A Proxy Architecture for Building Adaptive Applications

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Outline

- Vision: *Access Is the Killer App*

- Obstacles: Client Variation

- On-Demand Distillation and Refinement

- The Proxy Architecture

- Status

Access Is the Killer App!

"…there has to be a need…it has to solve somebody's problem"

—Mike Merrill, founder of "Totally Wireless"

- Access to *your* email (not a separate account!)
- Access to networked information (e.g. WWW)
- Groupware
  - Conferencing
  - Shared whiteboard
  - Appointment calendars

But…Client Variation

"The Office/PDA Mismatch"

Device	Bandwidth, bits/sec	CPU	Mem/ Disk	Screen size	Bits/ pixel
High-end PC	Ethernet (10Mbits), ISDN (128K)	120 Mhz Pentium	16/2G	1280x1024	16-24, color
Low-end PC		75-100 Mhz Pentium	8/500	1024x768	8-16, color
High-end notebook	Cellular (9600) or wireline (28.8K) modem			800x600	8, color
Low-end notebook		50-66 Mhz 486		640x480	4, gray
PDA	2400-14.4K modem	20 Mhz RISC or x86	2/0	320x200	1–2, gray

Client variation spans an order of magnitude.

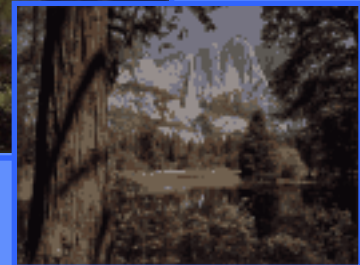# On-Demand Distillation

78 colors, 49K bytes

4 grays, 530 bytes, <2 sec.

>256 colors, 759K bytes (1024x768)

16 colors, 12K bytes, <6 sec.

- Lossy compression that preserves semantic content
- Each *transcoder* is datatype-specific

  Distillation works in real time on desktop PC's.

Distillation Addresses Client Variation

- *Hardware variation*
  - Shrink image to fit small screen
  - Apply contrast-enhanced graymap or colormap
- *Software variation*
  - Transcode to client's preferred image encoding
- *Network variation*
  - Smaller images require less bandwidth

Distillation addresses all 3 kinds of client variation, and lets you evaluate content quickly.

Refinement

- View some part of distilled object at higher quality
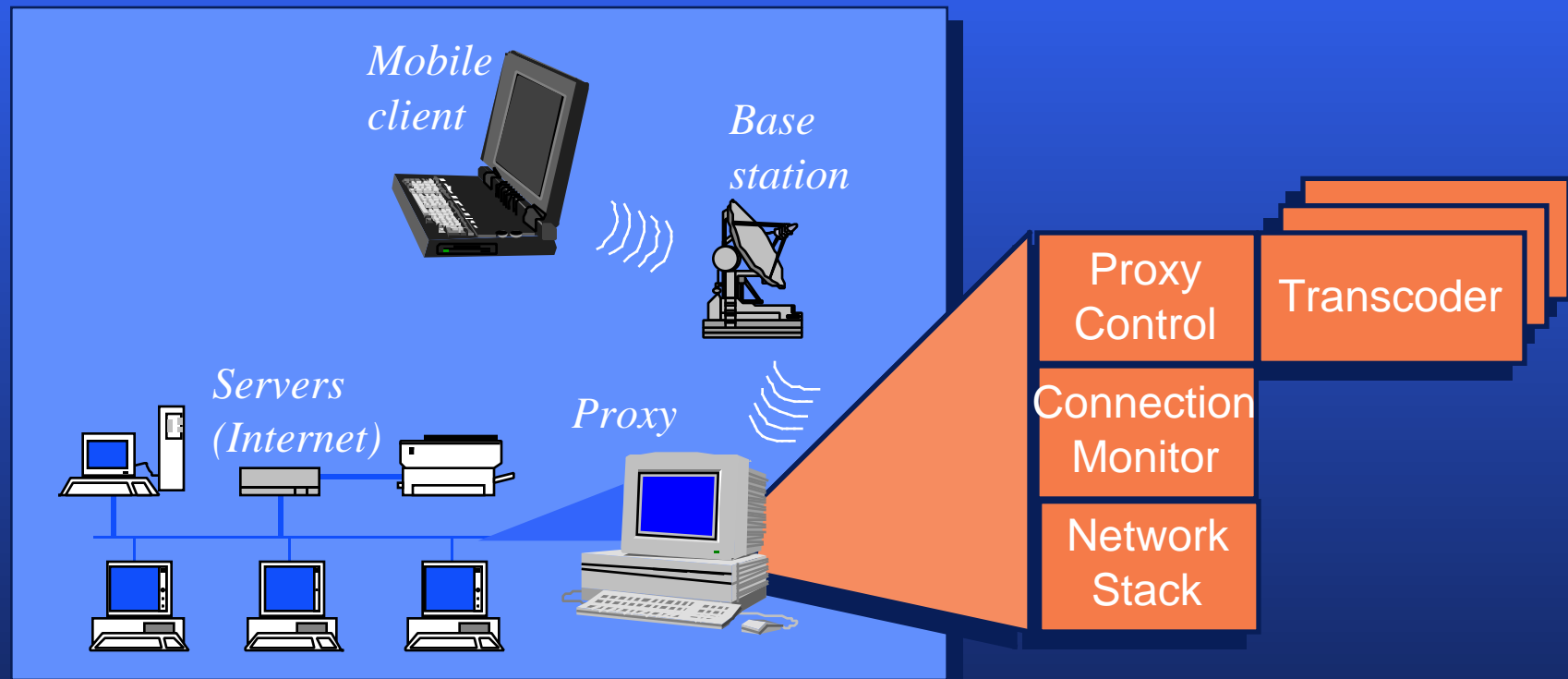
- Example: Zoom in on region of an image

249 colors, 12K bytes, <1 sec.

Refinement allows you to expend bandwidth on only the things you're interested in.

Proxy Architecture

- Proxy is at logical boundary of well-connectedness
- Use resources at proxy to address client variation

Building Adaptive Applications

- *Network Connection Monitor* detects changes in bandwidth/latency
  - Enter/leave radio shadow
  - Horizontal or vertical handoff
- NCM notifies Proxy
- Proxy modifies distillation parameters to continue delivering "best available" service

The NCM allows the proxy to adapt dynamically and automatically to network changes.

Current Status

- **Implemented WWW Proxy (Pythia)**
  - Distillation for off-the-shelf browsers
  - Image distillation, PostScript to HTML
  - Adapts automatically to vertical handoff
- **GloMop (client-side intelligent middleware)**
  - Tcl/Tk and TkPerl interfaces
  - Proxy control modules in Perl 5
- **Applications**
  - MH-compatible MIME email for MagicLink
  - WhitePad (proxied MBONE WhiteBoard)
  - Web Browser for PDA's

Research Issues

- **Scalability**
  - Performance under stress (thousands of users)
  - Load balancing across multiple machines

- **"GloMop SDK"**
  - Uniform methodology for "growing" a proxied app from an existing desktop app

- **Event delivery abstractions in the API**
  - Interactive groupware (*wb*), notification services, etc.
  - "Integrated delivery" policies when MH is off (proxy pages you to tell you new mail has arrived)

Conclusions

■ **On-demand Distillation & Refinement address all 3 kinds of client variation**
  – *Hardware*: adapt to client physical constraints
  – *Software*: transcode to client-friendly formats
  – *Network*: smaller objects require less bandwidth

■ **Proxy architecture provides uniform client interface without changing servers**

■ **NCM makes network adaptation automatic and dynamic**