

# **Convergence & Handoff Issues in Next-Generation Wireless Networks**

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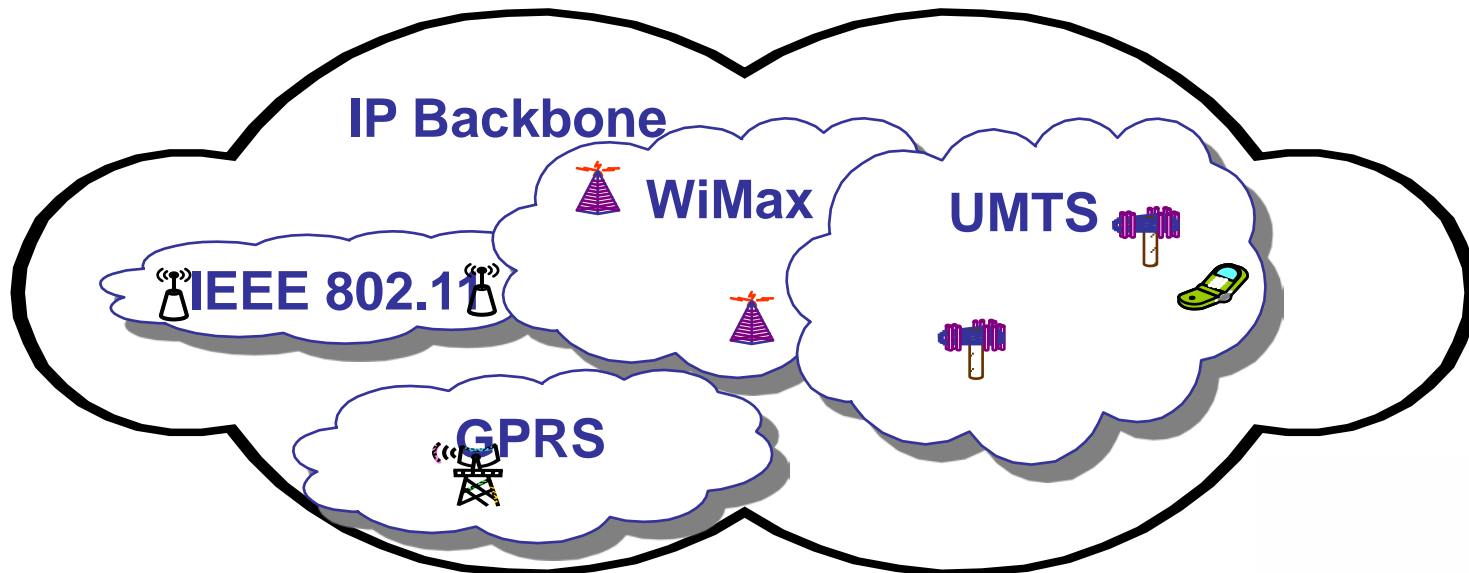
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# Presentation outline

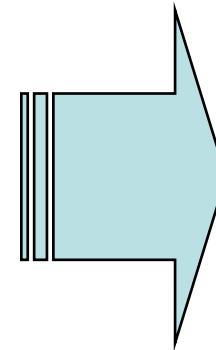
- Introduction
  - Background
  - Problem Statement
  - Objectives
  - Methodology
  - Conclusion
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# Introduction

- NGWN → integration of heterogeneous but complementary wireless access networks
- Convergence over IP based infrastructure
  - Interwork & interoperate



- NGWN provide ubiquitous network access
  - Anywhere, anytime
  - mobile users exploit a variety of access networks to meet their requirements, e.g. charging, QoS, etc.
- Operators may
  - Offer compelling value-added services
  - Improve network capacity
  - Improve availability of services
  - Serve a wider set of users



Happy  
network  
users

- Challenge to the All-IP vision
    - vertical handover performance for ongoing real-time services → continuous network access required during handover
      - High handover delay disrupts service continuity hence degrades perceived quality of communication of active connections
        - reduce handover delay (optimize delay transparency)
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- Handover delay → time that a handover procedure takes to complete
  - L2 and L3 delays
  - L2 delay is link technology specific
  - L3 delay can be reduced/optimized globally

Movement detection		IP configuration (CoA/DAD)	Binding
<i>Discovery</i>	<i>Authentication</i>		Update

—————→  
Handover delay

- Can not be avoided but can be optimized/reduced

# Problem

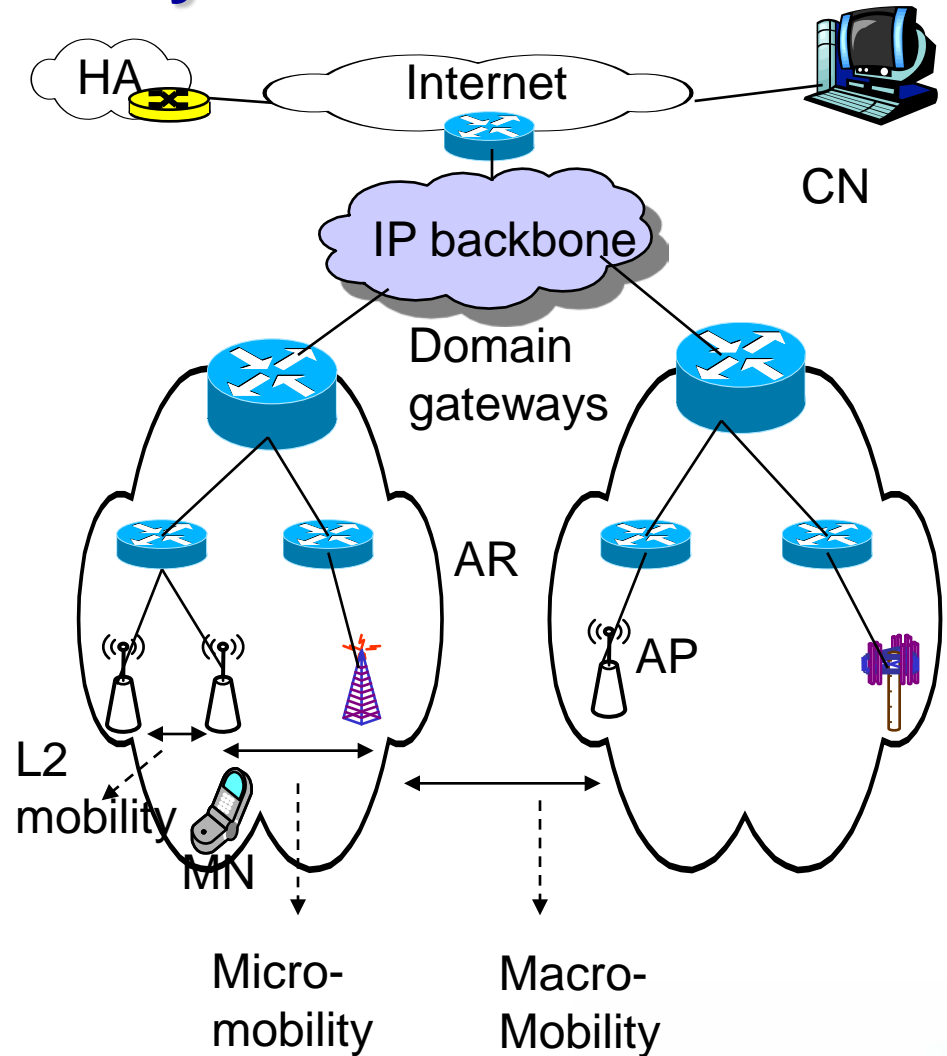
- Various mobility management (MM) protocols proposed at different protocol stack layers to provide connection transparency, e.g.
    - Link layer MM protocols, SCTP, SIP, MIP, etc.
  - Various drawbacks, particularly in terms of handover, e.g.
    - MM protocols maintain mobility binding (reachability state)
      - bindings cannot seamlessly transfer & continue ongoing sessions without disruptions
    - Handover trigger based on signal strength
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# Problem

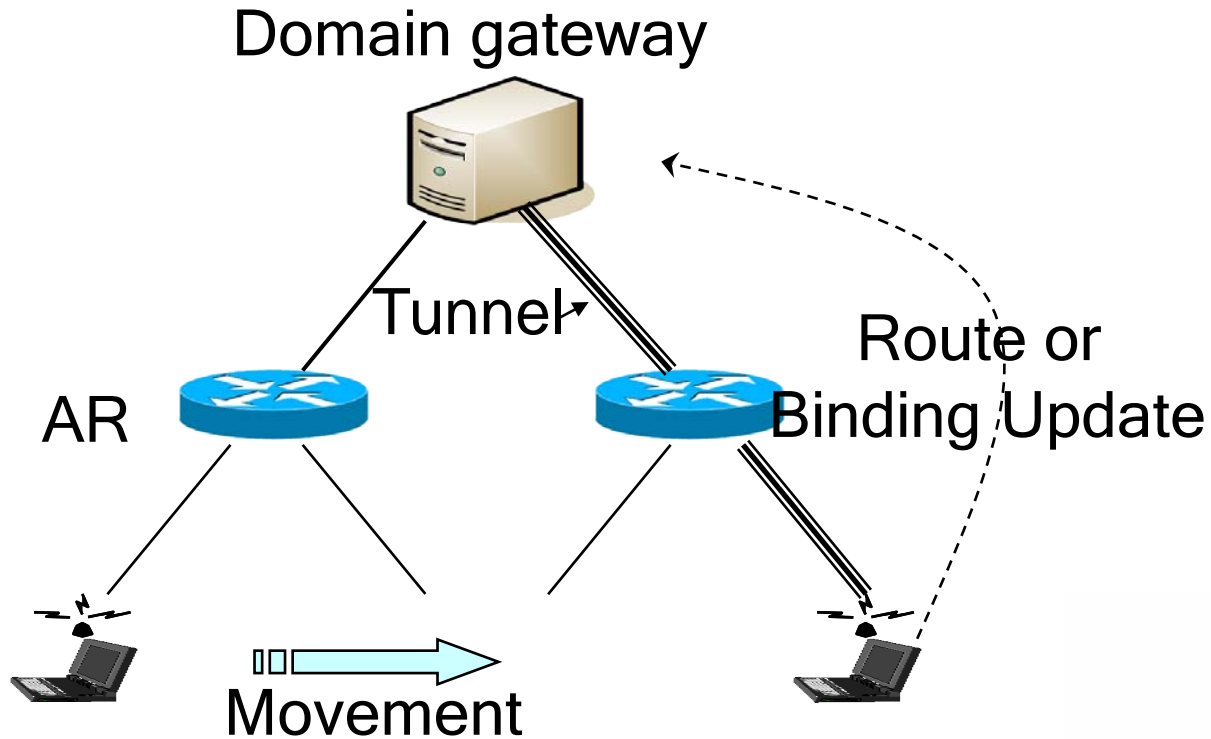
- No network selection & handover initiation capabilities
  - Dependent on reactive manipulations of handover process, e.g.
    - Handover initiated when network change is detected @ IP layer
  - High handover delay
  - Not suitable for NGWN in their current form
    - Additional mechanisms required to enhance handover performance
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# Towards handover delay reduction in NGWN

- MIPv6 → widely accepted MM protocol for NGWN
- Inherently very long handover delay
- To improve handover performance: split MM
  - Global (macro)
  - Localized (micro)



- Example Localized MM protocols
  - HMIPv6, Cellular IP, HAWAAI, etc.
  - Fast handover protocols, FMIPv6 → proactive registration to reduce handover delay
- Host-based



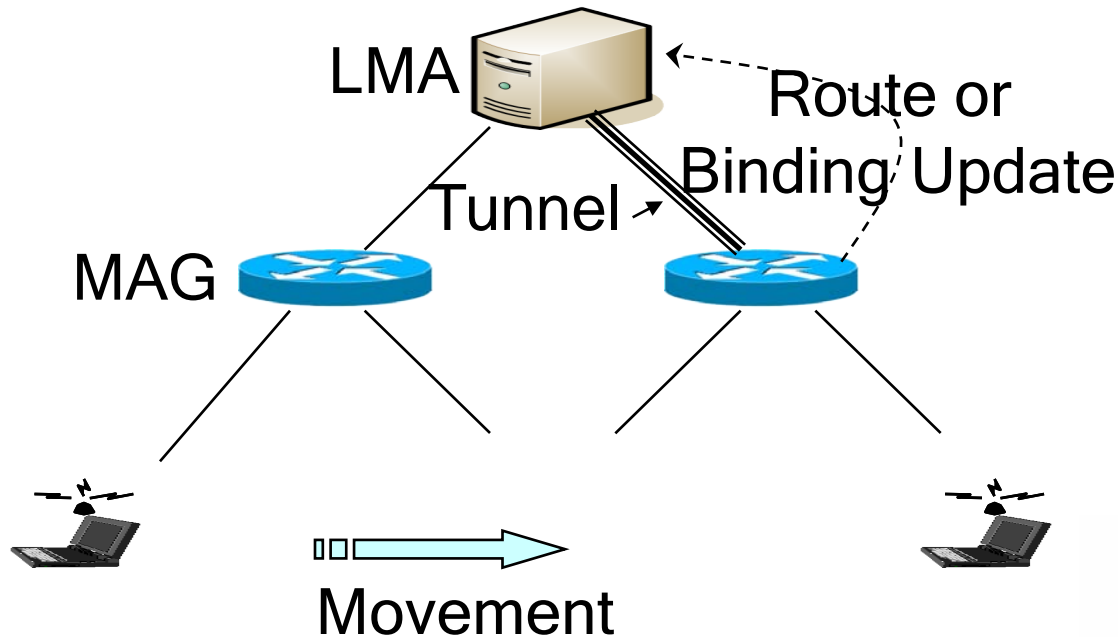
- Utilization of L2 triggers/hints to enhance L3 handover procedure
    - Expense → MIPv6 has to be dependent on underlying L2 technology → hints not standardized
  - Various other works have been done to improve handover performance & network selectivity. However,
    - Handover delay still high for real time services
    - Handover (network) selectivity without impacting on handover delay is still a challenge
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# Objectives

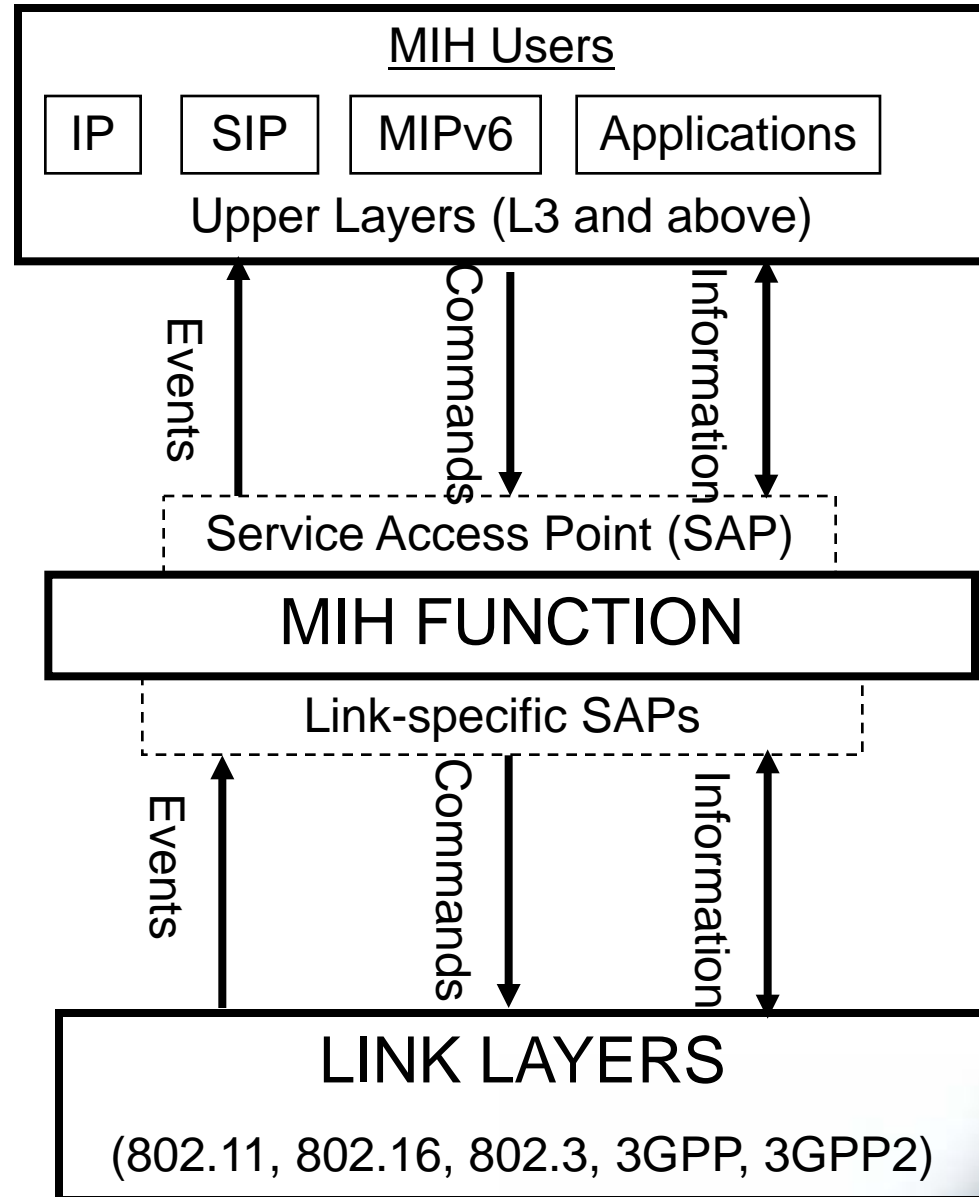
- To develop an intelligent architectural framework to improve vertical handover performance for real-time services
    - Reduce IP handover delay
      - To avoid perceptible service disruptions
    - Make faster & accurate network selectivity before handover
      - Perform optimal network selection among heterogeneous access networks in a short time scale
  - Investigate and evaluate tradeoffs (cost benefits)
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# Methodology

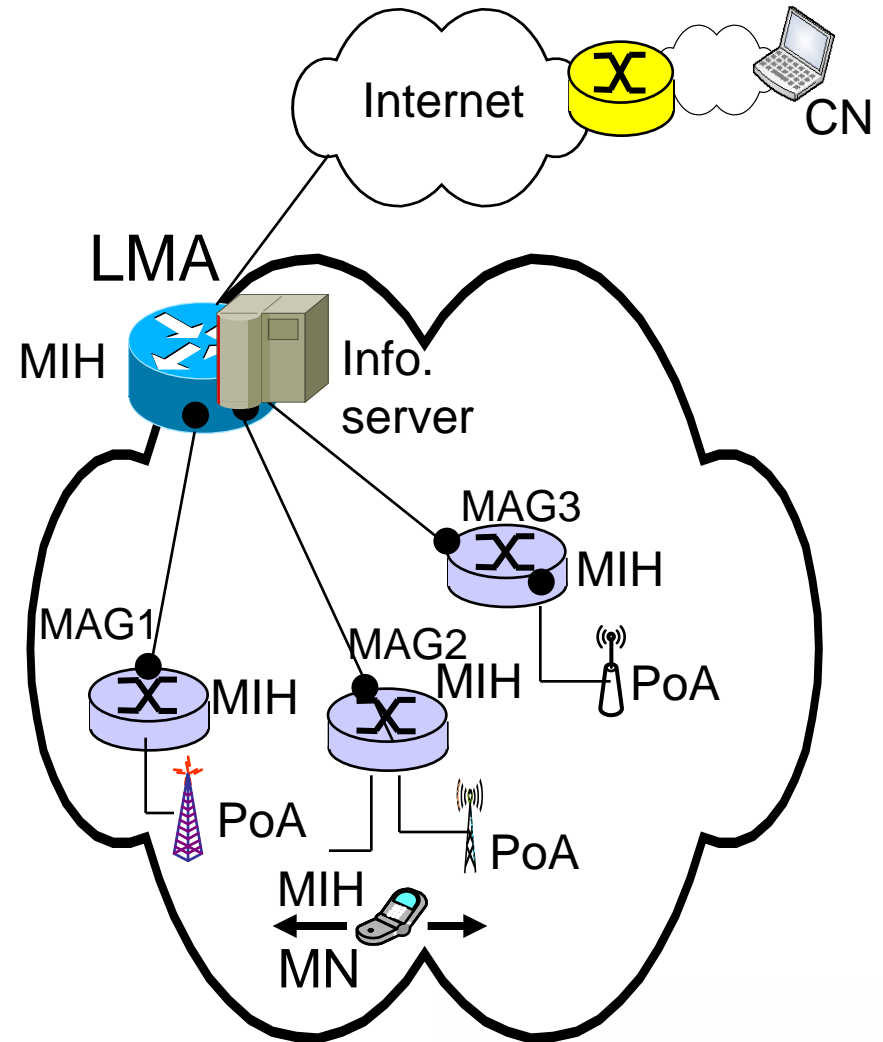
- Intelligent synthesis of a network-based MM scheme and a technology-aware handover mechanism over a cross-layer design architectural framework



- Utilization of IEEE802.21 MIH services → enhance handover performance
- MIES
  - Report dynamically changing lower layer events to upper layers
- MICS
  - Enable MIH users to manage & control link behaviour related to mobility & handovers
- MIIS
  - Facilitate network selection & effective handover decisions
    - Provide information about services & characteristics of neighbourhood



- MN & AR utilize MIH → updating & retrieval of information elements (→info/MIIS server)
- included
  - General info. & access network specific info. (e.g. cost, Qos, security, etc)
  - PoA specific info. (e.g. CoA, data rates, MAC addr., etc)
  - *Stable IDs for attached MNs*
  - *Authentication information*
  - *Dynamic information*
  - Each MAG up-to-date about surroundings

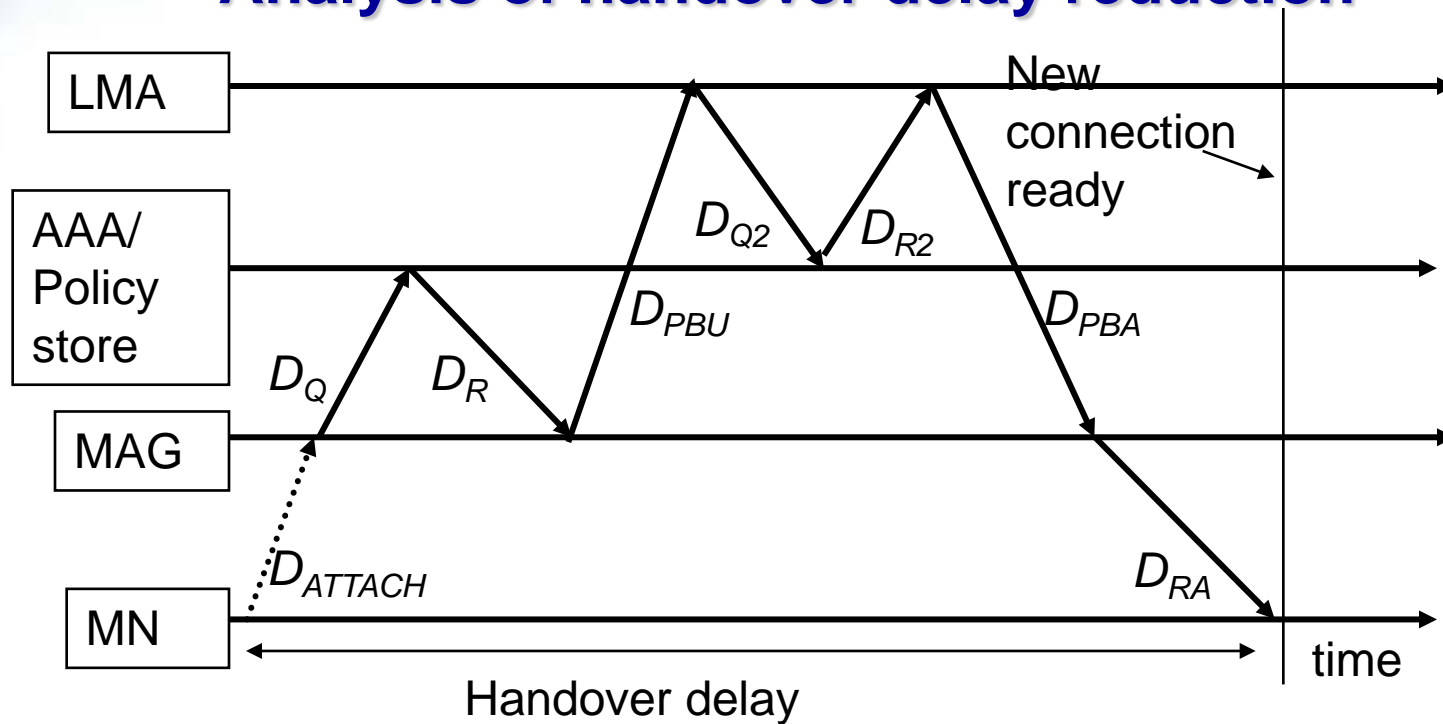


- Information exchange done before hand
    - Proactive signalling deliberations
  - One domain under single administrative management → maintenance of info. server very feasible
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- Cross-layer design architectural framework to further improve handover performance
    - Protocol layers adapt & collaborate to optimize handover performance
      - Provision of faster signalling for network selection decision and handover initiation support
      - Handover delay is jointly optimized
    - Facilitates relevant decision algorithms to react to corresponding handover-causing (initiation) scenarios for fast & accurate handover decisions
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- *Any available network*
    - Forced handover due to deteriorating signal strength or loss of resources
      - Parameters: RSS, battery power, resources, etc.
  - *Best convenient network*
    - Unforced handover mainly due to user preferences
      - Parameters: cost, available services, etc.
  - *Active service-related handover*
    - real-time & multimedia services
      - Parameters: network latency, data rate, QoS, etc.
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# Analysis of handover delay reduction

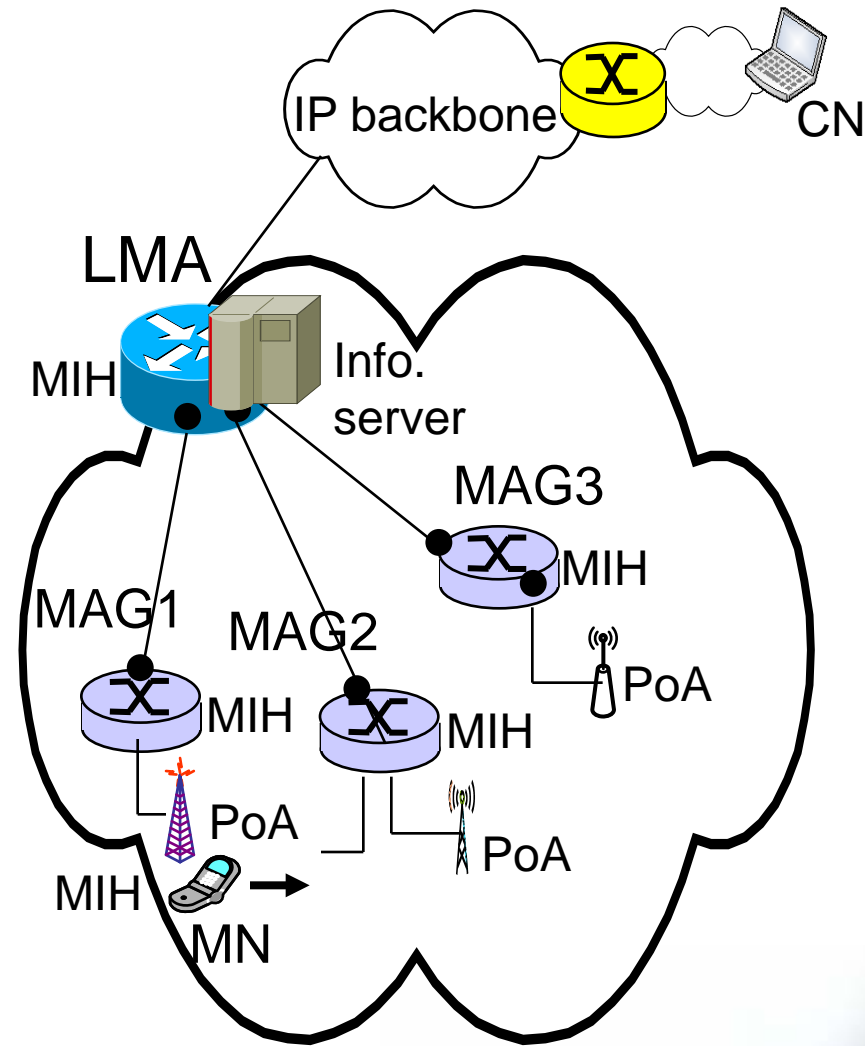


- Typical handover delay:
- Attachment notification delay,  $D_{ATTACH}$
- Authentication delay,  $MAG \leftrightarrow MN$ ,  $D_{AUTH}$ 
  - $D_{AUTH} = D_Q + D_R$
- Authentication delay,  $MAG \leftrightarrow LMA$ ,  $D_{AUTH\_2}$ 
  - $D_{AUTH\_2} = D_{Q2} + D_{R2}$

- Proxy Binding delay,  $MAG \leftrightarrow LMA$ ,  $D_{BINDING}$ 
    - $D_{BINDING} = D_{PBU} + D_{PBA}$
  - Router Advertisement delay,  $MGA \rightarrow MN$ ,  $D_{RA}$
  - IP configuration delay,  $D_{CONFIG} \rightarrow 0$  when MN is already in PMIPv6 domain  $\rightarrow$  per-MN-prefix
  - Duplicate Address Detection (DAD) delay,  $D_{DAD} \approx 0$  when MN is already in PMIPv6 domain
  - Total handover delay
    - $D_{PMIPv6} = D_{ATTACH} + D_{AUTH} + D_{AUTH\_2} + D_{BINDING} + D_{RA}$
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# IEEE802.21-enabled Proposed Handover

- During MN handover, new MAG would already know about attaching MN from relevant information element in server  
→  $D_{ATTACH} \approx 0$
- MN authenticated “before hand” when first discovered in information server  
→  $D_{AUTH} \rightarrow 0$   
→  $D_{AUTH\_2} \rightarrow 0$
- Hence, handover delay in our proposed scheme becomes
  - $D_{PMIPv6\_802.21} = D_{BINDING} + D_{RA}$



# Conclusion

- A handover delay reduction mechanism is proposed
  - Future work
    - Experimental evaluations through simulations
      - NS-2 and/or OPNET
  - Performance evaluation
    - Comparison with standardized fast handover schemes, e.g. FMIPv6
    - Comparison with standard performance requirements for real time traffic
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