



Exhibit 8 – User Manual

Motorola Customer Premise Equipment (CPE)

FCC ID: MIJZEPCPE-USB-01

Model No. LT 20M-00

8 Product Functional Requirements (User Manual)

8.1 Scope

The requirements described herein are functional in nature and describe Zephyr product features required to meet LMDS Service Provider expectations. Development Engineering will generate technical specifications which trace to or are derived from the requirements defined herein. Product qualification shall demonstrate and verify that the following product requirements are met.

8.2 Introduction

Section 8.2, 8.2.1, 8.2.2, 8.2.3 and 8.2.4 are provided for information only. Requirements are defined in detail in sections 8.3 and 8.4 in their entirety.

LMDS Systems utilize Customer Premise Equipment (CPE) to provide an interface for system subscribers to input data to and receive data from the system. The CPE functional block diagram is shown in Figure 8.2-1.

In order to input user data to the LMDS system:

- User data is input to the Indoor Unit (IDU).
- The IDU generates an upstream IF signal modulated with user data.
- The upstream IF is input to the Zephyr Outdoor Unit (ODU) through the Power Control Unit (PCU).
- The ODU up converts the upstream IF to the upstream carrier frequency for over the air transmission to the LMDS hub.

In order to receive data from the LMDS system:

- The ODU down converts the received over the air downstream signal to the downstream receive IF.
- The downstream IF is input to the IDU through the PCU.
- The IDU demodulates the IF signal and recovers the user data.
- Data is output to the user.

The physical interface between the IDU and PCU is a single cable. Similarly, the physical interface between the PCU and ODU is a single cable. The IDU is a DOCSIS compliant cable MODEM.

In order to communicate with the Outdoor Unit to perform service or installation tasks, a serial communication path is provided from the ODU through the PCU to an attached personal computer. The PC executes an application program known as Radio Service Software. Based on operator selections, the PC can query the ODU to determine health status, configuration, etc.

The Zephyr Product is a major portion of the subscriber CPE as indicated by the dashed line in Figure 8.2-1. The Zephyr Subsystem contains the following components:

1. Zephyr ODU
2. Zephyr Firmware
3. Zephyr Power Control Unit (PCU)
4. Zephyr Radio Service Software

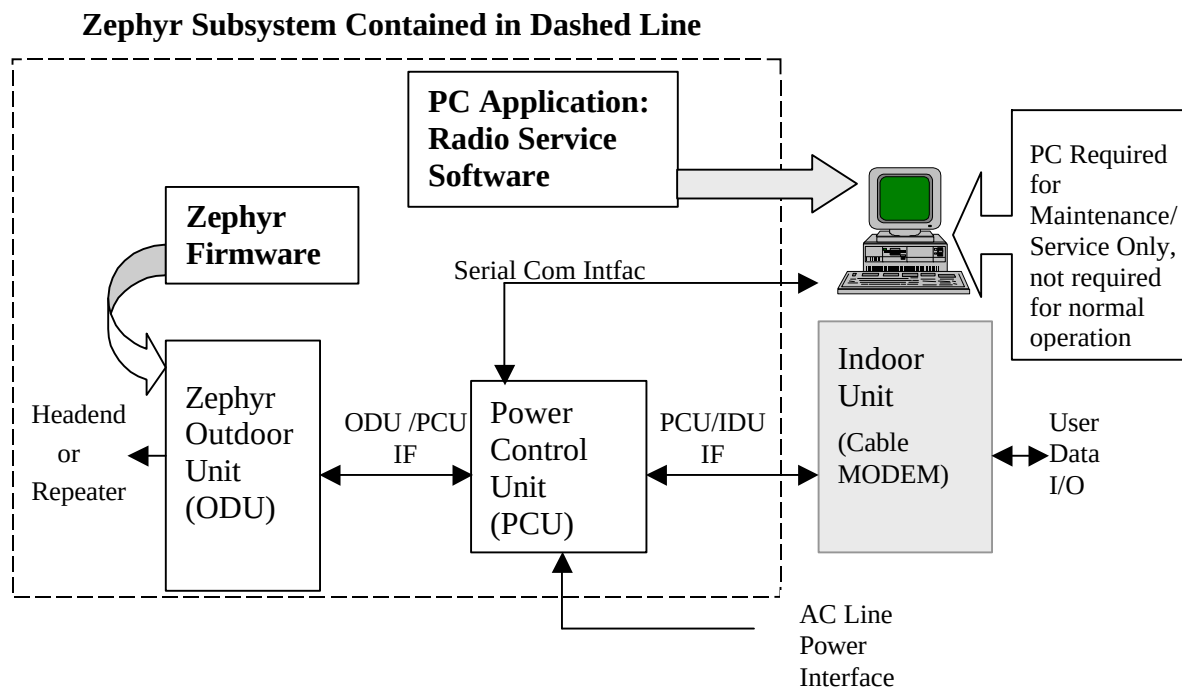


Figure 8.2-1

8.2.1 Zephyr Outdoor Unit ODU

The Zephyr ODU is a microwave transceiver, it performs two primary functions:

1. The ODU up converts the upstream IF generated by the Indoor Unit for over the air transmission to the LMDS Hub.
2. The ODU down converts over the air signals transmitted by the LMDS Hub to a receive IF and outputs the signal to the Indoor Unit for demodulation and data recovery.

Additionally, the ODU provides a serial communication interface to a personal computer attached through the PCU. The personal computer is used for service or ODU equipment programming, it is not required for normal operation.

The ODU interfaces to the Indoor Unit through the Power Control Unit using a single coaxial cable connection. Upstream IF, Downstream IF, Power supply voltage and the serial communication interface to the ODU are multiplexed over the coaxial cable connection.

The transceiver will typically be located outdoors and must operate in various harsh environments.

8.2.2 Zephyr Firmware

The Zephyr ODU contains a microcontroller. The microcontroller executes embedded firmware to manage transceiver functions. The Zephyr firmware is reprogrammable through the serial communication interface.

8.2.3 Zephyr Power Control Unit (PCU)

The Zephyr PCU performs several functions:

1. The PCU converts line voltage to the DC supply voltage required to power the ODU.
2. The PCU combines the DC supply voltage with the Indoor Unit IF interface for input to the ODU via the IF interface.
3. The PCU provides a MODEM function to allow a PC to interface to the ODU via the IF interface.

The Power Control Unit is located indoors. As such, its operating environment is benign.

8.2.4 Zephyr Radio Service Software

Radio Service Software is a PC application program that communicates with the ODU via the serial communication interface. The application program provides a user interface to download firmware, reprogram/read radio configuration data and determine rudimentary health status.

Radio Service Software is to be used by Maintenance/Repair Depots and Service Provider technicians, it is not to be made available to equipment end users.

8.3 *Zephyr Subsystem Requirements*

This section defines requirements for the combination of the Zephyr components.

8.3.1 Interoperability

The Zephyr subsystem is one system element of the overall LMDS system. As such, it is required to interoperate with other system elements.

8.3.1.1 *Hub and Router*

The Zephyr Subsystem shall operate with the Motorola DOCSIS compatible Cable Router and the Millitech B Band Headend Sector Unit.

8.3.1.2 *DOCSIS MODEM*

The Zephyr Subsystem shall operate with DOCSIS compatible cable MODEMs.

8.3.2 Unit Production Cost

The unit production cost of the Zephyr B band subsystem, which includes the ODU and PCU components only, shall be less than \$1,020 U.S.

8.3.3 Reliability

The Mean Time Between Failure (MTBF) of the Zephyr subsystem shall exceed 30,000 hours.

8.3.4 Regulatory Requirements

The initial market for Zephyr is the USA. The Zephyr subsystem shall be certified for all safety and RF emission standards required by Motorola and US regulatory agencies for product distribution in the USA.

8.3.5 Serial Communication Interface

The combination of the PCU and ODU shall provide a serial communication interface allowing a personal computer to communicate with the ODU. This interface is to be used by a service technician to verify ODU health, download firmware or perform other service functions. The physical connection for the personal computer shall be to the PCU. This allows initial ODU test or service to be performed at the PCU location which is typically indoors. The physical connection between the PCU and ODU shall be via the IF interface.

Product Differentiating Feature

The serial communication interface is a product differentiator in comparison to the current Millitech product line. The Millitech unit does not have a controller, as such it has no information or an interface to communicate to an outside entity.

8.3.6 Physical Separation Between PCU and ODU

The design of the ODU and PCU shall support ODU/PCU physical separation requirements as defined in the Eurus system specifications. Zephyr shall meet these requirements when installed as specified in the Eurus specification.

8.3.7 Installation

The installation task shall require one service technician only. With the installation mast available, mounting the ODU to the mast shall be accomplished in less than 10 minutes. As a design consideration, the installation of Zephyr should be less complex than the equivalent Millitech product.

8.3.8 Interfaces

All physical interfaces shall be protected for ESD and weather effects such as rain and snow. For the case of lightening, the equipment shall be protected from the induced energy effects of lightening. Survival of a direct lightening strike is not required.

8.3.8.1 ODU/PCU IF

The upstream IF interface shall be a single cable. The connector type and the required interconnect medium shall be selected based on common use in the cable industry. Note that the cable is not included with the unit at the time of sale or in unit production cost analysis.

8.3.8.2 PCU/IDU IF

The upstream IF interface shall be a single cable. The connector type and the required interconnect medium should be selected based on common use in the cable industry. Note that the cable is not included with the unit at the time of sale or in unit production cost analysis.

8.3.8.3 Serial Communication Interface

The physical serial communication interface shall be selected based on availability in common personal computers.

8.3.8.4 AC Line Voltage

AC line voltage shall connect directly to the Power Control Unit only. Reference Section 8.4.3 for details regarding the line voltage interface to the PCU.

8.4 Component Specifications

This section defines requirements for the Components of the Zephyr Subsystem.

8.4.1 Outdoor Unit (ODU)

This section defines the requirements for the Zephyr Outdoor Unit.

8.4.1.1 Frequency Range

The ODU shall operate in the LMDS Block B frequency band with sub-bands defined in the following table. All frequencies are in MHz.

Band Name	Downstream		Pilot	Upstream Sub-bands			
	Low	High	Center	'a' Low	'a' High	'b' High	'c' High
B	31003	31075	31001.5	31225	31250	31275	31300

One ODU hardware platform shall support all upstream sub-bands. Only a programming configuration change shall be required to modify the sub-band of operation.

Product Differentiating Feature

The configurable upstream sub band requirement is a product differentiator in comparison to the current Millitech product line. Millitech requires the Service Provider to purchase a different ODU model for each sub-band. Following are some advantages provided by software configurable sub-bands:

- The Service Provider is required to forecast and carry fewer part types in inventory.
- The Service Provider is afforded the flexibility to use the ODU in any of the upstream bands when installed in the field.
- CPE operating upstream sub-band may be modified after the equipment has been deployed, as the system is built out.

8.4.1.2 Transmit Function

The Zephyr ODU shall upconvert and perform over the air transmission of the upstream IF input from the IDU. Transmit upstream sub-band is based on programmed configuration. The RF performance, power level and radiation pattern of the up conversion and transmit function shall be as required to meet LMDS

Eurus system communication link and interference requirements. Ancillary components external to the ODU, such as attenuators, shall not be required for proper unit and system operation in various installation locations and system layouts. Installation technician intervention to adjust the transmit output power for proper unit and system operation shall not be required.

Product Differentiating Feature

The requirement for no ancillary components is a differentiating feature comparison to the current Millitech product line. The Millitech product requires attenuators external to the ODU. The attenuation value is dependent on the installation location and system layout. Following are advantages of this feature:

- Reduced installation time since signal strength measurements and attenuator installation are not required.
- Fewer components stored in inventory to support installation and fewer components carried by service technician.
- Reduced cost of installation due to the elimination of attenuator components.

8.4.1.3 Receive Function

The Zephyr ODU shall receive and down convert the over the air downstream signal to an IF for input to the IDU. The RF performance of the receiver and down converter shall be as required to meet LMDS Eurus system communication link requirements.

The Zephyr ODU shall meet RF performance requirements for receiving and down converting the desired downstream channel while simultaneously receiving the downstream pilot signal and five additional downstream channels. The ODU shall meet this specification when installed the minimum distance from the LMDS Hub per the Eurus system specification.

Ancillary components external to the ODU, such as attenuators, shall not be required for proper unit operation in various installation locations and system layouts. Installation technician intervention to adjust receiver dynamic range for proper unit and system operation shall not be required.

Product Differentiating Feature

The requirement for no ancillary components is a differentiating feature comparison to the current Millitech product line. The Millitech product requires attenuators external to the ODU. Advantages are similar to those described in 8.4.1.2.

8.4.1.4 Physical Characteristics

When installed, the ODU is mounted external to various structures including office buildings etc. The appearance should be clean and uncluttered.

The physical size shall not exceed 45 x 45 x 45 cm and the weight shall not exceed 10kg.

The unit color shall be Off White. The color shall be a Motorola Communications Enterprise standard color.

The ODU shall generate a DC voltage proportional to the signal strength of the received pilot signal. The voltage shall be accessible external to the ODU chassis. The RSSI signal is to be used to optimize antenna pointing during installation.

8.4.1.5 Antenna

The ODU shall contain an integral antenna.

The ODU shall provide the capability to operate with an appropriate RF connected test fixture to allow testing of the unit with the antenna removed. This capability is required for maintenance and certification testing.

8.4.1.6 Antenna Polarity

- [1] Relative polarization between the upstream and downstream signals shall be orthogonal.
- [2] The ODU shall be capable of being installed in the vertical or horizontal polarized position.

8.4.1.7 Health Monitoring Capability

The ODU shall have the capability to self monitor key ODU functions and attributes in order to indicate health status. The ODU shall be able to detect 80% of failed operation of its major functions including but not limited to:

- Receive Function
- Transmit Function
- Microprocessor Controller

The status of indicators is communicated to a service/installation technician via the serial communication interface. Additionally, this feature may be used in the future to perform network management.

Product Differentiating Feature

The self monitor function is a product differentiator in comparison to the current Millitech product line. This feature used in conjunction with Radio Service Software is used by a field service technician to quickly determine the health of an installed ODU. This feature may be used in the future to perform network management functions.

8.4.1.8 Configuration Storage

The configuration of the ODU shall be stored in nonvolatile memory located within the ODU in order to facilitate service and maintenance of the ODU. Configuration parameters shall include, but are not limited to:

- Serial Number
- Band of operation
- Software version
- Hardware Version

All configuration data shall be programmed prior to arrival at the customer destination.

8.4.1.9 Power Supply Requirements

The ODU shall not require direct connection to AC line voltage.

8.4.1.10 Product Labeling

The product shall be labeled with:

- Motorola serial and model number markings
- Compliance and Certification markings
- Motorola brand logo
- Safety Markings

8.4.1.11 Environment

The operating and storage environment shall be consistent with Eurus system operating and storage environments for the Outdoor Unit. The integrity of the installation shall survive the environment without impairing system performance.

8.4.1.12 Life Cycle and Maintenance

The expected life span of use for the Zephyr product is 10 years.

The Zephyr product shall not require scheduled maintenance during a life span of 10 years. The Zephyr product design shall not include fan filters or other “wear items” with a projected life of less than 10 years.

8.4.1.13 Design Considerations

Any fuses utilized in the Zephyr product design shall not be accessible for replacement without opening the ODU or PCU.

The Zephyr product design shall not include battery components.

8.4.1.14 Motorola Common Requirements

The Zephyr product shall meet Motorola requirements for end of life disposal.

8.4.2 Zephyr Firmware

8.4.2.1 Storage

The ODU shall store the firmware program in nonvolatile memory.

8.4.2.2 Firmware Download

Firmware shall be downloaded via the serial communication interface with no requirements to disassemble the ODU. The unit shall remain in operation without disruption while firmware is downloaded and execution of the new firmware version is initiated.

8.4.2.3 Version Numbering

The firmware version numbering scheme shall indicate the feature set provided.

8.4.2.4 Media

The media used for Zephyr Firmware distribution shall be CD ROM.

8.4.3 Power Control Unit

The Power Control Unit (PCU) provides DC power to the ODU. Additionally, it provides a data connector for the serial communication interface between a personal computer and the ODU. The PCU shall be applicable to all Zephyr ODU products independent of ODU operating frequency and geographic location. As indicated in Section 8.3.4, the PCU must be certified for use in the USA to support initial rollout of the B band product. Additionally, for future market rollout, the PCU shall be capable of regulatory certification in all other regions around the world.

8.4.3.1 Power Supply Function

The PCU shall convert AC line power to DC voltage to provide power required by the ODU. The PCU shall operate for AC voltages in the range of 90V_{ac} to 260V_{ac} and in the frequency range of 50Hz to 60Hz.

The PCU shall automatically sense the input voltage and operate with that voltage. No operator selection shall be required.

The PCU shall survive without damage a short circuit of the output voltage to ground. Operation shall be restored automatically with no requirement for user intervention when the short circuit condition is remedied.

8.4.3.2 Power Supply Multiplexing Function

The PCU shall combine the power supply output voltage with the IDU IF for input to the ODU via the IF cable.

8.4.4 Line Cord Receptacle

The PCU line cord receptacle shall be an IEC 320 style connector or an equivalent. This allows operation with a wide variety of power outlets around the world.

8.4.5 Serial Communication Interface

The data I/O connector for the serial communication interface to the ODU shall be located on the PCU.

8.4.6 ODU and IDU IF Interface

The PCU design shall prevent or significantly reduce the occurrence of the service technician cross connecting the ODU and IDU interfaces on the PCU.

8.4.6.1 Physical Characteristics

The PCU shall be suitable for installation on a 19 inch equipment rack shelf or a desk top. The PCU shall be similar in look in feel to Motorola ING cable MODEM products. The weight shall be less than 3 kg.

8.4.6.2 Labeling

The product shall be labeled with:

- Motorola serial and model number markings
- Compliance and Certification markings
- Motorola brand logo
- Safety Markings

8.4.6.3 Indicators

The PCU shall provide indication of whether the unit is powered up and turned on.

The PCU shall provide indication of whether the ODU is drawing current.

8.4.6.4 Environment

The operating and storage environment shall be consistent with Eurus system operating and storage environments for the Indoor Unit.

8.4.7 Radio Service Software (RSS)

Radio Service Software is an application program executed on a personal computer that provides a user interface to allow communication to the ODU. The target audience for Radio Service Software is a service technician tasked with repair, installation or software upgrade of an LMDS CPE. As such, operating efficiency and speed are key factors.

8.4.7.1 Operating Platform and Operating System

The operating system shall be Windows NT and Windows 98.

8.4.7.2 Graphical User Interface

The application shall be a graphical user interface with Windows look and feel.

8.4.7.3 Functions

- [1] RSS shall be capable of reading the configuration of the radio and providing display to the user. Configuration items are described in 8.4.1.9.
- [2] RSS shall be capable of programming the upstream sub band operating frequency of the ODU.
- [3] RSS shall be capable of reading the ODU health status indicators and providing display to the user. Health indicators are defined in Section 8.4.1.8.
- [4] RSS shall be capable of downloading firmware to the ODU.
- [5] RSS shall be capable of reading and displaying the ODU RSSI. RSSI is described in 8.4.1.5.

8.4.7.4 Media

The media used for RSS distribution shall be CD ROM. Distribution using the Internet or other alternative means may be considered at a future date.