ENHANCING TV VIEWER EXPERIENCE WITH ULTRA HD GLASSES-FREE 3D

A Qualcomm® Snapdragon™ 800 Processor Case Study Featuring Intrinsyc Technologies and Stream TV Networks

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Introduction: Creating an Amazing 3D Viewing Experience – without Glasses

The television viewing ecosystem is evolving rapidly. Beyond instant content and high definition, viewers now want to watch TV in a whole new way, as if they were part of the picture, in the 3-dimensional world.

Helping make this possible is Stream TV Networks, Inc. ("Stream"), a Philadelphia-based media technology company. Stream is taking viewers to the next level of the 3D experience – 3D viewing without glasses. They have achieved this by collaborating with Intrinsyc Technologies Corporation and using their embedded computing solutions based on Qualcomm® Snapdragon™ processors from Qualcomm Technologies, Inc. (QTI).

Stream has developed Ultra-D™, a proprietary combination of hardware, firmware and software that results in a state-of-the-art 3D display that does not require glasses. Using Ultra-D technology, viewers can convert any source to glasses-free 3D in real time.

Stream recently worked with Intrinsyc Technologies to integrate the real-time-video conversion aspect of its Ultra-D technology directly into televisions. Using a single board computer powered by a Snapdragon 800 processor, Ultra-D processing has moved from an external PC based converter box to an internal conversion process inside the TV.

Case Study Highlights

- *Using the Snapdragon processor and Intrinsyc's leading-edge product development solutions, Stream TV was able to integrate Ultra-D conversion into televisions and enable 3D viewing without glasses.*
- *Results—Enhanced viewing experience. No glasses necessary. Real-time conversion inside the device. Create new industry standard. Meet rapidly changing ecosystem. Take advantage of high-resolution technology.*

The result is the ultimate in TV viewing for customers – a simplified, built-in 3D-without-glasses conversion and playback system with improved image quality, wider viewing angle, and enjoyable viewing experience.

Stream was founded in 2009 by Mathu Rajan, who serves as its CEO. Stream recruited engineers in the Netherlands who had worked on the early forms of the technology for many years. Stream brought in capital and created a wholly-owned R&D subsidiary called SeeCubic, BV ("SeeCubic") to complete the development of the technology. Now those initial five engineers have grown to a team of more than 40 to develop a broad base of expertise covering hardware, software, and commercialization in the area of 3D without glasses.

How Ultra-D Works

Stream's pioneering Ultra-D technology is the result of years of research and development in the field of 3D optical delivery. The process includes two parts: display and content conversion.

The display integrates hardware, firmware and software. An underlying LCD, LED or OLED panel is combined with specially-designed optical layers that use refractive and diffractive technologies to create a 140-degree continuous light front. The resulting 3D optical system is integrated with firmware that instructs the display how to operate at a sub-pixel level. Software then decodes the formatted content. The technology is adaptable to panels of nearly any type and size.

The conversion process allows any kind of content (such as cable, satellite, or internet streaming video) to be converted to the Ultra-D format. A proprietary software algorithm running in the Ultra-D Real Time Conversion hardware takes the original 1080p input signal and creates new pixel information from the depth domain. This new pixel data is then processed as a 2160p auto-stereoscopic signal by Stream's rendering chip, which results in a glasses-free 3D view on the ultra-high definition display. The conversion hardware can convert both 2D and 3D-with-glasses content into 2160p glasses-free 3D in real time. The amount of depth is fully adjustable, allowing viewers to

customize the viewing experience by turning the 3D "up" or "down" much like volume or brightness.

Integrating Conversion into the TV Using a Snapdragon Processor

During Stream's initial development of the Ultra-D technology, real-time conversion algorithms were run on an external PC-based converter box as proof of concept (these algorithms convert video content, either 2D or 3D with glasses, into its proprietary Ultra-D glasses-free 3D format). The quality of the glasses-free viewing experience helped Stream secure a variety of consumer electronics brand partners around the world, but these partners made it clear that the technology must run on an internal embedded computer and Stream realized there would be a variety of benefits resulting from porting to a high performance, power and thermal-efficient SoC: including reduced production costs, smaller footprint, improved aesthetics, ease of use, reduced service issues, and more.

To help them make this transition, Stream explored potential solutions offered by several major chip makers. QTI represented the perfect balance of technological capability and willingness to contribute to the project.

About the Developer

- *Company Name: Intrinsyc*
- *Description: QTI licensee and a leader in Snapdragon product development for the embedded systems ecosystem.*
- *Location: Vancouver, BC, Canada*

"In fact, the overwhelming positive attitude of the Qualcomm Technologies, Inc. team exuded from the first demo was one of great enthusiasm. They saw the opportunity to enhance their significant presence in the mobile space with an expansion into glasses-free 3D televisions and asked a single but important question: 'How can we help?' We felt an instant connection with them as collaborators, not merely as vendor-buyer," explained Bud Robertson, Stream's vice president of business development.

The Power of Snapdragon 800

- *First processors to support 4K Ultra HD video viewing*
- *Enables cinema-quality noise suppression, frame rate compensation, image scaling, and color and picture adjustments*
- *Includes one of the highest-performing CPUs, with a maximum clock speed of 2.3 GHz, and four cores, resulting in extremely efficient multi-tasking when compared to dual-core processors*
- *Includes Qualcomm® Adreno™ 330 GPU, from Qualcomm Technologies, Inc., for accelerated creation and output of images to display*
- *Includes a specialized digital signal microprocessor that is used with analog signals such as audio, video, and mobile broadband signals. Each analog signal is converted into a digital signal that is then processed by the DSP at a lower latency (relative to the CPU running the same digital signal processing algorithm), thus improving performance.*

During that first demo, Intrinsyc Technologies Corporation emerged as the leading integrator for Stream in reaching their objective. Intrinsyc is a QTI licensee and a leader in Snapdragon product development for the embedded computing ecosystem. Based in Vancouver, Canada, Intrinsyc specializes in embedded systems development, optimization, and customization using Snapdragon processors.

"We clearly felt that Intrinsyc was nimble enough to work with our accelerated development schedule but seasoned enough to navigate the sizable pitfalls that a project of our scope might encounter," said Robertson.

After reviewing the specifications of several chips, Stream and SeeCubic's engineering team selected the Snapdragon 800 processor because it was fully capable of running Ultra-D's sophisticated real-time conversion algorithms, supported 4K video, and was very thermal and power efficient.

The Development Story

Stream set three primary goals for the project:

- Improve and simplify the user experience by seamlessly integrating the content conversion feature and Ultra-D video player with 3D rendering.

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This required developments to maximize chip performance, maintaining peak levels for long periods of time while handling issues like heat dissipation. The chip – and how it was used – had to provide a solid foundation.

- Reduce BOM costs for brand customers, allowing them to lower the cost to consumers and increase sales with accelerated rate of adoption. Eliminating external peripherals in favor of an internal chip was a big step in that direction.

- Pave the way for tablets, phones, and other portable products with a single-chip solution.

After deciding on the Snapdragon 800 processor, the development teams at Intrinsyc and Stream worked together to develop a Proof of Concept (PoC) platform. The PoC platform was a rapid prototype 3-board solution based on Intrinsyc's Open-Q™ 8074 System on Module (SoM), a Custom Carrier Board (CCB) and a custom Digital to Analog Conversion (DAC) board. The PoC platform has been integrated into over 300 TV sets used for marketing and testing purposes. Intrinsyc and Stream have continued to refine the platform, creating two Single Board Computer (SBC) derivative designs based on the original PoC platform. The teams continue to enhance hardware and software features, establishing designs for product verification. The development teams faced and overcame challenges in several areas, including technical, communication, and testing.

Technical – HDMI signal input conversion was the major hurdle in adapting a mobile-based chip to a video-based solution. Development centered on a hardware design that had to convert an incoming HDMI signal to a MIPI CSI (camera input) signal. Toshiba America Electronic Components worked with the team to provide the necessary bridge chip.

Optimization – To enhance performance, Stream worked with QTI and Intrinsyc to better and understand and utilize the various heterogeneous computing resources on the Snapdragon processor, such as CPU, GPU, and the programmable DSP.

Communication – With Intrinsyc located in Vancouver, Stream located in Philadelphia and SeeCubic located in The Netherlands, the 9-hour time difference and nearly 8,000 mile distance made regularly-scheduled calls very important to communicating anticipated issues and solution breakthroughs. By remaining proactive rather than reactive, the development process was more efficient that it might otherwise have been.

Testing – As the hardware matured, it was important to instigate detailed testing procedures. However, the sophistication of Stream's algorithms made standard Android testing insufficient and required development of new methods. Managing testing procedures for both the OS and the library became a critical focus. A collaboration between the two parties to put proper testing procedures in place at Intrinsyc to better troubleshoot and debug problems at Intrinsyc vs. sending to Eindhoven for testing saved days of downtime and man-hours in the project.

Customer Quote

"There was enthusiasm from QTI from the beginning, a sense of what is possible and we will help you get there. We enjoyed the spirit of the whole relationship."

- *Bud Robertson, Vice President of Business Development, Stream TV Networks, Inc.*

Ready for Commercialization

Engineering samples have already been assembled in the factory of Stream's Asian manufacturing partner. Those units are currently being used for evaluation and sales purposes by strategic partners across the globe.

The company expects to begin mass production runs in the second quarter of 2015, with screen sizes ranging from 50" to 65". Most of this initial inventory will be aimed at China, where 3D TV continues to grow in popularity, with plans to enter the US in the second half of the year.

Why Does Ultra-D on Snapdragon Processor Matter?

Ultra-D offers a unique and enhanced viewing experience using 4K panel technology. For average big screens (under 84" for example) watched in a normal home viewing environment, 4K content is not yet widely available, Robertson explained.

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Customer Quote

"Perhaps the biggest benefit of having our conversion algorithms integrated into the devices themselves is a fantastic, out-of-the-box experience for consumers."

- *Bud Robertson, Vice President of Business Development, Stream TV Networks, Inc.*

Ultra-D uses the extra 6 million pixels of the 4K panel to create depth, rather than simply increasing the 2D resolution. The result is a vibrant image with easily perceived depth, a benefit that viewers recognize the instant they see it. The content does not have to be 4K, so all HD content can be viewed in Ultra-D with the help of the real-time conversion.

"Perhaps the biggest benefit of having our conversion algorithms integrated into the devices themselves is a fantastic, out-of-the-box experience for consumers." said Robertson.

"They have unlimited content available. Connect any Blu-ray player, cable or satellite box, video game player, streaming box, etc. and they're ready to start watching in glasses-free 3D."

For More Information

- Visit www.streamtvnenetworks.com and www.ultra-d.com for more information on Stream TV Networks Ultra-D technology.
- Visit www.intrinsyc.com for more information on Snapdragon product development.
- Visit www.qualcomm.com/products/snapdragon/embedded-computing for more information on Snapdragon processors and development kits for embedded processing.

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