... Throughput Performance OR-system

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Introduction

When evaluating throughput of outdoor systems for fixed wireless Point to Point links among competing vendors, it is very important to use the right method of comparison in order to ensure accurate results. This document will describe how to accurately measure such throughput.

There are different ways to test the throughput of a system. The throughput depends on a number of different factors, the most important factors are:

- Signal quality (Signal to noise ratio)
- Interference, other equipment working in the same frequency range. E.g. Microwave, 802.11. etc.
- Speed of the computers.
- Type of file transfer; Uni-directional or Bi-directional.

Uni-directional versus bi-directional file transfer

The type of file transfer (uni- or bi-directional) influences the throughput.

Whereas the uni-directional transfer is the most easy to perform and therefor most used, **the bi-directional transfer is a more realistic measurement because in a typical situation the traffic will flow in both directions.**

A typical situation for these products is to create a wireless connection between two buildings each with their own LAN. In such a situation network traffic will flow in both directions.

In general when people measure throughput they measure only uni-directional file transfers in an unshielded environment. **The measurements below show that Lucents' OR System performs best with a bi-directional file transfer** that most resembles a typical network situation.

Also testing in an unshielded environment makes it difficult to compare and reproduce measurements. This because noise and interference from other IEEE802.11 equipment is random and will influence the measurements.

Measurement results

When comparing the new Outdoor Router 1.41 release to our previous version of the same product, called LINK WP-II and to Cisco's Aironet 340 Series Wireless Bridge, our Outdoor Router version 1.41 significantly outperformed the others.

The test results in this bulletin are measured by transferring a file from one PC to another and measuring the transfer time.

Three different outdoor products are compared in the test set-up described above, namely:

1. ORiNOCO Outdoor Router Release 1.41, (kernel 3.69) - 11 Mbps
2. LINK WP-II (kernel 3.57) - 8 Mbps
3. Cisco Aironet 340 Series Wireless Bridge - 11 Mbps

The table below gives an overview of the measured data throughput values for a double and an uni-directional file transfer at –66dBm.

Product	Bi-directional speed Mbps	Uni-directional speed Mbps
OR 3.69 (11 Mb)	4.50	3.61
PtP (8Mb)	3.46	3.59
CISCO (11 Mb)	4.25	4.53
PC Direct	7.63	7.38

NOTE: The values are not absolute, in test setup with other computers, OS, tools, environment, etc they could differentiate.

The first measurement focused on the data throughput for a bi-directional file transfer versus received signal strength (This is the strength of the signal at the antenna

connector of the receiving radio). The results are shown in the graph below.

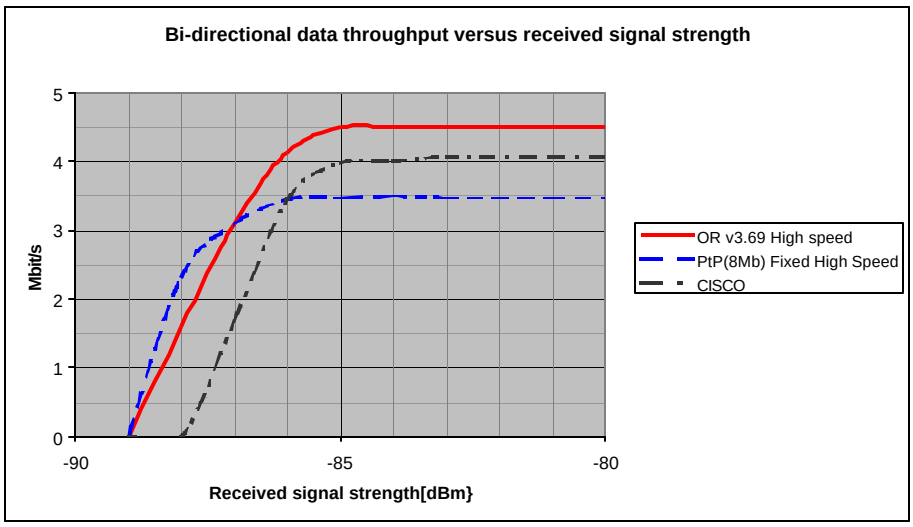

Figure 1 Bi-directional throughput graph

The second measurement focused on the data throughput for an uni-directional file transfer versus received signal strength. The results are shown in the graph below

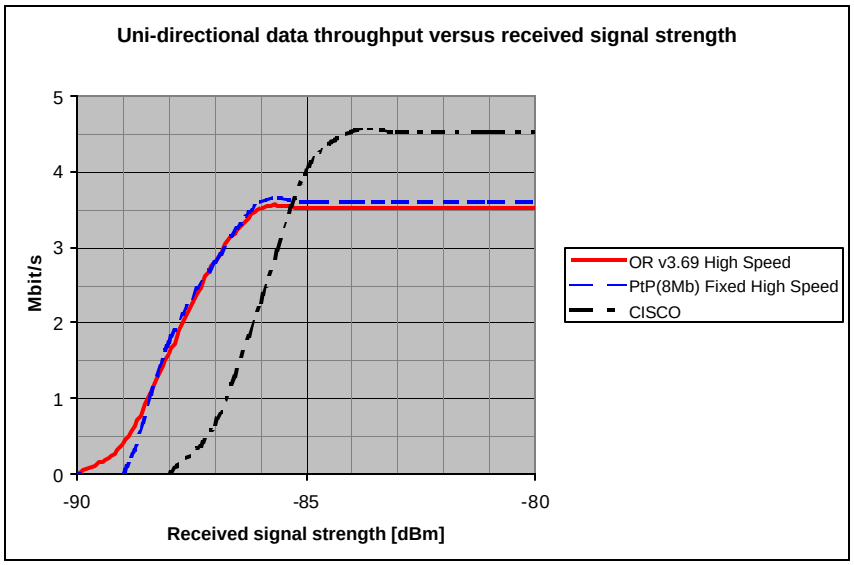

Figure 2 Uni-directional throughput graph

The graphs above show that in a Point to Point link:

1. Release 1.41 throughput for a bi-directional file transfer is higher than a PtP (8mb) link and the CISCO bridge.
2. There is an extra 2 dB link budget, which corresponds to a 10% range improvement.

A third measurement is a bi-directional file transfer versus received signal strength for different transfer rates. Measured in an ROR-master to ROR–slave link.

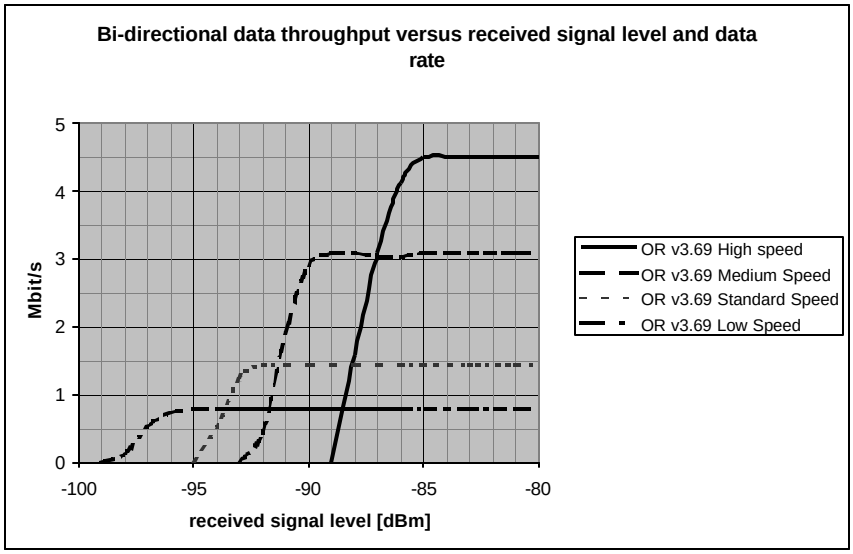

Figure 3 Throughput versus link budget and data-rate

Test Setup

The figure below shows the HW set-up used during the measurements. When we talk of a bi-directional file transfer we mean a simultaneous file transfer from ftp client 1 to ftp server 2 and from ftp client 2 to ftp server 1. A single side transfer is a from ftp client 2 to ftp server 1.

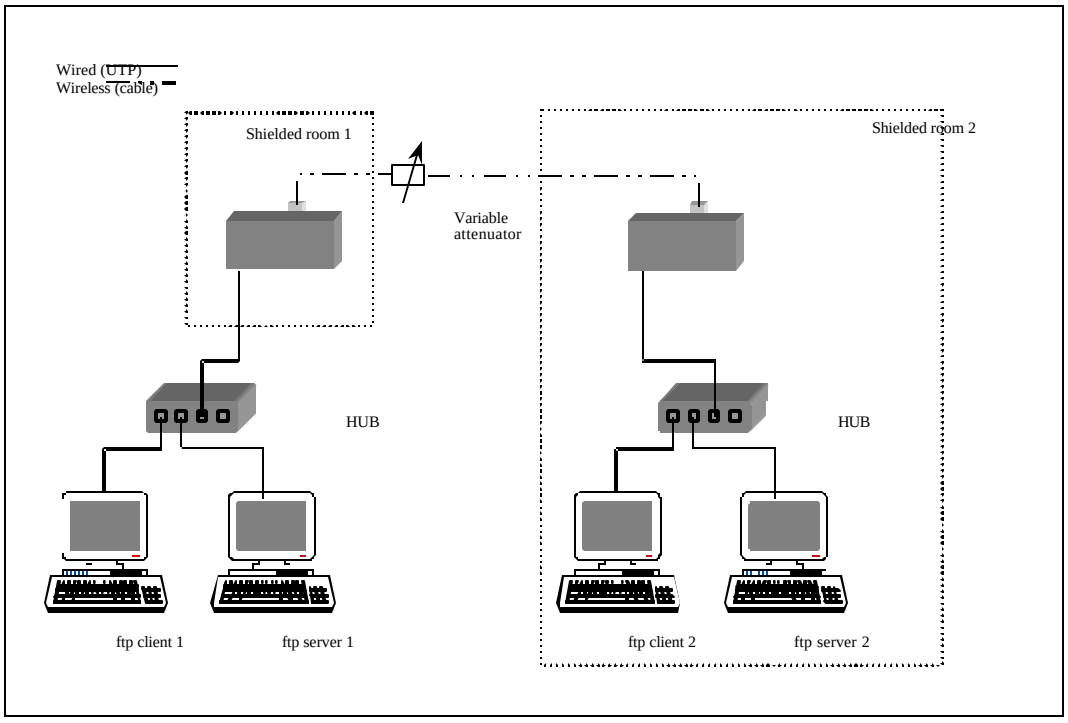

Figure 4 Test setup

To minimize the influence of the signal quality and interference measurement has been done in two shielded rooms and connecting the radios via a cable.

A variable attenuator is used to vary the signal strength at the receiving radio. This is directly linked with signal to noise ratios (link distance is directly proportional with SNR).

The influence of the PC speed is made constant by using exactly the same set-up for every measurement.

Computers & Software

For the test described above the following PC's and software is used:

FTP client 1

Laptop: Toshiba Satellite 4070 CDT (Outdoor testpc001)

Processor	:	Pentium Pro(r)
RAM	:	64 Mb
OS	:	Windows 95 4.00.950 b
Ethernet	:	3Com 10 Mbps LAN model 3C589
Ftp software	:	CuteFTP 4.0.19

FTP server 1

Desktop: Digital PC 3000

Processor	:	AMD-K6 166 MHz
RAM	:	32 Mb
OS	:	Windows 95 4.00.950 b
Ethernet	:	10 Mbps
Ftp software	:	WarFTP Deamon 1.70 exe version 1.70.1.4

FTP client 2

Laptop: Toshiba Satellite 4070 CDT (Outdoor testpc002)

Processor	:	Pentium Pro(r)
RAM	:	64 Mb
OS	:	Windows 95 4.00.950 b
Ethernet	:	3Com 10 Mbps LAN model 3C589
ftp software	:	CuteFTP 4.0.19

FTP server 2

Desktop: Digital PC 3000

Processor	:	AMD-K6 200 MHz
RAM	:	14 Mb
OS	:	Windows 95 4.00.950 b
Ethernet	:	10 Mbps
ftp software	:	WarFTP Deamon 1.70 exe version 1.70.1.4

HUB

10-Base-T Ethernet HUB KTI networks model KH-5M

