



MOBILICOM

MCU-30 Family User Manual

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1 Quick Start Guide

If you are familiar with Mobilicom's MCUs, use this guide to prepare for operation. If you are not familiar with the Mobilicom MCUs, it is recommended to read the entire user guide. You can also visit the Mobilicom website for more material and videos at <http://www.mobilicom.com>

Before turning the MCU on:

1. Connect antennas to the MCU RF1 and RF2 connectors.
2. Connect the GPS antenna to the AUX connector (For a Mobile MESH and Collaborative MESH links it is mandatory to connect the GPS antenna).
3. Connect the data cable to the MAIN connector.
4. Connect the power cable.
5. Connect a DC power source to the power cable according to the specification.
6. If the MCUs are pre-configured, they will start operating automatically (plug and play).
5. Otherwise: connect an Ethernet cable between the data cable and the PC's Ethernet adapter.
7. Use the MC-EMA to configure the unit.



CAUTION – Powering up an MCU unit without connecting the antennas can cause unrepairable damage to the MCU-30.

2 Introduction

As a leading global mission-critical-communications solution provider, Mobilicom develops and delivers Bound-Free Mobile Private Network® technology and solutions for wireless mobile networks, without the need for any infrastructure. By leveraging 4G technology combined with Mobile MESH network topology, Mobilicom assures optimal secured wireless communications.

All our products and solutions are designed to operate as a unified entity on a single platform, regardless of which unit is operating. With versatile network topologies and large product portfolio, Mobilicom caters to every deployment and project scope from small to large scale with the highest flexibility, reliability and mobility in the market.

2.1 Abbreviation List

BPS	Bits Per Second
BW	Bandwidth
CEP	Circular Error Probable (Accuracy)
CINR	Carrier to Interference and Noise Ratio (Signal to Noise Ratio)
CPLD	Complex programmable logic device
CRC	Cyclic Redundancy Code
dB	Decibel
dBm	Power ratio in decibels of the measured power referenced to one milliwatt
CDD	Cyclic Delay Diversity
CTC	Convolutional Turbo Code
DC	Direct Current
EMA	Element Management Application
EMI	Electromagnetic Interference
ETH	Ethernet
ETSI	European Telecommunication Standard Institute
FAE	Field Application Engineer
FCC	Federal Communication Commission
FEC	Forward Error Correction
FFT	Fast Fourier Transform

Freq.	Frequency
FW	Firmware
GHz	Gigahertz
GPS	Global Positioning System
HD	High Definition (Video)
HPA	High Power Amplifier
HW	Hardware
ID	Identification (Number)
IP	Internet Protocol
LAN	Local Area Network
LAT	Latitude
LED	Light Emitting Diode
LON	Longitude
LOS	Line Of Sight
mW	Milli Watt
MBR	Multi Band Radio
MCU	Mobilicom Communications Unit
MHz	Mega Hertz
MIMO	Multiple In Multiple Out
MRC	Maximal Ratio Combining
MPTMP	Multi-Point To Multi-Point
Node	Mobilicom Communications Unit, In PTP setup act as end point communication unit
N.C	Not Connected
OEM	Original Equipment Manufacturer
OFDM	Orthogonal Frequency Division Modulation
OS	Operating System
PC	Personal Computer
PPS	Pulse Per Second
PTP	Point To Point
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying (modulation)
RF	Radio Frequency

RMS	Root Mean Square (Average)
RSSI	Receiver Signal Strength Indication
RX	Receive
SBAS	Satellite Based Augmentation System
SW	Software
TDD	Time Division Duplexing
TDMA	Time Division Multiple Access
TX	Transmit
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
VC	Virtual Concentrator, Mobilicom Communications Unit in PTP setup act as end point communications unit that distribute clocks in the system
VLAN	Virtual LAN
VPN	Virtual Private Network

Table 1: Abbreviation List

3 Overview

Mobilicom's multifunctional MCU-30 unit is a 4G Technology combined with Mobile MESH (not a cellular device), IP communications unit that delivers ad-hoc direct wireless mobile communication including HD Video, data and VoIP without the need for any infrastructure.



Figure 1: MCU-30

Communications between MCU units is both robust and broadband quality, of several Mbps transmission between units. Ideal for large area coverage, including non-line-of-sight (N-LOS), conditions in rural and urban areas, with extended range provided by a powerful relay capability. Its compact size makes this device suitable for public transportation, utility grids, emergency/security vehicles as well as helicopters / UAV / UGV usage.

The MCU-30 is part of Mobilicom's Mobile Communications Unit (MCU) product line which also includes the MCU-200, a high-end, high performance product optimized for various land, air and sea platforms. MC-HPA, is a High-Power Amplifier that enables extended range when required and MC-EMA, MCU management software.

3.1 Network Topologies and Applications

3.1.1 Mobile Point-to-Point (PTP)

A mobile point-to-point system includes 2 units, while the bandwidth ratio between the two MCU units is configurable according to the application. It can be symmetric when a full duplex communication is required (50% to each unit) or asymmetric up to 10% to one unit (VC or node) and 90% to the other unit (i.e. Helicopter which transmits video to the ground unit and its camera is controlled by it).

Example for asymmetric link: 8.4Mb/s configuration, where 10% of available BW is allocated for uplink and 90% is allocated for downlink

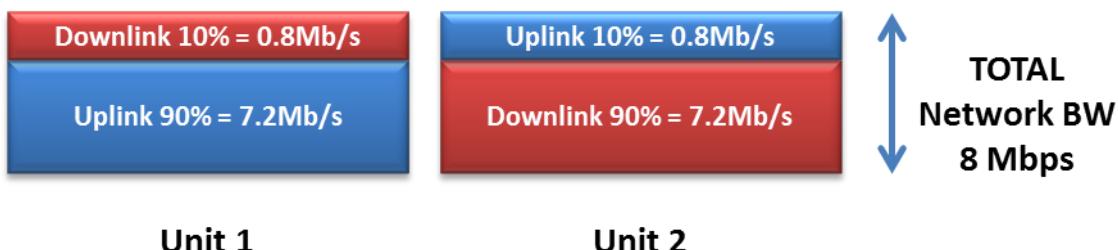


Figure 2: Asymmetric link configuration

3.1.2 Mobile MESH - Multi-Point-to-Multi-Point (MPTMP)

A multi-point-to-multi-point network is a cluster of MCUs over a radio link. The cluster includes at least 2 MCU units and can run up to 32 MCUs. Each MCU unit receives from, and transmits to, all other members of the cluster within a reception range.

3.1.3 Collaborative MESH – Collaborative Relay

The Mobilicom Collaborative MESH technology is an enhancement to the Mobile MESH capabilities. The Collaborative MESH allows to choose the data, which is received by all cluster members simultaneously, to be relayed by any of the cluster members (i.e. multiple MCUs can relay the data transmitted from a specific unit at the same time). This feature significantly extends the network's range and reliability, without any implication on its capacity (compared to a simple relay system).

3.2 MCU-30 Main Features

-
- Diversity support MIMO antenna processing technologies.
- Scalable solution from a Mobile Point-to-Point to a MPTMP MESH
- High mobility with continuous transmissions up to 800km/h
- Mobile broadband network
- Small physical dimensions (portable device)
- Low power consumption (less than 10W)
- Plug-and-play installation
- Battery operated
- Dual power feed for hot swap during operation

3.3 Packets supported by the Mobilicom network

The MCU physical link supports Ethernet (IEEE 802.3) which includes:

1. Ethernet, VLAN Services, VPN and any other Protocol over IP.
2. Including real time applications using RT Protocols such as: Voice, Video, Data
3. Broadcast, Multicast, Unicast

Any Ethernet packet received by the MCU's Ethernet port, is encapsulated with Mobilicom's standard frame for transmitting over the air-link to the remote MCU. The remote MCU recovers the original Ethernet packet and forwards it to the Ethernet port.



NOTE – The MCU is similar to Ethernet layer 1 (physical layer) which makes the integration with your equipment to be nothing more than connecting the ETH cable.

4 Physical Description

4.1 Front View Connectors

RF1: Antenna 1 Connector, SMA/F 50 Ohm

RF2: Antenna 2 Connector, SMA/F 50 Ohm

AUX: GPS Antenna Connector, SMA (Female)



Figure 3: MCU-30 Front View

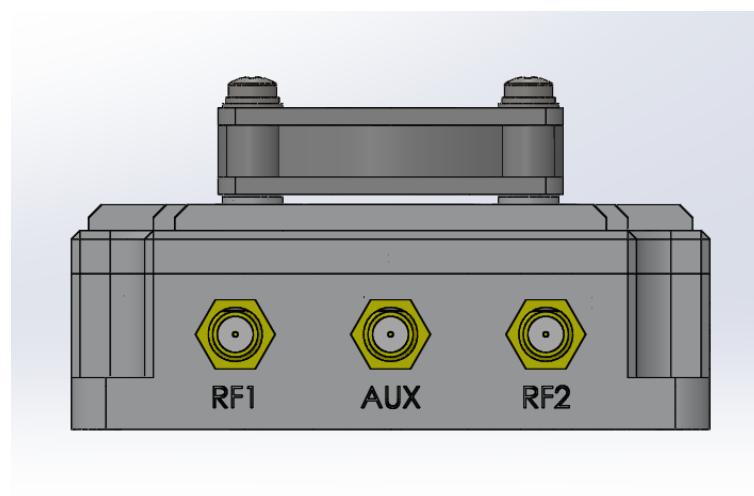


Figure 4: MCU-30 Lite Front View

4.2 Rear View Connectors

Main:

MCU-30: A HR22-12WTRA-20P connector is used.

MCU-30 Lite: A Molex P/N: 5015715007 connector is used.

The data connectors include 10/100Mbps ETHERNET port and can in additional support Serial RS-232 port.

Power:

MCU-30: A LF10WBRB-4P connector is used.

MCU-30 Lite: A Molex P/N: 5023520600 connector is used.

The power connectors utilizing 7-14.5VDC. The connector includes Dual Inputs for Hot Swap during operation.



CAUTION – Connecting two batteries in parallel for a long period might cause common discharge. For hot swap connect the second battery and disconnect the first one after.



CAUTION – When an MCU-30 is carried by a personnel, environment temperature should not exceed 45°C (113°F)



NOTE –Information about the connectors pin assignment is available in Appendix C – Connectors Pinout

LED: The MCU-30 LED indicates power up and link status



Figure 5: MCU-30 Rear View

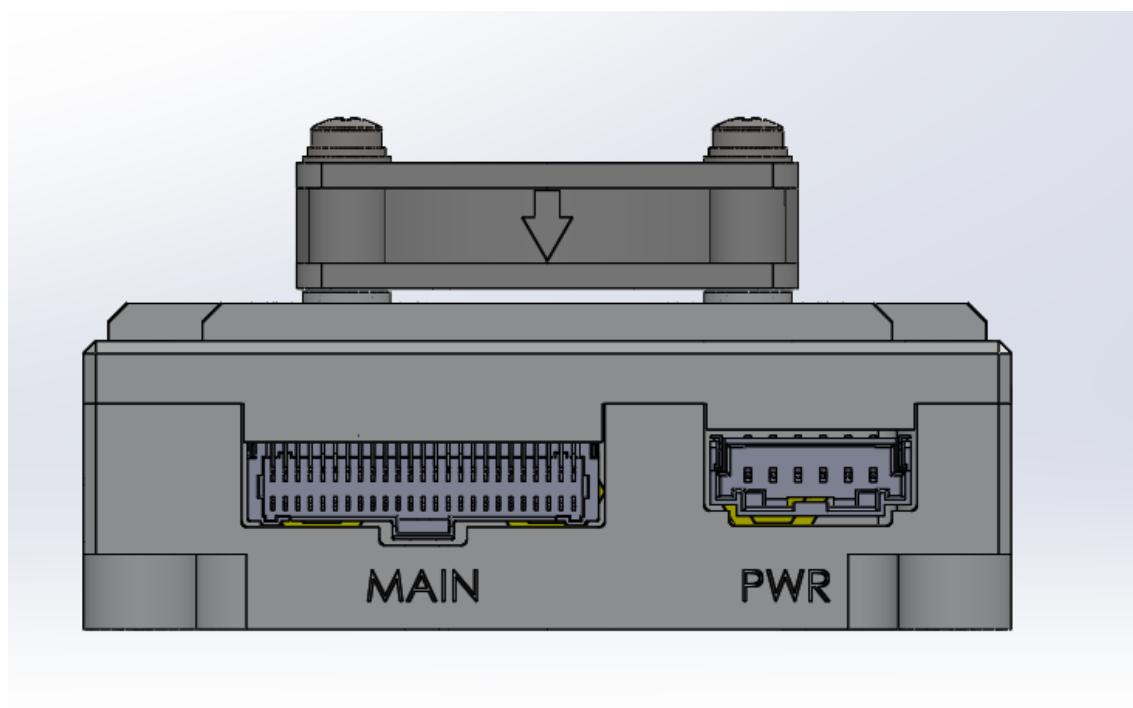


Figure 6: MCU-30 Lite Rear View

5 Mechanical Specifications

The MCU-30 has various packaging options enabling a wide range of applications and installation scenarios.

The most common packaging option is the outdoor unit with rugged casing, designed for harsh environment conditions and flight ready.

An extended ruggedized environmental casing should be used for extreme environmental conditions and is available for ordering.

There is an option for an Lite package (electronic boards only) which does not include any casing. It is commonly used for embedding the unit as OEM into systems such as UAVs, robots and other applications. In such cases, the customer/partner is responsible for the mechanical casing and mechanical design considerations such as cooling, (heat sink), sealing etc.

The following table shows the MCU-30 mechanical details for various packages types.

Dimensions	[HxWxD] cm	[HxWxD] inch	Weight (g)	Weight (Oz)
Lite Package	7.4 x 8.0 x 2.7 cm	2.9 x 3.15 x 1.1"	140 gr.	4.94 oz.
Ruggedized	12 x 9 x 6 cm	4.7 x 3.5 x 2.3"	550 gr.	19.5 oz.
Extended Rugged	12 x 9 x 6 cm	4.7 x 3.5 x 2.3"	550 gr.	19.5 oz.

Table 2: MCU-30 Mechanical Specifications

6 Technical Specifications

6.1 Radio and Modem Specifications

6.1.1 Frequency bands available with the MCU-30:

- 700-950MHz
- 2.3-2.7GHz
- 2.4GHz unlicensed band
- 4.9-5.9GHz (including all the unlicensed bands).

Additionally, there is an option for a multiband radio including 2 different bands within the same MCU unit. The MCU-30 family is hardware ready to support any frequency between 70MHz and 6GHz upon specific demand submitted by the customer.

6.1.2 Antennas

Various standard antennas Dipole, 2dBi maximum gain, Omni with SMA/M connector can be supported.

6.1.3 RF Characteristics

- Max output power: 2 x 0.5W per channel
- Average output power :2x 200mW per channel (23dBm)
- Noise Figure: 5dBm
- Transmission Power Control Range: 50dB in 1dB steps.
- Radio Access Method: OFDM - TDMA
- Configuration & Diversity Support: 2X2 MIMO with MRC(RX) and CDD(TX)
- Frequency Resolution: 0.25MHz
- Channel bandwidth: Configurable 4.2/8.4MHz
- FFT Supported: 512
- Guard band: 64 sub-carries each side
- Total subcarriers used per symbol: 384
- Data carriers used: 336
- Pilot carriers used: 48
- Sub carrier spacing: 13KHz for 5MHz bandwidth with 5msec frame
- Modulations: QPSK
- FEC methods: CTC
- FEC Ratios $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$
- Error Detection: CRC32
- Full TDD asymmetrical duplexing

Flexible ratio from 1:1 to 1:9 in Mobile PTP

Resolution of 1% between all units in Mobile MESH and Collaborative MESH networks



NOTE – The wide configurable power control range enables transmitting in low TX power when not needed and by that reducing the power consumption.

6.2 Power Specifications

The MCU-30 is designed to be battery operated (DC) with low power consumption. Its design allows for multiple battery cell configurations (different voltages).

Power - LF10WBRB-4P	
DC Voltage (Battery Operated)	7-14.5VDC Dual Inputs Hot swap during operation
Power Consumption	8 Watts average use Up to 12 Watt Depends on the operational scenario (TX:RX Ratio)

Table 3: MCU-30 Power Specifications

6.3 Environmental Specifications

The MCU-30 is designed to meet international EMI, Radio & Environmental Standards, such as wireless ETSI & FCC etc.

Environmental		
Temperature Range	Operating	Storage
Ruggedized	-20°C to 50°C	-50°C to 85°C
Extended Rugged	-20°C to 60°C	-50°C to 85°C
Lite	N/A	-50°C to 85°C
Humidity	5 to 95%	
Sealing	Outdoor, rain proof	

Table 4: MCU-30 Environmental Specifications

6.4 Embedded GPS Characteristics

The MCU-30 has a built in GPS receiver. In a Mobile PTP network configuration it is used for location information only (which can be operated by the customer via the Mobilicom API). In a Mobile MESH and Collaborative MESH configuration it is used for synchronization and can also be used by the customer for location purposes. The MCU-30 can use both active and passive GPS antennas. The power for the active antenna is provided by the MCU via a regular GPS SMA connector.

Item	Description
Receiver Type	GPS L1 C/A code
Accuracy	Position 2.5 m CEP
	SBAS 2.0 m CEP
Acquisition	Cold start: 27 s
	Aided start: < 3 s
	Hot start: 1 s
Sensitivity	Tracking: -161 dBm
	Cold start: -147 dBm
	Hot start: -156 dBm
Timing Accuracy	RMS 30 ns
	99% < 60 ns
	Granularity 21 ns

Table 5: Embedded GPS Characteristics of the MCU-30

7 TDMA

Time division multiple access (TDMA) is a channel access method for shared medium networks. It allows several MCUs to share the same frequency channel by dividing the signal into different time slots. The MCUs transmit and receive on the same frequency in a synchronized manner. Every MCU transmits in its own dedicated time slots. On the other time slots it receives the transmission sent by the other units' which are members of the same network (which are also transmitting on their own dedicated slots).

TDMA require synchronization system. The system is synchronized internally, externally or via GPS (synchronization varies between topologies and method used).

The MCU uses TDMA regardless of the application type, Mobile PTP, Mobile MESH or Collaborative MESH.

8 Mobile PTP (Point-to-Point)

A Mobile PTP network is a radio link between 2 MCUs. The configuration (frequency and profile) of both units must be the same with only one difference, one MCU is configured as a VC (Virtual Concentrator) while the other unit is configured as a Node.

The VC works with its internal clock and synchronizes the Node. After power-up the VC starts transmitting regardless of link status. The node however, does not transmit and stays in RX mode, it tries to acquire synchronization by finding a preamble (synchronization pattern). As soon as the node recognizes the pattern, it starts to transmit according to its allocated time slot.

The transmission bandwidth ratio is pre-defined as part of the profile configuration. It can be symmetric when full duplex communications is required (50% to each unit) or asymmetric up to 10% to one unit (VC or node) and 90% to the other unit.

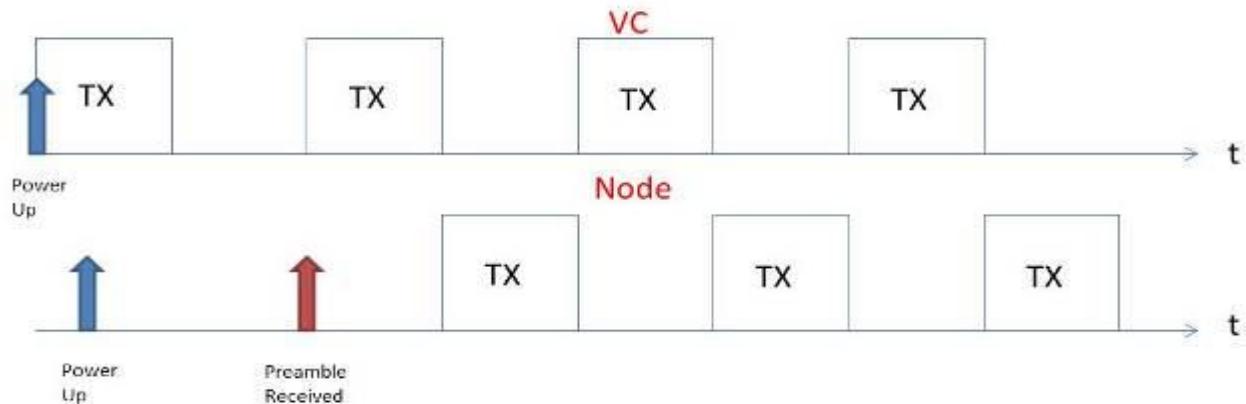


Figure 7: shows the transmit frames of VC and Node from Power Up

8.1 Mobile PTP Link Step-by-Step Configuration

In order to build a Mobile PTP link, 2 MCUs are required. One MCU acts as a VC, while the other as a Node.

1. Connect antennas to RF1 and RF2 connectors, and power up the MCU.



CAUTION – Powering up an MCU unit without connecting the antennas can cause unreparable damage to it.

2. Connect the MCU to a PC using a standard Ethernet Cat 5 cable.
3. Set static IP in the 192.168.131.xxx subnet. (for more information see MC-EMA P2P User Manual).
4. Using the MC-EMA: connect to the MCU (VC or Node, by default. The MCUs are shipped with a Mobile PTP SW and are set as a VC). From the MC-EMA, connect to screen choose the unit and click on the “Connect” button.

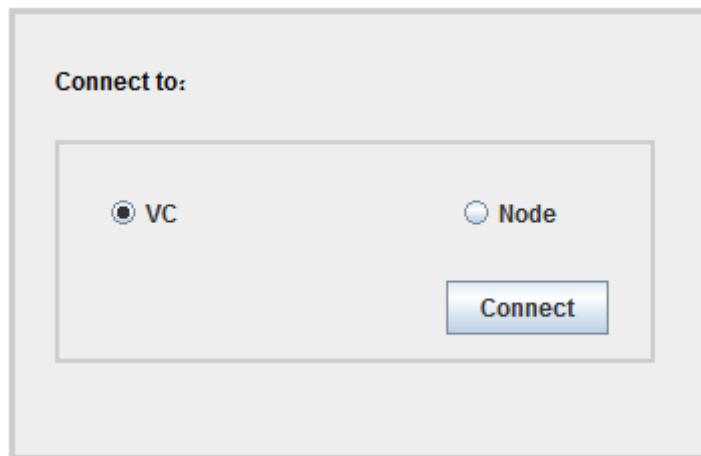


Figure 8: MC-EMA-PTP connect to screen

5. From the MC-EMA main menu (on the left side) choose the configuration screen and set the MCU to VC (if needed) by choosing the VC “radio button” than click on the “Set Mode” button – the unit will reboot
6. Change the frequency to the required frequency and click on the “Set Frequency” button – the unit will reboot
7. Set the profile as required (RF bandwidth, bitrate and ratio) click on the “Set” button “- the unit will reboot
8. Repeat stages 1-4 with the 2nd unit.
9. Go to configuration screen and set the MCU to Node (if needed) – the unit will reboot.
10. Repeat stages 6-7 with the 2nd unit.

Configuration

Mode	<input type="radio"/> Node <input checked="" type="radio"/> VC	<input type="button" value="Set Mode"/>
GPS Antenna Type	<input type="radio"/> Active <input checked="" type="radio"/> Passive	<input type="button" value="Set Antenna"/>
Tx Power (dBm)	<input type="text" value="-10"/>	<input type="button" value="Set Tx"/>
Frequency (MHz)	<input type="text" value="2510.0"/>	<input type="button" value="Set Frequency"/>

Profile

RF BW <input checked="" type="radio"/> 4.2 MHz <input type="radio"/> 8.4 MHz	Bit Rate <input type="radio"/> 1.6 Mb <input checked="" type="radio"/> 3.2 Mb <input type="radio"/> 4 Mb	Ratio <input checked="" type="radio"/> 50 / 50 <input type="radio"/> 90 / 10 <input type="radio"/> 10 / 90	Profile is OK <input type="button" value="Set"/>
---	--	--	---

Firmware Update

File:	<input type="text"/>	<input type="button" value="Browse"/>
-------	----------------------	---------------------------------------

Figure 9: MC-EMA-PTP Configuration screen



NOTE – A Mobile PTP requires 2 MCU's configured with same Frequency, and Profile.

8.2 MCU-30 LED indicator

By following the LED on the MCU the power and link status can be monitored, it is described as follows:

- LED is ON – the unit is on, air link is down and no data is transmitted.
- LED blinks slowly – Air link is up but there is no data over the link
- LED blinks fast – Air link is up and data is transferred over the air link

Link status, CINR, RSSI, throughput and unit log information is available using the MC-EMA.

9 Mobile MESH (Multi-Point-to- Multi-Point) Network

A Mobile MESH network is a cluster of MCUs over a radio link. The cluster includes at least 2 MCU units and can range up to 32 MCUs. Each MCU unit receives from, and transmits to, all other members of the cluster within the reception range.

The system is synchronized using a GPS or 1PPS External source. The MCU has an internal GPS receiver and an external connector for GPS antenna (passive or active).

In the Mobile MESH network, the transmission bandwidth is pre-allocated to each member of the cluster; this allocation is called a transmission vector and can be configured using the MC-EMA. All MCUs in the cluster **must** have the same configuration (Frequency, Profile and Transmission Vector) with only one difference, unit ID number.

An MCU can be a “listener” only, receiving the information from all other members of the cluster without consuming any bandwidth by not transmitting. In such configuration the “listener” unit cannot be monitored via other units (over the air), it cannot be seen in the link monitor screen since it does not transmit at any time. This application can be used when transmitting broadcast data to several units, when there is no need for sending data to the other direction. It can also be used when a unit is needed as a relay only unit.

After powering up the MCU, it waits for synchronization (1PPS). As soon as the MCU is synchronized (regardless of other units' synchronization) it starts to transmit in its dedicated time slot(s).



NOTE – The MCU can be synchronized by an external 1PPS source. For further information on this option, contact: support@mobilicom.com.

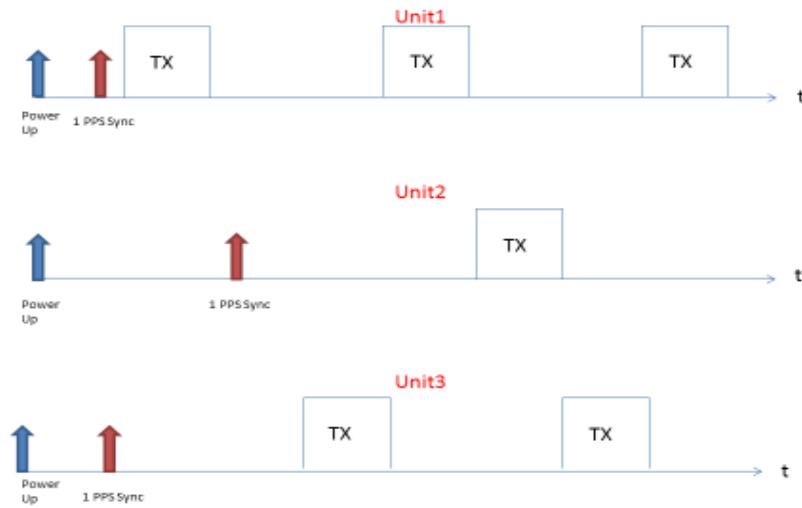


Figure 10: Transmit frames of MCUs in Mobile MESH from Power Up

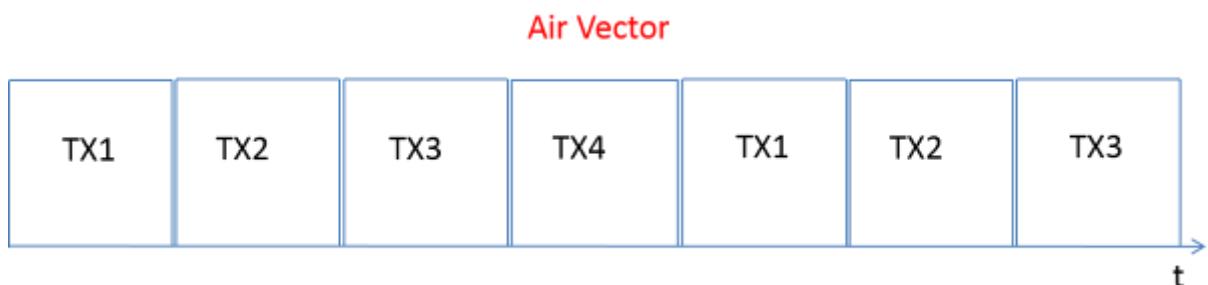


Figure 11: Simple air transmission vector

9.1 Mobile MESH Network Step-by-Step Configuration

1. Connect antennas to RF1 and RF2 connectors, and power up the MCU.



CAUTION – Powering up an MCU unit without connecting the antennas can cause unrepairable damage to it.

2. Connect the MCU to your PC using Ethernet cable.
3. Set static IP in the 192.168.131.xxx subnet. (for more information see MC-EMA MPTMP User Manual).
4. Using the MC-EMA (MPTMP Version) connect to the MCU by clicking the button of the unit ID (by default MPTMP configuration the unit ID is set to 1)

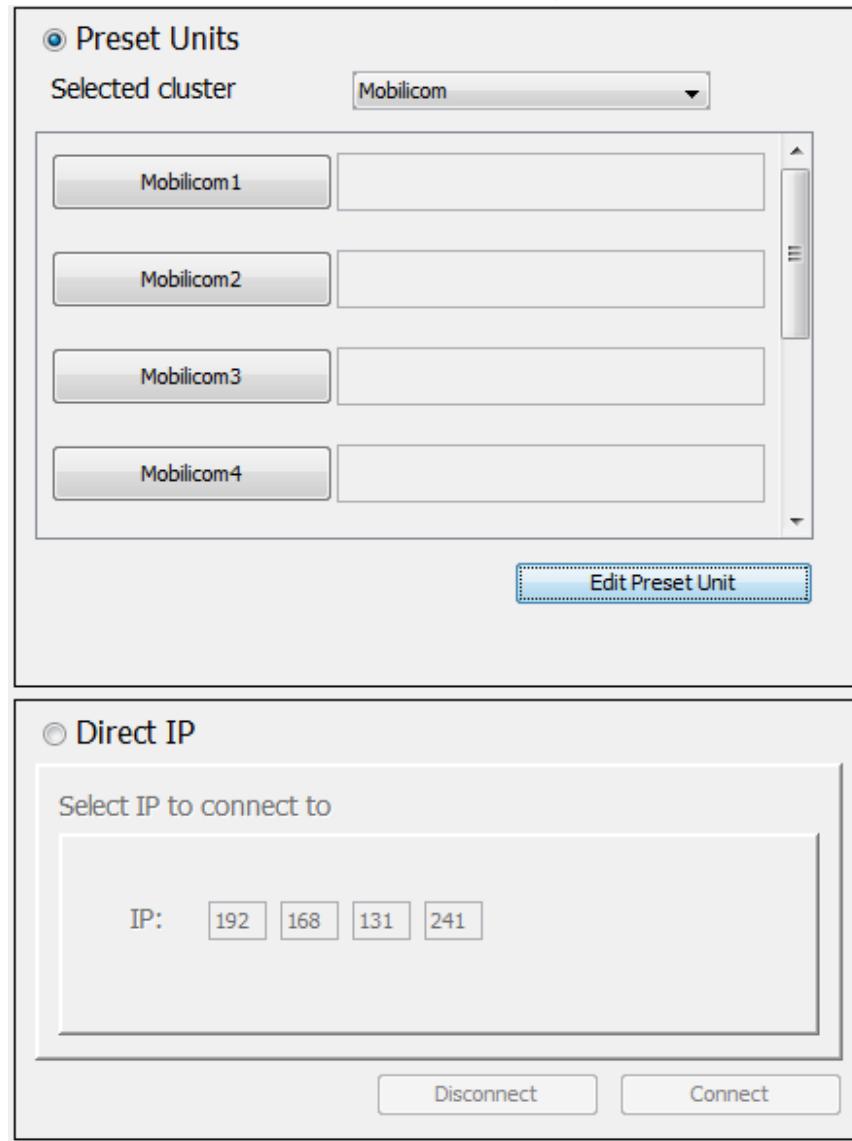


Figure 12: MC-EMA-MPTMP connect to screen

5. From the MC-EMA main menu (left side of the screen) go to network configuration screen and configure:
 - a. Network Frequency
 - b. TX Power
 - c. Transmission Vector (bandwidth allocation)
 - d. Profile
6. Click 'Verify' and chose the unit ID from the dropdown list.

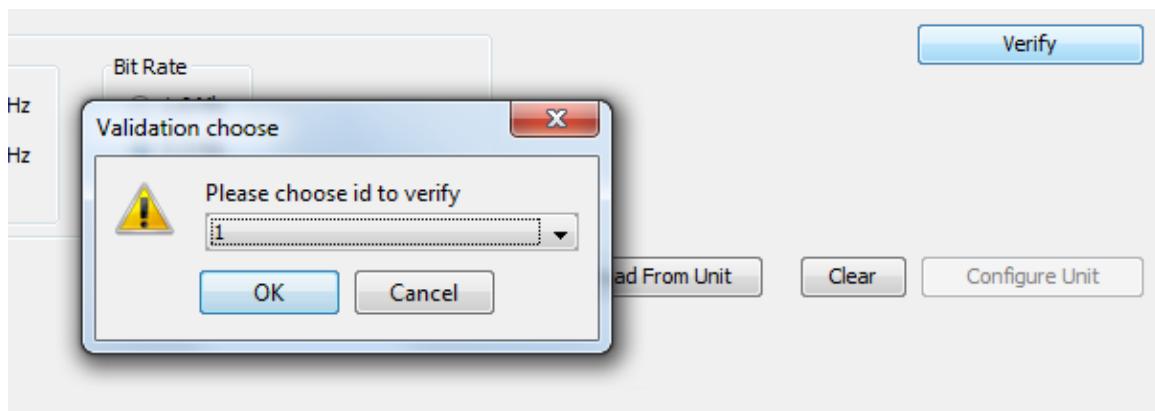


Figure 13: MC-EMA-MPTMP configuration validation

7. Click “configure unit” the configuration is now downloaded to the MCU.
8. The MCU reboots with the new configuration and unit ID number.
9. Repeat stages 1-10 with other units in the network.

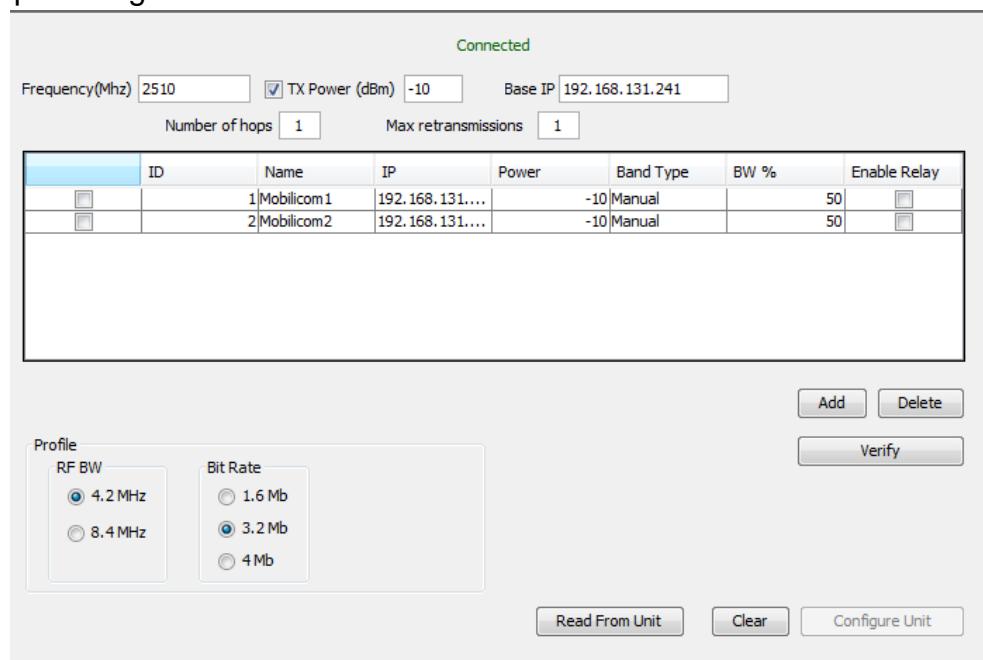


Figure 14: MC-EMA-MPTMP Network configuration screen



NOTE – Verify that each unit has a different unit ID



NOTE – In a Mobile MESH network configuration, the Number of Hops and Max retransmit parameters should be set to 1.



NOTE – unlimited amount of MCUs can use the same unit ID when in “listener only” mode.



NOTE – A Mobile MESH network requires at least 2 MCUs configured with same Transmission Vector, Frequency and Profile.

9.2 MCU-30 LED indicator

By following the LED on the MCU the power and link status can be monitored, it is described as follows:

- LED is ON – the unit is on, air link is down and no data is transmitted.
- LED blinks slowly – 1 PPS signal is locked but there is no data over the link
- LED blinks fast – Air link is up and data is transferred over the air link

Link status, CINR, RSSI, Throughput and unit Log are available using the MC-EMA.

10 Collaborative MESH – (Collaborative Relay)

In telecommunications, a relay/repeater is an electronic device that receives a signal and retransmits it at a higher level or higher power, or onto the other side of an obstruction, so that the signal can cover longer distances. Unlike the description above, Mobilicom's Collaborative MESH does not require special hardware. In a Mobilicom Collaborative MESH network that is based on the Mobilicom's Mobile MESH network, the user needs only to choose the MCU whose data needs to be relayed (can be one MCU or the entire cluster), and any member of the cluster (even listener only units) that are within the reception range repeat it on a dedicated time slots. By that, the network achieves better relay capabilities although the MCUs' locations may changes randomly. The data can be relayed up to 4 times (4 hops). It can be relayed by the originating MCU or any other MCU that has already received the data in the previous relay slots. As a result the link is more robust and can reach longer distances.

As in the Mobile MESH network, the air time is divided into time slots. Each unit has its own slots in which it transmits data. Every unit which is defined as a relayed unit, gets specific dedicated relay slots to it. These slots are taken from the allocated bandwidth of the relayed unit. For this reason, only the relayed unit has "lost" from its allocated bandwidth for the relay transmission. The other units' bandwidth is not affected this way.

The actual bandwidth of an MCU that is "marked" as a relayed unit is the allocated bandwidth (in the Transmission Vector configuration) divided by the Number of Hops.

A Hop represents one portion of the path between source and destination. We can say that any members of the cluster within a reception range of the current transmitting MCU is one Hop from this MCU. Other members of the cluster within the reception range of these MCUs is in 2 Hops from the original MCU and any cluster member that in the reception range of these units is in 3 Hops from the original MCU and so on.

As a Mobile MESH network, the system is synchronized using a GPS or external 1PPS source.

The configuration is the same as in the Mobile MESH network where All MCUs in the cluster **must** have the same configuration (Frequency, Profile and Transmission Vector) with only one difference - unit ID number. Additional configuration which is specific to the Collaborative MESH network is the Number of Hops, Max retransmission and "enabled relay" check box per node in the cluster.

After powering up the MCU, the unit waits for synchronization. As soon as the MCU is synchronized (regardless to other units' synchronization) it starts to transmit on its dedicated time slot(s).

10.1 Collaborative MESH Network Example:

1. Units 2 and 3 are within the reception range of unit 1.
2. Units 4 and 5 are within the reception range of unit 3.
3. We configure unit 1 as a unit that needs to be relayed.
4. When unit 1 transmits its data, it is received by units 2 and 3.

Units 1, 2 and 3 retransmit the same data, as unit 1 transmitted in the previous slot at the same time (achieved by the fact that it is a synchronized network) this time the data is received by units 4 and 5.

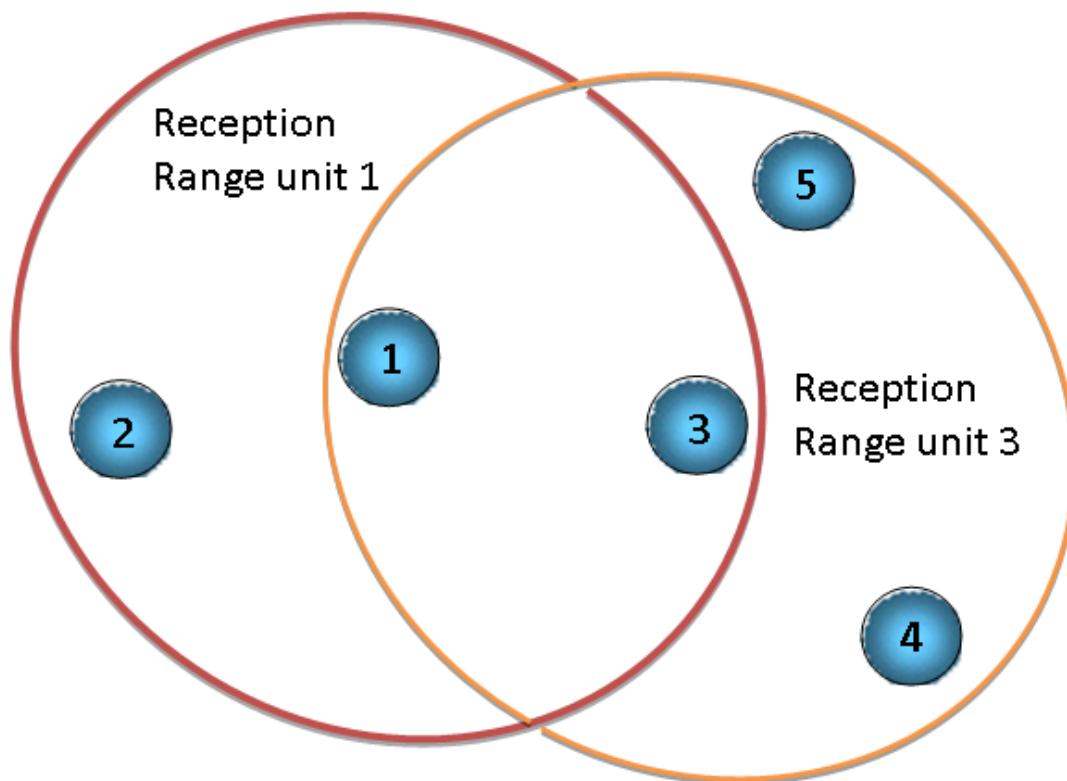


Figure 15: Collaborative MESH



Figure 16: C.MESH network transmission in a 3 units' network which all units are relayed

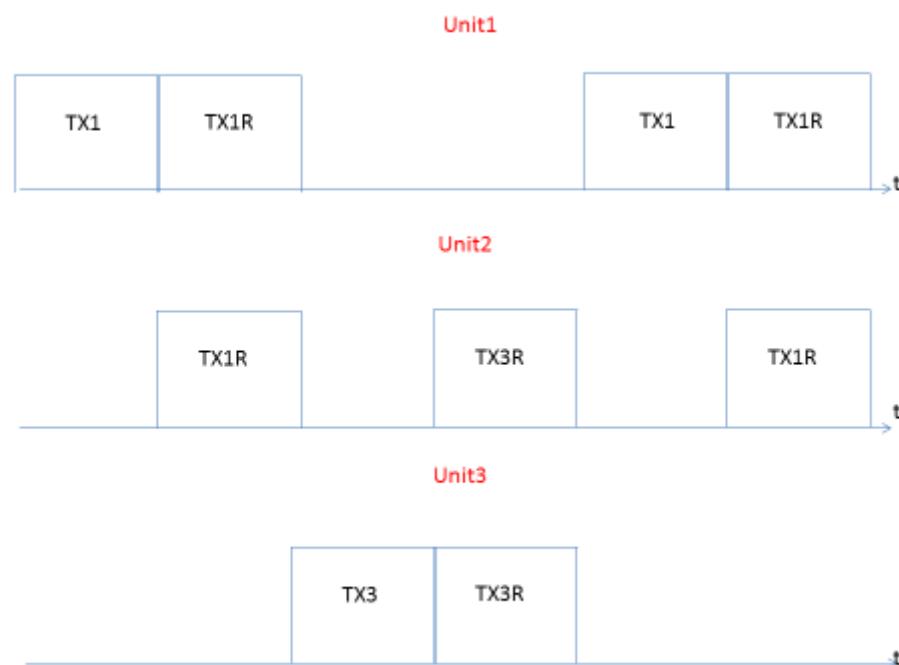


Figure 17: C.MESH network transmission in a 3 units' network unit 2 is relay only

10.2 Configuring a Collaborative MESH Network

1. Connect antennas to RF1 and RF2 connectors, and power up the MCU.



CAUTION – Powering up an MCU unit without connecting the antennas can cause unreparable damage to it.

2. Connect the MCU to a PC using Ethernet cable.
3. Set static IP in the 192.168.131.xxx subnet. (for more information see MC-EMA MPTMP User Manual).
4. Using the MC-EMA (MPTMP Version): connect to the MCU by clicking the button of the unit ID (by default, the unit ID is set to 1)

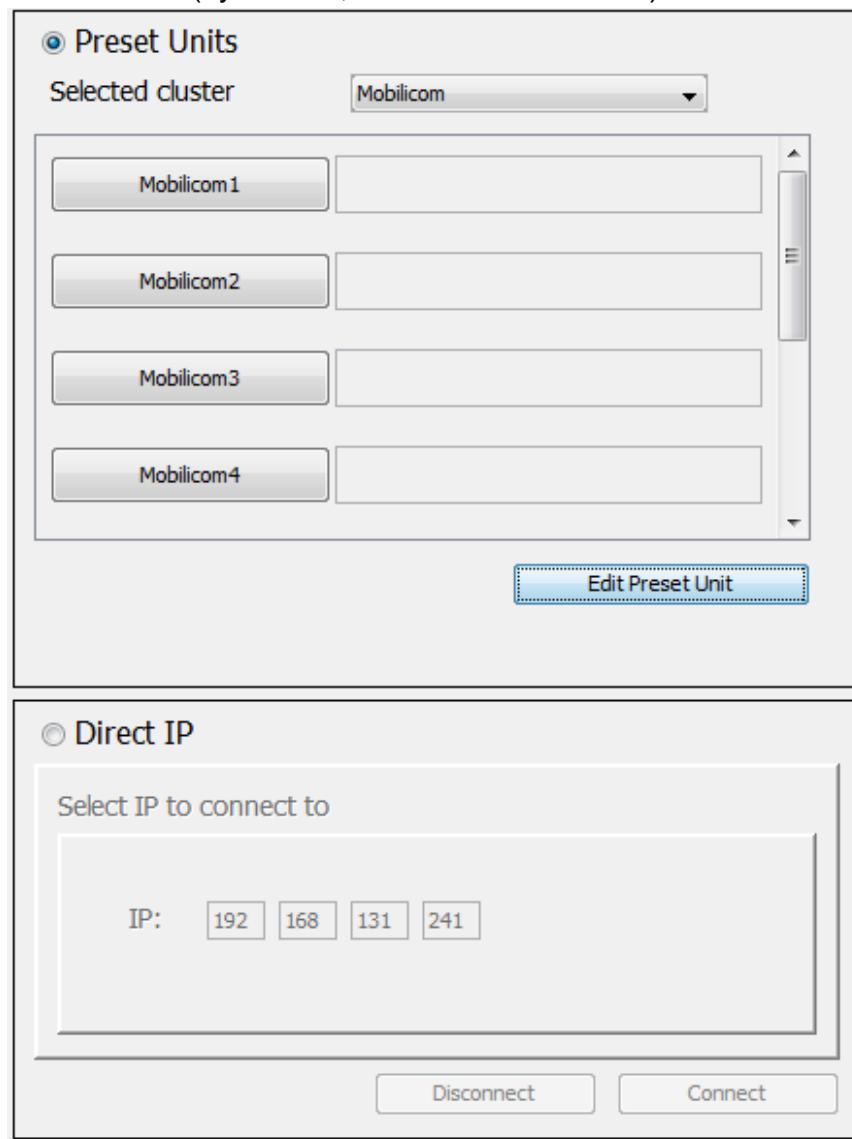


Figure 18: MC-EMA-MPTMP connect to screen

5. From the MC-EMA main menu (left side of the screen) go to network configuration screen and configure:
 - a. Network Frequency
 - b. TX Power
 - c. Number of Hops and Max Retransmission (should be equal)
 - d. Transmission Vector (bandwidth allocation)
 - e. Profile
6. Click Verify and chose the unit ID from the dropdown list.

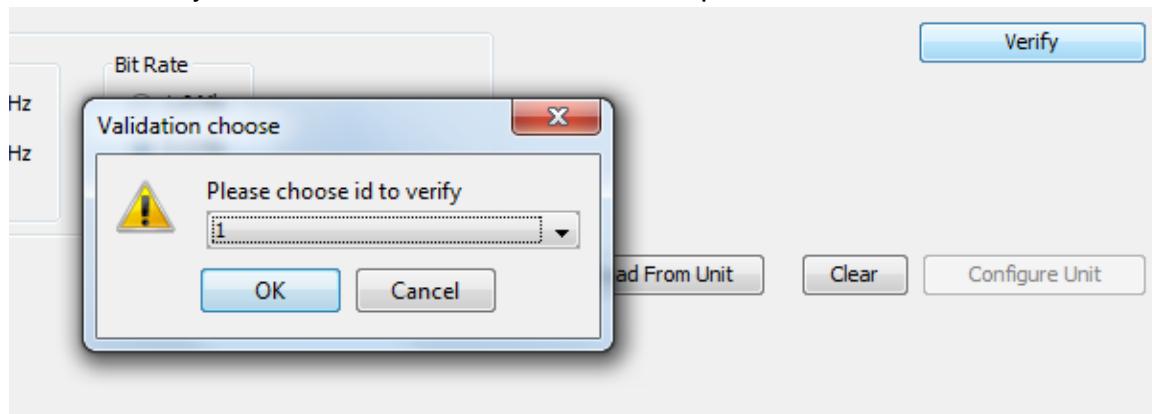


Figure 19: MC-EMA-MPTMP configuration validation

7. Click “configure unit” the configuration is now downloaded to the MCU.
8. The MCU reboots with the new configuration and unit ID number.
9. Repeat stages 1-10 with the other units in the network.

Unit ID : 1 is ready to be configured

Frequency(Mhz)	2510	<input checked="" type="checkbox"/> TX Power (dBm)	-10	Base IP	192.168.131.241		
Number of hops	2	Max retransmissions		2			
	ID	Name	IP	Power	Band Type	BW %	Enable Relay
<input type="checkbox"/>	1	Mobilicom1	192.168.131....	-10	Manual	80	<input checked="" type="checkbox"/>
<input type="checkbox"/>	2	Mobilicom2	192.168.131....	-10	Manual	10	<input type="checkbox"/>
<input type="checkbox"/>	3	UNIT_NAME	192.168.131....	-10	Manual	10	<input checked="" type="checkbox"/>

Figure 20: MC-EMA-MPTMP network configuration screen



NOTE – Verify that each unit has a different unit ID



NOTE – unlimited amount of MCUs can use the same unit ID when in “listener only” mode.



NOTE – A Collaborative MESH network requires at least 3 MCUs configured with the same transmission vector (including relayed units), Frequency and Profile.

10.3 MCU-30 LED indicator

The Led Indications are the same as in the Mobile MESH section (9.2).

11 Introduction to PTMP (Point-to- Multi-Point)

A PTMP network is a unique topology; it can be achieved by Mobile MESH networks. It is widely used for multicast/broadcast data distribution from a main unit to many stations. In this case only one of the stations is controlling the main unit (bi-directional link) while the other units are only receiving the data.

In this network, there is one MCU which is set to be unit ID 1, this unit is the data distributor, unit with the unit ID 2 is the controller. In this network there are many "listener" units which are defined by different unit IDs. The transmission vector includes 3 units when the 3rd unit members' bandwidth allocation is set to 0.

In cases where a handoff of the controller position is needed (between other "listener" members), the transmission vector will be set to 2 units. All the "listener" units will be configured with unit ID 2 as well. The TX power of unit 1 and 2 (controller) should be set to maximum (23dBm) and the other "listener" units' TX power should be set to minimum (-40dBm). The handoff procedure should be done in the following steps:

1. TX power of the current controller should be set to minimum (-40dBm)
2. TX power of the new controller should be set to maximum (23dBm)



NOTE –“listener” MCU cannot be monitored over the air and isn’t present in link monitor.

12 Installation and Setup

12.1 Package Contents

- MCU-30
- 2 Detachable Antennas

12.2 Connecting the Antennas

Antennas installation vary in size, shape, requirements and mounting method. The antennas should be as close to the MCU-30 as possible and can be connected to it directly. Recommended distance between antennas is ~1.5m (for 2.XGHz).

Cables should be chosen according to their attenuation (lower attenuation gives better results) and flexibility (according to the path they pass through). Each cable should have SMA Male connector on the MCU end, and a connector matching to the antenna's connector on the other. Recommended cable standards can be supplied by Mobilicom.

12.3 Connecting the Power

The MCU-30 has a dual power feed enabling hot-swap battery replacement during operation.



CAUTION – Powering up an MCU unit without connecting the antennas can cause unrepairable damage to the MCU.

13 Appendix A - Data Sheet

Radio and Modem	
Frequency	902-928 MHz (ISM) 2.4-2.480GHz (ISM)
Antenna	2dBi , Dipole, SMA/M connector
Antenna's Connectors	2 x SMA Female
GPS	Active and Passive
Output Power (Average per channel)	2x23dBm or 2x18dBm for 5GHz
TX Power Control	50dB
RX Dynamic Range	70dB
Sensitivity	Max -101dBm
Radio Access Method	OFDM - TDMA
Duplexing	TDD
Configuration	Diversity support MIMO 2X2
Channel BW	4.2MHz/ 8.4MHz
Frequency Resolution	0.25MHz
Diversity Support	TX & RX Diversity
FFT Supported	512 32 – 2048 upon request
FEC method	CTC
Modulations	QPSK
Throughput	Up to : 8Mbps
Synchronization	For P2P - Not required For Mobile MESH: GPS/ External 1PPS
Encryption*	AES-128/256

*Upgrade Options

Environmental		
Temperature Range	Operating	Storage
Ruggedized	-20°C to 50°C	-50°C to 85°C
Extended Rugged	-20°C to 60°C	-50°C to 85°C
Lite	-10°C to 45°C*	-50°C to 85°C
Humidity	5 to 95%	
Interfaces		
Data	Ethernet 10/100Mbps	
Full Ethernet Protocol Transparency	IP,TCP,UDP, RTP, HTTP Broadcast, Multicast, Unicast Ethernet, VLAN, VPN	
Optional Interfaces*	RS232 /485 / 422GPIO, 1pps	

Dimensions	[HxWxD] cm	[HxWxD] inch
Lite Package	7.4 x 8 x 2.7 cm	2.9 x 3.15 x 1.1"
Ruggedized	12 x 9 x 6 cm	4.7 x 3.5 x 2.3"
Extended Rugged	12 x 9 x 6 cm	4.7 x 3.5 x 2.3"
Weight	Grams	Ounce
Lite Package	140 gr.	4.94 oz.
Ruggedized	550 gr.	15.5 oz.
Extended Rugged	550 gr.	19.0 oz.

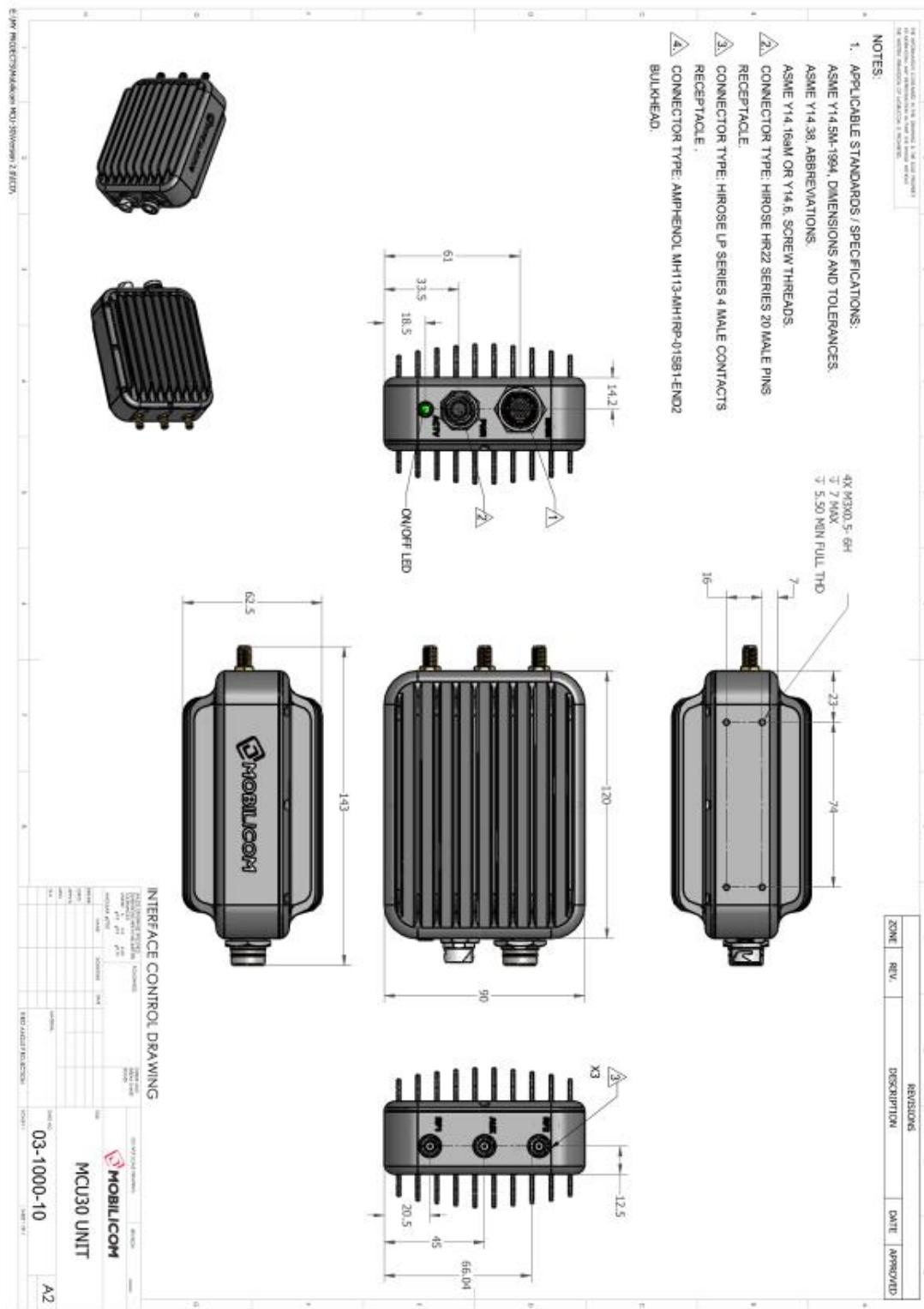
Power		
DC Voltage (Battery Operated)	7-14.5VDC	
Power Consumption	Up to12 Watt 8W Average	

Configuration and Management		
Unit Monitoring Application	MC-EMA	
Network Management Application	MC-NMA*	

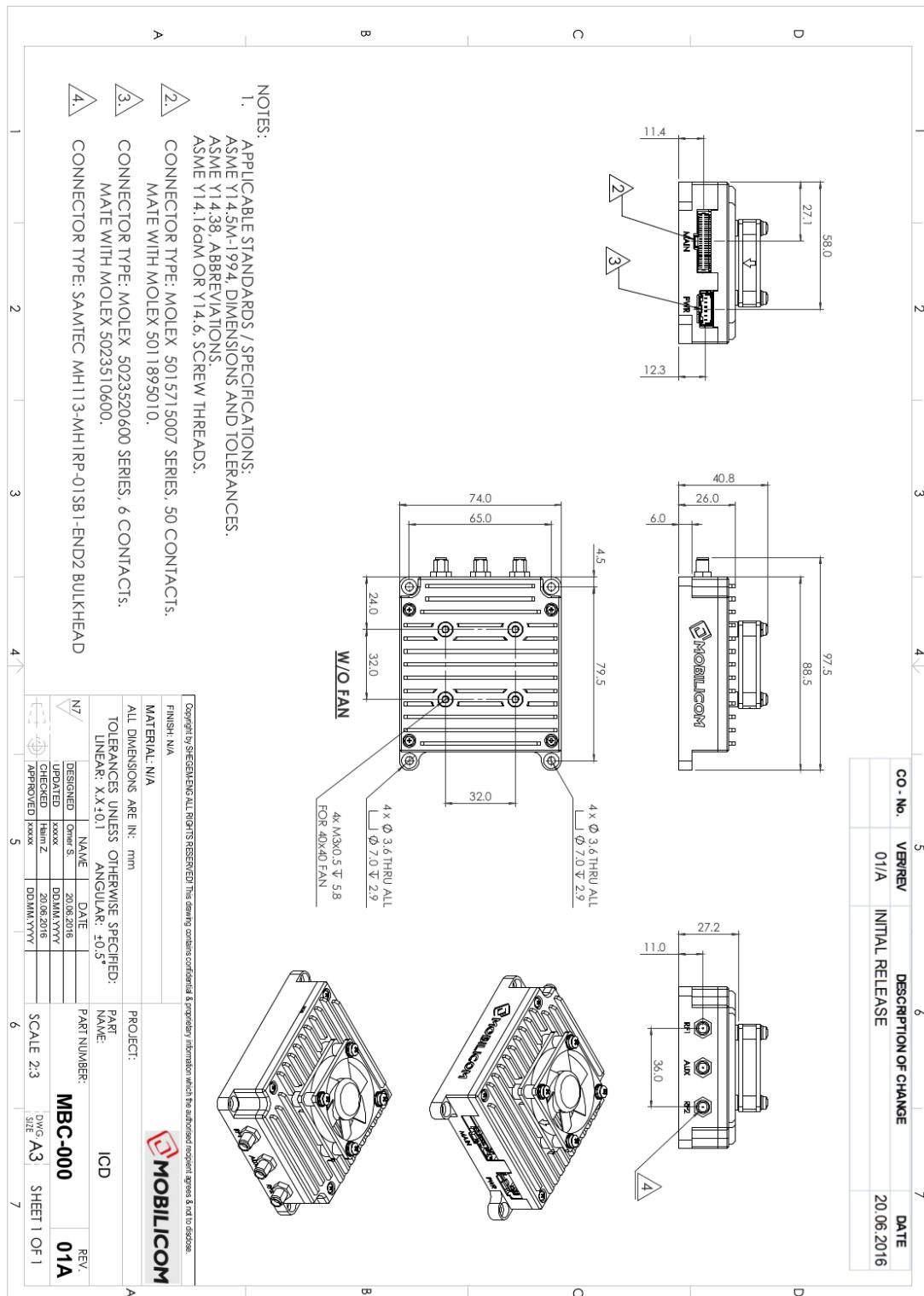
*Depends on the customer's installation

14 Appendix B - Mechanical Drawings

14.1 MCU-30 Rugged Drawings



14.2 MCU-30 Lite Drawings



15 Appendix C – Connectors’ Pinout

15.1 MAIN (Data) Cable

Use a shielded CAT 5E (or higher) cable with 26 AWG gauge (or thicker) wires to connect the MAIN connector to a shielded RJ-45 connector (which then can be used for maintenance or plugged to an IP device as Camera and monitor). Follow the instructions provided in the connector's datasheets. Make sure the cable's shield drain wire is properly connected to the shields of the connectors on both sides. The connector on the MCU side is: Hirose HR22-12WTRA-20P, on the cable side it is: HR22-12TPD-20S (73)

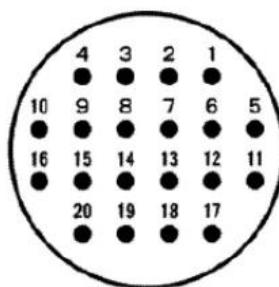


Figure 21: MAIN Connector Front View (MCU-30 side)

MCU-30: HR22-12TPD-20S(73)	RJ45 Pin	Name	Description
1	1	Tx_D1+	Fast Ethernet 10/100 TPOP Transceiver Data +
2	2	R_D1-	Fast Ethernet 10/100 TPON Transceiver Data -
3	3	Rx_D2+	Fast Ethernet 10/100 TPIP Receive Data +
4	6	Rx_D2-	Fast Ethernet 10/100 TPIN Receive Data -

Table 6: MAIN Connector Type and Pin Mapping (connectors on cable side)

15.2 Power Cable

Use a cable with 18 AWG gauge (or thicker) wires to connect the PWR connector to proper terminations that will connect to the DC source. Make sure the grounding pin is connected to a solid grounding point. The connector on the MCU side is: Hirose LF10WBRB-4P, On the Cable side it is: Hirose LF10WBP-4S.

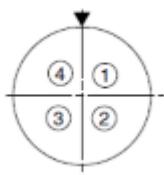


Figure 22: PWR Connector Front View (MCU-30 side)

MCU-30 LF10WBP-4S	Description
1	GND (-VDC)
2	Vin1 (+VDC)
3	Vin2 (+VDC)
4	GND (-VDC)

Table 7: PWR Connector Type and Pin Mapping

15.3 Lite system Data Connector

This connector is used for Ethernet, LED, RS232 connectivity to the unit.

For the Ethernet connector use a shielded CAT 5E (or higher) cable with 26 AWG gauge (or thicker) wires to connect the data connector to a shielded RJ-45 connector. Follow the instructions provided in the connector's datasheets. Make sure the cable's shield drain wire is properly connected to the shields of the connectors on both sides. The connector on the MCU side is: Molex P/N: 5015715007:

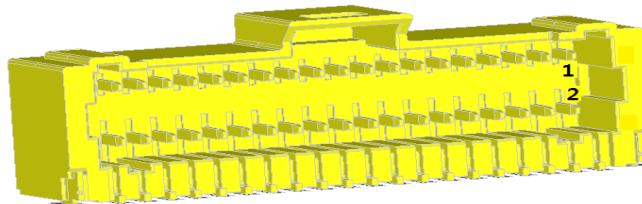


Figure 23: Lite System Data Connector (MCU-30 side)

MCU-30: Molex P/N: 5015715007	General Pins	Name	Description
1	GND	GND	GND 0V
2	GND	GND	GND 0V
30	External Led		The Status LED indicates that the unit is powered on, and displays special status modes
RS-232 (D9)		User Interface	
3	3	Input	For GND (Pin 5 in the D9 connector) use GND (pin 1 or 2)
5	2	Output	
RS-232 (D9)		Internal Use - Debug	
15	3	Input	For GND (Pin 5 in the D9 connector) use GND (pin 1 or 2)
17	2	Output	
RJ45 Pin		Description	
35	1	Tx_D1+	Fast Ethernet 10/100 TPOP Transceiver Data +
37	2	R_D1-	Fast Ethernet 10/100 TPON Transceiver Data -
39	6	Rx_D2-	Fast Ethernet 10/100 TPIN Receive Data -
41	3	Rx_D2+	Fast Ethernet 10/100 TPIP Receive Data +

Table 8: Lite System Data Connector Pin Mapping

15.4 Lite system Power Connector

The MCU30 is fed from one of the two inputs. Use a cable with 18 AWG gauge (or thicker) wires to connect to the connector.

The connector on the MCU side is: Molex P/N: 5023520600

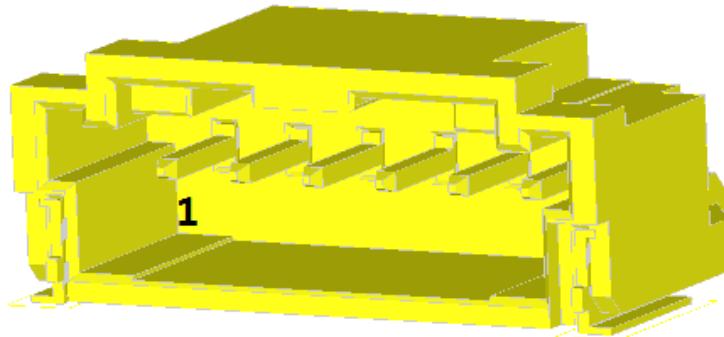


Figure 24: Lite System Power Connector (MCU-30 side)

MCU-30 LF10WBP-4S	Description
1	GND (-VDC)
2	Vin1 (+VDC)
3	N.C
4	Vin2 (+VDC)
5	N.C
6	GND (-VDC)

Table 9: Lite System Power Connector Pin Mapping

16 Appendix D –Troubleshooting

Symptom	Possible Cause	Action Needed
LED is off	Not connected to power source or battery is empty	<ol style="list-style-type: none"> 1. Verify power cable properly connected to the MCU PWR connector. 2. Verify that the battery or power supply is connected to the MCU power cable and to a power outlet. 3. Replace the battery or check the outlet. 4. Replace the power cable.
LED light is always on	MPTMP – Not sync with 1PPS PTP –Unit is in boot mode	<p>MPTMP :</p> <ol style="list-style-type: none"> 1. Verify GPS antenna is connected to AUX connector. 2. Verify the antenna can “see” the sky. 3. Using the MC-EMA, verify that the antenna type is configured correctly (Active/Passive) and change it if required. 4. Replace the GPS antenna. <p>PTP</p> <ol style="list-style-type: none"> 1. Check the power source 2. Reboot the MCU.
Cannot connect to MCU using MC-EMA	<ol style="list-style-type: none"> 1. The PC isn't configured with a correct static IP 2. Using incompatibility MC-EMA version (PTP/MPTMP) 3. Unit isn't powered up 4. Ethernet cable isn't connected or damaged data cable 5. Firewall is blocking traffic 6. ETH port set to auto negotiation off with 1GE 7. Trying to connect to remote unit when link is down. 	<ol style="list-style-type: none"> 1. Verify your PC is set with a static IP in the subnet of 192.168.131.xxx. 2. Check that the ETH port is set to auto negotiation on. 3. Verify the unit is powered up. 4. Verify that the PC ETH port status isn't unplugged or disabled. 5. Disable the PC firewall 6. Verify ETH cable is connected to the PCs ETH port and to the MCU MAIN connector. If needed: replace cables. 7. Verify using PTP-EMA for a PTP configured MCU and MP2MP-EMA to MPTMP configured MCU. 8. Ping the unit. 9. Try to connect to the local MCU and verify link is up

No link between MCUs	<ol style="list-style-type: none"> 1. Configuration isn't the same on all of the MCUs. 2. PTP – both MCUs set as VC or both as Node. MPTMP many MCUs uses the same ID. 3. The MCUs aren't within reception range 	<ol style="list-style-type: none"> 1. Connect to each MCU and verify they have the same configuration (Frequency, profile, and Transmission Vector (for MPTMP only) 2. PTP -Verify 1 unit is set as a VC and the other as a Node. MPTMP - verify each transmitting MCU have different unit ID. 3. Verify that TX power is set to the maximum. 4. Verify the antennas fit the used Frequency (antenna spec).
Data with high delay and disconnecting data	Trying to send higher amount of data than the allocated bandwidth set to in the unit.	<ol style="list-style-type: none"> 1. Verify that the data bandwidth sent to the unit from the connected device(s) does not exceed the allocated bandwidth (in its configuration). 2. Decrease the data received by the data source or change the allocated bandwidth via MC-EMA

Federal Communications Commission (FCC) Statement

Labelling requirement for small device statement (FCC15.19(3))

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

Radio Frequency Interference (RFI) (FCC 15.105)

This equipment has been tested and found to comply with the limits for Class B digital devices pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Labeling Requirements (FCC 15.19)

This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Modifications (FCC 15.21)

Changes or modifications to this equipment not expressly approved by Mobilicom LTD. may void the user's authority to operate this equipment.

RF Exposure info (FCC 2.1093)

This equipment has been approved for mobile applications where the equipment must be used at distances greater than 20cm from the human body. Operation at distances less than 20 cm is strictly prohibited

Corporate & EMEA Headquarters

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Marketing, Media and Analyst Inquiries

Marketing: marketing@mobilicom.com

Feb 14, 2018

Supplier's Declaration of Conformity



We, Mobilicom LTD

Address: 31 Hametzuda St, Azur, Israel

Declare under our sole responsibility that the product and in combination with our accessories:

Product name:	MCU-30
Trade name:	MCU30
Accessories:	None

To which this declaration relates is in conformity with the requirements of the following specifications:

ANSI C63.4

FCC 47 CFR Part 15, Subpart B,
Class B Digital Device.

Supplementary information:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Signature:



Name: Yossi Segal

Title: VP R&D

Place and of issue: Azur Israel 14-2-2018