



*A/V Connectivity Without Compromise*

IEEE Consumer Electronics Society  
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# What's Required for Wireless in CE?

1. Ability to stream uncompressed (baseband) HD video along with audio and data
2. Provide a high-reliability viewing experience
3. Deliver low cost product to consumers
4. Provide low power solutions for portable devices

# WirelessHD Consortium

*Started in early 2005, seven market leaders and industry experts have joined together to create a special interest group, the WirelessHD™ Consortium, to develop an interoperable wireless specification for a wireless high-definition digital interface that is intended to enable high-definition baseband audio/video (A/V) streaming and high-speed media transmission for consumer electronics (CE) devices.*



Panasonic

NEC

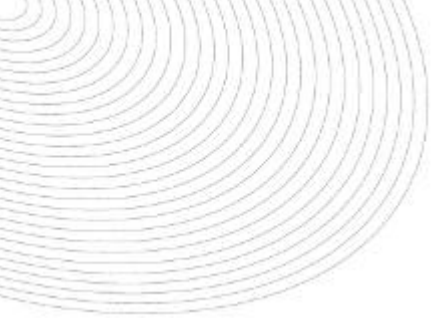


SONY

TOSHIBA

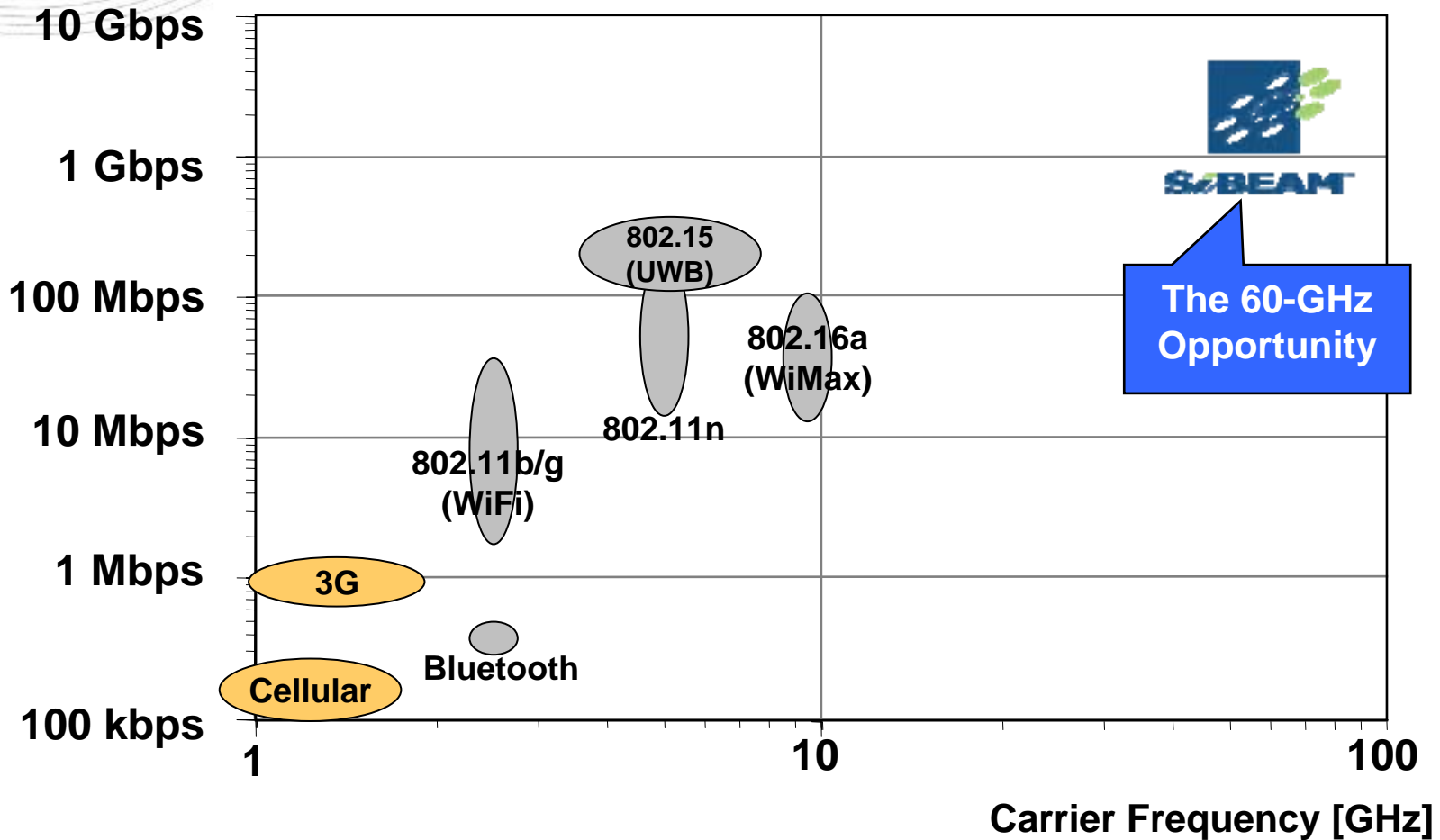
# WirelessHD Key Characteristics

- Open special interest group for wireless video area network (WVAN) specification
- Uncompressed HD video, audio and data transmission, scaleable to future high-definition A/V formats
- Smart antenna technology for reliable, high-quality consumer experience
- Device control for simple operation of consumer electronics products
- Up to 4 Gbps data rates at 10 meters in-room
- Interoperability supported by major CE device manufacturers
- Device control for simple operation of consumer electronics products
- Error protection, framing and timing control techniques for a quality consumer experience



# Why 60 GHz?

# Wireless Communications Landscape



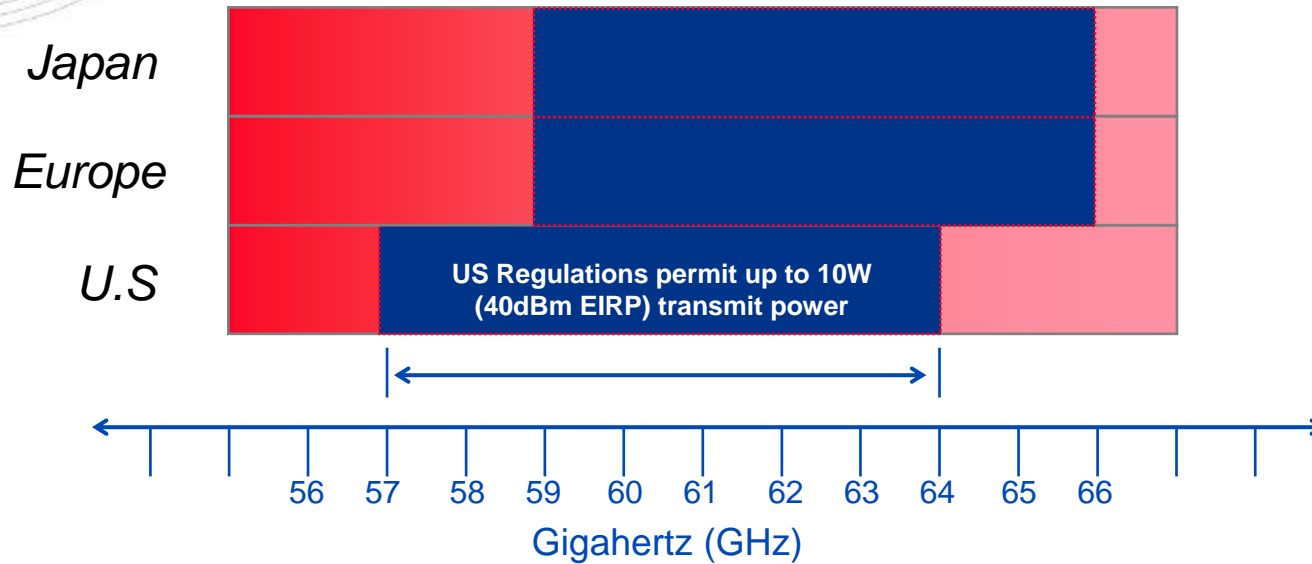
# 60GHz Advantage for High Rate Applications

	Spectral Availability	Max Transmit Power (EIRP)	Max Raw Data Rate	bps/Hz for 4 Gbps (WiFi = 2.7)	WW Availability
<b>60 GHz</b>	<b>7 GHz</b>	<b>8,000 mW (39 dBm)</b>	<b>25,000 Mbps</b>	<b>1.6 bps/Hz with 2.5GHz channel</b>	<b>Y</b>
802.11n	0.66 GHz	160-3200 mW (22-35 dBm)	600 Mbps	100.0 bps/Hz with 40MHz channel	Y
UWB	1.5 GHz – 7.5 GHz*	0.1 mW (-10 dBm)	480 Mbps	8.0 bps/Hz with 520MHz channel	N

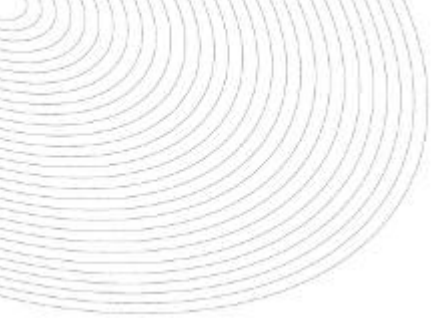
**60 GHz best achieves gigabit-plus data rates!** \* Depending on geography



# Worldwide Availability & License Exempt Operation

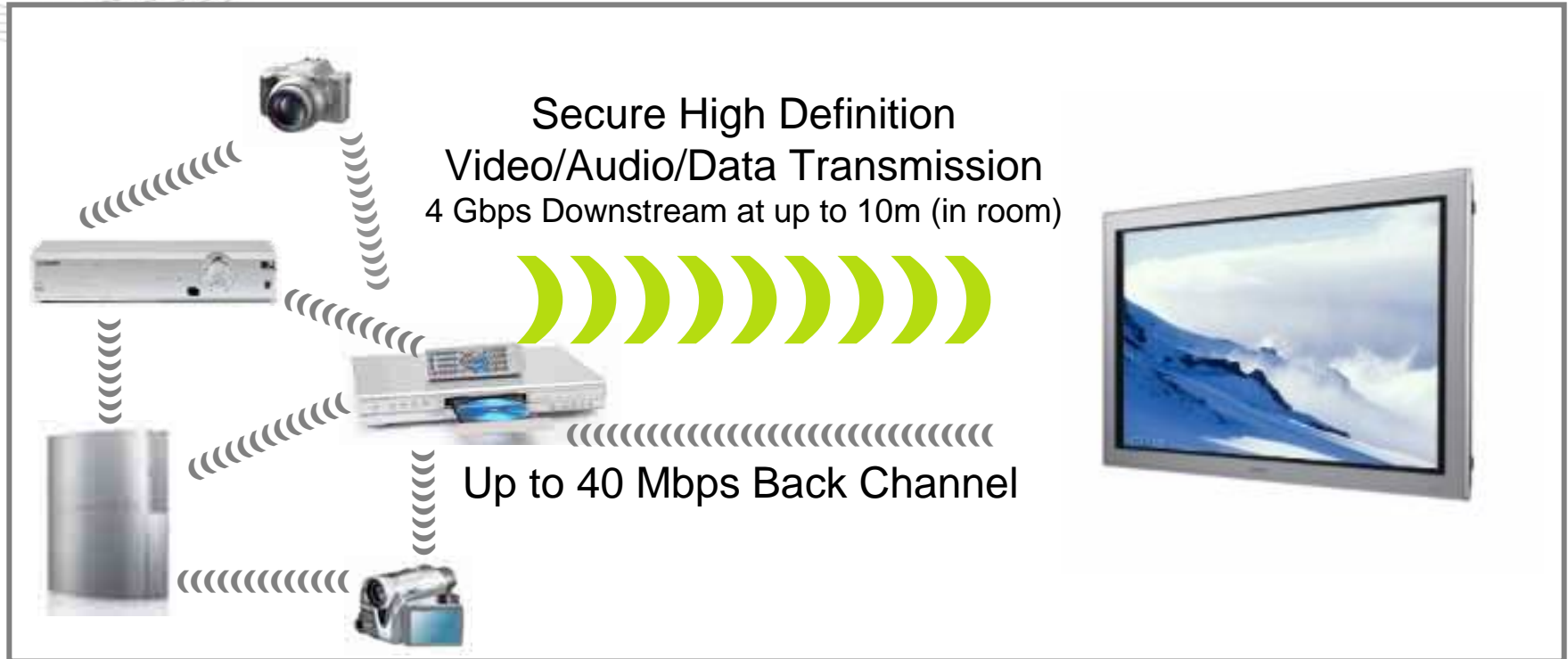


- Regulatory status is stable and predictable
  - FCC - license free in US
  - MIC - license exempt in Japan
  - EU- license exempt in most EU countries
- Results in affordable, global products requiring minimal homologation



# WirelessHD - Intelligent Wireless Video Area Networks

# Enabling Wireless Video Area Networks



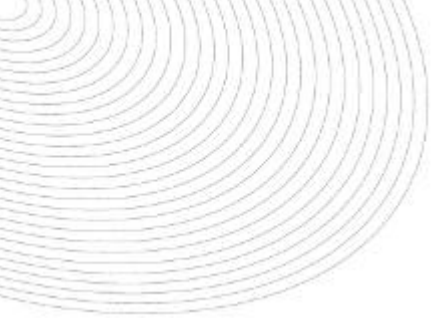
# WirelessHD - Enabling WVANs



## Wireless Video Area Networks (WVAN)

1. Determines devices are in WVAN
2. Device capabilities exchanged
3. Continuous monitoring of WVAN and stations within or joining/leaving WVAN





# Compressed vs. Uncompressed

Why is this so important to CE manufacturers?

# Challenge of Compressed Plus UWB/WiFi

- Incremental system cost
- Lack of standards
- Interference with other 802.11-based networks
- Impacts consumer experience – both latency and image quality



**Set-top Box**



**HDTV**

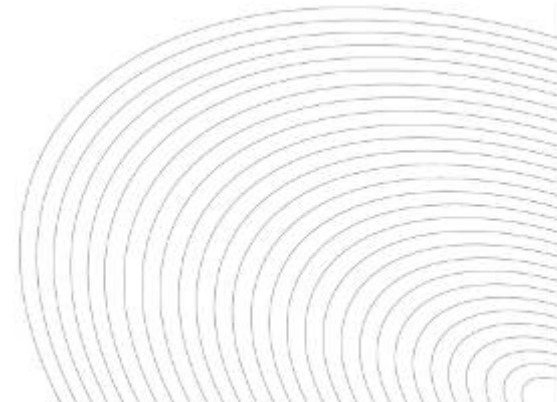
# The Uncompressed Value Proposition

- Lower cost solution
- Avoids encoding generated latency
- Preserves best image and audio quality
- Copy protection
- WirelessHD specification compliant





## Usage Case Scenarios



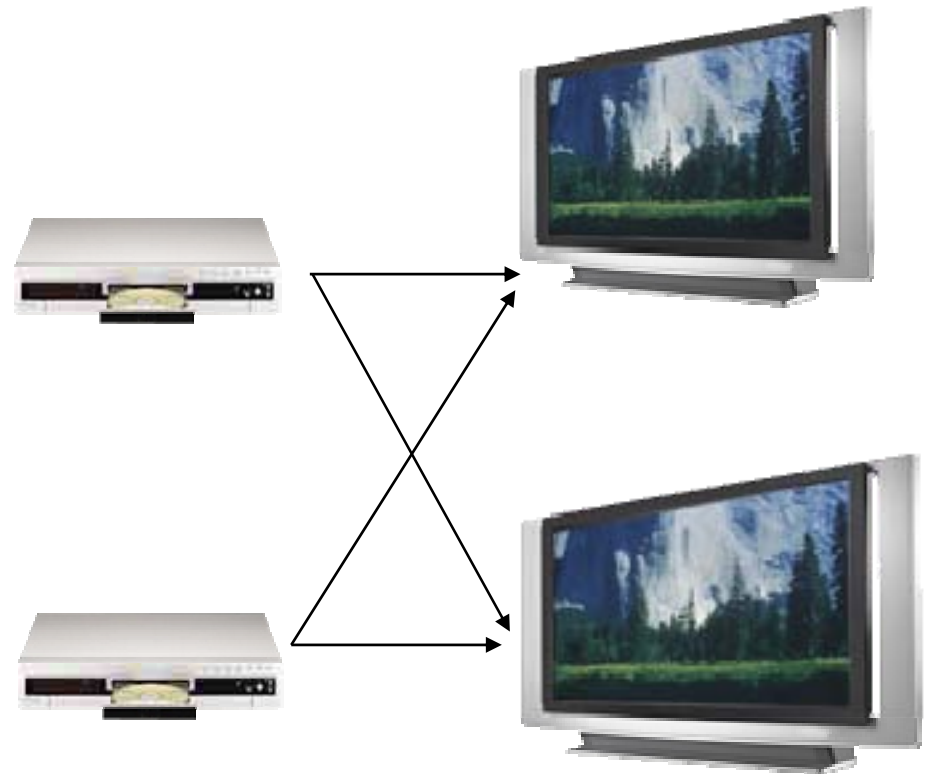


# Direct Audio/Video Streaming

HDTV, HD Projectors, HD Disc (BD/HD-DVD), Set-Top Box (STB)

- Summary Requirements

- 1080p resolutions, scalable
- $10^{-9}$  pixel error rates
- Support all EIA-861 video formats
- Multiple video streams for picture-in-picture (PIP)
- Multiple video streams for single source to multiple displays
- Range of up to 10m near line-of-sight
- Device control



# Networked A/V Streaming

Home Theater (HT) Systems, Audio/Video Receivers, Speakers)

- Summary Requirements

- 13.1 channels of 24-bit 192 KHz compressed Dolby TrueHD or DTS-HD audio, 5.1 channels of 24-bit 96 KHz multi-channel LPCM audio, 2 channels of 192 KHz 2 channel LPCM
- Maximum of 15ms latency between multi-channel links, 5 ms typical
- Device control and monitoring of multiple sources and displays or speakers

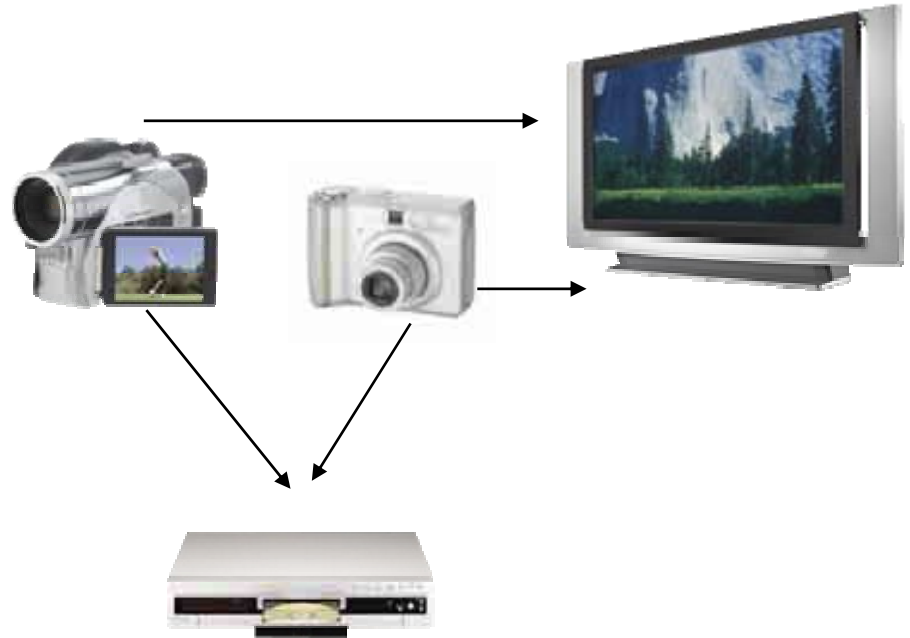


# Multimedia Streaming and File Transfer

Digital Still Camera (DSC), Digital Video Camera (DVC), Digital Video Recorder (DVR)

- Summary Requirements

- Multi-way copy-managed communication in both compressed (MPEG2, MPEG4, H.264, et. al.) and uncompressed (EIA-861) formats
- Low power and short range modes
- Multi-device video recording and editing control capability
- On-the-fly resolution and frame rate adjustment

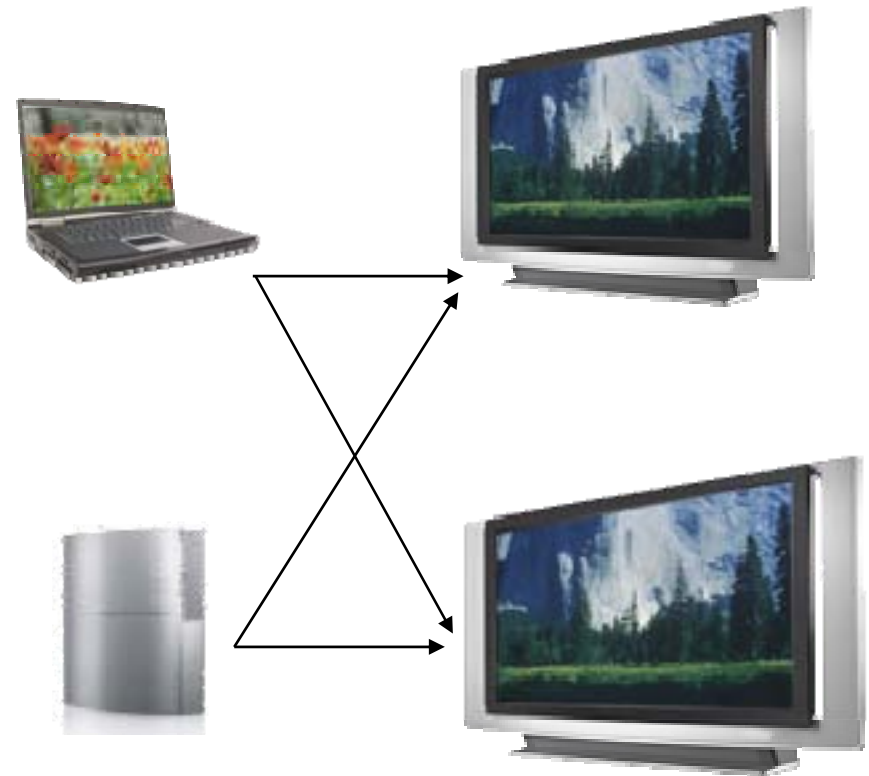


# Rendered Streaming

## Gaming Consoles, Personal Computers

### •Summary Requirements

- Scalable video/audio capability support
- Extremely low latency mode with direct communication links of less than 1ms
- Multiple color management and gamma control profiles linked to individual source/display pairs



# HD Source & Display Markets Are Growing!

*Market growth for devices generating and storing high resolution content is growing dramatically*

- Worldwide sales of devices with a high-speed digital A/V interface is expected to grow from 60M units in 2006 to 495M units in 2009. (In-Stat/MDR)
- Worldwide LCD TV sales surged in the April-June quarter by 135% to 9.4 million units over the same period in 2005. (DisplaySearch 2006)
- Worldwide plasma TV sales rose 95% to 2.2 million units in the same period (DisplaySearch 2006)
- Worldwide DVRs with a high-speed digital A/V interface are forecasted to grow from 3.35M units in 2006 to 20.45M units in 2008 (InStat/MDR)

# Summary

- Leading CE manufacturers have jumped into WirelessHD and 60GHz
- Manufacturers are choosing the better and more scalable solution, rather than the early solution
- Technology is ready for consumer price points
- WirelessHD is the **first** wireless specification that is:
  - Application-focused
  - CE industry-supported
  - Based on 60 GHz for *true* uncompressed A/V streaming

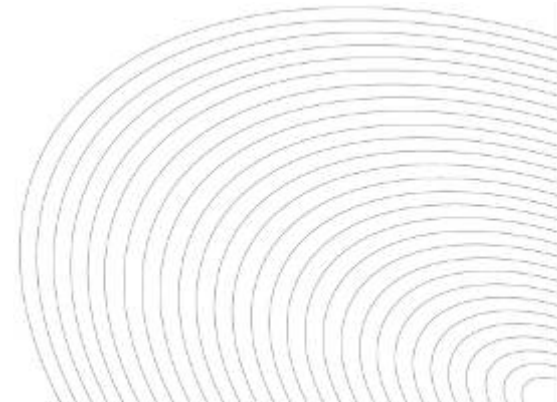
# Q&A

- Q: Will WirelessHD support MPEG Surround?
  - A: Absolutely! The data rate allocated to audio is plenty to handle any compressed audio format.
- Q: What do our CE partners say about lossless compression? Have they looked into it?
  - A: It is something that they would consider in the shorter term, but feel that uncompressed offers the best video quality, lowest latency and lowest cost.
- Q: How is UEP used in the WirelessHD spec?
  - A: At this time we cannot comment – this is a detail of the spec that has not yet been made public
- Q: What about health & safety of 60G?
  - A: A health & safety white paper has been included in the WirelessHD presentation follow-up materials. Similar safe radiation limits have been established for all consumer products (cell phones, TV station towers, microwave ovens, etc.). More data on the tests are available on the Internet.
- Q: Is WirelessHD just a cable replacement?
  - A: While one could argue that all wireless is cable replacement, the short answer is no. WirelessHD is more than a cable replacement because it enables a wireless video area network or WVAN. The coordinator, typically the TV, periodically sends a signal around the room to locate and exchange information about other WiHD-enabled devices. Once that information is exchanged, users are able to remotely control each of the device in the network. Not only can a DVD player 'talk' to a TV, it can also 'talk' to other devices in the room. An example is a customer may want to create a DVD from content on their HD digital video camera.
- Q: Are the antennas made using CMOS?
  - A: At this time, SiBEAM is not disclosing certain aspects of the chipset design. What we can say is that the 36 antenna array (ceramic substrate) is integrated with the 60G radio, which is mf'd using standard CMOS, as is the baseband.
- Q: How can I get the SiBEAM smart antenna animation demo?
  - A: It will be posted to the SiBEAM home site within the next few weeks
- Q: Explain  $10^{-9}$  bit error rate (BER)
  - A: A TV screen is made up of pixels. A 1080p HDTV has 1080 x 1920 pixels or a total of 2,073,600 pixels. Each pixel has 24 bits, 8 each for reds, greens & blues (RGB). BER is the percentage of bits that have errors relative to the total number of bits received in a transmission, usually expressed as ten to a negative power. The WirelessHD spec dictates a BER of 10 to the minus 9, meaning that, out of 1,000,000,000 billion bits transmitted, one bit was in error. This is an extremely high standard for wireless video delivery and equal to the latest HDMI specification.
- Q: Who else is working on 60G?
  - A: Most recently, due to the higher cost of previous 60 offerings and line of sight limitations, most applications have been in the military to communicate between ships and enterprise to extend LANs between buildings. Bridgewave Communications (not Terabeam as I erroneously noted) is an example of a company who offers this.
- SiBEAM White Papers: <http://www.sibeam.com/products/whitepapers.html>





Thank you.







**SiBEAM™**

*wireless beyond boundaries*

## 60GHz Safety

**Notes on safety aspects of wireless devices operating in the  
60GHz band of radio spectrum**

Dr. Gary L. Baldwin

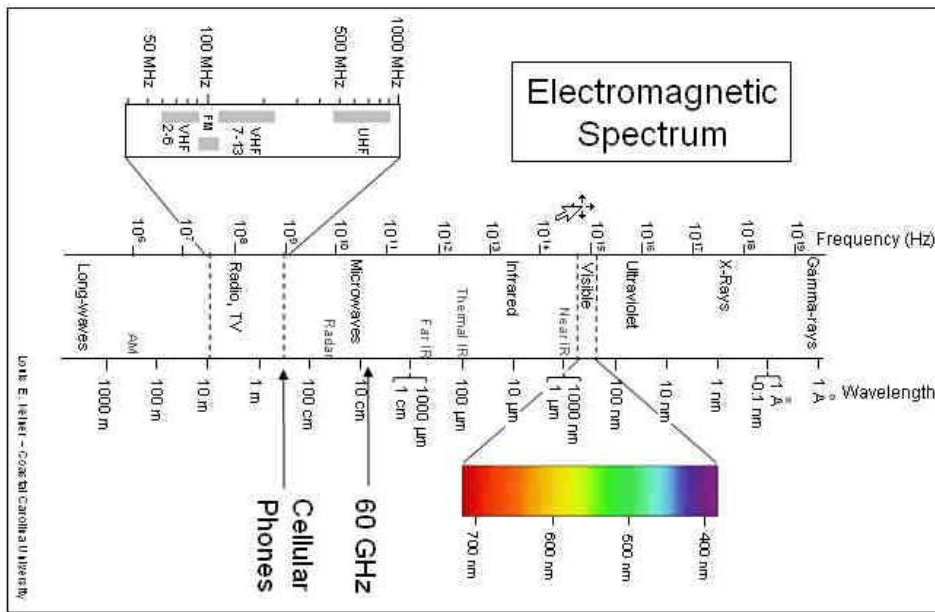
May 2007

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Over the past several decades, use of electromagnetic energy in the form of radio waves in consumer electronics has increased dramatically. In addition to radios and TVs, the omni-present cell phone and other wireless devices operate in some portion of the electromagnetic (EM) spectrum, ranging from a few megahertz up through infrared (see diagram below). Even TV / DVD / VCR remote controllers operate in some portion of the EM spectrum, whether their source is radio waves or an infrared light beam.

Any EM energy (sunlight is a familiar example) can be harmful if use is excessive or is outside the bounds that have been established to insure safe exposure for humans or other animals. Since it is always in the best interest of personal and public safety for consumer devices like those mentioned above to operate well within limits of safety, numerous medical, professional, and government oversight organizations have been most active in setting industry standards and licensing policies to protect the users of these devices.

Like those devices that operate in the lower microwave regime (cellular telephones (0.8 to 1.9 GHz) and wireless Internet access systems (2.4 to 5.8 GHz and higher)), wireless systems operating between 57 and 64 GHz are strictly regulated regarding the amount of output power that they may safely emit, in compliance with a rigid set of safety standards established by the



FCC. These standards are based on solid medical experimentation and evidence that show where the limits lie and what guidelines must be established to protect individual users. These standards and recommendations reflect the consensus of the scientific community and result from deliberations of panels and committees of scientists and citizens who continually review and interpret the extensive research literature.

The limits established by the FCC differ for different kinds of radio emissions in different parts of the spectrum. The usual concern is the potential for damage to biological tissue by too much exposure, and that damage has been found to be a function of the depth of penetration of the radio

waves into the biological tissue. Owing to the extremely short wavelengths used by wireless devices operating in the oxygen absorption band, the depth of penetration is limited to the superficial layers of tissue that are biologically sensitive. Ocular tissue is of principal concern because of its unique structure, location, biochemistry, physiology, and sensitivity to various physical agents<sup>1</sup>.

The FCC established its limitations on radio emissions in the 57 – 64 GHz based on the results obtained from the study by Dr. Kues cited in (1) above. From that study, it appears that neither single nor repeated exposure to 10 mW/cm<sup>2</sup> from a 60 GHz continuous wave source results in any observable ocular changes to the eyes of subject animals.

The FCC limitation for radiated power in the oxygen absorption band is fully ten times lower than that which was found in the Kues study<sup>2</sup>. Specifically, no commercial wireless systems operating in that band may radiate more than 1 mW/cm<sup>2</sup>, nor may it transmit more than 500 mW of peak power at any given time. That is **fully ten times lower** than the lowest level studied in the medical experiments, and – again – even that level produced no observable effects.

An additional safety factor results from the separation of 60 GHz devices from their users. The devices envisioned for the 60 GHz band operate much farther away (greater than a meter) from any human or other biological tissue than cell phones or other familiar consumer radio devices. In addition, owing to the limitations imposed by the electronics contained in these devices, they are simply not capable of putting out enough power to exceed the limitations imposed by the regulations.

Therefore, any wireless device operating in compliance with the international regulatory limitations established for the 57 – 64 GHz band will be completely safe for use by consumers.

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<sup>1</sup> *Absence of Ocular Effects After Either Single or Repeated Exposure to 10 mW/cm<sup>2</sup> from a 60 GHz CW Source*, Henry A. Kues, et. al., *Bioelectromagnetics*, Vol. 20, 1999, pp. 463-473.

<sup>2</sup> *Federal Register*, Vol. 63, No. 152, August 7, 1998, p. 42280.