

tec news

HARTING'S TECHNOLOGY MAGAZINE

"NEXT LEVEL CONNECTIVITY"

Dr. S. Melinu, Siemens

"INTO THE FUTURE WITH STANDARDS"

J. Stein, T. Sentko, DKE

EXPERTS IN THE SECTORS

M. Fritsche: ISO/IEC JTC 1/SC 25

W. Martin, R. Marques: Rockwell

A. Klees, J. Zellner: ZVK

N. Schlingmann: AEF

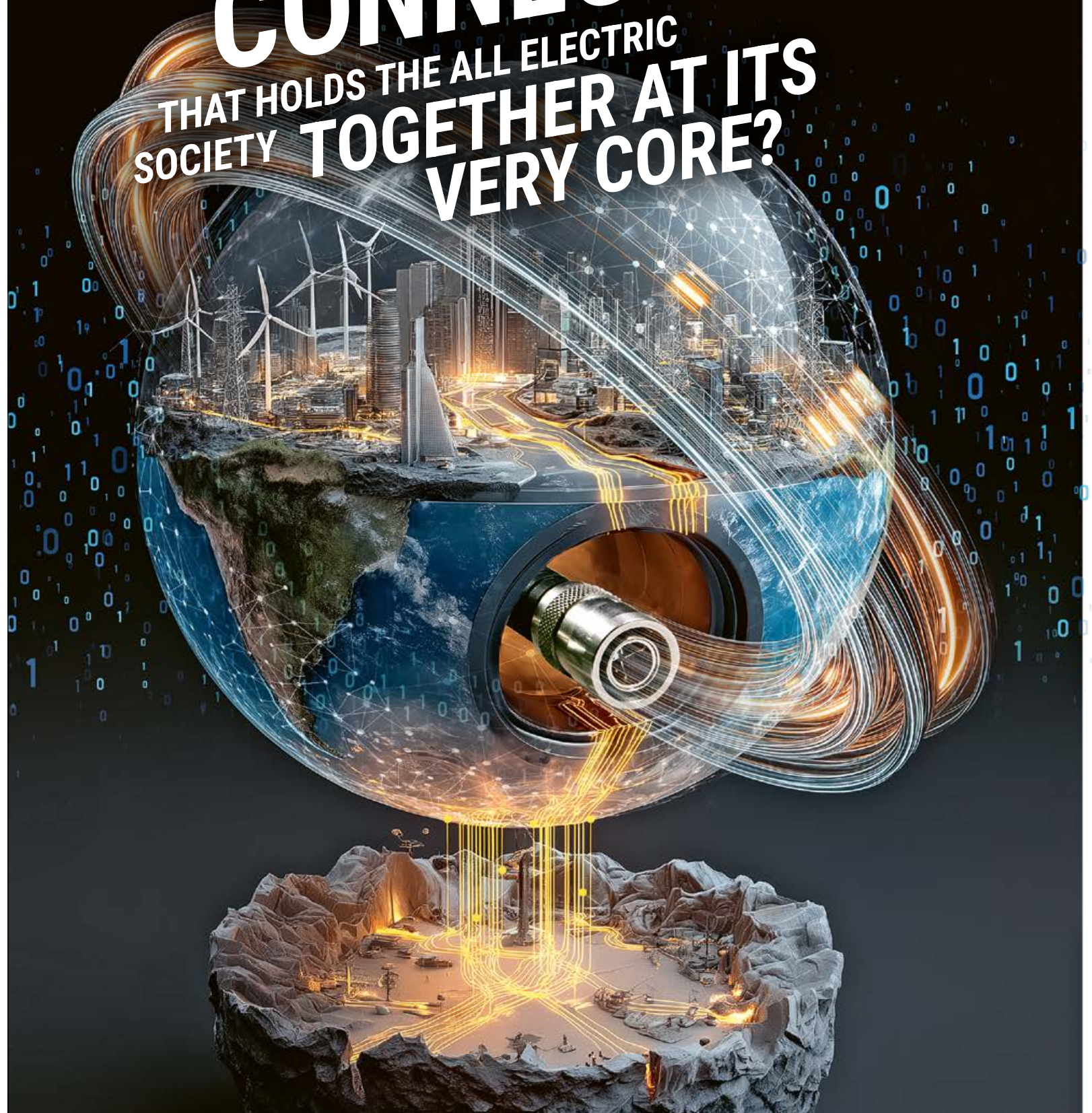
M. Roeingh: CC Isobus e.V.

NO CONNECTOR, NO DATA

All Electric Society:

Data as a lifeline
of the future

ISN'T
IT **THE**
CONNECTOR,
THAT HOLDS THE ALL ELECTRIC
SOCIETY **TOGETHER AT ITS**
VERY CORE?



Dear readers,

in an All Electric Society (AES), continuous networking is ubiquitous - the lifeline of data is just as self-evident as that of electrical power. Today, data is generated everywhere, and not least given the advent of the digital twin.

When we think of data rooms for a wide range of applications, artificial intelligence naturally comes to mind. What is often overlooked, however, is where all this data of the AES actually originates. Because once data has arrived in the cloud, it has already travelled a long way through a wide variety of data networks.

The network protocol, which enables data transmission through the network in the first place, is fundamental to this route. In terms of an all-electric society, however, this can only work across sectors if a convergent platform is created and in place.

In my opinion, Ethernet has the potential to become the gold standard for such a cross-sector communication platform..

But Ethernet must also be integrated into actual, real devices - into the sensor, into the edge device.

And this is precisely where the connector enters the picture.

So you could say: It is the connector that holds the All Electric Society together at its core. Because a connection to the data rooms is only possible if the right connector is in place. .

In this issue of tec.news, we decided to ask ourselves the question: What demands and requirements does the data lifeline in the AES ultimately place on connectors?

PS: Allow us to amplify and perhaps exaggerate connectors just a little bit at this point - this is quite simply due to our passion for this topic.

We hope you enjoy reading the latest issue of our tec.news



Philip Harting
CEO HARTING
Technology Group

tec|news

The technology magazine from



Pushing Performance
Since 1945



No connector, no connection, no data

Standardisation and openness are essential prerequisites for an all-electric society.

Issue 49 | Cover story:

NO CONNECTOR, NO DATA

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Into the future with standards

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The role of data technology in "public transport"

Ethernet becomes the standard in rail transport



The hub and linchpin

The digital twin creates transparency and effectiveness

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strategy

No connectors, no connection, no data

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Data enables carbon-neutral, efficient and safe railways – standardisation and networking are crucial



collaboration & co-creation

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Energy and data hand in hand: GeoPura delivers scalable, clean electricity thanks to hydrogen and smart networking



NO CONNECTOR, NO CONNECTION, NO DATA

Smartphones charge via induction, we connect headphones and headsets to their respective end devices by way of Bluetooth and we transmit data via wireless connections such as WLAN and the like. Even if we can hardly imagine this in our supposedly wireless age, the device our consumer end device is connected to by way of its data connection actually has a connector to transmit the data further. And the path to the cloud and the data space involves countless connectors. And even today, even in the digital space, nothing works without a simple but crucial element: the connector.

And even today, even in the digital space, nothing works without a simple but crucial element:

THE CONNECTOR.



Dr. Stephan Middelkamp
General Manager
Quality & Technologies,
HARTING Technology Group



Andreas Huhmann
Strategy Consultant
Connectivity & Networks,
HARTING Technology Group



"The notion that data connections are impossible without the right connectors is not just a technical truth. It also functions as a metaphor for the current challenges the All Electric Society is facing. At this point, sector coupling becomes the key issue (concept). But the concept of mere sector coupling actually falls short. After all, sector coupling ultimately extends far beyond just opening doors, i.e. simply overcoming the boundaries between sectors. Sector coupling calls for the far-reaching cross-sector interlinking of machines, systems and devices, including their sensors and actuators, which generate or consume energy in the various sectors in order to realise a genuinely networked electrical future."

**Data networking is the foundation of
the All Electric Society**

The central core message of these considerations is that sector coupling should not only be perceived as a means of breaking down silos between energy, industry, mobility and other sectors. **Rather, it is a comprehensive strategy aimed at integrating and networking the respective systems of different sectors in their depth and thereby creating a convergent platform in terms of data technology.**

This is because energy must be consumed precisely when it is produced. This requirement means that we have to analyse and interlink the various sectors in greater depth in order to ensure efficiency and sustainability.

"In the physical layer, networking is extremely far advanced thanks to the universal use of Ethernet. Its use here looks back on a decades-long history, which was initially characterised by the fact that different profiles were opted for, which differed in terms of the connector. This was initially due to the given application, as each automation profile, for example, represented a self-contained ecosystem. Today, the situation is entirely different. "

**Ethernet according
to IEEE is adhered
to as the standard.**

**This means that devices
can be used universally,
even in different sectors –
but naturally, only if the
connector also fits
the purpose.**

Ethernet according to IEEE is adhered to as the standard. This means that devices can be used universally, even in different sectors – but naturally, only if the connector also fits the purpose.

Standardisation, both on the physical and electromechanical layer, is becoming a crucial tool to support this integration. By creating broad, extensive standards for connectors, we are enabling seamless communication and interaction between the sectors. This delivers two benefits: On the one hand, there are advantages for users, who benefit from greater compatibility, scalability and interchangeability, for example, as well as a reduction in lock-in effects and maintenance input and costs. On the other hand, new possibilities arise in the use of decentralised end devices, which can be universally integrated in many sectors through standardised data interfaces, both physically, as well as electromechanically. This leads to innovation and dismantles old silos.



Sector coupling in the AES: LIFELINE ETHERNET

Openness instead of retreating

Protectionism is a prominent problem of the present day, which often hinders progress.

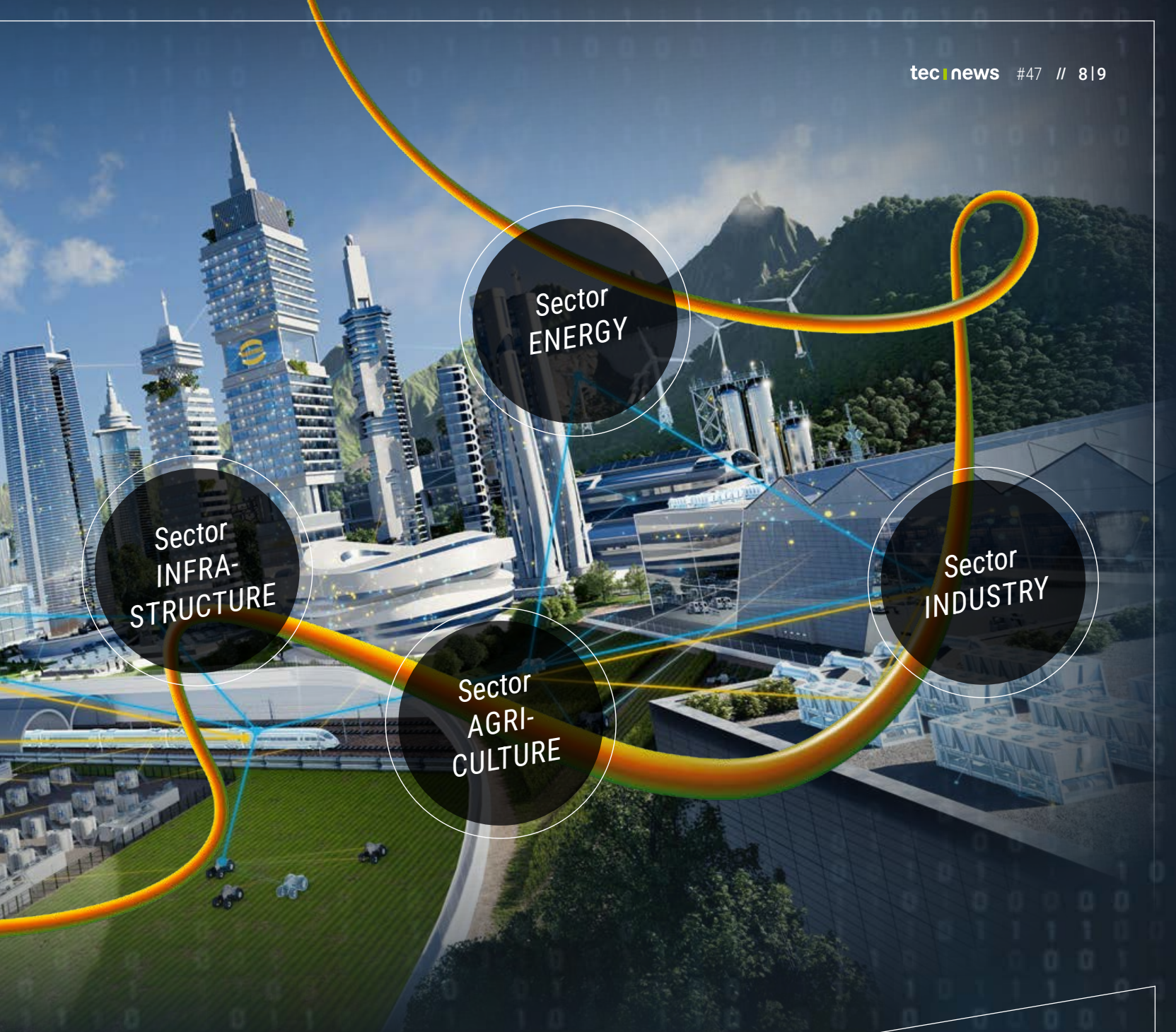
Breaking down silo thinking and promoting an open, integrative approach to sector coupling are crucial factors. Instead of protecting existing structures, we should work on establishing harmonious cooperation between the sectors, enabling synergies to be leveraged and innovation-friendly framework conditions to be created and put in place. The convergence of the physical layer must go hand in hand with the convergence of the electromechanical layer. For example, when we develop new technologies and systems that are able to work more efficiently and in a more environmentally friendly manner at the same time, appropriate interfaces and connections are required.

The need for data rooms is another key element supporting sector coupling over the long term. Data rooms provide a structured framework in which data can be effectively shared and find use. This not only promotes transparency and efficiency, but also enables the development of solutions that will benefit all sectors. If, for example, data from the energy generation sector flows into industry or mobility, the entire value chain can be optimised as a result.

Sector
MOBILITY

Crossing borders in the best sense of the word

It is important to emphasise that sector coupling is not an additional task, but the logical and necessary result of consistent and converging digitalisation.



The merging of data, technologies and processes is not only desirable, but essential in order to master ecological and economic challenges. We need to cross borders in the best sense of the word; after all, we are not merely bridging physical or technical boundaries, but creating new connections enabling us to work intelligently and utilise resources expediently.

A multitude of interfaces to the real world are crucial in order to achieve this. For example, edge devices are necessary within the context of the Internet of Things so that the data can enter the data room. But data will only arrive there if the right connectors are in place.

We are on our way to the All Electric Society. Comprehensive networking, supported by data standards and open interfaces, is the key to mastering the challenges of our times and shaping a sustainable, climate-neutral future.

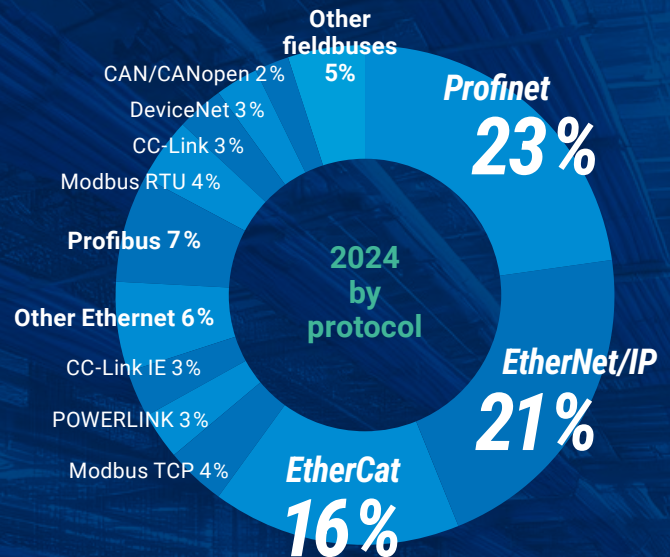
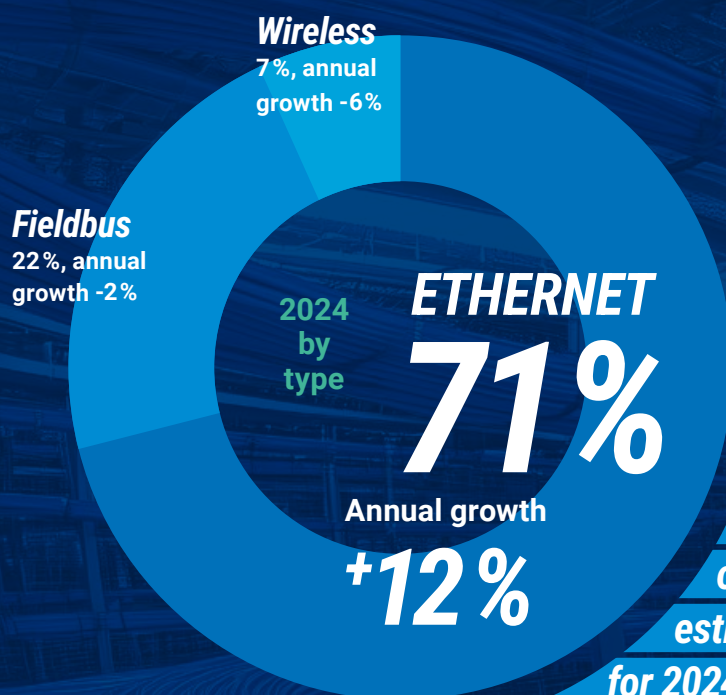
DATA STREAMS:

DIGITAL TRANSPARENCY FOR THE AES

Industrial IoT connectivity via Ethernet and the mounting focus on standardised protocols are essential building blocks and progress indicators on the path to an all-electric society. They facilitate the coupling and exchange of data between the energy, industry, mobility, infrastructure and agriculture sectors and elevate overall efficiency. This ensures the sustainable, efficient and cross-sector digitalisation and electrification of industrial systems.

Market shares of industrial connectivity with a focus on Ethernet

Source: HMS Networks

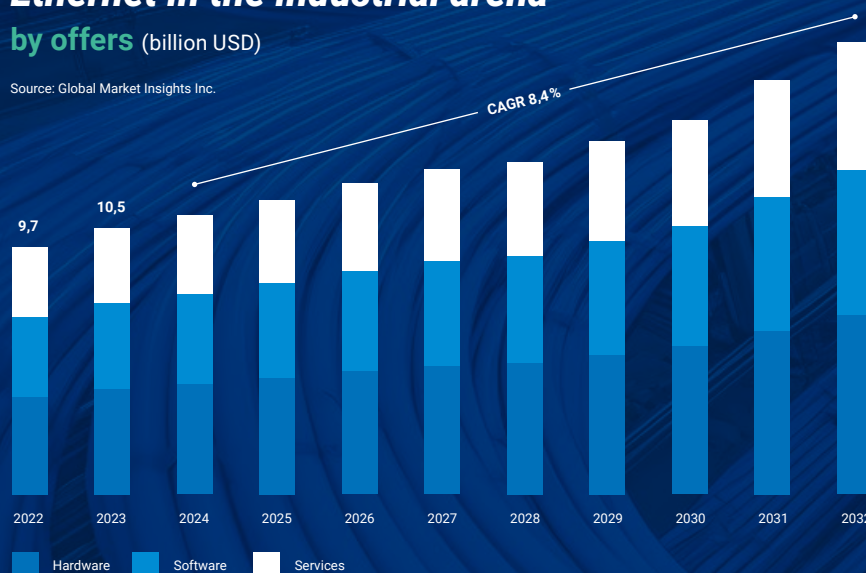


The total growth in the number of new nodes is estimated at +7% for 2024.



Ethernet in the industrial arena by offers (billion USD)

Source: Global Market Insights Inc.

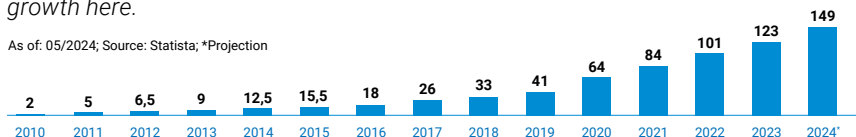


„The industrial Ethernet market was valued at USD 10.5 billion in 2023 and is expected to grow at a CAGR in excess of 8% between 2024 and 2032. Industry 4.0 and smart manufacturing initiatives are the key forces driving the market. These movements underline the adoption of advanced, leading edge digital technologies, including IoT, AI, and big data analytics, in industrial settings.“

DATA WORLDWIDE 2010...2024

In 2024, the total volume of data created, recorded, copied and consumed worldwide stood at around 150 zettabytes – 27 zettabytes (1 zettabyte = 1 quadrillion bytes) more than in 2023 – reflecting the tempestuous growth here.

As of: 05/2024; Source: Statista; *Projection



Data volume in zettabytes

2025 by end-user sectors

Source: Future Market Insights Inc.

The automotive and transport sector is expected to account for 25% of the industrial Ethernet market in 2025, reflecting the industry's leadership in the adoption of automation technologies and the advancement and further developments of manufacturing. The increasing prevalence of electric vehicle production and the ever rising complexity of automotive electronics are driving the demand for increasingly sophisticated communication networks. Industrial Ethernet's ability to support high-speed data transmission and deterministic communication makes it indispensable for next-generation automotive manufacturing facilities striving to optimise their production processes and maintain their competitive advantages and strengths.

13,5%
Oil & Gas

25,0%
Automotive production
& transport

12,6%
Energy & Power
generation

12,0%
Food &
Beverage

5,7%
Other

11,8%
Chemicals &
Fertilisers

10,1%
Electrical
engineering &
Electronics

9,3%
Aviation &
Defence

(100% =
13,3 billion
USD)

Sales comparison: The top 5 in 2025

As of 06/2024; Source: Statista Market Insights;
Data in current exchange rates, reflecting the impact
of the Russia-Ukraine war on the market

USA € 90,9 billion



China € 62,5 billion



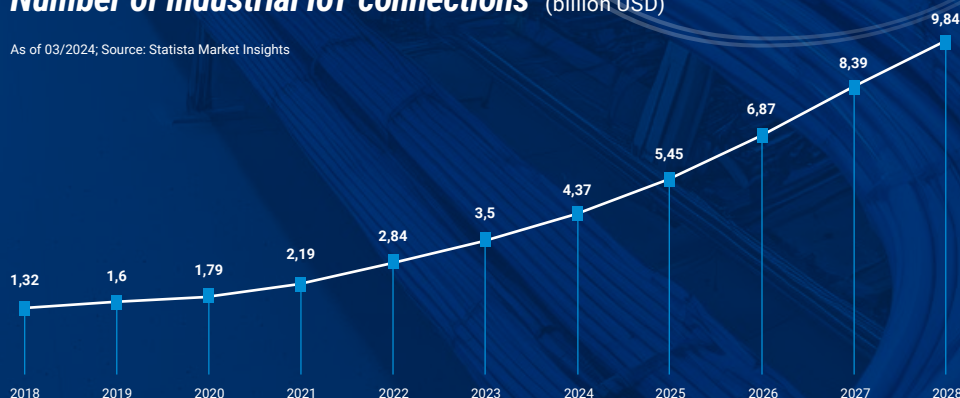
Germany € 8 billion

Japan € 7 billion

India € 6,5 billion

Number of industrial IoT connections (billion USD)

As of 03/2024; Source: Statista Market Insights



"IoT technologies can deliver real-time data on machine performance, production output and other key metrics, enabling manufacturers to optimise their operations and reduce downtime."

DATA AND ENERGY - THE HEARTBEAT OF THE ALL ELECTRIC SOCIETY

Data Connecting the Sectors



Jörg Scheer

Senior Vice President Market,
HARTING Technology Group

Speaking about the All Electric Society (AES), we often encounter the concept and term of two central lifelines: energy and data. These two resources are not only indispensable for the operation of electrified systems, but also for the optimisation and automation of industrial processes. While the generation, storage and use of renewable energies are considered the foundation of an ecologically sustainable energy supply, it is easy to underestimate the role of data. In an increasingly digitalised present, however, it is becoming clear that "data" is an absolutely indispensable complement to the lifeline of "power".

Energy and data:

a synergistic relationship

In the all electric society, the integration of energy and data represents a decisive factor for the efficiency in the generation, storage, distribution and use of energy that is of paramount importance. I am convinced that everything that can be electrified will be electrified. But without the underlying data, we will not be able to fully exploit the efficiency of electrified systems.

Data enables the real-time monitoring and control of processes, which not only optimises electricity consumption but also creates new business models.

Connectivity is increasingly becoming the decisive factor with regard to the architecture of the all-electric society. The future envisages traditionally isolated sectors – such as industry, energy supply and mobility – being networked by way of intelligent data communication. **The future of connectivity will be determined by intuitive interfaces and standardised protocols.**

The challenges of sector coupling

Sector coupling has the potential to significantly boost the efficiency of energy use. At the same time, we are facing major challenges in its practical implementation.

**While physical energy connections
are often diverse and
individually designed,
data interfaces need
to be standardised.**



The standardisation of communication protocols and interfaces presents the major obstacle. Currently, many systems and applications are equipped with proprietary protocols that impede seamless communication. It is crucial that the relevant players agree on cross-sector standards in order to maximise interoperability.

These hurdles are particularly noticeable in the area of data.

While physical energy connections are often diverse and individually designed, data interfaces need to be standardised.

It must be possible for us to use uniform protocols regardless of whether we are working in the private or professional sphere.

Physical infrastructure as the foundation

In the implementation of sector coupling, however, the existing physical infrastructure must not be neglected. The expansion of energy networks will play a pivotal role in the upcoming years, as energy demand is expected to double by 2050. Consequently, energy networks must be developed in such a way that they not only meet rising demand but also enable efficient distribution.

At the same time, better data infrastructures will also be required. In particular, the expansion of fibre optic networks is essential so as to ensure data transmission with the necessary bandwidth, speed and stability for sector coupling. This infrastructure must be adapted to the new requirements of digitalisation in order to enable real-time data processing, while progress in this area varies from region to region. Some countries already have very advanced infrastructure in place, while others still have some catching up to do.

Connectivity solutions for the key single connection

New connectivity solutions are required to guarantee the adaptability of data infrastructures – meaning that modular and pluggable systems will play a vital role in the future. The trend is towards a uniform standard that not only increases flexibility but also usability. Single Pair Ethernet (SPE) is a promising solution that enables energy and data to be transmitted by way of a single pair of wires.

Ideal: Standard(s)

In this context, I would like to emphasise once again how important the standardisation of communication protocols and open interfaces is for the realisation of the All Electric Society.

Without uniform protocols, integration and therefore the efficiency of sector coupling will be tremendously arduous.

The challenges in this area not only include technical aspects, but also political and economic conditions that can hinder progress.

The All Electric Society, however, is not a distant vision of the future, but a reality that is already emerging.

Companies and stakeholders in various sectors must take and master the challenges of standardising and implementing common protocols in order to reap the benefits of sector coupling and elevate the efficiency of their systems.

The Ethernet protocol standard for data is particularly promising – providing the foundation for robust data communication combined with the flexibility and compatibility to optimally link sectors with each other.

Consequently, the symbiosis of energy and data represents the key to a sustainable future – the All Electric Society. Time is critical and pressing, and the only way forward will be through close cooperation and courageous innovation on the part of all parties and protagonists involved.

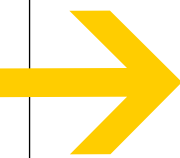
On the following pages we will be exploring the role of Ethernet in greater depth.

DATA FOR THE WORLD

In addition to power, data is an essential lifeline for our modern societies. Uniform international standards are an essential precondition for the smooth functioning of global communication systems.

The dominant transmission technology, especially in Local Area Networks (LAN), is based on the IEEE802 protocols. These include wireless data transmission, such as WiFi, Bluetooth or, in future, LiFi (short for "Light Fidelity") in accordance with IEEE802.11 and, of course, the cable-based IEEE802.3 transmission protocols for Ethernet.

The cable infrastructure for copper-based or optical cabling is specified in the **ISO/IEC 11801-x series** of standards. The standards are internationally valid and are usually adopted unchanged in European and national standards. This series of standards serves as guidelines and manual for setting up standardised cabling systems. The various application areas, such as office buildings, data centres or industrial networks, have adapted sections that address the specific requirements in each case. With regard to suitable cables and connection technology, reference is made to the relevant cable and connector standards.

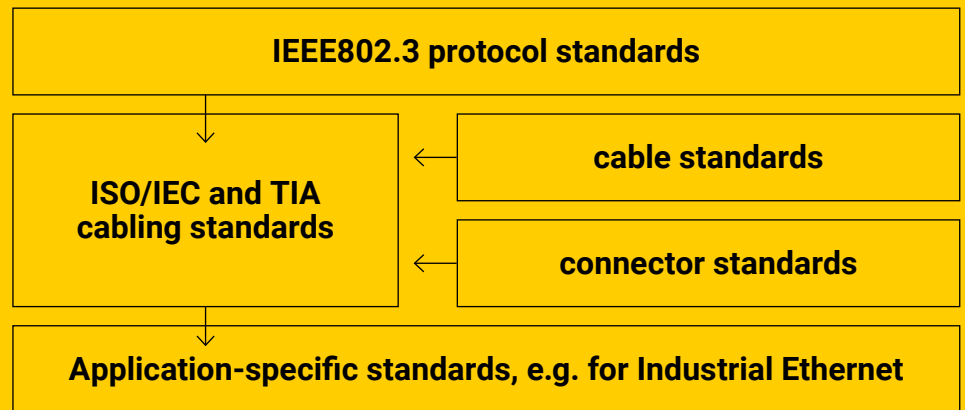


As a result, this standards landscape ranks as one of the most successful international standards projects of all time.



Matthias Fritsche

Chairman ISO/IEC JTC 1/SC 25,
Convenor CENELEC TC 215 / WG 1



This results in a complete and perfectly harmonised standards ecosystem comprising all the necessary information for planning, setting up and operating the cabling infrastructure. All the data that we use every day as a matter of course is transmitted by way of these networks. **The coordination work for these internationally uniform standards is what makes today's technologised world possible. Accordingly, this standards landscape and the associated product ecosystem ranks as one of the most successful international standards projects of all time.** This is also reflected by the globally standardised RJ45 interface, which is virtually omnipresent and is therefore also a figurative synonym for Ethernet.

Today, we encounter Ethernet not only in the IT world, but in all sectors of the All Electric Society (AES) with the Energy, Industry, Mobility, Infrastructure and Agriculture sectors relevant to HARTING. Naturally, the Ethernet transmission protocols used here are the same as in IT, but for these OT applications the cabling infrastructure must be adapted to the specific requirements of the respective sectors. This pertains to more robust cable designs that can withstand the often harsh ambient

requirements in terms of climate, as well as chemical and mechanical stability over the long term. The data interfaces must also be adapted to these requirements accordingly. **Power supply and data transmission are increasingly being combined in one single cable and one interface in order to save installation space and facilitate handling.** The charging cables for e-vehicles is a good example of this. A combined cabling infrastructure, however, is also becoming increasingly widespread in automation under the catchword of "One Cable Automation" (OCA for short).

Looking beyond the various sectors, it quickly becomes evident that the defined Ethernet protocols must be standardised, while the infrastructure must always be designed specifically for its intended use. **This means that in addition to the RJ45, which dominates the IT market, a whole range of connectors tailored to the respective requirements are called for.** To put it in a nutshell, we use standardised Ethernet protocols with a diverse cabling infrastructure and customised connection technology for the All Electric and Connected Society.

In this issue of tec.news focussing on data, you will discover an extensive range of cabling solutions and interfaces adapted to the specific requirements of the respective sectors.

Now that all applications can be connected from the device level down to the data centre with the Ethernet protocols at work today and the associated cabling infrastructure, the focus of ongoing IEEE activities is on completing the SPE protocols in terms of higher speeds and longer transmission lengths on the one hand and, in the area of high-performance data centres, on ever higher speeds of 200/400/800Gbit or, in the near future, of up to 1.6Tbit in order to provide the necessary bandwidth between servers for compute-intensive AI and AI applications.

ETHERNET IN 2025:

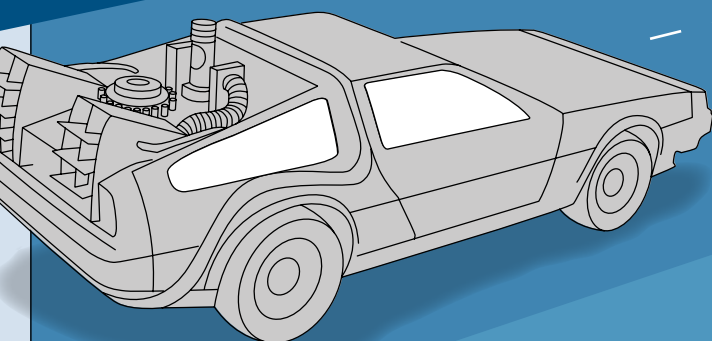


STILL EVOLVING, STILL ESSENTIAL

The fact that Ethernet is now more than 50 years old is just...wild. Yet, we're still building on that same foundation in 2025. One of the most resilient and versatile technologies in networking history started as a lab experiment that was first doodled out on a napkin. And it's probably making sure this page loads for you right now.

These days, Ethernet is everywhere. It's woven into just about everything – from smart cars to factory floors. So, what's behind its staying power? Simple: it's open, it scales without throwing a fit, and people keep finding new ways to improve it. Every year, it somehow gets a little cooler than before.

BACK TO THE FUTURE OF ETH ERNET *



Automation,
5G, automotive
industry,
companies

10 G
25 G

Auto-
mation,
Wi-Fi,
companies
and 5G

1 G
2,5 G
5 G



Peter Jones
Chairman
Ethernet Alliance

From Breakthrough to Backbone

Back in the early days, 10Mbps felt like a game changer. Now we're routinely seeing 400G and 800G deployments, and the next leap to 1.6T is already underway. **But the real story isn't just about speed. It's about Ethernet's ability to evolve** without losing its identity. Its rapid-fire rate of change, combined with a massive expansion in applications, means interoperability is mission-critical. However, Ethernet's evolution has been shaped by more than just clever engineering. Rather, it comes from a shared commitment across the industry to interoperability and open standards – **something the Ethernet Alliance continues to support through plugfests, testing programs, and industry collaboration.**

Today's Ethernet: the Hero the World Needs and Deserves

Ethernet's origin story is one of adaptability. It has broken free of the boundaries of traditional IT environments and made itself at home on the plant floor, in our energy grids, on the edge of emerging AI workloads, and aboard planes, trains, and automobiles. Thanks to the arrival of Single-Pair Ethernet (SPE), Ethernet can easily trek across longer distances in industrial settings with less complicated wiring. Simultaneously, Power over Ethernet (PoE), which uses a single, integrated cable to power sensors, wireless access points, and security cameras, continues to expand. With more than a billion PoE ports shipped to date, it's clear that **Ethernet is as much about power as it is about packets.**

Today, we're far beyond the notion of just speeds and feeds. Optical Ethernet is a focus area as networks scale for AI workloads and high-speed edge applications. Optical links, once treated as passive plumbing, are now viewed as active components that require just as much attention to resilience, thermal management, and even cybersecurity as the digital side of the network.

The Road Ahead: Smarter, Faster, and More Resilient

Faster Ethernet is coming. The IEEE 802.3 Ethernet Working Group is leading the way, having realized major milestones, for example, the completion of 100G-per-lane standards and energetic discussions around 200G-per-lane signaling. Connector innovations like OSFP-XD are redefining density and efficiency in next-gen switch and router designs. But it's not just about chasing speed. The Ethernet ecosystem is rethinking what "infrastructure" really means in an era of constant uptime and global connectivity. Physical-layer resilience is attracting a lot of attention, particularly for applications where downtime simply isn't an option.

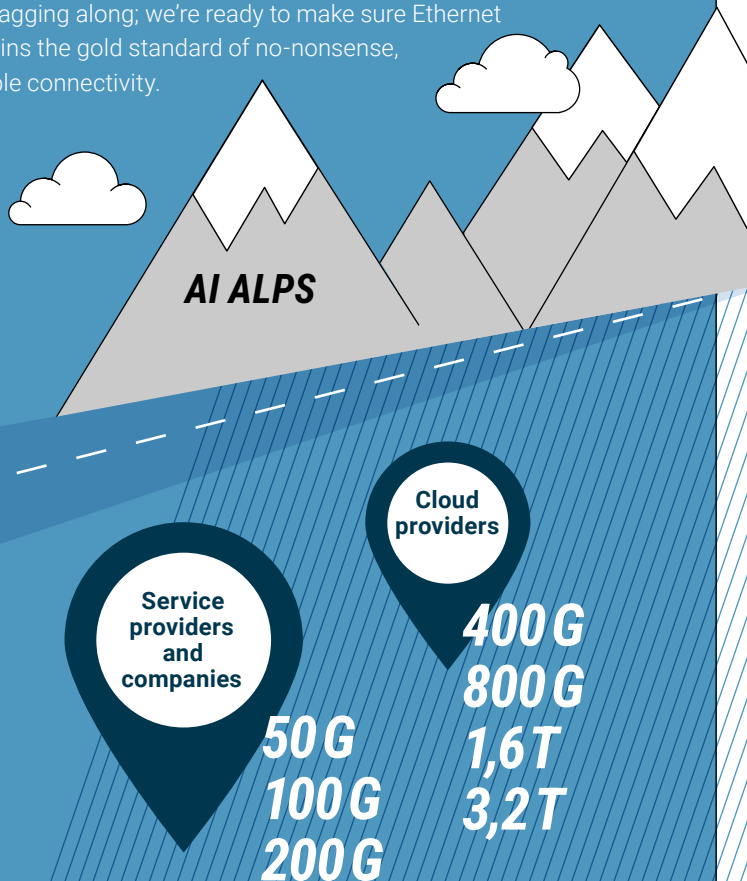
There's also a strong push toward greater sustainability, with an eye to less power-hungry hardware and more power-conscious designs that can stand up to extreme conditions, smarter thermal management, and regionally diverse and secure supply chains. These aren't merely buzzwords; they're baked into how Ethernet gets designed and deployed.

Ethernet: Still the Gold Standard

Despite being around since the 1970s, Ethernet has yet to show its age. Like a chameleon, it keeps reinventing itself, flexing, scaling, and adapting to whatever comes next.

No matter what the Next Big Thing is – from fully autonomous factories to fly-by-wire airplanes and beyond – Ethernet will be there to keep it all connected.

Being part of Ethernet's storied past and promising future is at the heart of the Ethernet Alliance's mission and mandate. We're not just tagging along; we're ready to make sure Ethernet remains the gold standard of no-nonsense, reliable connectivity.



* Simplified representation
For more insight,
we recommend taking a
look at our 2025
Ethernet Roadmap.

INTO THE FUTURE WITH STANDARDS

The All Electric Society: How the DKE is shaping the energy transition with standards and digitalisation

The decarbonisation of society and the transition to an All Electric Society (AES) are key challenges for industry. In our interview with the DKE (German Commission for Electrical, Electronic & Information Technologies), Thomas Sentko and Johannes Stein shed a light on how standardisation, digitalisation and sector coupling interact to make the energy transition possible in terms of technologies and organisation.

Thomas Sentko

Standards Manager, Components & Technologies,
Broadband, Fibre Optics & Connectors Technology,
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Electronic & Information Technologies

Johannes Stein

Senior Principal Expert Horizontal Topic Development
All Electric Society, DKE German Commission for
Electrical, Electronic & Information Technologies



Andreas Huhmann

Strategy Consultant
Connectivity & Networks,
HARTING Technology Group



tec.news: To what extent do you regard the AES as a driver of transformation? **Johannes Stein (JS):** The motivation behind the All Electric Society is plain and simple: In order to decarbonise society, renewable energies must be expanded and electrification driven forward. Applications such as electric cars and heat pumps are examples of these developments. The challenge lies in managing the volatility of renewable energies and ensuring supply security. **Digitalisation, data utilisation and automation are the keys to creating new, resilient energy systems.**

tec.news: Why are norms and standards so important for digital networking and the operation of critical infrastructures, and what role does DKE play in this?

Thomas Sentko (TS): A functioning communications infrastructure represents the backbone of the digital society. The DKE makes a significant contribution to establishing standards for the planning, operation and documentation of networks. Digital planning and standardised processes are what make it possible to build, operate and manage infrastructures efficiently - whether for energy, water, gas or telecommunications. Standardisation forms the basis for these processes.

Information technology Sector coupling

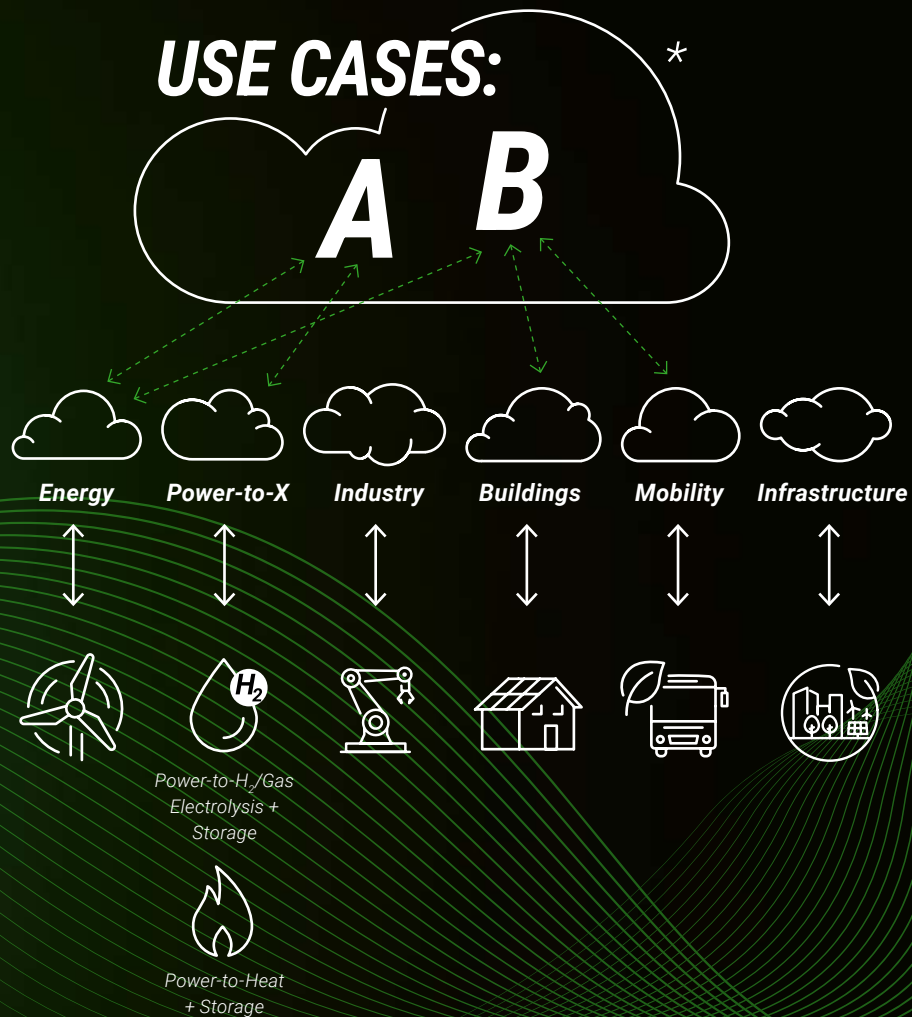
Applications access
semantically defined data
via registries for their tasks.

Decentralised "digital twins",
e.g. in the company's cloud
or a sector-specific,
cross-company "Cloud-X".

"Real world with devices,
sensors, applications (edge)"

Communication, API,
Connectors

* **Simplified representation



tec.news: How does the DKE contribute to cross-sector networking and harmonisation in the All Electric Society?

JS: Sector coupling is a central, pivotal goal of the AES – in other words the networking of electricity, heat, mobility and industry. DKE is promoting these objectives through studies, specialist conferences and pilot projects, for example with the University of Magdeburg. The new "All Electric Society Platform for Cross-Sector Data Economy" committee is now intended to bring loose threads together, harmonise approaches and Europeanise and internationalise solutions. The Digital Product Passport (DPP 4.0), based on the Asset Administration Shell (AAS), is an important building block for rendering data usable across sectors and in a standardised manner.

tec.news: How does DKE design the standardisation of the communication infrastructure within the framework of the AES and what role does Ethernet play in this?

TS: DKE supports the convergence to Ethernet as a universal communication platform. Standards for the passive infrastructure and the physical layer are being developed together with international committees such as the IEC. The asset administration shell ensures that components – from connectors to cables – can be described digitally and used interoperably.

tec.news: How does DKE perceive itself interacting with industry and other players in the development of standards for the AES?

JS: DKE perceives itself as a platform and moderator for industry. The organisation brings different specialist groups together, promotes consensus and internationalises solutions. Standards are recommendations, not legislation – their acceptance and dissemination depend on the commitment of industry. The DKE provides the framework for jointly developing standards that will enable the AES.

tec.news: Why are norms and standardisation by DKE so important for the success of the All Electric Society?

TS: The All Electric Society is the umbrella organisation for numerous technical solutions and innovations.

With its standardisation work, the DKE is creating the conditions for sustainability and cost-efficiency to go hand in hand.

The digitalisation of products, the harmonisation of interfaces and the development of cross-sector standards form the essential foundation for a successful energy transition.

THE ROLE OF DATA TECHNOLOGY IN PUBLIC TRANSPORT

RELIABLE DATA TRANSMISSION IS ESSENTIAL
FOR THE SAFE OPERATION AND CONTROL OF
MODERN TRAINS.

Rail-based transport systems such as trains and trams connect people and make decisive contributions to environmental protection. Efficient public rail transport reduces emissions, relieves road traffic and makes sustainable mobility accessible to all. In order to ensure that all this functions smoothly, data technology is increasingly gaining significance in railroad engineering for trains and trams.

Digital communication systems are not only used to transmit signals for controlling trains, but also to realise a wide range of comfort and safety functions. Ethernet technology is increasingly becoming established as the standard. Today, Ethernet networks are encountered in passenger trains for surveillance cameras, passenger information systems, WLAN services, passenger counting systems as well as many other applications. These systems not only improve the passenger experience, but also advance safety and efficiency in day-to-day operations.

HARTING solutions for tomorrow's mobility

As a reliable partner to the railway industry, HARTING is offering innovative data transmission solutions.

Robust Ethernet connections and cabling with M12 D and X-coded connectors, Han-Modular® or ix Industrial® and RJ45 interfaces are opted for here. In scenarios involving particularly high data rates and long distances, fibre optic connections are also deployed in some projects. We supply durable cabling systems for the railway industry and operators. We have a great deal of experience, particularly in the area of mechanically heavily burdened and stressed wagon interchanges, and develop, test and produce customised solutions for a wide range of installation conditions and load profiles.



Matthias Fritsche
Senior Specialist
Ethernet Connectivity,
HARTING Electronics GmbH



Trends: Ethernet conquers the train

THE DIGITALISATION OF RAIL VEHICLES IS PROGRESSING AND DRIVING THE NEED FOR HIGH-PERFORMANCE CONNECTIONS –

meaning that higher data rates and more interfaces are called for. **The Ethernet Train Backbone (ETB), standardised in the future in IEC 61375-2-5, will create a powerful communication infrastructure based on Ethernet technology and replace BUS systems such as MTB/WTB that are still widely encountered today.** These fully Ethernet-based trains enable the use of AI-supported video surveillance, precise passenger frequency counters and sensors for comprehensive condition monitoring catering to predictive maintenance requirements. High-resolution displays for passenger information systems, advanced entertainment systems and fast WLAN based on redundant mobile and satellite connections are increasingly in demand and necessitate a flexible, scalable network architecture.

For the future, standard Ethernet connections between the wagons via copper or fibre optic cables with redundant ring structures are required to achieve maximum reliability. Inside the rail vehicles, Single Pair Ethernet (SPE) offers a compact, lightweight and powerful solution that is optimally tailored to the requirements of tomorrow's systems. It is advisable to design the

network topology in trains so as to provide a separate redundant network for the actual train control system certified for maximum functional safety in addition to another network for the "comfort functions" such as WLAN, video surveillance and passenger information systems. This concept offers the advantage that only the network for train control will have to be designed to meet high SIL levels. Regular adjustments to the network for the additional functions, such as adapting to newer WLAN routers or new display systems, will therefore have no impact on the network for train control, simplifying operation over a long service life and thereby also contributing to sustainability.

With the advent of the European Train Control System (ETCS), the digitalisation of the rail network is also being realised thanks to a modern, standardised train control system. This will increase the safety and efficiency of rail transport in Europe through digital communication between trains and the trackside control centres. Thanks to the precise, continuous transmission of journey data, ETCS enables shorter train intervals, improving route utilisation and significantly increasing the capacity of the rail network. The introduction of ETCS will significantly advance the digitalisation of the railways, as outdated signal-based systems will be replaced by innovative, digital technologies. Here, too, the lifeline is characterised by Ethernet technology.

Outlook: Ethernet as mobility backbone

The replacement of conventional BUS systems such as MTB/WTB by fully Ethernet-based architectures is already foreseeable.

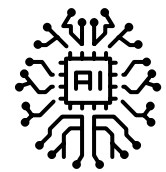
CONSEQUENTLY, ETHERNET IS BECOMING THE CONNECTING TECHNOLOGY OF CHOICE FOR ALL ON BOARD APPLICATIONS –

from control systems to passenger comfort features. HARTING is supporting these developments with a broad portfolio of products and continuously developing future-proof solutions for the requirements of urban mobility

One thing is clearly evident: Ethernet is also becoming increasingly pivotal in the mobility sector – and HARTING is ready to play an active role in shaping this future.

UNLOCKING THE POWER OF DATA

HOW INDUSTRIAL AUTOMATION IS SHAPING THE FUTURE OF MANUFACTURING



Rockwell Automation is a global leader in industrial automation and digital transformation, headquartered in Milwaukee, USA. The company supports customers with innovative solutions such as Allen-Bradley hardware and FactoryTalk software to increase productivity and sustainability in manufacturing. Rockwell Automation is also committed to international standards and open interfaces in the industry.

The industrial automation sector is undergoing a rapid transformation driven by the increasing need to collect, process, and utilize data. However, this journey is marked by significant challenges, especially given the diversity of legacy systems and varying levels of digital maturity among customers. Many factories still operate with isolated, non-networked equipment, making data collection complex and often costly. Upgrading to smart devices and modern network infrastructures requires substantial investment, but the benefits – such as reduced downtime and improved operational efficiency – are clear for those who embrace digitalization.

Roberto Marques

Power Control Business System
Architect, Rockwell Automation

William Martin

Business Manager
- Supply of Power,
Rockwell Automation



A key challenge lies in turning vast amounts of raw data into actionable insights. As devices become more intelligent, they generate an overwhelming volume of information. Without a clear strategy, organizations risk underutilizing their data collection systems. To address this, Rockwell Automation has developed solutions like FactoryTalk Alarm and Events, which automatically contextualize and visualize critical data, reducing the burden on users and enabling proactive decision-making.

The sector focuses on improving device intelligence, cybersecurity, and energy efficiency.

FactoryTalk Alarm and Events by Rockwell Automation is a software feature for centralized alarm management in industrial automation. It collects and displays alarms and events from various devices in real time, supports both controller- and server-based alarms, and offers flexible display and notification options. Logged alarms can be analyzed later to improve system reliability. The solution integrates seamlessly with Rockwell systems and supports OPC UA (Open Platform Communications Unified Architecture) for broader connectivity.

Interoperability is another crucial aspect. Standardized data formats and interfaces are essential for seamless integration across devices and sectors. Rockwell Automation is actively involved in harmonizing data naming conventions and supporting open standards such as OPC UA, MQTT (Message Queuing Telemetry Transport), and open APIs (Application Programming Interface). Collaboration with organizations like ODVA (Open DeviceNet Vendors Association) ensures that data objects—such as energy metrics—are consistently defined, facilitating easier data exchange and analysis.

Ethernet has become the backbone of industrial communication, with a shift towards fully standard IEEE-based solutions, including Single Pair Ethernet (SPE) for cost-effective connectivity of simple devices. While copper remains prevalent, fiber optics are increasingly used for long-distance or high-bandwidth applications. Wireless technologies are

gaining traction, particularly for data collection and mobile applications, though concerns about reliability and cybersecurity persist—especially for mission-critical control and safety functions.

Connector and cabling standards are evolving in parallel. The industry is moving towards universal connectors like M12 and RJ45, and efforts are underway to standardize SPE connectors, ensuring compatibility and simplifying integration across automation profiles.

Looking ahead, the sector is focused on enhancing device intelligence, cybersecurity, and energy efficiency. The integration of edge computing, standardized interfaces, and robust network infrastructures will be key to unlocking the full potential of industrial data—enabling predictive maintenance, energy management, and ultimately, a more sustainable and resilient manufacturing landscape.

THE ADAPTER IS KING

The demands placed on modern data communication are constantly trending upwards - and with them the complexity of infrastructures. Connectors are at the heart of these developments: they not only connect devices, but also entire generations of technologies. The future does not belong to a one-size-fits-all solution, but instead to intelligent adaptation. Adapters are becoming the key to flexibility and innovation.

Consolidation and diversity – the current situation

The last few decades have been characterised by the pursuit of standardisation and convergence. Ethernet has established itself as the universal physical layer, enabling cross-sector communication. Cabling standards – predominantly ISO/IEC 11801 and EN 5073 – ensure a certain degree of uniformity, particularly in office and data centre environments, but also in industrial production. Nevertheless, it is clear that the variety of connectors and cabling philosophies in use is greater than ever before.

Infrastructure in transition: copper, fibre optics and the convergence to Ethernet

Today, infrastructure can be roughly divided into three areas: The connection of end devices to the local area network (LAN), which is mainly based on copper technology, transmission in wide area networks (WAN) and the connection of data centres, where fibre optic technology prevails. Despite these differences, there is a clear convergence at the physical layer: everything runs over Ethernet. However, this layer is diverse – wireless technologies are deployed to connect many end devices, but these are in turn connected to the access point by way of classic connectivity, usually RJ45. In data centres, on the other hand, optical technology dominates with a large number of LC connectors for multiple fibres and MPO connectors for high packing densities and bandwidths.

In data centres, on the other hand, optical technologies prevail with LC duplex connectors with 2-fibre connections for transmitting and receiving (10/25G). MPO/MTP multi-fibre connectors for parallel optics are generally deployed for data rates of 40/100/200/400/800G/1.6T and high port densities.

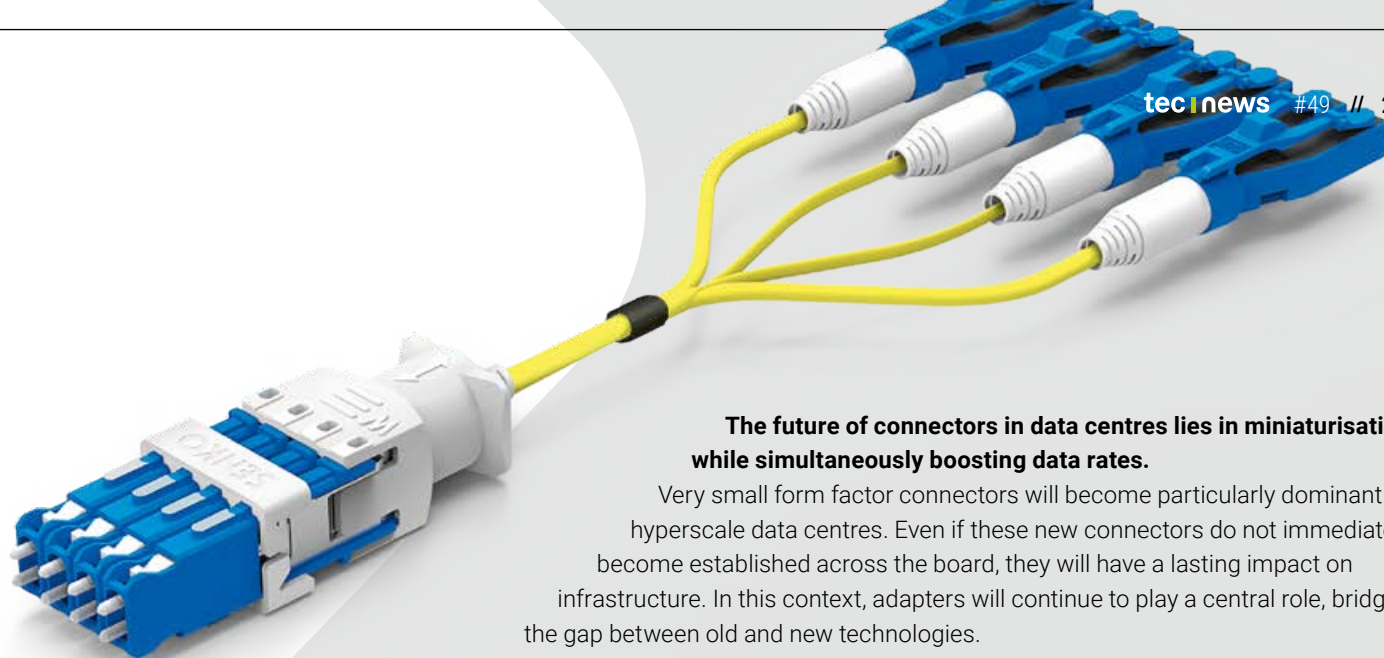
The state of the art shows that Ethernet has resulted in a convergence of connectors, but the systems have evolved and grown historically and will continue to grow in the future. Adapters have become indispensable for connecting the systems of yesterday, today and tomorrow. Adaptation is no longer a necessary evil, but a strategic advantage, as it always involves Ethernet according to IEEE 802.3, thereby ensuring absolute data transparency in terms of communication.

The role of adapters – flexibility instead of a one-size-fits-all solution

Adapters are strategic infrastructure components enabling flexible connections between different systems. They ensure data integrity and future-proofing by supporting adaptation to new technologies and devices without restricting data transmission. The data lifeline does not require absolute uniformity at Layer 0. Far more, it is crucial to choose the right, future-proof connector for the respective application. Data integrity and consistency are not restricted by adapter cables – on the contrary: they enable flexible adaptation to new technologies and end devices, ensuring that the infrastructure remains usable for decades.

Network technology in transition: outlook for the future

The future in the area of end devices will not only be shaped by RJ45 – Single Pair Ethernet (SPE) will become more significant and bring new connectors into play. Here, too, adapters will be needed to ensure compatibility between old and new systems. Multi-fibre connectors are becoming increasingly significant in data centres, with the number of fibres and performance levels



The future of connectors in data centres lies in miniaturisation, while simultaneously boosting data rates.

Very small form factor connectors will become particularly dominant in hyperscale data centres. Even if these new connectors do not immediately become established across the board, they will have a lasting impact on infrastructure. In this context, adapters will continue to play a central role, bridging the gap between old and new technologies.

The convergence of Ethernet-based data communication is a successful model. At Layer 0, however, the world remains colourful and diverse. The right selection and combination of connectors – supported by adapters – makes it possible to flexibly serve all the relevant applications and requirements. While standardisation remains important in order to create a certain foundation, the future belongs to diversity and adaptability.

The adapter is king – and therefore remains indispensable for the future.

steadily on the rise. While LC duplex connectors as small form factors are now standard, very small form factor connectors such as SN or MDC are setting new standards in terms of miniaturisation and port density. The same applies to multi-fiber connectors, where the new and more compact types such as SN-MT and MMC are already finding their way into the data centres of hyperscalers and AI/HPC clusters. This means that the same Ethernet is being transmitted by way of ever-new connectors – and this is also giving rise to new adapter solutions.

Joachim Zellner (left)
Managing Director of
ZVK GmbH

Andreas Klees (right)
Managing Director of
ZVK GmbH



ZVK GmbH is a leading provider of solutions in fibre optic and network technologies. The medium-sized company develops and manufactures high-quality cabling systems, connectors and components for demanding and sophisticated applications in the industrial arena, data centres and telecommunications. Drawing on many years of in-depth experience, innovative products and tailor-made services, ZVK supports its customers in implementing powerful and future-proof network infrastructures.

DATA EXCHANGE IN AGRICULTURE

OPPORTUNITIES AND CHALLENGES FROM
THE AEF'S PERSPECTIVE

Digitalisation has changed agriculture fundamentally over the last two decades. Today, machines are no longer merely mechanical tools, but networked participants in the digital ecosystem.

The AEF (Agricultural Industry Electronics Foundation) is facing the challenge of enabling data exchange between a wide variety of players and systems, while protecting the interests of farmers and machine manufacturers.

THE AEF

(Agricultural Industry Electronics Foundation) is an international, multi-vendor organisation with over 300 members dedicated to promoting and standardising electronics and software in agricultural technology. The AEF's goal is to ensure the interoperability and compatibility of machines, devices and systems from different manufacturers – in particular through the development and advancement of standards such as ISOBUS. The AEF brings together manufacturers, suppliers and other industry players to jointly develop solutions for the challenges of digitalisation and data exchange in agriculture. In this way, the AEF makes a significant contribution to driving innovation and increasing efficiency and sustainability in modern agriculture.



Norbert Schlingmann

Managing Director Agricultural Industry
Electronics Foundation (AEF)



High Speed ISOBUS (HSI) uses 1000BASE-T1 Type B (Single Pair Ethernet, 1 Gbit/s, up to 40 m) according to IEEE802.3 as its physical transmission layer.

HSI is a further development of the classic ISOBUS standard in agricultural technology and enables significantly faster data transmission between tractors, accessories and attachments. This enables complex machine functions, large data volumes and modern assistance systems to be controlled more efficiently and in real time.

exchange between agricultural machines to a new level. The aim is to make data exchange between machines up to 4000 times faster, to standardise interfaces for camera systems, for example, and to facilitate data exchange – thereby creating the foundation for innovative services.

Data rooms as a model for the future

The development of open, cross-manufacturer data spaces represents a crucial step towards secure and efficient data exchange in agriculture. Proprietary cloud solutions reach their limits when machines from different manufacturers are at work. As part of the "Common European Agricultural Data Space", Europe is working with numerous partners on networked, legally compliant data spaces. In view of international developments, such as the planned establishment of 100 agricultural data rooms in China by 2028, Europe must remain competitive.

The future of agriculture is in the intelligent use of data. Transparent data spaces that enable exchange between different manufacturers and systems are crucial for innovation and sustainable production.

From machines to networks – the evolution of data exchange

Initially, the focus was on transmitting data within the machine. With the introduction of GPS systems and ISOBUS terminals in the 2000s, external data exchange became increasingly significant. Today, machines are part of a network, often within a corporation and in a closed cloud environment.

The role of standards and cooperation

The diversity of electronics and the volumes of data collected necessitate the further development of ISOBUS towards faster transmission paths and therefore also towards new standards. This requirement and international cooperation with other industries such as earth moving, mining and truck & trailer resulted in the creation of ISO Joint Working Group 16 (JWG 16). In this international working group, experts from various industries are working on the development of High-Speed ISOBUS geared to taking electronic communication and data

management has become pivotal in agriculture and food production. Companies, from seed and chemical companies to food processors and agricultural consultants, use data to advance operational efficiency and enable precision farming. The exchange of data between different systems, however, is often inefficient and time-consuming. The AEF has recognised this need and developed the Agricultural Interoperability Network (AgIN) in order to create a harmonised data environment. AgIN promotes collaboration between members of the agricultural industry and enables peer-to-peer data connections. A legal framework and technical standards geared to improving interoperability are under development.

Only through cooperation, clearly defined legal frameworks and open solutions, which we are currently developing with AgIN, will we be able to master the challenges of data exchange and make agriculture fit for the future.

PRACTICAL DIGITALISATION AND DATA MANAGEMENT IN AGRICULTURAL TECHNOLOGY



The Competence Centre ISOBUS focuses on the practical implementation of digitalisation in agricultural technology. The aim is to support small and medium-sized manufacturers with technical solutions and targeted interest representation in the development and integration of modern ISOBUS based interfaces.

A great degree of diversity is encountered in the agricultural engineering sector: farmers use machines from different manufacturers and different methods of data collection – ranging from handwritten notes to automated, internet-based systems. In crop protection in particular, the spectrum extends from manual input to fully automated cloud transmission.

Standardisation originally set in with CAN bus-based systems and has been continuously developed ever since. Today, the industry is facing a transition to Ethernet-based solutions given that the demands and requirements for speed and data volume continue to trend upwards. Modern machines are equipped with numerous sensors whose data volume is pushing the CAN bus to its limits. Ethernet also enables the transmission of digital camera images,



Moritz Roeingh
Managing Director,
Competence Center ISOBUS e.V.

large data volumes can be exchanged efficiently and almost in real time between tractors and their accessories and attachments. The introduction of Ethernet technologies is also being driven forward in the interests of consistency, in order to simplify the use and further processing of data across different systems. With a look to the future, the industry is increasingly focusing on open standards that enable convenient integration and coupling with other sectors. Development is taking place in close cooperation with the Agricultural Industry Electronics Foundation (AEF), which coordinates standardisation worldwide and leverages synergies with other industries. This is not only an advantage but represents necessity in order to benefit from economies of scale and the widespread availability of components.

Copper-based Ethernet connections currently embody the state of the art, while wireless technologies such as WLAN are only deployed for connecting terminals to the internet. The development of Wireless Infield Communication has set in and focuses on wireless communication between agricultural machines and devices directly in the field. The aim is to exchange data such as the current coverage of a given area or track lines without a cable connection. Work is also underway on the transmission of video streams and the remote control of machines in order to be able to use platooning when transferring loads from the harvesting vehicle to the transport vehicle.

Standardisation is achieved through cooperation between the AEF and ISO, with the Competence Center ISOBUS e.V. representing the interests of SMEs and medium-sized manufacturers in particular. While the AEF further develops standards, the association pools expertise and jointly develops products for machine communication. This results in solutions that meet the requirements of modern agriculture while promoting innovation at the same time.

A key technological milestone is ISOBUS, which has been established as an international standard for over 20 years.

opening up new possibilities for machine operation and monitoring. Proven IEEE standards are currently opted for in the Ethernet field. The future High Speed ISOBUS (HSI) relies on 1000BASE-T1 Type B (Single Pair Ethernet, 1 Gbit/s, up to 40 m) according to IEEE 802.3 as the transmission layer. HSI is based on the classic ISOBUS and enables significantly faster data transmission, so that complex machine functions and

The Competence Center ISOBUS is a cross-manufacturer association of SMEs and medium-sized agricultural technology companies.

The aim is the joint development of software and components for the ISOBUS standard in order to improve communication and data exchange between machines from different manufacturers. The association pools expertise, supports international standardisation and promotes technology transfer in agriculture.

www.cc-isobus.com



NEXT LEVEL CONNECTIVITY:

HOW ARTIFICIAL INTELLIGENCE IS ACCELERATING CONNECTOR ENGINEERING

The industrial world is undergoing tempestuous change. Every day, we are experiencing how digital ecosystems, artificial intelligence and collaborative platforms are changing the way we develop products and launch them on the markets. A joint project between Microsoft, HARTING and Siemens is one particularly exciting example of this: an AI-supported generative engineering tool that is taking connector design to an entirely new level.

Networked data:

Digital ecosystems are key

Advancing and elevating networking is the decisive trend. Digital ecosystems and centralised data marketplaces enable companies to exchange data securely and efficiently – not only with each other, but vis-a-vis research institutions and start-ups. This openness creates the foundation for new business models and accelerates the development of innovative products.

The cloud is a central component in this context:

It makes data exchange flexible, scalable and cost efficient, for example thanks to the pay-per-use

principle. Accordingly, companies only pay for the services or resources that they actually use. As opposed to the traditional licence or flat-rate models, there is no need for high initial investments. Instead, cloud services, computing capacities or software applications, for example, are billed flexibly and according to demand – just like electricity or water. This makes the use of modern technologies not only more cost efficient, but also particularly adaptable to changing requirements within companies themselves.

Artificial intelligence as an engineering partner

Artificial intelligence is at the core of the project. Together with Microsoft and HARTING, Siemens has developed a solution that allows users to simply enter their technical requirements in natural words – by keyboard or by voice.

AI translates these inputs into technical specifications and uses them to create a customised 3D model of the desired connector.

The special aspect here: HARTING's product and configuration expertise remains protected within the company. Especially in open, digital ecosystems, it is essential that expertise and data sovereignty are maintained – and this is guaranteed by state-of-the-art cybersecurity.

From ideas to product concept in seconds

Processes that previously took weeks of engineering work are now completed by AI in just 15 to 30 seconds.

A standardised database is the foundation for this, for example by way of a product lifecycle management (PLM) system, which bundles all the relevant information and enables the AI-supported automation of the product development process chain, from design, on to simulation and all the way through to production.

Added value:

Sustainability, speed, customer focus

The advantages of this development are multifaceted: AI-supported designs can save material and installation space, while also contributing to ecological sustainability. In addition, time-to-market is significantly reduced and companies can meet individual customer requirements faster and more precisely. It is no longer merely about internal process optimisation, but about genuine collaboration and the development of new, data-driven business models.

Reaching the goal together: Networking expertise

One of the biggest challenges – and at the same time the key to success – is bringing people together with different expertise and from different disciplines. The potential of digitalisation can only be fully unleashed and leveraged if a common language and common goals are defined. The interaction between HARTING, Microsoft and Siemens shows just how valuable this co-operation can be: **together, we are shaping the future of industry – faster, smarter and more sustainable.**

The generative AI tool is just the beginning. With the right blend of technology, team spirit and openness to new ideas, an exciting journey lies ahead of us.

Dr. Sara Melinu

PreSales Manager
Electronics, Semiconductors
& Medical Devices,
Siemens Digital
Industries Software





Andreas Wedel

Director Digital Transformation,
HARTING Technology Group

DIGITAL TWIN: THE HUB AND LINCHPIN FOR NETWORKING THE PHYSICAL AND DIGITAL WORLD

With the focus on the "data" lifeline in the All Electric Society, we are also placing the importance of the digital twin centre stage and in the spotlight at this point. Digital twins act as digital mirror images of real systems and assets in all sectors. The significance of the "data" lifeline is crucial in the context of the digital twin, as it forms the foundation for communication between these digital units and opens the way to data spaces. This connection makes data an essential part and parcel of the digital infrastructure, enabling efficient and comprehensive networking.

HARTING is both a developer and provider, as well as a user of digital twins. The digital twin is not only at the core of the company's own production, but is also deployed as a pioneering model for customers. By relying on digital twins, customers are able to organise their processes precisely and efficiently - long before a physical product is available. This is part of the customer journey, in which connectors enter the picture at an early juncture in the system design-in phase. With a view to the digital twin, production is no longer viewed as an isolated process, but as part of the overall life cycle of a product – factoring in the circular economy, sustainability and value chains.

At HARTING, the digital twin is defined by the Asset Administration Shell (AAS). Thanks to this structured data modelling it is possible to derive and operate various digital twin formats, which is indispensable in today's increasingly globalised and standardised industry. **The aim is to create flexibility in order to utilise digitalisation across different markets.**

When products are selected and defined in the configurator, a digital twin is already generated, and the relevant data is transferred to production. The asset administration shell represents the most comprehensive model for describing a digital twin. **HARTING strives to achieve a universal data model that can be exported in various formats in order to be viable for every market and every customer.** In addition, the company ranks as one of the pioneers in the provision of these data formats and offers solutions for regulatory requirements and the digital product passport.



Summary:

The digitalisation of the production process by way of the Digital Twin creates transparency and sustainability, while ensuring cost-efficient and resilient production. This comprehensive integration of the digital twin is the key to future viability and global networking in the All Electric Society – based on a robust data structure.

A concrete example of the use of a digital twin: the customised product configurator at HARTING.

Customers select various modules and functions online, which are then combined to create a customised product. This configuration creates a digital twin containing all relevant product and process data. This twin is transferred directly to production, where it controls production automatically and accompanies the product throughout its entire life cycle. In this way, processes can be organised more efficiently, while traceability and quality are improved as well as providing information specifically for internal processes or the customer. The model is scalable and is undergoing continuous further development.

Factory of the Future in Espelkamp

The HARTING Technology Group is planning a significant investment of over 75 million euros at the Espelkamp site in order to build an advanced, future-oriented production facility. This "Factory of the Future" will not only expand physical production capacity, but also drive the company's digital transformation. The use of the digital twin represents a central component of this innovation process.

This investment is not only a step towards physical expansion, but also a sign of the strategic focus on digital technologies geared to boosting competitiveness and advancing sustainability. The digital twin will play a central role in this production by monitoring and controlling the entire product life cycle - from development and production all the way through to use by customers. This technology will enable HARTING to organise process steps more efficiently and promote communication throughout the sectors of the All Electric Society.

The energy transition has long since arrived in actual, every day practice - and with it intelligent solutions that extend far beyond traditional photovoltaics.

The "home power station" from E3/DC is a prime example here. This central supply unit for residential and commercial buildings combines all the components of a modern energy supply in one single system. Here it becomes crystal clear: **The future of energy supplies lies in the intelligent networking and sector coupling.**

This is because the infrastructure (photovoltaics and the connection of heat pumps), mobility (electric vehicles and wall boxes) and energy (battery storage and bidirectional charging) sectors all play a key role here.

PRETTY: SMART

HOME POWER STATIONS AS THE CONTROL CENTRES OF THE NETWORKED ENERGY WORLD



The home power station integrates solar inverters, battery packs and a sophisticated energy management system, aiming to optimise the control of electricity flows - both during storage and withdrawal. Maximum self-sufficiency is achieved by utilising solar power for households, mobility and heating as required; sector coupling is factored in right from the outset. Today, there are over 160,000 home power stations in use, which are adding around 20,000 new appliances every year - a decidedly system-relevant generation and storage capacity.



Ralf Ossenbrink
Head of Corporate Communication & PR,
Hager Energy GmbH

"Our customers are anticipating the energy transition in their personal sphere: maximum renewability, fully electrified and digitally networked."

Energy Hub Alliance Osnabrück – joining forces for greater interoperability



The Energy Hub Alliance in Osnabrück brings companies from different sectors together to create a joint, cloud-based data platform for energy management. The aim is to improve interoperability between PV systems, storage systems, heat pumps and electric vehicles and to network the sectors in a standardised manner by way of the lifeline of data – thereby accelerating the energy transition.

Data as the lifeline of the energy transition

Intelligent control is only possible if all devices

- from PV systems to wall boxes and on to heat pumps - **communicate with each other**. The E3/DC portal bundles generation, storage and consumption data, thereby enabling centralised control. Things get particularly exciting in the darker months of the year with dynamic electricity tariffs and AI-supported software: The new "AI 360°" extension analyses load curves and electricity market data so as to charge storage systems and vehicles at the optimum time – achieving maximum cost savings and a high share of renewable energy.

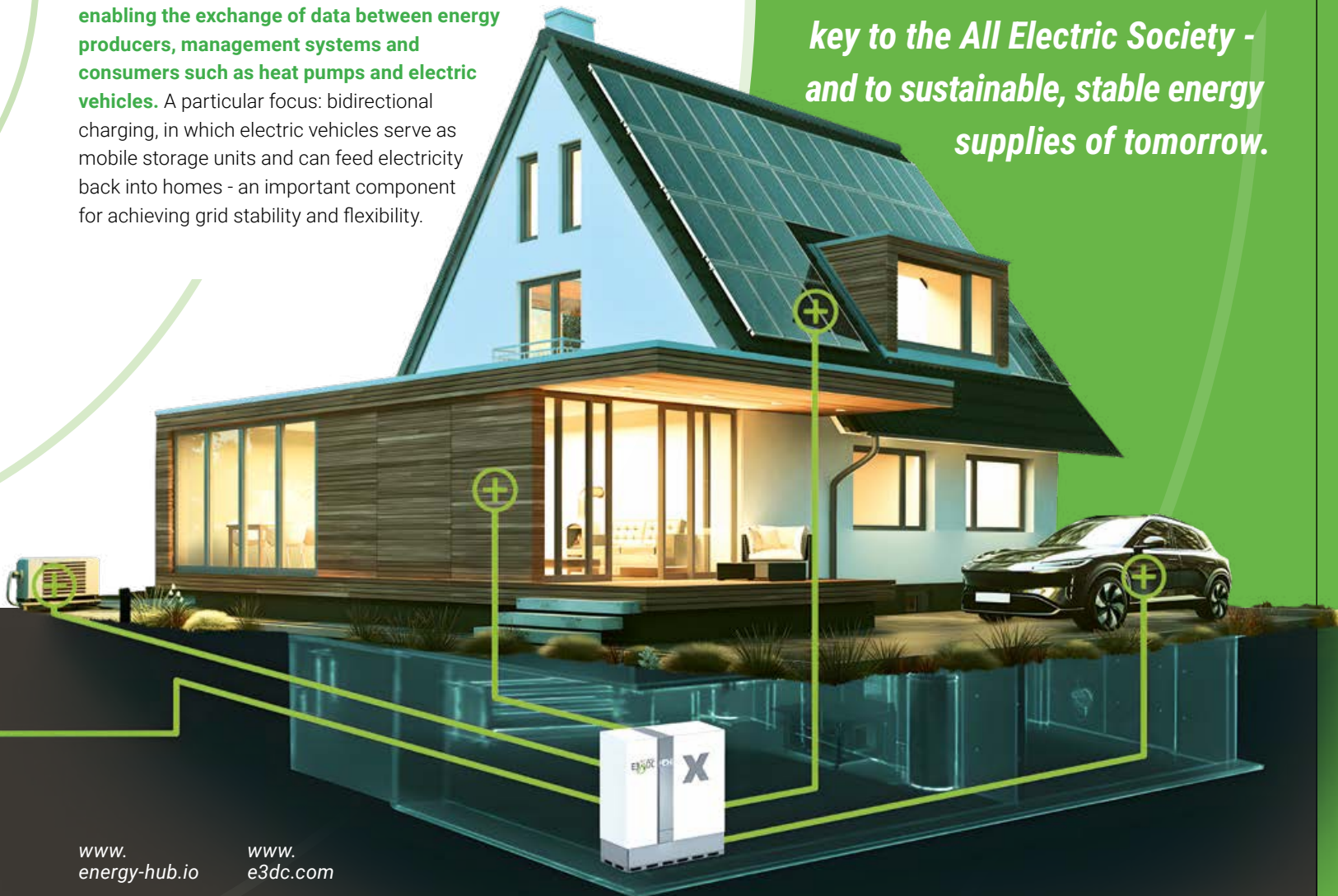
Interoperability is the key

Interoperability remains a central problem, as many devices still speak different "languages". Consequently, E3/DC is focussing on its own developments and is part of the Energy Hub Alliance in Osnabrück.

The aim is to create a cloud-based database enabling the exchange of data between energy producers, management systems and consumers such as heat pumps and electric vehicles. A particular focus: bidirectional charging, in which electric vehicles serve as mobile storage units and can feed electricity back into homes - an important component for achieving grid stability and flexibility.

Summary

What sounds like a dream of the future has long since become reality for E3/DC customers: Sector coupling, AI-supported energy management and decentralised storage solutions are now operating on a large scale. The intelligent networking of all sectors and devices is the key to the All Electric Society - and to sustainable, stable energy supplies of tomorrow.



www.energy-hub.io

www.e3dc.com



DATA AS THE LIFELINE OF ROLLING STOCK IN THE ALL ELECTRIC SOCIETY



Indian Railways aims to become a Net Zero Carbon Emitter by 2030. A key aspect of this initiative is improving energy efficiency through advanced technologies such as regenerative braking systems, smart trains with real-time monitoring, and the integration of artificial intelligence for predictive maintenance. Data is the lifeline that ensures safety, efficiency, and reliability across all facets of rolling stock.

The Technical Backbone: From Power to Intelligence

Traditionally, power systems dominated the design of rolling stock. With the advent of embedded electronics, sensors, automation controls, and predictive diagnostics, the focus has shifted towards robust and modular data infrastructures. Modern electric trains now utilize control data for traction control, braking systems, and train automation; operational data for monitoring onboard systems; passenger information systems for real-time updates; and predictive maintenance data to reduce downtime.

FUTURE DIRECTIONS

It is essential to invest in advanced technologies, standardize data formats and interfaces, and implement robust cybersecurity measures.



Sethubalaji Karthikeyan

Director of Engineering
HARTING India



Challenges in Data Collection, Processing, and Usage

Despite the benefits of data-driven decision-making, the railway sector faces several challenges: physical challenges such as harsh environments, data collection challenges due to legacy systems and lack of standardisation, data processing challenges from high data volumes and cybersecurity threats, and data usage challenges from fragmented data silos and regulatory issues.

Data Collection, Processing, and Usage in Indian Railways

Indian Railways collects data through advanced IoT sensors and digital ticketing systems, as well as platforms like UTS and IRCTC. Data processing involves big data and CRIS AI platforms, predictive maintenance systems, and security and operations management.

Importance of Standardised Data Formats and Interfaces

Standardised data formats and interfaces are crucial for seamless communication, efficiency, cost reduction, and enhanced safety..

Interface Technologies Used in Indian Railways

Indian Railways uses a combination of Ethernet, serial protocols like RS-232 and RS-485, and wireless communication systems like GSM-R and Wi-Fi.

Cabling and Connector Standards

Indian Railways adopts international standards for connectors and cabling, including RJ-45/M12 connectors for twisted pair cables and standard connectors like SC, LC, or ST for fiber optic installations.

CONCLUSION

By adopting advanced technologies and standardised data formats and interfaces, Indian Railways can improve operational efficiency, enhance passenger experience, and reduce its carbon footprint.



A more detailed version of this article can be found here.

DEMAND-DRIVEN ELECTRICITY FROM RENEWABLES:

HOW THE LIFELINES OF ENERGY AND DATA ARE WORKING HAND IN HAND



The development of scalable solutions for clean energy is decisive for an all-electric society and the decarbonisation of the global economy. GeoPura is offering solutions that harness hydrogen fuel cell technology to ensure the time-shifted, demand-driven utilisation of renewable energies.

The GeoPura Hydrogen Power Unit (HPU2) supplies up to 500 kW of electricity off-grid (scalable up to 50 MW), providing renewable energy whenever and wherever it happens to be required. Powered by emission-free combusting hydrogen, the HPU2 replaces diesel generators as an emergency power supply and serves as the main power source for data centres, e-charging stations, construction sites, film productions, events and many other scenarios. When sourcing hydrogen from renewables, the system guarantees clean and reliable power generation, with only water and heat as by-products.

GeoPura relies on the appropriate Han-Modular® Domino modules as connectors for the lifeline of data. **This is because data plays a decisive role in the monitoring, control and optimisation of fuel cells.** Querying voltage, power and temperature values, as well as the communication with sensors, actuators and external monitoring systems – all these features call for fast industrial Ethernet.

Specifically, RJ45 Domino Cubes are at work for Ethernet-based communication within the respective systems and enabling the seamless transition to higher-level networks, e.g. for monitoring/control, as well as scalability and mobility. According to requirements, larger units must be created quickly from 500 kW blocks. **Good connectors support convenient, straight forward assembly by way of modularity and "plug & play".** The more compact the individual components are, the more space remains in the power station for power transmission and the lighter and more space-saving the entire fuel cell container will be.

The HPUs have been mass-produced by Siemens Energy in the UK since 2019, a fact that stands for high production quality, reliability and good scalability. It was the partnership with Siemens Energy that had enabled GeoPura to develop advanced green hydrogen fuel cells in the first place. "Now we just need to scale up our existing solutions to meet the ever advancing global demand for clean energy," as Jeremy Stratford, Head of Electrical Engineering at GeoPura stated.



Luca Poggemöller
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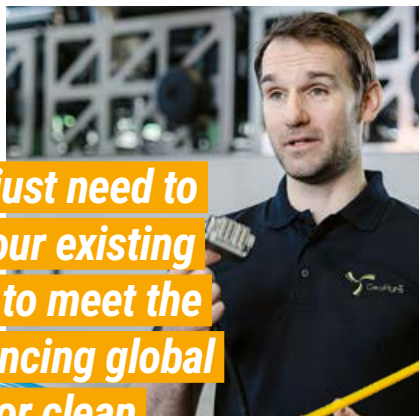
More information
about
the technology





Jeremy Stratford

Head of Electrical Engineering at GeoPura



"Now we just need to scale up our existing solutions to meet the ever advancing global demand for clean energy."



publication details

Published by:

HARTING Stiftung & Co. KG, Margrit Harting,
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Design and layout:

trio-group I.AM communication & marketing GmbH,
www.trio-group.de

Production and printing:

Meinders & Elstermann GmbH & Co. KG, Belm

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