Broadway

Universal Access to
Interactive Applications
over the Web

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Broadway

- "Universal Access to"
  - any user, any desktop
- "Interactive Applications"
  - what you always had before HTML
  - applications, not applets
- "over the Web"
  - any application, any place
  - well integrated and secure

Market Reality

- Heterogeneous environments
  - PCs on most desktops
  - UNIX servers and desktops
  - Windows NT servers at the doorstep
- Windows market is huge
  - UNIX and X **must** integrate with it

UNIX/Windows Integration

- Equal access to **all** applications
  - Windows
  - UNIX
- Equal access from **all** desktops
  - PCs
  - UNIX workstations
  - X terminals

Architectural Context

Choices

Client/Server Choices

- Database protocol [SQL]
- Passive data protocol [HTML, VRML]
- Weakly active [client-pull, server-push]
- Mobile code [Java, Safe-Tcl]
- Distributed objects [OLE, OpenDoc]
- Interactive graphics [X]

Remote Execution Choices

- UNIX “r” protocols [rsh, rexec, R6 rstart]
- CDE [ToolTalk, Actions]
- DCE [host daemon]
- CORBA [object requests]
- URLs [CGI scripts]

Compound Document Choices

- OLE, OpenDoc
- Web inlining [<IMG>, WWWInline{}]
- Web plug-ins, applets
- X embedding

Desktop Choices

- Windows 3.x / 95 / NT
- Mac
- UNIX, CDE
- X terminal
- Web browser
  - “single interface to all information”

Server Choices

- UNIX
- Windows NT
- Mainframes

Still "Mechanism, Not Policy"?

Client/Server, Remote Execution, Compound Documents, Desktops, Servers

- No single choice is exclusively better than the others
- Different requirements lead to different solutions
- Mix, match and integrate to meet needs

Architecture

Broadway Choices

- Desktops: All
  "Universal Access to"
- Servers: All
- Client/Server: X (+ more)
  "Interactive Applications"
- Remote Execution: URLs
- Compound Documents: X embedding
  "over the Web"

Broadway

- "Broadway" is the name of the combined package of technologies:
  - X Window System components
  - Audio components
  - Web components
  - ...
- Components retain their individual names

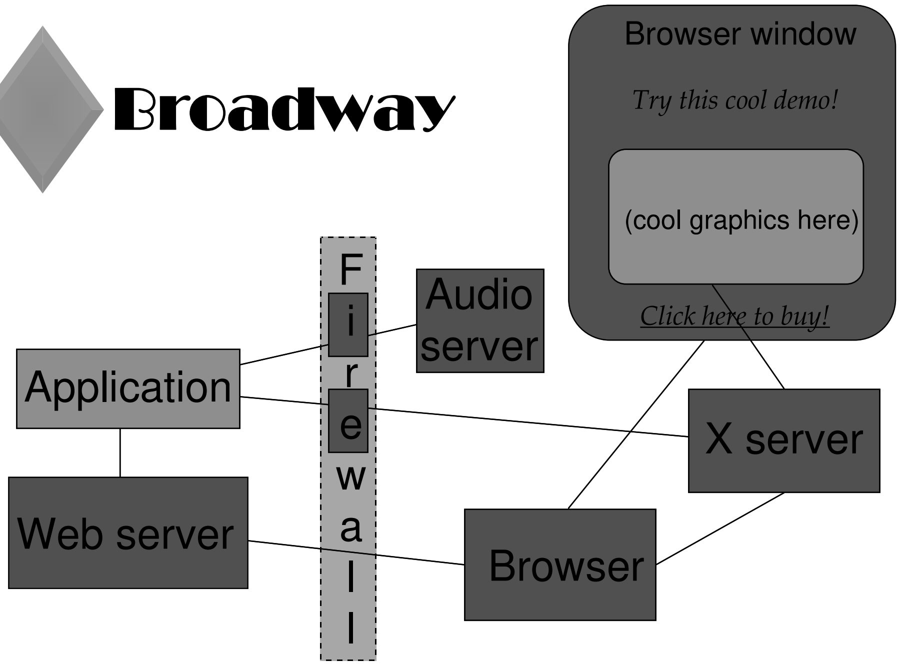
Broadway Features

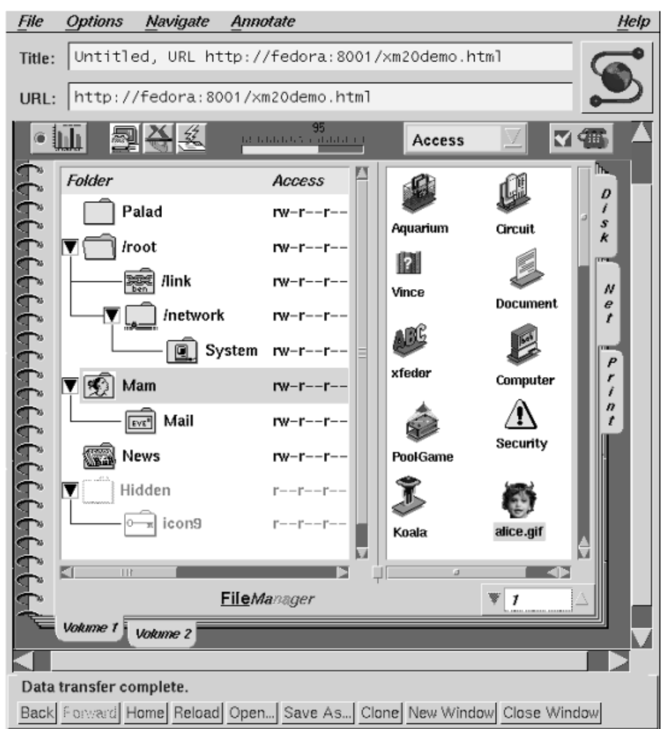
- Internet-optimized X protocol
- Internet-ready Audio protocol
- X and Audio security for Internet use
- Internet firewalls for X and Audio
- Application remote execution via Web
- Application embedding in Web browsers

For Internet and Intranet Use

- Global WANs
- Corporate-internal LANs and WANs
- Ethernet, ISDN, serial line connectivity

Broadway


Browser window
Try this cool demo!
(cool graphics here)
Click here to buy!
Audio server
Application
X server
Web server
Browser
F i r e w a l l


File Options Navigate Annotate Help
Title: Untitled, URL http://fedora:8001/xm20demo.html
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Access
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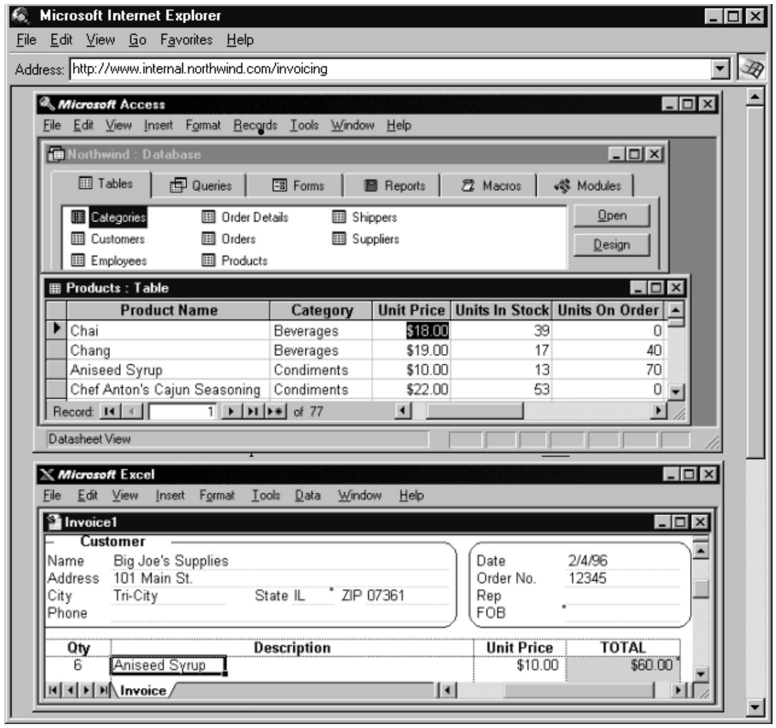
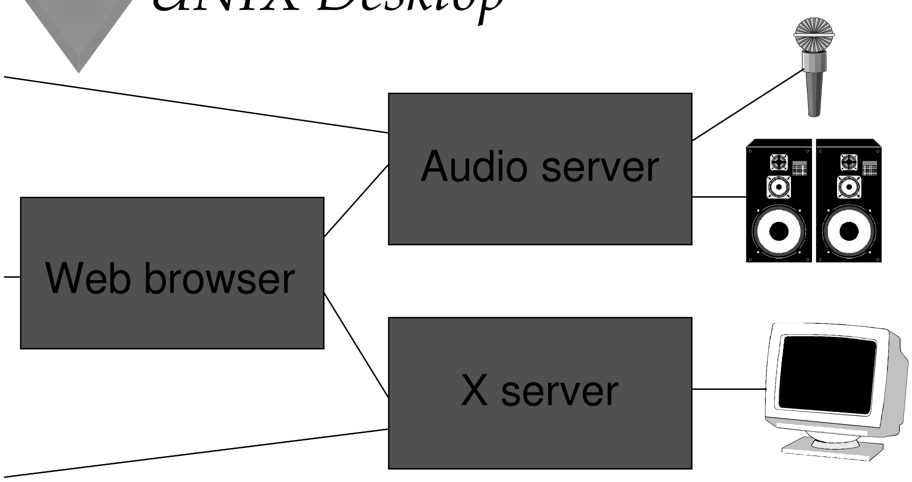
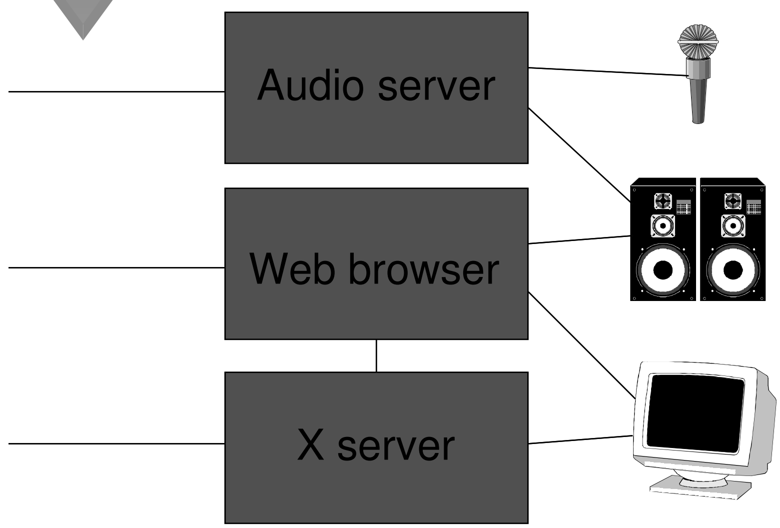


UNIX Desktop

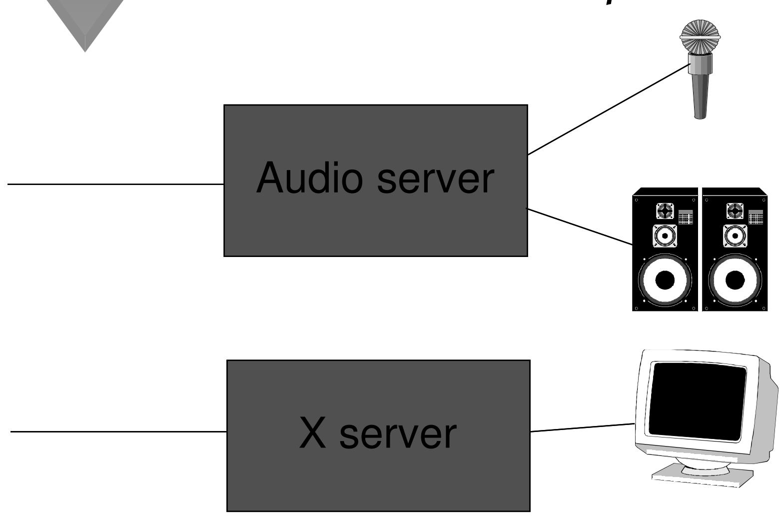


PC Desktop

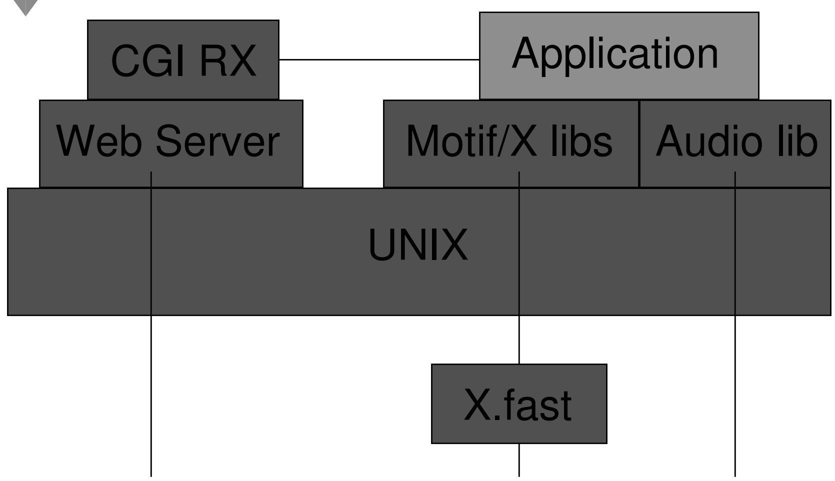


Architecture

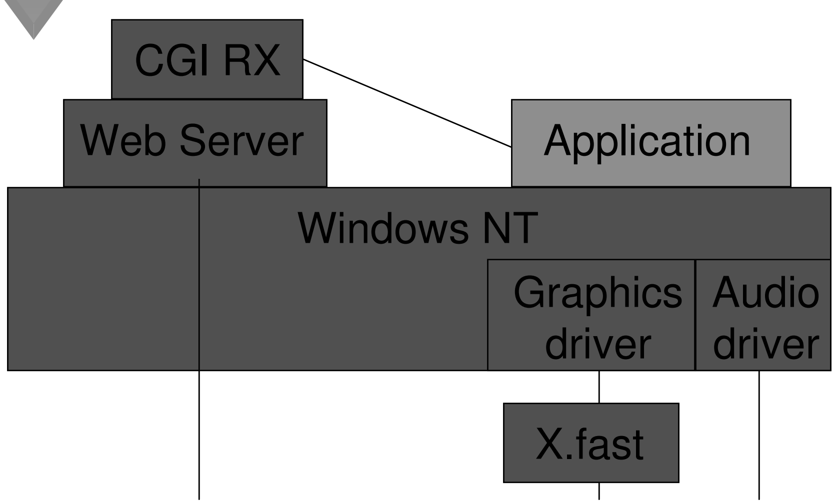
X Terminal Desktop



UNIX Web Server



Windows NT Web Server



Architectural Focus

- Emphasis is on **under-the-covers** protocols, not new APIs
- Create new opportunities for **existing** technology
  - huge number of existing applications
  - UNIX and Windows
- Make more effective use of what we already have

Architectural Focus

- Use **unmodified** existing applications
  - no reengineering to use HTML, Java, etc.
- Applications, not just applets
- Leverage existing know-how for building applications
  - using normal UNIX and Windows tools
    - compilers, libraries, toolkits, debuggers

Presentation Control

- Crucial to many content providers
  - **form** as important as substance
- Full layout control
- Full graphics capability
  - not just images
- Full font control
  - run your own font server on your Web server

Presentation Control

- Real user input control
- Full internationalization
  - rely on known facilities of Web server OS
  - rely on fonts from your own font server
  - provide input method facilities for user

Embedding User Interface

- Not trying to provide "full" compound document UI integration
  - no shared menubar
  - would require rewriting existing applications
- Reasonably consistent with Microsoft's Multiple Document Interface (MDI)

Technology

Internet-Optimized X Protocol

- Previously called LBX (Low-Bandwidth X)
  - will have a new name
  - called X.fast here
- Target is WAN and serial line use
- Serial line use includes
  - direct dial-up from home to office
  - via Internet Service Provider (ISP)

Internet-Optimized X Protocol

- Protocol optimizations
  - Data compression (3 layers)
  - Caching and short-circuiting
- Designed as proxy server
  - to work with existing applications
  - could be embedded in Xlib, NT driver

Internet-Ready Audio

- TCP-based client/server protocol
  - logically separate server from X server
- Record and playback
  - microphones, speakers, sound buckets
- Variety of audio formats
  - sample rate conversion

Audio Protocol Focus

- Support needed by
  - Web browsers
  - Windows audio applications
  - equivalent UNIX applications
- Security
- Synchronization with graphics, video
- Architecture to permit future growth

Relation to Other Web Audio

- RealAudio, Internet Wave, etc.
  - browser initiates connection
  - browser controls the playback
- Broadway Audio
  - application initiates connection
  - application controls the playback

Security

- Broadway security is in addition to existing Web security mechanisms
- Broadway does not depend on downloading programs

Primary Security Goal

- Divide applications into two classes
  - **trusted**: those inside the firewall
  - **untrusted**: those outside the firewall
- Prevent untrusted applications from stealing, destroying, or modifying trusted applications' data
- Unrestricted world-wide export is essential

Firewall Proxies

- Policy implemented in server, not proxy
- Proxy just restricts connections to servers supporting security
- Proxy does not have to understand details of protocol or extensions
- Single proxy can support all ICE protocols
  - not just Audio
- Proxy stays small, fast, and simple

Web-Based Remote Execution

- Can work with existing systems
- Web server
  - just new documents and CGI scripts
- Web browser
  - just new document type and helper program
    - but no embedding
- X server
  - no changes for Intranet use

Browser Embedding

- X server
  - new extension to support embedding
- Web browser
  - new communication with
    - X server for embedding
    - X/audio servers and firewall proxies for security
  - new embedded window management

Opportunities

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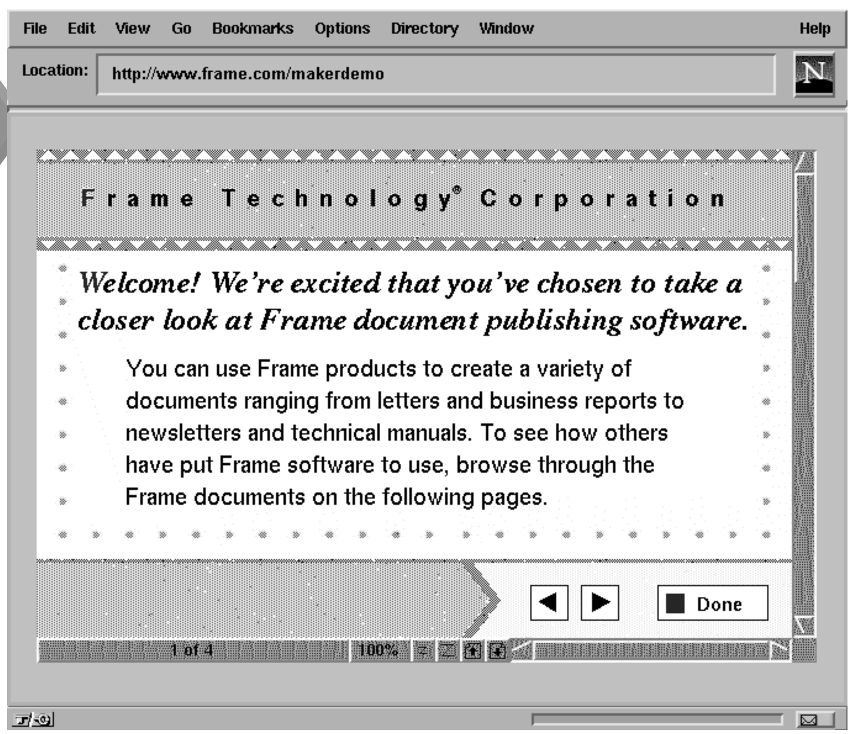
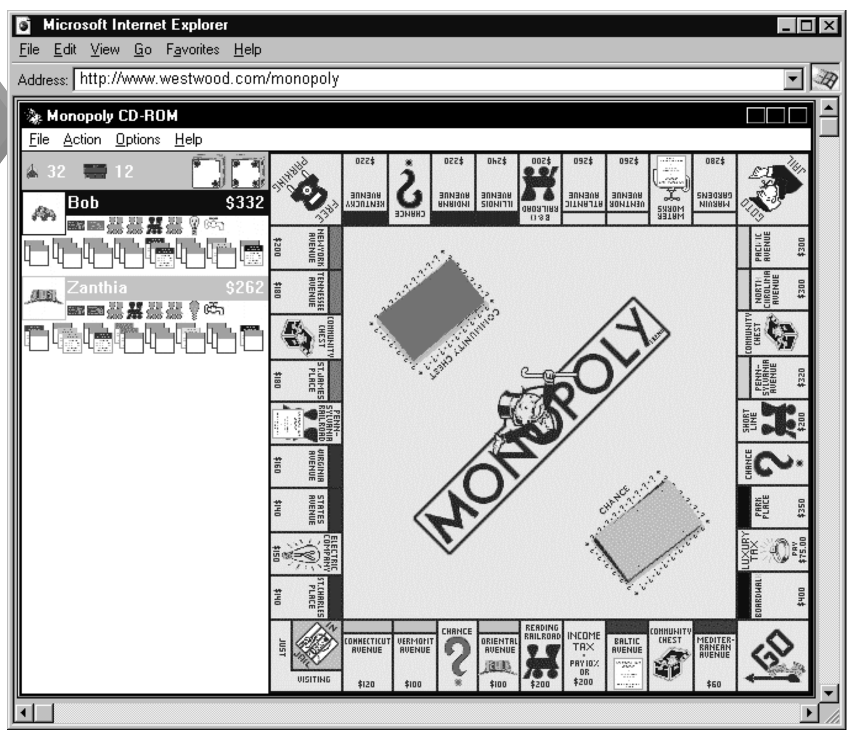


Product Demonstrations

- Over the Internet
- "Try before you buy"
- Avoid long download times
- No install/uninstall problems

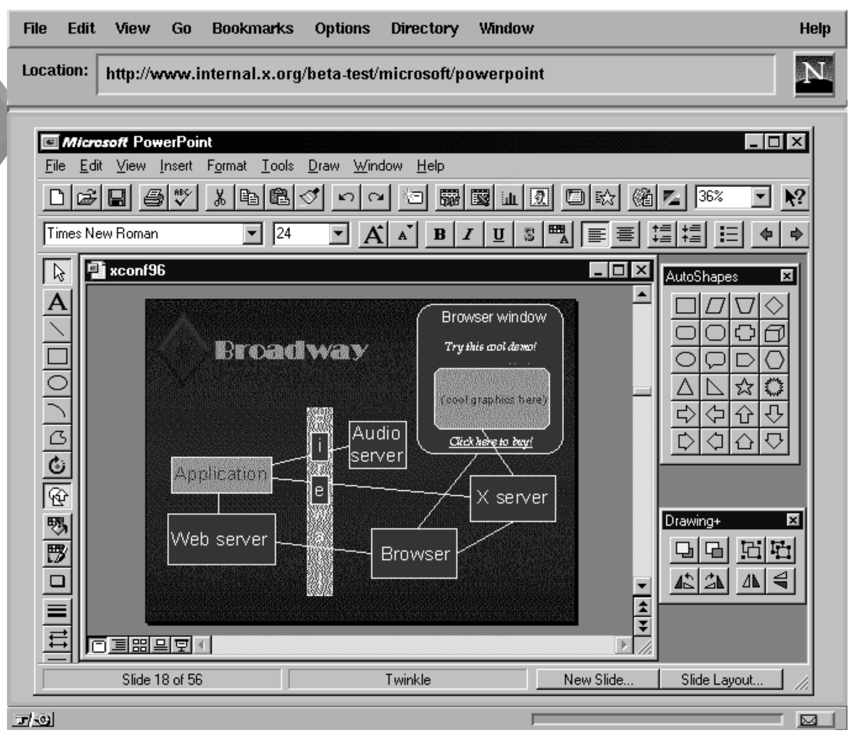
Games



Games

- ❖ Over the Internet
- ❖ “Pay per Play”
- ❖ Capture a larger market
  - infrequent players
  - spontaneous parties
  - employees avoiding work

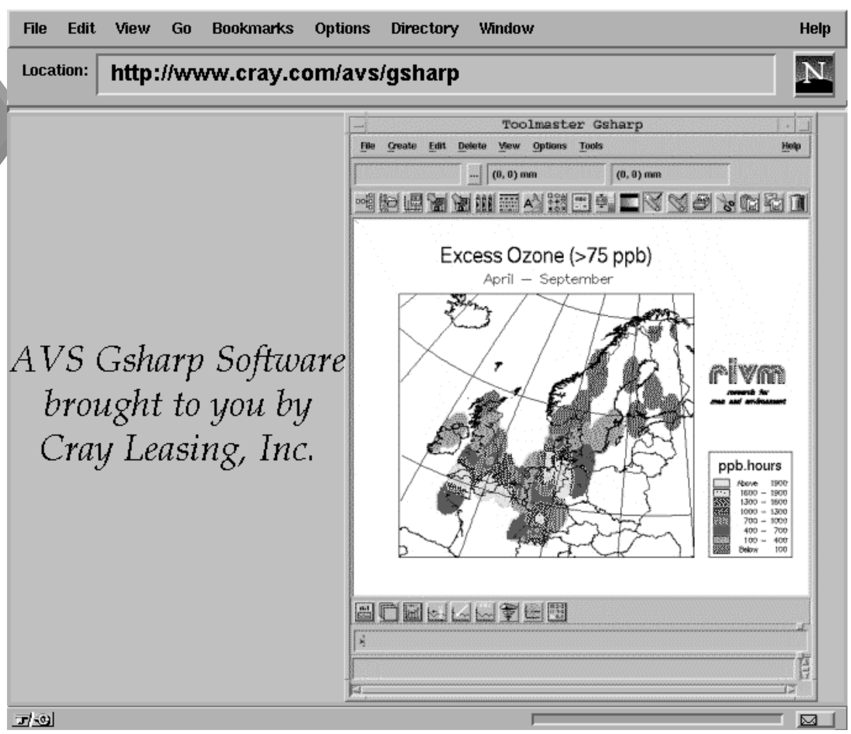
Beta Test



Software Beta Testing

- Within corporate Intranet
- "Try before you deploy"
- E.g., Windows 95 applications
  - install on a central Windows NT server
  - let users test before deploying on desktops

Leasing

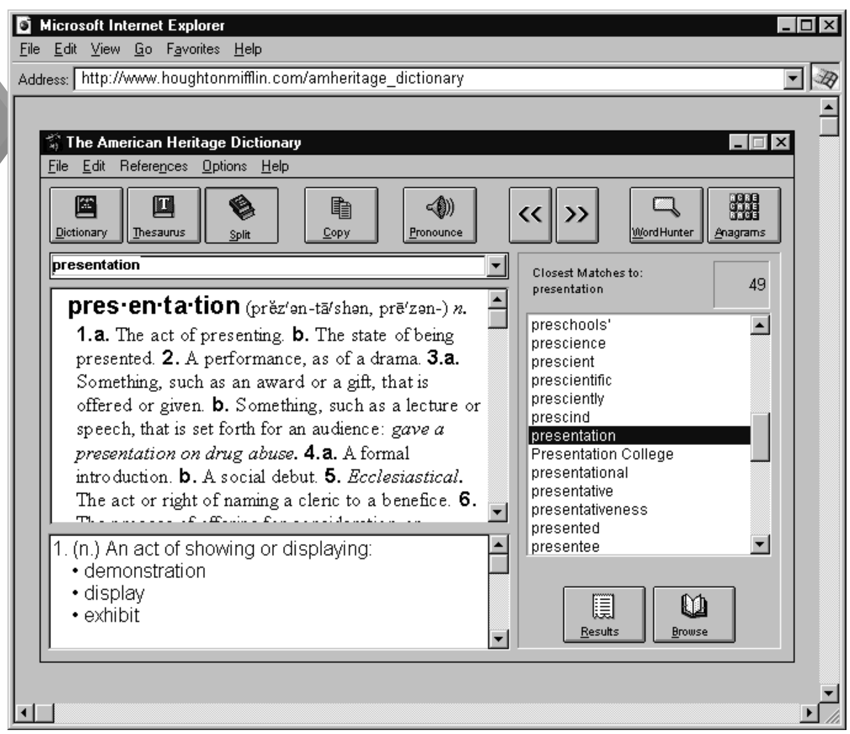


Opportunities

Software Leasing

- ❖ Over the Internet
- ❖ “Rent by the hour or by the day”
  - large, expensive software
  - provide more computational power
  - fast access to information databases

Database



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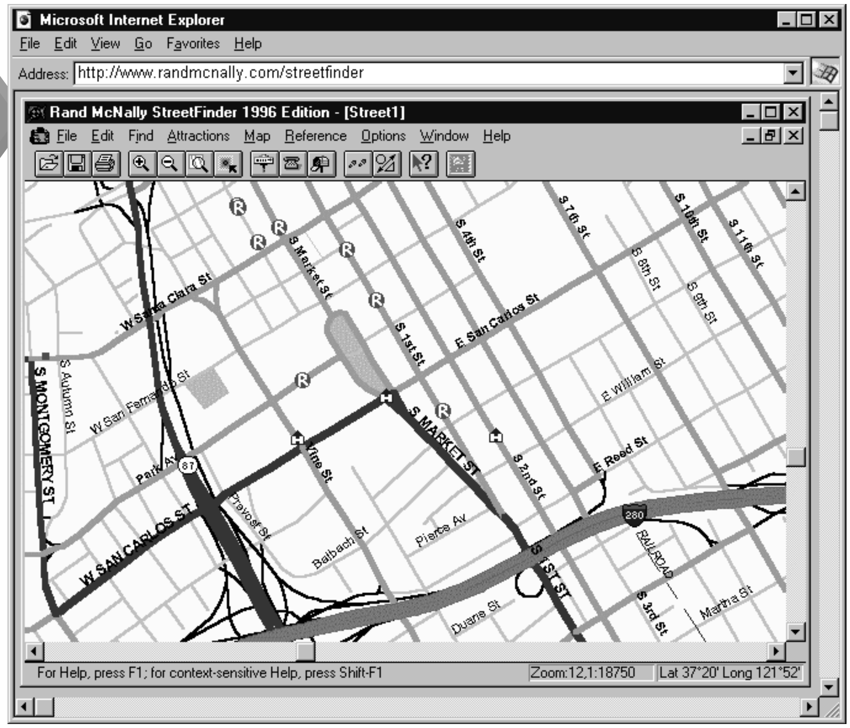

Information on Demand

- Internet and Intranet access
- Truly interactive access to databases
- Graphical output, not just text
- More than just HTML forms for input
- Content provider retains better control over their content and how it is used

Collaborative Applications

- Use existing X mechanisms for sharing applications [e.g., SharedX]

Underlying Technologies

- PC X server as Web browser add-on
- New life for X terminals
  - *aka* “Windows terminals”, “Web terminals”
  - as cheap as proposed “Java terminals”
- A good reason to buy Windows NT
  - multi-user Windows application server
- High-end server hardware
  - to run all those applications

On-line Service Providers

- Rebirth as full-service information providers
- “Application servers” to their customers
  - large, high-performance centralized systems
  - file storage for those who want it
- Collect fees from software vendors for hosting applications

Broadway: The Sequel

- Printing
  - X print server is the perfect solution
- Local (to user) file Open, Save
- Interaction with containing HTML document
- Mixing with Java and other Web extensions
- Video
  - **Broadway: The Movie**

Components from X Consortium

- Audio library and server for UNIX
- X.fast proxy
- X server extensions
  - security, embedding, X.fast
- X and ICE firewall proxies
- Remote execution support
  - browser and Web server
- Browser embedding support

Components from Vendors

- Audio server for Windows
- Multi-user Windows NT and device drivers
  - Wincenter Pro, NTrigue and others
- Broadway-enabled browsers
- PC browser/X server integration

Broadway

- Universal access from any desktop
- UNIX and Windows interactive applications
  - both existing and newly created
  - applications, not just applets
- Seamless integration into the Web
- Public release in second half of 1996