THE MERCHANT EMBEDDED COMPUTING MARKET

2011 EDITION

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Chapter 1
Introduction

1.1 Objective

This report examines in detail the size, trends, technology, and market opportunity in the merchant embedded computing (MEC) market. It relates technological advances and development of various product specifications, core technology road maps, and trends and issues of importance to the industry; it examines the market forces that are changing the nature of the business, including trends toward outsourcing; and it considers M&A impacts on industry consolidation and the issues that are altering the basic business and future success of the merchant vendors. Secondly, it analyzes business issues and forecasts the market size and growth for various segments and technologies. Finally, the report profiles selected vendors, summarizing their products, services, and primary value propositions.

The MEC report is designed to aid executives in senior management, sales, business development, and marketing among current and potential manufacturers and users of embedded computing products in making important strategic and product decisions.

The MEC business consists of several dozen large companies with diversified product portfolios and hundreds of small companies targeting product niches and often with special, long-established relationships with buyers. MEC products number in the thousands and unit shipments in the hundreds of thousands to millions as of this writing—hence, this report sizes the major applications and segments by revenue as well as analyzes trends and key issues facing MEC executives. It is not an exact science, as detailed data is often not available in all cases—at best, it is an estimate based on all available information and incomplete data.

In the last two years the MEC business and applications have undergone significant changes, particularly with respect to the end applications markets. Going forward, with the advent of 22-nm CMOS technology and 8 billion transistors, it is clear that in a few years a single-board computer (SBC) will have functionality and processing power equivalent to that found in the rows of computers in the raised-floor data centers of the past decade. And this functionality will be field programmable at the gate level.

1.2 Scope and Definitions

First, the market is very complex and its definitions are not precise. There are many overlaps in products and markets. Attempts to put everything into nice neat buckets and assign a number do not always work making market issues difficult to characterize. The term "embedded computing" has become a favorite buzzword and is freely used about the industry to refer to anything with a computer in a box; therefore, below we try to specify exactly how the term is used within the context of this report.

1.2.1 Merchant Embedded Computing (MEC) Definition

MEC is defined as a computer system consisting of a single-board computer or a series of boards and a backplane. The bus architectures are defined by a set of industry standards for the signaling, bus, connectors, and physical form factors.

- MEC systems are usually products available from multiple vendors offering a variety of standard, "off-the-shelf" boards available from merchant vendors within the open market.
- The system may run a proprietary operating system or a generic off-the-shelf operating system, with the application software usually product specific.
- The operating and application systems are not exposed to the end user, nor can the user change or run general-purpose applications software.

- Generally, the user does not see the actual function of the computer inside but may only access its operation with a button control panel, menu system, or screen with a dedicated application.
- Typical MEC applications might include use in a medical scanner, industrial robot, manufacturing process control system, various communications equipment, complex military equipment, etc. Some embedded computing systems are operated in such a way that the computer function is not apparent to the final application, while other embedded systems are clearly operated by computers that are integrated into a machine's functionality. An example is the highly complex imaging system of a CAT, PET, or MRI diagnostic system or an industrial automation robot.

Systems Not Included in MEC Definition and coverage:

- "A microprocessor on a board of electronics" not conforming to an industrial bus standard as its scope is too broad and could encompass virtually everything with a microprocessor.
- Single application-specific microcontroller-operated applications, such as a musical greeting card, appliance, stereo system, thermostat, etc., or any device that embeds a microprocessor of some kind
- Complex, single-chip embedded solutions and systems on chip (SoCs)
- PC motherboards and add-in boards

While PC motherboards are bus based and are popular in many industrial applications, they are designed primarily for general desktop applications, not for dedicated applications. However, capturing data about PC-grade motherboards used in the embedded market is quite difficult because a large percentage of such boards are sold through commercial channels. Motherboards sold by merchant vendors in this report are covered in the "PC/104, EPIC, EBX,

ATX, and ITX" category, as they typically have been enhanced beyond normal PC-grade quality used to run Windows, Google, and Facebook.

1.2.1.1 Scope

The MEC report analysis covers:

- Five vertical market application areas
- Nine bus architectures categories
- Four functional categories

1.2.1.2 Five Application Areas

While there are hundreds of sub-applications, MEC vendors generally compete in five basic vertical market application categories:

1) Communications (cellular infrastructure, CPE, etc.)
2) Industrial (process control, test and measurement, and other)
3) Medical (diagnostics/imaging, therapeutic, and surgical/monitoring)
4) Military/Aerospace (flight navigation, weapons, C3, and other)
5) Other (automotive, off-road, ships, trains, etc.)

These applications typically have common product characteristics and operating environments. Mil/Aero equipment requires battlefield-rugged architecture, whereas medical equipment typically operates in a "72 degrees and fluorescent lighting" environment of a hospital. Industrial automation boards may be in process control, mining, chemical, or agricultural equipment, or a production line robot; communication boards might be focused on high-speed, optical transfer data rates. Outside plant equipment may operate in harsh environments and require the ability to withstand –40ºC to +80ºC temperatures and greater amounts of shock, vibration, humidity, and electrostatic discharge.

1.2.1.3 Nine Bus Architectures

The industry-standard, committee, trade association bus architectures are addressed in this report. These include:

1) PCI
2) CompactPCI (cPCI)
3) AdvancedTCA (ATCA)
4) VMEbus
5) PMC
6) AdvancedMC (AMC) and MicroTCA (μTCA)
7) PC/104, EPIC, EBX, ATX, and ITX
8) Computer on Module (COM)
9) Other

Each bus architecture has evolved either from a specific technology or from a company spinoff that became an industry standard. Each architecture generally fulfills specific product requirements, although considerable overlap among many of the different buses has occurred over time. In some cases the bus structures compete head-on with each other. In other applications they are completely independent and do not compete. Some buses are designed for harsh operating environments such as outside plant, military-grade, etc., and others are designed for less stringent indoor applications. Some applications focus on high-speed interconnection while others require only low-speed interconnects. This can have a dramatic impact on how the boards are designed and which bus structures are selected. Lastly, some applications are price sensitive and require bus structures that are made in very high volumes in order to have low prices.

1.2.1.4 Four Functional Categories

The MEC industry revenues can be broken into four functional categories:

1) *SBC (Single-Board Computer) Boards/Modules:* A board or module whose primary function is data or control processing and that incorporates a combination of computing engines and I/O devices

2) *DSP (Digital Signal Processing) Boards/Modules:* A board or module whose primary function is processing a stream of analog signals and converting from analog to digital formats. This could be voice processing, image processing, communication signals, etc. The processor may be a "traditional" DSP or a general-purpose processor used as a signal processor, and now even graphic engines are being used. DSP processing usually involves Fourier waveform analysis.

3) *I/O Boards/Modules:* A board or module whose primary function is its connection to other parts of a system or network (or user interface). Such boards may contain various processors, but the primary function is moving data in and out of the system.

4) *Other:* Any board that does not fit the above categories, including the following:

   - Switchboards/Modules: Switch fabric cards
   - *Other Boards/Modules:* Any board that does not fit into another category, such as memory boards
   - *Chassis/Backplanes:* The physical components, including power supplies, connecting the system's boards and modules
   - *Software:* Software—typically OS or middleware—products sold by the merchant vendors
   - *System Integration:* The value placed by the merchant vendors on the integration of various products sold as a unit

1.2.2 Report Organization

This report is organized into eight chapters and an appendix.

Chapter 1, "Introduction," outlines the scope, organization, and methodology and it defines some common embedded terminology.

Chapter 2, "Executive Summary," highlights all key facts detailed within the main body of the report.

Chapter 3, "Technical Trends," presents the bus architectures and specifications.

Chapter 4, "Industry Structure," presents business issues that are altering the embedded computing market going forward.

Chapter 5, "Industry Analysis and History 2002–2010," analyzes the historical data and trends starting in 2002 and analyzes the industry's results for 2010

Chapter 6, "Industry Analysis and Forecast 2010–2015," analyzes key issues and trends for 2010–2015 by application.

Chapter 7, "Revenue by Bus Architecture, Functions, and Technologies," analyzes key issues and trends for 2010–2015 by technologies, bus architectures, and form factors.

Chapter 8, "Company Profiles," provides profiles of the key merchant companies competing in the merchant embedded computing market.

1.2.3 Methodology

The information presented in this report was gathered from a variety of sources. The primary sources were engineering, marketing, business development, and communications managers in merchant embedded computing companies who were contacted via the Internet, directly, or at trade shows and conferences. These individuals were asked to respond to a survey. In some cases,

the answers to the survey were delivered as written responses. In other cases, the information was conveyed through telephone or personal interviews.

The secondary sources were company literature (such as websites, annual reports, SEC filings, white papers, and press releases) and trade publications. Other secondary sources were materials distributed by companies during industry conferences and trade shows.