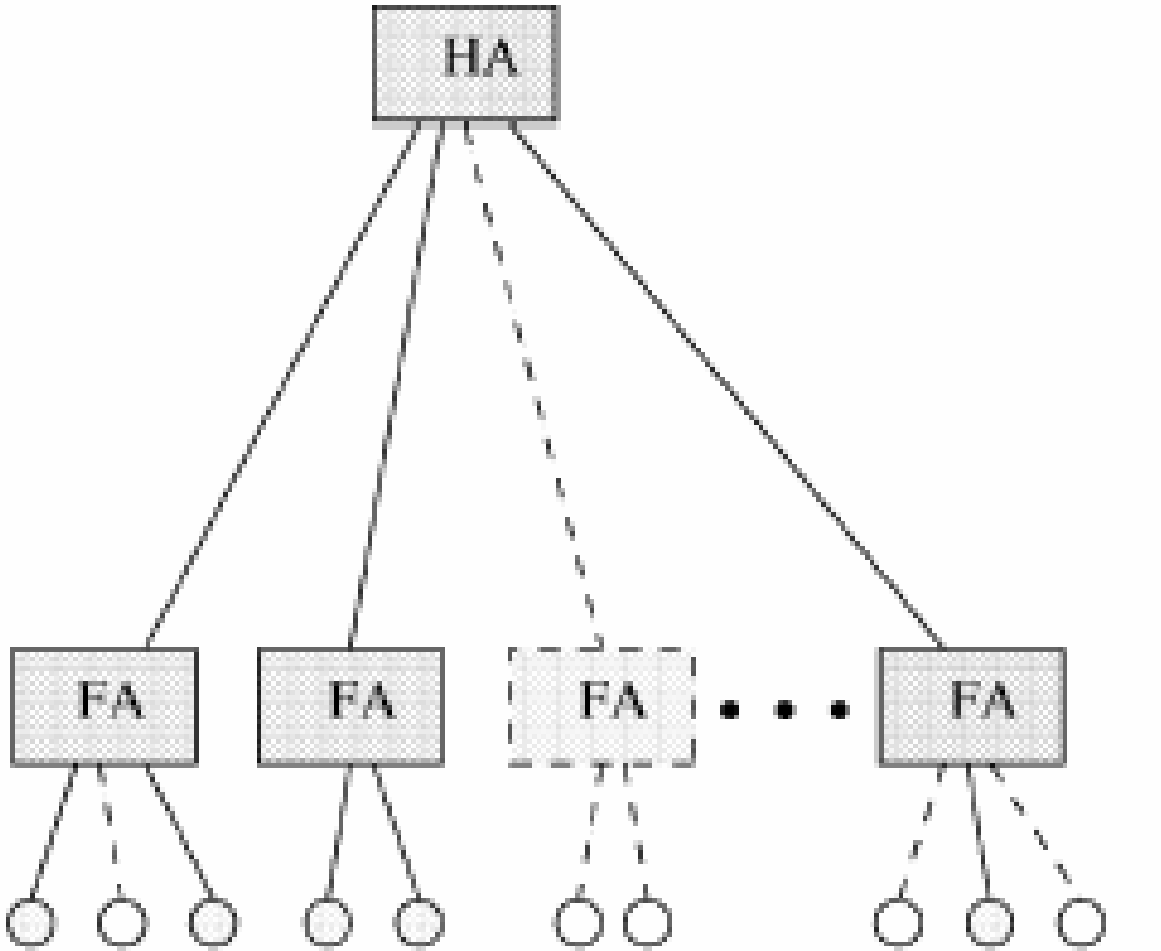
- The tunnel convergence problem
- The duplication problem
- Disruptions of multicast service

Multicast Tree



Multicast tree

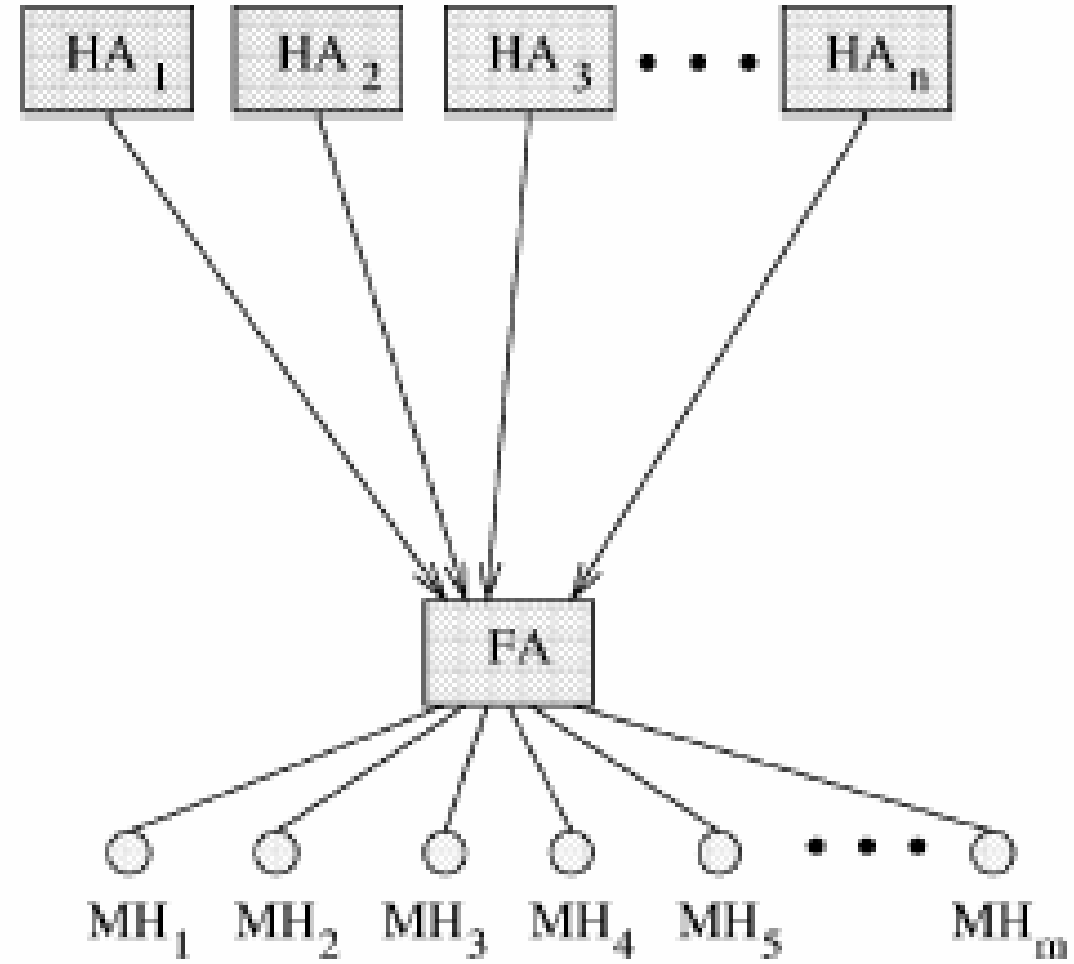
The duplication problem



The duplication problem

- If bi-directional tunneling is used, all multicast packets are forwarded individually to each MH by its HA
- MoM avoids the unnecessary duplication of multicast packets on the foreign network in the event that the HA has multiple MHs present there

The tunnel convergence problem



The tunnel convergence problem

- The foreign agent selects one home agent as the *designated multicast service provider* (DMSP) if a mobile host is the first mobile host to request subscription to group G at the foreign network
- The method solves the tunnel convergence problem , but it creates a handoff problem
  - Redundant DMSPs

Disruptions of multicast service

- When a mobile host moves
  - it moves to a foreign network that does not have an associated multicast router
    - Multicast service may be disrupted until the host moves again to a network with multicast capability
  - It moves from a foreign network to another network
    - Mobile IP there is no explicit deregistration with the foreign agent
      - HA – the mobile host reregisters at the new network
      - FA – timeout
    - a temporary disruption

MoM data structures

Home Agent Tables

Away Table

Host	FA	Timestamp

Group Information

Group ID

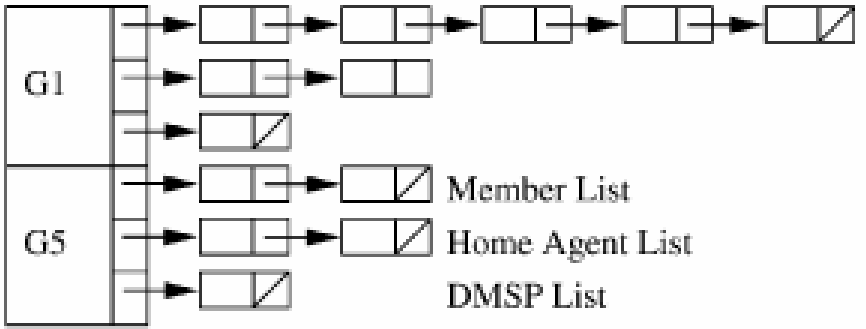
Foreign Agent Tables

Visitor Table

Host	HA	Timestamp

Group Information

Group ID



Protocol Detail

- Mobile host MH arrives at foreign network
- MH returns to its home network
- MH times out at a foreign network
- A unicast packet for MH arrives at MH's HA
- A multicast packet for group G arrives at HA
- A tunneled packet arrives at FA from HA

MH arrives at foreign network

1. Register with Foreign Agent (FA)
   1.1 Create Visitor Table entry for MH.
   1.2 Insert host name, HA info, and set timer.
   1.3 Notify FA of MH's current group memberships.
   For each multicast group G that MH is in:
   1.3.1 Make entry in GroupInfoTable, if needed.
   1.3.2 Add MH to group membership list for G.
   1.3.3 If this is the first MH from that HA
   at this FA, then add the MH's HA to the
   HA list for group G, else increment the
   host count for the MH's HA.
   1.3.4 Select a DMSP for this group from HA list.
   1.3.5 If the chosen DMSP differs from the
   old DMSP then perform DMSP handoff.

MH arrives at foreign network (cont.)

2. Register with Home Agent (HA)
   2.1 Create or update Away Table entry for MH.
   2.2 Record oldFA, if any.
   2.3 Insert host name, FA info, and set timer.
   2.4 Notify HA of MH's group memberships.
   For each multicast group G that MH is in:
   2.4.1 Make entry in GroupInfoTable, if needed.
   2.4.2 Add MH to G's membership list, if needed.
   2.4.3 If this is the first MH from this HA
   at that FA, then add the MH's FA to the
   FA list for group G, else increment the
   host count for the MH's FA.
   2.4.4 If the MH's new FA differs from oldFA
   then decrement host count for oldFA,
   discarding oldFA from list if count is zero.
   2.4.5 Record/update DMSP status (YES/NO) of
   HA for group G at FA (and oldFA, if needed).

MH returns to its home network

1. Notify the Home Agent (HA)
   1.1 Delete Away Table entry for MH, noting oldFA.
   1.2 For each multicast group G that MH is in:
      1.2.1 Delete MH from the membership list for G.
      1.2.2 Decrement the host count for MH's oldFA,
      discarding oldFA from FA list if count is zero,
      and deleting oldFA from DMSP list, if needed.

MH times out at a foreign network

1. Delete MH's entry from visitor list, noting HA.
2. For each multicast group G that MH is in:
   2.1 Delete MH from the membership list for G.
   2.2 Decrement the host count for MH's HA, discarding the HA from HA list if count is zero, and deleting the HA from the DMSP list, if needed.
   2.3 Select a DMSP from HA list for this group.
   2.4 If chosen DMSP differs from the old DMSP then perform DMSP handoff.

A unicast packet for MH arrives at MH's HA

1. Look up FA information for MH in Away Table.
2. Encapsulate packet and tunnel it to the FA.

A multicast packet for group G arrives at HA

1. Forward multicast packet to local members.
2. Look up membership information for the away members of that group.
3. Encapsulate packet and forward to each FA for which the HA is the DMSP for group G. This could be done using a separate Mobile IP unicast tunnel to each such FA, or as a multicast tunnel to the set of FAs for which the HA is the DMSP for group G.

A tunneled packet arrives at FA from HA

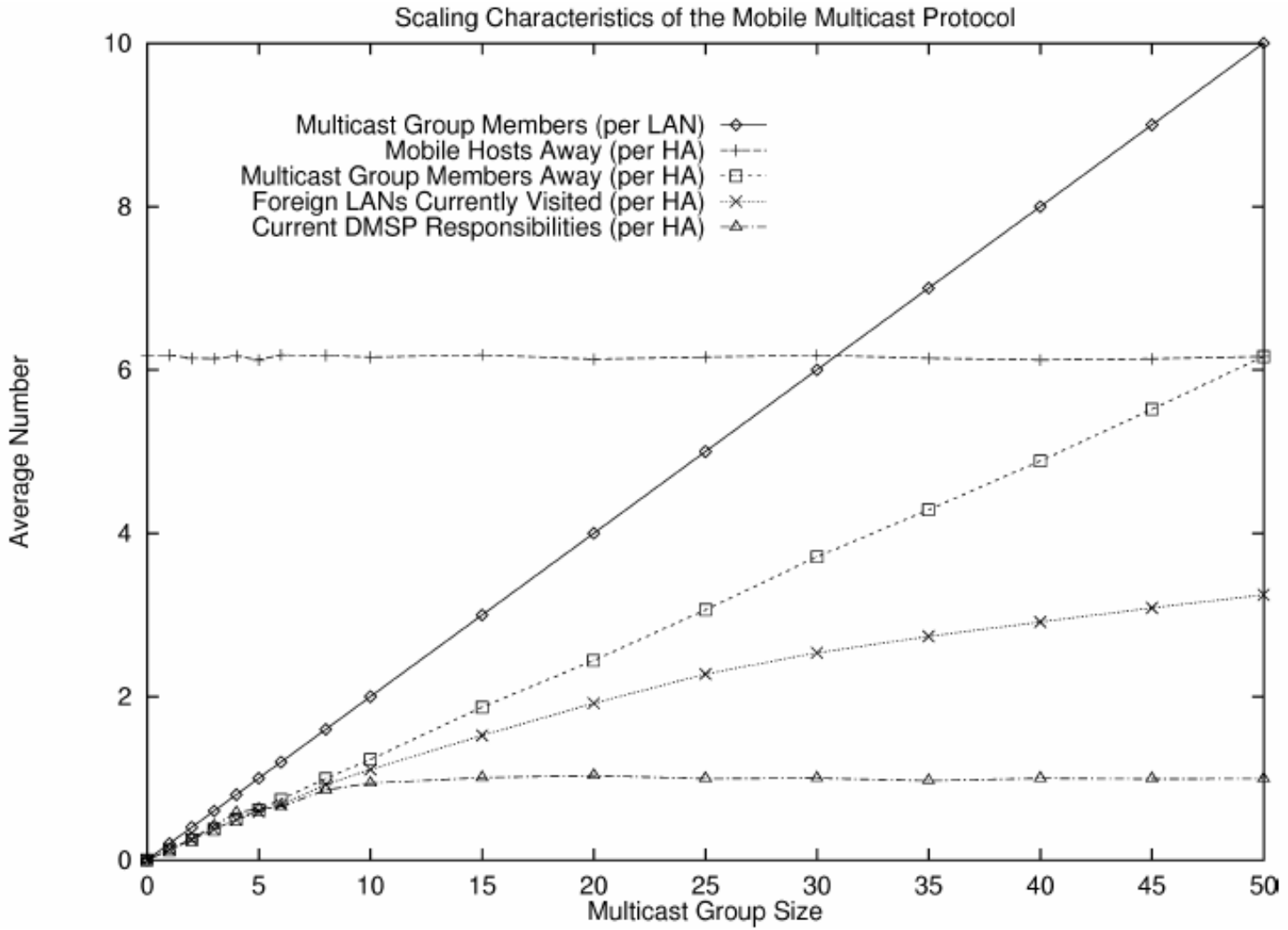
1. Decapsulate the packet.
2. If the packet is a unicast packet for a mobile host then forward to that host.
3. If the packet is a multicast packet for group G, then check for local members, and forward using link-level multicast if local members are found.

Comparison

A comparison of mobile multicast options.

Category	Remote subscription	Bi-directional tunneling	MoM
Optimal routing	Yes	No	No
Transparency	No	Yes	Yes
No Redundant packet delivery	Yes	No	Minimal
Delivery of scoped multicast	No	Yes	Yes
Multicast protocol independent	Yes	Yes	Yes
Join & graft delays	Yes	No	No
Foreign agent modification	No	No	Yes

Simulation


Scaling Characteristics of the Mobile Multicast Protocol
Multicast Group Members (per LAN)
Mobile Hosts Away (per HA)
Multicast Group Members Away (per HA)
Foreign LANs Currently Visited (per HA)
Current DMSP Responsibilities (per HA)
Average Number
Multicast Group Size
0
2
4
6
8
10
0
5
10
15
20
25
30
35
40
45
50

Limitations of MoM

- Packets that are sent and received by mobile hosts must always traverse the home network, making routing non-optimal
- Multiple unicasts are used by the home agent to tunnel multicast packets to foreign agents of mobile hosts that are group members

Related Work (cont.)

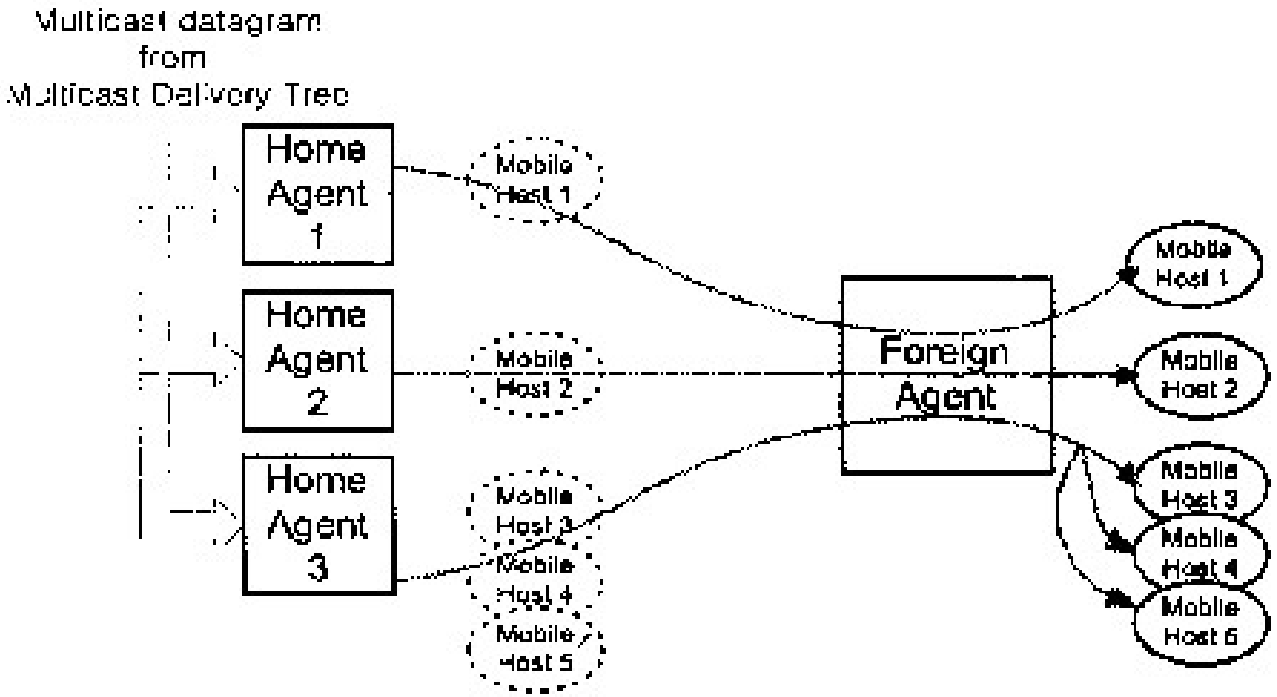


Fig. 2. Tunnel convergence problem

Related Work (cont.)

- MoM Protocol reduces multicast traffic by decreasing the number of duplicated datagrams.
- But…

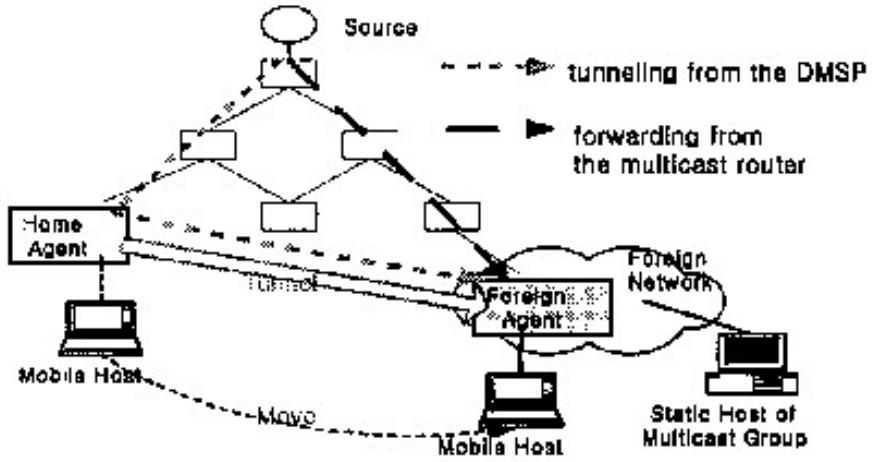


Fig. 3. Multicast data duplication problem

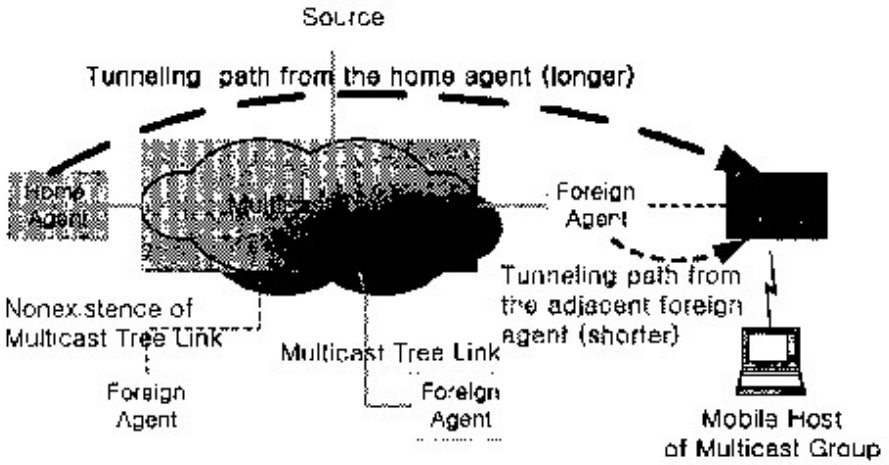
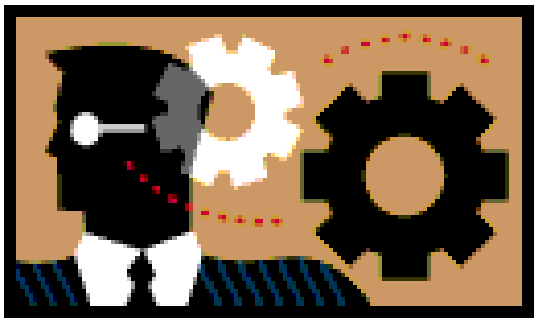


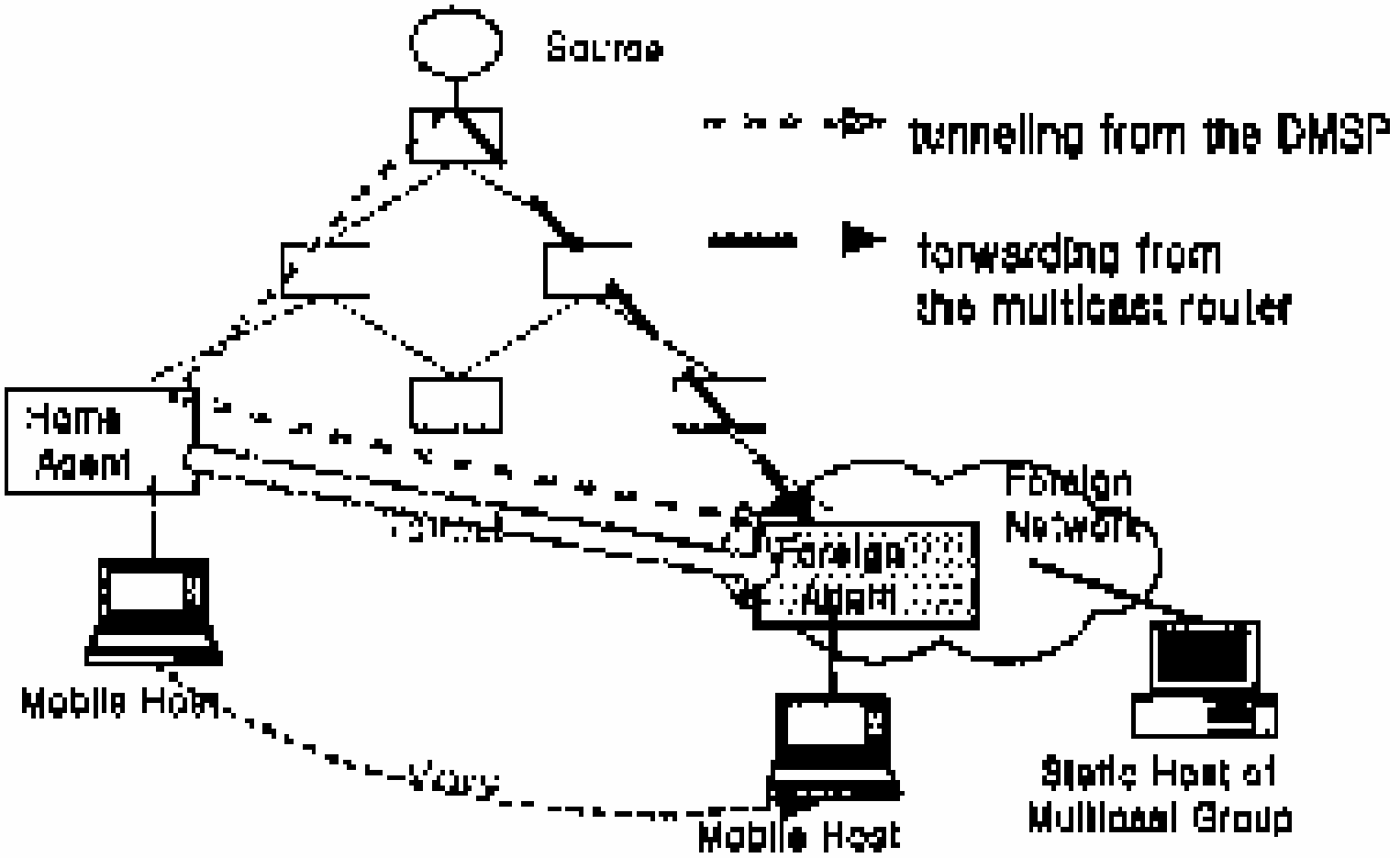
Fig. 4. Inefficient tunneling problem

Advanced Approach (II)



MMA (Mobile Multicast Agent)

Multicast Data Duplication Problem



MMA Protocol

- MMA protocol uses a multicast agent, where a mobile host receives a tunneled multicast datagram from a multicast agent located in a network close to it or directly from the multicast router in the current network.
- Goal
  - Decrease the number of duplicated datagrams
  - Reduce multicast data delivery path length
- MMA (Multicast by Multicast Agent)
  - Multicast Agent (MA)
  - Multicast Forwarder (MF)

Scenario

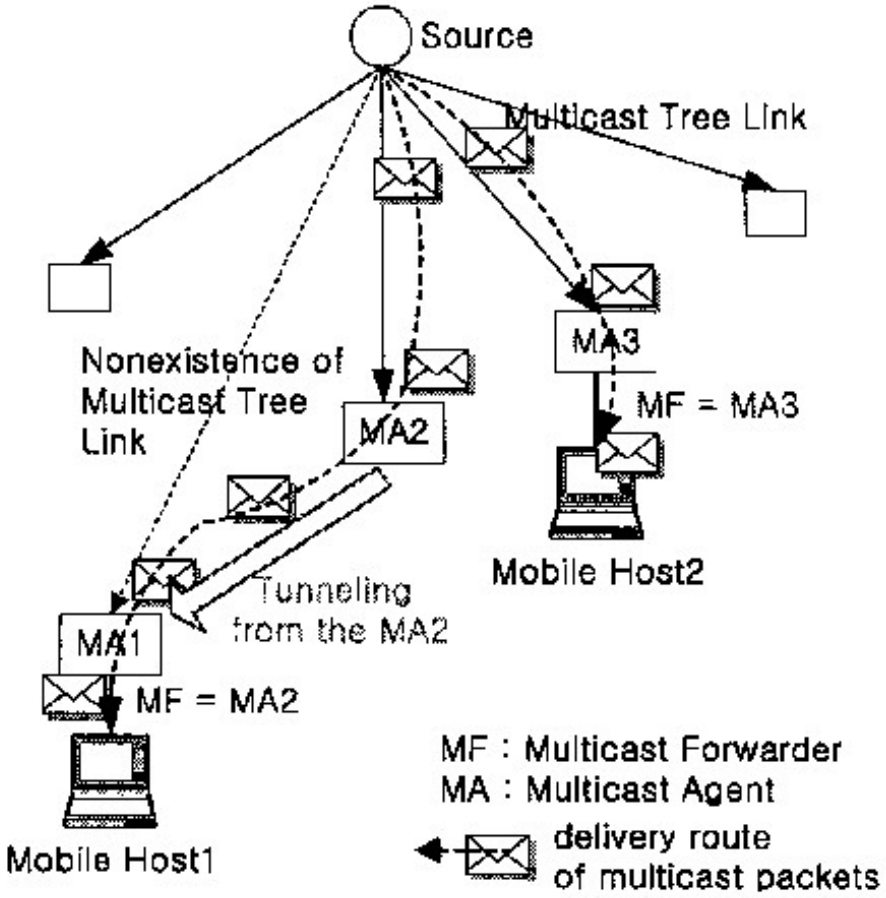


Fig. 5. Operation of the MMA protocol

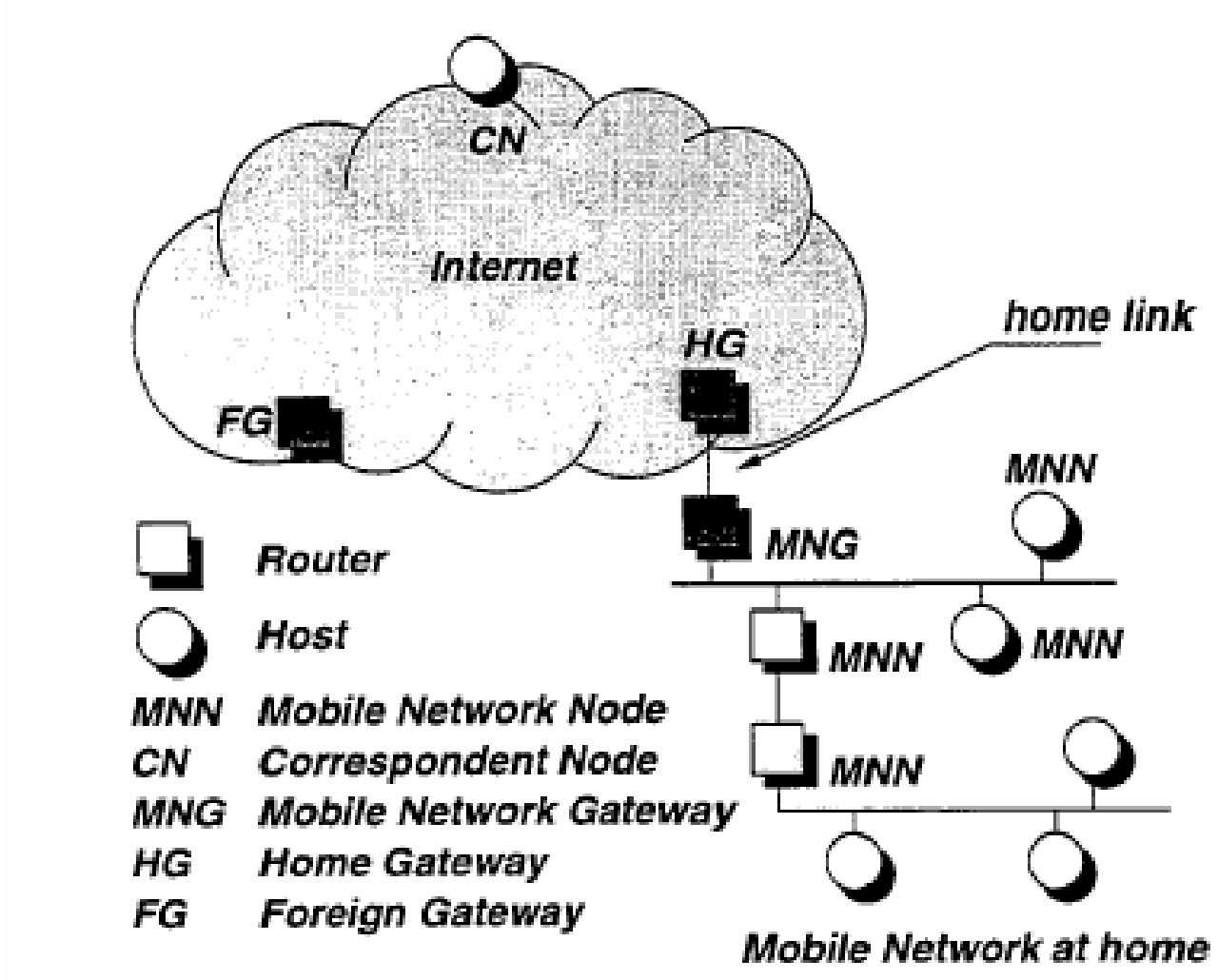
Advanced Approach (III) Extending Mobile-IPv6 with Multicast to support Mobile Networks in IPv6

Mobile Network Gateway

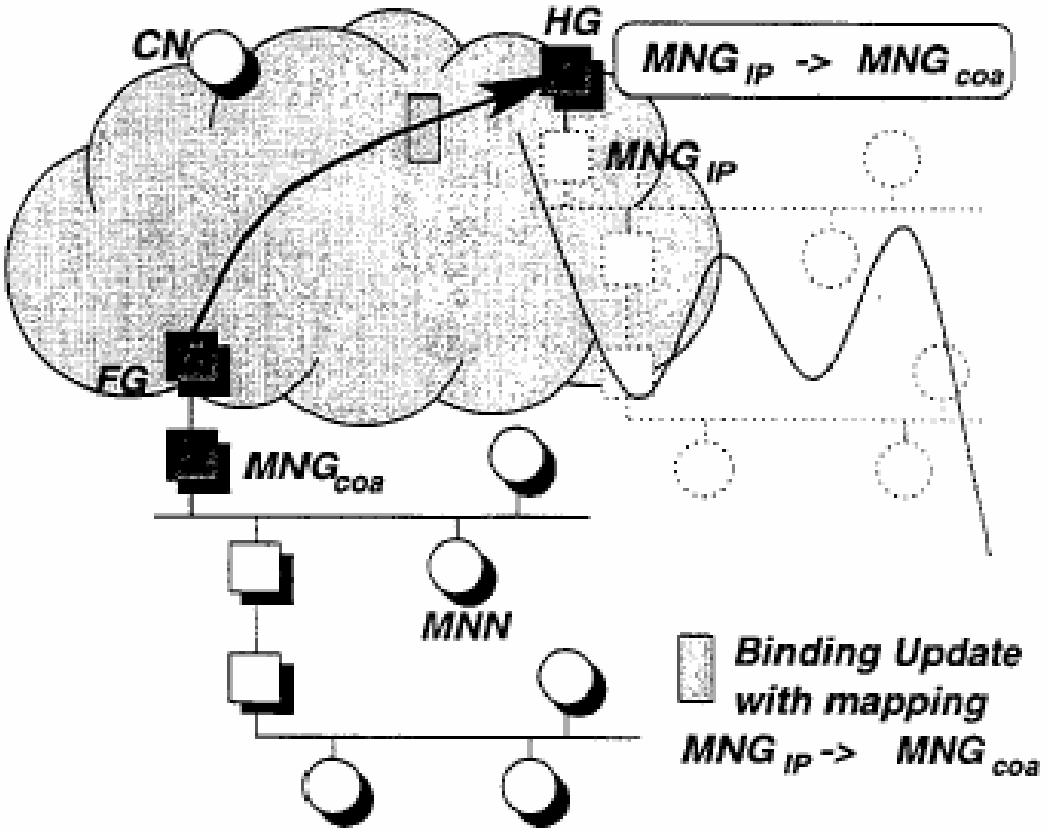
Outline

- Introduction
- Challenge
- Solution
- Evaluation
- Conclusion

Introduction



Introduction



Challenge

Challenge

- Optimal routing(Mobile-IPv4)
  - Use bind update packet
  - Home agent send this packet
- Optimal routing(Mobile-IPv6)
  - Use bind update packet
  - Mobile Node send this packet
    - (for loading of HA)

Challenge

- A MNN may communicate with multiple CNs
- There are hundreds of MNN in a MN (the size of a network)
- Binding update explosion!?

Challenge

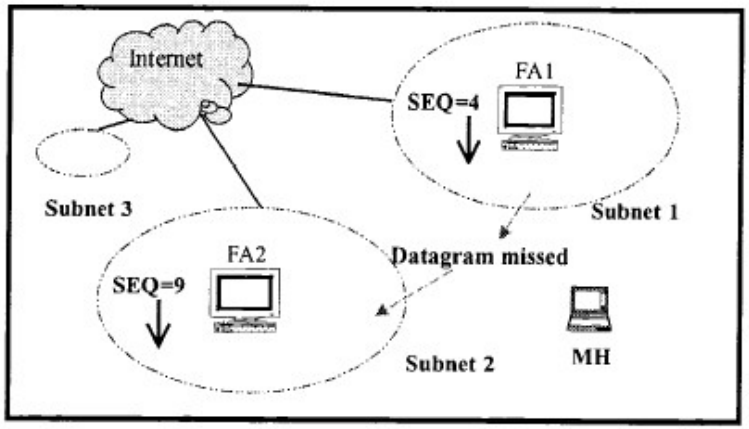
- Goal:
  - MNN send the bind update packet
  - MNNs shouldn't be concerned with mobility of their network
  - A solution for bind update explosion
  - Minimum modification of mobile-IPv6

Solution

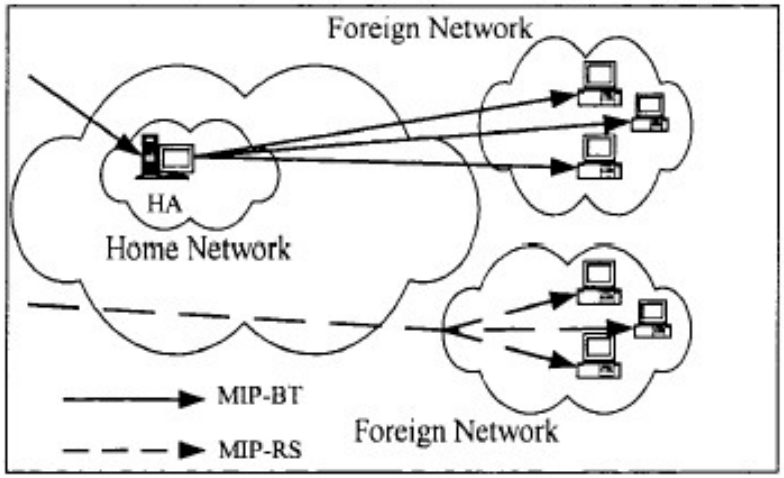
Advanced Approach (IV)

Data Synchronization

Datagram Delivery



(a) The out-of-synch problem in MIP-RS



(b) MIP-RS vs. MIP-BT

Figure 2. Datagram delivery