



Convergence, Interactive Media, and Innovation

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What is it about Canada and its people that has caused us to play such a significant role in the evolution of electronic communications and media? Although there could be no shortage of thoughtful theories on the subject, I have my own. Perhaps it is due to the vastness of our country and a desire to use technology to overcome distance and to build a community in a sparsely populated frontier.

Consider the early Canadian innovators and their inventions: Alexander Graham Bell and the telephone and its network; Reginald Aubrey Fessenden and the world's first radio broadcasts; and Edward Rogers, Sr. and the first alternating-current radio tube. Were these inventions a reaction to circumstance and environment? Regardless of the motivation, it would be difficult to dispute that these inventions, and the subsequent development of the telecommunications and broadcasting industries, have had a tremendous impact not only on Canada but on modern society everywhere.

Historically, Canadians have also been leaders in understanding media and its effect on society, as reflected in the seminal work of the legendary Canadian communications theorists Harold Innis and Marshall McLuhan. Today, Canadian researchers continue this tradition, taking leading roles in exploring new forms of communication and media.

If we look closely at the world around us, new forms and configurations of communication and media are in healthy evidence. Telephone companies are now television networks. Internet providers have become media developers. And software companies are cable television empires. Is it just another sign of a modern world with little respect for traditional boundaries? Not really. The explanation lies in one simple word: Convergence.

Convergence is the melding of previously segregated fields of computing, telecommunications, and broadcasting. It's a popular theme that found new relevance in the 1990s as media and communications mergers occurred in Canada and abroad. But the concept is not entirely new. There has long been a convergence of sorts as technological infrastructure has been unified and shared among seemingly unrelated fields. Need examples? Just take a short trip back to the 20th Century.

In the analogue era, vacuum tube electronic systems were the basis for both long line telephony and radio broadcasting. The telephone industry initiated the move to digital in the 1950s with digital audio transmission systems. And the transistor was invented by Bell Labs and then used extensively in telephony, radio, television, and even early computers. All these are prime examples of many different technologies converging and laying the foundation for our modern world. And now, at the beginning of the 21st Century, with digital technology the common core for all three of these industries, and with the emergence of large media/communications corporations, are we achieving the ultimate convergence?

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Before we can begin to deal with this question, a recounting of my own journey is in order. My personal quest for convergence in my work started in the early 1970s when I went searching for a university that would allow me to study both engineering and music. Although it was an almost impossible combination at most institutions, at Queen's University in Kingston they somehow shared my vision and saw only potential. Dr. David McLay, a physics professor and Associate Dean of Arts and Sciences at Queen's, thought it was a splendid idea and helped craft a special program of study that would combine my interests. Of course it didn't hurt that Dr. McLay was also a musician. Five years later, I was armed with a B.Sc. in electrical engineering and a B.A. in music. I had achieved my own particular brand of convergence.

Upon graduation, I was fortunate to join Northern Telecom's brand new Digital Switching Division. In my new position as part of a multidisciplinary research and development team, we developed and introduced the DMS line of switching products—a range of fully digital circuit switches that deliver local exchange and long distance services worldwide. The magic of these products was to take analogue audio, convert it into digital bits of information, and then use computer technology to connect telephone calls. It was a truly innovative technology in its convergence of audio media and digital computing. It became the basis for the tremendous success that Nortel subsequently experienced, allowing the company to become a major world telecommunications supplier. And it happened right here in Canada.

Years later, for many consumers of modern technology looking to the landmark inventions by Nortel, Bell, Fessenden, and Rogers, it may appear that little has changed since then; that there is almost no evidence of "convergence" in their daily lives as end users of technology. After all, since most of us still use a telephone, a radio, a television, a computer, and the Internet as purpose-built devices, these individuals reason that nothing has changed in the interaction between man and machine.

I suspected they were wrong. And it was this very suspicion that inspired me to pursue graduate research in the 1980s. At the time I realized that to discern how to combine some of these functions of technology, I needed to know more about how humans interact with machines. The answer for me was a doctoral program in information systems, with a focus on human-computer interaction and research into the new forms of end-user functional convergence. It ultimately led to a new career as a professor and researcher, and to new forms of end-user functional convergence.

The first of these took shape at the Rogers Communications Centre at Ryerson University in Toronto, where we have been experimenting with exciting new forms of Interactive Television (ITV). ITV combines traditional one-way television with two-way enhancements to allow viewers to engage in controlling, altering, or even creating content. As exciting as the concept is, however, ITV has been a technology looking for an audience for many years. Early ITV trials have used cumbersome technology and crude programming resulting in interactivity that was often facile. Today, ITV technology attempts to combine the best of traditional television broadcasting with the full two-way flexible form of interaction we have come to expect from computing and the Internet. This combination attempts to provide rich full-motion video, high-quality audio, and an Internet browser style of user navigation and control. The result? New

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forms of end-user functional convergence that provide more utility than simply viewing poor quality television on a computer screen.

Technology, however, is not the only point of concern in this new medium. There's also the business side. A fully interactive, two-way television environment has the potential to completely disrupt existing revenue models for the broadcast industry. It may also change the power relationship between content creators and formerly passive content consumers. Devices such as personal video recorders (that allow users to record television programming on a hard drive) threaten the advertising revenue base of broadcasters by making it easier for a viewer to pause real-time broadcasts and to fast-forward over commercial content. Since early research indicates that viewers are receptive to advertising if it is congruent with their interests and needs, the solution to the potential threat posed by ITV may lie in the delivery of smart advertising that is customized to match the individual viewer's profile and interests.

As with any new technology, especially one that brings together all the known and unknown elements associated with convergence, ITV has raised some questions. Can it provide more user control and shift the broadcast power structure to the audience? Is there a role for interactivity in telling linear stories? What is the financial model for ITV? Is it viable? The answers will come as the technology develops and is more widely implemented.

Another successful application of media technology to improve access is an initiative called Providing Education by Bringing Learning Environments to Students (PEBBLES). Headed by my Ryerson colleague Dr. Deb Fels, PEBBLES is an innovative system that combines video conferencing and robotics technologies to allow a student in a hospital to participate in regular school activities. It also serves to alleviate the isolation that these young patients experience in such situations. How does it work? One component of PEBBLES is located in the classroom, and the other is in the hospital. The school unit is a yellow child-sized, egg-shaped robot. It is the student's representative in the classroom and transmits a live, audio-visual image (like a picture telephone) of the classroom to the student in the hospital, and vice versa. PEBBLES was developed by a joint research team from Ryerson University and the University of Toronto, in conjunction with industrial partners, and is another prime example of modern convergence at work.

The convergence of broadcast and the Internet is also affecting how Canadians deliver education. As already outlined, ITV uses traditional broadcast or cable systems to deliver video combined with a traditional phone line or other channel for user input. However, all of the media can now be delivered using a high bandwidth Internet, such as the CANARIE CA-Net 3 network in Canada. This has the advantage of allowing the participant to generate and send, as well as receive, high bandwidth content such as video.

Ryerson University was a participant in the Wurcnet Knowledge Networking Initiative, an innovative research project that used the CANARIE Network (an Internet development organization headquartered in Ottawa) to deliver a graduate university course to participants at six Canadian universities—using video conferencing based on multicast backbone (mBone) technology. Dr. David Mitchell at the University of Calgary

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headed the project in which students and professors at each university site actively participated with each other using high-quality video links among the institutions. Responsibility for the lectures rotated between the sites, and guest speakers were brought on-screen across the country, providing graduate students with direct access to experts in Canada and, potentially, from around the world. Considering the size of Canada and its small population distributed across a vast distance, the entire initiative was particularly attractive because it would allow universities to collaborate and form the critical mass of researchers and students necessary to mount world-class programs. Many other active research projects using technology in education promise to significantly affect how we will deliver education in this country.

I firmly believe that two-way gigabit bandwidth network availability will affect the power relationship between content developers and content consumers. We have seen the evidence of this in the rapid growth of Napster, the controversial and now defunct music-sharing Web site, and other peer-to-peer Internet applications that have sprung up to replace it. Today's low- to medium-speed Internet connections are well matched for delivering audio content, and the recording industry has been the first affected by users freely sharing digital music and ignoring intellectual property ownership and copyright.

Over the next while, higher-speed connections will allow peer-to-peer sharing of much larger digital video (DVD) and other media files. The free distribution of a first-run movie over the Internet moments after its release is of concern to film and video producers. The threat will provide rich areas for research in digital watermarking, copy protection, and digital compression, not to mention the related ethical, legal, social, and business issues.

Gigabit Internet technology also promises to change the way media content is created and produced. Traditionally, the production of video and film has been an expensive process using specialized teams of people and equipment. Over high-speed networks, it will be possible for individuals to work collaboratively and gain access to Internet-based specialized production tools and services. This sharing of expertise and technology could significantly lower the costs of production, allowing a "desktop" production cottage industry to flourish. Small independent creators with important stories to tell could obtain shared access to state-of-the-art production tools and services for editing, digital animation, and rendering and special effects from their studios over inexpensive high-speed networks.

Many years after the first telephone, the first radio broadcast, and the first alternating-current radio tube, it is clear that Canada's strong tradition of innovation in communications and media will continue as the fields converge in the era of new media and the Internet. It has been a thrill to participate in the Canadian communications industry, and to witness the innovation and contributions to the field. Over the next few years, world demand for media services is expected to explode with the proliferation of wireless media devices, interactive broadcasting, and high bandwidth Internet connections. I am certain that Canada's community of researchers can be expected to continue to make significant contributions to the growth of these evolving digital content and technology industries.