MOTOROLA LABS

OverDRiVE

Spectrum Efficient Uni and Multicast Services Over Dynamic Multi Radio Networks in Vehicular Environment

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http://www.ist-overdrive.org/

OverDRiVE Overview

Historical Background

- **FP5 IST Project: IST-2001-35125**
- **OverDRiVE = IST DRiVE Project Follow Up**
- **New consortium**

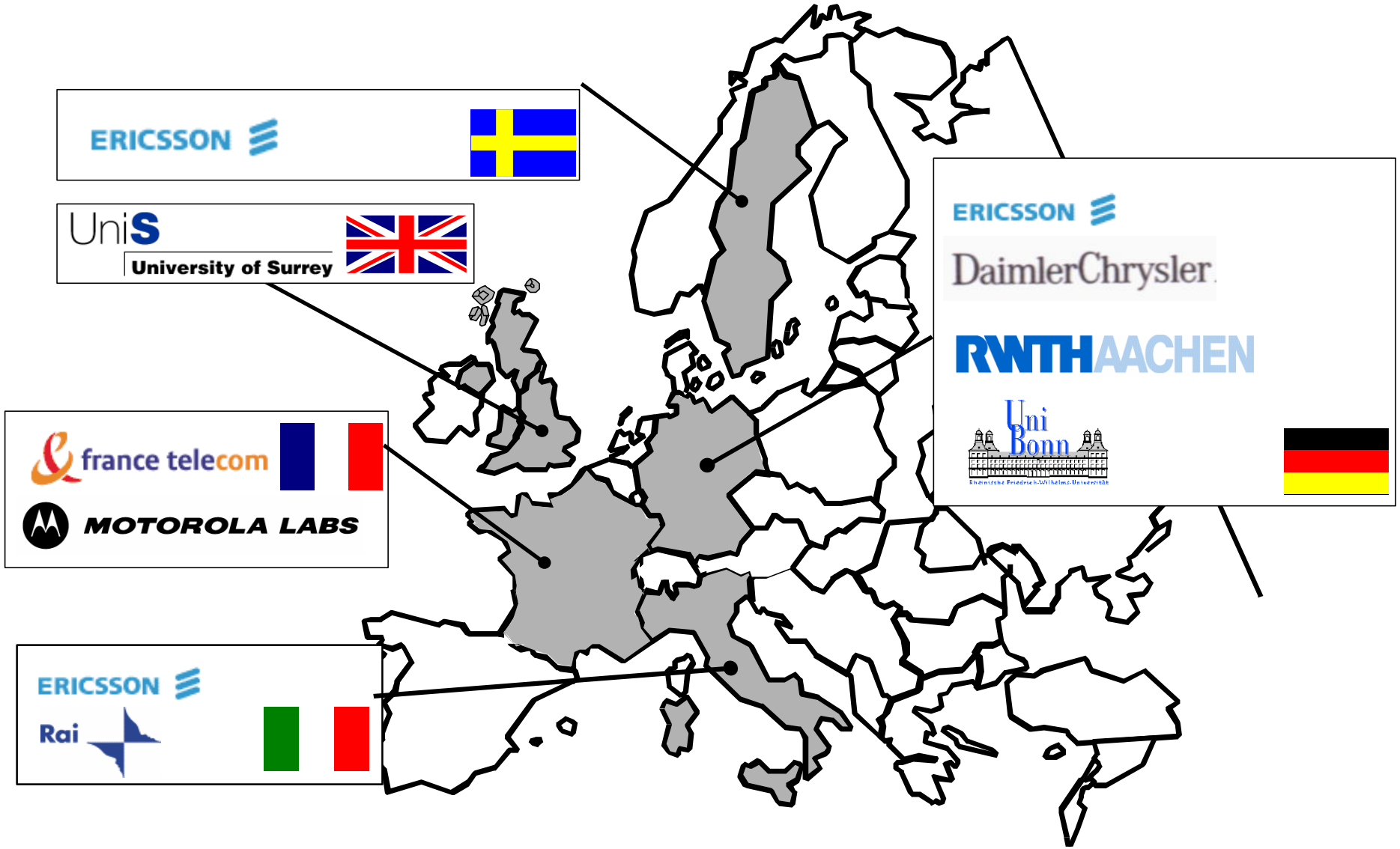
Key Dates

- **Start date = 2002-04-01**
- **End date = 2004-03-31**
- **Duration = 24 months**

Effort

- **Total budget = 6.4 M€**
- **Total staff months = 586.4**

OverDRiVE Consortium



OverDRiVE Objectives

Enable and Demonstrate the delivery of spectrum efficient multi- and unicast services to vehicles.

WP1: Spectrum Efficient Radio Resources Management

- System co-existence and Dynamic Spectrum Allocation
- DSA requirements on Reconfigurability
- Multicast over UTRAN
- Asymmetric UMTS

WP2: Mobile Multicast Protocols

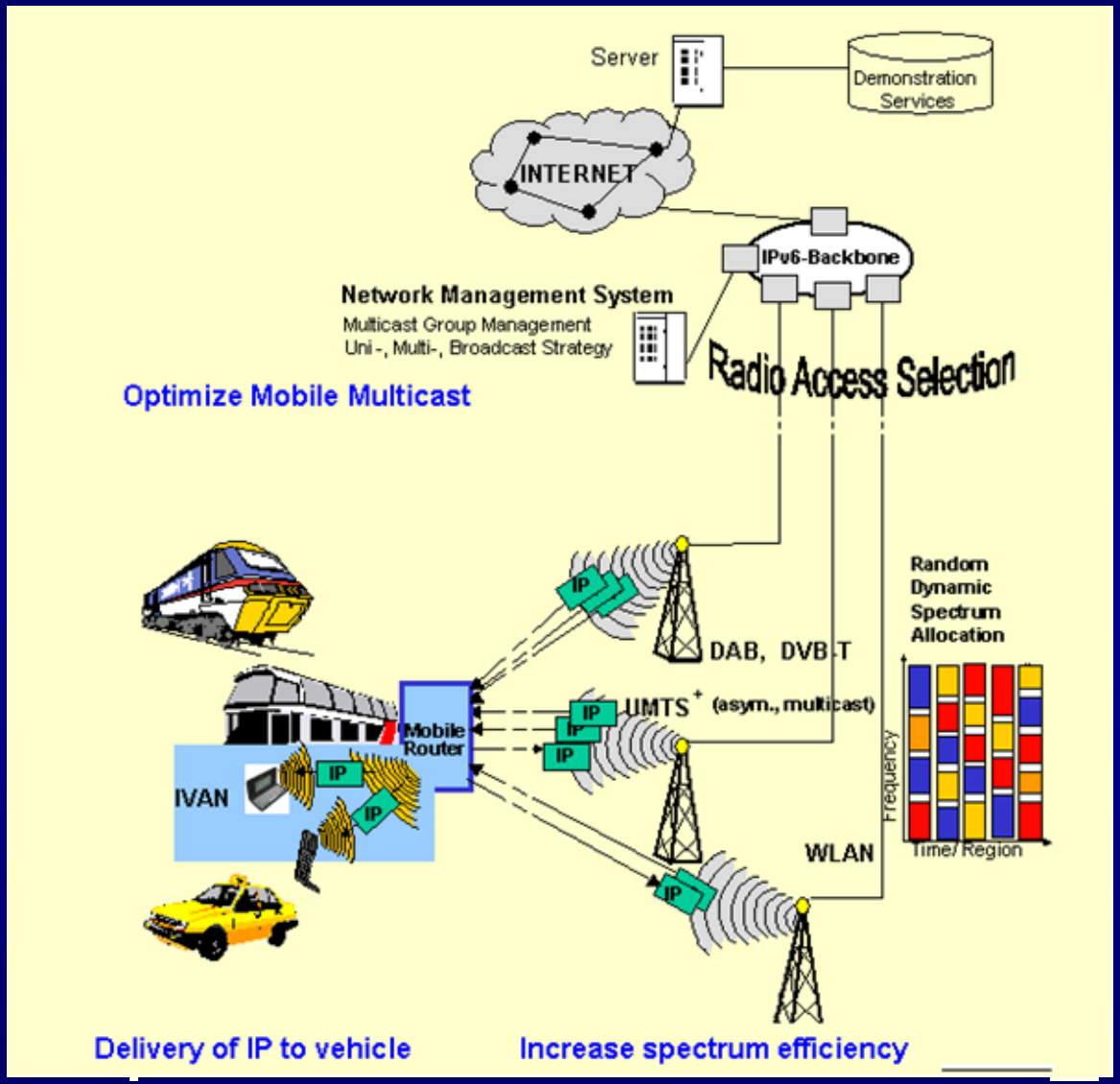
- IPv6 Mobile Multicast Protocol Architecture (inter-system mobile multicast)
- Impact on UMTS Multimedia Broadcast and Multicast Services (MBMS)
- Traffic Management: Trigger inter-system handover of multicast receivers

WP3: Mobile Router and Intra-Vehicular Area Network (IVAN)

- Mobile Router: Network Mobility support in IPv6
- Dynamic IVAN Management: AAA aspects

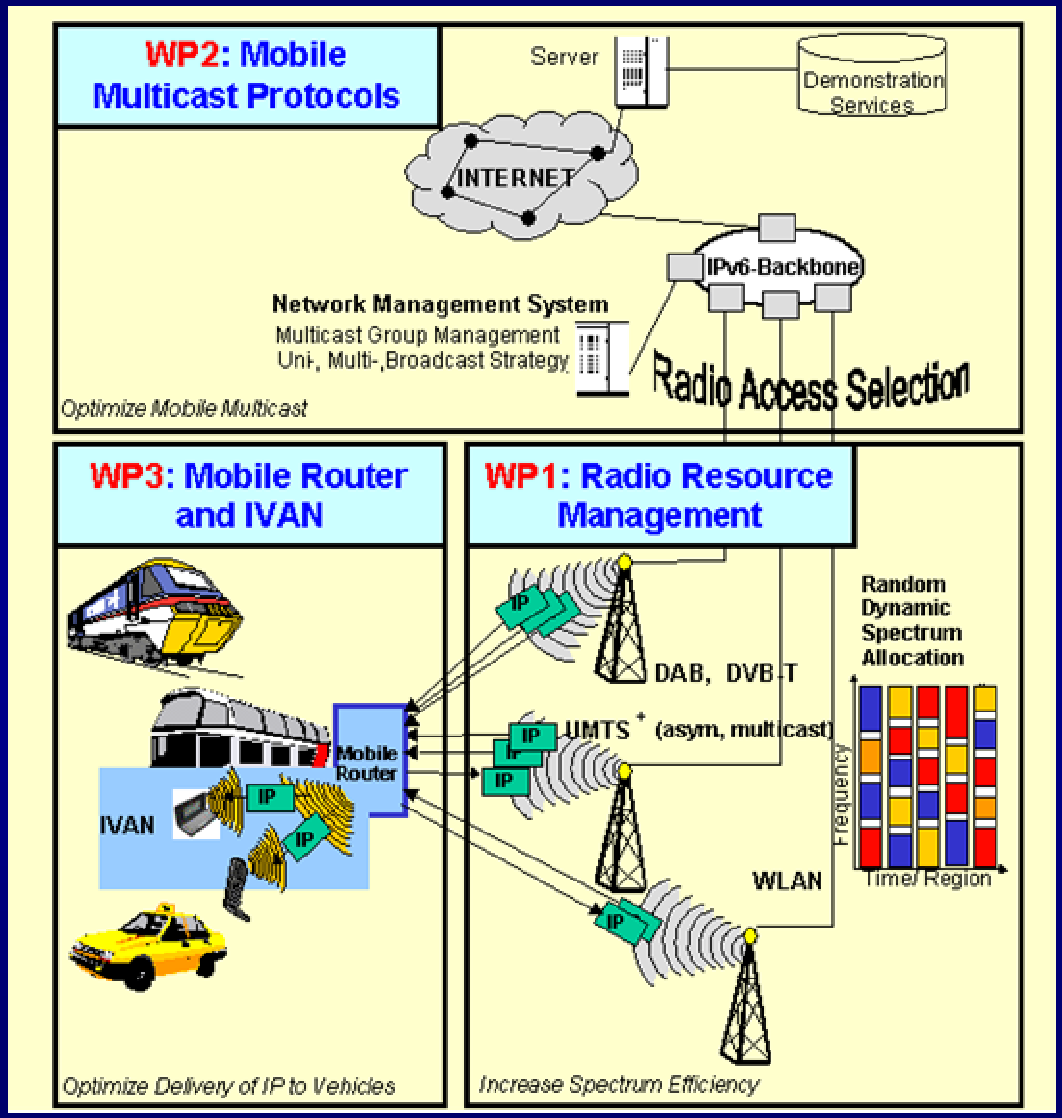
Integrated WP2-WP3 Demonstrator

OverDRiVE Architecture



- Spectrum Efficiency
- DSA
- Multicast over UTRAN
- Asymmetric UMTS
- IPv6
- IPv6 Mobile Multicast
- MBMS
- Multicast Group Mgmt
- Network Mobility
- AAA

OverDRiVE Architecture against WPs



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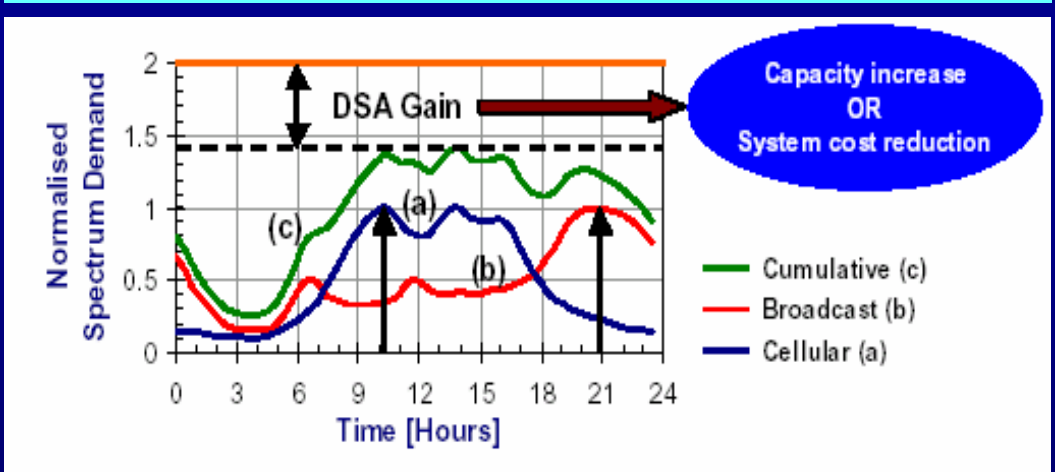
WP1: DSA

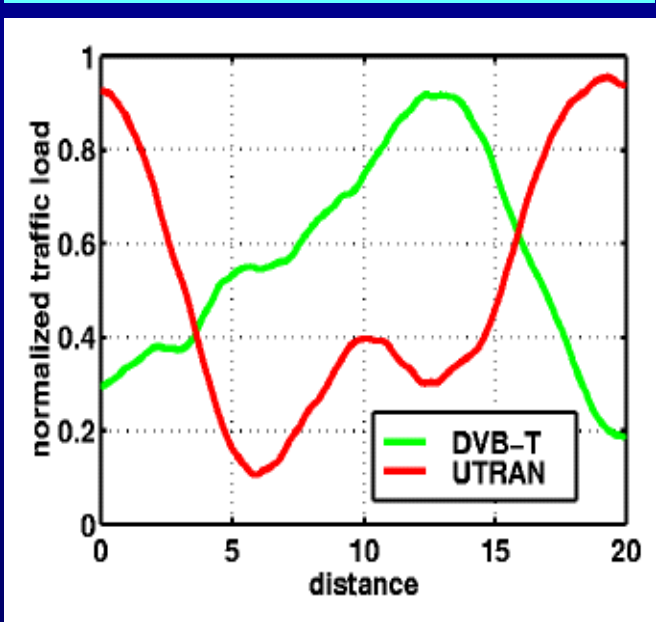
Motivations for Dynamic Spectrum Allocation (DSA)

- Traffic loads are time and space varying ✍ Spectrum usage is time and space varying
- Gain is expected (in term of capacity increase or spectrum save or cost reduction…)

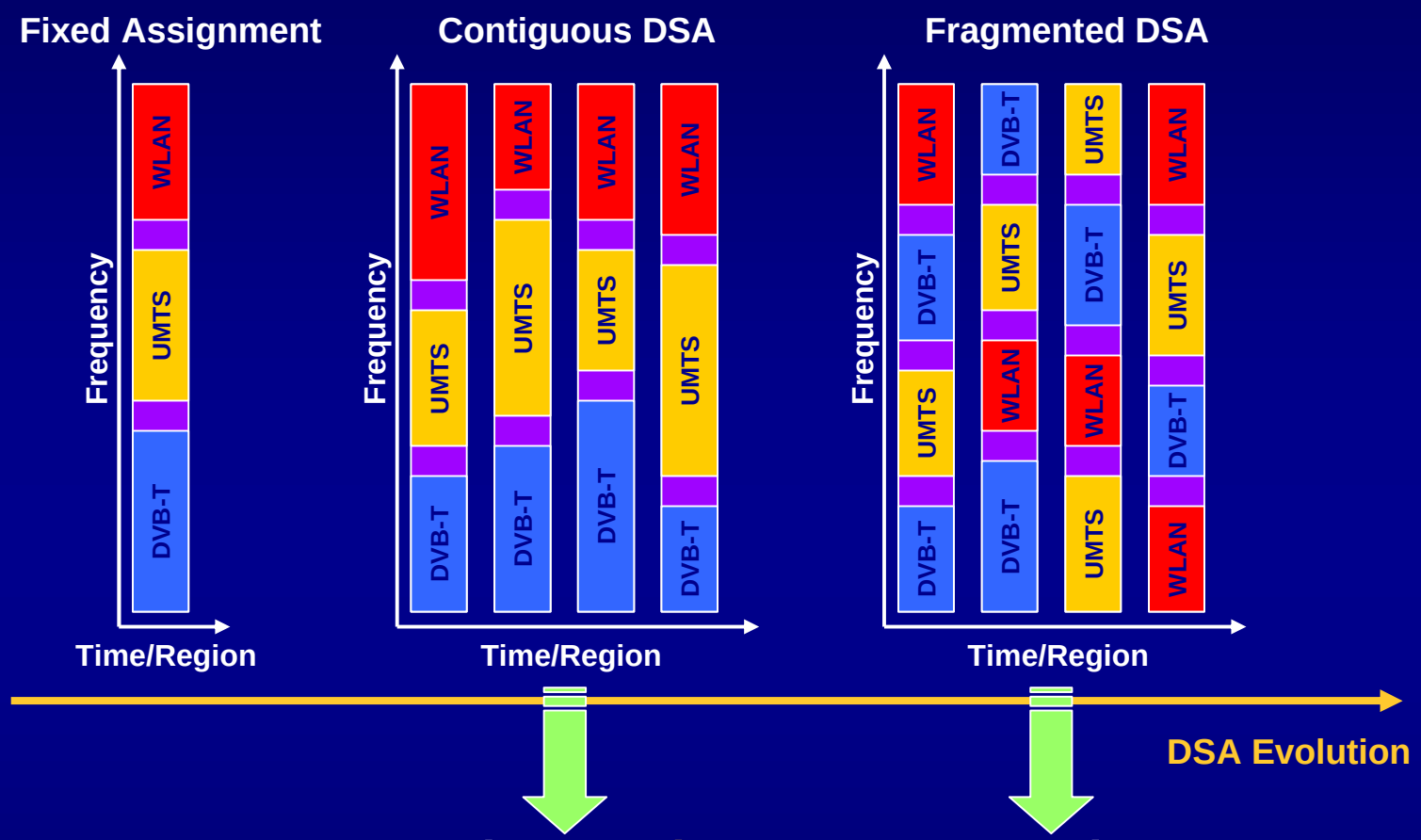
Temporal DSA



Spatial DSA



WP1: DSA



Previous DRiVE Project Research (~30% Capacity Gain)

On-going OverDRiVE Project Research

WP1

DSA

- Concept and algorithm
  - Temporal DSA
  - Spatial DSA
  - Combined temporal and spatial DSA
- DSA performance assessment
  - Theoretical analysis, Simulation
  - Case study: UMTS, DVB-T, WLAN

Impact of DSA requirements on systems in term of reconfigurability

Multicasting over UTRAN

- Identify the functional requirements for multicasting in UMTS (physical layer)
- Evaluate the performance of multicasting over UTRAN
- Perform investigations in the field of network planning with multicast UTRAN
- Performance assessment by theoretical and simulation approaches

Asymmetric traffic in UMTS

- Adapt UTRAN towards asymmetric services
- First solution: extend frequency band dedicated to downlink (system level)
- Second solution: use of High Speed Downlink Packet Access (physical level)
- Performance assessment by theoretical and simulation approaches

WP2

IPv6 Mobile Multicast

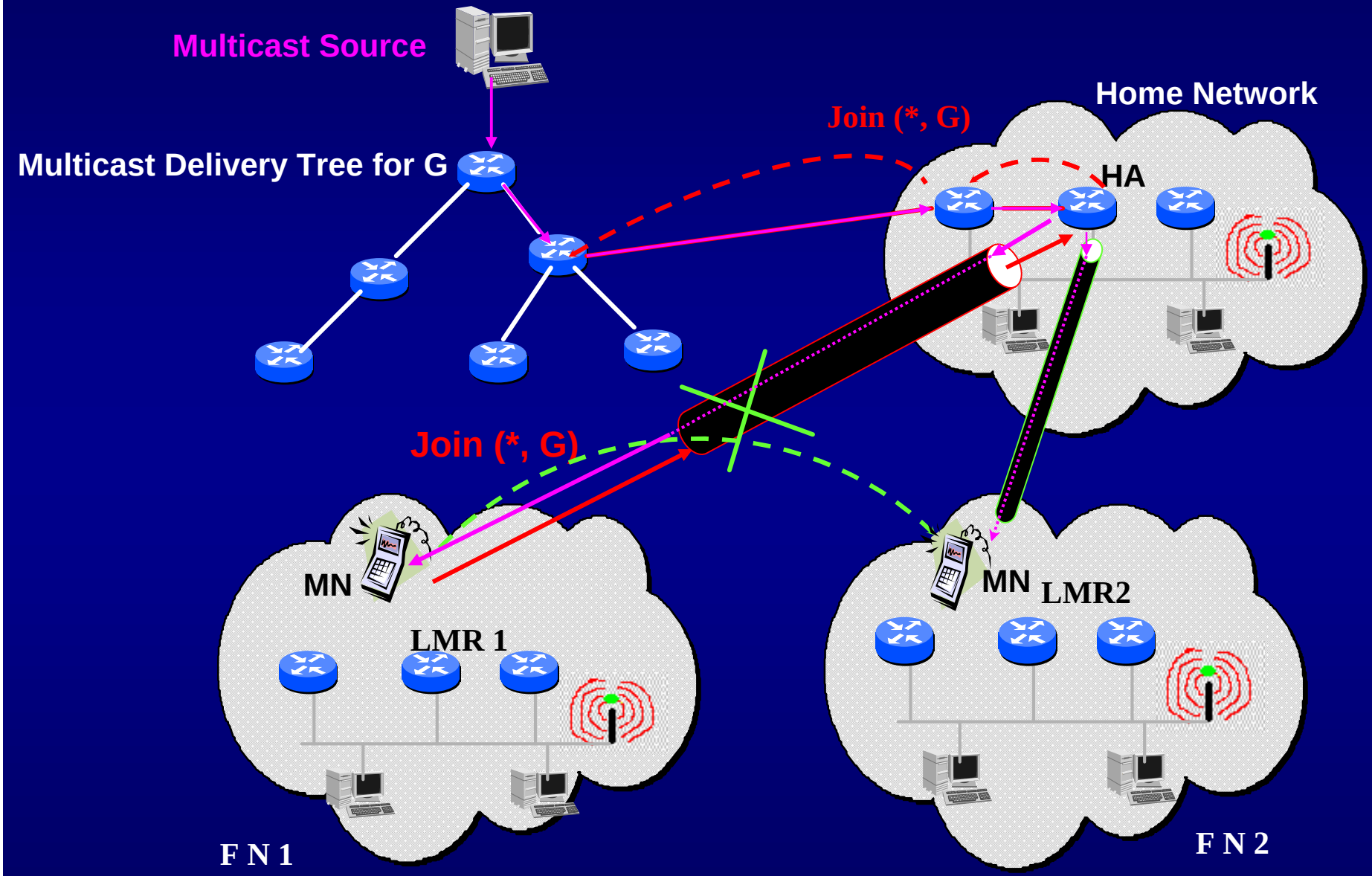
- Multicast session continuity for mobile hosts and mobile networks
- Per-flow handover: multi-homed mobile hosts and mobile networks
- Preserve multicast nature of the traffic along the path to the receivers
- Seamless handover
- Mobile sources and receivers
- Scalability

Impact on UMTS MBMS

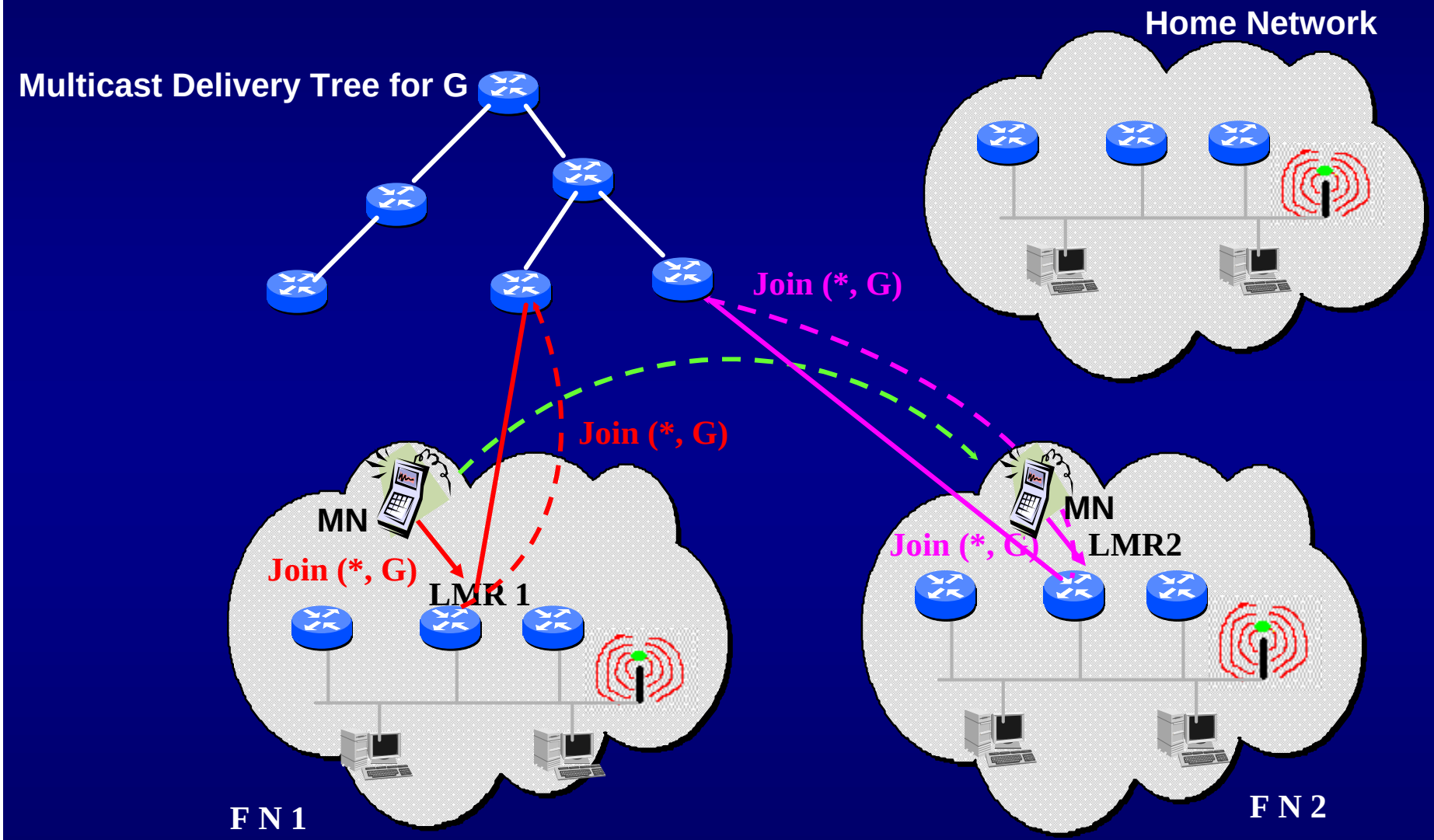
Dynamic Group Management

- Orthogonal to IGMP/MLD (IP multicast group membership management)
- Improve overall resources usage in multi-radio environment with:
  - Sub-grouping of multicast receivers by considering:
    - Access systems in visibility of each receiver
    - Terminal capabilities
  - Trigger Vertical handover of sub-groups (e.g UMTS ✍ DVB-T)
    - N (unicast) PDP contexts in UMTS ✍ only 1 broadcast flow in DVB-T
    - Consider also cell hierarchy within a single radio system
- Interactions with DSA

WP2: Bi-directional Tunnelling



WP2: Remote Subscription in Mobile IPv6

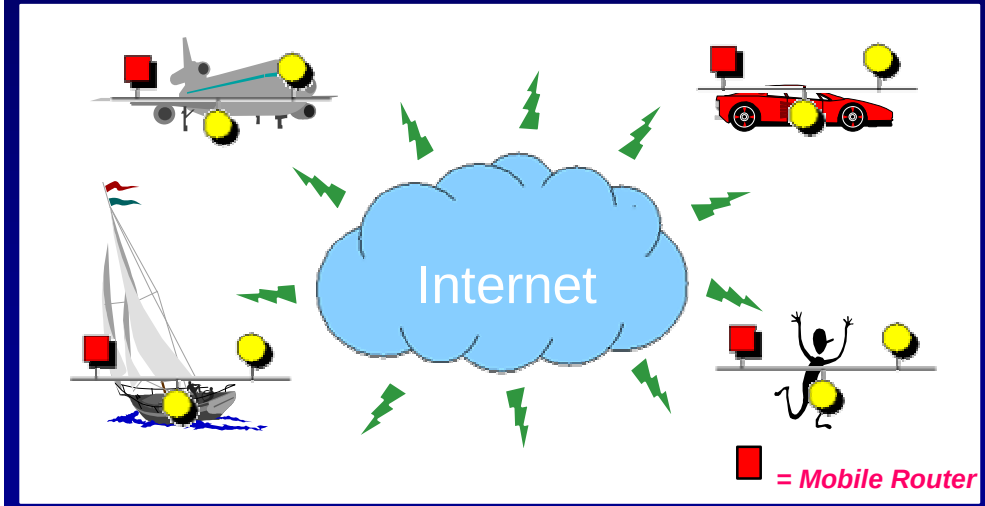


WP2: Comparison

D04 contains much more ✍ (11/2002)

	Bi-directional Tunnelling	Remote Subscription
Advantages	• Transparency of source and receiver mobility to the multicast tree • Join latency lower than RS • Allows the forwarding of multicast data local to the home network • Does not require multicast support at the foreign network • Can leverage on Mobile-IPv6 extensions (e.g FMIPv6)	• Optimal routing • Native support of per multicast flow handover • No need to run Mobile IPv6 • More scalable than bi-directional tunnelling
Drawbacks	• Non-optimal routing • HA is a single point of failure • Multicast-in-Unicast tunnels break the multicast nature of the flow (multicast avalanche problem) • No native support of per multicast flow handover (requires extensions to Mobile IPv6)	• Frequent reconstruction of the multicast tree • Join latency higher than bi-directional tunnelling • No support for mobile SSM source • Cannot leverage on Mobile IPv6 extensions such as FMIPv6 for smoother handovers • Requires native multicast support at the foreign network.

WP3: Network Mobility Support



A Mobile Network is mobile leaf-network with Mobile Routers (MRs) and its attached IP-subnet(s)

- MNN: Mobile Network Node

Scenarios

- PAN connected to the Internet
- In-car embedded networks connected to the Internet
- A WLAN network deployed in a train providing Internet access to passengers

Network Mobility Support

- Permanent connectivity and session continuity for MNNs
- Implementation in the IP layer
- Internet-wide mobility: preserve route aggregation, independent of any routing protocol

- Solution based on Mobile IPv6

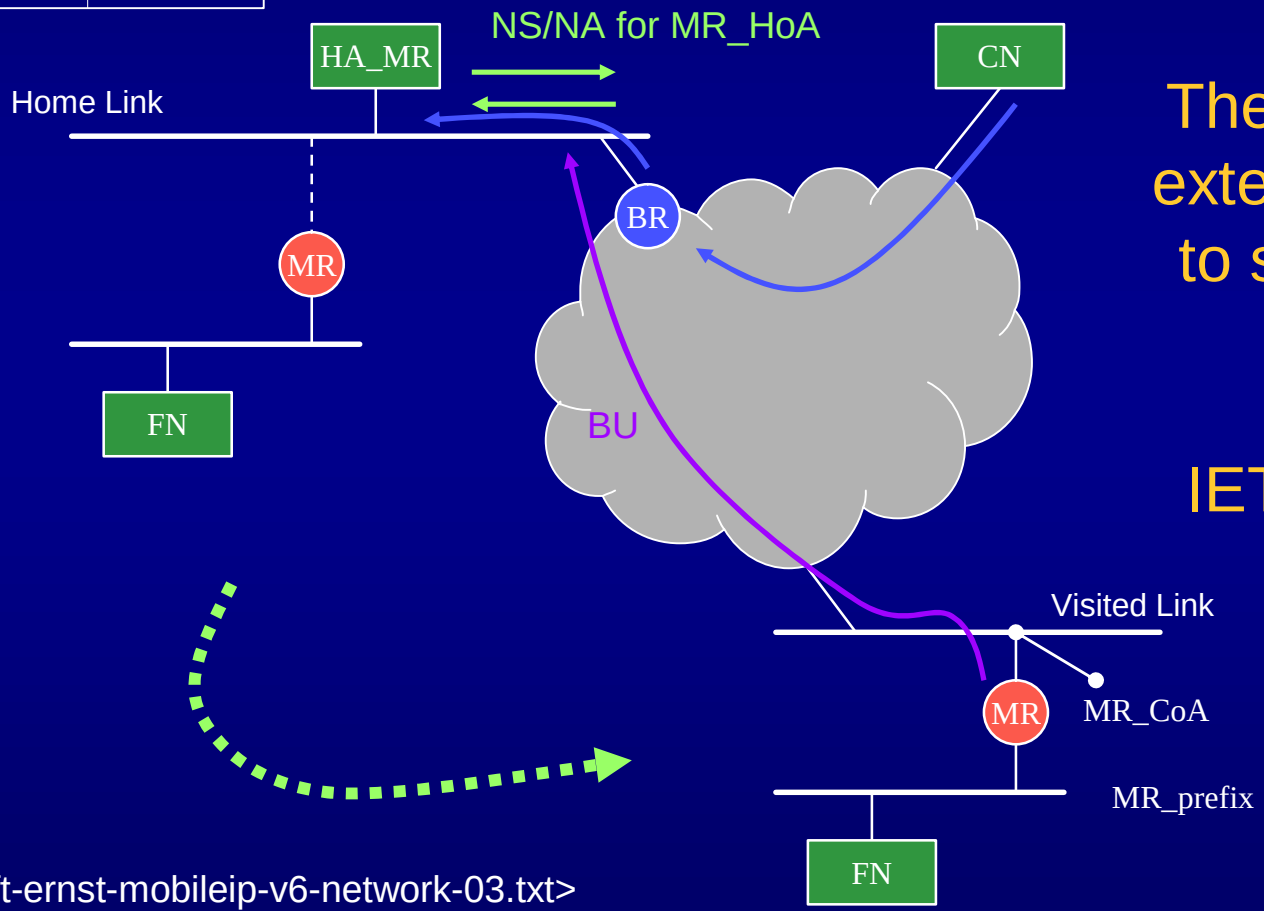
WP3: Shortcomings of Mobile IPv6

HA_MR Binding Cache	
MR_HoA	MR_COA
⋮	⋮

No Binding Cache entry for FN

Either:

- **Packet discarded, or**
- **Packet routed through default route towards BR ✍ ping pong**

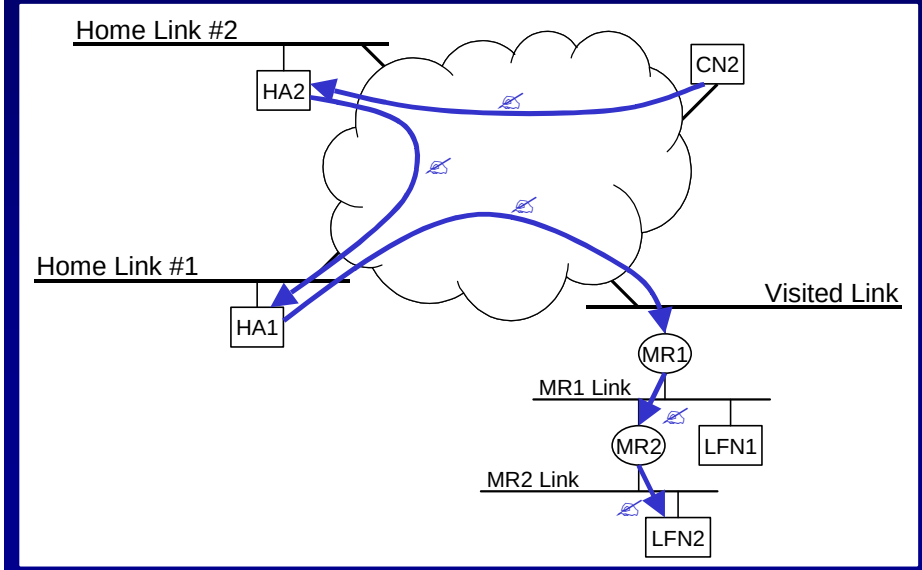


There is a need to extend Mobile IPv6 to support mobile networks

IETF NEMO WG

<draft-ernst-mobileip-v6-network-03.txt>

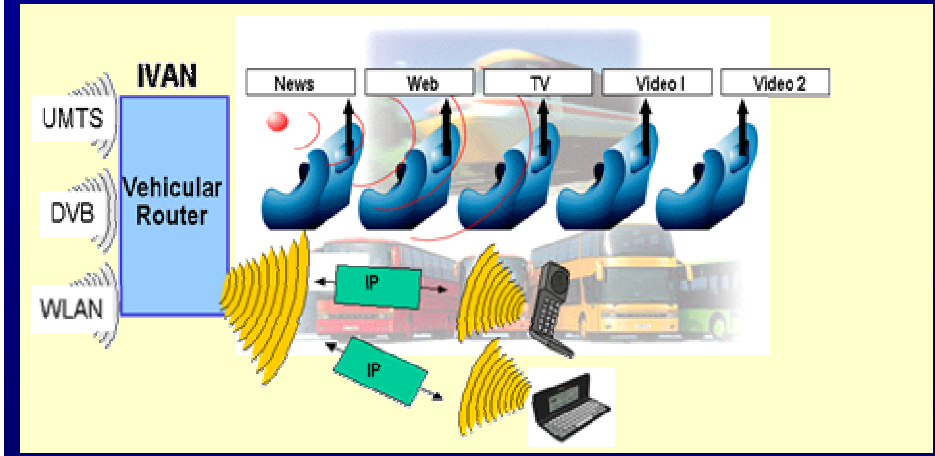
WP3: Mobile Router and IVAN



Intra-Vehicular Area Network (IVAN)

Requirement for Network Mobility

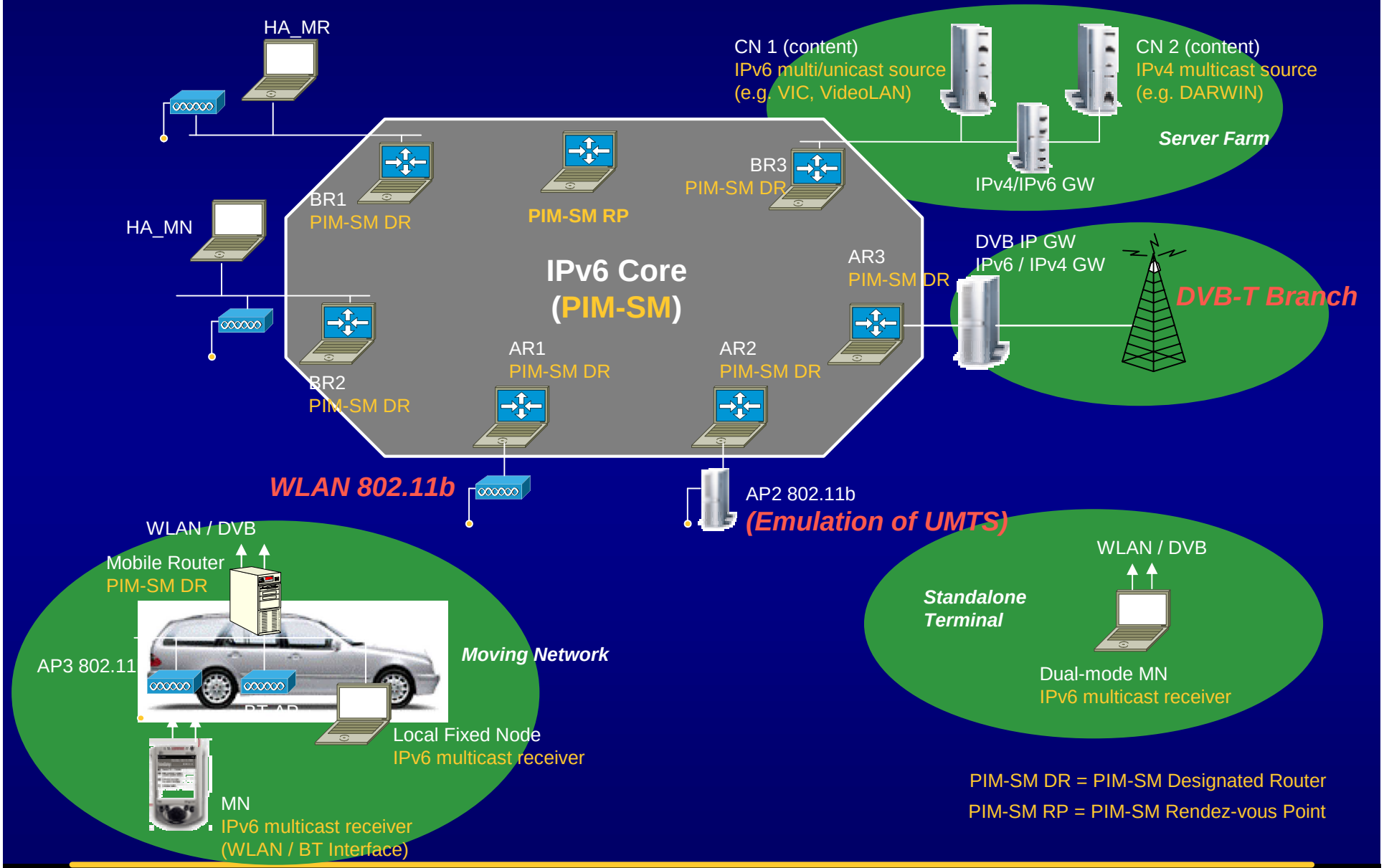
- Mobile networks of any size
- Nested mobility: mobile nodes and networks visiting mobile networks
- Multi-homing: MR with multiples radio interfaces
- Unicast and multicast traffic
- Route optimization



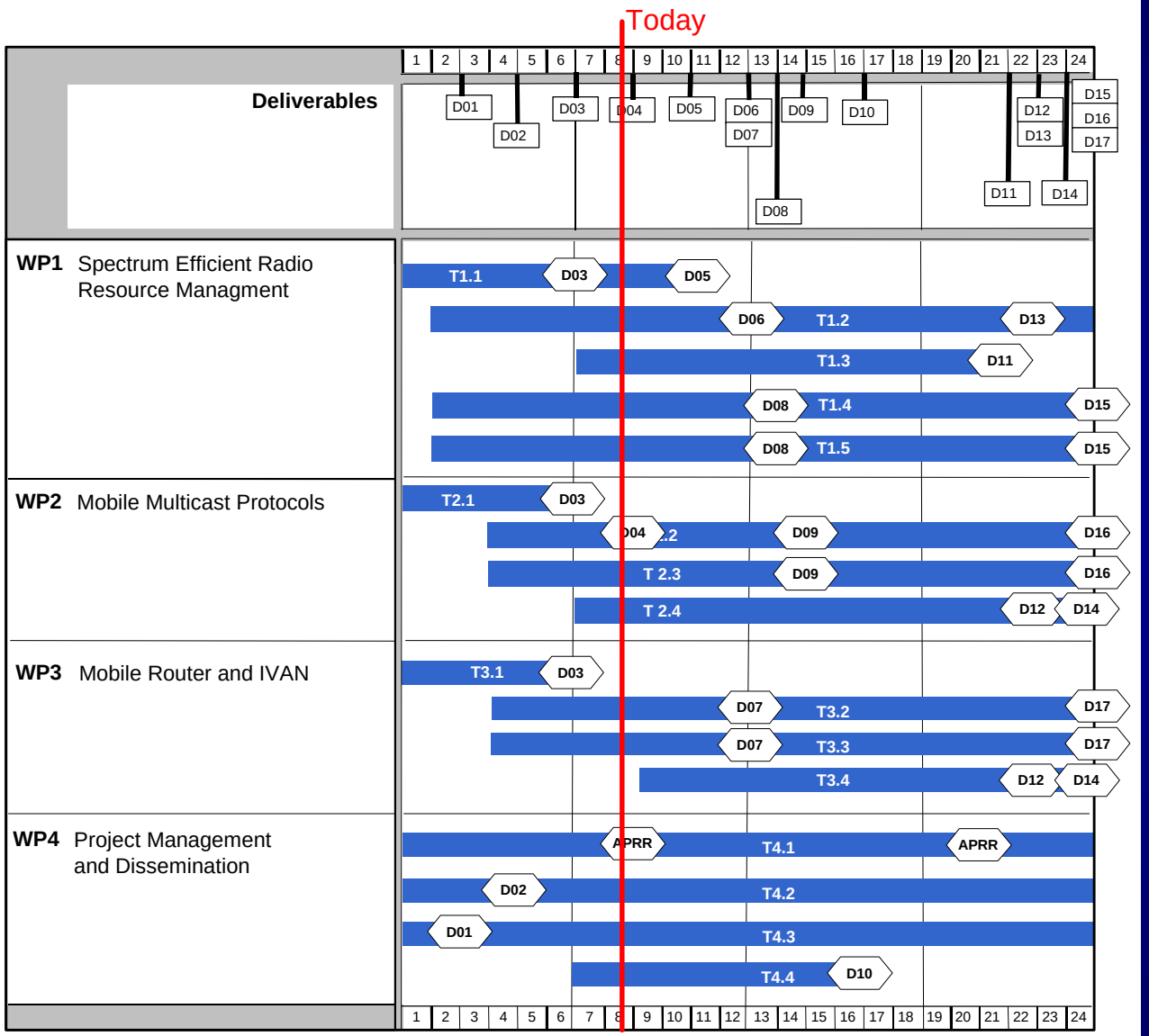
Authentication and Authorization

- MR ✍ to the infrastructure
- Visiting MN or MR ✍ to the IVAN

OverDRiVE Demonstrator



OverDRiVE Planning



Main Deliverables:

- •D03: Scenario, Services and Requirements (WP123)
- •D04: State-of-the-art of Mobile Multicast (WP2)
- •D06+D13: DSA algorithms and performance (WP1)
- •D08+D15: Multicast and Asymmetric services in UMTS: proposals and performances (WP1)
- • D11: Re-configurability Req. for DSA (WP1)
- •D09+D16: Mobile Multicast and Group Mgmt (WP2)
- •D07+D17: Mobile Router and IVAN Mgmt (WP3)
- •D14: Demonstrator (WP12)

Conclusion

OverDRiVE status

- In Month 8 (2-year project)
- Scenarios and requirements for DSA, Mobile Multicast, IVAN ready: D03
- Specification phase started
- 17 papers, 3 Internet drafts (NEMO)

Key dates

- November 2002: Audit
- Summer 2003: First demonstrator
- February 2004: Final demonstrator
- April 2004: end of project

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