Telecom Value Chain Dynamics and Carriers' Strategies in Converged Networks

by

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ABSTRACT

This thesis predicts the dynamics of value chains in the telecommunication industry and proposes telecommunication carriers' strategies in future converged networks. It predicts that large carriers will vertically integrate chains for the supply and management of network services. This will dis-integrate network service providers into back-end network providers and front-end service providers, pushing niche network service providers to outsource network operations from large carriers. Building on these forecasts, the thesis proposes the following strategies: First, carriers should do business as both front-end service providers and back-end network providers. Second, as a front-end service provider's strategy, carriers should reinforce their base of loyal customers by providing tailored supply and management services like "Dell Premier". Third, as a back-end network provider's strategy, carriers should create the value of a back-end network like "VISA", by providing services for the interoperation between front-end service providers. Fourth, carriers should also build complementary assets, such as "design-for-manegability" know-how/patents and the position to aggregate contents/applications/ASPs, taking advantage of their operation volume in back-end network services.

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Table of Contents

1. Introduction

Telecommunication carriers are still relying heavily on the revenues from traditional telephone calls. However, there is no doubt that telephony calls will sooner or later migrate to IP-based converged networks. Hence, telecommunication carriers must re-build their business models and strategies for future services on converged networks. This thesis aims to propose how carriers should build their business models and competitive advantages in future converged networks.

Re-defining business models involves one major difficulty; telecommunication carriers have traditionally built their competence on technical expertise for product innovation[1] and tried to increase their profits by developing new products (network services) with innovative technologies. However, carriers cannot readily apply this strategy to IP network services, because network equipment vendors have much stronger R&D forces than carriers and thus own technical leadership in advancing products. One reason for this is that the network service market has already been fragmented by regions and customer tastes, while the equipment market is getting consolidated by a few global players. As the result, it has become difficult for carriers to differentiate their products through technical innovation. Therefore, carrier must build new competence other than product innovation.

However, being the inventor of telephone, telecommunication carriers still have a "manufacturer's mental model" (or "inventor's mental model"), focusing too much on product innovation. Ironically, while telecommunication "service" companies are mired in a manufacturer's mental model, computer "manufacturers" have shifted their business to services. For example, it is often heard today that "IBM means service". This shift in business models has inspired me to analyze the value chain dynamics in the computer manufacturing industry and the strategies taken by computer manufacturers. (Since computer manufacturing is too broad a scope, I analyze the "PC hardware" industry.) This analysis should provide many insightful clues to carriers' future strategies, because the computer manufacturing industry and the telecommunication service industry share several similarities. Some of them are as follows:

1. Both of the two industries grew with dominant system developers, i.e. AT&T for telecommunication service and IBM for computer manufacturing.
2. AT&T and IBM are the two companies that used to own the largest corporate R&D centers in the world. This suggests that their competence were originally based on the technical expertise for innovation.
3. The two industries are still rapidly advancing technologies, but both AT&T and IBM are no longer leaders in technological innovation. Instead, a few component vendors, such as Cisco or Nortel in telecommunication and Intel in PC hardware, have taken over the leaderships.
4. Both network service providers and PC hardware vendors have proliferated.

As shown in Figure 1-1, this thesis is organized as follows. In chapter 2, I describe the trends of the telecommunication industry. In chapter 3, I present frameworks to analyze IT value chains. In chapter 4, I analyze the value chain dynamics of the PC hardware industry and the strategies taken by PC vendors. The analysis in chapter 4 serves as a fruit fly study, presenting several patterns of value chain dynamics in high-tech industries. Following chapter 4, chapters 5 and 6 analyze the current status of the telecom value chains and predict their future dynamics. Chapter 5 analyzes value chain dynamics for IP network service, and chapter 6 analyzes dynamics for E-Business. Chapter 7 builds strategic proposal on the analyses in chapters 5 and 6. In chapter 7, I first find competitive business models in the PC hardware industry that matches future telecom value chains. Then, I apply these business models to telecommunication services and create strategies for telecommunication carriers. The strategies present how telecommunication carriers build sustainable competitive advantages in future converged networks.

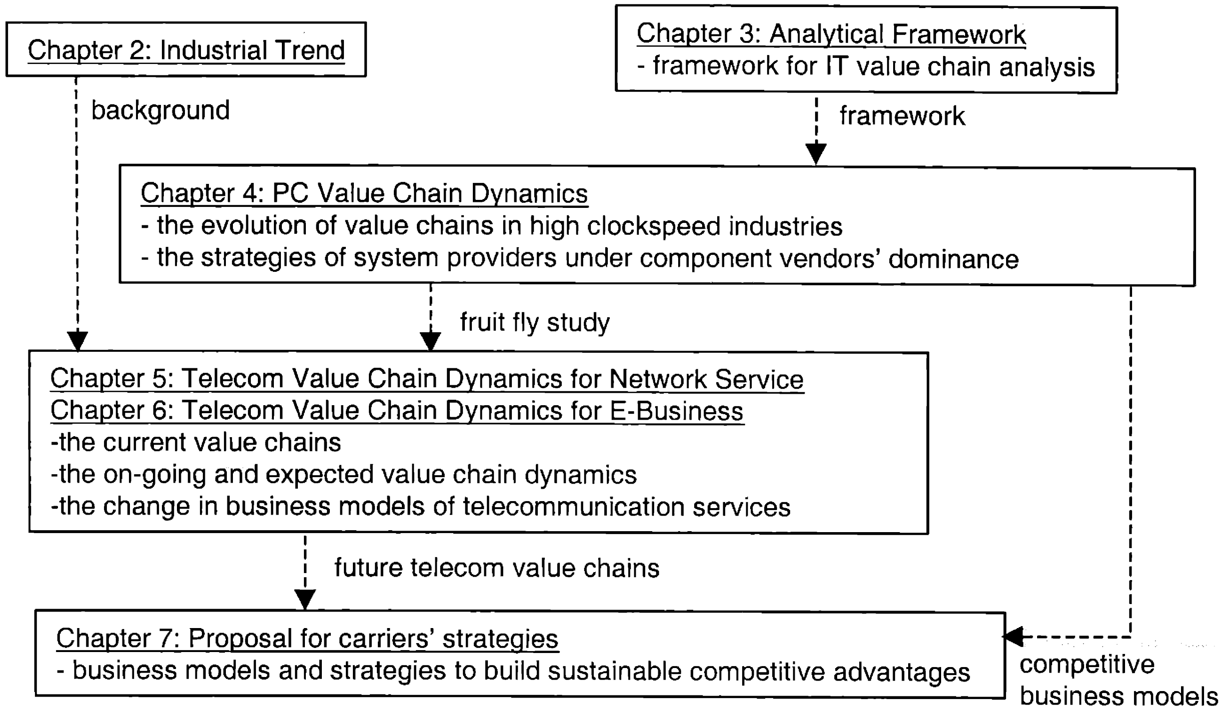


Figure 1-1 Structure of this thesis

2. Trends in the Telecommunication Industry

2.1. Technological Trends

2.1.1. Rapid Innovation of High-speed Access Technology

Driven by the evolution of the Internet, the industry has been rapidly inventing many technologies for high-speed access lines. Examples of these technologies include Always-On ISDN, xDSL, cable modem, FTTH (fiber-to-the-home), FWA (fixed wireless access). In future, 3G wireless (next generation mobile network) will also be an option. It is important to note that this high-speed innovation has increased the investment risk for network service providers.

Table 2-1 shows the number of high-speed data access lines. Here, "high-speed" is defined as over 200 kbps in at least one direction. High-speed data access lines have more than doubled. In particular, ADSL lines have increased five folds in one year. Among several access line types, coaxial cables are used most and account for 50.3% of the total lines. As can be seen in table 2, ADSL and cable modem are the key technologies for high-speed access lines. Driven by these technologies, the subscribers of high-speed access lines have been doubling every year.

Table 2-1 Subscribers of high-speed data [2]

	Dec. 1999	June 2000	Dec. 2000	CAGR
ADSL	369,792	951,583	1,977,377	+435%
Other wireline	609,909	764,099	1,063,563	+74.4%
Coaxial Cable	1,414,183	2,284,491	3,576,378	+153%
Fiber	312,204	307,151	376,506	+20.6%
Satellite & Fixed wireless	50,404	65,615	112,405	+123%
Total lines	2,756,492	4,372,939	7,106,229	+158%

2.1.2. Death of Distance

Network capacity (bandwidth) has been continuously increasing thanks to technical innovation. In particular, the trend for more bandwidth is much faster in core networks than in access networks. Wavelength division multiplex (WDM) technology has been doubling the transmission speed of an optical fiber every year. Table 2-2 shows the fiber capacity projected by Coffman [3]

Table 2-2 Fiber capacity realized by WDM [3]

Year	1996	1997	2000	2001	2002
Capacity	20Gb/s	40Gb/s	200Gb/s	800Gb/s	1.6 Tb/s

The increase of fiber capacity by WDM changes the cost balance between access networks and long-distance networks, because a significant portion of network cost is the construction and maintenance of physical fibers or cables. In an article titled "the death of distance" in Economist[4] in 1995, it was stated that local distribution accounts for 80% of network costs. This trend will cause the following changes in the future.

<u>Changes in Physical Network Topology</u>

As the increase of fiber capacity diminishes the economic benefit of bandwidth reduction, "mesh" networks that minimize bandwidth will no longer be optimum. In order to reduce the space and human cost, telecom carriers will reduce the number of exchange points. Hence, telecom networks will be gradually reorganized into a star-and-hub architecture with exchange points only in a few world major cities. However, the exchange points will not converge to a single point, because such a network will not be able to meet the delay requirement for conversational applications. (There is no technology that accelerates the speed of light.) Generally, 400 msec is the maximum tolerance on end-to-end delay for conversational applications. Assuming 200 msec delay for encoding, buffering, and decoding, 200 msec is the maximum tolerance on the network delay. This means the total fiber length should be no longer than 40,000 km (200,000 km* x 2/3 x 0.2). One central exchange point per continent or country may be the optimum topology for future networks.

*Light travels at 200,000 (not 300,000) km/sec in an optical fiber.

Changes in Logical Network Topology

Traditionally, telephone networks are structured according to the geographical hierarchy. This is seen in the structure of telephone number. On the other hand, IP defines a "logical subnet" for each organization (university, enterprise, public office, or ISP) and tranfer packets along this logical hierarchy.

As the network cost becomes less sensitive to distance, organizations expand their logical subnets geographically. This will dramatically change the logical topology of overall networks. In particular, it changes the role of "public" networks. In traditional telephone networks, most calls from one location to another transit public exchange points. However, in future networks, calls (including non-voice communication sessions) within an organization will no longer transit public exchange points. This indicates that carriers should give up the traditional revenue model based on per-call charges.

Changes in Business Models

The death of bandwidth has created a paradigm shift in carriers' business. In traditional carriers' business, revenues come primarily from per-call telephone charges and data networking business. Data networking business sells point-to-point "**private**" lines at prices differentiated by bandwidth and distance. The connotation of "private" used to be that bandwidth is reserved for the connection. However, reserving bandwidth for a point-to-point connection will no longer make sense, when the transit networks are with affluent bandwidth. Hence, the connotation of "private" is changing from bandwidth to other factors such as security and addressing. In addition, as reserving bandwidth between two points becomes less important, products to be sold are changing **from "lines" to "networks"**[5] . This has led to the emergence of a new service "VPN=Virtual Private Network".

2.1.3. IP-VPN

IP VPN replaces the layer 2 leased lines of enterprise networks with network service providers' IP networks. This architectural improvement brings customers two benefits. One is that it reduces the leased line subscription cost. The other is that it reduces the management task of customers. IP-VPN uses IP routers with VPN capabilities, which include the routing by private IP addresses and the encryption of packet data. As shown in Figure 2-1, there are two types of VPNs, core-based and CPE-based [5] .

In core-based VPN, the NSP's IP network transfers customers' packets, recognizing customers' private IP addresses. Core-based VPN is intended to serve traditional enterprise networking customers. Unlike the Internet, which provides "best-effort" network quality, the NSP's VPN networks, which I call "business class IP networks", typically provide stable quality under SLA (service level agreement). This assures that the replacement of leased lines, which are connections with reserved bandwidth, with IP networks does not degrade enterprise IP networks.

By contrast, CPE-based VPN is intended to provide private communication capability for Internet access users. In CPE-based VPN, the NSP's IP network is the Internet, and customers' VPN routers encrypt customers' private-IP packets, encapsulate them into public-IP packets, and send them to the Internet.

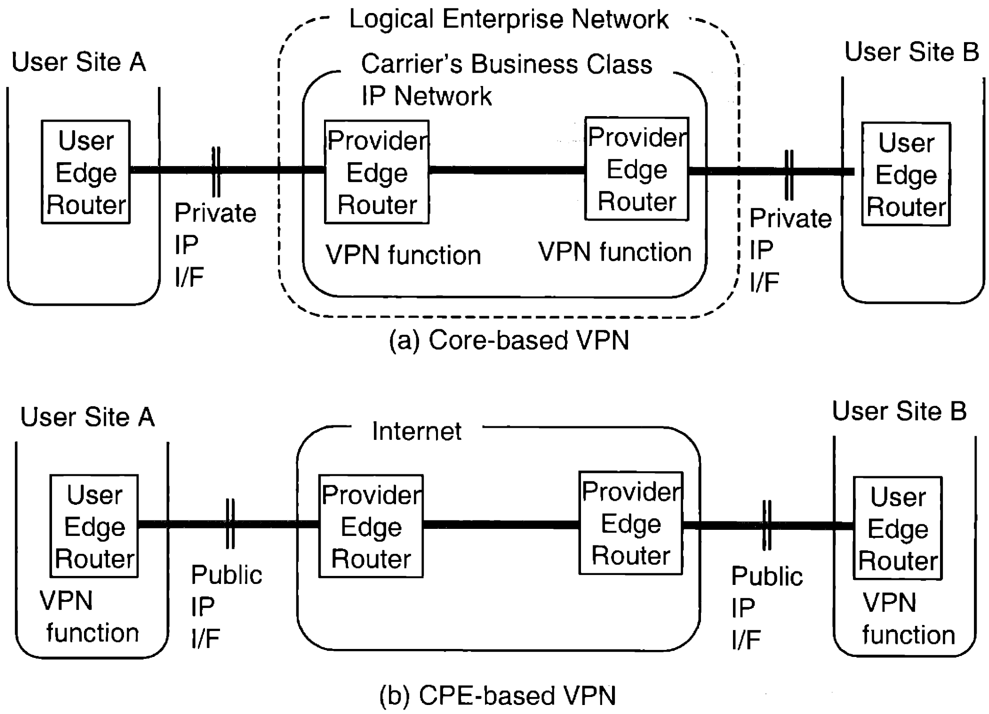


Figure 2-1 Core-based VPN and CPE-based VPN

2.1.4. VoIP and Network-level Convergence

The industry has invented voice over IP (VoIP) technology, which transfers voice signal over IP networks. This invention is expected to initiate the convergence of voice (telephony) and data. I classify this convergence into two types, network-level convergence and application-level convergence. Network-level convergence means replacing traditional telephone networks with IP networks while retaining the traditional usage of telephone. Application-level convergence means creating a telephone-integrated Web application that controls telephone connections as part of its program. In this subsection, I describe network-level convergence[7] .

Jupiter predicts the VoIP traffic for the U.S. consumer long distance market as shown in Table 2-3 [8] . Although the VoIP traffic accounts for only 2% of the total traffic, it is increasing by +43% annually.

Table 2-3 the VoIP traffic in the U.S. consumer long-distance market [8]

	2000	2001	2002	CAGR
VoIP share of total U.S telephone minutes %	1.40	2.04	2.88	+43.3%
VoIP total revenue $million	484.5	783.2	1,279.1	+62.5%

Type of VoIP Adoptions: by enterprises and by SOHO/residential users

There are two types of VoIP adoption, as shown in Figure 2-2. One is adoption by large enterprises and medium-sized businesses. The other is adoption by SOHO and residential users. For both adoption scenarios, the main diffusion driver is cost saving from traditional telephones.

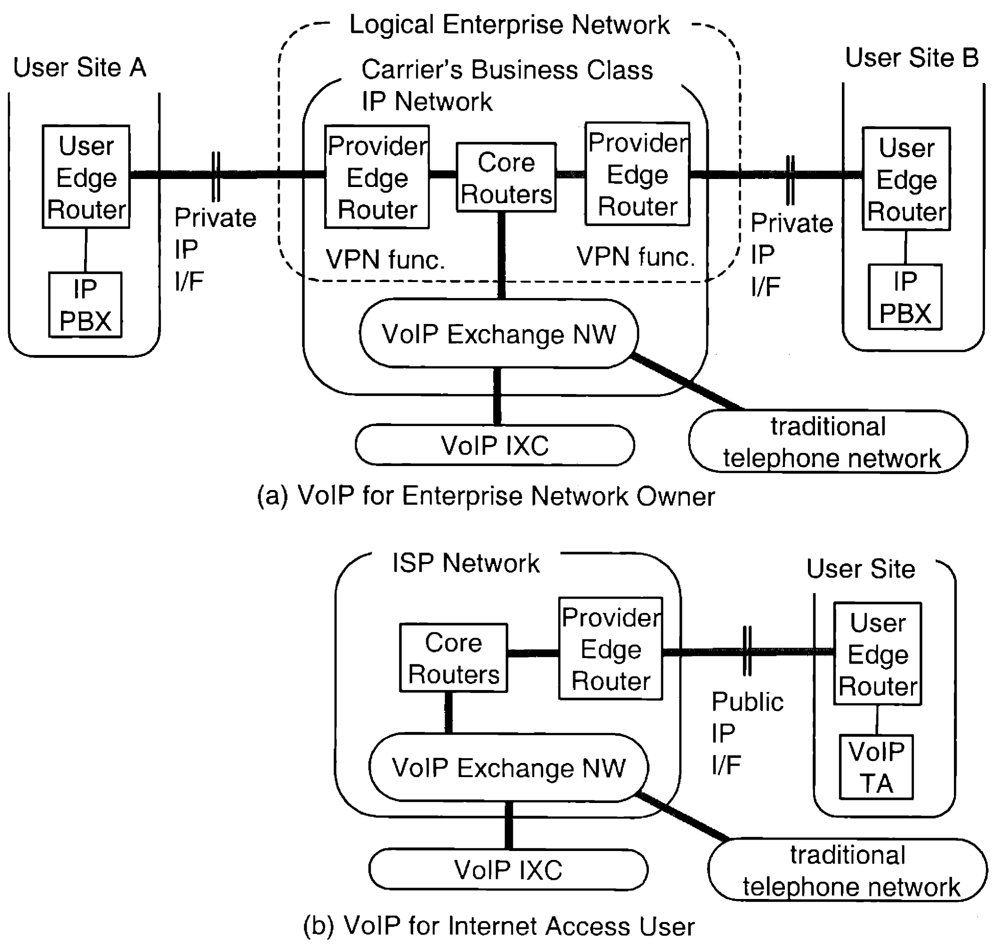


Figure 2-2 VoIP Service Scenarios

Enterprise Adoption

Enterprises are increasingly adopting VoIP for intra-company calls. Companies can reduce long-distance charges for intra-company calls by integrating voice, data, and fax into IP enterprise networks. Gartner reported in [9] that businesses can realize savings of 50+% with toll bypass. However, when calls terminate on another carrier's VoIP network, the cost saving is only 20 to 25%. Nortel claims that it shipped IP-PBX products that amount to 86,000 VoIP lines in the second quarter of 2001, and its market share is 34% [10] With a rough estimation from this, we can guess that about half million lines are being converted to VoIP annually. (86,000/0.25/0.34=1,011,764. I assume that only 50% of the lines are actually utilized.)

In this scenario, enterprises build private telephony networks by installing IP-based PBXs (IP-PBXs) in their offices and connecting them with their enterprise IP networks. For implementations on VPN-based enterprise networks, VPN providers are also providing VoIP exchange services, which enable enterprise customers to call outside of their organizations[11] . For example, AT&T is providing VoIP services, which enable its VPN customers to place calls to more than 40 countries [12] [13] .

SOHO/Residential Users Adoption

The ongoing growth of high-speed Internet users is expected to accelerate VoIP adoption by residential and SOHO users. In this adoption scenario, VoIP services are provided as options on top of Internet access services. In Japan, NTT-ME launched IP phone services for the subscribers of their Internet services in December 2001, and Yahoo-BB announced it would launch a similar service in the spring of 2002[14] . Many service providers are expected to follow. Telecom Services Association, an industrial consortium of non-facility-based telecommunication service providers in Japan, has established "VoIP promotion consultation committee" in April, 2001. Its members have more than doubled from 52 organizations to 106 organizations by January, 2002[14] .

When a VoIP call is placed between two companies residing in different VoIP exchange networks, it will be routed via VoIP IXC (inter-exchange carriers) or through a "peering" connection between the VoIP exchange networks. A few VoIP IXCs have already emerged. An example is arbinet thexchange [15] , which operates exchange points in New York and London, connecting 135 member carriers including the world's 10 largest telecom carriers. The arbinet's exchange points also provide the interconnection with circuit-switched telephone networks.

2.1.5. VoIP with Application-level Convergence

The application-level convergence of voice and data is expected to create many applications such as UnifiedMessaging and voice portal. Considered to be the most promising is a call center integrated with a CRM (customer relationship management) system. Gartner stated in [16] that "Call center is becoming the "heart" of modern business". It also stated that "By 2002, 75% of world-class contact centers will have implemented ATM-enabled voice switches, CTI middleware, workflow, thin clients, electronic access, T.120 and H.323 support, network routing and queuing". This trend led Nortel to acquire Clarify, one of the world's major CRM software providers, in 1999[17] . Cisco also offers its own CRM products.

VoIP also has a potential capability of realizing phone applications integrated with Web. Jupiter states in [18] that fighting long-distance for traditional telephony market is a loser's battle and VoIP providers should provide value-added products such as banner ad-supported phone calls. The report also discusses the possibility of free VoIP services on portals such as Yahoo. There is evidence that a sufficient number of consumers will jump on such service. Excite claimed that it observed 400,000 downloads in one month for the software required for its voice portal [8] .

Figure 2-3 and Figure 2-4 show the implementation of VoIP systems with application-level convergence. First, IP-PBX is functionally factorized into three separate components as shown in Figure 2-3. This separation enables call control applications and related database to be centralized in a data center, and only minimum memory-less call control devices to be installed in local offices.

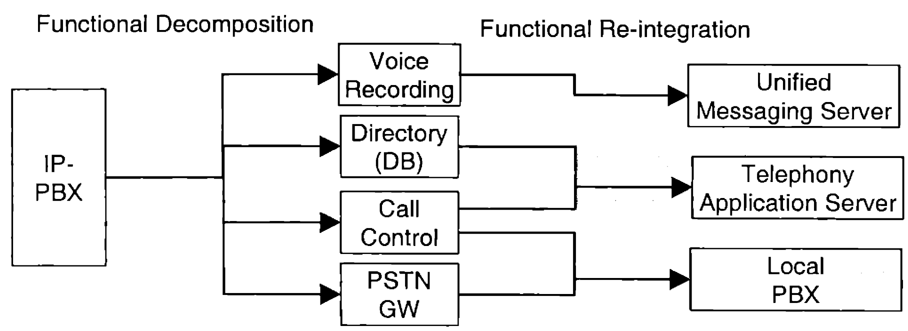


Figure 2-3 Functional decomposition and re-integration of IP-PBX

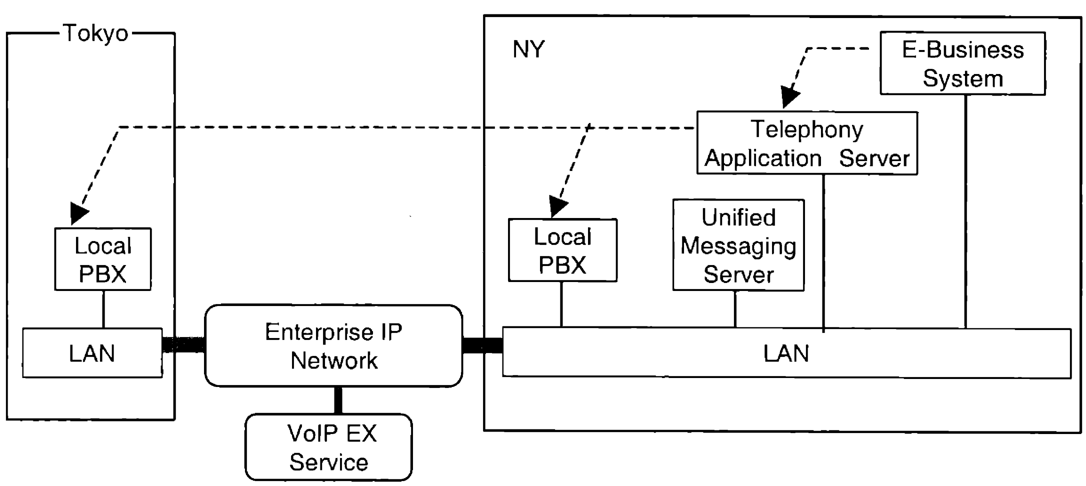


Figure 2-4 Centralization of Telephone Control Systems

2.1.6. Impact of VPN and VoIP on Carriers' Business Models

The current enterprise networking business by telecommunication carriers primarily consists of leased line sales. However, as I mentioned before, the death of distance will shift carriers' business from selling lines to selling networks. The advent of VPN and VoIP will lead carriers to sell private networks (IP-VPN), which are of reliable quality and are bundled with a set of applications such as VoIP and Internet access. I refer to this business model as "**business class IP suite**".

Similarly, ISPs will provide "**Internet access plus**" services, which include Internet access, VoIP exchange, and necessary services for CPE-based VPNs.

What differentiates business class IP suite from Internet Access "Plus" is currently quality of service, primarily bandwidth. However, since the bandwidth per cost has been increasing at a phenomenal rate, the two business models may converge, unless business class IP suite finds another dimension for differentiation. In other words, Internet access plus might become a disruptive technology to take over the main stream segment of enterprise networking [19] .

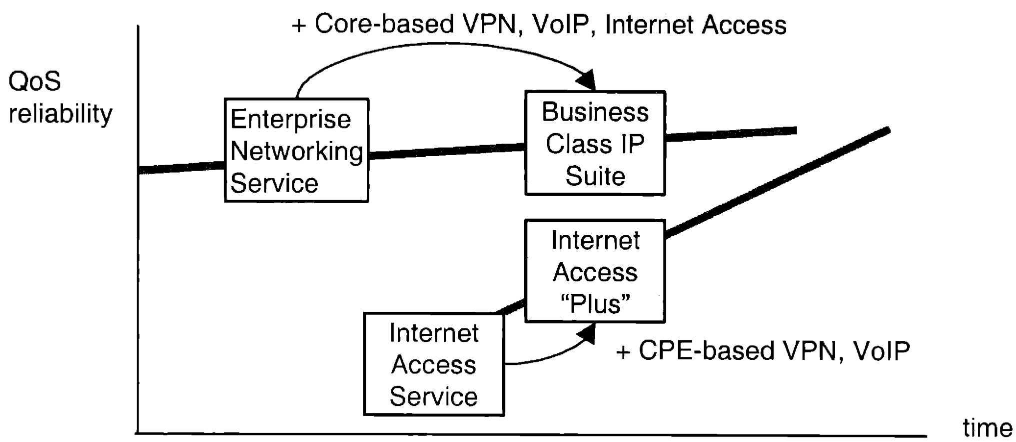


Figure 2-5 Future business model convergence in IP service

2.2. Business Trends

2.2.1. Customer Demographics

As shown in Table 2-4, the ratio of business subscriber lines to residential lines is about 34% to 66%. In terms of revenue, the business to residential ratio is 56% to 44%, as shown in Table 2-5 .

Table 2-4 Number of subscribers (from Table 4.10 in [20])

	1996	1998	20000	CAGR
Switched Lines, Business	49,247,530	56,900,690	57,807,641	+4.1%
Switched Lines, Residential	104,314,789	110,447,132	114,637,547	+2.4%
Mobile Phone Subscribers	61,438	142,386		+52%
Special Access Lines	22,719,925	35,943,026	70,604,556	+33%

Table 2-5 Toll Revenues (Million $) classified by users [1]

	1996	1998	1999	CAGR
Residential	40,461	44,543	45,896	4.24%
Nonresidential	52,900	60,512	62,350	5.57%
Total	93,361	105,055	108,246	5.00%

Table 2-6 and Table 2-7 show the distribution of businesses by the number of employees. As is often the case with other industries, few large enterprises account for a large fraction of the carriers' revenues. Jupiter Communications reported in 1998[8] that approximately 5% of teleco's customer base makes a significant number of international calls and these customers account for 65% of the teleco's profits.

Table 2-6 US businesses by size (as of March12, 1999) [21]

# of employees	# of companies
1-99	4,800,582
100-499	81,347
500-999	8,235
1000-2499	4,992
2500-4999	1,706
5,000-9,999	871
10,000+	936

Table 2-7 Japanese businesses by size [22] , [23]

# of employees	# of companies	Extranet Adoption %	Intranet Adoption %	Internet Adoption %
1-99	6,150,642	No Data	No Data	No Data
100-299	43,207	7.4	55.5	86.9
300-499	5500	11.0	59.7	94.0
500-999	2771	12.2	61.2	95.9
1000+	1129	25.8	74.28	98.7

2.2.2. Profit Erosion of Traditional Telephone Services

Voice calls have been increasing, and, in particular, long-distance calls have been increasing by over 10% annually. Table 2-8 shows the number of billed minutes of telephone. Hence, local calls are not included. This traffic increase can be attributed to several reasons such as the globalization of economy or society, and the adoption of wireless phones. In addition to these factors, analysts at Jupiter Communications point out that the users' demand on long distance calls is very elastic (sensitive) against prices [8] .

Table 2-8 Number of billed minutes (in million) [24]

	1996	1998	2000	CAGR
Intrastate calls	438,772	497,139	535,011	+5.08%
Interstate calls	159,791	193,385	257,252	+12.6%
International calls	19,325	24,250	not reported	+12.0%

However, the increased competition has commoditized telephone services and reduced the profit margin. Table 2-9 shows the revenue per one-minute call for long distance carriers. The per-minute price of international calls has been decreasing by –10.4% annually. Table 2-10 shows the toll revenues classified by the haul length. The revenue from interstate calls accounts for 50.4% of the total toll revenue and has been increasing by 8.2% annually. The revenue from international calls decreased in 1999, mainly because the competition drove down the per-minute prices largely.

Table 2-9: Revenue Per Minute for long distance carriers [25]

	1996	1998	1999	CAGR
Domestics Calls	$0.12	$0.11	$0.11	-2.8%
International Calls	$0.78	$0.68	$0.56	-10.4%
Average	$0.16	$0.14	$0.14	-4.3%

Table 2-10 Toll Revenues classified by haul length (Million $) [1]

	1996	1998	1999	CAGR
Intrastate	32,023	34,699	33,600	1.6%
Interstate	42,823	48,100	54,306	8.2%
International	18,515	22,256	20,340	3.2%
Total	93,361	105,055	108,246	5.00%

VoIP adoption is expected to reduce the local exchange carriers' revenue from interconnection charges. Table 2-11 shows the revenues reported incumbent local exchange carriers (ILECs)[20] . Local Service indicates the revenue ILECs receive from end users, while Network Access Service indicates the revenue ILECs receive from long distance carriers for inter-connection services. Local Network Service and Network Access Service account for 34% and 32% of the total revenue respectively. Most important, it is obvious that Network Access Service is the major source of profit for ILECs, as interconnecting with long distance carriers costs much less than providing end users local network service.

Table 2-11 the revenues reported by incumbent local exchange carriers [20]

Item	1996	1998	2000	CAGR
Local Service / Basic	35,764	40,410	39,811	+2.7%
Local Service / Private Line	1,290	1,549	1,845	+9.4%
Local Service/Others	12,424	13,104	18,089	+9.8%
Network Access Service	30,975	33,754	36,794	+4.4%
Long Distance Network Service	10,416	8,262	6,085	-12.6%
Others (Directory, Rent, etc)	11,241	14,202	17,682	+12.0%
Total	83,889	108,315	116,920	+8.7%

2.2.3. Growth of Data Services

As for data traffic, Coffman[26] estimated the U.S. Internet backbone traffic as shown in Table

2-12. The table shows the traffic during December of that year.

Table 2-12 the U.S Internet backbone traffic [26]

	1996	1998	2000	CAGR
Traffic TB/month	1,500	5,000-8,000	20,000-35,000	+120%

In order to compare voice traffic with data, we assume that voice signal is encoded at 64kbps. Under this assumption, the U.S. domestic voice traffic shown in Table 2-8 amounts to 31,690 TB/month. Hence, the voice traffic and the data traffic were about the same amount in 2000. Considering the difference in growth, the data traffic will be much higher than the voice traffic after 2000.

On the other hand, Coffman reported in [26] that Internet revenues were still under $25 billion in the U.S. in 2000.

2.2.4. Consolidation of Network Service Providers

Internet service providers once proliferated. But, their profit margin has been eroded by service commoditization and the investment required by accelerated technology upgrades. Under these circumstances, only very few service providers will be able to make profits[27] . Hence, the network service providers are now getting consolidated.

2.3. Summary

The key points of this chapter are as follows:

1. Although voice traffic has been increasing, the revenue from tradtional telephone has been decreasing.

2. Service commoditization and the infrastructure cost raised by accelerated technology upgrades have reduced the profit margin of Internet service providers, and Internet service providers are getting consolidated..

3. The death of distance (the bandwidth abundance created by optical data transport technologies) is shifting carriers' business model from selling point-to-point connections to selling networks (N-to-N) connectivity. For large enterprises and medium-sized businesses, carriers will sell "**business class IP suite**" services, which provide reliable virtual private networks (VPNs) bundled with applications such as VoIP and Internet access. For residential and SOHO users, carrier will sell "**Internet access plus**" services, which are high-speed Internet access services bundled with applications such as VoIP and support services for CPE-based VPN.

3. Analytical Frameworks

3.1. Customer Classification

In chapter 4, I present an analysis on the relationship between technology/market lifecycle and supply chain dynamics. To discuss market lifecycle, I classify customers as shown in Figure 3-1. Technology is first invented by innovators and then adopted by early adopters. I refer to early adopters as **class E** customers. Once a product is well adopted by class E customers, the market then expands into majority adopters. I refer to these customers as **class M** customers. Class M customers correspond to early majority, late majority, and laggard as defined in [28] . I refer to the remaining customers as **class L** (Last) customers.

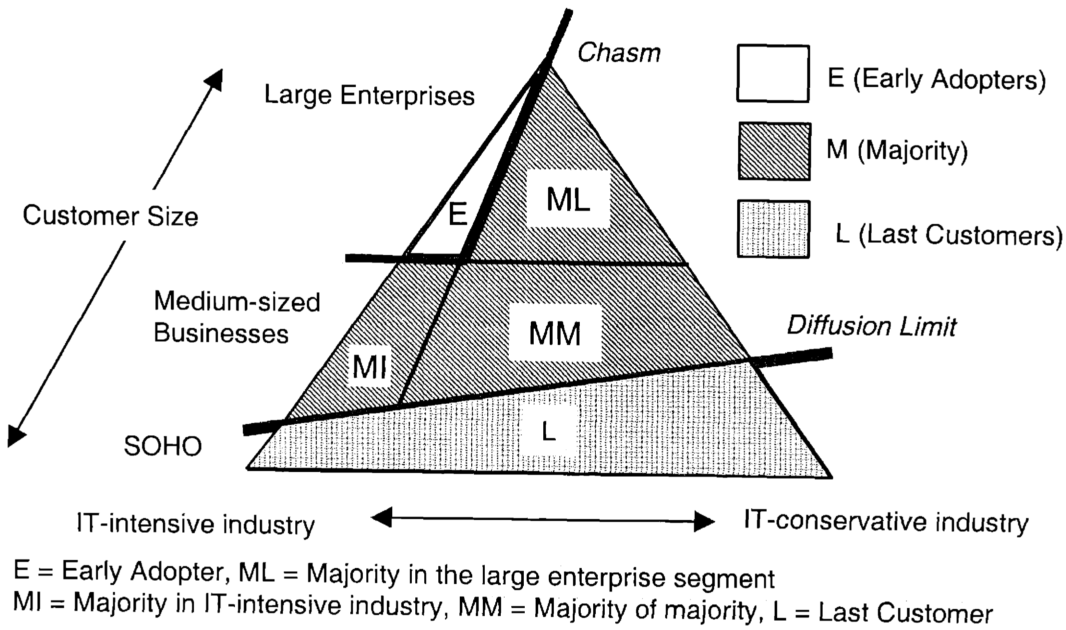


Figure 3-1 Customer Segmentation

In [28] , Moore points out the following characteristics about each class of customers.

Class E customers are visionary about technological innovation and very specific about their needs. As the result, they want products tailored to their needs. On the other hand, they are less concerned about system stability and manageability than other customers. They sometimes pick up niche products in order to satisfy their needs, instead of sacrificing their needs and choosing most-used products. They often exchange information about technology even with people outside of their industry.

On the other hand, class M customers are typically skeptical about new technology and concerned about financial return from technical investments. They are concerned about system stability and manageability. Their risk aversion leads them to choose the products that are most used in the market. Another important difference between class E and class M customers is how information flows among customers. Unlike class E customers, class M customers listen to only people inside their industry. They often take a story created by technology people as "vendors' hype".

I further classify class M customers into three subclasses, which are class ML, MI, and MM. **Class ML** (**Majority Large**) represents large enterprises of class M. Class ML customers are the most attractive for system providers, because they bring a large amount of revenue. However, they typically require customization to integrate new products with their existing infrastructure. Hence, in order to acquire ML customers, system providers need to have intimacy with customers and familiarity with customers' existing infrastructure. However, unlike class E customers, class ML customers do not require very innovative technology.

Class MI (Majority, **IT-intensive**) represents small and medium-sized businesses in the IT-intensive industries. It is often the case that a strong network effect among class MI customers in an industry accelerates product adoption in the industry. In other words, once a technology is accepted by an industry, the technology supplier can acquire new customers in the industry at a relatively low customer acquisition cost. Hence, class MI customers are also attractive for system providers. However, because of the lack of credibility, it is difficult for system providers to communicate with class MI customers in other industries.

Class MM (**Majority** of **Majority**) customers are users that are neither large enterprises nor in IT-intensive industries. Class MM covers a wide variety of users with different needs, tastes, and life-styles. There is no single company or brand that can market all of the class MM customers efficiently. Hence, system providers tend to proliferate when the market expands into class MM customers.

Class L (Last) customers are either very conservative or very small. They bring little marginal revenue, while their acquisition cost is high. Hence, it is often the case that the market cannot reach these customers. System providers also tend to neglect class L customers, focusing on class ML customers, who form the "main-stream" segment of the market. However, the system providers' little attention on class L customers sometimes creates "green-space" markets[5] for innovators to nurture disruptive technologies, as illustrated by Christensen.

3.2. Technology/Market Lifecycle

Combining the technology lifecycle as defined by Henderson[29] and Utterback[1] with the market adoption lifecycle[28] , I define a technology/market lifecycle with three phases, which are **phase F (Ferment)**, **phase E (Early Adoption)**, **phase M (Majority Adoption)**. (Note that, in general, we have to discuss technology innovation lifecycles and market adoption lifecycles separately. However, I am combining two lifecycles for typical IT products/services.) Phase F represents a period in which a dominant design for the system has not yet been established. Once a dominant design is established, the market enters phase E. In phase E, the adopters of systems are class E customers. After several dynamics described in chapter 4, the market enters phase M. In phase M, majority customers adopt systems.

3.3. Framework for Multi-dimensional Chain Analysis

3.3.1. Introduction

In [30] , Fine suggests supply chain design and analysis using three dimensions, which are technology, business capability, and organizational. In this subsection, I present a framework for multi-dimensional value chain analysis, which is based on this suggestion. The framework should provide a clear lens through which we can identify the shift of companies' competitive advantages and the power dynamics in an industry. I first briefly explain the definition of each dimension, and then explain how to analyze value chains with three dimensions.

3.3.2. Technology Chain

A technology supply chain shows what components are required and how these components should be integrated to build a system. In telecom systems, components include not only physical parts but also services. For example, a traditional enterprise intra-net does not function without a leased line service. Hence, when we view a traditional enterprise intra-net as a system, we consider a leased line service to be a part of the system.

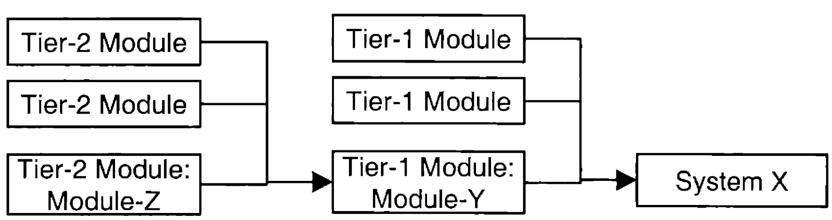


Figure 3-2 Technology Supply Chain for System X

As shown in Table 3-1, I classify technology components into several types, which are system, software, hardware, network service, and network element. Network element, hardware, and software are "elements" by definition. In other words, I do not analyze these components into further details. Systems are composite of components. A system can also include another system as its component.

Table 3-1 Technology Component Type Definitions

Type	Example
System	E-Businesss System, Enteprise Network, etc
Software	Web Server Software, CRM Software, industry-specific application, etc
Hardware	Server (computer), Storage, Router, Load Balancer, etc
Network Service	Leased line (ATM, Frame Relay, etc)
Network Element	Access Medium (Fiber, Local Loop, Air Bandwidth, etc), Access Datalink (ATM+DSL, etc), Long Distance Link (SONET, ATM)

Here, I define the representation rule of a technology supply chain. The below figure represents the technology supply chain of PC hardware as an example. Each box shows a component. A string in a box indicates the type and name of the component.

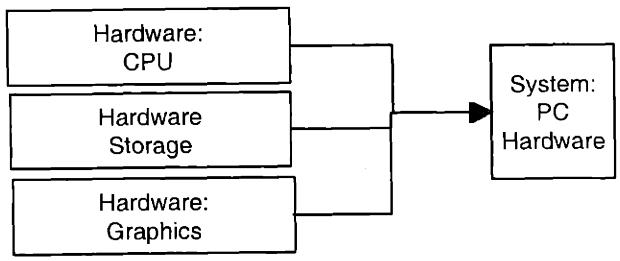


Figure 3-3 Technology Supply Chain of a PC

Although network services do not supply physical components, some elements or systems are required for the provisioning of a network service. In order to represent this dependency, I draw the required elements or systems as components of the network service. For example, Figure 3-4 shows the technology supply chain for an ATM leased line service. The "S" mark attached to a link represents the supply of a service run on the system as opposed to the supply of a physical product.

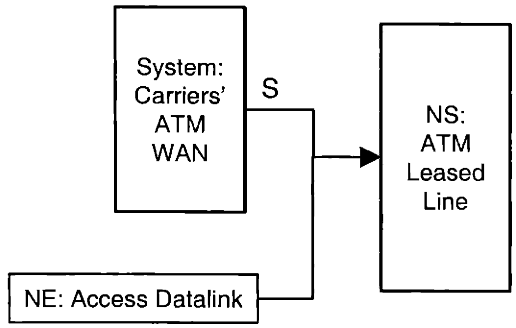


Figure 3-4 Technology Supply Chain for an ATM leased line service

3.3.3. Design / Supply / Management Chains

I analyze telecom value chains with a notion that a business or businesses should perform three business processes in order to provide a component or a system. The three business processes are namely design, supply, and management, and they are defined as follows:

Design represents the whole process of product/service development including concept design, detailed design, proto-typing, testing and debugging. The design of a system includes "system integration", which means testing the interoperability among components and securing enough system integrity.

Supply basically includes procurement, replication, and delivery. Depending on the type of a component, replication can be assembly (system), copy (software) or manufacturing (hardware). In the case of a network service, supply includes investing in an infrastructure, creating an user account, and providing an service. In order to achieve efficiency in supplying hardware components, an organization should reduce procurement delay and manage inventory with accurate demand forecast. Similarly, a network service supplier should reduce procurement delay for infrastructure updates and manage investment in infrastructure with accurate demand forecast.

Management includes installation, configuration, monitoring, and fault recovery. When we discuss the value chains of telecom systems, management is a very important business capability, because telecom systems require high availability. The management of a network service also includes logging service usage and billing.

The actual activities of these processes differ in details depending on the type of a component. Table 3-2 shows detailed activities for each component type.

Table 3-2 Detailed activities for each business capability

Element Type	Capability Details			
	Design	Supply	Management	Customer Acquisition
System	Design, Integration, Test	Procurement Assembly, Distribution	Installation, Configuration, Monitoring, Fault Recovery, Logging (NS) Billing (NS)	Branding, Pricing, Sales Customer Acquisition Customer Retention
Software	Design, Make, Test	Copy, Distribution		
Hardware	Design, Prototyping, Test	Procurement Manufacturing, Distribution		
Network Service	Design, Integration, Test	Infrastructure Investment Service activation		
Network Element	Design, Integration, Test	Construction, Service		

An important notion is that each of the three business processes should form a chain along the technology chain as shown in Figure 3-5. I refer to the chain of design processes as design chain. Similarly, I define supply chain and management chain. More importantly, these chains should be somehow integrated. Here, integration means reducing incoherence across the components in a chain. The implementation method of integration is not necessarily merging organizations. The existence of the chains and the need for their integration should be intuitively obvious. For example, a module cannot be designed without system design. In order to reduce the supply cost of a system, the system provider should integrate the supply chain. In order to operate a system at a high availability rate, the system provider should integrate the management chain.

Importantly, system providers, e.g. computer vendors, are not always the integrators of chains. For example, in today's value chains for PC hardware, Intel, a CPU vendor, is integrating the design chain. This suggests that system providers should re-build their competencies in the other chains. Like this example, we can identify the shift of competitive advantages and determine future strategies, by analyzing the structure of the three chains.

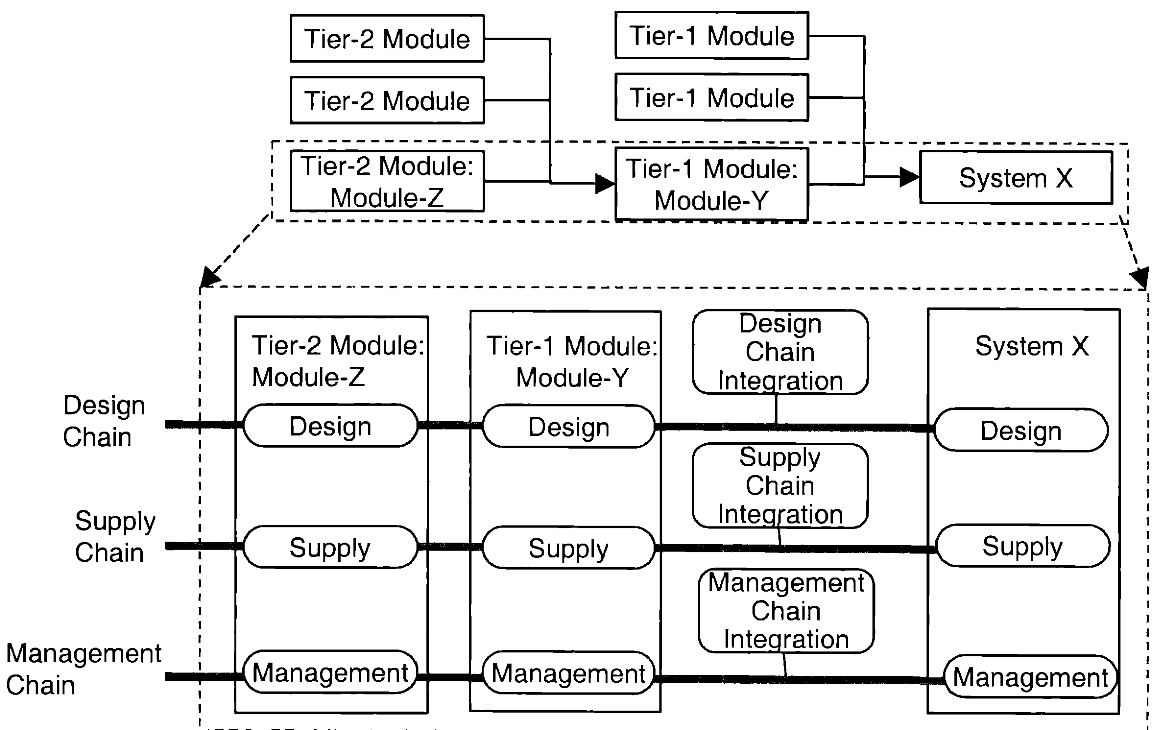


Figure 3-5 Design/Supply/Management Chains

3.3.4. Business Capability Chain

A business capability chain represents processes that are required to build and sell a system. Figure 3-6 shows a business capability chain. The definitions of some business capabilities in the figure can be found in 3.3.3. In business capability chain diagrams, DSM represents design, supply, and management capabilities. Customer acquisition is defined as follows:

Customer acquisition literally means getting new customers. However, in this thesis, I use this term to represent any activities necessary for getting and retaining customers. In addition to getting new customers, it includes identifying customer needs, pricing, branding, and customer retention.

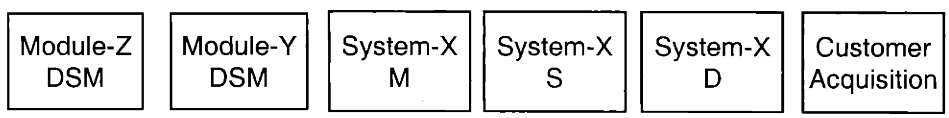


Figure 3-6 Business Capability Chain for System X

3.3.5. Organizational chain

An organizational chain is what most people referred to as "a supply chain". It represents the supplier-buyer relationships among organizations related to a product or a service. As an example, Figure 3-7 shows an organizational chain for PC hardware.

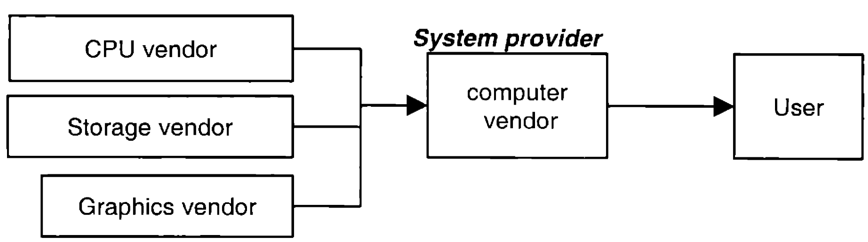


Figure 3-7 Organizational supply chain for PC hardware

3.3.6. Value chain analysis 1 – BC-Org Map -

A BC-Org map (Business Capability-Organization) map identifies business capability – organization relationships, in other words, which business capability is provided by which organization. For example, Table 3-3 shows the BC-Org map of a PC value chain.

Table 3-3 BC-Org map of a PC Value Chain

Business Capability	Organization			
	PC Vendor	CPU Vendor	Storage Vendor	Graphics Vendor
Customer Acquisition	X			
PC Hardware DSM	X			
CPU DSM		X		
Storage DSM			X	
Graphics Card DSM				X

3.3.7. Value chain analysis 2 – DSM Chain Structure –

I identify the strength of integration force and the integrator for each of the design, supply, management chains. I refer to a set of these attributes as DSM (Design, Supply, and Management) chain structure. For example, Table 3-4 shows the DSM chain structure of a PC hardware value chain.

Table 3-4 DSM chain structure of a PC hardware value chain

	Design	Supply	Management
Integration Force	Strong	Weak	Weak
Integrator	CPU vendor	System Provider	System Provider

I also sometimes present analyses using graphical representation as shown in Figure 3-3. In this diagram, each horizontal box should represent an organization. A bus represents a chain, and its thickness indicates the integration force of a chain. An oval with "I" stands for integration, and its location indicates the organization that is integrating the chain. (A rectangle with "D", "S", or "M" represents design, supply, and management process, respectively. An oval with "A" represents customer acquisition.)

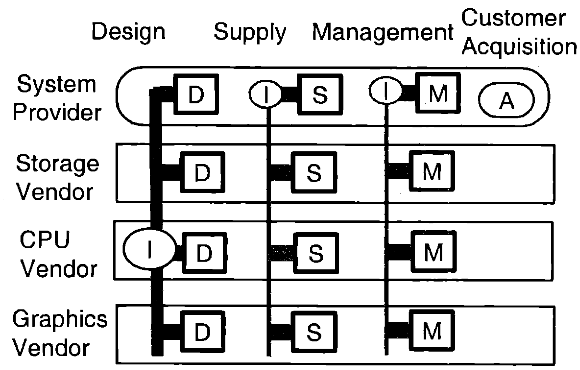


Figure 3-8 PC Hardware value chains

4. IT Value Chain Dynamics

4.1. Introduction

As Christensen[19] and Fine[30] have advanced their studies by looking at "fruit fly" industries, I start this study with analyzing the past value chain dynamics in the PC hardware industry. I do not mean to assert that anything that has happened in the computer industry will happen in other industries. However, by identifying the factors that initiated the computer value chain dynamics and examining whether these factors are also observed in our industry, we can predict the future dynamics in our industry. In fact, many of the factors that initiated the computer value chain dynamics are also observed in other industries such as telecom. I describe the value chain dynamics of the PC hardware industry, using technology/market lifecycle phase as defined in 3.2.

4.2. Phase F (Ferment Phase)

In the 1970s and the early 1980s, the PC industry was in the ferment phase. Because the cost and performance of computers were not good enough[31] for personal use, computer vendors such as IBM and DEC still had to continue architectural innovations. As is described in [30] , the system designs were based on integral architectures and the value chains were tightly integrated. The main reason for this was the need for architectural innovations as stated above. Architectural innovation means achieving effective improvements by changing the design of inter-dependent multiple components simultaneously. Hence, in this phase, a module that was designed for a system could not used for another system. As the result, the value chains were tightly (vertically) integrated, as shown in Figure 4-1 and Table 4-1.

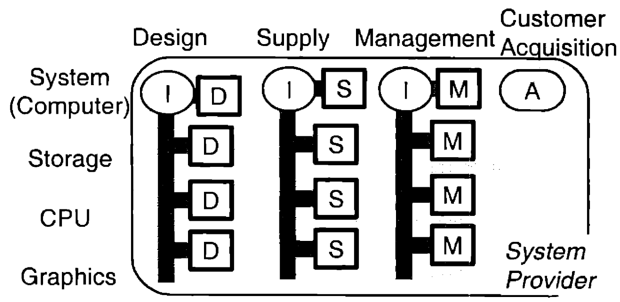


Figure 4-1 Value Chain in Phase F

Table 4-1 the DSM Chain Structure of PC hardware value chain

	Design	Supply	Management
Integration Force	Computer Vendor	Strong	Strong
Integrator	Computer Vendor (System Provider)	Computer Vendor (System Provider)	Computer Vendor (System Provider)

4.3. Disintegration of Value Chain(Emergence of Type E Chains)

Phase F terminates when the industry has achieved architectural innovations that realize "good enough" [31] systems and the system architectures have converged to a dominant design. During the transition from phase F to phase E, the industry disintegrates tightly integrated value chains. Disintegrating value chains means disclosing system specifications such as module interfaces and providing any supplier an opportunity to develop and supply a module. In the late 1970s, IBM developed a PC with modular system architecture and disintegrated its value chain[30] . There are several "forces" that lead system providers to disintegrate their value chains in this phase.

One force is the need of flexibility. Typical IT products, such as computers and networks, are designed to be application-independent and to cover a wide variety of applications. As the result, it is often the case that systems with the standard (or default) components cannot perfectly meet the requirements of a specific application. On the other hand, as described in 3.1, class E customers, who are potential customers in phase E, tend to desire products that perfectly meet their requirements. Hence, customization flexibility, such as the freedom to select a module among multiple choices, is necessary for market adoption. Disintegrated value chains with modular system architecture are favorable in achieving high flexibility for customization.

Another force is competition for standards. In this transition phase, different system designs by different system providers exist and they fiercely compete with each other to make their own systems survive as the standard. A system provider often tries to get "buy-in" from other companies, by disclosing its module interfaces and providing other companies business opportunities. This is typical phenomena in most of the IT products. As evidence, many new software products emphasize the availability of "API" (application programmers' interface).

It is noteworthy that, if the value of a system is reinforced by network effect, the system providers' top priority will be to build a large customer base faster than any other competitors. In this case, the competition for standards becomes strong. This is often the case with IT products.

Some may argue that the disintegration of value chains does not always happen. For example, in the consumer electronics (CE) industry, even when a product has achieved a "good enough" performance through architectural innovations, the value chain for the product does not get disintegrated. In these industries, there are at least three factors that counteract the disintegration forces.

The most important factor is the users' requirement on system integrity, in other words, the users' tolerance on faults. There is significant difference in users' tolerance on faults between CE and IT products. It is very hard to figure out why, but users accept (*or are forced to accept*) IT products as long as they do not contain fatal bugs. For example, people are using PC software products that sometimes crash with unexpected errors. Most people would not call software vendors and demand product recall even if they found bugs. On the other hand, in the CE industry, people would demand product recall. Disintegrating a value chain lowers system integrity and raises the possibility of system faults. Hence, when the users' tolerance on system faults is strict, it keeps system providers from disintegrating value chains.

Second factor is the scope of products. The scope of products means intended applications and customer segments. There is also significant difference in this respect between the CE and IT industries. CE products are designed for specific applications and customer segments. When the scope of a product is clear and narrowly defined, a system with standard (or default) modules can perfectly serve intended applications and customer segments. In this case, the need of customization flexibility is low, and hence the disintegration force is not strong.

Third factor is the network effect generated by products. One demerit of disintegrating a value chain is that system providers have to disclose technical know-how more or less. On the other hand, one of its merits is that system providers can widen the variety of users with increased flexibility. The value of the merit relative to the demerit is determined by the strength of the network effects of products. When the network effects are weak, the demerit overwhelms the merit and system providers have little incentives to disintegrate value chains, and vice versa. We can find several evidences in the CE industry; For products with strong network effects, such as VCR and digital camera, the industry often disintegrates value chains through OEM supply contracts and joint development.

4.4. Phase E (Early Adoption Phase)

Figure 4-2 shows a PC hardware value chain in phase E. As shown in Table 4-3, systems are designed with modular architecture and value chains are disintegrated in all of the three chains (D, S and M). I refer to this value chain as a type E value chain.

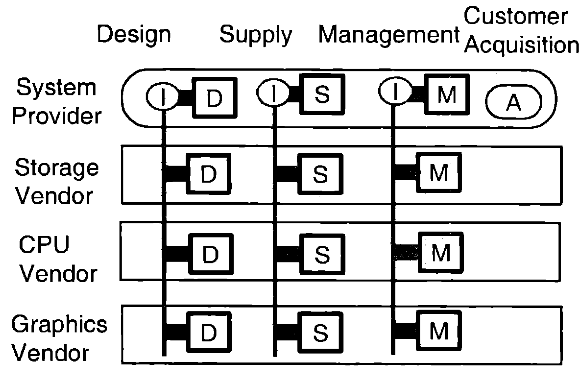


Figure 4-2 PC Hardware value chain in Phase E (Type E Value Chain)

Table 4-2 BC-Org map of a PC Value Chain

Business Capability	Organization			
	Computer Vendor	CPU Vendor	Graphics Vendor	Hard Disk Vendor
Customer Acquisition	X			
PC Hardware DSM	X			
CPU DSM		X		
Graphics DSM			X	
Hard Disk DSM				X

Table 4-3 DSM structure of a Type E PC hardware value chain

	Design	Supply	Management
Integration Force	Weak	Weak	Weak
Integrator	Computer Vendor (System Provider)	Computer Vendor (System Provider)	Computer Vendor (System Provider)

In this phase, modular system architecture accelerates two kinds of innovations.

First, modular architecture accelerates incremental innovations of modules, because the interchangeability of modules enables each module vendors to upgrade their products without being worried about compatibility. This may create opportunities for module vendors to build strong monopolistic positions with continuous incremental innovations.

Second, modular architecture accelerates application innovations, because system providers try to acquire a variety of class E customers, taking advantage of customization flexibility. This may lead to the fragmentation of module markets with the proliferation of module suppliers. System providers also proliferate with different customer focuses.

The two innovations create counteracting impacts on module suppliers; incremental innovations create a force to consolidate module supplier markets, while application innovations create a force to fragment them. The power balance between these two forces varies with the type of a module. This difference in the power balance creates the difference between modules in the level of market fragmentation, and eventually creates a monopolistic component supplier dominating the value chain. It is hard to identify which modules create monopolistic suppliers. In the case of PC hardware, CPU has created a monopolistic supplier, i.e. Intel. Some may argue that the reason why Intel was able to build its dominant position is that CPU is application-independent, by nature, and does not proliferate through application innovations. However, in fact, CPU could have diverged with different optimizations such as optimization for vector processing and that for float-point processing. Hence, application-independency may not be a factor that has created Intel's dominant position.

The competitive advantage of system providers is still system integration capability in this phase. However, a capability for architectural innovations is not required in this phase. Instead, a capability to provide systems tailored to individual customers is required, because class E customers, potential adopters of systems in this phase, are very specific about their requirements. It is noteworthy that system integration capability can become the competitive advantages of system providers all the more because it is difficult to secure enough system integrity under disintegrated value chains with proliferated module suppliers.

4.5. Re-integration of Design Chain (Emergence of Type M1 Chains)

During the transition from phase E to M, a dominant module supplier re-integrates the design chain. One factor that pushes the industry to re-integrate the design chain is the need for manageability. Because of the proliferation of applications and modules in phase E, system integrity or manageability is relatively low in this transition phase. On the other hand, unlike class E customers, class M customers require high system manageability. This need for system manageability becomes a force to re-integrate the design chain.

Importantly, it is not a system provider but a dominant module supplier (e.g. Intel in the case of PC hardware) that re-integrates the design chain. There are several reasons for this. First, the proliferation of system providers has weakened the industrial leadership of system providers. Second, some module supplier has a dominant market power as the result of continuous incremental innovations in phase E. I refer to dominant module suppliers as platform dominators. Examples of platform dominators include Intel in the PC hardware domain and Microsoft in the PC software domain.

Re-integrating a value chain means reinforcing ties among different organizations along the value chain. As Gawer and Cusumano explore in [32] , dominant platform suppliers achieve this re-integration, using several ways including partnerships and acquisitions. I describe below two major ways, which are "**Virtual integration**" and "**Vertical integration**":

In virtual integration, which is a form of partnership, a platform dominator specifies some requirements on other modules and certifies module vendors that comply with the requirements. The certificate issued by a platform dominator endorses the interoperability with the platform. This surely influences the vendor selections of potential buyers. Module suppliers naturally comply with the requirements. In this way, platform dominators can influence the design of other modules and improve the manageability of entire systems.

In vertical integration, a platform dominator extends its business and starts supplying other modules. An example of this vertical integration is Microsoft's entry into the office software market. An obvious advantage of vertical integration is that the system integrity between platform and modules is greatly improved, because they are supplied by a single organization. In addition, modular system architectures create separate modules for different applications. On the other hand, some applications can create additional values by interacting with other applications and performing atomic operations. In other words, some applications should desirably converge into one application. However, the separation of modules by applications hinders application convergence. In such cases, a platform dominator can effectively achieve application convergence, by integrating modules of different functions at the same time. The above Microsoft example also represents this case.

4.6. Phase M (Majority Adoption Phase)

In phase M, systems are designed with modular architecture but the design chain is re-integrated by a platform dominator. Figure 4-3 shows a value chain for PC hardware in phase M. I refer to the value chain shown in Figure 4-3 and Table 4-5 as a **type M1 value chain**. As I describe later, in phase M, the value chain diverges into multiple types. Type M1 is just a basic form of value chains in phase M.

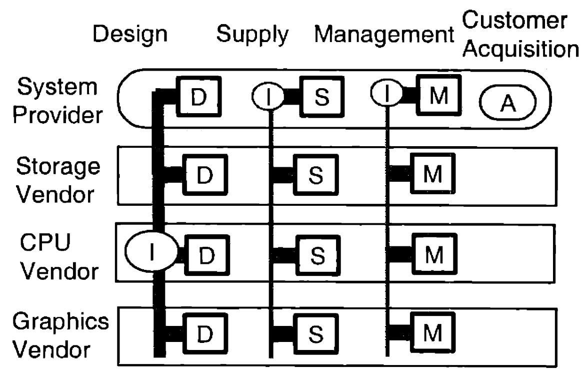


Figure 4-3 Basic PC Hardware value chain in phase M (Type M1 value chain)

Table 4-4 BC-Org map of a PC Value Chain

Business Capability	Organization			
	Computer Vendor	CPU Vendor	Graphics Vendor	Storage Vendor
Customer Acquisition	X			
PC DSM	X			
CPU DSM		X		
Graphics DSM			X	
Storage DSM				X

Table 4-5 DSM structure of a value chain (Type M1)

	Design	Supply	Management
Integration Force	Strong	Weak	Weak
Integrator	CPU Vendor (Platform Dominator)	Computer Vendor (System Provider)	Computer Vendor (System Provider)

Most important in this thesis, system integration capability no longer contributes to the competitive advantages of system providers in phase M. There are two major reasons for this:

First, because the platform dominator screens module vendors and secures system integrity, the required system integration skill is much lower in phase M than in phase E. Hence, the superiority of a system provider in system integration capability does not contribute to its competitive advantages. In addition, this means that system providers further proliferate.

Second, class M customers do not require customizations as much as class E customers do. More precisely, there is difference in desired customizations between class E and class M customers. Class E customers have their own functional requirements and ***order*** systems that meet their requirements, while class M customers ***select*** systems that match their preference from variations available at little extra cost. Hence, the customization required by class M customers is more like mass customization [33] .

System providers should rebuild their competitive advantages in phase M. There are two factors that can contribute to their new competitive advantages, which are customer intimacy and process superiority. I explain them below:

Customer intimacy primarily consists of a deep knowledge about customers and a capability to deliver systems that can fit customers' business (or life style). This sounds like the customization capability in type E value chains. They are pretty close. In both phase E and phase M, system providers need to know customers and have a system integration capability more or less. But there is subtle but significant difference between customization capability in phase E and customer intimacy in phase M. In phase E, what differentiates a system provider from others is system integration capability, in other words, knowledge about technology. In phase M, it is a better understanding about customers. Today's IBM is a good model of a company that has built its competitive advantage based on customer intimacy. IBM created the term "e-Business" to represent its customer-focused system integration service. One of the IBM's strengths is the IBM SE's knowledge about customers' business processes. It is not unusual that an IBM's SE knows the IT infrastructure of a company better than anyone of the company. Today, "e-Business" has become a synonym for business process innovation using information technologies.

Building competitive advantages with customer intimacy is a valid business strategy, because system providers with strong customer intimacy can serve well class ML customers, who form the most lucrative market segment. I refer to this strategy as type ML strategy. However, type ML strategy cannot scale to mass customers, because it depends on sales engineers who are highly skilled in observing customers and finding customers' needs.

Besides type ML strategy, there are two other strategies to create customer intimacy. One is to accumulate a deep knowledge about a specific industry and provide systems or applications tailored to the industry. I refer to this strategy as type MI. A good example of a company with type MI strategy is Apple before iMac, whose main customers were in the publishing and graphics industries. The other is to establish a brand to create loyal customers of a specific taste or life-style. I refer to this strategy as type Mb. A good example of a company with type Mb strategy is SONY, whose brand stands for a life-style of adopting innovative technologies for consumer use. Another example is Apple with iMac. I refer to a group of type ML, MI and Mb strategies as type Mc, or "customer intimacy strategy group".

Another competitive advantage is process superiority. Process superiority means the efficiency in supply and management processes. Particularly in high clockspeed industries, the efficiency of supply process is important to minimize inventory obsolescence cost. I refer to building competitive advantages with process superiority as type Mp strategy. Dell is a good model of a company with type Mp strategy. I elaborate on how Dell build its process superiority in next subsection and in chapter 7.

Of course, customer intimacy and process superiority are not mutually exclusive, and system providers must have more or less both competencies. Moreover, as both competencies become essential, the two strategies combine as described in 4.8.

Table 4-6 Strategies of product/service providers

User Class	Strategy Type	Core competency	Model company in the computer industry
ML	Mc/ML	customer intimacy / knowledge about customers	IBM
MI	Mc/MI	customer intimacy / knowledge about industry	Apple before iMac
MM	Mc/Mb	customer intimacy / brand for tastes or life-style	SONY, Apple with iMac
M	Mp	business process superiority e.g. supply and management	Dell

4.7. Re-integration of Supply and Management Chains (Emergence of Type M2 Chains)

Disintegrating a value chain lowers the efficiency of supply and management in terms of speed and cost. For example, the dis-integration raises the total inventory cost of a value chain. In addition, the larger the total inventory is, the longer it takes for a newly upgraded product to reach customers. This inefficiency creates a force to re-integrate the supply chain.

Re-integrating the supply chain is exactly what Dell has successfully done to build its process superiority. The critical success factor in supply chain management is the ownership of business process design for the entire supply chain. Dell is designing its end-to-end supply process and asking module suppliers to comply with Dell's process. It is noteworthy that the economy of scale is important for Dell to accomplish this supply chain re-integration. Since Dell does not own module suppliers, Dell's supply chain management can be considered as virtual integration [34] . Like the supply chain, the management chain can also be a target for re-integration, especially when IT products/services require high availability.

As the result of the re-integration of the supply and management chains, a value chain as shown in Figure 4-4 and Table 4-8 emerges. I refer to this value chain as a **type M2 value chain**.

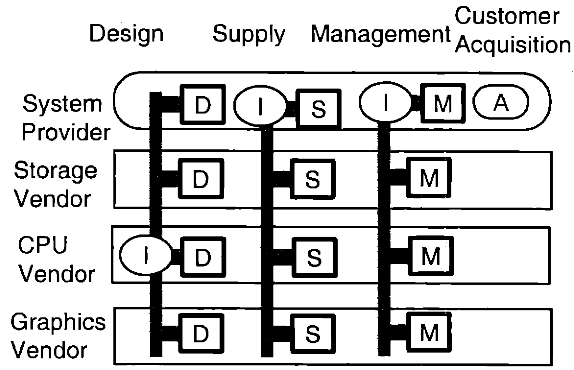


Figure 4-4 Type M2 PC value chain

Table 4-7 BC-Org map of a PC Value Chain (Type M2)

Business Capability	Organization			
	Computer Vendor	CPU Vendor	Graphics Vendor	Storage Vendor
Customer Acquisition	X			
PC DSM	X			
CPU DSM		X		
Graphics DSM			X	
Storage DSM				X

Table 4-8 DSM structure of a value chain (Type M2)

	Design	Supply	Management
Integration Force	Strong	**Strong**	**Strong**
Integrator	CPU Vendor (Platform Dominator)	Computer Vendor (System Provider)	Computer Vendor (System Provider)

4.8. Disintegration of System Providers (Emergence of Type M3 Chains)

As I described in the previous subsection, two factors, customer intimacy and process superiority can contribute to the competitive advantages of system providers in phase M. We can classify system providers' strategies into type Mc or Mp, by examining which factor is emphasized. However, any system provider cannot ignore either of the two factors. In particular, the emergence of type Mp system providers creates a strong pressure on type Mc system providers to improve their supply and management efficiency.

However, type Mc system providers face a dilemma between scale and focus; they cannot re-integrate the supply and management chains without having economy of enough scale. However, seeking economy of scale may jeopardize their focuses on customers.

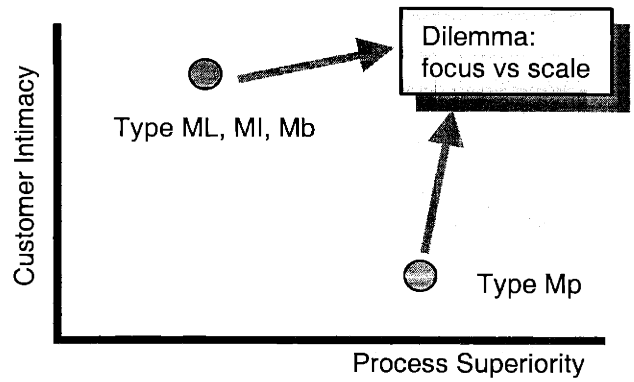


Figure 4-5 Resistance against strategy convergence

This dilemma creates a force to disintegrate system providers into front-end providers with customer intimacy and back-end providers with process superiority. As the result, a value chain shown in Figure 4-6 and Table 4-10 emerges. I refer to this value chain as a **type M3 value chain**. An example of type M3 value chains can be found in today's note PC industry. Several companies, including HP, Compaq, Gateway, and Apple, are providing their note PCs with type M3 value chains. In their value chains, Quanta, a Taiwanese contract manufacturer is playing the role of a back-end PC manufacturer[35] .

As system providers proliferate, some type Mc system providers try to emphasize their customer focuses and choose to outsource back-end capabilities. This creates a feedback loop reinforcing the strength of a back-end company; Back-end providers accumulate their knowledge on back-end processes and innovate their processes. This widens the gap in back-end capabilities between front-end system providers and back-end system providers. The increased gap presses more front-end system providers to outsource back-end capabilities. As evidence, Quanta is reinforcing its position with its accumulated know-how on flexible manufacturing with efficient supply chain management. Chapter 7 elaborates more on Quanta's strength.

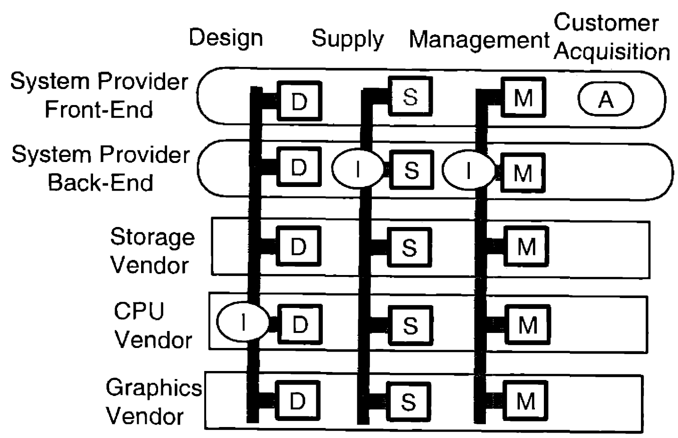


Figure 4-6 Type M3 PC value chain

Table 4-9 BC-Org map of a PC Value Chain (Type M3)

Business Capability	Organization				
	Front-End PC Vendor	Back-End PC Manu-facturer	CPU Vendor	Graphics Vendor	Storage Vendor
Customer Acquisition	X				
PC Hardware D	X				
PC Hardware S, M		X			
CPU DSM			X		
Graphics DSM				X	
Storage DSM					X

Table 4-10 DSM Structure of a Type M3 Value Chain

	Design	Supply	Management
Integration Force	Strong	Strong	Strong
Integrator	CPU Vendor (Platform Dominator)	Back-End PC Manufactuer	Back-End PC Manufacturer

The dilemma between customer focus and economy of scale creates a force to dis-integrate system providers. However, there is a way to achieve both customer intimacy and process superiority without dis-integrating system providers. As I elaborate on chapter 7, Dell has successfully built its competence by achieving both customer intimacy and process superiority on its flexible built-to-order supply system[34] . This competence is enabling Dell to hold the leadership position in the PC hardware market.

4.9. Transition from phase M to next

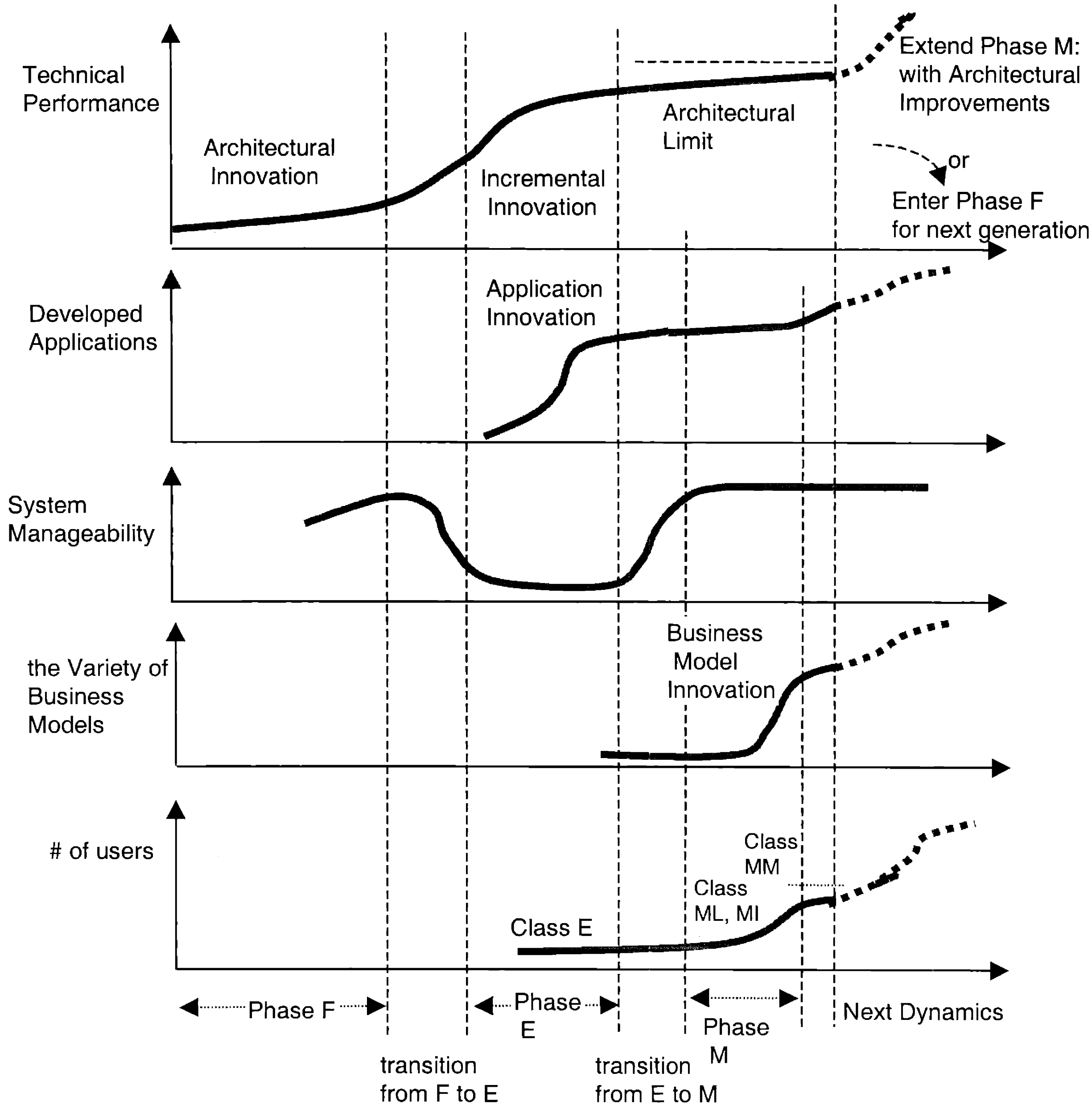
Evolving under fixed system architecture, an industry eventually faces two limits. One limit is on technical performance. Some system specification, such as the bandwidth of module interfaces, often becomes a bottleneck for performance improvement. Another limit is on market coverage. An industry often finds that a business model implied by system architecture cannot expand into the least profitable segment of the market, i.e. class L customers. These architectural limits lead an industry to either architectural improvement or architectural innovation.

Architectural improvement is partial modification on system specifications that does not change the structure of current value chains. It is initiated by platform dominators. An example of architectural improvement is the introduction of PCI-Bus by Intel. The PC hardware industry has been evolving with repeated architectural improvements, such as PCI-Bus, AGP, and USB.

Another possible scenario is an architectural innovation that destroys current value chains. It is initiated by a disruptive innovator outside value chains. The PC hardware industry has experienced several attempts of architectural innovation, including Networked Computer and Web TV. Although there is no accomplished architectural innovation in the PC industry, it is important to identify the possibility of an architectural innovation. As Christensen points out in [19] , an architectural innovation is first applied to the least profitable segment of the market. Hence, the innovation often looks as if it were creating a separate market.

4.10. Summary

In this chapter, I have described the dynamics of IT value chains, pointing out factors that change value chains. In addition, I have described how the strategies of system providers change in accordance with the value chain dynamics. The following diagrams summarize overall dynamics. Figure 4-7 shows the behaviors of key variables over the technology/market lifecycle. Figure 4-8 shows the value chain dynamics with transition forces over the technology/market lifecycle. Figure 4-9 and Table 4-11 show the changes in the strategies of system providers.



Phase F = Ferment Phase, Phase E = Early Adoption Phase,
Phase M = Majority Adoption Phase

Figure 4-7 Behaviors of key variables over the technology/market lifecycle

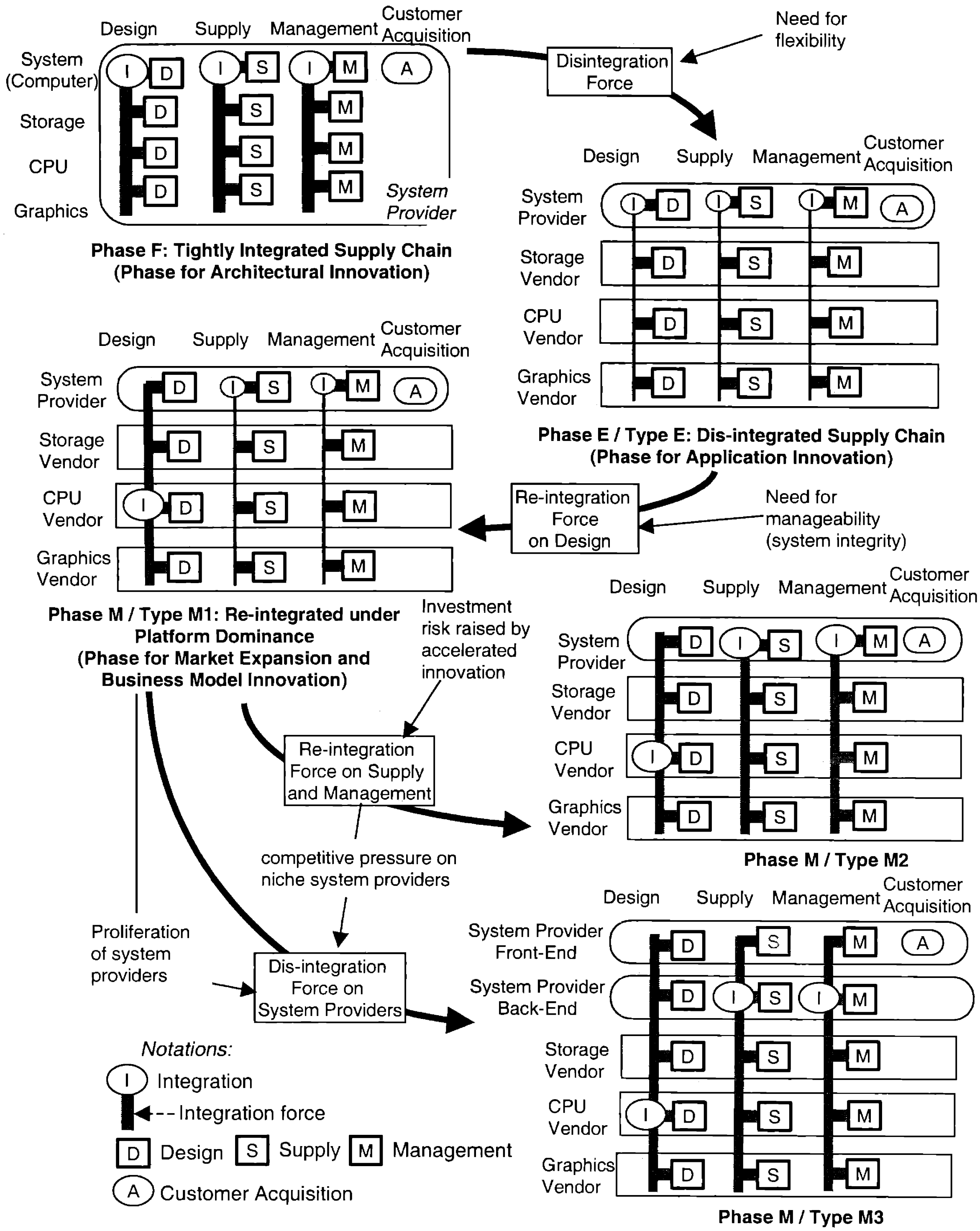


Figure 4-8 the value chain dynamics over the technology/market lifecycle

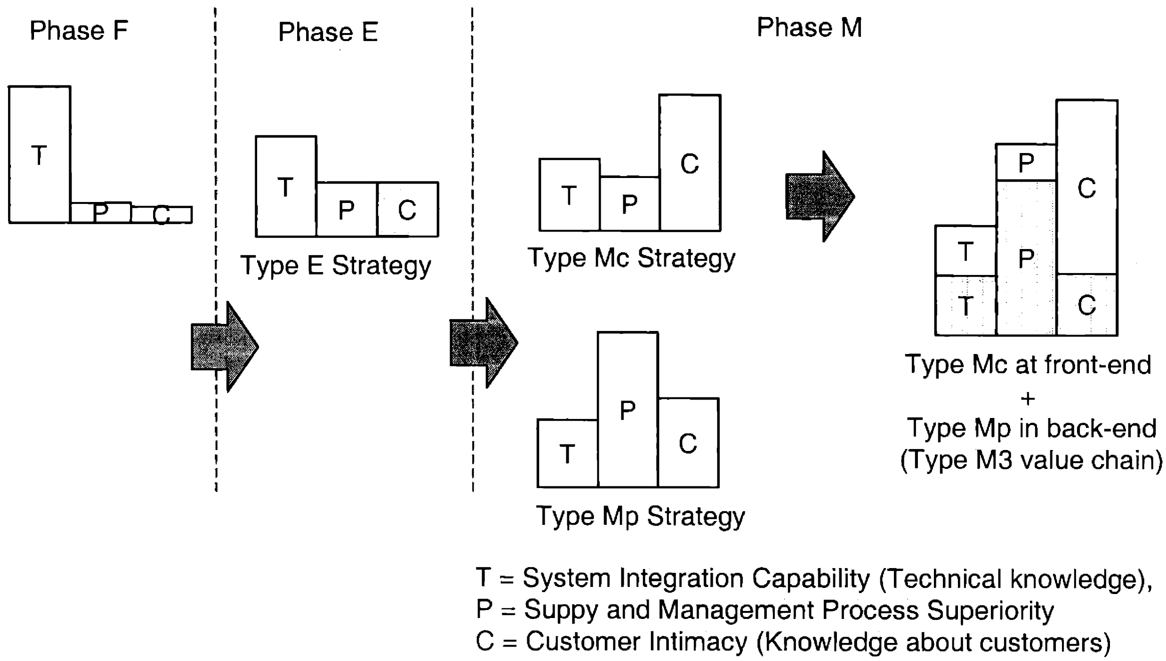


Figure 4-9 the shift of the competitive advantages of system providers

Table 4-11 Summary of PC Hardware Vendors' Strategies

Strategy Type	Phase	Value Chain Type	Core competence	Model Companies
E	E	E	Knowledge about technology	DEC, IBM
Mc/ML	M	M1, M3	Knowledge about customers	IBM
Mc/MI	M	M1, M3	Knowledge about industries	Apple before iMac
Mc/Mb	M	M1, M3	Knowledge about a specific customer segment associated with taste/life-style	SONY, Apple with iMac
Mp	M	M2	Efficiency in supply and management	Dell-1
Mp+Mc	M	M2	Flexibility and efficiency in supply and management	Dell-2 (see Chapter 7)

5. Telecom Value Chain Dynamics for Network Services

5.1. Introduction

In chapters 5 and 6, I apply the multidimensional value chain analysis to telecom value chains to identify their current status and ongoing dynamics. In chapter 5, I present the value chain dynamics related to enterprise networking and Internet access services. In chapter 6, I present that related to e-business system integration services.

5.2. Current Value Chain

5.2.1. Enterprise Networking (Services for Medium-sized and Large Enterprises)

Enterprise networking service is currently in phase M. In Japan, as of 1999, 75% of the large enterprises (1000+ employees) and 55% of the small and medium-sized businesses own intranets. However, this does not mean that most of the Japanese offices are connected, because even companies owning intranets have unconnected offices. There are two major factors that are limiting adoptions. One is the cost of access data links. However, this cost is now decreasing rapidly. The other factor is the lack of engineers to maintain network equipment.

Figure 5-1 and Table 5-1 shows the technology chain and the business capability-organization map for business class IP suite.

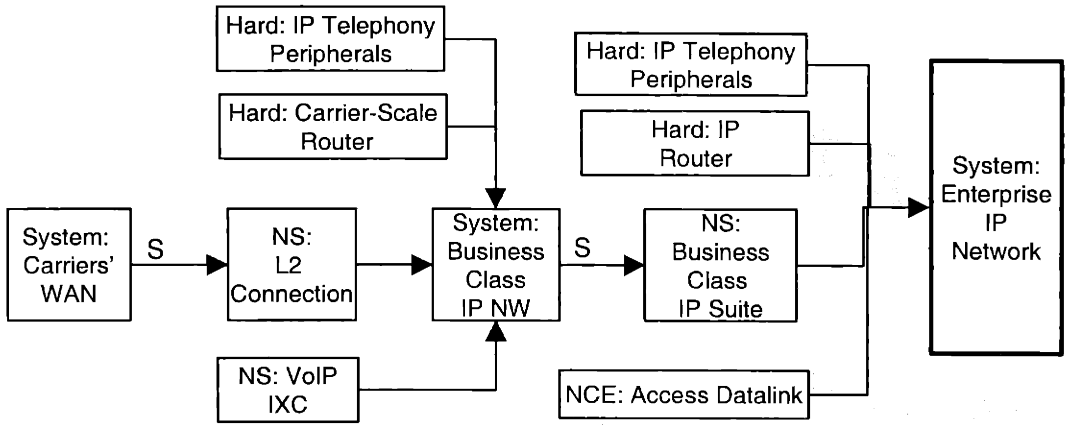


Figure 5-1 Technology chain for enterprise IP network with business class IP suite

Table 5-1 BC-Org map of Business class IP suite

Business Capability	Organization 0. User, 1. SI, 2. IP NSP, 3 WAN carrier, 4. Local carrier, 5 IP telephony vendor, 6. IP router vendor						
Description	0	1	2	3	4	5	6
Enteprise IP M Enteprise IP router M Enterprise IP telephony M	X						
Customer Acquisition Enterprise IP DS		X					
Business Class IP Suite DSM Provider IP router M Provider IP telephony M			X	X			
L2 Connection DSM				X			
Access Data Link DSM					X		
Enterprise IP telephony DS Provider IP telephony DS						X	X
Enterprise IP router DS Provider IP rotuer DS							X

5.2.2. Internet Access (Services for Residential and SOHO Users)

Internet access service is in phase M. In Japan, as of 2000, 98.7% of the large enterprises (1000+ employees) and 89% of the small and medium-sized businesses subscribe to Internet services. Figure 5-2 shows the technology chain and Table 5-2 shows the mapping between business capabilities and organizations for the value chain.

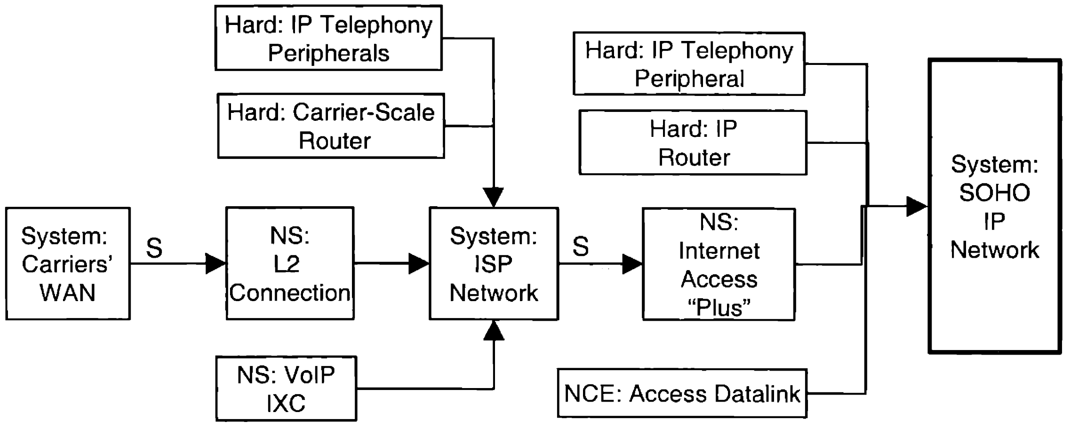


Figure 5-2 Technology Supply Chain for Internet Access Plus

Table 5-2 BC-Org map of Internet Access Plus

Business Capability	Organization 0. User, 1. ISP, 2 WAN carrier, 3. Local carrier, 4 IP telephony vendor, 5. IP router vendor					
Description	0	1	2	3	4	5
SOHO IP Network DSM SOHO IP telephony M SOHO IP router M	X					
Customer Acquisition Internet Access DSM		X	X			
Provider IP router M Provider IP telephony M		X	X			
L2 Connection DSM			X			
Access Data Link DSM			X	X		
SOHO IP telephony DS Provider IP telephony DS					X	
SOHO IP router DS Provider IP rotuer DS						X

5.3. Ongoing Dynamics

5.3.1. Design Chain Integration by IP Router Vendors

The current value chain is basically type M1. A few IP router vendors, such as Cisco, are integrating the design chain. Cisco's approach for the design chain re-integration is mainly based on virtual integration. It sets up several programs that secure system integrity and encourages other IP peripheral vendors to comply with them. Cisco also uses vertical integration involving acquisition. Table 5-4 and Table 5-5 show some evidences of Cisco's value chain reintegration activities regarding enterprise IP networking.

Table 5-3 DSM Chain Structure of IP Network Services

	Design	Supply	Management
Integration Force	Strong	Weak	Weak
Integrator	IP router vendor	SI / ISP / WAN Carriers, Local Carriers	SI / ISP / WAN Carriers / Users

Table 5-4 Cisco Partnership Program

Program	Description
Cisco AVVID Partner Program	"... *The Cisco AVVID Partner Program enables leading product and service companies to work with Cisco to develop and deliver innovative e-business solutions that enhance employee productivity, reduce costs, and improve customer care.* *Partners participating in the Cisco AVVID Partner Program benefit by:* *Increased market exposure* *Integration with Cisco AVVID* *Enhanced credibility with customers* *By joining the Cisco AVVID Partner Program, partners support standards and commit to interoperate with Cisco products, technology, and software. Cisco AVVID partners' products and services must pass lab test and interoperability criteria to insure conformance with Cisco AVVID integration standards. ...*" [36]
Cisco Service Provider Solutions Ecosystem	"*The Cisco Service Provider Solutions Ecosystem is a community of technology and services companies enabling service providers to rapidly deploy and manage innovative networking services. Cisco Service Provider Solutions Ecosystem partners support open, standards-based architectures and a shared commitment to interoperable, multi-vendor solutions. Membership in the Cisco Service Provider Solutions Ecosystem is offered to companies that demonstrate leading-edge capabilities and present mutual business opportunities.*"[37]
Cisco New World Ecosystem Program	"... *The Cisco New World Ecosystem is a community of technology partners working together to enable service providers to rapidly develop and deploy innovative networking services. Cisco and its partners offer a wide range of solutions for Packet Telephony, Voice Applications, Operations Support Systems and Business Support Systems (OSS/BSS), Internetworking and E-Business. Cisco New World Ecosystem partners support open, standards-based architectures and a shared commitment to interoperable, multi-vendor implementations. Concord's eHealth family of products will help Cisco New World Ecosystem customers support more subscribers and better manage internal resources - ultimately decreasing costs and ensuring high quality-of-service. ...*"[38] (Also in [39])
Cisco	"... *The Cisco Professional Services Partner Program, which is part of*

Professional Services Partner Program	*Cisco's New World Ecosystem Program tailored for professional services, qualifies and enables firms to deliver services for the planning, design, implementation, operation, and optimization of complex end-to-end networks using both new and existing technologies. Service delivery under the program will include the rapid deployment of next-generation technologies such as virtual private networks, voice and data integration, mobile and fixed wireless, optical internetworking, Cisco IOS, DSL, and open programmable switching. Firms in the program offer a variety of deployment services, network and system integration, program management, software development and integration, and strategic consulting. ..."* [40] (Also in [41])
Cisco Powered Network Program	... *Cisco Powered Network Program is a joint marketing agreement between Cisco and a select group of service providers who provision their services end to end with Cisco equipment. Cisco allows program members to use the value of the industry-leading Cisco brand name and its knowledge and expertise in the promotion of their services. Program members agree to maintain high level of network quality and a minimum annual investment in Cisco equipment.* ....[42]

Table 5-5 Cisco's Vertical Integration Activities

Date	Description
April 8, 1999	Acquired Fibex Systems. ... *Fibex Systems is a pioneer in Integrated Access Digital Loop Carrier (IADLC) products, devices that combine traditional voice services with data services using ATM as the underlying architecture. Sentient Networks has developed the industry's highest density ATM Circuit Emulation Service (CES) Gateway, which is capable of transporting circuit-based private line services across packet-based ATM networks.* ... [43]
Mar 1, 2000	Acquired Atlantech ... *Atlantech is a leading provider of network element management software, which is designed to help configure and monitor network hardware. ... [44]*

Cisco has been vigorously trying to keep its design leadership in the evolution of IP networks with VPN and VoIP. Table 5-6 and Table 5-7 show Cisco's virtual and vertical integration activities, respectively, for VPN. Table 5-8 shows Cisco's virtual integration activities for VoIP.

Table 5-6 Cisco's Virtual Integration Activity for VPN

Program	Description
Cisco AVVID Security and VPN Program	... *The Cisco AVVID Security and VPN Program delivers comprehensive, interoperable security and VPN solutions for Cisco networks based on the Cisco SAFE framework. These solutions are a key component of the Cisco SAFE security blueprint, providing an end-to-end security framework of products and services that empower companies to securely, reliably, and cost-effectively take advantage of*

	the Internet economy. .... [45]
August 9, 1999 Cisco Security Associate Program	*Cisco Systems today announced the introduction of its Security Associate program focused on creating proven multivendor security solutions for New World networks. Seventeen network security companies comprise the program's charter membership. As the key element of this new program, Cisco will use an independent testing laboratory to validate the interoperability of Security Associate member products with Cisco security products, such as its market-leading PIX firewall and IPSec encryption offerings. ....[46]*
March 28, 2001 Cisco Managed Security Services Initiative	.... *The Cisco Managed Security Services Initiative includes two new programs that have been designed to guide enterprise customers to qualified, best-in-class service providers for outsourced security services, including firewalls, VPNs and intrusion detection systems (IDS).* .... *Cisco Powered Network Managed Security Services Designation:* *The popular Cisco Powered Network program, which has about 500 members in 52 countries, has been extended to recognize key infrastructure partners who offer managed security services based on Cisco's industry-leading firewall and intrusion detection products. This new service category complements the existing and well-established VPN services category.* *Cisco AVVID Partner Program, Security and VPN Solution Set:* *The Security and VPN Solutions category of the Cisco AVVID Partner Program (an interoperability testing and co-marketing program based on Cisco AVVID - the Cisco Architecture for Voice, Video and Integrated Data) includes a new Outsourced Management & Monitoring section for qualified vendors. This is of particular interest to aggressive new providers who are specifically building their businesses for the delivery of managed security and VPN services.* *.... [47]*

Table 5-7 Cisco's Vertical Integration Activity for VPN

Date	Description
Jan 19, 2000	Acquired Altiga Networks and Compatible Systems. *... Altiga is a market leader in integrated VPN solutions for remote access applications. Its product suite will complement Cisco's existing family of VPN routers and security appliances. Altiga's integrated VPN client, remote access gateway and management solutions will extend Cisco's broad VPN portfolio, providing enhanced VPN scalability, manageability and performance for enterprise edge applications including service provider-managed remote access. ...* *...Compatible is a leading developer of standards-based, reliable and scalable VPN solutions for service provider networks. Its industry-leading platform enables service providers to deploy robust, IPSec architectures for VPN services. ...* [48]
Oct 2001	Acquired Allegro Systems, a developer of VPN acceleration technologies [49]

Table 5-8 Cisco's Virtual Integration Activity for VoIP

Program	Description
Cisco AVVID Voice and IP Telephony Program	.... *The Cisco AVVID Voice and IP Telephony Program provides enterprises with expanded customer choice and increased productivity via new world IP telephony vendor solutions and services—all based on industry standards and open protocols. ...[50]*
Oct. 10, 2001 Cisco Service Carrier Community :	... the Cisco Service Carrier Community program intended to promote the growth of VoIP (voice over Internet protocol) traffic and propel global service providers to new levels of revenue and profitability. As members of the Cisco Service Carrier Community, Cisco-based service providers around the world can work together to exchange traffic and maximize respective application strengths - with the ultimate objective of delivering end-to-end VoIP services. ... [51]

5.3.2. Indications of Management Chain Integration by Network Service Providers

Factors creating an integration force

Network management task for users has been increasing for the following two reasons, and this will create a force to integrate the management chain. One is increased security risk. The other is VoIP adoption, because there is significant difference in the required availability between Internet access and telephone. Furthermore, even today, the shortage of system engineers is a problem for small businesses and offices. These two factors result in the shortage of system manageability relative to the availability of system engineers. Hence, this shortage of system manageability is expected to generate a force to integrate the management chain. I describe below a few indications that large carriers may integrate the management chain.

Vertical Integration of local and long-distance carriers

Since the Telecommunications Act of 1996[52] , the boundary between local and long-distance services is getting blurred. Large long-distance carriers, such as AT&T and Worldcom, are entering local access business, acquiring CATV/DSL service providers and developing fixed wireless access services. For example, as shown in Table 5-9, Worldcom acquired local DSL, and fiber companies. In addition, Worldcom offers fixed wireless Internet services in several cities including Kansas, Bakersfield, Baton Rouge, Montgomery, Jackson, Chattanooga, Memphis, Tallahassee, and Minneapolis (as of November 9, 2001)[53] Worldcom has also formed an alliance with Hughes Network Systems to add VSAT as its access option[54] . On the other hand, incumbent local exchange carriers are entering long distance services and Internet services. In this business expansion, as shown in Table 5-11, SBC has established close ties with long-distance wholesale and Internet service companies, acquiring partial ownership of these companies. Table 5-12 shows the BC-Org map updated with these vertical integration activities.

Table 5-10 Access Network/Service Integration Activities by Worldcom

Date	Acquired company	Description
August 26, 1996	MFS networks	local and long-distance communication services for governments and businesses (fiber optics in NY) [55]
October 1, 1997	Brooks Fiber	all fiber optic local networks operated in 44 US cities [56]
September 25, 2001	Rhythm DSL	Worldcom bided on the Rhythm DSL assets [57]

Table 5-11 Long-distance Network/Service Integration Activities by SBC

Date	Partner	Description
February 8, 1999	William Communications (10% acquisition)	Formed a long-term strategic alliance with William Communications, which owns a fiber-based ATM backbone network. Under this alliance, SBC agrees to acquire 10% of the common stock of William communication's subsidiary, William Communications Group, Inc. [58]
November 15, 1999	Cocentric Network (4% acquisition)	Formed an alliance with Cocentric Network, a provider for complete, easy-to-use Internet business solutions for small- to medium-sized companies. Under this alliance, SBC offers the service with Cocentric in cities it does not serve. "*In these cities, Cocentric will handle circuit ordering, installation and customer support, and will supply the customer's on-site equipment. To provide SBC's enterprise customers with one consolidated bill, Concentric will private label, under the SBC brand, the ordering, installation, and billing processes.*" [59] (On October 20, 1998, SBC acquired 4% ownership of Cocentric Network [60])
November 22, 1999	Prodigy Communications (43% acquisition)	Formed an alliance with Prodigy Communications, a leading nationwide Internet service. "*Under terms of the agreement, ..., SBC will make Prodigy its exclusive retail consumer and small*

		business Internet access service ..... Prodigy will assume management of SBC's current 650,000 dial-up, ISDN and basic DSL Internet customer base, ... SBC will exclusively market Prodigy service through its extensive marketing channels with the commitment of delivering a minimum of 1.2 million new customers over the next three years to the Prodigy member base. The deal provides SBC with a 43 percent ownership stake in Prodigy." [61]

Table 5-12 BC-Org Map for Business Class IP Suite after vertical integration

Business Capability	Organization 0. User, 1. SI, 2. IP NSP, 3 WAN carrier, 4. Local carrier, 5 IP telephony vendor, 6. IP router vendor					
Business Class IP Suite DSM			X	X	X		
Internet Access DSM			X	X	X		
Provider IP router M Provider IP telephony M			X	X	X		
L2 Connection DSM				X	X		
Access Data Link DSM				X	X		

<u>Managed Services</u>

Many IP NSPs have started offering "managed services", in which NSPs configure and monitor enterprise IP networks[62] . Managed services are offered for enterprise network owners and for Internet access users. In typical managed services for Internet access users, NSPs partner with IP router vendors and resell IP routers and peripherals to customers, configuring them before delivery. For example, SBC announced, on May 7, 2001, CPE-based IP telephony solutions in which SBC resells equipment from Cisco and Nortel[63] ,[64] . AT&T also announced a router/T1 bundle service, in which the company supplies and manages Cisco routers for its managed Internet subscribers[65] .

Gartner defined the following service sub-categories for managed services and estimated their market size as shown in Table 5-13[9]. The total market size was $2,636 million in 1998 and will grow to $12,725 million in 2002. Gartner also pointed out that carriers are increasingly looking to managed services to offset the margin erosion in their native access and transport product line.

- Managed Edge Device Service : The service provider (carrier) monitors and maintains users' edge routers.
- Managed IP-VPN Service : The service provider maintains a private network IP for the user.
- Managed Public WAN Service : The service provider maintains a private wide-area network, such as ATM, Frame Relay and IP (IP in IP), for the user.
- Managed Network Service: The service provider provides the above three services plus application services such as voice exchange and data hosting.

Table 5-13 Managed Services U.S. Market (Millions of Dollars) [9]

	1998	2000	2002	2004	CAGR
Managed Edge Device	184	256	261	166.5	-4.8%
Managed IP-VPN	0	194.3	1,706	5,279	227.6%
Managed Public WAN	1,223	2,387	4,189	5,168	24.8%
Managed Network	1,229	3,609	6,568	9,852	32.6%
Total	2,636	6,446	12,725	20,466	36.4%

As shown in Table 5-14 and Table 5-15 , in managed services, the management processes of different technology components are vertically integrated by network service providers.

Table 5-14 BC-Org Map for Business Class IP Suite with Managed Services

Business Capability	Organization 0. User, 1. SI, 2. IP NSP, 3 WAN carrier, 4. Local carrier, 5 IP telephony vendor, 6. IP router vendor						
Description	0	1	2	3	4	5	6
Customer Acquisition Enterprise IP DS		X					
Managed Services: Enteprise IP M Enteprise IP router M Enterprise IP telephony M Enterprise IP router S (reselling) Enterprise IP telephony S (reselling)			X	X	X		
Business Class IP Suite DSM			X	X	X		
Provider IP router M Provider IP telephony M			X	X	X		
L2 Connection DSM				X	X		

Access Data Link DSM				X	X		
Enterprise IP telephony DS Provider IP telephony DS						X	
Enterprise IP router DS							X
Provider IP rotuer DS							

Table 5-15 BC-Org map for Internet Access Plus with Managed Services

Business Capability	Organization 0. User, 1. ISP, 2 WAN carrier, 3. Local carrier, 4 IP telephony vendor, 5. IP router vendor					
Description	0	1	2	3	4	5
Managed Service SOHO IP Network M SOHO IP telephony M SOHO IP router M SOHO IP telephony S (reselling) SOHO IP router S (reselling)		X	X	X		
Customer Acquisition Internet Access DSM		X	X	X		
Provider IP router M Provider IP telephony M		X	X	X		
L2 Connection DSM			X	X		
Access Data Link DSM			X	X		
SOHO IP telephony DS Provider IP telephony DS					X	
SOHO IP router DS Provider IP rotuer DS						X

5.4. Future Dynamics

5.4.1. Integration of the Supply/Management Chains (Emergence of Type M2 Chains)

Carriers are expected to continue vertical integration activities. These activities will eventually create type M2 value chains. As the result, carriers will build their competence in the efficiency of supply and management.

Different carriers seem to focus on different customer segments. For example, traditional long distance carriers, such as Worldcom and AT&T, focus on large and medium-sized businesses[66] .

By contrast, ILECs, such as SBC, seem to be focusing on residential and SOHO users, providing CPE-based managed VPN and voice services. A piece of evidence for this is SBC's strong emphasis on DSL services and partnership with a Internet service provider for small and medium sized businesses [59] . These focuses fit their strategic resources. Worldcom, with well-regarded data networking skills, is in a favorable position to satisfy class E, ML, MI customers. On the other hand, ILECs have large armies of engineers to provide the managed services for class MM and L customers.

Hence, traditional long-distance carriers will form type M2 value chains for business class IP suite services, and ILECs will form type M2 value chains for Internet Access Plus services, as shown in Table 5-16 and Table 5-17. These carriers will be competitive type Mp players.

Table 5-16 DSM structure of Business Class IP Suite Value Chain (Type M2)

	Design	Supply	Management
Integration Force	Strong	Strong	Strong
Integrator	IP router vendor	traditional long-distance carriers, e.g. AT&T and Worldcom	traditional long-distance carriers, e.g. AT&T and Worldcom

Table 5-17 DSM structure of Internet Access Plus Value Chain (Type M2)

	Design	Supply	Management
Integration Force	Strong	Strong	Strong
Integrator	IP router vendor	ILECS, e.g. SBC	ILECs, e.g. SBC

5.4.2. Disintegration of Network Service Providers (Emergence of Type M3 Chains)

As large carriers create type M2 value chains and provide services with efficient supply and management, niche network service providers will feel pressure to improve their supply and management efficiency. Eventually, these niche providers will choose to outsource network operations from these large carriers, forming type M3 value chains.

An existing example of a network service with a type M3 value chain is the relationship between Worldcom and AOL. In 1997, Worldcom acquired AOL Advanced Network Service, a AOL's subsidiary for network operation, and became the largest network service provider for AOL[67] . This reinforced Worldcom's position as a type Mp player and AOL's position as a type Mc player. Worldcom also launched a program to help companies in vertical market to provide Internet services in 2000[68] . In this program, members can outsource operations on demand from Worldcom.

5.4.3. Architectural Innovation by Wide-Area Ethernet

There is one ongoing architectural innovation for enterprise networking, which is wide-area ethernet service. In this service, customers can have logical ethernets. The main benefit of this service is that it can reduce the network maintenance cost of small offices. For example, there will be no need to set up a DHCP server /router in each office, because terminals in small offices can communicate with a DHCP server in a central office.

If IP-VPN and managed services cannot solve the shortage of system engineers, it is likely that wide-area ethernet service will take over the main stream market. Alternatively, carriers may co-opt wide-area ethernets to complement their business class IP suite services. In September 2001, AT&T announced Metro Ethernet and Managed Internet Service (MIS) Ethernet Access[69] . The Metro Ethernet service will provide users in 68 cities point-to-point Ethernet connections at 50 to 600 Mbps. The MIS Ethernet Access will enable users to accesss Internet at a rate up to 1Gbps.

5.5. Summary

The key findings of this chapter are as follows:

1. The current value chain is basically a type M1 value chain, with a few IP router vendors, such as Cisco, strongly integrating the design chain.

2. The vertical integration of long-distance and local carriers and the introduction of managed services indicate that large carriers will form type M2 value chains and become competitive type Mp players in near future.

3. The vertical integration will create type Mp players focusing on different customer segments. . Traditional long-distance carriers, such as Worldcom and AT&T, will focus on large enterprises and medium-sized businesses. On the other hand, ILECs, such as SBC, will focus on SOHO and residential users.

4. The emergence of type Mp players will create competitive pressure on niche ISPs (type Mc players) and push them to outsource their operations from type Mp players, forming type M3 value chains.

6. Value Chain Dynamics for E-Business System Integration

6.1. Introduction

The support of customers' E-Business system integration is becoming important in providing satisfactory network services for enterprise customers. Hence, .in this chapter, I analyze the value chain dynamics for E-Business system integration. I use the term "E-Business" to represent the support or implementation of business activities using information technology (IT). Examples of E-Business applications include electronic commerce (E-Commerce), customer relationship management (CRM), supply chain management (SCM), and enterprise resource planning (ERP). Systems for E-Business, or "E-Business systems", primarily consist of a cluster of servers (computers) and large storage connected with enterprise IP networks. E-Business servers are operated in data centers, which are facilities dedicated to server operation, featuring the robustness against contingency such as power down, criminal intrusion, and environmental tragedies (earthquakes).

6.2. Current Value Chain

Figure 6-1 shows the technology chain for E-Business system. E-Business middleware includes database software and web application server software. E-Business common applications include CRM, SCM,ERP, and E-Commerce software.

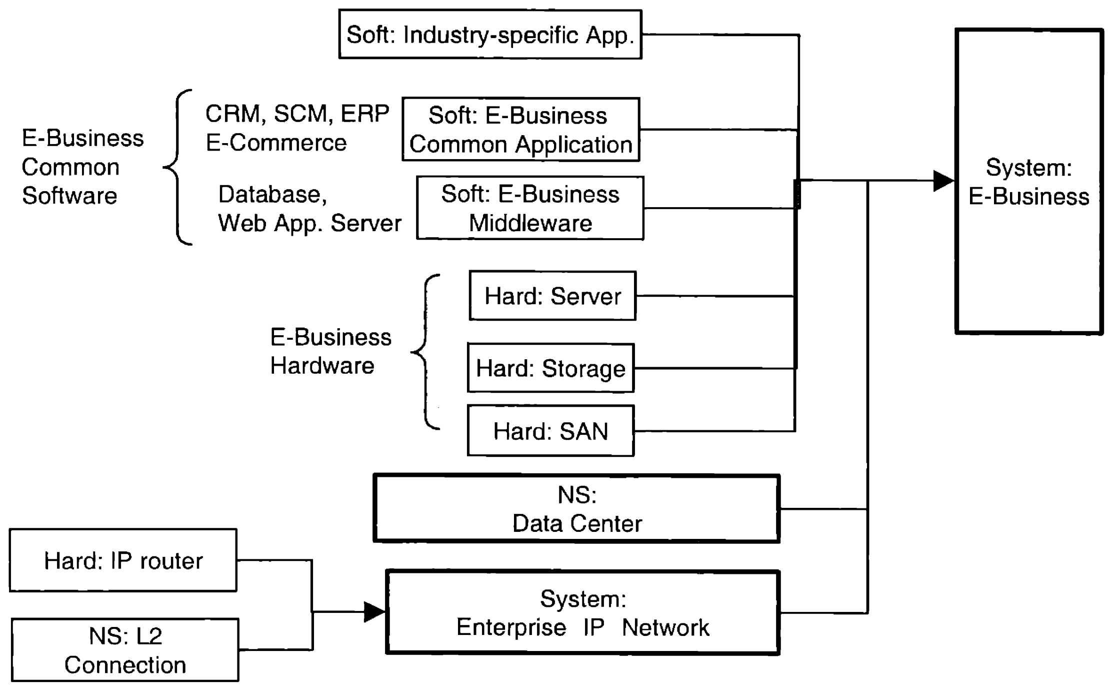


Figure 6-1 Technology chain for E-Business system

Figure 6-2and Table 6-1 show the organizational chain and the business capability-organization map, respectively. E-Business is still in phase E. Current customers are class E customers and most common E-business applications do not perfectly fit their requirements. Hence, the development of customer-specific applications on top of common applications is essential. In addition, common application vendors exist on the one vendor per one function (application) basis. Hence, integrating software from different vendors and securing system integrity are the key competency of system integrators. Table 6-2 shows the DSM structure of the E-Business value chain.

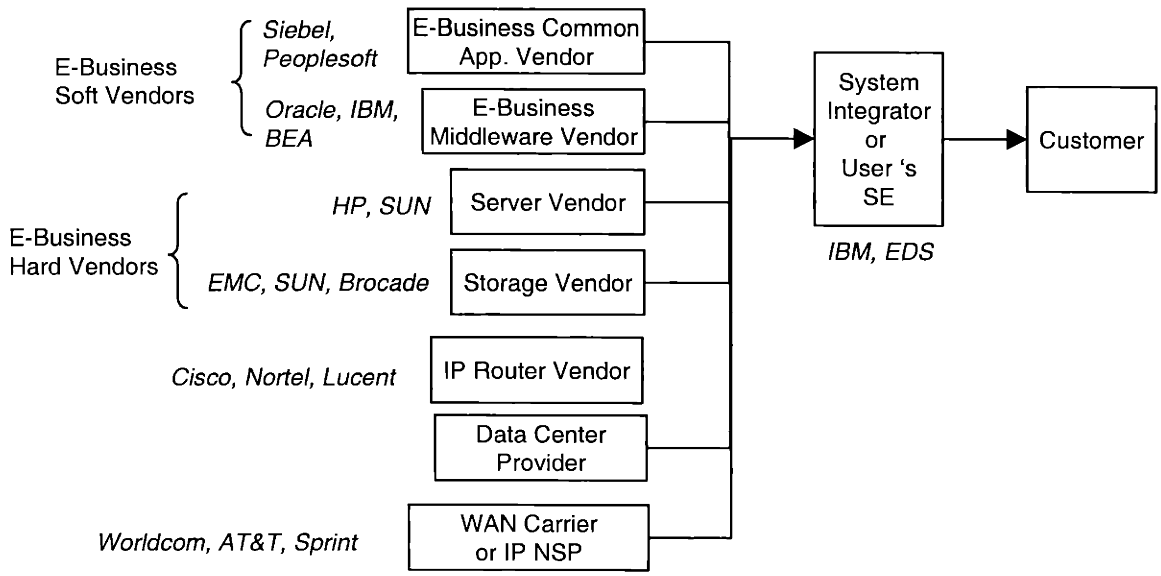


Figure 6-2 E-Business Organization Chain

Table 6-1 BC-Org map of E-Business value chain (Type E)

Business Capability	Organization 1. SI, 2. Data center provider, 3. NSP, 4 Common Apps Vendor, 5 E-Business Middleware Vendor, 6. E-Business hardware vendor					
Description	1	2	3	4	5	6
Customer Acquisition E-Business System DS Customer-Specific App DSM Enterprise IP DS	X					
Data center service E-Business System M E-Business Middleware M E-Business Common Apps M E-Business Hardware M	X	X	X			
Managed service Enteprise IP			X			
E-Business Common Apps DS				X		
E-Business Middleware DS					X	
E-Business Hardware DS						X

Table 6-2 DSM structure of E-Business Value Chain

	Design	Supply	Management
Integration Force	Weak	Weak	Weak
Integrator	SI	SI	Data center provider + Managed network provider

6.3. Ongoing Dynamics

6.3.1. Indications of Design Chain Integration by Middleware Vendors

There are a few middleware vendors that are trying to integrate the design chain of E-Business software.

BEA, a Web application server vendor, is one example. BEA seems to be seeking the virtual integration of the design chain through alliances with other E-Business application vendors. Table 6-3 shows BEA's recent corporate activities.

Table 6-3 BEA's Virtual Integration Activities

Date	Description
July 12, 2000	announced a strategic alliance to integrate Broadbase's market-leading analytic and marketing automation applications with BEA WebLogic Commerce Server™ and BEA WebLogic Personalization Server™, and to jointly market the product sets.[70] .
November 15, 2000	announced a strategic alliance under which BroadVision has agreed to embed BEA WebLogic Server™ within BroadVision One-To-One Enterprise®, BroadVision's e-business application platform. The two companies have agreed to engage in collaborative engineering and marketing initiatives. Together, the companies will supply next-generation e-business solutions that combine the market's leading Java-based application server with the leading e-business software applications.[71]
November 29, 2000	Peace Software has built Energy™ Version 6 using BEA WebLogic Server™, the market-leading J2EE Web application server. The new WebLogic-powered Energy solution is designed to streamline customer and commodity management for the retail energy industry. [72]
May 1, 2001	announced a global strategic alliance with Ariba,® Inc., under which BEA WebLogic® Server will be a core infrastructure upon which Ariba's B2B solutions will be based -- including Ariba Dynamic Trade™, Ariba Buyer™, and Ariba Sourcing™. Ariba Dynamic Trade and Ariba Sourcing are built on BEA WebLogic Server today, and Ariba Buyer will embed BEA WebLogic Server in future releases. In addition, BEA announced that it has become a Gold Level Partner in the Ariba Partner Marketing Program.[73] .
June 5, 2001	Bowstreet (www.bowstreet.com), a pioneer in WebServices automation, and BEA, today announced a global strategic alliance to accelerate their customers' ability to create, assemble and deploy integrated e-business solutions based on Web Services. The two companies will collaborate on the development, co-marketing and selling of solutions that combine their

	market-leading products. [74]
June 6, 2001	BEA Systems and PeopleSoft a leader in providing e-business applications, today announced that they are collaborating to create open standards integration for PeopleSoft customers. [75]
June 7, 2001	Siebel Systems, the world's leading provider of eBusiness applications software, and BEA Systems, today announced that they will expand their relationship to deliver complete, integrated customer-centric solutions to enterprise organizations. Siebel Systems and BEA have agreed to collaborate on the delivery of an application adapter between Siebel eBusiness Applications and BEA WebLogic® Integration. In addition to joint marketing and targeted sales efforts, the collaboration further extends integration development between Siebel eBusiness Applications and the BEA WebLogic E-Business Platform™. [76]
Sept 28, 2001	BEA's WebLogics will support the Edge Server Include mark-up language developed by Akamai [77]

On the other hand, Oracle is trying to vertically integrate the E-Business software, developing a gamut of E-Business software products by themselves. Figure 6-3 shows Oracle's product line for E-Business[78] . Oracle argues that an integrated suite product can achieve higher system manageability than "best-of-breed" integration on the one vendor per one application basis. In addition to Oracle and BEA, SAP is also providing a suite application for E-Business[79] .

E-Business Suite (Built-In Integration)		**Multi-Vendor (Complex Integration)**
Oracle	Marketing	E.piphany
Oracle	Webstore	BroadVision
Oracle	Sales	Siebel
Oracle	Support	Clarify
Oracle	Procurement	Ariba
Oracle	Supply Chain	i2
Oracle	Accounting	SAP
Oracle	Human Resources	PeopleSoft
Oracle	Application Server	BEA
Oracle	Database	IBM

Source: Oracle Corp.

Figure 6-3 Oracle's product line [78]

As the result of the re-integration effort by these companies, the value chain structure may shift from type E to type M1. The new value chain may allow the market to expand into medium-sized businesses. In particular, Oracle is trying to expand its business into medium-sized businesses by involving its resell partners in customers' system implementation[80] .

6.3.2. Emergence of Industrial Value Providers

The re-integration of the design chain by middleware vendors is creating "industrial value providers", pressing some application vendors to re-build their competitive advantages with the focuses on specific industries. For example, Siebel[81] is now trying to be a solution provider for selected industries, which are finance, healthcare, insurance, communications, energy, consumer sector (retailer, wholesaler), life sciences, public sector, automotive, and travel-and-transportation. Sybase is also promoting their vertical solutions for financial, healthcare, communications, public (government), and consulting services[82] .

6.3.3. Integration of IT and Network Services

As E-Business implementation is becoming a major application of enterprise data networking, how to integrate IT-related business (system integration business) is a major strategic agendum for telecommunication carriers. There is difference in carriers' integration strategies between the design chain and the management chain.

In the design chain, long-distance carriers have chosen to take virtual integration strategy, forming alliances with system integrators. For example, Worldcom changed its strategy for this issue from vertical integration to virtual integration. Worldcom used to own a subsidiary, MCI Systemhouse, as its system integration arm. However, on February 11, 1999, Worldcom announced an strategic outsourcing agreement with EDS, in which Worldcom outsources major portion of its IT services from EDS and, in return, EDS outsources the bulk of its global network to Worldcom [83] . In this alliance, EDS acquired MCI Systemhouse. AT&T has also formed an strategic alliance with IBM[84] . In an agreement in 2000, AT&T acquired IBM Global Network, and IBM agreed to have e-Business Hosting Centers in 9 AT&T data centers[85] . On the other hand, SBC took a vertical integration approach, acquiring a system integration company, Sterling Commerce, Inc., in February, 2000 [86] .

On the other hand, in the management chain, carriers are pursuing vertical integration. For example, Worldcom acquired Intermedia in September 2000 and gained the majority ownership of Digex, a major Web hosting company[87] . AT&T is also enhancing its hosting services with an alliance with IBM[85] . Both companies are seeking to be a one-stop-shopping place for enterprise customers[88] by integrating the management chain vertically from network element to data application. However, neither of the two companies is trying to become an application service provider (ASP). Instead, they are trying to host ASPs on their platform. In 2000, AT&T introduced its program, "AT&T's Ecosystem for ASPs". In this program, AT&T provides ASPs hosting services including data storage and content distribution[89] . Mr. Fred Briggs, the CTO of Worldcom, also states that Worldcom does not want to become an ASP and that it aims to become an infrastructure, providing "picks and shovels" for ASPs[90] .

6.3.4. Application-level Voice-Data Convergence

In terms of adoption lifecycle, the market for telephony-integrated application systems is still in phase E . The dis-integraition of VoIP components, which I described in chapter 2, increases system complexity. Until any vendor takes initiatives in integrating the design chain of the entire system, the value chain will remain type E and system integrators will play a major role in securing system integrity.

In the future transition from phase E to phase M, some vendors will integrate the design chain. Such vendors could be IP router vendors, e.g. Cisco or Nortel, or E-Business platform dominators, e.g. BEA or Oracle. As shown in Table 6-5, Cisco is trying to extend its control in the IP domain to E-Business-integrated call control applications. One of the reasons may be that there is not yet a strong E-Business platform dominator. Once an E-Business platform dominator emerges, Cisco will establish partnership with it for further design chain integration.

In addition to the design chain integration, the management chain integration will also be essential to achieve enough system availability, while reducing customers' management task. Hence, carriers will integrate the management chain, tightening the relationship with system integration partners or subsidiaries

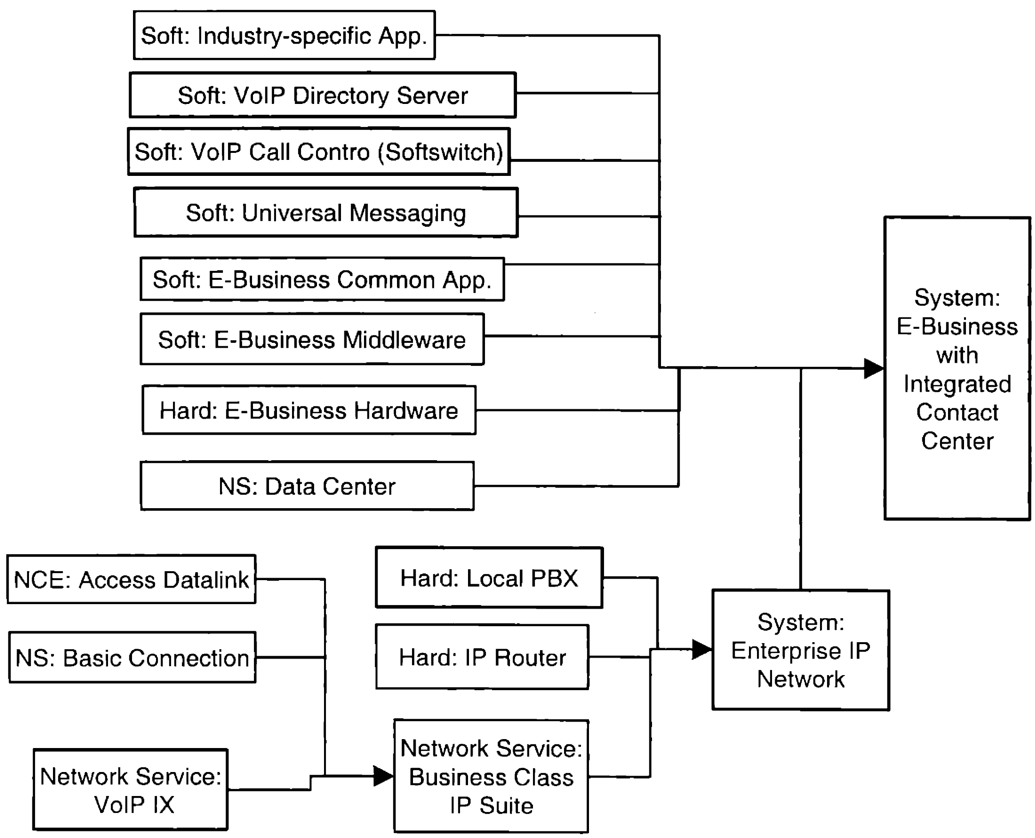


Figure 6-4 Technology Supply Chain for VoIP with application-level convergence

Table 6-4 Cisco In-house development activities for VoIP with application-level convergence

July 31, 2001 - Cisco Systems, Inc., ... announced ... new solution enhancements for the Cisco Internet Protocol Contact Center (IPCC) solution. With this announcement, Cisco is solidifying its position as a complete, IP-based end-to-end contact center solution delivering a viable ACD (automatic call distributor) alternative. ... Some new enhancements to the Cisco IPCC solution include increased application integration from the Cisco Intelligent Contact Management (ICM) 4.6 software, a key component of the Cisco IPCC solution, which features Cisco's new computer telephony integration (CTI) platform - the Cisco CTI Object Server (CTI OS). ... The new release of the Cisco IPCC solution will be available in Q3 of 2001 through Cisco and the following system integration companies: eLoyalty Corporation, Fulcra Solutions, Hewlett-Packard Consulting, IBM Global Services, Innova Solutions, KPMG Consulting, Inc., NetEffect, and Spanlink Communications. Pricing for the Cisco IPCC solution is dependent on configuration. [91]

Table 6-5 Cisco Partnership Program for VoIP with application-level convergence

Program	Description
Cisco AVVID Partner Program Customer Contact partner solutions	*"Customer Contact partner solutions provide innovative customer care enabling enterprises to engage, acquire, and retain customers in the Internet economy. These solutions help companies reduce operational costs and increase customer satisfaction, essential to gaining competitive advantage."* [92]
Cisco Powered Network – Unified Communications Solutions	*"The new designation-- Cisco Powered Network-Unified Communications Solutions (CPN-UCS)-- allows service providers targeting the unified communications market, to deliver differentiated service offerings to their customers by creating a high performance, reliable and secure integrated technology infrastructure"*.[93]
Cisco Service Providers Solutions Ecocystem	*"... Since the program was first launched in 1999, the Cisco Ecosystem has grown steadily by attracting best of breed Partners who work closely with Cisco to make sure their services or solutions provide real tangible benefits to service provider customers. Cisco and its Partners offer a wide range of solutions for Packet Telephony, Voice Applications, OSS/BSS, Broadband Access, Content Delivery, Wireless & Security Solutions and Integration/Deployment. ..."* VoIP partners mentioned in the press release: VocalData (softswitch), CoManage (OSS); Dialpad (telephony applications); E-go System, Ltd (voice); Gallery IP Telephony (voice); Gemini Voice Solutions (voice) Innomedia (voice); IP unity (voice); Italtel S.P.A. (softswitch); Itelco (voice); MediaRing.com Ltd. (voice); Opnet (optical/OSS); Telspec PLC (voice); and Wavve (OSS/BSS provisioning). [94]
Interoperability with ipVerse (softswitch)	*... ipVerse, a leading supplier of open softswitch solutions bridging voice and packet-based networks, has successfully completed interoperability with the Cisco System "Any Service, Any Port (ASAP)" architecture for its AS5000 series of universal gateways and ipVerse's signaling and call control platform, ControlSwitch,*

	in ipVerse's advanced testing labs. ...[95]
Interoperability with Openwave (unified messaging soft)	*Openwave Systems, Inc. (Nasdaq:OPWV), the worldwide leader of open IP-based communications infrastructure software and applications, today announced immediate availability of version 3.0 of the Openwave Unified Messaging solution. This third generation solution is a critical component of Openwave's broad Messaging Services strategy. ... Openwave's Unified Messaging is also designed to work with Cisco's AS5300 voice gateway and AS5350 and AS5400 universal gateways. ...[96]*

6.4. Future Dynamics: Architectural Innovation by WebServices or .NET

A few middleware vendors seem to be trying to establish platform dominance. However, no strong platform dominance may emerge as long as they keep seeking class E and ML customers. The next dynamics for market diffusion may be business model innovation accompanied by architectural innovation that can address class MM and L customers. This may be Web services or Microsoft .NET.

6.5. Summary

The key findings of this chapter are as follows:

1. The value chain for E-Business system integration is still phase E. However, there are some indications that a few middleware vendors are trying to take design leadership and form type M1 value chains.
2. Synchronized with the platform leadership activities by middleware vendors, some application providers and system integrators are trying to become industrial value providers, re-building their competence with focuses on specific industries.
3. Carriers are strengthening their efforts in IT hosting services, integrating the management chain from data centers to network elements.

7. Strategies Proposed for Telecommunication carriers

7.1. Introduction

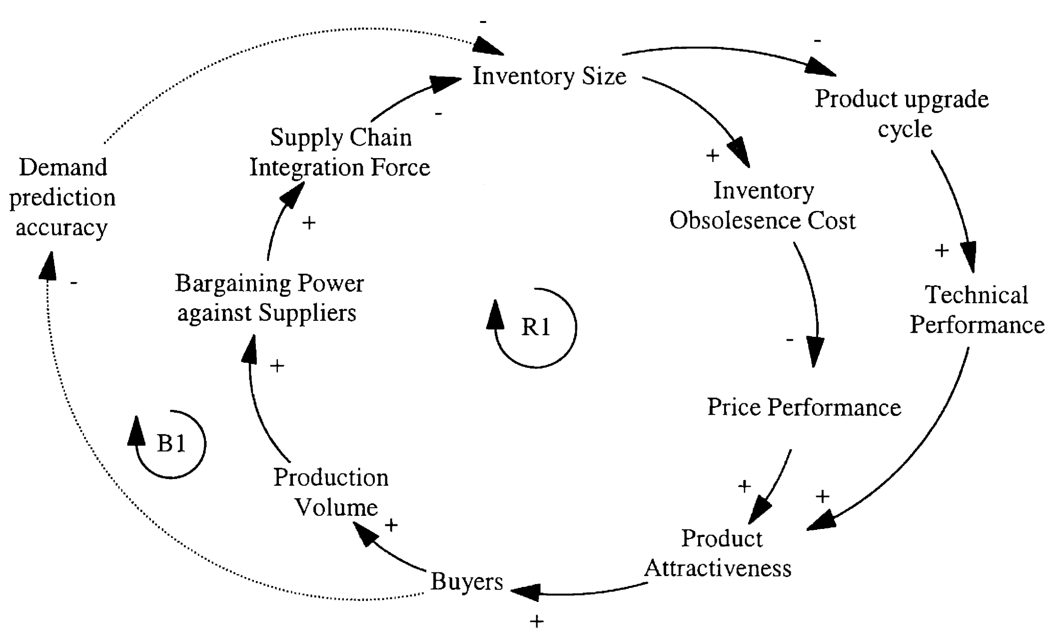
Having described the future value chain dynamics in the telecom industry, I propose in this chapter a business model for telecommunication carriers, which shows how carriers should build sustainable competitive advantages in future M2 and M3 value chains.

The first strategic agendum is whether telecom carriers should stay at customer front-end with a type M2 value chain or become back-end network providers in type M3 value chains. My answer to this question is that they should do both. The reason for staying at customer front-end is that carriers have already established their brands and got the base of loyal customers. As I describe in 7.2, the base of loyal customers is a valuable strategic asset in high-clockspeed industries where the accuracy in demand forecast is critical[27] . The reason for doing business as back-end network providers is that, in terms of customer intimacy, carriers will not be able to excel industrial value providers emerging in the E-Business value chain. In addition, by offering back-end network services to these industrial value providers, carriers can keep them from building their own infrastructure and acquiring comparable network operation skills [97] .

In sections 7.2 and 7.3, I analyze the business models of Dell and Quanta, two competitive companies in the PC hardware industry. The analysis on Dell shows how a system provider can build sustainable competitive advantages in a M2 value chain. On the other hand, the analysis on Quanta shows possible strategies of a back-end system provider to build sustainable competitive advantages in a M3 value chain. In addition, I analyze the business model of VISA, a back-end network provider in the payment industry. This analysis shows that a back-end network provider can expand its business, by creating network effects through co-branding with front-end service providers. Finally, I derive a business model for a telecommunication carrier by combining the sustainable competitive advantages of the three companies, i.e. Dell, Quanta and VISA.

7.2. Sustainable Competitive Advantage in a Type M2 Value Chain (Analysis on Dell)

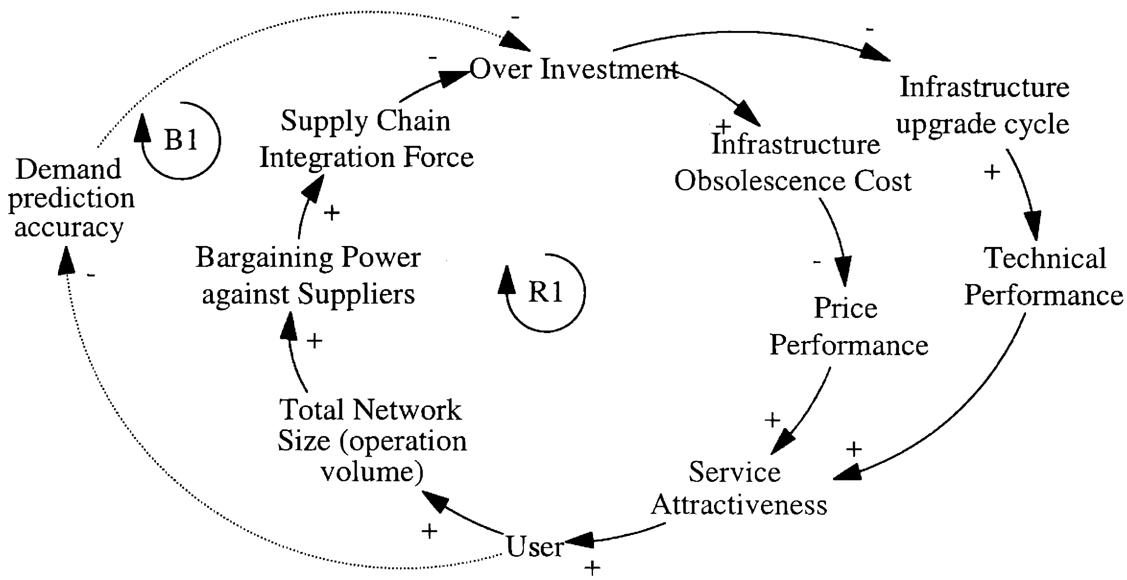
The essence of Dell's competence is a capability to form a M2 value chain, by virtually integrating the supply chain. Figure 7-1 shows how Dell was able to reinforce its competitive advantage in its early days. I refer to this model as "Dell 1". The core dynamics of this model is a positive feedback reinforcing the supply chain integration force (R1: supply chain integration loop); Integrating supply chain reduces the inventory size of PC parts, raising product attractiveness in terms of both technical and price performance. The enhanced attractiveness generates more buyers and thus strengthens the Dell's bargaining power against suppliers, enabling Dell to tighten its supply chain.



(R1: Supply Chain Virtual Integration Loop, B1: Inaccurate Demand Prediction Loop)

Figure 7-1 Dell-1 Business Model (positive feedback effect of supply chain integration)

Note that this supply chain virtual integration loop is also valid in any industries with fast technology upgrade cycle. Figure 7-2 shows how this loop applies to the telecommunication industry. In the telecommunication industry, the accelerated development lifecycle of network access technologies, such as always-on ISDN, xDSL, Fiber-to-the-Home,and WiFi (802.11), is now causing a great investment risk for network service providers [27] . Longer procurement delay and less accurate demand forecast lead to higher infrastructure obsolescence cost. Hence, integrating the supply chain and improving the accuracy in demand forecast create competitive advantages in telecommunication services, too.

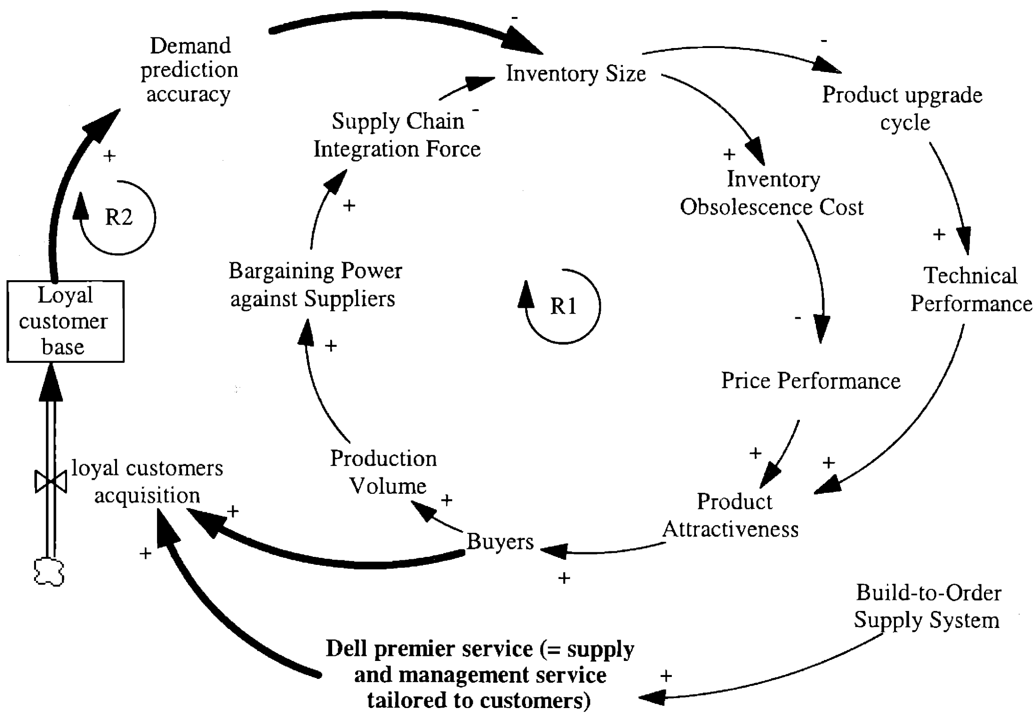


(R1: Smart Investment Loop, B1: Inaccurate Demand Prediction Loop)

Figure 7-2 Telecom Carriers' Competitive Advantage comparable to Dell-1

However, this model is too simple to explain current Dell's dominant position in the PC market. In fact, the model contains a balancing loop. As Dell buyers increase and the customer base expands, the demand prediction gets less accurate. This spoils the effect of the virtual integration and increases the inventory size. In addition, all the variables in the supply chain virtual integration loop (R1) are temporary. Hence, if any one of the parameters got worse, the loop would suddenly start running in the reverse direction. In order to create sustainable competitiveness, a company must build "non-fluid" strategic assets (or ***"strategic stocks"***) through its business activities. Figure 7-3 shows how Dell overcomes these problems and builds non-fluid strategic assets. I refer to this model as "Dell 2". Dell builds loyal customer base with its "Dell

Premier" service. Taking advantage of Dell's unique "build-to-order" supply system, Dell Premier service enables customers to define their own versions of products. In addition, Dell Premier pages include technical support, diagnostic tools, Return Material Authorization forms, and practical tools for commerce and help disk activities and order status[98] . On the Dell side, Dell Premier improves the efficiency in customer support by standardizing customers' PC desktop configuration on a corporate-wide basis and having these configuration data in Dell's database. On the customer side, customers benefit from the reduced PC configuration and management tasks. As the result, Dell Premier builds loyal customer base, enabling Dell to predict demands more accurately. Large companies and institutes account for 75% of Dell's business. Dell has been aiming to derive half of its business from the Web by providing dedicated salespeople and by designing customized Web sites[99] .



(R1: Supply Chain Virtual Integration Loop, R2: Loyal Customer Creation Loop)

Figure 7-3 Dell-2 Business Model

Dell Premier is a good example of concurrent engineering for the total optimization of product (design), supply and management. In other words, system providers cannot provide services comparable to Dell Premier without having both back-end manufacturing and front-end sales organizations and re-defining the business processes of two organizations simultaneously for a shared strategy. This leads to Dell's competitive advantages over front-end PC vendors in type M3 value chains.

Telecom carriers will also be able to build competitive advantages by providing services like Dell Premier and reinforcing their loyal customer base. Table 7-1 shows an example of telecom version of Dell Premier, which reduces customers' network and application maintenance cost.

Table 7-1 Telecom Premier Services in parallel with Dell Premier

	Dell Premier	Premier Managed Network Services/ Premier Internet Services
Customer segments	large enterprises, governments	Intranet: e.g. large enterprises, governments B2B: e.g. industrial extra-net B2E: e.g. life insurance companies B2C: e.g. educational institutes, security trading company
Customized products	PC with pre-installed desktop applications	1. Managed network service with a set of supported network applications 2. Internet service with a set of supported network applications
Customization factors	desktop applications: office tools, business applications	1.User router configuration 2.Network applications: PP2P, VoIP, conferencing, e-learning, E-Business applications, instant messaging, and etc
Provider services	supply & management	supply, installation, and management
Customer benefit	reduced installation, maintenance tasks	reduced installation, maintenance tasks
Provider benefit	loyal customer base efficient technical support	loyal customer base efficient technical support

7.3. Sustainable Competitive Advantage in a Type M3 Value chain (Analysis on Quanta)

As shown in Figure 7-4, the Dell-2 model does not create sustainable advantages for a back-end system provider in a type M3 chain, because loyal customer base is owned by a front-end system provider. This suggests that a back-end system provider must somehow create other strategic stocks to sustain its competitiveness.

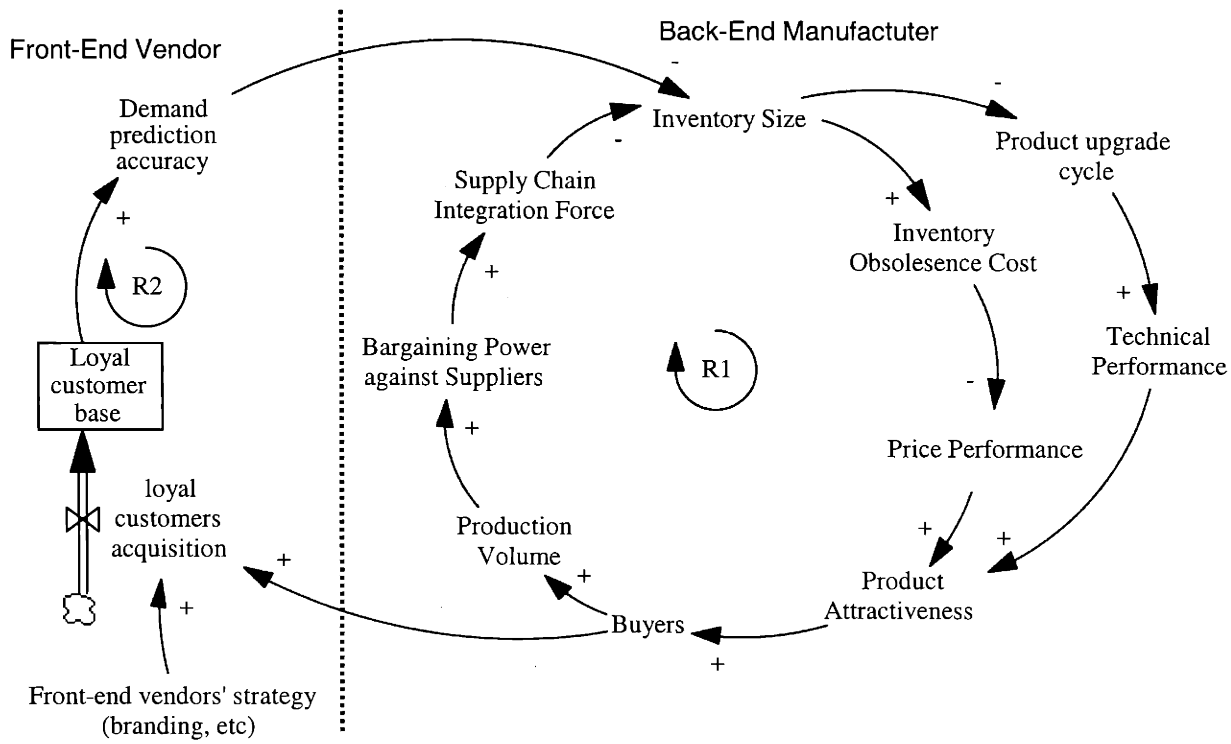
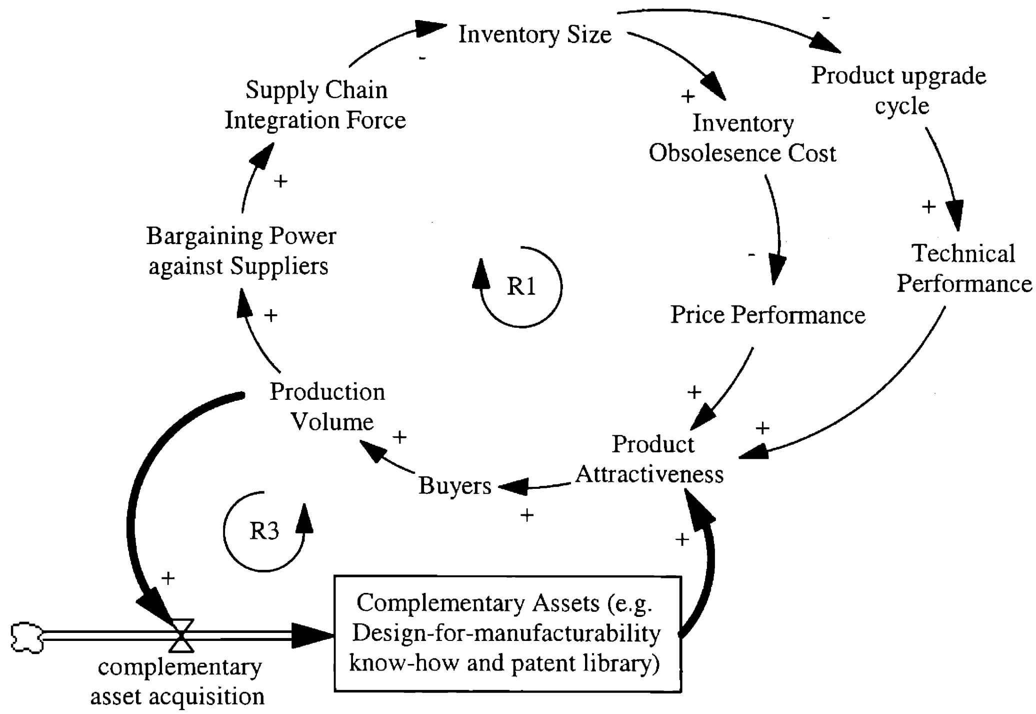


Figure 7-4 Dell-2 in a M3 value chain

Figure 7-5 shows how Quanta, a back-end note PC manufacturer, builds its strategic stock and sustainable competitive advantages. Like Dell, Quanta creates its value with its supply chain integration capability. However, at the same time, taking advantage of the manufacturing volume, Quanta builds complementary assets around its core capability (supply chain integration capability). In Quanta's case, such complementary assets include "design-for-manufacturability" know-how and patent libraries.



(R1: Supply Chain Virtual Integration Loop, R3: Complementary Asset Acquisition Loop)

Figure 7-5 Model for Quanta's reinforcing competitive advantage

Similarly, telecommunication carriers should build complementary assets other than supply and management skills, taking advantage of large-scale network operations in type M3 value chains. Table 7-2 shows examples of complementary assets. In addition to design knowledge, carriers may be able to build the position to aggregate contents, applications and ASPs and offer front-end service providers a choice of contents/applications to complement their unique values. For example, AT&T's Ecosystem for ASPs[89] may eventually make AT&T an ASP aggregator..

Table 7-2 Application of Quanta's business model to telecom carriers

	Quanta	Telecom Carriers
Core Capability	manufacturing and supply process	manufacturing and supply process
Complementary Assets: Design Knowledge	"Design-for-manufacturability" know-how and patent library	"Design-for-manageability" know-how and patent library (see Note 1)
Other complementary assets		Position to aggregate contents, applications, and ASPs

Note 1: For example, NTT Communications has developed a system architecture for manageability,

called "SMART = Scalability, Manageability, Availability, Reliability and Tractability". The company is promoting concurrent engineering in which the company, as a data center provider, gets involved in system design phase and minimizes system heterogeneity in order to reduce the per-system management cost [100] .

One issue to be considered is brand conflict. In order to avoid the conflict with customers, Quanta keeps its policy not to have products with its own brands. However, since most telecom carriers have already established their brands, it would not be a wise idea to give away these strategic assets. Besides, even in the Quanta's business, Quanta could alternatively seek a "co-branding" strategy, e.g. putting "Finished by Quanta" seals to manufactured products. As I analyze in the next subsection, co-branding creates a stronger business model particularly in industries in which network effects create customer benefits.

7.4. Sustainable Competitive Advantage of a Back-End Network (Analysis on VISA)

VISA is a competitive back-end network provider with a strong co-branding strategy[101] . As shown in Figure 7-6, VISA does not issue credit cards directly to consumers. In this sense, we can view VISA as a back-end provider in a type M3 value chain. Most important, consumers recognize two brands, VISA and a card issuer's brand. However, this does not create brand conflict. It rather makes effective "co-branding" by a "**network brand**", e.g. VISA, and a "customer intimacy brand", e.g. a card issuer's brand. For example, "Starbucks VISA card" is a combination of two strong brands. In this example, while Starbucks stands for life-style, VISA stands for the standardized usage and wide usability of the credit card.

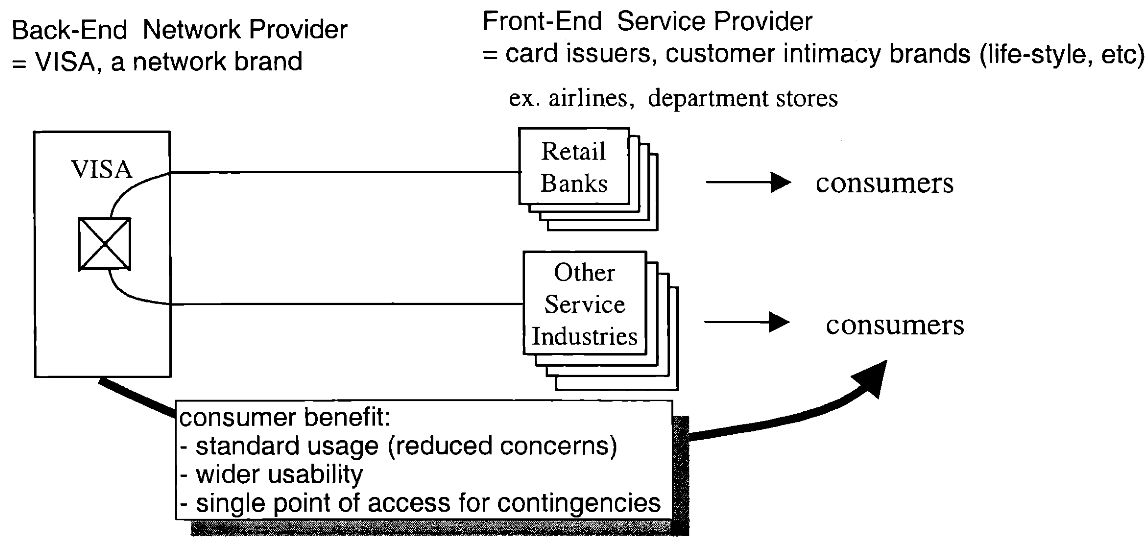
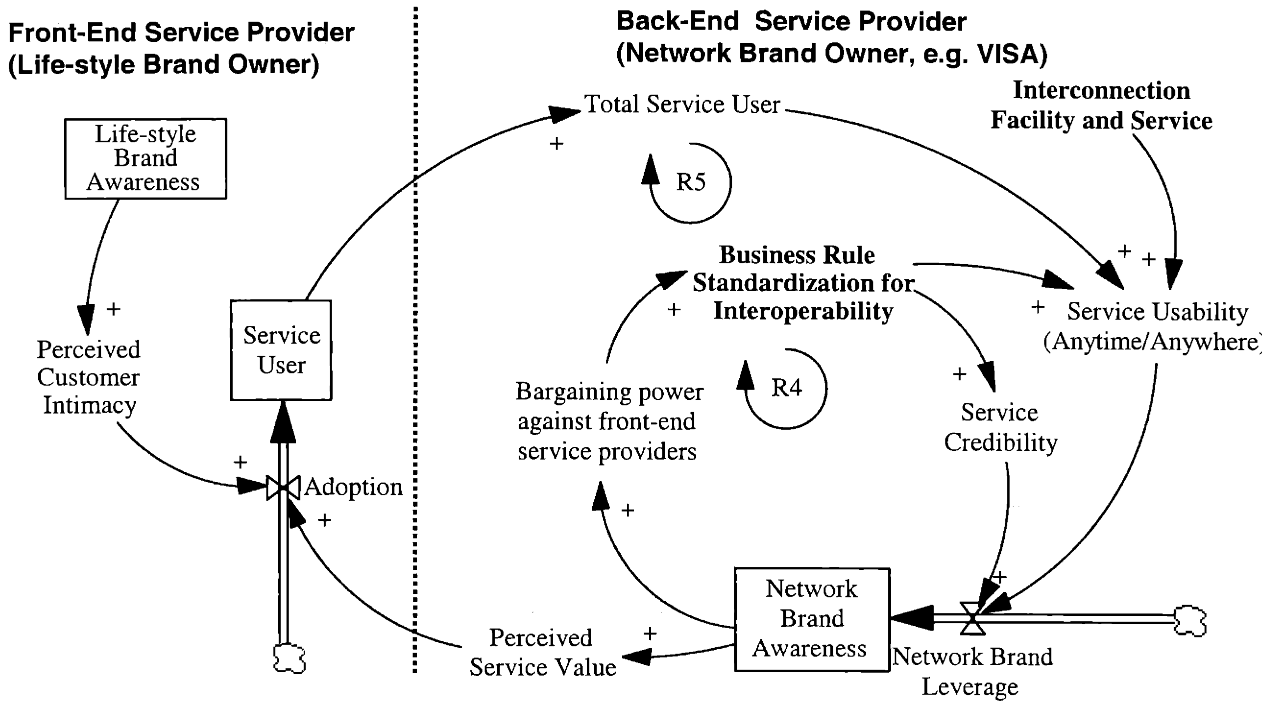


Figure 7-6 Value Chain of the Payment Industry

Figure 7-7 shows how VISA, a back-end network provider, reinforces its competitive advantages. The model contains two key points. First, a back-end network provider provides the infrastructure and services for the inter-operation between front-end service providers. Second, by taking leadership in standardizing business processes and rules for card payment, VISA makes consumers associate the VISA brand with a set of basic usage rules.

This co-branding will also be a vital model for telecom carriers in expanding their customer base through type M3 value chains with other strong "industrial" or "life-style" brand owners. Figure 7-8 and Table 7-3 show a back-end network business model for telecommunication carriers in parallel with VISA's.



(R4: Business Rule Standardization Rule, R5: Network Effects Loop)

Figure 7-7 Model for VISA's reinforcing competitive advantage

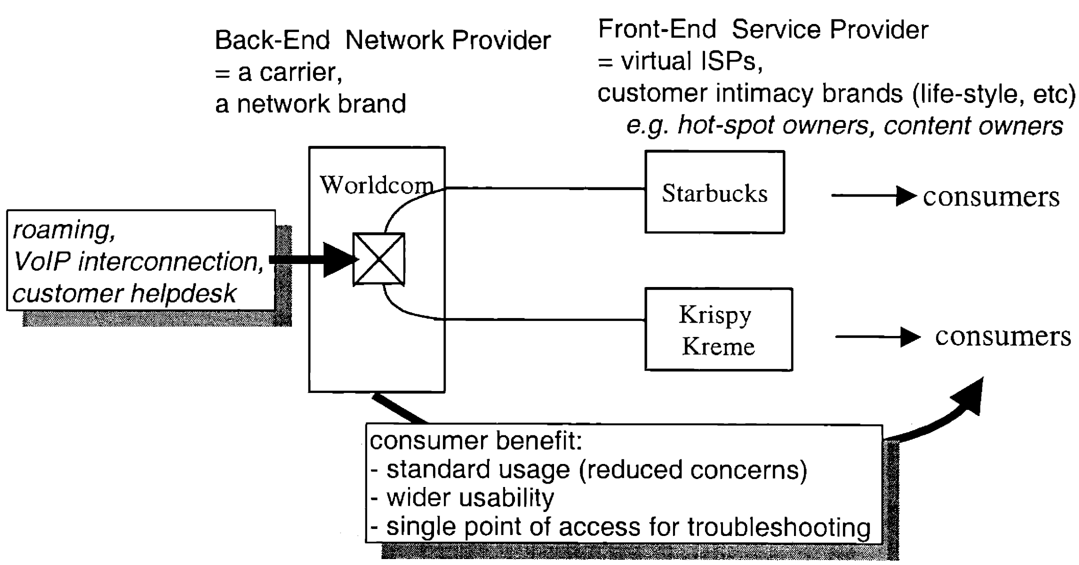


Figure 7-8 Back-end Network Business Model for Telecommunication Carriers

Table 7-3 VISA-like network services for telecommunication carriers

Back-End network provider	VISA	Carrier
Front-end service providers	Retail banks, department stores, airlines, any customer-intimacy brand owners	Virtual ISPs : hot-spot owners, content owners, any customer-intimacy brand owners)
Back-end network infrastructure	Settlement infrastructure, e.g. VISANet	Roaming and VoIP interconnection facilities
Back-end network services	- Settlement, - Customer support desk	- Roaming with settlement -VoIP interconnection with settlement - Customer support desk
Core value of back-end network service	- Wide usability - Standardized usage rules - Single point of access for contingencies/troubleshooting	

7.5. Summary (Business Models for Telecommunication Carriers)

The three competitive business models, Dell, Quanta, and VISA, can be integrated and applied to a telecommunication carrier as shown in Figure 7-9 and Figure 7-10. The key points are as follows:

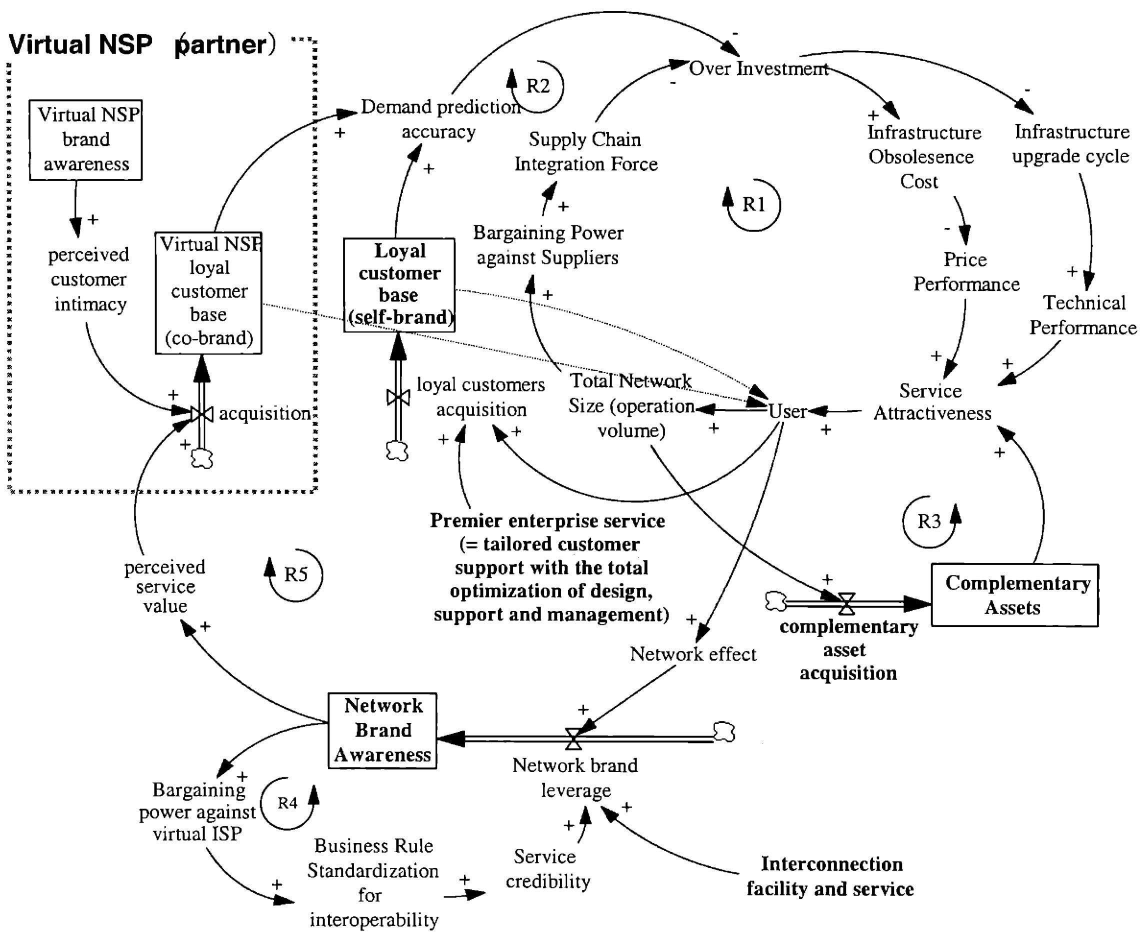
1. For enterprise customers, a carrier should provide **tailored supply and management services** like "Dell Premier". In these services, carriers should enable customers to customize network services to reduce their SE and network management cost. Examples of such customization include the configuration of routers and the installation and technical support of network applications.

2. A carrier should **partner with industrial value providers and virtual ISPs** and sell its network service through co-branding with these partners. In co-branded network services, a carrier should provide flexible network service, enabling these partners to customize and define their own network services.

3. In co-branded network services, a carrier should provide a VISA-like **back-end network services**, including roaming and VoIP interconnection settlements. A carrier should also take initiatives in standardizing business rules for roaming and interconnection and establish its brand as

a sign of common rules and wide usability.

4. In co-branded network services, a carrier should **fulfill the network operations** for front-end service providers. Taking advantage of its high operation volume, a carrier should build the following three competitive advantages. First, it should build efficient supply and management chains. Second, it should accumulate **design-for-manageability** know-how and proprietary technologies. Third, it should build a position to **aggregate contents, applications and ASPs**.



(R1: Smart Investment Loop, R2: Loyal Customer Creation Loop, R3 Complementary Asset Acquisition Loop, R4: Business Rule Standardization Loop, R5: Network Effect Loop)

Figure 7-9 Model for a telecom carrier's sustainable competitive advantage

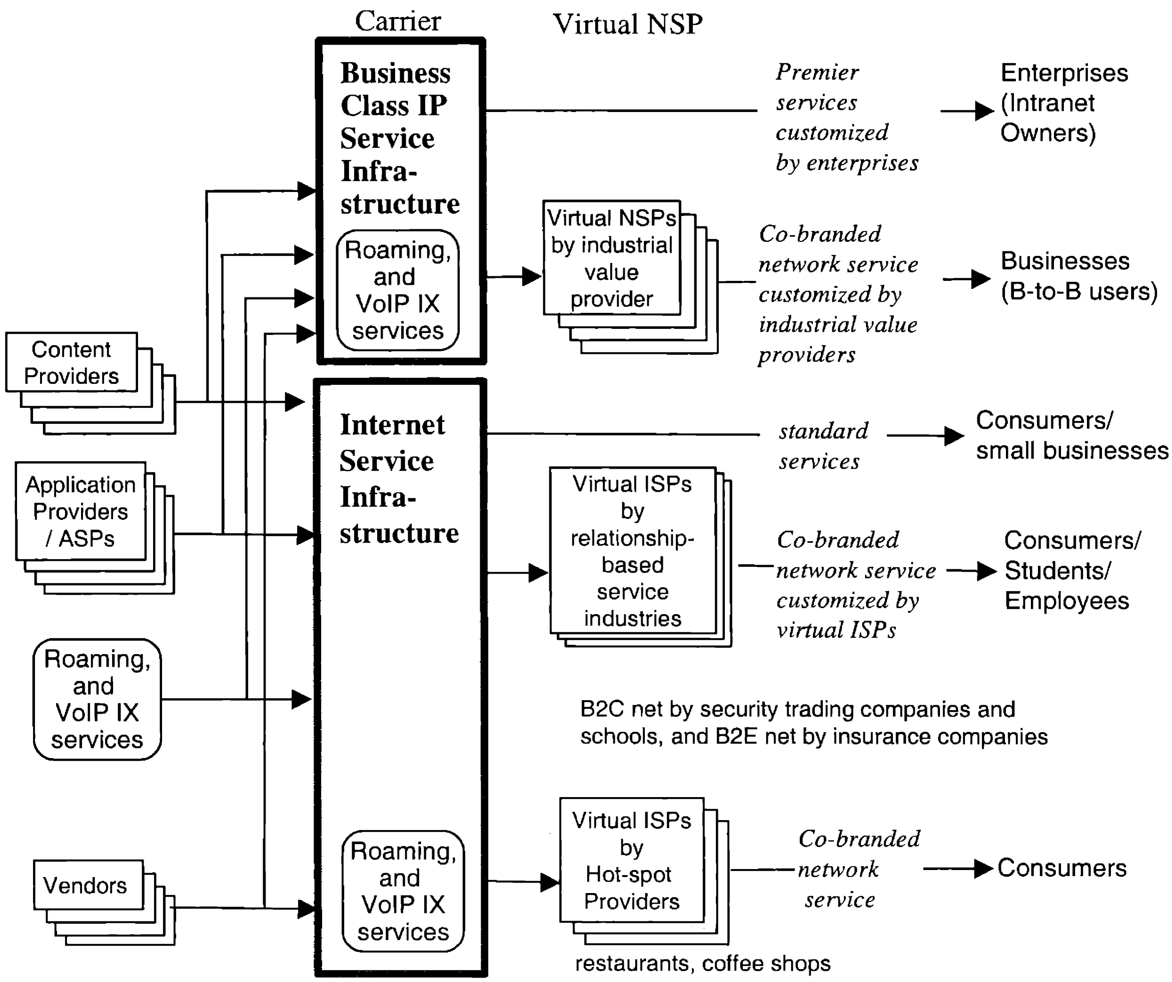


Figure 7-10 Value chains based on the proposed business model

8. Conclusion

The ultimate objective of this thesis is to identify carriers' strategy to re-build competitive advantages in future converged networks. I first analyzed the current value chains for telecommunication services and predicted how they will change in the future. Then, building on the prediction about future telecom value chain dynamics, I proposed future strategies.

I describe below the key points of each chapter and show how these key points are interrelated in Figure 8-1.

In chapter 2, I showed that the revenues of telecommunication carriers still largely account for traditional telephones despite the recent rapid evolution of IP services. In addition, I described that the death of bandwidth and distance, driven by optical transport technologies, will change carriers' business **from** selling **lines** (point-to-point connectivity) **to** selling **networks** (N-to-N connectivity). The advent of IP-VPN (IP virtual private network) and the migration of telephony applications to IP networks will change enterprise networking into "**business class IP suite**" services. In these services, carriers will provide reliable VPNs bundled with a set of applications such as E-mail, voice, fax, and Internet access (and data hosting as described in chapter 6). Similarly, the public services for consumers and small businesses will shift from telephony services to "**Internet access plus**" services, in which carriers provide Internet access services bundled with basic communication applications such as E-mail, voice, fax and the support for CPE-based VPN. In the long run, the two business models will converge. In this convergence, the Internet access plus services might take over business class IP suite services. Hence, although business class IP suite services are more profitable than Internet Access Plus services, it is important for carriers to be competitive in both markets.

In chapter 3, I presented frameworks to analyze telecom value chains. I basically adopted the customer classification by Moore, the technology lifecycle model by Henderson and Utterback, and the value chain dynamics model by Christensen and Fine, and the clockspeed value chain analysis by Fine. Then, I extended these frameworks by adding a new framework, DSM (Design, Supply, and Management) chain analysis. The DSM chain analysis captures three value chains, which are design (D), supply (S), management (M) chains, by probing a value chain from three angles, D, S, and M. For each of the three value chains, we examine whether the value chain is loosely integrated or tightly integrated and identify the chain master (the integrator of the value chain). This framework gives a clear view on the change in the power balance among organizations in a value chain.

In chapter 4, I conducted a fruit fly study, observing the PC hardware industry. The key finding is the re-integration of the value chains in the majority adoption phase (phase M).

Re-integrating a value chain means reducing the incoherence across organizations in the chain and thereby improving the integrity and efficiency of the business process (D, S, or M). There are two forms of re-integration, which are vertical integration and virtual integration. In vertical integration, an organization integrates a value chain by expanding its business along the value chain through acquisition or in-house development. In virtual integration, an organization integrates a value chain by developing tight partnership/agreements with the other organizations in the value chain.

First, a dominant component vendor, e.g. Intel in the case of the PC hardware industry, re-integrates the design chain, forming a **type M1 value chain**. The emergence of a type M1 value chain shifts the basis for competition among system vendors from technical expertise (knowledge about technology) to two other factors, which are **customer intimacy** (knowledge about customers) and

process superiority (supply and management efficiency). Many system vendors try to reinforce their customer intimacy. This causes system vendors to proliferate, segmenting the market with different customer focuses.

Then, some system vendors, e.g. Dell, try to excel others in process superiority, by re-inegrating the supply and management chains, forming a **type M2 value chain**. The emergence of a type M2 value chain favors large system vendors in terms of technical and price performance, because system vendors cannot re-integrate the supply and management chains without economy of enough scale. This dilemma between customer focus and economy of scale dis-integrates system vendors into **front-end** system vendors and **back-end** system manufacturers. This dis-integration creates a **type M3 value chain**.

Following a fruit fly study in chapter 4, I analyzed the value chain dynamics for IP network services in chapter 5 and for E-Business system integration in chapter 6, respectively. The key points of chapter 5 are as follows.

First, the value chain for IP network services is currently type M1. A few IP equipment vendors are taking leadership in the technical design of total network systems, by strongly influencing other component vendors with partner programs.

Second, there is a trend among **carriers** to form **type M2 value chains**. A piece of evidence is the introduction of managed network services, in which carriers fulfill the management of users' private networks, including network connectivity and network equipment. Another piece of evidence is the vertical integration of local and long-distance services.

Third, the emergence of strong carriers with superior supply and management skills will push niche service providers to outsource network operations from strong carriers, creating **type M3 value chains** with **front-end service providers** and **back-end network providers**.

The key points of chapter 6 are as follows. First, the value chains for E-Business system integration are currently type E. System integrators are still playing an essential role in securing the integrity of overall systems. Second, however, a few middleware vendors, such as Oracle and BEA, are now trying to form **type M1 value chains**. Synchronized with the activities by middleware vendors, some application vendors, such as Siebel and Sybase, and system integrators are becoming **industrial value providers** with focuses on specific industries. Third, carriers are adding IT hosting services to their portfolio of management services and thus integrating the management chain vertically from network element to data applications.

Following analyses in chapters 5 and chapter 6, I developed carriers' strategy for future converged networks in chapter 7. First, I analyzed the business models of Dell and Quanta, which are competitive companies in type M2 and M3 value chains, respectively. Then, I presented how their strategies can be applied to telecommunication services. In addition, I analyzed the business model of VISA, because the payment industry is with a type M3 value chain and VISA is a competitive back-end network provider. The key points for carriers' future strategy are as follows:

The first point is derived from Dell's strategy. Dell's core strength lies in the harmonization of process superiority and customer intimacy. With its "Dell Premier" services built upon its "built-to-order" supply system, Dell provides its supply and management services tailored to individual customers; Dell enables customers to define their own version of products by specifying installed applications and configurations and keeps these data in its database. Customers benefit from quicker order process and reduced installation and management tasks. On the other hand, Dell can improve the accuracy of demand predictions and efficiency of technical support. This can be viewed as concurrent engineering, which treats supply and management as an integrated issue and improves supply and management efficiencies at the same time. More important, Dell can build the base of loyal customers with Dell Premier. Following this approach, telecom carriers should provide "**Premier Managed Network Services**", allowing customers to define their own versions of services with a set of supported network applications and the configuration of routers and terminals. By providing end-to-end management services covering networks, clients and applications, carriers can reduce the management task of customers and reinforce their base of loyal customers. In addition, through this premier service, carriers will be able to acquire precise knowledge about customers' demands and thereby perform smart investment in infrastructures with accurate demand forecast. Similarly, carriers should provide "**Premier Internet Services**", allowing other organizations to define their own versions of Internet services. The customization factors include client configurations, domain name, portal, and bundled applications, contents and ASPs. After all, this premier Internet service will create "**virtual ISPs**", forming type M3 value chains. In addition, given that E-Business application vendors and solution providers are segmenting the market with industrial focuses, carriers should partner with these industrial value providers to develop premier network services tailored to individual industries. This includes an option to allow industrial value providers to customize carriers' network services and sell their own versions of network service as virtual network service providers.

The second point is derived from Quanta's strategy. Quanta's core competence lies in supply capability with strong supply chain management. But at the same time, taking advantage of its volume of manufacturing, Quanta is accumulating strategic complementary asses, such as know-how and a patent library in the area of "design-for-manufacturability". These complementary assets are important to make Quanta's competitive advantages sustainable, because know-how and a patent library are stocks while manufacturing volume is just a temporary variable.

Similarly, carriers should **build complementary assets** while providing back-end network services to virtual NSPs. Desired complementary assets include "**design-for-manageability**" know-how and a patent library and **the position to aggregate contents, applications and ASPs**.

The third point is derived from VISA's strategy. As a back-end network provider, VISA creates its value by standardizing business rules and providing facilities and services necessary for the interoperation between front-end service providers. It establishes its brand as a network brand, which conveys the network value of services to users, and sells its services with co-branding with customer intimacy brands. Similarly, as **back-end network providers** in type M3 value chains, carriers should create their values by standardizing business rules and providing facilities and **services** necessary for **the inter-operation between virtual NSPs at front-end**. Desired inter-operation services include the roaming, inter-connection, settlement, and customer helpdesk services for Internet access and VoIP calls. In doing so, carriers should establish their brands as network brands and expand their business with co-branding with virtual NSPs. With these inter-operation services for virtual NSPs, carriers should capture emerging hot-spot wireless ISPs as their virtual ISPs. This should widen the access modes of their network services.

To conclude shortly, carriers should realize the flexibility that enables users or other organizations to customize network services and should sell network services with both self-branding and co-branding strategies.

This thesis did not present implementation strategies. In fact, implementation strategies are much more critical. In [102] , Sull states that managers should ask "What hinders us" instead of asking "What should we do". His main point is that taking strategic actions for disruptive change without changing old organizational formula worsens company's situation. In [103] , Christensen makes a similar argument, pointing out organizational "**processes**" and "**values**" as the major elements of established organizational formula. Organizational processes mean organizational behaviors and norms, which include interaction, communication, and decision making. Organizational values mean priorities and attractive/unattractive decisions on new opportunities. Telecom carriers tend to seek business opportunities that cover a wide variety of users and thus are expected to generate billion dollars. One of the reasons for these organizational values is the high cost structure, e.g. per-person labor cost and overhead cost, of telecommunication companies. These ambitious organizational values sometimes lead telecom carriers to go through a slow business development process, creating a big plan, making consensus among multiple organizations, and producing too generic business concept. These values and processes may hinder carriers from creating flexible network services tailored to individual customer segments, because the **vertical focuses** on individual customer segments are required and service innovations for some customer segments may not be simultaneously applicable to other segments. Carriers should learn to "**think small**" and to have a small business unit introduce service innovations to targeted customer segments. This should be major required change in traditional corporate values and processes, and for this purpose carriers may have to remedy their cost structure. However, carriers should not completely forget the importance of creating economy of scale with a **horizontal** service **platform.** Therefore, the most important strategic topic for future telecommunication carriers is how to balance and mix vertical focus and horizontal scale successfully.

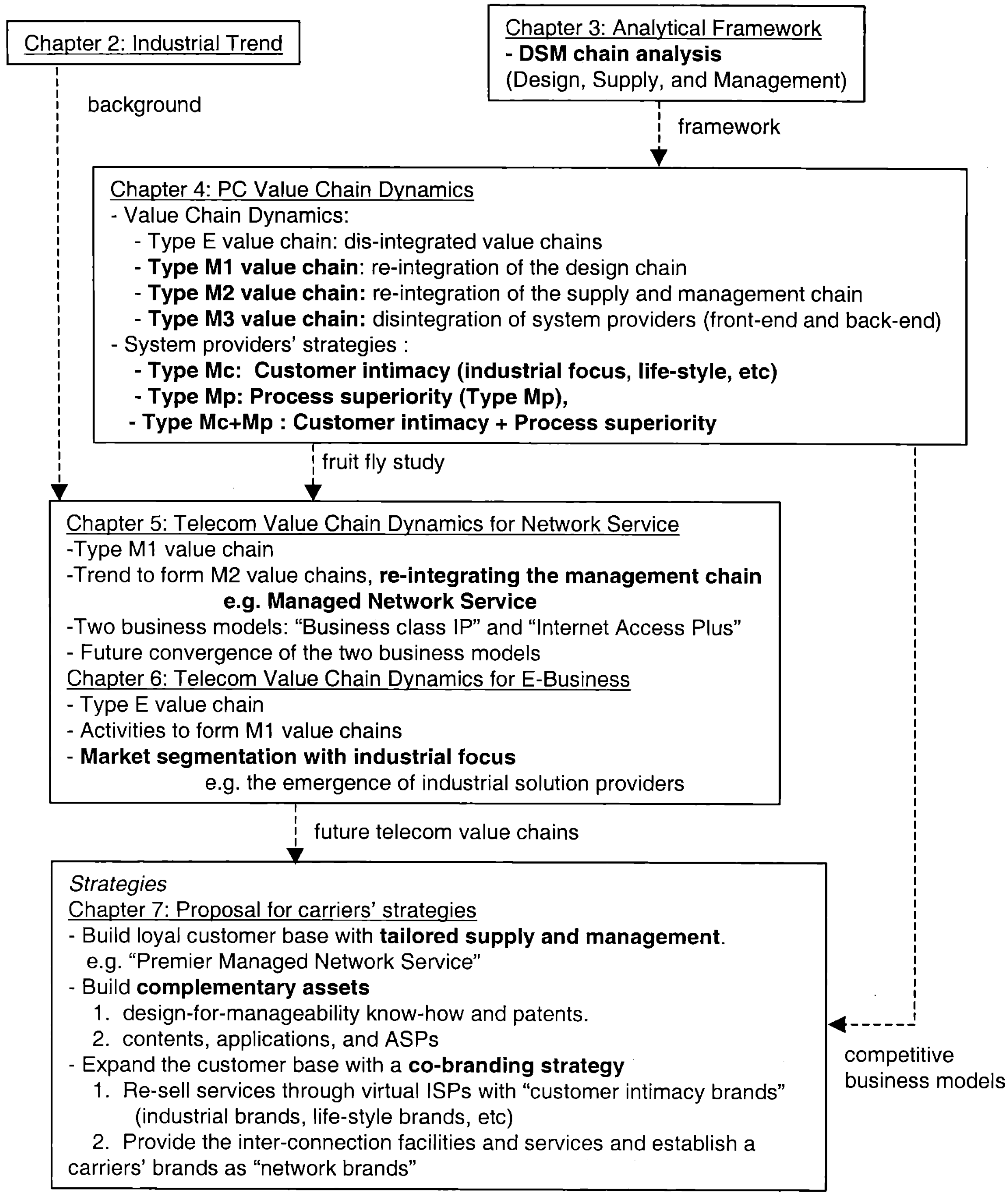


Figure 8-1 Key points of this thesis

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