Whitepaper

NVIDIA® Miracast Wireless Display Architecture

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Miracast Wireless Display Background

The fast rate of adoption of mobile handheld devices has made digital content consumption one of the largest growth areas in consumer technology and the ubiquity of Wi-Fi has helped to enable that growth. Wi-Fi has established itself as the de facto wireless standard and the rapid growth of residential wireless networks and wireless hotspots in public places such as airports, coffee shops, and retail outlets has enabled users to easily access and view online multimedia content on their mobile devices. The user experience can be further enhanced by enabling mobile devices to wirelessly stream content such as online videos, movies, games and webpages to external high definition displays.

Several proprietary wireless display solutions are currently available that enable users to wirelessly stream videos and games to external displays, however these solutions require users to invest in a single, closed eco-system such as Intel's WiDi or Apple's AirPlay. Other open standards such as DLNA are plagued with interoperability issues that have limited their traction in the market place. To address the limitations of these solutions, the Wi-Fi Alliance has created an open wireless display standard called Miracast.

Underpinning the Miracast specification is Wi-Fi Direct^{T} – a specification defined for peer-to-peer, direct wireless connectivity between devices. Miracast Certified devices will be able to connect with each other directly, without the mediation of a wireless access point, by leveraging the functionality introduced by Wi-Fi Direct. When two devices connect with each other directly, one assumes the role of the source (transmitting device) and the other becomes a sink (the devices receiving and rendering the content to the user) (Figure 1)

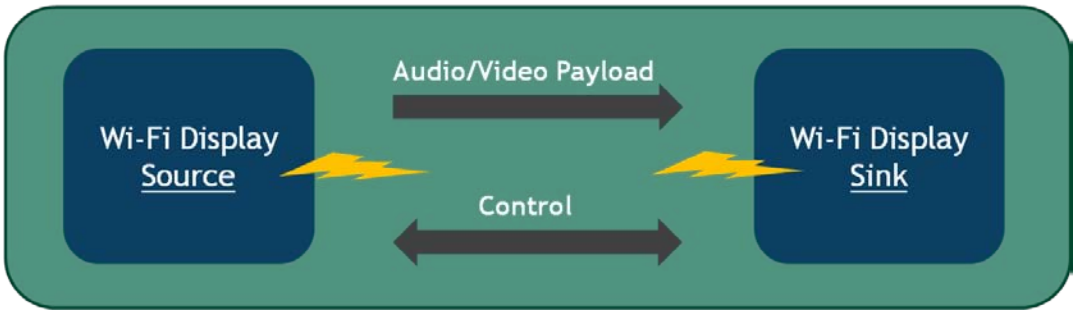

Figure 1 – Miracast Wireless Display Connectivity

The Wi-Fi Alliance and its ecosystem members, including NVIDIA, have developed Miracast with the aim at providing an open wireless display standard with the core goal of increasing the ease of use and quality of the end-user experience for streaming of audio and video content between Wi-Fi devices. By leveraging an established technology that consumers know and trust in devices they already have or plan to purchase and with the support of a wide industry ecosystem of devices, Miracast is poised to deliver on its goal.

NVIDIA Miracast Architecture

The NVIDIA® Miracast architecture draws on the company's experience in 3D graphics and video processing. Utilizing NVIDIA's advanced media capture libraries, the NVIDIA Tegra® optimized Miracast wireless display stack integrates into the Tegra mobile platform. This complete Miracast solution (source side) enables mobile phone/tablet OEMs to implement a Miracast certifiable product by combining the Tegra application processor (AP) and compatible Tegra Android BSP package as they do today. Figure 2 illustrates a simplified platform diagram.

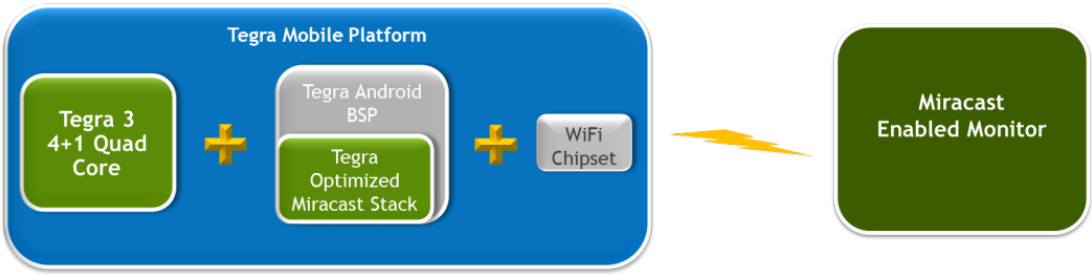

Figure 2 Tegra Miracast Wireless Display Topology

The Tegra optimized Miracast solution is comprised of two major components – the multimedia (video/audio) processing block and the industry compliant wireless display networking stack, see Figure 3. The multimedia processing block takes advantage of Tegra's multi-core graphics engine and dedicated hardware video/audio codecs to accelerate the decoding of video content, render graphics surfaces and perform the final compositing operations before encoding into a H.264 bit stream to be wirelessly transmitted.

In addition, based on the type of content that is to be transmitted, Tegra's multimedia architecture makes intelligent decisions that result in efficient use of system resources. For example, by determining whether the content is an HD video or a 3D game early in the process, the Tegra AP can reduce the number of processing operations that keep memory accesses and format conversions to a minimum thereby reducing latency and improving quality.

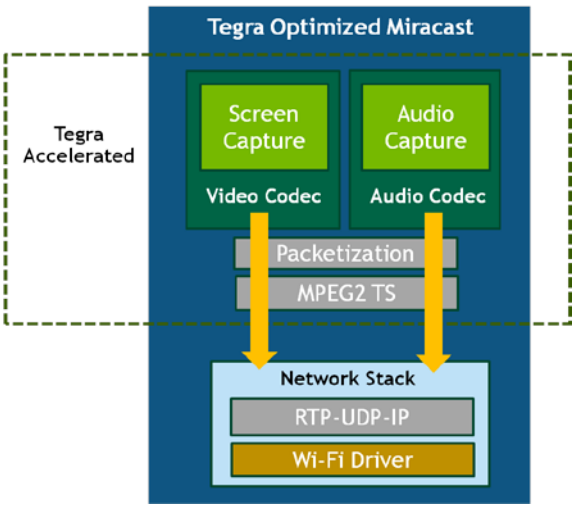

Figure 3 Tegra Optimized WFD

Benefits of NVIDIA Miracast Architecture

High Performance: Touch latency, the time delay between a touch input registered at the source device and the action displayed on the remote monitor, is an area that will greatly impact the end user experience. NVIDIA® advanced screen capture and image processing architecture are particularly suited to reduce this inherent characteristic in wireless display. One approach to reducing latency is by starting the screen capture process as soon as possible and reducing the number of operations required to complete the task. This results in passing the audio/video data off to the network stack as fast as possible for the sink device to display to the remote monitor. To the end user, this means that inputs at the source device can be observed to happen virtually instantly, thereby enabling performance intensive capabilities such as console quality gaming.

Additionally, video quality of the source content must be maintained. If the video is not rendered or composited with accuracy, it can result in visual artifacts at the destination screen. One approach at maintaining image quality is to reduce the number of format changes required during the video decode and encode stages. With each format change, video data can be “lost” reducing the image sharpness of the native content. The NVIDIA Miracast Architecture delivers both high definition video image quality and ultra low latency required for the best wireless display experience.

Lower Power: The CPU is tasked to assist in the multimedia processing as well as perform tasks such as packetizing the audio/video data and multiplexing them into a single MPEG-2 transport stream. Unique to NVIDIA Tegra® is the 4-PLUS-1 architecture that offers the advantage of having a 5th battery saver core which utilizes lower voltages thereby decreasing power consumption exponentially. By offloading the more intensive multimedia processing to the power efficient GPU and video decode/encode engines, the Tegra AP can completely power

off its main CPU cores and rely only on the battery saver core, thus reducing power consumption and maximizing battery life.

Feature Rich: Beyond just mirroring simple content, the NVIDIA® optimized Miracast solution will enable the level of performance users have come to expect with NVIDIA Tegra® such as support for advanced 3D game play, HD video playback, and game controller support all wirelessly. This also includes the support for NVIDIA's award winning 3D stereo capabilities for both video and gaming content.

Summary

The growth in mobile device usage and widespread availability of Wi-Fi has driven the consumption of digital multimedia content to new and ever-growing levels. By leveraging the Wi-Fi capabilities employed in nearly all mobile devices, the Wi-Fi Alliance and its eco-system members have developed Miracast as an open wireless display specification to facilitate industry adoption and increase the ease of use and quality of the end-user experience. NVIDIA, as a member of the Wi-Fi Alliance, is committed to providing a leading Miracast specification compliant solution in which sharing photos, playing back HD video content and enjoying 3D games can be easily streamed to an external display to further enhance the experience.

NVIDIA's high performance Tegra processors, coupled with NVIDIA's experience in 3D graphics and video processing, are well positioned to deliver a class leading consumer Miracast wireless display solution.

Document Revision History

Date	Version	Notes
7/24/2012	1.0	First Release