

# Beyond the Laboratory: Supporting Authentic Collaboration with Multiple Displays

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## ABSTRACT

It is increasingly common to find Multiple Display Environments (MDEs) in a variety of settings, including the workplace, the classroom, and perhaps soon, the home. While some technical challenges exist even in single-user MDEs, collaborative use of MDEs offers a rich set of opportunities for research and development. In this workshop, we will bring together experts in designing, developing, building and evaluating MDEs to improve our collective understanding of design guidelines, relevant real-world activities, evaluation methods and metrics, and opportunities for remote as well as collocated collaboration. We intend to create not only a broader understanding of this growing field, but also to foster a community of researchers interested in bringing these environments from the laboratory to the real world.

## INTRODUCTION

An enduring challenge in the CSCW community has been to understand how devices and applications designed to support individual users and their tasks can be transformed to support multi-user, collaborative tasks. Over the decades, several solutions paths have been explored to address this challenge. Some solutions have explored supporting multiple users at a single display (e.g. [1]) while others support multiple users across multiple independent devices (e.g. [4]).

A particularly promising solution path for supporting collocated collaboration is the concept of a Multiple Display Environment (MDE). Illustrated in Figure 1, an MDE is comprised of collocated personal displays (e.g. tablet and notebook PCs) as well as shared displays (e.g. plasma panels, projected displays) that are networked to form an integrated virtual workspace [12]. MDEs can range from simple ad-hoc configurations consisting of a few laptops and a projector, to highly instrumented environments with high resolution wall displays and many supporting devices. These environments offer many potential benefits for small workgroups, including the ability to place a variety of information artifacts on shared displays for comparing, discussing, and reflecting on ideas; to jointly create and modify information to enhance focused problem solving or enable opportunistic collaboration; and



Figure 1: An example multiple display environment.

to allow quick and seamless transitions between these work modes.

The increased availability of this hardware has allowed researchers to begin developing and deploying MDE prototype software technologies that seek to support collaboration in authentic task domains. Such domains include software development [4], geospatial planning tasks [6], creative design [9], patient care [3], and structured meetings [2].

While these and other projects have helped move prototype MDE software out the laboratory and into real world settings, they have also exposed many new non-trivial research challenges. For example, the need to develop a comprehensive set of design guidelines for the support of natural collaborative practices within an MDE, build a thorough understanding of how the use of MDE features fits into such practices, and create an appropriate set of techniques and metrics for evaluating the overall impact and benefits of MDE use.

Moving MDEs out of the lab and into practice presents a turning point within the MDE research community. The goal of this workshop is to provide a forum for existing and emerging MDE researchers to outline their visions for how the field will move forward. Through this process, we hope to create a unified and detailed road map for MDE research.

## WORKSHOP THEMES AND GOALS

In this workshop, we intended to explore the following research themes:

*Elicitation and process of distilling design guidelines for MDE systems and interfaces.* While MDE systems and interfaces have been around for decades, the community has yet to form a consensus regarding a clear set of guidelines for the design and implementation of software technologies for MDEs. Now that MDEs are starting to be used in authentic task domains, researchers are beginning to gain an evidence-based understanding of the effectiveness and implications of a range of design principles. Through bringing together researchers that have investigated the use of MDEs across different target domains, we will attempt to distil a set of generic design principles that apply across task domains, and to develop an understanding of limitations of previously published principles.

*Investigation and classification of activities suited for MDEs.* Until very recently, MDE frameworks were fairly limited in the types of activities that were supported (e.g. photo sharing and organization). As MDEs are deployed to support more complex collaborative tasks and a broader range of applications, researchers are beginning to understand more about the characteristics of these tasks (e.g. software development) and the activities (e.g. collaborative code generation, documentation, debugging,) that comprise them. Using the workshop to share experiences and distil activity commonalities across tasks has the potential to provide useful guidance for the design and evaluation of future systems and interfaces.

*Exploration and assessment of how existing groupware theories apply to collaboration in MDEs.* Over the decades, multiple theories of effective groupware design have been published (e.g. see [5, 7, 8, 10-12]). Only a few of such theories have been explicitly applied to the design of systems and interfaces for MDEs. The status-quo is partly due to the fact that most theories focus on distributed collaboration and partly due to MDE's context of use being poorly understood and/or explored. As MDEs mature, it would be beneficial to the community to reflect upon the existing body of groupware theories and determine the degree to which they apply to MDEs. By doing so, the community will develop a shared set of theories to inform practice and evaluation of future research.

*Evaluation techniques and metrics for assessing effectiveness of prototype MDE systems and interfaces.* Developing a standard set of evaluation techniques and metrics has been an enduring challenge within the MDE community. As the community begins to move beyond prototype implementations and controlled laboratory evaluations, the need is even greater. Having standard methods and metrics will allow results to more easily be compared across studies, and will also allow the community to better assess the outcome and quality of new work. This

workshop will provide a venue to begin to define useful evaluation techniques and metrics.

*Exploration of MDE use beyond strictly collocated collaboration.* While MDEs were originally envisioned to provide support for collocated collaborative tasks, there is an emerging interest in using these spaces to also support distributed workers. This change raises many interesting design considerations, such as providing effective access for remote users to interact with and place information on shared displays within the MDE. During the workshop we will explore the viability of MDEs to support these hybrid work configurations and begin to outline research challenges within this new space of MDE research.

## ACTIVITIES AND AGENDA

The workshop will be divided between short presentations by workshop participants and group discussion and brainstorming sessions surrounding the workshop themes.

Participants will be asked to structure their presentations to indicate clearly how their contributions address one or more of the workshop themes so as to inform later discussions. During the presentations, the organizers will update a master list of presenters' contributions to particular themes. This list will be used to structure conversations in the discussion sessions.

The goal of the discussion sessions will be to produce a tangible outcome (e.g. guidelines, examples, results). At the end of each session, we will elect one or more attendees to prepare a written summary and content for the workshop poster. Through this division of labor, we will not only ensure that all workshop participants have an equal voice, but also allow for a high-quality poster to be created in time for presentation at the main conference.

The following is an approximate schedule of the activities planned for our one day workshop. This schedule is not to be interpreted as final, and will be adjusted in response to the submissions received.

08:30 – 08:45	Coffee, welcome, and introductions
08:45 – 09:00	Organizers provide overview of day's agenda and introduce speakers
09:00 – 10:30	Presentations I
10:30 – 11:00	Coffee break
11:00 – 12:00	Presentations II
12:00 – 13:00	Group lunch
13:00 – 14:00	Discussion on design guidelines
14:00 – 14:45	Discussion on activities for MDEs
14:45 – 15:15	Coffee break
15:15 – 16:15	Discussion on groupware theories
16:15 – 17:15	Discussion on evaluation techniques and metrics

17:15 – 17:45	Discussion on MDEs beyond collocation
17:45 – 18:00	Closing remarks by organizers
18:30 -	Group dinner

## PARTICIPANTS

Participants will be asked to submit position papers (2-4 pages in SIGCHI proceedings format) to the organizers. Position papers could either (i) situate the participants' interests and background among the themes of the workshop, or (ii) report on preliminary research findings or case studies of MDE use in authentic task domains.

We hope to recruit a diverse set of approximately 20 participants (including the organizers) and intend this workshop to appeal to people with a range of research interests and theoretical traditions. Our selection criteria for inclusion in the workshop will be influenced by a desire to cover a range of topics and perspectives; in addition to research on the themes outlined above, we will solicit work on MDE topics of including (but not limited to):

- Software systems for support of collocated collaboration with MDEs
- Novel interaction techniques for multi-device interaction, including both large display and handheld devices
- Studies of collocated collaboration
- Work supporting synchronous collaborations
- Investigations of privacy and security issues in the context of MDE environments
- Issues related to the dynamic creation, configuration, and customization of MDEs by end users

We have already established contact with several researchers within MDE community, but also in related fields (e.g. mobile devices, large displays, synchronous collaborative systems). We will use these contacts as a basis for recruiting participants. We believe this approach, in addition to a general call posted on appropriate ACM mailing lists, will enable us to attract a diverse set of qualified participants.

## ORGANIZERS

Jacob Biehl is a Ph.D. candidate in the Department of Computer Science at the University of Illinois. His dissertation work focuses on the design, development, and evaluation of interfaces, interaction techniques, and interaction frameworks to support natural collaborative practices in multiple-display environments. He has served on the conference and program committees for both UIST and CHI conferences, respectively.

Gene Golovchinsky is a Senior Research Scientist at FX Palo Alto Laboratory, where he leads the Usable Smart

Environments group. Gene received a Ph.D. from the University of Toronto in 1996 in Human Factors (Dep't of Mechanical and Industrial Engineering). His interests include meeting room usability, ubiquitous computing, user interfaces for information seeking, dynamic hypertext, and pen-based computing. He has co-organized workshops at CSCW, SIGIR, and CHI conferences.

Kent Lyons is a Research Scientist at Intel Research. Kent received his Ph.D. in Computer Science from the Georgia Institute of Technology in 2005. His research interests are focused on the interaction issues surrounding mobile, ubiquitous, and wearable computing. In addition to organizing past conference workshops, Kent has served on conference committees for ISWC (including workshops chair) and on the program committees for ISWC and CHI.

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