Information Visualization on Handheld Devices

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Ubiquitous Computing

- The death of the computer
  - computers recede into the background of society
  - becomes pervasive technology
  - focus shifts to the implementation, not the technology
  - Alan Kay (Apple) calls this the “third paradigm” of computing

The Electric Motor

- Early years
  - factory: pulleys, belts and axels to transfer power to entire production floor
  - home: one per household
  - was not productive in itself; required the addition of accessories or peripherals
  - attachments for sewing machine, blender, mixer, fan, grinder, etc.

The Electric Motor (2)

- Early years (continued)
  - 1918 Sears Roebuck catalog

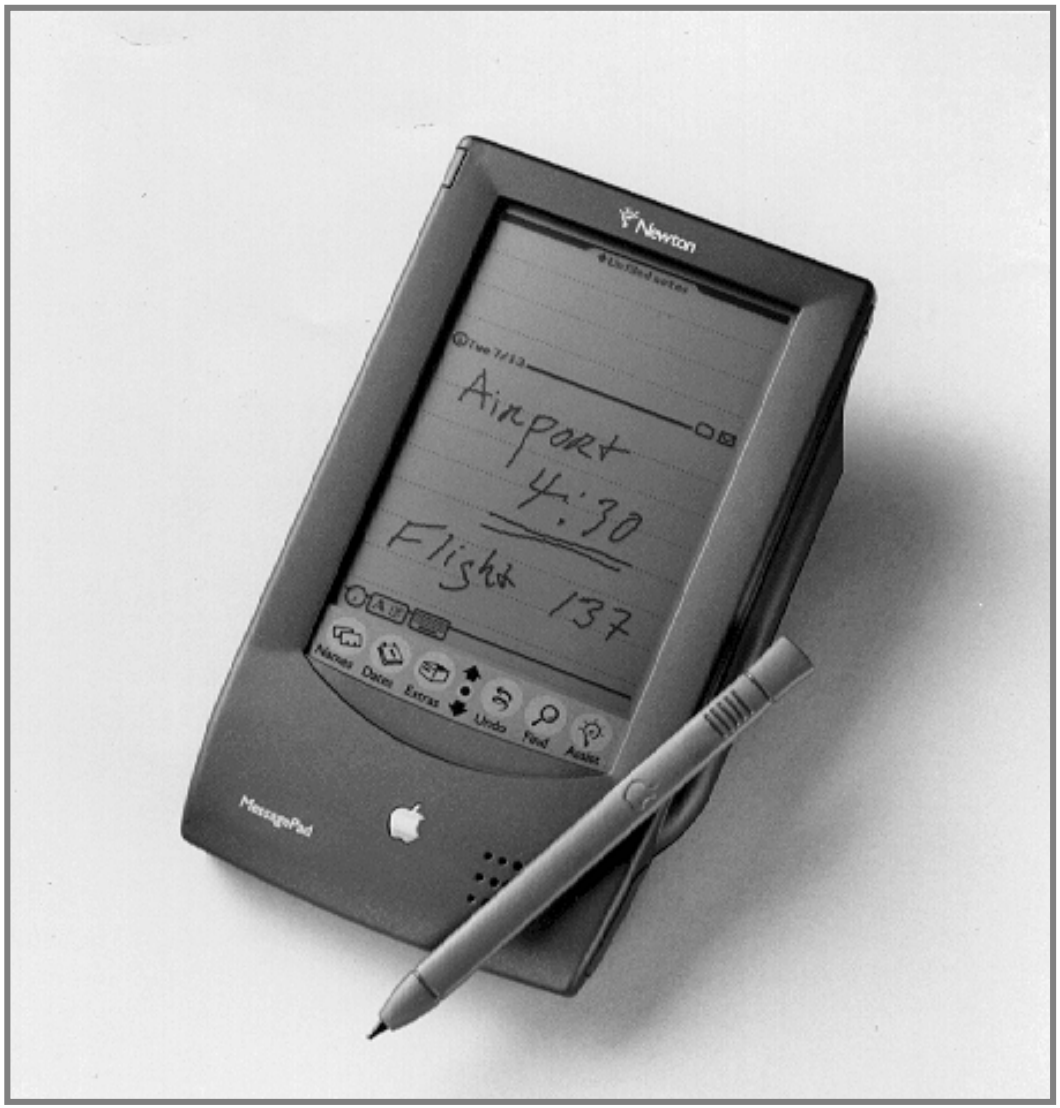
The Electric Motor (3)

- Today
  - typical household includes a dozen motors
  - hairdryer, blender, washer, dryer, heater, etc.
  - focus on implementation rather than technology
  - Kelly (Wired Magazine) believes that “dumb, cheap jelly bean chips are invading the world faster than PCs did”

Evolution of Handheld Devices

- History
  - wired remote controls for TVs (1950)
  - visible light remote control (1956)
  - ultrasonic remote control (1957)
  - first pocket calculator (1972)
  - infrared remote control (1980?)
  - graphing calculator (1985)
  - personal data assistants (1992)

Personal Data Assistants



Comparison of Typical Displays

- Handhelds
  - resolution: 160 x 160 … 240 x 320 pixels
  - size: 6 x 6 … 6 x 8 centimeters
  - depth: 4 grayscales … 64,000 colours
- Desktops
  - resolution: 800 x 600 … 1400 x 1050 pixels
  - size: 14 inches … 21 inches
  - depth: 256 … 16.8 million colours

spotlights - astronaut alumni service Hubble telescope
community contribution
apply for a summer fellowship

news - latest news, research, OpenCourseWare

about MIT - facts, map, virtual tour, evolving campus

academics - admissions, schools, courses, libraries

research - labs, centers, and programs

administration - offices and programs, giving to MIT

resources - for alumni, faculty, staff, and students

campus life - groups, activities, jobs available

events calendar - public events and activities, commencement

search - go

MIT web quick search

MIT
77 Massachusetts Avenue, Cambridge, MA 02139-4307
TEL 617.253.1000 TTY 617.258.9344

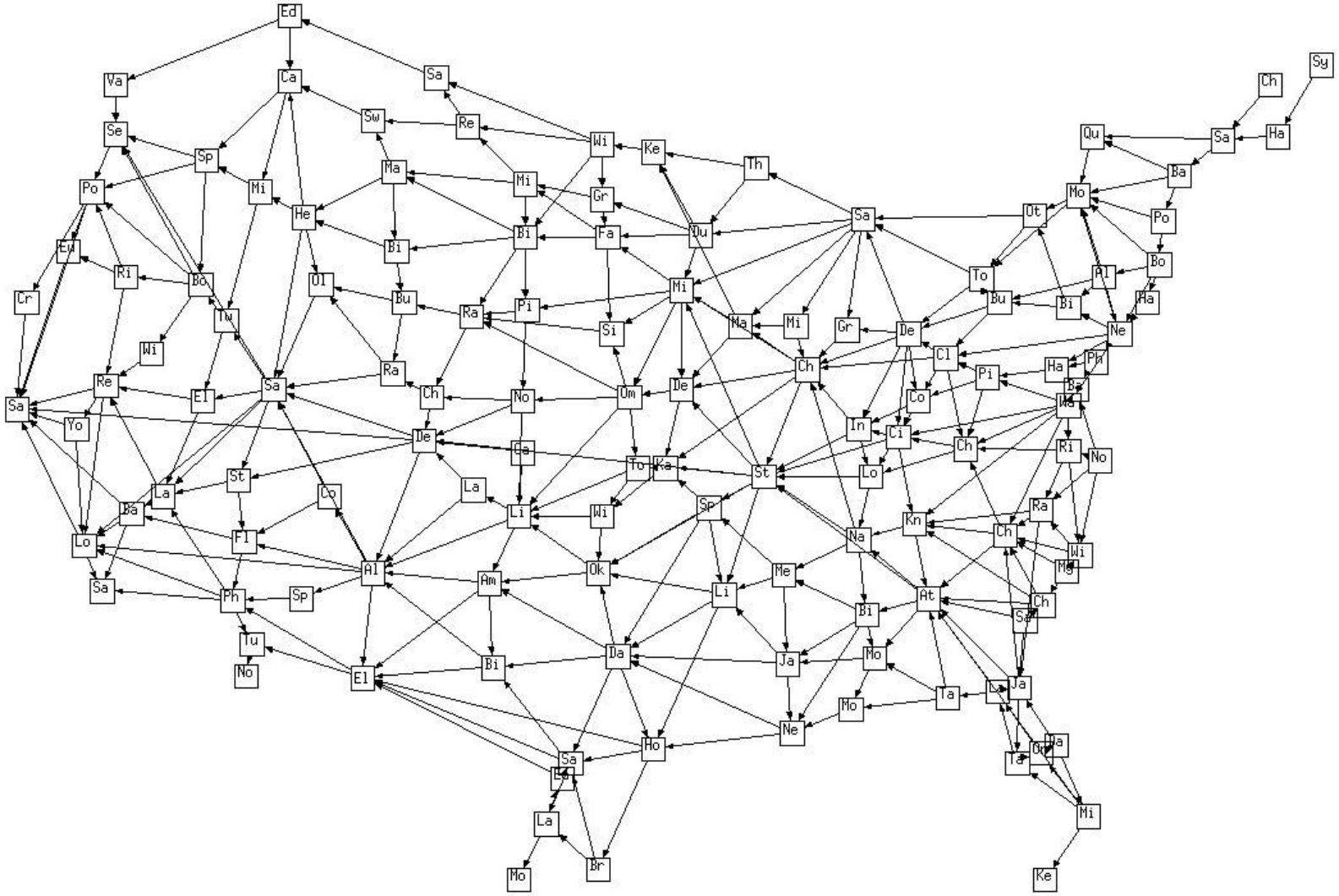
Focus + Context Solutions

- Focus + Context
  - area available is so small that context is extremely important for orientation
  - scaling ineffective due to poor screen resolution
- Three techniques
  - rubber sheets
  - zippers
  - flip zooming

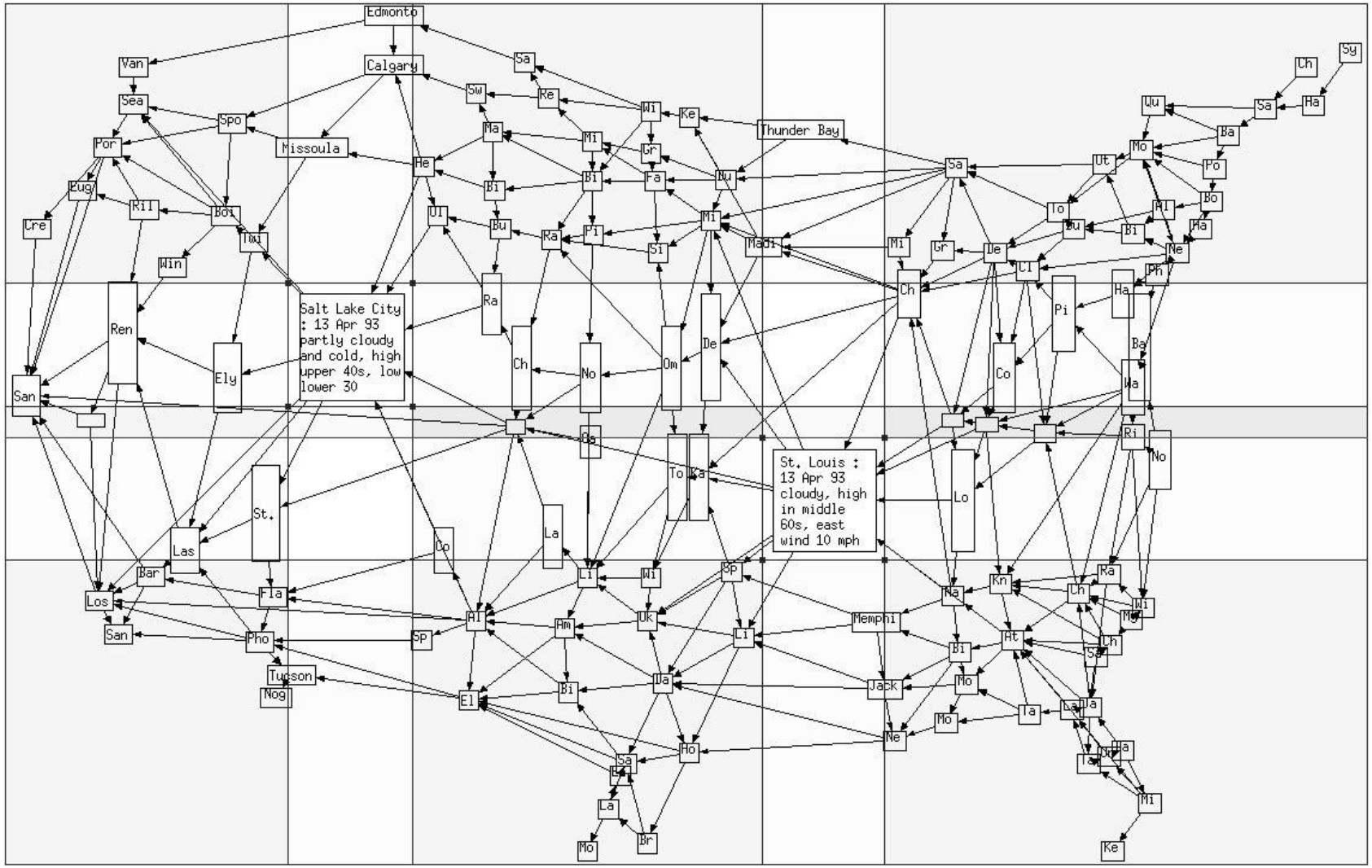
Rubber Sheets

- Sakar (1993)
  - proposed as a metaphor for viewing large layouts on small screens (not necessarily PDAs)
  - allows multiple foci while providing context
  - interactive to allow precise space allocation
- Familiar territory?
  - similar to the table lens or bifocal display

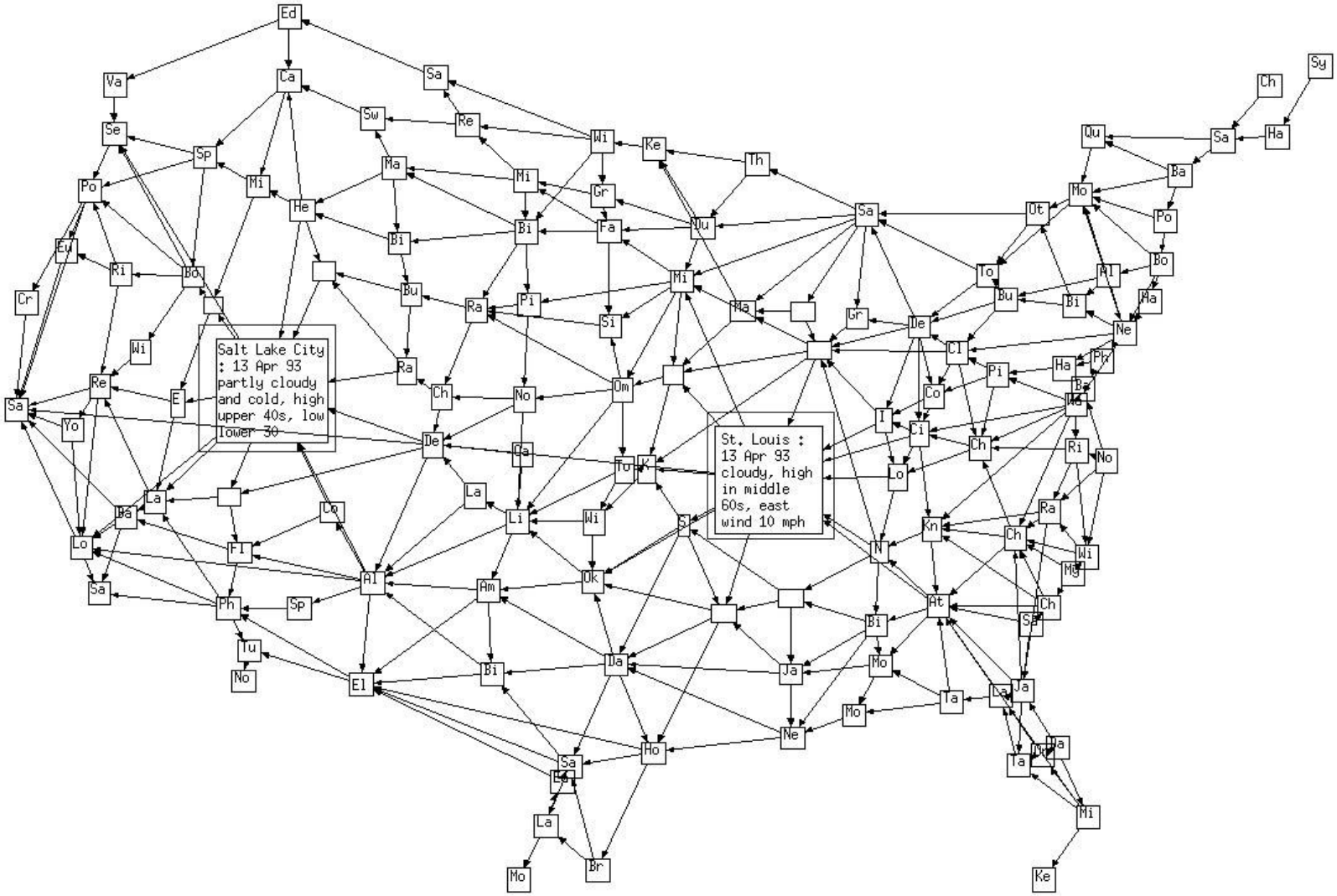
Rubber Sheets (2)



Rubber Sheets (3)



Rubber Sheets (4)



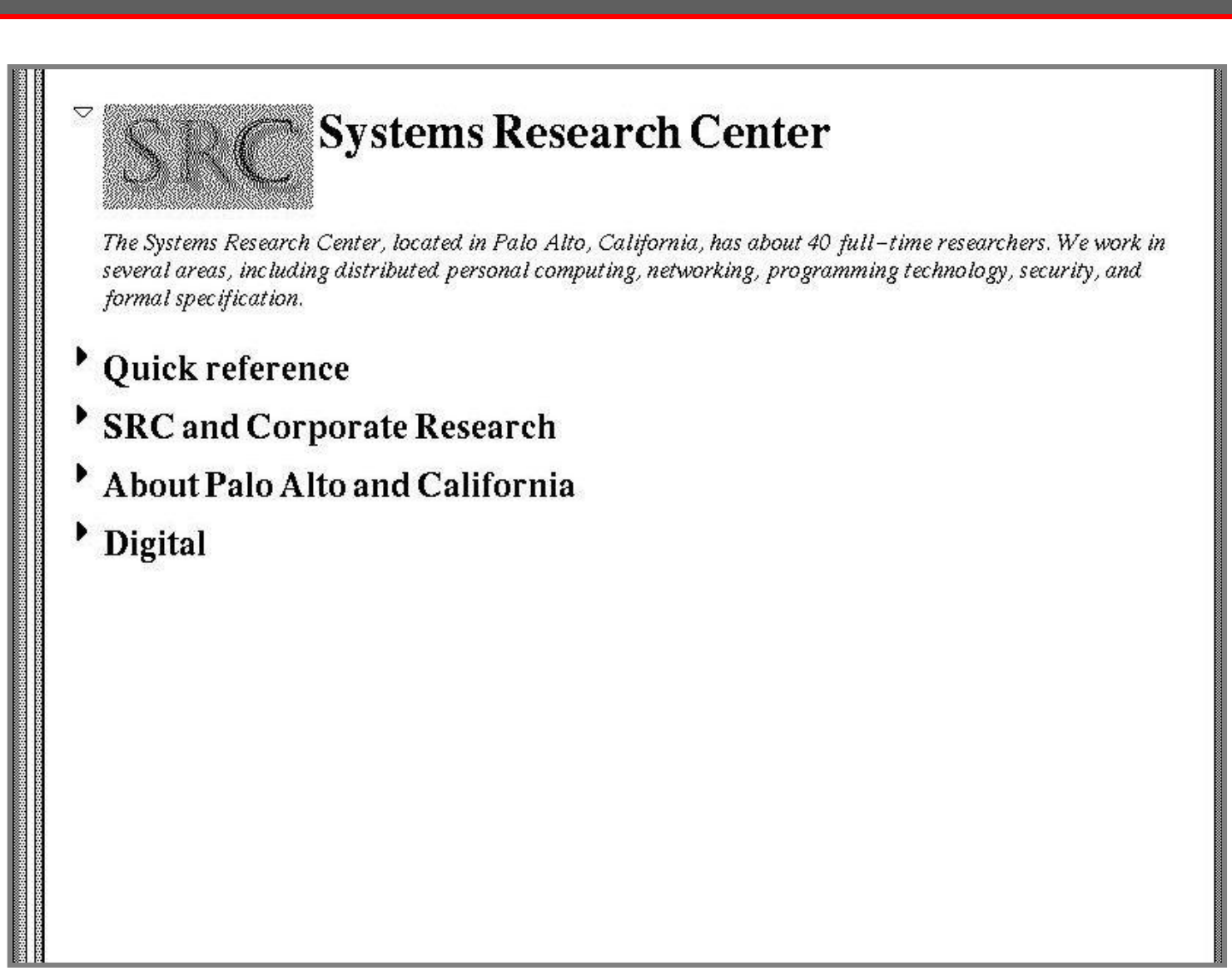
Rubber Sheets (5)

- Pros
  - allows users to focus on the information they want
  - provides navigational context for orientation
  - has the ability to handle large amounts of information
- Cons
  - requires a lot of screen space
  - provide complete overview of entire information space, not just the desired partition

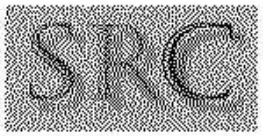
Zippers

- Brown (1996)
  - expands and contracts selected parts of a hierarchically-organized web document
  - displays contents of individual sections and overall structure simultaneously
  - reminiscent of Furnas' application of the fisheye view to source code
  - requires documents with sections that can be readily-abstracted into single sentences

Zippers (2)


SRC
Systems Research Center
The Systems Research Center, located in Palo Alto, California, has about 40 full-time researchers. We work in several areas, including distributed personal computing, networking, programming technology, security, and formal specification.
Quick reference
SRC and Corporate Research
About Palo Alto and California
Digital

Zippers (3)



Systems Research Center

The Systems Research Center, located in Palo Alto, California, has about 40 full-time researchers. We work in several areas, including distributed personal computing, networking, programming technology, security, and formal specification.

Quick reference

SRC and Corporate Research

- Events: NEW SRC Center Meeting talks
- Documentation: Welcome to SRC -- Lectern manuals -- Web Docs -- Modula 3 -- TCL
- Publications: Research Reports (Lectern) -- Papers, talks, and patents -- SRC Notes
- Research: 1995 CRG Research Plan -- SRC Projects -- Research Quarterly
- Gateways: NI -- NI2 -- VaxNotes -- abwho -- argo -- J-Video -- man -- VTX -- others

About Palo Alto and California

- Palo Alto: City -- *Active*map -- Stanford -- Stanford (ASSU)
- California: Virtual Tourist -- California phone book
- Food: Waiters on Wheels -- Bay Area Guide -- Chamber of Commerce
- Miscellany: Dilbert -- Fun stuff -- Local stores and services

Digital

Zippers (4)

- Pros
  - effective way of hiding information temporarily until desired by user
- Cons
  - only works on documents that have a clear hierarchy (useless on pages that have strong graphical content)
  - does not really address the problem of small screen size in handheld devices

Flip Zooming

- Zoom Browser (1998) 
  - chunks web pages into a number of small pages, or *cards*, that together comprise a *deck*
  - reduces the text of each card into a set of summarizing keywords
  - extracts hyperlinks on each page
  - provides three views: thumbnail, keyword, and link

Flip Zooming (2)

- Pros
  - area of focus is highly legible
  - provides excellent context for the morsels of information
  - fully addresses the issue of handheld screen size
- Cons
  - thumbnails are useless until card has been viewed at least once
  - keywords are chosen based on uniqueness; does not guarantee useful results

Flip Zooming (3)

- Hierarchical Image Browser (1999) 
  - extends basic flip zooming technique by allowing flip zooms inside flip zooms
  - removes the necessity for scrollbars
  - individual visualizations can be self-governing and configurable without modifying other containers
  - scales to include any depth (limited by screen resolution primarily)

Flip Zooming (4)

- Pros
  - allows groupings to be made within the visualizations
  - thumbnail view is more suitable as images are more readily identifiable than text
  - several inner visualizations can have full-focus views, allowing simultaneous comparison
- Cons
  - thumbnails can quickly become too small to manipulate properly; navigation is quirky

Conclusion

- Final words
  - current research into bettering information visualization on small handheld devices is negligible
  - focus + context system is best approach; as screen size decreases the cognitive demands on the user increases
  - flip zooming most promising technology as it adequately addresses the limitations of handheld devices