SAE INTERNATIONAL®

TRUCK & OFF-HIGHWAY ENGINEERING®

Production eCascadia

Freightliner reveals electric truck at ACT Expo

Executive Viewpoints

- The hydrogen highway
- Hydraulics in e-machines
- Retrofitting automation
- Megawatt charging

Ammonia, HVO promising diesel alternatives

Supplier Directory + Product Guide

June 2022 mobilityengineeringtech.com

CONTENTS

FEATURES

EXECUTIVE VIEWPOINTS

16 Paving the way for the hydrogen highway
Experts at SAE WCX 2022 look beyond EVs to other systems that can garner net-zero capabilities.

20 Electric mobile machines won't abandon hydraulics
Bosch Rexroth executive stresses that electrification in off-highway applications must make optimum use of both next-gen electric and hydraulic technology.

23 Aftermarket augments off-highway autonomous efforts
Kontron and Intel experts explain how rugged, modular COM Express solutions reduce complexity and allow retrofit of autonomous systems on heavy mobile equipment.

26 Solving the challenges of Megawatt chargers
Littelfuse executive details an alternative technique for fast and efficient high-power charging of commercial electric vehicles.

33 Supplier Directory
Complete listing of industry suppliers categorized by technology area.

ON THE COVER

Freightliner officially revealed the first production model of the all-electric version of its Cascadia at the ACT Expo in Long Beach, California, in May. *(Image: DTNA)*

10

REGULARS

2 Editorial
Alternatives poised for growth as diesel prices climb

4 Technical Innovations
4 Ammonia a promising alternative for marine sector | ALTERNATIVE FUELS
8 Allison toughens TerraTran off-highway transmission | POWERTRAIN
10 WAVE builds in-road inductive charging for large EVs | ELECTRIFICATION
12 Webasto delivers battery thermal management for Zeus EV chassis | THERMAL MANAGEMENT
13 New biodiesel strains offer measurable gains | ALTERNATIVE FUELS

29 Original Equipment
29 Production eCascadia ready for 230 miles of 'typical range'
31 Caterpillar launches next generation M-Series compact wheel loaders

42 Product Guide
42 Propulsion
44 Electronics
46 Materials & Manufacturing
48 Hydraulics & Actuators
49 Testing & Simulation

follow us @SAEOHEMag

Truck & Off-Highway Engineering®, June 2022, Volume 30, Number 3. *Truck & Off-Highway Engineering* (ISSN 2475-6148) is published in February, April, June, August, October, December by SAE Media Group, 261 Fifth Avenue, Suite 1901, New York, NY 10016 and printed in Mechanicsburg, PA.

Copyright © 2022 SAE International.

Annual print subscription for SAE International members: first subscription, $20 included in dues; additional single copies, $30 each North America, $35 each overseas. Prices for nonmember subscriptions are $100 North America, $150 overseas, $30.00 digital subscription, $30.00 single copies. Periodicals postage paid at New York, NY and additional mailing offices. POSTMASTER: Please send address changes to *Truck & Off-Highway Engineering*, P. O. Box 3525, Northbrook, IL 60062. SAE International is not responsible for the accuracy of information in the editorial, articles, and advertising sections of this publication. Readers should independently evaluate the accuracy of any statement in the editorial, articles, and advertising sections of this publication that are important to him/her and rely on his/her independent evaluation. For permission to reproduce or use content in other media, contact copyright@sae.org. To purchase reprints, contact advertising@sae.org. Claims for missing issues of the magazine must be submitted within a six-month time frame of the claimed issue's publication date. The *Truck & Off-Highway Engineering* title is registered in the U.S. Patent and Trademark Office, and feature articles are indexed and included in SAE Mobilus®. For additional information, free demos are available at https://saemobilus.sae.org/.
ISSN 2475-6148 (print)

Audited by BPA WORLDWIDE BUSINESS
SIGNET RESEARCH INC
SAE INTERNATIONAL®

Aftermarket augments off-highway autonomous efforts

Kontron and Intel experts explain how rugged, modular COM Express solutions reduce complexity and allow retrofit of autonomous systems on heavy mobile equipment.

by Jack London and Andrea Thomas

Kontron and Intel are helping embedded system developers address design requirements for mobile equipment with onboard edge-computing platforms based on industry-standard components.

Continually transformed with more than a century's advances in capabilities, hydraulics and fuel efficiency, today's heavy mobile equipment must also become more intelligent and better connected. Technologies such as artificial intelligence (AI), deep learning, big data, GPS, 5G and computer vision are proving their mettle — empowering far more efficient ways of carrying out unique and demanding tasks via advanced telematics, advanced driver assistance systems (ADAS) or varying levels of autonomy.

Heavy mobile equipment (HME) that can gather and apply data in real time operates and makes decisions in ways that humans cannot. This evolution toward automation promises not only leadership for manufacturers of more advanced systems, but also increased safety, economy, efficiency and ecological compatibility.

Automated performance is the next step for these indispensable vehicles, yet automating them is a deeply complex mission. For system designers and operators, transforming these machines requires well-defined fleet strategies and fleet-specific software and hardware that can be applied to a variety of use cases.

Modular standards-based COM Express solutions demonstrate high value here, often compatible with manufacturers' existing systems and playing a key role in developing connected machinery. These small-footprint systems blend high performance and rugged characteristics to enable heavy-equipment fleet operators to capitalize on cloud services, benefitting from machine-to-cloud and machine-to-machine communications.

Jack London, VP Business Development, Kontron North America.

Andrea Thomas, Senior Product Marketing Engineer, Intel.

"Automated performance is the next step for these indispensable vehicles… Retrofitting of systems is breaking new ground in this effort."

COM Express supports smart retrofit

Standards-based Com Express modules provide developers with design flexibility and a path to an open-architecture platform that can be deployed across a given vehicle portfolio. The COM Express standard defines a variety of form factors, allowing developers to strike a strong balance between cost and performance as well as flexibility needed for a spectrum of embedded devices. As such, COM Express is

CLOCKWISE FROM TOP: KONTRON; INTEL; KONTRON

uniquely positioned for rugged, small form factor applications that incorporate custom development.

Because all customization is designed into the system's carrier board (rather than the COM itself), systems can perform over technology generations using a range of CPU cores, for example, swapping out one for the next. As a result, COMs work well for devices that not only require scalability from generation to generation, but also within a single generation. These design characteristics add longevity that strongly aligns with HME long life cycles.

COM Express modules support a holistic strategy in which a single high-performance system can handle a diverse slate of data-driven applications. Fleet operators can avoid investing in multiple technologies that become unique to each vehicle asset, and instead maintain familiarity with a single solution that is applicable to all types of rugged end-use cases.

Systems driven by standards-based COMs also address the expectation that a "connected, intelligent vehicle" includes high startup costs, or even a rip-and-replace of costly fleet assets. The high cost and long service life of HME mean that the most effective way to deploy new technology is as an aftermarket solution installed into currently owned vehicles, naturally well-suited to small form factor COM Express-based systems. Aftermarket solutions are customizable, reusable, vehicle agnostic, affordable and can be expanded to incorporate new use cases as the needs of fleet operators change or grow.

On this design landscape, when system replacements are required, costs are minimized. Upgrades are inherently manageable: when scalability or performance advancements are needed, the module can be swapped for the next processor generation while still capitalizing on the customization and capital investment of the original supporting carrier board. Product longevity is also protected with close partnership between chip suppliers and system manufacturers – this includes extended lifecycle management, which capitalizes on embedded roadmap products and priority access to processors and components.

Readymade platform vs. building blocks

COM Express platforms offer two distinct development paths for data-intensive applications in construction, agriculture, trucking and mining industries. An optimized system can be illustrated by **Kontron**'s EvoTRAC — a validated, application-ready platform with built-in capabilities for in-vehicle AI, deep learning and high-performance embedded computing (HPEC). Deployable as a rugged, ready-made solution for applications onboard heavy-duty mobile machinery, the platform features an **Intel** Xeon D processor, Intel Dual

Kontron's EvoTRAC platform can be paired with the IP67-certified EvoTRAC-G103 Gateway, incorporating Kontron's hardened Type 6 COM Express CPU module and featuring an Intel Atom processor coupled with a ruggedized carrier board. The gateway integrates dual Gigabit Ethernet and dual CAN bus interfaces that support 2.0 A and B, along with two USB 2.0 interfaces, and Wi-Fi, 4G Advanced Pro+ for wireless connectivity.

10GbE network adapter card, and multiple GPU options for machine learning and AI workloads.

It is specifically designed to accelerate time to market and leverages the Intel Distribution of OpenVINO toolkit to enable high-performance computer vision and inference applications that can be more customized, optimized and more readily deployed. Built-in AI and machine learning capabilities help operators quickly capture and analyze relevant data and develop new processes. The solution also delivers increased automation in compliance with safety regulations. Kontron and Intel offer a safety mezzanine proof-of-concept option, allowing manufacturers to implement functional safety to their specifications.

Alternatively, the same platform can act as a building block to give developers a head-start on their own customized systems for autonomous applications. Application developers can tap into the inherent versatility of COM Express but develop their own carrier board and resulting full solution.

Once retrofitted, HME can readily access the processing power to capture, monitor and use data from other technology-equipped machines for greater insight into equipment operations. Workflow can be synchronized among machinery using the cloud, empowering both teams and equipment — safely and efficiently — for greater productivity.

The shift to greater automation has global impact on diverse, infrastructure industries. Autonomous mining machinery improves operations and safety, now manageable from a single remote location. This translates into steady improvements in productivity gains and return on investment. In agriculture, wireless connectivity empowers farmers to retrofit and automate existing equipment, handling field-specific fertilization and synchronizing autonomous tractor operations for harvesting and crop loading.

In construction, predictive data enables proactive maintenance, allowing operators to accelerate performance and more easily coordinate groups of machines for improved scheduling and fueling. Such a landscape brings both opportunity and challenge for the embedded developers behind this new generation of connected, autonomous machines. Managing complexity is crucial, as is taking smart steps to automate for broad competitive value.

KONTRON

Connected, intelligent and evolving

The global automated construction market is projected to reach a value of $186.6 billion by 2024, maintaining a compound annual growth rate (CAGR) of 15.5% from 2019-2024. The automated mining equipment market is similarly growth oriented, with expectations of a 7.21% CAGR through 2025. And the use of AI in the agricultural market is projected to grow from 2020's estimated $1BB to $4BB by 2026, a CAGR of 25.5%.

In agriculture, market growth is propelled by three key factors: the desire to implement data generated through sensors and aerial images for crops; increasing crop productivity due to deep-learning technology; and government support for the adoption of modern agricultural techniques. In the Americas, large-scale agriculture players are already using AI technology to significantly improve the speed and accuracy of crop planting and management techniques.

Intelligent and autonomous solutions are not luxuries: on board heavy-duty equipment, these applications are necessities that enable operators to run machinery safely, increase production, reduce waste and systemize their work. Retrofitting of systems is breaking new ground in this effort.

Tapping into efficient and cost-effective COM Express technology, fleet operators are capitalizing on machine-to-cloud and machine-to-machine communications. The world of heavy mobile equipment is poised to uncover new efficiencies and competitive advantage from data gathered and processed close to where it is generated – however rugged or unique the environment. ■

Improved productivity and safety mean organizations can move workers out of hazardous conditions to focus on higher-value tasks.

ISTOCK-896157870_SEVENTYFOUR

Jack London, VP Business Development, Kontron North America, and Andrea Thomas, Senior Product Marketing Engineer, Intel, cowrote this article for *TOHE* as part of the annual Executive Viewpoints series. Kontron is a member of PICMG, the consortium governing the COM Express specification, and its engineers continue to be involved in new developments for the standard.