



**HDMI**<sup>TM</sup>  
HIGH-DEFINITION MULTIMEDIA INTERFACE

# Connect Everything.

One Cable. One Standard.  
The Future-ready way to connect HD.

# Agenda

- HDMI Market Update
- New HDMI Trademark Usage Guidelines
- HDMI and Wireless
- HDMI/HDCP Compliance
- Clarifying Confusion between DisplayPort & HDMI



# HDMI Market Update

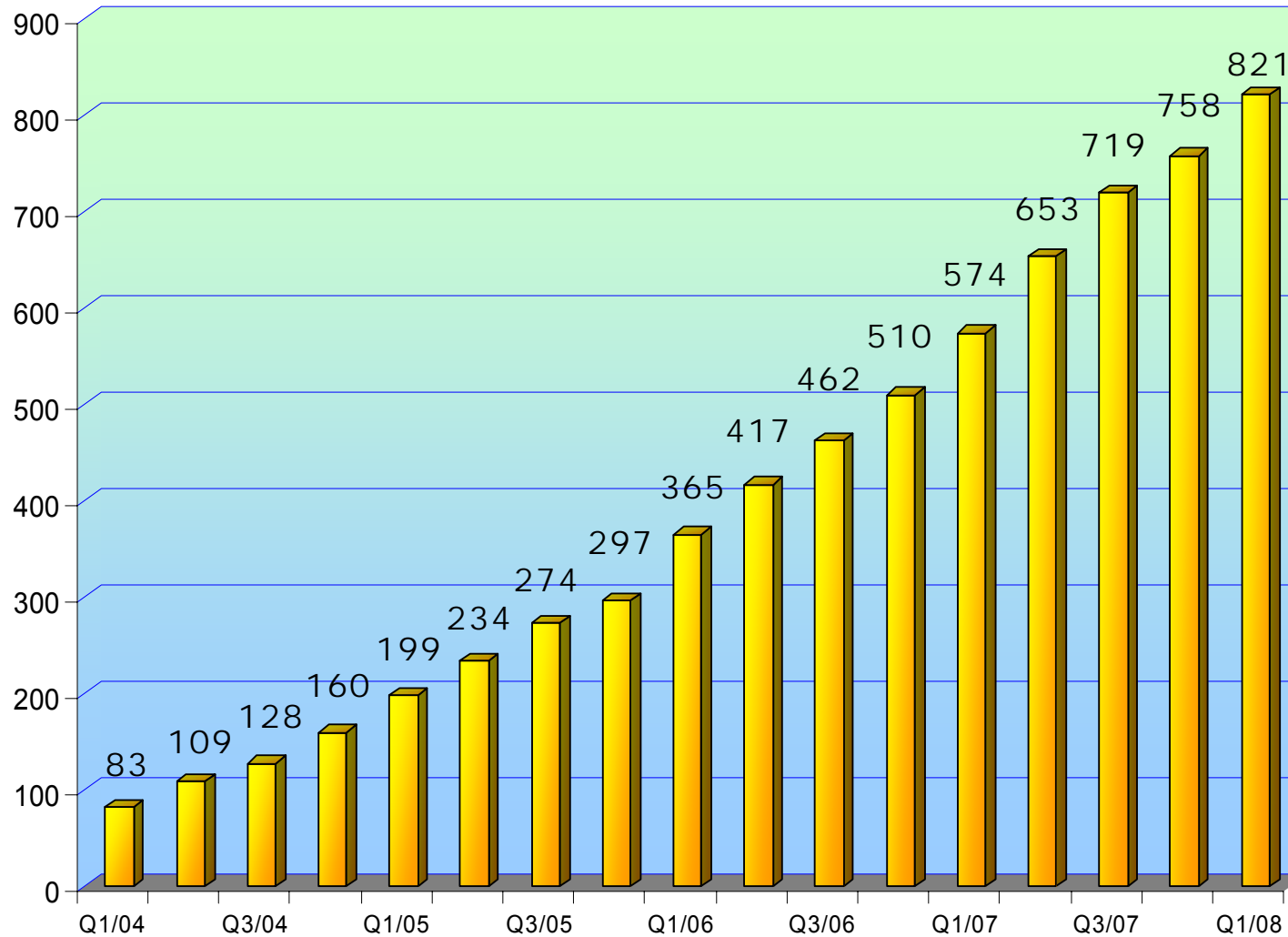
One Cable. One Standard.  
The Future-ready way to connect HD.

## HDMI Market Today

- HDMI is the de facto standard digital connection for consumer electronics
  - HDMI delivers the highest-quality audio and video signal over a single cable
- HDMI has achieved global acceptance\*
  - Over 800 manufacturers will ship nearly 230 Million HDMI-enabled devices in 2008
  - 2010 - installed base of nearly 1 Billion HDMI devices
    - 1.5 Billion HDMI + DVI

\*Source: In-Stat, Nov 2007

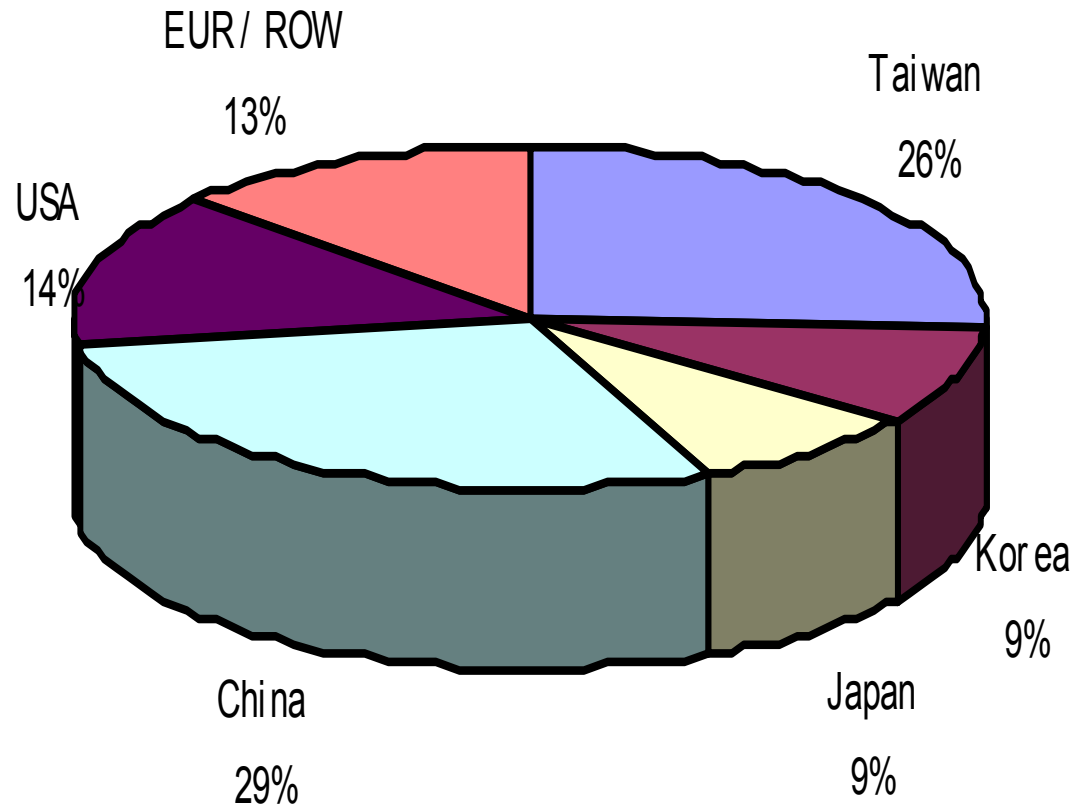
# Growth of HDMI Adopters



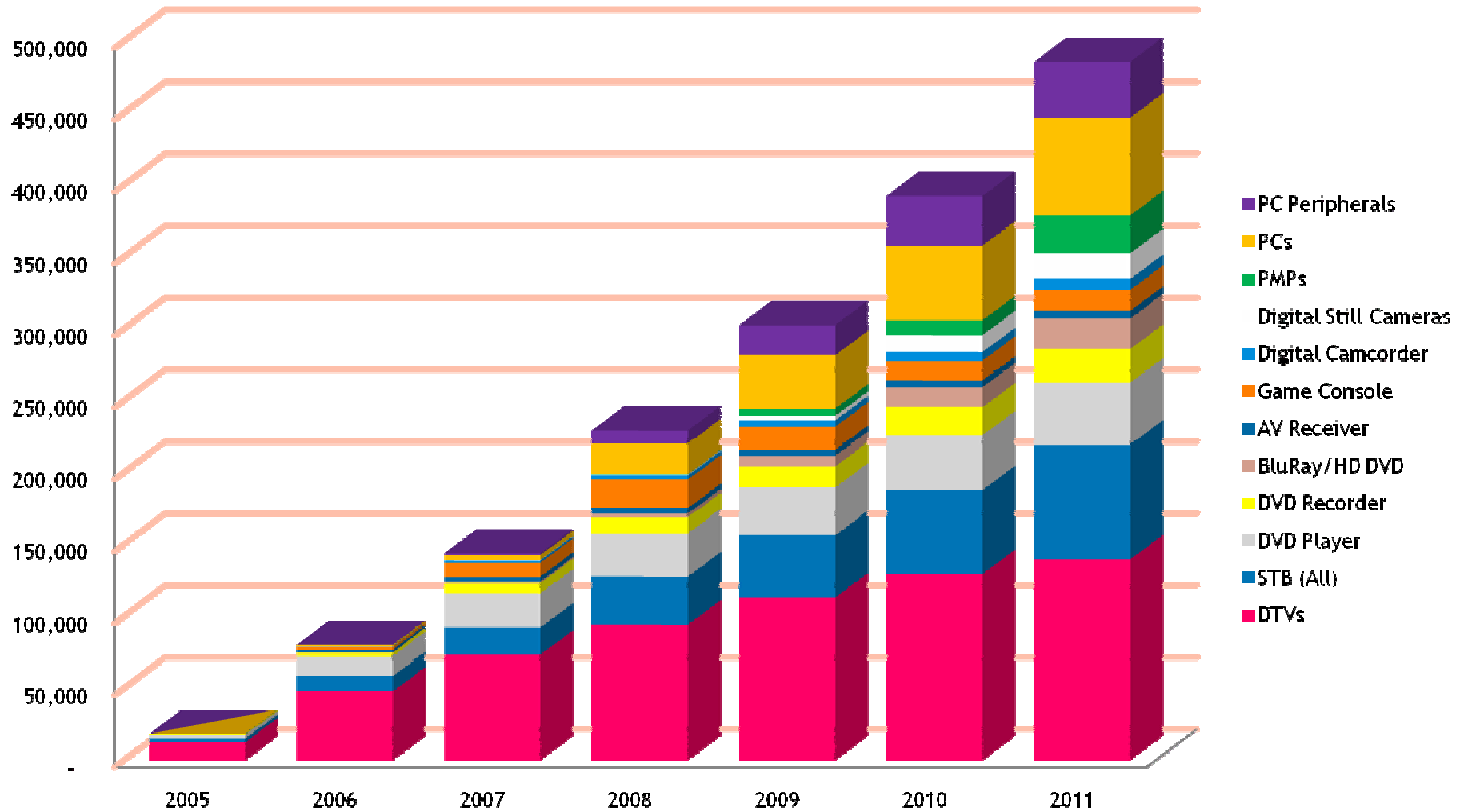
Source: 6/23/2008, HDMI Licensing, LLC

# 821 licensees as of March, 2008

*(does not include 7 HDMI Founders)*



# HDMI Device Growth 2005-2009



\*Source: In-Stat, Nov 2007

## HDMI Market Today

- HDMI emerging feature on portable devices & PCs
  - Becoming standard on HD camcorders (Sony, Panasonic, Canon, Sanyo), also digital cameras
  - Becoming standard on PC with media capability, particularly laptops
    - Required by Vista to view Blu-ray movies
    - Only HDMI is backwards compatible with DVI
- What's next?
  - Expect to see HDMI on cell phones, PMPs, more game consoles, and more PCs (potentially replacing DVI)

# Inaugural HDMI Developers Conference Shenzhen, China

- Held on 2007-09-12 in Shenzhen, China
- Co-sponsored by CVIA (largest Chinese CE organization)
- Keynote addresses by MII, HDMI, BestBuy, TCL and Sino Market Research
- Technical Seminars from Agilent Technologies, DCP, Quantum Data, Silicon Image, Simplay Labs, and Tektronix
- Approximately 350 attendees, primarily from China
  - Few of the companies that attended: Northstar, Foxconn, Freeport, Konka, Nvidia, Sanyo Shenzhen, Thomson, Zoran and many more CE companies from China

# 2008 HDMI Developers Conference Taipei, Taiwan

- 2008-9-11 in Taipei, Taiwan
- Keynote addresses by HDMI and Best Buy
- Technical Seminars from Tektronix, Agilent Technologies, DCP, Quantum Data, HDMI, Asus, and Silicon Image
- Sponsors: IIC Taiwan, Best Buy, Tektronix, Agilent Technologies, Quantum Data, Silicon Image, Sure-Fire, Asus, and many more.

Go to [www.hdmi.org](http://www.hdmi.org) to register!



# New HDMI Trademark Usage Guidelines

One Cable. One Standard.  
The Future-ready way to connect HD.

## New Guidelines: Why?

- Customers are confused about HD features and their benefits
- Difficult to have a conversation with consumers about technologies and their benefits
- Solution: define a common language to explain HDMI-enabled functionality
- Help manufacturers, retailers and installer to easily communicate HDMI features to consumers

# Compounding Confusion

- Some products focus on marketing only HDMI version number
  - HDMI LLC. encourage consumers to look for the specific features, not the version number
  - Limited effectiveness, given all of the technologies coming to the HD market

# New HDMI Branding Guideline

- Launching the new HDMI Trademark Guideline to address these issues
- Copies of the guidelines are available online:  
[http://www.hdmi.org/manufacturer/trademark\\_logo\\_pub.aspx](http://www.hdmi.org/manufacturer/trademark_logo_pub.aspx)
- Released 2007-09-17
- Goes into affect 2008-09-17

# Referencing HDMI Versions and Functionality

- Using only the version numbers (1.x) to describe the product's features or capabilities are no longer allowed:
  - Examples:
    - “HDMI 1.x”
    - “HDMI 1.x Compliant”
    - “Supports HDMI 1.x features, such as Deep Color and much more!”
    - “Supports HDMI 1.x features like Jeff’s super ABC!”

# Referencing HDMI Versions and Functionality: What's NOT allowed

- 6 A/V inputs, including:
  - 2 composite video
  - 2 S-video
  - 2 component video (accepts signals up to 1080p)
  - 2 HDMI v1.3 digital audio/video inputs (accepts signals up to 1080p)

Lots of connections, made easy: loads the industry with three rear HDMI 1.3 inputs and two rear component inputs for maximum HD connectivity. Both a front HDMI 1.3 input and front component video input allow you to easily connect your favorite HD game system.

Composite Video Outputs	Y
Component Video Outputs	Y
S-Video Outputs	Y
HDMI Outputs (Version)	1.3
Optical Digital Audio Outputs	Y
Coaxial Digital Audio Outputs	Y
Analog Audio Outputs	Y

# Referencing HDMI Versions and Functionality

- Usage of version numbers requires specific listing of all supported HDMI-specific functionality. For example:
  - “HDMI 1.x with Deep Color and x.v.Color”
  - “Supports HDMI 1.x features, such as Deep Color, x.v.Color and Lip Sync”
- Usage of version numbers are not required.
- Use of your own brand name for HDMI feature is prohibited (i.e. Deep Color, x.v.Color, etc.)

# Branding Guidelines Define Minimum Functionality

- Defines the minimum required functionality for the HDMI-enabled optional features
  - Deep Color Functionality
  - Extended Color Gamut (x.v.Color)
  - Audio
    - Recommended to list supported formats (i.e. SACD, Dolby TrueHD, DTS-HD MA, etc.)
  - Connectors
    - Type A = “HDMI Connector”
    - Type C = “HDMI Mini Connector”
  - Cables
    - Category 1 = “Standard HDMI” (74.25MHz)
    - Category 2 = “High Speed HDMI” (up to 340MHz)
  - Lip Sync (coming soon)

## Extended Color Gamut (x.v.Color)

- Requirements to list this feature:
  - Name and Logo Guideline for “x.v.Color” v2.1
  - HDMI “x.v.Color” Logo Technical Usage Guidelines for “x.v.Color” v2.1H
- Use the term “xvYCC” as a brand or description is prohibited.
- Devices shall be capable of delivering/accepting over interface, processing, and, for displays, displaying a greater color range than sRGB.

# Deep Color Functionality

- Deep Color Signal (defined for branding purposes)
  - Support 12-bit Color Depth (per HDMI spec)
  - Defined as a data stream having color bit depth greater than 8 bits per color where at least 10 bits are meaningfully derived, without the use of dummy bits
- Deep Color Sources
  - Transmit Deep Color signal
  - Support a clock speed of at least 111MHz for 4:4:4 color format, or 74.25MHz for 4:2:2 color format

# Deep Color Functionality

- **Deep Color Sink (display)**
  - Accept Deep Color signal
  - Processing the signal at greater than 8 bit color depth
  - Render/Display color bit depth of greater than 8 bits per color
  - Support a Max TMDS clock of at least 111MHz for 4:4:4 color format or 74.25MHz for 4:2:2 color format
- **Deep Color Repeater**
  - Pass a Deep Color Signal from a Deep Color source to a Deep Color sink

# Deep Color Minimum Requirements

	Before Oct. 17, 2008	Starting Oct. 17, 2008
HDMI Tx/Rx	12-bit	12-bit
Video Processing	None	10-bit
Display Panel (Sink only)	None	10-bit



**HDMI**<sup>TM</sup>  
HIGH-DEFINITION MULTIMEDIA INTERFACE

# HDMI and Wireless

One Cable. One Standard.  
The Future-ready way to connect HD.

# HDMI and Wireless

- There is no such thing as Wireless HDMI!
  - However, there are several companies working on wireless solutions for HD



# HDMI and Wireless

- The world is increasingly becoming a hybrid environment
- Wired versus wireless is a trade off between:
  - Mobility and speed (PCs)
  - Convenience and quality (Home Theater)
- Wired connections will remain the solution of choice for delivering the highest possible audio-video quality in the near term.



# HDMI/HDCP Compliance

One Cable. One Standard.  
The Future-ready way to connect HD.

# HDMI/HDCP ATCs Worldwide

Silicon Image ATC  
Shanghai, PRC

Sony ATC  
Tokyo, Japan

NXP ATC  
India

Silicon Image ATC  
Shenzhen, PRC

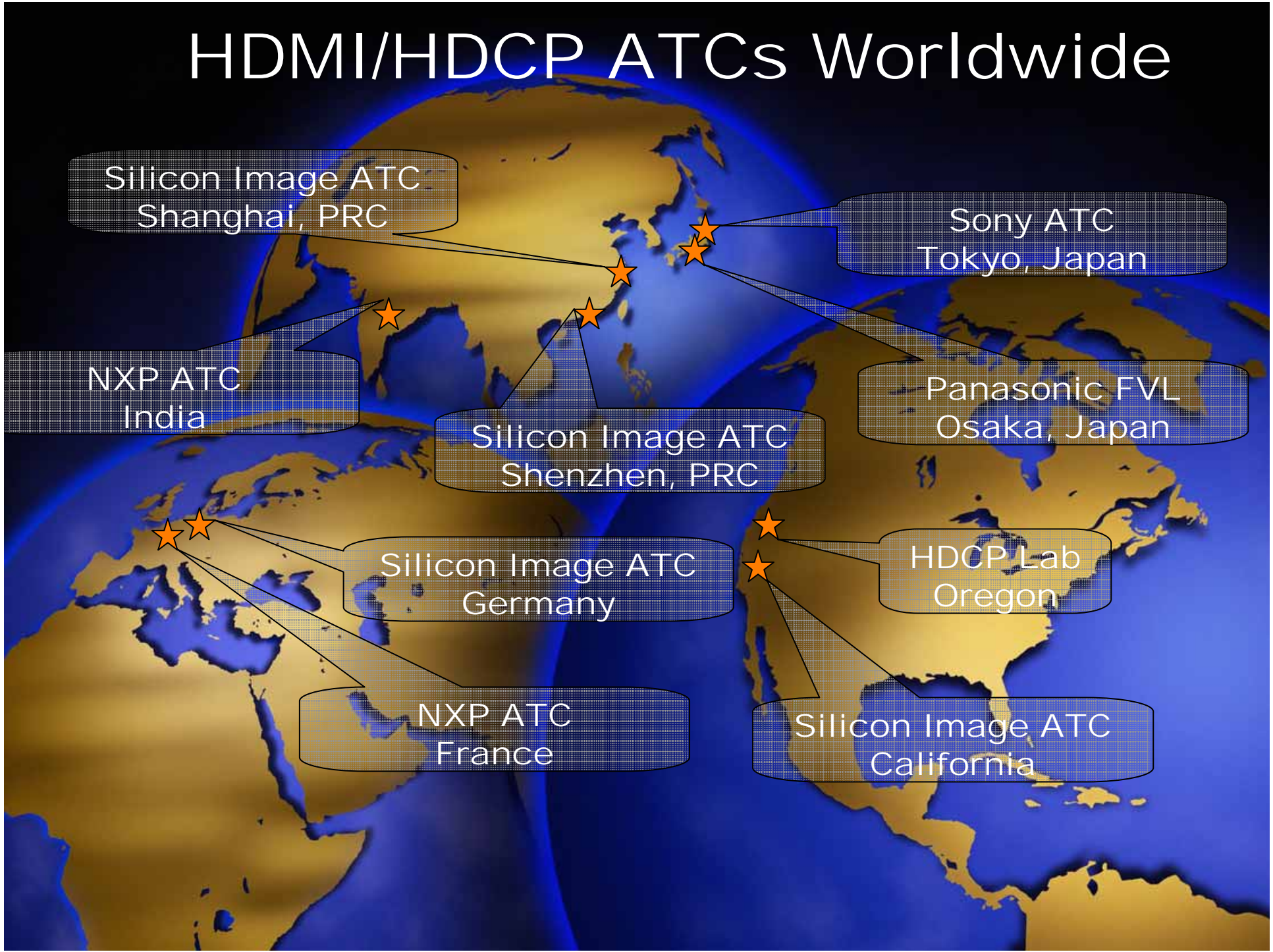
Panasonic FVL  
Osaka, Japan

Silicon Image ATC  
Germany

HDCP Lab  
Oregon

NXP ATC  
France

Silicon Image ATC  
California



## HDMI/HDCP ATCs

- All eight HDMI ATCs have full HDCP testing
  - Part of HDMI 1.3 testing
- HDCP only testing is offered at DCP LLC HDCP Lab
  - No charge to licensed HDCP Adopters to use this lab for self testing
  - Includes basic interop testing and is not part of the ATC report
- Self testing tools are available

# HDMI Test Tools

- Sample list of test tools used within ATCs
  - Tektronix
    - DPO/DSA70804, P7313SMA, DTG5334, DTG5274, AWG7102, AFG3102, TDS8200B
  - Agilent
    - 86100C, 54754A, 86112A
  - Quantum Data 882CA
- Complete list available in the HDMI CTS

# HDCP Test Tool

- Panasonic Universal Interoperability Test Analyzer - UITA-2000
- Used in all eight HDMI ATCs for HDCP testing
- Performs all 1A, 1B, 2C, 3A, 3B, 3C
- Requires external Source, Sink and Repeater
- Available for purchase for manufacturers through DCP



# HDMI/HDCP Implementation Recommendations

- Some HDCP recommendations from Bob Crepps of DCP
  - presented during recent 2007 HDMI DevCon

# Top Reasons for HDCP CTS Fail

- Source must respond to Hot Plug Detect
  - Must re-start authentication
  - Some DUTs check Bksv, Ri' and keep going - Fail
- Source DUT does not work with Repeater
  - This is not an option, it is a Requirement
- Not responding to Max\_Device\_Exceeded and Max\_Cascade\_Exceeded, or more Ksvs than DUT can handle

# Recommendations

- Must be able to read and understand the EDID (especially in devices that merge other device EDIDs i.e. Repeaters)
- Must recognize Hot Plug pulse width of 100 ms and react accordingly
- After writing A<sub>ksv</sub>, devices must wait for at least 100 ms before reading R<sub>i</sub>'.

For interoperability sake - wait for more than 100 ms (perhaps 125). It's not a race!

Give the downstream device a chance to compute it.

# Recommendations

- Play unencrypted video into downstream device for a few frames before reading HDCP registers.  
Many downstream devices will not make registers stable until they see pixel clocks.
- Some downstream devices use small microcontroller devices
  - Protocol does not require to read messages two or three times per millisecond.
  - Give the downstream microcontrollers a break! It will enhance operability.
  - One frame of video is ~16 milliseconds, no need to be faster!

# Recommendations

- Don't use DDC while Hot Plug is de-asserted
  - Downstream may be busy initializing or other
- Too many DDC reads i.e polling BCAPS or Ri' can cause downstream device issues

# HDMI Interoperability Work Group

- Interoperability Work Group (IWG) team formed
  - 26 active team members
  - Team representatives from 7 HDMI founding companies
  - Four non-founder participants
    - Tektronix - Test Equipment Maker
    - Agilent - Test Equipment Maker
    - Quantum Data - Test Equipment Maker
    - Allion - Testing Lab
- Goals:
  - Develop recommendations for interoperability issues out in the market
  - Focus on real world issues between both compliant and non-compliant devices
  - Development of an HDMI Best Practices Guide for adopters

## HDMI CTS 1.3c

- Released 2008/07/25
- Key Changes:
  - New Cable Type choices in the CDF
  - Removed Active Cable Test (5-9)
    - Additional tests for Active cable and Converter cable (new tests 5-2, through 5-9)
  - New Cable Test (5-10 through 5-14)
- Full list of changes available within the change history section of the HDMI CTS 1.3c

## HDIMI CTS 1.3c: What's new

- New Cable types for Compliance Testing:
  - Wire: Wire-only with no circuit components.
  - Passive (Equalized): Wire plus passive circuit components and no active circuit.
  - Active: Contains active circuit components with equalizer but has no Tx or Rx function.
  - Converter: Contains Rx and Tx function. Acts as a 1-to-1 repeater where both ends are cable plugs. (i.e. HDMI-to-Wireless, HDMI-to-Fiber, HDMI-to-Ethernet, etc.)



**HDMI**<sup>™</sup>  
HIGH-DEFINITION MULTIMEDIA INTERFACE

# Clarifying Confusion between DisplayPort & HDMI

One Cable. One Standard.  
The Future-ready way to connect HD.

# Common Statements Causing Confusion between HDMI & DisplayPort

- “DisplayPort is higher performance than HDMI”
- “DisplayPort is free”
- “DisplayPort is compatible with HDMI”

# “DisplayPort is higher performance than HDMI”

- HDMI has unique capabilities not available in DisplayPort
- HDMI 1.3 disproved claim that TMDS can never go faster than 165MHz
  - Foundation exists for HDMI to go faster in future

	HDMI	DisplayPort
Bandwidth	10.2 Gbit/sec	10.8 Gbit/sec
Audio	8-ch PCM, DVD-Audio, SACD, Dolby TrueHD, DTS-HD MA	8-ch PCM
Control	CEC	None
Ubiquitous Connectivity	One Billion installed base by 2010 (PC, CE & Mobile). 1.5 Billion if DVI is added.	Dongle required for all CE, PC & Mobile devices without a DP port

## “DisplayPort is free”

- VESA does not license any IP (DP IP is licensed by individual companies on their own terms), all its standards are **use at your own risk**
- DP Spec does not define zero royalty
  - Owners of IP (e.g. Genesis, JAE, Molex) only commit to license IP on unknown RAND terms
  - See D.P. Spec p. 8 - lists over 200 patent claims that must be licensed (may be more)

# IP License Disclaimers from DisplayPort

- DisplayPort spec 1.1, Pg. 9:

“Attention is drawn to the possibility that some of the elements of this VESA Specification may be the subject of IPR other than those identified above (Silicon Image). VESA shall not be held responsible for identifying any or all such IPR, and has made no inquiry into the possible existence of any such IPR.

THIS SPECIFICATION IS BEING OFFERED WITHOUT ANY WARRANTY WHATSOEVER, AND IN PARTICULAR, ANY WARRANTY OF NON-INFRINGEMENT IS EXPRESSLY DISCLAIMED. ANY IMPLEMENTATION OF THIS SPECIFICATION SHALL BE MADE ENTIRELY AT THE IMPLEMENTER'S OWN RISK, AND NEITHER VESA, NOR ANY OF ITS MEMBERS OR SUBMITTERS, SHALL HAVE ANY LIABILITY WHATSOEVER TO ANY IMPLEMENTER OR THIRD PARTY FOR ANY DAMAGES OF ANY NATURE WHATSOEVER DIRECTLY OR INDIRECTLY ARISING FROM THE IMPLEMENTATION OF THIS SPECIFICATION.”

## “DisplayPort is free”

- Problem: each Adopter must go to all holders of IP to negotiate a license
  - DP Spec identifies 4 (plus Intel for HDCP), but notes that there may be others
- Problem: No guarantee that all IP is available for license

## In contrast...

- HDMI has managed all the licensing for you
  - One stop shop for HDMI license
  - Do not need to go to every Adopter and Founder
- HDMI fees and royalties are clearly defined
  - Annual Fee: \$10,000 USD
  - Royalties: typically \$0.04 USD per unit
  - This contrasts with DP: uncertainty of licensing under unknown RAND terms from many, potentially unknown, licensors
- Each HDMI Adopter has the rights to use all the patents owned by Founders and other 800+ Adopters for one low fee

## “DisplayPort is compatible with HDMI”

- DisplayPort is NOT compatible with HDMI
- To make a product compatible with DP and HDMI, you must implement both DP and HDMI
  - Two separate licenses and royalties, two distinct compliance requirements must be met
- Dual mode DP/HDMI requires a dongle
  - DP was able to define the DP connector pins such that a DP Tx chip could use the same driver IOs and pins to drive AC-coupled DP or AC-coupled HDMI signals
  - Requires the DP-to-HDMI dongle to have passive pull down resistors to convert HDMI AC-coupled signals to DC-coupled
- Single mode DP devices require an active dongle (with active electronics) for HDMI connectivity

# Issues Regarding HDMI Compatibility

- HDMI & DisplayPort are being written independently
  - HDMI spec may change such that a dual mode DP/HDMI Tx would be very costly or difficult to design
- Burden is on consumers to figure out whether a DP product is “dual mode” capable or not
  - Dual mode DP with passive dongle
  - Single mode DP with active dongle



**HDMI**<sup>™</sup>  
HIGH-DEFINITION MULTIMEDIA INTERFACE

Thank You!

**Jeff Park**  
**HDMI Technology Evangelist**