The Impact of Broadband Options on the Disaggregation of the Media Industry

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Abstract

This paper discusses the impact on the media industry of fiber to the user, specifically to the home. It presents the overall technological aspects of this new technology, reviews the issues of distribution channels, and analyzes how FTTU can create a new electronic marketing and distribution channel which cane be greatly disruptive to current media players in the industry. The analysis goes further to assess what the position of potential new entrants and competitors may be as well as analyzes the potential of new technologies on this evolving market.

Contents

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1. INTRODUCTION

Broadband is potentially as destabilizing a challenge or more so than the Internet has been to certain markets. This is especially true to those in the media industry. Consider the film sector alone and some of the challenges of the past twenty years. Clearly the introduction of CATV, VCR, DVD, satellite, and now the Internet has presented multiple distribution alternatives and competitors for content well and above the classis movie theaters and television. Twenty five years ago all one had to be concerned about was the delay between theater release and television release. Now there is a panoply of different release schedules, distribution channels and opportunities for revenue generation. The good news is that the control of this is becoming more and more centralized.

This may soon change, as the distribution channels and costs of entry for new competitors change. Control over the distribution channel is control over the product and in turn it overall margins; which have only increased over the years. Consolidation of content and channels as is the case with Time Warner and Fox, soon to be with Comcast and others means that the content and conduit players are highly concentrated and that small content players have high costs of distribution unless they play with the big players and small conduit players have high costs of content, which in a monopoly market means just increasing costs to consumers.

But what is this change, namely a new technology, fiber to the home, FTTH, allowing a redefinition of the distribution channel, allowing access to any content provider and in turn potentially commidicizing content by opening conduit. The question is; is this possible, if so when, and if so what else can change on this horizon. Finally the key question is what will the current media owners do to respond to this challenge?

This paper considers the changes which we believe are not just potentially there on the horizon but what ones are currently being effected in the market with FTTH today.

The questions addressed in this paper are as follows:

1. *What is broadband and what alternatives are presented to the market? In that context, what is Fiber to the User, FTTU, and how can it be economically be implemented in a market?*

2. *If FTTU is truly broadband and open, then what changes will occur to the sales, distribution, promotion, and transactions of media content such as movies, games, and other content rich media elements?*

3. *Is wireless a player at all in this area? Is wireless merely a diversion with limited capability, an adjunct with complementary capabilities, or can it evolve into a first rate player?*

4. *In the current media market, who are the players and what roles do they play? How will those roles be affected as a result of a new electronic marketing and distribution channel?*

5. *What technologies will mast likely impact this change in electronic marketing and distribution channel and what will the most likely tipping technologies be?*

6. *Who are the most likely players in deploying the FTTU systems to create this change? What are the most likely impediments to their actions?*

7. *Are there any regulatory issues which may impact this area?*

8. *What is the timing associated with this change?*

We attempt to answer these questions from the perspective of the current markets. The implications are not just limited to the U.S. but focus on global markets as well. Clearly the impact on the video, game, and other content rich business.

2. WHAT IS BROADBAND

Broadband means many things to many people. To the existing monopoly telephone companies it means something faster than a dial up, not much more, but something which gets around occupying an expensive telephone switch by having the consumer pay more for less; namely instead of connecting to the telephone local central office switch, the ILEC gets the customer to pay to connect to a highly efficient than shared data access system, providing s slightly faster but lower costs system for the phone company. The fact is that DSL is really better for the local phone company than dial up. They in fact should incent people to change rather than leaving them stay on dial up and occupy expensive switch ports.

2.1 Key Questions

We first want to address several key questions as to what is broadband and how does it differ from the current network architectures. The differences that we develop here were first presented in the paper by McGarty in 1991. In that paper the concept of a changing network architecture was presented and it was done in the context of what was then called the NREN, the predecessor to the Internet as we now know it. The discussion in the 1991 paper articulates the fundamental changes in a fully distributed and open network. These issues, openness and distributed, with the intelligence at the edge of the network, is an essential factor in differentiating this network from others.

2.1.1 What is FTTH?

Fiber to the home, FTTH, or fiber to the user, FTTU, is the embodiment of a technology of providing an ultra high speed connection to an ultra high speed backbone in a fully open network architecture. The use of fiber allows fundamentally an near unlimited bandwidth to the end user. Fiber, by itself has that capacity and capability, but it it's the electronic overlay which will be the delimiting factor. For example, the ILECs want to overlay ATM on top of fiber. That is a clear telephony paradigm, it is a delimiting, controlling, and proprietary system, managed by one control point. This is not an open network architecture and is in fact the antithesis of what we see as a broadband infrastructure fabric. In fact, for FTTU to work it must be enabled by an open architecture at the higher protocol layers. Thus an Ethernet layer 2 and an IP layer 3, and finally a TCP at layer 4 are all essential. These are quite frankly the only alternatives to ensuring that the technology is enabling and not restricting.

2.1.2 What is "broadband"?

Broadband is fiber, plus electronics plus the overall management of the network, and the management is a philosophical as well as physical act. True broadband must be an open architecture, allowing each entity which can connect to the network to have peer status. There must be no sub-serviant states of connection. Each portal to the network, each appliance connecting must be equal to all others. Each entity using a portal to the broadband fabric must be able to effect the total use of any and all of the network resources as well as be able to communicate to any and all other users on the network. Just like the Internet as we currently understand it, broadband must been enabling by allowing the intelligence to reside at the edge of the network, an intelligence which can grow and expand an share itself with all other users.

2.1.3 What are the broadband alternatives?

Broadband is currently also a confusing term. The ILECs sell DSL as a broadband offering. It uses the existing copper wires of the telephone system, and can carry limited data rates as well as being inherently a highly proprietary network. The ILECs, with the express exception of Qwest, due most likely to its teetering on bankruptcy and its related civil and criminal charges, have all said they want to do FTTH, but not when and the ILECs use the ATM FTTH approach which is merely and extension of the copper proprietary architecture.

Cable modems are also an alternative. But cable system have limited bandwidth, typically because of use of coax cable. They may have 750-900 MHz of bandwidth almost all of which is dedicated to video. They

may allocate 6-18 MHZ for data. Coax is a very poor medium for this process and cable data has always been an add on to the basic cable fabric.

Wireless we shall discuss shortly, but it too has several major limitations.

2.1.4 What does FTTH do that other "broadband" networks do not?

FTTH if properly implemented is a dramatically different network fabric than any of the current schemes. It is the ultimate extension of the Internet to the end user. FTTH is an open network, which means that peer to peer communications is fostered and that the network is minimalist in implementation, namely is IP at the edge, and enable the full and complete migration of the intelligence to the end user. The Internet design was that of a network with minimalist structure and one where the end user was empowered to possess the maximum in intelligence at the edge. That is one of the key reasons why the Internet has been so successful. The users who access the Internet via dial up, DSL, or CATV, totally lose that capability by accessing via a proprietary and closed access facility, one typically owned and operated by a local monopolistic incumbent. FTTH networks allow for the migration of openness to the end user. FTTH may eliminate that proprietary end connection, allowing a much fuller implementation and facilitation of Internet access and applications.

2.1.5 Is it more than faster, cheaper, and more stuff?

The current view towards broadband is that it can provide the triple play of video, internet and telephony, and do so; better, cheaper, and faster. This is the double triple play. However, if that is all broadband can achieve it is nothing more than another commodity player in an over crowded market. In fact, broadband is much more than that. It is a fundamental sea state change in the way people communicate, transact, inform themselves and entertain themselves. It is a transaction, information and entertainment system which is transforming the existing physical marketing and distribution channels, it is an electronic marketing distribution channel and one which truly creates an electronic shopping mall for things, ideas, and "fun". Thus the issue of broadband just being a better, faster, and cheaper way of dong what we already do is but a small fraction of what broadband can truly accomplish.

2.2 Broadband Characteristics

There are certain characteristics which broadband must adhere, like those of the Internet as discussed above, to if it is going to achieve its full potential. Most of these characteristics have been learned from the steps we have taken with the development of the internet over the past twenty years.

2.2.1 Localism

Localism is a key concept at the MBN level. Localism means a participatory process driven by some form of co-ownership in the MBN. The participatory process and the ownership issue go hand in hand. The ownership may mean nothing more than a seat at the table with guarantees of openness. The participatory process demands an ability to allow those with vested interest to have their voices heard. Localism also means that there can be a focusing of the interactions and communications on a local level.

The major observation here is that as little as five years ago 95% or more of Internet traffic went to MAE East or West and then back again. Thus Europe communicated with web sites in the US and then back. India had over 99% of its traffic sent back and forth to the US. This has changed. Poland talks to Poland more than 50% of the time, France to France in excess of 70% of the time, and now India has over 70% of its Internet traffic to and from itself. Localism thus has a second dimension of internal communications and facilitating the process as well.

2.2.2 Openness

Openness is a powerful concept. It means that there is no proprietary control, that anyone may interconnect via a portal and that peer to peer communications is readily achievable. Moreover, openness means that anyone wanting commercial access can gain that access in a standard and predictable fashion.

Openness further implies an open and free flow of communications on both a global and local landscape. The localism element must become an integral part of openness.

2.2.3 Connectivity

Connectivity means allowing the networks to build and connect to one another. By having a minimalist connection criteria, a standard accepted by all, then connectivity can be achieved. Connectivity also demands that the local networks must agree to connect. The connection must also be done on a peer to peer basis with no economic limitations or fees. It is critical to eliminate the current transit fee construct which the Tier 1 Internet backbone carriers have which make for prohibitively costly interconnection to other networks.

The agreement to connect, local, open networks, then will circumvent the strangle hold of the Tier 1 Internet carriers. It will create a collection of locally interconnected open networks which will aggregate to a national and possible global open broadband infrastructure.

2.2.4 Minimalism

Minimalism is the essence of the Internet. The Internet is not the telephone networks of the past. The use of TCP/IP creates a minimalist schema for interconnecting, for expanding, and for achieving scale. This is the hour glass construct. Keep the internal simple, move the intelligence to the edge of the network where innovation is easily handled.

2.3 Wireless

Wireless has been touted as the true competitor to fiber in the broadband evolution. We argue here that wireless is an effective adjunct but is not in any way a competitor.

2.3.1 Why is wireless not a competitor?

Wireless is an adjunct. Wireless is not and is unlikely to ever be a competitor. Wireless needs a backbone to get to a jump off point and FTTU is a natural backbone. Why is wireless limited? For many reasons. The essence of true broadband is rapidly expandable bandwidth, r4ead that data rates, plus a fully open interconnectable network. Bandwidth expandability plus openness, these are the two key cornerstones of a true broadband fabric. Now consider wireless. The bandwidth available, and in turn the data rates, assuming some modulation efficiency as may be deployed, is limited to generally 10% of the center frequency. That is, technically, if one has a 4 GHz center frequency, the maximum bandwidth technically available is 400 MHz. At say 400 MHz, the bandwidth available is at most 40 MHz. Using a modulation efficiency of 1 bps/Hz, bandwidth equals data rate, and vice versa. One can always envision higher bandwidth effici3encies however, but we shall delay that for now. To take it one more step, at 40 GHz, we have 4 GHz bandwidth. At the 40 GHz range, we now have the bandwidth that we can readily terminate with a single strand of fiber in a FTTU system.

Let us now go back to the three bands; 400 MHz, 4 GHZ, and 40 GHz. The lower band is good for propagation, low on costs, and has very limited bandwidth. In addition, there just is not enough bandwidth available in that range.

At 4 GHz, we have some bandwidth available, most being controlled by the government for its uses, but no allowing what we really need. However, at this frequency range the propagation is only line of sight and the equipment costs begin to rise.

At 40 GHz, there is a great deal of spectrum, but it does not propagate very far and the equipment costs are quite high.

2.3.2 What is the Spectrum Problem?

The paper by McGarty and Medard in 1996 discussed this conundrum at length in analyzing what was called the "Gilder Conjecture". Specifically McGarty and Medard stated:

"There are two opposing camps that have evolved in the past several years as regards to spectrum allocation. At one extreme is the traditionalists who view spectrum as a finite resource that has value in and of itself, almost independent of its use. These "Traditionalists" then further hold that it is the responsibility of the FCC to divide and allocate spectrum. The Traditionalist school was born in the early age of spectrum allocation wherein radio spectrum was limited by technology to a single user per section of bandwidth. From this technological limitation arose a whole regulatory and business infrastructure. More recently there also arose the process of now auctioning the spectrum so that the value accrue immediately to the public coffers. The policy implications associated with this school are significant. We mention only the one concerning the future evolution of telephony to stimulate thought.

The new school of thought is focused around the concept that spectrum is highly flexible because technology has evolved so greatly that with a bit of extra thought it maybe possible to allow a plethora of uses shared amongst many players and that the control is now not of the spectrum per se but of interfaces or of similar end user technical factors. The most recent proponent of this school of "Innovationists", that is those seeking to free up the restrictions on spectrum are Gilder in his article of April, 1994. In this writing Gilder uses some of the technological alternatives proposed by Steinbrecher and takes them to and extreme in Innovationist thinking. Specifically he proposes that spectrum allocations along traditionalists grounds be abandoned. In 1992, McGarty, in an FCC filing first proposed this concept, in the Telmarc Group request for Pioneer Preference, and further detailed the architecture in June of 1992, which included the detailed integration of the Steinbrecher construct. The McGarty architecture of 1992 anticipated the Gilder construct but due to the limitations of technology at the time and the demands by the FCC for instant solutions, the implementation of the architecture was delayed until late 1993. Even then, the implementation admitted feasibility but not economic implementability for several years.

The Innovationist school assumes that spectrum need not be allocated. It stipulates that users create value by means of their use and that spectrum does not in and of itself have value. The Innovationist school further assumes that the Government from a policy perspective should delimit its involvement in bandwidth allocation and that further that if the Government desires to be compensated for its spectrum it be done so on a value added basis wherein the value is the explicit value of the use of the spectrum. This, the Innovationists would say, taxes or burdens all competitors equally and avoids the problem of the initial monopolists who have significant to loose via competition would not have a predatory influence perforce of their available capital.

In this paper we develop the arguments for the Traditionalists and Innovationist schools, and then analyze how they fit into the current trends in technology. We then discuss the issues of spectral efficiency and show what the optimal usage can provide and what the two differing schools provide separately. We spend a significant amount of effort on architectures for the four possible extremes when we analyze the possibilities divide along the lines of allocated or shred bandwidth, and proprietary of standard interfaces. We believe that these two dimensions, and the resulting four possible architectures provide the policy analysts with four extremes to help guide effective policy development. Finally we present several key policy observations that have been made pursuant to the study of this concept of shared bandwidth.

It is important to note that there have been many others who have raised this issue of shared bandwidth and that this paper is representative of a few of the current views. At the extreme end is a shared view wherein the Government owns and operates all spectrum, as it once did the post office and as it now does the FAA. At the other extreme is the view of the Libertarians that the Government has no useful role, and they use the examples of the Post Office and the FAA. We take no judgmental position on these extremes, but

suffice it to say, the structures developed herein may be readily applied to many other constructs. What is important in the policy debate however, is the need to have definitive architectures for what we they develop policy for.

2.3.3 Is Gilder wrong again?

George Gilder had made a name for himself before and during the dot com boom by hyping technologies without truly having the slightest understanding of what the implications or limits truly were. The following is an analysis of a Gilder projection/suggestion on wireless made almost a decade ago. It is important to revisit this set of conjecture because they all too often raise their heads again and again and need to be addressed and dealt with.

Gilder has postulated several conjectures, which we summarize, and will return to after the analysis. These conjectures are as follows:

(1) Many Users can occupy the same spectrum at one time.[2] ***There exists a well defined set of protocols that allow this and prevent collisions.***[3] ***There further exists a set of workable multiple access/interface technologies that can be interchangeably used.***[4]

Gilder assumes that there is a well developed technology base that can be operationally available and that permits multiple systems to operate simultaneously and that the industry as a whole has agreed to how best to handle the interference problem.

(2) Frequency and modulation/multiple access schemes are utterly unnecessary.[5]

Gilder assumes that worrying about the technical details such as modulation and multiple access is a secondary factor, at best.

(3) Networks can be made open and all of the processing done in software.[6]

Gilder assumes that hardware is de minimis in terms of its interaction with the operations and that all changes and operational issues are handled in software.

(4) Broadband Front Ends replace cell sites in functionality at lower costs.[7]

This conjecture is based upon the Steinbrecher hypothesis, namely that some simple device can replace all of the features and functions of a cell site, such as network management, billing, provisioning, and many other such functions.

(5) It is possible to manufacture spectrum at will.[8] ***Spectrum is abundant.***[9]

[2]Gilder, p. 100.

[3]Gilder, p. 112.

[4]Gilder p. 112.

[5]Gilder, p. 104.

[6]Gilder, p. 104.

[7]Gilder, p. 110.

[8]Forbes, p. 27.

[9]Gilder, p. 100.

This conjecture assumes or posits that spectrum can be "created" de novo from a combination of what is available and the technological "productivity" gains.

(6) Spectrum can be used any way one wants as long as one does not interfere.[10] ***New technology makes hash of the need to auction off exclusive spectrum, spectrum assignment is a technological absurdity.***[11]

The last conjecture is the one that says that given the above five conjectures, spectrum can be used in an almost arbitrary and capricious fashion, allowing the assumed technology to handle the conflicts, and not having to have the FCC handle the conflicts via a spectrum allocation process. The last Gilder conjecture states that technology obviates the needs for spectrum allocation of any form."

Thus, wireless has serious limitations, inherent in limited bandwidth, the regulatory process, its ineffieiciency and delay, as well as the overall costs of implementation.

What is being sold "Same services" or a Portal to an open network, what are the consumer perceptions?

The true open broadband network is dramatically different from any of the proprietary networks which have evolved over the past 100+ years. This difference means that if we are to look at this network as nothing more than doing what we already achieve by the classic methods, we are self defeating. The FTTU broadband is an open network, and users have portals to that network, and these portals have almost boundless interconnectivity and capacity. This means that the "service" that can be provided and moreover how they can be provided will be dramatically different. Furthermore, this network will be a direct challenge to what we see in existing service provision channels.

The essence of a marketing and sales channel is promotion and persuasion. It is the establishing a connection with the buyer and meeting the needs. It allows as best as possible a form of instant gratification for the purchase process. Broadband is clearly and enabler for that. Moreover, open network broadband will allow any new entrant access to that market as a purveyor of their goods and services.

2.4 Historical Comparisons

Many historical comparison can be made between existing infrastructures and the possible evolutionary paths of broadband. We first consider two and then attempt to extrapolate.

2.4.1 Public Power (1868-present)

Public Power is a capital intensive network with a goal to provide universal service of a type. It has always been a mix of municipal owned and operated companies with publicly/privately held companies and Co-Ops. There has been some but limited consolidation in this industry and limited success in de-regulation. There are three characteristics of import to public power:

1. Power outlet; Portal for appliances and open network: Power was not the end in itself. The end was the application of appliances. The network was ***minimalistic***, just delivered power via an outlet, and enabled users through a common outlet and voltage and power type, alternating current, to attaché appliances. In addition it was an "open" network. Each provider could readily connect to the network. In addition such small local providers called co-generation plants could also attach. It allowed ***full openness***. It was in many ways the precursor to the Internet in philosophy.

2. Appliances could connect anywhere on the power grid. Universality of interconnection was key. I could take my toaster from New York and move it to California. I could not do it as readily to

[10]Gilder, p. 111.

[11]Forbes, p. 27.

Prague. That was where a problem arose. In Europe in general there are almost a half dozen different outlets and this slows down progress.

3. Competition arose at **appliance** level. The local infrastructure was if you will a carriers carrier for what the appliances needed. The competition was not at that level but at the appliance level. The commonality and minimalism allowed, in fact fostered competition at the appliance level. That example is one that is key to understanding networks and network evolution philosophy.

2.4.2 Telephone (1874-1984)

In contrast to the power network the telephone network took an alternative route. It was a national monopoly. The political context was that it was essential for national security. That issue is a major driver in many of the political and business decisions made. It has the following three major characteristics:

1. Closed network, hierarchical: The telephone network was a totally hierarchical network. As McGarty [1990, Harvard] noted, the hierarchical fabric was typified in its five classes of switching, class 5 being the lowest and local and class 1 being the highest. All calls had to be controlled by the telephone company, as still do. Until 1984 the network was legally closed, and since 1996 the network is de factor limited, but since delay is the deadliest form of denial, most often it is de facto closed as well.

2. Black rotary phone, no services other than what ATT allowed: The classic story is that of Bob Kahn, the true father of the Internet, when he was at ARPA, meeting with Bell Labs at Murray Hill requesting to get the specs for the Bell modem so he could build a packet network. The said no. He then was forced to use his team of academics to find a way around this, and thus came the modem, the integrated circuit, and what we now see as a very diversified industry. In 1972 when Kahn attempted this the Bell System said no to everyone, including the Department of Defense, where ARPA was its major research arm. Now those decision makers from Bell may regret their arrogance of you can have whatever you want as long as it's a black rotary dial phone.

3. Monopoly: Monopolies are artifacts of economists dreams. The assumption that economists make is that bigger is better and that monopolies since they are as big as you can get are a good as you can get. Economists have never met the reality of technological change. For every monopolists there is a technologist trying to undermine its stranglehold. This is what has happened to the world of communications.

2.5 What is FTTU Broadband

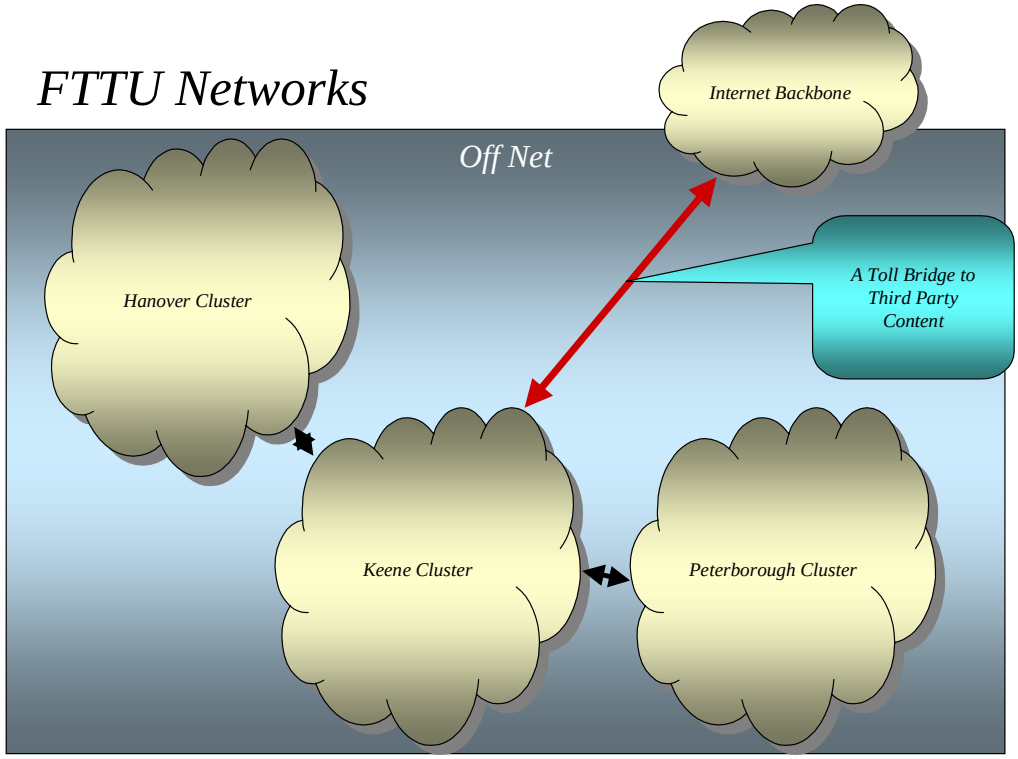
We can now expand on our understanding of broadband. It is the embodiment of a open network which enhances localism but in addition it does a great deal more. It is what you get already, but faster, but moreover,

1. It is a **portal** to an open broadband network, allowing any and all users on the broadband backbone to communicate between and amongst each other.

2. It is a Marketing Challenge, to have the users understand it is not just what they get from the existing players but much more…it is the Portal to a broadband environment.

3. It enables **appliances** to connect via portals; like electricity, it opens the network to everyone.

Consider the overall architecture of a broadband network shown below. It has two key elements; on net and off net. On net means anyone on the fiber network or its extension communicating with anyone else on net. The key observation which can be made is that the marginal costs for on net is zero, thus the marginal price for on net could also readily be zero. Once one has obtained a portal to the network, one has a place to park at the shopping mall and all other "purchase" are at the purveyors at the mall. The off net communications require fees. Communications to other networks require tolls to the gatekeepers and as such are tariff tolls.

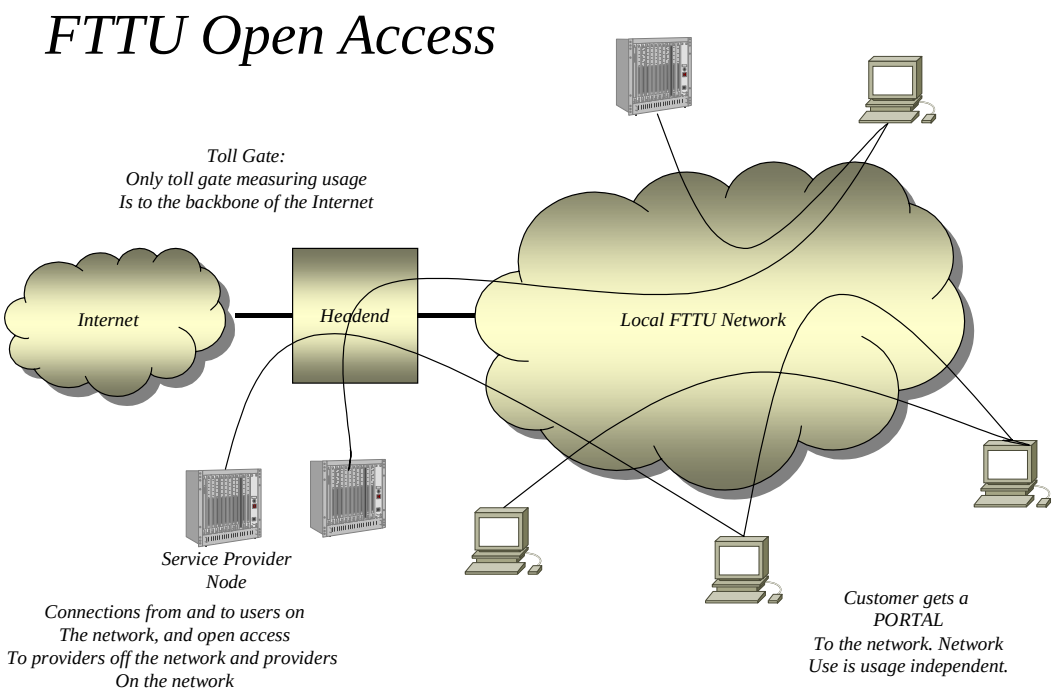


The following is a summary description of the various types of broadband capabilities. We have compared those there today with those anticipated in the near future. These include fiber and wireless options. We argue, as we did earlier that wireless is limited, but a good adjunct.

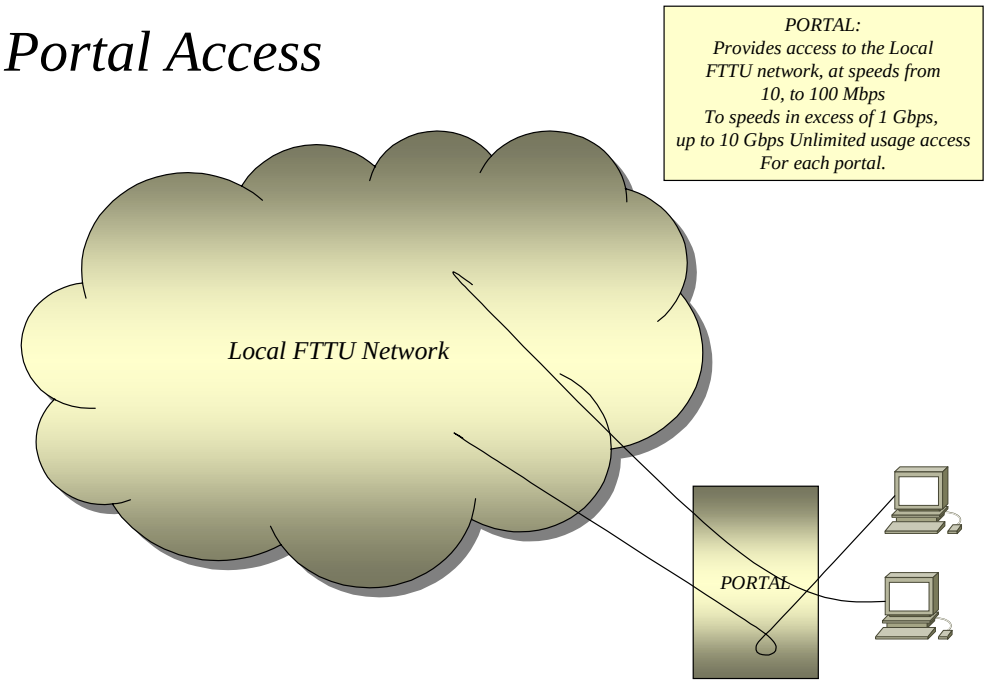
Attributes and Alternatives

Attribute	*Telco DSL*	*CATV*	*FTTU*	*DTH Satellite*	*802.11*	*802.16*
Speed	*Up to 1.5 Mbps*	*6 Mbps and up per channel*	*Terabits per second*	*1-5 Mbps*	*1-100 Mbps*	*1-100 Mbps*
Shared vs. Dedicated	*Dedicated*	*Shared*	*Dedicated*	*Shared*	*Shared*	*Shared or Dedicated*
Range	*1,000 to 2,000 ft*	*1-5 miles*	*25-100 miles*	*unlimited*	*100-500 ft*	*2,000 to 20,000 ft*
Connectivity	*Hierarchical*	*Hierarchical*	*Fully connected, peer to peer*	*Hierarchical*	*Fully connected, peer to peer*	*Fully connected, peer to peer*
Accessibility	*Company provided units*	*Company provided units*	*Any user can attach any device*	*Company provided units*	*Any user can attach any device*	*Any user can attach any device*
Security	*Moderate*	*Poor*	*Moderate to High*	*Poor*	*Poor*	*Poor*
Flexibility	*Limited*	*Limited*	*High*	*None*	*Limited*	*Limited to Moderate*
Expandability	*None*	*Add more channels*	*Near infinite*	*None*	*Limited, interference, power*	*Limited*

The following Figure depicts the concept of on net and off net in a more complete fashion. The portal is the access to the on net communications and interactions.



The portal access is a concept that will develop into a very sophisticated capability for all users of broadband. It is driven by the minimalist approach of the Internet, namely using IP, and allows for the development and deployment of a true set of IP appliances. The appliance evolution will be the next major thrust on Internet growth.



3. BROADBAND ECONOMICS: AN EXAMPLE

This section details the basic design and analysis methodology. It must be repeated that this is a Feasibility study and not a detailed design study. It is most likely that any third party making a bid to perform the work discussed herein may have a different design and in addition, there may be added design factors that may not have been included herein.

Thus, the methodology chosen is used for feasibility analysis only.

3.1 Methodology

The methodology is composed of several elements. The approach consists of the following steps:

1. Establishment of Headend.

2. Sectoring the town. This step breaks the town into sectors of no more than 1,500 HH and has sectors with generally consistent characteristics.

3. Establish of the network elements.

3.1.1 Headend

The headend is the key location for the central interconnection of all inbound and outbound communications. The headend is selected for each tow although it may be possible to combine headend for common towns.

3.1.2 Network Elements

The network is a series of a bundle of fibers. A typical bundle may have upwards of 36 strands of fiber. The end goal is to have a strand or strand pair per HH. The ability to perform this interconnection is based upon the integration of three units; the CSU, the FSU, and the EUU. The CSU is the main interconnection point, the FSU is a branching and sharing point, and the EUU is in the household.

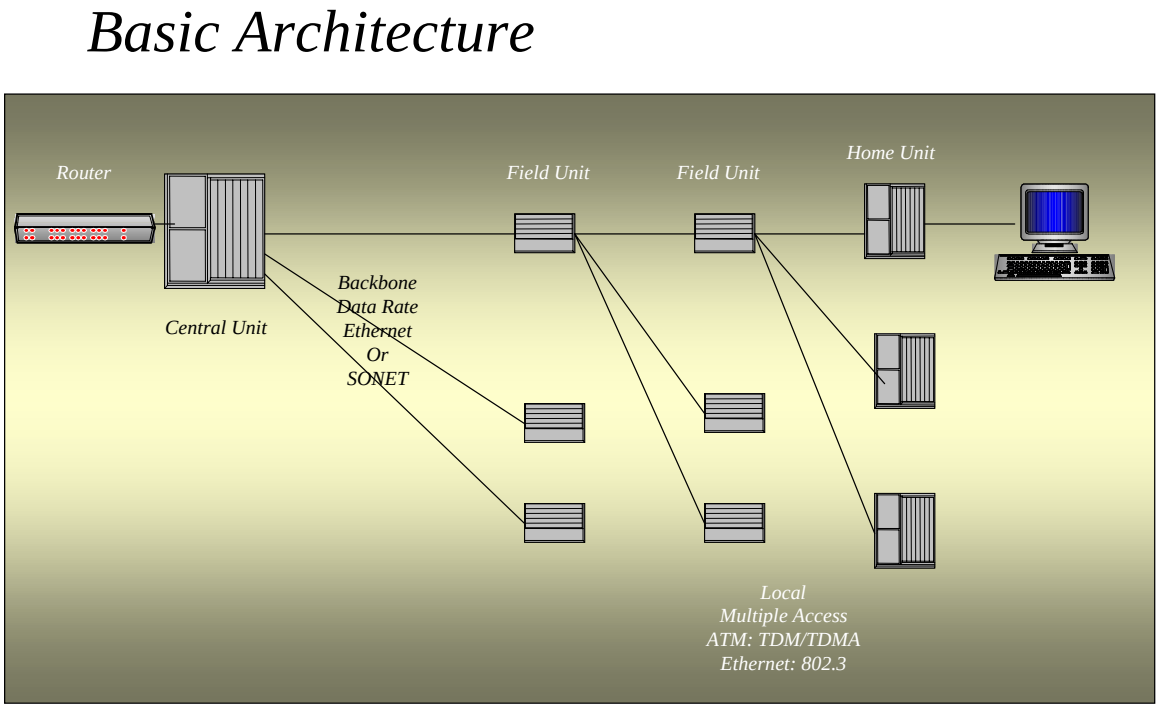
The network has the following elements:

Central Service Unit (CSU): This unit provides for the interconnection of any and all inbound and outbound communications. The unit had a fixed initial capacity, say 8,000 users, and variable capacity say 2,000 users per new unit element. These numbers will vary depending on the vendor. The CSU provides for interconnectivity of all services and its price and variability will depend upon the service mix. The CSU is in the headend.

Field Service Unit (FSU): The FSU interconnects a single or pair of fibers to multiple bundles of fiber. The fibers coming from the CSU are carrying a high-speed data backbone service of 1 Gbps or greater in both directions. The FSU then shares this amongst multiple outbound fiber bundles. The FSU has a fixed cost element for a minimal number of outgoing fiber bundles and a variable amount. In addition, the FSU has a maximum capacity of outgoing fiber bundles. The FSU is a branching element, which "shares" the bandwidth or data rate on the backbone with all end users on the final terminating leg. This is generally the bottleneck in any network. In PON designs, this is fixed and in GigE, this can be dynamically managed.

End User Unit (EUU): The EUU is the household interconnection device. It connects to the fiber or fiber pairs and then to the in home Internet access, telephony, or video.

The typical network is shown below:



3.1.3 Sectorizing

Sectorizing is based upon two factors:

1. Maximum capacity per single fiber bundle.

2. Commonality and clustering of proximate neighborhoods.

As stated above, the FSU has a maximum capacity. This again depends upon the specific vendor and technology. However, this means that sectors must be no larger than a single FSU capacity. The design initially starts with 50% or less maximum loading per sector. It should be noted that new sectors can be added at any time if additional capacity is required.

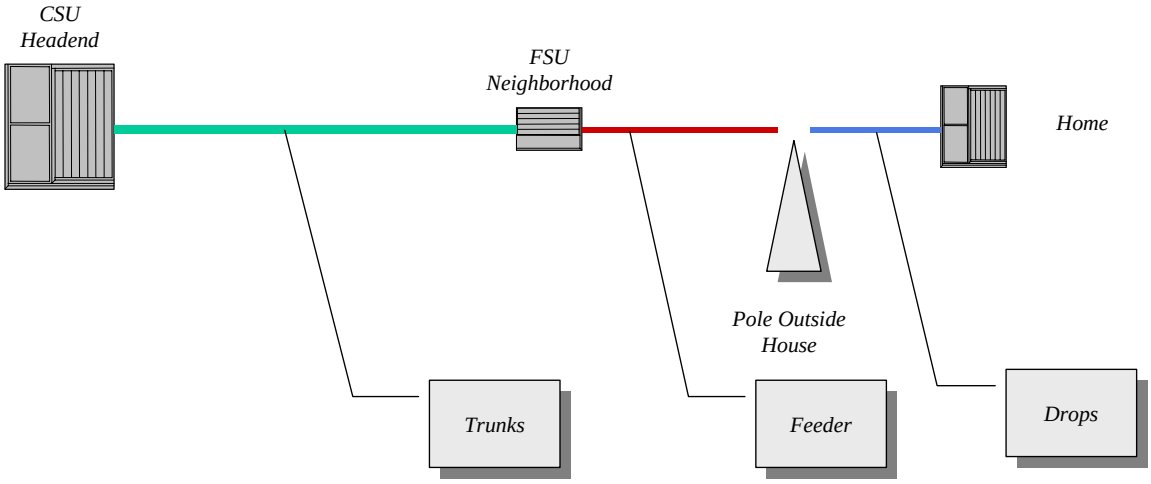
The second issue is that the sectors should have some commonality in terms of end users; household since, setback, frontage, aerial or otherwise, or other similar factors.

3.1.4 Network Layout

The network is deployed with an initial deployment of a fiber bundle to each sector, which connects to an FSU in each sector.

The three elements are shown below. They figure generally depicts the three elements of trunk, feeder and drop. The financial model uses this nomenclature and build costs elements.

Generic Fiber Network Elements



3.1.5 Trunking

Trunks are from the headend to the FSU. They are the high speed backbone elements of the network. The general scheme is a trunk is co-located with a sector. There may be more than one trunk per sector, however. In the initial designs a trunk and a sector are unique. The trunk has 48 fiber bundles, each fiber going to a FSU. The trunk may be most likely aerial. It will typically follow a major road but that will often be determined by the make ready costs associated with the poles on that route.

3.1.6 Feeders

From each FSU to each home there is a set of feeder cables. The feeders are sets of bundles emanating from a FSU. The number of bundles and in turn the number of feeder cables will depend on technology but

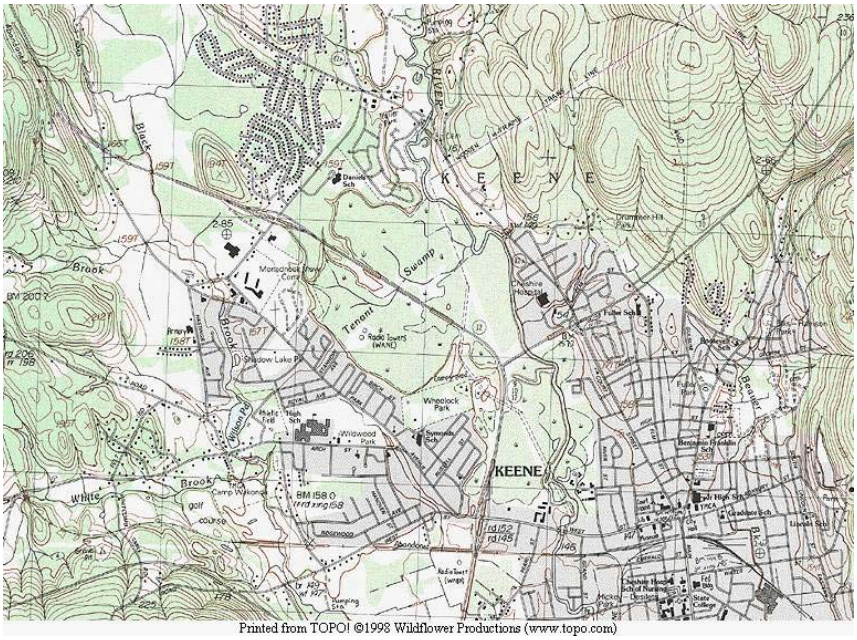
multiple ones are possible. Thus with a 48-strand trunk, and having a minimum of say 2 feeder per FSU, one can achieve 2X48X48 HH to be served, or 4,608 HH with that design alone.

3.1.7 Drops

The drops are the strands from the feeder to a single household. The drops are measured in what is termed set back distances. Whereas the trunks are typically 10-20% of the total road mileage, and the feeders make up the rest, the drops may become a significant additional set of build if the build requires large set back distances.

3.2 Capital Plant Estimates

We can now apply these models to a network using E PON technology foe an example. This is applied to the city of Keene, NH. The map of the coverage is shown below. The population is approximately 22,000 and the mile of roads is approximately 110 miles.



The following is an expanded version of the basic architecture applied to the E PON solution. We have detailed the fixed and variable elements.

3.2.1 Electronic Costs

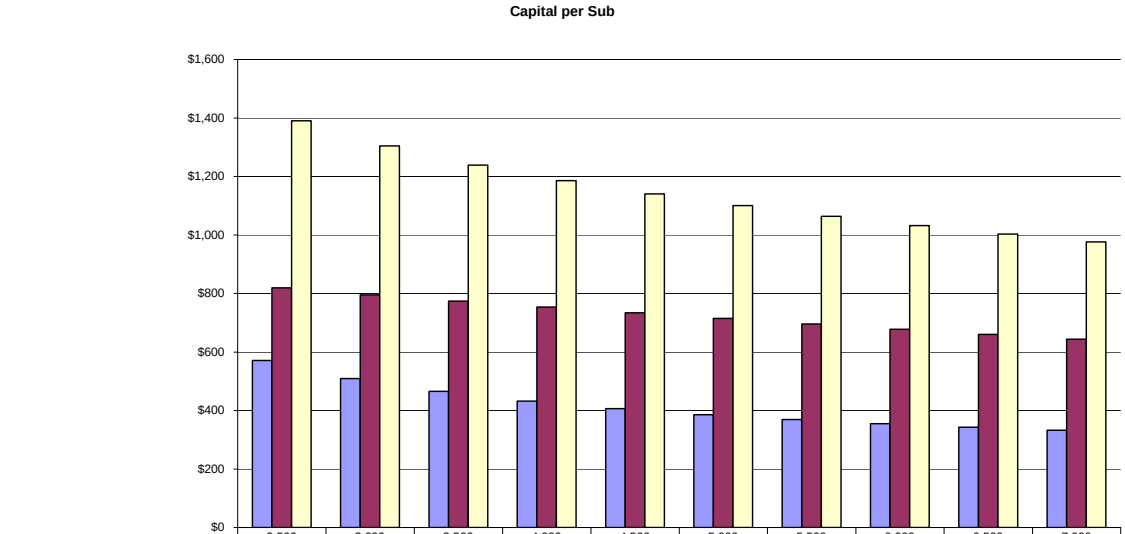
The following demonstrates the detailed electronic elements and interconnections for the above basic architecture. The backbone is 1 Gbps active transport using 2 fibers per field unit, in this case called a hub.

The cost elements for an E PON are summarized in the following charts. These are representative costs for the total network elements. Also shown are the capacities, maximum and minimum and the fixed and variable costs factors.

3.2.2 Capital Summary

The capital model focuses solely on the costs of infrastructure from a headend to the user premises. It includes fiber, with all installation and make ready costs, plus all electronics. It does not include any services elements such as video headends.

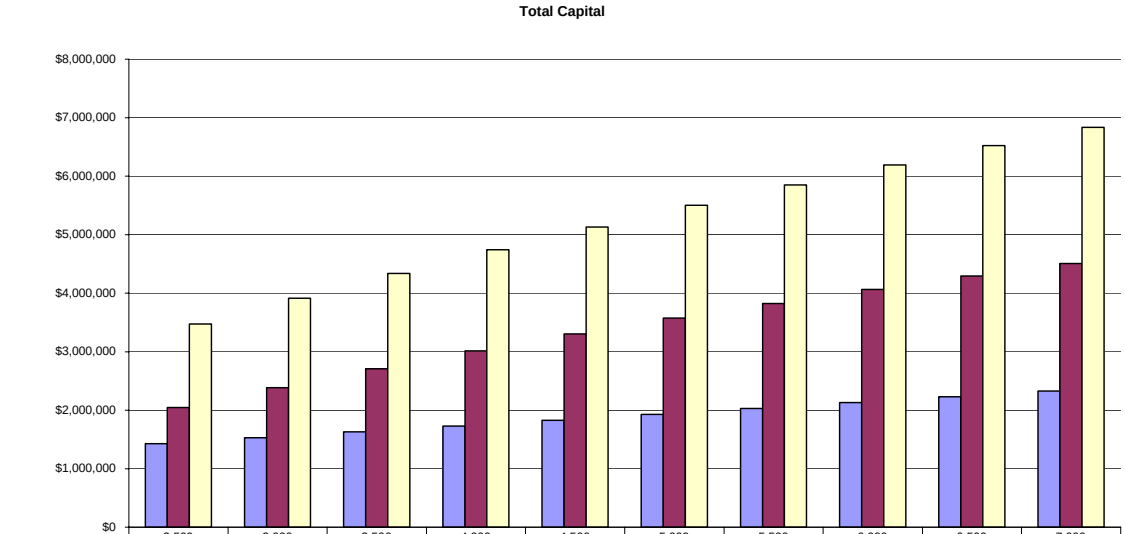
The following Figure depicts the capital per subscriber for fiber, electronics and total.



	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000
Fiber Capital per Sub	$571	$509	$465	$432	$406	$386	$369	$355	$343	$333
PON Equip Capital per Active End-User	$819	$795	$774	$753	$734	$715	$695	$677	$660	$644
Total Capital per Sub	$1,390	$1,304	$1,239	$1,186	$1,140	$1,100	$1,064	$1,032	$1,003	$976

Number Subs

The following Figure is the total capital, fiber, electronics, and total.



	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000
Total Fiber Capital	$1,428,351	$1,528,351	$1,628,351	$1,728,351	$1,828,351	$1,928,351	$2,028,351	$2,128,351	$2,228,351	$2,328,351
Total E Pon Capital	$2,047,225	$2,384,580	$2,709,030	$3,013,870	$3,303,670	$3,574,023	$3,824,793	$4,064,798	$4,292,736	$4,505,681
Total Capital	$3,475,576	$3,912,931	$4,337,381	$4,742,220	$5,132,021	$5,502,374	$5,853,143	$6,193,149	$6,521,087	$6,834,032

Number Subscribers

4. CURRENT INDUSTRY STRUCTURE AND CHANGES

The current industry structure and the impact of new electronic channels is examined in this section. The important observation is to try and observe the changes that the internet using proprietary narrow band has had on existing markets and then to envision what the impact will be is one introduces open non-proprietary broadband. The FTTH of open non-proprietary broadband is a dramatically different electronic marketing and distribution channel. It redefines roles and repositions players. It is fundamentally destabilizing.

4.1 Strategic Roles

The issue of strategic roles is one of the utmost importance in understanding how channels may change as new technologies are introduced. We assume that the full capabilities of FTTH are implements; namely an open network with full and ready access. We start with further clarification of the concept of strategic roles:

1. *Strategic Roles are defined in a manner which depicts stand alone business roles which in turn can be related to all other stand alone business roles*

2. *Strategic Roles are NOT functional elements of a business*

3. *Functional Elements, as found in a value chain analysis, are common functions in all Strategic Roles, such as sales, customer services etc*

4. *Scale exists when the business is large and scope exists if Strategic Roles are efficiently combined*

5. *Strategic Roles are not necessarily unique, completeness is essential in terms of the "food chain" of support elements, however*

Then the questions are; (i) what are the strategic roles in the current market, (ii) what changes are effected by FTTH capabilities, (iii) what changes to the existing roles will result from this implementation of FTTH, (iv) what reactions will result from the incumbents with the introduction of this technology.

4.2 Industry Strategic Roles

The following are the current strategic roles in the industry:

1. Suppliers: Providers of Transaction, Information or Entertainment Services.

2. Packagers: Positions and packages supplier offerings into a cohesive product or market image.

3. Distributors: Provides local marketing of bundle of product offerings and customer support.

4. Transport: Provides local transmission and support.

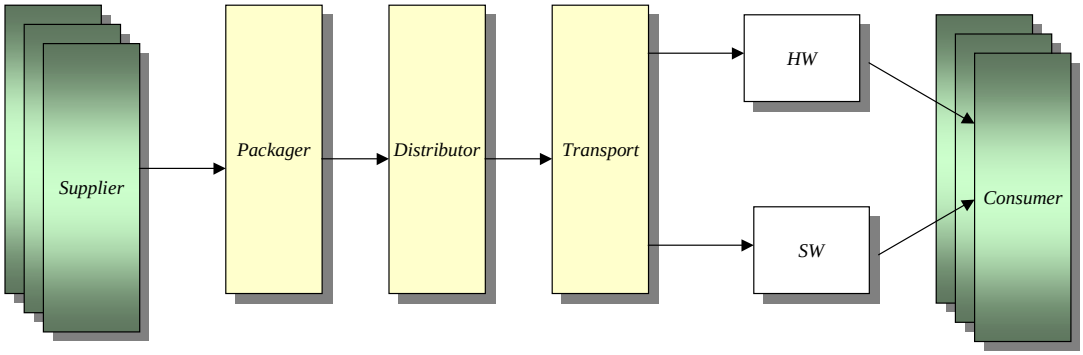
5. Hardware: Provides devices necessary to access; PCs etc

6. Software: Provides SW required to enable effective promotion and persuasion

7. Consumer/Subscriber: The buyer or utilize of suppliers goods and services.

The relationship of the strategic roles is as depicted below. The relationships are shown in a linear fashion. This structure of relationships is what we accept today in our physical markets.

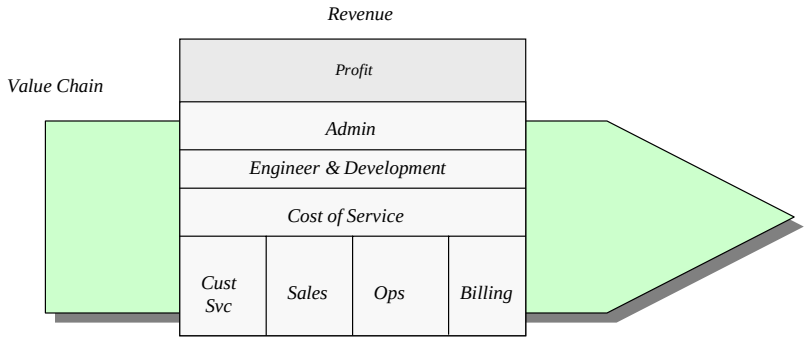
Industry Roles



4.3 Value Chain

The value chain concept has been around for many years. It simply states that each player in the business fabric has a relationship to others, and that certain functions and revenue can be related via these relationships. Further, the value of a business is how generate a profit or cash flow one can generate based upon the effective use of internal or external resources. These external resources depend on the relationships amongst players in the chain. This the “value” of a business measured by profit or cash flow will be maximized by maximizing revenue and/or minimizing expenses.

Strategic Role and Value Chain



- *Revenue is driven by prices which are market set and customer base which is a result of marketing & sales*
- *Functional costs may be self provided or leveraged by disaggregated provider*
- *Overhead elements are common*

The generation of value by a user has been discussed in a dynamic sense as the creation of value by increasing productivity on the part of a user or allowing for the development of new revenue sources.

Value was defined in terms of the increase of the flow of funds to a firm by performing a specific task.

The value chain concept, in contrast, is a static view of value projected back onto the operational elements of the firm. It is a key concept in the full grasping of the value flow to a firm with the introduction of a new technology. The value chain analysis, as developed by Porter (Porter, 1980, 1985, 1990), is a construct that overlays the rational utility function maximization process of the commercial user. As we indicated in the preceding paragraphs, we will focus on the commercial user because their utility function is generally more evaluateable and can be readily related to a rational decision process.

We demonstrate the concept of the value chain in Figure 19. We show the provider, the user and the customer. This is the natural food chain of the economic market place. The provider must provide the user with effective supplies necessary for the production and delivery of goods. The user, to attract a customer, must also provide the customer a similar set of benefits. If we view the revenue of the user as the size of the total box, and the expenses as their corresponding areas, then the users profit is the area left over after all expenses are taken care of. The revenue is provided by the customer, the expenses controlled in part by the provider. The company, namely the user, spends money on horizontal elements such as Administrative functions, and vertical elements such as Software development. The allocated profit is represented by revenue less expenses in each segment. The expenses are a product of a factor driven by the customer demand, the revenue factor, the company's productivity, and a unit cost. Thus for a fixed revenue, profit is increased by lowering costs or increasing productivity. The information networks that we have described are productivity enhancers, thus profit enhancers. This is the essence of the Porter theory.

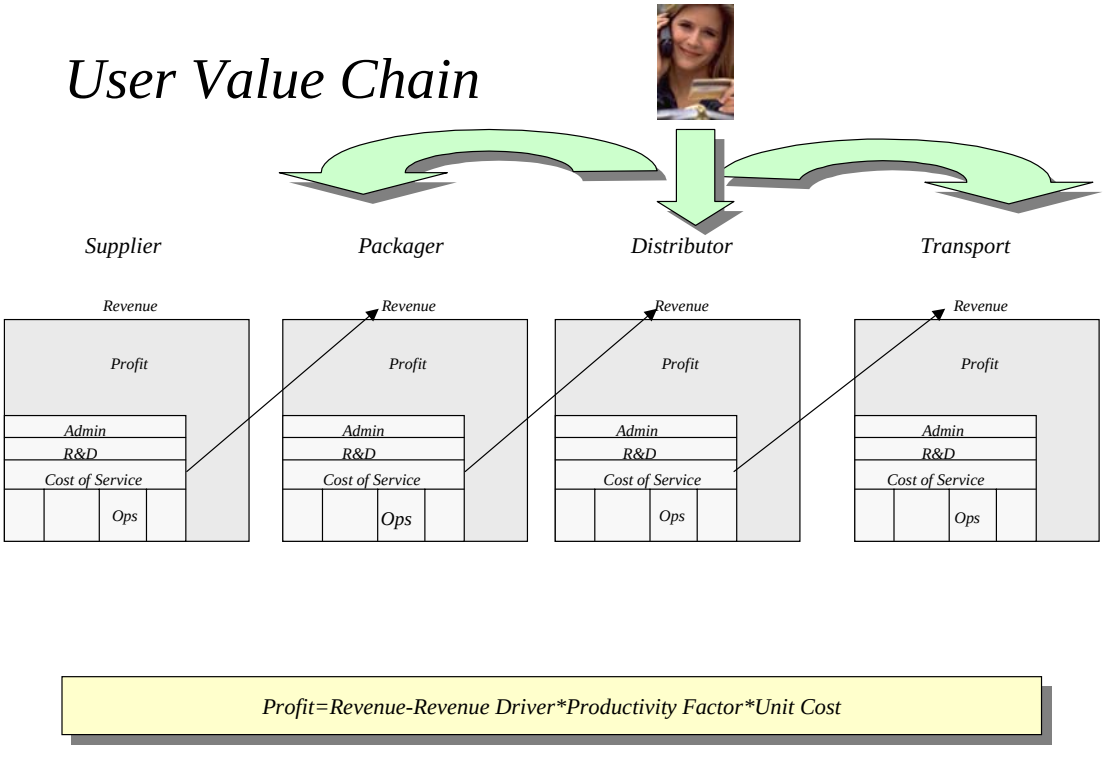
The value chain concept views the user as an operating entity with sequential and simultaneous operations as part of running the business. The sequential operations follow the flow of goods into the establishment,

through the processing done to add value and then out of the establishment. The simultaneous operations are followed over all tasks and may include such functions as finance, legal, and marketing. The company can then allocate costs and value to each of these elements, and then can compare them to its competitors.

The costs of each step in the process are the result of three factors; the revenue drivers, the unit productivity, and the unit costs. The use of information or communication networks allow the user to improve the productivity or reduce the costs. This allow for increased competitiveness and thus better margins. If the seller recognizes the value chain of the buyer, then the product that is sold can be positioned in a similar fashion, thus helping the buyer to improve their value chain. This will increase the revenue to the seller.

The value chain analysis provides a methodology to integrate the effects of communications and information services into the evaluation of a business. Porter has done this for many segments of many industries and McGarty (1989) has developed a detailed micro model to use in a detailed competitive analysis. As we look at the market factors, value chain theory states that the use of any new technology must be evaluated in terms of not only the end users value chain but also the value chain of their customers. The chains are linked and the effect is complex.

The following depicts the flow of the value chain interrelationships amongst and between the players.



Based upon the value chain analysis the following observations can be made:

1. The Value Chain states what elements add value, cash flow and/or profit to business
2. Revenue can be increased by lower price, better product etc

3. Margins can be increased by more efficient channels, technology, etc which lower costs
4. The Value Chain for one player in Strategic Roles is effected upon by another down the "food chain"

4.4 Theory of Disaggregation

In the paper by McGarty, (Columbia University CITI, March, 1996, Disaggregation) the author develops the theory of disaggregation as stated as follows:

"What the theory states is simply: The theory of disaggregation states that technology and industry has developed in such a fashion that it is possible to effect all elements of a business in a virtual form by obtaining all functions necessary to deliver a service by purchasing them from third parties each of whom has themselves other similar customers and thus each of whom can deliver their element of the functionality in a minimal marginal cost manner. The disaggregation theory then concludes with the result that in many technologically intense services business, a virtual company can exist wherein all the functions can be purchased from third parties or capital equipment may be purchased in a fully interconnected fashion so as to achieve near equality between average and marginal costs from the very commencement of the business. The Disaggregated Company is the embodiment of the virtual business."

The theory of disaggregation further states that technology and industry have developed in such a fashion that it is possible to effect all elements of a business in a virtual form by obtaining all functions necessary to deliver a service by purchasing them from third parties each of whom has themselves other similar customers and thus each of whom can deliver their element of the functionality in a minimal marginal cost manner. The disaggregation theory then concludes with the result that in many technologically intense services business, a virtual company can exist wherein all the functions can be purchased from third parties or capital equipment may be purchased in a fully interconnected fashion so as to achieve near equality between average and marginal costs from the very commencement of the business. The Disaggregated Company is the embodiment of the virtual business. The example below what the elements of any telephone company and how they may be Disaggregated.

Thus, to summarize, the theory of disaggregation states:

1. There exists a set of business functions, the collection of which make for the provision of service.

2. Each of these functions are separable but integratable.

3. Any service provider has access to these functions in a fully open and competitive market.

4. The service provider in a fully open and competitive market will execute those functions which it can produce at lowest costs itself and will procure those elements from third parties who can produce at lower costs due to scale or scope.

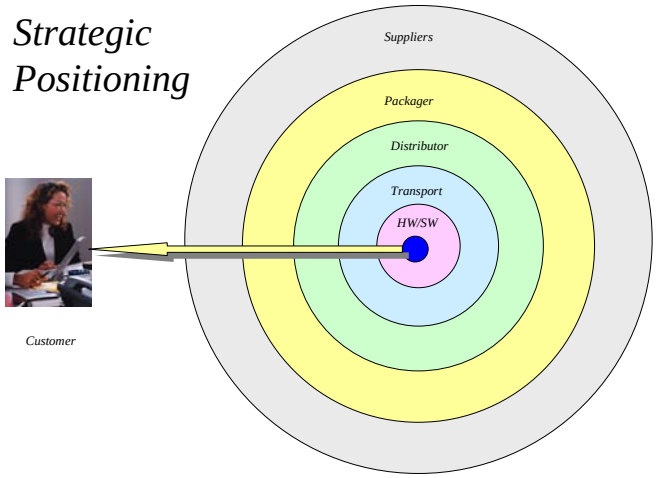
5. Communications based services are an open and interconnectable bundle of service elements which requires standardization for full interconnectivity.

6. Full interconnectivity and standardization create services and service elements which are commodicizable.

7. The consumer or end user will select a service provider in a commodicizable market based solely or total price, which is the sum of the service providers prices and any switching costs.

4.5 Strategic Positioning

One can look at strategic positioning in the context of today market. We do so by setting up the channels and roles in the following chart. The chart sets out a structure to view the interrelationship between the players and to also allow one to evaluate the strategy of many of the current media market players.



The following table depicts several of the key players and their positions in this market.

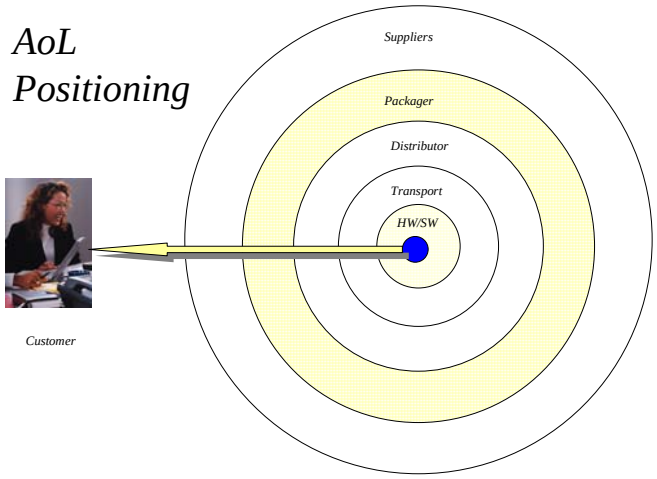
Examples of Positioning

Capability	*Supplier*	*Packager*	*Distributor*	*Transport*	*HW/SW*	*Consumer*
Dial Up	*All*	*AoL* *msn* *Yahoo* *Amazon*	*AoL* *msn* *Earthlink*	*Genuity* *Level 3*	*PC/* *Explorer or* *Netscape*	*Residential*
DSL	*All*	*Yahoo* *msn*	*Verizon* *SBC* *Bell South*	*Verizon* *SBC* *Covad*	*msn* *Verizon* *PC* *Explorer*	
Cable Modem	*All*		*AoL/TW* *Comcast*	*Time Warner* *ATT/Comcast*	*TW* *Comcast* *Explorer*	
FTTH	*All*	*AoL* *msn*	*Merton* *Staples* *Radio Shack*	*Munis/* *Merton*	*AoL* *msn*	

4.6 AoL Positioning

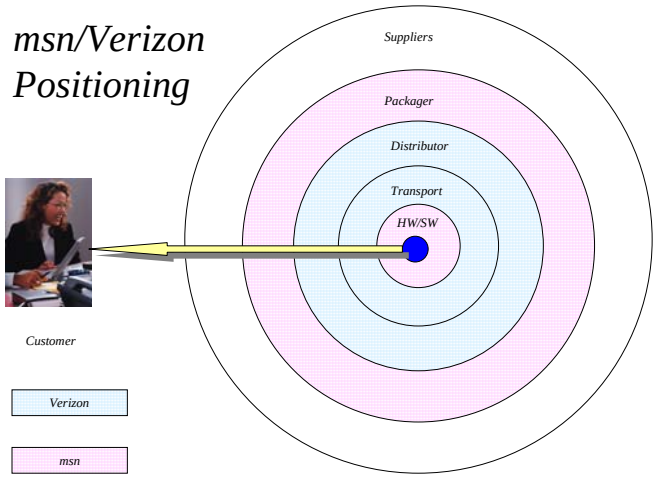
The example of AoL, in this case Time Warner with AoL, is shown below. The entity has suppliers, packagers, distributors, transport, software, and is in effect fully vertically integrated. However, it seems

not to work. Why the failure. The answer appears to be a lack of vision as to where and how this market is changing. The elements do not truly understand broadband and are protecting their existing turf. The CATV people do not want broadband, envisioned as we have as an open network, because it would lead to their short term change of control. The Suppliers and Packagers are always looking for new distribution channels but failed to have a vision of what technology can do. They have always been that way. They still use film when digital technology should really be replacing all file product. The software elements shows a total lack of understanding of broadband by adhering to the classic dial up paradigm of a window approach to information.



4.7 Verizon Positioning

In a similar fashion we can look at the position of a Verizon in this market. Over the years, it and its predecessors, have tried in many ways to take positions in each role available, with less that sparkling success. They even, when it was NYNEX tried to get into the movie content business, loosing hundreds of millions in the process. Currently a Verizon is taking a place in several strategic roles. However, as stated in the McGarty paper Imminent Collapse, 2002, the positions are quite weak in the long run.

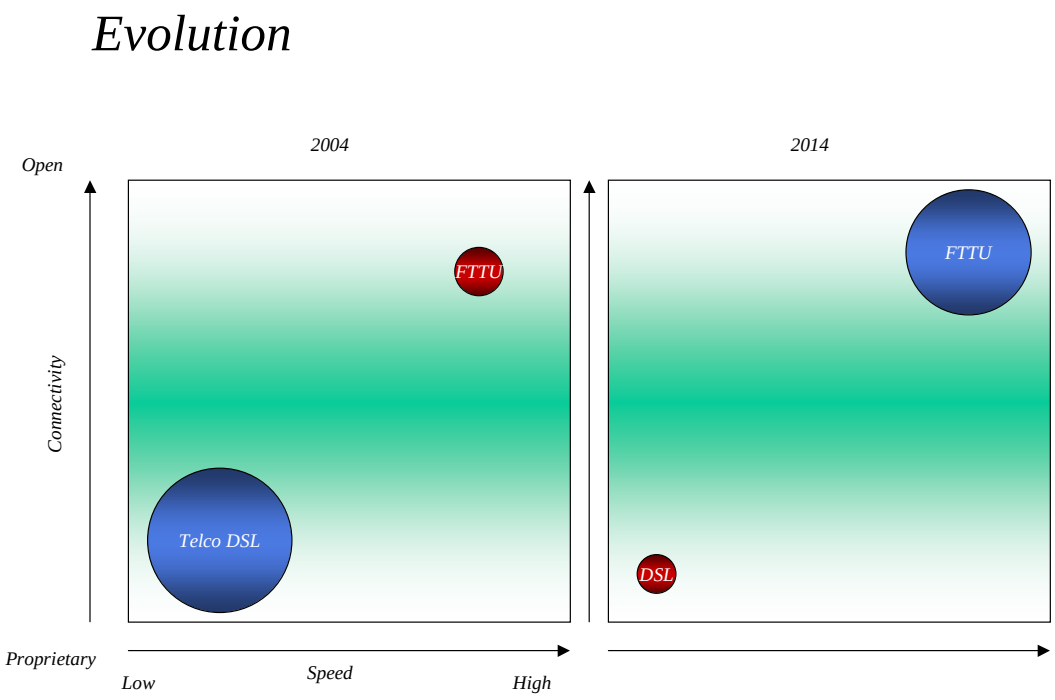


5. MEDIA INDUSTRY DISAGGREGATION

The evolution of the media industry will very strongly be influenced and directed by the evolution of broadband.

5.1 Broadband Evolution

The evolution of broadband is from slower speed and closed access to higher speeds and open access. In addition the open access at high speed will be accompanied by a significant amount of localism. We depict that fact below.



5.2 Gatesian Universes

We also postulate a Gatesian Universe for the media world, as well as for all others. This Gatesian universe can be viewed in three dimensions; connectivity, content, and speed. A Gatesian Universe is a fully connected, open, unlimited bandwidth, FTTU, and full content universe. It is not what we now have in the Internet, it is what we could have if we enable two things; bandwidth of an open form in a FTTU network to the end user AND access to the backbone in a peer relationship not in the current transit relationships.[12]

[12] See McGarty, Internet Peering and Transit, 2001. In this paper we develop the constructs of peering and its possibilities.
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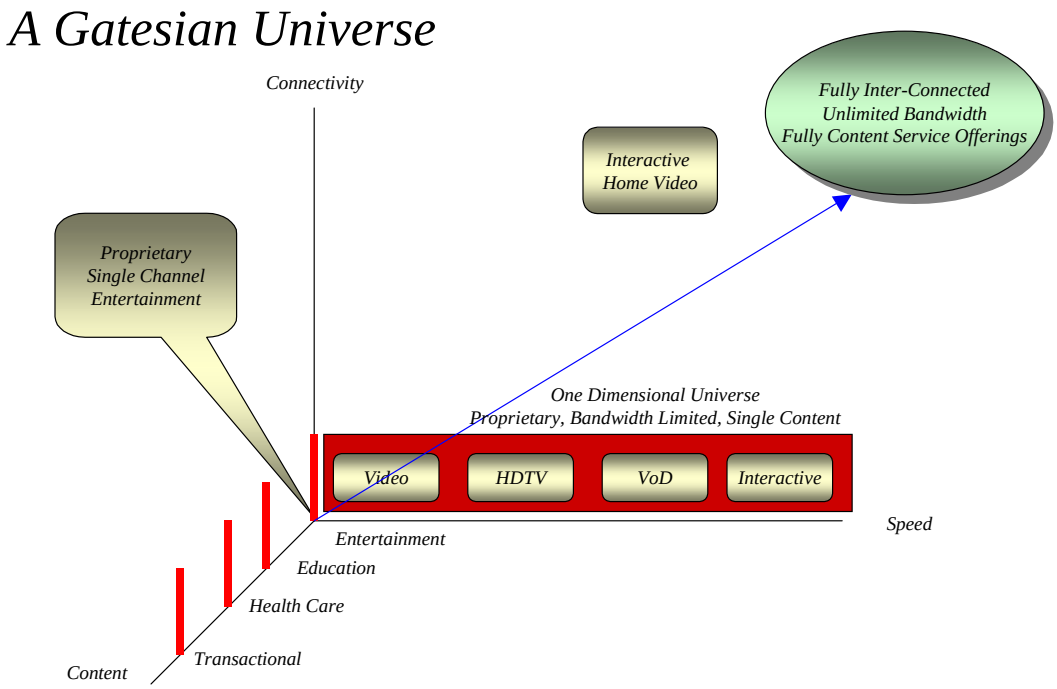
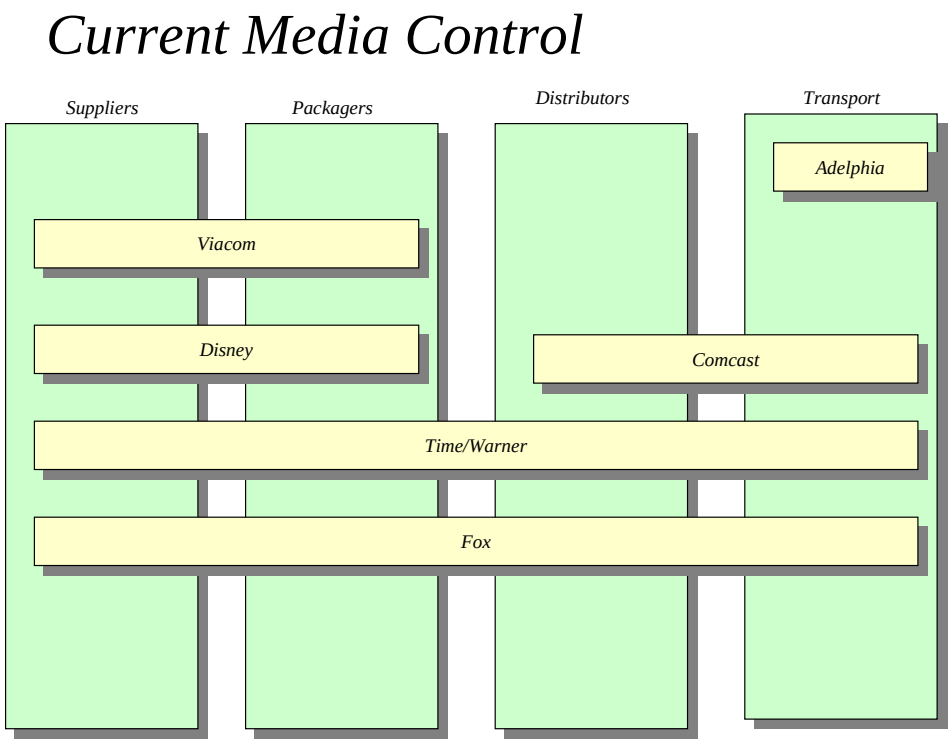


5.3 Current Media Markets

The current media control is focused at vertical integration. Such entities as Time Warner and Fox have content but they also want to control distribution, via cable or satellite respectively. Why buy one or the other, content. The recent entry of Voom is another example of content and channel combined. The following chart depicts some of the current industry players. Clearly Comcast wants Disney for that reason.

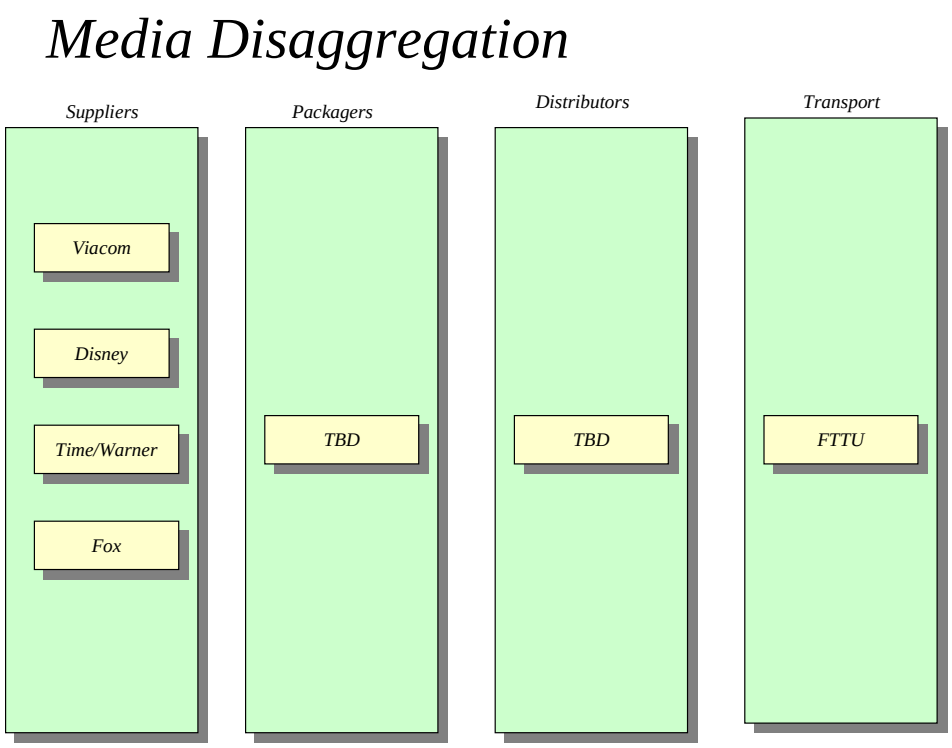
However, the owners of content all too frequently will sell to whatever channel is the best in generating revenue. In Time Warner there is no love lost between cable and the studios. The studios are the owners of content and if it is broadcast, satellite, DVD, VCR, or even Internet distribution, if it is large and lucrative enough they will go for it. What does this mean if there is a destabilizing technology which redefines the channels? As CATV was a threat to the over the air entities, and VCR was to CATV, and DVD to VCR, then what is the risk to the content players from broadband. We believe that it is significant. Broadband is a sea state change in distribution. It allows for promotion and persuasion, it allows for co branding, it allows for instant gratification, and further it allows for overall improved targeting and assessment of the product to the market. It establishes a one to one relationship between the content owner and the buyer.

This change in relationship, this change in cost to entry, since now anyone may become a video purveyor, allows for a disruption of the market.



5.4 Media Disaggregation

The following figure depicts what this disruption may appear like. Clearly content is still dominant. However, as stated content is now creatable and marketable at a lower cost of entry. The most recent example is the Gibson file The Passion which had to create a buzz to be marketed since it had received so much negative press from the incumbents. Once it found a distribution channel it was se loose. What would happen if one used the Internet for the creation of the buzz and then used the Internet to show the film on a pay per view basis over a broadband network. Then Gibson would not have to try the channels and use the negative publicity in a positive fashion. Of course it was the negative publicity which created interest as well.



6. COMPETITIVE AND DESTABLIZING TECHNOLOGIES

Having described a world of changing distribution channels and changing relationships in the sales of goods and services, we now ask the question as what technologies will impact this world and what technologies will further drive this world to a reality technologies are currently being developed and some are yet to be developed. This section provides an overview of these efforts.

6.1 Electronics: The Home Server

The home server is the next step in providing IP interconnectivity. It is more than just a local LAN server capability. It is the control element for a “personal” and “personalizable” network. It has the ability to provide the user with ubiquitous access and interconnectivity. It is a multimedia informational and transaction platform on a personal basis.

6.2 Software: Personal Agents

Personal agents can now be truly developed and deployed in a fully distributed fashion. The ability to have a fully “follow me” type of agent who can know where you are and discreetly communicate just with you to meet your needs is readily at hand. These agents are capable of not only entertaining and informing, but are transaction capable as well as handling such needs as you medical and health needs. Integrating the broadband fabric with wireless adjuncts will be a critical part of this development.

6.3 Multimedia Communications:

This area of multimedia communications is generally the least understood and most discussed area in both computers and communications. The challenge of multimedia communications is to create what we have

called "displaced conversationality". This means the provision of all sensory inputs and outputs to any human user at any time and place required for the transmission of information in order to transact a series of events, leading ultimately to an agreed consensus amongst the parties involved in the transaction. Simply put, it means the I can talk in simple terms with anybody else, using whatever displays, video, data, voice or other annotations I desire, either simultaneously of at a delayed period of time. This will place significant new demands on the Internet. It begs the question of whether the Internet must now consider raising the level of protocols it supports above just TCP into what we have called the session control protocol suite, SCP. Does Internet evolve into a SCP/TCP/IP network?

6.4 Access Expansion:

Access implies any and all physical communications means that a user may have to access the Internet, either through the Campus system, the Regional or even the Backbone. Today, we view the access to be achieved via a telephone line or possibly a LAN. In this paper we extend the access in two dimensions; CATV and wireless. CATV access means limited broadband access even with the systems in place today. This means 500 Kbps to 2 Mbps access in limited areas of coverage and this, combined with the advances in multimedia communications complement one another. The second access innovation is wireless access. Specifically the new and innovative access schemes at 1.8 to 2.0 GHz. This access scheme will enable the extensive Host Migration to PDAs, Personal Digital Assistants and the migration of network identity from host to person, and the demands put upon the network to "Find Me!". The cost of access in this new and competitive environment will be of primary importance. We have seen the cost of IEC access decrease by more that 50% since divestiture.

6.5 Host Migration:

Historically, an Internet user was identified with a Host. The user had access via the host and the user was merely an extension of this host. This made sense when the user requires access to the host for the host shared resources. With the power, increased capabilities and ubiquity of personal computers, migration of identity from the host to the user is more likely. The development of PDAs or Personal Digital Assistants, which are now user "resident" hosts, rather than host "resident" users, are a driven technological change which will cause significant architectural change in the Internet. The user can now be in possession of the Host and the host can be connected to the Internet in a wireless fashion, thus the need for "Find Me!" functions in the Internet fabric.

6.6 IP Appliances

Appliances using IP are starting to be deployed. For example, GE is making refrigerators and other of its appliance with IP chips so that they can be remotely diagnosed and repaired. In the long run, one may envision a house, office, or any location, fully wired and interconnected.

The more real time appliances are IP video and telephony. IP video had tremendous capabilities to provide video on demand, high resolution video, editable video. It will enable any video producer to present their product to an unfetter world. It means that the independent video producer can be all digital; recording, editing, and dissemination. This dramatically reduces costs. It allows for low cost editing stations, using PC type devises, and this allows for low cost storage and dissemination.

The development of newer IP devices, those between video/telephony and the GE refrigerator/washer/dryer will make for dramatic increases in the demand for IP access. This demand will allow for expansion of the marketing and distribution capabilities. IT will allow for promotion and persuasion to be totally as effective as one going thru a bazaar in Istanbul. It can target consumers, and target their needs in a timely fashion.

7. CONCLUSIONS

The impact of FTTU we believe will be significant. It will create a new electronic marketing and distribution channel. The technology is disruptive for several reasons:

1. It empowers alternative media content providers by have access which they did not have previously and by having a cost of entry which is dramatically lower than before.

2. It creates demand for appliances which is a pull through demand process from the consumer and requires openness, minimalism, and localism.

3. It allows for disaggregation of the market process by allowing new entrants and by permitting other entrants to obtain needed services from disaggregated providers. Thus the barriers to entry are dramatically reduced. There is no competitive advantage to “monopolistic” controls since the distribution channel is open.

8. REFERENCES

TBD