

Software Defined Radio in the Mobile Phone



ARC CHART

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An analysis of the maturing wireless technology set to disrupt the mobile ecosystem

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Executive Summary

With all the sophistication that characterizes mobile phones today, it is easy to forget that the handset, at heart, is a radio. Put simply, the mobile phone's basic function is to send and receive radio signals carrying voice or data information. These signals travel on different frequencies, utilising various waveforms. However, the growing base of mobile subscribers worldwide, along with the increasing sophistication of devices and the uptake of richer mobile applications, is leading to an increasing demand for additional waveforms and new frequency bands.

Traditionally, radios have been implemented entirely in hardware, with new waveforms added by integrating new hardware. However, jump forward three years and it is foreseeable that handsets sold into developed markets will need to support the following wireless standards: GSM, GPRS, EDGE, WCDMA, HSDPA, Long Term Evolution (LTE), GPS, mobile TV, Wi-Fi, Bluetooth and UWB. Add WiMAX to the mix, as well as multi-mode handsets able to work across GSM and CDMA networks, and the number of waveforms to be supported is considerable.

Integrating additional radio hardware into a device is impractical beyond a point because it increases handset size, complexity and cost. The attraction of Software Defined Radio (SDR) is its ability to support multiple waveforms by re-using the same hardware while changing its parameters in software. This has enormous benefits for handset size, cost, development cycle, upgrade and interoperability. SDR-enabled phones will also ease the challenges posed by spectrum scarcity and compliment the network-agnostic approach of IMS.

SDR in mobile phones is not a case of 'if' but 'when'. This report presents a detailed analysis of all facets of SDR activity and forecasts the timelines and market for SDR in mobile phones. As part of this research, ARCchart interviewed 25 stakeholders across the mobile phone value-chain, including OEMs, IP owners, chip experts, antenna specialists, operators, regulators and industry associations. These stakeholders discussed their SDR initiatives and shared their insights on the drivers for SDR, the technology and business challenges and the estimated timelines for the introduction of SDR in mobile phones.

The endgame for a SDR-enabled handset is a digital RF front-end, a high data-rate supporting baseband and a more agile and dynamic analogue-to-digital / digital-to-analogue converter block. From a technology perspective, the baseband is already software driven to a large extent in most commercial handsets. We estimate that handsets with fully re-programmable basebands will reach the market by the second half of 2009. The RF front-end and the antenna present greater design challenges, but products that facilitate a single step conversion from the RF signal to the baseband signal have already been launched and eventually these will be integrated with the re-programmable baseband. ARCchart predicts that commercial handsets with programmable RF front-ends will appear by 2010/11. Antennas will continue to be the most challenging functional block for re-programmability. However, we believe that antenna specialists will undergo heightened innovation activity and this may fuel mergers and acquisitions in the industry.

The report outlines the history of software defined radio, presenting its primary adopters, various initiatives and introduces the industry bodies that are driving SDR. Subsequently, the functional blocks of the mobile phone are described, including the codec, baseband, RF front-end and antenna. This discussion puts the drivers and challenges for mobile phone SDR in context by explaining the functions and common implementation methodologies of each of these blocks.

The key driver technologies that ARCchart believes will accelerate the adoption of SDR are identified: these include mobile TV, LTE, UWB, GPS and WiMAX, and we explain the compelling technological reasons that make these wireless standards the leading catalysts for SDR. An in-depth analysis of the commercial incentive for mobile phone SDR is presented – for example, OEMs can use SDR to turn-around new phones faster and operators can exploit SDR devices to make optimal use of their limited spectrum.

Although SDR is an appealing solution, the technology faces several challenges before its use in mobile phones becomes mainstream. A dissertation of these challenges is presented which includes, among others, the stakeholders' apprehensions about the disruption likely to be heralded by SDR. The report details the approaches adopted by the various industry stakeholders to address the technology and business challenges. Different specialists are tackling various functional blocks to synchronize them with SDR implementation milestones, and the report presents the state-of-the-art for each of these blocks. An analysis of SDR patent activity is conducted, shedding light on the innovation taking place within leading companies across various technology categories.

The report tracks the activity of the various stakeholders in relation to the implementation of SDR in handsets. The stakeholder groups identified include design IP vendors, chip vendors, handset OEMs, EMS providers, air interface specialists, operators, antenna specialists and industry associations. Some of the companies and organizations covered include ARM, Certicom, Infineon, PrismTech, Altera, BitWave Semiconductor, Freescale, Innovative Wireless Technologies, Sandbridge Technologies, TI, Xilinx, Alcatel-Lucent, Motorola, Nokia, picoChip, Vanu, Lyrtech, Qualcomm, Antenova, Sarantel, the E2R initiative and the SDR Forum.

The report provides forecasts for the timelines and markets for mobile phone SDR, covering optimistic and pessimistic scenarios. We believe that SDR will first be adopted in smartphones as these devices will be better able to absorb the higher cost of early SDR implementation. Across all devices, ARCchart estimates that SDR phone shipments will grow to more than 11% of the market in 2011 under our optimistic scenario. SDR-enabled handset shipments are also broken-down by region (North America, EMEA, Asia Pacific and the Caribbean and Latin America), showing early adoption likely to be by niche markets in Western Europe and North America, which are saturated in terms of mobile penetration and tele-density. However, the largest push for mobile phone SDR will come from the mainstream APAC market. An assessment is also provided of the readiness of key national markets such as Australia, Brazil, China, India, Japan, South Korea, the UK and the US.

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