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Tutorial Title

**Technologies of Communication Networks
for Automotive Systems**

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Tutorial Proposal

Tutorial Title:
**Technologies of Communication Networks for
Automotive Systems**

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Place: Orlando, Flórida, USA

Date: Monday, 10 November 2008

Time: 8-11:40 a.m. and 9:40-10 a.m.

Duration: 3 hours 20 minutes

Abstract - With the wide availability and low cost of current technology networks of communication of data, their employability to interconnect sensors, controllers and actuators are gaining wide acceptance in various fields of application such as aviation, automotive, industrial and more. The communication networks are the basic infrastructure of a distributed computing system in which applications are distributed in the form of tasks that communicate through the exchange of messages by a medium. The automotive industry is one of the big beneficiaries in the use of technologies for communications networks in their functions and distributed applications. The main advantages are to reduce costs of development and production, reducing weight and volume in the final products, traffic and fleet management, entertainment functions, ease in diagnosis and maintenance, and a wide range of functions at the level of comfort and safety to the end user. Several technologies for communications networks are available on the market today and depending on the level of automotive function can be classified in accordance with the requirements of communication required by distributed applications. There are proprietary networks where a supplier or group of suppliers has the total area of technology and networks of open standard that the technical functionality are widely available and standardized. The standardization of technologies for automotive networks is governed by bodies such as the SAE (Society of Automotive Engineers) and ISO (International Organization for Standardization). Some of the key technologies of networks available in the market are: UART (Universal Asynchronous Receiver and Transmitter), LIN (Local Interconnect Network), CAN (Controller Area Network), VAN (Vehicle Area Network), TTP / C (Protocol for Time-Trigger Class C), FlexRay, ByteFlight, MOST (Media Oriented Systems Transport), D2B (Domestic Digital Bus), UWB (Ultra-Wideband working Group), Zigbee, Bluetooth among others.

1 Motivation

The evolution of the functional solicitations in automotive systems is characterized as main requirement of automotive industry, which shimmers more and more for the reduction in the costs and time of production and quality in your products, with the principal satisfaction objective to the customer. Now, the automotive systems incorporate perceptible functions to the final user, such with systems of automatic air conditioning, intelligent navigation, and multimedia integrated systems among others.

Traditionally, the automotive industry contemplated additional functions in automotive systems based on mechanical systems and eletro-mechanic, which had an inherent physical restriction at the level of costs and time of production in a production line.

With the crescent functionality increase and reduction of costs of the devices micro-processor and communication networks, the substitution of elements purely mechanics for elements eletro-mechanics, of the certain flexibility so that the industry automotive can incorporate new functions at electronic level and of software.

This becomes extremely attractive to the fact of reduction of costs and time of production and flexibility in the variability of products with the minimum of modifications in a production line.

To satisfy the requirements of additional functions in automotive systems, he/she becomes growing the use for microprocessor devices, communication networks and paradigms of software developments, showing as well as the computation area became important and even having differentiated in the development of new products in automotive systems.

In this tutorial the main technologies and tools of employed in communication networks will be presented in automotive systems based on the requirements and main functions of a automotive system.

2 Biography

Prof. Max Mauro has graduation in Industrial Electrical Engineering at Catholic Institute of Minas Gerais (1993), Master in Electrical Engineering from Federal University of Santa Catarina (1996), Ph.D. in Production Engineering from Federal University of Santa Catarina (2004) and Post-Doctorate in Electrical Engineering from the University of Aveiro - Portugal (2005/2006). He worked at IBM and IBM USA as Automation Engineer. Atuou as professor at several universities as Catholic Institute of Minas Gerais (ICMG-MG), Fedral University of Vale do Rio Doce (UNIVALE-MG), University of Vale Itajaí (UNIVALI-SC), Federal University of Santa Catarina (UFSC-SC), University of Plateau Catarinense (UNIPLAC) and Integrated Colleges of Caratinga (FIC-MG). Coordinated the Project RedeAuto-FIAT (2005-2006); State Project Advansys the Faculty of Engineering of the University of Porto - Portugal (2005-2006); Member of the CLEOPATRE Project from University of Nantes - France (2003-2004). Currently D1/ADJ1.AA1 is professor and coordinator of the Research Group of Real-Time Systems (STR) of the University Center from the East of Minas Gerais. He is an Associate Editor of the "International Journal of Systems, Control and Communications - IJSCC" ISSN 1755-9340 (Print), 1755-9359 (Online) and "Electronic Journal of Information Systems - RESI" ISSN 1677-3071. Coordinator of the SisAuto project (016/2006 announcement) and Flex-by-Wire project (Edital 03/2007) funded by FAPEMIG. Member of the Production Engineering Course (CEP) and Research Assessor Committee (CAP) from UnilesteMG. Consultant Ad-Hoc Amparo of the Foundation for the Research of the State of Minas Gerais (FAPEMIG); Reviewer Graduate Course and Institutions of Higher Education by INEP / MEC; Founding Partner of the Brazilian Association of Electric Vehi-

cles (ABVE); Coordinator of 1st Contest Papers in Electric Vehicles, (ABVE); Instructor of the Brazilian Association of Automotive Engineering (SAA); Instructor of the Brazilian Association of Metallurgy and Materials (ABM). He was consultant and instructor in the areas of industrial networks and networks of various automotive companies such as RCS, USIMINAS, ACESITA, FORD, AEA, Cycle Engineering, GRABER among others. Classified on 1st position as Invited Professor to the Institut de Recherche en Communications et Cybernétique of Nantes - IRCCYN (03/2008). He is interested in searches for the following areas: automotive electronics, computer control systems, network control systems, wireless control systems, industrial networks, automotive networks, embedded systems, real-time systems, distributed systems, simulation, communication network, industrial automation, and hybrid electric vehicles, tracking and management fleet of vehicles and project circuit electronics.

3 Objective

Provide the participants a general knowledge about the main technologies of automotive networks and project tools, your classifications and applications, as well as the technological trends of the distributed automotive applications. The tutorial also seeks to familiarize the participant with the technical terms more used in the section, as well as to provide a theoretical support in the automotive area.

4 Program

1. Introduction

- a. Motivation
- b. Automotive electronics
- c. Requirements of automotive applications
- d. Commercial architectures

2. Paradigms of Communication Network

- a. OSI reference model
- b. OSI reduced for automotive applications
- c. Random access protocols
- d. Channel partitioning protocols

3. Technologies of Automotive Networks

- a. Class A: A-BUS, LIN, TTP/A,...
- b. Class B: CAN, VAN, J1939,...
- c. Class C: TTP/C, ByteFlight, FlexRay,...
- d. Wireless networks: UWB, Bluetooth, Wi-Fi,...
- e. Multimedia networks: MOST, D2B, FireWire, AMI-Consortium,...

4. X-by-Wire Systems

- a. Characteristic of X-by-Wire systems
- b. Adopted networks: TTP, Flexray and TT-CAN

5. Future Trends