

Maury Wood
+1-781-460-1577
mwood@ejlwireless.com



Wi-Fi Blasts Ahead with 11ac Wave 2 Chipsets

November 2014



Entire contents © 2014 EJL Wireless Research LLC. All Rights Reserved. Reproduction of this publication in any form without prior written permission is strictly forbidden and will be prosecuted to the fully extent of US and International laws. The transfer of this publication in either paper or electronic form to unlicensed third parties is strictly forbidden. The information contained herein has been obtained from sources EJL Wireless Research LLC deems reliable. EJL Wireless Research disclaims all warranties as to the accuracy, completeness, or adequacy of such information. EJL Wireless Research LLC shall have no liability for errors, omissions, or inadequacies in the information contained herein or for the interpretation thereof. The reader assumes sole responsibility for the selection of these materials to achieve its intended results. The opinions expressed herein are subject to change without notice.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	5
RESEARCH METHODOLOGY	19
CHAPTER 1: EVOLUTION OF THE IEEE 802.11 STANDARDS	20
Brief Technical Overview of Gigabit Wi-Fi	20
The 802.11g Physical Layer – Wireless Innovation	20
802.11n Physical Layer – Forward-Looking Innovation	22
802.11n Media Access Control Sublayer – Efficiency Reigns	26
Familiar 802.11n Enabled Devices – Beginning of the Boom	26
IEEE 802.11-2012 – Major Milestone for Wi-Fi	26
CHAPTER 2: IEEE 802.11AC – THE NEXT GENERATION	27
802.11ac W1 and W2 Capabilities – All About the PHY	27
802.11ac Physical Layer – More Better	27
802.11ac Media Access Control Layer – Optimized	34
5 GHz Band Plan – More Spectrum Opening Up	34
Power Levels for Wi-Fi – Going Up	34
Coexistence and Compatibility Mechanisms in 802.11ac – Play Nice	36
Summary – 802.11n and 802.11ac Differences	36
Rate at Range – Convergence at 100 Meters	37
CHAPTER 3: SYSTEM SOFTWARE IN WI-FI ACCESS POINTS	39
CHAPTER 4: WI-FI SEMICONDUCTOR CHIPSETS	41
Broadcom Corporation's Wi-Fi Products	42
Broadcom Access Point Chipsets	42
Broadcom Access Point Radios	42
Broadcom Wi-Fi Networking Processors	48
Broadcom Mobile Device Radios	53
Broadcom Wi-Fi Product Summary	55
Celeno Communications Wi-Fi Products	57
Celeno Access Point Radios	58
Celeno Wi-Fi Product Summary	60
Intel Corporation's Wi-Fi Products	61
Intel Mobile Device Radios	61
Intel Wi-Fi Product Summary	64
Marvell Technology Group's Wi-Fi Products	65
Marvell Access Point Radios	65
Marvell Wi-Fi Networking Processors	67
Marvell Mobile Device Radios	72
Marvell Wi-Fi Product Summary	73
MediaTek Inc.'s Wi-Fi Products	74
MediaTek Access Point Radios	74
MediaTek Wi-Fi Networking Processors	77
MediaTek Wi-Fi Product Summary	84
Qualcomm Technology Inc.'s Wi-Fi Products	85
Qualcomm Access Point Radios	85
Qualcomm Wi-Fi Networking Processors	89
Qualcomm Mobile Device Radios	95
Qualcomm Wi-Fi Product Summary	96
Quantenna Communications, Inc.'s Wi-Fi Products	97
Quantenna Access Point Radios	98

Quantenna Wi-Fi Product Summary	101
Realtek Semiconductor Corp.'s Wi-Fi Products	102
Realtek Access Point Radios.....	102
Realtek Wi-Fi Networking Processors.....	105
Realtek Wi-Fi Product Summary	110
Redpine Signals' Wi-Fi Products.....	111
Redpine Signals Access Point Radios	111
Redpine Signals Mobile Device Radios	114
Redpine Signals Wi-Fi Product Summary	115
RESEARCH REPORT FINDINGS.....	116
APPENDIX A – REFERENCES	118
APPENDIX B – ABBREVIATIONS	119

TABLES

Table 1: Best-in-Class Wi-Fi Radios from Nine Leadership Suppliers	9
Table 2: Best-In-Class Wi-Fi SoCs from Five Leadership Suppliers.....	11
Table 3: 802.11n MCS Index Numbers.....	25
Table 4: 802.11ac Single Spatial Stream MCS Index Numbers.....	31
Table 5: Maximum Spectral Efficiency of Wi-Fi Standards.....	33
Table 6: Primary Differences Between the 11n and 11ac Standards.....	37
Table 7: Broadcom BCM43462 Features.....	47
Table 8: Broadcom StrataGX BCM58625 Features	51
Table 9: Celeno CL2340 Features.....	59
Table 10: Intel Wireless AC7260 Features	63
Table 11: Marvell Avastar 88W8864 Features.....	66
Table 12: Marvell ARMADA 385 88F6828 Features	70
Table 13: MediaTek MT7612E Features	76
Table 14: MediaTek MT7621A Features.....	81
Table 15: Qualcomm VIVE QCA9990 Features	88
Table 16: Qualcomm Internet Processor IPQ8064 Features	92
Table 17: Quantenna QSR1000 Features.....	99
Table 18: Realtek RTL8813 Features	104
Table 19: Realtek RTL8197D Features	106
Table 20: Redpine Signals RS9333 Features.....	113

EXHIBITS

Exhibit 1: Global IP Traffic by Local Access Technology	5
Exhibit 2: Typical 2015 802.11ac Wi-Fi Access Point Top-Level System Diagram	15
Exhibit 3: Typical RF Front-End Functional Diagram	16
Exhibit 4: Typical 11n/ac Radio (1x1:1 Slice) 2.4 or 5 GHz Functional Diagram	17
Exhibit 5: Typical 802.11ac Wi-Fi Networking System-on-Chip Processor Functional Diagram	18
Exhibit 6: Frequency Domain View – OFDM Waveform with Orthogonal Subcarriers	21
Exhibit 7: Simplified 802.11g OFDM Transmitter	21
Exhibit 8: Simplified 802.11g OFDM Receiver	22
Exhibit 9: 802.11b/g/n Channel Spacing	23
Exhibit 10: 64-QAM and 256-QAM Constellation Mappings	30
Exhibit 11: 5 GHz Wi-Fi Channelization and Power Levels	35
Exhibit 12: Simulated Downlink Rate at Range for 802.11n, 802.11ac W1 & W2 (AP -> Client)	38
Exhibit 13: Broadcom's XStream 802.11ac System Architecture	45
Exhibit 14: Marvell ARMADA XP MV78260 System Diagram	68
Exhibit 15: Marvell 88W8797 802.11n Radio	73
Exhibit 16: MediaTek MT7620 Block Diagram	78
Exhibit 17: Redpine Signals NetCombo RS9333 Block Diagram	114