Towards a Third Generation Distributed Conferring System

Roger Hart

Abstract: The first of the RAPPI projects enabled Grade 2 to Grade 12 students in over 60 schools in four countries to use a computer conferencing system to share information about themselves, their school, their community, their culture, and their curricula.

Evaluations confirmed the findings of Dubrov that it is not sufficient to simply provide the hardware and the software: major efforts must also be placed on teaching people to make effective use of the hardware and software ('teachware') and developing the organizational arrangements ('orgware') to ensure that the participants are able to use the hardware and software effectively.

Following the success of this project, it is intended to establish the design parameters for a third generation distributed conferring system. Such a system will be capable of providing students in the participating schools with the essential features of a virtual network, and thereby remove many of the frustrations which are endemic to any 'centralized' system.

MYTHS AND REALITIES

In November of 1986 Robert Bernard, Editor of the *Canadian Journal of Educational Communication*, wrote to the contributors to the special issue of the journal concerned with computer conferencing. In this letter he said that he would like to consider a deviation from the normal review policy, and arrange for a CoSy conference in which the authors themselves could engage in a discussion concerning the papers, since "the most qualified reviewers of a collection of papers on computer conferencing [are] the authors themselves."

By February 1987, Bernard was chastising some of the authors with the phrase "LET'S GET ON WITH IT!!!. . .Let me point out another thing which you may have forgotten," he added. "If you, as experts in computer conferencing, cannot make this simple little conference work, then your credibility and that of this medium is seriously in jeopardy. Need I say more?".

Similarly, Tony Kaye, whose paper describing the excellent plans of the Open University appears in this issue (*Introducing Computer-Mediated Communication into a*

Roger Hart is Vice-President for Research with the Open Systems Applications Group, 235-560 Johnson St. Victoria, BC V8W 3C6. His research interests lie in the area of open systems architecture, and knowledge-based computer-aided learning. Reprints may be obtained from the author at the above address.

CJEC, VOL. 16, NO. 2, PAGES 137 - 152, ISSN 0710 - 4340

Distance Education System), made the following comment on-line:

> ====================
> bcjec/kaye #6, from tkaye, 152 chars, Tue Jan 27 07:35:07 1987
> This is a comment to message 5.
> ----------------------------------
> . . .well. I give up. The text of my paper has been completely garbled
> in transmission into CoSy. I will post a printed copy to Concordia.
> regards, Tony.

If these were isolated incidents, it would scarcely be worth drawing attention to them at the beginning of this paper. Unfortunately, they are far too common, not just with computer conferencing, but with many new developments in educational technology. We devise elaborate plans for using these new media, and develop theoretical typologies. However, in the process we appear to forget that there is a wealth of established theory and praxis which we can draw on in *using* these new technologies. As with the very name *computer conferencing* we appear to be so seduced by the new potential, that we forget that a perfectly good word (conferring) has existed since 1528, and invent a new one which is neither as concise nor as attractive as the original.[1]

For any emerging technology, there are always people who immediately see its potential. There are also projects which succeed far in excess of the original expectations. On the other hand, there are projects which, despite massive injections of people and money, never succeed in getting off the ground, and result in the technology itself being dismissed as inappropriate or unworkable.

In this paper I want to continue the theme which Godfrey and I (Godfrey, Hart & Woolard, 1986; Cowper, Godfrey, Hart & Sterling, 1987) have explored in our analysis of the North Island and GOLDCOIN initiatives. That is: how do you effectively integrate educational technologies into the learning process? For the purposes of the present paper I shall focus on the RAPPI projects which began in May 1985 and which are still on-going. I believe that the successes and heartaches of this project reinforce conclusions reached by other educators and researchers for the successful integration of any new technology. Just as importantly, I believe that starting from the goal of integrating technologies into learning, rather than seeing them as a mere appendage, allows us to make the technologies more appropriate for learning; liberating and enhancing what is a quintessentially human activity, rather than constraining and limiting it. This is particularly important as we anticipate the third generation telematic technologies which are likely to be available before the end of the present decade.

Open Learning NOT Distance Education

Central to many of the initiatives which have been launched in B.C. in the last decade is the view that we are dealing with Open Learning, not distance education. This is not mere semantics, but results in a different paradigm. The RAPPI projects, for example, have

---

[1] Since the ugly word *conferencing* has gained a degree of currency to describe systems like CoSy, I shall continue to use it in the present paper. However, I shall identify the proposed third generation systems as *conferring*, since they should indeed allow people to *confer* rather than to *conference*, and should thereby remove many of the frustrations which Tony Kaye's comment so appositely captures.

involved children in regular classrooms, but squarely draw on the philosophy and epistemology of Open Learning. Opportunities for the children's learning are being opened in new and exciting ways, which would have been prohibitively expensive only a few years ago.

All too often, *distance* education implies that the learner is being presented with something which is second best to the teaching which currently takes place on campus. The latter is even referred to, quite incorrectly, as *traditional means of instruction*, and ignores the major problem which Hawkridge has identified, that failure rates would be unacceptably high in campus courses, if students were required to demonstrate a complete mastery of the subject matter (Hawkridge & Lewis, 1979). Institutions like the Open University in Britain, or North Island College in Canada have clearly demonstrated that Open Learning is *much* more than mere correspondence courses (even when correspondence is used as a delivery medium). It can be a desirable and attractive alternative means of learning, with a high degree of understanding achieved by a large proportion of the learners. On a purely subjective note, it has always seemed to me that those institutions which regard Open Learning as somehow *second best* manage to convey that impression to their students through their uninspired courses, and achieve dismal completion rates. Objectively, the Open University has demonstrated unequivocally that it is possible for tens of thousands of adults to achieve good quality degrees in a relatively short period of time using Open Learning.

What does this have to do with conferring by computer? First of all I would like to draw an isophor between *distance education* and *computer conferencing* vis-a-vis *Open Learning* and *conferring by computer*. Equally importantly, I want to suggest that if we approach conferring by computer from the ontology of Open Learning we can design systems which are much more appropriate for human learning, using technologies which, if not yet in widespread use, are either extant or emerging. This is not to say that current conferencing systems cannot be used for effective learning. However, I would argue that this is a reflection of the importance of conversation in learning (Pask, 1976) which, with adequate organizational arrangements, or *orgware*, (Tribus, 1979) to ensure that the learners and tutors alike are able to use the hardware and software effectively, can result in enthusiastic learning despite the inadequacy of the technology.

To illustrate this last point, and to set the scene for the directions we need to chart in designing a conferring system, I want to briefly describe the first RAPPI project, *Open House*, which was initiated in 1985, with support from the Department of Communications, Canada.

RAPPI —'An Electronic Open House'

RAPPI (réseau d'ateliers pédagogiques, pilote international) is an ongoing series of international projects which link approximately 75 schools in Canada and western Europe in an electronic network.

As is evident from the subtitle, the first project was not aimed at computer science students, but used computer conferencing and the international X.25 switched packet networks as tools to allow children to find out directly from each other what it is like to live in their culture and community. The project, therefore, squarely belonged in the *socials* area and involved many teachers who had never previously used a computer. The teachers participating in the project were selected for their interest and experience in teaching social studies. Although computer science teachers proved to be invaluable resource people in a number of instances, the schools were asked to ensure that the project did not become sidetracked into another *computer science* project.

It was originally envisaged that the participating students would be in the early grades of Junior High School, but experience has shown that a much broader range of children have been actively involved. One school's experience with Grade 3 students was so positive that Grade 1 children were introduced to the system in subsequent projects. The range of topics discussed was as broad as the geographic separation of the schools and the ages of the participants. Some were deliberately *open* so that any participant could respond; others were reserved for a pair or group of schools. Typical titles included:

Canadian/European Cultural Comparisons;
Cooperative Story Telling;
Géographie Urbaine;
Riverview Junior High - Liceo Fermi Bologna;
Priory School, Weston Super Mare — J.V. Clarke School, Yukon;
AIDS;
Abortions;
Libya;
Canadian Humour; and
Should Shorts be Allowed in School?

Teachers and students used the system to communicate, in a variety of languages of their choice, with other schools in Canada and in each of the other countries. They were able to join conferences on a given topic, respond to existing discussions, and set up new discussions specific to their own interests. Teachers and students suggested new topics, exchanged general information and selected sub-projects and joint lessons to undertake with specific schools or amongst other users of the facility. French and English classes across the country practiced their skills and answered questions for each other in both languages, and topics in history and geography got 'on-the-spot' commentaries from people who actually live in the regions under study.

RAPPI is already a network that never sleeps. As users in Vancouver, B.C. are asking about schools in London, England, Italian students are signing on and preparing to respond to last night's comments from Manitoba. Help is available on the system and additional instruction can be obtained from the RAPPI Manager, who handles concerns about subject matter, users' addresses, the technicalities of messaging and computer accounts, as well as users' suggestions and concerns. Largely as a result of the efforts of the RAPPI Manager and a large number of professional educators who have given their support on a purely voluntary basis, RAPPI can become functional on the first day. Teachers retain control over access and subject matter and their suggestions influence the direction and development of each project.

Michel Cartier (Cartier, 1986) has pointed out that there is usually a lag of about five years from the introduction of a technology until the increasing quality and quantity in the storage capacity and intelligence of telematics systems allow the developments of new types of services. Although RAPPI has been almost universally praised for its significant contribution to the use of computers in education (Penny, 1986), it is using what Cartier refers to as first generation telematics technology. The key technologies are the X.25 switched packet networks (the original standard was developed in 1976), and a computer conferencing program at the University of British Columbia called *FORUM. *FORUM was originally written by two systems programmers at UBC, Alan Ballard and Jon Nightingale. It was apparently put together at fairly short notice after the authors had seen a similar system at the University of Michigan, and was intended primarily to allow programmers to discuss matters amongst themselves. The schools are almost all using 8 bit microcomputers and 300 baud modems. Even so, these modems were usually only obtained either after long discussions with administrative staff who could not understand why one would even want to link computers together, or by cookie sales, or other fund raising activities.

To access *FORUM, the school must typically load some terminal emulation/ communications software into their microcomputer, dial-up a public Datapac port (which will be long distance if the school is in a community such as Mayo in the Yukon, or Sturgeon Falls in Ontario), issue the Datapac access commands, enter the Datapac address of UBC, log-in to the UBC MTS system, use the commands to run *FORUM and only then begin to look at the new discussion and responses. For schools using the system from Europe there are additional complexities. For example, Italy did not have a nationwide X.25 service at the beginning of the project, and the school in Bologna had to dial long distance to France, access the French X.25 network and connect from there to the Canadian X.25 network.

Even though the students themselves only began accessing *FORUM in December, 1985, the quantity and level of discussion rapidly increased. Rather than attempting to read the recent responses at the dreadfully slow rate of 300 baud, many schools downloaded the discussions, so that they could either skim through them locally or print out hard copy versions. This, of course, added an extra level of complexity so that the school needed to either do a file transfer between two different operating systems or at a very minimum, a screen dump. Similarly, 300 baud is far too slow to allow a full screen editor to be used, so rather than struggle with the MTS line editor, many schools prepared their responses off-line, using a word processing package, and then uploaded these responses into the correct discussion. This meant that in order to use the system the students had to become familiar with a large number of application packages on at least two computers. They needed to master a word processing package, a file transfer package and a communications package on their in-house micro, with all of the attendant ramifications such as being familiar with the operating system, knowing of MTS (the UBC operating system), *FORUM, $MESSAGE, the MTS Editor, and the UBC portion of any file transfer software. This is a prodigious list, and it is indicative of the power of conversation that so many of them seem to take the mastering of these skills in their stride.

Even so, in 1987 there are good reasons to say that such contortions are no longer necessary nor desirable. Third generation telematics offers the possibility of making the technology virtually transparent to the users, while encouraging a much richer conversation.

The RAPPI Experience

Two formal evaluation reports were prepared for the first RAPPI project. One was prepared by Maria Cioni & Associates Inc. (1986) and the other by Catherine Williams (1986). The Cioni report was severely handicapped since that study did not commence until early summer of 1986 when most of the activity for the school year had already ceased. Only 18 out of the 95 teachers participating responded to Cioni's questionnaire. Williams, a teacher-librarian at Bishop Pinkham Junior High School in Calgary, was a participant-observer who had been involved in the project since late 1985. Although her report necessarily concentrates on the experience of the Calgary students it succeeds in capturing the educational aspects of the whole project.

Cioni notes that the financial resources *allocated* (it would be more accurate to say *available*) to this project were extremely modest — $14,500 excluding the evaluation studies — but seems to spend a disproportionate amount of time analysing the technical aspects of the project. While this is invaluable material for the present paper, it ignores the practical reality that something had to be done in order to demonstrate the educational opportunities. Had Cioni's advice been followed that "RAPPI should have been a small, adequately financed pilot project; a project where technical and administrative problems could have been ironed out" (1986, p. 32), it is likely that more than $14,500 would have been expended in planning, and the first children would not yet have actually used the system. One of the quite unexpected things that was learnt in the project was the total lack of understanding that many school administrators had in the advantages of linking one computer to another. For many schools, obtaining a one hundred dollar ($100) 300 baud modem was a major struggle. At least one school, which was intending to participate, was told that it could not acquire a modem since the district had an MS-DOS policy and signing-on to MTS at UBC would 'clearly' violate that policy.

Although that was the reality at the start of the project, by May 1986, Douglas A. Penny, Assistant Deputy Minister of Educational Technology Development in Ontario said, in a keynote address to the National Research Council's Symposium on Instructional Technology,

> I am particularly impressed by the RAPPI project. . .It is possible from our offices, to eavesdrop on the messages being sent, and they are fascinating. It is impossible to believe that students in Whitehorse in the Yukon, for example, sharing views with students in Milano, are not overcoming that provincialism which is so limiting and so dangerous to the development of a world society based on mutual understanding and empathy. (Penny, 1986, p. 6)

The significance of his remarks can be appreciated even more when it is realized that Penny's department had a budget of nearly $10 million per annum for the development of educational software for the Ontario public school system. Yet, up to the launching of RAPPI, it had not apparently even considered the possibility of children using a computer conferencing system, despite the outstanding work which the University of Guelph had already undertaken in the development of CoSy.

Penny's views are endorsed by both the Cioni and Williams reports. Cioni (1986) notes, almost with surprise, "The striking element about the students' responses is their lack of emphasis on computers and computing. They appeared to be more interested in the social communication, both within the context of the group effort of their class and the international communication with other students. . .Overall, the students were very positive and seemed willing to continue to participate in RAPPI. The [first] RAPPI project appeared to *concretize* academic work for the students and this perhaps is a major motivational factor that teachers could exploit further" (p. 31).

The Williams report reaches the same conclusion, though from the viewpoint of a teacher, rather than that of an information/communications consultant. She reports that Bishop Pinkham School felt strongly that it should have some educational objectives in order to integrate the project into the curriculum. As a result, the school established an advisory committee consisting of school personnel and specialists from the Calgary Board of Education and the University of Calgary.

By December, 1985, a few Calgary students had started to use the system, and this enabled the school to see what problems students would encounter when using the system. These, Williams (1986) notes, were the usual pen-pal correspondence. In order to bring the activities in line with the committee's goals, the sponsors of three school clubs, a social studies teacher with six different social studies classes, and a teacher who had bilingual students were all approached. By mid-January "students from social studies classes opened five discussions. . .and were elated when the first response appeared. Topics ranged from *Libya* to the *Chernobyl Incident*. Students were excited by the fact that they could enter into a discussion about the space shuttle explosion the day the incident occurred" (p. 4).

These observations are confirmed by the student reaction. Over 80% of the Calgary students said they would either be very interested in participating another year, or would like to be even more active in the following year, and 71.5% stated that they found the time allowed for participation to be too short. Such statistics, however, do not fully convey the enthusiasm which was expressed by the students themselves,

> 'The most positive aspects were that I got to know how kids in other countries feel about world issues.'
>
> 'It was fun, we learned how other people think.'
>
> 'I met people and learned a topic.'
>
> 'I feel that I learned more about what was going on in the world.'
>
> 'Yes, RAPPI has changed my attitudes. I now know how other kids feel about world issues.' (pp. 6-7)

the teachers,

> 'The value of the use of a new technology to enhance the learning process of students in a unique way cannot be emphasized enough.' (p. 11)

and parents,

> 'He (my son) states that the program is super, beneficial, etc.' (Williams, 1986, p. 12)

However, there were disappointments. Perhaps the biggest for the Calgary students was the lack of response with a school in Paris with which they had been *paired*, due apparently to lack of equipment and technological know-how. The class who were scheduled to converse with the Parisian students had planned extensively to share information, not only via telecommunications, but through yearbook exchange, letters, video tapes, etc. The resulting disappointment was obviously high. In addition, many schools in Canada and Europe were not able to achieve the curriculum integration which Bishop Pinkham had worked so hard to achieve, and sometimes responses could be slow in coming, or not be made at all. This could be particularly disheartening if a group of students had put a great deal of effort into developing a topic which they thought was interesting. This last point illustrates one of the biggest difficulties of this project: that of developing adequate *orgware* in all the participating schools. In Canada, education is under provincial, rather than federal, jurisdiction and there is considerable autonomy at the local board of education. To have attempted to link a number of schools through a formal (governmental) process would have been a complex and painfully slow undertaking. And although every attempt was made to involve schools which appeared to understand the need to integrate the technology into the learning process, in the final analysis, the success of the project in an individual school depended very heavily on the commitment of teachers and volunteers, and the support they were able to muster locally.

Frustrations with the Technology

I will return to this key question of organizational arrangements towards the end of the present paper, but before doing that I want to focus on the comments made both by Williams and particularly Cioni on the technology which was available for this first RAPPI project.

As Cioni notes in her report, the events which led to the creation of RAPPI began in 1982 at the Versailles economic summit. As a result of that conference, an international working group was established to deal with the application of new technologies to education, vocational training, and culture (ANTEM). Although ANTEM is the formal coordinator of the RAPPI Project, it is fair to say that no real activity involving children had taken place until a meeting of the Inter-Provincial Association of Telematics and Telecommunications (IPATT) was held at TVOntario in March, 1985. That meeting took the view that the only way of demonstrating the potential of the new technologies was to initiate a pilot project. At the time *no* funding was available for such a project, but IPATT had been using the MTS system at UBC for communication amongst its members, and therefore, not only had a credit balance of computer dollars (CC$), but had a number of key educators from all across Canada who had used the system for computer conferences and electronic mail. Thus, the UBC system was chosen, not because of any inherent technical superiority, but because it was immediately available for the project, and had a number of people who were sufficiently familiar with it in virtually every region of the country, who could provide some training at the local level.

In general the children seemed to have less difficulty than their teachers. Although some of the problems faced by the users would have been ameliorated by a more recently designed system, such as CoSy, the most critical ones are endemic to any centralized service which has to be accessed through low-speed (4,800 baud or slower) lines. Cioni (1986) identified some of these problems in her report.

- Editing was a problem; users knew how to use a full-screen editor but were unable to transfer the basics of editing to the more rudimentary line editor of the system.
- Downloading and printing out or creating text offline and uploading caused problems chiefly because the word processing package and the communications package did not work together.
- System glitches such as Datapac failure, noise on the line, system down for maintenance when some users tried to access the system. (p. 27)

The Williams report does not separate technical difficulties from other sources of frustration, but it is even more apparent from this report that a distributed, rather than a centralized system would alleviate many of the difficulties, namely:

- Waiting for replies;
- Breakdown of computer lines to UBC;
- Print-outs;
- Delays;
- Slow turn-around time for response from other schools;
- More telecommunication lines (from the school) would open the system to more students; and
- Additional computer hook-ups and more time allowed for participation. (pp. 7, 9, 12)

Some of the other problems which Cioni describes have been solved, to some extent, by systems such as CoSy. For example:

- Less talkative and better-designed help screens;
- A new user-friendly interface is required;
- Extensive documentation and support are needed to develop the users' own editor-transfer facilities, thereby reducing time on the host computer and maximizing users' familiarity with their own systems;
- Ability to use diacriticals; and
- Ability to have real time, side by side messaging. (p. 29)

However, there can be no doubt that a distributed, third generation system could provide an order of magnitude improvement over the best centralized systems which are currently available.

Distributed Messaging Systems

Imagine a classroom where each student has access, either individually or in a small group, to a bit-mapped workstation which is able to do true multi-tasking. Even in the early eighties this would have been prohibitively expensive. In 1987, this is reality in many classrooms in Ontario which are using tens of thousands of ICONs™ connected to local fileservers by a high-speed local area network. Although it was the first microcomputer to be specifically designed for an educational setting, the ICON™ is by no means the only choice. Although the Apple Macintosh™, the Atari ST™ and the Commodore Amiga™ were all designed as stand-alone computers for the home market, they can all be used as intelligent workstations to a multi-tasking supermicro such as the VAX™, at prices which, in the U.S. at least, start at only $300.

Now imagine the process by which an individual student would handle a message. When the student logs-in to his workstation, the system will inform him (probably through a system window and a *beep*) that incoming messages are waiting for him on his workstation. The student would invoke the messaging system software by simply pointing to the appropriate icon (an incoming mail tray?) and another window would indicate diagrammatically the messages being transferred to various folders which the student has already set up. Once this is completed, a piece of software, technically known as a *user agent* (or UA), would list the new, unread messages in the various folders complete with other pertinent information, such as who was the originator, what is the subject, how long is the message, is it confidential, urgent, etc. This information would also be displayed on windows, so that the student could see at a glance the details of all of the incoming messages.

Using a mouse or trackball, the student could quickly arrange these lists of unread messages in a pile, with the most important folders on top, and the less important ones at the bottom. This, of course, would be strictly a matter of choice and the student could spread all of the folders out in front of him if he wanted. The student could then begin to deal with his unread messages, again by simply using the mouse to pick up the ones which he felt required the most immediate attention. As each message was displayed and read, the student would have a number of choices: he could trash the message; archive it in one or several folders; set it so that it would automatically appear again at a certain time or under certain conditions. However, probably the most common action would be to *reply*.

A typical screen layout at this point in time would have the pile of unread messages in one window. Another, much smaller window would be used to advise the student of any newly arriving messages, and the contents of the *current* message would be displayed in a third window. Icons and/or pull down menus would appear at the edge of the screen as usual. In order to *reply* the student would point to the appropriate icon (a pen?) and this would automatically invoke a very fast, full-screen editor of the student's choice. However, unlike most editors currently used on such workstations (e.g., MacWrite™) this would appear in a window alongside the original message, and the student could *cut and paste* items from the original message into his reply. Naturally, most of the header fields in the reply would be automatically set (subject, recipient, etc.) although the student could always choose to override these, and similarly linkages (one-to-one or one-to-many) would indicate the history of the discussion. Naturally, the student would have immediate access to spelling checkers and other writing aids if he needed to use them.

The student would also have his own private database of aliases for peoples' network addresses. Such a database is a cross between a personal address book and an automatic dialer for the telephone system, the main difference being that an alias could refer to one or *any number* of people, who could well be on different computers and on different networks anywhere in the world. Unlike the telephone system, or the regular mail, it is just as easy to send an electronic message to a hundred people as it is to send it to one. Having completed his reply, the student could then browse through his database of aliases (which presumably would be displayed in yet another window) and indicate who should receive 'carbon' copies. Posting the message would be achieved by simply pointing to the appropriate icon (a mailbox?), with the student being able to specify whether the message was urgent, confidential, required confirmation of delivery, etc.

Having posted the message, another piece of software, technically known as a *message transfer agent* (or MTA), would handle the myriad complexities of ensuring it is safely delivered to the recipient(s). Routing pathways would be established depending on whether cost or speed were the prime consideration. If a part of the physical network were tempoarily out of operation, the MTAs would seek another route or wait until the service were reestablished. Furthermore, each and every message would be monitored closely so that the student could be informed if it were not possible to deliver it, or if confirmation of delivery had been requested. As far as the student is concerned, all of these complexities would be of no consequence. The MTAs would make delivering messages to or from other students at the other side of the world just as simple as communicating with another student in the same classroom.

X.400

At the beginning of 1987, this imaginary scenario is becoming increasingly close to reality. The concepts of UA's and MTA's, for example, have been formally defined in a series of recommendations adopted by the CCITT (Comité Consultatif International de Télégraphiqie et Téléphoniqie) in January 1985. These recommendations, known collectively as X.400, are not intended to replace the X.25 switched packet network (*Datapac*) standards, but provide a set of standards for distributed messaging systems. These standards define a number of protocols which allow users on one computer to send messages to users on other computers, regardless of the make of hardware or the particular operating system being used.

Distributed messaging systems have been in existence since the world's first computer network, ARPANET, was launched in 1969. The UNIX™ community probably has one of the largest distributed messaging systems, with over 10,000 computers linked together using the UUCP protocol. *Netnews*, a world-wide combination of discussions and software distribution, has become such an indispensable part of the UNIX™ community that each host now receives 1-million characters of information each day. More recently, Mindflight Technologies have developed a similar system, RBCS™, for the ICON™. However, all of these systems share the major disadvantage that they are non-standard. Only sites approved by the U.S. Department of Defense are allowed to join ARPANET; only computers running UNIX™ can use UUCP; and RBCS™ is a proprietary product which is currently only available on the ICON™.

The most significant feature of X.400 has already been mentioned. It is an international standard and therefore allows a user on one computer to send a message to a user (or many users) on another computer (or many computers) without requiring either the sender or the recipient(s) to log-in to a different computer than the one they normally use. Obviously, for a message to be transmitted from one computer to another, something has to be responsible for establishing the pathway and transferring the message. In X.400, this is done by a sophisticated piece of software called the MTA, which automatically and autonomously transfers messages from one computer to another. A message is delivered from an MTA to a user, or vis versa, by another piece of software, the UA. X.400 essentially defines the protocols by which the UA's and MTA's communicate with each other.[2] Provided these protocols are implemented on different operating systems, messages can be exchanged between different machines in a way which is totally transparent to the user.

EAN, which was the world's first implementation of an X.400 system, developed by the Distributed Systems Research Group at the University of British Columbia, required 30,000 lines of code. Although implementing X.400 obviously requires a great deal of technical sophistication, the underlying concepts are deceptively simple. Reports in the technical press suggest that X.400 is being adopted much more quickly than any previous standard. In March, 1985, KDD, the Japanese Telecommunications Company successfully demonstrated that their implementation of X.400 could be interconnected with EAN. Since then many companies, including Digital Equipment Corporation, the twelve largest

---

[2] P1 is the Messsage Transfer Protocol (MTA to MTA), P2 is the Interpersonal Messaging Protocol (a virtual protocol from UA to UA), and P3 is the Submission and Delivery Protocol. When the UA and the MTA are on different machines, P3 specifies the protocol between the UA and MTA. An additional protocol, P7, can also be used between the UA and MTA.

European computer manufacturers, the European PTT's, Teleglobe Canada, and GTE Mailnet in the U.S. have announced their intention of implementing X.400 in the near future. The reason for its widespread adoption was put succinctly by Gord Farmer, Telecom Canada's manager of business development for Envoy 100: "Prior to the acceptance of X.400 each messaging system was developed on a proprietary protocol. When it came to interconnecting them there was nothing standard between them. What X.400 does is make it so that everything can be connected" (Banks, no date).

The other key feature of X.400 is an electronic analogue of the way the post office handles mail: that of an envelope and contents. A message is a technical term which refers to the unit of communication at the session layer. This should not be confused with the more primitive concept of electronic mail. A message can be of arbitrary length, and so a software file millions of bits in length is still considered a message. The *envelope/contents* concept essentially allows the user to put whatever contents he wishes in an envelope, regardless of whether it is simple text, computer graphics, digitized sound or video, or even computer software. This is nothing like as simple as it would seem at first sight, since special characters may be interpreted as operating system commands by different computers. As a result, a great deal of work has to be performed by the software to ensure that what a sender inserts into an *envelope* is *exactly* what the recipient(s) will receive.

This, of course, is closely tied to the concept of reliability. If a user is to send a file of several million bits of software electronically, say from Vancouver, B.C. to Oslo, Norway, it may well be next to useless if a handful of errors occur in the middle of the file. The situation is ever worse if the file gets lost as it is being transferred from one MTA to another. Again, a great deal of the complexity of X.400, which is not apparent to the casual user, is in ensuring the highest possible level of reliability and closely monitoring the progress of each and every message as it is sent from one computer to another.

X.400 is also inherently independent of the type of the physical media over which the messages are sent. X.400 systems can and do use X.25 switched packet networks, direct dial telephone networks, leased lines and high speed local area networks. X.400 will work equally well over satellites, CATV cable, fibre optics, etc. As a result the user is not concerned that, for example, cable inherently has far fewer data transmission errors than a telephone line. Similarly, in the vast majority of cases, the user is not concerned at the speed by which a message is transmitted from one MTA to another. On the other hand, the system is flexible enough to have alternative pathways which may be chosen if speed is critical, if economy is needed, or if one node of the network is temporarily unavailable. The simple elegance of the system means that *the user need only use the computer and operating system he habitually uses*. His user agent will use standard features of that operating system, such as the full-screen editor, with which he is both comfortable and familiar, and the interface between the user and the UA will use data transmission speeds which are normal for such activities, namely, 19,200 baud for ASCII terminals and much higher for bit-mapped workstations. All of the complexities of ensuring that his messages are reliably and speedily delivered to users around the world, and that incoming messages are placed in his own work area, are handled competently and automatically by the UAs and MTAs.

X.400, therefore, promises to be the first step in the creation of a virtual network. It is important, however, to remember that work on X.400 is just beginning. It is not likely to be available on major microcomputers such as the IBM PC™ until the latter part of 1987, and some of the user friendly features described in the previous section will not be available until X.400 is implemented on the Macintosh™, ICON™, Amiga™, etc. However, some non-standard messaging systems, such as RBCS™, already make reasonable use of pull-down menus and a mouse or trackball, so it seems likely that these systems will eventually adopt X.400 or be replaced by systems that confirm to the international standard.

Systems for Conferring

It is clear that, at least in the area of electronic messaging, many of the technical and associated frustrations will be eliminated when X.400 becomes widely available. Many university researchers are already using such systems, and such users are immediately alerted to the fact that a message from halfway around the world has arrived *on the system they are currently using*, be it for word processing, AI research, simple calculations, or whatever. Because the users do not need to dial-up some remote computer to check their messages (all too frequently to find that the remote system is down for maintenance), even such things as speed and frequency of response are dramatically improved.

Messages, whether they are one-to-one, or one-to-many, lack many of the features which systems such as CoSy have shown to be so useful in group discussions. X.400, it will be recalled, specifies the protocols to be used between the MTAs and UAs. Current implementations make it a reasonably useful tool when two people wish to confer, but a great deal more work is still necessary to design a more general distributed conferring system.

In a very real sense, *Netnews* already is such a distributed system, but has bypassed the central problem by sending everything to everybody. As a result the communication costs for distributing *Netnews* in the U.S. alone are reported to be in excess of $1-million per month. In the school system, this would exacerbate a problem already observed with RAPPI: that children, even in high school are not familiar with techniques for reading selectively and skimming. Even though I would argue strongly that such techniques should be learned early in grade school, I still believe that technologies should be designed to improve human interaction and facilitate the acquisition of knowledge. For all its achievements, I regard *Netnews* as a step in the wrong direction.

Perhaps more hopeful is the EDAN project, which will be launched by TVOntario and the Ontario Ministry of Education early in 1987. This project will allow 75 schools from Ontario to use CoSy running under VMS™ on TVOntario's VAX™. Although it will replicate some of the work of RAPPI, it will allow much more attention to be paid to providing workshops and other means of assistance to the teachers. The project also has the advantage of having all of the participating schools use the same type of computer, the ICON™ and a common communications package, ICON Access™.

The same project will also use the RBCS™ software to allow distributed messaging directly between the schools. The fact that RBCS™ uses non-standard protocols will not present problems until the participants want to communicate outside the schools identified in the project. Hopefully they will ask, at an early stage, why they cannot send a message to TVOntario's VAX™ in the same way as they send one to another ICON™. Similarly, once they have begun to communicate, a) with each other directly using RBCS™, and b) with each other via the VAX™ using ICON Access™ and CoSy, they will also ask why they cannot have the best of both worlds, (i.e., the functionality of CoSy and the convenience of distributed messaging).

An even more ambitious initiative is being planned by the Knowledge Network in B.C. (Forsythe, Hart & Sinclair, 1986). Although the projects in this initiative will use many different media (satellite television, computer conferencing, audio conferencing, slow-scan, compressed-video, VSATs, etc.), all of them have been carefully built up from the grass roots to meet real educational needs. An important part of this initiative is to establish collaborative efforts which transcend the usual provincial boundaries. If students in the public school system are able to use relatively primitive technologies to converse with and collaborate with their peers across Canada and around the world, then it is surely reasonable to expect educational administrators and researchers to do likewise. As a result, people doing world class work, which appears relevant to the initiative, have been approached informally to explore the possibilities of co-operation, regardless of where they are physically located. Assuming funding is approved, one of these projects will develop a prototype node which will serve a given *geographic* region. Such a node will offer state-of-the-art services to schools, including X.400 messaging, database access, computer conferencing, etc. and provide an infrastructure of organizational support to ensure that these are integrated across the curriculum. One of the goals of the exercise would be to encourage similar nodes to be established by ministries of education, school districts, and schools across Canada and internationally. Although these nodes would begin by using CoSy as a conferencing system, it is anticipated that research would be undertaken in tandem with this work to:

1. Specifically design a system which pays special attention to the needs of children; and
2. Begin to link these nodes into an integrated network, using the X.400 recommendations as the inter-node protocol.

Such an approach will allow the node(s) to use leading edge, but proven technology, which is currently deemed too expensive for *in school* use. For the past 30 years, the cost of computer hardware has consistently declined by 40% per annum and there is every reason to believe this trend will continue. The nodes, therefore, will be reasonably indicative of the technologies which will be available for classroom use by the end of the decade and represent the best possible prediction of third generation telematic technologies, which Cartier (1986) suggests will start to appear at that time.

By developing such a systems architecture, and working collaboratively with researchers at Guelph, OISE, and elsewhere, it seems likely that by the time the third generation telematic technologies are widely available, the problems of implementing distributed conferring systems will have been largely overcome. Every student will not only have the world *in the classroom*, but the present low-bandwidth communication channels will have been replaced with a virtual network which really does allow people to *confer* rather than to *conference*.

The Issue is Learning

No matter how attractive new or emerging technologies may seem, the educators must continue to remind themselves that the issue is learning, *not* technology. As I noted at the beginning of this paper, it is far too easy to forget that there is a wealth of experience which is generally applied automatically to the production of, say, printed course units, but frequently ignored when more hi-tech media are involved. It seems to me that good Open Learning starts with the needs of the learner and chooses whichever technologies are most appropriate. Naturally there are biases, so that a *redbrick* university is likely to continue to use *formal* lectures of one or two hours duration, despite the evidence that such methods are inefficient and ineffective. A *distance learning* institution with an expensive printing press is likely to continue to churn out correspondence materials, even for courses which have low enrollments or which are poorly presented using the printed word. And similarly, knowing the energy and enthusiasm which some institutions have committed to the development of computer-based education, it should come as no surprise to see such institutions showing a marked preference for CBE, regardless of whether or not it is appropriate. The example of the part-time student who had to regularly drive 20 miles to a terminal in order to conference with his supervisor (McCreary & Van Duren, 1987) is indicative both of the power of the medium and the vagaries of inappropriate learning systems design.

In an effort to address this problem, David Godfrey and I (Godfrey, Hart & Woolard, 1986) have developed the concept of implementation engineering. This is a systematic approach to the design, production, and delivery of learning systems that goes well beyond the scope of course design. Certainly, even less is known about the implementation problems than, say, software production problems, but careful attention to details and patterns, and the search for rules that can be successfully applied in a variety of circumstances mark the beginning of implementation engineering as a recognizable and major category for telemathetics. For Canada, which already has an international leadership in communications and Open Learning, the implementation questions are in many ways the most challenging, which with future study and practice, will lead to equally spectacular results.

This concept has been used, with some success, in the introduction of CBE at North Island College (Cowper, Godfrey, Hart & Sterling, 1987) and East China Normal University (Godfrey, Gong, Hart & Smit, 1988). Furthermore, the experience of these projects confirm Dubrov's thesis that, for any significant technical advance to be applied successfully, the organizational arrangements must be developed to ensure that students and tutors alike are able to use the hardware and software effectively. Although the content of the knowledge may be contained in resources such as CBE, laserdisks, audio tapes, books, etc., knowledge itself is *as much the process or skill of acquiring it* as it is the content (Forsythe & Hart, 1980). As a result, any coherent, systemic approach which is applied to the use of new (or old) technologies in facilitating learning, inevitably includes a professional educator or *tutor* as a vital part of the delivery service. The role of the tutor is that of a guide, catalyst, learning helper, and motivator as well as an expert learner — in fact very much the role which Catherine Williams and other teachers around the country played wherever RAPPI was successfully integrated into the learning activities of an individual school.

REFERENCES

Banks, B. X.400 standard gaining momentum. *Computing Canada.*

Cartier, M. (1986). Un modèle d'accès à la connaissance. *Le laboratoire de télématique et de médiatique.* Montreal, PQ: Université de Québec à Montréal.

Cioni, M. & Associates (1986). *An evaluation report of the RAPPI project, September, 1985 - June, 1986: An international computer conferencing network* (Department of Communications). Ottawa, ON: Maria Cioni & Associates Inc.

Cowper, D., Godfrey, D., Hart, R., & Sterling, S. (1987). Teaching at a distance with CAL. *Open Learning, 2*,(1), pp. 25-30.

Forsythe, K., Hart, R., & Sinclair, G. (1986). Knowledge Network — Schools initiative. *Knowledge Network of the West Communications Authority.*

Godfrey, D., Gong S. K., Hart, R., & Smit, S. (in press). Project clear skies. *Computer Journal.*

Godfrey, D., Hart, R., & Woolard, R. (1986, May). *The GOLDCOIN consortium: From concept to transformation.* Paper presented at the Fifth Canadian Symposium on Instructional Technology (National Research Council), Ottawa, ON.

Hawkridge, D., & Lewis, B. N. (1979). *New methods of assessment and stronger methods of curriculum design* (Ford Foundation Project). Milton, Keynes: The Open University, Institute of Educational Technology.

Kaye, A. (1987). Introducting computer-mediated communication in a distance education system. *Canadian Journal of Educational Communication, 16*(2), 153-166.

McCreary, E. K., & Van Duren, J. (1987). Educational applications of computer conferencing. *Canadian Journal of Educational Communication, 16*(2), 107-115.

Pask, G. (1976). *Conversation theory.* Amsterdam: Elsevier.

Penny, D. (1986, May). *Reflections on reading the abstracts, or How do we get from where we are to where we want to go.* Paper presented at the Fifth Canadian Symposium on Instructional Technology (National Research Council), Ottawa, ON.

Tribus, M. (1979). *A new approach to teaching adults at a distance — problem-based learning* (CEAD Paper 35). Milton Keynes: The Open University.

Williams, C. (1986). *The RAPPI experience at Bishop Pinkham Junior High School* (Report to the Federal Minister of Communications). Calgary, AB: Department of Communications, Canada.