CANARIE Connection Fees Discussion Paper

Version 1.4

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Purpose

CANARIE is continuing to seek input from its stakeholder community on the model for and implementation of its connection fee policy. Any institution connected to the CANARIE network either directly or through their provincial or territorial ORANs will be affected by a connection fee policy implemented by CANARIE. This paper seeks to lay out the context for this initiative and provides additional information to prompt discussion and feedback on connection fee models from affected members of the community.

In the coming weeks and in the New Year, CANARIE will organize conference calls and host a face-to-face meeting to discuss and collect feedback from CANARIE's stakeholder community on this initiative. Individuals and groups wishing to provide written feedback on this document may do so via email to feedback@CANARIE.ca by **January 18, 2013.**

Context

In Budget 2012 the government of Canada provided $62 million to CANARIE over three years to support the mandate and objectives of CANARIE, including the continued operation and development of the network. This investment, at $20.7 million per year, compares to the investment of $24 million per year during CANARIE's last mandate, and represents a 14% decrease in funding.

The government has asked CANARIE to develop cost-recovery options to complement these investments. Specifically the government has requested a plan that "features how CANARIE will, as much as possible over the three year period from 2012-2015, recover its Eligible Project costs resulting from Eligible Projects."[1]

CANARIE's cost-recovery initiatives are not intended to take CANARIE to a position of self-sustainability with regard to the full cost of its projects, but rather to find ways to complement federal funds and hence ensure that CANARIE has sufficient resources to achieve the objectives of its current mandate. CANARIE has implemented a degree of cost recovery in its other programs. This document is focused on connection fee models for institutions benefitting from their connection to the CANARIE network.

CANARIE's objective in its cost-recovery initiative is to satisfy the government of Canada's objectives with respect to cost recovery and to achieve the funding levels required to meet the evolving needs of the community.

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[1] *Industry Canada – CANARIE Inc. Contribution Agreement*, (September 2012). Eligible Projects means "Network Projects, Technology Projects and Innovation Projects receiving funding from CANARIE for Eligible Activities, and carried on, or to be carried on by an Eligible Ultimate Recipient, in collaboration with other Participants, for the purpose of operating, deploying, extending and/or advancing innovation and commercialization of products and services and/or developing, testing, demonstrating of the CANARIE Network that have been approved by CANARIE."

Canada's Advanced Network Alliance

CANARIE does not work in isolation: CANARIE is the national backbone providing interprovincial and international connectivity. The intraprovincial connectivity is provided by the provincial and territorial networks (ORANs). Together, CANARIE and the ORANs form Canada's advanced network alliance, and deliver tangible benefits of ultra-high speed networking and connectivity to research networks, tools, and data resources across Canada and around the world.

ORANs across the country charge fees to connected institutions. These fees vary widely, but are generally understood and accepted by the connected institutions that pay them. CANARIE has not, over the course of its 20-year history, implemented any fees for connectivity to the backbone network. Institutions that choose to become members of CANARIE pay an annual fee of $2,500. Connected institutions are not required to become members of CANARIE. This history of CANARIE as a "no fee" service, and the fact that CANARIE is often not visible to end users (who primarily deal with ORANs), adds complexity to the implementation of any fee model. Information on ORAN fees may be found in Appendix 1.

In 2011, CANARIE conducted an analysis to determine the total investment in and sources of funding for the networks operated by the advanced network alliance, including the CANARIE network and all of the ORAN networks. The results showed that in the five years from 2007 to 2012 the federal government, through CANARIE, paid for 46% of the total operating and capital costs, with the remaining 54% being paid for by connected institutions (through ORAN membership fees) and provincial governments. Details of this analysis may be found in Appendix 2.

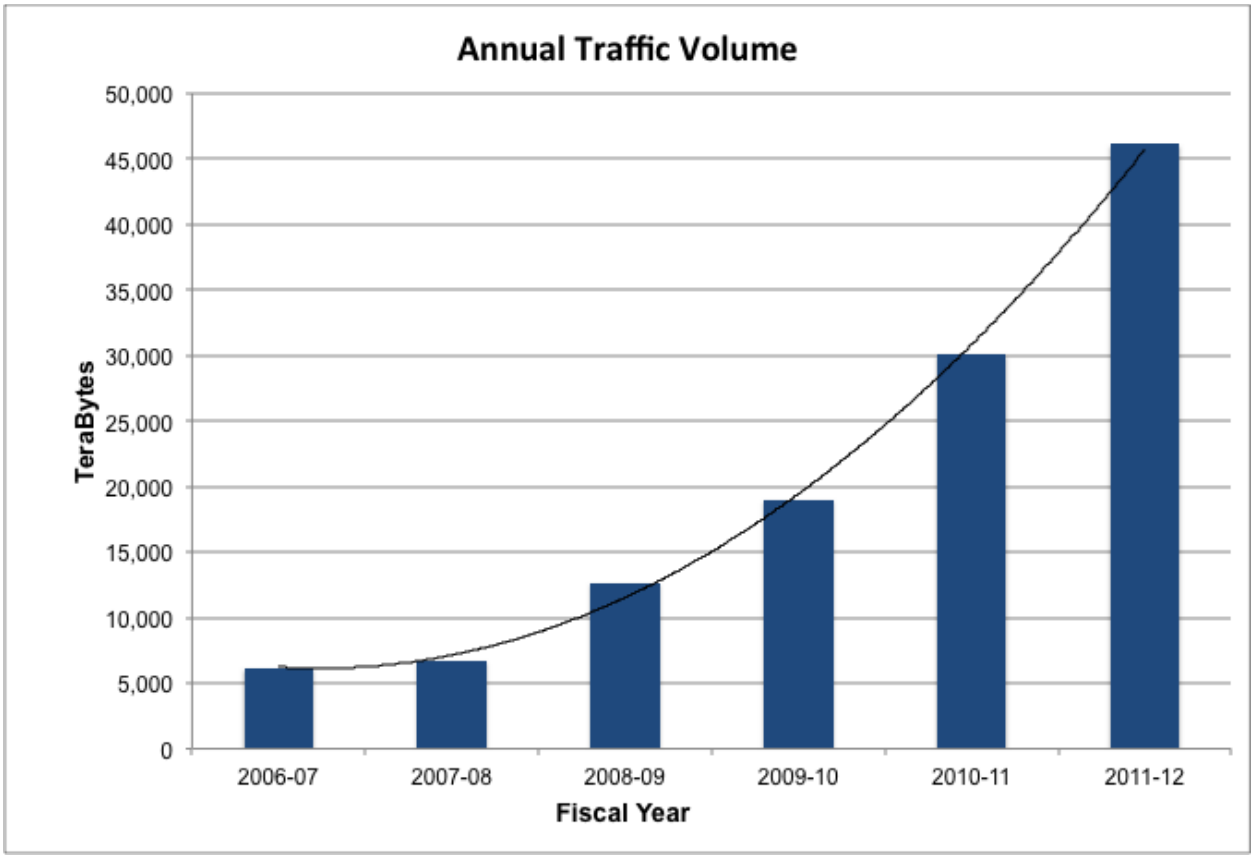
CANARIE has wide scope in the development of the cost-recovery model and implementation plan. This includes flexibility with respect to the amount of any fees and the timing of implementation to fulfill its cost-recovery mandate starting in April 2012. This autonomy enables CANARIE to consult widely with its community in the development of a cost-recovery model and implementation plan that delivers on its mandate to recover costs, operate the CANARIE network, support technology innovation and private sector innovation. In addition, the model should strengthen the fabric of the national network alliance and enhance the quality of digital research and education in Canada.

Value of CANARIE

CANARIE designs, delivers, and drives the adoption of digital infrastructure for Canada's research and education community. In addition to operating and evolving the high-speed network, CANARIE leads the development of research software platforms and offers cloud computing services to provide entrepreneurs in Canada with a digital testbed to accelerate their product development and enhance their competitive advantage. CANARIE is implementing cost-recovery models for all aspects of its operations. This discussion paper is focused only on cost recovery for connection to the network (connection fees).

For research and education institutions, a key value delivered by CANARIE is the connectivity to the high-speed backbone network. Through this connection (made through the institutions' connections to their provincial ORANs), users have access to data, tools and peers distributed across Canada and worldwide.

In recent years, traffic on the CANARIE network has increased steadily at a rate of approximately 50% per year. It is expected that this trend will continue. The chart below illustrates this dynamic. The planned consolidation of Compute Canada facilities will also likely result in increased traffic over the network. Additional information on CANARIE traffic by institution may be found in Appendix 3.



CANARIE's links to over one hundred other National Research and Education Networks (NRENs) worldwide, enabling Canadians to participate in a wide range of international projects. Some examples of international research collaborations, which might not have been possible without Canada's advanced network, include:

ATLAS | TRIUMF, Canada's National Laboratory for Nuclear and Particle Physics is a prestigious Tier 1 Data Centre for the ATLAS detector at the Large Hadron Collider located at CERN in Switzerland. The ATLAS team recently announced a breakthrough in the discovery of the Higgs boson. CANARIE is continuing to work with international partners to enable more efficient connectivity from the Large Hadron Collider at CERN, Switzerland, to Canadian institutions. These large "Big Science" projects rely on cooperation among national R & E networks to collectively align technologies and processes to deliver maximum utility and efficiency to end users.

Square Kilometre Array | The world's largest global science endeavour, the Square Kilometre Array (SKA) which is in development in Australia and South Africa will be the largest radio telescope in the world when it is complete. It will require very high performance central computing engines and long-haul links with a capacity greater than all the current global Internet traffic. During its previous mandate, CANARIE funded the development of the data architecture supporting the SKA in Canada, a tremendous opportunity to pioneer technologies that will support the enormous data streams that will be created by the SKA. These data will dwarf data streams currently being created in other scientific disciplines.

outGRID | A global software platform funded by CANARIE (**GBRAIN**) was chosen as one of three global platforms to provide neuroscientists with a remarkable repository of 3D brain imagery. outGrid also provides the tools required to make sense of the vast amount of this data to deepen our understanding of the complexities of brain development, and the progression of brain disease and degeneration.

Science Studio | Is a CANARIE-funded platform that enables remote experimentation at the Canadian Light Source, Canada's national synchrotron. This software is currently being implemented at the national synchrotron in Brazil and is being evaluated by the team at the Australian national synchrotron.

Both GBRAIN and Science Studio were developed under CANARIE's Network-Enabled Platforms program in its previous mandate, and were among 20 research platforms developed. Through this program, CANARIE addresses a critical gap in research infrastructure. In its current mandate, CANARIE is harvesting the "best of breed" services from these platforms to create a generic toolkit of services that will be used in the development of new software platforms. This strategy leverages previous investments, and promotes the use of advanced digital tools among the research community, with an overall goal of advancing research outcomes and accelerating discovery.

International Cancer Genome Consortium | The Ontario Institute for Cancer Research is a participant in this international organization devoted to the development of a comprehensive genomic description of fifty different tumour types that are of clinical and societal importance. Each country involved in the Consortium focuses on a specific type of cancerous tumour; the OICR is focussed on pancreatic and prostate cancers. CANARIE funded the Institute's connection to the research and education network in its previous mandate.

CANARIE is the Canadian voice of research networking on the international stage, working with international partners and organizations to shepherd the ongoing development of this infrastructure, and related services, to ensure Canadians continue to participate in advanced research and discovery.

Connection Services and Fees

The core CANARIE service delivering value to institutions is connectivity to the CANARIE network, which provides interprovincial and international access to research data, tools and peers.

Network connectivity and services include the following CANARIE services: IP connectivity, Content Delivery Service and lightpaths.

IP connectivity is the basic service of the national network. Through it, CANARIE and the ORANs provide researchers and educators extremely high bandwidth connectivity that can accommodate the sudden bursts of demand characteristic of many research activities.

Content Delivery Service is an extremely important and valuable service for many connected institutions because it allows them to use the CANARIE network to access Internet content relevant to research and education at higher bandwidth.

Lightpaths are dedicated fibre-optic links between organizations that provide unimpeded bandwidth to individual organizations. As an example, CANARIE provides lightpaths to TRIUMF, Canada's National Laboratory for Nuclear and Particle Physics, to enable the transmission of massive amounts of experimental data from the Large Hadron Collider at CERN, Switzerland.

CANARIE funds all operating and capital costs for the national backbone network. In addition, CANARIE provides funding to the ORANs for some of the operating and capital costs of the provincial networks. On average, during its previous mandate CANARIE invested $13.0 million per year in the national backbone network and ORAN networks. Of this amount, $8.2 million was spent on CANARIE network infrastructure and services and $4.8 million on ORAN programs. A breakdown of CANARIE investments in each province over the course of the last mandate may be found in Appendix 4.

In its current mandate, CANARIE plans to invest $10.5 million per year in the national backbone network and ORAN networks. Of this amount, $7.2 million is budgeted for CANARIE network infrastructure and services and $3.3 million for ORAN programs. To maintain the same level of service to meet the community's needs, CANARIE is suggesting a connection-fee model that recoups $3 million annually by the third year of the current mandate (ending March 31, 2015).

Through discussions with its community, CANARIE developed three models, including a tiered model based on research budgets and FTE counts; a usage-based model; and a model based on provincial populations and aggregate investments in research. These models, along with the considerations and data underlying their structure, may be found in Appendix 5. The models presented would generate roughly $3 million by the third year of the current mandate. It is the goal of this discussion paper and accompanying feedback mechanisms to test the assumption that this is the right amount of cost recovery and to collect a wide range of feedback from the institutions that will be affected by any connection fee model.

Considerations

CANARIE began consultations with its community in June 2012, soliciting feedback from its CIO Advisory Committee, the CUCCIO Board and membership, the ORAN Advisory Committee and other members of the community across the country. These consultations are ongoing. This discussion paper and subsequent scheduled calls and meetings are designed to ensure that the final proposed fee structure, while perhaps not welcomed by the community, would be viewed as being fair and reasonable given the value delivered by CANARIE and the need for CANARIE to meet the government's objectives for cost recovery.

One risk that CANARIE cannot manage is how institutions choose to allocate the new CANARIE fees internally. Some members of CANARIE's CIO Advisory Committee have suggested that the fees may be pushed down to individual researchers within the institution, who would be required to use their research grant funds to pay for a portion of digital infrastructure required to conduct their research.

CANARIE will not pursue fees from K-12 schools or school boards at this time as it does not directly support these institutions. This decision is based on a strong recommendation from CANARIE's ORAN partners, and CANARIE may revisit this decision in the future.

Next Steps

CANARIE has considered a range of options and analyzed various models of cost recovery for network connectivity. However, the primary impact of any connection fee structure is felt by connected institutions, and so CANARIE is actively seeking their input. CANARIE encourages the ultimate beneficiaries of connectivity to the CANARIE network, as well as key partners and others, to provide feedback on connection fee models that adequately represent the value CANARIE delivers while addressing the government's objectives with respect to cost recovery.

CANARIE encourages written feedback on the connection fee models presented in this document. Individuals and groups may provide feedback directly to CANARIE by emailing feedback@CANARIE.ca. CANARIE will collate and present this feedback, and engage stakeholders in a discussion on how to develop a fair and appropriate fee model for network connectivity, through several conference calls and meetings in late 2012 and early 2013.

CANARIE would like members of the community to respond to the following questions in their written feedback to this document:

1. **Is $3 million per year by the third year of this mandate an appropriate level of aggregate connection fees to be collected by CANARIE? Considering that the majority of these fees will be paid by provincially-funded institutions, what is the right balance between federal and provincial funders of Canada's advanced network alliance?**
2. **Please comment on the fee models presented in Appendix 5. Are these reasonable approaches to cost recovery? Why or why not? What would you recommend to make improvements or changes to any of these models, given CANARIE's new cost-recovery mandate?**

3. **Is there another fee model that you believe is more reasonable and meets CANARIE's objectives? Please describe.**

CANARIE encourages stakeholders to provide their feedback via email to feedback@CANARIE.ca by **January 18, 2013.**

CANARIE invites members of the community to participate in any one of the following scheduled conference calls to continue the discussion and provide feedback on potential connection fee models:

Wednesday, December 19, 2012: 1 pm – 3 pm ET

Wednesday, January 16, 2013: 10 am – 12 pm ET

Friday, January 18, 2013: 4 pm – 6 pm ET

Conference bridge: 888-289-4573

Participant code: 5548953

Following these consultations, CANARIE will host an in-person meeting in Ottawa on January 21, 2013 with representatives of stakeholder groups to develop a connection-fee model that will be incorporated into CANARIE's cost-recovery business plan and delivered to the federal government. CANARIE intends to provide this document to the government in February 2013. CANARIE will provide the community with information on the model proposed, and provide updates on the progress of the proposal and the government's response to it.

Thank you for your participation in helping shape a sustainable and appropriate model for CANARIE connection fees.

Appendix 1: High Level ORAN Financial Estimates (2011/2012)

Based on ORAN Surveys and Comparisons Version 1.0 (Sept 2012, study performed by John Sherwood)

ORAN	Total annual fees collected	Estimated In-kind Contributions	Average connection fee per institution[2]	Fee Model
ACORN - NL	$15,000	$200,000	$3,000	Flat fee per member
ACORN - NS	$86,000	$138,000	$5,000	Fee based on members' operating budget
PEI	$0	$40,000	$10,000	Flat fee per member
NB GigaPoP	$68,000	$25,000	$19,000	Fee based on connection speed
RISQ	$5,000,000	$620,000	$200,000	Fee based on student count and research grants but there is also a fixed administrative charge
Federal GigaPoP	$70,000	$96,000	$10,000	Flat fee per member
ORION	$3,276,000	$700,000	n/a	Fee based on Tiers
MRnet	$40,200	$90,000	$9,000	Fee based on Tiers (FTEs) and types of organizations
SRnet	$273,112	$200,000-$250,000	$24,000	Fee based on connection speed
Cybera	$300,000	$37,500	$5000 + connection fee based on individual agreement	Fee based on FTEs, in addition connection cost based on individual agreements
BCNET	$4,300,000	$0	$24,000	Different fee structures for (1) founding and core members and (2) other organizations.
NWT ORAN	$0	$27,500	$12,000	Fee based on revenues
YKnet	$0	$38,000	$0	No Fee.

Other Highlights from the report:

- RISQ connection fee is high in comparison to other connection fees, given that RISQ offers a suite of services including the cost of campus fibre loop maintenance and replacement (initial construction is covered by the members). RISQ also covers maintenance of campus edge equipment. The cost of transportation and distribution of Internet transit from QIX (Quebec Internet Exchange) is also included in the RISQ fee, along with other services.
- BCNET and RISQ are the only ORANs that cover the cost of local loops for their members

[2] Connection fee estimates are for a 15k FTE institution with a 1Gbps link

- All ORANs have one thing in common: they all offer connection to the CANARIE network to their connected institutions
- Only 6 out of 13 ORANs are incorporated legally and only four have budgets of more than $1M
- CANARIE/ORANs together provide connectivity to 95% of universities (based on AUCC numbers) and 81% of colleges (based on ACCC numbers)

Appendix 2: Funding of Canada's Advanced Network Alliance (2007/08-2011/12)

The information provided in the Table below was collected by CANARIE from the ORANs in 2010 as part of CANARIE's mandate renewal efforts. It was understood at the time that **financial data for 2010/11 and 2011/12 were estimates and could differ from actuals**. Also, it is important to recognize that not all organizations, including CANARIE, classify their revenues and expenditures in the categories used in the table below (e.g., users' fees, provincial funding, operating budget, etc). So in several instances, the financial data was derived by combining several categories and therefore represents the best available estimates. Some ORANs provided guidance on how to develop estimates while others provided the estimates for 2010/11 and 2011/12. (In-kind estimates are not included. All figures in millions.)

		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	YK&NT	Federal GigaPoP	CANARIE	Total	% of Total
Revenues	User Fees [3]	18.4	0.9	1.5	0.2	17.2	40.7	1.8	0.0	0.1	0.1	0.0	0.2	0.0	80.9	44%
	Provincial Government Funding [4]	4.4	10.9	0.0	0.0	0.0	1.7	0.5	0.0	0.0	0.0	0.1	0.0	0.0	17.5	10%
	Federal Government Funding [5]	1.2	0.4	0.9	1.5	5.2	3.0	3.5	1.8		0.7	0.2	0.0	67.0	85.3	46%
	Total Revenues	23.9	12.1	2.5	1.7	22.4	45.3	5.7	1.8	0.1	0.7	0.3	0.2	67.0	183.7	100%
Expenses	Operating Budget	15.9	23.4	1.9	1.4	12.2	32.4	1.3	1.8	0.0	0.7	0.0	0.0	12.6	103.4	52%
	Capital Budget	9.4	1.0	0.3	1.8	10.9	15.5	3.8	0.0	0.0	0.0	0.0	0.1	54.4	97.1	48%
	Total Expenses	25.2	24.4	2.3	3.2	23.1	47.8	5.1	1.8	0.0	0.7	0.0	0.1	67.0	200.5	100%

[3] "User Fees" refers to membership and connection fees collected by ORANs.

[4] "Provincial Government Funding" refers to funding from provincial governments to ORANs.

[5] "Federal Government Funding" for ORANs refers to funding from CANARIE through the various ORAN funding programs. Federal Government funding for CANARIE refers to funds provided to CANARIE by Government of Canada through Industry Canada.

Appendix 3: CANARIE Traffic

Traffic/Usage by Institutions from October 2011 – September 2012

TB = Terabyte

Institution	IP+Lighpath Traffic (TB)	Peering (TB)	Total (TB)
TRIUMF	2492	6	2498
University of Toronto	2111	0	2111
McGill University	1430	139	1569
WestGrid	1431	0	1431
University of British Columbia	281	806	1087
University of Saskatchewan	743	102	845
University of Alberta	332	294	626
Dalhousie University	312	150	461
National Research Council Canada	329	38	367
University of Manitoba	148	208	356
University of Victoria	283	27	310
Université du Québec (all campuses)	77	220	297
Simon Fraser University	123	128	251
Manitoba Education Research & Learning Information Networks (MERLIN)	53	171	224
University of Regina	99	106	206
University of Waterloo	199	0	199
University of New Brunswick	73	120	193
BC Genome Sequence Centre	184	8	192
Ontario Institute for Cancer Research	192	0	192
Acadia University	121	65	186
Saint Mary's University	60	109	169
Concordia University	66	90	157
Memorial University of Newfoundland	69	87	156
CMC Microsystems	153	2	153
Université de Montréal	55	81	136
McMaster University	121	0	121
Université Laval	67	54	120
Canadian Space Agency	109	0	109
Carleton University	106	0	106
Université de Sherbrooke	55	45	100
University of Lethbridge	23	76	98
Queen's University	94	0	94
St. Francis Xavier University	34	57	91
Environment Canada	87	0	87
Natural Resources Canada	83	0	83
University of Guelph	82	0	82
Communications Research Centre Canada	81	0	81
University of Calgary	80	0	80
Mount Allison University	33	33	66
Université de Moncton	14	51	65
Réseau d'informations scientifiques du Québec (RISQ) inc.	6	57	63
SHARCNET	63	0	63
York University	62	0	62
Ryerson University	60	0	60
Srnet	56	3	56
Grace Maternity Hospital	0	52	52
British Columbia Institute of Technology	0	52	52

Institution	IP+Lighpath Traffic (TB)	Peering (TB)	Total (TB)
Ecole Polytechnique de Montréal	23	28	51
University of Western Ontario	43	0	43
TRLabs	42	0	42
Capital District Health Authority (CDHA)	3.1	42	42
HEC (Ecole des Hautes Etudes Commerciales) Montréal	17	22	40
BCNET	19	19	37
University of Winnipeg	11	27	37
Atlantic Computational Excellence Network (ACEnet)	30	6	36
University of Ottawa	33	0	33
University of Prince Edward Island	15	14	29
Mount St. Vincent University	4	23	27
Cybera	23	0	23
Lakehead University	23	0	23
Forintek Canada Ltd.	21	0	21
Ecole de Technologie Superieure	5	16	21
FPInnovations - PAPRICAN	21	0	21
Bishop's University	0	20	20
The Banff Centre for Continuing Education	0	17	17
University of Ontario Institute of Technology	17	4	17
Canadian Broadcasting Corporation	13	3	17
Laurentian University	15	0	15
Innovation Place	14	0	14
Ouranos Consortium	13	0	13
River East Transcona	0	13	13
Brock University	12	0	12
Brandon University	0	12	12
University of Windsor	9	5	9
ONF ville St-Laurent	0	9	9
University of Northern British Columbia	2	6	8
BlackSun Inc.	8	0	8
Agriculture and Agri-Food Canada	6	0	6
Université de Saint-Boniface	0	6	6
Maritime College of Forest Technology	5	0	5
London Health Sciences Centre	0	2	2
Athabasca Universtiy	0	2	2

Appendix 4: CANARIE Investments in Provincial Network Infrastructure 2007-2012 (Actuals)

Province	Funded
BC	$1,999,197
AB	$411,129
SK	$465,425
MB	$1,460,550
ON	$5,372,260
QC	$3,235,256
NB	$3,191,794
NS	$2,005,410
NL	$455,269
NWT	$520,000
Total	$19,116,290

Decisions on provincial infrastructure investments are approved by CANARIE's Board of Directors based on specific criteria. These strategic investments were designed to deliver equality of opportunity with respect to CANARIE's digital infrastructure, and were aligned with the objectives of CANARIE's mandate. Investment decisions were made based on proposals made by ORAN partners.

These figures reflect ORAN Infrastructure Program (OIP) funds only and do not include investments to ORANs made through the ORAN Activities Support Program (OASP), the ORAN Communications Program (OCP) or the Infrastructure Extension Program (IEP) during the last mandate.

Appendix 5: Fee Model Options

CANARIE has analyzed several different connection fee models, all of which enable CANARIE to recoup $3M by year three of its current mandate. These models are presented below. These models are for discussion purposes only and are meant to encourage feedback from CANARIE's stakeholder community. At this point, CANARIE is not advocating for any particular model. The order in which the models are presented below does not reflect CANARIE's "preferred order".

Option A: Connection fee based on student Full Time Equivalents and research budgets

Tier	FTEs or Research Funding	FY2012/13 April 1/12 - March 31/13	FY2013/14 April 1/13 – March 31/14	FY2014/15 April 1/14 – March 31/15
1	Annual research funding > $100M or FTE> 20,000 (approximately 24 universities	$0	$25,000	$50,000
2	Annual research funding > $10M or FTE> 10,000 (approximately 18 universities)	$0	$15,000	$30,000
3*	All other institutions, including colleges, provincial labs, hospitals (approximately 300 institutions)	$0	$5,000	$10,000
Extraordinary Users	Heaviest users of the network (those who transmit more than 1 Petabyte of data per year; currently 4 users)	$0	$25,000	$50,000
	Total	$0	$1.44M	$2.88M

***These calculations of total fees collected reflect a projected 30% collection rate from Tier 3 institutions. As these smaller institutions currently have little or no visibility of CANARIE and the value CANARIE delivers, CANARIE projects a longer time frame to achieve 100% collection from this group.**

This model envisions a two-year phased-in tiered fee structure in which connected institutions would be charged a fee based on the amount of research funding the university receives annually and their FTE (student enrolment) numbers. The fee structure reflects usage of the network for research (using total research funding as the proxy) and value derived from Content Delivery Service (using student enrolment as the proxy).

Several steps were undertaken during the development of this tiered model:

- CANARIE calculated the amount a large urban university would pay in order to receive equivalent services from a commercial provider. Given that a large urban institution would

receive the best available pricing, this value was used as a proxy to determine the value of CANARIE services to all institutions. The delta between this cost and the cost of commercial service for more rural or remote institutions is viewed as the cost of network parity and is appropriately borne by the federal government. CANARIE analyzed the equivalent cost of CANARIE network services for large urban universities. These costs were used in the development of the model for tiered connection fees.

Institution	Data transmitted over the CANARIE network (TB)	Equivalent Cost of CANARIE services ($)
University of Toronto	2,111	$211,098
McGill University	1,569	$156,898
University of British Columbia	1,087	$108,664

- CANARIE assessed the value of the Content Delivery Service in terms of its impact on commercial ISP costs for institutions, under an assumption that since the need for Content Delivery Service would continue to increase, there would be a significant benefit to them from a reasonably priced CANARIE service that would decrease their overall ISP costs. However, it is important to note that ORION offers a peering service to their connected institutions, so there is little value attached to the CANARIE service in that jurisdiction.
- CANARIE assessed the levels of research dollars and full-time student enrolment (FTE) by institution, as these measures are respectively proxies for research activity and for usage of CANARIE's Content Delivery Service.
- CANARIE reviewed ORAN connection costs and the disparity among these costs between connected institutions. While CANARIE has no control over the fees that are charged by ORANs, the institution's total cost of service is an important consideration in establishing an appropriate CANARIE fee structure.
- CANARIE also reviewed network traffic patterns to identify the heaviest users of the network to determine if an additional charge for these users is warranted.
- Extraordinary users (for example, TRIUMF, located on the campus of the University of British Columbia) are often housed within universities, and therefore the fees for these users would be in addition to whatever tiered fees that institution is assessed.
- Smaller Tier 3 institutions often have little or no appreciation of the benefits of the CANARIE network, and there is a risk that these institutions would choose not to pay the connection fee.

Option B: Usage-based fee model

The following table presents potential examples of Tiers of connected institutions based on their data traffic over the CANARIE network. This model uses data transmission on the CANARIE network to assign fees, but does not consider any of the special characteristics of a highly advanced network such as CANARIE. The traffic information was collected using CANARIE's internal data transmission tools, which are also used for network monitoring.

Tiers	Data transmitted over the CANARIE network	# of connected institutions*	FY2012/13 April 1/12-March 31/13	FY2013/14 April 1/13-March 31/14	FY2014/15 April 1/14-March 31/15
1	>=500 Terabytes (TB)	7	$0	$100,000	$150,000
2	>=100 TB and <500TB	23	$0	$20,000	$50,000
3	<100TB	62	$0	$5,000	$10,000
Total			$0	$1.47M	$2.8M

* These figures are based on the top 100 users of the CANARIE network. Tier 3 figure doesn't take into account entities that are not among the top 100 users of the CANARIE network but yet connect to the network and will be assessed a fee for their usage

- CANARIE conducted a high level analysis and determined the Tier under which the top 100 users would fit.
- The annual fee for each Tier was based on the **average** data transmitted by connected institutions in each of the Tiers.
- While the benefits of a user-pay model include transparency and simplicity, there is significant downside risk to this model, as institutions that are facing budget pressures may choose to throttle back advanced digital research and thus negatively impact Canada's innovation capability.

This option is in some ways contradictory to one of key tenets of CANARIE's mandate of providing advanced networking capabilities to all Canadian researchers. This option can lead to unintended consequences such as bandwidth restrictions for researchers that rely on high-bandwidth availability to conduct research on "Big Data" projects, or to institutions "opting out" of the advanced network alliance.

Option C: Provincial population and research performed-based fee model

This option would charge each of the provincial ORANs for connectivity to the CANARIE network based on their population and the amount of research performed in the province. The following table presents information obtained from Statistics Canada with respect to population and research performed. The CANARIE fee was then calculated using the provincial portion of the Canadian total and assuming an outcome of collecting $3M annually in 2014/15. For example, Ontario represents 38.47% of Canadian population and thus would pay 38.47% of $3M to CANARIE.

Table: Population-Based and Research-performed-Based

Province	Population-based					Research-performed-based				
	Pop'n (M)	% of Canada	FY2012/13 April 1/12-March 31/13	FY2013/14 April 1/13-March 31/14	FY2014/15 April 1/13-March 31/14	Research Performed in Province ($M)	% Of Canada	FY2012/13 April 1/12-March 31/13	FY2013/14 April 1/13-March 31/14	FY2014/15 April 1/14-March 31/15
Ontario	12,851	38.47%	$0	$577,050	$1,154,100	$13,386	45.70%	$0	$685,500	$1,371,000
Quebec	7,903	23.66%	$0	$354,900	$709,800	$7,855	26.82%	$0	$402,300	$804,600
BC	4,400	13.17%	$0	$197,550	$395,100	$2,798	9.55%	$0	$143,250	$286,500
Alberta	3,645	10.91%	$0	$163,650	$327,300	$2,851	9.73%	$0	$145,950	$291,900
Manitoba	1,208	3.62%	$0	$54,300	$108,600	$653	2.23%	$0	$33,450	$66,900
Saskatchewan	1,033	3.09%	$0	$46,350	$92,700	$596	2.03%	$0	$30,450	$60,900
Nova Scotia	922	2.76%	$0	$41,400	$82,800	$500	1.71%	$0	$25,650	$51,300
New Brunswick	751	2.25%	$0	$33,750	$67,500	$327	1.12%	$0	$16,800	$33,600
NL and Labrador	514	1.54%	$0	$23,100	$46,200	$259	0.88%	$0	$13,200	$26,400
PEI	140	0.42%	$0	$6,300	$12,600	$66	0.23%	$0	$3,450	$6,900
Yukon	34	0.10%	$0	$1,500	$3,000		0.00%	$0	$0	$0
Total	**33,401**	**100%**	$0	**$1,499,850**	**$2,996,700**	**$29,291**	**100.00%**	**$0**	**$1,500,000**	**$3,000,000**

CANARIE's analysis of this option indicates that:

- Tasking ORANs with collecting these fees, either from their users or from their provincial governments or from a combination of the two, presents some challenges for smaller ORANs with limited administrative capacity. In some cases a provincial ORAN is staffed with one FTE or less, and this collection would present a real administrative challenge.
- This model puts the responsibility for CANARIE's cost recovery in the hands of CANARIE's ORAN partners, yet CANARIE is responsible for cost recovery to the government of Canada. This model therefore presents some accountability issues which may not be easily solvable.
- This model does not enable CANARIE to interact directly with the institutions that benefit from the CANARIE service, which may present additional collection problems.

Appendix 6: Revision History

Page(s)	Comments
Cover	Version number and date updated
3, 9	Deadline for written comments extended from January 10 to January 18
4	Change to federal/provincial percentages with respect to funding of Canada's advanced network alliance (CANARIE plus ORANs) based on updated information from Cybera
7	Updated forecast for investments in CANARIE and the ORANs in the current mandate
12	Appendix 2: Alberta provincial revenues number updated with information from Cybera
15	Appendix 4: Additional text explaining what program funding is represented in the table