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The Hansen Report

Software Development – MB.OS Base Layer

Editorial Notes

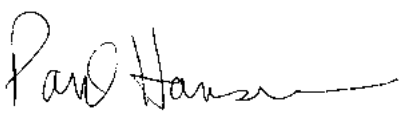
Dear Reader,

I continue to be reminded about the potential for catastrophic supply chain disruptions caused by the auto industry's reliance on chips from Taiwan Semiconductor Manufacturing Company. Way too much of what TSMC supplies to the auto industry is single sourced. As Chris Miller points out in his highly praised, bestselling book, Chip Wars, about the fight for the world's most critical technology, much of the chipmaking capacity the auto industry relies on "is within easy range of PLA [People's Liberation Army] missiles […] Looking at the role of semiconductors in the Russia-Ukraine war, Chinese government analysts have publicly argued that if tensions between the U.S. and China intensify, 'we must seize TSMC'."

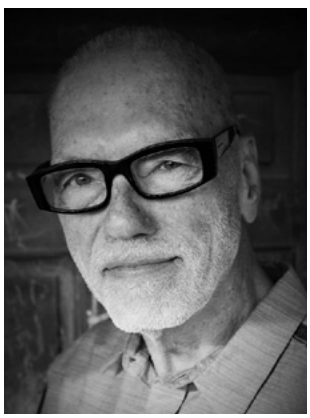
Chinese officials are not the only ones making inflammatory public statements about TSMC. According to a blog post at the Council on Foreign Relations website, a former U.S. national security advisor has advocated for the destruction of Taiwanese chip fabs should they fall into China's hands, implying that the threat would serve as a deterrent to Chinese aggression. The Council on Foreign Relations is an American think tank.

Thankfully, the U.S. security advisor's position isn't supported by the Council. Nevertheless, the geopolitical discourse around TSMC is worrisome and will likely lead many in the industry to redouble efforts to lineup second sources for the chips sourced from Taiwanese foundries. That transition will be arduous and expensive and, in the short term at least, will lead to more costly semiconductors.

Respectfully,



Paul Hansen
Editor



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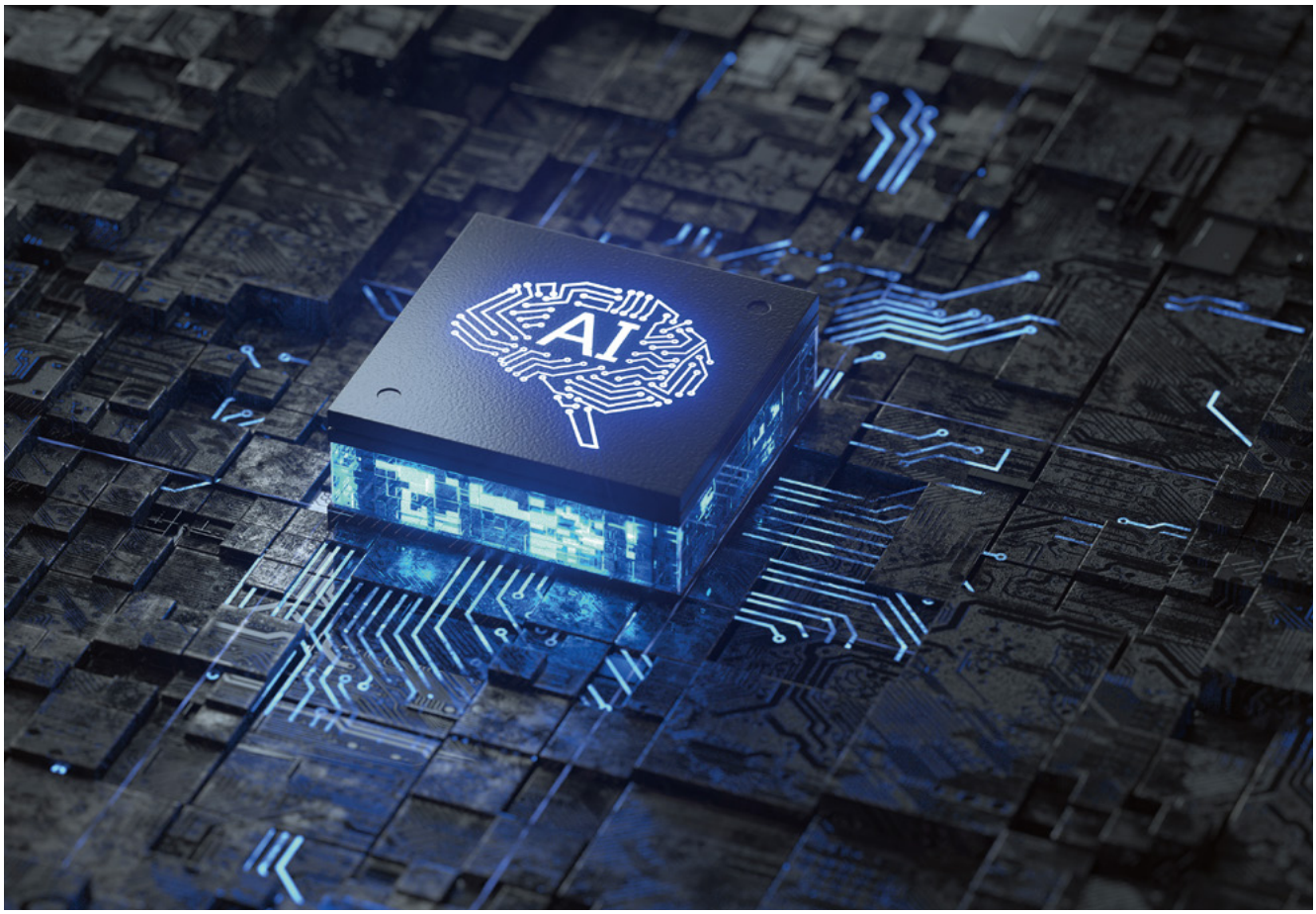
University of Liverpool | Ghost Autonomy | Stanford Center for AI Safety | Nvidia | Alliance for Automotive Innovation | Stellantis | **Can AI in Autos Be Trusted**



Can AI be trusted or will it be a bad choice for car makers as responsible operation might not always be given – explainable AI will be a key demand from regulators point of view

A few months ago, there was an explosion of news about the dangers posed by artificial intelligence (AI) following an open letter signed by thousands of experts, who warned that AI technologies such as GPT-4 present "profound risks to society and humanity." GPT-4 is a large language model that lets you have human-like interactions with a computer. It can answer questions, compose emails, write reports, and even software code. The worry, according to the letter's organizers: "AI systems are growing ever more powerful – and we don't know their upper bound. Malicious actors can use these systems to do bad things, and regular consumers might be misled, or worse, by their output." That made me curious about what risks AI poses to people in cars. Xiaowei Huang, director of the Trustworthy Autonomous Cyber-Physical Systems Lab at the University of Liverpool, is among a small group of people from the auto industry who signed the letter. In an email, he wrote that his concerns about AI extend to the auto industry. "We aren't sure if AI will run within our expectations. My concern is mainly on whether AI has been rigorously engineered to ensure its safety and trustworthiness. The engineering process would normally include falsification, verification, explanation, validation, and runtime monitoring. The key challenge will be how to organize these sub-processes to showcase to regulators and consumers AI's safety and trustworthiness."

AI use in cars began more than 20 years ago with speech systems. From there, machine learning has been applied to ADAS and, more recently, to autonomous driving systems. These systems employ AI-enabled perception systems trained to recognize patterns from cameras, ultrasonic sensors, radar and lidar. High-definition maps, needed for autonomous driving, also benefit from machine learning. Driver monitoring in support of the user experience is yet another application of AI. Large language models such as GPT-4 will likely be applied here, allowing the driver and passengers to engage in natural-language conversations with computers.

Among AI applications, autonomous driving stands out as the one with the greatest potential for harm, and there is much to be concerned about, according to the experts. As with the large language models, the main issue is that nobody knows for certain how safe they are. Millions of ADAS-equipped vehicles are already operating on the roads today as well as thousands of self-driving vehicles under test. A number of these vehicles have crashed, some causing fatalities. And while the number of accidents and the resulting loss of life haven't yet risen to a level that would cause outrage, there is no certainty that they won't. A surge in terrible accidents with loss of life caused by AI-powered machines will put a chill into the commercialization of autonomous driving technology.

Par Botes is chief product officer at Ghost Autonomy. He warned, "The biggest risk with statistical machine learning systems is they could encounter things they haven't been trained for and suggest maneuvers that are completely

wrong." It is impossible to train a neural network on everything it might encounter on the road, in every rotation, in every color, in every lighting and weather condition. Ghost Autonomy is developing next-generation AI solutions that don't rely on statistical learning, so-called autocoded generative models. An autoencoder is a type of artificial neural network used to learn efficient data encodings in an unsupervised manner. According to the Human-Centered Artificial Intelligence Research Institute at Stanford University, AI is used to simulate real-world conditions to safety-test autonomous vehicles, but work remains. "Our main challenge as a field is how do we guarantee that these amazing capabilities of AI systems are safe before we deploy them in places where human lives are at stake?" said Anthony Corso, executive director of the Stanford Center for AI Safety.

Regulations that would lead to commercialization of AI-based L3 and L4 systems are not nearly ready. Discussions about AI within UNECE WP.29's Working Party on Automated/Autonomous and Connected Vehicles (GRVA) began in late 2020. Barnaby Simkin, who works for Nvidia, has been an active participant in those discussions. In an email he wrote: "GRVA is interested in having an open dialogue to learn from the industry and evaluate the need, if any, to put specific horizontal requirements for AI-based systems in place." He pointed to two ongoing initiatives, ISO/PAS 8800 (for road vehicles) and ISO/IEC TR 5469 (a general framework), both of which cover the trustworthy AI principles including transparency, safety, privacy, and explainability. In Simkin's view, "the industry is not in need of specific AI regulation," and that "no particular stakeholder is pushing for regulation." While that may be true for now, it won't be true in the future if AI is implicated in a spate of fatal crashes involving autonomous vehicles currently under test on public roads.

Assuming that AI regulations of some sort are eventually established, automotive industry executives want those regulations to be harmonized globally and technology neutral. In a panel discussion on AI organized earlier this year by the Alliance for Automotive Innovation, Neda Cvijetic put her thoughts on regulation this way: "We need a regulation that will ensure safe and responsible operation without stifling innovation within this technically complex and not fully understood field of AI." Cvijetic is senior vice president, head of AI and autonomous driving at Stellantis.

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Michael Hafner on Software Development

A gradual transition to software competence in the automotive industry started more than two decades ago, when carmakers began to bring engine control system development in house. Over the last several years, the pace of the transition has accelerated as carmakers try to close the technology gap with Tesla. Carmakers now want to be "software driven."

Among the carmakers heading toward software competence, Mercedes is clearly among the most determined. "While a number of carmakers are content to rely on ecosystems that are available from the outside world, we aim to standardize on an architecture that we have defined, built and own," declared Michael Hafner, Vice President MB.OS Base Layer and MBUX (Mercedes-Benz User Experience). Hafner reports to Magnus Östberg, Mercedes-Benz Chief Software Officer. Comprised of base hardware, base software and middleware, MB.OS is a proprietary chip-to-cloud platform that enables decoupling software from hardware. The operating system will have full access to all vehicle domains, making them fully upgradeable and available to diagnostics.

We asked Hafner if he could point to a time when Mercedes began on its present path to becoming a software-driven company. "From 2014 to 2020, as we developed what is our current E/E architecture, we were forced to combine a lot of different pieces, each with different basic software technologies and different hardware. We had to find a way for all these ECUs to communicate with each other. We realized that this is no longer scalable. We need to go way deeper into software." Not yet complete, the platform will first appear in a production Mercedes vehicle in 2024. Coincident with its decision to go all-in on software, Mercedes-Benz determined that it would need

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Michael Hafner, Vice President MB.OS Base Layer and MBUX at Mercedes-Benz

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Mercedes-Benz User Experience (MBUX) Zero Layer: the feature developed for EQS was deployed into S- and C-Class via OTA

an additional 3,000 software developers. One thousand would be assigned to its Electric Software Hub in Sindelfingen, Germany; 2,000 more would be assigned to global tech hubs in Berlin, Tel Aviv, Seattle, Sunnyvale, Beijing, Tokyo and Bangalore. That staffing is nearly complete. According to the carmaker, by mid-decade, 25 % of Mercedes-Benz's R&D budget will be devoted to software.

Software Driven

Hafner outlined some of what it means to be software driven: "You are able to deliver software-based innovations at very high speeds, independent of the hardware. Your software developers are very iterative and agile. Data plays a huge role. And you are providing the right software development tool set." Mercedes is on a path to develop most of the software it needs in house. "As a luxury carmaker, we must differentiate, noted Hafner. "We need to own the software that makes us unique." We are taking the domains of our MB.OS in house. That includes infotainment, ADAS, body and comfort, and interior functions, followed by driving and charging." He added: "Where we don't differentiate, we can standardize. There is potential here to go more boldly into the free and open-source community." Moreover, in the future as Mercedes increasingly relies on standard software, Hafner expects outsourcing of software to grow. "There are opportunities to standardize both at the platform level and at the applications," he said. "For example, tuner software could be standard."

Within MB.OS, Mercedes standardized each of its five hardware base-layer clusters, including microcontroller: one cluster for each domain, plus the connectivity module. The carmaker teamed with Vector Informatik to jointly develop standard middleware for the base software layer. The work with Vector is based on Adaptive and Classic Autosar and the Autosar Runtime Environment. "MB.OS will take a lot of complexity out of the system and make us faster," Hafner asserted, "We also take software integration into our own hands. Two years ago, if I had an idea, I would have delivered a written specification to a supplier, asked for an offering, negotiated for a while, and then waited until they brought in what I wanted. That was the old world. In the new world, if I have an idea, I talk to my colleagues, and they start working on it. A few days later I have the first software version in a test vehicle."

Role Changes for Tier-1s

Tier-1 suppliers have been responsible for whole systems, both hardware and software. As carmakers bring software development and integration in house, the tier ones will be asked to do less. "In the past, we would develop a complete system with a supplier. If we wanted to go to a different supplier for the next-vehicle generation, we'd have to start from scratch, even if there were only incremental changes. That was a waste of resources," said Hafner. Mercedes will continue to purchase hardware from the tier ones, along with the software that is closely coupled with hardware. It would also like to involve tier-1s in the development of complete stacks that Mercedes and the supplier would co-own. That would let the carmaker and the supplier reuse parts of the stack as needed: "We want to focus on standardization and open source for the things where we don't differentiate from our competitors. Joint development projects such as these would promote standardization to the benefit of everyone."

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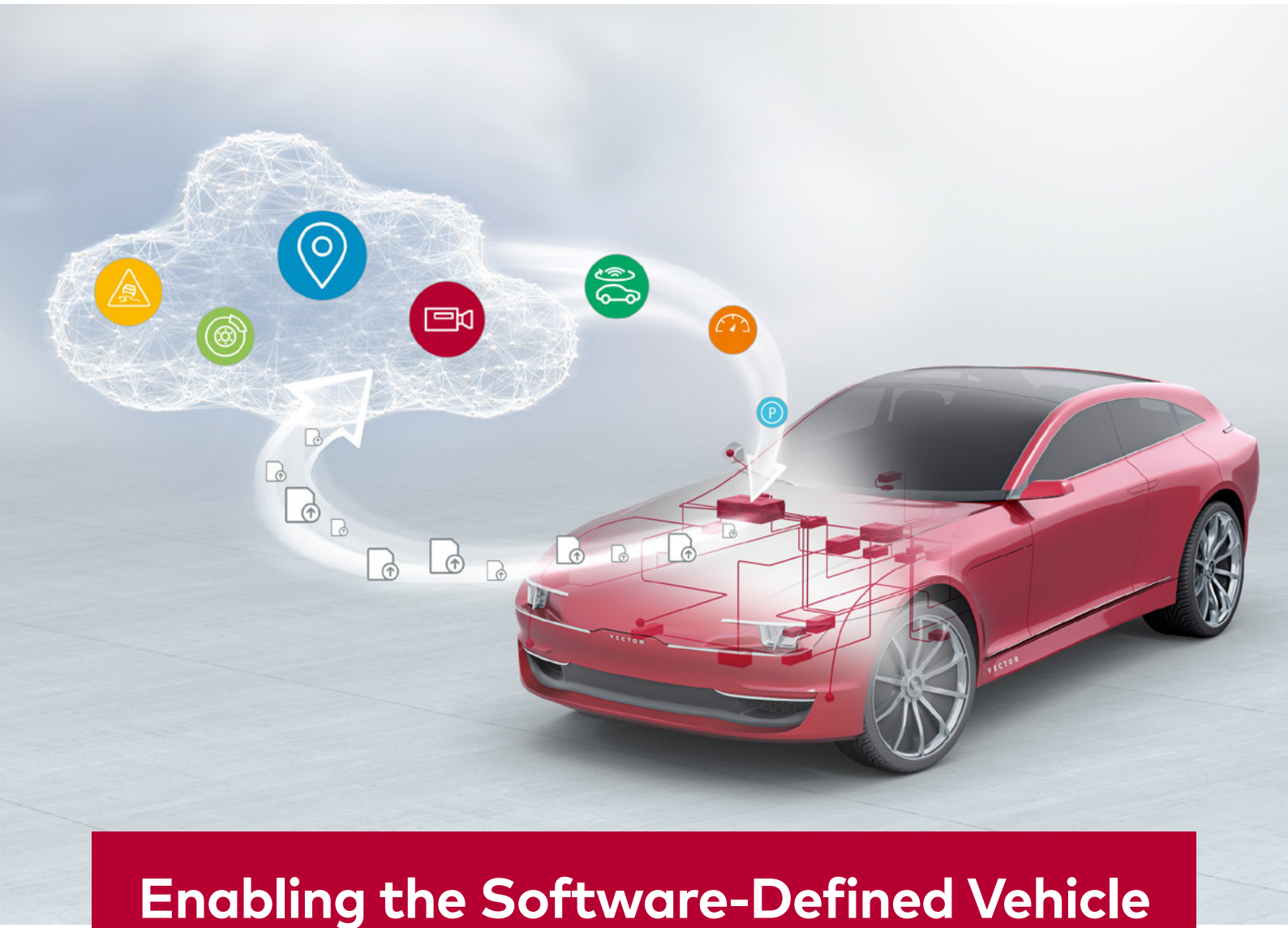

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