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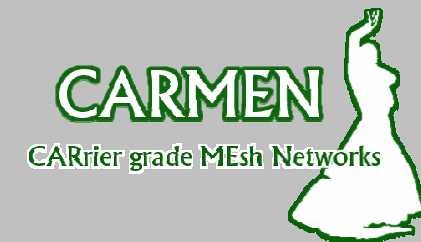
Workshop on “The Future of Broadband Wireless Between Feasibility and Profitability“
ITG Fachgruppe 5.2.4 “Mobility in IP-Based Networks”, Düsseldorf, February 28th, 2008

CARMEN - CARrier-grade Mesh Networks

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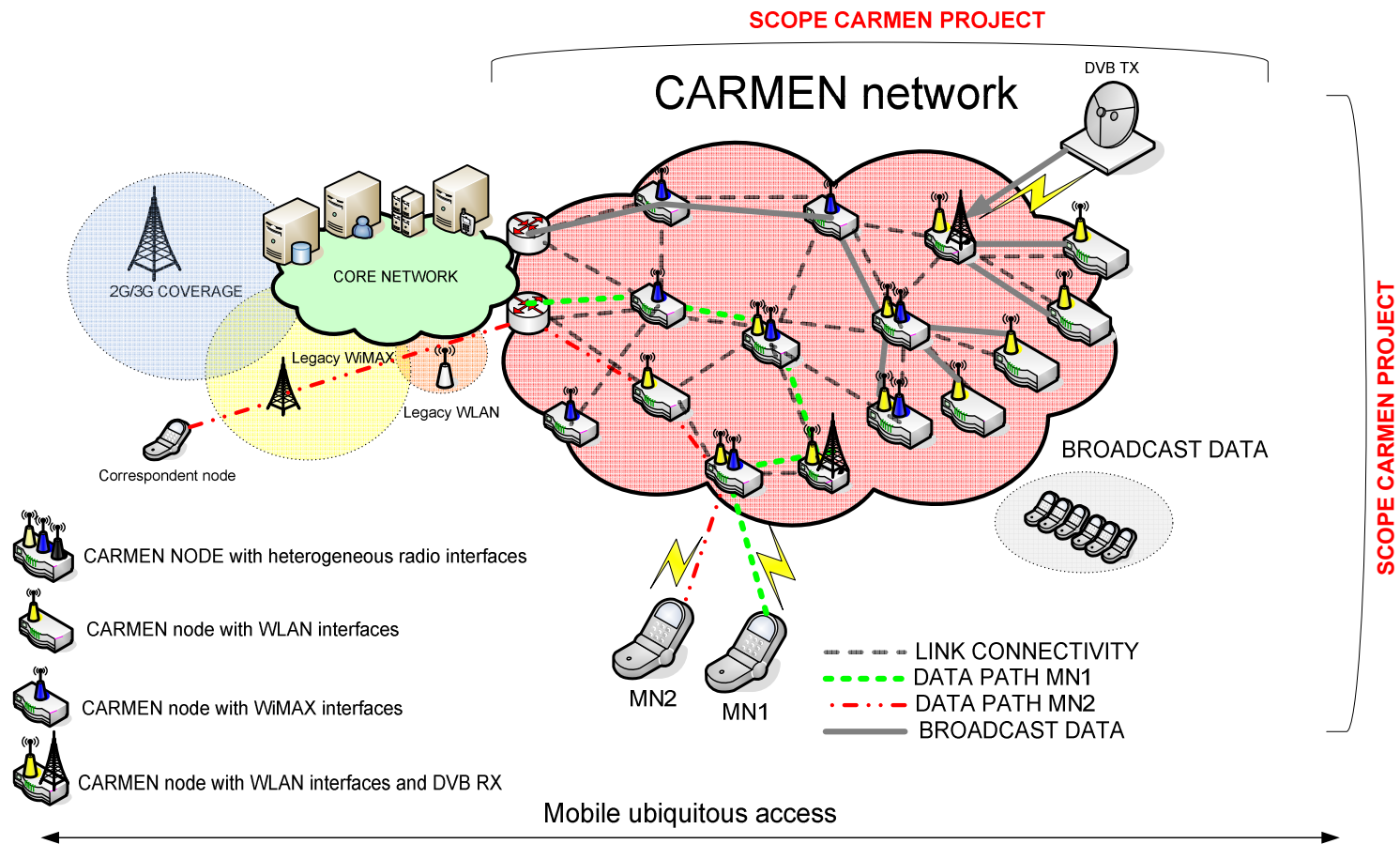
Project Overview



CARMEN Overview.

Project Concept.

Realise heterogeneous backhaul mesh networks for operators deployments with support for mobile unicast and broadcast carrier grade services



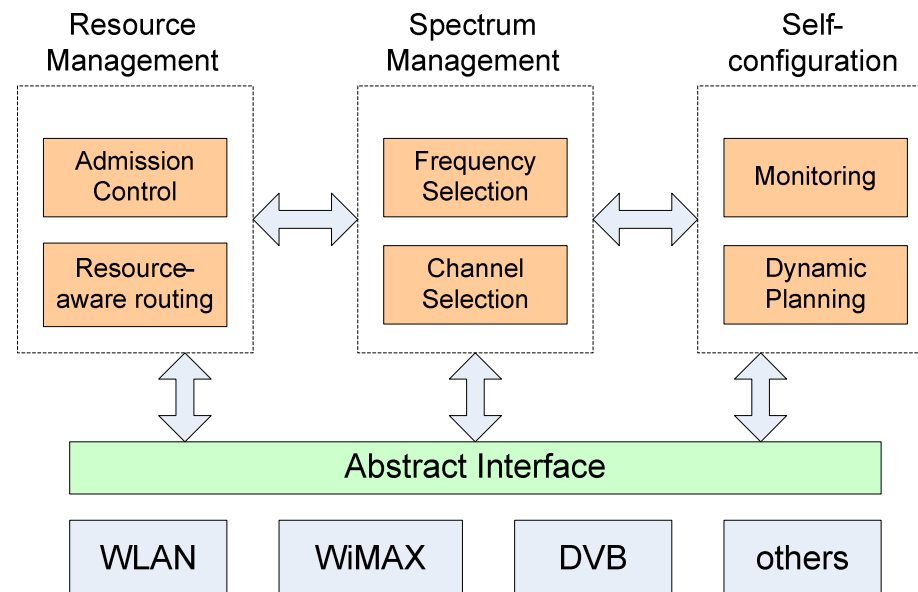
CARMEN Overview.

Project Concept.

CARMEN project will design an evolved architecture for multi-technology mesh networks developing an abstract convergence interface towards different underlying technologies

Key functionalities provided on this interface include

- resource management for carrier grade services
- efficient and flexible spectrum management
- dynamic self-configuration
- support for mobile users



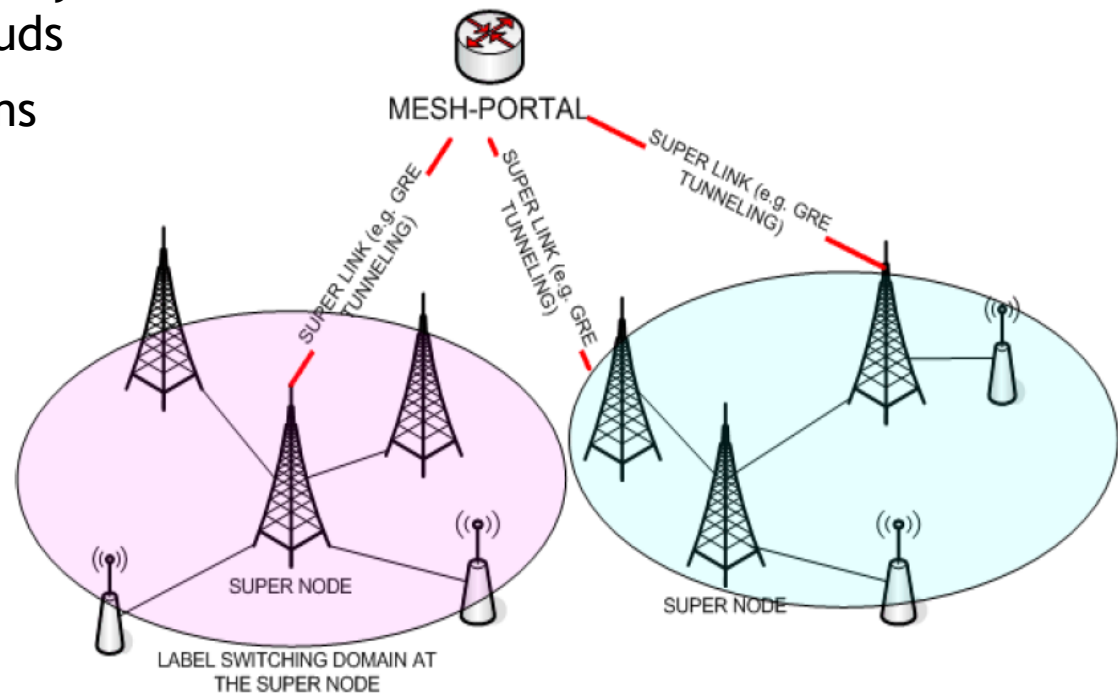
CARMEN Overview.

Project Concept.

Routing functionalities with respect to address allocation and mobility support

- An architecture separating location and identity has the great advantage of not requiring IP address re-configuration upon handover
- Layer 2 and 2.5 based mobility mechanisms within sub-clouds
- Location update mechanisms for mobility between sub-clouds

Load and traffic aware
multi-path routing
approaches within the mesh



CARMEN Overview.

Main Objectives.

Objective 1

- Support for multiple technologies by designing an interface to provide an abstraction of radio based MAC layers for mesh

Objective 2

- Create a cost-effective mesh network that supports carrier grade services

Objective 3

- Support for mobile unicast and broadcast services in a mesh environment

CARMEN Overview.

Roles of CARMEN Partners.

Operators: BT and DT

- CARMEN aims at developing an operator network
- BT and DT bring to the consortium an understanding of the operators requirements

Manufacturers: ALUD and NEC

- NEC is a terminal and network equipment manufacturer, ALUD is a network equipment manufacturer
- CARMEN aims at designing solutions for network equipment
- Manufacturers play a key role in the consortium

Research institutes (FHG) and universities (UC3M, UCD, AGH)

- These partners bring key technical expertise into the consortium

CARMEN Overview.

Exploitation Plans.

Field-trials and testbeds

- The operators of the consortium will seek to deploy trials to exploit the technology developed within CARMEN

Impact on products

- NEC and ALUD are interested in exploiting CARMEN by providing advanced technologies to future products
- Patent and standards contributions developed in CARMEN will represent an advantage for the positioning of these products

Publications

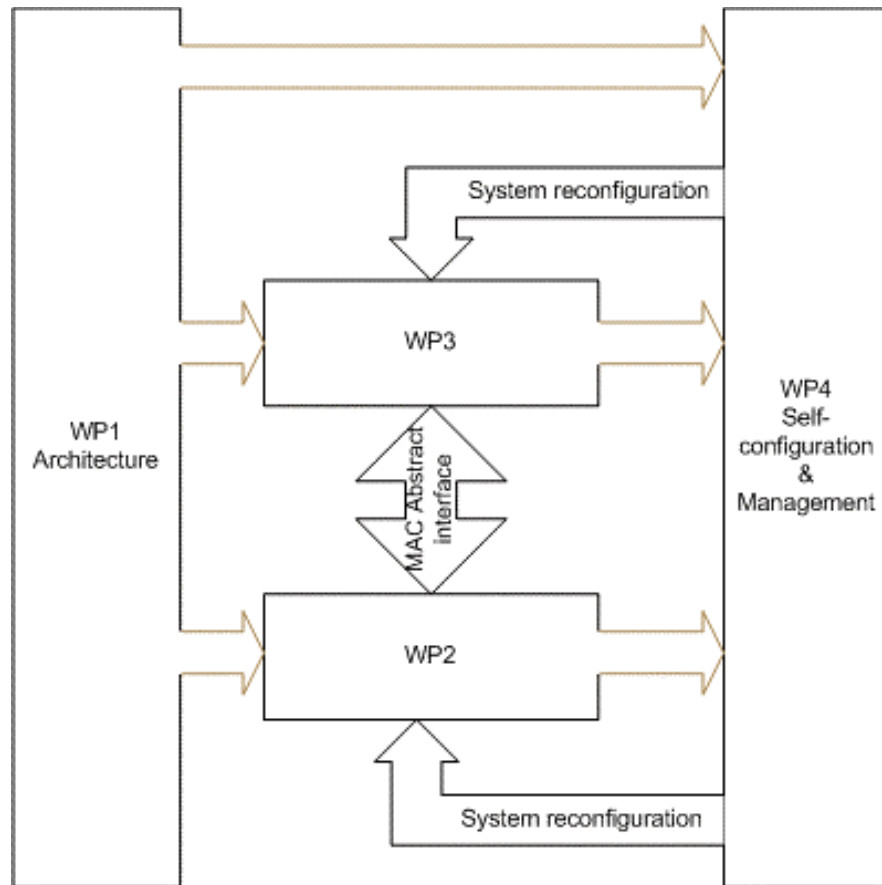
- At least three publications in prestigious scientific fora per objective

New research

- The know-how gained in CARMEN will be the basis for follow-up research activities for academic and industrial partners

CARMEN Overview.

Project Structure.



| No. | Workpackage | Lead |
|-----|--|------|
| WP0 | Project Management | UC3M |
| WP1 | Integration and global issues | NEC |
| WP2 | Abstraction and extension of MAC layers | ALUD |
| WP3 | Message Transfer | UC3M |
| WP4 | System self-configuration and Management | BT |

CARMEN Overview.

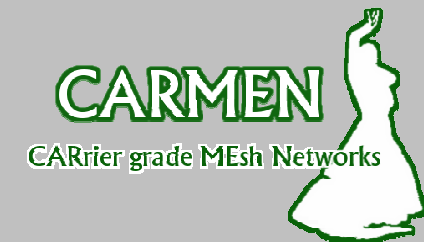
Project Structure.

Workpackages and Tasks

| WP0 Project Management (UC3M) | WP1 Integration and global issues (NEC) | WP2 Abstraction and extension of MAC layers (ALUD) | WP3 Message transfer (UC3M) | WP4 System self-configuration and management (BT) |
|---|---|---|--|---|
| <i>T0.1: Project management (UC3M, NEC)</i> | <i>T1.1: Architecture (UC3M, BT, DTAG, NEC, ALUD, FOKUS, NUID UCD)</i> | <i>T2.1: Service abstraction of radio based PHY and MAC layers (BT, ALUD)</i> | <i>T3.1: Routing (NUID UCD, UC3M, NEC, ALUD, FOKUS, AGH)</i> | <i>T4.1: Self-configuration (FOKUS, BT, ALUD, AGH)</i> |
| | <i>T1.2: Basic security requirements (NEC, FOKUS)</i> | <i>T2.2: Coordinated Media Access Control (ALUD, DTAG, NUID UCD)</i> | <i>T3.2: Connection with external networks (NUID UCD, UC3M, NEC)</i> | <i>T4.2: Monitoring system (BT, FOKUS, AGH)</i> |
| | <i>T1.3: Economical analysis (BT, DTAG, NUID UCD)</i> | <i>T2.3: Uncoordinated Media Access Control (UC3M, BT, DTAG, ALUD)</i> | <i>T3.3: Support for broadcast services (FOKUS, UC3M, NEC, NUID UCD)</i> | <i>T4.3: Radio planning and system management (ALUD, BT, FOKUS)</i> |
| | <i>T1.4: Standards and dissemination (ALUD, UC3M, BT, FOKUS)</i> | | <i>T3.4: Mobility support (NEC, UC3M, DTAG, NUID UCD, AGH)</i> | |
| | <i>T1.5: Validation and system trials (FOKUS, UC3M, DTAG, NEC, ALUD, AGH)</i> | | <i>T3.5: Service oriented capacity handling (ALUD, BT, NUID UCD, FOKUS, AGH)</i> | |

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Scenarios



Use case scenarios.

Emergency scenario for temporal deployment of radio access.

After a disaster (earth quake, tsunami, ..):

- Fully destroyed communication infrastructure within a large area
- Access coverage within a contiguous area (e.g. coast line) has to be served very fast for coordination of ambulance, volunteers, rescue teams
- Camps providing accommodation for volunteers as well as refugees and victims are equipped with sensor networks for surveillance and safety and infrastructure for voice and data communication.
- Functional areas (energy plant, hospital, engine park, food and water supply, school, etc.) are connected with prioritized (higher bandwidth) links

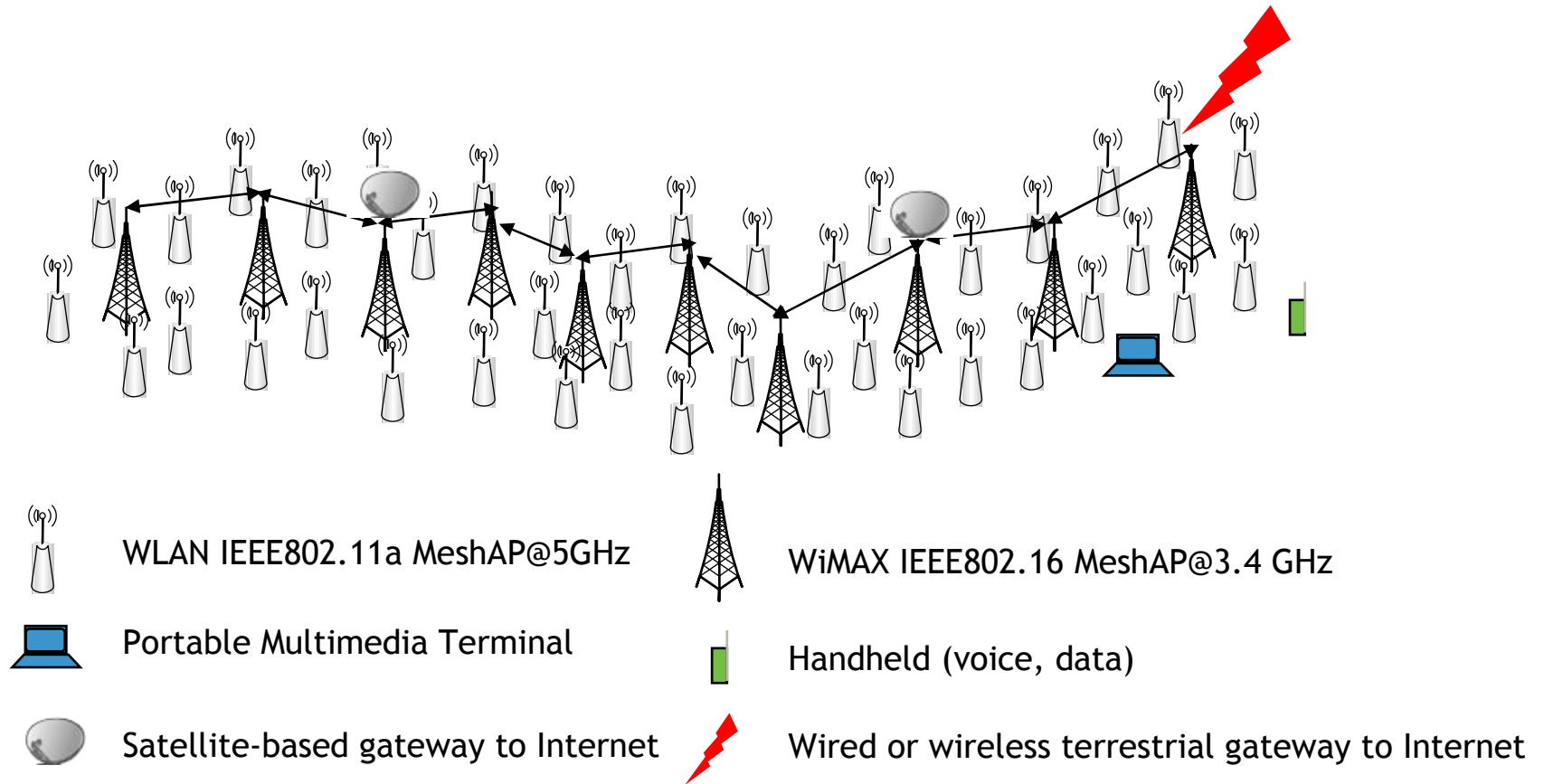
Technical assumptions:

- Point-to-Point and Point-to-Multipoint communication via mesh architecture
- Integrated system for voice, data, multimedia (Triple Play)
- Data security thanks to encryption
- Reliability thanks to multi-homed mesh gateways towards the Internet (e.g. via satellite and terrestrial connections in parallel)
- Service prioritization with different Quality of Service (QoS) classes (contrary to WLAN)
- Operation with stationary or portable terminals, global adaptation to WiFi possible (incl. adaptation to specific national regulation)
- Cost efficient equipment for voice and data

Use case scenarios.

CARMEN enables a service provider to offer flexible and just-in-time access to infrastructure worldwide.

Temporal deployment of radio access in an emergency scenario



Use case scenarios.

City Coverage Scenario.

Deployment in public places and low-fiber areas

- Complementary to mobile networks (e.g. HSPA)
- Realization of the vision of high-speed ubiquitous Internet access
- Today, many public places do not yet offer WiFi connectivity - hotspots are very limited

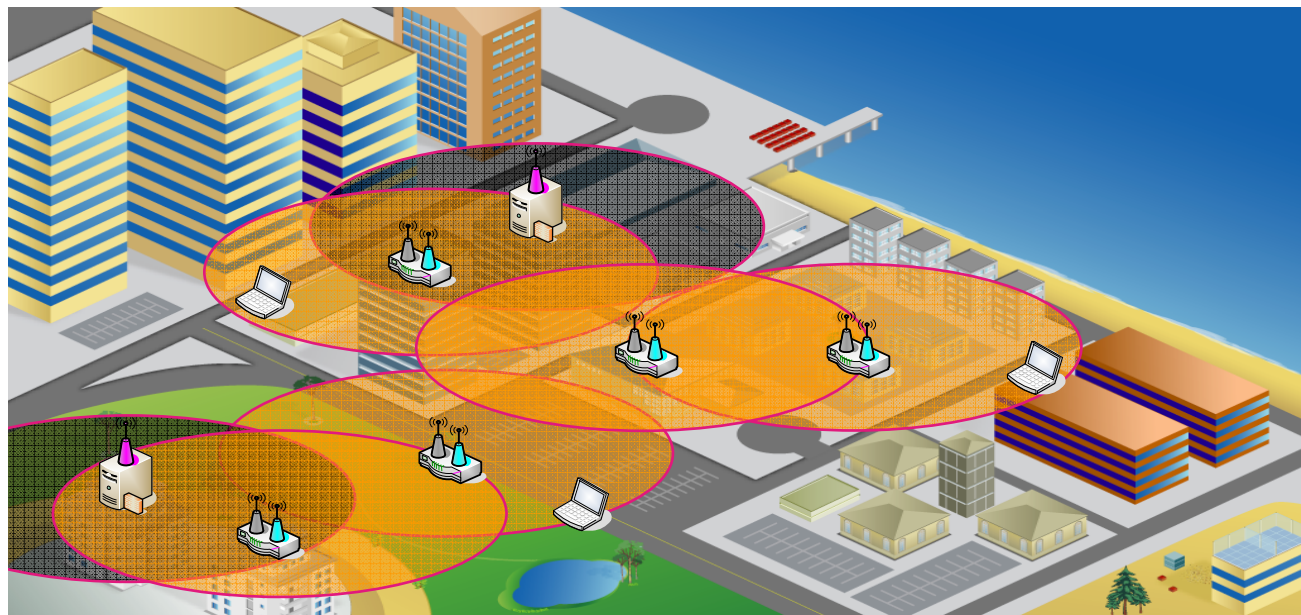
Developing countries

Municipal Applications (e.g. for administrations, police, fireworkers, surveillance)

Use case scenarios.

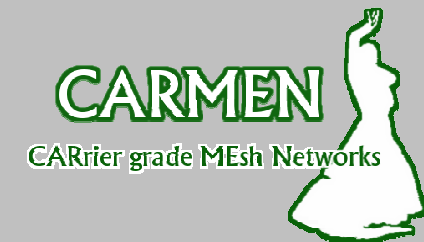
CARMEN enables a service provider to offer broadband wireless access in a flexible and cost efficient manner.

Temporal or permanent deployment of radio access in public places and for mass events



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Abstract Interface

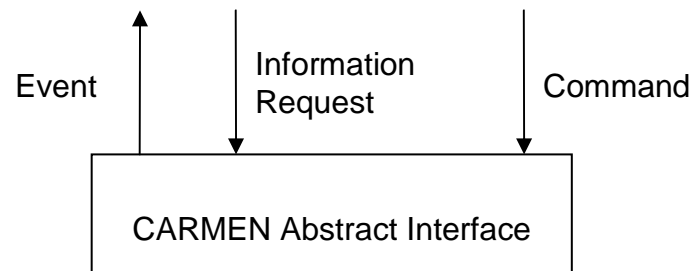


Abstract Interface.

Aims.

Design guidelines

- Being technology generic
- Providing user plane and control/management plane functionality

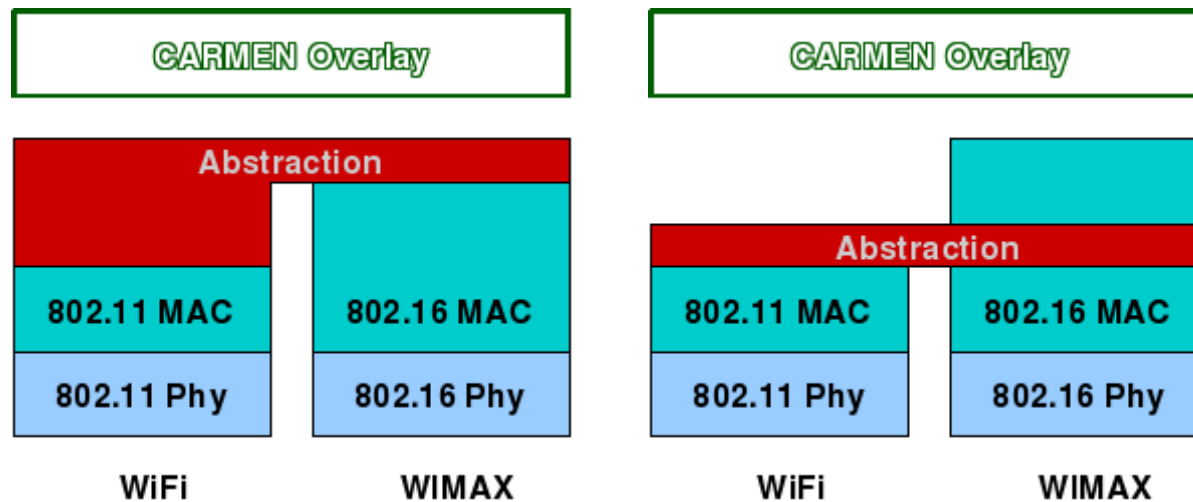


- Based on IEEE 802.21 Media Independent Handover Services (MIHS) ideas
- Basic concept of providing extended information on lower-layer status to higher layers through a layered system architecture

Abstract Interface.

Aims.

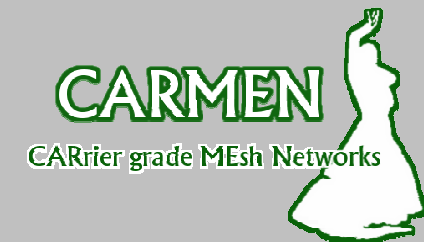
- Definition of CARMEN abstraction API/layer for carrier grade services
 - approach #1: coordinated MAC
 - approach #2: uncoordinated MAC



- Overlay routing using the multi-standard abstraction layer
 - for unicast data
 - for multicast data

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Capacity Handling



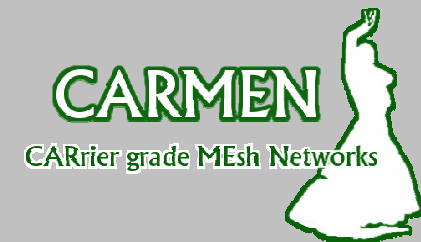
Capacity Handling.

Outline.

- Main Objective
 - Exploit capabilities of a meshed network for optimized traffic routing to provide QoS differentiated carrier-grade services
- Guidelines
 - Separate traffic by assigning all traffic to 4 traffic classes
 - Perform admission control for all flows at the entrance of the CARMEN network to allow traffic engineering
 - Traffic routing and capacity handling on the level of paths aggregating user flows of same traffic class between the same access point and gateway
 - Allows path allocation taking into account traffic class specific parameters
 - Keeps complexity low (# of flows increases with # of access points, not with # of subscribers)
 - Allows strictly local actions in access points for time-critical tasks (e.g. admission control) while allowing to do the less time-critical path routing and capacity planning with a global view

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Wrap-up



CARMEN Wrap-up

CARMEN Objectives

- Create a cost-effective mesh network that supports carrier grade services
- Support for mobile unicast and broadcast services in a mesh environment
- Support for multiple technologies by designing an interface to provide an abstraction of radio based MAC layers for mesh

Current Status

- Project started January 1st, 2008
- Currently, the architecture, abstract interface and capacity handling functions are under discussion

Future

- Testbeds
- Studies and evaluations on mesh functionalities under the constraints of carrier-grade service provisioning

www.ict-carmen.eu

www.alcatel-lucent.com

www.laboratories.telekom.com