INTEGRATING WIRELESS INTO CONSUMER GOODS

HDMI (high-definition multimedia interface) has been embraced by content providers and has a high adoption rate in consumer electronic AV products. It extends wireless connectivity between source devices, Blu-ray DVD players, for example, and display devices such as LCD, flat panel displays

The HDMI/HDCP licensing requirement mandates that integrating an HDMI wireless solution into a home entertainment system for any extension product requires a minimum of two devices: a device to extend from the video source or transmitter, and a device to extend to, i.e. the video sink, or receiver.

Such a solution should seamlessly extend the HDMI interface on a video source to the HDMI interface on a video display just as an HDMI cable would. The most challenging aspect of this is the transfer of the video and audio data between the two video products. However, the most critical portion of the design is compliance with the encryption requirements, as approved under the terms of the HDCP license agreement.

The throughput requirement of HD video (1080i is ~1.5Gbit/sec and 1080p ~3Gbit/sec) can exceed the data-carrying capacity of a given wireless link, so a visually lossless, low-latency video codec is desirable for transporting the video signal across the wireless connection. Pulse-Link, a UWB (ultra wideband) fabless semiconductor company, developed Wireless-for-HDMI technology based on its CWave UWB chipset.

The company chose JPEG2000 as the video compression codec. It encodes each video frame independently, so it is a near real-time (low latency) encoding system. It also has better error resiliency than other encoding schemes such as MPEG-2 or H.264. Additional features, such as layering, provide for graceful degradation in the image. It can also be throttled, i.e. the video codec's bit rate can be dynamically controlled to match the wireless channels performance. At close range the maximum performance of the video codec is enabled and as the distance or channel impairments increase the video codec can be scaled to lower bit rates and performance levels.

JPEG2000 is the same high-quality video codec used by movie theatres for 'digital cinema'. Finally, there are no licensing or royalty fees with JPEG2000 (unlike MPEG).

CWave is essentially a bit-pipe for transporting digital data with quality-of-service. It is therefore capable of supporting all digital audio/video codecs on the market today such as H.264 and MPEG and even new codecs yet to be invented.

Extension Basics

The CWave chipset comprises an RFIC (radio frequency integrated circuit) and LNA (low noise amplifier) implemented in SiGe and an integrated baseband/MAC implemented in CMOS. The same chipset supports use over wireless and coax, as well as hybrid systems. Evaluation kits and reference design kits are available for coax and wireless evaluation. This solution enables bridge connections between entertainment devices communicating via 1394, Ethernet or HDMI/DVI transport formats, as well as MPEG-2 or JPEG2000 transport streams.

CWave reference designs for HDMI solutions offer real-time, visually lossless wired and wireless streaming of high quality audio and video content between entertainment devices and HDTV displays.

The goal is to ensure that the video image transmitted across the link and displayed on the HDTV will be of the highest quality possible in a given wireless environment on a frame-by-frame basis. A dynamic, real-time, self-optimising suite of JPEG video encoding rates, image layering, antenna diversity and self-adjusting PHY rates enable CWave to meet this objective.

Pulse-Link premiered the first fully-integrated wireless-for-HDMI HDTV from Westinghouse Digital Electronics

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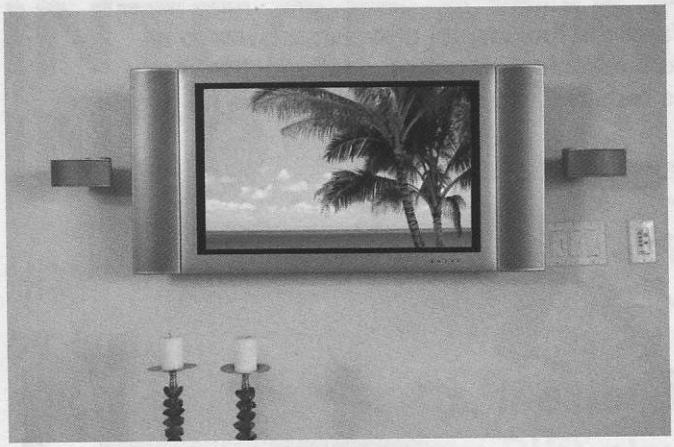

Optimal wireless

To optimise the wireless link, one of the easiest methods of maintaining link quality is through the use of antenna diversity. This is done by maintaining maximum throughput across the wireless link. Most digital radios step down through pre-determined settings to trade off between distance and throughput. There are different antennae designed for UWB, offering size, performance and coverage (omni-directional or directional) trade-offs.

Consumers may place their source devices and displays anywhere in a room without concerning themselves with wireless antenna placement or performance. So, an omni-directional antenna, is typically the preferred choice. This allows for the broadest possible configuration of transmit and receive devices from one home to the next.

There are primarily two configurations when using the CWave chipset for HDMI wireless solutions. The transmitter unit in both configurations will exist as a dongle that can be connected to one or more legacy video source devices. In one configuration, the receive unit is also a dongle that can be connected to the existing HDMI or component video port of a legacy HDTV. In the other configuration, the receive unit is integrated internally within the HDTV.

Antenna choice and placement are important design considerations. A directional receive antenna can be used, but is typically best-suited for professional installations. A variety of omni-directional UWB antennas are available. Larger antennae will perform better, but smaller antennae are available to meet various product design objectives. Size can range between a few inches long for a dipole antenna down to 'fingernail' size for smaller antennae.

If at least two antennae are always employed at both the transmit and receive ends of the wireless link, each antenna functions as a dual transmit/receive antenna. Antenna diversity provides increased performance as the physical separation between the two antennae increases.

A transmitter dongle will typically be placed inside a multimedia equipment rack or wall unit alongside the other video-source devices, so the antenna separation will typically be no more than 17in to 19in. This is consistent with the width of similar video-source devices to which the transmit unit is connected. This antenna separation can be achieved by either a permanent/fixed design of such width for the transmit dongle itself, or by using a flexible cable leading from a smaller dongle to one or more antennae that the consumer can place as desired. With such small antenna separation, signal loss due to antenna connector cables is not an issue.

Leveraging gains

The performance gains made possible through antenna diversity can be leveraged at the receive side of the wireless link. If possible, position the two antennae as far apart as the HDTV display is wide. Here, the use of a flexible antenna cable between the receive dongle and at least one external antenna is the most desirable design. If the receive unit is to be integrated within a new flat panel display, the antennas can be mounted inside the television frame on both the right and left sides of the HDTV.

One of the many benefits of the CWave chipset design is that it includes a LNA along with the CWave RFIC and baseband/MAC chips. This separate low-cost (sub-$1) LNA chip can be mounted directly at the antenna itself, physically separate from the RFIC and baseband/MAC chips. When an LNA is mounted at the antenna, the signal received at the antenna is amplified before being sent down the wire connecting the antenna to the chipset.

When the receiver is integrated within an HDTV panel, the panel's size and form factor typically allow for good separation between the two antennae to assist better performance for antenna diversity. However, the minimal panel thickness can also affect the size of antenna that might be used. The covers on a given HDTV panel are typically plastic and do not affect RF performance, but the interior typically contains a metal framework that supports the weight of the glass panel. The antenna design chosen for use within the LCD panel is typically a low cost, omni-directional, PCB design that could be easily mounted in the thin confines of the LCD packaging.

Directional antennae can be considered but when using them it can be difficult to achieve 'anywhere in the room' coverage with diversity. Custom installation for a particular room layout is often needed to ensure that directional antennas are properly aligned for the necessary wireless signal connection.

Thermal dissipation must be achieved within either the dongle enclosure or the HDTV unit inside which the wireless chipset will reside. This must be accomplished without the use of forced air-cooling (fans clog with dust, are noisy, and reduce device reliability).

The company provides two HDMI inputs and one component input. This allows up to three video sources to be wirelessly connected to the HDTV. The video source can be selected either manually by a select button on the transmitter or automatically, based on which input devices are powered on.

Remote control of these source commands can be performed either by using standard CEC commands supported by any remote control and included as part of the HDMI specification, or by the use of an infra-red back channel. A separate wireless link is established between the transmitter and receiver to pass infra-red signals from any remote control unit. The HDMI receiver reference design has an infra-red receiver and can repeat this signal from the HDMI transmitter to retransmit the infra-red signal to its local source devices.

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