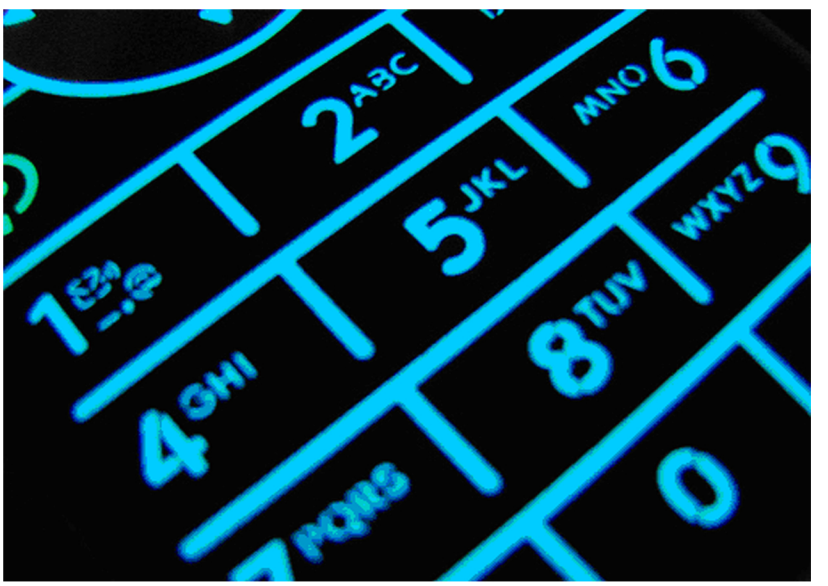
UNITED STATES INTERNATIONAL TRADE COMMISSION

Wireless Handsets



Industry & Trade Summary

Office of Industries
Publication ITS-05
March 2010

UNITED STATES INTERNATIONAL TRADE COMMISSION

Robert A. Rogowsky
Director of Operations

Karen Laney-Cummings
Director, Office of Industries

This report was principally prepared by:
Shannon Gaffney, Office of Industries
shannon.gaffney@usitc.gov

With supporting assistance from:
Monica Reed, Office of Industries

Under the direction of:
Michael Anderson, *Chief*
Advanced Technology and Machinery Division

Cover photo courtesy of Erica Dewolf,
Credit - **http://ericadewolf.files.wordpress.com/2008/02/cell_numbers.jpg**

Address all communication to
Secretary to the Commission
United States International Trade Commission
Washington, DC 20436
www.usitc.gov

PREFACE

The United States International Trade Commission (USITC) has initiated its current Industry and Trade Summary series of reports to provide information on the rapidly evolving trade and competitive situation of the thousands of products imported into and exported from the United States. Over the past 20 years, U.S. international trade in goods and services has risen by almost 350 percent, compared to an increase of 180 percent in the U.S. gross domestic product (GDP), before falling sharply in late 2008 and 2009 due to the economic downturn. During the same two decades, international supply chains have become more global and competition has increased.

Each Industry and Trade Summary addresses a different commodity or industry and contains information on trends in consumption, production, and trade, as well as an analysis of factors affecting industry trends and competitiveness in domestic and foreign markets. This report on the wireless handset industry primarily covers the period from 2004 to 2008.

CONTENTS

CONTENTS—*Continued*

CONTENTS—*Continued*

Page

Tables

ACRONYMS

3G	Third-generation
CDMA	code division multiple access
EMS	electronics contract manufacturers
GPS	global positioning system
GSM	global system for mobile communications
ITA	Information Technology Agreement
LTE	Long term evolution
OEMs	original equipment manufacturers
R&D	research and development
TDMA	time division multiple access
UMTS	universal mobile telecommunications system
W-CDMA	wideband code division multiple access
WiFi	wireless fidelity

ABSTRACT

This report addresses trade and industry conditions for wireless handsets for the period 2004 through 2008.

- The global wireless handset manufacturing industry is dominated by five top-tier firms (Nokia, Samsung, LG, Motorola, and Sony Ericsson) which collectively accounted for more than 70 percent of total sales throughout the period. Motorola is the largest U.S.-based producer in this extremely competitive industry and was the world's fourth largest handset producer in 2008. Leading second tier firms include Apple, Research in Motion, and HTC. The global supply chain for wireless handsets is concentrated in Asia; U.S. production is limited. Heightened domestic and international competition has resulted in the outsourcing of production, industry consolidation, firm specialization, and decreasing employment.

- Worldwide technological leadership in product design is concentrated in the United States, Finland, Korea, and the United Kingdom. Strong research and development (R&D) capabilities are imperative to leading firms in the industry. Up to one-third of the workforce of handset manufacturers is engaged in R&D activities, and firm level annual R&D spending amounts to $2–$4 billion. Major manufacturers have R&D facilities throughout the United States, including Texas, Florida, Arizona, Illinois, California, and New Jersey.

- Manufacturers traditionally competed on the basis of price, but they increasingly focus on innovations in product design that allow users to perform a wide variety of functions beyond traditional voice services, including texting, e-mail, digital mapping, and storage of music and photos. Smartphones, also known as converged devices, are the fastest-growing and most profitable segment of the overall market for wireless handsets. U.S. sales of smartphones rose from 4.5 million and 5 percent of total handset sales in 2004 to 27.3 million and 28 percent of total sales in 2008.[1]

- Because most handsets are produced in Asia and Latin America, the U.S. trade deficit for this product was large and widened substantially over the period, from $18.1 billion in 2004 to $30.7 billion in 2008. China accounted for 50 percent of U.S. imports in 2007 and 40 percent in 2008.

- Most countries involved in wireless handsets trade are signatories to the Information Technology Agreement (1997), which eliminated tariffs on high-technology equipment, including wireless handsets. A notable exception is Latin America, where many countries, excluding Mexico, impose tariffs on imports of wireless handsets of between 10 and 15 percent.[2]

- Global consumption of handsets is bifurcated into low-cost, voice-centric devices and high-level information appliances. Market growth in more sophisticated markets with higher penetration rates and income levels, including Europe and the United States, is the result of existing consumers upgrading to new devices. In the rest of the world, rapid user

[1] Telecommunications Industry Association (TIA), "2009 ICT Market Review and Forecast," 246.
[2] USITC staff, e-mail communication with the Department of Commerce, May 8, 2009.

uptake is driving enormous volume increases. India and China were the two fastest growing markets for wireless handsets in the world in 2008, respectively achieving 48 percent and 17 percent annual growth.

INTRODUCTION

The wireless handset[3] is a sophisticated two-way radio that allows users to communicate over the public switched telephone network from mobile locations.[4] Owing to the convenience of wireless communications, mobile handsets are the most popular consumer electronics product in the world. Global sales surpassed 1 billion in 2007, rising to 1.2 billion in 2008.[5] Global mobile subscribers exceeded 4.0 billion by the end of 2008,[6] an increase from 3.4 billion the previous year, when worldwide penetration reached 51 percent.[7]

As increased competition has emphasized the importance of technological innovation, the U.S. wireless handset industry (consisting of Motorola, Apple, and several foreign-based producers) has become a major part of the $700 billion worldwide wireless industry.[8] Smartphones, also known as converged devices, are the fastest-growing and most profitable segment of the overall market for wireless handsets. Smartphones are an important growth area in the United States, where sales rose from 4.5 million units in 2004 to 27.3 million in 2008.[9] North American firms Apple and Research in Motion have demonstrated leadership in this niche market by introducing popular features such as touchscreens and offering downloadable applications to add to the capacity of the devices and to further customize the look and feel of phones.

This report will analyze wireless handset manufacturing, investment, and trade during 2004–2008. Because of the rapidly changing nature of the industry and the global economic downturn, which continued beyond the period examined, more recent events in the industry are not addressed in this report. The first section of the report describes the structure of the industry, the production model, and the global supply chain. The second section provides information on trade trends and tariff information for the industry. The final section will examine market competition, demand conditions, and consumer characteristics.

[3] Wireless handsets are commonly referred to by several other terms, including cellular (or cell) phones, mobile phones, and mobile devices. This report uses these terms interchangeably.

[4] See appendix A for more details.

[5] Motorola Corp., submissions to the United States Securities and Exchange Commission, Form 10-K, 2007 and 2008: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007, Commission file number 1-7221, 2.

[6] International Telecommunications Union (ITU), ICT database.

[7] Standard & Poor's, *Industry Surveys: Communications Equipment*, 2008, 5.

[8] Salazar, "The State of the Industry Is Strong," February 26, 2009.

[9] Telecommunications Industry Association (TIA), "2009 ICT Market Review and Forecast," 246.

INDUSTRY COVERAGE

Products

While mobile phones fall along a continuum, they may be grouped into three general categories: basic phones, feature phones, and smartphones. Basic phones are the lowest priced and offer voice and texting functionality. Motorola's RAZR phones are successful basic phones in the United States.[10] Feature phones are basic phones characterized by one outstanding trait, usually a high-quality camera or mobile music player. LG's music-centric Chocolate phone is a popular feature phone in the United States.[11] Smartphones[12] extend the range of a handset's functionality beyond voice, texting, music, and pictures to include videos, email, and Internet access. The latest generation of smartphone models may be equipped with several gigabytes of memory, Global Positioning System (GPS) capabilities, and touchscreen interfaces. Common smartphone models in the United States include Research in Motion's BlackBerry and Apple's iPhone.

Technologies

The technologies underlying cellular networks differentiate both companies and countries, defining their competitive positioning in the global handset market (appendix C). Cellular networks are identified by generation. Japan introduced first-generation systems, which were analog, in 1979. Finland introduced second-generation technologies (2G), the first digital systems, in 1991. 2G systems include Global System for Mobile Communications (GSM) and Code Division Multiple Access (CDMA). While GSM is the dominant world standard, with approximately 3 billion mobile subscribers as of October 2008,[13] CDMA is the most common technology in North America. The United States market is unique in that both standards are used by major service providers. AT&T and T-Mobile operate GSM systems, whereas Verizon and SprintNextel operate CDMA networks. Third-generation (3G) networks are currently being deployed. The advent of 3G has nurtured the evolution of the wireless handset from a mobile phone to an information appliance. In addition to improving the quality of voice services, 3G service offers high-speed data access, bringing the Internet to mobile handsets at broadband speeds. In addition to the 3G standards for CDMA and GSM, China has established a unique domestic 3G standard, TD-SCDMA. The future trend, given the network strain caused by large volumes of data being accessed by users of smartphones, is the fourth generation (4G) of technologies, which offer data speeds that surpass 3G network capabilities. Mobile WiMAX is the only 4G standard currently available; Sprint Nextel launched WiMAX service in several U.S. cities in 2008 and continues to expand this

[10] TIA, "2009 ICT Market Review and Forecast," 246.

[11] Ibid.

[12] There is no universally accepted definition of a smartphone. TIA defines a smartphone as "a phone combined with a personal digital assistant (PDA). These devices can make phone calls, organize daily activities and provide instant access to e-mail. Traditionally, due to their high cost, smartphones were targeted to the business community. They are now being targeted to the consumer market. Basic smartphones…usually do not have touch screens and cannot be used to create spreadsheets or text documents. Advanced smartphones provide laptop capabilities in a phone." TIA, "2008 Telecommunications Market Review and Forecast," February 2008, 181.

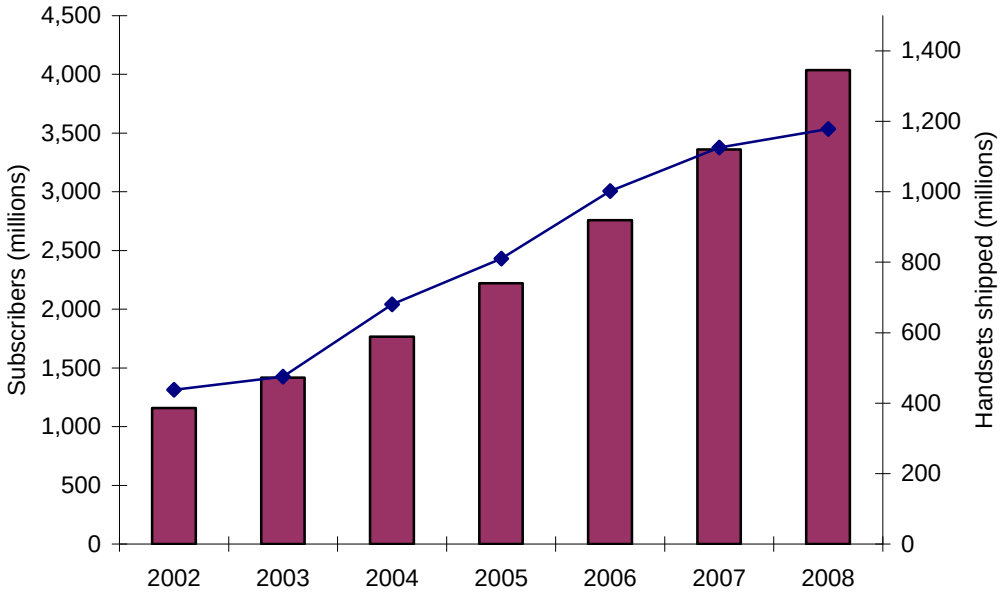
[13] Siegler, "The 'Emerging' Growth of GSM in a 3G World," October 13, 2008.

service. Verizon is currently testing another 4G standard, Long Term Evolution (LTE). Verizon intends to initiate a limited rollout at the end of 2010, but will not make LTE nationally available until 2012. U.S. carriers will not make 4G service commercially available nationwide until at least 2012.[14]

Overview of Industry Trends and Developments

The steadily decreasing cost of mobile phones and mobile calls, along with major technological advances, have driven a steep rise in global adoption, from 1 billion subscribers in 2002 to 4 billion subscribers by the end of 2008 (figure 1).

FIGURE 1 Worldwide mobility subscribers, 2002–08



Source: Compiled by USITC staff.

The increased adoption of wireless handsets is driven by three major long-term trends in equipment sales, influencing both high-end and low-end product development: (1) declining costs for both handsets and telecom services owing to intense competition in the mobile industry, along with technological improvements and network buildouts that have increased the quality and availability of service; (2) technology-driven convergence of voice and data functionality on sophisticated smartphones (primarily being adopted in the United States, Western Europe, and parts of Asia); and (3) increased reach of low-tier devices into emerging markets where fixed-line infrastructure is limited. The proliferation of mobile handset sales is also elevating production revenue. Between 2007 and 2008, global industry revenue increased by 7 percent, from $141.2 billion to $151.0 billion.[15] The increasing number of contract manufacturers has put downward pressure on handset prices, triggering consolidation among manufacturers and additional

[14] TIA, "2009 ICT Market Review and Forecast," 267, 270.
[15] Ford, Rebello, and Teng, "Mobile Handset Market Tracker," 2008, 1.

outsourcing of components. As a result, production has primarily shifted to low-cost manufacturing centers in Asia, particularly China.[16]

The increasing adoption of smartphones in advanced markets, including the United States and Western Europe, is attributable to improved network coverage and performance, flat rate monthly service plans, and an effort by manufacturers to broaden the appeal of the devices to consumers, beyond the traditional business users.

Conversely, fixed-line services are in a global decline owing to improvements in the quality of wireless networks and the prevalence of unlimited calling plans for mobile users. For example, a 2008 study by The Nielsen Company projected that by the end of that year, 20 percent of U.S. households would have discontinued landline service in favor of wireless telephony.[17]

Demand for cellular phones will likely continue to grow in both developed and emerging countries, even as the global economy experiences difficulties. However, it is likely that less favorable economic conditions and greater market saturation in the United States and Western Europe will dampen future growth of device sales, which increased at an annual rate of 23 percent from 2003 to 2008.[18]

[16] Motorola Corp., submissions to the United States Securities and Exchange Commission, Form 10-K, 2007: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007, Commission file number 1-7221, 7.

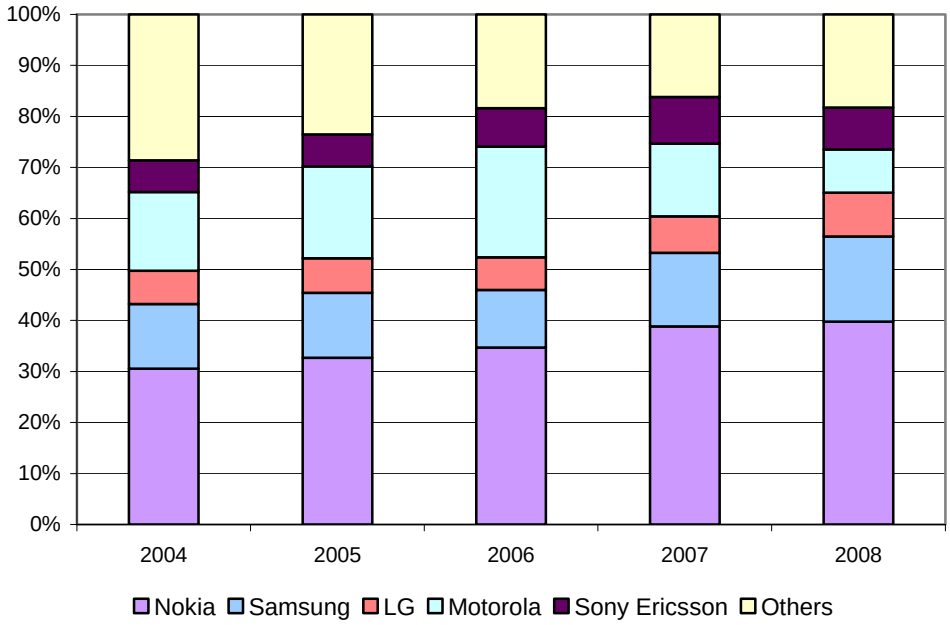
[17] Winter, "By Next Year, 1 in 5 U.S. Households Will Be Wireless Only," September 17, 2008.

[18] Strategy Analytics forecast that 2009 would be the weakest year for handset sales since the modern cellular phone industry originated in 1983. Carson, "By the Numbers: Top Five Mobile Device Vendors in the Fourth Quarter of 2008," January 23, 2009.

GLOBAL INDUSTRY OVERVIEW

The global wireless handset industry is highly concentrated, being dominated by five top-tier firms: Nokia, Samsung, LG, Motorola, and Sony Ericsson (figure 2). These firms are original equipment manufacturers (OEMs) and collectively accounted for more than 70 percent of worldwide handset sales from 2004 through 2008.[19] Because firm-level production data are not publicly available for the mobile handset industry, sales figures are used in this report as a proxy for production levels.

FIGURE 2 Global handset market shares, by sales volume, 2004–08



Source: Strategy Analytics.

These five firms are global technological leaders through their R&D investments in cutting-edge product development. Motorola pioneered the world's first commercial handheld mobile phone in 1983 and launched the U.S. wireless handset industry, in which it remains a major player.[20] Finland's Nokia became a leader in digital communications in the late 1990s and now dominates the global industry; it controls 38 percent of the global market, a share roughly equal to that of its next four competitors combined. Two Korean electronics firms, Samsung and LG Electronics, rose to international prominence in the handset market in the late 1990s. Japan's Sony and Sweden's Ericsson joined forces in 2001 to combine consumer electronics and scientific expertise in a new enterprise focused solely on handsets, Sony Ericsson. The leading OEMs are globally oriented and sell in most major wireless markets.[21] Again, because

[19] Standard & Poor's, *Industry Surveys: Communications Equipment*, 2008, 5; Strategy Analytics.

[20] EIU, *World Telecoms: Key Player: Motorola*, 2009, 1.

[21] One exception is Japan, whose government implemented unique technological standards incompatible with international mobile phone standards. As a result, the Japanese market is served only by local firms. Industry official, interviewed by Commission staff, October 22, 2008.

firm-level production data are not available, market data are presented to highlight the competitive positions of the major industry players (table 1).

TABLE 1 Global handset market shares, based on units shipped, 2004–08 (percent)

Vendor	2004	2005	2006	2007	2008
Nokia	30.5	32.7	34.7	38.9	39.8
Samsung	12.7	12.7	11.3	14.4	16.7
LG	6.5	6.8	6.4	7.2	8.6
Motorola	15.4	18.0	21.7	14.2	8.5
Sony Ericsson	6.2	6.3	7.5	9.2	8.2
Others	28.6	23.5	18.4	16.2	18.3
Total units shipped (million)	684	817.2	1,018.8	1,125.5	1,178.1

Source: Strategy Analytics.

Leading second tier firms are reported to include several companies that exclusively make smartphones (Apple, Research in Motion, and HTC) and Chinese firms Huawei and ZTE. [22] The battle for the remaining global market share is fiercely competitive. According to research firm IDC, the next 65 to 70 vendors all have less than 1 percent market share.[23] Many of these firms are small niche manufacturers.

The handset industry has become increasingly global in both supply and demand since the 1990s, with leading firms in the United States, Europe, and Korea earning more than one-half of their revenues through sales in foreign markets. The United States was Motorola's principal marketplace in 2008; revenues from this market accounted for 48 percent of total company revenues that year (table 2).

TABLE 2 Top five handset manufacturing companies, ranked by 2008 mobile revenue

Company	Headquarters	Total revenue (million $)	Mobile revenue (million $)	Largest market	Total employees
Nokia	Finland	74,612	51,621	China	125,829
Samsung	Korea	112,804	32,149	Europe	150,000
LG	Korea	58,900	14,900	North America	84,445
Motorola	United States	30,146	12,099	United States	64,000
Sony Ericsson	United Kingdom	11,244	11,244	[a]	9,000

Source: Datamonitor Company reports.

[a]Sony Ericsson's largest market—Europe, Middle East, and Africa (EMEA)—accounted for 53.1 percent of total revenues in 2008. Further disaggregation was not possible.

The Global Production Model

Globalization and specialization are the foremost factors underlying the production process for wireless handsets. While the supply chain for handsets is global, production of components and finished goods is concentrated in Asia and Latin America, and to a

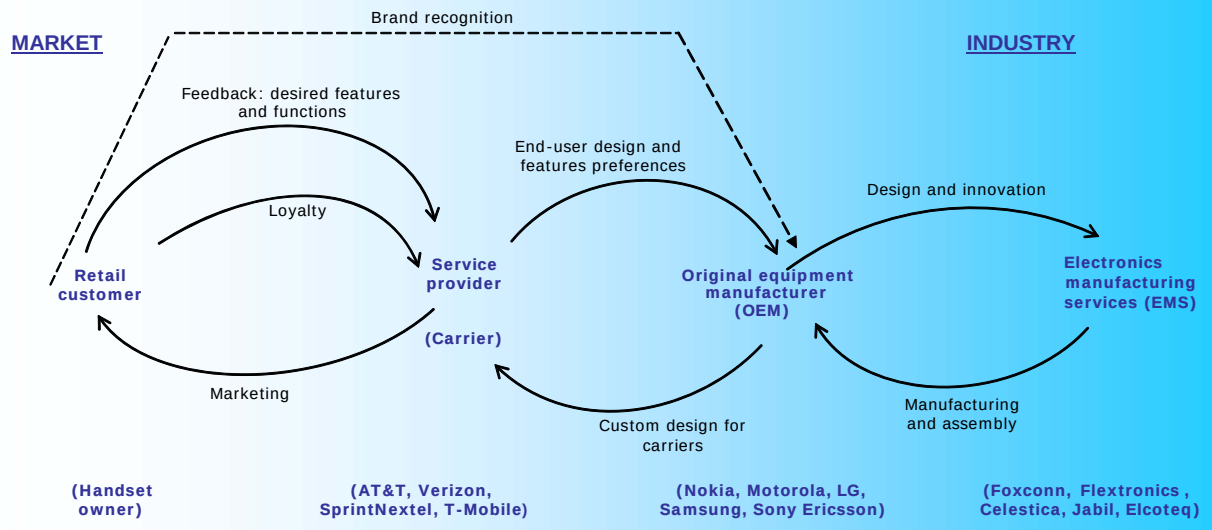
[22] Carson, "2009 Wireless Forecast: Handsets," February 2, 2009.
[23] Carson, "'Other' Vendors Surge on Smartphones, Niches," February 20, 2009.

lesser extent Eastern Europe.[24] Because OEMs focus on design and R&D rather than manufacturing, competitiveness depends critically on supply chain management.

Firm Specialization

The production of wireless handsets is carried out by two highly specialized groups: industry leaders that focus on technology-intensive processes (including R&D, design, and branding) and contract manufacturing firms that produce components. The largest OEMs are headquartered in developed economies, allowing them to leverage capital, technology, and R&D capabilities in product design and development (figure 3). It is common industry practice to locate R&D facilities near to the market being served in order to incorporate feedback from the retail customer into the product design process. Each of the major handset manufacturers conducts product development for the U.S. market in the United States. Their U.S. facilities also engage in retailing, marketing, and building relationships with U.S. carriers.[25]

FIGURE 3 Wireless handsets: Market and industry linkages



Source: Compiled by USITC staff.

[24] Industry official, interview by Commission staff, October 22, 2008.
[25] For further details, see the U.S. market section.

The outsourcing of parts manufacturing has accelerated with the increasing commoditization of mobile phones and with the entry of innovation-focused newcomers such as Apple into the market. Both of these factors have applied downward pressure on prices for phones and their components. As a result, OEMs have moved away from the vertically integrated production model of the 1980s to become design-centric firms. For example, firms such as Nokia have ceased internal chip design and production because of the emergence of specialized chip design firms that can cut/slash costs by focusing exclusively on chip design.[26]

OEMs now outsource sub-assembly for key handset components, including cameras, speakers, microphones and integrated circuits, as well as production of the parts themselves.[27] Suppliers of these products are large electronics contract manufacturers (Electronic Manufacturing Services, (EMS)) that rely on economies of scale for their competitive advantage. The broad scope of products made in such large, diversified facilities further adds to this advantage. EMS products bear the design and brand name of the OEM, allowing OEMs to sell other companies' products under their own brand. OEMs typically license the outsourced components and contract with the EMS to build the final product.[28]

The division of labor between OEM and EMS manufacturing facilities, and the extent of their relationship, is not clearly understood by outsiders. However, EMS firms generally locate production centers where they can benefit from low labor costs and proximity to the supplier base. Therefore, production capacity is concentrated in China, India, Latin America and, to a lesser extent, Eastern Europe. Products for the North American market are manufactured in large facilities in China, Mexico, and Brazil.[29] OEMs have also established their own networks of subsidiary production facilities in these countries that undertake certain manufacturing and assembly operations.

The EMS industry is a major component of the global supply chain for mobile handsets. EMS industry revenues in 2006 totaled $153 billion. The top five EMS companies in 2006 were headquartered in Asia and North America and controlled nearly two-thirds of global market share. For Taiwanese-based Foxconn, the EMS industry leader, consumer electronics products (primarily mobile devices and flat-panel TVs) accounted for more than half of total revenues in 2006. The second largest EMS, Singapore-based Flextronics, focused production on handsets, which generated 30 percent of total revenues in 2007. In 2007, 64 percent of Flextronics' revenue came from its top 10 customers, and more than 10 percent of annual revenues came from one customer, Sony-Ericsson.[30]

EMS firms have responded to increasing competitive pressures in the industry by consolidating. Flextronics' 2007 acquisition of the fourth largest EMS, Solectron,

---

[26] Industry official, interview by Commission staff, November 12, 2008.

[27] Ibid., October 22, 2008.

[28] Wikipedia, "Electronics Manufacturing Services," http://en.wikipedia.org/wiki/Electronics_Manufacturing_Services (accessed December 4, 2008). For example, major EMS firms include: Foxconn (owned by Hon Hai Precision Industries), Flextronics, Celestica, Jabil and Elcoteq.

[29] Industry official, interview by Commission staff, Washington, DC, October 22, 2008.

[30] Venture Outsource, "Dissecting the new Flextronics," http://www.ventureoutsource.com/contract-manufacturing/industry-pulse/2008/dissecting-the-new-flextronics, (accessed October 20, 2008).

satisfied many goals, including diversifying its product and customer bases, building economies of scale, discouraging competitors, and solidifying its position in the industry. Flextronics' largest manufacturing facilities are located in China, Malaysia, and Mexico.[31]

The Global Supply Chain

With the diversity of consumer markets across the globe, the key to launching a successful product is keen local knowledge. Because the top-tier OEMs no longer manufacture most products and parts, the supply management process is crucial to linking manufacturing capability with local market product design. The major OEMs, such as Nokia, maintain global production networks, with product development facilities located in or near leading markets (table 3).

TABLE 3 Nokia production facilities and primary markets, 2008

Major factory	Market served
Romania	Middle East/Africa
India	India
China	China, Japan, Asia
Brazil	Brazil and Latin America
Finland	Europe and North America

Source: Nokia official, interview by Commission staff, November 2008.

Note: These facilities are Nokia subsidiaries, not EMS partners.

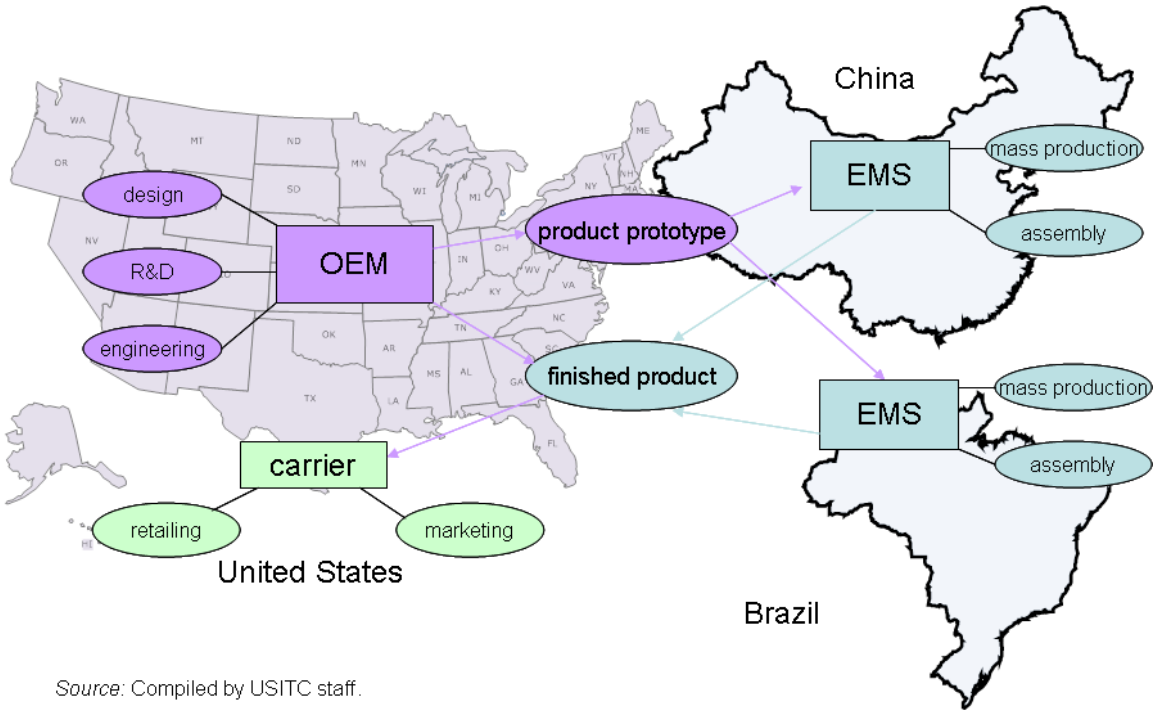
Global supply chain development takes years and involves constant refinement. Firms aim to strike a balance between local supplier capabilities, just-in-time manufacturing, and costs.[32] AMR research ranked Nokia as the number one supply chain in the world in 2007, and number two in 2008.[33] The global network supplies hardware to the major OEMs, including electronic components (chipsets, integrated circuits, microprocessors, memory devices, cameras, displays, batteries, and chargers) as well as mechanical components (covers, speakers, connectors, key mats, and antennas).

Mobile handset OEMs will typically open a production facility in close proximity to R&D centers. Prototypes are initially conceived and built in the local marketplace, and then transferred to overseas factories for mass production. The prototype manufacturing stage begins with building 10,000 to 15,000 units of a new product. If the product takes off, the "recipe" will be transferred to the lead factory for the intended market. If consumer demand continues to grow, production will spread to more factories in other regions (figure 4). Lead factories have the capacity to produce up to 1 million handsets per month. The overwhelming majority of mobile phones owned by consumers are made in one of the mass factory facilities. For example, Motorola's biggest prototype factory is in Illinois, and it uses larger facilities in Brazil and China for mass production. Each of these serves the regional market where it is located.[34]

[31] Ibid.
[32] Ibid.
[33] O'Marah, "Feasting on a Content Economy: Nokia Bites Apple," June 30, 2008.
[34] Industry official, interview by Commission staff, October 22, 2008.

Finished mobile phones are delivered to the customer through regional logistics centers. These regional facilities are placed according to several factors, including tariffs and other barriers to trade. For example, several OEMs maintain manufacturing bases in Brazil, owing to the tariffs charged for imported handsets in several Latin American countries.[35]

FIGURE 4 Production process of a typical cellular phone for the U.S. market



Source: Compiled by USITC staff.

Production Factors

Research and Development Remains Vital

Increasingly, the key to securing industry market share for OEMs lies in leveraging their formidable R&D budgets to generate new designs and quickly bringing those designs to market. Because R&D is the primary focus of both the major OEMs and second-tier firms attempting to move into the upper echelon of the market, industry players devote significant portions of their human and financial resources to R&D.

For example, Nokia is among the top five global corporations in R&D expenditures and owns more than 11,000 U.S. and foreign patents.[36] In 2008, Nokia's R&D expenditures totaled almost 12 percent of sales and employed 31 percent of its workers in 16 countries.[37] Motorola owns 10,000 U.S. patents and approximately 13,000 foreign patents covering its entire portfolio of products. Its R&D expenditures have grown steadily from

[35] Ibid.
[36] Industry official, interview by Commission staff, Washington, DC, November 12, 2008.
[37] EIU, *World telecoms: Key player: Nokia*, 2009, 2.

$3.6 billion in 2005 to $4.1 billion in 2006 and $4.4 billion in 2007.[38] LG has 38 research labs worldwide and spent $1.8 billion on R&D in 2007.[39] Samsung invested 9 percent or more of total revenues in R&D and earned 17,377 patents in 2006 alone; 2,665 of those were in the United States.[40]

Handset OEMs have also expanded their innovation capacity through strategic acquisitions of companies specializing in services that consumers desire, especially music, digital maps, and online videos.[41] OEMs recognize that services are driving consumer behavior and will define the future direction of the handset market. Nokia was the first OEM to offer its own mobile Internet services portal in 2007, with photo, video, social networking, and music functionality.[42] The success of Apple's iPhone music store has prompted other OEMs, including Nokia, Motorola, and Sony Ericsson, to offer their own self-branded mobile music portals.

In general, OEMs protect their technology assets by obtaining and enforcing their intellectual property rights. Intellectual property (IP) in the industry typically consists of patents but can also include trademarks and copyrights. Most IP infringement in the mobile handset industry occurs between major industry players with substantial IP rights to protect. For example, in 2008, Eastman Kodak Company accused Samsung and LG of infringing on its patents for digital cameras in mobile handsets.[43]

[38] Motorola Corp., submissions to the United States Securities and Exchange Commission, Form 10-K, 2007: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007, Commission file number 1-7221, 16. It is unclear how much of this expenditure is directed exclusively to wireless handsets.

[39] Datamonitor Company Report, *LG Electronics, Inc.*, 2008, 17.

[40] Samsung Web site. http://www.samsung.com/hk_en/aboutsamsung/companyprofile/researchanddevelopment/CompanyProfile_Overview.html (accessed July 2, 2009). Sony Ericsson's 2008 R&D expenditures were $1,379 million euros; the press release did not provide the U.S. dollar/euro exchange rate. Sony Ericsson Web site. http://www.sonyericsson.com/cws/download/1/593/596/1232079042/Q408_press_release_FINAL.pdf (accessed July 2, 2009).

[41] For example, Nokia acquired NAVTEQ, a company specializing in digital mapping technology, in 2008.

[42] Datamonitor Company report, *Nokia*, 2008, 29.

[43] For more details, see section on Trade Investigations.

U.S. INDUSTRY PROFILES[44]

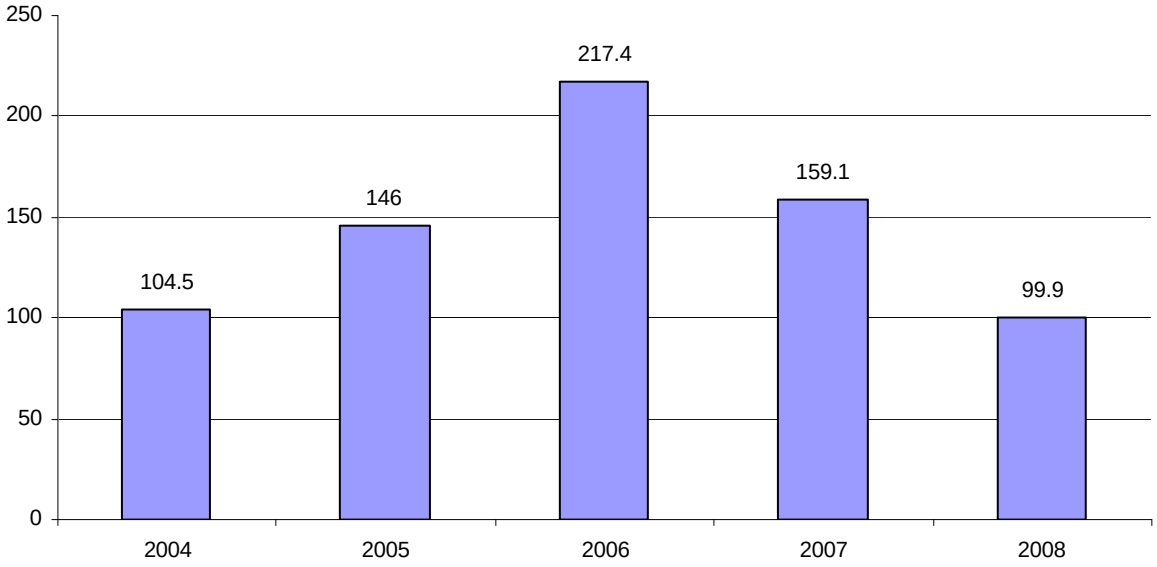
The technology-intensive U.S. handset industry is characterized by short product lifecycles and rapid turnover of new products. It consists of a few large global firms with significant R&D resources that engineer sophisticated, new devices for the domestic and global markets. The major domestic firms are Motorola and Apple. Like their global counterparts, these companies have no significant manufacturing presence in the United States. While specific production data are not available, anecdotal evidence suggests that domestic production is limited to prototypes and the initial batches of a new product being introduced into the market.

Motorola is headquartered in Libertyville, Illinois, but has research and development, design, manufacturing, and integration locations in many other states, including Florida, Texas, Arizona, California, and New Jersey.[45] In 2008, the Mobile Devices division[46] earned revenues of $12.1 billion, representing 40 percent of total net sales. Sales to the U.S. market accounted for 48 percent of total sales in 2008, a decrease of 21 percent from 2007.[47] Lower U.S. sales resulted from lower overall shipments and a decline in the average sale price per unit owing to a greater proportion of entry-level devices sold. The largest international markets for Motorola's mobile devices in 2008 were China, Brazil, and the United Kingdom.[48] Though Motorola is an industry stalwart that has traditionally dominated both the domestic and international marketplaces, it has struggled in recent years to adapt to changing market dynamics. In 2008, industry analysts indicated that Motorola had a narrow product portfolio in high-profit-margin mass-market and feature-rich phones.[49] According to the Economist Intelligence Unit, Motorola's portfolio was particularly thin in third-generation (3G) devices.[50] Motorola's global shipments in 2008 totaled 99.9 million units, accounting for 8.5 percent of global market share, down from 217.4 million and 22 percent in 2006 (figure 5, box 1).

Apple, Inc., headquartered in Cupertino, California, entered the handset market in 2007 and became the world's seventh largest producer of handsets in 2008.[51] Revenues for its mobile handset, the iPhone, totaled $1.8 billion in 2008, when 11.6 million devices were sold.[52] The iPhone began as a dramatic success, selling 1 million units within 47 days of its June 2007 launch.[53] Net sales reached 1.4 million in 2007, before the cheaper and more advanced 3G model was introduced in the summer of 2008.[54] The primary international markets for the iPhone were the United Kingdom, Germany, and France, which all introduced the product in late 2007.

[44] The NAICS code assigned to wireless handsets by the Commerce Department is 3342203107. Due to the small number of firms operating in the United States, industry data are not publicly available.
[45] Industry official, interviewed by Commission staff, October 22, 2008.
[46] The Mobile Devices division produces handsets with integrated software and accessory products.
[47] Datamonitor Company report, *Motorola*, 2009, 22.
[48] Ibid.
[49] Datamonitor Company report, *Motorola*, 2009, 25.
[50] EIU, *World Telecoms: Key Player: Motorola*, 2009.
[51] Carson, "'Other' Vendors Surge on Smartphones, Niches," February 20, 2009.
[52] Datamonitor, *Apple, Inc*., 2009, 29.
[53] Ibid., 2008, 20.
[54] Ibid., 25.

FIGURE 5 Motorola global wireless handsets shipments, 2004–08 (million units)



Source: Motorola representative, interview by Commission staff, Washington, DC, November 2008; Strategy Analytics (2008 data).

BOX 1 Motorola: The changing dynamics of competition

The U.S. industry once revolved around Motorola as the second largest manufacturer of handsets in the world. However, the company has struggled to launch a replacement for the popular RAZR series, sales of which exceeded 50 million units by February 2008.[a]

As a result of its focus on the RAZR, Motorola's product portfolio suffered at both the high and low ends of the scale, and its global market share declined rapidly after 2006, from 22 percent to 8.5 percent in 2008. Because of its limited smartphone and 3G product offerings, Motorola's market share declined in the United States and Western Europe. In China and Latin America, increased competition in entry-level devices forced the company to forfeit market share to Nokia and Samsung.[b] By the fourth quarter of 2008, Motorola had a mere 6.4 percent of the market, making it the fifth largest global manufacturer that quarter. Due to its lagging performance, Motorola announced in April 2008 its intention to spin off the Mobile Devices division of its business in 2009.[c]

The principal beneficiaries of Motorola's difficulties were Samsung and LG, both of which expanded their market shares in the United States and the global market. In 2008, Samsung climbed to 16.7 percent of the global market, outdistancing third-place LG (at 8.6 percent), Motorola, and Sony Ericsson (at 8.2 percent). Samsung also surpassed Motorola to become the leading supplier to the United States market in 2008. In addition, Samsung and LG have strengthened their relationships with all four major U.S. carriers, further eroding Motorola's advantage in its home market.[d]

[a] EIU, *Telecoms and Technology Forecast: United States of America*, 2008, 17.
[b] Industry official, interview by Commission staff, October 22, 2008.
[c] The spinoff has since been delayed due to the global economic downturn.
[d] Carson, "By the Numbers: Top Five Mobile Device Vendors in the Fourth Quarter of 2008," January 23, 2009.

Apple has differentiated itself from traditional OEMs by focusing on innovative designs and software. As a new entrant to the handset market, Apple has focused exclusively on smartphones, the most rapidly growing segment of the U.S. market.[55] Marketing and advertising are particularly important in explaining the iPhone's success because Apple is not traditionally known as a handset manufacturer. To preserve its brand name, Apple opened 251 of its own retail stores in the United States and 10 foreign countries to better train salespeople to market and repair its products, including iPhones.

In addition to the domestic OEMs, many foreign manufacturers are engaged in R&D, product design, marketing, and retailing activities in the United States. The few products conceived and manufactured domestically within the United States, likely prototypes, are almost exclusively intended for North American consumers. Nokia has offices in New York and Texas and a product creation center in San Diego, California.[56] Samsung Electronics has a production center in Austin, Texas.[57] LG Electronics has several R&D and design centers in the United States, including in New Jersey, New York, Chicago, and San Diego.[58] Huawei, the strongest Chinese competitor to the leading OEMs, has two R&D centers in the United States located in California's Silicon Valley and Dallas, Texas.[59] There is no evidence of EMS industrial activity within the United States.

Employment and Current Economic Conditions

Because of the tendency to outsource production, U.S. handset industry employment centers on the technology-intensive services inherent in product design and development (including R&D and engineering) and marketing to retailers. In the United States, marketing the product to retail consumers is generally executed by network service providers (figure 3).

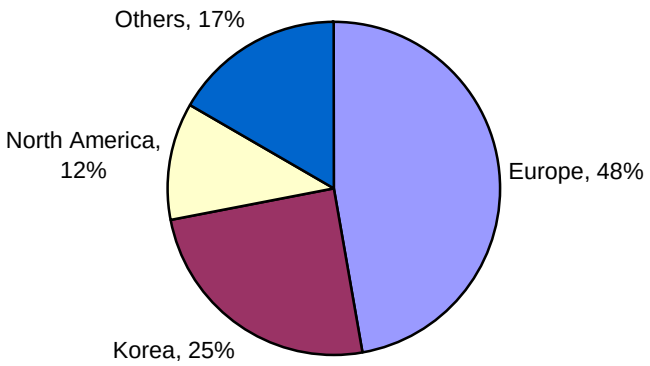
While specific data are not available, anecdotal information suggests that heightened industry competition and the economic downturn adversely affected industry employment in 2008. Sony Ericsson announced 2,000 layoffs in July 2008, including half of the work force (approximately 400 employees) at its North American headquarters in North Carolina.[60] Motorola had 66,000 employees at the end of 2007, but announced 3,400 layoffs in 2008, the majority of which were trimmed from the Mobile Devices division. The company further downsized its worldwide manufacturing facilities for mobile devices from three to two.[61] In January 2009, Motorola announced a further 4,000 layoffs.

[55] See U.S. Market section for more details.
[56] Industry official, interview by Commission staff, Washington DC, November 12, 2008.
[57] Samsung Annual Report, "Profile 2008," www.samsung.com (accessed August 3, 2009).
[58] LG Annual Report 2008, http://www.lge.com/about/corporate/overview.jsp, (accessed August 3, 2009).
[59] Datamonitor Company report, *Huawei*, 2009, 5.
[60] Walko, "Ericsson Calls Time on U.S. R&D Center," November 24, 2008.
[61] Carson, "Motorola's Path: In Flux," November 11, 2008, 2.

FOREIGN INDUSTRY PROFILES

U.S. handset manufacturers share global leadership in product development with Western European and Korean producers. Because firm-level production data are not publicly available, sales figures are used as a proxy for firm output. Further, sales are associated with the OEM's country of origin, rather than the country where manufacturing occurs. In 2008, North American producers (Motorola, Research in Motion, and Apple) had a 12 percent share of the global market, while European producers had 48 percent and Korean producers accounted for 25 percent (figure 6). However, manufacturing occurs in countries with low labor costs, primarily in Asia, Latin America, and Eastern Europe. Several smaller manufacturers in China, including Huawei and ZTE, have also begun to develop competitive offerings for the domestic and global markets.

FIGURE 6 Global handset sales share, by region of OEM country of origin, 2008



Total = 1,178.1 million[a]

Sources: Strategy Analytics and ABI Research.
[a] Calculation based on number of units shipped.

Due to the diffuse nature of manufacturing in the wireless handset industry, the following analysis will focus on the largest companies in the industry in each country rather than leading manufacturing countries.

Finland

Nokia, Finland's largest company is the industry leader in wireless handset production, with nearly 40 percent of global market share. Nokia's operations make up a significant portion of Finland's gross domestic product, exports, and R&D expenditures.[62] Nokia

[62] Lesser, "Case Study No. 1: Market Openness, Trade Liberalisation and Innovation Capacity in the Finnish Telecom Equipment Industry," July 2008, 25.

entered the mobile communications market in the 1970s and is now a global leader in digital communications, with production facilities in nine countries and sales in over 150 markets worldwide.

Nokia's total device shipments in 2008 were 468.4 million units, an increase of 7 percent over 2007. However, revenues for mobile devices and services in 2008 were $48.8 billion, a decline of 7 percent from the previous year's $52.5 billion.[63] Nokia continues to focus on maintaining its competitive edge through innovation. While it dominated sales of handsets in emerging markets with over 50 percent market share in basic mobile devices in 2007, it has further focused its efforts on refining high-end offerings for Western Europe and the United States. Nokia increased its sales of smartphones from 29 million in 2006 to 60.5 million in 2007, becoming the smartphone market leader with a 50 percent market share.[64]

In an environment increasingly driven by data services (e.g. text messaging, e-mail, and Internet searches) rather than voice services, Nokia has made a series of strategic acquisitions to increase the scope of services available to users of its mobile handsets. In 2007 it acquired several multimedia companies specializing in content and advertising, including Twango, Avvenu, and Enpocket. In July 2008 it finalized the absorption of Navteq, a provider of digital map systems. Several months later, it bought Symbian, the leading mobile operating system for smartphones, in which it had owned a controlling interest since 2004.[65]

Nokia is also the first OEM to originate an internet content provider. In 2007, it launched Share on Ovi, allowing users to share photos and video as well as sample and purchase music and games directly from their handsets.[66] As part of Ovi, the company debuted Nokia Music Store, offering users content exclusive to Nokia devices. The music service was launched in the United Kingdom in 2007 and expanded in 2008 to Sweden, Singapore, France, Australia, the Netherlands, and Ireland.[67] Ovi's mobile games portal, N-Gage, was available to consumers in early 2008.

Nokia's largest regional market is China and the Pacific, which accounted for 44 percent, of net handset sales in 2008.[68] China was Nokia's largest consumer market in 2007, accounting for approximately 12 percent of total revenues that year. India was the next largest, followed by Germany, the United Kingdom, the United States, and Finland. With 100,000 distribution outlets in India and 60,000 in China, the company has established a strong network some of the fastest-growing markets in the world.[69]

Nokia has developed a strong global supply chain, effectively leveraging economies of scale in mobile phone production and creating a flexible production base.[70] For example, the company ceased internal chip production after the emergence of specialized chip

[63] Nokia Annual Report, "Nokia in 2008."
[64] Nokia Corp., *Form 20-F 2007, Annual Report 2007*, 2008, 28, 57–58.
[65] Datamonitor, *Nokia Corporation*, 2008, 9.
[66] See www.ovi.com.
[67] Datamonitor, *Nokia Corporation*, 2009, 31.
[68] EIU, *World Telecoms: Key Player: Nokia*, 2009, 2.
[69] EIU, *South Korea Telecoms: LG Pushes for Risky Tack on Mobile*, 2008, 1.
[70] Open Gardens, "The ASUS Effect: Mobile Innovation Triggered By Open Source, Long Tail Devices And A Shift In The Device Value Chain," August 8, 2008.

design firms because of a need to diversify supply sources.[71] In 2008, Nokia closed its German production facility and shifted capacity to Romania after its local suppliers left the area in search of a lower cost base.[72]

Korea

he Korean handset industry is dominated by Korea two of the largest handset manufacturers in the world, LG and Samsung, both of which produce a wide variety of electronics products and accounted for roughly one-quarter of 2008 global handset sales. LG was the first to begin producing electronic devices, but Samsung currently dominates its domestic rival as the world's number two OEM in sales of mobile phones. [73] In 2008, Samsung shipped 197 million handsets globally, and LG shipped 101 million handsets.[74] Like the other top-tier OEMs, LG and Samsung have their handsets manufactured principally in large production facilities elsewhere in Asia, whereas their domestic activities primarily concentrate on product development and design efforts. For example, more than one-quarter of Samsung's employees are involved in R&D activities to maintain its technological edge.[75]

Samsung Telecommunications is the world's largest manufacturer (2008) of handsets for the CDMA standard.[76] After developing and manufacturing Korea's first mobile phone in 1988, Samsung gained more than 50 percent market share in the CDMA standard by 1999. In order to become a global player in handsets, Samsung entered the far larger GSM market and changed its focus to high-end phones. By the end of 2008, Samsung achieved the number two global position for all handsets, putting distance between itself and its nearest three rivals with 16.7 percent market share. In 2008, Samsung's revenues from its telecommunications segment totaled $32.1 billion, accounting for 29 percent of total corporate sales.[77]

Samsung's largest market in 2008 was Europe, with 28 percent of total revenues, followed by the Americas (21 percent) and Korea (19 percent).[78] In 2007, the company expanded its manufacturing activities to lower costs, increasing capacity in each of two Chinese plants and opening another site in Vietnam with the capacity to produce up to 100 million handsets annually.[79]

LG's focus on innovation is crucial to its success; its handset products are concentrated in high-end, premium models. LG developed the first commercial touchscreen phone in 2007.[80] In another strategic move, the company sold its chip production division in 1999 in order to streamline its operations and focus on product design.[81]

[71] Industry official, interview by Commission staff, Washington, DC, November 12, 2008.
[72] Datamonitor Company report, *Nokia*, 2008, 11.
[73] *Economist*, "Looking Good?," January 22, 2009.
[74] Cellular news, "Global Mobile Phone Shipments Dropped by 10% in Q4 2008," January 23, 2009.
[75] Datamonitor Company reports, *Samsung Electronics*, 2009, 19.
[76] Ibid., 2008, 20.
[77] Ibid., 2009, 16.
[78] Ibid.
[79] EIU, *China: Telecoms and Technology Forecast*, 2008, 3.
[80] Datamonitor Company reports, *LG Electronics*, 2008, 17.
[81] *Economist*, "Looking Good?" January 22, 2009.

LG's Mobile Communications Division generated revenues of $13.3 billion in 2008, 32 percent of total revenues.[82] LG has relied on building market share in the U.S. market as its engine of growth. In 2008, LG's largest markets (based on revenues) were the United States (26 percent), Europe (22 percent), and China (19 percent).[83] Of LG's 80,283 employees, 29,496 are domestic and the remaining 50,787 work overseas.[84] Handsets are manufactured in China, Brazil, Mexico, and India.[85]

According to EIU analysts, LG has a competitive disadvantage against market leaders Nokia and Samsung in emerging markets. Weak distribution channels in these countries, especially India and China, have so far prevented LG from increasing its brand recognition there and taking advantage of the growth opportunities.[86]

Both LG and Samsung have improved their relationships with the major U.S. carriers and expanded their retail presence in the United States. The broader product portfolios offered by the Korean manufacturers, featuring popular designs at both the high end and the low end, contributed to their increased U.S. market shares.[87]

United Kingdom

Sony Ericsson is a London-based joint venture between Sony Corporation and Ericsson Mobile Communications that exclusively produces wireless handsets. Sony Ericsson principally markets high-end handsets with advanced features, and introduced the world's first mobile phone with a music player. The key handsets in the company's product portfolio include a 3.2 megapixel Sony Cybershot imaging phone and a series of Walkman music phones.[88] In 2008, the company was the fifth-largest cell phone manufacturer in the world, with shipments of 97 million devices for the year.[89] Sony Ericsson is seeking to secure its competitive position by increasing brand visibility in the United States through greater offerings of high-end products, especially smartphones. This effort will be hampered because the company only makes handsets for the GSM standard, which are compatible with only two of the four major U.S. carriers' networks, AT&T and T-Mobile (appendix C).[90]

In addition to R&D operations in Sweden, Japan, and China, Sony Ericsson has manufacturing facilities in China.[91] In January 2007, the company announced it would begin manufacturing handsets in India through its EMS partners Flextronics and Foxconn.[92] Several months later, Sony Ericsson announced plans to establish an R&D facility in India.[93]

---

[82] LG Electronics, *Annual Report 2007*, 2008, 28.
[83] Datamonitor Company reports, *LG Electronics*, 2008, 14.
[84] Ibid., 58.
[85] LG Electronics, *Annual Report 2007*, 2008, 40.
[86] EIU, *South Korea Telecoms: LG Pushes For Risky Tack on Mobile*, 2008.
[87] LG Electronics, *Annual Report*, 2008, 40.
[88] Sony Ericsson Company Web site. http://www.sonyericsson.com (accessed December 10, 2008).
[89] Cellular News, "Global Mobile Phone Shipments Dropped by 10% in Q4 2008," January 23, 2009.
[90] Carson, "Sony Ericsson Challenged Financially, But Holding Ground," October 17, 2008.
[91] Datamonitor Company reports, *Sony Ericsson Mobile Communications AB*, 2008, 4.
[92] Walko, "Sony Ericsson to Make Mobile Handsets in India," January 31, 2007.
[93] Datamonitor Company reports, *Sony Ericsson Mobile Communications AB*, 2009, 6.

Canada

The Canadian telecommunications equipment industry has benefited from its proximity to the United States; many enterprises are integrated with U.S. companies, maintaining manufacturing and distribution capacities in both countries. In addition, a large pool of educated workers flows across two borders.[94]

The mobile handset industry in Canada is led by a smaller, innovative firm, Research in Motion (RIM). RIM pioneered the BlackBerry enterprise handset in 2000 and has since been adding new customers at a rapid pace. By August 2008, the number of BlackBerry users worldwide had nearly doubled to 19 million from 10.5 million the previous year.[95] RIM shipped 13.8 million devices[96] in 2008, more than double its 2007 total.[97] The company increased unit sales by 59 percent in 2007 over 2006, an impressive gain that grew markedly in the following years.[98]

RIM continues to leverage its competitive advantage in the corporate market through enhanced offerings to enable applications of business functions on the handset, including business intelligence and salesforce automation. While BlackBerrys continue to dominate the business sector, RIM has successfully introduced more consumer-friendly features, including cameras, music players, and a touchscreen. Noncorporate users currently represent more than 30 percent of subscribers.[99] RIM has broadened its appeal in emerging markets as well, offering cheaper plans by inducing service providers to bundle BlackBerrys with prepaid contracts. By the end of 2008, RIM handsets were offered in 135 countries.[100]

Handset revenues for RIM in 2008 were $4.8 billion, accounting for 73 percent of total revenues.[101] The United States was RIM's largest market in 2008, representing 59 percent of total revenues. In contrast, its domestic market accounted for 7 percent of the total.[102] Reflecting the importance of R&D, its R&D expenditures increased substantially from $159 million in 2006 to $236 million in 2007.[103] RIM employs 12,000 people, of which more than 5,000 are engaged in research and development activities.[104]

China

Fueled by both foreign and domestic investors, China is the world's largest producer and exporter of wireless handsets.[105] According to the Ministry of Industry and Information Technology, China's overall output in 2007 of 548.6 million handsets accounted for

[94] EIU, *Canada: Telecoms and Technology Profile*, 2008, 1–3.
[95] EIU, *World telecoms: Key player: Research in Motion,* 2008, 1.
[96] Research in Motion, http://www.rim.com/investors/pdf/RIM09AR_FINAL.pdf, 28 (accessed October 7, 2009).
[97] Datamonitor Company reports, *Research in Motion*, 2009, 26.
[98] Ibid., 16.
[99] EIU, *World telecoms: Key player: Research in Motion,* 2008, 2.
[100] Datamonitor Company reports, *Research in Motion*, 2009, 26.
[101] Ibid., 15.
[102] Ibid.
[103] Datamonitor Company reports, *Research in Motion*, 2009, 19.
[104] Ibid, 4, 26.
[105] EIU, *China Telecoms: Feeling the Pinch,* 2008, 1.

50 percent of the global market share, almost double China's share in 2005.[106] While sales of mobile phones within China increased by 11 percent in 2007, exports of phones increased by 33 percent, indicating that most production of wireless handsets in China is destined for other markets.[107] Foreign handset producers control more than 50 percent of sales in China's handset industry; Nokia and Motorola are the two largest foreign telecom investors in China.[108] The dominant domestic firms are Huawei and ZTE.

Regulatory changes in 2007 substantially increased the number of local handset manufacturers, resulting in increased competition in the low-tier segment of handsets for foreign OEMs. By the fourth quarter of 2007, shipments to China from foreign manufacturers declined as local vendors expanded domestic sales at the expense of foreign producers.[109] A recent increase in tax rates for foreign firms and uncertain encryption standards also impose adverse conditions on foreign OEMs operating in China.[110]

Domestic manufacturers ZTE and Huawei have attracted particular attention in the handset market. Both companies benefit from low-cost labor and government intervention to extend favorable financing to their customers in other emerging markets.[111] ZTE, which primarily manufactures 3G networking equipment, did not enter the handset market until 2002.[112] By 2007, it became a major handset producer, deriving 25 percent of total revenues from handsets, a share the company expects to rise to 50 percent by 2012. ZTE principally sells low-cost handsets to customers in the developing world; India is its largest market. However, ZTE's high-end products are very competitive in Europe and Canada, and the company launched two handsets specifically designed for the U.S. market in 2008.[113]

Rival Huawei became one of the top five telecommunications equipment producers in the world in 2008. However, the proposed sale of its handset division to a private equity firm was canceled owing to unfavorable economic conditions, signaling a potential lack of confidence in the company's handset portfolio on the part of industry analysts.[114] Huawei sold 33 million handsets in 2008[115] and the mobile division generated annual revenues of $23.3 billion.[116] It has 14 R&D centers worldwide, including two in the United States. As of June 2008, the company had 3,335 patents, and 43 percent of its 87,500 employees were engaged in R&D activities.[117]

---

[106] EIU, *China: Telecoms and Technology Forecast*, 2008, 3.
[107] Ibid.
[108] In 2006, Motorola was the second largest provider of cellular phones in China, with 22 percent market share. Due to increased market competition and sluggish product development, this share fell to 7 percent in 2008. EIU, *China Telecoms: Year of change*, 2008, 3.
[109] There are as many as 115 alternative manufacturers of handsets in China, predominantly engaged in manufacturing imitation products. These producers lack R&D funding and product development capabilities, relying on rock-bottom prices as their sole competitive advantage. EIU, *China Telecoms: Feeling the Pinch*, 2008, 2.
[110] Industry official, interview by Commission staff, Washington, DC, October 22, 2008.
[111] *Economist*, "Silent Mode," October 16, 2008.
[112] Ibid.
[113] EIU, *China Telecoms: Zealous ZTE*, 2008, 2.
[114] *Economist*, "Silent Mode," October 16, 2008.
[115] Lagorce, "Huawei Expects to Sell 30% More Handsets in 2009," February 17, 2009.
[116] Datamonitor Company reports, *Huawei Technologies*, 2008, 16.
[117] Huawei Company Web site. http://www.huawei.com/corporate_information.do (accessed August 11, 2009).

Both ZTE and Huawei have created strong customer relationships with service providers by allowing carriers to brand the majority (up to 70 percent) of handsets.[118] However, the result of this practice is that retail customers are loyal to the service provider instead of the manufacturer. In an effort to promote its brand, Huawei announced in September 2008 that it would shift manufacturing to primarily self-branded products.

GLOBAL TRADE

The United States was the world's largest importer of wireless handsets in both 2007 and 2008 (table 4). In 2008, the United States imported $30.5 billion in mobile handsets, nearly the same amount as the next two largest importers combined. U.S. handset imports in 2007 totaled $25.6 billion, accounting for nearly 30 percent of the global imports that year. Together, the United States and the European Union accounted for nearly 52 percent of all imports of wireless handsets in 2007.[119]

TABLE 4 Top 10 importing countries for wireless phones, 2007–08 (million $)

	2007	2008
United States	25,596,108	30,508,911
EU27 (External Trade)	20,452,128	22,258,023
Hong Kong	9,309,068	8,640,500
Singapore	6,766,906	5,549,776
Russia	5,194,839	5,246,960
Mexico	2,112,258	4,709,332
India	[a]	2,847,407
Japan	1,632,552	2,168,722
Australia	1,912,728	1,858,170
Canada	1,416,834	1,850,358
Other	12,618,690	16,597,578
Reporting total	88,874,621	107,316,008

Source: Global Trade Atlas.

[a] Not available.

China was the world's largest exporter of wireless handsets in both 2007 and 2008 (table 5). In 2007, China exported $36.1 billion in mobile phones, accounting for close to 40 percent of global exports that year. In 2007, China and Korea collectively generated for roughly 60 percent of all exports of wireless handsets.

[118] EIU, *China Telecoms: Huawei, ZTE to Retail Self-Branded Handsets*, 2008, 1, 2.

[119] Owing to changes in the Harmonized Tariff Schedule in 2007, constructing comparable data on global trade in mobile handsets for 2004–08 is problematic. Therefore, only global trade data for 2007 and 2008 are reported.

TABLE 5 Top 10 exporting countries for wireless phones, 2007–08 (million $)

	2007	2008
China	36,084,273	38,924,568
Korea	18,644,390	22,113,649
EU27 (External Trade)	14,971,350	13,836,712
Mexico	3,764,485	8,752,457
Singapore	6,459,091	4,861,834
Hong Kong	3,632,561	4,732,646
United States	3,076,148	3,800,306
Brazil	1,930,866	2,207,203
India	[a]	1,807,332
United Arab Emirates	[a]	1,643,686
Other	1,505,787	1,378,096
Reporting Total	90,542,144	106,062,196

Source: Global Trade Atlas.

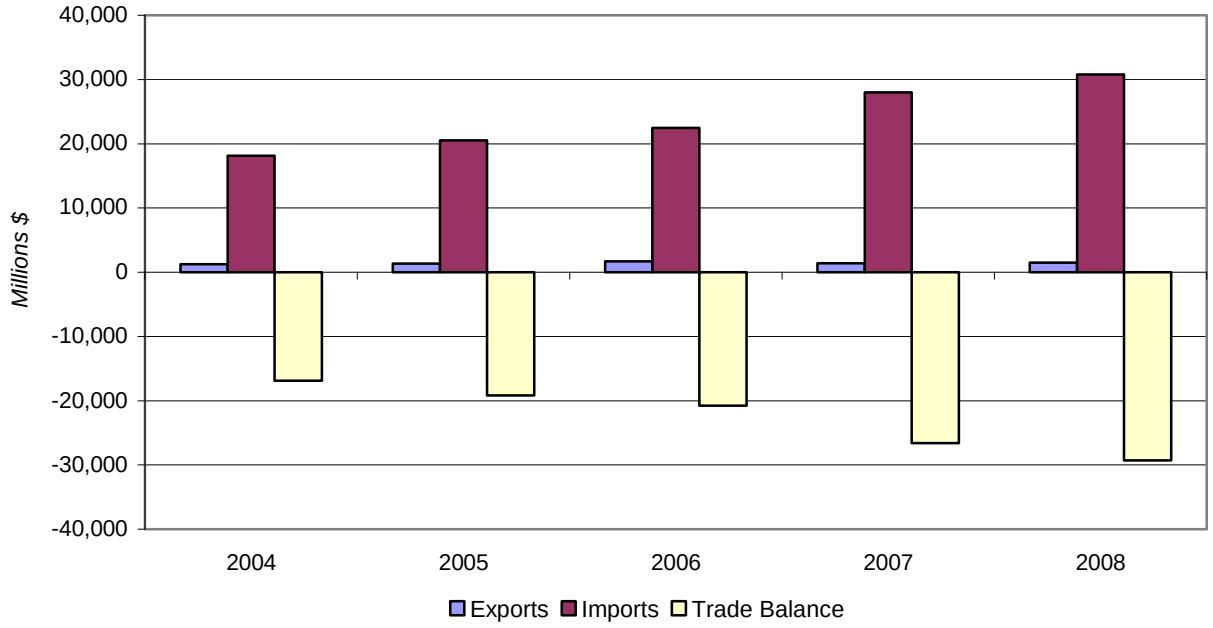
[a] Not available.

U.S. TRADE

Overview

The United States maintained a trade deficit in mobile phones throughout 2004–08 (figure 7). The trade deficit widened from $18.2 billion in 2004 to $29.2 billion in 2008, an increase of 60 percent. Imports in the period outpaced exports, growing at an average annual rate of 11.2 percent, compared to 4.2 percent for exports (table 6).

FIGURE 7 U.S. trade in wireless handsets, 2004–08



Source: Compiled from official statistics of the U.S. Department of Commerce.

TABLE 6 Wireless handsets: U.S. exports, and imports, by selected countries, 2004–08 (thousand $)

Item	2004	2005	2006	2007	2008	Percent change, 2004–08
U.S. exports of domestic merchandise:						
Mexico	253,159	142,979	321,949	321,610	215,022	–15.1
Venezuela	159,910	148,229	280,728	159,789	204,947	28.2
Hong Kong	28,067	63,737	132,902	98,849	168,871	501.7
Peru	43,141	38,608	83,407	45,357	80,395	86.4
United Arab Emirates	7,394	9,411	38,505	52,000	72,135	875.6
Honduras	10,687	11,266	12,799	45,734	59,721	458.8
Colombia	92,240	87,751	31,801	26,842	51,485	–44.2
Germany	12,185	16,672	12,310	18,243	50,614	315.4
Ecuador	60,029	117,829	105,595	41,393	49,819	–17.0
Dominican Republic	13,950	39,678	42,477	41,923	49,257	253.1
All other	550,828	655,645	631,237	549,465	506,960	–8.0
Total	1,231,590	1,331,805	1,693,710	1,401,205	1,509,226	22.5
U.S. imports for consumption:						
China	5,207,015	8,633,232	11,099,944	14,029,050	12,367,568	137.5
Korea	7,979,572	5,788,701	5,062,818	6,178,949	8,398,602	5.3
Mexico	1,899,385	1,992,379	1,606,411	2,610,630	4,882,680	157.1
Taiwan	137,391	753,529	1,531,116	1,322,964	1,709,432	1144.2
Canada	16,846	4,837	21,648	365,882	1,049,205	6128.2
Malaysia	1,272,044	1,354,736	1,470,274	1,140,747	782,880	–38.5
Hungary	28,225	19,880	75,769	132,017	567,352	1910.1
Singapore	436,312	342,185	413,288	1,289,682	362,713	–16.9
Japan	456,117	603,410	431,240	353,330	182,202	–60.1
Brazil	280,303	677,594	450,939	193,562	146,364	–47.8
All other	425,199	333,181	312,619	392,271	329,834	–22.4
Total	18,138,409	20,503,664	22,476,066	28,009,084	30,778,833	69.7

Source: Compiled from official statistics of the U.S. Department of Commerce.

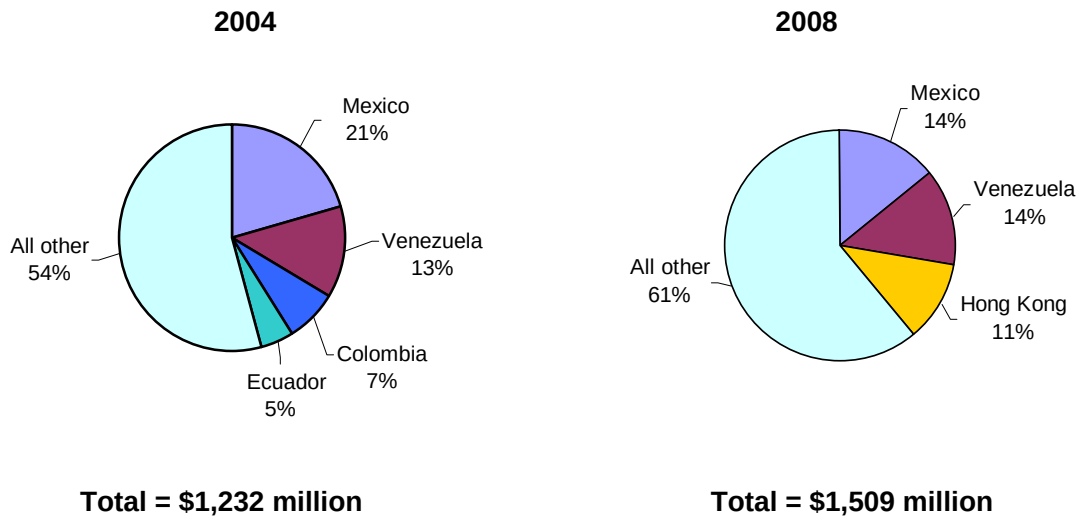
Note: Because of rounding, figures may not add to the totals shown.

U.S. Exports

U.S. exports represented a negligible share of total U.S. trade in wireless handsets during the period, comprising only 6 percent of total U.S. handset trade in 2004 and 5 percent of total U.S. handset trade in 2008. U.S. production of wireless handsets is believed to be largely limited to prototypes being routed to major production factories overseas, used phones being re-exported, and products that are intended to be refurbished abroad.

Over the period 2004 to 2008, U.S. exports to Mexico and Venezuela accounted for roughly one-third of total exports of wireless handsets (figure 8). Mexico's position as the leading

FIGURE 8 Major export markets for mobile handsets, 2004 and 2008



Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. export market is likely attributable to the duty-free status of equipment exported to Mexico under NAFTA.[120] Though Mexico's share of U.S. exports shrank to 14 percent in 2008, it remained the primary destination for U.S. exports of handsets throughout the period. In each of the final three years of the period, Mexico, Venezuela, and Hong Kong collectively accounted for approximately 40 percent of total U.S. exports of handsets. Latin America was the primary export market in the early part of the period. Mexico, Venezuela, Ecuador, and Colombia accounted for 46 percent of total U.S. exports in 2004 and 37 percent of exports in 2005 (figure 9).

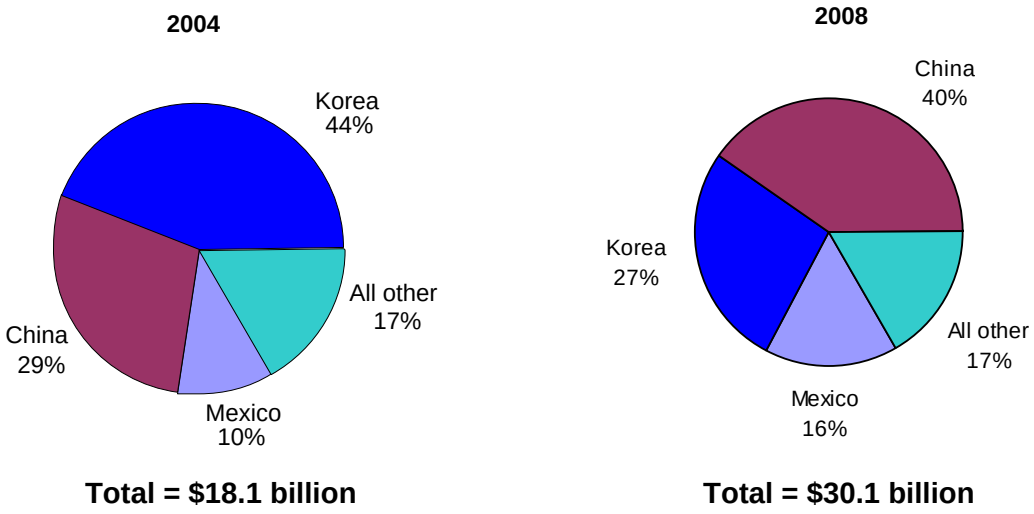
Strained relations between the United States and Venezuela and nationalization of the Venezuelan telecommunications sector in early 2007 led to lower investment in new technologies needed for further wireless penetration by both Venezuelan and foreign sources. [121] As a result, U.S. exports of cellular telephones to Venezuela fell by $121 million (43 percent) in 2007, though it remained the second largest market for U.S. handset exports that year and rebounded in 2008.

[120] TIA, *2008 Telecommunications Market Review and Forecast,* 2008, 235.
[121] EIU, *Telecoms and Technology: Venezuela*, 2007, 8.

U.S. Imports

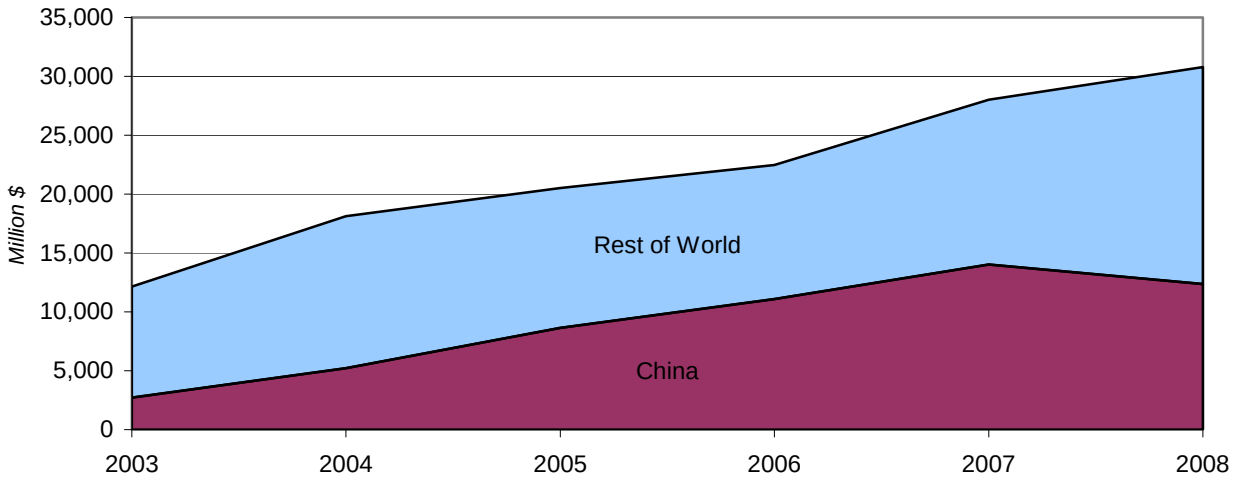
China, Korea, and Mexico were the top three suppliers of handsets to the United States throughout 2004–08, accounting for approximately 80 percent of total imports each year (figure 9). China's share of total mobile handset imports increased steadily from 2004 to 2007, reaching approximately 50 percent in 2007 (figure 10) before declining to 40 percent of the $30.7 billion total in 2008. Imports from Mexico nearly doubled between 2007 and 2008, from $2.6 billion to $4.8 billion, likely due in part to higher fuel and transpacific transportation costs for goods from Asia.

FIGURE 9 Major export markets for mobile handsets, 2004 and 2008



Source: Compiled from official statistics of the U.S. Department of Commerce.

FIGURE 10 China's share of U.S. mobile phone imports, 2004–08



Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. and Foreign Trade Measures

Tariff Measures

Cellular phone imports enter the United States free of duty. Duties on handsets were eliminated by the Information Technology Agreement (ITA), which came into effect in July 1997 and required all developed country signatories to eliminate tariffs on handsets by January 2000. There are currently 72 signatories to the ITA, covering more than 95 percent of trade in high-tech goods.[122] However, none of the largest economies in Latin America have signed.[123] Countries including Brazil, Argentina, Colombia, Ecuador, and Bolivia maintain tariffs ranging from 10 percent to 15 percent on handsets.[124]

As of January 1, 2007, imports of wireless handsets enter under subheading 8517.12 of the Harmonized Schedule (HS) (appendix C), the result of an international initiative to classify this equipment together (box 2). Handsets were previously classified in various HTS subheadings under heading 8525.

[122] Anderson and Mohs, "The Information Technology Agreement: An Assessment of World Trade in Information Technology Products," 2010, 1-3.

[123] GDP data are from the IMF World Economic Outlook database. www.imf.org (accessed December 16, 2008).

[124] Mexico's MFN tariff rate on cell phones is 0 percent though it is not an ITA member. USITC staff, e-mail communication with Department of Commerce official, May 8, 2009.

BOX 2 A new Harmonized Schedule (HS) heading for wireless handsets in 2007

Before 2007, wireless handset imports were classified under various subheadings in chapter 85 of the Harmonized Schedule (HS) (appendix C). As of January 1, 2007, handset imports fall under HTS rate line 8517.12.00.

The 2009 heading and subheadings appear as listed below:

8517	Telephone sets, including telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network), other than transmission or reception apparatus of heading 8443, 8525, 8527 or 8528; parts thereof:
8517.12.00	Telephones for cellular networks, or for other wireless networks
8517.12.0020	Radio telephones designed for installation in motor vehicles for the Public Cellular Radiotelecommunication Service
8517.12.0050	Other radio telephones designed for the Public Cellular Radiotelecommunication Service
8517.12.0080	Other

Source: Compiled by USITC staff.

Nontariff Measures

There are no known U.S. nontariff measures on imports of wireless handsets. As reported by the Office of the United States Trade Representative (USTR) in its 2008 National Trade Estimate Report on Foreign Trade Barriers, foreign nontariff barriers (NTBs) affecting the U.S. industry include the application of arbitrary standards to handsets and parts that deviate from international standards by foreign governments, and imposition of local testing and certification rules that unfairly disadvantage foreign handset manufacturers. In addition, government-funded programs have been undertaken in China for handset manufacturers, including government-subsidized financing to foreign customers for Chinese manufactured goods.[125] The following information highlights nontariff measures in leading foreign markets.

China

New telecom standards and testing procedures are made available to foreign firms on an inconsistent and haphazard basis which imposes additional costs on foreign competitors, leading to the exclusion of foreign suppliers.[126] Despite previous commitments to conform to internationally accepted standards for equipment, both the government and the chief telecom regulatory body have proposed unique domestic standards for cell phone batteries and Internet-enabled handsets. Further, the main regulatory body has not yet formally repealed its 1998 policy instructing local companies to buy

[125] See Foreign Industry Profiles for more information.
[126] TIA, Letter to USTR, 2008, 3.

telecommunications equipment and components from domestic sources.[127] Another factor increasing the cost for U.S. mobile handset producers in China is the difficulty of product testing and certification, which is more onerous than in other markets.[128]

Brazil

Mobile handset certifications are carried out by Anatel, the Brazilian regulatory agency. Because test data from abroad are not accepted, regulators must test handsets in the local market before accepting them. Foreign companies reportedly encounter a highly complex regulatory and tax structure, increasing the cost to export to the Brazilian market in a timely manner.[129]

Mexico

Product testing and certification required to enter the market are accepted only when performed by recognized Mexican labs. Accreditation and certification bodies located in the United States and Canada are not recognized, thus driving up the cost for foreign producers to export to Mexico. In addition, the application process is not transparent, and the timeframe for application submissions is unnecessarily long.[130]

Korea

According to the 2008 National Trade Estimate Report, the government is extensively involved in the telecommunications market, mandating particular standards or requiring the use of particular technologies. The imposition of these standards discriminates against U.S. suppliers by requiring them to test products in Korea and seek approval from additional certification organizations. The result of these measures is inconvenience, additional cost, and time lost in bringing products to market, all of which may restrict trade. [131]

Others

Additional testing is required for handsets in Russia because the government enforces stringent encryption rules for telecommunications equipment, favoring its own standards above international standards.[132] While EU countries accept a sticker CE mark, Turkey requires a permanent or engraved CE mark on all imported handsets.[133] The Egyptian government prohibits imports of GPS devices, precluding GPS-capable cell phones from entering the market.[134]

[127] USTR, "China," 2009, 7, 15.
[128] TIA, Letter to USTR, 2008, 3.
[129] Ibid., 2009, 8.
[130] USTR, "Mexico," 2009, 4–5.
[131] USTR, "South Korea," 2009, 5.
[132] Industry official, interview by Commission staff, Washington, DC, November 12, 2008.
[133] Ibid.
[134] Ibid.

Trade Investigations

Patent infringement investigations concerning imported products of mobile handsets and related parts, among a number of other factors, may reflect increasing market competition. During the period 2004–08, eight investigations were instituted with respect to handset imports by the Commission under section 337 of the Tariff Act of 1930. Information regarding these investigations is contained in box 3. [135]

BOX 3 Patent infringement investigations

Case Name and Number	Date initiated	Complainants	Respondents
Baseband Processor Chips and Chipsets, Transmitter and Receiver (Radio) Chips, Power Control Chips, and Products Containing Same, Including Cellular Telephone Handsets, 337-TA-543	June 21, 2005	Broadcom Corporation	Qualcomm Incorporated
Wireless Communication Equipment, Articles Therein, and Products Containing the Same, 337-TA-577	July 6, 2006	Samsung Telecommunications America LLP; Samsung Electronics Co., Ltd.	Ericsson, Inc.; Telefonaktiebolaget LM Ericsson; Sony Ericsson Mobile Communication AB; Sony Ericsson Mobile Communications (USA) Inc.
Mobile Telephone Handsets, Wireless Communication Devices, and Components Thereof, 337-TA-578	July 12, 2006	Qualcomm Incorporated	Nokia Corporation; Nokia Inc.
Wireless Communication Devices, Components Thereof, and Products Containing Same, 337-TA-583	September 6, 2006	Ericsson Inc.; Telefonaktiebolaget LM Ericsson	Samsung Telecommuniations America LLP; Samsung Electronics America, Inc.; Samsung Electronics Co., Ltd.

[135] Further details on current and pending patent infringement investigations can be found at the USITC web site, http://www.usitc.gov/intellectual_property/inv_his.htm.

BOX 3 Patent infringement investigations—*Continued*

Case Name and Number	Date initiated	Complainants	Respondents
3G Wideband Code Division Multiple Access (WCDMA) Handsets and Components Thereof, 337-TA-601	April 27, 2007	InterDigital Communications Corporation; InterDigital Technology Corporation	Samsung Electronics Co., Ltd.; Samsung Electronics America, Inc.; Samsung Telecommunications America LLC
3G Mobile Handsets and Components Thereof, 337-TA-613	September 11, 2007	InterDigital Communications LLC; InterDigital Technology Corporation	Nokia Corporation; Nokia Inc.
Wireless Communication Chips and Chipsets, and Products Containing Same, Including Wireless Handsets and Network Interface Cards, 337-TA-614	September 21, 2007	Nokia Corporation; Nokia Inc.	Qualcomm Incorporated
Mobile Telephones and Wireless Communication Devices Featuring Digital Cameras and Components Thereof, 337-TA-663	December 18, 2008	Eastman Kodak Company	Samsung Electronics Company, Ltd.; Samsung Electronics America, Inc.; Samsung Telecommunications America, LLC; LG Electronics, Inc.; LG Electronics USA, Inc.; LG Electronics MobileComm USA, Inc.

Source: Compiled by USITC staff.

GLOBAL MARKET PROFILE

China was the largest global market for wireless handsets throughout the period, followed by the Euro area (table 7). Global consumption of handsets is bifurcated into low-cost, voice-centric devices and high-level information appliances, largely influenced by the level of market sophistication and mobile penetration rates. [136] In general, higher penetration rates and income levels are closely correlated with demand for high-level phones (table 8).

TABLE 7 Mobile wireless subscribers (number of people), selected countries, 2004–08

	2004	2005	2006	2007	2008
China	334,824,000	393,406,016	461,057,984	547,305,984	634,000,000
Euro area	285,463,826	314,820,609	340,555,024	377,787,413	[a]
India	52,220,000	90,140,000	166,050,000	233,620,000	346,889,984
United States	184,819,008	213,000,000	241,800,000	255,395,600	270,500,000
Russian Federation	73,722,224	120,000,000	150,674,000	163,300,000	187,500,000
Brazil	65,605,000	86,210,336	99,918,624	120,980,104	150,641,408
Other	766,536,997	1,000,826,792	1,293,197,629	1,654,569,170	[a]
World	1,763,191,055	2,218,403,753	2,753,253,261	3,352,958,271	[a]

Source: World Bank, World Development Indicators.
[a] Not available.

TABLE 8 Mobile penetration rates (percent), selected countries, 2004–08

	2004	2005	2006	2007	2008
Euro area	89.57	98.22	105.65	116.54	121.59
Russian Federation	51.25	83.83	105.74	114.92	132.23
United States	63.04	71.98	80.94	84.67	88.96
China	25.83	30.18	35.17	41.52	47.83
Brazil	35.59	46.14	52.78	63.14	78.47
India	4.84	8.24	14.96	20.77	30.43

Source: World Bank, World Development Indicators.

In many Western European countries as well as the Russian Federation, mobile phone penetration rates exceed 100 percent. Growth in these saturated markets, as well as the United States, is driven by upgrading voice-centric handsets to more sophisticated devices that resemble computers. As a result, revenues from voice traffic are declining while data features, especially mobile Internet and TV, are expanding. For example, Cisco estimates that U.S. mobile subscribers streamed 60 to 70 billion videos on their handsets during 2007, more than double the 31 billion streams in 2006.[137] Because sales focus on high-tech replacement handsets that can deliver advanced services to the consumer, OEMs focus on profit margin rather than sales volume in these markets.

In Asia, Latin America, the Middle East, and Africa, rapid user uptake is driving enormous volume increases. China and India were the two fastest-growing mobile markets in the world in 2008, achieving 17 percent and 48 percent annual growth,

[136] Penetration rate represents the number of cell phone subscribers per 100 inhabitants.
[137] Standard & Poor's, *Industry Surveys: Communications Equipment*, 2008, 9.

respectively.[138] While only 16 African countries had mobile networks in 1993, today all 55 countries do.[139] In contrast to the United States and Europe, this growth is composed primarily of new subscribers who use the devices for voice services.

Distribution Channels

Globally, consumers of wireless handsets are divided into several broad categories: retail consumers, distributors, and network service providers. In many countries, individuals buy phones through retailers or retail stores and then select their service plan separately. In the United States, carriers sell phones bundled with a monthly service plan directly to consumers. As a result, most U.S. consumers associate the handsets they use with the service provider's name rather than the manufacturer's brand.

Because consumer behavior varies by region, OEMs adopt different strategies across world markets. For example, Nokia relies on a mix of distributors and service providers to execute its sales. In 2008, distributors were the main engine of device sales in several regions: Asia-Pacific (95 percent by distributors), Middle East and Africa (91 percent), and China (79 percent). In Europe, the distribution channels were more balanced: distributors accounted for 39 percent of device sales, while network service operators accounted for 46 percent. In the United States, network operators accounted for 84 percent of device sales in 2008.[140]

Smartphones: Driving Innovation in the Market

Smartphones, also known as converged devices, are the fastest-growing and most profitable segment of the global market for wireless handsets.[141] As the market for wireless handsets has matured, mobile devices have evolved beyond voice communications. The introduction of phones with QWERTY keypads facilitated texting and e-mail, the first steps toward a myriad of advanced functions. As consumers demand a wider range of mobile services on their devices, including banking, video, social networking, and music, handsets are being transformed from portable phones into information appliances. In 2008, global sales of smartphones reached 139 million, an increase of 14 percent over 2007.[142]

The high cost and limited scope of smartphone service previously limited these products to business users. However, several recent developments—notably, flat-rate charges for data plans, improved quality and availability of high-speed networks, and carrier subsidies on handsets—are helping spur adoption by individuals. As a phone's features are increasingly personalized for both carriers and end users, the market base for smartphones in the United States, Western Europe, and parts of Asia is expanding.

---

[138] Wireless Federation, "China Home to 641.23 Million Subscribers at 2008-end," February 3, 2009; Telecom Regulatory Authority of India. News Release from the Telecom Regulatory Authority of India, January 21, 2009.

[139] EIU, *World Telecoms: Crackle on the Line*, 2008, 1.

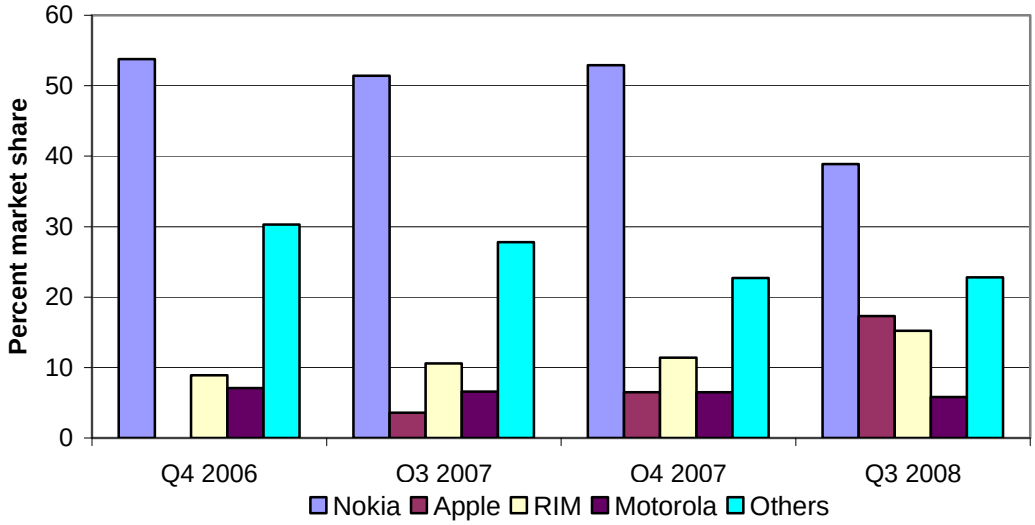
[140] Nokia Corp., submissions to the United States Securities and Exchange Commission, Form 20-F, 2008: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007, Commission file number 1-13202, 35.

[141] Industry official, interview by Commission staff, Washington, DC, November 2008.

[142] *Telephony Online*, "Fourth Quarter Mobile Device Sales," March 11, 2009.

While Nokia long dominated the global smartphone market with in excess of 50 percent market share, it lost ground in 2008 to competitors Apple and RIM. In the third quarter, Apple and RIM together claimed more than 30 percent of world market share and 70 percent of U.S. market share (figure 11).[143] Analysts contend that the primary reason for the shift was Nokia's failure to introduce a competitively priced touchscreen model. While the retail price of the iPhone has dropped substantially from its initial launch in June 2007 (from $600 and $500 to $300 and $200), Nokia's touchscreen N97 carried a price tag of $700 when it arrived in European markets in the first half of 2009.[144]

FIGURE 11 Smartphones: Global market share, 4th qtr. 2006–3rd qtr. 2008



Source: canalys.com 2008.
Note: Apple did not begin selling phones until the third quarter of 2007.

Pricing

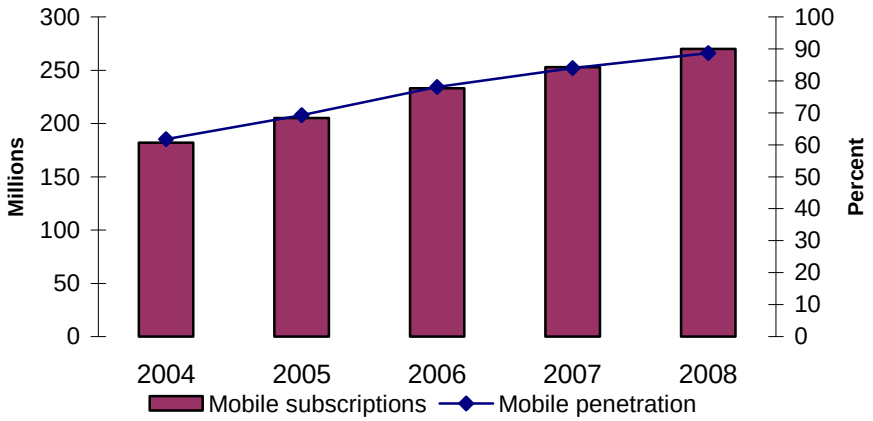
Retail price is very important to product sales, and the market trends of decreasing phone prices and service fees have accelerated global uptake. Rising mobile adoption in emerging markets has increased the share of device sales in these markets from 55 percent of total sales in 2006 to 60 percent in 2007.[145] This trend led to a lower average sale price (ASP) across the industry, reinforcing pricing pressures on handset manufacturers. In particular, Nokia relies heavily on sales in emerging markets to maintain its leading market share, especially India and China.

[143] Berka, "Apple up to 16 % of smartphone market, driving market growth," December 5, 2008.
[144] Chartier, "Apple, RIM winners in shrinking smartphone market," December 4, 2008.
[145] Nokia Corp., submissions to the United States Securities and Exchange Commission, Form 20-F, 2008: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007, Commission file number 1-13202, 57.

U.S. MARKET

Between June 2004 and June 2008, the number of wireless subscribers in the United States grew from 182 million to almost 263 million (figure 12).[146] While the level of subscribers continues to increase, the rate of growth has slowed to single digits from its peak in 2005, when it reached 15 percent.[147] Driving demand for handsets is an increase in the quality and quantity of services available to users, which led to a rapid expansion in the market for cellular phones in the United States in the late 1990s and the early years of the new millennium. Revenues for mobile services are rising with the adoption of smartphones, totaling $143.7 billion for the 12 months ending June 2008, more than 8 percent greater than the previous year.[148] This lucrative market continues to attract each of the top five OEMs, as well as second-tier firms.

FIGURE 12 U.S. mobile market, 2004–08

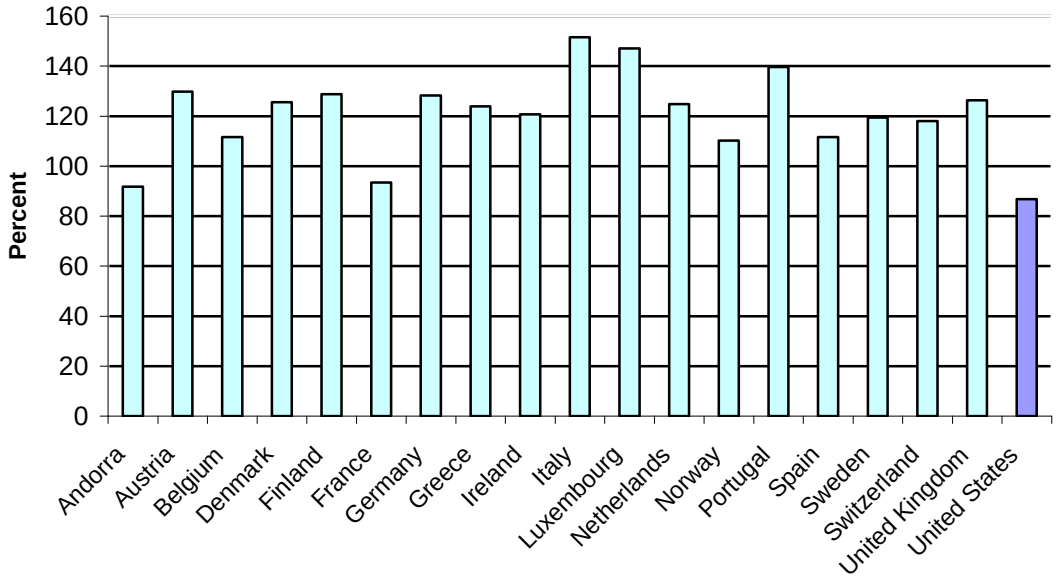


Source: EIU, *USA Telecoms and Technology Report* , February 2009.

U.S. mobile penetration, as measured by the number of cell phone subscribers per 100 inhabitants, rose from 39 percent in 2000 to 89 percent in 2008. In comparison to Western Europe, however, where penetration rates in 2008 exceeded 100 percent in every country except France and Andorra, the United States has one of the lowest rates of penetration in the industrialized world (figure 13). [149]

[146] EIU, *Telecoms and Technology Forecast: The United States of America*, 2009, 2. 2008 data from CTIA.
[147] Standard & Poor's: *Industry Survey: Telecommunications: Wireless*, 2009, 12.
[148] Ibid.
[149] ITU, ICT Statistics Database.

FIGURE 13 Mobile subscribers per 100 inhabitants, selected countries, 2008



Source: International Telecommunications Union.

While the Europeans converged on a single technological standard (GSM) for cell phones, the United States allowed companies with several differing standards to compete in the market, increasing uncertainty about the longevity of each standard and ultimately stalling consumer uptake. Eventually, two standards (GSM and CDMA) came to dominate the U.S. marketplace.

The lag in adoption of mobile devices led to speculation that the United States had a disadvantage in cellular technology. However, the rapid uptake of 3G devices is a clear indication of increased sophistication in the U.S. mobile handset market. By September 2008, the United States surpassed Western Europe in penetration of 3G-enabled handsets.[150] In order to achieve that milestone, the United States 3G subscriber base grew by 80 percent over the previous 12 months, to a total of 64.2 million 3G subscribers.[151] The growing popularity of 3G handsets represents the market segment with the most potential for all manufacturers hoping to increase market share in the United States. Because two of the four major U.S. carriers operate on the GSM network standard while the remaining two carriers operate on the CDMA standard, success for suppliers to the U.S. market is likely improved with a portfolio of devices that can operate on both standards (appendix C).

Leading suppliers to the U.S. market are primarily the top-tier OEMs with broad product offerings (table 9). Samsung surpassed Motorola to emerge as the top-selling brand in 2008, capturing 22.0 percent of U.S. handset sales, followed by Motorola (21.6 percent) and LG (20.7 percent).[152] RIM increased its U.S. market share from 4.5 percent in 2007

[150] 3G penetration in the United States reached 28.4 percent, while it was 28.3 percent in Western Europe.
[151] *RCR Wireless*, "3G Uptake in U.S. Outpacing W. Europe," September 18, 2008.
[152] EIU, *USA Telecoms: Samsung Beats Motorola as Top Handset Seller*, 2008.

to 9.0 percent in 2008 by introducing consumer-friendly smartphone models (including BlackBerry Pearl and BlackBerry Curve) and enhancing its relationships with U.S. carriers.[153] Imports are very important sources for the U.S. market, accounting for the majority of domestic consumption. As a result of the outsourcing of manufacturing, the majority of Americans buy and use cellular phones that are not produced within the United States.

TABLE 9 Top 5 suppliers to the U.S. market, 2007–08 (percent)

	2007 Market share	2008 Market share	Growth
Samsung	18.1	22.0	15.5
Motorola	33.4	21.6	–38.4
LG	15.1	20.7	30.4
Research in Motion	4.5	9.0	88.5
Nokia	10.0	8.5	–19.8

Source: IDC and RCR Wireless.

The primary factors affecting demand by retail consumers for wireless handsets in the U.S. market are price, functionality, design, and service quality and availability. For smartphones in particular, there is an emphasis on services, especially location-based functions like global position systems (GPS), and design elements, especially touchscreens. In addition, user-driven personalization of mobile devices is increasingly popular. Apple created the first online applications store with content specifically designed for its iPhone in 2007. As of January 2009, iPhone customers had downloaded nearly a half billion "apps" to their handsets.[154]

Smartphones: An Attractive Niche

Smartphones are the fastest-growing product in the U.S. handset market. Owing to a lack of available mobile phone production data, this report uses unit sales as a proxy for apparent consumption of handsets. Unit sales of smartphones have grown steadily since 2004, rising from 4.5 million devices and 5 percent of total handset sales to 37 million devices and 28 percent of total sales in 2008 (table 10).[155] While smartphone sales in the United States rose 53 percent between 2007 and 2008, shipments of other wireless handsets declined by 15 percent to 95 million.

[153] Carson, "The (New) American Handset Market," September 5, 2008.
[154] Perez, "Apple's App Store Hits Half a Billion Downloads," January 16, 2009.
[155] TIA, *2009 Market Review and Forecast,* 246.

TABLE 10 Wireless handset and smartphone sales, U.S. market, 2004–08

Year	Wireless handsets	Smartphones	Total handset sales	Smartphones share
		Millions		Percent
2004	80.1	4.5	84.6	5.3
2005	94.8	9.8	104.6	9.4
2006	109.6	14	123.6	11.3
2007	111.9	24.2	136.1	17.8
2008	95.0	37.0	132.0	28.0

Source: Telecommunications Industry Association.

Channels of Distribution

Unlike most other countries, the United States is a carrier-driven[156] market where individuals are the secondary customers of OEMs (figure 2). Service providers, which act as intermediaries between handset manufacturers and retail consumers, are the OEM's primary customers. Individual customers purchase handsets, bundled with a monthly service plan, directly from carriers.

There are four primary carriers in the United States: AT&T, Verizon, T-Mobile, and Sprint Nextel (table 11), representing 85 percent of U.S. wireless subscribers.[157] Thus, an OEM's relationships with U.S. carriers are essential to success because these few corporate customers are responsible for the majority of U.S. sales. Each of the five major OEMs have local subsidiaries in the United States, which allow them to work closely with the major U.S. carriers, tailoring handsets for each carrier according to its network and its target market.

TABLE 11 U.S. carriers, ranked by 2008 customers

Operator	Headquarters	2008 Revenue	Employees	2008 Wireless Revenue	Customers
AT&T	San Antonio, TX	$124,028,000	302,660	$44,249,000	77.0 million
Verizon	New York City, NY	$97,354,000	223,900	$49,226,000	72.1 million
Sprint Nextel	Overland Park, KS	$35,635,000	60,000[a]	$30,427,000	49.3 million
T-Mobile	Bellevue, WA	$21,885,000	36,000	$21,885,000	32.8 million

*Source: Datamonitor C*ompany reports, Sprint Web site, AT&T Web site.

[a] Employees as of December 31, 2007.

The two largest service providers (AT&T and Verizon) dominate the market with over half of all U.S. subscribers, but even smaller providers Sprint Nextel and T-Mobile have a significant advantage over regional operators. To succeed, the regional companies cannot compete head-to-head with the larger players; instead they must target market niches.[158] For example, Leap Wireless offers flat-rate, unlimited-use plans instead of the practice—more prevalent among leading providers—of charging users a flat rate for a

[156] Companies that provide service for wireless handsets are commonly referred to by several names, including carrier, service provider, and network provider. This report uses these terms interchangeably.
[157] Beckman, "By the Numbers: Top 10 Most Popular U.S. Handsets in November," January 8, 2009.
[158] Standard & Poor's, *Industry Survey: Telecommunications: Wireless*, 2009, 15.

limited number of (peak time) minutes, and charging by the minute for additional minutes.

Major mergers characterized the wireless landscape in the United States during 2004–08 (box 4). Carrier consolidation poses a challenge for OEMs because it reduces the number of customers in the marketplace and increases their bargaining power over manufacturers. Cingular Wireless, a joint venture between BellSouth Corporation and SBC Communications, merged with AT&T in 2006 to become the nation's largest wireless carrier at that time. Chief rival Verizon Wireless originated in 2000 as the result of a merger between Verizon Communications and Vodaphone. In a deal closed on January 9, 2009, Verizon acquired the fifth largest U.S. carrier, Alltel Corp., to overtake AT&T as the nation's largest carrier with 83.7 million subscribers.[159] Smaller regional carriers have also consolidated and been taken over by AT&T and Verizon so that the two largest companies could expand their coverage and reduce roaming costs.

Carriers compete in part through their product offerings, both by selling new models exclusively and by subsidizing initial purchases. Exclusivity deals with OEMs typically last three to six months before other carriers can begin to offer the same handset.[160] This arrangement benefits OEMs by improving their brand recognition, because some customers will change carriers in order to purchase new products. Larger carriers with greater scope and more market power have additional bargaining power with handset manufacturers and can negotiate better deals. Increasing competition for handset deals with OEMs, along with pricing pressure on handset subsidies, has benefited major carriers to the detriment of smaller players in the U.S. market. For example, AT&T was the first to launch the iPhone and BlackBerry Bold, while Verizon had exclusive rights to the BlackBerry Storm. T-Mobile captured HTC's strategically important G1, the first handset to incorporate a Google operating system. [161]

[159] Associated Press, "Verizon Wireless Completes $5.9 billion Alltel Buyout," January 9, 2009.
[160] Chang, "Proof That Handset Brands Help Sell Wireless Plans," October 28, 2008.
[161] Standard & Poor's, *Industry Survey: Telecommunications: Wireless,* 2009, 9.

BOX 4 The evolution of the wireless market in the United States

Service providers invested heavily in mobile network infrastructure from 1998 to 2000 in response to accelerating consumer demand for mobile devices. These networks were first-generation (1G) analog. In the early 1990s', networks advanced towards digital, second-generation (2G) standards, including TDMA, CDMA, and GSM, leading to more investments in new equipment. In 2000 alone, the number of mobile subscribers in the United States climbed 25 percent, and mobile carriers responded with high levels of capital investment. Beginning in 2000, wireless providers began to upgrade their 2G networks to high-speed 2.5G. However, from 2001 to 2003 the U.S. market witnessed a sharp decline in network infrastructure buildouts, as well as handset sales, owing to a distressed economy, reduced retail subsidies, and slower-than-expected uptake of next-generation services.

Spending on wireless infrastructure recovered in 2004, increasing appreciably. Also in that year, worldwide commercial 3G networks grew from 16 to 60. The boom continued in 2005, when the industry grew by 10 percent, owing to a migration from 2.5G to 3G technologies. Though 3G service is now widely available in the United States, most voice and text messaging services are delivered by 2G networks. 3G service results in faster data speeds, making e-mail, and Internet access available at broadband speeds on handsets. A further upgrade to 4G networks motivated further wireless infrastructure spending in 2007 and 2008.

Sources: IBIS World Reports, *Communication Equipment Manufacturing in the U.S.,* 2008, 38, 42, 47; and EIU, *Telecoms and Technology Forecast: The United States of America*, 2008, 16.

In the United States, the majority of handsets sold are priced according to the carrier-subsidy model.[162] Handset subsidies by carriers typically averaged $100 per unit until AT&T offered a $200 subsidy on the iPhone, forcing other carriers to act aggressively in order to stay competitive.[163] The effect of handset subsidies on the manufacturing industry is not clear. However, the subsidies appear to benefit the manufacturers by lowering the cost of phones for retail consumers at the expense of carriers.

Fierce competition among service providers makes marketing essential to the successful uptake of new devices by consumers. In the United States, this role is performed by the carrier rather than the OEM. Procter & Gamble is the only domestic corporation with a marketing budget larger than those of AT&T Mobility and Verizon Wireless.[164]

Major U.S. service providers have implemented cost-cutting measures as a result of the global recession. Leading carrier AT&T announced layoffs of 12,000, or four percent of the workforce, in December 2008.[165] Sprint Nextel also struggled, losing millions of subscribers in both 2007 and 2008. In January 2009, the company announced it would eliminate 8,000 jobs, accounting for 14 percent of its workforce, by March 31.[166] The impact on handset producers of slumping U.S. wireless services employment is unclear,

[162] Standard & Poor's, *Industry Survey: Telecommunications: Wireless*, 2009, 8.

[163] For example, AT&T pays an average of $375 per iPhone, which it sells to retail customers for $200 or $300. These initial purchase discounts are tied to a two-year monthly service contract with AT&T which allows the carrier recoup its initial loss. By reducing prices for retail consumers, subsidies may help smooth the effects of the economic downturn on handset sales. Chang, "Proof That Handset Brands Help Sell Wireless Plans," October 28, 2008.

[164] Ibid.

[165] Winter, "AT&T to Cut 12,000 Jobs," December 4, 2008.

[166] Kansas City Business Journal, "Sprint Nextel Announces 8,000 Layoffs," January 26, 2009.

but the economic health of wireless service providers is essential to future business prospects, as providers are the middlemen between end users and OEMs.

Several smaller U.S. carriers offer prepaid contracts to customers that lack the disposable income to afford more advanced phones. Leap Wireless and Metro PCS are the largest of these, with 3.84 million and 5.4 million subscribers, respectively.[167] These two carriers offer lower-end phones[168] from the major manufacturers, including Nokia, Samsung, and Motorola, but allow retail customers to purchase the phone separately from the service plan. The plan is generally a flat monthly rate, without a fixed-term contract. Because these plans are significantly cheaper than those offered by the four largest U.S. carriers, Leap Wireless and Metro PCS could see increased customer uptake during a period of economic contraction. At low usage levels, the savings from prepaid plans are pronounced, from a monthly bill of $10 to $15 versus $30 to $40 on a traditional contract, which would benefit the 30 percent of U.S. subscribers who use less than 100 minutes per month of mobile minutes.[169]

[167] Leap Wireless Web site, http://phx.corporate-ir.net/phoenix.zhtml?c=191722&p=irol-newsArticle&ID=1241648&highlight=, (accessed January 27, 2009); MetroPCS Web site, http://www.metropcs.com/, (accessed January 27, 2009).

[168] Generally, these phones do not offer users access to e-mail or the Internet, and do not allow users to store music or photos.

[169] *Yahoo!Finance*, "Prepaid Cell Phones Can Offer Savings," January 1, 2009.

FOREIGN MARKET PROFILES

Emerging markets account for a growing share of the mobile phone market, comprising 55 percent of global sales in 2006 and increasing to 60 percent in 2007.[170] As a result, the average sale price (ASP) of handsets fell across the entire industry, as demand in these markets is primarily for the lowest-cost models. A key adoption threshold in many developing countries is the $5 per month total cost of ownership (TCO), which incorporates the initial cost of the phone and monthly service charges.[171] While few countries have reached this milestone, it is significant for increasing handset sales.[172] This discussion will focus on the emerging Asian markets, namely China and India.

China

China is the largest market for mobile services in the world. By the end of 2008, it had approximately 640 million mobile phone subscribers, an increase of nearly 100 million over 2007.[173] The major drivers of this growth are technological advances, resulting in lower prices for both handsets and services, and greater competition in the services market. Further, favorable economic conditions have made wireless phones more affordable for China's vast population, and the government has initiated plans for universal service to support mobile subscriber additions.[174] The ongoing construction of a 3G mobile network in China, with its population of over one billion people, represents an enormous growth opportunity for equipment manufacturers. [175]

The government has a visible role in the mobile market, owning majority interests in all telecom providers and often intervening to increase competition and shuffle the balance of power among the dominant firms. During the final months of 2008, the government restructured the wireless market to support three major carriers and granted each carrier a license for 3G services. These three operators collectively plan to spend a total of $41.2 billion over the next three years to expand wireless infrastructure for 3G services.[176] Two carriers were assigned internationally accepted standards for their 3G networks while China Mobile will build a network with the unique domestic standard, TD-SCDMA. As demand grows for the government-mandated domestic standard, imports will diminish, as foreign manufacturers have not yet developed handsets for the TD-SCDMA standard, which does not exist in any other market in the world.
Because most Chinese subscribers only use voice services and text messaging, the Internet access and mobile video available on the new 3G networks will at first attract a limited premium market within China. Hence, future of mobile device sales in the

[170] Nokia Corp., submissions to the United States Securities and Exchange Commission, Form 20-F, 2008: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007, Commission file number 1-13202, 57.

[171] Industry official, interview by Commission staff, November 12, 2008.

[172] The total cost of ownership is the initial cost of the phone, plus the monthly bill multiplied by the length of the contract.

[173] Wireless Federation, "China Home to 641.23 Million Subscribers at 2008-end," February 3, 2009, http://wirelessfederation.com/news/china-home-to-64123mn-subscribers-at-2008-end/, (accessed February 4, 2009).

[174] EIU, *China: Telecoms and Technology Report*, 2008, 2.

[175] Ibid.

[176] EIU, *China Telecoms: Let the Game Begin*, 2009, 1.

country will likely follow the pattern observed in United States and Western Europe—existing subscribers upgrading to high-tech handsets.

As mobile phones become more popular in China, channels of distribution are moving away from specialist retailers in favor of household appliance chains and IT equipment distributors. IT and appliance distributors are efficient platforms for mobile sales because they can take advantage of their existing capabilities: diffused geographical presence, stocking capacity, and direct communication with consumers. First-tier distributors (handset retailers, handset distributors, handset agents, and operator outlets) accounted for over 80 percent of sales in 2002; of these, handset retailers were the largest source of sales. Handset retailers continue to sell phones, as well as phones bundled with prepaid service plans. Traditional plans, paid at the end of each month, are issued only directly by mobile service providers. [177]

India

India represents a tremendous growth opportunity for handset manufacturers, with 347 million subscribers by the end of 2008.[178] It was the fastest-growing mobile phone market in the world in 2008, adding 10 million new users every month to achieve an annual growth rate of 48 percent.[179] The number of wireless subscribers overtook the number of fixed-line users in October 2004. By September 2008, the ratio of mobile to fixed subscribers reached eight to one.[180]

In 2008, Nokia led the Indian market for mobile handsets, with a 60 percent market share. [181] Nokia's success in India is due to early market entry, innovative product offerings (including a phone for rural users with a flashlight and extended battery life), and an extensive distribution network. Of 130,000 mobile outlets in India, 75,000 offer Nokia phones exclusively. [182] Nokia entered the market in partnership with HCL (Hindustan Computers Ltd.), a well-established Indian brand with an extensive distribution network. The company then developed its own networks, including Nokia concept stores.[183]

Several key developments have encouraged the rapid uptake of wireless services and, in turn, handset purchases. Deregulation of the Indian telecom service industry over the last decade has increased market competition and significantly lowered the cost of both calls and handsets. Wireless service charges cost less than 2 cents per minute for outgoing calls, while incoming calls are free.[184] Further, India's thriving economy has endowed the growing middle class with more disposable income. Service operators have moved aggressively, expanding marketing efforts and offering prepaid service plans to further entice new subscribers. Retail prices will continue to decline in the face of increasing competition, further deregulation, and a widening portfolio of technologies. Nonetheless,

[177] China Business Solutions, "An Overview of Handset Distribution Channels in China," 2003, 3, 4, 6, and 12.
[178] EIU, *India: Telecoms and Technology Report,* 2009, 2.
[179] Telecommunications Regulatory Authority of India, www.trai.gov.in, (accessed April 29, 2009).
[180] EIU, *India: Telecoms and Technology Report,* 2008, 2.
[181] Cellular News, "Samsung Pushes Motorola Into 3rd Place in India," May 16, 2008.
[182] Kaur, "Handset Strategy: Ride to Rural India," November 7, 2008, 4.
[183] Knowledge@Wharton, "How Did Nokia Succeed in the Indian Mobile Market," August 23, 2007, 2.
[184] Bellman, "Rural India Snaps Up Mobile Phones," February 9, 2009.

obstacles to further growth remain, including a highly price-elastic market and limited coverage of networks that reach only 30 percent of the population.[185]

As public sector influence in the mobile services sector declines, private and foreign companies (including OEMs) are shaping the market. Foreign firms, including AT&T and Sony Ericsson, announced plans to invest in the telecom sector after the government raised the allowable limit of foreign direct investment (FDI) in the industry from 49 percent to 74 percent.[186] Licenses for 3G networks were granted by the government in January 2009, but more sophisticated services, including wireless internet and voice over Internet protocol (VoIP), are in their infancy.

The largest and fastest-growing market segment, the rural consumer, is characterized by an annual income below $1,000, no access to fixed-line phone services, and limited pricing and features preferences.[187] Manufacturers are developing new avenues of distribution accordingly. Rather than just selling a cheaper handset, retailers are bundling service plans with handsets in order to reduce the total cost of mobile phone ownership. To take advantage of preexisting customer relationships, manufacturers have moved toward selling phones in the shops of all kinds of retailers—from cloth merchants to mom and pop stores—rather than establish standalone phone stores.[188] LG and Samsung already sell other products to rural consumers, so their brands have name recognition in that market, giving them a competitive advantage over Motorola and Sony Ericsson.[189]

Impact of the Global Financial Crisis

The current unsettled macroeconomic environment affects the handset industry through three avenues: weaker consumer confidence, credit scarcity, and currency volatility for global enterprises. Sales will likely continue to be diminished by weaker consumer demand and inventory build-up by carriers that will need to be cleared before they make more purchases. Of particular concern is slowing trade with China and the resulting decline in domestic demand in the Chinese market.

Smartphones may help buoy the fortunes of those manufacturers that can continue to attract new customers. In the United States, carrier subsidies have fueled this growth.[190] GPS-enabled phones in particular are expected to stimulate strong consumer demand in 2009, and the manufacturers who will benefit most from this trend have strong portfolios in this area. As a result, operators are increasingly turning to new services to improve profitability. Handset manufacturers will continue to rely on software, services, and content rather than equipment for product differentiation that will drive sales of new products. Consumers and third party developers will lead this transition through innovation.[191]

Economic stresses on mobile operators are affecting other members of the global supply chain, including manufacturers, components suppliers, and consumers, as operators

[185] Siegler, "Analyst Angle: The 'Emerging' Growth of GSM in a 3G World," October 13, 2008.
[186] EIU, *India: Telecoms and Technology Report*, 2008, 4.
[187] Bellman, "Rural India Snaps Up Mobile Phones," February 9, 2009.
[188] Knowledge@Wharton, "How Did Nokia Succeed in the Indian Mobile Market," August 23, 2007, 2.
[189] Kaur, "Handset Strategy: Ride to Rural India," November 7, 2008, 3.
[190] Carson, "'Deteriorating Situation': 2009 Mobile Device Sales to be Sluggish," January 5, 2009.
[191] Gillis, "Making Mobile's Math Work," December 16, 2008.

eliminate costs by decreasing subsidies on handsets and delaying network upgrades. Pressure on OEMs to maintain profit margins on their equipment sales is increasing. This is a particular challenge in emerging markets, where sales are primarily focused on low-cost handsets.[192]

Analysts looking ahead to 2010 are predicting a rebound in the sector, with many experts agreeing that while handset sales are picking up in the second half of 2009, there will be fewer handsets sold in 2009 than in 2008.[193] Industry bellwether Nokia forecasted that sales of mobile devices would increase by 10 percent in 2010 over 2009, a cause for optimism for the global handset industry.[194]

[192] Informa, "Future Mobile Handsets (10th Edition)," Press released dated November 24, 2008 (accessed May 6, 2009).

[193] iStock Analyst, "Mobile Phone Market Turns Corner in Third Quarter, More Gains Expected in Q4, According to IDC," October 30, 2009.

[194] AFP, "Nokia Forecasts Global Mobile Phone Rebound in 2010," December 2, 2009.

Bibliography

Agence France-Presse. “Nokia Forecasts Global Mobile Phone Rebound in 2010.” December 2, 2009.

Associated Press. “Verizon Wireless Completes $5.9 Billion Alltel Buyout.” January 9, 2009.

Anderson, Michael and Mohs, Jacob. “The Information Technology Agreement: An Assessment of World Trade in Information Technology Products.” *Journal of International Commerce & Economics*, January 2010.

Beckman, Kristen. “By the Numbers: Top 10 Most Popular U.S. handsets in November.” *RCR Wireless*, January 8, 2009.

Bellman, Eric. “Rural India Snaps Up Mobile Phones.” *Wall Street Journal*, February 9, 2009.

Berka, Justin. “Apple Up to 16 % of Smartphone Market, Driving Market Growth.” *RCR Wireless*, December 5, 2008.

Carson, Phil. “2009 Wireless Forecast: Handsets.” *RCR Wireless*, February 2, 2009.

———.“By the Numbers: Top Five Mobile Device Vendors In The Fourth Quarter of 2008.” *RCR Wireless*, January 23, 2009.

———. “‘Deteriorating Situation’: 2009 Mobile Device Sales to Be Sluggish.” *RCR Wireless*, January 5, 2009.

———. “Handset Horserace Loses Cachet.” *RCR Wireless*, October 27, 2008.

———. “iPhone 3G Sales Way Down During Holidays.” *RCR Wireless*, January 21, 2009.

———. “LG’s U.S. Shipments Decline Sharply.” *RCR Wireless*, January 22, 2009.

———. “Motorola’s Path: In Flux.” *RCR Wireless*, November 11, 2008.

———. “Nokia in the Fourth Quarter: Trouble Ahead, Trouble Behind.” *RCR Wireless*, January 22, 2009.

———. “Other Vendors Surge on Smartphones, Niches.” *RCR Wireless*, February 20, 2009.

———. “Sony Ericsson Challenged Financially, But Holding Ground.” *RCR Wireless*, October 17, 2008.

———. “The (new) American Handset Market.” September 5, 2008.

Cellular News. “Global Mobile phone shipments dropped by 10 percent in Q4 2008.” January 23, 2009.

———. “Samsung Pushes Motorola into Third Place in India.” May 16, 2008.

Chang, Rita. “Proof That Handset Brands Help Sell Wireless Plans.” *RCR Wireless*, October 28, 2008.

Chartier, David. “Apple, RIM Winners in Shrinking Smartphone Market.” *Ars Technica*, December 4, 2008.

China Business Solutions, Ltd. “An Overview of Handset Distribution Channels in China.” February 2003.

CTIA–The Wireless Association. www.ctia.org/media/industry_info/index.cfm/AID/10320

———. “Wireless Quick Facts.” www.ctia.org/advocacy/research/index.cfm/AID/10323 (accessed January 15, 2009).

DATAMONITOR Company Reports. *Apple, Inc.* November 18, 2008. March 16, 2009.

———. *Huawei Technologies*. March 7, 2008. February 9, 2009.

———. *LG Electronics, Inc.* July 30, 2008. July 17, 2009.

———. *Motorola.* August 7, 2009

———. *Nokia Corporation*. August 4, 2008. July 24, 2009.

———. *Research in Motion*. July 4, 2008. July 27, 2009.

———. *Samsung Electronics*. August 5, 2008. July 16, 2009.

———. *Sony Ericsson Mobile Communications AB.* January 14, 2008. August 11, 2009.

Economist. “Looking Good?” January 22, 2009.

———. “Silent Mode.” October 16, 2008.

Economist Intelligence Unit (EIU). *China Telecoms: Feeling the Pinch*. New York: Economist Intelligence Unit, 2008.

———. *China Telecoms: Huawei, ZTE to Retail Self-branded Handsets*. October 2, 2008.

———. *China Telecoms: Let the Game Begin*. January 7, 2009.

———. *China Telecoms: Year of Change*. December 31, 2008.

———. *China Telecoms: Zealous ZTE*. March 18, 2008.

———. *Industry Forecast: Telecoms and Technology, Brazil*. 2007.

———. *Industry Forecast: Telecoms and Technology, Canada*. 2008.

———. *Industry Forecast: Telecoms and Technology, China.* 2008.

———. *Industry Forecast: Telecoms and Technology, India.* 2008.

———. *Industry Forecast: Telecoms and Technology, Mexico.* 2007.

———. *Industry Forecast: Telecoms and Technology, United States of America.* 2008; 2009.

———. *Industry Forecast: Telecoms and Technology, Venezuela*. 2007.

———. *South Korea Telecoms: LG Pushes for Risky Tack on Mobile*. November 6, 2008.

———. *USA Telecoms: Samsung Beats Motorola as Top Handset Seller*. November 7, 2008.

———. *USA Telecoms: Samsung Tops Phone Market After 11 years.* November 10, 2008.

———. *World Telecoms: Crackle on the Line*. August 11, 2008.

———. *World Telecoms: Key Player: Nokia*. January 27, 2009.

———. *World Telecoms: Key Player – Research in Motion*. December 17, 2008.

———. *World Telecoms: Key Player: Samsung Electronics*. October 2, 2009.

———. *World Telecoms: Smartphones Advanced but Expensive*. January 7, 2009.

Ford, Dale, Rebello, Jagdish and Teng, Tina. "Mobile Handset Market Tracker." iSuppli Report. 2008.

Gillis, Morgan."Making Mobile's Math Work." *RCR Wireless*, December 16, 2008.

IBISWorld Inc. *Communication Equipment Manufacturing in the U.S.* IBIS World Industry Report, August 2008.

International Monetary Fund (IMF). World Economic Outlook Database. www.imf.org (accessed various dates).

Informa Telecoms & Media. *Future Mobile Handsets (10th Edition)*. November 24, 2008. www.informatm.com/itmgcontent/icoms/s/sectors/handsets-devices/20017593580.html (accessed May 5, 2009).

International Telecommunications Union (ITU). ICT Statistics Database. http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx# (accessed various dates).

"iPhone Crowned Most Popular Phone in U.S." *CNET News*, November 10, 2008.

iStock Analyst. "Mobile Phone Market Turns Corner in Third Quarter, More Gains Expected in Q4, According to IDC." *Business Wire*. October 30, 2009.

Jung-a, Song. "Samsung Suffers Its First Quarterly Loss." *Financial Times*, January 23, 2009.

Kansas City Business Journal. "Sprint Nextel Announces 8,000 Layoffs." January 26, 2009.

Kaur, Gagandeep. "Handset Strategy: Ride to Rural India." *Voice and Data*, November 7, 2008.

Knowledge@Wharton. "How Did Nokia Succeed in Indian Mobile Market?" August 23, 2007.

Lagorce, Aude. "Huawei Expects to Sell 30% More Handsets in 2009." *MarketWatch*, February 17, 2009.

Lesser, Caroline. "Case Study No. 1: Market Openness, Trade Liberalisation and Innovation Capacity in the Finnish Telecom Equipment Industry." OECD Trade Policy Working Paper No. 73, July 29, 2008.

LG Electronics. *Annual Report 2007*, 2008. http://www.lge.com/global/ir/reports/annual-reports.jsp.

Motorola Corporation. *Form 10-K, 2007: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007*. Commission file number 1-7221, 2008.

———. *Form 10-K, 2008: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2008*. Commission file number 1-7221, 2009.

"News Release" http://www.trai.gov.in/WriteReadData/trai/upload/PressReleases/644/pr21jan09no11.pdf.

Nokia Corporation. *Annual Report*, www.nokia.com (accessed January 27, 2009).

———. *Form 20-F 2007: Annual Report Pursuant to Section 13 or 15(d) of the Securities and Exchange Act of 1934, for the fiscal year ended December 31, 2007*. Commission file number 1-13202, 2008.

NPD Group. "iPhone 3G Leads U.S. Consumer Mobile Phone Purchases In The Third Quarter of 2008." November 10, 2008.

O'Marah, Kevin. "Feasting on a Content Economy: Nokia Bites Apple." *AMR Research*, June 30, 2008.

Open Gardens. "The ASUS Effect: Mobile Innovation Triggered by Open Source, Long Tail Devices and A Shift in the Device Value Chain," August 8, 2008.

Perez, Martin. "Apple's App Store Hits Half Billion Downloads." *InformationWeek*, January 16, 2009.

RCR Wireless. "3G Uptake in U.S. Outpacing W. Europe." September 18, 2008.

Reuters. "Sony Ericsson Posts Fourth Quarter Loss and More Cost Cuts Coming." January 16, 2009.

Salazar, Gary. "The State of the Industry is Strong, Despite This Year's Travails, Reports IDC." *RCR Wireless*, February 26, 2009.

Samsung Electronics. "Annual Report 2007." http://www.samsung.com/uk/aboutsamsung/corporateprofile/ourperformance/annualreports_old.html

Siegler, Scott. "Analyst Angle: The 'Emerging' Growth of GSM in a 3G World." *RCR Wireless*, October 13, 2008.

Standard & Poor's. *Industry Surveys: Communications Equipment*, August 2008.

———. *Industry Surveys: Telecommunications: Wireless*. January 2009.

Telecommunications Industry Association (TIA). 2008 Telecommunications Market Review and Forecast, February 2008.

———. 2009 Telecommunications Market Review and Forecast, February 2009.

———. "Letter to Office of the U.S. Trade Representative RE: 2009 1377 Report." December 12, 2008.

———. "Submission to the U.S. Trade Representative on foreign barriers to U.S. telecommunications trade." http://www.tiaonline.org/gov_affairs/fcc_filings/USTR.cfm (accessed December 15, 2008).

U.S. International Trade Commission (USITC.) *Baseband Processor Chips and Chipsets, Transmitter and Receiver (Radio) Chips, Power Control Chips, and Products Containing Same, Including Cellular Telephone Handsets*. USITC Investigation 337-TA-543. Washington, DC: USITC 2007.

———. *Certain Mobile Telephones and Wireless Communication devices Featuring Digital Cameras and Components thereof*. USITC Investigation 337-TA-663. Washington, DC: USITC 2008.

———. *Certain 3G Wideband Code Division Muliple Access (WCDMA) Handsets and Components Thereof*, USITC Investigation 337-TA-601. Washington, DC: USITC, 2008.

United States Trade Representative (USTR). "China." *2009 National Trade Estimate Report on Foreign Trade Barriers*. Washington, DC: USTR, 2009.

———. "Mexico." *2009 National Trade Estimate Report on Foreign Trade Barriers*. Washington, DC: USTR, 2009.

———. "South Korea." *2009 National Trade Estimate Report on Foreign Trade Barriers*. Washington, DC: USTR, 2009.

Venture Outsource. "Dissecting the New Flextronics." http://www.ventureoutsource.com/contract-manufacturing/industry-pulse/2008/dissecting-the-new-flextronics (accessed on October 20, 2008).

Walko, John. "Ericsson Calls Time on U.S. R&D Center." *EE Times*, November 24, 2008.

———. "Electronics Manufacturing Services." http://en.wikipedia.org/wiki/Electronics_manufacturing_services (accessed December 4, 2008).

Winter, Allie. "AT&T to Cut 12,000 Jobs." *RCR Wireless*, December 4, 2008.

———. "Study: By next year, 1 in 5 U.S. Households Will be Wireless Only." *RCR Wireless*, September 17, 2008.

———. "Nokia shuffles Finnish Site Operations, Job Cuts on Deck." *RCR Wireless*, February 11, 2009.

Wireless Federation. “China Home to 641.23 Million Subscribers at 2008-end.” February 3, 2009. http://wirelessfederation.com/news/china-home-to-64123mn-subscribers-at-2008-end/.

Yahoo!Finance. “Prepaid Cell Phones Can Offer Savings.” January 1, 2009. http://finance.yahoo.com/news/Prepaid-cell-phones-can-offer-conreps-14032011.html.

APPENDIX A
Detailed Description of How Wireless Handsets Work

BOX A.1 How cell phones work

Wireless networks consist of a grid, dividing cities or regions into cells. One cell can range from a few city blocks up to 250 miles. Cells provide service though a set of radio frequencies. The power of the radio is controlled so that these frequencies can be used in multiple cells at the same time. This means many users in a given geographical area can be on the same frequency simultaneously.

Wireless phones have a low-power transceiver that transmits voice and data to the nearest base station, normally not more than five to eight miles away. Base station antenna are usually mounted on a tower, pole, or building, located throughout populated areas, then connected to a cabled communication network and switching system. When the mobile phone or data device is turned on, it registers with the mobile telephone exchange, or switch, with its unique identifiers. It is then alerted by the mobile switch when there is an incoming telephone call. The handset constantly listens for the strongest signal being received from the surrounding base stations and is able to switch seamlessly between the stations. As the user moves around the network, "handoffs" are performed to allow the device to switch sites without interrupting the call. Base stations have relatively low-power radio transmitters which broadcast their presence and relay communications between the mobile handset and the switch. The switch in turn connects the call to another subscriber of the same wireless service provider or the public telephone network, which includes networks of other wireless carriers.

The dialogue between handsets and base stations is a stream of digital data. First, the caller's voice is converted into a stream of binary numbers to form a packet. The packet then passes through the wireless network to the recipient's phone. Finally, the packet of binary data is then converted back into the caller's voice. Today, this digital technology converts not only voice but other data, including text messages, e-mail, and digital pictures, into binary data packets to move them across the wireless network. Which technology is used to achieve this depends on the system the mobile operator has adopted. Operators use a mix of predesignated frequency bands determined by the network requirements and local regulations.

The technologies are grouped by generation. The first-generation systems (1G) originated in 1979 in Japan and include AMPS and NMT. These systems are analog, not digital. The first digital systems, second-generation technologies (2G), arose in Finland in 1991; 2G systems include GSM, CDMA and TDMA. Third-generation (3G) networks, which are still being deployed, were launched in Japan in 2001. They offer high-speed data access in addition to voice services and include W-CDMA (also known as UMTS) and CDMA2000 EV-DO.

There are several categories of mobile phones, including basic phones, feature phones (music phones and camera phones), and smartphones. Nokia launched the first smartphone in 1996. The Nokia 9000 Communicator incorporated personal digital assistant (PDA) functionality into the basic mobile phone. As miniaturization and the increased processing power of microchips has enabled ever more features to be added to phones, the concept of a smartphone has evolved. What was a high-end smartphone five years ago is a standard phone today.

Source: CTIA, "How Wireless Technology Works," http://files.ctia.org/pdf/Brochure_HowWirelessWorks.pdf, (accessed November 18, 2008), 2–6.

APPENDIX B
Technical Glossary

Technical Glossary[1]

Analog – The traditional method of adapting radio signals so they can carry information. Amplitude Modulation (AM) and Frequency Modulation (FM) are the two most common analog systems. Analog has largely been replaced by digital technologies, which are more secure, more efficient, and of higher quality.

Base station – The central radio transmitter/receiver that communicates with mobile telephones within a given range, typically a cell site.

Carrier – Also known as a service provider or operator, a carrier is the communications company that provides customer service (including air time) for wireless phones.

CDMA (Code Division Multiple Access) – A technology used to transmit wireless calls by assigning them codes. Calls are spread out over the widest range of available channels. These codes allow many calls to travel on the same frequency and also guide those calls to the correct receiving phone.

CDMA2000 (1XEV-DV) – CDMA2000 1XEV (Evolution data-voice) represents the evolution of CDMA2000 into the third generation, improving packet transmission capabilities, increasing network speeds, and expanding voice capacity. It has been approved by the International Telecommunications Union (ITU), a standards body based in Geneva, as a 3G technology to provide data and voice services together, with data rates of up to 3.09Mbps.

Cell – The basic geographic unit of wireless coverage. Also, shorthand for the generic industry term "cellular." A region is divided into small "cells," each one equipped with a low-powered radio transmitter/receiver. Unique radio frequencies are assigned to each cell. As a wireless call moves from one cell to another, a computer at the mobile telephone switching office (MTSO) monitors the call, and at the proper time, transfers the phone call to a new radio frequency in a new cell. The handoff is performed so rapidly that it is not noticeable to the callers.

Cell site – The location where a wireless antenna and network communications equipment is placed in order to provide wireless service in a geographic area.

Digital – Technological approach that converts signals (including voice) into the binary digits '0' and '1.' This information is compressed, then transformed into electronic pulses for a wired network, optical light waves for fiber-optic networks, or radio waves for wireless networks. Digital wireless technology has largely superseded analog technology because digital delivers more capacity and supports more applications, as well as better sound quality and more secure signals.

[1] These definitions were obtained from a glossary of terms compiled by CTIA–The Wireless Association.

EDGE (Enhanced Data Rate for Global Evolution) – An evolutionary step in the GSM-development path for faster delivery of data, delivered at rates up to 384 Kbps. The standard is based on the GSM technology platform and uses the TDMA approach.

Evolution-Data Optimized (EV-DO) – A wireless radio broadband data standard adopted by CDMA mobile service providers in the United States and other countries. EV-DO is aimed at delivering maximum downlink speeds of 3.1 Mb/s.

GPRS (General Packet Radio Service) – A packet technology approach that enables high-speed wireless Internet and other GSM-based data communications. It makes very efficient use of available radio spectrum for transmission of data.

GPS (Global Positioning System) – A worldwide satellite navigational system, made up of 24 satellites orbiting the earth and their receivers on the earth's surface. The GPS satellites continuously transmit digital radio signals, with information used in location tracking, navigation, and other location or mapping technologies.

GSM (Global System for Mobile Communications) – A technological approach also based on dividing wireless calls into time slots. GSM is most common in Europe, Australia, and much of Asia and Africa. Generally, GSM phones from the United States are not compatible with international GSM networks because the U.S. uses different frequencies for mobile communications than many other countries. However, some phones are equipped with a multiband capability to operate on such other frequencies.

Megahertz (MHz) – A unit of frequency equal to one million hertz or cycles per second. Wireless mobile communications within the United States generally occur in the 800 MHz, 900 MHz, and 1900 MHz spectrum frequency bands.

MTSO (Mobile Telephone Switching Office) – The central computer that connects wireless phone calls to the public telephone network. The MTSO controls the series of operations required to complete wireless calls, including verifying calls, billing, and antenna handoffs.

MVNO (Mobile Virtual Network Operator) – A company that buys network capacity from a network operator in order to offer its own branded mobile subscriptions and value-added services to customers.

Packet – A piece of data sent over a packet-switching network, such as the Internet. A packet includes the data comprising the message, as well as address information about its origination and destination.

PCS (Personal Communication Services) – Defined by the Federal Communications Commission (FCC) as a broad family of wireless services, commonly viewed as including two-way digital voice, messaging, and data services. One set of "PCS" licenses established by the FCC operates in the 1900 MHz band.

PSD (Packet switched data) – A technological approach in which the communication "pipe" is shared by several users, thus making it very efficient. The data is sent to a specific address with a short delay. This delay depends on how many users are accessing the pipe at any one time, as well as the level of priority requested for the individual user. PSD is the technology used for data communication across the Internet and makes more efficient use of the network.

Smartphone – Wireless phones with advanced data features, including the ability to manage and transmit data in addition to voice calls. Often have keyboards.

Short messaging service (SMS) – Enables users to send and receive short text messages (usually 160 characters) on wireless handsets. Commonly referred to as "text messaging."

Time Division Multiple Access (TDMA) – A technological standard that permits the transmission of information by dividing calls into time slots, each one lasting only a fraction of a second. Each call is assigned a specific portion of time on a designated channel. By dividing each call into timed "packets," a single channel can carry many calls simultaneously.

Third-Generation (3G) – A general term that refers to technologies which offer increased capacity and capabilities delivered over digital wireless networks.

TD-SCDMA – A standard for 3G services that is unique to China.

Universal Mobile Telecommunications System (UMTS) – This is the third-generation technology generally based on W-CDMA (Wideband Code Division Multiple Access). UMTS promises a communications speed up to 2 Mbps.

Wideband Code Division Multiple Access (W-CDMA) – One of two third-generation standards. W-CDMA makes use of a wide spectrum than CDMA and can therefore transmit and receive information faster and more efficiently.

WiMax – A wireless technology based on the IEEE 802.16 standard providing metropolitan area network connectivity for fixed wireless access at broadband speeds.

Wireless Fidelity (WiFi) – WiFi provides wireless connectivity over unlicensed spectrum using the IEEE 802.11a or 802.11b standards), generally in the 2.4 and 5 GHz radio bands. WiFi offers local area connectivity to WiFi enabled computers.

Wireless Internet – General term for the use of wireless services to access the Internet, e-mail and/or the World Wide Web.

Wireless Local Loop (WLL) – A system that connects wireless users to the public switched telephone network (PSTN) using wireless technology and other circuitry to complete the "last mile" between the wireless user and the exchange equipment. Wireless systems can often be installed faster and cheaper than traditional wired systems.

APPENDIX C
Technical Standards for Wireless Handsets

Wireless Technology Standards

Generation	Access Technology	Transmission Speeds	Advantages/Disadvantages
2G	GSM	14.4 kbps	Widely deployed, allows international roaming.
	CDMAone (IS-95A)	14.4kbps	Stronger security features, longer handset battery life, more efficient use of bandwidth than GSM. Disadvantages include lack of global roaming capabilities, narrow deployment, fewer equipment suppliers, proprietary technology.
2.5G			
for GSM	GPRS	64 kbps	"Always on," allows easier internet browsing. Bandwidth shared with other users is a disadvantage.
	EDGE	384 kbps peak, 140-160 kbps more likely	Allows greater data rates per timeslot than GSM/GPRS.
for CDMA	CDMAone (IS-95B)	64 kbps peak, 14.4 kbps typical	4 to 5 times the capacity of GSM systems.
3G	W-CDMA	2 Mbps peak, 400 kbps typical	Faster data speeds and greater capacity than CDMA2000 1X. More expensive to deploy than CDMA2000 1X. Not compatible with earlier GSM networks.
	TD-SCDMA	2 Mbps peak, 1.2 Mbps typical	Excellent for transmitting Internet data. Wide coverage area, more efficient use of spectrum for one-way transfer. Disadvantages include no commercial deployments, few equipment vendors.
	CDMA2000 1X(Release 0)	307 kbps peak, 144 kbps typical	Greater voice and data transmission capacity than CDMAone using same bandwidth.
	CDMA 1X EV-DO (Evolution-Data Optimized)	2.4 Mbps peak, 750 kbps typical	Faster data speeds, handsets compatible with earlier CDMA networks.
	CDMA 1X EV-DV (Evolution-Data/Voice)	3.1 Mbps peak	Able to deliver real time video streaming.
3.5G			
for GSM/W-CDMA	HSPA (High-Speed Packet Access)	14 Mbps future potential, currently 3.6 Mpbs	Delivers streaming video, interactive gaming, and multimedia music tracks at speeds almost 3 times faster than W-CDMA. Compatible with GSM/W-CDMA.
for CDMA	CDMA 1X EV-DO Revision A (Evolution-Data Optimized)	3.1 Mbps peak download speed, 1.8 Mbps upload	Revision A is an upgrade for CDMA 1X EV-DO. Compatible with CDMA networks.

Source: Standard & Poor's *Industry Survey: Telecommunications: Wireless*, January 15, 2009, 19.

Standards for domestic networks

Operator	3G	2G
AT&T	WCDMA/UMTS	GSM
Verizon	CDMA2000 1xEVDO (Rev. A)	CDMA
Sprint Nextel	CDMA2000 1xEVDO (Rev. A)	CDMA
T-Mobile	WCDMA/UMTS	GSM

Source: Standard & Poor's: *Industry Survey: Telecommunications: Wireless January 15, 2009, 18.*

Fourth Generation (4G)

The 700-megahertz (MHz) band was auctioned off in the United States by the FCC from January 2008 through March 2008. Approximately 1,090 licenses were auctioned, many of which were purchased by Verizon Wireless and AT&T. Several regional carriers, including United States Cellular Corp., also acquired spectrum which lies in the optimal frequency band for broadband services.

Source: Standard & Poor's Industry Survey: Telecommunications: Wireless, January 15, 2009, 5.

APPENDIX D
Cellular or Other Wireless Telephones: Harmonized Tariff Schedule Subheading, Description, and Rate of Duty

Telephones for Cellular or Other Wireless Networks: Harmonized Tariff Schedule (HTS) Subheading, Description, U.S. Col. 1 Rate of Duty, U.S. Imports, and U.S. Exports, 2008

2009 HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 2009 General	U.S. imports, 2008	U.S. exports, 2008
		Percent	*Thousand $*	
8517.12.00	Telephones for cellular networks or for other wireless networks	Free	30,778,833	1,509,226
8517.12.00.20	Radio telephones designed for installation in motor vehicles for the Public Cellular Radiotelecommunication Service	Free	327,782	102,884
8517.12.00.50	Other radio telephones designed for the Public Cellular Radiotelecommunication Service	Free	29,304,237	926,111
8517.12.00.80	Other	Free	1,146,815	480,232

Source: U.S. exports and imports compiled from official statistics of the U.S. Department of Commerce.