

# The brain of the machine

*The logistics industry is booming. With growing demand, there is need for transport solutions, especially within the warehouses. BHS Intralogistics has developed an autonomous transport shuttle. The brain of the shuttle is STW's CANopen-capable ESX.4cs-gw control unit.*

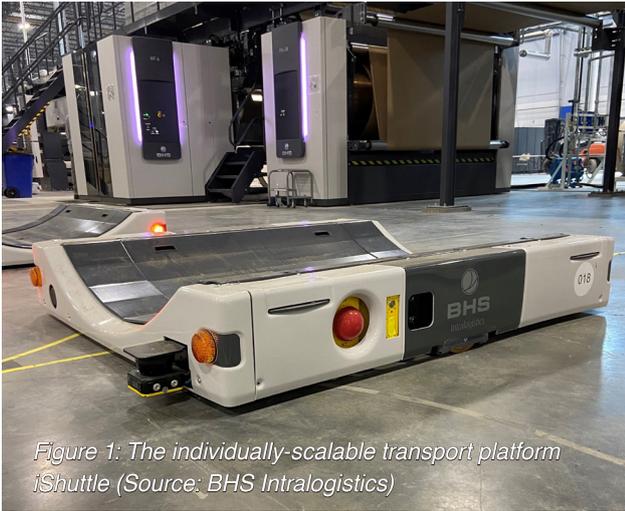


Figure 1: The individually-scalable transport platform iShuttle (Source: BHS Intralogistics)

Hardly any other industry has experienced the years of upswing than the logistics branch does currently. In 2020, the coronavirus pandemic (Covid-19) and the associated increase in demand in e-commerce meant positive results throughout the branch. However, continued growth is leading to a shortage of skilled workers within the industry and an increasing need for automation, especially in intralogistics. More and more frequently, autonomous trolley trains and automated high-bay warehouses are taking over tasks that were still being performed by skilled workers just a few years ago. This trend is enabled by increasing digitalization of the infrastructure within warehouses, and increasingly powerful control and sensing technology in autonomous vehicles and machines used in the internal material flow.

## An individually scalable transport platform

BHS Intralogistics is a joint venture, founded at the end of 2018 between the machine and plant manufacturer BHS Corrugated and automation and control specialist KS Control, which has specialized in the development of machines and systems for automated processes in internal material flow and load tracking.

One of these machines is the iShuttle, an autonomous mobile transport platform with a load capacity of up to 4,5 t. The shuttle is only 285 mm high and can be integrated into the in-plant transport flow, independent of the spatial conditions, with 2D laser navigation or camera supported line guidance. Multiple iShuttles of different sizes can be integrated as a fleet solution with the autonomous shuttles customizable to the customer's requirements.

With different platform configurations such as lift table, push and pull function for goods transfer, belt or chain conveyor, and variable travel speeds, the iShuttle is suitable for a wide range of intralogistics tasks.

## Safety first

Control systems from STW play a significant role in the safe operation of the autonomous transport platforms. The automation specialists have been supplying control components for mobile machinery for over 35 years, from agricultural technology and construction machinery to material handling machines, as in this case. When BHS Intralogistics was looking for a control system manufacturer that could offer proven functionally safe controllers for their industry, the choice quickly fell on the CANopen-capable ESX controller family from this long-established company from Kaufbeuren, Germany.

„With the development of our iShuttle, we did something very new. It represents the first autonomous driverless transport system in our portfolio, and we were looking for control expertise with plenty of experience, especially regarding the functionally safe design of mobile machines. STW is exceptionally well established in this field," explained Tristan Warias, software developer at BHS Intralogistics.

## Six CAN interfaces

In the iShuttle, an ESX.4cs-gw operates as the managing controller. The ESX.4cs-gw has a three-core processor (an Infineon Aurix, 3 x 300 MHz), six CAN interfaces, and five Ethernet interfaces. With the help of a managed ▶



Figure 2: The transport system in action (Source: BHS Intralogistics)

four-way 100 Mbit/s Ethernet switch, large amounts of data can be selectively forwarded in the system without using processor power. "With our new generation of controllers, machine manufacturers have even more performance at their disposal. The powerful processor and extensive support for sensor integration contribute to this," said Stefan Hohn, STW project manager, in explaining the advantages of the ESX.4cs-gw. To avoid any safety risk, the ESX controllers regulate the iShuttle's drives in accordance with safety integrity level 2 (SIL) and performance level d (PL d). This was the functional safety requirement for the iShuttle to be able to operate in an industrial environment. In the iShuttle, two additional ESX.3ios controllers are connected to the managing controller via CAN, expanding the functionality and connectivity options, for example for the autonomous vehicle's extensive sensor suite. Thus, in this application, the ESX.4cs-gw is found in its ideal role as a central node that can receive, process, and distribute a large number of CAN signals.

In general, all six CAN interfaces of the ESX.4cs-gw are CANopen-capable. The communication interfaces comply with the CANopen application layer and communication profile CiA 301. This includes the data types, encoding rules, and object dictionary objects as well as the CANopen communication services and protocols. In addition, this specification defines the CANopen network management services and protocols. It also defines the CANopen communication profile, e.g. the physical layer, the predefined communication object identifier connection set, and the content of the Emergency, Timestamp, and Sync communication objects.

For safety-relevant communication, the controller supports CANopen Safety and the CAN Safety protocol ECoS developed by STW. STW's SIL2/PL d-certified protocol significantly reduces the amount of data required on the CAN network, and so the bus load is significantly lower than that of the generic CANopen Safety protocol thanks to the reduced amount of data.

The ESX.4cs-gw from STW supports bit-rates of up to 1 Mbit/s. A reliable connection to the machine is guaranteed via an 80-pin Molex CMC connector in a 48/32-pin configuration. A wake-up functionality can be realized on CAN 1. CAN 4 can be implemented as a galvanically-isolated interface to isolate supplementary functions from core vehicle or application functions and prevent any potential interference.

Finally, two of the CAN lines can be daisy-chained with CAN-In and CAN-Out connectors. For machine manufacturers this means simpler implementation of CAN chains and a reduced cable harness.

## Application-specific programming

Users of the ESX.4cs-gw have various options for the development of the application software at their disposal: The free open-source development and life cycle management tool Opensyde from STW offers the possibility to map and test functionalities in "C" as well as according to IEC61131 (logi.CAD3) in Structured Text (ST). Even older, existing systems can be configured, managed, and updated with the help of Opensyde. Via the numerous



Figure 3: The brain of the machine: CANopen-capable control unit ESX.4cs-gw (Source: STW)

pre-installed widgets in the tool, data available via CAN or Ethernet can be displayed graphically and used in HMIs (human machine interface) or cloud solutions. Numerous convenient functions such as current controlling and ramp functions for outputs or frequency averaging for inputs are already integrated. Additional libraries simplify system integration. An 8 MiB flash memory, 2 MiB RAM, and a 32 KiB EEPROM are available for the customer application.

BHS Intralogistics used STW support and consulting during the development of the iShuttle to get the most out of the programming environment and to build a standards-compliant safety architecture. "Despite Covid-19 and the associated contact bans, STW service was there to help us with advice and support, providing various online seminars. This helped a lot with the system design," recalled Tristan Warias.

The iShuttle from BHS Intralogistics is a high technology solution for one of the fastest changing industries of our time. Anyone who has had the chance to experience a swarm of autonomous vehicles working together knows what an impressive sight this is. STW's flexible and safe control solutions are fundamental to this exciting experience. The iShuttle is another example of a successful partnership between an innovative machine manufacturer and the automation experts at STW. ◀

### Source

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