

EXHIBIT H

AppLens and LaunchTile: Two Designs for One-Handed Thumb Use on Small Devices



Amy Karlson, Ben Bederson

Computer Science Department
Human-Computer Interaction Lab (HCIL)
University of Maryland



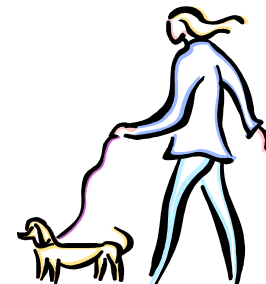
John SanGiovanni

Microsoft Research
Microsoft Corporation



Why One-Handed Interaction?

- One hand occupied



- Unstable environment

- Attention divided among tasks



- Two handed use unnatural

Input and Interaction on Existing Devices

■ Smartphones

- Input: Hardware Buttons
- Interaction: One-handed
Keypad-mapped functions
Directional navigation



■ Personal Digital Assistants (PDAs)

- Input: Touch Sensitive Display
Hardware Buttons
- Interaction: Two-handed
Small software targets
Directional navigation



Design Goal

- Scalable User Interface (ScUI)
 - Single design & interaction architecture
 - Multiple resolutions & aspect ratios
 - University of Maryland's PocketPiccolo.NET toolkit for Zoomable User Interfaces (ZUIs)



iMate Smartphone II

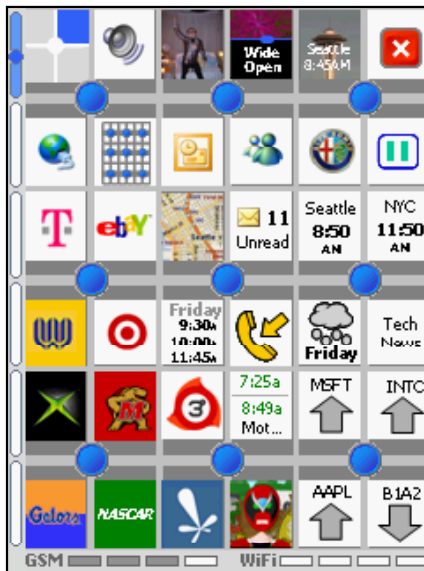
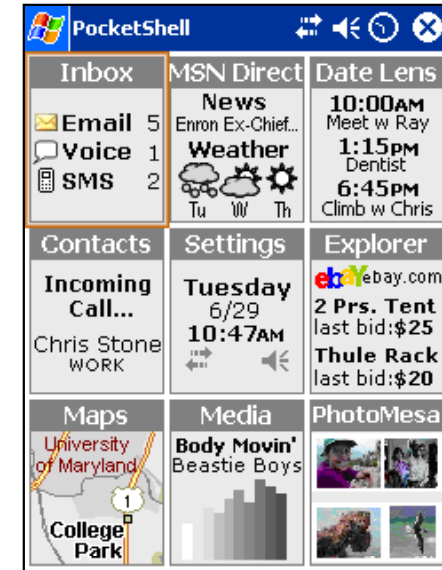


HP iPAQ PocketPC

One Application, Two Designs

AppLens: Fisheye+Pan

- 9 Application Tiles
- Fisheye Zoom
- Command-Based Gestures

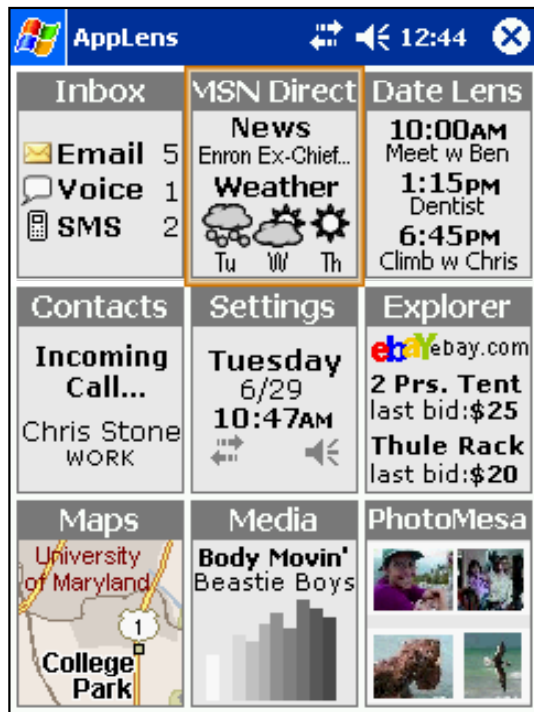


LaunchTile: Zoom+Pan

- 36 Application Tiles
- Pure Zoom
- Direct Manipulation Gestures

AppLens Visual Design

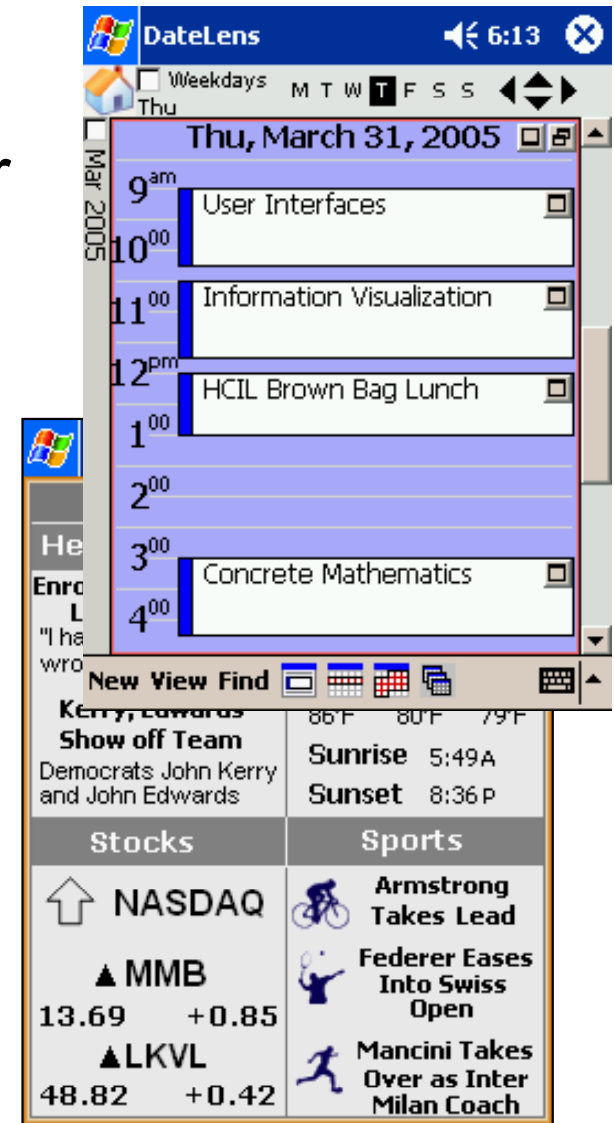
- Generalized tabular fisheye
 - Motivated by DateLens calendar
- Three fisheye zoom levels



Overview



Context / Fisheye



Detail

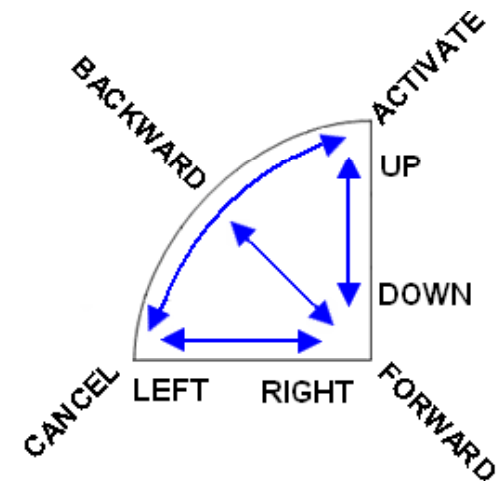
AppLens Interaction Design

- Input cursor



- Command gestures

- Issued anywhere
- Access distant widgets
- Don't interfere with tap



AppLens Video

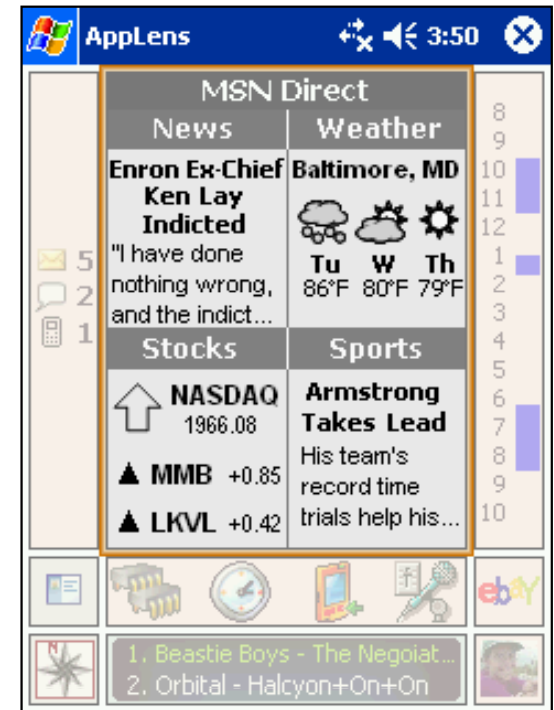
Interactive prototype based on images

We thank François Guimbretière for suggesting the arc-based design

Formative Study Results: AppLens

■ Likes

- ❑ Easy to learn
- ❑ Effective to navigate
- ❑ Comfortable
- ❑ Fisheye view valuable
- ❑ Simultaneous access to apps



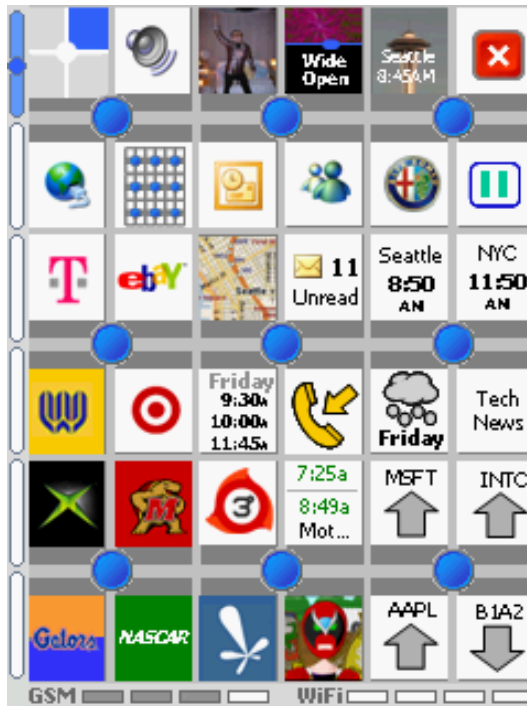
AppLens Fisheye View

■ Usability Issues

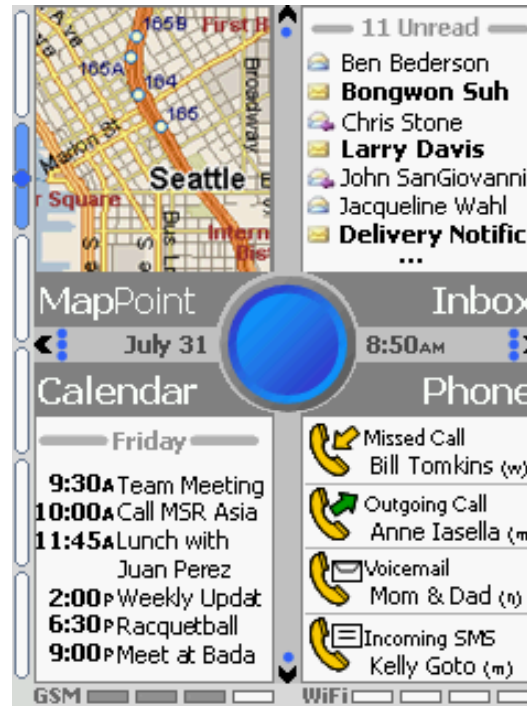
- ❑ Gestures were hardest part

LaunchTile Visual Design

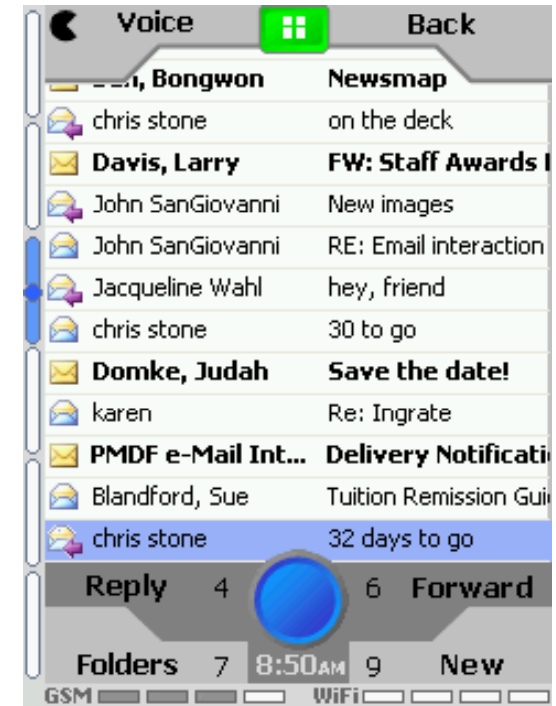
- Three pure zoom levels



Overview



Context / Zone



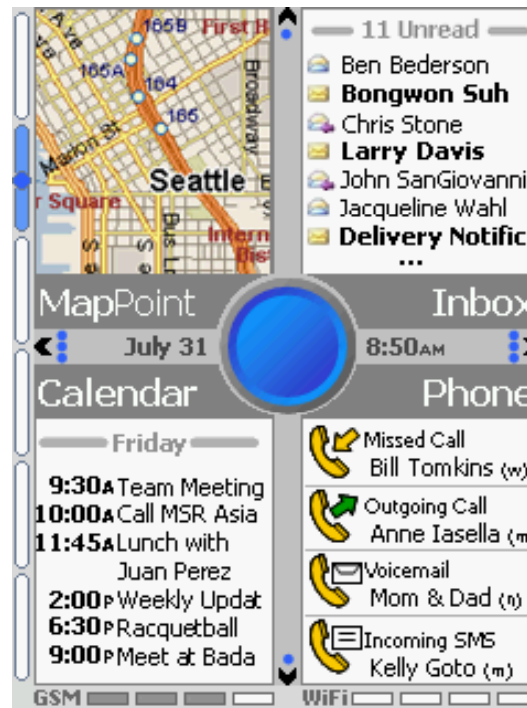
Detail

LaunchTile Visual Design

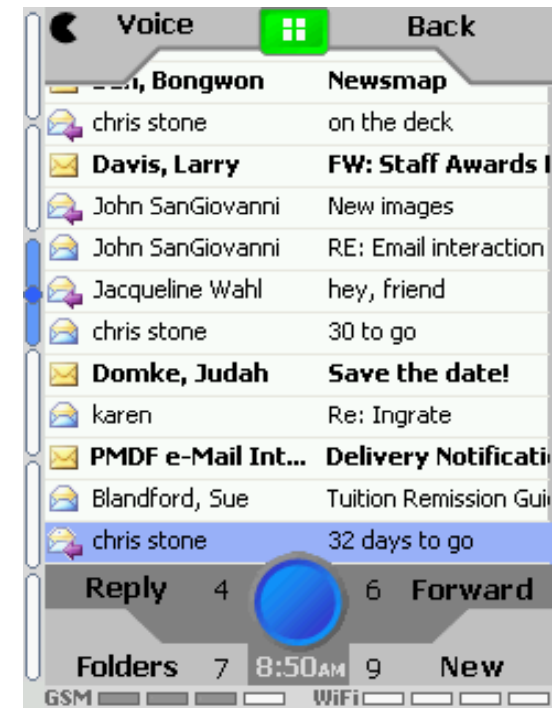
- Three pure zoom levels



Overview



Context / Zone



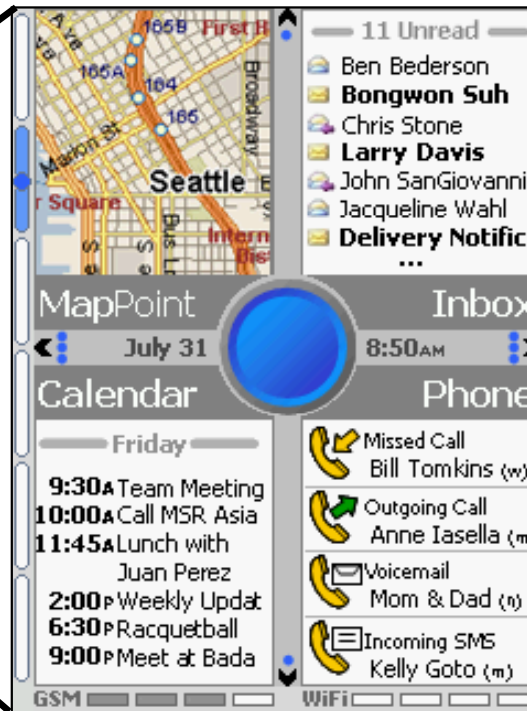
Detail

LaunchTile Visual Design

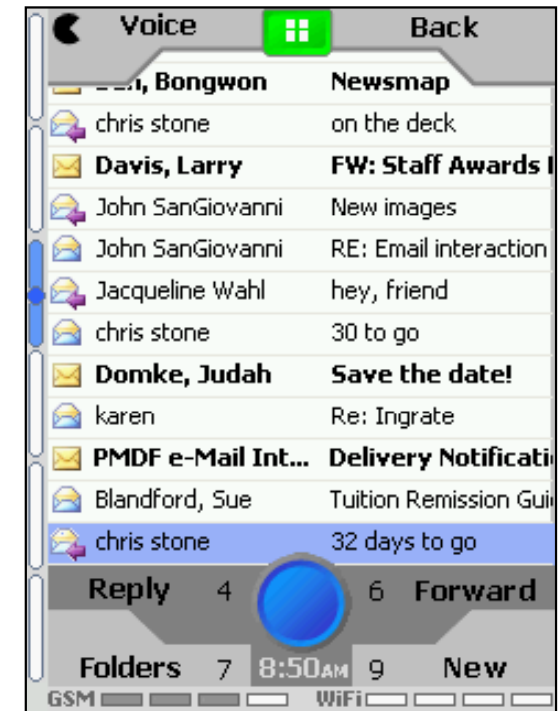
- Three pure zoom levels



Overview



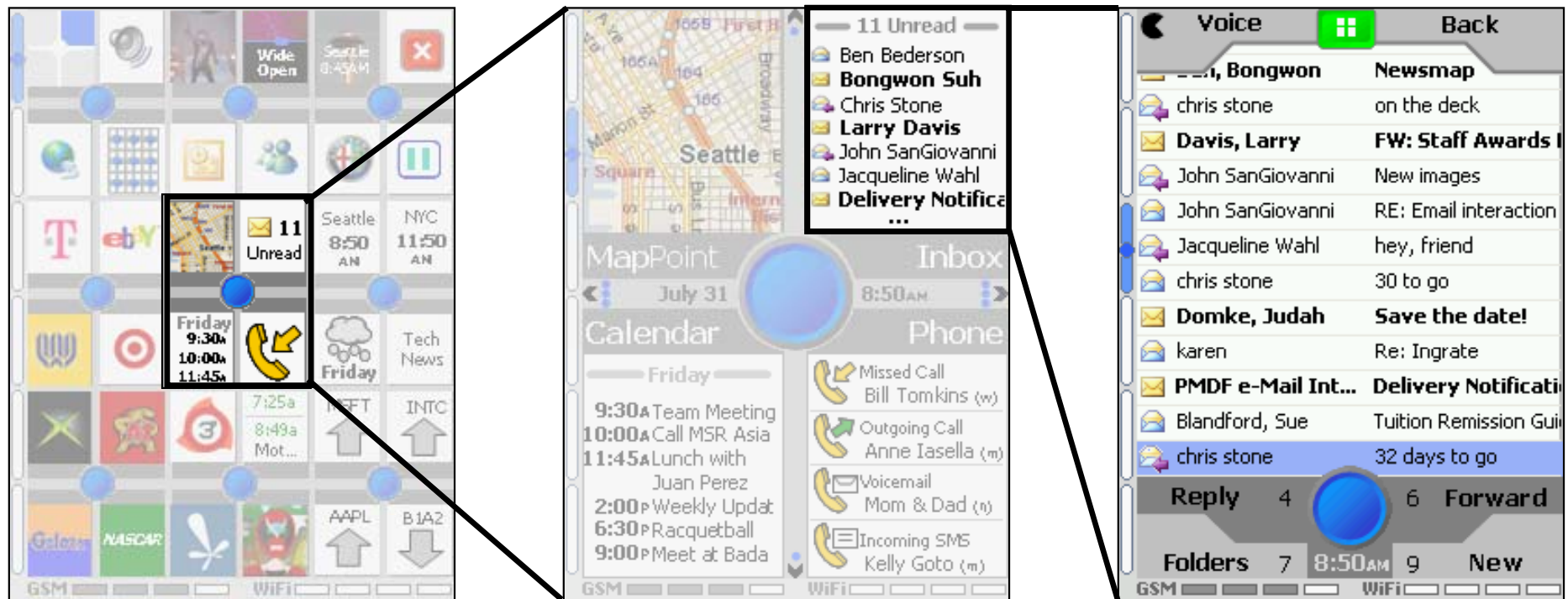
Context / Zone



Detail

LaunchTile Visual Design

- Three pure zoom levels



Overview

Context / Zone

Detail

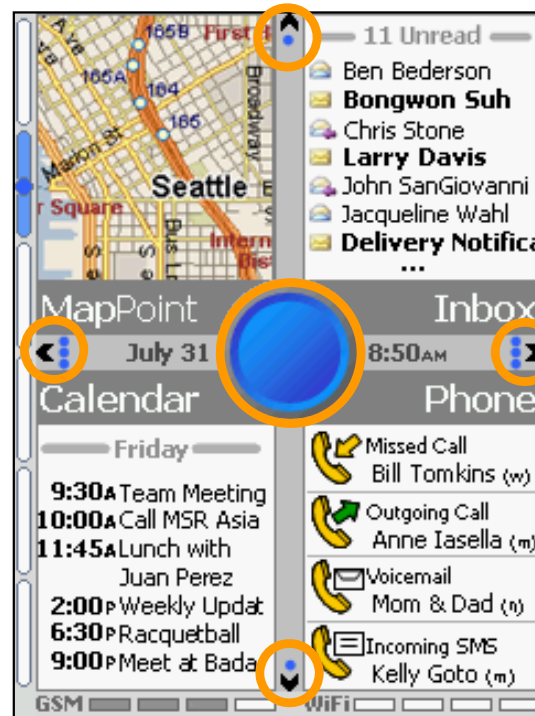
- Animated zooming to transition between views

LaunchTile Visual Design

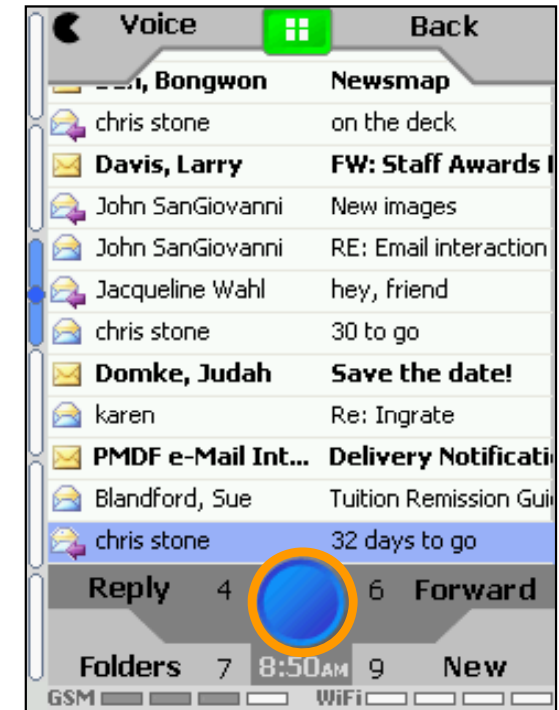
- Three pure zoom levels



Overview



Context / Zone

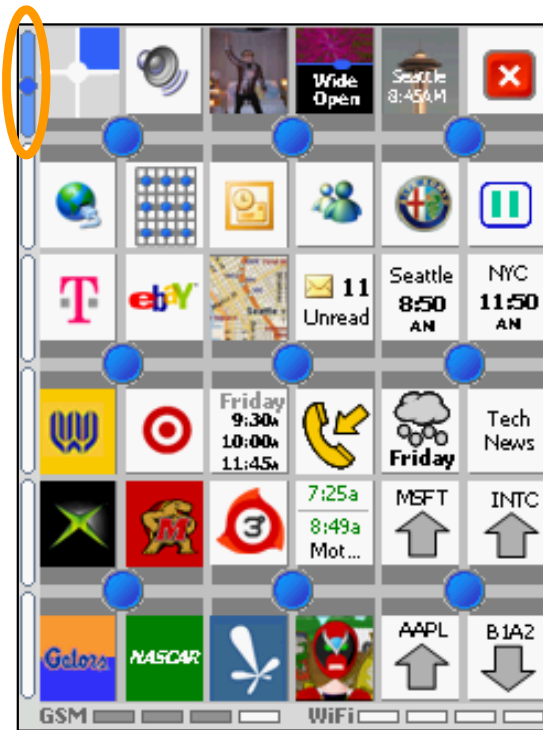


Detail

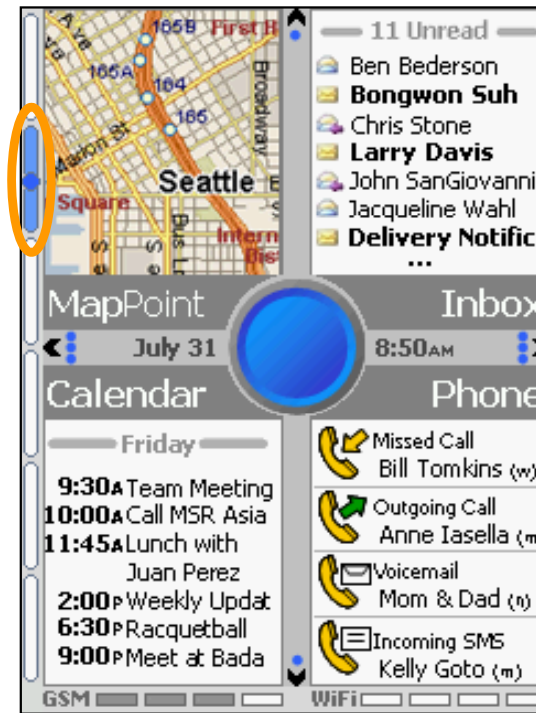
- Animated zooming to transition between views
- Visual landmarks

LaunchTile Visual Design

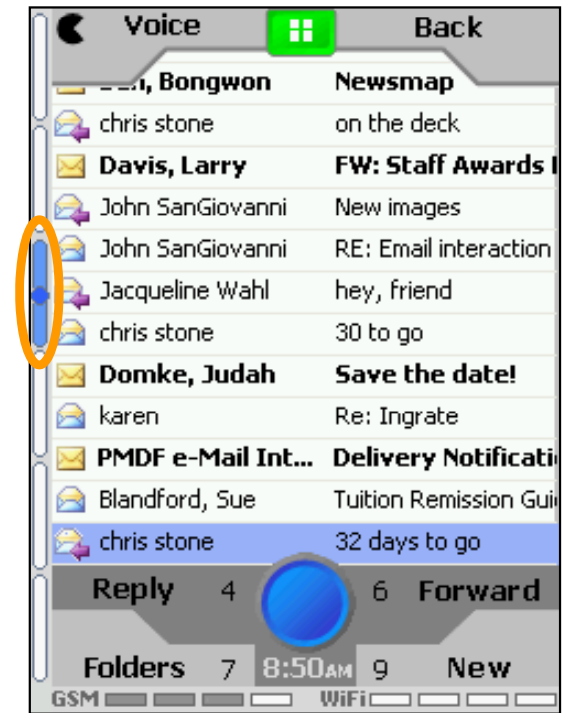
- Three pure zoom levels



Overview



Context / Zone

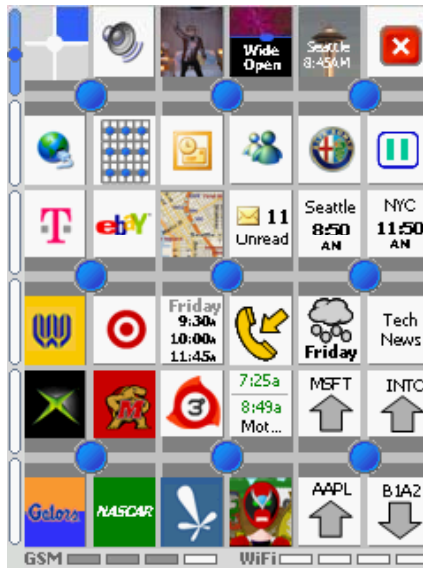


Detail

- Animated zooming to transition between views
- Visual landmarks

LaunchTile Interaction Design

- Thumb-sized, keypad-mapped targets



Overview

LaunchTile Interaction Design

- Thumb-sized, keypad-mapped targets



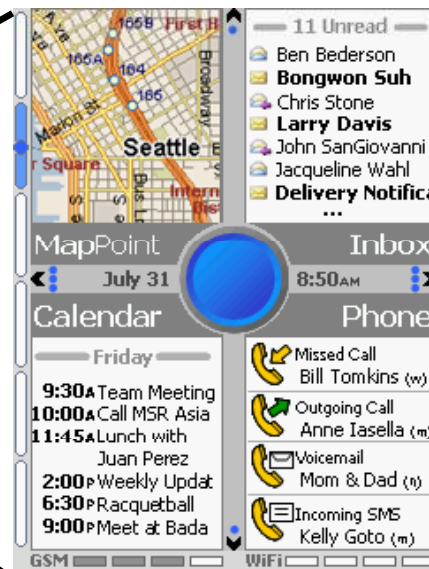
Overview

LaunchTile Interaction Design

- Thumb-sized, keypad-mapped targets



Overview



Context / Zone

LaunchTile Interaction Design

- Thumb-sized, keypad-mapped targets



Overview



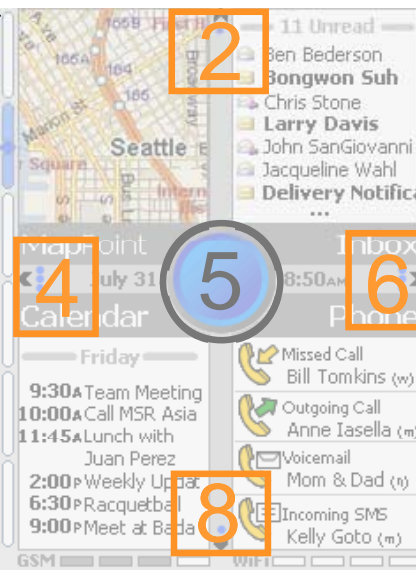
Context / Zone

LaunchTile Interaction Design

- Thumb-sized, keypad-mapped targets



Overview



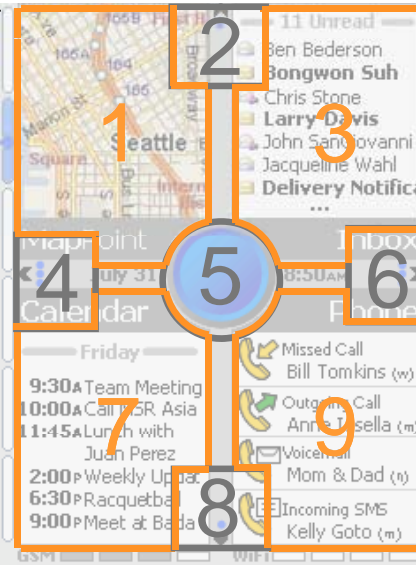
Context / Zone

LaunchTile Interaction Design

- Thumb-sized, keypad-mapped targets



Overview



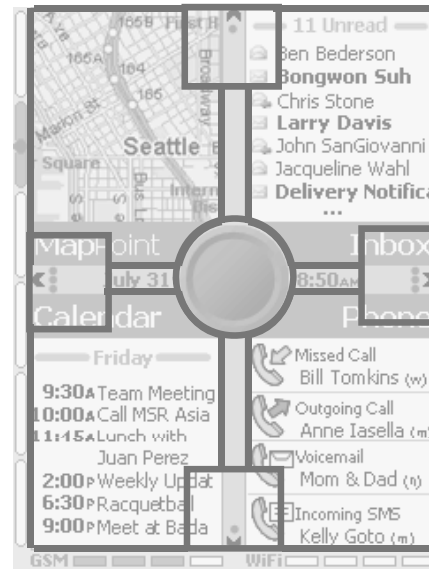
Context / Zone

LaunchTile Interaction Design

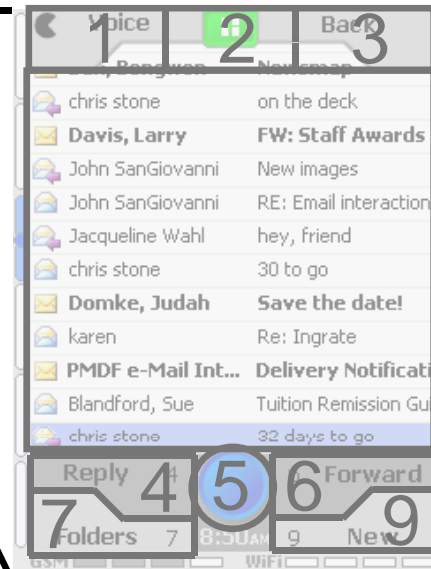
- Thumb-sized, keypad-mapped targets



Overview



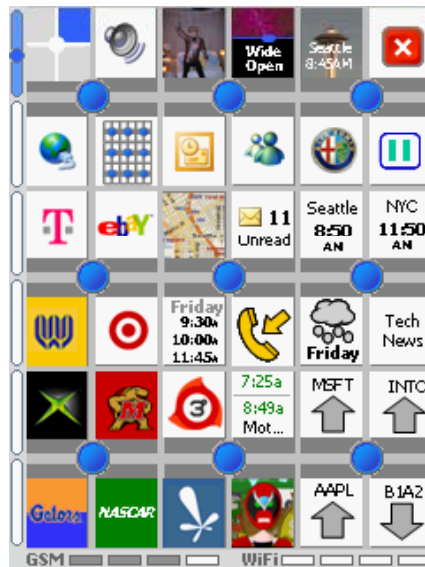
Context / Zone



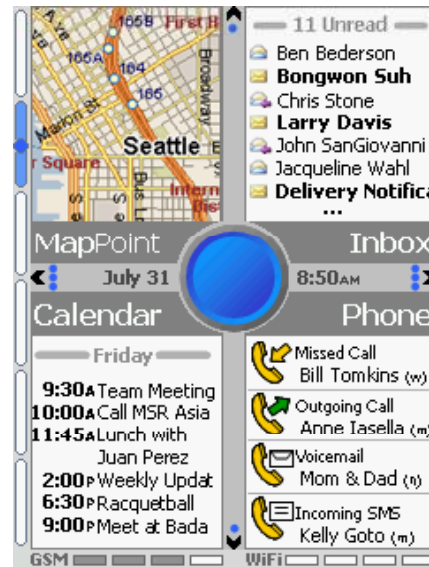
Detail

LaunchTile Interaction Design

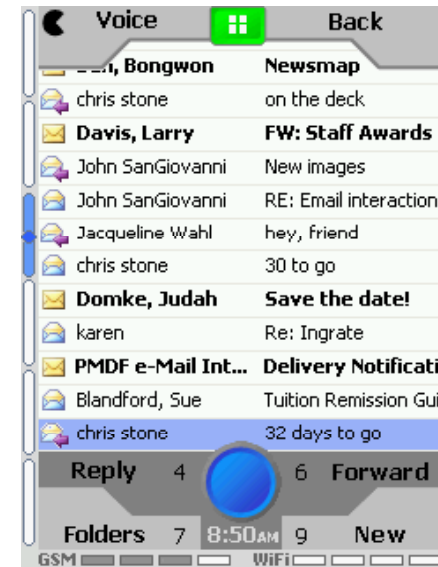
- Thumb-sized, keypad-mapped targets



Overview



Context / Zone



Detail

- Direct Manipulation Drag Gestures

- Zoomspace
- Application content
- Toolglass

[LaunchTile Video](#)

Interactive prototype based on images

Formative Study Results: LaunchTile

■ Likes

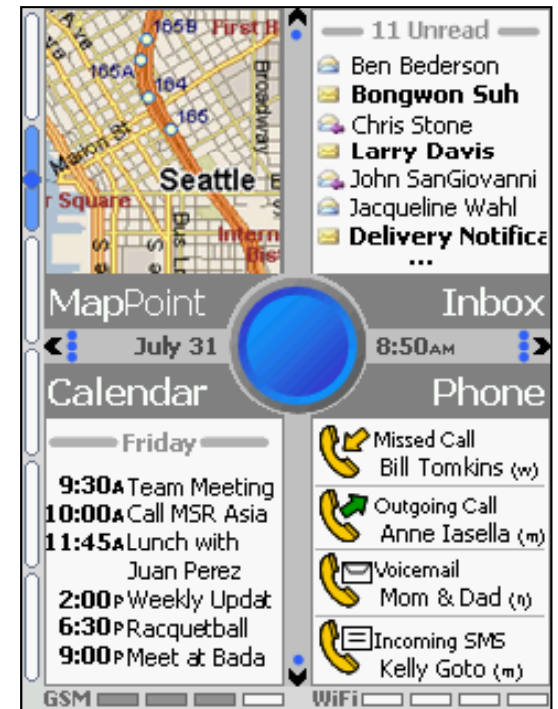
- ❑ Effective to navigate
- ❑ Comfortable
- ❑ Blue dot
- ❑ Access to many apps

■ Dislikes

- ❑ Too many apps

■ Usability Issues

- ❑ Multi-modal “Blue”



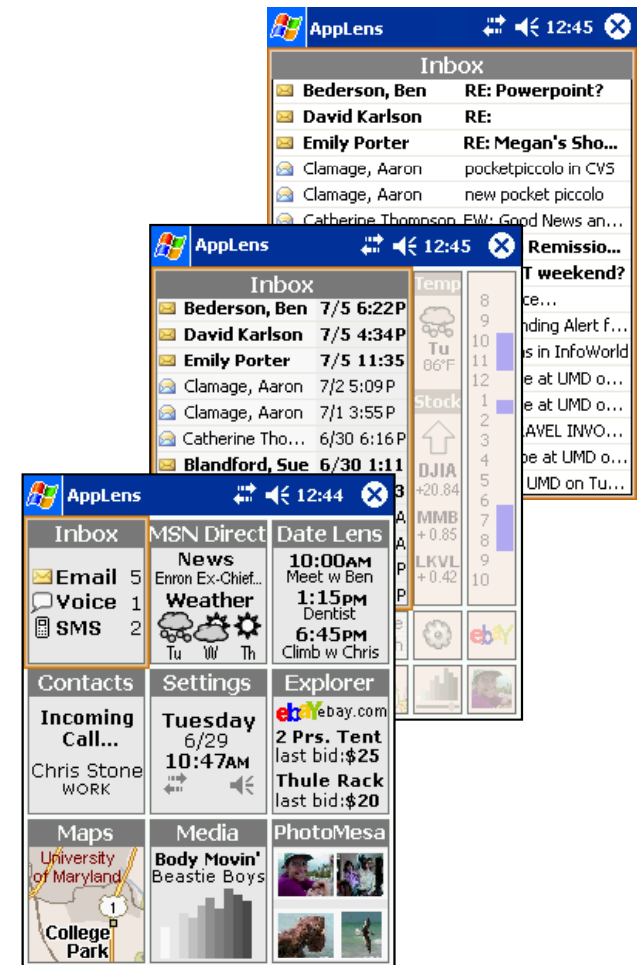
LaunchTile Context / Zone View

- ❑ Disorienting

- ❑ Panning in Zone view

Results: AppLens vs. LaunchTile

- With minimal training, AppLens preferred
 - Easier to use
 - Faster application access
 - Better at-a-glance value
- But...
 - Simpler design, fewer apps
- For both designs, users liked
 - Tap over gestures
 - Application summaries



Lessons Learned

- Promising Interfaces:
 - One-handed
 - Notification-based
 - Tappable
 - Cross-Device Implementation:
 - Different sizes and aspect ratios
 - Different input features
 - Potential Challenge:
 - Gesture-based interfaces
-