Webcasting: The Computing Paradigm Shifts into Third Gear

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Webcasting is one of the current buzzwords used to describe a new set of technologies and practices that extend the computer's usefulness into the arena of mass communication and distribution of information. Previously, computers functioned as stand-alone computing devices and as communication devices for e-mail, chat, and Web surfing. Now, this latest incarnation allows it to become a broadcast technology, a mass medium enabling communication from one source or "broadcaster" to many receivers at the same time. Webcasting is simply the latest product of the evolution of computer technology, and the comparison with the earlier stages in Table 1 clarifies how this new development differs from previous dominant paradigms of computing.

The addition of a broadcast dimension to computing presages a step-level change in the computing paradigm that will, in turn, affect every link in the chain tying the technology to its users. This new functionality has already had an impact on computer networks, and their most impressive public implementation—the Internet. It is also in the process of revolutionizing the enormous industries that provide the infrastructure, equipment, services, and content for the communication and information economy.

For example, while Webcasting may still require time, knowledge, and money to develop and produce content, the cost of using computers and computer networks to reach a mass audience is dramatically lower than it would be employing radio or televi-sion broadcasting technology, the telephone, or a mail delivery service. This cost reduction offers many people the opportunity to vie for the attention of an audience—to become information broadcasters, not just passive information receivers.

Computers are one of the most important technologies of our time, transforming every area of human endeavor from education and medicine to entertainment and warfare. They are powerful, useful, and efficient—but they are also profoundly disruptive. In part, computers create turbulence because they are themselves still evolving. Thus, the dark side of Moore's Law is that, every time the technology reaches a new level of performance or functionality, all the domains where its influence reigns must change to take advantage of the increased capabilities.

The purpose of the rest of this article is to highlight the new broadcast functionality of computers. The article will then describe the different technologies that comprise the field, covering the features, drivers, standards, market characteristics, and future directions of each segment.

In the Beginning Was the Word

"Webcasting" is only two years old. It has flourished with such astonishing rapidity and in so many directions that the activities that are grouped under this label lack a common terminology. People use different terms to describe the same referents and, worse, they sometimes use the same words to refer to technologies that are dissimilar in

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Table 1
Comparison of Evolutionary Stages of Computer Technology

	Stage 1	Stage 2	Stage 3	Stage 4
Advent of Technology	Abacus/Babbage/ PC	1961	1994	The future, maybe 2025
Form of Usage	Stand-alone computation	One-on-one communication: Wheel & sphere	Mass communication	Integrated communication
Popular Implementations: Killer Apps	Data processing & storage	E-mail, chat, & Web surfing	Webcasting: Push, PCTV, & AV via IP multicasting	Sun's concept of Java; Motorola's LON networks
Sender/Receiver Format	User/programmer	Point-to-point or one-to-one	Point-to-multipoint or one-to-many	Multipoint-to-multipoint or many-to-many
Interface	OS & application software	Browser	Interim: plug-in Final: TBA	TBA
Hardware & Infrastructure	A computational device	Computer, modem, telephone line	Computer, modem, high-speed network	Ubiquitous information appliances & richly-connected high-speed networks
Image	Extension of individual brain & nervous system	Extension of a personal network	Extension of a social network	Unknown—A geodesic sphere?

Source: J. Van Tassel

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design, procedures, market potential, audience reach, and content.

Webcasting is variously called "cybercasting," "netcasting," "datacasting," PCTV, Web-TV, Net-TV, push technology, and broadcasting over the Web (or Net). The embarrassment of nomenclature reflects the confusion of innovation, the development of numerous new technologies, and the reality that different actors perceive Webcasting through the lens of their own analysis, experience, and goals.

The scatter pattern is not confined to the vocabulary. Even within specific types of Webcasting, the technology is so new and evolving so rapidly that there is little technical standardization. Most companies promote their proprietary systems, hoping to capture sufficient market share to establish de facto market standards. About all the various Webcasting technologies have in common is that they include hardware, software, and a substantial Microsoft presence.

When the bits hit the information highway, Webcasting can refer to any of the following systems and techniques:

- Push technologies.
- Convergent technologies, PC to TV and TV to PC.
- Audio and video content transported over computer networks.

The next section will describe the essential features and applications of each of these segments. It will also cover the drivers, user communities, and standards underlying them.

New Functions, New Fictions

The hype-o-rama surrounding Webcasting is so blatant that it is easy to dismiss the conflagration as all smoke and no fire. The smoke is certainly an information manipulation technique to obscure the very real fragility and vulnerability of the particular instantiations of computer broadcasting.

Nevertheless, the fire is there and, even if every product on the market fails, new attempts will continue to emerge until the broadcasting capabilities of the PC come into being. The virtual certainty of this prediction stems from the fact that there is no faster, more efficient, less expensive way to reach and communicate with large numbers of specified individuals, making push a powerful and valuable weapon in the communications arsenal.

Webcasting Segment 1: Push Technology

Push technology fits a familiar model of communication. Television and radio are both push media; so is e-mail. In the context of computer communication, the term refers to the automatic distribution of messages that can include any combination of text, graphics, audio, and video to computer desktops.

The core technology behind push products has been known for 20 years, the Unix-based computer-to-computer remote procedure call. However, today's products have elaborate, customizable graphical user interfaces, seamlessly integrated with search engines, databases, tracking features, and report generation.

Minimally, push technology includes a server and the software to support sending data to a list of receivers on a regular basis. On the client side, a software engine decodes the material and an interface displays it.

The content of push technology reaches consumers through a recent innovation called a "channel." The metaphor is adapted from television and describes a collection of related information, assembled into an accessible package. Just as ESPN shows programs about sports and HBO concentrates on movies, so does an Internet channel forward information about a given topic. Users subscribe to channels they want to receive, which usually come to the user from within their Internet browser. At present, Marimba offers about 40 channels; the new Microsoft version of Internet Explorer makes available 250 channels.

The standards for push technology are not yet settled. At the moment, the standardization process is a political hostage to the browser wars, where Microsoft is battling the Sun/Oracle/Netscape coalition for control of the desktop.

Launching a sortie on the push front, Microsoft developed the CDF (channel definition format) and recently forwarded it to the W3C, the World Wide Web standards committee, for approval and adoption. Almost all push companies have signed onto the standard except for Netscape and its allies, Java-based Marimba and Intermind. Microsoft's Windows-optimized CDF initiative poses a direct threat to Marimba, which dominates the high-end Intranet market, because its complex software suite is written in the Sun-based Java language.

CDF defines:

- How to update a site.
- The frequency of site updates.
- The number of layers of the site that should be updated.
- How to subscribe to the site.
- How to secure the site.

The lack of standards has not inhibited the development of push products. They include a variety of applications, services, and systems:

- Notification services, such as Intermind, which sends users messages that there is material for them awaiting download.
- Delivery services, such as Netscape's In-Box Direct or HTML e-mail.
- Content developers, such as the PointCast news service.
- Content aggregators, such as Marimba.

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- Development tool providers (Marimba).
- Intelligent agents (Firefly).
- Hardware and software vendors (BackWeb makes servers and software; AirMedia is a hardware and wireless service provider).

The development of push technology applications is driven mainly by the needs of large and medium-sized organizations, rather than consumers. The important intra-organizational uses of push include:

- Automatic distribution, downloading, and set-up of software to user desktops.
- Distribution of company policies and employee information.
- Automated information search and retrieval.

Some industries also find push technology to be a useful tool for directing advertising and promotions to consumers, providing enough of their customers are on-line. For marketing executives schooled in the mass media, the push model of distributing unasked-for information in front of consumers is very comfortable.

Finally, Netscape and Microsoft have installed push technology in their latest browsers. Putting channels on the desktops of millions of Internet surfers ensures that they will have the opportunity to at least sample the convenience of automated information delivery.

Webcasting Segment 2: Convergent Technologies

Convergent Webcasting technologies refer to an array of techniques that will transform the Internet and Web functionality into a mass medium by bringing the television and the computer together into a TVPC or a PCTV. TVPCs are television sets that display Internet/computer/digital images and text; PCTVs are computer monitors that display TV programming. Even the terms TVPC, PCTV, and Webcasting, and all their derivatives, combine the two technologies, with "Web", "data," and "net" representing the PC side, and "casting" referring to the TV

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side. (See companion article entitled, "Converging Webcasting Technologies.")

There is great theoretical attractiveness in merging the computer and the television, combining the analytical and processing power of the one with the reach and high production quality of the other. However, the actual convergence is proving quite difficult to achieve.

The problems are not technical; the real obstacles are on the human side of the equation. Among many people in the computer industry, the prevailing view is that the PC will inevitably become the chief communications device in the home and the workplace, so they are anxious to embrace—and encompass—the television, as well as the telephone, radio, fax, answering machine, game player, intercom, home security system, and electrical power and programmable appliance manager.

Not surprisingly, executives in these various industries, especially broadcasting, find the prospect of being just one among many functions to be somewhat threatening. They fear complete compatibility between the different media, and they have fought the adoption of standards that would make it possible.

The difference in the attitudes of the two industries means that the computer industry initiates the innovation in both areas of the convergence arena. The broadcasters provide programming for the early trials and tests, with varying degrees of reluctance.

When digital data appears on the ubiquitous television set—the TVPC—the most popular Web activities are then available to 99% of U.S. homes. The combination analog/digital programming also offers the potential for creating added value to the audience:

- Internet access.
- World Wide Web surfing.
- E-mail.
- Enhanced TV programming information— interactive opportunities for more information, ordering, displayed products, and chat.

Similarly, conventional television pictures to the PC, or PCTV, can improve the experience of computer users, especially in the field of entertainment. Currently, the development of popular mainstream programming is inhibited by the poor quality of moving images due to bandwidth limitations. Likely applications for this hybrid medium would be:

- Interactive entertainment.
- Broadcast programming tightly linked with on-line chat.
- User-created information and experience tied to TV.
- Dual usage of TV and PC, especially during working hours.
- Blend of entertainment and information.
- Consumer-active advertising applications, especially through easy information acquisition about products and services.

Webcasting Segment 3: Audio and Video Over Computer Networks

IAV—Internet audio/video—refers to the ability to incorporate complex sound and detailed, realistic moving images as part of a digital message. The combination of text, still images, audio, and video is called "multimedia." When multimedia messages go to many receivers at once, the process is called Webcasting.

Currently, Webcasting occurs on a one-to-one basis, replicated many times. Computer users dial up their Internet service provider (ISP) or get on the Internet through a local area network and access a Website that is Webcasting some material. Through this established connection, the user launches a "player" that converts the compressed content into a visible image and sound.

Several companies are on the forefront of AV Webcasting. The premier player is RealNetworks, which supplies the RealPlayer free to users. Their income derives from the sale of software that encodes and compresses AV into a proprietary stream. VDOLive, Xing Technologies, Macromedia, VXtreme, Graham Technology Solutions, Telos, and a number of other companies

also provide some combination of hardware and/or software to provision a Webcast.

Essentially, then, this is a one-to-one connection. It means that every user is receiving a stream of data—500 users viewing 500 streams. Limitations on servers and ports now limit the number of simultaneous viewers.

The process as it exists today is wildly inefficient and highly problematic for the telephone system as a whole. If several million users happened to request AV streams at the same time, it is possible that the entire U.S. telephone system would crash.

To improve the efficiency and to increase the potential audience for Webcasts, most computer companies support the IP Multicast Initiative (IPMI). This system sends a single multimedia stream of each "program" over a dedicated backbone infrastructure called Mbones (a contraction of multimedia backbones) to the lowest possible level of server, where the stream is then replicated to users. The IPMI system means that, for most of its path, a given program is transmitted only once, until it reaches the local level. This solution would eliminate duplicated streams, thus greatly reducing the overall level of AV traffic over the Internet and the public switched telephone network.

Supporters expect rapid diffusion of IPMC (IP multicast) technology, predicting that it will reach most ISPs and services within the next two or three years. The barrier to acceptance is the cost to the ISP of new routers which can interpret Mbone addresses. While it may take somewhat longer for IPMC to reach smaller ISPs, and the storage problems for archived materials is not yet solved at the ISP level, implementation among larger ISPs is now well underway.

Webcasting: Win or Waterloo for Existing Players?

The birth of a new medium, in this case the interactive computer network, is always accompanied by a buzz of alternative scenarios about how existing institutions will

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adjust to the changed landscape. At conferences, exhibitions, and meetings, as well as on-line, two topics often come up for discussion among Webcasting devotees. Many wax enthusiastic about the impending demise of broadcast television, soon to succumb to the multiplicity of choices offered by the interactive Internet. A good number also fear the dominance of Microsoft, whose aggressive attempts to control the television set-top, in addition to the PC desktop, are all too apparent.

Neither scenario is likely.

While television broadcasters are a slow-moving lot who have generally failed to understand and respond to the digital challenge, they nevertheless occupy an inexpensive, high-quality, well-defined, profitable distribution system that fulfills important consumer needs and wants. As events and technological development force them to innovate, they will be able to alter their business models and product offerings to continue to make profits from the enormous bandwidth they control and the relatively stable consumer desires they satisfy.

The future may be uncertain, and some players may not survive. The system will have to change. Nevertheless, there are enough events that appeal to large enough numbers of people to continue to support some level of free, over-the-air television. The second frequently-discussed topic is the role of Microsoft in this new broadcast paradigm of computing. The software giant has made striking moves to dominate both the desktop and the set-top.

To beat off its desktop competitor, Netscape Navigator, and to position itself for any possible TV/PC convergence, Microsoft has:

(1) Bundled its browser, Internet Explorer, with its Windows operating system.
(2) Dominated standards for push technology with CDF.
(3) Partnered with Hughes to bring PCTV to computers via satellite.

(4) Partnered with WavePhore to bring PCTV to computers via the vertical blanking interval.
(5) Developed PC '98, a high-end PC entertainment system.
(6) Bought VXtreme, a high-quality AV Webcast software developer.
(7) Acquired interest in VDOLive, another developer of high quality AV Webcast software.
(8) Acquired interest in RealNetworks, a dominant player in the AV Webcast market, giving Microsoft access to RN technology.
(9) Dominated standards for streaming with ASF standard.

Microsoft has also been active on the set-top side of the TV/PC convergence. In this arena, MS has made the following moves:

(1) Bought $1 billion interest in cable multi-system operator, ComCast.
(2) Entered into agreement with TeleCommunications, Inc., second largest cable MSO, to incorporate Windows into TCI set-top boxes.
(3) Submitted the Windows design for set-top box standards to CableLabs.

These various activities are intimidating indeed. They show a determination to create an imposing position from which the company can dominate the convergence of the computer and television, including every aspect of Webcasting, from push to AV.

Yet there is reason to pause.

Microsoft's initiatives have raised the alarm among computer companies and users, cable companies, broadcasters, and finally, the U.S. Department of Justice, the attorneys general of a number of states, and the regulatory arm of the European Common Market. This coalescence of potential opponents does not bode well for Microsoft, despite the confidence (or arrogance, as Microsoft's enemies characterize it) that spokespeople project.

There is another consideration, as well, that springs from the nature of the digital

revolution itself. Microsoft was caught unaware by the explosion of the Web and the success of Netscape Navigator. That failure of vision almost cost Microsoft its control of the desktop, and still poses a considerable threat. Reeling from this near-disaster, Microsoft now spends lavishly to anticipate every possible avenue of development. Yet, it is always a danger to view the present (and the future) through the spectacles of yesterday's reality.

Moreover, innovation in digital technology is a race that goes to the swift rather than the wealthy. It is still very early in the Webcasting game, and the technology is barely developed. There are few standards, and the ones that are proposed will probably be superseded by technological advances. The landscape of new media is strewn with the bodies of dominant companies that, even with all their clout, money, smart people, and market research, failed to understand the evolution of the market. For example, IBM has taken years to recover from its mistaken approaches to the personal computer.

Webcasting, the new paradigm of computing, is here. It is possible to see how the outlines of how it will change one-to-many and many-to-many communication processes. However, the details of who, what technological configuration, and how it will be applied remain obscured by the veil of the near-future.

Clarity will emerge out of the struggle of the many contending solutions in the next five years, and probably not before that time. Although the pieces of the puzzle are fairly well understood, there are still a few technological problems that cannot be solved at a reasonable cost at the present time.

Like an automobile's third gear, which takes the vehicle from 25 to over 50 miles per hour, this third paradigm shift is going to be both lengthy and decisive. Through the shift, computing will move to become a true mass medium whose effects will ripple through decades to come. ntq