

The incoming ground & DC- cable is attached to the bottom of the ground block along with ground leads to the negative bus on the fuse block and the enclosure's ground lug.

The incoming DC+ cable is attached to the bottom of the DC+ bus on the fuse block. Cables to the individual Hub antennas (light gray) terminate on the right side of the fuse block. The electrolytic capacitor (2200 uF) across the power supply busses reduces transients when individual Hub power connectors are inserted or removed with power ON. It is normally not needed, but if it is used, be sure to observe the polarity.

Space is provided at the top of the box for additional lightning protectors, which have not proven to be necessary at our test site in San Jose, CA. Lightning protectors are installed on a ground bus in the base station equipment room to protect the indoor equipment.

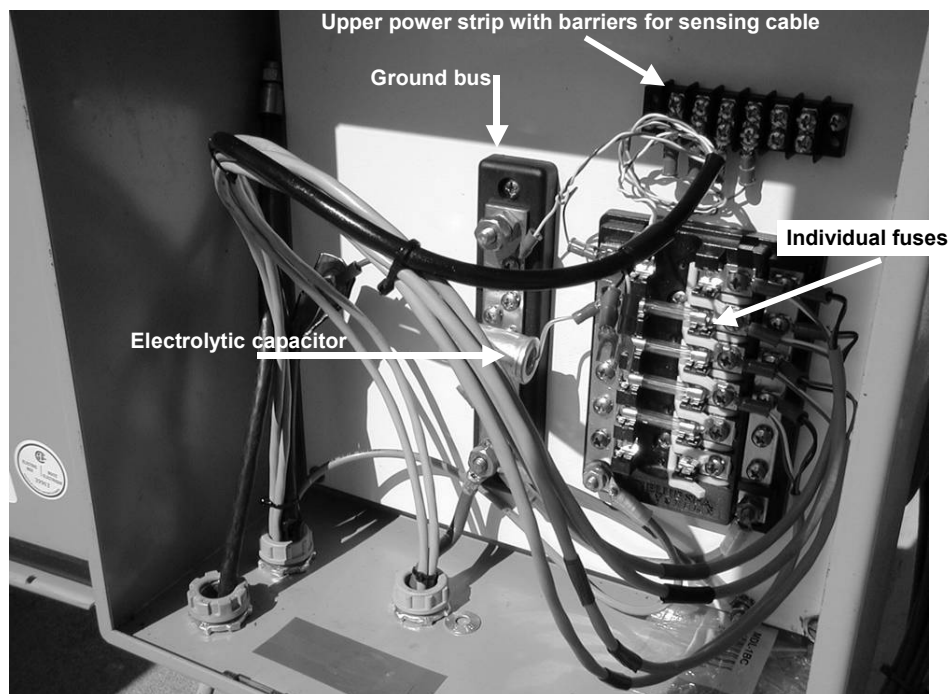


Figure 5-8: Close-up of OJB.

OJB Components

The OJB pictured here is assembled from the following components:

Device	Vendor & Part Number	Source	
Enclosure	Hoffman A-1412CH	Electric Supply Trade	www.hoffmanonline.com
Inner Panel	Hoffman A14P12	Electric Supply Trade	

Fuse Block	Blue Sea Systems 5015	West Marine Retail	www.blueseasystems.com
Ground Bus	Blue Sea Systems 2301	West Marine Retail	
Dual Bus (use in lieu of fuse block)			
	Blue Sea Systems 2702	West Marine Retail	
Rubber Insert 3/4" couplings, locknuts, bushings		Electric Supply Trade	
Shielded Cat 5 Cable	Superior Essex BBDN Part #04-001-34		Graybar Electric
Cat 5 Shield Bond Connectors	Hubbell BC285SB		Graybar Electric

5.3 Installation Detail – Indoor Equipment

Figure 5-9 provides a single line diagram illustrating one Hub Transceiver. When implementing multiple sector systems, replicate the IF cabling, lightning protection, 12 dB test taps, etc. for each Hub Transceiver.

Table 5-1 – Lightning Protector Part Numbers

Ref #	Item	Part #
1	75 ohm RG-6 transmit and receive cable	IS-75F-C1
2	DC Power Supply	IS-17VDC-30A-NG

The ground bus, in turn, should be connected with an appropriate conductor (minimum #6 AWG) to the hub site ground that includes the power service and building common ground, per the NEC and local codes.

Arcwave recommends the installer run a minimum #6 AWG conductor between the equipment room ground bus and a common ground point adjacent to the Hub Transceiver(s) unless the transceiver mounting system consists of a known low impedance ground (as a steel tower or monopole). In the case of a single sector Hub Transceiver installation, this point can be the antenna ground bolt or mounting bracket. In a multi sector installation including an outdoor junction box (OJB) this conductor can be connected to the ground bus in the OJB, which in turn, is connected to each transceiver and any nearby building or support structure ground.

Normally the Wireless CMTS (W-CMTS), upconverter(s), DC power supply, 100baseT data switch, etc. are mounted in a 19-inch equipment rack in the base station equipment room. This rack should also be connected to the ground bus, preferably by a conductor #6 AWG or greater.

When shielded cable is utilized to connect DC power between the hub equipment room and the hub antenna, ground the shield to the ground bus in the equipment room.

Figures 5-10 and detail 5-11 show a ground bus installation with the specified PolyPhaser protector on each IF cable and on the antenna lead for a backhaul microwave. Note the ground strap to the right, which connects to the equipment rack.

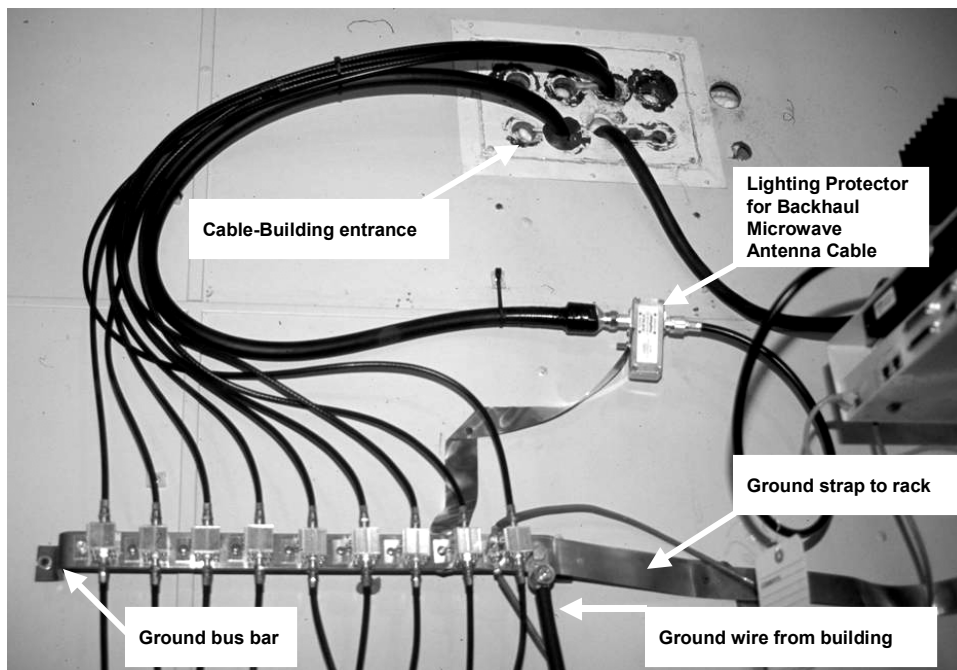


Figure 5-10: Example of Hub protection at building entrance.

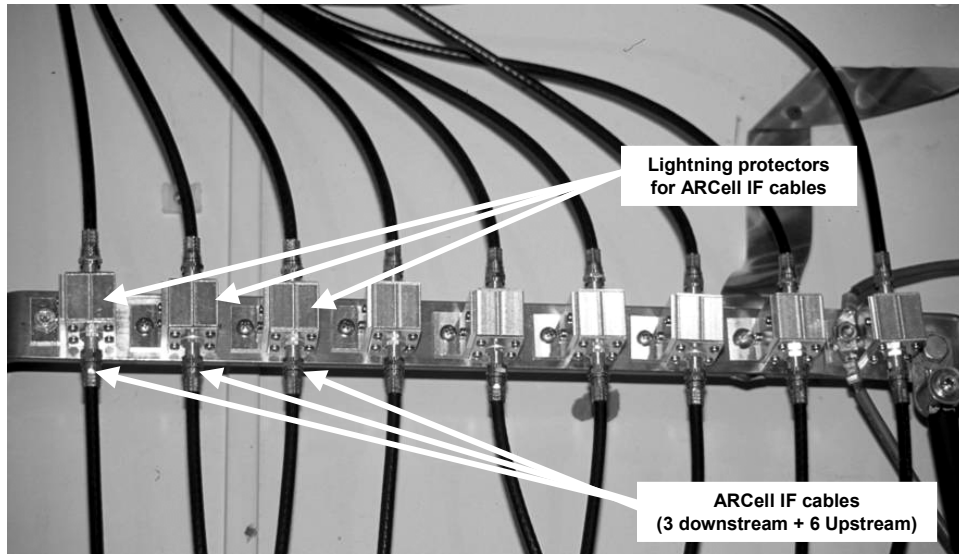


Figure 5-11: Details of Fig 5-10 IF cable protection.

5.3.2 DC Power

The Hub Transceiver requires 8.0 – 8.5 Vdc at the transceiver modules and draws approximately 900 mA of current.

In a one or two sector installation a small variable voltage linear DC power supply capable of supplying at least 1000 mA is employed. Arcwave has successfully tested the following power supply in a one or two sector configuration:

Agilent model E3610A

The voltage (IR) drop of the power cable is calculated and the output of the DC supply is set appropriately.

In a multi-sector installation the DC power supply is chosen with sufficient capacity to deliver at least 1000 mA for each Hub Transceiver. The DC+ lead is sized to provide reasonable voltage drop between the DC supply and the Outdoor Junction Box (OJB) installed near the Hub Transceivers. [It is the installer's responsibility to furnish, assemble and install the OJB].

The DC power supply is then adjusted to provide 8.0 – 8.5 Vdc at the Transceiver connector.

A power supply with an ammeter is a great help when trouble-shooting a Hub since experience has shown that a bad transmitter or receiver module may be “dead” or it may be drawing half its normal current. In either case it is usually very noticeable.

5.3.3 Transmit (Downstream) Signal Path

In the BSR1000W the Downstream upconverter is internal, and the output level can be set via the command line interface or network management software.

In the V3000W, the downstream signal is connected to the external upconverter (normally mounted in the rack with the W-CMTS). A 10 dB pad is inserted at the input to the upconverter to set the proper level.

The upconverter is adjusted to provide the downstream Intermediate Frequency (IF) signal at the center frequency appropriate for the transmit module within the Hub Transceiver to create the desired RF carrier frequency. See Table in the *Antenna and Frequency Planning* section of this manual for more information. The output of the upconverter is connected with RG-6 cables through a 12 dB tap, and thence through the lightning protector to the cable to the Hub Transceiver.

The 12 dB taps provide less than 1 dB of attenuation to the signal passing through and “copy” of the signal 12 dB lower in level to the tap port. These are utilized for inserting a spectrum analyzer for system set-up and maintenance without disturbing the normal cable connections.

5.3.4 Splitters, Pads and Taps

There are many vendors that make splitters, pads (attenuators) and taps for the Cable TV industry. Channel Vision is one vendor (www.channelvision.com), and photos of the items are in Figure 5-22. The splitter shown is 2:1, which is the most commonly used in the ARCell applications. It is important to select parts specified to 1 GHz, in contrast to the 900 MHz parts sold in grocery stores.

The Channel Vision 2:1 model #HS-2 has an insertion loss of 3.5 dB and is under \$4.

The Channel Vision 12 dB tap model #TP12dB has an insertion loss of less than 1 dB and is under \$7. Pay careful attention to the port labels. The main signal is attached to the “IN” port, the “TAP OUT” port is the signal attenuated by 12 dB, and the “OUT” port is the main signal with almost no attenuation.

The Channel Vision 10 dB pad model #3000-10 is under \$2.

Regardless of the brand, the tap and splitter have the same shape, so take care to connect the cables to the proper port on the proper unit.

The splitter is officially a splitter/combiner, but it is not used as a combiner in these examples.



Splitter



Tap



Pad

Figure 5-12: Splitter, Tap and Pad.

5.3.5 Receive (Upstream) Signal Path

The upstream signal IF signal from the Hub Transceiver is connected through the lightning protector and through the 12 dB tap to the upstream port of the W-CMTS. The Table in the *Antenna and Frequency Planning* section of this manual details the frequencies that are available. Unlike the downstream, where the frequency is established by the external or internal upconverter, the upstream IF frequency is established as a configuration parameter of the W-CMTS which commands the wireless cable (WCM) modem to transmit on a particular upstream IF frequency.

5.4 Hub Interfaces

This Section lists the interfaces encountered at the base station site.

5.4.1 Hub Transceiver

Transmit and receive signal interfaces:

- 75 ohm type F female connectors
- Premium quad-shielded RG-6 coax cable recommended (e.g. Belden 1189A)
- Upstream signal frequency 6.4 through 32 MHz, nominal signal level -4 dBmV¹⁰.
 - Maximum cable loss between Hub and W-CMTS: 15 dB at 30 MHz.
- Downstream signal frequency 477 through 577 MHz, nominal signal level 50 dBmV.
 - Maximum cable loss between upconverter/CMTS and Hub: 15 dB at 500 MHz.

Power interface:

- Switchcraft type EN3 6 pin male connector on both upstream and downstream radio enclosures (two per Hub Transceiver).
- Nominal 8.0 – 8.5 VDC at 920 mA +/- 50 mA, combined upstream and downstream.

Antenna interface:

- None. These are internal to the Hub Transceiver.

5.4.2 BSR1000W Wireless CMTS

Mirrors the above Transceiver, assuming no taps and only minor coaxial cable losses.

5.4.3 V3000W Wireless CMTS

- 75 ohm type F female connectors
- Upstream input signal frequency 6.4 through 32 MHz, nominal signal level -4 dBmV.
- Downstream output signal frequency: 44 MHz, nominal signal level 20 dBmV (input to Upconverter)
- Network connection RJ45 female connector: 100baseT Ethernet LAN.

¹⁰ For 75-Ohm systems, 1 mW = 0 dBm = 48.8 dBmV.

- The Ethernet switch port to which the V3000W W-CMTS is connected **must** be optioned to 100 Mbps, Full Duplex, No Auto-Negotiate.

5.4.3.1 Upconverter (Internal or external)

- 75 ohm type F female connectors
- Input signal frequency 44 MHz; level range +38 dBmV to +45 dBmV.
- Output signal frequency 477 through 577 MHz; maximum signal level +60 dBmV.

5.5 System Level-Setting Notes

5.5.1 General

The ARCell base station and subscriber transmitters are designed for linear operation at the maximum output power allowed for compliant operation under the FCC part 15 regulations. In both the headend and the subscriber units the input power level to the ARCell transceivers determines the output power. There is no gain adjustment available to the user in the transceiver.

5.5.2 Downstream Power

The AR3155 Hub Transceiver is factory calibrated to provide RF power output of +36 dBm maximum EIRP (FCC Rules Section 15.247) when the input power applied to the upconverter IF input connector is +35 dBmV. **This is the level required for FCC compliance.**

5.5.3 Downstream Power Adjustment Procedure

1. Disconnect the downstream IF cable at the input to the Hub Transceiver and connect the cable to the input of a suitably calibrated RF power meter such as a CATV level meter. Ensure that the IF signal power does not exceed +35 dBmV.
2. Alternatively, a spectrum analyzer can be utilized if it has a 75 ohm input impedance and can display power in dBmV.
 - a. Adjustment must be made for the resolution bandwidth (RBW) of the analyzer¹¹. For example, in the case of the AR3155, if the RBW is set for 1 MHz, the actual power level will be $10\log(5.25)$ or 7.2 dB higher than the average power displayed on the analyzer.
3. Set the IF output level of the W-CMTS or external upconverter, or by inserting fixed attenuators as needed.
4. If the AR3155 Hub Transceiver is inaccessible for power measurement, the level at the W-CMTS or external upconverter can be measured and adjustment made for transmission line loss¹². For example, if the transmission line loss is known to be 10 dB including any taps or splitters, the W-CMTS or external upconverter output can be set for +45 dBmV which will provide the required +35 dBmV power level at the input of the Hub Transceiver.

In any case, it is the responsibility of the system operator to ensure that the proper input level is applied to the AR3155 Hub Transceiver.

¹¹ The formula is (actual power) = (displayed power) + $10\log[(\text{signal bandwidth}) \div (\text{RBW})]$.

¹² See cable manufacturer's specifications. Standard RG-6 coaxial cable has a loss of 4.6 dB /100 ft. at 500 MHz.

IMPORTANT NOTE: To comply with FCC RF safe-human-exposure compliance requirements, antenna installation and device operating configuration described in this user manual must be satisfied. The transceiver(s) used for this device must be fixed-mounted on outdoor permanent structures with a separation of at least 1.5 meters from all persons during normal operation.

5.5.4 Upstream Power

The output level of the wireless cable modem (WCM) establishes the subscriber transceiver's output power. An automatic feedback loop, controlled by the W-CMTS, commands each WCM to adjust its output level such that all the signals are received at the Hub at about the same RF power. The user may tune this power control loop by modifying the appropriate parameter in the W-CMTS configuration. A discussion of this parameter follows in the *Installation Tuning* section of this manual.

The Subscriber Transceiver is factory calibrated to maximum FCC permissible EIRP when the DOCSIS WCM is at its maximum power output level.

Spectrum analyzer traces of the upstream signal are illustrated in the *Installation Tuning* section.

5.6 Installation Tuning

5.6.1 Downstream

The following diagrams showing the effects of overdriving the AR3155Hub Transceiver are for illustrative purposes only and should not be used as a guide for setting the RF power output level.

If the AR3155 RF power is set as described in Section 5.5.3 (above), transmitter linearity will be maintained for proper operation in QPSK and 16QAM downstream modes. For operation at 64QAM the downstream level may have to be reduced by 1 dB to 3 dB to ensure optimal error free performance.

Figure 5-13 illustrates a correct downstream signal at the subscriber location. This trace was captured by using a two-way splitter on the wireless cable modem side of the subscriber transceiver power inserter – one output to the wireless cable modem, the other to the spectrum analyzer.

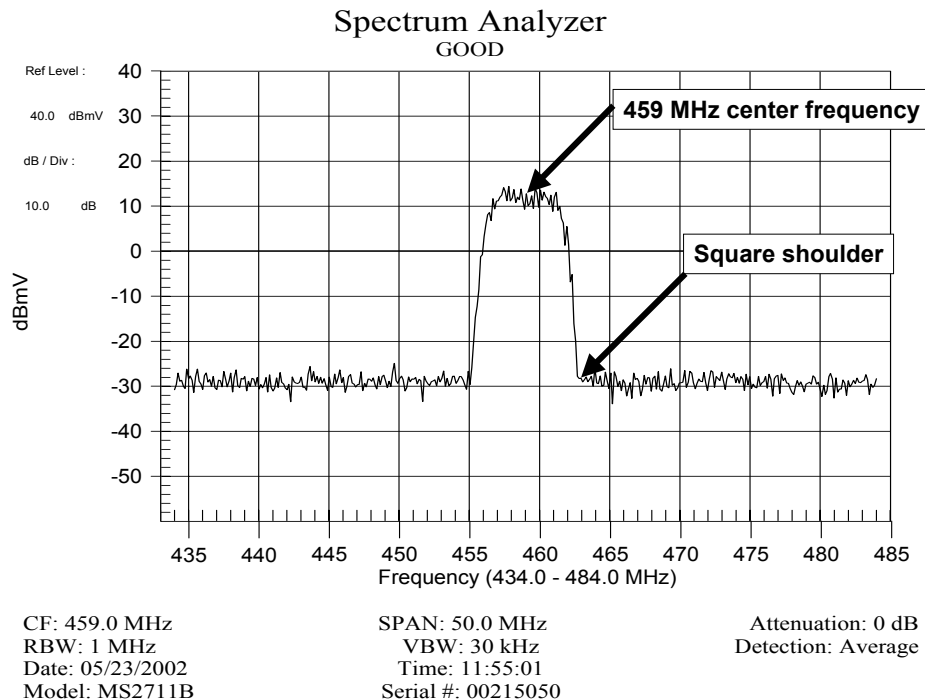


Figure 5-13: Proper downstream IF signal at subscriber location.

Note that the “shoulders” of the digital signal at 455 and 463 MHz are square – there is no rise in the noise base line adjacent to the signal.

Note also that the received IF center frequency is 52 MHz lower than the transmitted IF (transmit centered on 511 MHz, receive centered on 459 MHz (Figure 5-13)). This is the result of the design of the Subscriber Transceiver. The subscriber’s transmit (upconverter) IF frequencies and subscriber’s receive (modem) IF frequencies are detailed in the Table in *Frequency Planning* section of this manual. The frequencies are chosen such that the receive IF frequencies correspond to the center frequencies of the standard North American CATV frequency plan. The Figure shows 459 MHz, which is the center of channel 53. One of the

configuration options of the wireless cable modems is to search the CATV frequency plan looking for a valid downstream signal.

Figures 5-14 and 5-15 illustrate the effect of overdriving the Hub Transceiver. Both of these traces were captured in the identical setup as Figure 5-13. The drive to the Hub Transmitter was increased to create the distortion.

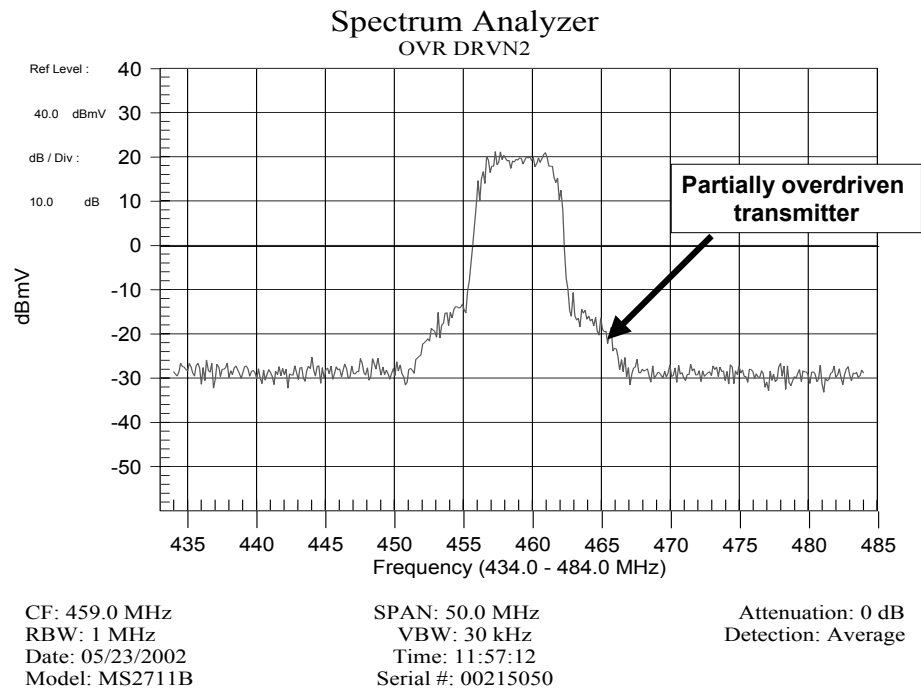


Figure 5-14: Example of slightly overdriven transmitter, at input to cable modem.

The wireless cable modem (WCM) may run with the signal shown in Figure 5-14, but the WCM performance will be degraded. Note that the top of the signal is approximately 7 dB higher than the desired signal shown in Figure 5-13.

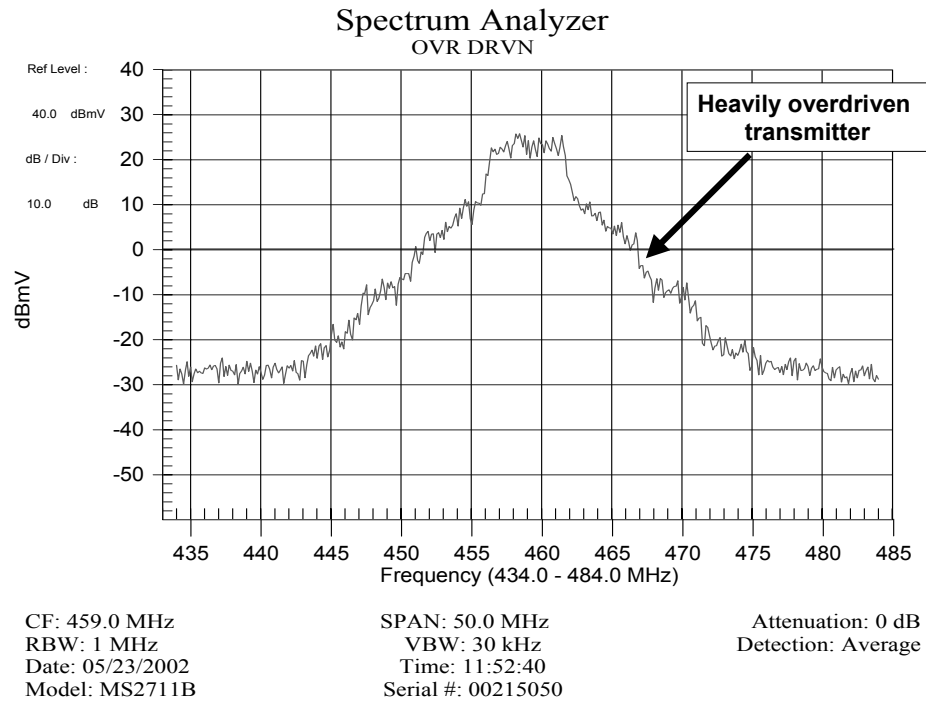


Figure 5-15: Example of heavily overdriven transmitter, at input to cable modem.

The WCM definitely will not run with a downstream signal as overdriven as shown in Figure 5-15. Note that the top of the signal is approximately 10 dB higher than the desired signal shown in Figure 5-13.

5.6.2 Upstream

The wireless cable modem (WCM) transmits an upstream signal (to the Hub Transceiver) under timing, power and frequency control of the W-CMTS. The W-CMTS can command the WCM to transmit its IF signal at an output level between 8 dBmV and 58 dBmV (inclusive), based on the signal the W-CMTS considers optimum for accurate demodulation. These parameters are established at the time a WCM is powered up, locates a valid downstream signal, and seeks to be recognized by the W-CMTS. This process is called ranging. It has been designed to be non-disruptive to subscribers already operating on the particular upstream channel (sector).

The upstream power level is the most important of these for the tuning of the system. The timing and frequency agility of the WCM are under the command of the W-CMTS. If a WCM is reporting frequent timing changes, multipath interference to the particular subscriber upstream transmission is probable. If the WCM is reporting frequent changes in transmit frequency, a service issue with the WCM or outdoor subscriber transceiver should be considered. If frequent frequency changes are reported by several WCMs in the same sector, a service issue with the receiver module within the Hub Transceiver should be considered.

5.6.2.1 *Upstream Power Level*

Each subscriber installation configured to transmit to this particular upstream channel (sector) is likely to have a different amount of signal loss between the WCM and the W-CMTS¹³. The W-CMTS uses its ability to command the WCM power at each subscriber individually to ensure that the signals received from each subscriber arrive at nearly the same signal level. For example, a nearby subscriber installation may need only a tenth of its possible power output to provide the W-CMTS with the signal it requires, while a subscriber at the outer range of the system may be commanded to nearly all of its possible power output to provide the same received level signal at the W-CMTS.

The *UpstreamRxGain* parameter in the W-CMTS configuration file provides a set point for the upstream gain loop. This parameter establishes the nominal upstream signal level at the W-CMTS input. Each WCM will be commanded (separately) to adjust its signal output such that its signal arrives at the W-CMTS input at this nominal level. Recall that each WCM is transmitting its upstream data in turn, under commands of the W-CMTS.

Arcwave recommends that the system installer set the *UpstreamRxGain* parameter such that the subscriber WCM with the most path loss (typically the most distant) operates at or just below 55 dBmV WCM output¹⁴. This will cause all of the other WCMs in the sector to operate at some lesser output level¹⁵, which the W-CMTS will automatically assign. The optimum value of this parameter may vary from sector to sector (upstream channel) in a given system due to factors such as different subscriber path lengths to the base station.

¹³ This is due primarily to the different physical distances between the various subscriber installations and the base station. Other factors are any obstructions in the path, location of the subscriber in the Hub Transceiver antenna pattern geometry, any misalignment of the subscriber transceiver antenna, different cable lengths between each WCM and its outdoor transceiver, etc.

¹⁴ This level setting will provide a nominal margin for signal fading of about 3 dB. The W-CMTS will operate at perhaps 5 dB of additional fading (lower signal) under exceptional conditions but this should happen rarely in the delivery of high quality performance to the subscriber.

¹⁵ As all remaining subscriber installations have less path loss than the “furthest” subscriber.

The trace was in Figure 5-17 captured at the 12 dB tap on the upstream input to the W-CMTS. It is centered on upstream frequency 6.4 MHz and built up with *Max Hold* for 30 seconds. Note that the bursts from the various WCMs are arriving at nearly the same amplitude. [Disregard signal below 4 MHz as noise, etc.].

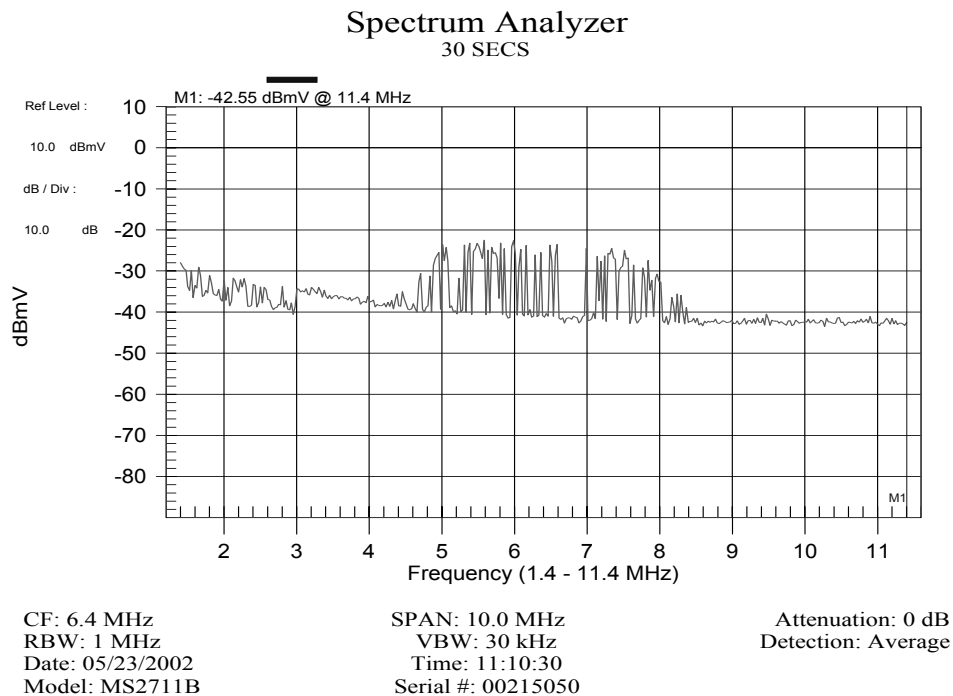


Figure 5-17: Spectrum at Upstream input to W-CMTS.

See also Figure 5-19, which was taken at the same point at another installation.

There is an important subtlety here. The individual modem bursts are not spikes as this display might suggest. Rather, each is a “standard” QPSK modulation envelope, 3.2 MHz wide, centered at 6.4 MHz. They appear as spikes as the bursts are very short duration relative to the sweep of the spectrum analyzer “window”. Thus only portions of the modulation envelope are captured in the display.

5.7 Installation Labeling and Documentation

It is strongly recommended that the installer thoroughly document the system after turn-up and a small number of pilot subscriber installations are complete and active – preferably at least one in each sector. A copy of this documentation should be kept in a binder at the base station for maintenance personnel access and hand updates as changes are made.

Examples of mandatory labels:

- Base station cabling: should be labeled at both ends as to its application: e.g. “Sector 3 U/S”, or “DC to Sector 1”. Many antenna installers utilize bands of colored tape to identify cabling running from the equipment room to the antennas. If so installed, a ‘key’ to the coding should be posted: “red-red-yellow = Sector 1 D/S”
- 12 dB tap points: “Sector 3 D/S”
- Upconverters (CADCO): “511 MHz – Sectors 1,3,5”
- Sector number approximate compass direction: “Sector 1 – North, Sector 2 – NE, etc.”

The documentation should include a single-line diagram (such as Figure 5-9) including every component of the base station installation. Labels on the diagram(s) should correspond exactly to the physical labels on the actual equipment (above).

A portable spectrum analyzer capable of viewing frequencies to 1 GHz is an invaluable tool for system maintenance and troubleshooting. Arcwave has found that the Anritsu MS2711B, which operates up to 3 GHz, works very well in the field and is considerably more portable and less expensive than lab spectrum analyzers. Whatever instrument is employed must have a method of capturing traces, whether it is a digital capture of an LCD screen (the Anritsu) or the traditional Polaroid of a CRT display.

At the time of system turn-up and a small number of pilot subscriber installations are complete and active, spectrum analyzer traces should be captured and included in the system documentation package. Three are three important spots in the system, which should be captured. Following are examples of each:

All downstream 12 dB tap points (upconverter outputs)

All upstream 12 dB tap points (upstream input to the W-CMTS)

All upstream inputs to the W-CMTS (requires taking the sector out of service for the trace capture)

5.7.1 Downstream 12 dB Tap points

Downstream 12 dB tap points are installed in the equipment room at the output of the internal or external Upconverter (or at the output of any splitter at the output of an Upconverter), just prior to the IF coaxial run to the lightning protector and thence to the Hub Transceiver.

Spectrum analyzer traces should be captured and saved at each of these points:

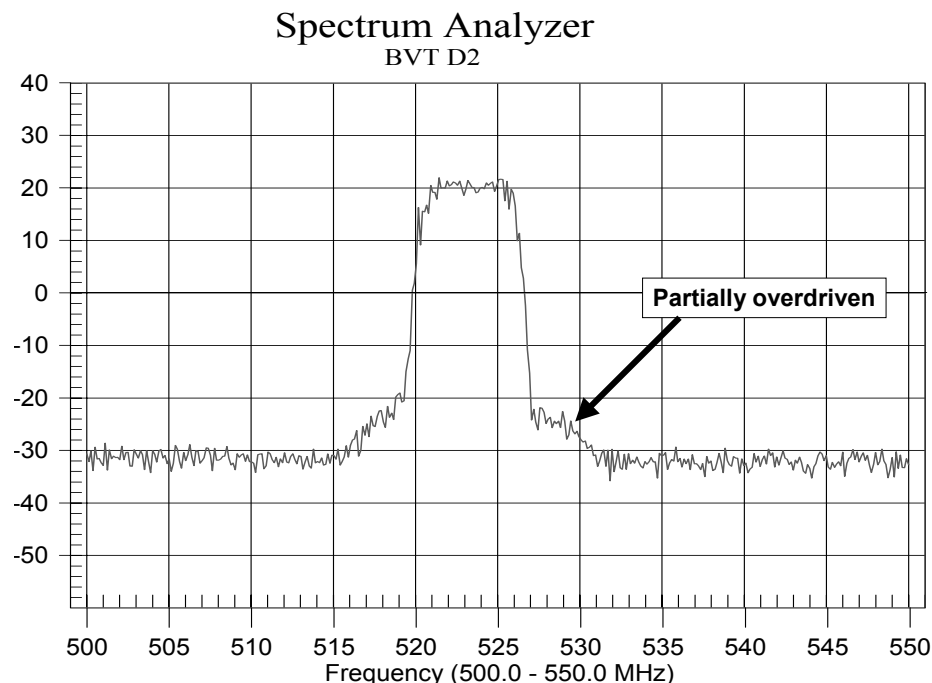


Figure 5-18: Example of Downstream IF at the Upconverter output, which is overdriven.

The 12 dB tap point in one installation's Downstream #2 is shown in Figure 5-18. The downstream center frequency (upconverter output) is 523 MHz.

Note in this particular example the “shoulders” on the trace caused by the upconverter being overdriven. The shoulders were eliminated by reducing the signal to the upconverter. This was done by increasing the value of the attenuator between the W-CMTS and the upconverter. If overdriving occurs when the upconverter is internal to the W-CMTS, the shoulders can be eliminated by reducing the Downstream output power.

The final Hub documentation package should include the trace after the adjustment.

5.7.2 Upstream 12 dB Tap points

Upstream 12 dB tap points are installed at the equipment room end of the IF cables from the Hub Transceiver immediately at the upstream input to the W-CMTS. Spectrum analyzer traces should be captured and saved at each of these points.

The 12 dB tap point in the same system’s Upstream #5 is shown in Figure 5-19. This upstream center frequency is 6.4 MHz.

Figure 5-19 is a 30 second Max Hold build-up of a lightly loaded sector. Note that the individual modem bursts are not spikes as this display might suggest. Rather, each is a “standard” QPSK modulation envelope, 3.2MHz wide, centered at 6.4 MHz. They appear as spikes as the bursts are very short duration relative to the sweep of the spectrum analyzer “window”. Thus only portions of the modulation envelope are captured in the display.

See the discussion of Figure 5-20 for an explanation of the bursts with energy greater than 8 MHz.

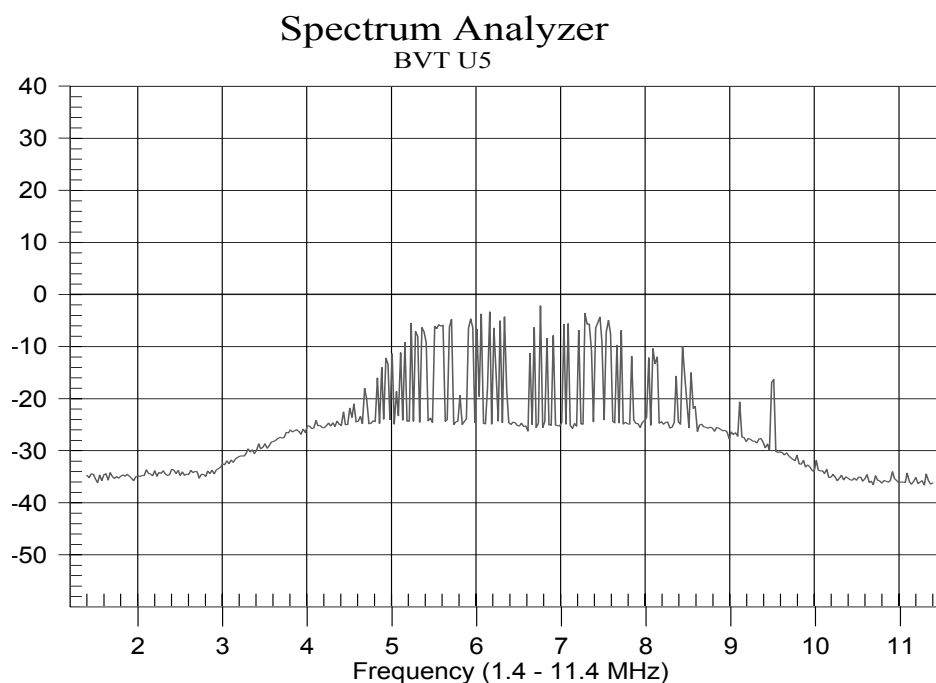


Figure 5-19: Upstream (Receive) input to W-CMTS.

5.7.3 Upstream Quiet Sector W-CMTS Input

During the installation process when there are no subscriber units bursting their upstreams at the base station, there can be a need to check to ensure that the receiver in the Hub Transceiver is powered up and operational.

Figure 5-20 shows a quiet sector – no modems bursting on the 6.4 MHz IF upstream. The solitary burst is on an adjacent sector centered at 9.6 MHz. This is evident as the modulation envelopes of the ARCell upstream signal are 3.2 MHz wide. Thus the 6.4 MHz-centered upstream has energy between 4.8 and 8 MHz. The solitary burst is greater than 8 MHz so it is part of an upstream signal centered at 9.6 MHz with energy between 8 and 11.2 MHz. In this system a physically adjacent sector is operating with a 9.6 MHz-centered upstream.

Note the rise in the noise floor of 6-8 dB centered on this trace. This is the result of a SAW filter internal to the downconverter in the Hub Transceiver. The noise floor in this trace acts like a tracking generator in that it shows a portion of the response (gain) increasing in the pass band of the downconverter. Actually the cutoff on either side of the filter is much greater than is shown here due to the noise floor of the particular spectrum analyzer. However, the nominal 5 MHz pass band of the filter admits the 3.2 MHz wide upstream signal, and in this case just enough of the upstream signal from an adjacent upstream channel (centered on 9.6 MHz) is present for the burst to be captured in the display.

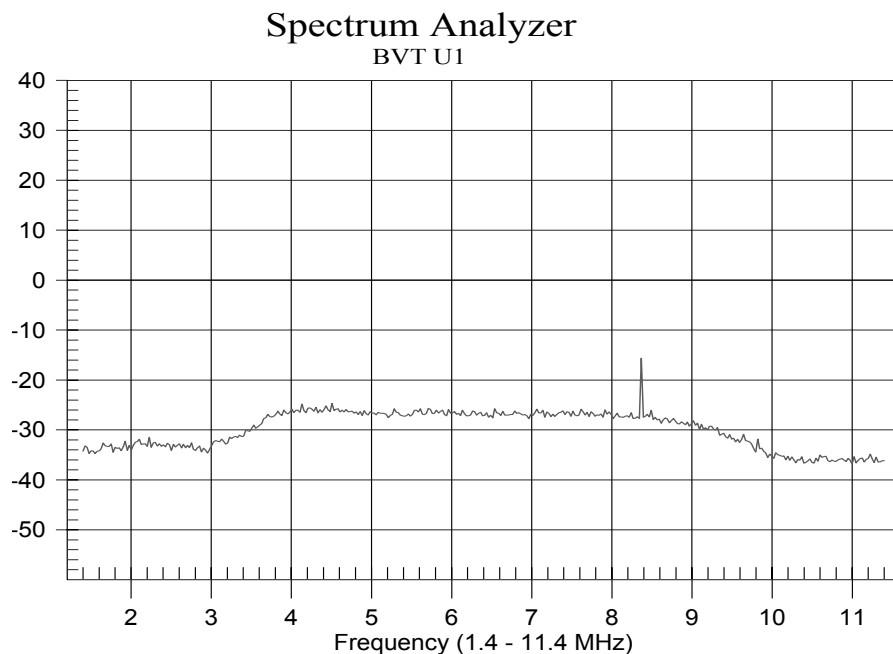


Figure 5-20: Spectrum of quiet sector (no subscriber units).

A very useful check for receiver operation is to use the spectrum analyzer at the upstream 12 dB tap point to check for the characteristic shape of the rise of the noise floor centered on the frequency of the particular upstream as shown in Figure 5-19. Occasionally (long IF cable runs) this shape is not noticeable as it is lost in the spectrum analyzer noise floor. In these cases the coaxial cable from the Hub Transceiver must be disconnected from the 12 dB tap and directly connected to the input of the spectrum analyzer.

5.8 Hub Power Cable Convention

The standard power cable shipped with the Hub units is a 25 ft cable with a connector at one end. The cable is made from Belden #8762 wire, which has one twisted pair, a shield, and a UV rated PVC grey jacket.

The power cable connector is Switchcraft EN3C6F, which is a female connector. The connector on the Transceiver is male.

Table 5-3: Cable wiring.

Pin	Signal	Belden 8762
1	DC Return (ground)	Black
2	+DC (+8.5 Vdc)	White or Red
3-6	Future	--

5.8.1 Internal Headers

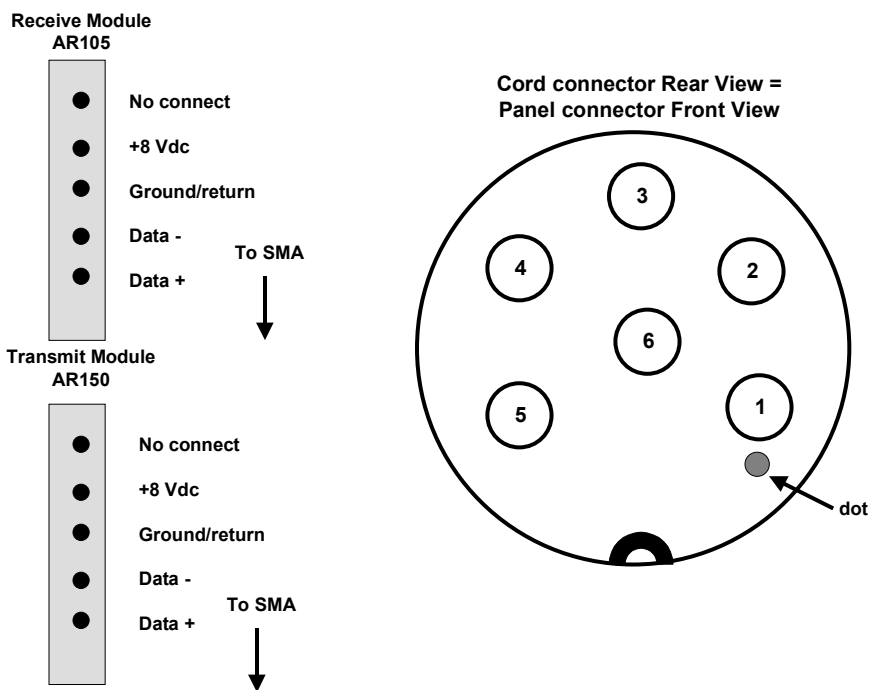


Figure 5-21: Internal connector pin-outs.

5.9 Downtilt

Generally tilting the ARCell Hub Transceiver downward is not needed to achieve the 5-mile range.

The math is: if a Hub Transceiver is mounted on top of a building at a total height H , and the farthest subscriber is a distance D , then the optimum downtilt is $\text{Arctangent} = H/D$.

However, in practice, mounting a pipe on a roof so the pipe is vertical is only accurate to 1 or 2 degrees at best. The common practice is to visually compare the vertical pipe to some vertical object. Another is to use a "spirit" level (the ones with a bubble) or a fence-post-level (also with bubbles). Under these circumstances, trying to downtilt by only 1 or 2 degrees is inappropriate.

Generally, the situations that merit considering downtilt are when the Hub is several hundred feet higher than the subscribers' transceivers.

6 Hub Installation Checklist – 6x60-degree

The Arcwave's AR1255 Hub Outdoor Transceiver is intended for professional installation only. Nothing in this manual supercedes local regulations.

6.1 ARCell Hub Outdoor Transceiver

1. Attach IF cables (upstream and downstream) to receiver and transmitter
2. Attach DC power cable to receiver and transmitter.
3. Dress power and IF cables with UV-rated tie wraps and pass them through the cable grommet at bottom of rear weather cap.
4. Install rear weather cap mounting screws.
5. Attach Hub Transceiver to vertical mounting pipe with at least 44 inches clear of unrelated hardware or other impediments. Pipe diameter to be between 1.5 and 2.25 inches, inclusive.
6. Adjust the nuts on the 5/16" threaded mounting bolts such that the antenna is oriented per system designer's specifications. Generally, a single Hub Transceiver is pointed centered on the population to be served, and multiple Hub Transceivers are oriented 60 degrees apart horizontally. Vertical orientation should generally be vertical, i.e., no downtilt.
7. Attach a properly terminated (minimum) #6 copper cable to the 1/4-20 ground bolt on the bottom flange of the Hub Transceiver. Connect by shortest path to clean and solid ground on mounting structure (tower steel, building frame, etc.). If the mounting structure is not well grounded the #6 copper cable must be routed to a suitable buried ground rod and/or building electrode.
8. Route the IF and DC power cables from the Hub Transceivers to the Outdoor Junction Box (OJB) – if employed in the particular installation - or directly to the base station equipment room. Utilize appropriate mounting hardware and/or UV-rated tie-wraps.

6.2 Outdoor Junction Box (OJB) – If Employed

1. An OJB can simplify installation and system maintenance if several Arcwave Hub Transceivers are installed at a common site and there is an accessible location for mounting the OJB enclosure. The OJB can serve as a junction and distribution point for any or all of:
 - a. DC power wiring and distribution to individual Hub Transceivers. A fuse block to allow protection and isolation of individual Arcwave Hub Transceivers is recommended. The OJB can contain a voltage regulator to allow a higher DC voltage to be run from the equipment room and then regulated at the OJB to 8.0 – 8.5 volts DC as required by the Hub Transceivers.
 - b. Common ground bus.
 - c. IF splitters. In some installations a single downstream IF signal is to be routed to several ARCell Hub Transceivers. The 75-Ohm passive splitter(s) can be located in the OJB.
 - d. For more information see the section *Installation Detail – Outdoor Junction Box*.
2. Ground the OJB enclosure and common ground bus with a properly terminated (minimum) #6 copper cable by the shortest path to clean and solid ground on mounting structure (tower steel, building frame, etc.).

3. Ground the Negative side of the Hub Transceiver DC cable to the OJB common ground bus.
4. Ground the shields of all DC and IF cables to the OJB common ground bus.
5. If there is any doubt about the continuity of structural ground between the OJB grounding point and the equipment room electrode, run a properly terminated (minimum) #6 copper cable from the OJB common ground bus to the ground bus bar in the equipment room.
6. Route the IF, DC power cable and ground cable from the OJB to the base station equipment room. Utilize appropriate mounting hardware and/or UV-rated tie-wraps.

6.3 Other Suppliers' Outdoor Equipment

1. Backhaul microwave antennas, etc. are to be mounted on the supporting structure per the recommendations of the manufacturer. All requirements for attachment, grounding, connector weatherproofing, etc. are to be carefully observed.
2. Route all cables and/or waveguide from the outdoor equipment(s) to the base station equipment room. Utilize appropriate mounting hardware and/or UV-rated tie-wraps.

6.4 Equipment Room Installation – Cable Entrance and Grounding

1. Mount a ground bus bar adjacent to the cable entrance to the equipment room structure.
 - a. Connect the ground bus bar to the ground electrode with a properly terminated (minimum) #6 copper cable [or copper ground strap of equivalent cross-sectional area] as described in the National Electric Code sections 820-33, 820-40 and 820-41. A common technique is to route the (minimum) #6 copper cable to a driven ground rod adjacent to the point of entry of the coax cable to the building containing the equipment room, and thence to the building electrical service ground point per NEC 820-40. If the Hub Transceivers are mounted on a metallic tower structure adjacent to the equipment room a similar properly terminated (minimum) #6 copper cable should also be run from the electrode to the tower steel. All grounding to conform to local codes.
 - b. Connect the ground bus bar to the indoor equipment rack with appropriate copper strap or (minimum) #6 copper cable.
 - c. Note that ground wires employed for lightning protection must **NEVER** be routed in metallic conduit, pipe, EMT, etc. If lightning ground wires are enclosed they must be routed through non-metallic tubing such as PVC.
2. Mount a suitable lightning protector (e.g. PolyPhaser Model IS-75F-C1) to the ground bus bar for each IF coaxial cable between an Hub Transceiver and the equipment room.
3. Mount a suitable lightning protector (e.g. PolyPhaser Model IS-17VDC-30A-NG) to the ground buss bar to protect the DC power supply.
4. Mount a suitable lightning protector to the ground bus to protect any other cable and/or waveguide routed between the antenna mounting structure and the equipment room.
5. Connect all shields associated with any wiring entering or leaving the equipment room to the ground bus bar.
6. Ensure that all coax cables and DC power cables are properly terminated and connected to the “antenna” or “surge” side of each lightning protector.
7. Note that the “equipment” or “protected” side of each lightning protector is a convenient and appropriate point to demarcate the outside portion of the installation as specified above, and the inside installation which will be specified following.

6.5 Equipment Room Installation – Inside Equipment

1. Customer to furnish cabinet or open-frame 19" equipment rack.
 - a. Cabinet racks to be secured to floor per local earthquake standards. Open frame racks must be secured and braced at the top as required by local codes and practice.
 - b. Minimum recommended clearances for equipment access and operation: 24" in the rear and 36" in the front for cabinet racks, proportionally greater for open frame racks.
 - c. Bond at least one side of front rack rail to the inside ground bus bar (item C1, above) with properly terminated (minimum) #6 copper cable [or copper ground strap of equivalent cross-sectional area].
2. All electronic equipment: Wireless CMTS (W-CMTS), PC(s), upconverters, power supplies, Ethernet switches, routers, UPS, etc. to be secured to the rack by at least four standard 10-32 rack screws.
3. If vertical rack space permits, it is desirable to leave one rack unit (RU = 1 ¾") between each rack-mounted device. At minimum, one space should be left above heat generating devices such as rack mount PCs.
4. Support all large heavy devices (PCs, UPS) with manufacturer-provide rear mounting hardware, or at minimum, a 1 RU blank rack panel secured across the rear rack rails in the space immediately below the device to be supported such that the bottom of the device rests on the top edge of the panel.
5. Furnish at least one dedicated 120 VAC 20 amp power circuit to a suitable receptacle(s) within two feet of the equipment rack. In areas of "dirty" power, protect all equipment with at least an appropriately sized shunt type power line protector.
6. Arcwave strongly recommends protecting the entire base station facility (including all outdoor equipment) with a suitable uninterruptible power supply (UPS). One unit Arcwave has found to be sized appropriately for one of its base stations is an APC 2U rack mount SmartUPS 1400 VA-RM. Ensure that the UPS is bonded to the rack or ground bus per manufacturer's instructions.
7. In addition to the equipment power circuit specified in item E5 (above), provide additional 120 VAC outlets in the vicinity of the equipment rack for portable test equipment, laptop computer chargers, etc.
8. Furnish suitable ambient and task lighting in the vicinity of the equipment rack to permit installation and maintenance activities.
9. Provide for building security appropriate to the installation environment.

6.6 Base Station Installation Documentation

1. Complete documentation immediately after system turn-up.
2. One complete copy is to be kept in a loose-leaf binder at the base station for maintenance personnel access and hand updates. At least one-second copy is to be provided to the system operator.
3. Every wire and cable is to be labeled with a suitable permanent wire marking system. Examples of label text are: "Sector 3 U/S", or "DC to Sector 1".
4. Many antenna installers utilize bands of colored tape to identify cabling running from the equipment room to the antennas. If so installed, a 'key' to the coding must be furnished, e.g., "red-red-yellow = Sector 1 D/S"
5. All 12 dB taps and signal splitters to be labeled: "Sector 1 D/S"

6. All up converters (CADCO's) to be labeled: "511 MHz – Sectors 1,3,5"
7. A key to sector number and approximate compass direction is to be posted: "Sector 1 – N, Sector 2 – NE, etc."
8. A complete single line diagram is to be furnished showing every component of the base station, including equipment, power cables, signal cables and grounding. Labels on the diagram must match exactly the physical labels on the actual equipment and cabling.
9. After system turn-up and a small number of pilot subscriber installations are complete and active, spectrum analyzer traces must be captured and included in the system documentation package.
 - a. All downstream 12 dB tap points (upconverter outputs)
 - b. All upstream 12 dB tap points (upstream input to the W-CMTS)
 - c. All upstream inputs to the W-CMTS (requires taking the sector out of service for the trace capture)

7 Link Budget Parameters for 6x60 Hub

The following numbers are for a system with Vyvo wireless cable modems at the customer site and the V3000W W-CMTS at the Hub. The six sectors involve upconverters and other devices.

Path Loss is primarily free space path loss in the 5 GHz band.

Free Space Path Loss (dB@5 GHz) = $112 + 20 \cdot \log(\text{miles})$.



Figure 7-1: Free Space Path Loss at 5 GHz band.

At the UNII frequency, the loss due to rain is negligible. For example, a heavy rain “cloudburst” (4 inches/hour) only adds 0.5 dB loss, about as much as a connector.

Table 7-1: Upstream Link Power Budget

	Minimum	Typical	Maximum	Comment
CPE WCM output (dBmV)	+8		+58	
IF coax cable loss		Calculate		Belden 9116 1.60 dB/100 ft @ 55 MHz
CPE IF input (dBmV)	+18		+58	
CPE RF output (dBm)	-30		+10	
CPE Tx Antenna gain (dBi)		+14		
Path Loss (dB)		Calculate		
Hub Receive Antenna gain (dBi)		16		
Hub RF input level (dBm)	-95	-85		
Hub RF output level	-42 dBm +6 dBmV	-32 dBm +16 dBmV		53 dB gain
IF Coax cable loss		Calculate		Belden 1189A 1.60 dB/100 ft @ 42 MHz
V3000W input (dBmV)	-15	+16	+35	

Table 7-2: Downstream Link Power Budget

	Minimum	Typical	Maximum	Comment
CPE WCM output (dBmV)	+20		+40	
CADCO Upconverter Input (dBmV)	+38		+45	
CADCO Upconverter Output (dBmV)	+40	+45	+50	
IF coax cable loss (dB)		Calculate	+15	Belden 1189A 4.6 dB/100 ft @ 550 MHz
Hub Tx IF input (dBmV)		+35		
Hub Tx RF output (dBm)		+17		
Hub Tx Antenna gain (dBi)		+13		EIRP=30 dBm
Path Loss (dB)		Calculate		
CPE Receive Antenna gain (dBi)		22		
CPE Rx input level (dBm)	-92		-52	
CPE Rx output level	-52 dBm -6 dBmV	-14 dBm +34 dBmV		38 dB gain
IF Coax cable loss		Calculate	+15	Belden 9116 4.6 dB/100 ft @ 550 MHz
WCM input (dBmV)(QPSK)	-20		+35	

8 Wireless Cable Modem Configuration – CXC150W

This Section will describe the DOCSIS parameters that are needed for the wireless cable modem configuration (CM) file. Any standard DOCSIS CM file generator or editor may be used as long as the minimum parameters are settable. This Section will show how to create a CM file using the Tality Cable Modem File Generator that is valid for use with any DOCSIS compliant modem with the BSR1000W.

The screenshot shows the 'Tality DOCSIS 1.1 Cable Modem Configuration File Editor' window. The 'File' menu is open, showing 'NEW'. The 'DOCSIS 1.0 Settings' section includes buttons for 'Network Access 2', 'Class of Service 6.1', '3 Downstream Frequency', 'Upstream Channel ID 4', 'Vendor ID', 'Software Upgrade Filename', 'SNMP Write Access Control', 'SNMP MIB Objects', 'CPE Ethernet MAC Addresses', 'SNMP IP Addresses', 'Baseline Privacy 6.2', '5 MAX CPE', 'TFTP Timestamp', 'TFTP CM IP', 'Software SRV IP', and 'Vendor Specific Information'. The 'DOCSIS 1.1 Settings' section includes buttons for 'Upstream Packet Classification', 'Downstream Pkt Classification', 'Upstream Service Flow', 'Downstream Service Flow', 'Payload Header Suppression', 'Max. Number Of Classifiers', 'Privacy Enable', 'SNMPV3 KickStart Value', 'Manufacturer CVC', and 'Co-Signer CVC'. The 'Miscellaneous' section includes buttons for 'Write CM MIC, CMTS MIC' and 'View Text File'. At the bottom, there is a row of buttons: 'NEW', 'OPEN', 'SAVE', 'SAVE AS', 'CLOSE', 'CANCEL', and 'EXIT'.

Button Placement

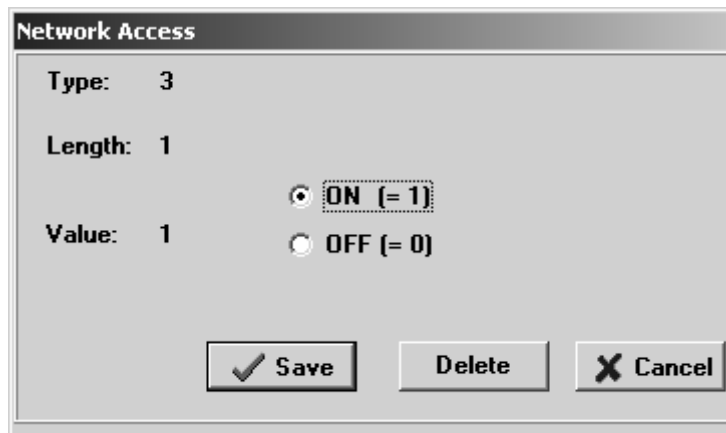
8.1.1 Creating a New File

With file generator open, click on **File** → **New** at the top of the window

8.1.2 Configure Network Access (required)

This option controls the status of the modem's network interface

Select the **Network Access** button and set the value to **ON** (=1), then click **Save**



Network Access

Type: 3

Length: 1

Value: 1

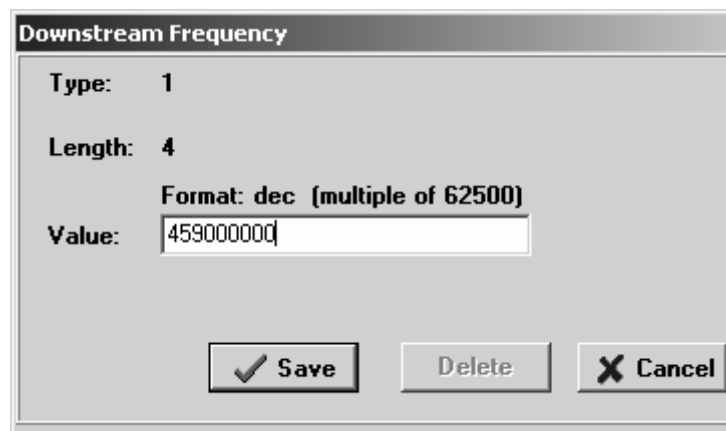
☒ ON (= 1)
☐ OFF (= 0)

Save Delete Cancel

8.1.3 Set the Downstream Frequency (optional, but recommended)

By setting the downstream frequency received by the modem from the ARCell Transceiver, modems will correctly center its downstream frequency. If this is not set, the modem may be slightly off frequency resulting in poor performance.

Select the **Downstream Frequency** button and enter the center downstream frequency in Hertz, then click **Save**.



Downstream Frequency

Type: 1

Length: 4

Format: dec (multiple of 62500)

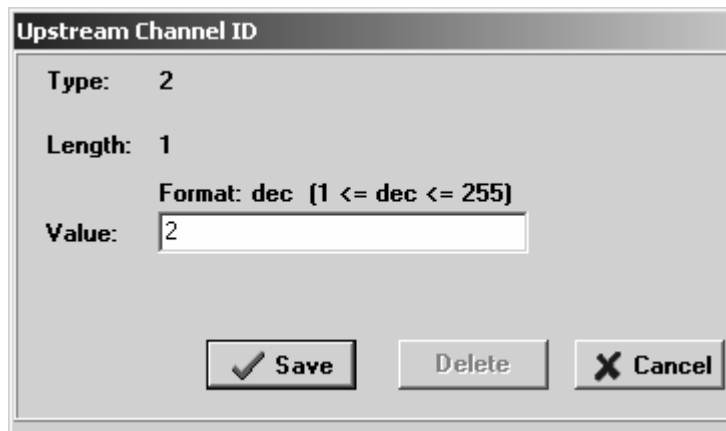
Value: 459000000

Save Delete Cancel

8.1.4 Assigning an Upstream (optional, but recommended)

Assigning the modem to a specific will prevent the modem from locking on the wrong upstream channel. When a modem can see multiple upstream channels it does not automatically pick the best one. Setting the upstream ID will guarantee that the modem will never lock on a different upstream channel

Click on the **Upstream Channel ID** button and enter the upstream ID that you want the modem to be on, then click **Save**.



Upstream Channel ID

Type: 2

Length: 1

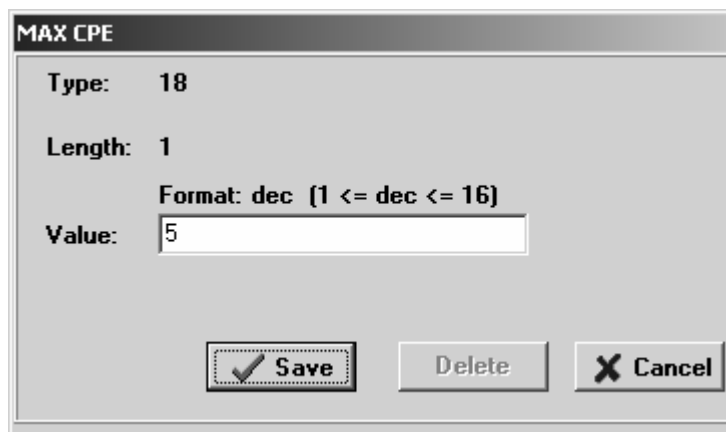
Format: dec (1 <= dec <= 255)

Value:

8.1.5 Specify the Maximum Number of CPEs behind the modem (required).

The maximum number of network devices (e.g. computers) that the modem will allow must be specified.

Click on the **MAX CPE** button and enter the upstream ID that you want the modem to be on. Click **Save**.



MAX CPE

Type: 18

Length: 1

Format: dec (1 <= dec <= 16)

Value:

8.1.6 Class of Service and Baseline Privacy (optional)

Click on the **Class of Service** button and the required parameters (all of them) click **Save**.

Recommended Parameter Values

- Class ID = 1
- Max Downstream = Not available at this time
- Max Upstream = Not available at this time
- US Channel Priority = 0
- Guar Min US Channel = 0
- Maximum US Burst
- CoS Privacy Enable = 1

Click on the **Baseline Privacy** button and the required parameters (all of them)

click **Save**.

Recommended Parameter Values

- Auth Wait Timeout = 10
- Re-auth Wait Timeout = 10
- Auth Grace Time = 300
- Oper. Wait Timeout = 10
- Re-key Wait Timeout = 10
- TEK Grace Time = 60
- Auth. Rej. Wait Timeout = 60

8.1.7 Save file

9 W-CMTS BSR1000W Setup Guide

The purpose of this Section is to assist in setting up the BSR1000W W-CMTS. It outlines the required steps need to bring up the CMTS. Advanced features of the CMTS will not be discussed. For more detailed description, refer to the manual that came with the CMTS.

9.1 Factory Settings BSR1000W

This Section describes how the BSR1000W is shipped from Arcwave. It has a single Downstream set to 511 MHz, and single Upstream set to 9.6 MHz. Instructions on changing settings follows.

All required passwords (telnet, console, etc): "arcell"

IP settings

Ethernet = 10.10.10.203 255.255.255.0

Cable IP address = 192.168.2.1 255.255.255.0

Cable helper address (location of DOCSIS TCP/IP services) = 10.10.10.201

Downstream configuration

Downstream 0 power-level 450

Downstream 0 frequency (Hertz) 511000000

Cable wireless downstream modulation QPSK

No downstream 0 shutdown (turns the downstream ON)

Upstream Configuration

Upstream 0 power-level 70

Upstream 0 frequency 9600000

Upstream 0 modulation-profile 2

Upstream 0 channel-width 3200000

No upstream 0 shutdown

***upstream 1-3 are off**

SNMP Server

Community name: public

Privileges: read/write

9.2 Connecting to the BSR1000 CMTS

1. Configure the terminal application on your PC's serial port to the following
 - Bits per second: 9600 bits per second
 - Data Bits: 8
 - Parity: None
 - Stop Bits: 1

- Flow Control: None
- 2. Connect the BSR1000 to the PC using a **NULL MODEM CABLE**
- 3. Power on the BSR1000 (DO NOT INTERRUPT THE BOOT PROCESS).

9.3 Setting the System Passwords

4. Once the boot process is complete, press the '**ENTER**' key and the prompt '**RDN>**' (or similar) should appear.
5. In order to view/make system changes, you must enter Privileged EXEC mode. This mode is entered using the '**enable**' command. Afterwards the system will prompt for a password. Units that are preconfigured by Arcwave will have the password set to '**arcell**'.
 - RDN > **enable**.
 - Password: **arcell** (system will not echo password)
 - RDN #
6. System changes must be made in GLOBAL CONFIGURATION MODE. You can this mode by typing '**configure**' from the Privileged EXEC mode
 - RDN # **configure** (typing 'config' will also work)
 - RDN (config) #
7. Set the password for the terminal session (Privileged EXEC mode)
 - RDN (config)# password 0 '**your password**' (must be less than 31 characters)
8. Set the password for telnet login (set only if you want telnet access)
 - RDN (config)# password telnet 0 '**your password**' (must be less than 31 characters)
9. Set the Privileged EXEC mode
 - RDN (config)# **enable password 0 'your password'** (must be less than 31 characters)

9.4 Configure the Ethernet IP Address

10. Enter the Interface Configuration mode for the Ethernet interface by entering '**interface ethernet**' command in Global Configuration mode.
 - RDN(config)# interface ethernet 0/0
 - RDN(config-if)#
11. Enter the primary Ethernet IP address and subnet mask for the BSR1000W by using the '**ip-address**' command.
 - RDN(config-if) # **ip address 10.10.10.203 255.255.255.0** (Arcwave preconfigured standard).
 - This sets the CMTS' IP address to 10.10.10.203 on the subnet 255.255.255.0
12. Activate the Ethernet port using the following command
 - RDN(config-if) # **no shutdown**

9.5 Configure Cable IP Address

13. Enter the Interface Configuration mode for the cable interface by entering '**interface cable**' command in Global Configuration mode.
 - RDN (config)# interface cable 0/0
 - RDN (config-if)#
14. Enter the cable IP address and subnet mask by using the '**ip-address**' command.
 - RDN(config-if) # **ip address 192.168.2.1 255.255.255.0** (ARCWAVE preconfigured standard).
15. Activate the cable interface using the following command
 - RDN(config-if) # **no shutdown**

9.6 Configure the CMTS

16. The '**cable helper-address**' function is used to disassemble a cable modem's DHCP broadcast packet, and reassemble the DHCP broadcast packet into a unicast packet so that the packet can traverse through the router and communicate with the DHCP server.
 - RDN(config-if) # **cable helper-address 10.10.10.201 cable-modem**, (10.10.10.201 is the IP address of the destination DHCP server)
 - RDN(config-if) # **cable helper-address 10.10.10.201 host** (This forwards DHCP requests from computers behind the modem)
 - RDN(config-if) # **ip dhcp relay information option**
 - RDN(config-if) # **ip helper-address 'gateway ip'** (This forwards all other packets to the gateway)

Note: 10.10.10.201 is the Arcwave standard IP address of the server that contains the DHCP, TOD, and TFTP servers.

9.7 Configure Downstream Port

The BSR1000W purchased from Arcwave, is a wireless enhanced DOCSIS CMTS. As a result, ignore the setup procedures presented in the Quick Start Guide. Please follow the following instructions:

17. In Global Configuration mode, enter the cable interface using the following command:
RDN(config) #**interface cable 0/0**
18. Set the fixed downstream center frequency using the following command:
 - RDN(config-if) #**cable downstream 0 frequency xxxxxxxxx** (where xxxxxxxxx represents the frequency in hertz).
19. Set the Wireless Downstream Modulation to QPSK or 16QAM using the following command:
 - RND(config-if)# cable wireless downstream modulation qpsk for QPSK
 - RND(config-if)# cable wireless downstream modulation 16qam for 16QAM
20. Set the downstream RF output level with the following command
 - RND(config-if)# **cable downstream 0 power-level #** (# ranges from 450-630).

21. Finally enable the downstream by using the following command:

- RDN(config-if) #no cable downstream 0 shutdown

9.8 Configure Upstream Ports:

22. Set the upstream center frequency for the upstream port by using the '**cable upstream frequency**' command

- RDN(config-if)# cable upstream 'port number <0-3>' frequency <5000000-42000000>
- Example: RDN(config-if)# cable upstream 0 frequency 9600000

23. Set the upstream channel width to 3.2Mhz.

- RDN(config-if)# cable upstream 'port number <0-3>' channel-width <hertz>
- Example: RDN(config-if)# cable upstream 0 channel-width 3200000

24. Apply a modulation profile to the upstream port. The ARCWAVE standard is profile 2.

- RDN(config-if)# cable upstream 'port number <0-3>' modulation-profile <1-16>
- Example: RDN(config-if)# cable upstream 0 modulation-profile 2

25. Set the expected upstream power-level the CMTS expects from the cable modems

- RDN(config-if)# cable upstream 'port number <0-3>' power-level <>
- Example: RDN(config-if)# cable upstream 0 power-level 70

26. Enable the upstream port using the following command

- (config-if)# no cable upstream 'port number <0-3>' shutdown

Note: Remember that your upstream frequency must match your ARCell upstream receiver.

9.9 Configure Basic Routing

You must specify where to direct IP packets originating from the BSR1000's cable interface. IP routing must be configured properly for cable modems behind the BSR1000 to access the Internet. The Quick Start Guide is not clear, so follow the instructions below:

27. In Global Configuration Mode, type the following

- RDN(config) # **ip route 0.0.0.0 0.0.0.0 xxx.xxx.xxx.xxx** (Where xxx.xxx.xxx.xxx is the IP address of the gateway)

9.10 Save the Configuration

28. In order to retain system configuration after system power off / reboot use the '**copy**' command in Privileged EXEC mode

- RDN# copy <source> <destination>
- Example: RDN# copy running-config startup-config

9.11 Creating a static route from the server to the BSR1000

A static route must be set on all servers on the network that will communicate to the cable interface (e.g. modems) of the BSR1000.

29. Windows 2000 Server: At DOS command prompt

- Route add <destination> mask <subnet> <gateway> -p
- Example: ***route add 192.168.2.0 mask 255.255.255.0 10.10.10.203 -p***
- 10.10.10.203 is the Ethernet IP address of the BSR1000

10 Windows 2000 DHCP Server

This Section is written for both the Motorola BSR1000W and for the Vyvo V3000 wireless CMTSSs.

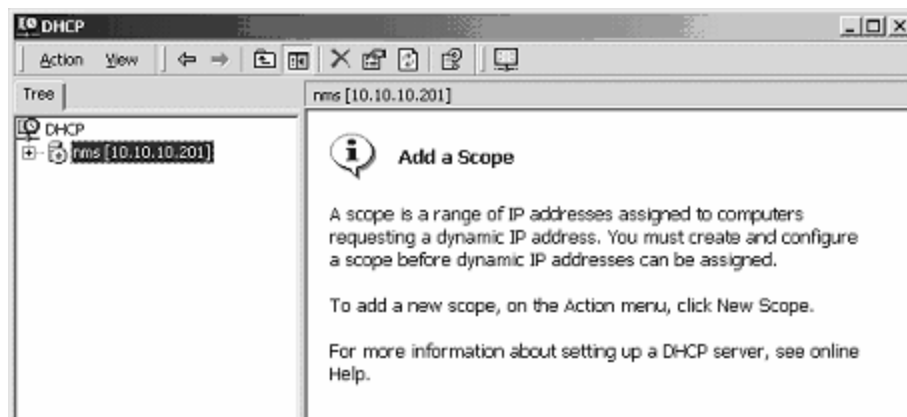
Most of the text is for a Motorola BSR1000 system. With the exception of the IP Addressing scheme, all other DHCP parameters values are valid for a Vyvo WMTS. Pay particular attention to any **bold** captions under screenshots for changes for Vyvo systems.

Requirements:

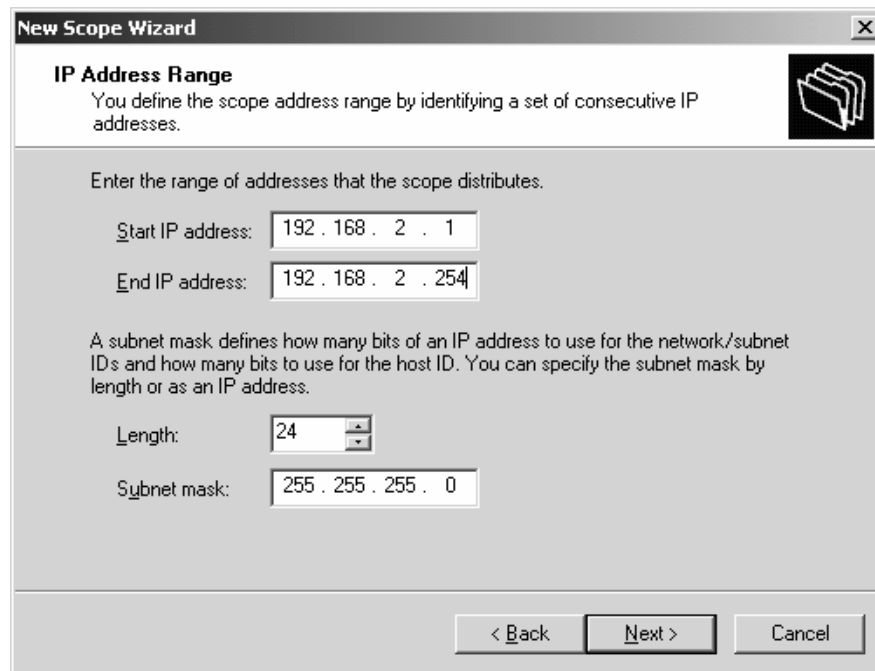
- Windows 2000 Server with DHCP installed

10.1 Setup Procedures

1. In the “Administrative Tools”, open DHCP.



2. Highlight the NMS machine and add a new scope by clicking on “Action” > “New Scope”.
3. Follow the on screen instructions entering necessary instructions
 - a. IP Address Range – Specify the valid address range for the server



New Scope Wizard

IP Address Range
You define the scope address range by identifying a set of consecutive IP addresses.

Enter the range of addresses that the scope distributes.

Start IP address: 192 . 168 . 2 . 1

End IP address: 192 . 168 . 2 . 254

A subnet mask defines how many bits of an IP address to use for the network/subnet IDs and how many bits to use for the host ID. You can specify the subnet mask by length or as an IP address.

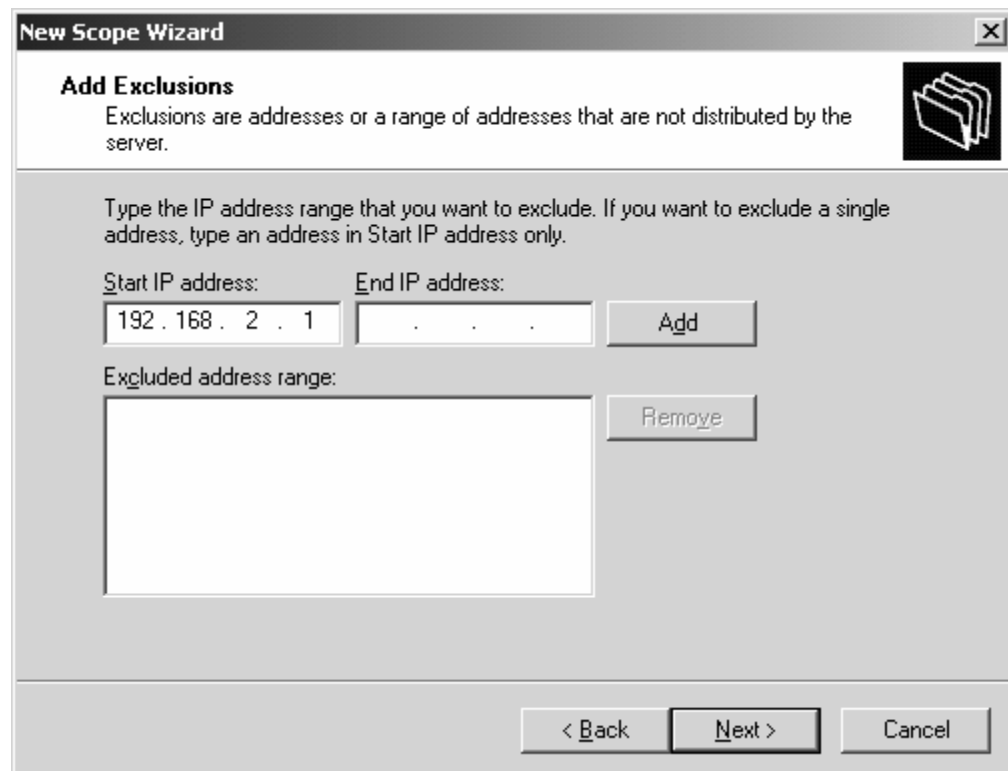
Length: 24

Subnet mask: 255 . 255 . 255 . 0

< Back Next > Cancel

***Arcwave standard addresses for the Vyvo is 10.10.10.1 – 10.10.10.254**

- b. Add Exclusions – Specify address that you do not want DHCP to issue. You must exclude the W-CMTS' cable IP address.



New Scope Wizard

Add Exclusions
Exclusions are addresses or a range of addresses that are not distributed by the server.

Type the IP address range that you want to exclude. If you want to exclude a single address, type an address in Start IP address only.

Start IP address: 192 . 168 . 2 . 1 End IP address: . . . Add

Excluded address range:

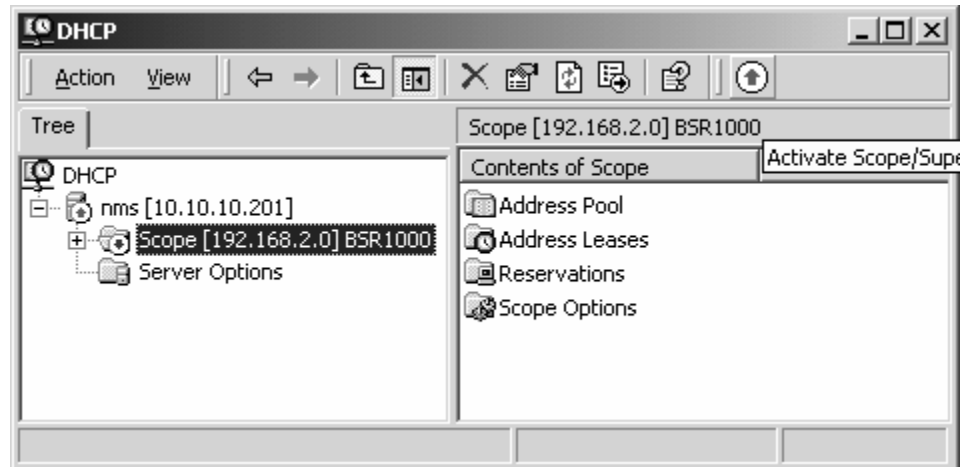
Remove

< Back Next > Cancel

***Exclude the WMTS and NMS IP Address for Vyvo systems**

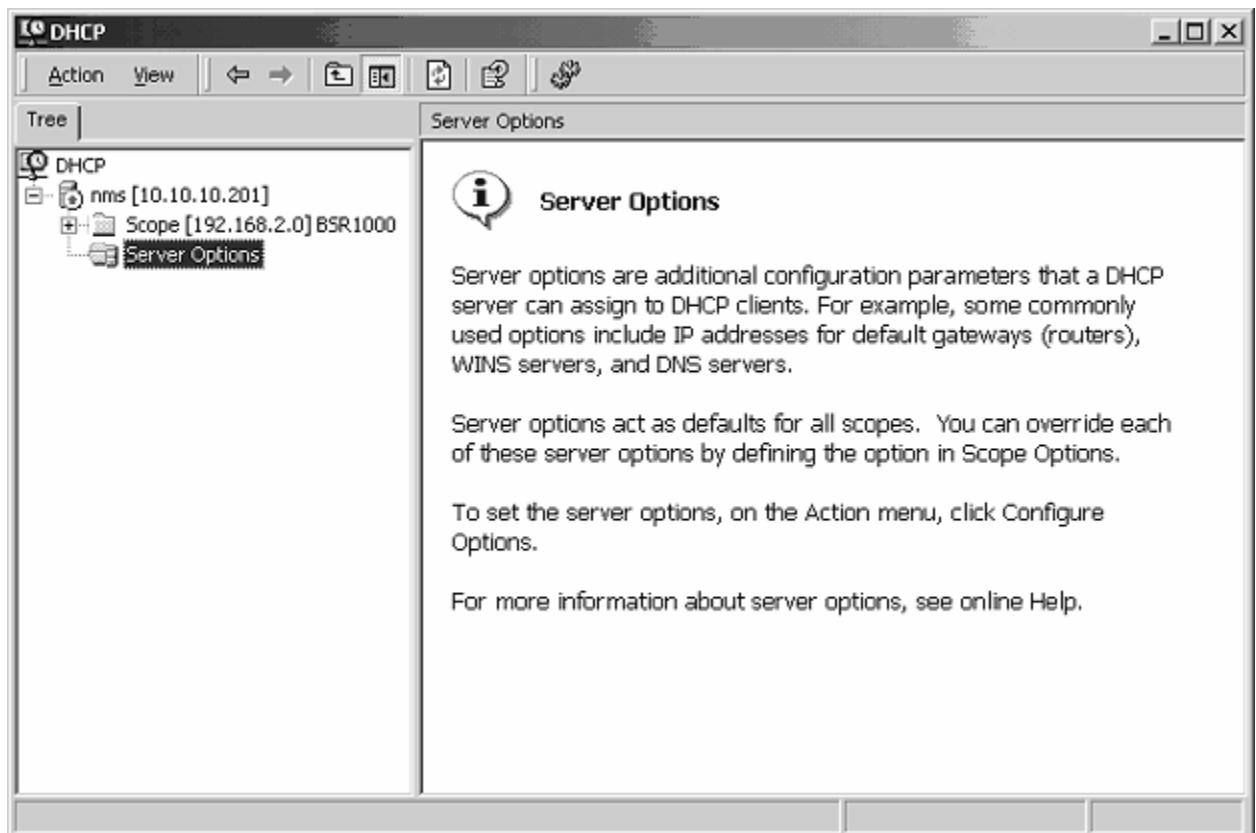
- c. Lease Duration

4. Configure DHCP options – Select “No” and click “Next”.
5. Activate Scope by highlighting the scope and click the  button.



10.2 Configuring Server Options

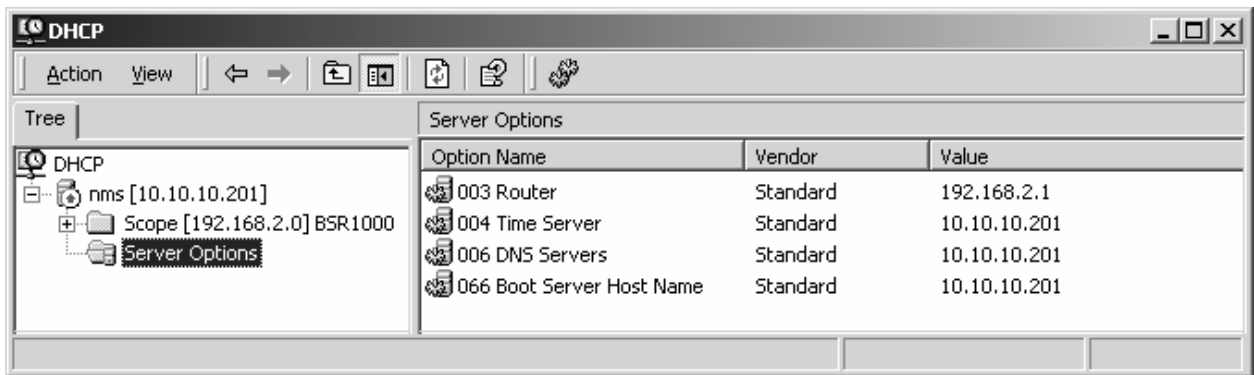
6. Highlight “Server Options” and Click “Action” → “Configure Options”.



7. In the “General Tab” , check the following and enter the specified value
 - a. 003 Router – Input: Enter router’s IP address (cable IP address) or Gateway for Vyvo systems.
 - b. 004 Time Server – Input: NMS’ IP address
 - c. 006 DNS Server –Enter the IP address of the DNS server (e.g. router or NMS)
 - d. 066 Boot Server Host Name - Input: NMS’ network ID (name).

OPTIONAL (DO NOT include if you are going to register modems. See below for more details)

- e. 067 Bootfile Name - Input: configuration file the modem loads (e.g. mic1.cfg)
8. When finished Click “Apply” then “OK”. Your window should now look similar to this:

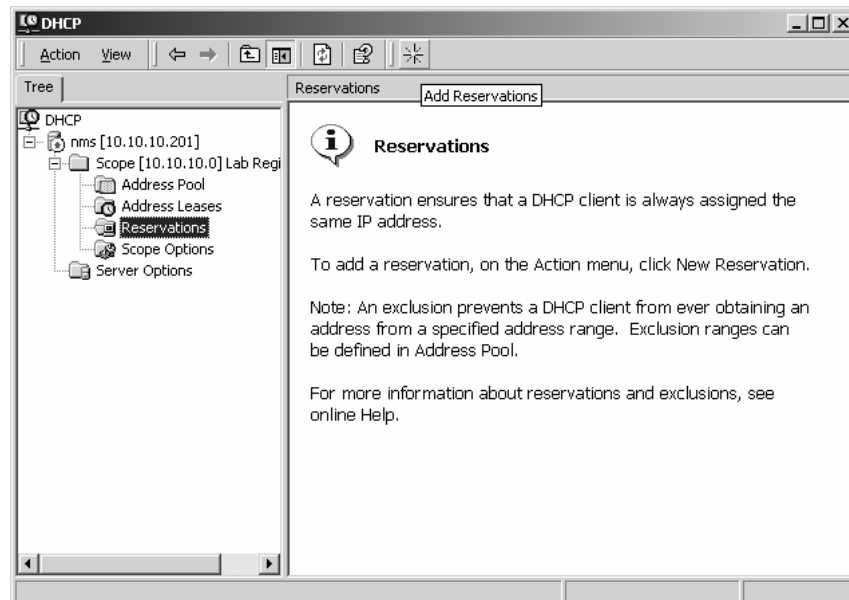


****Option 003 Router must will be the Gateway IP address for Vyvo systems***

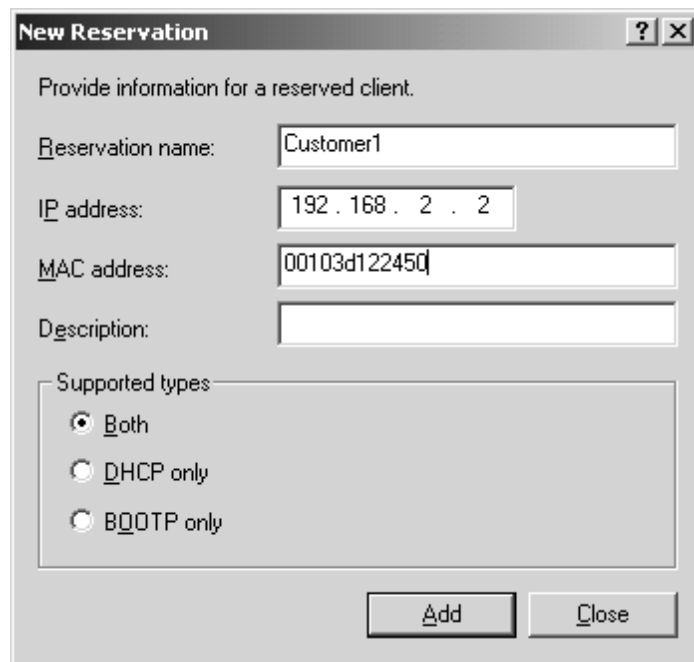
10.3 Registering Modems

If you only wish to allow specific modems to be in the network, then you must register the modem to a specific IP address. Here are the steps to register a modem:

9. Add a new “Reservation” in the Reservations under the Scope, by clicking on



10. Enter a required information, and click “Add” when finished

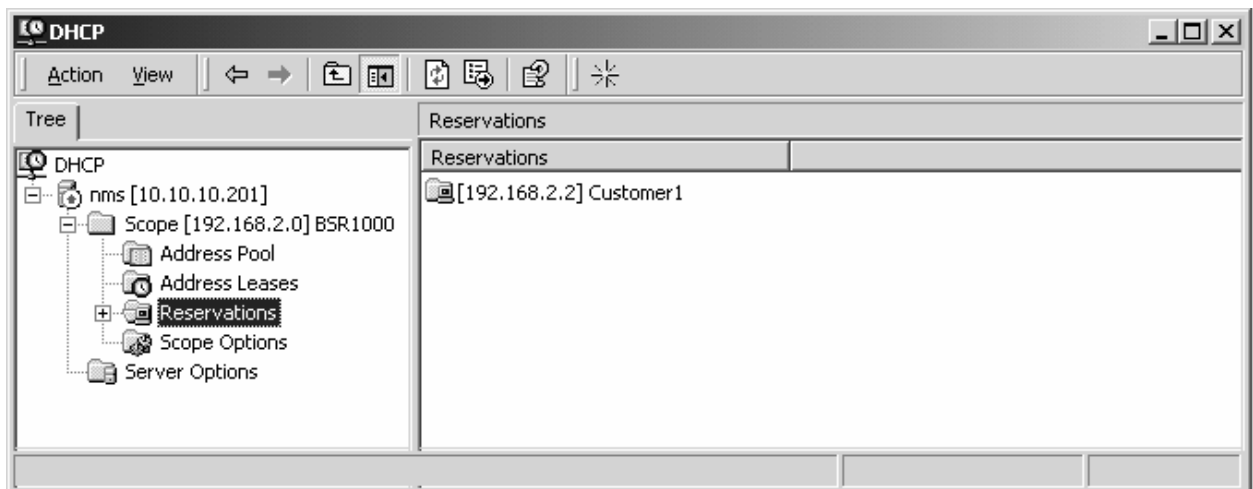


The 'New Reservation' dialog box is shown. It contains the following fields and options:

- Reservation name: Customer1
- IP address: 192.168.2.2
- MAC address: 00103d12245d
- Description: (empty)
- Supported types:
 - ☒ Both
 - ☐ DHCP only
 - ☐ BOOTP only
- Buttons: Add, Close

****Reservations for Vyvo Systems will have an IP address of 10.10.10.x***

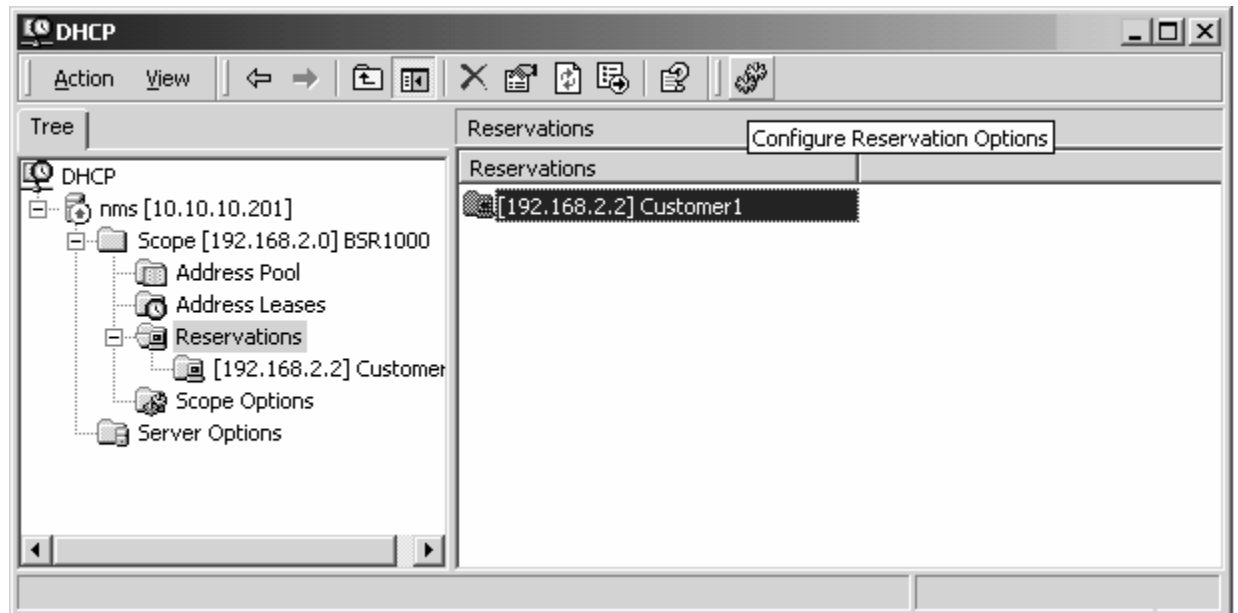
11. Your window should look similar to this:



****Reservations for Vyvo Systems will have an IP address of 10.10.10.x***

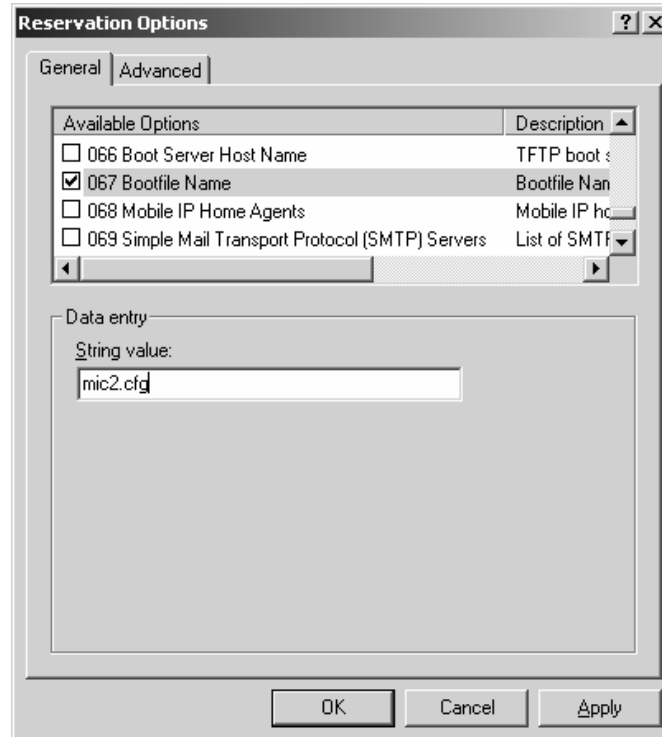
12. You must specify a bootfile for the registered modem to download.

- a. Go the “Reservations” and highlight the reservation you wish to configure.



***Reservations for Motorola systems will have an IP address of 192.168.2.x**

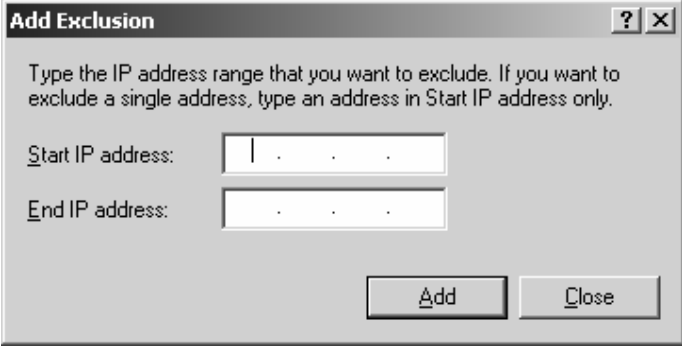
- b. Click  on the tool bar.
- c. In the “General” tab, check “067 Bootfile Name” and specify the new boot file.



Note: To prevent unauthorized modem into the network, remove option “067 Bootfile Name” from the “Server Options” in step 2 (this is NOT the same as “Reservation Options”).

10.4 Restricting Addresses

It's best to restrict a pool of addresses just for modems. In the "Address Pool" click  to add a restriction. Any unrestricted addresses will be used for other clients (e.g. computers, routers) on the network. This only needs to be set once.



The "Add Exclusion" dialog box is a standard Windows-style window with a title bar containing a question mark and a close button. The main text area contains the instruction: "Type the IP address range that you want to exclude. If you want to exclude a single address, type an address in Start IP address only." Below this text are two input fields. The first is labeled "Start IP address:" and contains a single dot ".". The second is labeled "End IP address:" and contains three dots "...". At the bottom right of the dialog are two buttons: "Add" and "Close".

10.5 Viewing Leases

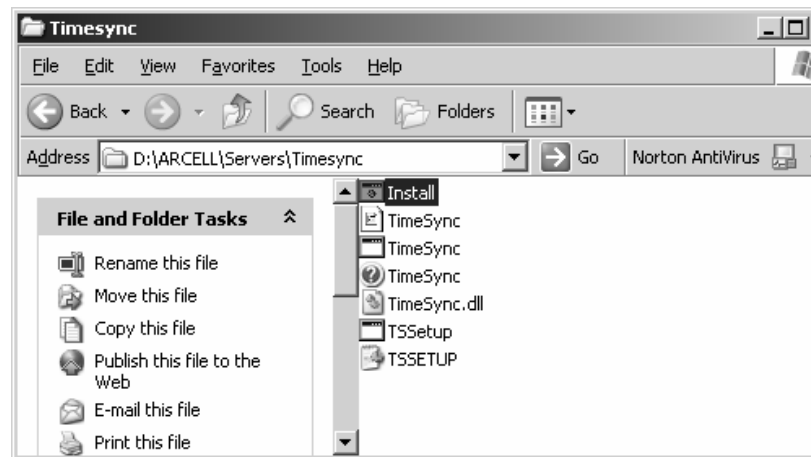
If you wish to view the IP Addresses that have been leased, click on "Address Leases" under the Scope.

11 Time-of-Day Server Setup Guide

The purpose of this Section is to review installing the TimeSync (RFC 868¹⁶) server for Arcwave systems. TimeSync will install on any Windows 2000/NT operating system and provide the time-of-day server required by DOCSIS.

11.1 Install TimeSync

1. Go to **ARCELL / Servers** directory, then to **Timesync**
2. Locate and run **Install**

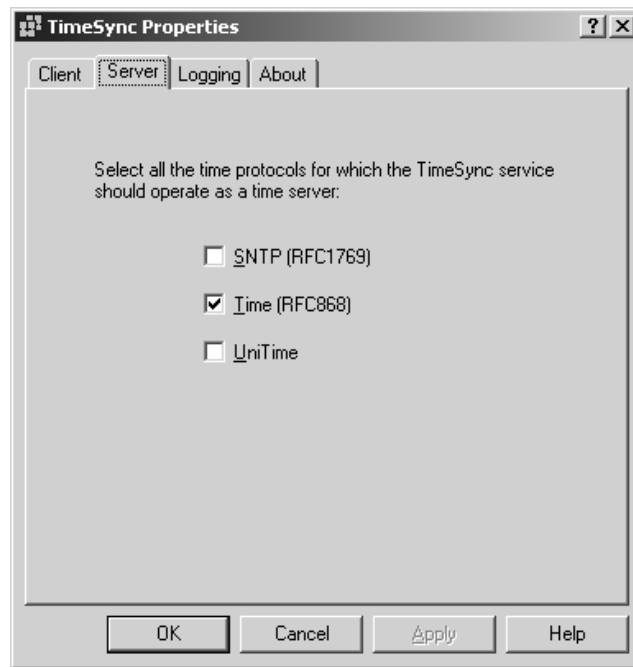


11.2 Configure TimeSync



3. Execute **TimeSync** which can be found in the Windows **Control Panel**.
4. Once running click on the **Server** tab and check **Time (RFC868)**
5. Click **OK** to finish

¹⁶ RFCs are "standards" set by the Internet Engineering Task Force (IETF) and are available at <http://www.ietf.org/rfc>.



12 BSR1000W SNMPc View and Community

The SNMP control function is located in the privilege exec mode of the CLI. In order to provision community names and access privileges such as Read Only, Read/Write, or Trap a **view** will need to be created.

From the RDN# prompt type *snmp view*, followed by the name (view) to be created and the following OID value *1.3.6* this is the location of where in the MIB OID that you will begin management. Follow that with *inc* or *exc* to *included* or *exclude* privileges.

example: RDN#(config) snmp view public_v 1.3.6 inc

Now that the view has been created Community Names will need to be set for the different privilege levels.

example: RDN#(config) snmp community public ro view public_v and

RDN#(config)snmp community private rw view public_v

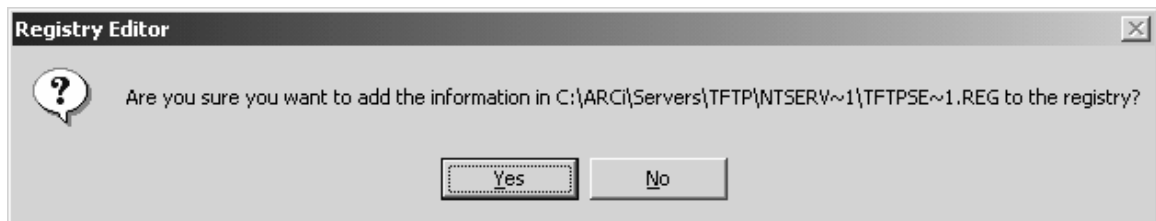
In the above examples we have created a view named *public_v* and have given that view Read only privileges with a community name of *public* and read/write privileges with a community name of *private*.

13 SolarWinds' TFTP-Server

The SolarWinds' TFTP Server allows initializing modems to download a cable modem file (cm file) to complete its registration process. This particular TFTP-Server will run on any Windows 2000/NT/XP operating system. All files/folders referred to in this document can be found either on the CD-ROM provided by ARCWAVE or in C:\ARCELL\

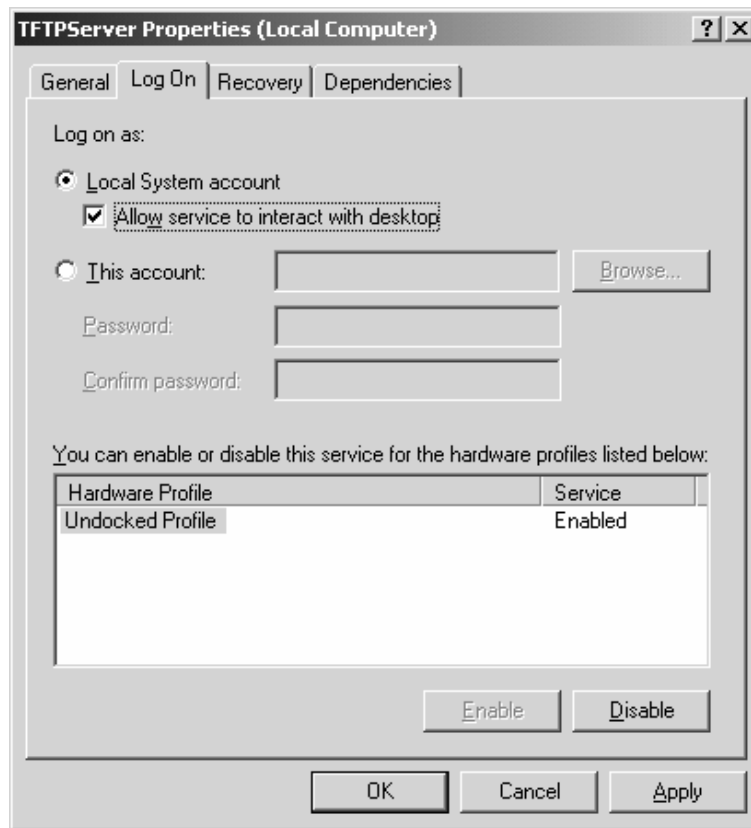
13.1 Installing the server

1. Execute **Install** located in **Servers \ TFTP**
 - 1.1. Accept Registry changes. Applying these changes will allow the TFTP server to run as a Windows Service.



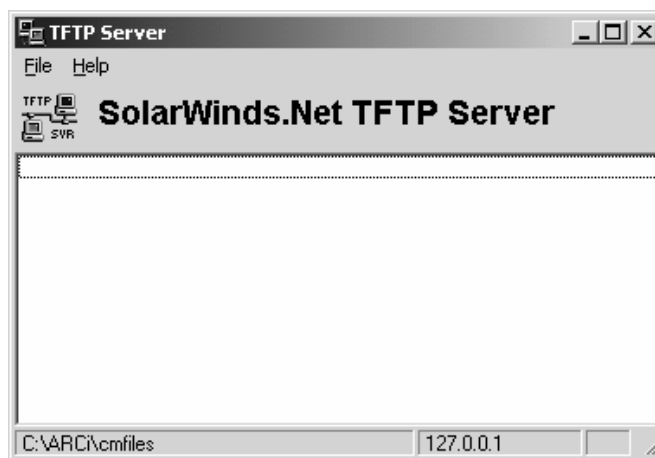
13.2 Configure the Window's Service

2. Open Windows **Services** which can be found in **Administration Tools** in the Windows **Control Panel**.
3. Double click on  TFTPService to bring up the properties window.
4. Verify that the "Startup type" is set to **Automatic**
5. Go to the Log On tab and enable the service to interact with the desktop.



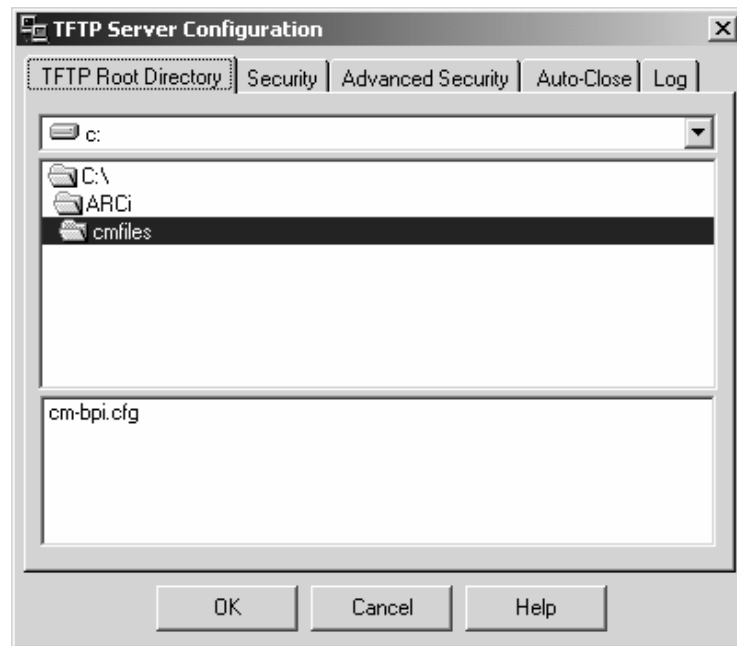
6. Click **OK** when finished
7. Check for proper operation by stopping the service, the restarting it. This can be done by right-clicking on  TFTPService.

If properly configured the TFTP-Server window will come up.



13.3 Configure the TFTP Server

8. Open the TFTP Server Configuration by going to **File** → **Configure**
9. Select the TFTP Root Directory. This is the directory that contains the CM files the modem will download. (Various ARCWAVE standards: \ARC\MIC, \ARCELL\cmfiles)



10. Go the Security tab and select **Transmit and Receive files** (for security reasons you may elect to select 'Transmit Only').



11. Click **OK** to finish.

14 Cable System Basics

This Section reviews the basic system operation between the CMTS and the Cable Modem. A hybrid fiber coax cable system looks like Figure 14-1.

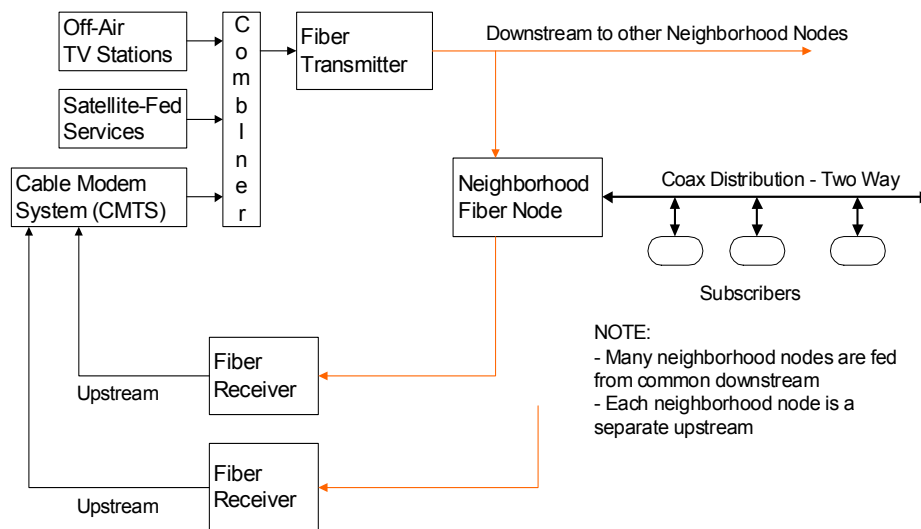


Figure 14-1: Typical Hybrid Fiber Coax cable system.

As a cable modem enters the system, it has to accomplish a number of tasks:

1. Tuning
2. Ranging
3. Connection
4. Configuration
5. Registration
6. Maintenance

These are briefly described below.

14.1 Tuning

The cable modem steps through the standard 6 MHz downstream channels listening for a signal. If it finds one, it looks for the DOCSIS frames. If it doesn't find one, it continues the scan.

If it finds a DOCSIS frame, then it synchronizes to it. This includes the modulation (QAM), error correction (FEC), etc.

The model extracts the information it needs, which includes the Upstream channel characteristics: channel, bandwidth, modulation, error correction, encoding, etc.

Note that DOCSIS permits multiple Upstream channels to work with a single Downstream channel.

14.2 Ranging

The CMTS is not aware that a new cable modem has entered the system until it receives an initial RF burst from the modem. As the CMTS receives this RF burst, it commands the modem to increase or decrease its transmitter power. The CMTS' receiver operates best when all the cable modems RF is received at the same power level.

The CMTS assigns the modem an initial time slot.

14.3 Connection

After the initial communications link is set up at the RF level, the cable modem has to start entering the system. The CMTS sends it information about the various servers it has to interact with: the IP addresses for the DHCP, ToD and other servers.

14.4 Configuration

The CMTS sends the modem the standard modem configuration file, which includes an IP address for the modem.

14.5 Registration

The cable modem initiates the registration process, which includes the class of service subscribed to and the general Authentication, Authorization and Accounting class of features and attributes.

Security is also handled during this phase, with RSA and DES encryption keys being exchanged, as appropriate.

14.6 Maintenance

Periodically the entire cable system will go through recalibration of power levels, frequency accuracy, channel assignments, load balancing, etc., all of which requires hand-shaking between the cable modem and the CMTS.

15 Reader Feedback

Readers of this Manual are encouraged to forward their corrections and comments to:

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