

Cost - Effective Communication System Solutions Using MMIC Technology For Rural And Remote Banking

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Introduction

The problems peculiar to the rural India require some innovative solutions to extend the outreach of financial services to the rural areas. In particular, wireless communications using laptops, cell phones, etc. would come handy given the absence of or unreliable last mile telecommunication link in many areas. Given this scenario, it becomes imperative to make these solutions cost-effective by adopting novel technologies. This article is an attempt to describe the present status of different forms of wireless technology and the possible inbuilt-technology solutions that do not compromise on quality even while reducing the cost further.

The mobile radio communication industry continues to grow faster than any other technology sector since its commercial inception more than a decade ago. It is still in a developing stages and promises to have a great future fuelled by research and development in digital and RF circuit fabrication techniques, large-scale circuit integration and other miniaturization technologies, making mobile radio equipment smaller, cheaper,

more reliable and efficient. Future wireless and mobile communication circuits will become fully integrated and miniaturized using 'System on a Chip' or 'Embedded Systems' concepts and technology.

Microwave and RF Communication have gained significant attention over the past two decades and many technological breakthroughs have been made possible in the field of telecommunications, satellite, radar, military and most recently in mobile and wireless communication in the Radio-Frequency spectrum. A major problem of conventional RF and microwave technology is the large physical size of couplers, filters, duplexers and transmission line components. New solutions are required for these circuits and in particular, these solutions must be integrated onto high-frequency substrates such as Gallium Arsenide (GaAs). Monolithic Microwave Integrated Circuits (MMICs) are used for this purpose.

Existing Mobile Scenario

Cellular is one of the fastest growing and most demanding telecommunications applications. Today, it represents a continuously increasing percentage of all new telephone subscriptions around the world. Currently, there are more than 45 million cellular subscribers worldwide. It is

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forecast that cellular systems using digital technology will soon become the universal method of telecommunications. There are two main competing network technologies: Global System for Mobile Communications (GSM) and Code Division Multiple Access (CDMA) – both offering their own set of technology standards and competitively evolving.

GSM is the world’s most widely used mobile system standard and is currently in use in more than 200 countries across five continents. By the end of this decade, GSM is forecast to be the most –used technology, commanding two thirds of the global mobile market. It is estimated there will be three billion mobile subscribers in the world by 2010.

CDMA is a proprietary standard designed by Qualcomm, USA and is more concentrated in the Americas as well as Korea, Japan and Australia. CDMA2000 is the current 3G standard and is an extension of the initial IS-95 standard of Qualcomm. There has been a steady growth in the CDMA subscriber levels as depicted in fig.2.

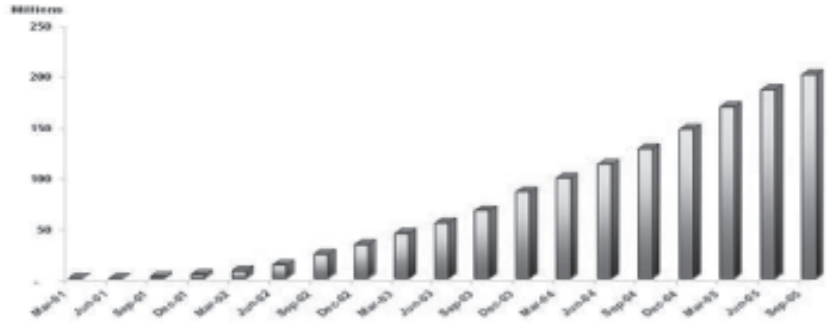


Fig. 2 -Global CDMA subscribers

Source – CDMA Development Group (CDG)

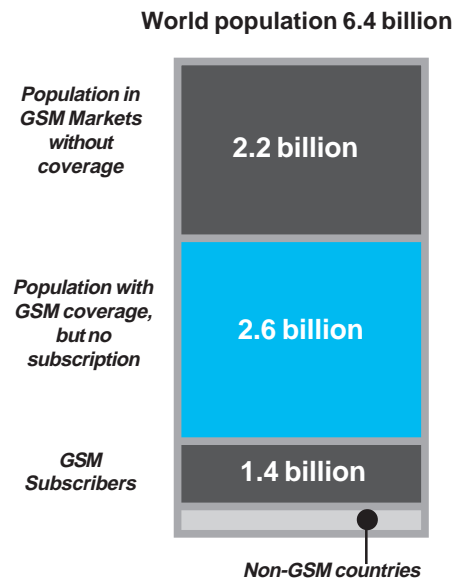


Fig. 1 -Global GSM penetration

Source – Ericsson, Communication for all, 2005.

Evolution

Various evolution standards have been proposed and some even deployed such as the HSCSD (High Speed Circuit Switched Data), GPRS (General Packet Radio Service), EDGE (Enhanced Data rates for GSM Evolution) in the case of GSM. W-CDMA (Wideband CDMA), CDMA2000 1xRTT (1x Radio Transmission Technology) and CDMA2000 EV-DO (Evolution-Data optimized) are some enhancements proposed in the case of CDMA technology. All of these protocols are designed for high-quality data, multimedia, streaming audio/video and broadcast type services with data rates as high as 2Mbps. These heavily rely on complimentary high-speed, low-power and ultra-compact RF equipment both at the base station and the mobile handset.

Other Wireless Technologies

WLAN

Wireless Local Area Network or more commonly known as Wi-Fi (Wireless Fidelity) was initially developed to reach places where physical network cables could not be laid. The protocol now seems to be replacing the Ethernet cable giving unplugged mobility for clients at data transfer speeds on par with its cabled cousin.

A comparison of related Wi-Fi protocols

Protocol	Throughput	Frequency band	Modulation scheme	Range
802.11 a	upto 54 Mbps	5 GHz	OFDM	60 ft
802.11 b	upto 11 Mbps	2.4 GHz	DS-SS	100 ft
802.11 g	upto 54 Mbps	2.4 GHz	OFDM/CCK	100 ft
802.11 super g	upto 108 Mbps	2.4 GHz	OFDM	150 ft

Future Protocols Significance

- 802.11 k For efficient use of available spectrum
- 802.11 n Higher throughput > 150 Mbps
- 802.11 r Inter cell hand-off. Voice over Wi-Fi (VoWiFi) applications
- 802.11 s Adaptive self-configuring mesh infrastructure

Wi-Fi has made a mark in the wire-free communication spectrum and has also inspired a few other standards such as Bluetooth and Wi-Max. Wi-Fi radios appear in laptops, Personal Digital Assistants (PDAs), entertainment devices and in futuristic mobile phones. In the next few years Wi-Fi will continue to become faster, more secure, more-reliable and fully-featured.

Bluetooth

The IEEE 802.15 standard is more commonly known as Bluetooth and is applicable to Wireless Personal Area Networks (WPANs). It is widely used in communication between portable devices such as PDA's, computer peripherals, mobile phones and consumer electronics for low-power, short-range personal networks.

Wi-Max

Wireless Metropolitan Area Networks (MANs), otherwise known as WiMax, provide the link between a subscriber unit and a core network such as PSTN (Public Switched Telephone Network) or internet. More appropriately, WiMax is used for 'last-mile wireless connectivity' of a Digital Subscriber Line (DSL) or cable network. The 802.16a standard set forth recently supports mesh architecture and works in the frequency band of 2-11 GHz with a throughput of 70 Mbps supporting large number of subscribers in a 50 km radius. With high Quality of Service (QoS), it is possible to support voice and streaming video applications. By 2010, the worldwide WiMAX market is forecast to reach \$3.5 billion and account for 4% of all broadband usage. This growth will be driven by new equipment from a growing list of hardware suppliers and an increasing number of WiMAX trials and deployments.

Voice Over Internet Protocol – VoIP

The basic underlying theme of VoIP is 'sending voice over the same network that we use for data communications' which is in positive contrast to the tradition of 'sending data packets over the voice network' an example of which is a PSTN dial-up internet. Thus, we have the term 'Internet telephony' which simply means coding voice into packets of data and transmitting through the internet which is received by a smart decoder that can change the data packets into voice again. This leaves VoIP to the mercy of the weak data network and QoS becomes a major concern addressing issues of latency (when packets arrive slowly), jitter (when packets arrive with variable delay) and worst packet loss (when the packets are dropped altogether). Proposed QoS protocols address these requirements and with higher bandwidth at our disposal, VoIP is set to make an impact in next generation telephony

VoIP in Wireless Environment – VoWiFi

Voice over WLAN is poised to emerge as the 'converged technology of the future' as it seamlessly combines VoIP technology with WiFi thus resulting in

transmission of voice packets wirelessly, making it equivalent to a mobile communication network. With the UMA (Unlicensed Mobile Access) technology (using native IP) on offer, it would be possible to offer both data and voice to the end-user over a single platform that leaves the user with mobility and optimal data-rates. Despite the various challenges such as QoS issues, protocol standardization and handset availability in its adoption, it should not be long before its commercial implementation. QoS and handoff issues are being addressed in the IEEE 802.11 e and r standards respectively. Texas Instruments is launching single-chip solutions (WiLink) for the mobile wireless LAN (mWLAN) platform for dual-mode handsets of the future. MMIC chip solutions will tackle the challenges of performance over wideband, single chip integrated solutions, size and cost minimization, minimal power requirement, etc.

Future Requirements – Technology Convergence

It would be desirable to converge the cellular and wireless technologies, standards and protocols which co-exist around the same frequency bands as they cater to similar end-user requirements. It would be of great help if these complimentary yet competitive technologies were to converge to operate simultaneously and allow the subscriber to choose between the technologies best suited for the type of application. The concept of convergence is being discussed and researched in most research and development centers across the globe involving protocol standardization committees and wireless discussion forums.

The worldwide demand for Wi-Fi and Cellular convergence would be assisted by the UMA technology which enables GSM mobile operators to offer fully converged connectivity using their existing core network. Subscribers will be able to seamlessly roam from the cellular network to a WLAN, maintaining their call as they move from one to the other. Development

of UMA-enabled handsets will create the economies of scale needed to lower the price and improve the performance of Wi-Fi and cellular handsets. However, VoIP service providers may find UMA services to be a new source of competition. Mobile carriers are expected to offer plans comparable to current VoIP 'unlimited plans' and the functionality offered would be very similar. These applications demand equipment of high-performance, high-speed, large bandwidth, low cost and minimal size for portability.

MMIC Solutions

The demand for large data-capacity, low power consumption and minimal installation costs explains the extensive use of microwave and millimeter wave frequencies in digital wireless broadband communications for both terrestrial and space-borne applications. The typical circuits that can be implemented using MMICs are amplifiers, mixers, oscillators, switches, attenuators, phase shifters, functional circuits (frequency triplers, comparators, duplexers), etc. MMICs can be used in a multitude of wireless applications like mobile communication equipment (GSM, PCN, UMTS), satellite communication (active phased arrays), radar, military components, instrumentation, Bluetooth, Hiperlan, wireless local loop, telemetry, etc.

Applications in Banking Industry

Numerous applications of wireless technology in the field of insurance and banking are possible. However in the present day, these contributions have been minimally exploited primarily due to the lack of understanding of possible applications, inadequate supply of infrastructure, the cost factor and affordability. Insurance and banking outreach can be extended to the remotest villages by Micro-Insurance and Micro-Finance institutions using communication technology and tailor-made devices. For the use of communication and information technology in rural banking and insurance scenarios, the Reserve Bank of India suggests 'Extension of Outreach of Banking Channels through ICT Solutions'.

The use of Simputers, Personal Digital Assistants (PDA's), suitably-adapted Automated Teller Machines (ATM's) and Smart cards are recommended.

The common challenge faced by these devices is their low cost availability so as to deploy them in such environments. Novel MMIC techniques will contribute much for the above discussed applications. Further, they also address issues concerning large scale integration and miniaturization, mobility, portability and high-bandwidth efficient data transfer.

Case Studies

(a) Deutsche Bank, Germany: One of the global leaders in corporate banking and securities, transaction banking, asset management and private wealth management with assets accounting to approximately Euro 972 billion. One of the first companies to use Electronic Funds Transfer (EFT) and Electronic Check Conversion (ECC) over GPRS enabled 3G mobiles.

Electronic banking, also known as Electronic Fund Transfer (EFT), uses computer and wireless technology as a substitute for checks and other paper transactions. EFTs are initiated through devices like cards or codes, or those the customer authorizes to access his account. EFT offers several services such as ATM's, Direct Deposit, Pay by Phone, Personal Computer Banking, Point-Of-Sale transfers, etc. that consumers may find practical. Electronic Cheque Conversion converts a paper cheque into an electronic payment at the point of sale or elsewhere. The cheque is processed through an electronic system that captures banking information and the amount of the cheque and must be validated. Deutsche Bank's pilot project integrating GPRS technology of 3G mobile phones for the remote and real-time validation of ECCs and EFT applications proved very successful in demonstrating the application of wireless technology in futuristic banking.

(b) Swayam Krishi Sangam Microfinance Ltd., India: Founded in 1998, SKS Microfinance is one of the fastest growing microfinance organizations in the world, with a current portfolio of \$14 million and a 99% on-time repayment rate. They have provided over \$36 million in loans to close to 140,000 women clients in one of the poorest parts of India, the drought-prone deccan region. In order to reduce loan delivery costs to their rural customers in sparsely populated parts of Andhra Pradesh, SKS gave clients smart cards and equipped loan officers with hand-held terminals. The objective was to speed loan administration, reduce errors and increase officer productivity. Even with the additional costs of cards and terminals, SKS calculated that this system would save about \$2,000 in costs per branch per year.

(c) Farm Works Ltd., UK: Founded in the summer of 1992 by Norman Teegardin, President of CTN Data Service Inc., USA. The object of Farm Works Software is to create a comprehensive farm management system while keeping it simple. They have developed a variety of software packages such as Farm Trac, Farm Funds, Farm Stock and Farm Site. Farm Trac is a GPS-integrated field record-keeping package written for MS Windows that allows farmers to keep notes on field history and chemical usage, calculate direct costs incurred at the field level and plan future farming operations. Farm Site adds GPS compatibility to Farm Trac and provides state-of-the-art positioning and a limitless number of layers, including soil types and soil tests, details of previous

activities and the outline of future plans. These two packages are complemented by field software. Using a pocket PC or a laptop, Trac Mate can be used for on-site field record keeping, while Site Mate -in combination with a GPS receiver - can be used for site-specific mapping, scouting, soil sampling and variable rate control. With Site Mate it is possible to create maps of field boundaries, weed areas, tile lines, spray paths and soil sample locations and the data can be used in most GIS programmes.

Conclusion

We have discussed in this paper, the present mobile communication scenario, a few other wireless technologies and their future implications. Having investigated the possible advantages of MMICs in these converged wireless devices, we have observed that a distributed amplifier circuit using both MIC and MMIC technology demonstrates the superiority of the latter in terms of their relative size and performance. The concluding discussion is over the contribution of MMIC

technology in developing low-cost, high performance, miniature devices finding applications in rural and remote banking. Mobile communication technology development is galloping fast and its quantum leaps have to see the matching strides in its area of application in various services. Financial services relating to rural banking have to utilize them so as to boost their nation's economic growth by engaging these hi-tech tools for providing efficient financial services to the less reached/unreachable segments of rural population. ■

ICICI Bank

Technology Initiatives for Under Banked

To reach out to the under-banked rural and urban poor, ICICI Bank is partnering with Local Financial Institutions that exist in various forms (MFI, NGO, etc.) as also leveraging technology to take banking to the last mile in a cost effective manner. A major initiative has been the issuance of Biometric (Fingerprint) enabled multi-application hybrid smart card, which is a unique, portable, personal object that easily combines secure identification and authentication functions for both the physical and the digital worlds and contains all necessary demographic information to allow bank to extend services to the micro-customer. These cards, as the most secure and reliable form of electronic identification, act as the cardholder's access key to information and services in both on-line and off-line mode and offer unparalleled flexibility and options for information sharing and transfer. The card's dynamic ability to communicate with information systems expedites traditionally lengthy identification processes, virtually eliminating paperwork and manual data entry, while streamlining operations and reducing costs. Biometric based authentication not only provides an added measure of security and convenience but also would be an efficient technology for illiterate micro-customers and allow for near foolproof customer authentication on the field. The smart cards enable a complete suite of banking services such as Saving, Loans, Recurring deposits, Term deposits, Credit on Tap etc. Apart from these, other financial services like insurance, micro-investments, commodity based lending etc. can be ported on card. Smart Card can also be used for offering non-

financial services like health care, PDS (Public Distribution System), Driving License etc. by having tie-up with various governmental and other organisations. Post-issuance functionality allows the flexibility of porting the applications on card in future based on requirements of the customers. Thus the multi-application feature makes entire gamut of services offered by different entities, program partners and government services available to the end customer on one single card. ICICI Bank is banking on proliferation of technology to provide single platform for delivery of multiple services. In order to achieve this, it is investing in automation of both front-end & back-end technologies.

Other technological initiatives include Rural ATM (being developed along with IIT Chennai), Cash Packet Vending Machine, Mobile Phones based banking services, Gold meter to assess the value of gold and Commodity tickers for real time updates, appointment of business correspondents. The benefits accruing will be (i) cutting down risk of fraud by eliminating dependency on photograph/documentary proofs (ii) elimination of duplication of work and improve the efficiency & accuracy of field agents (iii) elimination of time consuming process of manual data-entry into the system and (iv) utilisation of common platforms like cards for further applications such as insurance, ATMs, etc.

[Source: Presentation made by Shri Brahamanand Hegde, ICICI Bank at the Skoch Technologist Seminar at Mumbai]