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The Policymaker's Dilemma: The Impact of Government Intervention on Innovation in the Telecommunications Industry

Scott D. Anthony
Erik A. Roth
Clayton M. Christensen

EXECUTIVE SUMMARY

The job of the policymaker is difficult, filled with contradictions and conflicts that must be carefully balanced. Harmonizing constituent demands with political interests, the needs of special interest groups and industry dynamics often leaves policymakers promulgating policies that give some to all but everything to none. A policymaker's job is critically important, especially in a heavily regulated industry where every action can often determine financial gains or ruin. Determining the correct policy is further complicated because lawmakers and regulators are adept at writing and interpreting laws but often less experienced in the nuances and practices of business.

After interviewing legislators and regulators, it is evident that many decisions are made without the benefit of a strong theory to guide them – they operate without a fundamental understanding of what causes what in which situation. Instead, policymakers are left to wade through the relentless barrage of information and advice from corporations, lobbyists and consumers with limited capacity to interpret and prioritize these myriad and often conflicting inputs. Given this, deciding what policies to promote in historically heavily regulated, complex industries like telecommunications, health care and finance can be daunting.

This challenge is particularly acute in the realm of creating policies to promote competition and foster innovation. Without a theory to guide them, policymakers tend to promote one-size-fits-all policies that often end with unforeseen consequences leaving policymakers scratching their collective heads, wondering what exactly happened.

Aside from scattered Luddites, it is hard to find anyone who professes to be anti-innovation. Innovation is widely hailed as one of the bedrock pillars of the U.S. economy – arguably the largest and most powerful economy in the history of the world. Innovation, in particular disruptive innovation, is responsible for much of the tremendous economic growth over the past century. Innovation embodies the pursuit of something new and the rewards from successfully creating something that is valuable to others. While innovation is often spoken of in almost mythical terms, we have spent the past decade developing a set of theories that show that innovation follows predictable patterns.

In this research, we examine the relationship between government intervention and innovation, and reach the perhaps not-surprising conclusion that government actions can have a tremendous impact on the market for innovation. However, we believe the relationship is not as clear-cut as is generally perceived. It is not difficult to find publications by economists, business commentators, pundits and other qualified experts who arrive at the ostensibly obvious conclusion that regulation stifles innovation and deregulation unleashes competitive forces that promote innovation. Generally, no matter where you sit on the political spectrum, prevailing wisdom reinforces the notion that increased levels of government intervention signals trouble for potential innovators. However, we believe that there is a more elaborate, complex, and predictable interplay between these two forces and in this paper attempt to present our theory that explains this understated connection.

Policymakers' general lack of understanding into their capacity to define the market for innovation has created somewhat of a paradox. This paradox exists in heavily regulated industries such as telecommunications where decades of policies directed at creating economic welfare have fostered environments that have actually stifled the most dynamic type of innovation, disruption. We believe that if government officials understand what causes innovation, policies might not be so restrictive. As we have studied throughout our research, disruptive technologies are powerful Schumpterian forces capable of dramatically altering a competitive landscape while creating enormous economic and consumer welfare.

More specifically, our theory addresses the three dilemmas that confront policymakers in their attempts to develop policy that encourages innovation:

- Why do so many well-intended actions by regulators and legislators to promote competition and innovation have unintended consequences?
- What should policymakers do when they face a situation where industry participants have neither the motivation nor the ability to commercialize innovative products?
- When is it appropriate to try to encourage new entrants in a market, especially at seemingly integrated pieces of a value system? If moves to modularity and the creation of specialist marketplaces are predicated on competition, what can policymakers do when companies do not face competition?

In this paper, we build off our previous research examining the forces of innovation in the telecommunications industry and conclude that innovation and government intervention interact much more predictably than previously imagined.

There are six key findings from our work:

1. Two factors can be observed in market environments where innovation flourishes: *motivation*, defined as a pot of gold or market incentives, and *ability*, defined as the capability to obtain resources, craft them into a business model and offer them to customers.
2. Government intervention affects the forces of innovation in predictable ways by influencing either the motivation or the ability of entre- and intra- preneurs.
3. By increasing the availability of resources, taking down barriers and releasing true points of modularity, government can generically turn on the innovation spigot; taking the opposite of any of these actions tends to constrict the innovation spigot.
4. Government policy can be more effective at encouraging innovation and creating "panacea" environment for innovation to flourish. Policymakers must comprehend the conditions needed to encourage innovation and respect specific industry dynamics. We have captured our theories in a new motibility framework.
5. There are specific "dilemma" cases where both motivation and ability are lacking. To promote competition and innovation, our suggested approach is to encourage disruption in an adjacent industry.
6. Regulators and legislators in a monopoly setting have a choice – they can try to keep prices down by using policy mechanisms or they can stimulate innovation, specifically disruptive innovation, which over time will lead to lower prices. Policymakers often opt for the short-term more politically palatable option of continually influencing price. However, attempting to manage the price variable creates friction that leads to unintended consequences and discourages the disruptive technologies capable of generating successful lower cost business models.

Using this new theory we present policymakers with a step-by-step generalizeable approach to crafting policies that encourage and facilitate the process of innovation. After deriving the theory and explaining how it can be applied, we will focus our lenses on important legislative and regulatory events to demonstrate its power. Specifically, an analysis of the 1996 Telecommunications Reform Act suggests that the failures of the act could have been foreseen because it did not – and could not – address some of the factors that limited the motivation and ability of innovators. Unforeseen "legacy interdependencies" resulting from the lack of competition seriously limited the ability of new entrants to compete, but could have been

expected by using our theory. Lastly, we present an analysis highlighting the difficult choices facing policymakers as they become embroiled in the debate over what should be the role of government in the deployment of broadband. Because industry structure inhibits a "silver-bullet" policy, the "correct" approach depends critically on the objective of the policymaker and their beliefs about the nature of the industry and its participants.

By providing policymakers with tools to enable them to better understand how innovation works within the industry they oversee, we believe significant economic gains will follow. Our tools to describe the forces of innovation and the interplay between innovation and regulation should: aid policymakers as they seek to craft successful pro-innovation legislation and regulation; allow firms to better navigate the regulatory waters within which they sail; and buttress investor confidence by increasing certainty over what are sustainable versus temporal opportunities.

INTRODUCTION

The telecommunications industry is a large and vital part of the global economy. Within the United States, telecommunications accounts for roughly 3% of gross domestic product[1] and is widely recognized as a crucial component of its international competitiveness. From Alexander Graham Bell's initial discovery of the ability to send sound waves over a wire to the inventive engineers at Bell Laboratory that churned out decades of breakthrough inventions that have changed the way we live and work, the industry has a long-standing and impressive tradition of innovation. Despite this long history of sustaining innovations, our research failed to uncover any examples of what we term "disruption" – the most powerful form of innovation – within the telecommunications industry.[2]

Somewhat surprised by this finding, we set out to investigate what, if anything, was different about this industry. Our ongoing research into the telecommunications industry continually confronted the specter of government intervention, making it clear that this intervention has played a critical role in shaping the evolution of the industry and merited further study.

Ironically, this important relationship between regulation and innovation has rarely been studied in the telecommunications industry or a more general setting. While it is apparent that regulation distorts the market for innovation, as we would describe it through our frameworks, we believe it does so in predictable ways. Therefore, using the telecommunications industry as our basis for analysis, this paper describes how regulation impacts innovation and presents a set of tools to assist industry participants, legislators and regulators in harnessing the power of government intervention to foster innovation and craft successful pro-innovation policy. In researching this topic, we relied on the following four key assumptions.

- Innovation is good and a principle driver of growth and long-term economic value capable of producing significant consumer welfare. While sustaining innovations can bring incremental improvements, disruption is capable of creating innovations that redefine industry economics and produce significant consumer welfare.

- Truly free and fair competitive markets are the best mechanism to encourage and facilitate the process of innovation. These markets provide innovators with the least inhibited access to necessary resources (e.g., capital, raw materials and talent) and the most potential to reach target customers. Additionally, we believe that market incentives for innovators to pursue new growth opportunities are strongest in a competitive market. In fact, we believe the likelihood of disruption, the most dramatic form of innovation, increases substantially within competitive markets.

- The regulatory process is complex, opaque and rarely lends itself to simple analysis, making it difficult to extract and generalize broadly applicable lessons. We recognize that regulators and legislators are not like-minded, independent agents and instead operate in a rich environment of disparate interests. In particular, we acknowledge the almost symbiotic relationship between telecommunications companies and the entities that regulate them. The lack of visibility into this complex setting combined with the opaqueness of the regulatory process makes it difficult to explain sufficiently the anomalies observed in some singular examples.

- Our ability to provide unique insight depends on the rigorous application of our theories and frameworks that we believe correctly describe the forces of innovation.

Balancing our desire to present a meaningful and comprehensive analysis against the sheer magnitude and complexity of the industry, we have decided to focus our efforts on a few specific

areas we feel illustrate our theories and demonstrate their broader applicability. We recognize the limitations of this approach but believe our areas of investigation are indicative of the conditions and dynamics of the industry at large. Our hope is that industry participants and government officials will be able to use the tools we present in this paper to analyze policy decisions throughout telecommunications and in other industries as well. We focus heavily on the United States because we have the best understanding of its industry and regulatory structures, although again we believe our findings can be applied generically to other regimes.

What We Plan To Do

Using our theories that describe the forces of innovation as a foundation, this paper analyzes the relationship between these forces and government intervention. Through our research in telecommunications, we have found that government involvement in an industry can distort the two critical factors that drive innovation – the motivation and ability of individuals and firms to innovate. We believe that these distortions have predictable impacts on an industry. If these impacts are well understood, they can serve as a guide for policymakers to craft legislation and regulation that successful promotes competition and innovation. If these distortions are concealed from policymakers, the government will continue to experience the unintended consequences of its actions. The intended audience for this work is policymakers, including any official involved in the federal, state or local legislative and regulatory process, lobbyists who influence policy, and general industry participants who will benefit by gaining new, deeper insight into the market within which they compete.

There are three sections to this paper:

- **Section One** reviews the origins of government intervention in the telecommunications industry and presents some critical factors essential to understanding industry dynamics and the challenges policymakers confront.

- In **Section Two**, we review our "innovator's toolkit" describing the forces of innovation and show how the government affects the process of innovation in predictable ways.

- Using a new "motibility" framework, **Section Three** attempts to solve the "policymaker's dilemma," suggesting that the success of policy tools depends critically on industry dynamics. Finally, we show how policymakers can use the motibility framework by applying it retrospectively to the 1996 Telecommunications Reform Act and prospectively to guide policymakers in the current debate over the role government should play in the deployment of broadband technologies.

Government intervention has significantly influenced the evolution of the U.S. telecommunications industry and impacted the process of innovation, both positively and negatively. In their sometimes-overzealous attempts to protect voters, policymakers have at times caused more harm than good. While the endorsement of policies that "recognized" industry structure and created artificially low consumer prices may have lined the pockets of placated voters, government has denied the public the disruptive innovations that would have created lower cost business models and incredible amounts of economic welfare. Our frameworks are intended to help regulators, legislators and industry participants more accurately assess potential and likely outcomes. It is our hope that our frameworks will help industry participants separate "market signals" from "market noise" allowing them to intervene in markets in ways better suited to create productive competition that leads to innovation.

SECTION 1: FRAMING THE INDUSTRY AND REGULATORY ENVIRONMENT

Our investigation highlights a number of factors that distinguish telecommunications from the other industries we have studied. One critical difference is the degree of government intervention. Unlike firms we have studied within other industries, telecommunications firms do not operate in an unfettered market situation, but instead compete in a heavily regulated environment. Government intervention occurs simultaneously at the national, state and even local level, and has produced, after decades of policy implemented through myriad legislative and regulatory actions, a complex legal soup flavored by politicians, courtrooms, lawyers, and lobbyists.

Rationale for such a high degree of government oversight and intervention ranges from arguments of market failure and the existence of externalities (e.g., public goods) to the desire to promote innovation through deregulation and increased competition. While some observers argue that recent technological advancements demonstrate government actions have successfully stimulated innovation, a closer examination of the industry reveals that the natural market for innovation has been and continues to be heavily shaped and constrained by the legislative and regulatory context.

In this section, we present some of the critical background required to understand fundamental industry economics and the central components of the regulatory structure. Specifically, to appreciate the complex regulatory environment, it is critical to have a solid understanding of why government intervention has been deemed necessary and some of the factors, such as the economics of natural monopolies, universal service policy, interconnection pricing and cross-subsidization, that define this industry and complicate policymaking (the critical factors are summarized on **Exhibit 1**).

The origins of government intervention

The genesis of many of the economic and structural challenges that continue to plague the telecommunications industry today first became evident during the industry's very early days. Contrary to conventional wisdom, the U.S. telecommunications industry was not always heavily regulated. The expiration of Alexander Graham Bell's original telephone patents at the end of the

Exhibit 1

Critical factors impacting telecommunications

Industry Economics		Existence of irreversible capital investments (sunk costs) to construct and maintain most network infrastructures create significant barriers to entry. Related to these costs, the greater distance a customer is from a central office facility the greater the cost to serve, particularly in markets and geographies with low population density.
Natural Monopoly		Commonly defined as a market situation whereby a single producer is able to obtain an average cost per unit of production sufficiently low enough to make it inefficient for any other producer to supply that product. The local exchange market is generally recognized as a natural monopoly in that only one set of wires and one provider of service is economically efficient. Natural monopolies are more likely to exist in markets with high fixed capital costs.
Universal Access		Concept, first introduced in the late 19th century by then AT&T chairman Theordore Vail, refers to the idea that every citizen is entitled to have access to phone service (and AT&T should be the company to provide it). Over the years, *access* has been replace by the word *service* and the notion that every citizen must have basic telephone service. Rationale for this policy includes the theory that the value of the network increases with the number of users.
Cross-subsidization		Decades of complex pricing policies designed to uphold the principle of universal service. Basically, profits from long distance service subsidize local rates, business subsidizes residential, and urban subsidizes rural. These pricing mechanisms shift market incentives and dramatically alter investment patterns.
Interconnection		Refers to the right of one telephone company's network to exchange traffic with another telephony company's network for such things as call transport, origination and completion. Interconnection regimes create regulatory-based distinctions between different parts of the telecommunications network (e.g., local vs. long distance and basic enhanced services).

19th century unleashed a frenzy of competitive activity. Vigorous competition among hundreds of companies erupted to satisfy the rapidly growing demand for local telephony service.

The Bell System with its franchisees – local companies that licensed Bell's telephone technology[3] – enjoyed an early competitive advantage already having established operations in the most densely populated markets such as New York City and Boston. These markets also contained the highest concentration of business subscribers – the heaviest and most profitable telephony users. However, by 1904, independent phone companies – those not part of the Bell system – far outnumbered the Bell companies and dual or even multiple wireline service was available in about 60 percent of American cities with populations larger than 5,000 people.[4] Competition for local telephone service was present in about 2,300 American cities as the Bell and independent telephone systems raced to wire homes and acquire subscribers.[5] It was not uncommon to observe multiple sets of telephone wires strung between buildings in dense urban areas. Telephone service penetration rates soared as a result of the aggressive pricing tactics spurred by this turbulent competitive environment.

While historians, economists and scholars debate the inevitability of AT&T's ascendancy to monopoly status, it is apparent some combination of technological, political and corporate forces coalesced to create and fortify the notion that a monopoly was appropriate and economically beneficial. While many business historians note there were clear indications that AT&T peddled its size and political clout through its established relationships with state regulators, there were other forces afoot.[6]

Government intervention first appeared at the state level and targeted the predatory pricing tactics that accompanied the market for basic telephone service. State regulatory commissions enacted policies that prohibited aggressive price competition and curbed unfair or below-cost pricing through rate setting and control mechanisms intended to protect consumers. Regulation, however, generally favored AT&T because franchisees had spent significant resources cultivating relationships with state regulatory commissions. The next round of Government intervention also took the form of anti-trust action against AT&T and its Bell companies. AT&T's positioned strengthened as the firm refused to interconnect with independent companies who wanted to complete calls to subscribers on its network, citing a lack of technological compatibility and quality issues, and as demand shifted to long distance calling where AT&T had a monopoly.

It was not until 1912, after AT&T announced plans to acquire a significant share of its former competitor, Western Union, that the Justice Department stepped in to claim that AT&T's growing market dominance was in violation of the Sherman Anti-trust Act. Riding on the strength of its recent defeat of John D. Rockefeller that resulted in the break up of Standard Oil, the Justice Department turned its sights on the Bell system. Settled out of court in 1913 in what became known as the Kingsbury Commitment (see **Exhibit 2** for an overview of major legislative acts), the Bell System protected its local exchange monopolies by agreeing to stop its acquisition spree of additional local companies. While the agreement temporarily slowed the growth of the Bell System, it also communicated tacit acceptance of the phone companies' monopoly position in many markets. Banned from acquiring additional independent telephone companies without the prior approval of the Justice Department, AT&T was instead required to allow independent telephone service providers to interconnect to its long distance lines as long as the independents met the Bell System's technical standards. AT&T was also forced to sell its stake in Western Union.

With the exception of World War I, when the telephone system was temporarily nationalized, the Justice Department, guided by the Kingsbury Commitment, presided over the telephone service industry environment until the enactment of the Communications Act of 1934. Part of Franklin D.

Exhibit 2

Overview of major regulatory events (Prior to 1996)

The Federal Communications Act of 1934	Congressional Act created the Federal Communications Commission and granted it authority to regulate interstate telephone, telegraph and radio companies.
The 1956 Consent Decree or Final Judgment	Permitted AT&T to retain its monopoly status, but restricted operations to common carrier functions. Also required AT&T's Bell Labs to license unrelated patented technologies to companies that requested access.
***Carterfone* Decision**	Signaled the end of the foreign attachments restrictions that prohibited any non-tariff Bell Operating Company device from being interconnected with the network. FCC ruling opened the door to competition in the Customer Premise Equipment market.
The 1969 MCI Case	F.C.C ruling allowing MCI to interconnect its equipment to the public telephone network providing the network was not harmed. Recognized and supported competition on the long distance market.
The Modified Final Judgment (1982-1983) and the AT&T Divestiture (1984)	Agreement between AT&T and the Justice Department, with approval from Judge Harold Greene. Resulted in the division of AT&T into 22 Bell Operating Companies (BOCs), prohibited BOCs from inter-LATA (long-distance) service and the sale of CPE equipment, and mandated equal access to all inter-exchange carriers through 1-plus dialing. BOCs were merged into seven Regional Bell Operating Companies (RBOCs) and officially divested in 1984. AT&T retained long distance and manufacturing operations.

Roosevelt's New Deal agenda, the 1934 Act clearly envisioned a monopoly telephone service company and with this in mind created the Federal Communications Commission (FCC) as its primary regulator.

The Regulatory Structure and Players

The 1934 act established a basic regulatory infrastructure and defined the legal framework that presided over the industry for more than 60 years, eliminating most real hopes of introducing competition. In fact, the 1996 Telecommunications Reform Act represented the first major revision of this original structure.

At the federal level, the U.S. Congress and its independent regulatory agency – the FCC – are responsible for oversight of the telecommunications industry. Legislation outlining general policy is crafted on the floor of the House and Senate leaving the FCC to interpret and implement the specific provisions of Congressional acts. The Communications Act of 1934 was the first time the telephone was officially recognized as a "public good" requiring government regulation to protect the public interest. It also established clear regulatory demarcations between local and long distance service. While at the time the FCC's mission was limited to overseeing the nation's telephony network and services, the role of the agency has grown with the industry's evolution (although the agency's expansion has struggled to keep pace with technological advancements) and is now charged with regulating interstate and international communications by radio, television, wire, wireless, satellite and cable.

The Public Utility Commissions (PUCs) craft telecommunications policy at the state level. Each state has its own PUC charged with regulating telecommunications companies operating within state lines. PUCs play a critical role in everything from granting operating licenses to setting rate regulation. Telecommunications firms, particularly firms offering products and service to consumers, often find it necessary to dispatch government relations personnel on a state-by-state basis to ensure smooth operations. At an even more micro level, local zoning regulations can heavily influence network deployment through right-of-way and access rules.

The courts also play an important role as the ultimate arbiter of disputes. Whenever disputes arise between or among regulatory agencies and firms, it is not uncommon for the courts to assert their authority and settle these contentious debates. Perhaps the most notable example of court intervention was Judge Harold Greene's virtual regulatory dictatorship during the 1980s when

industry insiders credit him with single-handedly creating and controlling U.S. regulatory policy hurling fiats from the bench as he presided over such historic events as the break-up of AT&T in 1984.

Industry Economics

One critical contributor to the distinctiveness of the telecommunications industry is the existence of irreversible capital investments necessary to construct and maintain most network infrastructures. Initial deployment of telecommunications products and services typically require huge upfront capital investments. These costs include everything from gaining right of way access and "digging the ditches" for the physical network connections (often cited as more than 80% of the cost of deploying a new wireline network infrastructure) to acquiring and "lighting" the equipment that deliver and maintain new products or services. The greater the distance network elements are required to be deployed away from a central switching office, the higher the cost to serve those subscribers. This dynamic creates significant economic tension as low population density, rural areas become dramatically more expensive to offer service to than high population density, urban markets. Since investment in new networks and network elements is highly sensitive to the belief that there will be an adequate customer base to generate a return, it is especially difficult to justify new investment in rural markets.

Additionally, once network assets are deployed they are generally not recoverable. These huge sunk costs create barriers for new entrants, provide incumbents with enormous economic scale advantages, and discourage investment in innovation. Squeezing extra usage out of existing fully depreciated assets is more desirable to incurring the expense of deploying new assets. Specifically, there has been a noticeable lack of innovations – sustaining, or, even more importantly, disruptive – in the residential local access market or "last mile" where the Regional Bell Operating Companies (RBOCs) have long dominated as sole owners of the copper wire loops that connect our homes and businesses with the rest of the network infrastructure. Gone unchecked, these firms would have enjoyed the ability to capture significant economic rents. Recognizing the existence of this constant threat to consumers (also known as voters), government has remained an active participant in the industry.

Natural Monopoly

Recognizing the fundamental economics associated with the telephone network, for decades policymakers have propagated the notion that it is more economically efficient to have one provider of basic telephone service than multiple providers. In economic terms, a market such as this is known as a "natural monopoly." A natural monopoly is commonly defined as a market situation whereby a single producer is able to obtain an average cost per unit of production sufficiently low enough to make it inefficient for any other producer to supply that product or service.[7] Natural monopolies are typically observed in markets where there is a large fixed capital component coupled with steadily declining average marginal productions costs, allowing one supplier to attain unmatchable production advantages. Thus, duplication of an investment in huge fixed capital costs is neither privately nor publicly efficient nor desirable. Most industry participants and government officials agree that a natural monopoly exists in the local loop for basic telephone service. However, there is a long running debate among scholars, economists and business historians as to whether the local loop or "last mile" of the U.S. telecommunications telephony infrastructure is a true natural monopoly.

Some experts contend that the monopoly of integrated telephone service came about not because of the economies of supply, but some combination of the dynamics of demand, the realities of

network access and historical and political circumstances. Others argue that the economics created by the low average cost per unit of production justifies the existence of one firm, the RBOC in the case of the local loop, as the most economically efficient means of supplying telephony products or services. Restated in plain English, it just doesn't make sense for more than one firm to deploy another set of telephone wires to our homes, because the new entrant could never provide service as cheaply or as efficiently as one company could. Regardless of where you are on this debate, the government has officially acknowledged the existence of a natural monopoly in the local telephony market since 1934. This judgment was based on the government's belief that having a single integrated provider of telephone service created tremendous value and that allowing multiple providers would have been inefficient and produced competitive imbalances and low-quality service.

Many within the industry today still argue that economic rationale makes having more than one provider of basic local telephone service near impossible. The existence of a natural monopoly has been the prevailing belief for almost 100 years. However, technological change led by the advent of the Internet and the popularized trend known as convergence[8] is challenging this notion.

Universal Service

Theodore Vail, Chairman of AT&T first introduced the concept of universal access in the late 19th century and it has become perhaps one of the most important and influential forces within the industry. Originally, universal access referred to the idea that every American citizen had the right to have access to telephone service. Over the decades, the notion of universal *access* has evolved into that of universal *service* – a set of policies designed to ensure that every citizen had affordable telephone service. The universal service doctrine has manifested itself in a system of direct and indirect subsidies engineered to suppress the price of basic residential telephone service. Implicit in this principle is the notion that basic phone service is a public good that all citizens are entitled to and warrants the support and protection of the government. Given the underlying industry economics it is unlikely that basic phone service would be ubiquitously available to every U.S. household without government support, especially in rural areas.

In order to ensure that every household is able to have telephone service, the government maintains that it must prevent competition in order to protect the RBOCs ability to offer service in areas that would otherwise not receive telephone service. Because telephone service is supposedly profitable only at an aggregated level, competition would undermine the subsidization systems that RBOCs have cultivated for decades. This policy permits and encourages the RBOCs to use revenue generated in other businesses to deploy service in these unprofitable areas and keep prices below the true cost of delivering service. As such, today universal service is less about ensuring access and more about guaranteeing and maintaining artificially low residential phone rates. Also imbedded in the universal service concept is the idea the value of the network increases as the number of users grows. Therefore, the most economic value is created when the government can encourage high levels of subscription by keeping local phone rates low. Over the years, universal service has been used to justify government-supported subsidization of residential phone rates and has been a key part of the continual justification for the existence of a regulated telephone monopoly. Incidentally, universal service is also one of the cornerstones in the debate to determine the federal government's roll in the rollout of broadband.

Cross-subsidization

Decades of policies intended to uphold the principle of universal service have shaped the industry around a complex cross-subsidization scheme designed to keep residential phone rates artificially low and basic phone service penetration high. The mechanism of cross-subsidization originated in a 1930 Supreme Court decision in *Smith v. Illinois Bell*, that allowed telephone network operators to re-allocate costs based on the way the network was used instead of how it was deployed. The rationale was essentially that long distance toll and local calls were made using the same local network, but at the time the local Bell absorbed most of the cost. This ruling shifted the allocation of cost from the local company to AT&T's long lines business. This freed state regulators to artificially set prices for local service below true costs and force service providers to subsidize local service with revenues from other services or lines of business. Additionally, AT&T, as the long distance company, was required to pay the local company rates to use the local network that were above actual costs leading to artificially high prices being charged for long distance calling. This has led to a cross-subsidized pricing structure where long-distance rates subsidize local rates, business rates subsidize residential rates, and urban rates subsidize rural rates for basic telephone service.

Cross-subsidization mechanisms have shifted market incentives and dramatically altered investment patterns, competitive behavior and industry evolution. The inefficiencies caused by these mechanisms distort pricing and consumption patterns and create inaccurate market noise that attracts unsustainable business models. Additionally, the varying levels of subsidization (depending on geography and service) create high levels of inequity among subscribers penalizing urban, long distance and business customers. After decades of operating under this cross-subsidization framework, it is widely recognized that prices in the local exchange in many areas fail to cover the true cost of delivering service. Additionally, artificially high long distance and business prices have created market incentives encouraging unregulated competitors, such as Competitive Access Providers (CAPs), to invest in unsustainable regulatory arbitrage and cream-skimming business models (but not in the local exchange), stifling innovation. In fact, the artificially low prices in the local exchange create huge disincentives for investment and essentially block any chance of true competition in the local loop.

For example, inefficient pricing caused by cross-subsidization motivated MCI to go after the long-distance business market. Regulation ultimately granted MCI permission to utilize AT&T's price-subsidized local lines for call origination and completion and rely on its own facilities for long distance transmission. Under this pricing structure, MCI was able to profitably undercut AT&T prices for similar services. Another example of this arbitrage model was evident in the emergence of CAPs. These unregulated access providers (e.g., Teleport and MFS) took advantage of their unregulated status as competitive data local exchange companies and, by building their own facilities, bypassed the costs that they would have incurred by using RBOC local loop assets to create their own long distance services. These avoided costs enabled CAPs to pass on lower prices to customers and generate substantial profits.

Interconnection

Interconnection rights have been used both as a means to sustain cross-subsidization pricing to promote universal service and to encourage competition. Interconnection refers to the right of one telephone company network to exchange traffic with another telephone companies network for such things as call transport and completion. Original interconnection regimes created regulatory-based distinctions between different parts of the telecommunications network and types of service (e.g., local vs. long distance service, interstate vs. intrastate, basic vs. enhanced services) and

were predicated on the belief that a relatively equal volume of traffic would be exchanged between local networks. Reciprocal pricing mechanisms that reinforce the cross-subsidization scheme were designed with this principle in mind. For example, federal and state regulators have exempted RBOCs from paying each other access fees in many cases predicated on the belief of balanced traffic flow but permitted local phone companies to charge long distance providers above-cost access charges for originating and completing calls.

As the telecommunications industry has matured and new technologies have emerged, many of these distinctions have become increasingly irrelevant. Specifically, the advent of the Internet and Internet Protocol (IP)-based technologies has fundamentally altered the way voice and data traffic flow over the networks. Enhanced services companies (such as Internet service providers) have been exempted by the FCC from paying hefty local access charges. This absence of regulation on Internet companies has motivated firms to develop business models that leverage this new media to avoid regulatory costs and constraints of legacy networks (especially in the local loop market). This has put pressure on and raised questions about the relevance and purpose of the existing inter-connection regimes.

Summary

The telecommunications industry is complicated by the legacy results of almost 100 years of monopoly and government intervention that have dramatically shaped the course of the industry's evolution. Understanding and acknowledging the nuances that distinguish this industry from others will inevitably enhance the ability of policymakers to craft successful pro-innovation legislation and regulation. Next, we will turn to describing the forces of innovation and demonstrate how government intervention affects these forces in predictable ways.

SECTION II: HOW FRICTION AFFECTS OUR TOOLKIT

Introduction

Innovation is an incredibly powerful, often misunderstood force that can yield dramatic economic benefits as well as seismic shifts in industry structure. A central factor in all economic development, innovation, defined as a new product, service or business model, is often described in mythical terms, viewed as an unpredictable and often unexplainable phenomena that results from a volatile mixture of creativity, happenstance and divine intervention.

Our research into the forces of innovation has enabled us to develop a series of frameworks and models – which we term the "innovator's toolkit" – that describe the process of innovation and show how innovation is actually much more predictable than previously imagined. This toolkit is based on a classification scheme that helps to predict which firms are likely to successfully commercialize different types of innovations and what types of companies are likely to earn the most profitability in an industry.

In a truly open – or frictionless – environment, innovation is free to flourish and disruption, defined as a relatively low cost but flexible or convenient innovation that dramatically changes industry structure, has its greatest chance of occurring. Typical forms of government intervention distort the natural market for innovation by reshaping market incentives or altering the capacity of innovators to access the resources or markets required to support their development process. While the negative impact of government intervention on the market for innovation cannot be overlooked or ignored, government intervention can also be used to encourage innovation by promoting innovation-friendly policies. Hence, we will begin our analysis by reviewing our core frameworks and then proceed to a "friction analysis" where we introduce the influence of government intervention on our frameworks and describe how these factors impact the market for innovation.

Review of the "innovator's toolkit"

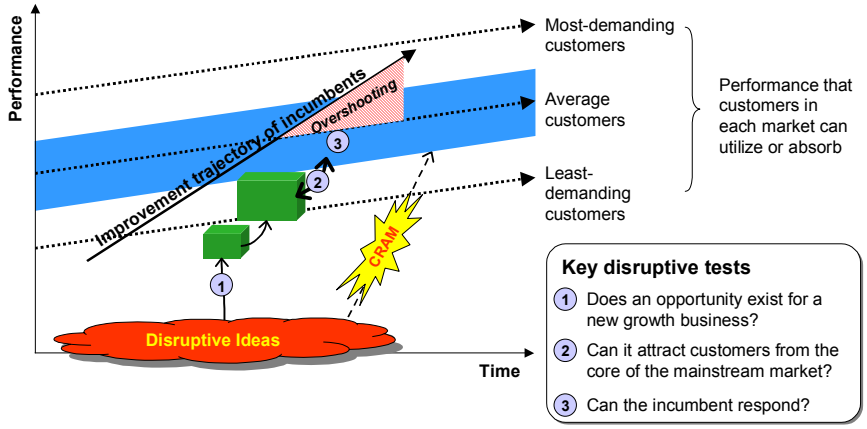
The innovator's toolkit is comprised of a series of frameworks to help industry participants understand the forces of innovation at work within an industry. The disruptive innovation framework, which separates "disruptive" innovations that have the power to topple incumbents from "sustaining" innovations that incumbents can use to enhance their operations to provide goods and services to existing customers, is at the core of the toolkit. While we will briefly describe the theoretical underpinning of each of the essential frameworks, the emphasis of this paper is on exploring the interplay between government intervention and innovation, so we will avoid presenting excruciating detail on any particular framework.[9]

Disruptive Innovation Framework

Many of the great business enterprises of the last 150 years were founded on a disruptive technology. Bell's telephone system was disruptive to the telegraph; Wal-Mart's discount retailing model was disruptive to the catalog-based department store, who in turn had disrupted the original downtown full-service integrated department store; Nucor's steel minimill was disruptive to the integrated steel mill; Cisco's IP-based router was disruptive to IBM's proprietary network architecture business. All of these innovations initially underperformed the needs of the most advanced customers of the day but as the technologies improved, they ultimately led to substantial changes in industry composition where incumbents were forced to exit a business or relegated to the sidelines. Disruption is a powerful force of innovation that leads to dramatic

Exhibit 3

Overview of the disruptive technology model



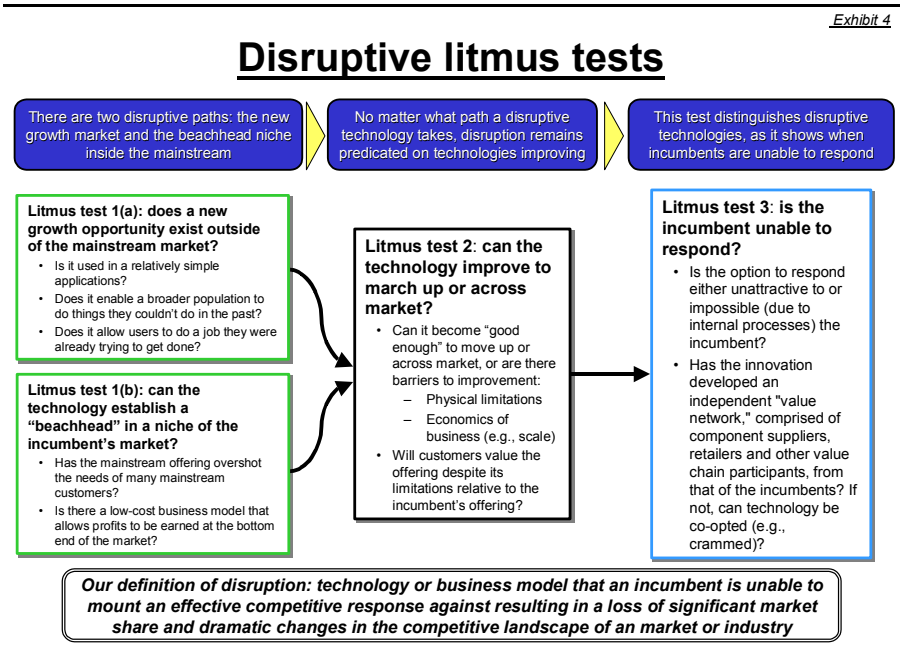
increases in consumer welfare by radically lowering the prices in an industry and introducing new levels of convenience.

Disruptive technologies are rooted in the phenomena of "overshooting," displayed in **Exhibit 3**. Well-run companies that listen to their best customers develop "sustaining" innovations that improve their products along the dimensions that customers have historically valued. Sustaining innovations essentially take a good product and make it better. However, firms almost always innovate faster than customer behavior can change to absorb the new innovations.[10] Eventually, incumbent firms create new products and services at a pace (illustrated by the dark arrow in **Exhibit 3**) that outstrips the ability of various groups of customers to utilize these incremental improvements (displayed in **Exhibit 3** as a series of dotted lines). Customers become increasingly less willing to pay for incremental product improvements – in the parlance of economists, consumers receive decreasing marginal utility from subsequent product improvements. This overshooting allows a company providing a simpler, cheaper, more convenient product to "come up from below" and "disrupt" the incumbent. Customers deriving decreasing utility from "sustaining" innovations will trade off the "extras" for a disruptive technology that offers at least comparable core functionality at a lower price and provides extra flexibility or convenience.

Predicting the disruptiveness of a technology is often difficult as there are many uncertainties. However, to aid innovators in evaluating the disruptive potential of an innovation, we have developed a three-part litmus test that is displayed in **Exhibit 4**. First the technology must find a new growth opportunity to fund its initial development, then it must improve to allow it to march up or across market and finally it must have certain characteristics that make response by an incumbent impossible.

Motivated by an opportunity, innovators obtain resources and craft them into a disruptive technology that initially underperforms the incumbent offering along the critical dimensions that customers value, necessitating finding a group of customers that is delighted with its rudimentary state and able to fund its improvement trajectory (litmus test one). This new product has characteristics like convenience or low price that are highly valued in one of two types of niche markets (displayed as the small three-dimensional green rectangles in **Exhibit 3**): either completely outside of the incumbent's market or among a subset of its least-demanding customers. Incumbents do not initially consider a disruptive technology threatening because their "best" customers will not demand this lesser-performing product. Additionally, disruptive technologies have business models that are very different than incumbents – usually indicated by

Exhibit 4



lower gross margins per unit and higher asset utilization. If incumbents attempt to commercialize a disruptive technology, they are forced to "cram" it into their existing business model (where it does not naturally fit) necessitating changes to the technology that will obviate its inherent disruptive energy.

The disruptive technology obtains the necessary resources to fund its continued improvement (litmus test two) until its relative benefits overcome its relative shortcomings and it begins to attract customers away from the mainstream market (displayed as the large blue parallelogram in **Exhibit 3**). While barriers such as fundamental physical limitations or the basic economics of an industry may appear to slow or deflect a disruptor's improvement trajectory, determined entrepreneurs can often find creative ways to circumvent obstacles. Both minicomputer manufacturers and steel minimill producers were able to improve their products substantially, despite overwhelming odds, to the point where their relative convenience or low cost became attractive to even the most demanding users.

For an innovation to be truly disruptive, it must avoid being "co-opted" by incumbents (litmus test three). Co-option occurs when an incumbent is able to force a disruptive technology to fit within its own business model. By definition, a truly disruptive technology cannot be co-opted. A truly disruptive product or service incubates within an independent "value network," comprised of component suppliers, retailers and other related value chain participants. This independent value network does not give incumbents an obvious route for co-option as the disruptive technology does not interact with any part of the incumbent's value chain. Stymied by its processes and resource-allocation criteria – typically based on higher gross margins returns – the incumbent finds it impossible to respond to the disruptive challenger, and retreats up market in search of more profitable customers to serve. Disruptive technologies steal market share from incumbents and cause dramatic changes to the competitive landscape. However, customers end up benefiting tremendously as a disruptive technology is accompanied by lower prices and provides new levels of convenience and flexibility.

There are three important principles to keep in mind when evaluating the disruptive potential of a new technology:

- **Process vs. event**: There is a critical distinction between the disruptive event – when an incumbent firm finds itself unable to respond having lost its core market – and the process that leads up to that event. Technologies can follow a disruptive process and

create exciting new growth opportunities without ever ending in a disruptive event. For example, wireless LAN providers using the 802.11 standard may create large new businesses serving "hot spots" like airport lounges and coffee shops, but may never "disrupt" wired network connections. 802.11 technologies appear to fail litmus test two and are likely to end up as a complementary piece of an incumbent's wireless network. Technologies that fail the final litmus test do so because they depend on or interact with the incumbent's value network, ultimately limiting the size of the opportunity or opening the door for "co-option."

- **Relativity**: Comparisons always matter, and the same technology can have very different implications for different companies. It is critically important to keep in mind what is being compared to what before proclaiming something disruptive. For example, while Internet retailing might be very disruptive to a high-service specialty retailer, it is quite sustaining to a low-cost catalog operator. The Internet as a sales channel fits very well within a low-cost catalog operator's processes and cost structure.

- **Asymmetry:** A firm determines whether or not to allocate resources to a new opportunity based on the amount of additional value a potential opportunity creates. Decisions are evaluated by analyzing the margins that a new opportunity is expected to generate and the processes required to support that model. Incumbent firms, with processes designed to support their higher-cost business models, typically demand much higher margins to justify a new investment than that of a disruptor, with its lower cost and higher asset utilization based business model. Thus, opportunities that look highly attractive to disruptors will seem relatively unattractive to incumbents. This asymmetry of opportunity reinforces the process of disruption and seals the incumbents fate.

The 4-D Model

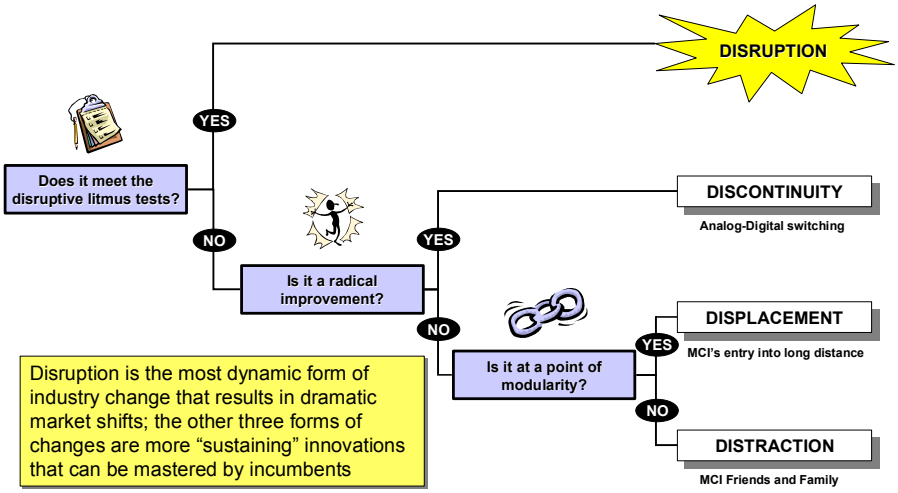
While disruptive innovations lead to the most dramatic changes to a marketplace, there are many other important forms of innovations. For example, while our previous research[11] did not uncover any examples of disruption in the U.S. telecommunications industry since the introduction of the telephone, the industry has quite obviously gone through substantial changes in the past 100 years driven by innovations that have quite literally changed the world. To help industry participants understand how different types of innovation-enabled change are likely to unfold, we have developed the "4-D" industry change classification model, displayed in **Exhibit 5**. In addition to disruptive innovations, the 4-D classification model describes three other types of innovations that can sustain the performance of well-run incumbent firms:

- **Discontinuity**: A discontinuity, otherwise known as a radical sustaining innovation, leads to substantial change within an industry as a new, more complicated, better performing technology is introduced. Discontinuities typically take the form of a system-wide upgrade, such as when the entire telephone system was upgraded from analog to digital standards. Incumbents who control large parts of the value chain typically are best positioned to manage the technological difficulties inherent in managing a discontinuity. Firms that best manage a discontinuity can seize long-term market share advantages. Discontinuities are often resource-intensive projects but result in substantial improvements to existing products or services.

- **Distraction**: A distraction is similar to a discontinuity but involves a less comprehensive change. Distractions are also known as incremental sustaining innovations. Because distractions still occur at places in the value chain where there are complex interdependencies (see following), incumbent firms remain best positioned to introduce

Exhibit 5

The 4D industry change classification model



and control distractions. New entrants can compete but often cannot produce a "plug-and-play" piece of a value chain and hence cannot match the performance of an incumbent. Because distractions are relatively simple, they do not tend to lead to long-term competitive changes. For example, when MCI introduced its innovative Friends & Family customer acquisition scheme, it caused a temporary market share shift away from AT&T but did not fundamentally change the competitive dynamics of the long-distance industry. AT&T was eventually able to implement bundled pricing packages of its own, limiting the impact of MCI's marketing programs.

- **Displacement**: Unlike the other two forms of sustaining innovations, new entrants often first introduce displacements. Displacements occur when a piece of a value chain becomes "modular," meaning it is no longer necessary for a vertically or horizontally integrated firm to produce that piece. Hence, a new entrant can come in and "displace" an incumbent provider. Like disruptions, displacements tend to feature more convenience and flexibility than incumbent offerings; unlike disruptions, displacements are at least as functionally good as incumbent offerings, allowing response by incumbents.

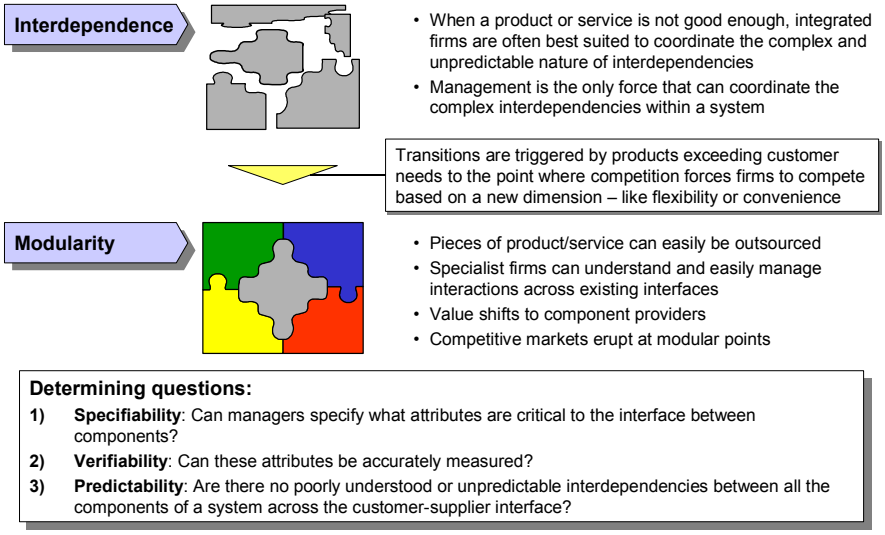
"Skate to the Money" framework

Imbedded in the 4-D classification scheme is the notion that industries tend to evolve from "interdependence," where individual firms are vertically integrated to "modularity," where specialist firms produce pieces of the value chain and often earn a disproportionate share of value in the industry (the process is displayed in **Exhibit 6**).

Before a product or service is "good enough" to meet the needs of the mainstream customer, integrated firms that control the entire part of the production and delivery process tend to be best able to coordinate the complexities involved in trying to improve the product. To improve products, companies need to use new and unproven technologies. Specialist firms that try to produce a piece of the value chain often find that their piece interacts unpredictably with components of other producers and leads to products that continually disappoint customers. Management is the only force capable of coordinating these "interdependencies." Thus, integrated firms tend to earn the lion's share of industry profit. **Exhibit 6** shows a puzzle whose pieces cannot easily fit together, showing the need for the hand of management to compete the entire puzzle.

Exhibit 6

Skate to the money framework



As products improve, they eventually are more than good enough for the needs of the average customer. Whereas firms previously competed on product functionality, customer demands forces them to compete increasingly based on flexibility or convenience. Speed to market also becomes a critical component of success. In an effort to develop products or services more quickly, companies tend to standardize interfaces between various parts of the product or service, allowing the creation of specialist firms capable of developing products that fit these interfaces. There are three tests that determine whether an interface truly can become modular, described in **Exhibit 6**. An interface is modular if the transactions that occur across it between components are specifiable, measurable and predictable. Modular interfaces enable specialist firms to understand and successfully manage the related interactions. **Exhibit 6** displays modularity as a puzzle where different firms produce different pieces of the product.

Once an interface is modular, previously integrated producers can outsource portions of the value chain at these points, and much of the profitability shifts from firms that manufacture and assemble entire products or services to firms that produce individual components – in this case to the specific components that themselves are not good enough and hence need to be designed interdependently. For instance, as computer assemblers needed to compete based on customization, they outsourced the operating system and microprocessors to Microsoft and Intel, who grew to earn a disproportionate amount of the profitability in the computer industry. Forward-thinking firms that follow the advice of hockey great Wayne Gretzky and skate not to where the money *is now* but where *it will be* in the future can profit tremendously.

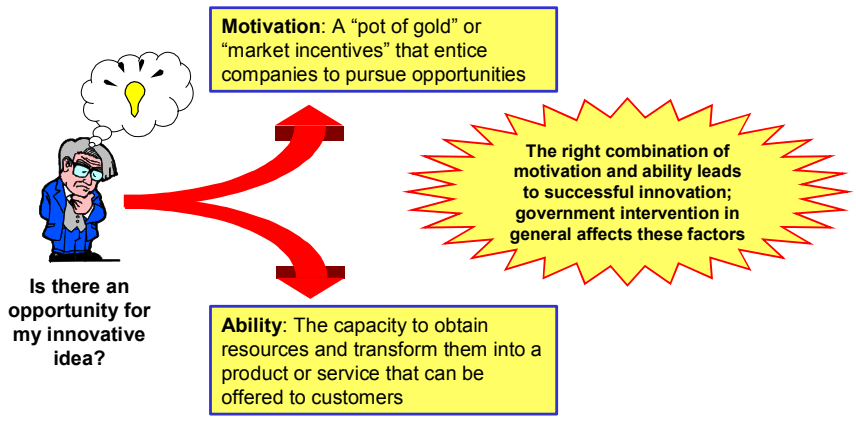
What Really Drives Innovation?

The disruptive technology model, 4-D industry classification scheme and "skate to the money" framework provide tools to understand how the process of innovation unfolds, helping industry participants to identify the firms with the best chance to profit from different types of innovation. While each instrument in the toolkit describes a different part of the process of innovation, there is an important commonality behind the frameworks. In each case, there are two factors that are necessary inputs to the process of innovation: motivation and ability (displayed in **Exhibit 7**).

- **Motivation** is defined as a set of market incentives or a "pot of gold" that entices innovators to pursue profitable business opportunities. Although social scientists argue that humans are intrinsically creative beings that will tinker for tinkering sake, the

Exhibit 7

True drivers of innovation



successful commercialization of a technology requires a company that wants to obtain a reward for its efforts. While solutions looking for markets exist, they rarely amount to significant business opportunities. Incumbents are not very interested in developing services their customers do not want to pay for; new entrants are not likely to attempt rolling out a product that no one will demand. For example, MCI realized in the 1960s and 1970s that if it could break into the long distance market, it could grab a piece of a large lucrative market. On the other hand, unattractive economics coupled with a regulated monopoly decreased the motivation of new entrants to offer competitive local exchange services in rural areas without some form of government assistance.

- Of course, motivation on its own is useless without **ability**, defined as the opportunity to obtain resources and transform them into a product or service that can be offered to customers. Although many entrepreneurs may be motivated to develop a matter transporter that moves objects at the speed of light, they have no ability to do so. A more germane example involves the provision of video on demand. While companies may be very motivated to offer theater-quality streaming video over the Internet on demand to residential customers, technological limitations simply deny them the ability to do so today.

Motivation and ability are certainly related. The ability to access resources and reach customers can lead to the discovery of a previously unrealized "pot of gold" and, given enough motivation, creative engineers and strategists will find ways around perceived constraints on ability. For example, the sense that customers will greatly value the ability to watch any movie on demand has led numerous entrepreneurs to try to figure out how to address this need using novel approaches within their constrained environment. The most successful markets for innovation require both motivation and ability. Understanding these two forces provides policymakers with a foundation to evaluate the impact government intervention has on innovation. As we will demonstrate, government intervention tends to affect one or both of these forces, distorting the market for innovation.

Unlocking disruption

There are numerous reasons – many of which are quite noble – why the government inserts itself into an industry. No one argues when governments successfully address obvious market failures

or support a public good that otherwise would not be provided by private enterprises. It also seems appropriate for the government to ensure that markets function in fair and just ways that: present equal opportunities to incumbents and new entrants, do not lead to dramatic disparities in living standards between haves and have-nots and do not harm investors or consumers. Nonetheless, even the most well-intentioned government legislation and regulation is bound to influence the course of an industry's evolution.

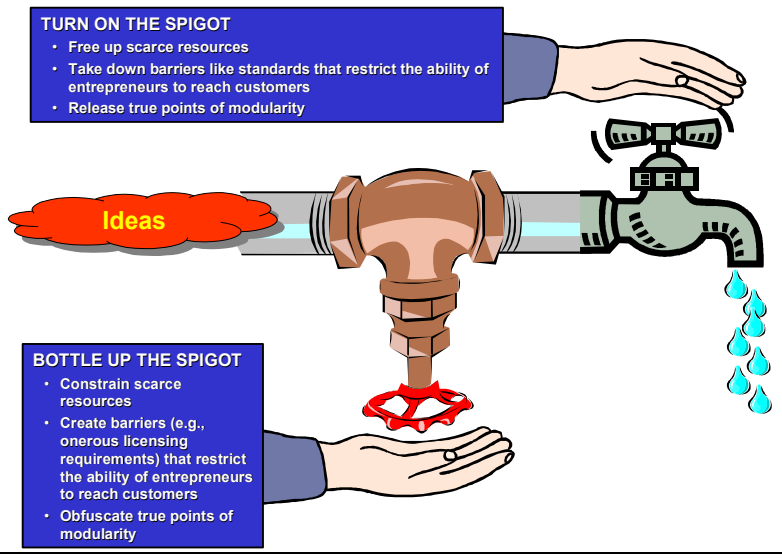
Our previous research into the telecommunications industry uncovered no examples of disruption in the world of traditional telecommunications service providers. While the industry has been rife with numerous other forms of innovations described in the "4-D" model, we identified several factors that insulated traditional service providers from the forces of disruption. For example, the high degree of system interdependence consistently deflects the disruptive trajectory of technologies like wireless telephony and Voice over the Internet Protocol (VoIP) creating opportunities for incumbents to co-opt these nascent technologies. The interdependencies exist at various places within the telecommunications network, such as operations support systems (OSS) in the central office, the physical layer and the complicated array of inter-related network-based services – like call-center management – that require mastery over a complex series of interactions within the entire system to function.

The government also has played an important role holding back disruptive forces in the telecommunications industry by altering the levers of innovation (displayed in **Exhibit 8**). Based on our frameworks, there are generic policies the government can use to "turn on" the spigot of innovation while there are other policies that close down the innovation spigot. To turn on the innovation spigot, the government can pursue the following actions:

- **Free up scarce resources**: Increasing the availability of resources (raw materials, capital and human capital) is a clear way to encourage the creation of more innovative products and services. For example, the government's tight control over spectrum allocation bounds the potential improvement technology of 802.11x-based technologies. If more blocks of spectrum were made available, wireless LAN providers could develop more robust functionality, enhancing their chances to come in from below and radically change the landscape of wireless services. Instead these technologies are limited to press against the boundaries of unlicensed spectrum. On the wireline side, difficulties affecting a firm's ability to obtain land and property rights-of-way make it more expensive and time

Exhibit 8

Generic tools policymakers can use



consuming for it to follow a facilities-based strategy.

- **Take down barriers**: Even with limitless resources, entrants and incumbents alike cannot create innovative services if government policies prevent them from reaching customers. Barriers particularly affect disruptive products that initially tend to be relatively poor performing. While there is certainly a role for oversight because unrestricted and unchecked access to customers by companies could lead to the realization of well-justified fears of consumer harm, allowing innovators to reach customers can also create significant consumer welfare. For example, AT&T initially asked for permission to offer voice mail services in the late 1970s but was not permitted to sell them on an integrated basis because they were deemed to be information services that at the time were illegal for AT&T to sell. It took until 1988 for the Modified Final Judgment (MFJ) court to finally relent and allow the RBOCs to offer the services. Massachusetts Institute of Technology Professor Jerry Hausmann estimates the cost of regulatory delay to be more than $1 billion in lost consumer welfare.[12] The case of voice mail demonstrates that government efforts to protect consumers actually denied them the opportunity to benefit tremendously by getting access to cheaper, more convenient technology that greatly enhanced their life. Conversely, government action in the mid-1990s to allow more companies to offer cellular services has led to a dynamic, competitive marketplace.

- **Release true points of modularity**: Points of the value chain that meet the modularity tests – meaning the interfaces are specifiable, verifiable and predictable in nature – can be "freed" and lead to the creation of a competitive marketplace. Releasing true points of modularity is similar in nature to taking down barriers – standards and licenses are tools the government uses to bottle up points of modularity. It is worth noting that incumbent firms often have strong motivation to try to bottle up points of modularity as long as possible, because releasing those points necessarily leads to the shifting of value downstream to component suppliers. If the government can successfully find pieces of the value chain that are specifiable, verifiable and predictable, it can successfully introduce competition into pieces of the network. Uncovering a true point of modularity in a tightly coupled network environment can be extremely difficult without intimate knowledge of the incumbent's product or service architecture. Forcing modularity at an interface best suited to remain interdependent is a very difficult and inefficient process. In general, the right place to look for such interfaces are points of interconnection between value systems or stages of value-add within an individual value chain. For example, long-term efforts by the government to open the long-distance and the customer premise equipment (CPE) markets to competition were the result of intervention at true modular points and led to important innovations that lowered prices and increased consumer choice.

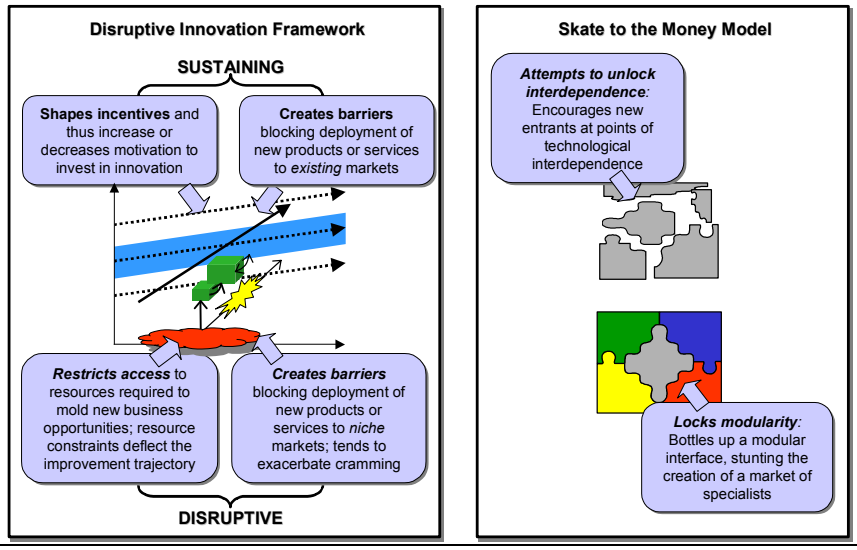
Following these actions generally encourages innovation in general and increases the probability of disruptive innovations as the giant hand in **Exhibit 8** turns on the "innovation faucet." However, what the government can give, it also can take away. Following the opposite course of any of these actions – constraining scarce resources, creating barriers to restrict the ability of companies to reach customers and obfuscating true points of modularity – will block the flow of innovation.

Applying Friction

Aside from generically "turning on" or "turning off" the innovation spigot, government intervention introduces additional "friction" to the otherwise unencumbered process of

Exhibit 9

Applying 'friction' to our frameworks



innovation. Exploring this friction through our theories that describe the forces of innovation and value migration highlights specific ways that government intervention alters the "natural" state (exhibited in **Exhibit 9**). While the notion of friction analysis necessarily leads to a negative bias in the assessment of the impact of government intervention, almost all of the effects work both ways: by affecting the forces of friction the government can either facilitate or stifle the natural progression described by our models.

1. **Shapes incentives, modifying motivation:** In regulated industries, the government has created numerous tools that influence the motivation of incumbents. For instance, price-caps that dictate what incumbents can charge create powerful incentives to develop cost-saving sustaining innovations. The more a firm can improve operating efficiencies, the more profit it can retain. However, return-rate regulation that assigns a fixed rate of return can reduce the motivation of incumbents to invest in new business opportunities because potential upside is limited by that government mandate. The current regulation that requires RBOCs to resell pieces of their network at total element long-run incremental cost (TELRIC) appears to create a powerful disincentive for investment in broadband technology. TELRIC prices estimate the forward-looking cost of a best-in-class network technology including depreciation charges. This pricing mechanism essentially gives new entrants a "free option" – they can wait for an incumbent to take the risk in developing a new technology and then "strike" the option if it is "in the money" indicated by increasing demand for the service.[13] Incumbents are unlikely to invest in deploying a system that their competition can free ride on.

2. **Controls access to resources, affecting ability**: Moving a potentially disruptive idea from the sketchpad to the salesperson requires the ability to acquire and transform raw resources. Governments have a variety of tools, like public property rights and trade policy, to shape the ability of entrepreneurs to access these resources. In the extreme case of the wireless industry, the government controls a critical raw material – spectrum – and hence the ability of innovators to come up with new wireless offerings is highly dependent on the government. The government's control over resources can inhibit or facilitate the innovation process and also halt the potential improvement trajectory of a product by denying access to the necessary additional resources.

3. **Creates or releases barriers to customers, affecting ability**: Some of the tools the government has in its arsenal, like licenses and minimum quality standards

requirements, can affect the ability of new entrants and incumbents alike to offer services by controlling the ability of firms to access groups of customers. These tools affect ability in two specific ways:

a. **Inhibits or facilitates disruption by controlling the ability of new entrants to access customers**: The government can influence the process of disruption by controlling the ability of innovators to target the niche groups of customers that initiate and fund the disruptive process. The barriers set up by the government can exacerbate the tendency of incumbents to "cram" potentially disruptive products in their own processes and business models. An innovator prevented from selling her potentially disruptive product to a group of customers may be forced to turn to deep-pocketed incumbents for access to those customers. Instead of embracing the inherently disruptive nature of the innovative product, the incumbent inevitably tries to morph the product to fit into its existing processes and make alterations that increase the product's appeal to its core customers. This effect is particularly pernicious in the health care industry because stringent Food and Drug Administration requirements mandate that products meet the needs of the most-demanding customers, which tends to encourage entrepreneurs to mutate potentially disruptive ideas into one-size-fits-all solutions. Minimum standards of reliability by state PUCs similarly constrain the ability of entrepreneurs to offer relatively simple, poor-performing technologies to less-demanding customers over the PSTN, reinforcing the hold of incumbents.

b. **Inhibits or facilitates the ability of incumbents to offer new products to their customers:** As the previously discussed voice mail case demonstrates, the government can deny incumbents the ability to offer new and novel services to existing customers.

4. **Affects the natural progression from interdependence to modularity, affecting ability and modifying motivation:** While the "skate to the money" framework suggests that shifts in value away from integrated companies to modular specialists occur naturally, the government can influence this progression. The natural transition from interdependence to modularity is further muddled in a monopoly environment where firms are shielded from the competitive forces that drive a firm to compete based on speed or convenience. This shield allows the monopoly provider to continue to squeeze out additional profitability by solving problems in an interdependent way. Stories abound of Bell System workers coming up with novel solutions because they intimately understand the subtle intricacies of the telecommunications network; their implicit knowledge of the complex interactions within the system enabled them to solve problems that an "outsider" often could not. More specifically, the government affects the progression from interdependence to modularity in two ways:

   a. Specific tools like asymmetric regulation and forced unbundling can incorrectly attempt to encourage new entrants at points of technological interdependence, highlighting an important distinction between *legal* ability and *technological* ability, which we will discuss in more detail in Section III. Data local exchange carriers (DLECs) ultimately failed because they were not entering at a truly modular point despite the government's best efforts to encourage new entrants.

   b. Conversely, the government can utilize several mechanisms to attempt to bottle up or release a potentially modular interface and prevent or assist the formation of a market of specialists. The creation of a competitive marketplace for CPE in

the 1970s is an example of the government unlocking a modular interface. A 1968 FCC decision that the Carterphone attachment – which allowed farmers to use a walkie-talkie like device to speak into their phone from a distance – did not threaten the premise of universal service paved the way for a court decision in the late 1970s that opened the market for competition.[14] Prior to the FCC's decision, the CPE interface was bottled up by "foreign attachment" regulation that prohibited the use of any non-AT&T device. A competitive market emerged once these regulations were lifted.

Although our unique insight stems from the application and understanding of our models, other actions the government can take to influence the process of innovation include ensuring a market functions properly with full competition or creating policies to enhance the flow of information and hence aid the transparency of a marketplace. Understanding our innovator's toolkit and the friction that government intervention introduces is a crucial first step for policy makers who want to craft successful innovation-friendly legislation and regulation.

SECTION III: SOLVING THE POLICY-MAKER'S DILEMMA

Introduction

The job of the policymaker is difficult, filled with contradictions and conflicts that must be carefully balanced. Harmonizing political interests, the needs of special interest groups and industry dynamics often leaves policymakers promulgating policies that give some to all but everything to none. Their job is critically important, especially in a heavily regulated yet dynamic industry such as telecommunications. In this section we will first build the policymaker's toolkit and then demonstrate how it can be used with two examples: the 1996 Telecommunications Reform Act and the current debate over broadband deployment.

We observe that policymakers do not have tools to help them through this process; they do not have theories to help them understand cause and effect and to discern market noise – feedback from the market that often can and should be ignored – from market signals that should be addressed. Understanding the implications of our toolkit – with the addition of an important new tool termed the "motibility" framework – can help resolve the dilemmas that policy makers face:

- Why do so many well-intended actions by regulators and legislators to promote competition and innovation have unintended consequences?
- What should policy makers do when they face a situation where industry participants have neither the motivation nor the ability to commercialize innovative products?
- When is it appropriate to try to encourage new entrants in a market, especially at seemingly integrated pieces of a value system? If moves to modularity and the creation of specialist marketplaces are predicated on competition, what can policymakers do when companies do not face competition?

Our framework is obviously not a "black box" for policy making, but can assist policymakers in crafting successful pro-innovation policies by suggesting broad categories of policy options and indicating the likelihood of a policy's success. Using the tools involves a two-step process: first policymakers must classify existing and potential new entrants in a market according to our "motibility" framework; second they should craft policies that can help move a market in the direction of a "panacea" while considering the issues and problems associated with various policy tools.

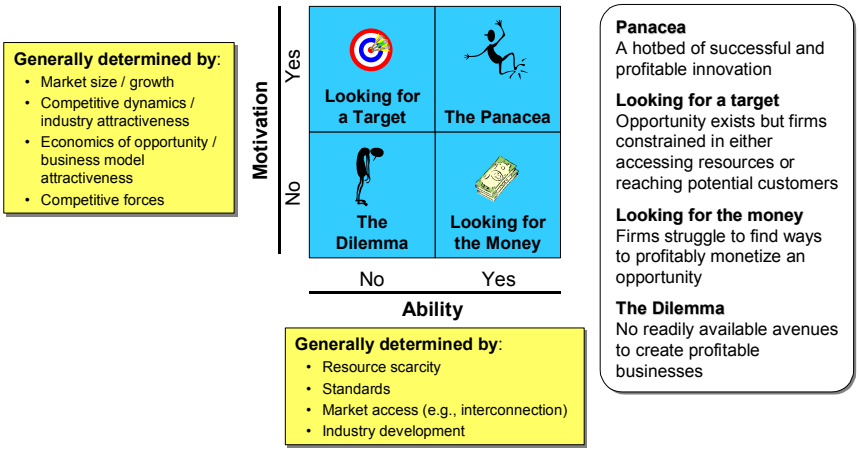
The motibility framework: separating signal from noise

Building off the previously introduced concepts of motivation and ability, we have created the "motibility" framework to assist government officials in understanding what types of policies to encourage innovation are appropriate given their goals and a particular market situation. The motibility framework is grounded in a classification scheme that describes the various conditions that either encourage or discourage innovation. Our theory is that innovation will flourish when innovators have both the motivation and the ability to innovate. Furthermore, policymakers can craft legislation and regulation that encourages innovation once they understand these conditions and the relative amount of motivation and ability of existing and potential innovators.

The motibility framework – presented in **Exhibit 10** – rests on the assumption that successful innovation requires both motivation, previously defined as a "pot of gold" or "market incentives," and ability, defined as the capacity to obtain resources, transform them into a product or service

Exhibit 10

Motivation / ability (motibility) framework



and offer that service to customers. **Exhibit 10** lists out some of the factors that determine the levels of motivation and ability within a market. Motivation is determined by the market size and its growth characteristics, the general industry attractiveness, the attractiveness of specific business models and the level of competition. Ability is determined by the availability of resources, existence of standards and other components of market access and industry and technological maturity. While motivation and ability are both continuous variables, it is useful to simplify the analysis by making each axis a "binary" yes or no question, which leads to four different industry situations:

- **The panacea**: An industry will rest in the upper-right hand quadrant of the framework when both motivation and ability exist. This situation is marked by a "hotbed" of successful and profitable innovation. The wireless telephony market is a panacea for incumbents but not new entrants. Incumbent wireless providers have both the motivation and the ability to roll out services to their customers and hence develop many profitable innovations. However, as noted previously, the lack of freely available spectrum limits the ability of potential new entrants, highlighting an important bifurcation that can be observed by applying our framework. In an ideal situation, both incumbents and new entrants would co-exist in the panacea quadrant, with opportunities for incumbents to pursue profitable sustaining innovations and for potentially disruptive entrants to establish freestanding value networks to attack the incumbent.

- **Looking for the money**: A stack of dollar bills in the lower-right hand quadrant illustrates situations where firms have the ability to create and offer services to customers but no motivation to do so. Here, an opportunity to innovate exists but firms struggle to find ways to profitably monetize it. Some argue that the current provision of broadband services by RBOCs fits in this quadrant (and will be discussed at some length later). RBOCs clearly have the ability to offer broadband services but seem to be dragging their feet because they do not seem to be able to profitably capitalize on the opportunity. Interestingly, incumbent firms would typically view potentially disruptive technologies as falling into this quadrant. While incumbent firms often have the theoretical ability to create a disruptive product or service (in fact, many historical disruptions were initially developed within incumbents) their processes and resource-allocation criteria will make these opportunities appear relatively unattractive and unappealing when compared to

their core business. As we will discuss, creating motivation to attempt to shift players to the panacea quadrant can yield unforeseen results.

- **Looking for the target**: Situations where motivation exists but ability is lacking presents the opposite problem as the looking for the money quadrant. Here, firms can see a profitable pot of gold at the end of the proverbial rainbow but are constrained in either the ability to access resources or to reach potential customers. Both the CPE industry and the IXC market prior to deregulation would fit into this quadrant. In both cases entrepreneurs sensed an opportunity but were frustrated by their lack of ability to offer services. Actions by the government to provide ability to these firms "pulled" the industries to the "panacea" quadrant. Both the IXC market and the CPE market exemplify situations that fall into the quadrant – firms sensed an opportunity and tried numerous ways to get around constraints on ability to capitalize on that opportunity. In this quadrant, the government can pursue policies that successfully promote disruptive and displacing new entrants. Innovations in this quadrant sometimes demand patience on the part of government as motivation can create ability through creativity.

- **The dilemma:** Finally, when firms have neither ability nor motivation they end up looking like the dejected figure in the lower-left quadrant in **Exhibit 10**. There are no readily available avenues to create profitable businesses and neither firms nor regulators know quite what to do. Competitive local exchange carriers in low-density areas prior to the 1996 Telecommunications Reform Act would fit into this quadrant. Because of regulation and industry economics, potential entrants had no motivation to offer services and had no ability to do so. While there are times in a dilemma when it is appropriate to intervene, the government must do so with the greatest of caution.

We believe that understanding and applying the motibility framework can lead to more successful pro-innovation policies. Using the motibility framework involves a two-stage process: 1) classification and 2) pushing towards the panacea while understanding the implications and limitations of the framework.

Step 1: Identify the Market and Classify Industry Participants

The first step in using the motibility framework is a three-part analysis (depicted in **Exhibit 11**) that ends with a comprehensive classification of all potential players within an industry.

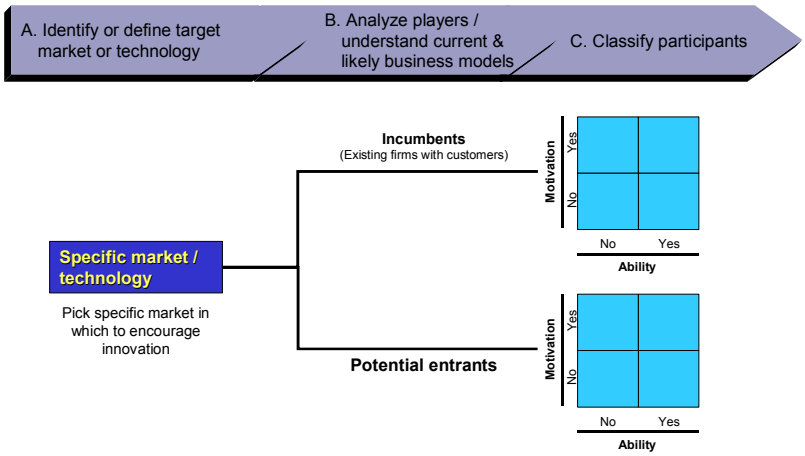
- **Part A: Identify or define target market or technology**. Before any policy can be crafted, it is necessary to step back and consider the target market or technology. Defining the target market or technology helps to draw boundaries facilitating the analysis in the next stage of the process.

- **Part B: Analyze players / understand current & likely business models**: The next stage of the classification process involves determining all current and likely players within a market or technology. It is important to analyze both players that are in the industry as well as potential new entrants – whether they be nascent start-up firms or lumbering incumbents from other industries. Each player's current or potential business model should be analyzed with an eye towards determining its motivation and its ability to offer current and new services.

- **Part C**: **Classify participants**: After all of the current and potential players have been analyzed thoroughly, they can be classified or "plotted" onto the motibility matrix.

Exhibit 11

Step 1: Define market and classify participants



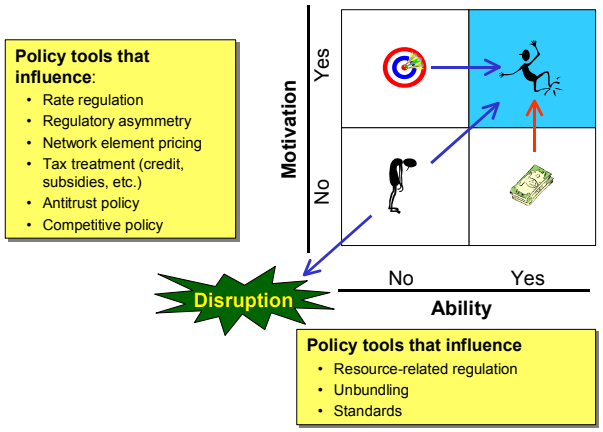
Assessing the CPE market in the mid 1960s illustrates Step 1 of the process. The key players to analyze are Western Electric and potential new entrants like Hush-a-Phone and Carterphone. We would classify Western Electric in the "looking for the money" quadrant – they had bountiful amounts of ability but limited motivation to innovate because their entrenched monopoly position shielded them from competitive forces. The potential new entrants were in the looking for a target position. Their constant efforts to get around regulatory barriers highlighted their motivation and lack of ability.

Step 2: Promulgate policies pushing towards the panacea while understanding the implications of the frameworks

To encourage innovation, policymakers should generally attempt to craft policy that moves firms towards the upper-right hand corner of the matrix – the panacea, where innovation is most likely to flourish. As **Exhibit 12** notes, if motivation is lacking, general tools that can encourage motivation include: rate regulation, asymmetric regulation, networking element pricing, tax treatment, antitrust policy and competitive policy. Ability can be affected by policies such as

Exhibit 12

Step 2: Push towards panacea respecting the model



resource-related regulation, bundling, unbundling and standards.

The classification from step one should suggest certain policy prescriptions depending on the goal of the policymaker. For instance, if incumbents and potential new entrants all have motivation and ability, then our theories suggest little reason for government intervention. However, if new entrants have motivation but are lacking ability, policies to encourage ability are warranted.

One limitation to the framework is that while problems can be identified, simple solutions often are elusive because different firms face different issues and fixing one set of problems often involves exacerbating another set of problems. For example, efforts to increase the ability of potential new entrants to offer local telephony services necessitated tying the hands of incumbents. Hence, it is critical for the policymaker to have a clear goal and also understand some of the subtleties involved in various policy prescriptions. While the general prescription is to push for policies that move all players to the upper-right quadrant, it is important that policymakers understand five important implications of the motibility framework lest unanticipated consequences rear their ugly heads:

1. **Increasing motivation: Interpreting signal from noise.** One problem that often appears to inhibit innovation in an industry is the lack of motivation by new entrants to enter a market. Policymakers often interpret this lack of motivation as a "signal" of a problem that needs to be addressed. That interpretation oftentimes is correct – the lack of motivation could be a result of a market imbalance created by an existing regulatory scheme or some form of externality. However, the lack of new entrant motivation can also be "noise" that results from basic industry economics or an interdependent system where new entrants will by definition be unsuccessful. When the government addresses a market signal and corrects an imbalance, it can create "real" motivation; if the government instead addresses market noise, it often results in "artificial" motivation. Because we define motivation as a pot of gold that entices innovation, artificial motivation can be thought of as the government putting gold on the table to attempt to encourage what certain behavior on the part of managers. However, efforts to create artificial motivation raise two concerns:

    a. Will the artificial motivation encourage gaming or some other form of unanticipated consequence? The U.S. market-based system is very good at directing resources to exploit an opportunity. When the government lays gold on the table, firms often come up with novel ways to game the system and grab the gold without addressing what the government had hoped to correct. There are numerous telecommunications examples of firms developing tariff arbitrage or cream-skimming[15] business models that take advantage of these regulatory regimes in unforeseen ways.

    b. Does the government or the capital markets have the patience to allow artificial motivation to morph into actual motivation? Artificial motivation has a chance of being successful if the government and investors have the stamina to patiently stick with a potential business model or innovation. Sometimes, government may be the only entity capable of sustaining this long-term view. While MCI did appear to enter at a somewhat modular point within the telecommunications system, it still required many years of protection by asymmetric regulation, which some could argue gave MCI "artificial" motivation, before it could be a viable standalone business.

2. **The double-edged sword of motivation.** Government tools that increase the motivation of one class of industry participants are often asymmetric as they tend to decrease the motivation of another class of industry participants. For example, using regulation to grant motivation to new entrants necessarily decreases the motivation of

incumbents. While many pundits point to the innovative power of entrepreneurs, shackling incumbents can be a self-defeating strategy because incumbents are usually the best positioned to develop many important forms of sustaining innovations. The type of "double-edged" tool that should be deployed also depends on the point at which an industry is at in its progression from interdependence to modularity. In general, policies that shackle new entrants but free incumbents can be successful at points of interdependence; policies that inhibit incumbents but encourage new entrants can be successful at points of modularity.

3. **Giving ability: easy but how efficacious?** Providing ability to new entrants often appears to be easier, and hence more seductive, than providing motivation. Giving new entrants more scarce resources or forcing incumbents to unbundle and resell pieces of their network to new entrants appear to be relatively easy policy prescriptions. In fact, if new entrants are motivated and are jostling at the gate of a market, held back only by a lack of ability, these types of policies can be very powerful and very successful. For instance, if the government can correctly identify interfaces "ready" to become modular and release them, it can successfully promote innovation and competition. However, ability is often a less powerful force than motivation. With enough motivation, entrepreneurs often find ways around perceived barriers in ability. For example, everyone was quite sure that minimills would be stymied by fundamental laws of chemistry and would never be able to produce steel that was of high enough quality to threaten the high margin markets of integrated steel mills. However, the large pot of gold that sat just out of reach of minimill operators served as powerful motivation, and the minimill operators eventually figured out ways to circumvent the perceived insurmountable barriers. While there appears to be a general pattern of motivation trumping a lack of ability, the converse does not appear to be true. Without motivation, granting ability can be fruitless unless the government also provides motivation by using a tool like direct subsidies. While abundant ability does give firms the chance to experiment with different business models and stumble on an unanticipated way to make money, this prescription can involve throwing good money after bad, a strategy not often favored by U.S. capital markets.

4. **The modularity test: is it blocking motivation or hindering ability?** The skate to the money framework raises two issues related to the motibility framework. It can explain why entrants lack motivation and it raises issues as to how much ability the government can create.

    a. If products and services are "not good enough" and require utilizing new technologies that result in an interdependent system to achieve desired customer outcomes, new entrants are not motivated to enter a market because the product or service is not ready to be modularized, and large integrated firms are still the most appropriate providers of the good or service. This effect is reinforced in monopoly markets or a network-based product or service where there can be many complex component interactions. While there is a natural progression to standardization over time, a competitive marketplace is the most powerful force to encourage a product to improve and create situations that give rise to modularity and create motivation for new entrants.

    b. Government officials have been known to confuse the concept of *legal* ability with *technological* ability – just because a company is legally allowed to do something does not necessarily mean it is technologically capable or even feasible, a distinction we will highlight further in our analysis of the 1996 Telecommunications Reform Act.

5. **What to do in a dilemma?** The most difficult position from which to craft policy is the so-called dilemma quadrant, when neither ability nor motivation exists. In this quadrant, there is a natural tendency to try to "do everything" and encourage ability and motivation simultaneously. These efforts almost always fail, especially given the compromising nature of the policymaking process. Horse-trading efforts to get bills passed lead to watered-down attempts to do everything that often end with serious unforeseen consequences, encouraging pernicious gaming on the part of incumbents or the creation of flimsy business models that take advantage of temporal arbitrage opportunities on the part of new entrants. Efforts to regulate management decisions often end up with serious unanticipated consequences. Before taking action in the dilemma quadrant, policymakers need to understand what their goals are as well as the reason the dilemma exists: efforts to create policies that do not go after the root cause of the dilemma can actually make a situation worse. In this quadrant, we suggest two possible approaches:

    a. The first approach is to concentrate on one of the two underlying problems, hopefully creating an environment where entrepreneurs figure out a way around the second problem. As motivation is typically a more powerful force than ability, it would be sensible to try to encourage motivation first if there are real market signals that need to be addressed. However, as we have pointed out, the outcome of increasing motivation is typically less predictable given the creativity of markets.

    b. The second approach is to try to create policies that accelerate the process of disruption, allowing firms to spring out of adjacent markets, develop independent value networks and force radical changes to the market where change seems to happen at such a glacial pace. A "do-nothing" approach can actually facilitate disruption by forcing companies to seek another avenue to fund the development of their product. With a hands-off approach, frustrated entrepreneurs will exit the market where they have neither ability nor motivation and seek out a freestanding value network that is delighted to embrace a relatively poor-performing product.

The motibility framework can be a powerful tool to help policymakers assess whether proposed policies will have their desired effects on a marketplace. To illustrate the tool "in action," we will use it look backwards at the 1996 Telecommunications Reform Act and forwards at the current debate swirling around the deployment of broadband technologies.

Motibility Analysis of the Telecommunications Act of 1996

There is no question that the Telecommunications Act of 1996 had dramatic effects on the U.S. economy. While many are quick to proclaim the 1996 Act a colossal failure, others laud the policy initiative for its sweeping pro-competitive reforms and the waves of innovation that radiated in its wake. Acknowledging that the existing regulatory structure was outdated, the drafters sought to encourage growth and innovation with competition and free-market mechanisms. However, with the bursting of the so-called dot.com and telecommunications bubbles, the chorus of naysayers appears to have drowned out the remaining enthusiasts. Furthermore, the failure of CLECs, the evaporation of a gargantuan amount of invested capital and the absence of any appreciable levels of competition in almost all local exchange markets provide further evidence of the Act's shortcomings.

The key question on our minds is would this outcome have been any different if policymakers had the benefit of our theories and a tool, such as the motibility framework, at their disposal? To answer this question properly, we first have to remind ourselves of the context in the early 1990s when the Act was conceived and enacted. We will briefly describe the market situation, what

policymakers attempted to do, and what happened. Then, we will present an analysis of what policymakers could have interpreted with the motibility framework and what alternative policy directions we would have recommended.

Setting the context

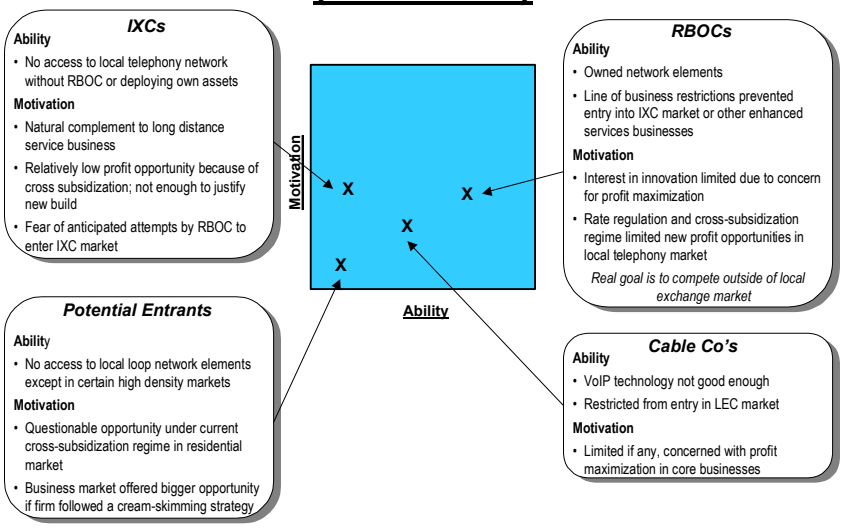
Briefly stepping back to 1995, the telecommunications world was a very different place. There was no competition in all but the most densely populated residential local exchanges as RBOCs controlled the protected monopoly on telephone services, other companies such as cable companies and electric utilities were prevented from offering telephony services (and in fact couldn't given the current state of technology), wireless was still in its infancy, and others were just beginning to explore a cool new technology called the Internet. Given this context, some might wonder what, if any, problems existed that warranted government intervention – especially since the industry structure and economics supported by a decades-old regulatory regime made many claim that change seemed unnecessary and inappropriate. However, growth had slowed and little to no motivation to innovate existed in the local exchange market. Cross-subsidization and interconnection pricing regimes designed to promote universal service artificially lowered prices and state controlled rate-of-return based regulation capped potential profits discouraging new investment. RBOCs, the only firms with the ability to innovate because of their proprietary access to the local loops, viewed residential telephony as a generator of profitable cash flows and preferred to milk existing depreciated assets. Meanwhile RBOCs eagerly eyed the then immensely profitable long distance oligopoly and IXCs sought new methods of reaching business customers in the local exchange.

Exhibit 13 illustrates how we would have classified and mapped the various categories of potential competitors for residential local exchange telephony services in 1995 using the motibility framework. This illustration highlights that the RBOCs were the only firms with the *ability* to innovate, but as we pointed out lacked the *motivation*. All other potential competitors found themselves in the "policymakers dilemma" quadrant, lacking both the motivation and the ability to enter this market space. As we previously stated, attempting to simultaneously grant ability and create motivation can prove frustrating, and betting on disruption in independent markets may be the only way to encourage meaningful and sustainable change.

In enacting the Telecommunications Act of 1996 the federal government, led by the Clinton administration, hoped to spur competition by breaking down barriers through further

Exhibit 13

Residential local telephony market context (circa 1995)



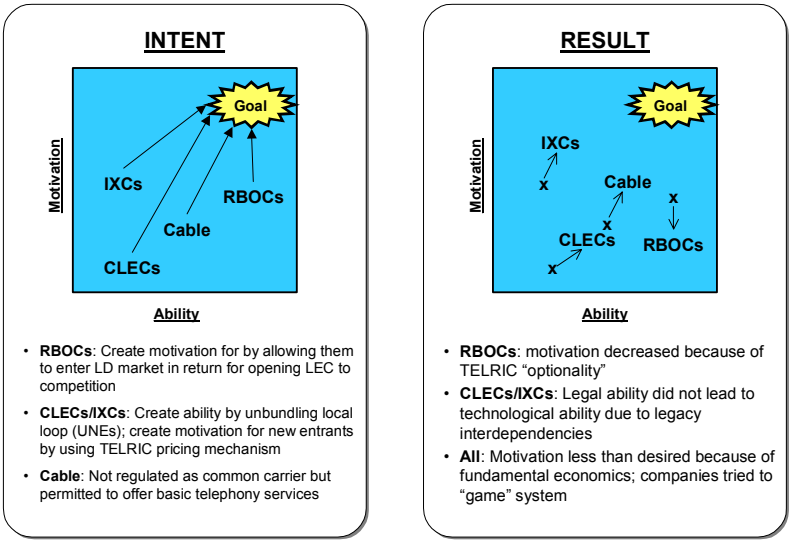
deregulation. With the stated goal "to promote competition and reduce regulation in order to secure lower prices and higher quality services for American telecommunications consumers and encourage the rapid deployment of new telecommunications technologies," it represented a major overhaul of the telecommunications regulatory regime fashioned by the 1934 Communications Act.[16] The 1996 Act, while intended to be deregulatory in nature, re-regulated the industry by introducing a new legal framework. While the 100-plus pages Act included a plethora of specific initiatives, a few of the key provisions included:

- Permission for cable TV companies, electric utilities, broadcasters, interexchange carriers and CAPs to sell local and local toll calling services.
- Forcing RBOCs to resell unbundled local loop network elements in order to encourage new firms to compete for local service and interconnect with local exchange facilities. The FCC later determined pricing for unbundled network elements (UNEs) based on TELRIC.
- Removal of line of business restrictions on RBOCs that permitted entry into the long distance market provided the RBOCs opened their local exchange market to competition. RBOCs could petition the FCC for the permission to offer long distance service once the RBOC prove that the local market was open for competition by satisfying a 14-point checklist (§ 271).
- Permission for RBOCs to offer advanced services through separate subsidiary.

In our language, Congress was essentially attempting to create both ability and motivation – something we predict is an ineffective approach (**Exhibit 14** shows what the government attempted to do and what resulted). Government hoped to increase *ability* for CLECs, IXCs and cable companies by enforcing local-loop unbundling requirements and removing restriction that prevented cable companies from offering residential telephony services. Regulators (FCC) later attempted to create *motivation* for new entrants by crafting the TELRIC pricing mechanism for the purchase of local loop elements. Motivation for cable companies was provided as they were not subjected to common carrier regulations. This allowed them to pursue a close-system strategy. The result of these actions through our model should have ideally moved IXCs, CLECs and cable companies into the panacea quadrant. However, the Act instead produced results unanticipated by those who drafted the legislation:

Exhibit 14

TRA: Intent vs. result (local residential)



- **RBOCs**: Create motivation for by allowing them to enter LD market in return for opening LEC to competition
- **CLECs/IXCs**: Create ability by unbundling local loop (UNEs); create motivation for new entrants by using TELRIC pricing mechanism
- **Cable**: Not regulated as common carrier but permitted to offer basic telephony services

- **RBOCs**: motivation decreased because of TELRIC "optionality"
- **CLECs/IXCs**: Legal ability did not lead to technological ability due to legacy interdependencies
- **All**: Motivation less than desired because of fundamental economics; companies tried to "game" system

- Actions of some of the industry participants were unforeseen and unexpected. Based on our interviews, policymakers' implicit goal was to encourage two to three new facilities-based competitors in the LEC market and support their ability to reach scale by allowing them to purchase UNEs to fill in service gaps. But TELRIC created artificial motivation for CLECs to create non-facilities based models. The CLECs attempted but ultimately failed to build profitable business models by purchasing UNEs from RBOCs. Additionally, while some RBOC resistance was understandable, more obstacles existed than expected as new entrants tried to share facilities.
- True *ability* for new entrants in the local exchange market did not materialize overnight and the perception of ability turned out to be greater than reality highlighting the difference between legal ability and technological or operational ability. Legacy interdependencies created by decades of single provider monopoly control were much greater than expected and dramatically slowed the forced unbundling – in our language modularization – of the local loop. New entrants encountered technological complexities that required more time to sort than was estimated or articulated in the multitude of new business plans that emerged.
- Exuberant capital markets fueled by this overestimation of ability and some confusion that legislated ability would easily and immediately translate to profitable opportunities encouraged over investment in CLEC opportunities, forcing unsustainable growth rates and poor customer acquisition decisions. Most investors did not understand the time required to establish and scale a business given the technological complexity involved in delivering service.
- Industry participants reacted unexpectedly to *motivation* created by government intervention. RBOCs did not cooperate as anticipated once they were given permission to enter the IXC market in exchange for opening up the local market because the long distance market was much less a "carrot" then expected. Increased competition coupled with cost-saving technological improvements led to rapidly declining prices. TELRIC pricing encouraged new entrants to "free ride" on existing network elements instead of investing in new facilities. Encouraged by a "hands-off" approach by the government, growth of the Internet exploded, further complicating the market by changing network traffic patterns considerably.

While these results stymied and frustrated many policymakers, we believe that these were actually quite predictable outcomes. Using the motibility framework combined with our innovators toolkit, for example, we could have seen that the act attempted to:

- Force modularity within the central office – in our view a complex and lengthy process. While theoretically the local loop consisted of highly mature technologies that should have been easily modularized, the absence of competition (as noted, the primary driver of the shift from interdependence to modularity) allowed the RBOCs to maintain highly interdependent systems. Decades of this interdependence allowed overly complex and cost-intensive network architectures to flourish. Additionally, the RBOC's resource allocation processes and firm values, which incorporate everything from investment decisions to the attitude of unionized technicians, would encourage and reinforce these interdependencies. Because legacy interdependencies existed everywhere, policymakers should have expected that unbundling would be more difficult to achieve and significant investments in time and resources as well as a good deal of patience would be required. Our theory of modularity could have been an important test of where unbundling was likely to succeed and how difficult it would be to accomplish.

- Create sustainable motivation – within the context of distorted industry economics that were extremely difficult to correct given that cross-subsidization schemes and regulatory rate caps discouraged investment. The numerous pricing distortions in the market created by decades of regulation made investment in the local loop unprofitable without additional artificial forms of motivation. As previously noted, artificial forms of motivation typically encourage gaming by firms in ways that policymakers may not have been able to anticipate. The motibility theory would have raised flags any time policymakers attempted to create motivation through artificial means.

Given this analysis, our theory would have suggested an alternative set of recommendations to policymakers. In order to encourage competition and innovation we would have recommended focusing on **either** increasing ability **or** creating sustainable motivation, but not both at the same time. Our recommendations would have been to:

- Increase *ability* by supporting a slower, phased unbundling process with measurable milestones that recognized the existence of legacy interdependencies, by managing expectations better with much less hype and rhetoric and by communicating that establishing sustainable new entrants would require the right investors, patience and time

  or

- Create sustainable *motivation* by not attempting to get a "big hit" with a TELRIC-like pricing mechanism. Instead, the government could address one of the underlying obstacles to innovation – the skewed industry economics – by reversing cross-subsidization schemes, eliminating rate caps, and allowing consumers prices to rise.
- Concurrent with either approach, bet on disruption by focusing on initiatives that "opened" the innovation spigot in another marketplace (e.g., free huge quantities of wireless spectrum) to encourage and facilitate spillover effects.

The broadband debate through motibility

Pundits have pontificated, proposals have been promulgated, politicians have pondered, the press has postulated, and lobbyists on all sides of the issue are all trying to address the hottest topic in telecommunications today: what, if any, is the government's role in the deployment of residential broadband technologies?[17] More specifically, is there a delay in the build out of broadband that justifies government intervention by subsidizing the deployment of these technologies? As lumbering incumbents drag their feet and new entrant after new entrant – from Covad to RhythmsNet to Excite@Home – have been eviscerated, the voices calling for some form of government action have grown from a murmur to a roar. Meanwhile, investors, still skittish from the bursting of the dot.com and telecommunications bubbles, are begging for guidance in the form of regulatory clarity.

Analyzing the industry using the motibility framework underscores the difficult choices facing the government – there does not appear to be a silver-bullet solution, as we believe each category of likely industry player currently occupies a different quadrant. This means crafting policies that successfully foster innovation and competition will depend on a number of factors including what type of innovation policymakers hope to encourage over what time frame, the degree to which different categories of competitors will likely compete and an assessment of which technologies are ready for wide scale deployment. Answers to these questions will help frame the debate and combined with our theories provide some guidance to policymakers. While there are no easy answers, our frameworks suggest a reasonable approach is to grant motivation to incumbents to

harness what are essentially sustaining innovations while betting on disruption springing out of a new industry.

Classification of the industry

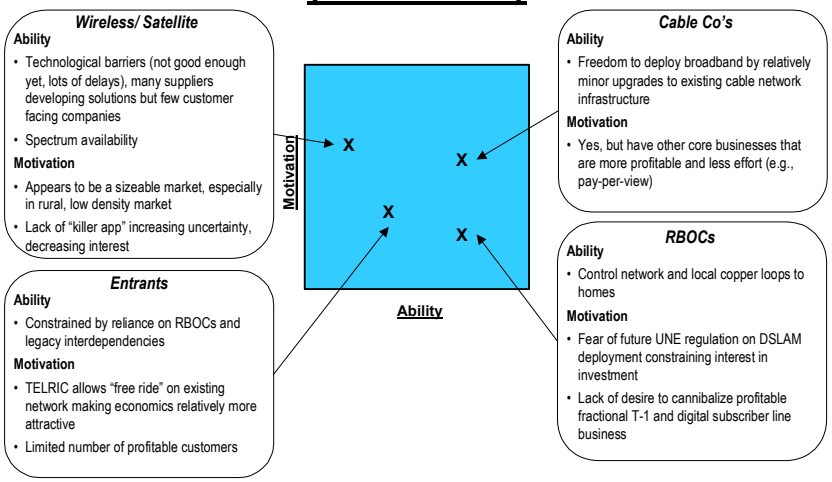
Using the FCC definition of broadband – any "high speed" technology infrastructure capable of delivering transmission speeds in excess or 200kbps either downstream of upstream – we can identify four primary groups of current and potential industry participants (shown in **Exhibit 15**)[18]: the RBOCs, new entrants, cable companies and wireless companies (including satellite cable). Before analyzing each class of player through the motibility framework, it is important to note some factors that affect the entire industry:

- **Demand uncertainty, lowering motivation**: The motivation of all players is diminished by the uncertainty surrounding the U.S. consumer's willingness to pay upwards of $50 a month for a high-speed connection. Although many consumers claim they seek always on, high-speed connectivity, the elusiveness of a so-called "killer application" has raised serious questions as to the demand for broadband-enabled services. While some make the classic chicken-and-egg argument that the killer application cannot be developed until more consumers have broadband technologies, the more than 10 million users with broadband connections should be a reasonably large enough market to justify investment in and stimulate the development of novel services.

- **Cost and difficulty of deploying services, limiting motivation and ability:** Although services like DSL were conceived in the laboratory decades ago, deploying broadband technologies is still very expensive, requiring extensive infrastructure upgrades. Furthermore, this effort is complicated by the existence of complex legacy interdependencies and the lack of good information on the state of the physical elements of the network. Although tremendous improvements have been made in the area of self-installation and provisioning, the current state of high-speed technologies cannot easily be rolled out to wide swaths of the population. This problem is especially acute for new facilities-based competitors where experts estimate a majority of costs are still associated with relatively "old economy" tasks such as digging ditches and gaining rights-of-way approvals from local zoning boards.

Exhibit 15

The residential broadband debate (circa 2002)



- **Limitations of today's technologies, lowering ability:** For those of you who have DSL and live next to a central office, are the only one in their neighborhood with a cable modem, or live in the virtually weatherless desert climate of Arizona or Nevada and elected to try a high-speed wireless connection, ignore this paragraph. For the remaining 95 percent of us, broadband technologies still have significant limitations. DSL can only be deployed to homes and businesses within 15,000 feet of a central office (and service degrades as elements are extended beyond 2,000 feet). Cable modems share available network capacity and thus slow down during heavy usage times and in densely populated neighborhoods. Wireless technologies suffer from line-of-sight restrictions and weather-generated interference. Needless to say, quality of service depends on any number of variables and can vary dramatically from installation to installation. Lastly, even when you have an ideal connection, connections speed are often not high enough to fulfill very demanding applications like watching a streaming video.

Although these factors affect all players in the industry, analyzing the situation with our motibility theory suggests that each class of industry participant faces a unique situation and resides in a separate quadrant of our framework (displayed in **Exhibit 15**):

- **Cablecos (panacea)**: After extensive infrastructure upgrades costing billions of dollars during the 1990s, cable companies are now in the enviable position of having the capability to offer high-speed access in many locations with relatively little incremental investment, indicating a wealth of ability and motivation to go after new profitable revenue streams. Additionally, the government has exercised its right of forbearance and opted not to intervene through either common carrier regulation or by mandating the unbundling of cable networks as they have with RBOCs. Cable companies' motivation to pursue broadband is only tempered by prioritizing potentially higher returns by offering incremental services like pay-per-view movies.

- **RBOCs (looking for the money)**: With their ownership of the network assets and copper loops, RBOCs clearly have the ability to offer services to many of their customers. However, their motivation is mitigated by two factors:

    - RBOCs believe that future unbundling requirements will force them to resell portions of any newly deployed broadband infrastructure to competitors at prices imposed by the regulators. As previously mentioned, the current TELRIC-based pricing mechanism lowers motivation for RBOCs to invest in new services by imbedding a "free option" to new entrants who rely on unbundled local loop elements for service origination or termination. RBOCs want to avoid taking the investment risk of upgrading their network, only to have new entrants jump in once demand for the technology is proven.

    - RBOCs are loath to cannibalize other extremely profitable business lines, such as second lines to the home, DS-3 connections and fractional T-1 lines. DSL technologies could easily replace these profitable businesses. Although the introduction of competition should eventually diminish this force, it has not done so to date.

- **Wireless and satellite companies (looking for the target)**: Both wireless and satellite companies are motivated to offer broadband services because they see the potential for attractive new revenue streams. However, these firms face serious technological hurdles before wireless broadband technologies are good enough for mass consumption. For example, beyond quality issues, satellite customers must still rely on slow dialup

connections for upstream communication. Spectrum scarcities also constrain the ability of wireless companies to offer bandwidth-intensive services in the short term.

- **New entrants (dilemma)**: Like potential new entrants on the voice side, potential new and nascent providers have neither the ability nor the motivation to offer broadband services. Despite the incessant hype in the sector over the last few years, these providers face the same legacy interdependencies that limited the ability of their CLEC cousins to offer services successfully on a widespread basis. While TELRIC pricing does help to create the motivation for new entrants, the need for heavy investment and the lack of a critical mass of profitable customers forces these players into the lower left-hand quadrant of the framework.

What to do?

Given the analysis, it is clear that there is no single prescription that can quickly move all industry players to the "panacea" box. Actions to increase the motivation of RBOCs are likely to decrease the motivation of new entrants; actions to increase the ability of new entrants are likely to further depress the motivation of RBOCs. However, there are a number of generic policies that are sensible for the government to pursue that will successfully promote innovation:

- Increase ability across the board by taking actions like making it easier for companies to get right-of-way access and releasing more wireless spectrum.
- Create artificial motivation where it is needed the most, in the rural areas where it is difficult to build economic business models.
- Increase motivation by allowing people access to content that can be shaped into the killer application. While some might argue that another way to increase motivation would be to sponsor research that can lead to the creation of the killer application, history shows that such efforts would likely not bear fruit because they would target the most-demanding applications.

While it is not the job of this paper to endorse or recommend a particular piece of legislation, we can suggest the process we would follow to determine what type of policy we would promote. We suggest a two-stage approach. First, we present a series of high-level questions for policymakers to consider while crafting a course of action. Second, we show how wielding our innovator's toolkit can lead to important insights for policymakers. Specific courses of action can differ widely depending on how policymakers answer the following high-level of questions:

Illustrative Questions

1) **Is there a problem that needs to be addressed?** While many industry participants suggest the answer to this is yes, there are more than 10 million households with high-speed access to the Internet, with growth rates exceeding 100 percent in most areas.[19] Additionally, analysis by McKinsey and J.P. Morgan of "micromarkets" suggests figures significantly higher in particular geographic areas. This study also found that almost 94% of the currently estimated 49 million homes are meaningful candidates for broadband. Even with these positive statistics, incumbent investment has slowed, broadband specialists such as DLECs have failed, broadband penetration is much more prevalent in densely populated areas and, as many economists argue, a slow roll out diminishes the vast economic benefits broadband is predicted to create. Lastly, another fear among politicians and certain lobbyist groups is that letting market forces direct deployment will exacerbate the so-called "digital divide."

2) **If there is a problem, can the policymaker determine his or her goal?** There are a variety of objectives the policymakers could seek regarding broadband, ranging from ensuring the universal access of broadband technologies (especially in rural areas) to using the technology as a "Trojan horse" to further deregulate the RBOCs. Using the motibility framework suggests particular actions for each goal. For instance, if the policy objective is to have universal access and policymakers believe that RBOCs are best suited to deploy services in rural areas, increasing their motivation by granting subsidies for rural deployment or even more drastically parceling out protected franchises could be reasonable courses of action. Without a specific goal, policymakers could fail to encourage innovation or even worse fall into the trap of creating a new regulatory regime that leads to gaming.

3) **Do you believe further unbundling will be successful?** As noted repeatedly, the 1996 Telecommunications Reform Act began the process of trying to unbundle network elements in the local loop and met limited success. The process of untangling the legacy interdependencies is arguably far enough along in most central offices to allow competition to enter. Given the progress made, it may not be prudent to abandon this policy direction and instead continue to support UNE regulations. To make this policy approach more effective and ultimately successful, the TELRIC pricing mechanism will need to be re-evaluated and replaced with a more fair assessment of element costs.

4) **Do you believe duopolistic competition between the cable companies and the RBOCs is "real" competition?** Some of the proposals currently being discussed implicitly provide additional motivation to RBOCs to lead the deployment of advanced services. These policies would move the RBOCs into the "panacea" box, where cable companies appear to reside today. For this "two-wire" policy to be successful, there must be enough competition between the RBOCs and the cable companies to motivate both classes of companies to roll out high-speed access. However, an argument can also be constructed that in a two-wire world, the cable companies would "take" video, the RBOCs would "take" voice services, and the two companies would find a way to carve up the data market, resulting in a cozy cartel that harms consumers and leads to little innovation.

5) **Do you believe in decoupling of services from the transport medium?** Even if a duopoly results in a cozy cartel, it could be a temporary phenomena that is made irrelevant if the continued move from circuit-based to packet-based technologies results in the separation of services from the transport medium over which they travel. If decoupling is "real," the end result of the deployment of broadband technologies could be a wide-scale modularization of the industry, with specialist providers providing services and cable companies and RBOCs providing pure access, much like today's electrical companies. Our "skate to the money" model would then predict these specialist service providers would earn the vast majority of profit in the industry. Believers in decoupling should support proposals pushing for the quick deployment of the technology by incumbents, who would ironically be writing their own death sentence.

6) **Do you believe in disruption from another technology?** Given the complexity of the current battle between Cablecos and RBOCs to deploy broadband, it is difficult to prescribe one correct approach. An alternative approach would be to encourage disruption in an independent market and hope that it leads to the creation of new business models capable of challenging the incumbents. For example, releasing additional spectrum could create the ability for new lower-cost wireless broadband companies to emerge.

We believe most policymakers have thought about the first two questions a great deal, about the next two questions less so and not at all about the final two questions. Rigorously working through the questions should help them understand how best to utilize the motibility framework.

Our approach

While again it is not our goal to promote specific policies we can recommend a general approach to broadband by utilizing our innovator's toolkit and motibility framework.[20] Our approach using the motibility framework is presented in **Exhibit 16**. While the ideal solution would involve free and unfettered competition and innovation, our suggestion calls for a perhaps less appealing but workable solution that features a two-wired world where incumbents are free to deploy broadband technologies – what we believe are highly sustaining innovations. This solution may not be so distasteful because our theories predict the money in the industry will eventually shift to content and services providers. However, the real insurance policy is to bet on the power of disruption to increase economic welfare by turning on the innovation spigot in other markets.

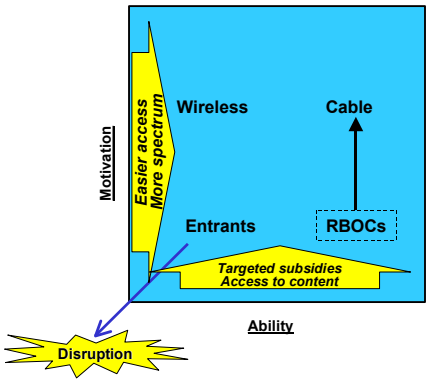
Our ultimate goal would be to encourage broadband deployment by relying on increased levels of competition and betting on disruption. While we recognize the inequities of current deployment schedules, we do not consider broadband to be a public good warranting some form of government sponsored industrial policy. Instead we believe that over, time innovation, and in particular disruption, will create new business models that will make broadband accessible and affordable to everyone. We have not seen this type of innovation in telephone service because of decades of regulatory intervention that have altered prices and shifted market incentives.

Policymakers must realize and agree that broadband technologies are sustaining innovations to the companies that deploy them. Through our lenses, DSL and cable modems are incremental improvements to the underlying infrastructures that enable them and allow RBOCs and cable companies to offer premium-priced services to existing customers. Assuming broadband is a sustaining technology, then, in absence of regulatory restrictions, we would predict that incumbents would ultimately master the technology and remain dominant players. Based on the motibility framework, we would recommend policies that increase the motivation of RBOCs to deploy broadband and move them from the "looking for the money" quadrant to the panacea.

This would create a "two-wire" situation where both the Cablecos and RBOCs have the

Exhibit 16

Residential broadband: Our approach



- Use targeted subsidies and improved access to content to bolster motivation across the board
- Allow easier access to rights-of-ways and spectrum to increase ability
- Free RBOCs from restrictions that dampen their motivation to offer DSL as they are best positioned to lead the sustaining technology
- Bet on disruption from an adjacent industry, like wireless
- Support unbundling at interfaces that are truly modular

motivation and ability to aggressively pursue the sustaining innovation that they are best suited to control. As we have described, many believe that this will simply create a duopoly that stifles, not encourages innovation. While this is plausible, it is also likely that there will be vigorous competition in many markets between these two categories of companies. Furthermore, alternative local access technology companies (e.g., satellite and wireless) will continue to develop technologies to get around constraints on ability, which could further increase competition.

Using the "skate to the money" framework, we would predict that more competition would increase pressure to modularize broadband so that companies could increase their speed to market. The most likely place to see modularization would be in CPE (e.g., cable modems and related accessories) and service provisioning (both already starting occurring in DSL as a result of the 1996 Telecommunications Reform Act). RBOCs and Cablecos will most likely be in a race to acquire subscribers in densely populated markets. Some kind of unbundling requirements could still be plausible and could play a meaningful role in promoting modularization in the industry, assuming the pricing mechanism is adjusted to better reflect actual network costs. However, we should reiterate that the market will be a more powerful force in driving modularity as companies are exposed to increased levels of competition.

It is also important to note that a two-wire world is still unlikely to lead to any new disruptions. Combined with the above policy that encourages broadband by creating incentives for sustaining innovation, we would also highly recommend crafting policy that encourages disruption in markets outside of the local loop and cable systems. Although it is impossible to predict exactly where a disruption would originate, one high potential market is wireless. In the wireless industry, the government should look to "turn on" the innovation spigot in markets such as wireless – the most likely source of a disruptive business model. Actions such as releasing spectrum, easing right of way access rights, and having the government provides funds to wirelessly enable its own infrastructure are all viable options to encourage disruption in this market.

In the long run, we believe that the wide scale industry modularization enabled by the IP internetworking paradigm will lead to the decoupling of services from the physical layers of the network. Value added services will no longer depend on interdependent ties to the network and new business models will emerge greatly increasing the utility and lowering the cost of broadband technologies. While this scenario will require time, new IP-based technologies (e.g., VoIP) and services are demonstrating and proving the inevitability of this reality.

APPENDIX

Korea: A Broadband Panacea?

With a per capita broadband penetration rate more than two times higher than any other OECD country, South Korea is widely hailed as the broadband capital of the world. As of June 2001, Korea had about 6.5 million broadband subscribers – about 14 percent of its total population – while the U.S. had a penetration rate of only 3 percent of its total population.[21] Subscriber growth continues at a staggering pace, with some industry watchers predicting that almost 30 percent of Korea's population will subscribe to broadband by 2004.[22] With competition fervent, prices dropping and content providers springing up to provide new services to consumers, Korea seems to be caught in an enviable virtuous cycle. The presence of several vibrant facilities-based competitors indicates how firms appear to have both the motivation and the ability to invest in the deployment of broadband; Korea truly seems to have "solved" many of the broadband problems confronting the United States today.

While there are lessons that the U.S. can learn from South Korea, some of its advantages appear to be unique and difficult to replicate. Our analysis highlights five specific factors:

- **High population density, facilitating ability and stimulating motivation**: Korea's population density of almost 500 people per square mile is more than 15 times the U.S.'s population density. With a large number of people in apartments in urban areas, almost 95 percent of the population can easily be served by DSL. This high population density increases the ability of firms to offer broadband technology and also increases their motivation by allowing them to quickly capture scale economics.

- **Historical accident of high levels of deployed fiber:** Korea's power company deployed a large quantity of fiber directly to apartment buildings, most of which was unused. It was happy to lease this to new companies for deployment

- **Government direct spend increasing motivation and facilitating ability**: The Korean government spent more than $500 million to build a backbone infrastructure connecting government and educational facilities. While this amount is trivial compared to the more than $10 billion spent by private companies, it still did help to stimulate demand for broadband technologies.

- **Government's active and non-active role:** The government has also played an important role in facilitating the deployment of broadband by not interfering with competition by not forcing players to unbundle pieces of their network to date. The government's large share in Korea Telecom, the country's leading broadband provider, certainly has helped spur KT to quicken its pace of deployment.

Through our lenses, Korea's natural situation led to strong motivation and ability for both incumbents and new entrants. Korea's government only augmented that natural motivation and ability through its direct spending, its influence over KT and its decision to let companies roll out services largely free from government intervention.

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[1] Bureau of Economic Analysis, National Income and Product Accounts. Available from www.bea.gov.

[2] See Christensen, Clayton M., Scott D. Anthony and Erik A. Roth. *Innovation in the Telecommunications Industry: Separating Hype from Reality*. 2001. www.claytonchristensen.com.

[3] Bell started the telephone system by licensing his patented technology to companies who wanted to establish service in a local market. In 1885, the Bell operating companies were reorganized underneath one corporate entity to increase the growth of the network through enhanced coordination and management. This entity was named the American Telephone and Telegraph (AT&T) Corporation.

[4] As stated in Friedlander, "Natural Monopoly and Universal Service," 39, from Barnett, "Organizational Ecology of the Early American Telephone Industry," 10.

[5] Thomas J. Dusterberg and Kenneth Gordon, "Competition and Deregulation in Telecommunications: The Case for a New Paradigm," *The Hudson Institute*, 1997, 49.

[6] Friedlander, Amy, Natural Monopoly and Universal Service: Telephones and Telegraphs in the U.S. Communications Infrastructure 1837-1940. Corporation for National Research Initiatives, Reston VA., 1997.

[7] *See generally*, Breyer, Stephen G. Regulation and its reform. Cambridge, MA: Harvard University Press. 1982; Kahn, Alfred E. The Economics of Regulation: Principles and Institutions. New York: Wiley, 1970; Sharkey, William W. The theory of natural monopoly. New York: Cambridge University Press, 1982; Wenders, John T. The economics of telecommunications: theory and policy. Cambridge, Mass.: Ballinger, 1987; Posner, Richard A. Natural monopoly and its regulation. Washington, D.C.:Cato Institute, 1999; Dusterberg, Thomas J., and Kenneth Gordon, Competition and Deregulation in Telecommunications: The Case for New Paradigm. The Hudson Institute, Indianapolis, IN, 1997; Friedlander.

[8] Convergence is commonly known as the merging of voice, video, and data communications onto one data network. It is predicated on the shift of voice and video traffic from analog-based technologies to digital-based technologies that treat all communications as data, ones and zeros, allowing for converged networks.

[9] More information on the frameworks can be found in *The Innovator's Dilemma*; "Skate to Where the Money Will Be," "Innovation in the Telecommunications Industry, Separating Hype From Reality," "Building Disruptive Growth Businesses."

[10] For example, each year, Microsoft's legions of engineers come up with scores of new features to put into its Office products. However, Microsoft's own research indicates that most consumers use less than five percent of the functionality in any given product – our behavior cannot change at a rapid enough pace to keep up with Microsoft's innovation.

[11] See Christensen, Roth and Anthony

[12] Hausman, Jerry A. "Valuing the Effect of Regulation in New Services in Telecommunications." Brookings Papers on Economic Activity: Microeconomics, 1997.

[13] See Crandall, Robert W. "The Telecom Act's Phone-y Deregulation." The Wall Street Journal, 27 January 1999. http://www.brook.edu/views/op-ed/crandall/19990127.htm; Crandall, Robert W. "An Assessment of the Competitive Local Exchange Carriers Five Years After the Passage of the Telecommunications Act." Criterion Economics." Criterion Economics, June 2001; Hausman, Jerry. "Competition and Regulation for Internet-related Services: Results of Asymmetric Regulation." Unpublished working paper. 25 August 2001. http://econ-www.mit.edu/faculty/jhausman/files/Columbia_v4.pdf.

[14] Wilson, Kevin G. Regulating Telecommunications; U.S. and Canadian Telecommunications, 1840-1997. Lanham, MD: Rowman & Littlefield Publishers, 2000.

[15] Cream skimming involves trying to reach an incumbent's most lucrative customers by offering them discounts.

[16] From the 1996 Telecommunications Act.

[17] We have made a conscious decision to focus on residential broadband, as that is the primary focus of much of the political debate to date. We believe our findings should be similar for small and medium businesses as well, although cable companies have less ability to serve these companies because their infrastructure tends to be built around residential areas.

[18] There clearly are distinctions between these different types of firms, yet this simplifying categorization is useful for the purpose of this analysis.

[19] See FCC *Third Notice of Inquiry* under section 706 of the 1996 Telecommunications Act, Docket # 98-146 dated August 10,2001. For more detailed independent analysis see joint J.P. Morgan and McKinsey & Company white paper, Broadband 2001, published April 2, 2001.

[20] This prescription is predicated on the belief that our theories correctly explain the forces of innovation and the assumption that a competitive marketplace is a preferred condition to encourage the greatest amount innovation and increase the possibility of disruption.

[21] Organization for Economic Co-Operation and Development. The Development of Broadband in OECD Countries. June 2001. http://www.oecd.org/pdf/M00020000/M00020255.pdf.

[22] Walsh, James. "The Korean Residential Broadband Market." The Yankee Group Report 3:2 (February 2002).

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