

EAST-EEA: An Embedded Electronic Architecture for the European Automotive Industry

5th ITEA Symposium, 7-8 October 2004
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Thomas Thurner, MBtech GmbH

EAST: Electronics Architecture and Software Technology
EEA: Embedded Electronics Architecture



Contents

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- 1 Motivation
- 2 Project overview
- 3 Technical Contents
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CAR CLASS B	CAR CLASS C	MOTORBUS	PRIVATE BUS
<ul style="list-style-type: none"> Engine Control Transmission Control Brake Control Steering Control Light Control Wiper Control Door Lock Control Window Control Interior Climate Control Exterior Climate Control Anti-Lock Braking System (ABS) Electronic Stability Control (ESC) Adaptive Cruise Control (ACC) Lane Departure Warning (LDW) Collision Avoidance System (CAS) Keyless Entry System (KES) Keyless Start System (KSS) Infotainment System Navigation System Telematics System Mobile Phone System Bluetooth System Wi-Fi System GPS System Radio System TV System CD Player DVD Player MP3 Player MP4 Player MP5 Player MP6 Player MP7 Player MP8 Player MP9 Player MP10 Player MP11 Player MP12 Player MP13 Player MP14 Player MP15 Player MP16 Player MP17 Player MP18 Player MP19 Player MP20 Player MP21 Player MP22 Player MP23 Player MP24 Player MP25 Player MP26 Player MP27 Player MP28 Player MP29 Player MP30 Player MP31 Player MP32 Player MP33 Player MP34 Player MP35 Player MP36 Player MP37 Player 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Player MP99 Player MP100 Player

Trend: Increasing E/E Complexity in Vehicles!
Where is the limit ?
How to manage the complexity in the future?

The approach of EAST-EEA:
Establishment of a framework towards standardisation of a software architecture for (networked) embedded systems.

Project Presentation EAST-EEA by Thomas Thurner
5th ITEA Symposium, 7 October 2004, Seville, Spain

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Motivation

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Before 1990: Independent, stand-alone systems in the vehicles

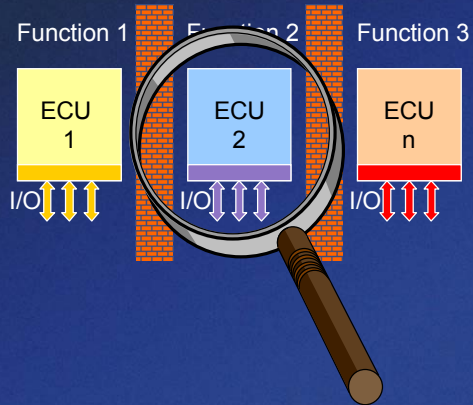
ECU = Electronic Control Unit

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Motivation

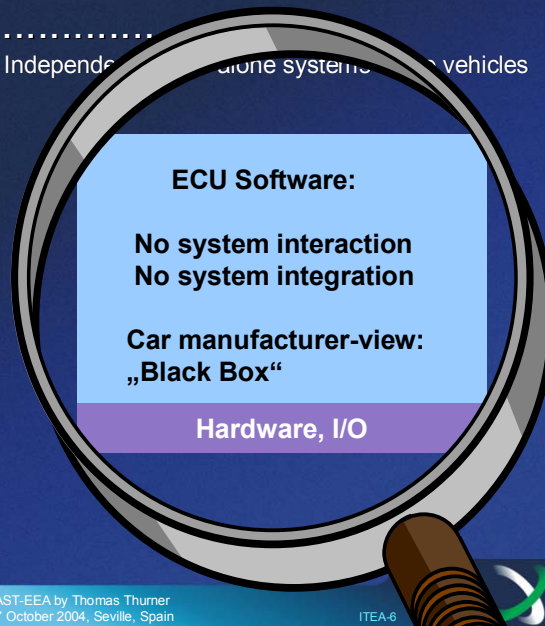
.....
Before 1990: Independent, stand-alone systems in the vehicles



ECU = Electronic Control Unit

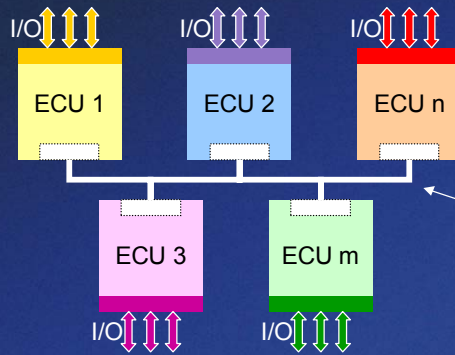
Motivation

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Before 1990: Independent, stand-alone systems in the vehicles



Motivation

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1990 – today: Connected ECU

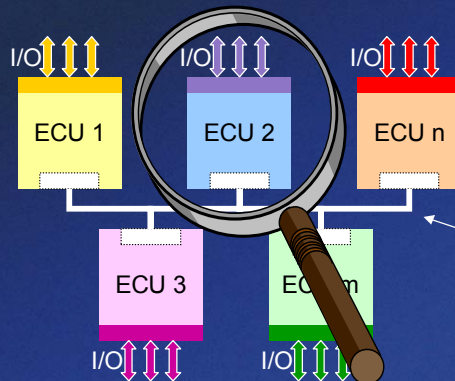


Databus:
Added value by
global information
exchange

System integration via databus ⇒ network-wide consistent operation

Motivation

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1990 – today: Connected ECU



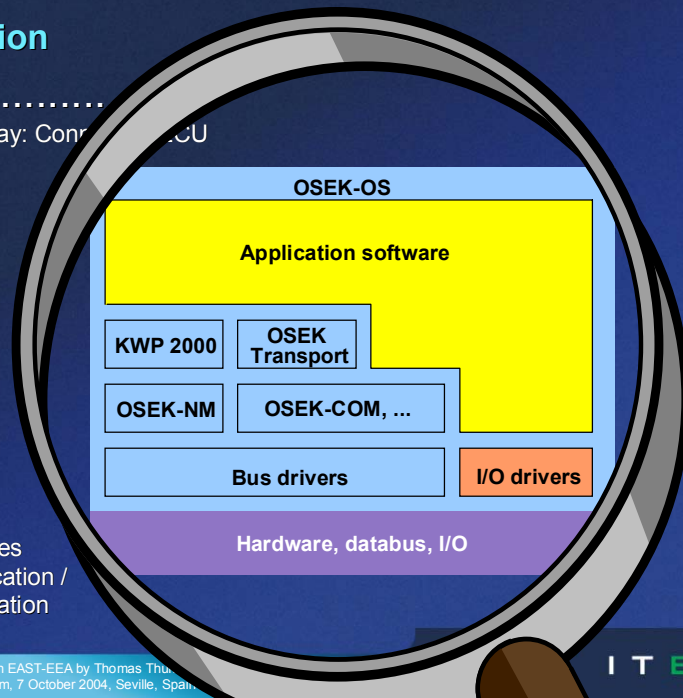
Databus:
Added value by
global information
exchange

System integration via databus ⇒ network-wide consistent operation

Motivation

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1990 – today: Connected ECU

Structured,
open interfaces
for communication /
network operation

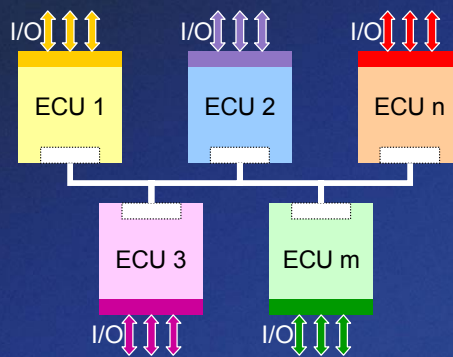


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Motivation

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1990 – today: Connected ECU



~~1 Function = 1 ECU = 1 Supplier~~

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Motivation

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1990 – today: Connected ECU

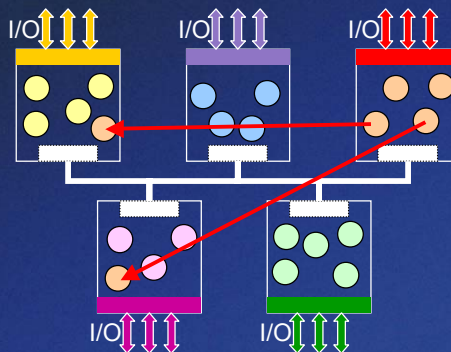
**Separation of functions, ECUs, and suppliers
e.g. SW-function as a component**

**Car manufacturers role:
From an integrator of ECUs to an
integrator of functions into a vehicle system**

~~1 Function = 1 ECU = 1 Supplier~~

Motivation

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Future: Data bus with transparent distributed functions

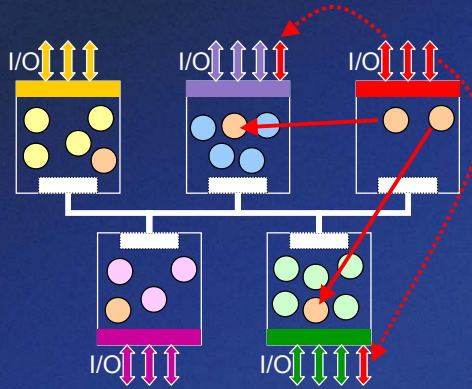


Moving of SW-
components
at design /
generation time

Motivation

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Future: Data bus with transparent distributed functions



Moving of components at design time: I/O ports and respective SW

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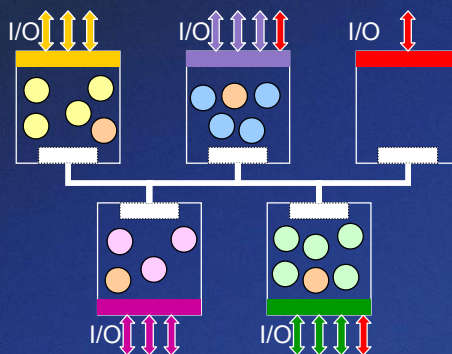
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Motivation

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Future: Data bus with transparent distributed functions



ECU is obsolete

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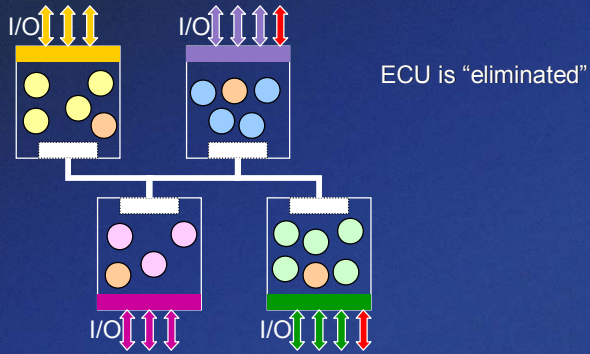
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Motivation

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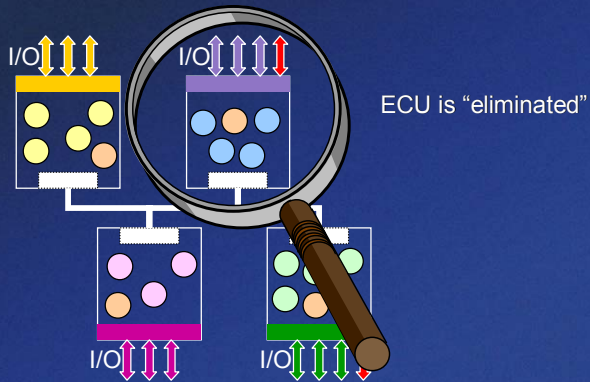
Future: Data bus with transparent distributed functions



Motivation

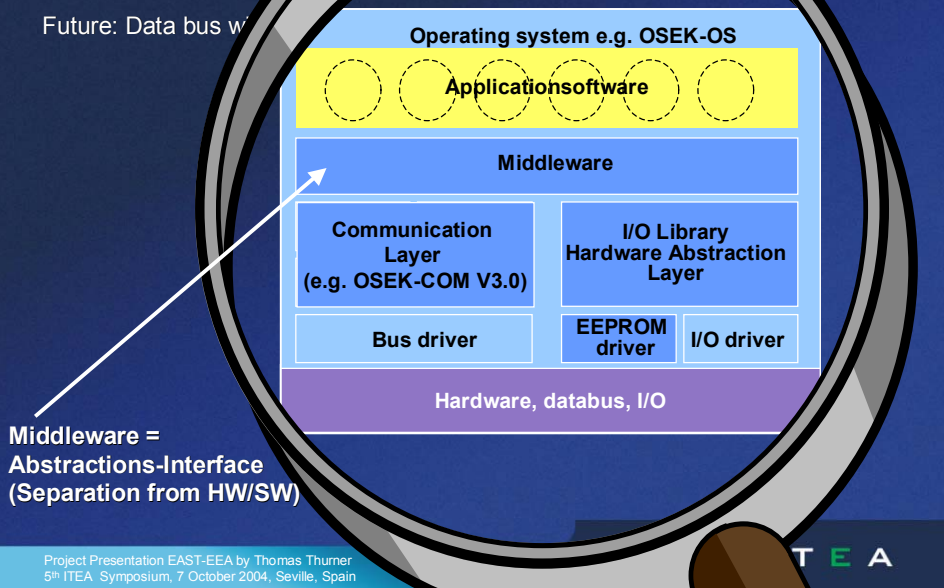
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Future: Data bus with transparent distributed functions



Motivation

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Future: Data bus w



Motivation

Middleware:

- Portability of software components
- Inter-operability between software components

Perspectives, potentials

- Software as a component; e.g. from different suppliers?
- Flexible system integration of software components
- Increased development effort and -speed

Challenges

- Similar activities at different automotive companies for example AEE, Titus, EUCAR-WGs, CLEPA (~1999, 2000)
- Harmonisation of specific, non-coordinated potential solutions



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Project Overview

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Goals of EAST-EEA:

- Common specification of middleware interface and services for portability and interoperability of (distributed) software-components.
 - Prototypical implementation and validation
 - Specification of an architecture description language ADL
 - Corresponding tool integration concept
- ⇒ **Pre-standardisation work** for a middleware based software architecture
- ⇒ New dimension: **paradigm shift in embedded SW-development and -integration**

Project Overview Partners

Manufacturers:

- Audi AG (D),
- BMW AG (D),
- DaimlerChrysler AG (D),
- CRF (I),
- Opel Powertrain GmbH (D),
- PSA (F),
- Renault (F),
- AB Volvo Technology (S)

SME:

- ETAS GmbH (D),
- VECTOR Informatik (D)

Suppliers:

- Robert Bosch GmbH (D),
- Siemens VDO Automotive (D, F),
- IXFIN Magneti Marelli S.p.A. (I),
- Valeo (F),
- ZF Friedrichshafen AG (D)
- Siemens Business Services – C-LAB (D)

Research:

- CEA-LIST (F),
- INRIA (F),
- IRCCyN (F),
- LORIA (F),
- Paderborn University (D),
- Darmstadt Univ. of Technology (D)

Project Overview Structure

EAST-EEA
(PSA)

Capacity: ~ 250 PY
Budget: ~ 40M€
Run time: 3 years
Summer 2001-2004

General
architecture
aspects (CRF)

- Scenarios
- Impacts
- Existing solutions
- Needs and Use Cases

Middleware
specification
(PSA)

- Requirements
- Framework
- Interoperability
- Portability
- Reference-Implementation

ADL
specification
(Renault)

- Architecture description language
- Exchangeable formats
- Tool-Integration

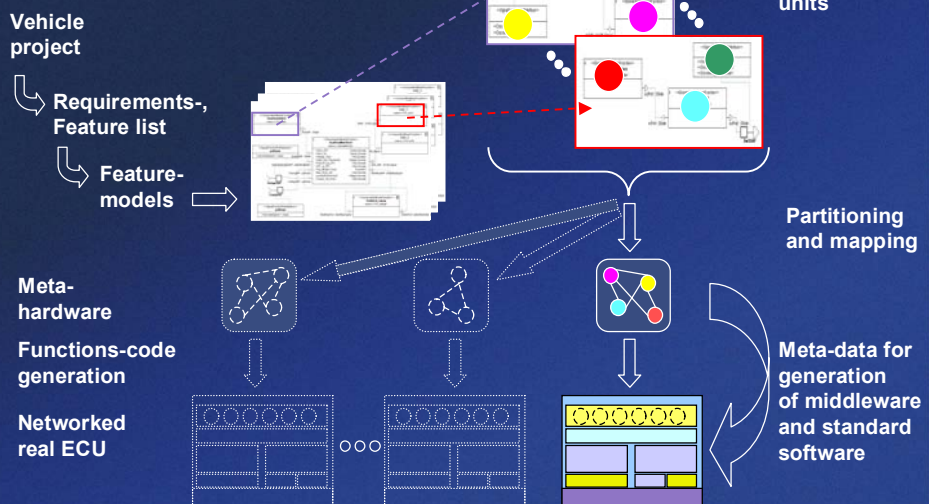
Validators
(BMW)

- Body
- Telematic + HMI
- Chassis
- Powertrain
- Cross domain

Contents

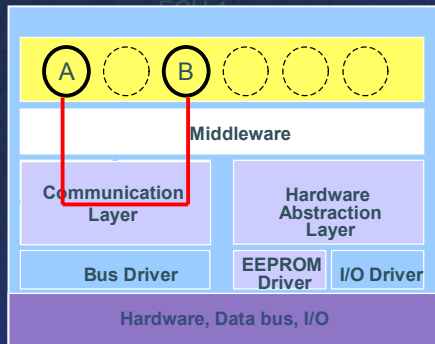
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Technical Contents Middleware concept



Technical Contents Middleware concept

Example: Partitioning / Distribution

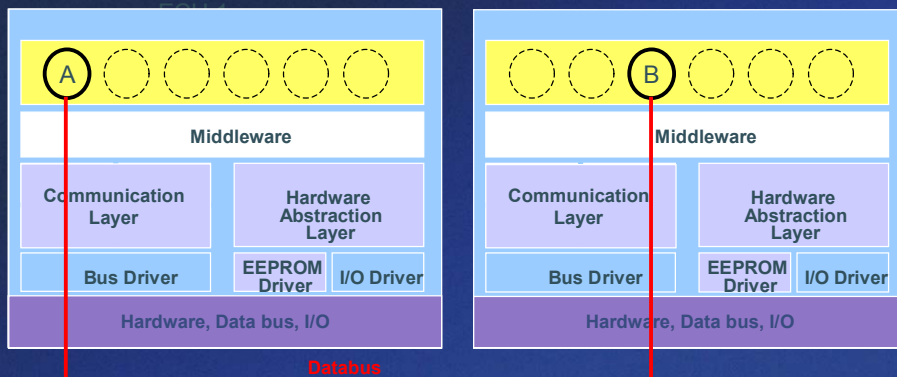


Software component A communicates with software component B inside ECU1. Middleware is generated/configured for ECU-internal communication

Software component A communicates with B in ECU 2 via data bus
Middleware accommodates the feature at compile time

Technical Contents Middleware concept

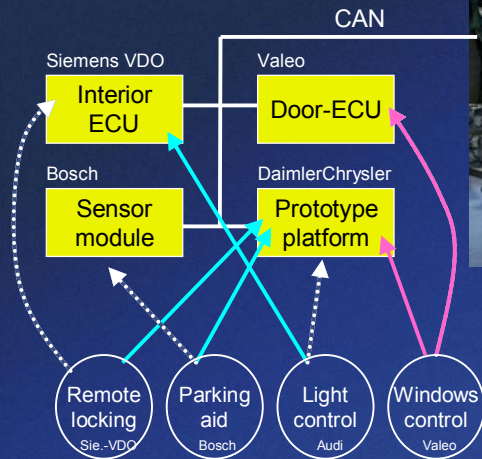
Example: Partitioning / Distribution



Software component A communicates with B in ECU 2 via data bus
Middleware accommodates the feature at compile time

Technical Contents Middleware concept

Example: Body domain



- Software components from different suppliers are combined and individual software components are moved
- Software components of one supplier are distributed

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Technical Contents Middleware concept

Invitation to visit the EAST-EEA booth



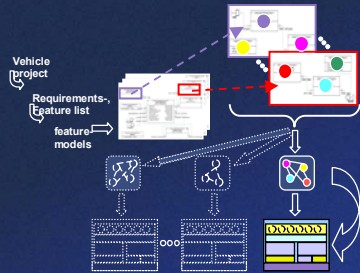
Exhibition of different use cases and examples

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Technical Contents Architecture Description Language (ADL)



- Graphic elements
- UML-based notation

*** SignalFunctionPort¶**

Concrete FunctionPort element to model distinct interaction points through which a functional entity can send and receive signals. The SignalFunctionPort may be outgoing or incoming depending on the isRequired attribute inherited from the UML2 Port.¶

Attributes¶
To be defined.¶

Associations¶
To be defined.¶

Figure 6: Incoming and outgoing SignalFunctionPorts of a Composite Software Function¶

*** OperationFunctionPort¶**

Concrete FunctionPort element to model distinct interaction points through which a functional entity can provide and request operation calls.¶

Attributes¶
To be defined.¶

Associations¶
To be defined.¶

Figure 7: Provided and Required Ports associated to a Composite Software Function¶

Deliverable 03_3a → Version 0.5 → 26

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Results and Conclusions

Project goals

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- Specification of
 - a general SW- architecture (mechanisms & principles)
 - a generic SW-development process and architecture artifacts
 - an architecture description language (and tool-chain)
 - hardware- and communication abstraction interfaces (middleware)
 - Implementation of middleware layers in different vehicle domains
 - Validation of use cases
 - Identification of open issues and necessary follow-on activities
- ⇒ Complete „package“ for realisation of a middleware concept ✓
- ⇒ Common European approach for future standard ✓
- ⇒ Success in primary technical objectives! ✓

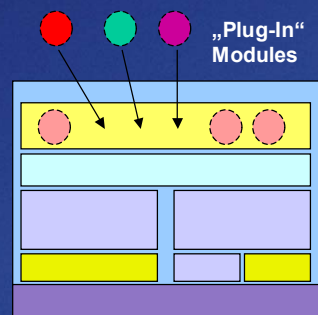
Results and Conclusions

Global view

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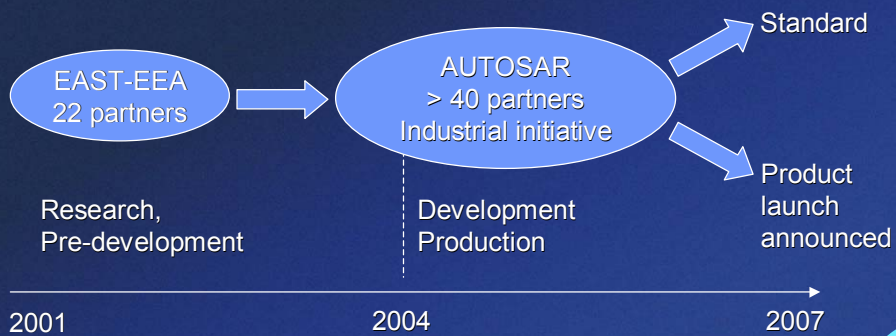
EAST-EEA is the first significant step to a standardisation of a software architecture for complex distributed embedded systems which allows the *plug-in of ECU-foreign software modules*

- ⇒ Open system architecture
- ⇒ Standardised interfaces
- ⇒ Seamless integration with high quality
- ⇒ Effective and efficient development
- ⇒ *New method for managing the complexity*



Results and Conclusions Exploitation

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⇒ Exploitation: from research to development in less than 3 years! ✓

* AUTOSAR = Consortium of about 40 international partners.
Objective: Production maturity level of middleware concept

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Results and Conclusions Business impacts

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EAST-EEA opens a window of opportunity for new business models

- relationship between car-manufacturers and established suppliers
- software as a product
- new companies (3rd party software supplier, tool-provider)

in the fields of vehicle software

⇒ EAST-EEA = key enabler for a new software technology

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Results and Conclusions

Market Relevance

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EAST-EEA

contributes to secure Europe's competitive power in the industrial sectors:

- Car manufacturer
- Automotive suppliers (system-, subsystem-, component-, part-level)
- Software suppliers (3rd party supplier)
- Tool providers



EAST-EEA strengthens international automotive competition in terms of:

- Leadership in technologies and standards
- Reduction of development time and time-to-market
- Management and quality support for future systems



Other industry branches will profit from EAST-EEA (AUTOSAR)



Acknowledgements and Credits

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The success of EAST-EEA is based on

- the support of ITEA
- the respective funding authorities

**who brought the European consortium together
and on**

- the contributions and experience of the partners
- and the project management (hard job with 22 partners!)

who realized the impressive results.

**Thanks to all involved parties
and persons for their effort!**





Thank you for your attention

Contributions by
J. Beretta (PSA), J. Eisenmann (DaimlerChrysler), U. Freund (ETAS), R. Geiger (ZF),
M. Haneberg (BMW), U. Virnich (SiemensVDO), S. Voget (Bosch)



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