

Exploring Multi-Device Task Management with the Collaboration Annex

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ABSTRACT

Users are increasingly limited in their use of multiple computing devices by the difficulty of managing information and tasks across those devices. We extend previous research on supporting task management and on interaction across devices by providing support for managing tasks across devices. As initial steps we identify dimensions for transforming the spatial context of tasks across devices and present a prototype exploring possible points in the design space.

INTRODUCTION

Today's users typically employ a heterogeneous collection of computing devices: desktop computers, laptops, tablets, cellular phones, etc. The commoditization of computing devices means that users are increasingly limited not by how many devices they can afford, but by how many they can manage. Our computing devices are still largely bound by the metaphor of the personal computer: each assumes that it is a user's only device and provides little or no support for managing information and tasks across devices.

Consider a manager who is analyzing her employees' yearly performance. She might open a spreadsheet to collect data, a number of intranet web pages to see summaries of her employees' output, and several external web pages to assess their impact on the outside world. She naturally spreads this task out over the multiple displays connected to her desktop computer. However, if she interrupts the task and wants to continue it at home or on an airplane, she must transfer the information to a new device. In the process she loses *task context* information, specifically the aggregation and spatial arrangement of the open windows. If she resumes the task on her work computer the next day, she must again transfer information and recreate the task context.

Previous research has focused on helping users manage tasks (e.g. [2, 3, 5, 7]) and on supporting interaction across

devices (e.g. [1, 4]). We propose extending this work to support users in managing tasks across multiple computing devices. As a first step, we provide support for transferring and transforming task context information across devices.

DIMENSIONS FOR TRANSFORMATION

Computing devices differ widely in their configuration and capabilities. As such, mechanisms for transferring task context should also support *transforming* that context to better suit the currently employed device(s). As a first step toward providing that support, we identified an initial set of six dimensions along which tasks might vary. They are:

- *Task availability* and *subtask availability* may change based on the availability of the required information (files) and applications.
- The *mapping* of information to application may change based on the types of available applications.
- The task-specific *amount of virtual display space*, the *mapping of virtual to physical displays*, and the *mapping of windows to virtual display space* may change based on the number and size of available physical displays, their layout, and intended usage.

APPROACH

As first steps toward a solution, we are developing the Collaboration Annex. Physically, a Collaboration Annex is a computer with a significant amount of screen real estate (our current prototype uses five 19" LCD displays) that users can opportunistically annex [6] using another device (typically a laptop). The Collaboration Annex's software supports transferring and transforming task context information between devices with very different display capabilities (Figure 1).

The Annex's software includes a virtual desktop manager (VDM) that we explicitly designed to handle multi-display environments. The VDM allows users to define tasks by creating virtual desktops, potentially containing multiple application windows, for each one. Users switch tasks by activating a new desktop, which causes only those windows to appear.

Users often divide screen real estate on devices with large or multiple displays between an active task and monitoring activities. To support this behavior we allow virtual desktops to consume only part of the screen real estate. Unoccupied portions render sections of a default desktop contain-



Figure 1: (Left) Three Annex screens showing pictures with our image display software. (Right) A laptop display showing part of the transferred task state.

ing windows that users want available independent of the current active task. Figure 2 shows a sample control panel for the VDM. The top row is the default desktop, while the others depict four tasks. The bottom task uses the entire display space, and completely occludes the default desktop.

When users transfer tasks between devices, we maintain the association of and spatial relationship between task windows. For devices with reduced screen real estate, we provide a virtual representation of the largest device's display space. On those devices, the virtual desktop manager allows users to select from a set of virtual desktops at the bottom of the screen. From this miniature representation, users can click arbitrary window thumbnails to display the associated window or select and display a particular monitor-sized region of the space (Figure 3).

In terms of the dimensions of transformation, our prototype handles *task and subtask availability* by storing files on a mobile device (we use a laptop) and providing access to other devices (such as the Annex) through support for remotely mounting a shared drive. We currently address *mapping information to applications* by making the simplifying assumption that the users will only handle a limited (but important) set of information types in cross-device tasks: web pages, images, and Microsoft Office documents.

For the *amount of display space*, we allow each task to utilize a virtual display that is at most as large as the physical Annex's aggregate display. We then provide some flexibility for users to affect the *mapping of virtual to physical displays* and *of task windows to virtual displays*. Users can currently map a portion of the virtual space to the laptop's screen or select a set of windows from the virtual space to display on their screen. We are also exploring other possible mappings.

CONCLUSIONS AND FUTURE WORK

We extend previous research by providing support for transferring and transforming tasks across multiple computing devices. We have created an initial hardware and software prototype that supports one point in the design space, but much remains to be done. As next steps, we plan to explore additional design points and conduct comparative user evaluations to identify strengths and weaknesses. We are also interested in exploring use of the Collaboration Annex itself: how users might productively employ it as an adjunct to their other devices, and how we might extend it with additional peripheral equipment (e.g. cameras, white-board capture devices).

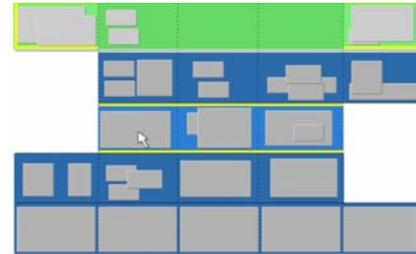


Figure 2: Sample design of control panel for VDM. Note that the desktops vary in size.



Figure 3: Part of an example laptop VDM view sitting above the Windows Taskbar.

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