

# **The NFV, SDN & Wireless Network Infrastructure Market: 2016 – 2030 – Opportunities, Challenges, Strategies and Forecasts**

<https://marketpublishers.com/r/N7455BD57E5EN.html>

Date: May 2016

Pages: 1680

Price: US\$ 4,000.00 (Single User License)

ID: N7455BD57E5EN

## **Abstracts**

Service providers continue to face increasing CapEx and OpEx burdens, amid growing requirements for high-speed mobile broadband services. By eliminating reliance on expensive proprietary hardware platforms, NFV (Network Functions Virtualization) and SDN (Software Defined Networking) promise to reduce service provider CapEx. In addition, both technologies can significantly slash OpEx due to a reduction in physical space, labor and power consumption.

Driven by the promise of TCO (Total Cost of Ownership) reduction, mobile operators are aggressively jumping on the NFV and SDN bandwagon, targeting deployments across a multitude of areas. By the end of 2020, SNS Research estimates that NFV and SDN investments on service provider networks will account for over \$18 Billion. These investments will initially focus on EPC/mobile core, IMS, policy control, CPE (Customer Premises Equipment), CDN (Content Delivery Network) and transport networks.

Spanning over 1,600 pages, the "NFV, SDN & Wireless Network Infrastructure Market: 2016 – 2030 – Opportunities, Challenges, Strategies and Forecasts" report package encompasses three comprehensive reports covering covering NFV, SDN, conventional 2G, 3G, 4G & 5G wireless network infrastructure and HetNet (Heterogeneous Network) infrastructure:

The SDN, NFV & Network Virtualization Ecosystem: 2016 – 2030 – Opportunities, Challenges, Strategies & Forecasts

The Wireless Network Infrastructure Ecosystem: 2016 – 2030 – Macrocell RAN, Small Cells, C-RAN, RRH, DAS, Carrier Wi-Fi, Mobile Core, Backhaul &

## Fronthaul

### The HetNet Ecosystem (Small Cells, Carrier Wi-Fi, C-RAN & DAS): 2016 – 2030 – Opportunities, Challenges, Strategies & Forecasts

This report package provides an in-depth assessment of NFV, SDN, network virtualization, 2G, 3G, 4G & 5G wireless network infrastructure and HetNet gear. Besides analyzing enabling technologies, key trends, market drivers, challenges, use cases, mobile operator case studies, regional CapEx commitments, regulatory landscape, standardization, opportunities, future roadmap, value chain, ecosystem player profiles and strategies, the report package also presents revenue and unit shipment forecasts for multiple submarkets including:

#### Conventional 2G, 3G, 4G & 5G Wireless Network Infrastructure

Macrocell RAN Base Stations

Macrocell Backhaul

Mobile Core

#### HetNet Infrastructure

Small Cells

Small Cell Backhaul

Carrier Wi-Fi

C-RAN (Centralized RAN)

C-RAN Fronthaul

DAS (Distributed Antenna Systems)

#### NFV

Hardware Appliances

Orchestration & Management Software

VNF (Virtualized Network Function) Software

## SDN

SDN-Enabled Hardware Appliances

SDN-Enabled Virtual Switches

Orchestration & Management Software

SDN Controller Software

Network Applications Software

The report package comes with an associated Excel datasheet suite covering quantitative data from all numeric forecasts presented in the report package.

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- 4.3.12 DT (Deutsche Telekom)
- 4.3.13 MTS (Mobile TeleSystems)
- 4.3.14 Orange
- 4.3.15 Telenor Group
- 4.3.16 SK Telecom
- 4.3.17 Vivo
- 4.3.18 TIM Brazil
- 4.3.19 LG Uplus
- 4.3.20 Telkomsel
- 4.3.21 Megafon
- 4.3.22 Bharti Airtel
- 4.3.23 Movistar Venezuela
- 4.3.24 TIM (Telecom Italia Mobile)
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- 4.6 Latin & Central America Mobile Network CapEx
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- 5.4 Regional Split
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  - 6.3.3 Growing Backhaul Capacity & Latency Requirements
  - 6.3.4 IPsec
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  - 6.3.6 Developing a HetNet Backhaul Strategy
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7.1.2 2020 - 2025: The Cloud RAN Era - Moving Towards C-RAN and Virtualization

7.1.3 2025 - 2030: Continued Investments with 5G Network Rollouts

## 7.2 Value Chain

## 7.3 Embedded Technology Ecosystem

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7.3.2 Embedded Component/Software Providers

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7.4.2 Pure-Play Small Cell OEMs

7.4.3 Wi-Fi Access Point OEMs

7.4.4 DAS & Repeater Solution Providers

7.4.5 C-RAN Solution Providers

7.4.6 Other Technology Providers

## 7.5 Transport Networking Ecosystem

7.5.1 Backhaul & Fronthaul Solution Providers

## 7.6 Mobile Core Ecosystem

7.6.1 Mobile Core Solution Providers

## 7.7 Connectivity Ecosystem

7.7.1 Mobile Operators

7.7.2 Wi-Fi Connectivity Providers

7.7.3 SCaaS (Small Cells as a Service) Providers

## 7.8 SON Ecosystem

7.8.1 SON Solution Providers

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7.9.1 SDN & NFV Providers

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8.1.1 Pricing & Growth Sustainability

8.1.2 Portfolio Diversification

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8.2.1 Macrocell RAN

8.2.2 Mobile Core

8.2.3 Small Cells

8.2.4 Carrier Wi-Fi

8.2.5 C-RAN

8.2.6 DAS

8.2.7 Backhaul & Fronthaul

## **9 CHAPTER 2.9: WIRELESS NETWORK INFRASTRUCTURE INCUMBENTS**

9.1 Cisco Systems

9.2 Ericsson

9.3 Fujitsu

9.4 Hitachi

9.5 Huawei

9.6 NEC Corporation

9.7 Nokia Networks & Alcatel-Lucent

9.8 Samsung Electronics

9.9 ZTE

## **10 CHAPTER 2.10: MACROCELL RAN, SMALL CELL, C-RAN & MOBILE CORE SPECIALISTS**

10.1 Accelleran

10.2 Adax

10.3 ADB

10.4 Affirmed Networks

10.5 Airspan Networks

10.6 Alpha Networks

10.7 AltioStar Networks

10.8 Arcadyan Technology Corporation

10.9 Argela

10.10 ARItel

10.11 Artemis Networks

10.12 Askey Computer Corporation

10.13 ASOCS

10.14 Athonet

10.15 Athena Wireless Communications (Google)

10.16 Axxcelera Broadband Wireless (Moseley Associates)

10.17 Brocade Communications Systems

10.18 Casa Systems

10.19 CCI (Competitive Companies, Inc.)

10.20 Contela

- 10.21 CS Corporation
- 10.22 Datang Mobile
- 10.23 Dongwon T&I
- 10.24 Femtel (Suzhou Femtel Communications)
- 10.25 Gemtek Technology Company
- 10.26 GENBAND
- 10.27 GWT (Global Wireless Technologies)
- 10.28 HP (Hewlett-Packard)
- 10.29 ip.access
- 10.30 Juni Global
- 10.31 Juniper Networks
- 10.32 Lemko
- 10.33 LGS Innovations
- 10.34 Mitel Networks Corporation
- 10.35 New Postcom Equipment Company
- 10.36 NewNet Communication Technologies
- 10.37 Nutaq
- 10.38 Oceus Networks
- 10.39 Panda Electronics (Nanjing Panda Electronics Company)
- 10.40 Parallel Wireless
- 10.41 Polaris Networks
- 10.42 Potevio (China Potevio Company)
- 10.43 Quanta Computer
- 10.44 Qucell
- 10.45 Quortus
- 10.46 Redline Communications
- 10.47 Sagemcom
- 10.48 Samji Electronics Company
- 10.49 SerComm Corporation
- 10.50 SK Telesys
- 10.51 SpiderCloud Wireless
- 10.52 Star Solutions
- 10.53 Sunnada (Fujian Sunnada Communication Company)
- 10.54 Taqua
- 10.55 Tecom
- 10.56 TEKTELIC Communications
- 10.57 Telum
- 10.58 Telrad Networks
- 10.59 WNC (Wistron NeWeb Corporation)



10.60 Z-Com (ZDC Wireless)

## **11 CHAPTER 2.11: ANTENNA, DAS & REPEATER SOLUTION SPECIALISTS**

- 11.1 AceAxis
- 11.2 ADRF (Advanced RF Technologies)
- 11.3 Affarii Technologies
- 11.4 American Tower Corporation
- 11.5 Arqiva
- 11.6 Axis Teknologies
- 11.7 Black Box Corporation
- 11.8 BTI Wireless
- 11.9 CCI (Communication Components Inc.)
- 11.10 CCI (Crown Castle International)
- 11.11 CCI Systems
- 11.12 Cobham Wireless
- 11.13 Comba Telecom Systems Holdings
- 11.14 CommScope
- 11.15 Corning
- 11.16 Dali Wireless
- 11.17 DeltaNode (Bird Technologies)
- 11.18 Ethertronics
- 11.19 ExteNet Systems
- 11.20 Foxcom
- 11.21 Galtronics
- 11.22 Goodman Networks
- 11.23 GrenTech (China GrenTech Corporation)
- 11.24 JRC (Japan Radio Company)
- 11.25 JMA Wireless
- 11.26 Kisan Telecom
- 11.27 KMW
- 11.28 Kathrein-Werke KG
- 11.29 MER-CelIO Wireless Solutions
- 11.30 Microlab (Wireless Telecom Group)
- 11.31 MTI Mobile
- 11.32 Nexius
- 11.33 Nextivity
- 11.34 RF Window
- 11.35 RFS (Radio Frequency Systems)

- 11.36 Rosenberger
- 11.37 SOLiD (SOLiD Technologies)
- 11.38 Sumitomo Electric Industries
- 11.39 Sunwave Communications
- 11.40 TESSCO Technologies
- 11.41 Westell Technologies
- 11.42 Zinwave

## **12 CHAPTER 2.12: CARRIER WI-FI SPECIALISTS**

- 12.1 4ipnet
- 12.2 ABB
- 12.3 Accuris Networks
- 12.4 Aerohive Networks
- 12.5 Alvarion Technologies
- 12.6 Aptilo Networks
- 12.7 Aruba Networks
- 12.8 Autelan
- 12.9 BandwidthX
- 12.10 Birdstep Technology
- 12.11 Browan Communications
- 12.12 BSG Wireless
- 12.13 D-Link Corporation
- 12.14 Edgewater Wireless Systems
- 12.15 EION Wireless
- 12.16 Firetide
- 12.17 Fortinet
- 12.18 Front Porch
- 12.19 GoNet Systems
- 12.20 Handlink Technologies
- 12.21 Meru Networks
- 12.22 Netgem
- 12.23 NETGEAR
- 12.24 Nomadix
- 12.25 Panasonic Corporation
- 12.26 Ro-Timak Technology
- 12.27 Ruckus Wireless
- 12.28 Senao Networks
- 12.29 Smith Micro Software

12.30 SpectrumMax  
12.31 Syniverse Technologies  
12.32 TP-LINK Technologies  
12.33 Tranzeo Wireless Technologies  
12.34 Ubiquiti Networks  
12.35 WeFi  
12.36 Zebra Technologies Corporation  
12.37 ZyXEL

## **13 CHAPTER 2.13: ENABLING TECHNOLOGY PROVIDERS**

13.1 6WIND  
13.2 Ablaze Wireless  
13.3 Absolute Analysis  
13.4 Accelink Technologies  
13.5 ADLINK Technology  
13.6 ADI (Analog Devices Inc.)  
13.7 Advantech  
13.8 AirHop Communications  
13.9 AKM (Asahi Kasei Microdevices)  
13.10 Allot Communications  
13.11 Amarisoft  
13.12 Amdocs  
13.13 Anritsu Corporation  
13.14 Aricent  
13.15 ARM Holdings  
13.16 Astellia  
13.17 ASTRI (Hong Kong Applied Science and Technology Research Institute)  
13.18 Artesyn Embedded Technologies  
13.19 Artiza Networks  
13.20 Avago Technologies  
13.21 Azcom Technology  
13.22 Benetel  
13.23 Blu Wireless Technology  
13.24 Broadcom Corporation  
13.25 Cadence Design Systems  
13.26 Cavium  
13.27 CeedTec  
13.28 Cellwize

- 13.29 Celtro
- 13.30 Coherent Logix
- 13.31 Comcores ApS
- 13.32 CommAgility
- 13.33 D2 Technologies
- 13.34 Dell
- 13.35 Direct Beam
- 13.36 eASIC Corporation
- 13.37 EDX Wireless
- 13.38 Eoptolink Technology
- 13.39 ERCOM
- 13.40 EXFO
- 13.41 Federated Wireless
- 13.42 Faraday Technology Corporation
- 13.43 Finisar Corporation
- 13.44 GigaLight (Shenzhen Gigalight Technology Company)
- 13.45 GlobalFoundaries
- 13.46 Hisense (Hisense Broadband Multimedia Technology)
- 13.47 HG Genuine
- 13.48 IDT (Integrated Device Technology)
- 13.49 IMEC International
- 13.50 InfoVista
- 13.51 InnoLight Technology Corporation
- 13.52 Intel Corporation
- 13.53 InterDigital
- 13.54 iPosi
- 13.55 Ixia
- 13.56 Keysight Technologies
- 13.57 Kumu Networks
- 13.58 Lattice Semiconductor
- 13.59 Lime Microsystems
- 13.60 Lumentum
- 13.61 Macom (M/A-COM Technology Solutions)
- 13.62 Maxim Integrated
- 13.63 Mellanox Technologies
- 13.64 Microsemi Corporation
- 13.65 Mitsubishi Electric Corporation
- 13.66 Mobiveil
- 13.67 Molex

13.68 Nash Technologies  
13.69 NetScout Systems  
13.70 Node-H  
13.71 Nomor Research  
13.72 NXP Semiconductors  
13.73 OE Solutions  
13.74 Octasic  
13.75 Optulink  
13.76 P.I. Works  
13.77 Pletronics  
13.78 PMC-Sierra  
13.79 Procera Networks  
13.80 Public Wireless  
13.81 Qualcomm  
13.82 Qulsar  
13.83 QEOS  
13.84 Qwilt  
13.85 RADCOM  
13.86 Radisys Corporation  
13.87 Rakon  
13.88 Red Hat  
13.89 Reverb Networks  
13.90 RF DSP  
13.91 Saguna Networks  
13.92 SAI Technology  
13.93 Sarokal Test Systems  
13.94 Silicon Labs  
13.95 Sistelbanda  
13.96 Source Photonics  
13.97 Tata Elxsi  
13.98 TEOCO Corporation  
13.99 TI (Texas Instruments)  
13.100 Tulinx  
13.101 U-blox  
13.102 Vectron International  
13.103 Viavi Solutions  
13.104 VPIsystems  
13.105 WiPro  
13.106 XCellAir

13.107 Xelic

13.108 Xilinx

## **14 CHAPTER 2.14: MOBILE BACKHAUL & FRONTHAUL VENDORS**

14.1 3Roam

14.2 4RF

14.3 Accedian Networks

14.4 Actelis Networks

14.5 Actiontec

14.6 Actus Networks

14.7 ADTRAN

14.8 ADVA Optical Networking

14.9 Advantech Wireless

14.10 ALAXALA Networks

14.11 Albis Technologies

14.12 ALCOMA

14.13 Allied Data Technologies

14.14 Allied Telesis

14.15 Aquantia

14.16 Arris

14.17 Avanti Communications

14.18 Aviat Networks

14.19 AVM

14.20 BLiNQ Networks

14.21 BluWan

14.22 BridgeWave Communications

14.23 BTI Systems

14.24 CableFree Solutions

14.25 Calix

14.26 Cambium Networks

14.27 Canoga Perkins

14.28 Carlson Wireless Technologies

14.29 CBNL (Cambridge Broadband Networks Ltd.)

14.30 CCS (Cambridge Communication Systems)

14.31 Ceragon

14.32 Cielo Networks

14.33 Ciena Corporation

14.34 Comtrend

14.35 Corecess  
14.36 Coriant  
14.37 DASAN Networks  
14.38 DragonWave  
14.39 E-Band Communications (Moseley Associates)  
14.40 EBLink  
14.41 ECI Telecom  
14.42 Elva-1  
14.43 Exalt Communications  
14.44 Extreme Networks  
14.45 FastBack Networks  
14.46 Fiberhome Technologies  
14.47 FibroLan  
14.48 Genmix Technology  
14.49 Gilat Satellite Networks  
14.50 HFR  
14.51 Huahuan  
14.52 Hughes Network Systems  
14.53 HXI  
14.54 iDirect  
14.55 Infinera  
14.56 Intracom Telecom  
14.57 IPITEK  
14.58 Iskratel  
14.59 KEYMILE  
14.60 LightPointe Communications  
14.61 Loea Corporation  
14.62 MAX4G  
14.63 Microwave Networks  
14.64 MIMOtech  
14.65 MRV Communications  
14.66 Nexcomm Systems  
14.67 NexxComm Wireless  
14.68 Omnitron Systems  
14.69 OneAccess Networks  
14.70 Polewall  
14.71 Positron  
14.72 Proxim Wireless Corporation  
14.73 RACOM

- 14.74 RAD Data Communications
- 14.75 RADWIN
- 14.76 SAF Tehnika
- 14.77 SIAE Microelectronics (SIAE Microelectronica)
- 14.78 Siklu
- 14.79 SkyFiber
- 14.80 SMC Networks
- 14.81 Solectek
- 14.82 Star Microwave
- 14.83 Tarana Wireless
- 14.84 Telco Systems
- 14.85 Tellion
- 14.86 Tellumat
- 14.87 Telsey
- 14.88 Tilgin
- 14.89 Trango Systems
- 14.90 Ubiquoss
- 14.91 UTStarcom
- 14.92 Vubiq Networks
- 14.93 Wave1
- 14.94 Wavesight
- 14.95 Xavi Technologies
- 14.96 Yamaha Corporation
- 14.97 Zhone Technologies

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- 15.1 Market Definition
- 15.2 Decomposing the Global Wireless Network Infrastructure Market
- 15.3 Macrocell RAN & Mobile Core
- 15.4 Macrocells
  - 15.4.1 Segmentation by Air Interface Technology
    - 15.4.1.1 2G & 3G
    - 15.4.1.2 FDD LTE
    - 15.4.1.3 TD-LTE
    - 15.4.1.4 WiMAX
    - 15.4.1.5 5G
- 15.5 Mobile Core
  - 15.5.1 Segmentation by Technology



- 15.5.1.1 3G Packet Core
- 15.5.1.2 HLR
- 15.5.1.3 MSS
- 15.5.1.4 LTE EPC
- 15.5.1.5 WiMAX
- 15.5.1.6 5G
- 15.6 Mobile Backhaul
  - 15.6.1 Segmentation by Technology
    - 15.6.1.1 Ethernet
    - 15.6.1.2 Microwave & Millimeter Wave
    - 15.6.1.3 Satellite
    - 15.6.1.4 WDM
    - 15.6.1.5 PON
    - 15.6.1.6 Others
- 15.7 Small Cells
  - 15.7.1 Segmentation by Use Case
    - 15.7.1.1 Residential
    - 15.7.1.2 Enterprise
    - 15.7.1.3 Urban
    - 15.7.1.4 Rural & Suburban
  - 15.7.2 Segmentation by Form Factor
    - 15.7.2.1 Femtocells
    - 15.7.2.2 Picocells
    - 15.7.2.3 Microcells
  - 15.7.3 Segmentation by Air Interface Technology
    - 15.7.3.1 2G & 3G
    - 15.7.3.2 LTE
    - 15.7.3.3 5G
  - 15.7.4 Segmentation by Deployment Model
    - 15.7.4.1 Indoor
    - 15.7.4.2 Outdoor
- 15.8 Small Cell Backhaul
  - 15.8.1 Segmentation by Technology
    - 15.8.1.1 DSL
    - 15.8.1.2 Ethernet
    - 15.8.1.3 Microwave
    - 15.8.1.4 Millimeter Wave
    - 15.8.1.5 Satellite
    - 15.8.1.6 Fiber & Others

## 15.9 Carrier Wi-Fi

### 15.9.1 Segmentation by Submarket

#### 15.9.1.1 Access Points

#### 15.9.1.2 Access Point Controllers

### 15.9.2 Segmentation by Integration Approach

#### 15.9.2.1 Standalone Wi-Fi Hotspots

#### 15.9.2.2 Managed Wi-Fi Offload

## 15.10 C-RAN

### 15.10.1 Segmentation by Submarket

#### 15.10.1.1 RRHs (Remote Radio Heads)

#### 15.10.1.2 BBUs (Baseband Units)

### 15.10.2 Segmentation by Air Interface Technology

#### 15.10.2.1 3G & LTE

#### 15.10.2.2 5G

### 15.10.3 Segmentation by Deployment Model

#### 15.10.3.1 Indoor

#### 15.10.3.2 Outdoor

## 15.11 C-RAN Fronthaul

### 15.11.1 Segmentation by Technology

#### 15.11.1.1 Dedicated Fiber

#### 15.11.1.2 WDM

#### 15.11.1.3 OTN & PON

#### 15.11.1.4 Ethernet

#### 15.11.1.5 Microwave

#### 15.11.1.6 Millimeter Wave

## 15.12 DAS

### 15.12.1 Segmentation by Deployment Model

#### 15.12.1.1 Indoor

#### 15.12.1.2 Outdoor

## 16 CHAPTER 2.16: REGIONAL MARKET ANALYSIS & FORECASTS

### 16.1 Segmentation by Region

#### 16.1.1 Macrocells

#### 16.1.2 Mobile Core

#### 16.1.3 Macrocell Backhaul

#### 16.1.4 Small Cells

#### 16.1.5 Small Cell Backhaul

#### 16.1.6 Carrier Wi-Fi

16.1.7 C-RAN

16.1.8 C-RAN Fronthaul

16.1.9 DAS

## 16.2 Asia Pacific

16.2.1 Macrocells

16.2.2 Mobile Core

16.2.3 Macrocell Backhaul

16.2.4 Small Cells

16.2.5 Small Cell Backhaul

16.2.6 Carrier Wi-Fi

16.2.7 C-RAN

16.2.8 C-RAN Fronthaul

16.2.9 DAS

## 16.3 Eastern Europe

16.3.1 Macrocells

16.3.2 Mobile Core

16.3.3 Macrocell Backhaul

16.3.4 Small Cells

16.3.5 Small Cell Backhaul

16.3.6 Carrier Wi-Fi

16.3.7 C-RAN

16.3.8 C-RAN Fronthaul

16.3.9 DAS

## 16.4 Latin & Central America

16.4.1 Macrocells

16.4.2 Mobile Core

16.4.3 Macrocell Backhaul

16.4.4 Small Cells

16.4.5 Small Cell Backhaul

16.4.6 Carrier Wi-Fi

16.4.7 C-RAN

16.4.8 C-RAN Fronthaul

16.4.9 DAS

## 16.5 Middle East & Africa

16.5.1 Macrocells

16.5.2 Mobile Core

16.5.3 Macrocell Backhaul

16.5.4 Small Cells

16.5.5 Small Cell Backhaul

- 16.5.6 Carrier Wi-Fi
- 16.5.7 C-RAN
- 16.5.8 C-RAN Fronthaul
- 16.5.9 DAS
- 16.6 North America
  - 16.6.1 Macrocells
  - 16.6.2 Mobile Core
  - 16.6.3 Macrocell Backhaul
  - 16.6.4 Small Cells
  - 16.6.5 Small Cell Backhaul
  - 16.6.6 Carrier Wi-Fi
  - 16.6.7 C-RAN
  - 16.6.8 C-RAN Fronthaul
  - 16.6.9 DAS
- 16.7 Western Europe
  - 16.7.1 Macrocells
  - 16.7.2 Mobile Core
  - 16.7.3 Macrocell Backhaul
  - 16.7.4 Small Cells
  - 16.7.5 Small Cell Backhaul
  - 16.7.6 Carrier Wi-Fi
  - 16.7.7 C-RAN
  - 16.7.8 C-RAN Fronthaul
  - 16.7.9 DAS

## **17 CHAPTER 2.17: CONCLUSION & STRATEGIC RECOMMENDATIONS**

- 17.1 Competitive Industry Landscape: Acquisitions, Alliances & Consolidation
- 17.2 Is Virtualization a Threat to the Wireless Network Infrastructure Market?
- 17.3 Growing Focus on Enterprise RAN Deployments
- 17.4 Vendor Specific HetNet Offerings: Disrupting Traditional Network Architectures
- 17.5 Moving Towards C-RAN Architecture
  - 17.5.1 Global Deployment Prospects
  - 17.5.2 From Centralized to Cloud RAN: Virtualizing the RAN
  - 17.5.3 Convergence of C-RAN and Small Cells: Distributing Baseband Intelligence
  - 17.5.4 Interface Options: Is Ethernet a Feasible Solution?
  - 17.5.5 Fronthaul Transport: Are Cheaper Options Emerging?
- 17.6 Standardization Driving RAN & Wi-Fi Integration
- 17.7 Outlook for LTE-Advanced

- 17.7.1 Upgrades for Capacity & Coverage Boosts
- 17.7.2 Moving Beyond Carrier Aggregation
- 17.7.3 Service Revenue Prospects
- 17.8 Status of TD-LTE Investments
  - 17.8.1 China Mobile: Starting an Era of Large-Scale TD-LTE Deployments
  - 17.8.2 Data Offloading Opportunities with TD-LTE Small Cells
  - 17.8.3 Capitalizing on Tight Interworking Between TDD and FDD
- 17.9 Outlook for VoLTE & RCS
- 17.10 Bringing LTE-Broadcast & eMBMS into Focus
- 17.11 Outlook for Unlicensed LTE Small Cells
- 17.12 5G Development Efforts
  - 17.12.1 Global Deployment Plans
  - 17.12.2 R&D Focus Areas
  - 17.12.3 5G Demonstrations & Performance Assessment
- 17.13 Smart Cities: Wireless Network Infrastructure Vendors to Lead the Way
- 17.14 Wireless Incumbents Could Face Cloud Rivals: Thanks to SDN & NFV
- 17.15 Spectrum: Driving Continued Acquisitions by Incumbent Mobile Operators
- 17.16 Mobile Operators Will Strive for Agility
- 17.17 Vertical Market Opportunities
- 17.18 SWOT Analysis
- 17.19 Strategic Recommendations
  - 17.19.1 Recommendations for Mobile Operators
  - 17.19.2 Recommendations for Wireless Network Infrastructure Vendors

## **REPORT 3: THE HETNET ECOSYSTEM (SMALL CELLS, CARRIER WI-FI, C-RAN & DAS): 2016 – 2030 – OPPORTUNITIES, CHALLENGES, STRATEGIES & FORECASTS**

### **1 CHAPTER 3.1: INTRODUCTION**

- 1.1 Executive Summary
- 1.2 Topics Covered
- 1.3 Forecast Segmentation
- 1.4 Key Questions Answered
- 1.5 Key Findings
- 1.6 Methodology
- 1.7 Target Audience
- 1.8 Companies & Organizations Mentioned

## **2 CHAPTER 3.2: AN OVERVIEW OF SMALL CELLS, CARRIER WI-FI, C-RAN & DAS**

### **2.1 An Evolving Heterogeneous Networking Ecosystem**

#### **2.1.1 The Growing Demand for Mobile Broadband**

#### **2.1.2 Is LTE the Answer to all Capacity Problems?**

#### **2.1.3 HetNets: An Evolution of Network Topology**

### **2.2 Small Cells**

#### **2.2.1 What Are Small Cells?**

#### **2.2.2 Why Deploy Small Cells?**

#### **2.2.3 Small Cell Categories**

##### **2.2.3.1 Femtocells**

##### **2.2.3.2 Picocells**

##### **2.2.3.3 Microcells**

### **2.3 Carrier Wi-Fi**

#### **2.3.1 Carrier Wi-Fi Integration Approaches**

#### **2.3.2 Standalone Hotspots**

#### **2.3.3 Managed Offload**

##### **2.3.3.1 SIM-based Wi-Fi Offload**

##### **2.3.3.2 RAN Integrated Wi-Fi Access**

### **2.4 C-RAN (Centralized RAN)**

#### **2.4.1 What is C-RAN?**

#### **2.4.2 Architectural Benefits and Challenges**

#### **2.4.3 Key Architectural Components**

##### **2.4.3.1 RRHs (Remote Radio Heads)**

##### **2.4.3.2 BBUs (Baseband Units)**

##### **2.4.3.3 Fronthaul**

### **2.5 Cloud RAN: Virtualizing C-RAN**

#### **2.5.1 Leveraging Commodity Technologies**

#### **2.5.2 Moving RAN to the Cloud**

### **2.6 DAS (Distributed Antenna Systems)**

#### **2.6.1 What is DAS?**

#### **2.6.2 Passive DAS**

#### **2.6.3 Active DAS**

#### **2.6.4 Hybrid DAS**

### **2.7 Alternative Options for Offloading Mobile Network Coverage and Capacity**

#### **2.7.1 Macrocell Network and Spectrum Expansion**

#### **2.7.2 Caching & Mobile CDN (Content Delivery Networks)**

### **2.8 The Business Case: Key Market Drivers**

- 2.8.1 Capacity & Coverage Improvement: Addressing the Mobile Data Traffic Tsunami
- 2.8.2 Endorsement from the Mobile Operator Community
- 2.8.3 In-Building & Enterprise Coverage Requirements
- 2.8.4 Capacity Offload in Congested Urban Environments
- 2.8.5 Cost-Effective Rural Coverage
- 2.8.6 CapEx Savings
- 2.8.7 Non-Expandability of Macrocell Networks
- 2.9 Challenges & Inhibitors to the HetNet Ecosystem
  - 2.9.1 Interference with Macrocell Infrastructure & Spectrum Constraints
  - 2.9.2 Conflicting HetNet Offerings
  - 2.9.3 Fronthaul & Backhaul Investments
  - 2.9.4 Migration from Legacy Architectures
  - 2.9.5 Economic Constraints & Deployment Challenges
  - 2.9.6 Security Concerns

### **3 CHAPTER 3.3: INTEGRATION & OFFLOADING TECHNOLOGY**

- 3.1 Integrating Small Cells into the Mobile Network
  - 3.1.1 Integration into 3G Networks
    - 3.1.1.1 Iuh based Integration: Residential & Enterprise Femtocells
    - 3.1.1.2 Iub: Microcells, Picocells and Femtocells
  - 3.1.2 S1: Integration into LTE Networks
    - 3.1.2.1 eNB Small Cell Architecture
    - 3.1.2.2 HeNB Small Cell Architecture
- 3.2 Integrating C-RAN into the Mobile Network
  - 3.2.1 CPRI (Common Public Radio Interface)
  - 3.2.2 OBSAI (Open Base Station Architecture Initiative)
  - 3.2.3 ORI (Open Radio Interface)
  - 3.2.4 Ethernet
- 3.3 Wi-Fi: The Evolution from an Ethernet Extension to Mobile RAN Integration
- 3.4 Enabling Technologies for Wi-Fi and Cellular RAN Interoperability
  - 3.4.1 ANDSF (Access Network Discovery and Selection Function)
    - 3.4.1.1 Enabling Seamless Mobility
    - 3.4.1.2 Commercial Availability of ANDSF Solutions
  - 3.4.2 Hotspot 2.0
    - 3.4.2.1 Discovery - 802.11u
    - 3.4.2.2 Encryption - 802.11i (WPA2)
    - 3.4.2.3 Authentication – 802.1x (EAP)
    - 3.4.2.4 OMA (Open Mobile Alliance) DM (Device Management)

- 3.4.2.5 Passpoint Wi-Fi Certification
- 3.4.3 NGH (Next Generation Hotspot)
  - 3.4.3.1 Working alongside Hotspot 2.0
  - 3.4.3.2 Enabling Seamless Mobile Network Connectivity
- 3.4.4 I-WLAN (Interworking Wireless LAN)
- 3.4.5 WISPr (Wireless Internet Service Provider Roaming)
- 3.4.6 MSAP (Mobility Services Advertisement Protocol)
- 3.4.7 Wi-Fi Direct
- 3.5 Small Cell and Mobile Core Offloading Technologies
  - 3.5.1 LIPA (Local IP Access)
    - 3.5.1.1 Is LIPA Specifically for Small Cells?
    - 3.5.1.2 Use Case Example: Local Network Multimedia Access
  - 3.5.2 SIPTO (Selected IP Traffic Offload)
    - 3.5.2.1 Use Case Example: Core Network Offload
    - 3.5.2.2 The Downside: Is SIPTO Suitable for All Traffic Profiles?
  - 3.5.3 IFOM (IP Flow Mobility and Seamless Offload)
    - 3.5.3.1 Enabling Seamless Integration between Wi-Fi and 3GPP RANs
- 3.6 Wi-Fi and Cellular RAN Integration: Commercial Implementations to Address the HetNet Challenge
  - 3.6.1 Wi-Fi Integration into Macrocell and Small Cell Base Stations
  - 3.6.2 Policy Driven Control
  - 3.6.3 Enabling Wi-Fi Calling: Dynamic Switching between Wi-Fi and LTE
- 3.7 Integration of SON (Self-Organizing Network) Capabilities
  - 3.7.1 Enabling Plug-and-play Functionality
  - 3.7.2 Enhancing HetNet Performance

## **4 CHAPTER 3.4: INDUSTRY ROADMAP AND VALUE CHAIN**

- 4.1 HetNet Industry Roadmap: 2016 – 2030
  - 4.1.1 2016 – 2020: Large Scale Small Cell, Carrier Wi-Fi & DAS Rollouts
  - 4.1.2 2020 – 2025: The Cloud RAN Era - Moving Towards C-RAN and Virtualization
  - 4.1.3 2025 – 2030: Continued Investments with 5G Network Rollouts
- 4.2 HetNet Value Chain
- 4.3 Embedded Technology Ecosystem
  - 4.3.1 Chipset Developers
  - 4.3.2 Embedded Component/Software Providers
- 4.4 RAN Ecosystem
  - 4.4.1 Macrocell RAN OEMs
  - 4.4.2 Pure-Play Small Cell OEMs



- 4.4.3 Wi-Fi Access Point OEMs
- 4.4.4 DAS & Repeater Solution Providers
- 4.4.5 C-RAN Solution Providers
- 4.4.6 Other Technology Providers
- 4.5 Transport Networking Ecosystem
  - 4.5.1 Backhaul & Fronthaul Solution Providers
- 4.6 Mobile Core Ecosystem
  - 4.6.1 Mobile Core Solution Providers
- 4.7 Connectivity Ecosystem
  - 4.7.1 Mobile Operators
  - 4.7.2 Wi-Fi Connectivity Providers
  - 4.7.3 SCaaS (Small Cells as a Service) Providers
- 4.8 SON Ecosystem
  - 4.8.1 SON Solution Providers
- 4.9 SDN & NFV Ecosystem
  - 4.9.1 SDN & NFV Providers

## **5 CHAPTER 3.5: HETNET DEPLOYMENT MODELS, USE CASES & VERTICAL MARKETS**

- 5.1 Deployment Models
  - 5.1.1 Indoor
  - 5.1.2 Outdoor
- 5.2 Use Cases
  - 5.2.1 Residential
  - 5.2.2 Enterprise
  - 5.2.3 Urban
  - 5.2.4 Rural & Suburban
- 5.3 Case Study: Small Cells in Emerging Rural Markets
  - 5.3.1 EE & Vodafone: Rural Small Cell Rollouts in the UK
  - 5.3.2 How are Vendors Addressing the Market?
  - 5.3.3 How Big is the Opportunity?
- 5.4 Wi-Fi Service Models
  - 5.4.1 Mobile Offload
  - 5.4.2 Wholesale
  - 5.4.3 Other Approaches
- 5.5 SCaaS (Small Cells as a Service)
  - 5.5.1 Addressing the Logistical Challenges of Small Cell Rollouts
  - 5.5.2 Cost & Structural Efficiencies

### 5.5.3 How Big is the Opportunity for SCaaS Providers?

### 5.5.4 Major SCaaS Commitments

#### 5.5.4.1 BT Group

#### 5.5.4.2 Cellcom

#### 5.5.4.3 ClearSky Technologies

#### 5.5.4.4 Cloudberry Mobile

#### 5.5.4.5 Colt Technology Services

#### 5.5.4.6 Towerstream

#### 5.5.4.7 Virgin Media

#### 5.5.4.8 Zayo Group

#### 5.5.4.9 Offerings from the Vendor Community

### 5.6 Key Vertical Markets

#### 5.6.1 Agriculture

#### 5.6.2 Construction

#### 5.6.3 Education

#### 5.6.4 Energy & Utilities

#### 5.6.5 Enterprises

#### 5.6.6 Healthcare

#### 5.6.7 Military

#### 5.6.8 Public Safety & Emergency Services

#### 5.6.9 Public Venues

#### 5.6.10 Residential

#### 5.6.11 Retail & Hospitality

## 6 CHAPTER 3.6: HETNET BACKHAUL & FRONTHAUL

### 6.1 Small Cell Backhaul Technology

#### 6.1.1 DSL

#### 6.1.2 Ethernet

#### 6.1.3 Microwave

#### 6.1.4 Millimeter Wave

#### 6.1.5 Satellite

#### 6.1.6 Fiber & Others

### 6.2 C-RAN Fronthaul Technology

#### 6.2.1 Dedicated Fiber (Dark Fiber)

#### 6.2.2 WDM (Wavelength Division Multiplexing)

#### 6.2.3 PON (Passive Optical Network)

#### 6.2.4 OTN (Optical Transport Network)

#### 6.2.5 Ethernet

6.2.6 Microwave

6.2.7 Millimeter Wave

### 6.3 Requirements for HetNet Backhaul & Fronthaul

6.3.1 Form Factor & Environmental Hardening

6.3.2 Power Supply & Consumption

6.3.3 Installation & Provisioning

6.3.4 Integration of OAM and SON Capabilities

6.3.5 Deployment & Maintenance Cost

### 6.4 Key Issues

6.4.1 Backhaul Sharing: Can Small Cells and Macrocells Share Resources?

6.4.2 Coverage Challenges

6.4.3 Capacity/Peak Throughput Challenges

6.4.4 Will Millimeter Wave be the Preferred Outdoor Small Cell Backhaul Solution?

6.4.5 Is Fronthaul the Bottleneck to C-RAN Rollouts?

6.4.6 Is Ethernet a Feasible Solution for C-RAN Fronthaul?

6.4.7 Is there a Market for Satellite based HetNet Transport?

6.4.8 Assessing the Impact of the SCaaS Ecosystem

## 7 CHAPTER 3.7: STANDARDIZATION & REGULATORY INITIATIVES

### 7.1 3GPP (3rd Generation Partnership Project)

7.1.1 Overview

7.1.2 HetNet Standardization Activities

### 7.2 3GPP2 (3rd Generation Partnership Project 2)

7.2.1 Overview

7.2.2 HetNet Standardization Activities

### 7.3 Broadband Forum

7.3.1 Overview

7.3.2 Key HetNet Initiatives

### 7.4 ETSI (European Telecommunications Standards Institute)

7.4.1 Overview

7.4.2 Small Cell Testing

7.4.3 ORI for Fronthaul

7.4.4 NFV (Network Functions Virtualization) for Small Cells & Cloud RAN

7.4.5 MEC (Mobile Edge Computing)

### 7.5 GSMA

7.5.1 Overview

7.5.2 Enabling Carrier Wi-Fi Roaming

### 7.6 HetNet Forum

- 7.6.1 Overview
- 7.6.2 Key Programs
- 7.7 IEEE (Institute of Electrical and Electronics Engineers)
  - 7.7.1 Overview
  - 7.7.2 IEEE 802.11 WLAN Standard
  - 7.7.3 Other Standards
- 7.8 ITU (International Telecommunications Union)
  - 7.8.1 Overview
  - 7.8.2 Focus Group on IMT-2020
- 7.9 MEF (Metro Ethernet Forum)
  - 7.9.1 Overview
  - 7.9.2 Ethernet Transport for Small Cells & C-RAN
- 7.10 NGMN (Next Generation Mobile Networks) Alliance
  - 7.10.1 Overview
  - 7.10.2 P-CRAN (Project Centralized RAN)
  - 7.10.3 Small Cell Project
  - 7.10.4 RAN Evolution Project
  - 7.10.5 Other Engagements
- 7.11 Small Cell Forum
  - 7.11.1 Overview
  - 7.11.2 Working Groups
  - 7.11.3 Release Program
- 7.12 WBA (Wireless Broadband Alliance)
  - 7.12.1 Overview
  - 7.12.2 Next Generation Wi-Fi Program for Mobile Operators
  - 7.12.3 Other Programs
- 7.13 Wi-Fi Alliance
  - 7.13.1 Overview
  - 7.13.2 Hotspot 2.0 & Passpoint Certification Program
  - 7.13.3 Other Programs
- 7.14 WiMAX Forum
  - 7.14.1 Overview
  - 7.14.2 WiMAX Small Cells

## **8 CHAPTER 3.8: MOBILE OPERATOR CASE STUDIES**

- 8.1 América Móvil Group
  - 8.1.1 Overview
  - 8.1.2 Key Vendors

- 8.1.3 HetNet Deployment Summary
- 8.2 AT&T Mobility
  - 8.2.1 Overview
  - 8.2.2 Key Vendors
  - 8.2.3 HetNet Deployment Summary
- 8.3 Bharti Airtel
  - 8.3.1 Overview
  - 8.3.2 Key Vendors
  - 8.3.3 HetNet Deployment Summary
- 8.4 BT Group
  - 8.4.1 Overview
  - 8.4.2 Key Vendors
  - 8.4.3 HetNet Deployment Summary
- 8.5 China Mobile
  - 8.5.1 Overview
  - 8.5.2 Key Vendors
  - 8.5.3 HetNet Deployment Summary
- 8.6 China Telecom
  - 8.6.1 Overview
  - 8.6.2 Key Vendors
  - 8.6.3 HetNet Deployment Summary
- 8.7 China Unicom
  - 8.7.1 Overview
  - 8.7.2 Key Vendors
  - 8.7.3 HetNet Deployment Summary
- 8.8 Chunghwa Telecom
  - 8.8.1 Overview
  - 8.8.2 Key Vendors
  - 8.8.3 HetNet Deployment Summary
- 8.9 KT Corporation
  - 8.9.1 Overview
  - 8.9.2 Key Vendors
  - 8.9.3 HetNet Deployment Summary
- 8.10 VimpelCom
  - 8.10.1 Overview
  - 8.10.2 Key Vendors
  - 8.10.3 HetNet Deployment Summary
- 8.11 LG Uplus
  - 8.11.1 Overview

- 8.11.2 Key Vendors
- 8.11.3 HetNet Deployment Summary
- 8.12 NTT DoCoMo
  - 8.12.1 Overview
  - 8.12.2 Key Vendors
  - 8.12.3 HetNet Deployment Summary
- 8.13 Orange
  - 8.13.1 Overview
  - 8.13.2 Key Vendors
  - 8.13.3 HetNet Deployment Summary
- 8.14 SK Telecom
  - 8.14.1 Overview
  - 8.14.2 Key Vendors
  - 8.14.3 HetNet Deployment Summary
- 8.15 SoftBank Mobile
  - 8.15.1 Overview
  - 8.15.2 Key Vendors
  - 8.15.3 HetNet Deployment Summary
- 8.16 Sprint
  - 8.16.1 Overview
  - 8.16.2 Key Vendors
  - 8.16.3 HetNet Deployment Summary
- 8.17 Telecom Italia
  - 8.17.1 Overview
  - 8.17.2 Key Vendors
  - 8.17.3 HetNet Deployment Summary
- 8.18 Telefónica
  - 8.18.1 Overview
  - 8.18.2 Key Vendors
  - 8.18.3 HetNet Deployment Summary
- 8.19 Verizon Wireless
  - 8.19.1 Overview
  - 8.19.2 Key Vendors
  - 8.19.3 HetNet Deployment Summary
- 8.20 Vodafone Group
  - 8.20.1 Overview
  - 8.20.2 Key Vendors
  - 8.20.3 HetNet Deployment Summary
- 8.21 SingTel

- 8.21.1 Overview
- 8.21.2 Key Vendors
- 8.21.3 HetNet Deployment Summary
- 8.22 SFR
  - 8.22.1 Overview
  - 8.22.2 Key Vendors
  - 8.22.3 HetNet Deployment Summary
- 8.23 Telenor Group
  - 8.23.1 Overview
  - 8.23.2 Key Vendors
  - 8.23.3 HetNet Deployment Summary
- 8.24 Telstra
  - 8.24.1 Overview
  - 8.24.2 Key Vendors
  - 8.24.3 HetNet Deployment Summary
- 8.25 Telus Mobility
  - 8.25.1 Overview
  - 8.25.2 Key Vendors
  - 8.25.3 HetNet Deployment Summary
- 8.26 DT (Deutsche Telekom)
  - 8.26.1 Overview
  - 8.26.2 Key Vendors
  - 8.26.3 HetNet Deployment Summary
- 8.27 MTS (Mobile TeleSystems)
  - 8.27.1 Overview
  - 8.27.2 Key Vendors
  - 8.27.3 HetNet Deployment Summary
- 8.28 KDDI
  - 8.28.1 Overview
  - 8.28.2 Key Vendors
  - 8.28.3 HetNet Deployment Summary
- 8.29 MegaFon
  - 8.29.1 Overview
  - 8.29.2 Key Vendors
  - 8.29.3 HetNet Deployment Summary
- 8.30 KPN
  - 8.30.1 Overview
  - 8.30.2 Key Vendors
  - 8.30.3 HetNet Deployment Summary

### 8.31 TeliaSonera

#### 8.31.1 Overview

#### 8.31.2 Key Vendors

#### 8.31.3 HetNet Deployment Summary

## **9 CHAPTER 3.9: WIRELESS NETWORK INFRASTRUCTURE INCUMBENTS**

### 9.1 Cisco Systems

### 9.2 Ericsson

### 9.3 Fujitsu

### 9.4 Hitachi

### 9.5 Huawei

### 9.6 NEC Corporation

### 9.7 Nokia Networks & Alcatel-Lucent

### 9.8 Samsung Electronics

### 9.9 ZTE

## **10 CHAPTER 3.10: MACROCELL RAN, SMALL CELL, C-RAN & MOBILE CORE SPECIALISTS**

### 10.1 Accelleran

### 10.2 Adax

### 10.3 ADB

### 10.4 Affirmed Networks

### 10.5 Airspan Networks

### 10.6 Alpha Networks

### 10.7 AltioStar Networks

### 10.8 Arcadyan Technology Corporation

### 10.9 Argela

### 10.10 ARItel

### 10.11 Artemis Networks

### 10.12 Askey Computer Corporation

### 10.13 ASOCS

### 10.14 Athonet

### 10.15 Athena Wireless Communications (Google)

### 10.16 Axxcelera Broadband Wireless (Moseley Associates)

### 10.17 Brocade Communications Systems

### 10.18 Casa Systems

### 10.19 CCI (Competitive Companies, Inc.)



- 10.20 Contela
- 10.21 CS Corporation
- 10.22 Datang Mobile
- 10.23 Dongwon T&I
- 10.24 Femtel (Suzhou Femtel Communications)
- 10.25 Gemtek Technology Company
- 10.26 GENBAND
- 10.27 GWT (Global Wireless Technologies)
- 10.28 HP (Hewlett-Packard)
- 10.29 ip.access
- 10.30 Juni Global
- 10.31 Juniper Networks
- 10.32 Lemko
- 10.33 LGS Innovations
- 10.34 Mitel Networks Corporation
- 10.35 New Postcom Equipment Company
- 10.36 NewNet Communication Technologies
- 10.37 Nutaq
- 10.38 Oceus Networks
- 10.39 Panda Electronics (Nanjing Panda Electronics Company)
- 10.40 Parallel Wireless
- 10.41 Polaris Networks
- 10.42 Potevio (China Potevio Company)
- 10.43 Quanta Computer
- 10.44 Qucell
- 10.45 Quortus
- 10.46 Redline Communications
- 10.47 Sagemcom
- 10.48 Samji Electronics Company
- 10.49 SerComm Corporation
- 10.50 SK Telesys
- 10.51 SpiderCloud Wireless
- 10.52 Star Solutions
- 10.53 Sunnada (Fujian Sunnada Communication Company)
- 10.54 Taqua
- 10.55 Tecom
- 10.56 TEKTELIC Communications
- 10.57 Telum
- 10.58 Telrad Networks

10.59 WNC (Wistron NeWeb Corporation)

10.60 Z-Com (ZDC Wireless)

## **11 CHAPTER 3.11: ANTENNA, DAS & REPEATER SOLUTION SPECIALISTS**

11.1 AceAxis

11.2 ADRF (Advanced RF Technologies)

11.3 Affarii Technologies

11.4 American Tower Corporation

11.5 Arqiva

11.6 Axis Teknologies

11.7 Black Box Corporation

11.8 BTI Wireless

11.9 CCI (Communication Components Inc.)

11.10 CCI (Crown Castle International)

11.11 CCI Systems

11.12 Cobham Wireless

11.13 Comba Telecom Systems Holdings

11.14 CommScope

11.15 Corning

11.16 Dali Wireless

11.17 DeltaNode (Bird Technologies)

11.18 Ethertronics

11.19 ExteNet Systems

11.20 Foxcom

11.21 Galtronics

11.22 Goodman Networks

11.23 GrenTech (China GrenTech Corporation)

11.24 JRC (Japan Radio Company)

11.25 JMA Wireless

11.26 Kisan Telecom

11.27 KMW

11.28 Kathrein-Werke KG

11.29 MER-Cello Wireless Solutions

11.30 Microlab (Wireless Telecom Group)

11.31 MTI Mobile

11.32 Nexius

11.33 Nextivity

11.34 RF Window

- 11.35 RFS (Radio Frequency Systems)
- 11.36 Rosenberger
- 11.37 SOLiD (SOLiD Technologies)
- 11.38 Sumitomo Electric Industries
- 11.39 Sunwave Communications
- 11.40 TESSCO Technologies
- 11.41 Westell Technologies
- 11.42 Zinwave

## **12 CHAPTER 3.12: CARRIER WI-FI SPECIALISTS**

- 12.1 4ipnet
- 12.2 ABB
- 12.3 Accuris Networks
- 12.4 Aerohive Networks
- 12.5 Alvarion Technologies
- 12.6 Aptilo Networks
- 12.7 Aruba Networks
- 12.8 Autelan
- 12.9 BandwidthX
- 12.10 Birdstep Technology
- 12.11 Browan Communications
- 12.12 BSG Wireless
- 12.13 D-Link Corporation
- 12.14 Edgewater Wireless Systems
- 12.15 EION Wireless
- 12.16 Firetide
- 12.17 Fortinet
- 12.18 Front Porch
- 12.19 GoNet Systems
- 12.20 Handlink Technologies
- 12.21 Meru Networks
- 12.22 Netgem
- 12.23 NETGEAR
- 12.24 Nomadix
- 12.25 Panasonic Corporation
- 12.26 Ro-Timak Technology
- 12.27 Ruckus Wireless
- 12.28 Senao Networks

- 12.29 Smith Micro Software
- 12.30 SpectrumMax
- 12.31 Syniverse Technologies
- 12.32 TP-LINK Technologies
- 12.33 Tranzeo Wireless Technologies
- 12.34 Ubiquiti Networks
- 12.35 WeFi
- 12.36 Zebra Technologies Corporation
- 12.37 ZyXEL

### **13 CHAPTER 3.13: ENABLING TECHNOLOGY PROVIDERS**

- 13.1 6WIND
- 13.2 Ablaze Wireless
- 13.3 Absolute Analysis
- 13.4 Accelink Technologies
- 13.5 ADLINK Technology
- 13.6 ADI (Analog Devices Inc.)
- 13.7 Advantech
- 13.8 AirHop Communications
- 13.9 AKM (Asahi Kasei Microdevices)
- 13.10 Allot Communications
- 13.11 Amarisoft
- 13.12 Amdocs
- 13.13 Anritsu Corporation
- 13.14 Aricent
- 13.15 ARM Holdings
- 13.16 Astellia
- 13.17 ASTRI (Hong Kong Applied Science and Technology Research Institute)
- 13.18 Artesyn Embedded Technologies
- 13.19 Artiza Networks
- 13.20 Avago Technologies
- 13.21 Azcom Technology
- 13.22 Benetel
- 13.23 Blu Wireless Technology
- 13.24 Broadcom Corporation
- 13.25 Cadence Design Systems
- 13.26 Cavium
- 13.27 CeedTec

- 13.28 Cellwize
- 13.29 Celtro
- 13.30 Coherent Logix
- 13.31 Comcores ApS
- 13.32 CommAgility
- 13.33 D2 Technologies
- 13.34 Dell
- 13.35 Direct Beam
- 13.36 eASIC Corporation
- 13.37 EDX Wireless
- 13.38 Eoptolink Technology
- 13.39 ERCOM
- 13.40 EXFO
- 13.41 Federated Wireless
- 13.42 Faraday Technology Corporation
- 13.43 Finisar Corporation
- 13.44 GigaLight (Shenzhen Gigalight Technology Company)
- 13.45 GlobalFoundries
- 13.46 Hisense (Hisense Broadband Multimedia Technology)
- 13.47 HG Genuine
- 13.48 IDT (Integrated Device Technology)
- 13.49 IMEC International
- 13.50 InfoVista
- 13.51 InnoLight Technology Corporation
- 13.52 Intel Corporation
- 13.53 InterDigital
- 13.54 iPosi
- 13.55 Ixia
- 13.56 Keysight Technologies
- 13.57 Kumu Networks
- 13.58 Lattice Semiconductor
- 13.59 Lime Microsystems
- 13.60 Lumentum
- 13.61 Macom (M/A-COM Technology Solutions)
- 13.62 Maxim Integrated
- 13.63 Mellanox Technologies
- 13.64 Microsemi Corporation
- 13.65 Mitsubishi Electric Corporation
- 13.66 Mobiveil

13.67 Molex  
13.68 Nash Technologies  
13.69 NetScout Systems  
13.70 Node-H  
13.71 Nomor Research  
13.72 NXP Semiconductors  
13.73 OE Solutions  
13.74 Octasic  
13.75 Optulink  
13.76 P.I. Works  
13.77 Pletronics  
13.78 PMC-Sierra  
13.79 Procera Networks  
13.80 Public Wireless  
13.81 Qualcomm  
13.82 Qulsar  
13.83 QEOS  
13.84 Qwilt  
13.85 RADCOM  
13.86 Radisys Corporation  
13.87 Rakon  
13.88 Red Hat  
13.89 Reverb Networks  
13.90 RF DSP  
13.91 Saguna Networks  
13.92 SAI Technology  
13.93 Sarokal Test Systems  
13.94 Silicon Labs  
13.95 Sistelbanda  
13.96 Source Photonics  
13.97 Tata Elxsi  
13.98 TEOCO Corporation  
13.99 TI (Texas Instruments)  
13.100 Tulinx  
13.101 U-blox  
13.102 Vectron International  
13.103 Viavi Solutions  
13.104 VPIsystems  
13.105 WiPro

13.106 XCellAir

13.107 Xelic

13.108 Xilinx

## **14 CHAPTER 3.14: MOBILE BACKHAUL & FRONTHAUL VENDORS**

14.1 3Roam

14.2 4RF

14.3 Accedian Networks

14.4 Actelis Networks

14.5 Actiontec

14.6 Actus Networks

14.7 ADTRAN

14.8 ADVA Optical Networking

14.9 Advantech Wireless

14.10 ALAXALA Networks

14.11 Albis Technologies

14.12 ALCOMA

14.13 Allied Data Technologies

14.14 Allied Telesis

14.15 Aquantia

14.16 Arris

14.17 Avanti Communications

14.18 Aviat Networks

14.19 AVM

14.20 BLiNQ Networks

14.21 BluWan

14.22 BridgeWave Communications

14.23 BTI Systems

14.24 CableFree Solutions

14.25 Calix

14.26 Cambium Networks

14.27 Canoga Perkins

14.28 Carlson Wireless Technologies

14.29 CBNL (Cambridge Broadband Networks Ltd.)

14.30 CCS (Cambridge Communication Systems)

14.31 Ceragon

14.32 Cielo Networks

14.33 Ciena Corporation

- 14.34 Comtrend
- 14.35 Corecess
- 14.36 Coriant
- 14.37 DASAN Networks
- 14.38 DragonWave
- 14.39 E-Band Communications (Moseley Associates)
- 14.40 EBlinc
- 14.41 ECI Telecom
- 14.42 Elva-1
- 14.43 Exalt Communications
- 14.44 Extreme Networks
- 14.45 FastBack Networks
- 14.46 Fiberhome Technologies
- 14.47 FibroLan
- 14.48 Genmix Technology
- 14.49 Gilat Satellite Networks
- 14.50 HFR
- 14.51 Huahuan
- 14.52 Hughes Network Systems
- 14.53 HXI
- 14.54 iDirect
- 14.55 Infinera
- 14.56 Intracom Telecom
- 14.57 IPITEK
- 14.58 Iskratel
- 14.59 KEYMILE
- 14.60 LightPointe Communications
- 14.61 Loea Corporation
- 14.62 MAX4G
- 14.63 Microwave Networks
- 14.64 MIMOtech
- 14.65 MRV Communications
- 14.66 Nexcomm Systems
- 14.67 NexxComm Wireless
- 14.68 Omnitron Systems
- 14.69 OneAccess Networks
- 14.70 Polewall
- 14.71 Positron
- 14.72 Proxim Wireless Corporation



- 14.73 RACOM
- 14.74 RAD Data Communications
- 14.75 RADWIN
- 14.76 SAF Tehnika
- 14.77 SIAE Microelectronics (SIAE Microelectronica)
- 14.78 Siklu
- 14.79 SkyFiber
- 14.80 SMC Networks
- 14.81 Solectek
- 14.82 Star Microwave
- 14.83 Tarana Wireless
- 14.84 Telco Systems
- 14.85 Tellion
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## **LIST OF COMPANIES MENTIONED**

3GPP (3rd Generation Partnership Project)

3GPP2 (3rd Generation Partnership Project 2)

3Roam

4ipnet  
4RF  
6WIND  
A10 Networks  
ABB  
Ablaze Wireless  
Absolute Analysis  
Accedian Networks  
Accelink Technologies  
Accelleran  
ACCESS CO.  
Accton Technology Corporation  
Accuris Networks  
AceAxis  
Actelis Networks  
Actiontec  
Active Broadband Networks  
Actus Networks  
ADARA Networks  
Adax  
ADB  
ADI (Analog Devices Inc.)  
ADLINK Technology  
ADRF (Advanced RF Technologies)  
ADTRAN  
ADVA Optical Networking  
Advantech  
Advantech Wireless  
Aerohive Networks  
Affarii Technologies  
Affirmed Networks  
Agema Systems  
Airbus Defence and Space  
AirHop Communications  
Airspan Networks  
Airvana  
Akamai Technologies  
AKM (Asahi Kasei Microdevices)  
ALAXALA Networks Corporation

Albis Technologies  
Alcatel-Lucent  
ALCOMA  
Allied Data Technologies  
Allied Telesis  
Allot Communications  
Alpha Networks  
ALTEN Calsoft Labs  
ALTEN Group  
Altera Corporation  
Altiosstar Networks  
Alvarion Technologies  
Amarisoft  
Amartus  
AMD (Advanced Micro Devices)  
Amdocs  
América Móvil Group  
American Tower Corporation  
ANEVIA  
Anite  
Anritsu Corporation  
Aptilo Networks  
Aquantia  
Arcadyan Technology Corporation  
Argela  
Aricent  
Arista Networks  
ARItel  
Arkoon Netasq  
ARM Holdings  
Arqiva  
Arris  
ARRIS Group  
Artemis Networks  
Artesyn Embedded Technologies  
Artiza Networks  
Aruba Networks  
Askey Computer Corporation  
ASOCS



Astellia  
ASTRI (Hong Kong Applied Science and Technology Research Institute)  
AT&T  
AT&T Mobility  
Athena Wireless Communications  
Athonet  
AudioCodes  
Autelan  
Avago Technologies  
Avanti Communications  
Avaya  
Aviat Networks  
AVM  
AWS (Amazon Web Services)  
Axis Teknologies  
Axxcelera Broadband Wireless (Moseley Associates)  
Azcom Technology  
Baidu  
Banco Santander  
BandwidthX  
Barracuda Networks  
Benetel  
Bharti Airtel  
Big Switch Networks  
Birdstep Technology  
Black Box Corporation  
BLiNQ Networks  
Blu Wireless Technology  
BlueCoat  
BluWan  
Brain4Net  
BridgeWave Communications  
Broadband Forum  
Broadcom  
Broadpeak  
BroadSoft  
Brocade Communications Systems  
Browan Communications  
BSG Wireless

BT Group  
BTI Systems  
BTI Wireless  
CableFree Solutions  
Cadence Design Systems  
Calix  
Cambium Networks  
Canoga Perkins  
Canonical  
Carlson Wireless Technologies  
Casa Systems  
Catbird Networks  
Cavium  
CBNL (Cambridge Broadband Networks Ltd.)  
CCI (Communication Components Inc.)  
CCI (Competitive Companies, Inc.)  
CCI (Crown Castle International)  
CCI Systems  
CCS (Cambridge Communication Systems)  
Cedexis  
CeedTec  
Cellcom  
Cellwize  
Celtro  
Centec Networks  
Ceragon Networks  
Certes Networks  
Check Point Software Technologies  
China Mobile  
China Telecom  
China Unicom  
Chunghwa Telecom  
Cielo Networks  
Ciena Corporation  
CIMI Corporation  
Cisco Systems  
Citigroup  
Citrix Systems  
Clavister

ClearPath Networks  
ClearSky Technologies  
Cloudberry Mobile  
Cloudscaling  
CloudWeaver  
Cobham Wireless  
Coherent Logix  
Cohesive Networks  
Colt Technology Services Group  
Comba Telecom Systems Holdings  
Comcores ApS  
CommAgility  
CommScope  
Comodo Security Solutions  
Compass-EOS  
Comptel  
Comtrend  
Concurrent  
Connectem  
Contela  
ConteXtream  
Corecess  
Coriant  
Corning  
Corsa Technology  
CS Corporation  
CSC (Computer Sciences Corporation)  
Cumulus Networks  
Cyan  
D2 Technologies  
Dali Wireless  
DASAN Networks  
Datang Mobile  
Dell  
DeltaNode (Bird Technologies)  
Dialogic  
Direct Beam  
Dish Network  
D-Link Corporation

Dongwon T&I  
Dorado Software  
DragonWave  
DT (Deutsche Telekom)  
eASIC Corporation  
E-Band Communications (Moseley Associates)  
EBlink  
ECI Telecom  
Eden Rock Communications  
Edgeware  
Edgewater Wireless Systems  
EDX Wireless  
EE  
EION Wireless  
Ekinops  
Elemental Technologies  
Elva-1  
Embrane  
EMC Corporation  
Enterasys Networks  
EnterpriseWeb  
Eoptolink Technology  
Equinix  
ERCOM  
Ericsson  
Ethertronics  
Etisalat  
ETSI (European Telecommunications Standards Institute)  
Exalt Communications  
EXFO  
ExteNet Systems  
Extreme Networks  
EZchip Semiconductor  
F5 Networks  
Faraday Technology Corporation  
FastBack Networks  
Federated Wireless  
Femtel (Suzhou Femtel Communications)  
Fiberhome Technologies

FibroLAN  
Fidelity Investments  
Finisar Corporation  
Firetide  
Flash Networks  
Flextronics International  
Fortinet  
Foxcom  
FRAFOS  
Freescale Semiconductor  
Front Porch  
Fujitsu  
Galtronics  
Gemtek Technology Company  
GENBAND  
Gencore Systems  
Genmix Technology  
GigaLight (Shenzhen Gigalight Technology Company)  
Gigamon  
GigaSpaces Technologies  
Gilat Satellite Networks  
GlobalFoundaries  
GoNet Systems  
Goodman Networks  
Google  
GrenTech (China GrenTech Corporation)  
Grupo Santander  
GSMA  
Guavus  
GWT (Global Wireless Technologies)  
H3C Technologies  
Handlink Technologies  
Harmonic  
HFR  
HG Genuine  
Hisense (Hisense Broadband Multimedia Technology)  
Hitachi  
HP (Hewlett-Packard)  
Hrvatski Telekom

Huahuan  
Huawei  
Hughes Network Systems  
HXI  
HyTrust  
IBM  
iDirect  
IDT (Integrated Device Technology)  
IEEE (Institute of Electrical and Electronics Engineers)  
IETF (Internet Engineering Task Force)  
IIJ (Internet Initiative Japan)  
Illumio  
Imagine Communications Corporation  
IMEC International  
Infinera  
Infoblox  
InfoVista  
InnoLight Technology Corporation  
Inocybe Technologies  
Intel Corporation  
InterDigital  
Interface Masters Technologies  
Intracom Telecom  
Intune Networks  
IP Infusion  
ip.access  
IPgallery  
iPhotonix  
IPITEK  
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MegaFon  
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Meru Networks  
Metaswitch Networks

Microlab (Wireless Telecom Group)  
Microsemi Corporation  
Microsoft  
Microwave Networks  
Midokura  
MIMOon  
MIMOtech  
Mirantis  
Mitel Networks Corporation  
Mitsubishi Electric Corporation  
Mobily Saudi Arabia  
Mobiveil  
Mojatatu Networks  
Molex  
Movistar Venezuela  
MRV Communications  
MTI Mobile  
MTS (Mobile TeleSystems)  
NAKA Mobile  
Nakina Systems  
Napatech  
Nash Technologies  
NCLC (NCL Communication)  
NEC Corporation  
NetCracker Technology  
NETGEAR  
Netgem  
Netronome  
Netrounds  
NetScout Systems  
NetYCE  
New Postcom Equipment Company  
NewNet Communication Technologies  
Nexcomm Systems  
Nexius  
Nextivity  
NexxComm Wireless  
NFVWare  
NGMN (Next Generation Mobile Networks) Alliance



Nippon Express  
Node-H  
Nokia Networks  
Nomadix  
Nominum  
Nomor Research  
NoviFlow  
NTT Communications  
NTT DoCoMo  
Nuage Networks  
NuRAN Wireless  
Nutaq  
NXP Semiconductors  
Oceus Networks  
Octasic  
OE Solutions  
Oi Brazil  
OMA (Open Mobile Alliance)  
OMG (Object Management Group)  
Omnitron Systems  
ON.Lab (Open Networking Lab)  
OneAccess Networks  
ONF (Open Networking Foundation)  
ONRC (Open Networking Research Center)  
OpenDaylight Foundation  
Openet  
OpenStack Foundation  
Openwave Mobility  
Opera Software  
OPNFV (Open Platform for NFV)  
Optelian  
Optulink  
Oracle Corporation  
Orange  
Orchestral networks  
OVA (Open Virtualization Alliance)  
Overture Networks  
OX (Open-Xchange)  
Ozono Security

P.I. Works  
Packet Ship Technologies  
Paddy Power Betfair  
Padtec  
Palo Alto Networks  
Panasonic Corporation  
Panda Electronics (Nanjing Panda Electronics Company)  
Panda Security  
Pantheon Technologies  
Parallel Wireless  
PeerApp  
Penguin  
Pertino  
Pica8  
Piston Cloud Computing  
Pletronics  
Plexxi  
PLUMgrid  
Pluribus Networks  
PMC-Sierra  
Polaris Networks  
Polatis  
Polewall  
Positron  
Potevio (China Potevio Company)  
PowerDNS  
Procera Networks  
Produban  
Proxim Wireless Corporation  
PT (Portugal Telecom)  
Public Wireless  
QCT (Quanta Cloud Technology)  
QEOS  
Qosmos  
Qualcomm  
Quanta Computer  
Qucell  
Qulsar  
Quortus

Qwilt  
Rackspace  
RACOM  
RAD Data Communications  
RADCOM  
Radisys Corporation  
Radware  
RADWIN  
Rakon  
Rapid7  
Realtek Semiconductor Corporation  
Rearden  
Red Hat  
Redknee  
Redline Communications  
Reverb Networks  
RF DSP  
RF Window  
RFS (Radio Frequency Systems)  
RightScale  
Riverbed Technology  
Rosenberger  
Ro-Timak Technology  
Ruckus Wireless  
SAF Tehnika  
Sagemcom  
Saguna Networks  
SAI Technology  
Saisei  
Samji Electronics Company  
Samsung Electronics  
Sandvine  
Sansay  
Sarokal Test Systems  
Senao Networks  
Sencore  
SerComm Corporation  
ServiceMesh  
SevOne

SFR  
Shutterfly  
SIAE Microelectronics (SIAE Microelectronica)  
Siklu  
Silicon Labs  
Silver Peak Systems  
SingTel  
Sistelbanda  
SK Telecom  
SK Telesys  
SkyFiber  
Small Cell Forum  
SMC Networks  
Smith Micro Software  
SoftBank Corporation  
SoftBank Mobile  
Solectek  
SOLiD (SOLiD Technologies)  
SonicWALL  
Sonus Networks  
Sophos  
Sorrento Networks  
Source Photonics  
SpectrumMax  
SpiderCloud Wireless  
Spirent Communications  
Sprint Corporation  
StackIQ  
Star Microwave  
Star Solutions  
Sub10 Systems  
Sumitomo Electric Industries  
Sunnada (Fujian Sunnada Communication Company)  
SunTec Business Solutions  
Sunwave Communications  
Supermicro (Super Micro Computer)  
Svarog Technology Group  
Symantec Corporation  
Syniverse Technologies

SysMaster  
Tail-f Systems  
Tango Telecom  
Taqua  
Tarana Wireless  
Tata Elxsi  
TE Connectivity  
TE SubCom  
Tecom  
Tejas Networks  
TEKTELIC Communications  
Telchemy  
Telco Systems  
Telcoware  
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Telefónica  
Telekom Austria Group  
Telenor Group  
TeliaSonera  
Telkomsel  
Tellion  
Tellumat  
Telrad Networks  
Telsey  
Telstra  
Telum  
Telus Mobility  
TEOCO Corporation  
TESSCO Technologies  
Thomson Video Networks  
TI (Texas Instruments)  
Tieto  
Tilera Corporation  
Tilgin  
TIM (Telecom Italia Mobile)  
TIM Brazil  
TitanHQ  
TM Forum  
T-Mobile USA

Towerstream  
TP-LINK Technologies  
Trango Systems  
Transmode  
Tranzeo Wireless Technologies  
Trend Micro  
Treq Labs  
Tulinx  
Turk Telekom  
U2 Cloud  
UBIqube  
Ubiquiti Networks  
Ubiquoss  
U-blox  
UBM Tech  
Ultra Electronics AEP  
UTStarcom  
vArmour  
Vectron International  
Vello Systems  
Verizon  
Verizon Wireless  
Versa Networks  
Veryx Technologies  
Viavi Solutions  
VimpelCom  
Vipnet  
Virgin Media  
Vivo  
VMware  
Vodafone Group  
VPIsystems  
Vubiq Networks  
WatchGuard Technologies  
Wave1  
Wavenet  
Wavesight  
WBA (Wireless Broadband Alliance)  
WebNMS

Wedge Networks  
WeFi  
Westell Technologies  
Wi-Fi Alliance  
WiMAX Forum  
Wind River  
Wipro  
WNC (Wistron NeWeb Corporation)  
Wowza Media Systems  
Xavi Technologies  
XCellAir  
Xelic  
Xilinx  
XOR Media  
Xtera Communications  
Xura  
Yamaha Corporation  
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