

SET-TOP BOX WARS THE BATTLE FOR THE INFOBAHN IS ABOUT TO START -- RIGHT IN YOUR LIVING ROOM

The household device that receives and decodes digital data could decide who wins control of the information highway.

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(FORTUNE Magazine) – WHICH TERM you choose to use, whether the electronic superhighway, the infobahn, or the national information infrastructure, may reveal whether you're an interested spectator, a cognoscente, or a policy wonk. No matter what you call it, the words, not to mention the hype, all converge on the same phenomenon -- the muscular network of wires and switches that will carry masses of movies, phone calls, electronic shopping catalogues, and computer files from place to place. Now the focus of the discussion is changing.

Companies that want to be players on the infobahn are awakening to the critical importance of what might be called the endgame: the devices that will be on the network's receiving end, making sense of the waves of digital data pouring into our living rooms and dens. Giving a hint of the struggles to come, high-tech companies are scrambling to make powerful new set-top boxes for cable TV systems. They include not only the established boxmakers, General Instrument and Scientific-Atlanta, but also computer makers such as Hewlett-Packard, Digital Equipment, and Silicon Graphics.

Such activity is a sure sign that cable and phone companies, separately or together, will indeed lurch ahead and build their futuristic networks. But it is far too early to declare the set-top box the winner of the race to become the endgame device. Other contenders include personal computers, digital TVs, and even communication controllers that will attach to the side of your house like a gas meter. The winning devices might turn out to be brawny enough to process material for every video screen and telephone in the house -- what some in the industry call an information furnace -- or they might be replicated atop every TV set and inside each PC. They might be owned by the cable TV operators or phone companies -- or, like CD players and cellular phones, by consumers.

Executives at phone and cable TV companies are realizing, with increasing anxiety, that a wrong bet on the endgame today may mean a fortune lost tomorrow. The endgame isn't solely a question of technology. It's also about predicting the "killer app" -- the service or experience that customers will be eager to pay for on the information highway -- and whether people will prefer to get it from a TV, a computer, or some hybrid that hasn't yet been invented. In this high-stakes poker game, everyone has reason to sweat.

The network builders worry that the gadget they use to decipher signals in people's homes may not be right for bringing consumers the services they want. Hardware companies fear that they may aim their devices at customers who will prove uninterested in the data highway -- TV watchers instead of PC users, say. Consumers face the risk of paying for gear that may end up in a technological backwater, the Betamax of the 21st century.

Heaping confusion upon uncertainty, companies must place their bets while the technology is changing at breakneck speed. But those that want a place at the infobahn table have to ante up now. The price for inaction, or even caution, may mean missing out entirely. Hewlett-Packard, for example, is a computer maker, but Richard Watts, H-P's general manager of personal information products, is focusing on set-top boxes because that's where the action is today. "We want to build something as fast as we can," he says. "We'll evolve with the market. But if we don't do

something now, we won't get invited." The one certainty about the endgame device is that someone will have to create it.

The information network can't function without a receiver in the house capable of understanding the ones and zeros of computer language. When traffic from the highway crosses your threshold, it will exist in a form that today's electronic devices can't use yet -- not even computers.

Communication companies will encrypt their signals to ensure that unauthorized users can't tap into the network. They will also compress the signals like so much electronic orange juice concentrate, squeezing out extraneous data to make transmission speedier. For example, if a section of the video screen remains solid blue through an entire shot in a movie, the digital bits that describe that section only need to be transmitted once.

The endgame gadget must know how to decompress the signal and how to display the blue throughout the shot. The players that seem most likely to build the highway -- cable TV and phone companies -- have had the first say in shaping the endgame. However much they may sound alike when rhapsodizing about digital networks, each comes with its own perspective and institutional prejudices.

Cable TV companies, for example, are wedded to the set-top box. They believe that if they continue to own this piece of equipment, they'll continue to own the customer. At a recent multimedia conference in Los Angeles, cable TV operators were talking about how many channels the information highway will have. But adding channels is the old way of improving systems -- not very infobahnlike at all. Neither is the typical cable system traffic pattern, in which information travels in only one direction, from the company to the consumer. Set-top box makers worry about this tendency to cling to old ways. They recognize that the Federal Communications Commission is not likely to allow cable companies to own every customer's set-top box indefinitely, just as over 25 years ago it decided AT&T didn't need to own all the telephones.

Indeed, so eager are the boxmakers to associate themselves with the digital future, not the cable TV past, that they are touchy about what the devices are called.

General Instrument CEO Daniel F. Akerson says: "You do a great disservice to the piece of equipment by calling it a box. I'd call it a broadband media computer." Telephone companies, meanwhile, want to move the endgame device outside the house. This conforms with the companies' public-utility view of the information highway -- as an Almighty Network predicated on absolute, central control.

An intelligent box on the side of the house would enable phone companies to keep control of the network, not least because under the terms of the deal that broke up AT&T, local phone companies can't legally own any equipment inside the house. And few consumers would be ready to pay the several hundred dollars such a box would cost if it stayed inside and they had to buy it outright. By keeping the equipment outside, the phone companies could pay for it and lease it to subscribers as part of their monthly service.

NETWORK economics give the set-top box at least one advantage. As the parts of the network get cheaper over time, so will the cost of constructing an information infrastructure, quickly depreciating the capital investment of the pioneering network builders. To get a return on their investment, they will need to earn money fast. That means pursuing cable TV users, the only customers who've proved that they're willing to pay for entertainment piped into their homes.

No wonder cable TV companies, led by Tele-Communications Inc., the nation's largest, started placing orders 18 months ago for digital set-top converters. By the time those converters get delivered, though, they may run smack into personal computers, which are proliferating among

the households that marketers covet most. About ten million people have bought home PCs in the past two years.

Over 25% of U.S. households own a PC now, and at least 50% are likely to by the end of the decade. As further evidence of activity on this front, Bob Luff, chief technical officer for Scientific-Atlanta, points to the big Christmas purchases of CD-ROM drives and add-on sound and graphics cards for computers. He says, "Every product relies heavily on early adopters. Are these people the early adopters of services on the information highway? Have they already begun to vote by those upgrades on their \$2,000 machines?" The network builders may end up depending on PCs because supplying entertainment alone won't earn them a profit.

Video on demand requires a lot of very expensive video servers, powerful computers that will store video in central offices and provide consumers with instant access to whatever they want to see. Geoffrey Roman, vice president of technology and new product development in General Instrument's communications division, says that even if video on demand captures 50% of the video store rental business, network builders wouldn't break even for 17 years. So while predicting confidently that video on demand is the killer app, communication companies quietly acknowledge that they have to make money on other services as well, like home shopping and home banking.

These interactive uses could be the apps that kill the set-top box. That's because PCs have begun to emerge as the preferred device for services that demand a lot of reading or input from the user: It's convenient to sit near the screen and have an elbow on the table while manipulating a mouse. In response, some cable TV companies, including TCI and Jones Intercable, are rushing to modify their systems so PC users with special cable modems can gain access to on-line computer services such as CompuServe and Prodigy, and to the Internet. Eventually the modems and new software will let a PC display full-motion video.

So who needs a TV? Well, plenty of people. Just because the TV may not be ideal for onscreen detail work, it won't necessarily be an electronic orphan. Shashi Raval, manager of H-P's new business development group, says: "It's a misconception for people to go around saying it's either a TV or a computer. One needs both of them." Even when PCs can play video programming, people won't sit with their noses 18 inches from a Macintosh monitor to watch Lawrence of Arabia. For a long time to come, millions of households won't have PCs either.

Arun Netravali of Bell Labs asks, "Do you want communication devices available only to people with PCs?" After all, in the United States more households have TVs than telephones, let alone PCs. The obituary for the television set is premature. In one scenario, TVs will get smarter too, and be able to take on some of the tasks of an intelligent endgame device.

A consortium that includes the Massachusetts Institute of Technology, AT&T, Zenith, General Instrument, Philips, and Thomson is working out the details of a broadcast standard for digital high-definition TV, an advance beyond the analog HDTV pioneered in Japan. The new sets will have supersharp wide screens and considerable built-in digital horsepower.

C.J. Brunet, CEO of First Pacific Networks, a maker of gear that lets cable TV systems carry phone calls, dismisses those who say TV is mired in a technological Dogpatch. "A lot of what people are saying presupposes things will go on the way we know today," he says. In his view, TVs will eventually have slots in the back for plug-in software modules -- not necessarily to balance your checkbook but to permit the tube to display, say, a video phone call.

As the cost of microprocessors falls, TVs may also incorporate chips that let them take over from set-top boxes the job of video decompression. That would be bad news for boxmakers like

Scientific-Atlanta and General Instrument. Even so, a lot of the endgame brainpower will almost certainly live outside the housing of the TV and even the PC.

Consumers won't like to pay for what they don't need. Some will want to exchange computer files with distant colleagues at high speed. But what use is a modem or set-top box that can spew out 45 million bits of data a second to the couch potato who only wants to order Lollapalooza '98? The diversity of interests and needs will lead to market segmentation. The high end of the market could indeed have large-screen PCs that double as video monitors. The low end would have TV sets connected to intelligent set-top boxes.

A system that lets people add endgame intelligence to existing TVs and computers -- rather than one requiring the circuitry to be built in -- will help new infobahn services take wing more quickly. That's because most people hold on to consumer electronics gear for a long time; they don't junk perfectly good equipment just to get something new. The CD, for example, would never have replaced the LP in the racks at Tower Records if music lovers had had to trash their stereos and buy entirely new sound systems to play CDs. TV sets in U.S. homes typically stay on the job for a decade or more. Even home computers last for six years, according to Dataquest, a Silicon Valley market research firm. That's surprising, since the blistering pace of technological innovation makes most PCs obsolete before you've pulled the staples from the carton. As a result, smart set-top box makers will design devices that can suit the preferences of each consumer and grow with the menu of services on the network.

General Instrument recently began showing off a modular set-top box -- er, broadband media computer -- called Joey that will be marketed to consumers. The basic unit will be able to decipher and decompress digital information. Users can add modules that will let them connect a computer, a printer, or a telephone.

Cable TV operators will control access to the network by supplying users with a plug-in card. The best of all possible endgame gadgets will be not only modular but also easily and cheaply upgradable. This goal, however, will require the creation of new and fabulously powerful microprocessors.

Today's general purpose chips, even Intel's Pentium, are not fast and agile enough to translate infobahn signals into a usable form on their own. For tasks like video decompression or translation of digital signals into sound, they need help from special chips that do one job and nothing else, and whose instructions are etched into their silicon.

General Instrument's first digital set-top box will have 15 of these single-minded chips. But using dedicated chips obstructs innovation because it freezes a device's abilities. The chips can't be altered, so once manufacturers start making them, the state of the art is fixed for a while. Indeed, manufacturers have had a hard time agreeing on specifications for decompression chips, slowing the growth of multimedia services.

A small Sunnyvale, California, company called MicroUnity Systems Engineering may have the solution. It will soon start making an advanced microprocessor that can handle all the jobs now done by dedicated chips as well as the control function performed by general purpose processors. Designed for digital communications, MicroUnity's chip will be faster than those that run computers today, and it will have different mathematical talents. Regular computer chips are good at doing arithmetic operations at great speed. MicroUnity's chip will be adept at mathematical permutation, so it can juggle packets of digital information and put them in the right order before translating them into usable form. Moreover, the instructions for each task will be encoded in software instead of being etched into silicon. Upgrades in technology will thus be instantaneously ingestible and will travel over the infobahn with the material to be displayed.

If that happens, haggling over standards can end, or at least proceed without the worry that each decision will be cast in silicon for years. Set-top boxes with superfast chips would be able to change their talents overnight. Such metamorphic ability should be a fillip for innovation and a boon for cable TV and telephone companies, which won't have to change \$ customers' equipment as often. "Running a truck to the neighborhood costs about \$50 per household," says MicroUnity CEO John Moussouris. "Upgrading software by sending it over the network would cost under a penny."

THE POTENTIAL of superchips fuels another interesting debate: whether people will have a single device that acts as a household's silicon brain or whether electronic gray matter will be spread around the premises. The answer will make or break businesses, since market power will go to those that control the largest share of in-home processing.

If all the power is concentrated in one box, the network builders that lease them to users could make a killing; if the endgame devices are scattered throughout the house, revenues will flow to the hardware makers that sell the devices.

AT&T argues in favor of a single-brain approach. This brain would need more than one microprocessor, since decompressing a digital video image is so demanding that even a superchip probably won't be able to power more than one TV or computer screen at a time. But AT&T argues that keeping all the chips in one basket brings the greatest efficiency. For example, a household with ten PCs, TVs, and VCRs could reasonably expect no more than three or four to be in use simultaneously. The family could order an information furnace containing four sets of communication chips, each of which could route a signal to any monitor in the house as needed. Thus, the family would save the cost of having one box next to every screen, most of which will be idle at any given moment. What undermines AT&T's case is human nature. While corporations routinely make this sort of decision, as when they calculate how many outside lines they need for their phone systems, the folks at home aren't used to it and may not want to bother.

Stu Personick, in charge of network research for Bellcore, the Bell operating companies' research arm, observes: "It's unreasonable to expect the consumer to become a system administrator, scurrying around trying to get economies of scope by using the set-top box as a combination of computer and entertainment appliance and maybe a controller for an electric toothbrush and can opener." The effort may not be worth the savings either. Mass-marketing drives down the price of electronics relentlessly. Eventually the cost of the chips will be trivial, only dollars per set, so duplicating them won't cause pain to consumers. "The most expensive part will be the display monitor," says Personick. "The second most expensive part will be the cabinet, unless the device is wireless, in which case the next most expensive part will be the battery."

Rather than relying on a single brain, systems could disperse processing power while keeping control centralized. An intelligent communication controller on the side of the house or in the basement could serve as an electronic traffic cop for all digital signals as they flow in and out. Computer chips and software inside this gadget would control access to the network and decode an incoming signal just enough to know where it should go. It would then direct it to a telephone, TV, or computer for decompression and processing or storage. This approach would have the powerful advantage of allowing households to link devices in networks, using as much of the existing wiring as possible.

Networking, after all, is the holy grail of communications. The so-called convergence of computers and communications is really a convergence of networks -- the computer network, the telephone network, and the cable TV network. There's no reason the convergence should stop at the threshold of the house.

IF EVERY telephone and video monitor in the home were plugged into a home network, infobahn pioneers could find an unexpected source of revenue outstripping all others. Says Avram Miller, Intel's vice president for corporate business development: "Advertising is probably going to be the killer app."

The home network will help advertisers learn what interests consumers and will allow them to get material into consumers' hands instantly. For example, H-P is developing intelligent household printers designed to plug into the same network as PCs and TVs. With the click of a computer mouse or a remote control, users would be able to print out anything that appears on any screen in the house. A TV viewer could request information about a product and receive a catalogue at once. Advertisers would pay a fee to the network operator, knowing they are spending to reach an interested party -- a marketer's dream. Plugged-in consumers could also subscribe to electronic magazines and automatically receive color printouts of articles on favorite topics -- accompanied by ads that match the reader's interests.

Others could benefit from a home network too. Power companies could plug into a communications controller or an intelligent set-top device and take meter readings long-distance, or even control big appliances like home ^ freezers at times of peak electrical demand. In the end, talking about the network of the future in the language of today's electronic devices can give us only a vague sense of what we will find.

The TV, the set-top box, the PC, and the telephone won't exist anymore; their descendants will. The video monitor may have the computer or the television as its progenitor, and a central controller may trace its genetic code to the set-top box. But following their evolution will take patience. Bob Kavner, until recently AT&T's multimedia chief and now a senior executive with Creative Artists Agency, believes that the full emergence of the information highway will require a lifetime. The birth of the multimedia industry five years ago created a lot of excitement about 21st-century communications, and when those expectations weren't immediately fulfilled, cynicism.

The next two or three years will be very important, just as are the years when a child goes from age 5 to age 8. But an 8-year-old isn't a mature being. By this calculus, AT&T's evocative TV commercials showing people with talking computers attending video meetings on the beach are about 20 years too soon. When the child reaches maturity, what will the world be like? "Looking into the far future," says John Moussouris of MicroUnity, "the information superhighway will be a network of copper and glass at the ends of which will be little pieces of silicon. They will be so small that they won't cost much more than light bulbs, and their function will be to convert the raw flow of information into a form that is visible to the human senses, just like the filament in a bulb converts electrical energy into visible light." How nice if we could be around to see it.