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## The set-top tightrope trauma

By Robert Poe, illustration by Dave Cutler -- 9/1/2003

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It's decision time all over again for makers of chips for set-top boxes (STBs), which serve as the junction between cable or satellite television networks and TV sets. Over the past few years, the industry, which dates back to the mid-1990s, reached a significant milestone: Putting all the functions of STBs on a single chip became commercially and technically viable.

That set the stage for a market takeoff, with prices coming down and volumes rising. It also laid the groundwork for an explosion of possible new uses for such chips and boxes, particularly with the growth of high-definition television (HDTV), an explosion that may launch a second cycle of integration. It would mean a great opportunity for chip suppliers but also a whole set of decisions.

At least prices are down and volume is climbing. But a cloudy economic climate has dampened prospects for the innovative and lucrative new services TV operators expected to sell and thus for the boxes that would provide them.

"There were a lot of plans to go into high-end set-top boxes," says Christine Arrington, principal analyst at Acacia Research. "Then the bottom fell out of the market. Operators said, 'We need the cheapest equipment possible. We're not going to invest in high-end boxes, because we can't get customers to pay for them.'"

That means that ultimately the biggest decision facing chip suppliers might be whether to attempt stage 2 at all.

### Growth and integration

At its most basic, a set-top box needs integrated circuits to do things such as demodulate the signal coming from the satellite or coaxial cable, decode the resulting digital video stream from its MPEG format, and put the resulting data into a format that can appear on a TV screen.

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It also has to provide a user interface, such as a graphical on-screen program guide. Although it's possible to do this by adding a microcontroller to one of the data-handling chips, adding or "embedding" powerful general-purpose processors makes it easier to enhance both the user interface and the overall capabilities of the set-top box, simply by adding or modifying software.

Many of the suppliers of set-top box ICs started as vendors of the data-handling chips. Thus, when they added processors to their offerings, they turned to existing designs—especially those provided by **MIPS Technologies Inc.**, Mountain View, CA—instead of developing their own versions from scratch.

Integrating—that is, putting more functions on fewer chips, and eventually all of them on one chip—is both a cause and an effect of market growth. Manufactured in sufficient volume, a single chip is cheaper to produce than a set. It also uses less power and takes up less space, which are always advantages, although less so in set-top boxes than in, say, portable electronic devices. All of this helps customers—in this case, the manufacturers of the set-top boxes—lower their prices and raise volume, thus helping expand the market.

But it also takes a growing market to justify integration in the first place. Designing an integrated chip "has a hugely heavy up-front cost," says Brian Sprague, director of marketing for STB products at chip maker **Broadcom Corp.**, Irvine, CA. The chip manufacturer can only make that cost back if sales volumes are high.

In addition, both the market requirements and the standards have to remain stable long enough for manufacturers to reach profitable production volumes before design revamps become necessary. "If things are in a state of flux, you can't have everything integrated," notes Sprague.

Over the past couple of years, the market has grown integration-friendly. Global sales of embedded processors used in cable and satellite set-top boxes totaled 18.6 million units last year, according to Ken Furer, an analyst with IDC. Acacia Research has a more optimistic figure of 27.2 million, up from 14.9 million in 2000 and 20.4 million in 2001.



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The dollar size of the market is hard to pin down, because so many processors are integrated with other circuits on chips and also because much of the cost goes to pay for intellectual property licensed from others, says Furer. Some analysts, however, say that the overall selling price of processors can be from \$25 to \$50 or more. That would make for a current market in a range of at least half a billion dollars.

And it's getting bigger. The global market for embedded STB chips will rise to 50 million in 2006, according to IDC numbers. That would represent sales as high as a billion dollars. Sales of digital satellite STBs alone will reach 32.6 million units in 2006, according to In-Stat/MDR (a division of *EB's* parent).

The impact of the trend is clear. "Three years ago, we weren't integrating everything on the chip," says Sprague of Broadcom. It is now, though: "The market is clearly taking off, and clearly cost is king."

That, however, imposes its own burdens. "People have gotten burned in this market," says Thomas Riordan, microprocessor products division vice president and general manager at **PMC-Sierra Inc.**, Santa Clara, CA. "When cost is the only thing that's important, you had better be doing enormous volume. You need to win everything." PMC-Sierra offers a MIPS-based stand-alone, rather than integrated, processor that set-top box makers can pair with chips that are more application-specific, as a high-end entry in the market.

#### **A plethora of possibilities**

Given the current climate, a growing market for basic equipment and services doesn't guarantee demand for fancier ones. So while Broadcom is charging full speed ahead from the low end, as is PMC-Sierra from the high end, others are dealing with rampant uncertainty.

For example, two companies cited as prominent STB chip makers—**LSI Logic Corp.**, Milpitas, CA, and **Integrated Device Technology Inc.** (IDT), Santa Clara, CA—say they are concentrating their efforts in the digital-TV realm on areas other than STB chips—LSI on DVD recording and playback, and IDT on broadband residential gateways. And **IBM Corp.**, Armonk, NY, isn't faring well even in current conditions: According to Acacia's Arrington, its already small market share has been decreasing.

That's not to say there will be no demand for more-advanced features. But implementing those features and selling them will involve even tougher decisions than would be the case in a sunnier market.

One promising area is the combination of function and service known as personal video recording, or PVR. At its simplest, it allows users to record 60 or more hours of TV programming on a hard disk, for replay later. More-sophisticated versions can access a centralized information service and guide to make recording and playback easier and better informed.

Although commercial services such as TiVo, offered by **TiVo Inc.**, Alviso, CA, and ReplayTV, from **Digital Networks North America Inc.**, Santa Clara, CA, can provide such capabilities through their own boxes, the trend is toward convergence of digital TV services and PVR, according to Jim Nguyen, senior manager of the market development group at MIPS. That means, for example, set-top boxes that can record programs via the service providers' on-screen guide.

"We're now seeing the incorporation of hard drives into cable and satellite set-top boxes to provide PVR functionality," says Greg Ireland, a research analyst at IDC. "Those are gaining momentum just this year." DirecTV,

for one, already offers the option of TiVo-based recording and playback capability with its satellite service.

Another promising area is cable modems, which provide high-speed Internet access over TV cable, using DOCSIS (data over cable service interface specification) modem circuitry. In addition, "Some manufacturers want to integrate video games into the same boxes," says Jim Turley, chief analyst at market research firm Silicon-Insider, Pacific Grove, CA. "Maybe you can also hook them up to the Internet and play Internet games or hook them up to the computer and play MP3 files."

Still another possibility is interactive TV, which will rely on middleware such as that from companies including **Liberate Inc.**, San Carlos, CA, and San Francisco-based **OpenTV Corp.** The middleware allows software vendors to write applications providing services such as pay-per-view TV or on-demand video. More complex possibilities include customized weather reports and travel guides, online shopping and viewer participation in TV game shows.

But the mother of all future blockbusters is high-definition television (HDTV), a market that looks poised for takeoff. "A couple of years ago, we sold a couple of thousand" sets of chips for HDTV applications, says Broadcom's Sprague. "Now it's tens of thousands, and next year it'll be hundreds of thousands. That's an order of magnitude a year."

But for HDTV to reach cruising altitude, service providers have to spend lots of money on high-definition equipment and programming and consumers have to buy a lot of equipment capable of receiving it. "It's a classic chicken-and-egg problem," says Turley. "The standards are pretty well pinned down, so now it's just a stare-down between service providers and consumers."

### Complex decisions

All these potential features present chip suppliers with decisions as complex as those that got them to this point—and which the tight market will only make trickier. Many of these decisions revolve around integration and processing power.

For example, demand for personal video recording is already high enough that Broadcom is integrating the capability for it into some of its STB chips. It's doing the same for cable modems, providing single-chip set-top box products with both DOCSIS-modem and PVR circuits.

On the other hand, although it seems clear that HDTV will eventually become a huge market, it's far from becoming a standard feature in set-top boxes, much less integrated on STB chips. And that won't happen quickly or easily, even though the standards are fairly firm. Because high-definition video can involve four to six times as much bandwidth as standard television, it requires circuits that are far more powerful. So great is the necessary performance leap that "a majority of chip companies have to start from scratch" to create such chips, says Nguyen of MIPS.

The cost of the effort is already apparent. Notes Dan Takise, senior marketing manager, digital consumer segment, at **NEC Electronics Inc.**, Santa Clara, CA, pressure from service providers has been driving down the cost of set-top boxes and the chips in them, but the increasing emphasis on high-definition technology has reversed the trend, sending average prices back up again.



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Even when both market demand and standards seem solid, fast-changing customer preferences can complicate matters. For example, Broadcom, which built support for USB 1.1, the widely used standard for computer and other peripheral devices, into its integrated chips a couple of years ago, has modified its products to handle the newer USB 2.0 version, due to customer pressure, says Sprague.

It's also too early to predict demand for playing video games or MP3 files through set-top boxes. These possibilities raise even more complicated technical questions. For example, running games would require significant 3-D graphics capability, notes Broadcom's Sprague, meaning extremely powerful graphics circuitry and also perhaps a processor with a floating-point unit.

On the other hand, the ability to play MP3 music files on TV equipment, perhaps transmitted from the computer over some sort of wireless home network, turns out to be relatively easy to handle in software on the embedded processor, according to Turley.

That wouldn't require any additional circuitry on the chip for the set-top box but would require a processor with enough power to handle the new task besides basic functions such as providing the user interface. And in fact, having plenty of processor power turns out to be important for a variety of other reasons.

One reason is that even if standards are solid, implementing functions entirely in hardware may not be the best approach. For example, hard-wired circuits are best for processing-intensive, well-standardized tasks such as basic demodulation and decoding of video streams, which require maximum speed and are unlikely to change often. But additional processing in areas such as synchronizing video and audio streams can vastly improve the quality perceived by the viewer, according to Broadcom's Sprague. And that is often done best in software.

Another reason is that many of the most interesting functions and services of the future will be software-based. This is particularly true of features that require flexibility, interactivity and customization. These include on-screen program guides and other user interface elements, which are a TV service provider's best means of differentiating itself from competitors.

In addition, you can often implement functions in software when you're not sure if demand for them will make hard-wiring them into chips worth the risk and expense. Upgrading through software is attractive, because it often involves simply downloading new software through the network.

### **Avoiding the truck roll**

Such downloading lets service providers avoid the dreaded "truck roll"—having to send someone out to upgrade or replace the customer's set-top box. "It cuts into service providers' bottom line to have to roll trucks," says Tony Massimini, an analyst with Semico Research. "They want to have enough performance on the box to continue to upgrade services remotely."

The ability to introduce new features through software is particularly crucial in that the most significant future application for set-top boxes will be what Broadcom's Sprague calls the TBD—"to be determined"—application. No one knows what it will be, but everyone wants to be ready for it. And only programmable embedded processors make that possible. The emphasis on processing power has reached the point where "some customers have specified how many CPU cycles have to be left after all functions of the set-top box have been handled," says Sprague.

Adding up the requirements, the chip makers' job description starts sounding like an impossible balancing act. "The challenge is to come up with chips that are versatile enough, having the right mix of features in hardware and software, hitting the right price points and having the highest-level performance," says Mike Gittings, marketing director for digital TV products at **ATI Technologies Inc.**, Markham, ON, Canada.

In the end, though, the most-profound effects on chip suppliers' fortunes result from matters far beyond their control. For example, the U.S. Federal Communications Commission has mandated that by 2006 all televisions sold in the United States must be capable of receiving digital signals. That means that some or all of the functions of set-top boxes will migrate into television sets.

And it will mean good news to some. "To us it just looks like an expansion of the customer base," says F. Matthew Rhodes, president of **Conexant Systems Inc.**, Newport Beach, CA. For others, it will mean losing some of the security of exclusive long-standing relationships with makers of set-top boxes.

In the end, though, chip suppliers' lack of control is a structural fact of life. "The demand comes from the service operator, but chip makers can try to sell only to box makers," says Acacia's Arrington. That means that although the chip suppliers can come up with all kinds of fancy features, it may be wasted energy. "If they can't convince box makers to buy and the service providers aren't demanding it," she says, "there's nothing they can do when a box maker comes back and says, 'All I want is a low-end chip.'"

And that means the chip suppliers have to make an over-the-top effort to be as flexible as possible.

**Will the set-top box market ever settle down? Share your thoughts in e-mail to [feedback@eb.reedbusiness.com](mailto:feedback@eb.reedbusiness.com).**

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#### TOP 2002 SUPPLIERS OF DIGITAL SET-TOP BOXES

Vendor	2002 sales	Market share	Market share of top 7
STMicroelectronics NV	1,308,100	4.81%	32.8%
Broadcom Corp.	1,073,400	3.94%	27.0%
Koninklijke Philips Electronics NV	981,750	3.61%	24.7%
IBM Corp.	271,000	1.00%	6.8%
LSI Logic Corp.	243,250	0.89%	6.1%
Intel Corp.	97,000	0.36%	2.4%
National Semiconductor Corp.*	7,700	0.03%	0.2%
Top 5 total	3,982,200	14.63%	
Other** total	23,237,700	85.37%	
Grand total	27,219,900	100.00%	

\* AMD acquired National's "information appliance" business unit in August 2003.

\*\*Other includes data STB vendors reported as unbranded. May include shipments from top listed vendors.

SOURCE: ACACIA STATVIEW DIGITAL SET TOP BOX DATABASE

#### TOP 2002 VENDORS OF DIGITAL SET-TOP BOXES

<b>Vendor</b>	<b>Unit sales</b>	<b>Market share</b>
Motorola Inc.	5,354,000	19.67%
Thomson/RCA	4,520,000	16.61%
Scientific-Atlanta Inc.	3,093,500	11.36%
Hughes Network Systems	2,618,000	9.62%
Pace	1,557,400	5.72%
Top 5 Total	17,142,900	62.98%
Other Total	10,077,000	37.02%
Grand Total	27,219,900	100.00%

SOURCE: ACACIA STATVIEW DIGITAL SET TOP BOX DATABASE

#### U-R-Linked

[www.broadcom.com](http://www.broadcom.com)

Broadcom Corp.

[www.ati.com](http://www.ati.com)

ATI Technologies Inc.

[www.mips.com](http://www.mips.com)

MIPS Technologies Inc.

[www.conexant.com](http://www.conexant.com)

Conexant Systems Inc.

[www.ibm.com](http://www.ibm.com)

IBM Corp.

[www.directv.com/dtvapp/aboutus/landing.jsp](http://www.directv.com/dtvapp/aboutus/landing.jsp)

DirecTV Inc.

<http://www.tivo.com/5.0.asp>

TiVo Inc.

<http://www.liberate.com>

Liberate Inc.

<http://www.opentv.com/company>

OpenTV Corp.

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