XCP – The way forward

Mohamad Sah, Vector Informatik India
Agenda

XCP: The Universal Protocol for ECU Measurement and Calibration

- What?
- Who?
- When?
- Why?
- Where?
- How?
What is XCP?

XCP Signifies “Universal Measurement & Calibration Protocol”.

“X” stands for the variable and interchangeable transport layer.

The measurement signals are transmitted over a serial network like CAN, LIN, FlexRay or Ethernet.

XCP works on master-slave architecture.

The primary applications of XCP are measurement and calibration of internal ECU parameters.

XCP is the successor of CCP.

The current version of XCP is 1.3.
Who defines and maintains the standard?

**Association for Standardisation of Automation and Measuring Systems (ASAM e.V.)**

Founded in 1998 by the European automotive manufacturers and suppliers.

Among the members are:

- **Automotive manufacturers**: Audi AG, BMW AG, Daimler AG, GM General Motors Corporation, MAN Nutzfahrzeuge AG, Porsche AG, Renault SA, Volkswagen AG, Volvo Technological Dev. Corp.

ASAM interface model

Who?

Higher level automation system

CANape

CCP / XCP driver

ECU

ASAM MCD 3 MC

ASAM MCD 1 MC

ASAM MCD 2 MC

*.a2l

ECU Measurement and Calibration Data Exchange Format
When XCP was introduced?

- CCP Protocol: as of 1992
- XCP Protocol: as of 2003

- CANape
- ECU
- CAN bus
- FlexRay bus
- Ethernet
## Why?

### Difference between CCP & XCP

<table>
<thead>
<tr>
<th>Features</th>
<th>XCP</th>
<th>CCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read/write accesses to device memory</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Calibration data page initialization/switching</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Synchronous data acquisition</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Flash programming</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Scalability</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Cold start measurement (Resume mode)</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td><strong>Better resource utilization in the ECU (Dynamic DAQ List)</strong></td>
<td>√</td>
<td>×</td>
</tr>
</tbody>
</table>

### Diagrams

- **Master** to **ECU**:
  - Short Upload command
  - Data
  - Measurement signal 1
  - Measurement signal 2

- **Master** to **ECU**:
  - Write DAQ
  - Data
  - DAQ table complete
  - Start the measurement

- **ECU**:
  - Writes an address table
  - Measurement signal 2
  - Measurement signal 1
**Why?**

**Difference between CCP & XCP**

<table>
<thead>
<tr>
<th>Features</th>
<th>XCP</th>
<th>CCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic detection of slaves</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Synchronous data stimulation (bypassing)</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Optimized communication by block transfer</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Precise measurement data acquisition by measuring timestamps in the ECU</td>
<td>✓</td>
<td>×</td>
</tr>
</tbody>
</table>

![XCP Message Frame](image)

*Figure 6: XCP packet*
Why?

Basic Features of XCP

- Synchronous data acquisition/stimulation
- Read/write accesses to device memory
- Calibration data page initialization/switching
- Flash programming
Extended Features of XCP

- Automatic detection and configuration of Slaves
- Block Transfer Mode for upload, download and flashing
- Dynamic DAQ lists configuration
- Acquisition of measured data with time stamps
- Synchronized and prioritized data transfer
- Power-up data transfer
- Download of flash programming routines
Benefits of XCP

- Reduced CAN bandwidth
- Tool and Vendor Independent Communication platform
- Block Transfers reduce download and upload time
- Significantly stronger security protection
- First loop data acquisition possible
- Improved measurement synchronization
- Small scalable code for any bandwidth
- Usable for every purpose: from function development and modeling to production car application
Benefits of XCP

- With Vector VX Interface, the users do not even need the XCP driver for measurement and calibration applications since the driver is already integrated in

Standard Debug / Trace Ports:
- JTAG / DAP(2)
- AUDII/ DigRF
- RTP / NEXUS / AURORA
Why?

Vector’s XCP Credentials

- Vector offer the most sophisticated XCP Master tool (CANape) and XCP source code in the market since 2002.

- XCP Professional Driver:
  - Purchased by over 100 global OEMs & Suppliers to date
  - Solid code base with high level of maturity
  - Leverage the enormous amount of validation testing already completed
  - Offers high value solution
Where?

Model in the Loop

- Both controller and plants are simulated as a model.
- Both models run in Simulink as runtime environment to analyze the behavior.
- Measurement and Calibration capabilities can be realized by integrating an XCP slave.
- No code generation or instrumentation of the model is necessary.
Software in the Loop

- Code generated from the model and the model is running in PC based environment as a DLL.
- Using XCP the model can be calibrated.
Hardware in the Loop

- Algorithm runs in a microcontroller platform while the plant continues to be simulated.
- The user has access to the algorithm in the ECU over XCP.
Rapid Control Prototyping

- Algorithm runs on a real time hardware instead of an real ECU.
- Integration of XCP helps in settings up an OEM independent tool chain.
- Helps in quickly develop a functional prototype.
XCP Implementation

- Vector provides free Basic driver for XCP.
- Available for free download at www.vector.com with documents on how to implement it in your ECU.
- Also available is a free XCP eBook for download.
How?

XCP Implementation

- Still need help?
- Please write to support@in.vector.com or mohamad.sah@vector.com
For more information about Vector and our products please visit

www.vector.com

Author:
Mohamad Sah
Vector Informatik India