

NSF CISE/EIA Research Infrastructure PI Workshop

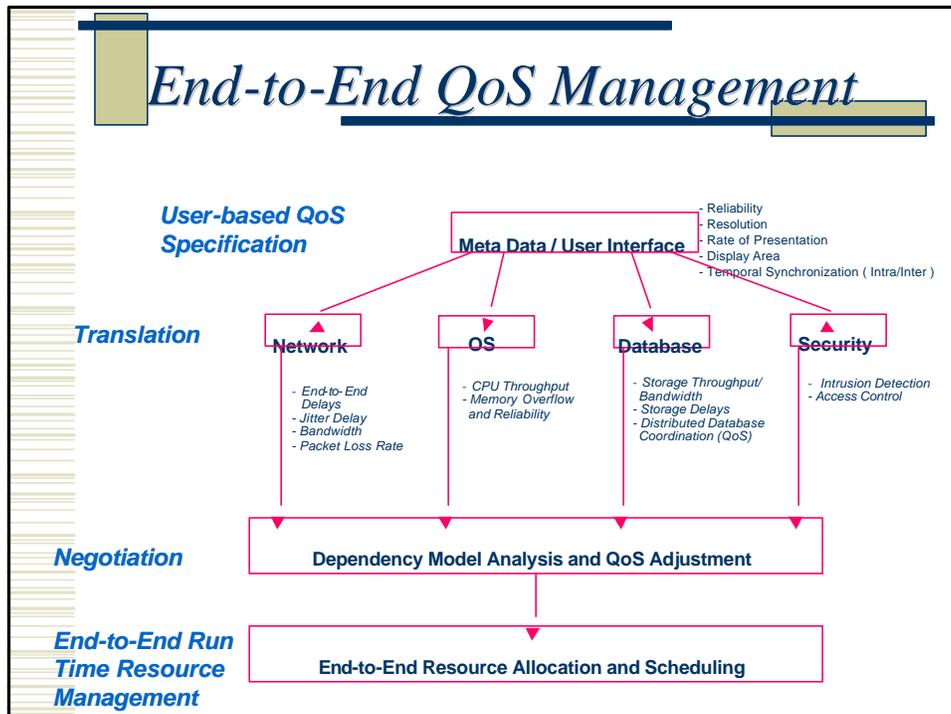
MSI: Research Infrastructure for Integrated Quality of Service (QoS) Management in Multimedia Computing Environments

A.K. Elmagarmid, A. Ghafoor, T. Korb, K. Park, E. Spafford
W. Aref, S. Fahmy, S. Prabhakar, D. Yau

Purdue University

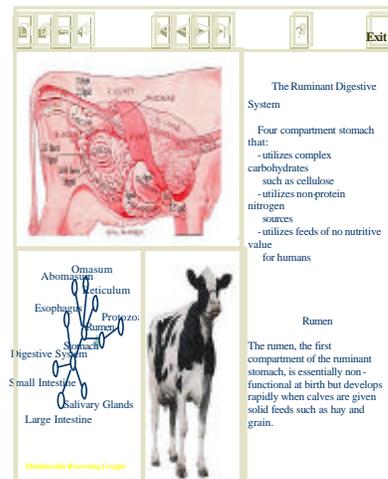
Project Objective

To develop an infrastructure that will integrate key information technologies which include database and storage management, networking, and security in order to support a comprehensive end-to-end QoS management framework for distributed multimedia document applications.



Research Activities for Multimedia Document Database and Storage Management

- ◆ Multimedia document modeling and QoP specification schema
 - Resolution, reliability, rate, synchronization, processing, contents, security attributes
- ◆ Development of efficient clustering, searching and indexing techniques for multimedia documents
- ◆ Distributed Object Management
- ◆ Network caching techniques for composition of distributed multimedia objects

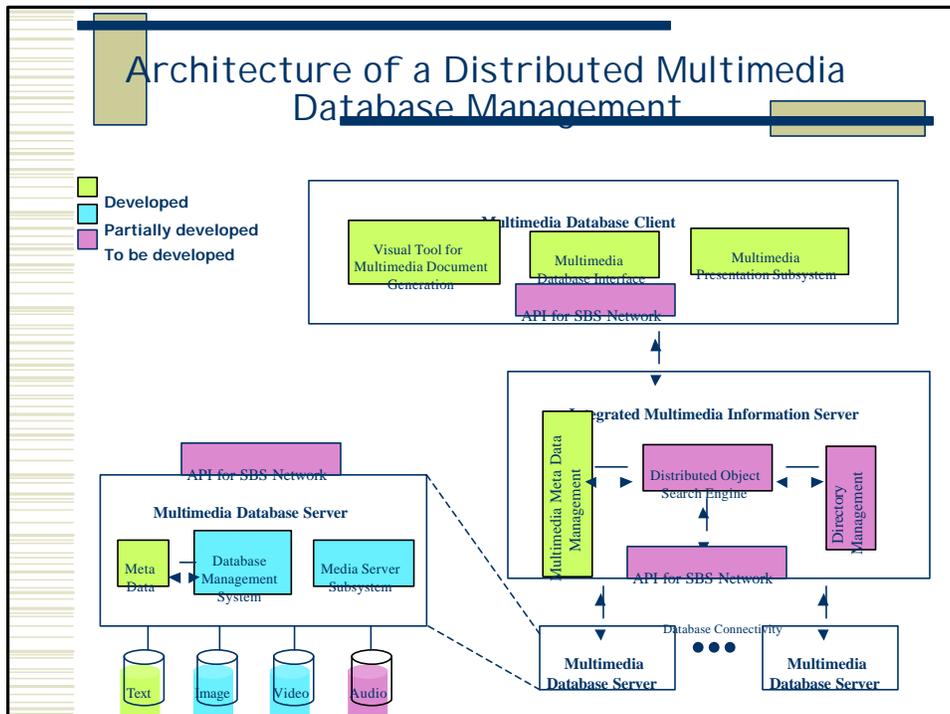


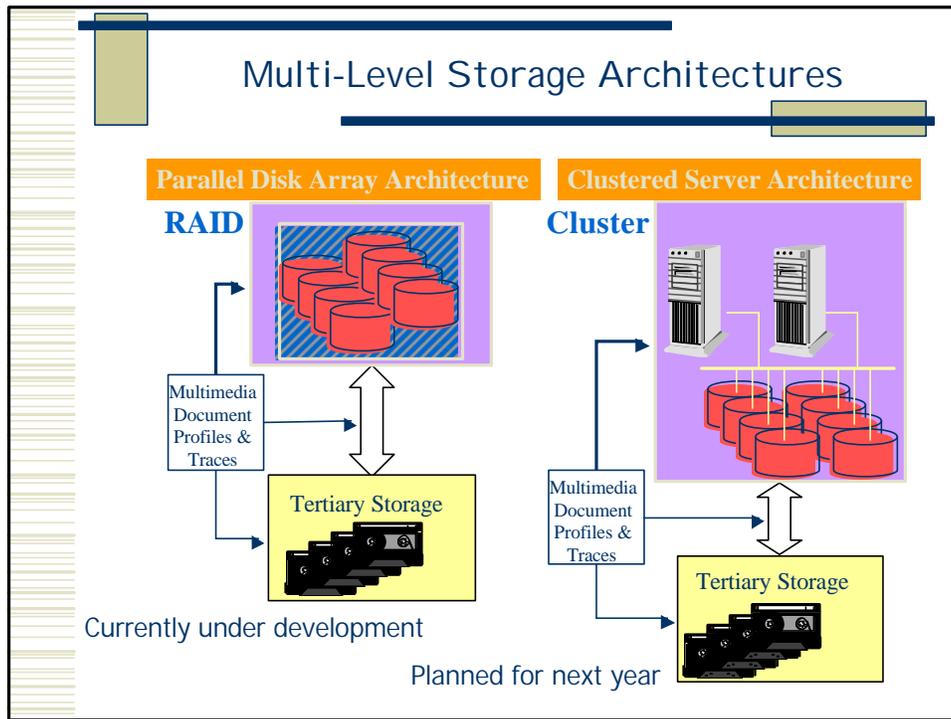
Research Activities for Multimedia Document Database and Storage Management

- ◆ Multimedia data placement and caching techniques for hierarchical storage management system
 - Parallel disk array architecture
 - Clustered server architecture
- ◆ QoS-sensitive real-time disk scheduling techniques for multimedia data

First Year Experimental Activities for Multimedia DBMS

- ◆ Architecture for distributed multimedia system has been developed
- ◆ GUI and search engine for content-based retrieval of multimedia documents have been partially implemented
- ◆ Several novel data placement and disk scheduling policies have been developed and implemented on a RAID architecture
- ◆ SHORE and PREDATOR object-oriented systems are being extended to serve as video and multimedia document database management systems





Issues and Objectives for Networking System

Objective: Diverse user QoS requirements and Sharing of network resources requires a framework which can facilitate QoS-sensitive sharing of network resources

Issues:

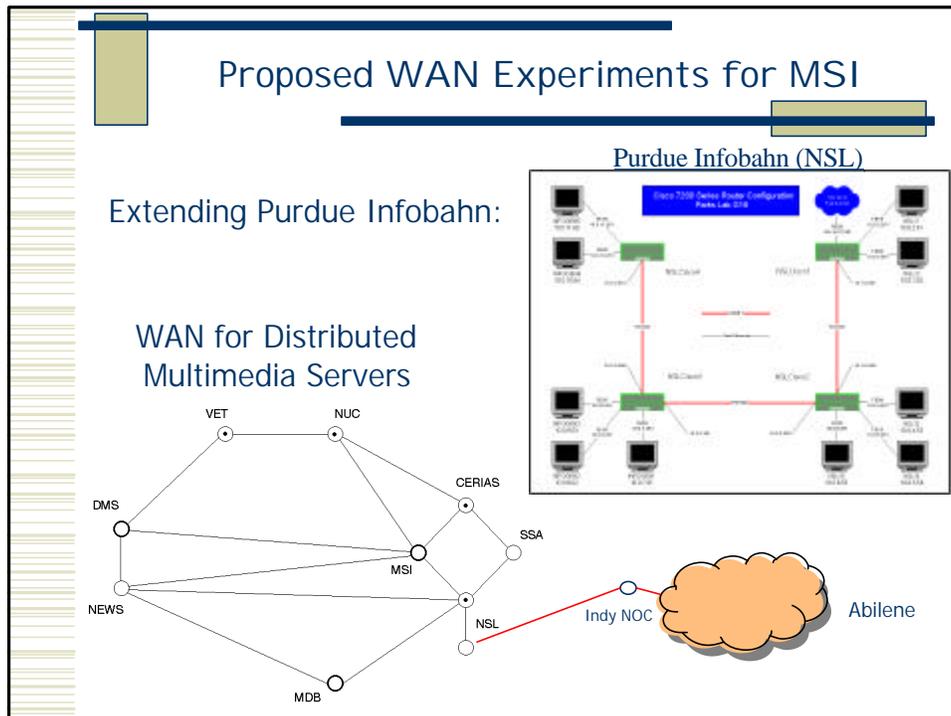
- ◆ Bursty traffic
- ◆ Scalability
- ◆ Efficiency
- ◆ Resource contention resolution
- ◆ Selfishness

Research Activities in Networking

- ◆ Multi-point channel set-up, resource reservation
- ◆ Bottleneck configuration
- ◆ Congestion susceptibility
 - traffic generators and packet drops
- ◆ Diff-Serv support
- ◆ Network monitoring & management
- ◆ Modified router software deployment (partial)
- ◆ Member institution benchmark participation
 - scale

Local Environment: Network Systems Lab

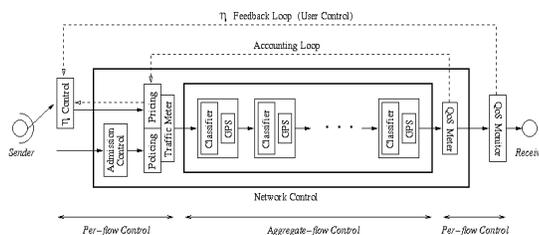
- ◆ Purdue Infobahn QoS testbed: 4+5 Cisco 7206 VXR routers
 - IP-over-SONET backbone
 - custom classifier implementation in IOS
- ◆ NSF vBNS and Abilene connectivity (DS-3)
 - Purdue vBNS/Internet2 Advisory Committee
- ◆ Fore ATM, FastEthernet switches
- ◆ Real-time MPEG I & II video/audio compression engines
 - Optibase, Futuretel (Windows NT)
- ◆ Video/audio capture equipment
- ◆ 35+ Sun/Intel/SGI workstations & PCs
- ◆ Prototype software systems: UNIX, Windows NT



- ### Planned WAN Experiments
- Performance Evaluation and Benchmarking
- ◆ Internet2 benchmarking of
 - Multiple time scale traffic control (TCP-MT, AFEC-MT)
 - Adaptive redundancy control (AFEC)
 - Adaptive label control (Diff-Serv router support)
 - vBNS/Abilene
 - ◆ Commodity Internet benchmarking
 - ◆ Evaluate effectiveness of end-to-end QoS amplification
 - model of future Internet (NGI)

Planned WAN Experiments (cont.)

- ◆ Pricing, accounting, and access control



- ◆ Incremental optimal aggregate-flow classifier deployment (Cisco IOS)
- ◆ IP-over-ATM, IP-over-SONET, IP-over-? issues

Research and Experimental Activities in Security

- ◆ Security-based access control of distributed multimedia objects
- ◆ Probabilistic packet-marking techniques for distributed denial of service attack prevention
- ◆ QoS, Security, and Fault-Tolerance
 - Security/QoS trade-off: overhead
 - “Reactive security” (vs. proactive)
- Fault-tolerance and QoS
 - Impact of fault-tolerance on QoS
 - Hierarchical fault-tolerance & self-healing
 - Network management
 - Availability



Collaboration with Other Organizations

- ◆ State of Indiana 21st Century funding for multimedia and telemedicine project
- ◆ Research collaboration with several industrial partners including Telcordia, Siemens, HP, NCR, and numerous Indiana-based industrial and health management organizations
- ◆ Research collaboration with Purdue's Center for Education and Research in Information Assurance and Security
- ◆ Close collaboration with several universities and HBUCs