

**U.S. Outdoor and  
Indoor DAS Forecast,  
2017 – 2022: *DAS in a  
Soon-to-Be 5G World***

Market Study  
Third Quarter 2018





---

# **U.S. Outdoor and Indoor DAS Forecast, 2017 – 2022: *DAS in a Soon-to-be 5G World***

---

## Market Study

Published Third Quarter 2018  
Version 1.0  
Report Number: 03Q2018-03

*iGR*  
12400 W. Hwy 71  
Suite 350 PMB 341  
Austin TX 78738

# Table of Contents

<b>Abstract</b> .....	<b>1</b>
<b>Executive Summary</b> .....	<b>3</b>
Figure A: Installed DAS Nodes, U.S. only, 2017-2022 .....	4
<b>Methodology</b> .....	<b>6</b>
<b>Basic Mobile Operator Network Architecture</b> .....	<b>8</b>
Figure 1: Basic Components of Cellular Voice/Data Network .....	8
<b>Wireless Spectrum</b> .....	<b>10</b>
<b>Cell Sites</b> .....	<b>11</b>
<b>The Different Types of Haul</b> .....	<b>13</b>
Figure 2: Cell Site Backhaul Capabilities and Use Cases, Wired and Wireless.....	14
<b>Setting the Stage for Small Cells</b> .....	<b>15</b>
<b>Network “Pain Points”</b> .....	<b>16</b>
<b>Different Types of Small Cells</b> .....	<b>16</b>
Figure 3: Het-Net Overview.....	17
<b>iGR’s Definitions of Small Cells</b> .....	<b>18</b>
Table 1: Different Types of Small Cells, Licensed and Unlicensed Spectrum .....	18
<b>Distributed Antenna Systems (DAS)</b> .....	<b>19</b>
Figure 4: Basic DAS Configuration .....	20
Figure 5: DAS, BTS Hotels, and Remote Radio Heads.....	21
<b>Hybrid Antenna System</b> .....	<b>21</b>
<b>DAS/Small Cell Architecture</b> .....	<b>22</b>
DAS Lite .....	23
<b>Neutral-Host DAS vs. Single Host DAS</b> .....	<b>23</b>
Table 2: Benefits of Neutral-Host DAS .....	24
<b>Changing Nature of DAS</b> .....	<b>24</b>
Figure 6: Types of DAS.....	25
<b>Signal Boosters</b> .....	<b>26</b>
<b>Femtocells and Picocells</b> .....	<b>27</b>
<b>Metrocells</b> .....	<b>28</b>
<b>Remote Radio Heads</b> .....	<b>28</b>
<b>Difference Between RRHs and oDAS</b> .....	<b>29</b>
<b>Difference between RRHs and Metrocells</b> .....	<b>29</b>
<b>Multi-band Small Cells</b> .....	<b>29</b>
Figure 7: 3GPP Approaches to Network Sharing.....	31
<b>In-Building Small Cells: Awareness, Pros and Cons</b> .....	<b>32</b>
<b>Benefits of Deploying In-Building Small Cells</b> .....	<b>32</b>
<b>Cons of Deploying In-Building Small Cells</b> .....	<b>32</b>
<b>Advantages Provided by DAS</b> .....	<b>33</b>
Table 3: Advantages of DAS.....	33

Quoting information from an iGillottResearch publication: external — any iGillottResearch information that is to be used in press releases, sales presentations, marketing materials, advertising, or promotional materials requires prior written approval from iGillottResearch. iGillottResearch reserves the right to deny approval of external usage for any reason. Internal-quoting individual sentences and paragraphs for use in your company’s internal communications activities does not require permission from iGillottResearch. The use of large portions or the reproduction of any iGillottResearch document in its entirety does require prior written approval and may have some financial implications.

Copyright © 2018 iGillottResearch, Inc. Reproduction is forbidden unless authorized.

FOR INFORMATION PLEASE CONTACT IAIN GILLOTT (512) 263-5682.

<b>Challenges with DAS Deployments .....</b>	<b>34</b>
Table 4: Challenges of DAS.....	34
<b>Related Topics: MEC, CBRS and Proptech .....</b>	<b>36</b>
<b>MEC.....</b>	<b>36</b>
<b>CBRS.....</b>	<b>37</b>
<b>Proptech.....</b>	<b>39</b>
<b>Commercial Buildings in the U.S. ....</b>	<b>40</b>
Table 5: Commercial Buildings in the U.S.....	40
Table 6: Commercial Buildings in the U.S.....	41
Figure 8: Commercial Buildings in the U.S.....	43
Table 7: Commercial Buildings in the U.S.....	43
Figure 9: Buildings in the U.S.....	44
Table 8: Number of Floors per Commercial Building .....	45
Figure 10: Number of Floors per Commercial Building .....	45
Table 9: Predominant Roof Material.....	46
Figure 11: Predominant Roof Material.....	47
Table 10: Predominant Exterior Wall Material.....	48
Figure 12: Predominant Exterior Wall Material .....	49
Table 11: Windows and Interior Lighting Features .....	50
Figure 13: Windows and Interior Lighting Features .....	51
<b>Housing in the U.S. ....</b>	<b>52</b>
Table 12: Number of Housing Units by Units in Structure, U.S. ....	52
Figure 14: Number of Housing Units by Units in Structure, U.S.....	53
Table 13: Structures by Number of Floors, U.S. ....	53
Figure 15: Housing Units by Number of Floors, U.S. ....	54
Table 14: Square Footage of Housing Units, AHS.....	54
Figure 16: Square Footage of Housing Units, AHS.....	55
<b>Outdoor Small Cell Deployment Issues .....</b>	<b>56</b>
<b>Small Cell Deployment Requirements .....</b>	<b>56</b>
<b>Small Cell Installations .....</b>	<b>57</b>
<b>Locations for Small Cells .....</b>	<b>58</b>
<b>Small Cell Deployment Issues .....</b>	<b>61</b>
Figure 17: Possible Interference Sources in a Loaded Network .....	61
X2.....	62
COMP .....	62
Figure 18: Overview of COMP .....	63
ICIC and eICIC .....	64
Figure 19: Example of Intercell Interference.....	64
Figure 20: Example of Coordinated Resource Blocks via ICIC .....	65
Figure 21: Blanking of subframes in eICIC .....	66
Synchronization.....	66
Latency .....	67
<b>General Trends / Assumptions around Outdoor Small Cells .....</b>	<b>68</b>
<b>Market Drivers .....</b>	<b>70</b>

Quoting information from an iGillottResearch publication: external — any iGillottResearch information that is to be used in press releases, sales presentations, marketing materials, advertising, or promotional materials requires prior written approval from iGillottResearch. iGillottResearch reserves the right to deny approval of external usage for any reason. Internal-quoting individual sentences and paragraphs for use in your company's internal communications activities does not require permission from iGillottResearch. The use of large portions or the reproduction of any iGillottResearch document in its entirety does require prior written approval and may have some financial implications.

Copyright © 2018 iGillottResearch, Inc. Reproduction is forbidden unless authorized.

FOR INFORMATION PLEASE CONTACT IAIN GILLOTT (512) 263-5682.

<b>Market Inhibitors .....</b>	<b>71</b>
<b>Assumptions around Indoor Small Cells.....</b>	<b>73</b>
<b>DAS: Actual Deployments.....</b>	<b>78</b>
<b>DAS-specific Assumptions.....</b>	<b>78</b>
<b>U.S. Installed DAS Nodes .....</b>	<b>81</b>
Table 15: U.S. Installed DAS Nodes, 2017-2022 .....	81
Figure 22: Actual U.S. DAS Deployments by Type, 2017-2022 .....	82
<b>U.S. DAS Systems.....</b>	<b>82</b>
Table 16: U.S. DAS Systems, 2017-2022 .....	83
Figure 23: U.S. DAS Systems, 2017-2022.....	84
<b>DAS Vendor Profiles .....</b>	<b>85</b>
<b>Advanced RF Technologies, Inc. (ADRF).....</b>	<b>85</b>
<b>Bandwidth Logic .....</b>	<b>86</b>
<b>Betacom Incorporated.....</b>	<b>86</b>
<b>BTI Wireless.....</b>	<b>87</b>
<b>C Squared Systems (C<sup>2</sup> Systems) .....</b>	<b>88</b>
<b>Cobham Wireless.....</b>	<b>89</b>
<b>Comba Telecom .....</b>	<b>92</b>
<b>CommScope .....</b>	<b>95</b>
<b>Connectivity Wireless Solutions.....</b>	<b>99</b>
<b>Corning.....</b>	<b>101</b>
<b>Crown Castle .....</b>	<b>103</b>
<b>Dali Wireless.....</b>	<b>106</b>
<b>ExteNet Systems.....</b>	<b>108</b>
<b>Galtronics .....</b>	<b>111</b>
<b>iBwave Solutions (Corning).....</b>	<b>112</b>
<b>SOLiD.....</b>	<b>114</b>
<b>Solutelia .....</b>	<b>117</b>
<b>Westell Technologies.....</b>	<b>119</b>
<b>Zinwave.....</b>	<b>120</b>
<b>Definitions .....</b>	<b>124</b>
Definitions Table .....	124
<b>About iGR.....</b>	<b>146</b>
<b>Disclaimer .....</b>	<b>146</b>

## Abstract

---

All of the talk these days is about 5G – with good reason. This is the year (2018) that marks the start of the transition of 4G LTE to 5G New Radio (NR).

Will distributed antenna systems, indoor and outdoor, have a role in the 5G world? Absolutely. But just as the architecture of radio access networks (RANs) will change as operators move from LTE to 5G, so too will DAS change.

That said, DAS began years ago with passive systems, donor antennas and coaxial cable. Today's DAS may look a bit different – with remote units, fiber, maybe even a CPRI connection or a small cell as the radio source. But, the function is unchanged – provide coverage inside a building (iDAS) or in an outdoor area (oDAS).

In a 5G world, indoor DAS will perform the same function – provide coverage and capacity indoors – but the RF source and the processing will no longer be in the building. Outdoor DAS is already getting supplanted by what is now called Distributed RAN (DRAN) which is, simply, baseband processing at a centralized location (central office, macrocell site). Eventually, DRAN will get supplanted by Cloud RAN (CRAN). That transition will happen slowly over the next few years.

Today, buildings increasingly need indoor cellular coverage and capacity. Many of the venues that need DAS – stadiums, hotels, airports, etc., – already have it. From an outdoor perspective, *iGR* believes that the market for oDAS is fading because "RRH as small cells" (which is the DRAN model, essentially) provides a similar level of coverage/capacity with better future flexibility – i.e., moving toward CRAN. Also, mobile operators need coverage/capacity in different places in an urban/metro area so, as compared to indoors where shared antennas can enable lower costs, that same shared antenna model may not work quite as well outdoors.

*iGR* splits the DAS market by indoor and outdoor and then further divides the indoor market into commercial buildings and residential (multiple dwelling units or MDUs). *iGR's* oDAS forecast grows out of its "outdoor small cell" model and market study, while its iDAS forecast grows out of its "indoor small cell" model and market study. This market study highlights the DAS-specific portions of those models and market studies. The commercial building segment is where *iGR* believes most of the DAS growth will occur over the next five years.

This market study provides a brief overview of the different types of small cells, including DAS, and the goals around future iDAS and oDAS deployments. It then provides an explanation of the methodology used to create the actual iDAS and oDAS forecasts, both for nodes and DAS systems.

Note that CBRS is not included in these forecasts. Although *iGR* believes that CBRS (3.5 GHz) will have a major role to play in the growth of in-building cellular networks, the rules governing CBRS are in debate right now. *iGR* will not include CBRS in this DAS forecast until the FCC's rules are finalized and their impact can be reasonably judged.

Key questions addressed in this market study include:

- What is an outdoor small cell? What are metrocells, RRHs and oDAS?
- What is an indoor small cell? What are femtocells, picocells and iDAS?
- What is a DAS?
- Why do the mobile networks need iDAS and oDAS?
- How does DAS fit into operators' evolving networks?
- What are the issues with deploying DAS in the U.S.? How do these issues impact the number of small cells in the market?
- What is the role of CPRI with iDAS and oDAS?
- How is DAS changing/evolving?
- Where are DAS nodes most likely to be located? What's their role?

Who should read this market study?

- Mobile operators
- Infrastructure OEMs
- Small cell product and solution vendors
- Backhaul service providers and equipment OEMs
- Financial analysts and investors.