Industry 4.0 from EBV –
Man AND Machine Solutions

The EBV IoT Smart, Secure, Connected – Everywhere

EBVElektronik

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Principally Industry 4.0 is the smart and safe collection and processing of data on the basis of an intensive exchange of data from all processing tiers. In this context, hardware is an enabler, as well as various core functions embedded in software, and specialized knowledge is essential.

The network provider Cisco has predicted that in 2020 about 50 billion applications will be connected over the Internet of Things (IoT). Although Industry 4.0 is a part of the overall IoT umbrella, it is not a final state that must be reached, but a constantly changing process leading to the development of IoT.

In Germany, research institutes such as the DFKI, the Technologiezentrum OWL and the RWTH Aachen, were the first to concentrate on the topic Industry 4.0. The research department Innovative Fabriksysteme (IFS) of the DFKI (Deutsches Forschungszentrum für Künstliche Intelligenz, German Research Centre for Artificial Intelligence) created the demonstration platform SmartFactoryKL, whereas the Technology Centre East Westphalia-Lippe (OWL) brings together more than 170 companies and institutions into a technology network dedicated to discussing solutions for Industry 4.0. At the technical university RWTH Aachen more than 20 institutes for materials and for manufacturing technology, in cooperation with Fraunhofer-Gesellschaft and prestigious production industry companies, research how to lay a foundation for a sustainable production strategy.

Meanwhile many companies are already active in Industry 4.0, as today there is virtually no other alternative: either you join in or you are in danger of not being a competitive company in the mid or long term. By focusing on Industry 4.0 enterprises sometimes have to alter their business model, but without developing in this direction they are likely to become irrelevant in the future.

Within the scope of Industry 4.0, EBV Elektronik considers itself a supporter of small and medium-sized enterprises (SME).

EBV advises and proposes components as well as solutions that will help SMEs to jump on the Industry 4.0 bandwagon, which is already evolving rapidly. As EBV Elektronik focuses on those companies that intend to develop components to be used within Industry 4.0, this article concentrates exclusively on development and design of elements for application in Industry 4.0; for instance on the design of a new machine control system.

TIME-TO-MARKET

To minimise time-to-market the development departments must be aware of their core competencies and the limits of their knowledge. Application designers can take advantage of the variety of hardware and software elements that are available virtually off-the-shelf, and intelligently use standard hardware and software components to maximise their efficiency.

For example, it wouldn't occur to many developers to develop a standard (embedded) PC on their own, because it is much cheaper and faster to buy the complete unit. This can be applied in the same way to a design, buying a processor board etc. as a complete solution and using this as the basis of their own application is much more efficient. Comparable practices work for areas such as high-frequency (RF) communication,

security, etc. As appropriate off-the-shelf components are not always available, cooperation with suitable partners is necessary; Industry 4.0 is the latest example of this. With its comprehensive partner network EBV Elektronik supports its customers in their search for optimally suited development partners.

CONNECTIVITY AND INTEROPERABILITY ON THE RF LEVEL

In principle Industry 4.0 is basically distributed intelligence communicated over a wired or wireless network, which must meet a variety of standards. Devices can be developed with reasonably priced microcontrollers and corresponding development tools are also available. Careful selection of controller sensors can also mean devices can be battery-operated due to their extremely low power.

Numerous sensors are used to detect measured variables like pressure, temperature, humidity, mechanical load and they must communicate reliably with the higher-ranking system with one partial battery charge over several years. However battery life also depends on the radio technology used, like for instance Bluetooth LE (Low Energy), WiFi etc.

Regardless of the radio technology used, interoperability on the RF level must be guaranteed, and the security of the connection must be considered. With a vertical segment, like RF, EBV Elektronik is optimally positioned to recommend the most suitable technology, independent of the manufacturer, to the developers: from the chip through software to the antenna.

More frequently the radio connection is employed within the control concept, as currently not every machine in the

field needs an industry-enabled display terminal. And with increased frequency (industrial) tablets are used to connect with the relevant unit whenever needed, to visualize data and to enable inputs. In most cases the respective communication between machine and tablet takes place via WiFi or Bluetooth: an application running on the tablet functions as a classical operating terminal. At the same time the app also has access to the sensors measuring speed, position, acceleration etc. plus the camera sensor integrated in the tablet (or even smartphone). With skilful utilization of the available data, radio path and the control unit, innovative operating concepts can be realized. EBV Elektronik supports newcomers and existing customers to recognize and to exploit suitable potential within Industry 4.0.

UNIFIED COMMUNICATION VIA TSN

EBV provides its customers virtually everything they need to enable them to develop the appropriate application. A good example is the communication on the production level in the factory floor through the future communication standard TSN (Time-Sensitive Networking).
On the lower field level the data is currently exchanged through proprietary buses like Profibus, Varan or through Ethernet variants like Ethernet/IP, Ethercat, Ethernet Powerlink, Safetynet-p or Profinet. One level above field level, on the control level, experts are trying to install a standard communication. As in the factories most machines work in parallel, often coming from different suppliers. The proprietary buses have to communicate through complicated gateways to enable some sort of a real-time communication at least.

Every single gateway represents an additional effort, which requires development resources as well as being costly, simultaneously introducing a time delay into the real-time communication, and increasing system complexity. Such gateways translate from, for example, Profinet to Ethercat, and Ethercat to Sercos etc.

Sercos III, the third generation of the Sercos interface series according to IEC/EN 61491, has been submitted to the IEC (International Electric/Electrotechnical Commission) for worldwide standardization, to become part of the international standards IEC 61800-7, IEC 61784 and eventually IEC 61158. Sercos is actively supported internationally by more than 50 control manufacturers and more than 30 drive manufacturers. The user organization Sercos International (SI) is responsible for further development of the standard.

Thus a unified communication standard like TSN is highly desirable to allow universal use of different components, especially since TSN facilitates seamless communication with the higher levels, in which the Manufacturing Execution Systems (MES) work. Typical representatives of MES are units like PLCs (Programmable Logic Control) and SCADA systems (Supervision Control And Data Acquisition). TSN is currently being standardized by the IEEE and originally comes from the automotive industry.
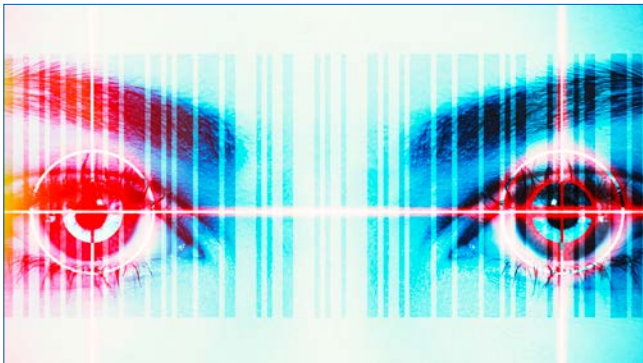
Due to the complexity of TSN, EBV Elektronik cooperates with partners that can help to support this standard. In this EBV works in cooperation with these partners regarding components like processors and switches in connection with the BSPs and the necessary software for its customers. Thus

EBV´s customers are in a position to develop TSN-compatible applications themselves with acceptable effort.

As opposed to the high volumes associated with the big automotive OEMs the production batches in the industrial segment are normally much smaller, so a cost-effective solution of a TSN development would not be possible without appropriate partnerships and tool kits for most companies.

SECURITY INCLUSIVE DATA SECURITY

This quasi-seamless connectivity also entails certain risks. To ensure a smooth operation the systems must do exactly what has to be done. To prevent hackers manipulating processes and to taking control, security – which is much more than "only" data integrity – is essential.

When it comes to implementation of security using cryptography chips at the board level, EBV Elektronik issues some recommendations, however when it comes to key security concepts partners like Fraunhofer, with its specialist knowledge, will come into play. These partners also support the company developing products with security analysis, plus detection and removal of potential security breaches. One thing should be clear for everyone: those who don´t implement appropriate security measures leave themselves open to hostile hackers obtaining access to the system to provoke inconveniences.

CORE ELEMENTS OF SECURITY

There are five different methods for implementing security: these are the basic aspects of authentication, data integrity and data security as well as anti-tampering and anti-counterfeiting.

Authentication ensures distinct identification of system components. For instance the system realizes that only truly approved components for drive and control, or terminals for remote maintenance are connected with it.

Data integrity concentrates on protecting against corruption of data during communication. This aspect is essential to protect firmware updates via the Internet, but also to make sure that the transmitted sensor data is really trustworthy.

Data security deals with the encrypted data communication using technologies for encryption and decryption.

Anti-tampering is the manipulation protection of a device. In case of manipulation, the system automatically deletes the corresponding security keys so the manipulation becomes apparent.

Anti-counterfeiting is simply a protection against reproduction implemented in hardware and software, where certain keys are stored in a cryptographic chip. The device functions only when the keys in the crypto-chip and in the related software fit together. This is one way the problem of overbuilding (unauthorized production of additional devices beyond the agreed production orders) with contract manufacturers can be tackled.

HIGH POTENTIAL

With Industry 4.0 new potential possibilities arise for European enterprises; accordingly they should utilize these possibilities to develop new business models to successfully maintain their position in the world market. If European Industrys do not use this potential, other companies will, ultimately undermining the European businesses by providing new solutions. Europe´s industry is currently at a crossroads: Industry 4.0 is not a question of "if?" but of "when?" and "who?"

Many SME's don´t have the engineering, IT and development

resources required to cover all aspects of Industry 4.0. For example many owners of medium-sized companies openly admit that they have no experience with application programming. Central European enterprises could achieve a lot with a new way of thinking, rather than trying to reinvent the wheel by modifying existing strategies. American and Chinese companies are much more flexible in this regard, they combine technologies from different service providers and companies to develop a new application, resulting in disruptive business models.

ACHIEVING OBJECTIVES WITH PARTNERSHIPS

A company active in the automation field has its core competencies in automation; this is where the specific IP of this firm lies. But it isn't a detailed knowledge of automation that is needed to communicate through RF radio links. By

purchasing adequate standard elements automation companies are enabled to develop a high-performance system within a shorter time frame.

Chip manufacturers have pursued this strategy for a long time, for instance employing processor cores from ARM. Only very few semiconductor manufacturers are able to differentiate themselves by the processor core, instead the differentiator is the total system, which has been created around one or more computing engines based on their systems knowledge. As the installed base of ARM processors is very high, a market has sprung up for the producers of corresponding development tools, this variety benefits chip users in regards to technology and price.

In the same way chip manufacturers use a variety of available products to develop new chips instead of developing products 100% in-house, there are possibilities in many other Industrys to selectively use external elements to reduce time to market. Today, IT resources can be rented or leased, so big hardware is no longer needed in-house, and there are a variety of companies who offer secure cloud services. In secure cloud services, for example, data security is part of the business model´s core element; in companies like SAP or IBM, a medium-sized company can only achieve the security level that is offered by these more or less off-the-shelf systems, often this can involve huge expenditures.
Therefore one of the secrets of success of Industry 4.0 is the tactical and selective use of external resources. EBV plays an active role in the procurement of these resources, even though the semiconductor distributor achieves no monetary profit for the mediation of such contacts. This added value is a means of building customer loyalty, and is also an investment in the future success of its customers. This long-term commitment to the customer often runs for two to three years after project launch, until the first successful applications come onto the market.

EBV has relationships with several partners including the Fraunhofer Institutes, for example Fraunhofer AISEC in Garching, who deals with security, or Fraunhofer-Institut IOSB-INA in Lemgo, who is active within the SmartFactoryOWL project and is devoted to topics such as TSN and OPC-UA, or several other partners who write software and adapt BSPs (Board Support Packages) on behalf of the end customer.

Projects can suffer from enormous delays when a company cooperates with a third-party who can't handle the envisaged project despite prior arrangement, either because of a lack of knowledge, manpower or financial stability. EBV Elektronik is not "only" a supplier but a valuable partner in the concept and the design phase. Customers frequently discuss which business models work within the scope of Industry 4.0, using EBV's expertise to identify the different possibilities and opportunities for the future.

On the other side EBV Elektronik also offers development boards enabling SMEs to evaluate and develop projects from a firm foundation. For example, the 'SoCrates' board perfectly demonstrates the possibilities of FPGAs from Altera. 'SoCrates' is more than a development board, as it is a complete reference design that allows rapid installation of security functionality for an individual application when special software from the EBV partner, Wibu-Systems, is used.

INTERESTING ALSO FOR SMALL COMPANIES

Formerly an enterprise had to be of a certain size and correspondingly employ many people to play and active and important role in the industrial market. With the scope of the IoT and Industry 4.0 new tools and support offered by the Internet, which would previously have only been available to large enterprises, means small companies, with for instance 15 employees, are able to bring highly attractive products to market. These communication tools and applications also offer the chance to enter the world market with an ingenious product very rapidly.

INDUSTRY 4.0 – WHAT DOES IT REALLY MEAN?

It all started at the Hanover Fair in 2011; the term "Industry 4.0" reached the attention of the public for the first time. Two years later, at Hanover Fair, the German government presented a final report with the title "Implementation Recommendations for the Future Project: Industry 4.0". Principally Industry 4.0 deals with digitalization in three main areas of the German industry: production, mechanical engineering and automation.

4th Industrial Revolution
Industry 4.0 is considered the fourth industrial revolution: After mechanization followed electrification (introduction of the assembly lines) and the introduction of computers. Now, within the scope of Industry 4.0, the Internet enters factories. Industry 4.0 deals with cyber-physical systems (CPS), physical systems, mechanical and electro-mechanical equipment or anything else that can gain new potential by using the Internet.

Remote Maintenance
A very classical application area of Industry 4.0 is remote maintenance that for example, permits maintaining a huge printing machine in Australia from Germany. When combined with augmented reality this becomes even more possible. For this, the installer in the field would put on special glasses (for instance Google Glass), to mark the exact screws that need to be removed in the correct sequence in order to repair the machine, all via visual displays on the glasses.

Down to Batch Size 1
Through inclusion of the Internet and CPS, Industry 4.0 will make the production more efficient and more flexible to allow a batch size 1 at affordable prices. In the same way consumers can have their muesli mixed to their individual preference, the Internet enables individual production of machines.

Cost Reduction
Additionally there can be tremendous cost reductions. For example, if a machine delivered from Germany to New Zealand monitors itself and discovers, that a certain element could fail within the next three months, then there is a possibility to cost-effectively dispatch the relevant spare part via a sea route rather than via air freight, significantly lowering costs especially with heavy machine parts.

Connected Supply Processes
Within the scope of Industry 4.0, besides maintenance and production, supply processes are also interconnected using the Internet. Manufacturers can communicate transparently with their supplier and their supplier's supplier. If the example machine in New Zealand signals an upcoming medium-term failure the producer can automatically order the required component at his (sub-) supplier or commission it.

Higher Quality
A high amount of sensor data can be accumulated from the remote control/remote maintenance process, so when producers systematically evaluate data collected from many similar machines, they can analyse it to draw conclusions about the causes of eventual failures or operational interruptions. After careful analysis producers can improve the quality and the longevity of future production through constructive measures.

Industry 4.0 Platform
The government of the Federal Republic of Germany has even installed an Industry 4.0 platform; its members include the VDMA (German Engineering Association) and the VDE (Association for Electrical, Electronic & Information Technologies) plus industrial companies. This platform primarily deals with standardizing issues.

Jobs
There are repeated claims that Industry 4.0 will cause a loss of jobs. In fact the opposite is true. Without Industry 4.0 there is a danger that the European industry will loose touch, and new players from Asia or America will take over the core markets for the German economy and European industry respectively. However, as Industry 4.0 requires ever more highly qualified personnel and less un-skilled workers, there is likely to be a shift in the quality of the jobs,
In the consumer electronics and telecommunication segments, Europe has already had to learn the painful lesson of the consequences of the exodus of a whole industry. For this reason it is especially important that the European industry actively takes its chances now, whilst they are available.

Worldwide Activities
There are activities in the Industry 4.0 area not only in Germany but also worldwide. Such initiatives include Smart Factory (the Netherlands), Usine du Futur (France), High Value Manufacturing Catapult (Great Britain), Fabbrica del Futuro (Italy), Made in China 2025 (China), Basque Industry 4.0 (Spain), Smart Manufacturing Leadership Coalition (USA) and Industrial Internet Consortium (USA).

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