

## A Guide to Mobile Connectivity Chips

Focusing on Wi-Fi, Bluetooth, and GPS

**Third Edition**

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**Authors:** Jag Bolaria and Michael Stanford

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### Connecting Mobile Devices

The evolution of mobile devices is accelerating the demand for advanced features such as Bluetooth, Wi-Fi, GPS, and FM radio. The growing popularity of smartphones is spurring the growth in Wi-Fi, which also serves as the basis for the new Bluetooth 3.0 standard. The attach rates of GPS and FM are increasing as the cost of these functions falls and service providers emphasize new location-based services. GPS is also found in increasingly popular automotive navigation systems and personal navigation devices (PNDs). NFC represents the next frontier in mobile connectivity.

Mobile-device designers are faced with a wide array of choices when adding these features to their designs. The simplest but most expensive solution has been to add a separate chip for each desired function. But chips that integrate both Bluetooth and FM are now quite popular, and the newest chips also incorporate GPS or Wi-Fi or even both. Some cellular baseband processors integrate connectivity functions as well; an approach that has been very popular for GPS.

### Decipher the Market

"A Guide to Mobile Connectivity Chips" looks at these various approaches, analyzing the products that support them and the leading vendors of these technologies. The report provides in-depth coverage of chips and technologies from Atheros, Broadcom, CSR, Marvell, Qualcomm, ST-Ericsson, and Texas Instruments. It also covers vendors with a more limited presence in mobile connectivity: CellGuide, HelloSoft, Infineon, Intel, MediaTek, Nanoradio, Redpine, Silicon Labs, Skytraq, and Telechips.

Rapid advances in mobile connectivity have resulted in an abundance of standards and terminology. For those less familiar with this market, the report provides an overview of Bluetooth, FM, GPS, Wi-Fi, and NFC fundamentals, with special emphasis on emerging versions such as 802.11n and Bluetooth LE. It also discusses the design of connectivity chips, including their radio subsystems, and future trends.

In addition, the report provides a quantitative overview of the market for the various types of mobile connectivity chips, including market share by vendor and forecasts of unit shipments, revenue, and attach rate. Our market data relies on a sophisticated model that combines both system and chip shipments, segregating both standalone and combo chips by the connectivity function(s) that they implement. This chapter also discusses technology trends and how they will affect connectivity-chip design.

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Analysts Jag Bolaria and Michael Stanford combine their experience in wireless, VoIP technology, and processor markets to deliver the strategic insight you need to understand this market. As the leading vendor of technology analysis for communications silicon, The Linley Group has the expertise to deliver a comprehensive look at the emerging connectivity market.

This report complements our other mobile reports, which cover cellular baseband processors and mobile application processors. The Linley Group's unique technology analysis helps you zero in on the right connectivity chips for smartphones and other handheld devices. Whether you are looking for an innovative design solution, a vendor to partner with, or a rising company to invest in, this report will cut your research time and save you money. Accelerate your learning. Order "A Guide to Mobile Connectivity Chips" today.

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- Marketing and engineering staff at companies that sell mobile connectivity chips or other chips for handheld devices
- Technology professionals who wish an introduction to mobile connectivity markets and technologies
- Financial analysts who desire a detailed analysis and comparison of connectivity companies and their chances of success
- Press and public-relations professionals who need to get up to speed on this important technology

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The following excerpt is from "[\*\*\*A Guide to Mobile Processors, Third Edition.\*\*\*](#)" This PDF contains the complete table of contents, list of figures, list of tables, preface, and executive summary. The full report may be purchased from The Linley Group.

# **A Guide to Mobile Connectivity Chips**

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By Jag Bolaria and Michael Stanford



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Prior to that, Jag was in Intel's PC division. As director of marketing for chip sets, he led the development of product plans, design wins, and customer support for Pentium and P6 chip sets, working with all major PC suppliers worldwide.

Before these positions, Jag worked in Intel's communications group in technical marketing, product marketing, strategic marketing, and marketing management roles. He had worldwide product management responsibility for codecs/filters, modems, ISDN components, and LAN devices. During that time, he worked with engineers at AT&T, Fujitsu, IBM, NEC, Nortel/BNR, Rolm, and Siemens, among others.

Jag started his career as an R&D engineer with Standard Telecom Labs (STL), then the research arm of ITT in the U.K. During his three-year tenure with STL, he developed hardware and software for the prototype ISDN switches and LAN ring architectures over optical fiber. Jag earned a bachelor of science degree in electronics, with honors, from the University of Salford in the U.K.

## Michael Stanford



Michael Stanford is an analyst at large for The Linley Group and coauthor of The Linley Group report *A Guide to Mobile Connectivity Chips*. He has been an entrepreneur and strategist in voice over IP (VoIP) for more than a decade and has proven technical ability as well as keen business and analytic skills for that market. The October 2006 issue of *Internet Telephony Magazine* recognized Michael as one of “the top 100 voices of IP communications,” and the November 2006 issue of *VoIP News* named him one of “the 50 most influential people in VoIP.” He has spoken at several events, including a keynote presentation at the 2005 VoIP Developer Conference.

Previously, Michael served as an Intel Principal Engineer and senior manager running a large multisite engineering team that developed an IP PBX system. He was later appointed Director of VoIP Strategy for Intel's Digital Enterprise Group. Michael also worked with Intel Capital to evaluate potential investments and represented Intel on the board of a portfolio company. During this time, he helped to develop and teach courses in business strategy for Intel University.

Michael has founded, run, and successfully sold two software companies: Lucid Corporation, which developed software for handheld computers, and Algo Communications, which developed application software for telephony and which was later acquired by Intel.

Michael is an experienced consultant specializing in VoIP for both Wi-Fi and WiMax. A technical innovator, Michael has four U.S. patents to his name. His blog on VoIP is available at [www.wirevolution.com](http://www.wirevolution.com).

# About the Publisher

## ***The Linley Group***

The Linley Group is the leading vendor of technology analysis on networking, communications, and consumer-electronics semiconductors, providing a unique combination of technical expertise and market knowledge. We help clients understand the market for these devices, their product requirements, the choices available, and which ones are best for a particular application.

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Our reports cover cellular-baseband processors, mobile application processors, mobile connectivity chips, processor IP, embedded processors, network processors, security processors, high-speed interconnect, and Ethernet chips. Additional titles are in development. We offer our reports in paper and PDF formats. Multiple paper copies and multiuser PDF licenses are available at significant discounts.

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- Helping established semiconductor vendors with competitive analysis, messaging, and positioning for upcoming product launches
- Working with young companies to improve their product definition to best differentiate themselves from potential future competitors
- Assisting system designers to identify the core silicon most appropriate for their application
- Providing valuable insights and technical due diligence to investment firms evaluating whether to invest in a semiconductor company

Our analysts start with a deep understanding of the key technologies in these markets, ignoring the hype and finding the features that make a difference. But we also understand that market success is based on business strategy as much as on technical excellence, and our recommendations are always steeped in the realities of the marketplace. We understand the dynamics of startups and established corporations alike and can shape our message to apply to the client's situation.

### Events

The Linley Group presents focused seminars and conferences that analyze products and design strategies in a particular technology segment, providing information that engineers can immediately use to improve their designs. These one- and two-day events feature in-depth technical presentations from our own analysts as well as leading technologists from the industry. Thousands of people have already attended.

Please check our web site for a list of upcoming dates, topics, and locations. The web site also offers the proceedings (slides) from past events free of charge.

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# Preface

## ***What This Report Covers***

This report covers Bluetooth, FM, GPS, and Wi-Fi chips that are designed for mobile applications. It covers both standalone chips and chips that combine multiple connectivity functions; these latter devices are known as combo chips. Although the primary application for mobile connectivity chips is in wireless handsets (cell phones), these chips are also used in portable game systems (e.g., Nintendo DS), media players, navigation devices, and other handheld devices.

This report does not cover connectivity chips designed for PCs, laptop computers, console video games, or wireless access points, as these chips typically use too much power for mobile devices. It does not cover Bluetooth chips for headsets, keyboards, mice, and other client applications. We omit some vendors of standalone chips that do not target handheld devices (e.g., GPS vendors that target only automotive applications).

## ***Who Should Read This Report***

This report is designed to meet the needs of a variety of readers:

- Engineers who are designing handheld devices and need to select a connectivity chip
- Marketing and engineering staff at companies that sell mobile connectivity chips or other chips for handheld devices
- Technology professionals who wish an introduction to mobile connectivity markets and technologies
- Financial analysts who desire a detailed analysis and comparison of connectivity companies and their chances of success
- Press and public-relations professionals who need to get up to speed on this important technology

As described below, the report is structured to allow different readers to skip certain sections as needed. For example, experienced design engineers may wish to focus on Chapters 5 through 14; financial analysts may instead focus on Chapters 1, 2, 5, 14, and 15.

## **Organization of the Report**

Chapter 1 is an overview of the target markets for mobile connectivity chips, including handsets, smartphones, navigation systems, and similar devices. The next three chapters provide background information and terminology relating to Bluetooth, FM, GPS, and Wi-Fi, including standard protocols, radio design, and chip design.

Chapter 5 provides a quantitative overview of the market for the various types of mobile connectivity chips, including market share by vendor and forecasts of unit shipments, revenue, and attach rates. Our market data relies on a sophisticated model that combines both system and chip shipments, segregating both standalone and combo chips by the connectivity functions that they implement. This chapter also discusses technology trends and how they will affect connectivity-chip design.

Chapters 6 through 12 provide a detailed look at the leading vendors of mobile connectivity chips and their current products. The companies covered are Atheros, Broadcom, CSR, Marvell, Qualcomm, ST-Ericsson, and Texas Instruments. For each vendor, the report provides a company overview, product description, design details, future products, announced customers, and overall conclusions.

Chapter 13 covers vendors with a more limited presence in mobile connectivity: CellGuide, HelloSoft, Infineon, Intel, MediaTek, Nanoradio, Redpine, Silicon Labs, Skytraq, and Telechips. This chapter provides an overview of each company and its products, along with analysis of how they fit into the market.

Chapters 14 and 15 conclude the report with a detailed comparison of the products and vendors discussed in the previous chapters. Chapter 14 provides technical specifications and comparisons for both standalone connectivity chips and combo chips. Chapter 15 provides a forward-looking view of the market, summarizing the outlook for each vendor and providing our thoughts on long-term market directions.

The index allows readers to quickly locate definitions of important terms and acronyms. The appendix lists additional sources of information.

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## Executive Summary

Mobile connectivity encompasses several technologies, including Bluetooth, FM, GPS, and Wi-Fi as well as future technologies such as NFC and mobile TV. Mobile-connectivity components are used in many applications, including navigation devices, handheld game players, personal media players, and medical equipment. Handsets, however, provide the largest market for mobile connectivity. Because not all applications need each of these connectivity technologies, the specific products range from standalone (single connectivity technology) devices to a host of combo products that provide two or more connectivity technologies in a single chip. We estimate that total revenue from mobile connectivity chips exceeded \$2.5 billion in 2009 and will grow 43% by 2014.

The handset market is large, but connectivity requirements vary by the type of handset. Ultra-low-cost phones have the budget for only an FM receiver, whereas basic phones include Bluetooth and may have either FM or GPS. Feature phones combine all three of these technologies, and smartphones usually add Wi-Fi to the mix. To meet these varied requirements, a chip vendor must offer a full range of technologies in standalone and combo products. These products must be constantly updated as new standards such as Bluetooth LE and Wi-Fi Direct emerge.

Mobile-connectivity suppliers fall into two categories: connectivity-only and complete handset solutions. The latter group supplies cellular baseband and application processors along with a complete set of connectivity chips. These suppliers include Qualcomm, ST-Ericsson, MediaTek, Broadcom, and Marvell. The connectivity-only category includes a few large companies that offer a broad range of connectivity functions: CSR, Texas Instruments (TI), and Atheros. This category also includes startups with a single connectivity product, such as HelloSoft, Nanoradio, and Redpine for Wi-Fi as well as Skytraq and CellGuide for GPS.

In all, more than 16 vendors are fielding mobile connectivity products. Although the connectivity market is large, it is not big enough to support all of these vendors. Future consolidation is certain—some vendors will merge, some startups will get acquired. We expect many of the smaller vendors will decide to look beyond the handset market.

Broadcom is the number-one supplier of connectivity chips today. It was early to market with combo products and won the high-volume Apple sockets. Although Broadcom does not offer industry-leading technology

in any one area, its technology is strong across the board, making it an excellent choice for OEMs seeking a single connectivity supplier.

In 2009, CSR fell to second place in connectivity shipments as the company lost design wins owing to shortcomings in its Bluetooth chips. CSR has addressed these problems in its newer chips, but the company remains weak in Wi-Fi, and its software-based GPS technology comes up short for navigation applications. Last year, the company acquired GPS leader Sirf to solve the latter problem, but integrating the Sirf GPS into its combo chips will take time.

Texas Instruments, which also sells the popular OMAP application processors, was the first vendor to deploy a Bluetooth+FM+GPS combo chip. In early 2010, TI sampled the industry's first four-function combo, giving it an edge for future smartphone wins. We remain concerned, however, about the quality of TI's GPS technology. The company is a major connectivity supplier to smartphone leaders Nokia, RIM, and HTC.

The biggest threat to the three top vendors is Qualcomm, which is the leading vendor of cellular processors. The company recently announced its first mobile Wi-Fi chip as well as a plan to integrate Bluetooth, FM, and GPS into its cellular chip sets. We expect many of Qualcomm's cellular customers to adopt these solutions, displacing connectivity chips from Broadcom, TI, and others. Two other leading cellular-processor vendors, MediaTek and ST-Ericsson, have recently strengthened their connectivity offerings in hopes of keeping these functions in house.

Other connectivity vendors are using best-in-class technology to establish a market position. Atheros offers leading receive sensitivity using its AR6003 Wi-Fi chip, and Infineon's Xposys has the smallest solution and best sensitivity for GPS. Marvell stumbled with its initial combo chips but has recently deployed a family of impressive new products under the Avastar brand. These vendors, however, will find it challenging to gain share in the competitive handset market.

Because of the rapid growth in shipments of Bluetooth+FM combo chips, shipments into handsets of both standalone Bluetooth and standalone FM chips declined last year. As GPS combo chips ramp, we expect standalone GPS shipments to peak in 2011. Ultimately, the integration of connectivity into the cellular chip set will slow the growth in combo chips. The standalone Wi-Fi market, however, will grow to \$900 million in 2013, because this technology is the hardest to integrate.

In this report, we profile each of the companies selling mobile connectivity and provide in-depth analysis of their connectivity products. We detail the differentiators of each product and determine the best product choices for each application. The report includes complete 2009 market share for each type of connectivity chip and forecasts of attach rates, shipments, and revenue through 2014.