# A Framework for Transferring Desktop Images and Remote Operations in Multiple Computer Environments

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### Abstract

A remote display system, which allows users to view a desktop image and to control a remote machine, can be valuable for small group communication in which each member is operating several machines. However, conventional server/client based remote display systems have not been considered for group communication or multi-machines environments. Most of these systems restrict the direction of transferring from server to client. Switching the direction of transferring may require several procedures. Moreover, the settings of the server on each host tend to be troublesome.

We propose a tool for group communication based on remote display system with natural and intuitive interface. We have implemented a system "comDesk," which utilizes P2P (peer to peer) mechanism suitable for group communication. P2P mechanism minimizes the users' setting burden with autonomous configuration and reduces restriction of transferring directions. comDesk provides a visual interface, in which users can specify both the source host and the destination host freely, with simple dragging operations. comDesk will encourage small group communication based on sharing desktop images.

## 1   Introduction

Many personal computers with network infrastructures are now deployed in group working environments like offices and laboratory workplaces. In these environments, workers usually handle their computers individually. However, they sometimes want to share information and communicate with other workers casually. Email, chat and instant messages can be used for textual communication but they are not suitable for the visual one.

We have been focusing on a remote display system for visual based communication among members of a group. It will be useful for sharing images, instructing usage of an application on a colleague's machine and understanding the current situation of the others. Conventional remote display systems such as VNC (Virtual Network Computing) [Richardson et al., 1998] and some commercial software are becoming popular. Such systems are valuable for personal use of remote operation, however, the following problems arise when we apply these systems to group communication:

(a)  the settings of these systems tend to be troublesome.

(b)  the interface for recognizing and controlling transferring sessions (connections) is not enough.

## 2   Framework for Group Communication System

To solve these problems, we propose a framework of remote display system for environments with multiple users and more than two computers.

## 2.1 Autonomous Configuration

In case that many computers are set, distinction of server/client may increase the possibility of troubles. One of the major troubles is "restriction of transferring direction," which derives from asymmetric configuration. The restriction may cause cognitive overhead from users. The other major trouble is the "setting," specifying server host for each host becomes harder when the user lets many computers join the group.

Therefore we choose a design in which each host has capabilities of both server and client. In this coordination, the user never suffers from any restriction regarding the transferring direction. Also we choose P2P (peer to peer) techniques for autonomous configuration mechanism, which allows users not to select a server when they join the group. Using this mechanism, no administrative server host is required for the group. Tuples of host, user and password are kept by the appropriate host in the group.

## 2.2 Equality in Controlling Sessions

We think that interfaces for recognizing and controlling transferring sessions are crucial in group communication. "Desktop screen image" may include large quantities of personal information. Thus users may feel uneasy if these interfaces are not provided.

A transferred image is usually shown as a window with session controls in the destination host. Therefore the user of the destination host can easily control the session. However, the owner of the source host has no intervention except for disconnection. We believe that *the owner of the source host should have the right to control the session as much as the user of the destination has*. For example, the owner should understand where and how the transferred screen window is shown by the destination host, and should control the size, resolution and location of the transferring image. Accordingly we provide a visual interface which allows users to control the current transferring sessions at any time. Since the situation can be changed frequently, the view should be updated as often as possible.

## 3  comDesk : a Communicable Desktop System

We have implemented the system "comDesk," a communicable desktop system based on the above framework. "comDesk" is designed to minimize the users' setting burden with autonomous configuration, and enables the users to specify both the source host and the destination host by using simple dragging operations on the virtual hosts icons. The users can also control the position and the size of the transferred desktop images by similar dragging operations. comDesk is fully implemented in Java with RMI (Remote Method Invocation). Autonomous configuration is enabled introducing P2P technique. Since our system works on almost all platforms without any configuration, the user can casually communicate with the other members.

A typical scenario of comDesk use is (1) more than two computers and users participate in a group (2) each user usually works independently (3) when communication is necessary, a session starts. Each user can join/leave the group at any time.

comDesk consists of two components: comDesk Commander and comDesk Window. comDesk Commander is an interface for controlling image transferring processes. comDesk Window is a holder of remote desktop image, and allows a user to manipulate the source host by transferring operations on the desktop image.

## 3.1   comDesk Commander

comDesk Commander represents the joining host as an icon (named *HostIcon*). Figure 1 shows an example of comDesk Commander running on host zidane. Figure 1 represents four computers (crescent, zidane, tidus, phobos) that are joined. HostIcon can show a desktop thumbnail image. HostIcon also shows "*WindowIcon*s" which represents comDesk Windows displayed on the host. Arrows indicate the transferring direction. In Figure 1, desktop images of crescent, tidus are transferred to zidane. In general, every joining host can start comDesk Commander at any time, and can recognize the current transferring sessions. comDesk Commander shows (1) host name (2) thumbnail (3) owner's name (4) session status, including where comDesk Window is shown.
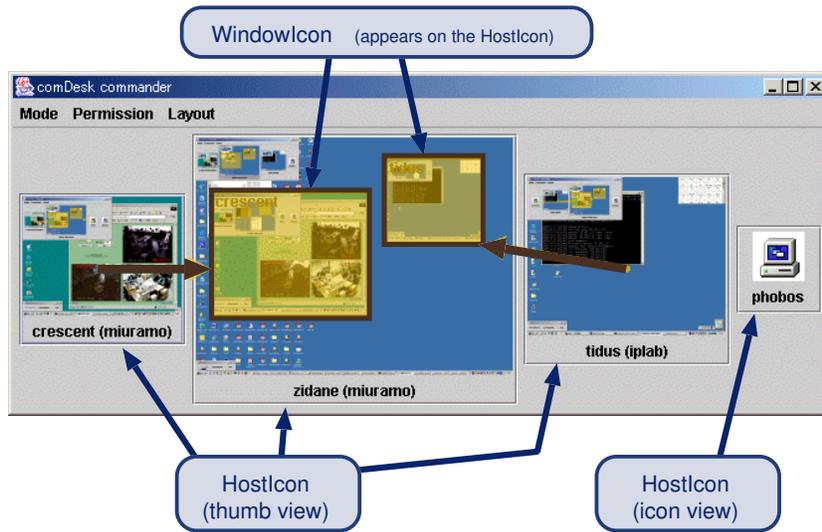


Figure 1: comDesk Commander

A transferring session starts by a drag&drop operation on HostIcon. When the user drags a HostIcon and drops it to another, comDesk Commander creates a transferring session. As a result, a new window (comDesk Window) appears in the dropped host. The dropped point determines the position of the window.

After the session starts, both the owner of the source host and the user of the destination host have permission to control the session by manipulating the WindowIcon shown in the HostIcon. Dragging a WindowIcon affects the corresponding comDesk Window, that is, the location and size of the comDesk Window can be changed by remote hosts. The lower-right area of WindowIcon is allocated for resizing, and the rest of the area for moving. In addition to this, the owner of the source host can drop the WindowIcon to another HostIcon, which causes "re-transferring of window." The "re-transferring of window" operation is more effective than the procedures of disconnection and re-connection. The common drag and drop interaction for both HostIcon and WindowIcon is intelligible for consistent paradigm of transferring operations to the users.

For the owner of the source host, the "re-transferring of window" is also used to regain the

transferring image. Other functions like changing resolution and disconnection are performed using the pop-up menu, which appears by pressing right button on the WindowIcon.

## 3.2 comDesk Window

comDesk Window is a window that shows a desktop image of the source host at the destination host. The user of the destination host can see the desktop image of the source host. comDesk Window appears at the destination host after the session starts. comDesk Window consists of two parts: remote desktop area and controller. The largest part of a comDesk Window is a remote desktop area. In Figure 2, the desktop of crescent is shown at the remote desktop area. The user of the destination host can change the resolution by "zoom rate combo-box."
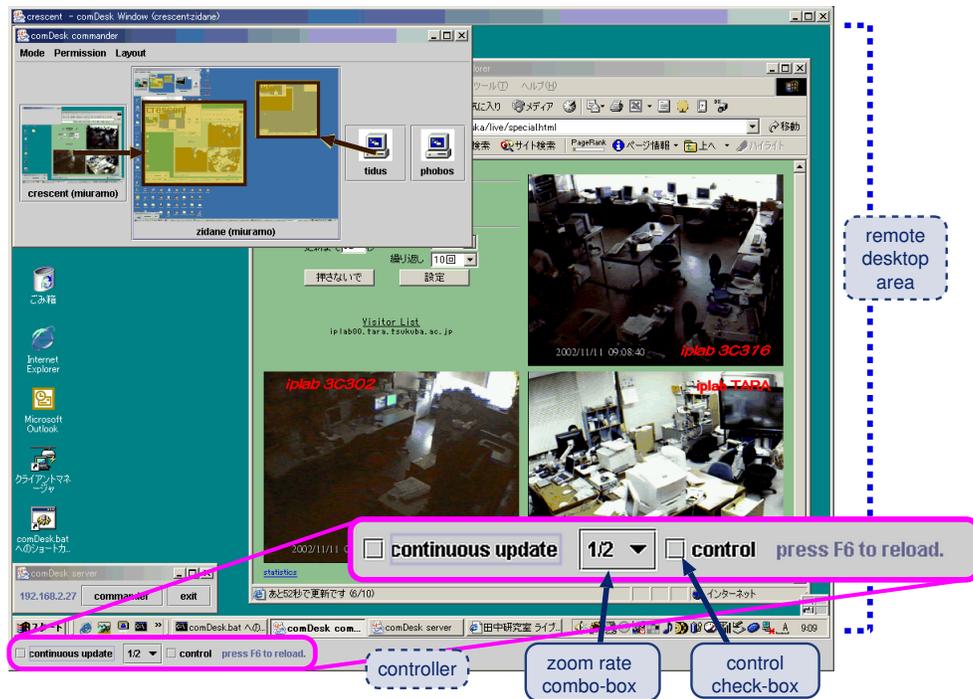


Figure 2: comDesk Window on host zidane. This comDesk Window corresponds to the left WindowIcon in the comDesk Commander (Figure 1). The source host is crescent and the destination host is zidane.

While the "control check-box" is on, mouse and keyboard operations are transferred to the source host. Therefore the user of the destination host can control the source host remotely.

Also the owner of the source host can control the session's properties (location, resolution, controllable option, and disconnection) by selecting pop-up menu from the corresponding WindowIcon on his/her comDesk Commander. If the owner of the source host makes the "control check-box" disable from the menu, the user of the destination host never operates the source host.

# 4 Related Work

Colab (Collaboration Laboratory) [Stefik et al., 1987] is a pioneer of large screen meeting rooms at Xerox PARC designed for small working groups of two to six people. It has a facility of multiuser interface, that provides a synchronized view and telepointing. i-land [Streitz et al., 1999] project in GMD (currently Fraunhofer-Gesellschaft) develops several communication devices embedded to a wall (DynaWall), table (InteracTable) and chairs (CommChair) for natural multi-user collaboration. iRoom [Fox et al., 2000] is a large display conference system with a mechanism for accepting heterogeneous devices like PDAs. In iRoom, communication infrastructure based on HTTP is proposed and developed for multi-device coordination. These environments with large display augment face-to-face meeting. comDesk focuses on casual and informal image-based communication among users, generally work independently.

# 5 Conclusion

"comDesk" encourages group communication based on desktop images and operations among users. Due to the P2P mechanism, the users can join the community with less setting burden. Also comDesk Commander provides efficient visual interfaces to share status information of transferring sessions, and enables the users to reconfigure the properties of the sessions. These characteristics may reduce the anxiety of the users. We believe this tool makes the relaxed image-based communication smoother.

# References

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