Brief summary of I4.0 initiative for electrical drives

Contents

1 Intent

Establish an almost-world-wide platform for field-to-field and cloud-to-field[1] data exchange that facilitates achieving "*Ind40 drive goals*" (see below), where I4.0 is intended as full digitalization and integration of the whole chain (industrial-value-creation chain). The use of ICT and IoT services enables an elevated degree of networking between producers, suppliers and customers, thus making the factories more "smart" and adding a new value.

From the point of view of drive manufacturer, I4.0 attempt to offer universal, cross-manufacturer interfaces and data structures that would facilitate cooperation between drive manufacturers, machine builders and plant operators. One of the goals is free combining of components, systems and solutions.

2 Specific goals of I40 drive initiative

- Nameplate data presentation in cloud-or-host-residing, commonly readable and shearable way, (it is necessary to rely on Industry 4.0 semantic, mapped digitally by means of already existing eCl@ss classification system for products and services)
- Graphical parametrization (tools that provide an ease of remote graphical parameter setting)
- Diagnostic of low power drives for scheduling preventive maintenance
- Data-based optimized predictive diagnostics of high power drives for early fault detections
- Cloud-or-host-based monitoring of drive systems for diagnostics, maintenance scheduling and optimization, with...

[1] Field device can be drive or any other operated asset connected to the net

- ...maintenance log which is transparent, shared and inheritable
- On-cloud simulation of drives and drive systems for the sake of an automated virtual comissioning (usefull upon replacements of individual components or subsystems)
- Cooperation capability (interchangeability od individual components or subsystems) with compliant dynamic response and application functions and services.
- Electric shaft (coupling of remote axis by means of controls and communication)
- Energy management - energy efficiency improvements by coordinated control
- Digital oscilloscope for remote diagnostics, identification, estimation and Autotuning
- Full parameter/model/history inhertance which is of uttermost significance in cases of replacing failed hardware asset with similar, but not identical one, with subsequent self-adjustment based on virtual comissioning that involves cloud-or-host simulation of the asset within its relevant system
- Cloud-host image of the asset
- Application cases & could image of asset (component or subsystem) should memorize desired and historical functionality, technical data, mechanics/electrics parameters, relevant documentation including certificates and approvals, even purchase order data, logistics data, interfaces as well as service-data, maintenance logs and support history, options and resources.

3 Cooperation capability:

In most general terms, adoption of the proposed solution and consideration of prerequisites listed below would enhance electrical drives, motion-control components and subsystems and promote their interchangeability on the following scale:

- Units with common protol are compatible
- If they share common interface, they become coexistent
- Provided with common data types and data access, units become connectable
- When sharing common parameter semantics, units are interworkable
- When sharing common application functionality, units are interoperable
- With the means of sharing and inheriting dynamic properties, units are interchangeable

4 Prerequisite: OPC-UA

It is necessary to adopt commonly accepted data-exchange procedures and forms so that every potential reader understands and uses the data correctly (*standardized exchange of data and information between devices*). Data provision has to be standardized and independent on the manufacturer. In order to achieve common understanding that guarantees to semantic interoperability, OPC-UA is proposed (Open Platform Communications United Architecture). OPC resolves IoT challenges, as well as IIoT challenges (*Industrial Internet of Things*). While OPC itself is Microsoft-dependent, OPC-UA can be implemented on a wider choice of platforms. In addition to structures, OPC-UA can use also models, and it gradually becomes one of data-exchange standards for machine-to-machine or cloud-to-machine communication.

5 Prerequisite: Time-sensitive network

Hardware and software layers of the communication system must provide a common and shared real time clock (RTC) compliant with time protocol IEEE 1588

6 Prerequisite: eCl@ss

In order to facilitate a most general, cross-manufacturer digital exchange of component/subsystem/system data, descriptions, models and logs, suggestion is to adopt eCl@ss standard, based on standardized data formats of IEC61360, in agreement with IEC Common Data Dictionary ISO 13584-4210, all of which already envisaged for a wider scope of digitizing and exchanging data on products and services.

7 Proposal: RAMI 4.0

German proposal of mapping and storing cloud-host-residing component properties envisages RAMI 4.0 data architecture, a 3-dimensional space where one of the axes virtually represents type/instance issues (development, operation, maintenance..., „life cycle value stream“), the second axis deals with hierarchy levels according to IEC62264(from product level towards the world), and the third axis provide space for categorization of layers from „asset“ towards „business“. The last one layer called „integration“ is dedicated to out-of-standard records to be dealth with.

8 Prerequisite: Asset Administration Cell

Each node/unit/asset/component/subsystems with cloud-host connection and virtualzation requires its own and internal dedicated software layer, „Asset Administration Cell“ (AAC) that facilitates/ translates/ /organizes bidieractional data flow in order to achieve the basic handling of the manifest as well as desired virtual representation, technical functionality, component management.

Other than being universal, the AAC concept, design and implementation have to provide an self-explanatory mapping of the unit/asset data logs, properties, parameters and dynamics into the IT world. Data flow towards cloud-host has to share (t.b.d.) the same semantics, cross-vocabulary and syntax.

9 First impression

In DM2020-like platforms, required interventions are prevalently software while the main concerns is the device speed (MFLOPS, number-crunching-capacity) and the available memory.