Extensive 5Ghz point to point comparison test with certified measuring equipment

There are many questions regarding 5Ghz point to point performance of various radio models of multiple vendors. Since most of these equipment are based on 11.N Atheros technology, it is sometimes very hard to explain what are the main differences in real life performance, because all of these devices feature 300Mbps data rates – on the datasheet.

Inter Crown Europe was approached by one of it's bigger WISP partners – Z-Net Mikronet – to help in an extensive comparison testing conducted on the customers own 36km long link.

It was a rare event because more distributor companies and even the representatives of two vendors (Motorola, InfiNet Wireless) were present and professional measuring equipment was used to get the most accurate results possible.

Test location and circumstances:

All testing were done on Z-Net's 36km long link between Marcali and Tapolca (south-western Hungary). Since the interference of the 5Ghz spectrum was considerable, the technicians of the customer deployed two 150cm GRANTE high performance antennas with Telco grade interference protection and all radio units were tested with the same antennas.

Measurement method:

We used Fluke Etherscope and Fluke Metroscope devices on each end of the link, which were directly connected to the Ethernet interfaces of the radio units. The Fluke devices arecapable to measure both copper and fiber based Gigabit connections and offer a wide set of different measurement possibilities. In order to measure all type of radio equipment, we used the RFC 2544 testing suite for bandwidth, latency and jitter measurement. You can find a detailed description of the RFC 2544 method following this link.

The test uses different packet sizes (64, 128, 256, 512, 1024, 1280, 1518) and applies the same load for each of these. We used 99,99% measurement accuracy for the testing which means that the Fluke units measured the dropped or retransmitted packets and decreased the load until the link reached 99,99% availability which means the pure and accurate throughput of the radio links.

Given the long distance of the link (36km) two radios (Ubiquiti RocketM5, Motorola PTP250) could only operate with 20Mhz channel size, given the Atheros ACK limitations that enable 40Mhz channel sizes up to 27km. This limitation does not apply for the InfiNet and Mikrotik radios where the engineers are using different drivers for the chipsets. The Motorola PTP600 uses proprietary wireless technology that is based on digital processors that employ hardware acceleration and does not use any technology based on wifi chipsets. The channel size of the PTP600 is 30Mhz and it uses 256QAM modulation, being the most advanced unit in the test.

Radios used in the test:

Ubiquiti Rocket M5: The multifunctional base station/bridge unit of Ubiquiti Networks is an easily integrated unit which can be swiftly attached to the antennas provided by the manufacturer and can be used for multiple roles.

Helpful software applications for first setup: Antenna alignment tool, spectrum analyzer, sniffer

Mikrotik RouterBoard 800 with Compex 17dBm miniPCI card: The most power full radio platform of Mikrotik is known by all WISP's. Given it's software and many interface options, it is the most versatile unit used in our test. The Compex miniPCI card is the most favored radio interface of Z-Net, used for nv2 nstereme links.

Helpful software applications for first setup: Antenna alignment tool, spectrum analyzer, sniffer

Motorola PTP 250: The newest Atheros based bridge of Motorola features a basic and easy to use firmware – which unfortunately lacks many features given it's new entry to the market. The vendor positions the PTP250 against professional Atheros based radio bridges.

Helpful software applications for first setup: There are currently no such applications but the vendor promises to improve the firmware soon.

InfiNet InfiLink 2x2 Pro 300Mbps 23dBm: The new flagship of InfiNet Wireless is present in many professional carrier and IP based CCTV networks and is known for it's uncompromising performance and high level of reliability. The platform offers advanced Layer3 features and a flexible licensing policy which makes it possible to use the same high performance hardware for more capacity needs.

Helpful software applications for first setup: Antenna alignment tool, advanced spectrum analyzer, sniffer

Motorola PTP 600: This radio was originally developed by Orthogon Systems and although it slowly reaches the end of it's lifetime, it's uncompromising hardware architecture offers the highest performance which is represented in it's price tag as well. The PTP600's hardware architecture is different from the other products featured in our test because it uses dedicated digital processing units rather than Atheros based 802.11N technology.

Helpful software applications for first setup: Spectrum analyzer, sniffer

Main parameters:

	Ubiquiti Rocket M5	Mikrotik RouterBoard 800	Motorola PTP 250	InfiNet InfiLink 2x2 Pro	Motorola PTP 600
					
Processor Type	Atheros MIPS 24KC, 400MHz	MPC8544 800MHz	Cavium 5010 MIPS64 500MHz	PPC460EX 1000 MHz	2x DSP TI TMS320C64 3x FPGA Virtex-II Pro
Output Power	27dBm	17dBm (featured)	22dBm	23dBm*	25dBm*
Wireless Protocol	802.11N based AirMAX	802.11N based nstreme nv2	802.11N based	802.11N based MINT	Proprietary
Supported Frequency	4,9Ghz – 6Ghz	4,9Ghz – 6Ghz	5,7Ghz–5,8 Ghz 5.4Ghz–5.7 Ghz	4,9Ghz – 6Ghz	5,7Ghz–5,8 Ghz 5.4Ghz–5.7 Ghz
Ethernet interface	10/100	3x 10/100/1000	10/100/1000	10/100/1000	10/100/1000
Highest modulation	64QAM	64QAM	64QAM	64QAM	256QAM
Chanel sizes	5/10/20/40Mhz	5/10/20/40Mhz	5/10/20/40Mhz	5/10/20/40Mhz	5/10/15/30Mhz
Max. power consumption	6,5 Watt	configuration dependant	35 Watt	12 Watt	55 Watt
Link price	150 USD	630 USD	3500 USD	6200 USD	13700 USD

*: The unit can use it's maximum output power at it's highest modulation setting

It is clear from the statistics displayed in the chart above, there is considerable difference in both hardware features and pricing – although all datasheets mention 300Mbps throughput. The real life measurements provided the following results:

	Ubiquiti Rocket M5	Mikrotik RouterBoard 800	Motorola PTP 250	InfiNet InfiLink 2x2 Pro	Motorola PTP 600
64 bit packets	6,72 Mbps	8,72 Mbps 13,3 Mbps	22,96 Mbps	107,66 Mbps 134,66 Mbps	360 Mbps
128 bit packets	13,4 Mbps	34,78 Mbps 7,5 Mbps	28,3 Mbps	120 Mbps 161,86 Mbps	320 Mbps
256 bit packets	27,66 Mbps	51,4 Mbps 50,54 Mbps	40,36 Mbps	114,72 Mbps 205,74 Mbps	304,28 Mbps
512 bit packets	49,2 Mbps	69,3 Mbps 183,28 Mbps	70,32 Mbps	112,46 Mbps 214,36 Mbps	297,12 Mbps
1024 bit packets	52,4 Mbps	78,74 Mbps 176,32 Mbps	89,52 Mbps	104,34 Mbps 204,8 Mbps	290,6 Mbps
1280 bit packets	61,86 Mbps	81,1 Mbps 176,18 Mbps	87,3 Mbps	107,88 Mbps 218 Mbps	286 Mbps
1518 bit packets	76,4 Mbps	78,7 Mbps 176,76 Mbps	85,28 Mbps	111,44 Mbps 219,6 Mbps	288,14 Mbps

All results marked with red were done using 40Mhz channel size. All results of the PTP600 were done using 30Mhz channel sizes. All results are aggregated meaning that they represent both uplink and downlink combined.

Real life circumstances affect the measurement process which can be seen from the results. Interference from foreign radios is sporadic, so more measurements were done and only the best results are displayed in the chart above. Packet loss at higher packet sizes results in lower overall throughput, because a larger chunk of data is being lost per packet. The biggest difference between the radios is packet forwarding performance with smaller packet sizes which represents the majority of real life internet traffic. Low cost radios have poor short packet performance which means that they are not able to utilize their full wireless potential because packet handling ability will result in a networking performance bottleneck.

The excellent short packet performance of the Motorola PTP600 is the result of a special packet compression feature.

After examining the test results, it is clear that the InfiLink 2x2 Pro has the best packet forwarding performance – and as a result the highest throughput – between the 802.11N based radios featured in the test. It supports the whole 5Ghz band and thanks to it's advanced spectrum analyzator and antenna alignment it makes possible to utilize it's full potential in any given situation. All available capacities (40/80/150/300 Mbps) feature the same hardware so they share the same packet performance!

We strongly recommend the usage of GRANTE High Performance Antennas in order to have maximum reliability and performance. These antennas are designed to operate in heavy duty weather conditions, have a fine alignment system, built in cabling and state of the

art frequency absorbing material that offers at least 30dB attenuation on the back and side lobes making it the perfect choice for uncompromising links.

Personal opinion of the CEO of Z-Net:

Ubiquiti Rocket M5:
The price/performance ratio of the unit is very good. 40 Mhz channel size is limited sadly to 26km's because of the Atheros ack limitation, and no ack mode is useless on long distances. The weak hardware results in low packet performance, the unit is absolutely unsuitable in the role of a long distance, high throughput backbone link. In addition to this, the plastic casing and RPSMA connectors (especially mounted on the top of the unit) are questionable in the case of a full outdoor product and the AirMAX software still needs fine tuning. All in all, it is still a good alternative for multipoint base station usage or a low capacity, low cost backbone link. It is very positive that it has a scanner and a spectrum analyzer.
MikroTik RB800:
This is the most expensive Routerboard. Since it is able to use 5 radios in basic configuration and has 3 gigabit LAN ports, it is the most universal of all the devices tested. When configured as a ptp bridge, it is able to handle more packets than the RocketM5 since it's processor is stronger. Mikrotik does not use the Atheros ack register system (since it uses RouterOS) so range is not limited. It is negative that the CPU is fan cooled, but it is positive that it features the most versatile software in the test.

Motorola PTP250:
The newcomer. It has the most convincing overall finish by looking at it. It has considerable advantage over cheaper devices when it comes to short packets which shows that there is engineering (software) work behind it, but this advantage melts away with bigger packets. The range limitation is also there which is derogatory for Motorola. Currently there is no scanner or analyzer software in it, which is an operational nightmare, but good news is that according to the vendor this will be a top priority for the development engineers. Currently this radio has the worst price/performance ratio with the actual firmware. I am eager to see upcoming firmware releases which could improve this situation.

InfiNet InfiLink 2x2 Pro:
The surprise. Although I am using it for quite a long time now, I was surprised by the testing results. The hardware is not significantly stronger than that of the RB/800, but it performs incredibly good in all tests, beating the competition by miles. The thanks goes to the absolutely positive and helpful approach of the Russian support engineers. All software, including the driver of the 802.11N card is their own development. The spectrum analyzer is the best in it's class. I have to admit that the original firmware release for the H08 platform had some bugs which were fixed. They also like to test on their customers as all other vendors do.

Motorola PTP600:
The very expensive. The device is good, but only if we are considering it's performance. It's pricing is not so good. A licensed wave link costs half the price and offers higher throughput. One more problem is high power consumption and extremely high operational temperature (7 year old technology). I am eagerly waiting for the next generation of this radio.

Comments on the test:

Testing time was mainly dedicated for the Motorola and InfiNet testing, and lower emphasis was put on the Rocket and the Routerboard. The test was initiated and organized by the Z-Net Mikronet Kft. so it could get useful information for future developments in it's own network.

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