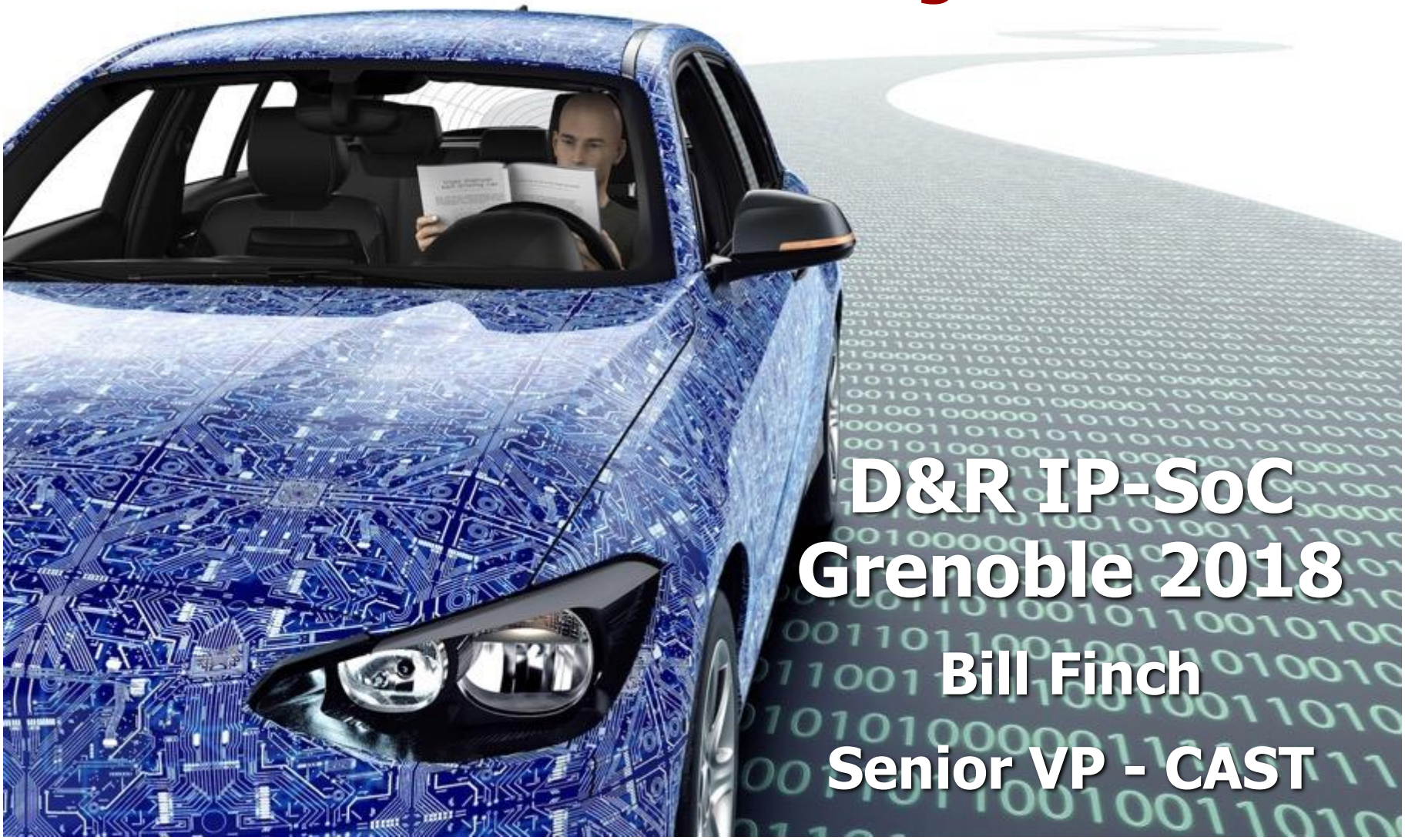
Automotive IP Cores: Challenges & Solutions



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Turbulence in Automotive Markets

- **ADAS, Self driving cars, Increased digitization throughout are causing disruption in traditional supply chains**
- **Traditional auto design teams are not well equipped to deal with issues**
  - Software / hardware tradeoffs
  - Custom ASICs vs. traditional system designs
  - Safety issues everywhere slowing investment
- **New competition**
  - Tesla, et.al.
  - Alternate modes of transport
- **Opportunity**
  - Focus on cores that will be essential in this new world

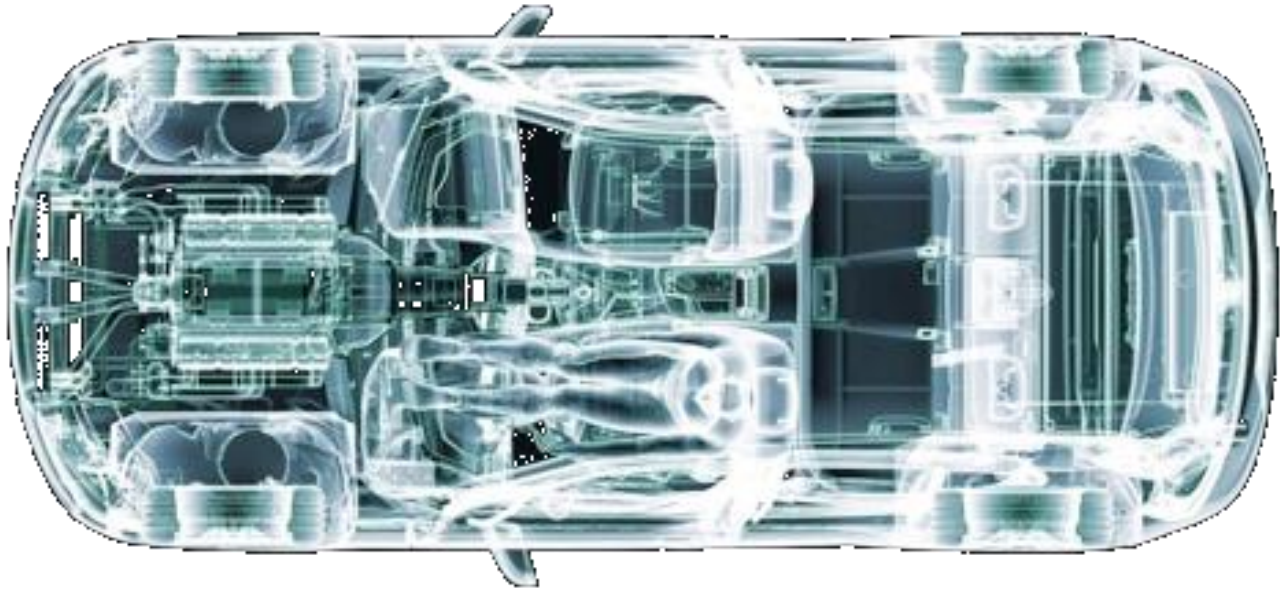
Data Center on Wheels

Cameras
20-40 MB/sec

GPS
~50 KB/sec

Sensors
1 - 3 MB/sec

LIDAR
10-50 MB/sec



GBytes/sec, TBytes/hour to be communicated, processed, and stored

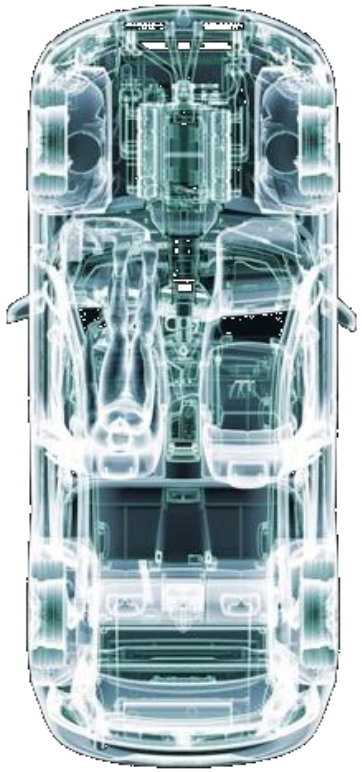
Some Challenges IP Cores Need to Address

- The vehicle network has to provide **higher bandwidth** BUT preserve the low-latency, deterministic time communication AND keep the wiring cost as low as possible
- **Compression** is key decrease power & cost for data communication and storage
- ADAS systems rely on **video** that not only needs higher bandwidth but also needs to be delivered with minimum latency and be of high quality under any lighting conditions
- Smart & connected sensors need to do some level of processing at the edge and rely low-power, **secure embedded processors**

Communications in Vehicle Networks Today & Tomorrow

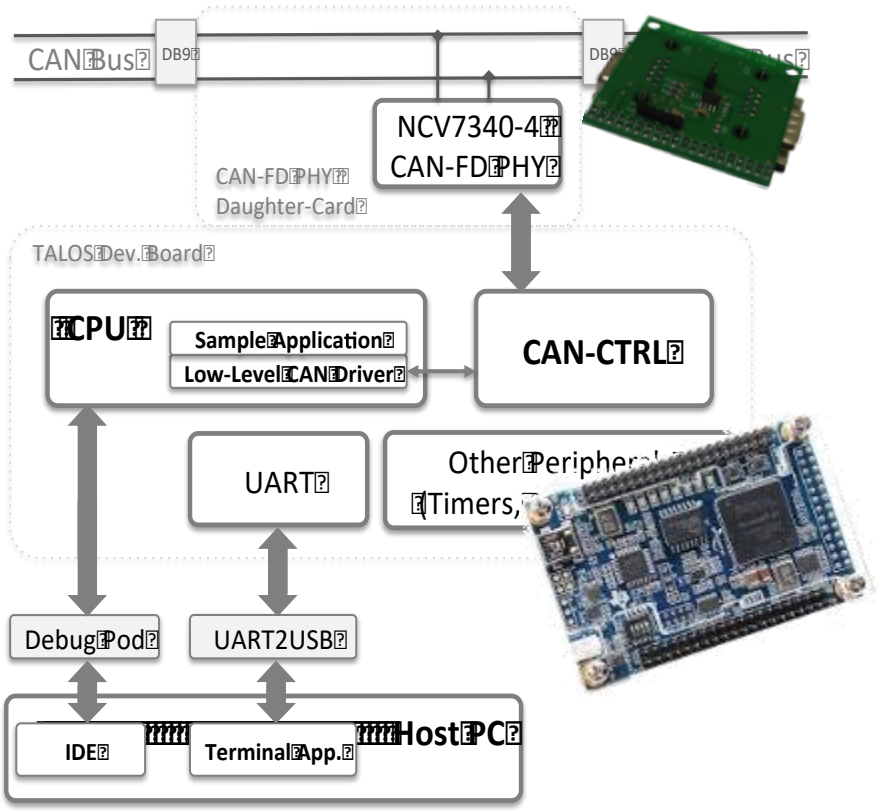
Domain	Latency	Bandwidth	Network
Powertrain	< 10 us	Low	CAN
Chassis / Safety	< 10 us	Low	Flexray, CAN-TT
Body & Comfort	< 10 ms	Low	LIN, SENT, CAN
Driver Assistance & Safety	< 250 us to <1 ms	10-100Mbps per camera	Ethernet
Human-Machine I/F	<10 ms to < 100	Few Kbps to few Mbps	Ethernet, CAN

	LIN, SENT	CAN 2.0	CAN-FD	TTCAN	Flexray
Cost	Very Low	Low	Medium	Medium	High
Max. Bit Rate	20 Kbps	1 Mbps	10 Mbps	10 Mbps	100 Mbps
Messaging	Deterministic	Event Triggered	Event-Triggered	Event & Time Triggered	Event & Time Triggered



TSN Ethernet is the new technology that enables low-cost, high-bandwidth, low-latency communications with traffic shaping capabilities able to accommodate all automotive requirements.

CAST CAN2.0/CAN-FD IP Core

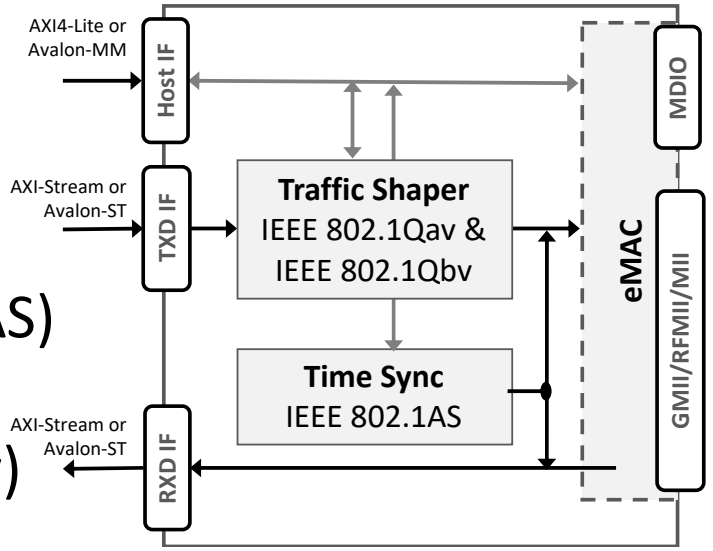


- **Survived three CIA Plug Fests**

- **In production use**
- **Most Highly Featured CAN core in the market**
- **Reference design & sample drivers for easy evaluation and integration**

CAST TSN Ethernet Subsystem

- **Eases the implementation of TSN ethernet endpoints.**
- **Integrates hardware stacks:**
  - Time Synchronization (IEEE 802.1AS)
  - Traffic Shaping/FQTSS (IEEE 802.1Qav and IEEE 802.1Qbv)
  - Ethernet MAC (Optionally)



- **Requires minimum software support, enables ultra-low-latency communication**
- **Proven in IIC and LNI Plug Fests**
- **Can be integrated with UDP/IP hardware stacks, and/or low-latency compression cores**

UDPIP Hardware Stack

- Hardware Stack Implementing in custom hardware UDP/IP, ARP, ICMP, IGMP, DHCP and supporting TSN Ethernet
- With NetCMD module enables remote access to any AXI/AHB address

✓ **Minimize latency for streaming over Ethernet**

✓ **Operate without any software assistance**

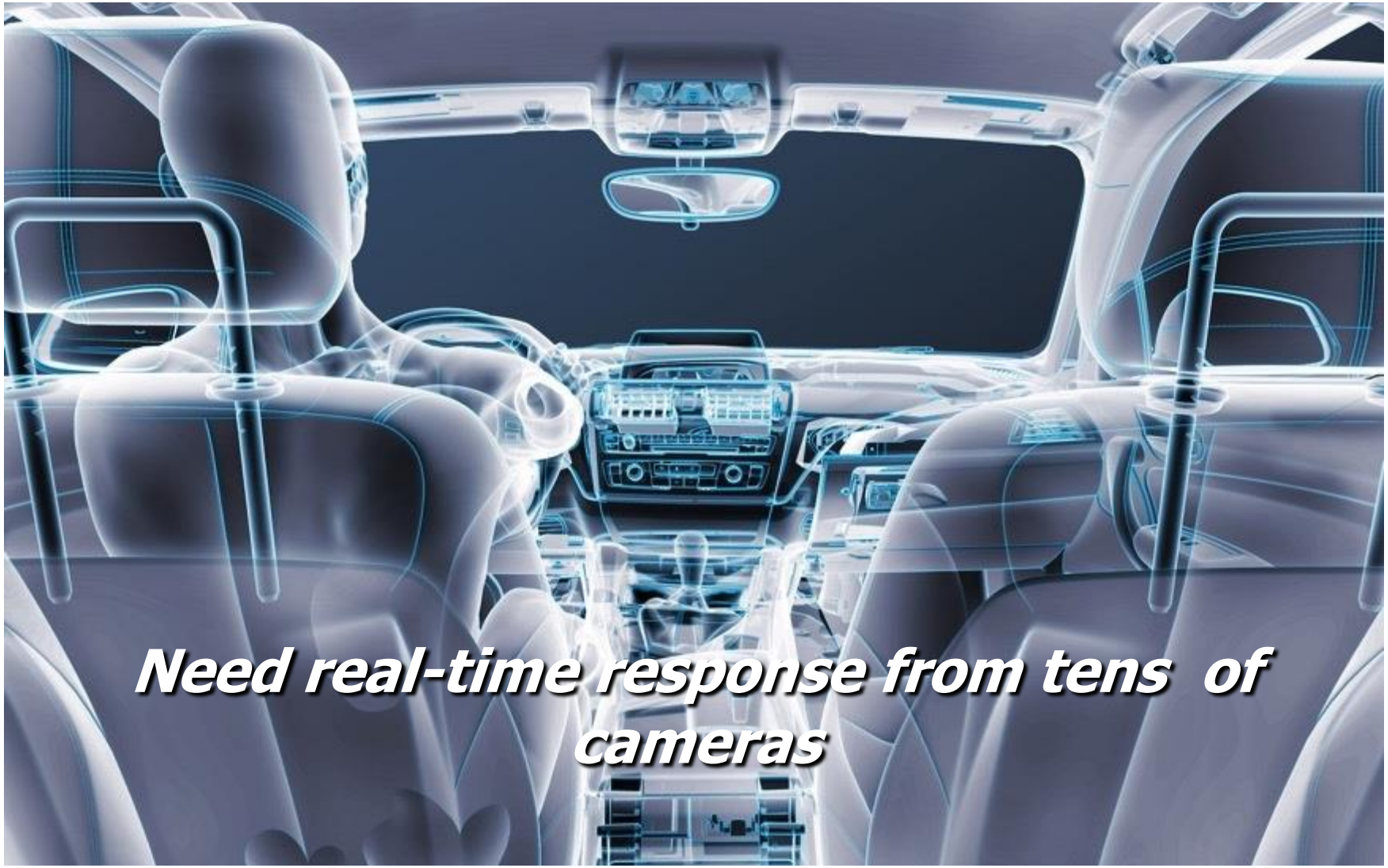
✓ **Enables monitor and control over Ethernet**

CAST GZIP Compression Cores

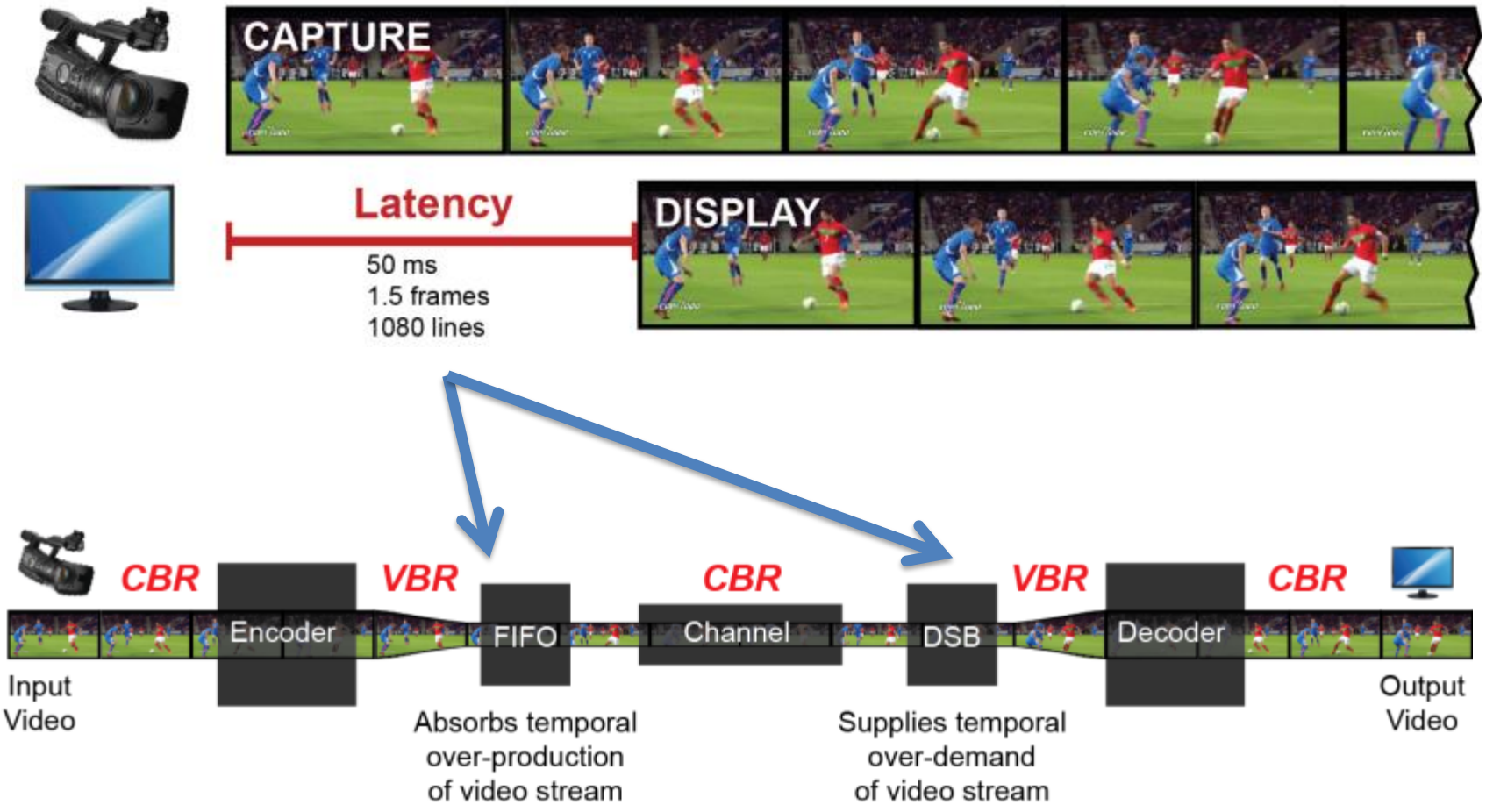
- **Industry-standard for compressing sensor and other data, either on the application or on the file-system level**
- **Configurable to adopt to different needs:**
  - Throughput-optimized versions provide over 100GBps
  - Size-optimized versions for 100K gates.
  - Latency-optimized version, have <100 cycles latency

- **Allows better utilization of available network bandwidth**
- **Optimizes cost of local storage**

Automotive Video Challenges

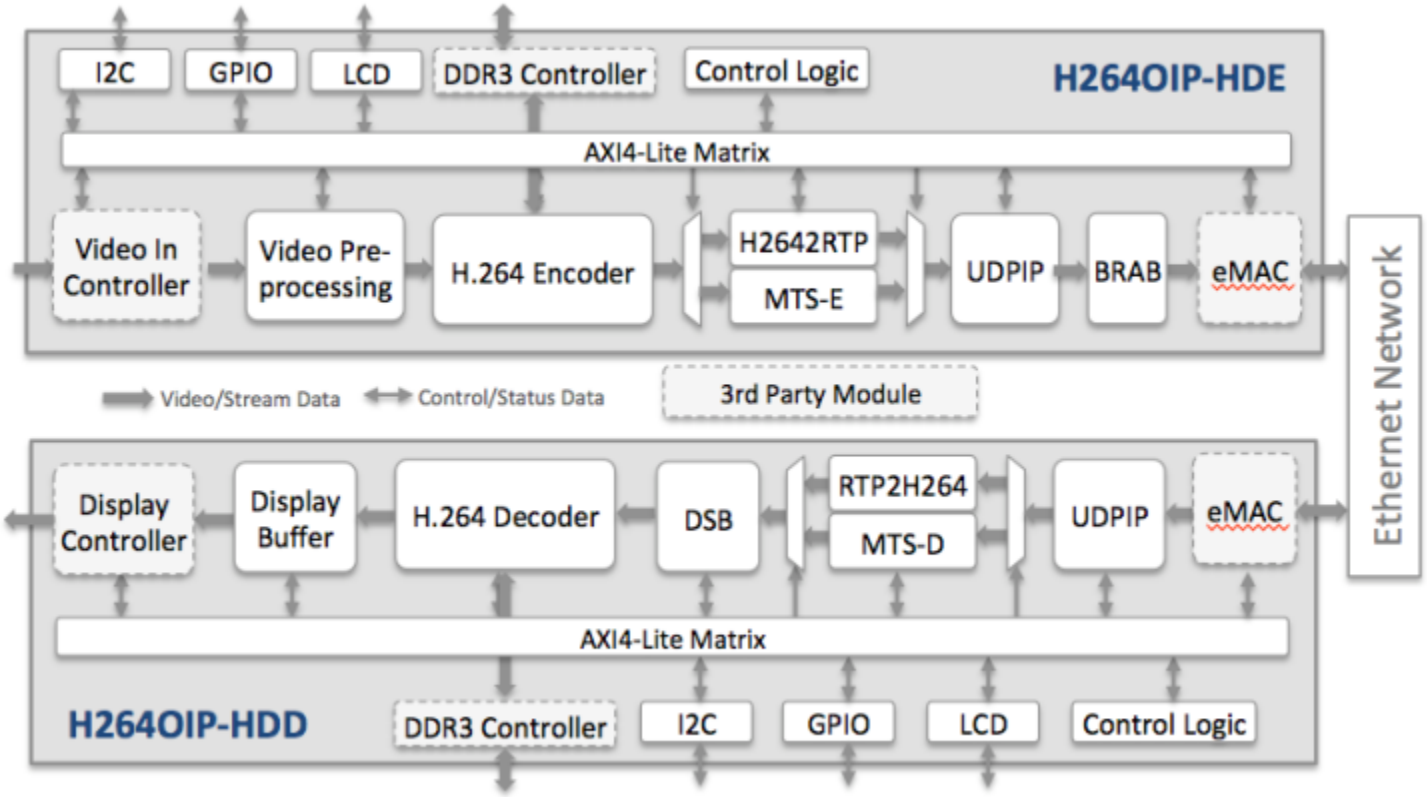


Real-time Response –
Live video streaming requires system low-latency



CAST Video Over IP Subsystems

- **H.264 and MJPEG video-over-IP sub-systems with deep sub-frame, end-to-end latency**



CAST WDR/HDR

- **Essential for machine vision in vehicles**
- **Improves image quality to create clear and sharp images under any lighting conditions.**
- **Processes the merging of 2, 3 or 4 exposures and provides tone mapping, white-balance adjustment, back correction and 2D noise reduction filter**

CAST Processors

CAST 8051 and BA22 32-bit processors currently used in many automotive sensor products:

- **8051: Small, low-power**
- **BA20/21/22: 32-bit embedded processors**
- **Geon Secure Execution Processor: BA22 enhanced with advanced security features**
  - Protects sensitive code and data during execution, storage, and transfer to/ from the processor
  - Uses two or more cryptographically isolated secure execution contexts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