Wireless Point−to−Point Quick Reference Sheet

Document ID: 9218

Introduction

This document is a quick reference to formulas and information useful for understanding a wireless link connection. Use these formulas and charts to become familiar with and help you troubleshoot your wireless link.

Prerequisites

Requirements

There are no specific prerequisites for this document.

Components Used

This document is not restricted to specific software and hardware versions.

The information presented in this document was created from devices in a specific lab environment. All the devices used in this document started with a cleared (default) configuration. If you work in a live network, ensure that you understand the potential impact of any command before you use it.

Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

Formulas

- Gain or Loss (dB) = 10 Log_{10} P2/P1

  P1 = Input power, P2 = Output power
- Power (dBm) = 10 Log_{10} (power(mW)/1mW)

  or

Power (dBW) = 10 Log_{10} (power (W)/1W

Note: 0 dBm = 1 mW

Note: 30 dBm = 1 W

Note: +30 dBm = 0 dBW

Note: −30 dBW = 0 dBm

- SNR (Signal−to−Noise Ratio) in dBm = amount signal level exceeds noise level

  = Signal Level (dBm) − Noise Level (dBm)
- EIRP (Effective Isotropically Radiated Power) in dBW/dBm = describes performance of a transmitting system

  = Tx Output Power (dBW/dBm) + Antenna Gain (dBi) − Line Loss (dB)
- Fade Margin (dB) = extra signal power added to a link to ensure it continues working if it suffers from signal propagation effects

  = System Gain + Ant. Gain (Tx + Rx) − Free Space Path Loss − Cable/Connector Loss (each end added together)
- System Gain (dBm) = total gain of the radio system without considering antennas/cables

  = Tx Power − Rx Sensitivity
- Free Space Path Loss (dB)= signal energy lost in traversing a path in free space only with no other obstructions

  = (96.6 + 20 Log_{10} (distance in miles) + 20 Log10 (frequency in GHz))

  = (92.4 + 20 Log_{10} (distance in kilometers) + 20 Log_{10} (frequency in GHz))
- Rx Level (dBm) =

  Tx Power − Cable/Connector Loss + Antenna Gain − FSPL + Antenna Gain − Cable/Connector Loss

  Some antennas are specified in dBd

  To convert from dBd to dBi add 2.

  Example: 20 dBd = 22 dBi

Frequency Bands

MDS = 2.150 GHz − 2.162 GHz

MMDS = 2.5 GHz − 2.690 GHz (licensed)

UNII = 5.725 GHz − 5.825 GHz (unlicensed)

LMDS = 27.5 GHz − 28.35 GHz, 29.10 GHz − 29.25 GHz, 31 GHz − 31.30 GHz

Antenna Gain

Frequency (GHz)	Size of Antenna Dish (ft)	Approximate Gain (dBi)
2.5	1	14.5
2.5	2	21
2.5	4	27
5.8	1	22.5
5.8	2	28.5
5.8	4	34.5

(Loss per connector = ~.25dB)

Receiver Sensitivity

Number of Antennas	Throughput Setting	Bandwidth (MHz)	Network Throughput (Mbps)	Delay Spread Tolerance (microseconds)	Minimum Sensitivity (dBm)
1	High	6	22	1.5	–79
2					–82
1	Medium	6	19	6.8	–79
2					–82
1	Low	6	11	6.8	–84
2					–87
1	High	12	44	2.4	–76
2					–79
1	Medium	12	38	7.8	–76
2					–79
1	Low	12	22	7.8	–81
2					–84

Some Key Points to Remember About RF

Gain: Indication of the concentration for the antenna of radiated power in a given direction.

Propagation: How an RF signal gets from one point to another.

Multipath Fading: Known as signal attenuation due to one of these factors:

Note: Also known as Selective Fading as the attenuation varies with the frequency

- Diffraction occurs when a signal encounters a sharp boundary between a region through which it can easily pass and a region of reflective obstruction. Diffraction causes the signal to bend around the corner formed by the boundary.

- Refraction occurs when there is a variation in air density that refracts or bends part of the signal away from the receiver.
- Reflection occurs when the signal is reflected by something such as a lake or glass window. The reflected signal distorts and attenuates and cancels out.
- Absorption occurs when objects absorb the signal energy and the intended full strength of the signal does not reach the receiver. Trees are notorious for absorbing signal energy.

Bandwidth: Band of frequencies that an antenna or system perform acceptably within.

Beamwidth: Total width in degrees of main radiation lobe of an antenna.

Polarization: Antennas for the same wireless link must both have the same polarization to work effectively.

Cable Loss: There is always be some RF energy loss with cables.

- The amount of loss of RF energy is proportional to the cable length and frequency.
- The amount of loss of RF energy is inversely proportional to the diameter of the cable.
- More flexible types of cables experience more loss.

Useful Charts and Commands: (radio interface commands)

Initial Configuration Commands

These are the necessary commands that you must enable for to make your wireless link operational.

- **radio channel−setup**
- **radio operating−band**
- **radio receive−antennas**
- **radio transmit−power**
- **radio master or slave**
- **radio cable−loss**

Troubleshooting Commands

radio loopback {IF | RF}

Example: **loopback local IF main**

- If **IF loopback** fails, the problem is a bad wireless linecard.
- If **RF loopback** fails but **IF loopback** does not, the problem is somewhere between linecard and transverter, or with the transverter itself.

Command: **radio antenna−alignment**

DC Voltage vs. Rx Level (voltage reading taken from ODU)

Rx Level (dBm)	DC Voltage (volts)
−26	2.27
−36	1.93
−46	1.51

−56	1.06
−66	0.69
−76	0.30

Command: **show int radio** *slot/port* **arq**

Latency vs. Throughput

12 MHz	Low	Medium	High
Minimum Latency	7ms	6ms	5ms
6 MHz	Low	Medium	High
Minimum Latency	11ms	7ms	7ms

(default is set at 11ms)

- Both ends must have the same arq settings configured for link to work.
- Data and voice latency are the same.

Monitoring Commands

radio metric−threshold:

```
show int radio slot/port metrics−threshold
```

- EFS − error free second
- ES − errored second
- SES − severely errored second
- CSES − consecutively errored second
- DS − degraded second
- DM − degraded minute

link−metrics:

- **show int radio** *slot/port* **link−metrics**
- **show int radio** *slot/port* **24hour−metrics**
- **show int radio** *slot/port* **1hour−metrics**
- **show int radio** *slot/port* **1minute−metrics**
- **show int radio** *slot/port* **1second−metrics**

Delta at end of command shows the change; otherwise data is cumulative. This command shows pre− and post−ARQ errors.

radio histogram:

```
radio histogram <constVariance/totalGain/in>
```

- Measurements made from min, average, max values given from histogram
- Constellation Variance =

SNR = −10 Log10 (Constellation Variance value from histogram/86016)

* Total Gain for Antenna = formula to calculate the Rx signal level from total gain =

  Rx Power in (dBm) = ((total gain value from histogram)/2 − 96) dBm
* IN for Antenna =

  SNR = −10 Log10 (IN value from histogram/65536) + 9

LEDs:

```
show int radio slot/port led
```

You can change the color of the LEDs to your preference.

Debug Commands:

debug radio log verbose

debug radio messages

Before attempting these debug commands, refer to Important Information on Debug Commands.

Calculate Signal Strength

The wireless modem card does not currently calculate or display received signal strength. The workaround is to use this procedure to calculate an estimate for the received signal strength:

1. Measure the total AGC attenuation of the system with the radio histogram totalGain <n> 1 2 50 coll 10 per 10 sum true command, where <n> is the antenna number (1 or 2).
2. Find the average total gain value in the displayed histogram data.
3. Calculate the estimated received signal strength (in dBm) with the following calculation:

   estimated received signal strength = ((average total gain) / 2) − 96 dBm

---

Related Information

* **Wireless Point−to−Point Frequently Asked Questions**
* **Wireless Troubleshooting Guide**
* **Wireless Troubleshooting FAQs and Checklist**
* **Wireless Sample Configuration and Command Reference**
* **Wireless Debug Outputs From Possible Physical Connection Problems**
* **Cisco uBR7200 Series Wireless Modem Card and Subsystem Installation**
* **Point−to−Point Wireless Support for the Cisco uBR7200 Series Universal Broadband Router**
* **Wireless Site Planning Considerations**
* **Wireless Installation Considerations**
* **Technical Support − Cisco Systems**

Contacts & Feedback | Help | Site Map
© 2008 − 2009 Cisco Systems, Inc. All rights reserved. Terms & Conditions | Privacy Statement | Cookie Policy | Trademarks of Cisco Systems, Inc.