Software Defined Radio in Mobile Phones

Description: An Analysis of the Maturing Wireless Technology Set To Disrupt the Mobile Ecosystem

With all the sophistication that characterizes today's mobile phones, it's easy to forget that the handset, at heart, is a radio! 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 all of the following wireless standards: GSM, GPRS, EDGE, WCDMA, HSDPA, 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 is impractical beyond a point because it increases the handset size, complexity and price. 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 presented by limited spectrum availability and act the prefect device compliment to the network-agnostic approach of IMS.

Handset SDR 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.

Topics of coverage include:

- A history of SDR: the primary adopters and various initiatives
- The technologies that are likely to accelerate the adoption of SDR
- Emerging waveforms and their challenging requirements
- The commercial and business incentives pushing the handset industry towards SDR
- The technical challenges to be addressed before SDR can become mainstream
- Approaches being undertaken to address the technology and business challenges of SDR
- Analysis of the SDR patent landscape
- Discussion of the impact which SDR-enabled handsets will have on the value-chain players: from chip makers to OEMs to operators to regulators
- Forecast for the growth in SDR mobile phone shipments broken down by regions and device category

Answers and opinions are provided with respect to the following essential questions:

- How is antenna re-programmability treated in the SDR paradigm?
- What are the regulators' attitudes towards SDR?
- What are the complexities of implementing the various mobile TV standards?
- How can the power consumption challenges of SDR be resolved?
- How will the SDR impact the positions of the big cellular IPR owners?
- What are the 'killer technologies' that will catalyse the advent of handset SDR?
- What are the apprehensions and hopes of stakeholders about handset SDR?
- What are the critical inflection points for SDR adoption?
- What are the integrated and piecemeal approaches towards achieving handset SDR?

Contents:

A. SDR: CONCEPT, HISTORY AND FRAMEWORK
A.1 Introduction
A.2 What is SDR?
   Definition
Software Defined Radio definition
A.3 History of SDR
   Software Communications Architecture (SCA)
   Joint Tactical Radio System (JTRS)
   SPEAKeasy
Other major SDR initiatives
A.4 Summary

B. THE HANDSET: ARCHITECTURE AND VALUE CHAIN
B.1 Functional blocks
   Antenna
   Introduction
   Mobile phone and antennas
   Internal antennas
   Microstrip antennas
   RF Front-end
   Introduction
   Mobile phone and the RF front-end
   Intermediate frequency filter
   RF power amplifier
   RF ADC and DAC
   Software Defined Radio in the Mobile Phone
      Baseband and Application Processors
      Introduction
      Handset analogue and digital baseband functions
      DigRF
      Components of the baseband and application processors
      Baseband memory
      Case-Studies: Popular integrated baseband and application processors
         Codec
         Mobile phone and codecs
         Comranding
   B.2 Mobile phone manufacturing cycle
   B.3 Summary

C. EMERGING WAVEFORMS AND THEIR CHALLENGING REQUIREMENTS
C.1 Mobile TV
   Digital Video Broadcast – Handheld (DVB-H)
   Integrating DVB-H components in the mobile phone
   MediaFLO
   Integrating MediaFLO components in the mobile phone
   Other Major Mobile TV Standards
C.2 Long Term Evolution (LTE)
   The mobile phone and LTE
C.3 Ultra-Wide Band (UWB)
   The mobile phones and UWB
   Case Study – Staccato Communications
C.4 Global Positioning System (GPS)
   The mobile phone and GPS
   Company review – TI
   Company review – Global Locate
C.5 WiMAX
C.6 Conclusion

D. SDR: BUSINESS CASE AND PREREQUISITES
D.1 Technology and business drivers of SDR
   Multi-protocol compatibility
   Cost and space savings
   Efficient spectrum usage
   Support for emerging standards
   Mapping SDR in the IP Multimedia Subsystem (IMS) framework
   Efficient supply chain and shorter time-to-market
D.2 Technology and business limitations of SDR
   RF front-end trade-offs
   Antenna trade-offs
   Billing complications
   Security considerations
   Power consumption
Incremental usage of hardware and software resources
Commercial inertia
Intellectual Property Rights (IPR)
Price
Technology factors
D.3 Conclusion

E.1 Changes in ADC/DAC
E.2 Changes in PA section
E.3 Changes in IF section
Single chip transceiver from Nexus
Single chip solution from Infineon
Deep submicron semiconductor technology
MEMS
E.4 Changes in baseband
Re-programmable baseband from Sandbridge
Middleware
Software Defined Radio in the Mobile Phone
Power efficient baseband from Infineon
E.5 Changes to the antenna
Ethertronics Isolated Magnetic Dipole (IMD)
Software defined antenna from TensorComm
MLA from SkyCross
Fractal based antenna from Fractus
LTCC
E.6 DSP, FPGA, ASIC – comparative analysis
DSP
FPGA
ASIC
Summary

F.1 Design IP Vendors
Overview
Company reviews
ARM
Certicom
Infineon
PrismTech
F.2 RF MEMS/DSP/ASIC/FPGA and other chip vendors
Overview
Company reviews
Altera
BitWave Semiconductor
Freescale
Innovative Wireless Technologies (IWT)
Sandbridge Technologies
Texas Instruments (TI)
Xilinx
F.3 OEMs
Overview
Company reviews
Alcatel-Lucent (ALU)
Motorola
Nokia
OEMs from the APAC region
picoChip
Vanu
F.4 EMS providers
Overview
Outlook
Company review
Lyretch
F.5 Air interface stakeholders
Introduction and overview
Company review
Qualcomm.
F.6 Operators
Overview
F.7 Antenna specialists
Overview
Company reviews
Antenova
Sarantel
F.8 Industry associations
Overview
Stakeholder overview
E2R
SDR Forum
F.9 Regulators
Overview
Software Defined Radio in the Mobile Phone
Regulator reviews
FCC.
Ofcom
IDA-Singapore

G. MARKET SIZE AND FORECASTS
G.1 Methodology
G.2 Handset SDR market size forecast
Driver analysis
Mobile TV
GPS
WiMAX
SDR-enabled handsets and smartphones
G.3 Regional Analysis
Asia Pacific (APAC)
Europe, Middle East and Africa (EMEA)
North America (NA)
Caribbean and Latin America (CA-LA)
Regional summary

H. KEY MARKETS AND PATENT ANALYSIS
H.1 Readiness assessment of key national markets
Australia
Brazil
China
India
Japan
South Korea
UK.
US.
H.2 Patent analysis
Patent activity history
Patent categories
Software Defined Radio in the Mobile Phone
ADC/DAC
Antenna
Baseband block
Dynamic configuration changes using the air interface
Power amplifier and modem
Processes and materials that facilitate SDR
RF front-end
SDR based business and technology innovations
Testing and approval of SDR equipment
Leading patent assignees.
Leading innovating countries

I. APPENDICES
I.1 IF filter
I.2 RF power amplifier
I.3 RF ADC and DAC
I.4 Mobile phone memory types
I.5 Mobile phone baseband ICs
   PNX5220
   ARM9
I.6 Companding methodology
I.7 RF front-end design limitations
I.8 Wheeler’s and Maxwell’s antenna equations
I.9 Static and dynamic power dissipation
I.10 ADC/DAC process enhancements
I.11 Digital linearization techniques and vendor specific process enhancements in PA
   Digital linearization techniques
   Vendor initiatives
I.12 Sirific Nexus HEDGE transceiver
I.13 Sandblaster architecture
I.14 IMD antenna from Ethertronics
I.15 Fractals
I.16 E2R use cases
   Policy Management
   Self-Configuring Protocols
   Traffic Load Prediction and Balancing

ACRONYMS AND ABBREVIATIONS

List of Figures
Figure A-1: The seven-layer OSI model
Figure A-2: The SCA architecture layer diagram
Figure B-1: Block diagram of an entry level mobile phone
Figure B-2: PIFA microstrip antenna
Figure B-3: Antenna electromagnetic field patterns
Figure B-4: The Impact of various RF blocks on the incoming signal
Figure B-5: Integration of the baseband with handset application blocks
Figure B-6: DigRF block diagram.
Figure B-7: Block diagram of ARM 926-EJ application processor
Figure B-8: Block Diagram of PNX 5220 baseband processor
Figure B-9: Block diagram of the STw5093 codec
Figure C-1: DVB-H delivery network
Figure C-2: Nokia N77 DVB-H mobile phone 2
Figure C-3: Block diagram of a DVB-H receiver
Figure C-4: Conceptual diagram of a DVB-H device
Figure C-5: MediaFLO technology deployment
Figure C-6: Conceptual hardware block diagram of MediaFLO handset
Figure C-7: The protocol stack of a MediaFLO mobile phone
Figure C-8: Test setup of a LTE handset
Figure C-9: Schematic representation of a MIMO antenna system
Figure C-10: Single Chip UWB Solution
Figure C-11: The WiMedia protocol independent kernel
Figure C-12: Block diagram of NL5350 Single-Chip GPS solution
Figure D-1: Accommodating parallel radios on the mobile phone
Figure D-2: IMS reference architecture
Figure E-1: Digital RF processor
Figure E-2: The Nexus HEDGE transceiver
Figure E-3: The Infineon Solution using SMB6272
Figure E-4: Mobile phone antenna based on Fractals
Figure F-1: The Certicom Solution Portfolio
Figure F-2: PrismTech Middleware Schematic
Figure F-3: The softransceiver RFIC architecture
Figure F-4: Sundance SMT8096 SDR platform
Figure F-5: The BenQ P51 smartphone (discontinued) based on Flextronics' Peabody platform
Figure F-6: Asus P535 PDA
Figure F-7: The SFF SDR
Figure F-8: The Qualcomm business model
Figure F-9: Qualcomm patent allocation matrix
Figure F-10: PENTANOVA Penta-band Antenna
Figure F-11: Top view of the RADIONOVA GPS Antenna
Figure F-12: The E2R operation flow
Figure F-13: UBM
Figure F-14: Singapore spectrum allocation chart
Figure G-1: Global handset unit shipments: 2007 - 2011
Figure G-2: SDR-enabled mobile phone shipments: 2007 - 2011
Figure G-3: Mobile TV and SDR handsets driver comparison: 2007 - 2011
Figure G-4: GPS and SDR handsets driver comparison: 2007 - 2011
Software Defined Radio in the Mobile Phone
Figure G-5: WiMAX and SDR handsets driver comparison: 2007 - 2011
Figure G-6: Comparison between SDR-enabled mobile phones and smartphone: 2007 - 2011
Figure G-7: APAC growth of SDR-enabled mobile phones: 2007 - 2011
Figure G-8: APAC SDR handset driver analysis and smartphone comparison: 2007 - 2011
Figure G-9: EMEA growth of SDR-enabled mobile phones: 2007 - 2011
Figure G-10: EMEA SDR handset driver analysis and smartphone comparison: 2007 - 2011
Figure G-11: North America growth of SDR-enabled mobile phones: 2007 - 2011
Figure G-12: North America SDR handset driver analysis and smartphone comparison: 2007 - 2011
Figure G-13: CA-LA growth of SDR-enabled mobile phones: 2007 - 2011
Figure G-14: CA-LA SDR handset driver analysis and smartphone comparison: 2007 - 2011
Figure G-15: Regional SDR-enabled handset shipment summary: 2007 - 2011
Figure I-1: Functional Blocks of an RF Power Amplifier
Figure I-2: µ-Law Companding Output
Figure I-3: Block diagram of the Nexus transceiver
Figure I-4: Sandbridge Technologies' SB3000 flexible baseband processor
Figure I-5: E2R policy management use-case
Figure I-6: E2R self-configuring protocols use-case
Figure I-7: E2R traffic load balancing use-case

List of Tables
Table A-1: Outline of the major SDR initiatives
Table C-1: Licensed waveforms: frequency bands and channel bandwidths
Table C-2: LTE Bandwidths and Data Rates
Table E-1: Comparison of ASICs, FPGAs & DSPs
Table G-1: SDR-enabled mobile phone shipments: 2007 - 2011
Table G-2: Mobile TV handset shipments: 2007 - 2011
Table G-3: GPS-enabled mobile phone shipments: 2007 - 2011
Table G-4: WiMAX-enabled mobile phone shipments: 2007 - 2011
Table G-5: Smartphone shipments: 2007 - 2011
Table G-6: APAC growth of SDR-enabled mobile phone: 2007 - 2011
Table G-7: EMEA growth of SDR-enabled mobile phones: 2007 - 2011
Table G-8: North America growth of SDR-enabled mobile phone shipments: 2007 - 2011
Table G-9: CA-LA - SDR-enabled mobile phone shipments
Table I-1: Choice of Semiconductor Technologies for RF Power Amplifiers

Ordering:
Order Online - http://www.researchandmarkets.com/reports/568646/
Order by Fax - using the form below
Order by Post - print the order form below and send to
Research and Markets,
Guinness Centre,
Taylors Lane,
Dublin 8,
Ireland.
Fax Order Form
To place an order via fax simply print this form, fill in the information below and fax the completed form to 646-607-1907 (from USA) or +353-1-481-1716 (from Rest of World). If you have any questions please visit http://www.researchandmarkets.com/contact/

Order Information
Please verify that the product information is correct and select the format(s) you require.

<table>
<thead>
<tr>
<th>Product Name:</th>
<th>Software Defined Radio in Mobile Phones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Address:</td>
<td><a href="http://www.researchandmarkets.com/reports/568646/">http://www.researchandmarkets.com/reports/568646/</a></td>
</tr>
<tr>
<td>Office Code:</td>
<td>SCA7KZK</td>
</tr>
</tbody>
</table>

Product Formats
Please select the product formats and quantity you require:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Electronic (PDF) - Single User: USD 2263</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electronic (PDF) - Site License: USD 4533</td>
</tr>
<tr>
<td></td>
<td>Electronic (PDF) - Enterprisewide: USD 7560</td>
</tr>
</tbody>
</table>

Contact Information
Please enter all the information below in BLOCK CAPITALS

Title: Title: [Mr] [Mrs] [Dr] [Miss] [Ms] [Prof]
First Name: ___________________________ Last Name: ___________________________
Email Address: * ___________________________
Job Title: ___________________________
Organisation: ___________________________
Address: ___________________________
City: ___________________________
Postal / Zip Code: ___________________________
Country: ___________________________
Phone Number: ___________________________
Fax Number: ___________________________

* Please refrain from using free email accounts when ordering (e.g. Yahoo, Hotmail, AOL)
Payment Information

Please indicate the payment method you would like to use by selecting the appropriate box.

☐ Pay by credit card: You will receive an email with a link to a secure webpage to enter your credit card details.

☐ Pay by check: Please post the check, accompanied by this form, to:
Research and Markets,
Guinness Center,
Taylors Lane,
Dublin 8,
Ireland.

☐ Pay by wire transfer: Please transfer funds to:

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account number</td>
<td>833 130 83</td>
</tr>
<tr>
<td>Sort code</td>
<td>98-53-30</td>
</tr>
<tr>
<td>Swift code</td>
<td>ULSBIE2D</td>
</tr>
<tr>
<td>IBAN number</td>
<td>IE78ULSB9853308313083</td>
</tr>
</tbody>
</table>
| Bank Address     | Ulster Bank,
                    27-35 Main Street,
                    Blackrock,
                    Co. Dublin,
                    Ireland. |

If you have a Marketing Code please enter it below:

Marketing Code: ________________________________

Please note that by ordering from Research and Markets you are agreeing to our Terms and Conditions at http://www.researchandmarkets.com/info/terms.asp

Please fax this form to:
(646) 607-1907 or (646) 964-6609 - From USA
+353-1-481-1716 or +353-1-653-1571 - From Rest of World