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Four papers on group communication

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Abstract: This collection consists of four parts.

Part 1 describes the main functions in Computer Conferencing Systems, both functions which almost all systems have, and functions only available in a few systems, but of value for distance education. For each function, the chapter describes how the function is implemented in some well-known conference systems and which terms are used to describe it. The chapter can be used as basis for a wish-list when procuring conference system software.

Part 2 discusses how standards for Computer Conferencing can be developed and describe the status of work in this area within ISO and CCITT.

Part 3 discusses whether the software design has any influence on user behaviour or not.

Part 4 discusses how the computer conferencing software and data base can be used to perform research on social behaviour in the systems.

Keywords: Computer Conferencing, Group Communication, Standards, Software design.

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Part 1: Computer conferencing functions and terminology

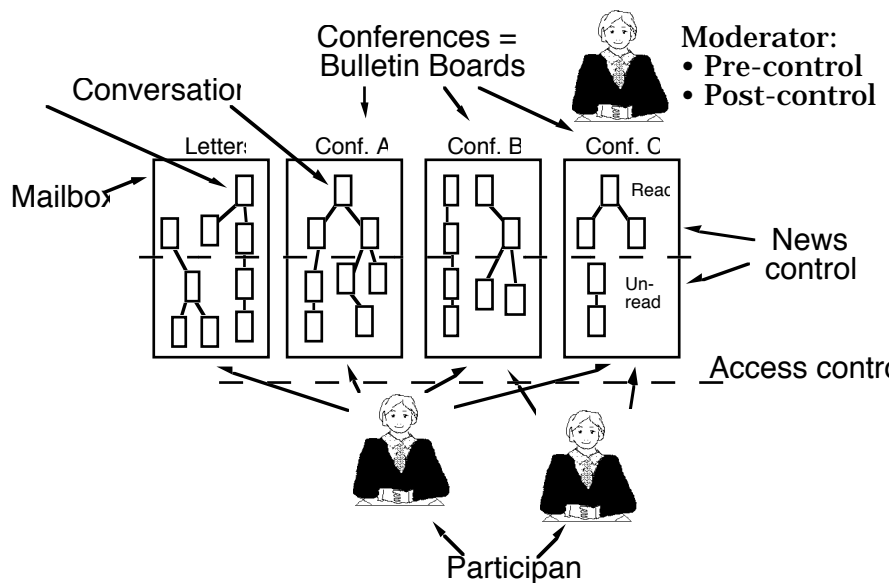


Figure 1
Terminology of computer conferencing

Figure 1 gives a pictorial introduction to the main terminology in computer conferencing.

Notation

For terminology, the various terms in different systems are given with the system name in parenthesis.

By (ISO) is meant the proposed terminology in the latest version of the ISO/CCITT working paper to become a forthcoming standard for computer conferencing. The standard is not ready, so the term may change [8].

By (KOM family) is meant all the systems in the KOM family of conference systems: COM, PortaCOM [16] and SuperKOM [14], [15].

By (EIES) is meant both EIES 1 and EIES 2 [18], [20].

Items

Inter-personal message

Function: Items of text sent to individually named recipients.

Terms: Message (EIES, Caucus), Mail message (COSY), Inter-personal message (X.400), Letter (KOM family).

Contribution

Function: Items of text sent to groups of recipients. In advanced systems, items can contain drawings and voice. Such items are called multi-media items.

Terms: Contribution (ISO), Article (Usenet News), Comment (EIES), Entry (KOM family), Message (Cosy), Item (Caucus).

Notifications

Function: Various kinds of notifications to a user when things of importance to that user happens, such as the re-sending of his/her contributions, their removal by the moderator, the addition of the user to a new conference etc.

Term: Notification.

Implementation: The type of notifications available vary between systems. Some systems present notification as news items, other only store them so that the user can request them when they are needed.

Conference types

Conference

Function: A set of participants and a set of contributions which they all can read and usually also write.

Terms: Bulletin Board, Group activity (ISO), Conference (EIES, SuperKOM, Cosy, Caucus), Meeting (PortaCOM), Newsgroup (Usenet News).

Open conference

Function: A conference which any participant can make himself a member of.

Terms: Open (ISO, KOM family, Cosy, Caucus), Public (EIES).

Closed conference

Function: A conference to which only the owner or moderator can add members.

Terms: Closed (ISO, KOM family, Cosy), Private (EIES, Caucus).

Restricted conference

Function: A conference to which some, but not all, participants can make themselves a member.

Terms: Restricted (PortaCOM), Open for (SuperKOM).

Implementation: The group of people who are allowed to add themselves as member to a restricted conference are often defined as the set of members in another conference.

Protected conference

Function: A conference on which no information, not even its name, is available to non-members.

Terms: Protected (KOM family), Hidden (EIES), Confidential (Cosy), Unlisted (Cosy, Caucus).

Write-protected conference

Function: A conference in which only some of the members can add entries to it.

Terms: Write-protected (KOM family), Read-only (Cosy, Caucus).

Implementation: Note that the right which is controlled is not the permission to write, but the permission to add contributions. The person who has these rights (usually the moderator of the conference) can thus add not only his own, but also entries written by other participants.

In Caucus, every conference can have full and readonly members, so a write-protected conference in Caucus would simply be an ordinary conference which has some readonly members.

In KOM, there is for every write-protected conference a superconference. If a member who is not allowed to write into the conference tries to add an entry, the entry is instead sent to the superconference.

In SuperKOM (version 2.3) write-protection only applies to original contributions, not to replies on them. A member can however set his membership so that he only sees the original contributions.

Subconferences

Function: Conferences within conferences.

Terms: Subconference (ISO, SuperKOM) Topic (Cosy).

Implementations: In Cosy, everyone who becomes a member of a conference automatically becomes a member of all topics within that conference. In SuperKOM, the subconference is announced in its superconference, and for open subconferences, members of the superconference can add themselves as members if they so wish. In SuperKOM, sub- and subsub-conferences can be nested to any depth.

Operations on conferences

Suspension

Function: The temporary cancelling of all rights to add entries to a conference or a conversation, usually controlled by the moderator.

Terms: Suspension (ISO), Closed/open (EIES), Frozen(Caucus).

Suspension in Caucus applies to conversations, not to conferences.

Announcement

Function: Aids for the creator of new conferences to announce their existence and for participants to be informed when new conferences are created.

Terms: Announcement.

Implementations: In SuperKOM, announcement of new conferences are handled in a similar manner to other contributions, and can be sent to any conference. Usually, such announcement messages are sent to special announcement conferences. By becoming a member of an announcement conference, a user will be told of new conferences announced in it, just as viewing ordinary new contributions in a conference, but in a special format suitable for choosing whether or not to join the new conference.

In many other systems, there is a special facility for telling users of new conferences, for example when they log into the system.

Conference directory

Function: Aids for finding which conferences exist.

Terms: Directory (SuperKOM, EIES), show command (Cosy), List conferences (Caucus).

Implementations: There is usually commands to list all conferences. The listing can in some systems be restricted to certain types of conferences (e.g. only open conferences), to only direct or indirect subconferences to a certain superconference (SuperKOM) or to only conferences which have been active (received new contributions) recently (COM, PortaCOM).

There is also often a facility to search the directory of conferences based on words in the name of the conferences and/or additional keywords on them.

User directory

Function: To find and read information about other users.

Terms: Directory (SuperKOM, ISO, EIES), Presentation (KOM family) Profile (Caucus).

Item directory

Function: Aids for finding contributions and other text items.

Terms: Directory (SuperKOM), index (EIES, ISO, Caucus).

The item directory is a way of assigning keywords to contributions and other text items and for finding them from their keywords, subjects and/or text contents via text retrieval commands.

Such directories can be closed within a certain group, or localized to only a certain conference or group of conferences.

Create conference operation

Function: The creation of a new conference.

Terms: Create conference (KOM family), Mod new (Cosy), Start (Caucus).

Implementation: In some systems, all participants can create new conferences, in some systems only certain privileged participants. In some systems, the owner of an installation of the system can choose whether all or only some participants can create new conferences. In a system with subconferences, the rights to create new conferences can vary with the level of the conference in the hierarchy.

Membership application

Function: To apply for membership in a conference.

Terms: Become member of (KOM family), subscribe (Grace), join (Cosy).

Implementation: For some conferences, called open or public conferences, some or all participants can make themselves members of the conference.

Some systems have a special facility for applying for membership to a closed conference, these applications are then either granted or rejected by the owner or moderator of the conference.

Withdraw

Function: To withdraw from a conference.

Terms: Withdraw (KOM family, Cosy), Resign (Caucus).

Implementation: In some systems, all members can always withdraw from conferences. In other systems, withdrawal is controlled by the moderator. In some systems, a member who has withdrawn, is allowed at a later time to make himself a member of the conference again.

Conference archive

Function: The facility to retrieve already seen contributions.

This is one of the major differences between conference systems and distribution list systems. Usually, new members of a conference can read contributions written before they became members.

Terms: Conference archive, Review seen (KOM family), View all accepted (EIES 2).

Membership lists

Function: The capability to find which are the members of a conference, and sometimes also how much they have left unread in the conference.

Implementation: This facility is available in most conference systems. It is useful because a person who writes in a conference wants to know who will read or have read his contributions.

Special procedures

Moderator

Function: A role with special privileges for a certain conference. Typical such privileges are to remove any entry from the conference, to add and remove members, to suspend and close the conference.

In **pre-moderated** conferences, the moderator must approve each contribution before it is accepted and made available to the conference members. In **post-moderated** conferences, the moderator does not approve items in advance, but can remove items after they have been sent out. The advantage with pre-moderation is that unnecessary duplication and non-pertinent items can be avoided in groups with very heavy load. The disadvantage with pre-moderation is that it slows down the group interaction very much. Typical delays between a contribution and replies to it are six hours in post-moderated conferences compared to one week in pre-moderated conferences.

Terms: Owner, Moderator (ISO, Cosy, EIES), Organizer (SuperKOM, Caucus).

Implementation: The moderator role is in some systems split into several roles, such as an owner (who controls membership), an editor (who can remove contributions) etc.

Roles

Function: When special rules apply to a conference, these rules will organize the members into groups with different capabilities.

Terms: Roles.

Office procedures

Function: Special rules applied to certain conferences. A set of rules, written in some kind of programming language, controls the actions in certain conferences.

Terms: Office procedures. The conference, which has special rules, may sometimes not resemble any ordinary conference at all, and the term domain is then preferred to the term conference.

Commitment

Function: Handling of information about tasks, priorities, promised delivery dates, who has promised to do what.

Terms: Commitment.

Deferred operation

Function: The storage of operations to be performed at a later time.

Term: Deferred delivery (X.400), deferred operation.

Implementation: There should be a possibility for users to find their deferred but not yet executed operations, and to modify or delete them.

Joint editing

Function: Support for the joint editing of a text by a geographically distributed set of users.

Term: Distributed authoring, joint editing.

Implementation: System with such support have a capability to hold a master copy of the document, to stop two users from modifying the same part of the document simultaneously, and to have discussions hanging on pieces of the draft document.

Voting

Function: Support for sending out vote queries and counting the replies.

Term: Voting, balloting, polling.

Implementation: Various algorithms for counting and presenting the result of the vote are used.

Data base

Function: Data base facilities built into the conference system.

Implementation: Contributions can be found by data base queries. Sometimes information can be created by automatic combining of information in other contributions.

Contributions

Anonymous/Pseudonymous contributions

Function: The possibility to write contributions where the author's name is withheld from the readers of the contribution.

Terms: Anonymous, pseudonymous contributions. For pseudonymous contributions, a pseudonym chosen by the user replaces the normal author name. EIES and Caucus have such a facility for writing pseudonymous contributions.

Implementations: In most systems, it may be possible using privileged commands to find out the real author of an anonymous or pseudonymous contribution. In some systems, it is possible to write personal replies to the author of anonymous or pseudonymous contribution without knowing the name of the person behind the pseudonym.

Submit contribution

Function: Submitting contributions to a conference.

Implementation: This right is usually open to all members of the conference. It can be restricted to only the moderator. In those cases, other members can sometimes submit contributions, but they are not added to the conference until they have been approved by the moderator.

Some systems also allow non-members to send contributions to all or some conferences.

Multi-recipient submission

Function: Submitting the same contribution to more than one conference, and possibly also as personal mail.

Implementation: In the KOM family, any participant can send a contribution to several conferences and/or personal recipients. Group replies are normally sent to the same set of conferences and personal recipients who received the replied-to entry.

In EIES 2, a contribution always belongs primarily to one conference. But a contribution or a set of contributions in one conference can be submitted as attachments to contributions in other conferences.

Group reply

Function: The ability to send a reply to all recipients of the replied-to item.

Terms: Comment (KOM family, Cosy), Add response (Caucus) Reply all, Group reply.

Implementation: There is often a way to let some special recipients see a particular item without forcing them to see all replies to it.

Obsoletes

Function: The ability to change already submitted contributions.

Terms: Obsoletes (X.400), change entry (SuperKOM), update (Cosy), change item and change response (Caucus).

Implementation: In SuperKOM, recipients of an obsoleted contribution will be shown that this contribution obsoletes a previous contribution, and can with a special command see the text before the change.

Delete contribution

Function: The ability to remove or delete contributions.

Terms: Remove, delete, erase, withdraw.

Implementation: In some systems (KOM, PortaCOM), removed items will not be visible even to those who have already received them. In other systems (SuperKOM) it is not possible to remove items from the mailboxes of the recipients, but they can be marked as deleted, which means that they are not shown as new.

Body types

Function: The ability to send contributions containing other data than ordinary text. Examples are word processing documents, spreadsheets, executable object programs, graphics etc.

A special case is where a contribution contains a program in a top-level language, which is executed when the recipient reads it. This facility is called activity in EIES 2 and delayed command in COM.

Terms: Attachment (EIES 2), Body part types (X.400).

Implementation: In EIES 2, such data can be put into attachments to ordinary contributions. In X.400, each message can consist of several body parts, each of a particular type.

Usually, there are safeguards to protect the recipient from being mistreated by such executable entries.

Expiration times

Function: Expiration times of various kinds on contributions.

Terms: Expiration time, validity time.

Implementation: There are two kinds of expiration time. One is the time before which a contribution may not be deleted, the other is a time after which a contribution should not any more be available.

PortaCOM has such a facility. In SuperKOM, entries can be marked as archived to protect against purging.

Security

Function: Use of special cryptographic security facilities to stop misuses like reading of items by non-authorized users, falsifying items, ensuring that the author of an entry is the one given etc.

Terms: Encryption, electronic signature etc.

Implementation: The various facilities are described in great detail in the X.400 messaging standard (not in the 1984 version of it).

Reading

News control

Function: The facility to find only unseen contributions.

Terms: News control, conference marker, view full text (EIES 2), read next unseen/entry/comment/letter (KOM family), Carriage Return key only (KOM family, Cosy), Show new (Caucus).

Implementation: There are two two main methods. One is via a conference marker, which for each conference marks how far in the list of contributions the user has read. This method (used in EIES 1, Cosy, PortaCOM) has the restriction that it will only work if users read contributions in sequential order. The other method is by information for each participant of which contributions that participant has read or not read. This method is used in SuperKOM, EIES 2 and Lotus Notes.

A special problem is how to handle the case where a user is a member of more than one conference, and an entry was sent to both conferences. Those systems which allows participants to submit the same entry to more than one conference, also usually have a facility so that such double members will not be shown the same entry as new more than once.

Filters

Function: The storage of a series of conditions, which are applied to new contributions to find those that satisfy certain criteria.

Term: Filter.

Implementation: Filters can operate on the incoming contributions for a particular participant, or on the whole stream of publicly available contributions. Selected contributions can be sorted into folders in the workspace of the user, or submitted to special conferences for receipt of filtered contributions.

Management

Purging

Function: Purging of old contributions.

Terms: Garbage collection, cleaning, purging.

Implementation: Most conference systems have some facility to automatically remove old contributions to save disk space. A good purging system should not delete a contribution before the deletion of group replies on it.

Distributed operation

Distributed service agents

Function: Distributed functionality I: Several conference system installations can be connected and run conferences in parallel.

Terms: Distributed operation, parallel conferences. This functionality is available in EIES 2, SuperKOM, Caucus and Lotus Notes.

Implementation: The implementations vary in the ease with which this is handled. In older systems, like PortaCOM, concerted action by moderators of both systems is needed to set up parallel conferences. In newer systems like EIES 2 and SuperKOM, conferences will automatically be copied in parallel to all hosts where there is at least one member of the conference.

Distributed user agents

Function: Distributed functionality II: Support programs for conferencing in personal computers and workstations.

Terms: User agent, PC version.

Implementation: In some implementations, the PC version mainly handles the user interface, but retrieves data when the user asks for it from the central systems. This method (used for example in the MacCOM and EasyCOM front-end programs for PortaCOM) often give long response times and delays unless the connection to the main system is very fast.

Other implementations keep a complete one-user conferencing data base on the PC/workstation, so that a user need only connect to the network to upload and download news. The user can then use the conferencing system off-line, and even read conference by conference and write new entries off-line. Systems in this category are SuperKOM and Lotus News. The SuperKOM user interface can either be used locally in the PC or in a unix server on the network, while Lotus News always runs the user process in the PC of the user.

The advantage with a full data base in the PC/workstation is very fast response times for most commands and that you save the cost of keeping a telephone line open during the whole session. The disadvantage is that it becomes more difficult for a user who wants to access the system sometimes from a PC at work, sometimes from a PC at home, sometimes from a third PC on travel.

Inter-personal mail standard support

Function: The ability to co-work with electronic mail.

Implementation: In most systems, this only means that you can send e-mail messages from conference systems. In some systems (PortaCOM and SuperKOM) it is also possible to receive incoming e-mail directly into conferences, and to make external e-mail mailboxes into members of conferences.

Standardized connection to other conference systems

Function: Capability to co-work with other conference system installations, so that parallel conferences can be run even though the sites use different conferencing software. Note that this is more than only the capability to interwork with other systems for the sending and receipt of personal electronic mail.

Implementation: This requires a standard for the interchange of information between the systems. No full such standard exists. However, some systems (PortaCOM, SuperKOM and Caucus) can communicate using the Internet/Usenet messaging standards.

Geographical/organizational restriction.

Function: A contribution can be sent to a conference, but be distributed only to a subset of its members, e.g. only to members within a certain country or a certain organization.

Terms: Geographical/Organizational restrictions on distribution.

Implementation: This facility is available in Usenet News. The existence of this facility is controversial, since some people say that it would be confusing and unwise to have such subsets of recipients. There are however obvious advantage, such as posting a notice that you want to sell a car only to recipients within your own geographical area.

Conversational support

Conversation scanning

Function: The capability to scan conversations in various ways.

This function allows a user to find, from one contribution, the other contributions which are related to it by being replies to each other.

Terms: Conversation, thread, tree.

Implementation: This capability is available in some conference systems, for example those in the KOM family and Caucus.

In Caucus, a conversation is handled in many ways similarly to conferences in other systems, users can thus see lists of conversations, find a conversation from its title etc.

Membership in conversational branches

Function: The capability to move conversational branches from one conference to another, and to add and remove recipients from conversational branches. Users can also themselves withdraw from reading further entries in conversations of less interest to them.

Implementation: This capability is available in SuperKOM. The Participate conferencing system has some of this capability.

Special support for distance education

Exams

Function: Support for giving exams to students in distance education.

Implementation: An exam facility typically will deliver the exam with a limited time for the student to answer each question, and where the student cannot take the same exam with the same questions more than once. In this way, cheating can be controlled.

Teacher questions

Function: Teacher asking questions to students in distance education.

Implementation: A typical implementation of this is where the teacher posts a question, the replies from the students are collected, and the students are not shown the replies from other students until they have answered themselves, or until the teacher makes the replies available.

Referring to passages within contributions

Function: The ability to write replies directed at certain words, phrases or paragraphs of a previous contribution.

This has many uses, one of them is in distance education, where it makes it easier for the teacher to correct and comment on papers written by the students.

Part 2: Computer Conferencing standards

With increasing use of electronic mail and computer conferencing, people will more and more often be required to participate in conferences in different installations with different software. And most people are not willing to go to the trouble of connecting to several different conference systems. This is especially true if they also will have to learn different user interfaces to different shades of functions.

This problem can be solved by standards.

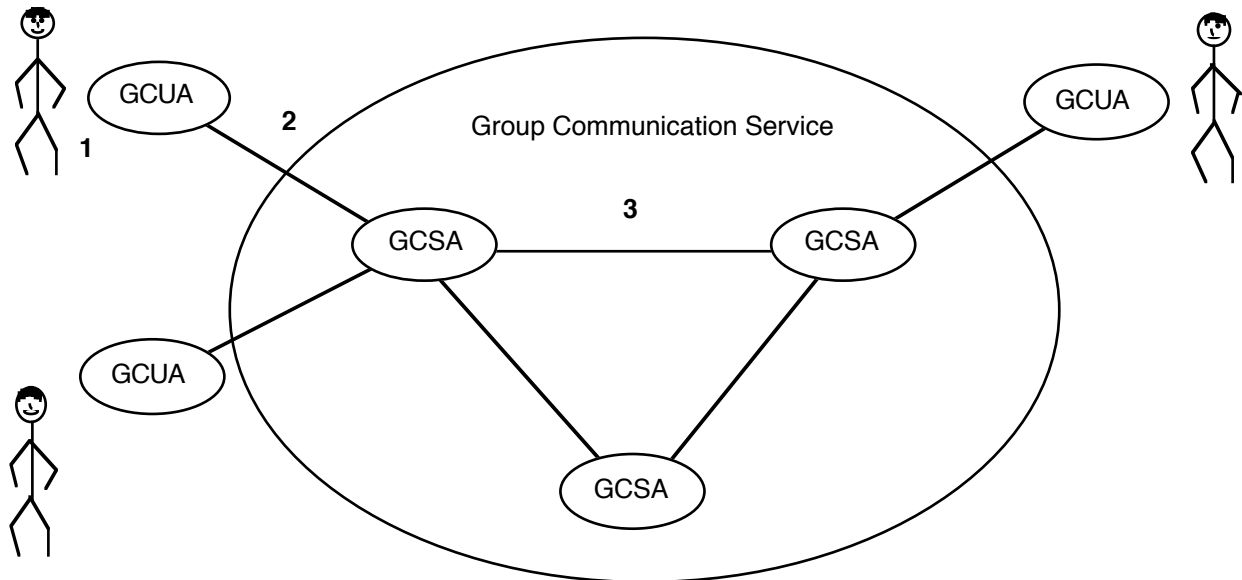


Figure 2
Group Communication Architectural Model

In order to understand the alternative options for writing standards, the model shown in figure 2 can be used. In this model, each user is connected to a User Agent or Group Communication User Agent (GCUA) which handles the interaction with that user, and maybe also a personal data base of messages for that user [1].

Each GCUA is connected to a multi-user server, called GCSA (Group Communication Service Agent) in figure 2. The GCSA can communicate with other GCSA-s.

The digit "1" in the figure represents the interface between the user and the conference system, as shown on the user screen.

Many modern conferencing systems have a software component which runs locally in the personal computer or workstation of the user. The digit "2" in the figure represents the communication between such a software component and a server. This means that for some conference systems, no such interface "2" exists.

The digit "3" in the figure represents the communication between two conference systems, of the same or different type.

A standard for computer conferencing could standardize any of these three interfaces, numbered 1, 2 and 3 in the figure.

Standardizing the interface 1 would thus mean that the words and commands used in the actual user interface is standardized. The disadvantage with such standards is that they hinder future development of new and better user interfaces. Because of this, standards organizations usually avoid standardizing this interface.

Standardizing the interface 2 would mean that the user can buy one piece of UA software, with one type of user interaction. This UA software could then connect to several different conference systems, but the user would still have the same user interface. The disadvantage with standardizing 2 is that all conference systems do not use such personal computer software, and that different systems divide the task between the GCUA and the GCSA in different ways.

Standardizing the interface 3 would mean to provide a standardized way of different conference systems to communicate with each other. All existing standards mainly standardize this interface.

The following standards exist today:

The Internet mail standards [3], [17]. These are mainly standards for inter-personal mail. They are widely used, but have very limited functionality.

The ISO/CCITT X.400/MOTIS standards [2]. These have much more functionality than the Internet mail standards, especially in the areas of notifications, body types and distribution lists.

The Usenet News standards [6]. This is a rather limited standard for the exchange of information between GCSA-s.

ISO and CCITT are working on the development of new standards. These may be ready in a first version in about 1995.

ISO/CCITT standards are based on the Open Systems Interconnection model [7]. This model provides basic facilities for the interconnection of systems. The Remote Operations Service (ROS, [10]) uses OSI to make it easy to develop new protocols. A special language, Abstract Syntax Notation 1 (ASN.1, [9]) is used to define the format of the data structures exchanged between systems in a computer-type-independent way.

The forthcoming ISO/CCITT standards are going to define an architecture, i.e. a description of the different types of nodes (like GCUA-s and GCSA-s) which can connect.

They will then define a common information model, a view of the data base organization in group communication systems. They will define the user functionality in what is called an Abstract Service Description.

They will then define the operations in the protocols to be defined, like the protocol between a GCUA and a GCSA (2 in the figure) and the protocol between a GCSA and another GCSA (3 in the figure).

The forthcoming ISO/CCITT standard will contain a basic general group communication model, and define applications based on this general model. Example of such applications are basic computer conferencing, voting, joint editing, distance education, office procedures etc.

Part 3: Does system design matter

Does it matter how a computer conference system is designed, other than that a bad user interface may discourage people from using the system?

One way to answer this question is to look at the experience with existing systems, and see if the actual behaviour of the user differs with different system design. There do not exist very many studies to investigate the user behaviour in different systems. Some information is however available from a number of cases:

Writing personally addressed mail versus conference contributions

Studies on use of the Forum-Planet computer conferencing system have shown that new users of these systems tend to write mainly conference contributions, while experienced users write more personally addressed mail. This is peculiar, since experience with most other conference systems is the opposite: Beginners tend to write mostly interpersonal mail.

The explanation is however easy if one looks at the user interface of Forum-Planet. This user interface makes it much easier to write a conference contribution than to write a personally addressed message.

Multi-conference messages

Many group communication environments have ethical rules which strongly discourages the sending of the same contribution to more than one group. This is peculiar, since it might seem natural in many cases to send a contribution to more than one group, if the topic of the contribution overlaps the areas of both groups.

The explanation for this rule is however obvious. The systems which have these ethical rules are designed in such a way, that if a contribution is sent to more than one group, and a recipient is a member of both groups, then that recipient will see the contribution twice.

Interesting to note is that no requests for such ethical rules have appeared in the KOM family of conference systems (KOM, PortaCOM, SuperKOM) where the software is designed so that a user is not shown the same contribution as new more than once, even if it is sent to more than one conference.

Allowing the sender to check if his/her message has been read

Some message systems allow the sender to find out if and when his/her messages have been read by their recipients. The existence of such a facility is controversial, some people claim that it is an infringement of privacy. However, such critical view are often heard for mail systems with distribution lists, but very seldom for conference systems. The probable explanation is that because the conference systems allow the recipient more control of what to read or not to read than pure mail systems with distribution lists, the user do not feel the same need for protection of privacy in the conference systems as in the mail systems.

Controlling who may start conferences

In a conference system at the Royal Institute of Technology in Stockholm many years ago, the administrators of the system decided that ordinary students (who were the main users of the system) should not be allowed to start conferences.

The effect of this was that the students instead discussed the topics they wanted in the conferences available, which meant that the discussion in the conferences often did not

agree very well with the intended topic of the conference. This however, led to rather violent clashes between those who wanted to discuss the intended topic of the conference and nothing else, and those who wanted to discuss other issues.

Conclusion

The conclusion from this is that system design does influence user behaviour, often in peculiar and unintended ways. To some extent, however, users will try to circumvent bad systems design by finding ways of getting around the limitations.

Part 4: Use of conference systems for research on them

Computer conference systems are often used to perform research on the systems themselves. Often, the systems are designed to collect a lot of statistics on their usage, which can be used for research. In fact, because all the interaction is handled by and stored in a computer [4], computer conference systems ought to be very useful tools for studying human behaviour in general, even though social science researchers do not yet often seem to be aware of this possibility.

Even better is if the researcher can cooperate with the designers of the systems, and get these to modify the design of the systems to collect research information.

Here are some examples of how I did exactly this. For fuller results, see [12] and [13].

New communication, or a replacement for old communication

In one investigation, I wanted to find out if the usage of a conference system was mainly new communication, or if it was a replacement for communication which previously took place using other means of communication.

The normal way to investigate this might be to make a query to the users of the system. However, such a query would tell how many users believe that the communication is new communication, and users' beliefs might not be correct.

Instead, I wrote a program which randomly selected contributions written in the system (both personally addressed mail and conference contributions). For each contribution the program sent a question to the writer of that contribution, asking them to what extent they believed they would have communicated the same information by other means if the conference system had not been available. They were also asked how many people they would have communicated this information to if the conference system had not been available. The answers were then weighed by the number of readers of the contribution. For example, if a contribution was read by 20 users, and the writer said that without the conference system, he would have communicated this to only 3 people, this was counted as 3 replacement communications and 17 new communications.

Thus, the figure which came out of the investigation was not how many of the users believed that conferencing replaces or does not replace other communication means, but rather what percentage of the actual communication going on in the system was a replacement for previous communication by other means.

The result of this investigation was as shown in figure 1:

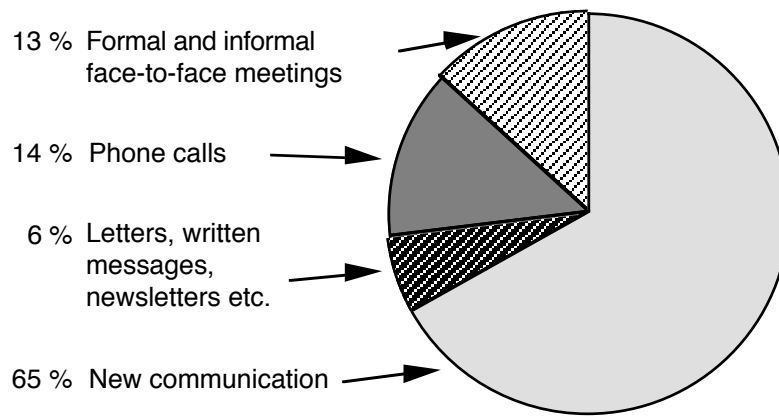


Figure 1: How much of the communication in a computer conference system is new communication, and how much is a replacement for previous communication by other means?

Organizational distance between sender and recipient

I wanted to find out to what extent computer conference influenced the organizational distance between the sender and the recipient of information. To investigate this I got a programmer to modify the conference system, so that every time anyone read a message or contribution, the organizational position of both the author and the reader was noted in a file. This investigation was made in a large Swedish government research agency with (at that time) about 1400 employees.

This file also noted if this was a personally addressed message, or if it was a conference contribution.

The result of this investigation was as shown in figure 2:

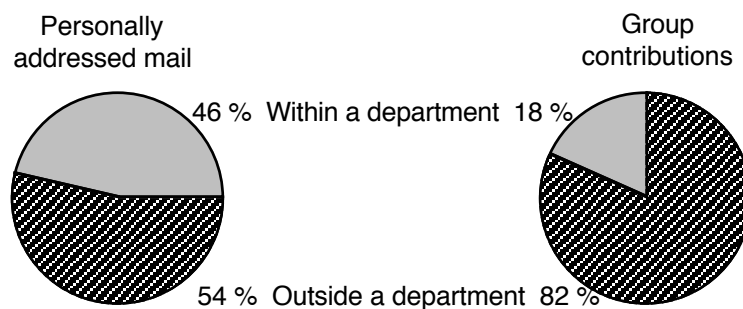


Figure 2: Distance of communication with personally addressed mail versus conference contributions.

Who are allowed to communicate?

In order to investigate this, I made a random sample of computer conference users, and also a random sample of people who were members of groups having face-to-face meetings. Informal face-to-face groups within a department was not included. I then checked the age, education and organizational position of the people who participated in these two communication means.

The result of this investigation is shown in figures 3:

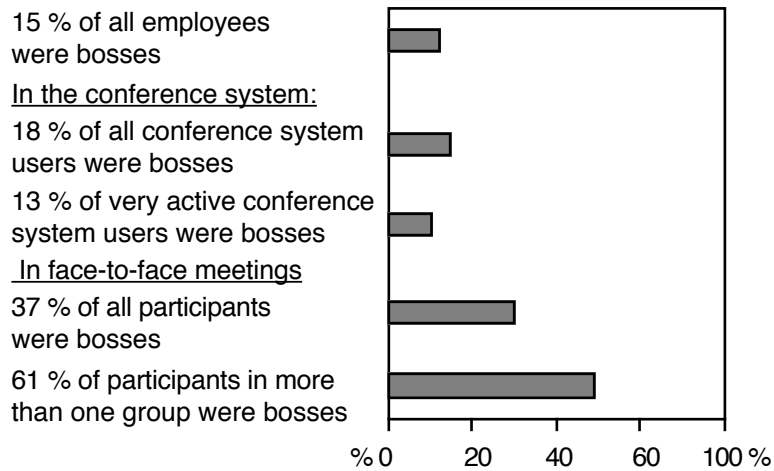


Figure 3: Percentage bosses among participants in computer conferences and face-to-face meetings.

The investigation of age showed that in face-to-face meetings, people older than 40 years of age were more frequent, while in computer conferences, people less than 40 years of age were more frequent.

The investigation of education showed that in both conference system and face-to-face meetings, people with higher education were overrepresented. This over-representation for people with higher education was however much stronger in face-to-face meetings than in computer conferences.

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