



An Interview with:

## *Brett Gaines from the DiiVA Consortium*

Prior to his role as president of the Digital Interactive Interface for Video & Audio (DiiVA), Brett Gaines was executive vice president, business development at VMark, an early-stage web software company serving the online video market. At VMark he was responsible for strategic partnerships as well as product development. Earlier, Gaines was vice president, strategic business development at Silicon Image, Inc. where he was responsible for building and expanding strategic relationships with major Hollywood studios and consumer electronics manufacturers, leading industry standards initiatives, and driving business development activities in emerging markets, including China and India. While at Silicon Image, Gaines also served as the inaugural president of HDMI Licensing, LLC where he helped drive the initial adoption of HDMI across consumer electronics products. In that capacity, Gaines was instrumental in the formation of the HDMI working group that led to the creation of the HDMI specification. Gaines also served as inaugural president of Panellink Cinema, LLC, known today as Simplay Labs, LLC—a leading provider of testing technologies, programs and interoperability design standards for the high-definition consumer electronics industry. Earlier in his career, Gaines held senior positions in business and corporate development at Sun Microsystems. Gaines holds a bachelor's degree in electrical engineering from Georgia Tech and an MBA from Stanford University.



**What is DiiVA?** DiiVA is the industry's first home entertainment networking standard for consumer electronics (including mobile devices and PCs) with provisions for uncompressed video and audio, data and power management.

**Please give us some background information about the DiiVA consortium.** The DiiVA consortium is comprised of Chinese CE OEMs brought together by the China Video Industry Association. Synerchip, a fabless semiconductor company, was invited to join the consortium to contribute expertise in high-speed serial link design and network processing. Together they had a common interest in forming a new home entertainment networking standard that fit the needs of both the Chinese and global markets. From those discussions, DiiVA was created.

**Why was the DiiVA consortium formed?** China is poised to become the largest TV market in the world and leading Chinese CE OEMs want to take their place as providers, rather than primarily consumers of technology. Chinese companies looked ahead to trends in their rapidly growing consumer electronics market and saw distribution of digital content within the CE cluster, as well as among clusters as an area for innovation and advancement and formed the DiiVA consortium to address this opportunity.

**What are the advantages of a networked solution?** Though existing AV interfaces have migrated from low-speed analog video—such as s-video and component video – to higher speed digital video and audio over HDMI, the basic and limited functionality of a point-to-point interface has remained largely unchanged. DiiVA leverages the power and benefits of a networked solution including:

- Discovery: every device on a network is cognizant of all other devices
- Control: every device on a network can be controlled by a central device
- Communication: every device on a network can communicate with all other devices
- Connectivity: restrictions of point-to-point interfaces (source-to-display) are eliminated and more flexible and user-friendly topologies can be employed
- Power management: energy savings are realized by powering down networked devices not in use
- Virtualization: devices on the network can share resources and capabilities

**What advantages does DiiVA offer to consumers?** The power of a networked solution translates into a set of key new features and powerful functions for the consumer:

- Simplicity of set-up: any new device brought home and connected to the DiiVA network is automatically detected and configured, with control established through the TV
- Simplicity of connectivity: Using only DiiVA cables, the DiiVA network can send uncompressed HD video to the TV from any device on the DiiVA network, can send audio to any other device on the DiiVA network, and provides seamless connectivity for Ethernet, USB and control between all DiiVA devices
- Simplicity of control: once the DiiVA network is established, the consumer can control all devices on the network through the TV with a single remote
- Simplicity of Internet access: any one device on the DiiVA network connected to the internet provides internet access to all other devices
- Routable USB: A USB port on a TV can serve as a virtual USB port for any upstream device. So, USB peripherals plugged directly into the TV can interact with other USB hosts on the DiiVA network.
- Energy savings: intelligent management of the power-state of all devices on the network can reduce home energy costs

**What problems does DiiVA solve for consumers?** As the number of CE devices in typical households has increased, the limitations of point-to-point connections have resulted in widespread frustration. Multiple remote controls are required, content control and access is confusing and often not readily understood by all members of a household, and the introduction of new content from the internet, portable devices or storage devices further challenges the typical household user. DiiVA provides an opportunity for true ease-of-use, simple set-up of new devices and full control from the TV of all devices on the home entertainment network. In addition, DiiVA enables the network to automatically power down devices that are not in use – enabling power savings.

**Do we really need another AV interface?** No. What's needed is a new networked solution that enables the transition from the confined connectivity of existing point-to-point AV interfaces to one that combines the power, features and functions of a network with the simplicity, quality and reduced system cost of supporting uncompressed video. DiiVA is that solution.

**Who is supporting DiiVA?** The DiiVA consortium's charter members (called the Promoters Group) include major CE and home appliance manufacturers Sichuan Chang Hong Electric Co.; Qingdao Haier Co.; Hisense Electric Co.; Konka Group; Nanjing Panda Electronics Co.; Skyworth Group; SVA Information Industry Co.; TCL Corporation; and chip developer, Synerchip Co., Ltd. The organization of Chinese CE manufacturers – the China Video Industry Association (CVIA) – has agreed to fully support the DiiVA standard. CVIA's leadership in the Chinese electronics industry and abroad will aid in consistent adoption of DiiVA as it moves toward becoming a global industry standard – ensuring interoperability among the varied brands implementing DiiVA technology. While addressing a DiiVA conference in China, Ms. Weimin Bai, secretary-general of CVIA, said the following:

“As far as the domestic Chinese consumer market goes, it is highly likely that an advanced home entertainment networking technology such as DiiVA will be an integral component of the future digital home entertainment environment with the support of industries, governments and CVIA. History instructs us that it is often the fast-growing, emerging markets that are the first to adopt new technologies due to the freedom they have from legacy technologies, consumer habits and business models. However, we do not expect that DiiVA will ultimately be limited to the Chinese domestic market. We are all witness to the technology revolution disruption that is currently occurring in the global home entertainment ecosystem with the looming introduction of internet-delivered video content and applications to the television viewing experience. We see that traditional home entertainment content distribution models are being threatened as DVD revenues from major content providers are declining. Even in traditionally strong consumer markets,

broadcast TV advertising revenues are coming under pressure from alternate content-delivery channels. As an emerging force in the global consumer electronics marketplace, the Chinese TV industry looks forward to partnering with major content providers around the world to develop new technologies and business models for content distribution and consumption that meet the needs of consumers and industry alike. With its capability to simultaneously support high-quality uncompressed audio/video content and additional data types such as Ethernet and USB, and its innovative digital home networking platform of Any-to-Any capability, it is my belief that DiiVA will be a key stepping stone to further speed up the fast-growing Chinese CE industry.”

Regarding global support, the DiiVA consortium announced in April 2009 that the following companies joined as contributors to the specification:

- CE Makers: LG Electronics, Panasonic, Samsung Electronics, Sharp, Wanlida (Malata), XOCECO (PRIMA)
- Semiconductor companies: MediaTek
- Test Equipment Makers: Agilent, Tektronix
- Connector Makers: Foxconn, JAE

The DiiVA consortium announced the release of the DiiVA 1.0 specification on April 22, 2009. Through DiiVA Licensing LLC, DiiVA adopters can now obtain a license to necessary claims to produce and sell DiiVA products.

**Please give us a technology overview of DiiVA 1.0** DiiVA is a new home multimedia networking interface standard that combines:

- uncompressed video
- multichannel audio
- bi-directional data such as USB and Ethernet, including support for compressed video (e.g., over DLNA)
- control protocol (so the TV can control other devices on the DiiVA network)
- content protection (leveraging existing content protection technologies)

As consumers increasingly integrate more electronic entertainment devices and digital appliances, the DiiVA interface will help streamline and simplify the connections between these devices, offering ease-of-configuration and use while maximizing the entertainment experience. Leveraging a single interface that integrates multimedia and data communication, the DiiVA standard is ideally-suited to become the backbone of a home entertainment network and upgrades home networks to provide multimedia capability at low cost. Technically, DiiVA is separated into 2 major parts:

- The uncompressed video link which can use 1 to 3 twisted pairs inside the DiiVA cable. Each differential pair can operate up to 4.5Gbps, providing a maximum of 13.5Gbps of throughput for uncompressed video.
- The hybrid link, which is a half duplex data channel carried over a single differential pair and can carry over 2Gbps data throughput bi-directionally. It is through the Hybrid Link that DiiVA sends audio, commands, bulk data such as USB and Ethernet, and supports content protection.

Data in the Hybrid Channel is encapsulated by a DiiVA header and footer and can be routed to any point in the DiiVA network. Depending on the type of packet, different levels of priority are assigned. This universal packet structure is what makes DiiVA unique – it is fast and flexible so as to handle multiple data protocols simultaneously.

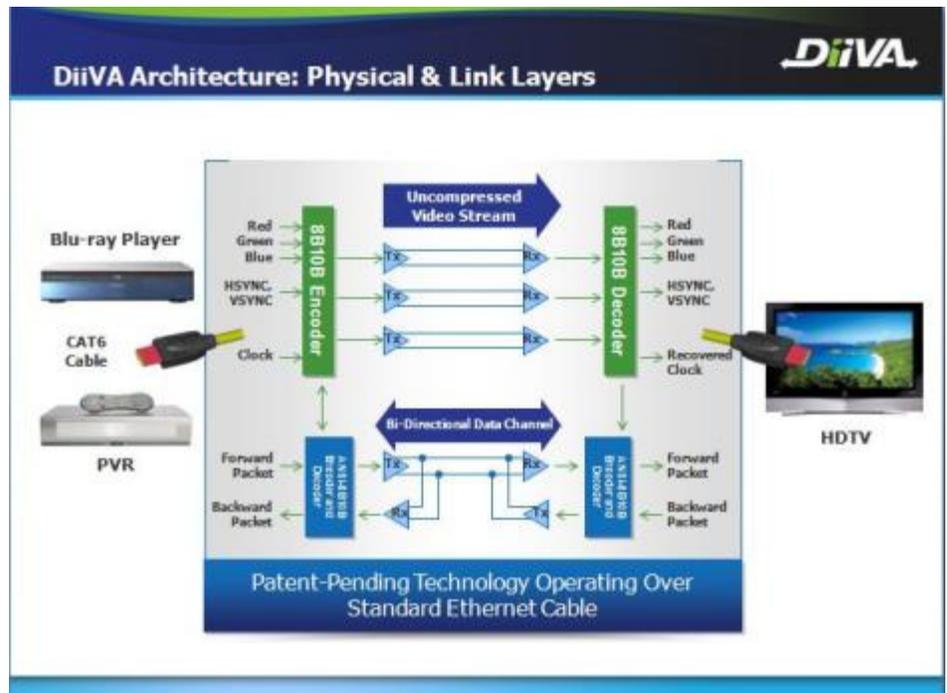
**Explain why the addition of Ethernet is important to DiiVA.** Ethernet enables connectivity between devices on the network and access to content and data on the internet. There are two other common approaches that have been previously used to support video and Ethernet simultaneously, and both methods have their challenges:

- Start with an existing display interface and add Ethernet: This methodology is problematic because the display interfaces are typically point-to-point and by extension, Ethernet becomes a point-to-point interface. This severely limits the type of networking that can be done because Ethernet has to fit within the limited network framework of the display interface.
- Start with IP network and treat video as a data packet: This methodology is problematic because home networking solutions are severely limited in bandwidth. Homes are equipped with 100 Mbps switches and use 802.xx wireless solutions. Uncompressed 1080p video requires multi-gigabits of bandwidth. In order to work around this limitation, video-over-IP solutions resort to compression and decompression on both sides of the link which adds cost and complexity in addition to degrading visual quality of the original image and limiting on-screen display/overlay capabilities. Furthermore, there are QoS issues as bandwidth required for video limits the amount of data bandwidth available for other uses.

DiiVA's packet structure enables a robust network that encapsulates and sends multiple formats of data such as USB, Ethernet, commands and content protection simultaneously with audio and video. The concept of encapsulation is important because it unifies data sent by DiiVA to a common packet format. Instead of dealing with multiple protocols, there is only one protocol to deal with – DiiVA.

Also, the separation of the video path from the data path guarantees necessary bandwidth for video quality while the packet protocol for data can check for errors to guarantee packets are not lost.

In summary, DiiVA is a more elegant solution than anything currently available in the market. Once DiiVA solved routing any kind of data from any point to any point on the network, while guaranteeing video quality, sending Ethernet packets and sharing Ethernet among devices was a natural by-product of the technology.



**Tell us what the DiiVA return channel enables and why it's important.**

The DiiVA specification defines three differential pairs used for uncompressed video and a fourth differential pair, the Hybrid Channel, that sends data bi-directionally. There is no need for additional wires since data packets are time multiplexed to send various data packets bi-directionally. Data types include Ethernet, USB, Device Control, Content Protection, and Network management (i.e. device discovery). There is bandwidth headroom to handle additional data types as necessary. If these need to be added in the future, new data packet types can be defined for the hybrid link and no new wires will need to be added.

**What about bandwidth? What are the limits related to how much information can be transmitted?** For uncompressed video, DiiVA provides a maximum of 13.5Gbps which is sufficient bandwidth for any likely application including deep color, high refresh rate and 3D video as well as 4Kx2k displays. For the Hybrid Link, we have a half-duplex single differential pair which operates at 4.26Gbps in a single direction (over 2Gbps of aggregate bi-directional bandwidth). We can mix and match USB, Ethernet and audio in both directions, as well as commands and content protection. USB devices and Ethernet traffic will consume most of the bandwidth if both

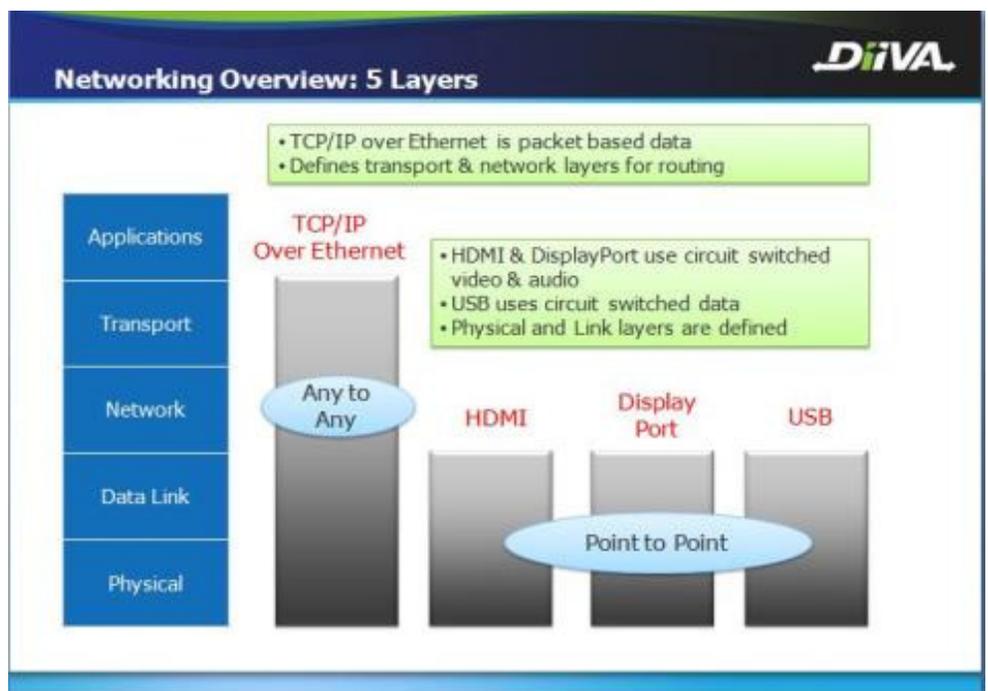
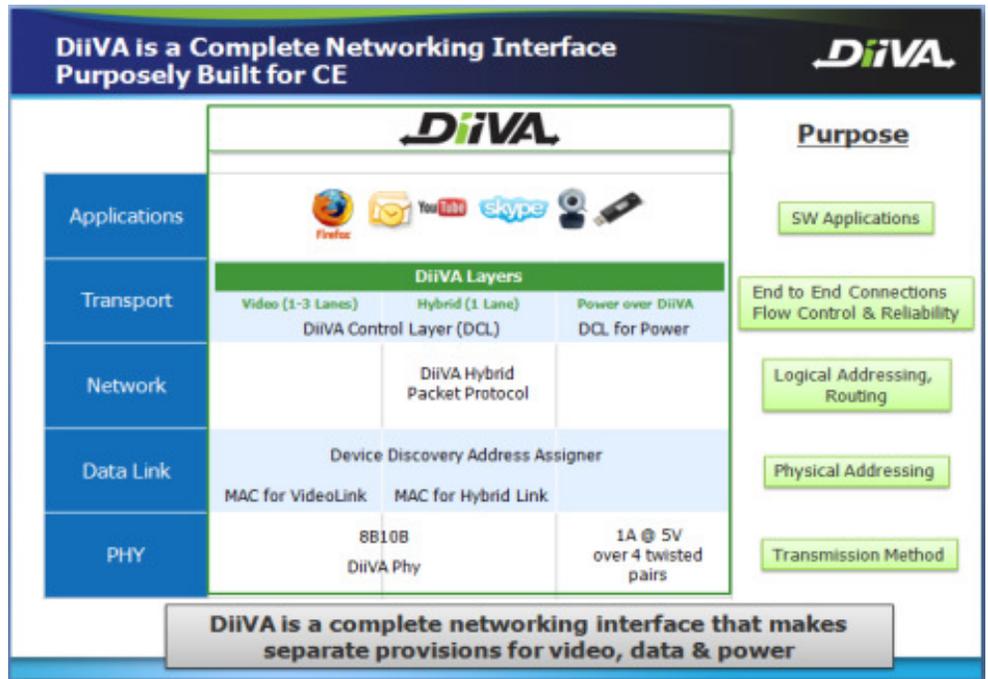
are active at the same time. However, there is enough bandwidth in the Hybrid Link so that DiiVA itself will not be the bottleneck when multiple sessions of USB and Ethernet are active simultaneously.

**How does DiiVA interconnect with existing VGA, DVI, HDMI, or other interface solutions?** Bridge solutions can be built by semiconductor or system companies to translate VGA, DVI, HDMI or any other video interface to the video lanes of the DiiVA interface. Since DiiVA can carry much more than video, bridge solutions are likely to take advantage of bridging USB, Ethernet and audio over DiiVA. Since DiiVA has a maximum cable distance of 25M (longer if repeaters are used), there is likely to be a market for simple cable extension solutions.

**Please describe the connector solutions that will be created for DiiVA.** DiiVA 1.0 has defined a standard connector unique to DiiVA. Foxconn and JAE are DiiVA contributors who have helped define the new connector specification. Please refer to the DiiVA 1.0 specification for more details. With respect to the cables, it is the intention of the specification that CAT6 cables can be used, which can lower cable costs as CAT6 already enjoys economies of scale. DiiVA is also in the process of defining a small form-factor mobile connector.

**What is the maximum cable distance for DiiVA?** The DiiVA specification calls for a maximum cable distance of 25 meters from point to point. A repeater device can be implemented and powered by DiiVA. In this case, distances of 50 meters can be supported.

**What are DiiVA's plans for content protection?** DiiVA plans to support HDCP 2.0 and DTCP-IP content protection systems. HDCP 2.0 would be the baseline content protection for uncompressed video and audio. Since content protection keys are passed as data packets in the Hybrid Channel, multiple content protection schemes can be supported within DiiVA. So if another content protection scheme is required in addition to HDCP 2.0 or DTCP-IP, e.g., to meet regional requirements, it can be readily implemented within DiiVA without the need to redefine the specification.



**HDMI 1.4 seems to offer many of the same benefits as DiiVA 1.0. What are the differences between HDMI 1.4 and DiiVA?** On the surface, HDMI 1.4 offers some of the benefits of DiiVA, but there are several fundamental differences:

- DiiVA is designed to be a networking interface. DiiVA defines a network and a transport layer, much like TCP/IP over Ethernet. HDMI was never designed to be a networking interface as there is no network or transport layer defined in its specification. It was designed to be a link layer point-to-point interface.
- DiiVA sends data as its own DiiVA packet. This enables DiiVA to encapsulate multiple protocols like Ethernet and USB and send it anywhere on the network. This uniform packet structure will enable simpler compliance testing. In contrast, HDMI does not have its own data packet structure. So whenever HDMI needs to send data it requires additional wires to be a dedicated for those signals. This is why new cables are needed to send Ethernet in HDMI 1.4. DiiVA can support a much higher data throughput, sending over 2Gbps of data bi-directionally. HDMI's Ethernet channel is limited to 100Mbps.
- DiiVA can send USB through the network. HDMI cannot. This is important as there are many USB devices that consumers will want to add to and access through the network.
- DiiVA's back channel audio can be sent from any point, to any point on the network. HDMI audio return channel can only be returned one hop (e.g., from a TV back to an AV receiver).
- DiiVA can provide power through the cable for dongles, bridges, repeaters and mobile devices.
- DiiVA signals can pass through a device in a daisy-chain while the device is in standby mode, reducing the need for unused devices to be powered on.

Because of DiiVA's network capabilities, its uniform packet structure for different types of data and its higher throughput - we believe CE manufacturers and consumers will see the advantages that DiiVA brings as a home entertainment networking solution.

**Given your personal historical ties to HDMI, and HDMI's substantial base in the consumer electronics market and growing presence in the PC market, can you highlight any links between DiiVA and HDMI? In other words, do you see DiiVA as a replacement interface to HDMI, an additional interface solution, or is DiiVA somehow serving an entirely different need?** HDMI is an excellent interface for supporting video and audio in a point-to-point connection between a source and a display and we expect it will continue to be used as such for the foreseeable future. DiiVA was developed to meet a different set of requirements – leveraging the power of a fully networked solution – and we believe it will co-exist with HDMI in many applications.

**How do you hope to gain market mind-share against the dominant HDMI interface?** As stated previously, we expect HDMI and DiiVA to coexist in many applications. HDMI came to market at a time where the opportunities and challenges were different than today. HDMI rose in conjunction with the broad transition from analog-to-digital content and devices in the US, Western Europe, and select Asian countries that began early in this decade. As we approach 2010, the challenges and opportunities have changed. Content owners are being forced to explore new online business models as revenue from packaged media and traditional broadcasting are under pressure. China is already the world's largest TV market and will be the largest flat panel TV market by 2012. Consumers are looking to the web more than ever for video content, and they want that content on their TVs as well as available to the other devices that they own. And all these devices have to work together simply and cost effectively so the consumer can actually use them. These are the challenges that DiiVA is rising to address. To the extent that DiiVA is successful in meeting them, it has a good chance of acceptance in not only China but the global marketplace.

**Tell us about licensing fees/royalty structures related to DiiVA, especially as compared to HDMI.** Adopter Annual fee: \$5,000 (HDMI is \$10,000); per unit end-product royalty: 2 cents (HDMI is 4 cents).

