Open Access in Network Industries

Research conducted for the Canada Transportation Act Review

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OPEN ACCESS

IN NETWORK INDUSTRIES

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PREFACE

This report has been prepared by George Hariton of TIA Telecommunications Issues and Analysis and Peter J. Milne of Peter J. Milne & Associates for the CTA Review Panel. The purpose is to examine the role of open access in other network industries, and the impact of its implementation, with a view to possible applications in the rail transport industry.

Network industries use a network to connect different locations. This network aggregates traffic between different origin-destination pairs and concentrates it on common links, thus leading to economies of scale. However, these very economies of scale can create bottlenecks. Open access is intended to overcome these bottlenecks, enabling multiple suppliers and competition.

Open access has recently been introduced in a number of industries in Canada. This report looks to long distance and local telecommunications, and to natural gas. Electricity is another pertinent industry. However, it is only now in the process of being opened to competition, and it is not yet clear what role open access will play. As a result, electricity was not included.

EXECUTIVE SUMMARY

Network Industries

Rail transport, local and long distance telecommunications, and natural gas transport are all network industries. They use a network to connect different locations. This network aggregates traffic between different origin-destination pairs and concentrates it on interoffice or intercity links. This allows traffic to use high-capacity links, even though the traffic between any origin and destination may in fact be low volume. In turn, use of shared high-capacity links lead to much lower unit costs for the traffic going over them.

Individual customers need to access the core network. In telecommunications, competition has developed in the core network, and access by customers has been a bottleneck. Competition has been encouraged by allowing customers to reach their preferred supplier over the access facilities already in place. In natural gas, while there are numerous producers of gas, the transport function has been a monopoly.[1] Competition has been encouraged by unbundling transport from the ownership and marketing of the gas,

Access in Telecommunications

The long distance telecommunications market was opened to competition in the early 1990s. The regulator ordered incumbents to interconnect their networks with new entrants in the long distance market. As a result, new entrants only needed to put in place an intercity network. New entrants pay the incumbent an interconnection charge per minute of traffic originated or terminated.

In the case of a customer that generates a very large volume of traffic at a given location, the new entrant can set up, or require the incumbent to provide, a dedicated link between its point of presence and the customer. This allows the new entrant to bypass the incumbent's switched local network and its interconnection charges. Opening of the long distance market to competition was also promoted by obliging incumbents to allow the resale of facilities and services.

[1] This is starting to change with the construction of the new Alliance pipeline project.

Despite these measures to encourage entry into the long distance communications market, the regulator found that, for long distance competition to be viable in the long run, the local telecommunications market should also be opened to competition. In this way, new entrants would no longer be dependent on incumbents' facilities or services. They would also benefit from economies of scope across different services.

To open up the local market to competition, the regulator again relied on interconnection and resale of facilities and services.[2] Any carrier can require another carrier to new entrants unbundled local loops, i.e. copper wire pairs from the incumbent's central office to the customer premise. The incumbent must also allow the CLEC to co-locate its facilities within the incumbent's central office.

New entrants can resell incumbents' services, as another means to reach customers. However, the regulator's approach to local competition has been to encourage facilities-based competition from the outset. This is in marked contrast to the approach it took to long distance competition, where it believed that resale-based competition would give new entry a chance to win market share, and finance the construction of facilities later.

The Impact of Access in Telecommunications

Competition in the long distance market has flourished. Price rivalry is intense, and incumbents have lost between 30% and 40% of the market to new entrants. There has been some consolidation, but new sources of competition are expected, e.g. Telus versus the Bell Canada family of companies.

The impact of long distance competition is still a matter of some controversy. Customers certainly have more choice than before. In the short term, efficiency has suffered, and unit costs actually increased, a change from their long-run downward trend.[3] In the long term, it is expected that competitive forces will lead to greater efficiency, market growth, and innovation.

Prices for long distance services have dropped dramatically, despite increases in unit costs. This has been mainly due to a very significant reduction in cross-subsidies generated from long distance and used to keep the price of residential local services below cost.

[2] Here, resale of facilities is indirect. It involves their lease and incorporation into a competing carrier's network, and hence into the services offered to end-users.

[3] Interconnection has caused both start-up and ongoing costs. As well, sales and marketing costs have increased dramatically, and, more controversially, benefits from economies of scale have been reduced. As a partial offset, the increased sales and marketing have stimulated demand and increased the size of the market.

Competition in the local market is still in the early stages. However, again short-term reductions in efficiency are expected to be followed by longer-term gains. Prices of residential local service have more than doubled and are expected to increase further, as cross-subsidies to these services are reduced.

Access in Natural Gas

The market for the commodity natural gas, excluding gas transportation, was deregulated and opened to competition in 1985. Prior to that, integrated pipeline companies purchased natural gas at the point of production and transported it by pipeline to destination markets. These pipelines only offered a fully bundled service to buyers, that is, gas could only be purchased on a delivered basis. As part of deregulation, pipelines became simple common carriers, providing shippers, including buyers and sellers, with non-discriminatory open access transport services. Pipelines no longer purchase or sell gas,[4] and they are required to transport gas for others under the same toll schedule and terms as they transport gas for their own marketing subsidiaries.

Traditionally, the main natural gas pipeline systems, Nova/TCPL and Westcoast, have operated as monopolies. However, competition is being introduced with the recent construction of the Alliance Pipeline, a large capacity pipeline that runs from northeastern B.C. across Alberta and south to Chicago, and the current construction of the Vector Pipeline from Chicago east to southwestern Ontario. Both these pipelines will be in service before the end of 2000 and will compete directly for the same market as Nova/TCPL and, to a lesser extent, Westcoast. This is also the first time there will be significant excess pipeline capacity capable of moving Alberta gas eastward to U.S. and central Canadian markets. At issue today is the degree of pricing flexibility the incumbent pipelines need in the face of this new competition.

Local distribution companies traditionally purchased natural gas from integrated pipelines and sold it to the end customers, on a monopoly basis. Over the last ten years, they too have been required to unbundle various aspects of their service, starting with the gas product itself. Further unbundling has identified those services that competing gas marketers can supply themselves (e.g., meter reading billing and possibly storage services). Associated issues involve treatment of any stranded assets owned by the utility (e.g., billing systems), asset valuation when assets are transferred from a regulated utility to an unregulated subsidiary or affiliate (e.g., storage assets), and codes of conduct, where the utility has entered into the competitive activities such as gas marketing.

[4] The pipelines created gas marketing subsidiaries to manage their gas purchasing and sales activities.

The Impact of Access in Natural Gas

Has natural gas deregulation improve the efficiency of the natural gas industry? The answer with respect to the commodity natural gas itself is an unequivocal, yes. The impact of gas deregulation on the efficiency of pipeline transportation is less clear.

The changes to natural gas regulation since 1985 have clearly improved the efficiency of the industry, as regards production and marketing. Highly competitive, liquid, transparent and hence efficient markets for natural gas have emerged at key points in the country. In addition, several financial products and futures contracts are available in the marketplace to enable both buyers and sellers to manage the price risks inherent in commodity markets. Consumers have enjoyed competitive gas prices since 1986 that have been well below the level of regulated prices. It is only in the last 12 months that market prices for natural gas have exceeded the level of regulated prices that were in place until 1986. The efficiencies of today's gas markets far exceed the expectations of policymakers in the mid 1980s.

The impact of gas deregulation on the efficiency of gas pipelines has not been so dramatic. Certainly deregulation required the pipelines to change the way they operate by opening up their systems to third parties on a non-discriminatory basis, but it did not result in reduced tolls or costs. While pipelines operated at very high utilization rates (typically 100% load factor), these high utilization rates were symptomatic of a shortage of capacity, (a classic characteristic of a monopoly).

In fairness to the pipelines, since deregulation in the 1980s, they have taken a number of steps to respond to the needs of their shippers. However, most of these changes and new services were to make gas markets more efficient and liquid (e.g., inventory transfers, diversions, streamlined nomination procedures and assignments). These changes did not make the pipelines themselves more efficient or less costly.

The Alliance Pipeline will compete directly with TransCanada for shippers. The industry is hopeful that this competition will lead to more efficient and lower cost pipeline service.

Implications for Rail Transport

Open access in telecommunications has taken two forms: (1) interconnection, and (2) resale of facilities and functionalities. Both have analogues in rail transport.

Interconnection consists of one carrier handing off traffic to another carrier, to enable it to reach locations it does not serve directly. In long distance telecommunications, it involves using other carriers' local networks. In local telecommunications, it involves call termination on another local carrier's network. In rail transport, it involves interswitching and Competitive Line Rates to access locations on another railway's network.[5] Interconnection has worked well and should continue.

Resale of facilities and services has a more limited role in telecommunications access. It is composed mainly of dedicated transport links: private lines between cities, local arrangements within a city, and unbundled loops to reach customers. The analogy in rail transport is with running rights over another carrier's track.

In the case of essential facilities, which cannot be duplicated, regulated access is necessary. For other facilities and services, regulated resale is expected to be a transitional measure in telecommunications, until facilities-based competition is established. Resale of facilities is expected to continue on a commercial basis, where it is to the advantage of both parties. However, there are not the same externalities to justify ongoing government intervention as there are for interconnection.

Access in the context of the natural gas industry is less directly applicable to rail transport. The main emphasis to date has been the unbundling of ownership of the gas from its carriage. Previously, pipelines purchased the gas from producers, transported it, and sold it to local distribution systems. Now, end users can purchase the long haul transport services separately, and make their own arrangements directly with competing gas producers and with local distributors. By contrast, railways have traditionally provided the transport function alone, unbundled from ownership of the commodities being shipped.

The transport of gas is only now becoming competitive, with the construction of an alternative pipeline system. Pipelines interconnect with each other. However, there has been no discussion, to date, of allowing competitors to directly use capacity or operate any aspect of another company's pipeline.[6] Thus, pipelines do not have the equivalent of railway running rights.

[5] Trucking may also be used to access a railway's network.
[6] There would be many difficult technical issues, e.g. the operation of compressors.

ACCESS IN TELECOMMUNICATIONS

1. THE NATURE OF TELECOMMUNICATIONS

Introduction

This paper discusses the role of open access in promoting competition in telecommunications. The intent is to draw out lessons which could be useful when examining rail transport.

The rest of this section examines the nature of telecommunications and how services are provisioned. Section 2 gives a very brief introduction to telecommunications costs and pricing. These two sections set the stage for the issues of competition and open access.

Section 3 describes the introduction of competition, first in the long distance market, and then in the local market. Section 4 concerns the role of open access in the long distance market, while Section 5 does the same for the local market. In both sections, the success of open access policies is evaluated.

Finally, Section 6 draws some lessons. While rail transport and telecommunications are sufficiently different that analogies are dangerous, nevertheless, the telecommunications experience is suggestive.

The Product

Telecommunications transfers information from an origin to a destination. The information can be voice messages, images, video, or packets of data. In each case, it can be reduced to a stream of bits from origin to destination.

The type of information will affect the nature of the bit stream. Thus, voice requires relatively low speeds, and is relatively tolerant of errors, but intolerant of any delays.

Video is similar to voice, but requires much higher speeds. Both voice and video bit streams are fairly steady for the duration of the session (voice conversation or video transmission). Thus it is usual to set up a fixed connection between origin and destination and dedicate it for the length of the session.

Data, on the other hand, typically comes in a series of short bursts, which can reach very high volumes. Transmission errors are much more serious, as data transmissions do not have the same natural redundancy as do voice and video. It is usual to set up multiple connections, which share the same high-speed, high-quality facilities. Each packet of data is processed as it arrives, and routed to destination when the next available bit of capacity becomes available. As a result, there is no fixed connection for the duration of the session, and traffic from different sources is mixed together, or multiplexed. Such connections are referred to as packet-switched, while the connections for voice are referred to as circuit-switched.

There are also many ancillary services, which are intended to make the transfer of information easier. These include store-and-forward at a time of the recipient's choice, such as voice mail; user control over routing; information on the calling party; and operator services, such as directory assistance.

Provisioning of the Service

For over sixty years, from the 1920s to 1990, the general design of the telecommunications system changed very little (although there were dramatic changes in the technology used to implement that design).

A customer is connected to a telephone company local central office by a pair of copper wires, called a local loop, dedicated to the customer. At the local office, calls are switched to another customer's local loop (if that customer is also served by the same central office), or routed into the network. If the call is a local call, i.e. within the same city or extended calling area, it is transported along shared high-capacity interoffice trunks to the relevant local office[7] and then switched again to the local loop at destination. If the call is a long distance call, i.e. destined to another city, it is routed to a toll office. From there, it is transported over shared intercity trunks to the toll office nearest the destination, and on to the relevant local office and switched to the destination local loop.

[7] A local office is also called a class 5 office, and a toll office is also called a class 4 office. This terminology is left over from a time when there was a five-level hierarchy of switching offices. Today, the top three levels of the hierarchy have been removed, and all class 4 offices can communicate with other class 4 offices through dynamic routing, which identifies the least congested routes at any given time. Although the intent is to remove the distinction between class 4 and class 5 switches, and have only one network, in practice the distinction remains. See discussion below.

Signaling serves to set up a call, i.e. to reserve resources along the path, to notify the called party of the call, and to notify the calling party of a response, or the lack of one. Signaling also serves to free up resources once the call is terminated. (The resources are dedicated to the call for its duration, regardless of whether anyone is actually talking.)

For many years, signaling was performed using the same network that carries customer traffic (called in-band signaling). For the last fifteen years, signaling has used a separate network (called out-of-band signaling). This has allowed more efficient use of resources. Combined with software "triggers" in switches, out-of-band signaling has also permitted a host of ancillary services, which use carrier data bases and intelligence.[8]

Two other technological changes have dramatically altered the provisioning of service. The first is the change from analog to digital technology.[9] Using analog technology, if the same interoffice facility was to carry multiple calls simultaneously, a technique called frequency division multiplexing was used: the frequency spectrum of the facility was divided into different bands, which were assigned to different callers. Digital technology uses time division multiplexing instead (or in addition). Capacity is divided into time slots, e.g. 125 slots per second. Each slot is assigned to a different call. The call is sampled 125 times per second, and the results digitized and placed in the relevant time slot. Sampling this frequently allows the reconstruction of the information at the destination.[10] The result of introducing digital technology has been: (1) expanded capacity and lower costs (2) potentially, a higher quality of service (3) new services, based on call rerouting and the addition of network "intelligence".

The second technological change was the introduction of fiber optics as a substitute for copper cable and microwave facilities. Once a fiber cable is in position, its capacity can be increased by many multiples, merely by upgrading the electronic equipment at each end and at repeaters along the way. The fiber cable itself can accommodate huge increases in traffic. As well, since light over fiber is less subject to "noise" than electric current over copper wire, or microwaves, the quality is greatly improved.

Use of fiber optics has resulted in the cost of transport falling very quickly, much more quickly than the cost of switching. In turn, this has led to a reduction in the number of switching locations, and a restructuring of the interoffice and intercity networks, which has become much more "meshed", or complete.

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[8] For example, a multi-location business may specify that, after 6 pm, calls to its Halifax office be routed to its Vancouver office instead.

[9] Strictly speaking, analog switches have been replaced by digital switches, and interoffice transport has been digitized. Most local loops are still at least partly analog (the exceptions being ISDN and, more recently, XDSL).

[10] Compression algorithms allow sampling much more infrequently, while still producing the same fidelity. They exploit redundancies and "dead time" in speech. This permits up to ten or fifteen calls to be squeezed into the time slot once used for a single call (and explains why cell phones have such low quality – capacity is especially scarce there, and so compression is used much more extensively).

Fiber optics, together with digitization, have also led to dramatic changes in the local loop. They have allowed parts of the host switch to be moved closer to the customer, who now terminates on a remote unit, linked to the host switch by fiber umbilical cables. This has led to a distinction between the distribution part of the access network, which connects customers to remotes, and the feeder part of the network, which connects the remotes to the host switches. Over time, the feeder part is growing and the distribution part is shrinking, as remotes become smaller and more versatile, and fiber connections cheaper.[11]

Data Services

The network, as described in the preceding paragraphs, was designed and operated for voice traffic, which has been the predominant type of traffic historically.[12] Data traffic was treated in one of two ways. Some of it was encoded so as to use voice facilities, e.g. facsimile transmission. For the rest, a separate network was constructed, with its own packet switches and its own transport facilities.[13]

Over the past decade, telecommunications equipment manufacturers, and telephone companies, have been pushing for an integration of the voice and data networks. This would, in theory, allow for significant economies of scale, both in provisioning and in operating the single network. This has become very alluring in recent years, as data traffic has experienced dramatic increases, and now looks set to overtake all other forms of traffic in a few years.[14] The current conventional wisdom is that the network of the future will look like a data network, with all traffic, including voice, divided into packets of data and routed to destination packet-by-packet in a virtual connection.[15] However, conventional wisdom is particularly unstable in this industry, and the network of the future is still uncertain.

The network design described above is used by incumbent telephone companies and by most new entrants. However, two alternative technologies should be noted. First, cable operators have a network that delivers broadcasting to the vast majority of Canadian

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[11] The end result will be fiber all the way to the home or office. However, the fiber electronics are still too expensive for a set per customer, and is likely to remain so for another decade or so. In the meantime, telephone companies are increasing the capacity of existing copper distribution plant by using higher frequencies, e.g. ADSL.

[12] Going back to the nineteenth century, the predominant type of traffic was telegraphy, which was a form of data, and which had its own very extensive network.

[13] Off-net locations could access the data network through dial-up connections over the voice network.

[14] Voice traffic is growing annually at 2% to 5% in the local network, and 8% to 10% in the long distance network. By contrast, data traffic is growing at over 40% per year, driven principally by the public Internet and various private Intranets.

[15] This provides a challenge because voice, unlike data, degrades quickly with even minor delays. A virtual connection in a packet-switched network will never be as good as a dedicated connection in a circuit-switched network: the challenge is to make it “good enough”.

homes. Originally unidirectional, this network is now being converted to allow bi-directional traffic. The immediate objective is to offer high-speed data access, particularly to the Internet, but delivery of voice and other services is planned. Second, wireless access to customers is also a possibility. It exists today, of course, for mobile service, but falling costs suggest that fixed-location wireless access, at reasonably high speeds, may become economical.[16]

Finally, mention should be made of private lines. Telephone companies have long made available, on a rental basis, intercity and local transport links, i.e. transport with no switching or signaling. Intercity private lines have traditionally been rented by very large customers, who use them to build their own internal networks. Local private lines were used for services that were "always on", such as sensors for burglar or fire alarms, or connecting street traffic signals to a central computer. Today, local and intercity private lines are both being used by new entrants into telecommunications, to piece out networks without having to build all the necessary facilities themselves.

2. TELECOMMUNICATIONS COSTS AND PRICING

Cost Structure

Telecommunications are characterized by very high fixed costs and very low incremental costs.[17] For example, incremental cost of (voice) domestic long distance service is in the range of three to five cents per minute. Including an allocation of fixed costs, which is somewhat arbitrary but has been done repeatedly by regulators, can lead to an average total cost of some ten to fifteen cents.[18] While the discrepancy is less marked for local services, the regulator has held that a mark-up of 25% for prices over incremental costs is not unreasonable, given fixed and common costs.

High fixed and low incremental costs are a result of significant economies of scale and scope that exist in telecommunications. These economies have three sources: (1) plant

[16] Wideband fixed wireless, such as LMCS, is already offered on a small scale in Canada. Standards for wideband mobile services have been agreed, but equipment is only expected to become available in 2001.
[17] The telecommunications industry measures (average) incremental cost, rather that marginal cost, which is often zero. Incremental cost is defined by the cost of adding a new service, or accommodating a year's growth in an existing service, and expressing the result as an average cost per additional unit of output.
[18] These costs are from the early 1990s. More recent costs are confidential and not available publicly. Recent statements in the trade press suggest that, while costs may have fallen over all, their structure has not changed much. See e.g. Stu Verge, then with Bell Atlantic, discussing circuit-switched v. packet-switched costs.

and equipment, (2) "back-room" operations such as order processing and billing, and (3) marketing and sales efforts, including building an image of reliability and quality.[19]

Economies in plant and equipment arise from the nature of fiber optics, as mentioned above. Once fiber cable is laid, its capacity can be upgraded many times by simply changing the electronic equipment that generates, repeats, and captures the light impulses. The resulting transport is so cheap that very circuitous routings can be justified, e.g. Toronto to Quebec City via Vancouver.

Economies also arise from copper transport facilities, although not nearly to the same degree as for fiber. Digging trenches or erecting pole lines cost the same, regardless of the number of copper pairs being accommodated. As well, maintenance costs tend to vary with route miles, regardless of the capacity on a route. The signaling network itself is essentially a fixed cost, due to its indivisibilities. Finally, there are economies in switching, e.g. because annual licenses for the use of software tend to be per switch, regardless of the amount of usage.[20]

Since fiber is ubiquitous in intercity and interoffice transport, but more limited in local access and distribution, economies of scale are much more significant in the long distance part of the industry. This is confirmed by the ratios of fixed to incremental costs. Note, however, that plant and equipment costs for long distance services have fallen so much that they make up less than 20% of total costs of service. Thus, while the economies of scale due to plant and equipment may be large, the impact on total costs of service is modest.

The second source of economies of scale lies in "back-room operations". These include order processing, customer inquiries, billing and collection, and network monitoring, provisioning, and maintenance systems. Expenditures on such systems are very significant, running to hundreds of millions of dollars, and can outstrip spending on plant and equipment. Beyond a certain size, however, the systems tend to be insensitive to the volume of traffic. For example, a modification to the billing system to accommodate a new pricing scheme need be done only once, no matter how many customers are affected. Such systems may also give rise to economies of scope across services.[21]

The third source of economies of scale arises in marketing and building a brand. Empirical models have shown the importance of establishing a reputation for quality and

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[19] Recently, telecommunications companies have argued that there are significant economies of scope in providing both content and carriage. However, they have not articulated how these economies come about. (I will probably remove this footnote in the final version, since it is controversial and does not advance understanding in the present discussion.)

[20] Software costs can amount to half the costs of a switch. Some equipment manufacturers are trying to restructure the way they charge for software, making at least some of it usage-sensitive.

[21] Anecdotal evidence suggests that operating support systems, such as the ones described above, are a major barrier to large-scale entry. While small systems are readily available, they do not "scale" well, and large systems are quite challenging. Indeed, even incumbents tend to have a lot of trouble expanding and modifying their systems.

reliability.[22] This is particularly important for an input such as telecommunications, upon which many businesses are critically dependent. Service failure for a few hours can mean millions of dollars in losses. There are significant economies of scale in image-building advertising campaigns and promotion of sports and entertainment events.

The second and third factors give rise to significant economies of scale when looking at a carrier's total costs. Indeed, in 1990, when presenting its case that long distance telecommunications is a natural monopoly, Bell Canada focused principally on non-plant factors.

A different perspective on cost structure is the extent to which cost elements are sunk or fungible (i.e. whether the assets can be redeployed in another use, or sold in place to another party). This is an important consideration for new entrants. If investments are fungible, the risk associated with unsuccessful entry is less.

Generally, interoffice and intercity plant is fungible. As mentioned above, traffic can be rerouted to take advantage of capacity on alternative facilities.[23] The situation is more complicated in the local access portion. Feeder plant can generally be redeployed to serve other customers. Distribution plant, however, is at risk of being stranded if a competitor, using his own facilities, wins the customer. Even less fungible are the operating support systems, such as billing. Finally, brands and public confidence are usually completely non-fungible. Thus, large-scale entry requires significant investment that may turn out to be sunk.

As a result of technological change and economies of scale, productivity gains in the telecommunications industry have far outstripped the average for the economy. Various Canadian studies, covering the period from 1960 to 1995, have found increases in total factor productivity averaging 4% per year, both for the period as a whole, and for each decade within the period.[24] Technology has been a fundamental cause. As well, productivity gains have been higher during periods of strong economic growth, as new facilities and their capacity were used more fully. Productivity gains have led to lower unit costs and lower prices, which in turn have stimulated demand and led to further productivity growth, in a virtuous circle[25]

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[22] This problem is similar to that faced by airlines, who must invest heavily in advertising and marketing (and in reservation systems). The underlying problem is that both air transport and telecommunications are instantly perishable service, where the unit of demand is much smaller than the unit of supply. Carriers must aggregate large numbers of customers, and this requires mass marketing campaigns.

[23] Some commentators worry about a glut of capacity, given the nature of fiber optics. The glut has yet to develop, however. Transcontinental fiber still sells for hundreds of millions of dollars.

[24] See CRTC Decision 97-9. By contrast, in the U.S., TFP for telecommunications carriers has averaged 3% per year. See Robert Crandall, testimony before the CRTC, June 1991.

[25] There is some evidence that suggests that the introduction of competition has led to a slowdown in productivity growth in the short run. It remains to be seen whether competition results in higher growth in the longer run. This is discussed in more detail below.

Pricing

Traditionally, telecommunications was treated as a public utility, with service levels and prices tightly regulated by an administrative tribunal. Carriers had a monopoly over a territory, and were obliged to provide service on demand within that territory.

Regulators had two main concerns. First, prices were not to be unduly discriminatory. This led to a very high degree of price averaging. Second, universal service was actively pursued. Regulators kept the price of residential local service as low as possible, generating maximum cross-subsidies from other services.[26] If a carrier needed additional revenues, the regulator looked to the prices of all other services first. In addition, the regulator was especially concerned with the prices of residential local service in rural and small urban communities, keeping these below the level in larger urban centers.[27]

This resulted in four major cross-subsidies. The first was from long distance to local services. This subsidy peaked in the late 1980's in Canada, at a level of some $1.6 billion per year. Since then, and especially with the introduction of competition, the regulator came to realize that the subsidy was unsustainable, and has allowed a gradual "rebalancing" of rates, resulting in a halving of long distance prices and a doubling of prices for residential local service.[28] The remaining subsidy has been converted into an explicit, competition-neutral subsidy of some $300 million per year.[29]

The second subsidy is from business local services to residential local services. The latter are, for the most part, still priced below incremental cost, while the former are priced well above. This is true even though, since 1997, business local rates have decreased significantly, due to the type of price caps regulation introduced in 1998.[30]

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[26] Keeping prices for local access below incremental costs can be justified in terms of network externalities: the more people that can be reached by me, the more valuable is my connection to the network. However, as the vast majority of the population connected to the network, the value of additional connections became smaller, and is no longer of any significance.

[27] This was originally justified on the basis of "value of service". The claim was that customers in rural or small urban centers could reach fewer callers as part of the local price, and had to pay long distance charges to have as great a reach as larger urban customers. More recently, the policy has been justified by the need to keep telephone service "affordable" in rural area. Of course, some of these rural areas are cottage country.

[28] Various parties also advocated rate rebalancing on social welfare grounds. The price elasticity of demand for long distance service was measured at –0.45, while that for residential local service was around –0.01. Thus rebalancing significantly increased consumers' surplus. It is unclear, however, to what extent this argument influenced regulators.

[29] A contribution charge of between 0.4 cents and 2 cents per minute is collected at each end of a long distance call. The money is then distributed to certified suppliers of local service, per residential line served. Higher amounts per line are paid in rural areas, declining to zero in larger cities. The subsidy will be reviewed in 2001, and will probably be targeted specifically to areas with high costs of service.

[30] Further details are given below.

The third subsidy is from urban to rural areas. Until recently, rural rates were lower than urban rates, even though costs were much higher. In the last few years, rural rates have been generally brought in line with urban rates and, for business customers, have surpassed them.

The fourth subsidy is from ancillary services (known as options and features, or O&F), such as caller identification and three-way calling. These services are relatively cheap to provide, and have been growing rapidly. Profits from these services were taken into account by the regulator in setting residential local prices. While the resulting subsidy is implicit, and thus not public, it is believed to be large and increasing.

Thus, three of the four cross-subsidies are shrinking, as is their total. The result, as mentioned above, has been a doubling on average of prices for residential local service, and a move generally of prices closer to costs.[31]

The highly averaged nature of telecommunications prices has also been significantly attenuated. With the introduction of long distance competition, the regulator permitted discounts for volume and time commitments, and eventually forbore from regulation of prices for long distance and data services.[32] As a result, large customers negotiate customized arrangements, while the mass market enjoys a plethora of discount "plans". The same trend has started for local services, although it is much less advanced.

3. COMPETITION AND DEREGULATION

For most of the twentieth century, telecommunications was treated as a natural monopoly.[33] Each carrier had its own operating territory, typically a province in Canada. (Bell Canada served both Ontario and Quebec.)[34] Companies interconnected to terminate calls that crossed provincial or national boundaries, and "settled" or divided the resulting revenues according to very complex formulas. Rates and service were regulated, with prices set to produce a fair rate of return on the carrier's equity investment. As described above, rates were highly averaged and residential local service was heavily subsidized.

[31] Contrary to the fears of some groups, the increases to residential rates have not reduced the percentage of households subscribing to telephone service, which remains above 98% nationally. However, there are still pockets with very low penetration levels, such as Indian reserves.

[32] The basic long distance schedule is still regulated, but almost all traffic is carried under some discount plan.

[33] Even the terminals or telephone sets were supplied on a monopoly basis, until 1964 in the U.S. and 1980 in Canada.

[34] In addition, there was a number of small "independent" telephone companies serving mostly rural areas.

The result, when compared to the experience of other countries, was reliable, affordable service, with over 90% of households in Canada subscribing to service.

Change first came in the U.S., with the availability of microwave technology. This allowed very large customers to build their own links, instead of purchasing transport from carriers. In the 1970's, MCI began to provide such facilities for large and medium businesses, and eventually offered ordinary long distance service as well. After lengthy legal battles, in 1977 the courts overruled the regulator and affirmed MCI's right to compete in this market. By this time, competition was being promoted in other sectors of the U.S. economy, such as transportation. In the 1980s, competition gradually evolved into the principal government policy objective.[35]

Canada first introduced competition in for private lines and data services in 1979. It had always been open to anybody who could acquire the necessary rights of way to build a network parallel to the telephone companies. However, the telephone companies refuse to interconnect with anybody else, and as a result, a new entrant could not reach enough locations to offer acceptable service. Decision 79-11 ordered the telephone companies to provide interconnection for private line and data services. In practice, this meant that a competing carrier could rent a local loop from the telephone company and use it to access a customer.

Although a breakthrough conceptually, this decision had little impact in practice. Interconnection for competing switched voice services was still forbidden. Both private lines and data services accounted for a very small part of the total market, and the only competitor, CNCP Telecommunications, had little success outside of its Telex service (a replacement for telegraph service).

Long distance switched voice services, with their huge margins intended to cross-subsidize local service, were an obvious target for new entrants. CNCP Telecommunications applied for interconnection for switched voice services in 1984, but this was refused.[36] Nevertheless, resale of private lines was now permitted, and users could form sharing groups who would make purchases as a single customer. As well, pursuant to Decision 84-18, competitors could offer enhanced services, by adding features to the telephone companies' basic service. This latter provision was open to abuse, and by the late 1980s Call-Net was essentially leasing private lines and reselling switched long distance service. Several attempts by the regulator to close down Call-Net were overturned by the federal cabinet, and in 1990 the CRTC decided to allow the resale of private lines and switched services, for whatever purpose the reseller wanted.[37]

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[35] In 1984, in a measure to promote competition, the former Bell System was broken up into a long distance carrier and five regional local carriers, each barred from the other's line of business.

[36] The main reason was that competition would lower prices for the small number of large users, at the expense of the many small users who would pay higher prices. (Personal communication, John Lawrence, Vice Chairman, Telecommunications, CRTC).

[37] Thus long distance competition came to Canada via a different route than in the U.S.

Resale-based competition ultimately depended on arbitrage. Telephone companies' long distance prices to large customers were low, to induce these customers not to build their own private networks. At the same time, prices to small and medium customers were very high, to generate cross-subsidies for local service. [38] Resellers were thus vulnerable to incumbents' pricing structure.

Interconnection for facilities-based competitors was finally ordered in 1992. Vast quantities of evidence were presented on consequences for costs, innovation, and stimulation of market growth. The regulator found this evidence inconclusive. It did, however, find that customer choice was very important, and that competition was the only way to ensure it.

Details of interconnection arrangements will be discussed in the next section. The regulator put in place two safeguards to prevent anticompetitive pricing. First, incremental costs were set as price floors, and were strictly enforced. Second, the mode of regulation was changed. From 1995 to 1997, during a transition period, the carriers disaggregated their financial statements into a competitive segment and a utility segment, and utility rates were justified solely on the financial performance of the utility segment. In particular, losses on long distance services could no longer be used to justify local rate increases. From 1998 onwards, earnings-based regulation was abandoned altogether, and replaced by price caps regulation for utility services only. This removed incentives to cross-subsidize prices for long distance and data services.

Industry participants quickly came to realize that there are significant economies of scope between local and long distance services. A company entering only the long distance market was at a disadvantage. As a result, in 1994 the regulator declared in principle the opening of the local market to competition.[39] Details, including interconnection, were decided in 1997, and are discussed in Section 5 below.

By the end of 1997, long distance and data competition had developed to the point that the regulator decided to forbear. Private lines on denser routes were also forborne, although regulation continued on other routes.

Local voice services, ancillary services, and services provided to competitors (e.g. interconnection) remain regulated, but carriers have more pricing flexibility than before. Services to end users face three sets of constraints. First, a subset of basic access services is subject to price caps. The average level of prices must change each year by inflation minus a productivity offset. This offset is currently set at 4.5%, regardless of carriers'

[38] Starting in the mid-1980s, the telephone companies urged the regulator to allow them to "rebalance" rates, dropping long distance rates and allowing offsetting local rate increases. This initiative would make the long distance market less vulnerable to entry.

[39] The telephone companies viewed opening up the local telephony market to competition as a quid pro quo to allowing them to enter the cable (i.e. broadcast distribution) market. Indeed, the cable companies were expected to be the first new entrants into local telephony. To date ,there has been no sign of the expected "convergence".

actual experience. With inflation well below this, the result has been significant price decreases, channeled to business customers, since residence prices are still generally below incremental costs. Second, all local services, whether capped or not, have price floors. These are generally equal to incremental costs. Third, the regulator still tries to ensure that customers receive the benefits of some price averaging. Nevertheless, large customers are generally able to negotiate arrangements and prices that fit their specific needs (as long as prices are above incremental costs).

The regulator has started a review of the state of the regulatory framework, with changes to be implemented by the beginning of 2002.

4. OPEN ACCESS AND LONG DISTANCE COMPETITION

Interconnection

The Canadian long distance telecommunications market was opened to competition in June 1992, pursuant to CRTC Decision 92-12. The crucial component was the ordering of interconnection of new entrants' long distance networks with incumbents' local networks. This allowed new entrants (Alternative Long Distance Providers, or APLDS) to originate and terminate calls without constructing their own local facilities to millions of customers.

A customer with local service from an Incumbent Local Exchange Company (or ILEC) could now use his local loop, and the ILEC's local switching and interoffice transport, to reach an APLDS' point of presence (POP). The APLDS would then carry the call to a POP close to the destination. At that point, it would hand the call off to the ILEC at the destination, and the call would be completed over the called party's local loop.

The APLDS has two choices for the point of interconnection. In a Direct Connect arrangement (or DC), interconnection occurs at the ILEC's local office closest to the customer. The ILEC then transports the call through its local access system, to or from the customer. The distance varies from a few hundred feet to several miles. In an Access Tandem arrangement (or AT), interconnection occurs at the ILEC's nearest toll office. The incumbent then transports the call along toll connecting trunks and local interoffice trunks to the appropriate local office, switching the call along the way, and proceeds to

deliver it over its local access system. In this case, the distance varies tremendously, and can range up to a thousand miles.[40]

Rates for both Direct Connect and Access Tandem are tightly regulated, based on long run incremental costs plus a mark-up towards fixed and common costs. The Direct Connect charge was set in 1994 at 0.7 cents per minute. This was reduced to 0.3 cents per minute in 2000, based on reductions in incremental costs. Access Tandem charges include the Direct Connect charge, plus an additional amount for the extra switching and transport. This extra amount varies by carrier, depending on its network configuration, but is in the range of 0.5 cents per minute. Thus the Access Tandem charge is currently on the order of 0.8 cents per minute.

APLDS have almost always chosen to use Access Tandem, interconnecting at the toll office. With forty such connections, an APLDS can cover all of Bell Canada territory, whereas connecting at the local offices with Direct Access connections would require almost a thousand connections. It would also require the APLDS to provide its own transport to the local offices. As a result, Direct Connect is only used when the APLDS' POP is close to the local office and where the APLDS has a significant amount of traffic to or from that local office.

An some cases, an APLDS serves a customer that generates a very large volume of traffic. The APLDS then sets up a dedicated link, or Direct Access Line (DAL) between its POP and the customer's premises. The DAL may consist of a facility put in place and owned by the APLDS. It can also be supplied by cable companies or by specialized carriers.[41] More often, it is a local private line (copper pair or fiber cable) leased from the ILEC for a flat monthly fee. Depending on the volume of traffic and the monthly charge, a DAL can be much more economical than paying a per-minute charge.[42]

An important aspect of interconnection is the provision of what is referred to as Equal Access. Originally, if a customer wanted to use the services of an APLDS, he had to dial a seven-digit number to reach the APLDS, then a personal code to identify himself, and then the ten-digit number of the person he wanted to reach. Having to dial extra digits proved to be a major barrier to customers switching to an APLDS. Even if the head of the household did subscribe to an APLDS, other family members often did not dial the extra digits, and so ended up using the incumbent's service.[43]

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[40] For example, local offices in the remote North home in on a toll switch in Ottawa. An Access Tandem connection would allow an APLDS with a POP in Ottawa to have traffic delivered by Bell Canada to Fort Chimo.

[41] Provision of Direct Access Lines was at the origin of competition for the local network in the U.S.

[42] Direct Access Line arrangements are often referred to as "bypass", because the traffic bypasses the incumbent's switched local network. However, in many cases, the DAL is supplied by the incumbent, and the APLDS has merely substituted one service for another. This is sometimes referred to as "service bypass". In other cases, the APLDS uses facilities supplied by another company. This is referred to as "facilities bypass".

[43] This problem was mitigated somewhat for large business customers, who owned their own private switch (or PBX) and could program it so as to automatically dial the extra digits.

To make interconnection more useful, the regulator ordered incumbents to convert their local switches to Equal Access. The local switch is notified that a call is long distance by a leading "1". In the past, upon receiving such a call, the local switch would route the call to the incumbent's toll switch. Under Equal Access, however, the local switch looks up the customer in a database, which indicates the customer's preferred long distance carrier. If that turned out to be an APLDS, the call is routed to the appropriate POP and handed over to the APLDS. If the incumbent is the preferred carrier, the call is routed over its intercity network, as before.

The cost of modifying the incumbents' networks to enable interconnection, including Equal Access, was estimated to be some $200 million. The regulator ordered that this expense be recovered from all participants according to market share. In practice, this meant the imposition of a charge of 0.11 cents per minute for all long distance minutes using Direct Connection or Access Tandem arrangements.[44]

Resale of Incumbent Services and Facilities

To encourage the development of competition in the long distance market, the regulator also required that the incumbents allow new entrants to resell its services and facilities. There were three main areas.

First, new entrants can use incumbents' private lines to provide the intercity transport part of their networks. Unitel (originally CNCP Telecommunications, now AT&T Canada) was the only new entrant to have a significant amount of intercity plant at entry. Other entrants depended largely on leasing facilities from incumbents, gradually building out their own networks, as traffic grows.

Second, new entrants can resell incumbents' long distance services. This allowed even regional entrants to achieve national coverage from the start. As well, APLDS tended to be large customers of the incumbents, and enjoyed the best volume discounts. Such arbitrage opportunities were seen as helpful in the early stages of entry, both to build a

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However, even in these cases, the result was that users had to wait for a few seconds to obtain a connection, and this proved to be unacceptable.

[44] Customers who did not choose an APLDS as their preferred carrier automatically had the incumbent as preferred carrier. New entrants argued that, given customer inertia, this unduly advantaged incumbents. They wanted all customers to have to actively choose a long distance carrier, through a ballot. Those customers not making a choice would be randomly allocated to a carrier, in proportion to the carriers' shares of customers who had made a positive choice. Such a scheme had been used in the U.S. The Canadian regulator, however, saw no need for it.

customer base and to start generating cash flow. However, it turned out that arbitrage could not be the basis for sustained operations.

Third, incumbents must provide new entrants with access to a number of ancillary resources, primarily databases, where it would be unreasonable to require these to be duplicated. An example is 800 or "toll-free" service. Every 800 number must be translated into a "real" number, with its proper area code and local office code, so as to route the call to destination. These translations require consultation of a database. There are two such databases in Canada, one in Toronto and the other in Calgary, and database "dips" are performed for new entrants by the incumbents. Incumbents must also provide certain operator and emergency services to new entrants, at their request.

Subsidies

The regulator recognized that new entrants in the long distance market should help finance subsidies to local service. It established a contribution charge, which would apply to each minute of long distance traffic going through a Direct Connect or Access Tandem arrangement.

The implicit contribution from incumbents' long distance to local services was estimated to be between 7 and 11 cents per minute per end in 1993. To encourage new entrants, the regulator granted them a series of explicit and implicit discounts, tapering down over a transition period of five years. By 1998, discounts were eliminated. At the same time, the regulator implemented rebalancing over three years, increasing local residential rates by $7.00 per month and lowering contribution rates correspondingly. As a result, contribution rates range from 0.5 cents in Ontario and Quebec to 2 cents elsewhere.[45]

Until 1998, only new entrants made explicit contribution payments, to incumbents. Incumbents were expected to use internal cross-subsidies to cover their share. Starting in 1998, all long distance carriers pay contribution into a central fund, which then distributes subsidies to local carriers on a competitively neutral basis.

Subsidies remain a very controversial issue. Most industry participants would like to see them further reduced and eventually phased out. On the other hand, the regulator is concerned that such a change would require rates in high cost areas to increase so much that service would no longer be affordable for a significant proportion of the population. As well, the regulator wants to retain the ability to direct subsidies to regions that are

[45] Subsidies, and hence contribution rates, are specific to each incumbent's operating territory. The 0.5 cents per minute is for Bell Canada. There are some independent telephone companies, chiefly in rural Quebec, that have contribution rates of more than 5 cents per minute.

currently unserved or underserved. Subsidies are being examined as part of the regulator's current review of regulation.

Evaluation

Competition in long distance communications is generally considered to have been a success. A major objective of the regulator was to provide customers with choices, and that has been achieved. Competitors started offering services at the beginning of 1993, and by the end of that year had gained some 7% of market share. A big boost came with the implementation of Equal Access in the fall of 1994. Although current market share information is kept confidential by market participants, the trade literature suggests that incumbents retain from 30% to 40% of the market.

The extent to which open access has led to increased efficiency gains is a matter of some controversy. Long distance prices have dropped by over 50% since 1992.[46] On the other hand, unit costs actually increased, at least for the first few years after competition was introduced. The decrease in prices was mainly due to the reduction in contribution charges resulting from the rate rebalancing program described above, and from reduced profitability.

Expectations, at the time of opening access in long distance, were that there might be a short run decline in static efficiency, but that gains in dynamic efficiency in the longer term would more than make up for this. Three factors were suggested by various parties as potential causes of a short run decline.

- Loss of economies of scale, both in plant and in back-room operations such as billing and order fulfillment. Existing plant and systems could accommodate all expected growth very cheaply.
- Additional costs of sales and marketing. Before open access, these were very small. Now, they are quite large, e.g. much larger than plant and equipment costs on an incremental basis.
- Costs of modifying the long distance network to accommodate interconnection. The regulator estimated $240 million in start-up costs and $1.2 billion for ongoing costs over ten years.

Details of expected long run increases in efficiency were not given, beyond a general belief in higher productivity, market stimulation, and innovation, due to competition.

At least some of these factors came to pass. Unit costs of long distance voice traffic rose significantly. As well, total factor productivity growth is available for Bell Canada for the

[46] Average revenue per minute is kept confidential by carriers. While mass-market price plans are public, agreements with large customers are not.

period 1960 to 1995. The results for 1993 to 1995 are markedly lower (0.8%, 2.9%, and 2.4% respectively, as compared to a long-run average of 4%). There is considerable controversy as to performance since 1995. [47]

Many companies entered the long distance industry after 1992. However, there has been a lot of consolidation, including two bankruptcies and many mergers and acquisitions. Currently, none of the APLDS make a profit, and it is not clear when they will start to do so.[48] There is, however, a new source of competition emerging. Until 1999, Telus and Bell Canada collaborated in the Stentor Alliance, and did not compete in each other's territory. With the end of the alliance, the companies are starting to compete with each other.

Apart from Unitel, new entrants into the long distance industry relied on the incumbents for private lines, limiting their own plant to switches and some transmission equipment. This was widely seen to be a disadvantageous strategy, and surviving APLDS are building or acquiring their own transport facilities.[49]

As stated above, there are significant economies of scope between long distance and local telephony.[50] By 1994, the regulator came to the conclusion that a competitor who was limited to the long distance market was at a disadvantage. The next step was opening the local market to competition, through interconnection.

5. OPEN ACCESS AND LOCAL COMPETITION

Interconnection

Competition in the local market had been approved in principle in 1994.. However, it was not until terms and conditions of interconnection were specified by the regulator in May 1997 that new entrants started to become active.

[47] Results for the years 1996 to 2000 will be available in early 2001. Little can be inferred from carriers' accounting earnings for this period, as there have been massive write-downs of assets in 1998 and 1999, resulting in part from under-depreciation for a number of years.

[48] The Unitel business plan, presented to the regulator in 1990, called for the company to have a positive cash flow by the fifth year, but the initial investment would not be recouped within the fifteen year life of the study.

[49] Ledcor Corporation built 48 strands of fiber along the CNR right-of-way from Vancouver to Montreal. These fibers have been purchased by various carriers.

[50] Economies of scope arise from the use of joint resources, such as equipment, billing systems, common sales forces, and common image-building advertising and promotions.

A company could routinely apply to become a Competitive local Exchange Carrier (or CLEC). It had to offer Equal Access to its customers (i.e. the possibility of choosing a different long distance carrier as preferred supplier), and it had to offer emergency service (i.e. 911) and message relay service, which enables the hearing impaired to use special keyboards with their telephone. In all other respects, a CLEC was unregulated.

In return, a CLEC could interconnect with any Incumbent Local Exchange Carrier (or ILEC), who would terminate calls destined for customers on its network. As long as interchanged traffic was roughly in balance, neither carrier would charge the other for terminating traffic. If studies showed that traffic in one direction was more than 10% of traffic in the other, there would be a charge. This charge was theoretically on a per minute basis. In practice, however, because of the difficulty of continually measuring traffic, the charge would be per interconnecting trunk per month.

Intrerconnection takes place at a mutually agreed point of interconnection (or POI). If a CLEC hands over traffic to an ILEC in one part of an extended local service area (or EAS), for delivery in another part, there is a transit charge.

Technical details of interconnection were handled by the CRTC Interconnection Steering Committee (or CISC), an industry forum with multiple working committees and subcommittees. If agreement could not be reached, the CRTC rendered a decision, but this did not happen very often.

Before local interconnection, any carrier that interconnected with the ILEC was treated as a customer. This was the case for wireless service providers (or WSPs), who offered mobile service. As non-CLECs they paid ILECs for terminating their calls. However, the ILECs did not pay the WSPs for terminating calls going the other way. However, as non-CLECs, the WSPs could keep the long-distance traffic originating from their mobile customers, because they did not have to offer Equal Access. In August 2000, Microcell and Clearnet (check that it was not Rogers) finally became CLECs.

Another advantage to becoming a CLEC is the receipt of subsidies from the central fund. Each ILEC's operating territory is divided into rate bands, very roughly corresponding to costs of service. A CLEC or ILEC serving a residential customer receives a monthly subsidy per line, with the level of the subsidy depending on the band. The subsidy is zero or negligible in large and medium urban areas -- the areas naturally targeted by new entrants -- and so does not much matter in practice.[51]

[51] The subsidy might play a role in certain circumstances. Some rural telephone companies may seek to expand into adjacent territories, e.g. Telephone Guevremont near St. Hyacinthe. As well, by a quirk, some suburbs just north of Toronto have been classified as semi-rural.

Resale of Services and Facilities

The regulator realized that building a new local network was extremely costly and time-consuming. A new entrant might have critical customers that it would not be able to reach for years. As well, there are significant economies of scale for certain elements in the supply of local service.

A critical element is the local loop, i.e. the transmission path from the customer's premise to the ILEC's local central office. The regulator ordered ILECs to unbundle local loops, i.e. to make available to CLECs just the copper pair to the customer, without local switching or transport or signaling. The regulator declared local loops to be essential facilities in smaller urban and rural areas. The price is set at incremental cost plus a markup determined by the regulator. Further, when the ILEC submits cost information to show that a service is not priced anti-competitively, the local loop must be included at price, not cost. In large and medium cities, the regulator found that loops were not essential facilities, as there would probably be alternative sources of supply. However, local loops were to be treated as if they were essential for a period of five years.[52]

Local loops terminate in the ILEC's central office. To enable CLECs to use them, they must be able to co-locate equipment in the central office, next to the ILEC's termination point (main distribution frame or fiber frame). ILECs must offer collocation at regulated cost-based prices to CLECs, and also to interconnecting APLDSs, if space permits. Since one of the effects of changing from copper to optical fiber is to free up space in central offices, in most cases, space is available.

The Canadian regulator refused to order the ILECs to unbundled any other network elements.[53] This is in contrast to the situation in the U.S., where ILECs are obliged to unbundled and offer on a stand-alone basis any network element where it is technically feasible to do so.

The Canadian regulator ordered that any retail service sold by an ILEC could be purchased at the retail rate and resold by a CLEC. This is attractive because the ILECs offer what amounts to a bulk discount to customers of their Centrex service, a very close substitute for business local service. Such resale reduces price discrimination, but is not otherwise a major factor in local competition.

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[52] The length of this period is currently under review.

[53] In August 2000, the regulator ordered an ILEC to make available access to the inside wire in a high-rise building, i.e. the copper cables running from the basement to the tenants on various floors. This subloop unbundling was ordered because it was not practical for the competitors already had a presence in the basement, and it was impractical for them to go all the way back to the ILEC's central office to interconnect. The order was an interim one, however, and the issue has been included as part of a broader proceeding.

Again, the Canadian regulator departed from the approach used by the FCC in the U.S. In the U.S., the FCC ordered that all retail services of an ILEC had to be made available to any CLEC at a wholesale price that was from 15% to 25% lower than the retail price. Thus, if the retail price dropped, so would the wholesale price. This measure was particularly controversial, and is the subject of multiple court challenges. By contrast, the Canadian regulator did not establish a wholesale price. On the whole, the CRTC was disappointed with the role of resale in creating long-run viable competition in the long distance industry. It explicitly favored facilities-based competition over resale-based competition when it came to opening the local market.[54]

Local Number Portability

If a customer is to switch to a new supplier of local service, generally he wants to be able to keep the same telephone number. Customers are very reluctant to change their telephone number.[55] Residential customers have given it out to friends, employers, and others. Business customers have it printed on their letterhead, promotional literature, and service guides as well. In addition, printed telephone directories are updated only once a year.

To promote local competition, the regulator ordered ILECs to modify their systems to allow local number portability, or LNP, so that customers can keep the same number even when they switch suppliers. This requires that, for every call set-up, there is a database dip to see whether the terminating number has been "ported" to another carrier, and if it has, the proper routing information.[56] LNP has been implemented in large and medium urban centers and is being rolled out elsewhere.[57]

Open Access and Internet Service Providers

[54] CRTC Decision 97-8. The point was made very forcefully orally by David Colville, Vice-Chairman of the CRTC, at an industry meeting on May 7, 1997.
[55] This is less true for second or third lines to the same location. In that case, however, a customer would have to obtain the first line from the ILEC and additional lines from a CLEC, which is cumbersome.
[56] This adds a half-second to call set-up time. In the U.S., ILECs proposed not to carry out database dips at central offices where they still served all of the customers. The FCC refused, saying that the differential in call set-up time would give incumbents an advantage over new entrants.
[57] ILECs have been allowed to pass the costs of implementation on to their customers. The assumption was that the resulting increase in ILEC prices would allow CLECs to recover their costs of implementation, without any need for formal regulatory approval.

Most Internet users obtain access through an Internet Service Provider (or ISP). Traditionally, this has been dial-up access at 56 kbps or less (often much less). Both telephone companies and cable operators are rolling out high-speed access, which promises to be from ten to twenty times as fast.

ISPs, such as AOL and PSInet, want to offer high-speed access service too. In response, the regulator has ordered both ILECs and cable carriers to accommodate ISPs. ILECs must provide unbundled copper loops that are of a high enough quality to permit the use of upper frequencies (and hence higher capacity). Cable operators must provide space on their fiber rings and coaxial cables. The terms and conditions of such access are still under review. Given the length of time that it is taking to reach an agreement, the regulator has ordered cable companies to make their retail high-speed access services available to ISPs at a wholesale price, i.e. 25% less than the retail price.

Evaluation

It is still early to evaluate the success of local competition. However, certain points can be made. First, entry into the local market is much more difficult than into the long distance market. To be successful, entry has to be facilities-based, rather than resale-based. In turn, that requires large investments and long lead times. As a result, to date, ILECs' market share loss is probably under 3%.[58]

Most new entrants have targeted business customers in downtown cores. A large number of multi-tenant buildings can be served with a relatively small amount of new plant. Both AT&T and Sprint Canada are pursuing this strategy, either by building their own facilities or by acquiring an existing CLEC (Metronet, in the case of AT&T). As well, this strategy is being pursued by a number of entrants who are not (yet) affiliated with an existing telecommunications supplier, e.g. GT Telecom and Axxent.

Another approach is being pursued by real estate developers. The most prominent is Metrus, a developer active in many areas, and especially in the northern suburbs of Toronto. It has created a subsidiary, Futureway, to serve the customers in the new developments it builds. Fiber optic facilities are put in place during the original construction, and so are quite economic. Futureway currently has about a thousand residential customers, and serves a dozen mid-size commercial buildings.

[58] This assumes that mobile telephony is a separate market. To date, prices for mobile telephony have been so high that it is not perceived as a substitute for fixed telephony, but rather a complement. However, as prices drop, the two markets are expected to merge.

Universities have also become providers of local telephone service. This is particularly easy for them, since students in residences are captive customers. Furthermore, the students' traffic peaks during evenings, while administrative traffic peaks during the day. Thus, fewer facilities are needed to serve a campus than if there were a more traditional mix of customers.

At present, universities aggregate traffic destined off-campus and hand it over to an ILEC, as if the university itself were the customer. They pay the usual end-user prices. Universities have contemplated whether or not to acquire CLEC status. If they were to become CLECs, they would no longer pay end-user charges to ILECs. Rather, they would only pay interconnection charges on any imbalance of traffic. Indeed, if traffic imbalance is in their favor, they may end up receiving interconnection payments from the ILECs.

On the other hand, if the universities were to become CLECs, they would be obliged to allow their customers to choose a preferred long distance supplier (through implementation of Equal Access). Many universities prefer an exclusive arrangement with a designated APLDS.

Some industry observers believe that Futureway and the universities are early examples of what may become a trend. Owners of multi-unit buildings, whether residential apartments or offices, are interested in becoming, effectively, telephone carriers. They can easily aggregate traffic from their tenants and hand hand it over to an ILEC for delivery. As for the universities, it is still an open issue whether or not it is to their advantage to become CLECs, as opposed to non-CLECs.

An issue currently receiving attention is whether a tenant in a multi-unit building can choose his local carrier. In particular, in answer to a customer request, can an ILEC or other carrier place its facilities in a building where the owner has chosen a different supplier, or is supplying service himself? The regulator's jurisdiction is limited to telecommunications carriers. To issue directives to building owners, the regulator would have to declare them to be telecommunications carriers. But that would lead to the creation of tens of thousands of new carriers. Further, the Telecommunications Act limits foreign ownership of Canadian carriers to 20% (33% through holding companies). Would foreign owners of buildings be barred from offering services to their tenants?

While local competition has been slow to develop, there are a number of potential new entrants, who could provide service on a very large scale. Indeed, cable operators were expected to start offering telephony even before interconnection was fully implemented. To date, they have not done so.[59] However, they do have usable plant passing most homes in Canada, and are well on the way to making that plant capable of bi-directional traffic. Suppliers of electricity and natural gas also have rights of way, and some usable plant, which they could use to enter the local telecommunications market. Finally, fixed

[59] Telephone companies, who won the right to offer cable television as a quid pro quo, have not entered that market either.

wireless links can be used by the possessors of new frequency licenses to avoid the need for rights-of-way altogether.[60]

The impacts of local competition are expected to be similar in nature to the impacts of long distance competition, although obviously they will be slower in coming. In particular, there will likely be some short-term losses in efficiency, which, it is hoped, will be more than offset by long-term gains. Again, reduced benefits from economies of scale, additional sales and marketing expenses, and costs of interconnection all are playing a role in the short term. Indeed, the complexity, and cost, of local interconnection, are turning out to be much higher than for long distance interconnection. However, customers are obtaining a choice of supplier.

6. ANALYSIS

Network Industries

Rail transport, local and long distance telecommunications are all network industries. They use a network to connect different locations. This network aggregates traffic between different origin-destination pairs and concentrates it on interoffice or intercity links. This allows traffic to use high-capacity links, even though the traffic between any origin and destination may in fact be low volume. In turn, use of shared high-capacity links lead to lower unit costs for the traffic going over them.[61]

Individual customers need to access the core network. In the case of rail transport, this is often done through customer-specific sidings or spurs.[62] (Smaller railway customers may use truck transport, with its higher cost per unit and transshipment costs.) In telecommunications, access has traditionally been provided through a dedicated copper wire pair or coaxial cable. The traffic on these access links is typically much less than on the core network. It consists of only the traffic sent or received by one customer.

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[60] As long as the incumbents are forced to price residential service below incremental costs, mass entry is unlikely. However, the business market is attractive today.

[61] In both rail and telecommunications, a customer may have a enough traffic between two points to warrant a dedicated link, e.g. a private line in telecommunications terminology. Such transport does not share the characteristics of a networked industry, and is not discussed further here.

[62] Smaller rail customers use truck transport to access .the railway.

Because traffic levels are much higher on the core network than on the access links, economies of scale are closer to being fully realized in the core network. Access costs are higher, and can act as a bottleneck.

Access links in telecommunications, and for high volume rail shippers, have typically been furnished on a monopoly basis. The traffic levels generated by most customers do not support multiple, competing suppliers. The result is that access is a bottleneck: while the core networks can be very competitive, access to these networks is usually much less so. To ensure that competition flourishes, access must be opened up, by regulation if necessary.[63]

Differences in Rail Transport and Telecommunications

While rail and telecommunications are similar in that they are network industries, they do differ as to demand characteristics and cost structure. These differences have implications as to the role of open access in promoting competition in each industry.

Rail transport is dominated by a small number of large shippers. In telecommunications, there is also a number of large customers. However, the bulk of the long distance market is a mass market, made up of millions of residential and small business users. This is even more extreme in the local telecommunications market. Here, even very large customers take a limited number of access lines.

As a result, access can be expected to be more of an obstacle to competition in telecommunications than in rail. Large customers in either industry are attractive targets for competitors, who may provide alternative access arrangements. As well, a large customer may supply his own access, to the network of his choice.[64] However, rail does not serve the very large number of small customers with their low levels of traffic that telecommunications does.[65]

Cost structure is another difference between rail and telecommunications. Both enjoy economies of scale. However, it would seem that these economies are much larger in

[63] This assumes that competition is desirable in itself, either because customer choice is a primary objective, or because it is believed that competition will have allocative and dynamic efficiencies that will outweigh any costs.
[64] For example, a shipper may truck his freight to a competing railway, or to the final destination in some cases.
[65] While large telecommunications customers gave the initial impetus to competition, it is concerns over access by smaller telecommunications customers that drove much of the regulatory opening of access.

telecommunications than in rail transport. Fiber optic cable, with its huge unexploited capacity, has no analogue in rail.[66] Its deployment in the interoffice and intercity network has led to huge economies of scale in the core network. As a result, access links to feed the core network are all the more important.

Fiber is also being placed in the access portion of the telecommunications network, both by incumbents and by new entrants. Fiber to the customer is being put in place principally for large customers, analogous to rail customers whose traffic would justify a new siding. For the mass market, the hope is that ADSL, followed by fiber, will allow the proliferation of new services, such as switched video.[67] If these services become widespread, they will change the cost structure and may justify more competitive access. For the time being, however, access is still a significant bottleneck for smaller customers.

Rail transport also differs from telecommunications in that commodities must be carried in physical containers that must be returned, often empty, to origin.[68] These physical containers cause safety concerns and a level of complexity that do not apply to telecommunications. Telecommunications traffic, on the other hand, is extremely time-sensitive. For example, voice traffic cannot tolerate delays of more than 300 to 500 milliseconds. This adds complexity that is absent from rail transport. In particular, it makes difficult the mixing together of voice and data traffic.

In conclusion, access is a more severe bottleneck in telecommunications than in rail transport, both because of more diffuse demand and more significant economies of scale in the former. As well, operations of the core networks in rail raise different, and perhaps more critical, difficulties. This means that comparisons between rail and telecommunications of open access policies must be interpreted with caution.

Interconnection

Interconnection is an important form of access to alternative networks for both rail and telecommunications.[69] Indeed, without interconnection in telecommunications, the

[66] As far as other elements are concerned, both telecommunications and railway carriers have sophisticated information systems ensure customer service (billing, order fulfillment, etc). However, telecommunications carriers, who aggregate millions of customers' traffic, must also invest heavily in marketing and brand promotion to a mass market. Although I know of no formal studies, it is my impression that fixed costs are a much higher ratio of total costs for telecommunications than for rail.

[67] E.g. routed over the Internet.

[68] Freight transport is usually unbalanced: backhaul, if it exists, rarely matches the volume in the main direction. In telecommunications, while voice traffic is two-way, data traffic is often one-way as well, with unbalanced backhauls.

[69] Interconnection also serves in a monopoly environment, to allow customers to reach destinations not served by their originating carrier.

current level of competition in both the long distance and local markets would never have happened. Entry would have had to be on such a large scale that it would not have been possible. By contrast, interconnection has played a lesser role in rail competition. Both interswitching and competitive line rates have seen limited use, although their availability may have had an impact out of proportion to their actual use.

A key aspect of interconnection is the price charged for it. In long distance telecommunications, the price for switching and aggregation is based on long run incremental costs plus a mark-up towards fixed and common costs. In rail transport, the interswitching rate is cost-based, while competitive line rates are based on revenues from the carrier's end-users for comparable traffic.

For interconnection in the long distance industry, APLDS also pay a per-minute surcharge, or contribution, that is used to subsidize residential local service. To date, most of the controversy over the price of interconnection has been over this contribution charge. The switching and aggregation charge has received relatively little attention.[70]

Rail transport does not have the equivalent of a contribution charge for interconnection, and thus interconnection charges are closer to costs. However, costs (and revenues) do change over time, and interconnection charges should be monitored and changed as appropriate.

Resale of Facilities

Interconnection consists of the exchange of traffic for origination or delivery on points not reached by the main carrier's network. Resale of facilities consists of leasing facilities so as to extend the main carrier's network to the customer. These facilities can be leased on an exclusive basis, i.e. the carrier takes exclusive possession of the physical facility for the duration of the lease. Much more frequently, however, facilities are leased on a shared basis, i.e. a schedule of specific time slots is dedicated to the lessee (private lines in telecommunications, running rights in rail).

In long distance telecommunications, two types of facilities are involved. First, leased intercity private lines allow a carrier to extend its network into areas where traffic does not justify a network build. More importantly, in the context of access, local private lines, called Direct Access Lines (or DALs), allow an APLDS to link a customer's premise with its point of presence, bypassing the incumbent's local switched facilities. The amount of

[70] As noted above, the Direct Connect portion was reduced from 0.7 cents to 0.3 cents this spring, as a result of an agreement between incumbents and new entrants, endorsed by the regulator. It should be noted that incumbents now find themselves in the role of new entrants as well, as Bell Canada extends its reach into western Canada, and Telus into eastern Canada.

traffic over DALs has been a matter of controversy over time. In the early years of competition, when interconnection charges were high, as much as 10% to 15% of new entrants' traffic may have used DALs. As charges have dropped, however, DALs are now limited to very large customers, and no longer play a major role in promoting competition.[71]

In local telecommunications, unbundled local loops were contemplated as a means for new entrants to build out their networks in areas where they had not yet reached a critical mass of customers. Such loops are priced at long run incremental cost plus a mark-up. To date, local competition has not occurred on a large enough scale to judge whether unbundled local loops are successfully playing the intended role. However, new entrants complain that the price for local loops is too high to make their use viable for general market penetration. Instead, they prefer to serve concentrated pockets of customers with their own facilities.

In conclusion, while resale of facilities (or time slots over facilities) has played a role in telecommunications competition, this role is expected to diminish as competitors put in place their own facilities in areas they wish to serve, and reach off-net locations through interconnection arrangements.[72]

The Role of Niche Suppliers

Niche suppliers exist in both telecommunications and rail transport, but their roles are quite different. In telecommunications, niche suppliers fulfill three main roles.

First, niche suppliers may be arbitrageurs. With millions of customers, and very inflexible billing systems, major telecommunications carriers negotiate individualized agreements only with the largest of their customers. The rest of the market is served by broadly based discount plans that leave many opportunities for arbitrageurs. However, as carriers improve their billing systems, arbitrage opportunities are shrinking, and this is expected to continue.

Second, niche suppliers may have specialized marketing skills. For example, they may serve immigrant communities in their own language. Others may be able to bundle services together in attractive ways, e.g. banks piggy-backing on credit card services. Yet others may offer more convenient pricing options, e.g. calling cards for international calls.

[71] However, the availability will always serve as an upper limit on interconnection charges.
[72] There is an analogy, although imperfect, with railway running rights.

Third, niche players may offer enhancements. For example, a supplier may manage all of a company's communications, in one package. Another may integrate communications into a company's other business processes. Of course, a niche player may offer less than a major carrier, at a lower price, for customers who are willing to accept lower quality, e.g. voice over Internet.

While niche telecommunications carriers may complement major carriers, more often they are in direct competition with them. In an industry characterized by marked economies of scale, the existence of niche players will always be precarious. In particular, they are vulnerable to initiatives from the major carriers. As a result, most niche carriers are following a strategy of growing or selling out to a larger player. The result is consolidation in the industry.

In rail transport, by contrast, short line railways often complement, rather than compete with, main line carriers. The short lines have simplified operations and cost structures that allow them to economically serve low-density traffic that main line carriers cannot.

Customers as Carriers

Depending on interconnection arrangements, it may be attractive to a large customer to become a carrier. None have done so yet in telecommunications, but the concept has been actively discussed.[73] As noted above, many universities and some large building owners already provide some localized service, and switch and aggregate traffic before handing it off to a major carrier. To date, however, none has become a certified local carrier, in part because of the regulatory requirements it would then face (especially provision of Equal Access).

Even if they do not actually set themselves up as carriers, large customers can use the possibility of doing so, to pressure existing carriers. When self-supply is technically and economically feasible, carriers generally respond with volume discounts to their largest customers. In the presence of resale, arbitrage ensures that part of these discounts are passed on to smaller customers.

On the other hand, proliferation of customers as carriers would lead to vastly more complex and costly interconnection, both in terms of operations and in terms of transaction costs to set up and administer the necessary agreements.

[73] Inevitably, in telecommunications, the concept has already spawned an acronym, BCPP, standing for building centric provider.

7. CONCLUSION

In conclusion, open access has been essential to the development of competition in both the long distance and the local telecommunications markets. However, it is important to distinguish interconnection from resale of facilities and functionalities. Interconnection, in the form of traffic termination, will always be necessary, so that customers can terminate traffic to locations not on their primary carrier's network. Interconnection accounts for network externalities, and helps to maximize benefits to both customers and suppliers.

Resale of facilities and functionalities, however, is generally a transitional measure, until competition becomes firmly established. If a facility is essential, in the sense that it cannot be duplicated for technical reasons, there may be an ongoing requirement to make it available to competitors. In other cases, there would seem to be no reason to oblige such resale.[74]

[74] Carriers may choose to lease facilities and functionalities to each other, when it is efficient to do so. Such decisions, however, are best left to the market.

NETWORKED INDUSTRIES: NATURAL GAS PIPELINES
THE INDUSTRY EXPERIENCE WITH DEREGULATION

THE NATURE OF NATURAL GAS PIPELINES

The Product

Natural gas is transported by pipeline in one of two forms; raw gas, which is untreated gas with varying amounts of impurities including water, acid and carbon dioxide; and residue or pipeline quality gas often referred to as marketable natural gas. Pipeline quality gas is a highly homogenous product that meets a uniform standard used by most pipelines throughout North America. Pipelines are designed to carry either raw gas or pipeline gas, but not both.

While this Brief focuses on both types of pipelines, the primary focus is on pipelines designed to transport marketable quality gas, that is, transmission pipelines and distribution pipelines.

The Pipelines

Some of the important characterizations common to both raw gas and marketable gas pipelines to consider when comparing pipelines to other network systems are:

- Pipelines in comparison with other network systems such as telecommunications are low tech. Pipeline technology has not changed dramatically over the last twenty or thirty years;

- Pipelines have very large economies of scale that stems from the fact that the capacity of the pipeline increases exponentially with the diameter of the pipe. (A 12 inch diameter pipeline can transport four times as much gas as a six inch pipeline, yet the cost of the right of way and installation is virtually identical.);
- Pipelines are highly capital intensive. The only significant operating cost that is a function of use is fuel cost;
- Natural gas pipelines are highly specialized. They can only transport natural gas. (They can be converted to carry other products such as oil or water, but conversions are expensive and permanent.);
- Pipelines are unidirectional, that is, gas can only flow in one direction. (A few, relatively short pieces of pipe are designed to operate on a bi-directional basis usually on a seasonal basis).

Raw Gas Pipelines

Raw gas pipelines in Alberta are typically small diameter (e.g., 2 to 4 inches) and relatively short length (e.g., fifty kilometers or less). Their purpose is to transport raw gas from several wells to a processing plant. Raw gas pipelines, (which are sometimes referred to as gathering systems) are frequently owned by one or more gas producers. While they fall under provincial jurisdiction, tolls and access are not actively regulated.

Non-owners wishing to tie their gas wells into a gathering system must first negotiate the terms of access and tolls with the owners. The industry practise in these circumstances is to set third party tolls for these gathering systems on the basis of the so-called "Jumping Pound" formula[75], which is effectively a cost based toll. If a third party shipper is unable to negotiate a mutually satisfactory arrangement, it can appeal to the regulator (the

[75] The Jumping Pound formula sets a toll based on an allowance for operating costs, depreciation based on booked facility costs and a field depletion rate, a regulated return on undepreciated assets (rate base) and an allowance for income tax.

Alberta Energy Utilities Board or "E.U.B.") to declare the pipeline a public utility and set a toll or it can apply to the Board to build its own pipeline.

For obvious reasons, operators of gathering lines do not want to be regulated as public utilities creating an incentive for them to negotiate "fairly" on the basis of the Jumping Pound formula. (Furthermore, a company may be a gathering line operator in one region, but dependant on the third party as an operator in another region.) If there is excess capacity on an existing gathering line serving a region, the regulators will typically not look favourably on an application to build a new line.

In B.C., the situation is essentially the same, except that operator owned gathering lines connect gas wells to larger raw gas gathering lines owned and operated by Westcoast which lead to centralized gas processing plants also owned by Westcoast (Westcoast's raw gas gathering and processing facilities are regulated by the National Energy Board). The independently owned gathering systems in B.C. are regulated passively and operate in the same manner as Alberta.

These regimes have been in place since the early 1960s and were virtually unaffected by industry deregulation that occurred in the mid-1980s.

Transmission Pipelines

Transmission pipelines are typically large diameter high pressure systems that only transport pipeline quality gas. In Canada there are four major gas transmission systems, Westcoast, Nova/TransCanada/TQM, Alliance Pipelines and Maritimes & Northeast Pipelines, and a number of smaller lines. All of these systems offer InterProvincial and/or international transportation services.

Below is a brief background discussion of these pipelines; a discussion of how the operation and regulation of these pipelines changed with natural gas deregulation in the mid 1980s; and a discussion of the issues facing these systems today.

Background

Since the completion of the TransCanada PipeLine system in 1960, all interprovincial and international pipelines fall under the jurisdiction of the National Energy Board ('NEB"). (Nova is an exception. Due to an arrangement of convenience between Mr. C.D. Howe and Premier Manning, Nova has always been regulated by Alberta although technically it is an interprovincial pipeline.) Initially the NEB only authorized and regulated the construction of new pipeline facilities through the issuance of certificates of public convenience and necessity. This section of the NEB Act (currently Part III) was and still is patterned after the Railway Act.

Westcoast and TCPL initially operated as private pipelines. TCPL purchased all the pipeline quality gas required to fill its pipeline from producers at the outlet of the gas processing plants under long-term, fixed price contracts (Referred to as supply aggregation). It first transported its gas from the point of purchase in Alberta to the Alberta/Saskatchewan border on the Nova pipeline under long-term transportation contracts. Then TCPL transported its gas on its own pipeline system to various delivery points across Canada, where it sold the gas to either local distribution companies (e.g., Consumers Gas) or to U.S. pipelines (e.g., Tennessee Gas) also under long-term contracts. As private carriers, TCPL did not nor was it obligated to carry gas for others.

Westcoast operated similarly, except it purchased raw gas from producers at the interconnect with its facilities. It processed the raw gas at one of its large centralized processing plants, transported the gas on its pipeline to various delivery points and sold the gas to either provincial LDCs or US pipelines (e.g., Northwest Pipe). Like TCPL, Westcoast was a private carrier and did not transport gas for others.

Initially these pipelines were not subject to economic regulation. The pipelines existed on the margin between the purchase price of the gas paid to producers and the sale price received from buyers. However, by the early 1970s, the pipeline companies were beginning to feel squeezed financially and beginning with TCPL, they applied to the NEB to have regulated tolls. At about the same time, the federal government began to regulate both domestic and export gas prices marking the beginning of a decade of very tightly regulated pipeline tolls and tariffs[76], which in many respects continues today.

Natural Gas Deregulation

The purpose of natural gas deregulation in late 1985 was to deregulate gas prices not pipeline tolls and tariffs. Producers wanted the flexibility to sell their gas directly to buyers rather than to pipeline companies such as TCPL or Westcoast. Buyers wanted the flexibility to buy directly from sellers other than pipelines. Both producers and buyers wanted the ability to negotiate their own prices. However, before this could happen, both buyers and sellers had to be assured of assess to the pipeline systems on non-discriminatory terms.

And so began the process of unbundling. The commodity natural gas was separated from transportation. Prior to deregulation pipelines only offered a fully bundled service, that is, gas could only be purchased on a delivered basis. As a result of deregulation, by mid 1986 pipelines became simple open access or common carriers. They no longer purchased or sold gas. (The pipelines created gas marketing subsidiaries to manage their gas purchasing and sales activities. These subsidiaries are guided by NEB approved codes of conduct and "Chinese walls".) Buyers and sellers could now contract for capacity on TCPL or Westcoast. Tolls were cost based and terms of service were non-

[76] Tariffs in the gas industry are the detailed terms and conditions of service. Tariffs must be approved by

discriminatory. Pipelines were required to transport gas for others under the same toll schedule and terms as it transported gas for their own marketing subsidiaries.

The features of unbundled pipeline service are:

- Two broad types; firm service and interruptible service;
- Firm service is a contract service with a minimum term of one year and if new facilities must be constructed, ten years. A monthly demand or reservation charge that is a function of how much capacity is reserved plus a commodity charge that is function of how much gas is moved in a month. Fuel ratios are approved by the NEB, but the shipper typically supplies the fuel. Tolls for firm service are cost based using traditional cost of service methodologies. Tolls and any changes to them must be approved by the NEB. The NEB also establishes the return allowed on rate base;
- Interruptible service is contracted on a monthly basis and is a best efforts type of service. The shipper is only charged for what it uses, and the toll is typically a function of the firm toll with bidding allowed within a defined range;
- The detailed terms and conditions of the tariff must also be approved by the NEB, and they may not be varied.
- The tolls and tariffs governing these services are the same regardless of the character of the shipper, that is, big shippers and little shippers all pay the same unit toll;
- Queues for new capacity are maintained on a first come first served basis;
- The cost of new facilities required to serve new customers are typically "rolled-in" to or averaged into the rate base and recovered from all shippers not just new shippers. (The major form of cross subsidization on transmission pipelines is old shippers subsidizing new shippers.)

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the NEB

Since the early 1990s, shippers have been allowed to trade their capacity rights on transmission pipelines. Any shipper that holds firm or interruptible capacity on a pipeline such as Nova, TCPL or Westcoast can sell (assign) all or part of its capacity for any period of time to other shippers at market clearing prices (the assignee must abide by all the terms of the tariff). In part, due to the uniform terms and conditions of service, the capacity market is very liquid and depending on market conditions, capacity trades at a discount or premium to the regulated toll.[77] Pipeline companies, however, may only sell capacity at the regulated toll.

When shippers contract for service on a pipeline it is typically for a uniform volume (10 MMcfd) each day for the term of the contract (e.g., one year). Gas must be delivered to a specified receipt point on the pipeline at a uniform flow rate throughout the 24-hour period. The gas must meet pipeline quality specifications and be at a specified minimum pressure. The shipper must also take delivery of a similar quantity of gas (less fuel) at a specified delivery point at a uniform rate. Shippers are not allowed to be out of balance. Deliveries into the pipeline each day must equal removal from the pipeline during the same day or penalties are applied. There is very little or no flexibility in the terms of service offered by the pipeline.

Until the early 1990s all issues related to tolls and tariffs were settled through long and expensive NEB hearings (typically held annually). More recently, the industry has experimented with incentive tolling regimes and Pipeline Task Forces in an effort to reduce the amount of time spent in the hearing room. Incentive regimes were designed to create incentives for the pipeline companies to generate efficiencies largely on the operating side and to share the benefits with shippers. The results to date have been mixed.

[77] On a day when the market price for gas in Alberta is $5.00/GJ and the market price at Toronto is $7.00/GJ, the market price of TCPL capacity from Alberta to Toronto will be $2.00/GJ, although the regulated toll is $1.00/GJ.

Pipeline Task Forces have met with greater success. These are committees made up of the pipeline (e.g., TCPL) and its shippers. These Committees attempt to resolve tolling and tariff issues outside of the hearing room. Where they are successful in achieving broad support for a change or new initiative, the change is typically approved by the NEB. If a solution cannot be negotiated, it is resolved at an NEB hearing.

When gas must be shipped over multiple connecting pipelines to reach its final destination (Canadian gas is shipped throughout North America.), a transportation agreement is required on each connecting pipeline. Over the past decade Canadian and US pipelines have worked to standardize their operating procedures to facilitate the movement of gas over several pipelines. The first step was the standardization of pipeline quality gas. Today all gas meets this standard allowing it to flow throughout the North American pipeline system. Other procedures that have been (or are being standardized) are nomination procedures, deadlines for nomination changes, gas balancing, computerization, etc. While the system is not yet seamless, gas moves readily from one pipeline to another.

Current Issues Facing Pipelines

The secure world of gas pipelines has been disrupted by the prospect of competition in recent years. As Nova's tolls increased as a result of the cost of new facilities being rolled into the cost of existing facilities, shippers located in regions with close proximity to export pipelines applied to construct their own pipelines. The risk of new competing pipelines is stranded capacity on Nova, which in the extreme can create a "death spiral".

To combat this threat Nova abandoned its long standing postage rate tolls (i.e., a uniform toll regardless of how far gas is transported on the system) and sought approval of distance based tolls which were approved by the regulator in the fall of 1999. It also sought and received approval of load retention or bypass rates under which it can negotiate rates with qualified shippers that are considering bypass. However, Nova is

only allowed to pass on part of the cost of the bypass rate to its shippers. Shareholders must bear the remainder of the cost.

More ominous competition for the Nova/TCPL system is the recent construction of the Alliance Pipeline, a large capacity pipeline that runs from northeastern B.C. across Alberta and south to Chicago. A new pipeline referred to as the Vector Pipeline is being constructed from Chicago east to southwestern Ontario. Both these pipelines will be in service before the end of 2000 and will compete directly for the same market that Nova/TCPL has served largely as a monopoly since 1960. It is also the first time there has been significant excess pipeline capacity capable of moving Alberta gas eastward to U.S. and central Canadian markets.

In response to Alliance, TCPL has proposed to its Task Force changes that would allow it to negotiate individual rates discounts with individual shippers to prevent any further shippers from switching from TCPL to the Alliance pipeline. The cost of the discount would be borne by other shippers. To date shippers have not agreed to the proposal and negotiations are continuing.

At this time, there are no protocols that would allow a shipper to move its gas first on Nova then into Alliance or on Alliance and then transfer to the TCPL system at any of the interconnect points. At this early stage of Alliance operations, it is unlikely that there have been any requests for such service.

Distribution Systems

Distribution pipelines or systems is the sector of the natural gas industry that most people recognize or come in contact with. Local distribution companies (LDCs) receive gas from one or more transmission pipelines at high pressure, reduce the pressure and deliver it to ultimate consumers, which include residential, commercial and industrial customers.

LDCs enjoy long-term franchise agreements with the municipalities granting them a monopoly position in the communities that they serve.

Prior to deregulation in 1985, LDCs only offered their customers fully bundled serves at the burner-tip. The package of services included:

- The commodity gas. The LDC purchased all its customers gas requirements from the transmission companies at the points where the distribution system connected with the pipeline (referred to as city gates);
- Gas transportation. The movement of the gas from the transmission pipeline (i.e., the city gate) to a customer's home or factory;
- Gas storage. LDCs attempt to purchase their annual gas requirements at a uniform daily rate from the transmission company (i.e., high load factors), which minimizes the per unit cost of purchased gas. However, end users or customers typically use gas on a seasonal basis. Many LDCs maintain large storage facilities in which they inject gas during summer months and withdraw from in winter months to meet peak day demands;
- Load balancing. The diversity of its customers' daily requirements allows LDC to load balance. For example, if one factory scales back its operations today, while another factory puts on another shift the LDC can balance these load variations against each other. The larger and more varied the LDC customer base is, the more efficiently it can do this;
- Metering and billing services. The LDC typically owns and operates the meters installed at each customer's outlet.

Deregulation of natural gas initiated a long process of unbundling these services and due to the complexity of these systems, the process continues today.

Historically, gas distribution including all the services identified above have been highly regulated by provincial governments on a cost of service basis. (e.g., the Ontario Energy Board, the B.C. Utilities Commission and the Regie de l'energie). Both the terms of

service and tolls are closely regulated. Again, the purpose of natural gas deregulation was not to deregulate gas distribution utilities. However, to afford end users including residential customers meaningful ability to shop for their natural gas supplies, significant changes in the operation of the gas distribution systems were required.

Unlike transmission pipelines, LDCs offer service packages or rates based on the character of the customer. In broad terms, these rates include residential rates, commercial rates and industrial rates and the principle factor distinguishing these rates is volume. In simple terms, the costs allocated to each customer class are based on the "average" customer. (LDCs have always had the ability to negotiate industrial rates within a specified range - range rates. However, the cost of any discount offered one customer must be recovered from other industrials in the same rate class.) Not surprisingly then, the issue of cross subsidization between and within rate classes is an ever present issue in LDC regulation.

Initially, LDC unbundling only removed the commodity gas from the package of services offered by LDCs. However, high load factor customers complained that they did not need all of the services in the package. All they needed was transportation and perhaps a small amount of storage. At the same time, new players - marketers - were entering the marketplace. Many marketers wanted to do their own meter reading and billing for their customers, they wanted to do their own load balancing and they wanted to manage their own storage capacity.

So began the long process of unbundling, which has continued for more than a decade. The key issues have been to identify the services which can be offered competitively, (e.g., meter reading billing and possibly storage services), treatment of any stranded assets owned by the utility (e.g., billing systems), asset valuation when assets are transferred from a regulated utility to an unregulated subsidiary or affiliate (e.g., storage assets), and codes of conduct, where the utility has entered into the competitive activities such as gas marketing.

The primary objectives of regulators throughout this process have been to ensure that basic distribution services are not compromised particularly to residential customers. That costs are allocated "fairly" and that when specific activities such as storage are deregulated that a reasonably competitive market and not an unregulated monopoly will emerge.

Summary

The passive regulation of raw gas gathering systems has not changed significantly in more than forty years nor is there any demand for change at this time.

Deregulation of natural gas as a commodity in the mid 1980s resulted in gas transmission systems becoming contract or common carriers, but they continue to be closely regulated on a cost of service basis. Today however, major transmission systems are facing real competitive alternatives (e.g., Nova/TCPL vs. Alliance/Vector), but they do not have the pricing flexibility necessary to compete effectively. This is the biggest issue facing pipelines, regulators and shippers today (and perhaps they should be looking to the railways for solutions).

Gas deregulation has also lead to major changes in gas distribution. In this sector, non-monopoly activities are being spun off and a menu of services is being created that will allow end users to purchase the exact amount of each service that they require.

Has natural gas deregulation improve the efficiency of the natural gas industry? The answer with respect to the commodity natural gas itself is an unequivocal, yes. The impact of gas deregulation on the efficiency of pipeline transportation is less clear.

Since gas deregulation in 1985, highly competitive, liquid, transparent and hence efficient markets for natural gas have emerged at key points in the country. In addition, several financial products and futures contracts are also available in the marketplace to enable both buyers and sellers to manage the price risks inherent in commodity markets. Consumers have enjoyed competitive gas prices since 1986 that have been well below the level of regulated prices. It is only in the last 12 months that market prices for natural gas have exceeded the level of regulated prices that were in place until 1986. The efficiencies of today's gas markets far exceed the expectations of policymakers in the mid 1980s. Natural gas deregulation is counted as one of the most successful economic policies of the 1980s.

The impact of gas deregulation on the efficiency of gas pipelines has not been so dramatic. Certainly deregulation required the pipelines to change the way they operate by opening up their systems to third parties on a non-discriminatory basis, but it but it did not result in reduced tolls or costs. While pipelines operated at very high utilization rates (typically 100% load factor), these high utilization were symptomatic of a shortage of capacity, (a classic characteristic of a monopoly).

In fairness to the pipelines, since deregulation in the 1980s, they have taken a number of steps to respond to the needs of their shippers. However, most of these changes and new services were to make gas markets more efficient and liquid (e.g., inventory transfers, diversions, streamlined nomination procedures and assignments). These changes did not make the pipelines themselves more efficient or less costly.

Out of frustration with what shippers perceived as high costs and weak regulation, the industry has experimented with incentive regulatory regimes over the last five years. These regimes have been designed to create incentives for the pipelines to save costs by allowing them to share in the savings. Todate, the results have been limited. These regimes have not led to significant new efficiencies.

In response to the shortage of new pipeline capacity necessary to transport growing Alberta gas production, a group of gas producers created their own pipeline project in the mid 1990s. This project became the Alliance Pipeline, which will be in-service before the end of 2000. For the first time, Alberta pipeline capacity will exceed Alberta gas production capability.

The Alliance Pipeline will compete directly with TransCanada for shippers. The industry is hopeful that this competition will lead to more efficient and lower cost pipeline service.

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