

ROADMAPPING THE COMMUNICATIONS VALUE CHAIN

Charlie Fine, *Professor, MIT Sloan School of Management*

Introduction

Over the past decade, the Communications industry has experienced enormous turbulence and instability due to regulatory change, technological change, business model innovation, business cycle dynamics, and, unfortunately, business fraud. Each of these, as a single phenomenon, would suffice to create a dynamic environment for the industry. However, occurring concurrently, the five phenomena have created a storm of unprecedented magnitude.

In combination with this storm, we observe a continued rapid rate of technological innovation and deployment, which will likely support additional highly disruptive business models. We also observe an industry where incumbents in each of the “silos” across the entire value chain – providers of components, systems equipment, networks, services, content, applications, and user appliances – are struggling to restore sustainable business models in the aftermath of this unprecedented volatility. Although communications services and technologies are as popular as ever with consumers and enterprises, we find an extreme lack of consensus (and a high degree of contention) on likely paths to regain robust health for the industry.

History suggests that phenomenal productive growth can often result in an industrial environment featuring decentralized, free-market, “bare knuckles” competition. The personal computer industry in the 1980’s and 1990’s might be characterized this way. However, one can also observe industries and eras where some industry-wide coordination or leadership, driven either by government forces or powerful vertically-integrated firms, has supported rapid growth and wealth creation. During the middle part of the twentieth century in the United States one might have characterized the electric power industry (government coordination), the automotive industry (General Motors), and the telecommunications industry (AT&T) in this way.

In the communications industry today, many of the challenges to growth can only be addressed by resolving issues that cut across the value chain. Contentious issues, from digital rights to access competition policy, have constituencies from many components of the chain, as well as from consumer groups and regulatory/legislative bodies. In the absence of some degree of coordinated or collaborative processes to break logjams, the communications sector might remain moribund for quite a long time.

Roadmapping Process as an Organizing Construct

We believe that the concept of a value chain roadmapping process might be a useful organizing framework for collaborative discussion and research into possible communications futures. How might we engage in roadmapping the communications value chain? First note that we prefer to use “roadmap” primarily as a verb, not a noun. That is, we think of the process of discussing and assessing future scenarios as a more fruitful undertaking than setting a target to write “*the roadmap*” for an industry as complex as communications. More usefully, we might try to create multiple possible future roadmaps and assess features of each.¹ Some of these might appear sufficiently compelling as to trigger a set of companies across the value chain to pursue such a vision. Other assessments might convince participants that certain scenarios are unsustainable, resulting in better-focused research investments and business models. Additionally, some scenario analyses and assessments might influence government policy productively.

Although the context and objectives were somewhat different, we find it useful to reflect on the roadmapping process undertaken since the 1980’s by the Semiconductor Industry Association (SIA) and Sematech for semiconductor manufacturing technology. Although Sematech was criticized on many fronts, one result of gathering in one place the entire set of US Semiconductor manufacturers was

¹ For example Nicholas Negroponte provides a brief description of a “viral” wireless communications scenario in *Wired* magazine at http://www.wired.com/wired/archive/10.10/wireless_pr.html.

the creation of consensus technology roadmaps. These roadmaps had a profound effect on the investment risk for semiconductor process equipment suppliers. Before Sematech, each supplier had to visit each semiconductor company to learn about that company's future technology needs. Since each customer had somewhat different technology plans, a supplier often needed a customized development program for each customer, with no guarantee that they would even win the business. This was a very risky investment environment and led to lower investment levels and slower technology development than was occurring in Japan, where there was more consensus and collaboration. With the creation of the SIA roadmaps for semiconductor processing technology, the development risk for each supplier was much lower because each could invest in a single development project that would have many potential customers. Although no one claims clear causality, the health of the US industry did get better after the creation of the roadmaps.

During the late 1990's, when the communications sector was awash in capital, as many as 1000 new companies were started just in the domain of optical components for communications networks. Many of these have already failed. Prospects for today's survivors are quite bleak. However, if there were a consensus roadmap for optical communications, agreed upon by a significant number of buyers in the value chain, such a roadmap would lower the risk for some of these firms, perhaps attracting some capital back into the sector. Others would recognize the futility of their efforts and perhaps join efforts of those on the roadmap.

Components of a Roadmapping Process

We believe that a value chain roadmapping process might be a useful organizing framework for collaborative discussion and research for generating and assessing possible futures for the communications industry. In our conception, we imagine seven types of dynamic processes that collectively would capture possible evolutionary paths in the communications industry. These are technology dynamics, business cycle dynamics, industry structure dynamics, capital market dynamics, customer preference dynamics, corporate strategy dynamics, and regulatory policy dynamics. We envision a research process whereby the deep technological expertise of MIT's engineering and science-based research programs contribute to roadmapping the technology dynamics of respective components of the value chains, whereas the

management, economics and policy experts would model the dynamics of the business, policy, and economic features of various future scenarios. Our objective is to integratively capture the co-evolutionary forces of technology, policy, and industry.

Identifying the forces of Turbulence in Telecom

Below, we discuss briefly some of the drivers of turbulence in telecom that we will incorporate into our analyses.

Regulatory Change

The Telecommunications Act of 1996 dramatically changed the "rules of the game" in the industry. The Act partially deregulated the industry and triggered an explosion of investment by new entrants, followed by an equally dramatic contraction. The aggressive entrants were optimistic that the Internet would trigger great growth in total telecommunications demand and that they would capture significant business. This flurry of entry may have increased the introduction rate of new services, but also greatly increased uncertainty for all players. The Act has drawn a great deal of criticism from many fronts. Key questions revolve around whether the act created an environment that can sustain a healthy industrial telecommunications sector. Numerous "fixes," legislative, administrative, and judicial, are under consideration. The resulting uncertainty in law and regulatory policy reduces incentives for companies to invest.

Outside the United States, we see many different regulatory regimes, which have helped to spawn very different looking telecom landscapes. In Europe, in the wake of the 3G spectrum auctions, we see severe financial distress and mountains of debt among many major players. In Northern Europe, we see high rates of broadband (Sweden) and wireless data services (Finland). Among the most populous Asian nations, China has seen a huge telecom boom while India is still waiting for one to happen. Japan has lead the way in higher-bandwidth wireless networks, devices, and services while Korea has rolled out broadband widely with wire and cables, as well as advanced CDMA. Differences in overall wealth, topography and demographics can only partially account for the variation across countries. Since most telecom technology is available globally through large multinational corporations, we must look to differences in government policy to help us understand these cross-national differences.

Technological Change and Convergence

The past decade has witnessed explosive growth in the use of four key technologies that have changed the face of communications and are likely to continue to drive change: Wireless telephony, DWDM (Dense wavelength-division multiplexing), Packet-switched networks, and Broadband access. Wireless telephony has brought mobile communications for hundreds of millions of users around the world, dramatically changing the pattern and footprint of person-to-person communications. DWDM has enabled an increase in the carrying capacity of optical fiber networks, leading to a current and perhaps future capacity glut and a depression in transmission prices and the value of long-haul networks. Packet-switched networks have enabled universally-available "Internet applications," leading to an explosion in the data traffic on communications networks, in the use of the Internet as a primary communication network for many business and personal applications, and in the creation of new modes of commerce. Broadband access has brought high-speed Internet access to millions of homes and small businesses making widely available a quality of service previously limited primarily to large corporations and institutions. These technology-drivers have, in turn, encouraged thousands of existing and entrepreneurial companies to create new businesses and industries to exploit new opportunities, changing the industrial landscape in numerous sectors of the communications industry and its customer-industries.

This technological change has driven convergence of markets and technologies across the communications industry landscape. In particular, we now see a blurring across local and long distance lines of business, across wireless and wired applications, across cable and telecom service offerings, across voice and data services, across computer and communications terminals/appliances, and across telecom and Internet applications and usage. These forces of convergence have increased the turbulence and uncertainty in the industry and are likely to assure a continually changing communications landscape.

Business Cycle Dynamics

Concurrent with the investment boom in Telecom triggered by the Act of 1996, the entire U.S. economy was undergoing a steep boom in economic activity, which had the effect of pouring gasoline on the telecom investment explosion. The resulting

capital investment rates and market valuations contributed to a glut of long-haul capacity in particular, and proved to be far from sustainable. The subsequent crash has triggered numerous bankruptcies, fire sales of assets, and a severe investment depression. Technology suppliers such as equipment and component companies have been especially severely impacted, potentially harming the innovative capacity of the industry for years to come. (Once decimated, you can't build or re-build a Bell Labs overnight.)

Cross-industry analysis suggests that business cycle volatility is often exacerbated by industry cost structures featuring high levels of fixed and sunk costs. The airline industry, for example, which has high fixed costs (but assets that are more easily redeployed), has seen more volatility since deregulation in the late 1970's. Added uncertainty that accompanies deregulation tends to increase the amplitude of the volatility.

Conclusions

The distress in the communications value chain today is severe, with few causes for optimism in the near term. A collaborative roadmapping process with partners from industry, government, and academia, aided by coherent models of industry dynamics and technology roadmaps, might usefully assess various technological, economic, business, and economic scenarios to aid in government policy-making as well as corporate decision making.

For more information on this topic, please visit the Communications Futures website at: <http://cfp.mit.edu/> or the MIT Center for eBusiness website at: <http://ebusiness.mit.edu/>.

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- The Impact of the Internet on the Future of the Financial Services Industry
- Pricing Products and Services in the High-Tech Industry

The Center for eBusiness has recently entered into Phase II, adjusting its agenda to focus more explicitly on business value, while at the same time including technologies beyond the Internet in its purview. The early period of exploration and experimentation is coming to an end and there is now the opportunity, and the necessity, to focus more explicitly on using digital technologies to deliver measurable business value. Amidst all this change, the business fundamentals of investment, revenues, expenses, profits, and satisfying customers have only grown more important. At the same time, a broader, inter-related set of technologies is at our disposal. While the Internet has been an important catalyst, related digital technologies are often at least as relevant.

We are co-located with MIT Sloan's Center for Information Systems Research initiative and the Center for Coordination Science to facilitate collaboration. We also collaborate with the Media Lab and the Program on Internet and Telecoms Convergence.



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CONTACT INFORMATION

Center for eBusiness at MIT
 MIT Sloan School of Management
 3 Cambridge Center, NE20-336
 Cambridge, MA 02142
 Telephone: 617/253-7054
 Facsimile: 617/452-3231
<http://ebusiness.mit.edu/>

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