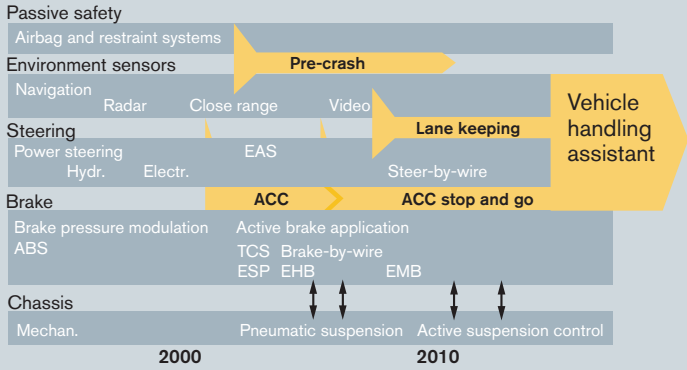# FlexRay™ Protocol

The Communications System for Advanced Automotive Control Applications

The rapid growth in advanced automotive control systems requires a new, more powerful communications protocol to ensure a network that works together to accomplish critical tasks within the vehicle. The FlexRay™ Consortium—made up of a group of industry heavyweights, including Freescale—formed to enable the development of next-generation by-wire systems and to promote an open-source network communications protocol for the automotive industry.

FlexRay founders Motorola (Freescale Semiconductor), Philips, BMW and DaimlerChrysler have been working together since 2000 to help speed the adoption of the FlexRay protocol, a communications protocol designed to handle the growing number of digital elements that make up a 21st century automobile. Over the past two years, others, including Bosch, General Motors, Ford, Volkswagen and Siemens VDO, have joined these leaders in an effort to make FlexRay the de facto standard for advanced applications in the automotive industry. As of August 2004, more than 80 companies from the automotive, semiconductor and software industries are supporting the FlexRay standard. The goal is for the first FlexRay enabled vehicles to hit the street by model year 2006.

ADVANCED APPLICATIONS: VEHICLE DYNAMICS AND DRIVER ASSISTANCE SYSTEMS

ABS = Antilock Braking System
EMB = Electro-Mechanical Braking
ESP = Electronic Stability Program
TCS = Traction Control System
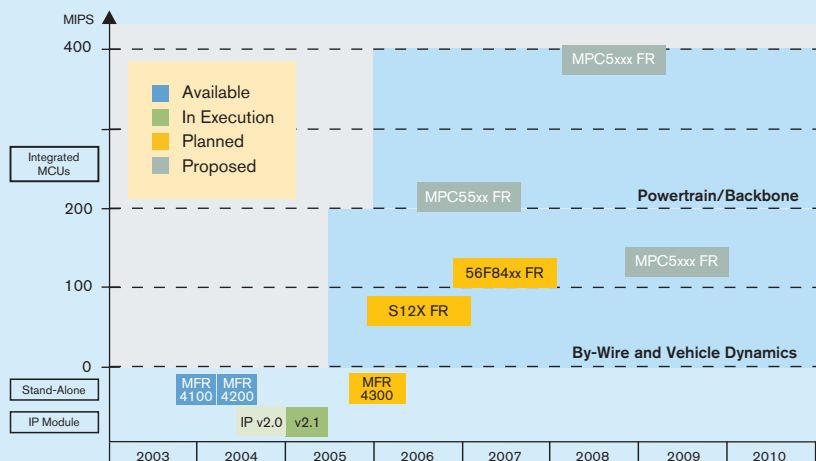
Systems Working Together

The FlexRay protocol is expected to be a comprehensive communication system, providing speed, flexibility and scalability for complex networks. The protocol's key features include:

> Time- and event-triggered communication schemes

> Support of fault-tolerant systems

> High error detection and error diagnosis capability

> Support of different network topologies for cost-effective and safety-enhanced partitioning of the system

> Dedicated automotive electrical physical layer with sophisticated powerdown and wake up mechanisms

> Flexible extendability and full scalability to enable upgrades

Among the applications that the FlexRay protocol is expected to make possible are x-by-wire systems such as brake-by-wire and steer-by-wire. X-by-wire removes the need for hydraulic and mechanical systems, connecting the driver to these systems using sophisticated electronic systems that are less expensive to build and easier to maintain.

Other applications that the FlexRay protocol is expected to enable include active and passive safety systems, collision avoidance systems, powertrain management systems and driver assistance systems. With a gross data rate of 10 Mbits/sec, FlexRay delivers approximately 20 times higher net bandwidth than the CAN protocol currently used in advanced automotive control applications.

freescale™ semiconductor

FLEXRAY INTERGRATED MCUs

MIPS

Legend:
- Available
- In Execution
- Planned
- Proposed

Integrated MCUs

	400	MPC5xxx FR
200	Powertrain/Backbone	MPC55xx FR
100	56F84xx FR	MPC5xxx FR
	S12X FR	
0	By-Wire and Vehicle Dynamics	

Stand-Alone: MFR 4100, MFR 4200, MFR 4300

IP Module: IP v2.0, v2.1

Years: 2003 2004 2005 2006 2007 2008 2009 2010

Except for historical information, all of the expectations and assumptions contained in this document are forward-looking statements involving risk and uncertainties. Important factors that could cause actual results to differ materially from such forward-looking statements, include, but are not limited to, the competitive environment for our products, changes of rates of all related services, and legislation that may affect the industry. For additional information regarding these and other risks associated with the Company's business, refer to the Company's reports with the SEC.

FLEXRAY™ FAMILY ROADMAP

- Autosar-Compliant Standard API
- FlexRay™ SW Drivers Middleware
- Processor Bus Interface
- Scalable Host Interface Customer-Specific Solutions
- Basic FlexRay Interface
- FlexRay Protocol Core
- Logical Line Interface
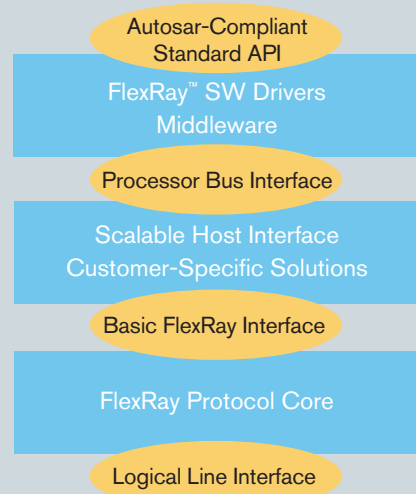
Freescale's Role in the FlexRay Consortium

Freescale is adding its expertise to the FlexRay initiative by codeveloping the specifications for the automotive data link layer. As for creating its own FlexRay ready products, initially Freescale will develop a FlexRay 2.0-compliant module that can be used for license, stand-alone communications controllers and integrated 16- and 32-bit microcontrollers. Freescale uses the same FlexRay block for all of its FlexRay products.

A single network protocol for automobiles can help to speed the development of system applications. It may also result in cost savings as industry suppliers take advantage of designing for a single platform and the economies of scale of manufacturing for one standard rather than for many.

The FlexRay protocol was finalized in July 2004. Freescale provided a field programmable gate array (FPGA) to DaimlerChrysler to display their first car equipped with a FlexRay brake-by-wire system in April 2002 at the first International FlexRay Workshop in Munich, Germany. Freescale provided the MFR4100, the world's first silicon chip of FlexRay, in October 2003 to the consortium and its members, with the FlexRay specification version available at that time. Freescale introduced the second FlexRay silicon chip in May 2004 and a device, the MFR4200, is expected to be qualified in the first half of 2005 for production.

Freescale continues to drive FlexRay Consortium activity to have a final reference model and a conformance test in place to ensure the interoperability of different implementations of FlexRay on the market.

The first cars equipped with networking capabilities based on the FlexRay protocol are expected in 2006.

Freescale also offers its FlexRay implementation to other semiconductor companies for license. This licensing ensures that multiple vendors offer interoperable solutions by making use of the same FlexRay protocol core that conforms to the FlexRay protocol specification. Customer-specific product diversification can be made at the host interface level.

FlexRay Advantages
> Backed by the majority of the automotive industry, including the world's three largest volume car manufacturers

> Working prototype cars for system evaluation in operation now

> Supported by a wide variety of tools available from many development partners

> FPGA and silicon prototypes from Freescale are available for key partners

Learn More: For more information about Freescale's automotive products, please visit us at **www.freescale.com**. To learn more about Freescale's FlexRay products, please visit **www.freescale.com/flexray**.

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