The EU IST Project BRAIN/MIND

An IP solution for systems beyond 3G

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ITU Seminar on IMT-2000 and systems beyond
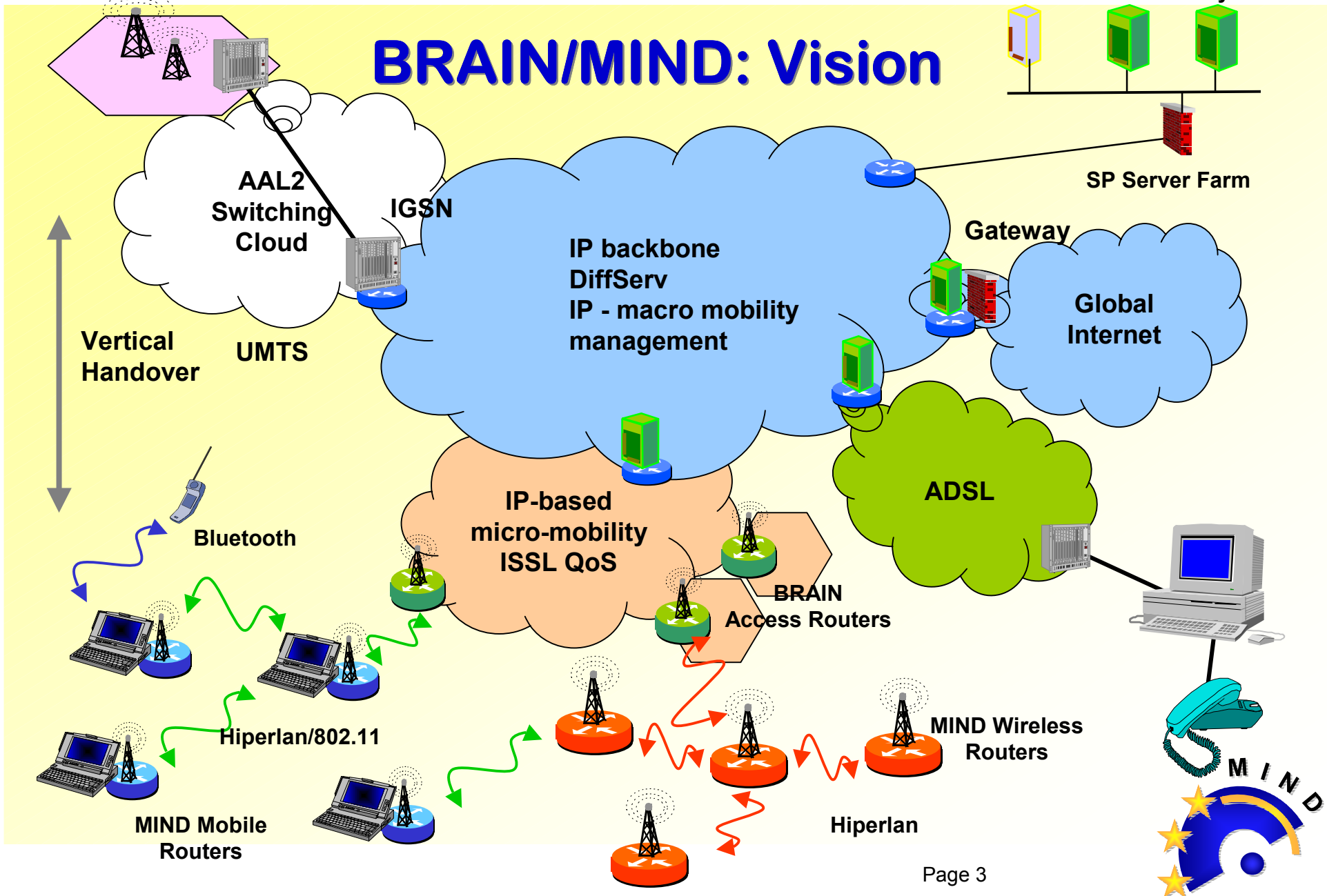
Ottawa, 28th May 2002

Introduction - Recent Developments

- **Dominance of IP applications**
  - **Voice over IP is becoming common**
  - **IP is the transport technology for UMTS Releases 4 and 5**
- **Growth of new access technologies**
  - **Wireless LANs – Public and corporate offerings in 2002 in the UK**
  - **ADSL – people become used to fast Internet/Intranet access**
- **New "User-driven" prospective**
  - **Requirement for personal mobility**
  - **Ad-hoc networks outside the control of operators**
- **More complicated business models**
  - **IP clearly separates networks and services**

BRAIN/MIND: Vision

Billing AAA SIP Proxy Server

SP Server Farm

AAL2 Switching Cloud

IGSN

Gateway

IP backbone
DiffServ
IP - macro mobility management

Global Internet

Vertical Handover

UMTS

Bluetooth

IP-based micro-mobility
ISSL QoS

ADSL

BRAIN Access Routers

Hiperlan/802.11

MIND Wireless Routers

MIND Mobile Routers

Hiperlan

MIND

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BRAIN/MIND Objectives

- **To enable broadband mobile multimedia applications**
    - Providing adaptation to changing QoS
    - Enabling flexible and dynamic service provision
- **To design an IP-based mobile access network**
    - With IP mobility, QoS and security functionality
    - Including wireless/mobile ad-hoc extensions
- **To define the requirements of a broadband air interface**
    - Interface to IP access network
    - Spectrum requirements for systems beyond 3G
- **To validate our fundamental design principles**
    - To trial the use of WLANs and IP access networks as a complement to UMTS
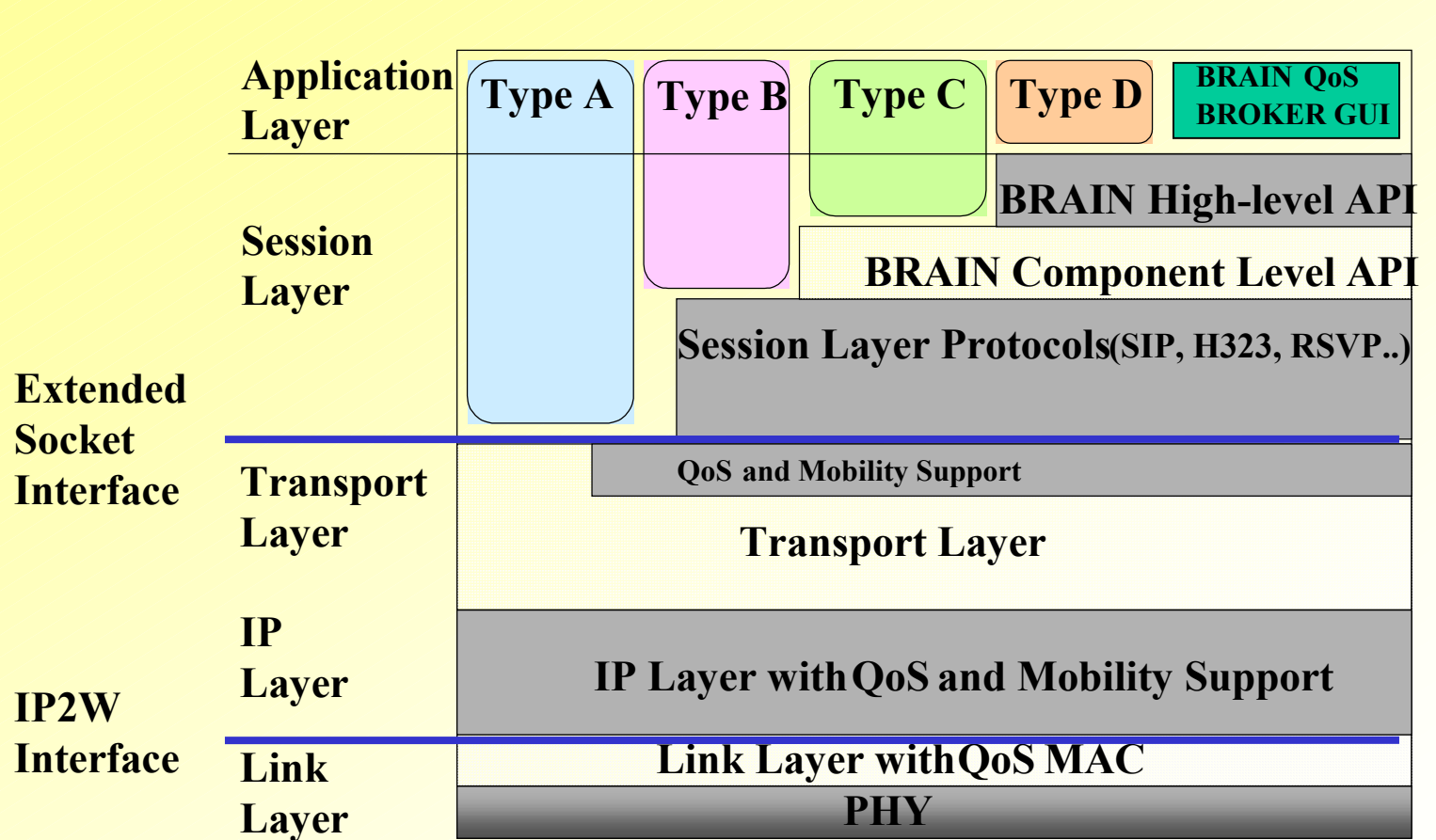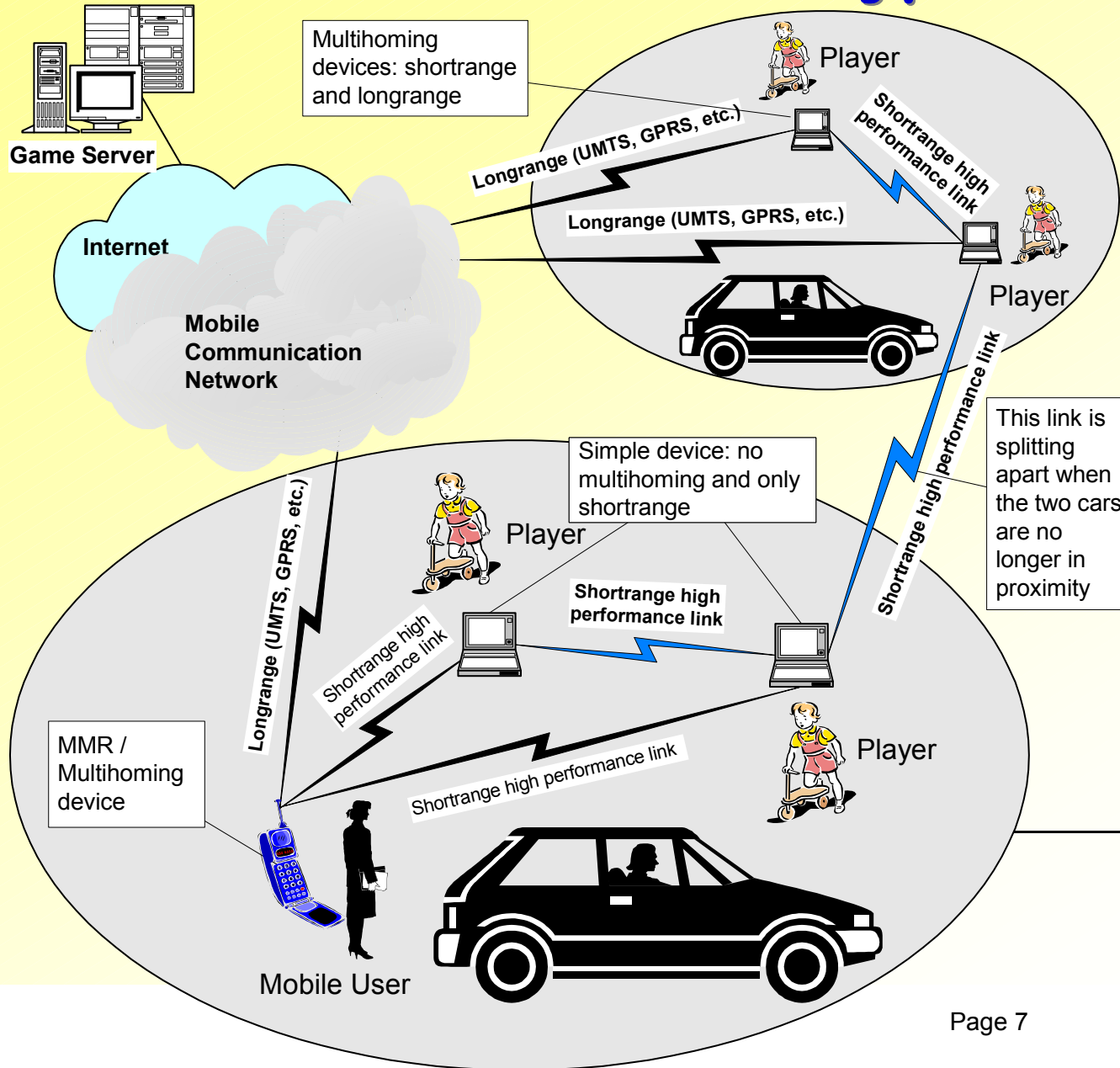- **To contribute to global standardization**

MIND Project Structure

- **RTD project of the IST Programme of the EU**
- **Duration: Jun 01 - Nov 02**
- **Website: http://www.ist-mind.org**

BRAIN End Terminal Architecture (BRENTA)

Application Layer	Type A	Type B	Type C	Type D	BRAIN QoS BROKER GUI

BRAIN High-level API

Session Layer

BRAIN Component Level API

Session Layer Protocols(SIP, H323, RSVP..)

Extended Socket Interface

Transport Layer

QoS and Mobility Support

Transport Layer

IP Layer

IP Layer with QoS and Mobility Support

IP2W Interface

Link Layer

Link Layer with QoS MAC

PHY

M I N D

Typical Scenario

Game Server

Internet

Mobile Communication Network

Multihoming devices: shortrange and longrange

Player

Longrange (UMTS, GPRS, etc.)

Longrange (UMTS, GPRS, etc.)

Shortrange high performance link

Player

Shortrange high performance link

This link is splitting apart when the two cars are no longer in proximity

Longrange (UMTS, GPRS, etc.)

Simple device: no multihoming and only shortrange

Player

Shortrange high performance link

Shortrange high performance link

MMR / Multihoming device

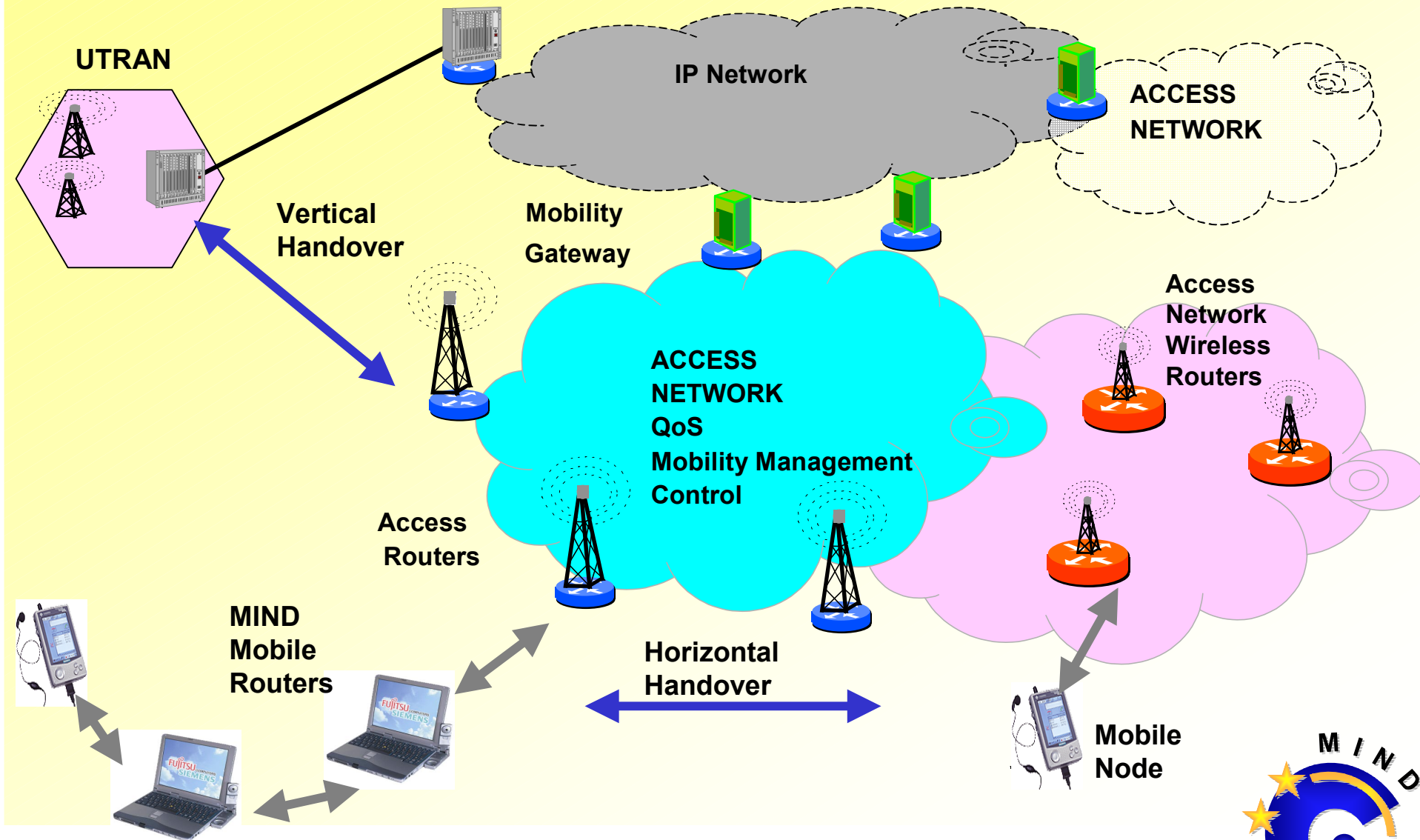Shortrange high performance link

Player

Mobile User

MIND

IP Design Principles (an all-IP network)

- **Network Transparency**
  - **The "End to End Principle" as applied to Mobile Wireless Networks**
  - **Network simply delivers packets (unopened)**
- **Enable & encourage future evolution**
  - **Means component independence**
  - **obey the layer model**
  - **Keep efficiency without tight integration (3G)**
- **Solve only the special problems of Mobile Wireless Access**
 - **Leave the fixed network to the IETF, and contribute mobile wireless parts there**

BAR

'Stupid looking' network
Connectionless QoS-assured IPv4/v6 packet delivery

IP packets sent to and received from terminal, *unchanged by network*

BMG

IP Core
Hosts using standard IP protocols
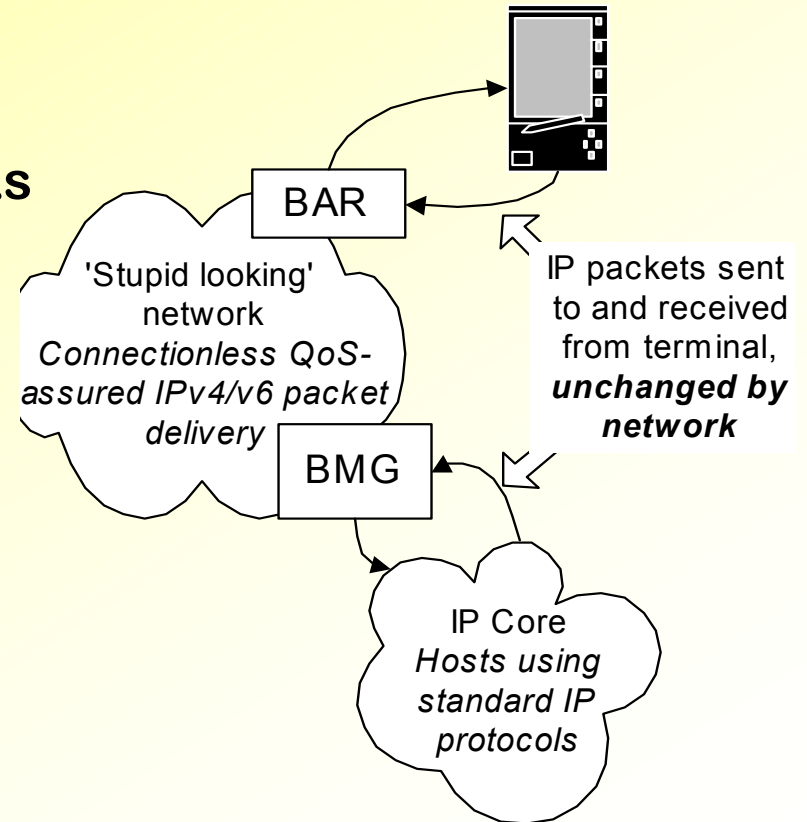
M I N D

MIND Network Architecture

UTRAN

IP Network

ACCESS NETWORK

Vertical Handover

Mobility Gateway

Access Network Wireless Routers

ACCESS NETWORK QoS Mobility Management Control

Access Routers

MIND Mobile Routers

Horizontal Handover

Mobile Node

M I N D

Mobility Management – Major Functions

Mobility Requirements
- **Minimise mobility signalling traffic**
- **Provide seamless handovers (Min. delay and without loss of packets)**
- **Be scalable**
- **Be robust, i.e. supports multiple routes or rapid re-routing**
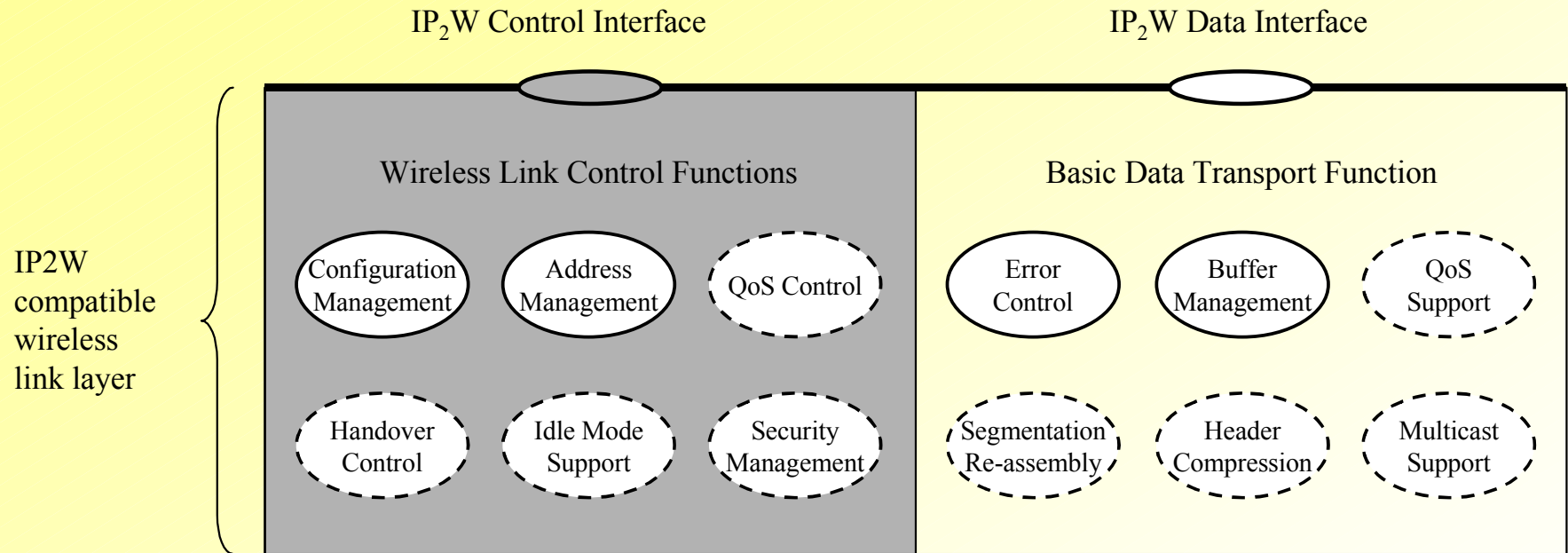- **Is compatible with other Internet protocols**

Path Updates

Handover Framework ↔ Paging

Mobile Node to Access Router Protocol
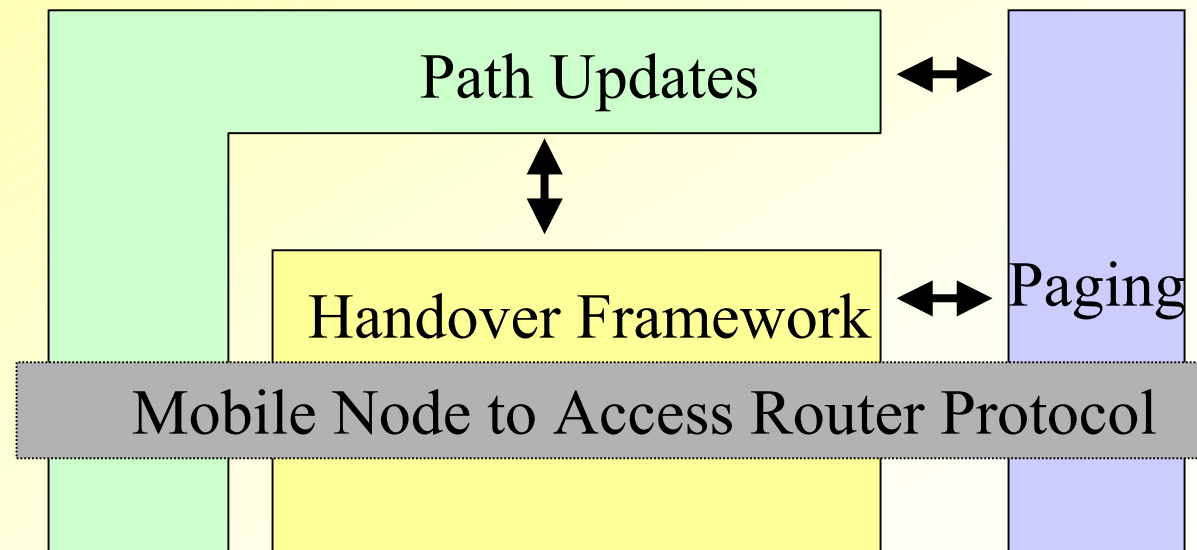
BRAIN Candidate Mobility Management Protocol
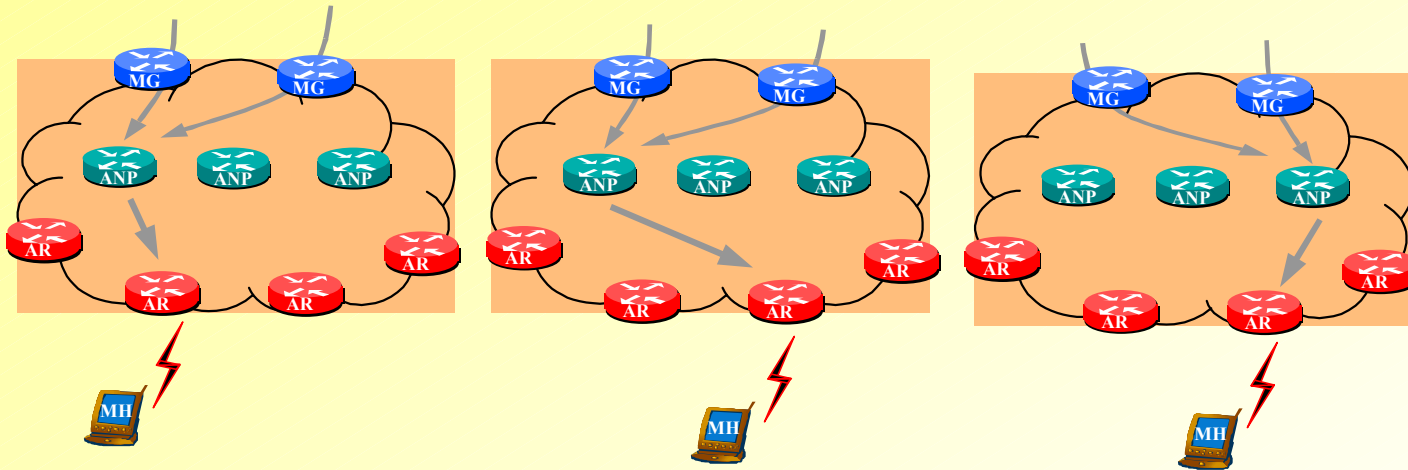
- *Access Routers (ARs)* are located at the access network edge   and offer IP connectivity, default router to the Mobile Hosts (MHs) that they serve

- *Anchor Points (ANPs)* are located 'inside' the access network, own & allocate addresses, authenticate users, maintain user records, tunnel packets to Access Routers

- *Mobility Gateways(MGs)* standard border routers (no mobility specific functionalities), distributing traffic to correct ANPs.
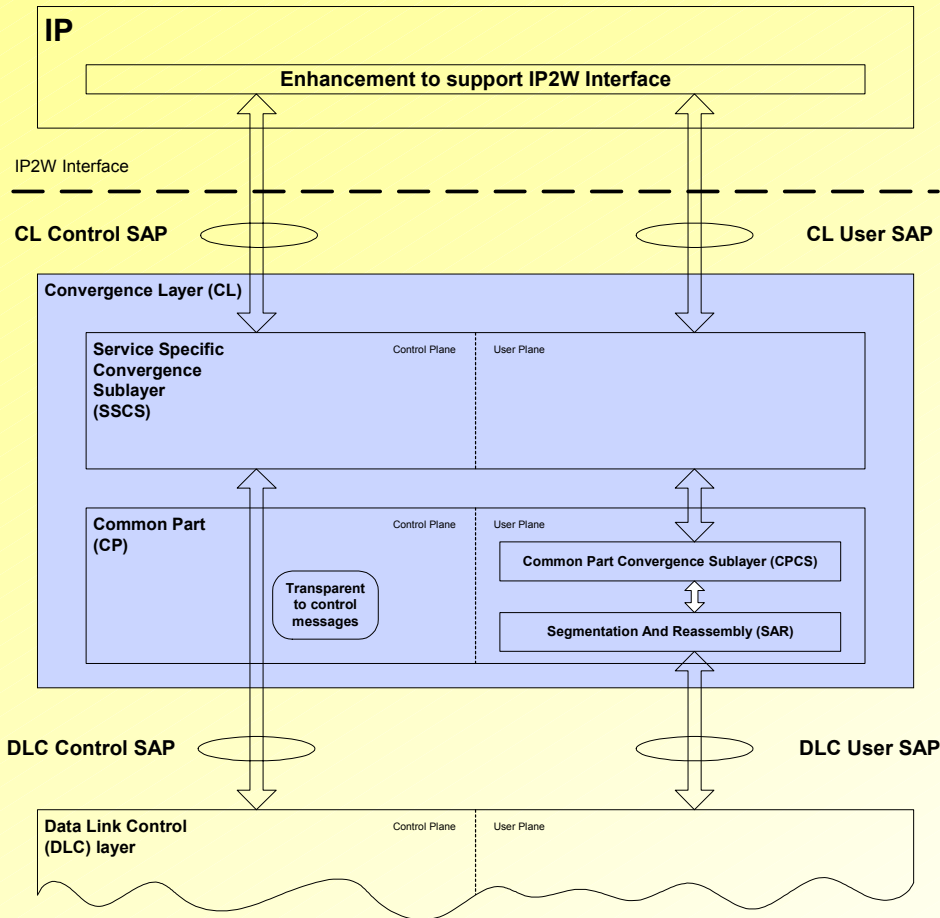
The MIND IP to Wireless (IP2W) Interface

IP$_2$W Control Interface   IP$_2$W Data Interface

IP2W compatible wireless link layer

Wireless Link Control Functions

- Configuration Management
- Address Management
- QoS Control
- Handover Control
- Idle Mode Support
- Security Management

Basic Data Transport Function

- Error Control
- Buffer Management
- QoS Support
- Segmentation Re-assembly
- Header Compression
- Multicast Support

- **IP$_2$W is applicable to different link layer technologies**

- **Makes the most efficient use of any functionality available below layer 3**

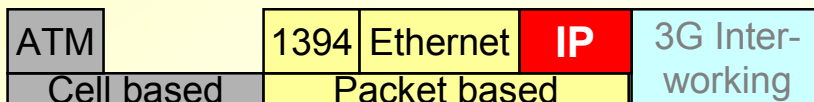- **QoS support must be provided below layer 3 on the wireless link**
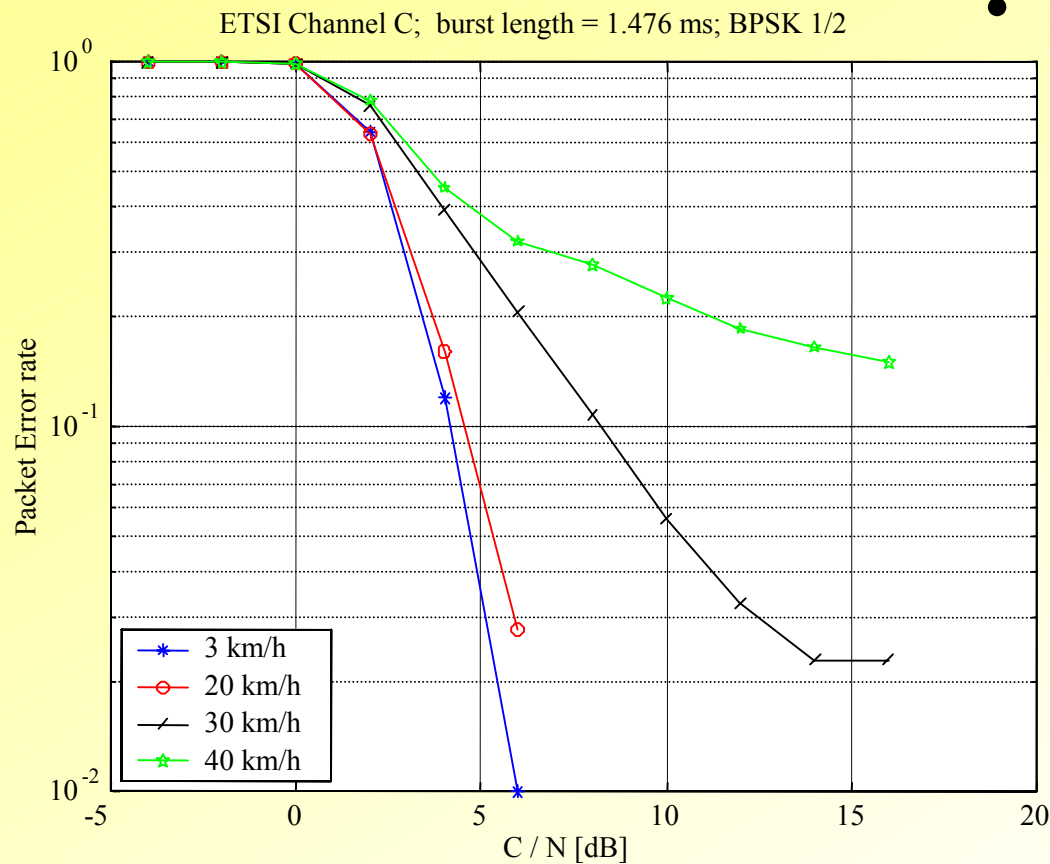
HIPERLAN/2 IP Convergence Layer

IP

Enhancement to support IP2W Interface

IP2W Interface

CL Control SAP — CL User SAP

Convergence Layer (CL)

Service Specific Convergence Sublayer (SSCS) — Control Plane — User Plane

Common Part (CP) — Control Plane — User Plane

Transparent to control messages

Common Part Convergence Sublayer (CPCS)

Segmentation And Reassembly (SAR)

DLC Control SAP — DLC User SAP

Data Link Control (DLC) layer — Control Plane — User Plane

H/2 Convergence Layer(s)

ATM		1394	Ethernet	IP	3G Inter-working
Cell based		Packet based			

- **Detailed IP SSCS specification completed**
- **IPv4 & IPv6 support**
  - IntServ, Diffserv
- **Detailed Address resolution schemes**
- **IP2W interface support**
  - QoS mapping & scheduling
  - detailed network handover
  - Paging (complies IETF drafts)
  - Unicast, Anycast, Multicasting

M I N D

HIPERLAN/2 Physical layer Enhancments

ETSI Channel C; burst length = 1.476 ms; BPSK 1/2

Packet Error rate

C / N [dB]

- 3 km/h
- 20 km/h
- 30 km/h
- 40 km/h

- **Enhancements**
  - **Range**
  - **Efficiency**
  - **Mobility support (speed)**
  - **Ad-hoc support**

Typical strategies

- **Multiple antennas**
- **Turbo coding**
- **Adaptive modulation**

Mac layer enhancements
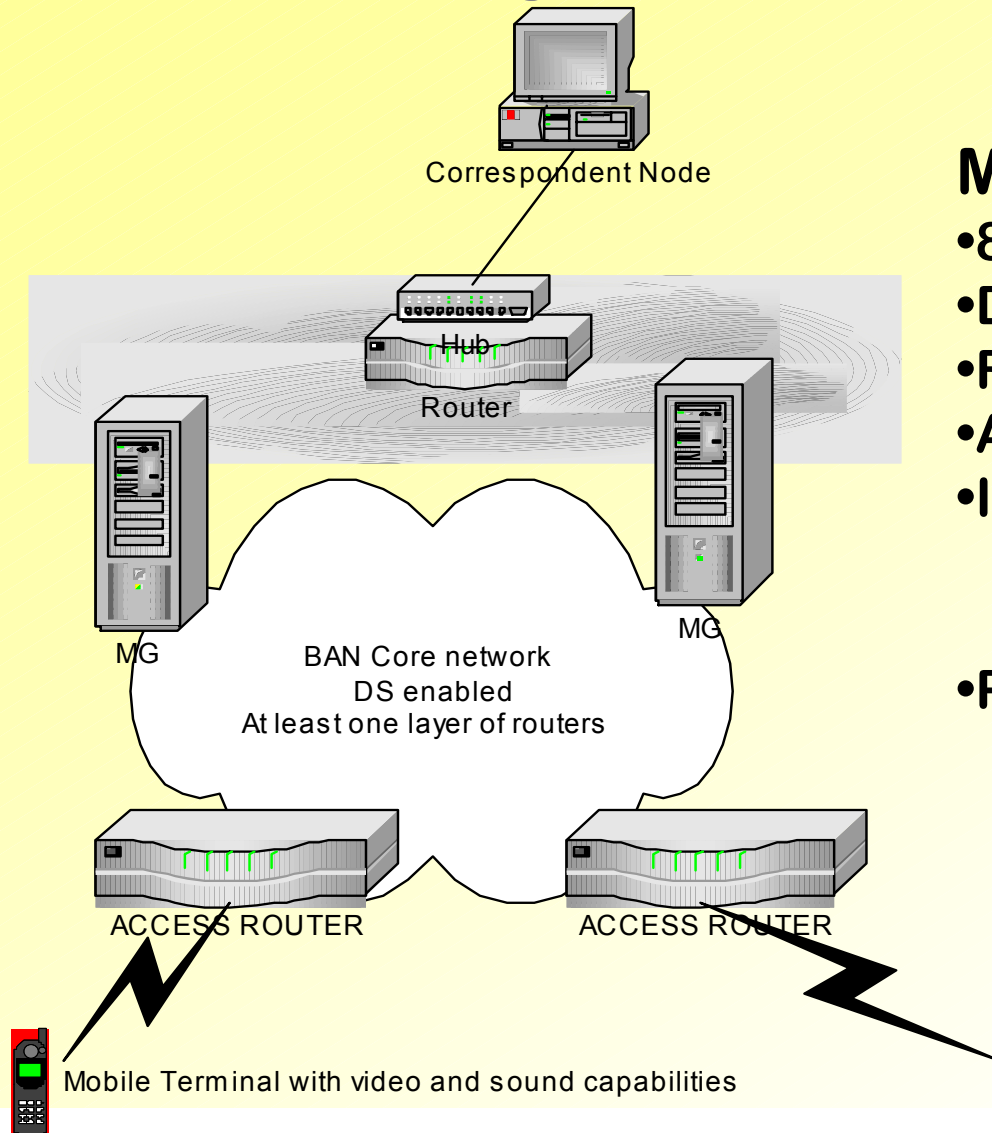
- **QoS support**
- **Multipoint - multipoint**

M I N D

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MIND Trials

- **Application QoS control**
- **WLAN - UMTS Handover**
  - Comparison of coupling techniques
  - Measurement of performance
- **Mobility and QoS protocol comparison and test**
  - BCMP vs HMIP
  - QoS framework and extensions
- **Evaluation of the H2 physical layer**
  - Evaluation of BRAIN enhancements
- **Integration**
  - Roaming and macro-mobility
  - Application, QoS and mobility interaction
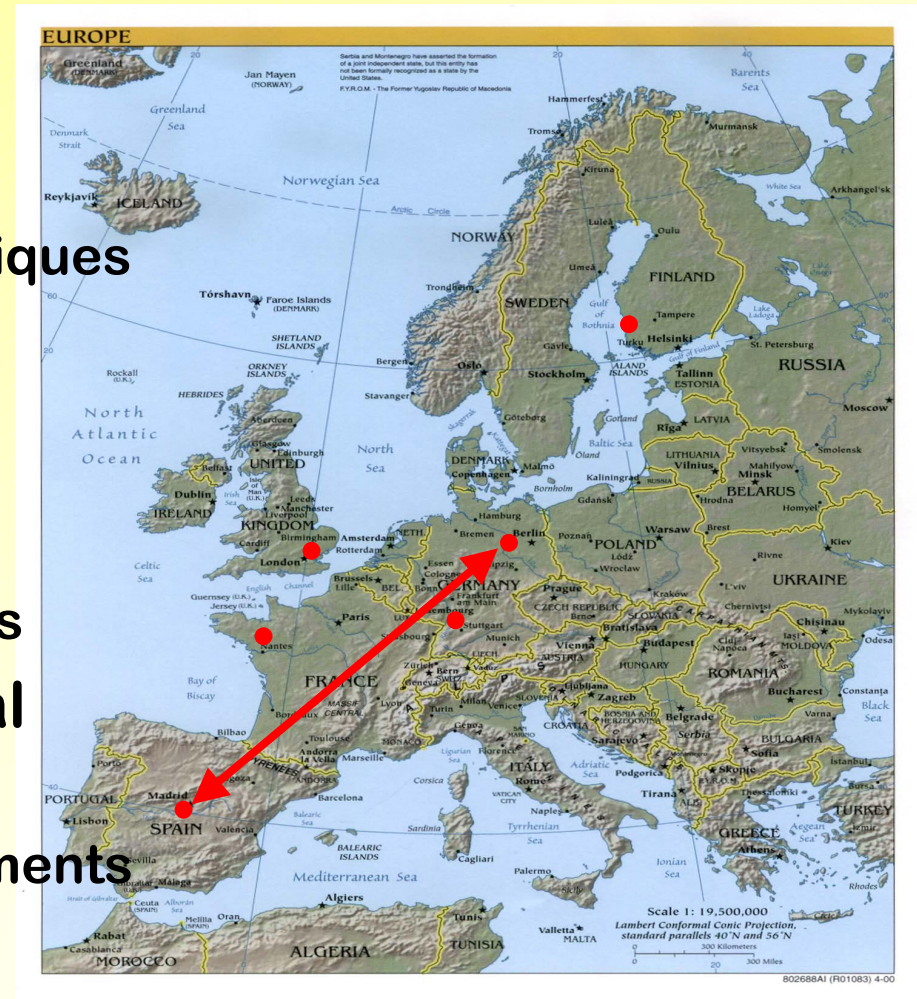
MIND IP layer QoS testbed

Correspondent Node

Hub

Router

MG

MG

BAN Core network
DS enabled
At least one layer of routers

ACCESS ROUTER

ACCESS ROUTER

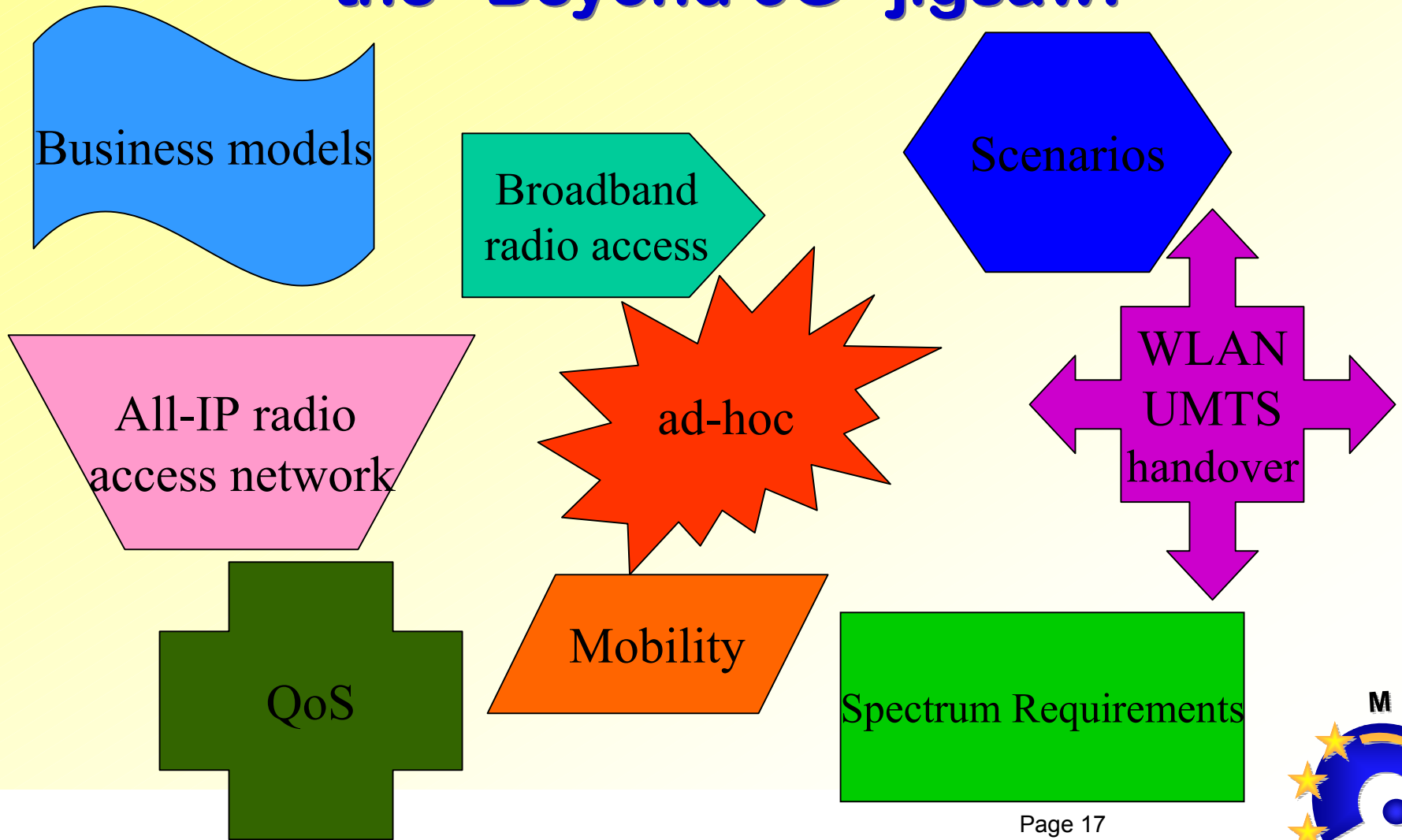Mobile Terminal with video and sound capabilities

MIND QoS Test-bed
- 802.11 Wireless Hops
- DiffServ Access network
- RSVP signalling
- Admission control at Access Nodes
- Interactions with mobility
  - Mobile IP v6
  - BCMP
- Possible extensions
  - QoS Broker
  - Bounded delay DiffServ

Summary - MIND continues to solve the "Beyond 3G" jigsaw!

Business models

Broadband radio access

Scenarios

All-IP radio access network

ad-hoc

WLAN UMTS handover

QoS

Mobility

Spectrum Requirements

MIND

Acknowledgements