

Macro and Massive-MIMO

Base Stations and Transceivers 2024



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Abstract: This report provides a forecast for Macro and Massive MIMO RAN Infrastructure. This includes base stations over 100 W and up to 15 GHz. 2G, 3G, 4G, 5G, and new 5G-Advanced deployments are included. Includes details on Remote Radio Heads (RRH) or Radio Units (RU), integration with Baseband Units (BBU, DU, CU), and breakdowns of transceivers. The level of Massive MIMO is forecasted in detail, with details of power levels, frequency bands, OEM market share, and other key factors. New analysis includes analysis of ORAN status, regional breakdowns of RRH units, and updated OEM market share analysis.

New this year: Coverage of frequency bands from 6 Ghz through 15 GHz and expected massive MIMO deployment for 5G-Advanced.

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DEFINITIONS AND METHODOLOGY

To create estimates and forecasts for Macro/mMIMO Network equipment shipments, Mobile Experts relied on direct input from more than 30 industry sources, plus 25+ different mobile operators contributing to the overall analysis to give a detailed global view of the market. Mobile Experts built a “top down” forecast based on direct input from mobile operators and based on trends in end-user demand for mobile services and specific plans for base stations. Then, Mobile Experts built a “bottom up” forecast through discussions with the supply chain. Notably, multiple key semiconductor suppliers have been willing to share shipment data with Mobile Experts, to confirm our shipment figures for 2023 and backlog+capacity estimates for 2024. Mobile Experts also used financial disclosures from publicly traded companies to confirm our quantitative view of the equipment market.

Mobile Experts defines the macro base station market with strict technical criteria, to keep it separate from the small cell and DAS equipment markets. Specifically, radio equipment is counted in the “Macro” category if the composite power for a sector exceeds 40 W for 2G or 3G systems and 100W or greater in 4G and 5G systems. In this definition, macro base stations may be omnidirectional, or sectorized... although almost all are sectorized. The transceivers counted in this study include transceivers in active antenna arrays (AAS), in remote radio heads (RRHs), and integrated into base station cabinets.

A “base station” is defined as the equipment supporting a single Macro site and a single frequency band: it refers to a baseband processing “unit” of capacity plus a number of Remote Radio Head units. Theoretically a site will have three RRH/RU units per site, but in practice operators use more. For example, the number for LTE networks is now 4.8 RRHs per BBU and for 5G networks the number is 3.6 RUs per BBU.

Because the definition of a base station is not crisp with regard to radio hardware, we use the number of RRH or RU units as our initial count for deployment, and then we verify the accuracy of these numbers by comparing the number of components supporting RRH/RU units. However, with the increasing integration of multiple bands into a single RU, this is another way to view the market. Mobile Experts uses “logical” RUs as the baseline for our analysis. This means each frequency counts as a separate RU. In our analysis in 2024, we are showing both the Logical and Physical RU (an RU that includes multiple frequencies) to highlight the impact. Tab 4 on the accompanying Excel file shows this analysis.

A Transceiver is defined as a physical radio transmitter path and all of the receivers that are related, including the main receiver, diversity, sampling, and sniffing

receivers. To be clear, a 64T64R radio box contains 64 transceivers. A 1T2R radio box contains one transceiver, despite two receivers for diversity.

A Remote Radio Head is defined as a physical box which converts a digital I/Q data stream into transmitter and receiver signals and boosts the transmit signal to the desired power level. A base station is considered to use the RRH architecture if CPRI, OBSAI, ORI, or any similar serial I/Q data stream is utilized between baseband processor and radio unit. We use the term RRH to refer to 2G thru 4G equipment, and RU to describe 5G radio units, because of the change in approach to include PHY/lower MAC baseband processing in 5G architectures.

Market shares are listed as the share of transceiver shipments in all cases, not as the share of revenue. Base station revenue is priced as a combination of hardware, software, and services, so the revenue associated with hardware is arbitrary, and traditional definitions of “base station market share” are meaningless. Therefore, Mobile Experts simply reports the share of transceiver shipments that we track through component vendors and operator inputs.

North America	USA and Canada
Latin America	Mexico through South America including Caribbean
Europe	Western and Eastern Europe, Including Russia
China	China, including Tibet and Hong Kong
Asia Pacific	India through Australia/Micronesia, Excluding China
Middle East/Africa	Pakistan and Turkey through Africa
Multimode	Capable of multiple simultaneous air interface standard (LTE, HSPA, GSM, etc.)
Adaptable	Capable of one air interface standard at a time, but reprogrammable
Single-mode	Capable of only one air interface standard
Multiband	Capable of operating in multiple frequency bands, one at a time
Carrier Aggregation	Units which operate in multiple bands simultaneously

Figure 1. Key definitions for regions and transceiver types

Source: Mobile Experts

Base Station:	A set of equipment which performs baseband processing to support mobile radio transmissions above 40W composite power, including BTS, nodeB, and enodeB types. NOTE: A Base Station Shipment can include a physical base station or simply a software upgrade so this metric can be misleading.
Macro Base Station:	Represents >40 W, operating at <6 GHz RAN equipment at SISO to 8T8R.
mMIMO Base Station:	Represents >40 W, operating at <6 GHz RAN equipment at greater than 8T8R, eg. 16T16R, 32T32R, 64T64R.
High Power Base Station	Term to describe either Macro or mMIMO base station to distinguish from other architectures such as Small Cells.
Transceiver:	An electronic assembly including transmitter (from DAC to modulated output) and one or more receiver chains (from antenna input to ADC). E.g. A 2x2 MIMO channel uses two transceivers at the base station. Note that a dual-band radio with one ADC/DAC and PA covering two bands will be counted as a single transceiver. A transceiver is equivalent to one spatial stream in this forecast.
2T2R, 4T4R, etc.	This numbering system refers to the number of transmitters and receivers associated with a single RU. For mobile infrastructure, the number of downlink transmitters is listed first, and the number of uplink receivers is listed second. In this way the RRH/RU is described by the number of physical transceivers, not the MIMO order.
MIMO:	In this forecast MIMO is categorized according to downlink configuration. MIMO order is designated by n x m, where n=number of transmit antennas and m=number of receive antennas. The MEXP forecast designates the number of distinct MIMO streams.
AAS:	Active antenna systems refer to beamsteering systems, with multiple antenna elements transmitting the same signal, phased for beamsteering control.
IAR:	Integrated Antenna Radio systems involve the physical integration of antennas with transceivers. Not all IAR systems result in beamsteering, and not all beamsteering systems use IAR.
MIMO Beam:	All Integrated Antenna Radio units are evaluated for the number of "beams" transmitted. Each beam represents a directional transmission/reception from the antenna array. For an IAR, a single beam can be used (simple fixed antenna configuration) or up to 16+ beams can be transmitted. The number of beams is typically less than 1/4 the number of antenna elements.
MU-MIMO Stream:	Each MU-MIMO stream represents a single logical flow of data from the baseband processor. A 2x2 MIMO link uses two MIMO streams, and a 4x4 MIMO link involves four MIMO streams.
CA:	Carrier Aggregation, in this forecast, refers to inter-band Carrier Aggregation and not to Intra-Band Carrier Aggregation.
Shipment Share:	Note that this forecast does NOT report traditional "Market Share" calculated by revenue. Instead Mobile Experts reports the share of transceiver shipments for each vendor.
Ultra High Density:	Traffic density above 0.1 Gbps/km ² /MHz
High Density:	Traffic density between 20 and 100 Mbps/km ² /MHz
Mid Density:	Traffic density between 5 Mbps/km ² /MHz and 20 Mbps/km ² /MHz
Rural:	Traffic density below 5 Mbps/km ² /MHz

Figure 2. Key definitions for other terminology

Source: Mobile Experts