The History of the Internet in Nova Scotia

by Alexa Thompson

with the help of the pioneers

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INTRODUCTION

This project started around the year 2000 with the excitement and pride of what we had accomplished, and the unease of the knowledge that the pioneers were starting to loose touch with each other.

What we had accomplished was the birth of the Internet in our corner of the world and, for at least a moment in history, the leadership in its popularization. The Internet has been around in an embryonic form since 1969, but only when it became a tool of the masses was its truly revolutionary nature revealed. That revolution was built on many developments including the personal computer, a ubiquitous communications network (Google "Carterphone" if you don't know what I mean), graphical interfaces, hypertext documents, search engines, and of course email. We were at the right time to catch the wave of this revolution, and we took it upon ourselves to make this the right place.

The pioneers largely have moved on to new challenges around the world. This is our attempt to capture at least some of their stories and to preserve this piece of our history. We were fortunate to be able to retain a long-time enthusiast, Alexa Thompson, to interview as many as we could find and to pen those interviews into the work you are reading. Please enjoy.

John Sherwood, Dalhousie University
February, 2005

The Internet can't be over-hyped. Best thing since sliced bread. The problems with spam and ads will go away just as they went away in print. It is now possible to buy books without advertisements in them. In Gutenberg's time, every book had an advertisement in the front or the back of the book.

Then, of course, we have successive generations of the Internet yet to come, each one of which will do more of what we want. I mean, in terms of the Internet, we're looking at the first five minutes of Gutenberg.

James Burke

Author of *Connections*

In a startlingly visionary article in the July 1945 edition of *Atlantic Monthly*, Dr. Vannar Bush, Director of the Office of Scientific Research, eerily predicted a sort of Internet by proposing individual storage devices that other scientists could consult. Dr. Bush identified the problem facing post-war researchers: so much information and so many ideas to share, and no easy means of sharing that information. It could take months for significant research to be written up and printed. It could take several more months for a scientist's peers, swamped by the sheer volume of research available, to analyse and respond to data presented. Dr. Bush vocalized the need of scientists to find a reliable and rapid way to network together to share information. He even visualized a device; what he called a "*memex*, in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory." The device would be very small and portable and could be used by other researchers to tap into its store of information. It sounds remarkably like a laptop computer. He also theorized that rather like television, one *memex* could beam its information to another. Now that sounds like the Internet.

PRE-WORD

"For one fleeting moment, Nova Scotia had the highest Internet penetration in the world."
— David Colville, Vice Chairman,
Telecommunications and Commissioner, Atlantic of the
CRTC [Canadian Radio and Television Commission]

This is the story of Nova Scotia's part in getting Canada online. It is the combined memories of many of the people who were there in the 1980s and 1990s and if some of their dates are incorrect or information misplaced, it's because those were heady times and people were too busy creating an Internet to take the time to keep a journal. One fact to give the reader a glimpse at how fast things moved: within two years 96 per cent of the population of Nova Scotia gained access to local dialup modem service at a time when other Canadians outside large urban centres were paying crippling long distance telephone charges to creep onto the Internet. And as Mike Martineau, who ran NSTN (Nova Scotia Technical Network), the company that "wired" Nova Scotia, explained, things moved so fast that NSTN was still invoicing customers for time online with pen and paper while computers, not yet programmed, stood idle.

It didn't last long, of course. The rest of Canada soon caught up. But for a little while there, we were first.

For me, the Internet began in 1983 as I struggled with what I think was a 2400 baud modem and a Commodore 64 to transfer files for a report to a print shop across town. After a frustrating day on the phone with the printer, I junked the modem, saved my work to a floppy disk (5 1/4 inch in those days), got in my car and drove. Then there were bulletin boards and listservs in the late 1980s; and finally the world wide web and I arrived together in 1993 when I was issued my first email address: @fox.nstn.ca.

To me it was a revolution, as it was to many others. Now I could have my own web-site (keeping it very low key: don't want to be "flamed" for being "commercial") and could work from home while reaching out to writers and photographers from around the world. As the years went on, I became more adept. I too succumbed to verbs such as "google", "ftp" or "email". "Jpgs" and "pdfs" come flying down the pike. Now I can assemble a publication without ever having met in person a single contributor and transfer files of 250 megabytes or more in the time it takes to make coffee.

Can it be just 21 years? Has the Internet come of age within my adult lifetime? For 1983 was the year of the birth of the Internet as many of those who were there at the time would agree. January 1, 1983, at the stroke of the New Year the world switched to TCP/IP (Transfer Control Protocol/Internet Protocol), a robust protocol that made it easier for computers to share data.

Alexa Thompson
Fall, 2004

CHAPTER ONE: IN THE BEGINNING

1957. The space race to send a satellite into the Earth's upper atmosphere was on. Solar conditions favoured a launch between July 1957 and December 1958. The Americans, preparing to launch their first satellite in early 1958, were blindsided when the Soviets launched Sputnik 1 in early October 1957, soon followed on November 3 by Sputnik II, with a heavier payload and even a dog on board.

The reaction was swift. By January 7, 1958, President Dwight D. Eisenhower had requested of Congress funds to set up the Advanced Research Project Agency, or ARPA, as part of an Air Force appropriation bill. This funding favoured research institutions such as MIT with its Lincoln Laboratory that were already working on air defence systems and had security clearance. (The Lincoln Lab had been established by MIT specifically to "develop an air defence system that could detect, identify, intercept, and direct resources against hostile aircraft." [NERDS 1.0.1, p30])

MIT scientists working for ARPA included J.C.R. Licklider and Len Kleinrock. In 1963 Dr. Licklider first raised in a memorandum the idea of having computers networked together so they could share information. With hindsight his suggestion was so obvious. How time wasting to have two scientists at two different locations, both working on the same problem and unable to share data. A year earlier Dr. Kleinrock had been completing his doctoral dissertation. His topic was communications network and in it he wrote: "The nets consist of nodes that receive, sort, store, and transmit messages entering and leaving by way of links." [NERDS 2.0.1 p33] This paper laid the groundwork for his revolutionary idea of "packet-switching". Instead of transferring data over a dedicated circuit that had been set up between the originator and the destination (a system known as circuit-switching), packet-switching involved sending blocks (or packets) of data separately using the fastest means possible. If one route were blocked for any reason, that packet would be automatically switched to another route. The packages would then be reassembled when all reached their final destination. It is analogous to having a picture puzzle at one station. The various pieces are broken into separate packages and each packet is mailed individually. Some packets take a direct route (say by plane from Halifax to Toronto); others take a more circuitous route (Halifax, Fredericton, Montreal, Ottawa, Toronto). As the packages are received in Toronto, the puzzle is reassembled. If a parcel is lost or broken in transmission it can be resent, and the original puzzle can be accurately reconstructed. And from the point of view of the U.S. Defence Department, the attraction of packet-switching is that if one route is attacked and destroyed, the packet will find another one. This was all very appealing to ARPA.

Progress to network remote computers was slow during most of the 1960s. Despite millions of research dollars available from ARPA, most of the institutions involved in defence contracts simply did not want others "messing with their computers." These were huge,

cumbersome machines, many requiring a clean room in which to operate and scientists were very proprietary. As Dr. Kleinrock wrote:

"They couldn't imagine allowing the hoi polloi from less upscale groves of academe soiling their mainframe with mere workday research data. Though they could imagine wanting to get their hands on other people's computer resources, and they never had enough. Larry (Roberts at M.I.T.) was doing a similar thing from his side. The typical response was, 'Why?' I said, 'Well, look, you'll be part of a network and you can use other people's computers and they can use yours.' They said, 'No, nobody can use mine. It's overloaded already. A hundred percent right now. Don't touch me.' And I said, 'But you can have access to other people.' They were not interested." [Nerds pg. 59]

In the end ARPA dollars won out, and by 1967 planning for a network to connect computers (coined ARPAnet) had begun in the United States. Sites were chosen for the first four nodes, each of which had scientists working on ARPA-funded contracts: UCLA, Stanford Research Institute, the University of California at Santa Barbara, and the University of Utah. M.I.T. on the East Coast was not included, probably because of the cost of running lines across the country for an unproven experiment.

Once the sites had been chosen, the fun began. The computers at these sites had to be able to communicate with each other, but they were four different systems from three different manufacturers and they didn't use the same networking protocols. The protocol problem was overcome by the insertion of Interface Message Processors (IMP), minicomputers placed between the mainframe and the external network. The IMPs talked among themselves so that each mainframe needed only to talk to its IMP.

The first node was turned on at UCLA on September 2, 1969. The second, at the Stanford Research Institute in Menlo Park, California, arrived in mid-October. On October 29th the connection was made between the two. Nothing too elaborate: the UCLA team logged on using the software developed at M.I.T. and began to transmit LOGIN to the team at SRI. They got as far as the "G" before the system crashed. A few hours later it was up and running again, and the initial experiments with transferring data began. The nodes at the other two universities were online by the end of that month and within the year there were ten nodes spanning the country. The Internet had found its voice.

But was it a true Internet? Arguably not. ARPAnet was restricted to only those scientists working on US defence contracts. It was not open to others and other similar networks, if they existed, could not connect to it. Today we would consider it an Intranet.

By 1977 some experiments regarding packet-switching such as between ARPAnet and SATnet (connecting members of NATO) were taking place, but were still restricted to defence organizations. However these experiments were part of a milestone because they were the first interconnected networks to use a new protocol — TCP/IP.

Computer systems seem to develop around what becomes known, with hindsight, as "killer applications". For the MacIntosh, it was desktop publishing. For Intel-based operating systems, it was the spreadsheet. For the Internet, it was email; its development is an important part of this story.

In the early 1970s, while computer scientists were grappling with the transfer of files between systems, one young scientist, Ray Tomlinson, started messing around with ways of simply and effectively transferring data from one computer and dropping it into the "mailbox" of another one. Tomlinson, who wrote some of the earliest email programs, launched it in 1972 and called it READMAIL. He is also the one who came up with the now universally recognized "@" sign. Quite simply, so-and-so was *at* a particular computer.

Chances are high that if asked, ARPA would never have financed the development of email software (even though Tomlinson says it took him less than two weeks to concoct), but the application caught on quickly. Within the year ARPA was reporting that 75 per cent of its net use was for email.

Early file transferring programs were slow and cumbersome. Vincent Cerf, one of the young graduate students at UCLA in those early days, recalls all kinds of problems. Poorly allocated memory often meant that when packets arrived at their destination there wasn't enough memory left to reassemble them. Then again, the sheer volume and array of computer hardware and software programs needed was astounding. The network system, still in its infancy, was struggling to survive under its own weight.

A new, more reliable and more efficient protocol was imperative. Led by Cerf, then teaching at UCLA, computer scientists and graduate students developed TCP/IP (Transfer Control Protocol/Internet Protocol). Simply put, the IP part routes packets from the local network to a regional one and onto the Internet while the TCP verifies that the correct data has been delivered to the client and, if any information is missing or corrupted, issues a request for that portion to be resent. The scientists were young, energetic, and imaginative. Anyone could write a standard, send it out to the community as a Request for Comments (RFC) and if it worked, it was implemented. No hidden agendas. "It was," says one pioneer, "nimble, working, here and cheap."

The first demonstration of how this revolutionary protocol could work across multiple networks took place in July 1977 using an artificially constructed routing system. Packets originated from a packet radio system in a van on the San Francisco Bayshore Freeway, crossed the Atlantic Ocean via satellite to Norway, then to London by landline, back to West Virginia over SATNET, and finally to University of Southern California by ARPAnet. It was a 94,000-mile (including satellite links) return journey that ARPAnet, confined within its defence networks, could have completed in less than 800 miles return.

What Cerf and his team strived to demonstrate was that with this new, much more reliable protocol system, packets of information could whiz around the world, speeding off in different directions, and all arrive at their expected destinations, reassembled, and without the loss of a single bit of datum.

Over the next five years, TCP/IP was further developed, tested and refined. In

1982, ARPAnet decided to convert from its original protocol, NCP (Network Control Protocol), to the new one. At midnight on January 1, 1983, TCP/IP was turned on and the Internet was finally born.

On January 1, 2003, at a levée (a very Nova Scotian hospitality tradition to welcome in the New Year), computer pioneers from Dalhousie University joined colleagues to celebrate the 20th anniversary of the Internet.

BITNET

While computer scientists were grappling with making connections through ARPAnet, others outside the Defence Department's sphere of influence were also struggling to find ways to get computers to talk to each other. There was a move afoot to find ways of allowing all academics, and not just defence contractors, to share data. Computer service directors at the City University of New York and Yale University reasoned that IBM's NJE (Network Job Entry) protocol software would make it practical for universities to be linked. In March 1981, a consortium of computer service directors from a dozen East Coast universities met to set up BITnet (Because It's Time network). Within a couple of months and using a shared permanent telephone line, Yale and CUNY had established a Bitnet link. Another 25 computer centres soon came aboard. This network used the "store and forward" method of transferring files, meaning that files were transferred in their entirety to a mainframe, temporarily stored and then passed to an adjacent mainframe, then to the next, and finally delivered to the end user. This was not the revolutionary packet-switching used by ARPAnet and it did not use the flexible TCP/IP protocol, then still in its infancy, but it worked.

During its first few years Bitnet grew moderately, adding about 50 nodes a year until, by the beginning of 1984, there were a total of 157 computers networked. That year IBM started to provide funding which would last until 1987 for Bitnet operations, and the Bitnet executive adopted new regulations. Use of the network would be restricted to universities, non-profit institutions and organizations in support of higher education. It would not permit commercial traffic.

With the end of the IBM grant in 1987, Bitnet had to find other funding sources. The obvious answer was to increase membership. Over the next two years a number of general users, people without specific computer training, joined the organization. They used the system to share information and discuss issues of mutual interest. While Bitnet was still non-commercial, this had the effect of making a greater number of people aware of the various networks. If ARPAnet was the child of the Defence Department, Bitnet was the offspring of the general university faculty. And Bitnet is important to Nova Scotia's story because, as we shall see, it was the model for NetNorth, Canada's first national university network.

Bitnet may be gone now but we still have Listserv, which was adopted by Bitnet in the late 1980s. Listserv, written by graduate student Eric Thomas, is software that allows groups of subscribers to communicate with each other about a subject of particular interest. Unlike bulletin boards or

Usenet, Listserv members use email to communicate.

USENET

There was one other group plugging away unofficially at connecting computers: USEnet, a store-and-forward system that uses dial up telephone lines. Also known as the "poor man's ARPAnet", USEnet has been around since 1979 and was one of the earliest international networks. Technically USEnet is the software that runs the UUCP network (Unix-to-Unix CoPy), but it has become synonymous with the network itself today.

Usenet was similar to a bulletin board. Personal messages could be sent as email and stored, then retrieved when the user was available, generally at night when long distance dial up costs were cheaper. And public messages were posted in newsgroups, each dedicated to a specific topic. Usenet relied on a community of computer users, many of who dedicated their computers as nodes. These were the users who either had the technical expertise to handle the volume of traffic or the financial resources to cover the cost of long distance dial up. What began as an altruistic gesture by those allowing their computers to double as nodes soon became the downfall of Usenet. (It was considered poor computer etiquette to charge users for access). Node owners controlled Usenet. They controlled which newsgroups were distributed. They acted as self-appointed censors, rejected groups they thought too "racy". (Possibly as has been suggested in many forums because these newsgroup "managers" were charging the dial up charges to their own unsuspecting places of employment and didn't want to draw attention to themselves.)

Think of Usenet as the Internet for the "great unwashed" overseen by newsgroup managers who were quickly dubbed the "Backbone Cabal" for their control over Usenet's backbone. It was messy. It was not very democratically run. But within four years of its launch in 1979, it had topped ARPAnet in size with over 600 nodes and thousands of users. Those not a part of the academic or defence contractor elite had a means of networking; even a number of academics used Usenet to chat informally among themselves and swap email messages. Usenet spawned much of the Internet jingoism with terms such as *Net Gods* as well as acronyms that are still used by text messengers, such as *LOL* (Laugh out Loud) or *IMHO* (In my humble opinion).

By the mid-1980s, the United States had ARPAnet, Usenet and Bitnet, plus other more regional networks. ARPAnet used packet-switching technology and TCP/IP protocol so that remote computers could connect without going through a mainframe, but it was getting a little tired. Using the ARPAnet model, a series of super computer centres were funded by the National Science Foundation (NSF) and networked across the US. They were faster, they were better connected, and they were the NSFnet. The Internet was right around the corner.

Surfing on the Web

The event that more than any other drove the commercialisation of the Internet was the development of the World Wide Web, more commonly

known as the Web. While at the European Particle Physics Lab (CERN) in Switzerland, Tim Berners-Lee began playing around with the idea of a Universal Document Identifier, a hypertext global space to which all network-accessible data could be referred. In 1990, he wrote WorlDwidEweb, a point and click hypertext editor that ran on NeXT machines — the first Web-server. Users entered the realm of HTML (Hyper Text Markup Language), URLs (Universal Resource Locators and the replacements for UDIs), and HTTP (Hyper Text Transfer Protocol). It was to be a common information space in which people could communicate by sharing information, and it would be universal. It was also, wrote Berners-Lee in an online article, "dependent on the Web being so generally used that it (would become) a realistic mirror of the ways in which we work and play and socialize. …We would use computers to help us analyse and make sense of what we are doing, where we individually fit in, and how we can better work together."

Between 1991 and 1994, traffic on the first Web server (info.cern.ch) grew tenfold per year. In 1992, the academic world perked up interest, quickly followed by the industry in 1993. The pressure on the system and on its founder was immense. In September 1994, after much discussion, Berners-Lee and colleagues formed the World Wide Web Consortium, with bases at M.I.T., INRIA in France, and Keio University in Japan.

To navigate the Web, users, particularly those with only limited technical ability, needed a browser. Gopher was on its way out and had never been a part of the Web. In 1993 graduate students at the University of Illinois, led by Marc Andreessen, released free software designed to retrieve data more easily from computer networks. They called it Mosaic. It was, says Brent Conrad of Bell Canada, the first true GUI (Graphical User Interface) available for the Internet and it opened up the Internet to images as well as text. Its impact on the non-technical population was immediate. And although it was some years off, a browser that supported images provided part of the impetus for high speed internet that could bring up those images quickly. From 10,000 Mosaic users in April 1993, growth of surfing with browsers is expected to top one billion by 2005. That's just 12 years!

Marc Andreessen went on to found Netscape Communications Corporation with the intention of developing a more powerful version of Mosaic— a Mosaic Killer was quickly dubbed Mozilla.

CHAPTER TWO: THEN ALONG CAME CANADA

The Early Days: Canada Strives for a National Approach

Like their American counterparts, Canadian scientists throughout the 1960s grappled with ways to connect computers so that researchers at remote sites could share data. By 1970 the state-of-the-art connection was a monitor, with keyboard, linked to a mainframe on campus. If you wanted to send a message to a colleague, you sent it from your terminal to the mainframe, which, in turn, passed it on to the recipient. Not terribly efficient perhaps by today's standards, but it was electronic mail and it worked!

Then along came Dr. John Reid of the Université de Québec. In October of 1970, he attended a conference of the Inter-university Communications Council (a Council set up in 1964 to encourage universities to share information). Larry Roberts, formerly of M.I.T. and by this time director of ARPAnet, gave a presentation on packet-switching technology. Reid was hooked. ARPAnet, he realized, was on to something. Not only was it the first computer concentric network built from scratch; it was not application-specific. It had one job only: distribute data. He would have liked his university to be connected to ARPAnet, the first in Canada, but was blocked by U.S. Defence Department restrictions. ARPAnet was for their use or for universities with U.S. Defence contracts only.

With the technology of packet-switching, why, reasoned Reid, couldn't Canada develop its own net? He and colleagues from the University of Waterloo (then and now a leading university in computer research) made a joint proposal to the Federal Department of Communications (DoC) to set up CANUnet (Canadian universities), using packet-switching technology. Most universities approached agreed the project was worth investigating and DoC provided some research funding, but at a meeting in August of 1971 of CANUnet participants, it became clear that there was no consensus among delegates. Ontario was busy creating its own network. McGill University announced somewhat haughtily that it had its own computer resources and had no need of a network. No model proposed could be proven to be workable. And so when Reid made his report to the DoC the next year, it was not surprising that he was turned down flat. No funding from DoC meant no CANUnet.

The Department's decision may have been influenced in part by Dr. Leon Katz of the University of Saskatchewan, then head of the very influential Science Council of Canada (SCC). He foresaw that some day computers would be as common in the home as televisions or telephones. He felt that if this country relied on an American system, it could affect Canada's sovereignty. Instead Katz proposed in an August 1971 SCC report: why not create a digital network backbone right across Canada? Independent local and regional networks would then connect to the backbone. It would be a trans-Canadian model, a single backbone with links feeding into it from various institutions across the country, a model that the DoC preferred

over Reid's. All Reid had wanted was to try the thing: build a system, connect a couple of universities, and see if it worked. The DoC decision not to fund his model ended any chance of a Canada-wide network for ten years, though the idea had been broached and would continue to be discussed throughout the next decade.

The UNB Experience

One thing John Reid and his colleagues discovered as they criss-crossed Canadian campuses looking for support for CANUnet was that a number of provinces had already invested research time and money in exploring their own networking initiatives. The Internet developed regionally in Canada, with various provinces starting their own networking systems, almost invariably with a major university at its hub. In New Brunswick, the hub was at the University of New Brunswick (UNB). In Nova Scotia, it was located at Dalhousie University. The universities had the mainframe computers and the universities had researchers eager to share data through file transfer.

New Brunswick is a very interesting case study, despite being overlooked by Reid in his travels as being too small and too far from Central Canada. Precisely because of its isolation UNB was busily creating its own networking system even as Reid was arguing with DoC to set up CANUnet.

David Macneil takes up the story. By 1969, he and Dana Wasson, head of computer science at UNB, had convinced the New Brunswick Higher Education Commission that if New Brunswick universities were to attract the calibre of researchers, faculty and students drawn to larger institutions, notably those in Ontario and Québec, then they would have to find a way to pool networking resources. The result was the New Brunswick Community Education Network (NBCEN), a co-operative of university campuses with links to the IBM 370 mainframe on the campus of UNB in Fredericton. Participants included the UNB campuses in Fredericton and Saint John, the three campuses of the Université de Moncton, St. Thomas and Mount Allison Universities, and the Maritime Forest Rangers School.

By 1972, they were all connected to a number of IBM terminals, described by Laurie Mersereau at the time as being "basically an IBM Selectric typewriter with an interchangeable 'golf ball' element, packaged on a small table." [History of the Internet in New Brunswick, http://personal.nbnet.nb.ca/laurie/internet.html] Within the year, UNB had connected its terminals to a mainframe at the University of Toronto.

The University of Prince Edward Island in Charlottetown joined the New Brunswick consortium in 1976, and by 1980 ECN (the NB was dropped when Prince Edward Island came on board) was able to provide electronic messaging for all university students and faculty in the two provinces. It was a store-and-forward system, similar to BITnet in the USA. But, said Macneil, "it was low function, low speed and low cost."

Québec Goes its Own Way

In Québec, John Reid continued to be quite a visionary. He was determined to

build and test a network, but after the fiasco of CANUnet he restricted himself to a series of remote terminals connecting several dumb terminals on the campus of the Université de Québec to a centralized mainframe. By 1972, he had a network that linked Université de Québec campuses in Montreal, Chicoutimi, Trois-Rivières, Hull, and Rouyn to the mainframe in Québec City.

An interesting sidebar to the Québec story is that Richard Lacroix, director of the computer centre at the Université de Québec's Montreal campus, went on to work for the Ministry of Education in Québec. There he created a network connecting all of the province's school boards to the Ministry's mainframe. The network, with the acronym EDUPAC, had, by 1983 connected all provincial elementary and secondary school boards as well as the CEGEPS and various public organizations. In all, 200 centres were networked, and they all had their own electronic messaging system.

Canada's Western Provinces Go Online

Out on the west coast, the University of British Columbia (UBC) was fielding its own efforts. The university was the first in Canada to operate an IBM mainframe system 360/67 and, using a Michigan Terminal System (MTS) operating system, linked nine universities that included UBC, Simon Fraser University, and the University of Alberta. Among those working on the project in British Columbia were Paul Gilmore, head of computer science at UBC, and Gerald Neufeld of the Comité Consultatif International Téléphonique et Télégraphique (CCITT). Together they applied for and obtained NSERC (Natural Sciences and Engineering Research Council) funding for Neufeld to write messaging software. National funding required a national name for the network, and so the UBC system became CDNnet, with a $170,000 research grant from NSERC in 1981. Why did CDNnet succeed when CANUnet failed? Principally because CDNnet was an application built for an already existing network. The universities were already connected. They just needed messaging software to make it easier to communicate.

The messaging software Neufeld wrote was named EAN for his wife Ellen and son Andrew Neufeld. The software was accepted by CDNnet using existing X.25 protocol (used by Datapac and similar networks), which opened up CDNnet to a much wider audience. By 1982, CCITT had released the X.400 messaging protocol specifications, and within two months UBC had implemented EAN software to connect remote sites in other parts of Canada. But UBC remained the core of the network. All messages had to be sent to the university's mainframe and then passed on to the recipients. It was not true "packet-switching" as had inspired Dr. Reid over a decade earlier. Two remote terminals could not communicate with each other if the mainframe was "down" or flooded with messages.

DND Comes On Board

While university computing services directors were fumbling with the concept of a national backbone, Canada's Department of National Defence was also looking at the advantages of networking computers to share data.

By the early 1980s, ARPAnet (by now rechristened DARPAnet, the "D" for Defence) was no longer experimental. It worked. And Canada was intrigued, to say the least. The Defence Research and Development Board (DRDB) commissioned Intellitech Canada to carry out audits to see if National Defence would benefit from an ARPA-style network. The resulting reports stated that not only would a network of email and file transfer benefit DRDB, but that it would also give researchers access to colleagues outside the department. The question was: Build our own network or piggyback onto the American one?

The first plan was simple: create a network similar in structure to ARPAnet using the technology being developed in British Columbia for CDNnet; then connect the Canadian network to the American one and throw the switch. Even a location for the first hook up was quickly established. The Defence Research Establishment (DRE) in the Atlantic region (DREA) was working with researchers at Stanford University on Artificial Intelligence. Both labs would benefit from being able to share their data. So connect DREA, via the Defence Research Establishment Ottawa (DREO), to the Communications Research Centre (CRC) in Ottawa which was overseeing the project. Then connect the CRC to a node in Rochester, New York, and Canada would have its ARPAnet connection at long last.

Sounds simple. It wasn't. Although the connections were eventually made, deregulation of the American telecommunications system, which was going on at the time, created long delays on the CRC-Rochester connection. The Canadians were left standing at the border for over four months. And then there was the high cost of doing business by long distance. It is easy today, some twenty or more years later, to forget just how expensive it was to call Aunt Flo in another province, let alone another country. There were the minute rates, which fluctuated depending on time of day (nights and weekends, as with mobile phones, were cheaper). And there was the connection fee. Some paid for a minimum three-minute connection even if all they wanted to do was transfer a millisecond of data. The early 1980s were also a time of burgeoning deficits, rampant inflation and sky-rocketing interest rates. No wonder the CRC baulked. It was not going to spend thousands of dollars to fund a link between a handful of exclusive defence research labs.

That was not the end of the Defence Department's connection by any means. Dr. John Robinson, a post-doctoral researcher at CRC, together with Mike Martineau of Software Kinetics — an Ottawa-based defence contractor — decided instead that Canada would build its own system using the UBC X.25 packet-switching technology and building an Internet protocol over it. What they created became DREnet (Defence Research Establishments network), which was working by September 1985 even though still in its infancy. Still a pilot project, it connected DREA in Dartmouth, Nova Scotia, with the CRC in Ottawa. And the CRC had the connection to ARPAnet. What Robinson and Martineau had done was demonstrate that Canada could build its own system cheaply and effectively.

Perry Sisk, who worked for DREA in Dartmouth, recalls that Gavin Hemphill and Peter Gergley, on a defence research contract, spearheaded the Canadian connection with the American-base ARPAnet. The first plan was to connect Nova Scotia with Washington directly, but then the Defence Department in Ottawa got involved. The decision was revised to route the network to Ottawa and then through to NYSERnet (New York State Education and Research Network) in Troy, New York.

The decision to go with Software Kinetics was based on the company's experience with TCP/IP. Both BITnet in the U.S. and NetNorth in Canada used the IBM NJE protocol. What the Canadians wanted was the same protocol that was in use by ARPAnet and that was TCP/IP. It was not only robust but also able to handle hits and failures and keep on going. Defence units across the United States would still be able to communicate, explained Sisk, even if certain nodes went down.

There was a lot of sharing of ideas in those days, said Sisk. There weren't that many people working on the Internet and it was a very close community. Someone would come up with an idea and toss it out onto the Internet for discussion. Through listservs or email other computer technicians would discuss the idea, try it out, and offer feedback. No one was concerned with locking others out of his or her computer. In fact, added Sisk, in the early days of ARPAnet it was considered rude to lock down your machine.

By 1984, Dartmouth was connected to Ottawa and from there to ARPAnet. That made DREA one of the first nodes on the Defence Internet in Canada — quite an achievement.

It was Vincent Taylor, a Canadian with experience working with DARPA in the United States, who took charge of the management of this Eastern Canadian prototype and turned it into a functioning network connecting all the DRE labs across the country.

According to Sisk, in those days even hackers were the good guys. They were the ones with a passion for computers who wrote programs and put them out on the net for others to try. A few might lean towards the dark side and break into a machine, but always left a polite email to explain that your computer was vulnerable. Then they got bolder. A hacker would go into a machine and deliberately break something to teach you a lesson about leaving your computer open. That was when the media latched onto the term and it received a nasty connotation. And it shattered the open sharing on the Internet. Through the 1990s users locked down their computers with passwords and firewalls. That meant for hackers to get through they had to be particularly skilled. In the last five years or so even that has changed. There are so many tools available on the Internet that practically anyone can be a hacker.

By the mid-1980s, DREnet was completely operational. Various universities had their own networks. Canada had its ARPAnet connection.

The Arrival of NetNorth

Throughout the 1980s, a number of interested computer scientists struggled to find a way to create a national networking system. BITnet worked in

the United States, particularly in the Eastern half, primarily because the universities it linked were physically close to each other. The cost of long distance telephone lines made that impractical in Canada.

Many provinces were experimenting with their own networks. In Ontario, in November of 1983, a consortium of six university computer services directors held a conference at Ryerson Polytechnic to discuss ways of networking the various campuses. Included were: University of Toronto, York University, University of Western Ontario, Queens, and the Universities of Guelph and Waterloo. Among them was Dr. Peter Jones of the University of Western Ontario in London, who would, in 1984, join Dalhousie University as Executive Director of University Computing and Information Services (UCIS). His participation in the early development of networks in Ontario gave him valuable experience and contacts when he came to apply many of these same concepts in Nova Scotia. The Ontario group called itself OUNet for Ontario Universities Network, and the first priority was to link the two mainframes at Guelph and Waterloo.

One of the interesting aspects of this consortium was that it was based on cost-sharing among members. That meant that the more remote universities did not incur higher long distance charges than those in a local dial up area. It was a fair and logical idea, but it also made it difficult to accept new members. And others did want in, including Humber College, Ryerson Polytechnic Institute, McGill University and the University of Manitoba, along with Réseau d'informations scientifique du Québec (RISQ), a consortium of French speaking institutions. It was time for a name change. That came in June of 1984 when an ad hoc committee at a meeting of the Ontario Universities Computing Conference (OUCC) chose NetNorth. Basically OUNet, now renamed NetNorth, was ready and able to connect Canada, but did not have the resources.

Then along came Ken Fockler of IBM with money to pay for the telephone lines needed to establish the network. As one computer scientist from McGill University pointed out, IBM usually donated computer equipment. Here they were offering money to be paid directly to the phone companies. The NetNorth consortium suggested that IBM should consider linking the country from coast to coast and then down to the United States with a network similar to Bitnet. In other words, fund OUNet nationally as NetNorth.

Fockler travelled across the country and spoke to directors at most universities. Down east he got an enthusiastic welcome. New Brunswick and Prince Edward Island had been using their ECN connection for ten years and were delighted at the prospect of a Canada-wide IBM-based network. Dalhousie and Memorial Universities were equally enthused. Not so out west. The University of British Columbia and its affiliate universities had their system in place. Others out west were not using IBM computers and were reluctant to make the switch. But money won out. In all, IBM tossed about one million dollars into the pot and NetNorth was established.

The hub was an IBM 4341 mainframe located at the University of Guelph.

From here NetNorth was linked to Ithaca, New York and on to BITnet in the U.S. There was also a direct line to Simon Fraser University which acted as the hub for British Columbia, and another to the University of Alberta to cover the Prairie Provinces. Other hubs included York University (covering Ontario), McGill University (Québec), University of New Brunswick at Fredericton (a hub for New Brunswick, Prince Edward Island and Newfoundland), and Dalhousie University (Nova Scotia).

In 1985 NetNorth went national. Within five years its membership had risen from 21 institutions to 65, and included almost all of Canada's universities, a great many research institutions, key government agencies, the research and development departments of several high-tech companies, and a handful of community colleges. It worked because of the OUNet idea of cost-sharing among members and because it was popular. It was text-based, it was slow (never more than 9600 bps), and it was basically an electronic messaging system, but it did the job.

In Nova Scotia the connection was routed from the University of New Brunswick in Fredericton to Dalhousie University. From Dalhousie, connections went to the Technical University of Nova Scotia as well as Saint Mary's, Acadia, and Mount Saint Vincent Universities. And in Nova Scotia, at a mere 2400 bits per second, it handled the province's entire email service.

Like BITnet, NetNorth used a store-and-forward system. A message, say, from Ryerson Polytechnic in Toronto, bound for Acadia University in Wolfville would be routed in its entirety to the University of Toronto, then to the University of Guelph, on to the University of New Brunswick, down the pike to Dalhousie University, and finally to its destination at Acadia. Dalhousie used NetNorth for all its networking needs, including internal email, until the mid-1980s.

With its connection to BITnet in the United States, NetNorth became the first Canadian entry into worldwide email. There had been some email services available in Nova Scotia prior to NetNorth, according to John Sherwood at Dalhousie, with services such as ENVOY 100 available from the telephone company, but it was very expensive, slow and proprietary.

Enter CA*Net

Like Usenet in the United States, NetNorth played its role, but by 1990/91 it was being replaced by the Internet in the form of CA*Net. Remember: NetNorth was not an Internet system. It used the same store-and-forward method of transferring email that BITNET did in the U.S., requiring data to be queued through multiple mainframes on its way to the final destination.

By the end of the 1980s, Canada had NetNorth and DREnet as well as a few local networking sites between local institutions. But the movers and shakers in the university computing world wanted Canada on the Internet. Says John Sherwood of Dalhousie:

There was a real sense that this (the Internet) was going to be big and that we needed to be in on it. Build it and it will be used and become an important part of

the infrastructure. The idea of rolling out the Internet to the general public was still some years away, but universities by the late 1980s recognized it was something they had to have. The group around NetNorth became the leaders for developing plans for the Internet.

The annual meeting of NetNorth in May 1989 at Concordia University in Montreal attracted for the first time, the Minister of Industry, Science and Technology, Dr. William Winegard. He talked about uniting Canada's three solitudes: government, business and academia, using a single network, similar to that of NetNorth.

Peter Jones recalled that it all came together at a CA*Net Conference in Victoria, British Columbia, in 1990. But there were a couple of things happening prior to the conference that had a direct bearing on CA*Net. First of all, the National Research Council of Canada (NRC) wanted a network to link astronomy research laboratories in Victoria and Ottawa. The NRC had $2 million to develop such a network and was more than willing to co-operate with other universities to create one using TCP/IP. Meantime Digby Williams, actually an NRC scientist but on loan to Industry Canada (IC), had a different vision of a Canada-wide Internet, and IC too had the cash. But IC was considering IBM computers with the upcoming OSI protocol created by the international standards body.

The meeting in Victoria became quite confrontational, as both Peter Jones and John Sherwood remember it. Should CA*Net go with the NRC and TCP/IP or with Industry Canada and OSI? The universities favoured Vincent Cerf's robust and reliable TCP/IP protocol. Also Canada through NetNorth already had two TCP/IP connections to the U.S., according to Peter Jones, one in the west and one from the University of Guelph to Ithica, New York. In the end, in typical Canadian fashion, a compromise was reached. CA*Net would initially go with the NRC money and get an Internet up and running quickly. The long-term plan was to go with the Industry Canada model.

Those early days of CA*Net were fraught with many challenges. Regionalism would from time to time rear its head and there was always the threat that some of the regional networks that made up CA*Net would break off and establish their own direct link to the United States. After all, the University of Toronto is much closer to M.I.T. than to the University of British Columbia, and long distance telephone charges were still an issue. CA*Net continued the NetNorth arrangement of cost sharing so that smaller institutions, far removed from urban centres, could afford to be part of the network.

That cost sharing paid dividends. When CA*Net was wound down in 1995, there was still money in the bank, according to David Macneil. "Some of those computer services directors got an unexpected cheque," he said. Funds were apportioned according to how much each institution had invested initially.

CA*Net was funded by a limited grant. In this case National Research Council funding would expire in March 1993. That gave the network a timeframe in which to become financially self-sufficient. The first step was to award a contract to the University of Toronto to operate the network centre and the University, in turn, issued a contract to a

competitive leased line carrier as Sherwood explained it. There was one node, based at a host university, in every province. In Nova Scotia the host was Dalhousie. “That was our Internet connection — IBM PC/RTs, an offshoot of IBM PC with a different processor to run UNIX. A couple of those set up to run a router and that was our connection — 56 kbps.”

But access was never cheap. Each institution paid its provincial network for access, which could range from $15,000 to $50,000 annually, depending on usage. In turn the provincial networks paid CA*Net anything from $70,000 to $250,000 a year, depending on the number of users. Then there was another $1.2 million a year needed just to operate it. And the highest speed remained 56 kbps, unlike U.S. regional Internet systems, which were operating with T1 (1.5 Mbps) connections.

CA*Net, said David Macneil of CANARIE, was to be operated as a national backbone by researchers and educators primarily for email and file transfer. But traffic carried over backbone doubled almost every year from the initial 20 gigabytes a week. Each year more students, faculty and staff at various member universities and colleges were exploring the advantages of the Internet, leaving an increasing number of disgruntled individuals who knew of the Internet and wanted access but did not meet CA*Net’s Acceptable Use Policy (AUP). The AUP stated that the Internet was a communication tool for academic and government research and that access was not open to the general public or to recreational users. Furthermore, commercial enterprises were explicitly forbidden. That said, policing the Internet and ensuring it remained true to its AUP was difficult and generally left to the interpretation of the various regional and provincial networks.

CANARIE

At an Ottawa conference in 1991, proposals for CANARIE began to take shape. CANARIE would be responsible for upgrading CA*Net to T1 or higher connections by 1993. It was a difficult task. With NRC funding running out that year, with many provincial networks clogged up on 56 kbps connections, and with greater public demand, CA*Net was in a bind. There was also a chance that some of those provincial networks would get off the Canadian backbone and take advantage of the US backbone.

In the spring of 1992, it was decided to place CA*Net under the CANARIE project. By December of that same year, the government appeared ready to fund CANARIE with $26 million to get the project underway. CANARIE incorporated in 1993 and by June an agreement between the company and the federal government had been signed. CA*Net now had $5 million federal funding for the much needed upgrades.

Over the next few years, CA*Net frequently upgraded with funding from CANARIE. But by the mid-1990s, CA*Net had become a largely a commercial backbone and was not something that universities and research institutions felt they should be involved with. In 1995, explained Brent Conrad of Bell Canada, Bell was given the contract for the backbone and in Nova Scotia decided to move the point of presence from Dalhousie University to the MTT

central office. Within two years, Dalhousie was an MTT customer as was its associate, ISI-net.

Also in 1995, it was becoming obvious that the big players, such as MTT in Nova Scotia, were getting into the Internet Service Provider (ISP) business and taking over small ISP companies. As Bruce MacDougall explained it, small ISPs had to know how many customers could be serviced per modem. Assuming you had, say, 1000 customers and you knew they wouldn't all be online at once, you could get away with perhaps 200 modems. But as more customers came on line, there were more delays, more busy signals and more computer crashes while downloading large files. The time was ripe for the big players to move in, clean up, and offer a faster and more reliable service. And they were definitely "for profit" businesses. How should CA*Net handle this? At a board meeting that year, it was agreed that the universities could go it alone and the painful decision was taken to wind up CA*Net within two years. It ceased to operate the backbone as of April 1, 1997. Officially it ended at the last board meeting in Halifax on June 23, 1997. But it wasn't quite the end. At the same meeting the CA*Net Institute was established and it still exists, funding various projects including publication of *A Nation Goes Online*.

The research and education sectors had long since moved on. The National Test Network was introduced in 1995 at a time when ATM networks at 155 Mbps allowed for easy manipulation of images, sound and video. ACORN-NS[4], the Nova Scotia Regional Network associated with CANARIE, used the NTN to demonstrate high-bandwidth visualization applications to a supercomputer in Calgary during the Halifax G-7 First Ministers' Conference. Like the original concept of CA*Net, the NTN was for the exclusive use of the research and education community.

In June 1997, just in time for a National Network Conference at Dalhousie University, CA*Net 2 was connected for the first time. It was designed, said John Sherwood, to push technology faster than commercial Internets. According to David Macneil, it was the first research and education network that was build from the ground up for Internet traffic, using TCP/IP over ATM. It integrated applications and enabled the next generation of web services and high-speed networks.

[4] http://acorn-ns.ca/

CHAPTER THREE: THE INTERNET AND NOVA SCOTIA

Early Days in Nova Scotia: MPHEC

Here in Nova Scotia, in the late 1960s, the Maritime Provinces Higher Education Commission (MPHEC) provided funding for a computer to be located at Dalhousie University with rudimentary connections to other institutions.

The idea behind the MPHEC effort, said Intab Ali, who ran the computer facilities at Dalhousie until 2001, was that the university would offer computing facilities to other institutions in the province. Each campus, with its own small computer, would link via modems to Dalhousie's much larger mainframe. With connections funded by MPHEC, by the late 1970s seven institutions were linked to the Dalhousie mainframe — the University College of Cape Breton, University of King's College, Mount Saint Vincent, St. Francis Xavier, Acadia and Saint Mary's Universities, and the Agricultural College in Truro.

That old computer, an IBM 350/50 and housed in the law building (now the University Club) serviced Dalhousie until it was replaced in 1971. Amazingly, the air conditioning unit that cooled the old computer is still in use, possibly the oldest piece of computing equipment on campus in continual use.

In April 1982, the MPHEC tried again, signing separate agreements with universities in New Brunswick and Prince Edward Island, and Nova Scotia to set up provincial co-operatives to provide computer network services. In Nova Scotia it was called the Nova Scotia Educational Computer Network (NSECN) and it was to: "provide a reasonable level of computer services to the parties of the agreement, in order to meet their individual requirements in teaching, research and administrative applications."[1] The agreements would last until March 31, 1984, with Dalhousie providing the host computer in Nova Scotia. That meant that other institutions would need to buy compatible equipment and lease lines from Dalhousie to the mainframe. All file transfers and email correspondence would go through Dalhousie. St. Francis Xavier researchers wanted to transfer files with Saint Mary's faculty? The files went from St. F.X. to Dalhousie and then were forwarded to Saint Mary's. In fact, 81 per cent of traffic in the first 17 months was between three southend Halifax institutions: TUNS (35%), Dalhousie (32%) and Saint Mary's (14%).[2] Dr. Lawrence Landweber, who

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[1] Members of NSECN included Dalhousie University, Acadia University, Mount Saint Vincent University, the Technical University of Nova Scotia, St. Francis Xavier University and Saint Mary's University. It was also intended to eventually include the Atlantic Institute of Education, the Atlantic School of Theology, Université Sainte-Anne, the Nova Scotia Agricultural College, Nova Scotia College of Art and Design, Nova Scotia Land Survey Institute, Nova Scotia Teachers' College, University of King's College, and other institutions, colleges and community colleges.

[2] *Maritime Province Higher Education Commission: External Review of Nova Scotia and New Brunswick/Prince*

was hired as an external consultant to evaluate computer networks in the Maritime Provinces, recommended that the agreement be continued, with ongoing support from MPHEC.

The arrangement didn't last long in Nova Scotia, however. Some of the universities, such as Acadia, opted out to set up their own networks and soon the whole setup came apart. "And that," says John Sherwood, "was the end of the first Nova Scotia Network."

The problem, suggested David Macneil, was that unlike New Brunswick, which had developed a network system by consensus of the participants, Nova Scotia was working on a "majority vote" system. That meant that smaller institutions could band together and outvote a larger university, such as Dalhousie. "It was," said Macneil, "doomed from the start."

Dalhousie University and the Internet

Dalhousie University was always a keen player in the development of networking and the Internet in Canada. As far back as the late 1960s, the university was involved in projects to share information and ideas among its departments. In those days, according to Ali, there were about 25 or 30 keypunch machines which mathematics students used to input data. By the early 1970s he had convinced the university administration to replace these with terminals connected to the new Control Data 6400 computer located in the Killam Library. This new computer, said Aidan Evans of Dalhousie's Networks and Systems Department, had attached to it a data switch, known as a Gandalf PACX, housed in a separate machine room. The PACX had wires running to computer terminals and modems.

The terminals were teletype machines, each with a telephone dial on the front that the user would dial to log on. There were eventually, thought Evans, probably 100 terminals connected to the PACX across campus, although only about twenty could be used at one time. The computer itself was huge: easily eight feet tall, sixteen wide and eight long. It remained in operation until around 1979 when it was replaced by a Control Data Cyber 170/730. That one stayed put until 1989.

By the late 1970s dumb terminals had replaced the teletypes. "They may have been 'dumb'," said Ali, "but they were a lot smarter than those old keypunches." Through the early 1980s, the campus slowly became hardwired. Dalhousie's rabbit warren of underground service tunnels proved especially useful for running cables from the Killam Library to other buildings. And by 1984, numerous off-campus sites were also networked, among them the Technical University of Nova Scotia, then a separate institution affiliated with Dalhousie.

Another event that happened in 1984 was to have a profound affect on how the Internet was set up in Nova Scotia. That year the Weldon Law Building on the Dalhousie campus was struck by lighting and the top floor, holding the Law Library, caught fire. Since it was a library and librarians are notoriously anxious about water damage to rare

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Edward Island Educational Computer Networks, Prepared by Lawrence H. Landweber, December 1, 1982.

books, there was no sprinkler system. And because the fire occurred at night, it was well underway by the time anyone noticed. The library lost a lot of books and also its entire card catalogue. For months huge trucks, equipped with special vacuums for drying out the water-soaked books, were parked outside the building.

The catalogue was a big problem; it had to be replaced. A decision was taken that, rather than recreate it on paper, the university would bring in an automation system. The company chosen was GEAC, one of the world's largest suppliers of Library Information Systems. The new system, named NovaNet, worked so well that other university libraries soon bought into it. Interuniversity Services, which handles purchasing for member universities, posted NovaNet as a public company. Its importance was that it was already up and running long before Nova Scotia became involved in the Internet. It was effective, and many of the early Internet connections piggybacked on NovaNet. Or putting it another way, if you are going to bring nodes into a specific area, why not locate them in a library that already has space set aside for NovaNet nodes?

Email service was available on several of the larger campus computers by the early 1980s. The Dalhousie Computer Centre had email on their Cyber, as did the Biophysics Lab in the Faculty of Medicine on their VAX/780. It came first to the Math Department via a VAX /750, which was housed on the fourth level of the Killam Library in a walled off part of the floor. About the size of a washing machine, it was inherited by the successor to the Computer Centre, UCIS, when the Math Department moved on to the Chase Building. All of these were standalone email systems when first installed, with no connections between them.

It was the VAX 8800, installed in 1987, that offered the first campus-wide email connection. It was replaced by the smaller and more powerful VAX 4500 in September of 1994 (a time of the year called the "September Bubble" by Bruce Hudson, Network Services Support Supervisor at Dalhousie, because of the headaches to the computer centre caused by an influx of inexperienced students and even more inexperienced new faculty).

Before that, Hudson recalled, networking was by Unix Copy protocol. No packet-switching, it was store and forward, using off-peak dialup times. The new system meant that email could be sent and an answer received within hours, not days.

"I remember," he said, "getting a message off to Israel and getting an answer the same day. It seemed remarkable."

Support for the Internet

Quite early on Dalhousie became interested in creating a Nova Scotia based Internet, using packet-switching technology and TCP/IP. John Sherwood recalls trying to convince MT&T to become involved. He and a telephone company representative flew a "puddle-jumper" to Boston, then drove to Troy, near the New York capital of Albany, to chat with technicians from NYSERnet — a leading network provider at the time. John was there to learn the nuts

and bolts of running a network, but he also hoped the trip would enable MT&T to see the advantages of such a system. Unfortunately it didn't, and with hindsight that might be something the company now rues. But at that time it was not part of the strategic business plan; MT&T was not convinced that the Internet was the way to go, and turned Dalhousie down.

The next step came with a provincial government initiative. Yolanda MacDonald of System House Consultants in Halifax completed a report on how to best use the province's meagre computing resources and identified the possibility of an Internet connection in Nova Scotia. At the time (1988), the Tory government under then premier John Buchanan was in a spending mood. It had $12 million set aside to enhance communications in the province. Peter Jones, the then Executive Director of Dalhousie's University Computing and Information Services (UCIS) managed to convince the government that $2 million of that be allocated to creating an Internet connection in Nova Scotia.

Once the money was in place, things moved rapidly. On January 7, 1989, the government sent out a Request for Proposals to be returned by January 22. A number of organizations, including Dalhousie, RuSh Communications of Port Hawkesbury (who pulled out, complaining that the short time allowed to develop a proposal was insufficient), DMR Consultants, and Software Kinetics, the Ottawa-based company that had helped set up DREnet in Dartmouth a few years earlier and now had an office in Nova Scotia, all responded. Mike Martineau, the same engineer who had worked with DREA, was in charge of the Software Kinetics proposal.

The original Dalhousie plan had been to work in partnership with MT&T to create a Computer Networking Group (CNG). Why Dalhousie? Because it was already a hub with NetNorth and because it had become the ad hoc manager of the local DECnet which connected the Applied Microelectronics Institute, DREA, DEC, local universities and NovaNet. In other words, the university had the technical expertise. Why MT&T? The telephone company had the marketing expertise and it had equipment centres across the province where nodes could be housed. Together CNG would offer management services, promotion and marketing, technical operations, user support and administration. And the network proposed would interconnect Halifax to the Kentville/Wolfville area, Truro, New Glasgow, Antigonish, Sydney, Amherst, and Bridgewater. Not considered at the time was a connection to Yarmouth. This network would connect Nova Scotia to the over 50,000 computers world-wide already on the Internet. Dalhousie would also take over the ns.ca domain name registry for the province.[1]

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[1] As of 1988, dot-ca domain names were registered by the University of British Columbia. Each province, however, allocated its provincial domain names; in Nova Scotia it was Dalhousie University that designated ns.ca names. At the 1997 Canadian annual Internet conference in Halifax, it was decided to reform the dot-ca procedures and the following year, CIRA (Canadian Internet Registration Authority) was incorporated with responsibility for all dot-ca applications.

The Dalhousie proposal was similar to that in place in NYSERNET, which Sherwood had investigated earlier.

Although the partnership with MT&T never did work out (though MT&T did work with the eventual consortium to connect telephone lines), on January 31, 1989, Dalhousie learned that it had been short-listed along with DMR and Software Kinetics and that a business plan was required by February 22. The university was told that it could not be the principal player. The government would not fund an academic institution. In effect, says Sherwood, "We were told to go find ourselves another partner." Both of the short-listed companies were interviewed and Peter Jones favoured Software Kinetics for exactly the same reason it had been chosen by DRE — solid experience in creating Internet connections and in using TCP/IP. (There was still a question then, however, that TCP/IP might be replaced by OSI, the Standards Board protocol.) The government, according to Sherwood, was less than happy with the choice, most likely because Software Kinetics was seen as an Ottawa company although it had recently acquired Wycove Systems of Dartmouth. Martineau believes Software Kinetics eventually got the contract because of its experience with ARPA in the United States and DRE in Canada. Regardless, the government dragged its feet, waiting several months before eventually awarding the contract to Software Kinetics, with Dalhousie as a sub-contractor. It was for two years only. That meant that if the Internet was to continue after the funding had been used up, then it had better find itself some paying customers, and fast.

Peter Jones and his team wasted no time. As soon as Dalhousie learned it was on the shortlist, consultations began regarding setting up the network. One system investigated was JANET (Joint Academic NETwork), a network used in the United Kingdom to connect British universities. JANET could handle email, file transfer and terminal access, and it used packet-switching technology. But it was rejected in favour of an all-Canadian setup.

Enter NSTN

Software Kinetics was working quickly as well. On March 13, 1989, it reached a teaming agreement with itself as prime contractor and Dalhousie as the sub-contractor in an exchange between Mike Martineau and Peter Jones. By March 20, they had established a Network Implementation Strategy in which, "User sites will connect to the major nodes using star topology. Each user site will connect to the closest node using a link of the type most appropriate in the circumstances. In the Metro area this is expected to be 56 kbps Datapath." There would be six nodes, one each at Halifax, Truro, Kentville, Amherst, New Glasgow and Sydney. And on the 27th, in a memo between John Sherwood and Mike Martineau, the two suggest an awareness of the needs of smaller and medium sized businesses with a proposal to subsidize those businesses not located near one of the six nodes. Already the commercialization of the Internet was being explored, quite contrary to the Acceptable Use Policy of CA*Net.

Eventually the contract was awarded and Software Kinetics created NSTN Inc. as a separate subsidiary of the parent company. NSTN (Nova Scotia Technical

Network), said Sherwood, was chosen after banding about a number of other names, such as Fish Net (too like a lady's stockings) and Net Nova (a reverse on the favoured NovaNet, which had already been taken) or Scotia Net. NSTN may be dull, but it was solid and short and easy to type in as part of an email address. The new company's mission was to "Provide a network vehicle that will promote and encourage the use of advanced technology within the province." It would offer email and conferencing, remote file transfer, access to remote databases, and access to specialized computer facilities.

On November 1, 1989, Mike Martineau, Director of the newly formed company, was told that he would receive funding for a total of $1,954,440 to March 31, 1991. Two weeks later on November 14, 1989, the Nova Scotia Department of Industry and Technology in a joint statement by Elmer MacKay on behalf of the Government of Canada and Don Cameron on behalf of the Government of Nova Scotia announced the new contract. On November 30, Dalhousie released a statement about its participation with NSTN. A report in the Halifax *Chronicle Herald* of December 14, 1989, stated that NSTN would be operating with six users by February 1990 and would be fully operational by June. The company hoped to have 25 to 30 users by the end of 1990.

In an undated report on marketing strategies, NSTN identified its potential customers as individuals and organizations involved in research, engineering and education, most likely those with experience with LANs (Local Area Network) and looking for a WAN (Wide Area Network) in order to collaborate with other researchers or labs. Businesses, such as banks or insurance companies that might be interested in transferring large amounts of data would likely be uninterested in the services offered by NSTN.

In a later discussion, Mike Martineau admitted how wrong he was. He had no idea how swiftly the original project, involving universities and research centres, would evolve into a commercial network. It happened out of necessity because of the limit on government funding, but the speed with which it happened took many of the planners by surprise.

The first step for Dalhousie, according to John Sherwood, was to get some preliminary work done — "Get our feet wet." The first interim step was a low speed link of 19.2 kbps between Dalhousie's internal TCP/IP network and McGill University in Montreal. McGill, the University of Toronto, and the University of British Columbia already had private connections to the Internet in the US and so Dalhousie, once the connection to McGill was made, would join the Internet club.

Dan MacKay, the NOC (Network Operations Centre) Manager at Dalhousie, recalls some of the problems faced. He remembers the first time he met Mike Martineau, at a trade show where Martineau was extolling this wonderful new Internet stuff. MacKay was fresh out of university and a software programmer "I told him (Mike) he was hawking old technology that had been around for years. Martineau immediately invited me for an interview". Shortly after that Dalhousie

hired him as NOC Manager, although he was largely dedicated to the NSTN contract in the early days.

The biggest difficulty seemed to be the routers. Old files contain the paperwork for a flurry of memos between the university and Software Kinetics about routers. Dan MacKay explained that the original government contract required all hardware to be made in Canada. Software Kinetics had specified its own routers. "They were really badly done," said MacKay. "We fussed with them but we knew we would never get them working properly. It was the classic defence department $10,000 hammer. So we fell back on Newbridge who were also trying to build routers. They had been building first-class network equipment for some time, but no Internet routers. We spent a great deal of time trying to get (the system) to work, testing it inside and out. We had quite an amazing team, including Mark Dooley who did all the wiring. I did the software stuff. John (Sherwood) did everything else."

Bruce Hudson also recalls those routers. "NSTN started running Suns. There were problems with the routers. It was a wonky situation. Most likely a case of incompatibility." Hudson recalls the NSTN Newbridge routers, but Dalhousie had been using Cisco routers.

One of the first things done was to set up not one but two Sun Unix servers for the NSTN NOC. The first, nicknamed Owl, would be used to control the network; it would be the watcher. The second was intended to be redundant and would be used only if Owl failed. Looking for another, short name, John chose Fox. Later came Snoopy, the watcher for the Dalhousie NOC, and now the university has a Linus, a Sally, a Charlie Brown, Marcie and a host of other *Peanuts'* characters. But Owl and Fox were the original two. And Fox sat idle until NSTN needed it to serve its customers.

As John Sherwood explained it: "NSTN was set up as a commercial network and unique among the provinces. Other provinces were busy serving the public sector, mostly universities, while NSTN was selling itself to businesses as there would be no more money after two years. While universities were the first and largest customers, there were lots of government offices and various other companies around the province to be connected.

"NSTN was a world leader in terms of dial up Internet. Some work along these lines had been done in California, but mostly for use in universities. The idea of rolling it out to the public was a new one. The public had Compuserve[2], but

[2] Compuserve was founded in 1969 as a computer time-sharing service in Columbus, Ohio. CompuServe drove the initial emergence of the online service industry. In 1979, CompuServe became the first service to offer electronic mail capabilities and technical support to personal computer users. CompuServe broke new ground again in 1980 as the first online service to offer real-time chat online with its CB Simulator. By 1982, the company had formed its Network Services Division to provide wide-area networking (WAN)capabilities to corporate clients. It is now a part of AOL (America On Line). [webcenters.compuserve.com/compuserve/menu/about.jsp]

not the Internet. So the idea was to have strategic locations around the province for local calling. Maps were done up to show that if you had a modem bank in Amherst, Truro and New Glasgow, you could cover the North Shore and Central Nova. Dozens of communities, except Wallace (which didn't have toll-free calling to any major community), would be connected locally. These were the communities we targeted, like the Nova Scotia Community College in Kingston, and so on down the Valley. In the South Shore the connection was at Bridgewater's Park View Higher Education Centre. Before long we had coverage of about 96 per cent of the population."

That meant 96 per cent of Nova Scotians could, if they wished, have a local dial up Internet connection. Educational institutions tended to be the place where the Points of Presence or POPs[3] were placed because businesses, such as Michelin Tire in Bridgewater, which they had hoped to bring on board, were not interested at first.

While getting the hardware in place was one thing, the system wasn't going to work without software. Here Martineau showed his genius. The telephone protocol was SLIP, but personal computers of the day didn't support SLIP. Mike wrote ETHERSLIP. Essentially it fooled the computer into thinking itself connected to an ethernet LAN when it fact it was attached to a modem. Call up the modem. A little handshaking and, boom, you're online. It worked beautifully. It also made it easier for non-technically minded customers and that in turn made it possible to roll out this new Internet connection to the general public.

They were exciting days, recalled Martineau. First was a connection between NSTN and the university, a dialup service with lines dedicated to Internet software for PC systems. With Fox, he said, "We did things no one else did. Everything was from scratch, even the idea of using credit cards for service." (That in itself proved revolutionary. It has changed how many people handle their finances. Once reserved for holidays and big ticket items that were paid off over time, credit cards are now used online much like debit cards are used for day-to-day transactions.)

Those credit cards were a bane at first. "We had no way to process credit cards quickly," explained Martineau. "We had a lady who would go over the logs and write out credit card receipts one by one. Eventually we had up to four people hired just to write out receipts." As each customer was billed individually for time used online, it was an unbelievably time consuming method.

Luckily for NSTN, Michael "Moose" Dinn happened along. He was an early enthusiast who ran his own bulletin board in the 1980s and was one of the first to be hooked up at Dalhousie while still an undergraduate. In the summer of 1993, he was hired by Mike Martineau. At the end of the season he was told, "Go back to school or I'll give you a raise and keep you." With that offer, Dinn became Martineau's tenth employee and stayed until June 1, 1997. And one of the first things he did was

[3] A POP was a bank of telephone lines and modems with a link back to the main node in Halifax.

write software to process all those customer credit cards.

Those customers, Martineau added, were signed by knocking on doors, by word of mouth, or by talking directly to business folk. A little bit of advertising perhaps, but not much. Within the first year, NSTN had some of the earliest of the first 100 websites world-wide. Paul MacKinnon was hired to put together initial web work so that customers could set up their own sites. A part of its success was its cost. Revenue from commercial customers allowed Martineau to slash monthly dialup fees from over $400 to around $75 a month (and eventually even lower), depending on hours of usage — an affordable price for the dedicated Internet user of the early 1990s.

Customers were given all the support possible, but sometimes it wasn't enough, admitted Martineau, who recalled the original kit sent to new clients. In those days you needed NSTN software to get online. The kit consisted of three floppy disks. "At the end of the first one, it said to insert the next," recalled Martineau. "It didn't specifically say to take out the first." More than one customer called to complain that they couldn't get the second disk to go into the drive.

Then there was the Remax presentation. Martineau was anxious to convince a leading real estate agent that the Internet was the way of the future. He arrived unexpected at a Remax sales convention and managed to convince the organizers to give him a time slot. He was all prepared. The dial up was tested and running. The audience arrived. He gave his spiel, then turned to demonstrate and the whole system died. "The cleaning lady had been behind stage and had unplugged it," he ended.

Much of those early days were run by the seat of their pants. "You never knew what was going to happen from day to day," said Dinn. "You'd come in and if you saw a light blinking when the lines were not in use, then you would wonder if the government was watching. Or if you heard a whining sound, odds were that the bearings on the hard-drive were about to fail. There were three of us working in the backroom (at the office in Burnside, Dartmouth) and it was a lot of work, but a lot of fun.

"I remember one Labour Day Weekend. I was sent to Ottawa. They needed someone to configure three Internet providers in three days. I worked like a zombie but by the end of the weekend, everything was ready. Then from Ottawa I was shifted to Rimouski in Québec to train someone to be an Internet provider. I learned a lot of French in a very short while.

"They were crazy days. I was travelling eight months out of 12. I'd drive to Hearst in Northern Ontario, four and a half hours north of Timmins, then head to North Bay. From there to southern Ontario, where I set up an entire Internet provider in one day. On one trip, I spent three weeks in Vancouver, one in Toronto and then one at home (in Nova Scotia). I had three clocks on different time zones. I had no idea where I was. "

From 1989 until August of 1995, when NSTN was merged with fONOROLA, the company continued to build its commercial base, much to the chagrin of other parts of the country where the ideal

of an unsullied Internet for the exclusive use of universities, defence, and research prevailed. Other provinces might be grumbling, but Martineau, driven by the necessity to add more paying customers, prevailed. In fact as he tells it, he relished in it. He even took NSTN over provincial borders, which met with some resistance. Not quite right to be selling in someone else's backyard. But there was a need. Take New Brunswick. The universities there were well served with ECN, but organizations such as Blue Cross or Maritime Medical, both located in Moncton, had no service and they wanted it. So within the year, NSTN had invaded Moncton with service, then Kingston, Ontario, next Ottawa and before long, Toronto as Martineau and NSTN headed west with POPs for the densely populated parts of Canada.

"Some of those early modem banks were a sight to behold," remembers Sherwood. "To get the latest modems that we could afford, we went with consumer brand names and they have, to say the least, their challenges. They don't like to get hot. They like to be set out in a space all on their own. We were putting together ten or twenty modems and had to cram them together. So we had to make special arrangements to keep them cool. In the Killam Library (Dalhousie University) we used a huge industrial fan. In Ottawa we used a large closet with modems spread across the floor. Not a pretty sight, but we were feeling our way and had to make things work. Today 96 modems can be connected with one wire."

One of the most interesting parts about setting up the network, recalls Dan MacKay, was setting up the POPs. Most were placed in libraries and so he got to know library staff very well. "For them it was always a big deal. The Internet is coming today! We developed some nice procedures. We would order all the data lines at whatever speed was appropriate. While MT&T was busy with that, we built the equipment in a machine room at Dalhousie. We would test it and then trot off to the site to set it up.

"I remember Lorri Neilsen helped get the Internet pulled into Bridgewater (around 1993) and got the first high schools in Canada online. She had the ability to cope with the annoying level of technology to get a project through and she had the money to supply schools with the technology needed. Through Learning Connections she got two high schools online to talk to each other — Park View in Bridgewater and one in Vancouver. It was a neat project. Around 1993, we were using 386s or 486s, and scanners were rare and extremely expensive. So it was exciting to get a picture back by mail."

This is what made the NSTN venture unique within Canada if not the world. Against the AUP (Acceptable Use Policy) of CA*Net, Mike Martineau was taking his fledgling Internet connection in a very commercial direction. It caused more than a few ruffled feathers at CA*Net board meetings. There was no doubt that early NSTN commercial traffic did not meet with CA*Net AUP, regardless of attempts to explain away the presence of a gopher site, such as Roswell James Computer Books, as a service to subscribers. (James' site was commercial. He was selling books online in the very early 1990s at a time when the Internet was considered to be "pure" and attempts at commercialization where met with irate email. But NSTN passed

off his site as a service to people who needed computer books.)

The relationship between Dalhousie and NSTN seemed amiable. Dalhousie wanted only to build and maintain the equipment. As a university it was not in the business of serving the general public. NSTN sold the service and handled customer technical support. And Mike Martineau, who was an engineer by training, was more than able to trouble-shoot client problems. In fact, says Bruce MacDougall, a NSTN customer since 1992 and now a service provider himself, if your system was down and you couldn't get it up and you called NSTN for help, odds were Mike would answer the phone himself and help you sort it out. But as NSTN rolled into other provinces, Dalhousie's participation in the partnership began to wane and the university began to focus more on CA*Net, which was unfolding in the early 1990s.

NSTN was innovative and it helped put Nova Scotia ahead of the rest of Canada on the Internet. We had local dial up service while Ontario was still fumbling in the Internet dark. In 1995, Rainer Paduch of fONOROLA Internet joined with NSTN. fONOROLA was a long distance carrier with the rights to string fibre optics along railway lines, using a digger that entrenched the lines into the rail beds. The amalgamation produced iSTAR, based in Ottawa, which went public within three months and raised lots of money. It was cash rich and used the money to buy up small firms. But it wasn't generating revenue.

Perhaps it expanded too fast, thinks Martineau. When iSTAR took over NSTN, according to Martineau, "They hired people left, right and centre. It was a whole other world. Small companies had been thrust into one bigger company and that was a part of the problem. That year Sympatico came on line. Costs were going up and prices (for Internet service) were coming down. It was fiercely competitive.

"Fundamentally it was going to be the telephone and cable companies that would run the Internet. They know how to run large companies."

Dan MacKay recalls being offered NSTN employee shares at the height of the .com explosion at $11 each. On the public exchange, they started at $22, went to $30, then $40, and then the inevitable slow decline. When they dropped to $22 a share again, individuals started buying them once more figuring they had reached their starting price and were sure to go up once more. Instead they dropped to $18 and continued down to about $3. In the end, the shares were not worth the paper they were printed on.

fONOROLA in turn was acquired by 360 Networks, a Vancouver company with the rights to string fibre optics across the transcontinental railway lines. The company built a landing station near Herring Cove and laid fibre from there to Ireland, England and Boston before going bankrupt. Around then PSI, a spin off from NYSERNET, picked up iSTAR. In time Telus Canada bought the Canadian side of PSI and re-launched it as inter.net. It still exists. If, like Dan MacKay, you have hung onto your fox.nstn.ca email account, today it is run through inter.net.

An NSTN Customer

"I admired NSTN and how they operated. Mike Martineau had the vision to take it commercial."

Roswell James
Roswell Computer Books

What was it like to be an NSTN customer in those early days? One enthusiastic user was Roswell James, of Roswell Computer Books. Roswell started out in 1988 with a store in Montreal, opposite Concordia University, selling books to students and faculty, and within three years was nearly broke. It was not a good time to doing business as an Anglophone. He had an 18-foot sign in French above his store. But he also had a small slip of paper in the window of the shop, announcing in *English* that he had a computer students could rent. That English notice brought a visit by the Québec language police. So he decided to relocate: Calgary or Halifax? He wanted a university and government city or town because both students and civil servants buy books even in recessions. And he wanted no competition. Just as he was about to make a decision, Calgary opened a computer bookstore. Halifax it would be. But Halifax with a population of only 300,000 was a lot smaller than Montreal with its 2 million plus citizens. There had to be a new way to reach a wider customer base.

James was at a computer trade show in September 1992 and next to his booth was one manned by NSTN. They chatted during slow periods. Roswell James picks up the story: "I told them what I was doing and they were beginning to look at the commercial side of the Internet. It was taboo, but they felt it would be viable. They had sold some packages that year not to universities, research (labs) or the military but to consumers. So we started kicking around a way of putting Roswell Computer Books on the Internet. By October or November we had had enough discussions to realize it would work so long as we didn't advertise.

"Any direct advertising could get you flamed. It could put you out of business. It could put service providers out of business. If you sent someone unwanted email, you would get back the entire *Oxford English Dictionary*. Your business would be down because of the streams of garbage."

The first thing he did, with Dan MacKay's help, was to build his site. And this was 1992. It was not a web-based site; the World Wide Web had yet to be invented. It was a Gopher site. Text-based in one type font: courier. Text looked typewritten and graphics were unheard of. Gopher was menu-based. You navigated through text files, using your cursor arrow (no mouse in those days!). It was hierarchical like a branching tree. I have heard it said that Gopher was for the disciplined mind. You looked things up in an orderly manner and stayed with what you were pursuing. The World Wide Web is for the undisciplined with its random links in front of you. You can jump around so far and so fast that you easily forget where you began.

There was no Google for Gopher sites either. Veronica was one search engine (either an acronym for Very Easy Rodent Oriented Net-wide Index of Computerized Archives or the name of a character in the *Archie* comics) and it

was very limited in scope. Typographical errors were not tolerated. Even articles made a difference. Type in Roswell Company for The Roswell Company and because of the missing "the" Veronica would turn up nothing. In 1990, two graduate students at McGill University came up with a novel search engine. Named Archie (in deference to Veronica but also as a play on the word "Archivist"), this search engine would route through file transfer and Internet sites, locating and storing file names in its own archive. Users could search McGill's Archie server and with keywords or phrases, locate and download files. Within a few months Archie was available on servers around the world.

Once the Roswell Computer Books site was up, NSTN helped by sending out a news announcement that Roswell Computer Books was online as a special service to customers who wanted to buy computer books. Really quite a nifty piece of reverse advertising. And it worked. The first day saw the first customer, from the University of Edinburgh in Scotland.

And customers happily emailed their credit card information. Most Internet users were still involved in academia and they knew packet-switching technology. Why would anyone go onto the Internet knowing he or she had to capture all the packets regardless of the way they were routed, in order to pick up one customer's name, one full credit card number and the expiry date? It was daunting. And since this was not yet a fully commercial network, why would a hacker expect that credit card information would be whizzing around the world?

For a few years, with first his Gopher site and, in late 1994, his first WWW site, Roswell James was doing quite a tidy business. Then along came Amazon Books. The day that site was launched, he says, was the day the Internet ceased to be an academic environment.

"I was a good *netizen*. We were doing great business and making quite a bit of money. The difference between us and Amazon is that they started off as a big company and spent so much to create the site. We were a bookstore and Internet sales were gravy. Costs for our site were small and so we could keep expenses down. We were trying to operate in the environment as it was meant to be, which was academic, and as we didn't spend on advertising we actually made money."

James was also a pioneer in email newsletters. At the bottom of all email sent to customers, just below the signature, was mention of a news group to which they could subscribe. It wasn't Spam because the purpose of the email was to respond to a customer's query, not announce the news group. But in time word of the group spread and soon Roswell Computer Books was sending out an e-newsletter. The bookstore hired its first employee (other than Roswell and his wife) to answer email and work on the newsletter. And then he noticed something quite remarkable. Although sales online were less than five per cent of total sales, retail sales were doubling from year to year. Why? The realization came one day after sending numerous emails to a campus of the Nova Scotia Community College regarding three computer books. Nothing came of the correspondence. Then he noticed that a

huge order had come in by fax from the College Purchasing Department. Email and the Internet were driving his sales, but bulk purchases were coming in by more traditional methods that leave a paper trail.

> Roswell James still has his fox.nstn.ca account long after it was sold to iSTAR, then PSI, then inter.net. He does a lot of business in the United States and in any hotel in any U.S. city, he can plug in his laptop, dial up locally on his modem and through his fox.nstn.ca account, communicate with his store from anywhere in North America.

NovaNet in the 1990s

NovaNet, that library catalogue system from the mid-1980s, was reaching capacity by the mid-1990s. By now it was providing all Internet services to several provincial universities using NSTN lines, and these would get bogged down at times, especially in foul weather. Take the University College of Cape Breton. According to Dan MacKay, “For a long time microwaves connected Cape Breton across the strait and into Sydney, and on foggy days it would go down near Ben Eoin. There was a second problem because the bill for the UCCB connection was being paid by the university library for a dedicated line to run that library’s catalogue. Some said, ‘Use the dedicated line for the library and we’ll put the rest of the university on it too. You’ll hardly notice.’ But the microwave did go down, and the line did get overloaded, and the library had serious problems with it.” A new, reliable and fast connection was long overdue.

As John Sherwood explains it, around 1995-96, a parallel service was proposed to handle just NovaNet, or at least to prioritise NovaNet’s usage so that there would be no interference. The concept soon moved from the libraries to general university services. It was a great way for the universities to co-operate, to connect with Halifax and save money on their Internet fees. Before what became known as ISInet, a university, such as St. Francis Xavier that wanted a connection to NovaNet would pay to connect to NSTN. Meanwhile Dalhousie, where NovaNet was housed, would also pay for a connection to NSTN. Now both were paying for service and both services were overloaded. This new connection would allow all universities in Nova Scotia to be connected together and share a connection to the Internet at considerable savings. ISI would handle the business end of things and each institution would pay by their size and amount of usage. It was a wonderful cost-sharing plan. But as with so many ideas, explained Sherwood, it eventually floundered under the effort of trying to keep all participants content. Occasionally a university, such as Acadia, would bail for a while, upsetting the cost-sharing. The partnership failed. Dalhousie took it over as a business venture.

ISInet is still operating. Most Nova Scotian universities, TARA (the Telecommunications Application Research Alliance), Chebucto Community Network, provincial hospitals, and an array of other institutions are involved. “It is like a buying club,” explained Sherwood. “It is bulk buying. We were able to reduce prices by one-third and still have better connections. Traffic from Dalhousie to Saint Mary’s, for example, is virtually free and continuously available. Before we’d pay our (service) provider to send traffic to Saint Mary’s and they would

pay theirs to receive it; it made no sense."

Schoolnet and CAP

Since the 1990s, the Federal Government in Canada had been talking about a strategy for developing an Information Highway in Canada. The idea was to fund projects to get affordable Internet access to people living in rural areas of the country and in the North.

Discussion first took place at a Community Networking Conference, sponsored by the Department of Industry and Science, and held in Ottawa in August 1993. The scheme had limited success nationally. Basically it was funded federally and overseen by interested provinces, of which Nova Scotia was an active partner.

One spin off from this discussion was the launch of *School Net — Plugging Kids into the World*. It was designed to provide teachers, librarians and students with the electronic tools needed to develop information technology skills and it was intended to connect 300 schools during the 1993/94 academic year. In fact over 4000 schools nationwide accessed services in that one year.

School Net had one other major requirement — it had to provide public access. And so Community Access Programming or CAP became an important component. In 1994 the Federal Government put in place CAP pilot programs in Nova Scotia, New Brunswick and Manitoba. Nova Scotia was an obvious choice because it had NovaKnowledge.

NovaKnowledge, originally founded and chaired by Mike Martineau, started in 1993 as a community-based membership organization that would "build a sustainable knowledge economy in Nova Scotia" (www.novaknowledge.ns.ca/inside.asp). Over the years it has "moved from awareness raising to policy debate and influence, and from defining, measuring and monitoring knowledge economy progress to deeper analysis of the issues." But from the very beginning it has included a Technology Recycling Program. Outdated computers donated to NovaKnowledge are refurbished and upgraded by volunteer technicians and donated to schools. Over 12,000 have found their way into classrooms in the last six years alone.

With NovaKnowledge in place, a committee was set up to represent the Department of Education, Nova Scotia Community Colleges, MT&T and Nova Scotia School Boards. In all five pilot sites were established in Nova Scotia.

Chebucto Community Network

In the 1990s, Freenets emerged, beginning with Cleveland Free-Net, an idea that has become an international phenomenon. Today there are freenets around the world, with well over 70 functioning in Canada alone, and they arose out of the need for ordinary people to access the Internet to discuss ideas and exchange information. As long as the Internet remained within the exclusive realm of academia and defence, non-academics would be looking for a way to network computers.

The 1990s were an exciting decade in Nova Scotia. NSTN technicians were whizzing around the province, linking it from Sydney to Yarmouth. Individuals, such as Roswell James, were creating their own online Gopher sites. The Web was just around the corner, about to revolutionize how we use the Internet. And high speed Internet, which would allow us to be on line and stay on line at an affordable price, was about to come into being.

While those who were "net savvy" were happily engaged, others, with little or no understanding of computers let alone the Internet, were estranged.

That September 1993 meeting in Ottawa that spawned the Internet in the Schools project was also used by participants to discuss freenet models in Canada. The first was already operational: National Capital Freenet in Ottawa.

David Murdoch attended that crucial September meeting in Ottawa, which was hosted by Industry Canada. There he met five other Nova Scotians and together they created a local group. Back in Halifax, the newly formed group meet with members of Uniform, a UNIX users group that included David Trueman and Trent MacDougall. Trueman thought the idea was crazy. "Taking expensive equipment and give it free to the public? It was nuts." But Murdoch persisted.

After a few false starts, Chebucto Community Network (CCN) was up and running in early 1994. It was a remarkable feat undertaken by dedicated volunteers with limited government and business support. ACOA came up with $50,000, according to Bernard Hart, the only public money that went into CCN other than small individual grants for single projects. Dalhousie University provided computer facilities.

Trueman wrote the software (Chebucto Suite). "We saw the potential of the World Wide Web," he explained, "and it looked increasingly interesting to us. Therefore we developed CCN around a text-based Web. Freenets were networked on software written by Perdue University that we could have used. Or we could have used the software used by Ottawa (for National Capital Freenet). Instead we went one better, built our own (software) around the Web. We developed the initial software and started distributing it to others."

The Federal Government did provide some funding for a full translation of the software into French, which was completed by Robert Cormier, a professional translator who, when his contract had expired, continued to work on the translation. No mean feat, added Trueman. It is extremely difficult to translate computer code. Chebucto Suite software was adapted by freenets in Hamilton, Prince George, Toronto, and as far away as the Ukraine.

It was slow going in the early days. As David Murdoch explained, they had a bank of modems tacked together in a makeshift set-up and just two lines. Users shared the modems, which were programmed to give each person limited access so that others would have an opportunity to dial up the service. And the modems weren't superfast professional ones. They were cheap plastic commercial ones with a limited lifespan.

Access sites to CCN were set up at various places around the province so that individuals could drop in and make use of the Internet. There were sites at the Halifax and Dartmouth City Libraries as well as at senior retirement homes. This worked, said Murdoch, because technology at the time did not bring the Internet into people's home computers. Dial up access was limited to a remote computer.

Seniors in particular took to freenets. David Trueman's mother, for example, lives in a retirement home and uses email to keep in touch with old friends and family. Although her eyesight is fading and she has to rely on her daughter to read her emails, she is a touch typist and she can still write to her friends.

What made CCN work so well? Bernard Hart explained: "It is our experiences as a province in the co-operative approach in which users are also owners. For just $20, if you had the money, you could become a member of CCN, have your own web space and email account — and sit on the board if you wished. You were theoretically as much an owner as anyone else. Some people started with no knowledge (about the Internet) but as they gained greater knowledge they would sit on the board."

Then there were committed volunteers who worked all hours of the day and night. The project was also very well supported by the community at large, in particular, says Hart, by Joan Hicks-Brown of the Halifax Library.

"What interested me," added Hart, "were the discussions. We met once a week for almost a year. We knew we were building something special. People would move in and out (of the meetings), all of them dynamic, hard-working and upwardly mobile."

David Trueman admits that the freedom offered by an academic appointment (he was working at Dalhousie at the time) allowed him the opportunity to "moonlight" with Chebucto and he devoted all his spare time to CCN. Not only did he write the software, he was also involved in training sessions.

These training sessions, added Hart, were extremely well attended and invaluable for people with little or no Internet experience. With two sessions at Dalhousie and a little hands on experience a novice could learn to surf the Internet before the Web made it so easy. Other programs helped people create their own Internet pages. The Pier 21 society was one of the first to use CCN for its Internet presence. So did the City of Halifax and Metro Transit. And as an individual Janet MacKay created a personal website on CCN that was extremely complex and graphically rich for its time. It is still visited frequently, over ten years later.

The remarkable thing, added Hart, was the interest shown around the world, most likely by Canadians living abroad. "We had customers in China, Australia, Poland and Russia, not to mention the rest of Canada all using CCN email accounts."

"One thing we got right at Chebucto," commented Trueman, "was that we went out on a limb in early development. Everyone was doing Gopher and FTP (file transfer protocol). We saw the World Wide Web looked more

interesting and developed CCN around text on the Web. We were the first community network on the Web."

Both Murdoch and Trueman talked about how much more CCN could have been if the government had shown more vision. "Chebucto did have a vision that was far-reaching," said Trueman. "Some of the ideas we had at the time, if we had been able to do them, would have put Nova Scotia at the forefront of this (Internet development). CCN gave Nova Scotia a jumpstart and for a while the province had a disproportionate availability rate (for potential users). It would have been so easy for Nova Scotia to have been a technical leader.

"We had tonnes of ideas and no time to execute them. I was talking to the Feds through community access and negotiating for money for software development. To make CCN fly I needed to devote all my attention to it. I asked the Feds for funding for two years for a leave of absence (from his job at Dalhousie University), but they turned me down.

"Other ideas we had included facilitating e-commerce within local businesses. We also wanted to create an electronic community that would facilitate interaction between local Internet groups, local community groups and local businesses. It is one thing to find someone with your interests globally (on the Internet), but it is a wonderful process to find local people who share interests. I wanted it to build local communities, not just online communities. For example you could have local coffee shop meetings after meeting online."

One other thing CCN wanted was free graphical access to the Internet, with advertisements built into the graphics to cover costs. This brought CCN smack up against NSTN, which felt that the free service could affect NSTN's profitability. Not so, said Trueman, who believes that far from hindering NSTN, CCN would have fed the commercial service new customers. After all, the freenet service was taking neophytes and giving them Internet experience. In time they would have moved on to faster service. But NSTN was slow in providing CCN with service and it wasn't until Halifax Cable offered free high speed cable in the mid-1990s that access to CCN became easier to use. That hook up at the public library in Halifax made CCN the first community network in the world to have high speed Internet access — another first!

Into the Mid 1990s

MT&T (later MTT and since 1999 Aliant), the Nova Scotia telephone company that John Sherwood tried to interest in the late 1980s, never partnered Dalhousie in developing the Internet in Nova Scotia, but was always involved providing the telephone support NSTN needed for its dialup service.

Brent Conrad, now a Bell Canada employee, brought the Internet to the attention of MTT executives. His wife won a one-year subscription to NSTN in 1991. With a 2400 baud modem and a dos-based 386 computer, wading through Gopher sites, he landed at the University of Jerusalem. "All of a sudden I was pulling up documents from the university in my apartment in Dartmouth. How cool was that?"

Conrad recognized pretty quickly that this was something MTT should be exploring so, in early 1993, he began informal lunch hour information sessions on the Internet and invited NSTN in to give a demonstration. Here was a telecommunications company — the largest in Atlantic Canada — and not only was it *not* hooked up to the Internet itself, most of its staff knew nothing about it.

By 1994 many employees had NSTN connections in their homes and the local area network was connected using Novell software, but this was not the Internet. There was no TCP/IP. Conrad continues:

"A group of us got together and started to do some connections to web servers — prototypes and demonstrations that we showed to various executives. We proved the company could provide information on external networks."

The computer culture was beginning to emerge within the company, Gopher had gone the way of the dinosaur and Mosaic was the browser to surf the newly introduced web. To demonstrate the power of the Internet, Conrad connected through a dial up to a colleague, Fraser Smith, who had an NSTN hook up in his home. This was something company executives had not seen before. As he said to me, "'Someday,' he told them, 'every company would have a web handle.' That was a bold statement I made for 1994."

1995 was a pivotal year. That was the year that Jones Educational Network set up a Global Electronic Project. It just so happened that one Jones' employee had attended East Pictou Rural High School and so the school was chosen as part of the project to give students a taste of high speed Internet service with two leased telephone lines connecting the school via dialup to New Brunswick Telephone's NB NET.

A few months later MTT established their first dedicated connection to the Internet. It was a T1 connection to NBTel, supplying Internet for the Community College Campus in Halifax.

In June, leaders of the G7 were treated to a broadband Internet demonstration at the Super Nova Centre in Halifax. It took place in the old Zeller's building on Barrington Street in Halifax which had been converted into the Discovery Centre. The Centre was connected via CANARIE's 155Mbps ATM National Test Network (using MT&T, Bell, and Newfoundland Tel) to Calgary and St. John's. The Newfoundland end was basically a broadband videoconferencing demonstration. The Alberta site linked to a graphical visualization of a supercomputer simulation of burn patterns. The demonstration only attracted mild interest, but it was a step on the way to CA*Net 2.

High Speed Residential Internet

Arrives

The technology changed through the 1990s. For a long time customers used dialup modems from those old 300 and 1200 bps to 33 kbps modems. Although 56 kbps modems have been around since the late 1990s says Bruce MacDougall, they never quite reached 56k. "It was a best effort modulation scheme that didn't happen. Speed of 35 to 40 kbps

depends on the length and quality of the line from you to the nearest telephone switching office. It was a road of potholes. Way out into the country you could be down to 2400 bps with one of those things."

For businesses in particular, dial up modems were frustrating. Files took hours, not minutes, to download. System crashes were frequent. Modems would time themselves out if left unattended for too long, even in the midst of a down or upload operation. And even simple functions, such as bringing up a web-site image, took an agonizing time. Provincial urban centres and especially Halifax were ready to leap into the world of high speed Internet.

It arrived in the late 1990s, brought in by ADSL (Asynchronous Digital Subscriber Link), according to Sheldon MacDonald of Bell Canada. One of the first new systems was Mpowered, a home and business service offered by MTT and first tested in the spring of 1997. The connection used regular phone lines but allowed users to receive and make telephone voice calls while online, solving one of the irritations of dialup service. Unless you were willing to pay for more than one connection, you couldn't make calls on a landline while online. Not only that but sometimes incoming calls would disrupt your Internet connection. Now not only were you *not* online, you had missed your call.

Mpowered offered connections up to 250 times faster than the fastest dial up service and kept your regular phone line free. It was also relatively cheap, nearly on par with the dialup service offered by NSTN. The idea was that Mpowered would make money by charging for additional services, such as levying a monthly fee to use Microsoft Word or other readily available software. Instead of having to buy the software, you would rent it online from Mpowered. That part of the plan never really worked well. It might be that users wanted to own their own software to do with as they liked, that they already had paid for their software and knew they could get cheap upgrades, or simply that illegal sharing of software had cornered a part of the market. It had other drawbacks in the early days. Centrally located businesses could purchase the service, but homes had to be within three or four cable miles of an MTT office and all those offices had to install Mpowered equipment. Still it was fast. In less than a decade Internet connections had gone from 1200 bps to 1.5 Mbps, and it is still climbing!

The cable companies soon wanted in on the action. The Bragg Cable family, including Halifax Cable, and MT&T were traditionally on good terms. One provided television cable service; the other telephone service. The cable company piggybacked on telephone poles. In the fall of 1996, in a $45 Million share swap deal, the companies formed an alliance which planned to supply Sympatico's Internet service to Bragg's cable subscribers. Everyone sat on everyone else's boards in those days, according to John Sherwood, and all was rosy. The thorn was Dartmouth Cable. They were not part of the deal and challenged it to the Nova Scotia Court of Appeal. The appeal was unsuccessful, but the damage had been done. The deal fell apart in June of 1997 and the two companies headed down their independent, and competitive, paths as high-speed providers.

The effect of the break-up between the two companies cannot be overestimated: it stimulated competition that resulted in high speed Internet being available — and affordable — by the average household. Mpowered announced its upcoming service in September of the same year, promising a 7.2 Mbps Internet access. Customers would get an ADSL service that shared their telephone wiring and allowed a high speed connection that did not interfere with the customer's regular telephone service. Your children could chat to friends in chat rooms while you chatted to your friends by telephone.

Halifax Cable had already introduced its own high speed Internet service, called Andara, which was comparable to Mpowered but using their cable service. The failure of the agreement between MT&T and Halifax Cable was to be to the user's advantage. With rivalry, prices came down and Internet speeds went up. "Halifax was," said John Sherwood, "the most highly wired city in Canada."

Sheldon MacDonald of Bell Canada concurred. "The cable companies were into the telephone business. We (Aliant) are interested in getting into their backyard (providing digital cable service). What does that mean in driving bandwidth for customers? Will we need three separate fibres in the home for telephone, television, and Internet? Will we need to lay fibre to every business? For that we'd need to dig up the streets to put in more and more conduits."

Something between the two is possible, he continued. Those green boxes on street corners, called junction wire centres (JWC), belong to the telephone company and they are usually close to a customer — not more than 1.5 km away at most, a bit further in rural areas. What if a VDSL modem was put into every JWC in Nova Scotia? That would bring service closer to the customer. In such a world one connection would allow you to run three televisions, all on different stations, one high definition television and a cable game simultaneously. Will it happen? It depends, he replied, on marketing and business directions.

TIMELINE

1957 Sputnik I& II launched by the Soviet Union

1958 U.S. Congress approves funds to set up ARPA

1962 J.C.R. Linklider proposes packet-switching

1969, **September 29** First network connection between Stanford University Research Institute and UCLA

1960s, **late**, MPHEC funds a mainframe computer to be located at Dalhousie University and networked with other participating universities

1970, October Dr. John Reid of Université de Montréal is introduced to packet-switching by Larry Roberts, director of ARPAnet

1971, **August** Meeting of CANUnet participants, the first attempt in Canada to set up a national network

1972 READMAIL launched by Ray Tomlinson

1972 APRPA renamed DARPA for Defence Advanced Research Project Agency

1972 Québec network links campuses of the Université de Québec with campuses in Montreal, Chicoutimi, Trois-Rivieres, Hull and Rouyn to the mainframe in Québec

1973 New Brunswick's NBECN, networking provincial university computer centres, connected to mainframe at the University of Toronto

1976 Prince Edward Island joins NBECN, thereafter known as ECN

1977, **July** First demonstration of TCP/IP

1981, **March** East Coast universities set up BITnet

1981 UBC network, using the MTS operating system, receives a $170,000 grant from NSERC to set up CANnet

1982 ARPAnet converts to TCP/IP

1982. April Maritime Provinces Higher Education Commission (MPHEC) signs separate agreements with academic universities in New Brunswick and Nova Scotia to set up a co-operative venture to share computer resources in order to meet the institutions' individual requirements in teaching, research and administrative applications.

1982. April NSECH (Nova Scotia Educational Computer Network) is established. It consists of seven universities: Acadia University, College of Cape Breton, Dalhousie University, Mount Saint Vincent University, Technical University of Nova Scotia, Saint Francis Xavier University, and Saint Mary's University.

1982. December Dr. Lawrence H. Landweber submits a report that reviews the MPHEC agreements.

1983, **January 1** World switches to TCP/IP

1984 ARPANET split into MILNET (MILtary NETwork) and ARPANET, which continued to support research and education. The US Department of Defence continued to support both networks.

1984, **June** Introduction of NetNorth at a meeting of OUCC

1984 Fire in the library on the 5th floor of the Weldon Law Building at Dalhousie University causes destruction of card catalogue and leads to introduction of NovaNet computerized index system

1985, September Pilot project operational linking DREA in Dartmouth, Nova Scotia, to CRC in Ottawa

1985 NetNorth goes national with connections linking 21 institutions across Canada

1987 Email messaging made available campus-wide at Dalhousie University

1988 Nova Scotia government sets aside $12 million to enhance communications in the province. Peter Jones of Dalhousie University convinces the government to set aside $2 million specifically to set up an Internet connection in Nova Scotia

1989, January 1 Request for Proposals for a Nova Scotia Internet to connect the province to the over 50,000 computers world-wide linked to the Internet

1989, January 31 Dalhousie University learns it has been short-listed to develop Internet in Nova Scotia

1989, November 14 Nova Scotia Department of Industry and Technology announces the establishment of NSTN

1989 NetNorth annual meeting establishes CA*Net

1990 Tim Berners-Lee at Cern, Switzerland, writes WorlDwidEweb, a point and click hypertext editor — and launches the World Wide Web

1990/91 Introduction of CA*Net using packet-switching technology

1991/92 Introduction of World Wide Web internationally

1992 Roswell James establishes Roswell James Computer Books as a Gopher site on the Internet

1993 School Net set up in Nova Scotia

1993 Chebucto Freenet launched in Halifax

1994 Chebucto Freenet changes its name to Chebucto Community Net to better reflect its focus

1995 CAP or Community Access Program established separate from School Net

1993 CANARIE takes over responsibility for running CA*Net

1993 Marc Andreessen and other graduate students at the University of Illinois release Mosaic, an early Web browser

1995, June 15-17 Internet demonstration of CA*Net at the meeting of the leaders of the G7 in Halifax, Nova Scotia

1997 CA*NET 2 delivers high speed networking to the research and higher education users with IP over ATM

1999 Introduction of CA*NET 3, the first research and education network designed from the ground up for Internet traffic using TCP/IP over SONET

2002 CA*NET 4 replaces CA*NET 3, designed to support Third Wave applications and User Controlled Lightpaths

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