

## Some Issues on supporting Cooperative Work in stand-alone Environments

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### Extended Abstract

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Even recognising the concrete advantages of Computer-Supported Cooperative Work, most of the today's computational workspaces are still dominated by non-collaborative environments where facilities for integrated group work in terms of sharing of applications, files, and editors, group management and awareness, etc. remain at a specific exploratory level. This is mainly because the organisations haven't yet adopted complete integrated cooperative Solutions, and, on the other hand, workspaces are commonly stand-alone oriented.

In this paper we present some issues on integrating cooperative facilities in stand-alone environments, by a transparent and independent manner, maintaining the local space autonomy. A Framework for a generic support of group work at stand-alone environments is discussed and outlined.

### Resumo

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As vantagens do trabalho cooperativo suportado por computador são hoje em geral reconhecidas. No entanto ainda verificamos que a maioria dos ambientes computacionais da actualidade continuam a ser não cooperativos, onde a integração de facilidades de partilha de aplicações, ficheiros e editores, gestão e consciência de grupo, etc. ainda se encontra um estado de exploração. Isto deve-se principalmente ao facto das instituições ainda não terem adoptado soluções completas de suporte à cooperação e por outro lado, constata-se que os ambientes de trabalho são ainda comumente orientados para filosofias de um só utilizador.

Neste artigo são apresentadas alguns resultados e considerações sobre a problemática da integração de facilidades cooperativas em ambientes individuais (de um só utilizador), de forma transparente e independente, onde a manutenção da autonomia do espaço de trabalho é garantida. Um Esquema genérico de suporte de trabalho de grupo em ambientes individuais é apresentado e discutido.

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## 1. Introduction

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Stand-alone work is the first and general form of computational work, from the beginning of the computer era. Tasks are performed following the principle of directly asking and obtaining services from a machine or group of machines in terms of individual need. Computers act as directly manipulable tools and as information spaces, constantly waiting for requests or actions from the user [Shneiderman 1993]. In contrast to cooperative environments, no forms of collaboration with human counterparts are considered [Marcos 1998].

With the advent of the Networking facilities along with the evolution of CSCW and Multimedia technology, new perspectives of cooperative work through the computer came to light. Features such as email, audio and video communication and sharing of windows have been for years the response for the support of concrete scenarios on group work facilities. People working alone may need to share information, communicate and work together with other people connected over the same network. Most of the times, stand-alone users engage into cooperative processes by a rather spontaneous way, when they need to help each other on the network [Marcos & Hornung 1997][Marcos 1998]. Cooperative solutions for stand-alone environments shall take into account this "non-formal" characteristic, as well as the fact stand-alone environments are usually built up by non-cooperative applications.

On one hand, it is rather unacceptable for users, in particular, and organisations, in general, to have cooperative facilities, which discard their daily stand-alone applications or environments, especially if they are successful ones. On the other hand, re-design and re-implementation of the stand-alone applications or environments to receive collaborative features, are normally inadmissible, since they tend to comport prohibitive costs.

In this paper we bring into discussion some issues related to support cooperative facilities in context with specific non-cooperative environments such as the stand-alone ones. We start by analysing the need of Cooperation in stand-alone environments, followed by the outlining of a Framework for Cooperation in them. A concrete application – the VirtualX prototype is then presented, and finally we draw out some conclusions and future work directions.

## 2. The need for Cooperation in stand-alone Environments

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A today's common computing workspace includes necessarily a personal computer connected with other computers and systems within a network. In this scenario, interaction between people with each other occurs (should be) usually by a natural and intuitive manner.

It is expected that people working alone (at stand-alone configurations) may need to share information, communicate and work together with other people connected over the same network. When considering the case where no formal cooperative process exists, i.e., each user pursues his/her own tasks and objectives using his/her local computer facilities independently from the other users, then the need of Cooperation occurs generally by a spontaneous way and during short periods of time.

The factors causing the integration of Cooperative support in stand-alone environments are essentially related to:

- the emergence of Networking services – stand-alone users have suddenly found out other possible work partners on the Net;

- the emergence of concrete Cooperative environments - available CSCW services offer new effective perspectives of collaborative work through computational means;

Another important factor, possibly the most representative one, is the growing need of information sharing and Cooperation at several levels that today's World economy imposes to the organizations and individuals. Thus, resources such as expert opinions, other employees records, files, product catalogues, distance training, computer data and audio-visual or structured Multimedia information, all of which would not easily fit in a briefcase, are becoming more accessible.

On the other hand, a criticism frequently lodged at specialized CSCW systems, is that they are often completely disjoint from the software ordinarily used by individuals when working alone. Thus, there is a driving force to create solutions that support familiar single-user tools in group settings. There is also a vital need to seamlessly bridge the gap between applications designed to support single-user mode, point-to-point mode, and multipoint mode (cooperative ones) [Schooler 1993] [Schooler 1996][Marcos & Hornung 1997] [Marcos 1998].

We shall notice that although cooperative support is generally required and desirable, stand-alone work is usually not adopted by an accidental way. It depends on the specific conditions and working strategies of each organization, where work autonomy and strict division of labour, are crucial in many organizations. And when cooperative support is in fact integrated it must follow some basic, but essential conditions normally related with the maintenance of a kind of work autonomy.

The principle of work autonomy in collaborative processes is defined as the level of freedom necessary to preserve up to a certain degree, the privacy and confidentiality of any personal data, as also to keep the characteristics of the individual workspace, in general, and of the related applications, in particular, even when people engage in cooperative scenarios.

An inherent conclusion we can deduce from this definition is that each single user must be able to decide his/her own degree of privacy to be preserved during an eventual cooperative process. The cooperative support has to act as an additional set of services while not interfering with the functional characteristics of the target stand-alone environment [Marcos 1998].

Accordingly, cooperative mechanisms for stand-alone environments have to consider the following aspects:

- Maintenance of all functional characteristics of the stand-alone environment. The cooperative mechanisms shall not cancel features, change characteristics, as well as imply re-design or re-implementation of the existing stand-alone environment.
- Support of cooperative facilities for the stand-alone environment. Cooperative facilities should be integrated in order to permit groups of people to work together over their own stand-alone environments. These last ones should be presented to end-users as being cooperatively manipulable.
- Maintenance of inter-group awareness. Team members should be aware of each other within the cooperative environment.
- Maintenance of an adequate team organisation. The environment must support a hierarchic structure in terms of involved people, their responsibilities and tasks.
- Maintenance of private work autonomy. The environment must preserve privacy of individual work. Team members should be able to freely and independently complete their tasks.

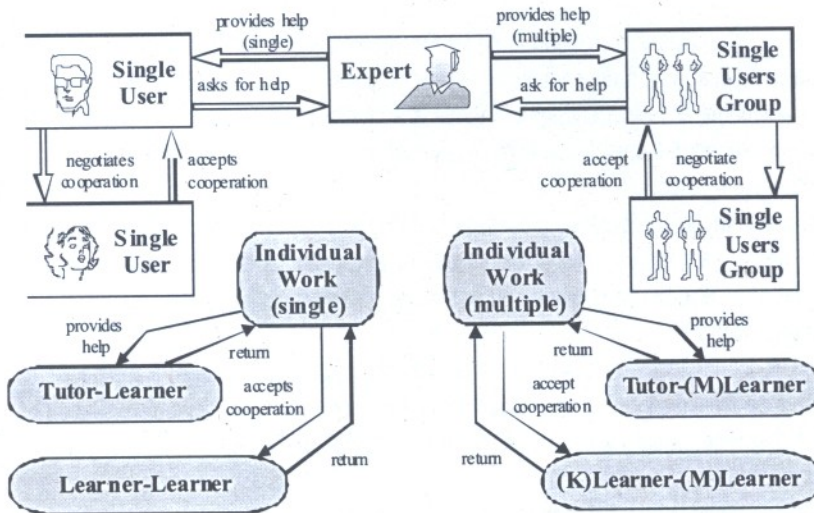
### 3 Discussing a Framework for Cooperation in Stand-alone Environments

#### 3.1. Preliminary Discussion

Stand-alone work is by definition not primarily about teamwork. It is most of the time exactly as its name says - the work of a single user. Cooperative facilities must hold an independent character, that is, they have to be integrable without demanding major changes on the target stand-alone environment. People actually want to have group work support as an additional and independent packet of services, which may be only used when needed.

Modelling cooperative support for stand-alone work requires, first of all, the set up of a working model. This has to establish a Framework for the process of cooperation, able to furnish an ample set of activities and their sequentialisation in order to get people involved working together and completing common goals successfully.

Fig. 1: The cooperation Framework for stand-alone environments.



The Framework has to be sufficiently generic to incorporate, as much as possible, the disparate types of group work activities that may take place at stand-alone arrangements.

When a user working alone needs to collaborate with (an)other user(s), he/she is usually looking for help. Who provides the help and support can be a single user (e.g. an external expert) or a whole group.

On the other hand, it can be that there is a specific and previously established common goal that requires a set of activities/tasks that have to be jointly realised by a group of single users. In this last case, the considered user simply establishes a connection to a shared workspace.

There are situations where people work strictly alone, in cooperation with exactly one partner or with a whole group of three or more participants. The shared work can be done under supervision of one coordinator. It can also be performed without any explicit supervision, being the people responsible for the coordination process. Furthermore, after a period of cooperative work, the participants may return to a pure stand-alone work phase. This alternating character between stand-alone and cooperative phases moulds effectively any cooperation process occurring in stand-alone environments [Marcos 1998].

Analysing further, we state that there are no forms of explicit team organisation in stand-alone work arrangements (a-priori). In this context, our domain of study is here specifically confined to those cases where people work explicitly alone, but would sporadically require group work facilities. This includes also the cases when a common goal is established between different active users, but the way to accomplish it remains a stand-alone one.

We can conclude that a cooperation Framework for stand-alone work has to be as much based on sporadic cooperative behaviours as on well-defined sequences of activities.

### 3.2. The Cooperation Framework

The relationship established between group members is based on the duality user-expert. The expert is here defined as the user who provides help and support. This relationship holds a high level of similarities to the relation learner-tutor happening in typical training environments. During the cooperative sessions the expert instructs about a common subject and supervises the actions of the users, who follow the instruction process affecting a learner or trainee. As a result, we employ in our considerations (when applicable) the terms tutor and learner instead of expert and user.

We propose a cooperation Framework including the following three phases:

1. Individual Work: It concerns formally about the pure stand-alone work;
2. Single-Joint Work: This phase represents the situation where exactly two users are working together. It entails two different cases, that we have defined as:
  - Tutor-Learner: One of the users (the learner) has been asked for and is currently receiving help from an expert (tutor). The tutor chairs the cooperative session;
  - Learner-Learner: Two users are completing together a common task. Both of them hold the same working status (there is no chairman in the session);
3. Multiple-Joint Work: Several users (more than two) are working together. The following general cases are possible (with  $N = \#Group$ ):
  - Tutor- (M) Learner: There is exactly one tutor supervising a cooperative session. M is the number of learners, which can be up to  $N-1$ ;
  - (K)Learner-(M)Learner:  $K+M$  learners are working together without (theoretically) explicit supervision. Taking into account the definition of stand-alone work, the K or M learners will rarely act as whole groups.  $K+M$  is a number up to N;

Other grouping combinations for the Multiple-Joint Work phase are theoretically possible such as: (K)(Tutor-(M)Learner) with  $K*(M+1) = N$ . However, these cases imply the co-existence of different independent groups. This represents a redundancy, since the object of this discussion is the group as unity. Furthermore, relations between whole groups generally involve only the interaction between their representative persons (e.g. the coordinators).

Although the Multiple-Joint Work phase seems to be a simple direct extension of the Single-joint Work one, it incorporates, in terms of intra-group interaction, the relation learner-learner when the tutor exists. This leads to problems such as: which kind of cooperative interaction can be allowed between them, thought their attention should be concentrated on the tutor presentation? Or if the interaction is allowed, which level of freedom should be permitted?

It is important to emphasise again that even grouped together people still remain working in and connected to their stand-alone workspaces. Moreover and as we have already stated, cooperation in stand-alone environments appears mostly by an ad-hoc and sporadic way.



Users can also maintain discussions through real-time Multimedia communication (text, audio and video) while sketching over a graphical background or over the shared workspace. This represents a complementary form of cooperation, since directly drawing over a specific application allows people to mark up details/aspects of it while maintaining direct communication. This turns the explanations of complex training tools easier than using only communication means.

Finally, VirtualX provides group awareness by allowing the traditional paradigms of cooperative editing: personalized multiple-cursors, WYSIWIS, social roles, users' identification, tele-pointing, multi-user interface, multi-user communication. Additional annotation features are available allowing users, or more precisely commentators, to perform comments on the shared documentation [Marcos & Hornung 1997] [Marcos 1998].

#### 4.1 The main Architecture

The VirtualX architecture is dealing with the system organization in terms of distribution of its physical processes and information among the different machines, as well as the way the communication is enabled. This architecture has been designed having as a main goal the support of the necessary means for the integration of cooperative work in stand-alone environments.

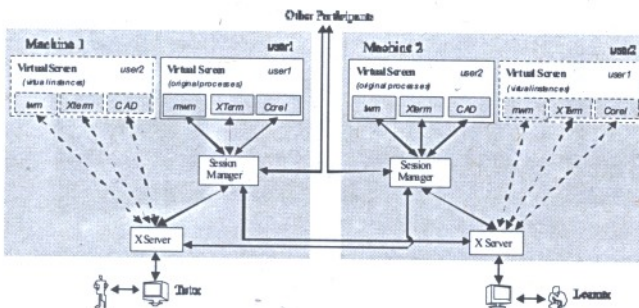
Consequently, since global coherence maintenance must be supported, we have adopted the client/server architecture as the primary platform for the subsequent components. A central process, the global server, holds the responsibility to synchronize all the information flow generated within the system while each local user process maintains an external user interface.

Additionally, a transparent sketching manager supports the related specific sketching facilities of the brainstorming process and session manager implements the application-sharing process.

#### 4.2 The multiple-workspace Sharing scheme

Since a stand-alone work environment may involve not only one but several applications, we have implemented the interface for the applications as a common drawing area holding a particular window manager (also cooperatively controlled) in order to support the collaborative window manipulation of all the workspace applications. This interface uses virtual-screen strategies. A virtual screen has dual identities. On the one hand, it is a common window which users can open, close, move, resize, iconify, and deiconify. On the other hand, a virtual screen, like a real screen, is used as a container for a group of windows and, when accompanying with a window manager, it allows users to manipulate individual windows on it.

Fig. 4. – The Multiple-workspace sharing scheme



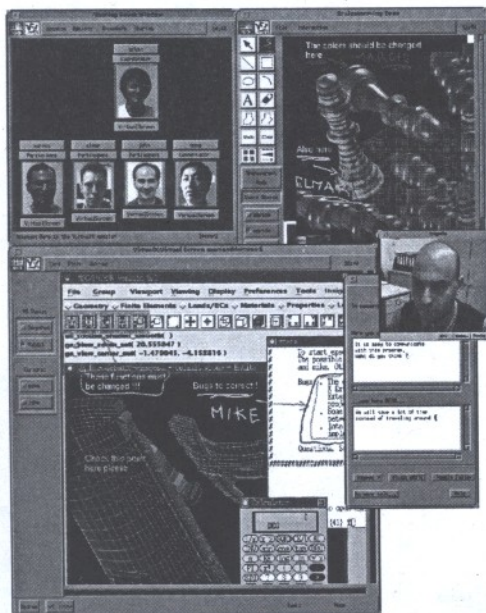
Unlike the other multiple workspace systems, virtual screen allows users to display more than one virtual screen at the same time so that they don't need to switch between workspaces. It is open to any client and window manager. When applying virtual screen, users can keep using their window managers and customary working applications (see [Lin 1992]).

In VirtualX, the virtual screen windows are applied in order to hold stand-alone workspaces/applications to be shared. Each participant can have his/her own virtual screen window where he/she can start his/her own local applications. These virtual screen windows are viewable in the distributed system and may be also made sharable to other group members. This implements a multiple-workspace sharing considering that, in fact, not only one workspace can be simultaneously manipulated among the group members, but a total of  $n$  different ones, being  $n$  the size of the group.

A network of stand-alone users may sporadically enter a joint collaborative process throughout the VirtualX multiple-workspace scheme.

In conclusion it can be here affirmed that the models adopted are expectably valid to any type of stand-alone environment. In fact, the virtual screen scheme plus the multiple-sharing strategy allows people not only to share single-applications but whole workspaces of any type. Moreover, the accessing policy along with the well-defined interaction rules of training process allows users to simultaneously share their workspaces while keeping a control over them. This enables the establishment of adequate work autonomy. Besides, features such as: communication, transparent sketching or multi-user interfaces represent in fact the "extra" cooperative facilities. They allow the integration of cooperation in stand-alone environments - the main objective of this work.

Fig. 5. VirtualX - Overview of the main windows. From left to right; top - down: the Meeting Room Window where a first overview of who is who is possible; Transparent Sketching Window - cooperative editing over a common picture; Virtual Screen Window where a complete workspace is being shared (as a set of running applications); Video and text communication channel



## 5. Conclusions

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Stand-alone environments involve per definition no forms of computer-supported cooperative work. People work alone by pursuing their own tasks and no other user can actually share their workspaces and help on the on-going work.

However, today's proliferation of network and communication facilities as also cooperative solutions have implied a growing call for group work services on side of the organisations still using the traditional stand-alone environments. These cooperative services must be integrated without implying major changes on the target stand-alone environment and also be kept as independent and additional features.

In this paper we have analysed the need of Cooperation in the stand-alone environments and the specific conditions and requirements that cooperative facilities shall have for them. We have concluded that Cooperation at stand-alone environments appears usually by a spontaneous way rather than a formal one. The single user establishes cooperative work when he/she requires and receives help/consulting from an external, both yet accessible, user - the expert. The process is similar to the traditional online remote training arrangements. A cooperation Framework has been presented accordingly. It is based on the principle of work autonomy maintenance. The cooperation Framework models the different forms of group work that can be established between single-user environments.

Finally we have described a concrete implementation of the concepts - the VirtualX system. It supports forms of collaboration at multiple stand-alone workspaces.

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