Performance and Industry Application Test of A High Power Access Point

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Abstract. This paper designs a high performance wireless communication access point based on 802.11n for mining for low communication speed and low transmission power in mine. The access point is composed of hardware layer and software layer. This access point supports double frequency at 2.4GHz and 5GHz, and it can reach communication speed at 300Mbps, which improved significantly performance of wireless communication for mining. We tested and optimized the access point in Lab. Finally we tested the access point in industry, the comprehensive test result showed that the access point can satisfy wireless communication requirements for mining.

Introduction

With the rapid development of computer and communication, a single cable communication is widely used in mining industry which becomes the performance bottleneck, and the high construction costs and fixed network topology has been difficult to adapt to the actual needs of safe and efficiency production in mine[1]. At present, the domestic research institutes have put forward a mixed network structure which mainly based on wired network and wireless network as a subsidiary, and which to a certain improved the extension and flexibility of the network. Industrial Ethernet has been widely used in mine enterprise, Wi-Fi wireless access technology access to markets. But the core technology remains basically in IEEE 802.11g stage which only can provide the highest link data transmission at 54Mbps. Also it is unable to complete HD video and real time control command transmission, which seriously limits overall performance of the network[2-4].

This paper designs a high-performance wireless communication wireless access point based on 802.11n for mining. This access point supports double frequency at 2.4GHz and 5GHz, and it can reach communication speed at 300Mbps, which improved significantly performance of wireless communication for mining.

Overall Design

High power Wi-Fi access point for mining is mainly used to build mining wireless communication network which holds data including HD video information, real-time voice information etc. multimedia data, environmental monitoring data and equipment control instruction. In those applications for underground, which require the following features:

（1） High speed of data transmission, which ensures data concurrent transmission in real time.

（2） Abundant physical interface, which realizes compatibility access for various of underground equipment.

（3） High transmitter power and rx sensitivity, which provides large enough wireless signal coverage and adapts to complex link environment .

（4） Steady operation ,which ensures communication system reliability and robustness.

Based on the above requests, on the background for underground application, this paper used modular design to complete designing access point overall design. The hardware of the access point

was composed of hardware layer and software layer . The overall framework is shown in Figure 1.The hardware mainly includes the core processor module, communication interface module and the wireless communication module which was composed of 5GHz RF module and 2.4GHz RF module. The software layer mainly includes Mips-Linux-2.6.31 kernel, hardware driver , IEEE 802.11n protocol stack , network protocol and application service etc..

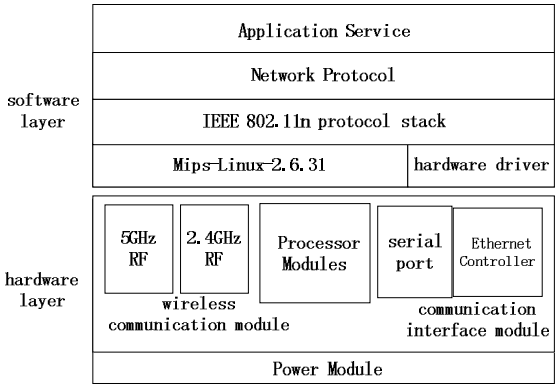

Fig. 1 Access Point general framework

Performance Test

To ensure access point performs well which can provide support the stable wireless communication for the industrial test. This paper tested the access point in many ways, including:

(1) RF indexes test.
(2) Ethernet and optical network communication test.
(3) Flow test.

RF Indexes Test

The wireless signal transmission falls into main direction: transmit and receive, the signal quality in every direction can affect the system communication effects. Litepoint IQ2010 is an RF equipment which integrates with transmitter and receiver. It has multiple concurrent compatible ability of wireless communication standard,so we chose it as access point test equipment to test the signal quality of transmit and receive.

We set the access point that debugged and optimized as test mode and loaded the test code, and then we use IQ2010 to calibrate and test. The test result is show as Figure 2.

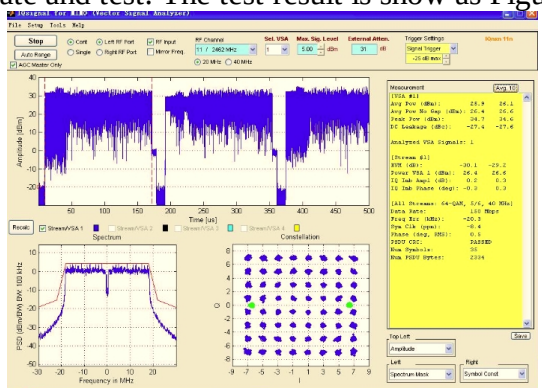

Fig. 2 The test result of signal quality of transmit and receive

Ethernet and optical network communication test

The stable network communications is basis forthe system running stability. In real industrial environment , the reasons that the high rate packet loss and instability flow of the device case various network problems. To ensure good data communications channel, so we test the quality of network communication of the 1000 Mbps Ethernet port and optical interface port of the communication system device. After we optimized above problems, and then got the following test results.

Flow Test

Table 1 Flow Test Result

PacketsSent Per Second (PPS)			Throughput Test	
Test Period	60		Test Number	1
Min Frame Size	Custom		InitialS peed	Custom
Max Frame Size	Custom		Min Speed	Custom
Frame Length Increment	Custom		Max Speed	Custom
Sending Mode	Bidirectional		Speed Precision	Custom
Frame Length	PacketsReceived	[1,1,2]-->[1,1,3](PPS(MPS))	[1,1,3]-->[1,1,2](PPS(MPS))	
		1000M --1000M	1000M --1000M	Total(PPS)
64	100%	1488096	1488096	2976192
128	100%	844595	844595	1689190
256	100%	452899	452899	905798
512	100%	234963	234963	469926
1024	100%	119732	119732	239464
1280	100%	96154	96154	192308
1518	100%	81275	81275	162550

The results showed that, the network flow transmission of access point can reache the industrial application level which provides high bandwidth and high quality in industrial field.

Network Delay Test

Table 2 Network Delay Test Result

Time Delay Unit (us)			Throughput Test	
Test Period	Test Period		Test Number	1
	Min Frame Size		InitialS peed	Custom
	Max Frame Size		Min Speed	Custom
	Frame Length Increment	Custom	Max Speed	Custom
	Sending Mode	Bidirectional	Speed Precision	Custom
Frame Length	PacketsReceived	[1,1,2]-->[1,1,3](PPS(MPS))	[1,1,3]-->[1,1,2](PPS(MPS))	
		1000M --1000M	1000M --1000M	avagre
64	100%	1.570	1.540	1.555
128	100%	1.700	1.630	1.655
256	100%	1.700	1.630	1.655
512	100%	1.700	1.630	1.655
1024	100%	1.700	1.630	1.655
1280	100%	1.700	1.630	1.655
1518	100%	1.720	1.650	1.685

The results showed that, the network delay test of access point performed well. In the test of frame length of 1518 bytes, the average delay is only 11.598μs, The access point can satisfy network delay in the industrial environment.

Table 3 Network Packet Loss Rate Test Result

Network Packet Loss Rate Test			Throughput Test	
	Test Period		Test Number	1
	Min Frame Size		InitialS peed	Custom
	Max Frame Size		Min Speed	Custom
	Frame Length Increment	Custom	Max Speed	Custom
	Sending Mode	Bidirectional	Speed Precision	Custom
Frame Length	Rate (100%)	[1,1,2]-->[1,1,3](PPS(MPS))	[1,1,3]-->[1,1,2](PPS(MPS))	
		1000M --1000M	1000M --1000M	avagre
64	100%	0%	0%	0%
128	100%	0%	0%	0%
256	100%	0%	0%	0%
512	100%	0%	0%	0%
1024	100%	0%	0%	0%
1280	100%	0%	0%	0%
1518	100%	0%	0%	0%

Network Packet Loss Rate Test

The results showed that the network packet loss rate of the access point is 0%,and it can realize needs that high speed forward of communication in mining.

Industry Test

In this paper we chose ZhongJin LingNan Company Fankou lead-zinc Mine as test site.We construct the wireless network at -240m Ramp . By comprehensive consideration of trend, width, height and transmitted power of the access point, we layout the access point as the following Figure 3.

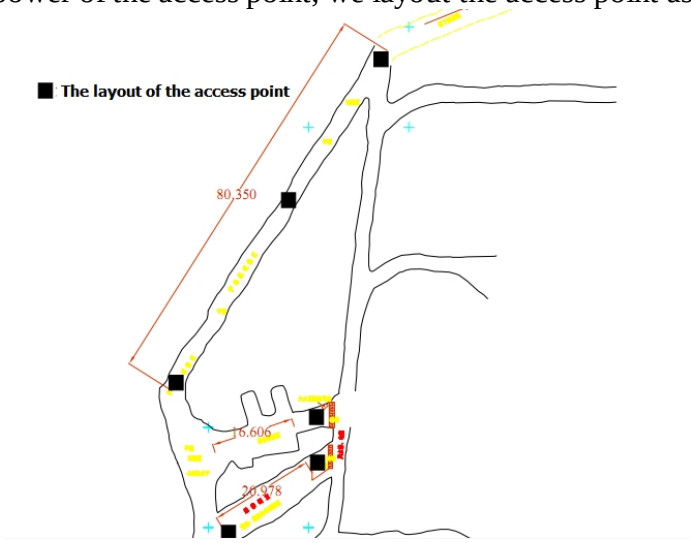

Fig.3 The layout of the access point

In the experiments,the intelligent equipment transmit HD video, control command and sensor information to monitoring center by the wireless network. We test the network delay, band width , stability test of the wireless network.

The comprehensive test showed that,

（1）The speed of wired network reach 1000Mbps；

（2）Wireless link rate reach 300Mbps；

（3）Network packet loss rate ＜0.003%；

Conclusions

This paper introduces a high-performance wireless communication wireless access point based on 802.11n for mining. It presents the accs composition, which includes hardware composition and software design. Through the access point, which can make up the low communication speed and low transmission power in mining. It will have fine application prospects in the mining .

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