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SCOPE

Ford’s Diagnostic Development Process in PD

- ECU On-Board Diagnostics

- Engineering process of creating the ECU diagnostic data & functions, and communicating to the Service / Plant Systems Testing and Validation of ECU diagnostics in PD

- Testing and Validation of ECU Diagnostics
Early 2000’s:

Globally unique processes, differed by brand and region
Ford North America, Ford Europe, Ford Asia-Pacific, Ford South America, Mazda, Jaguar, Land-Rover and Volvo

Differences with:

• Diagnostic Protocols
• Diagnostic Data und Functions
• Dokumentation delivered to Service and Manufacturing Plants

Not consistent with Ford’s plans to unify brands and share platforms globally.
HISTORY OF FORD’S DIAGNOSTICS DEVELOPMENT PROCESS

Need a better way!

Multiple Processes & Data Formats
- Ford-SA
- Ford-APA
- Ford-EU
- Ford-NA
- Jaguar
- Land Rover
- Volvo
- Mazda

Single Process & Data Formats
- Ford-APA
- Ford-EU
- Ford-SA
- Ford-NA

Service / Manufacturing Tools

Help!

One Ford

Yeah!

Service / Manufacturing Tools
The way forward:

• Exclusive use of CAN networks; moved away from legacy protocols such as SCP, ISO-9141, and UBP.

• Adoption of the ISO 14229-1 diagnostic standard for all ECUs on CAN.

• New ECU diagnostic development process in conjunction with the ISO 14229-1 diagnostic protocol.
FORD’S NEW GLOBAL DIAGNOSTIC DEVELOPMENT PROCESS

Key Components

Suppliers enter ECU diagnostic info based on direction from D&R (e.g., functional requirements spec).

ECU Diagnostic Spec

ECU Diagnostic Code (CANdesc)

Valid

Invalid (Feedback to Supplier)

MDX Validator Tool

MDX Formatting Tool

*.doc

*.rtf

ECU

<file>.C

<file>.h

Diagnostic Databases (e.g., Service and EOL)

GMRDB

GDX

CANdela Studio

Engineering Tools

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FORD’S NEW GLOBAL DIAGNOSTIC DEVELOPMENT PROCESS

• Global Master Reference Database (GMRDB)
  • Master list of all ECU CAN IDs, DIDs, DTCs, and Routines that may be used by an ECU.

• Vector’s CANdelaStudio diagnostic authoring tool
  • Common tool for suppliers to author On-board diagnostics.

• "Multiplex Diagnostic EXchange Format" (MDX)
  • XML diagnostic documentation for an ECU.

• ECU Diagnostic Validation & Conformance Tools
  • Verifies that an MDX file is correct, consistent, and plausible.
  • Verifies that an ECU actually behaves according to its diagnostic documentation (MDX).
FORD’S NEW GLOBAL DIAGNOSTIC DEVELOPMENT PROCESS

Key Components

- GMRDB
- GDX
- CANdela Studio
- MDX
- ECU Diagnostics Spec
- MDX Validator Tool
- MDX Formatting Tool
- ECU Diagnostic Code (CANdesc)
- ECU

Engineering Tools

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Conformance Tool

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FORD'S NEW GLOBAL DIAGNOSTIC DEVELOPMENT PROCESS

GMRDB = Global Master Reference Database

All Ford ISO 14229 ECUs use Diagnostic Data from this global core database.

- ECU Diagnostic IDs
- Data Identifiers (DIDs)
- Diagnostic Trouble Codes (DTCs)
- Control Routines

Common Global meaning of e.g. Parameter Number (e.g. DID 0x1234) same meaning in all Ford ECUs - globally

All GMRDB data exported to XML Format (GDX)

-> GDX “GMRDB Diagnostic EXchange Format”

Facilitates automatic import by other databases and tools, such as Ford Engineering Tools, Service Tools, EOL Tools und CANdelaStudio.
FORD'S NEW GLOBAL DIAGNOSTIC DEVELOPMENT PROCESS

Key Components

GMRDB

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Diagnosis Databases (e.g. Service and EOL)

Diagnostic

Databases

(e.g. Service
and EOL)

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GMRDB.CDD

GMRDB.CDD

CANdela Studio

ECU.CDD

XSLT

*.C

*.h

ECU Diagnostic Spec

ECU Diagnostic Code (CANdesc)
Vector’s **CANdelaStudio** used as Diagnostic Authoring Tool.

**CANdela Studio output used for:**
- Diagnostic embedded source code
- Diagnostic documentation (MDX)

**CANdela Studio captures all ECU Diagnostic Information**
- Some information affects documentation only
- Some information affects Embedded Source Code only
- Most information affects both documentation and embedded source code
Vector’s CANdelaStudio – Ford template

- Ford & Vector have created a special CANdelaStudio template for Ford diagnostics
- Helps guarantee specific Ford requirements are met
  - Contains mandatory diagnostic services and data parameters (e.g., DIDs, Routines, etc.)
- Two versions of the template exists:
  - Bootloader
  - Non-bootloader
- Ford has developed a detailed walk-through user guide that is specifically for the Ford CANdelaStudio templates.
GMRDB and Vector’s CANdelaStudio

- Ford and Vector have worked together to develop a linkage between Ford’s GDX format (global diagnostic data export) and CANdelaStudio.

- XSL Transformation (XSLT) is used to create a CANdelaStudio input file from the Ford GDX file. This includes:
  - DTCs (numbers and descriptions)
  - DIDs (numbers, descriptions, and all details)
  - Routines (numbers, descriptions, and all details)

- CANdelaStudio user opens both their ECU specific CDD file and the Ford GMRDB data CDD file.

- User can copy/paste or drag/drop data parameters from GMRDB CDD file to ECU specific CDD file.
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<file>

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FORD’S NEW GLOBAL DIAGNOSTIC DEVELOPMENT PROCESS

MDX

MDX = Multiplex Diagnostic Data Exchange Format

• Next Generation Ford ECU Specific Diagnostic Specification
  • XML based
  • Replaces Ford’s old Excel format diagnostic specification

• Global format for capturing diagnostic data in the ECU
  • ECU Name and ID, Protocol, Diagnostic Services, Sessions, DTCs, DIDs, Control Routines, Security Levels, etc.
  • Captures more details than traditionally captured by Ford in the past
MDX

• MDX does not capture any details of the diagnostic request / response PDUs.
  • Assumes underlying ISO 14229-1 service format.

• MDX captures all supported ECU data and all relationships between them.
  • MDX specifies a single method for documenting the supported diagnostic data and the relationships between them. E.g.
    • Supported diagnostic sessions, security levels, DIDs, DTCs, and Routines documented in a single standardized way.

• The single method is critical to ensuring MDX tool compatibility.
FORD’S NEW GLOBAL DIAGNOSTIC DEVELOPMENT PROCESS

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MDX Validator Tool
Automated validation that assists in ensuring an MDX file meets certain requirements.

Consistency checks for:
• MDX Specification / Structure
• GMRDB data
• DTC names, DID size, data type, resolution, etc.
• GDX files as input format
• General plausibility checks (e.g. mapping of DIDs with I/O control to related diagnostic session)
• Many of these checks previously performed manually
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ECU
ECU Conformance Tools

Ford created proprietary Tools for ECU Diagnostic Validation

Detailed Testing of supported Diagnostic Services / Data Parameters:

- Detailed testing of ISO 15765-2 network layer implementation (Ford ScriptPlayer)
- MDX file is critical input when configuring the conformance tool
- Validation of dependencies between Parameters, Sessions, and Security (e.g. test of supported DIDs in all supported Diag. Sessions)
- Important to have single method of documenting relationships with MDX
- Usage of proprietary Conformance Tools, other tools like e.g. Vector CANdiva possible (via CANdela export)
- Prior to MDX, all conformance tool data configured manually!
Summary

- Key components of the Ford Diagnostic Process are:
  - GMRDB, CANdelaStudio, MDX, Validation & Conformance Tools

- Benefits of the new Ford Diagnostic Prozess
  - ONE Global Process
  - CANdelaStudio and MDX help eliminating human error
    - Partial generation of embedded diagnostic source code
    - Helps to ensure that documentation matches implementation
  - Standardized elektronic exchange of diagnostic informationen between supplier, engineering, manufacturing and service using MDX
  - Automated validation of core diagnostic requirements, data consistency and diagnostic plausibility
Danke!
Gracias!
Thank You!
Merci!
Grazie!
Fragen…?
Questions…?
Domandas…?
Preguntas…?
Enjeux…?