*J*ournal of *R*ural and *C*ommunity *D*evelopment

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Authors: Reza Rajabiun* & Catherine Middleton

Citation:
Rajabiun, R., & Middleton, C. (2013). Rural Broadband Development in Canada's Provinces: An Overview of Policy Approaches. In W. Ashton & A. S. Carson (Eds.), [Special issue]. *The Journal of Rural and Community Development, 8*(2), 7-22.

Publisher:
Rural Development Institute, Brandon University.

Editor:
Dr. Doug Ramsey

*corresponding author

Open Access Policy:
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ISSN: 1712-8277 © Journal of Rural and Community Development
www.jrcd.ca

Rural Broadband Development in Canada's Provinces: An Overview of Policy Approaches

Reza Rajabiun
Ted Rogers School of Information Technology Management
Ryerson University
Toronto, Canada
reza.rajabiun@ryerson.ca

Catherine Middleton
Ted Rogers School of Information Technology Management
Ryerson University
Toronto, Canada
catherine.middleton@ryerson.ca

Abstract

Potential for private sector under-investment in rural broadband networks motivates a wide range of public sector initiatives around the world that aim to promote incentives to supply high-speed Internet access services in rural and remote communities. This paper provides an overview of policies and program design strategies that have shaped rural broadband development in Canada. The Canadian experience is particularly interesting in the context of broader debates about addressing the urban-rural digital divide because a combination of competition and targeted subsidies have helped achieve near universal access to some form of Internet connectivity.

Keywords: Rural development, broadband, policy analysis, Canada

1.0 Introduction

Policymakers and businesses around the world increasingly recognize that broadband networks are an integral element of social and business infrastructure, but private sector incentives to invest in advanced broadband networks are not always sufficient (Broadband Commission, 2013; OECD, 2009). The potential for private sector under-investment in digital infrastructure is particularly acute in rural and remote communities where a combination of factors such as a low population density, lower incomes, and challenging terrains make the business case for broadband deployment relatively less attractive than in urban environments (Alcatel-Lucent, 2011; Nayan, Zhao, Zhelev, Knospe, & Mas Machuca, 2012). To achieve political commitments to universal access and promote the digital economy, many national and sub-national government entities have adopted or are contemplating initiatives intended to address potential rural market failures. While there is some agreement about the important role the public sector can play in enabling broadband rollouts where market forces fail to produce satisfactory results, there are multiple approaches to designing contextually appropriate broadband promotion policies.

Understanding the range and efficacy of rural broadband policy strategies and program design choices is important because of local and global benefits associated with rural Internet connectivity. Previous research on the impact of rural broadband suggests that higher levels of broadband access and market competition in the provision of Internet access services are associated with higher levels of migration and firm entry into rural communities (Kim & Orazem, 2012; Mahasuweerachai, Whitacre, & Shideler, 2010). By making such communities more attractive places to live and conduct business, reliable broadband infrastructure serves as a platform for diversifying local economies, increasing the long term local tax base, and reducing the need for higher levels of governments to subsidize rural communities.

To offer a more specific example, reliable broadband connectivity is necessary in rural communities to enable the diffusion of a wide variety of applications that can enhance productivity in food production and distribution (FAO, 2013). By reducing the transaction costs of market interactions and increasing access to real time information, reliable rural broadband can generate significant improvements in agricultural productivity and is associated with increasing revenues and profits in the farming sector (Kandilov, Kandilov, Liu, & Renkow, 2011). Given the importance of agricultural efficiency to the supply of food to urban populations, access to reliable and affordable broadband infrastructure in rural areas that enables the widespread adoption of e-agriculture technologies represents a general policy concern.

With time, technological innovation is likely to further reduce the costs of provisioning network infrastructure and extend access in communities where the business case for broadband deployment is currently weak. Nevertheless, potential market failures in development of network infrastructure such as roads and telecommunications systems can be highly persistent. In order to meet universal broadband access commitments, governments in most advanced economies have therefore adopted a variety of public policies that aim to increase the pace of progress in network deployment in under-served areas. This paper contributes to broader discussions on possible remedies to the urban-rural digital infrastructure divide by examining policy choices and rural broadband development programs adopted by federal and provincial governments in Canada.

Section 2 provides an overview of policies at the national level and discusses their implications for rural broadband network development. Section 3 offers a more detailed assessment of a variety of rural broadband subsidy programs adopted by federal and provincial governments in order to address market failures in the development of Internet backbone and access networks. Section 4 concludes by drawing inferences for broader discussions about the design of rural broadband development policy.

2.0 Rural Broadband Policy Objectives and Instruments

Extending access to telecommunications infrastructure in rural and remote communities has been a historical policy priority for both national and provincial governments (Babe, 1990; Winseck, 1997). Although Canada has not adopted a statutory universal broadband obligation, Section 7.b of the 1993 *Telecommunications Act* (Canada, 1993) provides a legal basis for policies that promote rural connectivity by stating that one objective of telecommunications policy should be "to render reliable and affordable telecommunications services of

high quality accessible to Canadians in both urban and rural areas in all regions of Canada."

Federal policymakers have been reluctant to regulate the market for the provision of Internet access services and have relied primarily on market forces to meet demand for broadband connectivity (Governor in Council, 2006). Proposals for direct investments or subsidies for private operators aimed at mitigating the urban-rural digital infrastructure divide were recommended by the 2001 National Broadband Task Force (NBTF) and Telecommunications Policy Review Panel (2006), but have not been implemented by federal policymakers. Similarly, policies that promote industrial coordination and fixed-cost sharing for deploying next generation fibre-to-the-premises (FTTP) platforms (e.g. as in Japan and Korea) have also not been pursued at the federal level.

Instead, to achieve their objectives Canadian policymakers have relied on industrial policies targeting market failures in high-cost rural communities. Canada does not have a national broadband strategy, nor has the federal government set a target to define the nature of broadband connectivity that should be available to Canadians. In the absence of government direction, the Canadian Radio-television and Telecommunications Commission (CRTC), Canada's telecommunications regulator, has defined aspirational minimum service quality targets, stating that speeds of 5 Mbps (download) and 1 Mbps (upload) should be available to all Canadians by the end of 2015 (CRTC, 2011b). It is not clear how the CRTC plans to monitor progress toward these targets, but there is a need for policy makers to deploy network monitoring mechanisms.

The rural initiatives discussed here have all focused on providing broadband connectivity offering a minimum download speed of 1.5 Mbps. Despite the National Broadband Task Force's 2001 recommendation of a symmetrical 1.5 Mbps target speed for broadband across the country, the federal government substantially relaxed minimum standards for upload speeds (to 384 Kbps) in its 2009 Broadband Canada: Connecting Rural Canadians program (Industry Canada, 2009). Due to a lack of transparent program review processes and/or network monitoring, it is not clear how effective past policies have been in achieving their stated targets. This is particularly a concern in rural Canada where market forces are relatively weak and public sector subsidies for the operators have been employed to improve connectivity.

2.1 Access regulation and rural connectivity

The CRTC has not found it necessary or desirable to regulate retail Internet access services. Canada does have a regulated wholesale Internet access market, designed to encourage increased competition in the retail market by allowing new entrants (also called third parties) to use the fixed line infrastructure of incumbent Internet service providers[1] (i.e. an Internet service provider like TekSavvy can offer a

[1] Incumbent service providers were the monopoly operators of Canada's phone networks (e.g. Bell, SaskTel, Telus). They offer broadband services using digital subscriber line (DSL) technology on their copper telephone networks. The term incumbent is also used to refer to cable companies. There is an incumbent cable operator in each market in Canada (e.g. Rogers, Shaw, Vidéotron). Incumbent telephone companies compete with incumbent cable companies to provide broadband services, and wholesale regulations require these companies to make their fixed line infrastructure (described as 'last mile' connections)

service using the Bell or Telus copper DSL network, or the Rogers or Shaw cable network, rather than building its own networks). While Canada was one of the first countries to devise a wholesale access regime, previous studies suggest that relatively high regulated wholesale prices, and hesitation by the CRTC in application of the rules restricted the ability of non-incumbent Internet service providers to become effective competitors (Berkman Center, 2010; van Gorp & Middleton, 2010). Recent changes to the wholesale regulatory environment are making it somewhat easier for non-incumbents to develop competitive offerings but the regional duopolies of copper telephone and cable broadband operators still dominate the Canadian residential and business markets for Internet access services, with a 92% and 68% share of respective market revenues (CRTC, 2013). The initiatives described in this paper were developed when it was difficult for new entrants to gain effective, affordable wholesale access to incumbents' networks.

A detailed discussion of Canada's network access regime is beyond the scope of this paper, but it is important to point out that choices about regulating access to existing infrastructure have different implications for urban and rural broadband markets. In urban settings the fixed costs of upgrading network capacity or deploying new technologies can be spread across a relatively larger number of end users, which makes it possible to have multiple network platforms (e.g. copper and cable) that compete on price and quality of service. In rural and remote areas it is not necessarily feasible or desirable to build multiple fixed line networks because that would lead to too much duplication in fixed assets. As such, public policies that encourage private operators to share the fixed costs of upgrading and maintaining networks (e.g. backhaul capacity, local switching equipment, antennas, etc.) might be more appropriate for overcoming under-investment in high-cost areas and enhance incentives to deploy new broadband technologies. Recommendations by the National Broadband Task Force (2001) and Telecommunications Policy Review Panel (2006) to directly invest in or subsidize the private provision of shared, open access transmission facilities to rural communities reflected this insight.

2.2 Foreign investment restrictions

Section 7.d of the *Telecommunications Act* stipulates that one objective of federal policies should be "to promote the ownership and control of Canadian carriers by Canadians" (Canada, 1993). Unlike most other industrialized countries that liberalized capital flows in the sector in the 1990s, pursuant to Section 7.d. Canada retained regulatory barriers to control of telecommunications facilities operators by non-Canadian entities. This has protected the management of incumbent firms from various take-over attempts by foreign investors attracted by the relatively high margins of operators in the Canadian telecommunications industry (Bank of Montreal, 2013; Scotiabank, 2012). The regulatory restrictions have also made it more difficult for non-incumbent firms to raise external financing, which further reduces competitive risks facing incumbent operators and provides them with more pricing power in the retail market. In effect, the regulatory barriers have functioned as an implicit subsidy for investors in incumbent platform operators.

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available to competitors. See Middleton (2011) for more details of Canada's telecommunications policy environment.

Barriers to foreign participation have had particular implications for network development in high-cost areas where the rates of return on investment might be too low for incumbent platform operators. They have also limited the range of eligible bidders for public procurement contracts and subsidy initiatives needed to address market failures in rural connectivity. The National Broadband Task Force (2001) and Telecommunications Policy Review Panel (2006) both identified these entry barriers as impediments to broadband access growth and recommended addressing them. Although the proposals were ignored for a number of years, growing concerns about the pace of progress in digital infrastructure development (Government of Canada, 2010) finally motivated the federal government to partially relax foreign investment restrictions on smaller providers in 2012 (Canada, 2012).

It is not yet apparent if the recent liberalization will be sufficient to promote entry and investment by non-incumbent entities in rural connectivity. Furthermore, the implications of the reforms for rural connectivity are not obvious because future entrants might concentrate their investments in urban markets where fixed costs per customer are relatively lower and therefore expected rates of return are generally higher than in high-cost rural areas. This type of entry would be beneficial for urban consumers, but may also reduce the ability of incumbent broadband platform operators to implicitly cross-subsidize rural connectivity with cash flows from low-cost urban markets.

2.3 Targeted rural subsidies

In addition to recommending relaxation of foreign investment restrictions and encouraging open access policies, the National Broadband Task Force proposed a multi-billion dollar public investment initiative that would have made broadband available to businesses and households in every Canadian community by 2004. This policy model did not find sufficient support and federal policymakers instead essentially replicated the U.S. strategy of encouraging competition between DSL and cable platform operators. Nevertheless, policymakers started to recognize that incentives for commercial operators to develop digital infrastructure in very remote communities in Northern Canada were not going to be sufficient and initiated a number of programs targeting this problem.

The Broadband for Rural and Northern Development (BRAND) program (in operation between 2002 and 2007) provided $80 million in the form of matching funds to communities and their business partners to deploy broadband services in unserved areas (Industry Canada, 2005a). (Note that provincial programs like Connect Ontario: Broadband Regional Access (COBRA) were designed to leverage these funds (Connect Ontario, 2003)). The National Satellite Initiative (NSI) launched in 2003 complemented the federal government's strategy of digital connectivity with $155 million for purchasing satellite capacity and reducing the costs of bringing broadband to the far and mid-North (Industry Canada, 2005b).

By the mid-2000s it became increasingly apparent that rural broadband market failure was not limited to the North, and policymakers developed more systematic methods for identifying which communities lacked access to broadband across the country (Howard, Busch, & Sheets, 2010; Noce & McKeown, 2008; Sawada, Cossette, Wellar, & Kurt, 2006). These initiatives culminated in the implementation of two larger programs and a number of smaller projects where the federal government used its regulatory power and funding capacity to subsidize the

provision of broadband access networks in un-served communities. Differences in the design of the two programs highlights the transition in basic industrial policy instruments for financing universal access to telecommunications networks in high-cost areas.

a. Urban-rural cross-subsidies: In a series of decisions (i.e. Deferral Account decisions) the CRTC allowed incumbent DSL operators to keep nearly half a billion dollars of overcharges to urban telephone service customers in order to fund rural broadband connectivity (Telecom Decisions CRTC 2010-637, 638, and 639[2]). There has been significant concern about the effectiveness of this approach to financing digital infrastructure in high-cost areas and its potential for distorting market competition and technological choices in rural networks (Telecom Decision CRTC 2011-28; Telecom Order CRTC 2011-281[3]; CRTC letter to Bell Canada & Bell Aliant Regional Communications October 2012[4]). This policy model for financing rural broadband network development is not likely to be available in the future due to price deregulation in the telephony market.

b. Budgetary contributions: In addition to the two early programs targeting northern communities, the Broadband Canada: Connecting Rural Canadians program (Industry Canada, 2009) was introduced as part of the federal government's fiscal response to the economic downturn of the late 2000s. Operative between 2009 and 2012, this program provided nearly $200 million to cover up to half of the fixed costs for extending basic broadband network coverage (i.e. download speeds of 1.5 Mbps) to around 215,000 rural households without prior access (CRTC 2011a). A more detailed analysis of the design of this program follows in Section 3 along with discussion of a number of other provincial policy strategies for promoting rural connectivity. In addition to Connecting Rural Canadians a number of other broadband projects have been funded by the federal government through the Canadian Strategic Infrastructure Fund (CSIF). Ad hoc projects have primarily targeted northern communities and the Atlantic Provinces (totalling approximately $100 million), as well as Eastern Ontario ($50 million for the Eastern Ontario Regional Network). Federal funding initiatives tend to involve some measure of participation by lower levels of government and the private sector (and can also facilitate participation by not-for-profit organizations working to improve broadband availability).

Although it is hard to put an exact number on the total level of mandated and budgetary allocations for rural broadband, available data suggest that between 2002 and 2013 subsidies for the private provision of access services reached nearly $1 billion (with the bulk of these funds anticipated to support capital investment). Some of the federally funded programs were designed to match contributions from sub-national government entities, non-profit organizations, and private sector vendors (i.e. equipment and network service providers). Consequently, the overall level of public and private capital expenditures stimulated by federal subsidies is likely to be somewhat higher. Nevertheless, federal funding has been substantially

[2] CRTC telecommunications decisions are archived at http://crtc.gc.ca/eng/dno7.htm.
[3] Telecommunications orders are archived at http://crtc.gc.ca/eng/dno8.htm.
[4] Letter is archived at http://www.crtc.gc.ca/eng/archive/2012/lt121026.htm.

below the multibillion dollar proposal[5] by the NBTF (2001) a decade earlier to promote the transition from dial-up to broadband Internet connectivity.

No new specific funding initiatives were announced in the 2013 budget, but the federal government indicated that it would increase the flexibility it provides provincial and municipal governments in using general infrastructure transfer funds for broadband network development (Canada, 2013, Chapter 3.3). Fiscal decentralization potentially represents a unique opportunity for local communities where there are significant concerns about access, affordability, and broadband network quality. Since Canada's fiscal infrastructure transfer system primarily targets the Atlantic provinces, Quebec, and the North, communities in other provinces will have to continue their own search for innovative policy solutions to digital infrastructure problems. The next section focuses on the design of a number of past initiatives that have contributed to expanding geographic coverage of basic broadband services (i.e. 1.5 Mbps download speed) to the vast majority of rural households.[6]

3.0 Rural Broadband Program Design

Canadian provinces are primarily responsible for delivering social and business infrastructure. This creates some incentive for provincial governments to adopt policies that promote broadband network development, for example to reduce the costs of delivering other public goods (e.g. healthcare, education, emergency services) and to attract mobile international capital and jobs to local communities. This section analyzes the design of a set of provincial and federal funding programs intended to expand network coverage in rural communities where market incentives have been insufficient to the meet growing demand for broadband Internet connectivity.

Unfortunately, standards for disclosing information about publicly subsidized broadband projects differ across particular programs. For example, some public agencies publish project level data that captures financial inputs and the size of targeted population, but most governments only disclose aggregate program input numbers. Outcome indicators are rarely collected and/or made public. This makes it difficult to compare and evaluate past initiatives. Nevertheless, the experience in Canada offers a unique window into the range and challenges in the design of rural broadband development policy. The set of programs analyzed below is not exhaustive as it only reflects examples of different approaches to addressing market failures in rural broadband network development.

There are essentially two components of broadband networks that might be prone to under-investment: high-capacity transport facilities that connect rural communities to global transmission networks and access networks that aggregate local traffic to the Internet backbone. Public investments in high-capacity fibre backbones that extend connectivity to many communities are considered to be more efficient than programs that address access network issues in particular communities because they can impact a larger number of end users (OECD, 2009).

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[5] The NBTF report included estimates of $1.3 - $1.9 billion for providing transport to unserved communities, and also estimated up to $2 billion for connecting homes and businesses.

[6] CRTC, 2012 notes 83% of rural households could access broadband services by 2011.

Since private sector incentives for deploying access networks in high-cost areas are relatively weak, public subsidies for this last mile connectivity might be required even when sufficient transport capacity is available.

3.1 Alberta: Public Investment in the Internet Backbone and its Limits

Alberta's provincial government has invested more than $190 million in the Alberta SuperNet. This high capacity fibre and fixed wireless backbone network connects about 4200 schools, municipal offices, libraries, hospitals, and other public facilities in both urban and rural areas (Service Alberta, 2012a). Beyond the direct investment, the provincial government also committed to purchasing information services from the companies that operate the SuperNet. The amount of these procurement guarantees has not been disclosed, which makes it difficult to assess the ongoing financial costs of the SuperNet to the public sector.

In addition to providing broadband connectivity to public sector institutions, the SuperNet was designed to facilitate provision of broadband service in rural communities. The private operators of the SuperNet have been required to provide wholesale access from around 400 points of presence (POP) to third party Internet service providers (ISPs). Given the regulatory environment for wholesale access, however, it has been challenging for non-incumbent ISPs to access the SuperNet POPs using last mile infrastructure (the copper phone network) controlled by the incumbent DSL operator (see e.g. Alberta Council of Technologies, 2008; Telecom Decision CRTC 2009-326). Over the past few years this problem has become more evident and increased demand on local governments and community organizations to invest in local wireless and fibre access networks that enable end users to interconnect to the local SuperNet POPs (Government of Alberta, 2009; Settles, 2012).

To help address this problem, in 2009 the provincial government allocated $10 million in grants to 34 projects led by local governments and rural co-operative associations, primarily to assist with deploying wireless broadband networks (Alberta Rural Connections: Community Broadband Infrastructure Pilot Program, Alberta Agriculture and Rural Development, 2012). The grants ranged from under $20,000 to a maximum of $500,000, with a median per project funding of around $380,000. The Alberta Rural Broadband Coverage Study (2011) further documented that many communities with SuperNet POPs continued to lack private service providers and identified remaining gaps in access to basic broadband services (i.e. 1.5 Mbps download speed). In response, the 2012 Final Mile Rural Connectivity Initiative (FMRCI) committed a further $15 million to a multistage program for funding initiatives by local governments and network providers to extend connectivity to households that still lacked access to basic broadband services (Service Alberta, 2012b).

The experience in Alberta is particularly interesting because it highlights the importance of effective wholesale regulations for rural broadband development, and shows how provincial initiatives can be hindered by federal regulatory policies beyond provincial control. In developing its publicly funded open access transport network, Alberta did not select the local incumbent operator to build and manage the SuperNet. Consequently, the firm controlling last mile access has had limited incentives to cooperate with third parties and municipal entities that want to build last mile connections to local SuperNet POPs in high-cost areas. This has meant increasing demand on local and provincial governments to invest in wireless and

fibre projects that connect end users directly with the publicly financed backbone, bypassing the last mile copper network. Conflicts between the local incumbent and the operators of the SuperNet have also emerged regarding the disposition of rural subsidies from the Deferral Accounts noted above (Telecom Decision CRTC 2011-28).

3.2 British Columbia: Incumbent Co-option for Rural Connectivity

As in the case of Alberta, the province of British Columbia (BC) has also recognized the importance of third party access to last mile connections and middle mile transport infrastructure for rural connectivity and used its own demand for digital infrastructure to promote their development. However, instead of making direct investments in the Internet backbone the BC government entered into a series of long term procurement contracts with the local incumbent operator TELUS. These contracts were the 2006 Connecting Communities Agreement (CCA) and the 2011 Connecting British Columbia Agreement (CBCA) (Government of British Columbia & TELUS, 2011). Under BC's contractual solution to promoting connectivity, TELUS agreed to maintain points-of-presence in approximately 120 communities, offer affordable wholesale access services to third party Internet service providers, upgrade network facilities, and improve rural broadband speeds. In return the BC government entered into a 10 year procurement contract with TELUS covering a wide range of telecommunications and information technology services (e.g. long distance, data, cellular, strategic services) for core ministries, health authorities, and various other public entities.

In addition to using its buying power to encourage the incumbent to upgrade its rural facilities and cooperate with third party service providers, the BC government has also tried to enhance the local capacity for delivering last mile connectivity with programs that allocate relatively small grants to non-incumbent Internet service providers.[7] The Community Network Infrastructure Grants Program (2005-2006) provided funding for local infrastructure with grants up to a maximum of $20,000 to enable 57 communities to complete their last mile access networks. The subsequent Connecting Citizens Grant Program extended this approach, allocating nearly $7 million to approximately 150 projects led by local service providers and community organizations. This program capped per project funding at $50,000 and most projects which were led by local service providers and community associations received this fixed amount. An ongoing program focusing on First Nations Connectivity and Capacity Building aims to expand access and use of broadband in BC's 203 First Nations.

The approach adopted by BC further highlights the importance of policies that enhance incentives of incumbent operators to interconnect with third party providers of rural connectivity. Given the shortcomings of the wholesale regulatory environment, the BC government's long term procurement arrangement with TELUS represented an innovative contractual instrument for enabling connectivity. However, procurement lock-ins can be costly because they prevent public sector entities from entering into open bidding processes for the information technology and network services they require. It would be hard to assess the costs of public sector concessions that had to be made in order to induce the incumbent to upgrade its facilities in high-cost rural communities and interconnect with third

[7] See http://www.cio.gov.bc.ca/cio/networkbc/programs/index.page.

parties that want to provide rural access services. The design of BC's grants programs suggests that it may not be that expensive to support efforts by local firms and community organizations to resolve last mile connectivity problems. Implementing policies that motivate operators of existing transport and local access networks to cooperate with competing Internet service providers seems to have been the more pernicious and costly challenge.

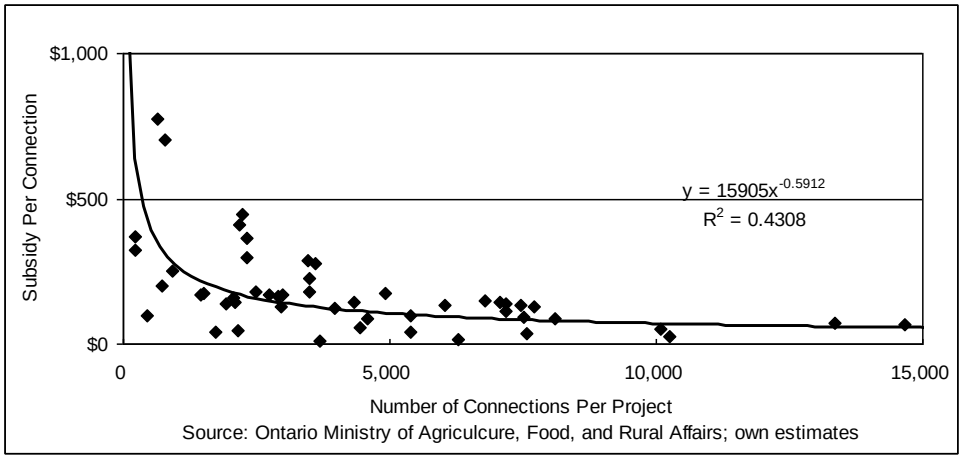
3.3 Ontario: Access Network Subsidies and Technological Complexity

Public investments and implicit subsidies in transport facilities employed in Alberta and BC are not necessarily cheap to implement and have not been employed in other provinces (with some exceptions noted below). The experiences in Alberta and BC highlight that market failures in local access networks can persist without targeted subsidies for connecting individual households and businesses to the backbone infrastructure. The federal government and most of the Canadian provinces have focused their efforts primarily on addressing this aspect of rural market failures with private sector subsidies that cover part of the capital costs of local access networks.

Implementing programs that deliver public funds to broadband access network development in rural areas can be a daunting challenge when the under-served communities differ significantly in their terrains, topology of households, and therefore appropriate combination of technologies. The BC government simplified this problem to an extent by providing small fixed grants to be used as seed money for service providers with links to local communities. In contrast, most other provinces and the federal government have employed a variable funding model for addressing under-investment in rural markets. The $32 million Rural Connections Broadband Program in Ontario (Ontario Ministry of Agriculture, Food and Rural Affairs, 2007) represents an example of this approach to program design. The program invested in 54 projects, with a median project subsidy of around $500,000 ($560,000 avg.). The program was designed to cover one third of the capital costs of broadband projects in under-served rural areas, while private providers were expected to contribute the rest. Detailed capital cost estimates for each project were compiled to determine the level of subsidy, and project level data on inputs and expected outcomes have been made publicly available. Figure 1 presents estimates of public funding per connection versus the size of the projects targeting rural communities without access to basic broadband services (i.e. above 1.5Mbps link capacity).[8]

[8] The data underlying Figure 1 have been compiled from the published list of projects funded under Ontario's Rural Broadband Connections program at:
http://www.omafra.gov.on.ca/english/rural/ruralconnections/broadband.htm
The public disclosures identify four indicators relating to project funding, number of people and businesses that were to be served by particular projects, and the status of the projects. According to this data most of the projects have been completed. To arrive at per connection estimates presented here, we have divided published numbers for "people served" by the average number of persons per household and assumed that each business represents one connection. The estimates are therefore subject to some degree of error due to the likely presence of residential dwellings and business premises that accommodate multiple households and firms. As a result figures presented here are likely to under-estimate the actual level of subsidies/capital expenditures per connection to some degree. It is also important to note the data reflect the number of people and businesses each project

Figure 1. Cost Estimations per Project



The variable subsidy program from Ontario illustrates that the fixed costs of extending basic broadband access to rural communities tend to decline very fast as the size of the targeted community grows. Average estimated fixed capital expenditure across the projects was about $750 per connection, which was substantially higher than the median of $430. The asymmetric distribution indicates that a smaller number of more expensive projects consumed more of the program budget than initiatives targeting market failures in larger rural communities, which is why they are receiving the fixed costs subsidies in the first place. Since the projects received a constant (1/3) level of public funding, the empirical model from the Ontario program provides a simple method for estimating capital expenditures necessary for delivering connectivity across a heterogeneous set of rural communities. The accuracy of fixed costs estimates based on the Ontario model is likely to be relatively high for larger rural communities (i.e. along the long tail of the power law distribution; plus 2 to 3 thousand connections per project) than for projects in very-high cost areas.

Project level data from Ontario also help illustrate why rural infrastructure development is often described in terms of failure in market forces. Assume that average revenues per customer will be at least equal to the national average of around $30 per month (for plans with advertised speeds between 1.5 to 4 Mbps, CRTC, 2012). If all households and business subscribed to the new broadband services, the payback period for the average project would be just over two years. If only 50% took up the offers and paid for available connections at the average price, the payback period would be just over four years. Although this might seem attractive from a financial perspective to some investors, market forces were apparently not sufficient to induce adequate investments in network infrastructure and public funds had to be used to extend access to basic broadband services. Notably, the average payback period for deploying first generation broadband networks (1.5 Mbps) in rural Ontario is about one half of the estimated payback period for rolling out next generation fibre-to-the-premises networks in rural areas (Alcatel-Lucent, 2011). This observation is particularly relevant for technological choices and performance standards in the design of policy initiatives by national

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was supposed to serve prior to project implementation. Data on how many people and businesses were actually served by each project after its completion have not been collected and/or released.

and sub-national governments intended to address the urban-rural digital infrastructure divide.

3.4 National: Connecting Rural Canadians

Both the BC and Ontario programs were more modest and targeted relatively smaller projects than the federal Connecting Rural Canadians program (Industry Canada, 2009), which invested around $190 million in 86 projects averaging just over $2.2 million per project (CRTC, 2011a). The federal program provided funds for half the eligible capital costs for extending rural connectivity, requiring the private sector to finance the other half. The average level of subsidy per household was around $900, suggesting an average fixed cost of $1800 per connection. This is more than two times higher than the average per connection costs in the Ontario program detailed above. Given that target performance standards in terms of connectivity speeds were the same (i.e. 1.5 Mbps), this discrepancy is puzzling particularly because the federally funded projects were relatively bigger (4 times on average) and therefore should have had lower per connection costs due to scale economies in network deployment. Regardless of its cause the difference in cost estimates between the two projects highlights the importance of employing empirical models such as the one presented above as a baseline for cross-checking accounting estimates of capital expenditures for particular projects provided by firms searching for public subsidies.

Unfortunately, project level data on financial inputs necessary for exploring this issue further have not been released by the federal government. Available aggregate program data suggests that Connecting Rural Canadians focused on projects to expand rural access in the West and Central Canada, particularly in Quebec. Most of the projects involved installing fixed wireless access networks. As documented in Table 1 there were significant differences in the size of the targeted populations and average project size, partly as a result of the diversity of rural communities across the country and remaining gaps in access to basic broadband services across the provinces at the time.

Table 1. Connecting Rural Canadians

Province	Number of households targeted	Number of projects	Avg. project size (households)	Broadband availability (% households; 2009)
British Columbia	14,650	26	563	94%
Alberta	40,988	11	3726	97%
Manitoba	30,984	9	3443	92%
Ontario	13,505	13	1039	98%
Quebec	112,923	25	4517	92%

Source: CRTC, 2011a

4.0 Summary and conclusions

Although demand for Internet connectivity has generated strong incentives for technological innovation and investment in broadband networks in urban and suburban communities, private sector incentives to extend high-speed services to

high-cost rural areas tend to be relatively limited. The potential for private sector under-investment in rural connectivity has led most industrialized countries to adopt policies intended to promote rural broadband network development. This paper provided an overview of policies and programs that have been implemented in Canada to address concerns about the urban-rural digital infrastructure divide.

The experience with rural broadband policy in Canada is particularly interesting because it highlights challenges in financing universal access to Internet connectivity in high-cost areas. With the erosion of the traditional regulated monopoly model, policymakers at different levels of government have had to search for innovative policy solutions that promote private sector incentives to build and manage Internet access services in rural communities. In contrast to a number of other governments in industrial countries, consecutive federal governments in Canada have been reluctant to implement proposals for large scale public investments or subsidies in open access Internet backbone infrastructure that serves rural communities.

As the scope of rural broadband market failures became more apparent over the past decade, the federal government has increasingly had to rely on private sector subsidies that cover part of the fixed costs of deploying access networks in un-served areas. Provincial governments have also responded to the problem. Alberta and British Columbia have emphasized the importance of open access transport facilities for expanding rural broadband access and have invested in and subsidized a rural backbone infrastructure with procurement guarantees. Others have followed the federal approach, focusing their efforts only on subsidizing last mile access network in high-cost areas.

A detailed assessment of one of these programs from Ontario provides an empirical model that can be used by policymakers to evaluate accounting estimates of capital expenditures required for extending access to basic broadband services across diverse rural communities. The federal and provincial policies described here to address rural access problems have helped to extend the availability of basic broadband access services to more than 80% of rural households in Canada. However, access to higher speed connections required for deploying more advanced Internet content and application services remains relatively limited and further action will be required to ensure the extension of higher speed networks into rural Canada. Concerns about the speed of Internet connectivity in rural Canada have led federal policymakers to adopt minimum performance targets that will only be achieved with further policy action. Past policies provide important insights about the challenges in the design of effective solutions to market failures in the provision of Internet transport and access infrastructure facilities in rural and remote communities, highlighting the need for different approaches in different contexts.

5.0 Acknowledgement

This research was undertaken, in part, thanks to funding from the Canada Research Chairs program and was supported by the Social Sciences and Humanities Research Council (Canada), the GRAND NCE and Ryerson University.

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