



Mobile Broadband in the Americas: Momentum Building in the AWS Band



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Global View Partners
Creating Value in Wireless

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I. Executive Summary

Due to dramatically increasing global demand, a number of new spectrum bands are being licensed to add capacity and/or foster new services and competition in mobile markets. In the Americas, the Advanced Wireless Services (AWS) band (90 MHz of spectrum in the 1.7-2.1 GHz range) has already added significant capacity and coverage to the US and Canadian markets, with many Latin American countries also expected to license this spectrum soon. However, some operators and regulators are concerned that devices to enable the full utilization of this new band may come to market too slowly. This concern may affect operator business plans as well as regulator willingness to license the AWS band in new markets. The primary objective of this paper is to assess and present factually the commercial viability and service launches of the GSM family of technologies (GSM, HSPA, LTE) in the AWS band in all relevant markets in the world, with a special emphasis on the Americas.

Analysis of spectrum policy, industry traffic trends, AWS auctions to-date, and the total addressable market across the Americas, as well as discussions with AWS industry participants and regulators, point to a number of key findings:

- **Public policy that supports the AWS band also benefits economic growth.** Regulators understand that rapidly growing wireless traffic will require incremental spectrum over time, and ample research now supports the positive correlation between wireless penetration and economic growth. Since the sizable AWS band represents an immediate opportunity throughout the Americas to allocate additional airwaves, licensing remains a priority.
- **Prices paid for AWS spectrum in the United States and Canada reveals high market demand.** For the US AWS auction, net bids totaled \$13.7 billion or \$0.53 per MHz-POP. In Canada, the AWS spectrum auctions produced net bids of \$4.2 billion, or \$1.55 per MHz-POP, higher than prices realized from PCS auctions.
- **The AWS band is sufficiently similar to other frequency bands and HSPA gear is ready today.** Given close frequency proximity to the IMT-2000¹ core band (1920-1980 MHz paired with 2110-2170 MHz) and PCS bands (1800 MHz and 1900 MHz), development and production of HSPA infrastructure equipment and handsets is not a technical challenge. T-Mobile USA reports no problems with equipment procurement and expects to cover more than 200 million POPs by year-end 2009, up from 107 million POPs covered at year-end 2008.
- **Production cost curves are comfortable and improving.** According to several vendors, cost curves are not all that different from mainstream products today and are not a deal breaker in terms of bringing AWS products to market. The component supply chain appears ready and excited to support AWS hardware in scale.
- **Small addressable market is poised for rapid growth.** With equipment readily available and cost curves comparable to existing products, operators can drive AWS market growth depending upon specific market share and deployment plans. So, while

¹ International Mobile Telecommunications-2000 (IMT-2000) is the global standard for third-generation (3G) wireless communications, defined by a set of interdependent ITU recommendations.

the initial market opportunity started small for potential suppliers, the addressable market is quickly expanding. T-Mobile USA expects to rapidly drive device and subscriber penetration over the next several years, with approximately one-half of the operator's subscriber base—or an estimated 20 million subscribers—expected to be on HSPA in the AWS band in two years and more than 90% in five years.

- **Meaningful growth in AWS subscribers and device volumes is projected for the Americas.** The continued push of T-Mobile USA and additional licensing across the Americas should bring total subscribers with AWS-enabled devices to an estimated 177.8 million at year-end 2013, a compound annual growth rate of 94% from an estimated 12.4 million at year-end 2009. As the subscriber base grows, estimated handset/device unit sales are also expected to increase rapidly, reaching an estimated 114.5 million in 2013, an annual compound growth rate of 80% from an estimated 10.9 million in 2009. Importantly, during this period, the licensed AWS population (POPs) is projected to increase to an estimated 732 million from an estimated 328 million at year-end 2008.
- **Operators' desire accelerated licensing in Latin America.** Current North American license holders are very interested in additional AWS licensing to occur soon across the Americas to further accelerate new device/handset introduction and enable inbound/outbound roaming in the band. Several Latin American operators are also very interested in accessing AWS spectrum to enable new mobile broadband services and provide additional coverage and capacity.
- **Conclusions.** In summary, regulators can be confident that infrastructure equipment and devices are increasingly available for the AWS band and, therefore, support accelerated licensing plans. Vendors can be confident that the addressable market justifies further product development and that the associated costs are comparable to other, similar bands such as PCS 1900 MHz and 2.1 GHz. Finally, operators can feel secure that they can obtain licenses and develop their business plans.

II. AWS and the Economic and Social Benefits of Mobile

A. Spectrum Policy and the Public Good

Anecdotal evidence of the economic and social benefits of mobile telecommunications is increasingly widespread and undeniable. Specific examples over the past decade include:

- Sales forces both small and large gained a new ability to increase productivity by having readily available communications on the go via cell phones.
- Parents improved their ability to juggle family and work commitments, coordinating who is in the best position to pick up kids from school.
- Taxi drivers added new paid rides thanks to carrying cell phones, allowing customers to contact them while they are on the road.
- Fishermen increased their income by knowing ahead of time in which port they can get a better price for their product.

- Farmers maximized their profits by following real-time price changes for their crops.
- In developing countries, many users made their first phone call on a mobile phone, which now is approaching 100% penetration in several emerging markets.

Quantifying the benefits. Despite compelling evidence through the years, economic and social benefits have been hard to quantify and largely missing from economic and telecommunications policy. In recent years, however, academic scholars and industry analysts have built a body of research that quantifies the benefits.²

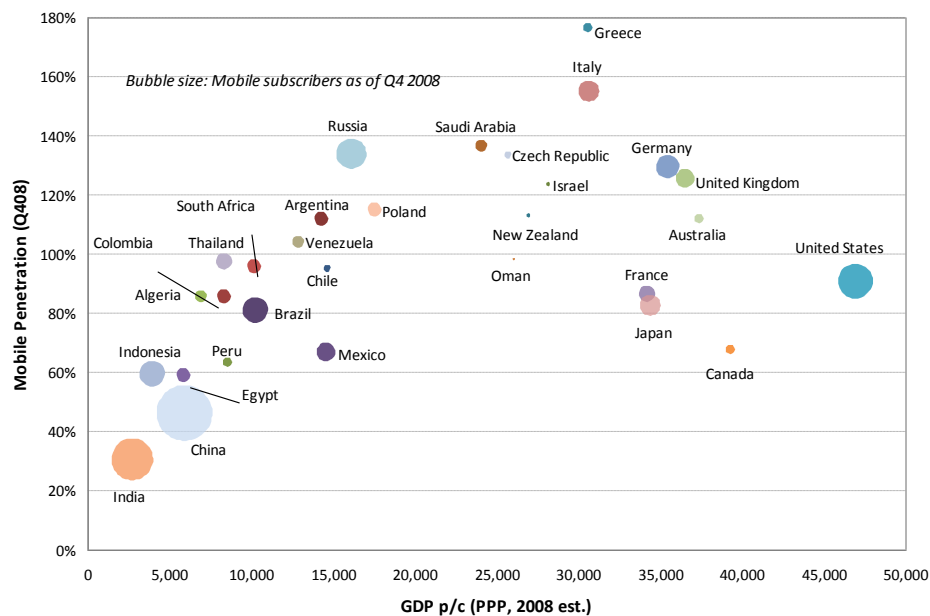
- Professor Waverman (2005) of the London Business School concluded that each additional 10% in mobile penetration increases Gross Domestic Product (GDP) by an average of 0.59% per year.
- McKinsey (2006) performed field work in China, measuring increases in productivity and improvements in social life thanks to the mobile phone, concluding that mobile telecommunications had an impact in 2005 that was equivalent to 4.9% of China's total GDP. In the Philippines, McKinsey concluded that improvements in mobile penetration drove the mobile industry's share of total GDP to 7.5% in 2005 alone.
- Deloitte (2008) expanded the analysis of indirect impacts of mobile industry growth to estimate that a 10% increase in mobile penetration can lead to a 1.2% increase in long-term growth per annum. Also, Deloitte estimated that the mobile industry contributed between 3.7% and 6.2% of GDP in 2007 in a six-country study of Serbia, Ukraine, Malaysia, Thailand, Bangladesh and Pakistan.

The surprisingly high numbers—sometimes two to four times above the usual estimates of mobile representing approximately 2.5% of a country's total GDP—are a result of modeling not only direct effects of mobile telecommunications (network build out and service provision), but also indirect effects, such as foreign direct investment, productivity increases, and human capital formation. The indirect effects promote economic activity across sectors because of more reliable communications infrastructure and connectivity, thereby enabling increased knowledge, skills, and economic growth. Thus, evidence now implies that a higher mobile penetration most likely drives maximum economic and social benefits that accelerate GDP growth.

Rational conclusion: minimize costs to expand mobile penetration. Based on the evidence, operators and regulators are highly incentivized to lower the minimum cost of ownership (MCO)—the upfront and ongoing minimum payments that consumers must make to stay connected—in order to expand mobile penetration. Figure 1 illustrates the positive relationship between mobile penetration and GDP per capita for selected countries around the world.

² See Ovum, "The economic contribution of mobile services in the European Union before its 2004 expansion," December 2004; Leonard Waverman, "The Impact of Telecoms on Economic Growth in Developing Countries," Vodafone Policy Paper Series, no. 2, March 2005; Ovum, "The economic benefits of mobile services in India," January 2005; Ovum, "The Economics and Social Benefits of Mobile in Bangladesh," April 2006; McKinsey & Co., "Wireless Unbound—The Surprising Economic Value and Untapped Potential of the Mobile Phone," September 2006; Deloitte, "Economic Impact of Mobile Communications in Serbia, Ukraine, Malaysia, Thailand, Bangladesh and Pakistan," January 2008; LECG, "3G mobile networks in emerging markets" The importance of timely investment and adoption," January 2009; McKinsey & Co., "Mobile broadband for the masses: Regulatory levers to make it happen," February 2009.

Figure 1 - World Mobile Penetration & GDP per Capita in USD



Sources: Wireless Intelligence, IMF and World Bank.

Focus now shifting to mobile data/broadband. The initial analyses of the economic and social impact of mobile were primarily focused on GSM networks that provided voice and SMS. As the GSM family of standards moved into GPRS, EDGE, and—more importantly—to HSPA, HSPA+, and LTE the debate has shifted greatly to mobile’s role as a supplier of broadband via mobile broadband. A forecast by Ovum and Ericsson in 2007 found that by 2012 the world will have 2 billion broadband connections, 65% of which will be mobile broadband.

Mobile broadband critical to growth in developed and emerging markets. In developed countries, broadband had a major impact in increasing economic productivity and driving economic growth. More recently, mobile broadband contributed to driving new applications and content. In emerging markets, the impact is even more pronounced, as limited existing copper infrastructure and low penetration of cable TV leave mobile broadband as the only feasible option to cost-effectively increase broadband penetration.

Potential benefits for emerging markets. McKinsey (2009) concluded that bringing broadband penetration levels in emerging markets to today’s Western European levels (54%) could potentially add \$300 billion to \$400 billion in global GDP and generate 10 million to 14 million new jobs across emerging economies. The study also concludes that only mobile broadband can achieve this goal. Today, broadband penetration in most developing countries is below 5%.

Economic conditions should spur further action. In the face of significant global economic challenges in 2009, mobile industry leaders believe increasing the availability of spectrum is the

single most important contribution that governments can make to help drive economic recovery. In a letter to the G-20 meeting in London last April, they wrote:

“We ask the G20 leaders to consider the vital contribution that mobile technology can make to global economic recovery and recognize the importance of these key enabling actions by government. The mobile industry stands ready to support the efforts of governments to stimulate sustainable economic recovery, through its unique ability to invest in long-term productivity enhancing technology that is also a powerful catalyst for entrepreneurial initiative, social capital, low carbon development, and digital inclusion.”³

B. Growing Spectrum Demand and Role of AWS Band

The high economic and social benefits of mobile broadband can only be realized when adequate radio spectrum is available, making the issue of spectrum licensing increasingly paramount. A broad range of new services, such as Internet access via mobile broadband, Web browsing on mobile phones, social networking, video calling, and a steady flow of new applications are dramatically increasing network data traffic and, therefore, spectrum usage. As a finite resource, spectrum—how much and in which bands—is the single most critical input to the economic viability of mobile broadband.

Sizing additional spectrum needs. Based on current trends, the International Telecommunications Union (ITU) predicted that in the next 12 years the mobile industry will utilize three times more spectrum than in the last 20 years. A key challenge will be recovering additional spectrum to license, which is scarce. ITU scenario results are included in Figure 2.

Figure 2 – Future Spectrum Needs

Demand Scenario	Total Spectrum Requirement (MHz)			
	2010	2015	2020	2025
High Demand Setting – ITU ⁽¹⁾	840	1300	1720	N/A
Low Demand Setting – ITU ⁽¹⁾	760	1300	1280 ⁽³⁾	N/A
High Urban Demand – U.K. ⁽²⁾	430	1270	1200 ⁽³⁾	1310
Low Urban Demand – U.K. ⁽²⁾	200	210	520	550

Source: Arthur D. Little, “Mobile Broadband, Competition and Spectrum Caps” ADL 2009, January 2009.

Notes: 1. ITU-R Report M.2078 (2006); 2. Analysis Mason, “Spectrum demand for non-government services 2005–2025,” report to the U.K. Independent Audit of Spectrum Holdings, <http://www.spectrumbaund.org.uk> - total capacity for mobile use in 900 MHz, 1800 MHz, 1.9/2.1GHz and 2.6 GHz bands in the United Kingdom is assumed to be 540 MHz; 3. Decrease due to deployment of more efficient systems beyond current and near-term IMT-2000 systems.

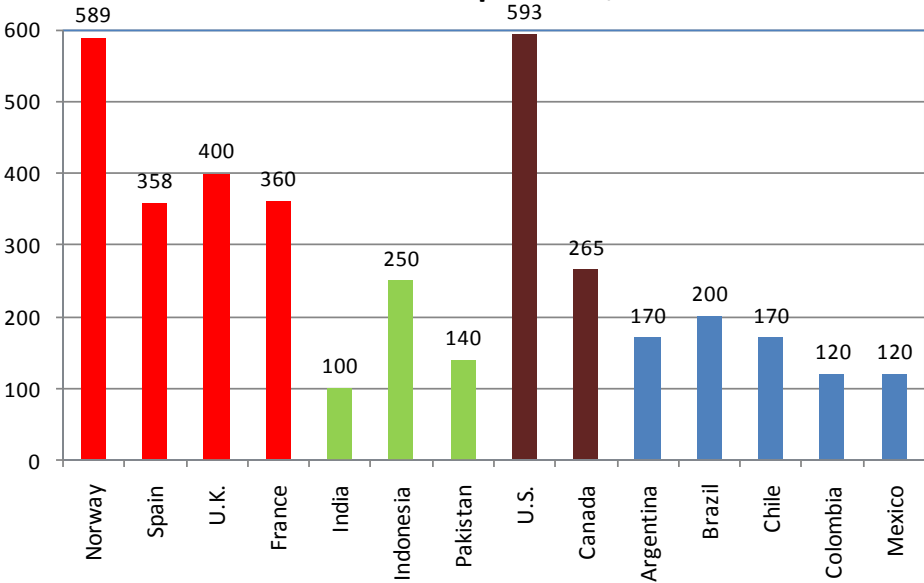
Optimal network provisioning. Mobile operators will require additional spectrum in order to increase economic efficiency in provisioning broadband via mobile. Advanced wireless networks utilizing HSPA, HSPA+ and LTE will allow for increases of data transmission speeds in the range of 1 to 50 Mb/s with theoretical peak rates of 172 Mb/s. While the economics of providing mobile broadband are still evolving—the cost per capacity is higher than for voice and SMS—certain technologies such as LTE operate more efficiently with channels of 2x20 MHz, leading to skyrocketing demand for spectrum.⁴

³ Mobile industry leaders’ letter to the G-20 meeting in London, April 2009.

⁴ See McKinsey 2009.

Current licensed spectrum around world and AWS. Providing additional capacity for broadband was one of the key motives behind the licensing of the AWS band in the United States and Canada. This is equally important for Latin American countries that also use the PCS 1900 MHz band. In Latin America, the spectrum currently licensed for mobile services is well below US and European market levels.⁵

Figure 3 – Currently Licensed Spectrum for Mobile Services in Selected Countries



Source: GSMA based on Arthur D. Little (2009), Plum, KB Enterprises LLC.

Notes: * India's value is the average per circle 2G. Pakistan's value is only for 2G services.

Recent 3G licensing and AWS plans in Latin America. In Asia, China and Vietnam licensed 3G in early 2009 to accelerate economic growth and overcome the recessionary trends in their domestic markets. In Latin America, Chile launched a “beauty contest” on April 16, 2009 to be completed by August 2009, while Argentina and Mexico are considering licensing the AWS band as an important measure to accelerate mobile broadband. In the next five years, most South and Central American countries are expected to make the AWS band available.

AWS licensing should positively impact many constituents. As a core 3G band in the Americas, the AWS 1.7-2.1 GHz band is crucial for mobile broadband. For mobile carriers, it will enhance the launch of new services that utilize USB dongles and new mobile broadband handsets and applications. For infrastructure vendors, it represents a unique opportunity to put the Americas on par with developed Asia and Europe in terms of 3G expansion and reach. For handset and device makers, the AWS band brings new opportunities in markets with pent-up demand for broadband services. For society in general, the band will unleash a critical new range of spectrum that will enhance mobile broadband’s ability to benefit consumers and increase economic productivity.

⁵ See Arthur D. Little (2009), p. 20.

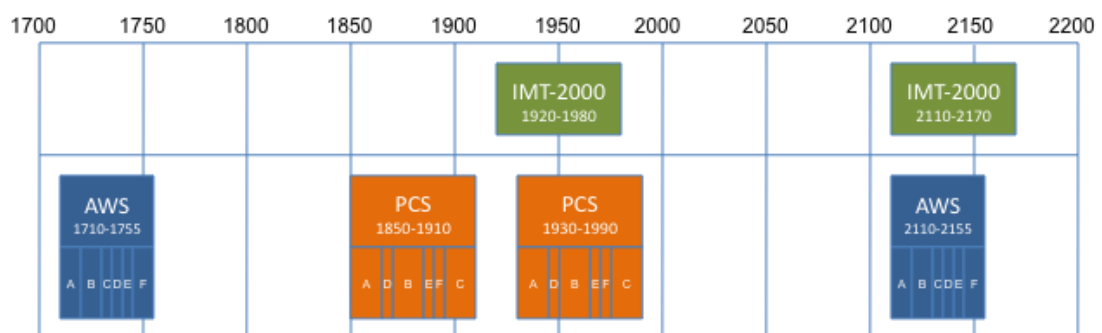
III. AWS Overview and Importance

In 2002, the United States allocated 90 MHz of spectrum for AWS at 1710-1755 MHz (transmit/uplink) and 2110-2155 MHz (receive/downlink), referred to as the AWS-1 band. The uplink AWS-1 spectrum was reclaimed from the Department of Defense and auctioned to qualified bidders in 2006 with incumbent relocation costs paid for by auction revenues. Canada followed the United States and conducted a spectrum auction in 2008 that included 90 MHz of AWS spectrum, 10 MHz of expansion PCS licenses and one block of 5 MHz at 1670-1676 in the AWS auction. There are two (2) different Band plans designated for AWS. Band 10 has an extra 15 MHz in the uplink and downlink compared to Band 4 allocations.

- FDD reference frequencies for Operating Band 4: UL 1712.6 MHz - 1752.4 MHz DL 2112.6 MHz - 2152.4 MHz Paired bands are of interest in region 2 and Japan. (This is being used by T-Mobile in USA.)
- FDD reference frequencies for Operating Band 10: UL 1712.6 MHz - 1767.4 MHz DL 2112.6 MHz - 2167.4 MHz

Frequency location relative to other bands. The AWS downlink channel is largely consistent with that of the IMT-2000 core band (2110-2170 MHz), while the uplink channel falls approximately 100-250 MHz below both the IMT-2000 (1920-1980 MHz) and PCS transmit channels. The downlink band aligns well with the global downlink but is smaller. The uplink band in the US, though, is less than what CITELE agreed to (1710-1770 MHz). Operators and vendors alike indicate that the propagation characteristics of the AWS band are sufficiently similar to the 3G core, 1800 MHz and 1900 MHz bands and, therefore, facilitate availability of network equipment and devices. Figure 4 below illustrates the AWS bands relative to IMT-2000 and PCS bands.

Figure 4 - Band Plans: IMT-2000, AWS (US & Canada), PCS (US)



Source: ITU, FCC, Industry Canada.

AWS represents a large portion of total mobile wireless airwaves. For the United States and Canada, the additional 90 MHz of AWS spectrum for commercial mobile wireless services

represents an estimated 15% and 34%, respectively, of total licensed spectrum through 2008.⁶ For other countries in the Americas, the percentage may range from 30% to 40%. Figure 5 below shows expected AWS spectrum as a percentage of total licensed mobile spectrum across the Americas.

Figure 5 – AWS Spectrum as % of Total Mobile Spectrum*

	2009E	2010E	2011E	2012E	2013E
United States	15%	18%	18%	21%	21%
Canada	34%	34%	34%	34%	34%
Mexico	0%	37%	37%	37%	37%
Argentina	35%	35%	35%	35%	35%
Chile	35%	35%	35%	35%	35%
Colombia	0%	43%	43%	43%	43%
Peru	0%	0%	41%	41%	41%
Venezuela	0%	0%	47%	47%	47%

Source: GVP estimates; Ricardo Raineri, "Análisis del Mercado de Telefonía Móvil e Incentivo de Operadores Preexistentes ante el Concurso de la Banda 3G en Chile," 2008, http://www.tdcl.cl/DocumentosMultiples/Informe_Ricardo_Raineri_Nextel.pdf.

* United States assumes issuance of additional AWS spectrum in 2010 and 2012; all other countries assume total licensed spectrum as of 2008 held constant through forecast period.

AWS meets pent-up demand. The AWS spectrum auction in the United States was especially significant because it marked the first auction of a large block of mobile spectrum with nationwide coverage to be auctioned since the PCS auctions in the early 1990s.⁷ The opportunity for operators to obtain wide bands of spectrum, along with growing capacity needs and uncertainty over potential 700 MHz band auctions (known as the "digital dividend"), created large, pent-up demand for additional wireless spectrum. Accordingly, there were over 250 auction applicants, 168 of which became qualified bidders.

Auction proceeds to-date. For the US AWS auction, gross bids totaled \$13.9 billion while net bids amounted to \$13.7 billion or \$0.53 per MHz-POP (net of bidding credits offered to small businesses). As shown in Figure 6 below, the proceeds were lower than the \$20.3 billion raised from the PCS auctions, yet still represent a very significant outlay.

Figure 6 - US AWS and PCS Auction Prices

Auction	Date	Spectrum	Revenue	Price/ MHz-POP
PCS A and B Block	1994	40 MHz	\$7,721,103,797	\$0.76
PCS C Block	1995	30 MHz	\$10,071,708,841	\$1.33
PCS D, E and F Blocks	1996	30 MHz	\$2,517,439,565	\$0.33
AWS Auction	2006	90 MHz	\$13,700,267,150	\$0.53

Source: FCC, KB Enterprises LLC.

⁶ Includes 700 MHz and 2.5 GHz spectrum for United States.

⁷ The PCS auctions in the United States were held in the early 1990s and the Wireless Communications Services auction (30 MHz in the 2300 MHz band) was held in 1997 with few auctions of mobile spectrum over 5 MHz covering the entire United States after that until the AWS auction. A list of all FCC spectrum auctions can be found at: http://wireless.fcc.gov/auctions/default.htm?job=auctions_all.

In Canada, the AWS spectrum auctions of 90 MHz produced net bids of \$4.2 billion, or \$1.55 per MHz-POP, higher than price per MHz-POP amounts realized from combined PCS auctions of 50 MHz. [Figure 7]

Figure 7 - Canadian AWS and PCS Auction Prices

Auction	Date	Spectrum	Revenue	Price/ MHz-Pop
PCS	2001	40 MHz	\$1,481,920,000	\$1.23
AWS	2008	90 MHz	\$4,177,503,000	\$1.55
PCS Expansion	2008	10 MHz	\$74,681,077	\$0.13

Source: Industry Canada, KB Enterprises LLC.

In Latin America, while no AWS spectrum has been licensed as yet, Chile recently moved forward with a beauty contest and Argentina is expected to hold an auction this year, with Mexico and other countries following in 2010.

IV. AWS Licensing To-Date and Expectations for the Americas

A. United States

AWS market participants. The AWS auction in 2006 garnered wide interest and participation from incumbent operators as well as new entrants into the wireless market. Of the incumbents, T-Mobile USA was the most aggressive given the operator's desire to establish a nationwide footprint suitable for 3G services. On the new entrant side, SpectrumCo—a consortium of cable operators including Comcast, Time Warner, Cox, and Advance Newhouse, and satellite operator, EchoStar—made a large push with the goal of offering new wireless services to their existing customer bases. It was reported that SpectrumCo hoped that other potential new entrants, including technology companies such as Google, eBay, and Skype, would wait for the 700 MHz auction and not compete for the AWS spectrum. All bidders were encouraged by T-Mobile's participation and believed that the operator would be a leader in the relocation of incumbent private and public licensees in the band. Bidders further believed that T-Mobile's global breadth would lead the way in encouraging chip and handset manufacturers to deliver compatible equipment for the band.

AWS license terms and conditions. Relative to prior licenses, the FCC structured AWS licenses with a longer term and relaxed "substantial service" requirements to give licensees more time to build out service in a spectrum band where equipment did not yet exist. In addition to the prediction of slow availability of type-accepted equipment for the AWS band, some relocation of government and private incumbent licensees also needed to occur. As a result, the term length was set at 15 years—compared to ten years for all other commercial radio licenses previously issued—and the FCC implemented vague "substantial service" requirements that allowed bidders to hold spectrum until equipment was manufactured and incumbents were relocated. Notably, the FCC did not specify exact coverage benchmarks for building and deploying the AWS service.⁸ Rather, substantial coverage was defined as service that is "sound,

⁸ Found in section 27.14(a) of the FCC's rules, substantial service is vaguely defined as "service which is sound, favorable, and substantially above a level of mediocre service which just might minimally warrant renewal." 47 C.F.R. § 27.14(a).

favorable, and substantially above a level of mediocre service....⁹ Finally, no spectrum was set-aside for any designated entities (i.e., new entrants), but small businesses (based on average annual revenues over the previous three years) were given bidding credits that reduced the bidder's final amount due.

Auction mechanics. The auction was conducted as a single simultaneous multiple round auction that included 1,122 licenses. The FCC imposed an aggregate reserve price of \$2.06 billion in order to ensure the recovery of the estimated relocation costs for government licensees at 1710 – 1755 MHz¹⁰.

Bidding and winners. The auction commenced August 9, 2006 and ended September 18, 2006, with 161 rounds conducted over 28 bidding days. There were 168 qualified bidders in the auction and 104 different bidders won 1,087 licenses. The gross bids totaled \$13,879,110,200 (bids net of the bidding credits offered to small businesses totaled \$13,700,267,150). As shown in Figure 8, T-Mobile USA, Verizon Wireless, SpectrumCo LLC, MetroPCS, Leap Wireless, and Denali Spectrum were the large winners.

Figure 8 - United States AWS Auction Winners

Top Ten License Winners	Winning Bids	Price/ MHz-pop	Licenses	Population*
T-Mobile License LLC	\$4,182,312,000.00	\$.63	120	474,718,308
Cellco Partnership d/b/a Verizon Wireless	\$2,808,599,000.00	\$.73	13	192,047,611
SpectrumCo LLC	\$2,377,609,000.00	\$.45	137	267,387,437
MetroPCS AWS, LLC	\$1,391,410,000.00	\$.97	8	144,544,402
AT&T (Cingular AWS, LLC)	\$1,334,610,000.00	\$.55	48	198,768,198
Leap (Cricket Licensee)	\$710,214,000.00	\$.44	99	117,802,839
Denali Spectrum License, LLC	\$365,445,000.00	\$.63	1	58,178,304
Barat Wireless, L.P.	\$169,520,000.00	\$.33	17	41,601,174
AWS Wireless Inc.	\$115,503,000.00	\$.12	154	60,498,394
Atlantic Wireless, L.P.	\$100,392,000.00	\$.27	15	35,803,110

Source: FCC, KB Enterprises LLC.

Note: * Represents the sum of the population covered by each license won by the bidder and may include overlap as multiple blocks cover the same population.

AWS license transfers. Since the AWS spectrum auction, a number of licenses have transferred ownership. Recent AWS spectrum trades are notable because they signal a viable secondary market for license assets and also move spectrum to operators with definitive near-term build-out plans. Figure 9 below summarizes the major changes in ownership of AWS licenses.

⁹ For a discussion of the details of substantial service as compared to specific population coverage benchmarks in build-out requirements, see Jennifer Prime, "Finding Substance in the FCC's Policy of "Substantial Service" Federal Communications Law Journal Vol. 56 No. 2, 2004.

¹⁰ If the price of all 1,122 licenses did not meet the aggregate reserve price, the results of the auction would be nullified.

Figure 9 - US AWS Major Spectrum Trades

Winning Bidder	Assignee	Number of Licenses	Type of Transfer
SpectrumCo	Cox Communications	15 15	Full Transfer Market Partition ¹¹
NextWave	T-Mobile	57	Full Transfer
NextWave	Flat Wireless	5	Full Transfer
NextWave	MetroPCS	9	Full Transfer
Daredevil	Flat Wireless	2	Full Transfer

Source: KB Enterprises LLC.

Network launches to-date. Of AWS license winners, T-Mobile, Leap Wireless, and MetroPCS have been most aggressive deploying networks in the AWS band. Large incumbents such as Verizon Wireless and AT&T seem to be taking more time, possibly saving the spectrum for future capacity needs or LTE. While Leap Wireless and MetroPCS are CDMA operators, their success in rapidly rolling out new markets and adding new customers reveals the viability of the AWS band and points to potential future deployments of LTE in the AWS band.

- T-Mobile USA.** T-Mobile is the fourth-largest US wireless carrier covering more than 268 million POPs and serving nearly 33 million subscribers as of year-end 2008. The operator aggressively deployed 3G UMTS/HSPA network coverage in the AWS band during 2008 to cover 27 markets and 107 million POPs at year-end. The operator launched its first HSPA handset in September 2008 and, according to Wireless Intelligence, had approximately 1.8 million HSPA subscribers at the end of 1Q09. T-Mobile plans to cover more than 200 million POPs by year-end 2009 and is quickly introducing new 3G devices. In March 2009, the operator announced the availability of the “T-Mobile webConnect USB Laptop Stick” from Huawei Technologies Co., which supports HSPA and WiFi (802.11 b/g) network access.
- MetroPCS.** MetroPCS is a large regional CDMA carrier covering 64 million POPs and serving 5.4 million subscribers as of year-end 2008. The operator pursues a strategy of offering flat-rate unlimited wireless service plans and is using AWS spectrum for capacity and footprint expansion in certain markets. Including AWS spectrum, MetroPCS plans to launch services in several major metropolitan markets in 2009 and 2010, bringing coverage to an additional 40 million POPs.
- Leap Wireless.** Leap Wireless is a large regional CDMA carrier covering 67 million POPs and serving 3.8 million subscribers as of year-end 2008. Like MetroPCS, Leap offers flat-rate unlimited wireless service plans. In addition, Leap offers an unlimited mobile broadband service using CDMA technology across all POPs. Leap and its spectrum partner, Denali Spectrum, collaborated in the AWS auctions to spend approximately \$1 billion and announced that the new licenses will enable the carrier to bring covered POPs to 182 million. During 2008, Leap launched AWS networks covering 11 million POPs and is targeting an additional 25 million POPs in 2009,

¹¹ The FCC allows licensees to partition or disaggregate licenses, thereby breaking them into smaller areas either geographically or in terms of radio frequencies. In this case, SpectrumCo fully assigned 15 licenses and assigned a portion of the geographic area in 15 other markets.

bringing total covered POPs to more than 90 million. For AWS markets, Leap expects to launch a “broader product family” this year, including voice/data, broadband, and pre-paid services.

- **Stelera Wireless.** Stelera Wireless is a new entrant that acquired 42 AWS licenses and currently deploys high-speed broadband services in rural areas covering almost 6 million POPs. Stelera began offering services in February 2008 under a flat, all-IP Internet High Speed Packet Access (I-HSPA) architecture solution provided by Nokia Siemens Networks.
- **Cox Communications.** Cox Communications is a multi-service broadband communications and entertainment company with more than 6 million total residential and commercial customers. To offer the “quadruple play” of cable, Internet, voice and wireless services, Cox is planning to build and launch a wireless network this year across the company’s cable markets using CDMA technology.

B. Canada

Market participants. Three major nationwide telecommunications carriers—Rogers, Bell and TELUS—hold the entire cellular and PCS license allocation in Canada. The following chart (Figure 10) summarizes the spectrum holdings of each carrier in each of the Canadian regions prior to the recent Canadian AWS spectrum auction. As in the United States, pent-up demand for additional spectrum and an uncertain timetable for digital dividend spectrum availability (in the 700 MHz band) created a situation in which incumbents desired spectrum in the AWS band.

Figure 10 - Canadian Spectrum Holdings in Cellular, PCS and ESMR services

Market	Population	Rogers MHz	Bell MHz	TELUS MHz
Toronto	4,883,800	75	55	50
Montreal	3,507,400	85	45	50
Vancouver	2,076,100	85	40	55
Ottawa-Gatineau	1,102,900	85	45	50
Calgary	976,800	85	40	55
Edmonton	961,500	85	40	55

Source: Lamay-Yates Associates, Inc. Canadian and US Mobile Spectrum Holdings Prepared for Mobilexchange Ltd. May 25, 2007; KB Enterprises LLC.

AWS license terms and conditions. Canada’s regulatory body, Industry Canada, closely followed the United States in implementing its AWS band plan and auction rules. However, unlike the United States, Industry Canada implemented a set-aside in the AWS spectrum band for new entrants, specific roaming requirements, and a 10-year license term.

- **Set-aside for new entrants.** For new entrants, 40 of the 90 MHz available in the AWS band were set aside in frequency blocks B, C, and D. To be eligible for the set-aside, a

new entrant was defined as *an entity, including affiliates and associated entities, which hold less than 10 percent of the national wireless market based on revenue.*¹²

- **Automatic roaming.** In order to facilitate the entry of new companies into the market, Industry Canada also required licensees to offer automatic digital roaming on their networks in conjunction with the AWS spectrum auction. Roaming arrangements were required to be offered wherever technically feasible, negotiated expeditiously and in good faith. Negotiations between carriers were to be time-limited, and if the parties were unable to come to an agreement within the established time frame, they were required to undertake binding arbitration.¹³
- **10-year term.** Canada implemented a 10-year initial license term and employed a population-based build-out requirement at a five-year roll-out target.

Auction mechanics. After the US success in the PCS spectrum auctions, Canada developed a similar auction system that employed simultaneous multiple round auction rules to allow bidders to aggregate spectrum across spectrum blocks and geographic areas. On May 27, 2008, Industry Canada conducted a spectrum auction that included 90 MHz AWS spectrum, 10 MHz of expansion PCS licenses and one block of 5 MHz at 1670-1676 in the AWS auction.

Bidding and winners. The policy choices by the government, along with the demand for spectrum bandwidth, paved the way for a robust competitive auction. The set-aside and roaming requirements reduced the risk for new entrants to enter the auction and significantly increased the spectrum auction competition for the incumbent carriers in the open eligibility blocks. In addition, the set-aside blocks created greater opportunity for at least one additional national wireless carrier. The resulting auction prices are included in Figure 11 below.

Figure 11 - The Winners of the 2008 Canadian Spectrum Auction (in US Dollars)

Top Ten License Winners	Winning Bids	Price/ MHz-pop	Licenses	Population*
Rogers	\$999,367,000	\$1.67	59	30,007,094
TELUS	\$879,889,000	\$1.82	59	30,007,094
Bell Mobility Inc.	\$740,928,000	\$1.75	54	27,245,106
Québecor Inc	\$554,549,000	\$1.46	17	14,687,045
Globalive Wireless	\$442,099,000	\$1.24	30	23,265,134
Data & Audio-Visual	\$243,159,000	\$1.39	10	16,121,864
Shaw Communications	\$189,519,000	\$1.01	18	9,351,375
SaskTel	\$65,690,000	\$1.35	3	975,717
6934579 Canada Inc.	\$52,385,077	\$0.15	4	17,675,254
MTS/Allstream	\$40,773,750	\$0.61	3	1,118,283

Source: Industry Canada, KB Enterprises LLC.

Notes: Represents the sum of the population covered by each license won by the bidder and may include overlap as multiple blocks cover the same population.

¹² <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08833.html#fig1> Policy Framework for the Auction for Spectrum Licenses for Advanced Wireless Services and other Spectrum in the 2 GHz Range. November 2007.

¹³ Id.

Network launches by new entrants expected by year-end 2009. Conversations with industry participants imply that new entrants may launch selected markets towards the end of 2009. Incumbent players appear to be taking a slower approach toward utilizing the band. Wireless Intelligence estimates that there were 584,765 HSPA subscribers in Canada at the end of 1Q09, all belonging to Rogers Wireless and in legacy spectrum bands.

C. Latin America

Many Latin American countries implemented US PCS 1900 services and structured their national band plans attributing the 1.7-2.1GHz band for IMT-2000 services, following ITU and CITELE (Inter-American Commission on Telecommunications) recommendations for Region 2. Although many countries could allocate 2x60 MHz (1710-1770 / 2110-2170MHz) for mobile services and reserve 2x15 MHz for future expansions (e.g., 1755 -1770 MHz paired with 2155 -2170 MHz), regulators tend to follow the US licensing program structure to create some level of geographic spectrum consistency. As a result, most plans call for the initial allocation of 90 MHz (2x45 MHz) and leave 25 MHz in the 2155-2180 MHz frequency band (known as AWS-3) for some time in the future.

To-date, based on Wireless Intelligence estimates, Latin America has more than 2 million 3G HSPA subscribers in frequency originally licensed for 2G use, totaling 41 HSPA networks in services in the region. Flexible licensing regimes in most of the countries allowed the “re-farming” of 2G frequencies within an existing license for 3G deployment. Only a few countries, such as Brazil and Uruguay, are following the 1.9-2.1 GHz IMT-2000 core band specifically for 3G services. All other countries in ITU Region 2 are expected to follow the United States in allocating 1.7-2.1 GHz band for 3G services.

Chile. The country telecom regulator, Subsecretaria de Telecomunicaciones (SubTel), launched a beauty contest for licensing the AWS (1.7-2.1 GHz) band spectrum. Three blocks of 30 MHz (2x15 MHz) nationwide spectrum (for a total of 90 MHz) will be offered exclusively for new entrants. The process officially started as of April 16, 2009 and is predicted to end in August 2009. In January 2009, a Supreme Court decision maintained a 60 MHz spectrum cap per operator for this particular AWS licensing, thereby excluding incumbents from participating in the new licensing program. The decision concluded a long controversy between incumbent mobile network operators and SubTel over the AWS band.

At least one new operator may begin offering services based in the AWS band by spring 2010. Fixed broadband penetration stands at 9% and growth is decelerating, placing increased importance on wireless broadband services to sustain increases in broadband penetration. Next-generation services launched to-date by three incumbent operators—Movistar, Entel PCS and Claro, using 850 MHz and 1900 MHz—have produced approximately 400,000 3G HSPA connections as of March 31, 2009.

SubTel is also planning to allocate frequencies in the 2.5-2.69 GHz and 700 MHz bands in the near future, as both bands are seemingly cleared and ready to be licensed. The exact timing awaits clarity on international harmonization options and technology and equipment availability. However, addressing the spectrum cap issue remains critical to allow incumbent mobile operators access to these spectrum bands.

Mexico. The AWS licensing process in Mexico, together with other frequencies to be allocated, started approximately two years ago and is moving forward sporadically. The policy maker, Secretaria de Comunicaciones y Transporte (SCT), and the regulator, Comision Federal de Telecomunicaciones (CoFeTel), are still trying to agree on the general basis for the bidding of 250 MHz in five bands (1.9 GHz, 1.7-2.1 GHz, 3.4-3.7 GHz, 71-81 GHz, and 410-430 MHz). According to a March 2008 joint statement made by both SCT and CoFeTel¹⁴, they plan to auction a total of 90 MHz (2x45 MHz) for AWS services in Mexico's nine cellular regions. Recent news reports indicate plans to reserve a block for one or more new entrants. Finally, a spectrum cap of 65 MHz currently applies to mobile network operators (MNOs) in Mexico, which could potentially prevent incumbent operators such as Telcel (America Movil) and Movistar (Telefonica) from applying for new spectrum. This is one of the key issues requiring resolution prior to proceeding with licensing.

Figure 12 - Mexican Band Plan Defined on March 2008

Block	Frequency	Paired	MHz Paired	Total MHz
A	1710-1720 MHz	2110-2120 MHz	2x10 MHz	20 MHz
B1	1720-1725 MHz	2120-2125 MHz	2x5 MHz	10 MHz
B2	1725-1730 MHz	2125-2130 MHz	2x5 MHz	10 MHz
C	1730-1735 MHz	2130-2135 MHz	2x5 MHz	10 MHz
D	1735-1740 MHz	2135-2140 MHz	2x5 MHz	10 MHz
E	1740-1745 MHz	2140-2145 MHz	2x5 MHz	10 MHz
F	1745-1755 MHz	2145-2155 MHz	2x10 MHz	20 MHz

Source: SCT, CoFeTel.

The licensing process could reasonably be expected to happen towards the end of 2009 or beginning of 2010 given operator needs for additional spectrum. Existing operators are increasingly seeking to compete by offering 3G in some regions within current spectrum assignments. The government is aware of the importance of allocating new spectrum as soon as possible to facilitate broadband penetration and economic growth. President Calderon's government objective, as set out in the National Program of Infrastructure 2007-2012, aims to achieve 22% broadband penetration by 2012, compared to current fixed broadband penetration of around 6%. Wireless broadband appears integral to achieving the 2012 target.

Argentina. The telecom regulator SeCom (Secretaría de Comunicaciones), which is part of the Ministry of Infrastructure and Federal Planning, is planning to launch a 3G auction in the 1.7-2.1 GHz band in July 2009. In September 2008, SeCom and its counterpart telecom control entity, the Comision Nacional de Comunicaciones (CNC), set up a technical working group to address future spectrum licensing processes that began launching a TDD auction in the 3.5 GHz band by the end of 2008. This group also has the mandate to further allocate vacant chunks of spectrum in 850 MHz and 1900 MHz and is evaluating the potential allocation of the 700 MHz band, which could become available after the digitalization of television¹⁵.

SeCom seems to have everything ready to auction the AWS (1.7-2.1 GHz) band this year and is hoping to attract a new entrant. Since 1998, a combined 50 MHz spectrum cap per operator in

¹⁴ SCT document "Nuevo Programa de Licitacion de Frecuencias" March 31st, 2008.

¹⁵ The decision of a digital terrestrial TV standard has been consistently postponed by Argentine authorities. However, unofficially it seems the country has already chosen the ISDV-T Japanese standard.

each region has been effective in the country. This is an issue the regulator will have to address if it wants incumbent operators to access this spectrum. The Argentine mobile market is very competitive and ranks first in the region in terms of mobile penetration, reaching 115% as of March 31, 2009. In addition, Argentina has a vibrant broadband market with fixed penetration now approaching 9%. Demand for mobile broadband is expected to increase significantly in the near future, and more spectrum availability will certainly facilitate growth. If the AWS auction occurs as scheduled in July 2009, operators might launch operations in this band as early as the second quarter of 2010.

Colombia. The 1.7-2.1 GHz band is reserved for IMT-2000 services by the Ministry of Communications, which is the national authority in charge of spectrum management. Although no license timing has been announced, the Ministry is believed to be working to publish a proposal to structure the AWS band shortly. The Ministry is very interested in promoting mobile broadband and the provision of new data services, including tourism, geo-location, logistics, and mobile banking and, on April 17th 2009, launched a licensing program for 90 MHz in the 2.5-2.69 GHz band. In addition, it has been reported by different news sources that the Ministry plans to grant an additional 15 MHz in the 1900 MHz band for the two largest incumbent mobile operators, Comcel (America Movil) and Movistar (Telefonica Moviles). These two operators, together with the third market player, Tigo (Millicom), have all reached to the top of the 40 MHz spectrum cap that is allowed for mobile operators, the most restrictive spectrum cap per operator in Latin America. The 2.6 GHz band licensing proposal would allow moving this cap from the existing 40 MHz to 60 MHz.

Other Latin American Countries. Most other Latin American countries also attribute the 1.7-2.1 GHz band for IMT-2000 services in their respective national frequency plans. Still, according to discussions with regulators responsible for allocating spectrum, many are holding off on developing a licensing program until major MNOs specifically request additional spectrum. However, based on increasing mobile penetration rates, larger countries such as Venezuela—with greater than 100% penetration—Peru and Ecuador are likely candidates to launch licensing programs soon after Chile, Mexico, Argentina and Colombia. By contrast, Central American countries—where in many cases the AWS band is not yet on the minds of regulators—are further off, with licensing perhaps not until 2012.

V. Insights from Carriers and Vendors

Discussions with leading wireless equipment vendors and AWS-band wireless operators produced a number of findings, many of which were surprisingly consistent. At a high level, vendors and operators concurred that (1) the AWS band is very similar to existing mobile wireless bands, (2) no technical roadblocks prevent delivery of equipment/handsets in scale, and (3) AWS product demand is accelerating on the back of T-Mobile USA's deployment. However, a commonly noted challenge relates to mobile baseband chipsets supporting a limited number of frequency bands. The good news is that newly announced products are expected to support more simultaneous bands in 2010, enabling full voice and data roaming across all regional and global bands such as 850 MHz, 900 MHz, 1800 MHz, 1900 MHz and 2.1GHz, in addition to AWS 1.7-2.1 GHz.

Key findings are outlined below and suggest that a healthy AWS ecosystem is developing to support HSPA deployment and additional licensing throughout the Americas.

- **The AWS band is sufficiently similar to other frequency bands and has similar propagation characteristics.** Close frequency proximity to IMT-2000 and PCS bands is enabling rapid product development and network deployment. With relatively minor engineering adjustments, vendors already offering 1800/1900 MHz band products can readily support AWS-band products. On the operator side, network planning and deployment in the AWS band is largely comparable to deploying in the 1900 MHz band across various morphologies (urban, suburban, and rural).

"For Operators around the world, nothing is more central to reliably serving customers, than having access to high quality radio spectrum. We know from experience at T-Mobile, that each band has its merits; the lower UHF bands provide excellent propagation characteristics yet typically have limited availability and smaller spectrum allocations. The higher bands, above 2.6GHz, usually have larger spectrum allocations, yet they do not provide the same valuable propagation benefits of the lower bands. For operators wishing to balance both capacity and propagation characteristics, the "sweet spot" lies between 1GHz and 2GHz on the spectrum chart. Consequently, the AWS band is ideal for delivering great voice and mobile broadband services to customers."
Neville Ray, Senior Vice President, Engineering Operations – T-Mobile USA

- **AWS infrastructure equipment and devices are ready today.** Given the close relationship to the other bands, AWS infrastructure equipment and devices are available in scale today, with increased volumes forthcoming.

"At T-Mobile USA, we are working with our suppliers to deliver a broad range of innovative AWS-banded devices to market. Our suppliers share our vision of the value the AWS band enables. Consistently, we observe suppliers leveraging investments made previously for the 1.9/2.1 band, and delivering high performing and price competitive AWS-banded devices. The AWS device eco-system is broadening each day and is tied to the burgeoning growth of 3G globally."
Neville Ray, Senior Vice President, Engineering Operations – T-Mobile USA

- **Production cost curves are comfortable and improving.** According to several vendors, cost curves are not all that different from mainstream products today and are not slowing the introduction of AWS products. Moreover, the component supply chain—particularly semiconductor players—appears ready and excited to support AWS hardware in scale.

“Qualcomm has long recognized the value of the AWS spectrum in the Americas as a logical extension of the existing 3G bands. Therefore, we have designed and implemented virtually across all of our chipset solutions to support our customers and operators with this capability.”

Alex Katouzian, Vice President, Qualcomm CDMA Technologies

- **Infrastructure ramping.** T-Mobile USA reports no problems with HSPA equipment procurement and expects to cover more than 200 million POPs by year-end 2009, up from 107 million POPs covered at year-end 2008. New entrant Stelera Wireless is also progressing with HSPA market expansion, aiming to cover 55 cities across the Midwestern United States by June 2009 and 110 cities by year-end 2010.

“Ericsson is a leader in AWS build outs, having provided infrastructure to T-Mobile USA to support its deployment of HSPA in the band. We look forward to further expanding AWS coverage bringing the benefits of high capacity, mobile broadband networks to consumers throughout the Americas”

Barbara Baffer, VP Public Affairs and Regulations, Ericsson Inc

- **Devices growing more plentiful.** According to T-Mobile USA, Motorola, Nokia, Samsung, Huawei, HTC and Sony Ericsson all have products in the AWS band today. Importantly, T-Mobile USA is “seeing a healthy supply of AWS-banded handset products from all major suppliers.” Further, of the operator’s 48 total devices currently offered, nine support the AWS band, and management expects approximately 50% of the portfolio will support AWS within one year, approximately 80% within two years, and more than 90% in five years.
- **Innovative Broadband devices.** In addition to handsets, AWS banded data cards, modems and routers are also becoming more available. BandRich, Huawei and Option, for example, have all either launched or are planning to launch AWS-banded data devices in 2009.
- **Field test tools.** To speed up network deployment, field test tool for AWS band network performance measurement and tuning is of critical importance. ASCOM, Anite and BandRich are coming out with AWS banded field test tools to support the network deployment ramp up.
- **Device caveat and roaming – devices currently support only two simultaneous “high” bands.** At present, devices can handle a maximum of two simultaneous high bands only (e.g., 1900 MHz and 2100 MHz), and third-generation mobile devices typically support three frequency bands total. The operator can specify two low (e.g., 800 MHz/900 MHz) and one high (e.g., 1900 MHz), or the opposite (one low, two high).

As a result, in the short-term 3G roaming service in certain countries may be limited depending upon band selection by the operator. Fortunately, multiple vendors are introducing handsets capable of supporting three (or more) simultaneous high bands with volume shipments available in 2010. T-Mobile USA is currently prioritizing high bands over lower bands due to the operator's spectrum asset portfolio in the United States and abroad.

- **AWS spectrum clearing not a roadblock in the United States.** Based on the rapid deployments of T-Mobile USA, MetroPCS, and Leap Wireless, relocation of incumbent users has not materially obstructed AWS network deployment. Specifically, T-Mobile indicated that “relocation of incumbents is progressing well and T-Mobile USA now sees a clear path to serving the majority of US POPs this year.” Early on, working with the various US Government agencies to clear the AWS spectrum was reportedly challenging for T-Mobile. That said, once they established the right kind of relationships, demonstrated their commitment and built mutual trust; they found the US Government agencies quite easy to deal with.
- **T-Mobile USA is trailblazing to achieve rapid AWS subscriber penetration.** While the initial market opportunity was small for potential suppliers, the addressable market is quickly expanding. T-Mobile USA expects to drive device and subscriber penetration rapidly over the next several years, with approximately one-half of the operator's subscriber base—or an estimated 20 million subscribers—expected to be on HSPA in the AWS band in two years and more than 90% in five years. Further, the operator foresees AWS inclusion in all network devices as soon as the latter part of 2010, when chipsets support three high bands. The success of MetroPCS and Leap Wireless on the CDMA side also spurs HSPA operators to move rapidly in the AWS band.
- **Areas for industry-wide collaboration.** The emerging AWS ecosystem points to several important areas to drive AWS forward:
 - Allocate and license AWS spectrum where available, while emphasizing global harmonization of spectrum bands and technology neutrality.
 - Promote the compatibility of the band in relation to the 1.9/2.1 GHz core band and also PCS 1900 MHz, which have similar propagation characteristics and operate well on similar cell site grid spacing.
 - Highlight the growing portfolio of available AWS devices and demonstrate that the band exhibits attractive propagation characteristics suitable for 2G, 3G and future 4G systems.

VI. Sample of Commercially Available Devices

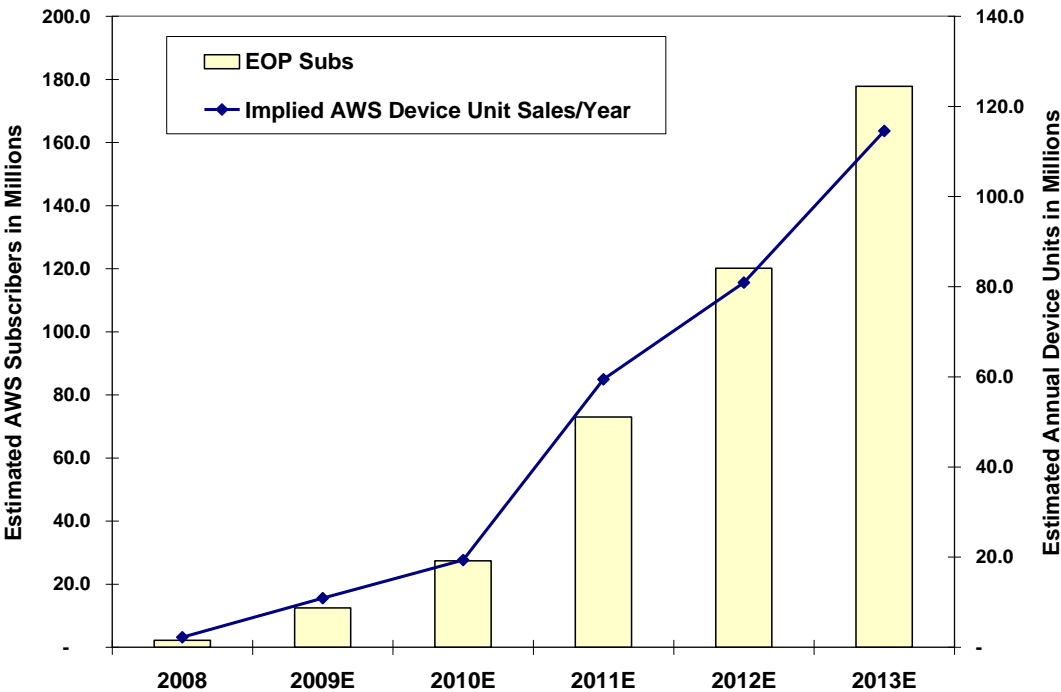
As highlighted elsewhere in this report, many AWS-enabled devices have been commercially launched in the marketplace and many more are in the pipeline and in the development or testing phases now. Following is just a sample of some of the devices which have already been commercially launched.

<p>Handsets</p>	 Samsung - Memoir	 Samsung - t639	 Samsung - Android I7500	 Samsung - Behold	 Samsung - t819
 Pharos - Traveler 137	 Sony Ericsson - TM-506	 Sony Ericsson - XPERIA X1	 Sony Ericsson - TM506	 Sidekick - LX	 Nokia - 3555
 Nokia - 6263	 HTC - G1	<p>USB Modems</p>	 webConnect - USB Stick	 Franklin W. - CGU-720	 BandRich - C105
 BandRich - C105	 FLYCARD - FLY-H1	<p>Wireless Routers/ Data Cards</p>	 FLYBOX - FLY-HR2	 Lightspeed - ROUTER-240T	 Lightspeed - HSDPA-110V

VII. AWS Total Addressable Market Forecast

The track record of AWS licensing in the United States and Canada, expectations for Latin America, and interviews with regulators and industry participants all provide a basis for establishing a five-year AWS subscriber and handset/device forecast model for the Americas. Including network launches of T-Mobile, Leap Wireless, and MetroPCS last year, the United States ended 2008 with an estimated 2.2 million customers in the band (perhaps two-thirds HSPA and one-third CDMA). The continued push of these carriers and additional licensing across the Americas brings total subscribers with AWS enabled devices to an estimated 177.8 million at year-end 2013, a compound annual growth rate of 94% from an estimated 12.4 million at year-end 2009. As the subscriber base grows, estimated handset/device unit sales are also expected to increase rapidly, reaching an estimated 114.5 million in 2013, an annual compound growth rate of 80% from an estimated 10.9 million in 2009. Importantly, during this period, the licensed AWS population (POPs) is projected to increase to an estimated 732 million from an estimated 328 million at year-end 2008. Summary results are included in Figure 13 below.

Figure 13 – Forecast AWS Subscribers and Handsets for the Americas



Source: GVP estimates, company and country reports.

Market launch assumptions. Based on insights for each country, the model assumes the following for AWS network launches:

- US: since mid-2008 (fact)
- Canada: end 2009 (assumption)
- Chile: early 2010 (assumption)

- Argentina: mid-2010 (assumption)
- Mexico: end 2010 (assumption)
- Colombia: end 2010 (assumption)
- Rest of South America: assume 2011-2012, especially for large countries such as Venezuela, Peru, Ecuador, and Paraguay
- Central America: assume licensing in 2012-2014

As noted previously, Brazil and Uruguay are following the 1.9-2.1 GHz IMT-2000 core band plan and, accordingly, are excluded from our model.

Methodology. The model produces country-level forecasts that are rolled up into the Americas forecast. For each country, the methodology incorporates the following:

- Wireless market penetration and implied covered POPs, total end-of-period (EOP) wireless subscribers, gross additions, disconnects (churn), and net additions.
- Three scenarios—low, base case, and high—for AWS subscriber penetration of total market subscribers in each year.
- Assumed AWS churn rates, handset/device upgrade rates, and handset/device discount rates drive total estimated AWS handset units in each year. The handset/device discount is applied to capture refurbished and gray market handsets, as well as multiple SIM cards that are included in calculated gross subscriber additions.

AWS penetration assumptions. Penetration assumptions in each market are the most critical variable. For all of the Americas, the model assumes gradual AWS penetration in the early years and acceleration in 2011-2013 as additional licensing is completed. The percentage of total market subscribers is estimated at 23% in 2013, up from an estimated 2% in 2009. Notably, forecast penetration is still below the approximate 30% of total licensed spectrum in each market that AWS spectrum will likely represent.

Figure 14 – Forecast Subscribers with AWS-Enabled Devices

<i>Sub Figures in Millions</i>	2008	2009E	2010E	2011E	2012E	2013E
Assumed % EOP Subs with AWS Capable Devices						
% Non-AWS Devices	99.6%	98.0%	96.0%	89.9%	84.1%	77.4%
% AWS 1.7/2.1 GHz	0.4%	2.0%	4.0%	10.1%	15.9%	22.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Implied EOP Subscribers						
Non-AWS	574.7	619.7	653.1	649.5	637.6	609.2
AWS 1.7/2.1 GHz	2.2	12.4	27.4	73.0	120.1	177.8
Total	576.9	632.1	680.5	722.4	757.7	787.0

Source: GVP estimates, company and country reports.

Detailed forecast results and scenario analysis. The model output summary for the Americas is included in Figure 15 below, highlighting certain of the key subscriber and handset/device assumptions from a global level.

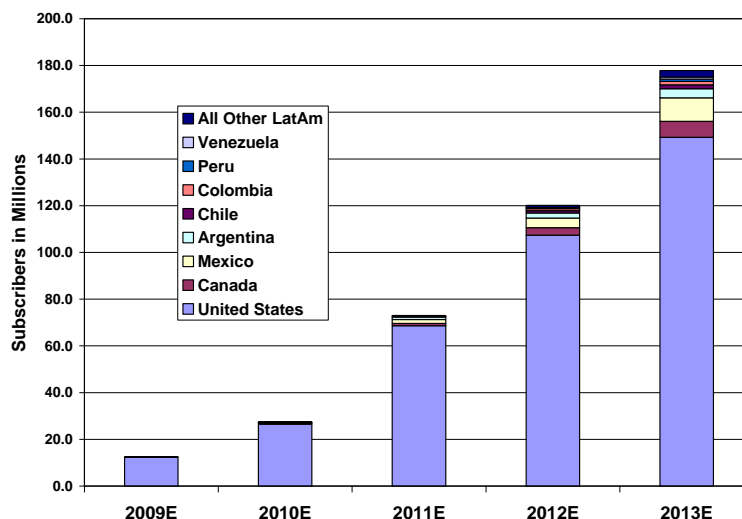
Figure 15 – AWS Subscriber and Handset/Device Forecast for the Americas – Base Case

Sub/Device Figures in Millions	2008	2009E	2010E	2011E	2012E	2013E
AWS Band Sub/Device Assumptions						
BOP Subs	-	2.2	12.4	27.4	73.0	120.1
Gross Additions	2.2	11.2	19.6	60.3	75.5	102.0
Disconnects	-	(0.9)	(4.7)	(14.7)	(28.3)	(44.3)
Net Additions	2.2	10.3	15.0	45.6	47.2	57.7
EOP Subs	2.2	12.4	27.4	73.0	120.1	177.8
% Change Y/Y		476%	120%	166%	65%	48%
Average Subs	1.1	7.3	19.9	50.2	96.5	148.9
Monthly Churn Rate	0.0%	1.0%	2.0%	2.4%	2.4%	2.5%
Annual Upgrade Rate as % BOP Subs	0%	2%	5%	10%	15%	17%
Estimated Upgrade Units	-	0.0	0.6	2.7	10.6	20.9
SIM/Refurbished Discount as % of GAs	0%	3%	5%	6%	7%	8%
SIM/Refurbished Discount Units	-	0.3	1.0	3.5	5.2	8.3
Implied AWS Device Unit Sales/Year	2.2	10.9	19.3	59.4	80.9	114.5
% Change Y/Y		388%	78%	208%	36%	42%
Cumulative AWS Device Unit Sales	2.2	13.1	32.4	91.8	172.8	287.3

Source: GVP estimates, company and country reports.

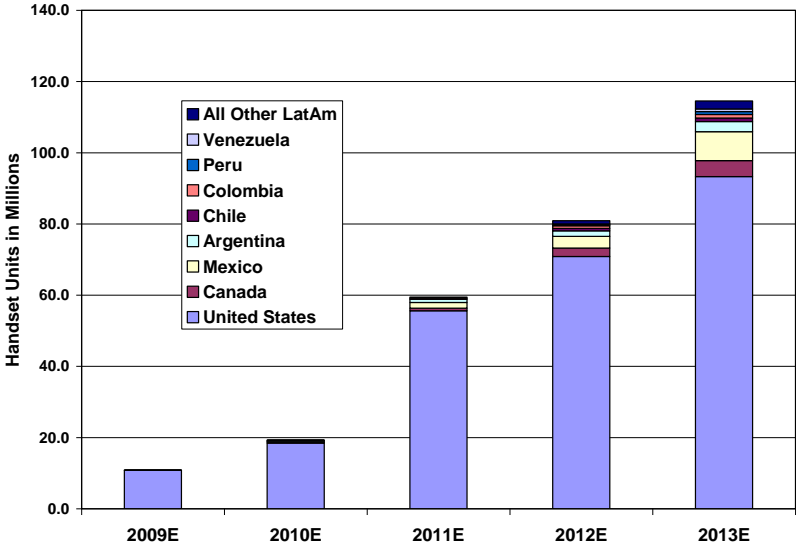
AWS networks in the United States are expected to represent the lion’s share of all Americas subscribers and handsets/device in the AWS band. The model assumes that LTE networks and/or incremental AWS capacity radios are introduced in 2010-11, leading to a step function in US AWS subscribers and device sales. Estimates by country are included in Figures 16 and 17 below.

Figure 16 – Estimated EOP AWS Subscribers by Market – Base Case



Source: GVP estimates, company and country reports.

Figure 17 - Estimated AWS Device Unit Sales per Year by Market – Base Case



Source: GVP estimates, company and country reports.

An approximate 5% swing in 2013 penetration increases/decreases subscribers by approximately 36 million customers and device sales by approximately 27 million units. Results for the three different penetration scenarios included in the model are illustrated in Figure 18 below.

Figure 18 – Scenario Analysis: Results from Low Case, Base Case, and High Case

Sub/Device Figures in Millions		2008	2009E	2010E	2011E	2012E	2013E
Scenarios:							
Penetration of EOP Subs with AWS Devices							
1	Low	0.2%	1.7%	3.4%	7.9%	13.4%	18.0%
2	Base Case	0.4%	2.0%	4.0%	10.1%	15.9%	22.6%
3	High	0.5%	2.2%	4.6%	12.3%	18.3%	27.2%
AWS Subscribers							
1	Low	1.4	10.7	23.4	57.0	101.8	141.6
2	Base Case	2.2	12.4	27.4	73.0	120.1	177.8
3	High	3.0	14.2	31.4	88.9	138.4	214.0
AWS Devices							
1	Low	1.4	9.8	16.4	45.1	71.7	87.6
2	Base Case	2.2	10.9	19.3	59.4	80.9	114.5
3	High	3.1	12.0	22.1	73.8	90.1	141.5

Source: GVP estimates, company and country reports.

Forecast caveats. The model depends on a number of assumptions, including timing and operator application of spectrum—for new advanced services or for fill-in capacity/coverage to complement existing voice/data services. In addition, each operator has different needs and objectives depending upon existing spectrum portfolios and footprints.

VIII. Alternate Spectrum Bands and Issues That May Impact AWS Band

700 MHz Band. The migration to digital terrestrial television from analog TV is freeing part of the UHF band to mobile services. This band is known as the “digital dividend.” The United States was the first country to license this band at 700 MHz in 2008. In the Americas—and more broadly in the world today—no other country has licensed the band except the United States. Canada and Chile are in the early stages of planning this band for wireless services, while most other countries are likely to do so only after 2015, as migration from analog to digital TV will likely take longer in these countries. In fact, only a few Latin American countries have begun the introduction of digital TV signals (notably Brazil). In Europe, most countries are currently beginning to plan the band for licensing in the next three to five years.

AWS versus 700 MHz in the United States. The 700 MHz auction was important in the US market because of the prime location of the band for mobile services and because it was the last large parcel of spectrum identified for auction in the foreseeable future. The auction raised over \$19 billion and 101 bidders won 1,090 licenses. While T-Mobile did not participate in the auction, other major AWS winners also won licenses in the 700 MHz auction, including Verizon, members of SpectrumCo and AT&T. Given very favorable propagation characteristics at the lower frequency and more stringent build-out requirements, companies that hold spectrum in both bands may give priority to 700 MHz holdings over AWS. However, as described earlier, growing voice/data network traffic will necessitate deployment in all available bands over time. Moreover, network equipment and handsets are available for the AWS band today, whereas more time is needed to bring commercial hardware to market for the 700 MHz band.

2.6 GHz. The 2500-2690 MHz band is aligned across all ITU regions. This harmonization can have a significant impact on equipment availability due to global economies of scale. There are distinct internal band designs, though, with the central issue being the separation between frequency division duplex (FDD) and time division duplex (TDD) within the band to prevent technical interference. The most common band design is the International Telecommunications Union’s option 1 (2x70 MHz for FDD with 50 MHz for TDD at the center of the band). In the Americas, many countries have used the band for MMDS cable-TV and are now converting the band for mobile broadband. In the United States, a consortium between Sprint and Clearwire is using the band for TDD only technologies (WiMax). In Canada, the regulator is discussing how to set up the band for both FDD and TDD. In Latin America, most regulators are discussing the utilization of ITU’s option 1 to introduce both FDD and TDD technologies, which would allow the band to be utilized in a more technology neutral way for both LTE and WiMax. Chile has already planned 2.6 GHz according to ITU’s option 1. In Europe, the 2.6 GHz band has begun to be licensed for mobile according to ITU’s option 1. Norway and Sweden have licensed it, and most other European countries are planning to license it in the next three years. Hong Kong has also successfully licensed the 2.6 GHz band.

AWS-2 and AWS-3 spectrum. Since carving out AWS-1 spectrum in 2002, the United States identified an additional 20 MHz of spectrum in the bands 1915-1920 MHz paired with 1995-2000 MHz, 2020-2025 MHz paired with 2175-2180 MHz, collectively referred to as AWS-2, and 20 MHz of spectrum in the bands 2155-2175 MHz (adjacent to the 2110-2155 MHz band of AWS-1 and the 2175-2180 MHz band of AWS-2), known as AWS-3.¹⁶ If AWS-2 and AWS-3 are made

¹⁶ Both the AWS-2 and AWS-3 bands are the subject of further rulemaking proceedings at the FCC involving technical standards and interference issues and no final service rules have been released. No auction dates will be set until the rules are released, and

available for mobile terrestrial services as expected, they will bring the total spectrum allocated to AWS services to 130 MHz. The FCC has not yet released rules for AWS-2 or AWS-3, but is expected to do so in the coming year with a possible auction in 2010.

AWS-3 technical issues. FCC proceedings related to the AWS-3 service rules could have an impact on the value of T-Mobile's AWS-1 spectrum holdings. In developing network plans, T-Mobile seemingly assumed that the AWS-3 licensee would use FDD technology. However, M2Z—one of the most vocal potential AWS-3 new entrants—is interested in deploying a TDD network. T-Mobile argues that a two-way operation in the adjacent AWS-3 spectrum would require technical rules that specify stringent guard bands. Therefore, if the AWS-3 rules are not structured to require the AWS-3 licensee to implement guard bands, its AWS-1 spectrum would be impacted. The debate over the AWS-3 service rules is the subject of a continuing rulemaking at the FCC fueled mainly by the M2Z petition to the FCC.

Potential for incremental US spectrum licensing. In response to growing wireless demand, the new US administration has pledged to assess current governmental spectrum allocations and consider more government to commercial reallocations in the future. On March 19, 2009, Senators John Kerry (D-Massachusetts) and Olympia Snowe (R-Maine) introduced legislation that would require the FCC and the National Telecommunications and Information Administration (NTIA)¹⁷ to conduct an inventory of radio spectrum within 180 days of enactment. While no specific bands have yet been identified for reallocation from government to commercial use, a CTIA report supports the conclusion that there isn't a near-term solution to the spectrum drought, "Given the long timeframes involved in going from planning to auction to deployment, as experienced with the AWS and 700 MHz bands, planning for new spectrum should begin as soon as possible."¹⁸ *With no concrete plans for making more spectrum available, and with the process of identifying, reallocating and then auctioning spectrum optimistically taking at least several years to complete, the large AWS and 700 MHz bands remain especially important to commercial mobile providers.*

an auction will not likely occur until at least six months after release of final rules, putting the earliest AWS-2 and AWS-3 auction sometime in 2010. In June 2008, the FCC sought comment on whether to include the 2175-2180 MHz band in AWS-3 as opposed to AWS-2, which would reduce AWS-2 to 15 MHz and increase AWS-3 to 25 MHz. The FCC has not yet reached a decision on the matter. (Further Notice of Proposed Rulemaking, FCC 08-158, released June 20, 2008.)

¹⁷ The NTIA is part of the US Department of Commerce and, among other things, regulates the spectrum held by the US Government.

¹⁸ CTIA report at 24.

IX. Conclusions

Analysis of spectrum policy, industry traffic trends, AWS auctions to-date, and the total addressable market across the Americas, as well as discussions with AWS industry participants and regulators, point to a number of key findings:

- AWS spectrum was identified by ITU for IMT2000 standards and is regionally harmonized by CITELE.
- Public policy that supports IMT-2000 technologies in the AWS band benefits economic growth.
- Prices paid for AWS spectrum in US and Canada reveals high market demand.
- AWS band is sufficiently similar to other frequency bands and HSPA ecosystem is ready today.
- Production cost curves are comfortable and improving.
- Addressable market is rapidly expanding.
- Meaningful growth in AWS subscribers and handset volumes is projected for the Americas.
- Operators are interested in accelerated licensing in Latin America.

➤ In Conclusion:

- **The AWS spectrum band is very well-suited to add significant and valuable bandwidth effectively and efficiently for wireless operators and consumers throughout the Americas**
- **AWS-capable devices and handsets are available and gaining critical mass with no visible limitations that might inhibit a strong and robust device ecosystem.**
- **Infrastructure is readily available and operator interest is high.**
- **Regulators throughout Latin America should promptly and rationally make this valuable spectrum available to meet the rapidly growing needs of the consumers in their hungry marketplaces**

Glossary

CDMA. Code Division Multiple Access (CDMA) assigns unique codes to each communication transmission to differentiate it from others in the same spectrum. 2G CDMA standards are branded cdmaOne and include IS-95A and IS-95B. The two primary IMT-2000 third-generation (3G) standards, CDMA2000 and WCDMA, are based on CDMA.

EOP. End of Period (EOP) typically refers to the value or amount as reported at the end of a measurement period.

FDD. Frequency Division Duplex (FDD), used in cellular communication systems such as GSM, is a radio technology using a paired spectrum.

HSPA. HSPA is the set of technologies that defines the migration path for 3G/WCDMA operators worldwide. HSPA, which uses the FDD transmission scheme, includes HSDPA (High Speed Downlink Packet Access), HSUPA (High Speed Uplink Packet Access) and HSPA Evolved.

GSM. GSM (Global System for Mobile communications: originally from Groupe Spécial Mobile) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM is used by over 4 billion customers across more than 219 countries and territories.

LTE. Long Term Evolution (LTE) is the next step from 3G/WCDMA and HSPA for operators already on the GSM technology platform, as well as other operators seeking an alternate evolution path. LTE is a new radio access technology and will be optimized to deliver very fast data speeds of up to 100 Mb/s downlink and 50 Mb/s uplink (peak rates).

TDD. Time Division Duplexing (TDD) refers to a transmission scheme that allows an asymmetric flow for uplink and downlink transmission that is more suited to data transmission. In a Time Division Duplex system, a common carrier is shared between the uplink and downlink, the resource being switched in time. Users are allocated one or more timeslots for uplink and downlink transmission.

UMTS. Universal Mobile Telecommunications System (UMTS) is a 3G mobile wireless standard that is also being developed into a 4G technology. UMTS uses wideband CDMA (WCDMA) as the underlying air interface and is standardized by the 3rd Generation Partnership Project (3GPP).

Appendix

Forecast Model – Americas Summary

Sub/Device Figures in Millions	2004	2005	2006	2007	2008	Year 1 2009E	Year 2 2010E	Year 3 2011E	Year 4 2012E	Year 5 2013E
SUMMARY - US, Canada, Mexico, Argentina, Chile, Colombia, Peru, Venezuela, All Other LatAm										
Covered POPs	662.5	670.7	677.8	685.7	692.8	698.2	705.5	714.0	723.0	732.0
% Change Y/Y		1.2%	1.1%	1.2%	1.0%	0.8%	1.1%	1.2%	1.3%	1.3%
Market Penetration - Cov'd POPs	45%	56%	66%	75%	83%	91%	96%	101%	105%	108%
Penetration Lift		10.8%	9.5%	9.5%	8.0%	7.3%	5.9%	4.7%	3.6%	2.7%
BOP Subs	218.0	301.2	377.2	445.7	515.8	576.9	632.1	680.5	722.4	757.7
Gross Additions	165.9	168.3	181.1	206.8	220.2	228.9	235.0	238.4	241.1	244.8
Disconnects	(82.7)	(92.3)	(112.7)	(136.7)	(159.1)	(173.7)	(186.7)	(196.5)	(205.8)	(215.5)
Net Additions	83.2	76.0	68.5	70.1	61.1	55.2	48.3	41.9	35.3	29.3
EOP Subs	301.2	377.2	445.7	515.8	576.9	632.1	680.5	722.4	757.7	787.0
% Change Y/Y		38%	25%	18%	16%	12%	10%	8%	6%	5%
Average Subs	259.6	339.2	411.4	480.7	546.4	604.5	656.3	701.4	740.1	772.4
Monthly Churn Rate	2.7%	2.3%	2.3%	2.4%	2.4%	2.4%	2.4%	2.3%	2.3%	2.3%
Sub Figures in Millions	2004	2005	2006	2007	2008	2009E	2010E	2011E	2012E	2013E
Assumed % EOP Subs with AWS Capable Devices										
% Non-AWS Devices	100.0%	100.0%	100.0%	100.0%	99.6%	98.0%	96.0%	89.9%	84.1%	77.4%
% AWS 1.7/2.1 GHz	0.0%	0.0%	0.0%	0.0%	0.4%	2.0%	4.0%	10.1%	15.9%	22.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Implied EOP Subscribers										
Non-AWS	301.2	377.2	445.7	515.8	574.7	619.7	653.1	649.5	637.6	609.2
AWS 1.7/2.1 GHz	-	-	-	-	2.2	12.4	27.4	73.0	120.1	177.8
Total	301.2	377.2	445.7	515.8	576.9	632.1	680.5	722.4	757.7	787.0
Scenarios:										
Penetration of EOP Subs with AWS Devices										
1	Low					0.2%	1.7%	3.4%	7.9%	13.4%
2	Base Case					0.4%	2.0%	4.0%	10.1%	15.9%
3	High					0.5%	2.2%	4.6%	12.3%	18.3%
AWS Subscribers										
1	Low					1.4	10.7	23.4	57.0	101.8
2	Base Case					2.2	12.4	27.4	73.0	120.1
3	High					3.0	14.2	31.4	88.9	138.4
AWS Devices										
1	Low					1.4	9.8	16.4	45.1	71.7
2	Base Case					2.2	10.9	19.3	59.4	80.9
3	High					3.1	12.0	22.1	73.8	90.1
Sub/Device Figures in Millions	2004	2005	2006	2007	2008	2009E	2010E	2011E	2012E	2013E
AWS Band Sub/Device Assumptions										
BOP Subs	-	-	-	-	-	2.2	12.4	27.4	73.0	120.1
Gross Additions	-	-	-	-	-	2.2	11.2	19.6	60.3	102.0
Disconnects	-	-	-	-	-	(0.9)	(4.7)	(14.7)	(28.3)	(44.3)
Net Additions	-	-	-	-	-	2.2	10.3	15.0	45.6	57.7
EOP Subs	-	-	-	-	-	2.2	12.4	27.4	73.0	120.1
% Change Y/Y						476%	120%	166%	65%	48%
Average Subs	-	-	-	-	-	1.1	7.3	19.9	50.2	96.5
Monthly Churn Rate	-	-	-	-	-	0.0%	1.0%	2.0%	2.4%	2.5%
Annual Upgrade Rate as % BOP Subs	-	-	-	-	-	0%	2%	5%	10%	17%
Estimated Upgrade Units	-	-	-	-	-	0.0	0.6	2.7	10.6	20.9
SIM/Refurbished Discount as % of GAs	-	-	-	-	-	0%	3%	5%	6%	7%
SIM/Refurbished Discount Units	-	-	-	-	-	0.3	1.0	3.5	5.2	8.3
- Base Case Scenario -										
Implied AWS Device Unit Sales/Year	-	-	-	-	-	2.2	10.9	19.3	59.4	80.9
% Change Y/Y						388%	78%	208%	36%	42%
Cumulative AWS Device Unit Sales						2.2	13.1	32.4	91.8	172.8

Source: GVP estimates, company and country reports.

Forecast Model – Americas Summary: Covered POPs and AWS Licensing Assumptions

<i>Sub/Device Figures in Millions</i>	2004	2005	2006	2007	2008	Year 1 2009E	Year 2 2010E	Year 3 2011E	Year 4 2012E	Year 5 2013E
Total Covered POPs (All Mobile Wireless Networks)										
United States	285.4	287.7	290.1	292.4	294.7	297.1	299.5	301.9	304.3	306.8
Canada	32.0	32.3	32.7	33.1	33.3	33.7	33.9	34.3	34.6	34.9
Mexico	104.9	106.3	107.8	109.6	110.6	109.7	111.0	113.3	115.9	118.5
Argentina	37.6	37.9	38.3	38.6	38.9	39.2	39.5	39.9	40.3	40.7
Chile	16.1	16.8	16.4	16.6	16.7	17.0	17.1	17.3	17.5	17.7
Colombia	44.9	45.6	46.3	47.0	47.6	48.3	49.0	49.6	50.3	50.9
Peru	27.6	28.0	28.4	28.8	29.2	29.6	30.0	30.4	30.8	31.2
Venezuela	26.2	26.6	27.1	27.6	28.0	28.5	29.0	29.4	29.9	30.3
All Other LatAm (Excl Brazil & Uruguay)	87.8	89.3	90.7	92.2	93.7	95.1	96.6	98.0	99.4	100.9
Total Covered POPs	662.5	670.7	677.8	685.7	692.8	698.2	705.5	714.0	723.0	732.0
% Change Y/Y		1%	1%	1%	1%	1%	1%	1%	1%	1%
Total Mobile Wireless Spectrum Licensed										
United States	144.0	144.0	234.0	234.0	294.0	294.0	314.0	314.0	334.0	334.0
Canada	175.0	175.0	175.0	175.0	265.0	265.0	265.0	265.0	265.0	265.0
Mexico	120.0	120.0	120.0	120.0	120.0	120.0	245.0	245.0	245.0	245.0
Argentina	170.0	170.0	170.0	170.0	170.0	260.0	260.0	260.0	260.0	260.0
Chile	140.0	140.0	140.0	170.0	170.0	260.0	260.0	260.0	260.0	260.0
Colombia	-	-	-	-	120.0	120.0	210.0	210.0	210.0	210.0
Peru	-	-	-	-	130.0	130.0	130.0	220.0	220.0	220.0
Venezuela	-	-	-	-	102.0	102.0	102.0	192.0	192.0	192.0
AWS Mobile Wireless Spectrum Licensed										
United States	-	-	90.0	90.0	90.0	90.0	110.0	110.0	130.0	130.0
Canada	-	-	-	-	90.0	90.0	90.0	90.0	90.0	90.0
Mexico	-	-	-	-	-	-	90.0	90.0	90.0	90.0
Argentina	-	-	-	-	-	90.0	90.0	90.0	90.0	90.0
Chile	-	-	-	-	-	90.0	90.0	90.0	90.0	90.0
Colombia	-	-	-	-	-	-	90.0	90.0	90.0	90.0
Peru	-	-	-	-	-	-	-	90.0	90.0	90.0
Venezuela	-	-	-	-	-	-	-	90.0	90.0	90.0
Total AWS Licensed POPs										
United States	-	-	290.1	292.4	294.7	297.1	299.5	301.9	304.3	306.8
Canada	-	-	-	-	33.3	33.7	33.9	34.3	34.6	34.9
Mexico	-	-	-	-	-	-	111.0	113.3	115.9	118.5
Argentina	-	-	-	-	-	39.2	39.5	39.9	40.3	40.7
Chile	-	-	-	-	-	17.0	17.1	17.3	17.5	17.7
Colombia	-	-	-	-	-	-	49.0	49.6	50.3	50.9
Peru	-	-	-	-	-	-	-	30.4	30.8	31.2
Venezuela	-	-	-	-	-	-	-	29.4	29.9	30.3
All Other LatAm (Excl Brazil & Uruguay)	-	-	-	-	-	-	-	49.0	99.4	100.9
Total AWS Licensed POPs	-	-	290.1	292.4	328.1	387.0	550.0	665.0	723.0	732.0
AWS Spectrum as % of Total Mobile Wireless Spectrum										
United States	0%	0%	38%	38%	31%	31%	35%	35%	39%	39%
Canada	0%	0%	0%	0%	34%	34%	34%	34%	34%	34%
Mexico	0%	0%	0%	0%	0%	0%	37%	37%	37%	37%
Argentina	0%	0%	0%	0%	0%	35%	35%	35%	35%	35%
Chile	0%	0%	0%	0%	0%	35%	35%	35%	35%	35%
Colombia	0%	0%	0%	0%	0%	0%	43%	43%	43%	43%
Peru	0%	0%	0%	0%	0%	0%	0%	41%	41%	41%
Venezuela	0%	0%	0%	0%	0%	0%	0%	47%	47%	47%

Source: GVP estimates, company and country reports, Rainieri.

Forecast Model – Americas “Base Case” Summary: EOP Total Subscribers, AWS Subscribers and Handsets/Devices

<i>Sub/Device Figures in Millions</i>	2004	2005	2006	2007	2008	Year 1 2009E	Year 2 2010E	Year 3 2011E	Year 4 2012E	Year 5 2013E
Total EOP Subs (All Mobile Wireless Networks)										
United States	184.7	214.3	232.1	252.1	266.9	284.0	298.7	310.7	320.4	329.1
Canada	15.6	17.5	19.3	20.9	22.5	23.9	25.0	26.1	27.0	27.3
Mexico	37.8	46.6	56.8	68.9	78.9	88.0	98.0	108.0	117.4	126.0
Argentina	13.0	21.4	30.2	38.6	43.6	47.5	50.6	53.0	54.8	55.5
Chile	9.6	11.7	13.1	14.6	15.9	17.3	18.3	19.2	19.8	20.4
Colombia	10.4	21.9	30.1	33.5	40.7	46.0	50.6	54.6	57.8	60.6
Peru	4.1	5.6	8.8	14.0	18.5	21.6	24.6	27.6	30.6	32.8
Venezuela	8.5	12.7	18.8	23.8	29.1	33.3	36.6	39.2	41.3	42.8
All Other LatAm (Excl Brazil & Uruguay)	17.5	25.5	36.5	49.5	60.9	70.6	78.1	84.0	88.7	92.5
Total EOP Subs	301.2	377.2	445.7	515.8	576.9	632.1	680.5	722.4	757.7	787.0
% Change Y/Y		25%	18%	16%	12%	10%	8%	6%	5%	4%
Estimated EOP AWS Subs										
United States	-	-	-	-	2.2	12.4	26.5	68.6	107.3	149.2
Canada	-	-	-	-	-	0.1	0.4	1.0	3.2	6.8
Mexico	-	-	-	-	-	-	0.2	1.6	4.1	10.1
Argentina	-	-	-	-	-	-	0.3	1.1	2.2	3.9
Chile	-	-	-	-	-	-	0.1	0.4	1.0	1.6
Colombia	-	-	-	-	-	-	-	0.3	0.9	1.5
Peru	-	-	-	-	-	-	-	-	0.3	1.0
Venezuela	-	-	-	-	-	-	-	-	0.2	0.9
All Other LatAm (Excl Brazil & Uruguay)	-	-	-	-	-	-	-	-	0.9	2.8
Total EOP AWS Subs	-	-	-	-	2.2	12.4	27.4	73.0	120.1	177.8
% Change Y/Y	-	-	-	-	-	476%	120%	166%	65%	48%
AWS Subs as % of Total EOP Subs										
United States	0.0%	0.0%	0.0%	0.0%	0.8%	4.4%	8.9%	22.1%	33.5%	45.3%
Canada	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1.5%	4.0%	12.0%	25.0%
Mexico	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	1.5%	3.5%	8.0%
Argentina	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	2.0%	4.0%	7.0%
Chile	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	2.0%	5.0%	8.0%
Colombia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	1.5%	2.5%
Peru	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	3.0%
Venezuela	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	2.0%
All Other LatAm (Excl Brazil & Uruguay)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	3.0%
Total	0.0%	0.0%	0.0%	0.0%	0.4%	2.0%	4.0%	10.1%	15.9%	22.6%
Estimated AWS Devices (Unit Sales/Year)										
United States	-	-	-	-	2.2	10.8	18.4	55.6	70.8	93.3
Canada	-	-	-	-	-	0.1	0.3	0.7	2.4	4.5
Mexico	-	-	-	-	-	-	0.2	1.6	3.3	8.1
Argentina	-	-	-	-	-	-	0.3	0.9	1.6	2.9
Chile	-	-	-	-	-	-	0.1	0.3	0.7	1.0
Colombia	-	-	-	-	-	-	-	0.3	0.7	1.0
Peru	-	-	-	-	-	-	-	-	0.3	0.8
Venezuela	-	-	-	-	-	-	-	-	0.2	0.7
All Other LatAm (Excl Brazil & Uruguay)	-	-	-	-	-	-	-	-	0.9	2.3
Total AWS Devices	-	-	-	-	2.2	10.9	19.3	59.4	80.9	114.5
% Change Y/Y	-	-	-	-	-	388%	78%	208%	36%	42%

Source: GVP estimates, company and country reports.

Operator Data – Part One

Country	Mobile Subs Q408	Mobile Penetration Q408	MNO	Subs per operator Q408	ARPU per operator Q408 (USD)	Churn (monthly) Q408	Total Spectrum licensed for Mobile Ops	Broadband Penetration Q408
United States	266,891,975	90.50%	Alltel	14,094,559	52.9	2.02%*	593 MHz (ADL)	25.30%
			AT&T	77,009,000	50.8	1.60%		
			Centennial	661,100	65	2.50%		
			Leap	3,844,660	42.4	3.80%		
			Qwest	873,438	n/a			
			Sprint	48,338,000	54.3	2.25%		
			T-Mobile	32,758,000	49	3.30%		
			US Cellular	6,196,000	52.7			
			Verizon	72,056,000	51.9	1.35%		
Other	11,061,218	n/a						
Canada	22,505,066	67.50%	Aliant	967,914	n/a		265MHz (ADL)	26.90%
			Bell	6,497,000	44.9	1.70%		
			FIRST Networks	3,450	n/a			
			Ice Wireless	19,840	n/a			
			MTS Allstream	434,776	47.6	1.47%		
			Rogers Wireless	7,942,000	52.8	1.48%		
			SaskTel	511,086	n/a			
Telus	6,129,000	51.5	1.62%					
Argentina	43,369,814	111.30%	Claro	15,229,331	n/a		170 MHz (ADL)	8.30%
			Movistar	14,829,600	11.7	1.80%		
			Personal	12,339,829	12.7			
			Nextel	971,054	43	1.90%		
Chile	15,903,040	95%	Claro	3,002,000	10.8	3.70%	140 MHz (ADL) 170 MHz (Raineri)	8.80%
			Entel PCS	6,001,000	16.1	1.59%		
			Movistar	6,875,000	15.4	1.80%		
			Nextel	25,040	n/a			
Mexico	78,941,658	71.40%	Iusacell	4,483,369	n/a		120 MHz (ADL) 155MHz (Raineri)	5.90%
			Movistar	15,330,600	10.8	2.70%		
			Nextel	2,756,689	68	2.30%		
			Telcel	56,371,000	13.5	3.40%		
Colombia	40,666,951	85.40%	Comcel	27,390,000	7.5	2.30%	120 MHz (ADL)	3.80%
			Movistar	9,963,100	8.2	3.70%		
			Tigo	3,313,851	n/a			

Source: Wireless Intelligence, Raineri, Hazlett.

Operator Data – Part Two

Country	Mobile Subs Q408	Mobile Penetration Q408	MNO	Subs per operator Q408	ARPU per operator Q408 (USD)	Total Spectrum licensed for Mobile Ops	Broadband Penetration Q408
Peru	18,442,869	63.20%	Claro	7,178,000	7.6*	80 MHz (Hazlet) 130.3 MHz (Raineri)	2.60%
			Movistar	10,612,700	7.8*		
			Nextel	652,169	30*		
Venezuela	29,090,487	103.70%	Digitel	6,902,958	n/a	57 MHz (Hazlet) 101.8 MHz (raineri)	4.10%
			Movilnet	11,603,529	19**		
			Movistar	10,584,000	26.77**		
Ecuador	11,921,190	85.65%	Alegro	494,690	n/a	80 MHz (Hazlet)	1.30%
			Movistar	3,122,500	9.8		
			Porta	8,304,000	10		
El Salvador	6,276,420	89.90%	Claro	1,963,471	n/a	137.87 MHz (Hazlet)	1.90%
			Digicel	458,129	n/a		
			Movistar	1,326,764	n/a		
			Tigo	2,528,056	n/a		
Costa Rica	1,475,157	32.40%	ICE	1,475,157	n/a	93 MHz (Hazlet)	3.90%
Honduras	5,928,214	76.80%	Claro	1,468,538	n/a	65 MHz (Hazlet)	0.80%
			Digicel	220,000	n/a		
			Hondutel	50,000	n/a		
			Tigo	4,239,676	n/a		
Guatemala	11,612,993	83.30%	Claro	4,205,044	n/a	140 MHz (Hazlet)	1.20%
			Movistar	2,994,430	n/a		
			Tigo	4,413,519	n/a		
Nicaragua	2,931,465	47.90%	Claro	2,000,396	n/a	84.84 MHz (Hazlet)	0.80%
			Movistar	931,069	n/a		
Dominican Republic	7,467,777	79.80%	Claro	3,943,380	n/a	n/a	2.30%
			Orange	2,401,000	n/a		
			Tricom	638,404	n/a		
			Viva	484,993	n/a		
Panama	2,991,265	87.80%	Mas Movil	1,887,849	n/a	49.56 MHz (Hazlet)	4.20%
			Movistar	1,103,416	n/a		

Source: Wireless Intelligence, Raineri, Hazlett.

United States AWS Auction Blocks

Block	Frequency Bands (MHz)	Total Bandwidth	Geographic Area Type	No. of Licenses
A	1710-1720 / 2110-2120	20 MHz	CMA ¹⁹	734
B	1720-1730 / 2120-2130	20 MHz	EA ²⁰	176
C	1730-1735 / 2130-2135	10 MHz	EA	176
D	1735-1740 / 2135-2140	10 MHz	REAG ²¹	12
E	1740-1745 / 2140-2145	10 MHz	REAG	12
F	1745-1755 / 2145-2155	20 MHz	REAG	12

Source: FCC, KB Enterprises LLC.

United States AWS Prices by Block

Block	Band	Revenue	Price/MHz-Pop
A	1710-1720, 2110-2120 MHz	\$999,267,000	\$.42
B	1720-1730, 2120-2130 MHz	\$727,470,000	\$.45
C	1730-1735, 2130-2135 MHz	\$405,790,000	\$.59
D	1735-1740, 2135-2140 MHz	\$380,549,000	\$.65
E	1740-1745, 2140-2145 MHz	\$517,063,000	\$.64
F	1745-1755, 2145-2155 MHz	\$1,147,364,000	\$.77

Source: FCC, KB Enterprises LLC.

¹⁹ Cellular Market Areas (CMAs) were originally developed by the Federal Communications Commission for cellular mobile radio service and include a total of 306 metropolitan statistical area (MSA) licenses and 428 rural service areas (RSA) license for a total of 734 license areas that cover the United States and its territories.

²⁰ EAs (Economic Areas) refer to the market areas delineated by the Regional Economic Analysis Division, Bureau of Economic Analysis, U.S. Department of Commerce in February 1995. There are a total of 176 EAs that cover the United States and its territories.

²¹ REAGs refer to the twelve Regional Economic Area Groupings that were developed by the Office of Engineering and Technology at the Federal Communications Commission.

Canada AWS Auction Blocks

Block	Frequency Bands (MHz)	Total Bandwidth	Geographic Tier ²²	No. of Licenses
A	1710-1720 MHz / 2110-2120 MHz	20 MHz	3	59
B	1720-1730 MHz / 2120-2130 MHz	20 MHz	2	14
C	1730-1735 MHz / 2130-2135 MHz	10 MHz	2	14
D	1735-1740 MHz / 2135-2140 MHz	10 MHz	3	59
E	1740-1745 MHz / 2140-2145 MHz	10 MHz	3	59
F	1745-1755 MHz / 2145-2155 MHz	20 MHz	3	59

Source: Industry Canada, KB Enterprises LLC.

Figure 19 - Auction Prices for the Canadian AWS Spectrum by Block in US Dollars

Block	Eligibility	Band	Revenue	Price/MHz-Pop
A	Open	1710-1720, 2110-2120 MHz	\$999,267,000	\$1.67
B	Set-aside	1720-1730, 2120-2130 MHz	\$727,470,000	\$1.21
C	Set-aside	1730-1735, 2130-2135 MHz	\$405,790,000	\$1.35
D	Set-aside	1735-1740, 2135-2140 MHz	\$380,549,000	\$1.27
E	Open	1740-1745, 2140-2145 MHz	\$517,063,000	\$1.72
F	Open	1745-1755, 2145-2155 MHz	\$1,147,364,000	\$1.91

Source: Industry Canada, KB Enterprises LLC.

²² For spectrum auctions, Industry Canada divides Canada into geographic service areas called "tiers," based on the geographic areas of Statistics Canada 1996 census subdivisions as follows: Tier 1 is a single national service area; Tier 2 consists of eight provincial and six large regional service areas; Tier 3 consists of 59 regional service areas; and Tier 4 comprises 172 localized service areas. For the AWS spectrum, the department adopted a range of Tier 2 and 3 service areas.

Canadian AWS Spectrum Auction by Region

Region	A Block 20 MHz	B Block* 10 MHz	C Block* 10 MHz	D Block* 20 MHz	E Block 10 MHz	F Block 20 MHz
Newfoundland Labrador	Rogers	Bragg	Bragg	Globalive	TELUS	Bell
Nova Scotia	Rogers	Bragg	Bragg	Globalive	TELUS	Bell
New Brunswick	Rogers	Bragg	Globalive	Bragg	TELUS	Bell
Eastern Quebec	Rogers	Quebecor	Quebecor	Quebecor	Bell	TELUS
Southern Quebec	Rogers	Quebecor	Quebecor	Quebecor	Bell	TELUS
Northern Quebec	Rogers	Quebecor	Quebecor	Quebecor	TELUS	Bell
Eastern Ontario	Rogers	Quebecor	Dave	Globalive	TELUS	Bell
Southern Ontario	Rogers	Globalive	Dave	Dave/Bragg	TELUS	Bell
Northern Ontario	Rogers	Bragg	Globalive	Bragg/Shaw	TELUS	Bell
Manitoba	Rogers	MTS	Shaw	Globalive	Shaw	TELUS
Saskatchewan	Rogers	SaskTel	SaskTel	Shaw	Globalive	TELUS
Alberta	Rogers	Shaw	Globalive	Dave/Shaw	Bell	TELUS
British Columbia	Roger	Shaw	Globalive	Shaw/Dave	Bell	TELUS
Yukon, NWT & Nunavut	Rogers	Globalive	Globalive	Globalive	TELUS	Bell

* New entrant set-aside block. Source: Industry Canada, KB Enterprises LLC.

Canadian AWS Spectrum Holdings Compared to Overall Wireless Spectrum Holdings by Market

Licensee	Service	MHz	Geography	% of Total
Rogers	AWS	20	National	29%
TELUS Communications	AWS	10-20	National	25%
Bell Mobility	AWS	10-20	National	23%
Quebecor	AWS	50	Quebec	100%*
Shaw Communications	AWS	10	Alberta	100%*
Bragg	AWS	10	See above Markets	100%*
Dave	AWS	10	Eastern and Southern Ontario	100%*
Globalive	AWS	10-20	National	100%*

*As a new entrant, this entity holds only AWS spectrum. Source: Estimates based on Industry Canada data, KB Enterprises LLC.



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