

Dearborn Electronics

Automotive Electronics Solutions

Innovative Technology Solutions

Submitted by



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Introduction

The development of Automotive Electronics systems aims at creating new functions or enhancing the existing function of the vehicle. We see an increase in these functionalities, their interconnections, increasing reliability and safety requirements, rising number of vehicle variants and varying lifecycles for software, hardware and vehicle represent requirements and constraints that has an impact on the development of software for the electronic systems of a vehicle.

Mastering the resulting complexity is a challenge for vehicle manufacturers and Suppliers. Safe handling of software and electronic systems must be ensured by appropriate measures during development.

Dearborn Electronics (DE) has extensive experience in developing Network Monitoring and Analysis Tools and developing software for Electronic Control Units (ECUs) by working with OEMs, Tier1 suppliers and Tool vendors. DE with its exceptional people comprising of software, domain, process and management experts make the difference in realizing the objective. DE has proven successful track record with well established software development methodologies for safety critical Automotive Systems which contributes to this goal.

DE provides the following hardware and software development services:

- ECU Software Development
- Application Software Development
- Complete Product Development
- Hardware Design & Prototyping
- Wireless and Cellular based Applications
- Testing & Validation

Core Skills

Automotive networking

- Automotive Network Protocols: CAN, LIN, Flexray, DCX J1850, GM Class 2, Ford SCP, J1708, J1939 and ISO 11783
- Vehicle Diagnostic Protocols: KWP 2000, ISO 15765, OBDII protocols and J1699

Embedded software development

- Microprocessors / Microcontrollers: Freescale: MAC7111, 68HC12, HCS12, HC08, NXP: LPC2292, LPC2468, ATMEL: AT91SAM7X, ST: STR912
- CAN Controllers: Intel 82527 and Phillips SJA1000
- Operating Systems: OSEK / VDX based OS; Motorola Metrowerks, Realogy RTA and Vector osCAN; FNOS, QNX and Linux
- Open Standards: AUTOSAR and OSEK
- Testing & Validation Tools: LabVIEW, Quality Assurance C (QAC), Rational Test RealTime (RTRT) and MxVDev

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- Network Interface Tools: Dearborn Group Gryphon / Hercules, Python, UNAT and Vector CANalyzer
- Embedded Development tools:
- In circuit Emulators: Lauterbach Trace32, IAR J-link and Nohau's Seehau
- Compilers: IAR Embedded Workbench, Cosmic and Tasking C166 Cross Compilers
- IDE: CodeWarrior
- Modeling, Simulation Tools: MATLAB and Simulink, Stateflow, Micro C and C++, CANoe and ASCET – SD.
- Programming Languages: C, Safer C, C++, Assembly
- Programming Guidelines: ISO and MISRA
- Configuration Management : Clearcase Multisite

Application development skills:

- Vehicle Programming Standards :VEPS, J2534 and RP1210
- Programming Technologies: COM / DCOM, ActiveX, DDE and ODBC
- Software Development Tools: Bounds Checker and True Coverage
- Databases: MS Access
- Design Skills: Object Oriented design using UML
- Operating Systems: Windows, Linux, Win CE, QNX, Palm OS and EPOC
- Programming Environment & Languages: VC++, VB, .NET, Crystal Reports, Java, Eclipse, XML and Perl
- Platforms: IBM Desktop PC, Pocket PC and PDAs

Case Studies – Embedded Software

Embedded Software Development for Instrument Clusters

Developed entire software for about six Instrument Cluster programs based on HCS12 microcontroller. The network interface has been implemented using CAN and J1939 protocols.

Modules include:

- HS – MS CAN gateway
- Telltales, Gauges and Chimes
- Display Manager and Illumination
- Odo / Trip Odo and Trip Computer (Including Average Fuel efficiency and Distance To Empty)
- Engineering, Test and Measurement (ETM) mode
- Boot Loader

Model based development of Central Electronics Module (CEM)

The project is to develop the embedded software for CEM (Central Electronics Module) based on MATLAB / simulink / Stateflow. CEM is one of key and smart ECUs in the vehicle to control following Body Control functionalities:

- Vehicle Operation Mode Management (Car, Ignition and Power Mode).

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- Electrical Energy Management by communicating with Alternator (ACM) and Engine (ECM) for energy balancing
- Car Configurations
- Electrical Load Control Management based on the available current and current consumption
- Exterior and Interior lights control by communicating with LSM (Light Switch Module), Driver Door Module (DDM) and Passenger Door Module (PDM)
- Locking System (Remote and Central)
- Climate and Air-conditioning
- Driver Information and Indications
- Theft and Access Protection by communicating with RFR and DIM
- Warning/Failure Indication to DIM
- Visibility control (Windscreen, Wiper and Headlamp Cleaning and Defrosters)
- Vehicle Diagnostics and Global Car Configurations(GCC)

Model based development for Smart Power Distribution Junction Box (SPDJB)

The project is to develop the embedded software for Smart Power Distribution Junction Box based on MATLAB / simulink / Stateflow. SPDJB is the Smart Junction Box to control following Body Control Features:

- Power and Energy Management
- Interior and Exterior Lighting
- Locking System
- Alarms
- TPMS
- Warning and Chimes
- Global Windows
- OMM
- Vehicle Starting Control (Immobilizer, Remote Start, Ignition Processing, Pushbutton Start, Passive Start Interface, Inferred Ignition Processing and Ignition Arbitrator etc.)
- Network Interfaces
- Diagnostics

Embedded Software for WIHL (Wireless In-Loop HGS System)

The WIHL system is intended for deployment into the next generation of self-adaptive HGS System. It provides enhanced performance by real-time monitoring of engine status using J-Bus and communication of this data to HGS, which in turn optimizes Hydrogen delivery based on engine operating performance requirement. The project involves the design (detailed design) development (coding) and testing (Unit, Integration and Functional) of firmware.

Following are the features as part of the firmware development, Startup/PLL, GPIO, External Memory, Scheduler, Watchdog timer, Interrupt Driver / Error handling, Timers, Code Check sum/SW version, CAN, J1939, J1857, ISO 11783, J1850, SPI, SCI, Message Handling, HIU and IIU Application.

Clutch Analysis Tool

This software along with Gryphon hardware is used in trucks on board to collect the clutch related data on J1939 link. This software calculates the energy per gear engagements that replaces the manual calculation procedures.

This has lead to a more cost effective and efficient method of cataloging clutch energy / wear levels

The following are features:

- Resides on Gryphon to capture the data on J1939 bus
- Performs interpolation and mathematical analysis on the captured data
- Writes the computed data into an additional flash card through PCMCIA slot.
- Reads / writes configurable data from / to Gryphon that will be used in mathematical computations.
- Provides a graphical bar chart for the energy absorbed by clutch for each gear engagement
- This software has been tested on board for different trucks
- This development has helped the customer to automatically calculate the clutch life and has saved the manual effort.

OTIM (OnStar TTY Interface Module) Implementation

The OTIM will act as the interface between the OnStar Vehicle Communications Platform (VCP) and approved TTY devices to improve the usability of the OnStar system by individuals those who are physically challenged.

The following are features implemented:

- Class 2 and CAN drivers
- Diagnostics layers on Class-II and CAN
- Network interface and management modules using CanGen for GMLAN

Cellular based Remote Vehicle Data Access

The Remote Vehicle Data Access System is built on Dearborn Group's Gryphon hardware platform that has modular architecture to support most of the In-Vehicle networks.

It works on GPRS and the communication to cell phones is through SMS. It has the following features:

- Request for an information on specific vehicle parameter one time or continuously at fixed time interval
- Alerts based on an event
- Request for Diagnostics Trouble Codes (DTCs)

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- Clearing all Diagnostics Trouble Codes (DTCs)

The applications of this product include

- Remote Diagnostics of the vehicle
- Road side assistance
- Emergency Services
- Vehicle health monitoring
- Fleet Management
- Can be extended with a GPS module to monitor the vehicle location.

Case Studies – Hardware Design & Prototyping

Design of a Gigabit Industrial Ethernet Switch

Designed an Industrial 8 port layer 2 unmanaged 8 10/100/1000 Mbps copper ports. DE has developed the following:

- Schematic development
- Layout design
- Prototype board
- Testing.

Tools used: PROTEL 99SE.

DE has provided all the required features of the product and delivered an economic and high quality product to Client.

Product Development - Vehicle Network Adapter

Electronic Control Unit in vehicle captures the data from various sensors and stores inside them. They communicate this data to outside world in various formats. The Vehicle Network Adapter acts as interface between ECU and PC. It detects the protocol ECU using and converts data from this protocol to USB format to send it to PC. Wireless connectivity is also provided through WIFI communication.

Designed and developed complete hardware with the following features:

- USB Interface module that interfaces with PC
- Protocol interfaces for KWP2000 (ISO 14230) and CAN (ISO 15765) through SAE J1962 interface
- Supports both 12 / 24V vehicles
- On board memory for data logging
- LEDs for status indication
- Power supply module that draws power from either Vehicle or PC.

The applications of this product include OBDII Diagnostics, Network Monitoring & Analysis, EOL and field flashing of the ECUs and stand alone data logging from the vehicles.

Product Development – Network Analysis & Monitoring Tool

DE has designed a Vehicle Network Adapter with a 32bit ARM Microcontroller. Features include

- 2 CAN channels
- 2 KWP channels
- USB client / host interface to PC / handhelds
- Onboard memory for data logging
- SD MMC interface for extended memory
- LEDs for status indications

It is a low cost and high quality product developed in a short span of time.

Case Studies – Network Modeling, Simulation & Testing

ECU / Network simulation with CANoe

The project is to simulate bus of 6 ECUs on a CAN network for Network Management.

Following are the features:

- Created a CANoe model for the network with virtual nodes and a Instrument Cluster as physical node. The six nodes are
 - ACU - Audio Control Unit
 - VRM - Voice Recognition Module
 - IC – Instrument Cluster
 - EATC - Electronic Automatic Temperature Control
 - GEM - Generic Electronic Module
 - RCM - Restraints Control Module
- OSEK NM component is configured for all the nodes except RCM as it is not ignition switched.
- Created virtual network ring to simulate wakeup / sleep conditions for the nodes.
- CAN NM message is constructed for each node with a base address of 0x500 and the node ID as the relative addresses.
- Created a test environment both for the total bus system and for ECUs with the help of the CANoe node blocks.

ECU Simulation / Validation for Instrument Cluster

The project is to simulate and validate Instrument Clusters using CANalyzer:

Following are the features:

- Configured DBC file based on the CAN message details provided by the customer.

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- Written and executed the CAPL scripts to simulate the network inputs from different ECUs on the network.
- Used test boxes to simulate hard wired inputs like Ignition ON / OFF, ACC and Battery.

Test / Validate the GMX-365 body control module

DE has carried out unit and Integration testing for the Body control module for the following features.

- GM Class2 interface
- Onstar monitoring systems
- Content Theft Deterrent functionality
- Vehicle Theft Deterrent functionality
- Driver Information Functionality
- Electrical Power Management
- EPM Battery Saver
- Exterior Lighting

Case Studies – Application Software

Validation Software for Transmission Control Module (TCM)

The project is to develop Validation software for Transmission Control Module (TCM). It has been developed on Visual Basic and interacts with NI DAQ cards to control the I/Os and DG Gryphon to communicate over CAN at 500 kbps.

The module is controlled by placing the module into a Diagnostics Mode using CAN bus messages, then sending CAN bus Parameter ID and Control ID messages (PIDs and CIDs) to read module inputs and control module outputs.

Following are the some of the tests performed using this software

- Battery Voltage and internal temperature monitoring
- Oil pump (Lube) Motor
- Shift Valve 1
- Shift Valve 2
- Lube Valve
- Park Pawl

TAOP Functional Tester

The project is enhancing the TAOP functional tester with additional features. The tester has been developed on LabVIEW with NI DAQ cards as interface. Following are some of the features:

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- Capability of test selection like Functional Test, General Usage Profile Test, EMC Test and High Temp Durability Test.
- Capable to handle up to 18 DUT's with configurable IGN status and wait times
- test inputs were made configurable using the .ini files where the duty cycle, timing parameters and DAQ port details
- The test results were logged into the log file at the end of the each test in the customer specified format.

Zeus – Generic Network Analysis Tool

Zeus is a generic high performance Network Analysis and Monitoring tool that can communicate with any of the In-Vehicle network protocols through a SAEJ2534 compliant hardware interface. The modularized software implemented through COM components and can be extended / customized easily for new requirements.

- Supports CAN
- Upto 255 independent Receive Windows with dbc files
- Multiple Transmit Windows
- Configurable Filters
- DBC Viewer
- XML based Configuration
- Multiple SAE J2534 devices support

CCP (CAN Calibration Protocol) Implementation

The project is to implement CCP on CAN for a Vehicle Network development tool. This tool consists of hardware Puma and the PC based software called Pantera. The CCP is implemented through a proprietary scripting language E-script using IDE provided by Pantera.

- Supports all CCP commands over CAN
- Implements the CAN message objects like
 - Command Receive Object (CRO)
 - Data Transmission Object (DTO)
- Supports error handling mechanism as described by CCP specifications
- Automatically gets launched as soon as Puma is powered up

Gryphon LabVIEW Toolkit

The project is to develop a NI LabVIEW toolkit to support ISO 15765 protocol for DG Gryphon Hardware.

Following are the features supported:

- Initializing / configuring ISO 15765 channels
- Managing ISO 15765 channels for communication
- Transmitting segmented / un-segmented messages
- Receiving segmented / un-segmented messages
- Setting up flow control filters.

Hercules – Multi Protocol Analyzer Tool

Hercules, the advanced Vehicle Network analysis and design tool used in development of vehicle networks like CAN, J1939, Fault Tolerant CAN, J1939, LIN, GM Class2, Ford SCP and GM Class2 networks and also in validating / testing the vehicle network systems before integrating into the network.

This tool is used worldwide by design, development and validation engineers in the automotive and control automation fields.

The following are the features:

- Configurable Databases
- Transmission of Single shot and periodic messages
- Monitors and Graphs to view real time data on the vehicle network
- Configurable Filters and Triggers
- Replay / Playback of network messages
- Statistics and error monitoring and logging
- User Configurable Scheduler
- Program Block Editor and Compiler

OBD Scan Tool

The Scan Tool is Vehicle Diagnostic scan tool software, which is used in testing of in-vehicle Network and Diagnostic features of vehicles. It is a PC based scan tool which supports ISO15031 specifications. This Software consists of features that will allow user to test the ECU parameters and many other in-vehicle network features.

Following are the features:

- Supports multiple vehicle protocols like J1850 VPM / GM Class 2, J1850 PWM / Ford SCP, ISO 9141-2 / ISO 14230-4 (KWP2000) and ISO 15765 CAN / GMLAN High, Mid and Low Speed.
- Supports J1979 generic test modes 1 to 9
- Communicates with a OBD hardware through a non-HID USB driver
- Supports Vehicle selection database, DTC, TSB libraries and generates reports with printing option.
- Provides Bar, line Graphical display, grid and meter / gauge display formats.
- Record / playback option of the logged data
- Online updatable option for software enhancements / patches.

Kernel Aware OSEK OS Debugger

This software works in conjunction with emulator software to provide the kernel aware debugging facility for OSEK / VDX applications. This software provides the information of all the Objects and Parameters of OSEK OS and also represents them in graphical form.

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The users of this software are the OSEK application development engineers to debug their applications during the development process.

The following are the features:

- Supports Motorola HC12 & Infineon C167 processor family
- An ActiveX control that uses both ORTI break and trace interfaces.
- Task information Name, priority, state, stack, events and wait events)
- Stack information (Name, Start address, Size and Stack contents)
- Current Status (Current running task, Service and current ISR)
- Counter, Alarm, Resource and Message information
- Real time graphical representation of Task / Service timings
- Real time graphical representation of stack / service usage
- Break emulation on event set
- Task preemption

J1699 Compliance Tool

J1699 is an OBDII Compliance Test cases specification developed by SAE. DE has developed a Test tool to validate the ECUs against this specification. This software can use any J2534 device to communicate to ECU.

The following are features:

- Provides GUI to execute all the test cases or to execute the test cases in a particular section.
- Provides a trace Window that shows a log of test sequence and also the test results.
- The test results log can be saved to a file.

This software is being used to validate the ECUs for the OBDII compliance.

OnStar Programming Tool

OnStar provides Telematics services to automobile occupants on a subscription basis.

The OnStar system is a vehicle owner information and convenience system designed to provide personal communication and data services, on demand. OnStar is a vehicle communication package (VCP) that is being used with any combination of the following: body wiring interface harness, bracket or impact detection sensor.

The system developed is used to program and validate the OnStar modules and to print the test results onto a label printer.

- Programs the OnStar module using GM class 2 protocol
- Logs the test data results to an ASCII file
- Interfaces a bar code reader for reading wiring harness serial number

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- Interfaces a National Instruments Data Acquisition Card to the power supply of an OnStar module
- Prints test results to a label printer

Vehicle Data Recorder (VDR) Test Suite

Vehicle Data Recorder is used by dealer network to record the vehicle data on CAN, ISO-9141 and Ford SCP networks. This system is used as an End of Line (EOL) manufacturing testing tool for VDR. The software performs all the tests on VDR module and writes the data to a file if any discrepancy is observed.

Following are the features:

- Linux based embedded client and Windows client application
- Transmits / receives the frames on CAN - High, CAN – Mid, KWP 2000 and SCP protocols.
- Perform a memory check on both host and protocol interface modules.
- Perform Pendant test and CAN protocol tests
- Write test results to a text file.

EQ Designer Toolkit

The aim of this program is to develop an EQ Designer Toolkit that enables DSP and acoustics engineers to rapidly equalize vehicles to meet development and production requirements for a Tier-1 Automotive supplier.

EQ Toolkit is an amplifier designed for controlling/simulating radio controls like volume, Bass, Mid, Treble, Balance, Fade etc., The Application has 8 channel audio mode and 12 channel audio mode where the user can select any of the audio mode and configure each channel. This Toolkit supports upto 25 EQs. This project supports CAN messages and Interfaces. Application communicates through the vehicle gateway using CAN (500 kbps).

Following features were developed for this application.

- **Upload flash** bank index table – Application supports opening of the saved EQ header file along with the tool configuration parameters from a component.
- **Internal Clip detect & limiters** – Application provides modifiable values for limiters and clip detects to channels.
- **DTC** – Application reads DTC for the speaker shorts, speaker open, dc offset, battery high, battery low, software checksum failures, bus faults and loss of communication with other modules set by the amplifier.
- **Flash File generation and Flashing Radios** –
The Toolkit takes input as either Header file format “. h” or Data File format “. Dat” and generates the Hex file which is used for flashing radios. Total file size of each EQ will be exactly 4K in size. Generated hex file will be flashed into the radios. Checksum comparison will be done internally. Flashing will be successful only if the expected checksum matches with the calculated checksum.

The major benefits of toolkit is

- Generic tool architecture to support the toolkit. The current EQ Designer Tool already uses base architecture for this class of tools. Enhancements may be required into this base architecture to accommodate new needs and create the reference architecture for the toolkit.
- Well-defined compatible code components to implement the architecture. A clear definition of algorithms, data and interfaces.
- And, a set of rules. These rules define the relationships among the different code components.

Seat Test Interface for Memory Seat Module (MSM)

This software is part of a PC based EOL Test Station to Test Memory Seat Modules (MSM) in the assembly line. This test is to verify the correct operation of every MSM manufactured. The Test Application is implemented using Citech Software package.

A set of APIs have been developed as Windows DLL that enables the Test Application to communicate with the Seat Module. The main purpose of the API is to encapsulate the details of underlying vehicle network protocol, CAN diagnostics implementation details etc. and provide a high level application interface.

Following are the capabilities of the software interface:

- Initiate diagnostics session and handle messaging to keep the session alive
- Ability to retrieve and reset trouble codes
- Ability to read and write data
- I/O control capability
- Terminating diagnostic session
- The MSM supports diagnostics communication as per ISO 14230 (KWP2000) specifications over CAN-B physical network.
- Dearborn Group's Gryphon, with an installed Fault Tolerant CAN card, has been used to interface with the Seat Module.

RP1210 Interface for Perkins Vehicle Network Adapter

The project is to develop RP1210 interface (API) for a hardware that provides CAN to parallel port interface to the computer. This interface was developed as Windows 32 bit Dynamic Link Library or DLL that can be used to write the diagnostic applications. The APIs are developed in accordance with RP1210.

The following are the project features:

- Implementation of J1939 transport layer within the DLL
- The DLL interacts with CAN protocol engine developed as low level parallel port drivers to provide the CAN interface
- Providing the APIs documented as per RP 1210 standard to the applications.

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- To write a generic test application to validate any RP1210 compliant DLL on any of the Windows platforms
- To validate the DLL using the test application

RP1210 is a recommended practice, which provides a series of guidelines for the development of any software application that uses the Windows operating system, and communicates with a vehicle data stream, such as CAN or J1708 or J1939.

Contact Info

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