Microwave
Engineering
Project

Air Interface Specification

The Microwave Engineering Project (MEP) is a high-speed digital microwave-band system for amateur radio that supports high-definition video, point-to-point, and multiple-access communications. This document describes requirements that form a standard. If a station is designed and built conforming to this standard, then that station will interoperate with other MEP stations.

Version 0.2

8 December 2008

E-Mail: mep-dev@uppermeadow.com
Web: www.delmarnorth.com/microwave

Table of Contents

Table of Figures... 1

Scope of the Air Interface Document... Error! Bookmark not defined.

Requirements Language 3

Definition of Terms 3

System Models... 3

Layered Architecture 5

MEP Air Interface Revision History... 9

Index 10

Table of Figures

Figure 1: Abstracted System Model 3

Figure 2: MEP System Decomposed into MEP Stations and Groundsat to show the Air Interfaces Between Them... 4

Figure 3: MEP Air Interface Layering Architecture - Layer Names and Descriptions 5

Figure 4: Types of Interfaces between Protocols... 5

Figure 5: MEP Air Interface Layering Architecture – Traditional High-Level Diagram 6

Scope of the Air Interface Document

These requirements form an interoperability specification for Microwave Engineering Project (MEP) stations. These requirements ensure that a station can communicate with any other station conforming to the standard. These requirements do not address the quality or reliability of communications, nor do they cover equipment performance or measurement procedures.

These requirements are intended to enable the design and implementation of MEP stations.

Provisions are included for future expansion of system capabilities. The architecture defined by this specification permits system expansion without the loss of backward compatibility to older MEP stations.

Requirements Language

Compatibility means that any MEP station can communicate with any other MEP station, any Groundsat can provide communications between any number of MEP stations up to the system capacity limit, and any MEP station can communicate to other MEP stations through any Groundsat up to the system capacity limit.

Definition of Terms

“Shall” and “shall not” identify requirements that must be strictly followed. No deviation is permitted.

“Should” indicates that one or several possibilities is recommended. A certain course of action is preferred but not necessarily required.

“Should not” indicates that a certain possibility or course of action is discouraged but not prohibited.

“May” and “need not” indicate a course of action permissible within the limits of the standard.

“Can” and “cannot” are used for statements of possibility and capability.

System Models

The most fundamental expression of MEP is that of the entire system interacting with the environment and with itself in order to achieve the system function, goal, and purpose.

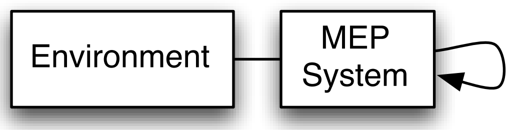

Figure 1: Abstracted System Model

The system environment consists of everything that exists, less the system itself, that influences the system. The system goal is the requirement that corresponds to the block in this diagram. It is equivalent to a customer need statement. This system goal is broken down in a process called requirements analysis that produces all the other system requirements. The overall function of the system is partitioned into subfunctions. The process stops when we have identified all of the system resources that can be produced by detailed design or purchased from a supplier.

Taking the MEP System block from Figure 1, and making our first decomposition into MEP stations and Groundsats, we can identify the Air Interface.

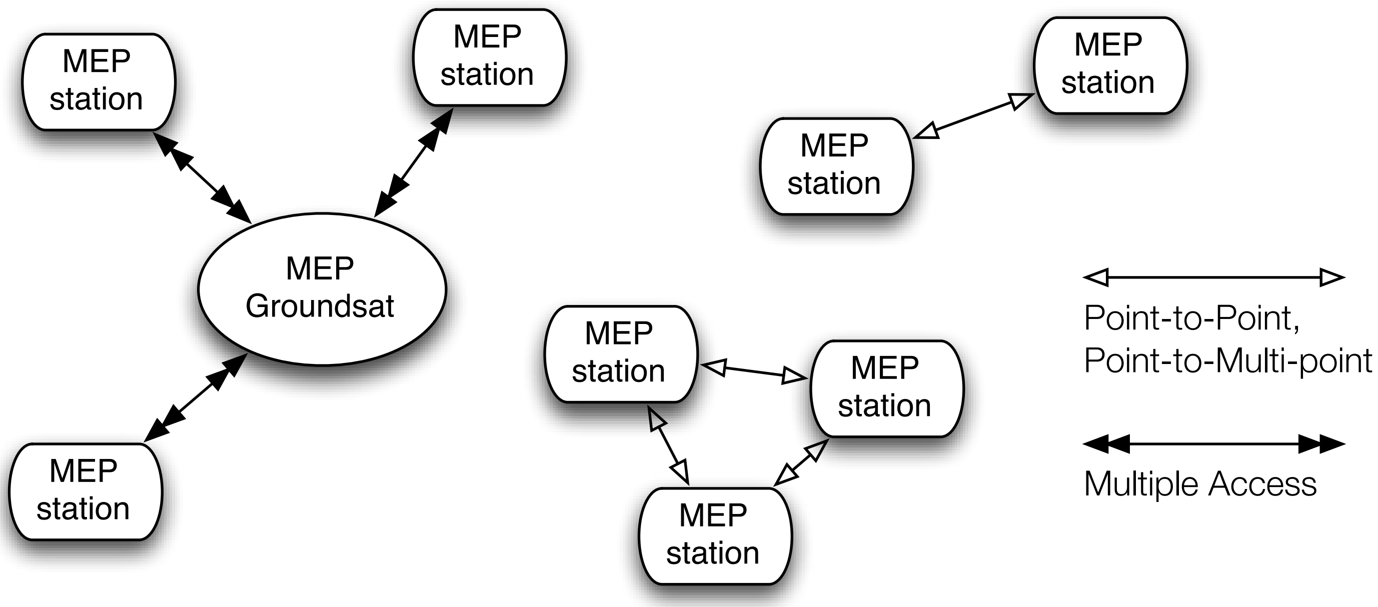

Figure 2: MEP System Decomposed into MEP Stations and Groundsat to show the Air Interfaces Between Them

The arrows in Figure 2 represent the Air Interfaces. There are two types: point-to-(multi)point and multiple access. The presence of the Groundsat enables duplex and extended range communications. Stations can transmit and receive at the same time and the range is extended due to the Groundsat acting as a repeater. The point-to-(multi)point air interface is achieved with half-duplex communications between stations, without an intermediate Groundsat node. Two stations having a conversation, with one station transmits while the other station listens (with stations taking turns reversing roles), is an example of point-to-point communications. Round-robin nets are an example of point-to-multipoint communications. Conversations where all participants can monitor, transmit to, and receive all other stations at the same time are an example of multiple access communications.

Point to point communications are communications between MEP stations. Multiple access communications are enabled by a MEP Groundsat. The function of a Groundsat is repeating of the signal to increase range and the use of protocols that allow one station to communicate with multiple other stations. The number of stations that a station can communicate with is limited by the system capacity.

MEP system capacity is the maximum system bandwidth. This is a measure of the amount of information per unit time that can be transmitted through the system. The maximum data transmission bandwidth available to the operator depends on how much of the system bandwidth is required for functions that enable communications but are not used for transmitting operator data. Examples of such functions include things like authentication, channel allocation schemes, beacons, monitors, and any other transmissions necessary to ensure successful communications within the capabilities of the system.

The specific maximum number of operators at a particular minimum quality of service will be derived from the maximum data bandwidth.

Layered Architecture

The Air Interface is layered. Each layer consists of one or more protocols that perform the layer's functionality. Each of these protocols can be individually negotiated. If a station wants to connect as a layer 2 (Ethernet) device, then the station negotiates up to layer 2. If a station would like to communicate from a particular application to another, then all of the layers up to and including the application layer are negotiated.

Layer	Description
Application	Programs the user runs. Data is input by and presented to the user.
IP	Fully functional IP network is established by this layer.
Medium Access Control	The procedures required in order to receive and transmit over the physical layer.
Physical	Channel structure, frequency, power output, modulation, and encoding specifications required for transmit and receive in point-to-(multi)point and multiple access modes.

Figure 3: MEP Air Interface Layering Architecture - Layer Names and Descriptions

Protocols use signaling messages or headers to convey information to their peer protocols on the other side of the link. These messages are standardized into a protocol, possibly the Signaling Network Protocol (SNP) or something similar to it. There are four types of interfaces between protocols.

Type of Interface	Role
Headers and Messages	Communicates between protocols.
Commands	One protocol sends a command to another protocol to obtain a service.
Indications	One protocol informs another about an event or change of status.
Public Data	Shares information in a controlled way between protocols and applications.

Figure 4: Types of Interfaces between Protocols

The behavior of a protocol changes in response to the environment. Contacts between stations begin and end, rooms are opened, files are transferred, stations are discovered, etc. The behavior is captured in a set of states and the events leading to a transition between states. This means the system can be described as a state machine.

A protocol is in either an active or inactive state. If a protocol has several different types of active states, then those states have their own name. Inactive means that the protocol is not functional at that time.

Headers and messages are binding on all implementations of MEP. Commands, indications, and public data may be implemented in different ways as long as the resulting behavior is identical. This allows different types of station implementations.

The next figure adds the layers and the protocol communications channels for both modes in a traditional layered architecture, where the layers communicate to the layer located immediately above or immediately below. This is in contrast to what is called cross-layer optimization, where select cases of a layer communicating directly to a layer that is noncontiguous are allowed in order to optimize the system in some way. An example of cross-layer communication would be the application layer directly controlling the physical layer without involving the media access control layer or the internet protocol layer.

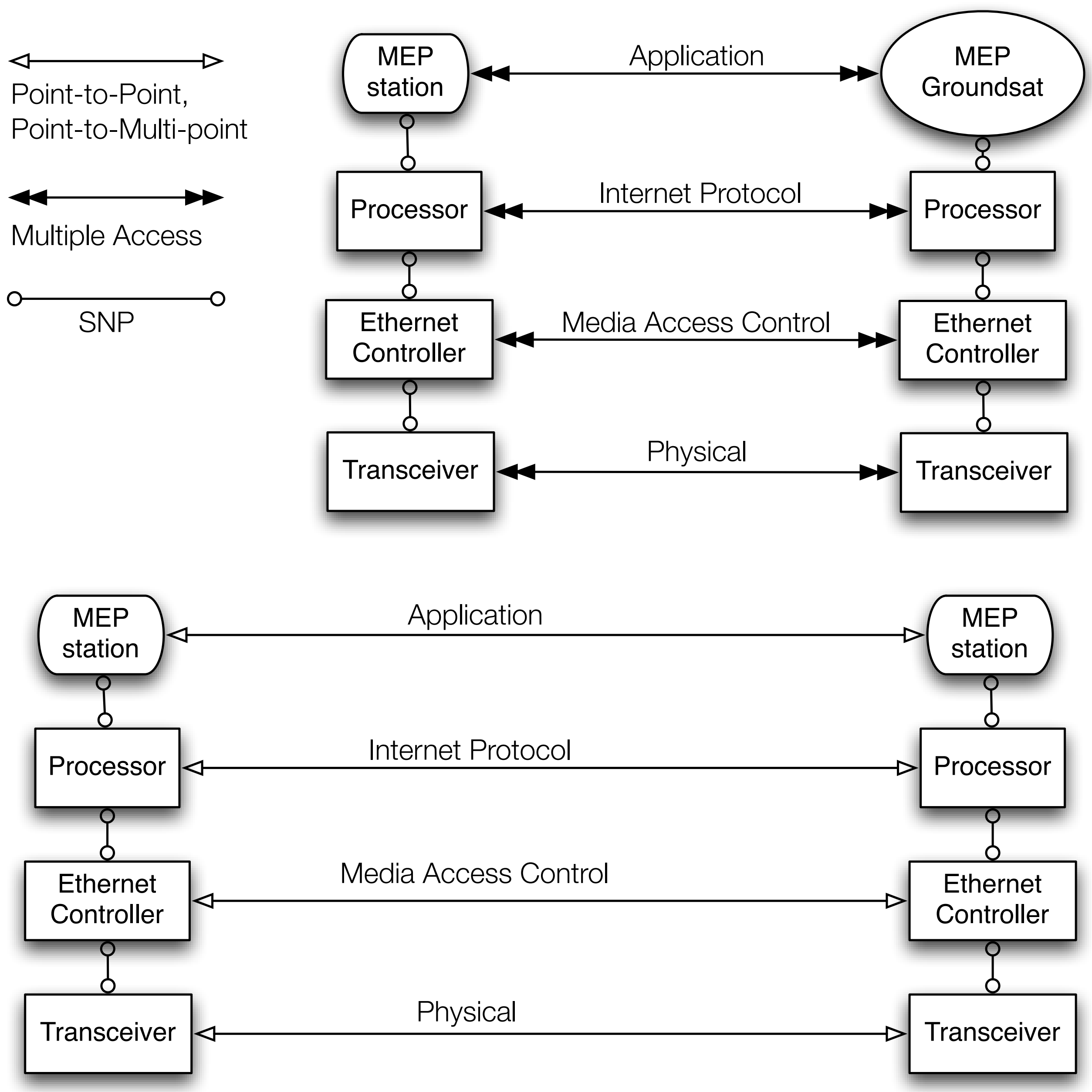

Figure 5: MEP Air Interface Layering Architecture – Traditional High-Level Diagram

Air Interface

Blah blah blah

Air Interface

MEP Air Interface Revision History

0.1 by Michelle Thompson 2 December 2008. Initial draft.

0.2 by Michelle Thompson 8 December 2008. Layering, protocols, index, table of contents, table of tables.

The MEP Process

Index

Figure 1: Abstracted System Model, 3
Figure 2: MEP System Decomposed into MEP Stations and Groundsat to show the Air Interfaces Between Them, 4
Figure 3: MEP Air Interface Layering Architecture - Layer Names and Descriptions, 5
Figure 4: Types of Interfaces between Protocols, 5
Figure 5: MEP Air Interface Layering Architecture – Traditional High-Level Diagram, 6
headers, 5
MEP. *See* Microwave Engineering Project
messages, 5
Microwave Engineering Project, 0
Revision History, 9
Signaling Network Protocol, 5
SNP. *See* Signaling Network Protocol
state machine, 5
The MEP Process, 9