Understanding Convergence and Digital Broadcasting Technologies for the Twenty-First Century

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Convergence, which, in broadcasting, is the combining of all types of media in digital form, has been one of the most discussed and debated developments in the media over the past decade or more. Some argue that convergence is a positive development that gives the media greater capabilities at lower cost. Others contend that convergence decreases media diversity and may lead to great profits but less public service. Some suggest media convergence is inevitable, and others see it as a technologically driven process over which media and other players have influence, helping shape the extent to which positive or negative outcomes occur.

In this essay, we subscribe to the latter notion, that convergence is technologically driven, but not necessarily inevitable. Moreover, the players, including the media, have some influence over the extent, nature, and consequences of convergence.

In broadcasting, convergence involves five broad areas of broadcast media processes:

1) tools for the acquisition or production of content or programming, including cameras, microphones, and other computer-based sensors and technologies for capturing or inputting information, whether visual, audio, or other format;
2) storage technologies, including archival and other digital storage media;
3) editing or other computer-based technologies or postproduction processing of visual, audio, or other text, or of graphical, multimedia, or interactive programming;
4) distribution technologies, or networking or telecommunications technologies, for distributing or communicating content;
5) display or presentation technologies for accessing or displaying audio, visual, or other programming.

Here I will examine these five areas of broadcasting and how they are in a digital, technological environment. After describing these five areas, I will then examine the consequences of these processes of broadcasting conver-

gence, especially in four areas:

1) how programming is changing,
2) how broadcast professionals do their work in new or altered ways,
3) how broadcast industry structures and culture are changing, and
4) how relationships between or among the broadcast industry and its many publics are changing.

FIVE AREAS OF DIGITAL MEDIA TECHNOLOGY

Convergence occurs in a digital technological environment in the five broad areas of broadcast media processes seen above. First let us look at the tools for acquisition or production of content or programming, including cameras, microphones, and other computer-based sensors and technologies for capturing or inputting information, whether visual, audio, or other format.

Acquisition

In broadcasting, the basic technological tools for producing programming are the microphone and the camera. For most of the history of broadcasting in the twentieth century, these basic devices were analog in format. That is, microphones and cameras acquired sound and moving pictures in their original wave forms. A signal was taken straight from a microphone and retransmitted or recorded in the same wave form. The wave from the microphone was an analog wave, and therefore the wave transmitted or recorded on tape was also analog.

> In *digital technology*, the analog wave is *sampled* at some interval, and then turned into *numbers* that are stored in the digital device. On a CD, the sampling rate is 44,000 samples per second. So on a CD, there are 44,000 numbers stored per second of music. To hear the music, the numbers are turned into a *voltage wave* that approximates the original wave.[1]

Digital sound technology offers two major advantages over analog: 1) recordings do not degrade over time and 2) groups of numbers can be compressed by identifying patterns and thereby producing more broadcast channel capacity than in an analog system.

Development of the digital video camera shows two important aspects. First is the change from a television pickup tube to the Charge Coupled Device, or CCD. The other is the final output format. NHK developed the

[1] Available at www.howstuffworks.com/question7.htm as of February 1, 2005.

high-definition camera using television pickup tubes on an experimental level in the 1970s. NHK and Sony used television pickup tubes for practical use in the 1980s, and Sony, Panasonic, and Ikegami used and developed the CCD for practical use in the 1990s.

When setting the final output format, NHK did not need to introduce the digital format in the 1970s and 1980s, even though signal processing was digitally processed at a late stage of television pickup tube development. With high definition television, the image is much clearer because the number of scanning lines is 1,125, compared to the 525 lines in a conventional television image. With digitization, the video signal could be reproduced without any signal loss and could be compressed and transmitted using less bandwidth (the amount of data transmitted via a certain channel of communications in a given span of time). For example, in a broadcasting environment, bandwidth would refer to how much data could be transmitted over a particular frequency. With compression, at least six channels of standard television in digital format could be transmitted over the same frequency that would accommodate only one standard television signal in analog format. Further, two HDTV channels could be transmitted in compressed digital format over that same frequency. In addition, digital video can be edited nonlinearly on a computer-based editing system, offering a variety of advantages over traditional tape-based editing systems. These will be discussed in detail in the "Production" section below.

Digital microphones and cameras also can be converged with various other computer-based, or digital technological systems. For example, digital cameras can be attached to robotic, remotely controlled operating systems permitting remotely controlled operation. This can negate the need for human camera operators, reducing cost and increasing operation efficiency. Moreover, preprogrammed camera moves can be created and stored for subsequent use and can be run using timers, with pan, tilts, zooms, and dollies all seamless and 100 percent accurate. Video signals can be directly fed into Internet and World Wide Web applications permitting high-powered Web cams and audio systems for highly efficient Web casting. This can enable on-demand television systems over the Internet.

Along with convergence, digital cameras and microphones are increasingly being miniaturized, yet made more powerful (i.e., higher in resolution, up to eight million pixels for consumer digital cameras) and less expensive. A December 2004 report indicated that by the end of that year 43 million per-

[2] Available at http://apnews1.iwon.com/article/20041213/D86URNAO0.html; Consumer Electronics Association: www.ce.org; major U.S. camera makers: www.kodak.com; www.sony.co; www.canon.com; www.olympus.com; www.hp.com; www.nikon.com; photo industry research firms: www.idc.com; www.infotrends-rgi.com; www.pmai.org.

sons in the United States would have digital cameras, the majority of which also shoot and record audio and video.[2] With digital audio and video capture, these systems are also capable of instantaneous computer-based processing, with intelligent video parsing and real-time computer-based spoken-word transcription. These will be covered in detail in the discussion of computer-based postproduction in the "Production" section below.

Digital cameras also present new capabilities previously not possible with analog systems. Because the signal is digital and can be converged with a computer in real time, digital signal processing can go far beyond compression. Among the capabilities now developed are extremely wide-field-of-view digital cameras. Such convergent digital systems include a 360-degree field of view or surround-video cameras. These cameras capture video in all directions, permitting editors to either select particular fields of view or to transmit the entire panoramic view. This has already been used in a number of broadcast environments, including at CBS News, where, in the late 1990s, a 360-degree video camera was placed in the newsroom and attached to the Web, permitting viewers to watch the goings-on in the network newsroom 24 hours a day.

One pioneering professor of computer science at Columbia University, Shree Nayar, has developed the "Cyclops," a 360 camera system that can be placed inside a spherical plexiglass ball with a robotic motor and wheel system, microphone, and wireless transmitter, permitting the system to enter locations that might be unsafe for humans and provide remote viewing. Nayar's website explains his "CAVE" (computer-aided vision environments), and he and fellow professor Steven Feiner note:

> In recent years, the fields of computer vision and computer graphics have converged to produce new and compelling forms of visual information. This convergence has given rise to a powerful set of techniques, such as image-based scene modeling, image-based rendering, computational video and visual user interfaces. The coming years are certain to witness significant advances in the capabilities of these approaches, as well as the creation of exciting new ones.[3]

Among the new capabilities now being tested in a convergent video environment is Nayar's dynamic-range imaging computational camera. This system allows video capture in situations where ambient lighting produces high contrast conditions normally obscuring at least a portion of the field of view.

Production

We now move on to editing or other computer-based technologies or post-

[3] Available at www1.cs.columbia.edu/cvgc/ as of February 1, 2005.

production processing of visual, audio, or other text, graphical, multimedia, or interactive programming. Computer processing power has increased exponentially since the middle of the twentieth century and shows no sign of slowing down. Consequently, the personal computer has become more powerful than supercomputers of only a decade ago and has revolutionized the world of media. Personal computers, even laptops, can be used for postproduction work, editing broadcast-quality full-motion video.

To understand the significance of these developments, consider some of the historical background in the evolution of machine-based computation.[4] In 1623, German mathematician Wilhelm Schickard created the first mechanical calculator, or "Calculating Clock," employing a set of metal wheels to add and subtract numbers. Two centuries later, English inventor Charles Babbage conceived a steam-powered digital calculating machine, the difference engine. Babbage has become known as the father of modern computing. But he didn't work alone. He was assisted by mathematician Ada, Countess of Lovelace, a member of the aristocracy and the daughter of Lord Byron. Babbage designed and developed in 1839 "the first true mechanical digital computer, which he described as a 'difference engine,' for solving mathematical problems including simple differential equations."[5] Lovelace was the first computer programmer.

In 1880, Herman Hollerith built the first working model of Babbage's invention, naming it the "electromechanical tabulator." Scottish physicist Lord Kelvin that same year introduced the idea for an analog computer using mechanical devices to process and manipulate numbers and information entered in numerical format. Fifty years later American engineer Vannevar Bush built a prototype analog computer called the "differential analyzer." In 1936, English mathematician Alan Mathison Turing developed "The Turing Machine," the precursor for today's multi-purpose computer. Turing also played a role in the development of modern cryptography, encryption, security, digital signature, and watermarks by helping the Allies during World War II break the code of the German Enigma Machine.

In 1939 Iowa State University professor John V. Atanasoff and graduate student Clifford E. Berry created the first electronic digital computer based on use of a binary code of 0s and 1s. This marked the beginning of modern computing, and is a key foundation for today's computer-based media technologies and convergence. About the same time, Hungarian John Louis von Neumann developed the Von Neumann architecture, the basis for modern

[4] For the following account, see http://www.columbia.edu/~jp35/newslab/lectures/newslab4.html available as of February 1, 2005.

[5] www.maxmon.com/timeline.htm as of February 1, 2005..

computing algorithms. At the end of World War II, Rear Admiral Grace Murray Hopper removed a two-inch moth from a navy computer, giving rise to the use of the term "bug" to describe all types of mysterious computer failures.

ENIAC, the first fully functional electronic computer completed, was publicly unveiled in 1946. It was completed too late for its original purpose of calculating firing tables for artillery weapons. "Instead, the first real task assigned to ENIAC during its test runs in 1945 involved millions of discrete calculations associated with top-secret studies of thermonuclear chain reactions—the hydrogen bomb."[6] The term "computer" was developed by the U.S. Military during World War II to describe women who calculated missile trajectories, and the term was later applied to machines performing the same task. In 1948 Bell Labs unveiled the transistor, invented by research team Walter Brattain, John Bardeen, and William Shockley. They shared a Nobel Prize in 1956 for their invention. In 1950, Alan Turing developed the Turing Test, laying the foundation for applications of artificial intelligence in natural language (computer-based) news analysis and summarization (i.e., the digital news project, The Columbia Newsblaster[7]). That same year, Claude Shannon proposed the first chess program, and less than half a century later, in 1977, IBM's Deep Blue would become the first computer chess program to beat the human World Chess Champion, the legendary Garry Kasparov.[8] In 1988, futurist Raymond Kurzweil had predicted that a computer would beat the world's best chess player by 1998. In 1999 Kurzweil predicted computers would become more intelligent than humans by 2020.

Among media applications of this development of machine-based computation was reporting that helped the *Detroit Free Press* win a Pulitzer Prize when journalism professor Philip E. Meyer pioneered the use of the computer in journalism in 1967, a move that spawned a form of reporting later described as "precision journalism" by distinguished educator Everette E. Dennis. Meyer's computerized study of survey data from riot-area blacks following the 1967 civil rights riots in Detroit produced a front-page series titled, "The People Beyond 12th Street." Meyer's pioneering effort was followed by former *New York Times*'s investigative reporter David Burnham's computer analysis of crime data in New York City in 1972.

Burnham, the author of award-winning books and articles, attained legendary status in New York City for his investigative work with police officer Frank Serpico, a narcotics officer whose testimony before the Knapp

[6] Available at http://page.mi.fu-berlin.de/~zoppke/D/history.html as of February 1, 2005.
[7] Available at www1.cs.columbia.edu/nlp/newsblaster/ as of February 1, 2005.
[8] Available at www.cnn.com/WORLD/9705/11/chess.update/ as of February 1, 2005.

Commission revealed widespread corruption and graft in the New York City police department. Burnham was the first journalist to use the computer to analyze public records, marking the beginning of what we today call computer-assisted reporting (CAR). Burnham used the *New York Times*'s mainframe computer to sort crime data by police precinct, revealing the first public mapping of the variation in crime rates throughout New York City.

In 1989, Pulitzer Prize winning investigative reporter Elliot Jaspin developed (with Dan Woods) NineTrack Express, software for computer-assisted investigative reporting that allows reporters to analyze public records using a personal computer. Since 1989, every Pulitzer Prize for investigative reporting has been awarded to a journalist whose research was based upon a computer analysis of public records.

In 1971, one of the most significant leaps in computer development since Wilhelm Schickard fashioned his "Calculating Clock" was made when the microprocessor was developed at Xerox PARC (Palo Alto Research Center), laying the foundation for the development of the personal computer. Less than a decade later, in 1977, the Apple II, the first personal computer sold in assembled form, was successfully marketed. Four years later, IBM introduced its first personal computer. In 1989, Avid introduced its first digital nonlinear postproduction Media Composer system. Now with more than 10,000 systems in use worldwide, Avid is the leading manufacturer of digital nonlinear editing systems. In today's convergence environment, digital postproduction in broadcasting and video editing is moving to software-based systems, such as Adobe Premier and Apple's Final Cut Pro.

Digital devices for media production are also becoming faster and smaller. In 1994, Intel manufactured the Pentium processor, the fastest computer chip to that date. Chip speed has continued to increase according to Moore's Law, and today's fastest processors are in excess of one trillion instructions or calculations per second. Moore's Law is named after former Intel chairman Gordon Moore, who observed in 1965 that computer chips were being manufactured with ever faster processing power. In fact, he noted, the number of transistors per square inch on integrated circuits had doubled every year since the integrated circuit was invented. Moore predicted that this trend would continue for the foreseeable future. In subsequent years, the pace slowed down a bit, but data density has doubled approximately every 18 months, and this is the current definition of Moore's Law, which Moore himself has blessed.[9] Moore and other experts expect Moore's Law to hold at least until 2020. In lay terms, Moore's Law suggests that computer-processing speed is doubling every 18 months, and consequently, smaller and smaller devices contain

[9] Available at www.webopedia.com/TERM/M/Moores_Law.html as of February 1, 2005.

increasingly powerful computer technology.

In 1995, professor of Columbia University Shih-Fu Chang and doctoral student Jon Smith developed a content-based approach to representing, indexing, and retrieving still and moving images. This and other developments have laid the foundation for semantic, or meaning-based, video editing, indexing, search, and retrieval systems. In 1997, Chang also developed WebClip, a nonlinear compressed digital video editing system for use on the World Wide Web. He then developed VideoQ for searching video based on characteristics of the video content, such as movement patterns. Similar tools have been developed at a variety of academic and industry research centers, including the University of Southern California, Cornell, and IBM. In addition, tools for face recognition, fingerprint recognition, and other biometric data sensors were developed by 1998. Combined, these developments have made possible the advent of "Desktop Filmmaking," as well as video editing in the field using lightweight, powerful, and portable technologies.

Miniaturization, along with Moore's Law, continues to drive innovative digital media applications and devices. One notable product that entered the market in 2004 is the cable television card.[10] The cable TV card is essentially a PC card designed for use with a digital television set or HDTV set, and it replaces the clumsy cable TV set-top box. One of the obvious advantages of the cable TV card is that it is much smaller than the set-top box, allowing the consumer to install a TV anywhere without having to take up space with a box. Moreover, the cable TV card uses less electricity than the box, so it offers immediate economic and environmental advantages. Further, the card allows the consumer to control their TV viewing using only one remote control, that of the TV set, so a single remote can change channels, volume, etc. The box and remote can be returned to the cable TV company when the consumer terminates service. Ironically, but not surprisingly, its own shortsightedness and competitive nature have meant that the cable TV industry has struggled to establish a standard for the cable TV card, and this has slowed its development, design, and introduction to the marketplace. Consequently, the current cable TV card is severely limited in terms of functionality, but not for technical reasons, rather for reasons of standards incompatibility. The most serious limitation of the card is that it is not two-way, unlike the cable TV box. As a result, the subscriber must go to the cable TV company's website or make a telephone call to order a pay-for-view movie, event, or premium service.

[10] Available at www.nytimes.com/2004/12/30/technology/circuits/30stat.html as of February 1, 2005.

Distribution

Now we turn to distribution technologies: computer networking or telecommunications technologies for distributing or communicating content. The traditional means of distributing television and radio transmissions has been undergoing an almost continual evolution since the advent of electronic broadcasting, but has been in a more radical transformation since the emergence of digital distribution in the 1990s.

The rise of digital satellite broadcasting, digital cable, and digital terrestrial broadcasting, and other digital wireless (e.g., 802.11.b or Wi-Fi) and wire line technologies (e.g., optical fiber), has begun to dramatically transform the system of distribution for audio and video (i.e., broadband) communications. Whereas in the first half of the twentieth century terrestrial broadcast transmission was the dominant means of distribution of television and radio signals to the viewer, only about one in ten viewers now receives over-the-air signals on their primary television set at home. Radio is still dominated by terrestrial broadcasting (since the 1970s FM has dominated AM radio), but digital satellite radio is growing rapidly. Washington, D.C.-based XM Satellite Radio reports that in December 2004 its subscriber total surpassed 3.1 million, up from 1.3 million at the start of the year.[11] New York-based Sirius Satellite radio (which recently signed celebrity shock-jock Howard Stern to a major contract) reports its subscriber total now exceeds one million, up from 240,000 at the beginning of the year 2004. XM signed a US$650 million 11-year deal with Major League Baseball and Sirius signed the National Football League. Sirius also hired former CBS head Mel Karmazin as CEO. XM charges US$9.99 a month and Sirius charges US$12.95 a month.

The Television Bureau of Advertising analysis of Nielsen Media Research data for February 2004 shows that direct broadcast satellite television usage is gaining on cable. "While DBS penetration increased to 17.8 percent from 15.6 percent, cable penetration hit a nine-year low, falling to 67.5 percent of TV households, down from 68.6 percent a year ago. Overall, the portion of TV households receiving cable programming via alternative delivery systems reached 18.8 percent in February, up from 16.7 percent in February 2003, with 64 markets showing an ADS penetration of 25 percent or more."[12]

Digital networks are increasingly merging with computer networks. These networks are characterized in terms of their scope and speed of transmission.

[11] Available at www.xmradio.com as of February 1, 2005.

[12] Available at www.mediaweek.com/mw/search/article_display.jsp?vnu_content_id=1000482311 as of February 1, 2005.

[13] Available at www.webopedia.com/TERM/W/wide_area_network_WAN.html as of February 1, 2005.

Consider a typology where one axis is scope, or size, of the network, covering either a wide area or a local area. Wide area networks are computer networks that span a relatively large geographical area.[13] A WAN is made up of two or more local area networks (LANs). The largest WAN is the Internet. LANs are commonly found in individual work places, universities, campuses, individual buildings, or homes. Computers on LANs are typically linked to WANs through public networks, including the telephone system. They might also be connected through leased lines or satellites.

The second axis of this typology is network speed or bandwidth. Bandwidth can refer to "a range within a band of frequencies or wavelengths" or "the amount of data that can be transmitted in a fixed amount of time."[14] Bandwidth for digital devices is typically stated in bits or bytes (bps) per second. For analog devices, bandwidth is stated in cycles per second, or Hertz (Hz).

For networks, the available bandwidth is a key factor in determining what functions users can perform on that network and how many users can simultaneously perform those functions.

Figure 1. Network Scope and Speed

	Local Area Network	Wide Area Network
Wire less	Wi-Fi Terrestrial Digital Broadcast	Satellite-based
Wire line	Ethernet	Internet

This typology provides a useful framework for understanding where the opportunities are for delivering digital content and services to the consumer. To date, most efforts have been concentrated in wire line network environments and, to a lesser degree, wide area network wireless environments. Local area network wireless content applications have been relatively limited and have only recently started to grow.

Among the most interesting potential content applications in the wireless LAN environment are location-based media. Location-based media refer to content that is specially designed for or related to a specific location and accessible to the consumer when at or near that location. The author and his colleague, Columbia University Computer Science Department professor Steven Feiner, have been collaborating on an experimental location-based

[14] Available at www.webopedia.com/TERM/b/bandwidth.html as of February 1, 2005.
[15] See www.cs.columbia.edu/projects/mars/mars.html.

media content application since 1997.[15] In this case, their project involves the use of a mobile wearable computer system referred to as a mobile augmented reality system (MARS). The MARS system they have developed and tested is called a Mobile Journalist Workstation (MJW) and is a hybrid, or convergent, digital media system involving high-speed LAN and WAN connectivity via Wi-Fi and the Global Positioning (satellite) System (GPS). Augmented reality is a cousin of virtual reality (VR), which involves the creation of completely computer-generated reality that replaces the user's experience with the immediate environment. In augmented reality, the user still sees, hears, and otherwise senses the physical world, but that experience is supplemented by additional computer-generated information, such as overlaid text, graphics, images, video, audio, or other multimedia information embedded virtually into the user's immediate environment. The system is mobile, meaning the user is not tethered, but rather is connected to a digital network via wireless technology.

Pavlik, Feiner, and their students have developed a series of prototype content applications using this system. Called the "situated documentary," these location-based media products allow the user to walk the Columbia University Morningside Heights campus on the upper west side of Manhattan, and see and hear it as it is today, yet travel back in time virtually to see or hear recent or distant past developments. Among the "stories" presented via this system is the 1968 student revolt or strike, when students and area residents opposed to the university's plans to build a gymnasium in nearby Morningside Park occupied by a portion of the university campus. Other situated documentaries presented via this mobile augmented reality system include the work of the inventor of FM radio, Columbia University professor Howard Armstrong; the early work of Enrico Fermi, the nuclear physicist who conducted nuclear fission experiments at Columbia University and later directed the Manhattan Project, which created the first atomic bomb; the story of the kilometer of tunnels that honeycomb the area beneath the campus (and were in fact used by Fermi when he had the Columbia football team carry radioactive materials across campus in an effort to begin building a nuclear pile in the basement of one of the campus buildings), and the prehistory of the campus when in the 1820s the same geographic area today occupied by the campus was home to the Bloomingdale Asylum for the Insane. Persons equipped with the Mobile Journalist Workstation (MJW) can walk the campus and access these multimedia stories embedded into the environment.

Although situated documentaries represent one type of location-based media content, they are only the tip of the iceberg. News media would be able to provide location-based content that might take the form of a news map,

where mobile news consumers might find out about the crime rate in a given neighborhood, street, or block; research local demographics or political leanings; check on upcoming local cultural events; or even access recent or historical news stories (perhaps featuring local celebrities or figures of historical significance) connected to a specific location. Such location-based media would appeal not only to local residents but to tourists as well.

Mobile media content opportunities are substantial in today's environment as wireless LANs grow around the nation and the world. Content providers are increasingly delivering news and other content services to consumers increasingly comfortable with obtaining news and entertainment on mobile, typically hand-held, devices. In addition, a growing number of interactive services are being developed for mobile devices, including games and text messaging, sometimes linked to content provided by a media organization.

Many networking technologies are themselves converging, opening up new possibilities. Moreover, network technologies and other components of the overall media system, including acquisition, display, storage, and production technologies, are often converging as well. In the past, each network in its analog form was separate and distinct, and merging them was not possible. Today, merging is increasingly common and cost effective.

One example of such convergence comes from the world of cable television. Although many cable television systems are still analog, many have converted to digital form, making it possible to compress signals in order to expand channel capacity or to permit transmission of high-definition signals that require more bandwidth. But, more than that, because the cable system, including the network, is digital, it is possible to merge the cable television network with other networks, especially fiber optic networks. The *Wall Street Journal* reports that a growing number of cable television companies have been leasing wavelength on fiber networks, but now some are beginning to lease or buy so-called dark fiber, or non-used fiber.[16] The largest cable company in the United States, Comcast, announced in early December 2004 that it was leasing 19,000 miles (about 30,000 kilometers) of dark fiber from Level 3 Communications Inc. in a 20-year agreement. Comcast will use the fiber to link together 95 percent of its cable systems. By leasing or buying dark fiber, the cable companies can build their own network from the ground up and make many new applications possible; they can also provide services, such as telephone service, to compete with traditional telephone companies.

One of the opportunities the fiber networks provide is based on the high

[16] Peter Grant, "On-Demand TV Expands via Underused Fiber Highways," *The Wall Street Journal* December 17, 2004, secs. B1, B2.

bandwidth available on optical fiber. Whereas cable television companies (and broadcasters) traditionally have distributed their video programming via satellite to head-end systems around the country (or to local affiliate stations), fiber makes it possible to distribute video programming faster and at less cost. The *Journal* reports, "Comcast's Mr. Fellows estimates that it takes close to a month to send 4,000 hours of on-demand content via satellites to all 500 Comcast head ends. Transmitting content through fiber-optic cabling is much faster," he explains. Further, the fiber network makes it possible to deliver on-demand video programming directly to the consumer in greater volume. Comcast reports that video on demand (VOD) programming requests in Philadelphia (one of Comcast's largest markets) have already grown dramatically since 2003, and by expanding fiber cabling to its network nationwide the potential is even greater. With approximately 800,000 digital subscribers in Philadelphia, requests for Comcast's VOD programming have grown nearly fourfold in 18 months, from fewer than five million in March/April 2003 to nearly 20 million requests for VOD in September/October. Comcast expects VOD requests in Philadelphia to exceed 20 million in November/December 2004.

Merging networks also opens up cross-market opportunities. Digital satellite providers, such as DirecTV, have already linked their satellite system with consumers' phone lines, making it possible to provide on-screen caller-ID services. Digital cable systems utilizing fiber networks will also be able to provide such services. Moreover, the digital network will permit delivery of a range of services, from Voice over Internet Protocol (VoIP), Video on Demand (VOD), video telephony, and interactive video games to multiple access or display devices, including computers, game stations, or television sets (either digital sets or sets linked to the network with a digital set-top box). Much of this is made possible by converged networks that are increasingly using Internet protocols. One Internet technology increasingly in use in these converged digital networks is called Gigabit Ethernet. This can be used not only to provide high-speed Internet access but also to deliver television signals at a high rate of transmission.

The convergence of distribution systems in digital form is also driving ownership convergence in the media business. The *Wall Street Journal* reports, "Time Warner Cable and Sprint Corp. are close to a deal that would let the cable company offer cellphone service on a trial basis early next year."[17] As of the end of the third quarter of 2004, Time Warner's subscriber totals are: 10.9

[17] Jesse Drucker and Peter Grant, "Cable Giant Is Close to Scoring Quadruple Play," *The Wall Street Journal* December 29, 2004, sec. B1.

million for basic cable, 4.6 million for digital cable, 3.7 million for high-speed Internet, and more than 200,000 for telephone service.

Storage

Since the late nineteenth century, electronic technology has been available for storing sound.[18] Since that time, significant advances have been made in electronic storage media, following five main trends. First, storage technology has moved from analog format to digital, or computer-based format. Second, the price of storage has fallen precipitously, so much so that in 2004 Google launched its free email service, gmail, with subscribers receiving one gigabit (GB) (1000 megabytes, MB) of free archival space. That is a lot of email. Third, although since the earliest electronic storage media the main medium has been magnetic, newer, more powerful storage media have emerged, especially optical, holographic, and other more experimental media, such as DNA storage. Fourth, whereas early technologies relied on steel bands, and later tape, and virtually all required some sort of mechanical or moving parts (even digital, magnetic, or optical hard-drives), the latest storage media, e.g., flash memory cards, have no moving parts. Fifth, the size of storage media has decreased substantially. The trend toward miniaturization is perhaps most significant because it means virtually all of today's digital media devices, including miniature mobile cameras, have embedded miniature, but powerful and low-cost, storage devices.

One of the convergence opportunities presented by advances in storage is already in full swing: the personal digital video recorder. PVRs have large hard drives, typically 80–120 GB or more, allowing for storage of up to 140 hours of standard-definition television or video with audio (roughly half that for HDTV). Leading the PVR marketplace is TiVo, but there are many other options, ranging from competing PVR brands to homemade PVRs. One of the advantages of the commercial offerings over the homemade versions is that, although they typically require a monthly service fee, they come equipped with advanced electronic programming guides and other services. TiVo offers a variety of services, including program recording management that enables the device to automatically record every episode of a viewer's chosen program throughout the viewing season; online scheduling; a search engine that permits searching by show title, actor, director, category, or keyword; access to a digital music service as well as to the consumer's MP3 files and photos on their home computer; transfer of shows from a computer to a TV set; and DVD burning. TiVo connects with any TV setup, including cable, digital cable, satellite, or other combinations. TiVo recorders (or other consumer

[18] See www.bbc.co.uk/dna/h2g2/A3224936.

PVRs) require a phone connection or broadband Internet connection. TiVo does not support HDTV, although other PVR services, such as DirecTV, offer HD PVR service.

Display

Finally, we will look at display or presentation technologies for accessing or displaying audio, visual, or other programming.

Perhaps the most compelling example of convergence today is the smartphone. Consider the Treo smartphone, particularly the Treo model 650 released in November 2004. This phone uses the Palm operating system, although calling it a phone is really a disservice and a vast understatement of its capabilities. True, the device does provide traditional telephone voice service, allowing users to call and talk to each other. But the Treo does much more through the convergence of many technologies. For example, it provides a variety of "telephone" type functions common to many other smartphones on the market, including text messaging, as well as email and a Web browser. It also provides voice mail. More than that, however, the device is a miniature computer and a fully functional, though small (requires the user to type with the thumbs), keyboard. It also has a camera, which permits it to take pictures as well as shoot video. The camera captures megapixel (more than one million pixels) resolution images and enables video and high-quality audio capture. Although the built-in memory is limited to twenty-three megabytes of RAM, a memory slot allows the user to insert a secure digital memory card, currently available with up to five gigabytes of capacity, more than enough to store over two hours of near-broadcast-quality video and audio. The 650 also has a quality video display with 320-by-320 pixels, offering vibrant and sharp images with 65,000 colors bright enough for easy viewing in full daylight. The 650 also plays MP3 music or other audio files with high stereophonic quality. Bluetooth wireless capability enables the 650 to synchronize with a wide spectrum of other, similarly enabled digital devices. Consequently, it is an easy matter to download or stream near-DVD-quality videos on the 650, and watch them quite comfortably, as the author recently did for the movie trailer of the hit 2004 comedy "Little Black Book." Bluetooth also enables the 650 to operate seamlessly with the author's Toyota Prius (gas-electric hybrid automobile) for totally hands-free telephone service using the Prius's built-in voice recognition function to place or receive calls.

Weighing just six ounces, the Treo 650 smartphone is a convenient size and is the first mobile device to integrate such a wide spectrum of functions seamlessly and comfortably. The US$600 price is still steep, but will fall as the product rolls out and competition enters the marketplace.

The real question is, just what is the Treo 650? Marketed as a smartphone,

it is really much more. The author routinely uses his Treo to take notes during meetings, to write memoranda or other documents when traveling, to surf the Web, to send and receive email, to schedule and keep track of appointments, to maintain an address book fully synchronized with both home and office computer and laptop, to make, edit, and display PowerPoint presentations, listen to music, watch movies, take pictures, shoot videos, record audio, and read long-form text documents, including books; the author recently read Dan Brown's bestseller, *The Da Vinci Code,* on his Treo while traveling. Essentially, just about anything that can be done on a computer or digital camera can be done on the Treo 650, except editing and broadcasting nonlinear video, but these capabilities are no doubt on the way. TV on the PC or PC on the TV . . . the consumer can choose.

Although far from the mainstream, today's PCs are increasingly capable of also being television sets, and many of today's television sets are increasingly capable of acting as PCs, or at least as devices for playing streaming video, surfing the Web, or accessing email. One of the leading Internet-via-the-TV sets is MSN TV 2, the second generation in this technology from Microsoft.[19] MSN TV 2 is in some ways a quintessential example of broadcast-Internet convergence. The device links a television set to the Microsoft Network, allowing the viewer to watch regular television programming, access the Internet, watch streaming video or listen to streaming audio, read or send email, view digital photos, and participate in online chat (instant messaging).

One digital TV system using Wi-Fi broadband in the home, introduced in 2004 by Sony, is called LocationFreeTV. The system involves "a portable personal broadband LCD television system that can be carried virtually anywhere across the country. Comprised of a 12.1-inch wireless touch screen LCD monitor and a base station, the personal TV system uses the industry's first dual band wireless connection and high speed Ethernet port to transmit data, transforming it into a mobile video entertainment powerhouse that allows users to enjoy television, video, Internet browsing/streaming video, email, and digital photos—all without a PC."[20]

Conversely, consumers also can use their PCs as television sets[21] or in combination with a TV set. In some ways, these devices reflect the full potential of media convergence. These systems are hybrids merging powerful computer processors, massive hard drives, advanced sound systems, and audio-visual

[19] See www.msntv.com/pc/.
[20] Available at http://news.sel.sony.com/pressrelease/4266 as of February 1, 2005.
[21] See www.digitaljoy.com.

presentation with surround-sound systems and large-screen video display, as well as high-speed Internet access and in-home wireless networking, linking a room or an entire home as a multimedia entertainment environment. One popular option is the Media Center running a Windows XP operating system. As the *Wall Street Journal*'s Walter S. Mossberg writes, "Media Center PCs typically include TV receivers and the ability to record TV programs to a hard disk, as well as to play music and videos and run slide shows of photos, all on a large TV screen. This year, Microsoft and its partners have built on that concept. The latest Media Center computers can beam TV programming, music, videos, and photos to televisions in distant parts of a home, using a home network and an add-on device called a Media Center Extender. And more PC makers are offering Media Center computers that look like home-entertainment-center components rather than traditional PCs."[22]

These systems come equipped with large amounts of memory (512 MB), a main 200GB hard disk, and a removable, back-up 160GB hard disk. But, as powerful as they are, they are not without their drawbacks. As Mossberg explains, some systems do not support the most popular form of home wireless networking, Wi-Fi. Moreover, price is a major drawback, with some of the systems running as high as US$1,800.

FOUR CONSEQUENCES OF CONVERGENCE

The broad areas of digital media technology presented above are increasingly interconnected, or converged. Together, they have four major types of consequences for broadcasting: programming implications, structural transformations, alterations in how media professionals work, and transformation of the audience relationship.

First, we discuss how programming or content is changing as a consequence of convergence. Second, we analyze how broadcast industry structures and cultures are changing in response to convergence. Third, we examine how convergence is transforming the way in which broadcast professionals do their work. Finally, we will assess how relationships between or among the broadcast industry and its many publics are changing as a consequence of convergence.

Programming Implications: Wireless, Mobile, Broadband

Wireless technology has significant implications for content or programming

[22] Walter S. Mossberg, "Entertainment Center Works Well in 1 Room But Not Through House," *The Wall Street Journal* December 23, 2004, sec. B1.

in broadcasting and the media in general. Consider the following wireless media typology, in which the content production or presentation model is represented by the vertical axis and bandwidth by the horizontal axis:

Figure 2. Wireless Media Typology

Bandwidth / Content Model	Narrowband	Broadband
Traditional	I Linear Text	II Linear Audio Video
New Media	III Hypertext, Blogs	IV Location-Based Multi-Media

There are two basic content models, at opposite ends of the spectrum. First is the traditional production or presentation model. In this model, the long-standing practices and assumptions of media storytelling guide production and presentation, whether print or broadcast, analog or digital. The model is based on linear presentation, with stories featuring a beginning, a middle, and an end, and all audience members receive or access the same story and experience it essentially in the same manner. This model has applied to most mass media throughout the twentieth and early part of the twenty-first centuries. The second content model utilizes the unique qualities and capabilities of a converging digital network. In particular, this model emphasizes interactivity and non-linearity of presentation, and in a broadband environment, multiple media modalities and location awareness.

Bandwidth is divided into two broad classes, distribution systems, or access speeds for the audience. These are narrowband (slow speed) and broadband (high speed). Narrowband wireless is analogous to dial-up wire line or fixed land-land telecommunications, and broadband is analogous to the traditional broadcast or satellite spectrum capabilities, except in the digital environment, where broadband capability is increasingly available in addressable form or on demand for each individual audience member or consumer. Using technologies, such as Wi-Fi, EV-DO (Verizon's new high speed wireless service rolled out to eighteen major U.S. metropolitan markets in 2004), 3G cellular, or Bluetooth, broadband digital wireless radio spectrum provides audience members or consumers with high-speed mobile access to a wide range of interactive services, ranging from text to voice to virtual reality applications.

In the two wireless content models presented in Figure 2, there are four content or programming types relevant to broadcasters and other media content providers, especially in the coming decade and beyond. Type I features content designed using traditional programming techniques and customized for a narrowband distribution or access environment. Most typically, this means linear text, frequently designed for analog delivery systems, such as

newspapers or videotext, but repurposed or packaged in digital form for Internet delivery via the World Wide Web for cell phones or other handheld devices with Internet access.

Type II features content designed using traditional models of programming or presentation and customized for broadband distribution or access environment. Most often, this means linear audio or video, frequently designed for analog delivery systems, such as terrestrial broadcast or cable or satellite distribution, but repurposed or packaged in digital form for Internet delivery via the World Wide Web for cell phones or other handheld devices with Internet access.

Type III features content designed using new media models of programming or presentation and customized for narrowband distribution or access environment. Most often, this means nonlinear text, such as hypertext or Web logs (blogs), sometimes enhanced with images, such as digital photos or interactive (clickable) graphics. Audio or video, designed for digital distribution, especially via online systems such as the Internet, and customized for access via digital cell phones or other handheld devices with Internet access, are other capabilities with Type III.

Type IV features content designed using new media models of programming or presentation and customized for broadband distribution or access environment. To date, there has been relatively little content produced for this type or category. Rather, most content produced or available for mobile devices has been in Types I, II, or III. These types of content have been the least expensive to produce, require the least investment in development, and offer the lowest risk. It has been relatively easy and straightforward to move from traditional models to new media models when bandwidth requirements have been low, or to repurpose existing programming for digital distribution. Creating quality content is always expensive, and to create it using largely unproven techniques requires considerable commitment to risk taking and to the possibility of failure. Moreover, it requires retraining staff or hiring new, young producers who may have an intuitive grasp of the new media models but may have not the seasoning or talent to guarantee quality programming in the competitive marketplace of the global media world. Consequently, it has not been surprising that little Type IV content or programming has emerged to date.

Yet, it is in Type IV where the greatest opportunity lies. Here there is opportunity, not without danger, to distinguish oneself from the pack, to separate from the mainstream, and to take the lead. Consider the development of what is increasingly being referred to as location-based media. Location-based media are those that involve content tailored to and accessible at specific geo-

graphic locations in the physcal world. One example of this is the situated documentary described earlier in this essay.

There are many other possible forms of content in Type IV. Among them are news maps. A news map might take the form of a data-driven graphic customized to a particular location. Further, 360 video, interactive 3D graphics, and flash animations might also be developed.

Transforming Structure

A major consequence of convergence for media is structural transformation. Convergence is not driving just technological change, but change in the organization of media operations as well as the ownership structure of media. This is especially evident on a national and international level, where converged media behemoths are emerging. But it is also occurring on a local level, where media companies with cross-media interests, such as the Chicago-based Tribune Company, are pursuing convergent markets where they have acquired or developed newspaper, broadcast, and online properties.

One of the potentially most significant developments in convergence is the converged newsroom. In the analog age, the newsroom was organized largely in terms of the requirements of the technology, and most news organizations gathered news for only one type of news delivery system: print, television, or radio.

In the digital age, we can, as *The New York Times*'s wordsmith and Assistant Managing Editor Allan M. Siegal once observed,[23] use digital technology, which enables us to organize the newsroom entirely as we wish and not be constrained by the limitations of analog technology.

Taking advantage of this technological opportunity, a growing number of media organizations have begun creating converged newsrooms in which reporters who formerly would have gathered news for delivery in only one medium are now working in a convergent environment where news in all formats is gathered, processed, and delivered on potentially all media platforms, in a process some call media divergence. Among the news organizations that have developed convergent newsrooms are *The New York Times*, CBS News, and *The Orlando Sentinel* in Florida.

In an editorial on delivering Internet via digital broadcast spectrum, Philip Laven of the European Broadcasting Union (EBU) asks the interesting convergence question, "Can digital TV deliver the Internet?"[24]

[23] Allan M. Siegal, comments on October 12, 1997 at the Media Studies Center, Columbia University, New York.

[24] Available at www.ebu.ch/trev_288-editorial.html as of February 1, 2005.

The answer is an equivocal "yes." Email and surfing the World Wide Web are two-way, one-to-one interactive services available on the Internet. Can a one-way, one-to-many broadcasting network accommodate these services? The answer is that, with digital spectrum, the broadcast transmission network could be used as a downstream or download channel with the upstream or individual audience requests being submitted via telephone lines (digital cable could also be used, but this would be an unlikely combination since if the user already has digital cable, they would not be inclined to also use slower broadcast Internet services). Email could be received via the broadcast spectrum but would be sent via the phone line. The text of the email would be shown on the viewer's home television set. Analog teletext has long offered similar service, primarily outside the United States. Laven explains, "Users can use their telephones to request private information, such as the latest statement of their bank account. The statements are transmitted via teletext and displayed on their TV screens."[25]

A Web page would be received via the broadcast spectrum, but the request for the page would be submitted via the phone line. Digital satellite Internet service from DirecTV, for example, called DirecWay, already works like this. For persons in remote, rural, or sparsely populated areas where digital cable or DSL service is not available, such services may be desirable as the only means to obtain relatively high-speed Internet service (at least for downloads). Laven explains that the effectiveness of such an approach is limited because of the shared nature of the bandwidth:

> Digital terrestrial and satellite TV transmissions can deliver data at, say, 24 Mbit/s. At first sight, this data rate seems impressive in comparison with 28.8 or 56 Kbit/s telephone modems—but the broadcast data transmission must be shared with other users. If a digital terrestrial transmitter serves 1 million people and if only 1 percent of the potential audience (i.e., 10,000 people) requests data via the digital transmitter, each individual would receive an average data rate of 2.4 Kbit/s. At this rate, users would not be happy to find that many web pages would take 100 seconds to appear! In practice, even this average data rate would be difficult to achieve as few broadcasters have sufficient spectrum to reserve an entire digital terrestrial TV multiplex for such "non-broadcast" services. Terrestrial broadcasters might decide to allocate 2 Mbit/s for such services, instead of 24 Mbit/s, thus further restricting the available data rate.[26]

[25] Available at www.ebu.ch/trev_288-editorial.html as of February 1, 2005.
[26] Available at www.ebu.ch/trev_288-editorial.html as of February 1, 2005.

Laven notes that the problem is less severe for satellite broadcasters:

> Data capacity is less of a constraint for satellite broadcasters: some already offer "high-speed" surfing to their customers, by delivering 20–30 Mbit/s per transponder for the downstream links. Again, the success of these services depends on the number of simultaneous users: if there are 1,000 users, the average data rate per user will be 20–30 Kbit/s. Practical experience of such systems confirms that the download speed depends on the number of simultaneous users: excellent results can be achieved in the middle of the night, but the results can be disappointing during busier periods. Of course, data rate is not the only criterion to judge the success of such services: one satellite beam can cover much of Europe, thus covering areas beyond the reach of wired "broad-band" services, such as ADSL or cable modems.

One approach that might be more viable for broadcasters would be to provide "walled garden" versions of the Internet. In this environment, broadcasters would distribute a limited pre-set selection of Web pages, perhaps the top 100, via the digital transmission channel. "The entire contents of the 100 pages might be transmitted via a data carousel every 20 seconds, thus giving an average waiting time of about 10 seconds."[27]

Changing How Media Professionals Work

In the current environment, most converged newsrooms work using almost exclusively digital technology to gather the news. Reporters may take notes using paper and pencil, but increasingly they utilize laptops, notebooks, or handheld devices to capture their notes digitally. Photographers and videographers use digital cameras and audio recording devices to capture images, motion pictures, actualities (sound bites from sources), and ambient sound for a story. Some reporters use these devices themselves when operating without a photographer or video crew. Using these digital devices provides a streamlining of the process and greatly increases efficiency of postproduction, and moreover, allows reporters to work closer to deadline. All of this means the reporter and editor can focus more on the story, the facts, and getting the details as well as the big picture right, or more accurate. Filing stories and multimedia materials can be done digitally as well, via wireless or other telecommunications technologies. This can save the reporter a trip back to the physical newsroom, further saving time and expense.

[27] Available at www.ebu.ch/trev_288-editorial.html as of February 1, 2005.

Once the material is filed, then editors at all desired levels can directly and instantly access the material, which can be indexed for better and faster searching, retrieval, and editing. This can enable further time saving and production efficiency. Edited stories can then be fed directly to various news outlets, including traditional print, broadcast, or online media, as well as placed into the news archive for later research purposes.

Next-generation systems will likely employ versions of the Mobile Journalist Workstation described in the "Distribution" section of this essay. Reporters using the MJW will find at least three major advantages in using the system for newsgathering. First, the system can automate much of the news capture and recording process, thus enabling the reporter to focus more on asking the right questions, finding the right sources, and producing better reports. The system can do this by employing technology, such as the 360 camera for video acquisition or a computer-based indexing system to automate indexing of content.

Second, the MJW system can embed digital watermarks directly into all materials acquired, thereby both authenticating and copyright-protecting content. In a time of rampant audio and video piracy, as well as questioning of the veracity of news content, such watermarking using GPS technology can be invaluable.

Third, the MJW system can record all the actions of reporters, including creating a virtual map of where they went and when. This can be a useful tool in protecting against potential libel or contempt of court proceedings where the journalist must, as part of a defense strategy, establish the professionalism of her or his actions. Moreover, such documentation on the fly could be life saving during times of crisis, where a reporter in a war zone, for instance, might need digital mapping capabilities to find the way out of unfamiliar terrain.

The Virtual Newsroom

One step even further into the future is the virtual newsroom, perhaps the ultimate in convergence. The virtual newsroom utilizes technological convergence to eliminate almost entirely the need for a physical newsroom. Instead, reporters spend virtually all their time where they should: in the field where the stories are, capturing news material, checking facts, interviewing sources, and generally getting the news. Reporters only occasionally return to the newsroom to meet with editors to review assignments, story development, and the like, and do not need their own exclusively assigned space. Instead, they can utilize a shared space on a rotating or flexible basis. Editors can work in a shared space, too, as well as utilize telecommuting capabilities to edit re-

motely. This can greatly reduce space costs and overhead and extend the human capital of a news organization by bringing in experts and specialists who may not live near the traditional pre-convergent newsroom organization. Reporters utilize the MJW and advanced wireless technologies to gather, process, and file stories in a digitally secure environment. All content is digitally watermarked, password-protected, and encrypted using public key encryption technology.

Some news organizations are already on a path toward the virtual newsroom. In Europe, a consortium of broadcast news organizations has pooled resources to create a working version of the Mobile Journalist Workstation to capture and produce news materials for the World Wide Web. Media production might generally exploit these digital opportunities as well, while exploring distributed edition and production techniques for entertainment programming.

ESPN.com: A Convergence Case Study

One of the most interesting examples of convergence comes in the form of a website.[28] A property of Bristol, CT (USA)-based ESPN, ESPN.com is a leading provider of sports news. As reported by Hoovers.com, Larry Bills, Tuesday, December 21, 2004:

> ESPN is a superstar of the sports broadcasting world. The company is the leading cable sports broadcaster with seven domestic networks—including its flagship ESPN, ESPN2 (sporting events, news, and original programming), ESPN Classic (historical sports footage), ESPN HD, and ESPNEWS (24-hour news and information)—that reach more than 88 million US homes. It also reaches another 145 countries through ESPN International. In addition, ESPN creates content for TV and radio and operates one of the most popular sports sites on the Internet. ESPN also has lent its name to a magazine and a chain of sports-themed restaurants. ESPN is 80 percent owned by Walt Disney (through Disney ABC Cable); Hearst has a 20 percent stake.[29]

With 2003 revenues of US$2.87 billion, the company saw 35.3 percent growth in the past year.

The ESPN website provides a combination of up-to-the-minute sports news; scores; statistics and analysis; extensive video and audio programming;

[28] See www.espn.com.

[29] Available at www.hoovers.com/espn/--ID__103583--/free-co-factsheet.xhtml as of February 1, 2005.

chats with players, ESPN experts, and sports personalities; and free as well as premium fantasy games. The site targets young and affluent male sports fans. The home page of ESPN.com simultaneously opens with text, graphics, and streaming audio and video. This multimedia combination provides a unique experience for the sports fan.

Transforming the Audience Relationship

One of the most important sets of consequences of convergence is the transformation of relationships between media organizations and their publics. These publics include, but are not limited to, these five groups: 1) the audience, 2) sources of news and information, 3) funders or sponsors of programming or content, 4) competitors, and 5) regulators.

There are four basic trends with regard to the transformation of these relationships. First, because of convergence, these relationships are cutting across media types. For example, media audiences are increasingly linked to a brand, regardless of whether it is in print, broadcast, or online. Second, these relationships are increasingly global in nature. This is especially evident with regard to regulators of media. Consider this 2004 case involving a subsidiary of e-Bay, a U.S.-based online auction website.[30] E-Bay is not normally thought of as a content provider, but at least some of the products its subscribers auction or sell include content, and in this case one particular content item drew international attention: a sexually explicit video put up for sale on the Indian shopping site Baazee.com, an e-Bay subsidiary, led to the arrest of the company's chief executive officer.

As reported by Yahoo! News Asia:

> Avnish Bajaj, the CEO of Baazee.com—India's most popular shopping portal, now owned by California-based eBay Inc.—was arrested Friday in connection with the sale of images showing teenage classmates at a New Delhi high school engaged in oral sex.
>
> The U.S. company said it was 'outraged' by the police action, saying the sale took place without the knowledge of company officials. The seller violated the company's policies and Baazee.com took appropriate action in removing the item from its site as soon as it became aware of it, the company said.
>
> Bajaj was in court on Saturday, where the judge refused bail and sent him to jail for a week. A U.S. Consular official also attended the court hearing, the U.S. Embassy statement said, but didn't elaborate.

[30] See www.ebay.com.

> The boy, who filmed the act on his camera-fitted mobile phone and circulated it to his friends, was arrested Sunday night after a weeklong hunt. Police believe his arrest will help in tracking how the video clip reached its seller—an engineering student in an eastern Indian city, who was arrested a week ago.
>
> "The video clip itself was not shown on the site; the seller offered to email the clip to the buyer directly," an eBay statement said. "The listing violated Baazee.com's policies and user agreement and was removed from the site once it was discovered," it said.[31]

Another example of audience relationship becoming global via convergence is the many audience members who are becoming content or programming providers. This was especially apparent during the days and weeks following the devastating earthquake and tsunami in south Asia in late December 2004. Video blogs (Web logs or Web diaries) grew in number and popularity, many offering extensive tsunami videos, oftentimes more than what was available on TV. One blog, "Cheese and Crackers,"[32] had been drawing just ten visitors a day prior to the publication of the tsunami videos, reports the *Wall Street Journal*, but registered 640,000 hits on December 30, 2004, when it posted tsunami videos.[33]

The third trend in the transformation of relationships because of convergence is the increasingly interactive nature of these connections. Through email, interactive TV, and other technologies, audiences, sources, and other publics are linked increasingly directly and frequently with those in the media. This includes journalists, editors, "talent," and management.

Finally, relationships are increasingly fleeting and fragmented. Whereas in the past, media generally had long-lasting relationships with sponsors, audiences, and other key publics, today's convergent media system, so global and competitive across media types, is highly unstable and fluid. Audiences can move quickly from one media channel to another, and have far less loyalty than in the past. On the other hand, media audiences are increasingly willing to pay for media content or programming they find desirable in a convergent system.

One of the opportunities presented by this change is the expansion of on-demand programming rather than scheduled programming. With a plethora of media options and convergent media devices and technologies, consumers are

[31] Available at http://asia.news.yahoo.com/041220/ap/d873bln00.html as of February 1, 2005.
[32] Available at http://jlgolson.blogspot.com as of February 1, 2005.
[33] Antonio Regaldo and Jessic Mintz, "Video Blogs Break Out With Tsunami Scenes," *The Wall Street Journal*, January 3, 2005, sec. B1.

increasingly availing themselves of on-demand media content, from on-demand movies to PVRs (such as TiVo) to blogs. Traditional broadcasters have a significant opportunity to introduce on-demand video programming. In many ways they still have among the highest quality video programming, but they are generally still clinging to traditional delivery strategies based on scheduled programming. Viewers, especially younger audiences, are comfortable with on-demand media (e.g., music) and are willing to pay for it when packaged well (e.g., consider the success of the iPod from Apple), and they are increasingly accustomed to an on-demand media consumption habit. Unless traditional broadcasters (i.e., video programmers) adapt to this new media landscape and make a serious commitment to on-demand video programming, they will likely see their audience base erode even further.

THE PITFALLS OF CONVERGENCE: A CAUTIONARY NOTE

This essay has examined convergence and its implications for broadcasting and the media. Five broad technological trends within the framework of the digitization of broadcasting and the media have been reviewed, including acquisition, production, storage, distribution, and display or access. Further, the consequences of these trends have been analyzed in four areas, including implications for media programming or content, media structure or organization, how media professionals do their work, and finally, the relationship between media and their publics, especially the audience.

In general, these convergence trends have been assessed in terms of the potential opportunities they present for developing and improving media organizations, programming, and production. Among these opportunities are increased operational efficiencies, more interactive and involving programming, expanded distribution or networking capabilities, and new creative avenues to be explored.

Although convergence offers many advantages to broadcast and other media organizations, there are at least four major areas of concern. First, convergence does not automatically provide better quality, improved efficiencies, or lower costs. Rather, convergence offers opportunities, but they must be systematically pursued and developed to realize their potential.

Second, convergence may actually undermine quality, especially in journalism, where reporters may be pushed to do too much. If reporters travel into the field equipped with excessive technology, they may lose sight of the story. They may be busy trying to capture all the sights and sounds, while neglecting to ask the right or tough questions. Further, the pressure to do more with less may create an inversion of priorities where cost savings are put at a pre-

mium over improved quality. Although cost reductions may increase profits or other economic gains in the short run, in the long run this is a surefire formula for failure, as audience base will gradually erode and audiences will move to alternative media where quality programming experiences are more available.

Third, convergence may create false expectations. Managers may see convergence as an end in itself. Convergence is only a means to an end. The end is better content. When properly designed and executed, convergence can help bring about that goal. Consider this "Technology" report by Chris Gabettas in "Three's Company." Gabettas writes:

> Corporate bosses had a vision of the future—a world driven by the reach and immediacy of the Internet, where wireless technologies make it possible to deliver news and information to consumers wherever they are, whenever they want. (If you can't live without your Palm Pilot now, you're already there.) "If we do nothing," says Bradley, "we're destined to die. We must figure out a way to meet the new media demands, and that's what we're trying to do in this facility."
>
> Convergence, according to WFLA president and station manager Rick Rogala, combines the immediacy of the Internet, the urgency and emotion of television and the depth of the print medium. Partnering with new technologies to deliver your news product is likely to guarantee your survival, he says. But some critics fear convergence will limit the amount and type of news covered within a community. Fewer points of view will be expressed. Fewer voices will be heard.
>
> University of Wisconsin-Madison journalism professor and media trend analyst, James Baughman, sees another problem: "big media companies becoming so pre-occupied with turning a profit" that they sacrifice good journalism to save a buck. Still others worry that reporters, rushing to prepare stories for various outlets, won't have the time to produce quality work.[34]

Finally, convergence is a global phenomenon cutting across all media types, including such newcomers as video games, now a multi-billion dollar industry rivaling Hollywood in economic status. As such, convergence is bringing cross-media and cross-border competition to new heights. Media organizations must be acutely aware of this competition, whether they are for-profit or public service organizations, and design their programming within this context.

[34] Available at www.rtndf.org/technology/convergence.shtml as of February 1, 2005.