Summary of 18 October Workshop on Comparative Perspectives on Broadband Regulation and Access

by Erik Bohlin & Romel Mostafa, Ivey Business School, and workshop presenters

The workshop on the theme "Comparative Perspectives on Broadband Regulation and Access", was convened on 14 October, 2023, at the Ivey Donald K. Johnson Centre in Toronto. It attracted more than 60 in-person registrations. The workshop was followed by more than 50 webinar participants, the majority of them students in the Ivey MSc class on Digital Strategy and Policy.

The workshop was convened by the Ivey Chair in Telecommunications Economics, Policy and Regulation, *Erik Bohlin*, and the Director of Lawrence National Centre for Policy and Management, *Romel Mostafa*, Ivey Business School at Western University.

The workshop addressed broadband policy in Canada and around the world. International experts pursued the design of a successful broadband policy with several questions in mind:

-What are the workable policy alternatives for government?
-How should everybody be included?
-How should companies invest and innovate?
-How should a competitive marketplace be built?
-How should the increased government funding for broadband be used?
-What will AI and metaverse mean for broadband policy?

The immediate background to this workshop was that Canadian broadband policy is being revised. The Canadian Radio-television and Telecommunications Commission (CRTC) opened a Notice of Hearing on the Wholesale High-speed Access Service Framework in March 2023, including a significant reconsideration of regulatory tools for wholesale broadband. Furthermore, the CRTC started a Broadband Fund Policy Review also in March 2023 that seek to address the future objectives of broadband funding, moving beyond access toward affordability. These initiatives were expected to have long-term impacts on the functioning of the Canadian broadband markets, access, and the state of competition.

These were just examples of questions that were discussed at workshop. International experts were invited to present research and perspectives on from other countries and regions, together with on-going developments in Canada by government officials. Complete presentations are available on https://www.ivey.uwo.ca/news/events/2023/10/comparative-perspectives-on-broadband-regulation-and-access/ together with the agenda of the day.

In the introduction, Professor *Erik Bohlin* emphasized that this was the first workshop organized under the auspices of Ivey's initiative on telecommunications policy. There are not many Chairs around on this topic, in the world, and this represents a unique opportunity for Ivey. This scientific field is growing, just exemplified by the sheer growth of papers submitted to main journal in the field, Telecommunications Policy. The scientific publications on telecommunications policy in Canada are however limited, with a traditional focus on the US, EU, Asia with more recent papers

on Africa. However, the practical field of Canadian telecommunications policy is a very active policy domain and with both policy, public and media debated and coverage. Against this backdrop, it seemed fitting to initiate a workshop with an international network of colleagues to bring in comparative perspectives on broadband policy, both access and digital divide, as this has been a long-standing topic elsewhere.

Vice Chairperson *Adam Scott* of the Canadian Radio-television and Telecommunications Commission (CRTC) started the program with a speech that provided an overview of telecommunications policy decision-making in Canada. The image of a landscape was used, including both mountains, rivers, ground, and buildings. While ISED and the Cabinet enjoyed the top floor and could see the full telecom and digital landscape, CRTC had also an reasonable overview, corresponding to its more limited role and responsibilities. The big firms have managed to cross and climb many mountains and barriers to secure a workable telecom landscape while smaller carriers and service-based operators were in a lower position, struggling to find a view and space. Many mountains still remained be chartered – not all in Canada enjoy access to broadband, and much needs to be done to make broadband affordable to all. To that end, CRTC is actively pursuing ways forward to reach the goals of universal access and lowering rates.

Professor Emeritus *Gérard Pogorel* at Télécom Paris, provided an overview of the evolution of the EU approach to broadband access and wholesale regulation. On the one hand, he emphasized that the 2010 Next Generation Access regulation allowed for a delegated approach to Member States, with the effect that countries such as Portugal, Spain and France refrained from extensive openness requirements while countries such as Germany took another route. Outside the industry, the recent so-called Gigabit Recommendation identifies that civil works and construction regulation as a major impediment to reaching the EU broadband goals. Moreover, the various forms of government funding through different regional and sectoral public funding is increasingly important. This additional funding is critical in the EU since a notable investment shortage has been identified, driven by the much lower pricing compared with North America. The mixture of private, government, competitive and collaborative models suggested the main title of Prof. Pogorel's presentation: "From Competitive Dynamics to Hybrid Post-modern Markets."

Dr. *Annegret Groebel*, Director of International Relations/Postal Regulation at the German Regulatory Authority for Electricity, Gas, Telecommunications, Post and Railway (BNetzA) gave an engaging overview of EU regulation in telecommunications, with focus on recent milestones, including the new so-called European Electronic Communications Code. She emphasized the important evolution towards adding connectivity as the central goal for the EU regulation, in concert earlier the earlier primary goal of competition. The Dr. Groebel guided the audience skillfully through the complex interaction between several directives and laws, with a short overview of the evolution of how dominance in terms of Significant Market Power (SMP) has been treated, now with less and less obligations. Moreover, Dr. Groebel provided an overview of the proposed Gigabit Recommendation and some concerns raised in the consultation process. Dr. Groebel provided also an overview of the discussion on how to administer and allow for co-investment, as both foreseen in the NGA Regulation and the latest Code. The governance structure in the EU and the roles of National Regulatory Authorities (NRA) were clarified, showing the delegations and also the role of the pan-Body of European Regulators for Electronic

Communications (BEREC). Finally, some remarks were made on spectrum management, a court case between BNeztA and Google and the EU approach toward margin squeeze problems.

Dr. *Sarah Oh Lam* of the Technology Policy Institute (TPI), followed up with some concrete tips and advice on how to use the U.S. broadband maps that her institute had developed. Dr. Oh Lam elaborated on the manifold data sources to gather this comprehensive tool for broadband planning and investment evaluation and provided pedagogical examples of how to use the map by regulators, communities and industry for detailed analysis and planning. There are many precise questions that can be answered through this extensive and detailed database, informing actors on various development stages of broadband, even on a very granular level. To that end, TPI has developed a Broadband Connectivity Index and also a manual for using the database. In addition, analytical publications such as TPI State of Broadband Report and the TPI Broadband Policy Guidebook have been launched. Developing such a tool and analysis for Canada should be useful for several stakeholders.

Professor *Carlo Cambini* at Politecnico di Torino provided an overview of EU's initiatives on geographical remedies and co-investment. The new Code and the more recent Gigabit Recommendation are in congruence on how to devise specific conditions for different geographic markets. The process involves the choice of defining sub-national markets, followed by a separate analysis and assessment of market power for each of these markets, or alternatively defining one national market, assessing market power within this market, and then differentiating remedies to take into account geographic differences. Where separate geographic markets have been identified, NRAs should ensure that regulation is withdrawn in geographic markets that are found to be effectively competitive in the absence of regulation, leading to pricing flexibility. However, NRAs should apply geographically segmented remedies if competition is absent or limited, including wholesale regulation. In addition, Prof. Cambini elaborated on several possible arrangement of co-investment with different trade-offs for the players, and presented evidence that suggested that co-investment was beneficial for broadband take-up in the EU. Finally, the recent initiative on copper switch-off was described.

Professor *Eli Noam* at Columbia Business School entitled the presentation as "Into the Next Generation of Wholesale Access: Metaverse, Streaming Video and AI." Prof. Noam started with elaboration of the state of the network neutrality discussion in the United States, and the likelihood that the Federal Communications Commission would reconsider earlier decision to repeal network neutrality. Regardless of this possibility, Prof. Noam expected that tables soon will be turned, so that the earlier protagonists of network neutrality would face the same demands – i.e. that so-called Big Tech will meet demands of open access. Specifically, there will be increasing demand for open access to so-called application programming interfaces (API). This demand goes back to the concern of essential facilities which has been a cornerstone of telecom regulation, and is expected to encompass not only Big Tech, but also firms active in artificial intelligence (AI). As regulation and courts increasingly expand the notion of essential facilities to require open access on firms active in platforms and AI, there are several multiple scenarios possible involving user control and restructuring. But before that, we will see new debates and arguments unfolding!

Professor Emerita *Heather Hudson* at University of San Francisco, and Affiliate Professor and Former Director, Institute of Social and Economic Research, University of Alaska Anchorage, asked

whether competition can reduce the digital divide? To that end, she focused on the challenges in the far north and rural areas of Canada. On the one hand, there is a great need for these inhabitants to partake of all the potential benefits for the digital society, including access to expert health care and high-quality education which may be reachable by virtual access. However, the difficulties in providing high quality broadband access to these regions are well-documented, as they are very remote, have low population density and have unfavorable climate. There are opportunities to collaborate between the large telecom operators and small community-based local companies who know the terrain and consumer demand well. These community-based initiatives have limited capital but local knowledge which will complement with the bigger players. If growth takes off in these areas, the incentives of the bigger players may however be less, and therefore government has role to provide positive incentives both for large and small players. Innovative solutions in satellite provide additional ways forward, and local solutions for renewable energy also reduces investment obligations. Regulation and government still have a potential to improve broadband access for these regions.

Professor Glenn Woroch at University of California at Berkeley, and a former FCC chief economist, focused on the middle-mile network as one area to facilitate increased retail broadband availability. He observed how under-investment in middle-mile facilities can strand entire regions, leaving residents with inadequate access to the internet. Middle-mile deployment not only adds capacity and resilience to the internet backbone but can also encourage providers to enter last-mile markets, expanding consumer options and driving down prices. These investments hold the promise of preventing and eliminating "digital discrimination" by ensuring affordable, equitable access to the internet. Such investment, however, is often lacking for low-density populations throughout rural and remote areas of the U.S. and Canada. Recognizing the benefits of middle-mile deployment, state and federal lawmakers have appropriated funds to subsidize these investments. Middle-mile programs complement other subsidies such as those targeting construction of last-mile networks and also demand-side subsidies for low-income households and other "covered populations." California's Middle Mile Broadband Initiative (MMBI), one of the largest middle-mile programs in the country, designed and built a state-owned middle-mile network to capture these benefits. A $6 billion program, the MMBI adopted an open access model with technology-neutral facilities acquired under a mix of strategies (lease, purchase, joint build and construction). Pricing of wholesale transport, often governed by commercial negotiation, determines investment incentives of both middle-mile and last-mile networks, and hence their ability to deliver fast, affordable broadband coverage. Regulation of open-access middle-mile networks can have ambiguous implications for broadband coverage, and hence its ability to close the digital divide.

Director General for Telecommunications and Internet Policy *Andre Arbour* at Innovation, Science, Economic Development Canada (ISED provided an overview of the state of Canadian telecommunications in international perspective. There are several important features that condition policy and regulation options in Canada. Mr. Arbour identifies five important market features and three policy options. On the market features, first, that Canada has an extensive cable network which has enabled infrastructure competition between cable providers and traditional telecom providers. Second, the Canadian telecom market is heavily regionalized, with essentially seven medium to large fixed line telephone and cable operators and then many smaller operators in more rural areas. Third, there are some real issues with market power since there are at most

two fixed-line broadband infrastructures in each market and limited or no interest to overbuild others. The fourth feature o is limited competition from large foreign players, owing from historical legislative barriers to foreign investment, and limited adjustments with the Telecommunications Act in 2012. Fifth, the vast geography of Canada puts the country in a rather unique position in the world. As for the policy options, while not exhaustive, there is first the possibility of structural or functional separation which has been implemented in several countries, but requires a national approach which is difficult with a regionalized Canadian telecom structure. Secondly, abandoning the wholesale open access regime has been suggested by several industry players, but the government has found it necessary to continue with open access to combat a stagnant equilibrium. Thirdly, community networks and government broadband funding has seemed an opportunity by some observers to provide additional competition but again difficult to really challenge the larger regional players. Finally, the instrument of reverse auctions has been considered as another way to generate local competition, where the winning firm promises to build networks for the lowest government subsidy. As a general conclusion, the Canadian government considerations have centered on the ramifications of market power.

An engaged discussion with the audience as moderated by Director *Romel Mostafa* followed with a number of questions and remarks.

The panel was introduced by *Georg Serentschy*, Managing Partner, Serentschy Advisory Services Gmbh, with the following concerns: For more than two decades, European telecommunications and broadband policy was guided by the belief that resale and mandated wholesale were some kind of silver bullet for achieving ubiquitous connectivity across Europe. Moreover, the so-called "ladder of investment", a concept invented by Prof. Martin Cave (2006), fueled the belief that resellers would gradually climb from the bottom rungs of this "ladder" and become infrastructure operators. This idea failed widely, as reselling at regulated prices proved to be very profitable and almost none of these resellers moved up. This even led to resellers asking regulators to maintain these terms forever, because otherwise their business model would fall apart. This, of course, is a complete misconception of what regulation should do, which is not to protect particular business models or individual operators, but to protect consumers from the harmful effects of monopolies. And sector specific regulation was always intended to be a transitory measure from monopoly to competition. This policy was successful in achieving low retail prices, but it was not sustainable because telecommunications companies were not able to cover the cost of capital. This led to a huge investment gap as investors walked away from the telecommunications sector in Europe. Now, after more than two decades, the European Commission makes a U-turn and admitting that under current conditions "investments are at risk," which is a euphemistic way of putting it. This situation triggered two things: (1) massive State Aid schemes and (2) birth of the idea on the part of telecom companies to request – what they call "fair share" – a financial contribution from streaming platforms as an additional source of funding for network expansion. However, the initiative of the "fair share" failed to attract support in the Commission's "exploratory consultation" concluded in early October, and instead ambitious ideas on a new Digital Network Act has been floated, as a hand-over to the in-coming European Commissioners, after the Parliament elections in 2024. In addition, network resilience has been surfacing as one very important topic for how infrastructures are managed and addressed by policy makers, providing additional concern for weak infrastructure investment incentives.

Professor Emerita *Heather Hudson* at University of San Francisco followed up on her previous presentation. An immediate piece of advice was for the students listening by the webinar to check out the proceedings of CRTC as they are very informative. In addition, students should consider government jobs such as CRTC and ISED as a very interesting start to a career. Moving to reflections for the industry and policy makers, what are the incentives to facilitate broadband to the very rural areas of Canada? Importantly, there are not just capital expenditures but operating costs that are high, and really insurmountable for small, community-based carriers. Should there not be subsidies also for operating costs, not only for providers but also for users? Moving further, Prof. Hudson emphasized the vast dependency that all have on the mobiles. With the mobile phones, we access social media, virtual meetings, education, government services, health services, games and so on. So, while we are discussing broadband, the essential access is mobile phones in terms of speed, reach, pricing and availability and here government should have a better plan.

Mr. *Ian Scott*, Former Chair, Canadian Radio-Television and Telecommunications Commission (CRTC), noted that while he was just nine months out of office, and had not complete liberties to speak his mind for that reason, he was in general agreement with much of what the two former panelists have said. Starting with access, there is not enough general appreciation of the great achievements that have been made both by industry and government to secure access in rural areas. In a recent Government Auditor Report, the remaining problem of digital divide was identified together with concerns that there were still much government funding in the broadband support funding mechanisms that remained to be spent. To this, Mr. Scott emphasized on the one hand the significant progress made over the last five years, but also that these big infrastructure projects take many years to complete, let alone plan. The auditor goal of 90% for 2022 has been surpassed by several percentages, and certainly, the funds will be spent! But what about the last seven or so percentages of broadband coverage and reaching all 100% is not easy. One example of the obstacles is that while the Telecom Act gives CRTC jurisdiction over all passive infrastructure such as poles and conduit, enforcing this role by the CRTC may create tensions between provinces, territories and the federal level which can only solved politically – which is not possible by a minority government. This passive infrastructure is typically shared by several owners, with different interests and claims. Another obstacle is really knowing the territory and the actual maps of broadband construction – the presentation by Sarah Oh Lam highlighted the many efforts done in the U.S., and Canada needs to improve in this regard. Finally, Mr. Scott reminded the audience of the geographical challenges of Canada – while the distance between the far west end of British Columbia to Newfoundland is comparable to Lisbon to Moscow, another staggering statistic is that about 140.000 persons live in the northern territories, corresponding to two thirds of Canadas aggregate land mass! There is a fundamental business challenge to serve the northern territories. But Mr. Scott agrees with the concerns of the auditors on affordability. We do not have enough data to fully understand affordability. And affordability is not primarily a CRTC or ISED responsibility, but an issue for the whole government. There needs to be a comprehensive approach on affordability.

A discussion with the audience ensued, moderated by *Romel Mostafa*, but here without attribution to individual speakers. Here are some of the issues that surfaced:

- Need for a national initiative that includes concern for climate change.
- New applications on the Internet of Things for farming, forestry, fisheries that will be essential for the rural areas.

- The potential of satellites to answer the fundamental needs in rural areas.
- The importance of industry applications for 5G business models.
- The importance of developing viable applications for health care in Canada, including coordination between government, the health care sector and the industry.
- Concerns that massive state-aid can create a "crowding-out" effect, reducing competition.
- Increased need for resiliency and redundancy will require a reconsideration of policies.
- A rich discussion on satellite options concluded the session, with many pro and con addressed, such as redundancy, capacity constraints, speed, pricing, and governance

The workshop was adjourned by *Erik Bohlin*, with thanks to the speakers, to all in the audience who gave their time, the staff supporting and in particular *Romel Mostafa* who moderated the whole day with such strong presence, reach and warm ambience.

Annex: Agenda of the Day – 18 October

Comparative Perspectives on Broadband Regulation and Access

Wednesday, October 18, 2023
12:00pm – 5:30pm
Donald K. Johnson Centre, First Canadian Place / Exchange Tower
130 King Street, Toronto, Ontario

Host: Ivey Business School, Western University, Ontario

Organizer: Erik Bohlin, Ivey Chair in Telecommunication Economics, Regulation and Policy – with support from Lawrence National Centre for Policy and Management, Ivey Business School

Schedule

12:00 pm – 1:00 pm	**Welcome Buffet Lunch**
1:00 pm – 1:15 pm	**Welcome and Introduction** Erik Bohlin, Professor, Ivey Business School Romel Mostafa, Director, Lawrence National Centre for Policy and Management, Ivey Business School
1:15 pm – 1:30 pm	**Opening Keynote** **Broadband in Canada: Surveying the Policy Landscape** Adam Scott, Vice Chair, Canadian Radio-Television and Telecommunications Commission (CRTC)
1:30 pm – 1:45 pm	**Three Decades of Broadband Access Regulation: From Competitive Dynamics to Post-modern Hybrid Markets** Gérard Pogorel, Professor Emeritus, Télécom Paris, France
1:45 pm – 2:00 pm	**How Have EU Regulators Changed Approach to Broadband Wholesale Regulation?** Annegret Groebel, Director International Relations, BNetzA, Germany *Presenting virtually
2:00 pm – 2:15 pm	**What to Expect from $100 Billion in U.S. Broadband Deployment and New Maps?** Sarah Oh Lam, Senior Fellow, Technology Policy Institute, United States *Presenting virtually

2:15 pm – 2:30 pm	**EU Broadband Regulation and Economics: Geographical Remedies and Co-investment** Carlo Cambini, Professor, Politecnico di Torino, Italy
2:30 pm – 3:00 pm	**Coffee Break**
3:00 pm – 3:15 pm	**Into the Next Generation of Wholesale Access: Metaverse, Streaming Video and AI** Eli Noam, Professor, Columbia University, United States *Presenting virtually*
3:15 pm – 3:30 pm	**How Can Competition Reduce the Digital Divide?** Heather Hudson, Professor Emerita, University of San Francisco, Affiliate Professor and Former Director, Institute of Social and Economic Research, University of Alaska Anchorage, United States
3:30 pm – 3:45 pm	**Can Wholesale Broadband Regulation Prevent and Eliminate Digital Discrimination?** Glenn Woroch, Adjunct Professor, University of California at Berkeley, United States *Presenting virtually*
3:45 pm – 4:00 pm	**Market Structure and Considerations on Cross-Country Policy Analysis** Andre Arbour, Director General, Telecommunications and Internet Policy, Innovation, Science, Economic Development Canada (ISED)
4:00 pm – 4:50 pm	**Panel Discussion** Moderated by Romel Mostafa, Director, Lawrence National Centre for Policy and Management, Ivey Business School Georg Serentschy, Serentschy Advisory Services, Austria Heather Hudson, Professor Emerita, University of San Francisco, United States Ian Scott, Former Chair, Canadian Radio-Television and Telecommunications Commission (CRTC)
4:50 pm	**Final Remarks and Reflections** Erik Bohlin, Professor, Ivey Business School
5:00 pm – 6:00 pm	**Networking Reception with Cocktails and Hors d'oeuvres**

Speakers

Andre Arbour is the Director General of Telecommunications and Internet Policy at Innovation, Science and Economic Development Canada. He is responsible for leading policy development on various telecommunications matters including Internet and mobile wireless competition, rural and remote access, international Internet governance and in relation to the Telecommunications Act. Prior to his current role he occupied a series positions working in telecommunications and public policy. Past initiatives including leading development of Canada's first national Connectivity Strategy, leading policy for $4 billion in connectivity program funding, and policy development on various issues related to net neutrality and consumer protection.

Erik Bohlin (Professor and Ivey Chair in Telecommunication Economics, Policy and Regulation, BEPP) is an expert in telecommunications policy, an inter-disciplinary topic concerned with the impact of digitalization in the economy and society. He is Editor-in-Chief of *Telecommunications Policy*, a premier journal in the field. He is on leave as Professor at Chalmers University of Technology, Sweden. His graduate degree is in Business Administration and Economics at the Stockholm School of Economics (1987) and his Ph.D. is from Chalmers University of Technology (1995). He is a Member of the Swedish Royal Academy of Engineering, and Past Chair of the International Telecommunications Society, an inter-disciplinary professional society convening conferences on the evolving digital society and policy needs.

Carlo Cambini is Full Professor of Industrial Organization at the Politecnico di Torino. He has an extensive background in research focusing on industrial economics, regulatory economics and competition policy with a strong background in telecommunications, energy markets and transportation. He won the award as best Young Economist at the International meeting of the European Association of Researcher in Industrial Economics – EARIE (Lausanne, 2000). His work has been published in leading scientific journals such as the *RAND Journal of Economics*, *Journal of Industrial Economics*, *Journal of Economics & Management Strategy*, *International Journal of Industrial Organization*, *Industrial and Corporate Change*. He has been invited as *Keynote Speaker* on regulation and competition issues in telecom markets in conferences organized by the Australian Competition and Consumer Commission (Brisbane, 2012), the New Zealand Commerce Commission (Wellington, 2013) and the Independent Regulators Group - IRG (Frauenfeld, 2014), i.e. the Association of European National Regulators in the Telecom markets. He also provides speeches and seminars in several Telecom National Regulator Authorities such as ACM (Netherlands), ComReg (Ireland), CNMC (Spain), Anacom (Portugal) and at the European Commission (DG COM). Last but not least, he was appointed as *Chief Economist* at the Italian Transport Authority until April 2021, and then he acted as economic expert at the Italian Office of the Prime Minister for the period May 2021 – October 2022.

Dr. **Annegret Groebel** is a Director of International Relations/Postal Regulation at the German Regulatory Authority for Electricity, Gas, Telecommunications, Post and Railway (BNetzA). Dr Groebel has worked for BNetzA since 1998. She has been CEER President since January 2019 and was a Vice-President of CEER as of 2012. She was appointed Vice-Chair of the International Confederation of Energy Regulators (ICER) in June 2020. She has also chaired the CEER Market Integrity and Transparency (MIT) Working Group since 2013. She is a member of the Board of Regulators of the Agency for the Cooperation of Energy Regulators (ACER). She has excellent knowledge of the European regulatory framework for electronic communications as well as the regulatory framework for the internal energy market and is actively involved in the work of the Body of European Regulators for Electronic Communications (BEREC). Since 2020 she has been Chair of the BEREC Office Advisory Group (BAG) and has been Co-Chair of the Remedies WG for many years. She is actively involved in the work of the European Regulators Group for Postal Services (ERGP) and IRG Rail. She is also a member of the OECD's Network of Economic Regulators (NER) and its Bureau, a working group of the OECD looking at cross-sectoral governance issues of economic regulators. She has experience in advising public authorities on regulatory reform and sector specific regulation in numerous projects. Apart from her professional duties, she has also been lecturing for a considerable time on various subjects in the fields of economics, finance, social policy, trade policy and European Integration, as well as on the regulatory framework in the German and European telecommunications and energy markets at a variety of universities and vocational training academies in Germany, the FSR in Italy, and Switzerland. Dr Groebel is the author of various publications in the field of telecommunications and energy regulation. Dr. Groebel has a doctoral degree in Economics from the University of Mannheim, a M.A. (Master of European Administrative Management) from FH Bund (Bruehl) and a Diploma in Economics from the University of Heidelberg.

Heather Hudson is Professor Emerita at the University of San Francisco, and Affiliate Professor and former Director at the Institute of Social and Economic Research, University of Alaska Anchorage. Her research focuses on applications of communication technologies for socio-economic development, regulatory issues, and policies and strategies to extend affordable access to telecommunications including broadband in rural and Indigenous regions. She has planned and evaluated communication projects in the Canadian North and Alaska and in more than 50 developing countries and emerging economies in Africa, Asia, the Caribbean and the South Pacific. She has consulted for many international organizations, for consumer and Indigenous organizations and for government agencies, and has testified at regulator proceedings in the U.S. and Canada. She is a Board member of the Pacific Telecommunications Council (PTC), the Global Telecommunications Women's Network (GTWN), and *Telecommunications Policy*. Professor Hudson is the author of numerous articles and several books.

Sarah Oh Lam is a Senior Fellow at the Technology Policy Institute. Sarah was previously the Operations and Research Director for the Information Economy Project at George Mason School of Law. She has also presented research at the Telecommunications Policy Research Conference and has co-authored work published in the Northwestern Journal of Technology & Intellectual Property among other research projects. Her research interests include law and economics, regulatory analysis, and technology policy. Sarah completed her PhD in Economics from George Mason University, and holds a JD from GMU and a BS in Management Science and Engineering from Stanford University

Romel Mostafa is an Assistant Professor of Business, Economics and Public Policy at the Ivey Business School. Romel's areas of research and expertise include strategy & capability development in new firms, innovation & competitive dynamics, industrial evolution & policy, as well as behavioural decision-making. He has published in a number of leading academic journals, including Academy of Management Journal, Journal of Behavioral Decision Making, Journal of Risk & Uncertainty, Organization Science and Management Science. His research and commentaries have been featured in global media outlets such as CNN, NPR and the New York Times. Romel has taught both at graduate and undergraduate levels, and received several teaching awards. He obtained his PhD and MSc from Carnegie Mellon University, and BA from Lawrence University. As the Director of Ivey's Lawrence National Centre for Policy and Management, Romel spearheads the Centre's research, outreach and teaching initiatives. The Centre advocates for sound policy and corporate action towards unlocking national competitive advantage, by focusing on critical challenges and opportunities around digital, trade and social infrastructural pillars.

Eli Noam has served as Professor of Economics and Finance at the Columbia Business School and its Garrett Professor of Public Policy and Business and is Director of the Columbia Institute for Tele-Information, a research center focusing on management and policy issues in telecommunications, internet, and electronic mass media. Served for three years as a Commissioner for Public Services of New York State. Appointed by the White House to the President's IT Advisory Committee. He has also taught at Columbia Law School, Princeton University's Economics Department and Woodrow Wilson School, and the Swiss universities of St. Gallen and Fribourg, and is active in the development of electronic distance education. Noam published 37 books and over 350 articles in economics journals, law reviews, and interdisciplinary journals, and was a regular columnist for the *Financial Times* online edition.

Gérard Pogorel is Professor emeritus of Economics, Institut Polytechnique de Paris-Telecom Paris Graduate School of Engineering, CNRS Interdisciplinary Institute for Innovation. He is an independent expert in international telecommunications, media and the digital economy. He published recently widely circulated and influential position books and papers: *Decoding EU Digital Strategy Autonomy (Co-Editor), EU Strategic Autonomy, industry implications in the changing world trade order (European Liberal Forum), 5G for Industry 4.0: Actors, Challenges, and a New Start for Europe, Convergence in Media and Telecom in the face of COVID-19* (Report to the Robert Schuman Foundation, co-authored with Augusto Preta), *The new post-COVID-19 International Trade Order, Spectrum 5.0 Re-thinking Spectrum Awards for Optimal 5G Deployment,* and a reference book *The Radio Spectrum: Managing a Strategic Resource.* He co-founded the European Spectrum Management Conferences, acted as its Chair/Rapporteur, and is a frequent speaker in international conferences. He is an expert with the European Commission, and was Chair of the European Union Framework Research & Technology Development Programme Monitoring Panel, and Chair of the Monitoring Committee of the EU Information Society and Technologies Research Programme. He co-authored a report to the Prime Minister of Italy assessing the investments by operators in Broadband networks in the European Digital Agenda perspective. He participates in numerous international Government-level and regulation Authorities Committees and Scientific Committees on telecom and media policy and regulation in Europe and Asia. He is a Senior Fellow with the European Liberal Forum (European Parliament) and Officier des Palmes académiques.

Adam Scott is currently the Vice-Chair of Telecommunications at the Canadian Radio-television and Telecommunications Commission. With over 20 years of telecommunications policy and regulatory experience, Adam has managed complex files with technological, economic, social and legal dimensions, including Canada's 5G spectrum auctions. He has 12 years of experience at the executive level and brings a wealth of legislative, policy, regulatory, and program expertise to the telecommunications space. During his time at Innovation, Science and Economic Development Canada, he was responsible for developing strategies on how to optimise social and economic benefits of wireless spectrum in Canada. For many years, he developed government programs to improve broadband access in rural and remote parts of Canada, and developed a vision and strategy for improving Canada's communications infrastructure, addressing rural gaps, affordability issues, competition, innovation and investment. Adam brings significant experience to the table in consulting and cooperating with industry, civil society, other levels of government, departments and agencies.

Ian Scott is former Chairperson and Chief Executive Officer at the Canadian Radio-television and Telecommunications Commission. His term ended in January 2023. Mr. Scott has over 25 years of policy and regulatory experience in broadcasting and telecommunications both in the public and private sectors. After working at the Competition Bureau, he joined the CRTC from 1990 to 1994, where he collaborated on the development of a framework for long-distance telephone service competition in Canada. Between 2007 and 2008, as part of the Executive Interchange Program, he was Senior Policy Advisor to the Chairman at the CRTC. Before rejoining the CRTC in 2017, Mr. Scott held various executive positions in the communications industry, including at Telesat Canada, Telus and Call-Net Enterprises, one of the first companies to offer competition in the Canadian long-distance market. He also provided leadership on broadcasting policy and regulatory issues as an executive at the Canadian Cable Television Association. Mr. Scott has served on various boards, including Women in Communications and Technology and Ski Quebec Alpin. Mr. Scott has a Bachelor of Arts in Political Science, McGill University.

Georg Serentschy advises C-level and top experts in the digital sector (platforms, telecommunications, media, and technology) on strategy, regulation & competition, spectrum policies, cybersecurity policies and innovation. A prime focus of his advisory work is the strategic positioning of companies in a specific regulatory environment. Experience shows that regulation is the most critical lever for driving commercial performance, investment and innovation in the digital sector. Georg's professional career spans more than 40 years. It began in nuclear physics, after which he turned to industrial research and development in various high-tech industrial areas such as software development, solar energy, aerospace, and telecommunications. After his career in industry, he joined Arthur D. Little, a strategy consulting firm. Then, for over a decade, he headed up the Regulatory Authority for Telecommunications in Austria (RTR-GmbH). The highlight of Georg's regulatory career was chairing and vice-chairing BEREC (Body of European Regulators for Electronic Communications). In 2014, he founded his consulting boutique, focused on advising C-suite and top digital sector experts on strategy, artificial intelligence, regulation & competition, spectrum policy, cybersecurity policy and innovation. In parallel, he continues to work with leading consultancies on a project basis.

Glenn Woroch is Adjunct Professor Emeritus of Economics, University of California, Berkeley where he taught microeconomics, industrial organization and econometrics for nearly 25 years. During 2020-2021, Dr. Woroch served as the Chief Economist of the Federal Communications Commission. For many years he was the Executive Director of the Center for Research on Telecommunications Policy, a research unit located in Berkeley's Haas School of Business. Previously, Dr. Woroch taught economics at the University of Rochester and Stanford University, and was a senior member of technical staff at GTE (Verizon) Laboratories. He holds a Ph.D. in economics and an M.A. in statistics from Berkeley and a B.A. from the University of Wisconsin, Madison.