

WiMAX RF Integration: How Will the Pieces Go Together?

Study Number RF102-08

July 2008

©Copyright 2008 Semico Research Corp. All rights reserved.

Reproduction in whole or part is prohibited without permission of Semico Research Corp.

The contents of this report represent the interpretation and analysis of statistics and information that is generally available to the public or released by responsible agencies or individuals, but is not guaranteed as to its accuracy or completeness.

Table of Contents

List of Tables	iv
List of Figures	vi
Executive Summary	1
Methodology	3
WiMAX (IEEE 802.16)	4
The Need for WiMAX	5
WiMAX versus Cell Phones	6
The WiMAX Integration Roadmap	8
Separate Components.....	8
Integrating the Transceiver and RF Sections	9
Integrating the Transceiver and the Baseband Processor	10
“One-Chip” WiMAX Solution	11
Integrating the PA	12
A Two-Chip WiMAX Solution with an Integrated PA	12
A One-Chip WiMAX Solution with an Integrated PA.....	12
WiMAX End Use Products Shipments Forecast	14
WiMAX End-Use Products Shipments Forecast by Application	14
Five-Year WiMAX End-Use Products Shipments Forecast by Fixed Versus Mobile Applications	16
WiMAX Semiconductor Shipments Forecast	17
Fixed WiMAX Semiconductor Forecast	18
Fixed WiMAX Solutions Penetration Rate by Category	18
Fixed WiMAX Separate Components Solution.....	19
Fixed WiMAX Integrated Transceiver and RF Section Solution.....	21
Fixed WiMAX Integrated Transceiver and Baseband Processor Solution....	22
“One-Chip” Fixed WiMAX Solution	23
Fixed WiMAX Integrated PA Solutions.....	24
Two-Chip Fixed WiMAX Solution with an Integrated PA	24
One-Chip Fixed WiMAX Solution with an Integrated PA.....	25
Total Semiconductor Shipments for Fixed WiMAX	26
Mobile WiMAX Semiconductor Forecast	27
Mobile WiMAX Solutions Penetration Rate by Category	28
Mobile WiMAX Separate Components Solution	29
Mobile WiMAX Integrated Transceiver and RF Section Solution	30
Mobile WiMAX Integrated Transceiver and Baseband Processor Solution ..	31
“One-Chip” Mobile WiMAX Solution.....	32
Mobile WiMAX Integrated PA Solutions	33
Two-Chip Mobile WiMAX Solution with an Integrated PA.....	33
One-Chip Mobile WiMAX Solution with an Integrated PA	34
Total Semiconductor Shipments for Mobile WiMAX.....	35

Total WiMAX Semiconductor Forecast	36
Five-Year Forecast for Total WiMAX Semiconductor Unit Shipments (Units in Millions)	36
Five-Year Forecast for WiMAX Aggregate ASPs	37
Five-Year Forecast for WiMAX Total Semiconductor Revenues	38
Disruptive Technologies	39
SOI (Silicon on Insulator).....	39
SiGe.....	40
CMOS Technology	40
WiMAX Semiconductor Vendors.....	42
Altair	42
Amicus Wireless Technology Inc.....	43
Analog Devices, Inc.....	43
ApaceWave.....	43
AsicAhead NV	43
Axiom Microdevices.....	44
Beceem Communications	44
Comsys Communication & Signal Processing Ltd.....	45
D-Clue Technologies	45
Coresonic AB	46
Design Art Networks	46
Freescale Semiconductor Inc	46
Fujitsu	47
GCT Semiconductor	47
Intel Corp.	47
Maxim Integrated Products, Inc.....	49
Mitsubishi Electric Corporation.....	50
NEC Corporation	50
NXP Semiconductors.....	50
Next Wave Wireless	50
picoChip Designs Limited	51
PMC-Sierra, Inc.	52
Redpine Signals, Inc.	53
RFMD [®] (RF Micro Devices, Inc.).....	53
Runcom Technologies Ltd.....	49
Sequans Communications.....	49
Sierra Monolithics, Inc.....	49
SiGe Semiconductor, Inc.	50
SiWave Corporation.....	50
Skyworks Solutions, Inc.	50
TeleCIS Wireless	50
Texas Instruments Incorporated.....	50
TriQuint Semiconductor	51
Troicom Corporation	51
Wavesat Inc.....	51

List of Tables

Table 1: Five-Year Forecast for Total WiMAX Semiconductor Sales	2
Table 2: Five-Year Fixed WiMAX End-Use Products Shipments by Application	1
Table 3: Five-Year Mobile WiMAX End-Use Products Shipments by Application.....	15
Table 4: Five-Year Shipments for Total WiMAX End-Use Products by Application.....	16
Table 5: Five-Year WiMAX Shipments by Fixed Versus Mobile Applications..	16
Table 6: Fixed WiMAX Solutions Penetration Rate by Category	18
Table 7: Semiconductor BOM for a Fixed WiMAX Separate Components Solution	19
Table 8: Semiconductor Unit Shipments for a Fixed WiMAX Separate Components Solution.....	20
Table 9: Semiconductor BOM for a Fixed WiMAX Integrated Transceiver and RF Section Solution.....	21
Table 10: Fixed WiMAX Semiconductor Unit Shipments for a Fixed WiMAX Integrated Transceiver and RF Section Solution.....	21
Table 11: Fixed WiMAX Semiconductor BOM for an Integrated Transceiver and Baseband Processor Solution.....	22
Table 12: Fixed WiMAX Semiconductor Unit Shipments for an Integrated Transceiver and Baseband Processor Solution	22
Table 13: Semiconductor BOM for a “One-Chip” Fixed WiMAX Solution.....	23
Table 14: Semiconductor Unit Shipments for “One Chip” Fixed WiMAX Solution	23
Table 15: Semiconductor BOM for a Two-Chip Fixed WiMAX Solution with an Integrated PA	24
Table 16: Semiconductor Unit Shipments for a Two-Chip Fixed WiMAX Solution with an Integrated PA	24
Table 17: Semiconductor BOM for a One-Chip Fixed WiMAX Solution with an Integrated PA	25
Table 18: Total Semiconductor Shipments for Fixed WiMAX	26
Table 19: Mobile WiMAX Solutions Penetration Rate by Category	28
Table 20: Semiconductor BOM for a Mobile WiMAX Separate Components Solution	29
Table 21: Mobile WiMAX Semiconductor Unit Shipments for a Mobile WiMAX Separate Components Solution.....	29
Table 22: Semiconductor BOM for a Mobile WiMAX Integrated Transceiver and RF Section Solution	30
Table 23: Mobile WiMAX Semiconductor Unit Shipments for a Mobile WiMAX Integrated Transceiver and RF Section Solution.....	30

Table 24: Mobile WiMAX Semiconductor BOM for an Integrated Transceiver and Baseband Processor Solution.....31

Table 25: Mobile WiMAX Semiconductor Unit Shipments for an Integrated Transceiver and Baseband Processor Solution31

Table 26: Semiconductor BOM for a “One-Chip” Mobile WiMAX Solution ...32

Table 27: Mobile WiMAX Semiconductor Unit Shipments for the “One-Chip” Solution32

Table 28: Semiconductor BOM for a Two-Chip Mobile WiMAX Solution with an Integrated PA33

Table 29: Semiconductor Unit Shipments for a Two-Chip Mobile WiMAX Solution with an Integrated PA33

List of Figures

Figure 1: Cell Phone versus WiMAX Characteristics	6
Figure 2: WiMAX Functional Block Diagram, Separate Components	8
Figure 3: Integrating the Transceiver and RF Sections	9
Figure 4: Integrated Transceiver and Baseband Processor.....	10
Figure 5: A One-Chip WiMAX Solution	11
Figure 6: A Two-Chip WiMAX Solution with an Integrated PA.....	12
Figure 7: A One-Chip WiMAX Solution with an Integrated PA.....	12
Figure 8: Fixed WiMAX Solutions Penetration Rate by Category	18
Figure 9: Block Diagram for a Fixed WiMAX Separate Components Solution	19
Figure 10: Block Diagram for an Integrated Transceiver and RF Section Fixed WiMAX Solution.....	21
Figure 11: Block Diagram for an Integrated Transceiver and Baseband Processor Fixed WiMAX Solution	22
Figure 12: Block Diagram for a “One Chip” Fixed WiMAX Solution.....	23
Figure 13: Block Diagram for a Two-Chip Fixed WiMAX Solution with an Integrated PA	24
Figure 14: Block Diagram for a One-Chip Fixed WiMAX Solution with an Integrated PA	25
Figure 15: Mobile WiMAX Solutions Penetration Rate by Category	28
Figure 16: Block Diagram for a Mobile WiMAX Separate Components Solution	29
Figure 17: Block Diagram for an Integrated Transceiver and RF Section Mobile WiMAX Solution.....	30
Figure 18: Block Diagram for an Integrated Transceiver and Baseband Processor Mobile WiMAX Solution	31
Figure 19: Block Diagram for a “One-Chip” Mobile WiMAX Solution	32
Figure 20: Block Diagram for a Two-Chip Mobile WiMAX Solution with an Integrated PA	33
Figure 21: Block Diagram for a One-Chip Mobile WiMAX Solution with an Integrated PA	34
Figure 22: AsicAhead NV AA1001 reference platform.....	44
Figure 23: Fujitsu MB89K1 WiMAX RF Module and MB86K21 Baseband Processor	47
Figure 24: Intel WiMAX Solution, Transceiver and Baseband Processor	48
Figure 25: Intel WiMAX Solution, Transceiver and Baseband Processor	49
Figure 26: Separate Components Solution Using an NXP Transceiver	50
Figure 27: picoChip Designs WiMAX Reference Design Block Diagram	51
Figure 28: picoChip Designs Ltd. PC203 Multicore DSP Block Diagram	52

Figure 29: PMC Sierra PM8800 WiZIRD Dual-Radio-Path Transceiver52
**Figure 30: Wavesat Mobile Handset Block Diagram Part Number Odyssey
8500.....51**