Enabling Long Reach MIPI CSI-2 Connectivity in Automotive with MIPI IP

Presented by Kelvin Xu
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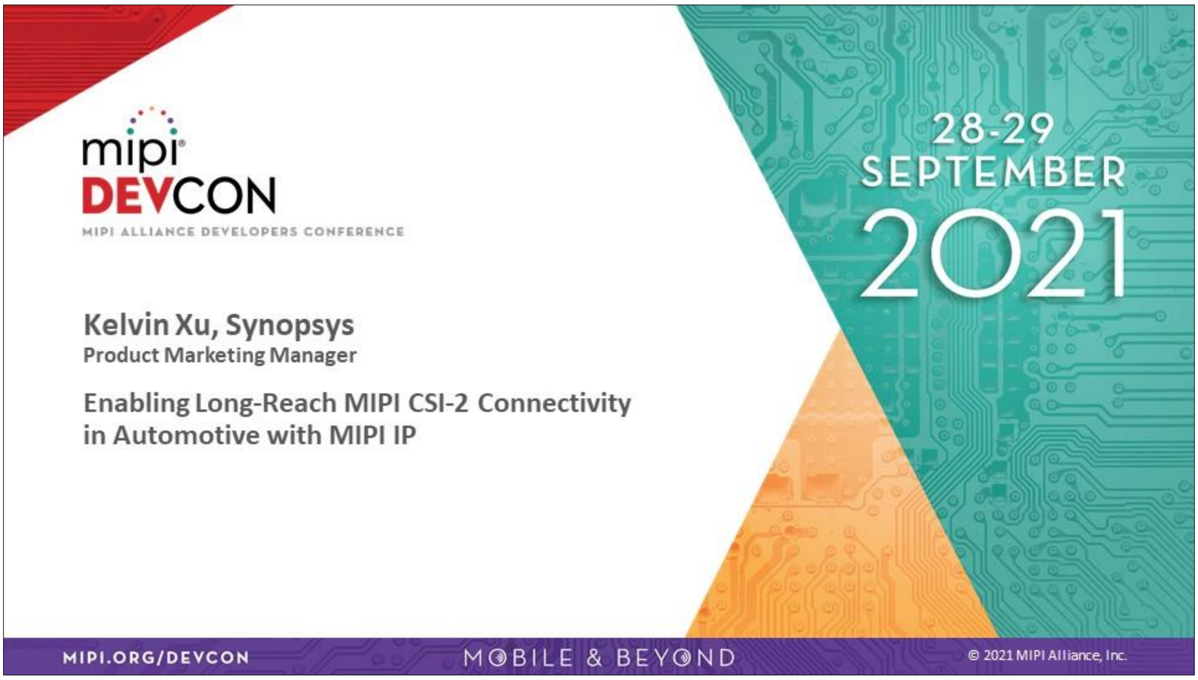
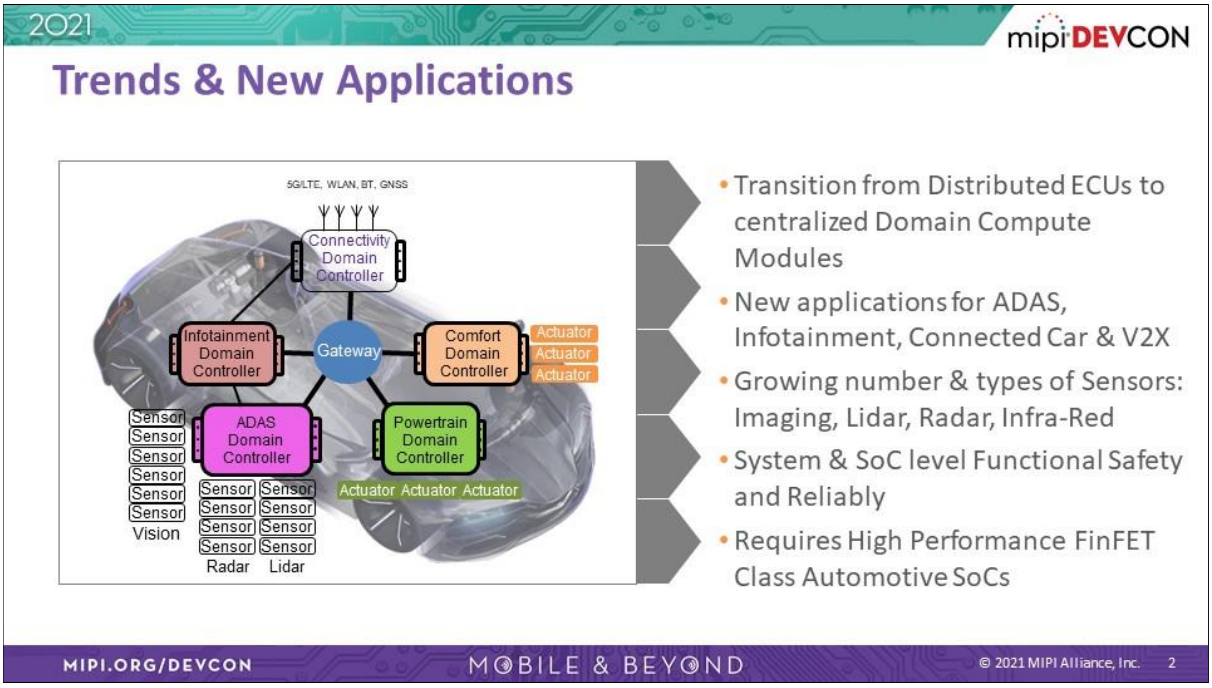
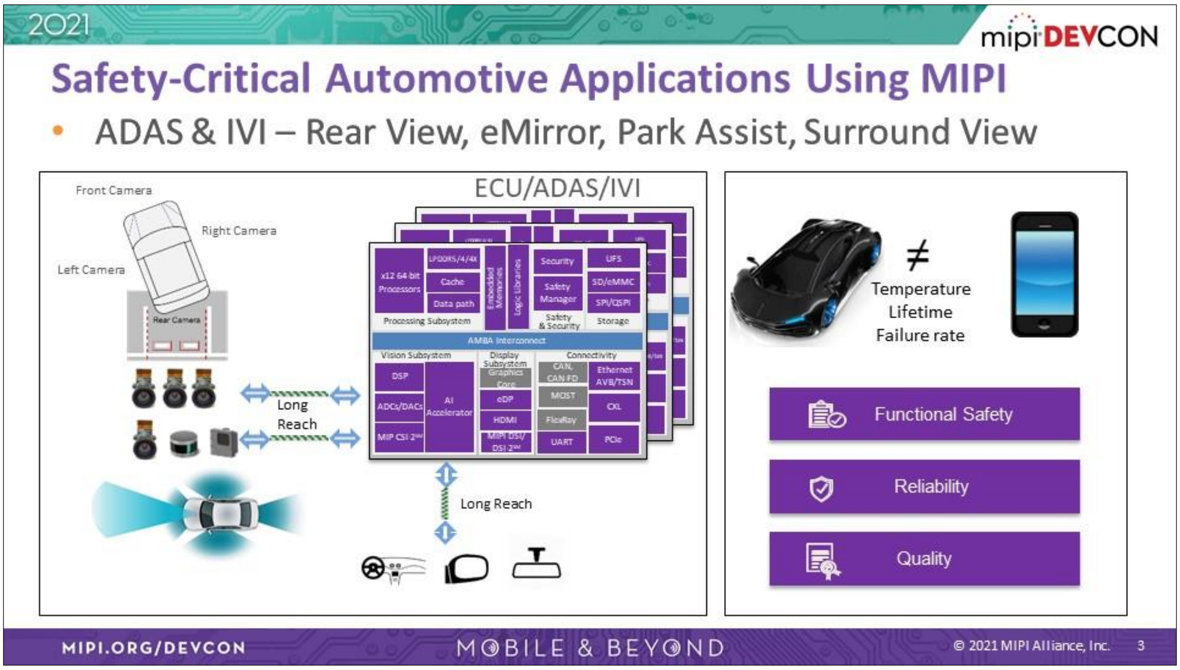


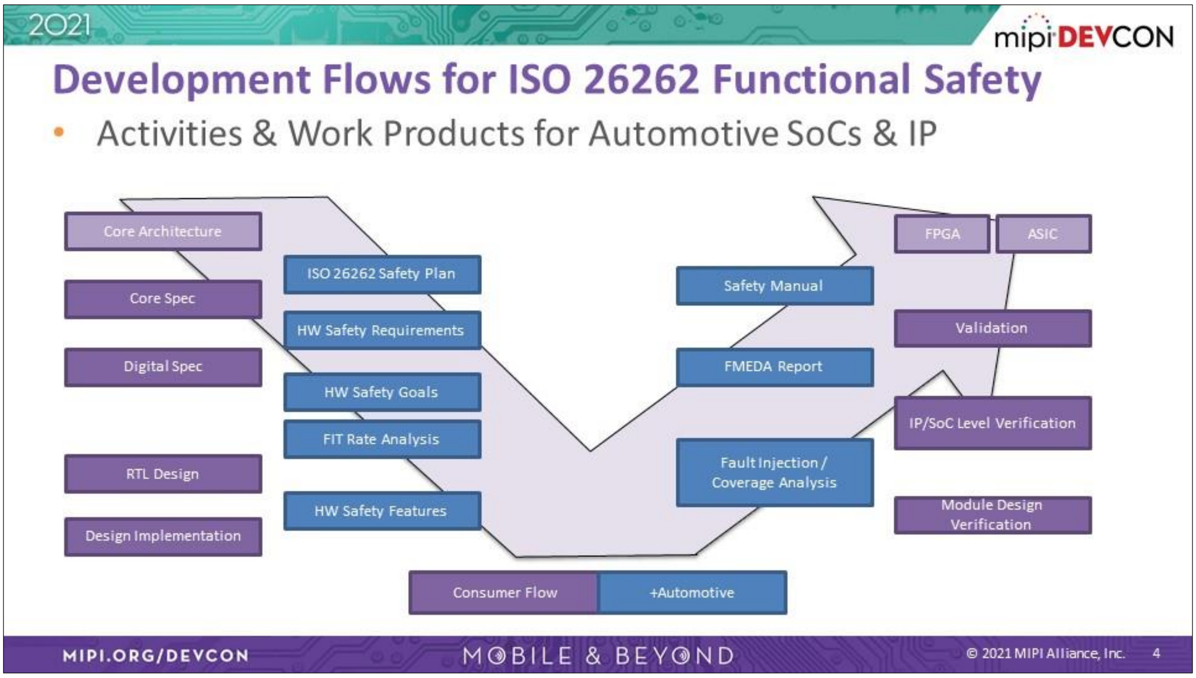
Good day, distinguished colleagues. Welcome to this session of MIPI DevCon. I am Kelvin, Product Marketing Manager of MIPI solutions at Synopsys. Today, we will explore the topic "Enabling Long-Reach MIPI CSI-2 Connectivity in Automotive with MIPI IP".



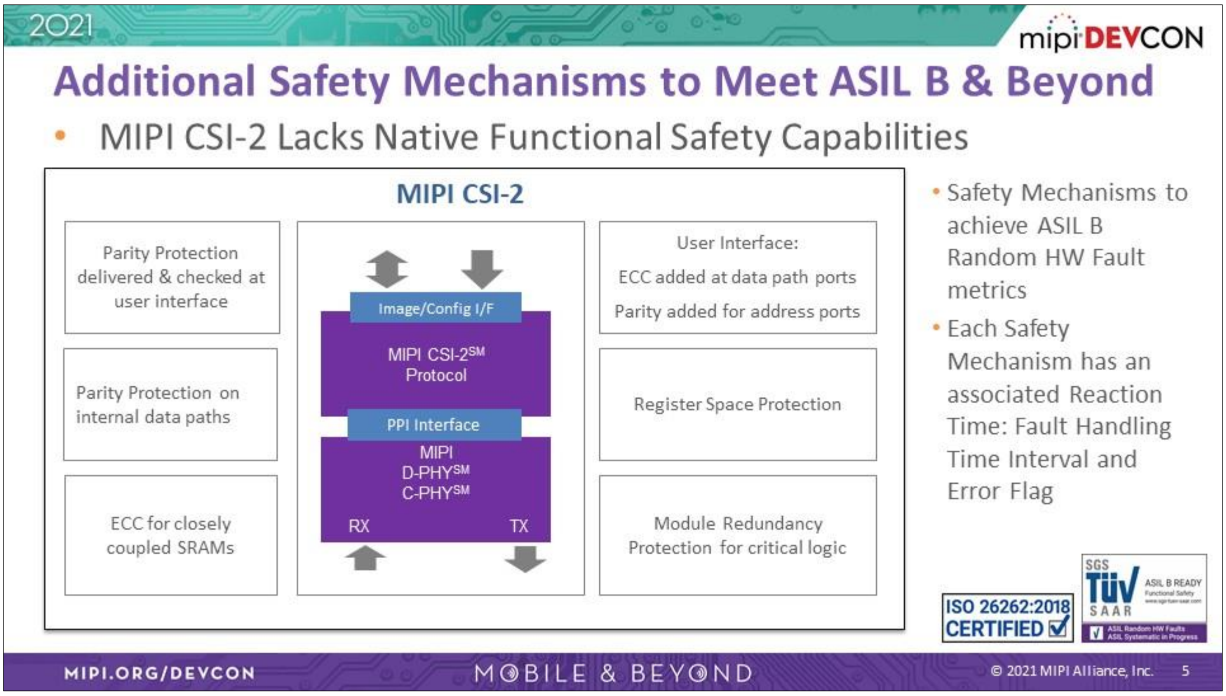
First, let’s look at industry trends and new applications. We have noticed that, in the automotive market, distributed ECUs have increasingly been replaced by centralized domain compute modules. In application scenarios, ADAS and in-vehicle infotainment are now widely adopted in current electronic and conventional vehicles, while connected car and V2X technologies have become more commonly integrated in advanced models. Meanwhile, with the growing number and types of sensors, including image sensors, lidar, and radar, there is more and more emphasis on the functional safety and reliability of the corresponding system and SoC level, leading to continuous improvement in quality and capabilities. The demanding performance requirements of automotive SoC necessitate the use of more advanced FinFET process technology.



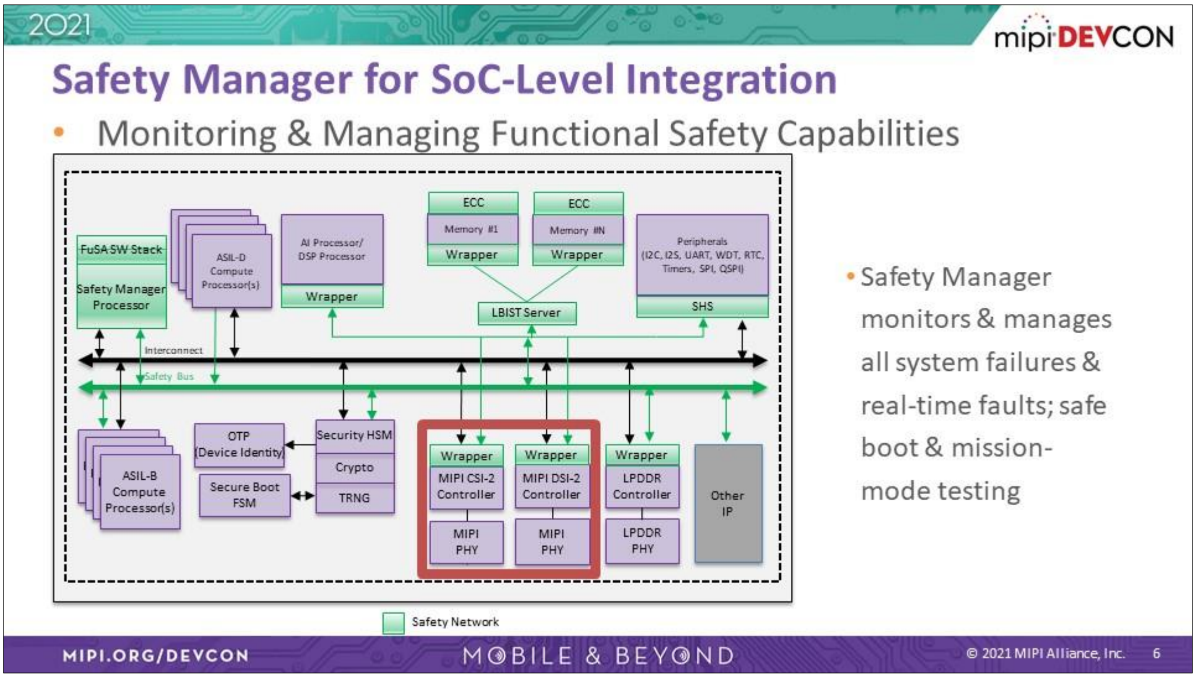
Let's take a look at further SoC requirements in application scenarios, which are critical to functional safety, including ADAS and IVI, both of which utilize a number of different sensors. Sensors are also used to facilitate rear view, surround view, and cruise control. A crucial challenge to these application scenarios is the enabling of long-reach connectivity for sensors. Unlike those in the mobile phone market, automotive SoCs face significantly higher temperatures, lifetime requirements, and failure rates, which calls for a corresponding enhancement of functional safety, reliability, and quality of the overall design.



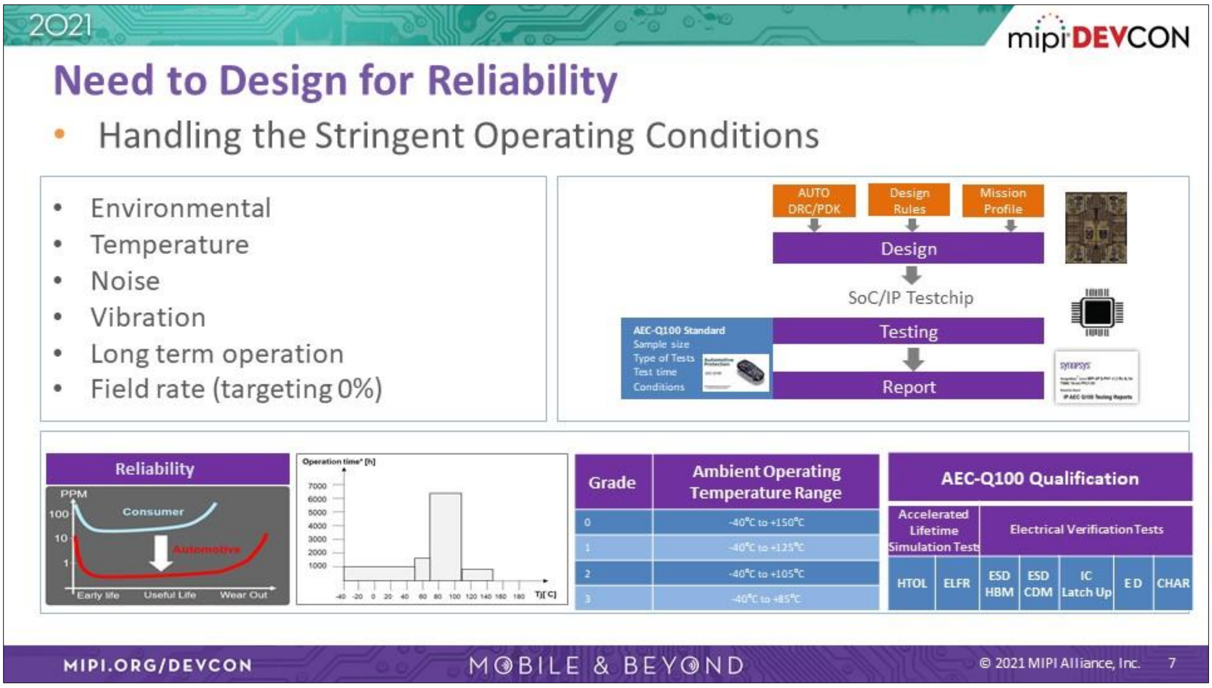
In an overview of the entire product development flow, we can see the differences between those for consumer-grade products and automotive-grade products. The items in purple represent the development flow of ASIC for consumer products, which I am sure we are all familiar with, starting from its architecture, specs, design, to validation and verification. Whereas automotive products include the additional steps presented in blue. In this typical V-shaped framework, we start with the ISO 26262 Safety Plan followed by hardware safety requirements, including safety goals, FIT rate analysis, and definition of safety features. Furthermore, documentation such as the safety manual and FMEDA report adds a considerable workload to the product development flow.



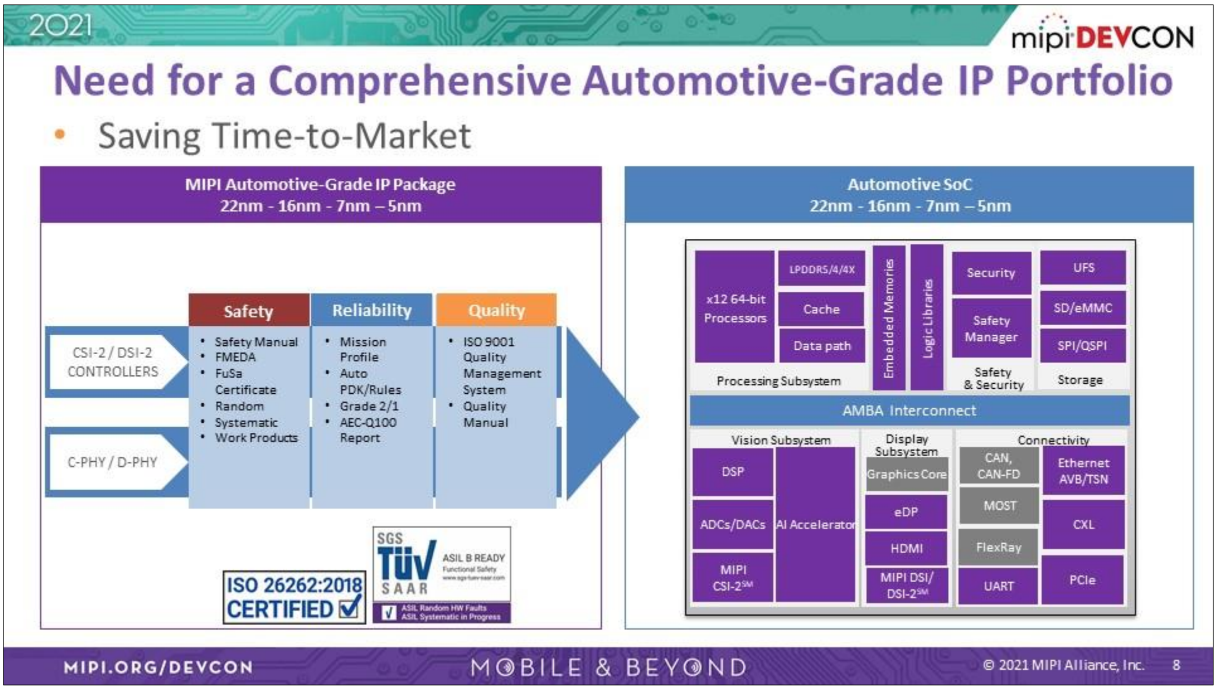
So, what concrete steps need to be taken to enhance MIPI functional safety capabilities? As we know, the MIPI CSI was designed for consumer electronics, and thus lacks native functional safety capabilities. Additional design is required for the MIPI CSI-2, including user interface and interface protocols. Safety mechanisms comprise parity protection, enhanced reliability, register space protection, and ECC protection. Finally, these safety mechanisms achieve the goal of detecting and mitigating random hardware faults. These are just some of the differences between consumer in terms of SoC design details.



In addition, Safety Manager is often integrated into the design process of automotive-grade SoCs. The purple items in this diagram denote the flow of a traditional IP block, whereas the Safety Manager is shown in green. The objective of the Safety Manager is to monitor and manage all possible system failures, including mission-mode testing. Here, you can see that the entire flow of the MIPI, starting from the wrapper, must conform to Safety Manager requirements.



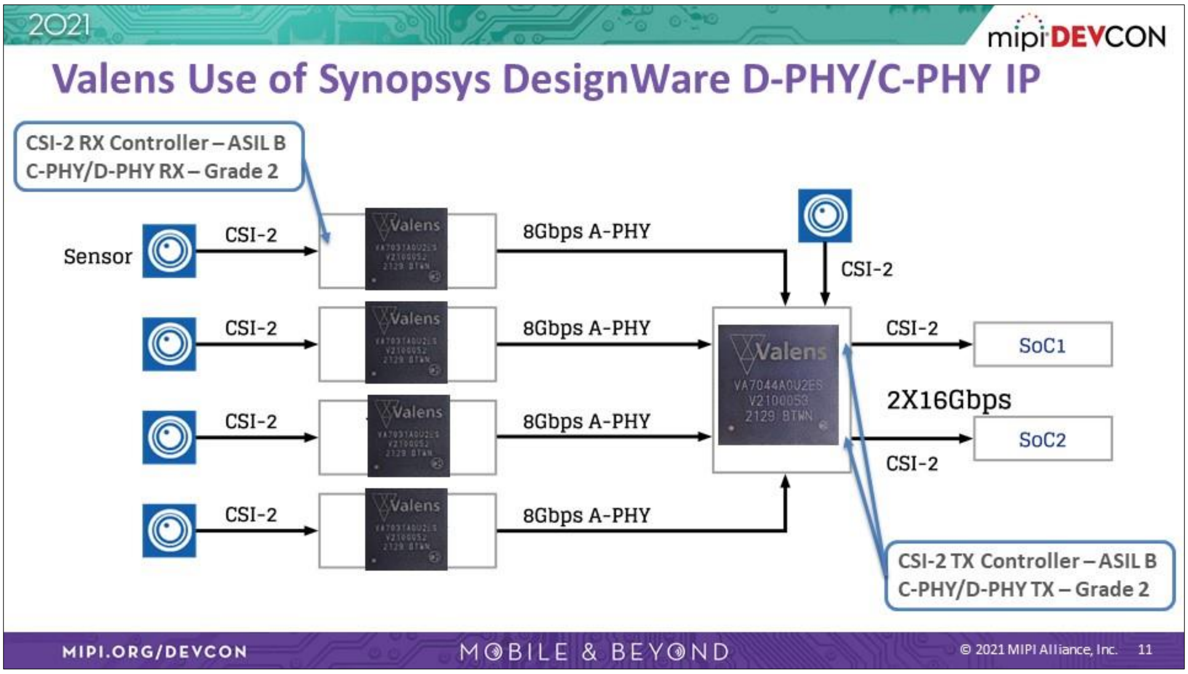
Designing for reliability is just as important as designing for functional safety, with rigorous operating standards in environment, temperature, noise, vibration, long-term operation, and field rate. The design process begins with PDK, DRC, and the mission profile, and even test chips undergo automotive-grade reliability testing and verification. Likewise, the certification for operating temperature range and qualification for operation lifetime are much more exacting than those for consumer electronics and consumer-grade products.



What this means is that, to create an automotive SoC, a MIPI automotive-grade IP package is required. This places stringent demands on IP reliability, functional safety, quality, and time-to-market, but also on suppliers as well.

Next, I will illustrate how our partner Valens uses Synopsys DesignWare MIPI IP to quickly complete their automotive product design.

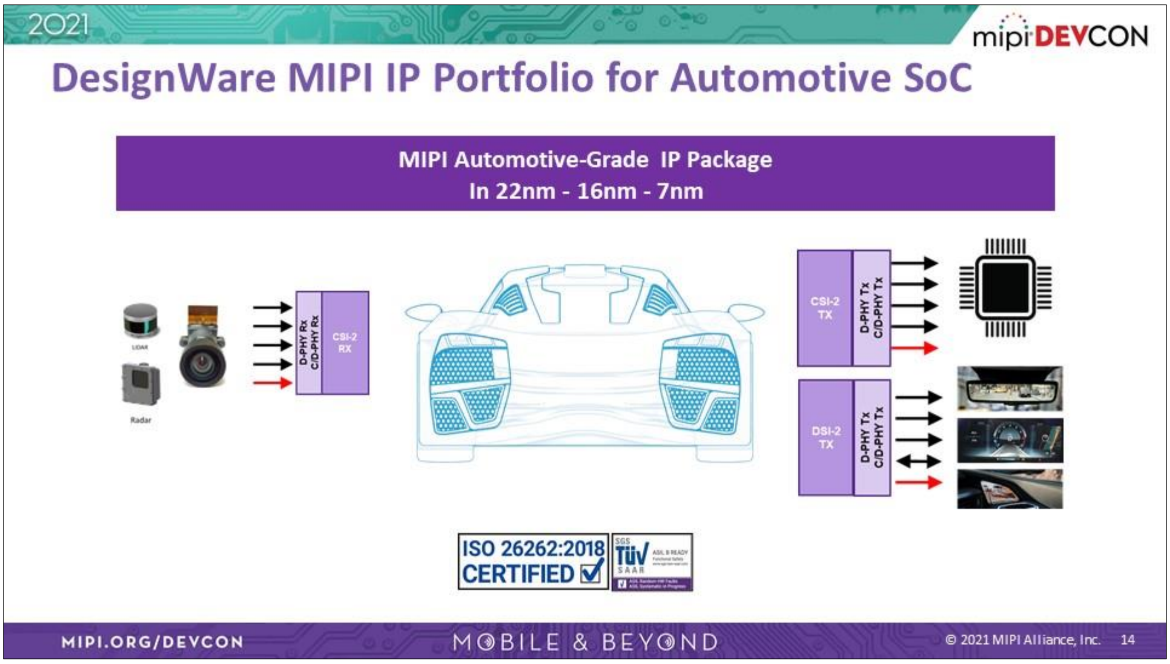
Valens is the first in the industry to introduce A-PHY compliant products. Since it was difficult for Valens to quickly develop automotive-grade IP on its own, it was important to partner with a company that could provide highly reliable IP. Synopsys is honored to be selected as their IP partner, and we have provided a comprehensive MIPI package. The first samples will be available in Q4 of this year, with three product numbers offering a range of specifications. Because of our IP reliability, their product development time has been significantly shortened and streamlined, allowing Valens to focus on their next generation of products.



This diagram provides further details about the product, which acts as a bridge between the sensors and the processor, thereby resolving issues of long-reach connectivity. On the RX end is Synopsys' CSI-2 RX Controller, an automotive-grade RX controller meeting ASIL B requirements, and C-PHY/D-PHY RX, of which the PHY meets the standards of ACQ-Grade 2. The transmitter on the right is outfitted with automotive-grade CSI-2 TX controller, and corresponding C-PHY/D-PHY TX. This package presents a very mature solution and is critical to the acceleration of the product design.

Finally, this brings us to the summary.

To move the automotive industry forward, we need advanced architecture, including more sophisticated FinFET processes. In terms of product design, safety-critical applications require MIPI IP that meet functional safety standards, which enables clients to reduce time-to-market. This means that IP that meets AEC-Q100 standards and other functional safety requirements allows for rapid integration. Synopsys' long-term investment in this area has built up its automotive-grade MIPI IP portfolio, which helps clients to accelerate design.



Synopsys' MIPI IP portfolio comprises very comprehensive solutions encompassing controllers from sensors to displays. With the PHY layer of CSI and DSI, the ecosystem includes D-PHY RX to D-PHY TX, from C-PHY/D-PHY RX to C-PHY/D-PHY TX. Our PHY IP is available on 22nm, 16nm, and 7nm processes.

Here are some of our related product links for your reference, as well as information on Valens' automotive solutions. This concludes my presentation for today. Thank you!