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Most (Media Oriented Systems Transport): A Comprehensive Analysis of the Automotive Multimedia Networking Protocol

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ABSTRACT: The proliferation of sophisticated infotainment and driver assistance systems within modern vehicles necessitates robust high-bandwidth in-vehicle networking (IVN) solutions. MOST (Media Oriented Systems Transport) emerged as a dedicated serial communication standard, specifically optimized by the automotive industry to handle the demanding requirements of multimedia data streams. This paper provides a comprehensive analysis of the MOST protocol, detailing its architecture, protocol stack, network topologies (primarily ring and daisy-chain), and physical layer options, including Plastic Optical Fiber (POF) and electrical conductors (Unshielded Twisted Pair - UTP). It examines the evolution of the standard through its key generations: MOST25, MOST50, and MOST150, highlighting the progressive increases in bandwidth and functionality, including the integration of an Ethernet channel in MOST150. The paper discusses MOST's synchronous, time-division multiplexing approach for transporting audio, video, voice, and packet data, contrasting it with other automotive networking protocols like CAN, LIN, FlexRay, and the increasingly prevalent Automotive Ethernet. The role of the MOST Cooperation in standardization and the protocol's widespread adoption by major automotive manufacturers are also addressed. While MOST significantly advanced automotive multimedia networking, its future role is considered in light of emerging technologies like Automotive Ethernet.

Keywords:MOST, Media Oriented Systems Transport, In-Vehicle Network (IVN), Automotive Networking, Multimedia Network, Protocol Stack, Physical Layer, POF, MOST25, MOST50, MOST150, Automotive Ethernet, Synchronous Communication

I. INTRODUCTION

The automotive industry has witnessed an exponential increase in the complexity and number of electronic control units (ECUs) within vehicles over the past decades. Driven by consumer demand for advanced infotainment, connectivity, and driver assistance features, the need for efficient and high-capacity communication networks became paramount [1]. Traditional automotive buses like CAN (Controller Area Network) and LIN (Local Interconnect Network), while effective for control and low-speed data exchange, lack the necessary bandwidth and quality-of-service (QoS) mechanisms for real-time multimedia applications such as high-fidelity audio streaming, video distribution, and camera feeds [3].

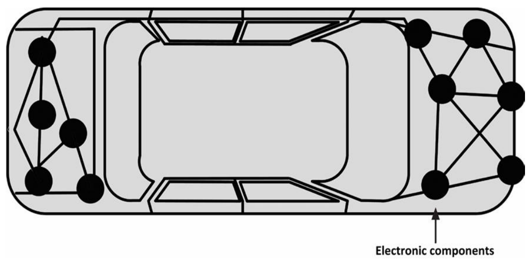

Fig. 1. Vehicle network systems[5]

To address this gap, the MOST (Media Oriented Systems Transport) protocol was developed. Initiated in 1998 by the MOST Cooperation, a consortium of automakers, Tier-1 suppliers, and component manufacturers, MOST was conceived as a dedicated, high-speed multimedia network standard tailored for the

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automotive environment[2]. Its primary goal was to provide a cost-effective, reliable, and standardized solution for transporting synchronous (streaming) and asynchronous (packet) data over a unified network infrastructure. MOST utilizes a synchronous, time-division multiplexing (TDM) approach, inherently suited for isochronous data like audio and video, ensuring low latency and jitter. This paper presents a detailed examination of the MOST protocol, its technical specifications across different generations, its implementation characteristics, and its position relative to other IVN technologies.

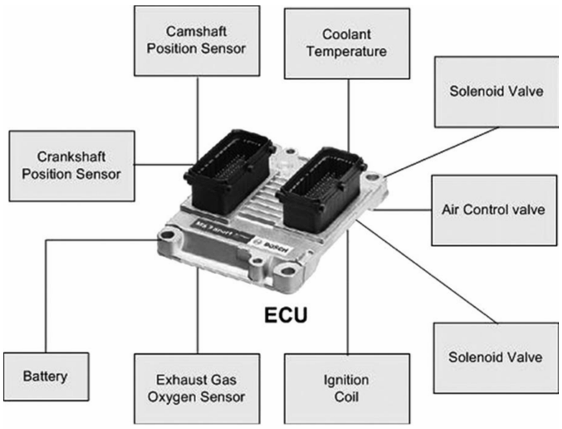

Fig. 2. CAN bus main properties

II. MOST ARCHITECTURE AND PROTOCOL STACK

The MOST specification defines not only the physical and data link layers but encompasses functionalities mapping across all seven layers of the ISO/OSI reference model, providing a complete networking solution [2].

2.1 Network Topology

MOST predominantly employs a ring topology, where data circulates sequentially through each node (ECU) in the network. This topology offers inherent redundancy possibilities and simplifies wiring. A daisy-chain topology is also supported. Within the network, one designated device acts as the Timing Master, responsible for generating the system clock and continuously injecting MOST frames into the ring, to which all other nodes (Timing Slaves) synchronize[1]. MOST supports plug-and-play functionality, allowing devices to be added or removed dynamically (within system design limits). While virtual star topologies are conceptually possible using specialized hub devices, the physical ring remains the most common implementation in vehicles due to its simplicity and cost-effectiveness for point-to-point links[2]. A maximum of 64 devices can theoretically be addressed within a single MOST network.

2.2 Protocol Stack and Data Transmission

MOST provides a standardized Application Programming Interface (API) for application developers, abstracting the complexities of the underlying network communication. This communication is managed by MOST Network Services, which handle protocol operations between the application layer (Layer 7) and the MOST Network Interface Controller (NIC) operating at the lower layers [2][6].

Data transmission relies on continuously circulating frames generated by the Timing Master. Each frame is divided into distinct channels:

Synchronous Data Channel: Carries streaming data (e.g., audio, video) allocated dedicated bandwidth within the frame. Data is transmitted isochronously based on the system clock (e.g., 44.1 kHz or 48 kHz).

Asynchronous Data Channel: Transports packet data (e.g., control messages, database information, IP traffic) using available bandwidth not occupied by synchronous channels.

Control Channel: A dedicated channel for network management, configuration messages, node discovery, and low-level control signals between devices [1][2].

The synchronous nature and TDM structure guarantee bandwidth and low latency for multimedia streams, a key advantage over purely asynchronous packet-switched networks for traditional A/V transport.

III. MOST GENERATIONS AND SPECIFICATIONS

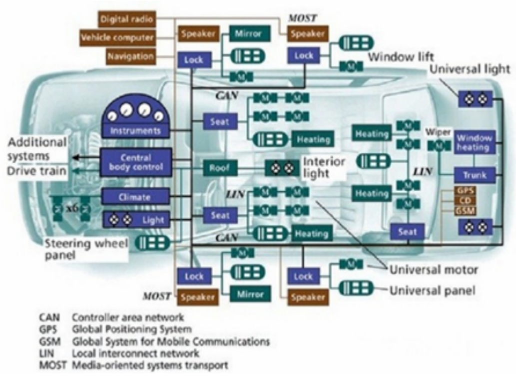

Fig. 3. MOST communication

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The MOST standard evolved over time to meet increasing bandwidth demands:

3.1 MOST25

The initial version, MOST25, offered a gross data rate of approximately 23 Mbaud over a POF physical layer [1]. The frame structure was divided into 60 physical channels, configurable in groups of four bytes (quadlets). It could support up to 15 uncompressed stereo CD-quality audio channels or multiple compressed video streams alongside control data [2]. The system frequency was typically locked to audio sampling rates like 44.1 kHz. While effective for its time, the effective throughput for asynchronous data was limited due to protocol overhead, typically around 10-12 Mbps net payload [1].

3.2 MOST50

MOST50 doubled the gross data rate to approximately 46 Mbaud, achieved by doubling the frame rate while maintaining compatibility with the MOST25 frame structure principles. It introduced a frame length of 1024 bits [2]. A significant addition was the support for an electrical physical layer using Unshielded Twisted Pair (UTP) cabling, alongside the existing POF option. MOST50 offered more flexible allocation between synchronous and asynchronous bandwidth compared to MOST25. The electrical implementation typically used a differential pair (UTP) for data and an additional control line for specific signaling functions [2].

3.3 MOST150

Introduced in 2007, MOST150 represented a major leap, increasing the gross data rate to 150 Mbps [2]. The frame length was extended to 3072 bits. Crucially, MOST150 integrated a dedicated Ethernet channel alongside the synchronous, asynchronous, and control channels. This allowed for the native transport of Ethernet frames (IEEE 802.3) over the MOST network, enabling seamless integration with IP-based protocols and applications. This significantly enhanced flexibility for applications like internet connectivity, diagnostics over IP (DoIP), and firmware updates. MOST150 supports both POF and electrical (Shielded or Unshielded Twisted Pair) physical layers and also introduced capabilities for isochronous transport, allowing synchronous data streams not strictly tied to the MOST frame rate[2]. This version provided the bandwidth necessary for high-definition video and complex multi-channel audio systems.

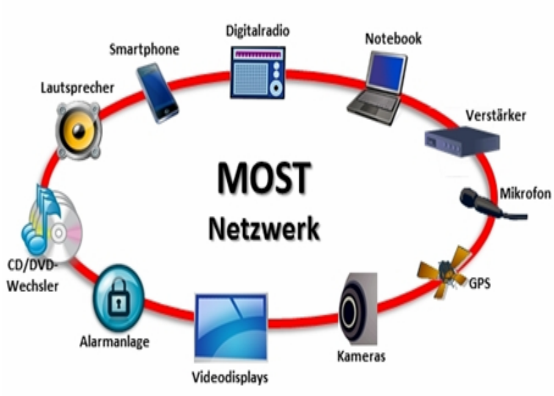

Fig. 4. MOST Network

IV. PHYSICAL LAYER OPTIONS

The choice of physical layer significantly impacts cost, weight, and electromagnetic compatibility (EMC).

4.1 Plastic Optical Fiber (POF)

POF was the original physical layer for MOST25 and remains an option for MOST50 and MOST150. It typically uses a 1mm core diameter fiber with red LED transceivers (around 650nm wavelength) [1].

Advantages: Complete immunity to electromagnetic interference (EMI), no electromagnetic emissions, lightweight, high flexibility, galvanic isolation between ECUs. These are critical benefits in the electromagnetically noisy automotive environment [1].

Disadvantages: Higher component and connector cost compared to copper, susceptibility to tight bend radio and physical damage if not routed carefully.

4.2 Electrical Physical Layer (Copper)

Introduced with MOST50 and supported by MOST150, this typically uses Unshielded Twisted Pair (UTP) or Shielded Twisted Pair (STP) copper wires.

Advantages: Lower component and connector cost established manufacturing processes for copper harnesses.

Disadvantages: Requires careful design and potentially shielding to meet stringent automotive EMC requirements (both susceptibility and emissions), heavier and less flexible than POF, lacks inherent galvanic isolation (requiring it at the transceiver level if needed)[2][3]. MOST50 electrical often employed a specific 3-wire setup

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(differential pair + control line), while MOST150 electrical implementations align more closely with standard differential pair signaling.

V. MOST IN THE AUTOMOTIVE ECOSYSTEM

5.1 MOST Cooperation and Standardization

The MOST Cooperation played a vital role in developing, standardizing, and promoting the technology. Its membership included major global automakers (e.g., Audi, BMW, Daimler, GM, Toyota, Volvo) and key Tier-1 suppliers[2]. This collaborative effort ensured interoperability and fostered a broad ecosystem of compatible devices and development tools from various vendors (e.g., Microchip Technology (formerly SMSC), Analog Devices, K2L, Vector Informatik, Ruetz System Solutions) [2, Section 2.8]. While the core specifications were standardized, certain aspects like the Data Link Layer details were initially proprietary before being licensed more openly [2, Section 2.8].

5.2 Market Adoption and Applications

MOST technology achieved widespread adoption, becoming the de facto standard for high-end infotainment networks in numerous vehicle models from the early 2000s through the late 2010s [1, Abstract]. It was primarily used for:

Connecting head units, amplifiers, CD/DVD changers, navigation systems, displays, and telematics modules.

Distributing audio and video signals throughout the vehicle cabin.

Providing a backbone for driver assistance features that relied on camera feeds (though often not for safety-critical control).

VI. COMPARISON WITH OTHER IN-VEHICLE NETWORKS

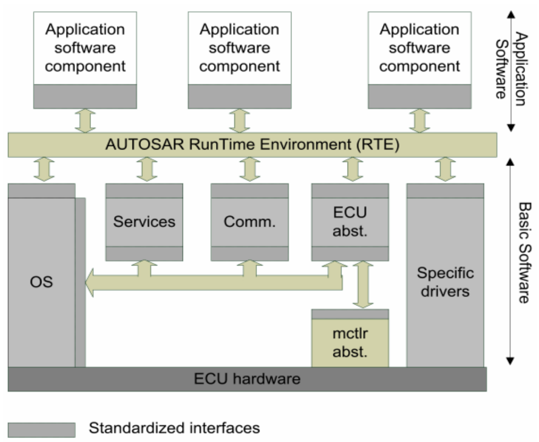

Fig. 5. AUTOSAR reference architecture [4]

MOST occupies a specific niche within the diverse landscape of automotive networks:

CAN/LIN: These are low-speed buses (CAN up to 1 Mbps, LIN typically < 20 kbps) designed for control, diagnostics, and sensor/actuator communication. They lack bandwidth for multimedia [3]

FlexRay: A high speed (up to 10 Mbps per channel), deterministic, fault-tolerant protocol primarily designed for safety-critical applications like X-by-Wire systems (steering, braking). While faster than CAN, its focus and cost structure differ significantly from MOST's multimedia orientation [3].

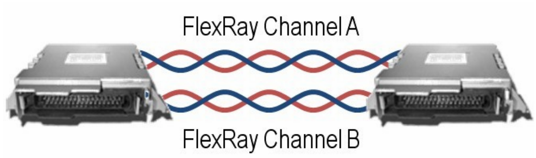

Fig. 6. FlexRay communications network

Automotive Ethernet (e.g., 100BASE-T1, 1000BASE-T1): This is increasingly replacing MOST in newer vehicle architectures. Based on IEEE standards (BroadR-Reach), it offers significantly higher bandwidth (100 Mbps, 1 Gbps, and beyond) over a single twisted pair (UTP). It leverages the ubiquity of IP protocols, facilitating service-oriented architectures and complex integrations. However, standard Ethernet is inherently asynchronous. Transporting low-latency audio/video reliably requires additional protocols like Audio Video Bridging (AVB) / Time-Sensitive Networking (TSN)[3]. The transition involves different physical layers, network topologies (typically switched star), and protocol stacks compared to MOST.

While MOST's synchronous TDM approach was well-suited for classic A/V streaming, the flexibility, scalability, and higher bandwidth potential of Automotive Ethernet, coupled with the industry's move towards IP-based architectures, have made Ethernet the preferred solution for new high-bandwidth IVN designs.

VII. CONCLUSION

MOST (Media Oriented Systems Transport) successfully addressed the automotive industry's need for a standardized, high-speed network dedicated to multimedia and infotainment applications for nearly two decades. Its synchronous architecture, evolution through MOST25, MOST50, and MOST150, and the advantages of its POF physical layer option provided a robust solution adopted by numerous manufacturers worldwide. The integration of an Ethernet channel in MOST150 demonstrated an attempt to bridge towards IP-based communication.

However, the relentless demand for higher bandwidth, driven by high-resolution displays, connected car services, advanced driver assistance systems (ADAS), and the move towards centralized domain or zonal architectures, has favored the adoption of Automotive Ethernet. Ethernet offers greater scalability, leverages established IP protocols and provides a path to multi-gigabit speeds. While MOST systems remain operational in millions of vehicles, new vehicle network architectures predominantly utilize Automotive Ethernet (often complemented by CAN/LIN/FlexRay for specific domains) as the backbone for high-data-rate communication. MOST stands as a significant milestone in automotive networking history, having paved the way for the complex, data-intensive vehicle networks of today.

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