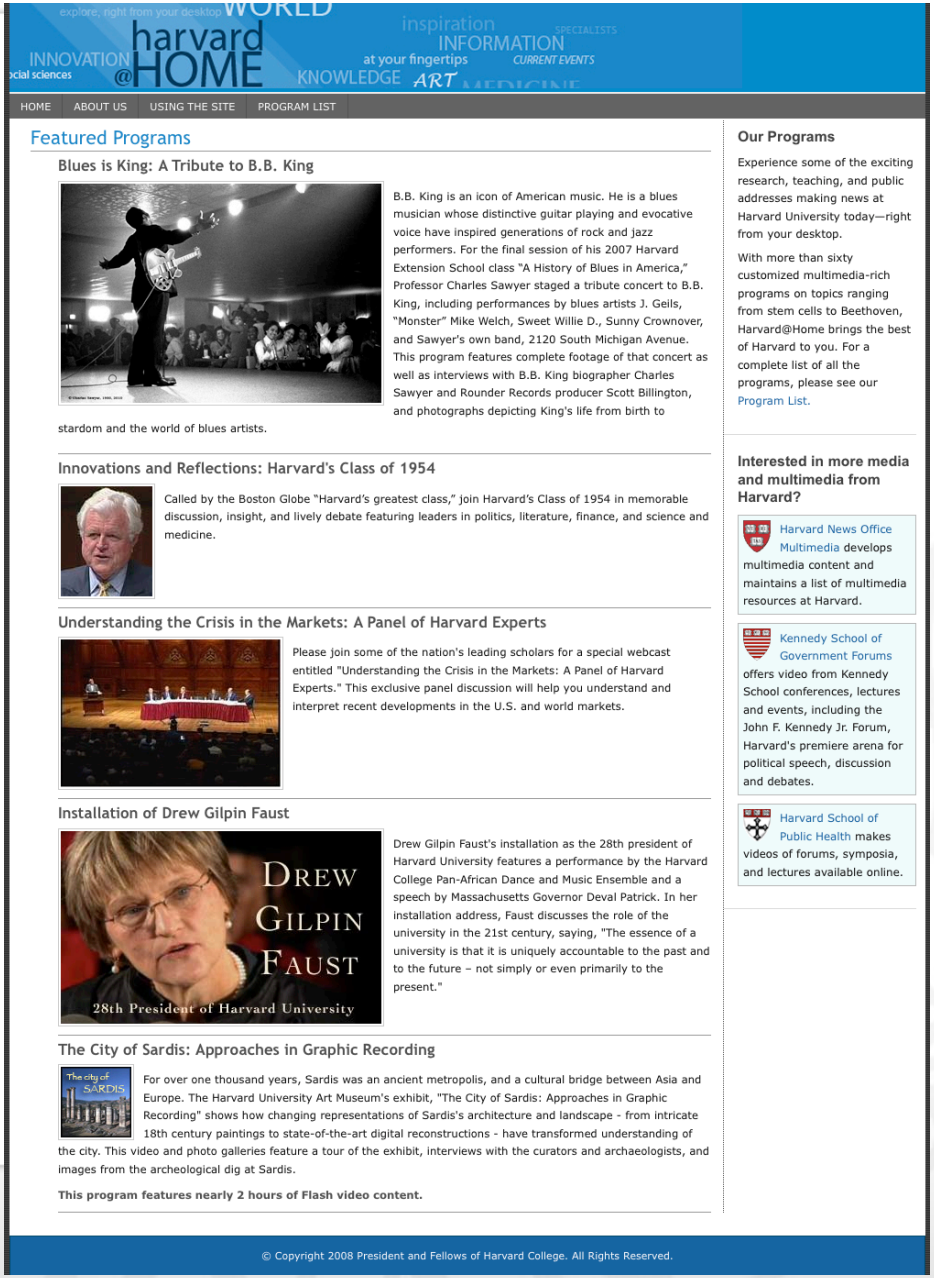
CDN Services for Video Encoding and Delivery

- The beginning
- CDN Implementation Examples
  - Instant Infrastructure: Flash JumpStart
  - Performance and Scale: Customer Origin/HPAC
  - Secure Delivery: Token-based authentication
  - Fast Flexibility: iSites Video Publishing Tool
  - Dealing with complexity and rapid change: Live Mobile Streaming
- Cost issues
- Goals and Next Steps

History of the Video CDN at Harvard

- Akamai streaming & storage account for Harvard@Home
  - Delivered RealVideo, WindowsMedia, Quicktime, Flash FLV
  - 100GB Storage
  - 250GB/mo delivery
  - $5500/mo
- UIS Live RealVideo streaming account for high-traffic events
- Had excess capacity (!) "We're already paying for this. Can we use it for anything else?"
- Eventually moved to LLNW for service/cost reasons



Initial Use Case: Instant Infrastructure

Flash "JumpStart" Program

- Use excess capacity to provide instant Flash streaming capability to schools/business units
- Provide sFTP accounts to schools to upload directly to CDN

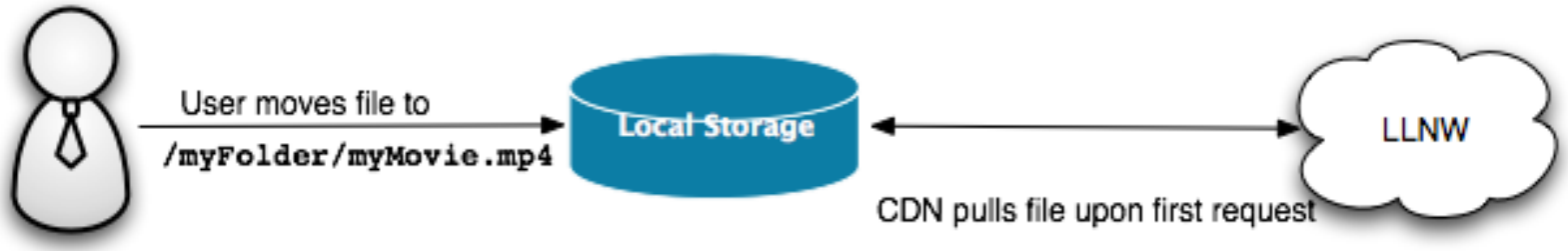
```
rtmp://media.isites.harvard.edu/a2232/o18/myDepartment/myMovie.mp4
http://media-ht.isites.harvard.edu/myDepartment/myMovie.mp4
```

- Five schools, several business units, HUIT
  - Has been used to replace internal infrastructure

Performance Enhancement & Unlimited Scale

Customer-origin delivery

- Local storage behind an HTTP server
  - HTTP headers, IP restrictions for security, if needed
- Cost-effective for large collections



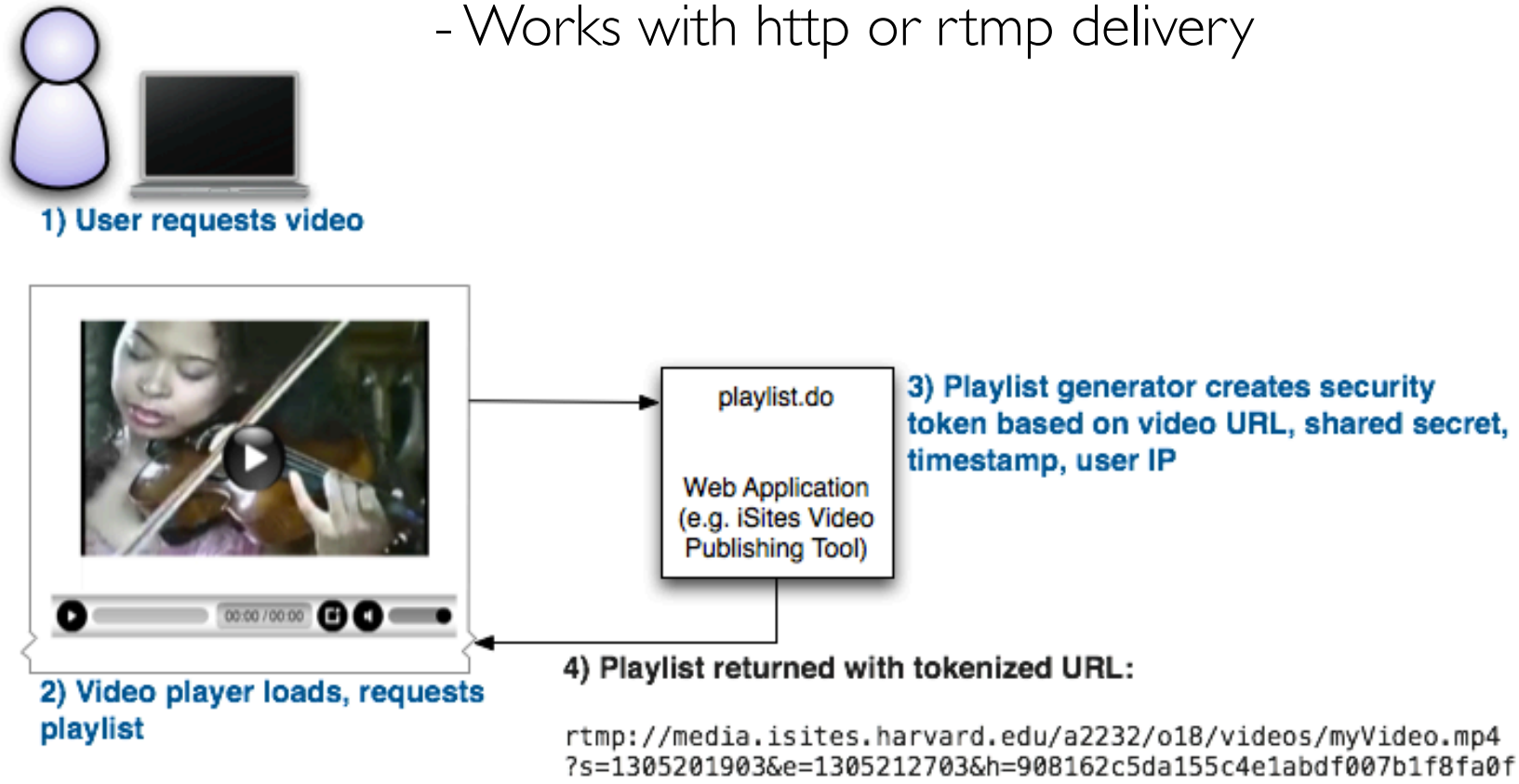

```
rtmp://media.isites.harvard.edu/a2232/e1/myFolder/myMovie.mp4
http://media-ht.isites.harvard.edu/myFolder/myMovie.mp4
```

- HPAC, HUIT, HKS (pilot), FAS Admissions

Secure/Authenticated Delivery

Limelight MediaVault token-based authentication

- Java code library available, or token-generation available through iSites Video Publishing Tool
- Protection configured at the directory level
  - Works with http or rtmp delivery



Fast Flexibility: iSites Video Publishing Tool

- Self-publishing tool available through iSites platform
- "Easy as YouTube" but secure, managed, integrated
- Features include:
  - Video publishing from file, camcorder, webcam source
  - Student submissions (at faculty discretion)
  - Chaptering & video annotations (shared and private)
  - Ability to publish video to any website
  - Support for Real, WindowsMedia, Quicktime, MPEG4, Flash, iOS (playback)
  - Automatic notifications (new video, new annotations, etc)
  - Metadata and indexing features for large collections
  - Secure Flash streaming from Limelight

CURRICULAR VIDEO

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Week 13 Week 14

ENTER DESIGN VIEW

- Course Site Admin
- History 1434 Home
- Section
- Syllabus
- Unit 1: Unsettled America
- Interlude: (Almost) Modern America: The 1920s
- Unit 2: The Rise and Fall of the New Deal Order
- Interlude: The Politics of the Cold War
- Unit 3: From Civil Rights to the Great Society
- **Unit 4: America's Right Turn**
  - **Week 13**
  - **Week 14**
- Reserve Reading List
- Library Resources
- Site Administrators Only
- Comprehensive by content type
- Class Handouts

Required Readings: Week 14

- Don DeLillo, *White Noise*
- Richard Viguerie, *America's Right Turn: How Conservatives Used New and Alternative Media to Take Power*, Pages TBA
- Ronald Reagan, "A Time for Choosing" (WL)
- Milton Friedman, *Capitalism and Freedom* (excerpt)

Audio: Week 14

Like a Rock (Bob Seeger)

Duration: **00:59**

Only a Lad (Oingo Boingo)

Duration: **04:10**

California Uber Allies (Dead Kennedys)

Duration: **03:27**

PUBLIC INSTITUTE EVENT SERIES

HARVARD INSTITUTE *for* GLOBAL HEALTH

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- Global Health Directory
- Events
  - Events Video Archive
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Events Video Archive

Event Video Archive

K-RITH - KwaZulu-Natal Research Institute for Tuberculosis and HIV Immunology Lecture Series, 1 of 14

- **Talk by:** **Harris Goldstein**, M.D., Assistant Dean for Scientific Resources; Director, Einstein-Montefiore Center for AIDS Research; Professor of Pediatrics and Microbiology & Immunology; Immunology Course Leader, 1st Year of Medical School Class, Albert Einstein College of Medicine
- **When:** January 18th, 2010
- **Where:** University of KwaZulu Natal, Durban South Africa, Nelson R. Mandela School of Medicine
- **Sponsored by:** **KwaZulu-Natal Research Institute for Tuberculosis and HIV**, **Harvard University Center for AIDS Research**, **Albert Einstein College of Medicine**
- See 'Attachments' for downloadable .pdf lecture slides
- *Video brought to you by the* ***Harvard Institute for Global Health***

Duration: **01:01:31**

K-RITH - KwaZulu-Natal Research Institute for Tuberculosis and HIV Immunology Lecture Series, 2 of 14

- **Talk by:** **Harris Goldstein**, M.D., Assistant Dean for Scientific Resources; Director, Einstein-Montefiore Center for AIDS Research; Professor of Pediatrics and Microbiology & Immunology; Immunology Course Leader, 1st Year of Medical School Class, Albert Einstein College of Medicine
- **When:** January 18th, 2010
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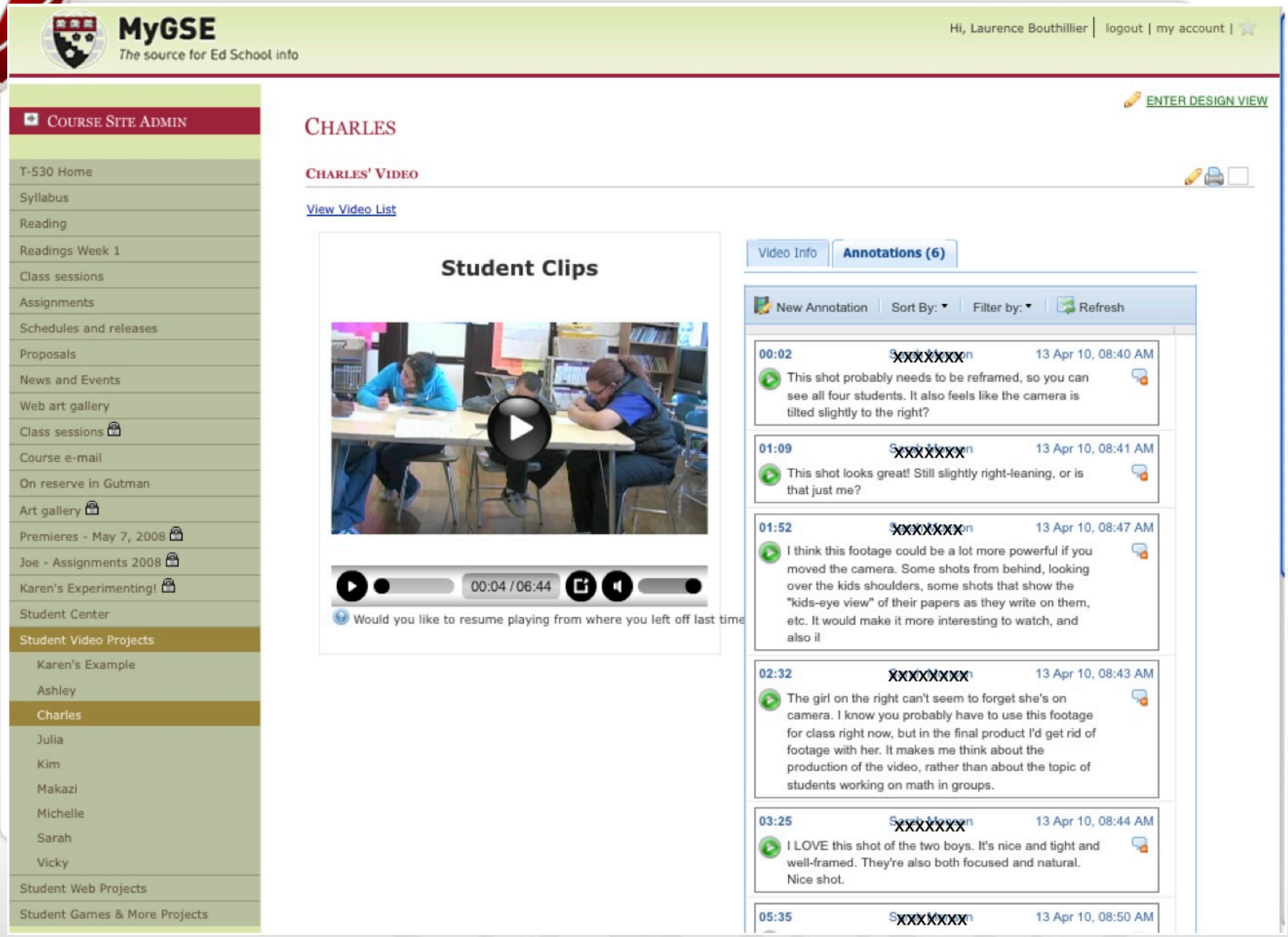
- See 'Attachments' for downloadable .pdf lecture slides
- *Video brought to you by the* ***Harvard Institute for Global Health***

Duration: **57:49**

K-RITH - KwaZulu-Natal Research Institute for Tuberculosis and HIV Immunology Lecture Series, 3 of 14

- **Talk by:** **Harris Goldstein**, M.D., Assistant Dean for Scientific Resources; Director, Einstein-Montefiore Center for AIDS Research; Professor of Pediatrics and Microbiology & Immunology; Immunology Course Leader, 1st Year of Medical School Class, Albert Einstein College of Medicine

SHARED ANNOTATIONS/GROUP PROJECTS



LANGUAGE EXERCISES

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Italian Cb (Spring 2008-2009)

COURSE SITE ADMIN

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- LA RECITA
- **VIDEO**
- Insegnanti
- Syllabus (Programma)
- Il caffè
- Il blog
- Chiacchieriamo con Gabcast
- Fiabe e favole
- Pinocchio
- Compiti e materiali
- Language Resource Center (LRC)
- Tutoring Center
- Al di là del ponte: risorse multimediali per l'Italia
- ELEZIONI 2006
- Skits
- Solo per gli insegnanti
- Sectioning
- Test page - Vocab game

Fantaghirò - La Principessa Guerriera

3/11/09: Fantaghiro (prima puntata, primo episodio)

L'avventura comincia! Lorena (Riassunto); Camille (0:00-1:59 & 6:00-8:3x); Veronica (2:00-2:59); Stacey (3:00-3:59); Liz (4:00-4:59); Miriam (5:00-5:59)

Duration: **08:30**

3/11/09: Fantaghiro (prima puntata, secondo episodio)

La nascità della principessa Becky (Riassunto); Romina (0:00-1:59 & 7:00-8:3x); Marcella (2:00-2:59); Sebastian (3:00-3:59); Antonia (4:00-4:59); Antonio (5:00-5:59); Riya (6:00-6:59)

Duration: **08:31**

3/12/09: Fantaghiro (prima puntata, terzo episodio)

La principessa cresce, e promette... Miriam (Riassunto); Lorena (0:00-1:59 & 6:00-8:3x); Camille (2:00-2:59); Veronica (3:00-3:59); Stacey (4:00-4:59); Liz (5:00-5:59)

Duration: **08:31**

3/12/09: Fantaghiro (prima puntata quarto episodio)

L'educazione della principessa Riya (Riassunto); Becky (0:00-1:59 & 7:00-8:3x); Romina (2:00-2:59); Marcella (3:00-3:59); Sebastian (4:00-4:59); Antonia (5:00-5:59); Antonio (6:00-6:59)

Duration: **08:33**

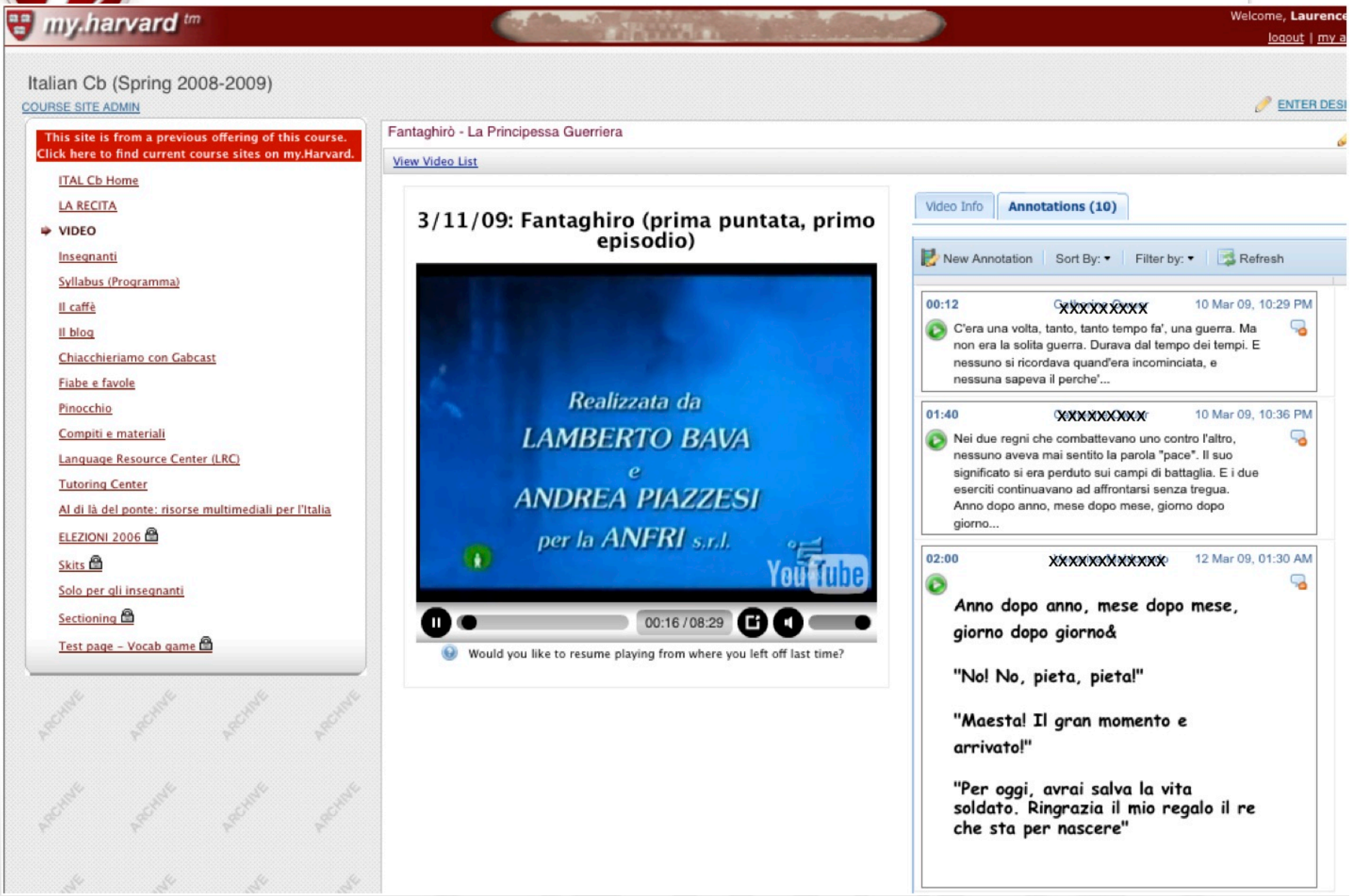
3/13/09: Fantaghiro (prima puntata, quinto episodio)

Liz (Riassunto); Miriam (0:00-1:59 & 6:00-8:3x); Lorena (2:00-2:59); Camille (3:00-3:59); Veronica (4:00-4:59); Stacey (5:00-5:59)

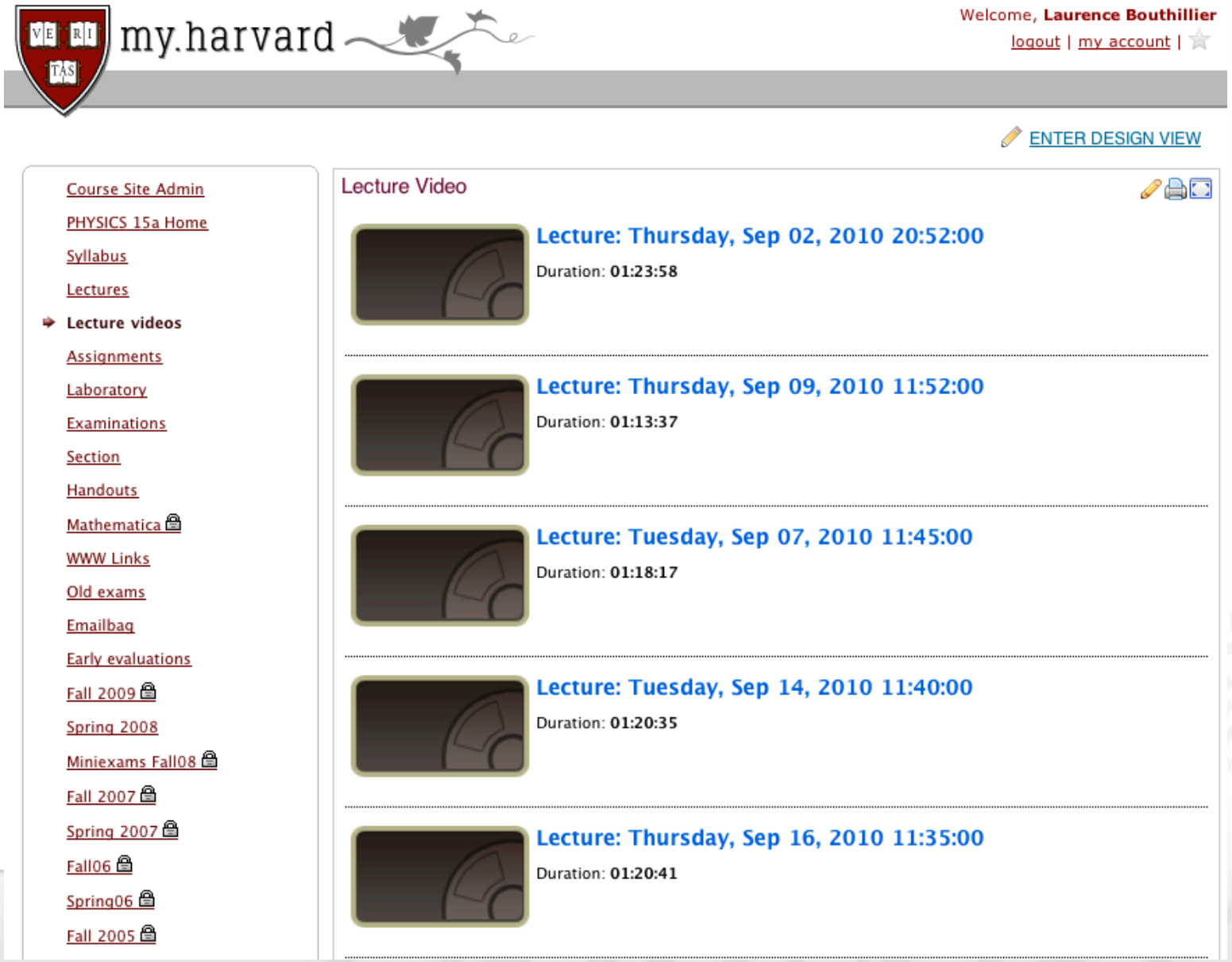
Duration: **08:31**

ARCHIVE

LANGUAGE EXERCISES



AUTOMATED LECTURE VIDEO PUBLISHING



COURSE TRAILERS

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general education

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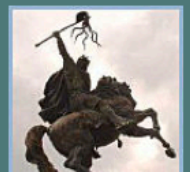
Fall 2010 Course Trailers

Is the American Racial Order Being Transforme

United States and the World 15: Is the American Racial Orde
Jennifer L. Hochschild (African and African American Studies; G
Course Website

Duration: **03:52**



The English Language as Literature

Aesthetic and Interpretive Understanding 38: The English L
Daniel Albright (English)
Course Website

Duration: **03:40**

Primitive Navigation

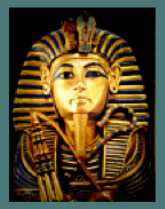
Science of the Physical Universe 26: Primitive Navigation
John Huth (Physics)
Course Website

Duration: **03:33**

Japan's Modern Revolution

Societies of the World 43: Japan's Modern Revolution
Ian J. Miller (History)
Course Website
Produced by the Teaching Staff of SW 43

Duration: **02:36**



Pyramid Schemes

Societies of the World 38: Pyramid Schemes: The Archaeological History of Ancient Egypt
Peter Der Manuelian (Near Eastern Languages and Civilizations; Anthropology)
WINNER of the Harvard Shorts Film Festival in the Category of 'Course and Department Trailers'
Course Website

Duration: **04:04**

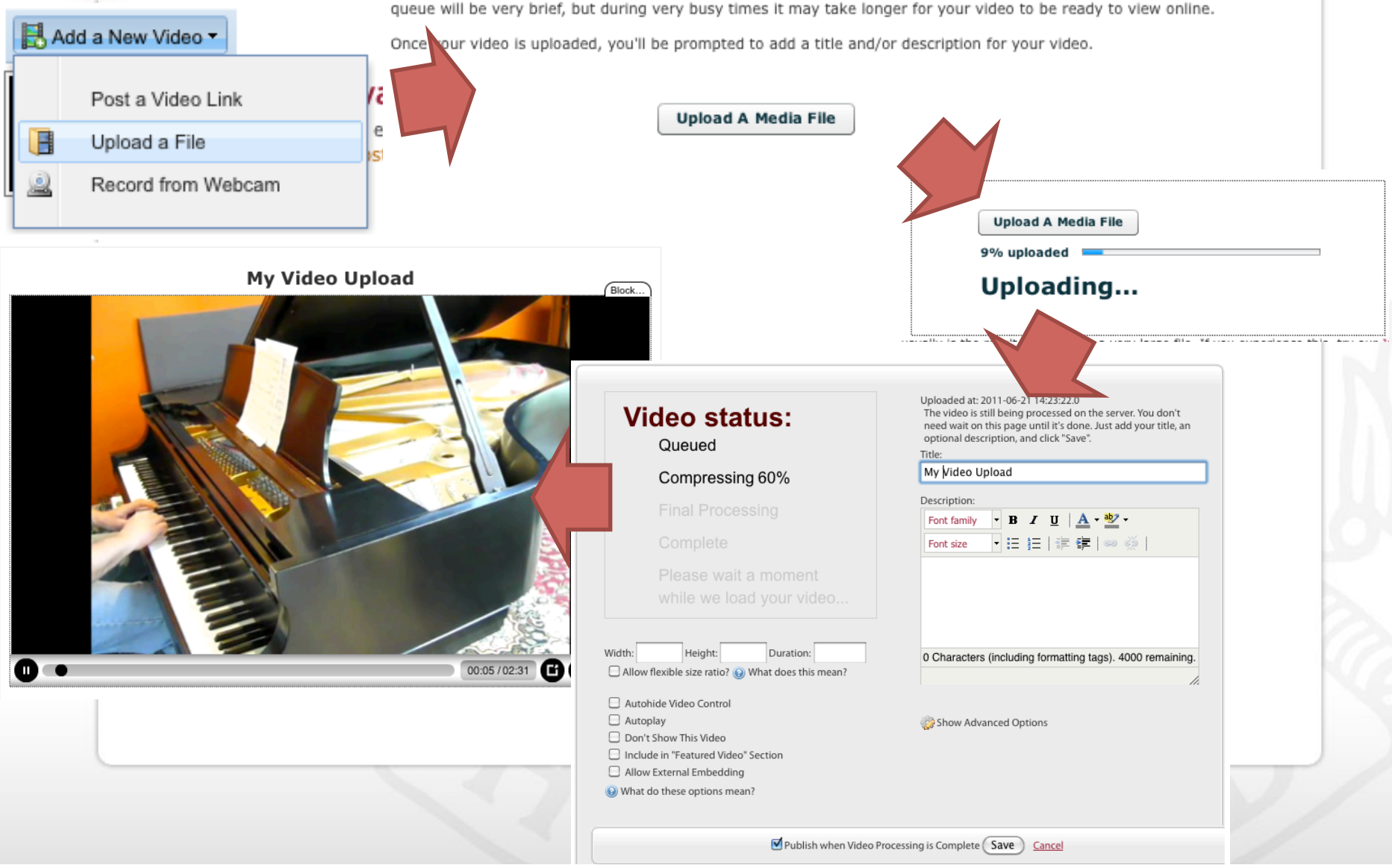
Medieval Europe

Societies of the World 41. Medieval Europe
Michael McCormick (History)
Produced by the teaching staff of SW 41

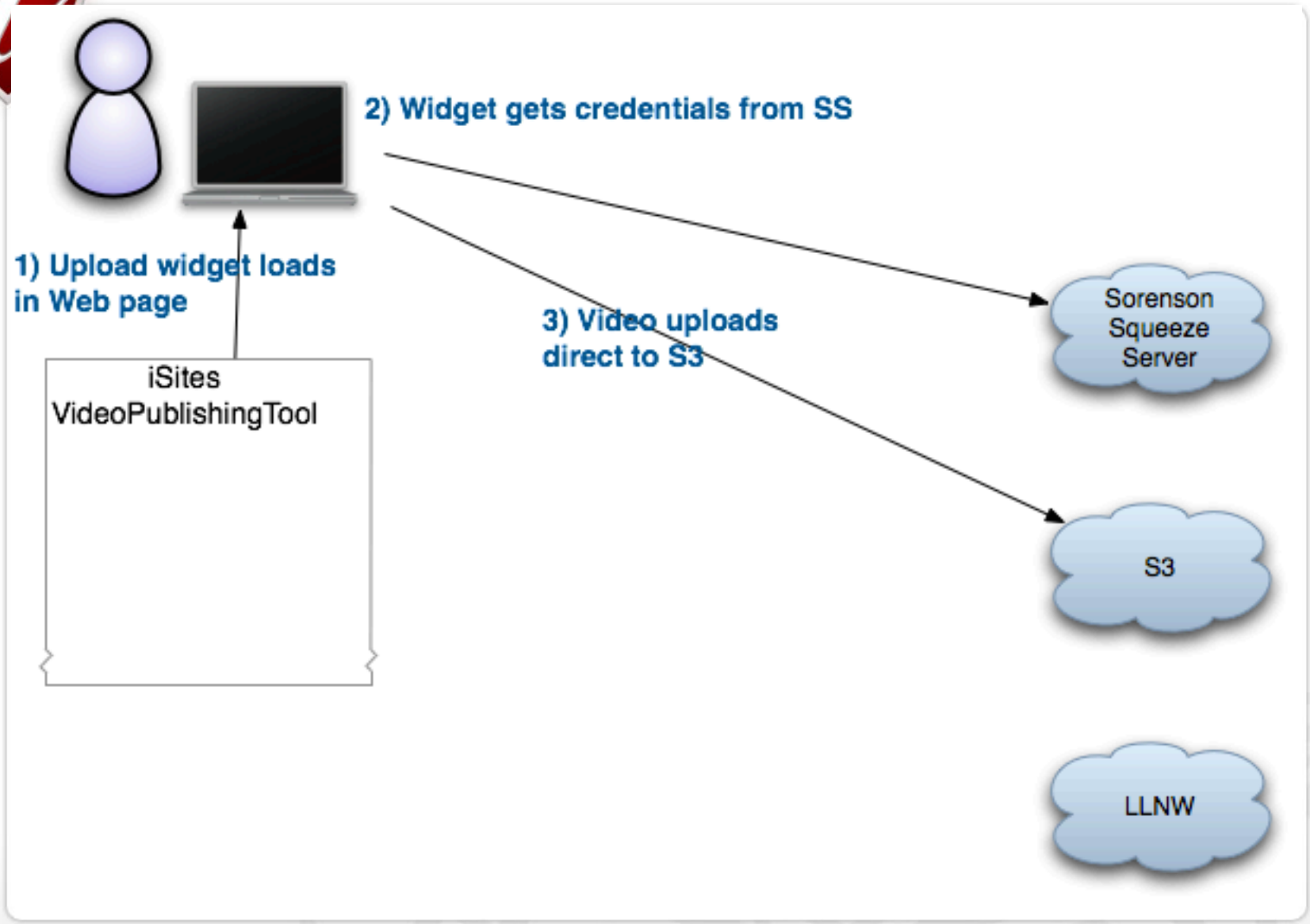
Course Website

Duration: **01:44**

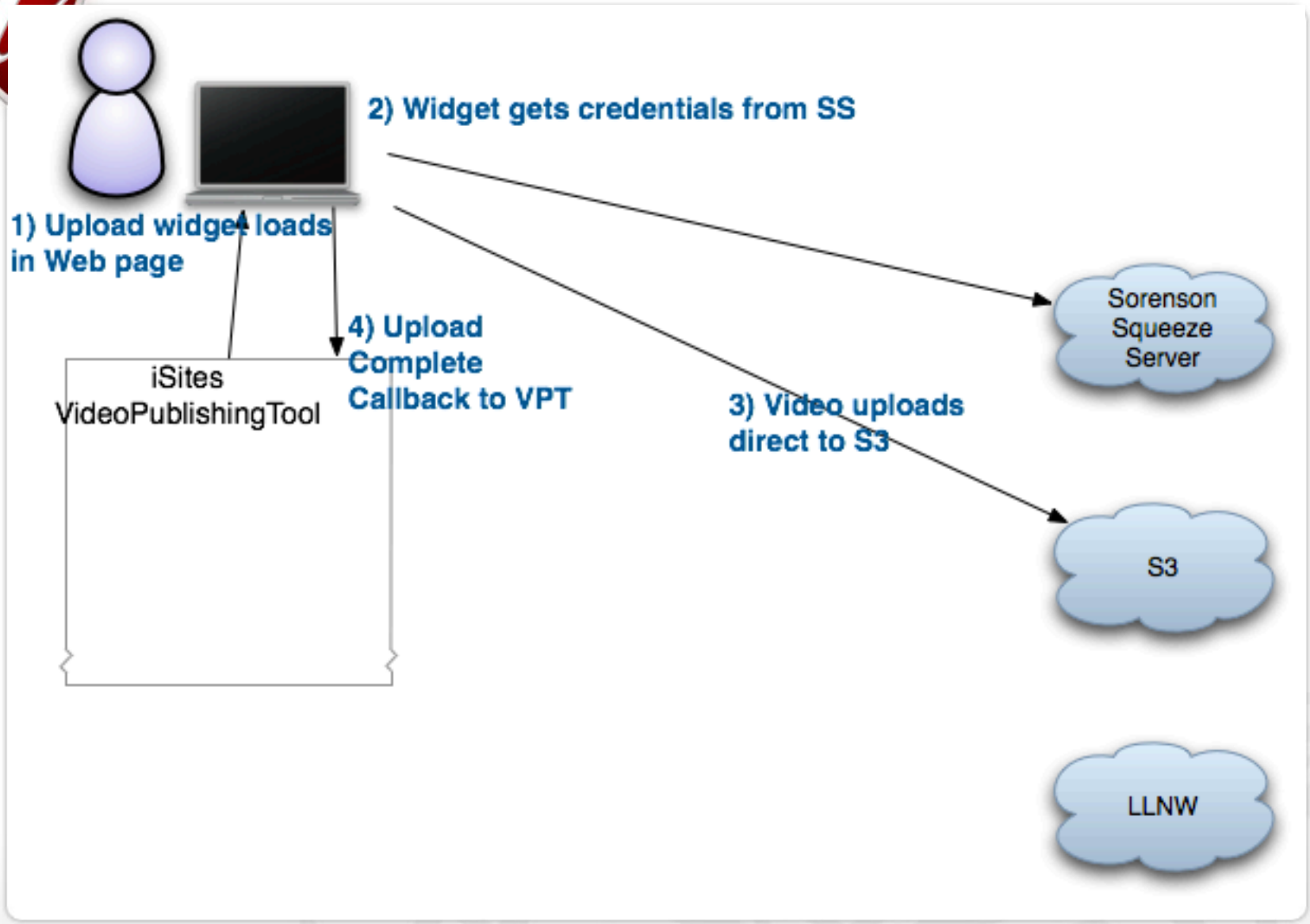
Uploading Video



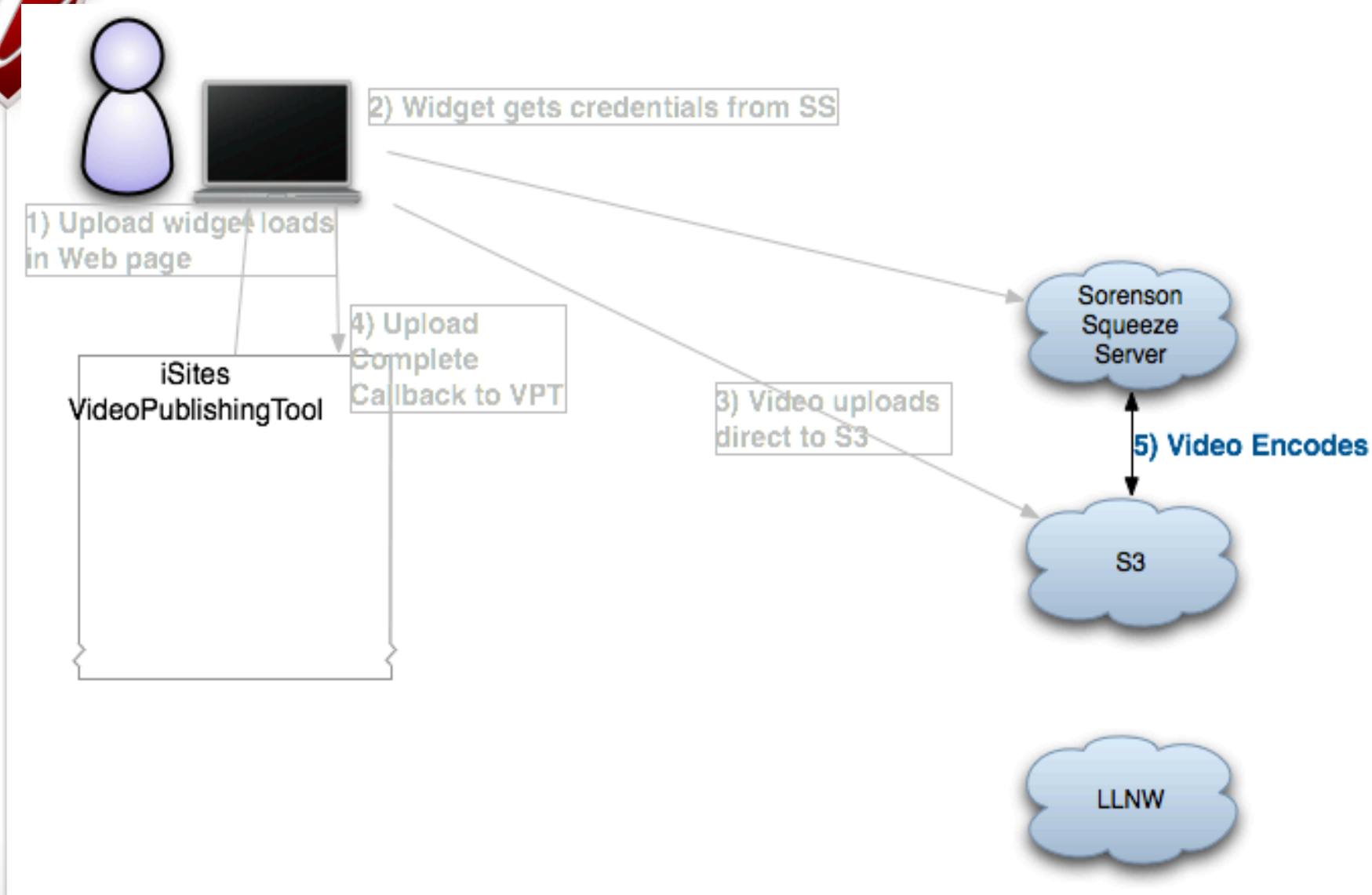
VPT: Cloud Interaction



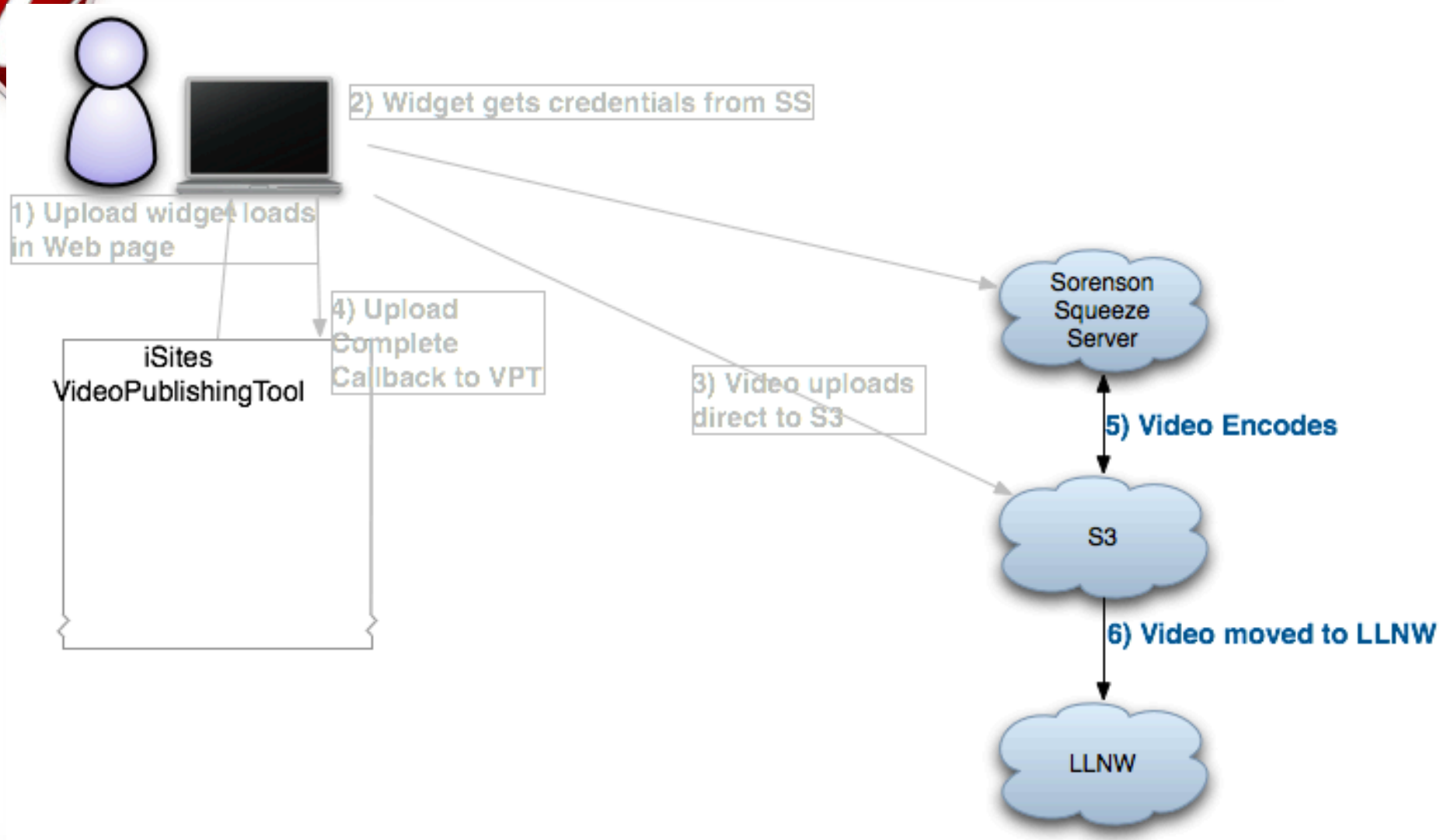
VPT: Cloud Interaction



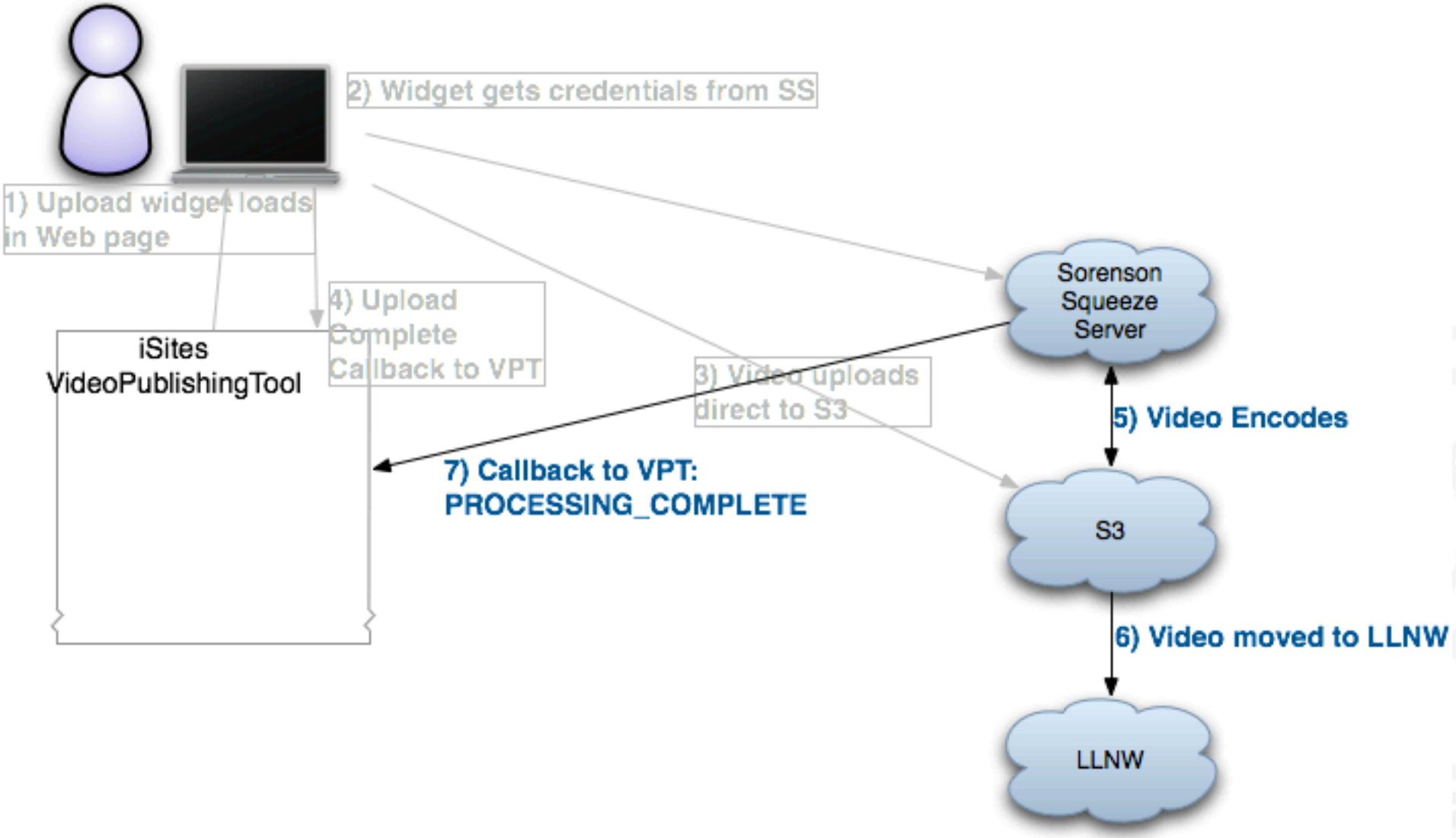
VPT: Cloud Interaction



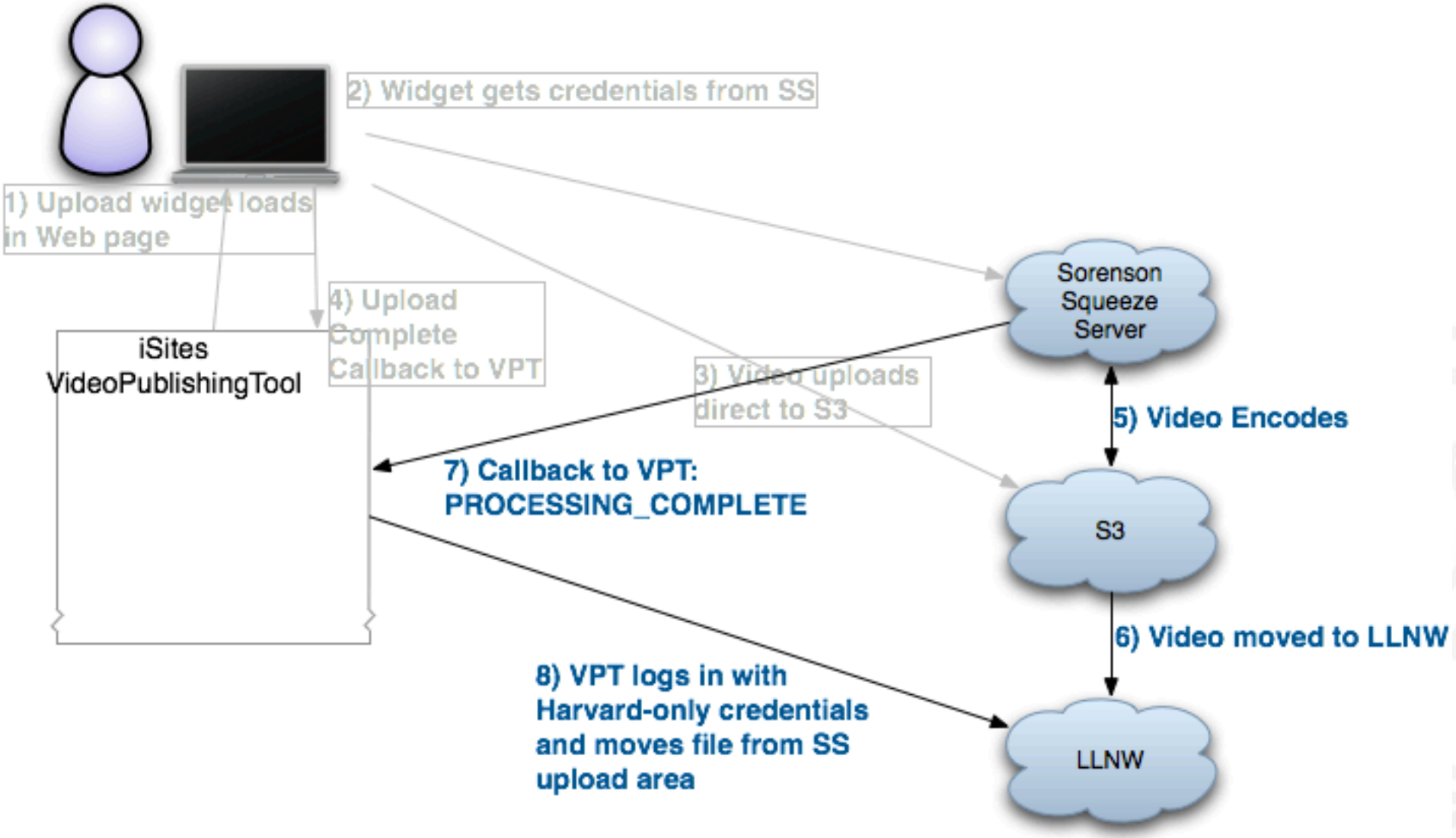
VPT: Cloud Interaction

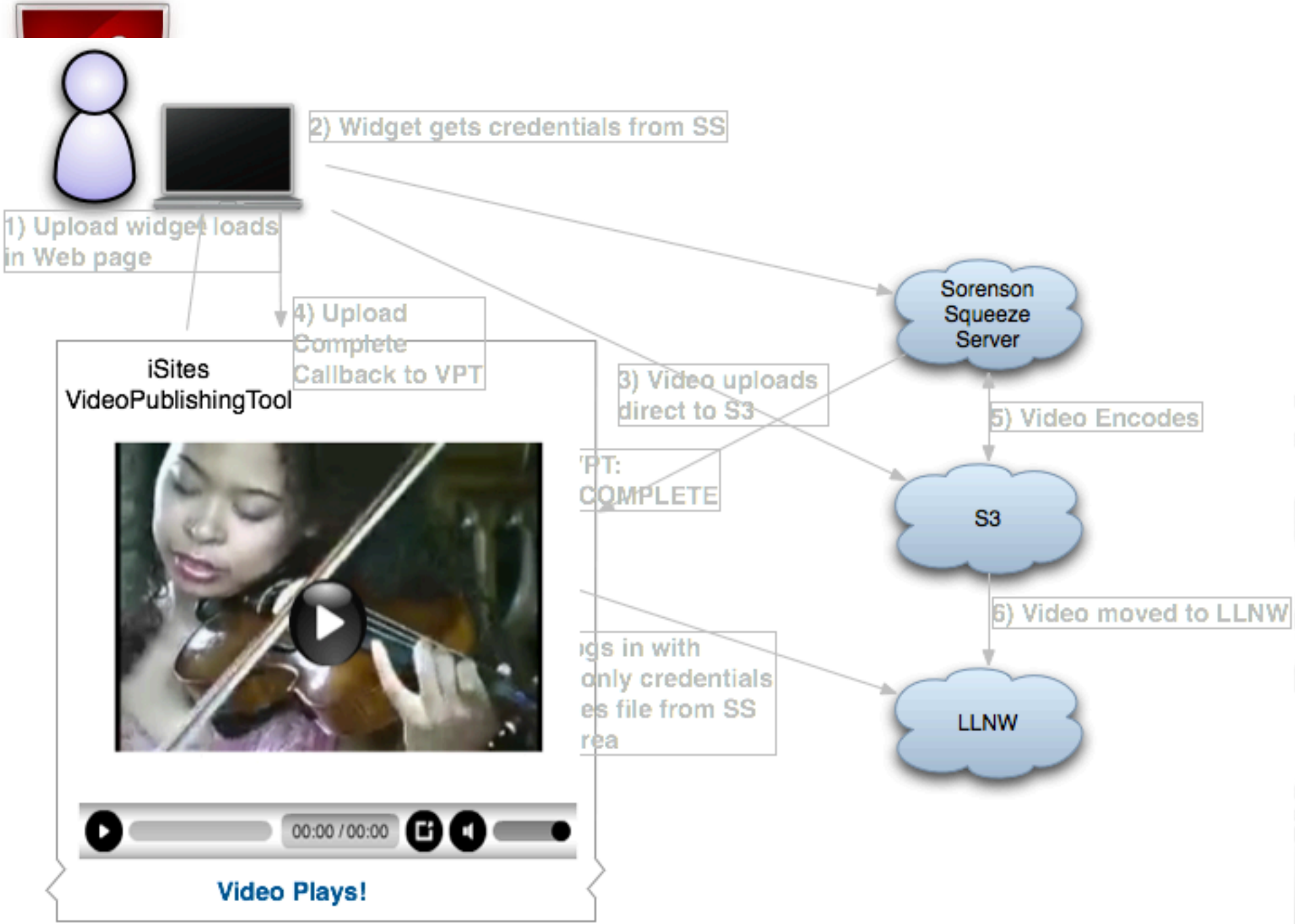


VPT: Cloud Interaction

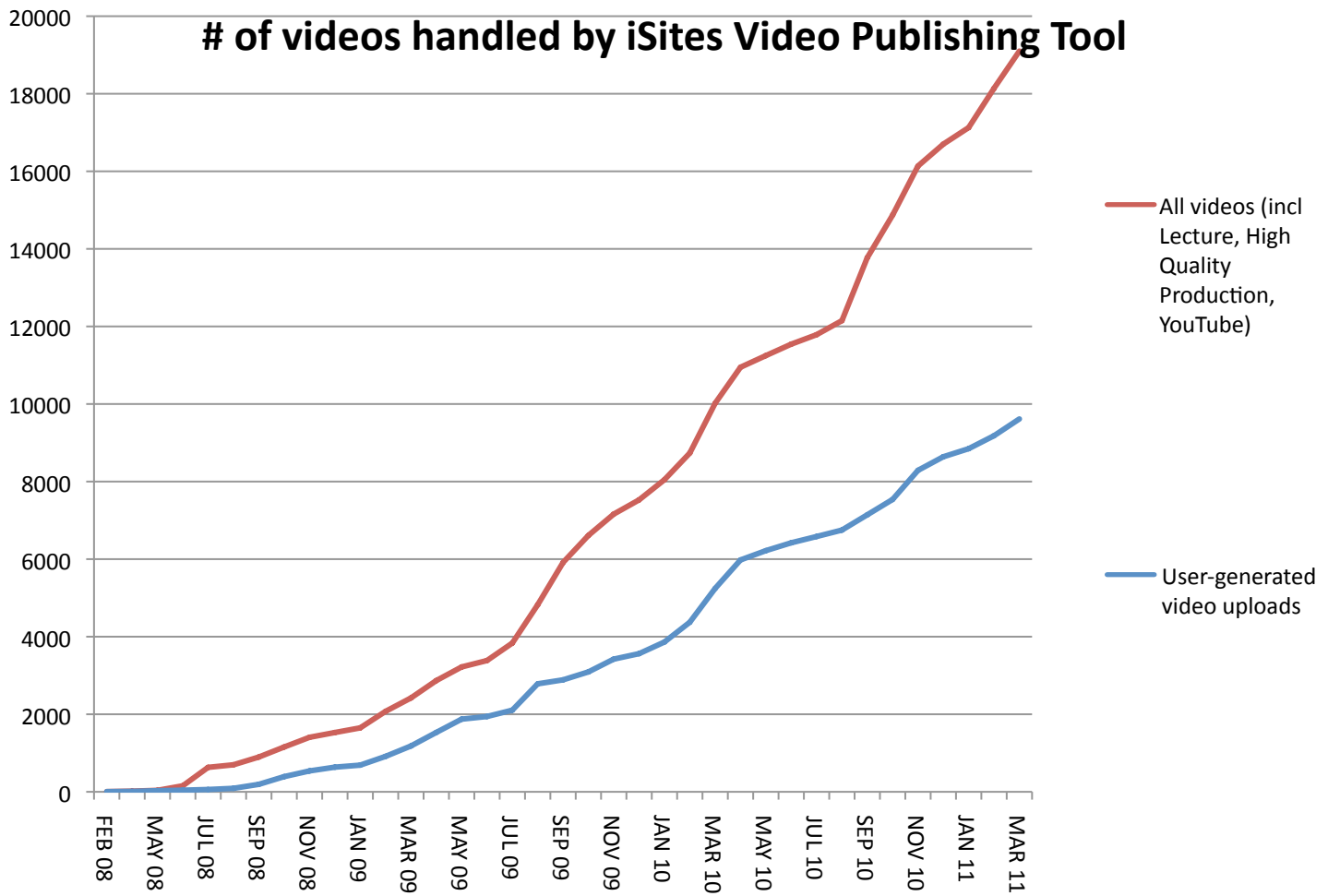


VPT: Cloud Interaction

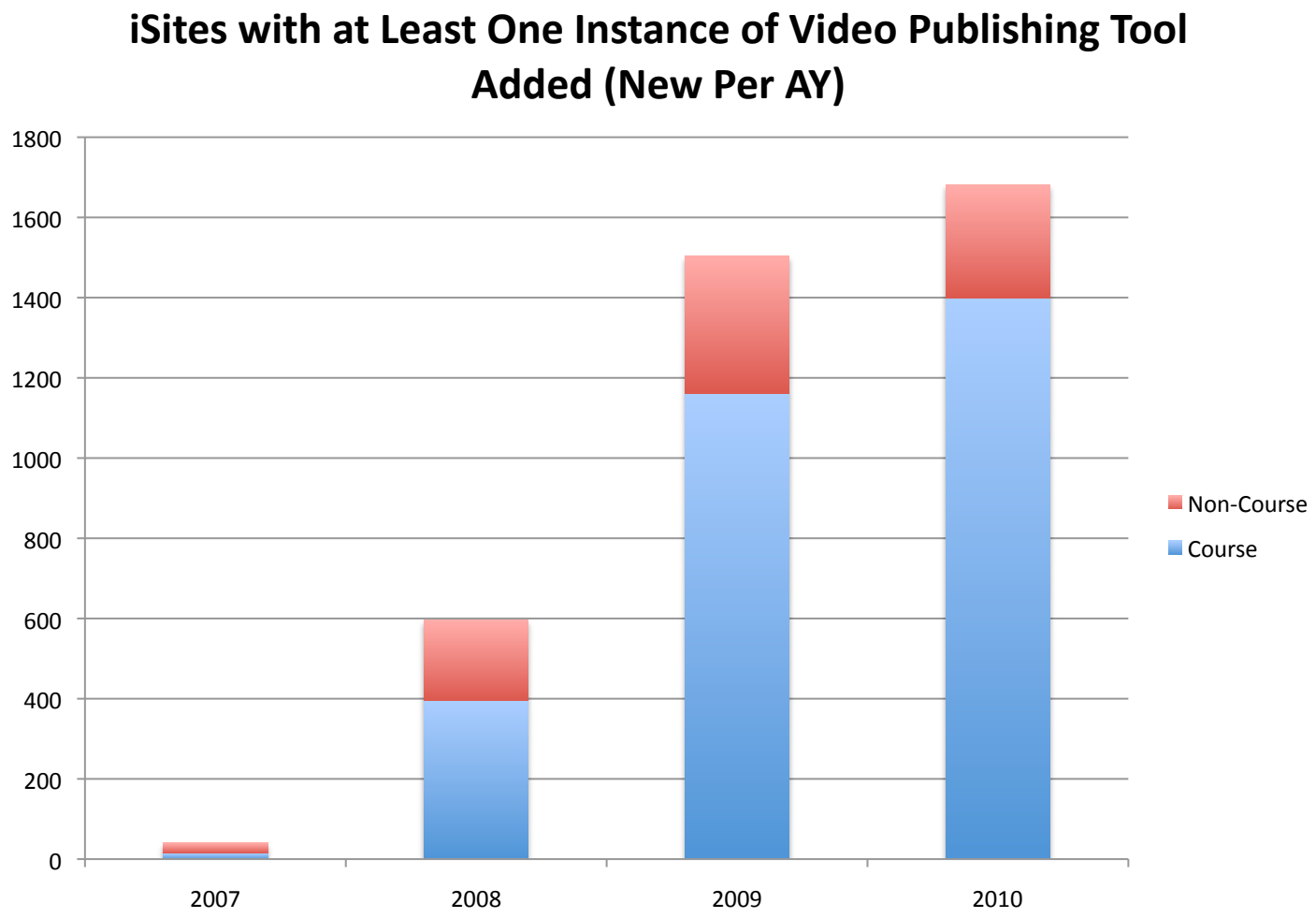



2) Widget gets credentials from SS
1) Upload widget loads in Web page
4) Upload Complete Callback to VPT
iSites VideoPublishingTool
3) Video uploads direct to S3
'PT: COMPLETE
gs in with only credentials es file from SS rea
Sorenson Squeeze Server
5) Video Encodes
S3
6) Video moved to LLNW
LLNW
00:00 / 00:00
Video Plays!

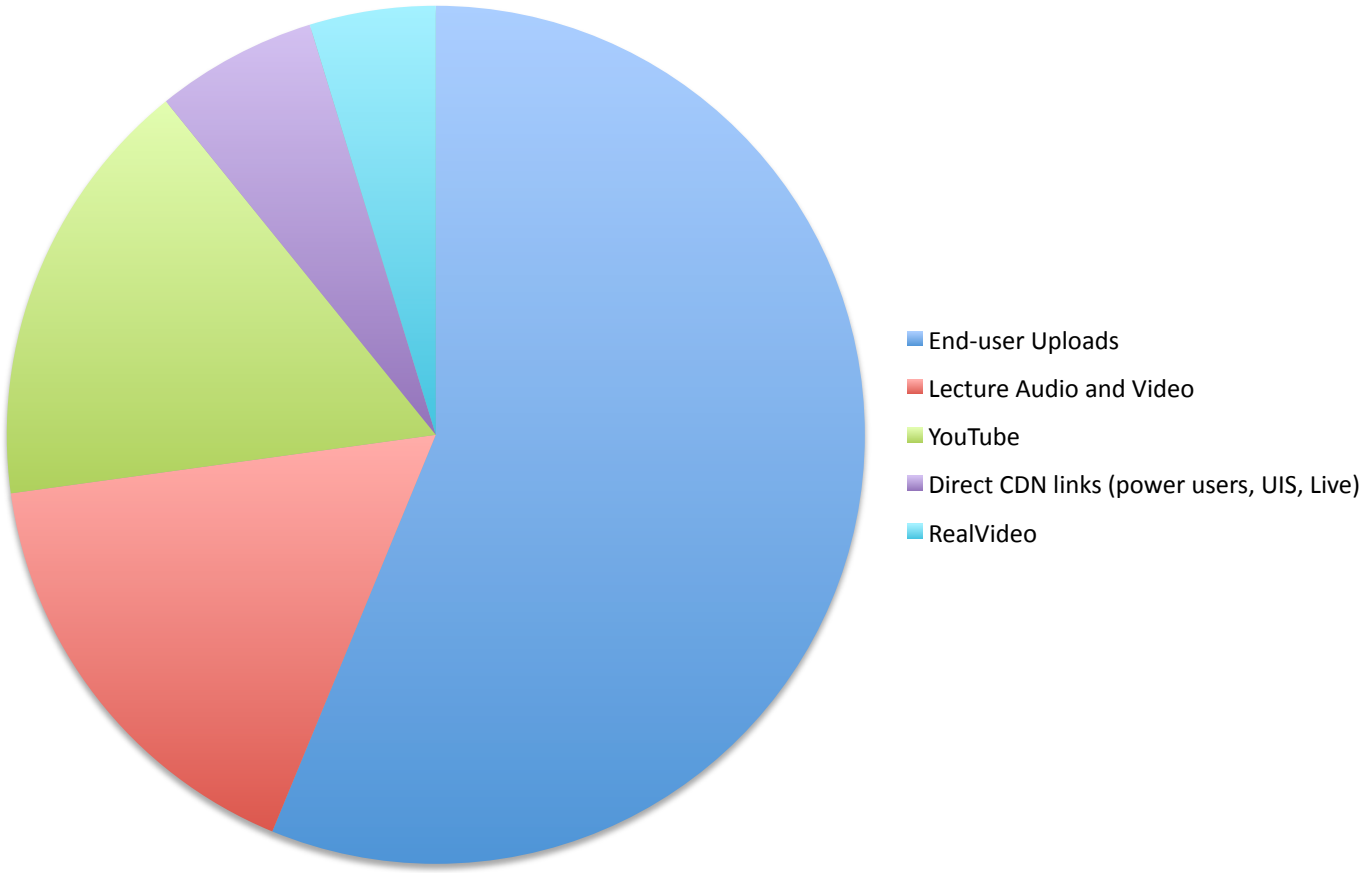
Video Publishing Tool: # of Videos Handled



Video Publishing Tool: # of Sites



Video Publishing Tool: Content Sources



Dealing With Complexity

Live Mobile Delivery: The Challenge

- Mobile OSs (iOS, Android, BlackBerry)
- Device Codec Support (video/audio)
- Screen Size/Resolution
- 3G vs Wifi
- Delivery Protocols (http/rtmp/rtsp)

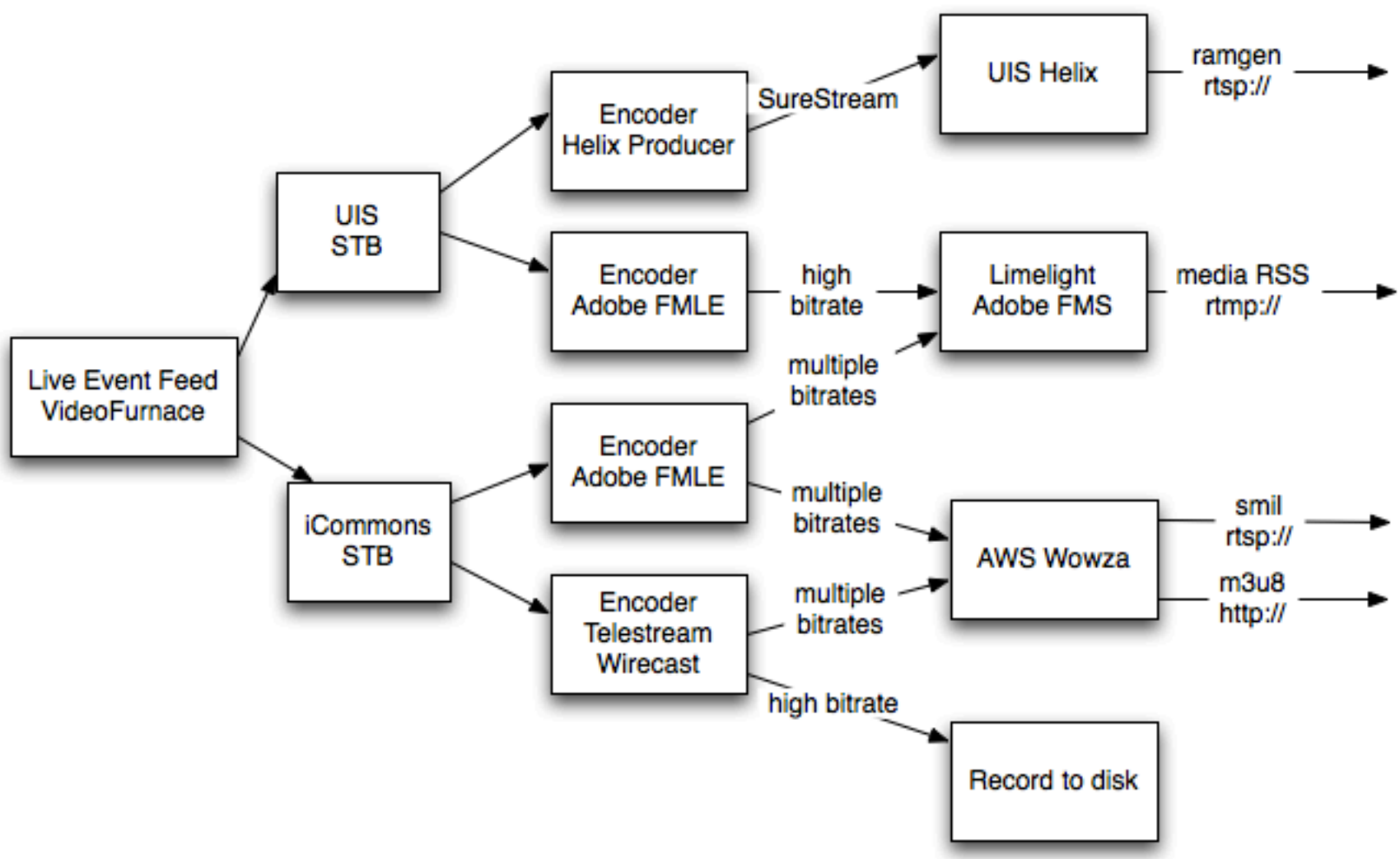
- Poor documentation
- Few tools
- Not much real expertise around

Live Mobile Delivery:V1.0

Commencement 2010

- Multi-Platform Approach
- UIS Helix for Real
- Limelight for Flash (FMS)
- Wowza on Amazon AWS/EC2 for mobile
  - Doesn't transcode, but is a "swiss army knife" of protocols
    - RTMP Flash for Web/Android
    - HTTP Live Streaming (HLS) for iOS
    - RTSP for Android/BlackBerry
  - $241 in AWS charges in all
- Multiple bitrates, sizes of H.264/AAC video
- Four machines capturing/encoding at different settings
  - 60 Oxford and 6 Story Street

Live Mobile Delivery:V1.0



Live Mobile Delivery V2.0

Must Simplify!

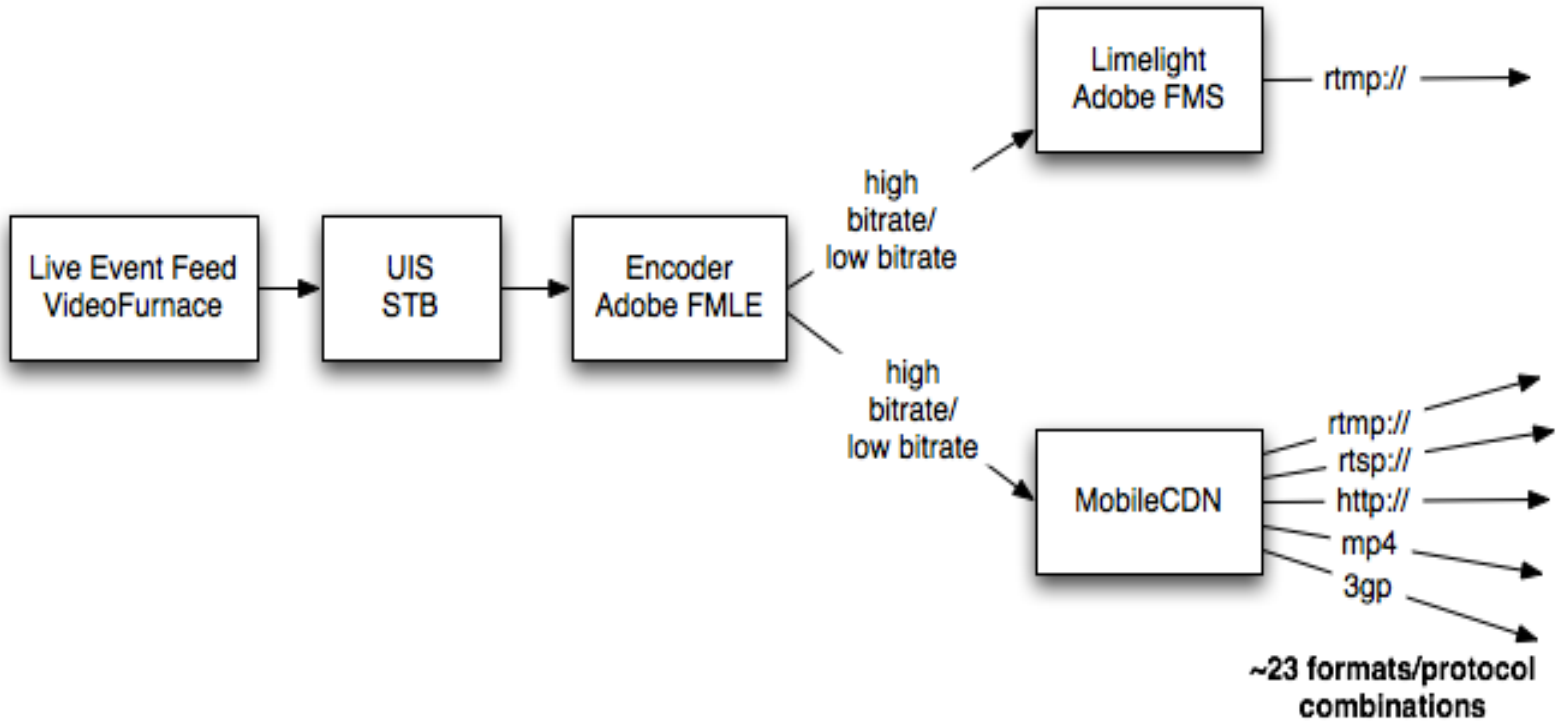
- Find a vendor to ingest one HD stream, do whatever magic is necessary

MobileCDN:

- HSPH broke ground, worked out the kinks with HSPH Forum program, available on all mobile devices
  - Not turn-key, at first
- Ready for Commencement 2011

Live Mobile Delivery V2.0

Device support included everything we tried



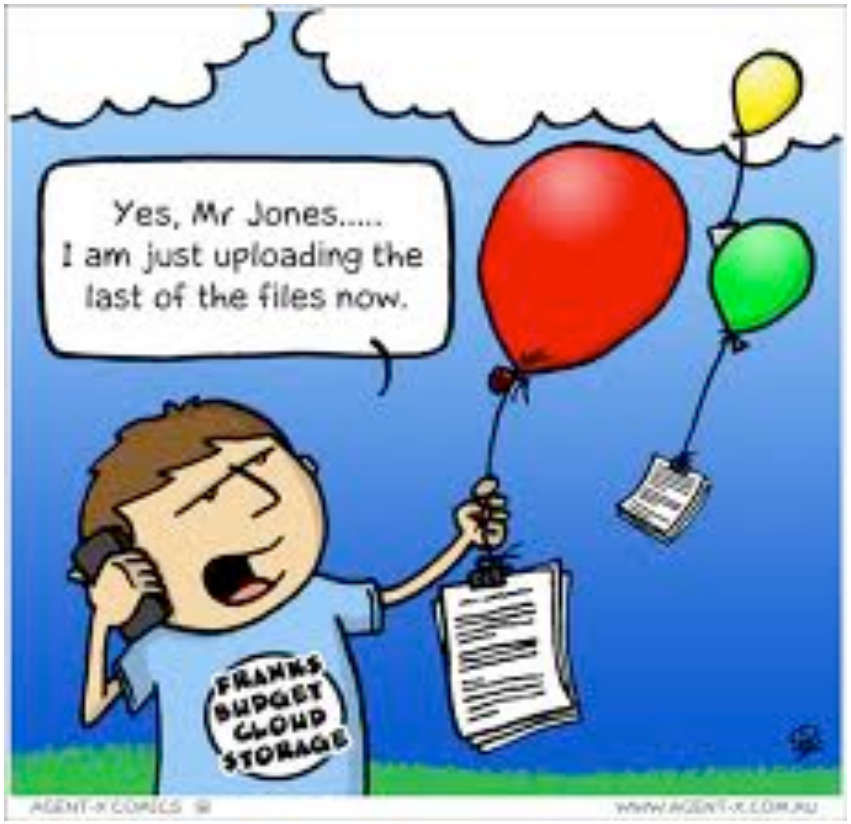
2010: 241 Mobile viewers

2011: 2000+ Mobile viewers

What to do about rising costs?

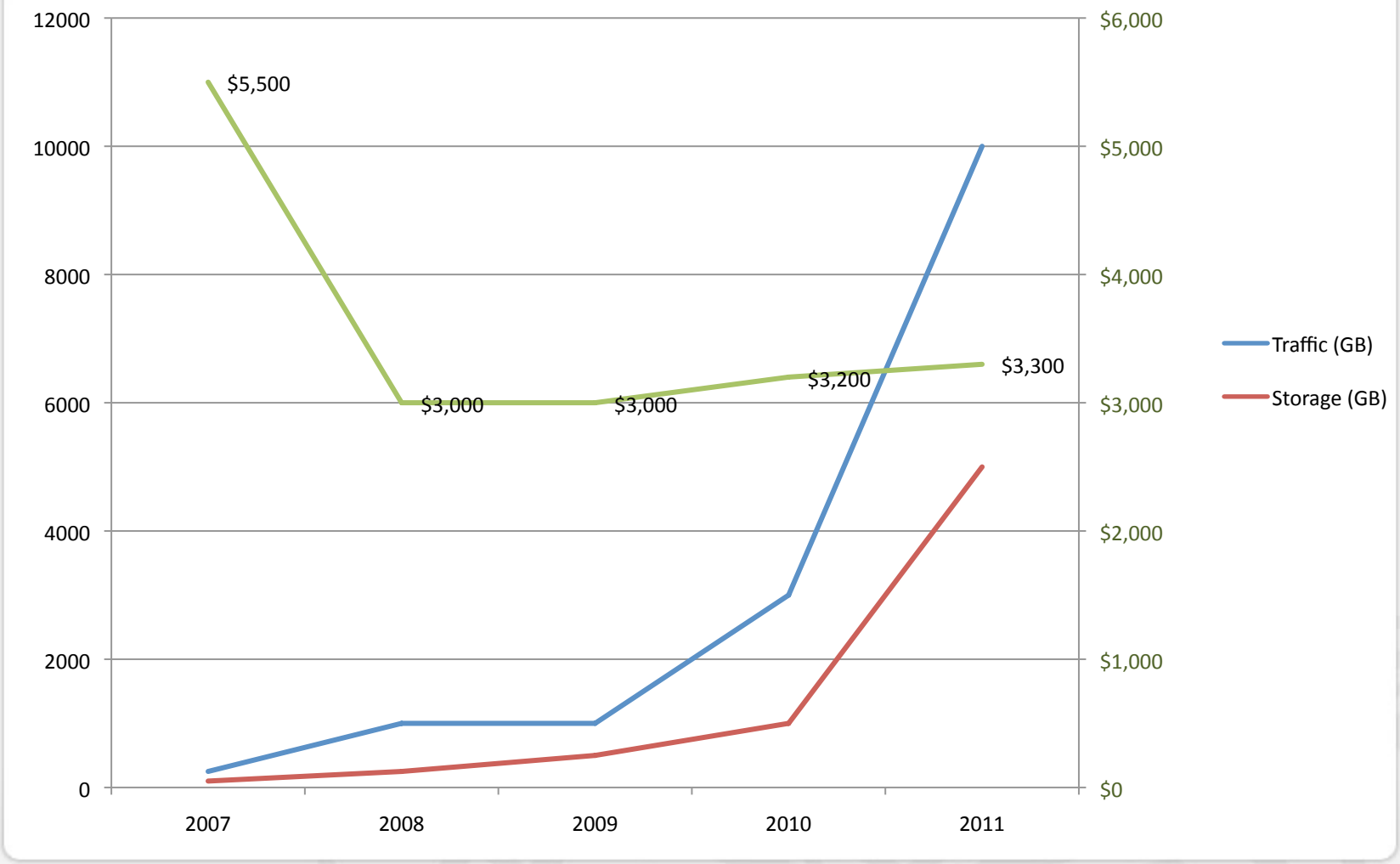
- Costs are variable based on traffic
- Traffic is a good thing – people are using the service
- Traffic is a bad thing – our costs suddenly skyrocket

- Go with the low-cost provider?



http://www.enterpriseirregulars.com/24193/cloud-computing-for-all-budgets/

What rising costs?



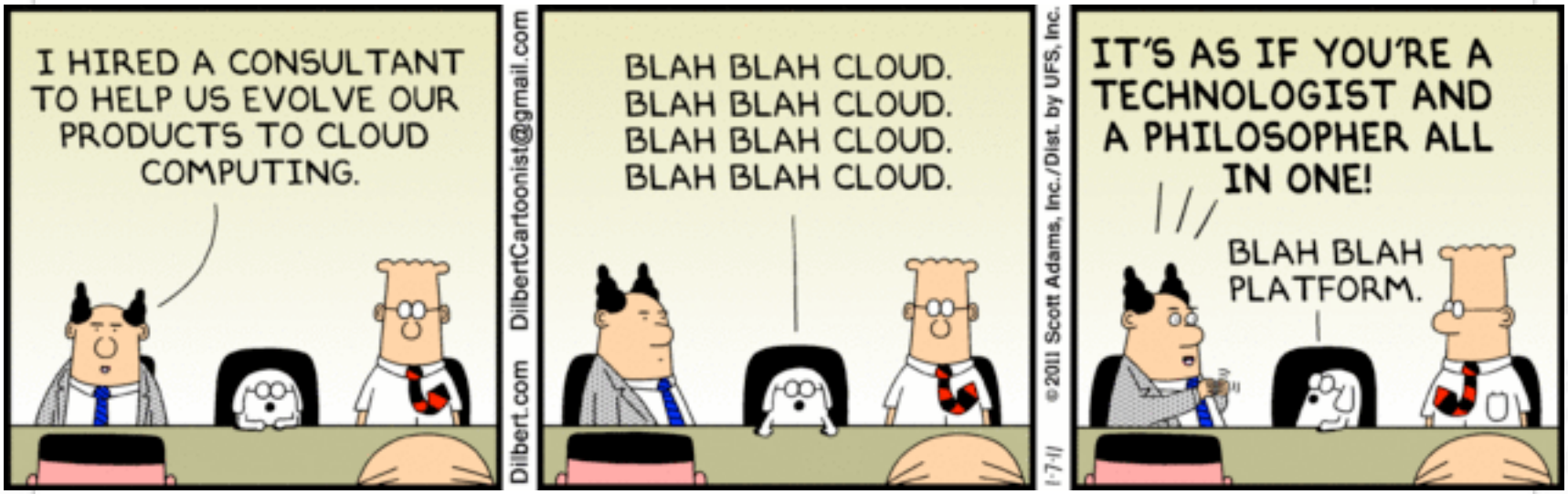
Ongoing Goals for CDN Services

- Infrastructure replacement and/or supplement, where cost-effective
- Reliability and performance of a global delivery network
- Stay up with the most current infrastructure/features
  - CDN upgrade cycle is short: latest and greatest usually available on launch day

Next Steps

- Operationalize mobile live streaming
  - Web page generation with device detection
  - Auto-archiving (w/ content management)
  - Auto-provisioning/self-service ("Easy as UStream?")
- Fully integrate with local asset management strategy
- Cost model
  - Increases in scale have (so far) negated increases in cost
  - Expectation #1: some day our monthly bill will go up
  - Expectation #2: when that day comes we will have to find a way to pay the bill
- Evaluate internal options for Flash streaming (e.g. on-campus to on-campus traffic)

Thank You!

…and thanks to the help and efforts of our partners in…DCE, FAS, GSD, GSE, HAA, HDS, HPAC, HSPH, HUIT, iCommons…and others

Larry Bouthillier
Digital Video Services, HUIT
larry_bouthillier@harvard.edu