WHITE PAPER

ON-BOARD ENTERTAINMENT SYSTEMS FOR RAIL

IMPROVE THE PASSENGER EXPERIENCE AND GENERATE NEW REVENUE STREAMS WITH OPEN ARCHITECTURE COMPUTING BUILDING BLOCKS

POSSIBILITIES START HERE kontron

CONTENT

THE ABILITY TO OFFER PASSENGERS STREAMING VIDEO, MOVIES, MUSIC AS WELL AS ACCESS TO THE INTERNET AND OTHER INFORMATION ENHANCES THE CUSTOMER EXPERIENCE.
THIS GIVES MASS TRANSIT OPERATORS COMPETITIVE ADVANTAGE, AND ALSO THE OPPORTUNITY FOR NEW REVENUE STREAMS FROM ADVERTISING AND OTHER PAID SERVICES.

Streaming video, movies and music along with access to the Internet for e-commerce and other information can make any journey more enjoyable and productive. As the share of video content on the Internet continues to grow steadily, it is expected to reach 72% of total mobile device Internet usage by 2020[1]. This represents a huge opportunity for intercity, commuter train and mass transit operators to increase customer loyalty and enhance the passenger experience by expanding the availability of on-board entertainment. Passengers today have an expectation of extended services that give them the freedom to bring their own devices (BYOD). Operators see the potential to increase ridership by providing local content entertainment. On-board entertainment also brings the compelling opportunity for additional revenue generation from passenger paid services as well as from advertising.

But before operators implement new on-board entertainment and passenger information systems, they must carefully assess the technology building blocks available for possible pitfalls that slow development or can cause operational issues down the road. A main concern is that these systems integrate multiple devices with many based on varying and proprietary technologies. Proprietary-based systems do not provide the compatibility necessary to facilitate interoperability with other systems in the infrastructure, and limit operators to only using platforms in a specific hardware format making it more difficult to support long life, upgradeable applications.

(1) Cisco Global Mobile Data Traffic Forecast - 2015-2020

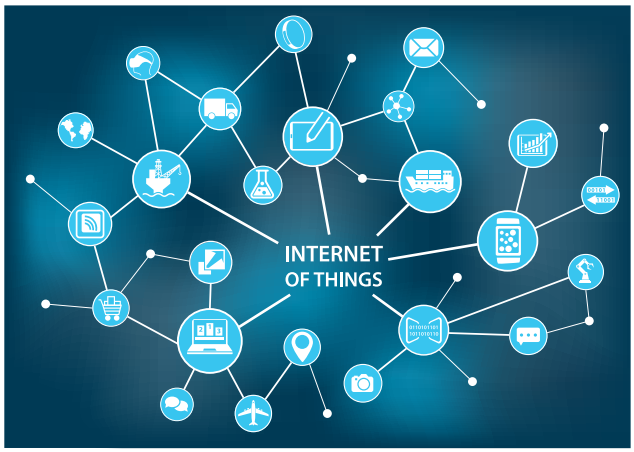
OPEN ARCHITECTURE TECHNOLOGY IS THE ANSWER

To solve these issues, open architecture Commercial Off-the-Shelf (COTS) computing platforms provide the flexible platforms required to reduce system complexity, ensure full security and support the necessary interoperability to seamlessly connect to multiple rail systems. COTS technology-based platforms are the answer to standardizing infrastructure equipment in the rail market. Without standardized modular building blocks, expanding an on-board entertainment system over a broader fleet of vehicles or upgrading the system to take advantage of more advanced, higher performance technologies is made more difficult if not impossible.

Implementing a COTS approach allows system integrators and software developers to focus on their specific applications with the knowledge that their open architecture hardware foundation is validated. Instead of piecing together varied solutions, on-board entertainment systems based on standardized elements such as access points, protocols, streaming content services and protection mechanisms used in the media industry give rail operators a certified and regulated infrastructure. Scalability is designed into COTS-based platforms compared to a system that uses proprietary technologies that may suffer from an extended time between technology iterations and innovations. Whereas, there is a broad ecosystem of companies for defining an open system standard. COTS building blocks assure transportation system developers of continued advancements in features and capabilities as well as a reliable level of backward compatibility.

Another advantage is that developers can benefit in working with a technology supplier that offers computing platforms that feature a uniform device structure. This way, they simplify development, certification and manufacturing through a single source to guarantee the highest quality and the meeting mandated standards such as ISO9001, EN50155 and SIL.

On-board entertainment and passenger information is also a part of what is seen as the data revolution in transportation and a driving factor for the Internet of Things (IoT). In an increasingly connected world, COTS open architecture computing platforms that have been fully validated for the transportation industry deliver the foundation for managing and controlling the explosion of data while meeting the requirements for IoT-enabled solution-ready-platform.



// KONTRON'S IOT-READY TECHNOLOGIES ADDRESS THE SYSTEM COMPLEXITY CHALLENGES FOUND IN TRANSPORTATION INFRA-STRUCTURE. IMPLEMENTING A UNIFORM DEVICE STRUCTURE, ALLOWS OPERATORS TO GET MAXIMUM UTILIZATION OF DATA, WHICH HAS BECOME THE LIFE BLOOD OF THE TRANSPORTATION INDUSTRY.

GOING FROM FRAGMENTED TO ENTERTAINMENT READY

Seeing a need in the industry to enhance a passenger's journey while helping them stay productive and delivering relevant content, Kontron and Axinom have collaborated on the transportation industry's first integrated and validated hardware and software on-board entertainment solution. With the understanding that standardizing infrastructure is critical to enabling connected systems, Kontron and Axinom developed a fully operational and extensible platform for rail so operators gain a truly future-proof technology foundation that meets passenger expectations for on-board entertainment, information and other connected services. Keeping passengeŕ s needs at the forefront, the platform is designed for reliable and seamless delivery with fast startup and loading times and offers easy and intuitive navigation.

Ensuring these needs are met and meeting operator requirements to limit the impact on rail Internet connections, the application-ready platform provides localized on-board media streaming. This way, it only requires a limited amount of data transfer over the Internet compared to media streaming over the Internet because video assets are stored on-board and streamed directly to passengers via a Wi-Fi connection.

It provides full on-board entertainment and passenger information capabilities including the ability to do credit card transactions, manage customer authentication/ preferences, handle premium content s security through digital rights management service and support real-time system monitoring of the media portal, license server and streaming server. There are also options that allow live channel streaming and newsfeeds depending upon

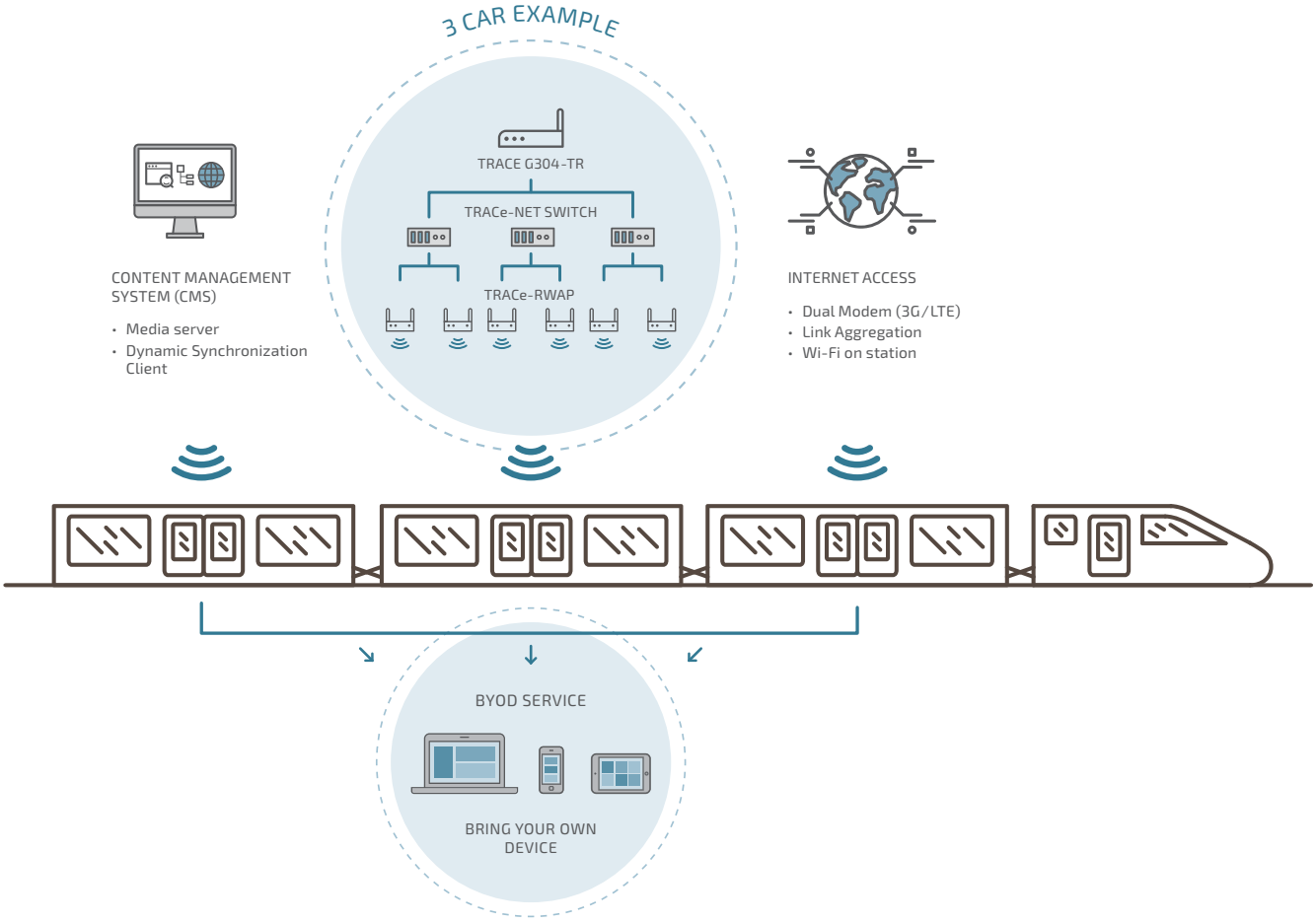
the train-to-ground bandwidth availability of the installed system.

The combined solution-ready platform is made up of multiple Kontron COTS-based TRACe™ computing platforms powered by Intel® processors, integrated with Axinom's on-board entertainment software and back office systems. These are independent COTS offerings that Kontron and Axinom have validated and optimized into a fully operational system that speeds deployment of next-generation on-board entertainment and passenger information services.

COTS Computing Hardware Building Blocks

Ensuring deployment confidence, Kontron is highly experienced in building products for the transportation industry with platforms currently deployed in many European and American rail transportation applications. Kontron's TRACe family is a comprehensive line of operational computers that are proven, rugged, and designed specifically for the transportation market. The Kontron TRACe hardware building blocks in the on-board entertainment platform include the TRACe B304-TR, TRACe-NET Switch and TRACe-RWAP Wi-Fi access point. All TRACe components embed Kontron's Health Management capabilities allowing operators to securely supervise the entire entertainment system.

The Kontron TRACe B304-TR makes up the core of the system. It is an EN50155 certified fanless operational computer based on the quad-core Intel® Atom™ processor E3845, which delivers power-efficient computing performance. The Intel Atom processor E3800 product family is the first system-on-chip (SoC) designed for intelligent systems, delivering outstanding compute, graphical, and media performance while operating in an extended range of thermal conditions prevalent in rail applications. TRACe-G304-TR wireless gateway variant, featuring Wi-Fi, LTE and SSD storage is also a perfect choice for an on-board entertainment architecture. The TRACe platform then acts as the on-board media server and gateway at the same time, enabling media content updates. Highlights of the product family include high I/O connectivity, integrated memory controller, virtualization, error correcting code (ECC) and high performance / watt ratio.



// KONTRON AND AXINOM DELIVER A COMPLIANT, APPLICATION-READY ON-BOARD ENTERTAINMENT PLATFORM THAT LEVERAGES PROVEN HARDWARE AND SOFTWARE EXPERTISE BACKED BY SOLID MARKET KNOWLEDGE.

Providing additional connectivity support is the TRACe-NET switch. TRACe-NET is an 8-port fully managed Layer 2 industrial Power over Ethernet (PoE) switch with 2 Gigabit uplink ports and has EN50155 approval. Its dual redundant power supplies, configurable system, compatibility with other switches and IP40 housing make TRACe-NET ideal for transportation environments. A future extension to the TRACe line will include TRACe-RWAP, a railway certified Wireless Access Point supporting the latest 802.11n/ac standards.

Maximizing secure connectivity, Kontron's next-generation TRACe family of products will be IoT-ready. This intelligent platform integrates embedded processing and remote communication that can share data with a network. Rail applications will have the ability to analyze any captured data, enabling new classes of services. With the IoT in place, rail systems become more efficient, and the added connectivity ultimately helps to make people's lives easier.

Kontron is the first embedded computing supplier to offer full security protection embedded in its products. With TRACe, rail customers will be assured of a comprehensive range of protection capabilities with Kontron's embedded Approtect security architecture. Beginning with the 6th generation Intel® Core™ processor, all Kontron products will be equipped with hardware-based embedded security as a "Kontron Standard". Security features include IP and integrity protection, license creation, management and tracking, license model implementation as well as the assignment of privileges and access levels. Using these advanced capabilities, customers can more easily address security needs at the application layer to provide necessary IoT connected device protection.

Content, Digital Rights and Delivery Management Software

Entertainment wise, Axinom has substantiated software solutions for the complete lifecycle of the content and is unique in offering an end-to-end on-board entertainment solution for any moving vehicle scenario. Axinom's rail-based software portfolio includes a Content Management System (CMS), Content Delivery System (CDS) and Digital Rights Management (DRM). Axinom's CMS is designed to manage any kind of digital content in one single interface. CMS is based on extensible workflow engine and is open to features extensibility. CDS software allows robust content synchronization using standardized communication protocols, and provides highly secure content delivery. The DRM service enables operators to offer MPAA rated content on a wide range of client OS platforms. It is designed to guarantee the security of premium content and can operate in a disconnected fashion enabling premium video on vehicles.

Designed as separate modular elements, each Axinom software product can be easily integrated into existing infrastructure equipment or customized to fit individual customers' needs. Axinom components are also interoperable working together seamlessly and facilitate efficient on-board system set-up. Axinom´s extensible and adaptable platform is structured in a way that it is capable of integrating other services, fulfilling the upcoming demands for features, extensions, and new possibilities.

// THE ON-BOARD ENTERTAINMENT SOLUTION-READY PLATFORM FROM KONTRON AND AXINOM GIVES DEVELOPERS THE OPTION TO OFFER PASSENGERS A PERSONALIZED VIEW OF THE CONTENT THAT ALLOWS THEM ACCESS TO FAVORITES, SCHEDULES, NOTIFICATIONS, ETC.

TRUST FROM PROVEN EXPERIENCE

Customers get a fully customizable and extensible digital platform that delivers maximum flexibility and enables them to easily and securely incorporate new services. Fully operational and cost-effective, this entertainment-ready platform delivers all the building blocks needed for developers to build their own solutions efficiently and quickly.

Allowing operators to be proactive in managing application functionality and ensure increased uptime, Kontron integrates advanced health management via an independent microcontroller. Significant efficiencies and benefits from remote monitoring, fleet availability, serviceability and anticipated maintenance that were previously unavailable are now possible using health management features.

Beyond its substantial experience in the development of rail system products, Kontron is able to leverage the company's leading expertise in complex IFE (In-Flight Entertainment) advancements for the commercial avionics market. Kontron products currently fly on many major US and international airlines providing a broad range of entertainment offerings including fast and reliable internet

service deployed in more than 3500 aircraft. This powerful combination demonstrates a unique competency in the development of robust, reliable systems ideally suited for the rail environment.

This proven track record in IFE and onboard rail systems combined with Axinom's extensive experience in delivering Hollywood studio-approved solutions provides a powerful resource that enables rail operators to benefit from the recent innovations in the avionics and media industry tailored to match the rail environment.

Tested for Performance

In joint performance tests, the combined Kontron and Axinom platform is shown to easily service 250 simultaneous streams at 3000 Kbps (Full HD) in a wired environment. With CPU usage at 20% and memory usage at only 15%, the system can deliver a total streaming throughput of 750 Mbps. These tests show the theoretical performance of the solution , however, they do not demonstrate a realistic business case simulation as the purpose of BYOD is to provide content to personal devices through Wi-Fi connectivity - not a wired environment.

▶ MAX NUMBER OF CONCURRENT STREAMS

Wi-Fi availability	stream bitrate				
	400 kbps	800 kbps	1200 kbps	2100 kbps	3000 kbps
100 MBPS	256	128	85	49	34
200 MBPS	512	256	171	98	68
300 MBPS	768	384	256	146	102
400 MBPS	1024	512	341	195	137
500 MBPS	1280	640	427	244	171

Assuming a 300 Mbps Wi-Fi connection available, the system can support 307 concurrent streams at 1 Mbps average bandwidth consumption per personal device. See the chart above for the possible numbers of concurrent streams depending on Wi-Fi availability and stream bitrate per device.

ADVANTAGES TO IMPROVING THE PASSENGER EXPERIENCE

On-board entertainment and passenger information systems are key elements of the connected train evolution that will help increase passenger loyalty and enable new revenue-generating services for operators. By standardizing the infrastructure with a highly integrated and validated entertainment-ready system, operators gain the ability to more easily integrate it with other services, fulfill future feature demands and are prepared for new opportunities. Using COTS open architecture building blocks for on-board entertainment lays a solid foundation for futureproof systems that helps sustain economic growth and strengthen security while also meeting passenger expectations.

// CUSTOMERS ALSO HAVE ACCESS TO KONTRON'S SYSTEM INTEGRATION LAB (SIL) ESTABLISHED AS A STABLE ENVIRONMENT FOR CONDUCTING ANALYSIS AND PERFORMANCE TESTS. REDUCING PROJECT RISK AND SPEEDING TIME TO DEPLOYMENT. SIL IS A VALUABLE RESOURCE TO TEST WI-FI BYOD DEVICES FOR SOFTWARE INTEGRATION AND PRETESTING BEFORE INSTALLATION

Leveraging their extensive, collective experience, Kontron and Axinom's integrated application-ready platform delivers the advanced and proven technologies for ongoing support of the most-demanded features and capabilities. While Axinom software and Kontron hardware are independent offerings, the two companies have shown the power of collaborating to optimize a fully operational solution-ready-platform. Rail operators benefit from the reliability and long-term availability of Kontron's TRACe product portfolio and Axinom's comprehensive software suite. This allows transportation OEMs to minimize design risk and realize a reduced total cost of ownership, getting to market fast with high quality standards-based entertainment services.

▶ For more detailed information on Kontron TRACe transportation computers, please visit: **www.kontron.com/industries/transportation.**
To learn more about Axinom railway solutions, please visit: **www.axinom.com/railway-industry**

About Kontron

Kontron, a global leader in embedded computing technology and trusted advisor in IoT, provides a complete and integrated portfolio of hardware, software and services. Kontron creates many of the standards that drive the world's embedded computing platforms, bringing to life numerous technologies and applications. The result is an accelerated time-to-market, reduced total-cost-of-ownership, product longevity and the best possible overall application with leading-edge, highest reliability embedded technology.

Kontron is a listed company. Its shares are traded in the Prime Standard segment of the Frankfurt Stock Exchange and on other exchanges under the symbol "KBC".
For more information, please visit: **www.kontron.com**

About the Intel® Internet of Things Solutions Alliance

From modular components to market-ready systems, Intel and the 400+ global member companies of the Intel® Internet of Things Solutions Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Close collaboration with Intel and each other enables Alliance members to innovate with the latest IoT technologies, helping developers deliver first-in-market solutions.

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