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UNLIMITED POTENTIAL

AS AN OPEN SOFTWARE PLATFORM FOR HIGHLY INTEGRATED CONTROL AND INFORMATION SYSTEMS, CROSSTALK PROVIDES A PLATFORM FOR ANY MACHINE – RATHER THAN FITTING THE MACHINE TO THE PLATFORM

The off-highway industry is facing a reality in which the majority of new, innovative functions in modern vehicles are realised with software. Software-controlled functions are rapidly increasing in importance, due, in part, to their improvement and replacement of electromechanical functions. They also enable innovative functions that were previously not imaginable, such as onboard diagnostics, video surveillance, software-based service tools and advanced back-office applications.

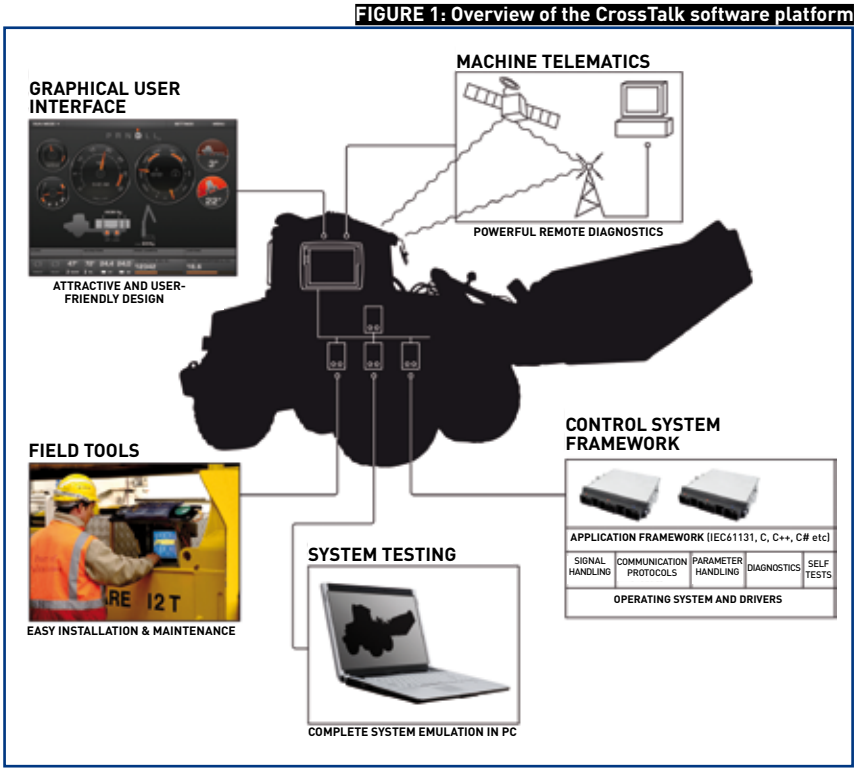
These functions rapidly become market expectations, meaning that to remain competitive, OEMs must equip their vehicles with more and more advanced collaborating software functions spread across different ECUs. At the same time software engineering is often – even today – not without its problems. The systems easily become complex, and in combination with increasing demands on quality attributes such as safety and reliability, the engineering challenges will be hard to beat.

To meet these challenges, the industry needs to view software as a first-class citizen when developing new vehicles. We must move from yesterday's trend to program ECUs with hardware vendor-specific pinpointed tools, resulting in systems with many different ECUs dealing with very specific tasks, and limited possibilities of interaction between them. Emphasis should instead be placed on the use of open, flexible software platforms, based on standards, where the users can create highly integrated solutions tailored for their machines, instead of solutions tailored and limited to suit hardware vendors' pinpointed tools.

Bearing all that in mind, as an open, flexible software platform meeting the growing needs for advanced, integrated onboard systems, the CrossTalk software platform initiative from CC Systems is without doubt a groundbreaking step in the right direction!

Figure 1 illustrates the types of components that constitute the CrossTalk platform. The control system framework is the core component, supporting the fieldbus communication and the architectural design of the system. The system-testing framework provides the means of efficient testing throughout the product lifecycle. Field tools simplify management of the system in the machine production process as well as in the field. The Graphical User Interface (GUI) framework enables design of user interfaces that are both user-friendly and deliver a look and feel that strengthens the brand message of the OEM's machine. Machine telematics provides a framework for creating advanced diagnostics and remote access to that information.

FIGURE 1: Overview of the CrossTalk software platform



Not all components in the platform may need to be deployed for a specific vehicle type. The platform is scalable, enabling OEMs and system integrators to make use of the components gradually, following the evolution of market expectations.

Control system framework

The CrossTalk control-system framework is flexible and open-ended. It efficiently supports development of most control system applications built with standard programming languages and paradigms such as IEC61131, C, C++, C#. This is made possible through using a component-based product-line architecture, where the core baseline has been carefully designed to include the components needed by essentially all in-vehicle applications. The tailoring process to meet the needs of specific systems becomes a rapid and cost-effective configuration of the base line where components are added. The result is a platform responding to needs of the intended application.

The configuration process can be summarised as the specification of desired system architecture, in terms of computer nodes, their responsibility, programming paradigms and languages. This is often available and established early in the process, in terms of ECUs,

FIGURE 2: **Example of premium design graphical user interface**

communication gateways, display units, equipment under control, and networks.

Platform components are selected, based on the functionality it is desired to allocate to each computer node. They are added to the baseline platform to create a software platform(s) for each node in the system where a platform from the family is desired. Each platform starts from the common baseline. Connectivity components to certain programming languages are finally added based on the desired programming languages for each node in question.

The control system platform is deployed on each of the nodes in the system. The application can then be built efficiently on top of a platform that includes the needed support.

The result is a suitable platform for each node in the system, meeting the desired usage of each node. Applications of different types can be integrated and efficiently share the same baseline components. A good example is the solution often used in CC Systems' display computer nodes where IEC61131 control applications and C# graphical applications coexist. The CrossTalk platform ensures efficient synchronisation and integrated sharing between the applications of core components such as signals, parameters, and diagnostics. Using the traditional approach, this would typically result in a less integrated system with limitations and duplications,such as the dedicated control node for the IEC61131 application, exchanging a limited number of signals with a C# application on a dedicated display node.

Each node would also typically be built on diverse and partly duplicated platforms. Besides possibilities for functions requiring more tight integration, an open platform has several other benefits, such as fewer ECUs, less cabling and a reduced number of connection points.

When internal diagnostics of a node is desired, the platform can be configured to include a capable set of self-tests. The self-test contains RAM memory tests, integrity tests of the program memory and CPU tests – all of which are executed upon each start-up of the unit.

Machine telematics and GUI

The foundation for telematics applications are a set of components enabling wireless data transfer, such as Bluetooth, WLAN, Wireless-CAN, GSM, GPRS and 3G. Some type of telematic support is often chosen in conjunction with platforms for the display nodes. They can easily be used to provide connectivity to standard back-office applications, such as messages via SMS or email in conjunction with certain alarms or events, vehicle tracking systems, fleet management systems, and production data systems.

On top of these components CrossTalk features a powerful machine-diagnostics run-time with an onboard database that logs desired events. The diagnostics run-time is configured to monitor desired internal events in the node and signals over the network, with associated conditions when some actions shall be performed. These actions can be a combination of logging in the database or activating/deactivating alarms. Database values can be discrete values, trend values with timestamps, or counter-values counting such things as operating time, number of mechanical movements and production data. The database holding the diagnostics is a fully Open DataBase Connectivity (ODBC) compatible SQL database, implying that it can be exchanged to any database supporting ODBC.

A web-server can be included to build in telematics-related applications such as remote interface to access some remote function in the vehicle. However, the generality and simplicity of the web-interface will likely be appreciated by field engineers and service technicians for accessing service data, configuration data, and other logs in the vehicle, using standard hand-held browser devices without the need for special tools and software packages.

The GUI framework includes a set of graphical components that have been designed by industrial-design specialists. With these components it is possible to easily create advanced, premium-design Graphical User Interfaces. This industrial-design expertise is also made available to customers for advice regarding overall design of user interfaces, based on the available GUI components or any other brand-specific graphical profile. A premium-design GUI in an industrial machine strengthens its brand message. The graphical components are typically used in conjunction with IEC 61131-3 programming tools or as components in the visual studio or Qt development environments.

The platform also offers support for digital or analogue video applications such as digital-streaming video, pre-loaded-video files, or analogue video-in connections. The applications are typically surveillance cameras, or instruction videos for certain tasks that can be performed with the machine.

Development testing

A virtual version of the CrossTalk platform is available for test purposes during system development. Using the virtual version, a control system with several nodes can be executed on the developer's host PC, using virtual communication buses and I/O.

Experience from using this technique as the main test platform in development projects for several years has shown that it greatly simplifies development of embedded systems. Most of the tests can be performed without involving the control system target hardware. Software test and development can start even before target hardware is available, and be performed in parallel with hardware development. Costly bugs that usually are found late in the project can be eliminated earlier in the development cycle.

Many tests may be moved to earlier phases of the project. The platform enables test cases that are not possible on target hardware, because the interaction possibilities are highly increased with an application running on a host workstation compared to remote testing the target hardware. However, this is a test platform with the purpose to simplify the software development – ultimately, the target system must be deployed and tested in its real environment.

The CrossTalk open platform initiative is a product family of platforms suitable for a wide range of industrial vehicle applications. The platform is component-based, signifying that different parts are well separated and can be exchanged and modified independently when needs arise due to new standards.

Crosstalk is realised as a product-line architecture, which gives the advantage of the rapid and cost-effective creation of new platforms suitable for new demands. The key benefits stemming from CrossTalk's architectural principles are the platform's openness and flexibility, allowing OEMs to create highly integrated systems tailored for their machines. No limitations. **iVT**

FIGURE 3: **Software-controlled functions are increasingly important in industrial vehicles**

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