New Product Update

New hardware-level solution for end node synchronization for higher levels of automation within ADAS

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Agenda

- Synchronization in Automotive:
  - Why?
  - Where?
- TI Ethernet PHYs – Precise synchronization
  - How?
  - 100Mbps Ethernet PHY: DP83TC817
  - 1000Mbps Ethernet PHY: Preview

Synchronization in Automotive: Why?

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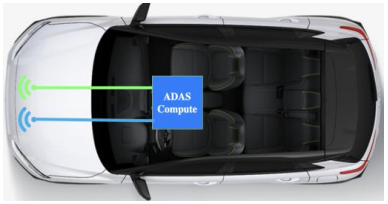
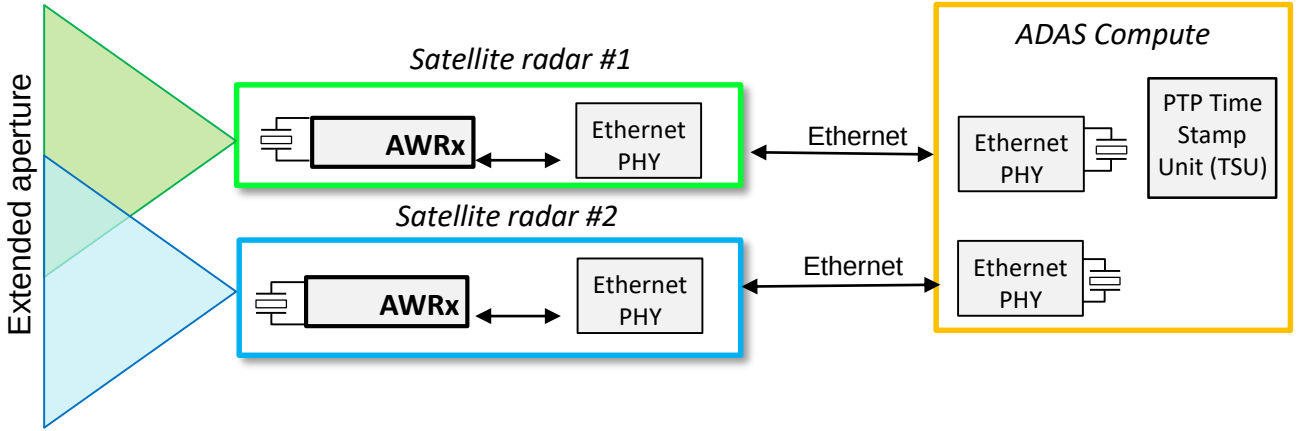
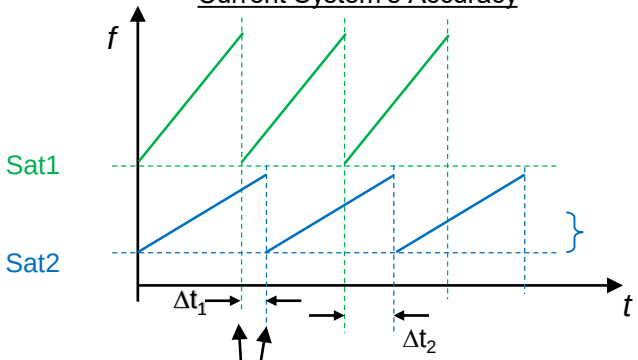
Distributed Coherent Radar



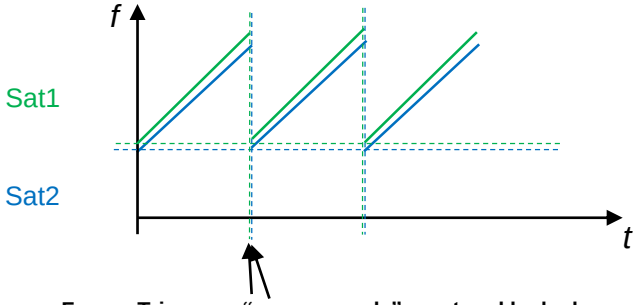


Current System's Accuracy



Frame_Triggers : "microseconds" apart and varying

Required Accuracy



Frame_Triggers : "nanoseconds" apart and locked

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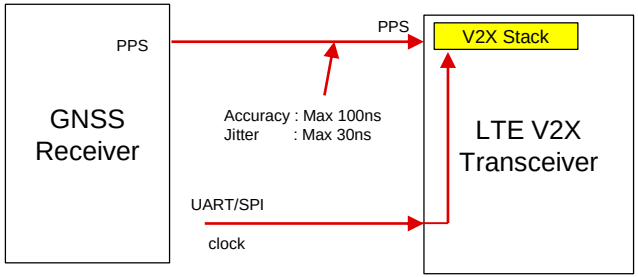
GPS Clock Distribution

Current Architecture : Multiple GNSS Receivers

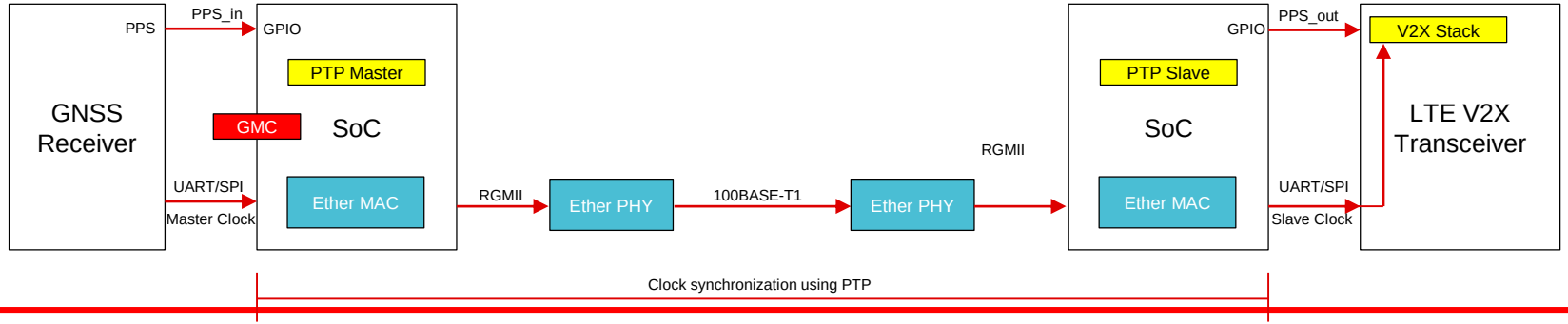
- One attached to every ECU looking for high accurate clock.
- Example: Dedicated GNSS receiver for V2X



Optimized Architecture : Single GNSS Receiver

- Shared with whole network
- Need “accurate” clock transfer

Required Accuracy : Max 100ns
Required Jitter : Max 30ns



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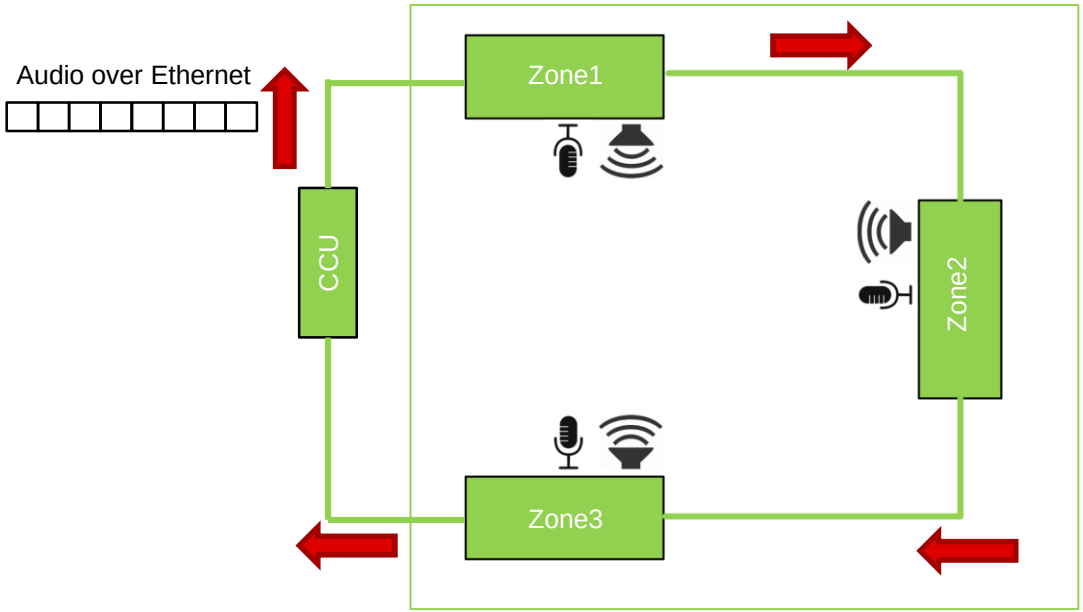
Audio Over Ethernet

- **High synchronization accuracy must for:**
  - High quality/synchronized audio
  - Accurate noise cancellation
  - Etherloop architecture: latency compensation



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Synchronization in Automotive: Where?

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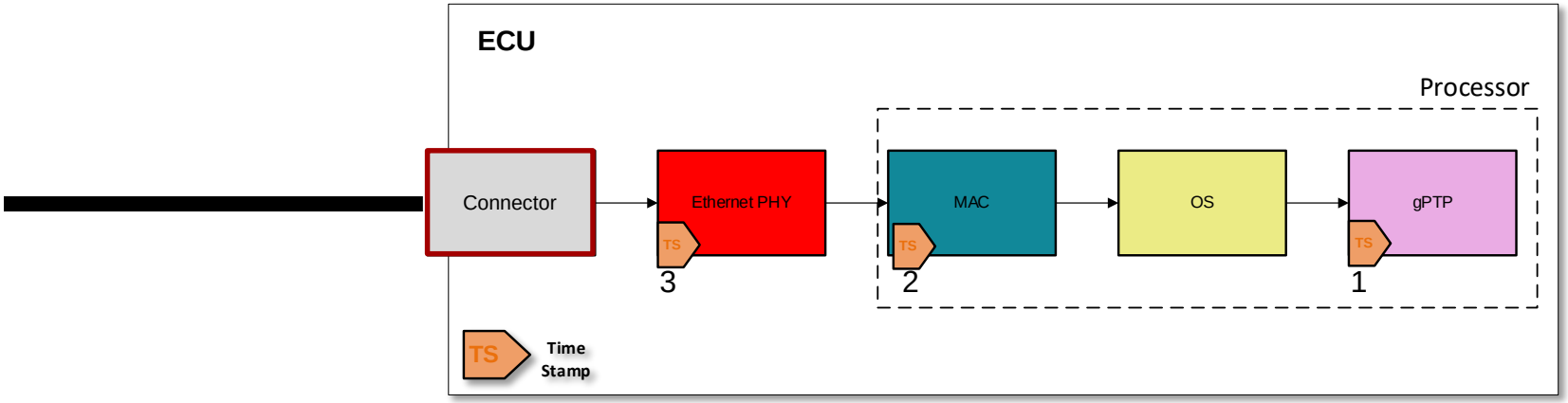
Possible Time Stamping Locations



- Software-based time-stamping : Least accurate! High variations! : 100us - ms
- Hardware-based time-stamping @ MAC in SOC : More accurate! Medium variations! : 10us – 100us
- Hardware-based time-stamping @ PHY : Most accurate! Low variations! : ns

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TI Ethernet PHYs – Precise synchronization

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TI Ethernet PHY: Highly Accurate Wall-clock

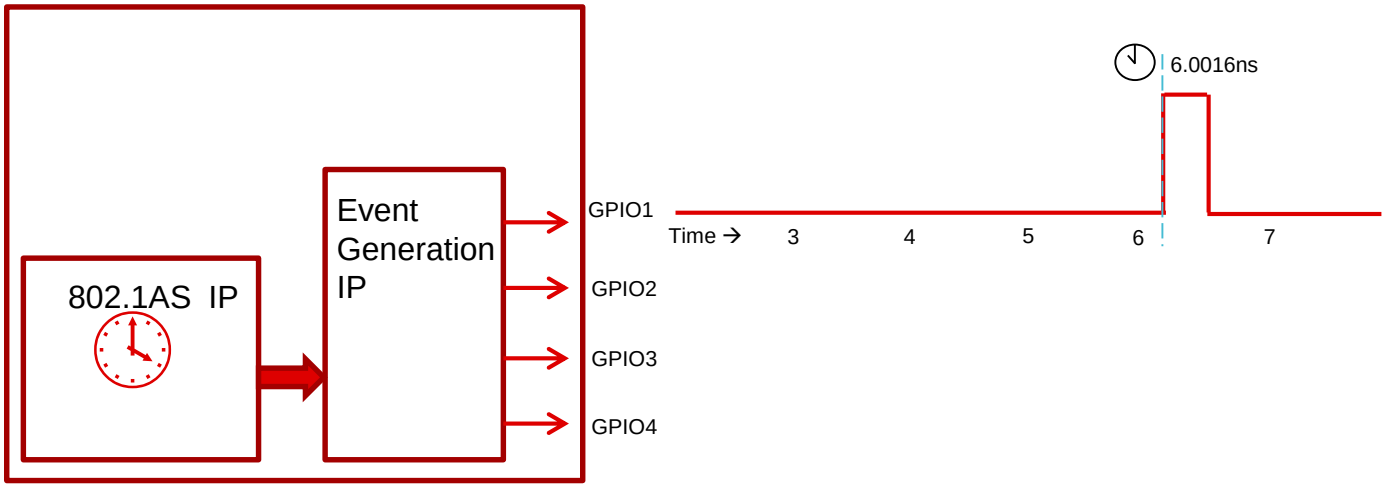
IEEE802.1as PTP Reference Clock (Time-of-Day)

Seconds (32 bit)	Nano Seconds (30bit)	Fraction Nanosecond (2^{-32}) (32 bit)

- **Enhanced Clock Counter Adjustments:**
  - Direct time set
  - Step adjustment
  - Temporary rate adjustment
  - Permanent rate adjustment

- **Reference Clock Selection Options:**
  - High-accuracy internal PLL
  - Recovered clock
  - External reference clock

Integrated Event Generations : Nanosecond Accuate



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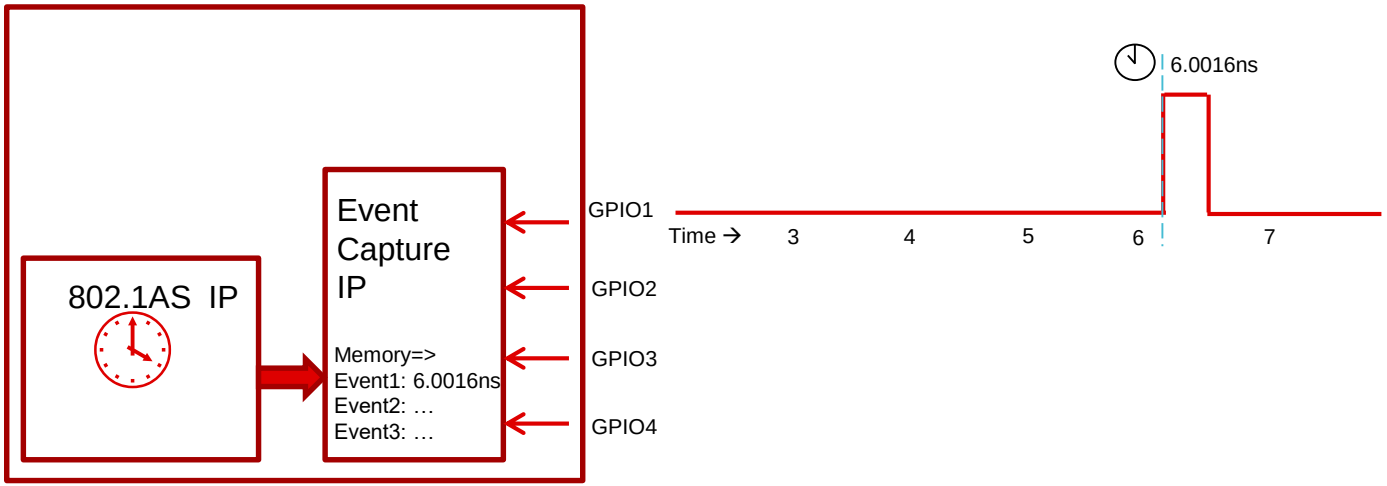
Integrated Event Capture : Nanosecond Accuate



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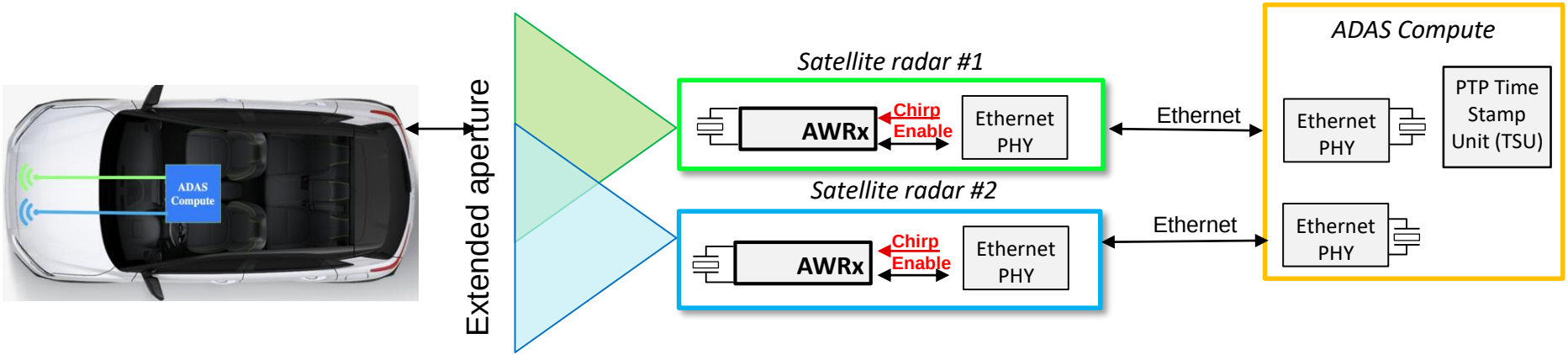
Distributed Coherent Radar – TI Advantage



TI PHYs generates synchronized "chirp enable" : "nanoseconds accuracy"

- ✓ Extends the object detection distance
- ✓ Increases object resolution
- ✓ Decreases hardware/software overhead on ADAS compute

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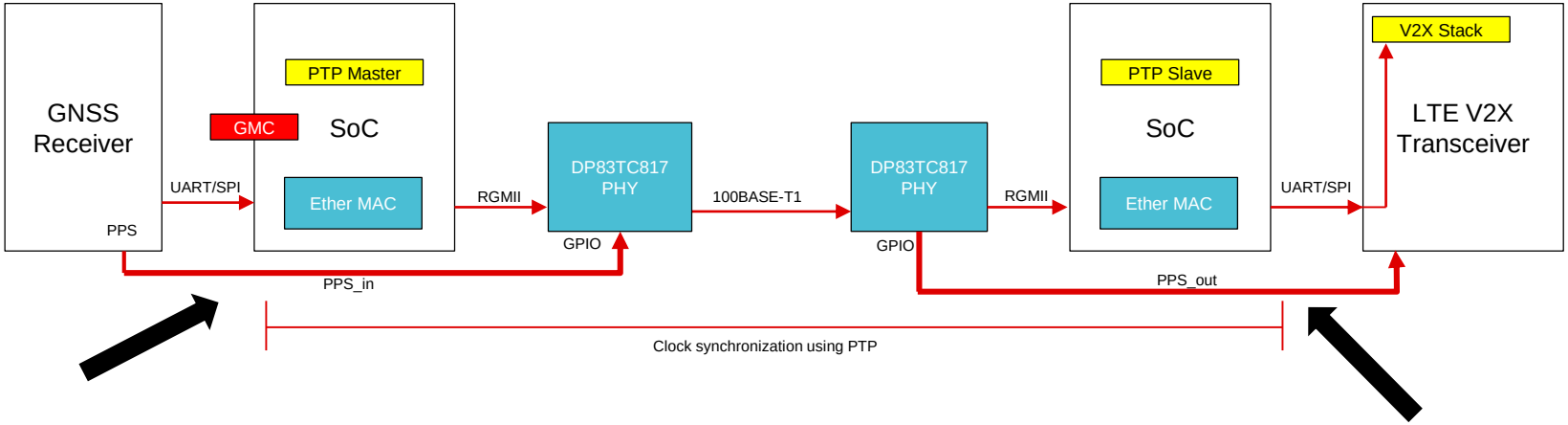
GPS Clock Distribution – TI's Solution



GPS clock input: direct to PHY

GPS clock output: direct from PHY

Accuracy : 10ns

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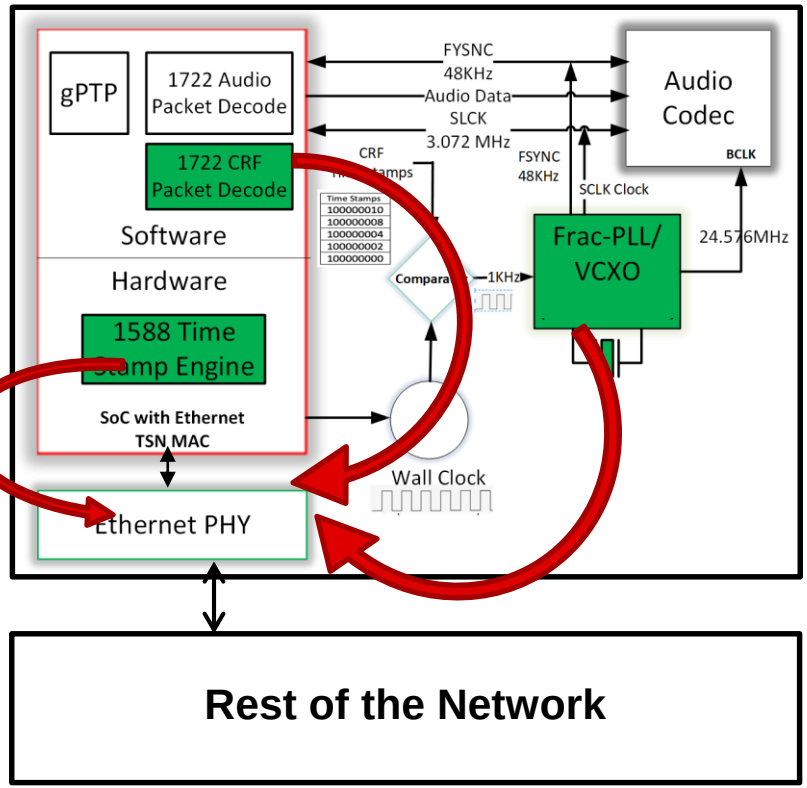
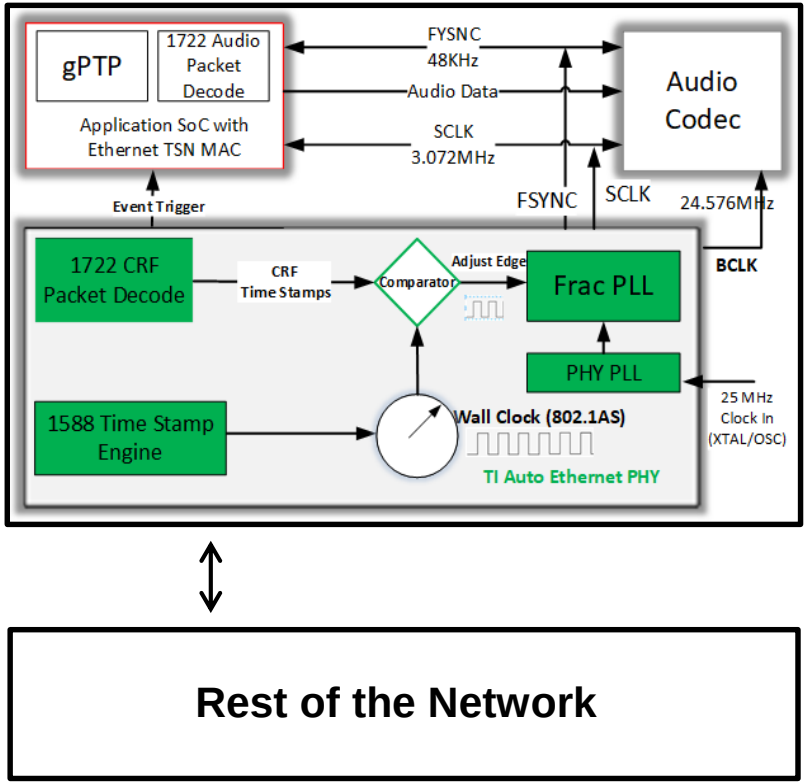
Integrated Audio Clock Gen and Sync: AVB

Yesterday's Solution



- ✓ **$2 BOM saving**
- ✓ **Simpler software**
- ✓ **Cheaper SoC**

TI's Solution



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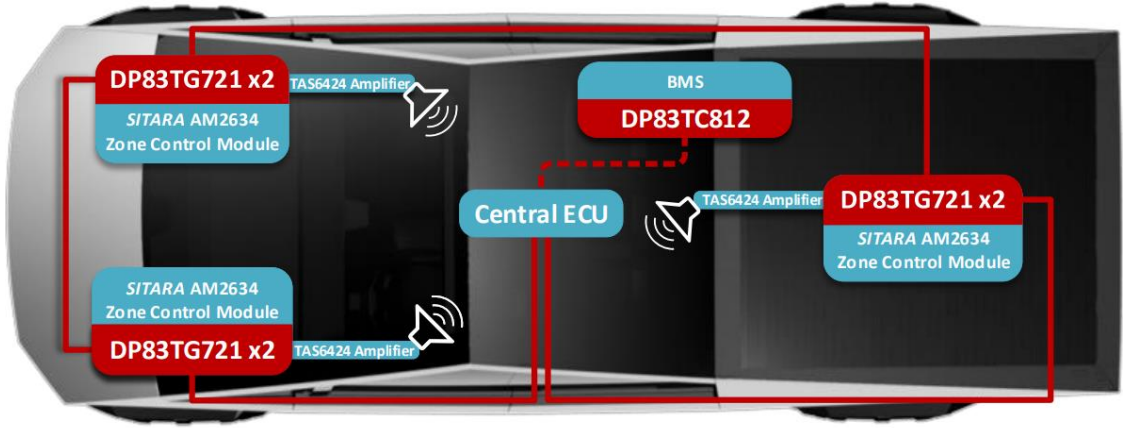
Etherloop with TI Ethernet PHYs

- 1000BASE-T1 EtherLoop proven on DP83TG721
- 100BASE-T1 EtherLoop possible on DP83TC818



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Resources: 100Mbps PHY with Advanced Synchronization

Status: Sampling

Product Page: https://www.ti.com/product/DP83TC817S-Q1

Product Brief: Available for download

Detailed Datasheet & Synchronization Implementation Guides: Available under NDA

EVM: Available under NDA

Resources: 1000Mbps PHY with Advanced Synchronization

Status: In production

Detailed Datasheet & Synchronization Implementation Guides: Available under NDA

EVM: Available under NDA

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