Hinge Technology Innovates Vehicle Network Architecture with Optical Fiber

As the demand for high-performance sensors in future autonomous vehicles increases—such as cameras with tens of millions of pixels, high-resolution lidars, and 4D millimeter-wave radars—the volume of internal data transmission in vehicles is expected to rise significantly. This necessitates a rapid increase in bandwidth requirements to 50~100 Gbps or even higher. However, traditional copper-based Electrical Electronic Architecture (EEA) struggles to meet the high bandwidth, ultra-low latency, and electromagnetic compatibility required for high-speed, real-time transmission scenarios, such as ADAS, autonomous driving, and unmanned driving, as illustrated in Figure 1.

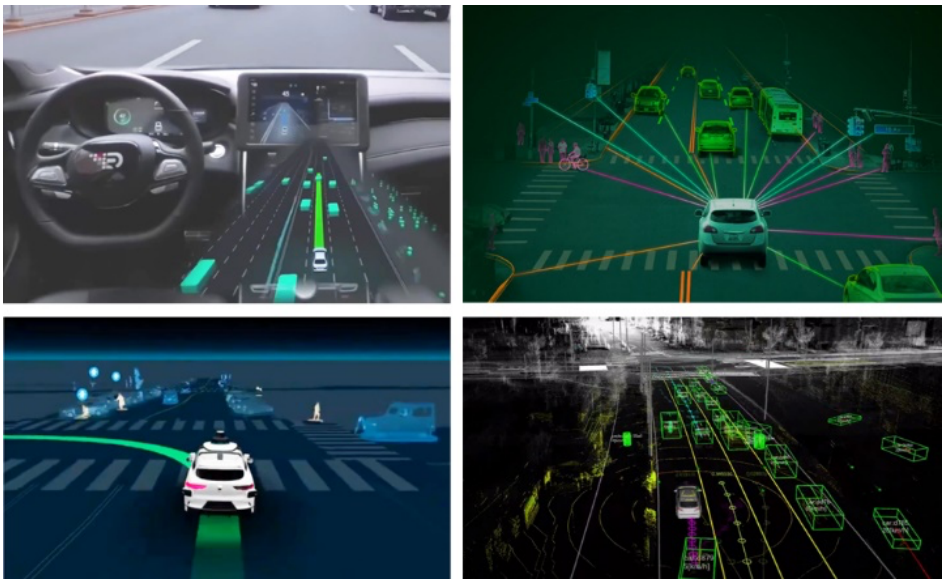

Figure 1: Schematic of High-Speed Communication Scenario in Automobiles

To address the challenges of high bandwidth, high reliability, real-time, and EMC in vehicle communication EEA, Hinge Technology has been advocating the use of optical fibers as the communication medium within the domain-centralized EEA for vehicle communication networks since 2020. This is aimed at accommodating high-end ADAS, autonomous driving, unmanned driving, and even future flying car scenarios. The domain-centralized EEA, based on Time-Sensitive Networking (TSN) and Audio Video Bridging (AVB) technologies, is designed to provide higher bandwidth, lower latency, and better electromagnetic compatibility.

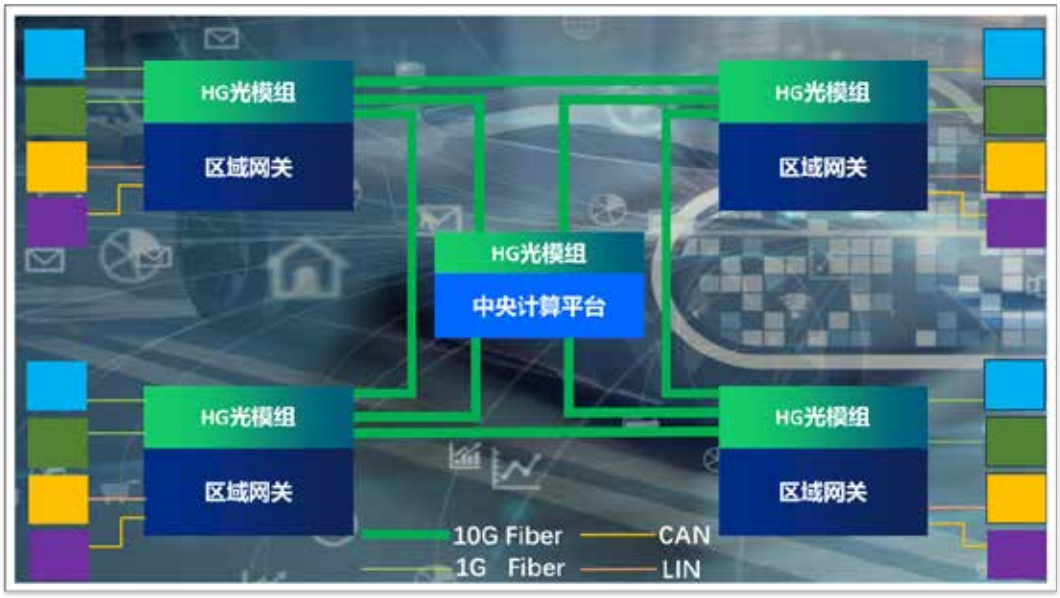

Figure 2: Schematic of Hinge Technology's EEA Optical Communication Architecture Built on Optical Modules.

Hinge Technology develops an EEA communication architecture based on optical modules. This model, customizable according to OEM requirements, utilizes multiple optical modules and area gateways for connectivity. The area gateways can be replaced with other hardware devices as needed, such as T-boxes or domain controllers. In the hardware design, BTB connectors are used to connect optical modules and area gateways, facilitating data and control signal transmission through interfaces like MIPI-CSI, SGMII, I2C/SPI, and GPIO. The optical modules mainly handle the reception and transmission of signals from GMSL2 camera, Ethernet camera, and lidar, as well as the forwarding of these signals. The EEA communication architecture based on optical modules can achieve ultra-high bandwidth, ultra-low latency transmission of large volumes of data, and good EMC performance. It can also be compatible with traditional hybrid networks that use copper as the medium (CAN, LIN).

However, the widespread application of optical communication in automotive production faces challenges, including harsh environmental conditions and the requirements for low cost and high reliability. To address key technical issues in the industrial application of optical communication in automobiles, Hinge Technology has established a strategic partnership with the leading upstream supplier, KDPOF (Spain), and has integrated connectors and optical fiber harness suppliers, thereby accelerating the industrialization of vehicle communication system products based on 1~50 Gbps optical communication. In the development and mass production of the vehicle's overall electrical and electronic architecture for optical fiber communication, Hinge Technology utilizes basic chips provided by KDPOF to design integrated optical modules combined with automotive-grade connectors and optical fiber harnesses to design the EEA. Additionally, relevant functional verification is conducted on mass-produced vehicle models, including assessing packet loss rates, signal transmission losses, optical module heat dissipation, optical module and optical connector optical path coupling solutions, and optical connection reliability in various road environments. Based on

the results of real vehicle verification, Hinge Technology develops corresponding solutions and provides feedback on technical issues related to optical chips to KDPOF for resolution.

Figure 3: Hinge Technology and KDPOF Automotive Optical Communication Solution Seminar

Figure 4 showcases a plastic fiber optic camera product developed by Hinge Technology using components provided by KDPOF. This optical fiber camera, when paired with an optical fiber surround view host, can be used to assemble a high-speed optical communication 360-degree surround view system or a reverse image system. The camera utilizes a 2MP high-quality image sensor for data collection, which is then processed and transmitted via plastic optical fiber to the controller for image display or processing. Compared to LVDS coaxial cameras, optical fiber cameras can achieve a stable transmission distance of up to 40 meters and deliver high-definition, real-time images, whereas LVDS cameras have no relay transmission capability and are limited to 15 meters. Therefore, optical fiber cameras and their accompanying systems from Hinge Technology demonstrate significant advantages in applications such as large commercial vehicles, trucks, and trailers.

Figure 4: 360-Degree Surround View System with High-Speed Fiber Optic Camera Transmission

For the foreseeable future, Hinge Technology and KDPOF will engage in deep collaboration in the field of automotive optical communication. In addition to developing optical EEA for vehicle communication, this partnership extends to the application of optical communication

technology in Battery Management Systems (BMS) for electric vehicles. Building on this foundation, Hinge Technology and KDPOF are also collaborating on the development and manufacturing of optical modules and System-on-Chip (SoC). We plan to introduce optical-electronic integrated chip packaging technology in regions with well-developed automotive industry clusters in China, establishing FAB facilities capable of packaging chips with bandwidths ranging from 1G to 10G.

Utilizing Chiplet technology solutions, we are jointly researching and developing advanced Chip-on-Panel (COP) packaging technology for low-cost, high-reliability optical processors, optical modules, and complementary optical components tailored for automotive optical communication. This initiative aims to ensure production capacity for various automotive optical communication products and plans to develop and manufacture higher-bandwidth optical communication chips in the future, driving continuous upgrades of EEA architecture for the global automotive industry.

About Hinge Technology

Hinge Electronic Technology Co., Ltd., was established in 2014 in Shanghai, China with a vision to driving continuous upgrades of EEA architecture for the global automotive industry. Since its creation, Hinge has pioneered the development of advanced automotive systems and products such as the self-adapting AUTOSAR system, in-vehicle TSN (time-sensitive networking) Ethernet, and optical Ethernet, essential technologies in crafting the electronic backbone for the smart vehicles of tomorrow. Powered by its R&D capability, Hinge has forged strategic partnerships with prominent entities (both upstream and downstream) across the automotive sector around the globe. Hinge has built a manufacturing and testing hub in Zhuji city, a facility encompassing 40 hectares with mass production capacity and delivery capability for OEMs.

More information: http://hinge-tech.com/

For enquiries:
Feng Li
Business Development Director
E-Mail: feng.li@hinge-tech.com
Phone: +971509392949