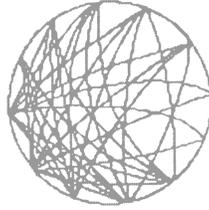

CHAPTER 9



LINKS

Being in Touch

Only connect! That was the whole of her sermon. Only connect the prose and the passion, and both will be exalted, and human love will be seen at its height. Live in fragments no longer.

—*Howards End* by E. M. Forster¹

Connecting across Centuries

August 19 is the national day of mourning in Nepal. Two young boys walk down Pulchowk Road (which links Kathmandu to Patan), steering a cow dressed like a clown. They're headed for Patan Durbar Square with Walkman stereos strapped to their heads. There the prime minister will tell jokes, front-page news in *The Kathmandu Post*. Mourning lasts for a year in Nepal, and then it's time to give it up. Laughter is the national cure.

Just around the corner and housed in a little clump of small buildings is the International Centre for Integrated Mountain Development.² ICIMOD has been around for a while, protecting the resource-rich, 2,100-mile-long Hindu Kush–Himalaya mountain range, home to more

than 140 million people in Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan.³

Many of ICIMOD's constituents live in remote villages where, as in much of the world, there are no phones, satellites, or any other distance-spanning technologies save the foot. It can take a month for an ICIMOD letter to reach northwestern Nepal and at least another for the reply to return.

Back in ICIMOD's charmingly modest headquarters, messages and information zip around the world, thanks to a very fast communication line⁴ that links it directly to Singapore. The organization, itself a collaboration of eight regional, four Scandinavian, and two European countries, has been online since April 1, 1996, when it declared "full-scale connectivity for electronic mail as well as its own Homepage on the World Wide Web."⁵ Clearly, Nepal, like much of the world, bridges the ages. In terms of access to technology, we are both in one another's backyards *and* we are universes apart.

Wrapped around our planet is the *connect*, the way to communicate at very low cost regardless of where we are in time or space. Spontaneously and with little planning, perpetual global conversations have erupted in a finger snap, making next-door neighbors of people in Yellow Springs, Ohio; Bangalore, India; and Banjul, The Gambia. No single organization owns the Internet, the earth's interconnected computer network of networks. No authoritative hierarchy governs it. And it has grown faster and in more directions than ever predicted. It's affecting the world in ways we never imagined.

Some people, like writer and electronic community pioneer Howard Rheingold, saw what was coming. In 1984, he wrote, "Before today's first-graders graduate from high school, hundreds of millions of people around the world will join together to create new kinds of human communities, making use of a tool that a small number of thinkers and tinkerers dreamed into being over the past century. . . . The computer of the twenty-first century will be everywhere."⁶

Rheingold went online for the first time in 1985 and, like a few tens of thousands of other people, got hooked.

"No one really predicted that this little subculture of the 1980s would become the web of the '90s and would change everything," Rheingold says today.⁷ "We didn't see all of the e-commerce and portals and a jillion web

pages, not developing as quickly as it has. It was just a little subculture for 20 years that began . . . with 1,000 people. The growth curve has been extraordinarily rapid recently, but existed for a long time. It's the 'network effect' that Kevin Kelly⁸ wrote about. Emergent properties from networks of people of certain sizes."

The Internet is an electronic technology that makes it possible for people to "only connect." The Network Age is all about the ability to develop relationships that endure across space and time. Geography is no longer a barrier to people's capacity to work together (co-labor, hence the word *colaborate*) and braid communities.

Telecommunications and the global economy have arrived for millions of people, bringing with them new partners in daily work. Colleagues can sleep to opposing clocks and still belong to the same team. This is true, but it is not easy. The explosion of links across every conceivable boundary is staggering in its complexity, as languages, cultures, governments, distance, and the mysterious nuances of human behavior all play their parts.

The technology network *supports* the people network. Those who regard the technology alone as the network miss the point. Networking means people connecting with people, which happens whether they're sitting around a conference table, checking messages, pressing phones to their ears, staring at computers, standing by fax machines, or opening the increasingly rare specimen of handwritten mail.

But the technology *is* amazing, and truly different.

Circa 2086

Motorola's product road map goes out to the year 2086. According to the plan, that's about the time, give or take a few years, you'll "be able to translate yourself from place to place *Star Trek*-style at the speed of light," says the company's chief technology officer Dennis Roberson. Johns Hopkins has already taken the first step toward the transporter, he reports. "They've translated a molecule. They've figured out what's there at one end and re-created it at the other."

Won't those who are reading (or writing) these words need replacement parts in order to be around to witness, or better still, experience, this? "We're working on those too," Roberson replies.

“Because We’re Motorola”

The company that got its start with five employees and the assets of a bankrupt business of battery eliminators (which allowed battery-operated home radios to operate on ordinary household current) was the first winner of the prized U.S. Malcolm Baldrige National Quality Award in 1988.

Motorola’s past, present, and future lie in distributed communications. The company makes the devices (pagers, phones) themselves, the chips that power them, and the systems that carry their signals, what Roberson describes as “a very large universe.” The company is responsible for so many distributed communication innovations that it has its own impressive museum at corporate headquarters in Schaumburg, Illinois. There you find a time line of push-button car radios, walkie-talkies, color TVs, pagers, cell phone systems, and global satellite grids that reach individuals. Fuel cells that are an order of magnitude higher performance than anything existing today, life science chips, and bioinformatics inventions (where biology and computers converge) also emanate from Motorola Labs.

Arriving in 1998 at Motorola from NCR, where he pioneered perpetual videoconferencing among continent-spanning engineering sites, Roberson found a 155,000-person organization operating in 116 countries and engineering efforts in 55 countries. It was a giant holding company with many autonomous businesses: police and fire safety communications; the service trades; cell phones; communication infrastructures; satellite systems; semiconductors; and, what Roberson calls “everything else, including world leadership in” automotive electronics, telecommunications electronics, digital ballasts for fluorescent lamps, and energy systems, including batteries and rechargers. The “Internet had also begun to dawn on Motorola,” so fledgling efforts were under way in that area as well.

So many disparate businesses operating independently spawned considerable inefficiencies, particularly in regard to communication, and the task of pulling all of Motorola’s communications components together fell to the communications business veteran, Merle Gilmore.

It was a monumental task that began by collocating a small cross-organizational team. They “established an outpost in the Motorola Museum,” Roberson reports. There, their tight skunkworks of people from around the world met around the clock “with person on top of per-

son, pulled together in open cubes, not even separated by office walls.” Their purpose was to make sense of all of Motorola’s many disparate communication businesses.

They used the usual small-group tools to communicate: e-mail, phone, fax, face-to-face meetings, and videoconferencing. The official launch of the Communications Enterprise, the new organization that resulted from the group’s work less than six months later, took place on a large scale when “75,000 people were brought together for a meeting that was telecast all over the world to Motorola locations with moderators standing in each of them.”

In reality, they were not all present because, as Roberson puts it, “Some thousands preferred to sleep at 2 A.M. For them, videos were sent out, which then moved into a regimen of quarterly updates that have migrated to webcasts. Now people attend major announcements at their desktops at their convenience. I’m downloading the video while I’m talking to you.”

Motorola makes heavy use of its own devices, in particular, its two-way pager/communicator technology, which “because we’re Motorola, is standard gear for most senior professionals in the company.”

The two-way pager communicator, PageWriter 2000, “offers you the opportunity to multitask and be working in semi-dead time,” Roberson explains. “You can talk while attending a meeting or even while presenting to a group.” Our call arrived when he was in a meeting. “Are you ready for phone interview?” his page from executive assistant Diane Lesner read. Yes, he replied in two keystrokes. On a busy day, he estimates that many senior people in Motorola send and receive 50 or more pages. “You’re trying to make decisions very quickly and this means you can be running transactions constantly. We all sit in too many long meetings that include vast voids of mind-numbing information.”

Roberson is a high-energy person. The first time we saw him in person he ran from the back of a large ballroom, hopped up on the stage, and opened with an animated cartoon of himself flying around the world, projected from a PC that he operated himself.⁹

The Worm Hole

At the time, Roberson was CTO at NCR, where he accomplished something that technology executives rarely do: His megaproject, involving

more than 1,000 people in 17 locations, met the market four months ahead of schedule. The computer his team developed was a behemoth than can be meaningfully described only by the weight of the disks it uses: Its 11-terabyte (a million megabytes) version weighs 20 tons. Such “terabrutes” manage massive amounts of data for banks, large retailers, telecommunications companies, and the like.

“We used various communications mechanisms to keep this very, very far flung team together,” Roberson said at the time, including “video-conferencing taken to its logical next step—a continuously open line so that you could have a meeting anytime you wanted to.”

The team affectionately nicknamed it “the Worm Hole.” Think of it, he said, as “a portal of instant transport from one place in the universe to another.” The reference comes from the opening credits sequence of *Star Trek* TV show *Deep Space Nine*, which suggests just such an intergalactic phenomenon.

The Worm Hole links three NCR engineering sites (Naperville, Illinois, Columbia, South Carolina, and San Diego, California) with a high-speed, full-bandwidth, always-on audio/video/data link.¹⁰ By the time we “met” Roberson, there was a fourth link, at the company’s headquarters in Dayton, Ohio.

We were escorted to an ordinary-looking conference room. Inside were three 32-inch TV screens along with a control pad to operate their cameras. Each screen served a different purpose: One was an electronic overhead projector casting foils onto a screen. Another was a standard PC monitor for real-time information sharing. The third was for people to see one another—and there was Dennis Roberson himself in South Carolina. He stood up and extended his hand electronically. It was a perfectly clear line, with no delays or weird movements.

Because of the top-quality connection, there was no strobe light effect or the sometimes not-so-humorous delays that people associate with what Roberson dubs “traditional” videoconferencing. “It was the only room of its type that I’d experienced where you really could forget that you were not in the same place,” he explains. The teams added some nice touches. “The grain of the wood on the table was the same in both Columbia and San Diego.” By angling the cameras properly—there were two or three in each location—the desk in one Worm Hole blended right into the desk on

the monitor at the other. “It was just a bright engineer who thought of that level of detail,” he pointed out. “That sort of thing really helped create the feeling of ‘being there.’ ”

With their three-hour time difference, the group in the east often was eating lunch while the one in the west was not (or vice versa). “Someone was always saying, ‘Can I pass you a sandwich?’ People thought they should because they felt like they were in the same room.”

The Worm Hole was important for organized meetings; the system could accommodate up to three sites simultaneously, with as many people in each location as could comfortably fit into the 18- by 24-foot conference rooms. “The next step was when the doors were left open, and people did in fact ‘meet in the hall.’ Someone yelled out through the tube and you would have meetings that took place on the fly.”

How far away were the engineers from the Worm Hole? Roberson stood up, and we manipulated the camera to follow him as he walked to the door. “Oh, they’re all within about 50 feet,” he remarked with a sweep of his arm.

Cellular Implants

A half decade later, Roberson observes the downside of that story: In the Worm Hole, you have to be there. “If you put Worm Holes everywhere on earth, you still don’t create an environment that people want to work in on an everyday basis. When people here in the U.S. are working, people in Asia are sleeping. How do you keep connected on a continuing basis when you’re working with teams that span the whole globe?”

“We’re moving to web-enabled devices that detect where human intervention is required, sending pages or short messages to individuals who send actions back to the machines, telling them what to do next, in the process expanding from people-to-people (or P2P) communications to people-to-machines (or P2T(hing)) communications, and for completeness, yes, thing-to-thing (T2T) communication is also on its way. Given the global nature of the Internet, the next logical step is that you can be connected anywhere in the world. Via GSM¹¹ [the global standard for mobile communication] you can be almost anywhere literally today and still be connected. You’re even freed from your laptop with handheld or even wearable mobile devices connected through the Internet.

“You can be involved in design on a continuing basis with people working with you around the world. You’re always connected and that’s a downside—you can never get away from work. The upside is that if you have critical projects and you have other responsibilities, you can continue to contribute, from virtually anywhere. You can be on the beach in the summer and find a few quiet moments to keep your project moving in very efficient ways, or during intermission in a school program, or even while waiting in line for a new driver’s license or for a doctor’s appointment. Traditional downtime is now translated into available uptime.

“Face-to-face is sometimes mandatory. But these days the vast majority of my one-on-one communication is time-disconnected, and that is different from the Worm Hole. I do more transactions with e-mail and two-way pages than I do over the phone or in person. ‘In person’ for me now means giving presentations or being presented.” For Roberson to meet one-on-one with his boss, Motorola president Bob Growney, more than once or twice a month is very rare.

“That’s not to say that we don’t communicate all the time. It’s crucial to maintain ongoing regular communication in the midst of very busy schedules: two-way pages, e-mails, quick grabs in hall, sometimes even in front of audiences, but our traditional ‘one-on-one-time-with-the-boss’ is minimal.”

Communication can be global as well. Roberson was in China doing his e-mail when “in came a flurry of e-mails from Chris Galvin, Motorola’s chairman and CEO [and grandson of its founder]. Six to be exact. He had just landed in the Middle East, where he downloaded his e-mails. One was hot and of considerable interest to me. Chris had copied Bob Growney, who’d just gotten into his office in Schaumburg at 7 A.M. So Chris was online in the Middle East, I was in China, and Bob was in Schaumburg. We sent back and forth a dozen e-mails and moved to a relatively decisive point around the technology issues that Chris had raised. We were very, very far away physically but nonetheless very close timewise even though we were using not-quite-state-of-the-art e-mail.”

The company provides security for such conversations through local dial-in numbers in most major cities around the planet, which “is what you want when the CEO, COO, and CTO are having a conversation.”

“The trick is communication,” Roberson says. “How do you keep in touch, have the right kind of contact, in the right ways? There you need an array of tools that work very effectively, many of them very traditional, but a few approaching state of the art. We now need to be able to pass around 10-, even 50-megabyte files that high-bandwidth connections have enabled.

“One of our costs now in more remote areas is stringing very high performance cable. We have a network that we’ve built around the world. The base pipes are necessary and critical, but alone they are not sufficient. You need the software that runs on top of it to enable the communication. We now have a consistent e-mail system in place worldwide, which didn’t exist a few years ago, and we’ve connected everyone up to our internal secure Internet. We have a very large web presence, as many high-tech companies do, so that everyone has access to the same information at the same time. It gives the global context, and everyone is connected globally.”

Motorola, through its research arm, Motorola Labs, is also pushing communication to its logical boundaries in the nearer term: telepathy and telekinesis. “I’m not talking about the science-fiction version. The fact is that as you give people ever greater communication capabilities and research continues on how the brain works, we will be able to compose messages in the brain and transmit them through electronics to other people and things,” says Roberson. He points to the prospect of microprocessors-based “systems on a chip” in light switches, door handles, household appliances, and even shirts that communicate. “You perform telekinesis [moving objects at a distance] by communicating with Internet-protocol-addressable chips that are thither and yon,” he explains.

“So that’s good for the base level. Now you need to overlay a whole set of processes for how people will use these tools. You need to know what to expect when you have 2,000 people around the globe in nearly 20 different sites, as we do in the Global Software organization. Common processes are the key to this highly distributed organization. Well-chosen, properly defined, and continuously updated processes are indeed at the heart of effective communications across Motorola and indeed all major corporations.

“When you’re into grand challenges—changing the world, making a visionary statement of the future, this is better done face-to-face. At

Motorola, we have the opportunity to literally change the world. If people think that's too lofty a goal, I revert back to PowerPoint slides and show how the walkie-talkie revolutionized military activities, and the cell phone is continuing to change the world."

Four Ages of Media

Marshall McLuhan woke people up to the weighty impact of media on human experience with his 1964 book *Understanding Media*.¹² His memorable phrase, "the medium is the message," summarizes his insights.

Imagine being asked to do something. Your interpretation of the request depends on whether the requester is your boss, subordinate, partner, or competitor. It also matters whether you receive the message in a face-to-face exchange, a handwritten note, e-mail, or a printed memo sent to everyone.

Many communications theorists separate the content of a message from its context. They point to the *metamessage*—the relationships, status, and interpretive cues that ride along with the literal symbols themselves. Scientist-philosopher Gregory Bateson calls these bells and whistles the "command" part of the message.

McLuhan goes a step further. He says that the transmission medium itself powerfully influences the total communications experience. That is, there is (1) the message, (2) the affect (influence) it carries, and (3) the medium by which it travels—a meta-metamessage so to speak.

The most basic message any medium sends is whether it expects, allows, or makes possible a response. Virtual teams need to maximize their use of media that enable interaction.

History of Communication

A signature style of communication typifies each era of human civilization, just as a signature organization does. In fact, different media usually are key features in differentiating the big break points in history.

- Speech shaped the nomadic era and the formation of storytelling small groups and camps.
- Writing emerged in the agricultural era and made large-scale hierarchies possible.
- Printing spread specialized knowledge in the bureaucratic Industrial Age.
- In the Network Age, electronic media are shrinking the planet to the “global village,” McLuhan’s famous phrase.

Each era—small group, hierarchy, bureaucracy, and network—brings its own capabilities that accumulate over time. Instead of new forms of organization wiping out the old, they incorporate them. Thus, today’s network benefits from and includes the positive aspects of its organizational predecessors: the specialized functions of bureaucracies, the levels of hierarchies, and the coherence of small groups.

As the new impacts the old, it brings modern variations to recurring themes. The virtual team is a new form of small group made possible and necessary by new forms of communication. While we now have geographically distributed small groups, we still retain access to the variations spawned in each previous era. Command-and-control hierarchical teams, such as military units, and rule-based bureaucratic groups, such as executive committees, are still with us.

Successive waves of change may have reduced the globe’s nomads to vanishingly small numbers. Yet the echo of communications in that age still reverberates distinctly in all human life in the twenty-first century.

Time has not diminished the importance of oral communication.

Writing, the second great leap in communication, makes speech enduring and transportable. Words, when written down, persist and can move independent of the writer. Printing in turn incorporates writing, making it available to larger numbers of people. New electronic media incorporate all previous ones. The inventions of the new include the innovations of the old.

Each type of media has features that influence effectiveness, cost, and accessibility. In particular:

*One-way media broadcast actions.
Two-way media enable interactions.*

This fundamental distinction—whether a medium is one-way or two-way—shapes virtual team communication. Virtual teams must produce products and interact across distances fractured by delays in time. One-way media are great for delivering products (and orders), but they do not enable the interaction (and goodwill) required for people to work in virtual teams. Imagine Motorola’s distributed software organization of 5,000 people, which literally operates around the clock with work handed off from one of its eight centers to another, trying to operate with one-way media only. Impossible.¹³

Technology has moved the human world of small groups from the assumed state of colocation in place and time to the option of working together at a distance. This change has been thousands of years in the making. For virtual teams, the conditions for communicating across space and time boundaries are intimately involved with the nature of their technology and how interactive it is.

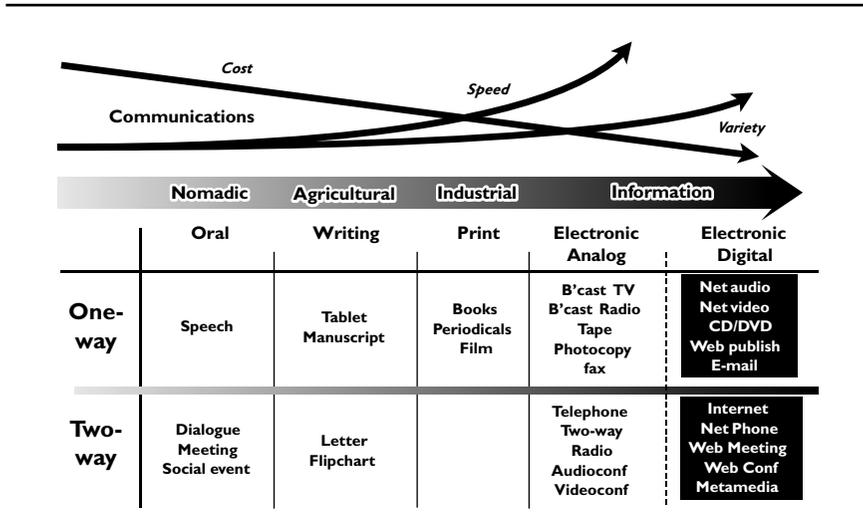
Virtual teams are beneficiaries of this long evolution of communications technology. Media, once developed, do not go away.

*We do not generally lose older forms of communication
as we acquire newer ones.*

We organize the varieties of ways that people and organizations use to send and receive information in the Communications Media Palette (Figure 9.1) by the four ages.

Each great era of communication carries a common set of advantages and constraints summarized along these dimensions:

Figure 9.1 Communications Media Palette



- *Interaction.* How far apart people are physically and how many people any medium can reach influence interaction, the back and forth (or lack of it) of communication.
- *Speed.* The pace of message production, the speed of its transmission, and the rate of its reception govern the swiftness of communication.
- *Memory.* The ability to hold and use a message depends upon its storage, its ease of recall, its difficulty in modification, and its reprocessing capability.

Speech

To speak to someone else without the aid of technology, both sender and receiver need to be in the same place (colocated) at the same time (synchronous). Consequently, a speaker can reach only as many people as the voice will carry to.

The physics of sound carries voice through the air. The receiver’s capacity to hear and comprehend speech rule reception. Given the requirement of shared space and time, speaking offers a medium with no appreciable delay between sender and receiver.

People retain what they hear only in the private places of their individual memories, not in the communication medium that links them. Unlike e-mail, for example, that records itself, speech evaporates. Reconstructing a remembered conversation has caused more than one argument. People interpret conversations privately, separate from the medium itself. In short, real-time oral communication has little inherent storage, recall, modification, or reprocessing features. Continuity persists through an oral tradition passed from memory to memory.

Speech encompasses all the possibilities: one-to-few-to-many channels that are both one- and two-way. Speeches, workshops, seminars, and briefings are predominately one-way, sender-based; conversations, meetings, and social events are all two-way and interactive.

Talking to one another is the work of small groups. The foundation is same-time and face-to-face. Rooted in our cultural genes, the oral communication made possible by the telephone is the heart of same-time connection that is free of place.

Written Media

Very roughly speaking, written languages, both alphabetic and ideographic, coevolved with the agricultural economy and the rise of hierarchy. Egyptian hieroglyphics and calendars, for example, developed 5,000 years ago, setting the stage for the Early Dynasty period and the rise of the first great cities. Writing offered options to message senders—from inscriptions on stone that have lasted for ages, to painstakingly penned and copied manuscripts, to the remarkably flexible medium of paper documents.

Writing represented a profound break with the limitations of the spoken word. Senders and receivers were no longer required to be in the same place at the same time; they could be in different places (distributed) at different times (asynchronous). The number of people reached by writing, while in principle virtually unlimited, was in fact quite small. The costs of production and transportation, together with the literacy required for individual use, capped the number of possible writers and readers.

Slower and more cumbersome than speaking, written interaction occurs when people exchange letters and notes. Delivery depends on the transport technology, which in the agricultural era included domesticated animals, wheeled vehicles, and boats, as well as fleet-footedness.

An individual's capacity to read governs the speed of reception. This adds up to a general delay between sender and receiver, dependent mainly on the distance between them.

The advent of writing freed communication from the constraints of space and time because of its most important quality in memory terms: the ability to be stored. Suddenly, human beings had a way to capture communications and make messages explicit, public, and permanent. While writing on paper is a great way to store ideas, its ability to help people recall or modify communications is limited. Witness how much time you spend riffling through files and piles looking for a particular piece of paper.

Words on paper are the ancestors of today's asynchronous media. Both signify a *conceptual leap*—from ephemeral thought to expressing it in concrete, transportable symbols. Using language and the alphabet to convey meaning remains central even as asynchronous communication possibilities erupt.

Print

Historians cite the invention of the printing press and the production of the Gutenberg Bible in 1456 as key early developments of the Industrial Era. Printing is primarily a one-way medium, whereby single senders can reach great audiences of receivers through proclamations, books, and other printed materials. Newspapers, magazines, and newsletters are print media where a few senders (publishers, writers, and advertisers) reach large audiences of generally passive readers. Monographs or limited run publications offer some small-scale options, but until the advent of computer-based desktop publishing, the cost of production had been so relatively high that printed media have had limited value for interactive communication.

Like writing by hand, printing breaks the bonds of space and time. Unlike writing, print reproduction is comparatively easy; the time and cost differences between a print run of 1,000 and 10,000 are marginal. Very large numbers of people are reachable through print.

Print production, however, is much more complicated and slower than writing. It involves not only the time required for writing, but also the time of transferring writing to the print mechanism and the time of printing the

product itself. Speed of delivery is again dependent on the transport technology, which greatly increased in the industrial machine era. Speed of reception, however, remains constrained by the speed of reading. These factors create what is usually a substantial delay between sending and receiving, rendering print almost useless for sustained interaction.

Like writing, printing provides storage integral to the medium. Its recall, however, is still limited to remembering the location of the information and then physically combing through material to find it. Modification is, if anything, more difficult in printing than in writing.

Atoms and Bits

It's been a century since relativity and quantum mechanics liquefied the Newtonian absolutes. Most of us point to the mid-twentieth century as the visible beginning of the transition from industrial to postindustrial eras. In the new millennium, technology, culture, economics, and organizations all are in the process of completing a fundamental transformation.

Half a century deep into the Information Age, we can recognize its major stages. In 1964, McLuhan described the media of our time as "electric," remarkable by the almost instantaneous nature of communications based on principles of electromagnetism. Writing in 1995, Nicholas Negroponte, director of MIT's Media Lab, drew a fundamental distinction between *Being Digital*¹⁴ and *being analog*. From Negroponte's point of view, analog TV shares more with books than it does with computer-based digital media.

In the analog world, *atoms* deliver information. We move molecules in the air, ship paper around, or modulate the structure of electromagnetic waves. In the digital world, *bits* deliver information. Bits are pure information, representations of on-off switches. They deconstruct the analog world into ephemeral strings of binary relationships and reconstruct them wherever. An analog book deteriorates over time, but a digital book is potentially timeless. An analog book occupies physical space, whereas a digital one occupies none the eye can see.

This very big difference between atoms and bits profoundly influences virtual teams. Accordingly, we separate the atom era from the bit era.

Atoms

Broadcast TV and radio, videotapes, audiocassettes, and the like are all one-way analog electronic media. They allow senders to reach groups of receivers at virtually any scale—from local to global. The boys with the cow and their Walkman stereos in Nepal are analog.

The telephone has been the most important addition to the human repertoire of one-to-one communication since the evolution of speech. It has made a new species of interactivity possible. Telephone conference calls and voice mail are group-oriented analog media. The same is true for traditional videoconferencing and its offspring, desktop videoconferencing. Analog electronic reproduction extends to print through media such as fax.

People often remark on the distributed nature of electronic media. However, this non-place-dependent feature does not distinguish them from earlier nonoral forms. Senders and receivers of writing and print can be just as far apart as the people who communicate via electronic media can.

In terms of time, however, there is an enormous difference. Electronic media completely fracture the constraints of time, offering real-time and non-real-time connections, or even both together, such as recording a broadcast for replay. These media extend to virtually unlimited scales, reaching billions of people at the same time (during the Olympics, for example).

Electronic communication effectively travels at the speed of light, a distribution speed that has no parallel in nonelectronic media. For introduction and reception, however, analog speed slams into real-time barriers. An hour's worth of information broadcast or viewed on a tape still takes an hour to meaningfully view (fast-forward aside). How quickly people can speak and listen limits the speed of the telephone connection. This is the real-time restraint of the analog world.

In memory terms, atoms offer little in the way of fundamentally new capabilities. Like writing and printing, electronic media can store communications, but provide limited support for recall and modification without additional digital capability.

While these media seemed to extend communications to vast global reach, over time it is the interactive qualities of these media that will be the really big story. Electronic real-time media offer opportunities for interaction that is essential to virtual life.

Bits

ENIAC, the first electronic computer, was unofficially turned on at the end of World War II. In early 1945, ENIAC help to compute some last-minute calculations for the first atomic bomb. The birth of the digital era is linked with the nuclear explosions in August of that year, which sundered human time into an irrevocable “before” and “after.”

Despite their dramatic entrance, computers stayed in the background for the next quarter-century, generally supporting the centralized, routine bureaucratic needs of the Industrial Age. They fueled the rise of IBM to the pinnacle of global companies. Computers subsequently shrank from mainframes to minis, led by then-new companies like the late Digital Equipment Corporation.¹⁵

When the computer-on-a-chip escaped from the labs in the mid-1970s, the digital revolution began to flower and directly touch everyday working life. It gave rise to the now-ubiquitous personal computer (PC) and companies like Apple (“computers for the rest of us”) and the striking “WinTel,” which combined Microsoft’s operating system with Intel’s chips to monopolize the world’s computing resources in the 1990s.

Somewhat simultaneous with the rise of the PC has been the development of computer networks, initially created to spread out use of the incredibly expensive mainframes through time sharing. These trends converged in the 1980s, heralded by the Macintosh, a PC with built-in networking. The network is now the central computing paradigm, linking computers of every size and capacity, from massively parallel supercomputers to mainframes, minis, workstations, desktop PCs, portables, palmtops, and chips embedded in all manner of appliances. More than one company has used the slogan that Sun Microsystems made famous: “The network is the computer.”

The total computing capacity available to society consists of both the individual devices and the network connections among them, what some

call “the matrix.”¹⁶ This combination has given rise to “computer-mediated communications,” in the parlance of early researchers in the field of *digital media*.

Like their analog counterparts, electronic digital media offer an array of one-way options, some (such as digital TV) still relatively new at the start of the millennium. Internet audio and video provide both one-way and two-way capabilities, although bandwidth limits are slowing their growth. The transmission of graphics, audio, and video requires bandwidth that is vastly greater than that needed for transmitting simple (ASCII) text such as e-mail that is almost instantly replicable and can reach millions or a few.

The new media also offer something else: *interactivity*.

Bits really shine in interactivity, exploding the limits to human organization and allowing a vast expansion in virtual group capability and variety.

The options of one person communicating with another, of a few communicating with a few, or of many communicating with many others flow almost seamlessly from one digital variety to the next. E-mail ranks with the telephone and face-to-face dialogue as a powerful and pervasive personal medium. Digital technology also allows the point-to-point exchange of files (including digitized print documents) and replicates the telephone system through Internet telephony. Small groups have a growing list of digital media available that allow a few people to communicate with a few others—from same-time online chat and electronic meetings to time-disconnected computer conferencing and topical discussions.

Digital media and especially the ubiquitous Internet represent historically unparalleled expansions of interactive capability. Just what is different?

The Digital Difference

As with every media since writing, digital media support communications across space. Like analog electronic media, digital communication

may be real-time or time-disconnected; it's effectively unlimited in terms of the numbers of people it can reach.

All computer-based media take full advantage of the speed of light. This is especially true at the nanoscale of the chips themselves, imperceptible to our natural senses. Production and reception speeds are not limited to real time. They may vary enormously according to the type of data being prepared and communicated. A database almost instantly produces information at processor speeds, whereas you type an e-mail note in real time.

The big difference, what makes it so effective for interaction, lies in its vastly increased memory capabilities (see highlights, Figure 9.2). This pertains not simply in storage, which all post-oral media share, but also in memory's other aspects. Recall is integral to digital media. One can peruse vast quantities of information in moments, or even seconds—needles picked instantly out of the proverbial haystacks of data. Modification is unlimited; it is easier (and incomparably faster) to turn bits on and off than it is to retype a page. Take a stroll down memory lane to compare the act of editing a document on a computer with retyping pages on a typewriter. (Typewriter? What's that?)

Figure 9.2 Media Similarities and Differences

	Oral	Written	Printed	Analog Electronic	Digital Electronic
<i>Interaction</i>					
Space	Colocated	Distributed	Distributed	Distributed	Distributed
Time	Synchronous	Async	Async	Sync/Async	Sync/Async
Size	Small	Small	Mass	Unlimited	Unlimited
<i>Speed</i>					
Produce	Speaking	Writing	Write+Print	Real-time	Variable
Deliver	Sound	Transport	Transport	Electronic	Electronic
Receive	Hearing	Reading	Reading	Real-time	Variable
Delay	None	Some	Lots	None	None
<i>Memory</i>					
Store	None	Integral	Integral	Integral	Integral
Recall	None	Limited	Limited	Limited	Integral
Modify	None	Limited	Limited	Limited	Unlimited
Reprocess	Separate	Separate	Separate	Separate	Integral

Reprocessing is unique to digital media.

No medium other than the computer-based one can reprocess its own stored information. Computers can compress, split apart, and recombine information in infinite varieties. The medium itself makes possible computer-enhanced images, data compression, packet switching, language translation, content filtering, and morphing, to name just a few of its capabilities.

It is not just what you can do with the bits that is so exciting, but what you can do with the content itself. Of special interest are the digital connections that can link concepts, data, pictures, diagrams, and all manner of media. We have barely scratched the surface of the cognitive capabilities that digital media offer to virtual teams and the organizational networks they undergird.

The underlined *hyperlink* is a brilliant bit of conceptual invention that represents only a wisp of code, yet its use can construct a practically infinite set of interconnections. Each connection on the web is embedded in a potentially meaningful context. It exactly captures those aspects of technology, interaction, and meaning that we seek to convey by using the word *links*, which stands for the multilayered concept of communications.

Digital also connects people interacting in old formats in entirely new ways. Online conversations, meetings, and conferences—real-time and time-disconnected—provide a new array of interactive media. They open abundant possibilities for communication among many senders and receivers—from groups of a few to vast numbers of participants.

The digital medium is the ultimately flexible one. It can take on the shape and contour of any of the others, from a highly centralized mass medium to a completely decentralized interactive one. Most remarkably, it can be all forms at once, available to match the right medium to the right need. For a virtual team that is working anywhere at any time, digital technology dramatically expands its communication bandwidth—professionally, organizationally, educationally, psychologically, personally, intellectually, emotionally, and socially.

Communicating

While communication has been critical to group life since the beginning of human time, today connective technologies are exploding exponentially. They enable small task-oriented groups to perform in extraordinary new ways.

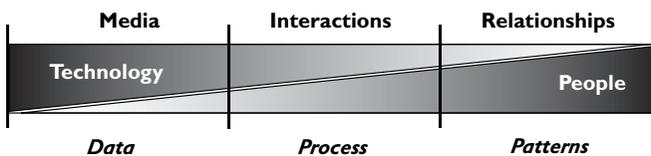
Communication has quite a diverse set of dictionary definitions in current usage. Key elements of the future are wrapped up in multiple meanings of the word *communication* that pull in different directions. The word works, however, because there is an essential interdependency among all the different meanings.

A simple example distinguishes the different but interdependent elements of communications. Physical phone connections are passive *media*. Jessica calls Jeff and the phone company records *interaction*, a measurable stream of communication at a particular time from this node to that. What is not recorded is the tangle of *relationships*, the interests and passions of the moment, the trust that threads the notes carried along the wire.

Links, the wonderful, vital term riding the global web wave and sweeping through the Information Age, is a short word for communication. At one end are concrete physical media like wires and telephones and even conversational airspace; at the other end are the elusive, mysterious relationships among people.

While “purpose” (see Chapter 6) flows from abstract vision to concrete results, communication links flow in the opposite direction. They move from the potential of actual tangible connections to the obscurities of human bonds. Between physical connections and human relationships lie interactions, the moment-by-moment, blow-by-blow stuff of daily social life (Figure 9.3).

Figure 9.3 Communication Links



Links are physical media that enable interactions that spawn and maintain relationships.

Many Media

Physical media provide the communication channels, the means of interaction. Channels exist quite separately from people or what they want to communicate. As technologies, they are passive and offer only the potential for communication, not the act itself. They are necessary, but not sufficient.

Choose the medium appropriate to the need:

- Face-to-face helps build trust.
- Real-time media keep people in sync.
- Asynchronous media create the ability to link over time, the persisting online meeting place.

As for human groups with rhythms and pulses (see Chapter 5, “Time”), we need to connect both in real time and over time. While face-to-face interaction is synchronous, it stands apart from all other modes of communication in the genetic depth of its rootedness in the group psyche.

Talking Across Boundaries

Interactions are all about process. To communicate is to interact; to interact is to communicate. Interactions are not separate from the people involved and how they interpret experience. They are also behaviors that generate public information for observers. Researchers study interactions to understand the dynamics of groups and teams.

The most basic human interaction is dialogue. At a profound level, groups are conversational constructs.¹⁷ Especially at management and executive levels, work life is a series of conversations larded with decisions and strategic direction. Conversation across boundaries is the great challenge of the virtual age.

At a more detailed level of work life, interactions are represented in the tasks that teams undertake and individuals execute. For large, com-

plex organizations, interactions become formalized in work flows. Once the bureaucratic province of policies and procedures, work flow now belongs to software that tracks a work path among a distributed group of people. More generally, the need to easily map and track interactions is basic to virtual groups at any scale.

Trusting Relationships

Ultimately, it's all about trust. Relationships come from the learning and emotions retained from the intensity of direct experience and fed back into future interactions. They are the patterns that simplify the complex. Over time, relationships develop among people in a group because of their experience with one another, eventually enabling them to become a team.

Even the simplest relationship belongs to both people together, never to one person or the other. Although relationships exist between people, they do not occupy any physical space. They grow over time, may span years of inactivity, and yet may fracture in a moment. Our relationships are at once the most durable, the most fragile, and the most rewarding parts of our lives. Relationships among the members are the bonds that tie virtual teams and networks (see Chapter 3, "Trust").

In an age where relationships are the coin of the realm, riches come with a price. Relationships among all the people and organizations involved with a network can add up to a staggeringly large number of possible permutations. They comprise every combination of the people in the group plus innumerable linkages outside the team—the whole web of the team. Mapping detailed relationships inside and outside even a small group of people can become frightfully complex.

Managing relationships is a critical skill for now and the future, offering those natural networkers among us an increasingly important role in our organizations. Fortunately for those of us more relationally challenged, this is also an area where data gathering and processing power help reduce unimaginable complexity to practical daily simplicity.