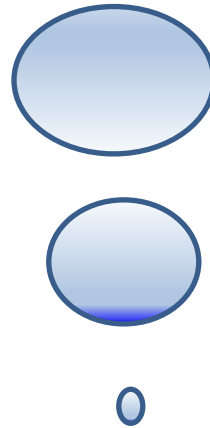


**WinterGreen Research, INC.**



**Small Cells:  
Market Shares, Strategies, and Forecasts,  
Worldwide, 2018 to 2024**



[www.wintergreenresearch.com](http://www.wintergreenresearch.com)  
(781) 863-5078

**WinterGreen Research, Inc.**  
**Lexington, Massachusetts**

REPORT # SH273224732

248 PAGES

135 TABLES AND FIGURES

2018

\$4,300 SINGLE GROUP COPY -- \$8,600 WEB SITE POSTING



**The Best Market Research, Backed by a Superb Research Team with Integrity**

**We are the best in the industry at answering your research questions after you purchase the report, even two years later.**

---

**REPORT # SH273224732**

**248 PAGES**

**135 TABLES AND FIGURES**

**\$4,300 SINGLE GROUP COPY -- \$8,600 WEB SITE POSTING**

**Small Cells: Disruptive Technology that Extends Broadband into the Corners of the Earth, Implements 5G**

**CHECK OUT THESE KEY TOPICS**

<b>Small Cells Virtualization Cloud Edge Functional splits. LTE Small Cell 5G Network Densification Hybrid Ethernet Based DAS DAS</b>	<b>In Building Wireless Broadband Traffic In Air Interface Solutions Outdoor and Stadium Deployments Heterogeneous Network Hung On Aerial Coax, Fiber, Or Electricity Cables Distributed business Enterprise</b>	<b>End-To-End Integrated Small Cells Metro Cell Solution Signal Transmission ADRF Positioning Bandwidth Allocation Across enterprise boundaries</b>
---	--	---

**Small Cells: Technology Evolves To Provide Better Management of Transactions in the Real Time Digital Economy**

**Description: WinterGreen Research provides deep insight into telco and the unfolding of small cells as they are used to implement the digital economy. Smart devices, smart cities, smart drones, smart agriculture, self-driving cars all have a need for more dense wireless transport infrastructure. Small cell address that need**

**Small Cells: Market Shares, Strategies, and Forecasts, Worldwide,  
2018-2024**

LEXINGTON, Massachusetts (January 29, 2018) – WinterGreen Research announces that it has published a new study Small Cells: Market Shares, Strategy, and Forecasts, Worldwide, 2018 to 2024. The 2018 study has 248 pages, 135 tables and figures. The leading vendors in the small cell market have invested in high-quality technology and processes to develop leading edge monitoring and digital triggering activation capability.

Small Cell markets encompass virtualization, cloud, edge, and functional splits. 5G requires increasing sophistication from mobile operators. The challenge is to bring together a growing number of LTE and 5G radio access technologies. A range of connectivity services are needed. Associated APIs are needed in each small cell to manage connectivity to a number of customer segments.

**Figure 1. Small Cell Market Driving Forces**

- Need for enabling evolution of local communications network
- Availability of fully virtualized, distributed, ultra-reliable software
- Effective software for controlling agile infrastructure
- Automation facilitates large-scale low-cost network densification
- Lowers cost by implementing network through third-party deployments
- Effective integration of base small cell technologies
- Systems integration achieved with open and interoperable standards
- Open and interoperable standards needed to ensure competition
- open and interoperable standards needed to ensure economies of scale
- Adoption of these 5G Era technologies will require culture shifts in processes

**Source: WinterGreen Research, Inc.**

Small cells need infrastructure across a broad range of commercial and governmental organizations. Each have a part to play in making small cells work along with tower infrastructure to create a broadband commercial network. Service providers are focused on densification. Small cells are a critical part of the infrastructure for several key 5G Era deployment scenarios:

### Figure 2. Small Cell Infrastructure Critical Issues

- Service providers are focused on densification
- Small cells are a critical part of the infrastructure for key 5G implementations
- 5G deployment needs small cells
- >6GHz spectrum propagation limits cell sizes
- Shared and license-exempt spectrum mandates lower power
- Areas of hyper-dense broadband traffic need small cells
- Small cells meet demand in cities, stadia, transport hubs
- Scalable deployment
- Low-cost deployment
- Using a low-skilled, third-party, or end-user workforce
- Small/medium enterprises requiring self-deployed indoor coverage
- Coverage extension in rural, remote, moving and temporary deployment
- Scenarios with equipment size, weight or power constraints.

**Source: WinterGreen Research, Inc.**

The total value of the small cell market is \$12.5 billion in 2017, up from \$10.35 billion in 2016. Markets grow to \$58.7 billion in 2024. Growth is a result of the implementation of the tremendous amount of digital content from video on smart phones, from the digital economy, IoT, robots, drones, self-driving cars, and artificial intelligence. The digital economy rides on the back of small cells 5G signal transmission which is a 10x improvement in capacity over existing broadband. This is the new world aspect, everything is monitored and activated digitally.

## WinterGreen Research, INC.

The digital economy, self-driving cars, drones, traffic lights, and smart things all need more wireless coverage. According to Susan Eustis, leader of the team that prepared the research, “Small cell suppliers have a focus on broadband improvement. Power and performance are being improved. Small cells improve the transmission coverage and density.”

This 5G coverage is needed as IoT, the Internet of things and smart phone video increase transmission needs. “Everything will be connected,” said SoftBank Chief Executive Masayoshi Son, announcing a ARM processor deal in London. “Cows will be connected, chickens will be connected, the sheep will be connected.”

WinterGreen Research is an independent research organization funded by the sale of market research studies all over the world and by the implementation of ROI models that are used to calculate the total cost of ownership of equipment, services, and software. The company has 35 distributors worldwide, including Global Information Info Shop, Market Research.com, Research and Markets, electronics.ca, and Thompson Financial. WinterGreen Research is positioned to help customers facing challenges that define the modern enterprises.

The increasingly global nature of science, technology and engineering is a reflection of the implementation of the globally integrated enterprise. Customers trust wintergreen research to work alongside them to ensure the success of the participation in a particular market segment.

WinterGreen Research supports various market segment programs; provides trusted technical services to the marketing departments. It carries out accurate market share and forecast analysis services for a range of commercial and government customers globally. These are all vital market research support solutions requiring trust and integrity.

Key words: Small Cells, Virtualization, Cloud, Edge, Functional splits. , LTE Small Cell, 5G, Network Densification, Hybrid Ethernet Based DAS, DAS, In Building Wireless, Broadband Traffic, In Air Interface Solutions, Outdoor and Stadium Deployments, Heterogeneous Network, Hung On Aerial Coax, Fiber, Or Electricity Cables, Distributed business, Enterprise, End-To-End Integrated Small Cells, Metro Cell Solution Signal Transmission, ADRF Positioning, Bandwidth Allocation, Across enterprise boundaries,

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING

**WinterGreen Research, INC.**

## **Companies Profiled**

### **Selected Market Leaders**

**Ericsson  
Nokia / Alcatel-Lucent  
ZTE  
Fujitsu**

**Huawei  
NEC  
Samsung**

### **Selected Market Participants**

**Airspan  
ANs  
ADRF  
AT&T  
Ciena  
Cisco Small Cells**

**CommScope  
Corning Spidercloud  
ip.access  
NTSI  
Optimos  
Qualcomm**

**Signal Booster.com  
Small Cell Forum  
Solid Technologies  
Zouk Capital / ip.access**

## **Small Cells: Market Shares, Strategies, and Forecasts, Worldwide, 2018 to 2024**

### **Report Methodology**

This is the 732nd report in a series of primary market research reports that provide forecasts in robotics, communications, telecommunications, the Internet, computer, software, telephone equipment, health equipment, and energy. Automated process and significant growth potential are priorities in topic selection. The project leaders take direct responsibility for writing and preparing each report. They have significant experience preparing industry studies. Forecasts are based on primary research and proprietary data bases.

**REPORT # SH27321424**

**248 PAGES**

**135-TABLES AND FIGURES**

**2018**

**781 863 5078 info@wintergreenresearch.com**

**\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING**

## WinterGreen Research, INC.

This Small Cells study is based on tracking integration software and dynamic processing that provides significant insight into the technology of Systems. Experience implementing broadband networking and mobile systems for different technologies using the Systems has been evaluated in many different contexts. Evaluation of the changes brought to the supply chain and transaction processing by the Internet are among factors that contribute to development of triangulation regarding market forecasts for the sector.

The primary research is conducted by talking to customers, distributors and companies. The survey data is not enough to make accurate assessment of market size, so WinterGreen Research looks at the value of shipments and the average price to achieve market assessments. Our track record in achieving accuracy is unsurpassed in the industry. We are known for being able to develop accurate market shares and projections. This is our specialty.

The analyst process is concentrated on getting good market numbers. This process involves looking at the markets from several different perspectives, including vendor shipments. The interview process is an essential aspect as well. We do have a lot of granular analysis of the different shipments by vendor in the study and addenda prepared after the study was published if that is appropriate.

Forecasts reflect analysis of the market trends in the segment and related segments. Unit and dollar shipments are analyzed through consideration of dollar volume of each market participant in the segment. Installed base analysis and unit analysis is based on interviews and an information search. Market share analysis includes conversations with key customers of products, industry segment leaders, marketing directors, distributors, leading market participants, opinion leaders, and companies seeking to develop measurable market share.

Over 200 in depth interviews are conducted for each report with a broad range of key participants and industry leaders in the market segment. We establish accurate market forecasts based on economic and market conditions as a base. Use input/output ratios, flow charts, and other economic methods to quantify data. Use in-house analysts who meet stringent quality standards.

Interviewing key industry participants, experts and end-users is a central part of the study. Our research includes access to large proprietary databases. Literature search includes analysis of trade publications, government reports, and corporate literature.

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING



## WinterGreen Research, INC.

Findings and conclusions of this report are based on information gathered from industry sources, including manufacturers, distributors, partners, opinion leaders, and users. Interview data was combined with information gathered through an extensive review of internet and printed sources such as trade publications, trade associations, company literature, and online databases. The projections contained in this report are checked from top down and bottom up analysis to be sure there is congruence from that perspective.

The base year for analysis and projection is 2017. With 2017 and several years prior to that as a baseline, market projections were developed for 2018 through 2024. These projections are based on a combination of a consensus among the opinion leader contacts interviewed combined with understanding of the key market drivers and their impact from a historical and analytical perspective. The analytical methodologies used to generate the market estimates are based on penetration analyses, similar market analyses, and delta calculations to supplement independent and dependent variable analysis. All analyses are displaying selected descriptions of products and services.

This research includes reference to an ROI model that is part of a series that provides IT systems financial planners access to information that supports analysis of all the numbers that impact management of a product launch or large and complex data center. The methodology used in the models relates to having a sophisticated analytical technique for understanding the impact of workload on processor consumption and cost.

WinterGreen Research has looked at the metrics and independent research to develop assumptions that reflect the actual anticipated usage and cost of systems. Comparative analyses reflect the input of these values into models.

The variables and assumptions provided in the market research study and the ROI models are based on extensive experience in providing research to large enterprise organizations and data centers. The ROI models have lists of servers from different manufacturers, Systems z models from IBM, and labor costs by category around the world.

This information has been developed from WinterGreen research proprietary data bases constructed as a result of preparing market research studies that address the software, energy, healthcare, telecommunications, and hardware businesses.

### YOU MUST HAVE THIS STUDY

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING

# Small Cells: Market Shares, Strategies, and Forecasts, Worldwide, 2018 to 2024

## Table of Contents

### Small Cells: Executive Summary

The study is designed to give a comprehensive overview of the Small Cells market segment. Research represents a selection from the mountains of data available of the most relevant and cogent market materials, with selections made by the most senior analysts. Commentary on every aspect of the market from independent analysts creates an independent perspective in the evaluation of the market. In this manner the study presents a comprehensive overview of what is going on in this market, assisting managers with designing market strategies likely to succeed.

Abstract: Small Cells Used to Improve Wireless Coverage, Close the Gaps in Coverage	1
<b>SMALL CELLS EXECUTIVE SUMMARY</b>	<b>18</b>
Small Cell Market Driving Forces	18
Small Cell Market Shares	23
Small Cell Market Forecasts	24
<b>1. SMALL CELLS: MARKET DESCRIPTION AND MARKET DYNAMICS</b>	<b>26</b>
1.1 Small Cells Definition	26
1.1.1 Small Cells Set To Be Major Enabler for 5G	27
1.1.2 Vision for 5G	27
1.1.3 Outdoor Small Cell Market Is in The Beginning Stages Of Deployment	29
1.2 Small Cells Bring Transformational 5G	31
Small Cells Market Driving Forces	32
1.3 Small Cell Networks	34
1.3.1 Small Cells Industry Addresses Fast-Paced Change	35
1.4 Small Cell Signal Enhancement	38
1.5 Shared Spectrum Radios	42
1.6 Base Station Functional Splits	43
1.6.1 Small Cells Miniature Cellular Base Stations	44
1.6.2 Small Cell Operator Challenges	47
1.6.3 Small Cell Base Stations	47
1.7 5G Envisioned As A Unifying Connectivity Fabric That Connects Everything Around Us	50
1.8 Business Model for Small Cells	53
1.8.1 Small Cell Site Risks Different From Tower Site Risks	54
<b>2. SMALL CELLS MARKET SHARES AND FORECASTS</b>	<b>57</b>
2.1 Small Cell Market Driving Forces	57
2.2 Small Cell Market Shares	62
2.2.1 Huawei	68
2.2.2 Ericsson Small Cells	70
2.2.3 Commscope / Airvana	71
2.3 Small Cell Market Forecasts	71
2.3.1 Small Cell Applications 3G, 4G, and 5G	74
2.3.1 Small Cell Installed Base	78
2.3.2 Small Cell Installation Issues	79

# WinterGreen Research, INC.

2.3.3	Microcells, Femtocells, and Picocells	80
2.3.4	Small Cell Backhaul	84
2.3.5	Small Cell Femtocells, Picocells, And Microcells	85
2.3.6	Enterprise Small Cell Market Forecast	92
2.3.7	Enterprise Needs For Indoor Coverage	95
2.3.8	Small Cells Industry Challenges	96
2.3.9	Small Cell Response to Market Challenges	97
2.3.10	DAS 98	
2.4	Small Cell Booster Units	101
2.5	Number Of Mobile Internet Users	103
2.5.1	Telecommunications Fiber	111
2.5.2	Internet Traffic Growth	113
2.6	Small Cell 5G Analysis	115
2.6.1	Crowdsourcing Small Cells	122
2.7	DAS Analysis	122
2.8	Fiber Markets	123
2.8.1	5G Handles 10x More Data Than 4G	125
2.9	Small Cell Prices	126
2.10	Small Cell Regional Market Analysis	131
2.10.1	Wholesale Turf Vendor Mobile Backhaul Network Operators	133
2.10.2	US Small Cell Networks	133
2.10.3	San Francisco Leads in Municipal Small Cell Deployment	135
2.10.4	San Francisco Leads the Way in Municipal Small Cell Deployment	137
2.10.5	Asia-Pacific Market	138
2.10.6	China 138	
2.10.7	Japan 138	
2.10.8	UK 138	
2.10.9	UK EE	138
2.10.10	Iran 139	
2.10.11	Small Cell Deployments by Region and Density, Indoor and Outdoor, Architecture	140
<b>3. SMALL CELLS PRODUCT DESCRIPTION</b>		<b>141</b>
3.1	Wireless Industry Small Cells for Homeowners	141
<b>4. SMALL CELLS RESEARCH AND TECHNOLOGY</b>		<b>146</b>
4.1	Modern Mobile Network	146
4.2	Small Cell Turfing Vendor Site Analysis	148
4.3	Session Border Controller (SBC)	149
4.3.1	China's Quantum-Key Network, the Largest Ever, Is Officially Online	150
4.4	Small Cell Legislation in California	150
4.4.1	Competitiveness of Nations	151
4.5	Industry Associations	156
4.5.1	Cambridge Wireless	156
4.6	Small Cells Local Regulations	156
4.6.1	ETSI 157	
4.7	Macro Network Layer	159
<b>5. SMALL CELLS COMPANY PROFILES</b>		<b>162</b>
5.1	Airspan	162
5.2	ANs 163	
5.2.1	ANS Distributed Antenna Systems (DAS), Small Cells	165
5.3	ADRF	166
5.4	AT&T	168
5.4.1	AT&T Small Cells	168
5.4.2	Fiber is Key to 5G	169
5.5	Ciena 170	
5.5.1	Ciena Reports Fiscal Fourth Quarter 2017 and Year-End Financial Results	171
5.6	Cisco Small Cells	171
5.6.1	Cisco Universal Small Cell 8000 Series End-Of-Life	172

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING

# WinterGreen Research, INC.

5.7	CommScope	173
5.7.1	Commscope Revenue	178
5.7.2	Airvana	178
5.7.3	Airvana Targets Mobile Operators	181
5.8	Corning Spidercloud	181
5.8.1	SpiderCloud LTE Small Cell Technology	182
5.8.2	Corning Acquires SpiderCloud Wireless	183
5.9	Ericsson Small Cells	184
5.9.1	Ericsson Holistic View Of The Network	184
5.9.2	Ericsson Benefits Of Integrated Small Cells	185
5.9.3	Ericsson Lightpole Site	188
5.9.4	Ericsson Radio Dot System	192
5.9.5	Ericsson Dual Band Radio Dot	193
5.9.6	Hardened Radio Dot for Outdoor and Stadium Deployments	194
5.9.7	Ericsson Small Cell In-Building Solutions	197
5.9.8	Ericsson AT&T Qualcomm, and Small cells	198
5.10	Huawei 199	
5.10.1	Huawei Small Cell Achievements in 4.5G/5G Technologies	202
5.10.2	Densify Cellular Networks, Creating Serious Inter-Cell Interference Solution	204
5.10.3	Huawei Revenue	207
5.11	ip.access208	
5.11.1	Industry Standard	209
5.12	Nokia 210	
5.12.1	Nokia Small Cells Improve TCO	211
5.12.2	Nokia Small Cells Deliver Cost-Effective Capacity And Coverage, Indoors And Outdoors, Key To Network Innovation	212
5.12.3	Small Cells Support Heterogeneous Network	222
5.12.4	Nokia Small Cell Deployments	222
5.12.5	Smart WiFi Delivers Carrier Grade Wireless Access with Nokia AirScale Wi-Fi	223
5.12.6	Nokia AirScale Wi-Fi Allows Service Providers Without Licensed Spectrum To Run a Wi-Fi service That Takes Advantage Of Mobile Edge Computing	223
5.13	NTSI 225	
5.14	Optimos 226	
5.14.1	City of New York selects Optimos	226
5.14.2	Irma and Maria Recovery – Acorn	227
5.14.3	Optimos International to Rollout PICO's Nationally	228
5.15	Qualcomm	229
5.16	Samsung	230
5.17	Signal Booster.com	231
5.17.1	Cellular Signal Booster, Das, Public Safety Das Equipment	231
5.17.2	Public Safety Bands	232
5.18	Small Cell Forum	233
5.19	Solid Technologies	236
5.20	Zouk Capital / ip.access	238
5.21	ZTE 239	
5.22	Selected List of Small Cell Companies	241
5.22.1	Cell Phone Signal Boosters For Home	241
	<b>WINTERGREEN RESEARCH,</b>	<b>243</b>
	WinterGreen Research Methodology	244
	WinterGreen Research Process	245
	Market Research Study	246
	WinterGreen Research Global Market Intelligence Company	247

Abstract: Small Cells Used to Improve Wireless Coverage, Close the Gaps in Coverage

1

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING



# WinterGreen Research, INC.

Figure 1.	Small Cell Market Driving Forces	18
Figure 2.	Small Cell Infrastructure Critical Issues	19
Figure 3.	Industry Increasing Network Bandwidth Dramatically	21
Figure 4.	Converged Networks	22
Figure 5.	Small Cell Market Shares, Dollars, Worldwide, 2017	23
Figure 6.	Small Cells Market Forecasts Dollars, Worldwide, 2018-2024	24
Figure 7.	Vision for 5G	28
Figure 8.	Small Cells That Amplify Cellular Phone Signals Making Possible More Uses Of A Mobile Phone Indoors	29
Figure 9.	Barriers To Market Development for Outdoor Small Cell Market In Beginning Stages Of Deployment	30
Figure 10.	Cost Of An Outdoor Small Cell Issues	30
Figure 11.	Constraints on 5G Development	31
Figure 12.	Small Cells Market Driving Forces	33
Figure 13.	Small Cells Industry Adaptation To Change	36
Figure 14.	Small Cells Industry Adaptations	37
Figure 15.	Small Cells Industry Imperatives	37
Figure 16.	Inside Building Poor RF Coverage, RF Distribution Systems	39
Figure 17.	Cell Phone Signal Enhancement Process	40
Figure 18.	Cell Phone Signal Simulation using iBwave	41
Figure 19.	Types of Buildings Using Cell Phone Signal Enhancement	41
Figure 20.	Shared Spectrum Radios Network Changes	42
Figure 21.	5G Small Cell Benefits	43
Figure 22.	Low Cost Characteristics Of Small Cells	45
Figure 23.	Fixed Mobile Convergence Handset Illustration	48
Figure 24.	5G Innovation Platform Features	51
Figure 25.	Small Cell Industry Increasing Network Bandwidth Dramatically	52
Figure 26.	Small Cell Business Model Elements	53
Figure 27.	Small Cell Operational Risks Different From Tower Site Rental Business	55
Figure 28.	Small Cell Market Driving Forces	57
Figure 29.	Small Cell Infrastructure Critical Issues	58
Figure 30.	Industry Increasing Network Bandwidth Dramatically	60
Figure 31.	Converged Networks	61
Figure 32.	Small Cell Market Shares, Dollars, Worldwide, 2017	62
Figure 33.	Small Cell Equipment Market Shares, Dollars, Worldwide, 2017	63
Figure 34.	Small Cell Market Driving Forces	64
Figure 35.	Small Cell Market Factors	65
Figure 36.	Fiber Homes Passed AT&T	66
Figure 37.	Small Cell 4.5G Technologies Implementations	69
Figure 38.	Ericsson Multi-Operator Dot Small Cell	70
Figure 39.	Small Cells Market Forecasts Dollars, Worldwide, 2018-2024	72
Figure 40.	Small Cell Market Forecasts, Dollars, Worldwide, 2018-2024	73
Figure 41.	Small Cell Market Forecasts Units, Worldwide, 2018-2024	73
Figure 42.	5G Application Network Improvements	75
Figure 43.	Small Cell Market Industry Segments, 3G, 4G, and 5G, Dollars, Worldwide, 2018-2024	76
Figure 44.	Small Cell Market Industry Segments, 3G, 4G, and 5G, Dollars and Percent, Worldwide, 2018-2024	77
Figure 45.	Small Cell Market Forecasts, Installed Units and Dollars Shipped, Worldwide, 2018-2024	78
Figure 46.	Small Cell Market Industry Segments, Microcells, Femtocells, Metrocell, Picocells, Dollars, Worldwide, 2018-2024	80
Figure 47.	Small Cell Market Industry Segments, Microcells, Femtocells, Metrocell, Picocells, Dollars and Percent, Worldwide, 2018-2024	82
Figure 48.	Power, Coverage, and Capacity of Small Cells	83
Figure 49.	Back Haul Small Cell Market Is Primarily Driving Factors	84

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING

# WinterGreen Research, INC.

Figure 50.	Small Cell Market Segment Forecasts, Small, Mid-Range, and High End, Dollars, Worldwide, 2018-2024	91
Figure 51.	Small Cell Market Industry Segments, Service Providers, Enterprise, Community Dollars, Worldwide, 2018-2024	92
Figure 52.	Small Cell Market Industry Segments, Service Providers, Enterprise, Community, Dollars and Percent, Worldwide, 2018-2024	93
Figure 53.	Small Cell Market Forecast Segments, Residential, Enterprise, Urban, Rural / Remote Units Shipped, Worldwide, 2018-2024	94
Figure 54.	Wireless Network Upgrades, Growth in Number of Cell Sites	99
Figure 55.	Number of Mobil Subscribers Worldwide, 2017	105
Figure 56.	CTIA Count of Wireless Subscribers in Americas	106
Figure 57.	Mobile Subscribers by Technology Generation 2015	107
Figure 58.	Billions of M to M Connections	108
Figure 59.	Annual Net Subscriber Additions in US by Service Provider	109
Figure 60.	Smartphone Traffic vs Tablets Other Wireless Hones, and Laptops	110
Figure 61.	Massive Investment Cycle: US Homes Passed with Fiber	112
Figure 62.	Key Market Driver	114
Figure 63.	Small Cell 5G Business Market Factors	115
Figure 64.	Small Cell Hyperdense Installation in Oakland CA	117
Figure 65.	Hyperdense Work Streams Features	118
Figure 66.	Hyper-dense 5G Smart Cell Features	119
Figure 67.	Small Cell Market Industry Segments, 3G, 4G, and 5G, Dollars, Worldwide, 2018-2024	120
Figure 68.	Small Cell Market Industry Segments, 3G, 4G, and 5G, Dollars and Percent, Worldwide, 2018-2024	121
Figure 69.	Nokia Femtocell Price Image	127
Figure 70.	Small Cell Prices And Coverage, Verizon, Samsung and AT&T	128
Figure 71.	Sprint Magicbox	130
Figure 72.	Small Cells Regional Market Segments, 2017	131
Figure 73.	Small Cells Regional Market Segments, 2017	132
Figure 74.	A Recent Crown Castle Small Cell with VZ on it at 35th & Lituanica, Chicago:	134
Figure 75.	Small Cells San Francisco and Oakland	135
Figure 76.	Small Cells and Electricity Distribution	136
Figure 77.	Small Cells vs. DAS Locations	142
Figure 78.	Houston Small Cell Separate Site Applications	143
Figure 79.	Industry Small Cell Installations vs. Examples	144
Figure 80.	Small Cell Forum Partners	146
Figure 81.	Small Cell Forum Collaboration Partners	148
Figure 82.	Small Cell Turfing Vendor Course Syllabus:	149
Figure 83.	Integrate Wireless Technology Into The Built Environment	151
Figure 84.	5G Licensed, Shared, and Unlicensed Spectrum Bands and Properties	152
Figure 85.	Bandwidth Allocation by Country	153
Figure 86.	5G Spectrum Utilizing Low, Mid, and High Bands	154
Figure 87.	5G NR mmWave Outdoor Coverage via co-Siting	155
Figure 88.	ANS Trusted Source of Backhaul Expertise	163
Figure 89.	DAS Services by ANS	164
Figure 90.	Small Cell Services by ANS	165
Figure 91.	DAS Services by ANS	166
Figure 92.	ADRF Positioning	166
Figure 93.	Ciena Revenue Q\$ 2017 and 2016	171
Figure 94.	Cisco Universal Small Cell 8000 Series	172
Figure 95.	Commscope Revenue by Segment	174
Figure 96.	Metro Cell Solution Locations	174
Figure 97.	Macro Cell Tower Solutions Locations	175
Figure 98.	Macro Cell Tower Solutions Signal Transmission Types	175

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING

# WinterGreen Research, INC.

Figure 99.	Metro Cell Solution Signal Transmission Types	176
Figure 100.	SpiderCloud LTE Small Cell Technology	182
Figure 101.	Ericsson Small Cell Portfolio Features:	186
Figure 102.	Ericsson Positioning for Small Cells	187
Figure 103.	Ericsson End-To-End Integrated Small Cells	188
Figure 104.	Ericsson Small Cell Strand-Mount Unit for Outdoor Micro Radios Making It Easier To Install Radios On Existing Grid: Hung On Aerial Coax, Fiber, Or Electricity Cables	189
Figure 105.	Ericsson Multi-Operator Dot and the Multi-Dot Enclosure Functions	191
Figure 106.	Ericsson Dual Band Radio Dot	193
Figure 107.	Ericsson Hardened Radio Dot for Outdoor and Stadium Deployments	194
Figure 108.	Outdoor and Stadium Ericsson Hardened Radio Dot Small Cell Features	196
Figure 109.	Ericsson Small Cell In-Building Solutions	197
Figure 110.	Huawei Small Cells	201
Figure 111.	Huawei Positioning with Small Cells to Address Network Operator Needs	203
Figure 112.	Huawei Significant Breakthroughs In Air Interface Solutions	204
Figure 113.	Nokia eNode Bs Features	212
Figure 114.	Nokia 5G AirScale and AirFrame Radio Portfolio	213
Figure 115.	Nokia Broadband Traffic	214
Figure 116.	Nokia AirScale	215
Figure 117.	Nokia 5G Applications Remote Vehicle SubArrays, Multiple Nodes with 128 Antennae elements, Indoor Mobility, Adaptive Beam Tracking, Outdoor Vehicular Mobility	216
Figure 118.	Nokia In Building Wireless	217
Figure 119.	Nokia Small Cell Target Markets	218
Figure 120.	Nokia DAS and Hybrid Ethernet Based DAS	219
Figure 121.	Nokia Supports Indoor Wireless	220
Figure 122.	Nokia Advantages of Small Cells	221
Figure 123.	Small Cells Support Heterogeneous Network	222
Figure 124.	Nokia Small Cell Deployments	222
Figure 125.	Nokia AirScale Wi-Fi'	224
Figure 126.	NTSI Customers	225
Figure 127.	Mobile Carriers And Wireless Networks That Need Enhanced Reception	231
Figure 128.	Small Cell Forum Standardization Of Key Elements Of Small Cell Technology	233
Figure 129.	Small Cell Forum Membership Standardization Of Key Elements Of Small Cell Technology	234
Figure 130.	5G Issues As They Relate To Small Cells And Network Densification	235
Figure 131.	Small Cell Forum Issues, Virtualization, Cloud, Edge, Shared Spectrum, RAN	236
Figure 132.	Operational and Deployment Requirements, Including Regulatory Frameworks, Backhaul And Sites Topics	236
Figure 133.	Solid Technologies Small Cells for Hospitals	238
Figure 134.	Series of ZTE LTE Small Cell products	239
Figure 135.	ZTE Small Cell Product Highlights	240

## ABOUT THE COMPANY

**WinterGreen Research**, research strategy relates to identifying market trends through reading and interviewing opinion leaders. By using analysis of published materials, interview material, private research, detailed research, social network materials, blogs, and electronic analytics, the market size, shares, and trends are identified. Analysis of the published materials and interviews permits WinterGreen Research senior analysts to learn a lot more about markets. Discovering, tracking, and thinking about market trends is a high priority at WinterGreen Research. As with all research, the value proposition for competitive analysis comes from intellectual input.

**WinterGreen Research**, founded in 1985, provides strategic market assessments in telecommunications, communications equipment, health care, Software, Internet, Energy Generation, Energy Storage, Renewable energy, and advanced computer technology.

Industry reports focus on opportunities that expand existing markets or develop major new markets. The reports access new product and service positioning strategies, new and evolving technologies, and technological impact on products, services, and markets. Innovation that drives markets is explored. Market shares are provided. Leading market participants are profiled, and their marketing strategies, acquisitions, and strategic alliances are discussed. The principals of WinterGreen Research have been involved in analysis and forecasting of international business opportunities in telecommunications and advanced computer technology markets for over 30 years.

The studies provide primary analytical insight about the market participants. By publishing material relevant to the positioning of each company, readers can look at the basis for analysis. By providing descriptions of each major participant in the market, the reader is not dependent on analyst assumptions, the information backing the assumptions is provided, permitting readers to examine the basis for the conclusions.

### About The Principal Authors

**Susan Eustis**, President, co-founder of WinterGreen Research is a senior analyst. She has done research in communications and computer markets and applications. She holds several patents in microcomputing and parallel processing. She has the original patents in electronic voting machines where she was featured in People Magazine in 1976. She has new patent applications in format varying, multiprocessing, and electronic voting. She is the author of recent studies of the Solar Renewable Energy, Wind Energy, Thin Film Batteries, Business Process Management marketing strategies, Internet equipment, biometrics, a study of Internet Equipment, Worldwide Telecommunications Equipment, Top Ten Telecommunications, Digital Loop Carrier, Web Hosting, Web Services, and Application Integration markets. Ms. Eustis is a graduate of Barnard College. Susan Eustis was named as top female executive of the year by Who's Who Worldwide in 2012. She was named page one of the top 100 Industry leaders in Who's Who Worldwide in 2013, 2014, 2015, and 2016. She has been twice featured on the cover of the Women of Distinction magazine. She was cited in a recent Time Magazine cover article and major media Washington Post and WSJ articles on Youth Sports market growth.

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING



## WinterGreen Research, INC.

**About the WinterGreen Research Team:** The WinterGreen Research Team is comprised of senior analysts that prepare the market research and analysis that is offered to the client and developed using an iterative process to achieve a final study. Typical projects include providing market/viability research. The team can look at how drones can be applied to critical infrastructures safety, including: type of market existing, Barriers, Forecast demand and competitors, SWOT and competitive advantages, Price Analysis, product design recommendations (marketing orientation).

Research is typically for many different regions or localities, for example EU countries including Spain, UK, Nordic, Germany, and France. Typical projects profile the United States and areas of Asia. It is common to three representative countries from South America, Brazil, Argentina, Chile, and Mexico. Representative countries from Asia APAC typically include Japan, China, India, and Australia.

Critical infrastructure safety, including: type of market existing, barriers to entry and to faithful execution of product provision, forecast of demand, market share, SWOT, competitive advantage of major competitors, identification of new technologies and new companies, price performance analysis, product design recommendations, and marketing considerations are typical topics covered.

REPORT # SH27321424

248 PAGES

135-TABLES AND FIGURES

2018

781 863 5078 info@wintergreenresearch.com

\$4,300 SINGLE COPY -- \$8,600 WEB SITE POSTING