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In the matter of Telecom Notice of Consultation CRTC 2017-259
Call for comments – Reconsideration of Telecom Decision 2017-56 regarding final terms and conditions for wholesale mobile wireless roaming service

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An assessment of wholesale roaming policy in Canada

The interaction of competition, regulation, access, and investment

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I. Scope of charge

(1) I have been asked by Shaw Communications Inc. ("Shaw") to analyse the potential impact of changes in mobile wireless wholesale access regulation in Canada along the lines suggested in a recent directive from the Governor in Council.[1] This paper considers the potential impact of those changes on investment, competition, and ultimately prices and innovation. It is informed by economic theory, the available empirical evidence, and my training and experience as an economist focused on competition issues. My curriculum vitae is included as Appendix B.

[1] Privy Council Office, Order in Council regarding Telecom Decision CRTC 2017-56, PC Number 2017-0557, June 1, 2017, *available at* http://www.pco-bcp.gc.ca/oic-ddc.asp?lang=eng&viewattach=34464.

II. Executive summary

(2) The Canadian Radio-television and Telecommunications Commission ("CRTC") has requested comments on its reconsideration of Telecom Decision 2017-56, regarding final terms and conditions for wholesale mobile wireless roaming service tariffs.[2] In this reconsideration, it has been directed to consider whether broadening the definition of "home network" to include other forms of connectivity such as Wi-Fi would have positive impacts on affordability that outweigh potential negative impacts on investment in wireless infrastructure.[3]

(3) Current wholesale access policy in Canada, as defined in Telecom Regulatory Policy CRTC 2015-177 and clarified in Telecom Decision CRTC 2017-56, attempts to remedy insufficient competition in wireless markets in Canada by mandating wholesale access by national incumbent carriers to other facilities-based carriers. This policy addresses an important barrier to competition among facilities-based carriers: the ability of new entrants and regional carriers to offer national voice and data access via wholesale agreements with the national incumbents. This policy promotes network investment and build-out by the regional carriers and thereby helps remedy the underlying competition problem identified by the CRTC.[4]

(4) Many jurisdictions worldwide supervise or regulate wholesale access to large facilities-based carriers for similar reasons.[5] There is a good empirical and theoretical justification for such a policy in Canada. Empirically, the fact that provinces in Canada with a robust regional competitor in addition to the three national competitors see much lower retail prices demonstrates the value of additional wireless competition. Theoretically, when faced with problems stemming from a lack of competition, regulation that promotes competition and thereby harnesses market forces rather than supersedes them is generally recognized as a better way of resolving problems caused by market power than more comprehensive government intervention.[6]

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2 CRTC, "Telecom Notice of Consultation CRTC 2017-259," July 20, 2017, *available at* http://www.crtc.gc.ca/eng/archive/2017/2017-259.htm.

3 *Id*, ¶ 3.

4 CRTC, "Telecom Regulatory Policy CRTC 2015-177," May 5, 2015, *available at* http://www.crtc.gc.ca/eng/archive/2015/2015-177.htm, ¶ 123. ("The Commission's determinations with respect to the regulation of rates, terms, and conditions for wholesale roaming . . . will allow smaller wireless carriers such as the new entrants to expand their wireless networks, thus becoming a viable alternative source of supply for MVNOs.") It was on this basis that the Commission determined "it is not appropriate to mandate wholesale MVNO access." (*Id*., ¶ 125). The CRTC defines an "MVNO" as "a wireless service provider that does not own spectrum or operate its own radio access network (RAN); instead, it relies on the spectrum and RAN of a wireless carrier and, in some cases, other facilities and/or services, to provide mobile wireless services to consumers." (*Id*., note 16). I use the term "reseller" throughout to distinguish entities that provide mobile wireless services through resale of access to a facilities-based carrier, from the facilities-based carriers themselves. While MVNOs are resellers, I wish to avoid discussion of the different precise definitions of MVNO that would not aid or alter my analysis.

5 *See, e.g.*, the US and UK regulatory regimes, discussed in Section VII below.

6 Indeed, this was recognized in the *Telecommunications Act*, (S.C. 1993, c. 38), which has as one of its objectives: "to foster increased reliance on market forces for the provision of telecommunications services and to ensure that regulation,

(5) A key restriction in the current wholesale access regime in Canada is that mandated roaming access must only be "incidental," meaning that carriers cannot sell a plan to a customer that would rely primarily on mandated roaming for mobile wireless access. The practical implication of this is that resale-based models of wireless service, as opposed to facilities-based models, are not guaranteed wholesale access at a regulated rate. This is an important component of a regulated wholesale access regime that is designed to promote facilities investment. Otherwise, such a regime risks undermining the incentives particularly of smaller facilities-based carriers to invest in and build-out wireless infrastructure, since they face high risk and uncertainty in this investment, and the investment would not give them the opportunity to win new customers without the "home network" restriction. The CRTC reiterated this risk in Decision 2017-56.[7]

(6) The recent directive from the Governor in Council suggests that the CRTC revisit its decision regarding certain types of reseller access to regulated wholesale rates, and in particular whether to allow some version of mandated wholesale access to Wi-Fi-based models.

(7) To the extent that a change in roaming policy gives reseller models a status similar to facilities-based carriers, it acts as a substitute for investment and build-out rather than a complement. It diminishes the incentives of facilities-based carriers to improve and expand their networks, since a lower risk and quicker way to offer service to customers nationwide would be to roam on existing networks and use existing infrastructure. To the extent that long run returns are diminished as a result of resellers' entry, internal resources available to undertake costly investment will also be reduced.

(8) Targeting particular reseller models with their own access regimes, while perhaps being less damaging to wireless investment than a broad roll-back of reseller restrictions, introduces additional definitional issues that are hard to navigate in an industry based on technological advancement; it also risks pushing the industry toward particular reseller models favoured by government regulation rather than underlying market forces.

(9) To the extent that reseller models offer novel marketing or technological approaches, they naturally will be incorporated into the market if there is sufficient facilities-based competition. Economic theory shows that increased network competition generally increases incentives for voluntary network interconnection and roaming. As competition among facilities-based carriers increases, as regional facilities-based carriers become more viable partners for resellers, and to the extent that resellers bring unique assets to the market, the incentives and ability of facilities-based carriers to make voluntary deals with resellers for interconnection will increase. Thus, to the extent that lack of reseller

where required, is efficient and effective" (§ 7(f)).

7 CRTC, "Telecom Decision CRTC 2017-56," Mar. 1, 2017, *available at* http://www.crtc.gc.ca/eng/archive/2017/2017-56.htm, 1.

presence is a problem, a wholesale access regime like the current one that promotes facilities-based competition will naturally lead to increased reseller access to the market.

(10) Historical experience in the United States and the United Kingdom, where numerous reseller models have been implemented through voluntary partnerships with the smaller facilities-based networks in particular, demonstrates the proposition that increased network competition and disruption from smaller facilities-based carriers increases wholesale access for resellers.

III. Canadian wireless industry and regulatory framework

(11) To understand the impact of a change to the current wholesale access regime, it is important to understand the current state of wireless competition and regulation in Canada.

III.A. Wireless competition in Canada

III.A.1. The national incumbents

(12) There were approximately 30 million wireless service subscribers in Canada in 2015, the most recent year for which data are available.[8] Eighty-two percent of mobile wireless revenues derived from customers with voice and data plans, 15% from those with voice-only plans, and 3% with data-only plans.[9]

(13) Three national incumbents together hold about 90% of the market: Bell Mobility Inc. ("Bell"), Rogers Communication Canada Inc. ("Rogers"), and TELUS Communications Company ("TELUS"). As of 2015, Rogers held a 33% share, TELUS held a 29% share, and Bell held a 28% share. Regional providers, and a small number of independent resellers, divide the remaining 10%.[10]

(14) Each national incumbent owns "flanker brands" that increase its capacity utilization and are designed to generate revenue from new market segments and thereby limit cannibalization of existing subscriber bases. These flanker brands include Bell's Virgin, Rogers's Fido and Chatr, and TELUS's Koodo. Prices for an incumbent's flanker brands are typically lower than those for its primary brands.[11]

III.A.2. Other facilities-based competitors

(15) A number of regional competitors and recent entrants compete with the national incumbents. As discussed in more detail in Section III.A.6, areas with large regional facilities-based carriers that compete with the national incumbents appear to have significantly lower retail wireless prices. The most significant regional competitors to the national incumbents are the following:

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8 CRTC, *Communications Monitoring Report 2016*, *available at* http://www.crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2016/cmr.htm [hereinafter CRTC, *Communications Monitoring Report 2016*], 284.

9 *Id*., 293.

10 *Id*., 286.

11 Wall Communications, "Price Comparisons of Wireline, Wireless and Internet Services in Canada and with Foreign Jurisdictions," prepared for the CRTC and Industry Canada, 2015, 22.

- **Freedom Mobile (Shaw):** Freedom Mobile (formerly Wind Mobile) has over 1,100,000 subscribers on its wireless network as of May 31, 2017.[12] Freedom is owned by Shaw Communications, which also provides landline telephone, Internet, and television services through its hybrid fibre-coax network in Western Canada and Northern Ontario. Shaw owns wireless spectrum in British Columbia, Alberta, and Ontario and has deployed network and active services in Edmonton, Calgary, Vancouver, Greater Toronto, and Ottawa.[13] Since the rollout of the mandated wholesale access rules in 2015, Freedom/Wind has seen gains in market share.[14] Shaw has recently launched the Long-Term Evolution ("LTE") standard on its network and has invested in other network upgrades to make its mobile wireless network more robust.[15] Shaw is still in the process of building out its network in many communities covered by its licenced spectrum.
- **Videotron:** Videotron is a cable, Internet, and telecommunications company that owns and operates a wireless network mostly in Quebec.[16] As of 2015, Videotron had approximately 750,000 subscribers on its wireless network.[17] Videotron is the largest cable operator in Quebec and has served that market since the 1960s.
- **Eastlink:** Eastlink, a subsidiary of Bragg Communications, operates a cable, Internet, and wireless business in the Atlantic Provinces and offers a 100% LTE network.[18]
- **SaskTel:** The incumbent telephone company in Saskatchewan, SaskTel provides wireline and mobile wireless services throughout Saskatchewan and has a 66% wireless market share in that province.[19]
- **TBayTel:** Formerly Thunder Bay Telephone Company, TBayTel supplies wireline and mobile wireless services in Thunder Bay, Ontario.
- **Xplornet:** Xplornet offers rural broadband Internet services through a combination of satellite and fixed wireless networks, and recently purchased six retail stores, 24,700 wireless subscribers,

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12 Shaw Communications, "Shaw Announces Third Quarter and Year-to-Date Results," news release, June 28, 2017, 10, *available at* http://assets.aws.newsroom.shaw.ca/uploadedfiles/newsroom/content/news_articles/2017/2017-06-28-shaw-announces-third-quarter-and-year-to-date-results-89werheui347f.pdf.

13 Email from Brian Monaco, Manager, Regulatory Counsel, Shaw Communications to Bates White (Aug. 22, 2017) (written response to Bates White request for information).

14 *Id*.

15 Shaw Communications, "Freedom Mobile Expands New LTE Network to Calgary and Edmonton," news release, May 17, 2017, *available at* http://newsroom.shaw.ca/materialDetail.aspx?MaterialID=6442451980. LTE, also sometimes known as 4G, is a wireless telecommunications standard capable of much faster data transfer than its predecessors. For example, LTE technologies can provide data transfer that is as much as 10 times faster than 3G.

16 The Videotron network also serves parts of New Brunswick and Ontario.

17 Videotron, "Our Company: Facts and Numbers," accessed Sep. 2, 2017, http://corpo.videotron.com/site/our-company/videotron-news/facts-numbers.jsp.

18 *See* Eastlink Wireless, "Canadian Wireless Coverage," accessed Sep. 2, 2017, http://www.eastlink.ca/wireless/networktravel/canadacoverage.aspx.

19 CRTC, *Communications Monitoring Report 2016*, 289.

and wireless spectrum in Manitoba from Bell as a part of Bell's 2017 acquisition of Manitoba Telecom Service ("MTS").[20] As part of the merger remedy, Bell will also provide various network services to Xplornet to help facilitate its entry into the wireless market in Manitoba.[21] Xplornet plans to launch wireless service in Manitoba in mid-2018.[22]

III.A.3. Facilities-based versus reseller model

(16) All the firms described above are "facilities-based carriers"—they own and operate the components of their wireless network on their "home network." Along with the national incumbents, they also offer roaming to customers making calls outside their home network. To provide a competitive mobile wireless service in Canada, a facilities-based carrier needs to make significant sunk investments, including in complex and quickly depreciating technology, and to enter into a number of commercial agreements that may be difficult to negotiate.

(17) First, a carrier needs to acquire sufficient (and appropriate) radio spectrum over which it can transmit its wireless signals. In Canada, the Minister of Innovation, Science and Economic Development ("ISED") allocates and assigns radio spectrum. Because spectrum is limited, ISED allocates only certain bands for mobile wireless services, and it issues spectrum licences for specific geographic areas.[23] Any carrier seeking to provide mobile wireless services must either obtain a spectrum licence from ISED (e.g., through auction) or purchase a licence from an existing spectrum holder after obtaining approval from ISED.

(18) In addition to obtaining spectrum, a facilities-based carrier also needs to build a network in the service area within which it has a licence. These essential network investments include building wireless towers or securing other sites for its radio antenna equipment and connecting that equipment to mobile wireless switches using fibre or fixed wireless backhaul.[24] Securing sites for radio equipment is a complex, costly, and time-consuming engineering, commercial, and public relations undertaking that can take several years for certain sites. Besides acquiring spectrum and building a network, a prospective wireless carrier would also need to purchase computer systems and construct databases to handle customer information, telephone portability issues, billing, and other back-office functions. It also would have to develop a system of retail distributors to sell its service and handsets

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20 Competition Bureau of Canada, "To Acquire MTS, Bell Must Sell Assets and Provide Services to Xplornet," news release, Feb. 15, 2017, *available at* http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04199.html.

21 *Id*.

22 Martin Cash, "Xplornet Playing Catch-Up Ahead of Bell Transition," *Winnipeg Free Press*, Aug. 18, 2017, https://www.winnipegfreepress.com/business/xplornet-playing-catch-up-ahead-of-bell-transition-441058073.html.

23 CRTC, "Telecom Notice of Consultation CRTC 2014-76," Feb 20., 2014, *available at* http://www.crtc.gc.ca/eng/archive/2014/2014-76.htm, ¶ 3.

24 *Id*.

and handle repairs. Finally, it would have to invest in advertising and other marketing activities to develop its brand.

(19) In contrast, a wireless reseller generally provides only marketing services, distribution channels, and billing services; it relies on facilities-based carriers for the rest of its business, including operation of the network.

III.A.4. Independent resellers in Canada

(20) Independent reseller carriers make up only a small part of the wireless market in Canada. Of the $22.2 billion generated from wireless retail in 2015, only 1% of subscribers and 1% of revenues came from independent resellers.[25] Three of the largest independent resellers are retail store based: Speakout Wireless is owned by 7-Eleven Stores, PC Mobile is owned by the grocery chain Loblaws, and Petro-Canada Mobility is owned by the gasoline retail chain Petro-Canada.[26] A number of other small independent resellers like DCI Wireless, Good2go Mobile Canada, and Phone Box also operate in Canada.[27]

III.A.5. "Wi-Fi first" model

(21) One particular reseller model is the "Wi-Fi first" model, whereby a firm offers calling through public Wi-Fi infrastructure along with roaming on cellular networks when Wi-Fi is not available. Sugar Mobile in Canada offered this model nationwide until March 2017, after the CRTC clarified that public Wi-Fi did not count as a "home network" for purposes of wholesale access.[28] Republic Wireless has offered this model in the United States since 2013 in voluntary partnership with Sprint and, more recently, T-Mobile.[29] Google offers a similar service in the United States in partnership with Sprint, T-Mobile, and US Cellular. Collectively, Wi-Fi first models have less than 1% market share in the United States, and "that space hasn't developed as some had hoped," according to one industry observer, due in part to intense competition and innovation among facilities-based carriers in the United States.[30]

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25 CRTC, *Communications Monitoring Report 2016*, 288.

26 *See* discussion of resellers/rebillers in CRTC, *Communications Monitoring Report 2016*, 288.

27 *See* MVNO Dynamics, "Canada MVNO, MVNA/E Complete List," accessed Sep. 2, 2017, https://www.mvnodynamics.com/mvno-companies/north-american-mvno-companies/canadian-mvno-companies/.

28 CRTC, "Telecom Decision CRTC 2017-56," Mar. 1, 2017, *available at* http://www.crtc.gc.ca/eng/archive/2017/2017-56.htm, ¶ 31.

29 Republic Wireless, "Republic Wireless: The Story So Far," Dec. 22, 2014, https://pwk.republicwireless.com/republic-wireless-the-story-so-far/; David Ranii, "Raleigh-based Republic Adds Cellular Network, New Phones," May 11, 2016, http://www.newsobserver.com/news/business/article77009072.html.

30 Mike Dano, "Editor's Corner—Whatever Happened to Google's Big MVNO, Project Fi?" *Fierce Wireless*, June 12, 2017, http://www.fiercewireless.com/wireless/whatever-happened-to-google-s-big-mvno-project-fi. One percent market share derived from 395.9 million total US subscribers in 2016 (CTIA (formerly the Cellular Telecommunications

III.A.6. Presence of strong regional facilities-based competitors leads to lower retail prices in Canada

(22) A recent Competition Bureau of Canada ("Bureau") study recently found that prices of wireless plans are significantly lower in the provinces of Saskatchewan, Manitoba, and Quebec, and in the city of Thunder Bay, where there has been a strong regional facilities-based player competing with the national incumbents.

(23) After its review of the Bell-MTS merger, which was resolved in part with a divestiture of assets to Xplornet, the Bureau wrote that it

> [C]onducted a thorough pricing analysis using confidential internal company data. The results of this analysis showed that mobile wireless pricing in Saskatchewan, Thunder Bay, Quebec and Manitoba is substantially lower than in the rest of Canada. These are all areas that have a strong regional competitor. . . . The Bureau concluded that these differences in price could not be explained by factors such as quality, differences in demand or demographics, but instead were based on the existence or nonexistence of a strong regional competitor.[31]

(24) The Bureau's study corroborates other evidence and anecdotal reports of the substantial impact that a regional competitor to the national incumbents has on wireless retail pricing in Canada. For example, a 2016 price comparison study prepared for the CRTC clearly shows that pricing for wireless mobile services in cities where the three national facilities-based competitors dominate is higher than pricing in areas with four strong facilities-based competitors.[32] These data are reproduced in Figure 1. Especially for higher levels of service, cities with four facilities-based competitors have substantially lower prices.

Industry Association), "Annual Wireless Industry Survey," May 2017, *available at* https://www.ctia.org /industry-data/ctia-annual-wireless-industry-survey), and 3 million Wi-Fi first customers noted by Dano.

[31] Competition Bureau of Canada, "Competition Bureau Statement Regarding Bell's Acquisition of MTS," news release, Feb. 15, 2017, *available at* http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04200.html.

[32] NGL Nordicity Group Ltd, "2016 Price Comparison Study of Telecommunications Services in Canada and Select Foreign Jurisdictions," prepared for the CRTC, Mar. 22, 2016, 79–84, *available at* http://www.crtc.gc.ca/eng /publications/reports/compar/compar2016.htm.

Figure 1. Mobile wireless service retail price ($) as a function of facilities-based competition, 2015

	3 facilities-based competitors			4 facilities-based competitors		
Service level	Vancouver, BC	Halifax, NS	Toronto, ON	Montreal, QC	Winnipeg, MT	Regina, SK
Level 1	38.21	37.37	37.54	37.46	32.98	32.43
Level 2	49.28	48.45	48.15	49.04	46.65	56.70
Level 3	88.32	86.76	87.36	82.96	73.54	72.56
Level 4	89.78	91.23	87.83	76.22	61.82	64.43
Level 5	117.65	122.21	117.93	94.67	65.76	65.62

Note: Level 1: 150 minutes. Level 2: 450 minutes and 300 text messages. Level 3: 1,200 minutes, 300 text messages, and 1 GB data. Level 4: Unlimited minutes and text messages, and 2 GB data. Level 5: Unlimited minutes and text messages, and 5 GB data. The CRTC's *Communications Monitoring Report 2016*, p. 289, shows that 2015 market shares for operators *other than* the 3 national carriers of 0%, 0%, and 1% for British Columbia, Nova Scotia, and Ontario, respectively, while the market shares for other carriers in Quebec, Manitoba, and Saskatchewan are 13%, 49%, and 66% respectively.

III.B. Current regulatory framework

(25) The CRTC and ISED (formerly Industry Canada) share authority over mobile wireless services in Canada. The CRTC oversees the rates, terms, and conditions and other business practices of mobile wireless carriers.[33] ISED runs periodic auctions of wireless spectrum. Both ISED and the CRTC have expressed concern about whether competition among mobile wireless carriers is sufficient to ensure that consumers enjoy high-quality services at low prices.[34]

(26) The current telecommunications regulatory regime in Canada attempts to remedy this situation by encouraging investment by facilities-based competitors to the national incumbents. Two avenues for this encouragement are its wholesale access regulation and regulation of spectrum auctions.

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33 CRTC, "Our Mandate, Mission and What We Do," accessed Aug. 31, 2017, http://www.crtc.gc.ca/eng/acrtc/acrtc.htm.

34 *See* Industry Canada, "Policy Framework for the Auction for Spectrum Licences for Advanced Wireless Services and Other Spectrum in the 2 GHz Range," Nov. 2007, *available at* https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj /awspolicy-e.pdf/$FILE/awspolicy-e.pdf. *See also* Industry Canada, "Government Opts for More Competition in the Wireless Sector," news release, Nov. 28, 2007, *available at* https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng /sf10021.html#nr. ("[M]ost publicly available studies suggest that prices in Canada are not as competitive as they could be. In particular, there appears to be a consistent view that prices charged for very high use packages and for data (Internet) services are relatively high in Canada.") *See also* CRTC, "Telecom Regulatory Policy CRTC 2015-177," May 5, 2015, *available at* http://www.crtc.gc.ca/eng/archive/2015/2015-177.htm, ¶¶ 35, 74. (The CRTC found that, in the retail wireless market, "[T]here has been very little change in retail market shares (either by revenue or by number of subscribers) in Canada in the past five years, despite entry into the market by several wireless carriers [and that] [w]hile no company has a national revenue market share greater than 35%, the national wireless carriers collectively continue to have national market shares of more than 90% for both revenues and numbers of subscribers," and that with respect to wholesale roaming, "Bell Mobility, RCP, and TCC collectively possess market power in the national market for GSM-based wholesale roaming.")

III.B.1. Current wholesale access regime

(27) Telecom regulatory policy mandates that Bell, Rogers, and TELUS provide wholesale roaming services to facilities-based wireless carriers at regulated rates and on regulated terms and conditions.[35] A key motivation for this regulation is a lack of competition among the three national carriers for wholesale access.[36] The CRTC has opined that absent regulation, the three national carriers have incentives to set wholesale access rates that competitively disadvantage rival facilities-based providers, which in turn diminishes retail competition.[37]

(28) Canadian regulators specified a goal of reasonable roaming rates being available to facilities-based carriers in order to allow new entrants and smaller competitors the foothold necessary to gain customers and thereby create incentives for them to invest in and build out their own networks.[38]

(29) Under the current regulatory framework, pure resellers do not themselves qualify for mandated wholesale roaming rates and conditions, though they can obtain roaming on similar conditions if they strike a deal with a facilities-based network as their "home network."[39] The CRTC determined that mandating direct wholesale reseller access would significantly undermine the investments of wireless carriers, including new entrants, particularly outside urban core areas, and would discourage continued investments in infrastructure. It therefore considered that the provision of reseller access services should continue to be driven largely by market forces.[40]

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35 CRTC, "Telecom Regulatory Policy CRTC 2015-177," May 5, 2015, *available at* http://www.crtc.gc.ca/eng/archive/2015/2015-177.htm, ¶ 129. ("The Commission directs Bell Mobility, RCP, and TCC to provide GSM-based wholesale roaming to Canadian wireless carriers other than Bell Mobility, RCP, and TCC, subject to the rates, terms, and conditions established by the Commission in this decision.")

36 *Id.*, ¶ 16. ("The Commission's determinations in this proceeding . . . were made with a view to achieving the following objectives with respect to the mobile wireless services market: . . . sustainable competition that provides benefits, such as reasonable prices and innovative services, to Canadians . . .")

37 *Id*., ¶¶ 74, 106. ("The Commission considers that the national wireless carriers collectively have the ability and incentive to, with regard to GSM-based wholesale roaming in the national market, maintain rates and impose terms and conditions that would not prevail in a competitive market. . . . The Commission determines that denying competitors access to GSM-based wholesale network access services at a national level would likely result in a substantial lessening or prevention of competition in the downstream retail market.")

38 *Id*., ¶ 71. ("The Commission determines that GSM-based wholesale roaming from the national wireless carriers under reasonable rates, terms, and conditions is necessary for smaller wireless carriers, including new entrants, to offer broad or national network coverage to their retail customers.")

39 CRTC, "Telecom Decision CRTC 2017-56," Mar. 1, 2017, *available at* http://www.crtc.gc.ca/eng/archive/2017/2017-56.htm, ¶¶ 28–29, 31–32. (The CRTC describes a reseller, Sugar Mobile, which has customers who access their service through public Wi-Fi at home or at coffee shops. Such access requires "no infrastructure investment" by the reseller. In particular, "the Commission clarifies that the MVNO subscriber roaming condition only permits wholesale roaming customers to provide their MVNO customers with access to their roaming arrangements on the same terms and conditions as they would obtain roaming services." Additionally, the CRTC directed the incumbents to include the following clause in their tariffs: "The wholesale roaming customer must ensure that any access to [incumbent]'s network on behalf of its reseller or MVNO customers occurs on the same basis, and with the same limitations, as set out in this wholesale roaming tariff.")

40 CRTC, "Telecom Regulatory Policy CRTC 2015-177," May 5, 2015, *available at* http://www.crtc.gc.ca/eng/archive/2015/2015-177.htm, ¶¶ 121–125.

III.B.2. Spectrum auction rules

(30) In 2007, ISED set aside 40 MHz of Advanced Wireless Services ("AWS") spectrum for "new entrants."[41] This policy enabled new industry suppliers, like Mobilicity and Wind Mobile, to purchase spectrum and offer mobile wireless telecommunication services. Cable providers Videotron and Eastlink also acquired spectrum and began to offer mobile wireless services.[42] In the 2015 AWS-3 auction, ISED again set aside certain spectrum bands for non-incumbent mobile wireless carriers; the winners were Videotron, Wind, and Eastlink.[43] ISED also had spectrum caps in the 2500-MHz and 700-MHz spectrum auctions that were designed to support facilities-based entry.[44] ISED has also proposed a set-aside of 30-MHz of 600-MHz spectrum for facilities-based non-incumbents.[45]

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41 Industry Canada, "Policy Framework for the Auction for Spectrum Licences for Advanced Wireless Services and Other Spectrum in the 2 GHz Range," Nov. 2007, *available at* https://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj /awspolicy-e.pdf/$FILE/awspolicy-e.pdf, 2, 5. *See also* Canadian Spectrum Policy Research, "Auctions," accessed Aug. 31, 2017, http://canadianspectrumpolicyresearch.org/auctions/.

42 Quebecor Media, "Quebecor Media Inc. Wins 17 Operating Licences in Spectrum Auction for Advanced Wireless Services," news release, July 21, 2008, *available at* http://www.marketwired.com/press-release/Quebecor-Media-Inc -Wins-17-Operating-Licenses-Spectrum-Auction-Advanced-Wireless-Services-881208.htm; Iain Marlow, "EastLink: The Biggest Cable Company You've Probably Never Heard Of," *The Globe and Mail*, May 28, 2010, *available at* https://beta.theglobeandmail.com/report-on-business/eastlink-the-biggest-cable-company-youve-probably-never-heard -of/article4321110/; Howard Solomon, "Eastlink to Launch Cellular," *IT World Canada*, Nov. 20, 2012, *available at* http://www.itworldcanada.com/article/eastlink-to-launch-cellular-soon/47102.

43 Industry Canada, "Technical, Policy and Licensing Framework for Advanced Wireless Services in the Bands 1755-1780 MHz and 2155-2180 MHz (AWS-3)," Dec. 18, 2014, *available at* http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng /sf10911.html. The nonincumbent winners were Videotron, Wind Mobile, and Bragg Communications Inc., which is the owner of Eastlink. Industry Canada, "AWS-3—Final Results," Apr. 30, 2015, *available at* http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10954.html.

44 Industry Canada, "Policy and Technical Framework: Mobile Broadband Services (MBS) — 700 MHz Band, Broadband Radio Service (BRS) — 2500 MHz Band," Mar. 2012, ¶¶ 34–36, *available at* http://www.ic.gc.ca/eic/site/smt-gst.nsf /eng/sf10121.html.

45 Industry Canada, "Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band," Aug. 2017, ¶¶ 23–25, *available at* http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11316.html.

IV. Mandated access to roaming can encourage or discourage investments in wireless infrastructure

(31) Network access rules can either encourage or discourage investments in wireless infrastructure. On one hand, providing roaming access to facilities-based carriers tends to encourage further investment in network infrastructure by the facilities-based carriers that are granted access. Roaming access improves their ability to market a nationwide network and gives them incentives to expand their home network to expand their customer base. Extending mandated roaming access to non-facilities-based providers, on the other hand, tends to undercut the incentive to invest in wireless facilities, to the extent that non-facilities-based providers can offer a similar product without the significant cost and risk associated with network build-out and thereby undermine the facilities-based business model.

(32) In the current regulatory environment in Canada, facilities-based carriers receive mandated wholesale access from the national incumbents. In this setting, roaming access and network investment and expansion are complements for the reasons described above. If the current regulatory environment were to change to one that mandated access to roaming for firms with no investment in facilities at similar terms to facilities-based carriers, roaming access and investment in wireless infrastructure would become more akin to substitutes. In that setting, regional facilities-based carriers have less incentive to invest and expand and thereby provide greater competition to the national incumbents.

(33) As theory would predict, researchers have found that mandated provision of access to resellers has resulted in lower investment by facilities-based carriers. A recent paper examining the effect of reseller access regulation on facilities-based carrier investment, using firm-level data for 58 mobile network operators in 21 countries from 2000–2008, found that mandated provision of reseller access is related to lower investment intensity of facilities-based network operators.[46]

[46] Jihwan Kim, Yunhee Kim, Noel Gaston, Romain Lestage, Yeonbae Kim, and David Flacher, "Access Regulation and Infrastructure Investment in the Mobile Telecommunications Industry," *Telecommunications Policy* 35 (2011): 907–19 [hereinafter Kim et al. (2011)]. ("The results suggest that mandated provision of access is related to lower investment intensity of MNOs, while voluntary access provision has no effect. Although reduced investment incentives do not necessarily correspond to under-investment, this underscores the need for those countries where MVNOs are provided access to address the issue of investment incentives.") Kim et al. (2011) generally considered MVNOs to be "mobile operators which do not possess their own frequency spectrum and infrastructure to lease the network facilities of mobile network operators (MNOs)."

V. Recent and planned investments by regional carriers show success of current wholesale access policy and risks in changing it

(34) The regional wireless competitors have expanded their footprint, spectrum ownership, and number of subscribers in recent years. In the most recent advanced wireless service auction, AWS-3, in 2015, Wind (now Freedom), Videotron, and Eastlink each made significant spectrum purchases.[47] Each is building out services within and adjacent to its footprint, with Eastlink concentrating on the Atlantic provinces; Videotron in the Quebec region; and Freedom building out in Ontario, Alberta, and British Columbia. While Videotron has recently sold spectrum it purchased in other areas of Canada to Shaw and Rogers, it plans to use the proceeds for expansion, densification, and upgrades within its network footprint in Quebec and Eastern Ontario.[48]

(35) To the extent that the CRTC wishes to encourage ongoing and new investment by new facilities-based entrants, preservation of the incentive to invest is vital. This investment may come from existing players or potential new facilities-based entrants. Both would be discouraged from investing in a wireless network by a policy that put resale-based business models on a similar footing to facilities-based business models for wholesale access. The impact is likely to be greatest on new competitors focused on building out and densifying their networks.[49]

V.A. Shaw's investments

(36) The current wholesale access regulatory regime facilitates Shaw's ability to offer customers in its home territory the ability to "automatically access voice, text, and data services by using a visited wireless carrier's network . . . when they travel outside [Shaw's] network footprint."[50] This gives Shaw and other regional carriers the ability to offer reasonably priced national service via roaming, which would otherwise be difficult due to the market power of the national networks. Under current

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47 In the 2015 AWS-3 auction, Wind purchased three licences covering 18.1 million people, Videotron purchased four licences covering 9.9 million people, and Eastlink purchased four licences covering 3.1 million people. *See* Industry Canada, "AWS-3 — Final Results," Apr. 30, 2015, *available at* http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10954.html.

48 Quebecor Media, "Quebecor Announces the Sale of its AWS-1 Spectrum Licence in Toronto to Rogers," news release, June 9, 2017, *available at* http://www.quebecor.com/en/comm/quebecor-announces-sale-its-aws-1-spectrum-licence-toronto-rogers; Quebecor Media, "Quebecor Announces Sale of 7 Licences to Shaw," news release, June 13, 2017, *available at* http://www.quebecor.com/en/comm/quebecor-announces-sale-7-licences-shaw.

49 Investments by new competitors would likely be riskier than those for established incumbents and would be larger relative to the size of their existing networks.

50 CRTC, "Telecom Regulatory Policy CRTC 2015-177," May 5, 2015, *available at* http://www.crtc.gc.ca/eng/archive/2015/2015-177.htm, ¶ 42.

policy, wireless roaming provides only "incidental access to the host network by the customers of a wireless carrier when these customers are outside their home network's footprint."[51]

(37) Shaw has an incentive to build out its network to acquire new customers and provide quality services in all of its licensed regions. Part of Shaw's incentive to build out its network is the ability to bring customers onto their network in new areas as Shaw's "home network" expands. If Shaw and others were able to enter new licensed territories relying entirely on another party's network without any corresponding network build-out, their incentive to expand their cell sites and spectrum would be reduced.

(38) Shaw has invested approximately $1 billion recently in upgrading 3G networks to LTE services, improving network performance, and acquiring additional spectrum from Videotron.[52] In addition, it has evaluated numerous markets across Canada as potential targets for additional investment.[53] A change in the current roaming regime that puts reseller models on a similar footing to facilities-based carriers for wholesale access would significantly impact Shaw's incentives to continue this build-out.

V.B. Risks of a change in policy

(39) Facilities-based carriers face high risk and uncertainty in the ultimate payoff of network investments due to the largely sunk nature of those investments, long lead times, long life-span, and large economies of scale.[54] Fluctuations in market and regulatory conditions increase the risk as well.

(40) Expanding mandated roaming rates to resale-based models (or some subset of them) reduces the payoff to network investment and expansion and exposes facilities-based carriers to additional risk. In contrast, resellers do not make these irreversible investments. They would likely only seek market access in favourable market conditions and as a consequence only share the upside benefit while avoiding the downside sunk cost risks. This asymmetric allocation of risks and payoffs discourages investment by facilities-based carriers and encourages firms to choose the resale model, to the detriment of additional facilities-based competition.[55]

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[51] *Id*., ¶ 45. *See also* the confirmation of this point in CRTC, "Telecom Decision CRTC 2017-56," Mar. 1, 2017, *available at* http://www.crtc.gc.ca/eng/archive/2017/2017-56.htm, ¶ 31. ("The Commission confirms that mandated wholesale roaming provides incidental, and not permanent, access to the incumbents' networks.")

[52] Shaw Communications written response to Bates White request for information, Aug. 22, 2017.

[53] *See* Appendix C of Shaw's Initial Intervention in Telecom Notice of Consultation CRTC 2017-259.

[54] *See* Kim et al. (2011), 909.

[55] Thomas M. Jorde, J. Gregory Sidak, and David J. Teece, "Innovation, Investment, and Unbundling," *Yale Journal on Regulation* 17, no. 1 (2000): 1–37; Graeme Guthrie, "Regulating Infrastructure: The Impact on Risk and Investment," *Journal of Economic Literature* 44, no. 4 (2006): 925–972. *See also* Kim et al. (2011), 909. ("Therefore, access regulation allocates more risk to network operators and less to service-based entrants, leading the operators to expect relatively lower returns on investments.")

(41) Shaw undertakes detailed modeling to assist with its investment decisions. In deciding whether to engage in a particular investment or expansion project, Shaw accounts for costs of the necessary spectrum, the number of planned sites, and retail outlets, among other things. Whether an investment or expansion is worthwhile depends in part on whether Shaw's prediction of the number of customers it can acquire will generate enough revenue to cover the capital and other costs required to service those customers, in a timeframe that can justify the investment and the trade-offs it must make in considering other investments in its business.

(42) Shaw's investment model, which it has filed in confidence with the CRTC, also captures the effect of increased reseller entry, through regulatory intervention, on build-out incentives. Shaw models increased reseller entry as reducing the number of customers that it expects to acquire following its build-out. Since the cost of the investment required to enter a new market is unchanged, the effect of increased reseller entry through regulatory intervention is to reduce the likelihood that a particular build-out plan will be commercially viable. The internal rate of return on Shaw's projects will decline, potentially turning an attractive investment prospect into an unattractive one, and the time required to recover the cost of the investment will increase. All else equal, such changes to rates of return and time to recover an investment decrease the likelihood that certain expansion plans will be pursued. Fewer viable expansion plans, diminished rates of return, and longer times to recover the cost of investment also imply a decrease in the internal resources available to undertake costly investment in the future.

(43) Shaw's investment model is conservative in its estimate of negative impact, as it does not take into account uncertainty or the risks of expansion, which are likely to be exacerbated by regulatory intervention to artificially enhance the presence of resellers in the market. For example, with competition in fledgling markets being more difficult to predict and additional uncertainty around the effect of reseller competition in such markets, the risk of a particularly poor outcome following expansion is heightened. Accounting for and protecting against outcomes with a potentially high downside will tend to reduce a firm's incentive to invest in expensive infrastructure.

VI. The economics of regulation and interconnection support a focus on facilities-based competition

(44) The economics of regulation and interconnection support a focus on improving facilities-based competition rather than mandating reseller access. It is a well-accepted result in economics that price-cap regulation applied over-broadly can harm the incentive for long-term infrastructure investment.[56] The economics of interconnection shows that increased incentives to reach agreement with resellers flow naturally from increased facilities-based competition. A policy targeting barriers to facilities-based competition will therefore also facilitate reseller access, without the negative impact on incentives to invest in facilities-based networks that a reseller mandate for wholesale access would entail.

VI.A. The economics of regulation

(45) An important objective of modern regulatory policy is to harness current and future competition. Competition—when not impeded by undue market power—generally is superior to regulation in achieving efficient outcomes.[57] For instance, one survey of the effects of cable regulation in the United States finds that "[s]atellite and telco competition has largely replaced price regulation as the constraining force on cable pricing and driving force for innovative services, a welcome outcome given the empirical record on regulation's effects in cable markets."[58]

(46) In the academic economics literature, the early work of Baron and Myerson (1982) and Laffont and Tirole (1986) expresses optimal regulation as a mechanism-design or procurement problem.[59] In that perspective, the relative value of competition and regulation is illuminated by the work of Bulow and Klemperer (1996), who show that in an auction, the value of additional competition is large relative to the value of an auctioneer's negotiation skill.[60] This supports the broadly accepted view that optimal

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[56] *See*, *e.g.*, Mark Armstrong and David E. M. Sappington, "Regulation, Competition, and Liberalization," *Journal of Economic Literature* 44 (2006): 341. ("[price cap regulation] may provide limited incentive for long-term infrastructure investment.") *See also* the seminal work by Michael Spence, who notes the difficulty of price regulation achieving the desired level of investment. (A. Michael Spence, "Monopoly, Quality, and Regulation," *Bell Journal of Economics* 6, no. 2 (1975): 417–29).

[57] Mark Armstrong and David E. M. Sappington, "Recent Developments in the Theory of Regulation," in *Handbook of Industrial Organization, Volume* 3, eds. Mark Armstrong and Robert H. Porter, 1640 (Amsterdam: North-Holland).

[58] Gregory S. Crawford, "Cable Regulation in the Internet Era," in *Economic Regulation and Its Reform: What Have We Learned?* ed. Nancy L. Rose, 187 (Cambridge, MA, and Chicago: NBER and The University of Chicago Press Books, 2014).

[59] David P. Baron and Roger B. Myerson, "Regulating a Monopolist with Unknown Costs," *Econometrica* 50, No. 4 (1982): 911–930; Jean-Jacques Laffont and Jean Tirole, "Using Cost Observation to Regulate Firms," *Journal of Political Economy* 94, No. 3 (1986): 614–641.

[60] Jeremy Bulow and Paul Klemperer, "Auctions Versus Negotiations," *American Economic Review* 86, No. 1 (1996): 180–94.

regulation of an industry may be less important than promoting competition.[61] The current wholesale access regime in Canada uses limited regulation in a way that promotes increased investment and competition by facilities-based carriers.

(47) In contrast, a broad expansion of wholesale access regulation to reseller models risks discouraging investment by facilities-based carriers. To the extent that it puts the reseller model in a comparable situation to those that have invested in a wireless network, it encourages inefficient free-riding, ultimately leading to less competition and lower surplus. Retarding investment incentives is a common problem of over-regulation. According to one survey,

> Studies demonstrated that regulation increased costs both directly and by reducing firm incentives to pursue more efficient operations, impeded the efficient allocation of goods and services to their highest value use, and often retarded innovation.[62]

(48) The Governor in Council has suggested that expansion of the wholesale access regime to resellers might be limited to particular types of resellers, for instance, Wi-Fi first models. That limitation could mitigate free-riding concerns somewhat, but could also introduce additional problems of precisely defining the favoured group of resellers in an industry with fast-moving technology. It also could inadvertently promote certain technological or business models simply because they are favoured by regulation, rather than allowing success or failure of particular business models to be based on their underlying efficiency.

(49) Ultimately, regulators avoid these problems by promoting vigourous facilities-based competition. Economic theory shows that robust facilities-based competition ultimately increases access to wireless networks for resellers, to the extent that resellers are able to bring something novel or valuable to a partnership with facilities-based carriers.

VI.B. The economics of interconnection

(50) The economics literature demonstrates the proposition that without regulatory intervention, a carrier with market power providing one-way access to its network often sets prices that are too high.[63] This

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61 *Id*.

62 Nancy L. Rose, "Learning from the Past: Insights for the Regulation of Economic Activity," in *Economic Regulation and Its Reform: What Have We Learned?* ed. Nancy L Rose, 2 (Cambridge, MA, and Chicago: NBER and The University of Chicago Press Book, 2014).

63 *See, e.g.*, Mark Armstrong, "The Theory of Access Pricing and Interconnection," in *Handbook of Telecommunications Economics, Volume 1*, eds. Martin E. Cave, Sumit K. Majumdar, and Ingo Vogelsang, 297–386 (North-Holland: Amsterdam)

understanding motivates the current mandated roaming access rates for the national incumbent carriers, which ultimately aims to increase competition among facilities-based carriers more broadly.

(51) Appendix A presents a model of network competition to illustrate how the incentive of a facilities-based network operator to provide access to resellers increases with the degree of competition among firms in the market. This occurs through three main avenues:

- Facilities-based network operators' opportunity cost of providing wholesale roaming access decreases substantially when there are other facilities-based carriers that stand ready to provide roaming access.
- Lower market shares of facilities-based network operators increase operators' incentives to partner with non-facilities-based resellers, all else equal.
- A lower retail price increases incentives of facilities-based network operators to partner with non-facilities-based resellers, all else equal.

(52) In the model, smaller facilities-based networks have a greater incentive to partner with resellers than do larger facilities-based networks, since such partnerships present less risk of cannibalization of their own business. By the same logic, a reseller that pursues consumer segments unrelated to those served by the facilities-based network is a more attractive partner for the facilities-based network operator, all else equal, because it presents less risk of cannibalization of its existing market.

(53) The model demonstrates how competition among facilities-based network operators gives these operators an increased incentive to sell roaming services at competitive rates to resellers; it thereby promotes non-facilities-based reseller access to facilities-based networks. These theoretical predictions are borne out in the experience of jurisdictions with a greater degree of network competition than Canada—the United States and the United Kingdom—where resellers have thrived not through mandated wholesale access but through voluntary partnerships with competitive facilities-based carriers.

VII. Experience in other jurisdictions demonstrates the value of promoting facilities-based competition

(54) Many other jurisdictions have confronted issues with market power of large national wireless incumbents leading to difficulties in wholesale access for smaller and new facilities-based carriers. A common response has been to regulate or at least provide oversight to roaming agreements between large national incumbents and other facilities-based networks. More rarely have jurisdictions extended this regulation to pure resellers.

(55) In 1999, the UK telecom regulator at the time, the Office of Telecommunications ("OFTEL"), considered but rejected the idea of extending wholesale access regulations to resellers.[64] A major consideration for OFTEL was the impact on facilities-based investment of a mandated reseller-access policy. It found that "depending on the form of MVNO the incentives to invest in infrastructure may decline, diluting the benefits of infrastructure competition. . . . Investment in network coverage may decline as a result of MVNO entry; existing network operators will not face the same incentives to build out their network."[65] It concluded that

> Regulatory action to require the provision of services to MVNOs would be a significant step that might fundamentally alter the way the mobile market operates. The risks associated with dictating the future market structure by regulation must be considered carefully. OFTEL is not certain that a fully competitive mobile market would support the existence of MVNOs, at least not in a form that OFTEL might anticipate in advance. . . . OFTEL is reluctant to take action that might dictate a particular form of MVNO when some of the benefits might also result from different arrangements that can be achieved by commercial negotiation. OFTEL believes that the best way to identify the exact form of MVNO operation that minimises the costs associated with MVNOs and adds maximum value to the mobile industry and consumers, is by commercial negotiation between network operators and potential MVNOs.[66]

(56) Subsequent experience in both the United Kingdom and the United States lends support to the proposition that, to the extent that resellers provide additional competition to the market by providing unique assets or approaches, robust facilities-based competition adequately addresses reseller access to roaming.

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64 OFTEL, "Statement on Mobile Virtual Network Operators," Oct. 1999, *available at* http://web.archive.org/web/20000817202735/http://www.oftel.gov.uk/competition/mvno1099.htm. Note that since OFTEL was absorbed into OFCOM, the website is only available on http://web.archive.org/.

65 *Id*. ¶¶ 2.25–2.26.

66 *Id*. ¶¶ 2.39, 2.41.

VII.A. The US experience

VII.A.1. US roaming regulation

(57) In 2007, the US Federal Communications Commission ("FCC") mandated automatic roaming for facilities-based commercial mobile radio service ("CMRS") providers for certain services, upon reasonable request "on a just, reasonable, and non-discriminatory" basis.[67] Disputes were to be resolved through an adjudicatory process.[68] At the time, the FCC clarified that resellers were not covered by this policy.[69]

(58) In 2011, the FCC adopted a rule on data roaming that "requires facilities-based providers of commercial mobile data services to offer data roaming arrangements to other such providers on commercially reasonable terms and conditions, subject to certain limitations."[70] The FCC wrote that it was "persuaded by the evidence that roaming arrangements help encourage investment by ensuring that providers wanting to invest in their networks can offer subscribers a competitive level of mobile network coverage."[71] The overwhelming majority of commenters supported the adoption of roaming rules for data services.[72] The sole objectors were Verizon and AT&T, the two parties with the largest and most advanced networks at the time.[73] T-Mobile and Sprint, the third and fourth largest carriers at the time, stated that the rule would "give them 'the resources and the confidence to continue to invest in their businesses, including in the construction of new network infrastructure.'"[74] Once again, the FCC made clear that pure reseller networks could not take advantage of these roaming obligations.[75] In a 2016 decision, the FCC reiterated that the rule does not apply to resellers, stating "[t]he

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67 US Federal Communications Commission, Report and Order and Further Notice of Proposed Rulemaking, *In re Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers,* WT Docket No. 05-265, Aug. 16, 2007. The decision covered "real-time, two-way switched voice or data services, provided by CMRS carriers, that are interconnected with the public switched network and utilize an in-network switching facility that enables the provider to reuse frequencies and accomplish seamless hand-offs of subscriber calls." (¶ 23).

68 *Id*., ¶ 30. ("[W]e concluded that many disputes involving automatic roaming services would be best resolved through an adjudicatory process.")

69 *Id*., ¶ 51. ("[W]e also determine that the automatic roaming obligation under Sections 201 and 202 and the home roaming exclusion are not intended to resurrect CMRS resale obligations. . . . We note that the Commission's mandatory resale rule was sunset in 2002, and automatic roaming obligations cannot be used as a backdoor way to create *de facto* mandatory resale obligations or virtual reseller networks.")

70 US Federal Communications Commission, Second Report and Order, *In re Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers and Other Providers of Mobile Data Services,* WT Docket No. 05-265, Apr. 7, 2011, ¶ 1.

71 *Id.*, ¶ 17. ("The overwhelming majority of commenters favor our adoption of roaming rules to promote the availability of commercial mobile data services.")

72 *Id*., ¶ 11. ("[O]nly AT&T and Verizon Wireless oppose the Commission's adoption of a data roaming requirement.")

73 *Id*., ¶ 12.

74 *Id.*, ¶ 17.

75 *Id.*, ¶ 88.

Commission has never required a provider to offer data roaming to an entity that does not provide facilities-based service to its customers."[76]

(59) The regulatory structure for the last decade in the United States has thus included mandated wholesale access under reasonable conditions, but it explicitly excludes resellers from the wholesale access regime. The meaning of "reasonable" is, of course, open to interpretation and has been the subject of a recent dispute between T-Mobile and Sprint on the one hand, and AT&T and Verizon on the other, calling for further clarification from the FCC.[77]

VII.A.2. The evolution of competition in the US wireless market

(60) In 2007, Verizon and AT&T collectively served 52% of wireless subscribers, with the next two largest carriers being Sprint and T-Mobile.[78] By 2011, the share of Verizon and AT&T had risen to 62% of wireless subscribers,[79] in part through their purchase of smaller carriers.[80] That year, AT&T attempted to purchase T-Mobile, which would have reduced the number of large national competitors from four to three. However, US antitrust officials sued to block the attempted acquisition, and the parties called off the merger. In its complaint, the US Department of Justice called T-Mobile a particularly aggressive competitor and noted that competition from T-Mobile generated lower prices and had spurred competitive responses by the other large networks, in part through T-Mobile's investments in an advanced high-speed network and its innovations in technology and service.[81]

(61) Over the next six years, T-Mobile's market share grew significantly. In 2012, Verizon, AT&T, Sprint, and T-Mobile held connection shares of 35%, 32%, 17%, and 9%, respectively.[82] By the end of 2015,

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76 US Federal Communications Commission, *In re Worldcall Interconnect, Inc. a/k/a Evolve Broadband, Complainant v. AT&T Mobility LLC, Defendant*, Proceeding No. 14-221, File No. EB-14-MD-011, Apr. 14, 2016, ¶¶ 14–16.

77 US Federal Communications Commission, Declaratory Ruling, *In re Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers and Other Providers of Data Services,* WT Docket No. 05-265, Dec. 18, 2014.

78 US Federal Communications Commission, Thirteenth Report, *In re Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services,* WT Docket No. 08-27, Jan. 15, 2009, Chart 1.

79 AT&T and Verizon wireless subscriber market shares are derived from Numbering Resource Utilization Forecast estimates of total 2011 US wireless connections and information from publicly available company documents compiled by the FCC for AT&T and Verizon's 2011 US wireless connections. Data from US Federal Communications Commission, Sixteenth Report, *In re Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services,* WT Docket No. 11-186, Mar. 21, 2013, 9 and Table 13.

80 Verizon purchased Rural Cellular in 2008 and Alltel in 2009. AT&T purchased Edge Wireless in 2008 and Centennial Communications in 2009.

81 Complaint, *United States of America v. AT&T Inc. et al.*, No. 1:11-cv-01560 (D.D.C. Aug. 31, 2011), ¶ 3.

82 Derived from data in US Federal Communications Commission, Nineteenth Report, *In re Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services,* WT Docket No. 16-137, Sep. 23, 2016, Table II.B.1.

Verizon and AT&T's shares of connections were almost the same, Sprint's had dipped to 15%, while T-Mobile's share had increased to 16%.[83]

(62) Market analysts have credited T-Mobile's competitive initiatives (and Sprint's to a lesser extent) to the expansion of unlimited data plans and other innovative strategies such as eliminating two-year contracts.[84]

(63) In its most recent state of wireless competition report, the FCC noted that 89% of the US population has access to advanced (LTE) wireless network services from four or more carriers.[85] As network quality and usage has dramatically increased, price per month, as measured by average revenue per subscriber ("ARPU"), has decreased from $49.26 in 2007 to $44.65 in 2015.[86] Network capacity has also expanded and become much cheaper recently; wholesale rates have fallen by as much as 65% in the last five years.[87]

VII.A.3. Network investment in the United States

(64) Coinciding with a regulatory emphasis on facilities-based competition has been competition among the major carriers to expand and upgrade their networks. In 2007, US investment in the electronic communication sector per household was US$603 compared to US$389 in the European Union ("EU"), a gap of US$214.[88] That gap increased to US$318 in 2012, when investment in US and EU households was, respectively, US$562 and US$244.[89]

(65) US carriers were also quicker to deploy extensive 4G LTE coverage than EU carriers. By 2012, 86% of the US population were covered by LTE networks, but only 27% of EU households.[90] One report

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83 *Id*.

84 James Stewart, "Brash C.E.O. Keeps the Giants of Mobile Off Balance," *The New York Times*, Nov. 29, 2013, *available at* http://www.nytimes.com/2013/11/30/business/brash-ceo-revives-a-moribund-t-mobile.html; Aaron Pressman, "T-Mobile Just Improved Its Unlimited Data Plan Again," *Fortune*, Mar. 9, 2017, *available at* http://fortune.com/2017/03/09/how-t-mobile-unlimited-data-plan/.

85 US Federal Communications Commission, Nineteenth Report, *In re Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services,* WT Docket No. 16-137, Sep. 23, 2016, ¶39 and Chart III.A.3.

86 *Id.,* Table II.E.i.

87 Olga Kharif, "The Phone Companies People Actually Love," *Bloomberg Businessweek*, Feb. 4. 2016, *available at* https://www.bloomberg.com/news/articles/2016-02-04/the-phone-companies-people-actually-love.

88 The "electronic communications sector" as defined here includes mobile telecommunications, fixed-line telecommunications, and pay television, among other things. Christopher S. Yoo, "US v. EU Broadband Deployment: What Do the Data Say?" University of Pennsylvania Law School Center for Technology, Innovation, and Competition, June 2014, Figure 5, *available at* https://www.law.upenn.edu/live/files/3352.

89 *Id.*

90 *Id*., Figure 4.

found that by 2015, 98.5% of US mobile consumers had access to LTE networks but only 59% of EU mobile consumers did.[91]

VII.A.4. Independent reseller access in the United States

(66) Although the FCC does not provide roaming guarantees to non-facilities-based providers, independent resellers have increased in both number and collective market share in recent years. They now number in the hundreds and serve about 10% of all wireless subscribers in the United States.[92]

(67) US resellers TextNow and Ting were founded and are headquartered in Canada but compete in the United States, in part because they are able to obtain attractive (unregulated) wholesale rates in the United States that are not matched by the facilities-based networks in Canada.[93]

(68) In 2017, the CEO of TextNow suggested that while Canadian carriers do not offer viable terms to resellers, "US carriers are much more motivated to play offence against each other."[94] There are numerous examples of resellers switching providers and of resellers partnering with multiple providers in the United States.[95] Sprint, and T-Mobile to a lesser extent, provided the impetus for this competition. In 2012, Sprint introduced an initiative to support resellers in various capacities so that it could "focus almost solely on acquiring customers."[96] Sprint built on this initiative in the following years, and T-Mobile followed suit.[97]

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91 Larry Downes, "How to Understand the US–E.U. Digital Divide," *Harvard Business Review*, Oct. 19, 2015, *available at* https://hbr.org/2015/10/how-to-understand-the-eu-u-s-digital-divide.

92 Olga Kharif, "The Phone Companies People Actually Love," *Bloomberg Businessweek*, Feb. 4. 2016, *available at* https://www.bloomberg.com/news/articles/2016-02-04/the-phone-companies-people-actually-love.

93 Peter Nowak, "Canadian Cellphone Startup Has Success Stateside, But Shut Out at Home," *The Globe and Mail*, Jul. 2, 2017, *available at* https://beta.theglobeandmail.com/report-on-business/small-business/startups/canadian-cellphone-startup-has-success-stateside-but-shut-out-at-home/article35509946/. *See also* Sophia Harris, "The Super-Cheap Canadian Cellphone Deals Only Americans Can Buy," *CBC News*, May 3, 2016, *available at* http://www.cbc.ca/news/business/cellphones-crtc-cheap-plans-1.3562679.

94 Peter Nowak, "Canadian Cellphone Startup Has Success Stateside, But Shut Out at Home," *The Globe and Mail*, July 2, 2017, *available at* https://beta.theglobeandmail.com/report-on-business/small-business/startups/canadian-cellphone-startup-has-success-stateside-but-shut-out-at-home/article35509946/.

95 Mike Dano, "Credo Mobile MVNO Dumps Sprint for Verizon: Source," *Fierce Wireless*, Aug. 17, 2016, http://www.fiercewireless.com/wireless/credo-mobile-mvno-dumps-sprint-for-verizon-source. Data from MVNODynamics.com identifies dozens of US MVNOs that partner with multiple providers (MVNO Dynamics, "USA MVNO (Mobile Virtual Network Operator), MVNA/E & MNO Company," accessed Sep. 2, 2017, http://www.mvnodynamics.com/mvno-companies/north-american-mvno-companies/us-mvno-companies/).

96 Sprint, "Sprint Single Source Enablement Offers Turnkey Solution for Companies Wanting to Enter the Wireless Industry," news release, July 17, 2012, *available at* http://newsroom.sprint.com/sprint-single-source-enablement-offers-turnkey-solution-for-companies-wanting-to-enter-the-wireless-industry.htm.

97 Sprint, "Sprint Panorama to Unleash a New Breed of MVNOs," news release, May 07, 2014, *available at* http://newsroom.sprint.com/sprint-panoramatm-to-unleash-a-new-breed-of-mvnos.htm; Sue Marek, "Sprint, T-Mobile Execs Explain the MVNO Explosion," *Fierce Wireless*, Aug. 2016, http://www.fiercewireless.com/special-report/sprint-t-mobile-execs-explain-mvno-explosion.

(69) Although AT&T and Verizon have worked with resellers as well, Sprint has generally offered more flexible terms and better support.[98] For several years, Verizon would not allow resellers access to its fastest and most advanced networks, and AT&T restricted available bandwidth.[99] Sprint, in contrast, has provided resellers uninhibited access to its 4G networks since 2012.[100] Sprint has also provided resellers much more flexible handset choices than AT&T.[101] Ting's CEO said in 2012 that "our view on AT&T and Verizon is that they come to wholesale very begrudgingly, and they will do only as much as the market forces them to. We believe that 'necessary evil' would better describe their view of [independent resellers] than 'if you can't beat 'em, join 'em'. . . . the incumbents will only be as flexible as the market forces them to be."[102]

(70) Figure 2 below shows for those resellers that are served by major national networks, the proportion primarily served by each network. Sprint has the most partnerships by far, and AT&T and Verizon the least.

[98] Kevin Fitchard, "Why Are MVNOs So Hot Right Now? Thank the Carriers," *Gigaom*, June 25, 2012, https://gigaom.com/2012/06/25/why-are-mvnos-so-hot-right-now-thank-the-carriers/. *See also* Sarah Thomas, "Touring Sprint's Well Oiled MVNO Factory," *Light Reading*, Nov. 21, 2013, http://www.lightreading.com/spit-(service-provider-it)/policy--charging/touring-sprints-well-oiled-mvno-factory/d/d-id/706688.

[99] *Id*.

[100] *Id*. *See also* Sprint, "Sprint Single Source Enablement Offers Turnkey Solution for Companies Wanting to Enter the Wireless Industry," news release, July 17, 2012, *available at* http://newsroom.sprint.com/sprint-single-source-enablement-offers-turnkey-solution-for-companies-wanting-to-enter-the-wireless-industry.htm.

[101] Kevin Fitchard, "Why Are MVNOs So Hot Right Now? Thank the Carriers," *Gigaom*, June 25, 2012, https://gigaom.com/2012/06/25/why-are-mvnos-so-hot-right-now-thank-the-carriers/.

[102] *Id.*

Figure 2. Proportion of resellers served primarily by each major national network in the United States

National network	Proportion of resellers primarily using network
Sprint	56%
T-Mobile	18%
AT&T	17%
Verizon	9%

Source: Calculations based on data at https://www.mvnodynamics.com/mvno-companies/north-american-mvno-companies/us-mvno-companies/. Only those resellers whose primary network was one of the four national networks are included in the calculations (206 of 235 total MVNOs listed as operating in the United States on http://www.mvnodynamics.com).

VII.B. The UK experience

VII.B.1. UK roaming regulation

(71) In 1999, OFTEL, the UK telecom regulator at the time, published a statement on national roaming, proposing a national roaming plan that acts as a "backstop" in the event that parties could not reach a commercial agreement. This was intended to "help level the playing field for new entrants."[103] The statement covered facilities-based operators, but not resellers.[104] Consequently, two incumbent operators, Vodafone and O2, agreed with the National Roaming Condition, Condition 69A. Condition 69A required Vodafone and O2 to negotiate a national roaming agreement with the new entrant 3UK, which allowed 3UK's users to roam on the first two organisations' 2G networks.[105]

(72) The UK Communications Act of 2003 implemented a set of EU directives from 2002 that sought to modernise and further harmonise communications regulation across the EU. Under the new regulatory framework, the National Roaming Condition issued to Vodafone and O2 was continued in 2003, pending OFCOM's (the Office of Communications, the regulator that inherited the duties of OFTEL) decision on whether it should be replaced with an access-related condition.[106]

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[103] OFTEL, "Statement on National Roaming, Revised Version," Oct. 1999, *available at* http://web.archive.org/web/20040808224720/http://www.ofcom.org.uk/static/archive/oftel/publications/1999/consumer/roam1099.htm.

[104] *Id*., ¶ 1.33. ("This paper does not contain any firm proposals for regulatory action. Even if regulatory action is taken at some point in the future in order to facilitate the introduction of MVNOs, O[FTEL] would expect charging for the use of network facilities by MVNOs to be based on the principle of retail minus. This does not put MVNOs in the same position as a new network operator that will ultimately use its own network to provide service to customers.")

[105] Ewan Sutherland, "The Regulation of National Roaming," *22nd European Regional Conference of the International Telecommunications Society*, Budapest, Sep. 2011, 8–9 [hereinafter Sutherland (2011)]; Ian Walden, ed., *Telecommunications Law and Regulation*, 4th ed. (Oxford: Oxford University Press, 2012), § 8.5.4.2.

[106] OFCOM, "National Roaming," accessed Sep. 4, 2017. https://www.ofcom.org.uk/consultations-and-statements/category-3/roaming.

(73) In 2004, OFCOM proposed to discontinue Condition 69A of the licences of Vodafone and O2. At the request of 3UK, OFCOM postponed this decision until 3UK had re-tendered for the roaming contract.[107] In 2006, 3UK successfully signed a contract with Orange for national roaming.[108] However, OFCOM decided not to withdraw Condition 69A, the national roaming licence condition applicable to O2 and Vodafone.[109] Condition 69A explicitly does not apply to resellers.

VII.B.2. The evolution of competition in the UK wireless market

(74) When 3G spectrum was auctioned in 2000, the UK government created five licences, reserving one of the larger ones for a new entrant to promote competition in the 3G market. 3UK and the other four incumbent mobile network operators ("MNOs") won the five 3G licences.[110]

(75) Figure 3 shows the evolution of wireless market shares in the United Kingdom from 2004–2015. The United Kingdom has long had at least four wireless networks with significant network infrastructure. Before 3UK entered in 2003, Orange, T-Mobile, Vodafone and O2 all had national wireless networks with significant share. 3UK's growth over time meant the market had five national facilities-based carriers at one point.

(76) As the smallest operator in the market, 3UK introduced new and attractive services to gain market share. 3UK offered, at market-leading rates, a new range of flexible tariffs that allowed consumers to mix text messaging and voice minutes and choose from a range of handsets in 2007; it also launched a smartphone tariff that offered unlimited data in 2010 and committed to not charge consumers a premium for 4G over 3G after launching its 4G services in 2013.[111]

(77) In 2010, the merger of Orange and T-Mobile formed "Everything Everywhere" ("EE"), and the number of competitors dropped to four.[112] This merger was approved with conditions, one of which

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[107] *Id. See also* Sutherland (2011), 9.

[108] 3UK, "3 Selects Orange as New National Roaming Partner," news release, May 10, 2006, *available at* http://web.archive.org/web/20120317024139/http://www.threemediacentre.co.uk/Press-Releases/3-selects-Orange-as-new-national-roaming-partner-7a.aspx. ("The 3 network provides coverage for voice, text and 3G mobile media services to 88% of the UK population and the new agreement with Orange, which has 99% coverage for voice and text services, will ensure 3 customers continue to enjoy the national coverage that they are used to.")

[109] Sutherland (2011), 8–9; Ian Walden, ed., *Telecommunications Law and Regulation*, 4th ed. (Oxford: Oxford University Press, 2012), § 8.5.4.2.

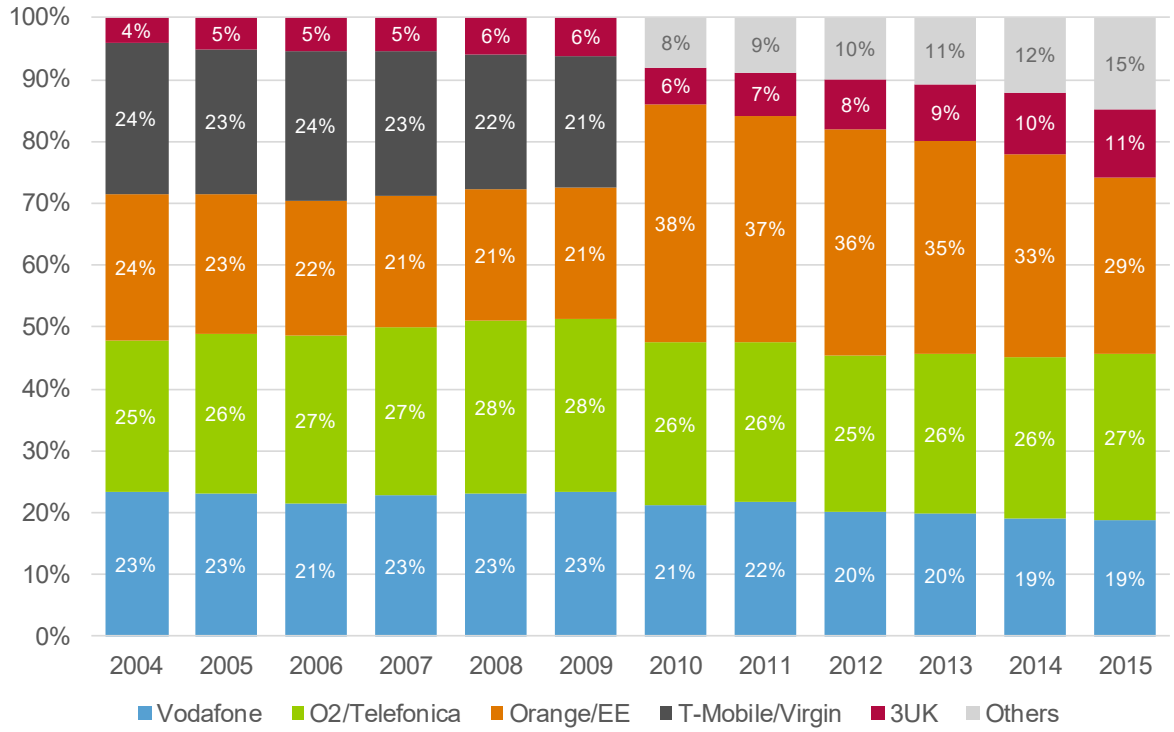
[110] National Audit Office, "The Auction of Radio Spectrum for the Third Generation of Mobile Telephones," Oct. 2001, ¶ 25, *available at* https://www.nao.org.uk/wp-content/uploads/2001/10/0102233.pdf.

[111] OECD, "Wireless Market Structures and Network Sharing," *OECD Digital Economy Papers*, No. 243 (2014): 48–49.

[112] Reuters, "EU Approves T-Mobile, Orange Merger," Mar. 1, 2010, *available at* http://uk.reuters.com/article/uk-tmobile-orange-eu/eu-approves-t-mobile-orange-merger-idUKTRE6202JT20100301; Martina Lees, "Orange and T-Mobile Merges as 'Everything Everywhere,'" May 11, 2010, *available at* http://www.dailymail.co.uk/money/article-1277392/Orange-T-Mobile-merges-Everything-Everywhere.html.

was "the amendment of an existing network sharing agreement with Hutchison 3G UK ("3UK"), to ensure that there remain sufficient competitors in the market."[113]

Figure 3. UK wireless market shares, by network, 2004–2015



Source: OFCOM/operators, with data provided in OFCOM, "Communications Market Report," Aug. 19, 2010, 321; OFCOM, "The Communications Market 2016," 154; OFCOM, "Mobile Call Termination Market Review 2015–2018," Mar. 17, 2015, 123. Note that beginning in 2010, OFCOM separately tracked "other" operators, which include resellers of facilities-based networks. Previously, these were included as part of the share of the network supplying the reseller's infrastructure. Since we do not have the data to assign these "other"' to the facilities-based networks accurately, we leave them separate but note that this will lead to an understatement of the facilities-based networks' market shares in 2010–2016 compared to 2004–2009.

(78) In 2015, 3UK's parent Hutchison tried to acquire O2, but the European Commission blocked the deal. In its decision, it cited "the anti-competitive effects would arise from a reduction of the number of [mobile network operators] from four to three and the elimination of the important competitive constraints that the Parties previously exercised upon each other and a reduction of competitive pressure on the remaining players on the market."[114]

(79) Competition among at least four major facilities-based carriers nationwide has led to falling prices and increased quality and diversity in mobile services:

[113] European Commission, "Mergers: Commission Approves Proposed Merger between UK Subsidiaries of France Telecom and Deutsche Telekom, Subject to Conditions," news release, Mar. 1, 2010, *available at* http://europa.eu/rapid/press-release_IP-10-208_en.htm.

[114] European Commission Decision, Case M.7612 (*Hutchison 3G UK / Telefonica UK*), May 11, 2016, ¶ 1226.

> Despite dramatic increases in the capabilities and use of mobile devices**,** the prices for services have fallen significantly over a decade [2005–2015] in which there were five and then four MNOs. For example, the price of a typical bundle of mobile services has more than halved over that period. Today, there is a wide range in the level of mobile services available to meet different patterns of consumer demand.[115]

Additionally, as of 2016, retail mobile prices in the United Kingdom are considered among the lowest in the EU.[116]

VII.B.3. Network investment in the United Kingdom

(80) 3G network coverage in the United Kingdom was initiated in 2003.[117] 4G service was first launched by EE in 2012. All four major providers received 4G licences in the United Kingdom's 4G spectrum auction in 2013 and started to launch 4G services.[118] All four major providers invested to improve mobile coverage.[119]

(81) 4G coverage has expanded rapidly in the United Kingdom. In 2015, only 8% of the country's landmass was covered by a 4G signal from all operators, whereas in 2016, 40% of the landmass was covered. 4G coverage for indoor premises also increased from 28% in 2015 to 72% in 2016.[120] The proportion of mobile subscriptions with 4G services also increased, from 46% in 2015 to 62% in 2016.[121] As of 2016, 4G networks covered 93% of households in the United Kingdom, compared to the 84% of households in the EU as a whole.[122] According to the 2015 broadband scorecard results released by OFCOM, compared with France, Germany, Italy, and Spain, the United Kingdom ranked first in the share of 4G mobile broadband connections and second in 4G mobile broadband coverage. The United Kingdom also led in terms of per capita data volumes consumed for 4G mobile data.[123]

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115 OECD, "Wireless Market Structures and Network Sharing," *OECD Digital Economy Papers*, 243, (2014), 50.

116 European Commission, "Mergers: Commission prohibits Hutchinson's proposed acquisition of Telefonica UK—Factsheet," news release, May 11, 2016, *available at* http://europa.eu/rapid/press-release_MEMO-16-1705_en.htm.

117 OFCOM, "Connected Nations Report 2016," Section 5, 3, *available at* https://www.ofcom.org.uk/__data/assets/pdf_file/0037/95896/CN16-05.pdf.

118 OFCOM, "The Communications Market 2016," 156, *available at* https://www.ofcom.org.uk/__data/assets/pdf_file/0026/26648/uk_telecoms.pdf. EE first launched the 4G service before the auction for 3G spectrum in the United Kingdom because it was granted a licence modification, which allowed EE to use its existing spectrum for 4G.

119 *Id,* 156–157.

120 OFCOM, "Connected Nations Report 2016," Section 5, 37, *available at* https://www.ofcom.org.uk/__data/assets/pdf_file/0037/95896/CN16-05.pdf.

121 OFCOM, "The Communications Market 2017," 157, *available at* https://www.ofcom.org.uk/__data/assets/pdf_file/0017/105074/cmr-2017-uk.pdf.

122 European Commission, "Europe's Digital Progress Report 2017," United Kingdom telecoms chapter, 1, *available at* https://ec.europa.eu/digital-single-market/en/news/europes-digital-progress-report-2017-country-profiles-telecom-country-reports. This coverage measure is based on the average coverage of operators' 4G networks.

123 OFCOM, "International Communications Market Report 2016: EU5 Broadband Scorecard," Dec. 16, 2016, 3, 6,

VII.B.4. Independent reseller access in the United Kingdom

(82) Resellers have gained share in the United Kingdom through voluntary agreements with facilities-based carriers at market terms. At the end of 2015, resellers had a combined 15% share of retail mobile subscriptions.[124] As of January 2017, there are 104 active UK resellers.[125] Major resellers include Tesco Mobile and Virgin Mobile, which have 7.6 million subscribers in total.[126]

(83) According to an EU report on the UK wireless market, as of January 2017, "Competition among MNOs allows MVNOs to obtain wholesale network access through commercial negotiation."[127]

VII.C. Summary of US and UK experience

(84) The experience of both the United States and the United Kingdom shows that robust competition by facilities-based wireless carriers leads to favourable outcomes on price and innovation dimensions. In both countries, a number of resellers have found traction as well, not due to any regulatory intervention regarding reseller access, but as a natural outgrowth of competition among facilities-based carriers.

available at https://www.ofcom.org.uk/__data/assets/pdf_file/0024/95712/ICMR-Broadband-Scorecard_EU5.pdf.

[124] OFCOM, "The Communications Market 2016," 154, *available at* https://www.ofcom.org.uk/__data/assets/pdf_file/0026/26648/uk_telecoms.pdf. Note that this number may include some resellers that are owned by major brands.

[125] Grant Thornton, "State of the UK MVNO Market," *available at* http://www.grantthornton.co.uk/globalassets/1.-member-firms/united-kingdom/pdf/publication/state-of-the-uk-mvno-market.pdf.

[126] *Id.*

[127] European Commission, "Europe's Digital Progress Report 2017," United Kingdom telecoms chapter, 2, *available at* https://ec.europa.eu/digital-single-market/en/news/europes-digital-progress-report-2017-country-profiles-telecom-country-reports.

VIII. Conclusion

(85) The existing wireless regulatory regime in Canada encourages competition among facilities-based carriers through regulation of wholesale access charges and spectrum auctions. This policy has been successful in promoting investment by regional carriers and, in areas in which regional carriers provide robust competition to the national incumbents, in lowering retail prices. While the current policy is complementary to network investment by facilities-based carriers, proposed changes to that policy, which would put some or all resellers on a similar footing to facilities-based carriers with respect to wholesale access, would threaten to undercut the incentives for network investments by regional facilities-based carriers.

(86) Both economic theory and empirical evidence demonstrate that to the extent that resellers bring unique assets or consumers to the market, they will naturally be incorporated into the market by voluntary agreements with facilities-based carriers as facilities-based competition becomes more robust. Thus, a telecommunications policy that promotes facilities-based competition and investment will also promote reseller access to the extent that it is valuable to consumers, while not undercutting incentives to invest in wireless networks.

Appendix A. A model of wireless roaming

(87) This appendix presents an economic model of wireless roaming. In general, the purpose of an economic model is not to capture every aspect of the relevant economic setting, but to simplify it so that some structured analysis can reveal insight into the issue at hand. The model below illustrates a few basic points that are important in evaluating the impact of facilities-based network competition on entry by resale-only wireless services.

(88) The model shows how the incentive for a facilities-based mobile network to allow roaming by non-facilities-based resellers depends on the size of the facilities-based network and the level of downstream competition. The model illustrates the point that, all else equal, smaller networks have a greater incentive than larger networks to allow resellers to roam on their networks, and that an increase in network competition generally increases all networks' incentives to allow roaming on their networks.

A.1. **The network's roaming decision**

(89) A facilities-based network operator, A, is considering whether to allow roaming on its network by a non-facilities-based reseller, E, and calculates the potential gain and loss from such a partnership. I ignore any capacity constraints throughout and for now assume that A has the option of supplying roaming to E, but that no other network operator may roam with E. This latter assumption will be relaxed later.

(90) The gain for A of allowing E to roam on its network is a function of the roaming rate r and the volume of roaming by E, $q_E = s_E M$, for market size M and share of market acquired by E *if they decide to enter*, s_E. A's loss is a function of the amount of cannibalization of its own sales on which it no longer receives any revenue and the impact on the market price for remaining sales that A makes post-entry.

(91) Let p_K represent the equilibrium market retail price that will prevail with K firms (facilities-based and resellers alike) offering retail mobile wireless plans, and assume that $p_K > p_{K+1} > 0$. This condition states that with more competitors, the market price will decrease. Assume also that $p_K - p_{K+1}$ is (weakly) decreasing in K, which simply means that the marginal impact of additional competition decreases in the number of firms in the market, a condition met in most standard demand systems.[128]

[128] I note that p_K is essentially treated as exogenous throughout. In a more fully specified model, the equilibrium value of p_K would in part depend on shares, costs, and indeed the roaming rate, which is determined as part of the model. For present purposes, the basic properties of price as described here are sufficient to illustrate the basic points. Note also that the choice of r is assumed to not affect the level of p_{K+1}. We abstract here from the complication that both r and p_{K+1}

Let d be the percentage of E's roaming calls that are acquired from A, and let the *pre-entry* share of the market captured by A be s_A, so that A's pre-entry quantity is $q_A = s_A M$.[129] A thus compares

$$\text{Gain} = rq_E = rs_E M$$

$$\begin{aligned}\text{Loss} &= p_K q_E d + (p_K - p_{K+1})(q_A - q_E d) \\ &= p_K s_E M d + (p_K - p_{K+1})(s_A M - s_E M d),\end{aligned}$$

where I assume without loss of generality that the marginal cost of providing the service is equal to 0. A will allow roaming by E if the gain is greater than the loss:

$$\begin{aligned}&rs_E M \geq p_K s_E M d + (p_K - p_{K+1})(s_A M - s_E M d) \\ &\Rightarrow r \geq p_K d + (p_K - p_{K+1})\frac{(s_A - s_E d)}{s_E}.\end{aligned}$$

(92) The loss percentage d is a function of the closeness of substitution between A's service and E's service. It is similar to the concept of a diversion ratio. The diversion ratio is a measure of closeness of substitution used in antitrust analysis that equals the percentage of lost sales after a price rise that is captured by a particular competitor.[130] The diversion ratio answers the question: of all the consumers leaving A, what proportion go to E? Absent better information, market shares are often used to calculate diversion ratios. In the present setting, for instance, if network operators A and B have 30% and 70% market share, respectively, a market share-based diversion to a new entrant would be 30% from A and 70% from B, reflecting the fact that the new entrant would tend to draw more customers from the larger network, all else equal. In line with the above, let the loss of A from the entry of E, d, equal A's share: $d = s_A$. A will find roaming profitable if and only if

$$r \geq p_K s_A + (p_K - p_{K+1})\frac{s_A(1 - s_E)}{s_E}.$$

(93) Let r_A^* be the reservation roaming rate—the rate at which A is indifferent between allowing roaming with E and not:

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may, in some models, be determined simultaneously, to maintain a sharper focus on the decision of when a network operator will prospectively partner with a potential reseller entrant in the first place.

[129] As in the case of market price, shares are discussed in a relatively exogenous manner throughout, though they will typically be the result of an equilibrium that I do not model. To the extent that we want to understand how differences in, e.g., share of A affects market outcomes, all else equal, this treatment is not particularly restrictive.

[130] The diversion ratio between firm A and firm E is defined as

$$Diversion_{AE} = \frac{\text{Increase in firm } E \text{ sales after firm } A \text{ price increase}}{\text{Total lost sales of firm } E \text{ after firm } A \text{ price increase}} = \frac{\partial Q_E / \partial P_A}{\partial Q_A / \partial P_A}.$$

$$r_A^* = p_K s_A + (p_K - p_{K+1}) \frac{s_A(1 - s_E)}{s_E}. \quad (1)$$

(94) **Lemma 1.** If $s_B > s_A$, then $r_B^* > r_A^*$.

Proof. In equation (1), r_A^* is monotonically increasing in s_A since $s_E \in (0,1)$, $p_K > 0$, and $p_K - p_{K+1} > 0$. Thus, the higher is s_A, the higher is r_A^*, and the result follows. □

(95) Though the exact calculation of the reservation roaming rate depends on prices and market shares, the intuition is that a larger network will lose more of its users to E and will also have a larger number of customers on which to suffer the effects of a price drop due to entry. Thus, a larger network will need to receive a higher roaming rate from E to compensate for these losses.

(96) Generally, E will only accept a roaming rate, r, if $r \leq p_{K+1}$; it would lose money on its resale of the roaming service otherwise. There will exist a rate at which A is willing to have E roam on its network, and E is willing to enter, if $r_A^* \leq p_{K+1}$, which requires that

$$p_K s_A + (p_K - p_{K+1}) \frac{s_A(1 - s_E)}{s_E} \leq p_{K+1}.$$

(97) By Lemma 1, we know that the left-hand side is monotonically increasing in s_A, and as $s_A \to 0$, the left-hand side approaches 0. Given that the left-hand side of the inequality is continuous in s_A, there must exist some $s_A > 0$ such that the above holds. Finally, note that it is profit maximizing for A to charge the highest price that E will accept.

(98) **Equilibrium 1.** If only one facilities-based network operator, A, may provide roaming service, then the equilibrium outcome is

1. If $r_A^* > p_{K+1}$: no entry,
2. If $r_A^* \leq p_{K+1}$: A serves E at price $r^* = p_{K+1}$.

A.2. The effect of competition on roaming rates and prices

(99) Maintain for now that only A may offer roaming service to E, though there may be multiple other facilities-based networks competing with A in the retail market. Increased competition between firms already in the market level can increase the likelihood that E enters in a number of ways.

(100) **Proposition 1.** Holding the share of A and E fixed, a market with more firms has a lower market price, lower reservation roaming rate, and—if demand is such that prices do not decrease sufficiently fast in response to entry—a higher likelihood of non-facilities-based entry.

Proof. Holding fixed the shares of A and E, s_A and s_E, increased competition can both lower the retail price p_K (since I assume p_K is lower the higher is K) and lower the incremental impact in price from entry by E (since $p_K - p_{K+1}$ is decreasing in K). Thus, both terms on the right-hand side of equation (1) decline as K increases, so r_A^* decreases. Intuitively, lower price means less lost revenue from customers acquired by the entrant, and a lower price difference ($p_K - p_{K+1}$) means less lost revenue on remaining sales from entry. Thus, given s_A and s_E, the reservation roaming rate is lower with more firms in the market driving the market price down.

From Equilibrium 1, we know that there will be entry if $r_A^* \leq p_{K+1}$. Note that $r_A^* \leq p_{K+1}$ is satisfied when

$$r_A^* = p_K s_A + (p_K - p_{K+1}) \frac{s_A(1 - s_E)}{s_E} \leq p_{K+1}$$
$$\Rightarrow \frac{s_A}{\left(s_E + s_A(1 - s_E)\right)} \leq \frac{p_{K+1}}{p_K}. \quad (2)$$

With multiple network providers in the market, $s_A < 1$, which implies that the left hand side of equation (2) is less than 1. The expression will be satisfied for a broader range of values of s_A the higher is p_{K+1}/p_K, which can be anything up to (but not including) 1. I note that p_{K+1}/p_K need not necessarily be increasing in the number of firms in the market (K), though the condition that p_{K+1}/p_K is increasing is intuitively appealing as it amounts to requiring that the larger is K, the smaller the percentage price decrease for one extra competitor. If p_{K+1}/p_K is decreasing in K, this suggests that prices may have dropped relatively quickly in response to facilities-based competition, thus nevertheless providing substantial benefits to consumers. □

(101) **Proposition 2.** Comparing two equilibria with K and $K + 1$ firms, if A has a lower pre-entry share in the second equilibrium, and if the post-entry share of E is the same in each, then the likelihood of E roaming on A's network is greater in the second equilibrium, due to a lower reservation roaming rate.

Proof. By Lemma 1, lower s_A leads to lower r_A^*, all else equal. Thus, there is more likely to be a price that is acceptable to the entrant. This is most precisely seen by the fact that the left-hand side of equation (2) is increasing in s_A, so a *decrease* in s_A makes it more likely that (2) holds. □

A.2.a. Competition for offering roaming

(102) We now introduce competitive roaming decisions into the basic model above. Network operators will know that if they do not partner with the resale-based entrant, another network might. A higher market-share facilities-based network operator B knows that a lower market share facilities-based network operator A will be willing to partner with a non-facilities-based reseller E at a price r_A^* defined earlier. If E is viable at a roaming price r_A^*—that is, if $r_A^* \leq p_{K+1}$ is true—then B knows that it will incur its loss from the entry *regardless of whether it partners with* E, and thus will be willing

to undercut A's roaming rate offer to at least receive some compensation for the entry. In other words, B's opportunity cost of providing roaming drops dramatically once A is willing to provide roaming access, making B much more willing to partner with E. By the same logic, A will be willing to undercut B, and competition will ultimately drive the roaming price down to marginal cost, yielding the following equilibrium:

(103) **Equilibrium 2.** If multiple facilities-based network operators may provide roaming service, then the equilibrium outcome is:

1. If no facilities-based network operator, I, exists, such that $r_I^* \leq p_{K+1}$: no entry
2. If at least one facilities-based network operator, I, exists, such that $r_I^* \leq p_{K+1}$: there is entry, and E pays the facilities-based network operator's marginal cost, with more than one facilities-based network operator offering a roaming rate equal to marginal cost.

(104) I note that while the discussion in this subsection pertains to circumstances with at least two rival facilities-based network operators that E may roam with, the conditions under which E enters (part 2 of Equilibrium 2) are in general easier to satisfy with more competition in the market.

(105) **Proposition 3.** In a market that does not yet have entry from a non-facilities-based reseller, if there is additional facilities-based network competition that lowers all firms' market shares, or if a facilities-based network enters with low share, the likelihood of non-facilities-based entry increases, all else equal, due to a lower reservation roaming rate of the lowest-share facilities-based network operator.

Proof. The fact that a lower share leads to a lower reservation roaming rate was shown in the proof of Proposition 2, above. Note also that what is important to spurring competition in Equilibrium 3 is that there exists *some* operator I for whom $r_I^* \leq p_{K+1}$. The result follows. □

(106) Proposition 1 can also apply to the setting with competition for offering roaming. Taking as given the market shares of the smaller facilities-based networks in particular, additional competition that lowers prices within the market can also lead to a lower reservation roaming rate and thus a higher likelihood that there exists *some* operator I for whom $r_I^* \leq p_{K+1}$.

(107) Note that while the competition described in Equilibrium 2 drives the roaming rate to marginal cost, it could well be that the roaming rate stays above marginal cost—in response to competition—due to factors not captured in this simple setting. For example, if the facilities-based network operators had differential fixed costs of serving an entrant due to administrative, contracting, or technology associated with the partnership, roaming rates would be above marginal cost in equilibrium.

(108) Finally, I have focused on a situation in which E and the facilities-based network operators compete for the same broad set of consumers. To the extent that E focuses on an unserved segment of the market or expands the size of the relevant base of consumers, the likelihood that E can successfully

partner with a facilities-based network operator will generally increase. In the model described above, the effect of E focusing on an unserved segment of the market is to lower the loss percentage d—possibly to 0. This makes it more likely that the facilities-based network operator will want to partner with E, since the loss from partnering is lower. If in addition, by serving a segment of the market not previously served, the price to existing customers is not affected and $p_K = p_{K+1}$, the facilities-based network operator's loss from partnering will go to 0 and there will only be gain from partnering with E.

Appendix B. Curriculum vitae

SUMMARY OF EXPERIENCE

Dr. Eric Emch has nearly 20 years of experience in the economic analysis of competition issues, including the competitive effects of horizontal and vertical mergers, analysis of single-firm conduct and monopolization, market definition, and collusion. His recent work has focused on merger and monopolization issues in a variety of industries, including the wireless telecommunication and oilfield services industries.

Dr. Emch joined Bates White from the Antitrust Division of the US Department of Justice (DOJ), where he served as Staff Economist and Assistant Chief of the Competition Policy Section. As Assistant Section Chief, Dr. Emch led teams of economists in theoretical and empirical analyses of merger, monopolization, and collusion cases primarily in the transportation, energy, and payment cards sectors. This included hiring and collaborating with outside economic experts, strategizing with legal teams on case approach, and incorporating economics into case development. As a staff economist, he conducted theoretical and empirical analysis in support of merger and non-merger investigations in a wide variety of industries, including support for the DOJ litigation team in United States v. Visa. He also prepared to be a testifying expert in two merger cases.

From 2007 to 2008, while on leave from the DOJ, Dr. Emch served as a Senior Economist at the Paris-based Organisation for Economic Co-operation and Development (OECD). In that role he led the OECD's Regional Competition Center in Seoul, Korea, where he designed, organized, and conducted competition policy training workshops for staffers of national competition authorities across Asia. Dr. Emch has continued his work in international antitrust enforcement at Bates White. In 2011 and 2014, he organized and led workshops for Asian competition authorities in Thailand, Vietnam and Korea. In December 2012 and March 2013, he led workshops in Budapest, Hungary for staffers of competition authorities in the region on competitive analysis of abuse of a dominant position. He has also presented seminars on antitrust before audiences at the Japanese Fair Trade Commission, the Korea Fair Trade Commission, the China Ministry of Commerce (MOFCOM), and the China State Administration of Industry and Commerce (SAIC), among others.

Dr. Emch has published in journals such as the *Journal of Industrial Economics*, *Review of Industrial Organization*, *Review of Network Economics*, and *Antitrust Law Journal* on a number of competition-related topics, including aftermarket effects, two-sided markets, and non-horizontal merger theories of harm. He has also taught econometrics in Johns Hopkins University's Masters of Applied Economics Program.

EDUCATION

- PhD, Economics, University of California at Berkeley, 1999
- AB, Economics and History, Brown University, 1991

PROFESSIONAL EXPERIENCE

- Partner, Bates White Economic Consulting, January 2014–present
- Principal, Bates White Economic Consulting, April 2011–January 2014
- Research Economist, DOJ Antitrust Division, January 2009–April 2011
- Senior Economist, OECD Competition Division, Paris, France, September 2007–December 2008
- Assistant Chief, DOJ Antitrust Division Competition Policy Section, August 2004–August 2007
- Economist, DOJ Antitrust Division, October 1999–August 2004

SELECTED BATES WHITE EXPERIENCE

- Prepared economic analysis on behalf of the Canadian Competition Bureau in support of its review of the acquisition of Manitoba Telecom Services, Inc., by BCE Inc.
- Prepared economic analysis and submitted declaration before the FCC discussing the role of competition and the definition of dominant carrier in a proceeding relating to special access tariffs.
- In *In re Determination of Rates and Terms for Making and Distributing Phonorecords*, led a team supporting the expert in preparing testimony on behalf of Spotify USA Inc. regarding royalty payments under Section 115 of the Copyright Act.
- Led the team supporting the expert on behalf of the US Department of Justice in its successful challenge of the proposed $34.6 billion merger of Halliburton and Baker Hughes.
- Led the team providing analysis and expert support for DOJ in analyzing the proposed merger of silicon metal producers FerroAtlantico and Globe Specialty Metals. Analyzed the competitive effects of the proposed transaction, and supported preparation of expert testimony in the event of a merger challenge. After an extended investigation, the Department did not challenge the merger, which was subsequently consummated.
- Led a team assessing the potential competitive effects of AT&T's proposed $48 billion acquisition of DirecTV during an extended review of the transaction by the DOJ and FCC. Analyzed competition and complementarities among broadband Internet and video programming services on behalf of AT&T. The merger was ultimately approved by both agencies.

- On behalf of Constellation Brands, analyzed the competitive effects of Anheuser-Busch InBev and Grupo Modelo's proposed divestiture of brewery and distribution assets to Constellation in response to DOJ's concerns about their proposed merger. Coauthored a white paper positing that the proposed divestiture resolved the concerns initially raised and would likely improve competition relative to the status quo. DOJ ultimately approved the merger, subject to the proposed divestiture package.
- Retained by DOJ's Antitrust Division to produce an expert report and serve as an expert witness for a proposed merger in the publishing industry. Analyzed competition between the merging firms, product and geographic market definition, potential unilateral and coordinated effects avenues of merger harm, and effects on final consumers. Merger was eventually approved after parties proposed a divestiture package resolving potential competitive concerns.
- Retained by DOJ's Antitrust Division to produce an expert report and serve as an expert witness for a proposed merger in the energy services industry. Merger was eventually approved after parties proposed a divestiture package resolving potential competitive concerns.
- On behalf of Express Scripts and Medco Health Solutions, provided economic analysis on a wide range of competitive issues that the FTC explored during its eight-month investigation of their merger. Demonstrated that the proposed transaction would not meaningfully put the combined company in a position to exercise market power in any relevant market or market segment. This analysis, which Bates White presented to the FTC, supported the agency's conclusion that there is a dynamic, competitive market for PBM services and that the proposed acquisition would not change this. The FTC closed its investigation after finding no likelihood of future unilateral effects, coordinated effects, or exercise of monopsony power resulting from the merger.
- On behalf of DuPont, provided economic analysis in an antitrust case against Kolon Industries related to sales of para-aramid fiber in the United States. The case involved monopolization counterclaims filed by Kolon against DuPont, subsequent to another case brought by DuPont that claimed theft of trade secrets. Kolon alleged that the use of certain supply agreements between DuPont and some of its customers was illegal exclusionary conduct under Section 2 of the Sherman Act and claimed damages for Kolon. Bates White provided expert testimony showing that DuPont is not a monopolist in the market for para-aramid fiber and that the supply agreements at issue are not detrimental to competition. DuPont was granted summary judgment in its favor, and Kolon's antitrust counterclaims were dismissed with prejudice.
- On behalf of an international competition authority, drafted new merger control regulations and merger enforcement guidelines.
- Developed and led four workshops for staff of Asian antitrust authorities on behalf of the OECD: (1) a workshop on "Cartel Fundamentals" for ASEAN member countries in Bangkok, Thailand in September 2014; (2) a workshop on monopolization and abuse of dominance in Jeju, Korea in June 2014; (3) a workshop on "Legitimate Business Practices or Cartels in Disguise?" in Hanoi,

Vietnam in October 2011; and (4) a workshop on monopolization and abuse of dominance in Busan, Korea in December 2011. Participants included staff from the competition authorities of China, India, Indonesia, the Philippines, Pakistan, Vietnam, Singapore, Myanmar, Malaysia, and Mongolia, among others.

- Developed and led workshops on pricing-related abuse of dominance and exclusionary practices for staff members of Eastern European competition authorities in Budapest, Hungary in December 2012 and March 2013 on behalf of the OECD.

SELECTED DEPARTMENT OF JUSTICE EXPERIENCE

- Led teams of economists evaluating economic theory and empirical evidence for cases in the transportation, energy, and payment cards sectors.
- Oversaw the analysis of effects on electricity prices from the merger of two large suppliers on the same regional interchange. Work included detailed merger simulation and analysis of the effects of long-term contracting on supply, and an analysis of how potential divestitures would affect postmerger pricing.
- Examined potential exclusionary conduct in payment cards markets, including theoretical modeling of potential anticompetitive effects.
- Provided support to Antitrust Division expert and trial team in *United States v. Visa USA*. Assisted with depositions of opposing experts and reviewed expert reports.
- Led economics teams in defining and analyzing possible non-horizontal effects of mergers in several cases in the software and manufacturing industries. Conducted extensive theoretical and empirical analyses of possible competitive effects from non-horizontal aspects of the proposed merger of General Electric and Honeywell in 2001.
- Worked with attorneys in incorporating economic content into legal arguments and in rebutting arguments of opposing economics experts in *United States v. First Data Corp.*
- Prepared as a testifying expert in two merger cases in the computer software industry. Conducted analyses of the transactions, including modeling of the competitive effects and data analysis to support theoretical predictions, and prepared draft expert reports.
- Conducted empirical analysis related to competitive effects and market definition in airline markets for inclusion in the Antitrust Division's comments to the Department of Transportation on a proposed swap of takeoff and landing rights between airlines.

SELECTED OECD EXPERIENCE

- Oversaw the development and implementation of training and outreach activities directed at staffers at emerging competition authorities in Asia.

- Developed a series of training workshops in Hanoi, Vietnam; Busan and Seoul, South Korea; and Singapore focused on merger policy, cartel enforcement, antitrust aspects of competitor collaborations, quantitative analysis in competition policy enforcement, and monopolization and abuse of dominance. Representatives from virtually all national competition authorities in Asia participated in one or more the workshops.
- Designed, organized, and led workshops on competition policy enforcement for China's Ministry of Commerce (MOFCOM) and State Administration for Industry and Commerce (SAIC).

PAPERS AND PUBLICATIONS

- Armington, Elizabeth, Eric R. Emch, and Ken Heyer. "The Year in Review: Economics at the Antitrust Division, 2005–2006." *Review of Industrial Organization* 29, no. 4 (2006): 305–26.
- Emch, Eric R. and T. Scott Thompson. "Market Definition and Market Power in Payment Card Networks." *Review of Network Economics* 5, no. 1 (2006): 45–60.
- Emch, Eric R., Ken Heyer, and Robert Majure. "The Year in Review: Economics at the Antitrust Division, 2004–2005." *Review of Industrial Organization* 27, no. 3 (2005): 197–221.
- Emch, Eric R. "GECAS and the GE/Honeywell Merger: A Response to Reynolds and Ordover." *Antitrust Law Journal* 72, no. 1 (2004): 233–66.
- Emch, Eric R. "'Portfolio Effects' in Merger Analysis: Differences between EU and US Practice and Recommendations for the Future." *Antitrust Bulletin*, Spring/Summer 2004, 55–100.
- Emch, Eric R. "Price Discrimination via Proprietary Aftermarkets." *Contributions to Economic Analysis & Policy* 2, no. 1 (2003). http://www.bepress.com/bejeap/contributions/vol2/iss1/art4.
- Dick, Andrew W., Aaron Edlin, and Eric R. Emch. "The Savings Impact of College Financial Aid." *Contributions to Economic Analysis & Policy* 2, no. 1 (2003). http://www.bepress.com/bejeap/contributions/vol2/iss1/art8.
- Edlin, Aaron and Eric R. Emch. "The Welfare Effects of Price Matching Policies." *Journal of Industrial Economics* 47, no. 2 (1999): 145–67.
- Emch, Eric R. "Does Opportunism Explain Markups in Laser Printer Toner and Memory? No and Yes; Evidence on aftermarket pricing for laser printers." *Department of Justice Discussion Paper* EAG 02-3, March 2002.

SELECTED PRESENTATIONS

- "Antitrust Mergers Workshop." ABA Section of Antitrust Law, September 28, 2017
- "Merger Enforcement." Panelist, 11th Annual Global Antitrust Enforcement Symposium, Georgetown Law, September 12, 2017

- "Fundamentals of Antitrust Economics Series: Market Power." Teleconference presentation, ABA Section of Antitrust Law, January 17, 2017
- "Price Discrimination Markets in Merger Cases: from Investigations to Courtrooms." Teleconference presentation, ABA Section of Antitrust Law, May 18, 2016
- "Fundamentals of Antitrust Economics Series: Market Power." Teleconference presentation, ABA Section of Antitrust Law, March 10, 2016
- "Fundamentals of Antitrust Economics Series: Coordinated and Vertical Effects." Teleconference presentation, ABA Section of Antitrust Law, February 13, 2015
- "Merger remedies in theory and practice." Panel moderator, 2014 Hal White Antitrust Conference, Bates White Economic Consulting, Washington, DC, June 9, 2014
- "Deviation in Dominance: Why is your client a monopolist there but not here?" Teleconference panelist, ABA Section of Antitrust Law, February 18, 2014
- "The Economics of Vertical Foreclosure." Panelist, 2013 Hal White Antitrust Conference, Bates White Economic Consulting, Washington, DC, June 3, 2013
- "Fundamentals: Antitrust Economics." Panelist, 61st ABA Antitrust Law Spring Meeting, Washington, DC, April 2013
- "Antitrust in Asia: Recent developments in China, Japan, and Korea." Presentation, Dechert LLP, Washington, DC, August 1, 2012
- "Using Data and Economic Logic to improve Antitrust Enforcement." Presentation, Workshop for the Chinese Ministry of Commerce, sponsored by the Asian Development Bank, Lijiang City, People's Republic of China, 2009
- "Antitrust Approaches to Partial Equity Investments." American Antitrust Institute 9th Annual Energy Roundtable, Washington, DC, 2009
- "Competition Enforcement versus Sector Regulation: An International Perspective." Presentation, Korean Competition Law Association International Symposium, Seoul, South Korea, 2008
- "The Theory and Application of Competition Policy." Presentation, International Symposium for Antitrust Enforcement, State Administration for Industry and Commerce, Beijing, People's Republic of China, 2007
- "Merger Policy: An International Perspective." Seminar, Shanghai University of Finance and Economics, Shanghai, People's Republic of China, 2007
- "The US Electricity Market: The Economics of the Exelon/PSEG Merger." Presentation, Workshop on the Liberalization of Electricity Markets, OECD Regional Competition Center, Budapest, Hungary, 2007

- "The Economics of Tying and Bundling." Presentation, International Seminar on Abuse of Dominance, sponsored by OECD and the Antimonopoly Office of the Slovak Republic, Bratislava, Slovakia, 2007
- "Market Definition and Market Power in Payment Card Networks." Presentation, Antitrust in Two-Sided Industries, eSapience conference, Boston, MA, 2006
- "The Economics of Vertical Mergers." Training session for Antitrust Division lawyers and economists, Washington, DC, 2005
- "The Competitive Effects of Horizontal Mergers: Unilateral and Coordinated." Annual training session for new Antitrust Division lawyers and economists, Washington, DC, 2003–2005
- "Competition Policy and Value Creation." Presentation, Productivity, Innovation, and Value Creation Conference, Conference Board, Amsterdam, Netherlands, 2004
- "GECAS and the GE/Honeywell Merger." Presentation, CRA International, Washington, DC, 2004
- "Market Definition in Payment Systems." Presentation, NY State Bar Association, New York, NY, 2004
- "Vertical Foreclosure in the Aircraft Engine Market? The Role of GE Capital Aviation Services in Killing the GE/Honeywell Merger." Presentation, INFORMS Marketing Science Conference, University of Maryland, College Park, MD, 2003
- "Antitrust Principles." Training sessions, Hungarian Office of Competition, Budapest, Hungary, 2001
- "Merger Analysis." Workshop, Romanian Office of Competition, Timisoara, Romania, 2001
- "The Role of Economics in Antitrust." Presentation, NEI, Rotterdam, Netherlands, 2000

COURSES TAUGHT

- Graduate Microeconometrics, Johns Hopkins University
- Undergraduate Industrial Organization and Public Policy, UC Berkeley

PROFESSIONAL ASSOCIATIONS

- American Bar Association
- American Economic Association
- Industrial Organization Society

REFEREE

- American Economic Review
- B.E. Journals in Economic Analysis and Policy
- Journal of Industrial Economics
- Review of Industrial Organization

DISTINCTIONS AND HONORS

- *Who's Who Among International Competition Economists*, 2014–present
- Antitrust Division Award of Distinction, 2004
- Victor Kramer Foundation Fellowship, 2002–2003
- Alfred P. Sloan Foundation Doctoral Dissertation Fellowship, 1998–1999
- UC Berkeley Department of Economics Fellowship, 1997–1998
- Olin Foundation Fellowship in Law and Economics, 1996–1997
- IBER Distinguished Graduate Fellowship, 1994–1995
- Flood Fellowship in Economics, 1993–1994
- Class of 1873 Prize for Excellence in Economics, Brown University, 1991