Empowered by Innovation NEC

Daidalos Seamless Mobility Technologies

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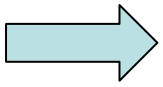
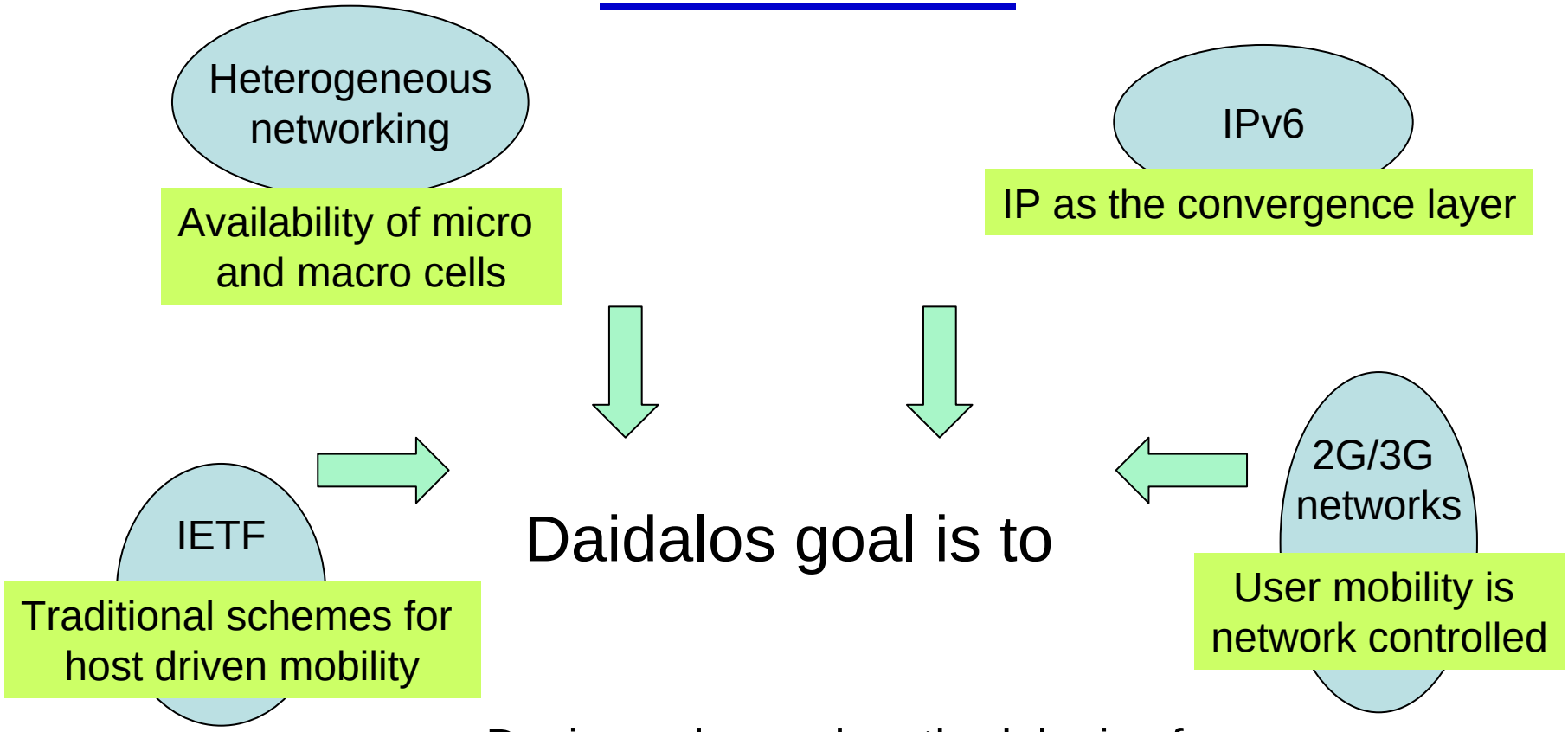
Daidalos 5 key concepts

- MARQS
  - Mobility
  - AAA
  - Resource Management
  - Quality of Service
  - Security
- Virtual Identities
- Ubiquitous and Seamless Pervasiveness
- Seamless Integration of Broadcast
- Federation



Focus of today's talk is on the combination of Mobility, Resource Management and Quality of Service

Motivation



Design enhanced methodologies for traditional host driven mobility schemes referred hereinafter as MIHO

Design a novel approach for network supported and network initiated handovers referred hereinafter as NIHO

Definition of Network Initiated Handover

- Action taken in the network to initiate the handover based on:
  - Link events originated in the mobile node:
    - radio link variations (e.g. RSSI, SNR)
    - powering on of new network devices
    - new service requirements
    - …
  - Events generated in the network:
    - resource management reasons
    - optimization based on location/services
    - multi homed devices
  - …

Mobility Architecture: design principles

- Abstraction Layers are used to hide technology specifics
  - They provide a common interface for all technologies
  - Interface Abstraction Layer (IAL) for Mobility
  - QoS Abstraction Layer (QoSAL)
- Terminal Intelligence
  - Interface selection upon startup/handover is performed by the terminal *intelligently*
  - User preferences are accounted for
  - QoS and signal strength also taken into account
- Network Intelligence
  - Handoffs may be triggered by the network
  - Load balancing purposes triggered by QoS

Close Interaction between QoS and mobility functions

A two-steps approach

1. NIHO studied as a general concept and compared to scenarios where MIHO-only is applied:
   - No signaling study
   - Aiming at
     - quantifying the benefit of the approach
     - Identifying conditions affecting relevance of NIHO support
   - Consider user mobility patterns and wireless overlapping
   - WLAN propagation model used for simplicity
2. NIHO studied from a signaling/mobility point of view:
   - IEEE 802.21 based signaling design
   - Network controlled and Network Initiated
   - Impact of signaling on terminal mobility

Step one (i)

- Customized simulator (results averaged over 30 simulation runs)
- Simplified setup by considering single technology and regular cells placement
- 6 access points in hexagonal grid (see next slides)
- Nodes' birth/death follow Poisson distribution
- Random way point model is used (different speeds accounted)
- Uniform distribution of users:
  - First, simulations have been performed in scenarios where only MIHO is used. This provides reference results.
  - In a second stage, the simulations combine both MIHO and NIHO techniques, and are then compared with the previous reference results.
- Change the scenario with not evenly distributed users

Step (i) – results on not evenly distributed users

Consider scenarios where users are concentrated in one portion of the network (e.g. hotspots, shopping malls)

Table I. Metrics values for different network loads (lambda)

λ	NumberUsers	RejectHOProb	RejectConnProb	NumberHO	Load
0.04	9.53%	83.2%	86.78%	14.16%	50.52%
0.06	7.64%	85.57%	85.6%	16.57%	63.9%
0.12	24.9%	64.73%	55.04%	84.8%	84.7%
0.31	30.52%	28.12%	44.8%	14.93%	92%
1	31.15%	9%	21.8%	56.13%	100%

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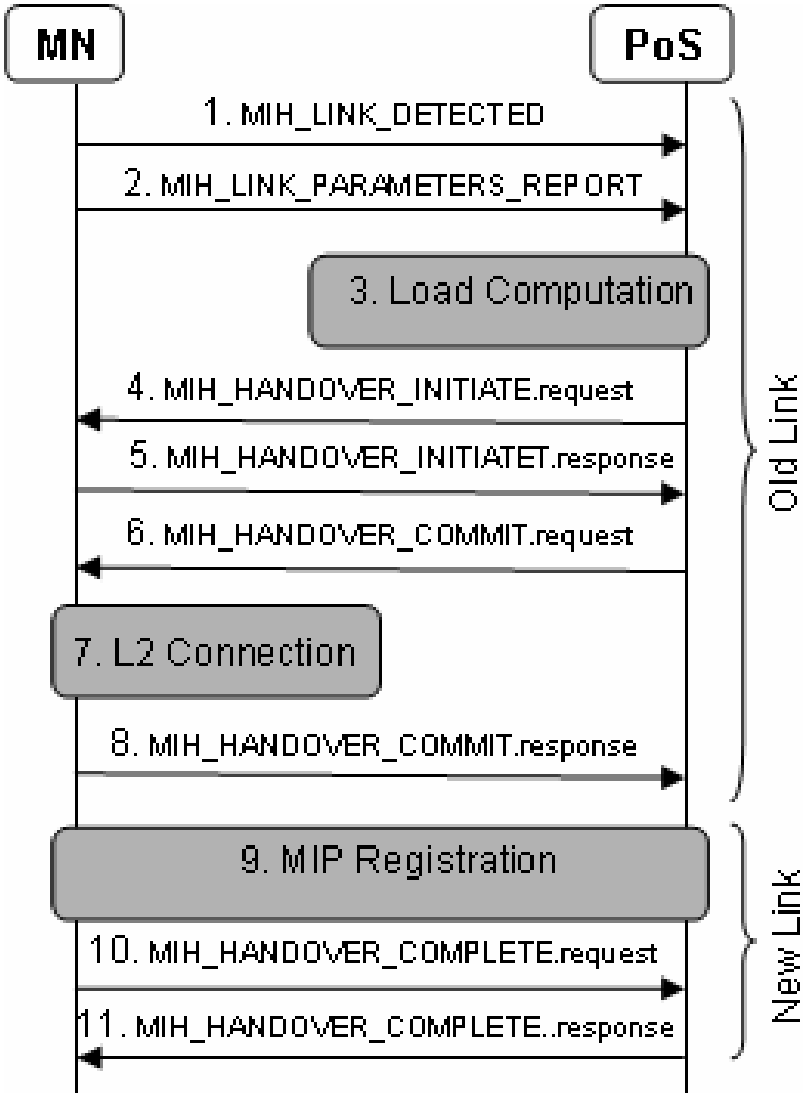
Step two (i)



- Terminal design based on [1]
- WLAN→3G and 3G→WLAN handovers
- Omnet++ simulation environment
- Results obtained with and without load control
- Several metrics considered:
  - Mean percentage of L2 handover without MIP registration
  - Mean number of 3G → WLAN handovers
  - Mean number of WLAN → 3G handovers
  - Mean wireless utilization time

Step two (ii) -- Considerations on 802.21 signaling

- Out of cell implementation for WLAN is required to not affect performance
- The location (Report message with AP MAC) is sufficiently accurate
- It is possible to achieve comparable results with and without load balancing
- Optimal threshold configuration allows 0 packet loss
- Framework handles race conditions
- RTT impact is not visible
- Seamless mobility is achievable

Conclusions

- In IP-based heterogeneous networks NIHO technology improves performance
- Depending on the scenarios a combination of both MIHO and NIHO is required
- Signaling for heterogeneous networking requires abstraction layers
- Reporting functions terminal-to-network are required for event handling
- If optimal configuration of mobile terminals is achieved handover performance is not affected

Dissemination effort

[1] T. Melia et al, *"Analysis of the effect of mobile terminal speed on WLAN/3G vertical handovers",* In proceedings Globecom 2006, Wireless Communications Symposium

[2] A. de la Oliva et al, "*A case study: IEEE 802.21 enabled mobile terminals for optimized WLAN/3G handovers*", to appear in ACM SIGMOBILE Mobile Computing and Communications Review (MC2R), 2006.

[3] T. Melia et al. *"Network Initiated handovers: challenges and possibilities"*, Submitted to Special issue on seamless handover, Personal Wireless Communication, Springer

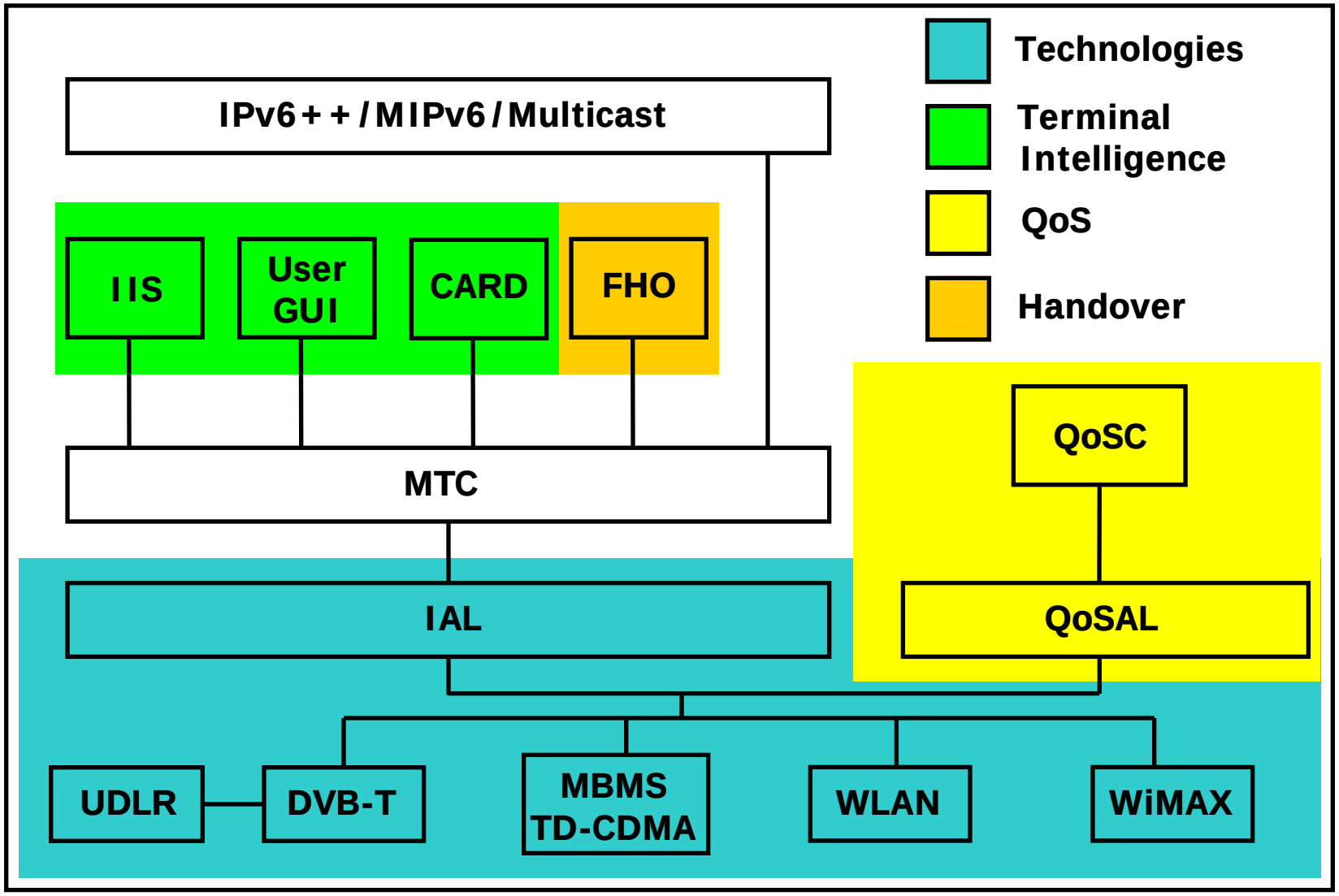
[4] T. Melia et al. "*Towards IP Converged Heterogeneous Mobility: A Network Controlled Approach*", Submitted to Infocom 2007

[5] A. Vidal, T. Melia, "QoS considerations in Network Initiated Handovers", IEEE 802.21 contribution, May 2006

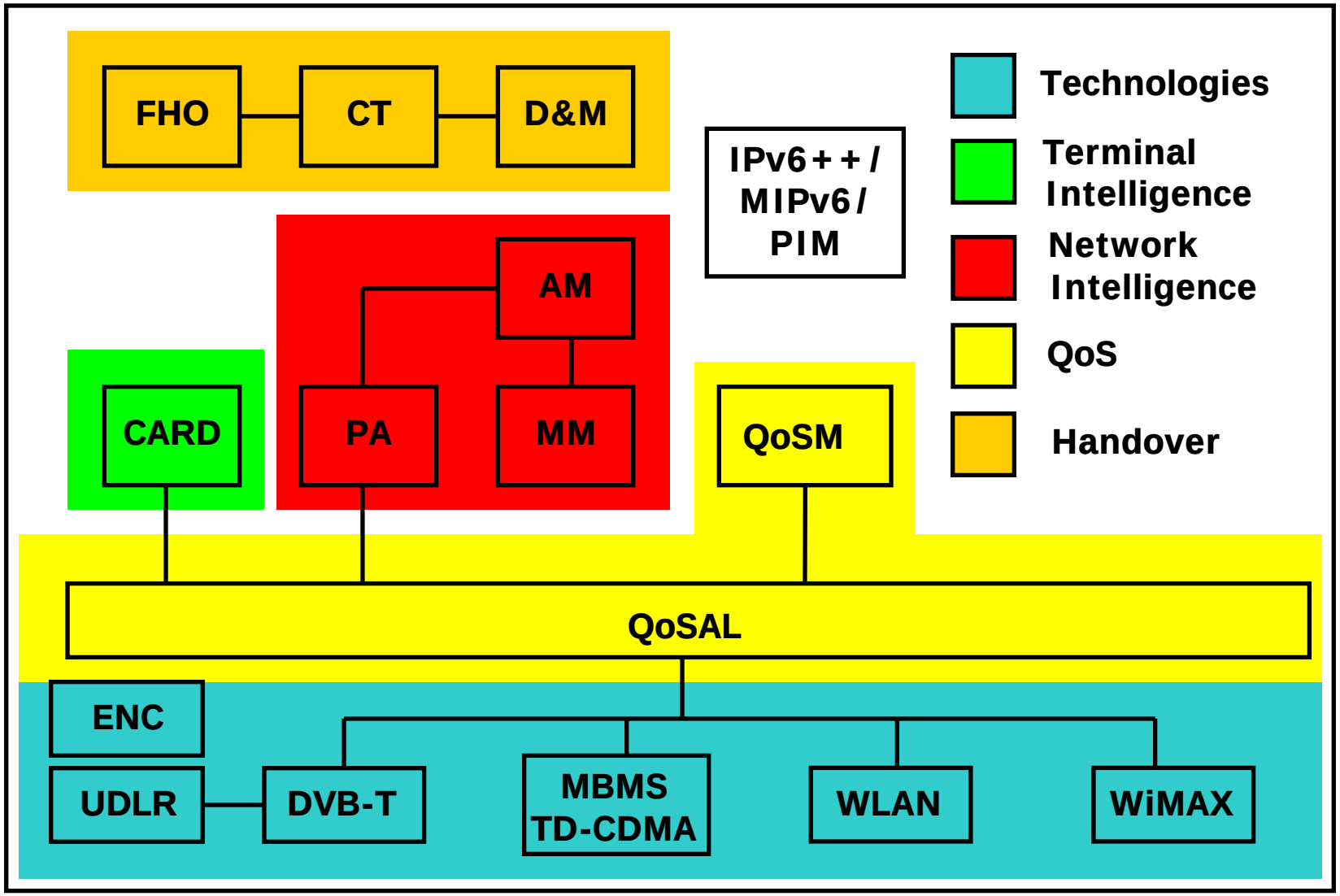
[6] E. Hepworth at al. "Mobility Services: Problem Statement", draft-melia-mipshop-mobility-services-ps-00, Internet draft

Backup

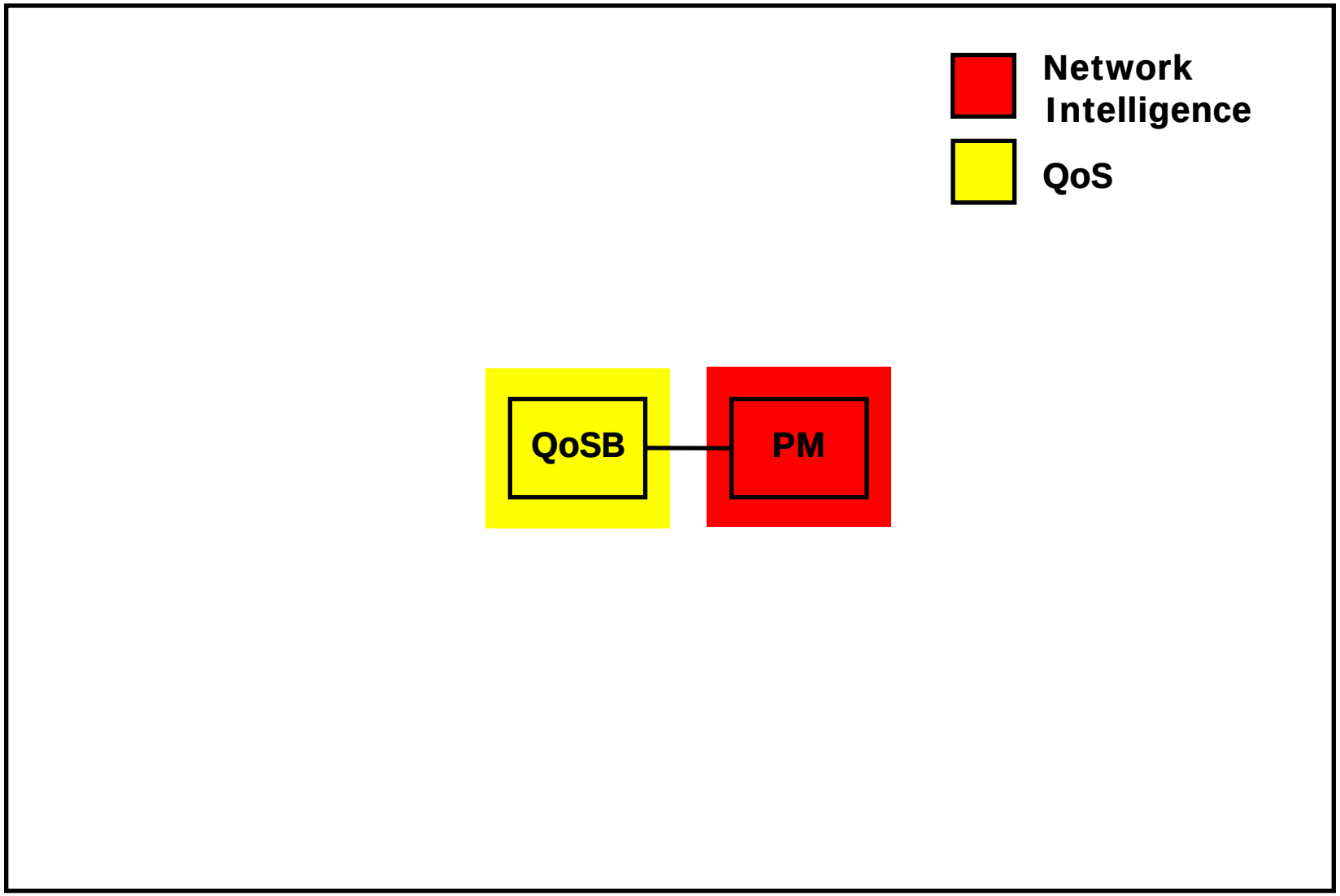
Mobile Terminal



Access Router / Access Point



QoS Broker



Handover Decision

- MIHO

Triggered
- **At startup**
- **Upon losing signal**

Accounts for
- **user preferences**
- **candidate APs load (QoS)**
- **signal strengths**

- NIHO

Triggered by
- **Overloaded AP (QoS)**
- **losing signal**

Accounts for
- **signal strengths of MTs**
- **APs load (QoS)**

Mobile Initiated Handover

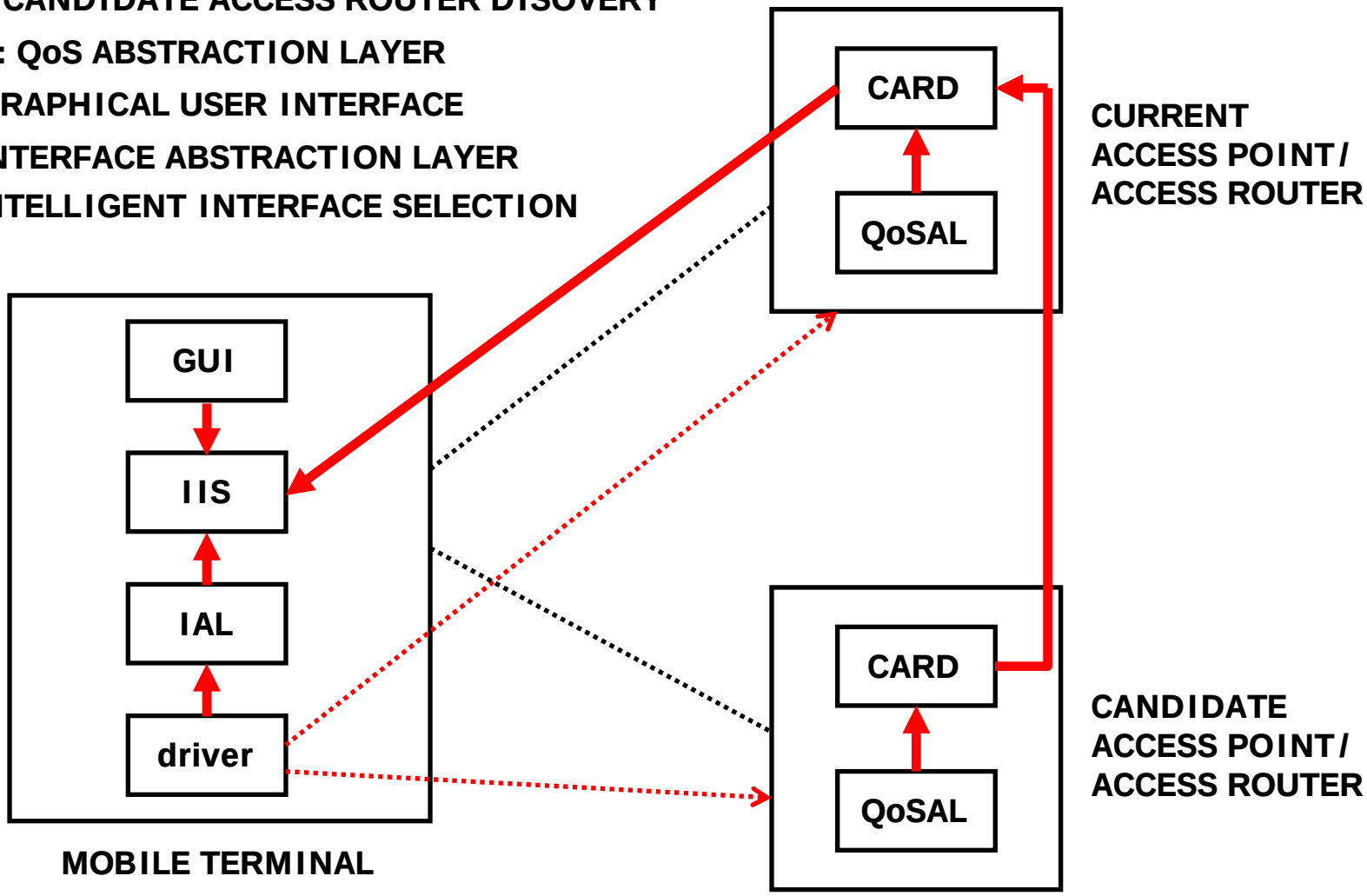
CARD: CANDIDATE ACCESS ROUTER DISOVERY

QoSAL: QoS ABSTRACTION LAYER

GUI: GRAPHICAL USER INTERFACE

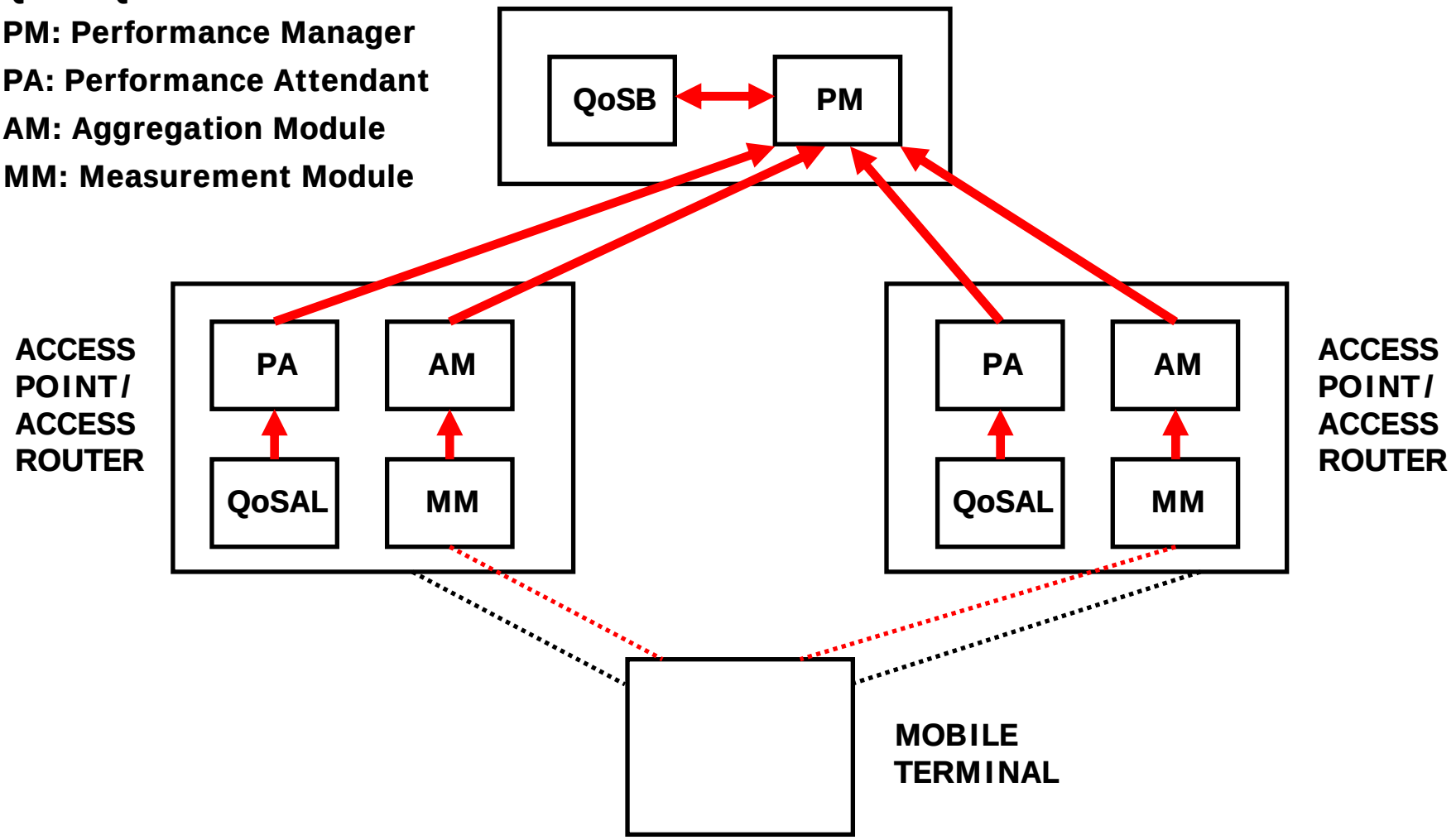
IAL: INTERFACE ABSTRACTION LAYER

IIS: INTELLIGENT INTERFACE SELECTION



Network Initiated Handover

QoSB: QoS Broker
PM: Performance Manager
PA: Performance Attendant
AM: Aggregation Module
MM: Measurement Module



Handover Execution

CT: Context Transfer

FHO: Fast Handover

D&M: Duplication and Merging