From Habitat to Global Cyberspace

F. Randall Farmer, Chip Morningstar, Douglas Crockford
Electric Communities

Abstract

Cyberspace.
Interactive Television.
Networked Multimedia.
The Great Convergence.
The Information Superhighway.
The National Information Infrastructure.

These are all names for the same thing: a huge network connecting people to other people using computers. Billions of dollars are being invested to develop this connectivity, ignoring the experience already available from the online industry. Cyberspace is the next important telecommunications paradigm: many-to-many communications. The authors relate their experiences with the Habitat and AMIX online services to outline the nature of the emerging Global Cyberspace Infrastructure.

The great confusion vs. People first!

News of a so-called "Great Convergence" of television, telephones, and computers makes good copy for the nation's media. Not too long ago, these same media were going giddy over another technology with big promises of changing everything: Virtual Reality. Now that the VR hype has faded, and the wild promises of many of its pundits have been shown to be gross exaggerations, one might ask, "Is this convergence hype just more of the same?" While it is true that many of the interactive TV demos now making the rounds are mostly high-tech fantasy, our experiences in developing and running the Habitat and American Information Exchange commercial services indicate that Cyberspace *is* a new medium and that it is already on the road to maturity.

Unlike the Virtual Reality field, the emerging data-highway field has been evolving over a very long period. Its roots are in the invention and global deployment of the telephone network. Sending machine-readable data over this infrastructure is almost as old as the computer. People have been chatting with each other using computers and modems for over 30 years.

When most interactive television advocates talk about video on demand and interactive home shopping as "killer apps", they are overlooking a primary lesson from the telephone and on-line services industries: People don't want to connect to computers, they want to connect with each other. Like the fans of the early VR industry, many data highway enthusiasts are more excited about the technology, and less concerned with the more important questions, such as, "What is the compelling need for this?" or, more simply, "Why would anyone want to use this?" They seem to believe in that famous line from the movie *Field of Dreams*: "If you build it, they will come."

Consider a lesson from Prodigy: The original Prodigy concept was a flat-fee information service based on a magazine model. Prodigy's income would be supplemented by advertising revenue from the commercials that constantly display on the bottom 20% of the screen. They initially projected that most usage would be information retrieval and interactive home shopping. This plan was not unlike the announced "killer app" schemes for interactive television. The main problem was that this model wasn't what the customers wanted. Instead of shopping or information retrieval, the primary customer use for Prodigy turns out to be the person-to-person services: electronic mail and discussion-oriented bulletin boards. (Through 1991, only 30% of revenue was the result of advertising, and we can expect that percentage to decrease significantly in light of Prodigy's recently announced hourly pricing.) As a result, Prodigy has changed its pricing system (twice) to be usage based, adopting a model that is essentially the same as the rest of the industry, albeit with higher prices. This has caused hundreds of thousands of their most active customers to defect to other providers who better understand customers' needs and whose services are more aggressively priced. People want to connect with people, first and foremost.

Many-to-many communications

Like the telecommunications infrastructure which provides us with telephone service, and also like the railroad system of a century ago, the Global Cyberspace Infrastructure will provide a crucial new medium for communications and trade. Cable television, computer and telephone companies are betting the farm on it.

Unlike these earlier media, Cyberspace is oriented around the idea of many-to-many communications. Simply put, this means interaction among a group of people. Until recently this was only reasonable when the members of a group were actually all in the same physical location. Telephone conference calls don't work very well. Participants don't receive enough cues to know when to speak. There are no facial expressions or other gestures to serve as a guage of other people's reactions. Video conferencing attempts to overcome these limitations by putting the parties into two halves of a room joined by video cameras and microphones. This works adequately for conferences between two or three small groups that schedule specific meeting times, but Cyberspace provides a more flexible alternative.

Persistent places

Cyberspace provides a very different model for many-to-many communications: one of persistent places. Since a computer is the host for encounters, the encounter environment can remain persistent across time, even when you aren't there. These persistent places are the essence of Cyberspace. They are human-created virtual worlds, each having its own rules of interaction, each with its own set of inhabitants working for their own ends.

The Internet connects millions of computers, many of which provide services to the net at large. Among the most popular of these services are the MUDs, text-based virtual communities with themes ranging from fantasy role playing to biology to media research to postmodern culture. Several are commercial ventures, charging an access fee. Others have started to form internal all-volunteer governments that pass laws that limit their fellow citizens' behavior or restrict the powers of the system administrators. The key point is this: these crude, text-only worlds are already of such high value to their citizens that these people will dedicate the time and emotional energy to build a functional society there.

A starting point: Habitat

Habitat is a graphical many-user virtual online environment, a make-believe world that people enter using home computers connected via telephones and packet nets to a centralized host running on a commercial online information service. It was originally available under the name Club Caribe through the Commodore 64-only QuantumLink service. It is currently thriving in Japan as Fujitsu Habitat on the NIFtyServe service. Efforts are underway to port the Fujitsu version of Habitat to America on PCs and Macs for Christmas of 1994.

Habitat presents each of its participants with a real-time animated view into an online simulated world in which people communicate, play games, go on adventures, fall in love, get married, get divorced, start businesses, found religions, wage wars, protest against them, and experiment with self-government.

Habitat has been a rich source of information on the nature of building and managing these new virtual worlds, and we've written extensively about it. But the lessons we've learned go far beyond these.

Economies in Cyberspace

Economies exist everywhere in Cyberspace. These economies provide a mechanism for the communities to flourish.

MUDs have two constrained resources: memory and compute cycles. The memory problem is addressed using distribution units called "quota". Quota allows MUD citizens to create objects and extend their virtual world. A fixed amount of quota is allocated to each new citizen, usually by a system administrator. Each object created by a participant consumes some amount of quota, and when the preassigned amount of quota is exhausted, the user must appeal to the administrator for more. This is an economy, but a very socialist one. Several MUDs administratively require that the person applying for more quota prove that their work is deserving of consideration, perhaps meeting some theme-oriented or social-improvement goal. Prove to the central government that you are worthy, and you shall be granted the power to create. Citizens are (usually) not free to trade quota with each other. In these systems, a large amount of quota is a powerful status symbol.

Habitat has an internal economy, complete with play money called "tokens". Citizens are granted tokens for connecting, and as prizes for planned events. Tokens can be used to purchase items from vending machines. These items can also later be recycled for somewhat fewer tokens using pawn machines. But this interaction with machines isn't really enough to establish the Token's real value. The most important use of tokens in Habitat is for trade between players. Habitat customers actually use tokens to gamble with each other, along with buying special objects and publications (like poems and stories) from each other.

Unfortunately, the Habitat economy is inflationary, as tokens are added to the system at a higher rate than they can be consumed by the supplied machines. After a little while, everyone has all the objects they want. Vending machines can make infinite numbers of the items on sale with no production costs. As a result, there is a secondary economy in the Habitats: heads.

In Habitat the primary way to change your appearance is by changing your head. You can buy new styles of head from a vending machine in the local "Head Shop", or you might win a unique head in a contest sponsored by the service administrator. After a while, everyone has a copy of any interesting but common head that may available from the vending machines, and there is nothing left to buy except the special one-of-a-kind prize heads. As a result, these rare heads trade for hundreds of times the price of the others. Without a doubt, the dominant symbol of wealth and stature in the Habitats is a large collection of unique heads, proudly on display in your virtual living room.

Commerce for Cyberspace -- AMIX

The American Information Exchange (AMIX) is the first attempt at bringing free markets to Cyberspace. Like Habitat, it has a client interface that runs on popular PCs and connects to the host via packet networks. What makes this service different is that it introduces a currency to Cyberspace: the American dollar. AMIX is designed to facilitate transactions of information, goods, and services *between customers*. The service makes its money by taking a cut of each transaction rather than by marking up connect time. Customers are free to buy and sell with each other. Documents (actually, any collection of bits) can be posted in the marketplace, each with its own description, price and payment terms (including "Payment On Evaluation"). An electronic mail system supports (and enforces) negotiations for online consulting contracts. Customers can sell their expertise and talent to each other.

AMIX is another persistent place, with the very desirable, but currently unique, attribute of a functioning, convertible currency. You can buy stuff from anyone else on the system at a mutually agreed price. Customers who have a positive account balance at the end of each month are actually mailed checks for that amount.

A real economy is probably the second most important feature required for broad acceptance with the general public. After all, trillions of dollars each year are already flowing through the global telecommunications networks, with interbank transfers, credit card validations, and other types of EFT transactions.

Electronic communities

We think that the most important feature of the future Global Cyberspace network will be the sense of community. A sense of place requires not only persistent locations to make it possible, and economic systems to provide some means of determining the value of things in it, but communities of people to give it life. People want to interact with other people who are interested in the same things that they are.

Some examples of community from the Habitats:

Performing arts troupes formed spontaneously. In Club Caribe, they were called "Wave Teams", and performed coordinated movement, gesturing, and typing, to create a sort of slow-motion dance that looks very much like cheerleading on Valium. (In those days connections were at 300 bps, much slower than is typical today.) These teams had regular scheduled practices and participated in monthly competitions judged by their fellow citizens. All of this happened without any outside assistance from service operators.

Back when Fujitsu Habitat had only 2,000 citizens, a bug in the teleport system turned up. Since the 'port charged two tokens for a ride, if you attempted to use it while holding only one token, it would give you back -1 token as change. In the host this number was exactly the same as 65,535 tokens, a gigantic sum. Several players capitalized on the bug before it was brought to the attention of the system administrators (called Oracles), who corrected the programming error, but then had the problem of all these tokens now in the economy. The topic of what to do was hashed out on the Habitat bulletin boards for a week. In the end the citizens *voluntarily* returned over 250,000 tokens to the Oracles. The Oracles arranged to have the entire amount redistributed equally to everyone.

Communities must be able to grow and transform. Many emerging electronic communities die for lack of the ability to adapt to change. Just as companies and small organizations go through serious growth pains and often disintegrate when they can't adapt, so too have early Cyberspace colonies. This type of adapt-or-die transformation occurs eventually in every growing virtual community we've experienced. A successful system will plan for it. Plan for growth. Plan for change. Sense of place is critical to the growth of community, as people adopt the emerging culture as part of their own.

Looking forward

The coming consumer-oriented digital communication network will bring about a new economic, technological, and social environment which will ultimately touch every individual in the world.

Looking at the Cyberspace worlds described here, and the many others that we've studied world-wide, one can begin to see the shape that this emerging Global Cyberspace Infrastructure will take.

The issues

We've stated the importance of understanding that Cyberspace should be about a sense of place, generated by computers but brought to life by communities of human inhabitants. Given this assertion, how should we proceed? How do we build a system where many-to-many is the basic model of communication, and the one-to-one (telephone) and one-to-many (television) modes are just special cases?

We propose that, broadly speaking, there are five technical and social issues to be addressed: Decentralization, Commerce, Equipment, Network, and Openness.

Decentralization

The network needs to be able to support the broadest possible range of services. This goal cannot be achieved with a centralized system, because a centralized system simply can't be scaled that large.

If we tried to put all possible useful services into a single centralized facility, we would end up with a server too gigantic to be practical and horrendous communications bottlenecks going into and out of it that would swamp the fastest broadband network. Clearly, this is unrealistic, which is why nobody does it this way. A distributed approach, of course, is what all serious, real-world computer networks employ, as does the telephone system itself. A distributed network topology, such as the Internet's, is required for Cyberspace to scale large enough to support everyone.

Beyond technological decentralization, however, we will also want to have creative decentralization and entrepreneurial decentralization. By this we mean that the network is an open system and the barriers to entry are low, so that individuals, small organizations, and large companies can all exist together in an open market, just as they do in the "real" world. Allowing division of labor and the natural forces of competition to come to bear on the services available in Cyberspace will be a major advance over existing online services, which, with the notable exception of the Internet, follow a centralized control and planning model. Market forces will tend to make the services that are available in Cyberspace attractive, easy to use, and well matched to the needs of the customers.

The Internet, though, offers a useful case study of what happens when there *is* an open system with low barriers to entry: explosive growth and a flourishing variety of services the likes of which the world has never seen: millions of computers, ten to twenty million users, countless resources and services offered, and all of this growing at a rate of five to ten percent per month. The Internet may well become the communications backbone of the Global Cyberspace Infrastructure that we envision here. However, the Internet itself is ultimately *just* a communications backbone. Without additional protocol layers it lacks the ability to be a true marketplace, for it lacks any general support for that fundamental ingredient of market economics: money.

Commerce

So the second issue that the Global Cyberspace Infrastructure needs to address is the addition of commerce. It is now possible

to do business electronically through a variety of channels. However, all of these channels require either an awkward out-of-band component (as with credit card transactions, where the merchant must contact the bank separately through some other means) or a pre-established business relationship between the parties to the transaction (as with EDI or EFT, where the transaction is backed by an elaborate set of contractual obligations as well as MIS staffs at both ends to make sure everything works at the technical level). However, the electronic environment currently has no mechanism to support the model which is in some ways the most basic, the way shops, vending machines, and mutual strangers of all sorts do business every day, all over the world: in cash.

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Cash, as a bearer instrument, solves a fundamental problem with transactions between mutual strangers, namely that a buyer and a seller don't necessarily have any a priori reason to trust each other. In the electronic environment they might not even be able to identify each other. If a trust relationship is required in order to do business, the transaction cost of establishing it may be more than the transaction itself is worth. However, since cash is, in a sense, self-validating, the transaction cost of a cash transaction can be low.

The problem with electronic cash, of course, is that it is just patterns of bits. These bits must be communicated over what is likely to be an insecure channel, necessitating cryptographic protocols for communications security. Furthermore, these bits can be copied by anyone who has them, including those who might have them legitimately (and who might legitimately want to make backup copies!), so making digital cash proof against forgery and duplication is a significant technical problem. Remarkably, cryptographic protocols to do this *do* exist; at least one these will have to be incorporated into the Cyberspace protocol suite.

All of the digital cash mechanisms that we know of require the money to flow in a loop of some sort. In order to be a credible medium of exchange, the money must be issued by a stable, well known entity with a sound reputation, such as a bank. The bank is one of the nodes through which the communications flows as the operation of the electronic cash protocols unfolds. Thus we can see that the development of Cyberspace encompasses not merely the technical aspects but the institutional infrastructure as well. In addition to supporting the monetary system, the other traditional functions of banks -- holding deposits and making loans -- will also continue to be important in the electronic environment. Thus we can expect that the migration of the banking system into Cyberspace will have to be an early development. Of course, banks are already largely creatures of the electronic world, but not now in a way that connects directly to the banking customer. There has been some limited experimentation in this arena, but this has mostly been concerned with automation of the conventional forms of retail bank usage (e.g., access to checking account statements). As far as we have been able to determine, there are currently no banks providing banking services within the computer networks per se.

Equipment

Present day cyberspaces are delivered using personal computers, and we expect this to continue. However, we also expect that broad acceptance of the Global Cyberspace Infrastructure will require the invention of a new device, which we, adopting telephone terminology, are tentatively calling the Cyberspace Terminal.

Unlike computer terminals of the past, a Cyberspace Terminal will have the capability of acting as both a client (consumer) and a server (provider) on the Global Cyberspace network. It will supply the potential for any user to offer services to anyone else.

It will combine the best features of telephones, televisions, and computers. Like all digital appliances, it is, in fact, a computer, but its personality will be completely different. In most ways it will be more like a telephone than a computer or a television.

Like a telephone, it will be an instant-on device, be extremely reliable, and have simple operation. No waiting for it to warm up or bootstrap. It will always be ready to help in an emergency. Anyone who can speak or push a few buttons will be able to operate it. It will simply work.

It will also deliver high performance at low cost, as a result of both the trajectory of electronics technology development and consumer market pressures. And finally, it must be multimedia capable. It must handle all the useful media formats of the future. This is particularly true of high-quality motion picture compression, in whatever form this is finally developed. Eventually it may even be portable and wireless.

Network

A critical component of the Global Cyberspace Infrastructure is of course the network. International deployment of digital network technology is already underway, but it is arriving in various formats, with wildly varying bandwidth and cost. So the question arises: Is there a minimum bandwidth or specific data format required for Cyberspace?

There are services which can operate adequately today using modems and dial-up analog connections. Habitat is an example of such a service.

There are other services which are offered today, but are not really useful in their current form, and will require greater bandwidth in order to be truly viable. Electronic catalog shopping, for example, is a service that may be significantly improved by wide-spread deployment of narrowband ISDN.

There are other services, such as delivery of video, which will require broadband ISDN, and we can speculate that in the future we will invent new services requiring even greater bandwidth.

The amount of bandwidth required for the Global Cyberspace Infrastructure is determined by the services to be offered rather than being some fundamental property of the medium itself. There are a few services which work adequately on analog lines with modems, some which require N-ISDN, and others which require B-ISDN.

The Global Cyberspace Infrastructure itself is independent of these pipeline issues. The more bandwidth available, the greater the range of services that can be provided. It should gracefully adapt and scale to the increased capabilities of improved networking technologies.

The Global Cyberspace Infrastructure can be built on top of any network, so long as it can, with some degree of reliability, send packets of bits there and back again.

Openness

The decentralization of Global Cyberspace refers to more than just distribution of host processing. It also applies to its development and the services themselves.

Cyberspace will be *big*, and, as such, must be an open system. No one institution, company, government or other entity can, or should, own it all. By necessity it must be an open environment with open standards. The recent rash of mega-mergers and strategic alliances by cable, television, movie, telephone and computer companies are all driven by doomed visions of the future of multimedia telecommunications, visions of centralized power rooted in a world of publishing and broadcasting whose business model is wildly inappropriate for Cyberspace. They are all floundering in the resulting confusion.

If open, Global Cyberspace will provide a robust infrastructure which can support any number of services, each connecting to the network whenever and wherever convenient. Likely services would, of course, include the expected range of services, such as entertainment systems like Habitat, various forms of home shopping, education, government services, and movie libraries.

However, anyone with a host computer, a telephone connection, and an electronic bank account should be able to launch a service. These services can vary wildly in the products they deliver, the customers they are targeting, their pricing policies, and their presentation and interface conventions. Some services will be adaptations of existing services. Others will be new inventions that we scarcely imagine today, businesses that could only exist in Cyberspace. These services will come in all shapes and sizes. They will all exist together in an electronic marketplace. By providing this marketplace with Habitat-style social interaction, we do more than just link machines together. We also link people together.

Conclusion

Our experiences show us that the many-to-many communications model currently provided by online services is more flexible than others proposed, and is what the consumers want. When AT&T did a trial of data-highway applications, people wanted to communicate and play simple games with each other more than any other activity. They followed up these conclusions by investing millions to purchase 20% of the ImagiNation Network, a games-oriented online services company.

The Habitat and AMIX projects mapped some new cyberspace territory, in the areas of interface, community and commerce. The lessons we learned from building them point to a design for an emerging Global Cyberspace Infrastructure based on the ideals of Decentralization, Security, and Community.

While the big players in the field are spending billions deploying fiber-optic cable, purchasing media conglomerates, and making slick science-fiction television commercials, we think they are missing a couple of the key components of Cyberspace. The winning design isn't just about slapping together some hardware, content, and packaging. One of the missing components is flexibility. This flexibility will be embodied in a Cyberspace Operating System, a suite of secure protocols designed to support a fully distributed network of interactive services. Our company is leading an open-systems effort for the design and implementation of these protocols. The other missing component is people. Cyberspace will be ultimately many-to-many, and services of all shapes and sizes will be provided for, and by, the communities that inhabit it.

Bibliography

Chaum, David. "Security without identification: Transaction systems to make Big Brother obsolete."*Communications of The ACM*, vol. 28, no. 10, October 1985, pp. 1030-1044.

Farmer, F. Randall. Habitat Citizenry in *Virtual Reality: A Survey of Technology and Culture*, Edited by Carl Eugene Loeffler. Van Nostrand Rheinhold, 1993.

Morningstar,Chip and F. Randall Farmer. "The Lessons of Lucasfilm's Habitat." in *Cyberspace: First Steps*, Edited by Michael Benedikt. Cambridge, Mass.: MIT Press, 1991,

Rheingold, Howard. *Virtual Communities: Homesteading on the Electronic Frontier*, Addison-Wesley, 1993.

Quarterman, John S., Gretchen Phillips, and Smoot Carl-Mitchell, "Network Host Growth Rates," *Matrix News*, vol. 3, no. 7, pp. 2-9, Matrix Information and Directory Services, Inc. (MIDS), Austin, July 1993.

Shapiro, Robert D. "This is not your father's Prodigy."*Wired* vol. 1.6, December 1993, pp. 98-101.

Tsuchiya, Tomoko and F. Randall Farmer, "Oracle Layza's Tales from Fujitsu Habitat." Unpublished. Available from www.communities.com

Yoshida, Atsuya, and Jun Kakuta. "People Who Live in an On-Line Virtual World." Department of Information Technology, Kyoto Institute of Technology, Matsugasaki, Sakyoku, Kyoto 606, Japan, 1993.