DAIMLERCHRYSLER

Vehicle IT and Services Research
Berlin · Stuttgart · Ulm · Palo Alto

driving connectivity

Workshop Vehicle Safety Communication
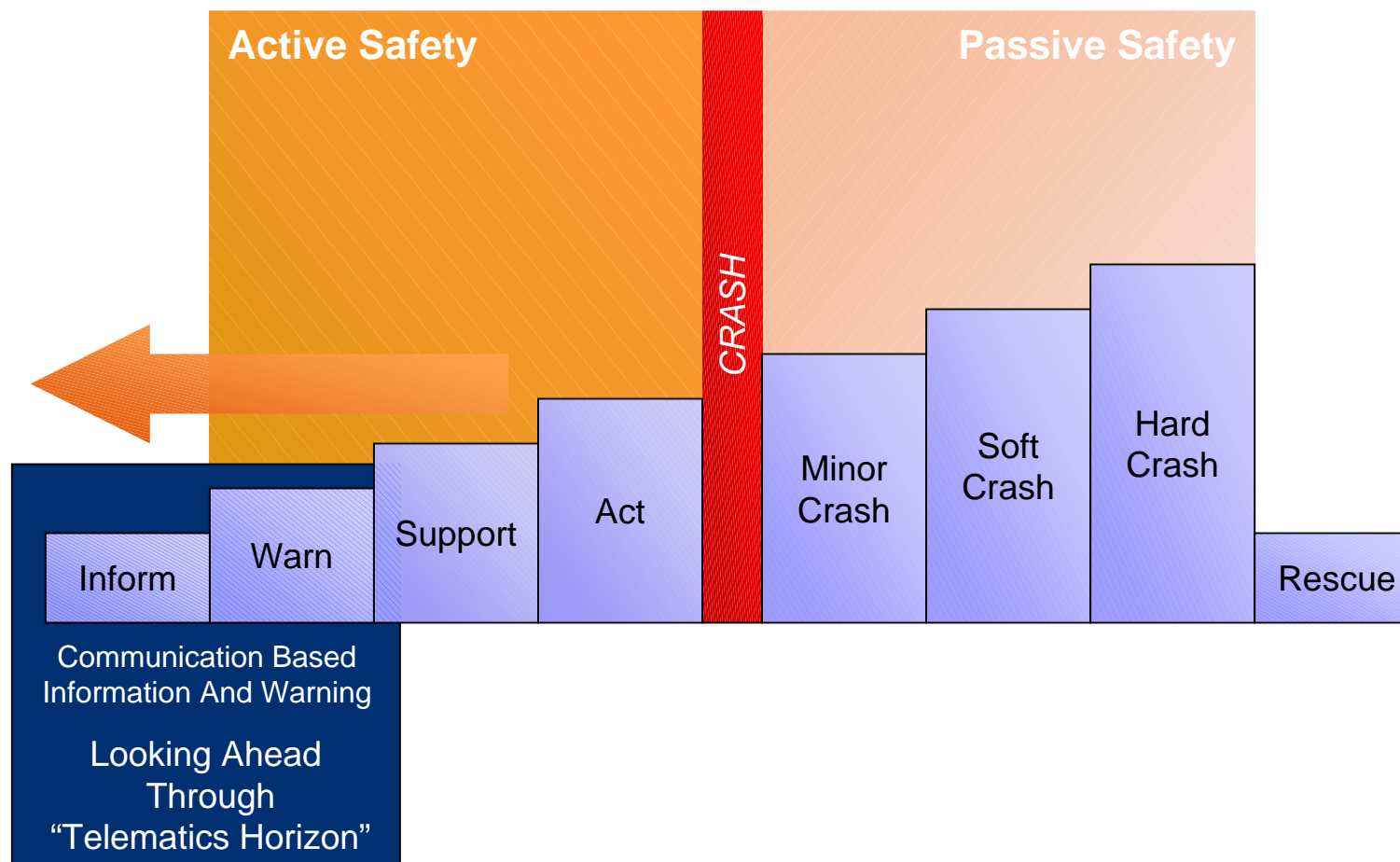
Matthias Schulze

Telematics Functions
(REI/VF)

27. Mai 2005

Communications and Safety

Focus in safety shifts towards accident avoidance and collision mitigation.

Active Safety

Passive Safety

CRASH

Inform

Warn

Support

Act

Minor Crash

Soft Crash

Hard Crash

Rescue

Communication Based Information And Warning

Looking Ahead Through "Telematics Horizon"

The General Principle: Looking Ahead

Reaching an area
- No other sensor can reach
- Even the driver can usually not reach

Creating a "Telematics Horizon"
- Looking further away
- Looking further ahead
- Looking beyond the surface
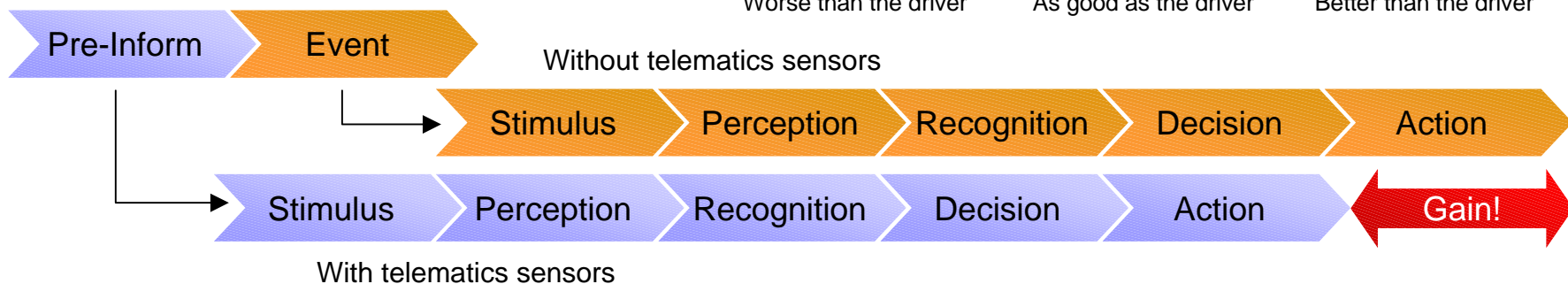 - Non-physical attributes
  - Rules
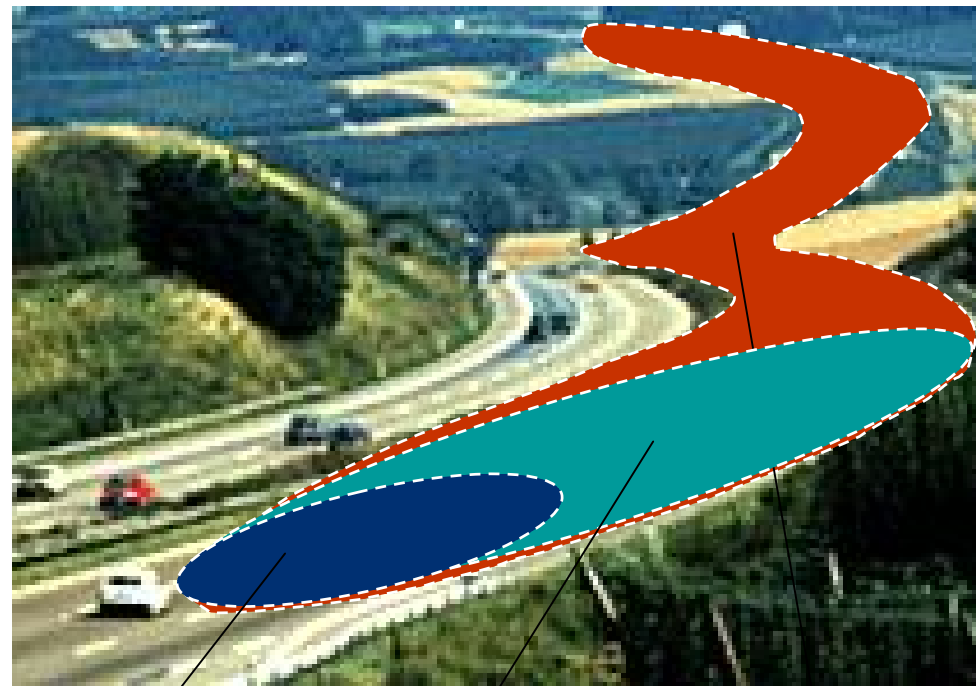
How it works:

Simple sensors:
Worse than the driver

Complex sensors:
As good as the driver

Telematics:
Better than the driver

Pre-Inform	Event

Without telematics sensors

Stimulus	Perception	Recognition	Decision	Action

Stimulus	Perception	Recognition	Decision	Action	Gain!

With telematics sensors

Various Initiatives in Germany and Europe

EU research projects:
- Past
  - Inter-Vehicle Hazard Warning
  - CarTALK 2000
- Now
  - PReVENT WILLWARN

German research projects:
- Past:
  - FleetNet – Internet on the Road
- Now:
  - NOW: Network on Wheels

OEM coordination group:
- Car 2 Car Communication Consortium

Inter-Vehicle Hazard Warning

IVHW

Inter-Vehicle Hazard Warning

Funded by:

- DEUFRAKO (German Ministry of Education and Research, Ministére de l'Equipement des Transports, du Logement, du Tourisme et de la Mer)

Partners:

- Cofiroute, **DaimlerChrysler AG,** Robert Bosch GmbH, PSA, Renault, ISIS, ESRI, BASt, INRETS

Term:

- 2001-2003

Objective:

- To design and evaluate a common concept for an Inter- Vehicle Hazard Warning system giving precedence to European highway traffic and also to assess its possible market introduction, taking into account costs and effectiveness.

Results:

- Developed a warning system specific for hazard warning in the 869 MHz spectrum
- Dedicated application/communication was deemed unfeasible for market introduction because of penetration issues

Further Information:

- www.deufrako.org

CarTALK 2000

Funded by:
- EU, IST-2000-28185, 5th Framework Program

Partners:
- **DaimlerChrysler AG,** Centro Ricerche Fiat, Robert Bosch GmbH, Siemens AG, Netherlands Organisation for Applied Scientific Research (TNO), University of Cologne, University of Stuttgart

Term:
- 2001-2004

Objective:
- Communication protocols and application development for safe and comfortable driving based upon inter-vehicle communication

Results:
- Identified and validated automotive applications based on communication

Further Information:
- www.cartalk2000.net

CarTALK 2000

IWF – Information and Warning Functions
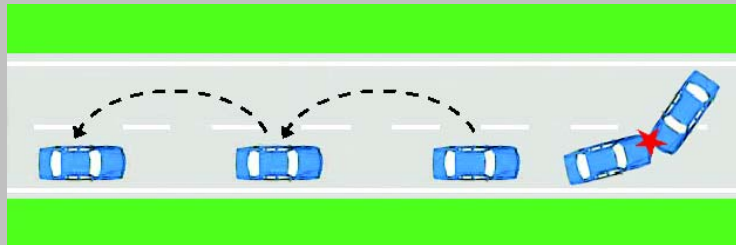
- Accident ahead, car break down
- Congestion
- Road condition monitoring
- Extended blind spot (e.g. lane merging)

CBLC – Communication-Based Longitudinal Control Systems
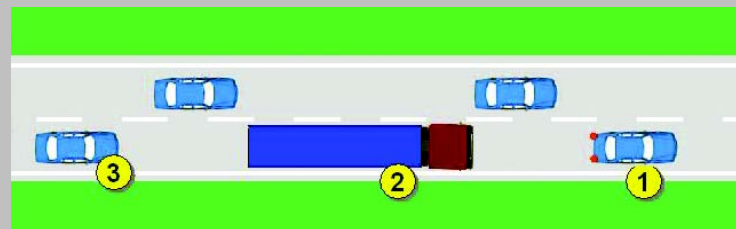
- Stop and go traffic
- Advanced distance keeping: anticipated driving, early braking
- Advanced flow control and throughput

CODA – Co-Operative Driver Assistance Systems

- Merging at highway ramps, merging two lanes
- Crossover merging

PReVENT WILLWARN

Funded by:
- EU, eSafety Initiative

Partners:
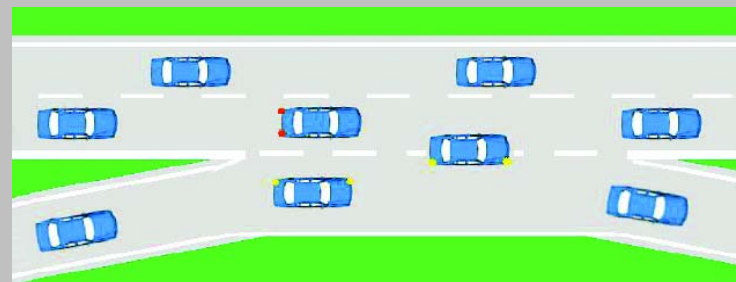- **DaimlerChrysler AG,** TNO Automotive, BMW Forschung und Technik GmbH, Philips, National Technical University of Athens, CNRS – Ile de France Est, HTW Forgis

Term:
- 2004-2007

Objective:
- Hazard detection algorithms (logics and observers) based on CAN data, GPS, and optional environment sensors e.g. radar
- Warning Message Management with messaging and forwarding strategies
- Message transport via oncoming traffic
- On-board relevance checks and warning evaluation
- Communication requirements, choice of radios, frequency allocation, and standardisation. System architecture and protocols for routing and application
- Guidelines for Human Machine Interface

Further Information:
- www.prevent-ip.org

PReVENT WILLWARN

WILLWARN
a PReVENT Project

Important Questions

- What happens in road networks depending on equipment rate?
- How long do messages survive depending on traffic?
- How to handle multiple messages from one event?
- Different types of messages: spot or area?

Architecture

```
        Communication
              ↕
          Warning
        Management
         ↙        ↘
     Hazard         HMI
    Detection
        ↑
      Sensors
```
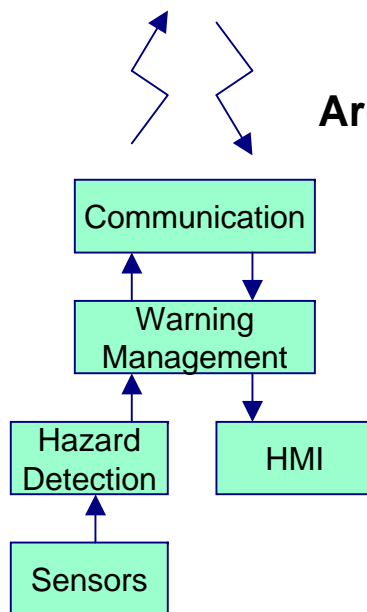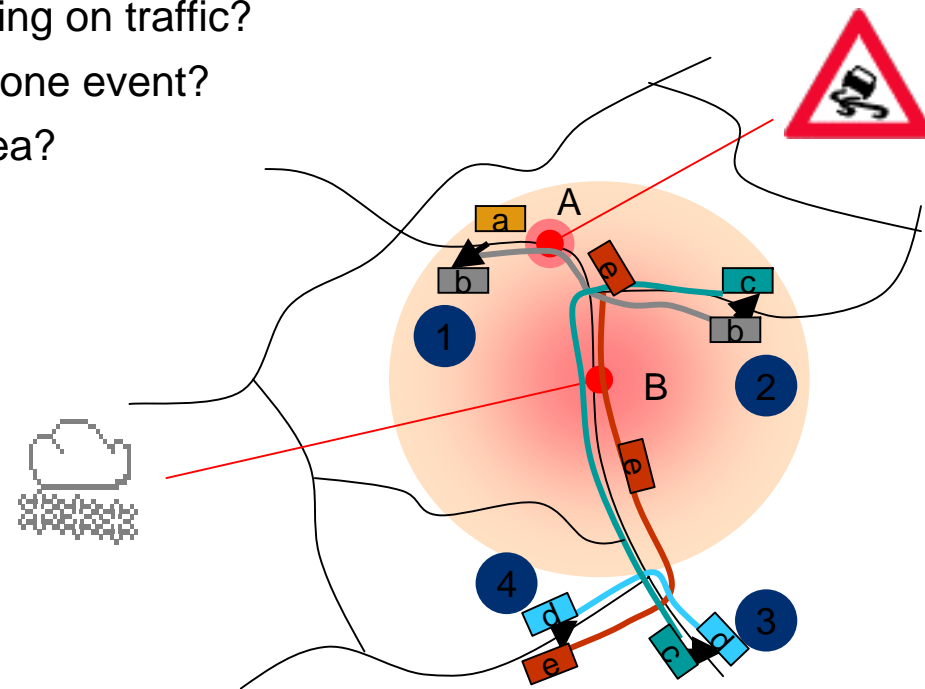
Message transport: 1 -> 2 -> 3 -> 4

FleetNet – Internet on the Road

Funded by:

- German Ministry of Education and Research

Partners:

- **DaimlerChrysler AG,** Fraunhofer Institut Fokus, NEC Europe Ltd., Robert Bosch GmbH, Siemens AG, TEMIC Speech Dialog Systems GmbH
- Subcontractors: TU Braunschweig, TU Hamburg-Harburg, University of Hannover, University of Mannheim

Term:

- 2000-2003

Objective:

- Development and demonstration of vehicular ad hoc networks for inter-vehicle communications to support active safety applications and information applications

Results:

- Communication protocols at the network layer for vehicle-to-vehicle communication

Further Information:

- www.et2.tu-harburg.de/fleetnet/

FleetNet – Internet on the Road

FleetNet

Inter-Vehicle Communications Platform

Internet

1. **Car-to-car direct**
2. **Car-to-car via relaying by intermediate cars**
3. **Car to stationary FleetNet gateway**
4 **Car - Internet via stationary FleetNet gateway**
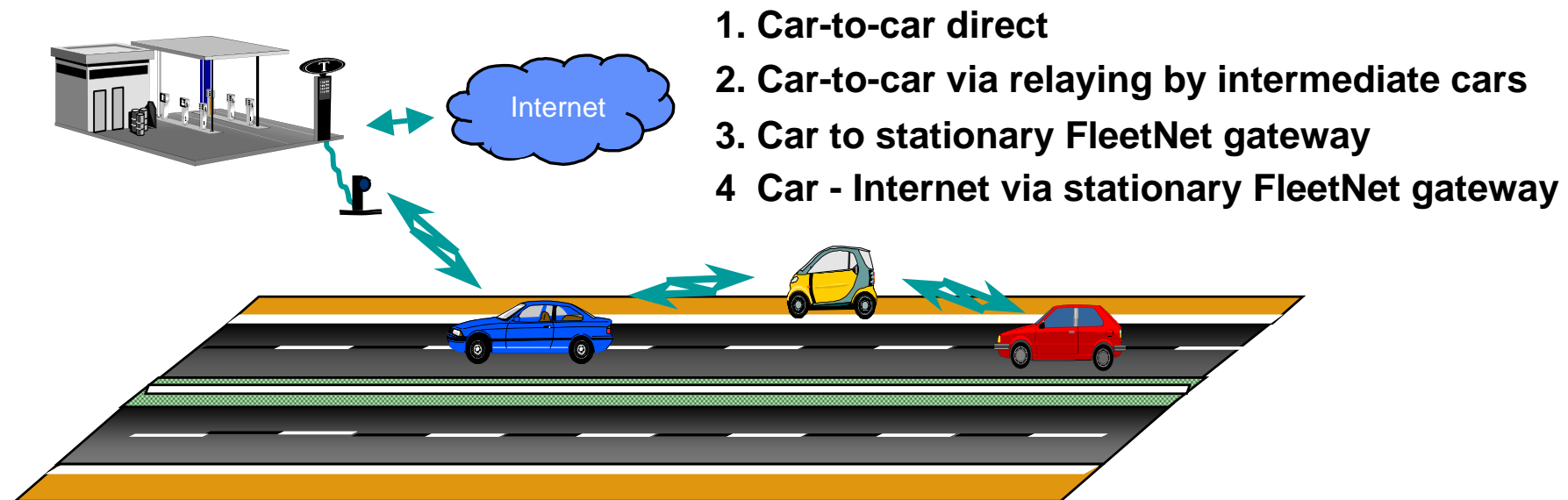
Applications
- **Cooperative Driver Assistance**
  - Emergency notifications
  - Platooning
- **Decentralized Floating Car Data**
  - Dynamic navigation
  - Route weather forecast
- **User Communication & Information Services**
  - Internet access
  - Mobile office

NOW: Network on Wheels

Funded by:

- German Ministry of Education and Research

Partners:

- BMW Forschung und Technik GmbH, **DaimlerChrysler AG,** Fraunhofer Institut Fokus, NEC Deutschland GmbH, Siemens AG, Volkswagen AG
- Subcontractors: TU Braunschweig, TU Hamburg-Harburg, University of Hannover, University of Mannheim

Term:

- 2004-2007

Objective:

- Development and demonstration of vehicular ad hoc networks for inter-vehicle communications to support active safety applications and information applications.
- Adoption of US protocols to Europe

Further Information:

- www.network-on-wheels.de (under construction)

NOW: Network on Wheels

Scientific Challenges

- **scaleable network layer protocols**

- **data security in VANETs**

- **investigation of example applications**

Standardization

- **Europe: Contributions to the *Car2Car Communication Consortium***

- **US / World: Harmonization as far as possible with *DSRC standardization***

- **Demonstrator: to develop VANET-Demonstrator from Proof-of-Concept system towards a reference system of the C2C-CC standard**

To Dos

New initiatives in Germany / Europe need to address three top issues:

- Frequency allocation
  - Agreement on a frequency spectrum for vehicular safety applications similar to the US
  - Initiatives are underway, but slow
  - ETSI TG 37 has developed draft technical document to be submitted to CEPT

- Protocol definition
  - Adoption of US / international protocols wherever possible

- Infrastructure deployment
  - Investigation of infrastructure deployment similar to the US and Japan
  - The only way to reach penetration quickly

Workshop for international coordination of the topic to be held on May 31, 2005 in Hannover, just before the European ITS Congress.

CAR 2 CAR
COMMUNICATION CONSORTIUM

Car 2 Car
Communication Consortium

Objectives
&
Organisational Structure

- The Car2Car Communication Consortium is a non-profit organisation initiated by European vehicle manufacturers

  - open for suppliers, research organisations and other partners
  - working on an open system supporting active safety applications as well as a broad range of information services

- is to bring out the idea of working together
  for more safety on the road

- is to establish an open European industry standard for
  Car2Car Communication systems

- is to promote the allocation of a royalty-free European-wide
  frequency band for Car2Car applications

- is to force the harmonisation of the Car2Car Communication
  standard worldwide

- Creating an open European industry standard for inter-vehicle-communication systems based on wireless LAN components off-the-shelf to guarantee European-wide inter-vehicle operability

- Ensuring high availability, reliability and the necessary data security and anonymity of the C2C system

- Enabling the development of active safety applications by specifying, prototyping and demonstrating the C2C system

- Developing realistic deployment strategies and business models to speed-up the market penetration

- Taking into consideration worldwide related activities

CAR 2 CAR
COMMUNICATION CONSORTIUM

NEC, Philips, Fraunhofer FOKUS

Other OEMs and suppliers about to join (e.g. Opel, Jaguar, Cisco, …)

- ## Back Up

CAR 2 CAR
COMMUNICATION CONSORTIUM

WG Application/ Requirements (APP)	WG Architecture			WG Standardisation (STA)
	WG Security/ Middle Ware (SEC+MW)	WG Network Layer (NET)	WG Physical Layer (PHY+MAC)	
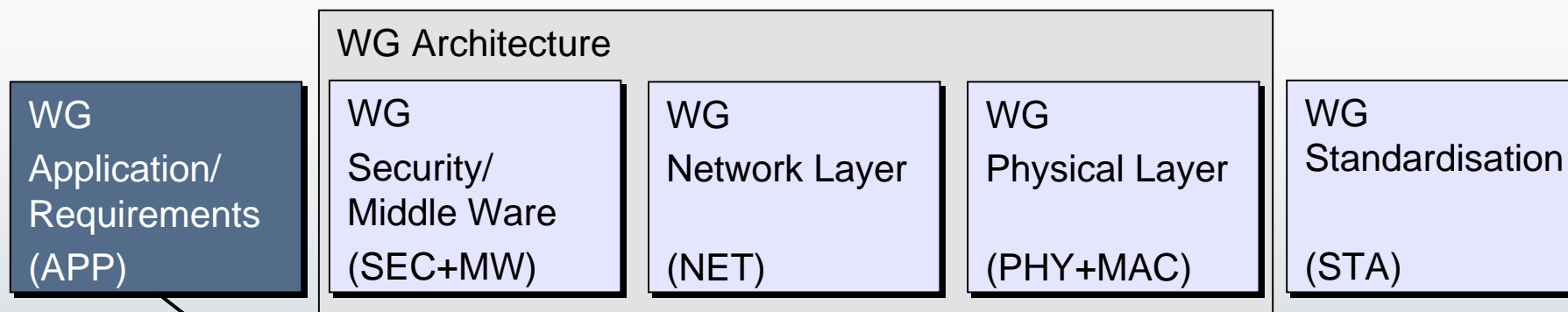
- Definitions of applications
- Technical requirements
- Specification of the Application Layer Interface
- Test of applications

CAR 2 CAR
COMMUNICATION CONSORTIUM

WG Architecture

| WG Application/ Requirements (APP) | WG Security/ Middleware (SEC+MW) | WG Network Layer (NET) | WG Physical Layer (PHY+MAC) | WG Standardisation (STA) |
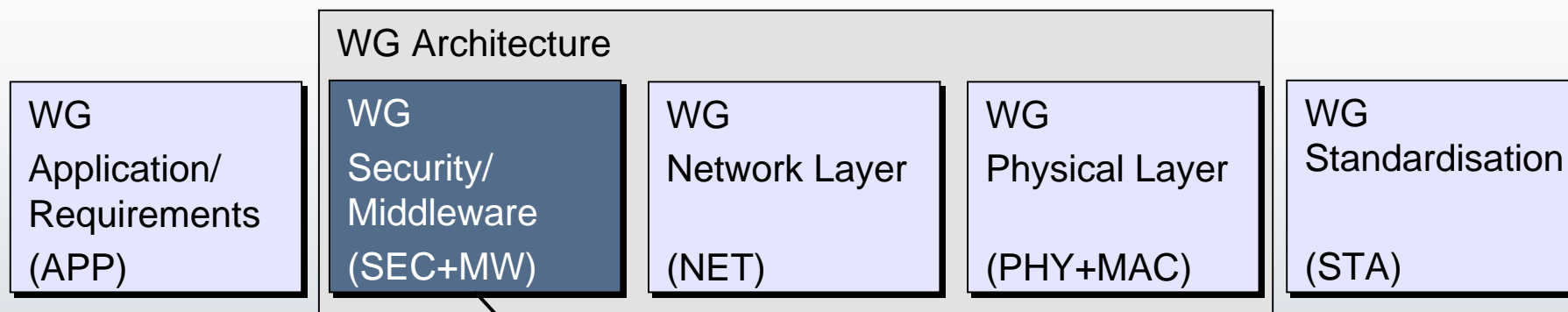
- Requirements with respect to security and middleware
- Definition of the required security level
- Procedures for authentication, encryption and integrity check of messages
- Distributed data management

CAR 2 CAR
COMMUNICATION CONSORTIUM

WG Architecture

WG Application/ Requirements (APP)	WG Security/ Middleware (SEC+MW)	WG Network Layer (NET)	WG Physical Layer (PHY+MAC)	WG Standardisation (STA)
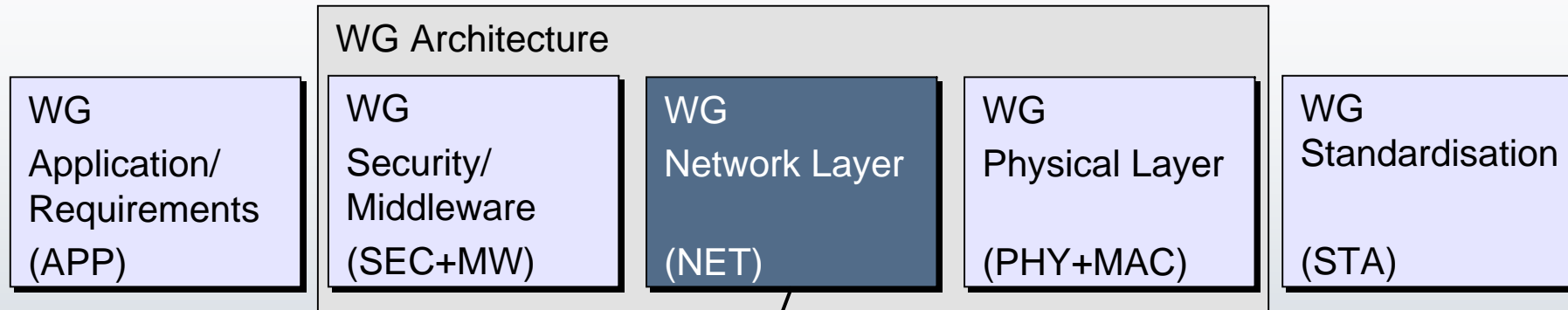
- Specification of mechanisms for routing and multi-hop forwarding
- Definition of service interfaces
- Specification of a transport protocol for reliable data transfer

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WG Architecture

WG Application/ Requirements (APP)	WG Security/ Middleware (SEC+MW)	WG Network Layer (NET)	WG Physical Layer (PHY+MAC)	WG Standardisation (STA)
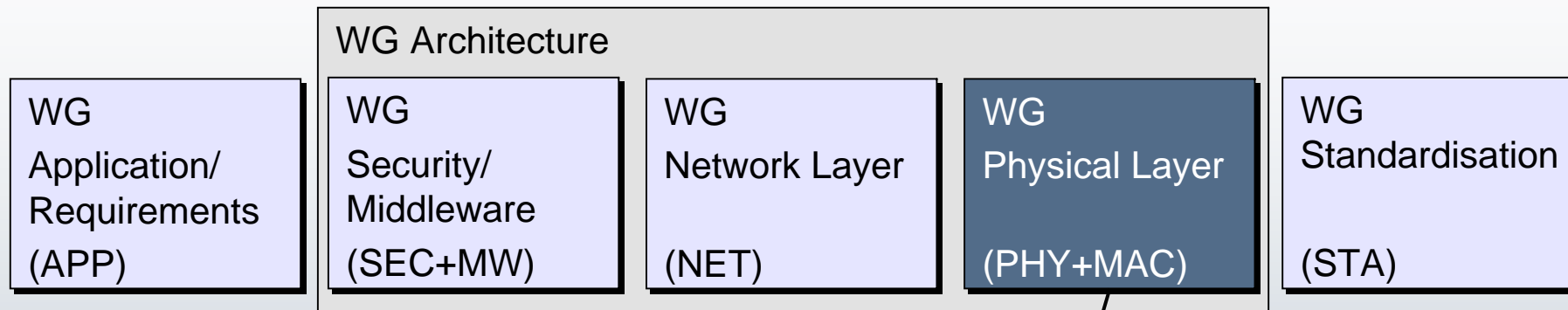
- Specification of the physical layer and the medium access layer considering:
  - time constraints
  - priorities
  - scalability
  - communication range
  - bandwidth etc.

CAR 2 CAR
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WG Architecture

| WG Application/ Requirements (APP) | WG Security/ Middleware (SEC+MW) | WG Network Layer (NET) | WG Physical Layer (PHY+MAC) | WG Standardisation (STA) |
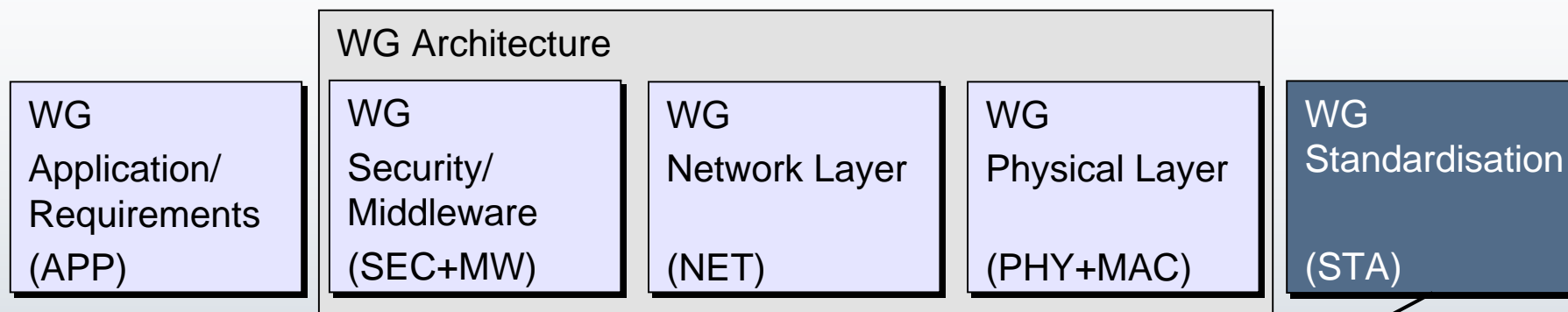
- Preparation of the communication standard based on the specifications of the WGs
- Observation of current standardisation activities and existing standards
- Presentation of the project results to the European standardisation bodies
- Proposals and negotiations for possible frequencies in contact with RegTP, CEPT etc.

CAR 2 CAR
COMMUNICATION CONSORTIUM

WG Architecture

WG
Application/
Requirements
(APP)

WG
Standardisation

(STA)

- Specification of the architecture
- Issues related to two or more of the WGs, where interfaces must be defined or overall coordination is necessary