

Amedia WiVi™ Technology

Wireless Video Goes the Distance at 5 GHz

Introduction

The wireless age is here. The conveniences of cell phones, wireless-enabled handheld devices, and WLAN equipped laptops have become part of everyday life. Wireless video is the natural progression. Imagine a mobile television that can follow you to the kitchen, bedroom, garden, garage, and even to the bathtub. Watch your favorite sports game at your backyard party. Not miss a single second of the game when you need a drink from the kitchen, or a quick stop to the bathroom. Have a large collection of MP3 music or MPEG movies on your computer hard drive in the study room, but rather enjoy them in the comfort of the living room? Bought a state-of-the-art big screen flat panel high definition television, but don't want to put it where the cable jack is? You need wireless multimedia.

The market demands for wireless video is clear. There are various candidate solutions competing in quality and range. However, they do not satisfy the unique requirements that are necessary to support robust wireless multimedia. Amedia's WiVi™ Technology unites a multitude of essential ingredients to achieve such a goal.

Solutions on Market Today

Old fashion analog FM solutions have long existed to try to satisfy the market demand for wireless video. The common analog disadvantages such as low quality picture, distortion, ghosting, statics and high transmission power had prevented its acceptance in the marketplace. The governments around the world¹ have also started to call off the analog usages of certain unlicensed spectrum due to high interfering and spectral inefficiency of analog transmission.

In recent years, IEEE 802.11 a/b/g WLAN, or Wi-Fi, based wireless data networking products experienced a great success in the market. A natural step going forward would be to put video over Wi-Fi. However, many earlier efforts have shown that 802.11 a/b/g based solutions don't fit well to the wireless video applications. There are issues that make its performance unsuitable:

- The Carrier Sensing Multiple Access with Collision Avoidance (CSMA/CA) protocol in 802.11 WLAN is designed for TCP/IP type data networks. Terminals "listen" for an empty channel before bursting a transmission. "Backoff" between transmissions is required to allow multiple access. Data throughput can be very bursty due to this protocol and possible collisions. This is a good design for data networks that aimed to maximize average throughput, but not suitable for time jitter sensitive multimedia applications where a guaranteed constant throughput is required (so called quality of service, or QoS).

¹ Such as Japan and Germany.

- The throughputs delivered by IEEE 802.11a/b/g leave much to be desired. 802.11b advertised up to 11 Mbps transmission rate, but the reported rate reaching the end-user is only close to 4 Mbps. 802.11a/g advertised up to 54 Mbps transmission rate, but end-user throughput is only close to 12-14 Mbps. DVD quality video is certainly out of the question for 802.11b, while it may be possible for 802.11a/g. However, it is impossible for 802.11a/g to support the upcoming High Definition Television (HDTV) at close to 20 Mbps video rate (up to 25 Mbps in Japan).
- Most of the standard multimedia processors such as MPEG2/4, H.264, and WM9 do not support data streams with TCP/IP protocol. Thus, WLAN solutions always need additional “glue” logics, or so called QoS circuitry, to bridge the TCP/IP data protocol to video transport stream (TS) before it can interface with the standard video processors. These “glue” logics unavoidably introduce uncertainty in the performance and increase the complexity and cost of the product.

The to-be-finalized² IEEE 802.11n standard has recently been considered for the wireless video applications. The proposed 802.11n standard adopted a space-time coding technology called multiple-input, multiple-output (MIMO) technology in its physical (PHY) layer of system. The MIMO technology would significantly improve the data throughput and distance. But as an extension of Wi-Fi, 802.11n still shares the same TCP/IP based media access control (MAC) protocol as other 802.11 solutions. Therefore, it doesn't fundamentally address the QoS requirement when it comes to the video applications. In addition, its high cost point due to the complexity of 11n standard itself also makes it less competitive for consume electronic marketplace.

Ultra Wideband (UWB) or IEEE 802.15.3a is another standard proposal for wireless connectivity of multimedia devices. Its MAC layer is designed to provide QoS required by multimedia applications, however its PHY layer only supports a short range of a few meters. The lack of penetration through objects such as walls and human body makes UWB solution unsuitable for wireless multimedia distribution over distance.

WiVi™ Technology: Uniqueness and Advantages

Overview

WiVi™ technology is Amedia Networks' proprietary technology that is highly integrated and optimized at the architectural level to facilitate a cost-effective solution particularly for high QoS wireless video applications. WiVi™ technology incorporates semiconductor and software to seamlessly support popular SDTV, HDTV and multimedia processors.

WiVi™ technology has its baseline established within the next generation WLAN and WPAN standards, i.e. IEEE802.11n and 802.15.3a (UWB). The PHY layer of WiVi™ technology shares the same foundation of that in 802.11n and employs MIMO space-time coding technology and operates at 5 GHz spectrum. The MAC layer of WiVi™ technology employs an isochronous architecture and time-division-multiple-access (TDMA) networking technology as that in UWB to guarantee QoS for real time video. This unique “hybrid” architecture has made WiVi™ technology the only 5 GHz wireless solution capable to deliver high QoS video over distance.

Figure 1 illustrates the position of WiVi™ technology versus WLAN and WPAN standards. It is worth pointing out that WiVi™ technology sharing same baselines with the upcoming standards of 802.11n and UWB leaves Amedia Networks quick paths to migrate the proprietary technology toward standardization.

² Most of the market observers estimated the battle over the development of this 11n standard will not be resolved until at least mid-2007.

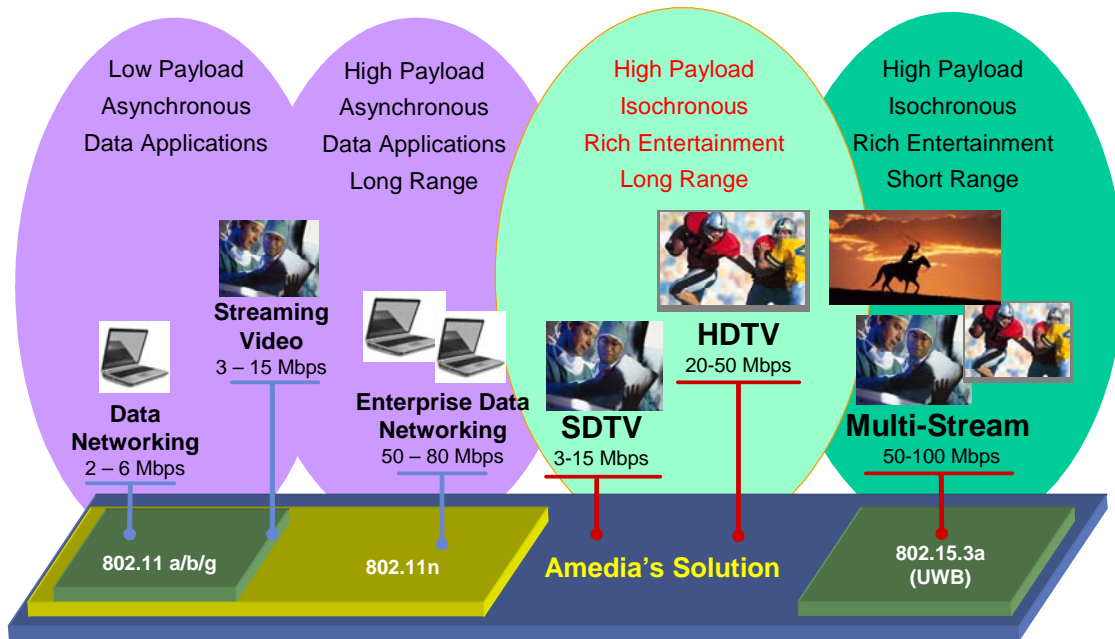


Figure 1. WiVi™ Technology vs. Standards

WiVi™ Technology Advantages

Full Quality of Service

WiVi™ technology has been specially designed for applications with high QoS requirement. The media access scheme is allocated and scheduled by the network master on a time slot by time slot basis. By doing so, the required bandwidth for transporting high QoS multimedia contents is guaranteed.

Multimedia applications have very stringent time delay requirements. Audio and video information is needed by the decoder at a steady pace with precise timing. The MPEG-2 specification allows 500 nanoseconds of jitter end-to-end, which is the time jitter allowed to be introduced from the processing at the headend office to the user's home theater. This leaves just 50 nanoseconds of leeway for the wireless distribution system. In the data networking world, jitter is more on the order of milliseconds. In WiVi™ technology, a jitter-less architecture is carefully designed to preserve the timing properties of real time multimedia data.

The real time requirement of multimedia data is architecturally integrated into the MAC protocol. Data retransmission effort is focused on the data segment most urgently needed by the decoder for timely reproduction. The retransmission scheme is designed for the real time needs of the decoder, rather than the traditional approach to maximize average throughput. With this special design, buffer management becomes straightforward and allows the overall system to guarantee no degradation from buffer overflow.

Long Distance and Full Coverage

With the superiority of the MIMO space-time diversity technology and high performance of the innovative 5 GHz radio architecture, WiVi™ technology enables wireless networks to have fewer “dead spots” and greater range than typical WLAN products. With WiVi™ technology, high quality video streams can be delivered wirelessly to anywhere in the home through walls for distances up to 70 meters while maintaining their original quality.

Figure 2 illustrates the performance of WiVi™ technology in a typical residential home environment: a two-story, stucco construction, approximately 2,600 square-foot house with lots of home appliances and furniture. WiVi™ technology enables a single network to cover the entire 2-story home with 25 Mbps HDTV stream. Even in the brick and masonry garage, 20 Mbps HDTV stream can be easily maintained.

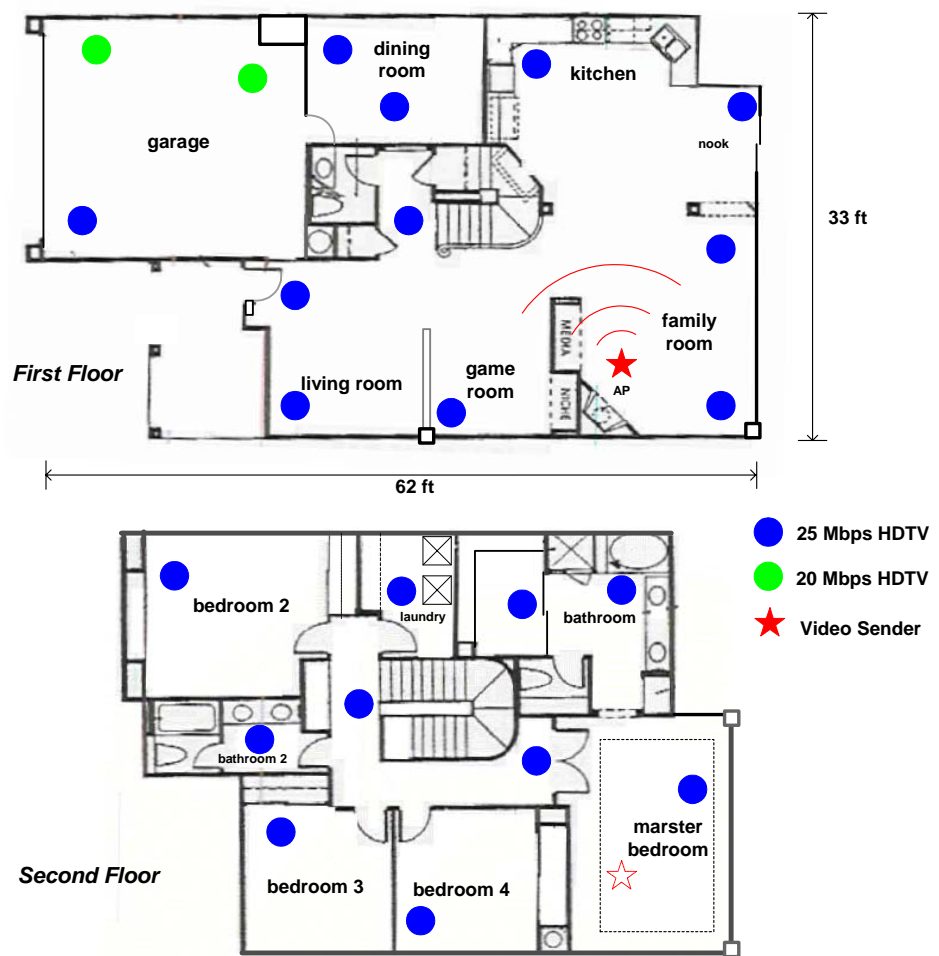


Figure 2. Field Test in Home Environment

Figure 3 illustrates the performance of WiVi™ technology in a typical enterprise environment: an approximately 10,000 square-foot office and lab space with heavy multipath and lots of moving objects and people. The link coverage is quite remarkable in that 20 Mbps HDTV stream is deliverable to most of the locations in this office/lab space except for two collection points that are shadowed by the elevator well. Even in this area, 15 Mbps SDTV stream can be easily maintained.

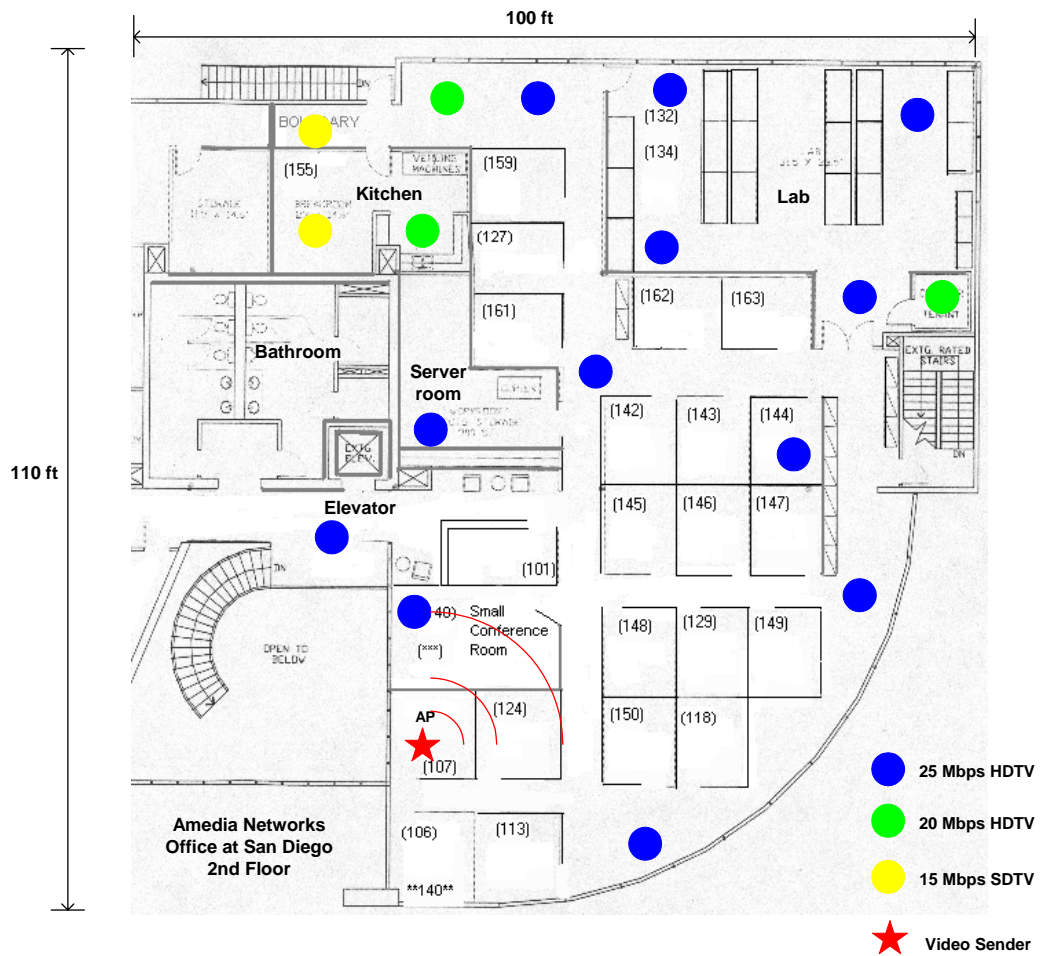


Figure 3. Field Test in Enterprise Environment

High Data Rate and Payload Efficiency

WiVi™ technology supports data rate up to 60 Mbps. More importantly, WiVi™ technology achieves an 80% video payload efficiency thus delivers up to 50 Mbps video throughput. This allows WiVi™ technology to support multiple wireless connections with full QoS. The high payload efficiency also inherently benefits link robustness. For example, WiVi™ technology can deliver the 25 Mbps payload requirement of HDTV in Japan using a 32 Mbps data transmission rate with the 80% payload efficiency. An alternate solution with only 45% payload efficiency would require at least a 55 Mbps data transmission rate in order to support 25 Mbps video payload. Note that 32 Mbps data transmission rate is much more sustainable than 55 Mbps given the same radio channel condition. So the high payload efficiency in turn helps to guarantee robust high-quality video even in the presence of sever radio channel impairments.

Reliable Link Resisting Interferences

WiVi™ technology operates at 5 GHz band. Unlike 2.4 GHz band which is rife with interfering devices such as microwaves, cordless phone and Bluetooth devices, the 5 GHz band is much cleaner and far away from common interferences. WiVi™ technology uses 20 MHz channel bandwidth, thus there are 23 non-

overlapping channels in the 5 GHz band³ compared to only 3 available channels in the 2.4 GHz band. More importantly, WiVi™ technology implemented dynamic channel selection (DCS) technique so that the system when confronted with interfering devices, can automatically detect the interference and subsequently hop to a cleaner channel without causing any video glitch on the screen. WiVi™ technology also implemented a rate/power adaptation technique so that the system needs to transmit just sufficient power (not too high, not too low) to ensure the link quality without causing unnecessary interference to its neighbor networks. This feature has made WiVi™ technology a suitable solution for dense deployment of wireless home networks.

Secure Networking

In WiVi™ technology, device authentication and data encryption using Advanced Encryption Standard (AES) with 128 bit hardware acceleration ensures any content transmitted wirelessly is safe and secure. Special network pairing feature shares a unique key between each network of AP and MT such that multiple networks can coexist within range. This also ensures privacy of each network. The network pairing feature allows total flexibility such that the user can freely control the hardware used in each network.

Complete Solution

WiVi™ technology is an end-to-end QoS solution for wireless video applications. It incorporates semiconductor and software to seamlessly interface with popular SDTV, HDTV and multimedia processors at transport stream layer. It directly supports most of the digital video formats including MPEG-2, MPEG-4, H.264 and WM9. WiVi™ technology is compatible with popular digital TV standards including DVB-T/C/S, ATSC, ARIB and OpenCable.

Unlike Wi-Fi based solutions that require a host for sophisticated application protocols and network control, WiVi™ technology is optimized for hostless applications such as TVs and other A/V consumer electronics. System integration effort therefore can be minimized for customers to develop fast-to-market wireless video products using WiVi™ technology.

Attractive Cost Point

From its architecture design of each sub-system to silicon fabrication process selection, the costs of different alternatives have been carefully analyzed and balanced in developing the WiVi™ chipset solution (WVA5000 chipset). The low-cost, highly-intergraded CMOS chipset has a built-in multimedia high-speed interface to enable seamless connection between WiVi™ chipset and standard multimedia processors. No need for any “glue” logics! As a complete solution for wireless video applications, WiVi™ technology has achieved an attractive cost point at the end product level.

Conclusion

Real-time video and audio wireless distribution within a home is fundamentally more difficult than providing connectivity for data. Amedia's WiVi™ Technology is the only 5 GHz wireless solution that addresses the high QoS video requirement and “whole-house” coverage with an attractive cost-point for consumer electronics marketplace.

³ With FCC regulation in the United States. It includes 11 new non-overlapping channels with new FCC rule in Nov 2003 that added 5.470 – 5.725 GHz band.