

The Effect of Technology on Cable Service to Large, Networked Communities

by

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B.S. Biology

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Submitted to the Engineering Systems Division
In Partial Fulfillment of the Requirements for the Degree of

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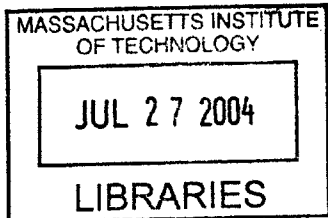
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ABSTRACT

Delivering cable television to college and university campuses is maintained by a highly specialized industry which involves significant technological and logistical challenges. As campuses continue to contribute financial resources into improving their data networks, companies that provide campus cable services will need to offer services over data networks comparable to the existing services they offer over dedicated co-axial cable networks.

This paper explores the business of providing cable services to university communities, describes the challenges these providers face and offers a glimpse into the future of IP-based desktop television.

Thesis Advisor: James Masters
Title: Executive Director, Master of Engineering in Logistics Program

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Biggie ups to Aetna, I give you sun, moon, chocolate, and lotofkiss. Respect.

Chris, Clint and the Ankur, good morning.

To the fam, thanks for your patience and guidance, I'll be home soon. DJ, please wax my board ☺

Inspiration

As a graduate student living on campus at one of the world's top universities, I rarely have the time to watch television. But when I do have time, it is nice to be able to flip on CNN to catch up on current events or tune in to ESPN for Sportscenter.

On February 26th, 2002, this privilege, which I had taken for granted, came crashing down when I received an email (see Appendix 1) from MIT Cable's provider-of-choice Falls Earth Station. It noted that on March 1st, there was a good probability that several channels, including CNN, ESPN, MTV, MSNBC, Discovery, TLC, and the Weather Channel, would be terminated. The reason Falls Earth provided was that one of their vendors, a company known as WSNet, was filing bankruptcy.

My first inclination was to say, "Well...that is what you get when you go with a company called Falls Earth Station". I suggested to the Director of MIT Cable that he drop Falls Earth immediately and sign a contract with a reputable cable company, the local provider here in Cambridge being Comcast. He responded kindly by noting my suggestion and informed me that the problem was probably more complex than I cared to understand.

With a possible war with Iraq rapidly approaching, friends in the Middle East, and no 24-hour news source, I became oblivious to the current events of the world. Determined to find out what had happened at MIT, I uncovered an extremely complicated industry, where technology was rapidly changing the playing field and offering up opportunities for small technology companies to take advantage of the network infrastructure of university-based communities.

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Chapter 1 – The Industry

1.1 – Introduction: Networked Communities

Telecommunication involves the transmission, emission or reception of signals, images, sounds or information over wire, radio, optical, video, microwave or other electromagnetical systems. It encompasses voice, video, data, broadband, wireless and satellite technologies.¹ The cable industry is one segment of the telecommunications industry, and deals specifically with the end-to-end delivery of cable television. There has never been a formal definition given to the networked community-based cable industry, rather, this “industry” is a subdivision within the cable industry. It is necessary to be even more specific when attempting to define this sector, and separate it further into two major categories, home-based and networked communities.

Networked communities can be, but are not limited to office buildings, government agencies, apartment and condominium complexes, hotels, motels, colleges and universities. These are frequently referred to as multi-dwelling units (MDUs) and will be referred to as such frequently throughout this paper. This project will deal specifically with one type of MDU environment, the university, where the population can include several thousand units and whose end-users can be students, staff and faculty.

Universities are unique in that they usually contain extensive infrastructure and networks that can connect students, dorms and classrooms; often at great distances from one another. The creation of these networks requires thoughtful planning and intuitive engineering. For example, issues arise when these private networks must cross public streets, although this

particular problem is now a bit outdated due to the advent and popularity of wireless networks.

This chapter will attempt to define each segment of this industry, from cable and satellite providers (like DirecTV & Time Warner Cable), to end-to-end aggregators like NWS Communications and Falls Earth Station, to hardware manufacturers and distributors like Adtec and Blonder Tongue. The major players in each segment will be introduced, along with their position within the industry as a whole.

1.2 - Cable and Satellite Providers

Most home-based and networked community-based multi-channel video programming (MCVP) is provided via cable or Direct Broadcast Satellite (DBS). As shown below in Table 1, 90.9 million of the total 94.89 million MCVP subscribers in October 2002 received their MCVP via one of these two methods.

	Subscribers (In Millions)	Percent of MVPD Market
Cable	72.2	76.09%
DBS	18.70	19.71%
C-Band	0.69	0.73%
MMDS	0.4	0.42%
SMATV	1.6	1.69%
Broadband Competitors	1.3	1.37%
Total MVPD	94.89	100.00%

Source: A.C. Nielsen, Kagan World Media, Cable Programming Investor, Sky Report, Media Business Corp.
SMATV = Satellite Master Antenna Television

**Table 1. Analysis of Multichannel Video Providers (MVPD)
(National Cable and Telecommunications Association 2002)**

According to the FCC, there were approximately 308 national cable providers in service at the end of 2002.² Although there are a large number of providers, significant consolidation has led to a handful of “major” providers. These cable giants include Comcast, Time Warner, Charter, Cox, Adelphia (which filed bankruptcy last year), Cablevision, Insight and MediaCom. The second column of Table 2 (below) lists the approximate number of subscribers for the top ten cable providers as of the end of the 3rd quarter of 2002.

Cable by the Numbers – (as of the end of 3Q 2002)

Basic Cable Subscriber Growth				
Operator	Homes Passed	Basic Subscribers	Basic Penetration	Q3 2002 Net Adds
Comcast/AT&T	39,286,100	21,625,800	55.0%	(131,500)
Time Warner	18,412,000	10,862,000	59.0%	41,000
Charter	11,972,800	6,897,900	55.9%	(88,000)
Cox	10,143,645	6,263,408	61.7%	13,372
Adelphia	9,500,000	5,337,026	56.6%	(74,705)
Cablevision	4,361,808	2,968,508	68.1%	(22,415)
Advance/Newhouse	3,459,000	2,026,000	58.6%	N/A
Mediacom	2,704,000	1,588,000	58.7%	3,000
Insight	2,248,000	1,289,000	57.3%	(2,000)
Cable One	1,250,000	721,000	57.7%	(15,100)
Total	103,337,753	59,418,642	57.5%	(274,348)

Sources: The Companies and Leichtman Research Group, Inc.
 Advance/Newhouse subscriber numbers are as of end of 2Q 2002.
 Adelphia basic subscriber numbers are "equivalent business units" (EBUs). Adelphia homes passed numbers are estimates.

Table 2. The Top Ten Cable Providers by Number of Subscribers (Leichtman Research 2002)

These ten companies comprise approximately 82% of cable subscribers nationwide. While eight of ten cable subscribers are serviced by one of the top ten cable providers, 99% of 18.7 million subscribers to DBS are serviced by one of two companies, DirecTV (10 million) or DISH Network (8.5 million).² University cable administrators can negotiate directly with these cable or DBS providers or use companies known as aggregators, discussed below in Section 1.3.

1.2a - Bulk packages

Cable companies and DBS providers deliver their services to networked communities as “bulk” packages. Bulk packages are combinations of several channels provided to the community for a cost usually based on the total number of dwelling units. Appendices 2-3 contain information on bulk packages and pricing from DirecTV and DISH Network.

There are several reasons why these companies will only offer bulk packages to networked communities. First, allowing them to receive and process only one payment for service to many individual units is much more cost-effective than receiving and processing checks from 5,000 individuals (to use MIT’s unit count as an example). Second, and perhaps more importantly, they usually need to provide service only to the headend. The headend is a local facility that incorporates and distributes the video programming to the networked community. By providing service only to the headend, the provider is therefore only responsible for service issues occurring on the way to the headend, whereas the local facility (i.e. MIT Cable) is responsible for customer service to its 5,000 students. So in effect the cable and DBS providers are earning revenue equivalent to that of 5,000 customers, but benefit by not actually having to provide them any service.

1.2b - Subscription-based offerings

As an alternative to bulk, some universities are choosing subscription-based services. These services can be created in-house, outsourced to aggregators like Falls Earth Station, or created in combination with local cable companies. Many universities have not implemented subscription-based services because they lack:

- a) technology that would allow them to restrict access to certain channels, and/or

b) billing systems that allow them to process payments.

Other companies do not see the value in providing students with the most robust cable/satellite television offerings in the marketplace, while some contend that their students should be studying and not watching television at all.

1.3 - Aggregators

The aggregators are so-named because they aggregate programming from various sources (C-band, DirecTV, DISH Network) and deliver it to the headend and/or the end-user student. Among the additional services they provide are engineering, construction, maintenance, financing and customer service.

Companies like Falls Earth Station, Campus TeleVideo and SCS Communications are three popular national aggregators. Using aggregators is logical for university cable systems because they can provide an end-to-end solution for the university, as well as allow the university itself to take part in the revenue stream.

When a university has a network in place and is looking at various options to provide cable television to its students, they have three basic options: (1) deal directly with the local cable provider, (2) deal directly with a DBS provider, or (3) use an aggregator. Although many schools choose to contract directly with the local cable or DBS provider, using an aggregator will give the cable administrator options that the local cable or DBS provider cannot provide. The aggregator has contracts in place with various programming providers and is able to offer the university several different options, including the choice of a bulk package

or subscription-based package. The aggregator supplies the university cable provider with more programming options than either the local cable or DBS provider, and the university can choose the most compatible package. The aggregator performs the necessary construction and engineering, such as setting up and wiring the receiver satellites to the university's headend. The aggregator also provides the necessary hardware at the headend (converters, i.e.) that will allow their infrastructure to merge with the university's cable network.

Another valuable service that the aggregator provides is billing. The aggregator pays the cable or DBS provider on behalf of the university. The students pay the aggregator directly, usually based on the level of programming they wish to receive. The profits derived therein are then shared with the university. Rather than having money going out in the form of direct payments to cable or DBS providers, the university can share in the revenue stream derived from the programming. The aggregators also take on the burden of dealing with several thousand students. One such aggregator, Falls Earth Station (FES), has a cost-effective, email-based support network that is extremely simple to manage. They will provide phone support, a more costly option than email support, only after determining that the problem cannot be solved through email. The aggregator's problem resolution system also interacts very closely with that of the university, so that the problem can be quickly designated to the responsible party. Usually, problems occurring before the signal reaches the headend are the responsibility of the aggregator and problems occurring after the headend (on the campus network), are dealt with by the university.

1.4 - Complete Solutions Providers

One must also mention companies like BNI Solutions, who provide complete solutions for their corporate, government and university customers. They provide design and installation of entire networks and work hand-in-hand with hardware manufacturers, software providers, DBS (and local cable) providers and aggregators to develop the best possible end-to-end solution for their customers. These complete solutions providers can be thought of as one-stop shopping for university cable administrators, and their pricing often matches the robust services they provide. Complete solutions providers are more often used by corporate and government clients than in the university environment.

1.5 - Channels/Networks

Among the most important players in the cable services industry are the networks that provide the programming. Several networks specifically target the college and university market. These include subscription-based networks like Showtime, HBO and Starz/Encore who offer commercial-free programming, targeted programming channels like MTV and ESPN and 24-hour news networks like the Fox News Channel and CNN. The goal of the advertising-based networks is to maximize the viewing audience for their programming, thereby increasing their ratings and the amount they can charge for advertising. Similarly, the goal of the subscription-based networks is to acquire as many subscribers as possible.

Three companies, AOL/Time Warner, Viacom and the Walt Disney Company, control 2/3 of the 50 most popular television channels. Listed below in Table 3 are the six major broadcast networks (BN) and 47 popular cable channels (with their rankings in the Lycos top 25 where applicable).^{3 4}

Parent	Channel/Network	Ranking	Parent	Channel/Network	Ranking
<i>Viacom (13)</i>	CBS Network	BN	<i>News Corporation (4)</i>	Fox Network	BN
	UPN Network	BN		Fox Sports	-
	BET	8		FNC	10
	Comedy Central	23		FX	-
	CMT	-	<i>General Electric (4)</i>	NBC Network	BN
	Movie Channel	19		Bravo	-
	MTV	4		CNBC	20
	TNN	24		MSNBC (w/Microsoft)	5
	Nickelodeon	12	<i>Discovery Communications (4)</i>	Animal Planet	25
	Noggin	-		Discovery Channel	11
	Showtime	18		Learning Channel	6
	TV Land	-		Travel Channel	-
	VH-1	22			
<i>AOL Time Warner (9)</i>	WB Network	BN	<i>Vivendi Universal (2)</i>	Sci-fi	-
	Cartoon Network	7		USA Network	-
	CNN	1		<i>A&E Networks (2)</i>	A&E
	CNNFN	-	History Channel		17
	CNN/SI	-	<i>Comcast (2)</i>		E! Entertainment
	HBO	16		QVC	9
	Headline News	-			
	TBS	-	<i>Liberty Media (2)</i>	E! Entertainment	-
	TNT	21		Encore	-
<i>Walt Disney (7)</i>	ABC Network	BN			
	ABC Family	-			
	Disney	-			
	E! Entertainment	-			
	ESPN	3			
	Lifetime	-			
	Toon Disney	-			

Table 3. Who Owns What
(Schatz 2002, SignalAlpha.com 2003)

1.6 - Hardware Manufacturers/Distributors/Retailers

These are the companies that make and distribute the controllers, decoders, encoders, filters, modulators, multiplexers, satellites and headends necessary to run and maintain the university cable networks. Two of the more popular hardware manufacturers in the US are Adtec Digital, who manufactures MPEG-2 encoders and decoders, and Blonder Tongue, who manufactures antennas, modulators and Quadrature Amplitude Modulation (QAM) set tops.

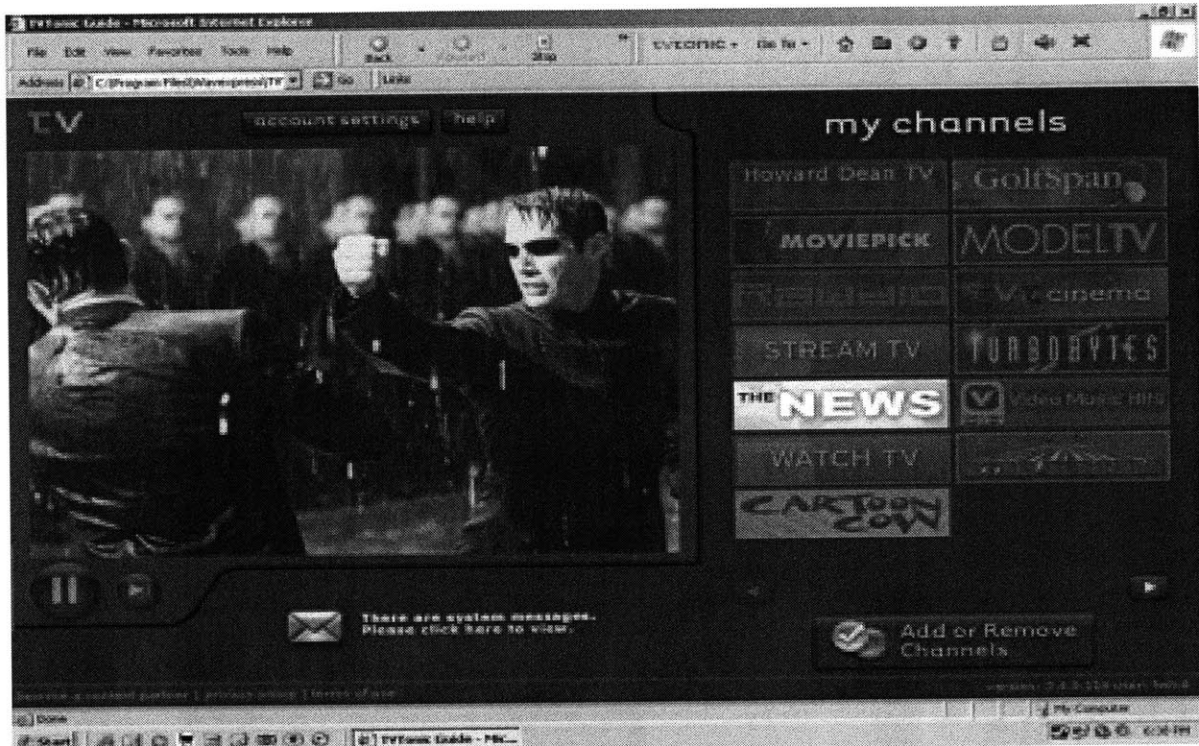
There is certainly no shortage of manufacturers, distributors or retailers. These companies sell their products directly and indirectly (through aggregators) to universities, and also to companies like BNI Solutions, who provide end-to-end services, including the complete design, installation and monitoring of high-bandwidth networks.

1.7 - Software Developers

Heading into the future, software development companies are increasingly becoming more prominent in the MDU video industry. Most of these companies are relatively young and provide new and better ways to create and distribute digital quality audio and video. Three leading software developers are Virage, Wavexpress and Video Furnace. They are discussed below.

Virage, Inc. builds integrated media solutions for government agencies, corporations and universities. Their software allows content owners to digitize, manage, retrieve and distribute video more efficiently, resulting in productivity increases and significant cost

savings.⁵ Wavexpress, Inc. has developed technology that utilizes digital bandwidth to deliver rich media products like movies, music and games. They also have produced software for packaging and protecting any IP-based content. But perhaps their most significant contribution is the development of TVTonic, a visionary product that allows one to watch television programming on his or her computer (see Figure 1).



**Figure 1 - Screenshot of TVTonic
(Wavexpress 2003)**

While Virage and Wavexpress both possess great technology, Video Furnace is poised to completely revolutionize the way students watch television. A thorough discussion of their technology takes place in Chapter 3, a case study involving Northwestern University.

Chapter 2 – MIT Case Study

2.1 – Introduction

This chapter and the one following it discuss two real cases that have taken place within the past two years, one at MIT and one at Northwestern University. Both of these cases are typical of situations cable administrators undergo when attempting to figure out the best solution to providing cable service to their MDUs. The cases each pose a situation, explain how a solution to the situation was determined, and elucidate the consequences of that particular decision.

2.2 – MIT Case Study

In early 2000, Randy Winchester, the Director of MIT Cable, had an interesting choice to make. He could choose to continue service with MediaOne, the local cable provider (who would eventually become AT&T Broadband and more recently Comcast), or choose to go with a company known as an aggregator, the two most popular being Campus Televideo and Falls Earth Station.⁶

MIT Cable had a long history of using the local cable company to provide its student housing complexes with cable television service. It was by far the easiest option. The cable network was already in place and students could pay MediaOne directly, saving MIT from having to service the 5,000 individual dwelling units.

Although continuing to use MediaOne was a simple solution, there were several problems: First was the issue of customer service. Many students had complained of service issues with MediaOne, and according to Winchester, although the cable programming was reliable,

their customer service was bordering on unacceptable. There were numerous occasions of students being billed incorrectly, and in several of these instances, the problems were never resolved. These issues were frustrating to the students as well as to Winchester and the rest of the housing administration.

Secondly, MIT was reaping no financial benefit from MediaOne. Since MediaOne was “the only game in town,” they had no reason to offer MIT any revenue that they generated from providing cable service to the students. The payment went directly from the students to MediaOne, with no kickbacks to the administration. Other companies had revenue-sharing agreements set up that paid a percentage of the revenue from students back to the administration, benefiting both the provider and the administration.

The contract between MIT and MediaOne was due to expire on August 31, 2001.⁶ In order to be able to provide continual service to the students, any project which involved a new vendor would need to be completed by early 2001. There would be a significant amount of integration that would need to take place if MIT were to decide to change providers.

The first step Winchester took was to get the students’ feelings on MIT’s cable offering. He posted a survey and the overwhelming majority of responding students wished to receive more varied programming than they were currently offered.

With the students’ thoughts in mind, as well as the desires of the administration to share in the revenue stream and his own personal desire for a provider with better customer service, Winchester started the vendor selection process. He quickly narrowed down the options to

three vendors. The first option was maintaining the status quo and keeping MediaOne. For reasons afore mentioned, this was the worst option financially (long-term) and potentially the worst customer service option. On the other hand, continuing with MediaOne would require no further technological integration, and no additional hardware or capital requirements. Since students would continue to pay MediaOne directly, MIT would also not be forced to construct a billing system or integrate any new billing system into MIT's own IT network.

The second option was an aggregator called Campus TeleVideo. Campus TeleVideo provided cable service to over 170 college campuses. They could provide more programming options than MediaOne could via use of satellite providers. Like MediaOne, this was a bulk-based service, meaning that all of the students would receive the same channels, based on what MIT Cable wished to provide. MIT would be able to profit-share in the revenue stream, but the hardware necessary to set up service with Campus TeleVideo would be extremely expensive.⁶ Although costly, Campus TeleVideo's service came highly recommended from other campuses at which it had been installed, and they earned praise from their clients for customer service and reliability.

The third option was a small, relatively unknown aggregator known as Falls Earth Station. With little credibility in tow, Falls Earth was looking for a school to test their vision of the future of university-based cable service. The first move they made in this endeavor was sending their CEO, Jerry Barnes, to MIT to meet and pitch this vision to Winchester, a vision which Gloria Duddy, Managing Director of CRConsulting called "the perfect campus cable TV offering".⁷ This offering was the product of a strategic partnership formed

between Falls Earth (FES), AT&T's Headend In The Sky (HITS), Motorola, Great Lakes Data Systems and WSNNet.

AT&T's HITS & Austin, Texas based WSNNet would provide the satellite-based digital programming. WSNNet would multiplex 41 core digital channels (CNN, ESPN, MSNBC, MTV) onto the space of six analog channels, which was crucial to MIT, who had a limited number of analog channels on which to provide programming. The other 150+ channels would be offered on the HITS platform. These signals would then be sent to dedicated satellite dishes (one each for WSNNet and HITS) on the MIT campus. Once on campus, the application of Falls Earth's QAM (Quadrature Amplitude Modulation) technology would allow these signals to be sent through MIT's existing cable television network and onto the individual dwelling units.

Each student subscribed to the service would be provided with a Motorola-produced DSR-470 receiver, which would enable the students to watch this digital line-up on their analog TVs. Subscribing to the service would be a simple internet-based process provided by Great Lakes Data Systems. This service would integrate with MIT's own cable website (<http://web.mit.edu/mitcable/www/index.html>) and allow students to sign up online by providing some basic information and a credit card. Upon signing up, students would then receive the Motorola receiver and digital remote control.

The result would be over 200 channels of digital quality programming for far less than the cost of regular cable television. FES would be responsible for the installation of all of the necessary hardware and assure its integration with MIT's current infrastructure.

Students would be extremely satisfied with the digital quality, the high number of channels and the relatively low cost of the service. MIT would benefit financially by earning a percentage of revenue for each student that subscribed to the service. FES would benefit by testing their recently-developed service on a campus with the existing infrastructure and patience necessary to support such a service for the long-term.

All of these factors led to the only reasonable conclusion for Winchester: Falls Earth would be chosen to provide cable services to MIT starting September 1, 2001. A contract was drawn up and signed, resulting in a partnership based on mutual respect and technological advancement.

2.3 - Update: April 2003

The Falls Earth service was initially well-received by the students at MIT, who were receiving exceptional quality and variety for a relatively low price. But late in the year 2002, a problem arose. WSNNet found themselves with financial problems and unable to maintain the necessary infusion of cash to stay afloat. There were numerous discussions with companies looking to continue WSNNet's services, which included expensive positions on Loral's Telstar 6 satellite. In October 2002, WSNNet declared bankruptcy, and at midnight on March 1st of 2003, WSNNet's services were shut off, leaving MIT's students without many of the core channels they were subscribed to, including CNN, MSNBC, ESPN, MTV and the Discovery Channel.

Without WSNNet, FES was left with only the HITS platform, and no alternative to providing the core channels in a multiplexed digital format. The MIT administration was inundated with angry letters from students, most of them upset over the loss of the 24-hour news networks CNN and MSNBC. With a possible war with Iraq rapidly approaching, the availability of a 24-hour news network was crucial. MIT's housing administration, who had tried hard to avoid a bulk subscription package, was forced to acquiesce to the wishes of the students.

Within two weeks of the loss of WSNNet, MIT had contracted with FES to provide DirecTV's "Fundamentals" package, which included 10 channels of programming (See Appendix 2) for a rate of \$1.25/unit. MIT Housing approved the cost and the students, most of whom were not subscribers to FES subscription services and received only local network channels, found themselves with new, free, cable programming.

The bankruptcy and termination of WSNNet's services ended what was a mutually beneficial partnership for the students, administration and FES. FES has since adjusted their business model and is looking toward the future, a future they believe lies in IP-based campus television.

Chapter 3 – Northwestern Case Study

When student dormitories at Northwestern University in Evanston, IL, opened on September 20, 2002, a new era of delivering what was previously known as cable television had begun.

Until that time, students living in Northwestern's dorms had no means of watching cable television in their rooms. Their best option was to watch local cable that was delivered to the common rooms on each floor. This was a major "quality of life" concern for the housing administration at Northwestern, who wished to provide the best possible amenities in order to compete with similar institutions. The fact that students did not have the opportunity to watch cable TV in their rooms was a drawback in trying to encourage the best possible candidates to attend the prestigious university.

In trying to solve this problem, Northwestern faced some serious challenges. The first and most severe was the fact that the individual rooms within the dormitory buildings were not wired for normal co-axial (co-ax) cable service. This meant that the first step in trying to solve this problem was determining the expense and the installation time. Since there were over 60 residence halls, the cost to wire every building with co-ax cable could run anywhere from \$2 million to \$5 million. The real problem with this solution was that it would take approximately four years and would cause severe disruptions in the students' normal routines and living conditions. Since having cable television was such a high priority for Northwestern students, the administration began to look at other alternatives. Using an aggregator was not an option, given that there was no network in place. How could they get cable television into student's dorms without physically wiring cable to each dorm?

To solve this problem, Northwestern turned to Libertyville, IL based Video Furnace. Video Furnace had developed an end-to-end enterprise system that delivered extremely high quality audio and video over an existing network infrastructure; television for the desktop. Unlike streaming technology, which often appeared blurry and patchy, Video Furnace's technology converted cable signals to a digital format which was then delivered over the network at speeds comparable to cable television.⁸ In the summer of 2001, Northwestern had upgraded their dorm network to switched 10Mbps Ethernet, which would provide the necessary bandwidth to enable distribution of the video over the network.

The technology developed by Video Furnace digitally encodes any video/audio source into MPEG format, summarizing and introducing the stream onto a network using standard IP protocols, which are then delivered to all desktops on the network. The viewer application is streamed to the client's computer when the video is requested, and removed when the session is terminated, so as to not leave footprints on the client's machine.⁹ Since each client is not required to download a large media application, the administrator need not be responsible for installation and support, a tremendous advantage when serving a large MDU community. By using multicasting technology, one single stream can be seen by all desktops on the network.⁹

The system is controlled by the network administrator remotely, a function referred to by Video Furnace as their “Pilot Configurator” (see Figure 2). This application allows the administrator to maintain control over the complete Video Furnace system from anywhere at anytime. Using the configurator, the administrator can control resolution and bit rates, adjust video quality, and add or subtract multicasted channels.⁹

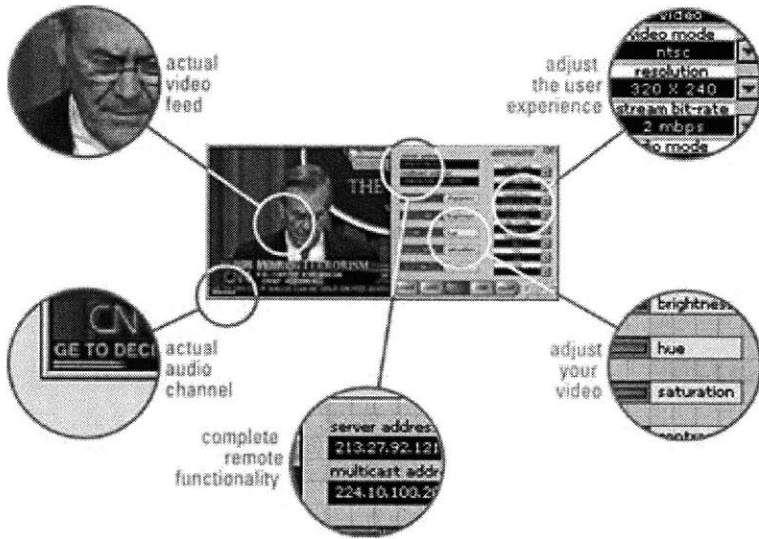


Figure 2 – The Pilot Configurator (Video Furnace 2003)

On the client end, a system known as “OnGuide” (see Figure 3) injects data into the player which allows the user to get information about what is being shown on each channel in the line-up. This system provides show information up to 14 days in advance. It also allows the user to browse show information while concurrently viewing thumbnails of various channels.⁹

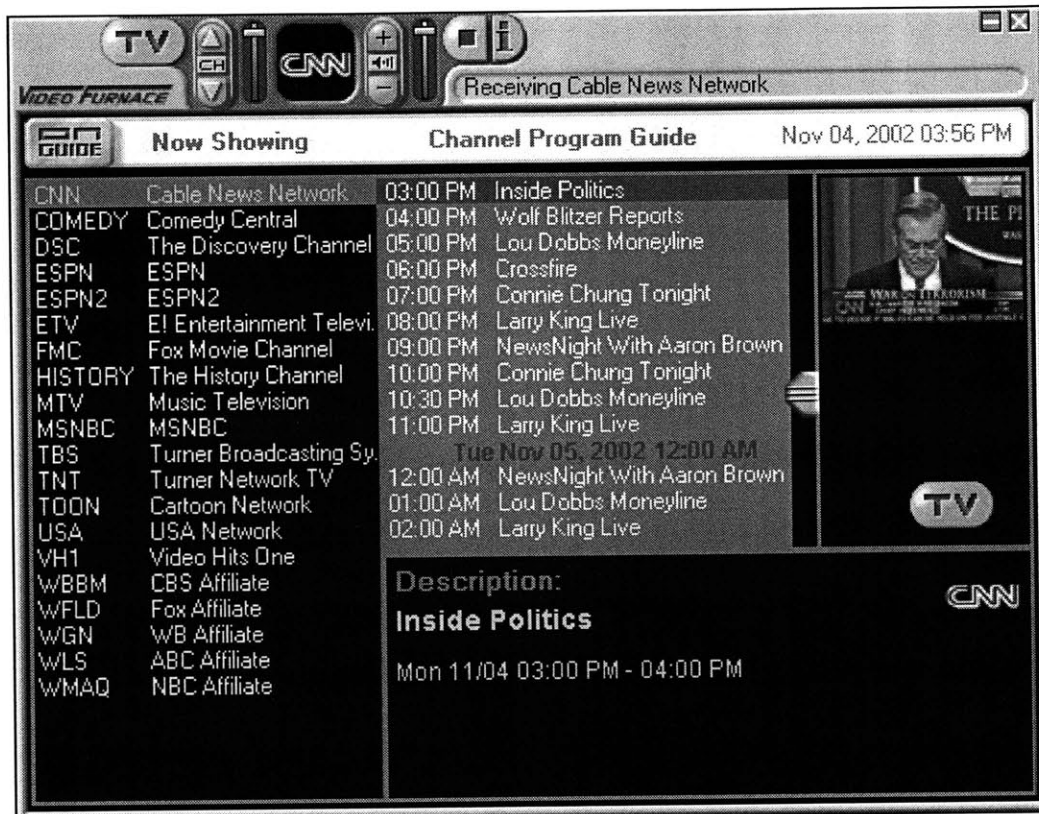


Figure 3 – The OnGuide System
(Video Furnace 2003)

Perhaps the most important feature of Video Furnace’s technology is their media player, known as the “inStream Player” (see Figure 4). Since it is streamed to the client, there is no need for the user to download anything and also the player always self-updates to the most current version.

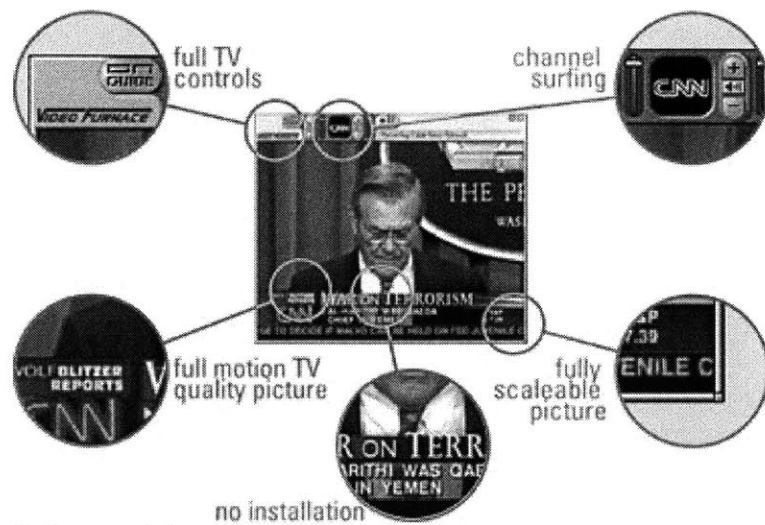
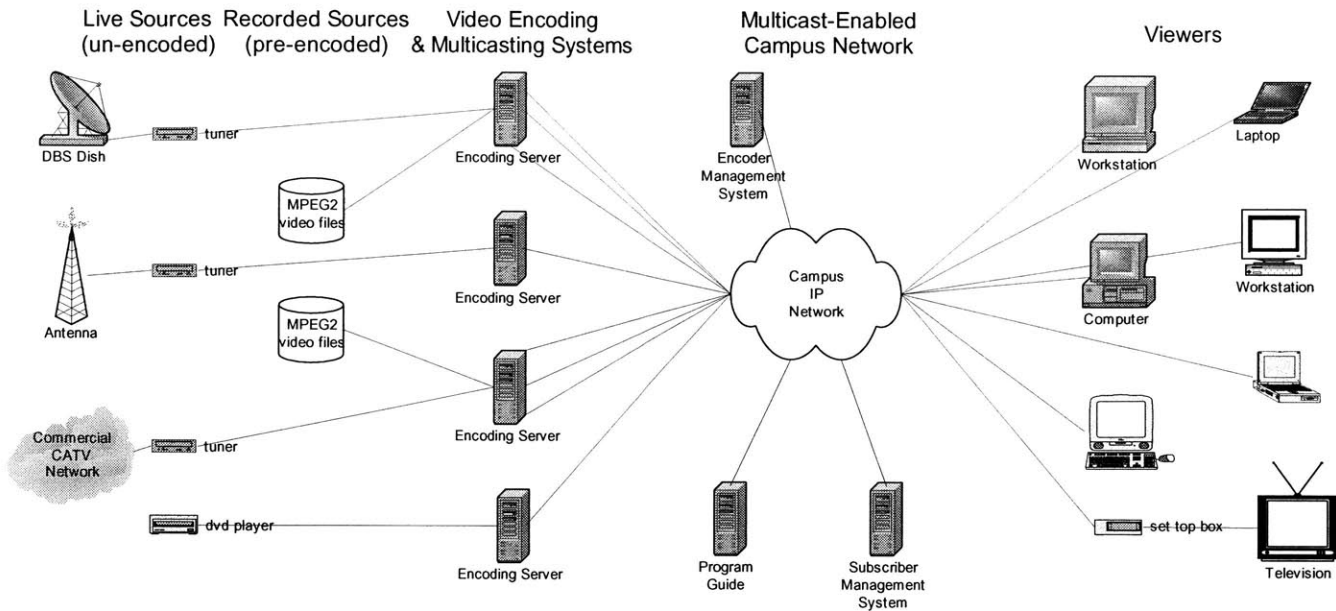


Figure 4 – The inStream Player
(Video Furnace 2003)

Northwestern decided to start small by testing four off-air channels for six weeks. The feedback they received from students was generally positive. Subsequent steps involved ramping up the system from 100 students to over 4,000 students in a period of three weeks.

There were some growing pains, but nothing major, according to Julian Koh, Network Engineer at Northwestern, “[We experienced] the usual crop of end-user system incompatibilities, some glitches with the cable feed and tuners, and a server failure,” while noting that these were all normal operational issues seen with any network or service. The service, known on campus as NUTV, currently consists of 20 channels of off-air and cable television programming. A diagram of the network is shown below in Figure 5.



**Figure 5 – Northwestern Network Diagram
(Koh 2003)**

In order to maintain the service, Northwestern pays Video Furnace for the servers, their software and an MPEG-2 licensing fee. They also pay the local cable provider for the content, negotiated as any normal multi-unit bulk contract based on the number of subscribers. NUTV is funded by the students, and every student living in a NUTV-serviced dorm pays an annual fee of approximately \$120.

Each channel's stream on the network consumes around 2Mbps of bandwidth. The multicast network takes care of distributing the streams only to the parts of the network that have requested them. According to Koh, "This means I could be watching 3 or 4 streams simultaneously on my computer and using just about all of the 10Mbps available in my switch port, but my roommate could not be watching NUTV at all and thus have all of his 10Mbps available for other purposes."

As for the long-term future of NUTV, Northwestern plans on adding more channels and changing some channels based on student feedback. Another improvement they hope to make in the near future is offering premium channels and/or pay-per-view content, which will require some major infrastructure improvements in authorization and authentication. Current plans include increasing the quality of the video stream from 320x320 at 2Mbps to 480x480 at 3 or 4 Mbps, which will result in a much sharper image.

Chapter 4 – Into the future of campus cable offerings

4.1 – Current Offerings

Today, colleges and universities are providing their students with cable television in a variety of formats. While some schools offer a free bulk service, others offer bulk plus subscription options, and some provide only a subscription option. Still other schools do not offer any cable television and as noted in the previous chapter, Northwestern is now offering students cable television delivered to their desktop.

Below is a listing of nineteen top schools (ranked by US News and World Report) and what cable options they offer, if any.

	Bulk	Subscription	IP
Princeton University	x		
Harvard University			
Yale University	x	x	
California Institute of Technology		x	
Duke University	x	x	
Massachusetts Institute of Technology	x	x	
Stanford University	x	x	
University of Pennsylvania	x	x	
Dartmouth College	x		
Columbia University	x	x	
Northwestern University	x		x
University of Chicago			
Washington University in St. Louis		x	
Cornell University	x	x	
Johns Hopkins University		x	
Rice University	x	x	
Brown University	x		
Emory University	x	x	
University of Notre Dame	x		

Figure 6 – Cable options offered by some campuses

As one can see, a vast majority of the schools (17 of 19) offer their students some type of cable option. Figure 7 shows a breakdown of these options.

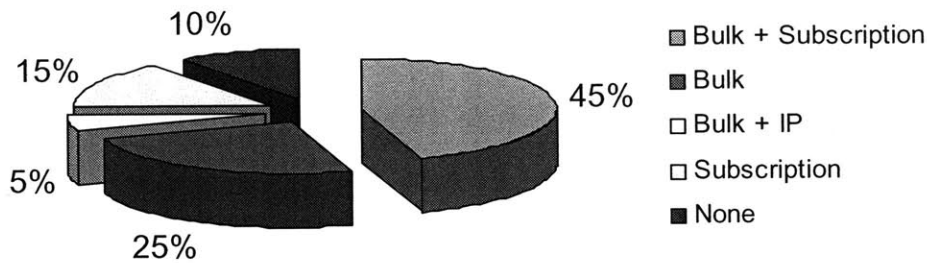


Figure 7 – Breakdown of campus cable offerings

From this chart one can see that bulk and bulk plus subscription are the most popular offerings. This indicates that schools are willing to spend money to provide their students with some kind of basic cable offering, although these bulk packages are often paid for by the students themselves in the form of an annual “cable” fee added to the cost of housing. With an increasing number of universities realizing that their students want varied programming, subscription services are becoming ever more popular.

4.2 – Co-axial versus Internet Protocol

Within the campus cable industry, there is general agreement that all campus programming will eventually be delivered in internet protocol (IP). The main reason for this transitioning is that most universities devote extensive money and resources to maintaining and improving their data networks. Universities hope to eventually merge voice, data and video onto one network, resulting in benefits in cost and control. It would be impractical for universities to maintain or improve their expensive, outdated co-axial cable networks, when such video programming can be provided on the data networks.

Most general residential units (i.e. houses) do not have the powerful data networks seen on college campuses. This is one area where the MDU cable industry will diverge from the overall cable industry. It is likely that while the majority of students will eventually get their cable via IP, most “non-students” will continue to receive their cable the old-fashioned way, via local cable or DBS provider.

4.3 – Two visions of the future

Falls Earth Station and Video Furnace are two companies highly invested in the future of the campus cable industry. Each of these companies has a distinct vision of what the future of campus cable will look like.

Before noting the differences between these two visions, it should be documented that both visions assume that IP-delivery of campus cable is going to be the dominant means of delivery in the near future (for reasons set forth in Section 4.2).. While both of these models assume IP-delivery, they are very different in how they propose to deliver these streams to the user.

4.3a – Digital Headend

The CEO of FES, Jerry Barnes, is a visionary. He created a partnership that was prepared to revolutionize campus cable delivery, but it fell short due to the financial shortcomings of one of the participants. But even before this fate befell WSNet, Barnes saw that IP-delivery was the future, and had a plan in place to deliver it (see Figure 8).

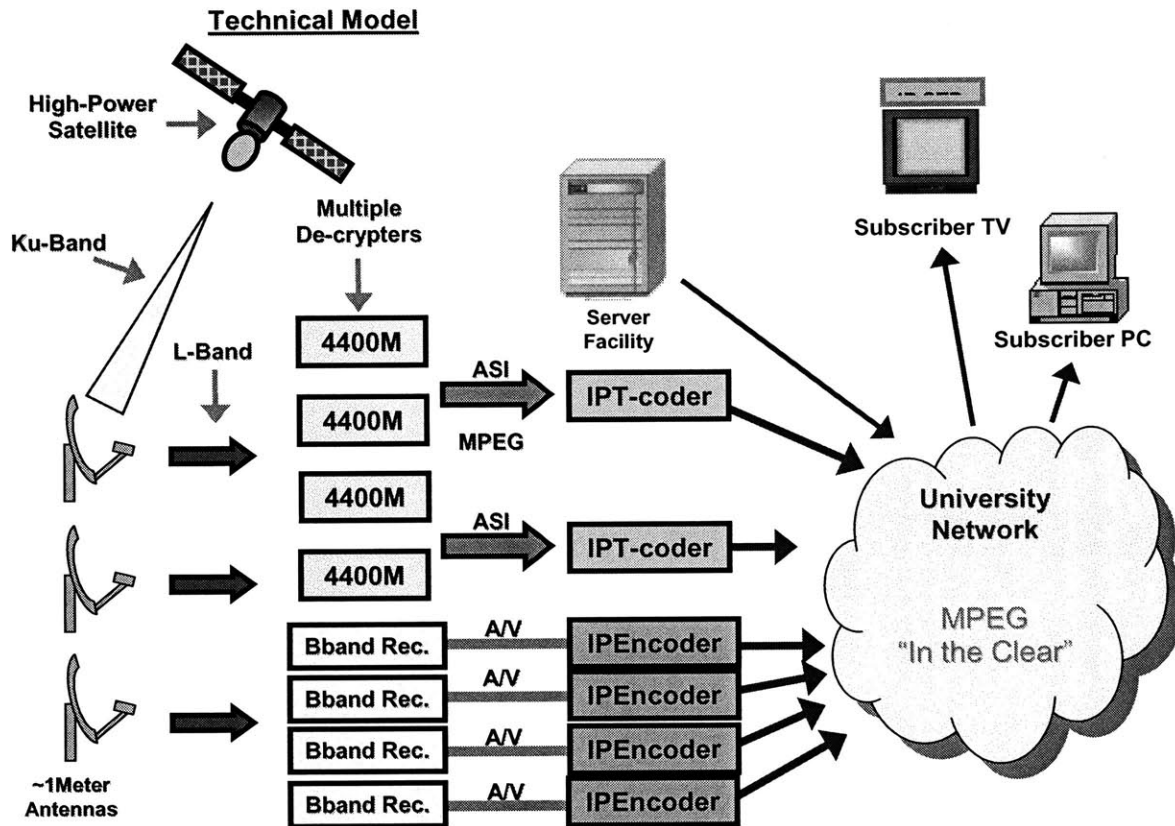


Figure 8 – FES Original IP Delivery Plan
(Barnes 2003)

But when one of the programming providers, WSNet, went bankrupt, Barnes and FES went back to the drawing board. The result of this brainstorming is shown below in Figure 9.

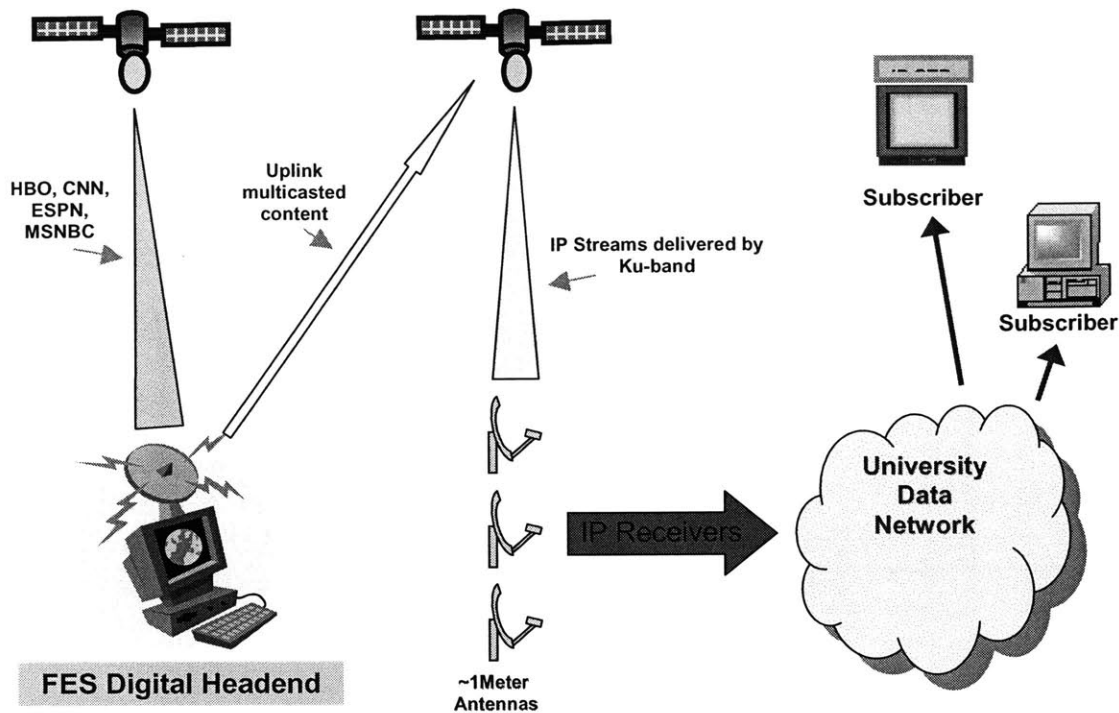


Figure 9 – FES Digital Headend

Since they were no longer able to remove streams from the WSNNet platform, it made no sense for them to try and locally encode the IP streams. In this new model, programming is encoded and multicast at a digital headend, most likely somewhere in the Midwest. These digital streams will be taken from various programming sources, a prime area of uncertainty in this model. Most of the networks have their own programming feeds which are picked up by companies like DirecTV. DirecTV digitizes and encrypts them (at facilities in Los Angeles and Colorado) before uplinking them back up. Once uplinked, these feeds can then be downlinked by satellite dishes all across the country.

In order for FES plan to make sense, they need to be able to skirt middlemen like DirecTV and Dish Network, and receive the programming directly from the networks. This will require FES to negotiate contracts with each of the individual networks, but the

consolidation of the industry will facilitate the process. As noted previously, three parties, AOL Time Warner, Viacom and the Walt Disney Corporation control 2/3 of the most popular 50 cable networks.³

These feeds will come into FES digital headend, and it is here that they will be converted to IP and multicast before being uplinked back into orbit. From here the streams will be available for downlink by 1-meter antennas (similar to DirecTV antennas) placed on each campus. IP receivers will be placed on campus to encrypt and allow the streams to enter the university's local network.

Since this will be a subscription service, students will have the ability to manage their accounts (update payment information, add/subtract channels, order PPV movies), through a web-based interface. FES already has plenty of experience in this area through their partnership with Great Lakes Data, and therefore it will not be difficult for them to manipulate this system to fit the IP-delivery model.

Selecting a location for the digital headend and securing the programming are two important business questions that FES will have to answer. They are also likely to face many technical challenges as well, but in the MDU cable industry, being the first to market an end-to-end IP solution will afford them a distinct advantage over the competition.

4.3b – Video Furnace

One of these competitors, Video Furnace, is already delivering IP-based cable programming to Northwestern University (see Chapter 3). They currently provide 20 channels of high-quality streams to 4,700 residents of Northwestern’s on-campus housing units.

One major difference in the business model of Video Furnace versus FES is in their cooperation with the cable industry. Unlike FES, which is an end-to-end solution, the Video Furnace technology is a last-mile solution. The university, Northwestern in this case, must still negotiate a bulk rate with the local cable provider for the actual programming. This programming is then encoded locally (via Video Furnace technology) into IP format before hitting the campus data network. Cooperating with the cable industry is advantageous considering its tremendous power, but also significantly decreases the opportunity for Video Furnace to generate revenue.

Howard Weinzimmer, the President of Video Furnace, believes the desire for campuses to converge services onto one network will be the driving force behind the adoption of Video Furnace’s technology. This will offer campuses significant cost savings associated with network maintenance and the upgrading of analog systems to digital ones.

Weinzimmer predicts extensive advantages in scalability and portability. Regarding portability, Weinzimmer said “It will be possible with our solutions to be watching something on your network connected [desktop] and seamlessly continue to watch that on a hand held device, “ and continued, “[For example] it’s the last 5 minutes of the Super Bowl

and you need to leave to go to a seminar, class, meeting, etc. You will be able to continue watching on your wireless device.”

Today, there is ample opportunity for Video Furnace to break further into the university market. They have the distinct advantage of being the sole provider that is actually delivering a real IP-based solution to a fluid, dynamic environment.

4.4 – Note on the Future of Networks

Another area of concern is the future of the networks themselves. Today programming is delivered via cable and satellite. What happens in the future if “cable programming” is replaced by online delivery? For example, it is very possible that in the near future CNN (or another popular network) will provide live programming 24/7 from CNN.com. In combination with the RealOne Player, CNN.com currently provides updated news briefs every hour via subscription at \$10/month. This is a major concern not only for campus cable providers, but for the entire cable industry. Any shift by the networks will need to be met with a similar upgrade by the campus cable providers. As of today this technology is still in its infancy, as is the adoption of broadband services like DSL that can deliver it.

The networks, regardless of how they continue to distribute their programming, will continue to be a powerful player in the industry. However, shifting from cable delivery to internet-based delivery could shift power away from the cable companies and toward the internet service providers (ISP). Fortunately for most of the major cable companies, they serve as both cable providers and ISPs, through their cable internet offerings.

There is a high degree of uncertainty about the future of the cable networks. Important questions arise regarding how programming will be delivered and how revenue will be generated (advertising, subscriptions, etc.). If and when online delivery becomes widespread, the future of aggregators like FES and technology providers like Video Furnace will be in doubt. Popular networks like CNN and ESPN will be glad to cut out these middlemen from a slice of the pie. Major cable companies like Comcast will also be affected, as their main means of revenue-generation will be disrupted. If programming gravitates to the internet, this will severely affect their bottom line. The major cable companies will be lobbying hard to maintain the status quo, preferring \$60/month (cable plus internet) to \$30/month (internet).

4.5 – Conclusion

The future of the campus cable industry will depend largely on the degree to which universities start to move toward IP-based programming delivery. As of today, one major university has made this move, and it was done primarily out of necessity (with no co-axial infrastructure in place). Several others are testing it, many are thinking about it and some are perfectly content with what they have now.

In order for companies that specialize in providing cable services to college and university campuses to succeed, they must be prepared to provide students with varied programming options, easy-to-use online account management functionality and reliable service. They also must be prepared to take advantage of the one feature that distinguishes campus environments from the general public: investment in data networks. This includes the ability to reliably deliver programming via IP. Once campus cable administrators see that there are

viable options for IP delivery, and that doing so will mean significant cost savings and control benefits, they will be remiss to ignore it.

The infrastructure for campus cable providers to succeed is in place. Universities house thousands of students desperate for news, sports, movies and music television, with the disposable income to pay for it. They maintain self-financed, constantly-updated data networks that connect all of their housing units. The key is the point-of-entry. By simply engaging the network (at one point-of-entry), providers can generate tremendous revenue from the many thousands of students residing on the network(s). This is where the ultimate battle of campus cable will lie. Several companies will deliver viable IP-based solutions; the question is whether or not the universities will buy them. Companies like FES and Video Furnace would be wise to make investments in their sales organizations which rival their investments in technology. Revolutionary technology might get their foot in the door, but it will take revolutionary people to keep it there.

Appendix 1

Dear Digital Cable Subscriber:

This is a notification that certain digital cable channels may become unavailable beginning this Saturday morning, 12:00 am, March 1st, 2003.

Only certain digital channels, those carried on satellite T6 and currently provided through the WSNet satellite service provider, may be terminated. The channels affected are:

200	ESPN	249	C-Span
220	TNNE	250	C-Span-2
221	FX	252	Cnn Int'l
222	TNT	260	OXY
223	TBS	262	DIY
224	WGN	263	Food
225	USAE	280	AMC
226	Lifetime	300	Halmrk
227	Discovery	301	Nicke
228	Learning	302	Cartoon
229	A&E	305	FxFmE
232	E!E	307	Animal
233	TeleM	308	Travel
234	Court	315	HSN
235	CmdyE	317	TVLand
240	CNN	319	Boomerang
241	CNN - HN	340	MTVE
243	MSNBC	345	VH-1
244	CNBC	350	CMTV
245	Cnn - fn	355	BET
247	Weather		

Unfortunately, the vendor providing the service has filed for bankruptcy. This termination of service would leave the general service provider or aggregator, Falls Earth Station, Inc. with no viable alternatives to replace the channels in question for an equivalent cost to the client community. The remaining digital satellite operator will continue to provide service for the foreseeable future, so subscribers to premium multi-plex services such as HBO, Cinemax, Encore and The Movie Channel will be able to receive these services from Falls Earth Station through the end of June 2003. Please note that any disruption of digital services will have no effect on MIT's free basic service which will continue to operate as usual. The MIT free basic channel guide can be seen at <http://web.mit.edu/mitcable/www/channels.html> .

In the event that the channels are terminated, the digital basic service channel lineup and subscription pricing will be revised downward accordingly. Details regarding these pricing changes have not been finalized and we will notify you as soon as possible once programming availability and pricing have been determined.

Subscribers to premium multi-plex services may continue to receive service at the normal rate, plus the price of the revised digital basic channel lineup.

MIT Cable Television and Falls Earth Station continue to investigate alternatives to fill some of the gaps in our channel line up. Although there may be service disruptions, we will be taking suggestions for implementing alternative services.

We apologize for the inconvenience, and we will keep you informed. For further information, please direct your questions to Falls Earth Station at t6mit@fallsearth.com <<mailto:t6mit@fallsearth.com>> or call 315-893-7650 between 8:30am - 4:30pm Monday through Friday.

Appendix 2



LODGING AND INSTITUTIONS RATE CARD

PURCHASING GUIDELINES: All rates are per Subscriber Unit* per month with a minimum of 20 subscriber units. Charges must be based on 100% of the subscriber units at all times. The property does not have to display all feeds or channels in a package. Blackout restrictions and other conditions apply to sports programming. All programming and pricing subject to change.

PACKAGED SERVICES

ESPN Package***:	ESPN, ESPN2, ESPNEWS, and ESPN Classic	\$2.40
Fox Sports Suite:	FSN, FX, and Fox Sports World	\$1.35
The Fundamentals:	Bloomberg, Cartoon Network, CNN, C-Span 2, Fox News, Headline News, TBS, The Weather Channel, TNT and USA Network	\$1.25
Family Favorites:	ABC Family Channel, American Movie Classics, Animal Planet, Discovery Channel and The Learning Channel	\$0.50
Business Networks:	CNBC, Bloomberg Television, Fox News, MSNBC and iectiv	\$0.50
Great Entertainment:	Comedy Central, Lifetime, MTV, MTV2, VH1 and Nickelodeon/Nick at Nite (East and West)	\$0.50
Music Extra:	Country Music Television, MuchMusic and The National Network	\$0.35
Facts & Fantasy:	CourtTV, The Sci-Fi Channel and E! Entertainment Television	\$0.25
Local Channels**:	See Local Channel Areas Lookup for available channels	\$24.95 per property

PREMIUM SERVICES

HBO® (7 channels)	\$3.50
CINEMAX® (3 channels)	\$3.50
Multichannel SHOWTIME® , The Movie Channel® , FLIX® and Sundance Channel®	\$5.00
Multichannel SHOWTIME® and FLIX®	\$4.10
Multichannel SHOWTIME® (4 channels & Showtime Extreme®)	\$3.00
STARZ! / Encore Super Pak¹ (12 channels with all 8 theme channels)	\$3.75
STARZ! / Encore + 3 Themes¹ (9 channels)	\$3.30
STARZ! / Encore + 1 Theme¹ (7 channels)	\$3.00
STARZ! / Encore (6 channels: 2 STARZ, 1 STARZ! Theater East, 1 Black STARZ Movies, 2 Encore)	\$2.50
Encore + 6 Themes (8 channels)	\$1.95
Encore + 3 Themes (5 channels)	\$1.35
Encore + 1 Themes (3 channels)	\$.95
Encore (2 channels: East and West)	\$.75

* **Subscriber Units** are defined as follows: **Hotel/Motel:** Total number of available rooms; **Hospital:** Total number of televisions in patient's rooms on premises; **Dormitory, Office Building, All Others:** Total number of cable drops connected to delivery system.

** \$25 minimum not required for activation of Local channels.

*** All local services must be delivered to each room.

¹ Theme Channels include: Westerns, Action, Mystery, True Stories, Long Stories and WAM!

07/03/02/14/15/16/17/18/19/20

Appendix 2 – Con’t



LODGING AND INSTITUTIONS
RATE CARD cont.

A La Carte and Bundled Services

A&E and The History Channel	\$0.35
BBC America, Newsworld International and TRIO	\$0.20
Black Entertainment Television (BET) and Game Show Network	\$0.15
Bravo, International Film Channel (IFC) and WE: Women's Entertainment	\$0.35
CNN International/CNNfn and Turner Classic Movies	\$0.30
C-Span and C-Span2	\$0.08
Disney Channel East and West	\$0.75
ESPN	\$2.65
Fox Movie Channel: Movies from Fox	\$1.00
Fox Sports World	\$0.20
FX	\$0.30
Galavisión and Univision	\$0.15
The Golf Channel	\$0.25
Home & Garden Television, Food Network and Travel Channel	\$0.15
Music Choice	\$0.17
NBA TV	\$0.35
Phoenix TV[®]	\$0.50
Sundance Channel	\$0.35
Turner Classic Movies and CNNfn/CNN International	\$0.30
WGN	\$0.14

Regional Sports Networks

Regional Sports Networks	\$0.99
YES Network	
In Market - NY, NYDMA	\$1.75
Out of Market - Available to viewers in New York, Connecticut, and portions of New Jersey and Pennsylvania	\$1.50

Free Add-On (Bloomberg Television, The Health Network, HSN, QVC, ShopNBC and Inspirational Life)

Free Add-On^{††}

Public Interest Channels (BYU TV, CCTV, Clara+Vision[™], EWTN[™], Inspirational Network, NASA TV, PBS You, RFD TV, Worldlink TV and Word Network)^{†††}

Free Add-On^{††}

^{††} Free add-on with purchase of any DIRECTV[®] In-Room programming.
^{†††} Free add-on with purchase of any DIRECTV In-Room programming. Must have DIRECTV[®] multi-satellite system to receive these channels. Procurement of equipment is customer's responsibility.
^{††††} **Public Interest Programming:** Satellite 101 - C-Span, ch 350; TBN, ch 372; PBS You, ch 377; Worldlink TV, ch 375. Satellite 119 - CCTV, ch 455; EWTN (DIRECTV PARA TODOS[™] service), ch 422; Clara+Vision, ch 438; NASA TV, ch 378; Inspirational Life, ch 439; RFD TV, ch 379.

01/2005/INSTITUTIONS/RATECARD/ENR2

Appendix 3



MDU BULK RATE CARD

April 1, 2003

(Pricing and programming subject to change without notice)

BASIC	Each unit per month
CNN, Bloomberg, CNN Headline News, TNT, TBS, Cartoon Network, The Weather Channel, USA, Discovery, Discovery Health, The Learning Channel, NASA, EWTN, TBN, CSPAN, CSPAN2, & Public Interest Channels	\$1.00
ESPN	\$2.10
ESPN, ESPN2, ESPNNews	\$2.40
<i>ESPN packages are only available with the purchase of the Bulk basic package</i>	
PREMIUM MOVIE CHANNELS	Each unit per month
Showtime Unlimited(10 services)	\$3.30
HBO The Works (8 services)	\$4.00
HBO/Cinemax (13 services)	\$6.75
STARZ/Encore (8 services)	\$3.00
Encore Thematics: Encore Love Stories, Encore Action/Adventure, Encore Mysteries, Encore True Stories, Encore WAM/Kidz, Encore Westerns	
Encore (East and West)	\$0.65
Encore +1	\$0.85
Encore +2	\$1.00
Encore +3	\$1.20
Encore +4	\$1.40
Encore +5	\$1.60
Encore +6	\$1.80

LOCAL NETWORKS++ NBC, ABC, CBS & FOX * Additional Local Channels Available on a Market Specific Basis	\$0.50/unit/mo
Albuquerque, Atlanta, Austin, Birmingham, Boston, Buffalo, Burlington, Cedar Rapids, Charlotte, Chicago, Cincinnati, Cleveland, Colorado Springs, Dallas/Ft. Worth, Denver, Des Moines, Detroit, Ft. Myers, Fresno, Grand Rapids, Greenville/Spartansburg, Harrisburg, Honolulu, Houston, Huntsville, Indianapolis, Jacksonville, Kansas City, Las Vegas, Los Angeles, Miami, Minneapolis/St. Paul, Nashville, New York, Oklahoma City, Omaha, Orlando, Philadelphia, Phoenix, Pittsburgh, Portland, Raleigh/Durham, Reno, Sacramento, Salt Lake City, San Antonio, San Diego, San Francisco, Seattle, Spokane, St. Louis, Tampa/St. Petersburg, Tucson, Tulsa, Tyler, Waco, Washington D.C. & West Palm Beach	

Appendix 3 – Con’t

POPULAR PACKAGES	Each unit per month
<p>America's Top 50 Commercial ESPN, ESPN2, ESPNEWS, VH1, Lifetime, COURTV, CNN, Good Samaritan Network, TLC, Angel One, CSPAN, CSPAN2, WorldLink TV, HITN, Food Network, CNBC, A&E, The Weather Channel, MTV, MTV2, Sci-Fi, Nick at Nite, Home Shopping, FSTV, Discovery Channel, TNT, Disney, Travel Channel, TV Land, CMT, QVC, Nickelodeon, History Channel, E!, Comedy Central, EWTN, TBS, Cartoon Network, USA, Univ. of California, TV Games, PBS You, TNN, TBN, Home & Garden TV, BYU, Research Channel, CNN Headline News, LinkMedia, Educating Everyone, Vision TV, NASA, NAU/ University House, ABC Family, StarNet, Safety-Net, CCN, Beauty & Fashion Channel, Colours TV, UWTV, ShopNBC, DELLL, Shop-at-Home, iShop, RFD TV, PAEC, Men's Channel, America's Collectibles Network</p>	\$8.00
<p>America's Top 100 Commercial <i>Includes all of AMERICA'S TOP 50 programming PLUS:</i> FOX Sports (RSN), ESPN Classic, WGN, MSNBC, Women's Entertainment, FOX News, MuchMusic USA, Animal Planet, Lifetime Movies, FX, BBC America, Game Show, Discovery Health, tech tv, WGN, TOON, Speed Channel, PAX, NOGGIN, Univision, Bravo, TCM, BET, Independent Film Channel, AMC, CNNFN/CNNI, Turner South, Turner Classic Movies, Galavision, DISH CD (30 channels of CD-quality music)</p>	\$13.50
<p>America's Top 150** <i>Includes all of AMERICA'S TOP 100 programming PLUS:</i> Biography, Bloomberg, Boomerang, CNBC World, DIY, Discovery Civilization, Discovery Kids, Discovery Home & Leisure, The Science Channel, Discovery Wings, Encore Love Stories, Encore Action/Adventure, Encore Mysteries, Encore True Stories, Encore West, Encore WAM, Style, Encore Westerns, Outdoor Channel, Outdoor Life, VH1 Classic, Soap Network, Golf Channel, Movie Chan. 2 West, Hallmark Channel, FOX Movie Channel, FOX Sports World, Movie Channel West, Wisdom TV, History Channel International, GAC (Great American Country), Nickelodeon Games & Sports, National Geographic, DISH CD (31 additional channels of CD-quality music)</p>	\$20.00
<p>DISH Latino ** HTV, Telemundo, Galavision, Univision, Playboy TV en Espanol, Television Espanol International, FOX Sports World Espanol, MTVS, TVChile, Gran Canal Latino, SUR, Mun2, Cine Latino, TV Azteca, Discovery En Espanol, CNN en Español, DISH CD Latino (6 channels)</p>	\$3.50
<p>Multi-Sport Package (available only with a minimum of AMERICA'S TOP 100) Regional Sports Networks: FOX Sports Detroit, FOX Sports Midwest, FOX Sports Northwest, FOX Sports Pittsburgh, FOX Sports Rocky Mountain, FOX Sports South, FOX Sports Southwest, FOX Sports West, FOX Sports Arizona, FOX Sports North, FOX Sports Florida, Comcast SportsNet, Empire Sports Network, Sunshine Network. <i>(Blackout restrictions will apply to a majority of professional sports and approximately 40% of the collegiate sports programming on out-of-market networks.)</i></p>	\$3.50

Appendix 3 – Con't

INTERNATIONAL PROGRAMMING	Each unit Per month
Arabic Elite Package (Arabic)**	\$0.50
RAI (Italian)**	\$0.50
Record International (Brazilian)**	\$0.50
TV GLOBO (Brazilian/Portuguese)**	\$1.00
Record Internacional + TV GLOBO**	\$1.50
Univision/Galavisión (Spanish)	\$0.15
DISH Latino (Spanish)**	\$3.50
TV5 (French)**	\$1.25
TV Japan****	\$2.00
PolSat 2 International**	\$0.50
Phoenix TV (Chinese)**	\$0.25
Chinese Plus Pack (ATV Home Channel, CCTV-4, Phoenix TV)**	\$0.50
Anrang (Korean)**	\$0.50
B4U (South Asian)**	\$0.50
Zee Cinema (South Asian)**	\$0.50
Zee TV/TV Asia/SET (Pick any two)**	\$0.75
Mega Pack (Zee TV, TV Asia, SET, B4U, & Zee Cinema)**	\$1.00
Sun TV (Tamil)**	\$1.00
The Israeli Network**	\$0.50
PTV Prime (Pakistani)**	\$0.50
TVN-24 (Polish)**	\$0.25
NTV America (Russian)**	\$7.00
Russian Language Programming (RTV and RTV+)**	\$10.00
Polish Package (PolSat 2/TVN-24)**	\$0.75

Add-on Packages (Only with Qualifying Programming)	Per drop/ Per Month
#2 – USA, Discovery Channel, BET, ABC Family	\$0.50
#4 – Game Show Network, Court TV, A&E, History Channel	\$0.40
#11 - Nickelodeon, TV Land, Comedy Central, MTV, MTV2, VH1	\$0.60
Action Pack: Outdoor Life, Outdoor Channel, Speed Channel, Discovery Wings, Do-it-Yourself Network	\$0.75
Discovery Pack: The Science Channel, Discovery Home & Leisure, Discovery Civilization, Discovery Kids, Discovery Wings	\$0.10
FOX NEWS	\$0.52

*Bulk Basic package in Alaska and Hawaii does not include The Weather Channel

**Denotes programming that is broadcast from an alternate satellite location, and may require a second dish antenna and/or DISH 500

***Action Pack must be purchased with the Basic Package, all other packages may be purchased with either the Basic package or a Premium package

****TV Japan is not available to customers in Hawaii. Customers located in Alaska will need to have a site survey to determine availability.

*****Discount Networks available on an a la carte basis, at a rate of \$0.50/channel/drop/line.

¹ McKinney, Jenny. "The Telecommunications Industry." About.com. April 2003
<<http://telecom.about.com/cs/theindustry/index.htm>>

² "Cable & Telecommunications Industry Overview 2002 Year-End." December 2002.
National Cable & Telecommunications Association. February 2003
<http://www.ncta.com/pdf_files/YERDraft.pdf>

³ "Radio and Television: Past and Present." 24 April 2003. SignalAlpha.com. April 2003
<http://www.signalalpha.com/who_owns_what.htm>

⁴ Schatz, Aaron. "The Lycos 50 Daily Report: Top Cable Networks." *Lycos.com* 27 September
2002. April 2003 <<http://50.lycos.com/092702.asp>>

⁵ "Virage.com Home Page." February 2003. Virage, Inc. February 2003
<<http://www.virage.com>>

⁶ Winchester, Randy. "An Analysis of Three Vendor Proposals for Cable Channel
Provisioning." March 2000. February 2003
<<http://web.mit.edu/is/discovery/cabletv/vendor-analysis.html>>

⁷ "Motorola Digital Receivers to Facilitate New TV Service at MIT, Cornell University, and
The University of the Arts." Motorola, Inc. Press release 23 October 2001.

⁸ Wallace, David J. "The Dorm Desktop as Portal to Cable TV." *New York Times on the Web*
19 September 2002. February 2003
<<http://query.nytimes.com/gst/abstract.html?res=FB0E11FA39540C7A8DDDA00894DA404482>>

⁹ "Video Furnace: Products." April 2003. Video Furnace. April 2003
<<http://www.videofurnace.com/products/products.html>>