



Web Lecture Archiving, Robotic Tracking Systems, and the Lecture Object

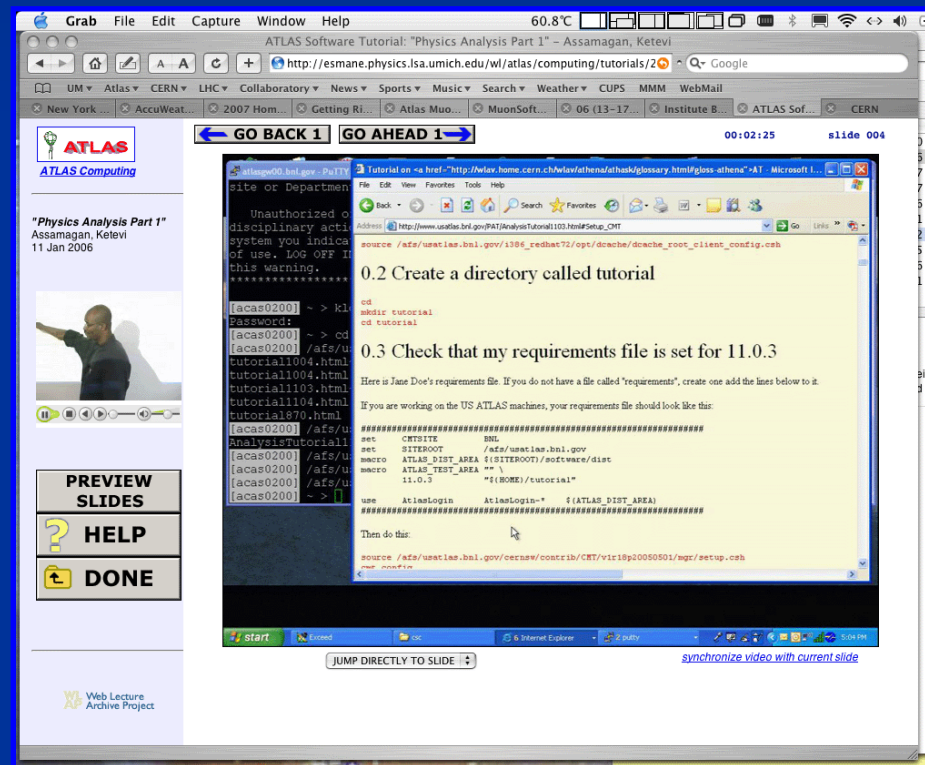
Jeremy Herr

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Shaping Collaboration 2006, Geneva

What is a Web Lecture?

- Media-rich presentation viewable by anyone in the world with:
 - any web browser
 - RealPlayer plug-in
- Media streams:
 - lecturer's audio
 - lecturer's video (low bandwidth)
 - high-res slide images
 - high-res chalkboard images
- Features
 - slide index
 - ability to “jump around”
 - platform independence
 - low bandwidth
 - ability to evaluate usage

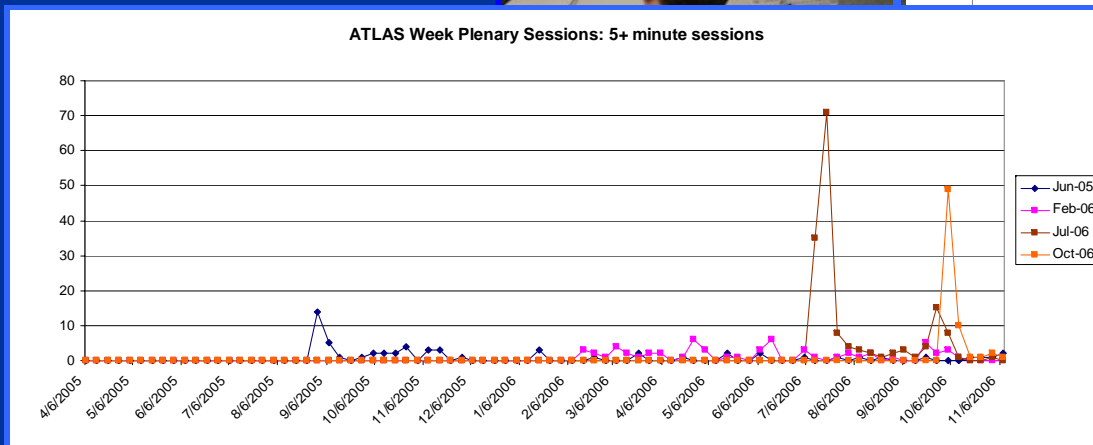
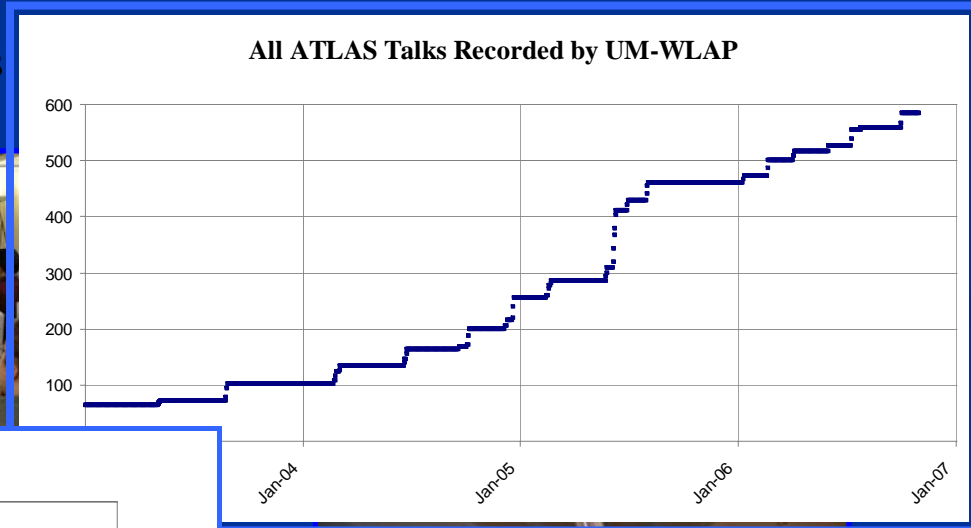


Web Lecture Recording

- Charles Severance wrote initial software in 1997
- Michigan based WLAP Archive started recording CERN Summer Student Lectures in 1999
- Our archive now has 1300+ lectures
- Talks recorded from:
 - The ATLAS experiment
 - CERN events
 - University of Michigan Events
 - U-M Saturday Morning Physics
 - American Physical Society (APS)
 - Int'l Conference on Systems Biology 2005 at Harvard
 - MScribe classroom recordings

Recordings for ATLAS

- ATLAS is funding UM's team to record several priority events per year for the Collaboration.
 - ATLAS Week Plenary Sessions
 - Software Tutorials
 - Workshops



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Mscribe Pilot Project

- Ambitious new project to completely automate the recording of classroom lectures
- 2006 Spring: tested system in Physics 140 lecture
- 2006 Fall: Pilot project began
 - 4 courses being recorded
 - courses and instructors selected based on requirements of pedagogical researchers
 - media server, integrated with CTools (Sakai)
 - about 200 hours of talks recorded

MScibe Recordings Fall 2006

- Entire courses (each 2 lectures/week)
 - AMCULT 100: Rethinking American Culture (Judy Daubenmier)
 - AMCULT 219: American Folklore (Bruce Conforth)
 - HISTART 112: The History of Photography (Matt Biro)
 - PSYCH 111: Introduction to Psychology (Brian Malley)
- Selected sessions of courses
 - STATS 350: Introduction to Statistics and Data Analysis (Brenda Gunderson)
 - ENVIRON 110: Introduction to Global Change I (Ben van der Pluijm)
- Other events
 - School of Education CSHPE Talks
 - Various Bioinformatics Talks
 - Saturday Morning Physics

Mscribe System

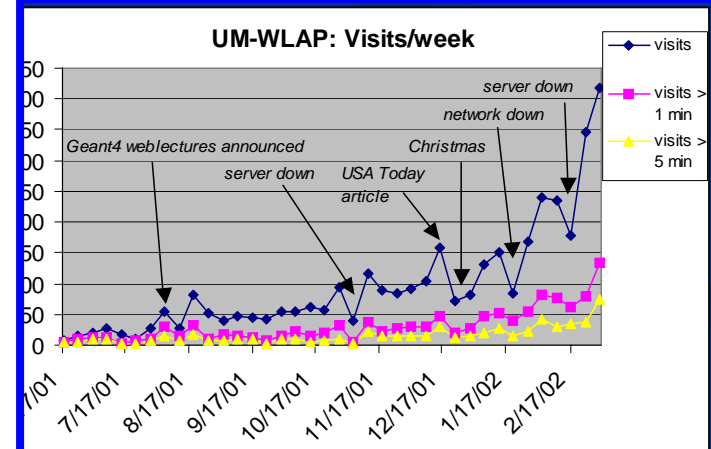
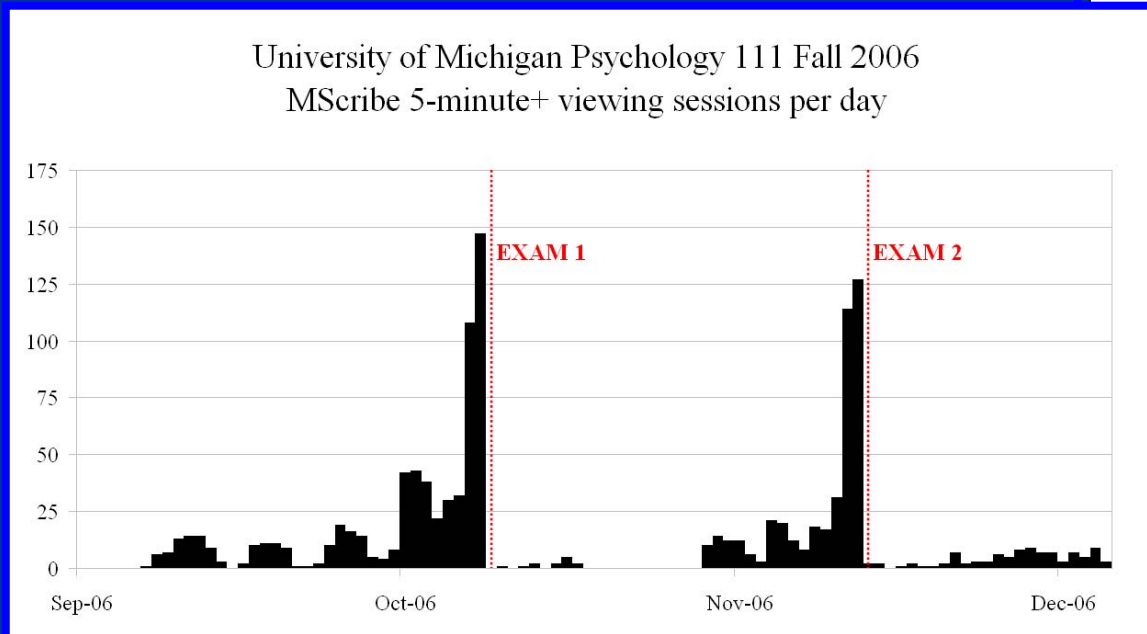
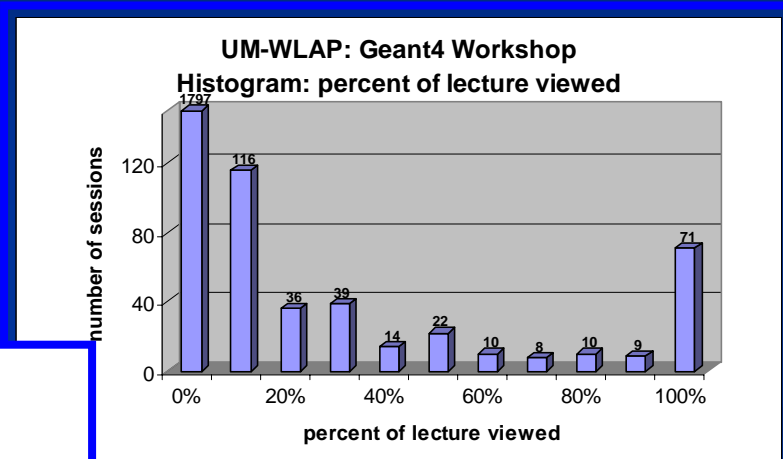
- 4 recording carts (roughly \$10K each)
 - one linux PC for media capture and tracking control
 - tracking camera system
 - high quality audio equipment
 - additional “chalkboard” camera
- Archive server (3 TB; each L.O. is about 2GB)
- Media server
- Lecture Object processing server
- iPod processing server
- Manpower:
 - 1 engineer (tracking research and development, cart design)
 - 1 web developer/manager (software development, schedule management, liaison with University support staff)
 - 2-3 part time work study students (pushing carts around, pressing START and STOP, reporting problems)

MSubscribe Pilot Components

- Automated recording, archiving, processing and publication systems
- Integrated pedagogical studies to evaluate the impact of this revolutionary technology on classroom learning
- Dissemination:
 - Sakai (CTools)
 - iTunesU podcasting

Usage Information

- MScribe pedagogical researchers are:
 - conducting student surveys
 - evaluating demographic data
 - performing comparisons to server log data.



Robotic Tracking

- To scale up web lecture recording, all aspects of recording, archiving and formatting must be automated
- Human camera operator must be replaced with a robot
- We received a \$250,000 grant from the NSF National Science Digital Library in 2003 to begin work on tracking.
- System Requirements
 - Portable
 - Robust
 - Affordable
 - Runs without expert intervention
 - Little setup or calibration



Survey of Existing Tracking Technologies

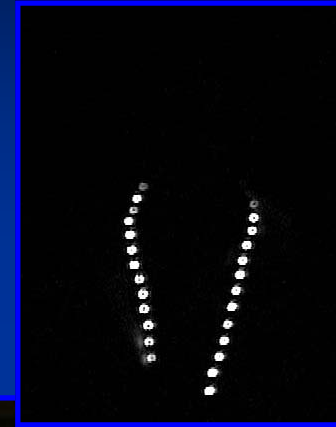
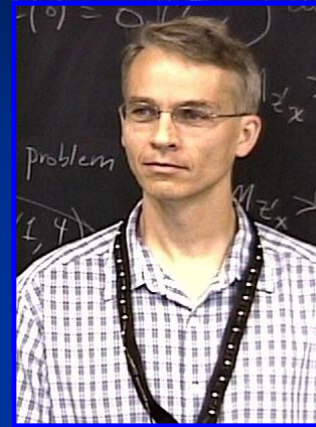
- We have investigated and ruled out the following tracking technologies

Human camera operator	Intelligent tracking that generates pleasing video	Very expensive, gets tired after several hours
Ultrasonic Developed by AT&T labs	Probably accurate enough for tracking a lecturer	Requires extensive permanent installation
Radio Frequency (RF) BlueSoft	Almost reasonably priced (6,000 USD)	Slow and insufficient accuracy, especially indoors
Ultra Wide Band (UWB) UbiSense	Almost reasonably priced (10,000 USD), more accurate than RF	Requires extensive set-up and calibration
“passive” IR Used in Boeing factories	Inexpensive (4000 USD), simple and very accurate	Very easily distracted by any reflective objects in the room

Jeremy Herr

Current Tracking System

- “Active” Infrared
 - necklace chain of bright IR LED’s
 - CCD camera follows it
 - PTZ commands sent to video camera
- This system satisfies our criteria
 - Portable: sits on a cart
 - Robust: simple design makes it very robust
 - Affordable: currently under 4 000 USD
 - No expert intervention: start it and it just works
 - Little setup: almost no calibration required
 - Accurate to within centimeters



Celebrate Invention 2005

- March 2005
 - Provisional patent filed, describing the current dual-camera with active IR necklace.
- October 2005
 - University of Michigan researchers filed 287 invention disclosures in 2005
 - Eight of these were selected to be featured at the 2005 Tech Transfer Inventor's Reception, as the most commercially promising and world-changing.
 - Our tracking system was one of these eight.
 - Most importantly, **I won an iPod!**



- March 2006
 - Permanent patent filed.

Current Tracking Research

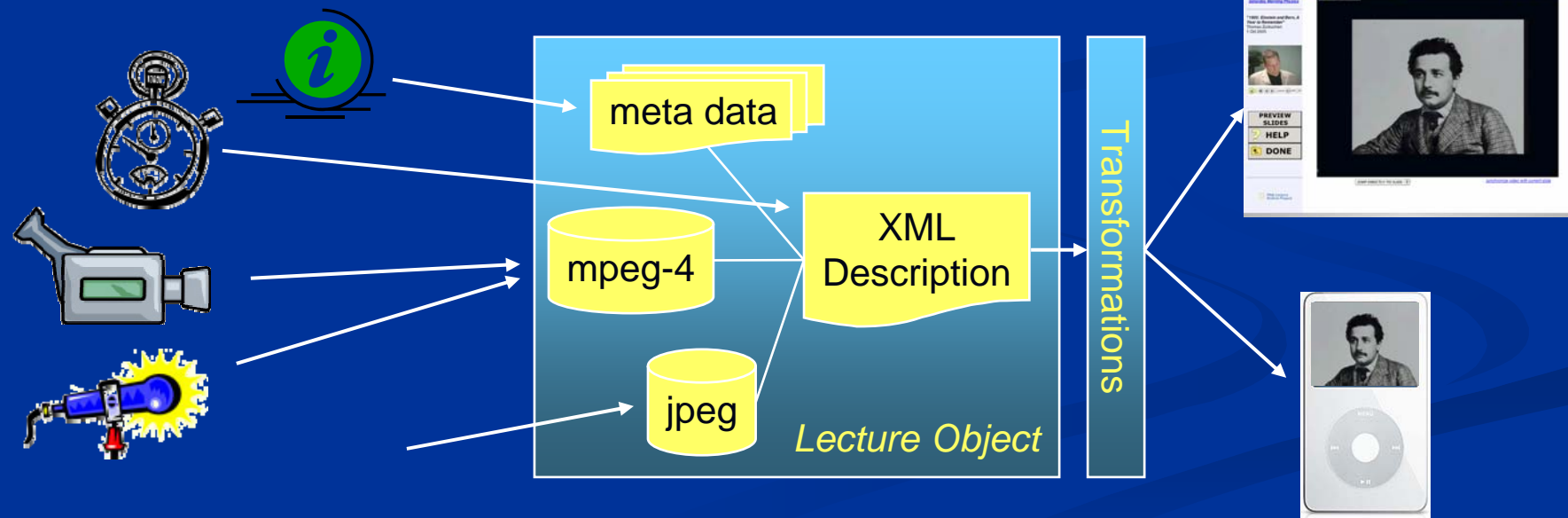
- CCD with synchronized pulsing LED's
- Quad detector
- Position Sensing Detector (PSD)
- Ultrasonic phase difference
- RF phase array

Lecture Object

- Originally proposed by Giosue Vitaglione at Pontignano 2000 conference
- A standardized data object containing
 - high-resolution, open format media files
 - timing data
 - standardized metadata (Dublin Core, IEEE LOM)
- Designed for
 - Longevity
 - Sharing among multiple institutions
 - Flexibility in viewing formats

Lecture Object

- Creation of the Lecture Object sets us apart from most other media recording activities, since it creates an additional step in the Web Lecture production process, but it is the right way to do it.



Users of Lecture Object

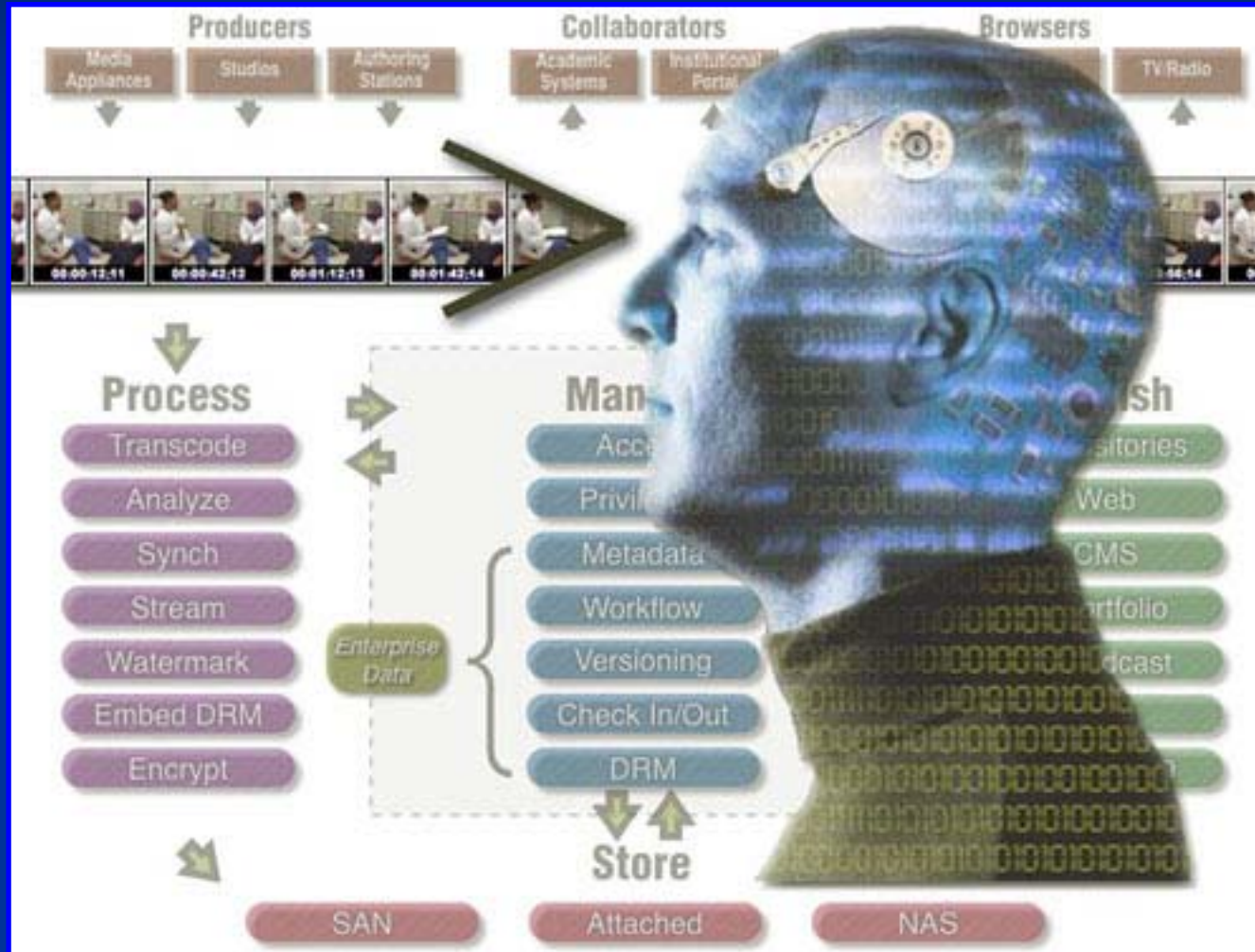
- Using a simple, open, well-defined global archival standard will:
 - encourage multiple institutions to share their archives
 - enable shoe-string operations as well as well-funded groups to easily produce compatible content
- Archives using UM-WLAP technology and Lecture Object maintained by:
 - University of Michigan WLAP / MScribe
 - CERN
 - American Physical Society (APS)
 - Fermilab

Lecture Object Development

- MScripte technical advisory committee is working on refining the standard
- We are collaborating with CERN in this development. Gregory Favre (CERN IT) is working to make SMAC support it.
- Next versions of the Lecture Object will:
 - support arbitrary numbers of streams
 - support access control, authorization, copyright
 - remain simple, minimal and easy to use
 - be targeted to **lectures**, not generalized “learning objects”

BlueStream

A deeply disturbing image...



Advanced Indexing and Search

- **BlueStream** is an online environment at the University of Michigan with powerful features for using digital video, audio, images, and documents in higher education.
- Each course recorded by MScribe will have at least 30 hours of recorded video available to students.
- Clearly, powerful search and indexing is needed.
- BlueStream has tools that ingest video, images and metadata and
 - transcode it to multiple formats
 - convert speech to text and index the video stream
 - perform OCR on the slide images
 - provide search functions that take the user directly to a point in the video
- BlueStream also supports sophisticated access control schemes

People

- Homer A. Neal
- Steven Goldfarb
- Jeremy Herr
- Jim Irrer
- Cang Ye
- Mitch McLachlan
- Charles Severance

Info

- <http://www.wlap.org>
- <http://www.umich.edu/~mscribe>