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**PROCEEDINGS
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ON
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The Computer Conferencing System
of the Institute for the Future

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The Institute for the Future began its investigation of teleconferencing in order to improve the methods by which experts from diverse fields address problems in social forecasting and technology assessment. In March 1971, the Institute proposed to the Advanced Research Projects Agency:

"....to explore the applicability of on-line group conferencing for policy formulation via computer terminals. The key goal of such conferencing will be the effective use of judgemental data as input for forecasting, planning, and decision-making, where the participants are geographically separated."

To create an advanced form of teleconferencing, we have now implemented and tested a computer system called FORUM. Its basic objective is to allow unhampered interaction of participants under the guidance of an organizer who defines a topic of discussion, assembles a panel of participants, and presents the relevant material. Each participant establishes communication with the computer network via a portable terminal with a standard typewriter keyboard. FORUM is able to convey questions and answers, assemble group opinions, protect anonymous statements, and supply other information to, and within, the group while the organizer monitors the proceedings and intervenes as necessary.

In order to illustrate the interaction made possible by FORUM, imagine a hypothetical discussion among a group of experts on the projected availability of mineral and energy resources, 1980-1990. There are about 20 participants. Among them are planners, economists, geologists, and petroleum experts. Two are specialists in computerized data bases. In addition, there might be representatives from power and utility companies, and the president of a mining corporation. The conference organizer has experience in dealing with groups, and is familiar with various techniques used to draw out forecasts and intuitive judgements in technological areas.

This hypothetical conference differs from the usual workshop in that the participants are not meeting face-to-face. Instead, they are geographically separated and use a variety of communication media. Some are sitting around a terminal in a Washington D.C. office building. A geologist is in the computer room of the Branch of Computations of the U.S. Geological Survey in Denver. One of the economists is

in his office at Stanford University. Another one may be sitting in his study at home in New Jersey or in London, for that matter. (These experts are in telephone communication with a central operator who can instantly advise them of the status of the conference, of the progress of work done in subcommittees, or of the reasons for any particular difficulty or delay.) The substantive part of the interaction takes place through entries typed on standard terminals. They are connected to the network and controlled by a computer.

This is the capability of FORUM. The research issues addressed in creating this fall into two categories. First, from a computer science viewpoint, the central problem reduces to that of identifying, defining, and implementing a range of structures under which the participants are able to share information and enter comments into a common computer storage file. Second, from a human-factors viewpoint, our research has identified certain basic principles of computer communication, and created methods for displaying, in a meaningful way, both the contents and the dynamics of this communication. This task raises some unusual design problems: a group of experts, or decision-makers typically does not have much knowledge of, or interest in, computer technology per se. There is no opportunity to train them in the use of a text-oriented language before the conference. It is not feasible to ask them to interface with their peers through information specialists, because each participant has a unique awareness of the problem at hand and needs to experience direct contact with his data and with other participants in order to perform at the "cutting edge" of his thinking.

As a teleconferencing system, FORUM has unique characteristics not typical of other systems. Of primary concern in its development have been the techniques of translating the perceived flow of a face-to-face discussion into the medium provided by the computer. The information flow in a synchronous conference is now well displayed by FORUM. The ability of a participant to join an activity in an asynchronous manner created an unforeseen demand on the system: the need to review past entries, add new comments or ideas, or suggest changes, for example, plays a more significant role than had been anticipated. As a result, it has been necessary to expand the range of work styles available to users.

When a group communicates via FORUM, each participant uses a terminal which has been logged into a computer network. The user is presented with a list of discussions which he can attend (just as he would if he were to walk into the lobby of a convention center to review the day's program). Having selected an activity, the conferee is given a short background statement describing it. He is then free to observe the ongoing discussion, to review past comments, or to start typing his own remarks. At any point during the

discussion, a conferee can send a private message to another participant or make an anonymous entry. All of these can be entered without the participant's having to learn a single command, thus avoiding a major problem of most interactive systems in existence; namely, that system commands get in the way of the participant and clutter the transcript with extraneous lines meaningful only for the machine.

An important facet of FORUM conferences lies in the ease with which the participants have access to services outside the discussion: they can, for instance, submit a prepared statement to the rest of the group or inset parts of the discussion into a personal file. They can also draw responses from a data-base system and enter them into the general discussion. Clearly, the level of interaction thus reached is one not found in face-to-face meetings where experts usually are cut off from their files and personal notes.

The initial tasks of the FORUM project included an analysis of available resources, and a review of existing terminal technology in terms of character set, plotting symbols, size of frame, speed of presentation, and interface standards. A decision involving the programming language to be used had to be made early; after exploring the languages available on the PDP-10 under the TENEX operating system, we reluctantly concluded that assembly language was the only suitable medium to gain access to shared files and to control terminal behavior, both functions being critical to our goal. Additional requirements were speed and low central-processor utilization.

Finally, a major requirement has been to master technique to adapt the behavior of the system to the demonstrated skill of the user. This task has two aspects:

1. introducing an "intelligent" mechanism in FORUM to recognize the user's success at learning the functions of the system, with a provision for downgrading this skill when the functions are not used over a certain period of time; and
2. learning how to phrase information, as well as system prompts and responses, in a way that is adapted to the user's skill for a particular function and takes into account that this information may or may not have been presented previously.

Based on this mechanism, FORUM makes decisions that match the user's demonstrated expertise, and it adjusts the degree of verbosity of its response to suit the needs and experience of the human participant.

The FORUM system is still very primitive in several respects: first, the implications of synchronous (simultaneous) conferencing remain largely unknown, both in terms of computer support of thought processes and in terms of user behavior; second, the possibility of multimedia (audio and video) adjuncts to computer conferences has hardly been explored.

Much of our work to date has consisted of inventing structures and access mechanisms suitable for the use of computers as a communication medium. We have encountered two major technical obstacles in this respect.

1. Ordinary computer architecture creates severe limitations for our conferencing needs. Teleconferencing will require a revision of the organization of various computer resources to make efficient communication among many users possible.
2. Ordinary concepts in file processing, that rely on separation of user files and access paths, do not apply in the conferencing environment. We have found that a single user, namely FORUM itself, had to have complete access control. This leads to an unusual situation in terms of privacy, protection, and accounting.

An extremely rich domain for further research has been identified in the course of this effort. The specific computer-science questions it addresses (leaving aside the entire field of social impact and psychological reaction to the medium) follow:

- How can conferencing be interfaced with other functions in the areas of text editing and fact retrieval?
- How can a mechanism be provided for the identification of semantic threads and subgoals in a discussion?
- How can the knowledge of man/machine interaction be adapted, or extended, to a nonclassical situation of computer-mediated group communication (man/machine/man interaction)?
- How can a conferencing program be offered at a very high level of reliability over a network where actual processing of the conference activity becomes machine-independent?

When computer communication becomes more widespread, we foresee a number of new problem areas that deserve careful

exploration. One of these involves the coupling of conferencing activities to other functions, such as document preparation and publication, that are equally vital to the management task. Another is the definition of retrieval functions capable of operating on what is basically an unstructured, unindexed data base. Yet another area deals with the adaptation of the computer to an office environment.

In considering the last point, it is useful to remember that management information systems have largely failed because their assimilation in the framework of an executive's activities presents too high a threshold in terms of training usage patterns, and restriction of information types. Reliability and privacy are the main requirements for a successful system, and these must be addressed immediately. It is unlikely, however, that certain constraints--for instance, the need to type on a keyboard--will be removed within the next ten years. Human aspects of software design have been generally neglected; under these conditions we feel that considerable attention should be devoted to psychological and social factors before introducing teleconferencing into a large, operating environment.

Another aspect that requires further examination is the trade-off between travel and communication. Writing in the February 1974 issue of Telecommunications, Paul Polishuk has stated that:

"The Office of Telecommunications believes, based on analyses conducted to date, that as much as 5 percent of the total annual petroleum consumption in the US can be saved by substituting telecommunications for the transport of people and goods."

While our own project intends to explore these substitution possibilities further, experience with the FORUM medium leads us to consider as equally exciting the opportunity to regard computer conferencing as a genuinely new way for groups to exchange ideas, to do planning, and to arrive at decisions. If a communication framework can be maintained, and even enhanced, while members of a research group or management team are physically separated by large distances, then a major change in work styles and intellectual patterns seems to be possible. Such a change may be even more significant in the long run than the energy savings which teleconferencing may provide in the near future.