



Systems View of 1394 Automotive

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Agenda

- ⊙ Automotive System of Systems Overview
 - Safety Critical System Group
 - Convenience System Group
 - Entertainment & Navigation System Group
- ⊙ Network Bus Overview
- ⊙ 1394 Solution



Autos are a System of Systems

- ◎ Safety Critical Systems
 - Engine
 - Brakes
 - Steering, etc.
- ◎ Convenience Systems
 - Navigation
 - Vision aids
 - Electric windows, etc.
- ◎ Entertainment
 - Video, music, games, etc.



Automotive Systems Overview

- ⊙ Automakers need network buses to:
 - Reduce the thickness of wiring bundles
 - Reduce cost and weight .
- ⊙ Automakers need standard architectures to:
 - Prevent having to reengineer vendor products, which also yields a cost reduction.



Automotive Systems Overview

Today the automotive world is experiencing a period of sufferance mainly due to the global economical recession which is affecting many industrial activities all over the world.

⊙ Automakers Strategy to overcome situation:

- Enlarging partnerships
- Establishing new joint ventures.

⊙ Electronics will continue to play an important role:

- Advancements
- Safety
- Environmentally friendly.



Automotive Systems Overview

- ⊙ Modern cars continue to adopt more electronics and sophisticated devices.
 - Sensors, actuators, navigation systems, stabilization and traction control aids, audio and video entertainment, and so on.
- ⊙ Devices are now requiring peer to peer connections more than ever.
 - Exchanging information
 - Monitoring of operative state.



Automotive Systems Overview

- ⦿ Electrical and/or optical connections and a complete protocol are required to accomplish this task.
- ⦿ In recent years the number of buses and protocols has increased as the corresponding number of electronic appliances installed on new car models increased.



Automotive Systems Overview

- ◎ Each **bus** has its own characteristics and performance level. Typical parameters include:
 - Data rate
 - Complexity and costs of associated physical layer and protocol
 - Robustness
 - Safety level
 - Performance in harsh environments
 - Immunity grade from external noise.



Automotive Systems Overview

Networks are not new, but their application to the vehicle is.

⊙ Vehicle networks demand:

- Low Cost
- Immunity from external noise
- Ability to operate in harsh environments
- Overall robustness and reliability

⊙ Although in the past the vehicle network did not place too much emphasis on the data throughput;

- Demand for more on-board computing
- Need to provide higher-speed communication between modules.



Automotive Systems Overview

- ◎ Standard networks in production **today** that must be bridged.
 - CAN
 - LIN
 - MOST
 - SAE J1850
 - FlexRay



Automotive Systems Overview

CAN (Controlled Area Network):

- Low speed serial Bus developed in 1986 in Germany, by Robert Bosch GmbH.
- Designed for in-vehicle networks
- Uses twisted wire pairs
- Reliable solution in noisy and electromagnetically interfered environments.
- Allows multiple bus implementations in a single vehicle
 - Low speed CAN for window and seat operations
 - High speed CAN for engine management and brake control
- Also used in industrial automation, aerospace systems, and home & building automation.
- Maximum data rate 1 Mbps at 40m, 125 Kbps at 500m, and 50 Kbps at 1000m.



Automotive Systems Overview

LIN (Local Interconnect Network).

- ⦿ Low speed serial bus protocol designed for in-vehicle connection and communication by the LIN consortium.
 - Based on a 8-bit UART interface, and supports the Single Master/Multi Slave architecture.
- ⦿ Supports Intelligent sensors and actuators.
- ⦿ Requires only a 12V single wire for the physical implementation (the vehicle chassis is used as the current return path).
- ⦿ Considered as a low cost solution
- ⦿ Master node is able to synchronize all the slaves, so that an external clock or oscillator is not necessary.
- ⦿ Applicable Controls:
 - air conditioning systems, seats, doors, climate control, sunroof actuators, intelligent wipers, small motors, and rain or temperature sensors.
 - high speed, redundancy, or fault tolerance are not required for these devices.
- ⦿ Maximum 19200 baud over a maximum cable length of 40 meters
 - Also supports 2400 and 9600 baud rates.



Automotive Systems Overview

MOST (Media Oriented Systems Transport)

- ⊙ Optical Fiber serial protocol designed for automotive multimedia applications.
- ⊙ Transmission bitrate
 - 25Mbps, 50Mbps (future plans 150Mbps)
- ⊙ Adopted today for multimedia car equipments.
 - CD
 - DVD players
 - Radios
 - GPS navigation systems



Automotive Systems Overview

SAE J1850:

- ◎ Serial protocol bus developed in 1994 for diagnostics and data sharing applications
 - Off-road and on-road vehicles.
- ◎ Two types of SAE J1850 implementations:
 - Two-wire differential implementation able to provide a data rate of 41.6 Kbps with Pulse Width Modulation (PWM)
 - Single-wire implementation able to provide a data rate of 10.4 Kbps with Variable Pulse Width (VPW)



1394 AUTO



Automotive Systems Overview

FlexRay:

- ⦿ High-speed serial communication bus developed in 1999 for in-vehicle networks
- ⦿ Consortium under the leadership of BMW and DaimlerChrysler in 1999.
- ⦿ Characteristics:
 - Two communication channels capable of 10 Mbps data rate.
 - Redundancy scheme enables an aggregate bus data rate of 20 Mbps
- ⦿ Fault-tolerance and synchronization capability
- ⦿ Determinism ability
 - Messages are divided in synchronous (treated in a deterministic way on a strict time schedule) and asynchronous (used to deal with event driven messages).
 - Introduce x-by-wire (steer-by-wire and brake-by-wire) systems on automobiles.



Automotive Systems Overview

⊙ Systems being investigated

- 1394
- USB
- Ethernet
- WiMax
- LVDS
- GVIF
- HMDI



Automotive Systems Overview

The automotive industry quickly realized the complexity of wiring each module to every other module.

⦿ Wiring design is challenging

- Complex
- Module dependent
 - Vehicle without the anti-lock brake module would have to be wired differently than one that included anti-lock brakes.



Automotive Systems Overview

The industry's answer:

- ⊙ Create a central network in the vehicle.
- ⊙ Modules that can be 'plugged' into the network
- ⊙ Modules able to communicate peer to peer
- ⊙ Design
 - Easier to manufacture and maintain
 - Provides the flexibility to add and remove options without affecting the entire vehicle's wiring architecture.
 - Each module, a node on the vehicle network, controls specific components
 - Each module communicates with the other modules as necessary.
 - Uses an Industry Standard Protocol.



Automotive Systems Overview

The goal:

- ⊙ Smaller number of nodes
- ⊙ Combine more applications into single nodes.
- ⊙ Move toward forward-looking applications
 - adaptive cruise control
 - collision avoidance
 - automated lane-tracking
- ⊙ Increase communication signals within the vehicle by ten-fold.
 - Requires more bandwidth.
- ⊙ Central backbone is essential to achieve this.




The Answer



I394 AUTOMOTIVE TECH SEMINAR + APRIL 30th, 2009 + DEARBORN, MICHIGAN

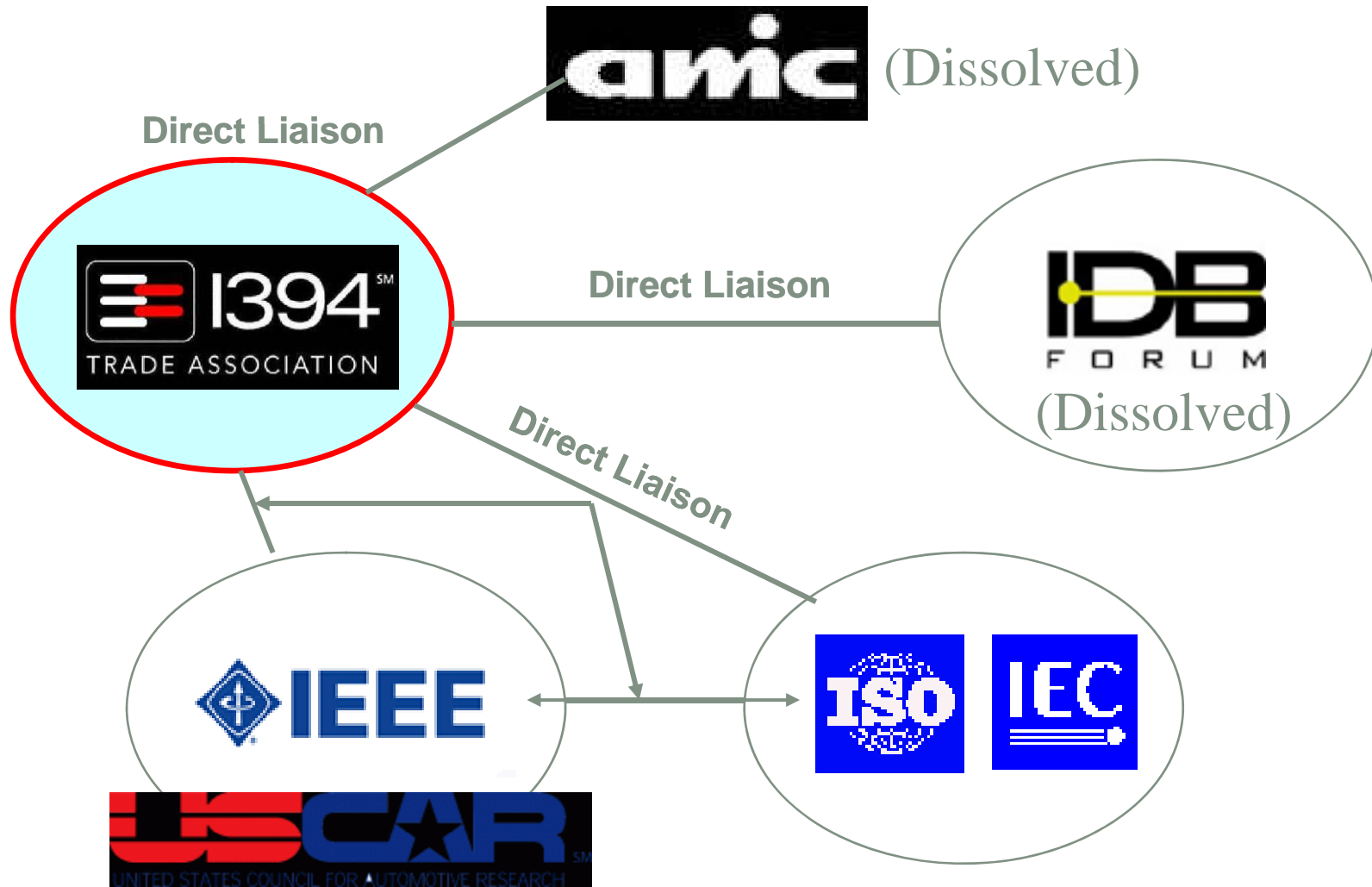


I394SM **AUTO Solution**

- ◎  I394SM **AUTO** specifications are based on 1394b.
 - Supports Plastic Optical Fiber (POF) and various copper backbones
 - Backward compatible with 1394a- very important
 - High speed S100-S800
 - Asynchronous and Isochronous (very critical)
 - Peer to peer bus with no PC/Host needed
 - Self ID and configure of devices
 - Arbitrated master/slave bus model, real-time get priority



1394 Standards Bodies



Network Architecture Statements

- ⦿ Design Specifications linked to external Standards.
- ⦿ Multiple Physical Layers developed.
- ⦿ Adopts AV/C protocol to ensure compatibility with CE products.
- ⦿ Adopts AMI-C/ISO protocol to implement functions specific to Automotive.
- ⦿ It is a Host Centric Scheme capable of managing multiple displays and multiple content sources.



Automotive Related Specifications

IEEE Std 1394-1995

IEEE Standard for a High-Performance Serial Bus

IEEE Std 1394a-2000

IEEE Standard for a High-Performance Serial Bus – Amendment 1

IEEE Std 1394b-2002

IEEE Standard for a High-Performance Serial Bus – Amendment 2

TA Document 2001018

IDB-1394 Automotive Specification

TA Document 2008001

1394 Copper Automotive Standard (1394cu)

TA Document 2007007

IDB-1394 HPCF Automotive Specification (Amendment 1)

TA Document 2002005

Base 1394 Test Suite Def with Extension for 1394b

AMI-C 4001/ISO 22902-7

AMI-C Physical Spec (POF)

Physical Layer Specifications

Test Procedures: Mechanical & Electrical & EMC



Automotive Related Specifications

AMI-C 2001/ISO 22902-4

AMI-C network protocol requirements for vehicle access

AMI-C 2002/ISO 22902-5

AMI-C Common Message Set

IEC61883-1/6

Consumer Audio/Video

TA Document 2006020

BT.601 Transport over IEE1394

AMI-C 3003-1

AMI-C 1394 Test Spec

AMI-C 3003-3/4

AMI-C 1394 EPOC

AMI-C 2002 1.0.2

AMI-C CMS for Power Management

AMI-C 3013-1/3023-1

AMI-C Power Management Architecture & Spec

AMI-C 3033/3034

AMI-C Power Management Test & EPOC

High Layer Specifications

Network Messages: AV/C, Vehicle Data Status, and System Management



1394:AUTO



Automotive Related Specifications

		1394	MOST	LVDS	GVIF	HDMI
Enough Bandwidth ?	Command transmission	OK	OK	NG	NG	With limitation
	Audio multiple transmission	OK	OK	NG	NG	NG
	Video multiple transmission	OK 800Mbps	With limitation 150Mbps	NG	NG	NG
Content Protection		OK DTCP	OK DTCP	NG	OK HDCP	OK HDCP
Network ?	Topology	OK	With limitation Ring only	NG	NG	NG
	Number of Cable & Connector	OK	OK	NG	NG	NG

Only 1ch video transmission

Peer to Peer interface

Increase of Cable & Connector



I394SM **AUTO System Summary**

- ① A variety of commercial network components can be easily adapted to the automotive environment.
 - Development Cycle time reduction
 - Cost reduction
 - Protocol stack
- ① A variety of commercial development tools available to support Automotive.
 - Protocol Analyzers
 - Signal Testers
 - Data Loggers
- ① Adoption of 1394 standard allows automakers to easily incorporate commercial applications.
 - Blu-ray
 - DVD
 - HDTV, etc..
- ① Automaker's Design Specifications can be easily implemented by referencing to existing Standard Specifications.
 - 1394TA
 - IEC
 - AMI-C/ISO, etc.





Thank you

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