Dynamically Self-Configuring Automotive Systems

Presentation at NeRES 2007

Aveiro, Portugal

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The DySCAS Project

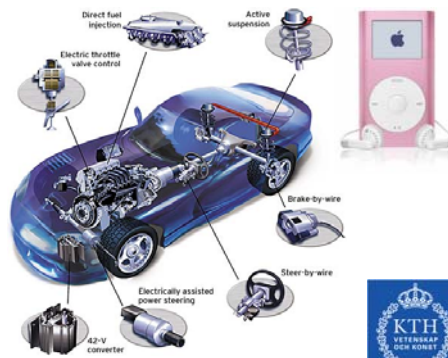- **EU Project**
  - Sixth Framework Programme
  - Information Society Technologies
  - Specific Targeted Research or Innovation Project (STREP)
- **Timeline**
  - Start: June 2006 - December 2008
- **Partners**
  - **Industry:** DaimlerChrysler, Volvo Technologies, Bosch, Enea
  - **Academia:** KTH, University of Greenwich, University of Paderborn

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Introduction

- Increasing Number of ECUs
  - Specific Functions
  - High Failure Probability
  - Difficult Upgrades
- Need For Cooperation
  - Consumer Electronics
  - Embedded Computing Devices
  - External Networks
- Advantages
  - Flexibility
  - Robustness
  - Fault Tolerance

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Vision

Future automotive systems shall provide …

Secure, reliable, efficient in-vehicle and inter-domain communication and collaboration

Means for adding and removing of resources and functions dynamically

Autonomic system configuration and adaptation

Transparency and comprehensibility

Runtime migration of functions among control units and execution domains
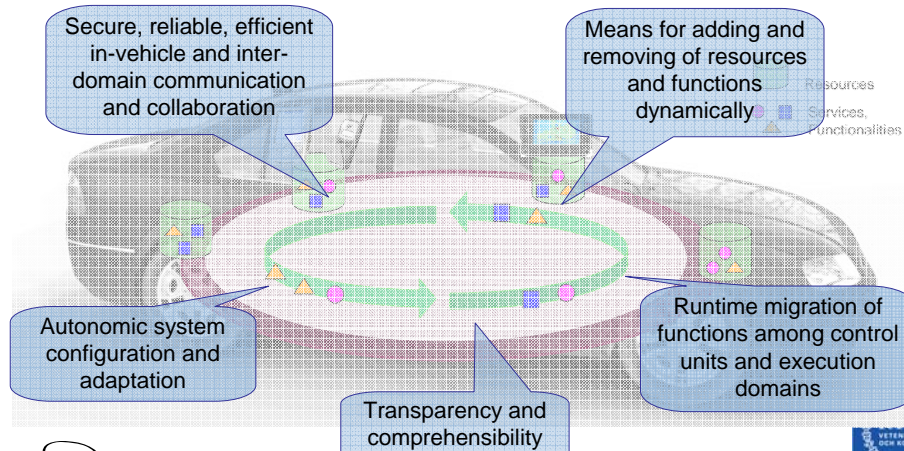
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Research Domains

- Autonomic Computing (IBM)
  - Policy Based Computing
- Control Theoretic Approach
- Middlewares
- Automotive Embedded Systems Architecture
- Mobile Communications
- Ad-hoc Networking
- Real-Time Operating Systems
- Quality of Service
- Load Balancing and Scheduling

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Technological Advances

- Automatic Fault Detection, Analysis and Reporting
- Automatic Resilience Through Software Relocation
- Dynamic Reconfiguration based on Current Resource Demands
- Software Downloads of Plug and Play Components
- Automatic Support for both Push and Pull Software Patches
- Inclusion of Sporadically Available Resources
- Simplification and Standardization of the Software Developer role

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Use cases

- **GUC1: New Device Attached to the Vehicle**
  - PDA, phone, MP3 player, additional ECU, wireless hotspots, ...
- **GUC2: Integrating New Software Functionality**
  - Example: Software download
- **GUC3: Closed Reconfiguration**
  - Caused by external event: load balancing, graceful degradation
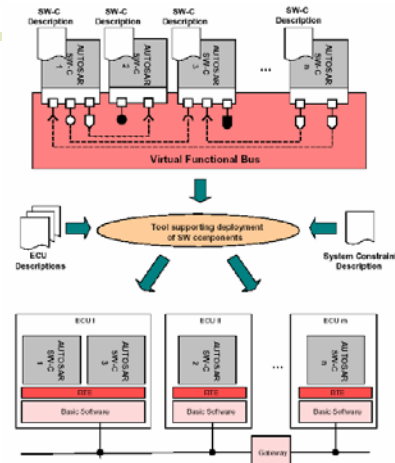- **GUC4: Resource Optimization**
  - Internal

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Related Techniques

- **AUTOSAR** (Automotive Open System Architecture)
  - Flexibility at Design Time
  - Standardized Software Infrastructure and Services
  - Virtual Function Bus
  - **No support for Dynamic System Reconfiguration**

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Architecture of DySCAS middleware

- **Features**
  - **Self Managing**
  - Run Time Reorganization
  - Expedition of Urgent Processes
  - Component Reconfigurability
  - Discovery of New Components and Service Level Agreements

- **Services**
  - Discovery
  - Interface Provisioning/negotiation
  - Resource Mapping
  - Security
  - Storage Management
  - Rollback Management
  - Reliable Download
  - SW / Policy Installer / Upgrader
  - Error Management
  - Migration of Service
  - Data Logging
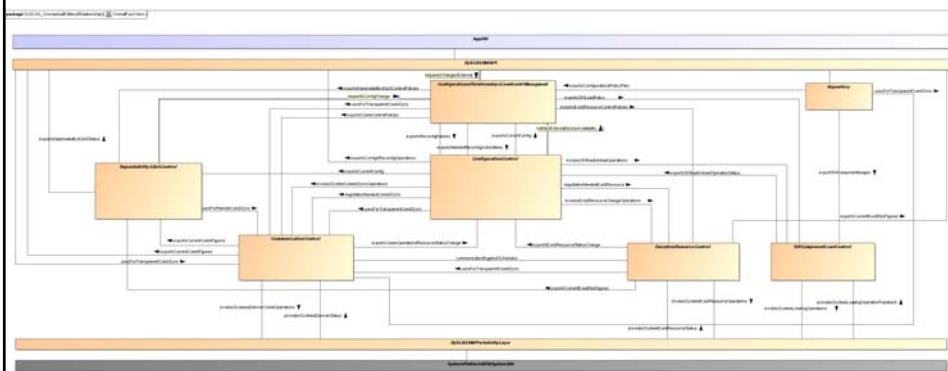 - Dynamic Service Prioritization
  - SW / HW reconfiguration

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Conceptual architecture

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Ongoing work

- State of The Art Survey
- Modelling and Simulation of the Future Platform and Concepts
- Architecture Design
  - UML modelling support
- Behaviour definition
  - Modes, blocks, policies, ...
- Demonstrators
- ...

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Summary

- Future Vehicle Electronics System
  - Fault Tolerance
  - Robustness
  - Access to Mobile Devices (PDAs, Laptops...)
  - Improved Efficiency (Cost and Performance)
  - Adaptation
  - Flexibility
  - Extension of existing middleware e.g. AUTOSAR

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Thank you for your Attention

Comments and questions?

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