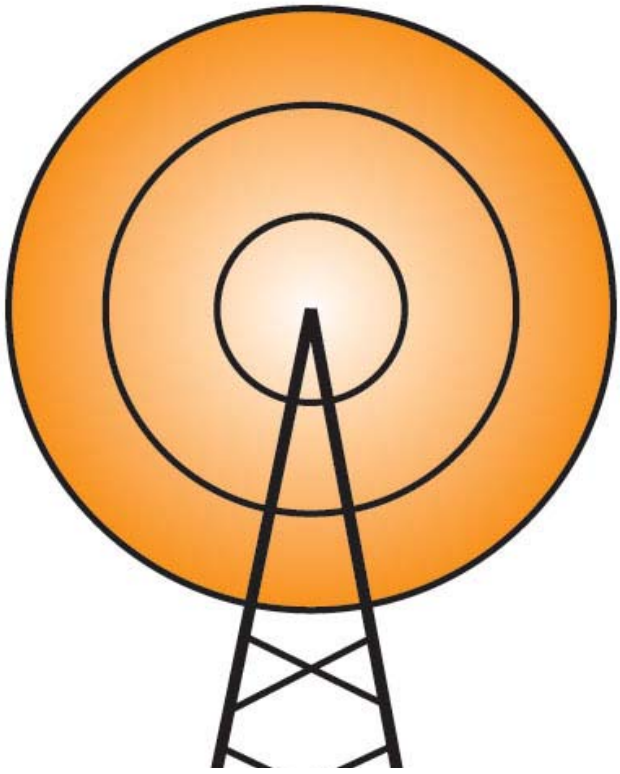
ARRIS

System Description



2.5 GHz
INBAND MMDS
BROADBAND
WIRELESS ACCESS

February 2005

Table of Contents

1 Executive Summary

ARRIS is pleased to present you with this summary description of a typical Broadband Wireless Access network solution based on proven Data over Cable Service Interface Specifications (DOCSIS®) technology.

Our network solution proposal marries DOCSIS® to our Cable Modem Termination Systems (CMTS) with ARRIS radio frequency (RF) technology. Commercial deployments have demonstrated that the CMTS approach achieves high performance and reliability in a cost-effective fashion.

ARRIS designs and supplies leading-edge broadband access transmission equipment, primarily for broadband fixed wireless networks and data over cable. Service providers use ARRIS's products to deliver high-speed data, Internet, video on demand (VOD), Voice over IP (VoIP), and other bandwidth-intensive services to residential and business subscribers. ARRIS's products are designed to allow service providers to rapidly and cost-effectively bridge the last mile, by overcoming the bottleneck resulting from insufficient bandwidth existing in legacy last mile infrastructures. The Company's customer base includes original equipment manufacturers (OEM), system integrators, and leading multiple system operators (MSO) and other service providers. Please find details at http://www.arrisi.com/.

The key feature of ARRIS's solution is that high volumes of standard DOCSIS® modems are being produced by a large number of manufacturers; the economies of scale thus created result in inexpensive, feature-rich subscriber equipment.

The basic, most cost-effective network is designed with only a limited amount of redundancy. Options are available that provide full 1-to-1 redundancy for all CMTS and base station RF equipment.

2 System Overview

The architecture of the system uses standard DOCSIS® cable equipment as the network elements. Complementing this standard DOCSIS® setup is ARRIS-sourced RF hardware designed to translate specific sub-bands of the DOCSIS® cable frequency plan into the frequency allocations of each specific customer.

Key characteristics of the system are:

- 27 Mbps time division multiplexed downstream using 64QAM in a 6 MHz channel
- 256 Kbps to 10 Mbps time division multiple access (TDMA) burst per upstream using QPSK ,QAM8 or 16QAM in 200 KHz to 3.2 MHz bandwidths

- near line of sight performance at many frequencies
- systems already operating at 700 MHz, 1.9 GHz, 2.1 GHz, 2.3 GHz, 2.5 GHz , 3.5 GHz and 5.8 GHz
- audible installation alignment beeper available on some models to facilitate customer self-install and avoid a truck roll
- economies of scale by reusing existing DOCSIS® products which are now being deployed in high volume worldwide

2.1 DOCSIS® Overview

DOCSIS® is an open industry standard developed and coordinated through the efforts of cable MSOs and technology manufacturers such as ARRIS. Under the watch of the non-profit institution CableLabs®, DOCSIS® technology is mature and in operation in many countries around the world as the standard for Internet access on hybrid fiber coax cable systems. A fundamental advantage of using DOCSIS® is the wide variety of manufacturers producing cable modems and the volumes currently being deployed which translate into very cost-effective subscriber equipment. Over 15 million DOCSIS® cable modems are currently deployed worldwide with over 200,000 upstream DOCSIS® ports.

DOCSIS® wireless-based cable modem pricing is now less than US$65 when purchased in quantity.

The technology behind DOCSIS® also lends itself very well to use as a fixed broadband wireless access mechanism. A well-developed physical layer, sophisticated media access control, and a complete network reference model provide for a commercial grade wireless system.

A quick overview of features is given below, but a more thorough discussion on the specific technical requirements for wireless can be provided as your project matures. The CableLabs® website, http://www.cablemodem.com/ also contains the current DOCSIS® specifications.

2.1.1 Physical Layer Characteristics

Key parameters of the physical layer include:

Downstream:

- 27 Mbps in a 6 MHz RF channel (standard DOCSIS®)
- 64QAM, 16 QAM, and QPSK modulations
- Reed-Solomon forward error correction (~10% overhead)

- continuous transmission

Upstream:

- variable channel bandwidths from 200 KHz to 6.4 MHz
- QPSK, 8QAM, and 16QAM modulations
- Reed-Solomon forward error correction (~10% overhead)
- burst mode transmission
- error correction
- signal precompensation
- adaptive power control over 50 dB range

2.1.2 Media Access Control (MAC)

The DOCSIS® MAC uses a request/grant mechanism under central management of the CMTS. This time division multiple access (TDMA) reservation-based protocol requires each CPE to request a time to transmit data. The CMTS examines all of the incoming requests and grants a time to transmit based on a multitude of parameters including CPE data rate limitations and service priorities. A DOCSIS® compliant system with full QoS features is standard.

2.1.3 Security

Baseline Privacy Plus (BPI+), included as part of the DOCSIS® protocol, provides advanced security and privacy features for both the service provider and the customer. All over-the-air communications operate with 56-bit DES encryption (or 40-bit where regulations require).

Additionally, encrypted key management between the CMTS and modems requires subscriber authorization and registration to ensure reliable and secure billing for multiple server classes, which prevents unauthorized access to the system. Cable modems can support end-to-end 3DES encryption.

2.2 Point to Multipoint Configuration

Figure 1 shows the overall system diagram for point to multipoint communication. A generic diagram of a supercell configuration is used. In this drawing, a single downstream and upstream antenna is shown. Many combinations of antennas and sectorization can be deployed. Detailed network capacity and RF planning is necessary to determine the optimum solution for a specific customer requirement.

FIGURE 1 - POINT TO MULTIPOINT SYSTEM OVERVIEW NORTH AMERICAN INBAND MMDS

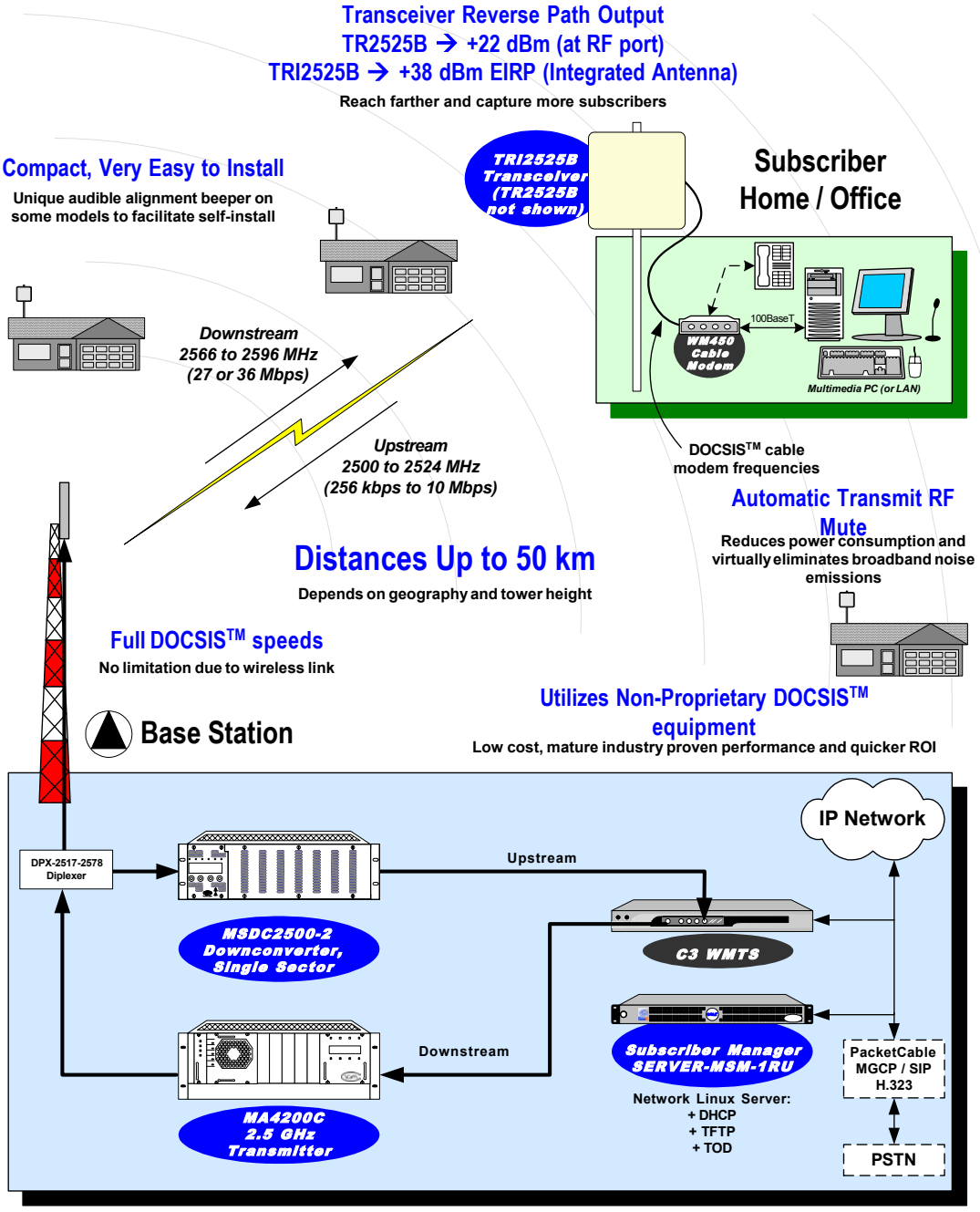


Figure 1: Point-to-Multipoint Overview

2.2.1 Base Station

Figure 1 shows a detailed diagram of the most simple base station configuration; the transport/network connection ties directly into the hub CMTS. This capability at 2.5 GHz requires three additional ARRIS-supplied components to complement the CMTS at the base station (hub) site. These additional components serve to convert the standard DOCSIS® cable frequency plan to the required 2.5 GHz frequency plan and include the following:

- MSDC2500-2 Agile Upstream Downconverter (Indoor Unit)
- MA4200C Power Amplifier and Downstream Upconverter (Indoor Unit)
- Antenna Diplex Filter

Downstream subscriber traffic is time-division multiplexed and modulated by the DOCSIS® CMTS into a 6 MHz (27 Mbps) downstream RF channel. This modulated signal at 44 MHz is fed into the MA4200C upconverter for translation to any desired RF channel within the frequency of operation. Following upconversion to the MMDS band, amplification through the Power Amplifier brings the total output power to a maximum of +37 dBm. A diplex filer is used to filter the output spectrum for harmonic content and combine the transmit signal with the receive filter for supplying a single antenna. Low loss 50-ohm feeder cable runs up the tower to the omnidirectional antenna.

The MMDS receive signal is taken from the diplex filter and downconverted via the MSDC2500 for feeding directly to the CMTS.

In Figure 2, is the more standard arrangement used of this type of operation. Separate receive and transmit antennas are used eliminating the need of the antenna diplexer.

Subscribers within the main supercell are split into four 90º sectors to minimize the effect of multipath interference and increase upstream capacity. Each of these four sectors has a separate flat panel antenna and low-loss feeder cable that feeds into the MSDC2500 headend downconverter. The MSDC2500 again downconverts the upstream band into the 18MHz to 42MHz return band required by the CMTS. The CMTS demodulates each upstream sector and routes to the appropriate network segment accordingly.

FIGURE 2 - POINT TO MULTIPOINT BASE STATION DETAIL
NORTH AMERICAN INBAND MMDS
Omnidirectional Downstream & 4 Sector Upstream

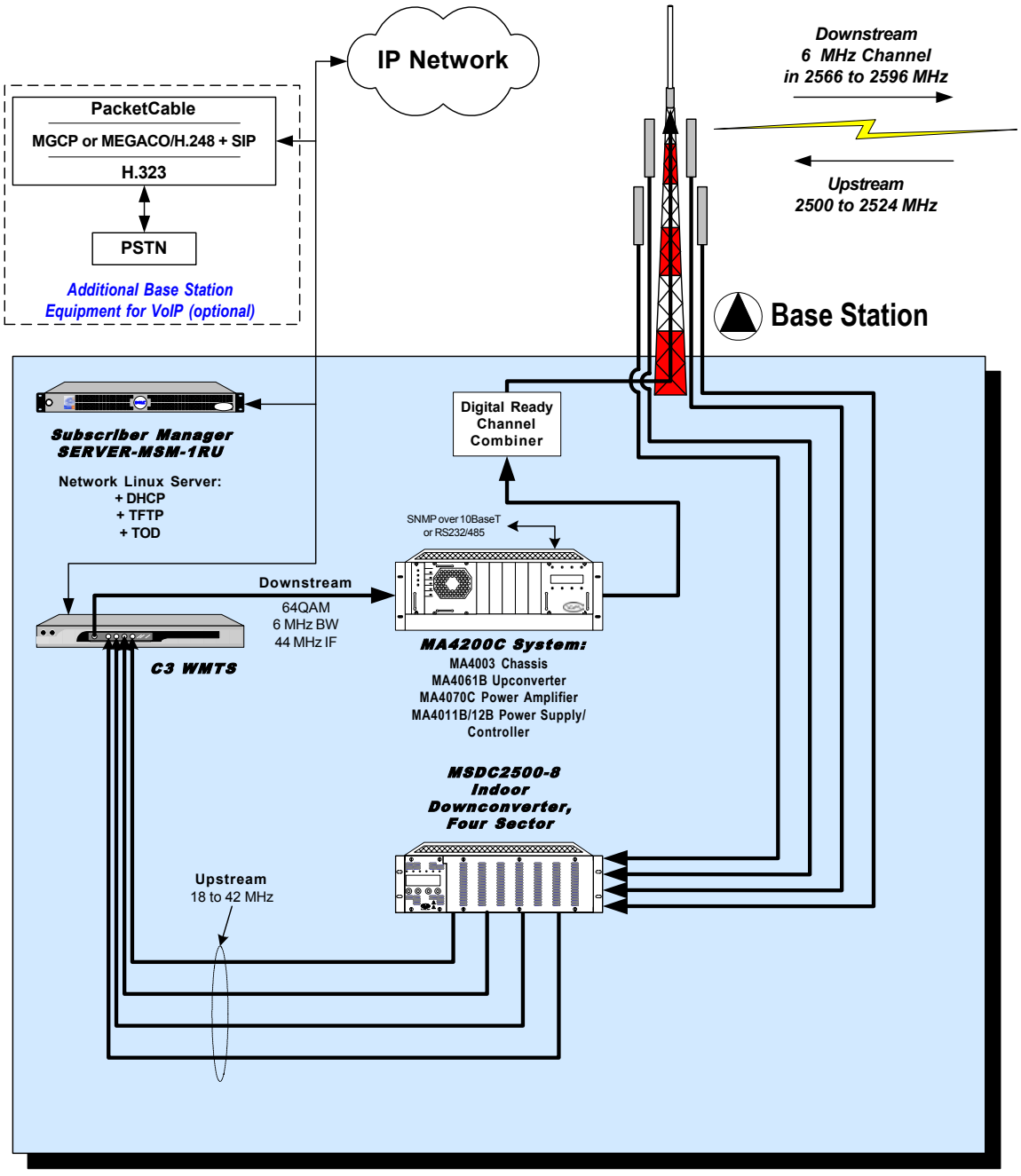


Figure 2: Point-to-Multipoint North American MMDS Base Station Detail

2.2.2 Subscriber

Figure 3 details the configuration for a standard subscriber installation. There are two fundamental elements, each with multiple options depending on performance and feature set: the outdoor RF transceiver (TR2525 or TRI2525) and the indoor DOCSIS® WM450 modem.

The TRI2525 Subscriber Transceiver with Integrated Antenna serves to translate frequencies and amplify the upstream and downstream signals to the appropriate cable frequencies for use by the indoor DOCSIS® modem. A single low-cost 75 ohm cable (that is, RG-59 or RG-6) is used to connect between the transceiver IF port and indoor AC/DC power inserter. A short jumper cable is used to connect to the DOCSIS® modem.

The TR2525 is a standalone RF transceiver that is used with a separate antenna. This choice is effective when a different style or gain of antenna is needed. A short 50ohm cable connects this device to the antenna.

If voice service (VoIP) is also desired, the ARRIS WM402A voice and data unit can be substituted for the WM450 modem.

FIGURE 3 - POINT TO MULTIPOINT SUBSCRIBER DETAIL
Subscriber Home/Office

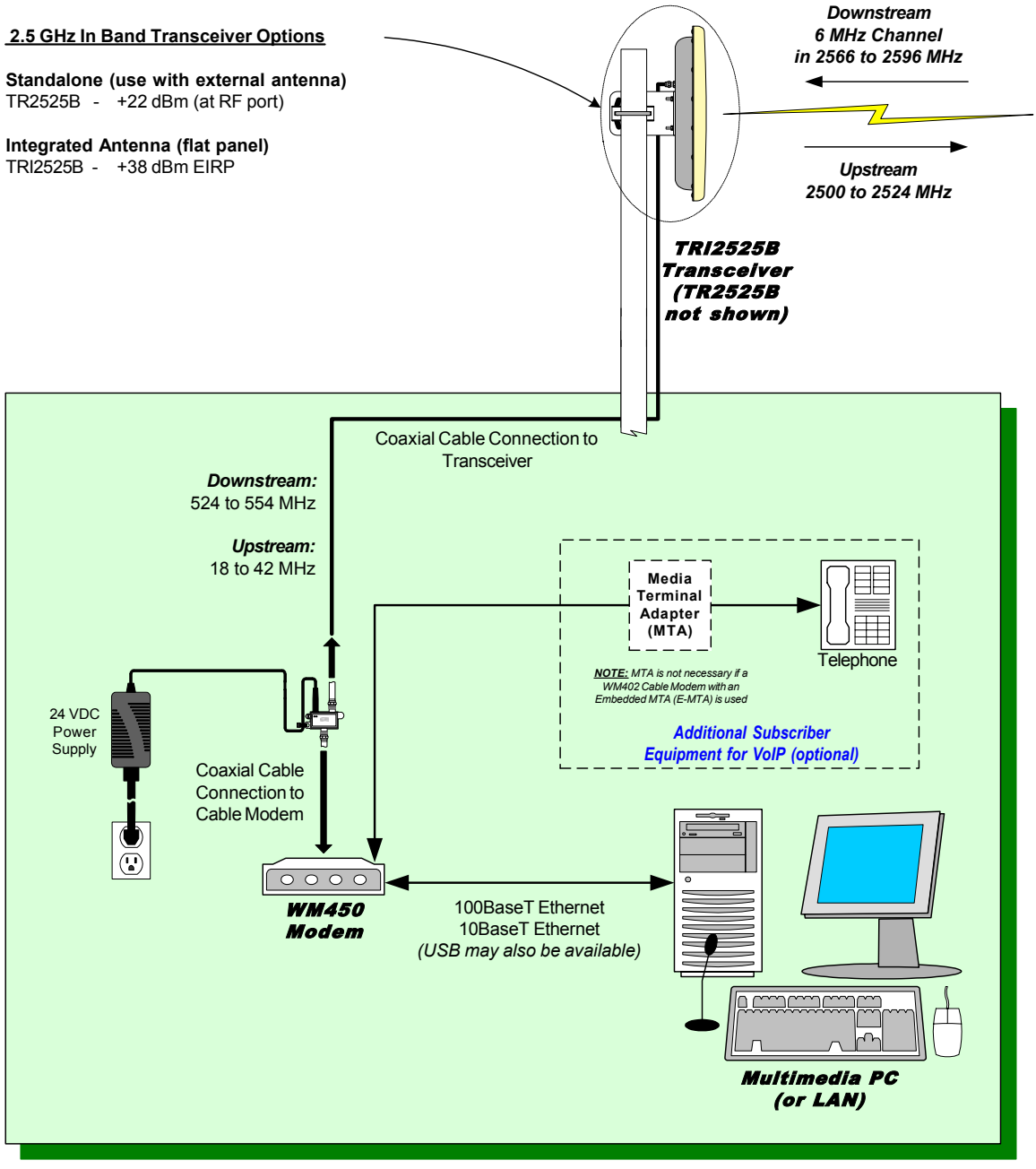


Figure 3: Point-to-Multipoint Subscriber Home/Office Detail

2.3 Element and Network Management

For smaller systems, all network and RF elements, with the exception of the subscriber RF transceivers, are fully visible on the network when using the PC Server. This unit is a Linux-based Web server configured with the Microwave History Manager (MHM) software. The MHM software offers basic logging and display of cable modem performance and usage statistics.

The optional Microwave Subscriber Manager (MSM) software offers DHCP, TFTP, customer database, individual control of cable modems, and latitude/longitude mapping support functions in addition to the basic functions available in MHM.

For larger scale systems and those requiring VoIP services, ARRIS's ALOPA subscriber management system provides all of the features required to maintain and control large numbers of subscribers. It can also be used to directly interface many of the customer billing systems available.

3 Ongoing Field Trial

ARRIS can now supply 33 different transceiver designs covering frequency bands from 500 MHz to 6 GHz.

References to customers with operational systems on four continents are available on request.

ARRIS would be pleased to demonstrate this system and to put in place any particular tests or equipment configurations to demonstrate the performance and manageability of the system.

4 Contact Information

For more information contact:

ARRIS International

800-469-6569 (in the U.S.)

e-mail: wireless@arrisi.com

www.arriswireless.com

www. arrisi.com

From North America, call toll-free: 800-469-6569. Outside North America: +1-678-473-2000.