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COMMUNICATION OF REMOTE CONTROL KEY CODES IN THE HOME NETWORK

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ABSTRACT

This paper describes CEA-931-A, a standard method for communication of Remote Control Unit (RCU) key presses across the home audio/video network. The new standard is also applicable where "infrared blaster" techniques were previously employed, offering many benefits.

INTRODUCTION

Technologies such as those built on the IEEE 1394 high-speed serial bus protocol are well suited to the delivery of high-quality audio and video in the Home Network. Methods for device discovery, addressing and encapsulating MPEG-2 Transport Streams within isochronous channels on the 1394 bus are well understood. Although universal agreement among manufacturers has not yet been reached on the methods that would allow the user to interact with and control the various devices on the network, recent work coordinated through the Consumer Electronics Association (CEA) has resulted in a new protocol for representation of "basic user intents" such as RCU key presses. This paper presents a brief overview of the new standard, designated CEA-931-A.

Overview

In a Home Network, an audio/video source device may not be located in the same room as the video display device, or may be in the same room but not within direct line-of-sight of the viewer. To address these concerns, a standard protocol is needed to allow any device to use the network to communicate the simple user intents commonly associated with RCU key presses. This way for example, the RCU provided with a digital television could offer a PLAY key, and if that key were pressed, the DTV receiver would be able to relay that event through the network to the currently selected playback device.

In some scenarios, an "infrared (IR) blaster" approach is used to allow one device to control another device. The controlling device emulates the IR pulses emitted by the target unit's own RCU. A Personal Video Recorder (PVR), for example, can cause the channels of the satellite or cable set-top box to change by sending the proper sequence of key codes. While usable, IR blasters are

challenging for a consumer to set up and may be unreliable. For a device to use an IR blaster to tune a cable set-top box, for example, several numeric keys must be sent with proper spacing between them, possibly terminated by an ENTER key. If the keys are sent too close together, they may not be properly recognized.

Further complicating matters, the effects of certain RCU keys depend upon the prior state of the device. For example, the RECORD command to a VCR or Personal Video Recorder will not be accepted if the device is "off" (in standby power state). Commands issued using the IR blaster method may not always have the desired effect.

THE CEA-931-A STANDARD

CEA-931-A offers a solution in support of simple IR blaster applications, and provides a solution to the general problem of communicating RCU commands across the Home Network. Figure 1 illustrates a digital television receiver connected by a Home Network bus to a PVR. The DTV offers a RCU with media control keys.

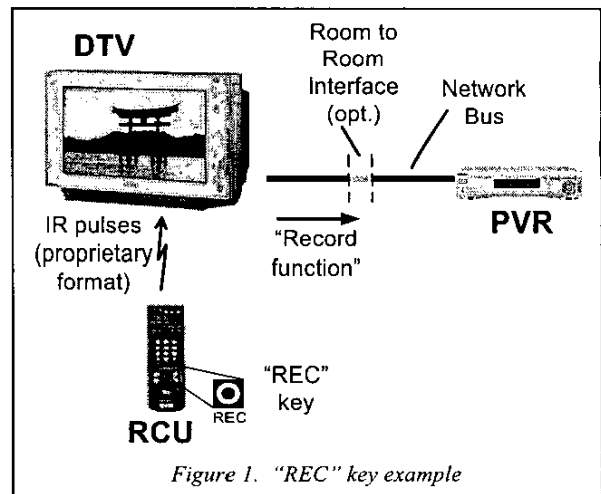


Figure 1. "REC" key example

When the user presses the REC key, the RCU emits IR pulses in a proprietary format interpreted by the DTV receiver. The DTV recognizes the REC key is intended for whatever device the user has currently chosen as the

Table 1. Defined Operation ID values.

| Category | User operations | |
|-----------------|--|--|
| Navigation keys | Digits 0-9, Select, Up, Down, Left, Right, Right-up, Right-down, Left-up, Left-down | |
| Menu selection | Root menu, Setup menu, Favorite menu, Exit | |
| Media control | Play, Stop, Pause, Record, Rewind, Forward, Fast forward, Eject, Backward, Angle, Subpicture | |
| Channel control | Channel up, Channel down, Previous channel | |
| Miscellaneous | Power, Volume up, Volume down, Mute, Sound select, Input select | |

| Deterministic Functions | | |
|-----------------------------|--|---------------------------------|
| Name | Function | Parameter |
| Play function | Start (or continue) playing content | Speed and direction of play |
| Record function | Start (or continue) recording | - |
| Pause-play, Pause-record | Pause playback or recording | - |
| Stop function | Stop playback or recording | - |
| Mute function | Mute audio | - |
| Restore volume function | Restore audio to previous volume level | - |
| Tune function | Tune to indicated channel (or virtual channel) | One- or two-part channel number |
| Select disk function | Select indicated physical media | Disk number (1-65,535) |
| Select A/V input function | Select indicated A/V input | A/V input (1-255) |
| Select audio input function | Select indicated audio input | Audio input (1-255) |

source. It packages the key according to the CEA-931-A protocol as a "Record function" and addresses it to the PVR. The PVR, which also supports CEA-931-A, processes the "Record function" by unconditionally beginning (or continuing) recording.

Summary of CEA-931-A Operations

Table 1 lists the categories of RCU keys defined in CEA-931-A. The standard defines "operation ID" codes representing all the common RCU keys including the arrows and numeric digits, media playback and record keys, channel and volume control, as well as keys that bring up menu functions. While not reaching the holy grail of enabling the "universal" remote, CEA-931-A is a clear step in that direction.

CEA-931-A addresses the shortcomings of typical IR blaster applications by including a number of "deterministic functions" in its repertoire of command codes. Whereas certain RCU key presses may toggle the target device's operation between two states, the deterministic functions are specified to be non-toggling, thus eliminating the need in the controller device to keep track of target device state. These codes include tuning functions to allow a controller device such as a PVR to directly set the tuner in a source device to a desired channel, as well as functions appropriate for control of playback and recording. Unattended recording is supported cleanly, requiring no special user setup at all.

A digital cable or terrestrial broadcast set-top box supporting the CEA-931-A protocol can be tuned to a specified channel number by means of the "Tune function." Other deterministic functions are intended to allow devices in the Home Network simple control over

audio/video source selection and signal routing. Functions for selection of A/V and audio inputs on compliant A/V Receivers are provided, as is a function allowing selection of a particular disk in a carousel or other multi-disk player.

For control of device power state, CEA-931-A requires compliant devices to respond to the POWER control command defined in the AV/C Digital Interface General Specification [2].

CONCLUSION

The new CEA-931-A protocol represents a helpful and powerful standard method for representation and delivery of RCU keys across the Home Network. It includes features specifically designed to support applications such as unattended recording, replacing the "IR blaster" approaches of the past.

Growing support for the protocol in the industry is evident. CEA-931-A was specifically cited in the historic digital cable compatibility agreements announced in December 2002 between the cable and consumer electronics industries. Cable operators have pledged to support it on high-definition digital cable set-top boxes, which will also feature an IEEE 1394 port for use by consumer digital video recorders.

References

- [1] CEA-931-A *Remote Control Command Pass-through Standard for Home Networking*, Consumer Electronics Association, 2003.
- [2] *AV/C Digital Interface Command Set General Specification*, Version 4.1, 1394 Trade Association.