

Evaluating Recording Hardware Options for Departmental use with a Centrally-Managed Kaltura Video Platform

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Academic Health Center Classroom Services
Jacob Swogger, Sr. Communications Technician
V. Paul Virtucio, Service Coordinator

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Executive Summary

Scope and objective:

AHC Classroom Services has been providing Health Science classroom recording for about 10 years using Sonic Foundry Mediasite, a stand-alone closed ecosystem recording, streaming and archiving solution. UMN-IT is now providing Kaltura as a video management tool for the whole university to publish, store and distribute video content. Our office wanted to see if we could align our recording services with this new central tool, and what that would mean for our current workflow, hardware costs, and overall UMN Classroom Recording landscape. We investigated four hardware manufacturers offerings and how they connect to our central systems and local processes.

Findings and recommendations:

Each evaluation unit provided quality recordings that work well in Kaltura's dynamic multiple-layout and playback speed format. The differentiating factors were in how scheduling was handled and how content gets sorted and distributed once published to Kaltura. Because we're moving away from an all-in-one recording/publishing/distribution ecosystem with Mediasite, the ways each manufacturer took in and passed information through from one step in the process to the next was crucial for a sustainable classroom recording system.

We were able to replicate our current workflow successfully with one manufacturer in particular, Winnov. The other manufacturers could work in less demanding scheduling requirements from a given department.

Classroom-Based Recording

To distinguish Classroom Recording" from "Lecture Capture," we're defining it as a recording taking place in a physical learning space, such as a class that is in session with students on site. It is does not include a faculty member recording a lecture outside class time in the growing number of One-Button Studios or in her office using a laptop and software like Techsmith Relay or Screencast-o-matic (though this can and does happen in classroom spaces today). We're also including a robust scheduling and automation component as part of any Classroom Recording system.

Classroom Recording Systems consist of three main parts.

1. Scheduling
2. Recording, uploading to content servers, and recorder fleet management
3. Storage, publication and distribution

These three things are connected and each process needs to consider the others. The classroom recording solution that our department and a few others in the University of

Minnesota system employ, Mediasite, is an end-to-end ecosystem that includes these processes. Because it is a closed and proprietary system, it is relatively expensive and it does not readily work with other content delivery platforms.

For this evaluation, the statements below describe the operational assumptions we are making.

1. Google Calendar will schedule recordings.
2. Third-party hardware will capture and upload the recording.
3. The UMN Kaltura instance will store and distribute the recording.

Health Sciences Classroom Recording Background

Health Science's classroom recording started in the Medical School about 2004 when a tech-savvy student DIY'd a student-driven recording solution. It consisted of a Sony Handycam on a tripod in the projection booth, focused on the screen. Its output was captured via Real Producer then manually uploaded to the student's server, which allowed Medical School students to download an .AVI file to review later.

A version of this "Lectures Online" Medical School-student-run operation still operates today.

Other schools wanted access to classroom recordings and AHC Classroom Services was asked to find a solution.

Why Dedicated Recording Hardware?

A dedicated recorder that receives the same content as the projector, recording any source that may be projected in the classroom (User's laptop, the dedicated podium PC, the Document Camera) allowed maximum flexibility for faculty to present in the way that they felt most appropriate.

Dedicated hardware is scheduleable and allowed for automated content management after the recording was complete.

Without dedicated hardware recording whatever presentation source, you'd be relying on recording lectures with a wide variety of faculty laptops. In the Health Sciences, there are many one-time, special guest lecturer. About half of the presenters use their laptop instead of the shared, dedicated room PC, requiring recording software on all the devices. This would have been problematic and put the burden of additional software management on the faculty.

We chose an opt-in, request-only approach. We relied on Mediasite's scheduling system that allowed us to automate capture. The faculty and departments who wanted to use it could request it when they scheduled the classroom. It was relatively low demand at the time.

Some departments schedule and manage their own content. Our office now schedules about half of a typical semester's 1800-2000 hours of recordings.

Why Mediasite?

While researching the market in 2008, I found Sonic Foundry Mediasite to be the most robust, complete, and automatable and the only system that could be implemented given our staffing levels (1 Technologist FTE at the time plus assist from AHC-IS Server Ops). AHC Classroom Services and Carlson School of Management purchased independent systems and licenses around this time.

Classroom Recording in the Health Sciences

What All UMN Health Science Departmental Users have in Common

All Health Sciences schools are bringing in many highly specialized guest lecturers and subject matter experts. Many have complex, dynamic schedules while utilizing a set of shared classroom facilities.

See "Health Science Departments Use Classroom Recordings Differently" chart appendix for more information.

Mediasite Workflow in AHC Classroom Services

Over the years, our office developed a workflow that was borne out of four important factors.

1. The UMN Health Sciences schools' schedules are often irregular, complex, and outside the standard scheduling protocols of the University at large.
2. It was an "Opt-in" service and each school managed that a little differently.
3. Our staff was limited with only 1.5 FTE AV tech for nearly 8 years. With three FTE tech staff, we struggle at times to meet all the growing AV Tech needs of nearly 50 classrooms, including classroom recording.
4. Because of some reliability issues with the hardware early, we developed workflows that included physical checks of all recorders daily. We vetted our schedules to ensure what was requested by our users is what was or will be recorded. Sonic Foundry did improve the hardware and software capabilities over the years.

Scheduling Challenges

The UMN currently uses Astra Schedule as the main, centrally-supported classroom reservation system. Mediasite and Astra are not integrated. That means that the system that we use to

schedule classrooms does not provide that information to Mediasite. We have to schedule the recording separately.

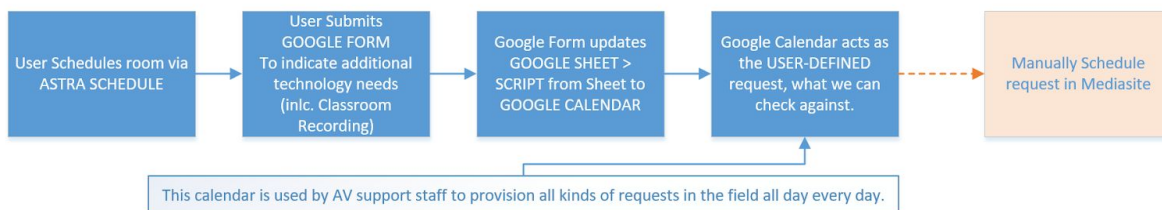
Classroom Recording is one of several technology-related service layers our office provides: AV orientation, livestream or videoconferencing, onsite staffing, and extra AV equipment. Classroom recordings became part of a larger provisioning process with some level of redundancy to catch errors and changes.

UMN becomes a Google G Suite Enterprise Campus

When UMN became a Google G Suite campus in 2013, we began using Google Forms and Google sheets to replace inefficient PDF request forms (download/print/fill out/sign/scan/email) to help make the request process quicker and more accurate.

Current Process using Mediasite

We now use five different pieces of software to ensure what is requested to be recorded, is in fact recorded:



Currently, the *User-defined* Google form populates a google sheet, which then has a script run on it. This script populates the *User-defined* dates, times, and details into a Google Calendar shared by all Classroom Services staff. The AV Service Coordinator then assigns the appropriate staff (might be a student or an FTE) to deliver the requested service.

If the service request includes Classroom Recording, it is processed manually in the Mediasite Management Portal, where presentations are scheduled. The user-defined Classroom Recording schedule, whether one-time, regularly recurring or irregularly recurring, exists in Google calendar along with the other service requests. This Google Calendar system then serves our office well as a daily “To-Do” for AV technology staff to ensure service delivery.

Why Evaluate New Hardware Now?

Several major factors contributed to our deep dive into new hardware recording options:

1. UMN-IT replaced homegrown Media Mill with Kaltura Mediaspace
2. Health Sciences Education Center was funded

3. More Classroom Recording hardware options exist
4. Current Mediasite SAN storage needs to change in 2019, unsure of options moving forward.

2017: UMN Central IT Licenses Kaltura

In 2016, UMN-IT asked for proposals for a new centrally managed video publishing, storage, and distribution tool to replace the College of Liberal Arts-developed application called Media Mill. Kaltura was ultimately chosen as the video management platform.

While the Sonic Foundry Mediasite ecosystem has worked well overall, the University didn't select Mediasite as the central platform. For our small team to not align our recording efforts with central would be choosing not to leverage UMN-IT's service and support for all our Health Sciences users. It would be expensive to continue to stand up our own Mediasite system.

Leveraging a centrally-managed Kaltura platform meant UMN-IT could provide campus-level application management and support to all users, providing a more consistent experience to more users, better user management and better LMS integration. Our office would then focus on providing the Classroom-specific hardware and support that our Health Sciences schools and departments expect.

2017: Health Science Education Center (HSEC) is funded, Technology Package calls for Increases in Capture Recording Needs

In 2017, Minnesota State Legislature funded a new Interprofessional Health Science Education Center (HSEC) building. The function of classroom recording is called for specifically in many of its learning spaces. Once built, this facility would more than double our office's fleet of hardware recorders.

More Hardware Options Exist

As we considered leveraging the UMN-IT Kaltura system as the new video publishing platform, we could also consider new hardware options that have come along in recent years. All the hardware we evaluated presents significant Cost of Ownership savings.

Current Mediasite Storage Solution Needs to Change

For reasons beyond our control, we need to change our storage solution. This was one more reason we started to look a bit more intently at our recording service as a whole. Details are getting sorted out as I write this. We're hopeful that we can get through the storage server change relatively painlessly and that Mediasite performance is at least as good as it is now.

There's also an option to set up dedicated hardware servers (currently we're using a virtual environment) at a cost of about \$15,000 every 4-5 years to keep our Mediasite system up and running. We don't see this as a good use of resources at this time.

Hardware Evaluation Project Goal

At the time of Mediasite's original selection, it was the clear choice for our unique needs at the time. We needed an all-in-one solution as there were little or no resources to schedule and distribute the recordings. Ten years later, UMN-IT is now providing Kaltura as a central video storage platform that we could realistically leverage as a publishing destination for Classroom Recording.

Our goal was to find out how we could leverage current 3rd party hardware options with Kaltura to provide a classroom based recording at a similar scale and process as we do now with Mediasite.

Evaluation Hardware Selection Criteria

As we selected hardware to evaluate, we looked at hardware that could potentially satisfy five main criteria:

1. It had to be able to record and output two independent video inputs (typically camera + presentation source) with synchronized, summed audio to allow for a dynamic end user playback experience in Kaltura.
2. The hardware must publish to more than one video platform. It must operate independently of any one-vendor ecosystem. The video repository currently in use at the UMN is Kaltura Mediaspace, but if that were to change, the capture solution should be able to point to the new repository.
3. The hardware has to be scheduleable and automatable, ideally without additional licences like the Kaltura Classroom license that UMN didn't purchase. Simultaneously, it also needs to allow for ad hoc recordings and dynamic, last minute changes.
4. We have to be able to sustainably manage a fleet of twenty or more recorders.
5. The cost of ownership would be less than our current lecture capture hardware, which costs our office between \$4500-5250 per recorder, per year to operate (Recorder Hardware + Server Hardware + Software and Support).

Evaluation Scope

Manufacturer competency in basic multi-source lecture capture was a prerequisite in order to be considered. While we'd certainly be looking at the quality of the recordings, the heavy lifting would lie in the various processes around the actual activity of recordings.

Primarily, we're looking at how each recorder works within the context of Kaltura? Specifically:

1. How can the process of scheduling various departments' recordings would work? Can we manage the complex, dynamic schedules that Health Sciences schools and departments present?
2. How would we monitor the recorders as they operate each day? How can we keep tabs on a fleet of about 20 recorders?
3. Ultimately, how does the uploaded recording get to the proper distribution repository (Kaltura Mediaspace or Canvas Course Media Gallery, etc)?

Each recorder's final evaluation is heavily weighted in the areas that allow us to effectively and efficiently schedule recordings, reliably record, and accurately publish to a Kaltura Mediaspace or Canvas destination. As we evaluated the hardware in person, we looked at several other factors that will be detailed later.

Evaluation Setups & Manufacturer Rep Walkthroughs



We set up the recorders as they arrived in one of our main lecture hall AV booths (Moos 2-650). Once registered to the UMN network, we did a hardware walkthrough with the vendors, in person, webconference, or by phone conference.

We connected each to the lecture hall's AV rack-mounted HDMI record out for slide content, RCA analog audio record out for summed audio, and a consumer-grade Sony Handycam 1080p camera for a camera source. The hall's built-in camera is standard definition composite out, which only one recorder accommodated.

We made an effort to put each unit through the same tests. The initial plan was to connect all of them to the same audio and video outputs split to each and record a set of standard presentation scenarios simultaneously. Unfortunately, it was difficult to connect the recorders to the UMN test instance of Kaltura and to figure out how to integrate the Kaltura Classroom Module for scheduling. Over the course of our evaluation, each recorder became operational one by one, so we did not do simultaneous evaluations. To keep the process rolling, we focused our attention on figuring out how we would deploy each recorder with as much scheduling and publishing automation as each could manage.

Evaluation Discoveries

Kaltura and Canvas Permissions

We spent the vast majority of our time with each of the devices working with the manufacturers and UMN-IT to connect to Kaltura and figure out how to automate the sorting of recorded content to the correct publishing destinations.

One main issue was that the hardware would be departmentally owned and managed, but the centrally-supported media management repository was separately administered. AHC Classroom Services does not have administrative permissions in Kaltura. Without these permissions, we were reliant on having the Kaltura admin onsite or accessible via web conference to overcome the barriers we experienced getting our recorders connected to the system in the beginning. We eventually overcame the barriers when we were granted permission to use admin credentials to troubleshoot our Kaltura connections on our own.

By comparison, in discussions with Indiana University¹ about how they provide classroom recording, they didn't experience the same roadblocks, because the same central IT departments who administered Kaltura and Canvas were also managing their own hardware recorders (about 60 hardware recorders plus software recorders loaded on classroom computers in some instances).

Some specific challenges we faced with centrally-managed services we needed to interface with:

Canvas

Our office is not responsible for managing any courses or course-related LMS sites. We only have tangential interactions with these elements when assisting individual faculty or course

¹ Indiana University also uses Kaltura as their video storage and distribution platform. They had evaluated some of the same hardware several years ago. IU ultimately deployed one of them widely in their classroom spaces.

designers with getting content we capture into their eLearning or online collaboration sites. A side-note, Canvas is also only now being widely adopted at the UMN campus.

Kaltura

UMN-IT did a soft-launch of Kaltura in Fall 2018, but has not yet deployed all of its available features. Our understanding of Kaltura is limited to just the features that have been released. Some module licenses were not purchased, or might be purchased in the future.

Canvas doesn't automatically integrate with Kaltura, even though it's the media management system. A designer or teacher role in a Canvas course must initiate the connection via that person's My Media or via that course's Media Gallery, which creates a path in Kaltura using the Canvas course ID.

Media Management

Deploying Classroom Recording hardware means that our office will be recording content on behalf of other users. Under our previous system, content we captured was stored in a repository that we managed, with guidance from AHC-IS (now called HST).

Now that we intend to use the UMN centrally-supported media management system, we understood that we could not continue to manage other users' content in that same fashion. We knew it will be essential that we can publish our recordings in the appropriate destinations so that users can manage their content.

Something to take note of is that UMN-IT requires users to put course content in Canvas and non-course content elsewhere. Additionally, UMN-IT does not provide any repository for PHI or HIPAA-related content.

There are two elements — herein referred to as metadata — that are required to publish content correctly. The first pertains to the user who has the permissions to manage the content. The primary role is a Kaltura Entry Owner role, which is designated to the person who will have complete administrative permissions over that content, such as editing, publishing, and deleting. Recorded content will appear under the Entry Owner's My Media tab. Other users can have roles such as Co-Publisher and Co-Editor to assist media management.

The second element is the Kaltura Site ID, which is a numerical code that names a specific Kaltura Mediaspace destination for non-course content or a specific Canvas course site for course-related content.

There are three ways content can make its way to the correct destination.

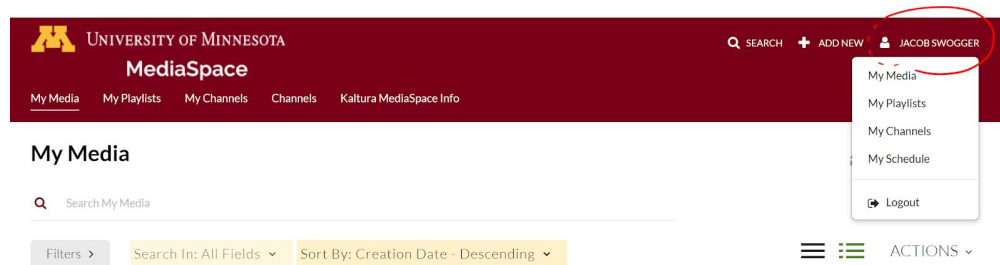
1. We publish to Kaltura with an Entry Owner metadata and that person can manually publish the content appropriately. For a small department with only a few publishing destinations, this is manageable.
2. We publish content to Kaltura with an Entry Owner and a Co-Publisher metadata. By adding the Co-Publisher role at the point of capture, we are able to sort content based on subordinate groups to the main group. This could be appropriate for large departments or units with many separate sub-units.
3. We publish to Kaltura with an Entry Owner and a Kaltura Site ID metadata. The Entry Owner (and any Co-Publishers or Co-Editors designated later) can manage the data, but we have already put the content directly in the appropriate publishing destinations. This would be most appropriate for Schools with dozens of courses whose content needs to be accessible soon after capture.

Kaltura Classroom License / Lecture Capture Functionality

UMN-IT has not licensed the Kaltura Classroom Module which would allow the recorders to be scheduled through the Kaltura Mediaspace interface. We've evaluated the recorders for this functionality in the UMN Kaltura test instance but are assuming we will not have access to it in production.

With the Kaltura Classroom Module, a recorder appears in Kaltura Mediaspace as a resource. This resource could be a dedicated hardware recorder as we've been testing. It could also be a standard podium computer that has the Kaltura Classroom software loaded on it. This computer receives camera and audio feeds via USB. We did test this in fall 2017 briefly while UMN-IT was starting to configure Kaltura. See the "Why Dedicated Recording Hardware?" section for reasons why you may still want to use one of these devices even if we did licence this feature.

In Kaltura Mediaspace, an option called "My Schedule" appears in a dropdown menu under the user's name in the upper right.



Scheduling recordings via the Kaltura Classroom Module is much more straightforward. Through this interface, in addition to adding recording name and recurrence, a user can easily add the Entry Owner, Co-Publisher, Co-Editor, and Kaltura Site IDs in the right Entry fields.

It should be noted that there are several drawbacks currently to scheduling via Kaltura Classroom module.

1. This method doesn't readily allow for us to schedule our more complex scheduling needs. You're limited to an entry per meeting pattern. So MWF 9am-10am in Room 1 is ok, for example. But if you have any irregularly recurring events, you're going to have to add additional Kaltura Schedule entries for each.
2. It doesn't allow for us to define any recorder-specific settings like layouts or encoding profiles if we wanted to.

Live Streaming

None of the units we evaluated can deliver a livestream of content as it's being recorded in the same way that Mediasite can. Because Mediasite's ecosystem provides capture and media management, the system created a unique URL for the final recording before it was recorded. If livestream was needed, that same link serves double-duty as the livestream link during the recording process, and then turned into the on-demand link soon after the recording finished. The Mediasite management system could handle hundreds of concurrent users watching any number of live and on-demand content at the same time.

All the units we evaluated could only stream content to a single or a few destinations for content delivery to multiple users simultaneously. An example is YouTube, which allows users to send an RTMP stream from a recorder to its servers that are then made available to viewers. If multiple people tried to view the RTMP stream directly from the recorders, bypassing YouTube, it would bog down the appliance.

Additionally, none of the recorders create new livestream URLs with each recording. They are limited to streaming content to pre-defined URLs, such as a URL dedicated to a room in which the recording took place or a URL dedicated to a specific course for which the content is intended or a URL dedicated to a single speaker series to which the content belongs.

Live Streaming in a Kaltura-based Classroom Recording Environment

Kaltura Mediaspace has an RTMP streaming feature that is not deployed in the UMN-IT instance. Called Kaltura Live, it exists in the test instance, which we evaluated with one of the recorders. A UMN-IT Kaltura admin created an RTMP URL and Key for us. Like any other content in Kaltura Mediaspace, the RTMP URL exists as part of the Entry Owner's My Media. Co-Editors and Co-Publishers can also be assigned to it.

Once the stream ends (and presumably the recording ends), the content appears in the My Media and any other destination to which it's published for on-demand viewing. The stream URL shows a blank screen when nothing is streaming, meaning if a viewer wanted to watch the recording after having just watched the livestream, the user would go to a different URL.

Today, the majority of our course-based users do not require livestream. Class attendance is often required or emphasized. Among our non-course users, livestream use is on the rise. Our office uses Mediasite's livestream to monitor individual recordings during the day.

One assumption we have not yet had a chance to evaluate is that some users might find Zoom to be a more appropriate tool for recordings with a livestream component. However, that would mean content recorded in Zoom would have to be manually transferred to the correct Kaltura publishing destination as a long term repository.

No Public-Facing Kaltura Channels Currently

A UMN requirement is that course-related content is accessed via Canvas so that only the students enrolled in a course can see that set of recordings.

Kaltura Mediaspace is the repository for non-course-related content. A user can create an Unlisted Link to a recording that can be shared for anyone to view.

But a user cannot curate a collection of recordings that can be publicly viewed. The tool for curating in Kaltura Mediaspace is a Channel, but UMN-IT only allows Restricted Channels, which means viewers need a UMN x500 ID to log in.

Currently, if a department wants to create a collection of recordings that are publicly viewable, such as a department's Grand Rounds, or a periodic speaker series, UMN-IT recommends they create a YouTube channel.

Kaltura Admin Secret

The Kaltura Admin Secret is part of the credentials that allows UMN instance of Kaltura to upload content to Kaltura's servers. It is an all-powerful credential that we're told cannot be changed.

Two of the four evaluated devices require the use of the Kaltura Admin Secret in order to connect to Kaltura KMC. Our Kaltura System Administrators do not want to allow recorders to have the Admin Secret for security reasons, the primary being that if a unit is stolen, the Admin Secret is exposed and possibly the UMN instance of Kaltura could be breached. These manufacturers said that they could likely make this authentication method change if that is what was needed.

Who Does the Work?

Mediasite is an end-to-end media management platform, from scheduling to capturing to distributing. In our deployment of Mediasite, AHC Classroom Services performs all the required tasks from the point a user requests a recording up until the user shares the link. We maintain the recording hardware and co-manage the media servers with HST (though they manage the server hardware exclusively).

Except for a couple instances, faculty and staff of other departments do not have access to the Mediasite Management Portal to perform any of the tasks involved with Mediasite.

Leveraging Kaltura as our media management platform, work will shift. UMN-IT will manage the media management platform while Kaltura manages the server hardware. They work with Academic Leadership to determine retention policies, fulfil captioning and accessibility requirements, etc.

A bigger shift is that content owners will now manage their content once it's published to Kaltura. That could mean that faculty and staff of departments, rather than AHC Classroom Services, will handle editing, deleting, and distributing content.

So, for AHC Classroom Services, that leaves all the tasks that precede recording up until the content is recorded and uploaded. We will schedule recordings for users, maintain the recording hardware, and make sure that content arrives to the appropriate destinations.

HIPAA / PHI Concerns

In our current classroom recording system, we put the responsibility of making sure no PHI or HIPAA-related content is broadcast or recorded on the users who make the request. As part of the request process, there is a statement they have to agree with that requires them to do so, much like the statements UMN-IT relies on for users not to broadcast or record HIPAA content in Zoom. For requests that come via email or phone, we make sure we get an email reply from the user stating s/he will adhere to the no-HIPAA rule.

However, we can only police what we see ourselves. If we see questionable content, we pause a recording or livestream. But because we rely on an automated system, we don't see all the content that comes through our recorders.

Working in the Health Sciences, how is HIPAA / PHI handled when it comes up in a recorded classroom? Who is responsible for stopping or pausing a recording? How can we ensure no HIPAA / PHI content is recorded at all? If something is recorded that may violate HIPAA / PHI Policies, who takes action and by what process will that be corrected?

Scheduling Recordings May Become More Rigid

We currently schedule some pad time before and after scheduled recordings today in Mediasite. If a class starts at 9:05 and ends at 9:55, we typically will start the recording at 9:00 and end it at 10:00 because, from experience, we knew that the Mediasite recorder didn't always start right on time and that lecturers sometimes taught right to the last minute.

If schedules overlap, Mediasite sent a notification so we could correct the issue. It has a hierarchy that prioritized scheduled recordings over ad hoc recordings that were started at the recorder. It would end the ad hoc and start the scheduled one. If an overlap existed between

scheduled recordings, Mediasite would start the second soon after the first one, no matter how late it had to start.

This practice will have to end with any new process because none of the recorders we evaluated have overlap notifications. Additionally, the recorders have different approaches to a hierarchy of schedules.

What to do with Legacy Content captured in Mediasite or other systems?

Finally, if we align Classroom Recording efforts with UMN-IT's Kaltura service, how do we handle 10 years of recordings in other systems? Per UMN's contract with Kaltura, we are allowed to bulk upload Mediasite content to the Kaltura servers. UMN-IT Video Services has a process take Mediasite Publish To Go files and import them as dual stream objects in Kaltura. This will take significant effort to get legacy content into this format because we don't use it. We would need audit our recordings to figure out which to transfer, create Publish To Go files for that subset, then export and upload to Kaltura for its servers to convert into a dual stream format. We're coordinating with the various stakeholders to get this work done Summer of 2019.

Additionally, once we perform the bulk upload, it does not make sense for us to continue recording in Mediasite afterwards. That brings up the question of when to upgrade the old rooms that are not part of the HSEC budget, or whether there's a process to individually upload files to Kaltura as they're created. We're working on these details now.

Evaluated Classroom Recording Hardware

Cattura CaptureCast Pro 2U

Extron SMP-352

Matrox Monarch LCS

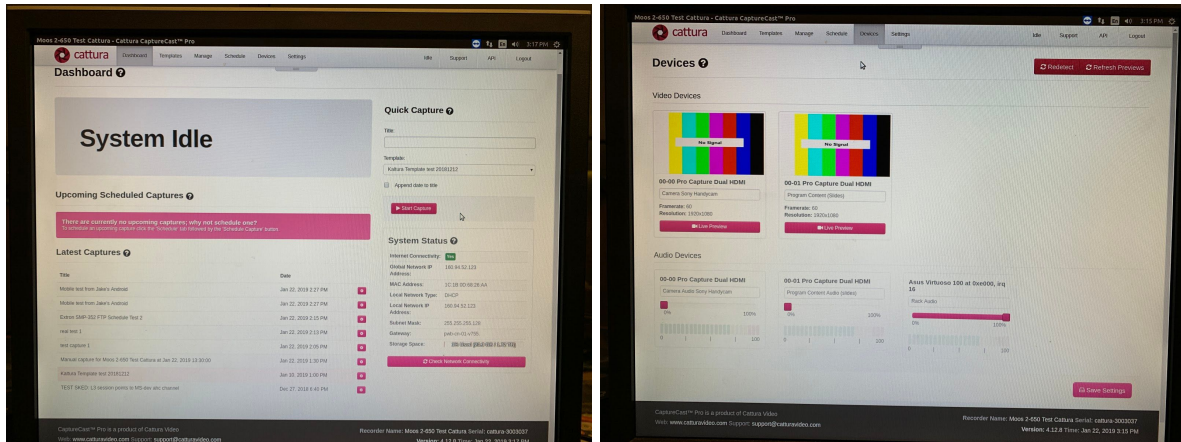
Winnov Cbox L3 (and S3)

Hardware Evaluation Results

Cattura CaptureCast Pro 2U



The CaptureCast was one of the units (along with a Winnov appliance) we were able to test for a short time in late 2017 when UMN-IT was doing some initial evaluations while beginning to implement Kaltura. We knew at the time it wasn't quite ready for our environment but I had made a note that I wanted to see where was at in 6-12 months.



The Caltura Capture Cast Pro is a 2-RU appliance with solid build quality running on a Linux OS.

It is relatively easy to set up as it's a stand-alone recording appliance. It can take two HDMI inputs or two SDI inputs, and line-level audio from a phono jack. It has HDMI out for a monitor, USB ports for peripherals, and an ethernet jack.

Management software is via an IP address and web browser that can be called up locally on the recorder or remotely via another device as long as the network is not blocked. We did not evaluate fleet management options.

How it Works: The Basics

The Capture Cast Pro is primarily a capture-and-publish appliance. A user can start an ad hoc recording right from the dashboard, giving it a time and duration, and calling up a specific recording template. It has a built-in scheduler that allows users to create one-time or regularly recurring recording programs, and can set different templates for each schedule.

These templates set the inputs that the recorder should use, any processing or compositing of the video and slide sources, and where content will be published. A template can point content right to a specific Kaltura destination, Google Drive, YouTube account, local recording, etc. Integrating Kaltura or other destinations only requires a username and password; no Kaltura admin secret required.

Capture Cast Pro can use an iCal file or URL to pull recording schedules manually. However, only one template at a time can be selected when synchronizing recording events. So, courses

and or events going to different publishing destinations need to be synchronized separately. A user can link the Kaltura Scheduler to the appliance so that it can take schedules through the Kaltura Classroom Module. These schedules can make use of a default template that only records locally and then rely on Kaltura publishing metadata to point content to the correct destination.

Cattura Pros

- Easy, out-of-the-box setup as a standalone recorder
- Information-rich dashboard to know recorder status, have manual controls of recordings, and to know what's upcoming
- Plenty of integrations to publish content to multiple destinations
- Good quality video and content capture
- Doesn't require the admin secret for Kaltura integration.

Cattura Cons

- Schedules relying on templates for different destinations is cumbersome to manage and automate. Additionally, requiring manual sync-ing of iCal calendars is a weakness. The built-in scheduler does not accommodate irregularly recurring schedules.
- Duplicate or overlapping recording schedules are possible in this system.
- Relying on templates to manage publishing destinations means for every course (of different events), there needs to be a corresponding template.

Is the Cattura Capturecast Pro Right for Your Application?

As a standalone device for a department that is not tech savvy and only needs recordings from a single room and going to a single destination, the Cattura Capture Cast Pro can be useful. But if there are multiple publishing destinations or automation needs, the recorder is deficient.

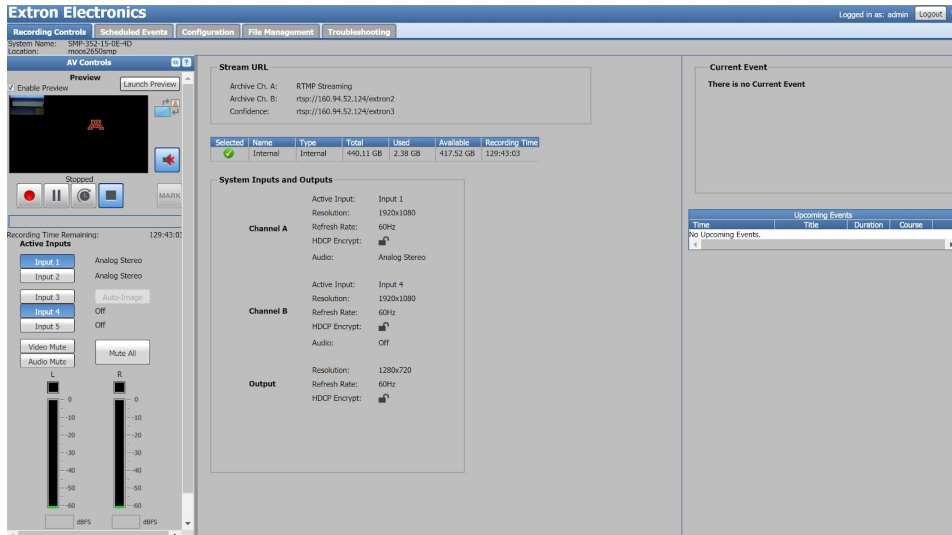
[Here's a video walkthrough that V. Paul Virtucio made of the Cattura CaptureCast Pro that shows some of what we've described here for further review.](#)

Cattura-provided a Product Roadmap for us to include as well. This is as of February 2019.

- Kaltura live webcasting scheduling integration.
- Support for AV over IP using NDI - support up to six NDI capture streams
- Integrate computer vision for new ML/AI media framework
- Upgrade audio engine to support richer mixing, signal detection, noise cancellation, and more to expand audio capture capability
- Major upgrade to our centralized command server to mirror our new V5 updates
- Process spoken word search with transcript integration partners directly on the hardware
- Video editor update: Drive video editing by spoken word search. Tools to quickly search, select, and export segments of the video with real-time video feedback.

- These are the top ones we want to accomplish in 2019, the others will be minor enhancement and updates to keep up with our partners
- Video editing and kaltura live webcasting scheduling integration is coming Qtr 1

Extron SMP-352



The Extron SMP Web GUI

The Extron SMP-351 and SMP352 was a product series I had been curious about for a few years as it really looked great on paper. Our classrooms have utilized many Extron products for years as they've been installed for various AV needs, so we're familiar with the brand and how their products generally work, as well as had a good track record with reliability (except for some power supply issues here and there).

The 352 differs from the 351 in that the harddrive is 4x the capacity and it comes with some soft-capabilities already unlocked. Extron noted that you could make a 351 a 352 by purchasing additional "LinkLicenses" later (minus the larger HDD). To *publish* to Kaltura, no additional LinkLicense is required. However, an additional LinkLicense is required for an SMP to be seen as a *schedulable* Resource in Kaltura via the Kaltura Classroom functionality or Live Streaming through Kaltura, neither which is currently available in the UMN-IT instance.

How It Works

The SMP352 seems to be focused on being “AV integrator-friendly” and that shows in many ways, Some good and some bad. It’s a technically impressive recorder and will sit well with an AV System as advertised, and it performs fine as such.

The SMP352 has two encoders, an Archive Encoder which saves higher quality version for later upload, and a “Confidence Stream” which is a composite of channels A and B, encoded at a lower bitrate, primarily intended for recorder monitoring, not larger live stream audiences.

Extron Pros

The unit has a great build quality. It’s compact, taking up only 1RU. It has two different encoders, a live preview stream (composite right off the box, not suitable for “live streaming” purposes).

Easy to use controls on the face of the device for basic Ad Hoc Recording.

Internal storage as well as easy to use thumb drive USB slot on the front to the device

Web GUI interface is robust and allows for a lot of control.

Extron Cons

IP-based web GUI is the only way to work with the device. No local monitoring or direct “At the Box” controls other than basic record functions (there are more if you menu-dive).

No screen-based UI when “at the box”. Have to interface via web GUI.

Need to purchase an additional license when using connecting to Kaltura as a Publishing destination.

Required the Kaltura Admin Secret to publish to Kaltura.

Scheduling

The biggest problem we encountered with the SMP was scheduling. While it could *technically* do what we needed, it was very cumbersome. In order to get a Google Calendar-based schedule to the SMP then the resulting recording up to Kaltura with an Entry-Owner attached, a lot of legwork had to be done. The scheduling option that seemed most appropriate for our application according to Extron representative was the “Import iCalendar Data Periodically”.

Metadata Mapping from gCal is an issue for us. The SMP will currently only pass these Google Calendar Fields:

1. Title
2. Start / End Date and Time(s)
3. Location
4. Description

No Kaltura entry owner or Kaltura or Canvas course identifiers will currently map through. This means, anything recorded from gCal events will upload the Kaltura Management Console (KMC), but it will be assigned to the Admin User that is authenticating the device to the KMC and the content will essentially be an “orphan”, not showing up in the right users’ Kaltura MyMedia or Canvas Courses. To get content show up in a given user’s MyMedia tab in Kaltura, you’d need to add them as an ORGANIZER in the .ics file since there’s currently no way to parse that metadata via Google Calendar.

Scheduling + Metadata process in short:

1. set up your calendar information in gCal
2. Export an entire semester for all recorders in the fleet to an .ICS file
3. Open .ics file in Notepad++ (Extron-recommended notepad application).
4. Add metatdata fields for each event in Notepad++ (see highlighted “Organizer: swogg001@umn.edu” Screenshot above, illustrating how we’d need to add the “Entry-Owner” to events).
5. Save edited .ics file and upload it to FTP or SFTP server (SFTP in this case).
6. Point each extron SMP to the same (S)FTP server file location.

Each recorder then looks for the events that have it’s Location (as defined in each Extron’s device management tab) named in the Google Calendar event “Location” field and ignores the rest. All recorders would share one .ics file.

Individual Extron SMP event calendars would then populate with their events. The Google calendar is the way you’d need to track fleet tasks.

If any edits need to be made, you’d need to redo this process and repoint the devices to a new .ics file.

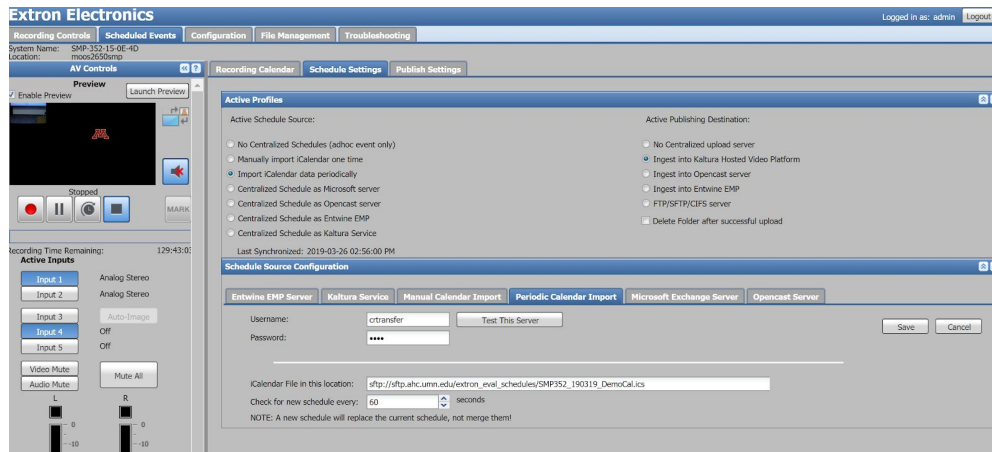
We did successfully schedule the SMP352 with Kaltura Classroom Schedules, which is significantly easier. But there are several drawbacks to this as well. First, UMN-IT currently doesn’t license this feature. Secondly, you need to purchase an Extron LinkLicense to enable it

```

ExtronSMPMetadataExamples.txt SMP352_190215_Metadataatest1.ic
21 TRANSP:OPAQUE
22 END:VEVENT
23 BEGIN:VEVENT
24 DTSTART:20190118T175000Z
25 DTEND:20190118T175200Z
26 DTSTAMP:20190215T165440Z
27 UID:105a3h1r6f5hvb9u0p5qf2n0hu@google.com
28 CREATED:20190117T195509Z
29 DESCRIPTION:Adding Metadata in Notepad++ aft
30 .
31 LAST-MODIFIED:20190118T173837Z
32 LOCATION:moos2650
33 SEQUENCE:6
34 STATUS:CONFIRMED
35 SUMMARY:SMP Metadata Schedule 5
36 TRANSP:OPAQUE
37 END:VEVENT
38 BEGIN:VEVENT
39 DTSTART:20190118T180000Z
40 DTEND:20190118T180200Z
41 DTSTAMP:20190215T165440Z
42 UID:4tcdcn053jfsfo0b4198mf3749@google.com
43 CREATED:20190118T161918Z
44 DESCRIPTION:Adding Metadata in Notepad++ aft
45 .
46 LAST-MODIFIED:20190118T173910Z
47 LOCATION:moos2650
48 SEQUENCE:3
49 STATUS:CONFIRMED
50 SUMMARY:SMP Metadata Schedule 6
51 TRANSP:OPAQUE
52 END:VEVENT
53 BEGIN:VEVENT
54 DTSTART:20190215T173000Z
55 DTEND:20190215T173500Z
56 DTSTAMP:20190215T165440Z
57 UID:359iungh22n0ct3m4eqm0k650g@google.com
58 CREATED:20190212T164850Z
59 DESCRIPTION:Testing metadata parsing from D
60 LAST-MODIFIED:20190215T165241Z
61 LOCATION:moos2650smp
62 SEQUENCE:3
63 STATUS:CONFIRMED
64 SUMMARY:190215 SMP Metadata test 1
65 TRANSP:OPAQUE
66 ORGANIZER: swogg001@umn.edu
67 END:VEVENT
68 END:VCALENDAR
69

```

on the recorder side. The Kaltura scheduling piece is also not as robust as leveraging Google Calendar (see Kaltura Classroom License / Lecture Capture Functionality section above).



Extron SMP 352 Scheduling Settings Tab

Is the Extron SMP352 right for your application?

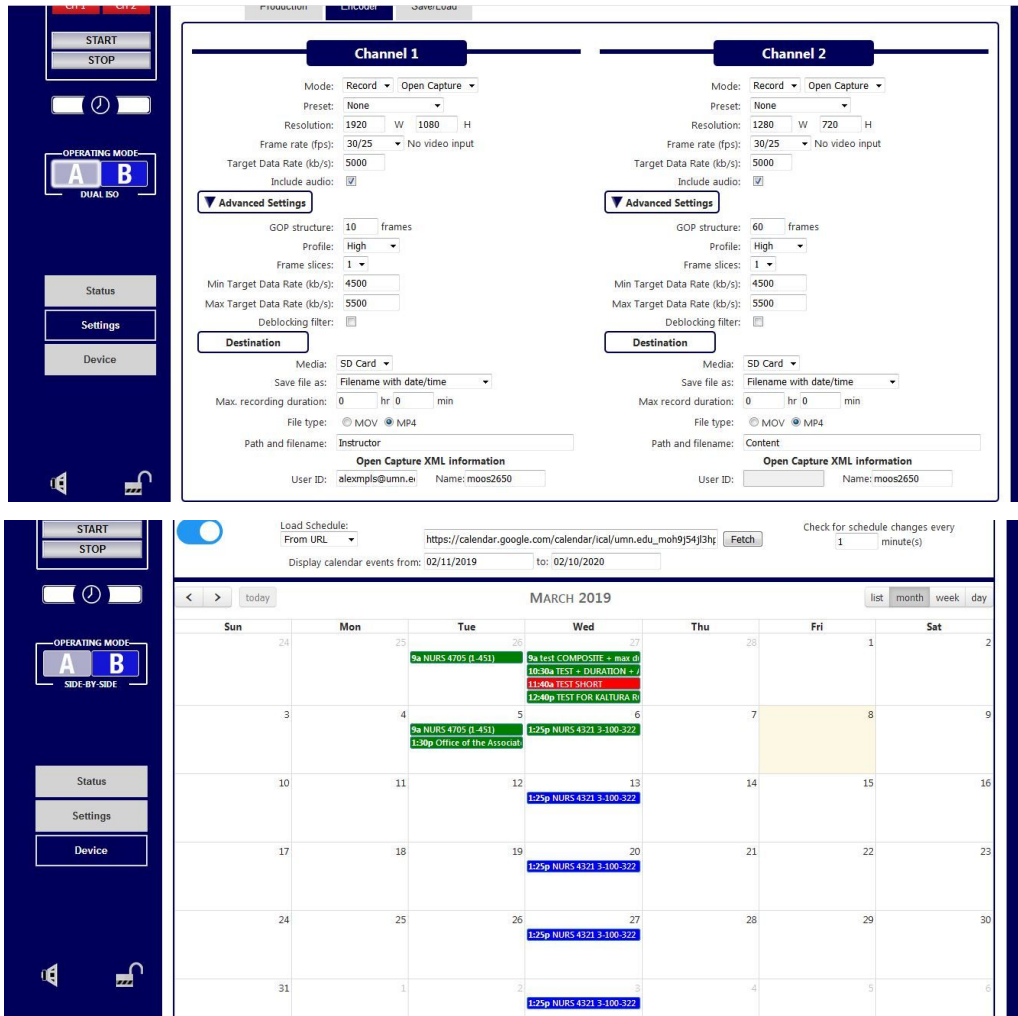
If you're looking for an established hardware manufacturer that has a lot of AV-integrator-friendly features to built into a departmental classroom and you're looking for reliable, manual recording approach, either by presenters recording to their own flash drives or by uploading to only a limited number of Kaltura entry-owners / Canvas Courses.

If UMN-IT does license the Kaltura Classroom lecture capture features, this unit would function in a much more schedule-friendly way, but this will require a LinkLicense purchase.

The SMP352 is a relatively expensive solution that lacks some key features we emphasize. If drawn to the Extron, we recommend looking at the SMP351 and seeing if you could limit the LinkLicense purchases (no Kaltura Scheduling, no Dual Stream etc.).

Matrox Monarch LCS





We evaluated the Matrox Monarch LCS recorder and Radar, its fleet management software. However, because we only had one recorder, we could not fully simulate managing multiple recorders.

The Matrox is a custom-built .5 rack-unit recorder with two HDMI inputs, two SDI inputs, one HDMI output, an 1/8" line audio input, and an 1/8" line audio output. It does not have onboard storage for recording; instead it has an SD card slot and a USB port for storage, plus a second USB port for updates. It has an ethernet jack for network connectivity. It also has buttons to start/stop recordings or to change HDMI sources.

Matrox was recommended by AV technology consultants working on a large project in the Health Sciences area. This was the least expensive of the units we evaluated.

The Monarch has a web interface that is accessed by browsing to its IP address. There are three main pages for operations: Status, Device, and Settings. There is a start/stop button for

recordings, plus indicators to show whether the recorder is in standby, actively recording, scheduled, and transferring files.

How It Works: The Basics

The Matrox Monarch is primarily a capture-and-publish solution. It can capture video and slide content via separate channels, output them individually, or composite them into one output channel. It has a native scheduling component that can accommodate one-time and regularly-recurring events. And it can publish captured streams to a drop folder or FTP site, from which the content would then need to be managed for distribution. The Monarch can also output an RTMP stream to a platform that would livestream out to many users.

However, the Monarch only has two outbound streams. If a user wanted to publish a stream and livestream it, it could only be of a composite being published and streamed. They could not publish the two separate channels and then livestream a composite of the two, for example, because that would require three output channels.

A user can create recording profiles to manage these inputs and outputs. One profile would be to capture and publish each source separately. Another profile would capture, publish, and livestream the sources as a side-by-side. And yet another could be set up to capture and publish slides + audio, yet livestream a PiP of video, slides, and audio. Only one profile can be active at one time, which means in a series of recordings, the user has to manually switch profiles between scheduled recordings if different profiles are called for. There is a method of scripting this action to automate the changing, but we did not evaluate that as it was not something we wanted to manage.

The Monarch has a scheduling function that accommodates one-time and regularly recurring schedules. It can be linked to a Kaltura Classroom Scheduler that would push events to it or to an iCal calendar via a URL that it would pull events from. However, it can only take schedules from one of these sources at a time. But activating one of them, it negates the linkage to the others.

Publishing to Kaltura from the Monarch requires using self-hosted FTP server or a drop folder, which Kaltura provides. The Monarch can only publish files when it is sitting idle; it cannot publish a recording package while capturing the subsequent one. A user can set it up to transfer files immediately while idle or to do the transfer at a scheduled time, such as overnight. If the Kaltura scheduler was used, a user can point files from the Monarch to specific publishing destinations and attach a specific Entry Owner. If the built-in or the iCal schedulers were used, by default the files would simply go to the root folder of the KMC and would have to be manually moved into the correct destinations by the Kaltura admin. Though Matrox has a method of using metadata in iCal to auto publish content to destinations, we could not get it to work correctly, even with their customer service support.

Matrox Pros

- Inexpensive, by far the lowest cost of ownership.
- Responsive Support who are willing to implement changes to the units if it makes sense for a large number of users.
- When used in conjunction with Kaltura Scheduler, the Monarch is easy to use.
- RADAR fleet management system.

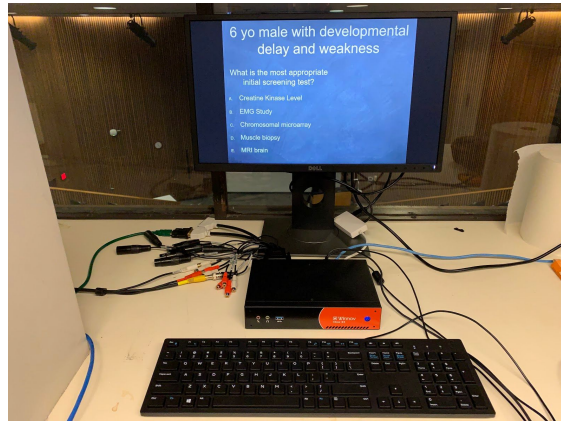
Matrox Cons

- Reliability was the main issue. The Monarch unit we evaluated was inflexible when ingesting different video signals from our AV system. It wants to see consistent signal resolution and frame rates (a scaler is recommended to sit right before each input in the signal chain). If it didn't like the signal, it simply wouldn't see it without giving indication that the signal was a problem. If the SD card did not have a fast enough write-speed, the recording would error out but it didn't give any indication that it was a storage issue. And finally, the Monarch would indicate it was transferring files to the drop folder for our publishing destination, but nothing would arrive even though the Monarch indicated it was successful. That said, we spoke with one large university who has many of these units deployed and didn't seem to experience the same issues.
- Auto-publishing content to specific destinations and to specific Entry Owners is challenging to manage. The method works if the Kaltura Scheduler was used, but it doesn't work with iCal, which is our preferred method of scheduling the Monarch. The engineering staff at Matrox seemed willing to implement better Metadata parsing via iCal/gCal if we were a customer. The team was very responsive during our evaluation.

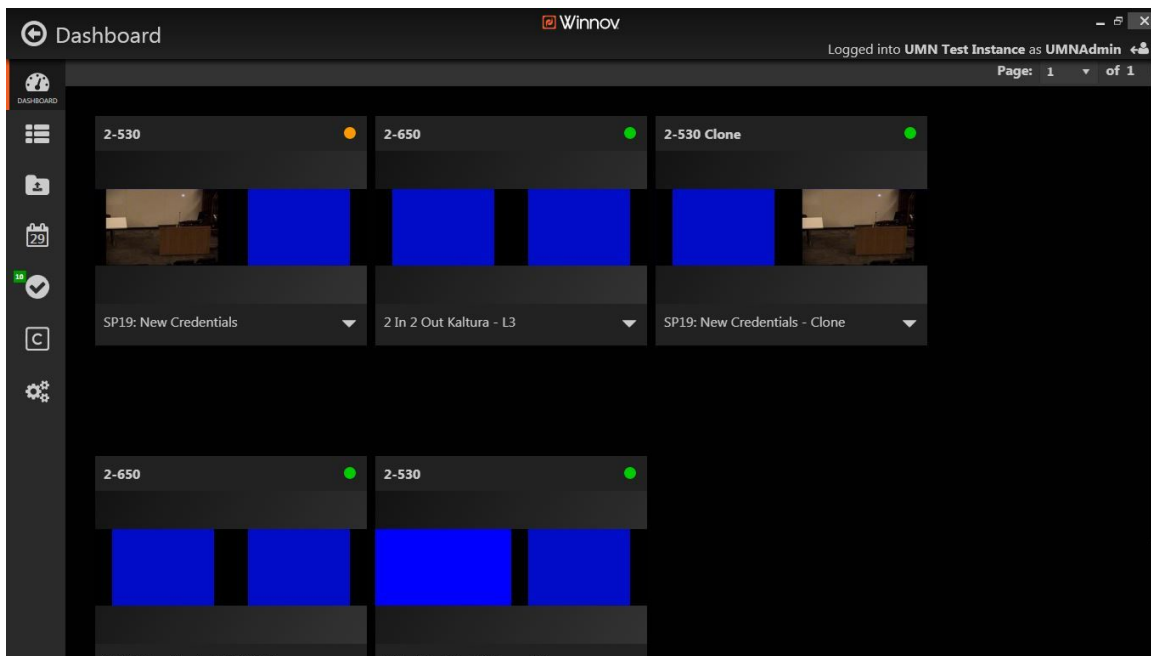
Is the Matrox Monarch LCS right for your application?

The cost of ownership is by far the lowest of all evaluation units, which makes the Monarch worth investigating. The Monarch would work for a small department that had one room with consumer-level record outs to capture a simple, consistent schedule of mostly one-time events, and a single publishing destination where if content could be managed manually.

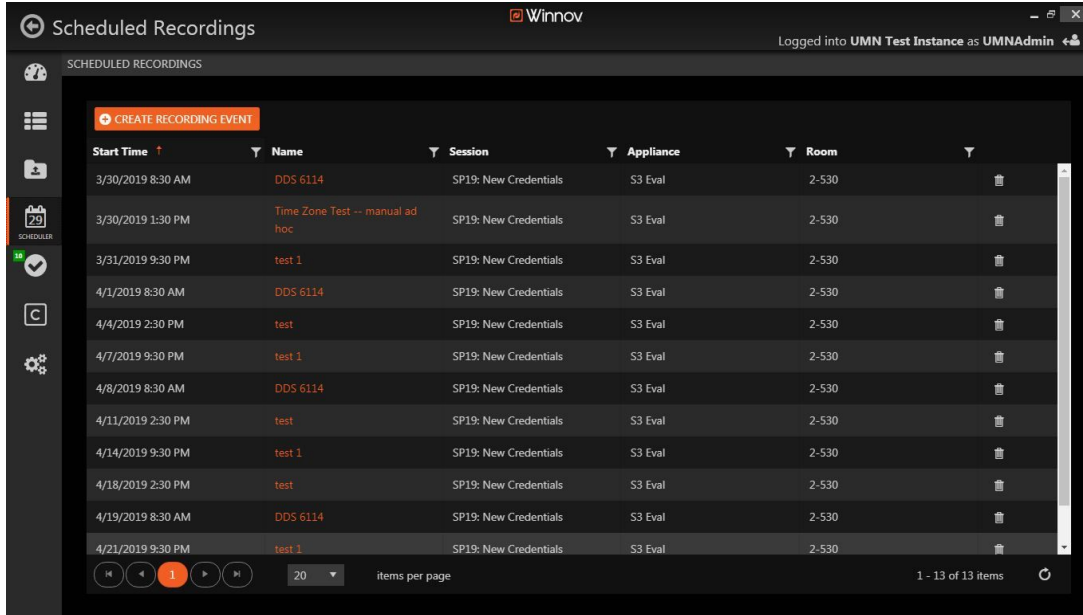
Winnov Cbox L3 & S3



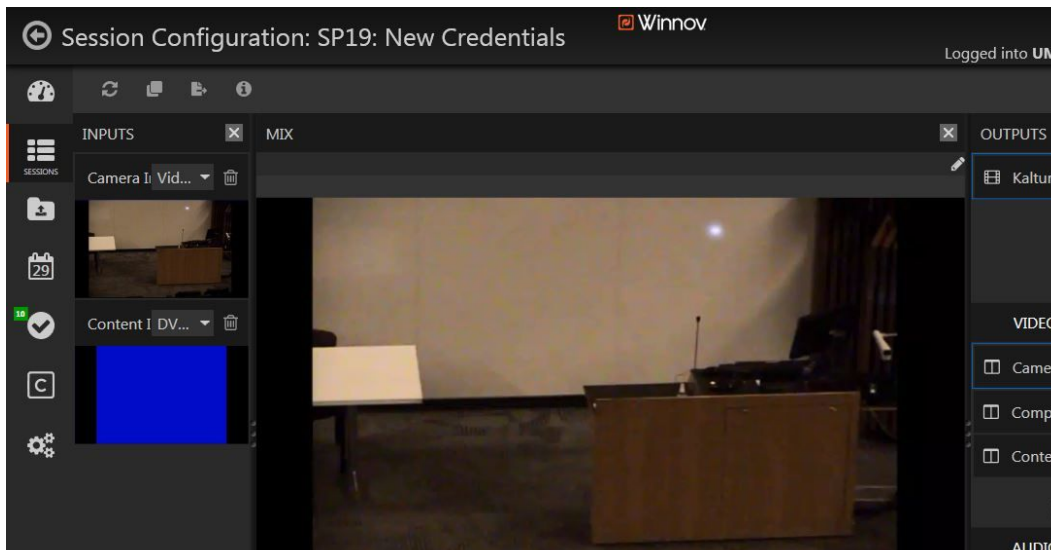
.5U rack sized hardware



Winnov Command Center Dashboard



Command Center Schedule View



Session Configuration

We evaluated two Winnov Cbox recorders, the L3 and the S3, as well as the cloud-instance of Winnov's Command Center software that allowed us to simulate management of a fleet of recorders.

A Cbox is basically a custom-built, 1 rack unit-sized PC with Windows 10. There are at least two users set up on it: a Kiosk account that can only see the Winnov Kiosk environment, and an Admin account that allows access to the Windows 10 environment.

The Kiosk environment is primarily for a user to see the live AV inputs, as well as a status page that shows network connectivity info. It is a limited, non-operational view of the recorder.

The Windows 10 environment is typical to any other computer, including access to the hard drive and file structure where recording files are stored. In this environment, a user can run the Windows Command Center software to operate the recorder, such as start/stop recordings, change inputs, manage schedules, create templates, etc.

A Cbox has three integrated SDI inputs, two DVI inputs via a Y-cable, and 1 composite video input via BNC. It has four RCA stereo inputs, two XLR stereo inputs, one phono stereo output, and two XLR stereo outputs. It also has two mini-display port outputs for monitors, USB ports for peripherals, and an ethernet jack for network connectivity.

How It Works: The Basics

The Winnov solution is primarily a capture-and-publish solution. It has a native scheduling component that can accommodate one-time and regularly-recurring events. And it can publish captured streams to multiple destinations, such as Kaltura, YouTube, network drives, and USB drives, as well as to a recorder's local storage. Winnov can also output an RTMP stream to a platform that would livestream out to many users. However, Winnov does not handle content distribution and management; once the file has been uploaded, Command Center cannot access it.

A user creates a Session, which manages what inputs and outputs are needed, whether streams need to be composited, and where content should be published. There can be multiple Sessions on a recorder: one is the default if no session is specified at the time of initiating a recording, and the rest can be specifically called up as needed. From Command Center, a user can initiate a recording from within the Session interface, or schedule a recording.

A user can integrate an external calendar to schedule recordings in Command Center. There is Google Calendar integration where a Google Calendar Event with Subject, Start Date, End Date, Start Time, End Time, Location, and Description can indicate to a specific recorder when to start and stop recording. Command Center would pull schedules from Google Calendar at prescribed intervals. Additionally, there is also a Kaltura Classroom Module integration that allows users to schedule specific recorders from within Kaltura Mediaspace. The module would push an event into Command Center.

Publication destinations for content can be set either in a Session, or via an integrated Calendar, or via the Kaltura Classroom Module. And content can be set to publish differently to

each destination; eg. Kaltura could receive a video stream and slide stream separately, while simultaneously YouTube would receive a composited stream of video and slides.

Winnov Pros

- The Winnov Command Center most closely approximates our current Mediasite deployment, making it easier to transition our workflow, scheduling processes, and fleet management.
- The Google Calendar integration accommodates a robust scheduling platform for bulk upload of complex schedules; eg. a CSV file of 57 events is uploaded in bulk to Google Calendar which schedules the various recorders, instead of a user having to input 57 distinct recording event schedules.
- During our evaluation period, customer support from Winnov was immediate, detailed, and effective.
- The quality of the recorded files as well as the reliability of the recorders was impressive. In the relatively short period we evaluated the units and put a rigorous recording schedule on them that was on par with an individual Mediasite recorder, the Cbox proved itself a reliable unit.
- Cost of ownership is about \$1,500 per year per unit.

Winnov Cons

- The Kiosk environment at the recorder does not accommodate operations. It's best to leave the recorder in the Windows 10 environment so that a user can at least access a version of Command Center.
- The User Interface of Command Center can be obtuse. For example, it is not drag-and-drop friendly for arranging visual elements when creating a composite. Users make change via manipulating x-y-axes fields.
- Winnov has no native function to manage or prevent overlapping schedules. It operates on first-in-first-out and it gives no notifications of pending overlapping schedules. A user has to rely on external, integrated calendars to avoid overlaps.
- Winnov does not have a public-facing help or knowledge base. There is no transparency to functionality or characteristics that are unique to the hardware or software, though Winnov says this is coming soon.

Is the Winnov CBox Right for Your Application?

Of all the units we evaluated, the Winnov Cbox + Command Center solution is best for departments/users that have to manage a fleet of recorders to perform automated, complex schedules and publish to multiple destinations reliably.

Winnov may be overkill for departments who only need one recorder to perform regularly recurring recording schedules that go to one destination or that are manually schedules and distributed.

Additional Documentation:

[Hardware Evaluation Criteria, Workflow and Cost of Ownership Comparisons](#)

Evaluation Big Take-Aways

- Mediasite is far from perfect, but their ecosystem approach offers some significant advantages.
 - A system that is truly integrated throughout hardware, software, servers, fleet management, live streaming and on demand presentation viewing.
 - Our experience with Mediasite proves it can accommodate for our demanding, dynamic scheduling challenges, and last minute changes.
 - Their support structure is strong and extends through the whole system of recorders, software, servers, and presentations that the end user interacts with. This includes sales and sales engineers, helpdesk case support, online forum and KBA support, as well as a video library of how-tos, introductions to concepts and software.
- Classroom Recording using one of these units will be modular, with either a native scheduling component or an external one, a capture device and software component, and a content distribution component .
- How we livestream will change and will most likely be done in a system outside the content distribution component . For example, via YouTube or Zoom.
- The Kaltura Classroom License, which UMN-IT did not license, could be useful for departments with simple event recording schedules, but not for ones with irregular recurrences in multiple rooms, for example. Even if the UMN licensed it for the whole University to use, some of our complex schedules in the Health Sciences would be more challenging to manage than in our current system.
- Other scheduling methods are necessary to replicate more closely our Mediasite setup with another capture solution, as the native schedulers of these evaluated products have limited utility.
- The work related to recording management will shift to departmental staff.

Cost of Ownership Breakdowns

This is an abbreviated version of this chart. See detail chart at end of report or [click here](#).

Category	Mediasite RL940-R0	Cattura CaptureCast Pro 2U	Winnov Cbox L3/S3	Matrox Monarch LCS	Extron SMP-352
List Price of Appliance as tested	~\$15,000	\$5,495.00	\$2,995	\$2,500	\$6,258
Any Additional Licensing Costs from appliance manufacturer	Yes	No	No	No	Yes
Annual Support Agreement Costs	Recorder Cust. Assur. \$1,950/yr/unit Enterpr. Video Platform Cust. Assur. \$1740/yr(x1)	Each Recorder comes w/ 2 years of support \$295.00 / year / unit after 2 years	Bundled Hardware and Cloud Fleet Mgmt software = \$1,348 for 3 years / unit \$450/unit/yr	No	No
Additional Licensing Costs from Kaltura to Achieve Needed Functionality	Unknown Custom Programming Costs	No	No	No	\$1200 one-time or \$595 annually for scheduling and streaming. None for Publishing
Manufacturer-Recommended Lifecycle plan	4 Years ~\$8,000/unit Refresh trade-in price	4-5 years (figuring 4 yrs for our purposes here)	3 years Winnov has a hardware trade-in program as well	4 years ?	4-5 years
Total Cost of Ownership per Year per Unit	Total ~ \$4,400 / Year / Recorder See Detailed chart or click here for more Info	Total = \$1,521.25 / year / unit (list) + any optional support plan See Detailed chart or click here for more Info	L3 total = \$1,447.66 / year / unit (list) See Detailed chart or click here for more Info	Total = \$625 /year/unit	\$1492 (included Link License at flat fee)

Health Science Departmental Use of Classroom Recording

Department	Recording Platform	Publishing Platform	Schedule + Recording Mgmt	Approx Number of Courses Recorded / Semester	Notes
School of Dentistry	Mediasite	Mediasite	AHC Classroom Svcs	20	Complex schedules and meeting patterns.
College of Veterinary Medicine	Mediasite (CVM owns 3 recorders)	Mediasite	CVM Students + CVM Academic Technologist	40	CVM's three classes each have their own "home" room. Recorder management is closer to what many hardware manufacturers envision, more static scheduling needs.
Medical School Twin Cities	Mediasite	Mediasite	MS-TC Students + MS-TC Academic Technologists	8	MS-TC Students manually manage recordings. If any PHI/HIPAA concerns come up during a class, the students stop or pause the recording while information is discussed
Medical School Duluth	Mediasite (MS-D owns two recorders)	Mediasite	MS-D Academic Technologist		Med School-D captures PP slides and audio only (no video). MS-D Tech Staff were able to leverage the Mediasite API and MS's own LMS "Blackbag" to schedule & post
Neuroscience (undergrad)	Mediasite	Mediasite	AHC Classroom Svcs	4	
School of Nursing	Mediasite, Voicethread, Screencast-O-magic	Mediasite, Kaltura (Canvas)	SoN Online Learning, AHC Classroom Svcs	7	
College of Pharmacy	Tandberg Content Server (TCS)	Google Drive	CoP Academic Technologist	30	Four Year Retention. All core courses are recorded. Most electives are recorded. Most administrative meetings are recorded.
School of Public Health	Captivate, Screencast-o-matic, Kaltura, Webex	Kaltura, Mediasite	SPH eLearning Academic Technologists, AHC Classroom Services		SPH Academic Technologists record about 500 hours a semester of content for online courses and typically manage around 1000 active recorded lectures. AHC CS provides classroom recording support to 2-3 courses a semester as well as to periodic department events and speaker series.
Grand Rounds (Various)	Mediasite	Mediasite	AHC Classroom Svcs		Various Dept. Grand Rounds use Mediasite to live stream & record weekly series to busy participants on the Riverside / other offsite locations

Admin Training	Mediasite	Mediasite	AHC Classroom Svcs		AHC Administrative units have recorded in-person training sessions on new policies, procedures and training.
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