

Microwave Radio (MW)
CableFree MMR - Modular Microwave Radio
Carrier Ethernet Datasheet



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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 Microwave

Using the latest RF technology, our microwave links operate in all the popular bands from 4-42GHz, distances over 40km and net throughput up to 400Mbps up to 1Gbps. Our advanced Indoor units provide a common platform with flexible IP/Ethernet, Gigabit Ethernet, PDH (16xE1/T1) and optional SDH interfaces, to which traffic can be allocated under software control.

Flexibility, performance and low cost of ownership are ensured.

CableFree Modular Microwave Radios 4-38GHz

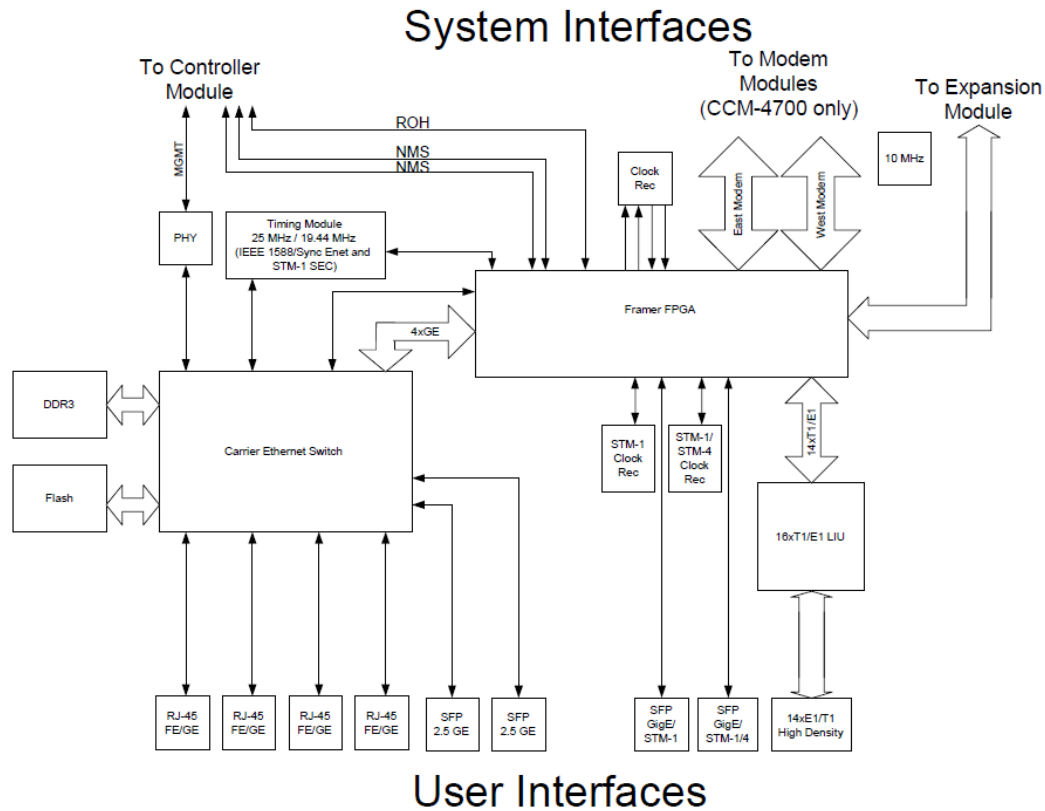
Carrier Ethernet Master IO Module Specification

1 Introduction

1.1 Overview

This document describes the functional specifications for the CFMMR-44xx Carrier Ethernet Master IO module designed for the CableFree Modular Indoor Unit (MMR IDU). The MMR IDU's Carrier Ethernet Master IO is designed for installation into the Master IO slot.

A block diagram of the module is shown here:



1.2 Reference Documents

1.2.1 Industry Standards

- IEEE 802.3
- IEEE 802.3ad (LACP)
- IEEE 802.3af-2003 (PoE)
- IEEE 802.1D-2004 (Bridging, RSTP)
- IEEE 802.1Q-2003 (VLAN, MSTP)
- IEEE 802.1ag (Connectivity Fault Management)
- IEEE 802.3ah (OAM)
- IEEE 1588v2 (Precision Time Protocol)
- ITU-T Rec. G.957 (SDH)
- ITU-T Rec. G.703 (E1, T1, SDH)
- ITU-T Rec. G.823 (E1)
- ITU-T Rec. G.824 (T1)
- ITU-T Rec. G.825 (SDH)
- ITU-T Rec. G.813 (SDH)

- ITU-T Rec. G.8031 (Ethernet Path Protection)
- ITU-T Rec. G.8032 (Ethernet Ring Protection)
- ITU-T Rec. G.8261 (SyncE)
- ITU-T Rec. G.8262 (SyncE)
- ITU-T Rec. G.8264 (SyncE)
- ITU-T Rec. G.8265.1 (Precision Time Protocol)
- ITU-T Rec. Y.1731 (Ethernet Performance Monitoring)
- MEF9
- MEF14
- SFP Multi Source Agreement (MSA)

1.3 Module Capabilities

The CFMMR-44x Carrier Ethernet Master IO module is designed with several variants to allow for capability and cost trade-offs. Table 1 shows the capabilities per variant. Figure 2 shows the front-panel face-plates for the module variants.

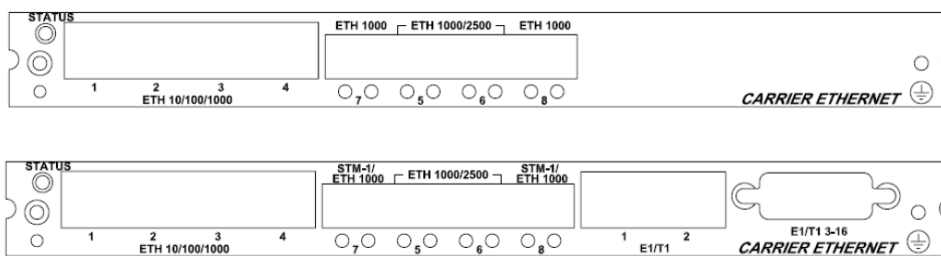


Table 1: MMR IDU Carrier Ethernet Capabilities by Module Variant

	CFMMR-4440	CFMMR-4441	CFMMR-4460	CFMMR-4461
MMR IDU Chassis	✓	✓	✓	✓
CFMMR-4325		✓		✓
Synchronous Ethernet		✓		✓
IEEE 1588v2		✓		✓
Power-over-Ethernet	N/A	N/A	N/A	N/A
2.5 Gbps SFP	✓	✓	✓	✓
1000 Mbps SFP	✓	✓	✓	✓
STM-1 Passthrough	0	0	2xSTM-1	2xSTM-1
STM-1 Mux/Demux	CFMMR-4312	CFMMR-4312	CFMMR-4312	CFMMR-4312
E1/T1 Passthrough	0	0	16xE1/T1	16xE1/T1

Ethernet

- Packet Processor
- 4xRJ-45 Electrical Ethernet ports providing 10/100/1000 Mbps
- 2xSFP slots for 1000/2500 Mbps Electrical and Optical Ethernet interfaces
- 2xSFP slots for 1000 Mbps or STM-1 Passthrough
- Ethernet bridging
- Rapid Spanning Tree and Multiple Spanning Tree protection mechanisms
- VLANs
- OoS
- Carrier Ethernet OAM and CFMMR
- Metro Ethernet Forum
- Synchronous Ethernet (supported with CFMMR-4325 plug-on module)
- 2+0 E/E and 2+0 XPIC load-balancing
- Ethernet Path and Ring protection
- IEEE 1588v2 (supported with CFMMR-4325 plug-on module)

E1/T1

- Front-panel interfaces for up to 16xE1/T1 channels (See Table 1 for support per variant)
- E1/T1 Any-to-Any Crosspoint switch capable of cross-connecting up to 512 E1/T1 channels,
- Support for incoming and outgoing E1/T1 synchronization on one channel.

STM-1 (supported by variants, see Table 1)

- 2xSFP slots capable of supporting 2xSTM-1 optical and/or electrical SFP modules and
- STM-1 Any-to-Any crosspoint switch.

CFMMR-4325 Timing Module for SyncE

- Synchronizes to references:
 - Ethernet ports
 - E1/T1 ports
 - STM-1 ports
 - RF link
- Provides synchronization reference to:
 - Ethernet ports
 - E1/T1 ports
 - RF link
- Failover
- Holdover
- Free-run

2 INTERFACES

2.1 Ethernet Electrical Interfaces

The CFMMR-44xx Carrier Ethernet module is equipped with four electrical Ethernet interfaces, which comply with the relevant clauses of IEEE 802.3. The four electrical Ethernet interfaces supports the following capabilities:

- 1000Base-T (1000 Mbps)
- 100Base-TX (100 Mbps)
- 10Base-T (10 Mbps)
- Full-Duplex
- Half-Duplex
- Flow Control
- Auto-Negotiation

The four ports are equivalent and may be used interchangeably. These ports support incoming and outgoing Synchronous Ethernet operation.

2.1.1 Electrical Ethernet Interface Connectors

The four electrical Ethernet interface I/Os terminates in four RJ-45 connectors.

Each electrical Ethernet interface has two status LEDs. The status LEDs provides the following status information:

Table 2: Ethernet Status LEDs

LED	Color	Description
1	Green	This LED will light/flash when traffic is passing on the associated Ethernet port.
2	Green/Orange	This LED will indicate the speed for the associated port: Orange = 1000 Mbps Green = 100 Mbps Unlit = 10 Mbps

2.2 SFP Interfaces

The CFMMR-44xx Carrier Ethernet module is equipped with four SFP interfaces. The SFP interfaces support the following SFP module types:

- Ethernet (IEEE 802.3)
 - 1000Base-T (copper)
 - 1000Base-SX (optical)
 - 1000Base-LX (optical)
 - 1000Base-ZX (optical)
- STM-1 (ITU-T Recommendation G.957)
 - S-1.1

The SFP ports do not support Synchronous Ethernet operation for 1000Base-T (copper) SFP modules.

2.2.1 SFP Connectors

The SFP module interfaces shall terminate in a SFP compliant slot (Reference SFP MSA).

2.2.2 SFP Interface Status LEDs

Each SFP interface has two status LEDs. The status LEDs provides the following status information:

Table 3: SFP Status LEDs

LED	Color	Description
1	Green	Lit to indicate an active connection.
2	Amber	Flashes to indicated traffic passing on associated port.

2.5 System Interfaces

The CFMMR-44xx Carrier Ethernet Master IO module integrates with the rest of the MMR IDU by supporting the following required interfaces via a PCI backplane connector:

- JTAG interface from controller card (FPGA programming interface).
- I2C interface from controller card with serial EEPROM and temperature measurement device attached.
- Power disable control from controller card.
- Status/Fault indication from controller card.
- Card present indication to controller card.
- Board shall accept 5V and 3.3V power and ground with hot swap control.
- Expansion IO interface with nine LVDS pairs and nine single-ended TTL lines.
- Modem interfaces with LVDS and single-ended TTL lines.
- ROH and NMS interfaces to/from the controller card.

3 ETHERNET

3.1 Layer 1 Capabilities

3.1.1 Synchronous Ethernet

The CFMMR-44xx Carrier Ethernet Master IO module shall support Synchronous Ethernet (SyncE) with the installation of a CFMMR-4325 timing module. Synchronous Ethernet is based on the following ITU-T Recommendations:

- G.8261
- G.8262
- G.8264

3.2 Layer 2 Capabilities

3.2.1 Bridging

The CFMMR-44xx Carrier Ethernet Master IO module shall provide Ethernet bridging capabilities as per IEEE 802.1D-2004 and IEEE 802.1Q-2003.

3.2.1.1 Rapid Spanning Tree Protocol (RSTP)

The CFMMR-44xx Carrier Master IO module shall provide Rapid Spanning Tree Protocol capability as per IEEE 802.3D-2004.

3.2.2 VLAN

The CFMMR-44xx Carrier Master IO module shall provide VLAN capabilities per IEEE 802.1Q-2003.

3.2.2.1 Multiple Spanning Tree Protocol (MSTP)

The CFMMR-44xx Carrier Master IO module shall provide MSTP capabilities per IEEE 802.1Q-2005.

3.2.3 Quality of Service (QoS)

The CFMMR-44xx Carrier Master IO module shall provide Quality of Service (QoS) capabilities. Incoming packets shall be classified and prioritized based on:

- DSCP (DiffServ) from IPv4 header
- VLAN PRI
- Ingress Port
- VLAN ID (TBR, future growth)
- EthType field from Ethernet II frame (TBR, future growth)
- MPLS Label QoS field
- MAC Destination Address (TBR, future growth)

- MAC Source Address (TBR, future growth)

Classified packets may be prioritized into 8 priority queues. The priority queues shall be scheduled using one of the following user-selectable algorithms:

- Queues 0-5 Deficit Weight Round Robin (DWRR) or Strict-Priority
- Queues 6-7 Strict-Priority only

Congestion avoidance shall be provided using the WRED algorithm (future growth). The algorithm shall support both marking and dropping.

3.2.4 Jumbo Frames

The CFMMR-44xx Carrier Ethernet Master IO module supports Ethernet frames up 9600 bytes (TBR, determined based on testing).

3.2.5 Flow Control

The CFMMR-44xx Carrier Ethernet Master IO module supports generation and reception of PAUSE frames during Full-Duplex Ethernet port operation.

The CFMMR-44xx Carrier Ethernet Master IO module supports back-pressure during half-duplex Ethernet port operation.

3.2.6 Link Aggregation Control Protocol (LACP)

The CFMMR-44xx Carrier Ethernet Master IO module supports Link Aggregation Control Protocol (LACP), as defined in IEEE 802.3ad, on the front-panel ports. LACP frames are not be passed transparently through the MMR IDU.

3.2.7 Ethernet Ring Protection

The CFMMR-44xx Carrier Ethernet Master IO module supports Ethernet Ring Protection as defined in ITU-T Rec. G.8032.

3.2.8 Ethernet Path Protection (future growth)

The CFMMR-44xx Carrier Ethernet Master IO module supports Ethernet Path Protection as defined in ITU-T Rec. G.8031.

3.3 Carrier Ethernet Capabilities

The CFMMR-44xx Carrier Ethernet Master IO module supports the following Carrier Ethernet capabilities.

3.3.1 Ethernet Connectivity Fault Management (CFMMR)

The CFMMR-44xx Carrier Ethernet Master IO module supports Ethernet CFMMR and PM per the following standards:

- IEEE 802.1ag
- ITU-T Rec. Y.1731

3.3.2 Ethernet Operations, Administration, and Maintenance (OAM)

The CFMMR-44xx Carrier Ethernet Master IO module supports Ethernet OAM and PM per IEEE 802.3ah.

3.4 Metro Ethernet Forum Certifications

The CFMMR-44xx Carrier Master IO module implements the following Metro Ethernet Forum (MEF) standards:

- MEF 6 – Ethernet Services Definition,
- MEF 10.1 – Ethernet Services Attributes, and
- MEF 11 – User Network Interface (UNI) Requirements and Framework.

The module is CableFree self-certified to the following MEF test suites:

- MEF 9
- MEF 14

3.5 Latency (future growth)

The CFMMR-44xx Carrier Ethernet Master IO module provides a low-latency path for Ethernet that bypasses the on-board Ethernet Switch.

4 E1/T1 Interfaces

4.1 E1/T1 Synchronization

The E1/T1 channels shall support passthrough timing. The clock used to transmit an E1/T1 signal egressing from the front-panel is recovered from the E1/T1 data received by the MMR IDU over the RF link.

4.2 E1/T1 Crosspoint Switch

The CFMMR-44xx Carrier Ethernet Master IO module provides an E1/T1 crosspoint switch. The crosspoint switch supports any-to-any cross connection of up to 512 E1/T1 channels between the following interfaces:

- RF Link (up to 126xE1/T1 per RF link),
- Master IO Front-Panel (see Table 1),
- Expansion IO Front-Panel, and
- STM-1 Add/Drop Mux on the Expansion IO module (up to 126xE1 channels).

4.3 E1/T1 SNCP-Like Tributary Protection

The CFMMR-44xx Carrier Ethernet Master IO module supports the MMR IDU's SNCP-Like capability.

4.4 E1/T1 Protected Ring

The CFMMR-44xx Carrier Ethernet Master IO module supports the MMR IDU's E1/T1 Protected Ring capability.

5 STM-1 / SDH Interfaces

5.1 STM-n Synchronization

The CFMMR-44xx Carrier Ethernet Master IO module supports transmit/receive of STM-1 signals from the front-panel. The received STM-1 signals are routed to the Master IO module Framer for transmission across the RF link. Transmitted signals are routed from the Master IO module Framer as received from the RF link.

The MMR IDU shall not act as a network element when passing through STM-1 signals. Therefore, no performance monitoring for the STM-1 signals are provided. The MMR IDU shall raise alarms for Loss-of-Signal for each STM-1 signal. In the event the RF link is offline, the transmitted STM-1 signals may be muted.

This mode uses through-timing for STM-1 Tx synchronization. An STM-1 signal received by the transmitting MMR IDU is framed into the MMR IDU Modem Frame format. The receiving MMR IDU de-frames the STM-1 signal and recovers the STM-1 timing from the received signal. The STM-1 is transmitted out the front-panel using the recovered timing. The STM-1 Tx and Rx paths are independent for synchronization purposes.

5.2 STM-1 Crosspoint Switch

The CFMMR-44xx Carrier Master IO module provides a crosspoint switch for STM-1 signals to allow any-to-any routing between front-panel ports and RF links.

6 CFMMR-4325 TIMING MODULE

6.1 Ethernet and STM-1

The CFMMR-44xx Carrier Ethernet Master IO module supports the CFMMR-4325 plug-on Timing Module (TM). The TM shall be able to be referenced to an incoming clock source, and provides a clock for outgoing Ethernet (SyncE) and/or STM-1 signals. The TM meets synchronization requirements as specified in ITU-T Recommendation G.813 (SDH) and G.8261/G.8262 (Synchronous Ethernet).

6.2 Synchronization Sources

The TM is configurable to reference the following synchronization sources:

- Incoming Ethernet on RJ-45 electrical ports (including SFP)
- Incoming Ethernet on optical SFP modules (see Table 1)
- Incoming E1 signal on Master IO front-panel (future growth, see Table 1)
- Incoming E1 signal on the Expansion IO front-panel (future growth, see Table 1)
- Incoming STM-1 signal on Master IO front-panel (SFP) (future growth, see Table 1)
- Incoming STM-1 signal on the Expansion IO front-panel (future growth, see Table 1)
- Synchronization from the RF link (from CFMMR-44xx link partner equipped MMR IDU)
- Local IEEE 1588v2 Ordinary/Boundary Clock
- Free-running (internal)

6.3 Synchronization Automatic Failover

The TM supports automatic failover from the primary synchronization reference to one user-configurable fallback reference, and to a holdover mode.

6.4 Synchronization Holdover

The TM supports a holdover mode that keeps the last known synchronization reference for a TBD duration in the case of primary and secondary synchronization reference failures.

6.5 Synchronization Free-run

The TM meets Stratum 3 frequency stability during free-running operation.

6.6 IEEE 1588v2

The CFMMR-44xx Carrier Ethernet Master IO module supports IEEE 1588v2 protocol (see Table 1). The CFMMR-44xx Carrier Ethernet Master IO module supports Hitless ACM capability when supported by the MMR IDU.

7.2 Ethernet Link Aggregation

The CFMMR-44xx Carrier Ethernet Master IO module shall support Ethernet link aggregation for 2+0 E/E and 2+0 XPIC links. The module supports usage in a 4+0 East/East or 2+2 XPIC link aggregation using two MMR IDUs at each end of the link.

8 INTEROPERABILITY

8.1 Hardware Interoperability

The CFMMR-44xx Carrier Master IO module interoperates with the MMR IDU modules list in Table 4, with any noted limitations.

Table 4: Carrier Ethernet Master IO Hardware Interoperability

Module	Module Name	Notes
CFMMR-4500	Controller Module	32 Mbyte version required
CFMMR-4501	Controller Module	
CFMMR-4600	Standard Band Modem	Will not support ACM and XPIC
CFMMR-4660	Wideband Modem	Will not support XPIC
CFMMR-4700	Unified Modem	
CFMMR-4132	16xE1/T1 Expansion IO Module	
CFMMR-4163	21xE1/T1 Expansion IO Module	
CFMMR-4311/4312	2xSTM-1 Expansion IO module	<p>Due to power dissipation limitations the following restrictions must be observed for operation at +55 degrees C:</p> <ul style="list-style-type: none"> -For 1+1, 2+0 operation with 2xCFMMR-4700: 16xE1/T1 may be used with maximum E1/T1 cable length of 3 meters -For 1+1, 2+0 operation with 2xCFMMR-4600: 2xE1/T1 may be used with maximum E1/T1 cable length of 3 meters -For 1+1, 2+0 operation with 2xCFMMR-4660: not supported

8.2 Link Level Interoperability

The Carrier Ethernet Master IO module shall be link interoperable with the Master IO modules shown in Table 5, with any noted limitations.

Table 5: Carrier Ethernet Master IO Link Level Hardware Interoperability

MMR IDU Module	MMR IDU Module Name	Supported Capabilities
CFMMR-44xx	Carrier Ethernet Master IO module	<p>Non-hitless ACM</p> <p>Header compression (TBR, future feature)</p> <p>Ethernet Link Aggregation</p> <ul style="list-style-type: none"> • 2+0 E/E • 2+0 XPIC • 4+0 E/E • 2+2 XPIC <p>Timing Module Synchronization Source</p> <p>E1/T1 Protected Ring</p> <p>E1/T1 SNCP-Like Protection</p> <p>Jumbo Frames (9,600 bytes)</p> <p>Ethernet Ring Switching (G.8032)</p> <p>Ethernet Path Switching (G.8031)</p>
CFMMR-4100/4120	Standard/Enhanced Master IO	<p>Non-hitless ACM</p> <p>E1/T1 Protected Ring</p>

CFMMR-4101/4121	Standard/Enhanced Master IO	Non-hitless ACM Ethernet Link Aggregation (4121 Only) <ul style="list-style-type: none"> • 2+0 E/E • 2+0 XPIC E1/T1 Protected Ring E1/T1 SNCP-Like Protection Jumbo Frames (2048 bytes)
CFMMR-4142	42xE1/T1 Master IO	Non-hitless ACM Ethernet Link Aggregation <ul style="list-style-type: none"> • 2+0 E/E • 2+0 XPIC E1/T1 Protected Ring E1/T1 SNCP-Like Protection Jumbo Frames (2048 bytes)
CFMMR-4110/4130	Gigabit Ethernet Standard/Enhanced Master IO	Non-hitless ACM Ethernet Link Aggregation <ul style="list-style-type: none"> • 2+0 E/E • 2+0 XPIC • 4+0 E/E • 2+2 XPIC E1/T1 Protected Ring E1/T1 SNCP-Like Protection (4130 Only) Jumbo Frames: 4110: 4,000 bytes 4130: 9,728 bytes

9 VERIFICATION METHODS

CableFree MMR IDU requirement verification shall be accomplished by the following methods:

9.1 Inspection

Visual inspection of equipment and evaluation of drawings and other pertinent design data and processes shall be used to verify conformance with characteristics such as physical, materials, parts and product marking, and workmanship.

9.2 Analysis

Analysis is the use of recognized analytical techniques (including computer models) to interpret or explain the behaviour/performance of the system element. Analysis of test data or review and analysis of design data shall be used, as appropriate, to verify requirements.

9.3 Demonstration

Demonstration is the performance of operations on the system element where one time or first article observations are the primary means of production verification.

9.4 Test

Test is an activity designed to provide data in an operational environment, under fully controlled and traceable conditions. The data are subsequently used to evaluate quantitative characteristics. Evaluation includes comparison of the demonstrated characteristics with requirements. Tests are conducted when an acceptable level of confidence cannot be established by other methods, or if testing can be shown to be the most cost effective verification method.

9.4.1 Other

"Other" includes all verification methods not covered by acceptance tests, qualification tests or reliability/maintainability tests, or verification to be performed at a different level of assembly.

10 PERFORMANCE VERIFICATION

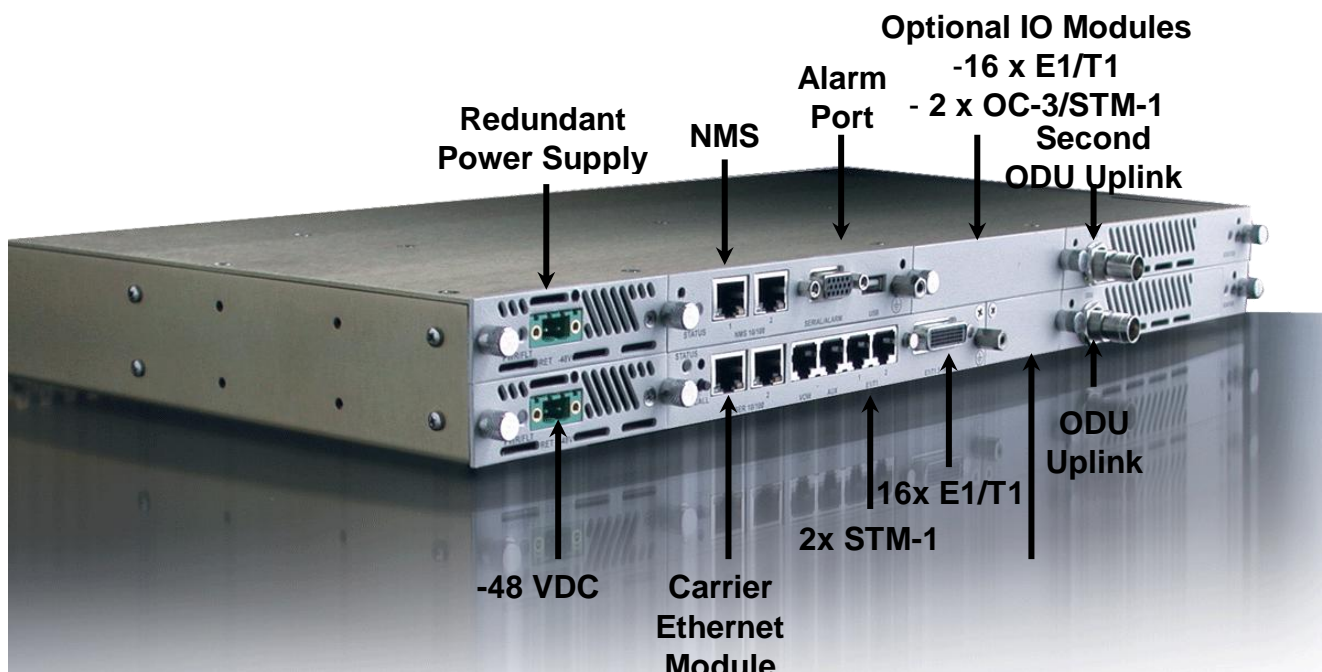
10.1 System Configurations

The CableFree MMR chassis consists multiple plug-in board assemblies that connect via a common backplane. The minimum configuration consists of a modem/IF assembly, controller assembly, standard I/O assembly and power supply assembly. All four assemblies are required to operate in the standard Carrier Ethernet configuration. An additional OC-3/STM-1 expansion assembly can be inserted to provide SDH functionality. An additional modem/IF assembly and power supply assembly can be added to support 1+1 redundancy or East/West operation within a single chassis. All testing will be performed in the standard Carrier Ethernet, SDH or 1+1 configurations. The following verification test matrix indicates which system configuration(s) will be used and the verification method for each required specification.

10.2 Verification Test Matrix

MMR IDU Verification Checklist	Verification Method (I=Inspection, A=Analysis, D=Demonstrate, T=Test)	Verification Status	Comments
Req. 2. Interfaces	-		
Req. 2.1 Ethernet Electrical Interfaces	I/T		
Req. 2.1.1 Electrical Ethernet Interface Connectors	I		
Req. 2.1.2 Ethernet Status LEDs	I/T		
Req. 2.2 SFP Interfaces	I/T		
Req. 2.2.1 SFP Connectors	I		
Req. 2.2.2 SFP Interface Status LEDs	I/T		
Req. 2.3 E1/T1 Interfaces	I/T		
Req. 2.3.1.1 E1/T1 Interface Connectors	I		
Req. 2.4 Status LED	T		
Req. 2.5 System Interaces	A/T		
Req. 3. Ethernet	-		
Req. 3.1 Layer 1 Capabilities	-		
Req. 3.1.1 Synchronous Ethernet	A/T		
Req. 3.2 Layer 2 Capabilities	-		
Req. 3.2.1 Bridging	A/T		
Req. 3.2.1.1 Rapid Spanning Tree Protocol (RSTP)	A/T		
Req. 3.2.2 VLAN	A/T		
Req. 3.2.2.1 Multiple Spanning Tree Protocol (MSTP)	A/T		
Req. 3.2.3 Quality of Service	A/T		
Req. 3.2.4 Jumbo Frames	A/T		
Req. 3.2.5 Flow Control	A/T		
Req. 3.2.6 Link Aggregation Control Protocol	A/T		
Req. 3.2.7 Ethernet Ring Protection	A/T		
Req. 3.2.8 Ethernet Path Protection	A/T		
Req. 3.3 Carrier Ethernet Capabilities	-		
Req. 3.3.1 Ethernet Connectivity Fault Management	A/T		
Req. 3.3.2 Ethernet OAM	A/T		

Req. 3.4 MEF	A/T	
Req. 3.5 Latency		Future Growth
Req. 4. E1/T1	-	
Req. 4.1 E1/T1 Synchronization	T	
Req. 4.2 E1/T1 Crosspoint Switch	T	
Req. 4.3 E1/T1 SNCP-Like Tributary Protection	T	
Req. 4.4 E1/T1 Protected Ring	T	
Req. 5. STM	-	
Req. 5.1 STM-n Synchronization		Future growth
Req. 5.2 STM-1 Crosspoint Switch	T	
Req. 6. Timing Module	-	
Req. 6.1 Ethernet and STM-1	T	
Req. 6.2 Synchronization Sources	T	
Req. 6.3 Synchronization Automatic Failover	T	
Req. 6.4. Synchronization Holdover	T	
Req. 6.5 Synchronization Free-run	T	
Req. 6.6 IEEE 1588v2	T	
Req. 7. MODEM/RF	-	
Req. 7.1 Adaptive Coding and Modulation	-	
Req. 7.1.1 Non-Hitless ACM	T	
Req. 7.1.2 Hitless ACM	-	Future growth
Req. 7.2 Ethernet Link Aggregation	T	
Req. 8. Interoperability		
Req. 8.1 Hardware Interoperability	T	
Req. 8.2 Link Level Interoperability	T	



Example of CableFree MMR IDU in Dual-Modem 1U configuration. Units can be "clustered" for Nodal Solutions.

Product codes

Product Code	Description
CFMMR-MMR-256QAM-IO-xxx - N+M-xxx	CableFree Modular Microwave Radio, please specify configurations including N+M options, STM-1 and Ethernet interfaces, Space Diversity and other resilience options, Frequency band, Power supplies. Frequency License required

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

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