

**Wireless Portable Communications**  
**Trends and Challenges**  
(Invited Talk)

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## **ABSTRACT**

The electronic wireless communications age has its earliest origins with Thomas Edison and Guglielmo Marconi about 100 years ago. Early R&D on portable communications systems was carried out over forty years ago at AT&T Bell Labs, who led much of the earliest development in communications in the United States. Motorola pursued mobile wireless communications research beginning in the 1960s resulting in the first mobile cellular telephone service in the early 1980s. Decades of continuous cost / performance improvements from the semiconductor and IC packaging industry have had a dramatic impact on reducing the costs, and hence affordability, of all forms of commercial electronics and communications systems. Furthermore, the recent decade has seen an increased desire for personal and business communications mobility, security and access to information at any time, anywhere. Many of these factors have launched numerous commercial wireless communications systems, such as paging and cellular phone systems from a relatively high-end niche market into the multi-billion dollar

consumer electronics businesses of today.

## **I. THE MARKET**

Currently there are about 145 million analog and digital cellular phone customers in the world. About one third of these customers are in the United States. They average about one hundred air time minutes per month. Growth rates of wireless communication products such as cellular phones are very significant. From now through the year 2000, CAGR forecasts for digital cellular phone service is at about 30%. Analog cellular phones will continue to be in demand for many years to come as the lowest -cost solution for emerging and lower volume markets. However only two percent of all phone calls in the US. are currently made using a cellular phone.

As the cost of ownership and usage of wireless communications has come down there has been a dramatic expansion of wireless communication products into the newly developing countries of the world as well. There is a significant demand for reliable phone service in the poorer countries around the world. Wired phone service can not meet this demand fast enough. A

paging system, for example, can be installed and made operational in only a few weeks time, giving reliable communications to thousands. China, India, the Eastern European countries, Russia, Mexico, the countries of South America, etc. are all rapidly employing wireless local loop communication systems. The costs for wireless communication phone systems need only to fall a bit more before wireless phone systems will be more cost-effective to deploy than conventional wireline phone systems. AT&T announced in February of this year just such a plan for POTS to further compete with the Baby Bells. Analog and digital cordless telephones are emerging rapidly in popularity, especially in Japan. The Personal Handyphone System (PHS) in Japan has had strong government support and is now enjoying dramatic growth. These phones operate in both the home and in a reasonably large metropolitan area outside the home. Although PHS and similar US and European (DECT) cordless communications systems are not designed to handle the rapid hand-offs required for moving vehicle operation, the potential for these next generation cordless phones is very high. Unit shipments of handyphones in Japan could be almost 20 million in 3 or 4 years. Despite the rapid globalization of portable communications, only about fifty percent of the world's population have ever made a phone call!

## II. TECHNOLOGY TRENDS AND CHALLENGES

Some of the trends and challenges for successful portable communication products in the future are obvious, such as lower cost, low-power and high efficiency IC technologies, improved batteries, smaller size, reduced weight, etc. The Dick Tracy radio will clearly fall within technical feasibility in the not-too-distant future as today's next generation technologies move from the laboratory into the commercial mainstream. For example, over the past ten years, the weight of a cellular phone has fallen 10X to well under 100 gms today. Motorola's SarTAC cellular phone is only 3.1 oz. or 88 gms. On the infrastructure side are similar trends on not only reducing the cost and size of the hardware but also operational ease of training, maintenance, software upgrades, etc. The environments of the home, office and car provide a technology and standards challenge for seamless robust portable communications requiring multiband, multimode operation. Expanding beyond today's global wireless voice communications, there are emerging additional wireless services such as secure two-way data, monetary transactions, fax and internet / intranet access. Many of these trends conflict with the desire for lower overall costs against the desire for expanded features and services. Issues such as available spectrum, conflicting or lack of standards and effective data encryption are all important, and they are receiving increased global attention by governments and leading industrial communications companies. Within a few years, new Earth satellite systems will allow both mobile and

hand-held portable communications to and from essentially any location on the earth's surface.

### **III. 'WEARABLE PRODUCTS FOR COMMUNICATIONS**

The on-going evolution and merging of the portable computer and various wireless communication products is already well underway, with customer driven services such as voice, paging, fax, data, internet / intranet access now available. However, today's PC is much too large and heavy to be a "wearable" communications product. A significant limitation to "wearable" portable communication products of the future, which are capable of voice, data and color images / video, is a suitable display technology. Today's direct view color AMLCD displays still dissipate significant power resulting in reduced battery life. Furthermore, the conflicting requires of more visual information and small size can not be achieved with direct view displays. A key pad becomes hard to easily use if made too small. Virtual low-power displays and robust voice recognition technology may provide partial answers here. On-going advances in low voltage, low power CMOS, BiCMOS and GaAs ICs will certainly happen and will further drive the cost / performance ratio lower in the future. Finally, continuous improvement in packaging, assembly and manufacturing capabilities and costs / operation,

bode well for advanced "wearable" electronics.

### **IV. OTHER TRENDS**

As with most products of the future, there will be a need to be able to recycle the hardware in a cost-effective manner. The product hardware will be modular, designed for automation and efficient recycling. New features or services will be quickly customized for the customer through such modular hardware designs. and flexible software platforms. Customer pricing for wireless products and services in the United States has moved toward essentially "free" hardware in exchange for longer-term service contracts. Packaging of wireline and wireless services from a single service provider, initiated by MCI, is a trend that will likely continue as both a customer and service provider benefit.

### **V. GLOBAL IMPACT**

Finally, the political and social impact of pervasive, portable communications is already having a profound impact around the world. Being "in touch" at any time, anywhere is here today, globally tomorrow. With the past forty years as our benchmark, the next forty years will see a cost / performance spectrum of wireless communications products that will profoundly influence every person on earth.