



## 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

The screenshot shows the Harvard@Home website interface. At the top, there is a navigation bar with links for HOME, ABOUT US, USING THE SITE, and PROGRAM LIST. Below this, the 'Featured Programs' section is displayed, featuring several program cards. Each card includes a thumbnail image, a title, and a brief description. The programs listed are: 'Blues is King: A Tribute to B.B. King', 'Innovations and Reflections: Harvard's Class of 1954', 'Understanding the Crisis in the Markets: A Panel of Harvard Experts', 'Installation of Drew Gilpin Faust', and 'The City of Sardis: Approaches in Graphic Recording'. To the right of the featured programs, there is a sidebar titled 'Our Programs' which lists various multimedia resources available on the site, including content from the Harvard News Office, Kennedy School of Government, and Harvard School of Public Health. The footer of the page contains the copyright notice: '© Copyright 2008 President and Fellows of Harvard College. All Rights Reserved.'



## 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`

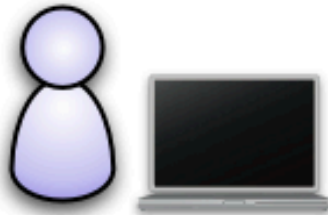
- HPAC, HUIT, HKS (pilot), FAS Admissions



## Secure/Authenticated Delivery

Limelight MediaVault token-based authentication

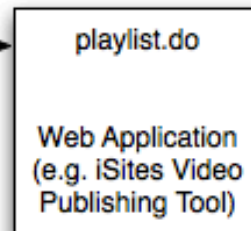
- Java code library available, or token-generation available through iSites Video Publishing Tool
- Protection configured at the directory level
- Works with http or rtmp delivery



1) User requests video



2) Video player loads, requests playlist



3) Playlist generator creates security token based on video URL, shared secret, timestamp, user IP

4) Playlist returned with tokenized URL:

```
rtmp://media.isites.harvard.edu/a2232/o18/videos/myVideo.mp4?s=1305201903&e=1305212703&h=908162c5da155c4e1abdf007b1f8fa0f
```



## 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



my.harvard



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Week 13 | **Week 14**

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[Unit 3: From Civil Rights to the Great Society](#)

➔ **Unit 4: America's Right Turn**

**Week 13**

➔ **Week 14**

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## 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



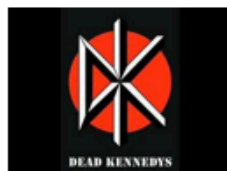
### Like a Rock (Bob Seeger)

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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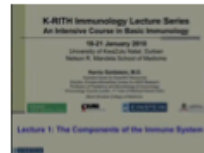
Support Global Health

HIGH Intranet

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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
- **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: **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



**MyGSE**

The source for Ed School info

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**Student Video Projects**

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[Ashley](#)

**Charles**

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[Kim](#)

[Makazi](#)

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[Student Web Projects](#)

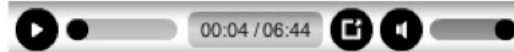
[Student Games & More Projects](#)

## CHARLES

### CHARLES' VIDEO

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### Student Clips



Would you like to resume playing from where you left off last time?

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Video Info **Annotations (6)**

New Annotation | Sort By: ▾ | Filter by: ▾ | Refresh

00:02 ~~XXXXXXXXXX~~n 13 Apr 10, 08:40 AM

This shot probably needs to be reframed, so you can see all four students. It also feels like the camera is tilted slightly to the right?

01:09 ~~XXXXXXXXXX~~n 13 Apr 10, 08:41 AM

This shot looks great! Still slightly right-leaning, or is that just me?

01:52 ~~XXXXXXXXXX~~n 13 Apr 10, 08:47 AM

I think this footage could be a lot more powerful if you moved the camera. Some shots from behind, looking over the kids shoulders, some shots that show the "kids-eye view" of their papers as they write on them, etc. It would make it more interesting to watch, and also il

02:32 ~~XXXXXXXXXX~~n 13 Apr 10, 08:43 AM

The girl on the right can't seem to forget she's on camera. I know you probably have to use this footage for class right now, but in the final product I'd get rid of footage with her. It makes me think about the production of the video, rather than about the topic of students working on math in groups.

03:25 ~~XXXXXXXXXX~~n 13 Apr 10, 08:44 AM

I LOVE this shot of the two boys. It's nice and tight and well-framed. They're also both focused and natural. Nice shot.

05:35 ~~XXXXXXXXXX~~n 13 Apr 10, 08:50 AM



# LANGUAGE EXERCISES

Italian Cb (Spring 2008-2009)

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## Fantaghiò - La Principessa Guerriera



### 3/11/09: Fantaghiò (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)

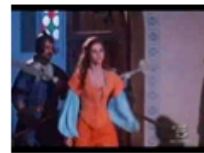
Duration: 08:30



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

La nascita 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: Fantaghiò (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: Fantaghiò (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: Fantaghiò (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 ARCHIVE ARCHIVE ARCHIVE  
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# LANGUAGE EXERCISES

## Italian Cb (Spring 2008-2009)

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### Fantaghirò - La Principessa Guerriera

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



Would you like to resume playing from where you left off last time?

Video Info

Annotations (10)

[New Annotation](#) | Sort By: ▾ | Filter by: ▾ | [Refresh](#)

00:12 XXXXXXXXXX 10 Mar 09, 10:29 PM

C'era una volta, tanto, tanto tempo fa', una guerra. Ma non era la solita guerra. Durava dal tempo dei tempi. E nessuno si ricordava quand'era incominciata, e nessuna sapeva il perché'...

01:40 XXXXXXXXXX 10 Mar 09, 10:36 PM

Nei due regni che combattevano uno contro l'altro, nessuno aveva mai sentito la parola "pace". Il suo significato si era perduto sui campi di battaglia. E i due eserciti continuavano ad affrontarsi senza tregua. Anno dopo anno, mese dopo mese, giorno dopo giorno...

02:00 XXXXXXXXXXXX 12 Mar 09, 01:30 AM


Anno dopo anno, mese dopo mese, giorno dopo giorno&  
"No! No, pieta, pieta!"  
"Maesta! Il gran momento e arrivato!"  
"Per oggi, avrai salva la vita soldato. Ringrazia il mio regalo il re che sta per nascere"

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# AUTOMATED LECTURE VIDEO PUBLISHING



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[Fall 2007](#) 

[Spring 2007](#) 

[Fall06](#) 

[Spring06](#) 

[Fall 2005](#) 

## Lecture Video



**Lecture: Thursday, Sep 02, 2010 20:52:00**

Duration: 01:23:58



**Lecture: Thursday, Sep 09, 2010 11:52:00**

Duration: 01:13:37



**Lecture: Tuesday, Sep 07, 2010 11:45:00**

Duration: 01:18:17



**Lecture: Tuesday, Sep 14, 2010 11:40:00**

Duration: 01:20:35



**Lecture: Thursday, Sep 16, 2010 11:35:00**

Duration: 01:20:41





# COURSE TRAILERS



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general education

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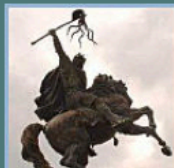
## Fall 2010 Course Trailers



### Is the American Racial Order Being Transformed?

United States and the World 15: Is the American Racial Order Being Transformed?  
*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 Language as Literature  
*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

## Upload a Video (Step 1 of 2)

When you upload a video, the date and time will be recorded and it will be queued for processing. In most cases the queue will be very brief, but during very busy times it may take longer for your video to be ready to view online.

Once your video is uploaded, you'll be prompted to add a title and/or description for your video.

**Add a New Video**

- Post a Video Link
- Upload a File**
- Record from Webcam

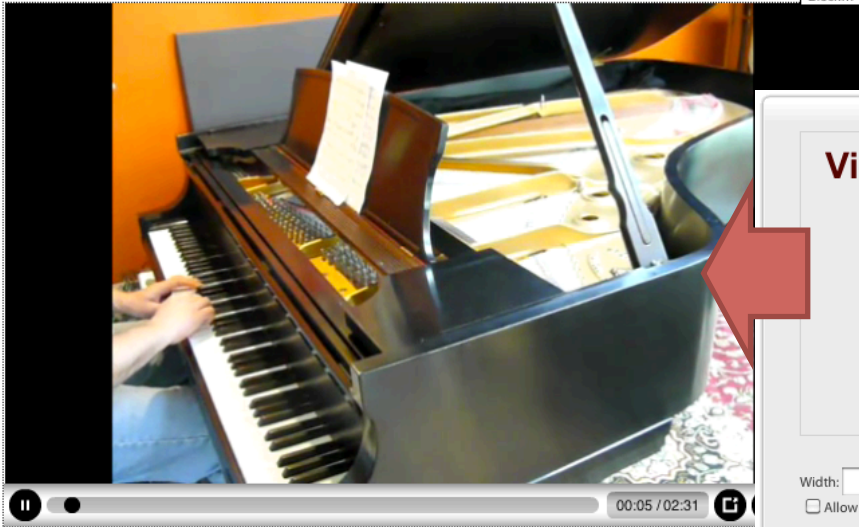
**Upload A Media File**

**Upload A Media File**

9% uploaded

**Uploading...**

### My Video Upload



### Video status:

Queued

Compressing 60%

Final Processing

Complete

Please wait a moment while we load your video...

Width:  Height:  Duration:

Allow flexible size ratio? [What does this mean?](#)

- Autohide Video Control
- Autoplay
- Don't Show This Video
- Include in "Featured Video" Section
- Allow External Embedding
- [What do these options mean?](#)

Uploaded at: 2011-06-21 14:23:22.0  
The video is still being processed on the server. You don't need wait on this page until it's done. Just add your title, an optional description, and click "Save".

Title:

Description:

Font family  **B** *I* U

Font size

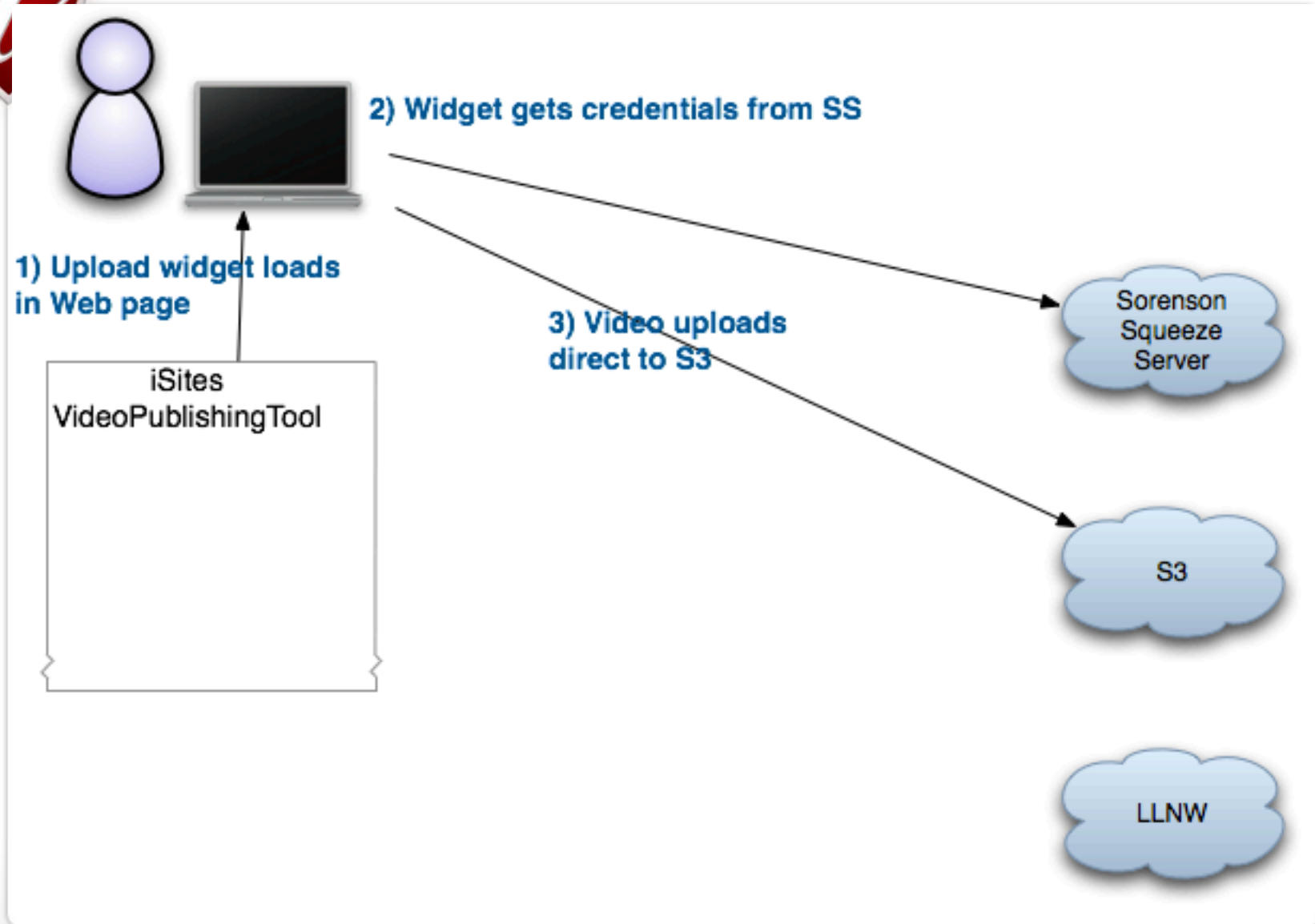
0 Characters (including formatting tags). 4000 remaining.

Show Advanced Options

Publish when Video Processing is Complete **Save** **Cancel**



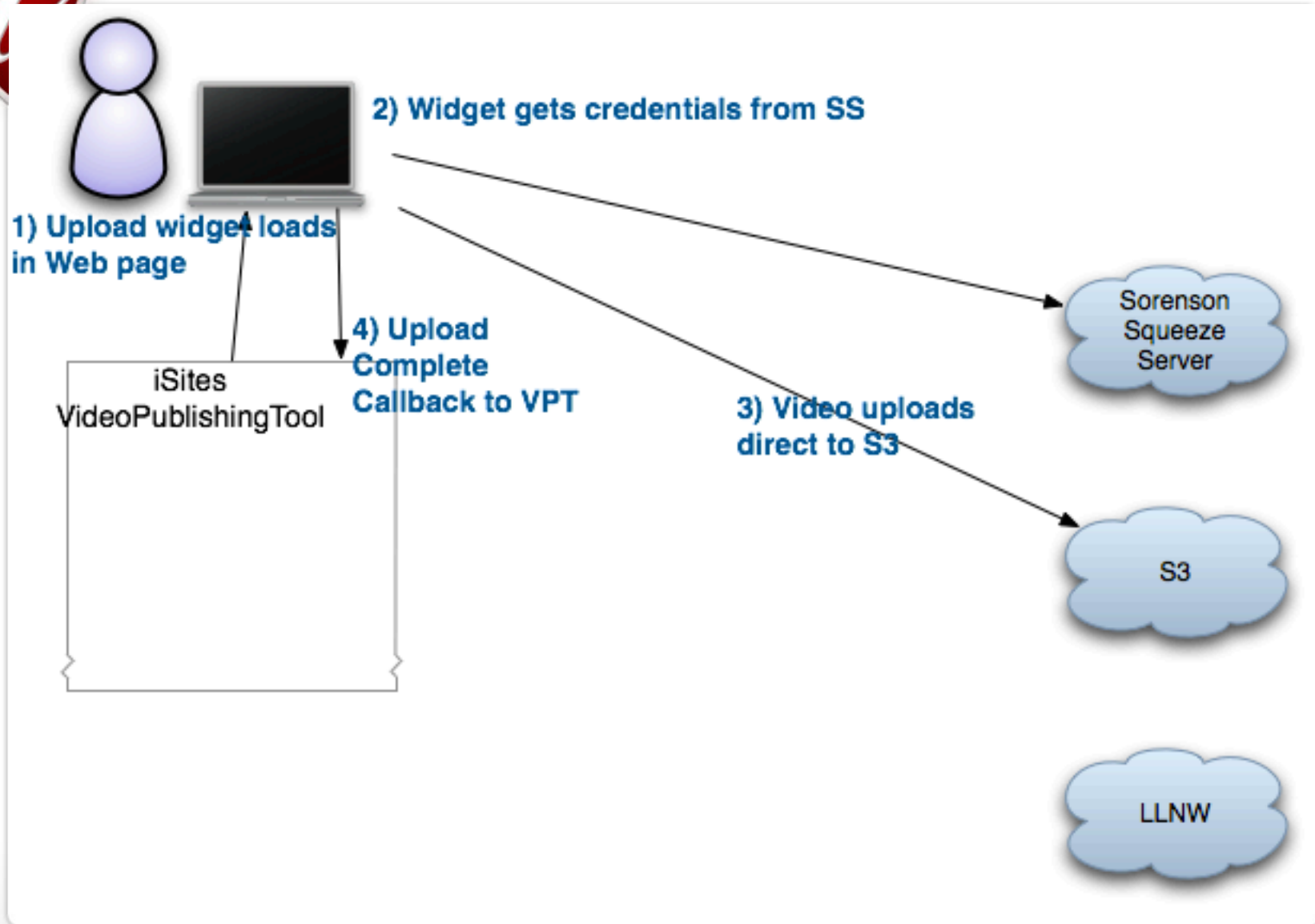
## VPT: Cloud Interaction





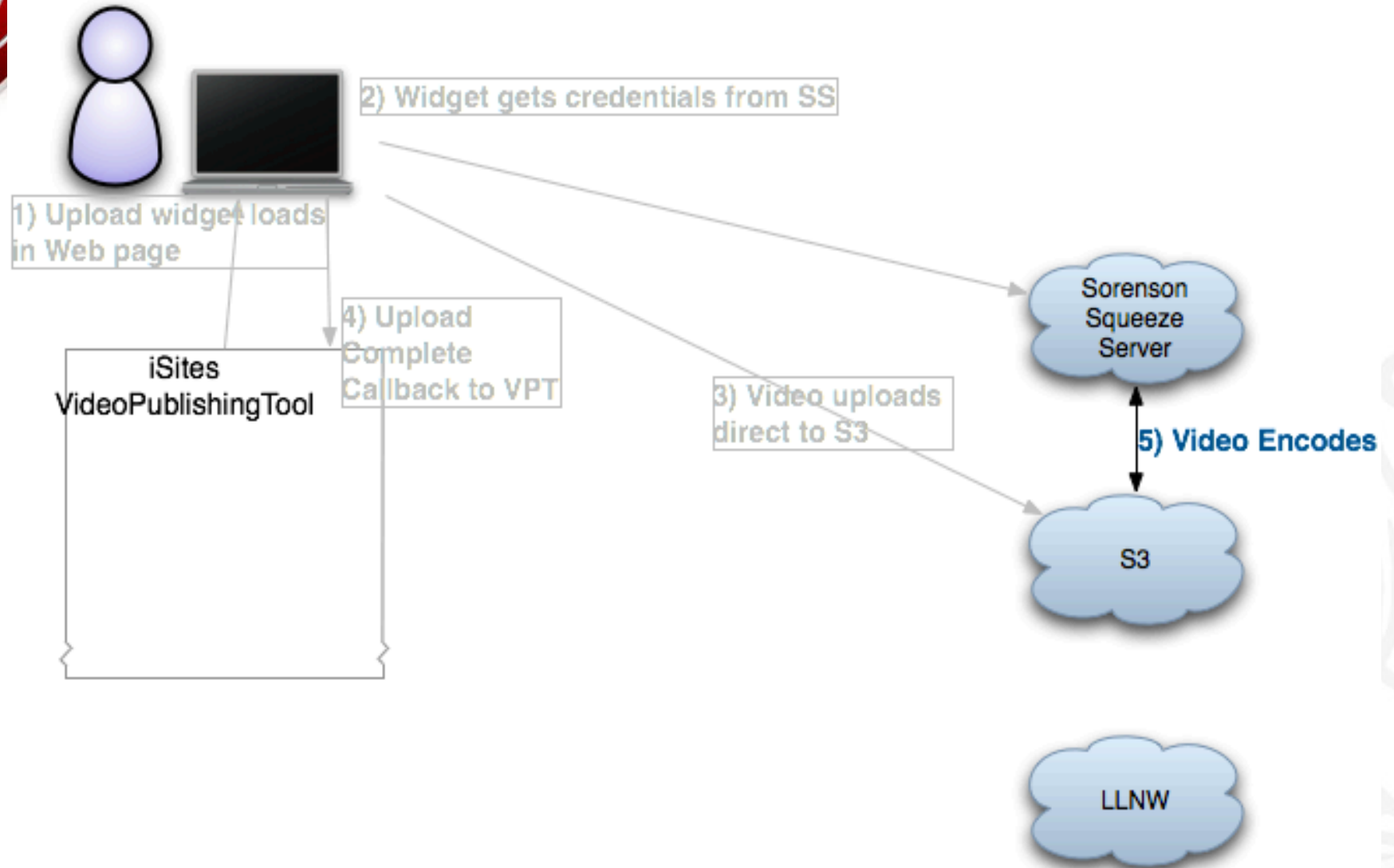


## VPT: Cloud Interaction



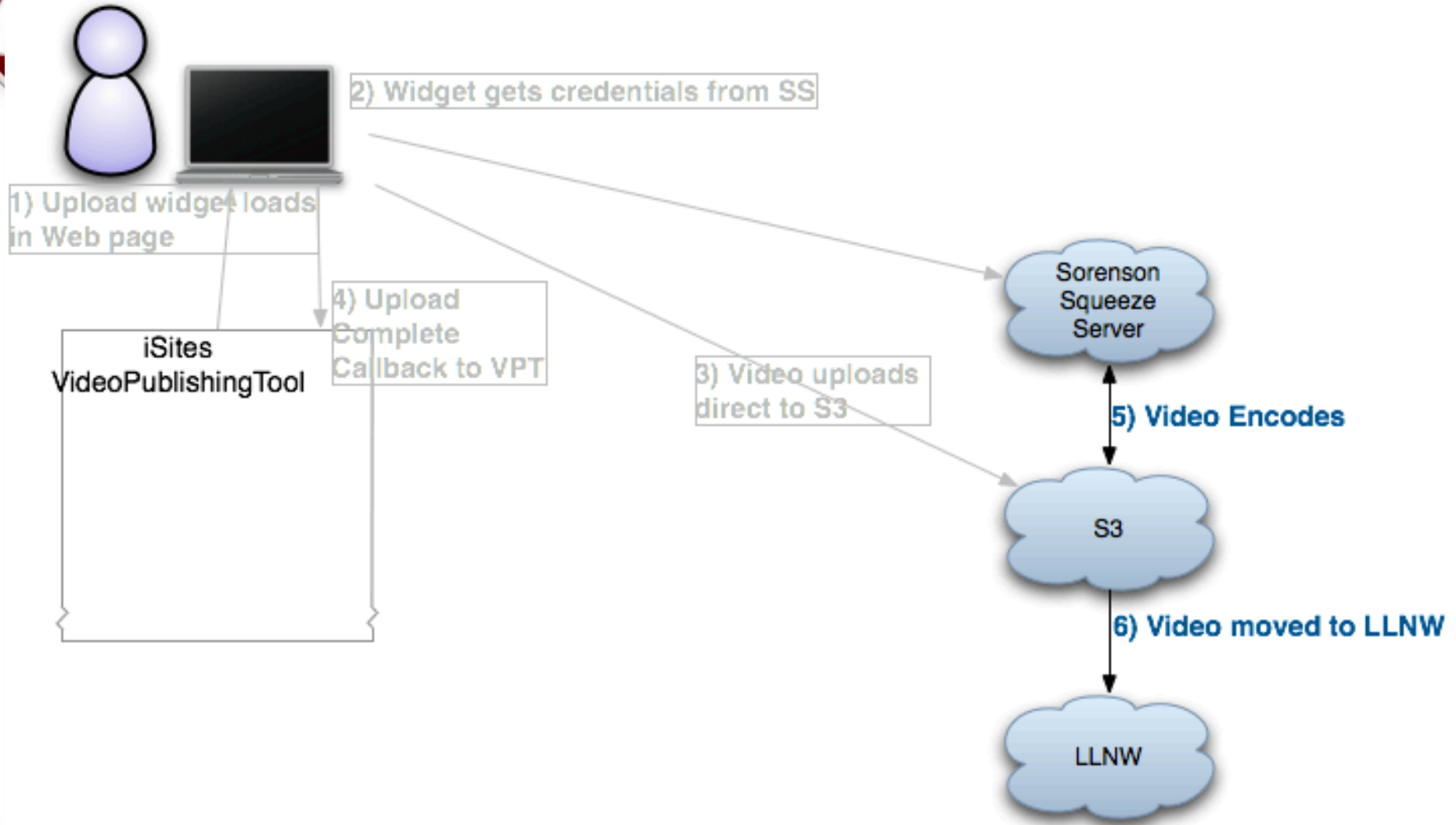


## VPT: Cloud Interaction



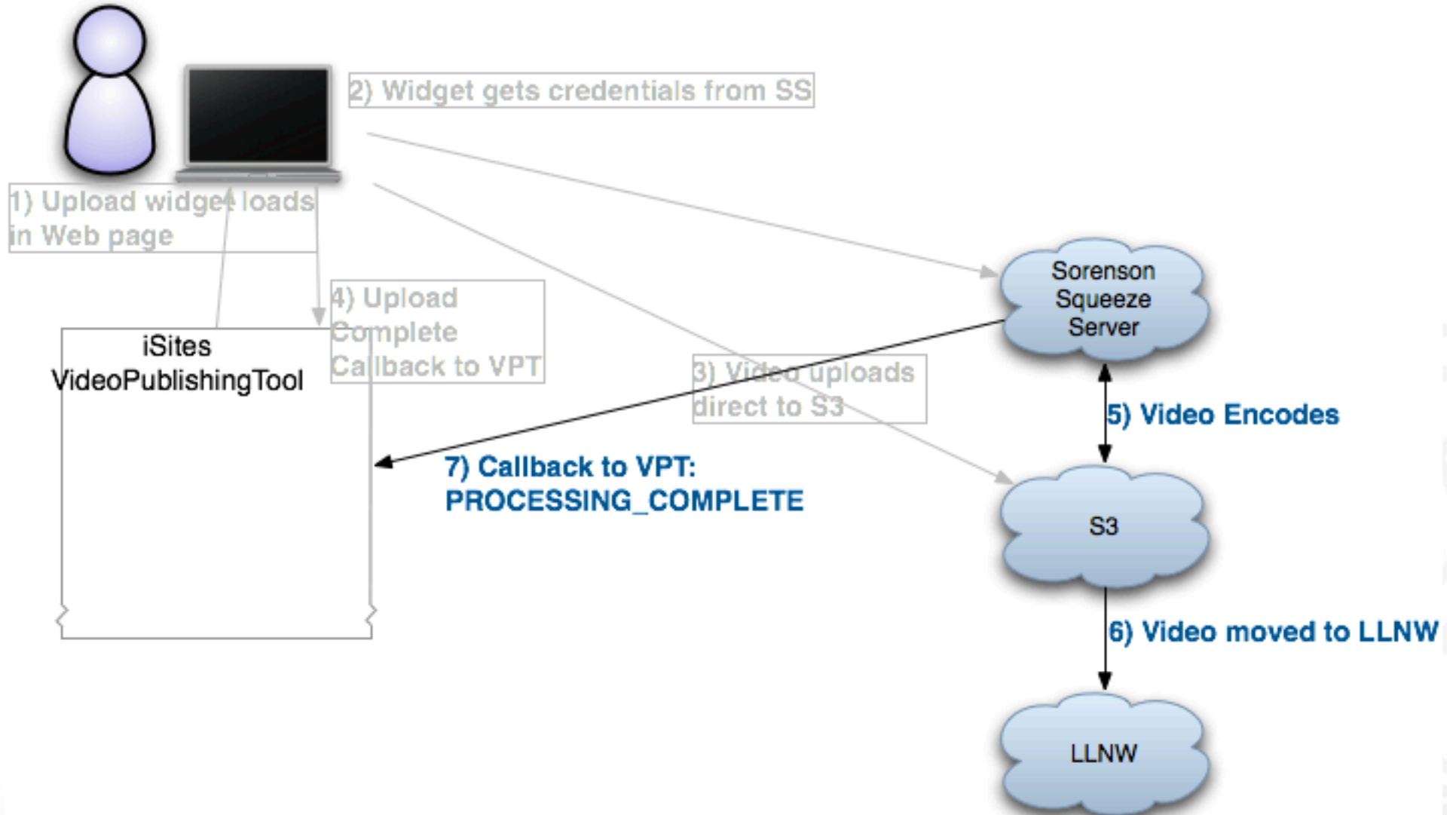


## VPT: Cloud Interaction



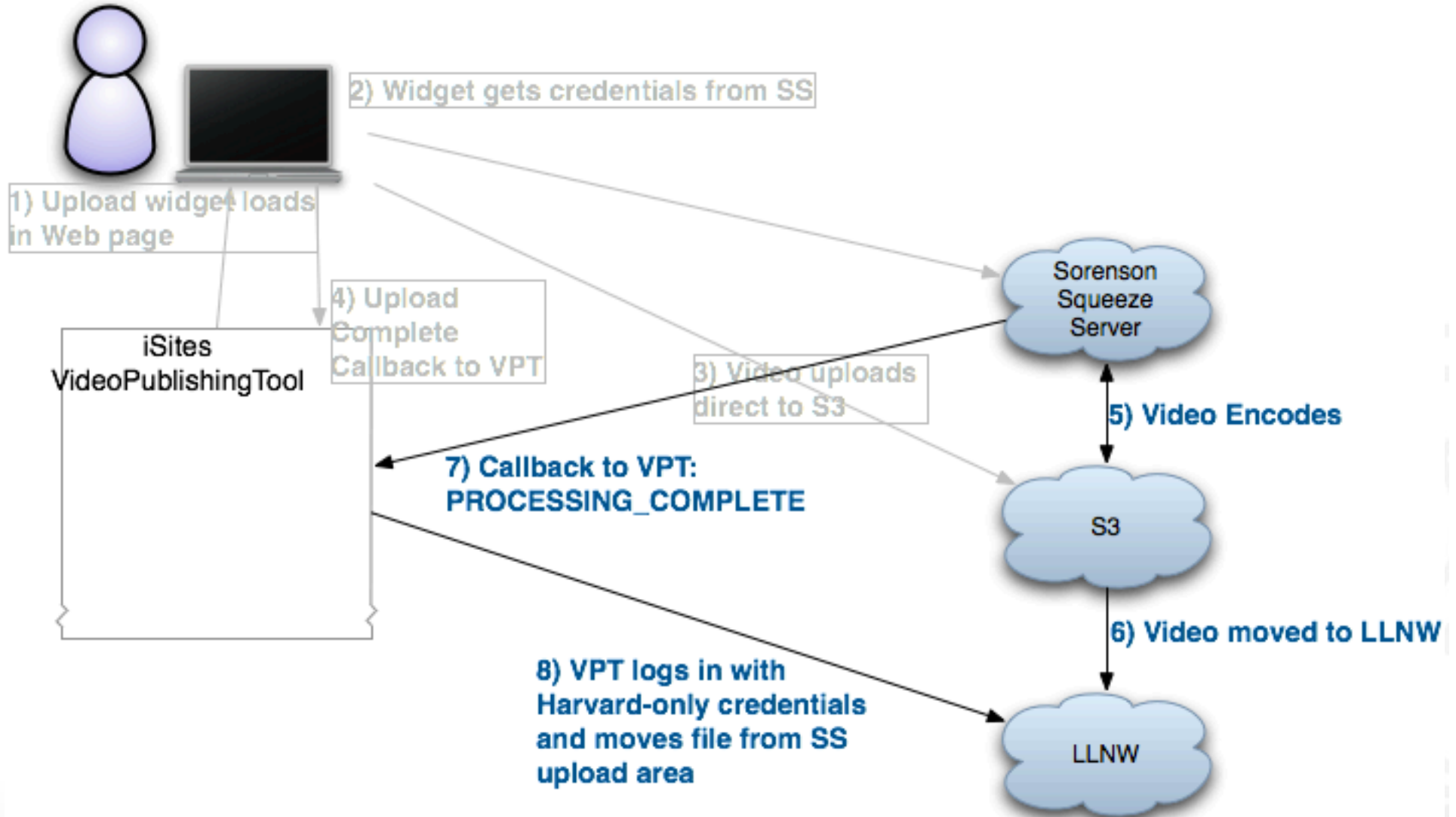


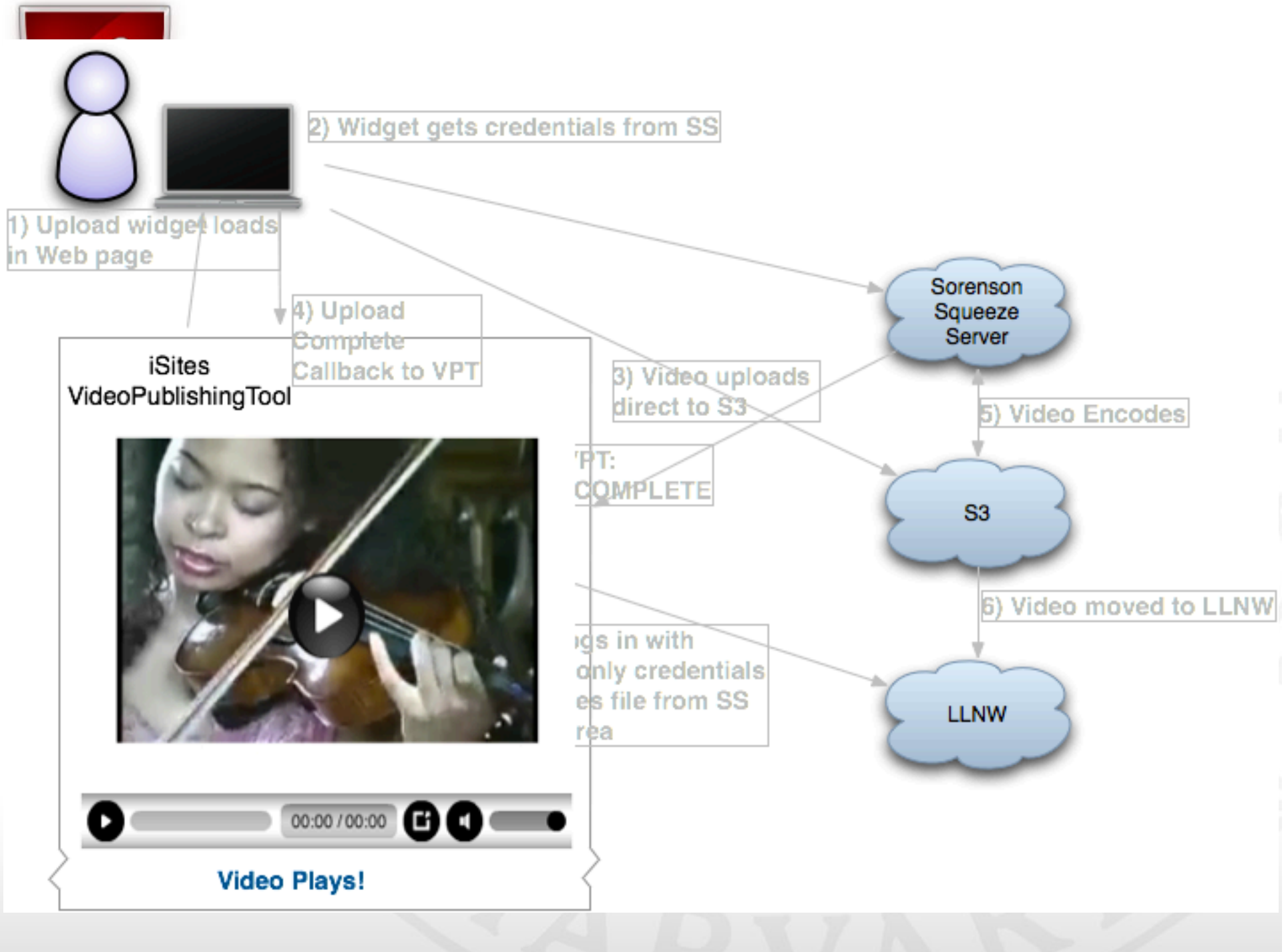
## VPT: Cloud Interaction





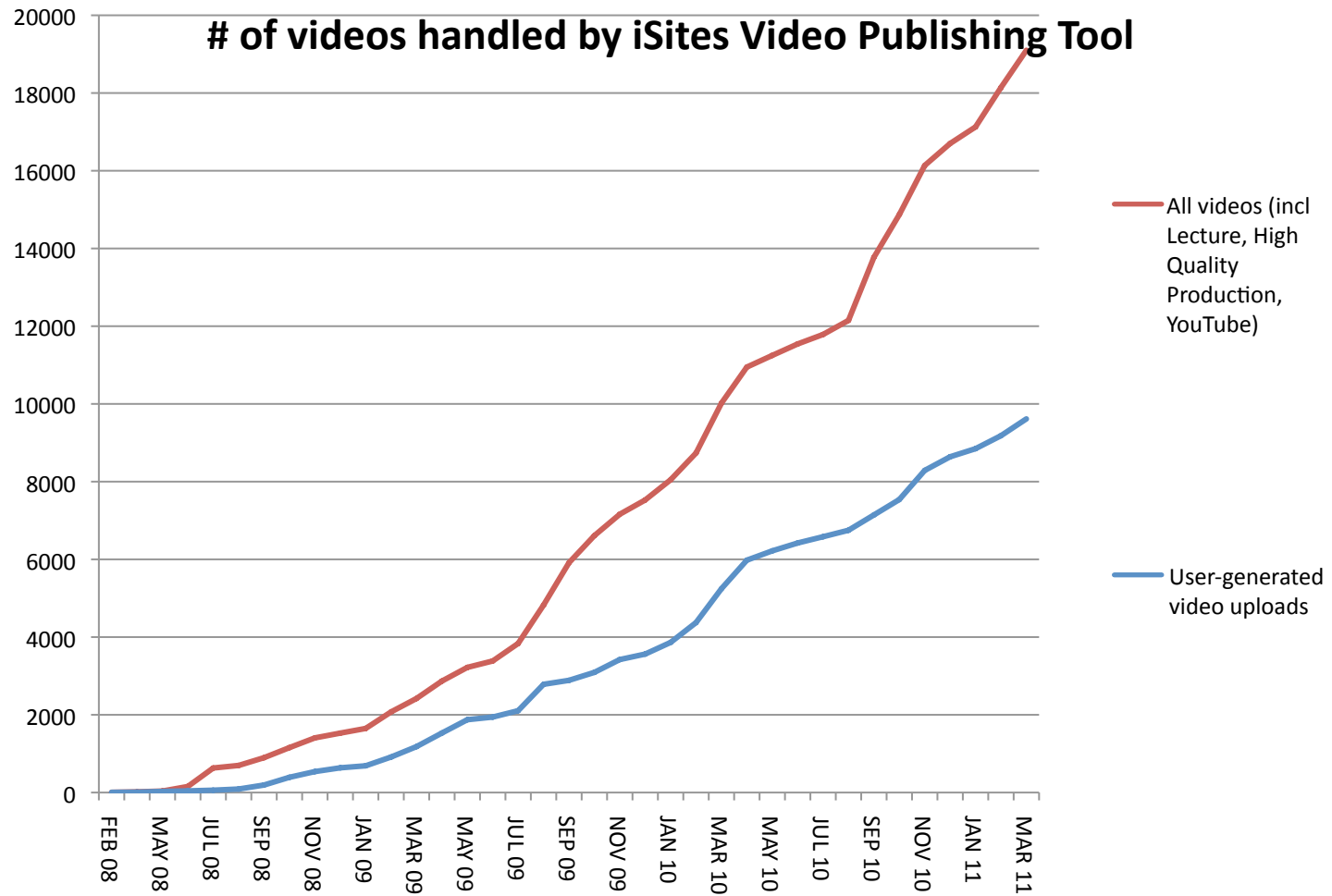
## VPT: Cloud Interaction







## Video Publishing Tool: # of Videos Handled

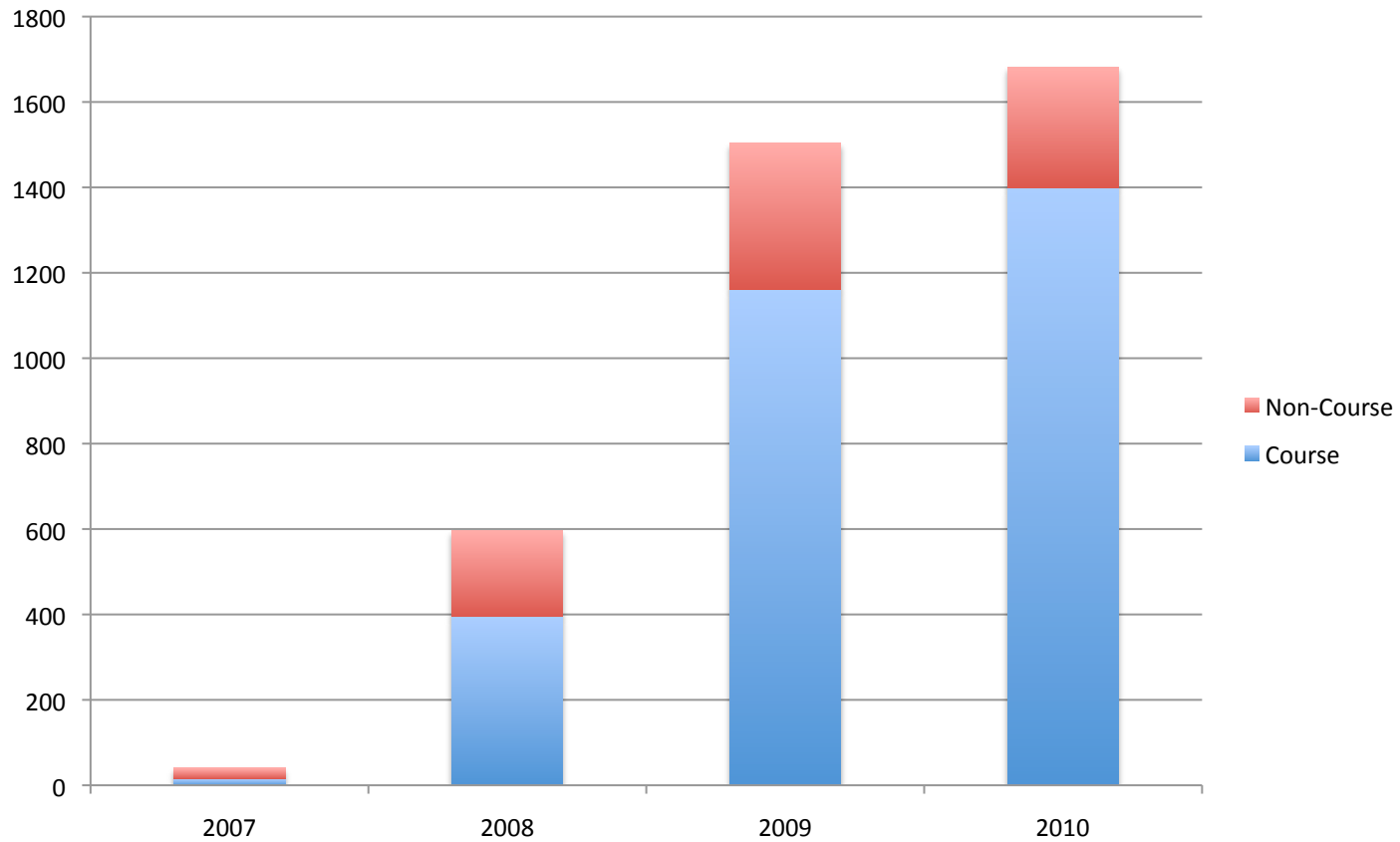






## Video Publishing Tool: # of Sites

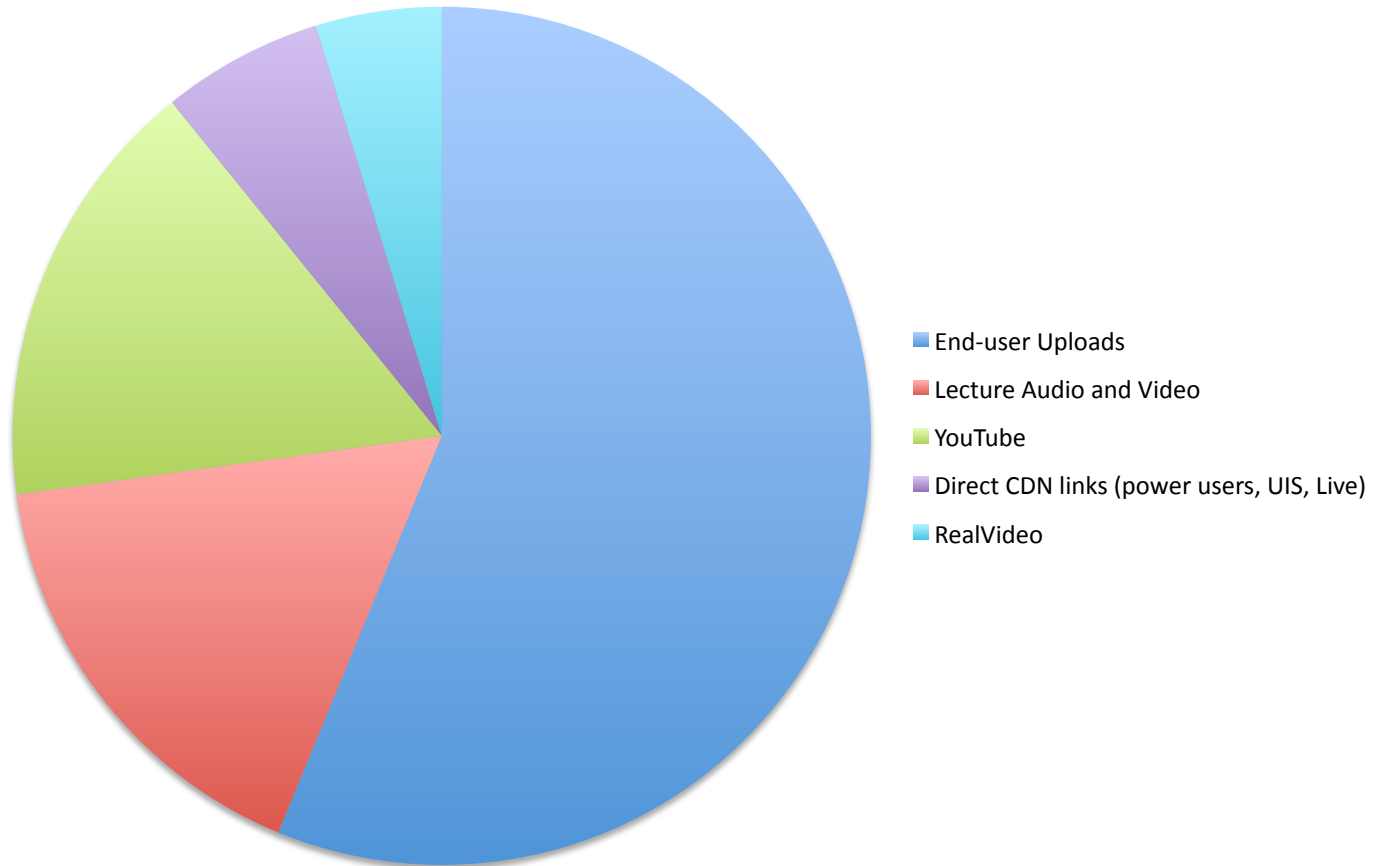
**iSites with at Least One Instance of Video Publishing Tool  
Added (New Per AY)**





## Video Publishing Tool: Content Sources

Sources of iSites Video





## 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



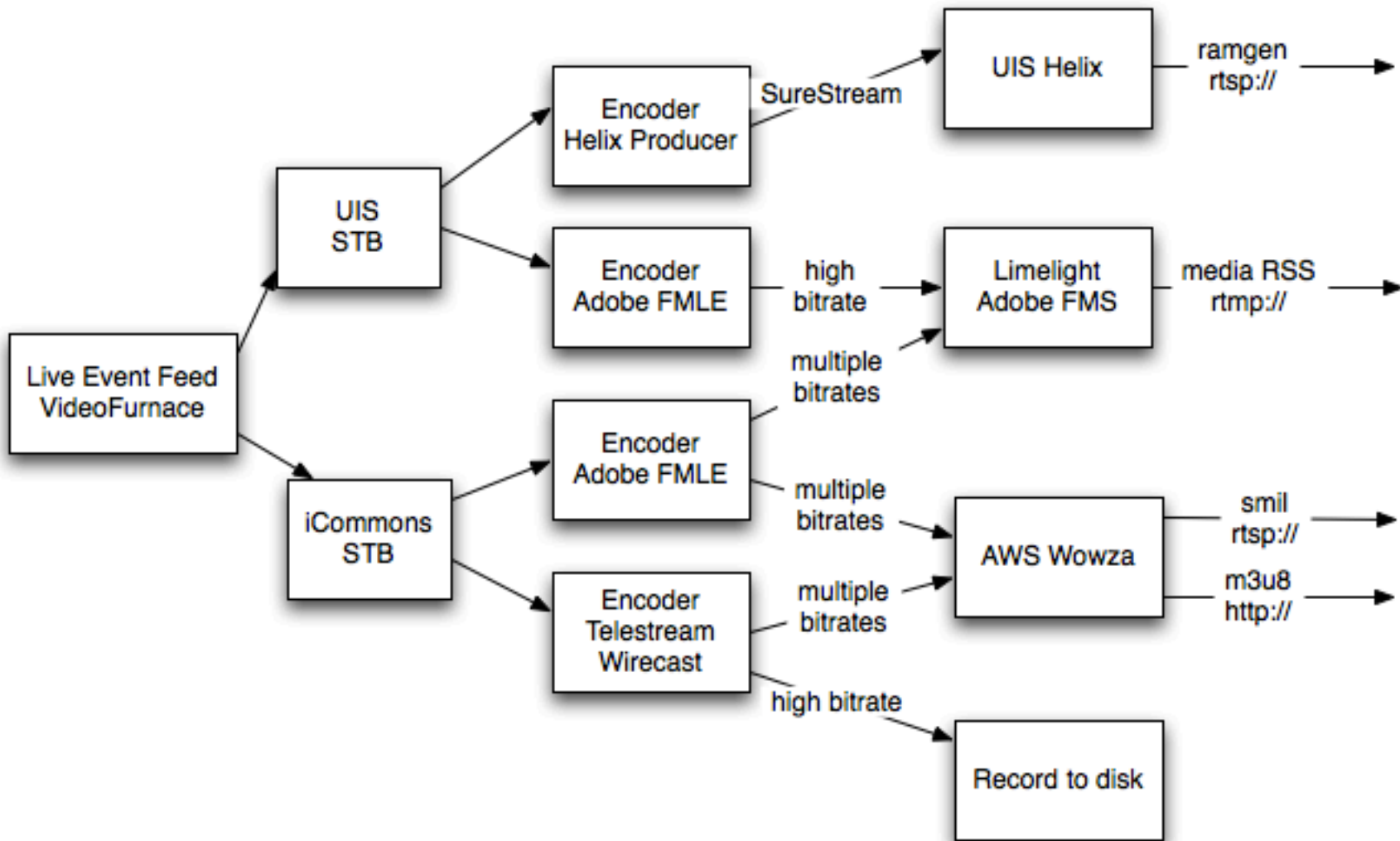
## Live Mobile Delivery:V1.0

### 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

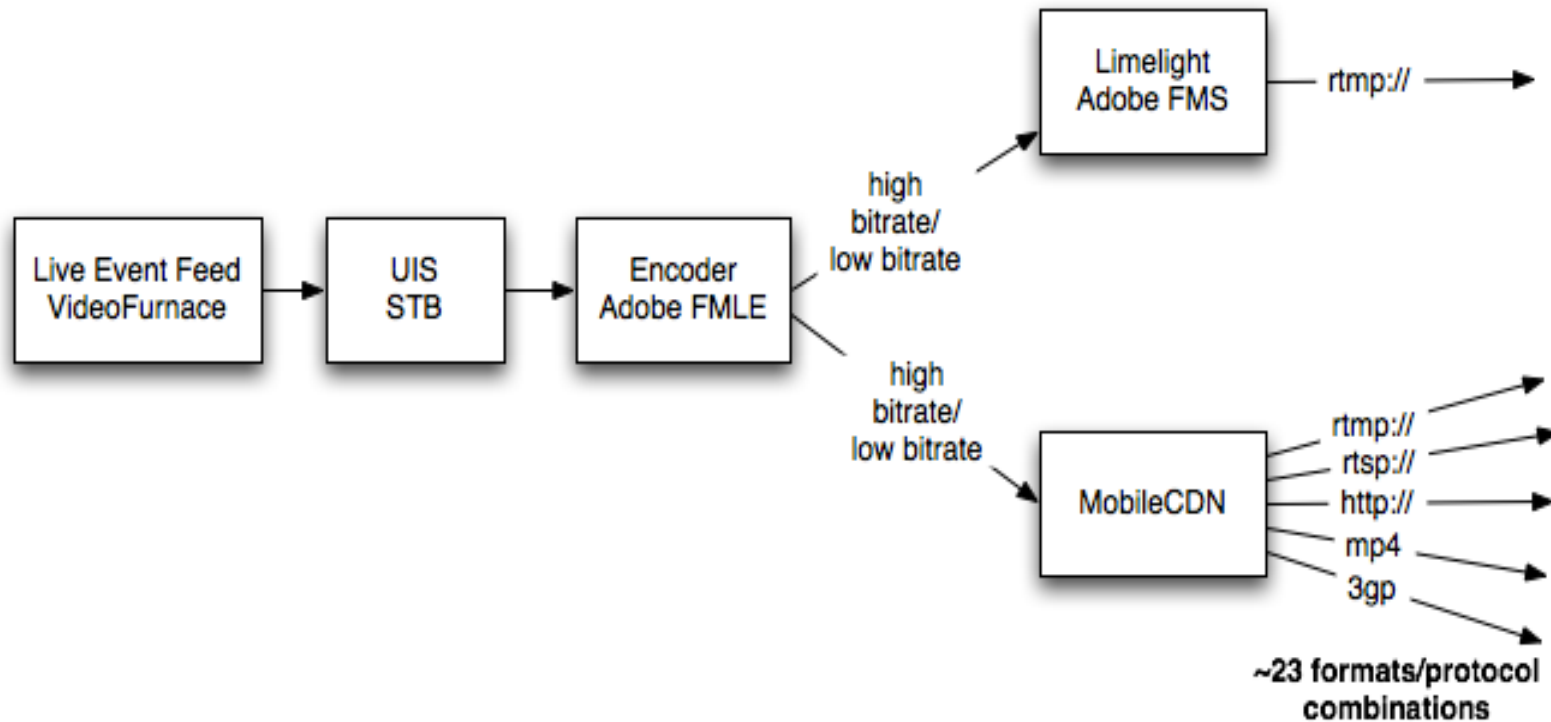
MobileCDN:

- 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

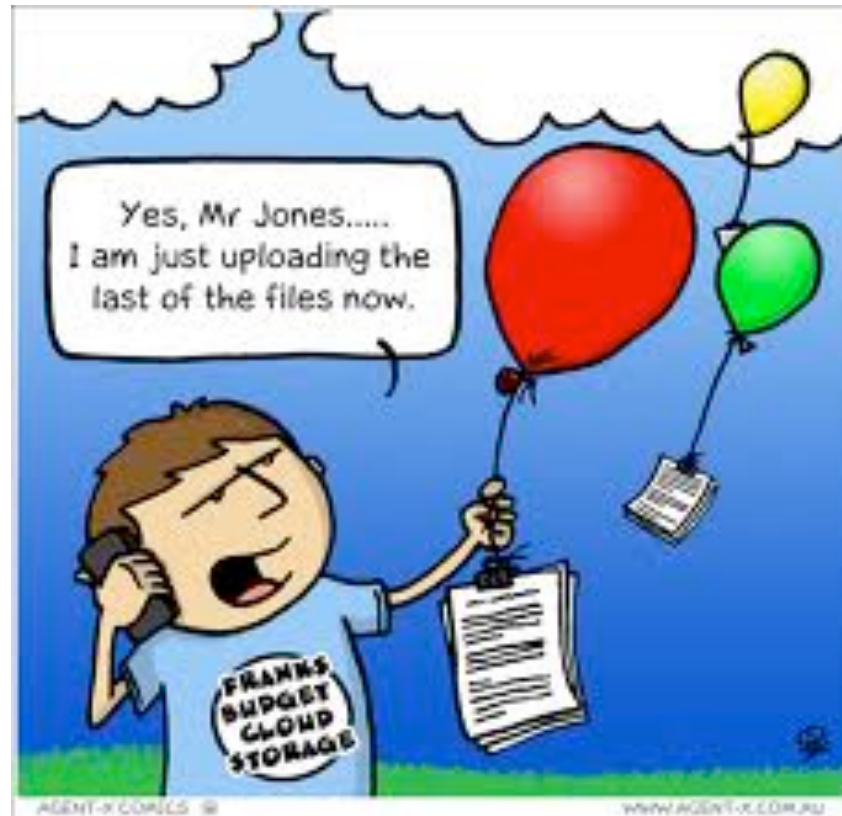
2011: 2000+ Mobile viewers





## What to do about rising costs?

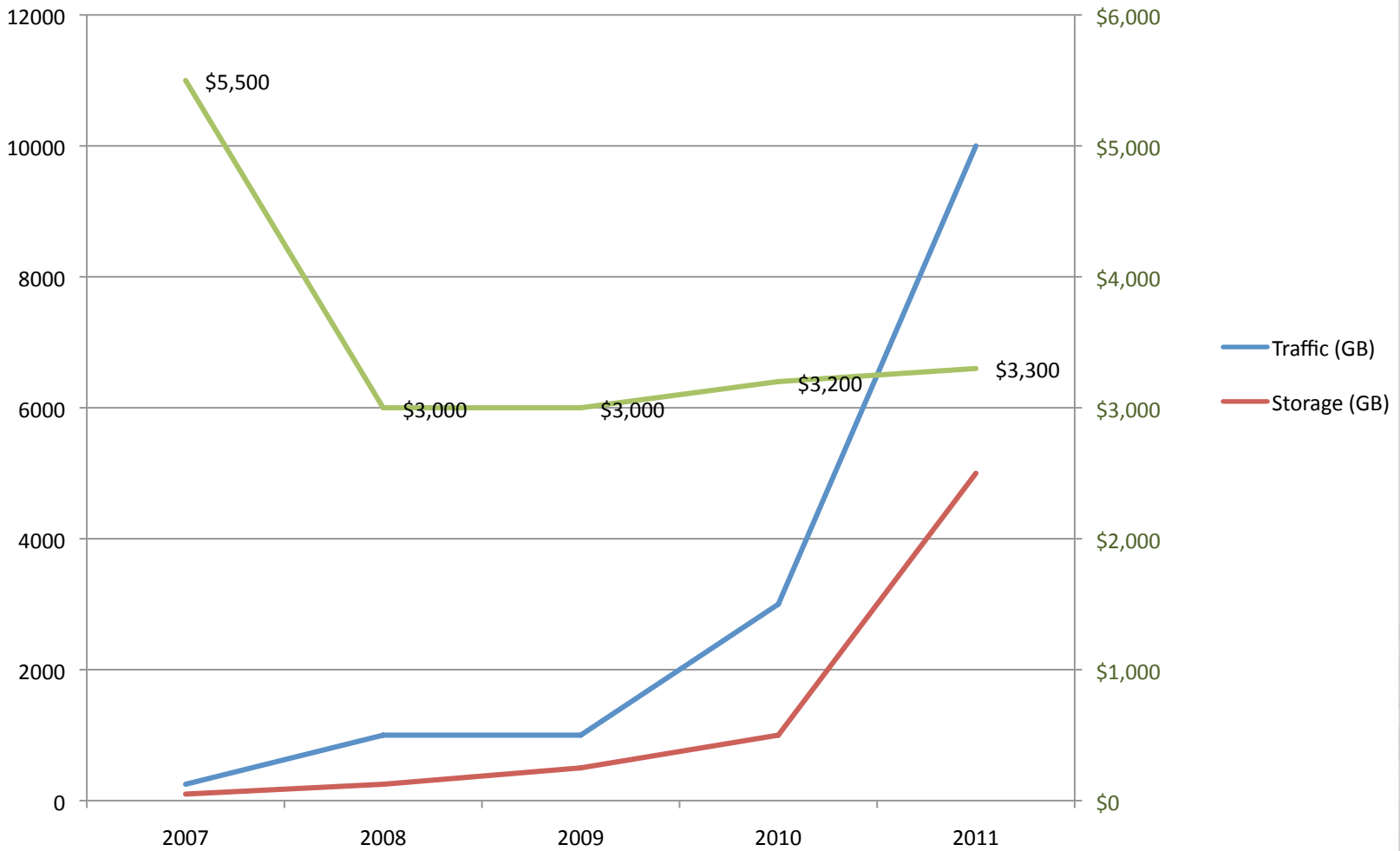
- Costs are variable based on traffic
  - Traffic is a good thing – people are using the service
  - Traffic is a bad thing – our costs suddenly skyrocket
- 
- Go with the low-cost provider?



<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

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