comDesk: A Cooperative Assistance Tool based on P2P Techniques

Motoki Miura, Buntarou Shizuki, and Jiro Tanaka

Institute of Information Sciences and Electronics
University of Tsukuba
1-1-1 Tennodai, Tsukuba, Ibaraki, 305-8573, Japan
{miuramo,shizuki,jiro}@iplab.is.tsukuba.ac.jp
http://www.iplab.is.tsukuba.ac.jp/

Abstract. We have designed and implemented a desktop sharing system based on P2P (peer-to-peer) techniques, named "comDesk", which enables users to exchange the desktop images as well as to control remote hosts. Using the P2P mechanisms, the users can start communication without pre-located servers. Also the equality of peers is well appropriate to make image transfers and operations bi-directional. comDesk also provides a graphical interface for users to observing, creating and managing the transfer sessions on the one window. The latter two functions are allocated to simple drag&drop operations. These operations are so intuitive and less time-consuming task that the user can immediately start a new session by calling these functions. We also mention that how comDesk does work effective especially for cooperative assistance tasks.

1 Introduction

Emerging lightweight computers accelerates portable use. With these portable and personal computers we can easily hold an informal meeting or an instant discussion at any space. We consider that these activities in temporal meeting/working space become popular hereafter. At the temporal space, the participants want to exchange data/objects in a broader bandwidth channel to improve the efficiency of the local activity. To realize the requirement we have to prepare a communicative service such as EventHeap[1] in advance. However we can not expect any facilities in these temporal spaces. Moreover in terms of the temporal space, the participants and their PCs in the space can be changed: they might leave away from the space, or a new member might come and join to the group.

We have designed and implemented a remote display application named "comDesk," (short for communicable desktop system)[3]. Basic features of comDesk are a desktop image transferring and a remote operation. comDesk is applicable for wide variety of situations including group work in a temporal space because comDesk utilizes P2P (peer-to-peer, definitions in [5, 2]) techniques as a basic concept. comDesk includes an automatic host composition mechanism which finds the hosts running comDesk instances in the subnet, and stores the necessary host-management information among the hosts. With this mechanism there is no need to prepare any communicable services

prior to their use. This is a reason why comDesk is applicable for an activities in a temporal space. Also the composition mechanism takes away an obstacle to use the desktop sharing because the participants are free from settings of any IP-addresses.

In addition to the host composition mechanism, comDesk emphasizes the merit of "symmetry of the hosts," one of the characteristic of P2P, contributes a flexible adaptation for environment which includes more than two computers. A server/client model works well among two computers or one to many transfer, but the model restricts direction of desktop image flows. Therefore P2P features are effective for desktop sharing tasks among multiple computers and multiple participants, even if the frequent changes occur.

In the following sections, we describe an overview of comDesk system with new feature (partial transferring) and technical details. Then we explain advantages of comDesk as a tool of cooperative assistance. Finally we discuss effectiveness of comDesk with the result of comparison with VNC[4].

2 Interface and functions of comDesk: System Overview

We have designed a graphical interface for the users to gain a benefit of P2P mechanism. The key interface of the system is comDesk commander (see Figure 1).

2.1 Management of sessions with comDesk commander

comDesk commander shows a list of hosts running comDesk instances by an icon named *host icon*, and provides three functions for transfer sessions; observing, creating and managing.
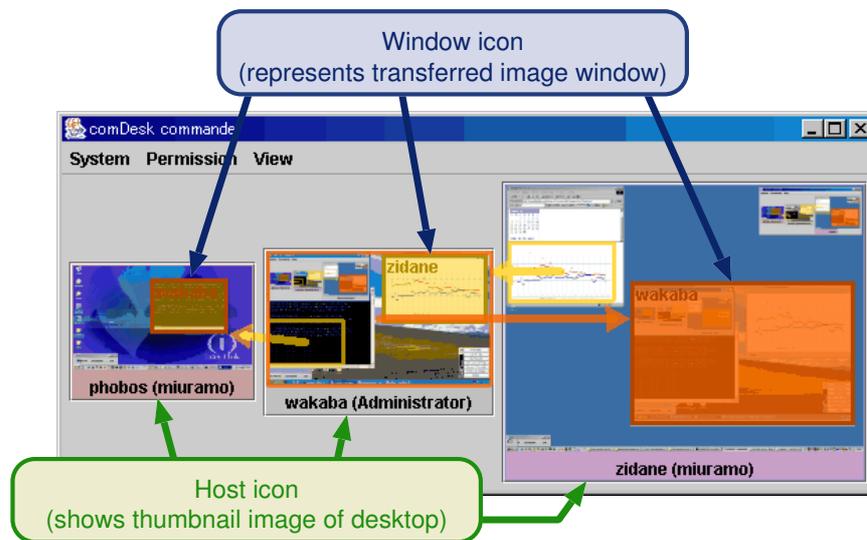

Fig. 1. comDesk commander window

Observing current sessions Figure 1 shows a comDesk commander window formed by three comDesk instances (phobos, wakaba and zidane). The thumbnail image of desktop can be shown in the host icon. With the host icons, the user can understand the people participated in the group. Moreover comDesk commander indicates transfer sessions by three visual elements; "*source region*," "*window icon*" and "*arrow*." These visual elements represent that a desktop image of *source region* is transferred to the area of *window icons* as a window (named *comDesk image window*). The arrow shows a direction of the transfer session. In Figure 1, we can see three comDesk sessions: (1) whole desktop image of wakaba is transferred to zidane (2) partial desktop image of wakaba is transferred to phobos (3) partial desktop image of zidane is transferred to wakaba. comDesk commander shows (a) host name, (b) owner's name ,(c) session status, and (d) thumbnail image, if it is permitted by the owner. These information of transferring sessions are so useful for group communication and awareness that we decided to make comDesk publicize them. All participants (the user of comDesk) can refer these kinds of view from one of the joining host they use.

Creating a new session When the user drags a host icon and drops it to another, comDesk commander creates a new transferring session. As a result, a new comDesk image window (see Figure 2) appears on the drop-targeted host. A comDesk image window enables the remote user to see detail view and control the source host by mouse operation. The user can choose "source host" and "destination host" with simple drag and drop operation. To protect users' privacy, comDesk asks for the remote user's agreement before creating sessions if the remote user and the operating user is different. If the operating user is the third person, that is neither the owner (user of source host) nor the receiver (user of destination host), the transfer request is rejected. The restriction prevents irresponsible transferring sessions among the hosts.

Managing the sessions After the session starts, not only the receiver but also the owner have permission to supervise the session and its associated image window by manipulating the window icon. This operation is also performed by simple dragging, that is, the location and size of the comDesk image window can be changed by the owner. The lower-right border area of window icon is allocated for resizing, and the rest of the area for moving.

In addition to the operation, the owner can drop the window icon to another host icon, which causes "re-transferring of window." The "re-transferring of window" operation is more effective and intuitive than the procedures of disconnection and re-connection. The common drag and drop interaction for both host icon and window icon 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 permitted to regain the transferring image. Other functions such as disconnection and changing resolution can be performed using a pop-up menu, which appears by pressing right button on the window icon.

2.2 Communication with comDesk image window

In this section, we describe the functions around the comDesk image window (Figure 2).
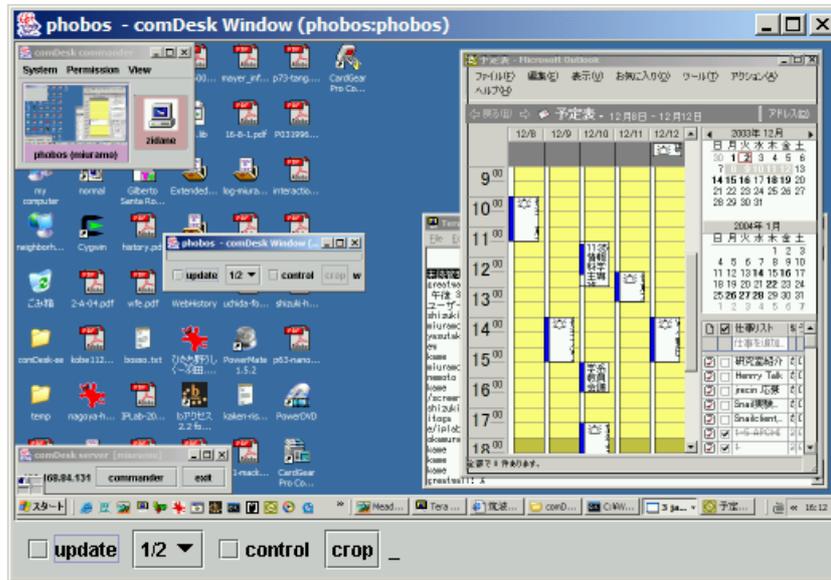
Fig. 2. comDesk image window

Basic features comDesk image window is the incarnation of transferring session. It is used for showing image as well as controlling remote host. The desktop image of the source host is presented in the window. The default shrink rate of the image is 1/2 at first. The rate can be changed by both the receiver and the owner from the combo-box below the image. While the "update" check-box is on, the image is automatically reloaded. Since the default image in comDesk is PNG format so far, the update task consumes much computation power in capturing and compressing of an image. In the current version of comDesk, written fully in Java, the update is performed every two seconds (XGA size, 1/2 scale, cpu 850MHz). We let users to select the update strategy. If the user needs pleasant remote mouse control, the user can make the "update" off. The static image is also useful if the user wants to keep a snapshot of momentary scene. The static image is kept even if the "re-transferring" is performed.

The "control" check-box defines the state whether the operation on the comDesk image window is transferred or not. The check-box can be managed by not only the owner but also the receiver. But the owner of the image has a right to disable the check-box ultimately by a pop-up menu of window icon. Changing the preference of menu-item immediately affects the corresponding check-box of the comDesk image window. Also the owner can quit the session. The default state of check-box and the preference of menu-item are decided depends on the relationships of the persons concerned; owner, receiver, and operator.

Partial transferring We have added "partial transferring" mechanism to comDesk. The "partial transferring" allows owners to specify the portion of the desktop image to

be transferred. This function is effective because of three reasons; (1) it can relieve the privacy problem, (2) the partial transferring can be used to specify the region to let the receiver to focus on the specific area, and (3) the size of cropped image becomes smaller therefore the update can be faster. Also the receiver can easily handle the cropped view.

To start the partial transferring, the owner first initiates a session that the destination is the same host as the source. This is possible by dragging the host icon and drop itself. After that, the owner defines the crop region by dragging on the comDesk image window. Then the owner clicks the "crop" button to determine the area. Finally the owner re-transfers the "cropped" comDesk image window by dragging corresponding window icon. On the partial transferring session, an operating remotely is also possible within the limited areas.

3 Advantages for cooperative assistance

Cooperative assistance means to perform tasks with helps of people in a group. We usually employ computers but not all applications are simple and familiar to the user. When we meet a problem during a task, one of the way to accomplish the task quickly is getting a help by asking someone knows well. We consider that comDesk can ease a burden of asking an expert by relaxed and informal image-based communication. For the expert, comDesk is suitable because he/she can rapidly understand the situation and the inquiry rather than text. The expert may solve the trouble directly by remote manipulation of the host.

Though there are some remote assistance tools such as VNC[4] and part of operating system like Windows XP, comDesk is more applicable for these tasks in some reasons. First, comDesk is suitable for instant image based communication. Drag&drop operation eases the overhead of connections. Secondly, no limitation in direction is quite convenience. The user can quickly start transferring of images both sending and receiving. Thirdly, the user can delegate the problem to the specialist if the user cannot solve the problem by re-transferring the image immediately. Therefore comDesk is suitable for cooperative assistance activities in a group, which may increase efficiency of the group works totally.

4 Discussion based on practical comparison

We consider that the relaxed transferring of images is essential to activate cooperative assistance. Our assumption is that the comDesk has an advantage in the relaxed transferring because it can reduce the burden of setting and transferring operations, especially in multiple computers environment. Therefore we performed experiments to assess the burden of transferring task. We choose VNC (WinVNC ver. 3.3.6) as a competitor, which does not designed for handling multiple computers.

We prepared two scenarios for each experiment. Scenario of experiment 1 is making an exchange among two users. Experiment 2 is a case of co-working with a shared large display. Two users acquire the image of a shared computer first. Then, the two users post their desktop images to the shared computer. In experiment 2, programs of VNC server, VNC viewer in listening mode, and comDesk were prepared and worked at host A in advance. Figure 3 shows the flow and the detail of startup tasks in each scenario. Black-dot indicates the host where the operation is performed. Arrow represents a direction of

transfer. We measured time, left click counts, and numbers of key inputs, in setting tasks for each scenario. The time includes three seconds of host-lookup timeout by comDesk. We tried the experiments three times, and the best result is adopted.
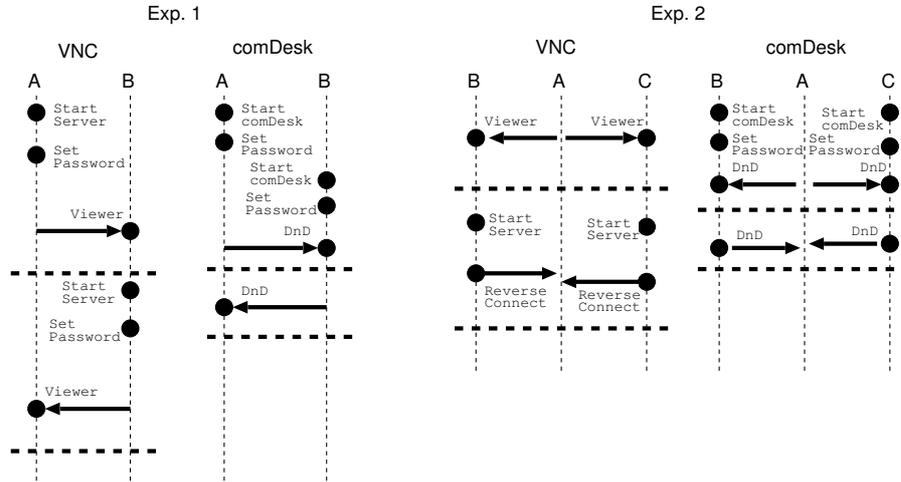

Fig. 3. Flowcharts of the startup tasks. Black-dot indicates the host where the operation is performed. Arrow represents a direction of transfer (whole desktop image).

Table 1. Comparison of startup tasks between VNC and comDesk (Exp. 1)

step	Time (sec)		Left Click (times)		Key Input (times)	
	VNC	comDesk	VNC	comDesk	VNC	comDesk
A to B	24	19	6+4	6+7	4+20	4+4
B to A	33	8	5+7	0+0	20+4	0+0
total	57	27	22	13	48	8

Table 2. Comparison of startup tasks between VNC and comDesk (Exp. 2)

step	Time (sec)		Left Click (times)		Key Input (times)	
	VNC	comDesk	VNC	comDesk	VNC	comDesk
A to B,C	13+16	17+13	8+7	7+6	19+19	4+5
B,C to A	12+15	4+6	5+5	2+2	12+13	0+0
total	56	40	25	17	63	9

Table 1 indicates the results of experiment 1. The notation of value "$A+B$" in click counts and key inputs represents the result of host A and B respectively. The total time of comDesk is less than the half of VNC. In VNC, the user must start server and set password in both hosts. The comDesk also needs to be started and to be set password.

But the cost of the transfer operation is relatively low, and the cost of reverse connection is the same. The number of key input affects the cost. Table 2 is the result of experiment 2. The paired notation value "$B+C$" represents the result of host B and host C. The total time of comDesk is less than the time of VNC, but the difference is slighter than experiment 1. The reason is that the user did not have to care the host A, and the passwords of VNC server at B, C were not set. Incidentally, the time necessary to start VNC server then set password was about 10 seconds. The time necessary to start comDesk then set password was about 9 seconds (it includes 3 seconds timeout). There is not obvious difference but when it comes to diverse connection, the user must start many VNC servers and VNC viewers. In conclusion, comDesk is effective under the situation which several servers are required, and the connections are changed frequently.

5 Conclusions

We have designed and implemented comDesk, which can improves the efficiency of a cooperative working/assistance task with relaxed desktop image transferring. In addition to the P2P techniques applied, the interface of comDesk increases the efficiency of operations in observation and manipulation of transferring sessions. Also we have showed some reasons why comDesk is more applicable in terms of cooperative assistance.

comDesk is available from the following URI.

http://www.iplab.is.tsukuba.ac.jp/~miuramo/comdesk/

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