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Telecommunications
Engineers***

**ENGINEERING COMMITTEE
Digital Video Subcommittee**

AMERICAN NATIONAL STANDARD

ANSI/SCTE 105 2005

**Uni-Directional Receiving Device Standard for
Digital Cable**

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1 SCOPE

1.1 Uni-Directional Receiving Device Overview

The goal of this standard is to define certain requirements for host devices that are interoperable across cable systems in North America. Information is presented in this document to define the minimum requirements for Uni-Directional Receiving Devices (“UDRDs”) to operate on North American Digital Cable systems. This standard details requirements on UDRDs necessary to ensure that the UDRD:

- (1) Will not technically disrupt, impede or impair delivery of services to cable subscribers,
- (2) Will not cause physical harm to the cable network or the POD¹,
- (3) Will not facilitate theft of service or otherwise interfere with reasonable actions taken by Cable Operators to prevent theft of service,
- (4) Will not jeopardize the security of any services offered over the cable system,
- (5) Will not interfere with or disable the ability of a Cable Operator to communicate with or disable a POD Module or to disable services being transmitted through a POD Module, or
- (6) Will not impede or impair control of content protection.

In general, UDRDs:

1. Are also capable of receiving analog cable television services provided according to ANSI/SCTE 40 2004 [23].
2. Are compatible with secure services provided via a renewable and replaceable core encryption system (POD module).
3. Co-exist with existing set-top devices, such as those leased by cable operators.

Note that this standard does not attempt to define certification requirements, license terms or encoding rules applicable to Uni-Directional Receiving Devices, which are out of scope.

2 REFERENCES

2.1 Normative References

The following documents contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

¹ The term CableCARD™ is a marketing term that has been adopted by the cable and consumer electronics industries for the Point of Deployment (POD) security module. It is used with the permission of CableLabs.

-
- [1] ANSI/SCTE 54 2004: Digital Video Service Multiplex and Transport System Standard for Cable Television
 - [2] ANSI/SCTE 55-1 2002: Digital Broadband Delivery System: Out-of-band Transport – Mode A
 - [3] ANSI/SCTE 55-2 2002: Digital Broadband Delivery System: Out-of-band Transport – Mode B
 - [4] ANSI/SCTE 65 2002: Service Information Delivered Out-of-Band for Digital Cable Television
 - [5] ATSC A/53C: ATSC Digital Television Standard, Rev. C, with amendment No. 1.
 - [6] CEA-542-B: Cable Television Channel Identification Plan
 - [7] CEA-608-B: Recommended Practice for Line 21 Data Service
 - [8] FCC 47 CFR Part 15 – Radio Frequency Devices, Class B
 - [9] FCC 47 CFR Part 76 – Cable Television Service
 - [10] ANSI/SCTE 28 2004 POD/Host Interface Specification
 - [11] CEA-766-A: U.S. and Canadian Region Rating Table (RRT) and Content Advisory Descriptor for Transport of Content Advisory Information Using ATSC A/65, A66 and A67, Program and System Information Protocol (PSIP)
 - [12] ANSI/SCTE 41 2004 POD Copy Protection System Specification
 - [13] ITU-T Recommendation X.509 (03/2000), Information technology - Open Systems Interconnection - The Directory: Public-key and attribute certificate frameworks
 - [14] PKCS #1: RSA Encryption Standard, Version 1.5, RSA Laboratories, November 1, 1993
 - [15] ANSI/SCTE 07 2000 (formerly DVS 031), Digital Video Transmission Standard for Television
 - [16] ANSI/SCTE 20 2004 Standard Methods for Carriage of Closed Captions and Non-Real Time Sampled Video
 - [17] ANSI/SCTE 21 2001 (formerly DVS 053), Standard for Carriage of NTSC VBI Data in Cable Digital Transport Streams
 - [18] IETF RFC 3280, “Internet X.509 Public Key Infrastructure Certificate and CRL Profile”, R. Housley, W. Ford, W. Polk, D. Solo, January 2002
 - [19] CEA-23-A Measurement Procedures for Determining Compliance with FCC Rules for “Cable-Ready Consumer Electronics Equipment”, December 2004

2.2 Informative References

- [20] ANSI-J-STD-042-2002 Emergency Alert Message for Cable
- [21] ANSI/SCTE 43 2004 Digital Video Systems Characteristics Standard for Cable Television
- [22] ATSC A/52A: ATSC Digital Audio Compression Standard
- [23] ANSI/SCTE 40 2004 Digital Cable Network Interface Specification
- [24] CEA 708B: Digital Television (DTV) Closed Captioning
- [25] ISO/IEC 13818-1:2000: Information technology -- Generic coding of moving pictures and associated audio information: Systems (MPEG-2 Systems)

2.3 Reference Acquisition

SCTE Standards:

- Society of Cable Telecommunications Engineers Inc., 140 Philips Road, Exton, PA 19341
Phone: 1-800-542-5040, Fax: 610-363-5898 Internet: <http://www.scte.org>;
email: standards@scte.org

CEA Standards:

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO
USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet <http://global.ihs.com>; email
global@ihs.com

FCC Documents:

- Qualex International. Room CY- B402, 445 12th Street, SW, Washington, DC, 20554 Phone 202-
863-2893; email: QUALEXINT@AOL.COM

ATSC Standards:

- Advanced Television Systems Committee (ATSC), 1750 K Street NW, Suite 1200, Washington,
DC 20006; Phone 202-872-9160; Fax 202-872-9161; Internet <http://www.atsc.org>.

ISO/IEC Standards:

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO.
USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet <http://global.ihs.com>; email
global@ihs.com.

IETF:

- IETF Secretariat c/o Corporation for National Research Initiatives 1895 Preston White Drive,
Suite 100 Reston, VA 20191 IETF
- Request For Comments: Internet <http://www.ietf.org/rfc.html>

ITU-T Recommendations:

- International Telecommunications Union, Place des Nations, CH-1211 Geneva 20, Switzerland;
Phone +41 22 730 51 11; Fax +41 22 733 7256; Internet <http://www.itu.int>.

RSA Standards:

- RSA Security, 174 Middlesex Turnpike, Bedford, MA USA 01730; Phone 781 515 5000; Fax 781
515 5010; Internet <http://www.rsasecurity.com>

3 GLOSSARY

This document defines the following terms:

CA Certificate:	An X.509 version 3 certificate of the CA that issues Device Certificates for the device identity authentication. It is issued by the CableLabs Manufacturer Root CA. The CA Certificate is also referred to as a Manufacturer CA Certificate.
CableCARD	The Point-of-Deployment module is also known as a CableCARD device.
CableLabs CA	An X.509 certificate authority authorized by CableLabs Manufacturer Root CA to issue Card or Host Certificates. This authority is also called a Manufacturer XCA.
CableLabs Manufacturer Root CA	The X.509 certificate root authority controlled by CableLabs to issue CA Certificates. This authority is also called the PHICA.
Card	The same as CableCARD brand removable security module.
Card CA Certificate	The CA Certificate installed in the Card at the factory or during a field code update. This is the Certificate of the CA that issued the Card's Device Certificate.
Card Certificate	A Device Certificate issued to a Card. It is also called a POD Certificate or POD Device Certificate
Card Certificate List	The Card CA Certificate and Card Certificate installed in the Card. This list is also called a POD Certificate List.
Controlled Content	Content that has been transmitted from the Card with the encryption mode indicator ("EMI") bits set to a value other than zero, zero (0,0).
Device Certificate	An X.509 version 3 certificate used for Card and Uni-Directional Receiving Device identity authentication. It is issued by a CableLabs CA.
Host	Any device that includes a SCTE 28 & SCTE 41 compliant Card slot (e.g. UDRD)
PKCS	RSA Security Inc.'s publications titled "Public Key Cryptography Standards"
Receiving	For digital signal, means picture and sound with no impairments lower than a rating of 4 on the ITU-R BT.500 scale. ("Perceptible, but not annoying")
Root CA Certificate	A self-signed X.509 version 3 certificate used for device identity authentication. It is maintained by CableLabs. This certificate is also referred to as the CableLabs Manufacturer Root CA Certificate. The Root CA Certificate is installed in both the Card and UDRD.
Uni-Directional Receiving Device (UDRD)	A receiving device compliant with this standard that operates on cable plants that provide signals compliant with ANSI/SCTE 40 2004 [23], and does not transmit data on any return data channel (i.e. unidirectional).

4 COMPLIANCE NOTATION

Table 1 – Compliance Notation Chart

“SHALL”	This word or the adjective “REQUIRED” means that the item is an absolute requirement of this specification.
“SHALL NOT”	This phrase means that the item is an absolute prohibition of this specification.
“SHOULD”	This word or the adjective “RECOMMENDED” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
“SHOULD NOT”	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
“MAY”	This word or the adjective “OPTIONAL” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

5 OVERVIEW OF CORE SERVICES AND FUNCTIONALITIES (INFORMATIVE)

This section describes the core services that Uni-Directional Receiving Devices may support as well as the core functions required to implement those services. A block diagram showing a possible configuration of a Uni-Directional Receiving Device is shown in Figure 1.

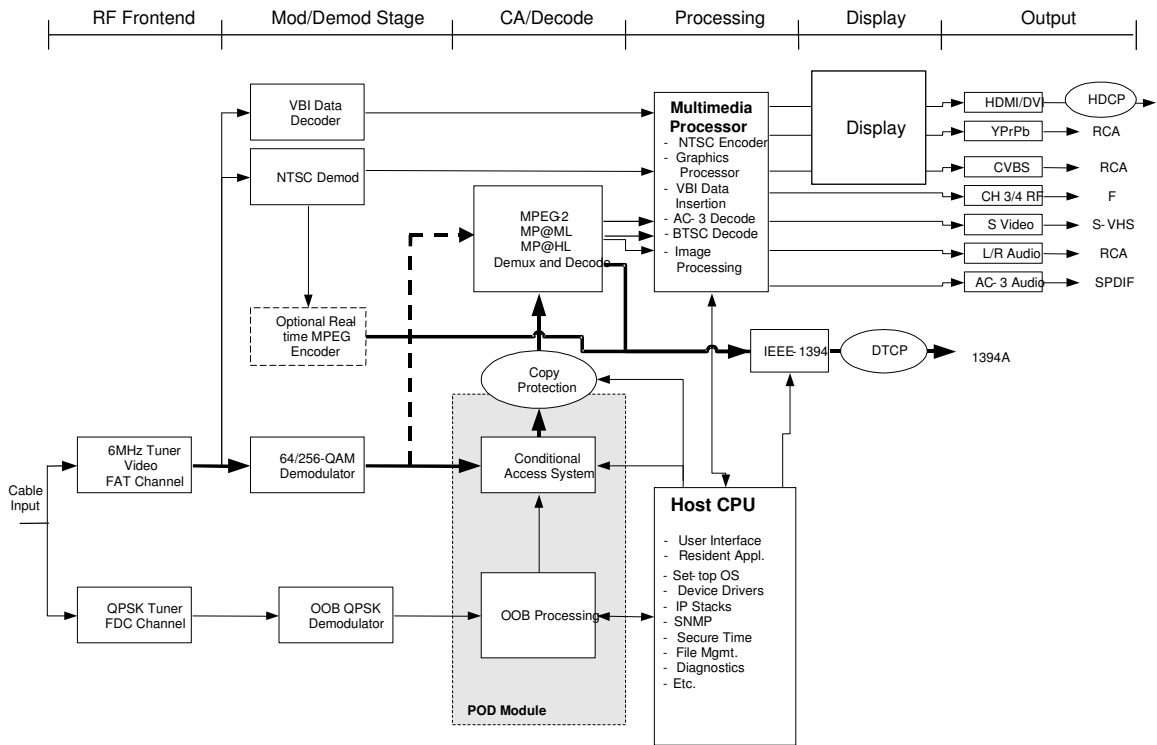


Figure 1. Uni-Directional Receiving Device Block Diagram

The Uni-Directional Receiving Device receives multimedia information by tuning to one of many 6 MHz input channels available via a connection to a cable television network. When the input channel is an analog channel, the signal is processed via the NTSC decoder and the VBI data decoder. When the input channel is a digital channel, it is processed via the QAM demodulator and then passed to the Point of Deployment (POD) module where secure and scrambled information are processed. Services that are authorized are decrypted and conditionally reencrypted for copy protection, and passed through the POD module to the MPEG-2 Transport Demultiplexer. When the POD module is not inserted, the output of the QAM demodulator is routed directly to the MPEG-2 Transport Demultiplexer. The multi-media processor handles the synchronization and display of audio-visual material.

The Uni-Directional Receiving Device also receives control information and other data by tuning to an out-of-band (OOB) Forward Data Channel (FDC). The Uni-Directional Receiving Device will remain tuned to the OOB forward data channel to continuously receive information. This information is passed to the POD for processing, and relevant information is passed back to the Uni-Directional Receiving Device.

5.1 Core Services

The following services are enabled by the Standard for Uni-Directional Receiving Devices:

- Analog NTSC audio-visual programming: (clear, non-scrambled).
- Digital audio-visual programming utilizing MPEG-2 main profile @ main level and main profile @ high level video and Dolby AC-3 audio: broadcast, subscription, music (audio only) channels, and call-ahead Pay-Per-View (PPV).

NOTE – Call-ahead Pay-Per-View is a paid service in which the viewer pre-subscribes selected programming via telephone and is subject to availability.

NOTE – Some music (audio-only) services also include ‘video stills’ that comply with SCTE 54, 2004.

5.2 Core Functions and Features

The features and functions of the Uni-Directional Receiving Device may include the following:

- 54 - 864 MHz, analog and digital (64/256-QAM) tuning and demodulation
- Closed Caption pass-through for analog video (line 21, fields 1 and 2) output when input is analog video
- Closed Caption reinsertion into the VBI of reconstructed analog NTSC output(s) when input is digital video
- Copy protection on analog and digital outputs
- Emergency Alert System in compliance with ANSI-J-STD-042-2002 [20]
- QPSK out-of-band tuner & demodulator (compliant with ANSI/SCTE 55-1 2002: Digital Broadband Delivery System: Out-of-band Transport – Mode A [2] and ANSI/SCTE 55-2 2002: Digital Broadband Delivery System: Out-of-band Transport – Mode B [3])
- Analog NTSC RF Channel 3/4 output
- Support for RF bypass
- Baseband Video output
- L&R Baseband Audio outputs
- SP/DIF Digital Audio output
- High speed IEEE-1394 digital interface with DTCP
- POD/Host digital interface with copy protection (see ANSI/SCTE 28 2004 POD/Host Interface Specification [10] and ANSI/SCTE 41 2004 POD Copy Protection System Specification [12])
- DVI or HDMI digital interface with HDCP

6 POWER MANAGEMENT

- Requirement 1: The Uni-Directional Receiving Device shall be capable of supplying up to 250mA on the VPP pins while maintaining 3.3V +/- 0.3 VDC (per card) before reading the Card Information Structure (CIS).
- Requirement 2: If the Uni-Directional Receiving Device does support the value of 0x3h in the Power field of the Feature Selection Byte (TPCE_FS) as defined by [10], the Uni-Directional Receiving Device shall supply either 3.3V or 5V as requested on VPP1 and VPP2 pins.
- Requirement 3a: If the Uni-Directional Receiving Device is operating in the Polling mode, it shall poll the Card no less frequently than once every 100 msec.
- Requirement 3b: If the Uni-Directional Receiving Device is operating in the interrupt mode, it shall respond to interrupts within 100 msec and poll the Card no less frequently than once every 5 seconds

7 OTHER REQUIREMENTS OF A UNI-DIRECTIONAL RECEIVING DEVICE

- Requirement 318 The Uni-Directional Receiving Device shall support the Host-POD Interface in accordance with ANSI/SCTE 28 2004 [10].
- Requirement 4: For UDRDs sold or marketed after July 1, 2005, conducted emissions (including LO and spurious) at the RF input shall be less than or equal to -30 dBmV over the range 54 MHz to 864 MHz and -26 dBmV over the range 5 MHz up to but not including 54 MHz, measured with a 9 kHz bandwidth.
- Requirement 14: The Uni-Directional Receiving Device shall have a nominal RF Input impedance of 75 ohms unbalanced.

8 COPY PROTECTION SUPPORT

- Requirement 319 The Uni-Directional Receiving Device shall support Host-POD Copy Protection in accordance with ANSI/SCTE 41 2004 POD Copy Protection System Specification [12].
- Requirement 102: When the ID Reporting Screen is selected, typically from a Host menu after the Card has provided an invalid certificate to the Uni-Directional Receiving Device, then the UDRD shall generate and display the following message: “Please call your cable operator and report an invalid CableCARD”

9 CERTIFICATE MANAGEMENT

- Requirement 300: The Uni-Directional Receiving Device validation² shall comply with the certificate validation requirements in RFC 3280 [18], where they are referred to as “Certificate Path Validation”, except the Uni-Directional Receiving Device SHALL NOT implement the certificate revocation check described in section 6.1.3 (a) (3) of RFC 3280³.
- Requirement 301: The Uni-Directional Receiving Device signature mechanism shall use SHA-1 with RSA [14] Encryption with specific OID 1.2.840.113549.1.1.5
- Requirement 302: The Uni-Directional Receiving Device shall have the Root CA Certificate as provided by CableLabs. A field description describing the current values is provided for information in Table 2.

Table 2 – CableLabs Manufacturer Root CA Certificate (Informative)

Certificate Field	Certificate Field Description
subject	C=US O=CableLabs CN=CableLabs Manufacturer Root CA
validity	30+ years. It is intended that the validity period is long enough that this certificate is never re-issued.

² This requirement is for verification of the Uni-Directional Receiving Device ability to perform certificate chain validation of the Card.

³ The revocation check cannot be performed, so it is omitted during the certificate path validation process. The certificate revocation check is performed as part of the Authentication Phase 2 described in the SCTE 41 2004 [12].

subjectPublicKeyInfo	The certificate's RSA public key (modulus length is 2048 bits)
Extensions	keyUsage[c,m](keyCertSign, cRLSign) subjectKeyIdentifier[n,m] basicConstraints[c,m](cA=TRUE)
Informative Note: Extension details are specified by - [c:critical, n:non-critical; m:mandatory, o:optional]. Optional subject naming attributes are surrounded by square brackets (e.g., [L = <city>]). Variable naming attribute values are surrounded by angle brackets. (e.g., CN = <Company > Device). Values not surrounded by angle brackets are static and cannot be modified.	

Requirement 303: The Uni-Directional Receiving Device shall have a CA Certificate as issued by the Manufacturer Root CA. A field description describing the current values is provided for information in Table 3.

Table 3 – Manufacturer CA Certificate (Informative)⁴

Certificate Field	Certificate Field Description
subject	C=US O=CableLabs, Inc. S=Colorado L=Louisville OU= <CA Designator> CN=CableLabs, Inc. Mfg CA
validity	20 to 30 Years
subjectPublicKeyInfo	The certificate's RSA public key (modulus length is 2048 bits)
Extensions ⁵	keyUsage[c,m](keyCertSign, cRLSign) subjectKeyIdentifier[n,m] authorityKeyIdentifier[n,m](keyIdentifier=<subjectKeyIdentifier value from CableLabs' Manufacturer Root CA Certificate>) basicConstraints[c,m](cA=TRUE, pathLenConstraint=0) subjectAltName [n,o] (Directory Address)
Informative Note: Extension details are specified by - [c:critical, n:non-critical; m:mandatory, o:optional]. Optional subject naming attributes are surrounded by square brackets (e.g., [L = <city>]). Variable naming attribute values are surrounded by angle brackets. (e.g., CN = <Company > Device). Values not surrounded by angle brackets are static and cannot be modified.	

Requirement 304: The Uni-Directional Receiving Device shall validate that the keyUsage extension in the Card CA Certificate is present and that the extension's keyCertSign parameter is set to 1.

⁴ This certificate is issued to each device manufacturer by the CableLabs Manufacturer Root CA and can be provided to each device either at manufacture time, or during a field code update. This certificate appears as a read-only parameter in the device. This certificate, along with the CableLabs Manufacturer Root CA Certificate and the Device Certificate, is used to authenticate the device identity. This certificate is signed by the CableLabs Manufacturer Root CA.

⁵ Other certificate extensions can also be included but would also be marked as non-critical.

Requirement 305: The Uni-Directional Receiving Device shall validate that the subjectKeyIdentifier extension is present in the Card CA Certificate.

Requirement 306: The Uni-Directional Receiving Device shall validate the authorityKeyIdentifier extension in the Card CA Certificate by checking that:

- The extension is present
- The extension's keyIdentifier value is identical to the CableLabs Manufacturer Root CA Certificate's subjectKeyIdentifier value

Requirement 307: The Uni-Directional Receiving Device shall validate the basicConstraints extension in the Card CA Certificate by checking that:

- The extension is present
- The extension's cA parameter is set to TRUE
- The extension's pathLenConstraint parameter is set

Requirement 308: The Uni-Directional Receiving Device shall have a Device Certificate as issued by the Manufacturer CA. A field description describing the current values is provided for information in Table 4.

Table 4 – Device Certificate (Informative)⁶

Certificate Field	Certificate Field Description
subject	C=<country> O=<Company Name> [ST=<state/province>] [L=<city>] [OU=OpenCable] [OU=JTS] [OU=<Product Name>] [OU=<Manufacturer's Facility>] CN=< Host ID or POD ID> ⁷ [OU=<MFG ID>]
validity	30 years
subjectPublicKeyInfo	The certificate's RSA public key (modulus length is 1024 bits)
Extensions	keyUsage[c,m](digitalSignature, keyEncipherment), authorityKeyIdentifier [n, m](keyIdentifier=<subjectKeyIdentifier value from CA Certificate>)
<p>Informative Note: Extension details are specified by - [c:critical, n:non-critical; m:mandatory, o:optional]. Optional subject naming attributes are surrounded by square brackets (e.g., [L = <city>]). Variable naming attribute values are surrounded by angle brackets. (e.g., CN = <Company > Device). Values not surrounded by angle brackets are static and cannot be modified.</p>	

⁶ This certificate is issued by the Manufacturer CA and installed in the POD or Host device at the factory. The head-end cannot update this certificate. This certificate appears as a read-only parameter in the device. This certificate is signed by the Manufacturer CA.

⁷ There are 40 bits or 5 bytes for the Host ID, which requires 10 bytes of ASCII to represent this in the X.509 CN field.)

Requirement 309: The Uni-Directional Receiving Device shall validate the keyUsage extension in the Card Certificate by checking that:

- The extension is present
- The extension's digitalSignature parameter is set to 1
- The extension's keyEncipherment parameter is set to 1

Requirement 310: The Uni-Directional Receiving Device shall validate the authorityKeyIdentifier extension in the Card Certificate by checking that:

- The extension is present
- The extension's keyIdentifier value is identical to the Card CA Certificate's subjectKeyIdentifier value

Requirement 311: The Uni-Directional Receiving Device Host_ID shall be expressed as 10 upper-case hexadecimal digits in the Device Certificate.

Requirement 312: The Uni-Directional Receiving Device Host_ID defined in the CN field of the X.509 certificate shall comply with the following requirements:

- The 10 most significant bits of the Host_ID shall be set equal to the binary equivalent of the CableLabs assigned 3 decimal digit Host manufacturer number.
- The remaining 30-bits of the Host_ID shall be set equal to a value between zero and 999,999,999 decimal, 3B9AC9FF hexadecimal, to facilitate on-screen presentation to subscribers and manual report back.
- The Host_ID (40-bits) assigned to each Device Certificate shall be unique to each Uni-Directional Receiving Device.

Requirement 315: The Uni-Directional Receiving Device shall validate that the current time falls within the Card Certificate validity period.

Requirement 317: Uni-Directional Receiving Devices shall be designed and manufactured in a manner to effectively frustrate attempts to discover or reveal (i) the unique number, of a specified bit length, assigned to each Unidirectional Digital Cable Product, the numbers used in the process for encryption or decryption of Controlled Content, or the private key used in the process for encryption or decryption of Controlled Content (collectively, "Keys") and (ii) the methods and cryptographic algorithms used to generate such Keys. For the avoidance of doubt, Keys includes the private key used for authentication. All authentication private keys shall be protected using encryption or obfuscation methods when being transferred across internal buses and stored in memory.

10 IN-BAND CHANNEL SUPPORT

Requirement 9: Uni-Directional Receiving Device shall be able to process MPEG-2 compliant Transport Streams that comply with ANSI/SCTE 54 2004: Digital Video Service Multiplex and Transport System Standard for Cable Television [1]

Requirement 9a: Uni-Directional Receiving Device shall not be adversely affected by the presence of an incorrect service location descriptor in the PSIP TVCT. UDRD built after Jan 1, 2006 should not be adversely affected by PID ranges from SCTE 54, 2004 that were valid before Jan 1, 2006.

Requirement 10: Uni-Directional Receiving Device shall not be adversely affected by the presence or absence of descriptors formatted according to [25] and not otherwise required by [1].

11 OOB FDC CHANNEL SUPPORT

Requirement 11: The Uni-Directional Receiving Device shall be able to navigate (tune) using the System Information when it is carried in OOB-FDC, as described in reference ANSI/SCTE 65 2002: Service Information Delivered Out-of-Band for Digital Cable Television [4]

12 FAT CHANNEL RF PERFORMANCE PARAMETERS

Requirement 12: The Uni-Directional Receiving Device shall be able to demodulate signals compliant with ANSI/SCTE 07 2000 [15] transmission, physical layer modulation, coding, synchronization, and error correction.

Requirement 13: The Uni-Directional Receiving Device shall have tuning agility over the range of 54 MHz to 864MHz (IRC/HRC/Standard channel plans [6]).

Requirement 15: The Uni-Directional Receiving Device RF input return loss shall be 3 dB minimum over full tuning range.

Requirement 16: The Uni-Directional Receiving Device shall tune and receive analog visual carrier signals over the RF input level range from 0 dBmV minimum to +15 dBmV maximum.

Requirement 17: The Uni-Directional Receiving Device shall tune and receive analog aural carrier signals over the RF input level range from -10 to -17 dBc.

Requirement 18: The Uni-Directional Receiving Device shall tune and receive digital 64-QAM signals over the RF input level range signal from -15 dBmV to +15 dBmV.

Requirement 19: The Uni-Directional Receiving Device shall tune and receive digital 256-QAM signals over the RF input level range signal from -12 dBmV to +15 dBmV.

Requirement 20: The Uni-Directional Receiving Device shall tune and receive Standard/HRC/IRC signals that deviate in frequency by no more than the tolerance specified in CEA-23-A [19] Section 3.3.3 or as described in 47 CFR 76.612 [9], whichever is less, for each channel within the tuning range of the Device.

Requirement 23: The Uni-Directional Receiving Device shall not be adversely affected by AM hum modulation on digital carriers of less than or equal to 3% p-p.

Requirement 24: The Uni-Directional Receiving Device shall tune and receive with group delay variation of $< 0.25 \mu\text{sec}/\text{MHz}$ across the 6-MHz channel with group delay variation introduced such that the chroma/luma delay of 47 CFR 76 [9], the amplitude ripple of Requirement 27 and the microreflections of Requirement 28 are not exceeded.

Requirement 25: The Uni-Directional Receiving Device shall tune and receive with phase noise of $< -86 \text{ dBc}/\text{Hz}$ @ 10 kHz offset (relative to the center of QAM signal spectrum).

Requirement 26: The Uni-Directional Receiving Device shall tune and receive with amplitude ripple on digital channels of $< 5 \text{ dB p-p}$ within the 6-MHz channel with amplitude ripple introduced such that the chroma/luma delay is less than 47 CFR 76 [9], group delay variation of Requirement 24, and the microreflections of Requirement 28 are not exceeded.

-
- Requirement 27: The Uni-Directional Receiving Device shall tune and receive with amplitude ripple on analog channels of < 4 dB p-p within the 6-MHz channel with amplitude ripple introduced such that the chroma/luma delay is less than CRF47.76, and group delay variation of Requirement 24 and the microreflections of Requirement 28 are not exceeded.
- Requirement 28: The Uni-Directional Receiving Device shall tune and receive with microreflections of: (assumes one dominant echo with maximum specified amplitude in dB relative to the primary QAM signal);
- 10 dB at < 0.5 μ s
 - 15 dB at < 1 μ s
 - 20 dB at < 1.5 μ s
 - 30 dB at < 4.5 μ s
- With microreflections introduced such that the chroma/luma delay is less than 47 CFR 76 [9], group delay variation of Requirement 24 and the amplitude ripple of Requirement 27 are not exceeded.
- Requirement 54: The Uni-Directional Receiving Device shall be capable of Receiving digital 64-QAM signals at a level of -10 dBmV with an interleaver setting of I=128 (J=1) and the following simultaneous impairments⁸: 33 dB C/N, -18 dB ghost at 0.5 μ s, and 5 dB C/N bursts of 25 μ s at a 10 Hz repetition rate.
- Requirement 54a: The Uni-Directional Receiving Device shall be capable of Receiving digital 256-QAM signals at a level of -7 dBmV with an interleaver setting of I=128 (J=4) and the following simultaneous impairments⁹: 36 dB C/N, -18 dB ghost at 0.5 μ s, and 5 dB C/N bursts of 16 μ s at a 10 Hz repetition rate.

13 FD CHANNEL RF PERFORMANCE PARAMETERS

- Requirement 30: The Uni-Directional Receiving Device shall be capable of receiving symbols transmitted with a frequency stability of +/- 50 ppm measured at the upper limit of the frequency range.
- Requirement 31: The Uni-Directional Receiving Device shall be capable of receiving FDC with a RF input level range of -15 to +15 dBmV.
- Requirement 32: The Uni-Directional Receiving Device shall tolerate a group delay variation in channel, measured over Nyquist bandwidth of 200 ns max in channel. With group delay variation introduced such that the chroma/luma delay is less than or equal to the amplitude ripple of Requirement 27 and the microreflections of Requirement 28 are not exceeded.
- Requirement 100: The Uni-Directional Receiving Device shall be able to tune FDC signals over the range from 70 MHz to 130 MHz.
- Requirement 101: The Uni-Directional Receiving Device shall be able to tune any nominal carrier frequency in the FDC that is an integer multiple of 250 kHz between the minimum and maximum carrier frequencies, inclusive and the specific fixed frequency of 104.200 MHz.

⁸ The impairments defined in this requirement are the current judgment of an appropriate set of values, which are subject to further study and revision.

⁹ The impairments defined in this requirement are the current judgment of an appropriate set of values, which are subject to further study and revision.

14 DIGITAL AUDIO

Requirement 33: The Uni-Directional Receiving Device shall not be adversely affected by any audio service type (bsmod), as defined in ATSC A/53B Standard: Digital Television Standard, Revision B. [5]

15 ANALOG TELEVISION CHANNELS

Requirement 34: The Uni-Directional Receiving Device shall receive analog channels that are NTSC RF AM-VSB modulated signals in accordance with cable-system practice and applicable FCC rules.

16 CONTENT ADVISORY INFORMATION

Requirement 201: Uni-Directional Receiving Devices with integrated display and without off-air tuning capability that also provide component analog or uncompressed digital output streams, shall act upon content advisory data (defined in both CEA-608-B [7] and CEA-766-A [11]) as required by FCC 47 CFR Part 15.120 [8].

Requirement 38: All Uni-Directional Receiving Devices with integrated displays and without off-air tuning capability shall have a priori knowledge of the US region RRT and support CEA-766-A [11] (i.e., the table is stored in the Uni-Directional Receiving Device). The US rating_region shall be the default rating_region for all Uni-Directional Receiving Devices.

17 ANALOG CLOSED CAPTION

Requirement 35: For analog NTSC, closed captions are carried in line 21 of the vertical blanking interval (VBI). The encoding of NTSC closed caption is based on FCC part 15.119 [8] and CEA-608-B [7]. Uni-Directional Receiving Devices with integrated displays and without off-air tuning capability shall be able to display this information.

18 DIGITAL CLOSED CAPTION

Requirement 36: The Uni-Directional Receiving Device shall process and extract closed captioning information from MPEG picture level user_data() fields formatted and transported using ANSI/SCTE 21 2001 [17], when present, identified with user_data_type_code value of '0x03' and cc_type values '00' and '01' and carried in the cc_data_1 and cc_data_2 fields.

Requirement 36a: Uni-Directional Receiving Devices built before July 1st, 2008, shall process and extract closed captioning information from MPEG picture level user_data() fields formatted and transported using ANSI/SCTE 20 2004 [16], when present, unless MPEG picture level user_data() fields formatted and transported using ANSI/SCTE 21 [17] is also available. UDRDs built after July 1, 2008 should not be adversely affected by the presence of SCTE 20 [16] data complying with SCTE 43, 2004 [21].

Requirement 36b: In the case where a MPEG picture level user_data() field includes data formatted and transported via both aforementioned methods (ANSI/SCTE 20 [16] and

ANSI/SCTE 21 [17]), the Uni-Directional Receiving Device may use closed captioning data recovered from either method.

- Requirement 36c: In the case where a MPEG picture level user_data() field formatted and transported via ANSI/SCTE 21 [17] includes any cc_type values of '10' or '11', the Uni-Directional Receiving Device may use such data exclusively for captioning operation, notwithstanding the output requirements of Requirement 36d.
- Requirement 36d: The Uni-Directional Receiving Device shall, on all analog standard definition television outputs, modulate such extracted data (Requirement 36, Requirement 36a, Requirement 36b) on video line 21 (both fields) as specified in 47 CFR 15.122 [8] and CEA-608-B [7] above.
- Requirement 37: If the Uni-Directional Receiving Device with an integrated display and without off-air tuning capability provides component analog or uncompressed digital output streams, decoding and display of this caption data (Requirement 36, Requirement 36a, Requirement 36b) shall be provided according to 47 CFR 15.122 [8].

19 MAXIMUM INDIVIDUAL CARRIER AMPLITUDE

- Requirement 47: The Uni-Directional Receiving Device shall not be adversely affected by the presence of the following interfering signals:
- 42 dBmV, 5 MHz to 30 MHz
 - 24 dBmV, 30 MHz to 41 MHz
 - 0 dBmV, 41 MHz to 48 MHz
 - 10 dBmV, 48 MHz to 54 MHz
- Requirement 48: The Uni-Directional Receiving Device shall be capable of receiving signals where the maximum rms value of any other individual signal whose frequency exceeds 54 MHz shall be less than 10 mV across a 75 ohm terminating impedance (+20 dBmV) measured at the input to the Uni-Directional Receiving Device.

20 RF SIGNAL LEVELS AND ADJACENT CHANNEL CHARACTERISTICS

- Requirement 49: The Uni-Directional Receiving Device shall be capable of receiving an analog signal with a visual signal level that is within ± 3 dB of the visual signal level of any adjacent analog channel (within a 6 MHz nominal frequency separation as specified in 47CFR 76.605) [9].
- Requirement 49c: The Uni-Directional Receiving Device shall be capable of receiving digital QPSK FDC signal with a signal level that is ± 15 dBmV within the minimum channel spacing as specified in ANSI/SCTE 55-1 2002 [2] and ANSI/SCTE 55-2 2002 [3]. For digital QPSK FDC signals "capable of receiving" is defined as producing a digital stream with a bit error rate (BER) of $2.5e-06$ or less.
- Requirement 50: The Uni-Directional Receiving Device shall be capable of receiving analog television signals at a level of +5 dBmV with "worst case"¹⁰ adjacent channel performance of:

Undesired

D/U Ratio¹¹

¹⁰ "Worst case" means the highest degree of interference that may be encountered.

Analog NTSC	-3.0 dB
64-QAM	-1.0 dB
256-QAM	-6.0dB
QPSK FDC	-6.0dB

Requirement 51: The Uni-Directional Receiving Device shall be capable of receiving digital 64-QAM signals at a level of -6 dBmV with an interleaver depth set to I = 128, J = 1 for “worst case” adjacent channel performance of:

Undesired	D/U Ratio
Analog NTSC	-21.0 dB
64-QAM	-6.0 dB
256-QAM	-21.0 dB
QPSK FDC	-21.0 dB

Requirement 52: The Uni-Directional Receiving Device shall be capable of receiving digital 256-QAM signals at a level of -1 dBmV with an interleaver depth set to I=128, J = 4 for “worst case” adjacent channel performance of:

Undesired	D/U Ratio
Analog NTSC	-16.0 dB
64-QAM	-11.0 dB
256-QAM	-6.0 dB
QPSK FDC	-16.0 dB

Requirement 53: The Uni-Directional Receiving Device shall be capable of receiving digital QPSK FDC signals at a level of -7 dBmV with “worst case” adjacent channel¹² performance of:

Undesired	D/U Ratio
Analog NTSC	-22.0 dB
64-QAM	-17.0dB
256-QAM	-22.0dB
QPSK FDC	-6.0 dB

For digital QPSK FDC signals “capable of receiving” is defined as producing a digital stream with a bit error rate (BER) of 2.5e-06 or less.

21 UNI-DIRECTIONAL RECEIVING DEVICE FUNCTIONALITY WITHOUT A POD MODULE

Requirement 55: The UNI-DIRECTIONAL RECEIVING DEVICE shall tune (and display or cause to be displayed if applicable) unscrambled analog NTSC audio-visual programming

¹¹ D/U ratio is defined as the ratio of the average power of the desired signal D divided by the total average power of the undesired adjacent channel signals U where the power in each channel is measured within a 6 MHz bandwidth.

¹² "Adjacent Channel" in this case means that there is no guard band between the QPSK FDC signal and the undesired signal. Also, the undesired signal may be 6 MHz in bandwidth while the QPSK FDC signal is expected to be narrower than 6 MHz in bandwidth.

delivered in adherence to Standard, HRC or IRC frequency plans of CEA-542-B [6].

- Requirement 56: The UNI-DIRECTIONAL RECEIVING DEVICE shall discover, tune (and display or cause to be displayed if applicable) unscrambled digital services, delivered in adherence to Standard, HRC or IRC frequency plans of CEA-542-B [6].
- Requirement 57b: When no POD module is present and when one or more unscrambled services are available in the Transport Stream, and when a CVCT is present to describe one or more of the unscrambled services, the Uni-Directional Receiving Device shall use the CVCT for navigation to the unscrambled services.
- Requirement 57c: When no POD module is present and when one or more unscrambled services are available in the Transport Stream, and when no CVCT is present, but a TVCT is present to describe one or more of the unscrambled services, the Uni-Directional Receiving Device shall use the TVCT for navigation to the unscrambled services.
- Requirement 59: When the Uni-Directional Receiving Device is operating without a POD module any channel map created from OOB data while previously operating with a POD module shall not be used.
- Requirement 60: The Uni-Directional Receiving Device shall not be adversely affected by the presence of any valid PSIP data, content or structure.

22 VIRTUAL CHANNEL NUMBER PROCESSING

- Requirement 60b: When an out-of-band channel is available and profiles 4 or 5 are in use, the Uni-Directional Receiving Device shall use the two-part channel number in the two_part_channel_number_descriptor(), if such descriptor is present for a given channel, for identification and navigation of that channel.

23 ENVIRONMENTAL

- Requirement 61: The Uni-Directional Receiving Device shall provide a thermal design for the POD module, such that while operating with a reference power load Card drawing an average of 2.5 Watts, no non-consumer-accessible surface point is hotter than 65°C in a room where the ambient temperature is 40°C.
- Requirement 200: The Uni-Directional Receiving Device shall meet radiated emissions limits caused by cable signals on the product's cable RF connector input in accordance with 47 CFR 76.605 [9] (15 uV/m at 30 m for frequencies outside the range 54 to 216 MHz and 20 uV/m at 3 m for frequencies inside the range 54 to 216 MHz).
- Requirement 202: The Uni-Directional Receiving Device shall meet the requirements of 47 CFR 15.118 (c)(3) Direct pickup interference [8].