

MATTERHORN

Open Source Lecture Capture, Processing & Distribution
From your friends at the Opencast Project



Image copyright [Found in Love](#)

OPENCAST VS. MATTERHORN

- Community started in 2008
- Matterhorn development started in July 2009
- 1.0 delivered August 2010
- 1.1 delivered April 2011
- 1.2 RC1 this week

SPOILER ALERT!

- I. Double Feature
- II. Lights, Camera, Action
- III. Post Production
- IV. The Sequel

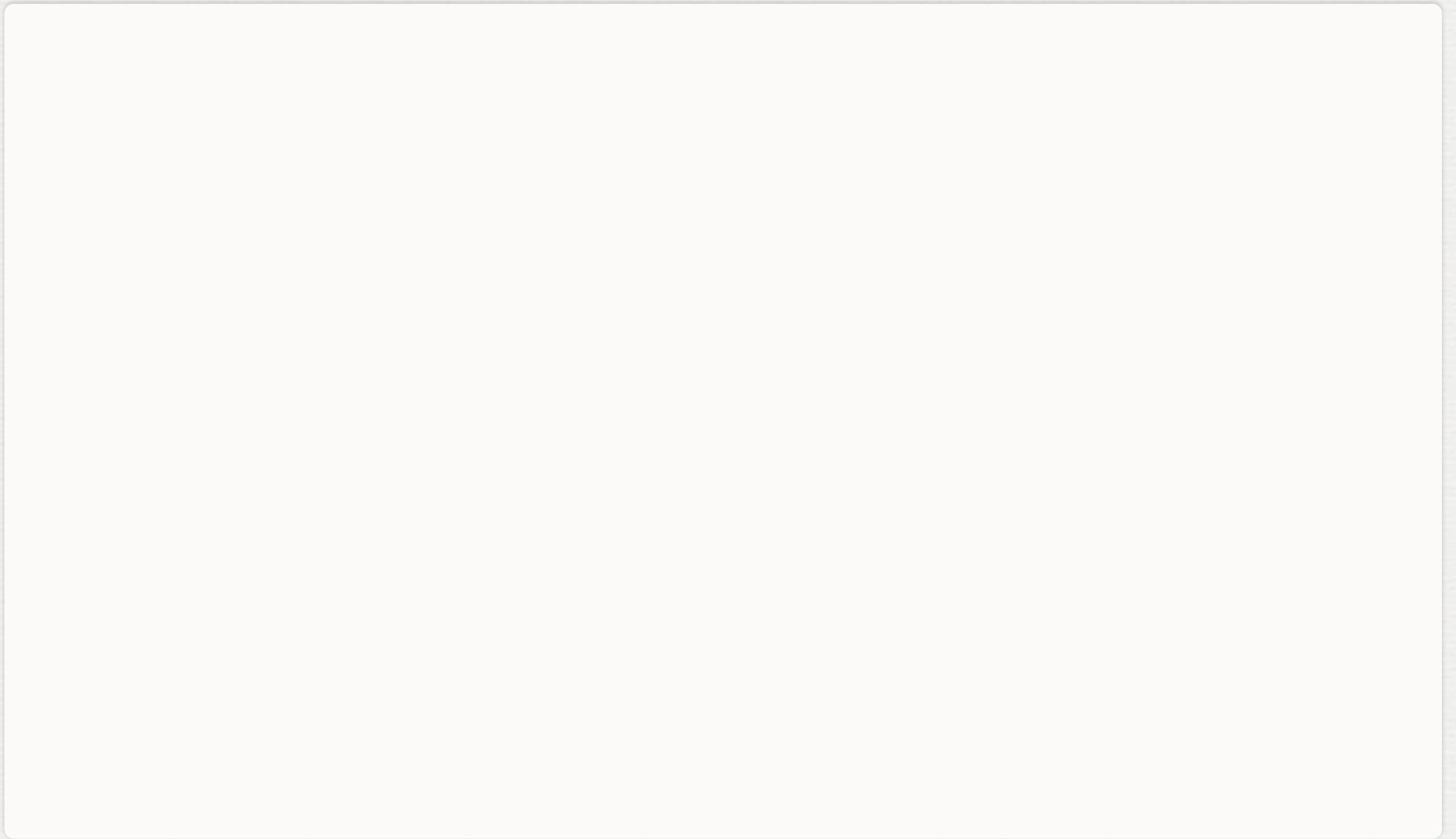
I. What does Matterhorn do?

II. Anatomy of an installation. Devices, servers, filesystems, databases, etc.

III. Campus integration

IV. What's next for Matterhorn: features, community, etc.

DOUBLE FEATURE (CAPTURE)



Thursday, May 26, 2011

4

What are the features of a lecture capture system? First, we need to capture lectures. Matterhorn does a whole lot more than just lecture capture, but that's where everything starts: capturing the content.

Matterhorn captures inputs from a variety of sources. A typical setup includes camera, microphone, and vga. We've tested a number of hardware components, and more are being added in each release.

The ability to capture from multiple sources is one of the key differentiators for Matterhorn. There are software-only solutions in the market that handle screencast, but having a dedicated hardware appliance in classrooms gives much more flexibility and capability. In the end, the capture of all of these resources is what will enable richer learning environments.

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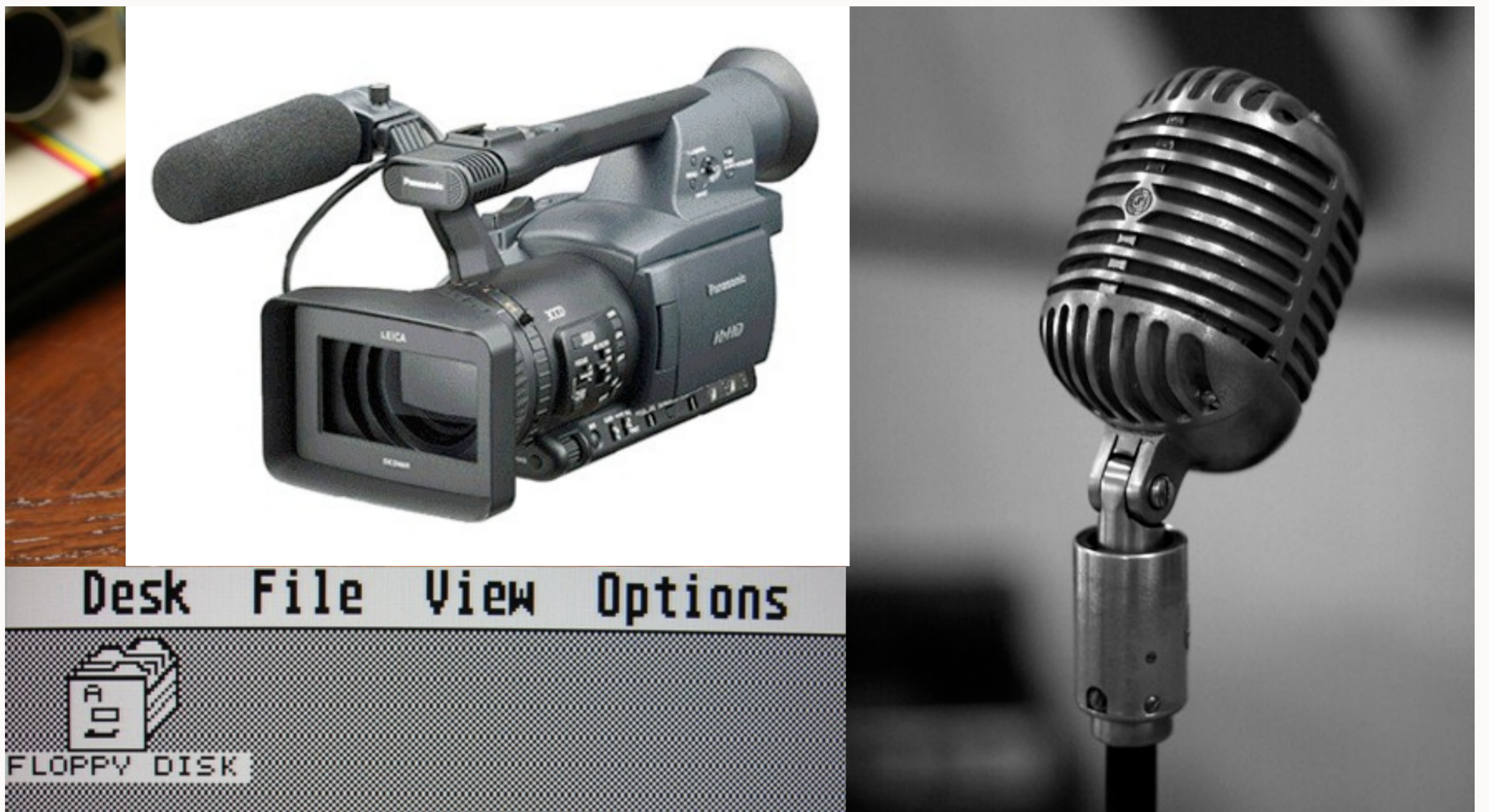
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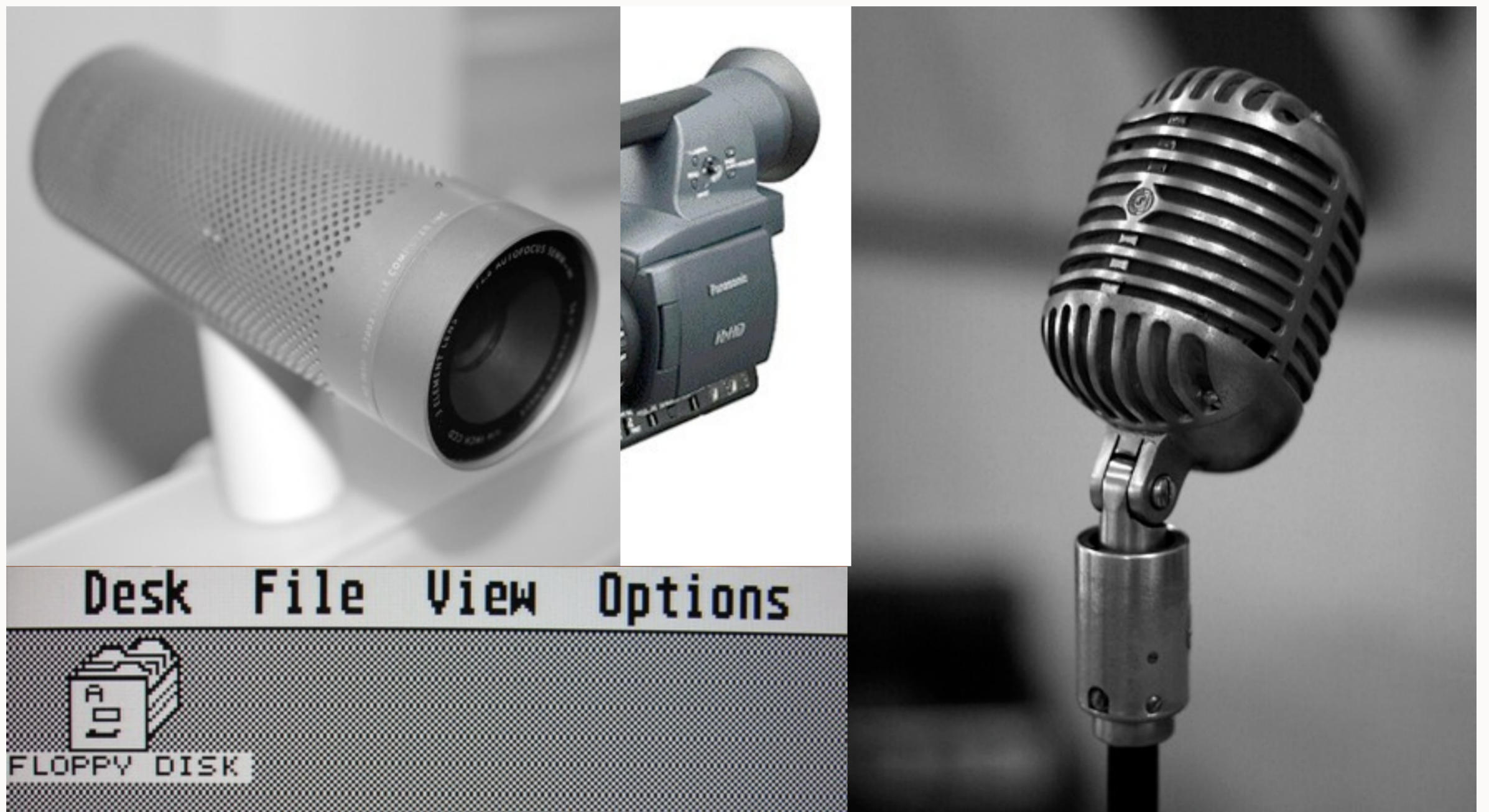
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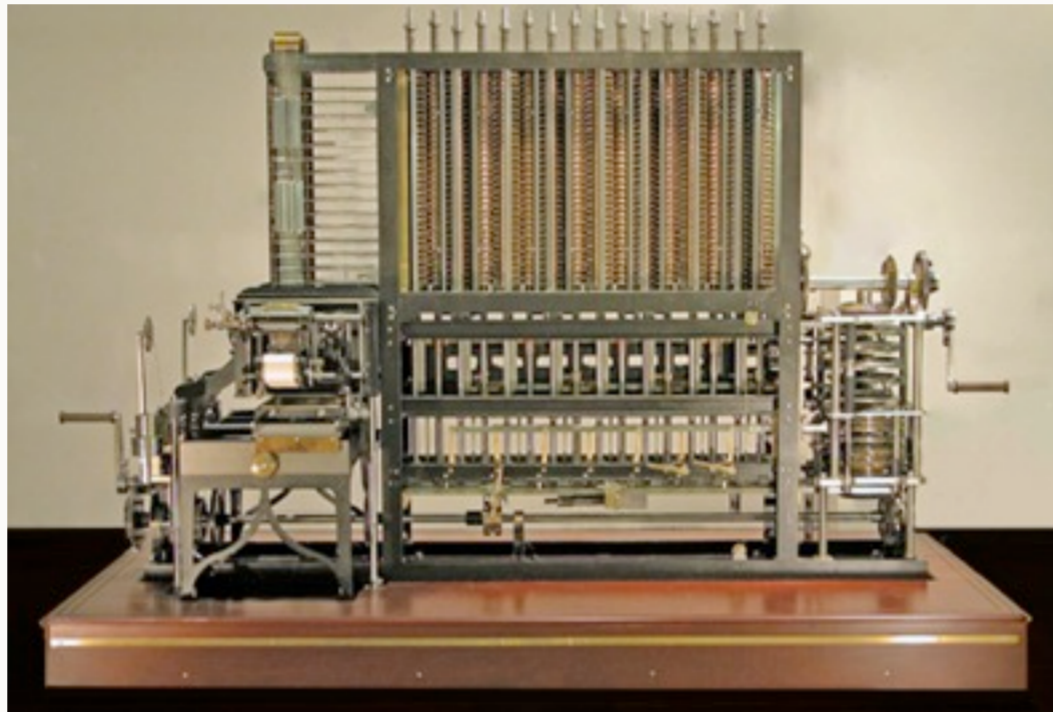


Image courtesy of Computer History Museum

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5

Matterhorn's processing servers, what we typically call "workers", crank out the usual suspects: H264, Flash video, VP8, etc. The real value comes in the analysis services. [explain slide segmentation and text extraction]

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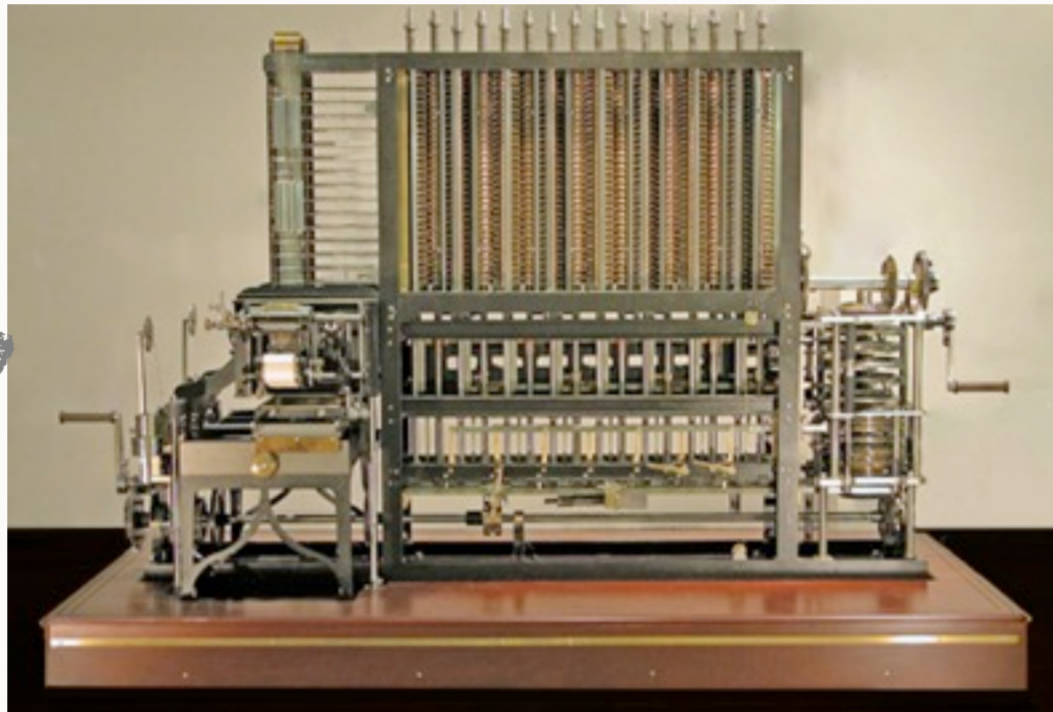


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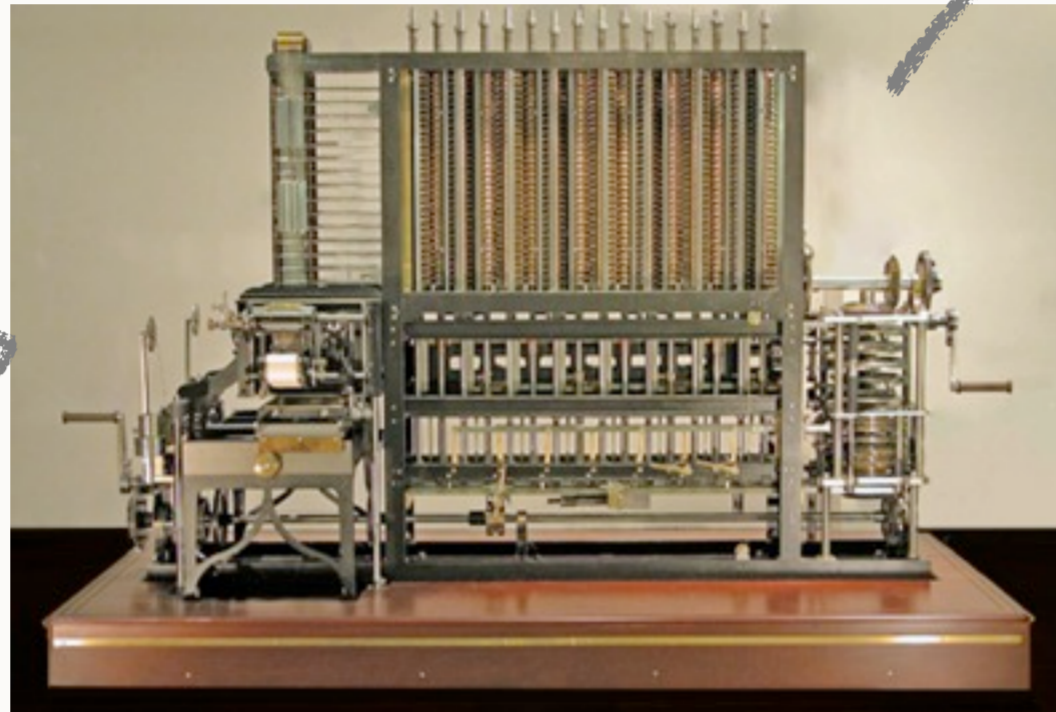


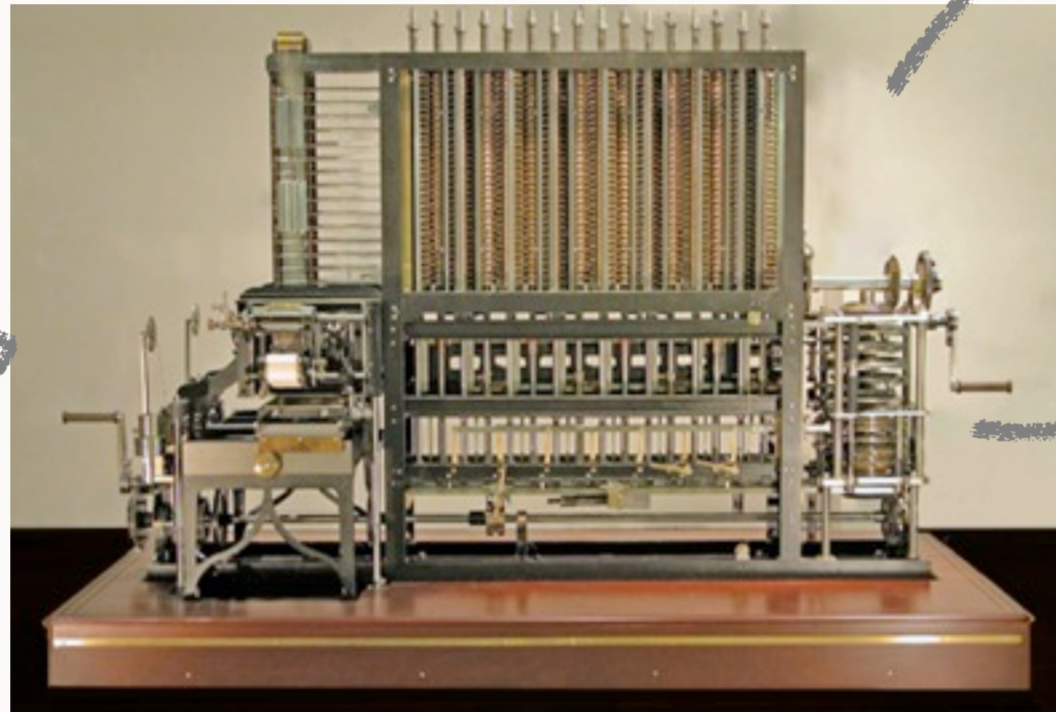
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webm

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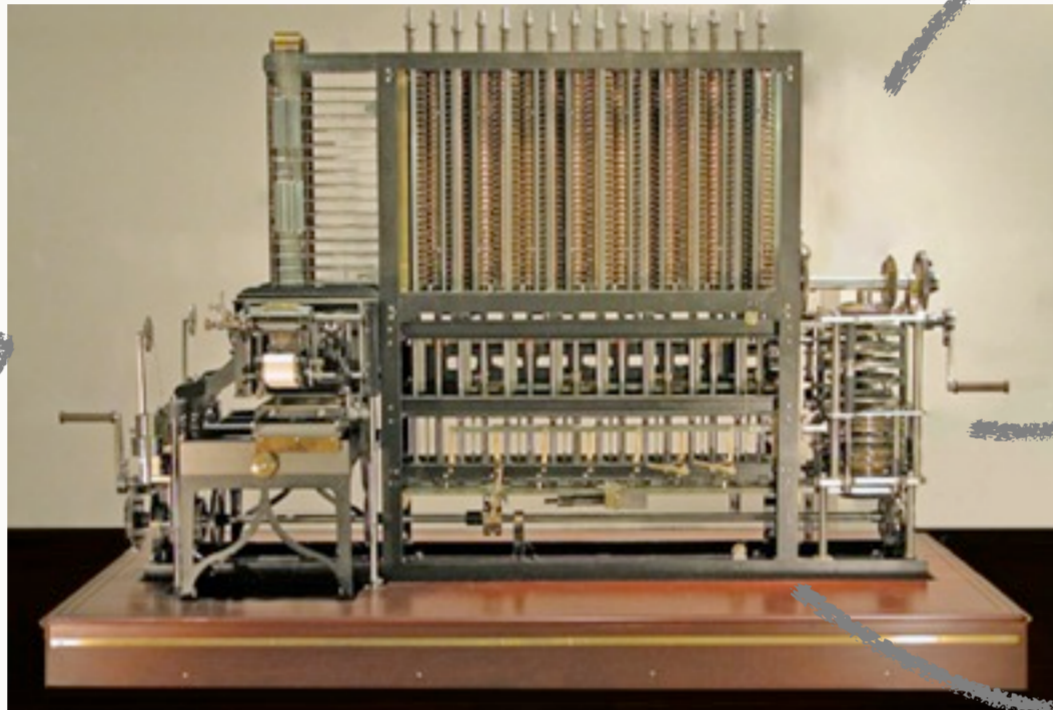


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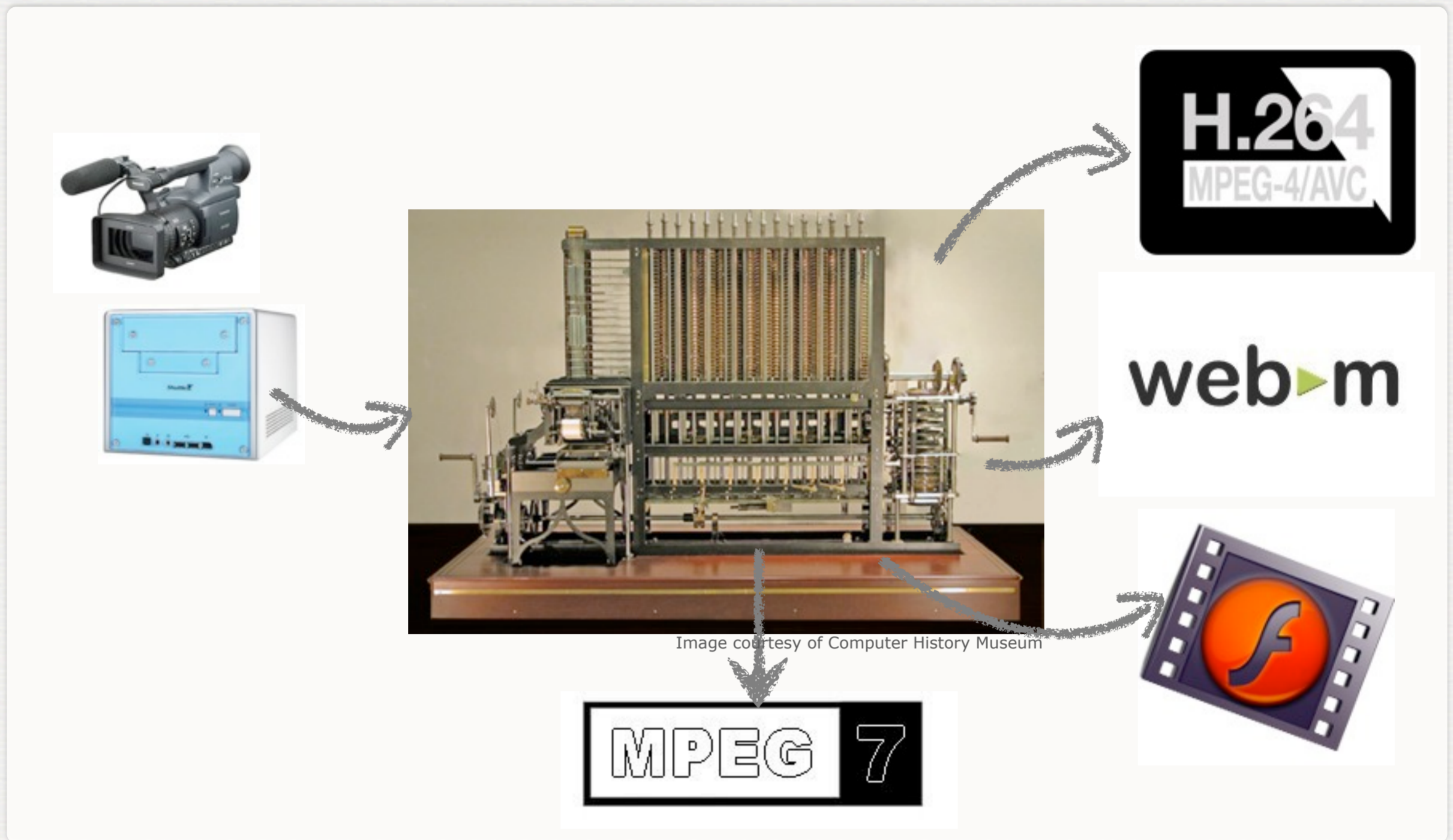


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DOUBLE FEATURE (DISTRIBUTION)

- Progressive Download



- RTMP Streaming



- 3rd Party Channels



We distribute videos with an embedded jetty server, but there are a lot of great products out there for progressive download and streaming. Rather than reinvent these, we leverage those products: lighttpd for pseudo-streaming, red5 for open source RTMP, wowza if you want to go with a commercial product. YouTube and iTunes are primitive in 1.0, will be more full-featured in 1.3.

DOUBLE FEATURE (ENGAGE)

- Hybrid Flash + JavaScript player
- Search
- In-video search

I mentioned extracting metadata and storing it in mpeg7 catalogs earlier. This is where it really comes in useful: we can search using both static metadata (e.g. title) and time-based metadata.

DOUBLE FEATURE

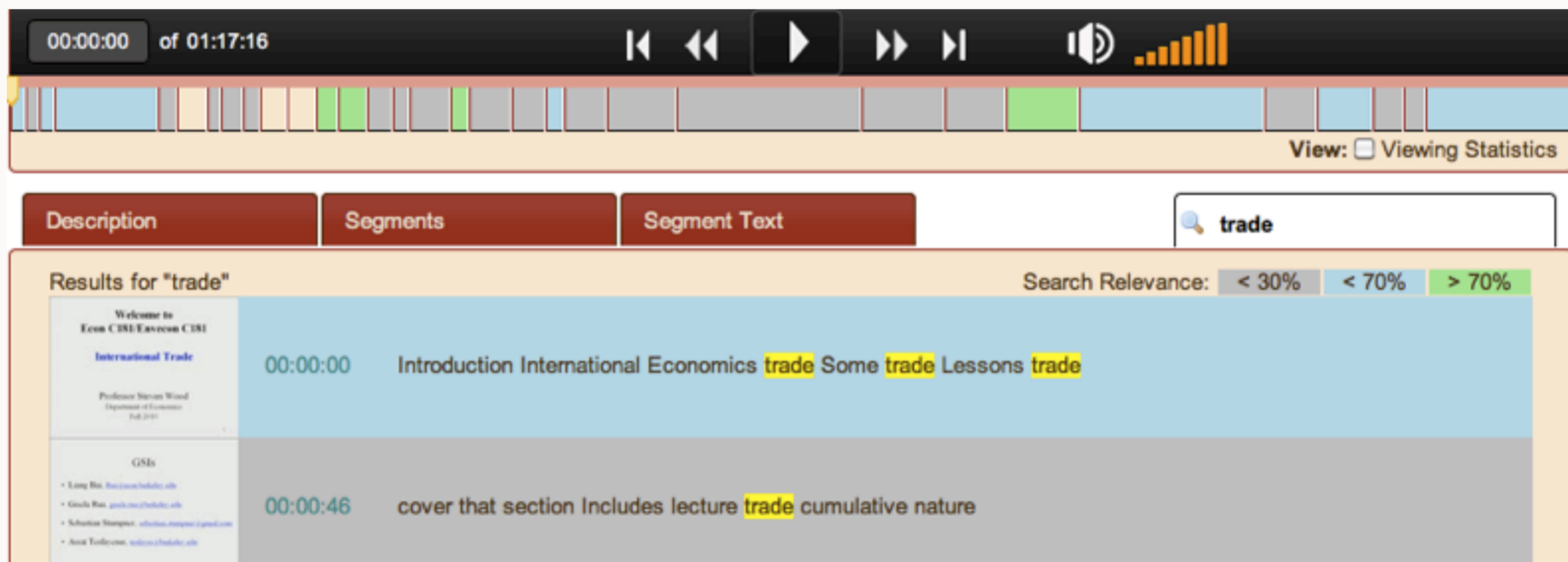
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DOUBLE FEATURE (ENGAGE)

- Hybrid Flash + JavaScript player
- Search 
- In-video search



The screenshot displays a video player interface with a search overlay. The video player shows a progress bar at the top with a time of 00:00:00 of 01:17:16. Below the player, there are three tabs: "Description", "Segments", and "Segment Text". A search bar on the right contains the word "trade". The search results are displayed in a table with columns for "Description", "Segments", and "Segment Text". The results are filtered by "Search Relevance" with options for "< 30%", "< 70%", and "> 70%".

Description	Segments	Segment Text
Results for "trade"		Search Relevance: < 30% < 70% > 70%
Welcome to Econ CISE/Econ CISE International Trade Professor Steven Wood Department of Economics Fall 2011	00:00:00	Introduction International Economics trade Some trade Lessons trade
GISs • Long Bin, bin@econ.berkeley.edu • Guido Ros, ros@econ.berkeley.edu • Sebastian Strumpf, strumpf@econ.berkeley.edu • Avner Trefler, trefler@econ.berkeley.edu	00:00:46	cover that section Includes lecture trade cumulative nature

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DOUBLE FEATURE (ENGAGE)

- Hybrid Flash + JavaScript player

- Search

words extracted from video

- In-video search

00:00:00 of 01:17:16

View: Viewing Statistics

Description	Segments	Segment Text
Results for "trade" Search Relevance: < 30% < 70% > 70%		
Welcome to Econ CISE/Economic CISE International Trade Professor Steven Wood Department of Economics Fall 2011	00:00:00	Introduction International Economics trade Some trade Lessons trade
GISs • Long Run: http://econ.chadwick.edu • Growth Run: http://econ.chadwick.edu • Short-run Stages: http://econ.chadwick.edu • Asset Allocation: http://econ.chadwick.edu	00:00:46	cover that section Includes lecture trade cumulative nature

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DOUBLE FEATURE (TECHNOLOGIES)

- Services oriented: RESTful XML and JSON servoces
- Open Standards
 - Dublin Core
 - iCalendar
 - Mpeg-7
 - XACML
- Modular: OSGI
- Scalable

The mediapackages that Matterhorn produces are documents pointing to media files, metadata catalogs, and attachments. Each have a type: DC for the episode, DC for the series, XACML defining the access rules for this mediapackage, etc.

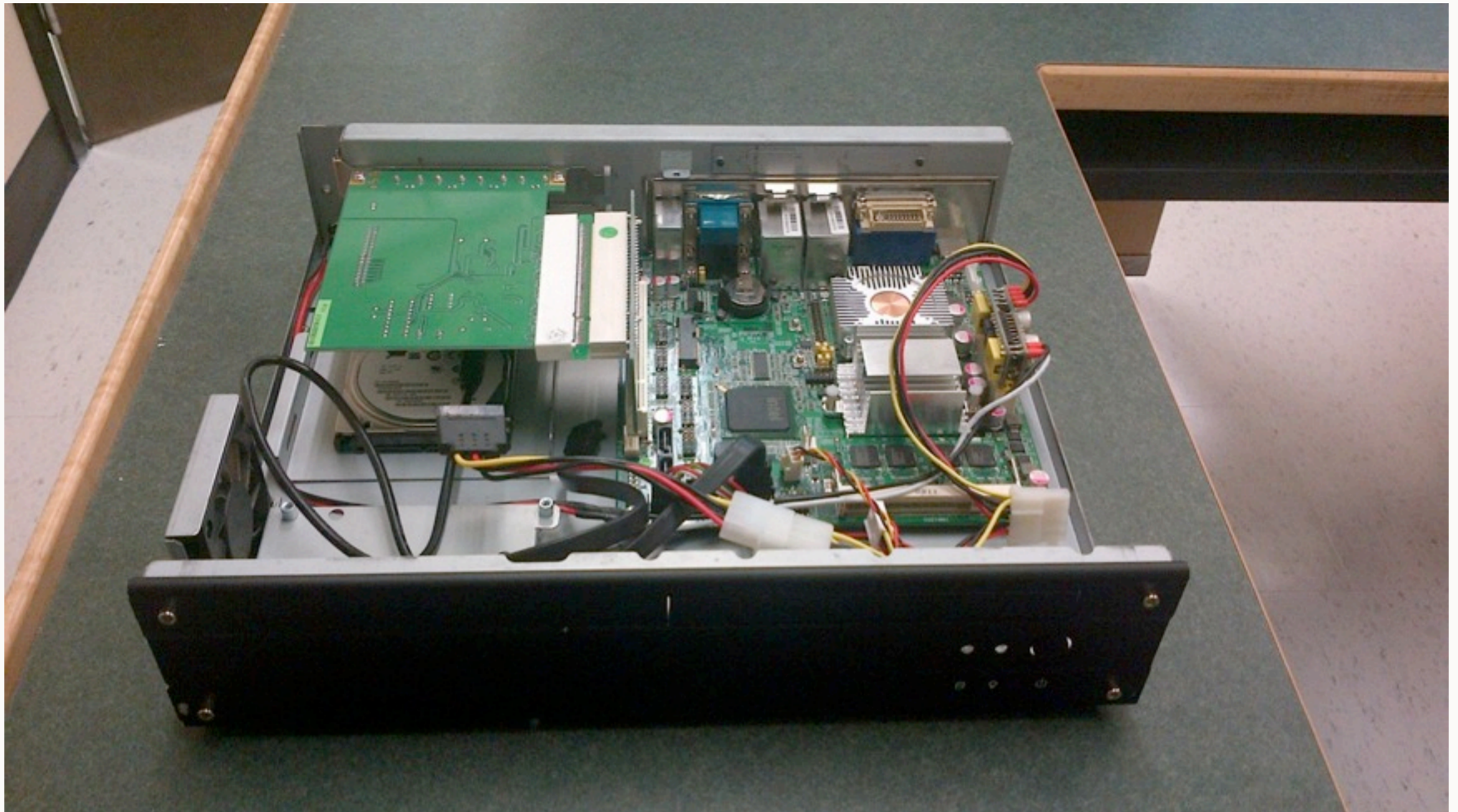
LIGHTS, CAMERA, ACTION (CAPTURE)



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The reference hardware for a Matterhorn capture agent.

LIGHTS, CAMERA, ACTION (CAPTURE)



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The first step is to put together a capture agent. We have a recommended build available on our wiki including a case that is sized to fit in audio racks. It runs laptop parts to survive the heat that exists inside most audio cabinets at post-secondary institutions. The beefier the machine the more options you have for how you record your media. The capture agent runs ubuntu and supports a variety devices both inside and outside the case. Capture devices such as VGA frame grabbers, DVI frame grabbers, NTSC and PAL standard def capture cards. Theoretically anything that is supported by Ubuntu and Gstreamer is possible although the more you get away from the standard build, the more gstreamer knowledge you will need.

LIGHTS, CAMERA, ACTION (CAPTURE)



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The great aspect to this is that you can customize the hardware required for each individual room. Have two projectors? Several Cameras? Piles of boxes lying around begging to be used? All of these are possible.

LIGHTS, CAMERA, ACTION (CAPTURE)



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Here's one at UC Berkeley, attached to a VGA2USB.

LIGHTS, CAMERA, ACTION (CAPTURE)



LIGHTS, CAMERA, ACTION (CAPTURE)

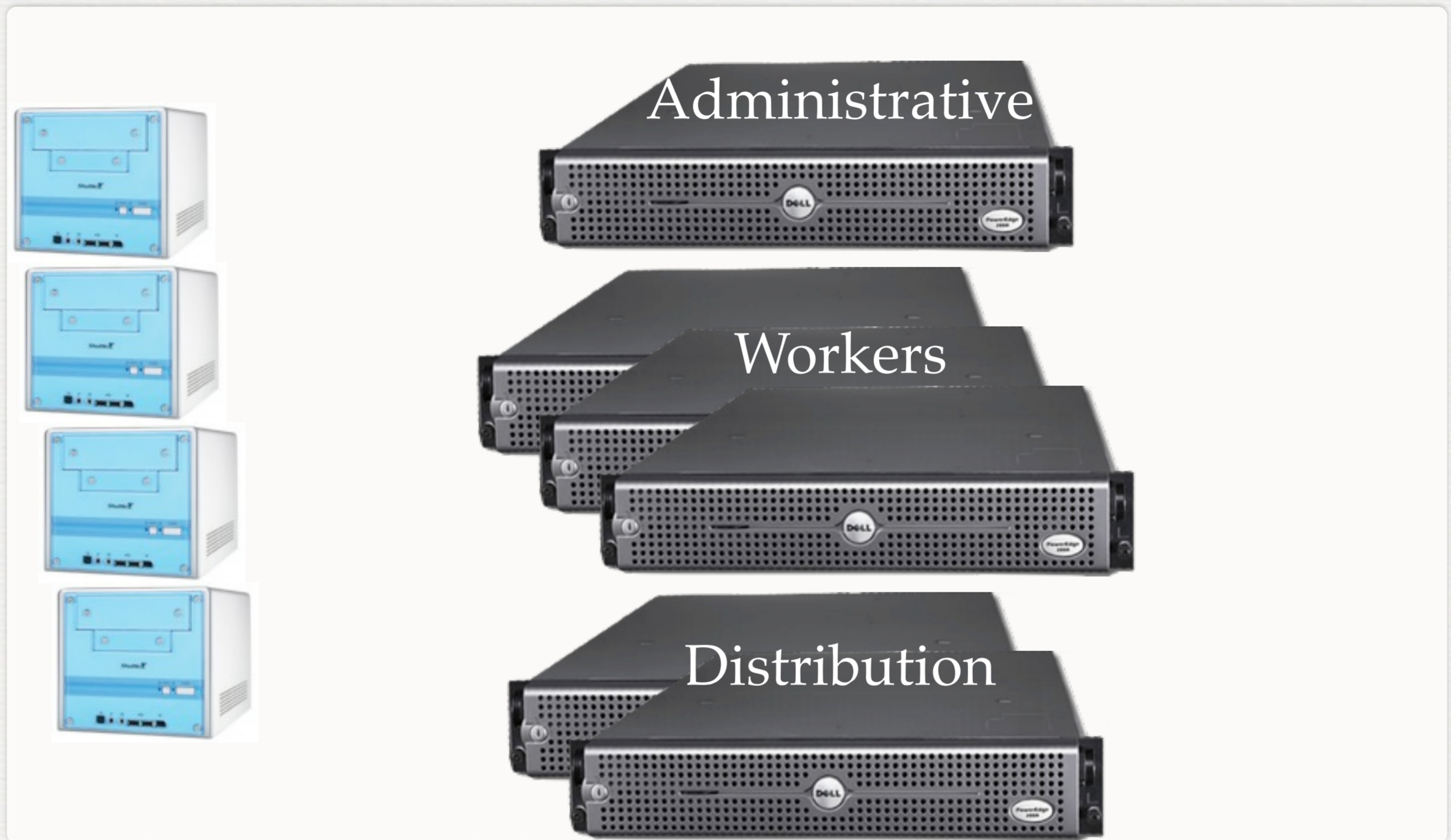


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A mobile capture cart at University of Nebraska, Lincoln.

LIGHTS, CAMERA, ACTION



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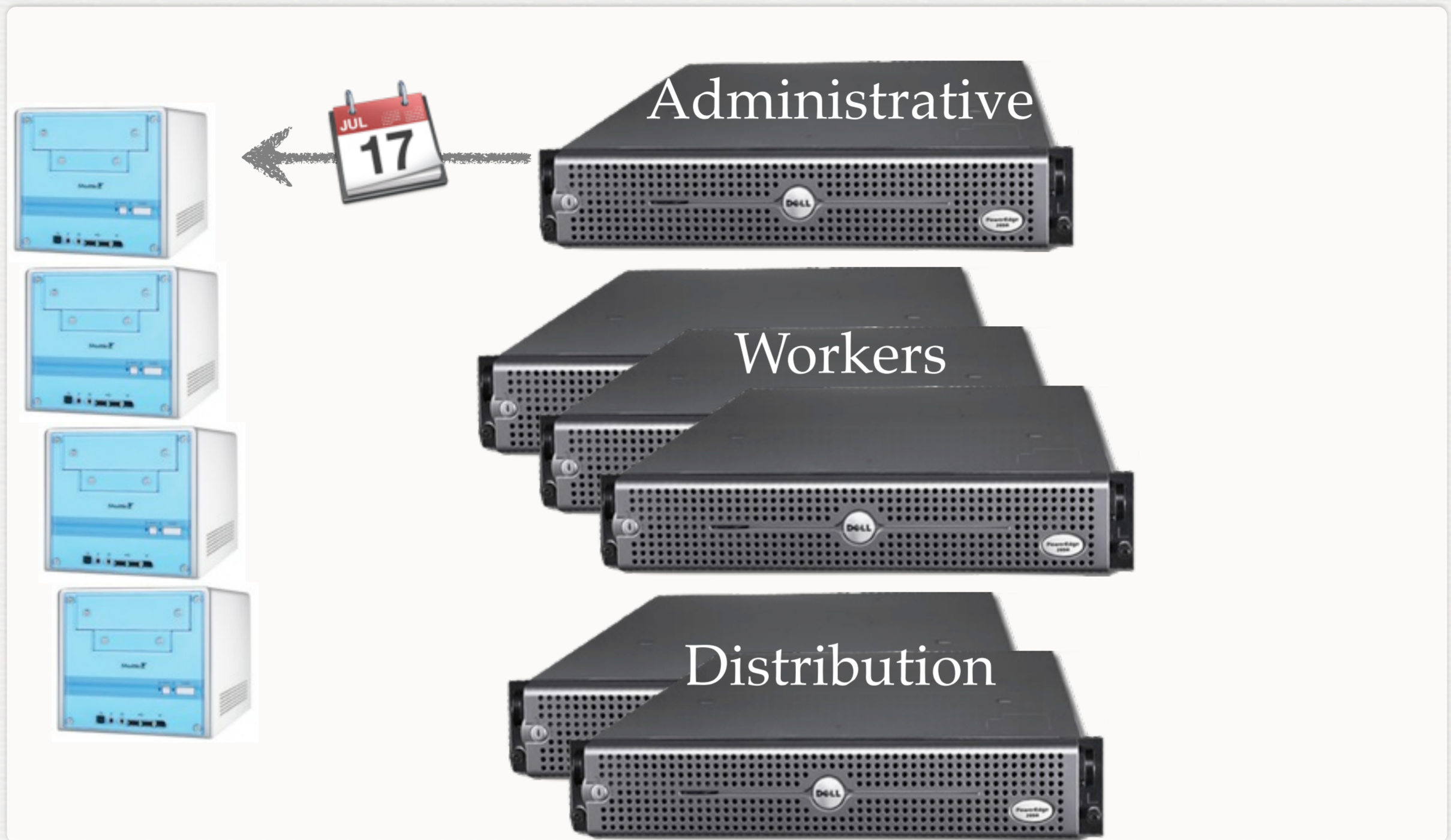
Notes from Josh: Matterhorn is very modular, so different components can be installed on different devices. In fact, the servers used to schedule the devices here are located in Nebraska. The devices will be uploading the content later to the same server for processing and distribution. We don't want to saturate the local network, so we're leaving the devices offline during the conference.

Notes from Adam:

1) After the capture agent has been installed in the lecture halls then you need to setup the backend distribution. Matterhorn is very modular so different components can be installed on different machines. The coordinator of all of these is the the administrative module.

2) First of all the events are scheduled on the administrative end. This sends a calendar to the capture agent who caches it in case the network goes down.

LIGHTS, CAMERA, ACTION



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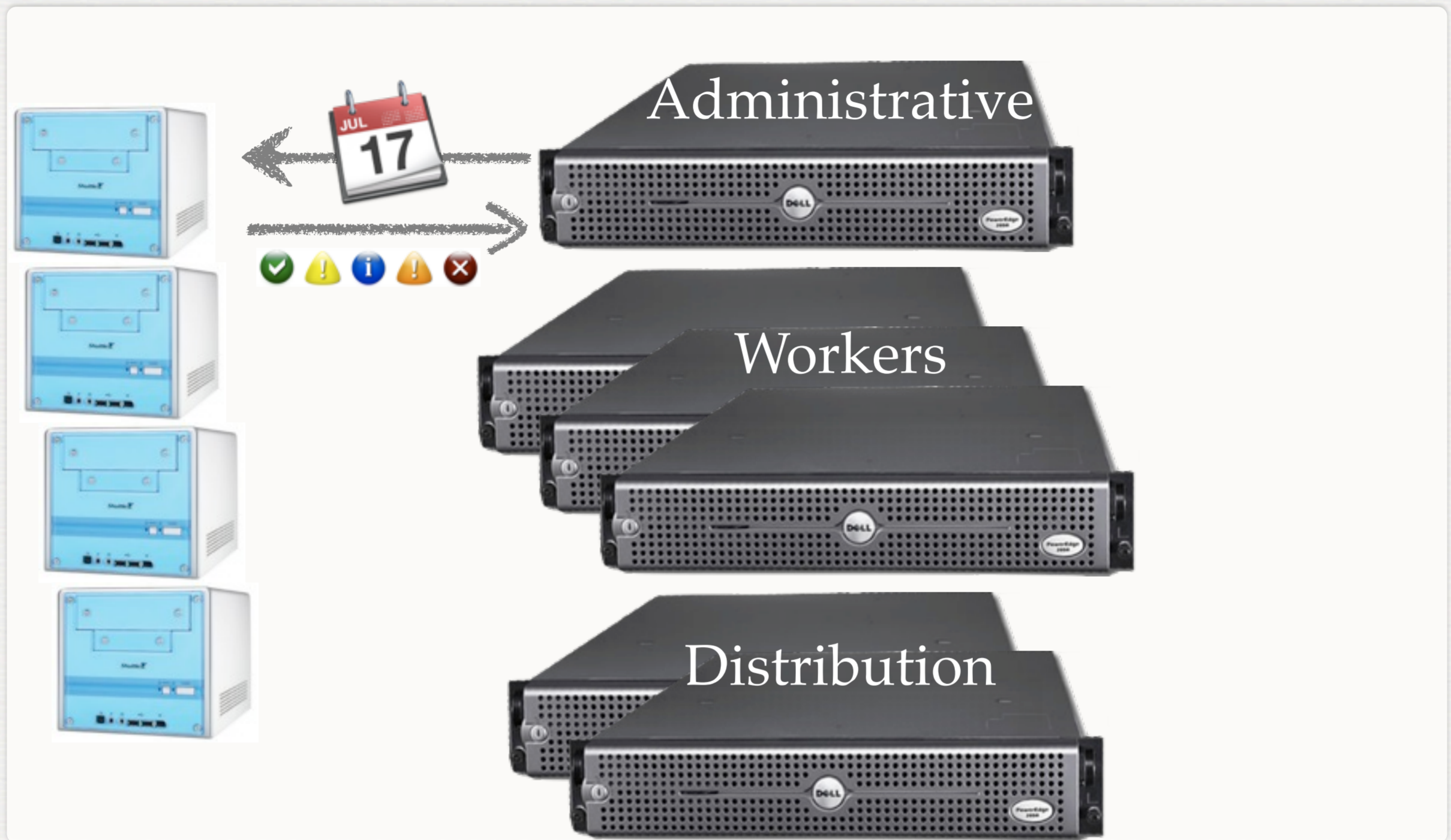
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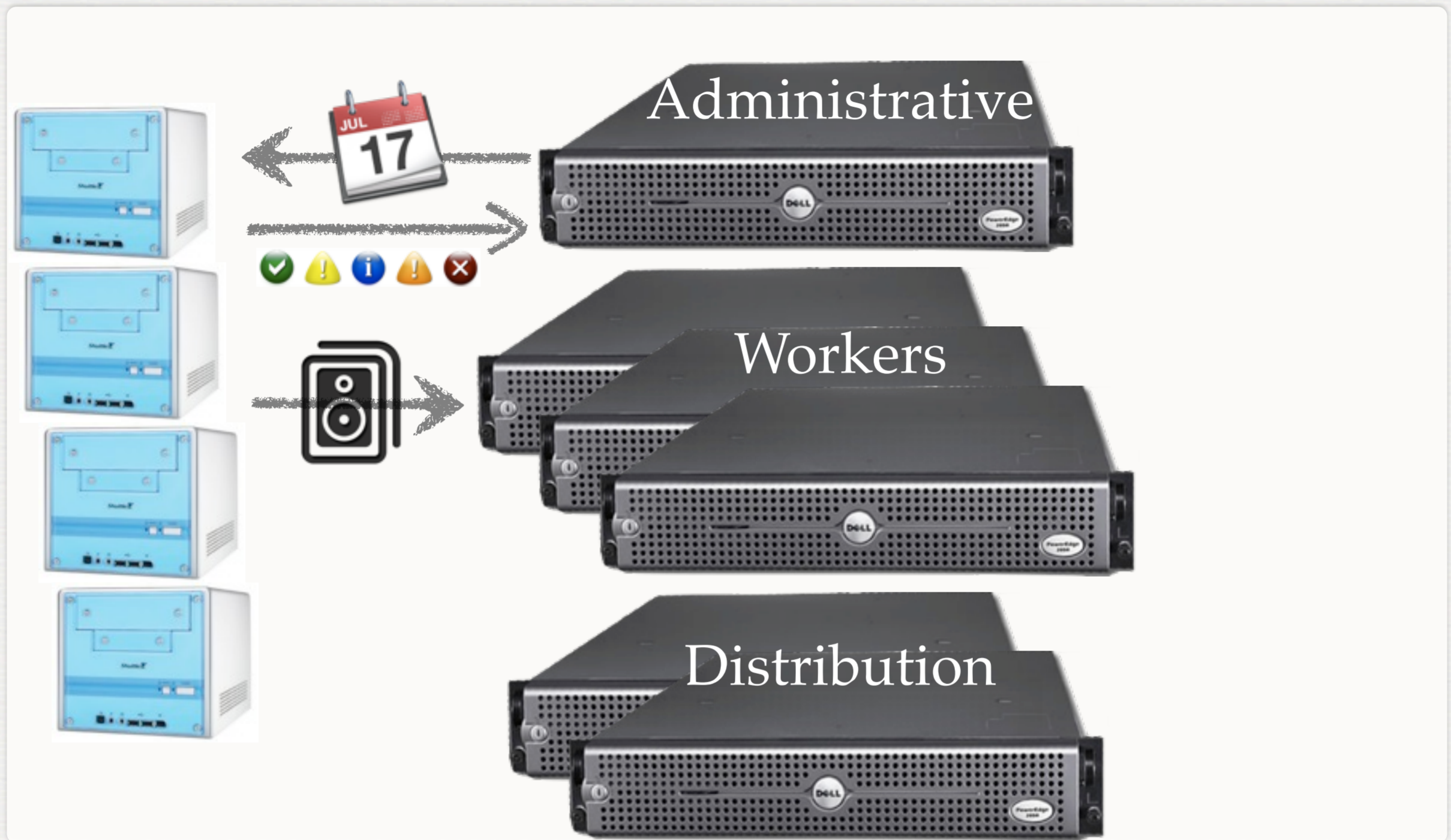
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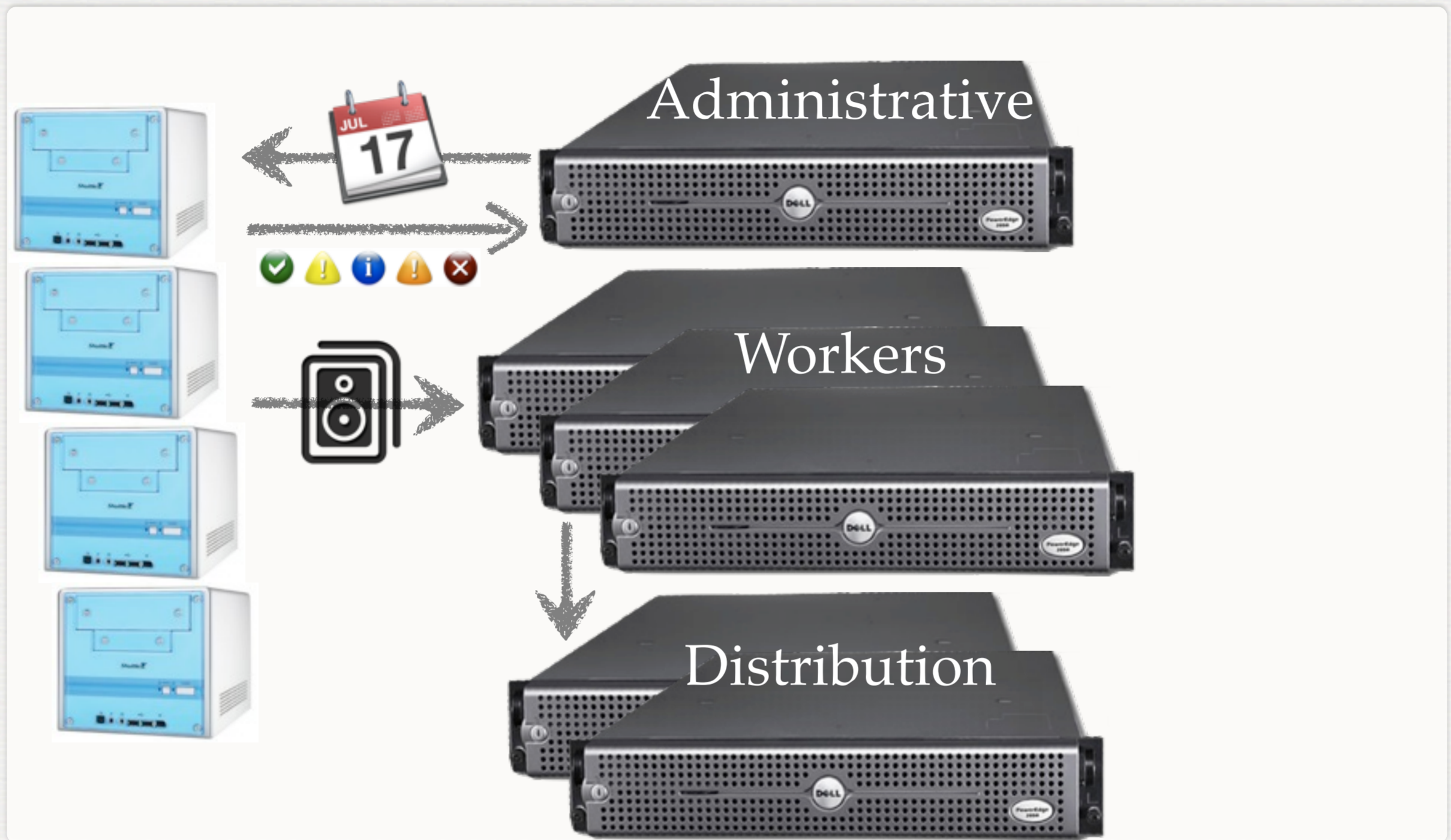
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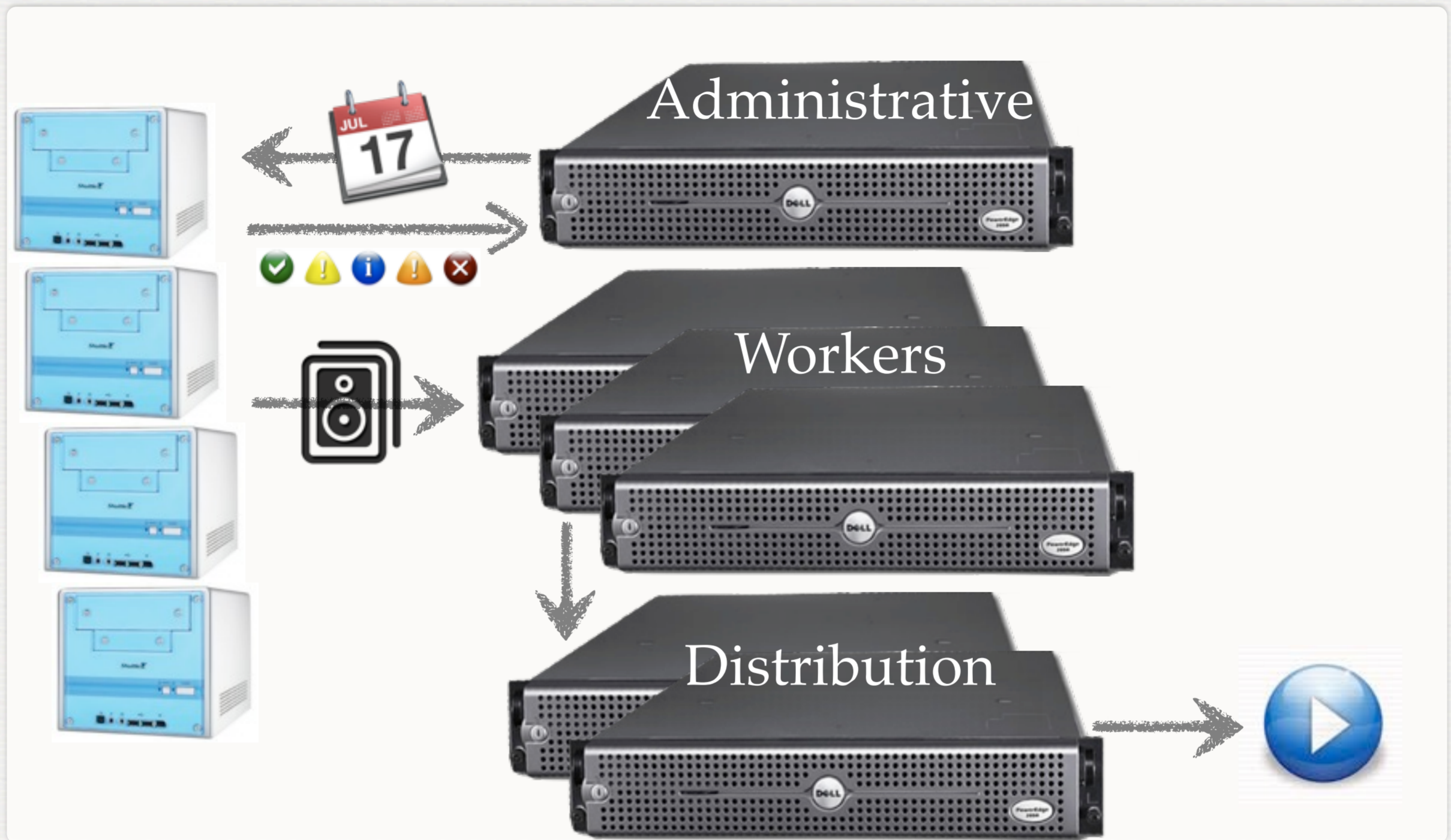
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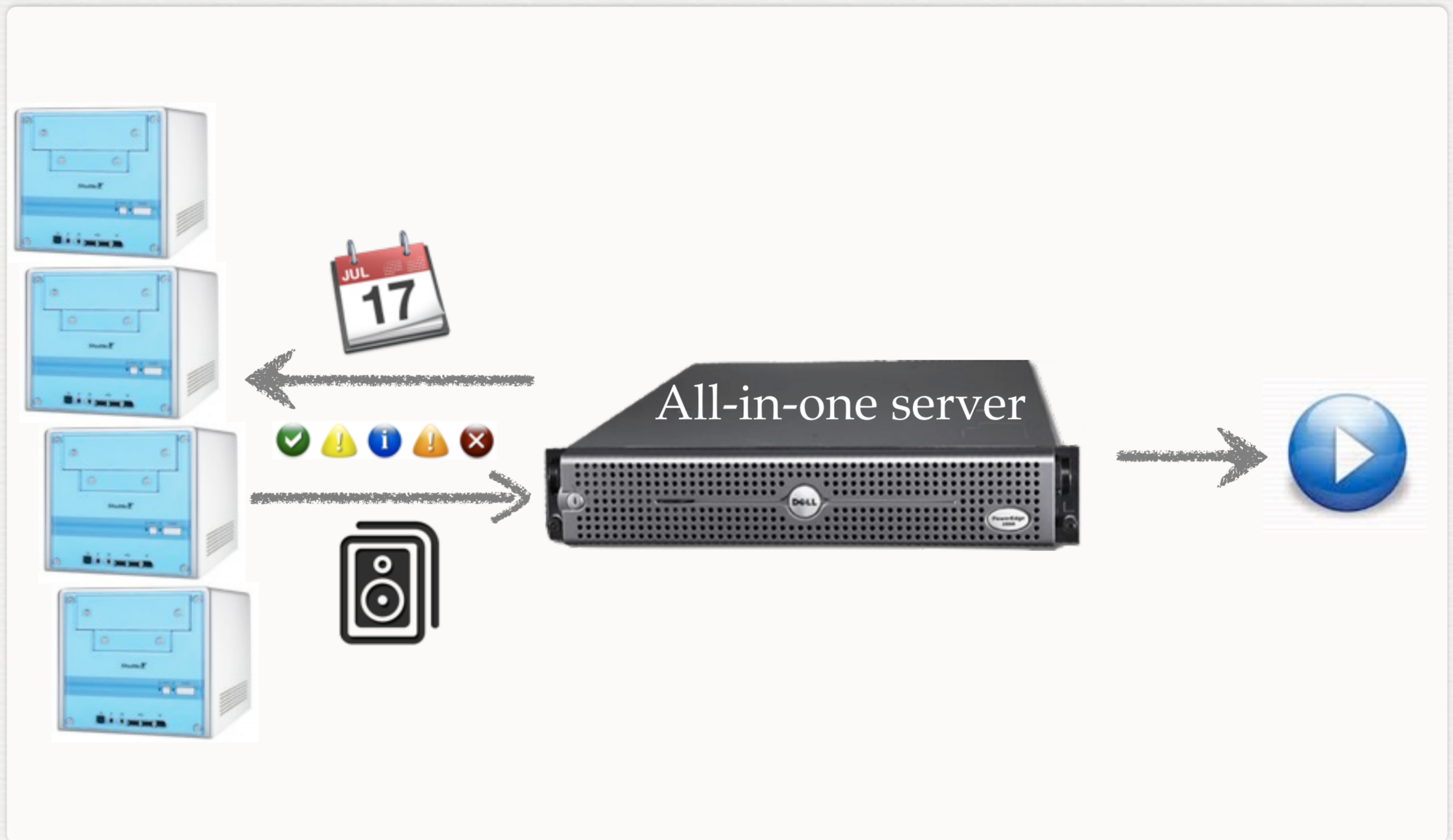
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LIGHTS, CAMERA, ACTION



Josh: Or if you prefer, just install each Matternorn module on one server.

Adam: If you prefer you can run all of these matterhorn modules on a single server.

LIGHTS, CAMERA, ACTION



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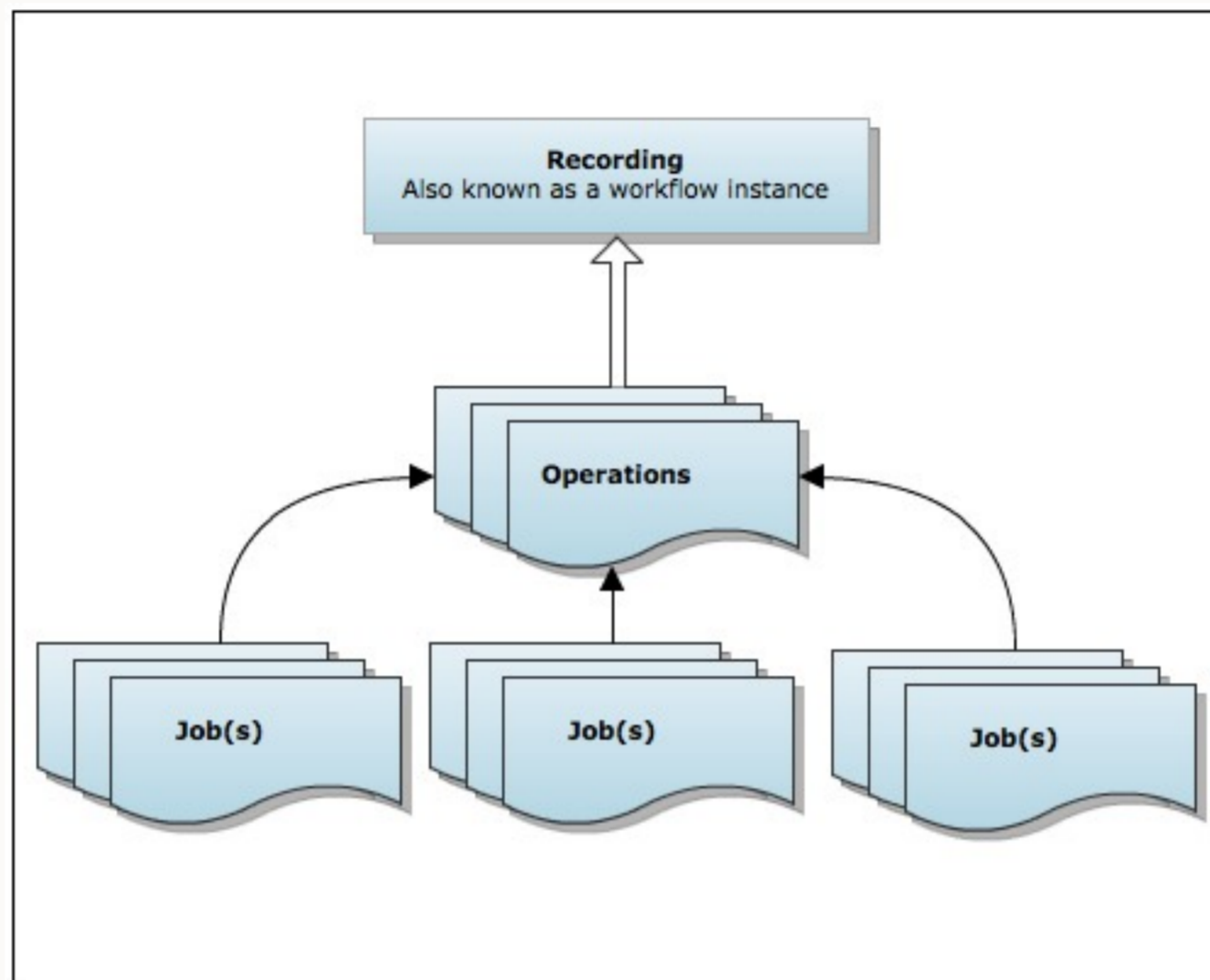
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Josh: Or just plug your camera, audio, and/or vga sources directly into an all-in-one installation, and you're ready to go

Adam: You can take it one step further and attach your capture devices directly to the all in one server and have everything done in one place.

LIGHTS, CAMERA, ACTION (PROCESSING)

- Workflow: configurable processing instructions



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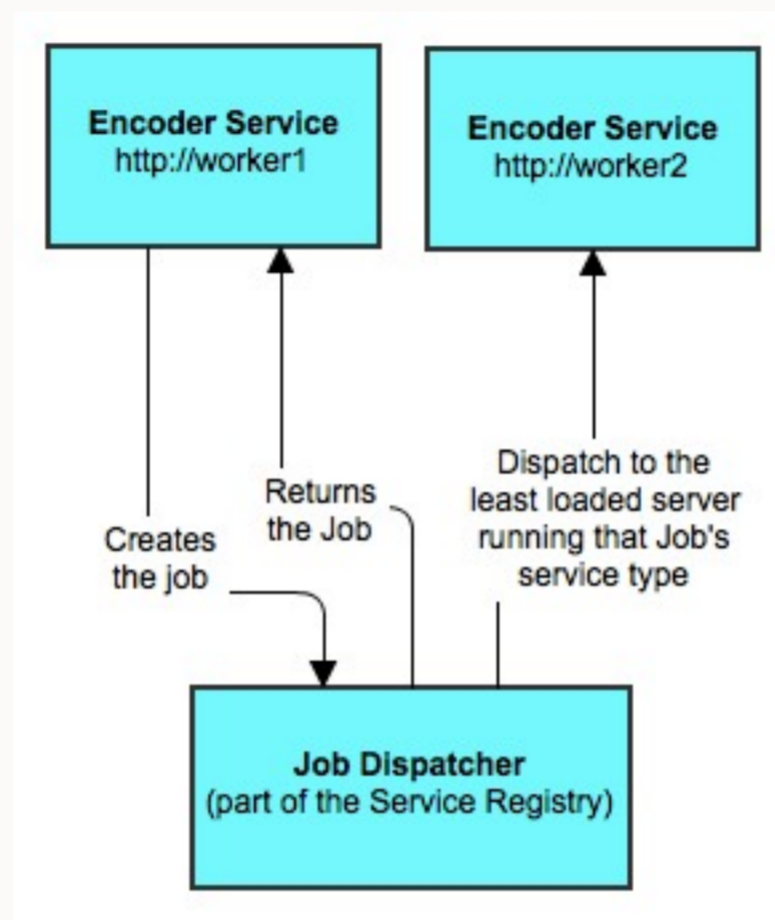
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Josh: Each processing workflow is made up of distinct operations, and each operation is broken up into jobs. For instance, text analysis requires that we produce images for each segment of the video. So we first produce the images, then run OCR on each image, then collect all of that into a single mpeg7 catalog.

Adam: Each recording, also known as a workflow instance, is processed by customizable jobs.

LIGHTS, CAMERA, ACTION (PROCESSING)

- Jobs are load balanced among servers



- Jobs can be transferred from one server to another

Josh: By splitting up these individual steps (again, all within the text analysis operation), we gain parallelization, load balancing, and failover. Here's how these long running operations in Matterhorn look: When a service is asked to perform an action (here, it's "encode"), the service simply stores all of the details of the request in a job. The job is then dispatched to the server most ready to handle it. The client can then use the job to poll for updates on the status of the job.

Adam: For each of the jobs the administrator decides which worker is the least loaded and sends the new jobs to it.

POST PRODUCTION (SECURITY)

- Spring security: very configurable

```
<!-- Enable anonymous access to the engage player and the GET endpoints it requires -->  
<sec:intercept-url pattern='/engage/ui/**' access='ROLE_ANONYMOUS, ROLE_USER' />  
<sec:intercept-url pattern='/search/**' method="GET" access='ROLE_ANONYMOUS, ROLE_USER' />
```

- JPA and LDAP user and role providers
- CAS, OpenID, OAuth support

The security configuration in Matterhorn is very flexible. You can define which roles are allowed to perform which HTTP verbs at which URLs. You can also plug in your own user and role providers, and even enable single sign on, open ID, and oauth access to resources.

POST PRODUCTION (ENCODING, FEEDS, WORKFLOW)

- Add feeds for custom search queries at runtime

```
feed.uri=subject  
feed.query=dc_subject:{0}
```

- Customize encoding profiles

```
flash-hd = -strict inofficial -i #{in.video.path} -r 25 -vcodec flv -qscale 3 -deinterlace -s  
1280x720 -acodec libmp3lame -ab 128k -ar 44100 #{out.dir}/ #{out.name}#{out.suffix}
```

- Customize workflows

Feeds can be added or removed any time, even when the system is running. Feeds are generated dynamically from the Matterhorn search service, so you can create a feed for any possible solr expression.

Encoding profiles can also be changed, again at runtime. These are currently ffmpeg commands with a few variables.

And we've seen how workflows can be customized for your business processes, too.

LIGHTS, CAMERA, ACTION (PROCESSING)

- Workflow: configurable processing instructions

```
<definition>
  <id>full</id>
  <operations>
    <operation id="inspect" />
    <operation id="compose" if="{trimHold}">
      <configurations>
        <configuration key="encoding-profile">
          flash-preview.http
        </configuration>
      </configurations>
    </operation>
    ...
```

Josh: Workflows can be customized to meet your needs. Here, we conditionally encode a preview file. If the administrator chose not to “hold” the workflow to enter trim points when scheduling or uploading the video, there’s no need for a preview, so we skip this step and reduce the processing time.

Adam: You can customize how each processing job is run by either customizing xml or developing some simple java classes. In this example the media is inspected first to make sure it is appropriate for processing. Then if the user specifies the variable trimhold for this particular recording when the media is ready to be processed it waits for a user to use the UI to trim the media to the appropriate content and then mark it ready for processing. Finally the type of processing will be a flash preview low bandwidth media that will be created from the input.

POST PRODUCTION (REMIX)

Services Documentation

- Annotation REST Endpoint Docs
- Caption REST Endpoint Docs
- Capture Agent Admin REST Endpoint Docs
- Capture REST Endpoint Docs
- Composer REST Endpoint Docs
- Confidence Monitoring REST Endpoint Docs
- Download Distribution REST Endpoint Docs
- Ingest REST Endpoint Docs
- Media Inspection REST Endpoint Docs
- Organization listing REST endpoint Docs
- Role listing REST endpoint Docs
- Runtime Information REST Endpoint Docs
- Scheduler REST Endpoint Docs
- Search REST Endpoint Docs
- Series REST Endpoint Docs
- Service Registry REST Endpoint Docs
- State REST Endpoint Docs
- Streaming Distribution REST Endpoint Docs
- Text Analysis REST Endpoint Docs
- User Tracking REST Endpoint Docs
- Video Segmentation REST Endpoint Docs
- Workflow REST Endpoint Docs
- Working File Repository REST Endpoint Docs

Composer REST Documentation

/composer/ffmpeg

This service creates and augments Matterhorn media packages that include media tracks, metadata catalogs and attachments.

Read methods

NAME	VALUE and NOTES
Method / Path:	GET /profiles.xml
Description:	Retrieve the encoding profiles
Path params:	NONE
Optional (query) params:	NONE
Response formats:	text/xml
Status codes:	200: OK, Results in an xml document describing the available encoding profiles
Returned Entity Schema:	Click to view
Testing:	Sample: /profiles.xml /composer/ffmpeg/profiles.xml

NAME	VALUE and NOTES
Method / Path:	GET /profile/{id}.xml
Description:	Retrieve an encoding profile
Path params:	id: the profile ID
Optional (query) params:	NONE
Response formats:	text/xml
Status codes:	200: OK, Results in an xml document describing the requested encoding profile
Testing:	Sample: /profile/{id}.xml Testing form (click to reveal)

If you want to use data managed my Matterhorn elsewhere, you can get everything from its RESTful services. Alternatively, if you want to populate Matterhorn with data from elsewhere (a common use case is with series, or schedules), you can use the REST services for that as well. In order to make these tasks easier, Matterhorn includes a full developer documentation library, complete with testing forms to GET, PUT, POST, and DELETE data to/from Matterhorn.

THE SEQUEL

- Governance transition

- More hardware support

Webcams, PCI cards, dedicated capture devices

- Fine grained authorization

Lock individual workflow instances and operations

- Multitenancy

Run one instance for many institutions

CREDITS

- Opencast site: <http://www.opencast.org>
- Mailing lists: <http://lists.opencastproject.org>
- IRC: [#opencast](irc://irc.freenode.net)

Josh Holtzman <jholtzman@berkeley.edu>
Adam Mckenzie <akm220@mail.usask.ca>
Micah Sutton <msutton3@unl.edu>

QUESTIONS

