Overview of Garnet Collaboration System

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Goals and Features of Garnet

- Support distance education, collaborative computing and building electronic communities (such as for American Indian Tribal Colleges)
- Uses desktop HearMe Audio Conferencing or Access Grid
- Builds on lessons from Tango (Syracuse) and commercial WebEx Placeware and Centra
- Integrate synchronous and asynchronous collaboration
- Supports universal access including PDA's collaborating with desktops

Architecture of Collaboration

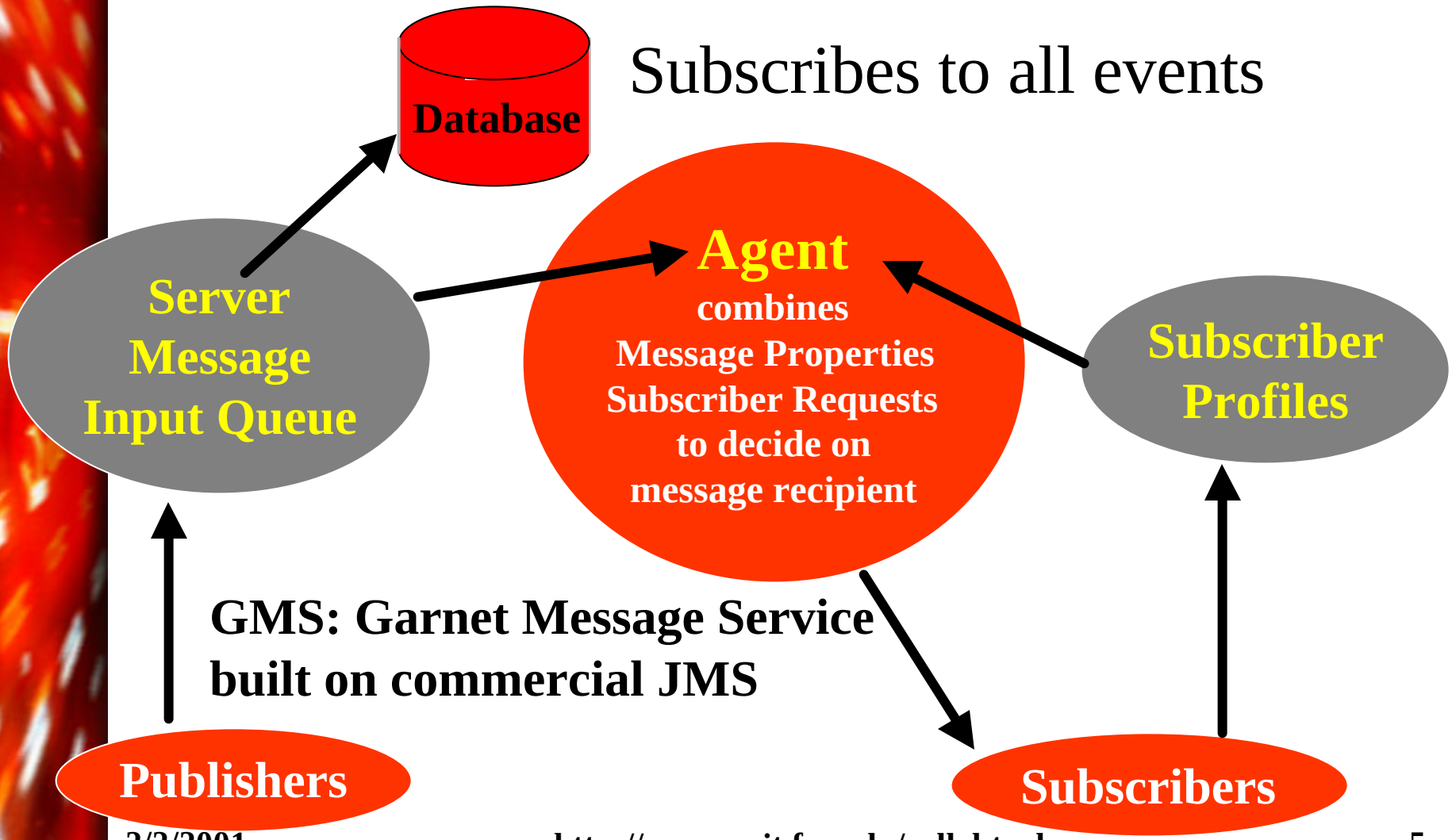
- The web is full of objects – web pages sitting on web servers – and these support asynchronous collaboration
  - You post a web page and I later look at it in my own time
- Replacing web document by a "CGI script" or servlet (web interface to program, database etc.) gives general multi-tier object sharing
- This is Publish/Subscribe mechanism
  - If add some mechanism (automatic email or word of mouth) to tell viewing client when new information is posted
  - We build on JMS (Java Message Service) as Industry standard for publish/subscribe systems
- Synchronous Collaboration provides "real-time" notification and automatic update of changed objects
  - Also Publish/Subscribe ….

Garnet Architecture Underpinnings

- All software written in Java; all data structures defined in XML GXOS
- Unified Event Model – assume all systems communicate with XML based messages (possibly wrapped) – portalML
- All entities – computers, users, programs -- defined in XML – resourceML
- All events archived to enable fault tolerance and replay
- GMS -- Garnet(Grid?) Message Service -- extends JMS to XML not text properties to allow server side intelligence
  - Assume clients can crash but servers persistent

GMS Model for Messages

- Agent based messaging with server (broker) side intelligence and archiving



Architecture of Collaboration II

- All forms of Collaboration are Event based
  - Different modes: Display, Export, "Event" correspond to events generated at different places in object rendering pipeline
- Shared Display – Events contain updates to frame buffer
- Shared "Event" – Events contain updates to state of either original or transformed object
- Shared Export – Convert (rendering of) object to some standard form that is more flexible than bitmap of Shared Display. Build a custom sharing for this exported form
  - WebEx uses "patented sharing of virtual printer" which is equivalent to sharing export to PDF
  - I like shared HTML (web pages) or SVG described later

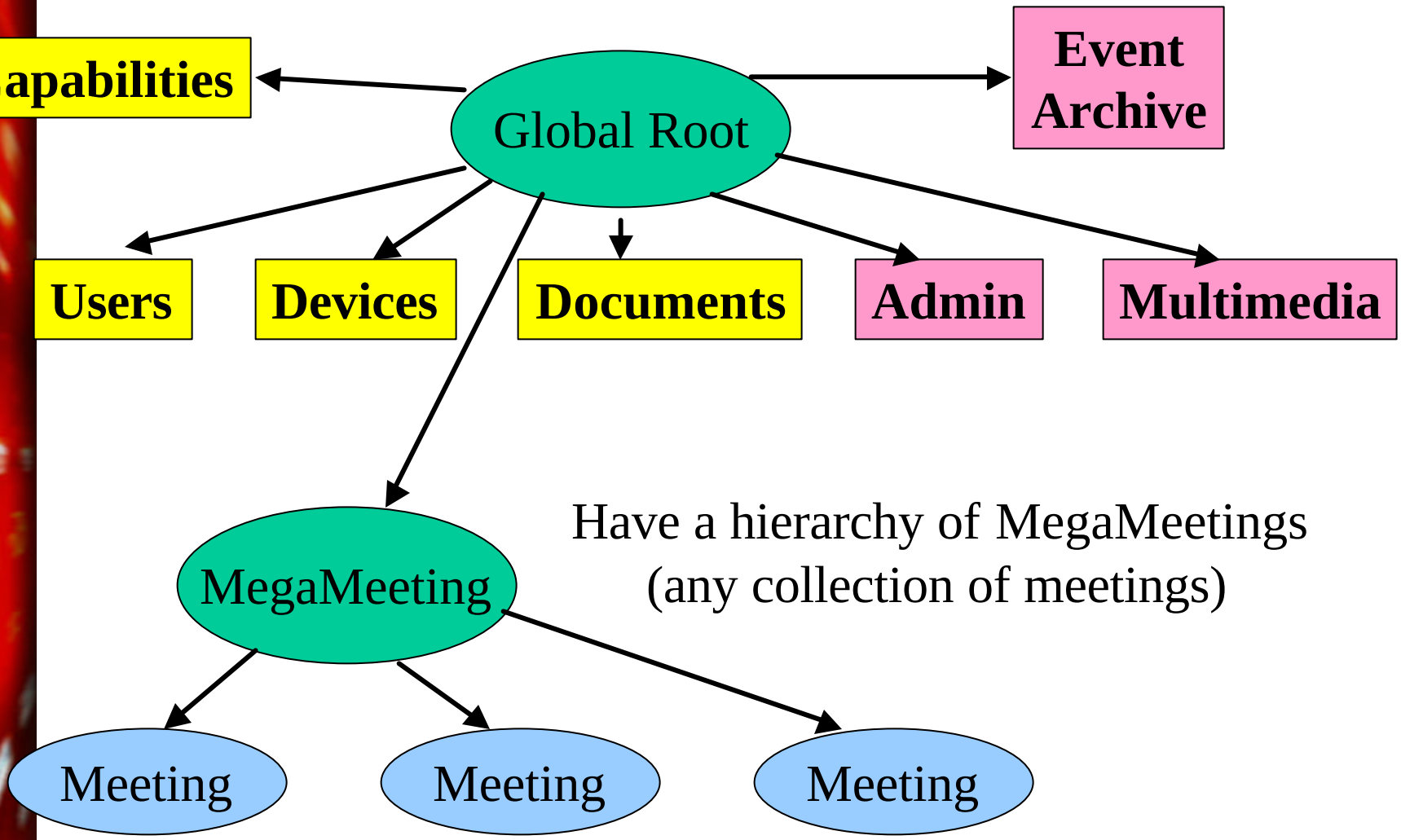
GXOS GNDI Structure I

- Typically GXOS does NOT hold the object but rather all the metadata for object including where to find it
  - internalND defines where the metadata is (GNDI Garnet Naming/Directory)
  - externalND where the object is (JNDI Java Naming/Directory Interface)
  - Idea used in WebFlow/Gateway portals – implies efficient as use natural high performance mechanisms for "real objects"
- GXOS uses classic UNIX style directory structure such as //Education/University/FSU/CS/PhD/Course/Lecture
  - Structure says can handle quadrillion meta-objects //Jefferson/HallD/Run1/May132005/Tape5/Event1234/Detector3 …
- Events are a special type of GXOS object defined with GMS Extension to basic hierarchical object

GXOS GNDI Structure II

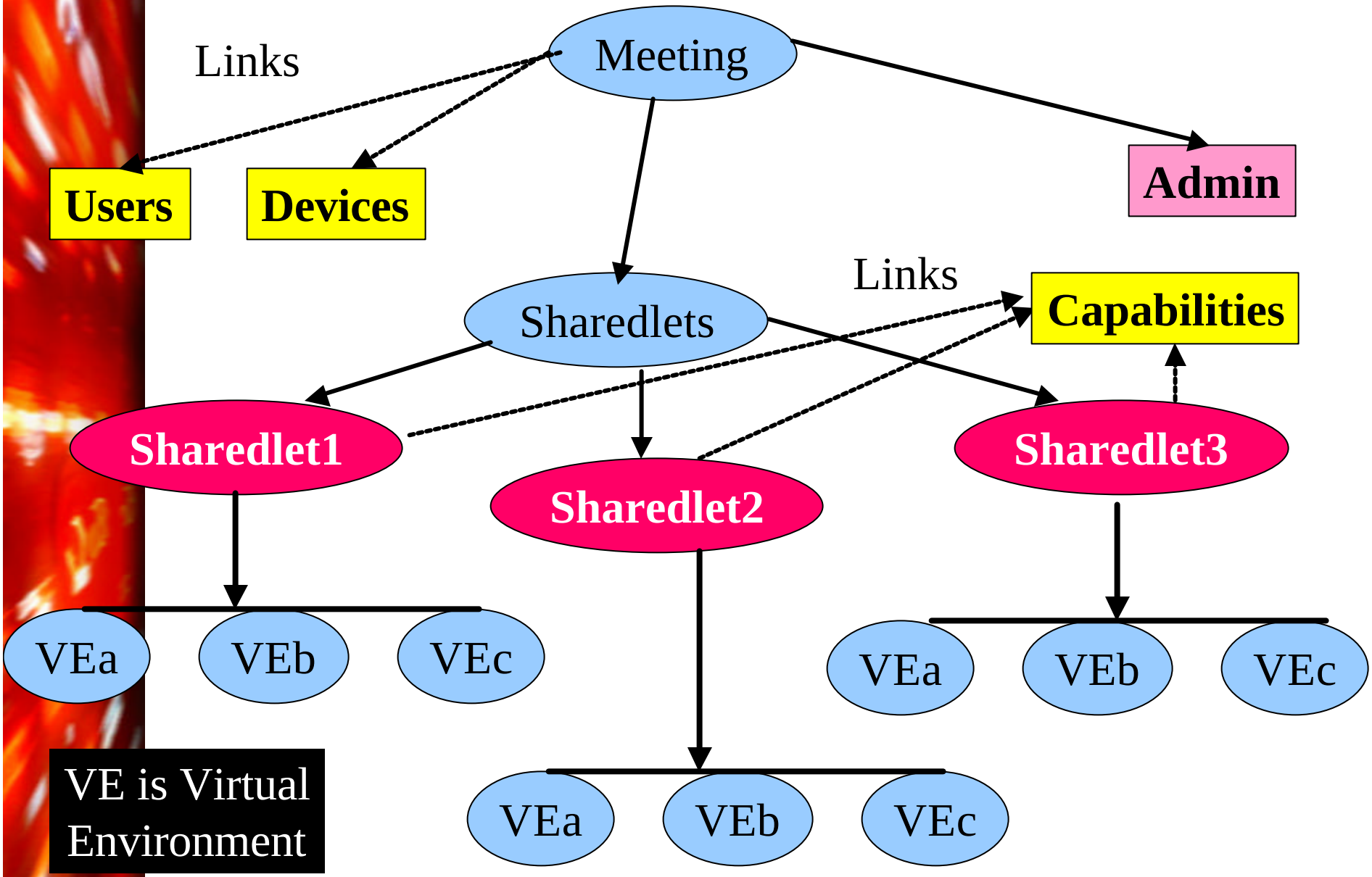
- The more you know about an object, the easier it is to build a collaborative system
  - It is hard to share a general program as properties are not explicit
- All GXOS objects can be containers as well as having full object characteristics
  - Unlike UNIX where directories (only containers) and files (never explicit containers) are different
- Can create a link (internalND pointer) with a profile to define special properties of this object in a new context
  - Intelligent symbolic links
  - One links User, Client Device to VE (Virtual Environment) with XML profiles mapping user to this session

Overall Structure of GXOS for a MegaMeeting



Have a hierarchy of MegaMeetings
(any collection of meetings)

Structure of GXOS For a Collaborative Session



VE is Virtual Environment

Important Collaboration Concepts

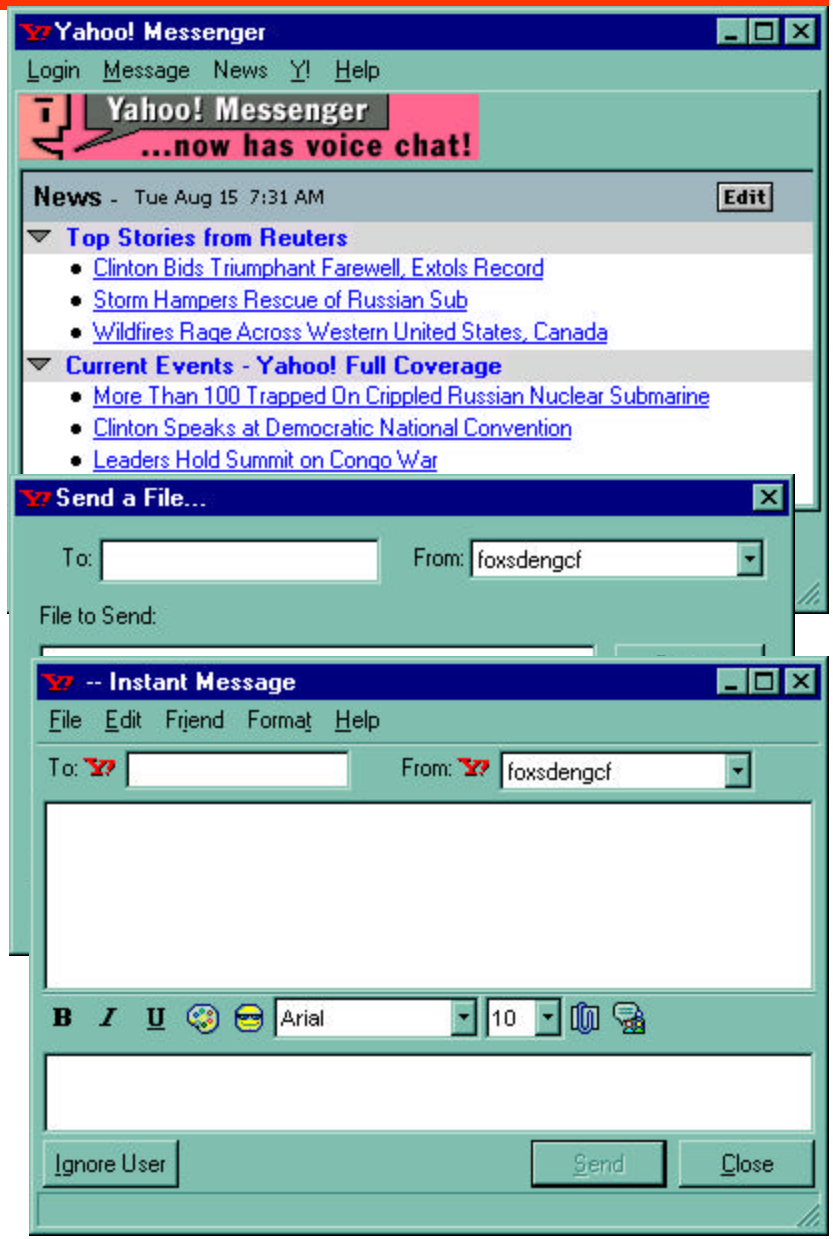
- Must be able to record and replay all features of session (SMIL)
  - A/V, Presentation, Annotations, Text Chat
- Developing SVG (Scalable Vector Graphics) Shared Export
  - 2D Scientific Visualization (Whiteboard)
  - Macromedia (Flash~SVG) and Adobe
- Initial source of SVG: Convert PowerPoint VML to SVG
  - Would give shared export model for PowerPoint with each client able to scale independently at high resolution
- Shared Java Server Pages for Gateway Computing Portal
- "Universal Access" and support of Palm/Windows CE Clients
  - Java based MyProfessor or MyCommunity Yahoo Messenger like interface

MetaObject Event-based Computing Paradigm

- All entities are MetaObjects defined in universal GXOS XML Syntax – Meta means GXOS doesn't really want to manage Object, just information required to find, render and share it
  - Rendering includes Palm devices as well as PC's
  - Entities are people, computers, data sources, information from e-mail, scientific visualization to digitized Bible
- All actions including object changes are events – all events are GXOS objects
  - e-mail, paging etc. are all GXOS events uniformly routed/archived etc.
- All action is instantiated or recorded in messages which are events themselves
- All events are archived allowing actions to be undone and to be reviewed
- There is an MetaObject Shell MyXoS with basic Services (copy, create, collaborate etc.)

myHPCC Portal Interface

- Yahoo Messenger is an interesting model for the myANL or more generally myProfessor (Education) or myHPCC (general computing) interface
- "Small" Application that invokes browser
- Runs on PC or Palmtop and "only" contains summary information suitable for Palms – can we use Java (J2ME)
- Has services like file manipulation, send a message and set of custom buttons
  - Access News, Weather, Stocks etc.
- Develop myHPCC with computers, papers, programs and sensors instead of news and stocks
- Develop myProfessor with school events, classes etc.



Typical Virtual Class(Meeting)room

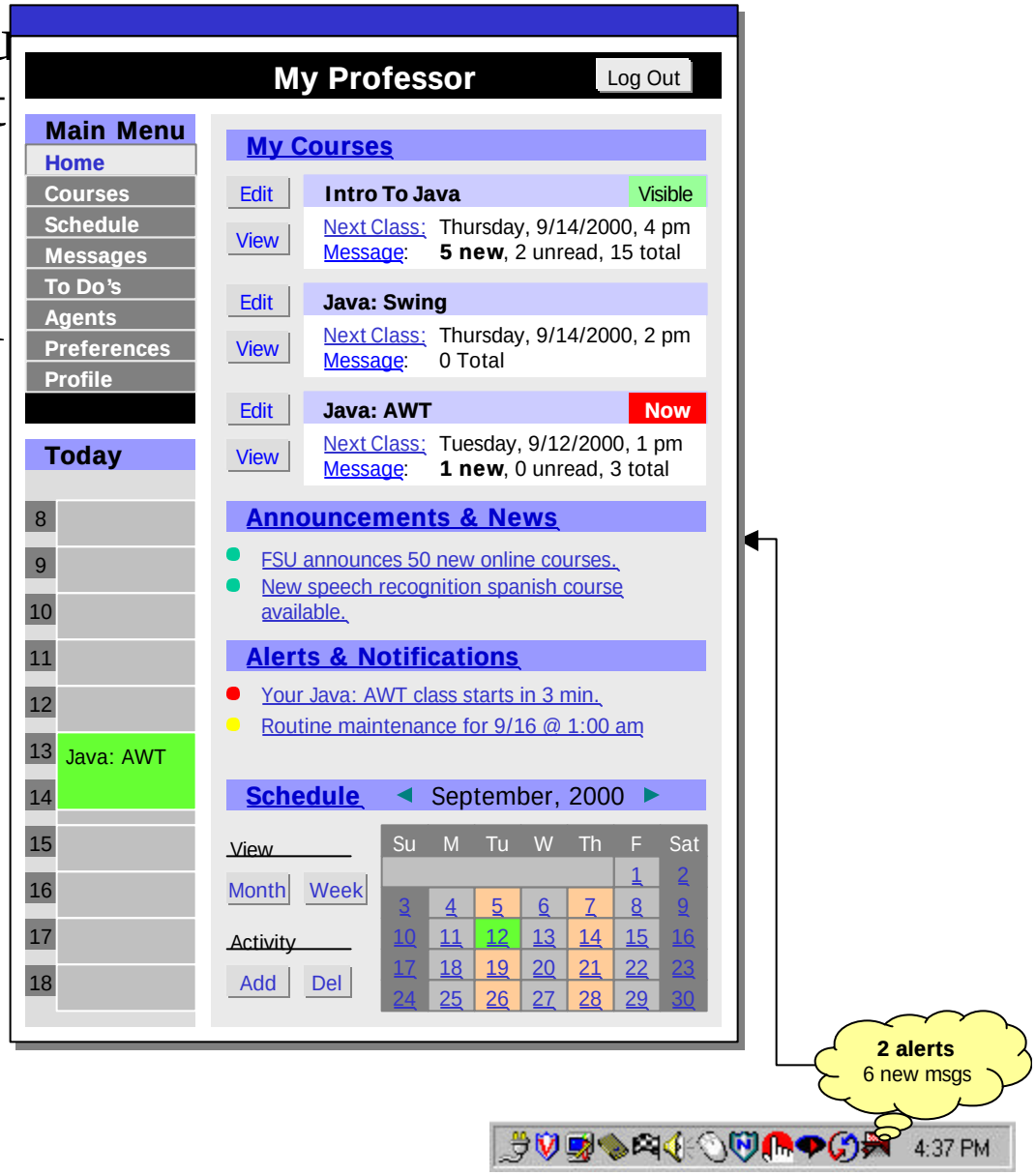
- Invoke this from myANL or myProfessor
- See Centra, Placeware, WebEx….

Control buttons for Audio/Video/Floor Control etc.

Lecture Page Annotations (student, teacher) Pointers etc.

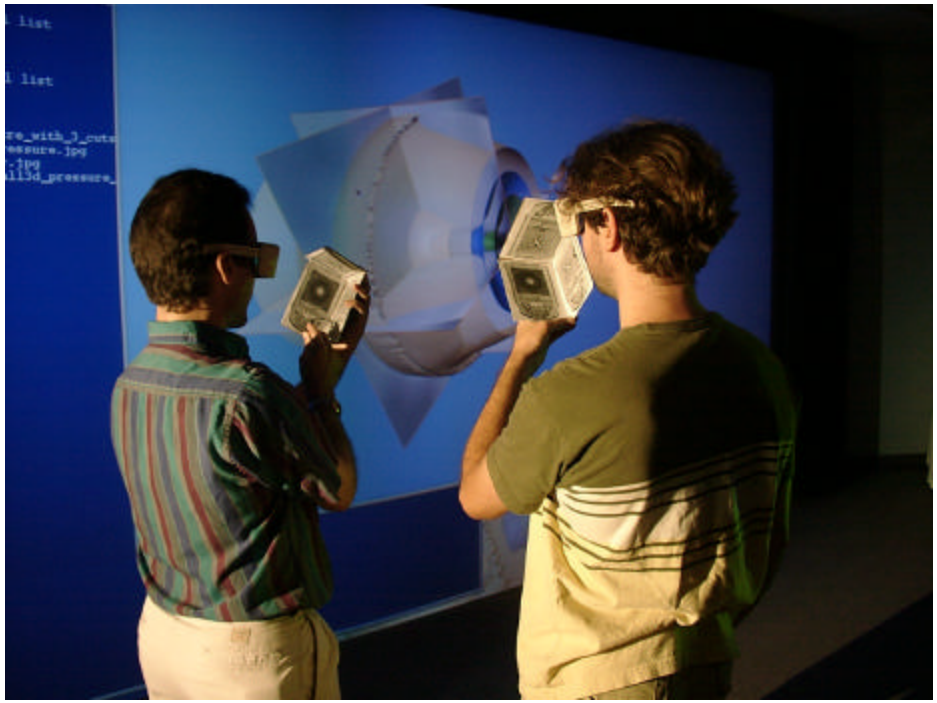
Typical MyProfessor Interface

- Messages will give you access to email, instant messenger, voice messages, alerts etc.
- Agents scan for useful resources you requested e.g. news about Enterprise Javabeans
- Calendar and Scheduler supports CDIS, CAP and CIP data Interchange, access and Interoperability standards (see iPlanet Calendar Server 2.1)



Hand Held devices and Device Control

- Ubiquitous access to resources from palm-top devices will allow new HPCC access modes from simple job submission through visualization of results
  - Implement as collaboration between Palmtops and viz devices
  - Control large screen displays – Banks and Erlebacher
  - Control active walls of Flat Panel screens
  - Note by 2005 65% of Broadband Internet access expected to be from non desktop devices



A Sample Collaboratory

- Here is a sample collaboratory designed for "HallD" – a proposed experiment at DoE's Jefferson Laboratory
- HallD produces 10^{15} data or simulation objects per year
- HallD involves hundreds of scientists around the country collaborating in taking data, processing it and analyzing it to find nifty science breakthroughs
- One first would establish HallD Digital Object Standard covering everything from LED on experimental apparatus, data produced in each part of apparatus, plots and other analysis artifacts, presentations and papers
  - GNDI Organizes systematically in natural hierarchical fashion and it will be efficient

MyHallD Collaborative Portal

- **MyHallD is the portal door to the**
  - **Virtual HallD Experiment Control Room**
  - **Virtual HallD Monte Carlo Farm**
  - **Virtual HallD DST Factory**
  - **Virtual HallD Physics Engine**
  - **Virtual HallD Board Room**
  - **HallD Education and Outreach Area**
- **These share access to 10^{15} HallD digital objects but access (and make) them in different ways and are optimized in different ways**
- **They share certain features and services**
  - **All actions are archived as GMS Events (in XML)**
  - **Common security infrastructure**
  - **Access can be from PC or Hand Held device**

Features of MyHallD and it's HallD Virtual Places

- **MyHallD would have:**
  - **"Handles" to open 6 Community Virtual Places as well as ability to open private virtual rooms**
  - **HallD/Jefferson/HEP Calendar, Phone lists etc.**
  - **News Items with browser links**
  - **Experiment Status etc.**
  - **Invoke basic Collaboration Tools – Internet Phone; Local and remote cameras; Chat; Whiteboard**
  - **Automatic Update (to myHallD) Feature**
  - **Indicator as to which places you are in and who else is active there.**
  - **To do list for you in HallD**
  - **Gentle and Crass ways of getting people's attention**

Features of Virtual MyHallD Places

- HallD Board room can be done today for some capabilities using WebEx Placeware or Centra
- DST Factory and Monte Carlo Farm do not require significant synchronous collaboration; build computing portals for standard Physics packages
  - Need strong management functions
- HallD Physics Engine could benefit from innovative user interfaces and collaboration in analysis of results
  - Here is where difficult decisions made (how to run Minuit optimization program) and distributed experts could be useful
  - Share analysis results and choice of parameters for future large analysis (which partial waves to include)
- HallD Education and Outreach can use standard Virtual Classroom model

Features of Virtual MyHallD Places

- Virtual Experiment Control Room could be a big win as (unexpected) real-time decisions need "experts-on-demand"
  - Similar model with DoD and IMT experiments or NASA for remote spacecraft mission control and real-time scientific analysis of earthquakes
  - Needs to evaluate collaborative decision making (vote?) and planning tools
  - Needs to allow shared streaming data as well as shared read-outs of experimental monitors (output of all devices must be distributed objects which can be shared)
  - Needs to support experts caught on their sailboat with poor connectivity or in their car with just a cell phone and a PDA