

INFORMATION SERVICES

ACADEMIC TECHNOLOGY

Evaluation of Lecture Capture Appliances

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Introduction

Lecture capture is the process of recording an instructional presentation for academic purposes. We will report on our testing and evaluation of lecture capture appliances from six different manufacturers to determine which device may best suit the needs of a particular client with specific needs. We sought to perform a true “apples to apples” comparison of these devices so that higher education institutions can make an informed decision when it comes to what can be a high-priced investment.

Background

As with most higher education institutions, Oregon State University has been leveraging lecture capture technology in its various forms for decades. In the early years, lecture capture usually involved dedicated studios with engineers and videographers. A barebones solution may have involved a camera and video tape. In the 1990s, computers in classrooms became more ubiquitous, and pre-recording lectures gave way to capturing a lecture *in situ* in the classroom, usually involving a device attached to the computer. In the earliest iterations, classroom lecture capture may have been something as simple as a VCR, which soon evolved into more advanced recording devices with internal hard drives, and then led to more intelligent managed systems such as Apple’s Podcast Producer and Echo360. But with a plethora of streaming technologies such as Apple Quicktime, Microsoft Windows Media, and Real Video, delivery over the last mile – not the means of capturing – became the true friction point. Delivery of recordings didn’t get any easier with the advent of widely adopted but proprietary software codecs such as Adobe Flash and later Microsoft Silverlight, both of which have now reached their end-of-life.



Anystream Apreso Coursecaster – An early generation lecture capture solution may have involved this device, which ingested content and passed it on via the network, but did not actually capture audio or video itself.

As streaming technologies mushroomed, so did Online Video Platforms (OVPs). In-house streaming infrastructure – based on Apple’s Darwin, Real Network’s Helix, or Adobe’s Flash Media Server – was soon supplanted by cloud services, some of them from lecture capture manufacturers themselves, such as Echo360 or Sonic Foundry, and some from third parties, like Kaltura, MediaCore, or Ensemble. The trick was finding a managed lecture capture solution that didn’t also lock users into a single manufacturer’s ecosystem. With few common standards in the industry, this was a difficult proposition.



Canopus TwinPact 100 – Similar to the Anystream, the Canopus device was designed to ingest analog content from a computer, microphone, and/or camera. It could then be outputted to a recording.




Apple Xserve – The Apple Podcast Producer solution relied on an array of Xserve servers and data storage. devices meet these requirements.

In the past, lecture capture was the domain of a select few manufacturers, but the convergence of AV and IT has brought a proliferation of lecture capture devices to the market. Manufacturers who previously produced streaming encoder devices, for instance, now position these same appliances as stand-alone capture devices. With an abundance of choices on the market, it’s important to identify what functionality is truly relevant in the higher education field and which

Goal

At Oregon State University, we’ve been using the Crestron CAPTURE-HD appliance since 2012. It is an economical, easy to implement, but barebones device. We are now seeking a next generation modular solution that will integrate with any delivery platform, while at the same time seeking to “future-proof” ourselves. Ideally we’d like a device able to produce separate independent recordings of each source and allow for viewer



manipulation of the content layout. Equally important is a device that can both be automated to start and stop recording at pre-determined times as well as be started *ad hoc* by an instructor with simple push button functionality without involving an engineer or technician. Additionally, to support the increasing popularity of distance learning, the device should support simultaneous lecture capture and live streaming.


Scope

While Pennsylvania State University has garnered considerable attention with their One Button Studio solution (<http://onebutton.psu.edu>), we're seeking a comprehensive "one box" solution for lecture capture rather than a mini-recording studio environment. It's important to note that just because a device might not meet a certain criterion doesn't mean it isn't the right solution. At the same time, we will not be evaluating all the functionality of a lecture capture appliance, but only those features we feel are most relevant to Oregon State University as well as other higher education institutions. We have tested a vast range of features but the needs of any single institution are unlikely to include all features tested.

Process & Methodology

Our criteria for testing lecture capture devices comes from years of experience, knowing and understanding the workflows of our teaching faculty, and communication with our colleagues at other higher education institutions.

We connected each lecture capture appliance to the same audio visual (AV) presentation switcher (a Crestron DMPS-300-C) and fed the same two sources via HDMI: a Microsoft Surface Pro laptop and a Wolfvision VZ-9plus3 document camera, each set to output a resolution of 1920x1080. We connected the appliances through an AV switcher in order to emulate common classroom installations and DVI, HDMI, and Mini DisplayPort adapters were used where necessary.



Video from the laptop was of an on-screen clock (from Time.is) with background music and the document camera was displaying a page from a product manual with 12pt text to test the recording for legibility of small text. Audio formats tested were 2-channel digital embedded via HDMI from the connected laptop and 2-channel analog from a smartphone. Audio sources were a mix of music and spoken word (audiobooks).

We configured each lecture capture appliance to record both video sources in a variety of screen layouts—side-by-side/picture-by-picture, picture-in-picture, and independent recordings where possible. We set the recordings for 30-45 minutes after which they were automatically uploaded to a local FTP server or to an external USB drive (or both where possible).

We played back the recorded video files and evaluated them for quality in VLC media player (<http://videolan.com>), and reviewed the file parameters using MediaInfo (<https://mediainfo.net>).

We submitted the results to each manufacturer prior to publication for review and feedback, and any inconsistencies were clarified.

Potential Complications

In our experience, the two most common service disruptions to a successful lecture capture are intermittent network connectivity and users inadvertently removing USB drives from the front of the appliance before the recording has finished transferring. Depending on the selected recording file format, either of these events can permanently corrupt a recording. We replicated the network scenarios by waiting for a recording to complete and as it started to upload, we simply disconnected the network cable to see how each appliance would respond. When faced with network disconnects, most appliances would simply retry the upload until network connectivity was re-established and the transfer completed successfully. Some appliances, however, did not attempt to retry the upload and others simply determined the upload was complete even when it was not. For

the USB disruption, as soon as the recording completed, we disconnected the USB drive from the appliance to see how each would react. In all cases, the early USB disconnect corrupted the recording.

Devices

We tested six lecture capture appliances for this report. We sought out high-end models from manufacturers that were most likely to meet our requirements. We spoke to each manufacturer extensively about their appliances and related to them our goal of producing a report based on our evaluation of multiple devices. After testing the appliance, we once again communicated with the manufacturer and reviewed our results in order to make certain nothing had been missed.

Devices were tested as is. While some manufacturers promised functionality in future iterations of software or firmware, or perhaps new versions of the hardware, we could only evaluate what we had on hand. The matrix indicates where future changes may impact the results, but changes to a device might affect cost, which is often a deciding factor when selecting a lecture capture solution.

General specifications for each device are listed, including maximum recording video resolution, video frame rate and bitrate for recording (but not streaming), as well as the manufacturer's suggested retail price (MSRP) in US dollars. Many of these manufacturers provide preferential pricing for

Glossary

Real Time Messaging Protocol (RTMP)

is a streaming protocol originally created by Macromedia (and owned by Adobe) for streaming of Flash video. It has since been widely adopted by services such as YouTube, Ustream, Livestream, and Kaltura and has become the *de facto* protocol for transmitting video for live streaming to these services.

Real Time Streaming Protocol (RTSP)


is a legacy streaming protocol used ideally for transporting video from one appliance to another over a network but is less scalable in nature, limiting it as a means of delivering video to end users.

Transport Stream (TS)

is an MPEG-2 video container format that produces high quality images with little compression. Because of this, TS recordings are often considerably larger than those of MP4. File extensions include .ts, .mts, and .m2ts.

MPEG-4 (MP4)

is a video container format using the H.264 codec, usually marked by the .mp4 file extension. The format is very common, supported by most video players and editors, and has supplanted most other multimedia file formats. Other file extensions that may be encoded in MPEG-4 include .avi, .mov, and .m4v.



educational clients, but as the discounts may vary from manufacturer to manufacturer, reseller to reseller, and school to school, the only way to compare price is through MSRP.

We were unable to test lecture capture appliances from two manufacturers with significant market presence – Winnov and Echo360. Winnov is currently late in the development cycle of a new product release and they could not deliver an appliance prior to the end of our evaluation window. Echo360 was very frank in disclosing that their appliances work exclusively with their own Active Learning Platform and would not be a good candidate for this evaluation.

Cattura

CaptureCast Pro

Cattura should not be confused with Kaltura, the video platform vendor. It is a stand-alone vendor of lecture capture devices,



unaffiliated with Kaltura. In addition to their CaptureCast Pro appliance, Cattura also sells lecture capture software that can be installed on compatible PC hardware.

Specifications

MSRP: \$6,500

Input: HDMI (dual), 3G-SDI (optional)

Recording file extensions: .mp4

Maximum recording resolution: 1920x1080

Maximum frame rate: 30 fps

Maximum recording bitrate: 15 Mbps

External scheduling options: iCal, Google Calendar

Content system integration: Kaltura, Opencast, Panopto, Vimeo, YouTube

Remote access to internal storage: Web

Crestron

CAPTURE-HD



Crestron is one of the largest manufacturers of

audio video integration products. Oregon State University has a deployment of over 50 Crestron CAPTURE-HD appliances and has been using the device for since 2012. We currently include a CAPTURE-HD in all new classrooms and in most upgrades of existing classroom AV systems.

Specifications

MSRP: \$3,800, \$5,800 for 3G-SDI

Input: HDMI (dual), 3G-SDI (optional)

Recording file extensions: .mp4, .ts

Maximum recording resolution: 1920x1080

Maximum frame rate: 24 fps

Maximum recording bitrate: 6 Mbps

External scheduling options: Crestron Fusion

Content system integration: none

Remote access to internal storage: none

Epiphan Video

Pearl

Epiphan has been producing AV equipment since 2003. They are best known for an extensive line of capture cards and frame grabbers. In addition to their portable Pearl device, they also produce the Pearl Rackmount which amounts to the same hardware in a different form factor.



Specifications

MSRP: \$4875, \$5375 for Pearl Rackmount
Input: HDMI (dual), 3G-SDI (dual)
Recording file extensions: .avi, .mp4, .mov, .mpeg-ts
Maximum recording resolution: 1920x1080
Maximum frame rate: 85 fps
Maximum recording bitrate: 50 Mbps
External scheduling options: none
Content system integration: none
Remote access to internal storage: FTP, Web

Extron

SMP-351

Extron Electronics is well known to higher education



institutions for their control, switching, and scaling products. The SMP-351 has been on the market since 2014 and Extron has been diligent in regularly adding functionality to the device.

Specifications

MSRP: \$4,790, \$5,990 for 3G-SDI; plus \$3,990 for software upgrade for dual independent recording
Input: HDMI (dual), 3G-SDI (optional)
Recording file extensions: .m4v
Maximum recording resolution: 1920x1080
Maximum frame rate: 30 fps
Maximum recording bitrate: 10 Mbps
External scheduling options: iCal, Microsoft Exchange, Opencast
Content system integration: Kaltura, Opencast
Remote access to internal storage: FTP, Web

NCast

Presentation Recorder Hydra

NCast is focused entirely on streaming and capture. Their Hydra device, like its namesake, is a multi-faceted device which promises a wide variety of functionality.



Specifications

MSRP: \$5,395

Input: HDMI (dual), 3G-SDI

Recording file extensions: .mp4

Maximum recording resolution: 1920x1080

Maximum frame rate: 60 fps

Maximum recording bitrate: 10 Mbps

External schedule options: iCal, Google Calendar

Content system integration: Kaltura, Opencast

Remote access to internal storage: Web

Sonic Foundry

Mediasite RL760 Recorder

Sonic Foundry is one of the old guards of lecture capture. Like Echo360, Panopto, Tegrity, and Camtasia – the latter three of which now focus exclusively on software based capture solutions – Sonic Foundry’s Mediasite platform is an end-to-end solution to lecture capture with a goal of delivering a full suite of products from recording to delivery. The Mediasite RL series of recorders is Sonic Foundry’s latest line of hardware capture appliances.



Specifications

MSRP: \$32,495; plus \$4,995 one year support and maintenance plan

Input: HDMI (via DVI adapter), 3G-SDI (optional)

Recording file extensions: .mp4

Maximum recording resolution: 1920x1080

Maximum frame rate: 30 fps

Maximum recording bitrate: 5.5 Mbps

External scheduling options: Sonic Foundry Mediasite

Content system integration: Sonic Foundry Mediasite

Remote access to internal storage: Web

Criteria

Although every lecture capture appliance offers a wide assortment of functionality, our testing focused on the following criteria which we determined to be the most relevant to use cases and workflows in higher education.

Criteria	Definition
Record 2 or more HD sources simultaneously	record multiple sources concurrently in high definition (1920x1080)
“Sidecar” data file	produce an associated file (XML, JSON, etc.) to accompany the recording to provide metadata related to that recording
Separate Recordings for each source	produce independent video files for each source recorded
Stream (RTSP)	stream a source via the RTSP protocol
Stream (RTMP)	stream a source via the RTMP protocol
Upload (FTP)	upload any produced files (video, audio, data file, etc.) via FTP to an assigned destination
Upload (SFTP)	upload any produced files (video, audio, data file, etc.) via SFTP to an assigned destination
Record and upload simultaneously	multitask, recording while also uploading a previous recording
Record and stream simultaneously	multitask, recording while also streaming to a remote viewer(s) or CDN/reflector
Record to user accessible removable media	record to external media, such as a USB drive, via a user-accessible location, such as the front panel
Record to two locations simultaneously	record to more than one destination concurrently, such as internal and external storage at the same time
Control the cascade of priority for recording destinations	determine the order of recording destinations; e.g., if a USB drive is present, it will record to this destination first; but should no USB drive be present, it will record to an internal destination instead
Recover from failed transfers	successfully complete a transfer, even when intermittent network connectivity is encountered
Logging	provide basic time stamped log related to appliance functions and operations
Alarms/Alerts/Notifications	provide alerts for specific events – either successful or unsuccessful – and send notifications related to these events
Audio meters (web interface)	show audio levels for a source via a web interface

Audio meters (front panel)	show audio levels for a source via a front panel indicator
Confidence monitor (loop out)	provide a live “video out” of the content currently being recorded to an external display, allowing for live monitoring by an instructor or technician
Confidence monitor (web interface)	provide a live stream of what is currently being recorded via a web interface
Confidence monitor (front panel)	provide a means of monitoring what is currently being recorded via a front panel screen
External control system compatibility	integrate into a control system and allow for operation either via RS-232 (serial) or Ethernet (IP) commands
Internal scheduling options	include internal scheduling tools for starting and stopping recordings
External scheduling options	allow for integration of external scheduling tools such as Google Calendar, Microsoft Exchange, Schedule25, or others
Direct operation (front panel)	ability to operate appliance through push button or touch screen controls on the front panel
API	an application program interface for developing integration with other systems
External content system integration	provide integration with external content delivery systems such as Kaltura, Ensemble, Opencast, Mediasite, etc.
Remote access to internal storage	provide remote access to files stored on the device via FTP or web browser

Results

Here are our observations and reactions to the performance of the lecture capture devices, in alphabetical order by manufacturer.

Cattura CaptureCast Pro

Cattura's CaptureCast Pro seems to be suffering from growing pains.

The device we evaluated was pre-release and there were some bugs and quirks to deal with, but presumably these will be addressed in short order. The CaptureCast Pro is the first appliance to support the Open Video Capture Standard, a standard initiated by Kaltura with the goal of making it simple and easy for educational institutions to centrally manage their captured content in a way that is neutral to the software or hardware they used to capture it. The standard was submitted to the IMS Global Learning Consortium in 2015, now in the process of being finalized. The lack of documented external control system support – either RS-232 or Ethernet – has us concerned as to how this appliance would integrate into a university classroom AV system.



Testing Rack – Our testing rack showing lecture capture appliances from Epiphan, Crestron and Extron.

Crestron CAPTURE-HD

The chief benefit of the Crestron CAPTURE-HD is its affordability. Going forward it's clear that the CAPTURE-HD is not keeping up with its competitors and the price point is being matched by vastly superior devices. The device has seen no significant updates since it was first implemented at Oregon State University in 2012 and Crestron has not communicated a roadmap to us indicating any imminent upgrades. The CAPTURE-HD is barebones, without so much as logging or alerts to help determine why a recording may have failed.



Epiphan Pearl

Having approached the lecture capture realm from a production video stand-point, Epiphan's Pearl has much more functionality beyond simple lecture capture. Of particular note is the Pearl's ability to produce multi-track video files; that is, a single video file that can carry multiple video sources. This is unprecedented in lecture capture, meaning there are few platforms that will support delivery of this type of video file natively. The Pearl also has a large LCD screen on the front which is touch-capable and can be used for both control and monitoring. One thing we're hoping to see in a future release, though, is native support for either RS-232 or Ethernet control. Right now that's handled through a USB dongle, which can prove unreliable at times.

Extron SMP-351

The SMP-351 from Extron is suitable for both video production and classroom installation environments. Although it is marketed with Extron's own server and client software, neither are a requirement for operation. With constant updates that bring new functionality to the device, Extron has clearly put a focus on making the SMP-351 a competitive device in the lecture capture market. For example, RTMP streaming functionality is expected in the near future, and the ability to record two video sources separately is now being offered with a license upgrade, albeit a costly one.

NCast Presentation Recorder Hydra

NCast, unlike many lecture capture vendors, doesn't produce a PC-based chassis running lecture capture software. The NCast Presentation Recorder Hydra is a robust appliance dedicated to recording and streaming lectures, with a wealth of functionality, meeting almost every requirement set forth in our testing. It should be noted that the Hydra was the only device tested that required modifying a text file to set a static IP address.

Sonic Foundry Mediasite RL760 Recorder

Sonic Foundry's lecture capture solution revolves around its own delivery platform, which requires a separate subscription. Most of the functionality of the Mediasite recorder is tied directly to the cloud service. You cannot stream directly from the appliance and you can upload only to the Mediasite cloud service.

Table 1: Does each appliance meet specified criteria?

	Cattura CaptureCast Pro	Crestron Capture HD	Epiphan Pearl	Extron SMP-351	NCast Presentation Recorder Hydra	SonicFoundry Mediasite RL760 Recorder
Record 2 or more HD sources	✓	✗	✓	✓	✓	✓
"Sidecar" data file	✓	✓	✗	✓	✓	✓
Separate recordings	✓	✗	✓	✓ ²	✓	✓
Stream (RTSP)	✗	✓	✓	✓	✓	✗
Stream (RTMP)	✓	✗	✓	✗ ¹	✓	✗
Upload (FTP)	✓	✓	✓	✓	✓	✗
Upload (SFTP)	✓	✓	✓	✓	✓	✗
Record and upload	✓	✗	✓	✓	✓	✓
Record and stream	✓	✗	✓	✓	✓	✗
Record to user accessible removable media	✗	✓	✓	✓	✓	✗
Record to two locations simultaneously	✗	✗	✗ ¹	✓	✓	✗
Control the cascade of priority for recording destinations	✗	✗	✗ ¹	✓	✓	✗
Recover from failed transfers	✗	✗	✓	✓	✓	✓
Logging	✓	✗	✓	✓	✓	✓
Alarms/Alerts/Notifications	✓	✗	✗	✓	✓	✓
Audio meters (web interface)	✓	✗	✓	✗	✓	✓
Audio meters (front panel)	✗	✓	✓	✓	✗	✗
Confidence monitor (loop out)	✗	✓	✓	✓	✓	✓
Confidence monitor (web interface)	✓	✗	✓	✓	✓	✓
Confidence monitor (front panel)	✗	✗	✓	✗	✗	✗
External control system compatibility	✗	✓	✓ ³	✓	✓	✓
Internal scheduling options	✓	✗	✗ ¹	✓	✗	✗
External scheduling options	✓	✓	✗	✓	✓	✓
Direct operation (front panel)	✗	✓	✓	✓	✗	✗
API	✓	✓	✓	✓	✓	✓
External content system integration	✓	✗	✗	✓	✓	✓
Remote access to internal storage	✓	✗	✓	✓	✓	✓

¹ On the roadmap for a possible future release

² Available with license upgrade

³ Via USB adapter

Table 2: Scores weighted to Oregon State University's specific needs

	Maximum Points	Cattura CaptureCast Pro	Crestron Capture HD	Epiphany Pearl	Extron SMP-351	NCast Presentation Recorder Hydra	SonicFoundry Mediasite RL760 Recorder
Record 2 or more HD sources	5	5	0	5	5	5	5
"Sidecar" data file	2	2	2	0	2	2	2
Separate recordings	5	5	0	5	5	5	5
Stream (RTSP)	2	0	2	2	2	2	0
Stream (RTMP)	5	5	0	5	0	5	0
Upload (FTP)	3	3	3	3	3	3	0
Upload (SFTP)	4	4	4	4	4	4	0
Record and upload	5	5	0	5	5	5	5
Record and stream	5	5	0	5	5	5	0
Record to user accessible removable media	5	0	5	5	5	5	0
Record to two locations simultaneously	1	0	0	0	1	1	0
Control the cascade of priority for recording destinations	1	0	0	0	1	1	0
Recover from failed transfers	5	0	0	5	5	5	5
Logging	5	5	0	5	5	5	5
Alarms/Alerts/Notifications	4	4	0	0	4	4	4
Audio meters (web interface)	3	3	0	3	0	3	3
Audio meters (front panel)	3	0	3	3	3	0	0
Confidence monitor (loop out)	3	0	3	3	3	3	3
Confidence monitor (web interface)	5	5	0	5	5	5	5
Confidence monitor (front panel)	1	0	0	1	0	0	0
External control system compatibility	5	0	5	3	5	5	5
Internal scheduling options	1	1	0	0	1	0	0
External scheduling options	4	4	4	0	4	4	4
Direct operation (front panel)	3	0	3	3	3	0	0
API	1	1	1	1	1	1	1
External content system integration	1	1	0	0	1	1	1
Remote access to internal storage	3	3	0	3	3	3	3
Price	10	6	10	8	4	8	1
Total	100	67	45	82	85	90	57

Conclusion

The variety of appliances tested is indicative of an industry in flux. Appliances are becoming smaller, more affordable, and carry more features. The feature set is a way for a manufacturer to differentiate itself from competitors, but ultimately a core set of reliable recording and streaming functions, easy integration into an existing AV hardware framework, interoperability with a wide variety of OVPs, and an affordable price are what most higher education institutions are looking for.

Ultimately, the Extron SMP-351 seems to offer the best value if you are willing to forego RTMP streaming and dual independent recording capabilities—while it can record each source separately, the license upgrade fee is considerable. But if you're looking for a full suite of functionality at a reasonable price, as of this writing, the NCast Presentation Recorder Hydra meets almost every criterion.



Resources

Cattura

<https://www.catturavideo.com>

5711 NW Parkway, Suite 200
San Antonio, TX 78249
1-800-417-3230

Crestron

<https://www.crestron.com>

15 Volvo Drive
Rockleigh, NJ 07647
1-888-273-7876

Epiphan

<http://www.epiphan.com>

116 University Avenue, Suite 100
Palo Alto, CA 94301
1-877-599-6581

Extron

<http://www.extron.com>

1025 E. Ball Road
Anaheim, CA 92805
1-800-633-9876

NCast

<http://www.ncast.com>

4677 Old Ironsides Drive, Suite 430
Santa Clara, CA 95054
1-408-844-9080

Sonic Foundry

<http://www.sonicfoundry.com>

222 West Washington Avenue
Madison, WI 53703
1-877-783-7987

About Oregon State University

Oregon State is a leading public research university located in Corvallis, Oregon. Founded in 1868, Oregon State is the state's land-grant institution and is one of only two universities in the U.S. to have Sea Grant, Space Grant and Sun Grant designations. With 11 colleges, 15 Agricultural Experiment Stations, 35 county Extension offices, the Hatfield Marine Science Center in Newport and OSU-Cascades in Bend, Oregon State has a presence in every one of Oregon's 36 counties.

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