Immersive 3D Visualization over Enhanced Access Grid

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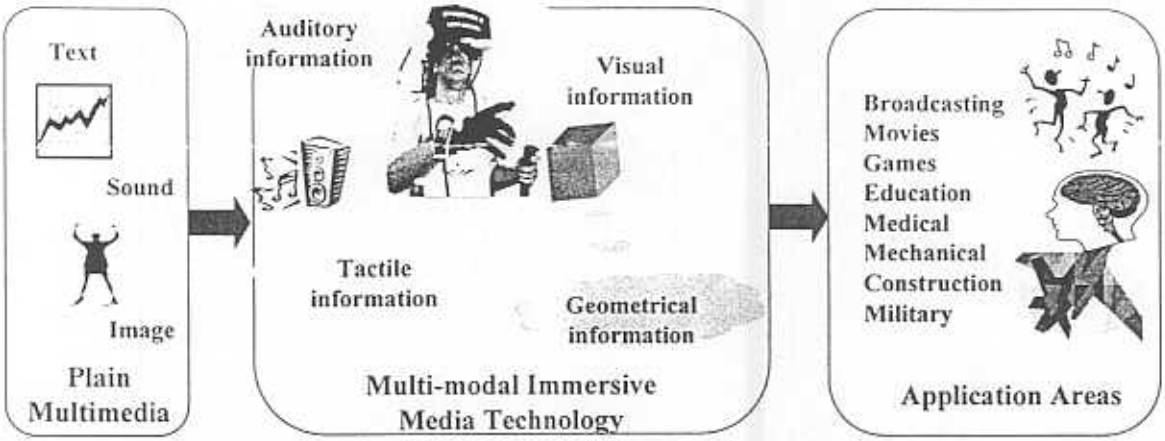
Outline

- Introduction
  - Immersive Media
  - Why (enhanced) Access Grid?
  - Applications: Net VR
- 3D AG project
  - Testbed: system configuration
  - KJIST testbed: M-Class room
- Lessons & Demo
  - 3D delivery & display between KJIST & KISTI

Immersive Media

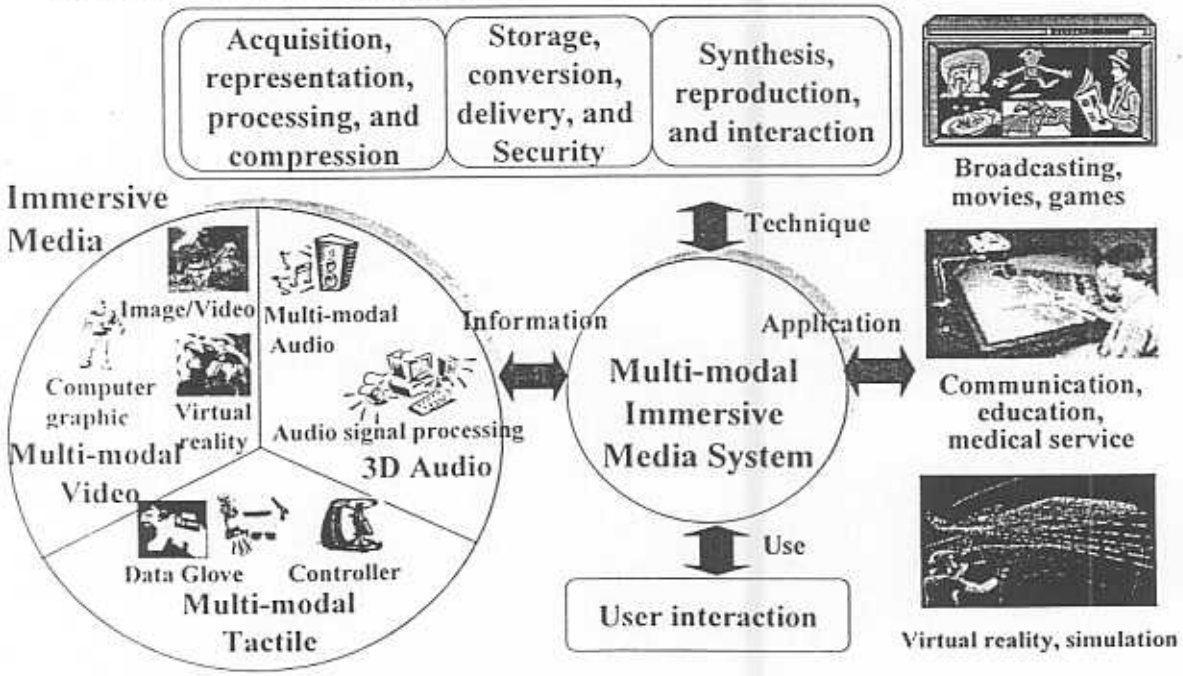
▪ Multi-modal Immersive Media Technology



- Increasing demand for user-centered multi-modal immersive media
- Growing needs for multi-modal interaction with users over the network
- Expected to serve as the core technology for next-generation IT industry
- Enables diverse application areas to provide add-on services

Immersive Media

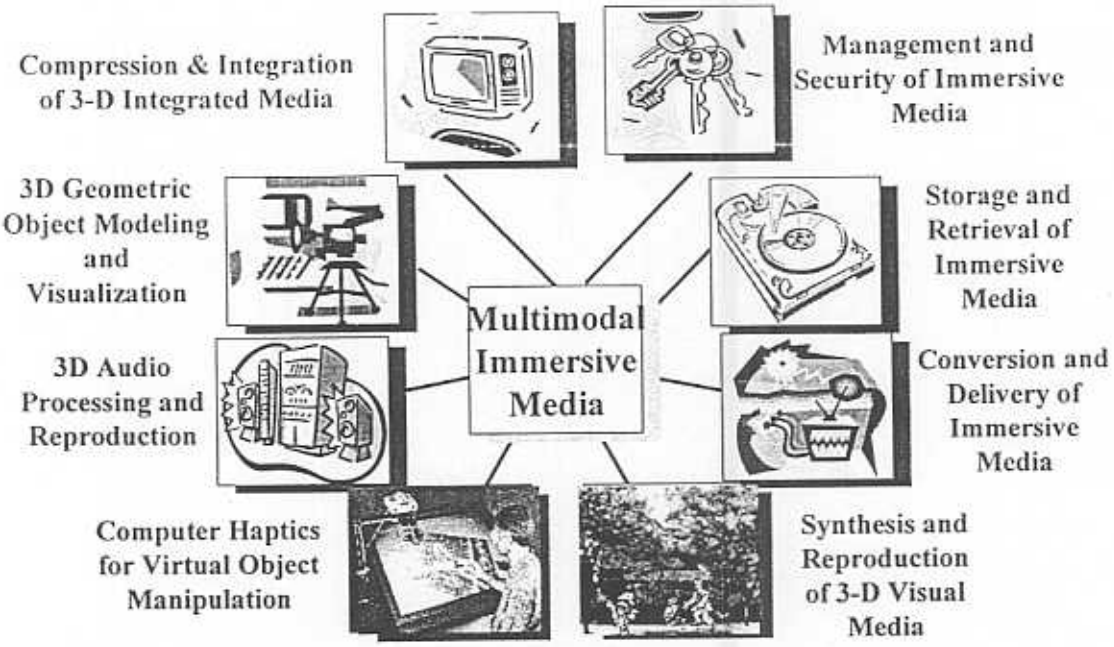
▪ Multi-modal Immersive Media System



Immersive Media

NETMEDIA

- Core Tech. for I-Media System Integration

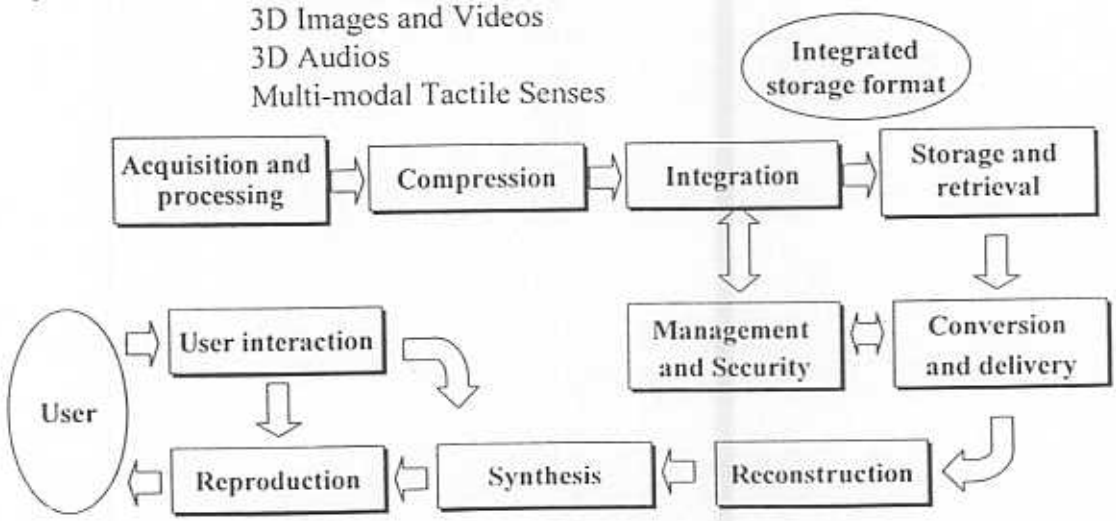


Immersive Media

NETMEDIA

- Life Cycle of Multi-modal I-Media

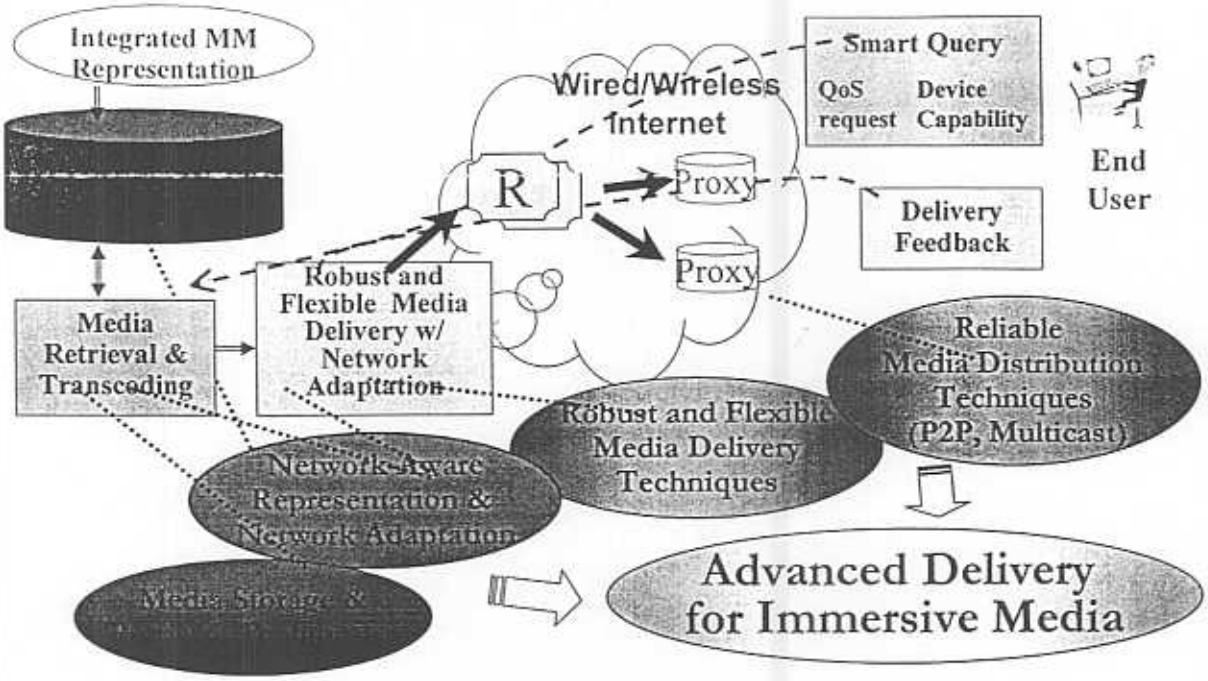
3D Geometric Objects
3D Images and Videos
3D Audios
Multi-modal Tactile Senses



Immersive Media

NETMEDIA

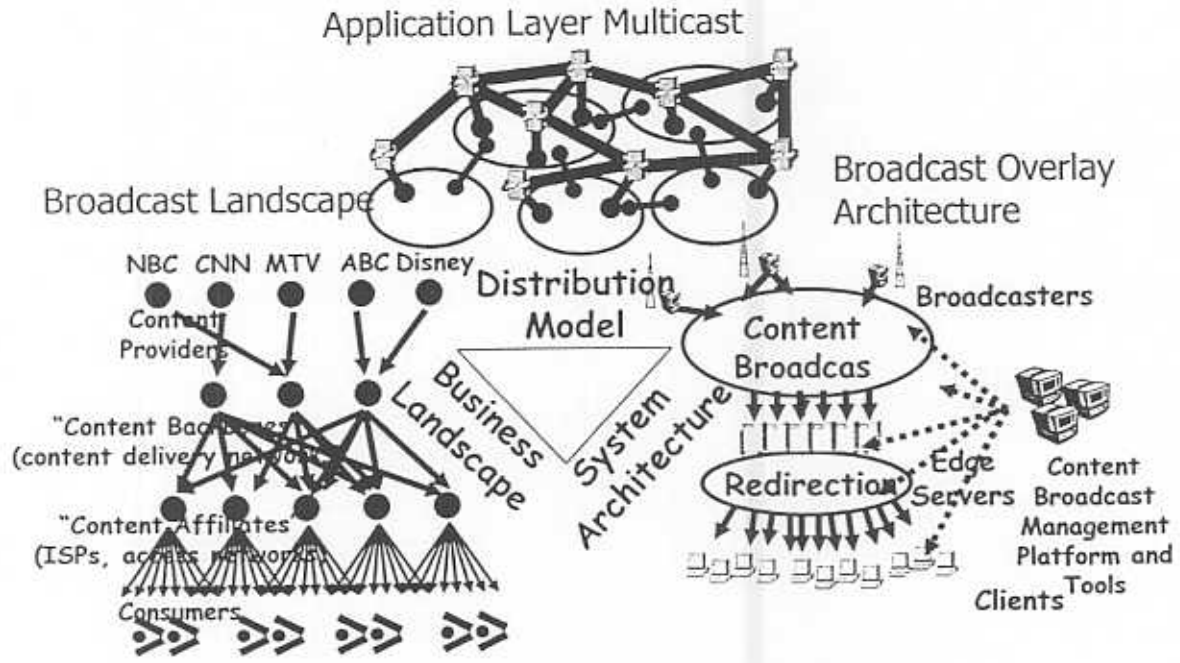
- Immersive Media Delivery



Immersive Media

NETMEDIA

- Futuristic Content Distribution Architecture

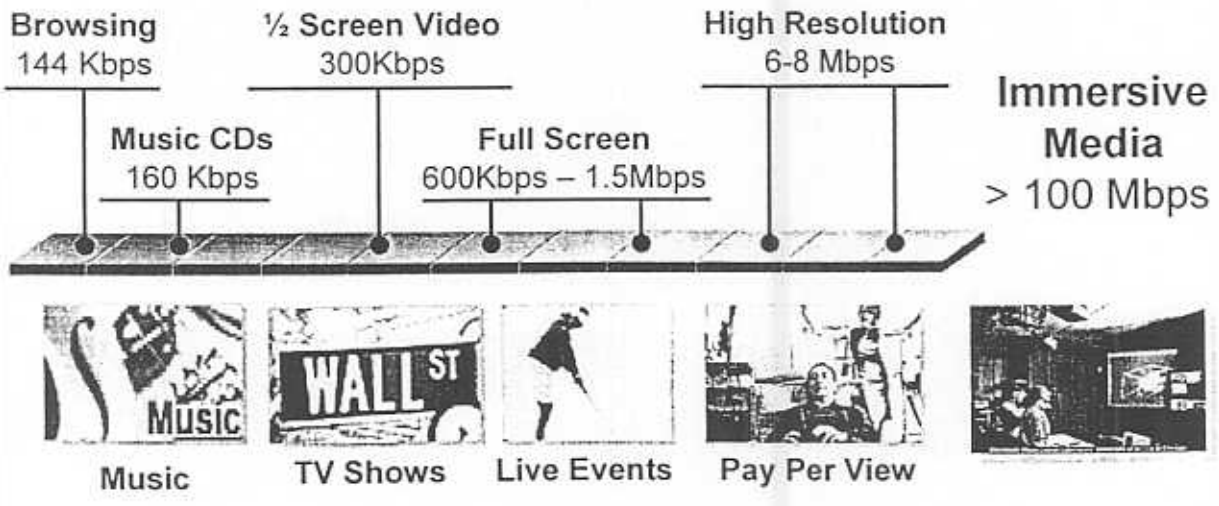


Immersive Media

- Application Characteristics – Overall Issues
  - Quality and Speed, Live/Recorded
  - Reliability/Availability
  - Source/Destination:
    - 1-1, 1-Many, Many-Many
    - Symmetric/Asymmetric bandwidth
  - Interactivity
  - Security, Storage requirements
  - Standards compliance
  - Application Features / Capabilities
  - Application management
  - Digital Rights Management

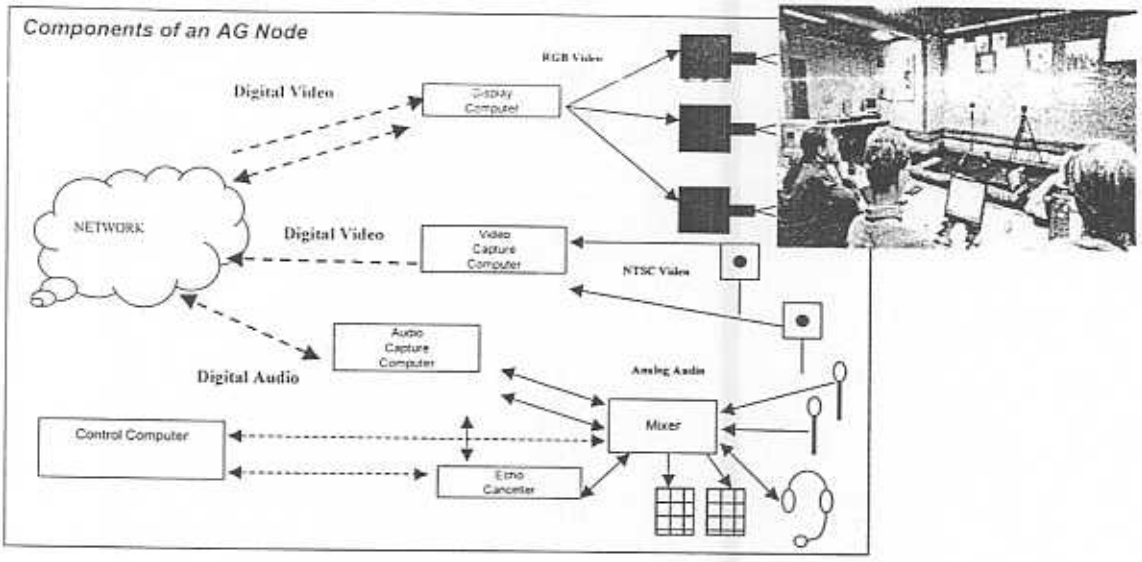
Why Access Grid?

- Broadband Content Requires More...



What's Access Grid?

- Access GRID
  - Support group-to-group interaction across the Grid

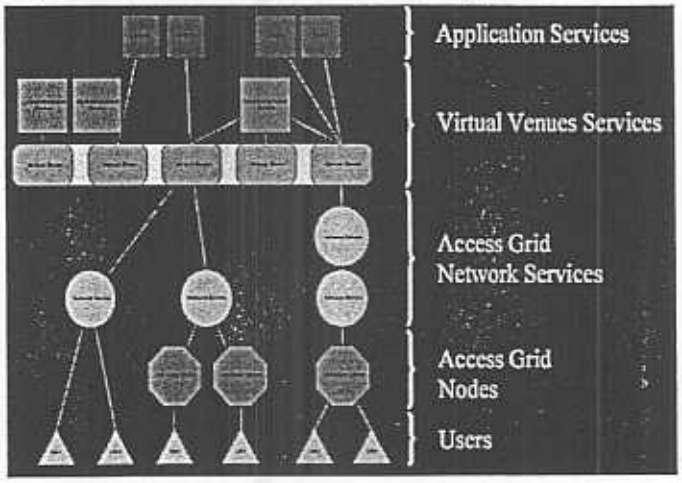


What's Access Grid?

- Access GRID: Goal
  - Enable group-to-group interactions at a distance
  - Improve the user experience
    - Provide an increased sense of presence
    - Support natural human and instrument interaction
    - Eliminate the boundaries of the monitor and the location
  - Enable multi-site visual & collaborative experiences
    - Integrate with high-end visualization environments
    - ActiveMural, Powerwall, CAVE, Flatland, Workbenches
  - Build on integrated GRID services architecture
  - Use quality but affordable digital IP based AV

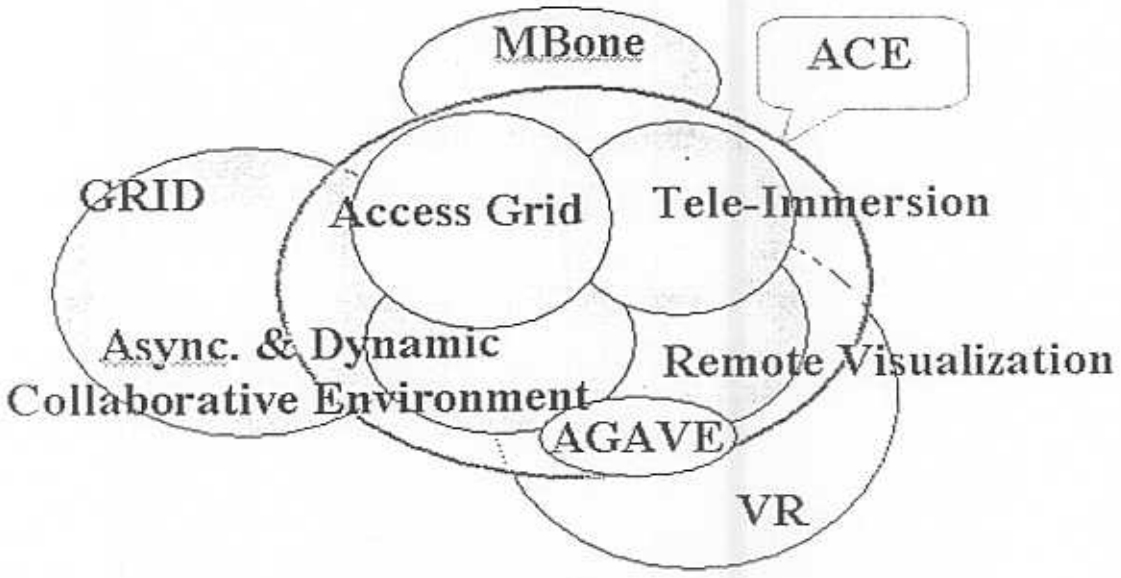
What's Access Grid?

- Access Grid Evolution
  - Network Support
  - Improved Audio
  - Enhanced Video (HD, Stereo/3D Video, ...)
  - Usability
  - Inter-operability
  - Security



Why enhanced AG?

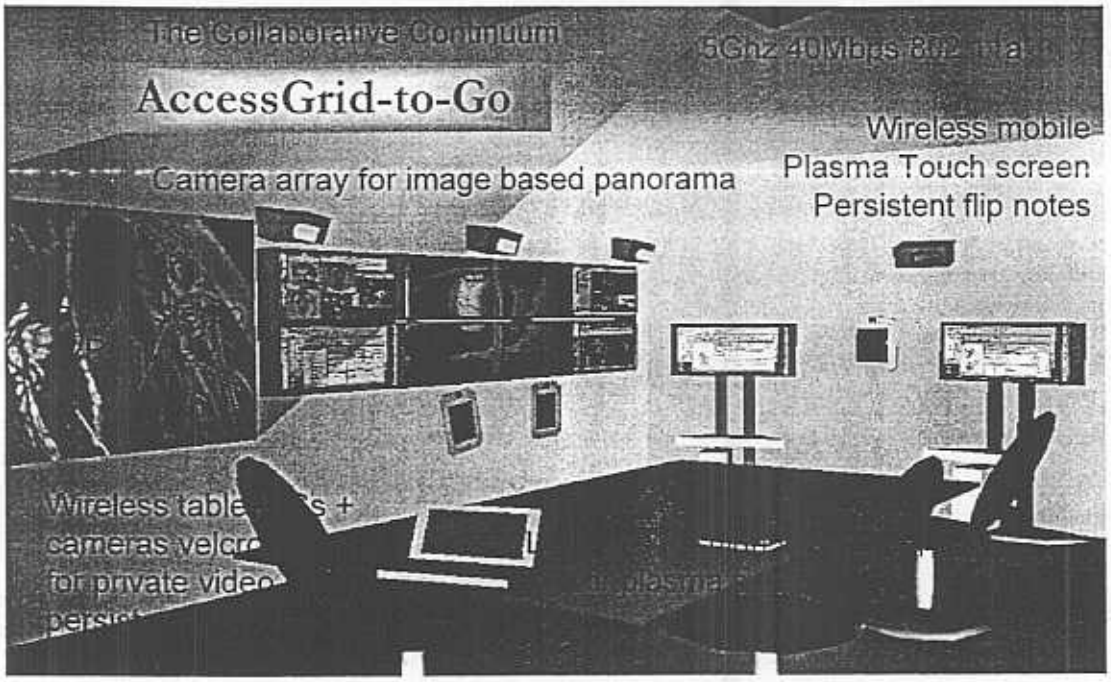
- Advanced Collaboration Environment



ACE : Advanced Collaborative Environment
AGAVE : Access Grid Augmented Virtual Environment

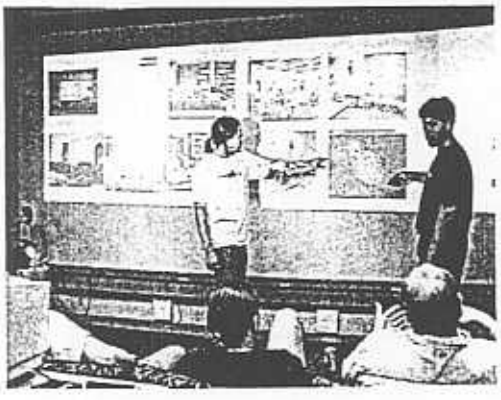
Why enhanced AG?

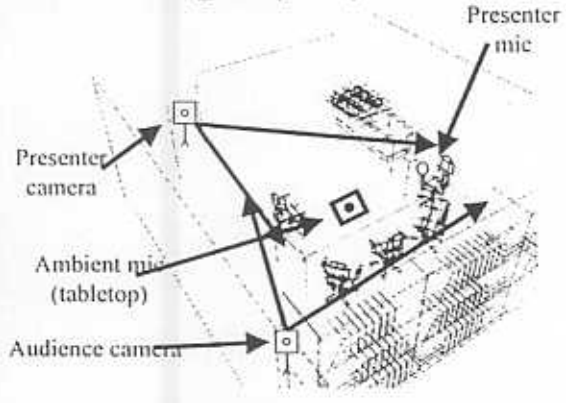
- Access Grid Collaboration



Why enhanced AG?

- Access Grid Collaboration
  - Enable collaborative work at dozens of sites worldwide, with strong sense of shared presence
  - Combination of commodity audio/video tech + Grid technologies for security, discovery, etc.
  - 130+ sites worldwide, number rising rapidly



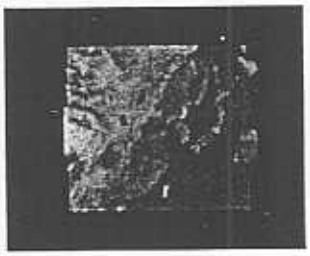


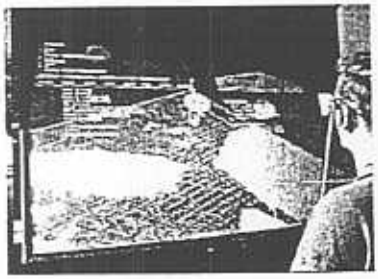
Why enhanced AG?

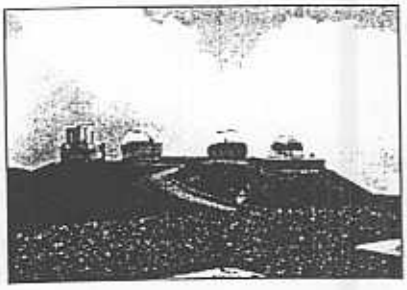
- Realization of Advanced Collaboration Env. via Immersive Media

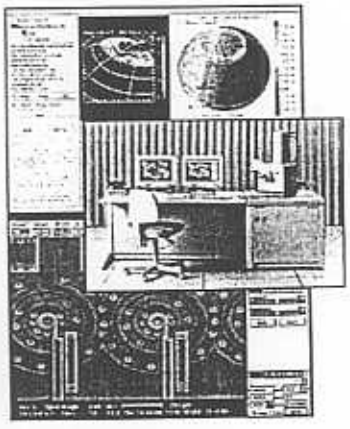
Applications: e-AG

- Applications Cases
  - Interactive collaboration
  - Real-time access to remote resources
  - Shared virtual reality
  - Large-scale, multi-site computation and data mining
  - Any combination of the above









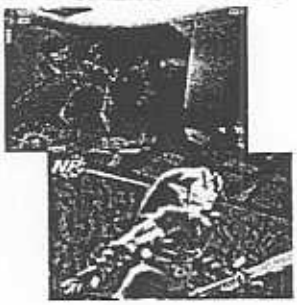
Applications: e-AG

- Tele-immersive "Office of the Future"

University of North Carolina

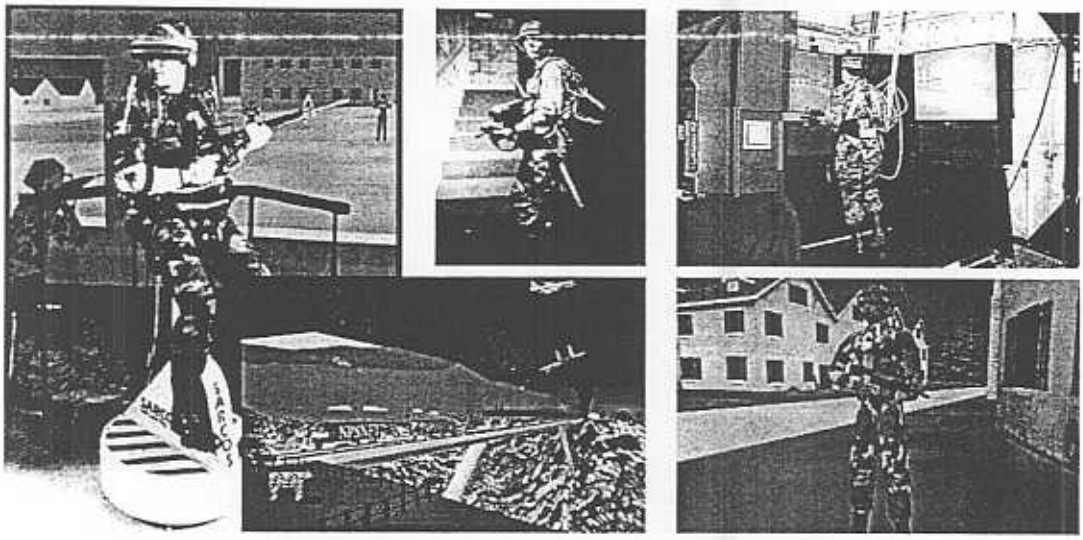
Applications: e-AG

- Application Cases
  - Collaborative design and engineering
    - airplane – wing, engine
  - Multiplayer games
  - Virtual shopping malls (e-commerce)
  - Online tradeshows and conferences
  - Remote customer support
  - Distance learning
  - Virtual Heritage



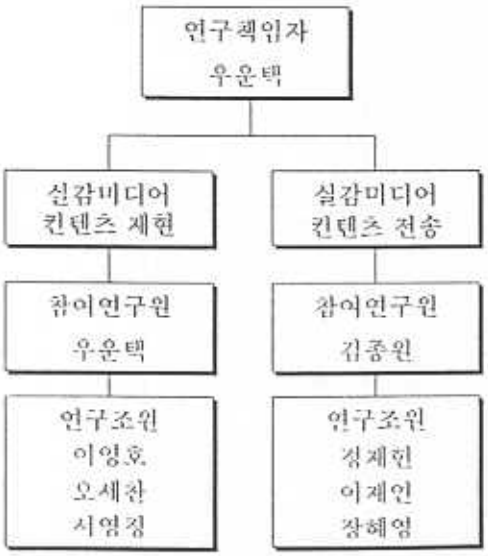
Applications: e-AG

- Application Cases
  - Military and industrial team training/simulation
    - military campaign - tank, plane, infantry



3D AG Project

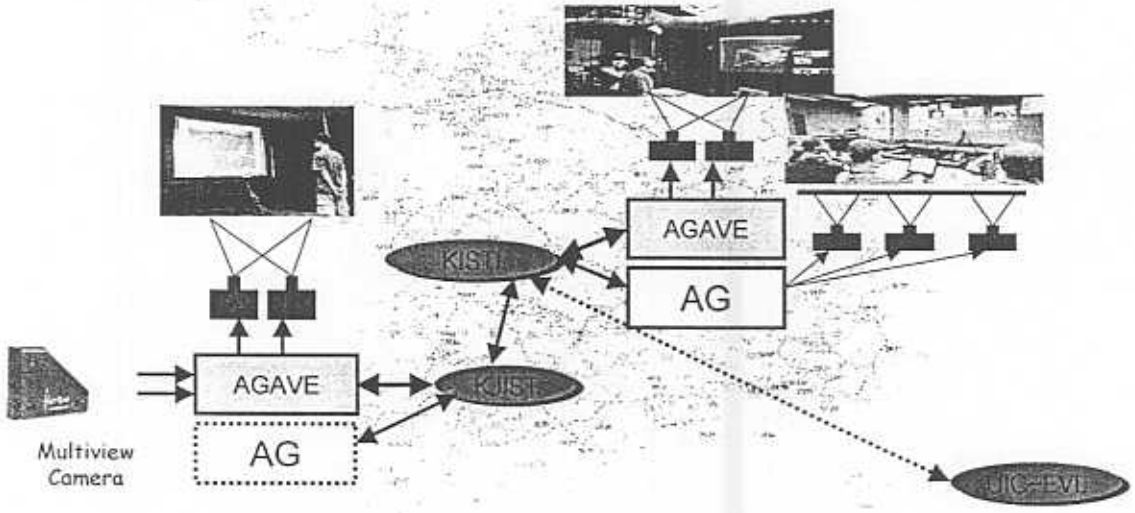
- 3D AG Project
  - Joint project btw KJIST U-VR Lab & NetMedia Lab



- 기존 *AG* 시스템의 화질 한계를 극복하도록 고화질 대용량 비디오 전달을 위한 요소기술 개선
  - 고화질 비디오 획득 및 처리, 압축 및 전송, 복원 및 재현 과정에 걸친 전체적인 효율성 개선에 의한 대용량 비디오 전송기술
  - 초고속 선도시험망의 전송 한계(155Mbps)를 극복하면서 실감형 비디오를 전송하는 AG 기술
- 실감형 상호작용 환경을 위한 고화질 3차원 영상 미디어 전송 및 재현 기술 개발
  - 다채널 (Stereoscopic) 3D 또는 파노라마 비디오 전송 및 재현을 위한 AG 구현 기술
  - AGAVE 시스템 기반 3차원 실감영상 재현 시스템 구축

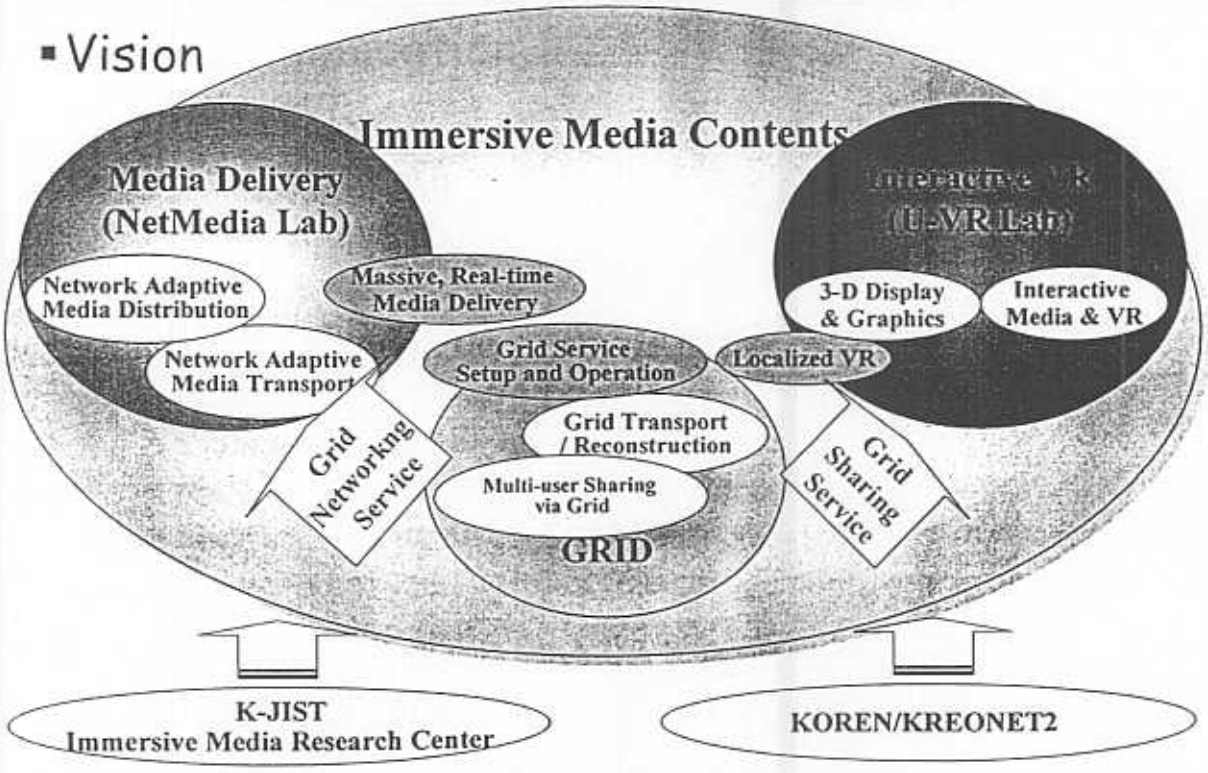
3D AG Project

- Goal of 3D AG Project
  - Realization of immersive media delivery/display
  - Development of 3D video delivery/display techniques to enhance the immersiveness of AG



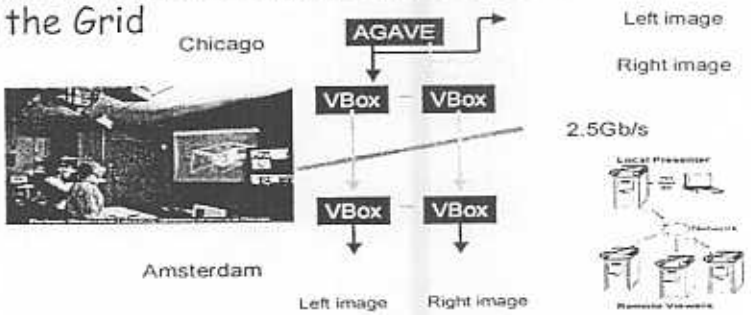
3D AG Project

- Vision



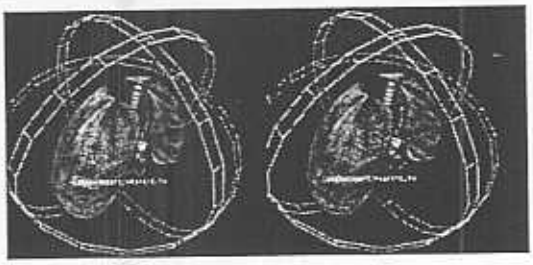
3D AG Project

- Previous research: AGAVE (UIC EVL)
  - Access Grid Augmented Virtual Environment
  - Goal:
    - to augment the Access Grid to allow collaborators to immersively share 3D contents
    - A low cost passive stereo-graphics projection system and accompanying networked PC
    - The ensemble of resources that can be used to support HCI across the Grid



3D AG Project

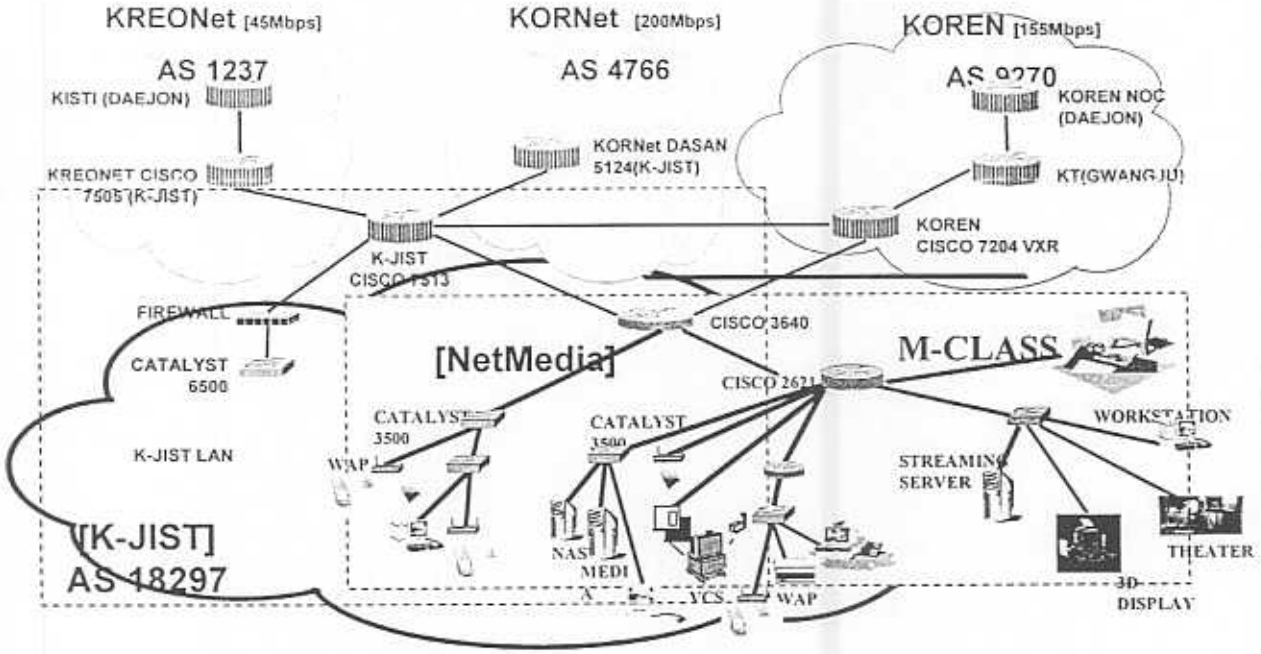
- AGAVE Application
  - ImmersaView
- CAVE Library
  - API for immersive display
  - Simple but powerful
  - Handle the creating robust application for VE
    - Window and viewport creation
    - Displaying multiple graphics channels
    - Multi-processing and multi-threading
    - Cluster synchronization and data sharing
    - Viewer-centered perspective calculation
    - Stereoscopic viewing
    - Networking



3D AG Project

NETMEDIA

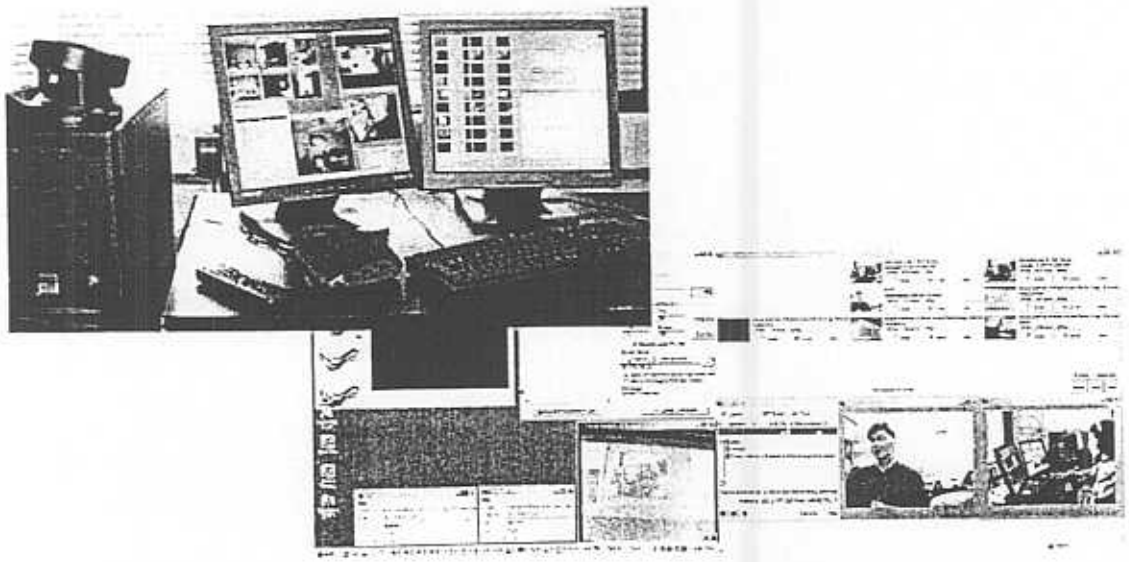
- KJIST e-AG: Network Status



3D AG Project

NETMEDIA

- KJIST Mini AG
  - PIG: Personal Interface to AG (v.1.2, Oct. 2002)
    - Networking: KJIST – KISTI -KIST



3D AG Project

- KJIST e-AG: 3D Video Coding
  - Why 3D visual media delivery with multiview?
    - Immersive visual communication
    - (Object-based) functionality (interactivity)
  - Trade-offs: immersive vs. the amount of data
    - Channel BW, protocols, data amount

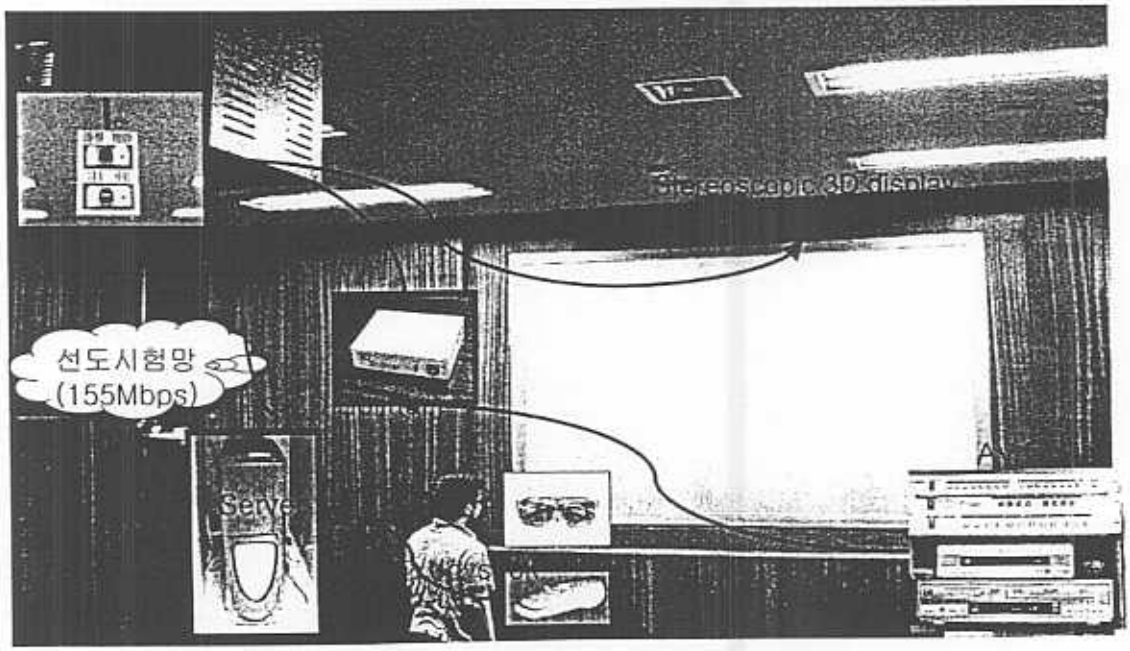
Encoder

Channel

Decoder

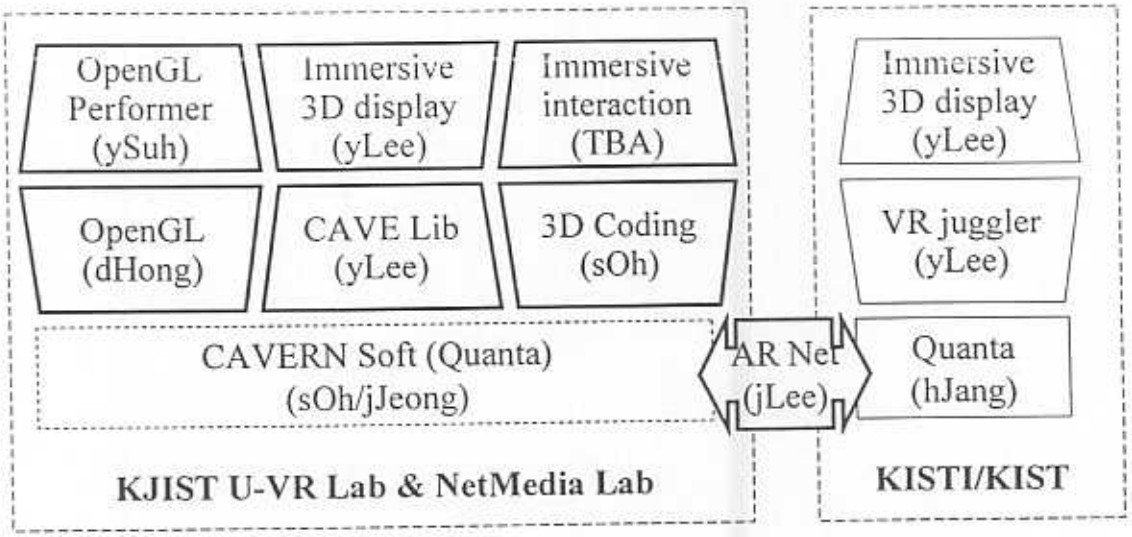
3D AG Project

- KJIST e-AG: Testbed Setup



3D AG Project

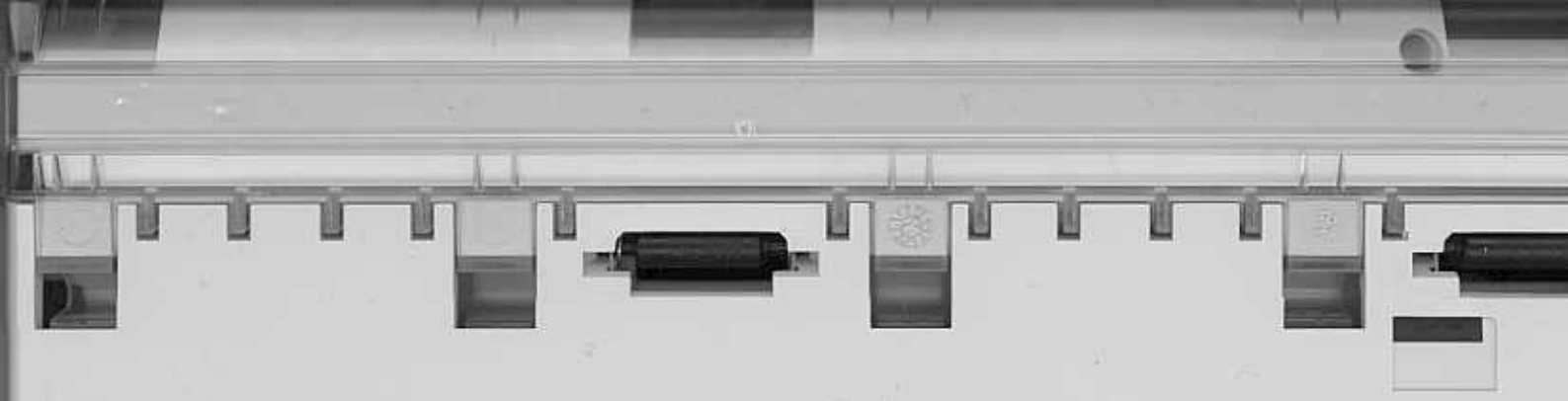
- Testbed: e-AG (VR Grid)
  - Networking btw KJIST & KISTI/KIST:



3D AG Project

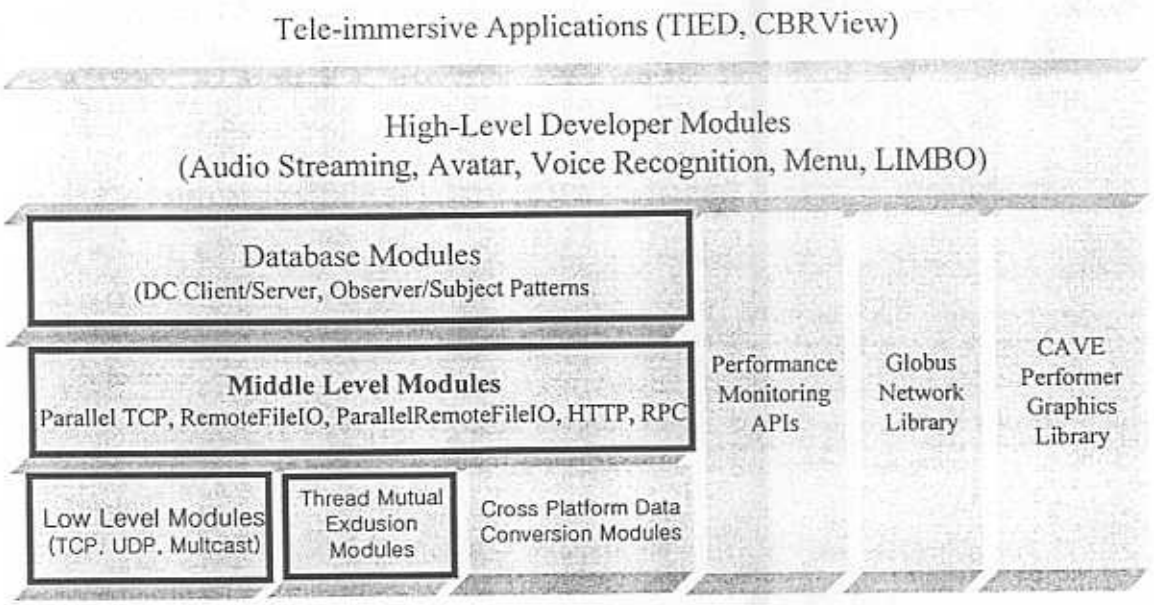
- KJIST testbed: HW & SW Spec
  - Projectors with polarizing filters
  - Projection (silver) screen
    - Standard projection screens do not preserve polarization
  - PC: Dell 530 (dual Xeon 1.7GHz) x 2
    - CG card: Wildcat6110 (Matrox G550, GeForce2 MX)
  - Software (Redhat Linux 7.3)

- Redhat linux: http://www.redhat.com/
- xfree86 4.0.2: http://www.xfree.org/
- Wildcat 6110: drivers http://www.3dlabs.com/
- CAVE Library: http://www.vrco.com/
- OpenGL Performer: http://www.sgi.com/software/performer/
- CAVERNsoft: http://www.evl.uic.edu/cavern/cavernG2/



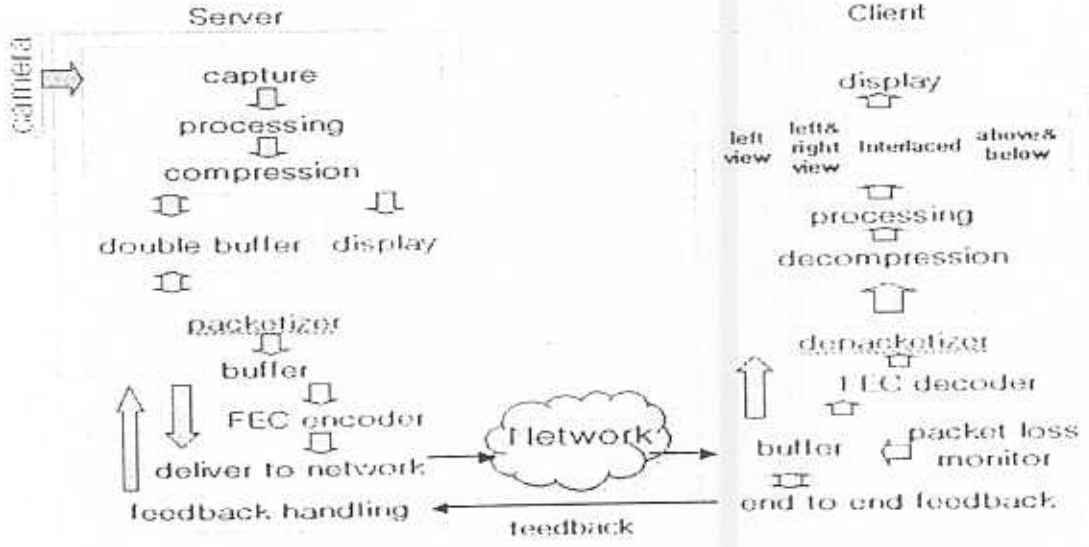
3D AG Project

- KJIST e-AG:
  - Networking: CAVERNSoft G2, Quanta



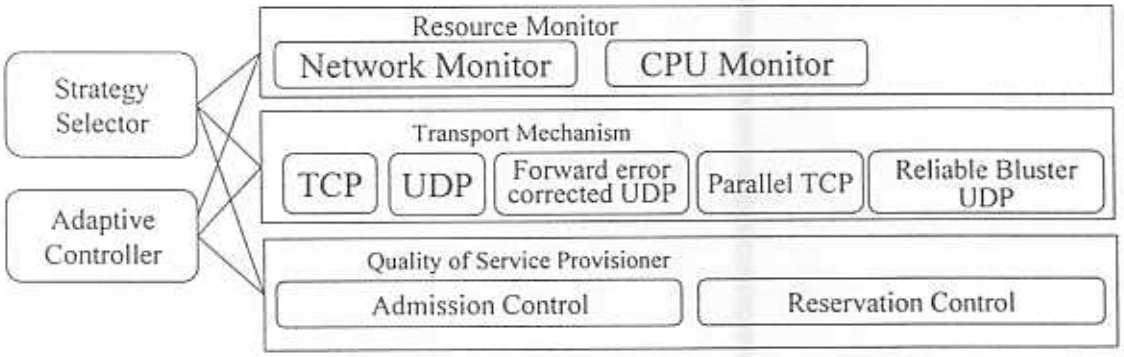
3D AG Project

- KJIST e-AG:
  - 3D Video Processing and Networking



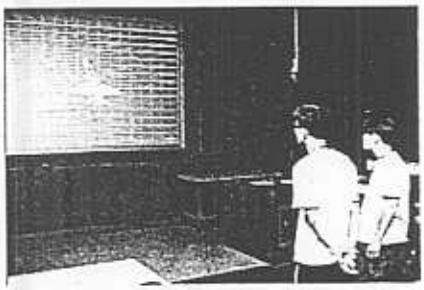
3D AG Project

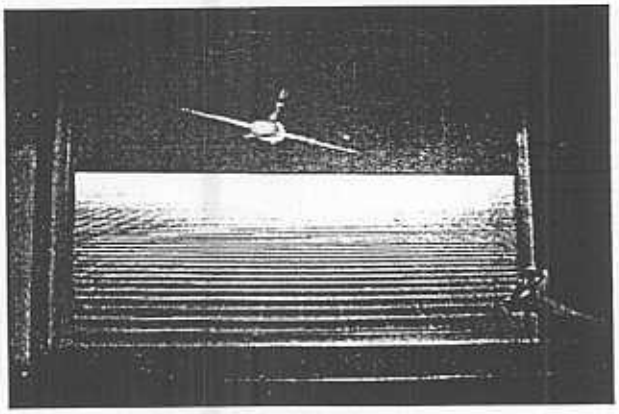
- KJIST e-AG: Networking - QUANTA
  - Low-level modules: TCP, UDP, FEC+UDP, Parallel-TCP, Reliable Blast UDP
  - Thread/Mutual Exclusion modules: Thread management, mutual exclusion capabilities
  - Middle-level modules: Http, UDP and TCP reflector, Parallel socket TCP / Remote File I/O, RPC
  - Database modules: Distributed Shared Memory emulation



3D AG Project

- KJIST e-AG (3D CG)

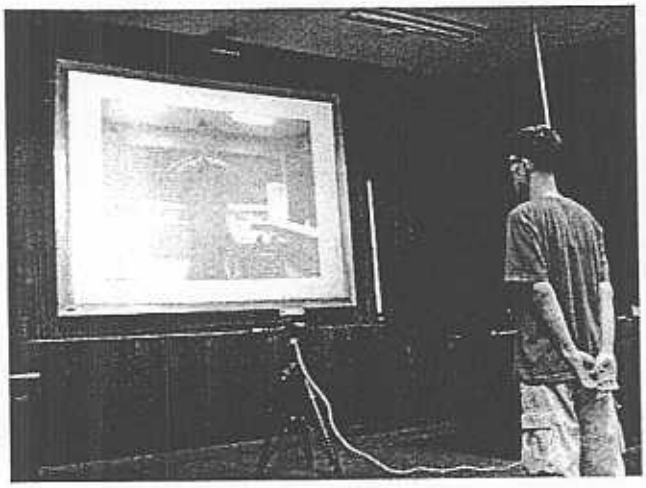


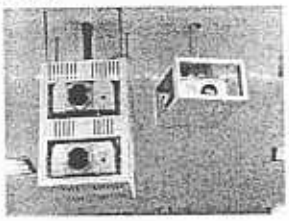


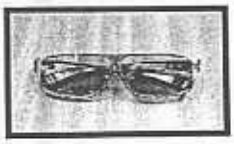
Stereoscopic Display and Interaction with Joystick

3D AG Project

- KJIST e-AG (3D Video)
  - Completed Interface btw 3D Video + Networking
  - 3D Video processing & simple compression
  - Test and stabilize for Local LAN

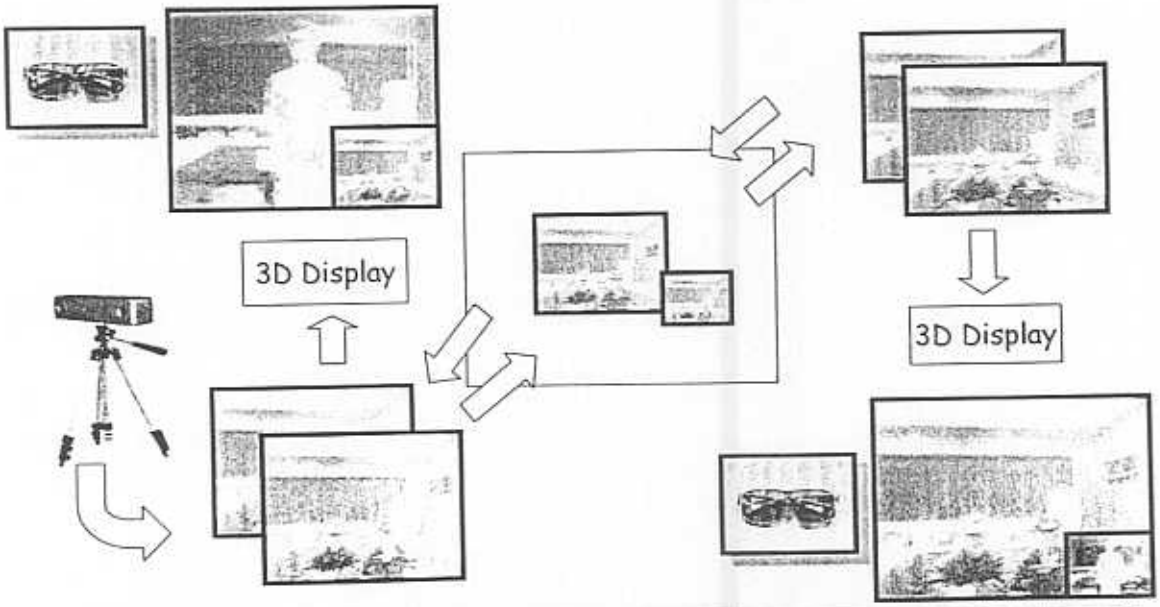






3D AG Project

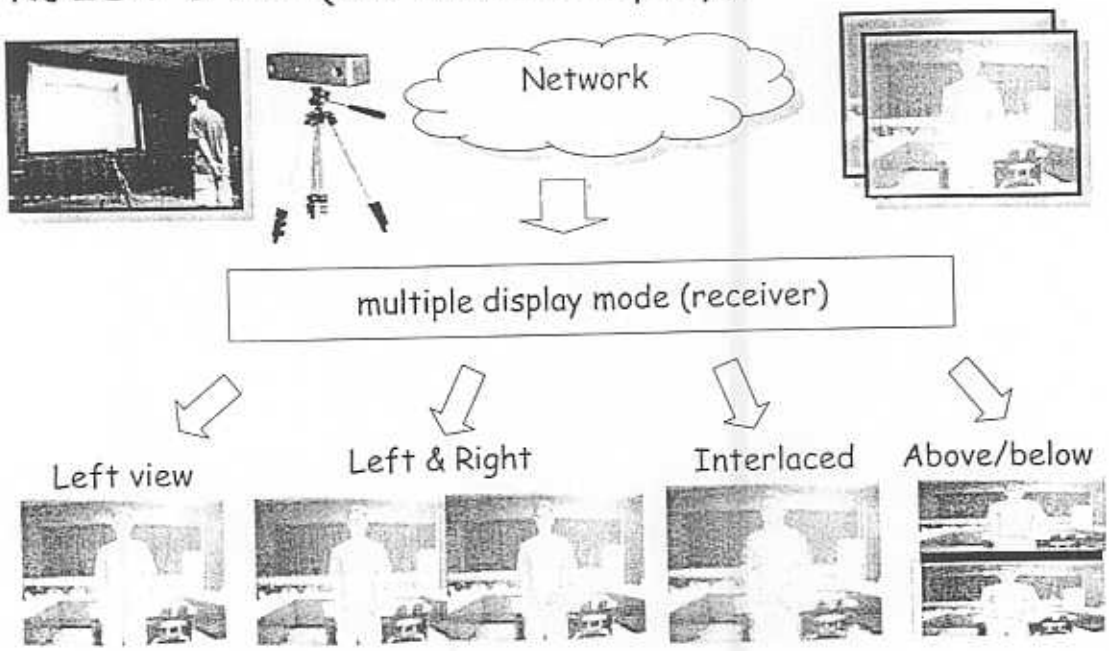
- KJIST e-AG (3D Video Delivery)



3D AG Project

NETMEDIA

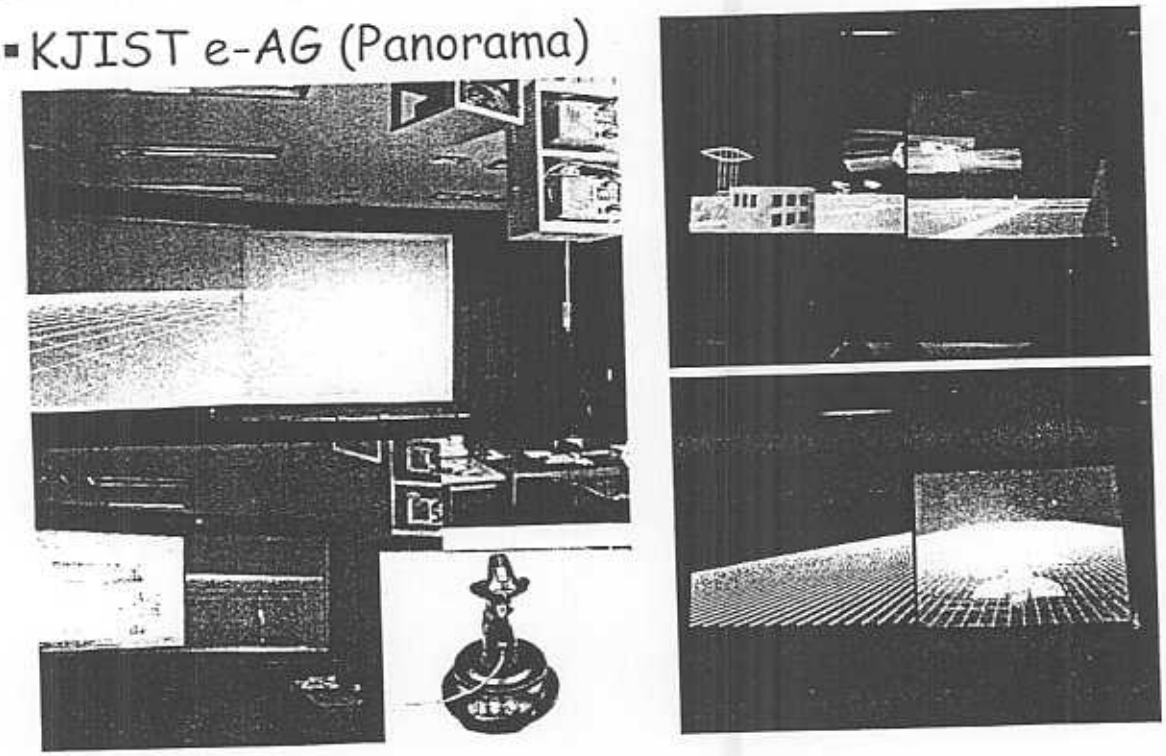
- KJIST e-AG (3D Video Display)



3D AG Project

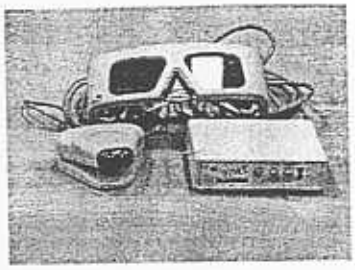
NETMEDIA

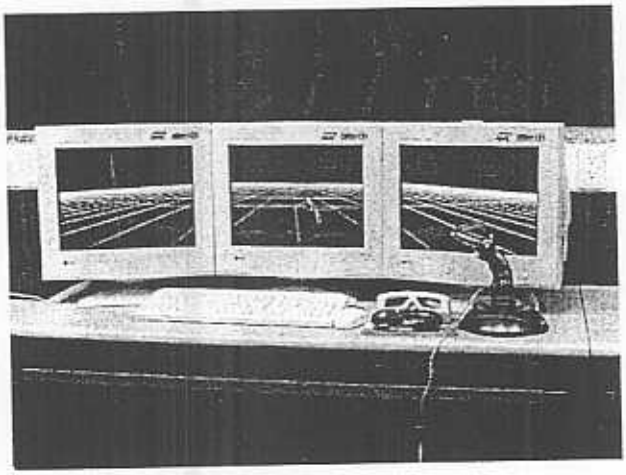
- KJIST e-AG (Panorama)



3D AG Project

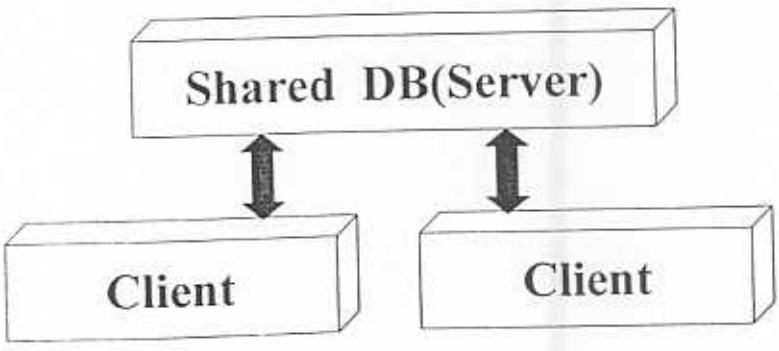
- KJIST e-AG (Panorama)
  - Setup
    - WildCat6110, Matrox Mystique
    - Active Stereo Display
    - CAVELib, VR Juggler
  - Networking
    - CAVELib & VR Juggler
    - Quanta





3D AG Project

- KJIST e-AG (Panorama)
  - Shared DB Model: Client/Server Model
    - Using TCP Reflector
    - Clients: Sending information to server
    - Server: update information to all clients

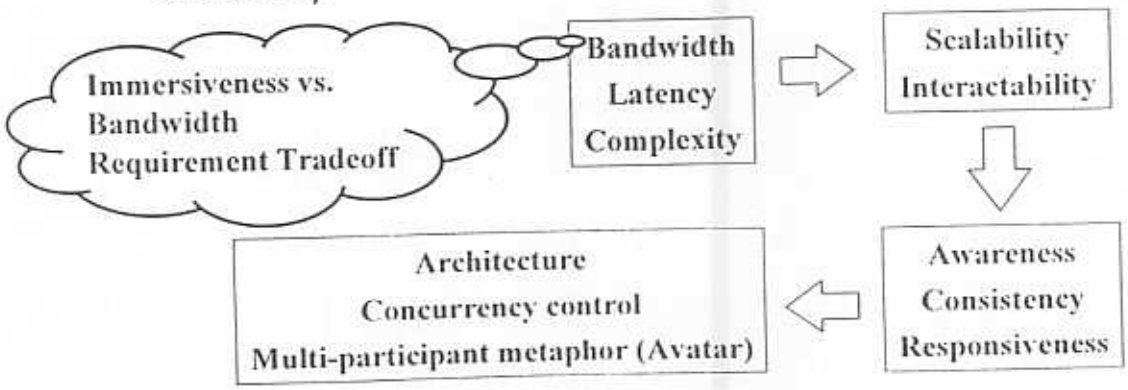


3D AG Project

- Next Phase
  - KJIST - KISTI delivery test and enhancement
  - Wrap-up
  - Maybe in 2003, interactive VE setup between
    - KJIST e-AG and KISTI CAVE
    - KJIST e-AG and KIST CAVE
    - KJIST e-AG and UIC EVL

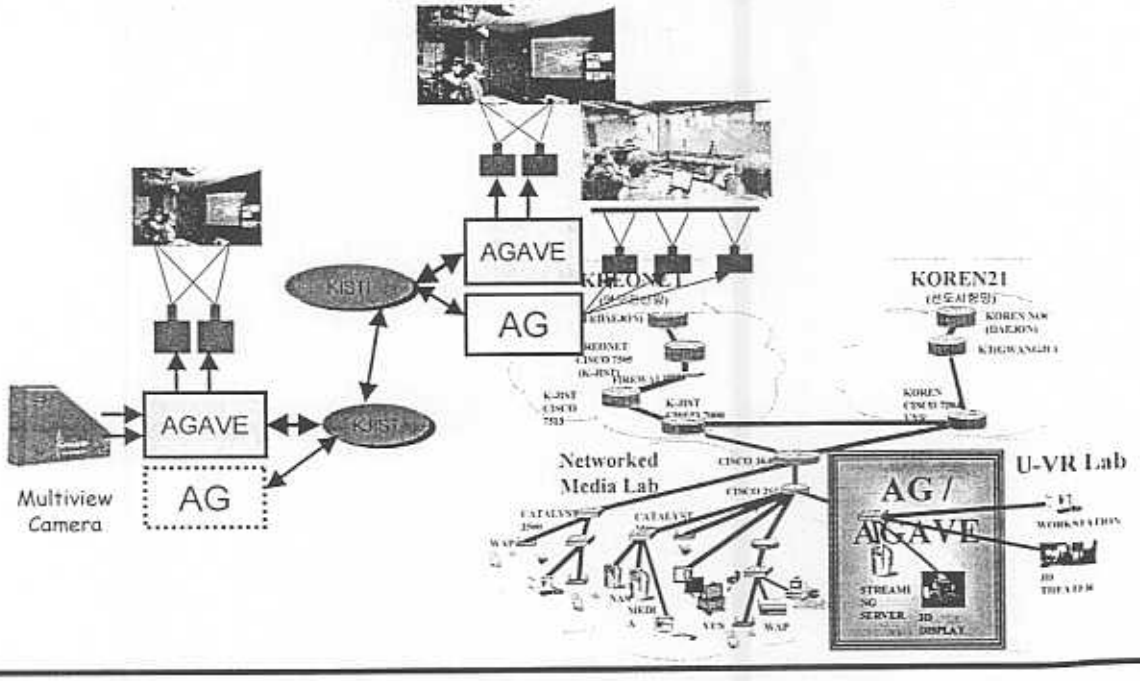
3D AG Project

- Next Phase (in 2003)
  - Immersive Media + e-AG Challenges
    - Bandwidth - Content (Stereo video 1K x 1K x 30fps x 24 bits x 2 = 1.4 Gbps)
    - Latency
    - Consistency
    - Scalability



3D AG Project

- Demo
  - Network: Local (100Mbps) + KOREN (155Mbps)



Conclusion ?

Summary & Discussion

Thank You!

- Discussions (Q&A)
  - mailto:wwoo@kjist.ac.kr

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