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Qualcomm Incorporated 2009

Dr. Paul Jacobs, chairman and chief executive officer of San Diego-based Qualcomm Incorporated (Qualcomm), couldn't help but smile as he walked through the firm's lobby, past its "hall of patents" corridor. Jacobs' father, Dr. Irwin Jacobs, founded Qualcomm in 1985 and spent the years since promoting the company's Code Division Multiple Access (CDMA) technology as the preeminent technology available for wireless communications applications. By the summer of 2009, CDMA was the basis for all third generation (3G) technologies available for cellular transmissions. As a result of Qualcomm's technology, along with its exceptional execution and policy of widely licensing its technology worldwide, the company had transformed from a fledgling startup into a *Fortune 500* wireless technology leader and the second most valuable semiconductor company in the world.

Jacobs understood that Qualcomm was among the best-positioned players in the technology world. Each of the three main operating modes of the 3G standard adopted by the International Telecommunications Union (ITU) depended to some extent upon Qualcomm's core CDMA intellectual property (IP). However, most of the next generation modes, often referred to as 4G, in development were based on Orthogonal Frequency Division Multiple Access (OFDMA), rather than CDMA technology. Qualcomm had invested heavily in acquiring and developing OFDMA technologies, but Jacobs knew that 4G could be a new game in which Qualcomm would once again need to demonstrate the value of its technology.

As Jacobs got in the elevator to head to his office, he remained optimistic about the company's prospects. Qualcomm had recently settled litigation with Nokia Corporation (Nokia), the world's largest cell phone company, and seemed poised for continued growth. Smartphones, utilizing some flavor of CDMA, were the fastest growing mobile handset category, despite the global recession. However, Jacobs still had a number of concerns. Would Qualcomm's contributions to 4G solutions, called LTE (Long Term Evolution) or WiMax, be as successful as prior generations? How could Qualcomm further help China and India to continue to roll out CDMA-based networks? Could the company's new services be developed into a new "third" leg for Qualcomm? How aggressively should Qualcomm address the newly emerging netbook and "smartbook" segment?

Background and History of Qualcomm

Qualcomm's founder, Irwin Jacobs, held an M.S. and Sc.D. in electrical engineering from the Massachusetts Institute of Technology. In its early days, Qualcomm primarily provided contract research and development services to the wireless telecommunications industry. Irwin Jacobs made the crucial and risky decision to bet Qualcomm's future on CDMA, just at the time that Europe, U.S.

Professors David Yoffie and Andrei Hagiu, and Senior Researcher Liz Kind prepared this case. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

and Japan were betting on an alternative digital technology standard called TDMA (primarily commercialized as GSM) to replace existing analog cellular systems. (See **Appendix** for background information on wireless technology.) Conventional wisdom in the late 1980s held that CDMA had virtually no chance of adoption as the second generation ("2G") technology to replace analog technology: it was late to market, incompatible with TDMA, and there were several tough engineering problems, especially designing and manufacturing handsets that would not be too big, complicated and expensive.[1] However, by the end of 1989, Qualcomm had built a prototype and successfully tested the technology in a small-scale operation. Still, skepticism remained. Europe went forward with GSM, Japan adopted a proprietary version of TDMA, called PDC, and AT&T Corp. (AT&T) and most other American companies chose yet another version of TDMA, all of which were incompatible.[2]

The Battle for CDMA

Despite being late to market, Irwin Jacobs believed CDMA had technical advantages over GSM which would win over operators once Qualcomm could solve the engineering problems. Ultimately, CDMA used spectrum more efficiently, which saved money for operators. Believing in his technology, Irwin Jacobs persisted against the odds, developing CDMA chipsets for both phones and infrastructure. Since he was getting limited support from equipment manufacturers, he incorporated the chips in infrastructure and handsets, developing a commercial product to demonstrate the technology's viability. Most equipment manufacturers remained skeptical, but Tony Thornley, Qualcomm's former president and chief operating officer, commented, "We had the fundamental patents so we were able to sign on licensees before CDMA was even a standard. At the time, companies were hedging their bets just in case CDMA took off. By signing agreements with us, they were assured a license and access to CDMA. Originally, I don't believe that many companies really thought CDMA was going to happen in a big way." As a result, AT&T, which later spun-out its equipment business as Lucent Technologies, was the first to sign up, followed by Motorola, Inc. (Motorola). Soon thereafter, Nokia, Ericsson, Siemens, Samsung, LG Electronics (LG), and others signed Qualcomm's licensing agreements, which required, according to an article in *The Wall Street Journal*, upfront licensing fees plus royalty rates believed to average 4% to 5% of the wholesale price of CDMA-based equipment.[3]

With Europe committed to GSM, Qualcomm still had to convince skeptical service providers to adopt a new untested standard and find a way to get CDMA approved as a wireless standard. After extensive lobbying by Qualcomm, the Telecommunications Industry Association (TIA) adopted a standard based on CDMA in 1993. At the same time, Irwin Jacobs wanted to convince the FCC in the United States not to repeat the European pattern of mandating a single standard, which in 1993-1994, would not have been CDMA. Reed Hundt, then FCC chairman, remembered, "Irwin came into my office, and said, if you let me paraphrase after all these years, 'I'm just an engineer, and I want a chance to compete. Don't pick a national standard, such as GSM. Give CDMA an opportunity to compete on standards.'" Ultimately, Hundt agreed with Irwin Jacobs' assessment that competition among service providers should include competition on standards, and if some or all service

[1] "Spread Betting," *The Economist Technology Quarterly*, June 21, 2003.

[2] "Qualcomm's Dr. Strangelove: Irwin Jacobs has built a company on intellect. How much can he persuade the mobile phone companies to pay for it?" *The Economist*, June 15, 2000.

[3] Don Clark, "Qualcomm's Outlook Rattles Investors," *The Wall Street Journal*, November 9, 2007, p. B6.

providers chose to use CDMA that would presumably produce a more efficient use of spectrum and perhaps even an American firm that could compete successfully on a global level.[4]

Finally, in October 1995, the first commercial CDMA network was launched in Hong Kong. In January 1996, South Korea became the first country to launch CDMA networks nationwide and was quickly followed in the U.S. by Bell Atlantic Corp. (Bell Atlantic). Throughout this time, Qualcomm continued to file patents protecting its investment in CDMA technology and invested in the development, commercialization, and manufacture of infrastructure and subscriber products in order to promote the growth of CDMA deployments. The resulting infrastructure and subscriber products businesses, heavily dependent upon manufacturing technologies, represented a diversion from Qualcomm's core technology strengths but were deemed necessary to demonstrate the feasibility and manufacturability of such products to the industry.

The dynamics of the U.S. cell phone industry had changed radically since the advent of 2G digital networks. TDMA-based technology had been widely adopted for 2G systems and mobile phone growth soared, exceeding spectrum capacity even with the new 2G implementations. The explosive growth in wireless communications accentuated the technical weaknesses in TDMA. Some operators, eager for improvements in capacity utilization and voice quality, and seeing the successful introduction of CDMA products in Hong Kong and Korea, turned to CDMA. Sprint, GTE, Airtouch, Nynex, and Bell Atlantic all launched CDMA in the U.S. In 1998, KDDI Corporation launched Japan's first CDMA network. By 1999, CDMA had approximately 50 million subscribers and 13% of the global wireless market. While GSM was still deeply entrenched, CDMA had quickly become the fastest growing network technology.

The battle over mobile phone standards changed course with the explosion of the Internet in the late 1990s. Suddenly, voice capability over mobile phones was no longer enough: there was growing demand for mobile data at speeds that would allow multimedia on a cell phone. In 1998, the ITU began requesting proposals for 3G standards that would be compatible worldwide. The U.S.'s TIA proposed a next generation CDMA technology developed by Qualcomm, CDMA2000, while Europe proposed to combine GSM network design and CDMA radio technology into a new standard called Universal Mobile Telecommunications System or UMTS. (The underlying technology was called WCDMA and the terms UMTS and WCDMA were often used interchangeably.) Both CDMA2000 and WCDMA incorporated Qualcomm's core patented technologies as their basic underpinning.

During the same period, Irwin Jacobs had many sleepless nights worrying about the infrastructure business, and especially the requirement at the time to finance major telecom customers. He also was concerned that the manufacturing activities of the infrastructure and subscriber handset products businesses were a diversion from Qualcomm's technical and management focus on its core competencies: technology development and chipset/software design and development. In 1999, in order to reduce financing risks and reduce the aforementioned diversion from its core competencies, Qualcomm divested its network infrastructure business to Ericsson, and its handset business to Kyocera Wireless (Kyocera).

In June 2000, the ITU decided to adopt a global 3G standard with three modes of operation, all of which included elements of Qualcomm's CDMA technology: CDMA2000, WCDMA, and TD-SCDMA. Qualcomm began to expand the scope of its license agreements with existing licensees to cover the new 3G standards and enter into agreements with unlicensed companies who became interested in participating in the market with 3G devices. In both cases, the financial terms were the same as the 2G CDMA licensing agreements. Nevertheless, Qualcomm continued to face resistance

[4] David Yoffie, Pai-Ling Yin, and Elizabeth Kind, "QUALCOMM, Inc. 2004," HBS No. 705-401 (Boston: Harvard Business School Publishing, 2004).

from a few companies, including Nokia, to an extension of the same terms for the 3G standards-based products that applied to the 2G CDMA products. Since many GSM companies claimed significant WCDMA and/or GSM patent positions, they threatened to sue Qualcomm for patent infringement to force a reduction in Qualcomm's royalty rates. (WCDMA handsets and baseband chipsets used GSM for backward compatibility when roaming to 2G GSM systems.) However, Qualcomm ultimately was able to convince Nokia and other companies that the value of its patents warranted the compensation being sought by Qualcomm.

With the technology in place, the 3G rollout was ready. (See **Exhibit 1** for network migration to 3G.) Since the majority of the world's cell phones were GSM, most countries moved to WCDMA. However, the U.S., Korea and Japan, among other countries with 2G CDMA deployments, deployed CDMA2000. Once the early technical problems were addressed, WCDMA handset prices dropped dramatically, and adoption grew rapidly. At the same time, CDMA2000 also experienced dramatically decreasing handset prices and rapid growth. By 2005, more than 143 operators had deployed CDMA2000 in 67 countries.

The Wireless Industry Wars Continue

In July 2005, Paul Jacobs took over for his father as Qualcomm's CEO. (In March 2009, Irwin Jacobs stepped down as chairman of the board and Paul Jacobs took over that role as well.) Jacobs earned his B.S., M.S., and Ph.D. degrees in electrical engineering from the University of California at Berkeley. He joined Qualcomm in 1990 as an engineer in the company's wireless technology development group and later ran Qualcomm's handset division. In 2001, he led Qualcomm's Wireless and Internet (QWI) segment, where he spearheaded projects to create a range of mobile customer services.

In October 2005, Nokia, Ericsson, Texas Instruments Incorporated (TI), Broadcom Corp. (Broadcom), NEC, and Panasonic complained to European regulators, accusing Qualcomm of breaking European Union competition (antitrust) law. At issue was Qualcomm's royalty rate for WCDMA handsets. The complainants contended, among other things, that Qualcomm had a lower percentage of patents required to implement the WCDMA standard than its percentage of patents required to implement the 2G CDMA standard, and that it should therefore be charging a lower royalty rate on WCDMA handsets than on CDMA handsets. According to a lawyer representing the complainants, Qualcomm's royalty rates "…violate[d] the company's promise, made to international standards bodies, to license its technology on a fair and nondiscriminatory basis."[5] Nokia also discontinued its payment of royalties to Qualcomm on WCDMA subscriber devices and filed civil law suits. Qualcomm counter-sued. In July 2008, Qualcomm and Nokia agreed to end their legal battles. In a 15-year deal, Nokia agreed to pay a non-refundable upfront cash payment of $2.5 billion to Qualcomm, transfer ownership of 120 patent families, and pay ongoing royalties, which some analysts estimated at roughly 2%. The agreement covered all CDMA-based products, single-mode OFDMA products, and multi-mode CDMA/OFDMA products. Nokia also agreed to withdraw its complaint from the European regulators and settled all pending litigation with Qualcomm.

On a different legal front, Qualcomm and Broadcom had sued each other over patent rights. The battle was fought in the courts and the U.S. International Trade Commission (ITC) for more than two years before announcing a settlement and multi-year patent agreement in April 2009. To settle the dispute, Qualcomm agreed to pay Broadcom $891 million over four years. Both firms agreed to end their litigation and not to assert patents against each other for their respective integrated circuit

[5] Don Clark and Adam Cohen, "EU Regulators Get Complaints about Qualcomm," *The Wall Street Journal*, October 29, 2005, p. A3.

products as well as certain other products and services. In addition, Broadcom agreed to drop its complaints against Qualcomm with European and South Korean regulators. (Despite Broadcom's withdrawal of support, South Korea fined Qualcomm $208 million in July 2009 for offering discounts to large Korean handset manufacturers that used Qualcomm's chips.)

The Battle for Next Generation Wireless Services

During the years marked by ongoing litigation, industry participants continued to position themselves for the next generation of wireless technology. While Qualcomm's CDMA technology was being deployed globally, three main contenders were emerging as viable alternatives for next generation systems: LTE, WiMax, and UMB (Ultra Mobile Broadband). All were based on OFDM or OFDMA (Orthogonal Frequency Division Multiple Access) technologies, and all offered ubiquitous broadband service using larger spectrum bands. These so-called 4G solutions were designed to offer data rates at speeds higher than existing 3G technologies.

The WiMax initiative had originated in the computer industry, primarily by companies with relatively little experience in the wireless business. WiMax was based on OFDMA technology, and reportedly had broadly distributed intellectual property, with many companies claiming ownership of necessary or applicable patents. In 2001, a small group of four companies created the WiMax Forum to develop and promote the technology. In 2005, a version of WiMax was standardized by the IEEE, and in 2007, the fixed version of WiMax was formally accepted by the ITU as a 3G standard (even though it was based on OFDMA). By 2009, the WiMax Forum had over 500 members. The biggest carrier investor in WiMax operations was a joint venture between Sprint Nextel and Clearwire, which launched its first mobile WiMax network in Baltimore, MD, followed by Portland, Oregon and Atlanta in 2009. By the summer of 2009, only approximately 3 million subscribers had been activated on WiMax systems worldwide.

An alternative to WiMax was developed by Flarion Technologies, Inc. (Flarion), with their FLASH OFDM technology. Flarion had an extensive patent portfolio and had launched the first commercial OFDM network. Supporters argued that the Flarion technology was superior to existing cellular technology because it relied on Internet protocols rather than older, circuit-switch technology. In 2006, Qualcomm acquired Flarion and all of its patents for approximately $800 million. Jacobs noted, "The Flarion acquisition helped to make our [OFDM] portfolio broader."

Qualcomm also developed UMB, another OFDM technology, as an upgrade to the CDMA2000/EV-DO family. UMB supported data speeds comparable to that of LTE. However, after several U.S. wireless carriers announced their intent to back alternative 4G options, Qualcomm decided to suspend further development of UMB and focus their OFDM developments efforts on LTE. Jacobs commented, "I would argue that UMB is still the best technology, but it doesn't matter. People were worried that Qualcomm would have an unfair advantage in getting its chip share."

In 2009, the leading contender for the 4G standard was clearly LTE, which had been developed by the Third Generation Partnership Project, the standards body responsible for the GSM family of standards. LTE was being evaluated as an evolution for WCDMA and HSDPA networks utilizing new, larger spectrum bandwidths. Qualcomm, Samsung, Matsushita, Nokia, Motorola, Nortel, Ericsson and others all claimed to hold patents necessary and applicable to implementation of the LTE standard. In November 2007, Verizon announced its decision to deploy LTE as its 4G technology, and in February 2008, AT&T announced the same. Commercial availability of LTE service was not expected until the end of 2010 at the earliest. Verizon was doing limited testing of LTE in 2009, demonstrating peak data speeds as high as 60 megabits per second. (See **Exhibit 7** for

data rate comparisons.) The formal establishment of international 4G standards was not expected to be set until October 2011, the date of the next scheduled general meeting of the ITU.

The timing of large scale LTE deployments was uncertain. Most operators had voiced their support for moving to LTE at some point. However, with a substantial upgrade path ahead for 3G CDMA2000 and WCDMA networks, extensive LTE deployments and subscriber growth were not expected for a number of years. In fact, most operators were expected to launch LTE primarily to address very densely populated urban areas and continue to offer 3G for roaming purposes for the foreseeable future. Multimode 3G/4G devices would be needed in that environment, which was beneficial for Qualcomm's licensing business. Qualcomm's existing licensing agreements would apply to all multimode 3G/4G products. Separate license agreements for single-mode OFDM products, though, would be required if and when such a market developed (except for the companies Qualcomm had already entered into licenses with for single-mode OFDM subscriber devices).

By 2009, Qualcomm had established early momentum in single-mode OFDM licensing, by completing royalty bearing license agreements with Nokia and one other large wireless handset manufacturer, as well as a number of smaller players looking to get into the nascent 4G business.

Qualcomm's Business in 2009

In 2009, Qualcomm reported its financial results across four segments: Qualcomm CDMA Technologies (the chipset business), Qualcomm Technology Licensing (the licensing business), Qualcomm Wireless and Internet (the services business), and Qualcomm Strategic Initiatives. (See **Exhibit 2** for more detailed segment information and **Exhibit 3** for selected consolidated operating results.) Qualcomm was cash rich—with almost $16 billion of cash and marketable securities as of June 2009. Qualcomm had roughly 144 offices around the world, and employed approximately 15,400 full-time and temporary employees. The vast majority of Qualcomm's employees were engineers. Qualcomm executives believed the continued success of the company depended on constant technological innovation. In fiscal 2008, the company spent $2.3 billion on research and development. According to Qualcomm's head of human resources, Dan Sullivan, "Irwin wanted to create a company that would 'dare to do the impossible.' At the same time, we tried to create an environment that was simultaneously highly innovative and strongly results focused… In some ways, our work environment is similar to a college campus—people work hard and play hard." As a result, *Fortune* magazine named Qualcomm as one of the "100 Best Companies to Work For" since 1999.

Chipsets

Qualcomm's CDMA Technologies business developed and sold integrated circuits and system software for wireless voice communication and data transmission. Qualcomm's chipsets and related software products were designed for wireless devices—particularly mobile phone handsets and data cards—and the infrastructure equipment used to run wireless communications networks.

Qualcomm used a "fabless" strategy—focusing on the design and development of its chips, and contracting with other companies to manufacture them. Qualcomm's newer products enabled high-speed transmission of data and voice, as well as the ability to use GPS, cameras, video, games, and other forms of multimedia activities on mobile phones. Qualcomm's R&D efforts helped the company continue to reduce the size of the chipset, while adding more features and maintaining competitive costs. In addition to selling individual components, Qualcomm also packaged together all the necessary components into a chipset so that it could offer a turnkey solution for those customers desiring one.

Competition in 3G wireless chipsets was intense, fueled by two distinct business models: integrated systems providers and component providers. Qualcomm's chipset business had been focused on providing a system solution for many years and had invested heavily to integrate, at the request of its customers, a broad number of technologies into its products, enabling handset manufacturers to focus on things that differentiated themselves from the competition. Many other chipset providers had focused exclusively on providing individual components, like standalone basebands or applications processors, to handset manufacturers. The individual component model required handset manufacturers to complete the expensive and time consuming effort to integrate the different components themselves.

This integrated system solution was showing some recent traction for Qualcomm's chipset business with new customers for WCDMA chip products. In February 2009, Nokia and Qualcomm announced plans to collaborate on a WCDMA subscriber device expected to reach the North American market in mid-2010. Research in Motion Limited (RIM), Motorola, and Sony Ericsson Mobile Communications AB (Sony Ericsson) had also recently launched new WCDMA devices using Qualcomm's integrated system solutions.

As of April 2009, Qualcomm had more than 5 billion application-specific integrated circuit (ASIC) chip shipments around the world.[6] Revenue for the chipset segment was $6.7 billion for fiscal 2008, with mobile phone chipsets representing the lion's share of the total. Since 2001, the segment accounted for roughly 50% to 60% of total corporate revenue. Two customers—Samsung and LG—accounted for a significant portion of total chipset sales.

Qualcomm had also been developing new chip products, designed not just for mobile phone handsets, but also for mobile consumer electronics devices such as laptops, smartbooks, and netbooks. The company announced its "Snapdragon" platform of chipset products in November 2006, which included an ARM-based microprocessor and the full range of wireless connectivity capabilities for mobile computing. Qualcomm targeted devices ranging from small smartbooks and netbooks to touch screen tablets only slightly larger than most smartphones. Toshiba launched the first Snapdragon-based device in 2009. Qualcomm also offered its "Gobi" chipsets, which provided embedded radio communications and allowed certain notebook computers to connect to the Internet via 3G operators worldwide.

Licensing

Historically, Qualcomm charged one-time licensing fees and ongoing royalty revenues for the right to use its intellectual property for the manufacture and sale of CDMA products. Companies that made CDMA-based chips, handsets, or infrastructure equipment needed to obtain a license from Qualcomm to make or sell those products. (See **Exhibit 2** for financial data on Qualcomm's licensing segment.) As of fiscal 2008, Qualcomm had cumulatively filed or acquired approximately 2,900 U.S. patents and had over 8,900 U.S. patent applications pending.[7] At that time, the company had approximately 14,300 patents outside the U.S., with approximately 44,000 patent applications pending.[8]

Qualcomm created a very thorough licensing structure, with licensees obtaining rights to sell the specific categories of products in which they were interested. When Qualcomm licensed a handset

[6] Qualcomm Web site.

[7] Qualcomm, September 28, 2008 10-K (San Diego: Qualcomm, Inc.), p. 14.

[8] Ibid.

manufacturer, such as Samsung, to make and sell a CDMA subscriber device (phone), the licensee could get their CDMA chipsets by designing them themselves, or by buying them from Qualcomm or one of the many other chip providers who had obtained the right to make and sell such chips using Qualcomm's patents. Handset manufacturers could not sell CDMA chipsets to third parties without a separate agreement with Qualcomm covering such sales. Further, Qualcomm authorized chipset manufacturers had no "pass through" rights. In other words, a handset manufacturer that incorporated chips manufactured by a Qualcomm authorized chip provider still needed its own subscriber device license from Qualcomm.

Qualcomm generally maintained standard royalty rates across their licensees and across the different CDMA-based technologies. Qualcomm had departed from its standard practices on occasion, such as in China in order to get government approval for CDMA2000 to be adopted (see "China and Other Emerging Opportunities" section), but Qualcomm still offered its other licensees the opportunity to accept those terms in place of their existing ones.

As of July 2009, Qualcomm had more than 175 3G CDMA-based licensees (including more than 105 WCDMA/TD-SCDMA licensees) and 8 single-mode OFDM/OFDMA licensees.[9] Marv Blecker, senior vice president of corporate licensing, explained Qualcomm's early licensing strategies:

> From the beginning, we decided to offer licenses to our entire patent portfolio of technically and commercially necessary patents at a single royalty rate. Although we were also willing to offer a license to fewer of our patents (and some licensees had entered into agreements covering fewer patents), the vast majority of our licensees have demanded—and received—a license to our broad portfolio of essential and applicable patents. The advantage to a licensee of such a portfolio license was that the licensee was free to conduct its business without having to be concerned about its products infringing any of Qualcomm's patents as they were already licensed. The licensee also did not need to worry about having overlooked, at the time of executing the license agreement, its need for additional Qualcomm patents and the associated additional royalties or fees.
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> Many companies approach us for licenses, but we also market our patented technology to companies that are outside of the wireless industry, such as camera and computer makers, in an attempt to grow the market for our wireless technologies. We also pursue companies in other countries such as India and Korea. We will license to anyone, including our competitors. However, we don't participate in patent pools, which are generally more beneficial for companies with little or no experience or competence in licensing activities. We feel that we are entitled to the benefits of a fair return on our inventions and investments as determined through bilateral negotiations in the market.

The bottom line was that Qualcomm historically had charged roughly the same standard royalty rates across all the three 3G CDMA-based technologies (CDMA, WCDMA and TD-SCDMA). And with the conclusion of its licensing deal with Nokia in July 2008, Qualcomm was collecting royalties on all 3G device shipments around the world. As of July 2009, Qualcomm estimated approximately 540 to 590 million CDMA and WCDMA devices would ship in calendar 2009.[10] At that time, the

[9] "Third Quarter Fiscal 2009 Earnings (Business Segment Highlights)" PowerPoint presentation, July 22, 2009. Qualcomm, Inc., San Diego, CA. Available at http://www.qualcomm.com, (accessed on September 23, 2009).

[10] "Qualcomm Announces Third Quarter Fiscal 2009 Results: Revenues $2.8 Billion, EPS $0.44, Pro forma EPS $0.54," Qualcomm, Inc.: San Diego, CA, "Current Guidance Calendar 2009 Estimates," July 22, 2009, p. 7.

company also estimated that CDMA and WCDMA phones would have an average wholesale price of $199 for fiscal 2009.[11] (See **Exhibit** 4 for wireless phone industry statistics and forecasts.)

Wireless and Internet

Qualcomm's Wireless and Internet segment was comprised of four divisions: Qualcomm Internet Services (QIS), Qualcomm Enterprise Services (QES), Qualcomm Government Technologies (QGOV), and Firethorn. A core part of the segment and part of QIS was BREW, short for Binary Runtime Environment for Wireless. Qualcomm licensed and delivered BREW to carriers as a platform and distribution system for consumers to download games, videos, e-mail, and other multimedia applications onto their cell phones. Launched in 2001, BREW was an early precursor to Apple Inc.'s (Apple) iPhone app store. Jacobs explained that "Our original strategy for BREW was to drive CDMA market growth by helping operators more quickly transition to offering data services. As we got into the business, we realized that BREW would not only help grow CDMA, but that it also had the potential to be a profitable, standalone business in its own right."

As of 2009, over sixty commercial operators in 25 countries had launched BREW. Verizon was one of BREW's most visible customers with its "Get It Now" and "Vcast" branded services. As of March 2009, Qualcomm estimated that BREW generated over 2 billion revenue transactions and over $2 billion in developer earnings.[12] As Apple's app store exploded (over 100,000 applications and over 100 million downloads per month),[13] BREW faced significant competition: every major player in the industry announced plans to launch app stores, including Research in Motion Limited (Blackberry), Microsoft, Palm, Inc., and Nokia. In response, Qualcomm launched Plaza, a widget based content platform using the foundations of BREW. The May 2009 launch of Plaza Retail provided operators with an open platform to support application stores on any mobile device. However, the success of Apple's app store and the emergence of other stores raised new challenges for Qualcomm: would the industry continue to evolve "horizontally," with players such as Qualcomm providing the underlying technology across many vendors (see **Exhibit 10**); or would a "vertical" model emerge, where Apple, Blackberry, or Nokia would control critical elements of their own ecosystem?

Qualcomm was also investing in its Qualcomm MEMS Technology (QMT) business. QMT was developing the industry's first micro-electro-mechanical-systems (MEMS)-based display for mobile devices, a new technological innovation that offered low power consumption, color and high resolution viewing quality in a wide range of environmental conditions, including bright sunlight. The display worked by reflecting light, rather than using backlighting like current displays in the market. While still in the early stages of commercialization, this new display technology had the potential to greatly increase the capabilities of mobile devices while minimizing power consumption. Backlit displays were the number one consumer of battery capacity on wireless devices.

Qualcomm Strategic Initiatives (QSI)

Qualcomm's strategic initiatives segment primarily focused on promoting the development and adoption of 3G wireless communications technologies around the world. The QSI group originally provided financing to certain CDMA operators and made a number of strategic investments to

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[11] Ibid.

[12] Qualcomm Inc., "About BREW," Qualcomm, Inc. Web site, http://brew.qualcomm.com/brew/en/about/about_brew.html (accessed on June 25, 2009).

[13] Ben Lorical, "Waiting for the Billionth Download," *O'Reilly Radar*, April 16, 2009 as accessed at http://radar.oreilly.com/2009/04/itunes-app-store-billionth-download.html.

encourage CDMA development and usage. Qualcomm Ventures, which was part of QSI, began in 2002 with a $500 million fund.

One of QSI's largest initiatives was FLO TV (previously, MediaFLO). Started in late 2004, FLO TV's plan was to deliver broadcast television services and content to subscribers of U.S. wireless carriers on their mobile devices via a separate OFDM broadcast network. Early providers of mobile TV downloaded their programming from the Internet, resulting in time delays, inefficient use of network capacity and quality issues, such as buffering and pixilation. Instead, Qualcomm's broadcast network used existing broadcast towers and dedicated UHF spectrum previously used by TV broadcasters and made available as a result of the transition of U.S. TV broadcasters to digital technology. As a result, FLO TV provided scalable, extremely high picture quality, similar to a viewer's perception of traditional television. The company initially estimated that the cash requirements for the FLO TV business plan would be approximately $800 million during its first four to five years.[14]

Opportunities for Growth

Around the world, the transition from 2G to 3G had begun, with different levels of adoption across developed and developing markets. As of mid 2009, approximately 830 million subscribers were using CDMA-based 3G technologies; Qualcomm forecasted 600-650 million CDMA devices would be sold in fiscal 2010. With more than 4 billion wireless subscribers worldwide, the continued transition of 2G to 3G subscribers on existing networks combined with new 3G network launches provided substantial growth opportunities for Qualcomm in the years ahead.

While the transition from 2G to 3G was a key growth driver for Qualcomm (see **Exhibit 5**), it was harder to discern how 4G would develop and over what time period. In 2008, Qualcomm discontinued its UMB development efforts and dedicated its OFDMA development efforts primarily to LTE. As the likely migration path for WCDMA operators, LTE was gaining significant momentum in the wireless community. As of the summer of 2009, most of the major carriers in the U.S. and Europe, except Sprint Nextel, had committed to future deployments of LTE.[15]

Qualcomm's chipset business needed to implement another technology, LTE, in order to provide its customers with a complete system solution. As a result, Qualcomm's chipset business needed to ensure its products were available when operators chose to launch LTE. For the licensing business, Qualcomm's existing CDMA license agreements would cover multi-mode 4G/3G products. Therefore, only if and/or when single-mode 4G became a meaningful part of the market would Qualcomm need to pursue additional licensing agreements beyond those already announced.

Eight companies, including Nokia and another major manufacturer, had signed license agreements with Qualcomm for single-mode products using OFDMA technology, including LTE technology, by 2009. In December 2008, Qualcomm had disclosed that, "Qualcomm expects that it will charge royalties for a license under its standards essential LTE patents and/or standards essential WiMax patents for complete, end user subscriber devices that implement LTE and/or WiMax standards, but do not implement any 3G CDMA standards, of approximately 3.25% of the wholesale selling price of each such device, subject to reciprocity and other standard terms and conditions."

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[14] "Qualcomm Subsidiary to Support Nationwide Delivery of Mobile Multimedia in 700MHz Spectrum," Qualcomm company press release, November 1, 2004.

[15] Michael Kennedy, "LTE comes out of the Lab," available at http://www.telecommagazine.com, April 20, 2009 (accessed June 1, 2009).

China and Other Emerging Opportunities

As Jacobs thought about areas for future growth, China, India, and other developing nations were major priorities for Qualcomm. (See **Exhibit 6** for data on subscribers by country.) China had the world's largest mobile network, with over 687 million subscribers, accounting for 17% of global wireless communications subscribers. However, cell phone penetration in China was only 50%, providing even more potential growth opportunities for the industry.[16]

The wireless industry had been speculating for years on the launch of 3G networks in China. In May 2008, the Chinese government completed a restructuring of the country's telecom industry, creating three carriers that each provided both fixed and wireless services. (As part of the restructuring, China Unicom merged with China Netcom and sold its CDMA network to China Telecom for $15.8 million.) Finally, in January 2009, the Ministry of Industry and Information Technology Industries awarded China's wireless operators with officially sanctioned 3G technology licenses. China Mobile got a license to deploy TD-SCDMA, while China Unicom was granted a license for WCDMA, and China Telecom was granted a license for CDMA2000.

With approximately 464 million subscribers in early 2009, China Mobile was significantly larger than any other mobile operator in China, both before and after the industry restructuring. China Unicom, with 134 million mobile subscribers, ranked a distant second. In 2007, the government authorized China Mobile to begin building a national TD-SDCMA network. The company spent billions on the network, yet its success with the technology had been limited. China Mobile's commercial trials, begun in 2008, were plagued with technical failures, such as dropped calls and inconsistent coverage. While the Chinese government set a target of 10 million TD-SCDMA subscribers by the end of 2010, few industry observers believed China would reach its goal. Many analysts speculated that China Mobile would devote as few resources as possible to TD-SCDMA and instead, attempt to move quickly to 4G TD-LTE technology.

Jing Wang, Qualcomm's EVP Asia Pacific & Middle East and Africa, explained how Qualcomm viewed its options with regard to China:

> Qualcomm's success in China will hinge upon its ability to tap into that massive country's demand for 3G products and services and to enable the local manufacturers for the purpose of strengthening the worldwide 3G ecosystem. Qualcomm has formed strategic alliances with China Telecom and China Unicom to roll out CDMA2000 and WCDMA networks, develop compelling 3G data services, and source a wide variety of cost competitive terminals to address their target market segments. Qualcomm also works closely with its Chinese licensees to enable them to commercialize and promote their 3G infrastructure and terminal products in China and abroad.

China Mobile was in an interesting predicament with its TD-SCDMA license. The operator had several options to consider. One option was to deploy TD-SCDMA aggressively and invest significant resources to build up TD-SCDMA's ecosystem and subscriber base. This was a monumental task even for the world's largest mobile operator. The second option was to limit its TD-SCDMA network roll-out, relying on its strong market position to retain its market share, and wait for the advent of TD-LTE. This option opened up a window of opportunity for both China Telecom and China Unicom to churn away some of China Mobile's high-end subscribers. The third option was to lobby the government to grant it a WCDMA license to offset its loss of subscribers and market valuation due to the immaturity of TD-SCDMA. The likelihood of this option playing out

[16] "Mobile Phone Industry Tops 50% in China," *Shanghai Daily*, as accessed at http://www.china.org.cn on May 26, 2009.

was small due to the government's nationally vested interest in TD-SCDMA. Regardless of which option China Mobile elected to pursue, Qualcomm wanted to be one of its strongest strategic partners.

Jacobs commented, "We are eager to help China Mobile, but we need to assess how important it is to include TD-SCDMA as a component of a chip. If we don't include it, are we missing a piece that provides an opportunity for someone else?" By the summer of 2009, Qualcomm had licensed a large number of companies, including Chinese and non-Chinese companies, for TD-SCDMA technology. In the past, the Chinese government had implied that TD-SCDMA was not dependent on Qualcomm's intellectual property. According to Wang, "We have started receiving royalty revenue on TD-SCDMA, but, so far, the TD-SCDMA deployment has been small. Multi-mode WCDMA/TD-SCDMA and CDMA2000/TD-SCDMA products were also generally covered by our existing agreements covering WCDMA and CDMA2000 products, respectively. We'll have to wait and see how the deployments develop before negotiating licensing terms for single-mode TD-SCDMA products with the remaining manufacturers."

Another growth opportunity for Qualcomm was in India. 3G had been launched by a number of government owned operators there and regulators had announced plans to auction additional 3G spectrum later in 2009. Some predicted that as many as nine 3G networks could be operating in India by the end of 2010.

Qualcomm was also targeting other geographic areas, including Indonesia, Thailand, Vietnam, and South America. On the one hand, it was critical that Qualcomm help drive adoption of 2G to 3G and bring down prices of cell phones in emerging areas given their tremendous subscriber growth potential. However, on the other hand, low average selling prices of handsets meant lower royalty dollars per device and lower chipset prices. Peggy Johnson, EVP of the Americas and India, elaborated with regard to India:

> In India today, all of the handsets are imported, except for the ones made by a company called Spice. They're super low end, which is good because the biggest challenge to growing sales of handsets is handset prices. We helped drive CDMA2000 handset prices down to $20 or $21 and we have to do the same thing with WCDMA. For CDMA2000, we developed a low end chip that stripped out everything that wasn't needed—like GPS, for example. Then we worked with the handset manufacturers to help them lower their costs. Another thing we've done for both CDMA2000 and WCDMA technologies is to develop a system-on-a-chip called QSC (Qualcomm Single-Chip solution). By bringing down the number of chips, we drive down the cost and the price.

New Services, New Markets and New Customers

Within Qualcomm, there was debate about whether the company's services business could become a major generator of revenue and profits, or if it should be considered a strategic investment to drive higher data usage. In addition, as computer-focused semiconductor companies, such as Intel and AMD, tried to move into connected mobile devices, such as netbooks, should Qualcomm use its handset technology to become a major player in the non-phone, connected mobile device market?

With regard to addressing new mobile opportunities, Jacobs believed that a perfect storm could be emerging for Qualcomm. "If you combine better cellular networks with cloud computing, Linux, and cheap devices," noted Jacobs, "it may be possible to free the world from the grip of Wintel." Qualcomm began offering its own microprocessor, Snapdragon, for sale with the emerging categories of netbooks and "smartbooks" (which Jacobs described as a hybrid smartphone and computer, with very long battery life and always on the network, see **Exhibit 11**). In some countries, including the

U.S., cellular operators were experimenting with giving away netbooks in exchange for a two-year data contract. Jacobs suggested that since Qualcomm had close relationships with cellular operators, this might create the opportunity to build an ecosystem around Snapdragon, and push Qualcomm into a converging communications and computing industry.

The expanding 3G industry was also attracting some new customers and partners for Qualcomm. The chipset business had leveraged its integrated system solution strategy to make some inroads with certain new WCDMA handset customers, including Nokia, RIM, Motorola and Sony Ericsson. Qualcomm had also started to work closely with a number of traditional Internet and computer companies who were pushing into the 3G mobile broadband space, such as Google, Inc., Amazon.com, Inc., Microsoft, Dell Inc. and Hewlett-Packard Company.

Regarding the role of services, Len Lauer, Qualcomm's chief operating officer, argued that services could be the next cornerstone for the company's profits and growth:

> Qualcomm is primarily a chip company and a licensing company. When we started developing our first service, BREW, most people saw it as a catalyst to adopt data services and in turn, help the licensing and the chip businesses. Now, we are starting to view services as a potential third core competency for the company.

Qualcomm was investing in a host of service businesses. The major ones included BREW, FLO TV, mobile commerce, and mobile healthcare. While BREW made modest profits, it had not been as financially successful as the company hoped. Lauer believed the recent changes in BREW—from opening the platform to expanding BREW to support WCDMA—would help grow the service.

The other major service was FLO TV. Qualcomm had built a strong distribution network for television programming on an "on demand" basis through its commitments from AT&T and Verizon. FLO launched in 2006, and was one of several similar multimedia broadcasting systems, such as T-DMB (deployed in Korea), ISDB-T (launched in Japan), and DVB-H (the existing European standard). In 2007, Qualcomm developed a universal chip that supported three mobile television technologies. FLO TV provided real time delivery of Internet protocol data such as stock market prices, weather, traffic, and sports scores. Qualcomm hired TV producers to develop original programming and negotiated distribution deals for popular entertainment, news, sports, and children's programs. Qualcomm also hoped to take the business beyond handsets to different devices, including cars. Eventually, Qualcomm hoped to build a brand around FLO TV. In the fall of 2009, Qualcomm started advertising the FLO TV brand directly to consumers. In the short-run, however, Verizon did not co-brand FLO TV and AT&T advertised 'AT&T Mobile with FLO TV.'

One of the big challenges for FLO TV was the cost of content. Qualcomm had largely built out its broadcast towers and purchased spectrum. But content from broadcasters was expensive. Ultimately, Qualcomm's plan was to get paid on a monthly basis by the carriers, based on numbers of subscribers. The carriers, in turn, added a mark up and charged their customers a monthly subscription fee. Many analysts believed that price was the single largest impediment to subscription growth. Surveys showed consumers were interested in mobile TV and were willing to pay for it, but only up to $5 per month.[17] Many consumers chose individual downloads (typically about $2 per download) over monthly subscriptions. Major television events such as presidential elections and important sporting events spurred demand for mobile television. Consumers also required FLO enabled phones, which sold from $125-$300. Qualcomm had not published FLO TV's subscriber numbers, but company management noted a somewhat slow ramp up.

[17] Amol Sharma, "AT&T is Set to Introduce Television Service for Cellphones," *The Wall Street Journal*, May 1, 2008, p. B6.

Founded in 1999, MobiTV, another provider of on demand television programming, announced it passed the six million subscriber mark in February 2009. Many observers believed that for mobile TV to take off, the service would have to be provided for free or subsidized by advertising revenue. (MobiTV earned a small amount—"less than 10%"—of its revenue from advertisers.)[18] Many experts believed mobile TV would eventually be successful, but that it would take time. Nonetheless, skeptics questioned how much interest there would ever be in watching TV on a phone. The jury was still out on Asian countries that had offered mobile television services for some time.

In November 2007, Qualcomm acquired Firethorn, a leading U.S. provider of mobile commerce for $210 million. Qualcomm's vision for the business was to develop a mobile wallet for consumers. Lauer described the concept, "We're basically digitizing your credit cards, your loyalty cards—like your Starbucks or Target gift cards—and couponing. Then we're adding account services such as bill payment and transferring funds. Ideally, you would never have to carry a wallet again." Qualcomm had signed mobile commerce agreements with six of the country's top ten banks. The company got paid a small monthly servicing fee per subscriber from the banks.

Lauer also saw the display business, described above, as well as mobile healthcare as big opportunities for Qualcomm. He explained, "A large percentage of Americans are managing a chronic disease. However, most do not appropriately manage it, but wait until they're in really bad shape and have to go to the emergency room. With sensor-based technology, biorhythms and medical information can be remotely communicated to healthcare professionals."

Lauer summarized Qualcomm's objectives in developing new services and products:

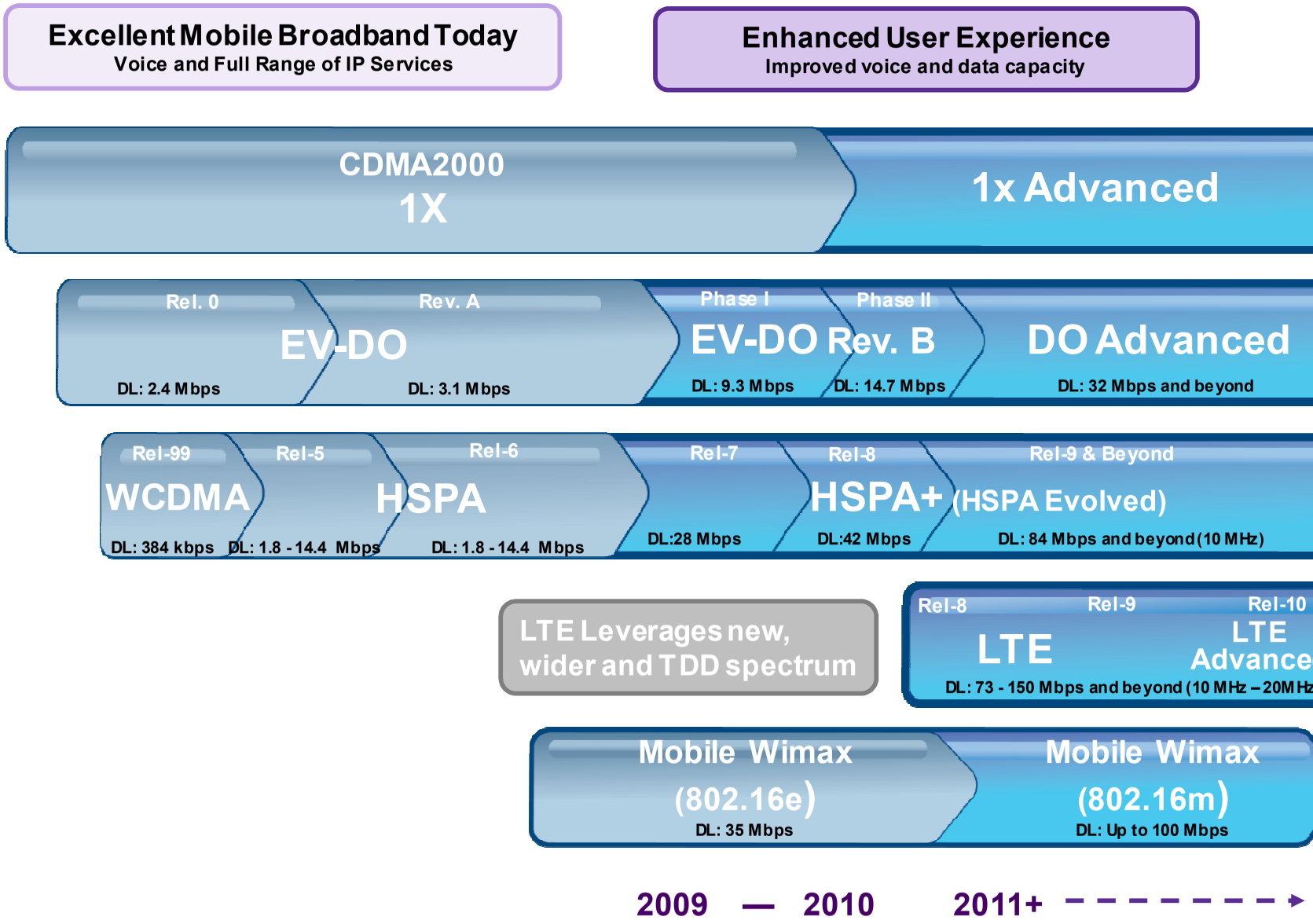
> There is a lot of debate about whether we should just be a licensing and a chip company. We're diversifying through a wide variety of new services and products. We're losing money on these businesses since they are in the early growth phase. With a portfolio approach, if we're lucky, one or two of them will become significant. We're believers. We've got the cash flow to invest and be patient, and if we are successful we could create a third leg to the stool.

Looking Forward

As Jacobs thought about Qualcomm's future, his main concern was growth. Since its founding, the company had enjoyed tremendous success in developing and promoting its CDMA-based technologies. Its chipset business and technology licensing strategy had generated substantial shareholder value and provided the funds for significant R&D activity and technology leadership. Nonetheless, Jacobs knew he needed to develop strategies for sustaining the company's considerable achievements. Jacobs struggled with a variety of resource allocation issues. How could Qualcomm best help accelerate the 2G to 3G wireless migration? How much energy should Qualcomm be devoting to LTE? How should Qualcomm best monetize its TD-SCDMA patented technologies in China? What kind of support should Qualcomm provide to operators in emerging nations like China and India? What else could Qualcomm be doing in less chartered geographies? How could Qualcomm spur adoption and develop its new services into profitable business units? Jacobs turned on his computer and smiled as he noticed that Qualcomm's stock price was up for the week.

[18] M.Dano, "Ad-subsidized Mobile Video: Where is MobiTV?," FierceMobileContent, http://www.fiercemobilecontecnt.com, April 21, 2009.

Exhibit 1 Mobile Technology Evolution Roadmap



Source: Adapted by casewriter based on data provided by Qualcomm and CDMA Development Group, available at http://www/cdg.org.

Note: DL represents download peak rates. Upload rates generally range from one-third to one half of download rates.

Exhibit 2 Segment Financials, Qualcomm Incorporated

(in millions)	QCT	QTL	QWI	QSI	Reconciling Items	Total
2008						
Revenue	$6,717	$3,622	$785	$12	$6	$11,142
Earnings Before Taxes	1,833	3,142	(1)	(304)	(844)	3,826
Total Assets	1,425	2,668	183	1,458	18,829	24,563
2007						
Revenue	$5,275	$2,772	$828	$1	$(5)	$8,871
Earnings Before Taxes	1,547	2,340	88	(240)	(109)	3,626
Total Assets	921	29	200	896	16,449	18,495
2006						
Revenue	$4,332	$2,467	$731	$--	(4)	7,526
Earnings Before Taxes	1,298	2,233	78	(133)	(320)	3,156
Total Assets	651	60	215	660	13,622	15,208

Revenue for each of Qualcomm's divisions aggregated into QWI were:

(in millions)	QES	QIS	QGOV	Firethorn	Eliminations	Total
					(2)	785
2008	$423	$299	$67	$(2)		
2007	501	272	57	--	(2)	828
2006	490	194	47	--	--	731

Source: Qualcomm Incorporated Form 10-K for the fiscal year ended September 28, 2008.

Notes:

1. Qualcomm's fiscal year ended on the last Sunday in September. As a result, fiscal 2007 included 53 weeks.

2. QSI's assets related to the FLO TV business totaled $1.2 billion, $457 million, and $329 million at September 28, 2008, September 30, 2007, and September 24, 2006.

Exhibit 3 Selected Financial Data, Qualcomm Incorporated ($ in millions)

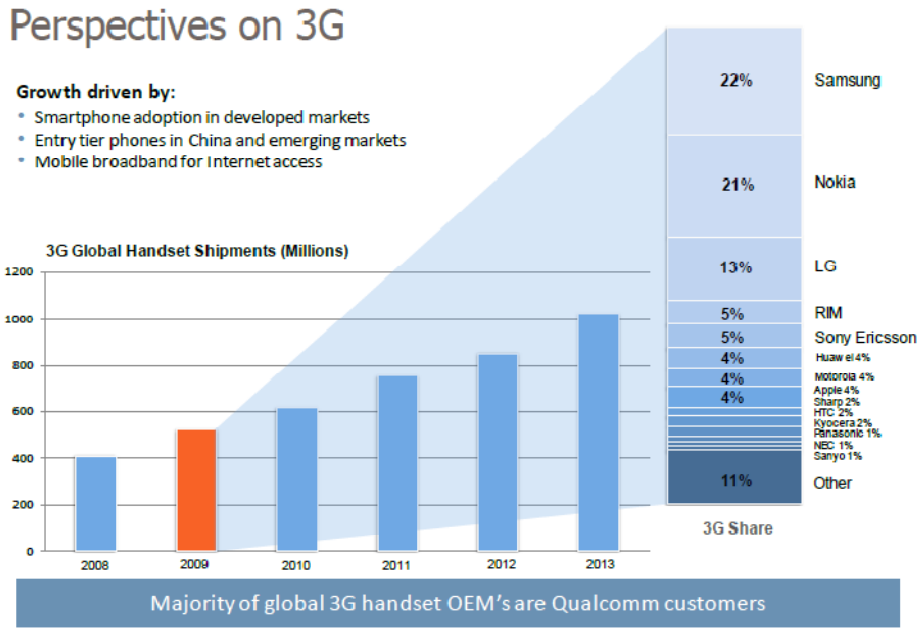
	For the Fiscal Years Ended on or about September 30,				LTM Ended
(in millions)	**2005**	**2006**	**2007 (1)**	**2008**	**June 28, 2009 (3)**
Operating Data:					
Revenue	$5,673	$7,526	$8,871	$11,142	$11,060
Operating Income	2,386	2,690	2,883	3,730	3,173
Net income	2,143	2,470	3,303	3,160	2,416
Balance Sheet Data:					
Cash, equivalents, and marketable securities	$8,681	$9,949	$11,815	$11,269	$15,681
Total assets	12,479	15,208	18,495	24,563	25,713
Long-term debt (2)	3	58	91	142	NA
Total stockholders' equity	11,119	13,406	15,835	17,944	18,711

Source: Qualcomm Incorporated Form 10-K for the fiscal year ended September 28, 2008 and Form 10-Q for the quarter ended June 28, 2009.

Notes:

1. Qualcomm's fiscal year ended on the last Sunday in September. As a result, fiscal 2007 included 53 weeks.
2. Long-term debt consisted of capital lease obligations, which were included in other liabilities in the company's consolidated balance sheets.
3. In the second quarter of fiscal 2009, Qualcomm incurred a $748 million charge for litigation settlement related to the settlement and patent agreement with Broadcom. The operating data above were adjusted to present Qualcomm's financial results before the $748 million charge.

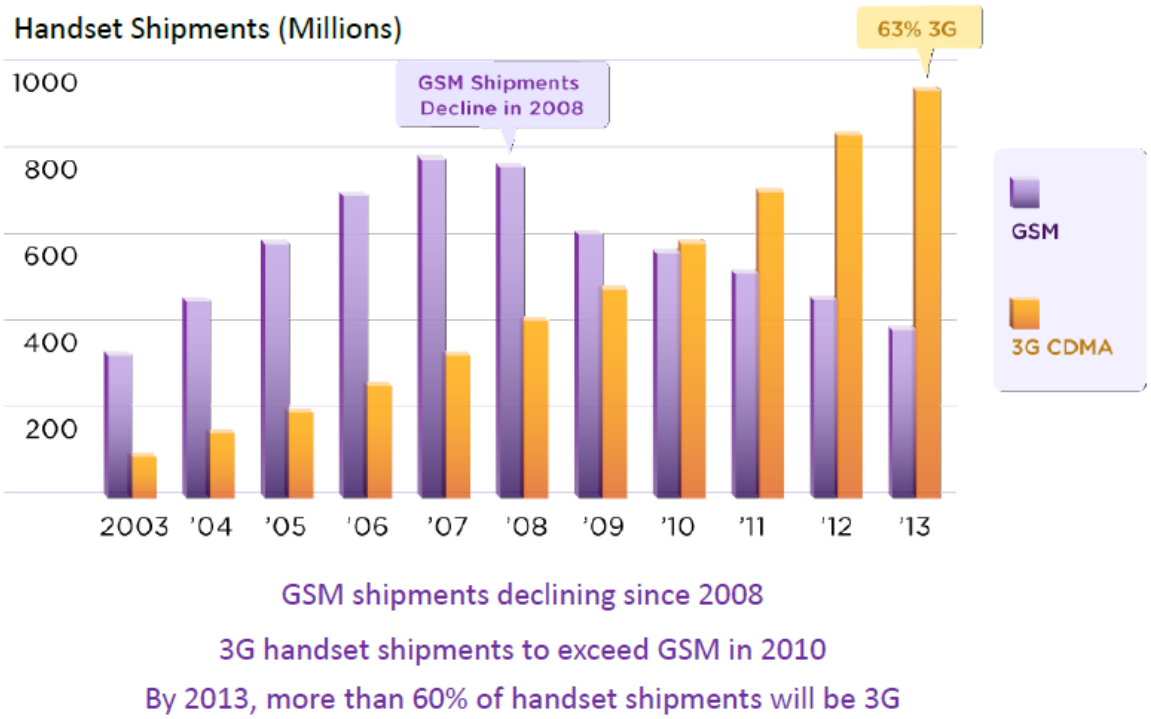
Exhibit 4 Worldwide Wireless Phone Industry: 3G Global Handset Shipment Forecast



Source: Adapted from IDC (April 2009), as included in Qualcomm presentation for the June 10, 2009 William Blair 29th Annual Growth Stock Conference, http://www.qualcomm.com, accessed July 29, 2009.

Exhibit 5 GSM vs. 3G

Strong Growth forecasted for 3G handset Shipments



Source: 3G CDMA -Average of ABI (Q2'09), Yankee (Jul'09), Gartner (Jul'09), IDC (May'09), WCIS+ (Jul'09), Strategy Analytics (May'09) GSM –Average of ABI (Q2'09), WCIS+ (Jul'09), Gartner (Jul'09) and Strategy Analytics (May'09), as included in Qualcomm presentation for the September 16, 2009 Jefferies Technology Conference, http://www.qualcomm.com, accessed September 29, 2009.

Exhibit 6 2008 Wireless Phone Subscribers

China	634,000
India	346,890
Indonesia	140,578
Japan	110,395
Thailand	62,000
United States	270,500
Viet Nam	70,000
Total Worldwide	4,000,544

Source: Adapted from International Telecommunications Union, "Mobile Cellular Subscriptions per 100 People", http://www.itu.int/ITU/ict/statistics, accessed August 10, 2009.

Exhibit 7 Wireless Data Rate Comparison

Technology	Average Rate	Peak Rate
GSM/GPRS	36-50 kb/s	100 kb/s
CDMA 1X RTT	60-90 kb/s	144-307 kb/s
WCDMA/UMTS	600-900 kb/s	2 Mb/s
3CDMA 1X/EV-DO	300-500 kb/s	2.4 Mb/s
EDGE	105 kb/s	170-384 kb/s
CDMA 1X EV-DV	--	4-8 Mb/s
UMTS HSDPA	4.8 Mb/s	10-14 Mb/s
Wi-Fi 802.11b	0-5 Mb/s	11 Mb/s
Wi-Fi 802.11g/a	--	54 Mb/s
WiMax	70 Mb/s	268 Mb/s
LTE	60 Mb/s	278 Mb/s

Source: Dan O'Shea, "HSDPA: GSM's Long Answer to EV-DO," *Telephony*, May 17, 2004, p. 37. Reprinted with the permission of Primedia Business Magazines & Media. Copyright 2004. All rights reserved.

Note: Average rate ranges by network. Peak rates theoretical, based on UMTS World estimates and various sources. To achieve the above numbers, CDMA used a bandwidth of 1.25 MHz while WCDMA used 5MHz.

Exhibit 8 Key Players by Wireless Industry Sector

Sector and Description	Key Players
Handset Manufacturers—Designed and developed handsets	Nokia, Motorola, Samsung, Sony Ericsson, LG, Apple, RIM, Huawei, ZTE, Kyocera
Chip Manufacturers—Designed and developed chips for use in cell phones	Texas Instruments, Motorola, NEC, Freescale, Infineon, Qualcomm
Infrastructure Providers—Assembled base stations and towers, developed and sold components such as switches, gateways and modems	Nortel, Nokia, Motorola, Ericsson, Siemens, Alcatel-Lucent, Huawei, ZTE
Network Operators—Interacted with consumers, provided and managed phone numbers, maintained regional coverage, etc.	U.S.: Verizon, AT&T, Sprint Nextel, T-Mobile Europe: Vodafone, Orange, KPN Mobile, Telefonica Japan: NTT DoCoMo, KDDI, J-Phone China: China Mobile, China Unicom South Korea: SK Telecom, KT
Application Developers—Created and distributed applications such as games and services for use on cell phones	Thousands of small companies

Source: Casewriter research.

Exhibit 9 Handset Units Sold and Market Share (Millions of Units)

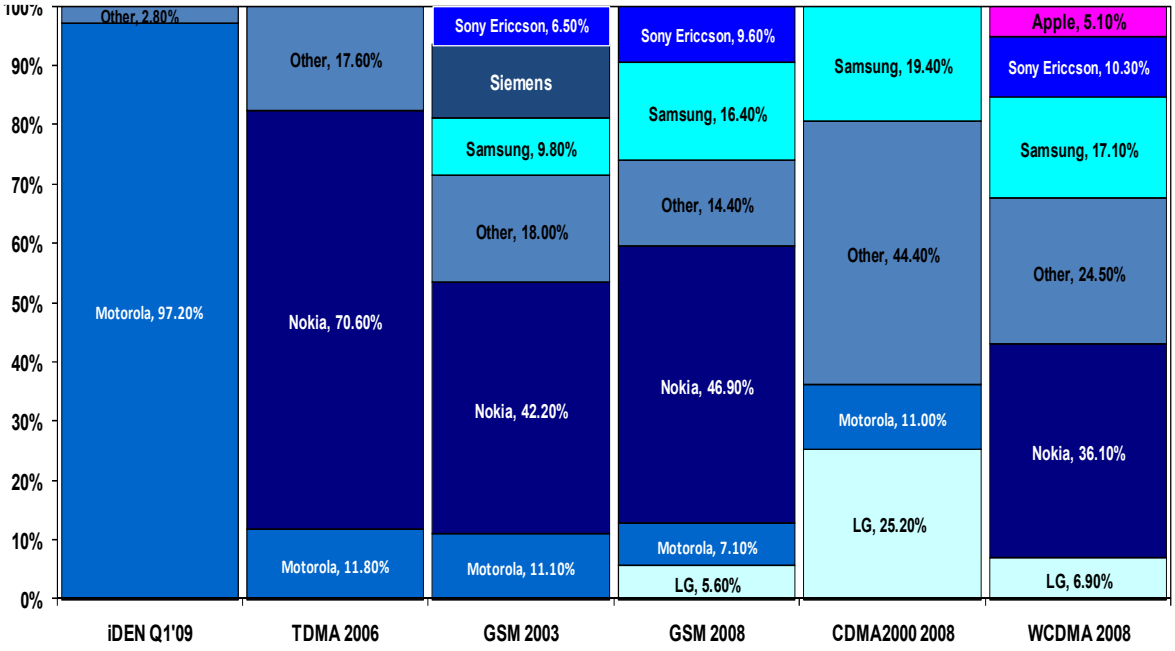
	1st Q 2009 Units Sold(M)	Share	4th Q 2008 Units Sold (M)	Share
Nokia	93.0	40.4%	113.0	38.3%
Samsung	45.8	19.9%	53.0	18.02%
LG	22.6	9.8%	26.0	8.8%
Motorola	14.7	6.4%	19.2	6.5%
Blackberry				
Apple	3.8	1.7%	4.4	1.5%
Sony Ericsson	14.5	6.3%	24.2	8.2%
Others	27.8	12.1%	55.2	18.7%
Total	230.0	100.0%	295	100.0%

Source: Adapted from www.mobileisgood.com/statistics.php, accessed August 3, 2009.

Exhibit 10 Market Share Evolution

Market Share Changes as Technology evolved to CDMA

(Market Share)



Source: Qualcomm. Company document.

Exhibit 11a Smartbooks and Netbooks

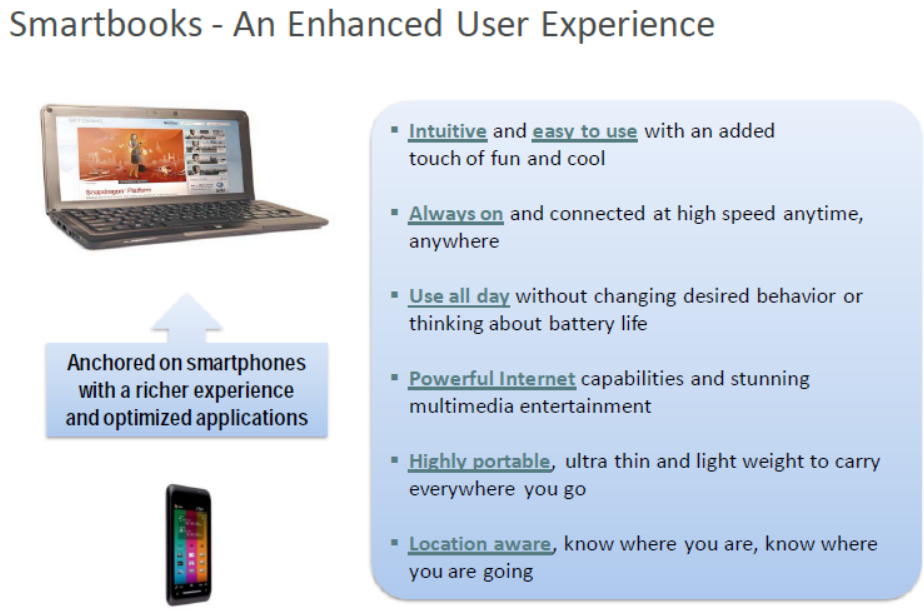
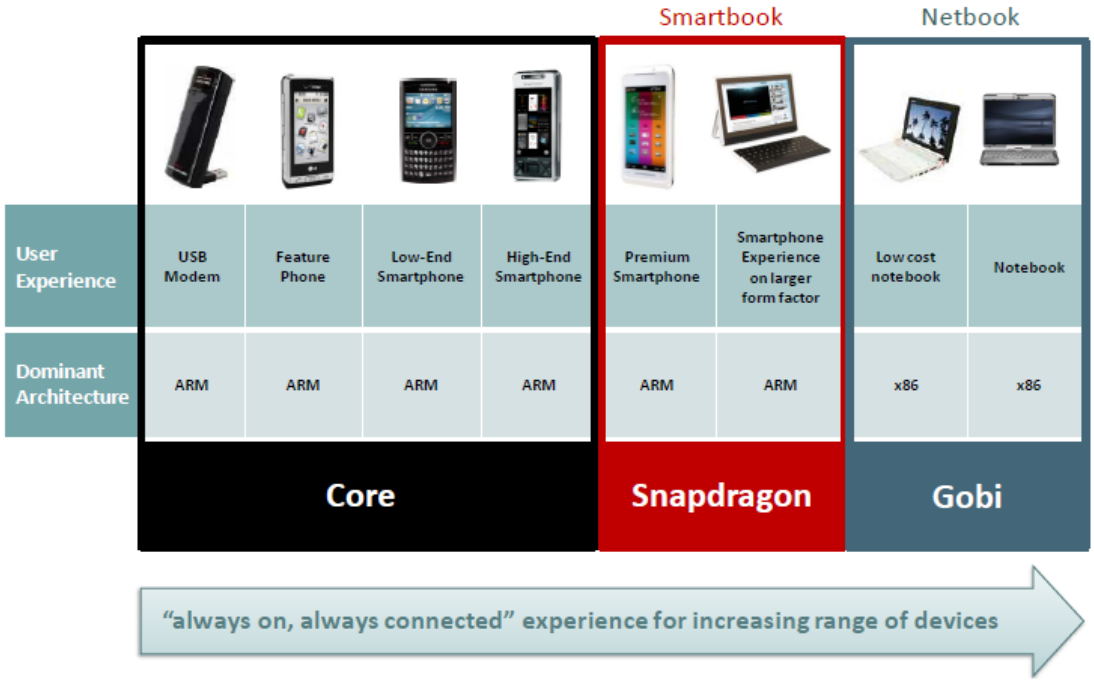


Exhibit 11b Smartbooks and Netbooks



Source: Qualcomm. Company document.

Exhibit 11c Smartbook and Netbook Shipment Volume

	PC Notebooks	Netbooks
2008	**124 million**	**11.2 million**
2009	**138 million**	**22.6 million**
CAGR	**11.3%**	**102%**

Source: Taiwan's Ministry of Economic Affairs, Nov 27, 2008, http://www.pcb007.com/pages/zone.cgi?a=46730.

Appendix

Wireless Technology

Wireless phones were enabled by a combination of infrastructure, hardware, and software. Infrastructure included base stations, towers, and switches that helped direct messages across radio frequencies to desired recipients. Hardware equipment consisted of chipsets (a collection of specialized microprocessors for phones, also referred to as chips or integrated circuits), keypads, screens, microphones, and casings. Cellular phone software included a broad range of applications that did everything from storing numbers to facilitating games.

The companies that competed in the wireless industry could be broken down into five sectors: infrastructure providers, handset manufacturers, chip manufacturers, network operators (carriers), and application developers. (**Exhibit 8** describes each sector and lists several major players for each.) A number of companies, such as Nokia and Motorola, competed in multiple sectors (chips, handsets and infrastructure), while others such as Verizon specialized in one sector (network operator). Basic commercial wireless networks started appearing in the early 1980s, and the technology grew increasingly sophisticated over the next two decades. In 2009, Qualcomm and TI were the leading suppliers of chipsets; Nokia, followed by Samsung and LG, were the leading suppliers of handsets; and the network operator business remained geographically fragmented, though national carriers tended to dominate their geographies (DoCoMo in Japan, Deutsche Telekom AG in Germany, SK Telecom in South Korea, and China Mobile in China.) (See **Exhibits 9** and **10** for handset market share data.)

Second Generation (2G)

In the late 1980s several second-generation digital technologies began to emerge that promised improved call quality, enhanced efficiency, and significantly increased capacity relative to analog systems. A number of 2G technologies were developed including: frequency-division multiple access (FDMA), time division multiple access (TDMA), global system for mobile communications (GSM), and CDMA.

FDMA separated each call into a distinct radio frequency. TDMA and GSM allowed simultaneous conversations to use the same radio frequency by taking turns. GSM was first introduced in Europe in 1991, and by the late 1990s had quickly become the dominant form of cellular technology around the globe.

CDMA technology broke a call into small bits and coded the bit stream to allow the receiving end to put the bits back together. This technology required phones and base stations to have sophisticated software and powerful hardware to do the necessary scrambling and unscrambling, both of which were developed and patented by Qualcomm. Although CDMA was considered in some circles to be technically superior to FDMA, TDMA, and GSM, both with regard to capacity utilization and quality, industry participants that had already invested in other technologies were reluctant to make the switch. Nevertheless, new markets such as Hong Kong and South Korea adopted CDMA in the mid to late 1990s with great success. The American standard setting agency, U.S. Telecommunications Industry Association, allowed multiple 2G standards, and CDMA quickly gained subscribers in the U.S.

Third Generation (3G)

By the early 2000s, industry participants were preparing for the third generation of wireless technology, designed to handle both voice and data transmission. 3G phones were being developed

to accept photos and streaming video at high speeds, similar to computers and personal digital assistants (PDAs) with wireless Internet access. Global migration to 3G required substantial investments in infrastructure (e.g., base stations) as well as new handset hardware and software that could accommodate the multimedia data. Three primary operating modes emerged as part of the new 3G standard, all of which utilized CDMA for the radio interface.

WCDMA—Wideband CDMA (WCDMA), as the technology used in universal mobile telephone system (UMTS), was a 3G technology with the potential to offer higher peak data speeds than its main predecessors, GSM and 2G CDMA by using wider bandwidth. (Both terms—WCDMA and UMTS—were often used interchangeably.) Most companies and countries that had been relying on GSM technology were planning to adopt WCDMA. The radio interface of WCDMA used CDMA, but it was not compatible with existing 2G CDMA networks. The network equipment was an evolution of the GSM network. European equipment manufacturers were required to license Qualcomm intellectual property for WCDMA or UMTS, despite an initial attempt to limit their reliance on Qualcomm by seeking workarounds for Qualcomm's patented technology. Initially, the transition from GSM to WCDMA was technically complex and the upgrade process was slower than expected. However, the growth of WCDMA deployments and subscriber activations had since grown dramatically. As of July 2009, two hundred and eighty GSM operators had upgraded to WCDMA technology.[19]

CDMA2000—Qualcomm developed an alternative 3G technology, CDMA2000 that was also based on its existing CDMA technology. The upgrade process from CDMA-based systems to CDMA2000 was faster and less costly than for GSM-based systems migrating to any of the various 3G technologies. The biggest difference between CDMA and CDMA2000 was an optimization of the radio link for voice and data based on the extensive experience with CDMA that provided almost twice the voice capacity of CDMA, the computing power in the handsets and the reception of data files. As of mid 2009, two hundred and eighty operators in the US and abroad had migrated to CDMA2000 technologies.[20]

TD-SCDMA—As most of the world moved toward WCDMA and CDMA2000, China was contemplating a third alternative, time division duplex (TD-SCDMA). As the name implied, it also relied on elements of CDMA; however, some in China questioned how much it drew on Qualcomm's patented components. As of 2009, TD-SCDMA was the least developed of the 3G alternatives and had just recently been launched commercially.

Fourth Generation (4G)

In the late 1990s and early 2000s, technology providers began preparing for a new generation of wireless technology that was capable of fast and ubiquitous broadband, at speeds that were substantially higher than 3G offerings and operated in wider bands of spectrum. All emerging 4G alternatives were based on flat IP (Internet protocol) and OFDM or OFDMA technology.

LTE—Long Term Evolution (LTE), was an upgrade path for carriers that had large amounts of spectrum available combined with significant customer demand for data services. LTE was expected to support high data rates in up to 20 MHz channels. LTE was targeted to support data rates up to 143 Mbps on the downlink and 75 Mbps on the uplink with two based stations antennas and two handset antennas. With four base station and hand set antennas, LTE was targeted to support

[19] As reported by the Global Mobile Suppliers Association, in their July 2009 reports.

[20] According to public reports made available by www.cdg.org as of July 20, 2009.

downlink peak data rates of up to 278 Mbps.[21] Commercial deployment of LTE technology was not expected until late 2010.

WiMAX—Also known as 802.16, WiMax was a close cousin of Wi-Fi that covered greater areas—up to 31 miles—with less disruptions. WiMax operated in the 2 to 11 GHz bands and allowed Internet connectivity without a direct line-of-sight to a base station. WiMax was adopted as a standard by the IEEE in December 2005, and by the ITU in October 2007. As of June 2009, over 400 operators were building WiMax networks, and the technology was being deployed by Sprint Nextel and Clearwire in the U.S. and SK Telecom in Korea.

TD-LTE—TD-LTE (time division duplex of the LTE platform) was an upgraded version of TD-SCDMA. TD-LTE was expected to provide data up to 50 times faster than TD-SCDMA.

UMB—Ultra Mobile Broadband (UMB) was developed by Qualcomm to provide high data speed, multimedia, and broadcast capabilities to the CDMA2000 family. UMB was expected to provide data rate performances similar to that of LTE.[22] As of June 2009, there were no plans for a commercial launch of UMB.

Source: Casewriter.

[21] Qualcomm 10-K, for the fiscal year ended September 28, 2008, p. 5.

[22] Ibid.