

**U.S. Mobile Data
on Unlicensed
Spectrum Forecast,
2016-2021: *How
will Wi-Fi Offload
and Unlicensed LTE
help meet demand?***

Market Study
Second Quarter 2017





U.S. Mobile Data on Unlicensed Spectrum Forecast, 2016-2021: *How will Wi-Fi Offload and Unlicensed LTE help meet demand?*

Market Study

Published Second Quarter 2017

Version 1.0

Report Number: 022017-02

iGR

12400 W. Hwy 71

Suite 350 PMB 341

Austin TX 78738

Table of Contents

Abstract	1
Executive Summary	3
Wi-Fi Offload	3
Figure A: Total Wi-Fi Offload Traffic by Type (TB/Month), 2016-2021	4
Unlicensed LTE.....	4
Figure B: Mobile Data Traffic by Licensed and Unlicensed LTE (TB/Month), 2016-2021	5
Combined Impact of Wi-Fi Offload and Unlicensed LTE	5
Figure C: Wi-Fi Offload and Licensed and Unlicensed Mobile Data Traffic (TB/Month), 2016-2021.....	6
Methodology.....	7
Unlicensed Spectrum – Overview	8
Wi-Fi.....	8
Unlicensed LTE.....	8
Wi-Fi	10
Types of Wi-Fi Networks.....	10
Types of Wi-Fi Business Models	10
Wi-Fi Offload	12
Why offload?	12
Adoption of Offload.....	14
Benefits of Wi-Fi Offload	15
Potential Issues with Wi-Fi Offload	15
Wi-Fi Offload Standards	18
Wi-Fi Standards	18
Passpoint / Hotspot 2.0	19
Wi-Fi Roaming	20
VoWiFi.....	21
ANDSF	22
Wi-Fi Networks	23
CableWiFi Alliance	23
Comcast.....	23
Altice USA.....	23
Charter	24
Other Wi-Fi Networks.....	24
Unlicensed LTE	26
The 5 GHz Band	26
Figure 1: Simplified 5 GHz Band Plan	27
A Quick Aside on Spectrum.....	27
How Wi-Fi Shares	28
LTE-U	29



How does LTE-U Share?.....	30
Figure 2: How LTE-U Shares Unlicensed Spectrum	30
What's the Issue with LTE-U?	32
Evolve Forum.....	33
LAA.....	33
Figure 3: 3GPP View of Unlicensed LTE	34
LWA.....	35
Figure 4: Overview of How LWA Works	36
Qualcomm MulteFire.....	37
The Cage Match	37
What has the FCC Done?	38
Unlicensed LTE Developments	39
Deployment Status Summary.....	40
Mobile Data Traffic Forecast Methodology.....	42
Connections, not Subscribers.....	43
Quartiles	43
Data Traffic on Unlicensed Spectrum Methodology	45
Wi-Fi Offload	45
Assumptions.....	45
Methodology for User-Driven Wi-Fi Offload	46
Methodology for Carrier-Driven Wi-Fi Offload	46
Unlicensed LTE.....	47
Assumptions.....	47
Methodology for Unlicensed LTE	48
Mobile Data Traffic on Unlicensed Spectrum Forecast	49
Wi-Fi Offload	49
Table 1: Mobile Data and Wi-Fi Offload Connections (000), 2016-2021.....	49
Figure 5: Mobile Data and Wi-Fi Offload Connections (000) , 2016-2021.....	50
Table 2: Total Wi-Fi Offload Traffic by Type (TB/Month), 2016-2021	50
Figure 6: Total Wi-Fi Offload Traffic by Type (TB/Month), 2016-2021	51
Table 3: Total Wi-Fi Offload Traffic by Type (Percent), 2016-2021	51
Figure 7: Total Wi-Fi Offload Traffic by Type (Percent), 2016-2021	52
Table 4: Wi-Fi Offload Traffic Compared to Mobile Data Traffic, 2016-2021.....	53
Figure 8: Wi-Fi Offload Traffic Compared to Mobile Data Traffic (TB/Month), 2016-2021 ..	53
Unlicensed LTE.....	53
Table 5: Mobile Data and Unlicensed LTE Connections (000), 2016-2021.....	54
Figure 9: Mobile Data and Unlicensed LTE Connections (000).....	54
Table 6: Mobile Data Traffic by Licensed and Unlicensed LTE (TB/Month), 2016-2021	55
Figure 10: Mobile Data Traffic by Licensed and Unlicensed LTE (TB/Month), 2016-2021	56
Table 7: Mobile Data Traffic by Licensed and Unlicensed LTE (Percent), 2016-2021	56
Figure 11: Mobile Data Traffic by Licensed and Unlicensed LTE (Percent), 2016-2021	57
Combined Forecast for Wi-Fi Offload and Unlicensed LTE	57
Table 8: Wi-Fi Offload and Licensed and Unlicensed Mobile Data Traffic (TB/Month), 2016-2021.....	57
Figure 12: Wi-Fi Offload and Licensed and Unlicensed Mobile Data Traffic (TB/Month), 2016-2021	58

Table 9: Wi-Fi Offload and Licensed and Unlicensed Mobile Data Traffic (Percent), 2016-2021.....	59
--	----

Figure 13: Wi-Fi Offload and Licensed and Unlicensed Mobile Data Traffic (Percent), 2016-2021.....	59
--	----

Vendor Profiles	60
Accuris Networks.....	60
Airspar Networks	62
Alcadis ISP Solutions.....	65
Altice	66
Anyfi Networks.....	68
Aptilo Networks	72
Aruba Networks, a Hewlett Packard Enterprise Company	74
AT&T	76
Boingo	80
Broadcom Limited	83
Cambium Networks	84
CenturyLink, Inc.	86
Charter Communications, Inc.....	87
Cisco	90
Comcast Corporation	94
Cox Communications	96
Devicescape.....	99
Ericsson	101
Federated Wireless.....	104
GCI	106
Gogo.....	107
Google.....	109
Huawei	110
InterDigital	112
iPass	114
NetScout Systems.....	116
Nokia Networks.....	119
Qualcomm.....	123
Ruckus Wireless.....	125
SpiderCloud Wireless.....	128
T-Mobile US.....	132
Verizon	134
Way4orth	136
XCellAir	136
Xirrus.....	137
Definitions	142
General	142
Device Types.....	142
Services	143
Network Technology.....	144
About IGR.....	148



Disclaimer148



Abstract

As mobile operators have deployed more LTE over the past few years, the demand for high speed mobile data has also increased. One way to supply that demand is for mobile operators to acquire more spectrum, but licensed spectrum is expensive and rare. The other option for mobile operators is to use unlicensed spectrum in one of two ways:

- Offload traffic to a Wi-Fi network
- Use unlicensed spectrum (specifically, 5 GHz) for LTE.

Although a few years ago Wi-Fi Offload was seen as the primary method for mobile operators to take advantage of unlicensed spectrum, in the last two years, there has been significant interest in (and controversy surrounding) the use of LTE on unlicensed spectrum, specifically 5 GHz.

This market study provides a discussion of the options available for mobile operators. It discusses both user-driven and carrier-driven Wi-Fi Offload, gives updates on the deployment of the related technologies, and discusses the benefits and issues surrounding its continued and expanded deployment.

The market study also discusses the various types of Unlicensed LTE technology that allow LTE to be used in the unlicensed 5 GHz spectrum band, including LTE-U, LAA, LWA and MulteFire. It discusses the controversy surrounding their use and gives updates regarding its deployment in the U.S.

Finally, a five-year forecast is provided, which shows the amount of U.S. Wi-Fi Offload traffic and unlicensed LTE traffic and how this number compares to the total amount of U.S. mobile data traffic.

Key questions addressed in this study:

- What is user-driven and carrier-driven Wi-Fi Offload?
- What are some of the key standards efforts associated with Wi-Fi offload?
- What are the benefits and issues associated with Wi-Fi offload?
- What is Unlicensed LTE?
- What is the 5 GHz band and why is it important?
- What are LTE-U, LAA, LWA and MulteFire? How are they the same? And how do they differ?

- What is Listen Before Talk and why is it important?
- What are the benefits and issues associated with Unlicensed LTE?
- When will Unlicensed LTE technology be deployed?
- How much U.S. mobile data traffic is expected to be put on unlicensed spectrum (using both Wi-Fi Offload and Unlicensed LTE) over the next five years?

This market study is recommended for:

- Mobile operators, particularly those servicing the U.S. market
- Mobile backhaul providers, including telcos and cable MSOs
- Wired and wireless backhaul vendors and solution providers
- Mobile OEMs, particularly those servicing the U.S. market
- Wired and wireless infrastructure vendors, particularly those servicing the U.S. market
- Financial and investment analysts.

