Lip Sync of Audio/Video Distribution and Display

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Lip Sync Overview

- The Problem
- Sources of Delay
- Solutions and Comments
- Display Delay Experiment and Demo

The Problem

Content consists of Audio and Video elements which have a specific temporal relation.

Lip sync errors are introduced when audio and video elements are subjected to different relative delays.

Sources of Delay

1) Capture
2) Processing / Post-Production
3) Transmission
4) Presentation

Sources of Delay

1) **Capture**

Speed of Sound vs. Speed of Light

Image Sensor – Frame / Field Buffer

Storage

Sources of Delay

2) Processing / Post-Production

Playback - Editing

Effects

Single / Double System

Sources of Delay

3) Transmission

Analog / Digital

Compression

Receiver / Set-Top Box

Sources of Delay

4) Presentation

Speed of Sound vs. Speed of Light

Signal Processing

CRT

New Technology Displays

Observations

1) Everyone complains about lip sync
2) A lot of finger pointing
3) No direct financial incentive to fix problem
4) No simple comprehensive solution currently exists
5) No testing/measurement/certification of **ANY** hardware for lip sync exists

Solutions

1) **Embedded Approach**

   Insert a synchronizing signal during capture in both picture and sound.

   Use this signal at presentation to fix all delay issues.

Solutions

2) Localized Approach

Every step between capture and presentation receives program in sync, and corrects for its own sync error before passing on the program to next step.

Comments

1) **Embedded Approach**

   Complicated.
   Any intermediate presentation requires compliant system.
   Catastrophic failure if sync signal is lost.
   IP issues ???

2) **Localized Approach**

   Simple – already exists “just not working”.
   Manual Solution – requires operator intervention
   Automatic Solution – requires “in sync” hardware

Comments

In the last 18 months, SMPTE S22 has issued two RFIs on lip sync issues and control signals for picture and sound delay equipment.

Many replies have been received and will be discussed next Tuesday.

For further information, contact Graham Jones at GJones@nab.org

Proposal

SMPTE should write a document specifying sync tolerance and document the requirement for localized picture and sound synchronization.

SMPTE should write an additional document to standardize the interoperability control of picture and sound delay equipment.

Conclusion

There has been no financial incentive or technical requirement to address this problem.

Only program suppliers and distributors can fix this problem.

Those in this room have the ability to make lip sync happen. **THIS IS YOUR CALL TO ARMS**.

Presentation Delay Experiments

Goal

Compare presentation delay between CRT, LCD and DLP front projection display technology

Method

Send same video signal to 3 displays and capture output with a digital still camera.

Results

Relative delay between CRT→LCD and CRT→DLP was determined to be about 1 frame and 2 frames respectively.

Experiment Details

Equipment

Video Source – D5

Splitter / Converter - Aja

Experiment Details

Equipment

Displays – CRT, LCD, DLP Projector

Camera – Canon handheld

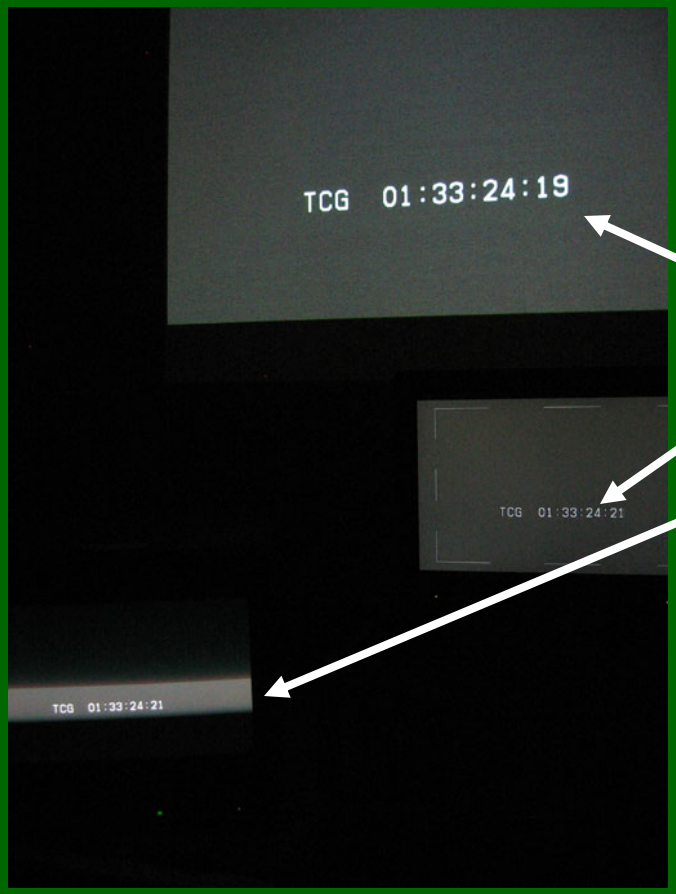
Experiment Details

Video Source Material

Gray Field with Time Code

Experiment Results

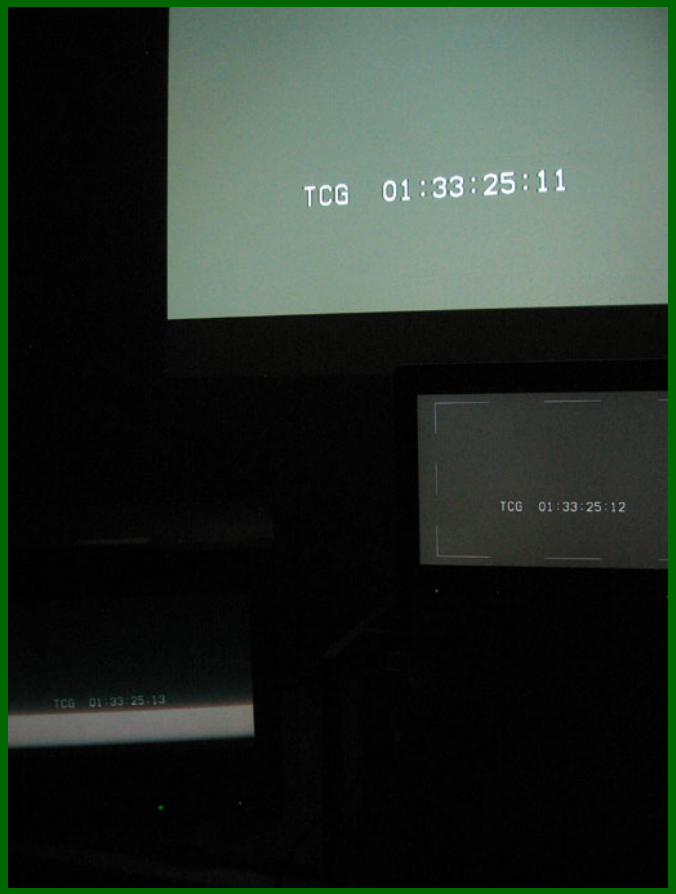
1080 – 24sf



	Time Code	Delay
DLP	01:33:24:19	00:00:00:02
LCD	01:33:24:21	00:00:00:00
CRT	01:33:24:21	n/a

Experiment Results

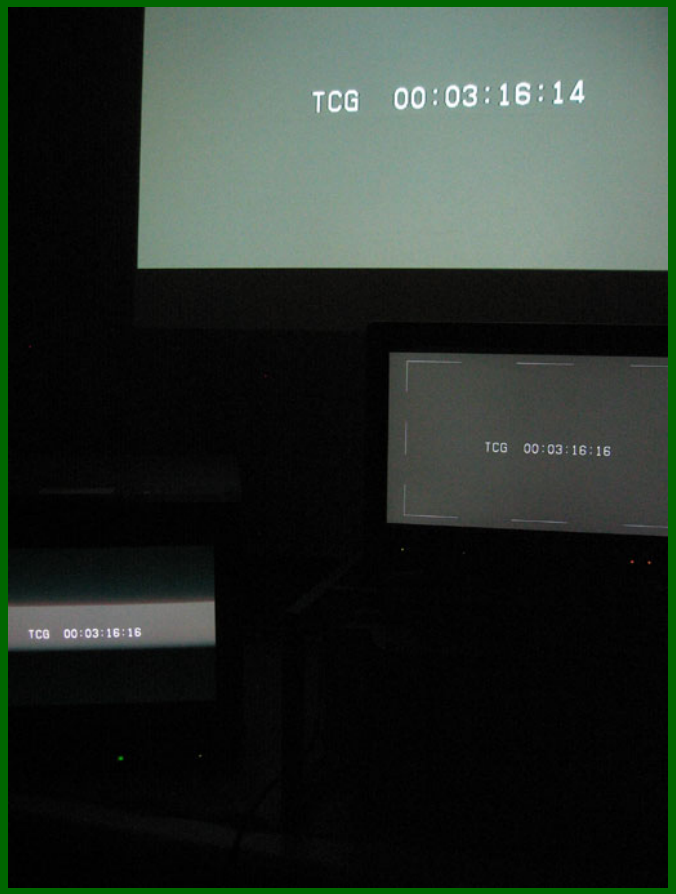
1080 – 24sf



	Time Code	Delay
DLP	01:33:25:11	00:00:00:02
LCD	01:33:25:12	00:00:00:01
CRT	01:33:25:13	n/a

Experiment Results

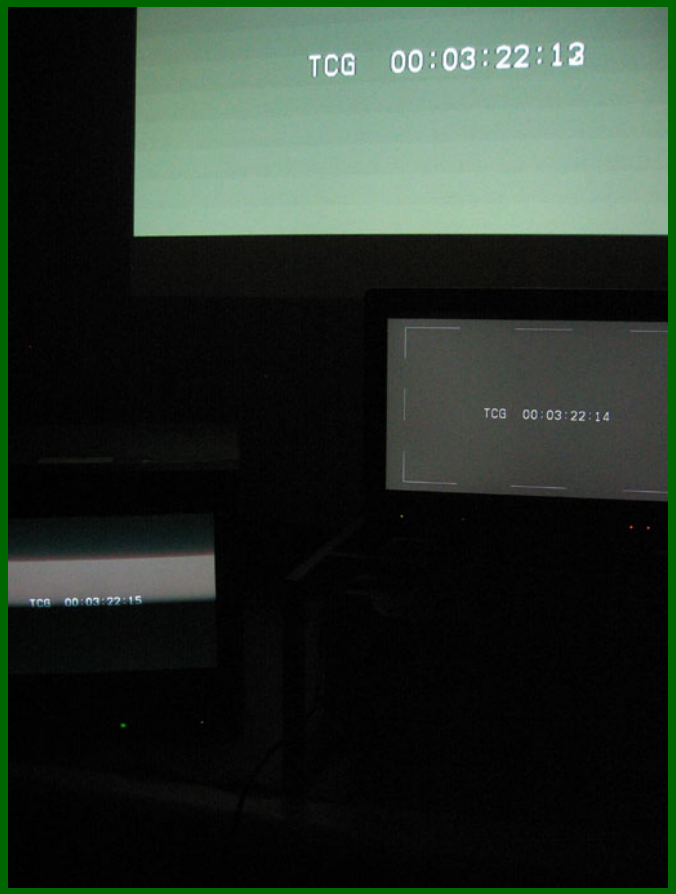
1080 – 24sf



	Time Code	Delay
DLP	00:03:16:14	00:00:00:02
LCD	00:03:16:16	00:00:00:00
CRT	00:03:16:16	n/a

Experiment Results

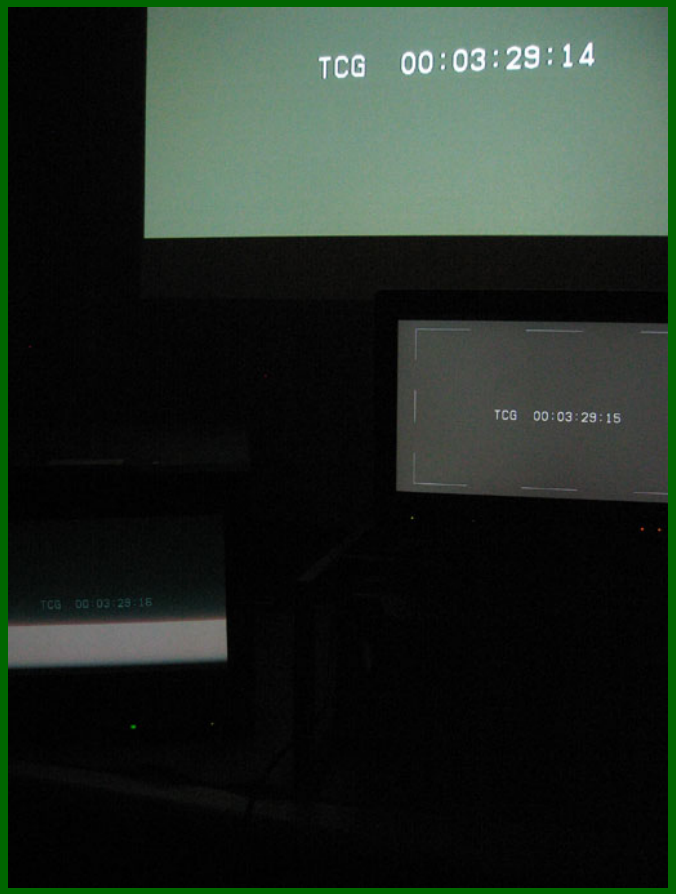
1080 – 24sf



	Time Code	Delay
DLP	00:03:22:13	00:00:00:02
LCD	00:03:22:14	00:00:00:01
CRT	00:03:22:15	n/a

Experiment Results

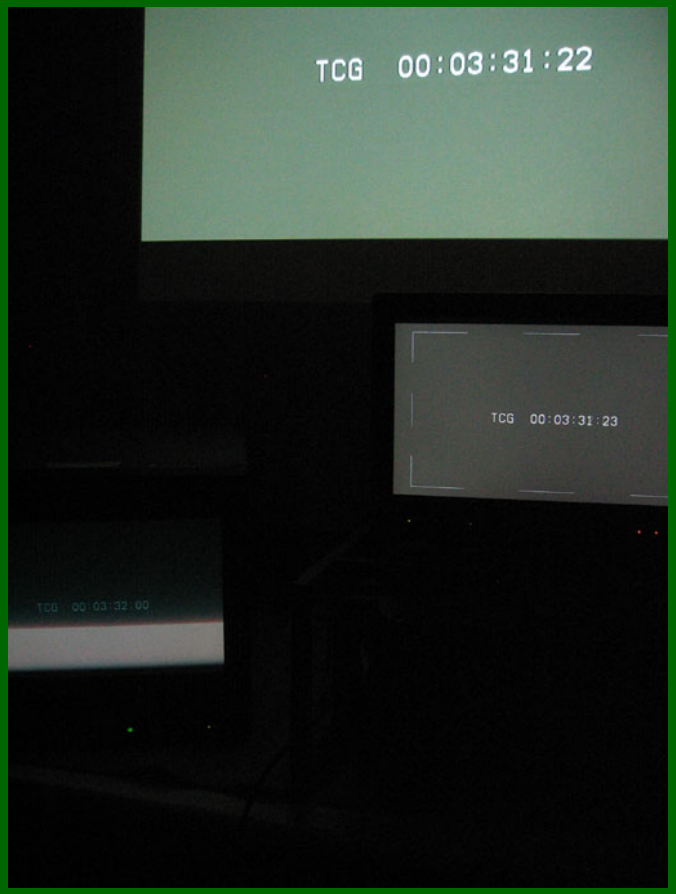
1080 – 24sf



	Time Code	Delay
DLP	00:03:29:14	00:00:00:02
LCD	00:03:29:15	00:00:00:01
CRT	00:03:29:16	n/a

Experiment Results

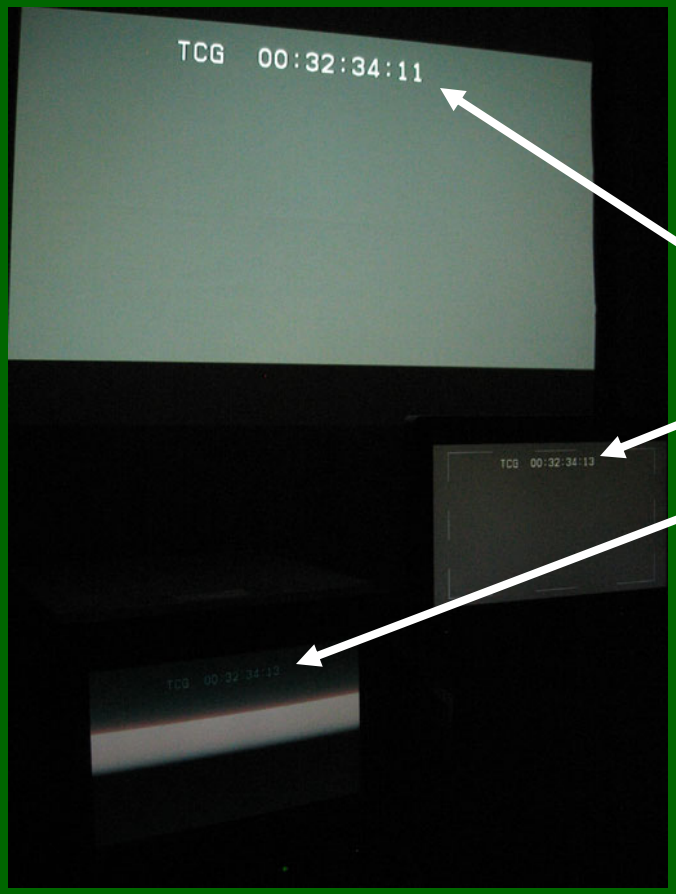
1080 – 24sf



	Time Code	Delay
DLP	00:03:31:22	00:00:00:02
LCD	00:03:31:23	00:00:00:01
CRT	00:03:31:00	n/a

Experiment Results

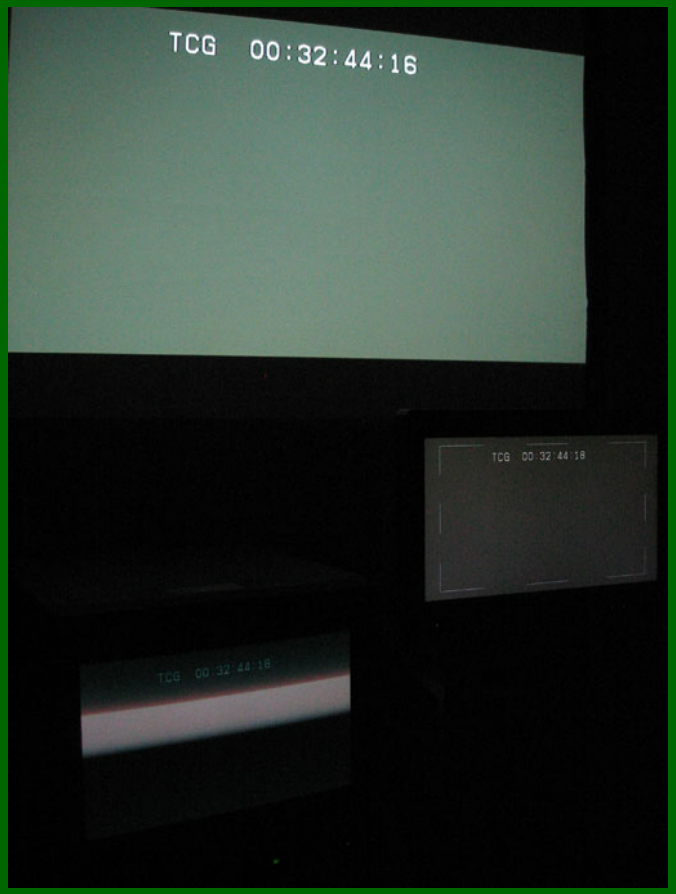
1080 – 59.94i



	Time Code	Delay
DLP	00:32:34:11	00:00:00:02
LCD	00:32:34:13	00:00:00:00
CRT	00:32:34:13	n/a

Experiment Results

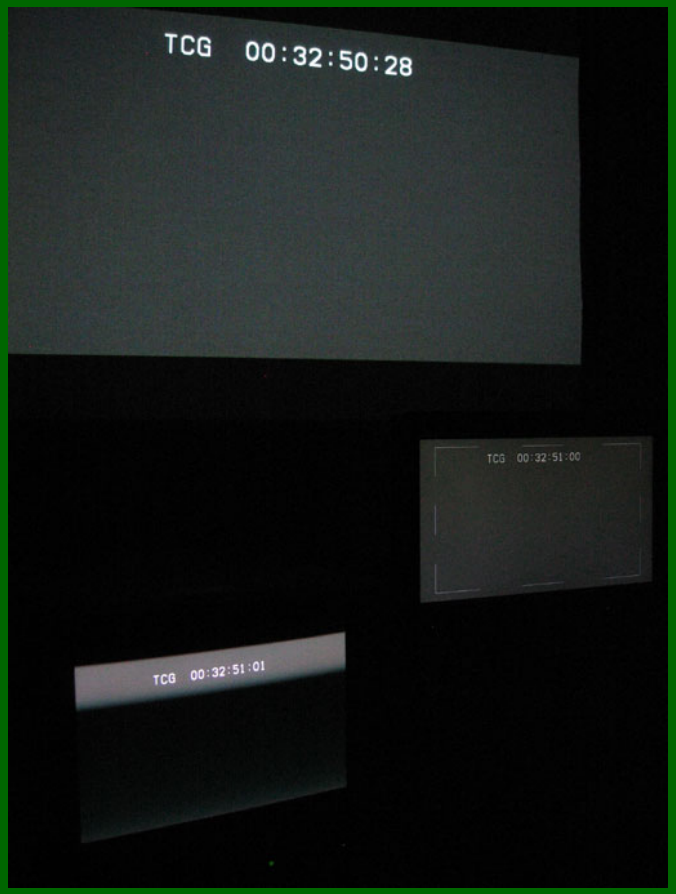
1080 – 59.94i



	Time Code	Delay
DLP	00:32:44:16	00:00:00:02
LCD	00:32:44:18	00:00:00:00
CRT	00:32:44:18	n/a

Experiment Results

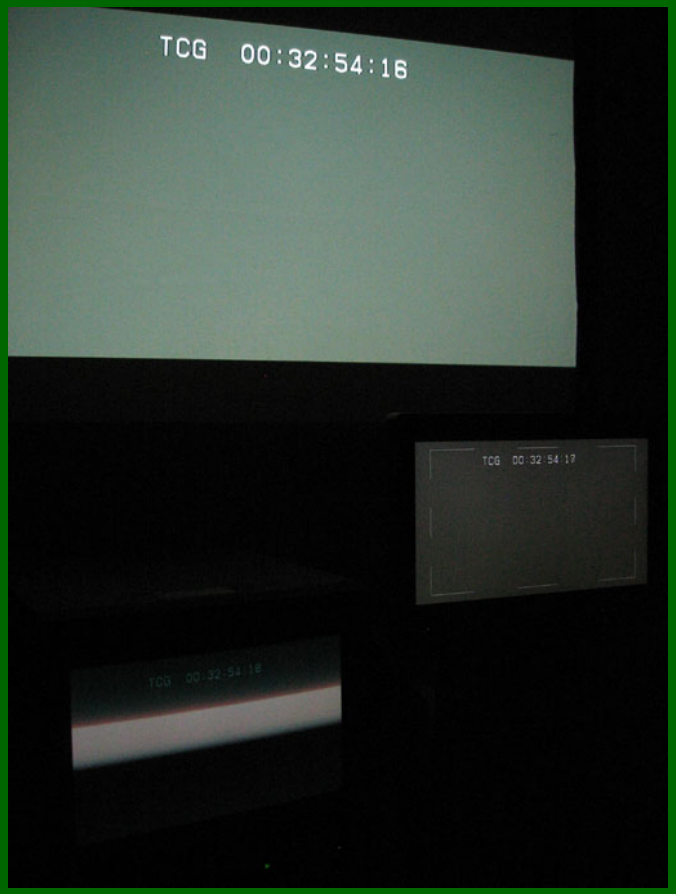
1080 – 59.94i



	Time Code	Delay
DLP	00:32:50:28	00:00:00:02
LCD	00:32:51:00	00:00:00:01
CRT	00:32:51:01	n/a

Experiment Results

1080 – 59.94i



	Time Code	Delay
DLP	00:32:54:16	00:00:00:02
LCD	00:32:54:17	00:00:00:01
CRT	00:32:54:18	n/a

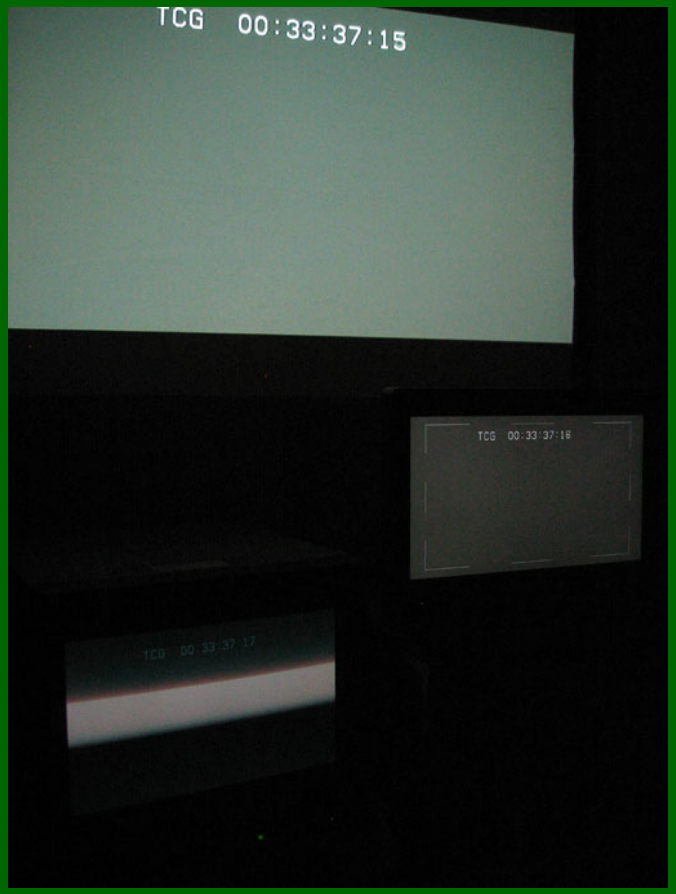
Experiment Results

1080 – 59.94i

	Time Code	Delay
DLP	00:33:08:18	00:00:00:02
LCD	00:33:08:20	00:00:00:00
CRT	00:33:08:20	n/a

Experiment Results

1080 – 59.94i



	Time Code	Delay
DLP	00:33:37:15	00:00:00:02
LCD	00:33:37:16	00:00:00:01
CRT	00:33:37:17	n/a

Experiment Conclusions

1080 – 24sf

1 time code unit = 1/24 sec = 42 milliseconds

Average Delay (over 6 experiment samples)

LCD = (4/6) * 42ms = 28 ms

DLP = (12/6) * 42ms = 84 ms

1080 – 59.94i

1 time code unit = 1/29.97 sec = 33 milliseconds

Average Delay (over 6 experiment samples)

LCD = (4/6) * 33ms = 22 ms

DLP = (12/6) * 33ms = 66 ms

HPA Lip Sync Demo

Program:

DVD contains synchronized BEEP and FLASH.

Measurement:

Optical sensor detects FLASH and outputs signal

Computer software analyzes offset between BEEP and signal from optical sensor.

Fix:

Command is sent to Denon receiver via serial port, “delay audio by XX milliseconds”.

End of Presentation