



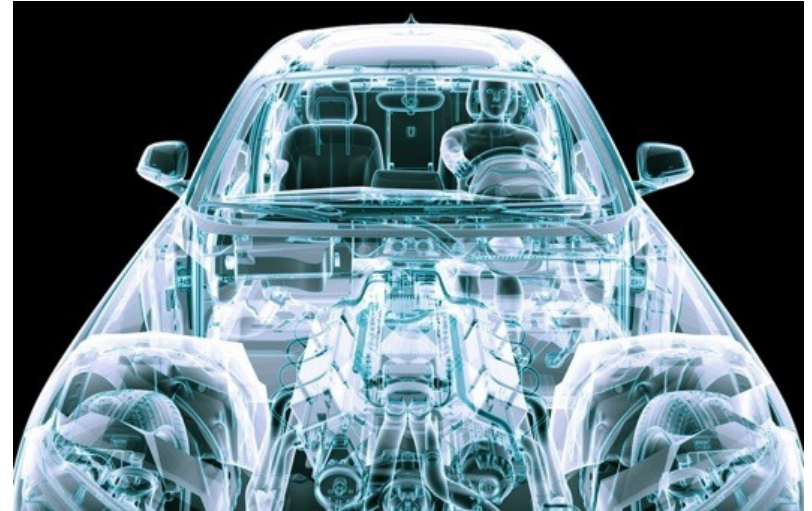
Automotive Challenges Addressed by Standard and Non-Standard Based IP

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Increasing Needs/New Challenges

- ▶ **Outlook for 2019 exceeding 100K sensors and 500 processors**
- ▶ **Live video streaming from ≥ 10 cameras**
- ▶ **Cyber-attack proof**



What IP is needed in these systems as they evolve?

Increasing Needs/New Challenges

Applicable IP cores are small, low-power, fast, easy to integrate, and don't require processor intervention!

Currently supporting automotive applications, and addressing **new challenges**:

- ▶ **Processors – R8051XC2, BA22, GEON**
- ▶ **Interconnect – CAN, LIN, SENT, 802_1AS**
- ▶ **Video and image needs – JPEG, JPEGLS, H.264, Hardware Stacks, WDR/HDR**
- ▶ **Data Storage – GZIP, AES**

CAST Processors

Currently used in many automotive sensor products:

- ▶ **8051 — Small, low-power**
- ▶ **BA22 — 32-bit processor**

Introducing:

- ▶ **Geon — low-power, efficient 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

Communications in Vehicle Networks Today

CAN

1Mbps

- Engine
- Seatbelts
- Audio
- Radar
- Navigation
- Instruments
- Climate

CAN Safety

- Seatbelt
- Airbags

LIN

19.2 kBaud

- Wipers
- Sensors
- Mirror
- Doors
- Seats
- Lights
- Turn Signals
- Window
- Locks

FlexRay

10Mbps

- deterministic*
- Brakes
 - Advanced Driver Assistance Systems (ADAS)

MOST

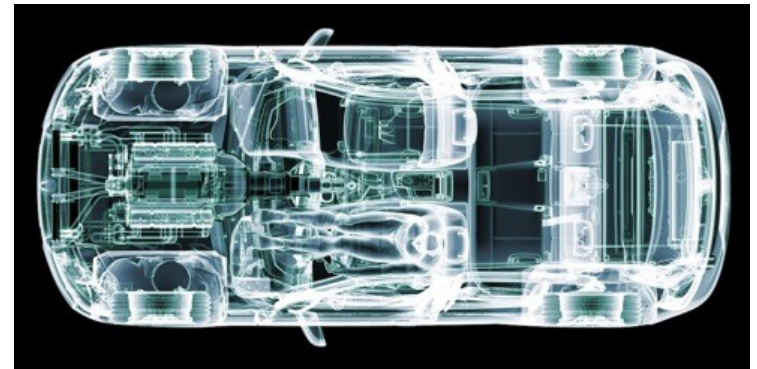
150 Mbps

- Speakers
- Radio
- Navigation
- GPS

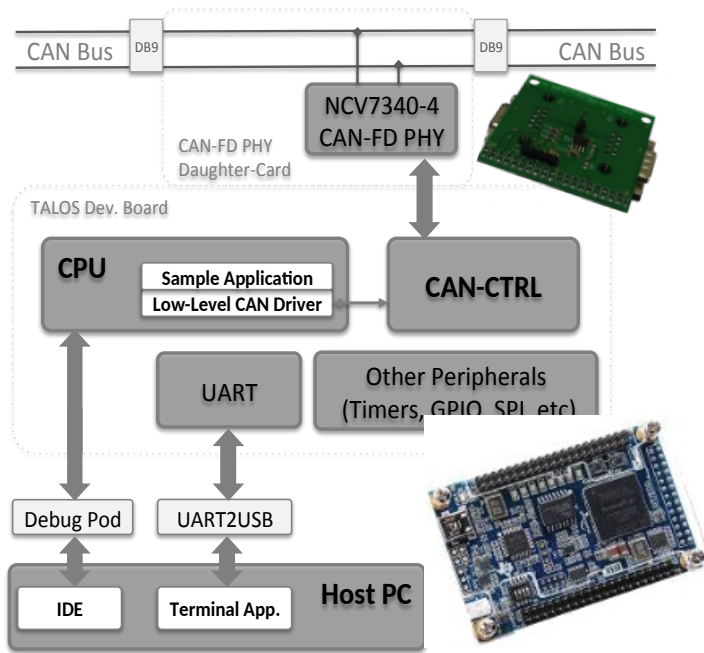
Ethernet

100 Mbps

- Diagnostics
- Backup Cameras



Example of a Robust Low-Risk IP Core: CAST CAN2.0/CAN-FD



► **Survived three CIA Plug Fests**



► **In production use**

► **Avery VIP available**

► **Reference design board for easy evaluation**

The Single-Nibble Transmission Protocol: SENT

- ▶ **Unidirectional, low-cost, interface for high-precision automotive sensors**
 - Low-cost: Uses only one wire for data transmission (and VDD and GND) and does not require special PHY on receiver or transmitter
 - For high-precision sensors: Up to 24-data bits per message
- ▶ **Standardized by SAE (SAE J2716) and used by several automotive sensor providers**

Lower cost & higher bit-rate alternative to LIN

Increasing Needs for Real-Time Response



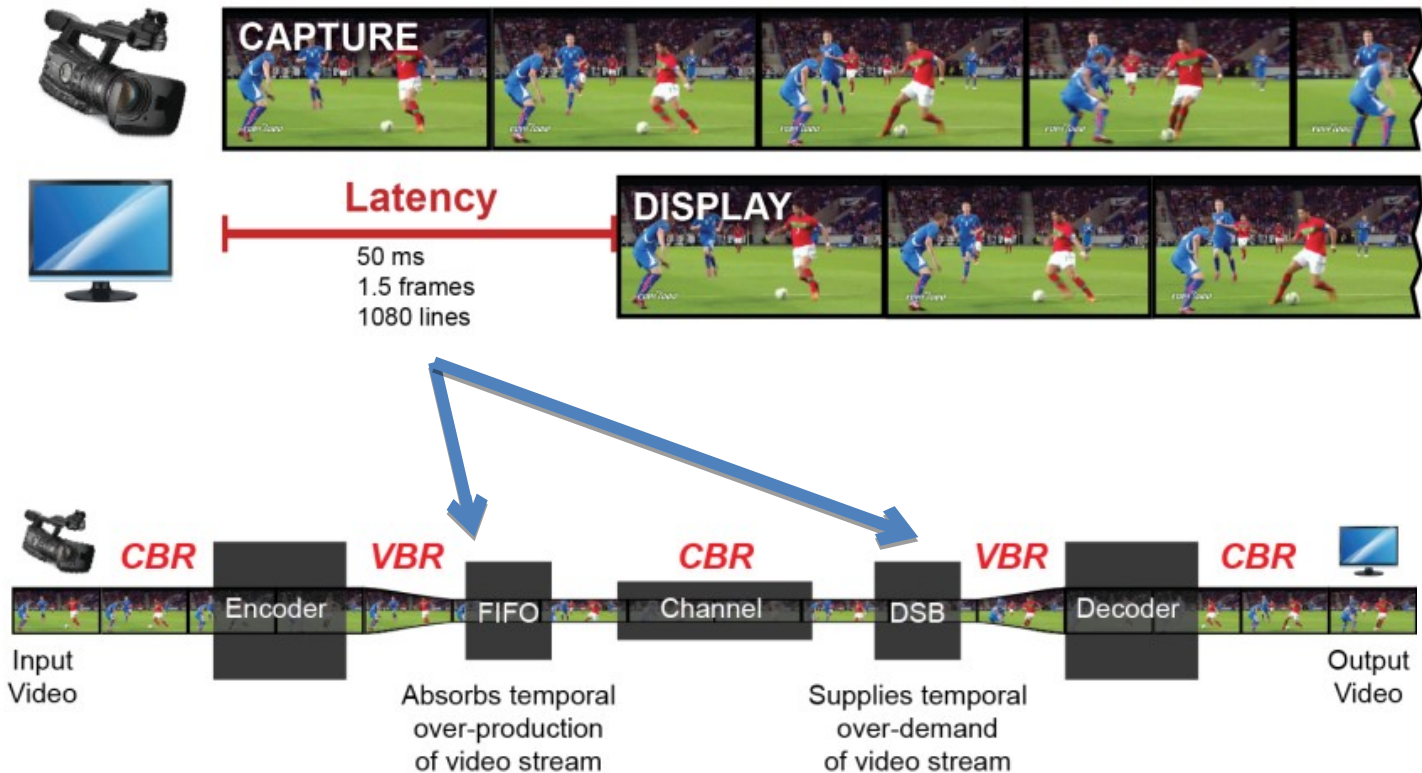
Automotive Ethernet

TSN Time Sensitive Network – enables a **predictable, deterministic, delivery time.** Hardware Stacks for time-aware application development.

- ▶ **IEEE 802.1AS** for providing a common time reference to all devices participating in the real-time network
- ▶ **IEEE 802.1Qav/bv** for time-aware traffic scheduling (coming soon)
- ▶ **UDPIP** for low-latency transmission of data

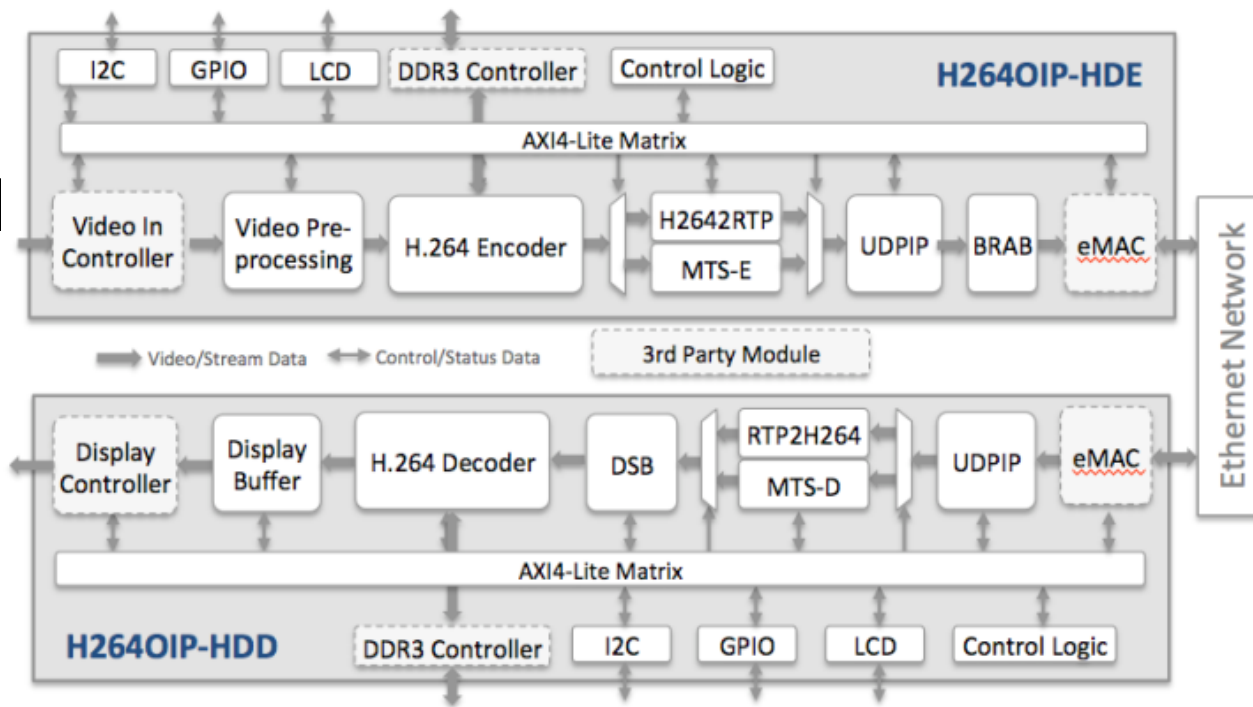
Real-Time Response

Live video streaming requires system low-latency



Meeting Real-Time Requirements

- ▶ **H.264 and MJPEG video subsystems with deep sub-frame, end-to-end latency**



Save on Bandwidth and Storage, while Preserving Data Accuracy

▶ **Compression is key to reduce the networking and storage cost, but full accuracy of some types data needs to be preserved**

- Industry-standard GZIP for sensor and other data
- JPEG-LS for image data - leading lossless compression efficiency and lowest complexity (silicon cost and power)



▶ **Standards allow interoperability with software systems**

WDR/HDR Increases Image Clarity

- ▶ **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**



Preserving Vehicle Data-Security

- ▶ **Security is a major concern for the in-vehicle network and data-storage, and the vehicle as an IoT node**
- ▶ **Security standards are based on the same industry-standard algorithmic primitives:**
 - AES, AES-GCM, AES-CCM, AES-XTS, MD-5, SHA-1, SHA-256, Keccak/SHA3 ...
- ▶ **CAST offers a wide-range of Low Power, High Throughput, Proven Hardware Encryption Primitives**



CAST

IP Products

CONTROLLERS & PROCESSORS

32-bit BA2x Family
Application Processors
Full & Basic
Embedded Processors
Cache-Enabled
Deeply Embedded
PipelineZero Low-Power
Dev & Debug Packages
8051 Compatibles:
Super-Fast Advanced
Fast & Mature; Tiny
Legacy-Configurable
16-bit 80251s: Fast, Tiny

COMPRESSION

Lossless Data Compression
GZIP/ZLIB/Deflate
H.264/AVC Encoders:
Low-Power through Ultra-Fast; Intra-Only

H.264/AVC Decoders:
Low-Latency, Low-Power

JPEG & Motion JPEG:
Encoders & Decoders:
Baseline, Extended 16-bit,
Ultra-Fast

JPEGLS:
Lossless image compression

Video Over IP Subsystems &
Ref. Designs

H.265/HEVC Decoder
WDR/HDR Image Processor

INTERCONNECTS

CAN2.0, CAN FD, LIN
UARTS, I2C/SMBUS, SPI &
QSPI
SDLC & HDLC, Ethernet MAC
PCI Express X1/X4 & X8
controllers, app interface

Automotive Ethernet
802.1AS

SENT/SAE J2716

SECURITY & ENCRYPTION

AES, Programmable, GCM, CCM
Key Expander

DES Single, Triple

Hash Functions
Keccak/SHA-3
SHA-1, SHA-256, SHA-3,
MD5

PERIPHERALS

AMBA Infrastructure Cores
AHB matrix, multi-layer AXI,
AHB/APB/AXI Bus-Bridges,
DMAs, Peripherals & AHB
Cache Controller

Device Controllers:
Smart Card Reader, TFT-
LCD Display Parallel NOR
Flash & Serial NOR Flash
(QSPI-XIP)

Network Stacks:
MPEG Transport Stream
UDP/IP Stack
Hardware RTP Stack

Legacy Peripherals:
DMA Controllers, UARTs,
Timer/Counter



CAST

**Thank
You.**

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