

Emerald Cellular Product Range (4G & 5G LTE)

Advanced 4G & 5G LTE Small Cell Outdoor Version

Overview- n78 1W



About Wireless Excellence

Founded in 1996 and with headquarters in Oxford UK, Wireless Excellence Limited is a leading designer and supplier of outdoor and indoor Broadband Wireless communication products

With a complete range of solutions including Radio, Microwave, Millimeter-Wave, Free Space Optics, WiFi and 4G/5G/LTE, customers in over 80 countries have chosen Wireless Excellence as the "one stop shop" solution of choice for dependable wireless networking

About 4G & 5G Base Stations

Using the latest Software Defined Radio and RF technology, our cellular Base Station products operate in all the common cellular bands from 380MHz-4400MHz, distances over 20km and high net throughput to subscriber devices

Our advanced 4G & 5G Cellular Base Station platform with IP/Ethernet interfaces supports LTE Release 16/17 software updates for future features. Flexibility, performance and low cost of ownership are ensured

Advanced 4G & 5G LTE Software Defined Radio Small Cell Base Station

CableFree: Wireless Excellence offers high performance 4G & 5G LTE Small Cell Base stations solutions for a wide variety of applications. Covering all common 4G & 5G LTE bands the base stations feature Software Defined Radio (SDR) which enables great flexibility of operation and future upgrade path.

4G & 5G LTE networks using CableFree Emerald 4G & 5G LTE SDR Small Cell base stations enjoy great flexibility, high performance as well as very low cost of operation and ownership. "Stand Alone" operation is possible which enables the 4G/5G Base station to connect remote terminals without need for external network elements.. This is ideal for closed network type applications such as CCTV, campus sites and disaster recovery scenarios, where there is no centralised infrastructure or Network Operations Centre.

System Features

- Compact, Software-Defined 4G & 5G LTE Base Station
- Small Cell: Compact, all-outdoor installation
- Spectrally Efficient, Software-Defined Radio
- n78 (3300-3800MHz) specific version
- Supports TDD mode
- Transmit Power up to 1W per Tx
- Supports MIMO 2x2 as standard
- Options for 4x4 MIMO and Dual 2x2 MIMO
- Wide Channel Widths for 5G available
- Supports LTE release 15-17 (4G & 5G LTE)
- Supports NB-IoT (Internet of Things) Modes
- 4G migration to 5G with software updates
- Support for LTE in 5GHz Unlicensed Bands
- Time Synchronisation using flexible choice of GPS, Galileo, GLONASS and BeiDou Satellite networks

Applications

- Telecom Service Providers & ISPs
- Cellular Network operators
- Point-to-Multipoint Point Wireless networking
- CCTV connection for multiple cameras
- Oil & Gas Utilities
- Fast Roll-out & Temporary Deployment

Enhanced Performance, Flexibility & Features

The CableFree: Wireless Excellence Emerald Small Cell platform is an integrated advanced system capable of handling 4G or 5G LTE wireless network waveforms. Provided in a sealed carrier grade unit for outdoor installation, or with an optional indoor version for wall or ceiling mount, the Emerald RF platform is at the forefront in terms of digital pre-distortion technology and signal processing associated to advanced PA architecture. The Emerald platform is ideal for implementation of cellular and advanced wireless communications market.

The Emerald RF platform is suitable as a multicarrier power amplifier either in the Base station or aggregated within the deployment To achieve maximum flexibility in terms of utilisation, units can support:

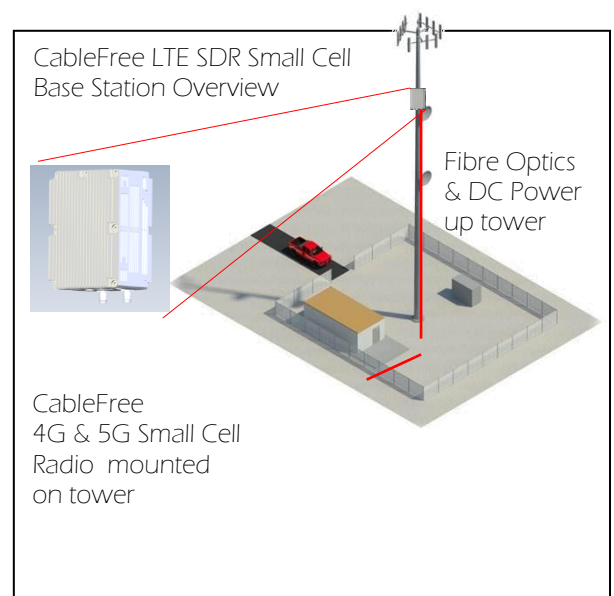
- TDD or FDD Modes
- 4G (eNodeB) & 5G (gNodeB) Modes
- Additional Customer specific frequencies

The duplexer used for TDD modes ensures compliance with the ETSI TS136 104 specifications.

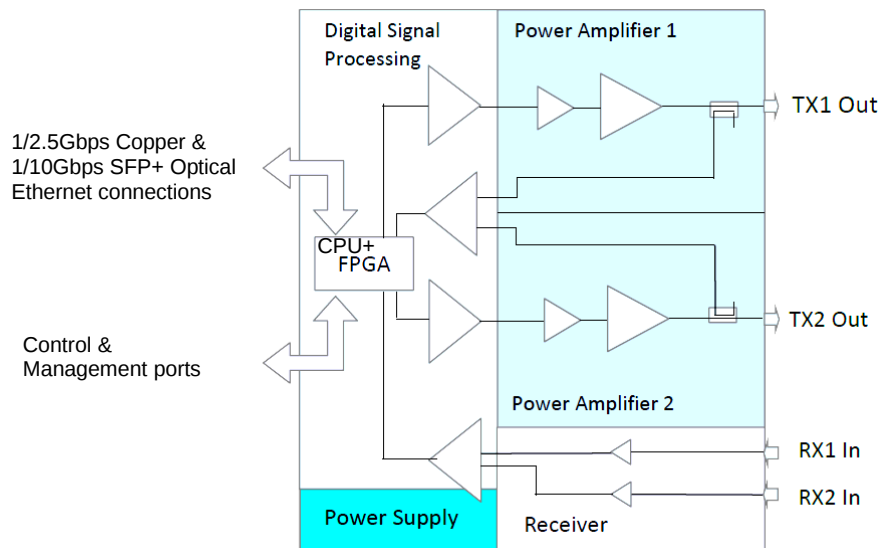
The Emerald RF platform allows management through the Ethernet based connection. This allows for the transceiver to be managed or upgraded either via local connection or via secure remote protocols.

CableFree Small Cell platform allows for the Rx inputs to operate in high or low sensitivity modes for NF receiver performance.

The Small Cell Unit carries Ethernet 1Gbps (optional 2.5 & 10Gbps) Copper and Optical network connections to allow for the latest generation of LTE architecture to be implemented.



CableFree Emerald Platform eNodeB & gNodeB Small Cell Radio Unit block diagram:



Emerald Small Cell Platform Specifications

gNodeB Features (5G)

- 3GPP NR release 16 compliant
- FDD/TDD FR1 (< 6 GHz) and FR2 (≥ 6 GHz). (Note. FR2 ranges are for future product support)
- Data subcarrier spacing: 15, 30, 60 or 120 kHz. SSB subcarrier spacing: 15, 30, 120 or 240 kHz. All SSB/data subcarrier spacing combinations are supported
- Up to 8x8 downlink MIMO
- 256QAM
- All PUCCH and PRACH formats
- PUSCH with and without transform precoding. PUSCH and PDSCH with user configurable DMRS and number of symbols
- User configurable TDD UL/DL pattern and k0, k1 and k2 values
- PDCCH with DCI 0 0, 0 1, 1 0 and 1 1.
- Scheduling Request support
- PHY test mode: support for continuous PDSCH and PUSCH transmission
- EN-DC support
- Dynamic LTE/NR DRB configuration
- User selectable DRB configuration for each QCI
- DRX support
- RRC measurement with measurement gap support
- PScell change support
- Standalone support



eNodeB Features (4G)

PHY layer:

- LTE release 12, 13, 14 compliant.
- Supports FDD and TDD configuration.
- Available bandwidths: 1.4, 3, 5, 10, 15 and 20 MHz.
- Handle several cells sharing the same antenna on identical or different frequencies.
- Transmission mode: 1 (single antenna) and 2 to 10 (MIMO 4x4).
- Wideband CQI/PMI reports.
- All DL channels are supported: PSS, SSS, PBCH, PCFICH, PHICH, PDCCH, PDSCH.
- All UL channels are supported: PRACH, PUSCH, PUCCH, SRS.
- HARQ support.
- Timing measurement thru the PRACH.
- Closed-loop UE power control.
- Frequency based MMSE equalizer.

- Highly optimized turbo decoder.
- PAPR reduction support.
- Positioning Reference Signals (PRS) support.
- CSI-RS support
- Multi-cluster PUSCH allocation
- PUCCH 3 and PUCCH channel selection support
- Carrier Aggregation support with cross-carrier scheduling (tested with 3 DL channels, supports up to 8 DL channels)
- CoMP testing features (DMRS scrambling identity and OCL parameters can be selected)
- 256QAM DL support for PDSCH and MBMS
- 1024QAM support for PDSCH
- Support of release 11 TDD special subframe configurations 7 and 9

Protocol Layer:

- LTE release 12, 13, 14 compliant.
- Implements the MAC, RLC, PDCP and RRC layers.
- Round-robin MAC scheduler with dynamic MCS selection.
- Support of full and half duplex UEs.
- Number of active users only limited by the available time/frequency resources.
- Fully configurable System Information Blocks.
- Integrity check and encryption using the AES and Snow3G algorithms.
- Support of RRC measurement with measurement gap.
- Supports intra eNodeB, S1 or X2 handovers.
- QoS support with user selectable DRB configuration for each QCI.
- ROHC support(RTP, UDP and IP v1 profiles).
- Public Warning System (CMAS/ETWS) support.
- MBMS support
- Category 0 UE support
- eDRX support
- EN-DC support

LTE-M

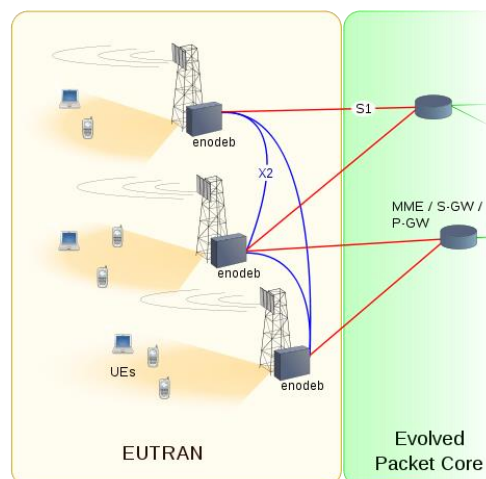
- Release 14 compliant
- Category M1 UE support
- TM6 and TM9 support
- FDD only (FDD and HD-FDD UEs are supported)
- Support of multiple CE levels (Note: only CE-Mode A is supported).
- Support of message repetition for MPDCCH, PDSCH and PUSCH in full duplex.
- Support of localized MPDCCH transmission
- EPDCCH support for Category M1
- No frequency hopping
- Bandwidth must be ≥ 5 MHz

NB-IoT (Internet of Things)

- NB-IoT release 14 compliant
- Single-tone and multi-tone category NB1 and NB2 UE support
- 15 kHz and 3.75 kHz subcarrier spacing are supported
- All operation modes (in-band, guard band and standalone) are supported
- Multiple NB-IoT and LTE cells can be used at the same time in the same eNodeB
- Support of multiple coverage levels
- Support of all NPDCCH, NPDSCH, NPUSCH and NPRACH configurations
- Support of control plane CIoT optimization
- Support of multi-DRB mode
- Support of non-anchor carriers (Release 14 NPRACH on non-anchor carriers is not supported)
- Support of two HARQ processes
- DRX support

Network interface:

- 1Gbps and 10Gbps options available. Copper RJ45 and Fibre Optic Options.
- Standard S1AP and GTP-U interfaces to the Core



Network:

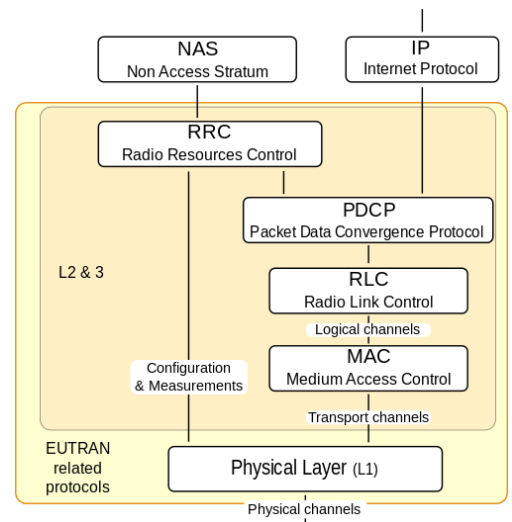
- Standard S1AP and GTP-U interfaces to the Core Network. Several PLMNs and S1 interfaces can be used simultaneously.
- X2AP interface between eNodeBs.
- M1 and M2 interfaces for MBMS
- IPv6 support

User interface:

- Configurable logging system for all channels with built-in text decoders.
- Wireshark MAC-LTE capture.
- Plots for QAM constellations and channel response
- Command line monitor.
- Test commands to initiate handover and to dynamically change the power level of each cell.

Core Network (EPC) Features

- Implements one MME with built-in SGW, PGW and HSS.
- Supports several eNodeBs with standard S1 interface (S1AP and GTP-U protocols).
- NAS integrity check and encryption using the AES and Snow3G algorithms.
- Support of USIM cards using the XOR or Milenage authentication algorithm.
- Handling of UE procedures: attach, authentication, detach, tracking area update, service access, radio bearer establishment, paging.
- Multi-PDN support and built-in dynamic ERAB setup for easy VoLTE/IMS testing.
- Transparent access to the IP network (no external Serving Gateway nor PDN Gateway are necessary).
- Configurable access point name, IP range, DNS and E-RAB QoS.
- Configurable user database. No external HSS is needed.
- IPv6 support.
- Support sending of Public Warning System messages (ETWS/CMAS)
- Configurable logging system for all channels with built-in text decoders.
- Command line monitor.



Upcoming features in future software releases:

- SON (eNB/MME)
- HSS or database support for UE provisioning (MME)
- Updated MAC scheduler

Available in versions to cover all 4G & 5G LTE Bands

The CableFree Emerald range is available in versions to cover all commonly used LTE bands.

Frequency Bands used worldwide for 4G LTE networks:

5G NR Frequency Bands: Frequency Range 1 (FR1)

Band	Duplex mode	f (MHz)	Common name	Subset of band	Uplink (MHz)	Downlink (MHz)	Duplex spacing (MHz)	Channel bandwidths (MHz)
<u>78</u>	TDD	3500	C-Band	N77	3300 – 3800	3300 – 3800	N/A	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100

These bands Include Frequency division duplexing (FDD); time division duplexing (TDD); FDD supplemental downlink (SDL); FDD supplemental uplink (SUL)

FDD 4G & 5G LTE Bands & Frequencies

Many of the allocations of radio spectrum that has been reserved for FDD (frequency division duplex) 4G & 5G LTE use. FDD bands use separate frequencies for Uplink (UL) and Downlink (DL) between the base station and user device with simultaneous signal transmission and reception.

TDD 4G & 5G LTE frequency band allocations

TDD uses unpaired frequency allocations that are allocated and used for 4G & 5G LTE. The TDD LTE bands are unpaired because the uplink and downlink share the same frequency, being time multiplexed. TDD is popular for 5G, Wireless ISPs and data-centric networks with no legacy of 2G or 3G due to higher spectral utilisation.

Custom Bands and Frequencies

CableFree 4G & 5G LTE Base stations can be supplied for custom bands and frequencies if/as required.

Product Features and Performance options

Please check carefully with CableFree Technical Support that the specific combinations of frequency, bandwidth, modulation, power and capacity you desire are available before confirming any orders. The advanced reconfigurable technology used in CableFree 4G & 5G base stations is highly flexible but certain combinations of bands and modes may require extra hardware, have certain restrictions in use or in very unusual cases be unavailable. We will be very happy to advise on most suitable configurations to ensure you have the best performing network available.

4G & 5G-SA supported

Please note that current models of Small Cells feature a single radio interface which can be configured for 4G or 5G-SA modes. Currently the Small Cell radio does not support 5G-NSA modes internally, which is a future roadmap plan.

System Variant	CF-Emerald-SC-2x2-n78-1W-X
System Parameters	
Max. No Carriers per TX/RX	4G: (5, 10, 15, 20MHz channel widths: depends on band) 5G: (5, 10, 15, 20, 25, 30, 40, 45, 50MHz channel widths: depends on band)
4G/5G Small Cell Transmitter	
2 ports (2x2 MIMO) Note: Options for 4x4 MIMO	
Tx Max Pout per port	Up to 1W average, per chain
Tx Frequency range*	3300 – 3800MHz (hardware factory options, one band per radio)
4G/5G Small Cell Receiver	
2 ports (2x2 MIMO) Note: Options for 4x4 MIMO	
Rx frequency range*	3300 – 3800MHz (hardware factory options, one band per radio)
Rx input level	-28dBm Max
LTE sensitivity (5,10,20 MHz)	<-101.5dBm
4G/5G Network Synchronisation	
Time Synchronisation	Flexible choice of GPS, Galileo, GLONASS and BeiDou Satellite networks
Regulatory	
LTE Compliancy	ETSI TS 136 104 cat B Opt2
Electrical safety	UL 60950 - Ed.3 2000, EN 60950 Ed.2001, CSA C22.2 No 60950
Environmental Conditions	ETSI EN 300 019-1, ETSI EN 300 019-1, ETSI EN 300 019-3, IP67
Mechanical	IEC 60297-3 - Standard definition for 19" modules
Inflammability	UL94
Physical Interfaces	
RF Connectors	2x 4.3/10 connectors to external antennas. 1x SMA connector for GPS/GNSS Sync
Ethernet	1x RJ45 1Gbps Copper Interface (factory option for 2.5Gbps) 1x SFP 1Gbps Optical SFP cage (factory option for 10Gbps SFP+)
Local Management & Debugging	HDMI + 2x USB ports for factory/lab initial setup
Physical Parameters	
Operational Temperature	-20°C to 55°C ETS 300 019-2-4 Class 4M5
Humidity	0 to 95%, non-condensing (outdoor version)
Power Supply	DC 36-60 V
Overall Efficiency	>20% (with duplexer*)
Power Consumption	<100 W (depends on version: note 4x4 is higher)
Weights and Dimensions	
Dimensions	Small Cell - various versions - check your specific model 325 x 210 x 156mm (HxWxD)* (outdoor 2x2 version) Note: 4x4 & high power versions are larger
Weight	Typ <13kg (depends on power level - outdoor version)

Product codes

Product Code	Description
CF-Emerald-SC-2x2-n78-1W-X	Emerald 4G/5G BS Outdoor SC 2x2 MIMO n78 (3500MHz) 1W
CF-Emerald-SC-4x4-n78-1W-X	Emerald 4G/5G BS Outdoor SC 4x4 MIMO n78 (3500MHz) 1W
CF-Emerald-SC-EPC-X	Emerald 4G/5G BS EPC (various options, including "on radio" core)
CF-Emerald-SC-5GC-X	Emerald 4G/5G BS 5G Core (various options, including "on radio" core)

Note – precise product code depends on frequency, band, antennas, resilience and other options. Please contact Wireless Excellence for more information

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