



*Set-Top Box Solutions: Helping Customers
Meet the Challenges of Convergence*

Abstract

IBM's semiconductor experience and intellectual property in computers, communications, and consumer electronics uniquely positions it to become a leader in the set-top box industry. IBM Microelectronics' current strategy, based on Core + ASIC methodology, includes plans for offering both standard and custom, highly integrated digital set-top box semiconductor solutions. This set-top box architecture provides a path from today's discrete solution to tomorrow's integrated solution.

Right now, customers can start set-top box development using IBM Microelectronics' existing, proven discrete set-top box semiconductor solutions and can even begin architecting a custom, integrated solution based on our large, expanding set-top box core library.

IBM Microelectronics' current discrete set-top box solution features a trio of high-performance chips. In

addition, IBM Microelectronics has allied with leading operating system and development tool vendors to produce a complete set-top box reference design kit that includes a fully functional set-top box reference board. This kit includes everything your set-top box development team needs to jump-start the development of your IBM-based products. This total set-top box solution can significantly reduce development time, helping manufacturers speed their time to market.

Furthermore, the company's set-top box architecture is flexible, scaleable, and upgradeable. IBM Microelectronics offers you the solution you need today and a roadmap for migrating that solution to the next-generation, integrated set-top box architecture.

The Challenges of Convergence for Set-Top Box Manufacturers

The convergence of consumer products and communications presents a set of challenges to hardware and software engineers who design and manufacture set-top boxes for digital satellite, cable, and wireless (Multi-channel Multi-point Delivery Service, MMDS) applications.

Service providers (Multiple Service Organizations) want advanced applications to capture consumer interest in this highly competitive industry. While application ideas abound—ranging from banking, investing, and shopping over the Internet to entertainment offerings such as telegaming, advanced electronic program guides, and video on demand—nobody knows which services consumers are really willing to pay for.

Nobody knows what applications will make it to mass market, and nobody knows for sure what technology will be required to support those applications. One can reasonably predict what technology will be required, but until these new applications are developed and benchmarked, we cannot be sure of the magnitude of the burden that will be placed on the processor and other elements of the system.

Software development for the set-top box is particularly challenging because nobody knows what applications consumers want. It is difficult to research the market and identify definitive results because the convergence of communications and consumer electronics is so new. Most consumers do not understand what is possible and what can be accomplished through software innovation. Without clear consumer demand, service providers can sometimes only guess what the killer apps might be. As a result, service providers' requirements change as market research provides more, sometimes conflicting, data.

With time-to-market pressures, there is no time to wait for all these issues to be resolved. Software development needs to start now, to give software engineers the opportunity to become familiar with the architecture and to design prototypes for demonstration purposes. It is important for the semiconductor vendor to provide a flexible development environment to service providers, set-top box manufacturers, and software developers so they can tailor their solutions to the current and future demands of their customers.

This business climate means that set-top box manufacturers establish demanding requirements for the architecture upon which they build their products:

Flexibility The architecture must be flexible so that manufacturers can quickly implement changes in response to rapidly evolving demands of service providers in their attempt to meet perceived consumer interest.

Time-to-market As with any new product or service in a highly competitive industry, early availability means improved opportunities both for capturing market share and for developing leading-edge, high-quality products.

Competitive Cost Keeping costs low enough to attract consumers while maintaining profitability depends on reducing the costs of goods, reducing development expense, minimizing rework, and reusing software technology from generation to generation.

High Performance Consumers expect immediate response from remote-control input, higher levels of interactivity, and PC-like graphical user interfaces. The architecture must be able to accommodate these high-performance requirements.

There are a number of key factors set-top box manufacturers should consider when choosing a semiconductor vendor for their next generation, highly integrated digital set-top box solution. It is important that:

- The silicon supplier own the key intellectual property that is the foundation of the set-top box architecture: the processor architecture, and the MPEG technology.
- The vendor has experience with these technologies and can demonstrate working, high-quality set-top box semiconductor solutions today.
- The silicon supplier has industry-leading process technology roadmap to enable the very high integration, low-cost solutions that are required to meet the demands of this industry.
- The vendor's architecture is supported widely by third-party software and tool vendors so that there is truly a total solution.
- The vendor has put in place the resources to make development easier: sample hardware and software solutions, and experienced field and factory technical support.
- The vendor is capable of being a leader and demonstrates a commitment to the industry.

Meeting the Challenges of Convergence

IBM Microelectronics is uniquely qualified to help customers develop products that combine the technologies of networking, computing, communications, and consumer electronics.

IBM Microelectronics offers:

- Technological depth and breadth; significant experience designing and building semiconductor products in each of these converging technologies
- Leadership in advanced semiconductor design and silicon process technology
- PowerPC™ software infrastructure
- System development support
- Growth path for the future
- Complete development system available today

Technological Depth and Breadth

IBM has been an industry leader in the design and manufacture of products in each of the converging technologies: communications, computers, and consumer electronics. IBM has developed a wide range of products in each of these areas over the course of many years, affording the company a vast knowledge base upon which to confront the challenges of convergence. IBM knows computers. IBM knows communications. IBM knows consumer electronics. IBM knows networking. This knowledge can be leveraged by IBM's customers to accelerate their own product development. And IBM's system development support team can help customers design components with the necessary functionality, using standard and customized products.

Leadership in Advanced Semiconductor Design and Process Technology

IBM is the leader in integrating systems. Its track record of successful products proves it has the intellectual property, know-how, capabilities, and resources to unite leading-edge technology, advanced ASIC methodology, and manufacturing.

IBM Microelectronics has developed a complete Core + ASIC program, building on its extensive experience in ASIC development and PowerPC processor cores. This methodology is used for building application-specific semiconductor products (ASSPs) that customers can buy "off-the-shelf" and for designing customer-specific semiconductor products (CSSPs) tailored to a customer's specifications.

The foundation of the Core + ASIC program is a library of functional blocks, or cores, that can be incorporated into customer's ASIC designs and IBM Microelectronics' own standard products. IBM Microelectronics' system building blocks are integrated using proven ASIC methodology. Customers' designs can incorporate industry-standard building blocks and the latest emerging technology.

IBM Microelectronics will work with customers to develop system-on-a-chip solutions required for today's highly integrated products. IBM Microelectronics' ASIC Core design methodology is a proven process for designing right-the-first-time, high-density, power-optimized, high-performance ASIC chips. IBM Microelectronics' vast experience in developing complex system ASICs gives it the expertise to enable the design of highly integrated single-chip solutions.

Through IBM's Core + ASIC program, IBM Microelectronics customers can leverage IBM intellectual property and experience into their products. What does this mean for IBM's customers?

Time-to-market A large and growing core library, coupled with IBM Microelectronics' solid technical experience and industry-leading methodology, creates customized functional products without lengthy development cycles. Because standard cores have already been tested and qualified, customers can have confidence that they will work in the CSSP the first time. Also, since the base architecture is unchanged, customers can reuse much of their software, thereby reducing development time generation after generation.

Competitive costs Integration of multiple functions onto a single chip can decrease total system costs. Core libraries provide a low-cost way for customers to differentiate their products.

Scaleable and flexible solutions

IBM Microelectronics' extensive core library includes many of the key functions required for a set-top box application. Combining these cores with customer-specific logic, and modifying existing cores allows IBM Microelectronics to tailor a solution to best fit the customer's application. In addition, as the set-top box industry evolves, IBM Microelectronics plans to add new features and functions to the core library to meet future needs.

Customers can choose from three design styles:

- Custom Design Team Options: The customer's engineering team can design

and implement a chip integrating ASIC System Building Block core function and the customer's own logic.

- Collaborative Design Team Options: The customer and IBM work together. The customer formulates the initiative; IBM Microelectronics provides as much or as little support as required. For example, the customer may perform some development tasks, and IBM performs others.
- IBM Design Team Options: The customer provides IBM with a design, and IBM Microelectronics' engineering support team implements it using the most appropriate system building blocks. In return, the customer receives a tested ASIC chip, ready for integration into its product.

IBM's ASIC System Building Block program is a full-service solution for customers' design requirements. It includes access to advanced technology, world-class manufacturing facilities, and cost-effective packaging options. IBM Microelectronics' core offerings can support customers' requirements by providing both industry-standard and customized functions. IBM people, technology, and tools help customers minimize risks and time to market.

PowerPC Software Infrastructure

The PowerPC processor, the processor in IBM Microelectronics' set-top box solution, has become an industry standard because of its low-power, scaleable, high-performance 32-bit RISC architecture. The popularity of the PowerPC processor with customers has created the demand needed to drive an extensive portfolio of third-party software and hardware tools that makes the PowerPC processor the processor of choice for set-top box applications.

IBM's position as the owner of the PowerPC architecture and its intellectual property enables it to control its development. This ability to manage architectural changes helps preserve customers' existing software investment, and can enable the reuse of existing code with new releases of PowerPC processors and cores.

System Development Support

IBM Microelectronics provides off-the-shelf set-top box solutions and a corresponding reference design kit. In addition, IBM can assist customers by customizing and modifying products to meet unique requirements. These customized chips, CSSPs, let manufacturers differentiate their products. IBM resources available to help customers in this process include expert engineers, industry-standard design tools, and superior design and test methodology. All this expertise, coupled with the Core + ASIC methodology described earlier, translates to improved time-to-market opportunities for IBM's customers.

There is no question that high-quality technical support is important to the engineering community. Engineers working in fast-paced environments need timely, accurate answers to technical questions and help with technical problems from qualified technical support personnel.

IBM Microelectronics provides hardware and software technical support through application engineers, and design services through regional design centers worldwide.

With its technical expertise and depth, its experience with system platforms in the consumer, communications, and computer markets, and its vast global support network, IBM is uniquely positioned to help manufacturers avoid

roadblocks and solve problems. The IBM name has been synonymous with quality service for decades.

Growth Path for the Future

Product design and manufacturing are resource-intensive activities. Pressures to keep product costs competitive make it critical to reduce infrastructure costs. A manufacturer must continually improve the quality and functionality of its products to satisfy customers' demands and to retain or build market share. How efficiently engineers can develop new products depends on how much they can build on and reuse previous design work.

Engineers also need newer, more powerful tools and materials to save them time. They depend on their suppliers to upgrade their tools and materials to keep pace with their needs. A particular risk for engineers working with leading-edge technology is that the suppliers of their materials, tools, and support services will go out of business or abandon their product area.

IBM Microelectronics intends to be a major player in the set-top box industry, with competitive, high-quality, leading-edge products. IBM Microelectronics is creating standard and custom integrated solutions by building on proven technology, using proven intellectual property.

IBM has already invested significant resources in developing and packaging components for the set-top box industry.

Figure 1 outlines the discrete solutions available today from the company, and its roadmap for the future.

Looking ahead, IBM Microelectronics is giving customers greater flexibility to choose the building blocks they need with Core + ASIC solutions. The next-generation products will be single-chip solutions. IBM's PowerPC processors,

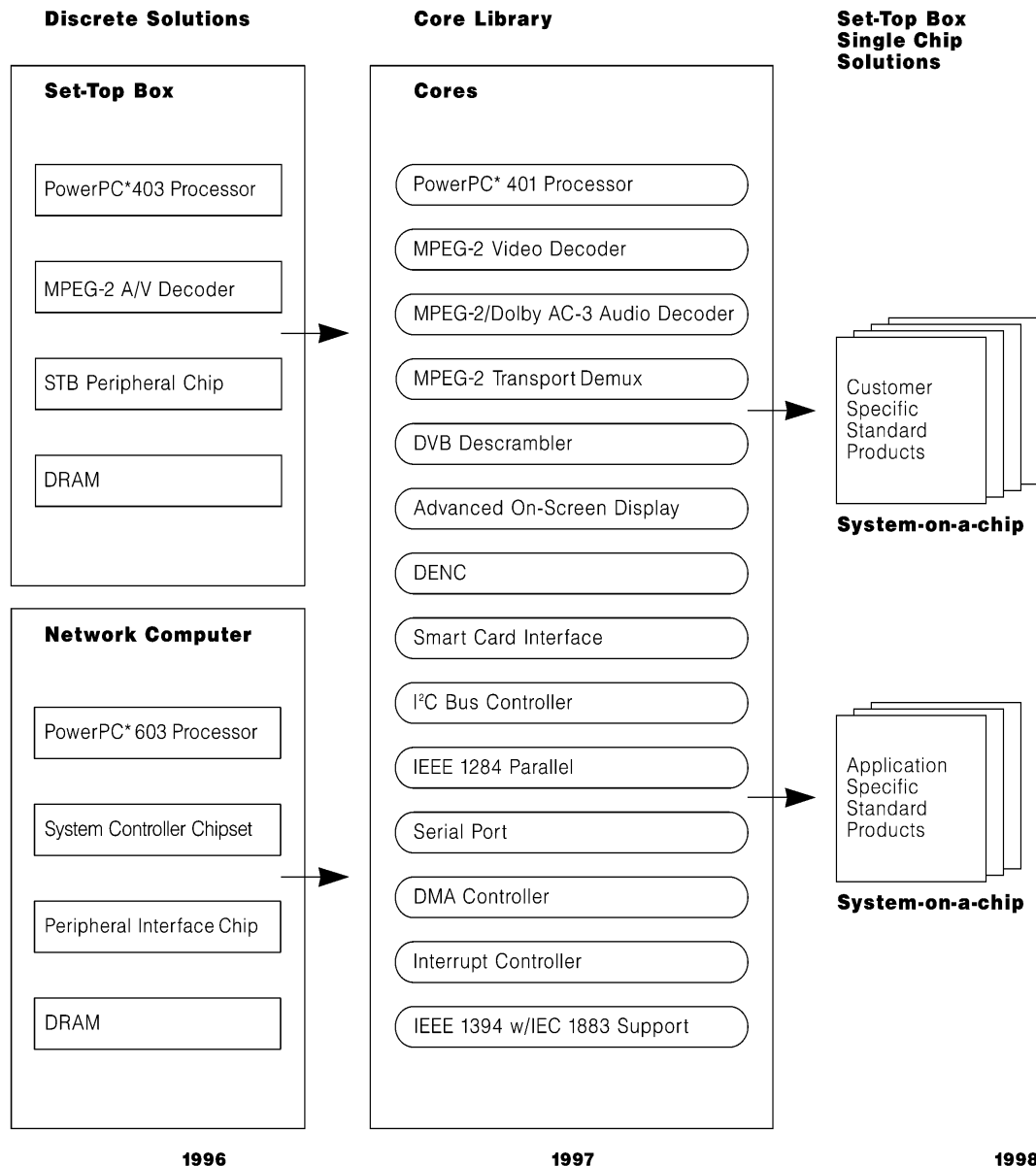


Figure 1: Set-Top Box Roadmap

MPEG-2 audio/video decoders, and Set-Top Box Peripheral Chip are the cornerstones of its core library. Our growing set-top box core library and our set-top box architecture provide the foundation for highly integrated, cost-effective set-top box solutions.

Complete Development System Available Today

To assist manufacturers to get started with

IBM set-top box technology, IBM Microelectronics offers a scaleable and upgradeable Set-Top Box Reference Design Kit, including sets of integrated chips, a choice of software development environments, and a collection of design tools, along with comprehensive technical support and service.

The reference design kit incorporates a hardware reference design and software tools into a fully functional prototype set-

top box that manufacturers can use and modify to move quickly to market.

Additionally, with an extensive and growing core library, IBM Microelectronics is ready to build CSSPs to meet customers' unique requirements. Together with IBM, set-top box manufacturers can start developing a custom silicon solution today, and concurrently develop software for the custom solution using the development environment that is available now.

Reference Design Kit Overview

The following sections describe the digital Set-top Box Reference Design Kit available today from IBM Microelectronics. This package includes a hardware reference board, schematics, real-time operating systems, and software development tools—a complete hardware and software development environment to speed your products to market.

Chipset Overview

The board design, shown in Figure 2, is based on a set of three chips that provide the basis for building a set-top box system.

PowerPC 403 Processor

The PowerPC 403 processor is a powerful embedded 32-bit RISC processor with integrated peripherals for excellent system price/performance. The PowerPC processor is a high-performance, competitively priced, scalable chip using proven technology.

There are currently four versions of the PowerPC 403 processor: 403GA, 403GB, 403GC, and 403GCX. The PowerPC 403GB processor, when used with the IBM Set-Top Box Peripheral Chip, provides the most cost-effective, complete solution for most set-top box applications. The PowerPC 403GA processor adds a serial port and two additional DRAM and DMA channels to the PowerPC 403GB processor. The PowerPC 403GC processor is pin- and feature-compatible with the PowerPC 403GA processor, but also includes an MMU. The PowerPC 403GCX processor is pin- and feature-compatible with the PowerPC 403GC processor, but is a clock-doubled version with 8 times larger instruction and data caches.

Wide adoption has made the PowerPC processor an industry-standard platform

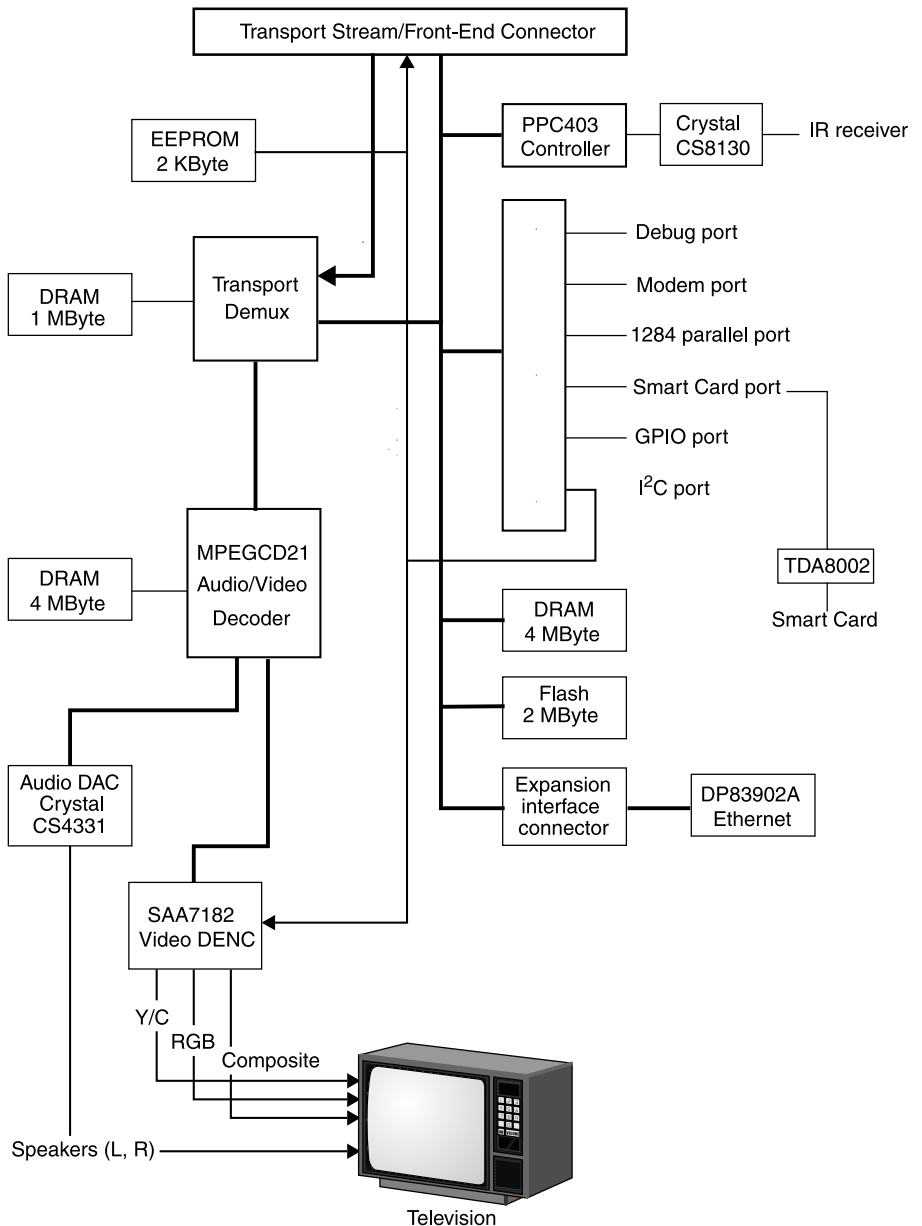


Figure 2. Set-Top Box Reference Board Block Diagram

upon which numerous third-party developers have created software and hardware tools, giving the customer a broad portfolio of options.

CD20/CD21 MPEG-2 Audio/Video Decoders

The MPEG-2 audio/video decoders provides a broad range of functionality and exceptionally high-quality video using industry-leading technology. In fact, IBM's MPEG-2 audio/video decoders lead the industry in picture quality, error handling, and features. (As a developer of MPEG-2 digital video encoders, IBM Microelectronics has extraordinary expertise and depth in this technology.)

In addition to decoding the MPEG stream, the CD20/CD21 MPEG-2 decoders control the On Screen Display (OSD) functions.

The CD20/CD21 MPEG-2 decoder operates independently of processor intervention, freeing the high-performance PowerPC processor for other chores, such as speedy handling of user interactions.

The CD20 MPEG-2 audio/video decoder is targeted for consumer set-top box applications. For professional set-top box applications, IBM Microelectronics offers the higher performance CD21 MPEG-2 audio/video decoder, which supports full 4:2:2 decode.

Set-Top Box Peripheral Chip

A significant number of the I/O functions required for a typical set-top box have been integrated into a single peripheral chip. This not only minimizes design time, but also saves cost, power, and board real estate.

The peripheral chip provides two serial ports, a smart card interface, an IEEE bi-directional parallel port, general-purpose

I/O (GPIO), three Pulse Width Modulation channels, an I²C serial bus controller, an SCP bus controller, and two DMA channels.

Reference Board Overview

The reference board provides a modular set-top box development platform with the IBM PowerPC 403 processor, IBM CD20/21 MPEG-2 decoder, IBM Set-Top Box Peripheral Chip, VLSI transport demultiplexer, and a back-end video display subsystem. This development board also includes a front-end expansion connector to support the connection of a Network Interface Unit (NIU) and conditional access module. Alternatively, a streamer module can be connected to the front-end expansion connector. Another expansion port allows the connection of additional modules, such as an ETHERNET* expansion card for use during software development and debugging.

The reference board is a complete set-top box design, configured as a stand-alone, desktop mounted board with daughter card connectors for peripheral expansion. The purpose of the reference design is to give manufacturers a head start in building set-top boxes.

The reference board accepts, decodes, and displays MPEG-2 audio and video transport streams brought in through the front-end connector. A bitstream-generator product (optional) can be connected to the front-end connector to feed MPEG-2 transport streams for testing purposes. Other transport stream sources can be connected to the board through the front-end connector. The customer can connect a QPSK daughter card to capture DVB test streams from satellite service providers such as Canal+, Alphastar, EchoStar, BSkyB, and PerfecTV. A QAM demodulator module can be connected to work with streams from cable TV delivery networks. Custom front-end boards can be de-

signed by customers for conditional access and other functionality.

The reference board includes DRAM and Flash memory, serial and parallel ports, an infrared receiver, a smart card interface socket, a transport stream front-end unit connector, and a peripheral expansion connector. Also included are standard connectors for analog video and audio output and a VCXO for system clock recovery.

Schematic diagrams and source code for sample applications and boot code are included. Also available, though not included in the base reference design, is a transport stream generator.

Software Development Environment Overview

Set-top box manufacturers can differentiate their products from competitors' products through high-quality software, including creative, powerful applications and well-designed user interfaces.

Applications include electronic mail, Internet connections, Web browsing, advanced graphics, shopping (catalogs, merchant web pages, online malls), entertainment (electronic program guides, digital audio/video, video-on-demand and near-video-on-demand), games (telegaming, accelerated graphics), sports, and finance (banking, bill paying, stock and mutual fund trades).

Through strategic relationships with third-party software suppliers, IBM Microelectronics plans to make available two software development environments to provide a software solution that complements the IBM Microelectronics set-top box hardware reference board. These development environments are based on the pSOS** real-time operating system (RTOS) from Integrated Systems Inc. and OS/9000** RTOS from Microware. Also included are the corresponding tools

appropriate for the operating system. The Diab Data** compiler and SDS** debugger are provided for pSOS development. The Fas Trak compiler and debugger are provided for OS/9000 development.

Software engineers can use the development tools shipped with the reference design kit to create demonstration software, using live feeds and highlighting OSD functions and user interfaces, for applications such as electronic program guides, pay-per-view, and video on demand. An application developer can develop and run an application and display it on a television. With the introduction of the pSOS and OS/9000 environments, applications can be developed quickly.

In addition to the operating systems and tools, the development environment will also include the necessary device drivers and boot code for the various components on the board, with device driver support for the CD20/CD21 MPEG-2 decoder, VLSI transport demultiplexer, and Set-Top Box Peripheral Chip.

Other features include software examples (for controlling OSD functions, infrared remote controls, and program selection) and sample streams (video clips for use in testing and demonstrating applications).

Support Overview

IBM Microelectronics can work with manufacturers to customize and modify products to meet unique requirements.

Hardware and software design services are provided through design centers around the world. Experienced application engineers provide hardware and software technical support worldwide.

Set-Top Box Reference Design Kit Specifications

Features of the Reference Design Kit

Hardware

- IBM PowerPC 403GC processor
- IBM Set-Top Box Peripheral Chip
- IBM CD20/CD21 MPEG-2 audio/video decoder
- 4 MB system DRAM memory SIMM (can be upgraded for more memory)
- 4 MB video DRAM memory
- 2 MB boot-block Flash memory
- 2 KB serial EEPROM
- VLSI VES 2020 transport chip (no DVB descrambler); if desired, a VLSI VES 2030 (with DVB descrambler) can be installed
- Philips SAA7182 Video DENC providing NTSC, PAL, or SECAM composite video or S-Video output (RGB provided via a SCART connector)
- Crystal CS4331 Audio Digital to Analog Converter (DAC), providing stereo audio output to RCA phone jacks
- 27 MHz VCXO for system clock recovery
- Power supply

Interfaces

- Smart card interface socket (connects from the Set-Top Box Peripheral Chip to external TD8002 chip and then smart card connector)
- 2 RS232 serial ports, 1 with modem control support
- IEEE 1284 parallel port for connection to external PC or printer
- Infrared receiver (using Crystal 8130) with standard controller unit; uses second RS232 port on Set-Top Box Peripheral Chip
- Analog video and audio output on standard connectors
- Transport stream front-end module connector, supporting a range of data input and conditional access mechanisms
- Peripheral expansion module socket (The included expansion card supports ETHERNET connectivity with 10baseT and 10base2 connectors. The card also supports a 9-button keyboard for user input testing.)
- Development system connectors for RISCWatch and RISCTrace

Software

- Real-time operating system: pSOS from Integrated Systems or OS/9000 from Microware
- Compiler (Diab Data for use with pSOS; Fas Trak for use with OS/9000)
- Debugger (SDS for use with pSOS; Fas Trak for use with OS/9000)

Design Tools, Collateral, Resources

- Transport stream generator available (not provided with base reference design)
- Schematic diagrams
- Source code for device drivers and sample applications
- Sample software for OSD functions, IR remote control, and program selection
- Demo support through streamer station and demo streams

MPEG-2 Decoder Specifications

The CD20/CD21 MPEG-2 audio/video decoder decodes the MPEG stream and controls the On Screen Display and OSD functions. The CD20 typically requires 2 MB of DRAM in a set-top box application.

Features of the CD20/CD21 MPEG-2 Decoder

- Video Decoder — ISO/IEC 13818-2 Main Profile at Main Level (MP@ML)
 - Audio Decoder — ISO/IEC 13818-3 MPEG-1 and MPEG-2 Layers I & II, as well as PCM
 - Supports European DVB standard
 - PES layer decoding for both audio and video to extract the PTS
 - MPEG-2 MP@ML compliance with 2 MB DRAM. Only 2 MB of DRAM are needed to decode full ITU-R BT601 (formerly CCIR601) resolution NTSC and PAL encoded MPEG-2 bit streams with sustained data rates up to 15 Mb/s
 - Audio Ancillary Data and Video User Data handling through DRAM access from host
 - Horizontal and Vertical filters deliver high quality video. Pan and scan supported in 1/16 pel accuracy
 - An enhanced version of CD20 will support an SDRAM interface, 8 bpp color resolution, and 16:9 letterbox format
 - The supported input image sizes for the automatic expansion are as follows:
- | NTSC 4:3 | PAL 4:3 | NTSC 16:9 P&S | PAL 16:9 P&S |
|-----------|-----------|---------------|--------------|
| 352 x 240 | 352 x 288 | 720 x 480 | 720 x 576 |
| 352 x 480 | 352 x 576 | 544 x 480 | 544 x 576 |
| 480 x 480 | 480 x 576 | 480 x 480 | 480 x 576 |
| 544 x 480 | 544 x 480 | 352 x 240 | 352 x 288 |
| | | 352 x 480 | 352 x 576 |
- Advanced, flexible On-Screen Display (OSD)
 - Animation graphics
 - Vertical scrolling
 - Programmable OSD size
 - Multiple regions
 - Overlay and video blending
 - Video shading in OSD area
 - Programmable bitmap resolution
 - 2 bits/pixel pair
 - 2 bits/pixel
 - 4 bits/pixel
 - Input interface flexibility
 - 8-bit or 16-bit audio/video compressed data and host data interface
 - 8-bit with acknowledge for easy connection to transport chip
 - Serial audio compressed data for transport chip connection
 - Serial video compressed data input with simultaneous host data interface
 - Output interface flexibility (programmable controls)
 - Composite blanking and Field ID signals
 - V sync and H sync signals
 - V ref and H ref signals
 - Programmable signal polarity
 - Flexible interface to DRAM
 - 1 MB DRAM, 32-bit interface for MPEG-1 and some MPEG-2 streams
 - 2 MB DRAM, 64-bit interface for MPEG-2, NTSC, PAL up to 15 Mb/s
 - 4 MB DRAM addressing capability for extended applications
 - Sophisticated error concealment including transport error support
 - 3:2 pull-down support
 - VBI support (including special teletext mode)
 - Support for multiplexing of external video with OSD
 - Built-in PLL to provide the audio clocks for audio and video synchronization
 - Common 16-bit serial audio output interfaces to support most DAC interfaces
 - Audio tone generation
 - Audio attenuation and de-emphasis controls
 - Single clock (27 MHz) input

PowerPC System Processor Specifications

The system processor is IBM's PowerPC 403GC 32-bit RISC processor. The processor handles system initialization, diagnostics, and application program functions. Processor intervention is not required for decoding and synchronizing the audio and video. The CD20/CD21 MPEG-2 decoder handles decoding and synchronization independently of the processor, leaving the processor fully available for applications, graphics assistance, handling user input, and control of MPEG Video User Data and Audio Ancillary Data. Processor memory requirements for a typical set-top box application would be 1 MB of DRAM and 512K of Flash. The reference design includes 4 MB of DRAM and 2 MB of Flash to provide more flexibility in evaluation and development environments.

Features of the 403GC System Processor

- 34 KDrystone MIPS @ 27 MHz
- 4-channel DRAM controller
- 4-channel MMIO controller
- 4-channel DMA controller
- Non-multiplexed address and data buses
- 32-bit, 16-bit, 8-bit data bus operation
- 2K I cache, 1K D cache
- 5 interrupts
- 1 critical interrupt
- Serial port

Set-Top Box Peripheral Chip Specifications

A complete set-top box requires a number of peripheral functions. These functions have been consolidated into an IBM ASIC. There is a serial port for back channel modem data, a smart card interface used in descrambling and transaction processing, an IEEE 1284 bi-directional parallel port for high-speed communications and printing, general-purpose I/O for indicators and front panel controls, Pulse Width Modulation channels for IR control, and an I²C bus controller. The Set-Top Box Peripheral Chip is tightly coupled to the PowerPC 403 processor, and all peripherals are controlled by the system processor.

Features of the Set-Top Box Peripheral Chip

- System bus interface for the 403Gx processor
- 2 DMA channels
- 2 serial ports, 16550 compatible
- Smart card interface
- 3 Pulse Width Modulation channels
- IEEE 1284 parallel port
- I²C serial bus
- SCP serial bus
- 24 general-purpose I/O
 - Input, output, bi-directional
 - Can be configured for interrupt generation



Summary

IBM Microelectronics provides a total solution for set-top box design that engineers can implement today. Due to the flexibility and scalability of the IBM Microelectronics set-top box architecture, engineers can design solutions now and build on that investment for next-generation products. Using the IBM set-top box architecture and leveraging IBM's experience, manufacturers can be positioned to meet the challenges in the evolution of the set-top box and convergence of computer, communications, and consumer products.

Product Availability

For more information about the IBM Microelectronics digital set-top box products, visit our Web Site at <http://www.chips.ibm.com> or contact your IBM Microelectronics sales representative.

© International Business Machines Corporation 1997
Printed in the United States of America
3-97

All Rights Reserved

* Indicates a trademark or registered trademark of the International Business Machines Corporation.

** All other products and company names are trademarks or registered trademarks of their respective holders.

The information contained in this document is subject to change without notice. The products described in this document are NOT intended for use in implantation or other life support applications where malfunction may result in injury or death to persons.

The information contained in this document does not affect or change IBM's product specifications or warranties. Nothing in this document shall operate as an express or implied license or indemnity under the intellectual property rights of IBM or third parties. All the information contained in this document was obtained in specific environments, and is presented as an illustration. The results obtained in other operating environments may vary.

THE INFORMATION CONTAINED IN THIS DOCUMENT IS PROVIDED ON AN "AS IS" BASIS.

In no event will IBM be liable for any damages arising directly or indirectly from any use of the information contained in this document.

IBM Microelectronics Division
1580 Route 52, Bldg. 504
Hopewell Junction, NY
12533-6531

The IBM home page can be found at:
<http://www.ibm.com>

The IBM Microelectronics Division home page can be found at:
<http://www.chips.ibm.com>

Fax Service 415-855-4121
Fax Document # 80013



G522-0302-00