Success Story
COMET

CDP
Austrian Center for Digital Production
Programme: COMET – Competence Centers for Excellent Technologies
Programme line: K1-Centres/K-Projects
COMET subproject, duration and type of project:
Demonstrator Project 2 “Adaptive Production System” multi-firm

Flexible safety networks

Heterogeneous production lines place a new range of demands on communication and interoperability. A key aspect thereby is functional safety and its technical implementation. Up to now, safety-relevant connections heavily build upon dedicated cables, which causes additional costs and is highly inflexible. Therefore, the Austrian Center for Digital Production (CDP) developed a new, flexible system architecture that enables safe and non-safe communication on a single connection. It is based upon multiple vendor-neutral technologies: Time-Sensitive Networking (TSN), OPC Unified Architecture (OPC UA) and a suitable safety protocol.

Introduction

At the core of Cyber-Physical Production Systems (CPPS) and related concepts is the need for interoperability. Factories, in this context, comprised of a heterogeneous array of machines integrated as a singular production line, pose a set of challenges.

Currently, dedicated cables have to be installed to connect the safety features of various machines in a production line. Additionally, these cables require monitoring for open-circuit and short-circuit faults in order to guarantee proper functioning of safety features.

Existing technologies such as TSN and OPC UA address the demands for interoperability across a multitude of vendors and manufacturers. However, no specification exists which covers the need for interoperability, discovery, and automatic configuration in the field of functional-safety-related applications.

Building blocks and enabling technologies

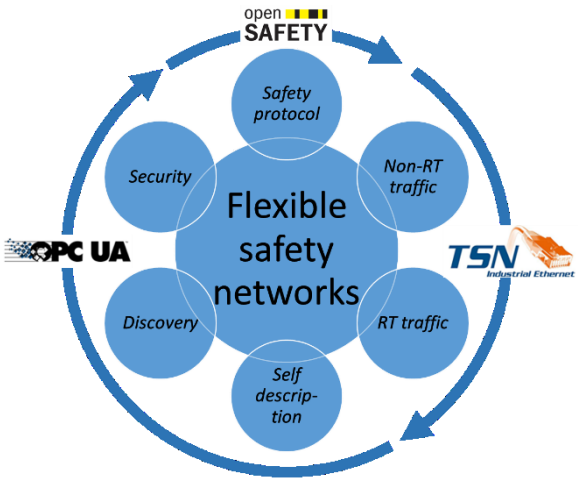

Fig. 1: Building blocks of flexible safety networks and suitable enabling technologies

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As a preliminary step, the CDP identified a number of building blocks required to cope with increased requirements regarding cost efficiency, vendor interoperability and flexibility, which will arise from future CPPS (cf. Fig. 1). Subsequently, openSAFETY, TSN and OPC UA have been chosen from a wide range of standards and protocols as the ones being most promising to cover the identified building blocks but also other ongoing developments in the field of CPPS.

openSAFETY is used as a safety protocol. It detects any loss of communication and transmission error immediately and triggers the system to change to a safe state, to prevent damage of equipment and injury of personnel. TSN handles the transmission of real-time (RT) and non-RT traffic on the same physical connection, both of which are required in any CPPS. Finally, OPC UA provides additional services that allow devices to describe their capabilities (e.g. triggering an emergency stop), search for capabilities offered by other devices and provide state of the art information security.

Safety network architecture

Fig. 2 illustrates the developed safety network architecture based on a simple example setup. The setup represents a modular and heterogeneous production line that consists of machines from various manufacturers and an additional emergency button. Pushing one of these emergency buttons stops the drive on its corresponding machine as well as all drives belonging to the same production line.

Initial setup of the production line is tremendously simplified as the same network connection is used for RT, non-RT and safe communication. Furthermore, adding an additional module, e.g. an industrial robot, is done almost autonomously based on the description of its capabilities and the available discovery services. Only the final check and confirmation is still performed by a human operator.

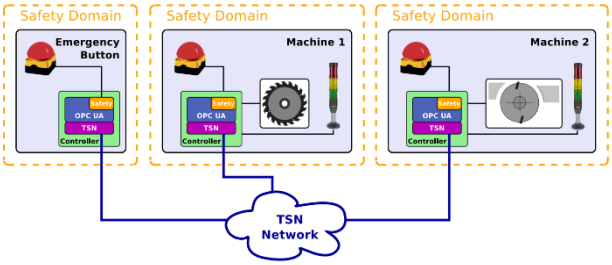

Fig. 2: Flexible safety network architecture

Impact and effects

CDP currently implements a prototype of the developed safety network architecture. It will certainly be an important step forward towards flexible production lines, in particular for small and medium sized companies that ate specialized on small lot sizes.

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