

TRANSPORTATION





Entire contents ©2018 by ON World. All rights reserved. The information contained herein has been obtained from sources believed to be reliable. ON World takes no responsibility for any inaccuracies, completeness or adequacy of such information. ON World shall have no liability for errors, omissions or inadequacies in the information contained herein or for interpretations 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.

No part of this report excerpt may be given, lent, resold, or disclosed to non-customers without permission. Reproduction or disclosure in whole or in part to other parties is permitted only with the written and express consent of ON World.

This document is a free report excerpt. A full version of the report may be purchased directly from our website for an immediate download. If you need an invoice, please call or email us at: research@onworld.com

ON World Inc.
Emerald Plaza Center
402 West Broadway
Suite 400
San Diego, California 92101
<http://www.onworld.com>

Toll free (U.S.): 888.312.2619
International: 858.259.2397



Executive Summary

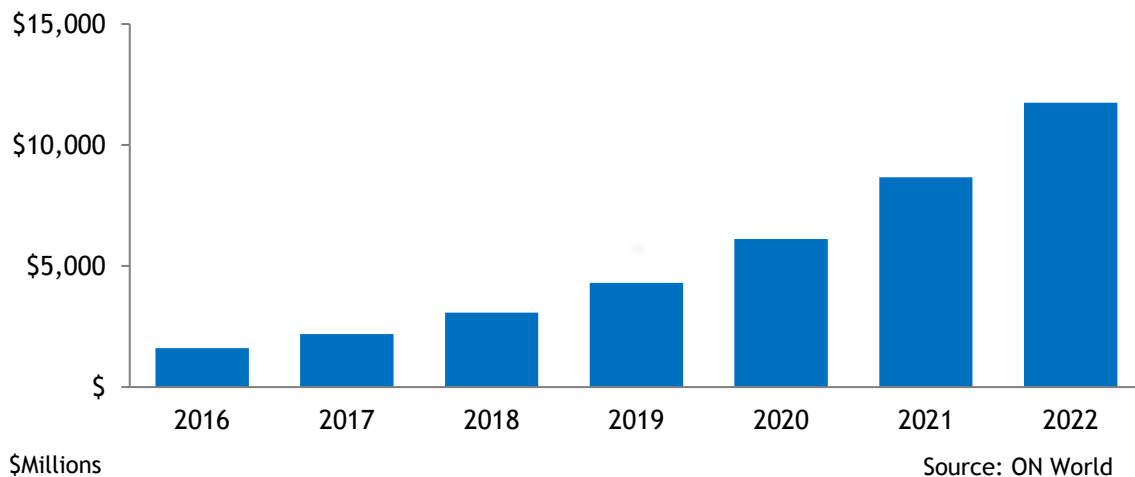
This report covers the Internet of Things (IoT) opportunities provided by Low Power Wide Area (LPWA) networking for the multi-trillion-dollar transportation industry. LPWA technologies such as Sigfox, LoRa^{®1}, LTE-M and NB-IoT are providing transportation markets with low cost multi-kilometer ubiquitous cloud connectivity. These LPWA technologies and their ecosystems are rapidly reshaping low power outdoor sensing and control networks.

LTE-M and LoRa provide unique advantages for transportation IoT by enabling ultra-low power consumption for mobile vehicle sensors. NB-IoT is most suited to fixed wireless sensing such as parking management, streetlight monitoring and electric vehicle charging infrastructure monitoring. Most LPWA technologies are targeting tracking and locating mobile assets with an accuracy of a hundred meters. For example, bicycles and rapidly expanding e-Bike offerings represents one of the largest potential LPWA markets with over 1 billion in use worldwide. Intensifying efforts to reduce dependence on gas-powered vehicles has resulted in today’s billion-dollar bike sharing industry and accelerating adoption of electric vehicles.

Driven by the enormous popularity and brand awareness of Tesla’s vehicles, self-driving electric cars and trucks that travel hundreds of miles on a single charge has transformed the auto industry. At the same time, smart city initiatives are appearing worldwide for energy efficiency, pollution abatement and streamlined resident services such as streetlight monitoring, parking availability, traffic signal optimization, electronic tolling and monitoring of bridges, dams, canals and tunnels.

Transportation LPWA revenues will increase 550% to reach \$11.8 billion in 2022. However, the opportunities vary significantly for each of the market segments.

Figure 1: Global Transportation LPWA Revenues (2016-2022)



¹ The LoRa[®] Mark is a trademark of Semtech Corporation or its subsidiaries.

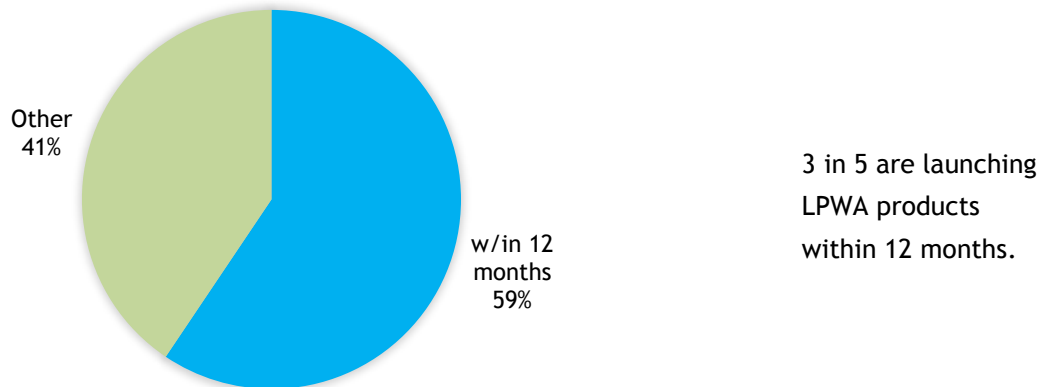


LPWA technology developments over the past year include 3GPP’s Release 13 that includes LTE-NB1 (NB-IoT) and LTE-M1 that has resulted in rapid LTE network deployments with trials for bicycle tracking, parking management and streetlight monitoring under way.

In October 2017, the LoRa Alliance released the LoRaWAN^{TM2} 1.1 specification with support for passive and active roaming, class B devices as well as security enhancements. These features are especially suited for mobile transportation applications such as vehicle tracking and monitoring but LoRaWAN’s use is also growing for fixed transportation wireless sensing applications including parking, streetlights as well as monitoring of dams, canals and embankments that are essential for land and water transportation.

Our latest phone interviews and surveys with 250+ industrial IoT professionals found that nearly half are researching or developing LPWA networking solutions. Sixty-one (61%) of LPWA developers are planning to launch their LPWA products within the next 12 months.

Figure 2: LPWA Developers Product Launch Timeline



Source: ON World

In this report, we cover the growing LPWA market opportunities for transportation systems, electric vehicle charging infrastructure as well as connected vehicles and bikes. It includes market size forecasts (2016-2022) for connected devices, annual unit shipments and breakdowns by market, application, technology, geography and equipment/services; the results from several surveys; an in-depth technology evaluation; and analysis of the value system with 100+ companies.

² LoRa AllianceTM and LoRaWANTM are marks used under license from the LoRa Alliance.



Methodology/Scope

This report covers the global market opportunity for Low Power Wide Area (LPWA) technologies for transportation including smart city applications as well as connected cars, electric vehicle charging infrastructure and bicycle tracking. In addition, we include the total addressable market for connected wireless sensing, tracking and control devices for each market segment (LPWA and others). Our methodology uses extensive primary research with hundreds of individuals across the whole transportation IoT value chain, an in-depth technology evaluation, weighted market drivers and a competitive analysis of 100+ companies. The major components of our research include the following:

Data Collection/Investigation:

- 250+ surveys/phone interviews with transportation IoT professionals, network operators, IoT platform providers, equipment manufacturers, component suppliers and other experts.
- Analysis of hundreds of financial, industry and technical reports.

Segmentation:

Geographies:	North America, Western Europe, Asia Pacific and Rest of World
Markets segments:	Transportation systems, Connected Vehicles, EV Charging Infrastructure, Connected Bikes
Solutions:	Streetlight monitoring, traffic management, parking management, geotechnical monitoring, asset tracking/monitoring and other condition monitoring.
Product segments:	LPWA equipment (End nodes, repeaters, gateways and associated software) and services (installation, maintenance, connectivity and value-added services)

Competitive Forces & Technology Dynamics:

- Product segmentation, value chain and business model analysis
- Distribution channels, product availability and vendor strength
- Standards developments, technology adoption and emerging technologies
- Analysis of 100+ companies (offerings, pricing, partners, financials and potential for disruption/sustainability)

Market Size Forecasts:

- **Market data:** Recent data is collected from vendors, suppliers and end users on unit sales, growth trends, applications, hardware/service pricing, distribution channels, etc.
- **Market drivers:** Analysis of the weighted driver impact for each solution/market.
- **Projections:** Using all the above, we create data models from a moderate and aggressive viewpoint. Breakdowns are provided by target market, application, product segment, geography and technology. Revenues are for equipment, RF modules and services.
- **Verification:** Forecasts are benchmarked with secondary sources and verified with market leading vendors and industry experts.



Table of Contents

- Executive Summary 1
- Methodology/Scope 3
- The Ecosystem 4
 - Smart Cities..... 4
 - Transportation Systems..... 5
 - Traffic Management 5
 - Electronic Tolling 6
 - Geotechnical Monitoring..... 6
 - Parking Management 6
 - Streetlight Monitoring 8
- Connected Vehicles 9
- LPWA Applications..... 12
 - EV Charging Infrastructure 12
 - Connected Car Aftermarket..... 13
 - Car/Ride Sharing 14
- Connected Bicycles 15
- Total Potential Market Sizing..... 16
 - Connected Vehicles & Bikes 16
 - Transportation Systems 17
 - TPM by Geographical Region..... 17
- Industrial IoT Survey 19
 - Respondent Overview 19
 - Wireless Sensor Networks 21
 - Most Important Features 21
 - Satisfaction with Current WSN Systems..... 21
 - Future WSN Applications 22
 - Adoption Inhibitors 23
 - Innovation Areas 23
 - Strategic Investments 24
 - IoT Platforms Used 24
- Low Power Wide Area (LPWA) Networks 25
 - LPWA Awareness 25
 - LPWA Applications 26
 - Product Development 27
 - LPWA Channels 27
 - Market Impact 28
 - LPWA Disruption 28
 - Future Projections 29



 Surveyed Organizations 30

Technology Dynamics 32

 Cellular Based LPWA Technologies 33

 3GPP 33

 LTE-M1 33

 NB-IoT 33

 Non-Cellular LPWA Technologies 34

 Sigfox 34

 LoRa Alliance 34

 Weightless SIG 35

 ETSI’s Low Throughput Networks (LTN) 35

 IEEE 802.15.4k (Low Energy Critical Infrastructure Networks) 36

 Other LPWAN Technologies 36

 RPMA (Ingenu) 36

 Qowisio 36

 Link Labs 36

 NB-Fi (WAVIoT) 37

 Telematics Wireless 37

 vMonitor (Rockwell) 37

 LPWA Network Tests 38

Global Total Market Size Forecasts 39

 Methodology 39

 Global Connected Devices 40

 Global Connected Devices by Market 41

 Global Total Revenues by Market 42

 Global Total Units, Moderate & Aggressive 43

 Global Total Units by Solution 44

 Global Total Revenues by Solution 45

 Global Total Revenues by Equipment & Services 46

 Global Total Revenues by Geography 47

 Global Total Units by Technology 48

Transportation Systems 49

 Summary 49

 Total Connected Devices 50

 Unit Shipments 51

 Units by Solution 52

 Revenues by Solution 53

 Revenues by Equipment & Services 54

 Revenues by Geography 55

 Unit Shipments by Technology 56



Connected Vehicles 57

 Summary..... 57

 Total Connected Devices 58

 Unit Shipments 59

 Revenues for Equipment & Services 60

 Revenues by Geography 61

 Unit Shipments by Technology 62

Electric Vehicle Charging Infrastructure 63

 Summary..... 63

 Total Connected Devices 64

 Unit Shipments 65

 Revenues for Equipment & Services 66

 Revenues by Geography 67

 Unit Shipments by Technology 68

Connected Bicycles 69

 Summary..... 69

 Total Connected Devices 70

 Unit Shipments 71

 Revenues by Equipment & Services..... 72

 Revenues by Geography 73

 Unit Shipments by Technology 74

Competitive Landscape..... 75

 Components 75

 Product Segmentation 75

 Company Profiles 76

IoT Connectivity, Device Management & Integration 78

 Product Segmentation 78

 Company Profiles 79

Smart City IoT Systems & Platforms..... 81

 Company Profiles 81

Connected Car Systems & Platforms 83

 Company Profiles 83

Network Operators 87

 Company Profiles 87

List of Figures

Figure 1: Global Transportation LPWA Revenues (2016-2022)..... 1

Figure 2: LPWA Developers Product Launch Timeline 2

Figure 3: The Smart City IoT Value System 4



Figure 4: Parking Management, Smart Parking & Others (2017-2025) 7

Figure 5: Global Smart Street Lights (2017-2025) 8

Figure 6: Connected Car Adoption Drivers Rated 9

Figure 7: Consumers Most Likely Paid Connected Car Services (Select) 10

Figure 8: Global Connected Vehicles (2016-2025) 10

Figure 9: Global Public EVSE Connectors Installed by Region (2016-2022)..... 12

Figure 10: Connected Car Revenues, Car/Ride Sharing & Others (2016-2022) 14

Figure 11: Global Connected Bikes in Use (2017-2025) 15

Figure 12: Global Connected Cars & Bikes by Market Segment 16

Figure 13: Global Transportation LPWA TPM by Market Segment..... 17

Figure 14: Global Transportation LPWA TPM by Region 17

Figure 15: Transportation LPWA TPM by Region and Application 18

Figure 16: Respondents by Industry Role 19

Figure 17: Respondents by Job Position 19

Figure 18: Respondents by Geographical Region 20

Figure 19: Respondents by Targeted Industry 20

Figure 20: Most Important WSN Features Rated 21

Figure 21: Satisfaction with WSN Systems 21

Figure 22: Planning Future/Additional WSN 22

Figure 23: Planned WSN Applications 22

Figure 24: WSN Inhibitors Rated 23

Figure 25: Most Important IoT Innovations..... 23

Figure 26: Most Important Strategic Investments 24

Figure 27: IoT Platforms Used 24

Figure 28: LPWA Adoption Status..... 25

Figure 29: Awareness of LPWA Technologies 25

Figure 30: Wireless Sensing/M2M Applications Requiring >1K Bytes/Day 26

Figure 31: LPWA Most Likely Types of Applications 26

Figure 32: LPWA Product Timeline 27

Figure 33: Most Likely LPWA Channels..... 27

Figure 34: LPWA’s Impact by Market..... 28

Figure 35: LPWA’s Disruption on Existing WSN Technologies 28

Figure 36: LPWA IoT Penetration Rate by 2025 29

Figure 37: Most Likely LPWA Technologies..... 29

Figure 38: LPWAN Technologies - Range in Meters 38

Figure 39: LPWAN Technologies - 5000 Node Percent Complete vs Power Used..... 38

Figure 40: Global Transportation Connected WSN Devices, LPWA & Others (2016-2022) 40

Figure 41: Global Transportation Connected LPWA Devices by Market (2016-2022) 41

Figure 42: Global Transportation LPWA Revenues by Market (2016-2022) 42

Figure 43: Global Transportation LPWA Annual Units, Moderate & Aggressive (2016-2022) 43



Figure 44: Global Transportation LPWA Units by Solution (2016-2022)..... 44

Figure 45: Global Transportation LPWA Revenues by Solution (2016-2022) 45

Figure 46: Global Transportation LPWA Revenues by Eqpmnt & Services (2016-2022) 46

Figure 47: Global Transportation LPWA Revenues by Geography (2016-2022) 47

Figure 48: Global Transportation LPWA Chipsets by Technology (2016-2022)..... 48

Figure 49: Global Smart City Transportation WSN Connections (2016-2022) 49

Figure 50: Global Gov’t Transportation Connected WSN Devices, LPWA & Others (2016-2022) 50

Figure 51: Global Gov’t Transportation LPWA Annual Units, Moderate & Aggressive (2016-2022) .. 51

Figure 52: Global Gov’t Transportation LPWA Annual Units by Solution (2016-2022)..... 52

Figure 53: Global Gov’t Transportation LPWA Revenues by Solution (2016-2022)..... 53

Figure 54: Global Gov’t Transportation LPWA Revenues by Eqpmnt & Services (2016-2022)..... 54

Figure 55: Global Gov’t Transportation LPWA Revenues by Geography (2016-2022) 55

Figure 56: Global Gov’t Transportation LPWA Chipsets by Technology (2016-2022)..... 56

Figure 57: Global Connected Vehicles (2016-2022) 57

Figure 58: Global Connected Vehicle WSN Devices, LPWA & Others (2016-2022) 58

Figure 59: Global Connected Vehicle LPWA Annual Units, Moderate & Aggressive (2016-2022) 59

Figure 60: Global Connected Vehicle LPWA Revenues by Eqpmnt & Services (2016-2022) 60

Figure 61: Global Connected Vehicle LPWA Revenues by Geography (2016-2022) 61

Figure 62: Global Connected Vehicle LPWA Chipsets by Technology (2016-2022)..... 62

Figure 63: Global Installed Commercial/Public EV Charging Station (2016-2022) 63

Figure 64: Global Networked EV Charging Stations, LPWA & Others (2016-2022) 64

Figure 65: Global EV Charging LPWA Annual Units, Moderate & Aggressive (2016-2022)..... 65

Figure 67: Global EV Charging LPWA Revenues by Eqpmnt & Services (2016-2022)..... 66

Figure 68: Global EV Charging LPWA Revenues by Geography (2016-2022)..... 67

Figure 69: Global EV Charging LPWA Chipsets by Technology (2016-2022) 68

Figure 70: Global Connected Bikes (2016-2022) 69

Figure 71: Global Connected Bikes, LPWA & Others (2016-2022)..... 70

Figure 72: Global Connected Bike LPWA Annual Units, Moderate & Aggressive (2016-2022)..... 71

Figure 73: Global Connected Bike LPWA Revenues by Eqpmnt & Services (2016-2022) 72

Figure 74: Global Connected Bike LPWA Revenues by Geography (2016-2022) 73

Figure 75: Global Connected Bike LPWA Chipsets by Technology (2016-2022)..... 74

List of Tables

Table 1: The Connected Vehicle Value System 11

Table 2: The Electric Vehicle Charging Value System 13

Table 3: LPWA Technologies Compared 32

Table 4: Global Transportation Connected WSN Devices, LPWA & Others (2016-2022) 40

Table 5: Global Transportation Connected LPWA Devices by Market (2016-2022) 41



Table 6: Global Transportation LPWA Revenues by Market (2016-2022) 42

Table 7: Global Transportation LPWA Annual Units, Moderate & Aggressive (2016-2022) 43

Table 8: Global Transportation LPWA Units by Solution (2016-2022) 44

Table 9: Global Transportation LPWA Revenues by Solution (2016-2022)..... 45

Table 10: Global Transportation LPWA Revenues by Eqpmnt & Services (2016-2022) 46

Table 11: Global Transportation LPWA Revenues by Geography (2016-2022) 47

Table 12: Global Transportation LPWA Chipsets by Technology (2016-2022) 48

Table 13: Global Gov't Transportation Connected WSN Devices, LPWA & Others (2016-2022) 50

Table 14: Global Gov't Transportation LPWA Annual Units, Moderate & Aggressive (2016-2022) ... 51

Table 15: Global Gov't Transportation LPWA Annual Units by Solution (2016-2022)..... 52

Table 16: Global Gov't Transportation LPWA Revenues by Solution (2016-2022) 53

Table 17: Global Gov't Transportation LPWA Revenues by Eqpmnt & Services (2016-2022) 54

Table 18: Global Gov't Transportation LPWA Revenues by Geography (2016-2022) 55

Table 19: Global Gov't Transportation LPWA Chipsets by Technology (2016-2022)..... 56

Table 20: Global Connected Vehicle WSN Devices, LPWA & Others (2016-2022) 58

Table 21: Global Connected Vehicle LPWA Annual Units, Moderate & Aggressive (2016-2022) 59

Table 22: Global Connected Vehicle LPWA Revenues by Eqpmnt & Services (2016-2022) 60

Table 23: Global Connected Vehicle LPWA Revenues by Geography (2016-2022) 61

Table 24: Global Connected Vehicle LPWA Chipsets by Technology (2016-2022)..... 62

Table 25: Global Networked EV Charging Stations, LPWA & Others (2016-2022) 64

Table 26: Global EV Charging LPWA Annual Units, Moderate & Aggressive (2016-2022) 65

Table 28: Global EV Charging LPWA Revenues by Eqpmnt & Services (2016-2022)..... 66

Table 29: Global EV Charging LPWA Revenues by Geography (2016-2022)..... 67

Table 30: Global EV Charging LPWA Chipsets by Technology (2016-2022) 68

Table 31: Global Connected Bikes, LPWA & Others (2016-2022) 70

Table 32: Global Connected Bike LPWA Annual Units, Moderate & Aggressive (2016-2022)..... 71

Table 33: Global Connected Bike LPWA Revenues by Eqpmnt & Services (2016-2022) 72

Table 34: Global Connected Bike LPWA Revenues by Geography (2016-2022) 73

Table 35: Global Connected Bike LPWA Chipsets by Technology (2016-2022) 74

Table 36: LPWAN Component Suppliers by Product Segment 75

Table 37: LPWA Components - Profiles 76

Table 38: IoT Connectivity & Device Mgmt Platforms by Product Segment..... 78

Table 39: IoT/LPWA Connectivity & Device Mgmt Platforms - Profiles 79

Table 40: Smart City/ Transportation IoT Systems & Platforms - Profiles 81

Table 41: Connected Car/EV Charging Systems & Platforms - Profiles 83

Table 42: (Select) LPWA Network Operators 87



ON World Inc.
Emerald Plaza Center
402 West Broadway
Suite 400
San Diego, California 92101
<http://www.onworld.com>

Toll free phone (U.S.): 888.312.2619
International callers: 858.259.2397

ON World provides business intelligence on Internet of Things markets. Our market research is used by Fortune 1000 companies, startups and investors worldwide.

If you have any questions on the report, please call us or send us an email at: research@onworld.com