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Press release

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CES 2021: Bosch puts its faith in AI and connectivity – for the protection of people and the environment

Intelligent, climate-friendly solutions for health, living, industry, and mobility

- Bosch board of management member Michael Bolle: “Bosch combines AI and connectivity to form the AIoT so it can improve energy efficiency and fight the coronavirus.”
- Intelligent health and safety: Bosch AIoT solutions honored with CES® Innovation Award Honorees.
- More advanced software: Bosch’s rapid coronavirus test can now detect positive samples in less than 30 minutes.
- Sustainable #LikeABosch: latest installment of image campaign shows how everyone can do their part to contribute to climate protection.
- Climate action is paying off: Carbon Disclosure Project adds Bosch to its A List.
- AI in space: Bosch expertise to help navigate mini robots on lunar surface.

Stuttgart, Germany / Detroit, USA – To improve people’s health and to protect our planet, Bosch is counting on AIoT, taking advantage of the possibilities offered by data, artificial intelligence, and the internet of things to benefit people and the environment with technical solutions. “We combine AI and connectivity to form the AIoT, which helps us improve energy efficiency and fight the coronavirus,” says Michael Bolle, Bosch board of management member. “AIoT offers enormous potential. We are already unlocking this potential and plan to expand our efforts in the future.” Under the tagline “Sustainable #LikeABosch,” the company will be presenting intelligent, sustainable solutions for health, living, and mobility at the virtual tech trade fair CES 2021.

Among the innovations Bosch is debuting at the tech show is the world’s first self-learning AI sensor for wearables and hearables in fitness tracking. Since the AI runs on the sensor itself (edge AI), there’s no longer any need for an internet connection during an exercise session – this improves energy efficiency and data

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privacy. The company is also presenting a sensor that measures factors such as air quality and relative humidity. This delivers information about the concentration of aerosols in the air – data that has become especially important in the fight against the coronavirus. Bosch security cameras can also help in the fight against the virus. AI makes it possible for them to execute a wide array of customer-specific applications. For example, a new camera solution with integrated intelligent video analysis measures body temperature contactlessly, anonymously, and with high precision – with a maximum deviation of half a degree. Moreover, using a software solution for the open camera platform of the Bosch startup Security and Safety Things, these cameras can detect whether the number of people in a shop complies with the prevailing coronavirus restrictions. This platform was designated a 2021 CES® Innovation Award Honoree, making it one of four Bosch solutions singled out this year. Another premiere is a portable hemoglobin monitor that can detect anemia by means of a finger scan. The device is particularly well suited for regions that have insufficient access to medical care. Equipped with AI, the hemoglobin monitor delivers a result within 30 seconds – no lab test or blood draw necessary.

At the moment, the best example of how innovative Bosch technology can improve health and well-being is the coronavirus PCR test on the Bosch Vivalytic testing device. This now delivers results even more quickly: laboratories, doctors' offices, nursing homes, and hospitals can evaluate five samples simultaneously in 39 minutes – technology literally "invented for life." Thanks to improved software, positive samples can be detected even in under 30 minutes. The development of the Vivalytic system, which consists of an analysis device and test cartridges, grew out of a long-standing collaboration between Bosch's corporate research and advance engineering, Bosch Healthcare Solutions, and the Robert Bosch Hospital.

Sustainable #LikeABosch: Bosch as a pioneer in climate action

A study recently published in Germany indicated that AIoT can go beyond health applications to support climate action as well. The study found that comprehensive digitalization in mobility, manufacturing, and building technology could help get the country nearly halfway to achieving the Paris Agreement emissions targets (source: Accenture).

Here is where Bosch takes a hand: its tagline for this year's CES – "Sustainable #LikeABosch" – expresses one aspect of the company's entrepreneurial responsibility. The sequel of the #LikeABosch image campaign highlights how everyone can do their part to protect the environment with sustainable products. Bosch itself is leading by example: according to in-house calculations, all the company's 400 locations worldwide have been carbon neutral since 2020. Bosch

is the first globally operating industrial enterprise to achieve net zero carbon emissions with respect to the energy it produces and the energy it sources externally. “The next step for Bosch is to address emissions along the entire value chain, from procurement to product use,” Bolle says. In that vein, Bosch is the first automotive supplier to join the Science Based Targets initiative with a specific and ambitious goal: by 2030, to cut upstream and downstream CO_2 emissions by 15 percent. Bosch’s achievements in climate action have won recognition outside the company as well: the non-profit Carbon Disclosure Project (CDP) has added Bosch to its A List.

Through its advisory company Bosch Climate Solutions, founded last year, Bosch shares its experience as a climate action pioneer with other companies. The Bosch startup markets several solutions, including the Bosch cloud-based energy platform, which applies intelligent algorithms to reduce the energy consumption of machines and thus increase the efficiency of production processes. Bosch has already deployed the platform at more than 100 locations, making a major contribution to improving energy efficiency – the main lever in the company’s efforts to go carbon neutral.

Digital and sustainable is the way forward: into the pole position with industrial AI

As this example shows, digitalization is paving the way for sustainability. “We want to be the leading AIoT company in every area that we operate in,” Bolle explains. Trust in AI is the most important prerequisite for it to become established, so that it can improve the lives of people and help limit climate change. To this end, Bosch relies on industrial AI, which explains the physical world to machines – instead of teaching them how to behave like people. Nonetheless, this requires ethical guidelines. To set them, Bosch has drawn up an AI code of ethics that centers on the idea that humans always retain control.

In addition to improving energy efficiency in manufacturing, Bosch is systematically adding connectivity to its products for buildings and mobility to help consumers save energy. One of these products is an energy manager that the company offers for use in private homes. When combined with a heat pump and photovoltaic system, the manager can cut energy consumption by up to 60 percent. In the mobility sphere, drivers of electric vehicles can benefit from services such as Battery in the Cloud, which uses smart software analysis to reduce battery wear by up to 20 percent.

In general, the combination of electrified and automated driving with personalized and connected services will open up a broad field for software applications. Vehicle computers are central to Bosch's efforts to extend its leading role in software-intensive electronic systems. To meet this demand, the new Cross-Domain Computing Systems division and its 17,000 associates started operations at the beginning of the year. In this unit, Bosch is combining its capabilities in hardware and software engineering for vehicle computers, sensors, and control units for all vehicle domains. This reduces complexity in vehicle development and will get new functions on the road significantly faster.

Expertise to help explore the moon: aiming high with Bosch AI

From earthbound roads to activities in space: whereas last year's CES saw the premiere of the SoundSee AI sensor system for the International Space Station, this time Bosch has set its sights on the moon. As part of NASA's Tipping Point program, Bosch is joining forces with the companies Astrobotic and WiBotic as well as the University of Washington to research and develop technology to intelligently navigate and wirelessly charge small robots for operation on the moon. Bosch researchers working on the project in Pittsburgh and Silicon Valley are contributing their expertise in AI-based intelligent data analysis and wireless connectivity solutions. The resulting findings will flow into the further development of Bosch AIoT solutions back on earth.

All this clearly shows how much potential AIoT offers, as well as the key role sustainability plays in it. "Only companies that pursue sustainability today and unlock the enormous potential of AIoT, will be successful tomorrow," Bolle says.

Press photos: #d6116b1e, #ccdc18ef, #824fb764, #6d49c767, #f1b09ab7, #7dd7b2bb, #3071535, #3071196, #3071536, #fd7517ed

Bosch at the all-digital CES 2021:

- **PRESS CONFERENCE: Monday, January 11, 2021** from 14:00 to 14:30 CET (08:00 to 08:30 EST) with Dr. Michael Bolle, member of the board of management, Robert Bosch GmbH, and Mike Mansuetti, president of Bosch North America, at Bosch Media Service.
  VIRTUAL BOOTH: January 12–February 15, 2021 at www.ces.tech.
- **FOLLOW** the Bosch CES 2021 highlights on Twitter: **#BoschCES.**
- **DEEP-DIVE SESSIONS WITH BOSCH EXPERTS: January 12–February 15, 2021** at www.ces.tech.
  - *"Sustainable #LikeABosch: How a key global industry player drives carbon neutrality":* January 13, 2021 from 8:15 to 8:45 EST (14:15-14:45 CET) with **Torsten Kallweit**, head of Corporate EHS and Sustainability and also CTO at Bosch Climate Solutions GmbH, and **Annette Wagner**, head of Sustainability and Ideas Lab.
  - *"Move #LikeABosch: Technology for sustainable future mobility":* January 12, 2021 from 12:15 – 12:45 pm EST (18:15-18:45 CET) with **Mike Mansuetti**, president of Bosch North America, and **Tim Frasier**, president of Automotive Electronics for North America.
  - *"AI in action: Application examples from the fields of fitness tracking and well-being to smart cameras"* with **Kaustubh Gandhi**, Senior Product Manager, and **Sina Isabell Springer**, Business Development Manager.
  - *"Perfectly keyless advanced"* with **Tim Frasier**, president of Automotive Electronics for North America, **Daniel Kornek**, Head of Product Area Vehicle Access (Perfectly Keyless), and **Jia Hou**, Business Development Manager.

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The Bosch Group is a leading global supplier of technology and services. It employs roughly 400,000 associates worldwide (as of December 31, 2019). The company generated sales of 77.7 billion euros in 2019. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT provider, Bosch offers innovative solutions for smart homes, Industry 4.0, and connected mobility. Bosch is pursuing a vision of mobility that is sustainable, safe, and exciting. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to facilitate connected living with products and solutions that either contain artificial intelligence (AI) or have been developed or manufactured with its help. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. Bosch employs some 72,600 associates in research and development at 126 locations across the globe, as well as roughly 30,000 software engineers.

The company was set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as "Workshop for Precision Mechanics and Electrical Engineering." The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant upfront investments in the safeguarding of its future. Ninety-four percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The remaining shares are held by the Bosch family, by a corporation owned by the family, and by Robert Bosch GmbH. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust.

Additional information is available online at www.bosch.com, www.iot.bosch.com, www.bosch-press.com, www.twitter.com/BoschPresse.

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Sustainable “like a Bosch”:

Smart, climate-friendly solutions for health, home, industry, and mobility

Dr. Michael Bolle,

member of the board of management

of Robert Bosch GmbH,

and Mike Mansuetti,

president of Bosch in North America,

for broadcast at the Consumer Electronics Show

on January 11, 2021

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Good morning – or depending on where you are – good afternoon or good evening, ladies and gentlemen.

Welcome to this world-first digital Bosch press conference at CES. Even though nothing can replace face-to-face interaction, and the excitement of seeing innovations first hand, we absolutely believe that everyone's health and safety comes first. As such, we're very pleased that the CTA was able to realize an alternative format for us all to come together virtually and share information about all the latest developments in the world of technology.

Every year, thousands of people come together at CES and discuss how technology can improve our lives. Over the past few months, however, we've had the truth of this demonstrated in unprecedented ways. A few decades ago, a pandemic such as the one we're experiencing would have meant the total breakdown of our social and working lives. Today, we can at least talk and laugh with our loved ones via screens, even if we can't see them in person. And thanks to the technology that makes remote working possible, hundreds of millions of people have seen little to no drop in their productivity.

From our perspective, this only confirms what we've known all along. At Bosch, using technology to improve people's lives is at the core of our strategic imperative "Invented for life." Today, we'd like to give you some examples of how we're harnessing the power of cutting-edge technologies like AI and connectivity to help us overcome some of the biggest challenges of our time – in particular, those involving our own health and the health of our planet.

Climate change remains our biggest threat – and top priority

Living through a global health crisis this past year, we've had the chance to reflect on the broader meaning of "Invented for life." If anything, focusing on the global existential threat from the pandemic

has strengthened our resolve to play our part in tackling the even greater existential threat facing us all: climate change. In many ways, both challenges require colossal effort and collaboration to change the course. This is why we see it as particularly important that we continue to lead by example and push forward with our comprehensive sustainability efforts – even in the face of the current economic uncertainty. After all, while climate action costs money, doing nothing will cost even more.

Ladies and gentlemen, eighteen months ago, we announced our intention to make all Bosch locations carbon neutral by the end of 2020. We kept our promise and were the first global industrial enterprise to achieve this: according to internal calculations, we are now climate-neutral. This means that our 400 locations worldwide no longer leave a carbon footprint, and we expect to soon have confirmation in the form of an independent auditor's report. As a validation of our achievement, we just received word that we've been included on the prestigious "A" list published by the Carbon Disclosure Project, a non-profit organization that ranks the environmental impact of companies and cities worldwide.

To make this success possible, we've applied four strategies: increasing energy efficiency, expanding the production of renewable energy, procuring more green electricity, and offsetting unavoidable CO_2 emissions. In fact, no other industrial company has made a voluntary commitment to carbon neutrality that can compare with ours in terms of scope and time frame. But we also didn't conjure this commitment out of thin air. It's a logical consequence of our long-term strategy at Bosch.

Now that we've met our carbon neutrality goal, we're not slowing down. In fact, we're shifting our focus to an even bigger challenge: the emissions of our entire value chain – from the goods we purchase to

the disposal of the products we sell, across all of our business areas. The emissions from these upstream and downstream sources are 100 times greater than the emissions of our locations at the time we announced our carbon-neutrality target. By 2030, our goal is to reduce these emissions along our entire value chain by 15 percent. This is not a number we came up with on our own. We agreed to this goal with the Science-Based Targets initiative, an international partnership set up to facilitate swift climate action in the private sector. We are the first automotive supplier to join this effort with a defined target.

Think of it like a multiplier effect: the more people along our value chain we get on board, the more impact we can have.
If you were with us two years ago, you might remember that we launched our acclaimed “Like a Bosch” campaign right here at CES. Well, we’re doing it again! The newest installment in the series calls on everyone to “live sustainable like a Bosch” and join us in fighting climate change.

Sustainability anchored in product portfolio
As we show in the campaign, our products themselves are a major focus of our sustainability efforts. On the consumer side, they help people reduce their environmental footprint. Our state-of-the-art heating systems, for example, can help individual households save 2.5 tons of CO_2 annually in Germany alone. And, our dishwashers equipped with Zeolith technology offer an energy savings of up to 20 percent. Our washing machines help people to save water. Our durable power tools feature intelligent power management technology that increases their lifespans – and helps people reduce electronic waste.

And in our core mobility business, our wide variety of solutions and services help people reduce their carbon footprint. Here, we’re working toward a vision of mobility products that, when employed, can have no

negative impact on the global climate and urban air quality. To pursue our vision, we're developing a full range of powertrain solutions – from combustion engines to battery-electric powertrains to fuel cells, powering everything from e-bikes to trucks.

For more than ten years, our eBike Systems division has been setting new standards with high quality drive systems, consisting of drive units, batteries, and smart control panels for electric bicycles. The latest generation of our Nyon control panel, for example, offers on-board navigation, fitness tracking, digital locking, and topography-based range estimates – and is a CES 2021 Innovation Award honoree.

When it comes to vehicle-based e-mobility, we have a more broad-based portfolio than any other company. Early on, we started applying our knowledge – and a great deal of financial resources – to help e-mobility achieve a breakthrough. Last year alone, Bosch invested more than 600 million dollars (500 million euros) in electromobility. Our electrical powertrain components are featured in more than 1.5 million vehicles around the world. From powertrains to steering systems to brakes, we have all the building blocks for electrification in our portfolio.

AIoT as complementary driver of strategy

Alongside climate action, another major pillar of our strategy at Bosch is driving forward advances in AIoT – where AI meets the internet of things. In fact, these two strategic paths are strongly intertwined, with AIoT and data often holding the technological key to enabling greater sustainability. This is the case, for example, with our cloud-based Energy Platform, which optimizes equipment and processes in manufacturing operations. It uses intelligent algorithms to help predict energy consumption, avoid peak loads, and correct deviations in typical patterns of consumption. This helps reduce CO_2 emissions in

factories; for example, Bosch's lead plant for Industry 4.0 in Homburg, Germany, cut its emissions by some 10 percent within two years. The solution is already in use at more than 100 Bosch locations worldwide, including for example in Charleston, South Carolina, and is also being marketed to other companies.

And we're not the only ones to have uncovered the link between technology and sustainability. According to a recent study conducted in Germany, comprehensive digitalization in the mobility, manufacturing, and building technology segments could help the country get nearly halfway to the emissions targets it pledged as part of the Paris Agreement (source: Accenture). Another study identified digital solutions as indispensable enablers in meeting all 17 United Nations Sustainable Development Goals (source: Econsense). This comes as no surprise to us: we're so convinced of the beneficial potential of AI and connectivity, we aim to be a leading AIoT company in every domain we operate.

In the case of AI in particular, we're pursuing development along a path we call "industrial AI." For many other tech companies, artificial intelligence is primarily about creating models of human behavior, focusing especially on purchasing preferences. Our approach, by contrast, focuses on the world of objects and their interaction with their environment. Whether in an automotive emergency braking assistant or when identifying faulty parts in production – in these cases, artificial intelligence is not telling machines what people are doing, but explaining the physical world to machines. In this way, we can enable intelligent behavior and optimize the way they work. We want to harness the potential of artificial intelligence to improve people's lives. To help us stay true to this aim, we've created an AI code of ethics for our development and application of AI, especially in cases of doubt and dilemma. Ultimately, though, we will only be able to tap its full

potential if we can convince people of the benefits of AI – and above all build trust in the technology.

AIoT for health and home applications

Nowhere are these benefits as obvious as in the domains of health and well-being. Here, the combined challenges of the pandemic and climate change have offered us another opportunity to demonstrate how literally we take our strategic imperative “Invented for life.” In recent months, that has meant a focus on developing and producing technological solutions for the fight against the virus.

The solution we’re most proud of in this regard is our rapid test for coronavirus. Using our mobile Vivalytic medical analysis device, we developed the PCR test in six short weeks and launched it in March of last year. Offering an initial time-to-result of two and half hours, we have since shaved this down to less than 30 minutes for positive samples. We also adapted the test cartridges to accommodate up to five samples simultaneously, thus boosting capacities considerably. The tests are currently in use in a variety of settings from nursing homes to doctors’ offices. We’re currently ramping up production with the aim of increasing our testing capacity to three million this year.

As for how it harnesses AIoT, this connected device gets software updates via our Vivasuite cloud platform – all it needs is an internet connection. That means when we reduce turnaround time for our Covid tests, devices deployed in the field are also automatically updated with the optimized procedure.

Our new open security camera solution from our Security and Safety Things startup addresses a very different kind of pandemic-related need. This camera ecosystem – which is another 2021 CES Innovation Award honoree – allows cameras of different manufacturers to be equipped with customized applications. Among these is an AI-based

one which enables, for instance, customer numbers in retail spaces to be automatically detected and limited in accordance with local Covid regulations, or the presence of facial coverings to be verified.

For private households, we've developed a smart solution in the form of an innovative air-quality sensor. Along with conventional indicators including temperature, humidity, and air purity, this new sensor can also measure the amount of exhaled air and aerosols present in a room. Based on these readings, it can alert you when ventilation is needed, as both can be a risk factor in Covid transmission. This new sensor is being built into two of our existing smart-home products: our Twinguard intelligent smoke detector and our Spexor mobile alarm device.

Although we're currently devoting a lot of resources to Covid, it's certainly not the only disease we're using technology to fight. For instance, we've just developed a new mobile anemia screening solution, which is also a 2021 CES Innovation Award honoree. Our hemoglobin monitor is a compact, non-invasive, point-of-care solution powered with machine learning algorithms. Delivering results within 30 seconds, it offers a fast and reliable method of diagnosing and monitoring anemia, which is responsible for a million annual deaths worldwide.

Of course, health is about more than just treating and preventing disease. With this in mind, we're premiering a new AI-enabled sensor for devices that many of us use to help keep ourselves in optimum form: wearable fitness trackers. Bosch Sensortec has developed a revolutionary self-learning motion sensor that adds artificial intelligence to portable devices. Among other things, it enables them to recognize and record any type of fitness activity that is based on repetitive, cyclical patterns. And thanks to the use of edge AI, where AI runs on the sensor itself, not only are latency and power consumption

minimized, but user data remains fully private, since it doesn't need a cloud connection or tethered smartphone to work.

Building expertise and exploring new horizons in AIoT

In our quest for AIoT leadership we're not only focusing on technology, however, but also on people. Remember the AI training initiative at Bosch I announced last year? We're now well on our way to training 20,000 of our associates in the principles of AI. And as a member of the CTA Apprenticeship Coalition, we recently launched an apprentice model focused on software engineering, or as we call it, our IoT apprenticeship, in the United States. The goals of this 12 month program are simple. First, we recruit talented non-engineers with transferable skills. Then, we train them in system architecture, design, and coding. And ultimately, we hope to employ these apprentices once their program is complete. Our IoT apprenticeship model is the manifestation of a "build" strategy for talent that helps us meet our software engineering needs in a very challenging recruiting environment.

Our first cohort of IoT apprentices includes a former chef, a shop technician, and a personal banking manager. It's fascinating to hear what motivated them to make such a career change – some want to gain real-world technological experience. And some are looking for a chance to work on interesting projects. This team is engaged and ready to learn, and we are equally excited to see them embark on their IoT journey.

Speaking of updates, here's one on our most far-out application of AI – *quite literally!* Last year I told you how NASA planned to install our SoundSee AI-based sensor system on the International Space Station, where it would perform deep audio analytics. I'm happy to say our system is indeed orbiting far above us. And, we're collaborating with NASA on another AI-based application for space.

This time, our technology is going to the moon as part of NASA's Tipping Point program. In partnership with Astrobotic, WiBotic, and the University of Washington, we're going to be researching and developing technology for intelligent autonomous navigation and the wireless charging of small robots on the lunar surface. These shoebox-sized robots – called CubeRovers – will be equipped and trained to navigate the moon's harsh, unpredictable conditions and get themselves to a docking station in an environment where GPS is not an option. Our researchers in Pittsburgh and Silicon Valley will be contributing their expertise in AI-driven intelligent data analytics and wireless connectivity solutions, with a goal of having the system demonstration-ready by mid-2023.

But back to Earth, and to the benefits AIoT technologies can deliver closer to home. In the mobility domain, they're already demonstrating how they can help make getting from A to B more climate-friendly. Solutions for connected and automated driving can help eliminate gridlock and ensure smooth traffic flows in cities, which significantly reduces both consumption and emissions.

The same is true for parking, particularly in urban centers. Here, we've been continuing to refine our automated valet parking solution – and have now debuted this technology in the U.S. Last year, we teamed up with Ford and the real-estate developer Bedrock to demonstrate fully automated parking in Detroit. It was the first U.S. infrastructure-based solution for automated valet parking inside a parking garage. In Germany, Bosch is working with partners to provide the world's first commercial automated valet parking service at an airport parking garage.

The AIoT is also enabling us to achieve sustainability gains via mobility-based services. Take electric-vehicle batteries, for example.

To help maximize their lifespan and prevent premature aging, Bosch has developed a suite of “battery in the cloud” services that help to substantially improve batteries’ performance and extend their service life. Smart software functions in the cloud continually analyze the battery status and take appropriate action to prevent or slow down cell aging. This can reduce the wear and tear on the battery by as much as 20 percent which means replacement less often – and a better environmental profile.

The combination of electrified and automated driving – with personalized and connected services – is causing increasing demand for automotive software and electronics. Where a car included roughly 10 million lines of software code in 2010, the software of today’s non-automated vehicles already runs to 100 million lines of code. Tomorrow’s automated cars will require up to 500 million. At the same time, electronics engineering is becoming rapidly more complex, in line with more sophisticated vehicle functions.

In order for us to capitalize on our long-standing expertise in both of these domains, we are now pooling our software and automotive electronics expertise from the areas of driver assistance, automated driving, car multimedia, powertrain, and body electronics in a new division called Cross-Domain Computing Solutions, which started operation just ten days ago.

This division is home to 17,000 Bosch associates around the world, nearly half of whom are software engineers. In setting it up, we intend to master and reduce complexity in future vehicles through cross-domain software and electronics solutions. In particular, we’re focusing on powerful vehicle computers, which will take over from the multitude of individual control units used today. Our goal is to get new vehicle functions on the road significantly faster in the future, make cars more intelligent, and provide drivers with tangible benefits.

Sustainability and competitiveness are two sides of same coin

As all these examples show, Bosch is investing heavily – in promising technologies, in our workforce, and in our operations. We're doing this to ensure our competitiveness in a world where climate change and a global pandemic are accelerating transformation and change. Our investments underscore the deep commitment we have to our role in creating a sustainable world for future generations, as well as our commitment to the future of our business. And in fact, we see no conflict between these: in our view, sustainability and profitability are two sides of the same coin.

First, pursuing sustainability is obliging us to pursue energy efficiency, which in turn is driving cost efficiency. Second, it's enabling us to gain independence from rising energy prices. Third, it's opening up new markets as we strive to satisfy growing demand for eco-friendly products. Fourth, it's unlocking innovative potential as we are forced to think outside the box to develop climate-friendly solutions.

And last but not least, new business opportunities for us are emerging from these new green technologies and in the form of carbon-neutrality consulting and services. To this end, we've established our new Bosch Climate Solutions subsidiary, which provides an advisory service for other companies to help them become climate neutral. Our aim here is to pass on the knowledge and experience we've gained from achieving carbon neutrality and from projects we've successfully carried out worldwide.

Conclusion

Ladies and gentlemen, at Bosch we firmly believe that technological innovation, business success, and climate action are not mutually exclusive. But more than that, we believe that all three are interdependent: only companies that pursue sustainability today will be

successful tomorrow, and only by harnessing the potential of technology will we succeed in combating climate change and challenges like Covid-19. This belief is the bedrock of our corporate strategy – and it's the motivation behind our extensive portfolio of products, services, and business models that are true to our strategic imperative "Invented for life" in every possible sense of the term.

Thank you for joining us today. And please, stay safe and healthy.

Press release
Bosch Smart Home

Smart life, smart options – innovations from Bosch Smart Home at the CES 2021

11th January 2021
PI 11254 HOME CT

The highlights at a glance:

Keeping an even closer eye on room climate

- New “Healthy Room Climate” service with personal ventilation reminder

Smart home meets smart car

- Control your Bosch Smart Home by voice within your Mercedes-Benz

Bosch Smart Home is becoming even more international

- Sales are planned in a total of fifteen European countries

Stuttgart/Las Vegas. Intelligently networked devices are now enriching many people’s homes and everyday lives. To coincide with CES 2021, Bosch is offering a preview of the technological options that the new year holds in store to provide users with greater safety, comfort and everyday convenience. And all this will soon be available in eleven additional European countries.

Healthy air is safer: Bosch presents a new ventilation reminder service

The year of 2021 begins with a topic that is important for all of us. In view of the on-going pandemic, a healthy climate inside our homes remains a high priority. Bosch Smart Home has always focused on safety and on supporting its users in their daily lives. That’s why the company has now introduced a new “Healthy Room Climate” service for its Bosch Smart Home App. The first feature is the ventilation detector, which makes it even more convenient for users to monitor air quality with the Twinguard.

Receiving the ventilation reminder, users can set up their own ventilation ”traffic light” based on the measured purity of the indoor air. The convenient assistant guides its users through the setup in three simple steps: selecting the room; setting the limits for the three warning levels (red, yellow and green); and specifying the period of use. Alerts can be sent to a smartphone via a push message while being simultaneously displayed as coloured warning lights on the integrated smart lamps from Philips Hue or LEDVANCE Smart+.

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“Bosch Smart Home has the goal of making connected life and the daily life of its users as simple and convenient as possible. We always keep our users’ positive experience in mind. These benefits already begin during the setup and are further augmented by the smallest details of everyday use. Requests and feedback from our users serve us as a basis for the continual optimization and further development of our Smart Home products. This impetus has also given rise to the new functionality of the ventilation detector, which is designed to enable all Bosch Smart Home users to set up their own ventilation light via few intuitive setup steps – and thus to enjoy the winter in good health”, says Christian Thess, Board Member Bosch Smart Home, about the new service.

Two partners for a shared vision: smart home meets smart car

Our frequently stressful everyday lives mean that when we are already in our car driving to the office or to our children’s school or day-care centre, our thoughts often still revolve around the home and whether we have left everything there in proper order. Are the lights switched off? Are the windows and doors closed? Is the heating turned down? Fortunately, it is now easy to instantly check all these things. With a simple voice command and a “Hey, Mercedes”, the most important Bosch Smart Home functions are already available aboard the Mercedes-Benz and can be controlled directly within the car. The driver’s hands remain on the steering wheel and the driver’s attention stays on the traffic – for optimal safety on the road.

The integration is made possible by an open interface that Bosch Smart Home began offering early in 2020. The interface enables partners such as Mercedes-Benz to integrate Bosch Smart Home devices into their own solutions via a cloud API. The following Bosch Smart Home products have been controllable from Mercedes S-Class cars since December 2020: Smart Plug, Room Thermostat, Radiator Thermostat, Shutter Control, Door/Window Contact, Light Control and Motion Detector. Successive expansion to include other model series from Mercedes-Benz is planned in the course of the year.

“Our collaboration with Mercedes-Benz as a strong partner not only creates a meaningful link between the topics of home and mobility, but also unites our corporate philosophies of ‘Technology for Life’ and ‘The Best or Nothing’ under a common goal. This brings new ease into the connected lives of our users, from which they will benefit greatly”, Christian Thess comments on the new partnership.

Europe clearly in view: Bosch Smart Home becomes more international

With strong partners on board, Bosch Smart Home is also taking the next step on the sales side in 2021. Now that the company’s intelligently networked products have successfully established themselves on the market in Germany, Austria, France and the United Kingdom, Bosch Smart Home is gradually expanding its portfolio further in Europe. The system and its individual solutions also became available in the Netherlands, Spain, and Italy at the beginning of the year. With a step-by-step expansion plan, market entry is

scheduled for Switzerland as the next distribution country, followed by Portugal, Belgium, Denmark, Finland, Norway, Sweden and Luxembourg in the course of the year.

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The Robert Bosch Smart Home GmbH was founded as a wholly-owned subsidiary of the Robert Bosch GmbH. Based in Stuttgart-Vaihingen, the company offers intelligent solutions for retail customers who desire a networked home from a single source. Bosch Smart Home simplifies the life at home by unobtrusively controlling routine activities in the background. It offers greater comfort, convenience, security and energy efficiency.

More information is available at www.bosch-smarthome.com.

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About Mercedes-Benz AG

Mercedes-Benz AG directs the global business of Mercedes-Benz Cars and Mercedes-Benz Vans with over 173,000 employees worldwide. Ola Källenius is Chairman of the Board of Management of Mercedes-Benz AG. The company focuses on the development, production and sales of cars and vans as well as of services. Furthermore, the company aspires to be a leader in the fields of networking,

autonomous driving and alternative powertrains with its trailblazing innovations. The product portfolio comprises the Mercedes-Benz brand with the sub-brands Mercedes-AMG, Mercedes-Maybach and Mercedes me – as well as the smart brand, and the EQ product and technology brand for electric mobility. Mercedes-Benz AG is one of the world's largest producers of premium cars. In 2019, the company sold more than 2.4 million cars and over 438,000 vans. In its two business divisions, Mercedes-Benz AG is continually expanding its worldwide production network with over 40 production sites on four continents, while aligning itself to meet the requirements of electric mobility. At the same time, the company is developing its global battery production network on three continents. Sustainable actions play a decisive role in both business divisions. For the company, sustainability means permanently creating value for all stakeholders: customers, employees, investors, business partners, and society as a whole. The basis for this is Daimler's sustainable corporate strategy: the company assumes responsibility for the economic, ecological and social effects of its business activity, and takes full account of the entire value chain.

Presse Information
Bosch Healthcare Solutions

January, 11 2021
PI11260

Bosch Hemoglobin Monitor: Early detection of anemia without blood tests
Artificial intelligence helps determine hemoglobin levels

- Non-invasive, safe and rapid detection of hemoglobin value at point-of-care
- Portable and compact device mainly for use in emerging and developing economies
- Named CES Innovation Award Honoree
- Machine learning algorithms help determine hemoglobin levels

Bengaluru, India / Waiblingen, Germany – According to estimations by the WHO 1.6 billion people suffer from Anemia, a condition resulting from the reduced hemoglobin concentration in the blood. This has prompted the WHO to define the fight against anemia as one of its critical sustainable development goals for 2025. Bosch has developed a portable Hemoglobin Monitor Solution (HMS) especially for regions where routine access to medical care tends to be difficult. This HMS allows a large number of people to be screened for anemia rapidly, safely, using a non-invasive approach. The solution has been named a CES Innovation Award Honoree in the “Health and Wellness” category. “Bosch has developed the non-invasive Hemoglobin monitor as an innovative solution and as an alternative to traditional methods for the early detection of anemia. This should offer people better diagnosis options even in resource constrained conditions. The use of artificial intelligence is revolutionizing anemia management, specifically in point-of-care setups and closer to the patient”, explains Dattatri Salagame, President and Managing Director of Robert Bosch Engineering and Business Solutions Private Limited (RBEI).

Hemoglobin is a protein found in red blood cells and is responsible for carrying oxygen and carbon dioxide throughout the body. People with a low hemoglobin count may experience symptoms such as general fatigue, weakness, pale skin, and even serious illnesses. Anemia particularly affects women, even more so when they are pregnant, and also people suffering from malnutrition. In cancer patients undergoing chemotherapy or in palliative care, hemoglobin levels should be checked regularly.

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Hemoglobin results in 30 seconds using a non-invasive AI measurement
The intelligent solution by Bosch is designed for use directly at the point-of-care and is completely pain-free with no need for a blood test, as the value is determined by a finger scanner using multi-wavelength spectrophotometry on the surface of the skin. The system uses an optical sensor to precisely and reliably measure the photoplethysmogram (PPG) signals. Photoplethysmography, or PPG, is an optical technique used to detect volumetric changes in blood in peripheral circulation. The device provides a reliable result within 30 seconds even for low hemoglobin concentrations. This is where machine learning comes in: the device's algorithm monitors the wavelength of the light and uses 27 different characteristics to determine and classify the hemoglobin value. The algorithm has been trained with more than 10,000 anemia data points. These clinically collected data along with the corresponding ground truth data, are the basis for the machine learning algorithm. The more validated data sets are put into the continuously learning algorithm, the more precise the results will be.

Lab-free results without risk of infection
A laboratory analysis is not necessary and there is no risk of infection from contaminated needles. Participants receive their test results quickly at the point of care. The device is battery operated, does not need subsequent calibration, and is extremely easy to use. It is intended for use in outlying and remote regions by healthcare professionals. Location-based reporting ensures easy clinical traceability. Organizations that operate multiple devices can draw conclusions through heat maps about specific regions. Patient data remains anonymous. Market release in India is expected by mid-2021.

Press image: #ab8dc58b

Bosch at CES 2021:

- **VIRTUAL PRESS CONFERENCE: Monday, January 11, 2021**, from 8:00 to 8:30 EST (14:00–14:30 CET) with Dr. Michael Bolle, Bosch CTO, CDO, and management board member, and Mike Mansuetti, president of Bosch North America, at the Bosch Media Service.
- **VIRTUAL BOOTH: January 12 – February 15, 2021,** at www.ces.tech
- **FOLLOW** the Bosch CES 2021 highlights on Twitter: **#BoschCES**

- **DEEP-DIVE SESSIONS WITH BOSCH-EXPERTS: January 12 – February 15, 2021,** at www.ces.tech

  - *Sustainable #LikeABosch: How a key global industry player drives carbon neutrality at its* sites with **Torsten Kallweit**, Head of Corporate Office Health, Safety, Environmental and Fire Protection as well as Sustainability and Manager CTO Bosch Climate Solutions GmbH, and **Annette Wagner**, Head of Sustainability and Ideas Lab
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  - *Perfectly keyless advanced* with **Tim Frasier**, Regional President Automotive Electronics North America, **Daniel Kornek**, Head of Product Area Vehicle Access (Perfectly Keyless), and **Jia Hou**, Business Development Manager

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The Bosch Group is a leading global supplier of technology and services. It employs roughly 400,000 associates worldwide (as of December 31, 2019). The company generated sales of 77.7 billion euros in 2019. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT provider, Bosch offers innovative solutions for smart homes, Industry 4.0, and connected mobility. Bosch is pursuing a vision of mobility that is sustainable, safe, and exciting. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to facilitate connected living with products and solutions that either contain artificial intelligence (AI) or have been developed or manufactured with its help. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life."

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www.bosch-press.com,

Press release

December 18, 2020
PI 11236 RB DW/af

Bosch's rapid coronavirus test delivers results for positive samples in less than 30 minutes

Cloud-based software update means a faster PCR test for SARS-CoV-2

- Improved software for Vivalytic: turnaround time for positive SARS-CoV-2 samples reduced to under 30 minutes.
- Expansion of production: Launch of two new productions lines in December.
- New jobs created: 80 associates – some from Bosch's mobility division – were newly hired this year.
- Update from the cloud: Vivalytic analysis devices are updated over the internet.

Stuttgart, Germany – Thanks to improved software for the Vivalytic analysis device, the Bosch rapid coronavirus test, which uses polymerase chain reactions (PCR), now delivers its results even faster. By applying optimized evaluation strategies, the Vivalytic analysis device can detect a positive sample through its high viral load in less than 30 minutes, right where the sample is collected. "In the fight to contain the coronavirus pandemic, speed is of the essence. With Vivalytic, we are delivering cutting-edge medical technology. Our IT and software expertise have helped to make the Bosch Corona test for positive samples even faster – all within a short period of time," says Dr. Volkmar Denner, chairman of the board of management of Robert Bosch GmbH. This modified product is part of a research and development project relating specifically to Covid-19, funded by the German Federal Ministry of Education and Research (BMBF) to the tune of 4.97 million euros. The project's aim is to expand the options for detecting acute infections of the coronavirus, looking particularly at on-the-spot testing in which the sample is analyzed in a fully automatic PCR process, as this offers rapid yet reliable results.

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The turnaround time for samples negative for SARS-CoV-2 is still 39 minutes. PCR tests are considered the gold standard, and Bosch's rapid coronavirus tests have a sensitivity of 98 percent and a specificity of 100 percent. They are already available in 26 countries, mostly in Europe. "To meet the high demand, we launched two new production lines at our headquarters in Waiblingen in December," says Marc Meier, president of Bosch Healthcare Solutions. "In total, we were able to create more than 80 new jobs this year, some of which have been filled by associates from Bosch's mobility division," Marc Meier continues.

Update from the cloud platform Vivasuite

The new update is available for the SARS-CoV-2 singleplex test and the SARS-CoV-2 pooled test. Updating the Vivalytic testing devices is simple and straightforward – all that is required is an internet connection to access the Bosch cloud platform Vivasuite. Developed in-house at Bosch, the Vivasuite cloud platform allows users to digitally manage and update all their Bosch Healthcare Solutions devices. This is also an advantage when Vivalytic devices are in use in the field. The platform meets the strictest security standards and data privacy is guaranteed at all times: for example, there is no remote access to Vivalytic devices, and no possibility of accessing patient data.

Press photographs: #824fb764, #10f50c30, #1269b43d, #6d49c767**,** #515d1fa1

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Bosch at the all-digital CES 2021:

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Press release
Bosch Research

November 17, 2020
PI 118

Intelligent Navigation and Wireless Charging for Mini Robots on the Moon

Bosch, Astrobotic, WiBotic and University of Washington to develop ultra-fast proximity charging for critical space applications

- $5.8 million in funding from NASA Tipping Point program enables research and development of solutions for wireless charging for lunar payloads.
- Shoebox-sized CubeRover from Astrobotic will operate autonomously and charge wirelessly.
- Project brings together Astrobotic, Bosch, WiBotic, the University of Washington and the NASA Glenn Research Center (GRC).
- Bosch researchers in areas of Wireless Connectivity and Intelligent IoT will support project, which aims for a mid-2023 demonstration.

PITTSBURGH – Even on the Moon, robots need power. Normally, onboard solar panels provide the power, but smaller robots or ones that operate during the lunar night will need a complementary power source. To make this possible two emerging technologies – wireless charging and intelligent autonomous navigation – will be combined. Small robots will be equipped and trained to navigate harsh, unpredictable conditions to get to a wireless docking station in an environment where GPS is not an option.

The National Aeronautics and Space Administration (NASA) recently announced funding for Ultra Fast Proximity Charging for Critical Space Applications, a project where a group of organizations will research and develop technology to intelligently navigate and wirelessly charge small robots for operation on the Moon. Astrobotic, which specializes in space robotics, serves as the Principal Investigator on the project and is joined by Bosch, the University of Washington, WiBotic, and the NASA Glenn Research Center. Bosch and Astrobotic, together with the other partners, developed the key technology and scoped the proposal from the beginning – a nearly two-year process.

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The goal of the project, which was awarded $5.8 million through NASA's Tipping Point program, is to develop a system for magnetic resonance-based wireless charging for use in lunar settings. This includes the precise autonomous navigation of robots to the wireless charging station. The aim is to develop the full system for demonstration by the middle of 2023.

AI and connectivity expertise drives robots

Bosch will contribute its expertise in AI-driven intelligent data analytics and wireless connectivity solutions to the project.

Bosch researchers in Pittsburgh and Sunnyvale, Calif. will focus on intelligent processing capability that will enable autonomous navigation of robots on the Moon's surface. The project showcases Bosch's expertise in AIoT - when Artificial Intelligence meets the Internet of Things. Bosch is focused on connecting things to get data, processing the data and using AI to obtain information. The information learned can improve products and add value.

"Navigating a robot on the Moon is not the same as navigating a robotic vacuum through your home or navigating a self-driving car on the road," said Dr. Samarjit Das, leader of the Intelligent Internet of Things group at Bosch Research in Pittsburgh. "First of all, radio-based terrestrial localization solutions are not available on the Moon. In addition, unpredictable lunar terrain and dust make it even harder to perform precise navigation using visual cues alone. Thus, we will need intelligent fusion and perception on the robot's multi-sensory data to solve this unique challenge on the harsh environment of the Moon."

Bosch will study and develop multi-sensor fusion technologies that could include video, inertial measurement units (IMU), radio frequency (RF) movements and vibration sensors on the small robots to create complementary modalities that enable highly-precise navigation. The first specific navigation is guiding the robot to a docking station for wireless charging.

"If a robot can master the specific navigation back to the charging station, it provides the blueprint of more autonomous missions for the robot on the Moon," said Dr. Vivek Jain, head of the Wireless Connectivity and Sensing group at Bosch Research in Silicon Valley. "All aspects of wireless - communication, sensing, localization and charging, have to work optimally along with multi-sensor fusion to provide a robust solution."

Featuring a modular, scalable shoebox-sized rover

The robot featured in the project will be Astrobotic's CubeRover, an ultralight, rechargeable planetary rover developed in collaboration with the NASA Kennedy Space Center. The rover is roughly the size of a shoebox and weighs fewer than five pounds. It can carry its own payload or team up with other CubeRovers to scout for larger rovers and landers.

The CubeRover, which was previously awarded funding as part of NASA's Tipping Point program, are built in three sizes, 2U, 4U, and 6U, and are based on internationally recognized CubeSat standards to simplify payload integration efforts. The rover trio introduces an off-the-shelf mobile platform for payloads that can host an array of instruments such as spectrometers, neutron detectors, cameras, and other important scientific sensors. These instruments will support payloads for extended mission durations at a reduced weight and lower cost, demonstrating new space technologies and filling key knowledge gaps in our scientific understanding of the Moon.

Bosch and Astrobotic previously collaborated on SoundSee, a module that uses artificial intelligence to analyze audio data, now in orbit aboard the International Space Station (ISS).

Wireless – a new power source for lunar robots

The CubeRovers will need power. Wireless charging expertise will come from WiBotic, a Seattle company that specializes in advanced wireless charging and power optimization solutions for the rapidly expanding ecosystem of aerial, mobile and marine robots. The company, which was co-founded by Dr. Joshua Smith and Dr. Ben Waters and announced a Series A funding round of $5.7 million in June 2020, creates wireless charging and power optimization solutions for the robotics industry via next-generation hardware and software systems for use with a broad ranges of robots or drones.

WiBotic will also be supported by the University of Washington, where the topic of wireless charging has been studied for a number of years under the leadership of Dr. Smith, who leads the Sensor Systems Laboratory. Dr. Smith has been a long-time collaborator with Bosch Research in Silicon Valley in the area of wireless charging.

The combined team will develop a lightweight, ultra-fast proximity charging solution, comprised of a base station and power receiver to enable critical space applications.

System testing to simulate space

Results of the collaboration will be tested at NASA's Glenn Research Center (GRC) in Cleveland. There, the CubeRover with intelligent navigation and wireless charging technology will be deployed in GRC's Space Power Facility, the world's largest thermal vacuum chamber. Tests will showcase how the system can enable lunar night survival for small-scale robotics.

Public-private partnership gives a boost to technology development

The project was selected as part of NASA's fifth competitive Tipping Point solicitation for public-private partnerships. As part of the program, NASA seeks technology that is at a tipping point where investment would help to mature the technology, increase the likelihood of its use in a commercial space application and bring the technology to market for both governmental and commercial applications.

Press photographs:

Additional information:

Soundsee blasts off

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Having established a regional presence in 1906 in North America, the Bosch Group employs 35,400 associates in more than 100 locations, as of December 31, 2019. In 2019 Bosch generated consolidated sales of $14.4 billion in the U.S., Canada and Mexico. For more information, visit www.bosch.us, www.bosch.ca and www.bosch.mx.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 403,000 associates worldwide (as of December 31, 2019). According to preliminary figures, the company generated sales of $86.5 billion in 2019. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. At 125 locations across the globe, Bosch employs some 72,000 associates in research and development.

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Exchange rate: 1 EUR = $1.1027

Press release

The market of the future: Bosch wins orders worth billions for vehicle computers

December 16, 2020
PI11243 BBM Fi/af

- Harald Kroeger: “Vehicle computers are the key to significantly reducing the complexity of electronic systems.”
- Bosch is developing vehicle computers for all automotive applications.
- Vehicles featuring Bosch central computers have been on the roads since 2019.
- Cross-Domain Computing Solutions division to start operations in January.

Stuttgart, Germany – In modern cars, intelligence counts for a lot, and Bosch vehicle computers are there to provide it. These computers, the new all-rounders of automotive electronics, are incorporating ever more functions of individual control units into central, highly powerful electronic modules. For more than a year now, Bosch vehicle computers have been controlling functions such as driver assistance systems and motion in production vehicles. And soon, they will be joined by central computers for cockpit functions and body electronics. When it comes to vehicle computers, therefore, no other company can match Bosch’s broad portfolio, since the supplier of technology and services can offer production-ready computers for every aspect of modern vehicles. And business-wise as well, this is paying off. Bosch has now won orders worth several billion euros for its vehicle computers – 2.5 billion euros’ worth since this past summer alone. “Vehicle computers have huge business potential for Bosch. Even now, our high-performance computers mean that automakers view us as one of their leading engineering and technology partners,” says Harald Kroeger, who sits on the board of management of Robert Bosch GmbH. Vehicle computers are central to Bosch’s efforts to extend its leading role in software-intensive electronic systems. The market for these systems is worth some 20 billion euros, and is set to grow 15 percent annually between now and 2030. To meet this demand, the new Cross-Domain Computing Solutions division and its 17,000 associates will start operations in January 2021. In this unit, Bosch is bringing together its hardware and software engineering for vehicle computers, sensors, and control units for all vehicle domains.

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Automotive electronics is getting fit for the future

In the future, high-performance control units will be a must-have for all cars. These central nodes are where all the car's "nerves" converge. Thanks to their prodigious computing power of several billion operations per second, central computers are even capable of processing the big data needed for automated driving, data-based services, and permanent software updates. According to McKinsey, software's share in the value of a vehicle will rise from just 10 percent today to 30 percent in the future. This development underscores how important bits and bytes will be for vehicles in the future. And vehicle computers that can handle such software functions and data volumes will therefore soon be a standard feature in all vehicles, whether compacts, premium sedans, or 40-ton trucks. Bosch is developing computers for cockpit and connectivity functions, for driver assistance systems and automated driving, and for the powertrain and body electronics. This means it will be possible to concentrate control over all central vehicle functions in just a handful of high-performance central computers. Take the information domain computer Bosch is developing. In the next vehicle generation, it will assume the tasks done by as many as ten control units. Some vehicles now feature more than 100 control units in total, and this development will allow automakers to significantly reduce this number. "Vehicle computers are the key to significantly reducing the complexity of electronic systems, and to making them as secure as possible," Kroeger says. Moreover, installing more central high-performance computers will save on wiring, and thus reduce cost, weight, and installation space.

In the vanguard of automotive electronics

In the years ahead, vehicle computers will be entrusted with tasks from different parts of the vehicle – or domains, as the experts call them. When this happens, just one central computer will be responsible for controlling not only vehicle motion, but also body electronics, say. Such central computers will then be all the more powerful: over the past 20 years, the computing power of a control unit originally intended for navigation has grown by a factor of 3,000. This is almost three times the increase predicted by Moore's law, which states that computing power doubles every two years. The result is that a modern cockpit computer can control not only displays, infotainment, and voice commands, but also the tasks of other domains, such as certain assistance functions. "Bosch vehicle computers will make it possible to master even highly complex driving functions across individual vehicle domains," says Dr. Mathias Pillin, who will be assuming the position of president of the new Cross-Domain Computing Solutions division from January 2021. The new division's name is no coincidence. Here, under one roof, Bosch will be pooling its capabilities in software, electrical, and electronic engineering from the domains of driver assistance and automated driving, car multimedia, powertrain, and body electronics.

Modular design offers business potential

Bosch offers its vehicle computers as a scalable kit that contains the right electronic system, including hardware and software, for all requirements and conditions. The ultimate aim is a software and systems architecture for the entire vehicle, in which all central computers, sensors, and control units are perfectly compatible with each other. For automakers, the benefit of such a modular design is that it gives them extra flexibility when developing vehicle computers for different vehicle models. If, for example, a fundamental architecture has been defined for hardware and software, the computer can be designed along those lines, according to customer wishes.

In the case of a premium vehicle, additional functions can be provided by adding extra software modules or special chips to the printed circuit boards. In the case of a compact vehicle, the structure of the vehicle computer can be modified so that it provides central control over basic safety-relevant functions. "Our modular design for vehicle computers and our broad portfolio mean that Bosch can cater to all automakers' needs," Pillin says. This design principle also means huge business potential for these high-performance computers, since it will allow Bosch to tap into an enormous market.

Press photos: #3071196, #2936862, #3071268, #3071536, #3071535, #517626db, # 76176558

Additional information:

Bosch pools its software and electronics expertise in one division with 17,000 associates

Facts about automotive software and electronics

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Bosch at CES 2021:

- **VIRTUAL PRESS CONFERENCE: Monday, January 11, 2021**, from 8:00 to 8:30 EST (14:00–14:30 CET) with Dr. Michael Bolle, Bosch CTO, CDO, and management board member, and Mike Mansuetti, president of Bosch North America, at the Bosch Media Service.
- **VIRTUAL BOOTH: January 12 – February 15, 2021,** at www.ces.tech
- **FOLLOW** the Bosch CES 2021 highlights on Twitter: **#BoschCES**
- **DEEP-DIVE SESSIONS WITH BOSCH-EXPERTS: January 12 – February 15, 2021,** at www.ces.tech

- *Sustainable #LikeABosch: How a key global industry player drives carbon neutrality at its* sites with **Torsten Kallweit**, Head of Corporate Office Health, Safety, Environmental and Fire Protection as well as Sustainability and Manager CTO Bosch Climate Solutions GmbH, and **Annette Wagner**, Head of Sustainability and Ideas Lab
- *Move #LikeABosch: Technology for sustainable future mobility* with **Mike Mansuetti**, President of Bosch North America, and **Tim Frasier**, Regional President Automotive Electronics North America
- *Artificial intelligence in use: Application examples from the fields of fitness tracking and well-being to smart cameras* with **Kaustubh Gandhi**, Senior Product Manager, and **Sina Isabell Springer**, Business Development Manager
- *Perfectly keyless advanced* with **Tim Frasier**, Regional President Automotive Electronics North America, **Daniel Kornek**, Head of Product Area Vehicle Access (Perfectly Keyless), and **Jia Hou**, Business Development Manager

Mobility Solutions is the largest Bosch Group business sector. In 2019, its sales came to 46.8 billion euros, or 60 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers. The Mobility Solutions business sector pursues a vision of mobility that is safe, sustainable, and exciting, and combines the group's expertise in the domains of personalization, automation, electrification, and connectivity. For its customers, the outcome is integrated mobility solutions. The business sector's main areas of activity are injection technology and powertrain peripherals for internal-combustion engines, diverse solutions for powertrain electrification, vehicle safety systems, driver-assistance and automated functions, technology for user-friendly infotainment as well as vehicle-to-vehicle and vehicle-to-infrastructure communication, repair-shop concepts, and technology and services for the automotive aftermarket. Bosch is synonymous with important automotive innovations, such as electronic engine management, the ESP anti-skid system, and common-rail diesel technology.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 400,000 associates worldwide (as of December 31, 2019). The company generated sales of 77.7 billion euros in 2019. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT provider, Bosch offers innovative solutions for smart homes, Industry 4.0, and connected mobility. Bosch is pursuing a vision of mobility that is sustainable, safe, and exciting. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to facilitate connected living with products and solutions that either contain artificial intelligence (AI) or have been developed or manufactured with its help. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm.
In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. Bosch employs some 72,600 associates in research and development at 126 locations across the globe, as well as roughly 30,000 software engineers.

Additional information is available online at www.bosch.com, iot.bosch.com, www.bosch-press.com, twitter.com/BoschPresse