

Technical Support Fault Decision Tree

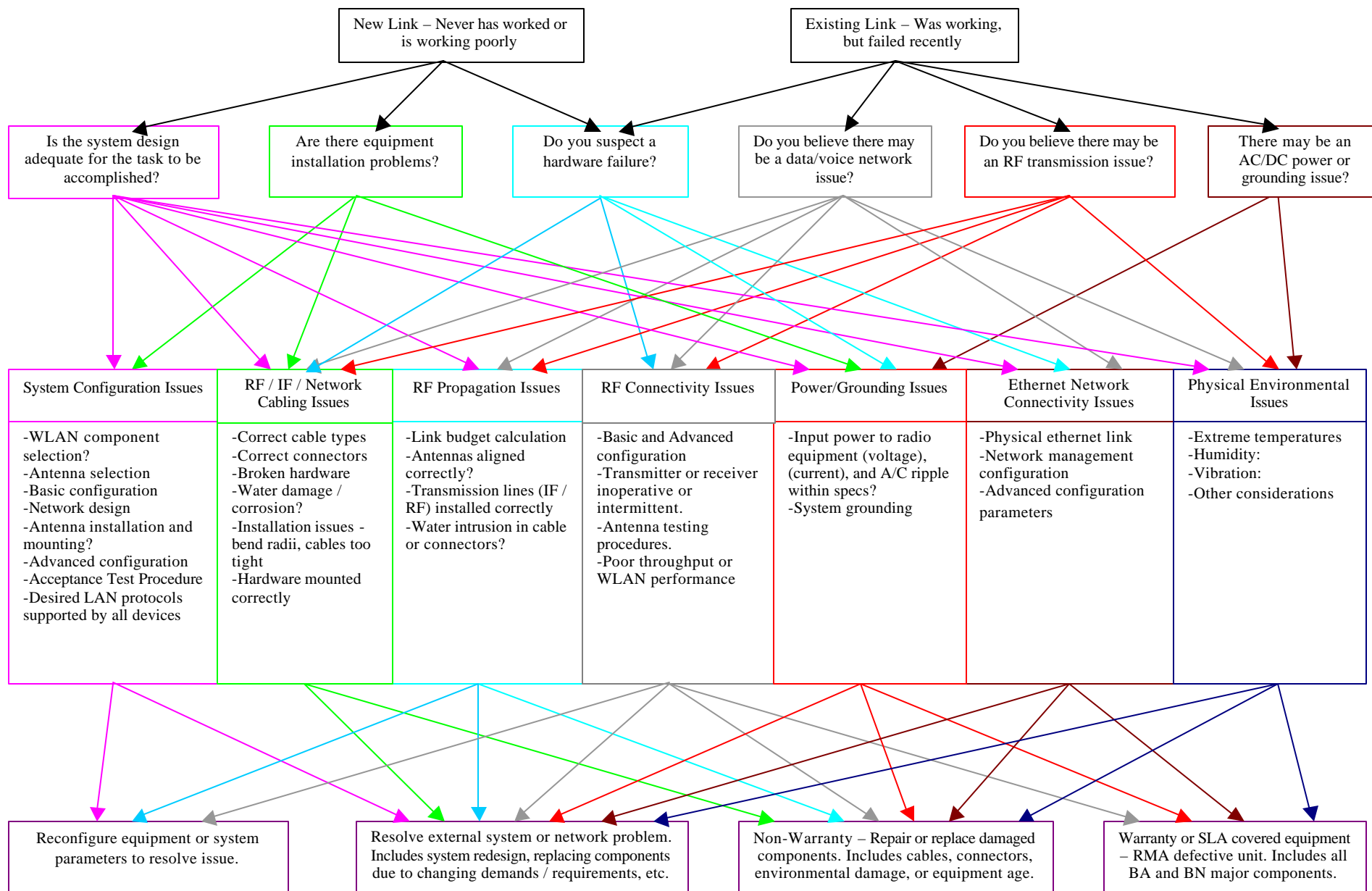
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BreezeACCESS/BreezeNET Fault Discovery Tree



Introduction

This document will address the issue of troubleshooting BreezeACCESS / BreezeNET systems remotely, that is such as when an end user or system operator calls or emails into Tech Support. This document will serve as a guide to the AE or TSE to help ask the questions needed to get to the root of the problem quickly. This document may not cover every single circumstance, but when used in conjunction with any applicable standard, a solution, or at least a method of attacking the problem can be worked out.

The methodology employed here is to provide a framework for the AE / TSE to ask enough questions to work past the operator's bias, as he / she has probably spent quite a bit of time with the problem before calling or emailing a question. When speaking to a operator that you do not know, carefully establish what their WLAN education and experience level is. Many problems are resolved simply by educating the operator on principles or features of the equipment. Simultaneously, the operator becomes comfortable with the AE/TSE's experience, and so the exchange of information can be beneficial to both the TSE and operator.

To use this document, simply start from the top of the flow chart page in the first row, and using a measure of common sense and question asking ability, work your way through the possibilities as determined testing and observation results. When a problem's root is discovered in the third row, then proceed to the applicable choices in the fourth row, and resolve the issue.

When the system operator is equipped with the correct information, they will often make the correct decision about the problem without further direct intervention from any TSE or AE, and it re-affirms our commitment to make the operator skilled at BA/BN deployment and problem solving, and technically self-sufficient. Confident operators purchase a lot more equipment in a shorter time frame! If the education level seems low, encourage them to sign up for a course in their area, and always encourage them to read the manuals.

Anyone using this guide shall be expected to have a working knowledge of the following standards and protocol:

- IEEE 802.11 Wireless Networking Protocol
 - Use 802.11 Handbook as a guide to current standards and implementations.
- IEEE 802.3 Ethernet Protocols as applicable
- Some of the IEEE 802.1 Interface Standards and Protocols
 - 802.1d MAC Bridges
 - 802.1q V-LAN
 - 802.1p QoS
- Some of the IEEE RFC's as required:
 - RFC 721 IP
 - RFC 1213 MIB-II
 - RFC 1286 Bridge MIB
 - RFC 2516 ToS

Much information is available at www.ieee.org. Feel free to use this site as a reference guide for all the applicable ethernet standards that we may need to have a working knowledge of.

Any information that is included in the installation manuals or administration guide is not included here, as knowing the manuals intimately are a prerequisite for handling technical support issues. Since we cannot have total recall of all the information we read, and hear, much emphasis needs to be placed on moving carefully through the help request, and providing superb technical support through a complete engineering team effort. This document has been designed to be used on a computer running Microsoft Office 2000, as there are links to spreadsheet objects, and internet URL's throughout.

Also, a sound working knowledge of RF transmission theory is required; as many problems faced by those installing and operating BreezeACCESS equipment is related to propagation, and interference issues. This document will include some of the basic tools necessary to troubleshoot the units in an RF environment.

This document shall be updated as often as required, to adapt it for use with future products and services that Alvarion may supply. Also included are white papers, and other support documents written by Alvarion Engineering to emphasize their importance in the context in which they were written.

To use this document effectively, simply click on the hyper-link underlined in the flow chart. This will take you to the detailed description of the process, or procedure to test that function. When finished, simply use the "alt" + left arrow to go back to the flow chart.

Close Proximity Association Test – aka The Stack Test

When performed on AU-I (AP-10), and SU-I (SA/WB-10) on a test bench, this test is also known as the stack test. When possible, perform this test with the AU-I and SU-I cabled together with a known attenuator inserted inline in the cable between the antenna ports. Now that we have both indoor (AU /SU-I) and outdoor units (AU-E / SU-A), testing for the ability to associate, and getting some kind of calibrated RSSI reading can be considerably more difficult, but not impossible.

For AP/AU-I and SA/WB/SU-I 's the test is quite simple:

- Restore both units to factory default – this makes the ESSID be "ESSID1", and reset each radio.
- Configure IP address on the SU to 10.0.0.2 / 8 bit subnet.
- Set the SU on top of the AU with no antenna connected.
- Connect SU-x-1d or -8d to a computer NIC to complete the association process. Make sure computer has a static IP address within the subnet of the radios.

- Use a monitor session to each unit to determine that association has occurred, and ping each radio to be sure data can pass.
- Use Q-Check or other applications to pass data between 2 computers to ensure both units are operational.

For testing AU-E's and SU-A's the procedure is slightly more complex. For testing units that are not yet installed, simply place them side-by-side on a bench, and perform the procedure as above.

For testing an AU already installed, use the procedure detailed below:

- Use an SU-I-D with a Uni-9 antenna (or equivalent) connected of a known good quality.
- Configure the SU's ESSID to the same as the AU's ESSID.
- Configure a laptop to an IP address in the same range as the AU.
- Set up the SU at a location that has CLOS to the AU antenna, at a known distance.
- Using a link budget calculator, and the AU antenna polar charts as required, predict what the SU's RSSI should be.
- Observe the actual RSSI on the SU. If the AU's transmitter is OK, the RSSI will be within +1, -6 dB of your prediction.
- Use ping to verify that data can pass over the link, re-configure your computer to the correct subnet for the LAN behind the AU, if it is different. Use Q-Check or some application to verify data transfer through the AU.
- Restore the AU to proper network configuration.

For testing an SU already installed, the procedure is similar.

- Set up a known good AU and Uni-9 antenna in a location with CLOS to the SU antenna, and at a known distance from the SU's antenna.
- Change the ESSID of the SU to something different than the working network's.
- Configure the AU with the same ESSID.
- Configure your computer with an IP address in the SU's range.
- Verify association. Telnet into the SU and observe continuous RSSI. Compare this reading to the value calculated in a link budget, using the same procedure as above.
- Finally, use Q-Check or other application to transfer data across the link as above.
- Restore the SU to proper network configuration.

These tests are very important because we do not have any self-diagnostic hardware or firmware for the RF section of the BA radios. Proper execution of these tests will shorten troubleshooting time by a huge amount, as it will be easy to separate a simple hardware problem from a more difficult system issue.

Fault Discovery Tree Testing Requirements and Test Procedures

System Configuration Issues

WLAN Component Selection

- Are the components chosen correct for the application, for example, are they using an SU-I with a 24dBi antenna, when they should be using an SU-A for better RF performance?
- Are they using direct sequence, when frequency hopping is the correct technology to use?

Antenna Selection

- Use the link budget calculator to determine optimum antenna type(s).
- For an AU/AP site, the antenna choice is influenced by physical space allowed, number of AU's on the site, other systems on or near the site, performance required, RF network topology needed, etc.
- Are the antennas and outdoor units mounted in the correct manner?

Basic Configuration

- ESSID, hopping sequence, hopping set, etc.
- Management configuration correct?
 - Trap IP
 - Management screens and filters
 - Communities

Network Design

- IP addressing scheme sane?

- Are EIA/TIA Cat-5 rules enforced?
- Are V-LAN's or QoS required?
- Are all devices directly connected to the radio system configured to 10Mb/s, half duplex mode only?
- Are SU-x-BD/WB-10's being used in the correct locations?
 - SU-x-1D/8D or SA-10/40 used in locations that should use a BD/WB unit.
 - Are backhauls sized correctly?

Antenna Installation and Mounting

- Mounting hardware correct and tight?
 - On long links, antenna deflection caused by wind may be an issue.
- Are the antenna's installed correctly?
 - Polarity as required
 - All covers and reflectors installed?
 - Are all antennas mounted far enough apart on the mounting structure to eliminate any possible interference?
 - Use the manufacturer's antenna specifications to determine isolation required between your antenna and all other antennas on the site.
 - Some knowledge of the other systems on your structure is required:
 - System frequencies
 - System power outputs
 - Antenna types, polarization, and manufacturer specifications.
 - Minimum co-channel (same frequency) isolation required is 120dB.
 - Minimum adjacent channel (off frequency, same band) isolation required is 70dB.
 - Minimum out of band isolation required is 50dB.
 - To achieve higher performance, an external band-pass filter between your antenna and your radio may be required. See section on RF Connectivity for more information.
- For BreezeNET Pro.11 installations using amplifiers:
 - Are the amplifiers installed as per the manufacturer's manual?
 - Are band-pass filters (SPF-1 or equivalent) installed correctly?
 - Have you used DC flow-through lightning arrestors?
- For BreezeNET DS.11 Outdoor products:

- Have you installed the proper outdoor, shielded EIA/TIA Cat-5 standard cable?
- Is the outdoor Cat-5 cable sheath properly grounded at the building entry location?
- Is the grounding as per Alvarion and local electrical code standard?
- Are all the connections exposed to weather waterproofed?
 - If cables or connectors were installed without waterproofing, and water ingresses, that cable will have to be replaced.

Advanced Configuration

- Factory default parameters usually provide the best performance
 - It is best if your network design incorporates radio system considerations with factory default configurations
 - For larger WLAN and ACCESS networks:
 - All advanced parameters should be considered within the network design.
 - Particular attention should be given to Voice and V-LAN parameters, if used.
 - Air Interface Parameters
 - Are all parameters set properly according your system requirements?
 - Maximum data rate set to maximum rate that is configurable?
 - Multicast data rate set to lowest data rate supported.
 - Performance
 - RTS enabled in all SA/SU's.
 - Multi-rate support enabled
 - Re-transmission configuration configured for desired ethernet reliability
 - Fewer re-transmissions require the application to re-send a dropped frame
 - HTML is very tolerant of frame loss, so most regular Internet access radio systems can be configured to 1 retransmission only without significant degradation.
 - More re-transmissions allow the radio system to re-transmit the frame without intervention from the application.
 - Database applications are usually very intolerant of frame loss, so intranet service may require 3 or more retransmissions to eliminate computer system lock-ups, and maintain network connectivity.
- Bridging
 - V-LAN
 - QoS parameters
 - MAC Aging parameters
 - Forwarding and Relaying parameters
- Filters

- IP Filters
- Broadcast Filters
- Management Filters
- H.323 Voice specific parameters
- Radius Accounting
 - Radius accounting server IP address

Acceptance Test Practice

- Has the system been documented?
 - Physical equipment layout records
 - Is cabling labeled?
 - Multiple co-located Alvarion units:
 - Antenna type and azimuth.
 - Local management information
 - Power supplies, UPS, breakers, etc., labels?
 - Router/Switch configurations
 - Ports labeled in configuration and physically on the port?
 - Radio system configuration parameters exported to text files?
 - Administration passwords, or password conventions documented?
 - Antenna heights, azimuth, transmission line length and type at each site?
 - Calculated or actual signal level measurements included as required?
 - RF transmission line insertion loss.
 - Insertion loss recorded of any lightning protection devices, band-pass filters, or other devices in the RF path.
 - Auxiliary components
 - Band pass filters, lightning protectors
- Have all components been individually tested, as well as tested in the system?
 - Are proper procedures documented for adding one more radio system to a site?
 - For example, is the process to add one more AU to a site documented?

RF / IF / Network Cabling Issues

Correct Cable Types

- Is the ethernet cabling certified EIA/TIA Cat-5?
 - All runs to radio system equipment under 90m?
 - RJ-45 connections clean and tight?
 - Patch cords in good shape?
 - If using PI-CAT-5, is the total run length less than 100m including patch cords?
 - Have connections been tested with a wire-map indicator, or Cat-5 tester?
- IF Cabling
 - Is the cable impedance 50 ohm and of a type certified by Alvarion?
 - Has cable been tested for short circuits, open circuit, <15dB @ 440 Mhz, and <1.5 Ohms resistance?
- RF Cabling
 - Is the cable's 50-ohm impedance and of a type certified by Alvarion?
 - Have the cables been tested for short circuits, or open circuits?

Cable Connectors

- Are the connectors "crimp on" types?
 - "Crimp on" connector types are usually more robust and easier to install than "manual solder" type connectors.

Broken or Otherwise Damaged Hardware

- Is the cabling sheath scraped or otherwise visually damaged?
- Are the female connectors on the hardware tight, and securely mounted?
- Are the male connectors on the cables loose, the center pins extending far enough, or suffering from any other obvious damage?

Water Damage / Corrosion

- RF / IF cabling
 - Is there water in the connectors, or evidence that the connector has been wet in the past?
- RF Cabling and antennas

- Typical problems noted:
 - Is the RSSI very low compared to the value calculated by the link budget worksheet?
 - Cannot transfer data at the rate expected
 - Re-transmission values high
 - No connectivity at all with obvious clear line of sight path.
- IF Cabling
 - May be damaged or open circuited if the results of “Close Proximity Test” indicate:
 - No apparent transmit output.
 - Receive sensitivity very poor.
- Ethernet Cabling
 - Hardware link intermittent
 - Connectors show signs of corrosion
 - PI-Cat-5
 - Unit may randomly associate / disassociate as power fluctuates.
 - Unit may reset often.
 - Overall performance is poor.

Cable Installation

- Are any cables installed too tightly?
 - Are minimum bend radius specifications met?
 - See manufacturer’s specifications for requirements.
 - Are cable bundles securely, but not too tightly wrapped?
 - RF/IF transmission line and Ethernet cabling will have much higher signal leakage between cables when bound too tightly.
 - RF Insertion loss will increase if the cable is compressed at its mounting locations.
 - Are there any “splices” in any cable run?
 - Increase insertion loss of RF/IF transmission line dramatically!
 - Spliced ethernet cable will not pass Cat-5 tests, and data performance may be affected.
 - Only 4 RJ-45 Jack /Plug connections are allowed between a network device port, and the radio system port.

Cable Attachment and Strain Relief Hardware

- Are outdoor cables installed with proper strain relief hardware?

- Are IF and RF cable ground kits installed correctly, and waterproofed as required?
- Is the IF and RF cables snugly attached to the mounting structure with wide, low-pressure cable-ties, or other proper vertical cable support clamps?
- Are the ethernet patch cords routed neatly around the network devices?

RF Propagation Issues

Link Budget Calculation

- Obtain up-to-date topographical information about the path for reference below.
- On both ends of the link, verify the following information:
 - Transmit power output of the radios
 - RF transmission line type, and estimated loss
 - Any extra filters or lightning protection devices
 - Antenna type and gain
 - Receive sensitivity at the desired data rate
 - Fade margin at the desired data rate
 - Minimum 10dB for short links
 - Follow the guideline calculated in the Alvarion Link Budget Spreadsheet

Fresnel Zone

- Clear line of sight required on all paths longer than a few hundred meters.
 - 80% of 1st Fresnel zone radius free of obstructions is considered Clear Line of Sight.
 - 1st Fresnel zone always extends behind the antenna as well. Always try to mount antennas in free space, with no reflecting or obstructing surfaces within the 1st Fresnel area.
 - Mounting an antenna flat on a wall requires added fade margin.
 - Antennas should be mounted away from a tower leg or other hardware on the support structure by at least $\frac{1}{4}\lambda$.
- Fade margin needs to be increased if the path has obstructions.

- A few meters of trees will require 10dB to 20dB greater fade margin, which will reduce maximum path length to ¼ to 1/16 CLOS path.
- Many trees require 30dB to 40dB or more of added fade margin, which greatly restricts allowable path length.
- Topographical obstruction, such as a hill will block any useable signal completely.

RF Connectivity Issues

Basic and advanced Configuration

- Basic Configuration Parameters
 - ESSID Correct?
 - Operator / Prefix ESSID correct?
 - Hopping Standard correct?
 - For BA-MMDS and BA-XL
 - Are frequency ranges correct and the same in both the AU and SU?
- Advanced Configuration Parameters
 - Use “Factory Default” settings

Radio Unit Problem - Transmitter, Receiver Inoperative, or Intermittent

- Perform a “Close Proximity Test” at both ends of the link using known good components to verify unit under test performance. **Always perform this test first when the performance of a unit is in doubt to eliminate any hardware issues!**
 - Calculate the expected RSSI based on location and antenna gain of test radio.
 - Use a test SA/SU at the AU site
 - On sites with multiple AP /AU’s installed, permanently installing an SA/SU in the site may be quite valuable as a test tool.
 - Use a test AP/AU at the SU site.
 - Run throughput test at both locations during testing.
 - RSSI and throughput should coincide with values determined by Close Proximity Test link budget.
 - Lower than expected RSSI means low transmitter output or bad antenna system.
 - Replace unit under test and re-test
 - Replace antenna in speculation or perform antenna-testing procedures.

Antenna testing procedures

- **Perform these tests when expected RSSI calculated from link budget is much less than expected.**
 - Use Anritsu Sitemaster or spectrum analyzer / tracking generator/ return loss bridge to sweep antenna for proper return loss specifications as per manufacturer.
 - Procedure for testing antenna and long lengths of transmission line
 - Connect Sitemaster to RF antenna cable.
 - Measure the return loss of the transmission line and antenna at the RF frequency.
 - Record the value observed.
 - Disconnect antenna and install precision 50-ohm termination on transmission line.
 - Measure return loss of transmission line at RF frequency.
 - Return loss must equal values stated by manufacturer or equal the return loss of the precision termination + 2 times the insertion loss of the transmission line.
 - Return loss too low indicates damaged cable.
 - Return loss too high indicates water intrusion in cable.
 - Disconnect precision termination.
 - Measure insertion loss of transmission line.
 - With an open circuit on a transmission line, use the return loss measurement on the Sitemaster
 - Return loss measured will be 2 times the actual value of the insertion loss.
 - Value must equal manufacturer's loss per unit value. For example, 50 feet of LMR 400 will measure an open circuit return loss value of 7dB, telling us that the insertion loss of 50 feet of cable is 3.5dB.
 - Analysis of observations
 - If the return loss of the transmission line is very high (greater than 40dB), replace the cable and retest.
 - If the return loss of the transmission line is very low (less than 20dB), replace the cable and retest.
 - If the return loss of both the antenna and transmission line is about 14dB plus 2 times the insertion loss, the antenna is fine.
 - If the return loss is greater than 14dB plus 2 times Insertion loss, then antenna is probably corroded in the feed line, or full of water.
 - If the return loss is less than 14dB plus 2 times the insertion loss, then the antenna feed line is open, or damaged.
 - Repair or replace defective components as required or reconnect the antenna.

Poor Throughput or Poor WLAN Performance

- **Introduction**
 - Poor throughput is always caused by one of the following:

- 802.11 protocol holding frames in the transmit buffer because RF activity has been detected, thus reducing the number of frames per second that can be passed.
- Frames re-transmitted because receive errors.
- Number of frames per second has reached the maximum the radio system can process. For example, BAI currently can handle 400 to 550 frames per second, while the BU-DS.11 can handle about 750 frames per second maximum.
- **Poor RF connectivity is measured by testing ethernet throughput, as there is no other way to directly test a transmitter or receiver. Often, the ethernet counters will seem to indicate a problem when, in fact, the counters are simply indicating that the multi-rate, and re-transmission algorithms are working correctly to optimize performance given the current set of RF circumstances. The testing procedures listed below should be completed only if ethernet throughput performance is well below the expected minimum. In any equipment operating in any ISM band, receiving interference from an external source is always a possibility. Alvarion radio equipment has been designed to accept moderate levels of interference and still ensure data integrity.**

- **Testing Procedures**

- Ensure system design requirements have been met.
 - Adequate fade margins on all links under test.
 - Basic configuration correct.
 - Network ports directly connected to the radio system configured correctly.
 - During the troubleshooting and testing process, the operator and client networks should be disconnected, and known good computers with throughput testing endpoints installed should be used. **Data flow measurements from the client network traffic should not be used as a test indicator.**
 - Ensure all hardware has been installed correctly. Most problems occur because installation recommendations have not been observed. Ensure the following:
 - Antenna and mounting hardware tight.
 - Radios components mounted correctly.
 - Power connections clean and tight.
 - All cabling terminated and installed correctly.
 - All Alvarion required grounding requirements met.
 - All Alvarion environmental conditions met.
 - Ensure that all radios have been reset to factory default configuration. This eliminates any “Advanced” configuration combinations that may be causing the symptoms. The Advanced configuration parameters can be re-configured later.
- **Establish “baseline” performance parameters using an ethernet throughput test.** If baseline testing shows adequate performance between the throughput-test endpoints, proceed to the Ethernet Network Connectivity Issues section in this document, as the RF performance is adequate.
 - Baseline Performance Test – Always test for baseline performance in a logical manner. Use care when interpreting results, as too little data can skew the results!
 - Recommended test equipment:
 - 2 Laptop or portable computers equipped with

- 10Mb/s, half-duplex capable Network Interface Card,
 - Throughput testing software,
 - Terminal emulation software,
 - Telnet,
 - Ethernet hub
 - Proper serial port interface cable to establish a monitor session to units under test.
 - Ethernet patch cords as required.
- **Calibrate your test!** Test end point computer to endpoint computer maximum performance through an ethernet hub to establish the measurement maximum.
 - Be sure the NIC devices in these computers are configured for 10Mb/s, half-duplex only!
 - Using a switch, or a simple crossover cable for this test is not recommended, as the hub forces normal ethernet flow-control to operate correctly between the computers.
 - Move your calibrated computers to the sites under scrutiny.
 - Test from the AP/AU to the SA/SU unit using the same computers and throughput program to ensure conformity.
 - Always record the values observed in the ethernet counters in your AP/AU and your SA/SU before and after each test, and the RSSI values observed in the SA/SU's for use during troubleshooting or analysis later.
 - Run your tests over a period of a few hours and repeat at least 3 times to gather enough meaningful data from the radio system.
 - This will compensate for changes in propagation, and levels in any interference that may be present.
- Analysis of baseline test results.
 - Determine RSSI values read in each SA/SU
 - Using the tables found in the administration/user manuals for your equipment, observe what data rate can be supported by the SA/SU with the lowest RSSI.
 - Use the results of this SA/SU to determine your system's baseline performance.
 - Throughput test results should be about 1/4 the data rate determined above. For example, you have 4 SU-I-D's associated with an AU-E-NI-2.4. The RSSI's noted range from 55 (-78dBm) to 86 (-57dBm). The SU with the RSSI of 55 will be the SU you need to use for your baseline measurement. Since an RSSI value of 55 means the SU can only support a 1Mb/s data rate, your expected baseline performance should be about 400 to 500kb/s.
 - Record the results:
 - Throughput test values observed,
 - The ethernet counter values in both the AP/AU and the SA/SU before and after the throughput test,
 - The RSSI value observed at the SA/SU.
 - **The SA/SU that has the lowest RSSI will use more of the AP/AU's time per frame, and will have the effect of lowering the effective throughput of the sector. Because of the nature of ethernet, you will not**

be able to control which of the associated SA/SU is communicating with the AP/AU at what time, so the SA/SU's with the poorest performance tend to monopolize the AP/AU's time the most.

- When using MRTG or other performance monitor software, the actual measured performance will range from a few Kbits/second over the network, with no data flowing, to some value between your baseline measurement and 1/2 of the data rate supported by the SA/SU with the highest RSSI, which would be peak performance. Normally, live data measured over a network has a low average throughput value, with intermittent peaks to the highest performance attainable.
- **Do not use live data as the mechanism to determine your sector's performance. When performing baseline throughput tests, use a throughput measurement program such as Chariot to determine if the actual data rate carried by your SA/SU with the lowest RSSI does meet calculated expectations above. If the test results are much lower than the expected results, make sure all hardware, power/ grounding, environment and installation issues are resolved, then proceed to Resolving Interference Issues.**

- **Identifying causes of poor performance**

- **Intimate knowledge of the WLAN system is required for the following procedures!**
- Ethernet counter analysis
 - AP/AU and SA/SU counters can reveal clues to performance degradation issues
 - Refer to the applicable IEEE standard for information on proper data and signaling sequences.
 - For example, BreezeACCESS and BreezeNET's data flow are based on the IEEE 802.11 standard.
 - Counter definitions are also part of the applicable IEEE standard protocol for each Alvarion system.
 - Use the applicable administration or users manual to learn counter definitions
 - Some counters reveal that frames are requiring to be re-transmitted
 - Examples: ACKTOUT and ACKCRC
 - Some counters reveal that frames are being held in buffer for a longer interval
 - Examples: CSL, RTSC, and EOD
 - Some counters reveal that performance throttling mechanism is working
 - Examples: Frames Dropped due to MIR/CIR
 - Some counters reveal that rate fallback mechanisms are working
 - Examples: SU rate counters.
 - Some counters determine indicate the status of the internal operation of the radio
 - Examples: H/W, ABR,
 - Always read counters before and after known data quantities over specific time intervals have transferred in both upstream and downstream directions across the radio system. Use a throughput program to evaluate the counters as client data is too unpredictable for proper analysis.
- Interpreting events discovered
 - Errors originating at the ethernet port have the highest impact on the system
 - For example, an AU connected to a very busy network may be receiving and dropping 200 to 300 frames per second, which means that the maximum frame rate transmitted and received can only be about 100 to 200 frames per second.

- Errors that cause re-transmissions have the next greatest impact on performance
 - For example, an SU used in Internet access service shows an ACKTOUT rate of 40% of the transmitted fragment counter value.
 - This indicates that the baseline throughput to this device is probably about ¼ of the RF data rate supported by the RSSI value.
- Errors that cause frames to be held up have the least impact.
 - For example, an AU with a CSL counter value of 20% of the transmitted fragment value indicates that frames have been held up because other RF activity is detected, but there has been no frame loss, so chances are that the application would not know an event occurred.
- **Careful analysis is required. After you have determined the largest contributor to your system’s performance loss, you can then explore ways to reduce those particular errors! Most of the time, performance issues are related to the RF link itself – link budget (distance between the AP/AU site and the SA/SU site), and Clear Line of Sight issues (obstructions in the path). Very creative problem solving techniques may be required to solve these problems.**
- **In the un-licensed ISM bands, your options for increasing performance may be limited. Some things to consider:**
 - Reducing coverage area of each AP/AU.
 - Smaller coverage areas mean higher average RSSI levels and better performance.
 - Make use of micro-cells to reduce path length.
 - Ensure clear line of sight as much as possible
 - Ensure that your Advanced Configuration parameters are configured correctly for your particular network configuration.
 - Factory defaults in Alvarion equipment are acceptable for 90% or more of all installations.
 - Document all configuration changes, and observe the effect of each change on data throughput.
- **Identifying On-site and Off-site Interference Issues**
 - If interference is suspected, a procedure must be used to achieve the following:
 - Verify the existence of interference
 - Hardware problems often mask themselves as interference.
 - Be sure “Close Proximity Test” has been done on both the AP/AU, and the SA/SU, and that throughput is up to expected rate.
 - Poor power supplies can cause a transmitter to emit spurious (off frequency) energy.
 - Bad receiver sensitivity or low transmitter output can cause high numbers of re-transmissions.
 - Antenna accessories can simulate interference problems, and can cause high levels of re-transmissions:
 - Lightning arrestors that are open,
 - Band-pass filters that have gotten wet, or have become open circuited,
 - Antenna cables with poorly installed connectors.
 - Your own equipment can cause interference
 - Other’s equipment installed on the same site can be the culprit.
 - Other’s equipment installed at nearby sites.

- Isolate the interference source.
 - Make some kind of judgment toward a solution of the problem.
 - Re-establish a baseline measurement after a solution has been implemented.
- Test equipment required:
 - Baseline performance test results obtained above.
 - Antenna and systems information obtained while designing and installing your antennas – See “System Configuration Issues”
 - Test results obtained from “Antenna Testing Procedures” if performed.
 - This information is not necessary, as other tests will reveal information required.
 - Spectrum Analyzer
 - Bandwidth: 100Mhz to max RF frequency required
 - Sensitivity: -100dBm
 - Input dynamic range: 150dB
 - Coaxial adapters and connecting cables as required
 - 50ohm precision termination
- Isolate the interference source
 - Co-channel and adjacent channel interference on site and off site:
 - Connect spectrum analyzer to antenna from unit under test.
 - Look for any sources of energy.
 - Make note of any energy observed that exceeds these guidelines:
 - Co-channel (on frequency) energy above –95dBm
 - Adjacent channel (off frequency, in band) energy above –50dBm
 - Any detectable out of band energy above –35dBm.
 - Look for I.F. interference when other systems are installed on your site. When using AU-E, or SU-E devices suspected of I.F. frequency interference, use the following procedure:
 - Disconnect the IF cable from the indoor unit.
 - Disconnect the IF cable from the outdoor unit.
 - Connect the precision termination onto the ID cable at the outdoor unit end – note cable will have TNC male connectors installed.
 - Connect the spectrum analyzer to cable disconnected at the indoor unit.
 - Look for any energy observable in the entire spectrum.
 - At 338 to 442 Mhz, the energy observed should be less than –95dBm.
 - Between 100 and 1000Mhz, level observed should be less than –65dBm.
 - If any energy is detected above the levels illustrated above, WLAN link performance may be reduced.
- Reduce the effects of co-channel and adjacent channel interference.
 - Co-channel and adjacent channel interference is caused by the operators own equipment most of the time!
 - Move antennas farther apart or install antennas with increased gain, and higher off-azimuth isolation to interference from signals originating on site.

- Most ISM antennas have the best isolation characteristics when mounted on the same vertical structure, with each antenna mounted as near to straight line vertically, adjusted for the proper azimuth for correct operation.
 - Antennas mounted with horizontal separation (that is, side by side) will have much less isolation.
 - Rule of thumb – 1m of vertical clearance is the same as 100m of horizontal separation.
- Reduce the transmit power levels of all co-located transmitters causing interference.
- Make sure “Advanced Configuration” parameters are set to factory default.
 - Increase the allowed re-transmissions from 1 to 2 or 3 over 2 dwell periods for greater reliability.
 - Enable multi-rate support
 - If 1Mb/s is the only data rate that may be supported by any RSSI level, then the multi-rate algorithm will reduce the error rate as much as possible. If the interference level is reduced, the radio system will speed up as much as possible automatically.
- Much co-ordination may be required on sites where other operators are causing your in-band interference.
 - In this situation, moving to another site may be more expedient.
 - Industry Canada and Federal Communications Commission do not enforce any “last operator on site works out all interference issues” rule; so all co-located operators must work together to eliminate interference.
- **There are no “magical” configuration parameters to eliminate interference. Factory default parameters are the optimum configuration settings. Minimizing the level of the interference is the best course of action.**
 - Changing any advanced configuration parameters will only increase performance marginally.
 - CSL threshold may be adjusted to the same level as the interfering signals
 - This will enable frames in the transmit buffer to be sent without delay.
 - Because the interference is desensitizing the receiver, the ACK frame sent from the far end of the link may not be received, and the re-transmission rate may go up if CSL is adjusted.
 - Duplicate frames received may track up on the far end of the link as well.
 - Adjusting the CSL threshold has no effect on the receiver.
- Reduce the effects of “out-of-band interference”
 - Move your antennas as far away from the interference source as possible.
 - Use band-pass filters (Alvarion part #SPF-1) to increase isolation by an extra 15 to 20dB.
 - Microwave Filter Company, and others can custom design a filter network for your specific needs, if extra filtering is required.
- Reduce the effects of I.F. interference
 - Replace the IF cable with a solid sheath cable such as Andrew LDF4-50A or equivalent.
 - Make sure the IF cable has no “splices” or connections other than the bulkhead ground connection at the building entry point, as per Alvarion grounding specification.
- Reduce the effects of co-channel, off site interference
 - Re-align your antennas as much as possible to reduce the interference level, while maintaining acceptable signal to your own sites.
 - Make sure that all your equipment has RTS/CTS enabled (both AP/AU’s and SA/SU’s).
 - On frequency hopping equipment, you can reduce the dwell period to 64ms from 128ms.

Power / Grounding Issues

Input Power to Radio Equipment

- AC “wall brick” type power supplies
 - Do wall plug and barrel connector on radio equipment fit snugly?
 - Is the DC output voltage within limits?
 - For 5-volt supplies,
 - Open circuit DC output should be within 4.9vDC and 6.0vDC.
 - Open circuit AC ripple should be less than 0.1vAC.
 - For 12-volt supplies,
 - Open circuit DC output should be 11.9vDC to 13.2vDC
 - Open circuit AC ripple should be less than 0.1vAC
 - Power supply should no warm during operation - you can comfortably touch it.
- Base Station Power Supplies
 - RM2412 12vAC to 48vDC
 - Output under load should be between –48.0vDC and –52.4vDC.
 - AC ripple under load should be less than 0.01vAC.
 - BS-PS Base Station shelf supply
 - LED’s should be normal as per BS-SH Installation guide
 - BS-PS-AC
 - LED’s should be normal as per the installation guide.

Grounding

- Ground all equipment as per local and national electrical codes.
- In addition to code requirements, ground all antennas, outdoor units, and IF/RF transmission lines as per Alvarion specification
 - BreezeACCESS Indoor units do not require grounding
 - IF cables do require that the sheath is grounded at the building entry point
 - BreezeACCESS outdoor units require grounding on the mounting studs, or on the ground lug provided on the case.
 - Gas tube lightning protection is built into the outdoor units, so no external suppression device is needed.

- All network equipment directly connected to any Alvarion radio system equipment should be grounded as per the manufacturer's specification to the same ground system as the IF/RF cable sheath is grounded to.
 - Ground loops can cause strange intermittent problems.
 - Loops are formed when part of a network system is connected to one ground bus, and other directly connected parts of the network are connected to another ground bus.
- All ground connections must be clean and tight!
 - Connections exposed to the elements must be waterproofed if the connection is a “clamp” type connection.
 - Connections exposed to the elements may be left exposed if the connection is a “crimp” type of connection.
 - Use Electrical Industry standard crimping equipment and “C” type crimp connectors of the proper size for all conductors in your crimp.
 - Brazing, or welding is allowed on braided ground conductors only.
 - Soldering ground conductors is never allowed!
 - All grounds on the sheath of the IF/RF transmission line must be waterproofed!
- All outdoor EIA/TIA Category 5 shielded cabling used outdoors must have the sheath or foil grounded at the building entry point as per local / national electrical code.

Ethernet Network Connectivity Issues

Physical Ethernet Links

- Port configurations
 - All network devices directly connected to the radio system components must be configured for 10Mb/s, half duplex for best performance.
 - Any auto negotiation protocol should be disabled
 - Do not use switches / routers that cannot be configured to half duplex port operation
 - For most hubs, LAN ports are half-duplex, up-link ports are usually full duplex
 - Maximum Transmission Unit should be set no higher than 1518 bytes.
 - All ethernet cabling and patching should conform to EIA/TIA 568A standard, and Category 5 performance specifications
 - Pins 1,2,3,and six are used for ethernet signals in all devices
 - PI-CAT-5 Power inserter uses spare conductors for power.
 - RB/BU-DS-11 uses spare conductors for outdoor unit power, WLAN LED indication, and System Reset.
- Problems symptoms observed when ethernet ports are not configured correctly:

- One SA/SU can monopolize all an AP/AU's bandwidth for a time.
 - Other users appear to have no bandwidth available to them at all
 - Frame latency goes very high with moderate traffic,
 - Frame latency varies from 20ms to 2000ms on the same link.
 - Often, use of MIR/CIR is attempted as a fix for physical port problems, and does not work well at all!
- Data flow seems erratic, and unpredictable.
 - Use of a network sniffer such as Sniffer-Pro will show that frames may be dropped randomly.
 - Take a sample of frames between the network device and the radio system at one end of the link using data generated by a throughput measurement program.
 - Take a sample of frames at the far end of the link and compare the results.
 - Ethernet counters in the radio system may not show any frames dropped
 - The frame is discarded right at the radio ethernet port, before the radio's bridge has a chance to process the frame.

Network Management Configuration

- All Alvarion ethernet based products are OSI model layer 2 bridges:
 - System communication is based on MAC address only
 - No IP routing functions are done at all in BreezeACCESS, or BreezeNET products.
 - In BreezeACCESS, IP filters are used to restrict client access to the radio system.
 - IP address is only used for system management purposes
 - IP address required when using SNMP and telnet management for all Alvarion radio system products.
 - Parameters required to enable remote management and monitoring:
 - IP address
 - Sub-net mask
 - Default gateway
 - SNMP traps enabled
 - SNMP traps are alarms or advisory messages that each radio transmits when certain events occur. See the applicable administration, user manual, or applicable MIB text file for a list of messages.
 - SNMP trap host address
 - IP address can also be used as an IP dialing address when the SU has the voice interface board installed
 - Models SU-x-xx1V-xxx only!
- BreezeACCESS supports RS232 serial, telnet, and SNMP management
 - Read Only password for serial, telnet and read only SNMP community string are the same radio system variable
 - Factory default – “public”
 - Installer password for serial and telnet only
 - Factory default- “user”

- Administrator password for serial, telnet and read/write community string are the same radio system variable
 - Factory default- “private”
- Only one telnet or serial session is allowed at one time
 - Always use <ctrl> x to end either type of session, which is the close session command.
 - Session timer is enabled to automatically close a telnet or serial session after a period of inactivity
 - Factory default is 5 minutes.
 - SNMP is frame based, so many SNMP managers may communicate with one radio at a time.
- BreezeNET Pro.11 supports RS232 serial and SNMP management
 - Read only password for serial and the read only SNMP community string are the same radio system variable
 - Factory default- “public”
 - Installer password for serial access only.
 - Factory default- “user”
 - Firmware 5.1.36 uses the installer password with the Alvarion provided SNMP configuration utility available from our website.
 - Read/write SNMP community string
 - Factory default- “private”
- BreezeNET DS.11 outdoor products support SNMP management only.
 - Read only SNMP community string
 - Factory default- “public”
 - Read/write SNMP community string
 - Factory default- “private”
- Reset to factory defaults:
 - Reset partial defaults restores all advanced configuration parameters to factory default setting only.
 - Reset complete factory defaults restores all configuration values to factory default, including IP addressing and SNMP management passwords.

Advanced Configuration Parameters – BreezeACCESS Only

- Network management
 - Access to network management can be disabled from WLAN or Ethernet port or both
 - Factory default is enabled on both WALN and Ethernet port
 - Remote access can be limited to maximum 3 IP addresses only.
 - Factory default is unlimited access

- SNMP traps can be sent to maximum 3 different IP addresses
 - Factory default is traps disabled, no IP addresses configured.
- Network management and the voice port (if equipped) share the same V-LAN ID.
 - Factory default is V-LAN disabled
- PPPoE filter
 - When enabled, only properly formatted Point-to-Point Protocol over Ethernet frames are allowed over the radio system.
 - Only broadcasts allowed are PPPoE type broadcasts.
 - All other ethernet frames are discarded.
 - The PPPoE client must be installed external to the radio system, as there is no PPPoE client included in BreezeACCESS.
- V-LAN
 - Client data and network management are capable of different V-LAN ID's.
 - Enabling V-LAN will logically separate all data from all management frames, and is effective for added network security.
 - Clients will be unable to change any management parameters even if they know the administration password.
 - All devices connected to the Access Unit side of the network must be V-LAN aware.
 - Client devices connected to the Subscriber units may or may not be V-LAN aware.
 - The SU can function as the terminal of the V-LAN, or simply pass a V-LAN frame that the client equipment has created.
 - AU's and SU can include unlimited number of V-LAN's or enable a V-LAN filter
 - Up to 20 V-LAN's can be included in each AU and SU. All others will be excluded.
 - There are no known issues with our V-LAN implementation
 - See the BreezeACCESS administration manual for configuration details
- H.323 VoIP
 - Frame jitter (that is, how variable the latency of any given frame is) is the prime ethernet concern throughout your WLAN.
 - Provide the best RF environment you can for your system– re-transmissions contribute greatly to frame jitter.
 - Avoid interference
 - Make sure all links have adequate fade margin for their length
 - Avoid overloading the AP/AU.
 - BreezeACCESS, and BreezeNET Pro.11 can process about 400 frames per second, maximum.
 - BreezeNET Outdoor DS.11 can process about 750 frames per second, maximum.
 - Adjust your CODEC used for the best combination of audio performance and frame size:
 - Higher compression puts more data in each frame, so one missed frame has a larger effect.
 - When using any CODEC other than G.711 (64kb/s), use silence suppression to limit traffic with no audio encoded.
 - The VoIP features included are dependent on the version of firmware running in the BA unit.
 - Make sure that all BA units in your VoIP network are using the same version of firmware.
 - Refer to the release notes for each firmware version for detailed supported feature list.

Physical Environmental Issues

Extreme Temperatures

- All Alvarion indoor units are designed to operate between 0 degrees Celsius and +40 degrees Celsius only.
 - Operation is temperatures higher and lower that this range may produce calibration and processor errors
 - Adequate ventilation across the unit is required as the processor and power regulators produce a lot of heat.
 - Indoor units are often very warm to touch, and is normal.
- Alvarion outdoor units are designed to operate between –40 degrees Celsius and +50 degrees Celsius.
 - There are no known temperature issues with any outdoor devices.

Humidity

- Alvarion indoor products are designed to operate in a 5% to 95% relative humidity environment.
 - Do not store or operate indoor units in environments where water is condensing on surfaces around the indoor unit.
 - Use moisture sealed cabinet with adequate ventilation when installing units in this environment.
- Alvarion outdoor units are designed to withstand all normal to severe weather conditions for extended periods.
 - Do not mount outdoor units upside down, as water collecting on the LED's may eventually leak into the unit.
 - For BreezeACCESS, mount the outdoor unit with the TNC female connector, and LED's facing down.
 - For BreezeNET DS.11, mount the outdoor unit with the Cat-5 cable and the LED's facing down.
- Water damage is not covered under warranty.
- Make sure all cable connections are waterproofed, as water can enter the unit through the TNC and N Female connectors for the IF cable and antenna.

Vibration

- Alvarion indoor and outdoor equipment is not designed for high vibration environments.
 - Be sure all equipment is securely mounted and protected from excessive vibration and shock.
 - Ensure that all outdoor units and antennas are securely mounted on their tower.
 - Towers “quiver” to some degree all the time, and connectors can be damaged if the unit or antenna comes loose.

Other Issues

- Do not over-tighten the mast mounting clamps on the outdoor units.
 - They are built very light and strong, but cannot stand to be over stressed.
 - Only tighten to a few inch-pounds of force, as the rear portion of the clamp breaks quite easily if over-tightened.