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Video Coding Development for Super Hi-Vision (Ultra HDTV)

Engineers at NHK (Japan Broadcasting Corporation) continue to develop a system for the delivery of television content at quality levels well beyond those possible with HDTV today. NHK's proposed "Super Hi-Vision" system would deliver 16x9 images at a resolution of 7680×4320/60p, plus 22.2 channel audio, at a transport-stream bit-rate of 260 Mb/s. A session at the upcoming NAB Broadcast Engineering Conference (BEC, April 9 –14, 2011, Las Vegas, Nev. – see below for additional information) entitled "*The Impact of Innovative Technologies*" includes a paper, excerpted here, which presents an update on the current state of video coding development for this system. This paper is entitled "*Development of High Performance Video Codec for Super Hi-Vision*," and was written by Yoshiaki Shishikui, Kazuhisa Iguchi, and Shinichi Sakaida of NHK, and Kimihiko Kazui and Akira Nakagawa of Fujitsu Laboratories Ltd.

ABSTRACT – To help pave the way for Super Hi-Vision (SHV) broadcasting, we have developed a codec system that can encode and decode SHV signals in real time. This third-generation SHV real-time hardware codec system maintains high picture quality by using eight 1080/60p (60 frames per second) encoding units and a video format converter with signal compensation processing that takes the properties of the SHV dual-green format into account. The format converter divides an SHV image spatially into eight 1920 × 1080 portions, each of which is fed to the encoding unit. In the first- and second-generation SHV codec systems, the SHV image is divided into 16 portions (spatially eight and temporally two), and 16 1080/30p encoding units are used. The new system uses about half the bit-rate and is about 50% smaller than the second-generation one. We have conducted the world's first SHV international transmission over an advanced Internet using the codec system at a TS rate of 260 Mbps. The received picture quality was good enough to show any kind of SHV content on a large screen.

INTRODUCTION – The Super Hi-Vision (SHV) system is being developed by NHK as a future broadcast system that will give viewers a much greater sensation of reality. SHV consists of an extremely high-resolution imagery system and a super surround multi-channel sound system. Its video format consists of 7680 × 4320 pixels and a 59.94-Hz frame rate with progressive scanning. It uses a 22.2 multi-channel sound system (22 audio channels with 2 low frequency effect channels) and has been designed to give viewers a strong sense of reality. The final goal of our research and development of SHV is to deliver highly realistic images and sound to viewers' homes.

To achieve this goal of broadcasting SHV programs to homes, we need a high-efficiency compression coding system. The first- and second-generation SHV hardware codec systems were developed on the basis of MPEG-2 and MPEG-4 AVC/H.264 video coding standards. We have now developed a third-generation SHV real-time hardware codec system that features improved coding efficiency with smaller hardware. We conducted an international live transmission test of SHV signals over an advanced Internet by using this codec.

In this paper, we give an overview of the progress of SHV codec systems, together with results of SHV transmission experiments, and describe the technologies and performance of the new codec.

SUPER HI-VISION – NHK Science and Technology Research Laboratories (STRL) started developing SHV in 1995 and in the following decade made steady progress towards its practical use. The plan is to deliver SHV through a cost-effective network to homes, where it will then be recorded onto a home-use receiver. We anticipate that experimental SHV broadcasts will start in 2020 using a 21-GHz-band satellite, which is a potential delivery media for high-bit-rate transmissions. The SHV system has the potential for use in various applications in addition to broadcasting, e.g., art, medicine, security, and monitoring. In-theater presentation of sports events, concerts, etc. will be implemented before the broadcasting stage. The SHV systems can also be used in non-theater environments such as for advertisements, image archive materials, and background images for HDTV program production.

Video system of SHV – SHV is now the highest resolution TV system available. NHK has developed key equipment for SHV broadcasting systems, such as cameras, display systems, and disk recorders. SHV requires an imaging device and a

display device with 33 million pixels; however, integrated devices with such high resolution were not available until recently. Although we have developed a experimental model SHV camera with 33 million pixels, most of the current SHV cameras use four panels with 8 million pixels each for green 1 (G1), green 2 (G2) (dual-green), red (R), and blue (B) channels, using the pixel-offset method to increase the effective number of pixels both horizontally and vertically. This pixel arrangement is called dual-green format.

Author Yoshiaki Shishikui, senior research engineer at NHK, will present this paper on Tuesday, April 12, 2011 starting at 9:30 a.m. in room S226 of the Las Vegas Convention Center. The paper will also be included in its entirety in the 2011 NAB Broadcast Engineering Conference Proceedings, on sale at the 2011 NAB Show Store and available on-line from the NAB Store (www.nabstore.com) after the convention. (The video coding system described in this paper will also be demonstrated at NHK's theater in the International Research Park, Booth N233 of the Las Vegas Convention Center, throughout the 2011 NAB Show.)

Other papers being presented during this session include the following:

- *The Impact of Innovative Technologies: Trial to Scale,* Mark Johnson, product manager, Harris Corporation
- *Single Frequency Network Experiences in NYC,* Ted Karam, director of engineering, Thomson Broadcast
- *Embedded TV: Creating a New Digital Ecosystem for Broadcasters,* Jeremy Edmonds, sr. dir., bus. development & customer engineering, ActiveVideo Networks
- *Secure, Efficient Bulk Data Transport Using Global-reach RDMA,* David T. Southwell, Ph.D, CTO, Obsidian Strategics Inc
- *A Study and Comparison of Efficiency Enhancement Techniques for RF Power Amplifiers,* Geoffrey Mendenhall, vice president, Transmission Research and Technology, Harris Corporation

For additional conference information visit the NAB Show Web page at www.nabshow.com.

Attending the NAB Broadcast Engineering Conference? Don't Miss Renowned Author, Technologist Steven Johnson at the Technology Luncheon

Three-time national bestselling author, celebrated lecturer and technologist Steven Berlin Johnson will speak at the NAB Show Technology Luncheon on Wednesday, April 13 in the Las Vegas Hilton. Johnson's address will focus on the origins of ideas that lead to groundbreaking innovations, a key component of his latest book, *Where Good Ideas Come From: The Natural History of Innovation*. (View related media here.)

Named one of *Newsweek's* "Fifty People Who Matter Most on the Internet," Johnson is a social critic and technologist with writings that have influenced the way political campaigns use the Internet, explored cutting-edge ideas in urban planning, and examined the battle against 21st-century terrorism. Much of Johnson's work studies mapping the future, a concept that predicts and explains the real-world impact of emerging trends and cutting-edge developments in science, technology and media.

Johnson is currently contributing editor for *Wired* magazine and monthly columnist for *Discover* magazine. He is the recent recipient of the Newhouse School's Mirror Awards for his *TIME* magazine cover article titled "How Twitter Will Change the Way We Live," and has previously written for *The New York Times*, *The Wall Street Journal* and *The Nation.* An engaging and informative lecturer, Johnson was the 2009 Hearst New Media Professional-in-Residence at Columbia University's Journalism School, where he lectured widely on technological, scientific and cultural issues.

Johnson has co-created three influential websites: the pioneering online magazine *FEED*, the Webby-Award-winning community site, Plastic.com, and most recently the hyperlocal

media site outside.in. He has appeared on many television programs, including "The Charlie Rose Show," "The Daily Show with Jon Stewart," and "The NewsHour" with Jim Lehrer. You can also check his recent presentations out on youtube.

The NAB Technology Luncheon will also feature the presentation of the NAB Engineering Achievement Awards to Thomas B. Keller, T. Keller Corporation and L. Robert du Treil, du Treil, Lundin and Rackley and the Technology Innovation Award honoring organizations that bring advanced technology exhibits and demonstrations of significant merit to the NAB Show. The NAB Best Paper Award, established in 2010, will also be presented.

IEEE Broadcast Technology Society Issues Call for Papers

A Call for Papers has been issued for the 2011 IEEE Broadcast Symposium, to be held October 19-21, 2011, in Alexandria, Va. The Symposium Committee seeks timely and relevant technical papers relating to all aspects of broadcast technology, in particular on the following topics:

- Digital radio and television systems: terrestrial, cable, satellite, Internet, wireless
- Mobile DTV systems (all aspects, both transmission and reception)
- Technical issues associated with the termination of analog television broadcasting
- Transmission, propagation, reception, re-distribution of broadcast signals
- AM, FM, and TV transmitter and antenna systems
- Tests and measurements
- Cable and satellite interconnection with terrestrial broadcasters
- Transport stream issues – ancillary services
- Unlicensed device operation in TV white spaces
- Advanced technologies and systems for emerging broadcasting applications
- DTV and IBOC reception issues and new technologies
- ATSC and other broadcast standards developments
- Broadcast spectrum issues – re-packing, sharing

The submission deadline for abstracts is May 1, 2011. There is additional information on the Symposium on the IEEE Broadcast Technology Society website.