CABLE & CE INDUSTRY COOPERATION ON UNIDIRECTIONAL DIGITAL CABLE RECEIVERS

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Abstract

As consumer electronics companies and the cable industry continue to work together to accelerate the deployment of high-definition digital television (HDTV), they have created a memorandum of understanding (MOU) that defines how cable systems will deliver services and essential elements needed for unidirectional digital cable-ready receivers to receive such services. The MOU relies on Society of Cable Telecommunications Engineers (SCTE) and Consumer Electronics Association (CEA) standards to provide the framework for interoperability. This paper describes the December 2002 MOU and focuses on the standards referenced therein that define requirements for cable systems and receivers.

This paper provides an overview of the agreement as a foundation for providing a more detailed looked at the self-certification program it requires. The paper describes the categories of tests prescribed by the agreement including Critical Tests, Non-critical Tests, and Network Harm Tests. Taken together, these test make up the Test Suite, jointly developed by CEA and CableLabs®. The Test Suite is derived from existing work by CableLabs as part of the OpenCable project. This paper describes in greater detail the foregoing testing methodology and the expected benefits to the industry.

OVERVIEW OF DECEMBER 2002 MOU

In December 2002, 14 television manufacturers and eight cable system operators signed a memorandum of understanding covering interoperability of unidirectional digital cable products and cable systems. The MOU culminated months of work, facilitated by the Consumer Electronics Association and the National Cable Telecommunications Association, to reach consensus on how best to achieve the mutual goal of retail availability of cable ready receivers while ensuring cable services are delivered as intended. The MOU deals with four impediments that prevented television manufacturers from being able to introduce cable ready TVs through the OpenCable process: (1) legal concerns with the available POD Host Interface License Agreement, (2) certainty that a large percentage of cable systems nationwide would follow specific digital transmission standards, (3) the lack of encoding rules for copy protection, and (4) a test or certification regime in keeping with the way televisions are typically measured for compliance.

MSOs rightfully sought to ensure that in reconciling these CE manufacturer concerns their own goals not be sacrificed. These goals being: (1) cable services are delivered consistently whether through a leased device or a retail device, (2) cable not be competitively disadvantaged with respect to other video distributors, (3) operators have freedom to develop and market new services, and (4) retail cable ready devices not harm the cable network or allow theft of service.

Elements of the MOU obviously deal with certain aspects of these goals, as evidenced by the inclusion of a new DFAST license agreement and encoding rules. Enough ink will be spent on these mostly

legal matters elsewhere. This paper instead focuses on the standards that both parties have agreed to rely on for compatibility and the self-certification process for the retail devices.

STANDARDS THAT APPLY

The Core Standards

In the MOU, cable system operators commit that cable systems with an activated channel capacity of 750 MHz or greater shall comply with the following SCTE standards.

- SCTE 40 2001, as amended by DVS/535
- ANSI/SCTE 65 2002
- ANSI/SCTE 54 2002, as amended by DVS/435r4

And all digital cable systems shall comply with these standards.

- ANSI/SCTE 28 2001, as amended by DVS/519r2
- ANSI/SCTE 41 2001, as amended by DVS/301r4

The ''as amended by'' notation reflected the need to point to these standards that were at the time being revised in the SCTE DVS committee. A quick description of each standard and its status as of this writing follows.

SCTE 40 2001, titled Digital Cable Network Interface Standard, is in the final SCTE approval stages and should publish as SCTE 40 2003. SCTE 40 defines the key characteristics of what the cable system delivers to the television in terms RF, transport layer, and other services, such as emergency alerts and closed captioning.

ANSI/SCTE 65 2002, titled Service Information Delivered Out Of Band for Digital Cable Television, is unchanged since the MOU was signed. This standard defines Service Information tables providing the data necessary to tune and display the services offered by the operator. The term Out Of Band indicates that the SI tables are delivered by a possibly proprietary transport to the POD and then forwarded in a standardized fashion to the cable ready device (Host) through the Extended Channel.

ANSI/SCTE 54 2002, titled Digital Video Service Multiplex and Transport System Standard for Cable Television, is now SCTE 54 2003 after completing its revision process. This standard builds on MPEG-2 Transport Stream coding to define how cable systems construct multi-program Transport Streams.

ANSI/SCTE 28 2001, titled HOST-POD Interface Standard, is in the final editorial stages after completing its ballot and should publish as SCTE 28 2003. This standard defines just what its title suggests – clearly necessary for developing unidirectional digital cable products.

ANSI/SCTE 41 2001, titled POD Copy Protection System, is near the end of a major revision related to switching the copy protection system to reliance on X.509 certificates. This standard defines how the interface between the POD and HOST is protected from having to expose video content in the clear.

The first three standards above are an obligation for 750 MHz cable systems to deliver digital video by these standards. The HOST-POD Interface and its associated copy protection standard are an obligation of all cable systems, regardless of whether digital transmission is used. Similarly, digital cable products marketing under this MOU are obligated to tune digital channels in accordance with SCTE 40, navigate using SCTE 65, respond to emergency alerts per SCTE 54, and include a POD interface compliant with SCTE 28 and SCTE 41.

Other Standards

The MOU relies on other standards, particularly related to certain interfaces on leased set top boxes and retail digital cable products. Television manufacturers commit to providing DVI or HDMI interfaces on a phase-in and resolution basis and cable operators commit to providing IEEE 1394 and DVI interfaces on HD set top boxes on a phase-in basis. Cable operators expressed an interest in DVI (uncompressed video) as the preferred interface, hence the commitment by television manufacturers to support it. Television manufacturers needed support for a compressed video interface on set top boxes for recordability, explaining the inclusion of this interface on leased boxes.

The IEEE 1394 interface described in the MOU is actually defined by a pair of standards, ANSI/SCTE 26 2001 and CEA-931-A. SCTE 26, Home Digital Network Interface Specification with Copy Protection, builds on EIA-775-A and EIA-779, which in turn build on IEEE 1394, to completely define how this interface is used between a cable device and another CE product. CEA-931-A, Remote Control Command Pass-through Standard for Home Networking, adds the usability feature that a display device can pass-through remote control commands to the video source at the other end of the 1394 interface.

ADDITIONAL REQUIREMENTS

Harm Prevention Tests, those meant to protect the cable system and its ability to deliver services, are singled out as applying to all products under the MOU. A mutually agreed upon set of harm prevention requirements does not exist in the form of an SCTE or CEA standard. The MOU recognizes this deficit by pointing to EIA/CEA-818-D and DVS/538 as sources for these requirements.

EIA/CEA-818-D, Cable Compatibility Requirements, collects together requirements from other standards for application to digital cable systems and compatible receivers. Part I states minimum requirements for receiver-compatible digital cable TV systems, and Part II states minimum requirements for cable-compatible digital TV receivers. SCTE DVS/538r1, Uni-Directional Receiving Device Standard for Digital Cable (Input), is a proposal for standardization of receiver requirements intended to complement the transmission standards used by digital cable TV systems. Neither of these documents are referenced directly by the MOU, except as sources for harm prevention test items.

PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT

One of the tools that often is used in the process of verification of a complex product that follows a number of industry standards is the Protocol Implementation Conformance Statement (PICS). This document is a detailed collection of every one of the requirements from all the referenced standards. This document creates a traceability matrix and serves as the basis for any conformance statement of a manufacturer seeking certification.

Since the MOU and the proposed rules for a unidirectional cable receiving device were written, a team of engineers from several manufacturers, along with staff of CableLabs and CEA, have been working to complete this critical piece of documentation. In the first quarter of 2003, this team participated in meetings and conference calls totaling more than 120 hours and spent in excess of $10,000 on conference call services to this end. This concentrated effort shows how critical is the element of accurately documenting each testable requirement.

The PICS document contains over 600 unique requirements. In many cases each line item includes a direct quotation of a normative statement from the applicable industry standard, along with a chapter and verse reference location. In some cases, a requirement was stated without any citable industry standard to reference. In those cases each new requirement is added to an appendix at the end of the PICS.

This process of including requirements without an external reference does represent a departure from the usual process of developing a PICS. This departure from past CableLabs practice was necessary since the MOU relies solely on published SCTE and CEA standards and some mutually agreed requirements derived from other sources, including OpenCable, EIA/CEA-818-D, and DVS/538.

The PICS documentation also serves as the detailed breakdown showing which requirements relate to Critical Tests and Non-Critical Tests. The Critical Test items are further divided to show which apply to ‘‘Tune and Display’’ requirements and which remain as Harm to Network, Security, or other harm related tests. The purpose of this division is to show which requirements apply to the different type of products defined in the MOU and proposed rules.

The final purpose of the PICS documentation is to list the requirements that need to be tested in the Acceptance Test Plan. This completes the traceability so that every test may be traced back to one or more line item in the PICS, each of which can be traced back to a normative statement of a referenced industry standard.

ACCEPTANCE TEST PLAN

The Acceptance Test Plan (ATP) is another document that is included in the Joint Test Suite (JTS). This document details each of the unique test procedures that are used to verify the requirements stated in the PICS. The ATP gives instructions to the test technician who performs the test and it details the equipment settings, connections, and other test conditions. The ATP also defines the range of acceptable results and how the results should be documented.

There are three basic guidelines that were used in creating the tests within the ATP: (1) All of the tests are ‘‘black-box-tests’’ meaning that the tests are performed on a closed box, using only the available input and output interfaces; (2) The tests are not meant to limit the type of test or procedure that can be used to verify compliance, but are simply a record of an agreed upon group of tests that are applicable; (3) The test plan is not static or complete, further revisions are expected as additional tests are developed and new test equipment becomes available.

The ATP is divided to match the breakdown of the PICS into Critical and Non-critical, with the Critical tests further divided to show Harm prevention tests, security tests and tune and display tests. This breakdown is prescribed by the terms of the MOU.

Each test within the ATP may be used to verify one or more of the numbered requirements of the PICS. Each test identifies what is being tested, the test equipment to be used, and the instructions on the exact settings of the controls and instruments used. Connection diagrams and further explanations of the setup are provided so that all tests are readily repeatable.

A variety of tests are necessary to fully determine compliance with the standards. One group of tests can confirm a portion of the requirements using a POD simulation tool that can be programmed to provide many of the message types that are used on the POD

interface. This tool logs the response from the unidirectional receiving device and analyzes the response to confirm compliance.

The cable side has proposed also to include interoperability tests which use a genuine POD on a live cable plant. This type of test has been found to be important in previous CableLabs testing since the simulation tools do not contain proprietary circuitry needed to work on a real cable plant. Without those circuits, the tool is not able to receive messages from a cable headend which is necessary to confirm the receiver is not interfering with headend communications according to the requirements of the Harm tests. Further, there are a variety of requirements associated with the proper reception of the OOB signals, which vary widely from plant to plant that are not testable using the simulation tools. Television manufacturers believe this type of interoperability testing is not part of the MOU's self-certification process and offered instead to work with cable on interoperability events.

The ATP also includes the forms that record the results of each test. Blank space is provided to record the measured results right next to the defined range of acceptable results. This documentation becomes part of the first prototype test suite results that are recorded at CableLabs.

SELF CERTIFICATION PROCESS

Certification is the process of verifying compliance with the required standards necessary to earn the right to use the digital certificates necessary to operate on a cable plant. Without these digital security certificates, the product would not be recognized by the cable system. When the digital cable receiving product is first plugged into the Point of Deployment card (POD), a digital authentication process ensues. Each device verifies the authenticity of the certificates held by the other device. If both sides agree, the interface is said to be authenticated. If this process fails, cable services are disabled.

"Self-Certification" is the form of this certification process that is prescribed by the MOU and that relies upon the individual manufacturer's own statements and documentation. While the exact details of the self-certification process are not fully defined nor agreed upon at the time this paper was prepared, the following basic principles are expected to be used:

1) The first prototypes of the unidirectional digital television product will be brought to CableLabs or an appropriately qualified third party testing facility where the Test Suite will be executed. Test events will be scheduled at CableLabs to reasonably accommodate the demand and will be coordinated to make best use of resources.

2) If the test results reveal any failures of the Critical Tests and the product is a unidirectional digital television product, then corrections must be applied and the product resubmitted to CableLabs for re-testing as many times as it takes to correct all the Critical Test failures. If the first prototype submitted is not a television, and has critical test failures, only the corrections to the Harm Prevention Test failures need be retested.

3) Once the manufacturer has successfully passed all Critical Tests and corrected all other test failures as needed, the passing test results are submitted to CableLabs along with the self certification documentation. This additional documentation includes the affirmative conformance statement and other details that have not been fully defined at this time.

4) Once the passing test results and the Self Certification Documentation has been

submitted, CableLabs authorizes the assigned Certificate Authority to begin issuing the X.509 certificates to the manufacturer for the model and range of products specified.

5) Subsequent products by the same manufacturer have no obligation to be tested at CableLabs, but need only the Self Certification Documentation to be authorized for digital certificates.

NEXT STEPS

At the time of this writing, work remained on the PICS and ATP; they are expected to be completed by the time this reaches print. There will also be some further negotiation and documentation needed to fully define the details of the Self Certification process.

Of course, the FCC must endorse the proposed rules as submitted with the MOU in order for this process to be activated. In the mean time some manufacturers are going ahead and making products designed to meet the full OpenCable requirements under the PHILA agreement while others are waiting to take advantage of the MOU process.

There also remains some risk that the FCC may not endorse the exact proposal as submitted. If that happens the MOU says the deal is off and everyone will have to reassess how to proceed.

REFERENCES

The MOU is available under the FCC Further Notice of Proposed Rulemaking, FCC 03-3, in Dockets CS No. 97-80 and PP No. 00-67.

SCTE standards are available at www.scte.org.

CEA/EIA standards are available at http://global.ihs.com/.