

# OBD Implementation in J1939

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# Topics

- Introduction
- Standards Development for HD OBD
- WWH OBD

# Introduction

- Regulations
- Standards Development Organizations
- HD Industry Structure
- Prior Practices

# Existing and Planned OBD Regulations

Term	Regulation
HD OBD	13 CCR 1971.1 (adopted July 21, 2005)
	<i>Title 40 CFR 86 ... TBA</i>
EURO III, IV, V	e.g. UNECE Regulation No. 83; Annex 11
OBD II	13 CCR 1968.2 (under biennial review)
	Title 40 CFR 86.005-17 et. al.
WWH OBD	World Wide Harmonized On Board Diag.

# Standards Organization Overlap

Vehicle Type/ Standards Group	On Road		Off Road	Stationary
	Class 1-3	Class 4-8	Con/ Ag	
SAE MVC Datalink Comm.	<b>x</b>			
ISO On Road TC 22/SC3/WG1	<b>x</b>	<b>x</b>		
SAE T&B Control & Communication SC		<b>x</b>	<b>x</b>	<b>x</b>
ISO Ag & Forestry TC23/SC19			<b>x</b>	<i>ISO 11783 reuses J1939 concepts</i>

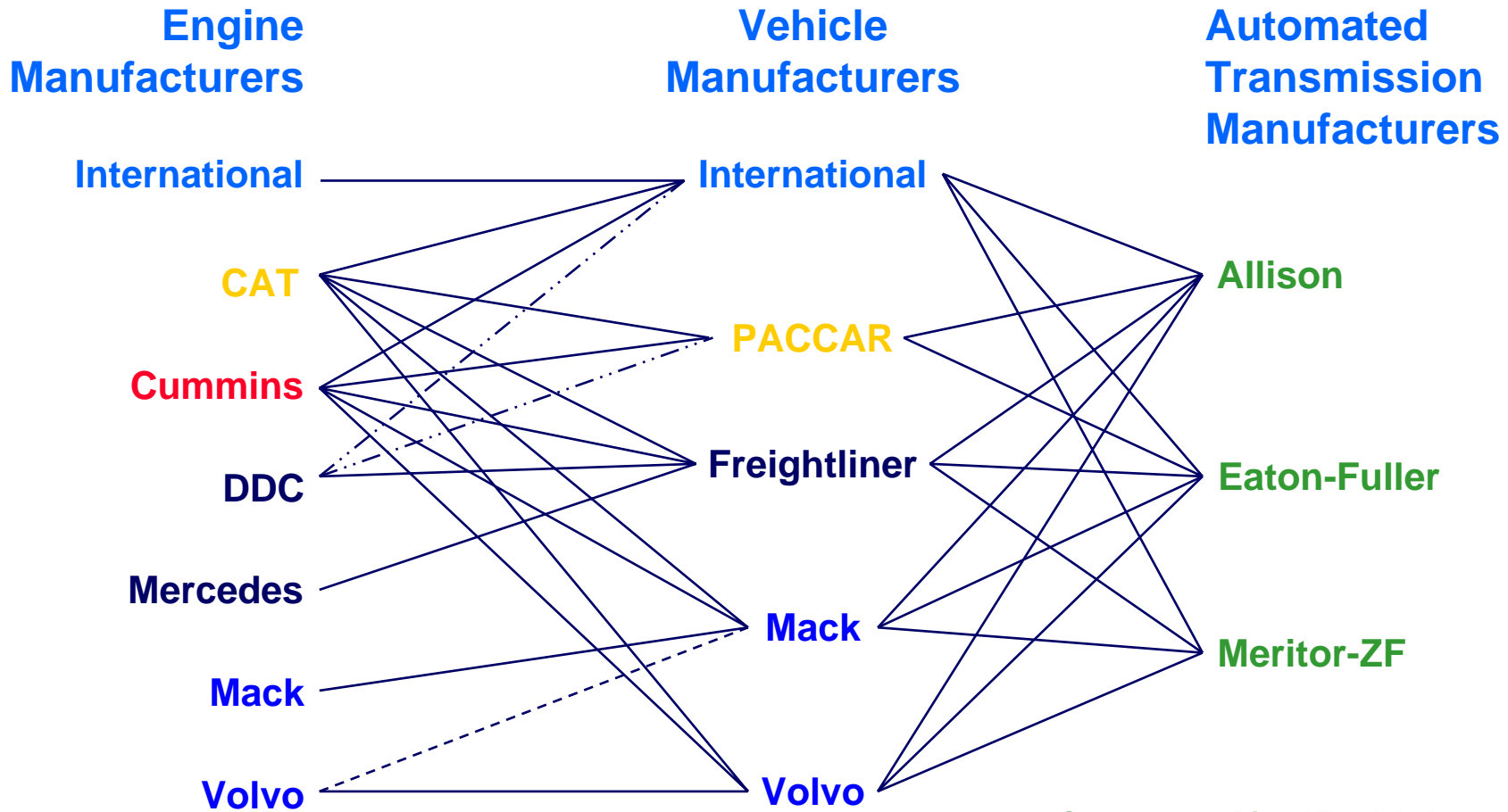
# Introduction

- Regulations
- Standards Development Organizations
- HD Industry Structure
  - ≡ Market Size
  - ≡ Market Integration
  - ≡ Complexity Comparison
- Prior Practices

# NA Medium/Heavy Truck Market Size

Weight Class	2000-2001 U.S. Avg. Retail Sales
III - 10,001-14,000 lbs.	104,686
<i>IV - 14,000-16,000 lbs.</i>	<i>49,727</i>
<i>V - 16,001-19,500 lbs.</i>	<i>26,763</i>
<i>VI - 19,501-26,000 lbs.</i>	<i>46,799</i>
<i>VII - 26,001-33,000 lbs.</i>	<i>107,089</i>
<i>VIII - 33,001 &amp; above lbs.</i>	<i>175,584</i>
<b><i>Total Class IV &amp; above</i></b>	<b><i>405,962</i></b>

# NA Horizontal Integration for HDD over 26K lbs (classes 7-8)



Source: 2002 Diesel Truck Index



# Industry Complexity Comparison

Attribute	HDD Vehicles	LD Vehicles	Comment
Volume, NA	~500K	~15 M	30:1 ratio → increases amortized costs per unit
Eng./Xmsn offerings	Dozens / Model with reuse	< 5 / Model with reuse	HD Models also drive variation through accessory and electrical system differences.
Final Drive offerings	Custom order from 2.64 to 7.17	< 5 / Model with reuse	
Emissions Certification	Engine Dynamometer	Vehicle Dynamometer	HD emissions/diagnostics are developed independently of the vehicle

# Introduction

- Regulations
- Standards Development Organizations
- Industry Structure
- Prior Practices
  - ≡ Approaches
  - ≡ LD/HD Approach Comparison

# Communication Approaches

## ■ Polling Model

Stimulus Response Behavior System to gather information.

- ⌘ Increases tool communication demands for parametric data
- ⌘ Permits fully optimized point to point communication
- ⌘ Polling Model implemented in SAE J1978/SAE J1979

## ■ Broadcast Model

Schedule of provided information available to all connected participants.

- ⌘ Reduces tool communication demands for parametric data
- ⌘ Presumes there is more than one user for many data items
- ⌘ Presumes an architecture to develop a schedule of the public information.
- ⌘ Fixed formats create empty space
- ⌘ *NA HD Vehicles have used a broadcast model since 1988*

# LD/HD Approach Comparison

Data Link Function	LD Approach	NA HD Approach
Tool Parametric Data	ISO 15031-5 Annex B	SAE J1939-71
- Emissions Related	<i>Mode x01 PID x03 – x1B</i>	<i>Standard Broadcasts</i>
- Not Emissions Related	<i>Enhanced/Proprietary</i>	<i>Standard Broadcasts</i>
Confirmed/pending	Mode x03/Mode x07	DM12/DM6
MIL Status	<i>Polled, Mode x01</i>	<i>Broadcast (DM1)</i>
Data Labels	<i>PID in Wrapper</i>	<i>Embedded in PDU</i>
Normal Mode Messages	<i>Proprietary</i>	<i>Standard Broadcasts</i>
Service Bay Tests	<i>Mode x08, Enhanced/Proprietary</i>	<i>DM7, Proprietary</i>
Diagnostic Codes	<i>Pxxx</i> SAE J2012/ISO 15031-6	<i>Signal Name+Failure Mode</i> SAE J1939-73,
Physical/Application Layers	SAE J1850, ISO 9141/ SAE J1979, ISO 15031-5	SAE J1708/SAE J1587 SAE J1939-11/J1939-71, -73



# Standards Development for HD OBD

- Existing OBD Features in J1939
- Adopted Protocols for HD OBD
- Regulation Standardization Needs
- Standards updates to meet 13 CCR 1971.1
- J1939 Document Structure and Application

# Standards Development for HD OBD

- Existing OBD Features in J1939
  - ≡ Application Layer Summary
  - ≡ OBD Features in J1939-73
  - ≡ OBD Feature Mapping from Light Duty
  - ≡ OBD II Messages in J1939
  - ≡ Diagnostic Trouble Code Structure
  - ≡ DTC Process Models
- Adopted Protocols for HD OBD
- Regulation Standardization Needs
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- J1939 Document Structure and Application

# J1939 Application Layer Summary

- Control (XMSN, ABS, ATC) ... J1939-71
  - ⌘ Engine/Retarder Torque/Speed Control [TSC1]
- Engine Properties ... J1939-71
  - ⌘ Torque Map
- Multiplexing (IC, Operator Controls)... J1939-71
  - ⌘ Boost (MAP), Coolant Temp, Vehicle Speed, Engine Speed
  - ⌘ Cruise Control, Brake Application
- Diagnostic Services ... J1939-73
  - ⌘ Fault Code Read/Clear
  - ⌘ MIL Status, Readiness
- Memory Access ... J1939-73
  - ⌘ Secure, Namespace Labeled read/write

# OBD Features in J1939

OBD II Requirements	Industry	
	LD	HD
Diagnostic Monitoring Algorithms	OBD II Reg.	Proprietary
Diagnostic Services	J1979, J1939-73	J1939-73
Diagnostic Trouble Codes	J2012	J1939-73, -71
Monitoring Parameter	J1979	J1939-71
Diagnostic Lamps	OBD II Reg.	J1939-73
Diagnostic Off-Board Connector	J1962	J1939-13
Data Link: Electrical, Message Formatting, Addressing	ISO 15764-4, J1850, ISO 9141-2	J1939-11, -21, -81
Scan Tool Requirements	J1978	J1978
Pass through programming	J2534	J1939-71
Service Documentation Format	J2008	Proprietary
Terms / Definitions / Acronyms	J1930	J2403



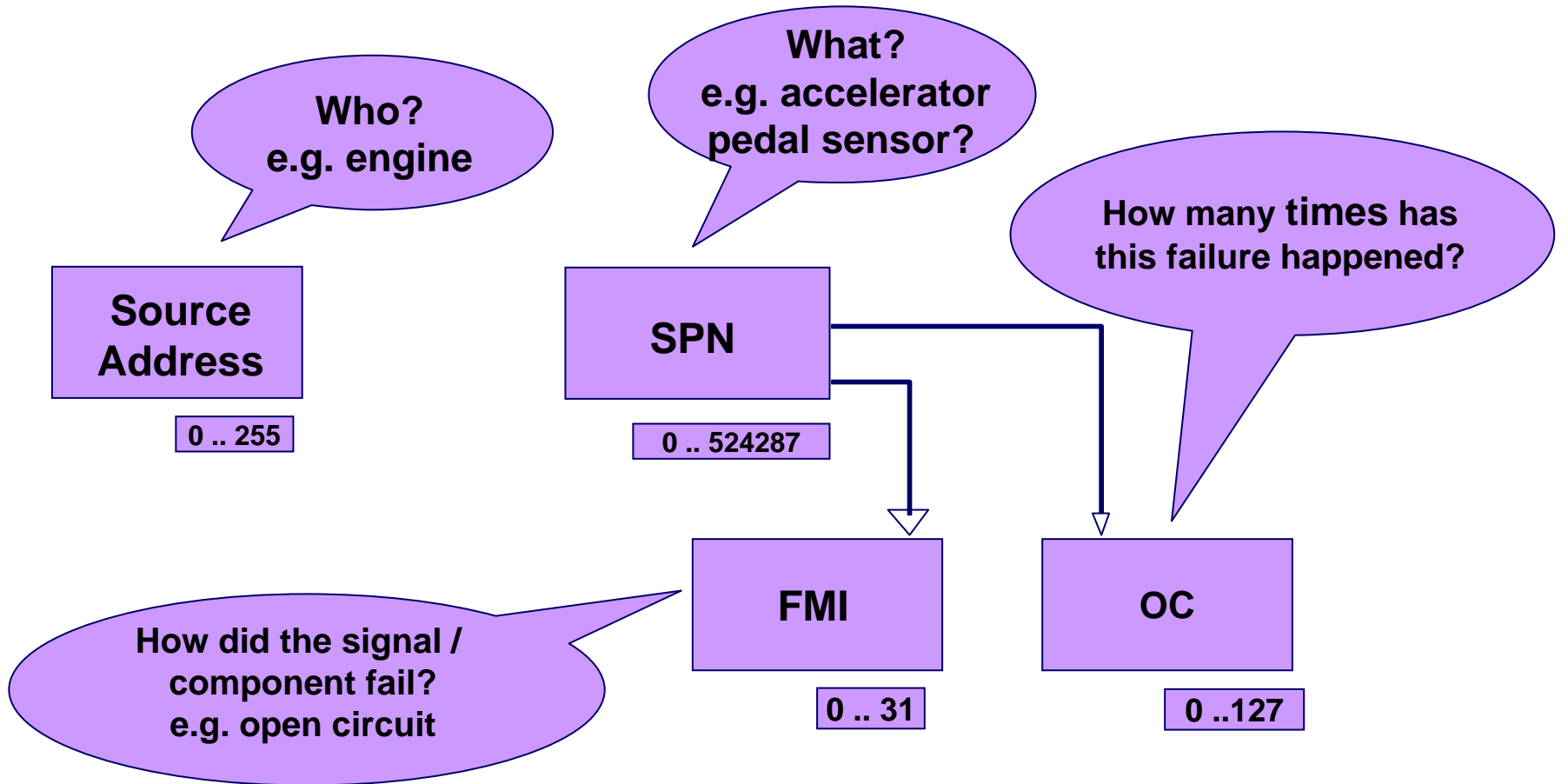
# J1939-73 Feature Mapping

Diagnostic Services	LD & MD	HD
	J1979	J1939-73
Monitored Parameters	Mode 1	J1939-71
Diagnostic Readiness	Mode 1	DM5
Lamp Status	Mode 1	DM1, DM2, DM12
Freeze Frame	Mode 2	DM4
Report DTCs (A, PA, EA)	Mode 3	DM1 <sub>Broadcast</sub> (A), DM2 (PA), DM12 (EA)
Clear Diagnostic Information	Mode 4	DM3(PA), DM11(A)
Report O <sub>2</sub> Sensor Test Results	Mode 5	DM8
Request Test ID Support	Mode 6	DM10
Request Test Results	Mode 6	DM7
Report Test Results: Continuous Non-continuous	Mode 7 Mode 6	DM6 DM8
Request control of system, test or component	Mode 8	DM7 Request Test DM8 Report Results
Report VIN, CID, and CVN	Mode 9	PGN 65260 and DM19

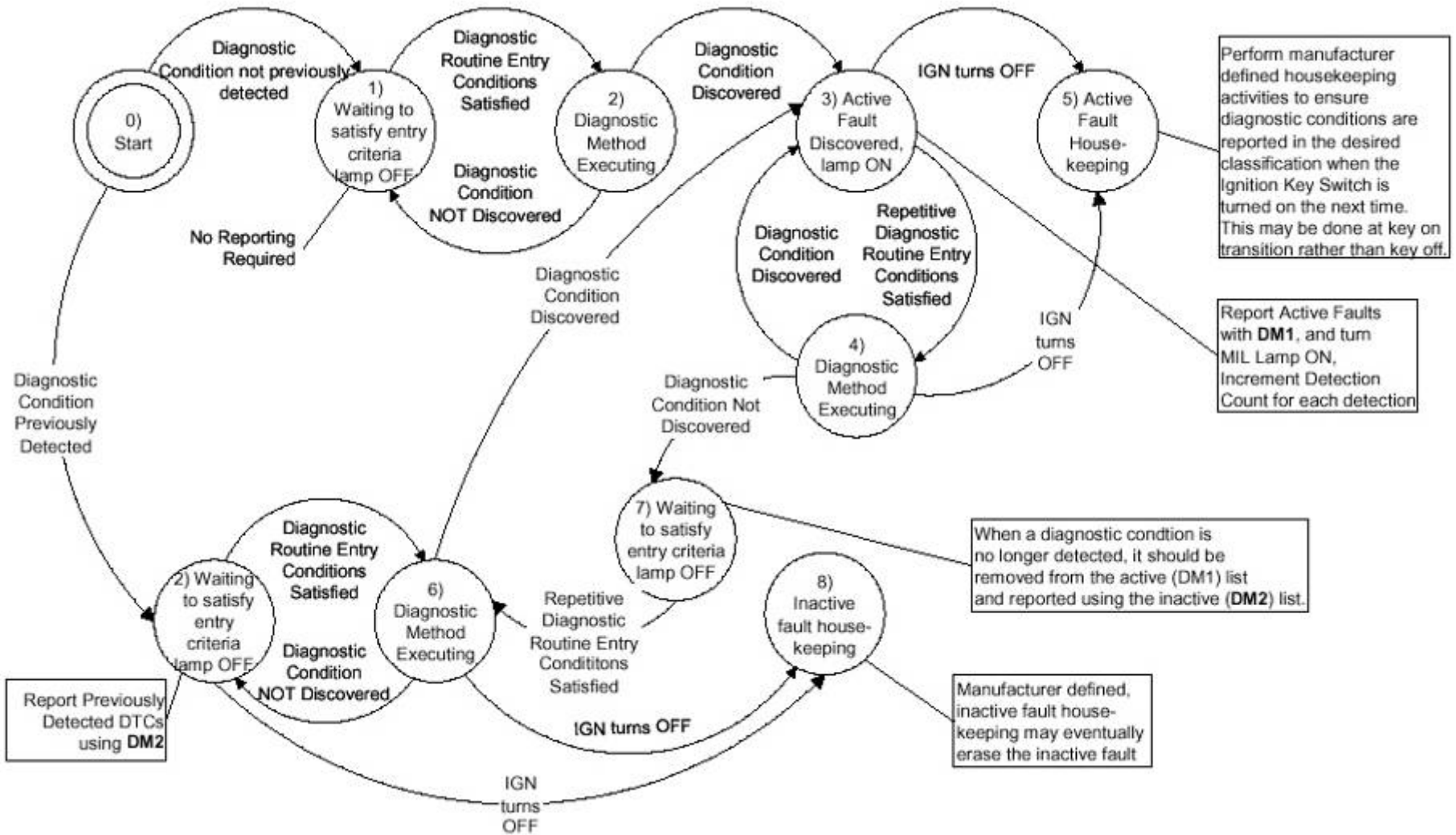
# J1939 Messages for OBD II

	<b>PGN Description</b>	<b>Parameters</b>
DM1	Active DTCs	
DM12	Emission Related Active DTCs	
DM11, DM3	Clear diagnostic trouble codes	
DM4	Freeze Frame	
DM5	Diagnostic Readiness	
DM6	Continuous Monitor Test Results	
DM7	Command Test	
DM8	Report Test Results	
DM10	Test Identifiers Supported	
DM19	Calibration Information	
65260	VIN	
65262	Engine Temperatures	Engine Coolant Temperature
65265	Cruise Control/Vehicle Speed	MPH
65270	Inlet/Exhaust Conditions	Boost Pressure, Intake Manifold Temperature
61443	Electronic Engine Controller #2	Accelerator Pedal Position, % Load at Current Speed
61444	Electronic Engine Controller #1	Actual Engine % Torque, RPM
65159	Ignition Timing	Actual Ignition Timing
59392	Acknowledgement Message	
59904	Request PGN	
60416	Transport Protocol–Connection Mgmt	
60160	Transport Protocol–Data Transfer	

# DTC Structure SPN+FMI +OC



# J1939 Active/Previously Active Model





# Standards Development for HD OBD

- Existing OBD Features in J1939
- Adopted Protocols
- Regulation Standardization Needs
  - ≡ New Requirements in 13 CCR 1971.1 HD OBD
  - ≡ From Active/Previously Active to Pending, Confirmed, Permanent
- Standards updates to meet 13 CCR 1971.1
- J1939 Document Structure and Application

# Adopted Approaches for HD OBD

- Implementation for 13 CCR 1971.1 may use
  - ≡ ISO 15765-4, ISO 15031-4 et. al.
  - ≡ SAE J1939-73, et. al. or
- Both are also permitted in Euro III, IV, V
- J1939 is also recognized by US EPA for HD

# New Requirements in HD OBD

- Diesel Monitor Readiness
  - ⌘ New elements for PM, SCR, NOx Catalysts
  - ⌘ “This driving cycle” readiness (new for 13 CCR 1968.2)
- DTC Message Architecture
  - ⌘ Permanent Faults – new service
  - ⌘ Pending/Confirmed vs. Directions for active/inactive DTCs
- NTE Zone
  - ⌘ Indication of exceptional operating conditions
- Engine Hours, Idle Time, PTO Time
  - ⌘ 3 min per bit (0.05 hr/bit) proposed to regulators



# Standards Development for HD OBD

- Existing OBD Features in J1939
- Adopted Protocols
- Regulation Standardization Needs
- Standards updates to meet 13 CCR 1971.1
  - ≡ New Communication Content
  - ≡ Existing Communication Content
- J1939 Document Structure and Application

# HD OBD-driven Updates J1939 et.al.

- J1939
  - ⌘ Reference changes for new versions
- J1939-03 Implementation Guide for HD OBD on J1939 (New)
  - ⌘ Provides a vehicle context for HD OBD
    - Summarizes key datalink requirements supporting HD OBD
    - Provides conventions for multiplexed controls and outputs
  - ⌘ Models IM process based on the ETI process for J1979
- J1939-84 OBD Scan Tool Compliance (New)
  - ⌘ Leverages J1699-3 process and adapts it for J1939-73.
- J1939-73 Application Layer – Diagnostics (Revised)
  - ⌘ New diagnostics data and services to match regulation provisions

# Standards Development for HD OBD

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# J1939 Document Structure & Application

The T&B Communication and Control SC believe the following standards support HD OBD regulations. New and revisions noted.

- ≡ J1939 (*Revised, document reference set*)
  - Document references, Industry Groups, SPN list, Function Names, Manufacturer Identifications
  - ***A new publication date will be needed for (h)(1.8)***
- ≡ J1939-03 Implementation Guide for HD OBD on J1939 (*NEW*)
  - Key requirements for Scan Tool Interoperability
  - Model IM process
- ≡ J1939-13 Diagnostic Connector
- ≡ J1939-21 Datalink Layer
  - PDU Structure (use of CAN frame control fields)
  - Transport Protocol TP\_CM, TP\_BAM
  - Request / Acknowledgement

# J1939 Document Structure - 2

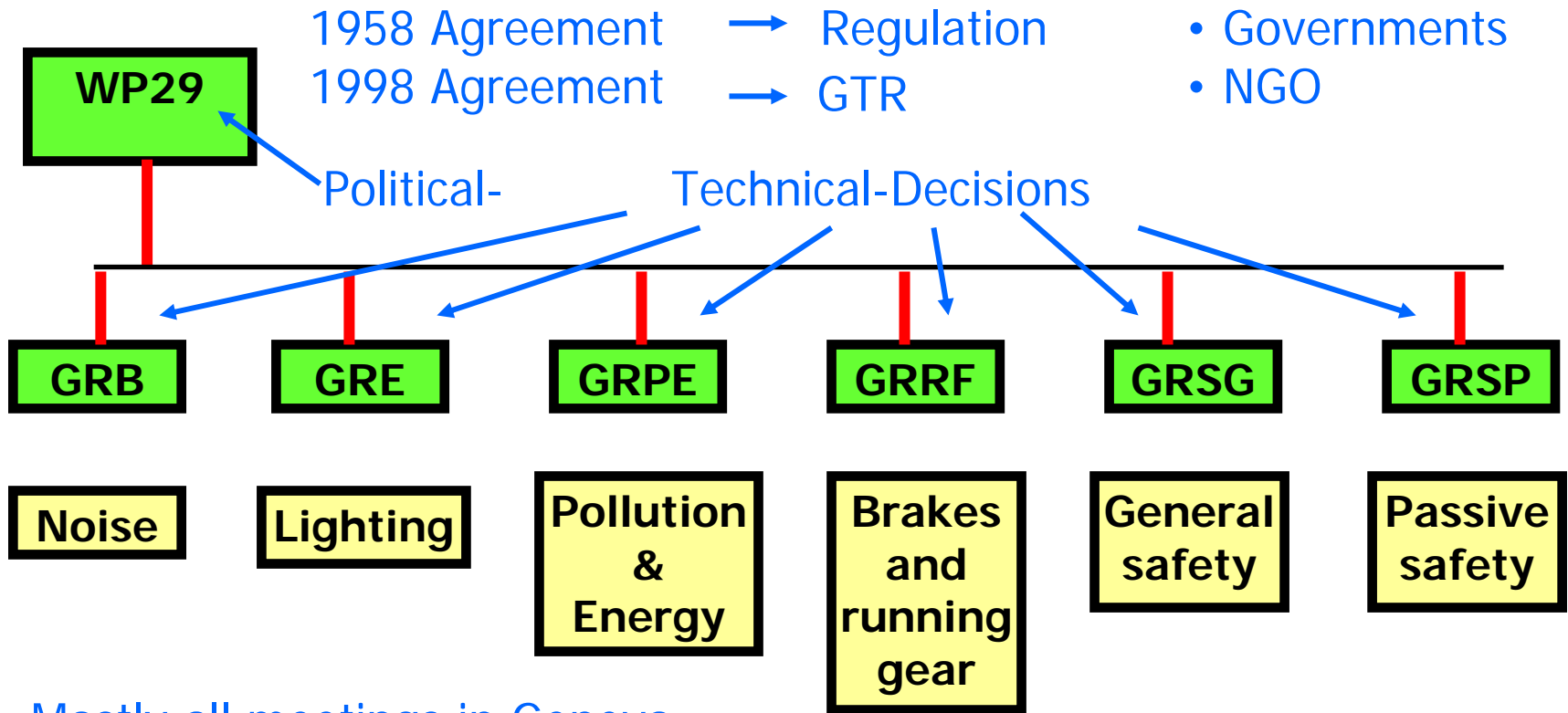
- ≡ J1939-71 Application Layer (*Updated Quarterly*)
  - Engine Operating Conditions - Broadcast Messages
  - “Normal Mode” PGN, SPN Data Dictionary
- ≡ J1939-73 Application Layer – Diagnostics (*Revised*)
  - Diagnostic Messages
  - Data Dictionary for OBD Communications
- ≡ J1939-81 Network Management
  - Address Claim (Name)
    - Physical Address Management and Function Identification
- ≡ J1939-84 HD OBD Scan Tool Compliance (*New*)
  - Leverages J1699-3 process and adapts it for J1939-73.

# WWH OBD

## World Wide Harmonized On Board Diagnostics

- Global Regulatory Framework
- GTR Proposal
- WWH OBD Problem
- Existing Proposal

# UN/ECE/WP29 World Forum for Harmonization of Vehicle Regulations



Mostly all meetings in Geneva

- WP29 3 meetings per year
- GRs normally 2 meetings per year

# Initiation of Global Technical Regulation

- Article 6.3 of the 1998 Global Agreement.
- Develop a harmonized OBD system for light-duty vehicles, heavy-duty vehicles, or both
- Direct emission measurement may be an important technology to achieve diesel engine closed-loop feedback
- Monitor emission related power train components to assure that malfunctions, which would cause emissions to exceed standards by a specified amount are detected, and the vehicle operator is alerted to the need for maintenance or repair.

*Source: Informal document No. 13*

*(125th WP.29, 6-9 November 2001, agenda items A.6.2. and B.2.2.)*

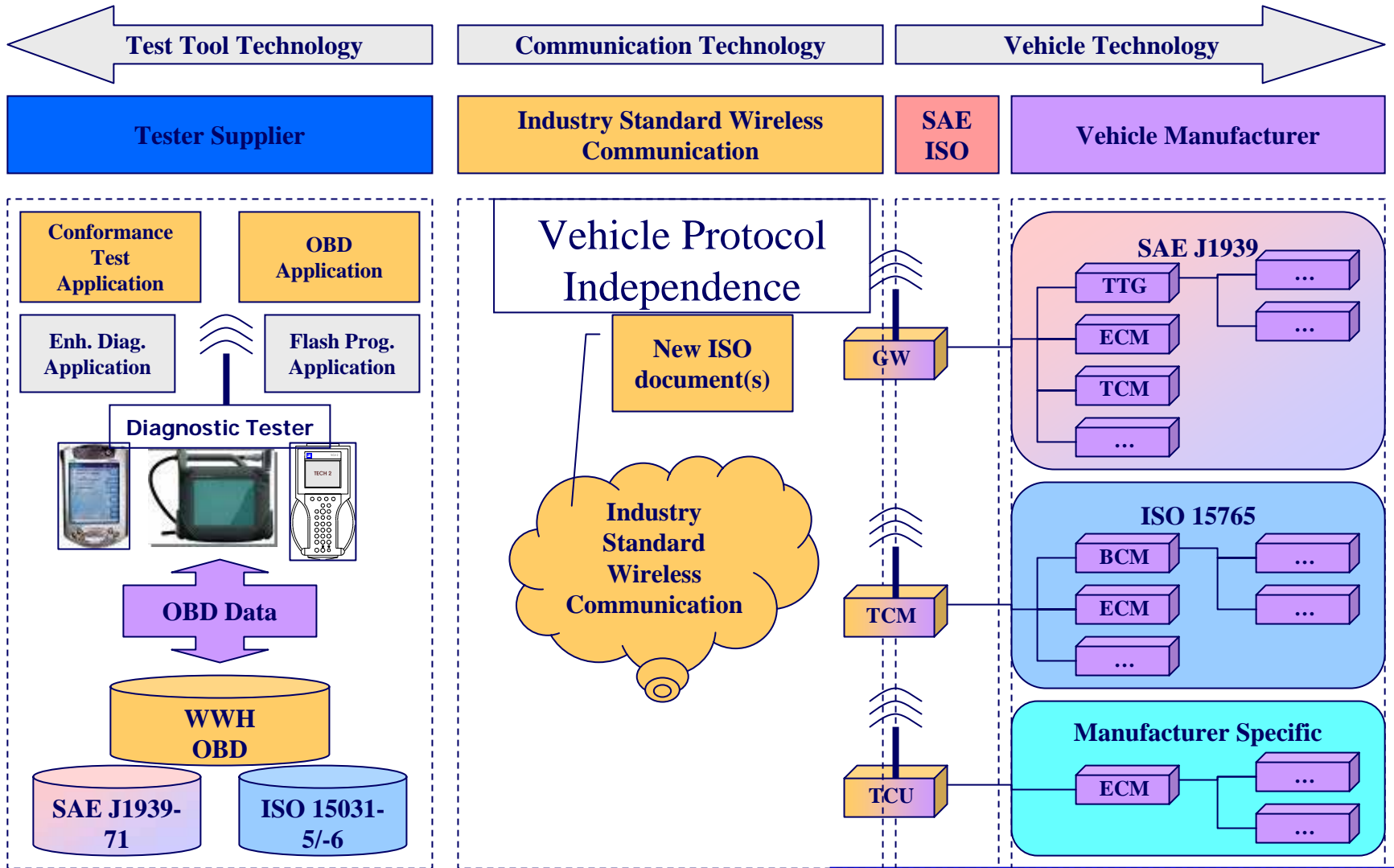


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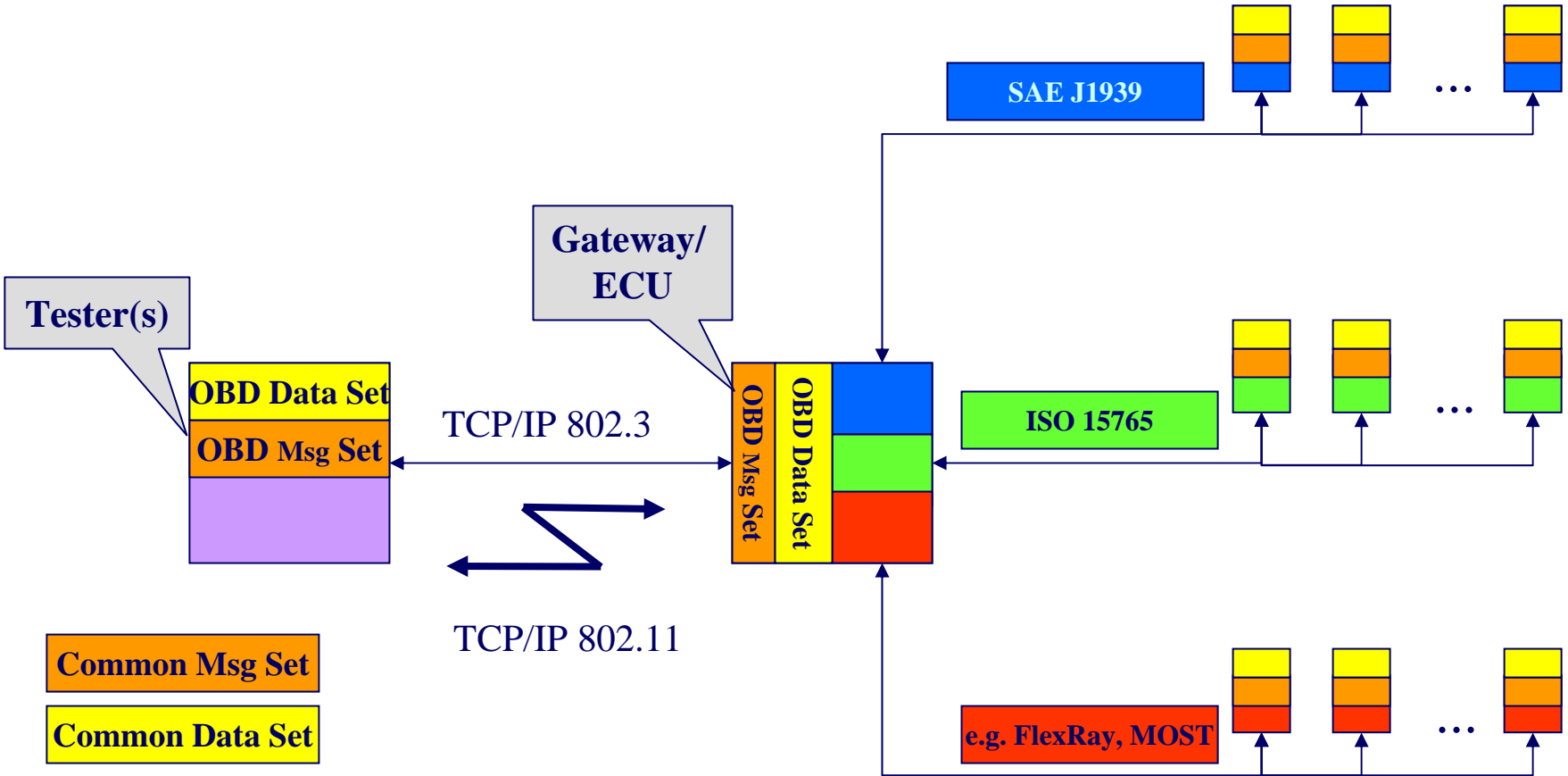
## World Wide Harmonized On Board Diagnostics

- Global Regulatory Framework
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# WWH OBD Problem



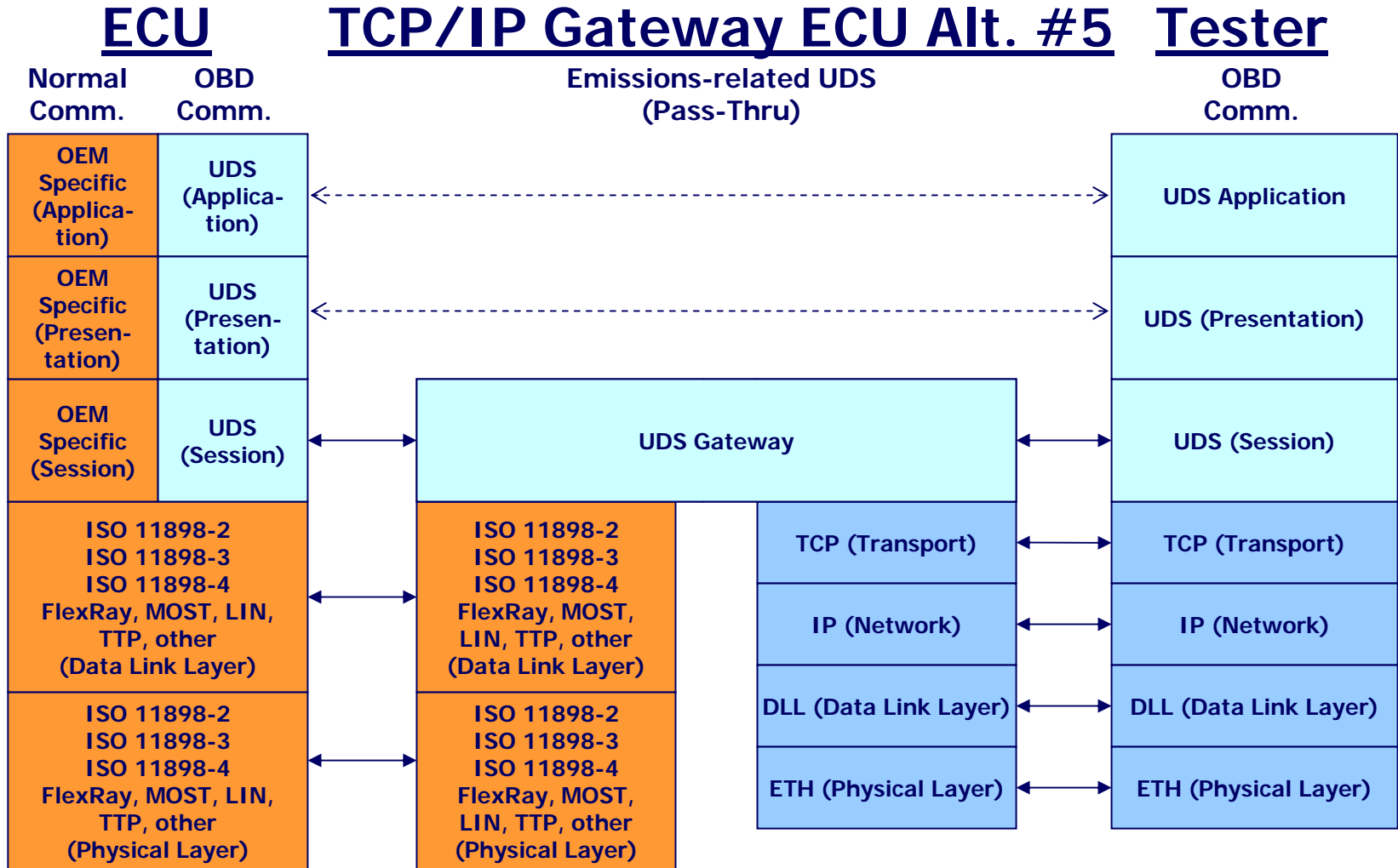
# Emissions-related UDS on TCP/IP on Ethernet (IEEE 802.3 CSMA/CD) or WLAN (IEEE 802.11)



*Note UDS [Universal Diagnostic Services] refers to DIS 14229 et al  
Adapted from Ralf Heistert – DSA, Gangolf Feiter – GM SPO 7/04*



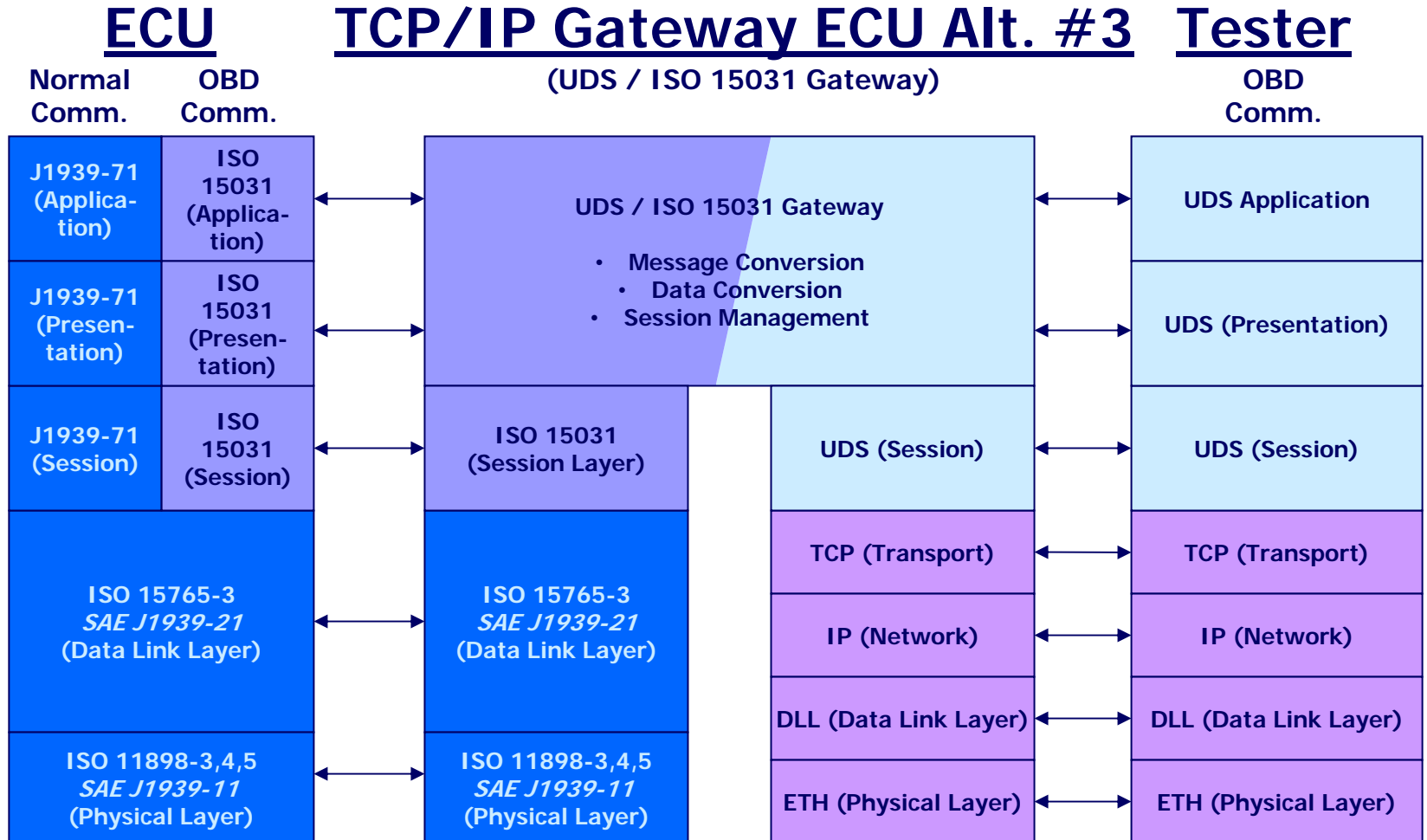
# WWH-OBD UDS-Server



*Adapted from Ralf Heistert – DSA, Gangolf Feiter – GM SPO 7/04*



# WWH-OBD UDS-Server



*Adapted from Ralf Heistert – DSA, Gangolf Feiter – GM SPO 7/04*



# WWH OBD

## World Wide Harmonized On Board Diagnostics

- Global Regulatory Framework
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# ISO New Work Item Proposal

- The ISO Ad-Hoc task force defined a 'New Work Item Proposal' for an ISO Standard for WWH OBD.
- NWIP was submitted to TC22/SC3/WG1 (4/8/05).
- Road vehicles - On board diagnostics (WWH-OBD) implementation
  - ≡ Part 1 - General Information and use case definitions
  - ≡ Part 2 - Common emissions-related data dictionary
  - ≡ Part 3 - Common message dictionary
  - ≡ Part 4 - Wired connection
  - ≡ Part 5 - Wireless connection
  - ≡ Part 6 - Conformance test

See Document: [W161\\_ISO\\_WWH\\_NWIP\\_4-7-05.rtf](#)

*Source WWH WG1 Report Berlin April 7<sup>th</sup> 2005*

# Current Status of Work

- 'Skeleton' documents for Parts 1, 2, and 3 started
- A close relationship has been formed with the SAE DSRC group to monitor the progress of their work which will be crucial to the Part 5 development.
  - ≡ *Proposals for wireless applications were forwarded in January*
  - ≡ *Part 5 will follow work on parts 1, 2, and 3.*

*Source WWH WG1 Report Berlin April 7<sup>th</sup> 2005*



# Current Issues

- The group has been working to resolve several concerns that it has not been possible to reach consensus on at this time.
  1. The selection of the addressing (many vs. fixed set of CAN ID's) to be used by the Tester and ECU's for WWH OBD ?
  2. Development of a single data set (DTC's DPID's/PGN's etc.) for WWH OBD. Recommendation is a 'Blank Sheet Approach' to best serve the 'Technician' in fixing the vehicle in the future'.
  3. Selection and implementation of a Transport Network Protocol. Should the work focus around support of UDS services on a SAE J1939 network with additional SAE J1939 CAN ID's already reserved and utilising ISO 15765-2 Transport Protocol. Or should the work focus on using the SAE J1939 transport protocol as is.

## *Notes:*

- *A subsequent TC22/SC3/WG1 resolution directed sole use of ISO 15765-3 to resolve these issues.*
- *It is recommended that the data item enumeration uses the same identifier for a parametric data item and to prefix its associated failure modes.*

*Source WWH WG1 Report Berlin April 7<sup>th</sup> 2005*

# Questions?

