



# Seeing Further: Extending Visualization as a Basis for Usable Security

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# Outline

- Introduction
- Overview of the Impromptu test bed
- User study design
- User study results
- Design implications
- New Features
- Additional User Study



# Introduction

- We see two approaches to usability & security:
  - “strict usability” vs “everyday use”
- The critical concern for usable security is that people be able to make informed decisions about their actions.
- Traditional security is often “automatic” and “transparent”.
- We advocate making security more visible, allowing users to understand the consequences of their actions and empowering them to make “effective” security choices.



# Design Approach

In support of “effective security” we are exploring three design principles:

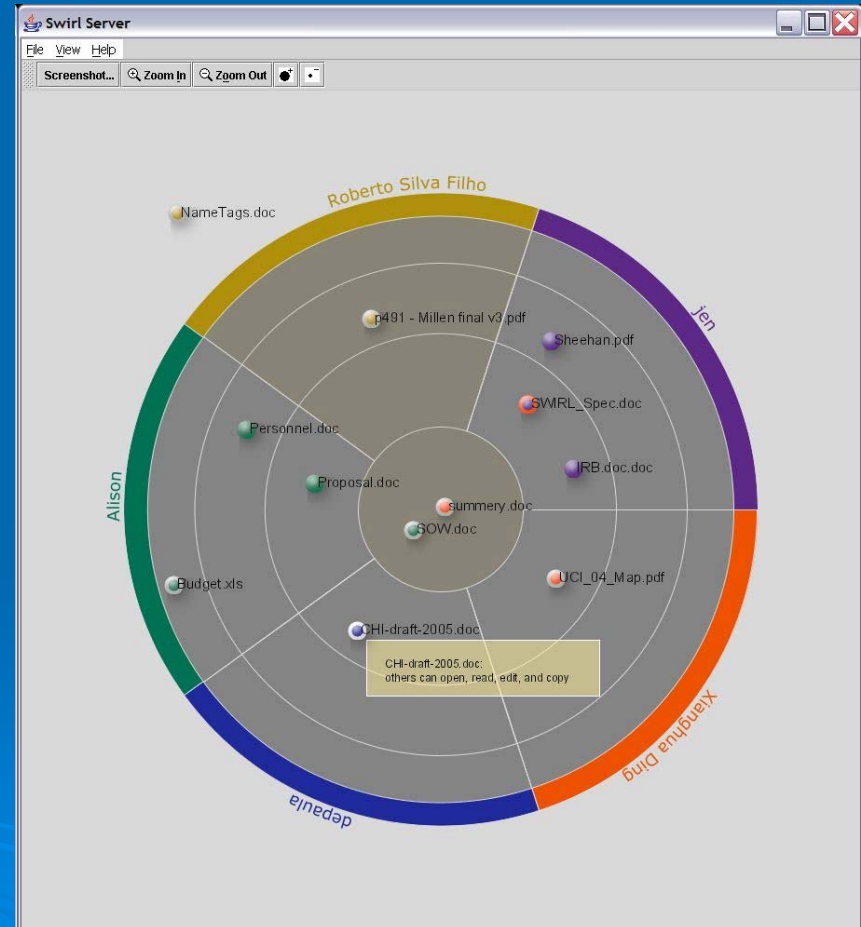
- Dynamic visualization of system activity
- Integration of Configuration and Action
- Event-based architectures



# Impromptu Overview

Our testbed is *Impromptu*, an ad-hoc peer-to-peer file sharing application.

- Pie metaphor
- Dots are shared files
- Use of color
- Visualizing user activity
- Sharing levels





# User Study

- Wanted to test ‘everyday use’ of our file sharing software
- As this was a prototype we chose to test it in a lab, so we could iterate on the design before investing the effort to make a user installable version



# Study Design

- 24 students in 8 small group sessions w/mixture of strong and weak ties.
- In each session 3 participants used Impromptu
- Data:
  - Audio tape of sessions
  - Notetaker- one per users
  - Debrief interview with negative and positive critique of interface



# Task Description

- Task: collaborate on a research budget for a grant
  - Create an individual budget & justify expenses
  - Negotiate merging into a group budget
- Budget had a max. Participants received cost estimates.
- Told to imagine it was there one chance to get their advisor to pay for all of the equipment and travel, the everyday financial realities of their research.





# Sharing to Accomplish Task

- Asked them to share files to do task, but not required, so they could choose
  - what to share
  - when and under what circumstance
  - level of sharing
- Participants were competing for resources they could create strategies to help maximize the amount of money that would be allocated to them.
- Variety of sharing strategies emerged



# Sharing Strategies

- Strategies varied including:
  - free sharing of information from the start (e.g. session 4)
  - hiding personal budget until the last possible minute (e.g. participant A in session 6)
  - sharing despite other's strategies (8b)
  - maliciously editing other budget justifications to help ensure they received more money (7c)
- This meant that privacy in the form of setting access control of one's own files were instrumental to the task.



# Findings

- UI and implementation
- Configuration and action
- Dynamic visualization of system activity



# Findings: UI & Implementation

- While we had designed a collaboration tool participants viewed Impromptu as a file sharing tool:
  - 9 user complained it didn't update files live
- Suggests that interface succeeded
  - In creating a sense of shared activity
  - That that sharing and interaction was the primary focus— not security



# Findings: Configuration & Action

Impromptu allows:

- Context sensitive negotiation of sharing
- Participants to develop explicit strategies of sharing to achieve goals. Recognition of norms relies on configuration being visible to all parties.

Participant 7a: *“Do I have to share?”*

Participant 7c: *“Come on. Put it in the second ring”*

Facilitator: *“Why did you say the second ring?”*

Participant 7c: *“Well, you know. It’s the norm, and you don’t want to share more than necessary, right.”*



# Findings: Dynamic Visualization of System Activity

- Gave others a sense of participation:
  - Allowed participant's to know whose files were whose
  - Recognized new files added, changes in permissions, and changes in files
- However, history of interaction provided inadequate as indicated by the rings





# Discussion of Study Results

- Integration of configuration and action was successful, as supported by:
  - Subjects ability to master interface and
  - Subjects stated it was easy to use during the debrief, and comments to that effect during tasks
- Concreteness and mutual visibility was successful, as supported by:
  - Emergence of group norms through discussions and uniformity in participant's final permissions
  - Informal conversations about configuration





# Design Implications

- 3 findings influence our future work
  1. Understanding of previous activities
  2. Allow participants to assess security risks presented by new users as they join collaboration
  3. Real estate problems
- Remainder of this talk will address 5 features we implemented to address these issues





# Design Extensions

- History
  - Rings and ripples
  - History pie
  - Activity wear
- Security risks of unfamiliar users
  - User characterization
  - Media characterization
- Screen Real estate
  - Thin client

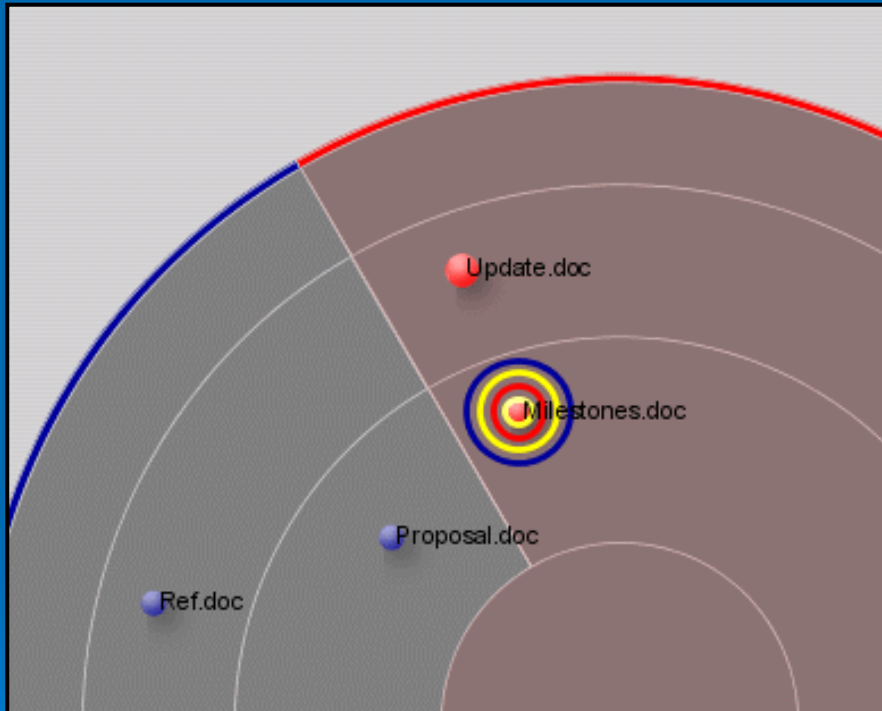


# Types of New Visualizations

- History
  - Rings and ripples
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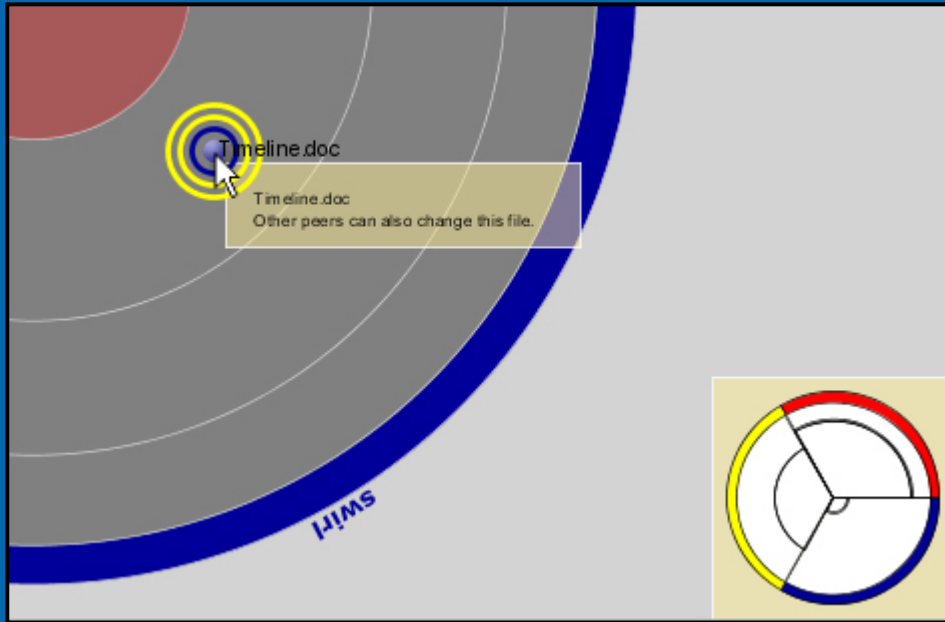
# Rings and Ripples



- Problem: Test subjects wanted to see more than simply the most recent action
- Solution: We introduce multiple rings which indicate the 4 most recent activities
  - Rings “ripple outwards,” as ripples in a pond
  - Most recent activity is persistent
  - Older events radiate outwards and eventually disappear



# History Pie



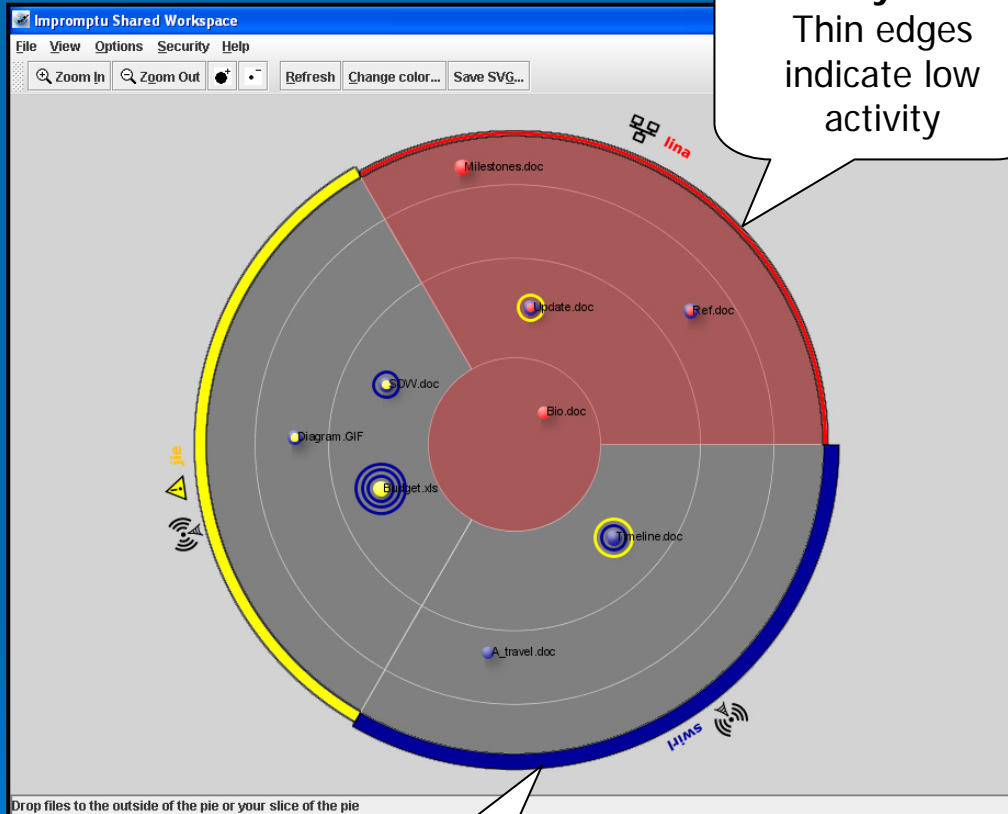
- New Problem: Only the 4 most recent activities are shown
  - Want to show the *entire* history of activity on a file during a user session

- Solution: On a mouseover, provide a complete temporal history for one file

- Layout reflects the spatial arrangement of the “main pie”
- Arcs correspond to a particular user’s activity on that file
- Effect resembles the growth rings on a tree



# Activity Wear



**Activity wear:**  
Thin edges  
indicate low  
activity

**Activity wear:**  
Thick edges  
indicate high  
activity

- Problem: Need a sense of *user* activity
- Solution: Allow edge thickness to reflect the user's activity level
  - At-a-glance indicator of relative activity
  - We borrow from *Edit Wear* and *Read Wear*, Hill et al.



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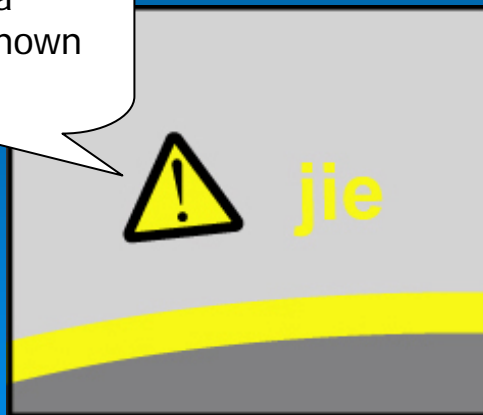


# User Characterization

- Problem: Distinguish between familiar and unfamiliar users
  - Convey a sense of prior activity, over multiple sessions

- Solution: Visualize mappings of users to their Ethernet addresses
- Flag unknown or unexpected users with alert icons

**Warning symbol**  
indicating a  
previously unknown  
user



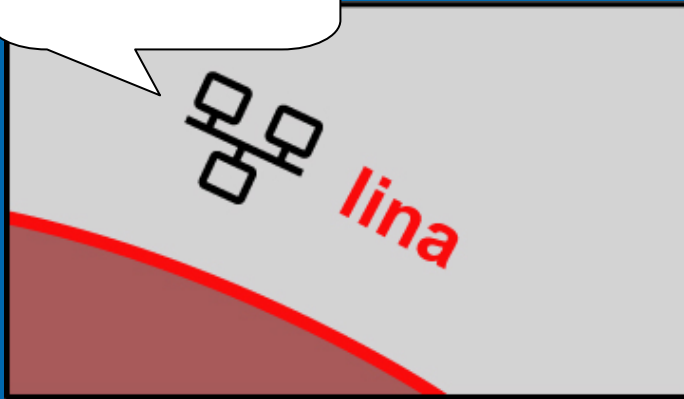
- Unknown user: no established trust
- Familiar username, with a new MAC address: man-in-the-middle attack or masquerading





# Media Characterization

Wired network connection icon



Wireless network connection icon



- Problem: Connection details usually made transparent in the interface
  - Different media have different security repercussions
- Solution: Allow connection methods to be apparent in the interface
  - Display wireless & wired Ethernet icons adjacent to usernames





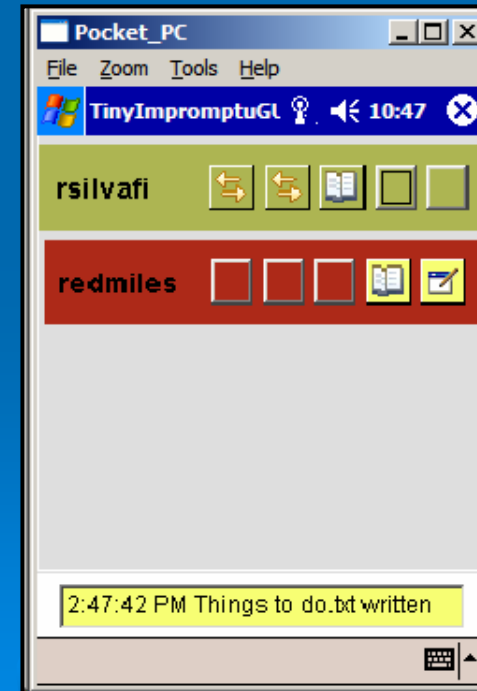
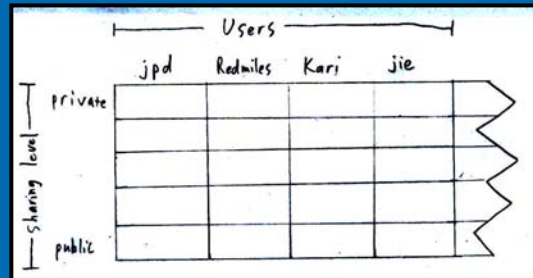
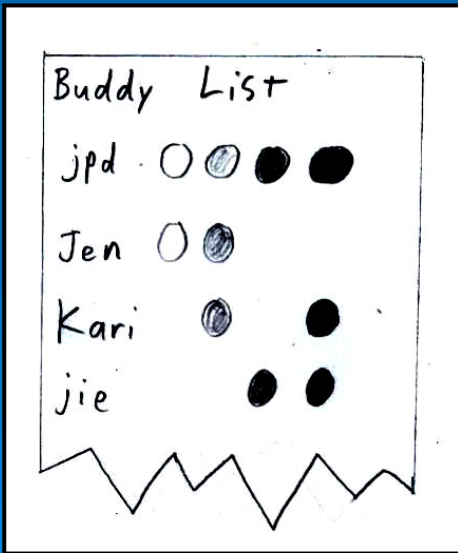
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# Thin Client

- Problem: Applications can obscure *Impromptu*
- Iterative design: Performed task analysis, followed by paper mockups
- Solution: PocketPC implementation
  - Peripheral *Impromptu* visualization





# Evaluation of History Features\*

\*Carolina Johansson's Master's Dissertation work

- 6 groups evaluated (total of 12 subjects)
- Results:
  - Ripples and history pie were understood by study participants
    - ripples/rings: from 65% to 88%,  $p < 0.05$
    - history pie: from 49% to 82%,  $p < 0.05$
  - On a Likert scale, most users agreed/strongly agreed:
    - That they knew when others had interacted with their files
    - That others could see what *they* were doing



# Evaluation of History Features\*

*\*Carolina Johansson's Master's Dissertation work*

- However, users wanted more fine-grained activity information
  - Ability to tell exactly where in the file the activity was taking place
- Re-affirms the our success
  - Users were focusing on task instead of security



# Conclusions

- Further evaluated our interface from SOUPS '05
- Extended our interface as part of our ongoing iterative design process
- Evaluated our extended visualizations
- Provided evidence for our 'everyday use' approach by establishing the need for:
  - Dynamic visualizations of system activity
  - Combining configuration and action



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## Project Website:

<http://www.isr.uci.edu/projects/swirl>