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 $\geq 10$ 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

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

Automotive Interface Controller Cores
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

Need real-time response from hundreds of sensors and cameras
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

Latency
50 ms
1.5 frames
1080 lines
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

Automotive Interface Controller Cores
Thank You.

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