

Cornell University



Cornell University

Delivering Live TV Over a Campus-wide IP Network

Kevin Feeney

Sr. InfoTech Engineer CIT-NCS Network Engineering



CCC '06



Presentation outline

- History of CUTV
 - Review of Campus Life cable need and business case
- Technical concept and business partners
- Service Roll Out
 - Sign up process, inventory and support
- Where we are today
 - Current status and student response
- Where we want to be tomorrow
 - Roadmap for the near future
- What we've learned along the way
- Summary



Cornell University

About Cornell University

- Founded by Ezra Cornell and Andrew Dickson White in 1865
- Member of the Ivy league, partner of State University New York
- 20,000 students representing every state and 120 countries
- 11,000 faculty and staff, 35,000 Ethernet ports
- 14 Colleges and Schools located in Ithaca, NYC and Qatar

Home to nation's first
Colleges devoted to
Hotel Administration,
Industrial and Labor Relations
Veterinary Medicine.



Ezra Cornell: "I would found an institution where any person can find instruction in any study."



CUTV – Cornell University Television

- IPTV service initially provided to student residents on the Cornell campus. Now available campus wide.
- Available on computer or Set Top Box to view on TV set.
- IPTV infrastructure provided by Thomson/Grass Valley and Irdeto.
- 50+ channels news and entertainment content provided by Time Warner and local feeds.
- Partnership between Cornell's IT department (CIT) and Cornell's housing and student life organization (Campus Life).



Campus Life Cable TV Needs and History

- State of Cable TV access in residence halls in 2001
 - 8 of 37 residential buildings, 2 of 3 apartment complexes
 - 1,300 of 7,000 potential residential contract holders (19%)
 - Local cable subscribers – 225 (17% penetration)
- Campus Life goals for Cable TV
 - Equal availability of news and entertainment programming.
 - Affordable to our students.
 - Revenue generating opportunity for Campus Life enterprise.
 - Options for Cornell specific programming (Cornell Content Channels).
- Options explored
 - Issued RFP for provision of plant and content
 - Coax Infrastructure costs were higher than IPTV solutions
 - Profit sharing options were minimal
 - Most affordable and attractive solutions required either
 - A. Bundling into housing rates – not an option
 - B. Use of Cornell CIT fiber – none available



Cornell University

Residence Halls





Exploring IPTV

- Discussions in leasing fiber from CIT led to discussions of IPTV, a whole new option for delivery of news and entertainment programming
- 2001 edge upgrades – switched 10 mbps service or better
- Campus Life secured a year by year contract for cable services with Falls Earth in new residence halls while IPTV technology was explored. Falls Earth was also a partner in exploring IPTV technologies.
- CIT and Campus Life formed a partnership to pilot IPTV delivery of service to residence spaces
 - Risk sharing on service start-up costs
 - Subscription service aimed at cost recovery



Business Case Development (1)

- Student survey
 - Expected use ~ 10-20+% (out of 7,000 potential subscribers)
 - Little to no staff use
- Concerns about technology adoption
 - Computer or TV: surveys showed 80% wanted computer
- Concerns about cost of end-user support
- No good benchmark data from peer institutions
- Windows only
 - Insufficient business case for Apple / Unix support
 - Too short a development cycle to accomplish porting



Business Case Development 2

- After great debate and a leap of faith ...set subscription fee to:
 - \$30 per month software based service (USB)
 - \$45 per month Set Top Box (STB)
- Break even 2 years out after implementation
 - Broader value of CUTV infrastructure to enable Cornell content delivery.
 - Coax savings. No redundant infrastructure in new buildings.
 - Service access for all students.



System planning (1)

- MPEG2 – standards based
 - Good quality at reasonable data rates
 - Enough campus backbone bandwidth to support it
 - Wide variety of solutions available for it
 - Licensing issues clearer than MPEG4
- Encoding by content supplier – Time Warner
 - Benefit of Fiber to Campus.
 - Benefit of MPEG2 streams.
 - Time Warner owns much of the content and was able to help ease content source provider concerns about piracy.
 - Long and challenging negotiating process...pioneering!
 - Problem with use of terms: E.g. “data”, “Cable TV service”, “Internet”, “IP”



System planning (2)

- Encryption by Irdeto.
- Custom SmartVision Windows client with Irdeto decryption built into client.
- Development support by both Irdeto and Thales/Grass Valley for custom client was key to success.
- Amino Set Top Boxes also support Irdeto decryption.
- Set Top Boxes were intended primarily for Apple and Linux users, TV users.



System planning (3)

- SmartVision Subscription Management System (SMS) forms the core of the system.
- Manages the clients and licenses.
 - Provides the Electronic Program Guide.
 - Manages channel offerings and selection.
 - SMS also manages encryption smart cards and sims by communicating with the CAS.



System planning (4)

- Cornell built web front end to integrate to SmartVision SMS for our special needs.
 - University needed to interface to our student database, but keep it isolated from SMS.
 - Created online signup portal for the students.
 - Interface to our inventory control system.
 - Interface to our billing system.
 - Grass Valley provided great support for integrating our front end to the SmartVision SMS.

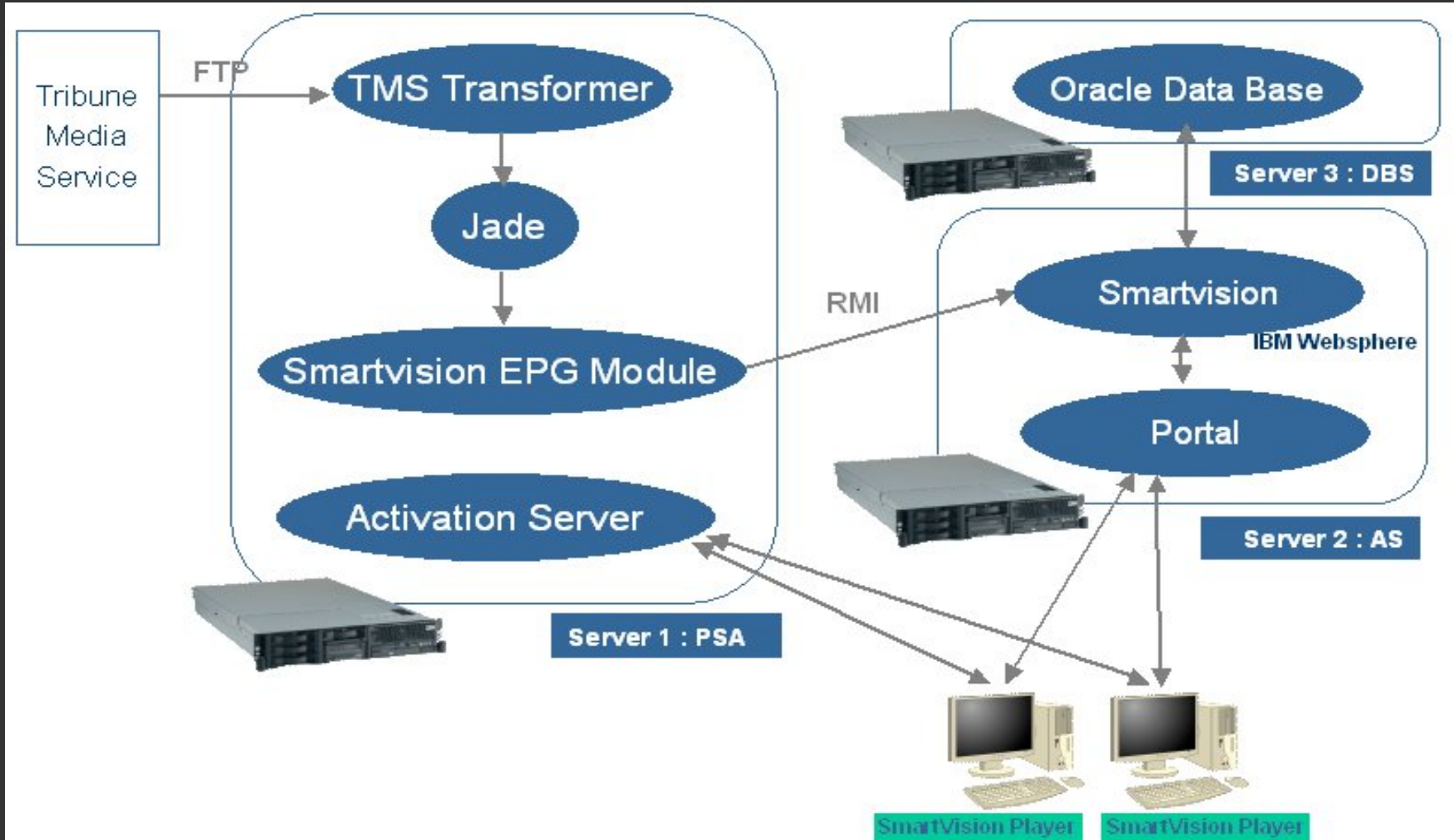


System Description

- MPEG-2 encoding, 3.8 Mbps.
- Electronic Program Guide (EPG), 7 days long.
- Content protection and Rights Management by Irdeto CAS.
- Oracle Database.
- Feature set is based on SmartVision release 1.5
- Web based subscriber interface – custom developed to interface to SMS.
- Up to 2,000 defined customers in the database (but the hardware could support up to 6,000 by software upgrade).
- Live TV service : up to 60 Channels (scrambled by Irdeto CAS).
- Up to 20 different service plans.
- No Video On Demand....yet.
- No redundancy...yet.
- IBM Web sphere Application Server architecture (J2EE compliant architecture).
- Hardware based on IBM Servers.



CUTV System





CUTV Channels

- A&E
- ABC (WIXT)
- Animal Planet
- Annenberg Channel
- AZN
- BET
- Bloomberg
- Cartoon Channel
- CBS (WTVH)
- CNBC
- CNBC world
- CNN
- Comedy Central
- Cornell Events
- Country Music TV
- CSPAN
- CW
- Discovery Channel
- Discovery Civilization
- Discovery Health
- Discovery Science
- Disney
- E! Entertainment
- ESPN
- ESPN 2
- Food Network
- FOX (WSYT)
- Fox News Network



- Fox Sports NY
- FX Network
- G4
- History Channel
- ISATE
- Learning Channel
- Military Channel
- MSNBC
- MTV
- National Geographic
- NBC (WSTM)
- Nickelodeon
- PBS (WCNY)
- Sci-Fi
- SCOLA
- Speed channel
- Spike TV
- TBS
- Time Warner News 10
- TNT
- Turner Classic Movies
- USA Network
- VH-1
- WB (WNYS)
- Weather Channel



CUTV screenshots

23 WB
24 CARTOON CHANN
25 DISNEY
26 NICKELODEON
31 ESPN
32 ESPN 2
33 FOX SPORTS NY
34 SPEED CHANNEL
38 TURNER CLASSI
41 MTV
42 COUNTRY MUSIC
43 VH-1
46 FOX NEWS NETW
47 CNN
48 CNBC WORLD
49 CNBC
50 CSPAN
51 MSNBC
52 WEATHER CHANN
53 SCOLA

Bobby Dunkwell
Team: San Jose Speed
Position: Guard
Jersey Number: 23
Height: 6' 6"
Birth Date: February 12, 1983
Birthplace: Brooklyn, NY
NBA Experience: 14th Season
Championships: 0

Total Games: 82
Total Minutes: 3,181
Points per Game: 26.7

34 SPEED CHANNEL
Motorcycle Racin... From the Bank One Ballpark in Phoenix.
4:00 PM 5:00 PM

CUTV! Your TV. Your Choice.

23 WB
24 CARTOON CHANN
25 DISNEY
26 NICKELODEON
31 ESPN
32 ESPN 2
33 FOX SPORTS NY
34 SPEED CHANNEL
38 TURNER CLASSI
41 MTV
42 COUNTRY MUSIC
43 VH-1
46 FOX NEWS NETW
47 CNN
48 CNBC WORLD
49 CNBC
50 CSPAN
51 MSNBC
52 WEATHER CHANN
53 SCOLA

6:00 AM Consumer Product Show...
6:30 AM Consumer Product Show...
7:00 AM Inside Nextel Cup
8:00 AM 7 Days
8:30 AM NBS 24-7
9:00 AM Back in the Day
9:30 AM NASCAR Past Champions
10:00 AM Wind Tunnel With Dave...
11:00 AM Consumer Product Show...
11:30 AM Consumer Product Show...
12:00 PM Motorcycle Racing
1:00 PM Motorcycle Racing
2:00 PM Motorcycle Racing
3:00 PM Motorcycle Racing
4:00 PM Motorcycle Racing

34 SPEED CHANNEL
Motorcycle Racin... From the Bank One Ballpark in Phoenix.
4:00 PM 5:00 PM

CUTV! Your TV. Your Choice.



Cornell University

CUTV Service Roll-out

After working through the CUTV project with an aggressive time line (5 months!) and great support from our business partners during the entire process it was time for....

Opening weekend : August 19, 2005

bulk sign up!





CUTV Student subscription process

- Web-based subscription (ASP.NET)
- Student prints confirmation.
 - Confirmation is also emailed to student.
 - Confirmation needed to activate service.

Cornell University CUTV Student Account Management

Welcome -> Agree to Terms -> Create Logon -> Print Confirmation

Subscriber Information

Please complete the subscription form below. All fields are required.

Name: Donald Sevey

Campus Address: 1152 Balch Hall

CU TV User Type: staff (bursar billable: N)

Account # to Bill:

CU TV Hardware: USB Connector and SIM Chip @ \$30/mo, plus \$45 deposit (choose this for viewing through your computer)

CU TV Login: dds29

CU TV Password: confirm:

***NOTE:** For security reasons, do not use your kerberos (Cornell e-mail) password. This password must be at least eight characters. Please make a note of this password, as it will be required when you use CUTV for the first time!

© 2005 Cornell University Campus Life | CUT (v28/10/05)good
Send questions or comments to: help_serve_purcell@cornell.edu

Cornell University CUTV Student Account Management

Welcome -> Agree to Terms -> Create Logon -> Print Confirmation

Thanks for subscribing to CUTV!

Please print this page. Bring it with you, along with your Cornell ID card or other picture ID, to your service center Monday - Friday between 9:00 AM and 4:00 PM to complete the subscription process. If you don't live in a residence hall, then just stop by the [Robert Purcell Community Center](#).

Confirmation #: 9-M28A-1807

Date and Time: 9/30/2005 8:59:03 AM

Confirmation Email sent to: dds29@cornell.edu

Hardware Requested: USB Connector and SIM Chip

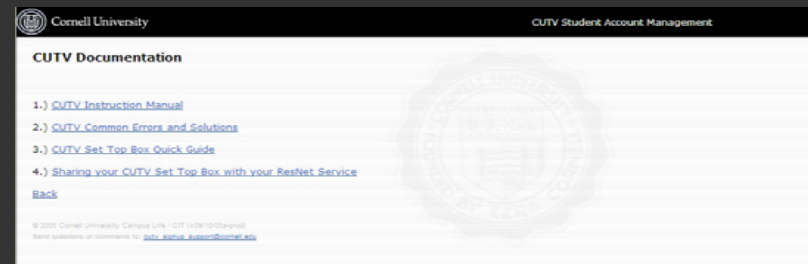
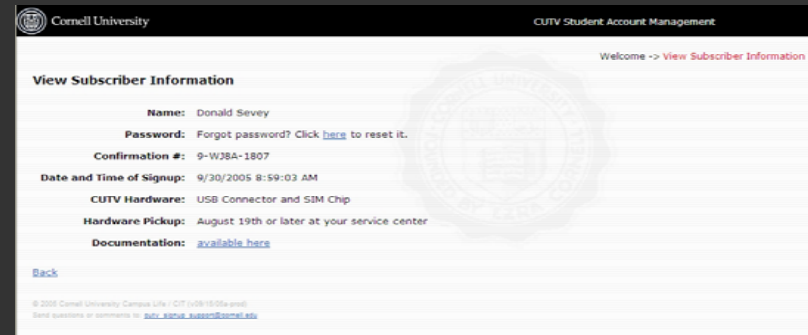
[Go to the Campus Life Service Centers Homepage](#)

© 2005 Cornell University Campus Life | CUT (v28/10/05)good
Send questions or comments to: help_serve_purcell@cornell.edu



CUTV Student Account Management Functions

- Review Subscription information.
- Change Password.
- Access CUTV documentation:
 - Terms of Service
 - FAQ
 - Installation Guides
 - Troubleshooting Guide





Hardware Distribution and administration

- Campus Life Service Centers
 - Key distribution points
 - Assign hardware
 - Activate / Cancel Service
 - Hardware Inventory Control
 - Reporting

Activate / Check-out hardware

Cornell University CUTV Service Center Account Management

Search Results

Sevey, Donald (dds29)

Conf. #:	Sub. Type:	Subscriber's Address:	Signup Date:	Sub. Start Date:	Sub. End Date:	Pre-Sub Cancel?
9-MYE6-771	USB	1152 Balch Hall	8/18/2005	8/22/2005	8/22/2005	N
7-4K6Z-1331	USB	1152 Balch Hall	8/25/2005	9/9/2005	9/9/2005	Y
9-W38A-1807	USB	1152 Balch Hall	9/30/2005	Not Active (assign hardware)	Not Active	N (click here to cancel)

Conf. #:	Received Hardware?	Returned Hardware?	Refunded Deposit?
9-MYE6-771	USB - (SIM Card 40103701583 / SIM Reader 50708152444) on 8/22/2005 1:41:24 PM	8/22/2005 1:44:07 PM	Y

[back to main menu](#)

© 2005 Cornell University Campus Life - CUT (02/10/05a.ans)

Cancel / Check-in hardware

Cornell University CUTV Service Center Account Management

Search Results

ORKIN, MICHAEL (mco23)

Conf. #:	Sub. Type:	Subscriber's Address:	Signup Date:	Sub. Start Date:	Sub. End Date:	Pre-Sub Cancel?
5-TVU9-1101	USB	5514 High Rise 5	8/21/2005	8/21/2005	Active (click here to cancel)	N

Conf. #:	Received Hardware?	Returned Hardware?	Refunded Deposit?
5-TVU9-1101	USB - (SIM Card 40103700056 / SIM Reader 50712144707) on 8/21/2005 12:19:49 PM	check-in hardware pair	Y

[back to main menu](#)

© 2005 Cornell University Campus Life - CUT (02/10/05a.ans)

Assign hardware

Cornell University CUTV Service Center Account Management

Hardware Checkout

Please complete the hardware checkout form below. All fields are required.

Confirmation ID: 9-W38A-1807

Subscriber Name: Sevey, Donald (dds29)

Payment Method: (account # can be modified later)

CU TV Hardware: (confirm selection w/ student)

SIM Card Serial Number: (Please scan the **CARD** barcode.)

[back to main menu](#)

© 2005 Cornell University Campus Life - CUT (02/10/05a.ans)



End User Support

- Tiered Support Structure
 - Level 1 –Level 2 – CIT – NCS Help Desk (Technical Support)
 - Level 2 – CIT –NCS Network Engineering
- Support Metrics – Year 1, 6 week snapshot
 - 211 problem reports from a population of 533 subscribers
 - 172 out of 211 (82%) were resolved in level one troubleshooting via telephone or e-mail.
 - 39 cases required on-site support



User Support Analysis

- Analysis
 - Firewall issues
 - Wireless instead of wired network selected
 - Wrong TV input for STB users
 - Network switches required for STB

“Where’s the cable guy?”

- Due to compressed timeline of project the user documentation was not as robust as needed.
- No time for limited deployment to anticipate specific user issues.
- Educate users on the fact the IPTV is a computer service and not exactly Cable Television.



Where we are today

- Year 1 Peaked at over 650 subscribers before spring semesters end
 - Approximately 60% Set Top Box (STB) users
 - Approximately 40% USB users instead of predicted 80% - why?
 - 10% penetration, half way to our goal of 20% coverage in the residence halls.
- Year 2 peaked at about 800 subscribers
 - 69% STB users, 31% USB users
 - TV service now available for all 7,000 potential residential users (instead of 1,300).
 - Tripled the number of students who are now able to watch TV on campus (from 225 to 601) in year 1. Nearly quadrupled in year 2.



Campus wide deployment April 2006

- CUTV deployment to faculty and staff
 - Full campus deployment to campus was made available in April.
 - Active marketing to public spaces like lounges, lobbies and kiosks.
 - Developed a support model to have the STB installed by CIT.
 - Self installation for USB model.
 - Leverage technical support structure on campus for support (OSS).



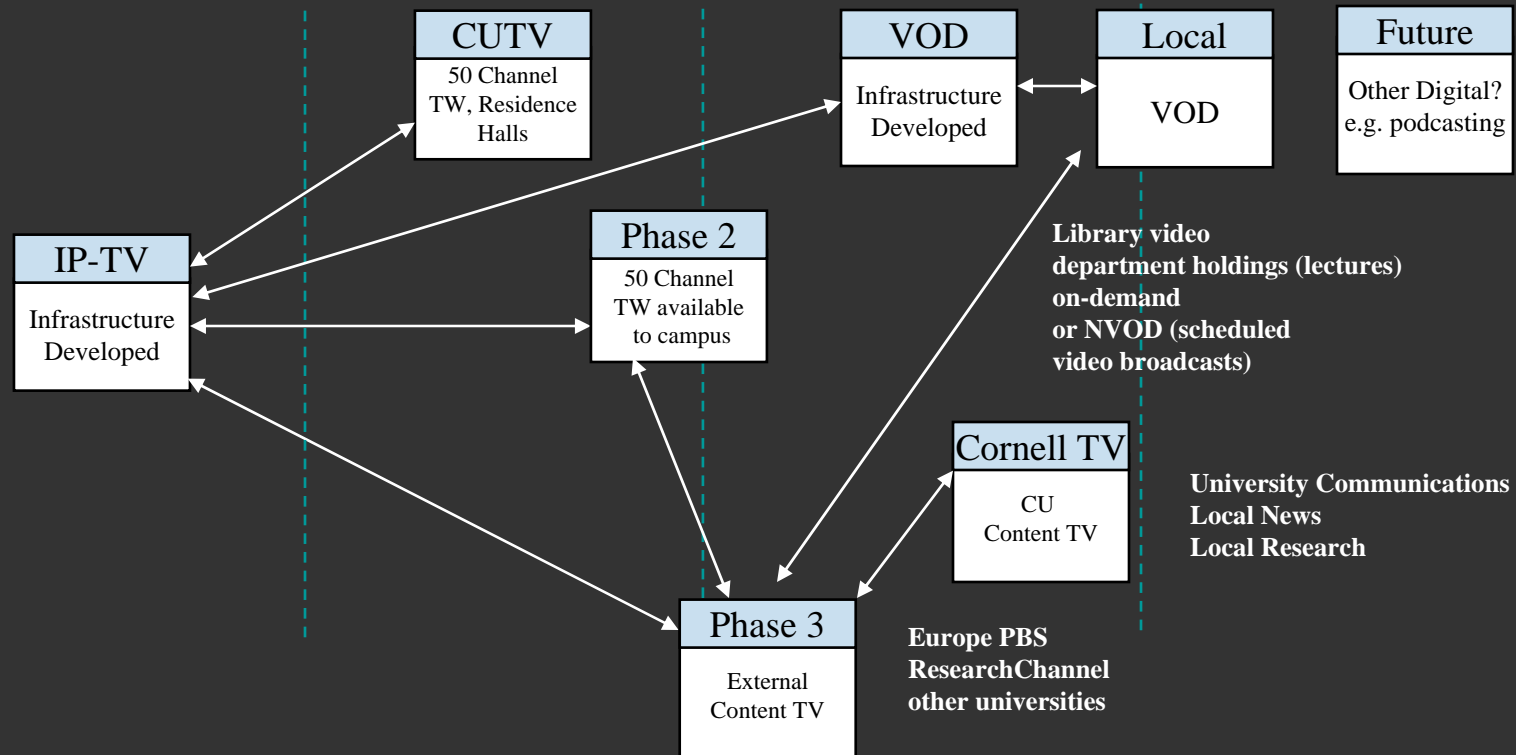
Roadmap TV / Video Concepts for Cornell

2004

2005

2006

2007





Cornell and external content

- Cornell-produced TV content
 - Cornell has the capability to produce Cornell content.
 - Can be made available for external (non Cornell) users.
 - Could CU news & events programming attract faculty viewers?
 - Could taped lectures, symposia, etc. support and enhance teaching?
- External content TV
 - Academic and university-oriented TV produced elsewhere.
 - Universities, consortia and other organizations are producing quality university-oriented TV and video in increasing volume, most of it free of charge.
 - E.g. The Research Channel, the Open Student Television Network (OSTN), some overseas public television consortia such as the Dutch language channel BVN.



Near Video and Video on Demand

- Video-on-Demand (VOD)
 - Many universities already use VOD services such as serving taped classroom lectures to students via the Web.
 - Cornell has a significant store of archived general video.
 - Network intensive.
- Near Video-on-Demand (NVOD)
 - Video clips broadcast (multicast) to subscribers on a pre-set schedule.
- Conclusions:
 - Faculty wants TV and video broadcast to classrooms, live, scheduled or on demand.
 - Strong interest in for Video on Demand.



What we've learned – year 1

- Initially we tried to use Residence Advisors for first level triage. This didn't work well at all – the RA's were already overloaded and resented the extra demands on their time. Nearly had a mutiny!
- Documentation needed to be more robust, and we need to convince them to read it!
- We needed to stress the fact that CUTV was a network service, not "Cable TV" to help set expectations. (no "cable guy" to come hook it up).



What we've learned - year 1 (cont)

- Residence hall distribution centers had difficulties processing the rapid end of semester equipment returns along with their other duties. Caused some inventory issues.
- Subscription termination was triggered by equipment return. This led to a number of ongoing subscriptions when equipment was abandoned in place, which had to be manually cleaned up later. We now end all subscriptions automatically at the end of the spring semester to avoid this.



What we've learned - year 1 (cont)

- All returned equipment needed to be inspected and tested. This required building a special test network with special fast cycling on DHCP so we wouldn't run out of addresses.
- Each STB can be tested in about 2 minutes on average.
- The main problem with STBs is broken card stops.



What we've learned – year 2

- Dispersion of the core team that implemented CUTV has had an impact on continuity. Most of the key players have new assignments and only support CUTV part time. The same is true with our key contacts inside our vendors.
- Most of our 'troubles' seem to involve the encryption system smartcards/SIMs – lost cards, broken card stops, failed cards, failed SIMs, failed card readers, driver problems, rare network problems involving key stream.



What we've learned – year 2 (cont)

- We would like to move away from encryption for general content if possible. May retain it for premium content.
- We are looking into trimming the cards to reduce the card stops being broken – 80 percent of our STB troubles involve this.
- New Lead Free RoHS compliant STB's required new versions of code and decryption code.



What we've learned – year 2 (cont)

- Microsoft giveth and Microsoft taketh away – of course Vista does not run with the CUTV client, or USB SIM reader. We hope this will be resolved before fall semester.
- Difficult to find time for major upgrades – with reduced staff support and relatively short breaks we haven't been able to upgrade to Smartvision 2.0 during the school year. Planned for this summer.



What we've learned – year 2 (cont)

- We'd like to avoid having to move the equipment from Campus Life to CIT and back each year which is a significant logistical burden. This would require moving the testing and inventory over to Campus Life.
- The tilt towards STB's over the windows client continues, nearly 2:1 this year. STB users require significantly more capital investment, nearly 4:1 per user.



Considerations for the future

- Mac and Linux support.
 - Requirement for expanding market in higher education.
- Add more content.
 - College specific channels, ,OSTN, MTVU. Zilo, Sundance, others?
 - Cornell University channel – pilot work in progress
 - Other Cornell content such as academic, sports, public service
- Price sensitivity
- Investigate how to deliver premium content (HBO etc.)
- Desire to not have a physical key for decryption.
 - Simplify inventory issues, reduce support issues.
- Eventual migration to newer codecs (MPEG4 AVC,VC-1), HDTV.
- Explore limited availability of lower bandwidth channels (MPEG4) via WiFi in the future.



Happy...

- Happy with CUTV
 - Successful introduction of IPTV service to the student population at Cornell University and the campus at large.
 - The infrastructure for Cornell content is there.
- Happy with our choice of vendors
 - both offer good technical solutions in the IPTV space.
 - They worked through a couple of iterations of system design with us including a change from satellite to terrestrial content delivery.
 - Both Grass Valley and Irdeto have proven to be a dedicated and committed partners to work with.
 - Outstanding support throughout the system integration.
 - Adherence to schedule.



Cornell University

Would we do it again?

Yes!

**IPTV is clearly the future for
campus wide distribution of
television content!**