Welcome to the Webinar
“Embedded Software for J1939”

On November 11 at 9 AM (CET)
Agenda

> J1939 Basics

CANbedded J1939

MICROSAR J1939

MICROSAR J1939 with ISOBUS extensions

Feature Matrix: J1939 Embedded Solutions

J1939 Roadmap & History
“The SAE J1939 communications network is applicable for light-duty, medium-duty, and heavy-duty vehicles used on-road or off-road, and for appropriate stationary applications which use vehicle derived components (e.g. generator sets). Vehicles of interest include, but are not limited to, on-highway and off-highway trucks and their trailers, construction equipment, and agricultural equipment and implements.”

Cited from: SAEJ1939 “Serial Control and Communications Heavy Duty Vehicle Network - Top Level Document” (www.sae.org)
J1939 Basics

Relevant Documents

J1939  Top Level Document for a Serial Control and Communications Vehicle Network.

J1939-0X An application document, where X refers to a specific network/application version of network. This document will identify the industry or applications for which it pertains and will list the specific versions of each layer that makes up this network.

J1939-01 Recommended Practice for Control and Communications Network for On-Highway Equipment

J1939-02 Agricultural and Forestry Off-Road Machinery Control and Communication Network

J1939-03 On Board Diagnostics Implementation Guide

J1939-05 Marine Stern Drive and Inboard Spark-Ignition Engine On-Board Diagnostics Implementation Guide

J1939-1X A Physical Layer document, where X refers to a specific version of the Physical Layer.

J1939-11 Physical Layer, 250K bits/s, Twisted Shielded Pair

J1939-13 Off-Board Diagnostic Connector

J1939-15 Reduced Physical Layer, 250K bits/sec, Unshielded Twisted Pairs (UTP)

J1939-21 Data Link Layer

J1939-21-1 Data Link Layer document, where 1 refers to a specific version of the Data Link Layer.

J1939-3X Network Layer document, where X refers to a specific version of the Network Layer.

J1939-31 Network Layer

J1939-4X Transport Layer document, where X refers to a specific version of the Transport Layer. No Transport Layer documents are presently defined.

J1939-5X Session Layer document, where X refers to a specific version of the Session Layer. No Session Layer documents are presently defined.

J1939-6X Presentation Layer document, where X refers to a specific version of the Presentation Layer. No Presentation Layer docs are presently defined.

J1939-7X Application Layer Document, where X refers to a specific version of the Application Layer.

J1939-71 Application Layer

J1939-73 Application Layer - Diagnostics

J1939-74 Application Layer - Configurable Messaging

J1939-75 Application Layer - General Off-Highway

J1939-78 Application Layer - Locomotive Operations

J1939-8X Network Management (no alternative versions permitted)

J1939-81 Network Management

J1939-82 Compliance - Truck and Bus

J1939-84 OBD Communications Compliance Test Cases for Heavy Duty Components and Vehicles
J1939 Basics

J1939 Message Format

- The SAE specifies a set of possible ECUs (controller functions) and messages (PGs)

- The manufacturer defines the mapping of PGs to controller functions

- J1939 uses 29-bit CAN identifier with a defined layout
  - Priority
  - Parameter group
  - Destination address
  - Source address
J1939 Basics

Features: Network Management (J1939-81)

- Each ECU (controller function) needs a unique address
  - Used as SA and DA
  - Assigned statically at ECU configuration time or dynamically at runtime

- Network Management is responsible for address assignment
  - Use case: Some ECUs are not known at configuration time
  - Address claiming sequence (AC) performed at network startup or when new nodes are connected during runtime

- Does not support sleep/wakeup handling!
J1939 Basics
Features: Transport Layer (J1939-21)

- For large data (9 .. 1785 Bytes)
- Broadcast Announce Message (BAM) [1:n]
- Connection Mode Data Transfer (CMDDT, aka RTS/CTS) [1:1]

Auxiliary TPs:
- ISO-11783 Extended TP (1785 Bytes .. 115 MB) [1:1]
- NMEA®2000 Fast Packet TP (1 .. 223 Bytes) [1:n]
J1939 Basics

Request Handling (J1939-21)

- Most messages (PGN) can be requested
- Positive/negative acknowledgement available
- Used heavily for J1939 diagnostics
J1939 Basics

Features: Diagnostics (J1939-73)

- J1939 specifies diagnostic messages (DM1 – DM57)
- Similar possibilities as ISO-15765/14229/14230 (UDS/KWP2000)

- Compatibility to UDS Diagnostics
  - J1939 reserves specific PGNs for ISO-15765 TP messages
  - UDS can be run in parallel to J1939 diagnostics
  - Typical use case: European trucks
Agenda

- J1939 Basics
  - CANbedded J1939
    - MICROSAR J1939
    - MICROSAR J1939 with ISOBUS extensions
    - Feature Matrix: J1939 Embedded Solutions
    - J1939 Roadmap & History
CANbedded J1939

Architecture

J1939/7X: Application Layer

J1939/21: Transport Protocols (DLC> 8)
J1939 Base Module

J1939/81: Network Management

J1939/7X: Application Layer

J1939 Dynamic Interaction Layer

J1939/1X: Physical layer

CAN controller

CAN Driver

ISO TP

* ISO Diag

J1939 dyn. NM

TP BAM

TP CMDT

TP ETP

TP FP

Application

Generation Tool

GENy

© 2011. Vector Informatik GmbH. All rights reserved. Any distribution or copying is subject to prior written approval by Vector.
Slide: 11
CANbedded J1939

Example: Typical Truck Configuration

*Diagnostic options: UDS or KWP2000
Agenda

J1939 Basics

CANbedded J1939

> MICROSAR J1939

MICROSAR J1939 with ISOBUS extensions

Feature Matrix: J1939 Embedded Solutions

J1939 Roadmap & History
MICROSAR J1939
MICROSAR4 – Vector’s full range of Basic Software Modules for J1939

<table>
<thead>
<tr>
<th>Module</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSWM</td>
<td>Basic Software</td>
</tr>
<tr>
<td>CDMM</td>
<td>Design Module</td>
</tr>
<tr>
<td>J1939DCM</td>
<td>J1939 Module</td>
</tr>
<tr>
<td>COM</td>
<td>Communication</td>
</tr>
<tr>
<td>IPDUM</td>
<td>IP Data Uplink</td>
</tr>
<tr>
<td>NM</td>
<td>Network Manager</td>
</tr>
<tr>
<td>PDUR</td>
<td>Power Distribution Unit</td>
</tr>
<tr>
<td>CAN</td>
<td>CAN Module</td>
</tr>
<tr>
<td>31939TP</td>
<td>J1939 TP Module</td>
</tr>
<tr>
<td>31939NM</td>
<td>J1939 NM Module</td>
</tr>
<tr>
<td>31939RM</td>
<td>J1939 RM Module</td>
</tr>
<tr>
<td>CANSM</td>
<td>CAN Smallest</td>
</tr>
<tr>
<td>CANIF</td>
<td>CAN Interface</td>
</tr>
<tr>
<td>XCP</td>
<td>Cross-Plane Control Protocol</td>
</tr>
<tr>
<td>MCAL</td>
<td>Microcontroller</td>
</tr>
<tr>
<td>CANDRV</td>
<td>CAN Driver</td>
</tr>
<tr>
<td>EXT</td>
<td>External Module</td>
</tr>
<tr>
<td>CANTRCV</td>
<td>CAN Transceiver</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Microcontroller Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vector Standard Software</td>
</tr>
<tr>
<td>Affected by J1939</td>
</tr>
</tbody>
</table>

1 Available extensions for AUTOSAR
MICROSAR J1939

Features of AUTOSAR 4.1

- Meta Data:
  - Transmission/Reception with variable CAN IDs

- J1939Nm features:
  - AddressClaimed / CannotClaimAddress
  - Evaluation of received AddressClaimed

- J1939Tp features:
  - Transparent switching between protocols

- J1939Rm features:
  - Transmission and reception of Request and Acknowledgement
MICROSAR J1939
Features of AUTOSAR 4.1

- J1939Dcm\(^1\) features:
  - Support for the most common diagnostic messages
  - Central handling of diagnostic data in DEM\(^2\)
  - Same data accessed by J1939 and UDS diagnostics

<table>
<thead>
<tr>
<th>Name</th>
<th>Size</th>
<th>Received</th>
<th>Transmitted</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM1</td>
<td>Var.</td>
<td>-</td>
<td>Cyclic 1s</td>
<td>Active Diagnostic Trouble Codes</td>
</tr>
<tr>
<td>DM2</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Previously Active Diagnostic Trouble Codes</td>
</tr>
<tr>
<td>DM3</td>
<td>-</td>
<td>-</td>
<td>On Request</td>
<td>Diagnostic Data Clear/Reset for Previously Active DTCs</td>
</tr>
<tr>
<td>DM4</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Freeze Frame Parameters</td>
</tr>
<tr>
<td>DM5</td>
<td>8</td>
<td>-</td>
<td>On Request</td>
<td>Diagnostic Readiness 1</td>
</tr>
<tr>
<td>DM6</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Emission Related Pending DTCs</td>
</tr>
<tr>
<td>DM11</td>
<td>-</td>
<td>-</td>
<td>On Request</td>
<td>Diagnostic Data Clear/Reset for Active DTCs</td>
</tr>
<tr>
<td>DM12</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Emissions Related Active DTCs</td>
</tr>
<tr>
<td>DM13</td>
<td>8</td>
<td>X</td>
<td>-</td>
<td>Stop Start Broadcast</td>
</tr>
<tr>
<td>DM19</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Calibration Information</td>
</tr>
<tr>
<td>DM21</td>
<td>8</td>
<td>-</td>
<td>On Request</td>
<td>Diagnostic Readiness 2</td>
</tr>
<tr>
<td>DM23</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Previously Active Emission Related Faults</td>
</tr>
<tr>
<td>DM24</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>SPN Support</td>
</tr>
<tr>
<td>DM25</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Expanded Freeze Frame</td>
</tr>
<tr>
<td>DM26</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Diagnostic Readiness 3</td>
</tr>
<tr>
<td>DM28</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Permanent DTCs</td>
</tr>
<tr>
<td>DM29</td>
<td>8</td>
<td>-</td>
<td>On Request</td>
<td>Regulated DTC Counts (Pending, Permanent, MIL-On, PMIL-On)</td>
</tr>
<tr>
<td>DM31</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>DTC to Lamp Association</td>
</tr>
<tr>
<td>DM35</td>
<td>Var.</td>
<td>-</td>
<td>On Request</td>
<td>Immediate Fault Status</td>
</tr>
</tbody>
</table>

\(^1\) J1939Dcm: SAE J1939 Diagnostics Communication Manager (see AUTOSAR)

\(^2\) DEM: Diagnostics Event Manager (see AUTOSAR)
Agenda

J1939 Basics

CANbedded J1939

MICROSAR J1939

> MICROSRAR J1939 with ISOBUS extensions

Feature Matrix: J1939 Embedded Solutions

J1939 Roadmap & History
MICROSAR J1939 with ISOBUS extensions
Architecture (proposal)

- **Green** text: New module
- **Red** text: Changed module
MICROSAR J1939 with ISOBUS extensions

Details

- Change in J1939Nm:
  - Fully dynamic address assignment for local ECU
  - Tracking of dynamically assigned addresses of other ECUs

- Extension of J1939Tp:
  - Support for Extended TP (ETP, defined in ISO 11783-3)
  - Fast Packet Transport Protocol (FPTP, defined by NMEA® 2000)

- Change in J1939Rm:
  - ACKM: Use SA as DA, set AddressAcknowledged to 0xFFFF

- Change in J1939Dcm:
  - Different timing of DM1
Agenda

J1939 Basics

CANbedded J1939

MICROSAR J1939

MICROSAR J1939 with ISOBUS extensions

> Feature Matrix: J1939 Embedded Solutions

J1939 Roadmap & History
### Feature Matrix: J1939 Embedded Solutions

<table>
<thead>
<tr>
<th>Feature</th>
<th>CANbedded</th>
<th>MICROSAR3</th>
<th>MICROSAR4</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1939 Transport Protocols</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>J1939 Network Management</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>J1939 Request handling</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>J1939 Diagnostics</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>ISOBUS ETP</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>NMEA® 2000 FastPacket TP</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>ISOBUS deviations from J1939</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Separate API for J1939</td>
<td>✓</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Common API for all modules</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**MICROSAR:** Vector AUTOSAR solution  
**ISOBUS:** ISO-11783 compliant application
J1939 Roadmap & History

- CANbedded
  - First deliveries >10 years ago,
  - Stack still maintained as an alternative to AUTOSAR stack

- AUTOSAR3
  - Serial production version available.
  - First OEM started serial production 1 year ago.

- AUTOSAR4
  - Serial production version of J1939Tp available
  - Other serial production versions planned for Q3/2015
  - Developed and improved in cooperation with major OEMs of the truck and agriculture industry
Please visit us at www.vector.com

**embedded@vector.com**

Thank you for your attention.