

When One Isn't Enough: An Analysis of Virtual Desktop Usage Strategies and Their Implications for Design

Meredith Ringel

Stanford University, Computer Science Department

353 Serra Mall, Stanford, CA 94305 USA

merrie@cs.stanford.edu

ABSTRACT

Screen space is a limited resource for computer users—multiple monitors are one means of workspace expansion, and “virtual desktops” are yet another way to increase screen real-estate. We present a taxonomy of organization strategies based on our observations during a series of interviews with virtual desktop users. Additionally, we explore causes of varying user preferences for physical versus virtual means of screen-space expansion. Finally, we discuss the design implications of our findings.

Keywords

Virtual desktops, multiple monitors, information organization.

INTRODUCTION

Virtual desktops are window management systems that expand the space available for application windows by allowing users to switch between different workspaces. We interviewed twenty people who use virtual desktops on a regular basis in order to learn how information organization strategies differ between virtual desktop users and multiple monitor users, and to learn what guides users' preferences for either virtual or physical means of expanding their workspaces.

Related Work

Grudin's field study of multiple monitor use [1] explored current user practices in “multimon” situations. He found that most people used their extra monitor as a place for keeping secondary applications, such as email, while their main monitor (often larger and/or higher resolution) was devoted to their primary task.

FIELD STUDY

The population we interviewed for our study is representative of typical virtual desktop adopters—twenty men aged 20 through 50 who work with computers on a daily basis. All participants were asked a series of questions about their experience with virtual desktops and multiple monitors and about their computer setup. Interviews were tape recorded, with the participants' permission.

We observed that the participants' information organization

strategies could be grouped into five distinct categories, and that their mappings of windows to particular virtual desktops were remarkably consistent for individual users over time. We also learned that many users did not view virtual desktops as a cheaper and less optimal solution than multiple monitors, but rather that they preferred to use virtual desktops in some situations and multi-monitor setups in others.

Partitioning Strategies

After asking twenty users about how they divided their windows among the available virtual desktops, five different organization strategies emerged:

- *Tasks* (6 users): Examples included having one desktop devoted to each course that the user was taking, or having one desktop for each of several different programming projects, with each desktop containing all the code, testing, and documentation related to one of the projects.
- *Subtasks* (9 users): This group of users tended to be working on a single large programming project, and would typically devote one desktop to source code editing, another desktop for testing, and another desktop for support documentation.
- *Primary/Secondary* (2 users): These users had one desktop for work, and another for email and the web. Both of the participants who used this strategy also said that they would prefer to use multiple monitors instead of virtual desktops; interestingly, Grudin observed that primary/secondary was the predominant organization strategy among multimon users [1].
- *Systems* (2 users): Different operating systems (via remote shells or windows) were on separate desktops.
- *Applications* (1 user): Applications were grouped onto virtual desktops by type, rather than by task. For example, all text documents were on one desktop, all web browser windows on another, source code editors on a third, etc.

Consistency of Mappings

There was an unexpected amount of consistency in users' mappings of groups of windows onto specific virtual desktops. Here, “consistency” refers to day-to-day consistency for each individual, rather than to uniformity across multiple users. Consistency in mappings suggests

that users may be taking advantage of spatial memory to locate items among their desktops. Spatial memory has demonstrated utility in information organization and retrieval systems such as [3] and [4].

Twelve of the twenty users described their mappings as overwhelmingly consistent for most of their virtual desktops, although most of them did have one “miscellaneous” desktop. An additional three users described their mappings as partially consistent, meaning that at least one of their desktops was always mapped to the same application (generally email and/or a calendar), but the remaining desktops were “fair game” for any other windows. Another user said his mappings were consistent within a project, but when starting a new project his mappings were not necessarily the same as for the previous one. The remaining four interviewees said that their mappings were not consistent at all.

Four users had more than one machine running virtual desktops; of those, three mentioned that their application-window-to-desktop mappings were consistent across both of their machines.

Virtual Desktops vs. Multiple Monitors

Before conducting this study, we suspected that most people used virtual desktops because they lacked money or space for an extra monitor. However, we found that several other considerations also impacted this choice. We learned that our interviewees were evenly divided over their preferences for multiple monitors versus virtual desktops: 5 having no preference, 7 preferring virtual desktops, and 8 preferring multiple monitor setups.

Users favoring multiple monitors mentioned benefits such as the ability to view two documents simultaneously in order to compare them and the ability to peripherally monitor some part of the system for change.

Those users who preferred virtual desktops cited several “minuses” of multiple monitor use. Some participants claimed that the time to switch between different virtual desktops was faster than the time required to drag the mouse across two monitors, and was also faster than the time to turn their head to find something on a second monitor. (Note that we have not validated the empirical truth of this efficiency claim, but are merely reporting what some users perceived to be an advantage of virtual desktops over multiple monitors.)

Several users also mentioned that having peripheral tasks such as email on a separate desktop helped them be more productive, because they were not distracted by every arriving message. This “out of sight, out of mind” advantage stands in contrast to the “peripheral awareness” advantage cited by some of our multiple monitor advocates.

Although we had postulated that laptop users might prefer virtual desktops because of their utility in mobile situations, we found that laptop use did not correlate to a preference for either virtual desktops or multiple monitors. However,

laptop users did use more virtual desktops, on average, than desktop users. This could be explained by the fact that the laptop users all had smaller monitor sizes (13” – 15”) than the desktop users (17” or larger), although screen resolution between the two groups was not different.

DESIGN IMPLICATIONS

The prevalence of task and subtask-based organization strategies suggests a model different than today’s predominantly application-based conceptual models. Many operating systems group all documents of the same type together on the taskbar; it may be beneficial if documents related to a particular task were grouped together, instead. Work like the Task Gallery [4] is a step towards taking advantage of the prevalence of task-based organization schemata.

The overwhelming consistency of peoples’ mappings suggests desktop enhancements that allow an application to “remember” what desktop it was last open on. More generally, this consistency implies that when designing applications, it may be beneficial to allow users to leverage their spatial memory for search. Limits of memory also play a role; we observed that the number of virtual desktops typically used is about 4, which may reflect the fact that a greater number of desktops imposes too great a cognitive load on the user.

The disparity in users’ preferences for peripheral distractions and for virtual versus physical extensions of their workspace raises an issue regarding “one size fits all” computer solutions. An interesting avenue for future work is the exploration of whether certain classes of tasks are better suited for either virtual desktop or multiple monitor environments. A more formal study comparing the two is warranted; it would be valuable to supplement this preliminary self-report data with objective measurements. It would also be valuable to explore whether certain classes of tasks engender particular types of organization strategies, which could have implications for the design of applications supporting those tasks. More formal experiments will provide valuable insight into the results obtained by our interviews.

REFERENCES

1. Grudin, Jonathan. Partitioning Digital Worlds: Focal and Peripheral Awareness in Multiple Monitor Use. *Proceedings of CHI 2001*, 458-465.
2. Henderson, D., and Card, S. Rooms: The Use of Multiple Virtual Workspaces to Reduce Space Contention in a Window-Based Graphical User Interface. *ACM Transactions on Graphics*, 5(3), 211-243. July 1986.
3. Robertson, G., et al. Data Mountain: Using Spatial Memory for Document Management. *Proceedings of UIST 1998*, 153-162.
4. Robertson, G., et al. The Task Gallery: A 3D Window Manager. *Proceedings of CHI 2000*, 494-501.