Technology Mythology

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Presentation Overview

- Essential take-aways
- Reference, Genlock & Timing
- A/V synchronization (lip-sync)
- Equipment power

Some typical racks of analog equipment (Smithsonian Archives, DC)

Essential Take-aways

Media archivists work with equipment and formats originally designed for specific commercial purposes.

Equipment behaves the way it does because of its original purpose--little thought was given to archiving.

In particular, professional tape formats evolved for use in production, post and delivery.

Consumer tape formats were designed for acceptable quality, relative simplicity, and low cost.

Essential Take-aways

This equipment is part of a technical “ecosystem” with its own history, vocabulary, and arcane knowledge.

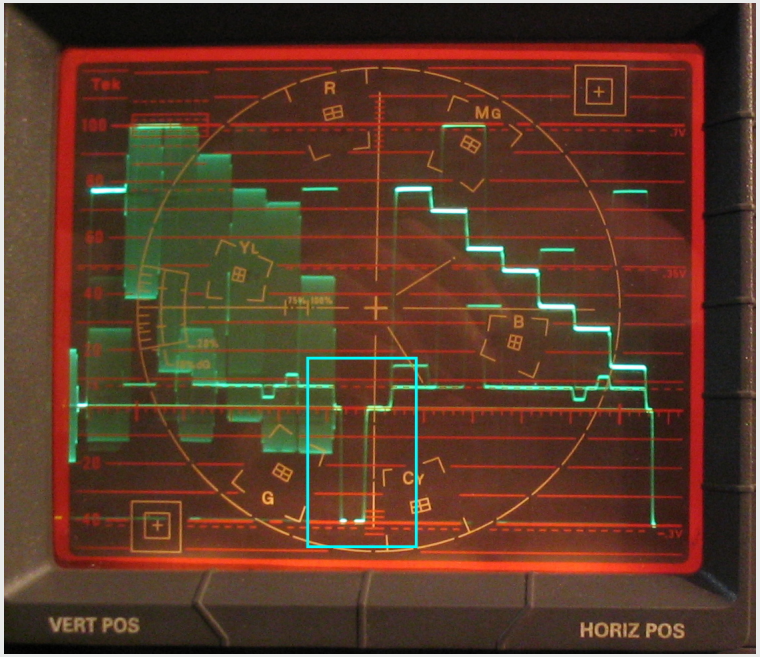
Without having worked in this world, archivists are stuck playing catch-up to understand what’s going on.

But it also means there is a whole industry out there that is still in the professional media business.

Experienced (old) video/broadcast engineers can provide insight that improves quality and saves time and money.

Reference, Genlock & Timing

- Synchronization information is necessary in a video signal to know where horizontal lines and vertical frames begin/end.
- The sync information is carried with the video.



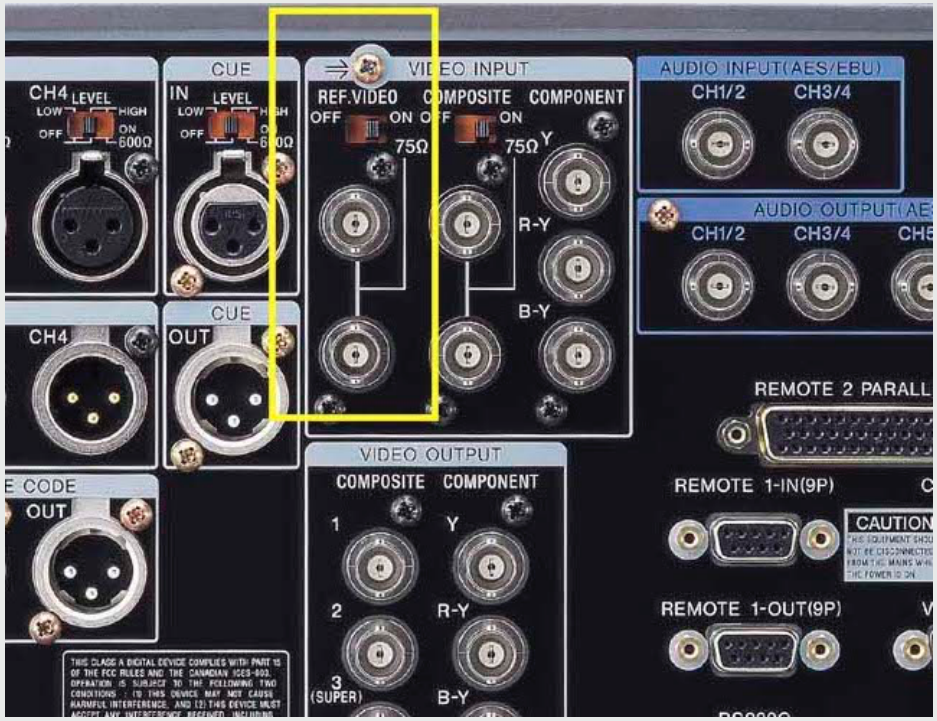
Reference, Genlock & Timing

- Every piece of video equipment that outputs (plays) video contains an internal sync circuit to create the necessary signals.*
- These internal circuits are usually good enough to play the format at the “nominal” correct speed.

* Some very old equipment needs external sync signals in order to operate.

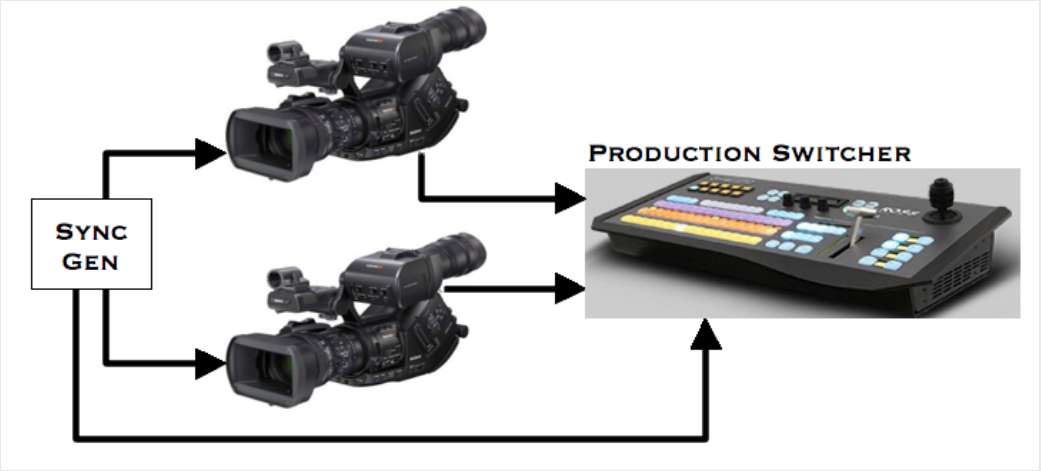
Reference, Genlock & Timing

- On professional equipment, the internal sync generator can be “locked to” (synchronized with) an external signal.



Reference, Genlock & Timing

- Locking to a reference (genlock) makes equipment produce output signals in sync with each other, for the purpose of clean switching.



- "Timing" is about the relationship between two devices both feeding a third device (such as cameras into a production switcher).

Reference, Genlock & Timing

- In any recording system, the recording device must lock to the sync in the signal coming from the source device.

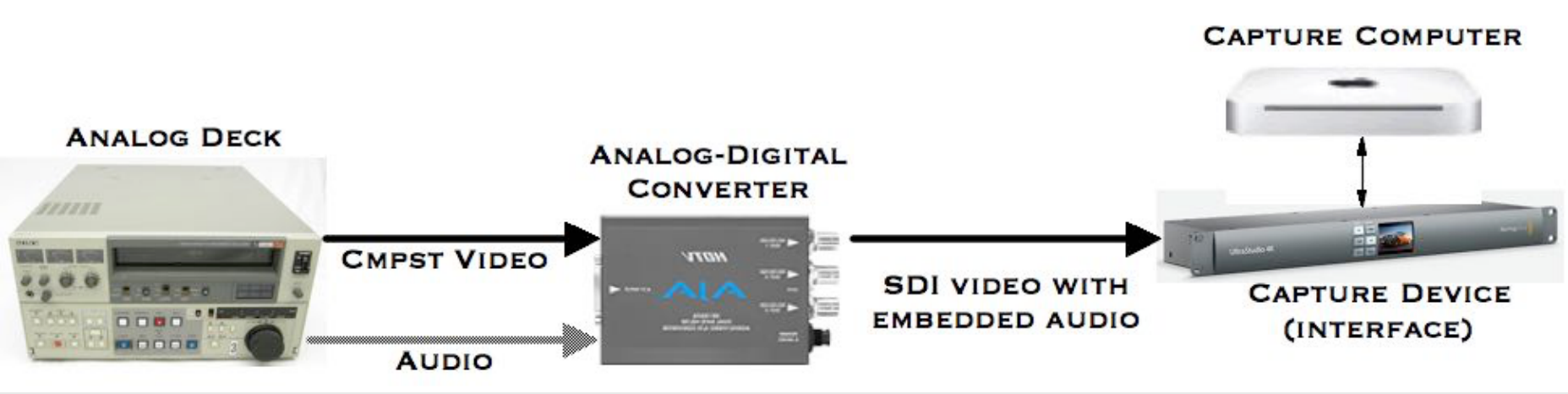
- In an archive capture system there is no need for external reference or genlock, therefore no external sync generator.

A/V “Lip-Sync” -- Intro

- When video and audio seem out of kilter... Something feels off with the sound and picture...
- This was almost never seen in conventional broadcast and cable television, but is now quite common on TV and streaming due to many factors.
- It’s most noticeable on “impact” sounds or speech close-ups (depending on speaker and language).

A/V “Lip-Sync” -- Intro

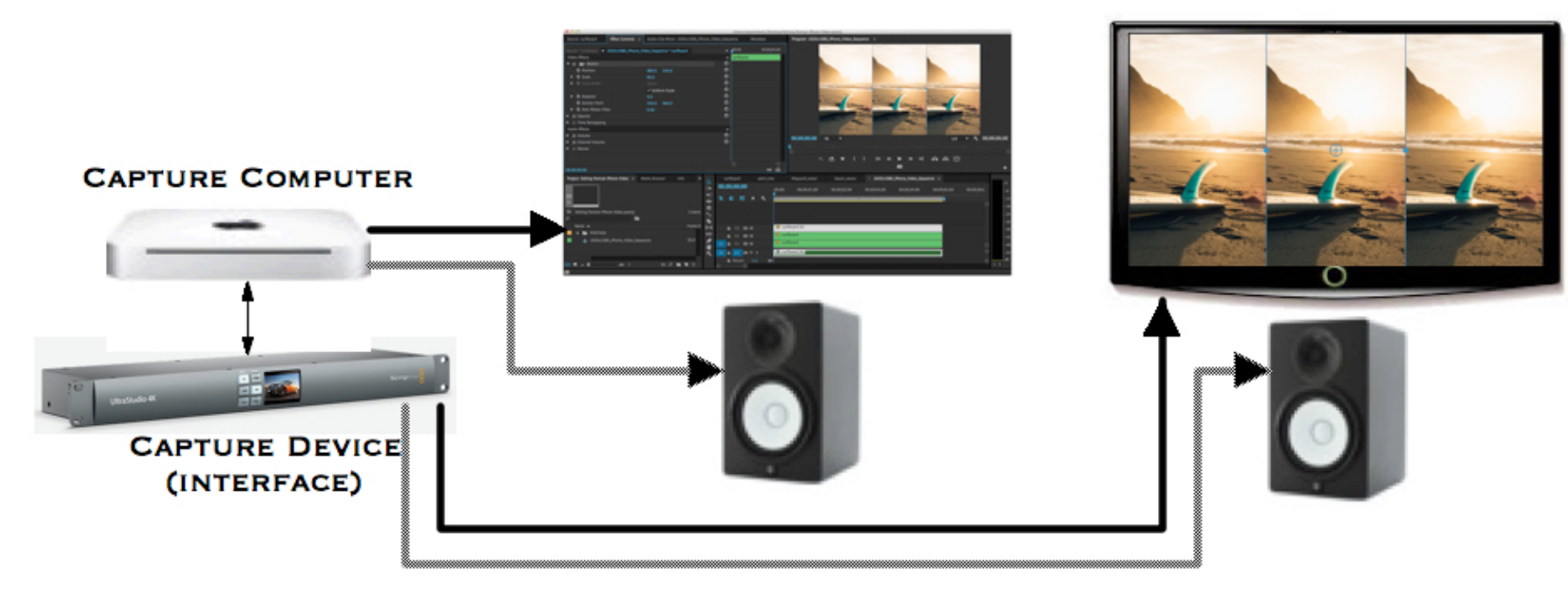
Virtually nothing in an archive capture system can create an actual A/V sync error that is recorded into a file.



A/V “Lip-Sync” -- Intro

- Do you notice a problem?
  - A video frame at 30 (29.97) fps is 33mS.
  - It’s very hard for people to detect A/V sync errors less than a couple frames.
  - It’s more likely that video will lag audio (and this is unusual in our natural experience).
  - There are test signals and devices for checking A/V sync, but they are unique and finicky.

A/V “Lip-Sync” -- Apparent

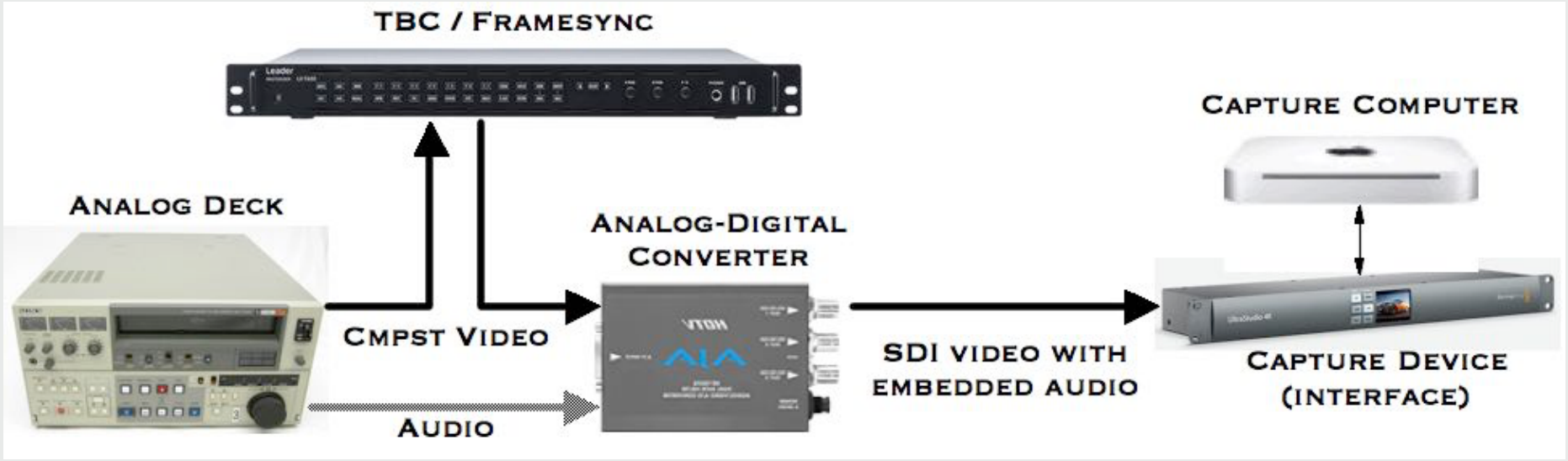


A/V “Lip-Sync” -- Apparent

- What can cause apparent lip-sync error?
  - Assume flat-panel displays introduce at least 1 frame of video delay inherently due to internal processing (unlike CRTs).
  - Software settings and software/driver funkiness could lead to an offset between audio and video at the output--even when playing a good file.

A/V “Lip-Sync” -- Actual

- What can create an actual lip-sync error?
  - Frame synchronizers (not necessarily TBCs) delay 1-2 frames. Some have analog audio pass-through for compensation.

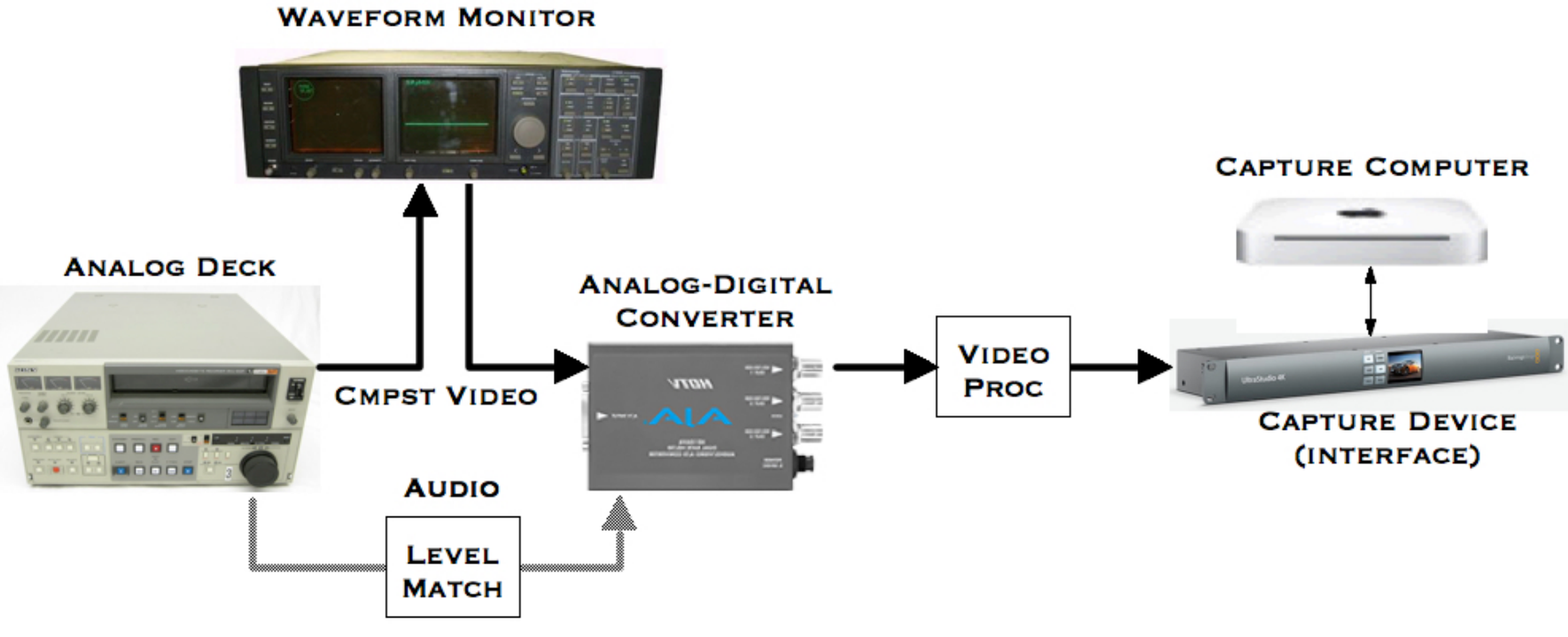


A/V “Lip-Sync” -- Actual

- What else can create actual lip-sync error?
  - Capture devices and software should not create lip-sync errors, but it happens.
  - Editing and processing software can cause trouble if the audio and video are handled separately or “slipped” on the timeline.
  - Double-system film transfers, if not synced and resolved correctly, could create both fixed and drifting lip-sync errors.

A/V “Lip-Sync” -- Not a Cause

- What does NOT cause lip-sync error?



A/V “Lip-Sync” -- Not a Cause

- What does NOT cause lip-sync error?
  - VTRs are designed to maintain A/V sync from all outputs. This is necessary for them to be usable!
  - Converters and processers such as A/D or D/A, embedder/disembedder, proc amp, mixer, have no significant latency.
  - Routing or processing of SDI or HDMI video with embedded audio will not disturb the A/V sync.
  - No routing, patching, or cables add any delay to video or audio in this context. That’s the physics.

A/V “Lip-Sync” -- Troubleshoot

- If you think there’s a problem...
  - Remember: Almost nothing in an archival system can create an A/V sync error in the captured file.
  - Examine monitoring issues first. Test with a known good file!
  - Is the video going through multiple frame-sync stages independent of audio? Why? (TBCs internal to a VTR are not an issue--the deck accounts for any delay.)
  - The culprit is probably the capture device--reboot, update software, update firmware, call tech support.
  - If the lip-sync drifts it’s definitely the capture device (unless you’re doing double-system film).

Equipment Power -- Intro

- The industry that sells power conditioning and backup products depends greatly on scare tactics, obfuscation and ignorance.
- There are good reasons to use power products, and good products to use, but there's a lot of nonsense out there.
- This is actually a very complex topic, with many competing technologies and opinions. In the end there's the real world, and there's marketing.

Equipment Power -- Intro

- What are we trying to protect against?
  - Data loss in computers and storage from a power outage
  - Equipment damage from power line instability immediately following an outage, or fast up/down occurances
  - Failure of cheap power supplies (such as “wall warts”) due to power line fluctuations

Equipment Power -- Devices

- Some end-user products sold for those problems:
  - Surge protectors

  - Power line filters

  - Power line conditioners
  - Uninterruptable power supplies (UPS)

Equipment Power -- Devices

- Most common “surge protectors” use MOV semiconductors that shunt overvoltages away from equipment, but then are destroyed (sacrificial). Many cannot handle a true catastrophic overage like lightning.
- Simple power line “filters” can reduce some kinds of noise, but does this actually matter?
- These kinds of products don’t regulate voltage or protect against power loss. They don’t hurt, but have limited real value.

Equipment Power -- Devices

- Surge protectors using series-mode circuits are more effective than MOVs and are not sacrificial.
- Sophisticated "power conditioners" may have voltage regulation, high-quality filtering, and more effective surge protection. But a good UPS does much the same.

Equipment Power -- UPS

- Uninterruptable Power Supplies (UPS)
  - All types have batteries and an inverter to make 120VAC power when the power line fails.
  - Standby: Connects the power line directly to equipment and switches to battery if the power line drops below a threshold.
  - Line-interactive: Operates like Standby but adds voltage regulation of the power line.
  - Double-conversion: Actually converts power line to DC and back to AC at all times, providing complete isolation from the power line.

Equipment Power -- UPS

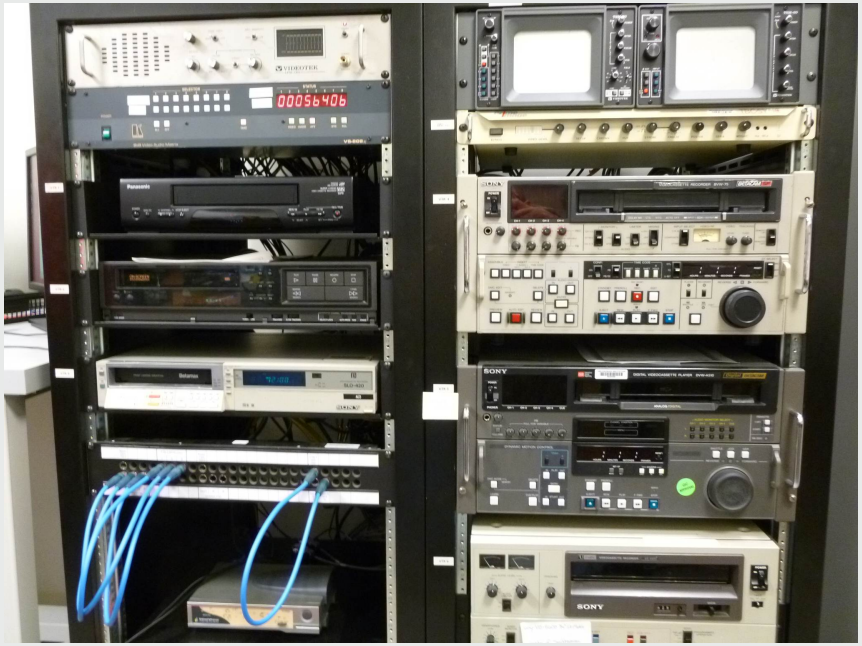
- Uninterruptable Power Supplies (UPS)
  - UPS power ratings are usually in VA (volt-amps) which gives an unrealistic idea of load capacity. Use the wattage rating to determine if the UPS can support the equipment plugged in (load).
  - Add up equipment watts to calculate the total load (for simple purposes, watts = volts x amps)
  - Most tower and rack-mount UPSes use standard lead-acid batteries, usually replaceable and easy to get. Be sure to match size, voltage, A-h and connectors.

Equipment Power – Why?

- What really matters to us?
  - Keep computers and drives running through momentary power fluctuations, or long enough in an outage to shut down safely.
  - Lots of new equipment uses switch-mode “wall-wart” power supplies, many of which are cheap and fail easily. Even some internal supplies are not well designed.

Equipment Power – Bottom Line

- My bottom lines:
  - Most “legacy” equipment, particularly for professional production, has robust internal power supplies that don’t care much about power problems.



Equipment Power – Bottom Line

- My bottom lines:
  - Put computers and drives on a double-conversion UPS if possible. Figure model size on wattage. Don't forget the computer monitor!
  - If double-conversion is too expensive, get a high-quality standby or line-interactive model.
  - I'm not a fan of APC, which is ubiquitous. I recommend Eaton.

Thank you for attending!

Handy links:

https://www.tvtechnology.com/opinions/the-lipsync-problem-that-wont-go-away
(the parts about compression latency are not applicable to archivists)

https://www.eaton.com/us/en-us/products/backup-power-ups-surge-it-power-distribution/backup-power-ups/uninterruptible-power-supply-faq.html

https://www.ametekesp.com/resources/white-papers

https://www.lab-tech-systems.com/articles.htm

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