Standardized debugging in AUTOSAR

6° Automotive SPIN Italia Workshop

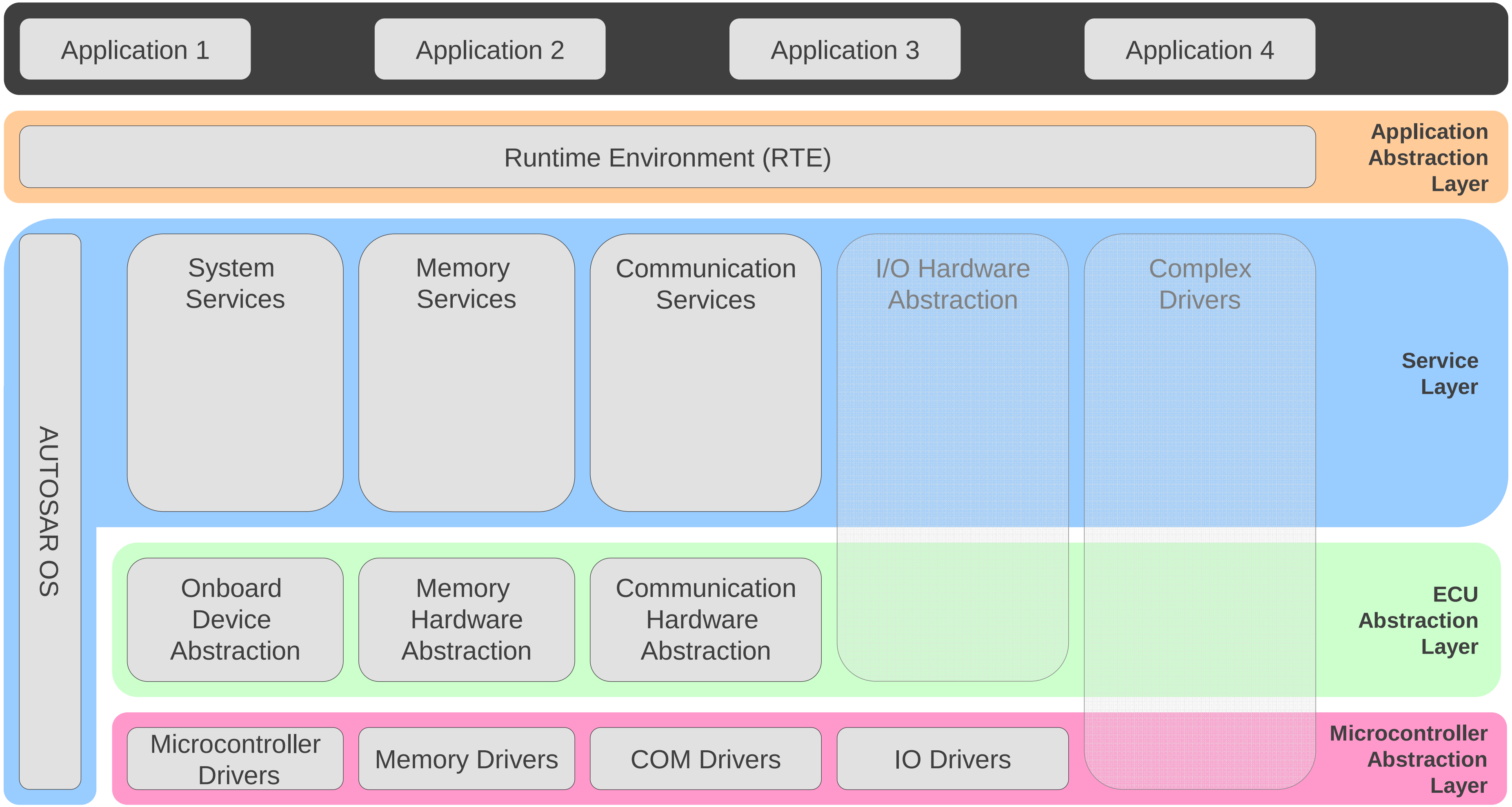
Milano - December 4th, 2009

Jochen Olig

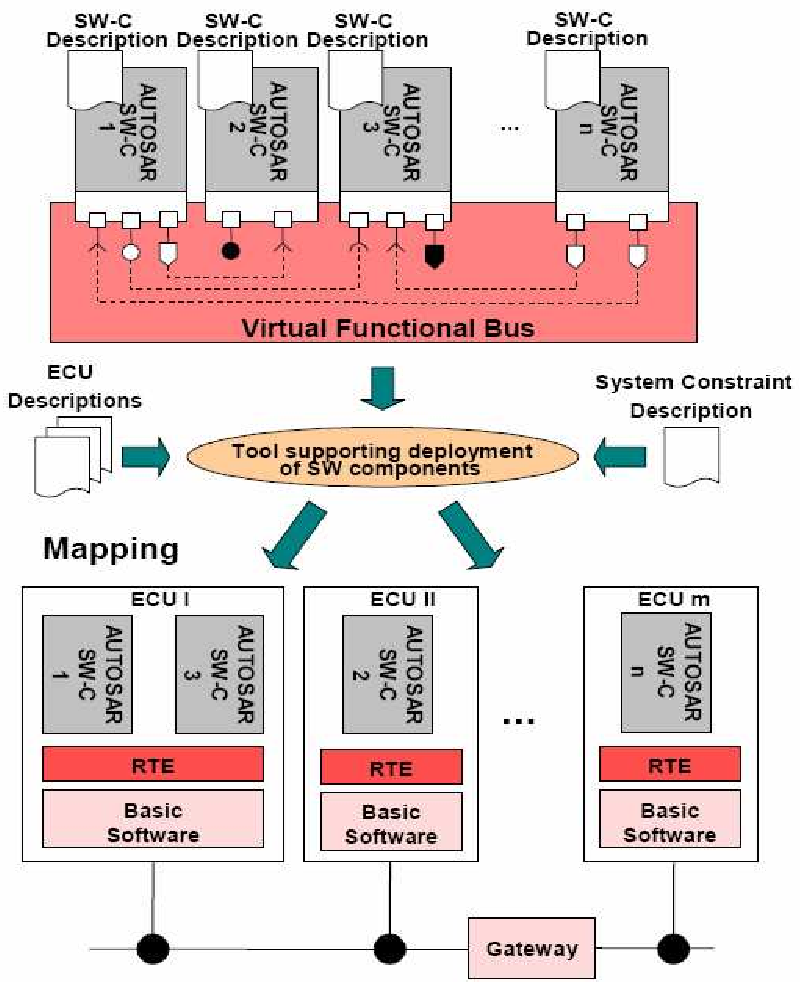
Overview

- Basic Concepts in AUTOSAR: Layered SW Architecture, VFB/RTE
- Challenges in AUTOSAR development
- AUTOSAR Debugging module
- Implementation of a debugging module
- Conclusion

The AUTOSAR Software Layers



Virtual function bus and SW Components



- Application Software is described in SW Components (SW-C)
- SW-C communication through
  - Sender/Receiver interfaces
  - Client/Server interfaces
- Specified at design time, without knowledge of HW and network topology

- Mapping of “Software Components“ to ECUs and configuration of basic software
- RTE then implements the VFB for the current ECU specific configuration

AUTOSAR – Challenges

- ~ 50 configurable AUTOSAR Basic SW modules
- Huge number of parameters to configure (> 6000)
- Complex configuration process
- Optimization for execution speed and memory footprint necessary
- Integration of various SW-Cs from different manufacturers
- Consistency of data and runtime behavior must be correct to assure the functionality of the whole system

AUTOSAR – Roles and Challenges

- Function developer
  - Get quick overview of the system status
  - Help to find problems without detailed AUTOSAR module know-how
- Stack integrator
  - Smart methodology for step-by-step integration needed
  - Wizards which guide the user during the configuration are needed
  - Debug and trace tools for seeking of problems needed

AUTOSAR Debugging – Key Features

- Basic idea: Debug and trace Basic SW modules during runtime using standardized functions and bus systems
- Available from AUTOSAR 4.0 onwards
- Collects raw data on the target
- Transmits collected data to a host system using standard AUTOSAR interfaces
- Let the host analyze/visualize the data

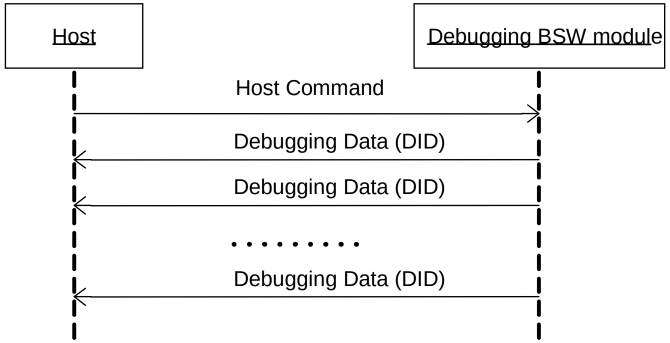
Data collection on the target

- Collection is based on so called DIDs (**D**ebugging **ID**entifiers). DIDs contain the data traced by the debugging module
- There are two types of DIDs with different behavior:
  - Standard DIDs: Can be used to trace data (plain memory dump or data structure dump) requested based on time, external event or internal Dbg API function call
  - Predefined DIDs: Can be used to trace function calls of
    - DET: Trace DET error codes
    - RTE: VFB tracing
    - OS: Tracing of Pre- and PostTaskHook
    - All BSW: Tracing of function entry and exit
- Data tracing
  - Cyclically: Standard DIDs only
  - Explicitly: Standard and Predefined DIDs
- Tracing data can be stored in a buffer to handle bursts

Transmission of data to a host system

- The message format between target and host system is standardized →Hosts and target systems of different vendors can be combined
- The format is optimized to be usable on CAN (bandwidth, maximum message size)
  - Other interfaces like FlexRay or Ethernet will yield a much better tracing performance
- A Transport Layer is part of the Debugging module which allows transmission of large DIDs
- Also support proprietary interfaces by partitioning the debugging module into a data collection and a transmission part
- Sending of data
  - Continuously: Whenever data was traced it is sent immediately
  - On request: Explicit request to send by host

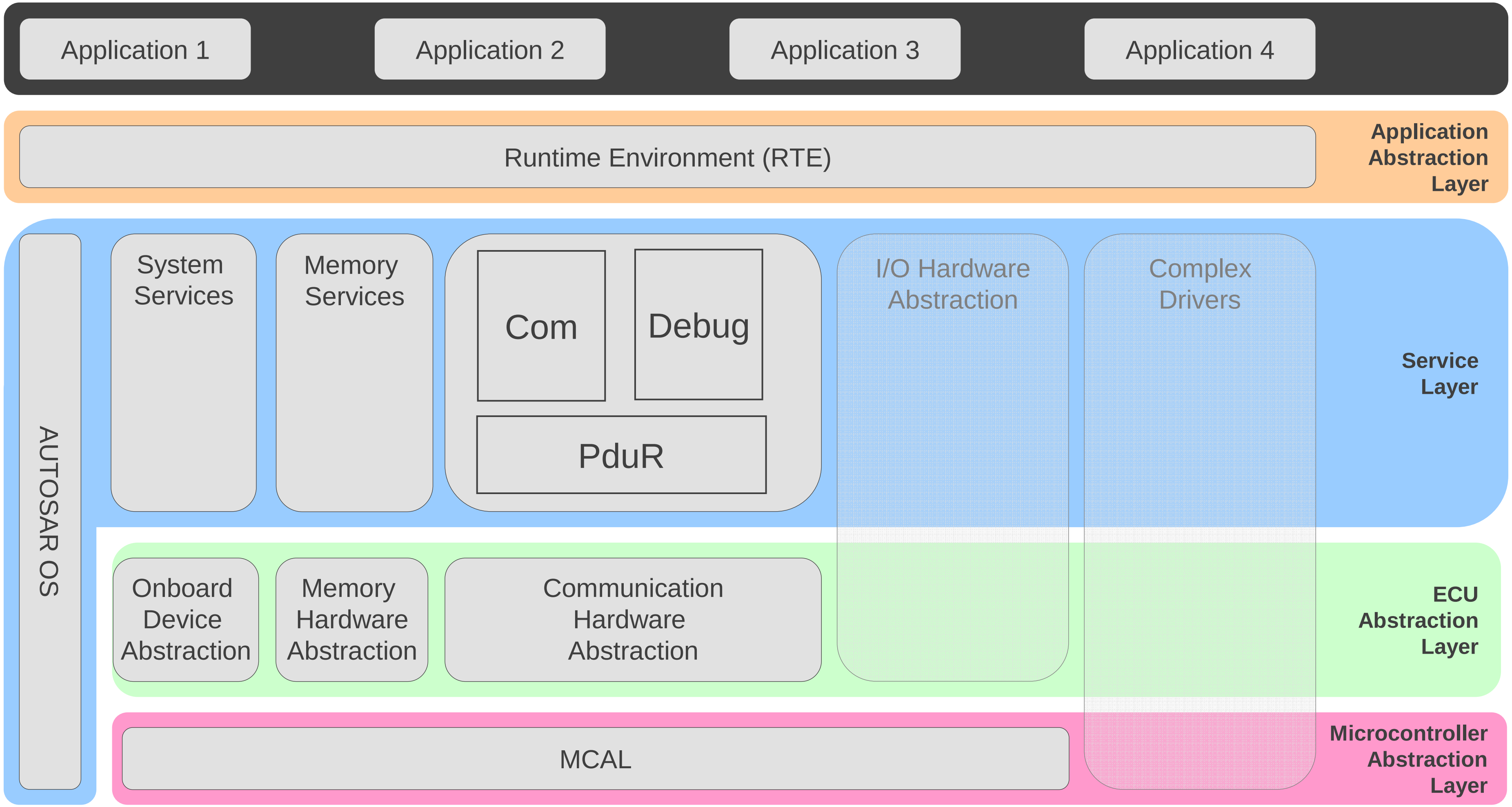
AUTOSAR Debugging



- The debugging host sends commands to the target system (via control channel)

- Among others, the following properties can be changed during runtime
  - Switching ON/OFF of tracing of individual DIDs
  - Buffering ON/OFF: Direct sending or buffering of DIDs
  - Continuous sending ON/OFF: Buffer content is sent when new data was stored

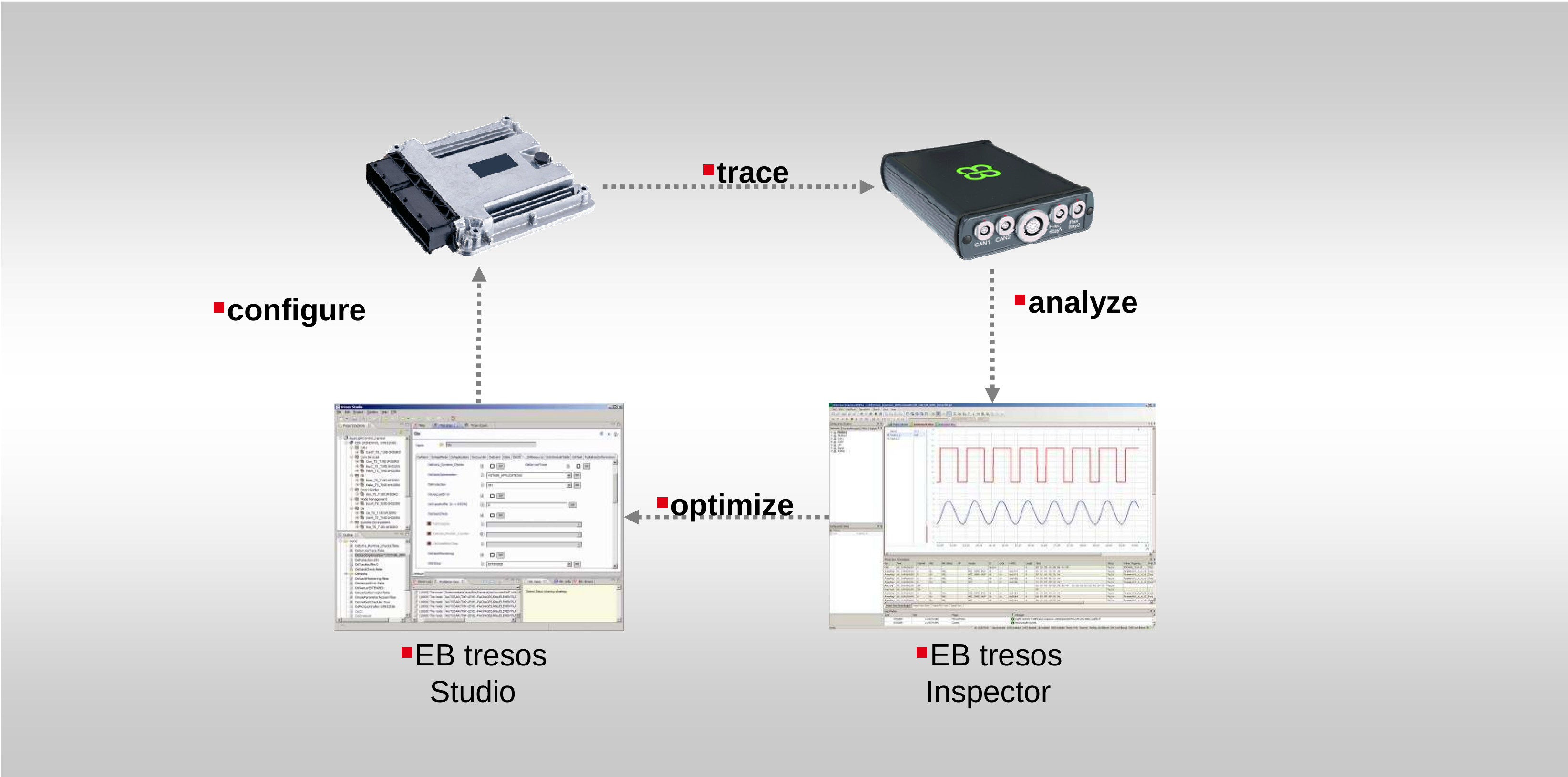
Embedding AUTOSAR Debugging



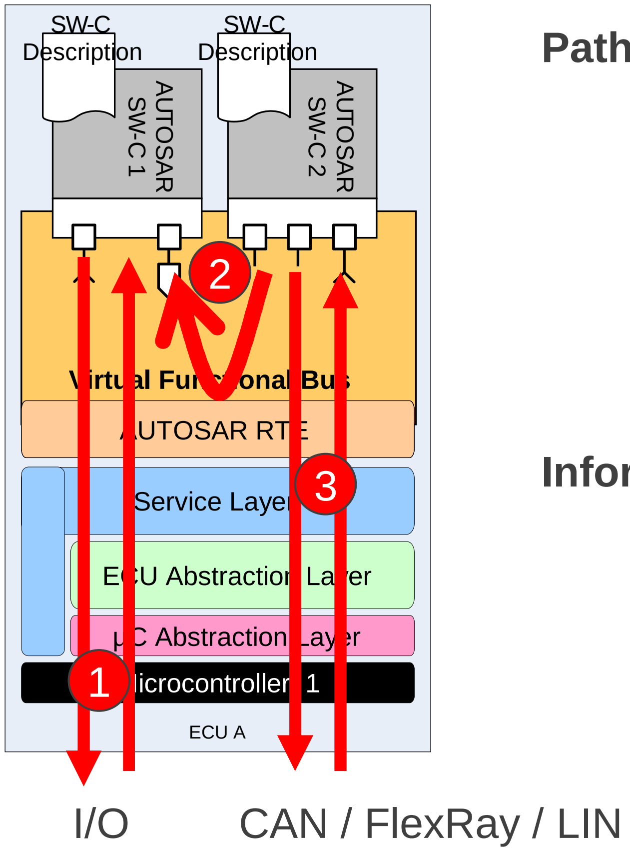
EB tresos *Debug & Trace* - Features

- Transmission of *Debug & Trace* data via CAN or FlexRay
- Buffering of data in ECU memory
- Switching traced data on/off during run-time
- RTE tracing
  - Sender/Receiver signals
  - Client/Server calls
  - Enter/Exit of Runnable entities
- DET tracing
- OS Pre-/Post-Task-Hooks
- Generic function tracing (Extension to AUTOSAR)
  - Enter/Exit of function calls
  - Parameter values
- Generic state machine tracing (Extension to AUTOSAR)
  - Old and new state of configured state variables

EB tresos *Debug & Trace*



Functional Overview - Rte Tracing



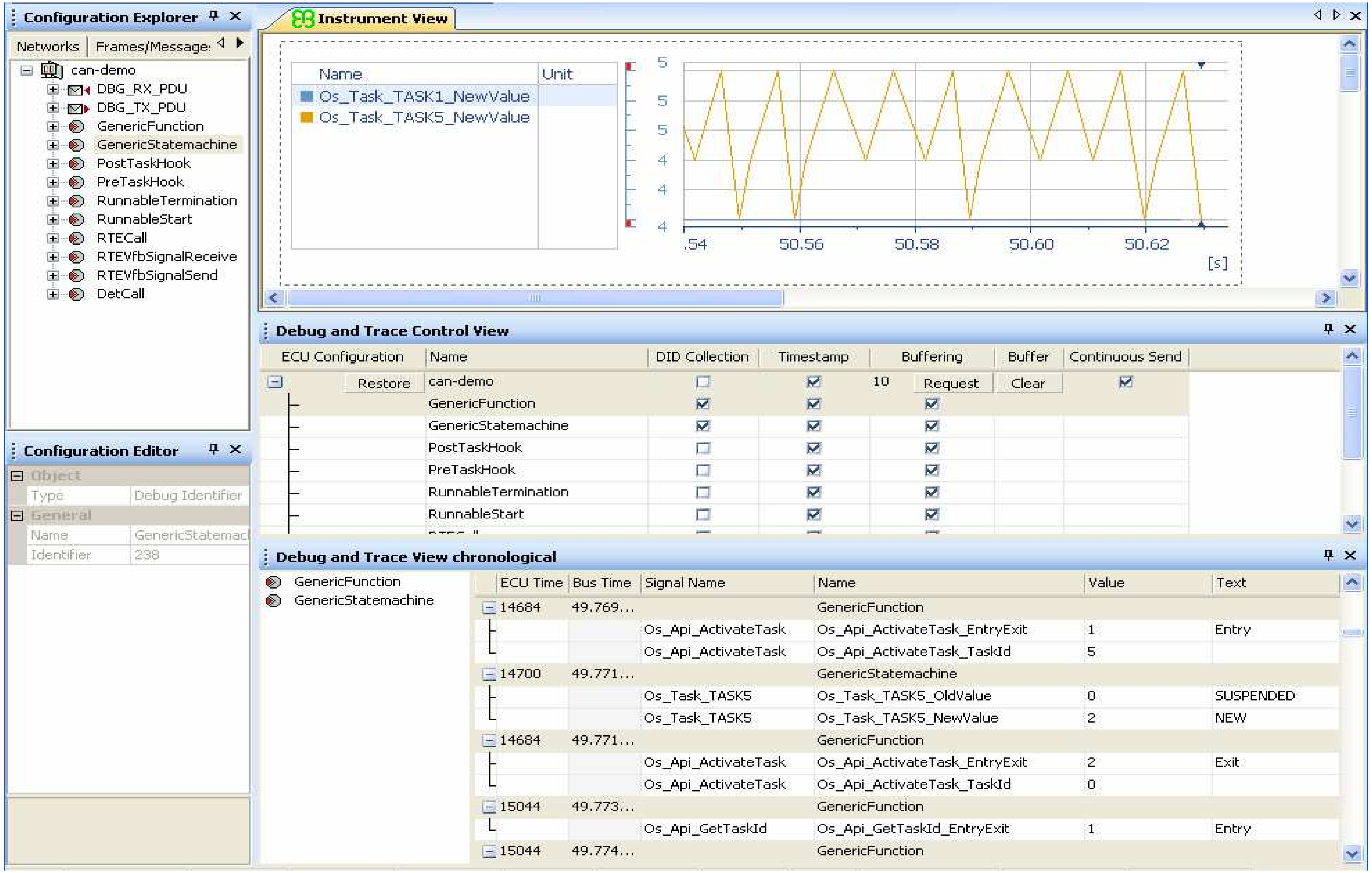
Paths of TX/RX Signals to be traced

- SW-C to ECU I/O 1
- SW-C to SW-C of same ECU 2
- SW-C to Network (CAN, FlexRay, LIN) 3

Information traced

- Signal Id
- Time stamp of Rte-Call Rte_Send_Signal / Rte_Receive_Signal
- Value transmitted (Basic data types, no arrays)

Analysis with EB tresos Inspector



Debug & Trace - Outlook

- OS task tracing
  - Show task statistics (min. / max. / avr. runtime)
  - Show task activation and preemptions
  - Show ISR
- Show online status of AUTOSAR Modules
- Tracing of multiple ECUs at the same time
- PDU tracing
- Back annotation to tresos Studio

Conclusion

- Integration of application software components and assuring their interoperability is crucial
- Complex configuration of basic software in AUTOSAR based development
- AUTOSAR debugging
  - is seamlessly integrated in AUTOSAR SW architecture
  - uses existing communication channels
  - enables in deep analysis of ECU Software during runtime
  - supports both function developers and stack integrators
- Implementation as *EB Debug & Trace* is available!

Thank you!

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