

Hacking together a FreeBSD presentation streaming box For as little as possible

Tom Jones

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Hacking together a FreeBSD presentation streaming box For as little as possible

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- Internet Engineer
- Foolish volunteer
 - "I said yes because I don't know how to say no"
- Founder, sometime organiser at local hackerspace
 - I take the hackerspace camping every summer (campgnd.com)
- Organiser of Techmeetup Aberdeen
 - Monthly event with beer, pizza and talks

When will the talks be up?

"What is needed is adding logos to the front of the video and uploading them to YouTube. That takes time and effort."

"Video is not high priority. It is a volunteer effort done only because folks want it. There is so much work and effort put into the the conference in the months before the conference, that once it is over, we want to attend to so many other tasks which have been pushed to the side. We need to get caught up on our personal lives. This is part of why it takes so long to get post-conference tasks completed."

- Dan Langille

Why this talk?

- Recording talks is easy
 - uploading them is nigh on impossible
- Streaming
 - expensive
 - hard
 - require multiple people to operate
 - physically exhausting and emotionally devastating
- If we can can make the equipment cheap the *event* can own it
- If the *event* owns the equipment they can train a team

What this talk is

- Architecture, tools and equipment to stream events
- Technical explanation of what these pieces do
- Instructions on how to hack these pieces together
- Tools to debug

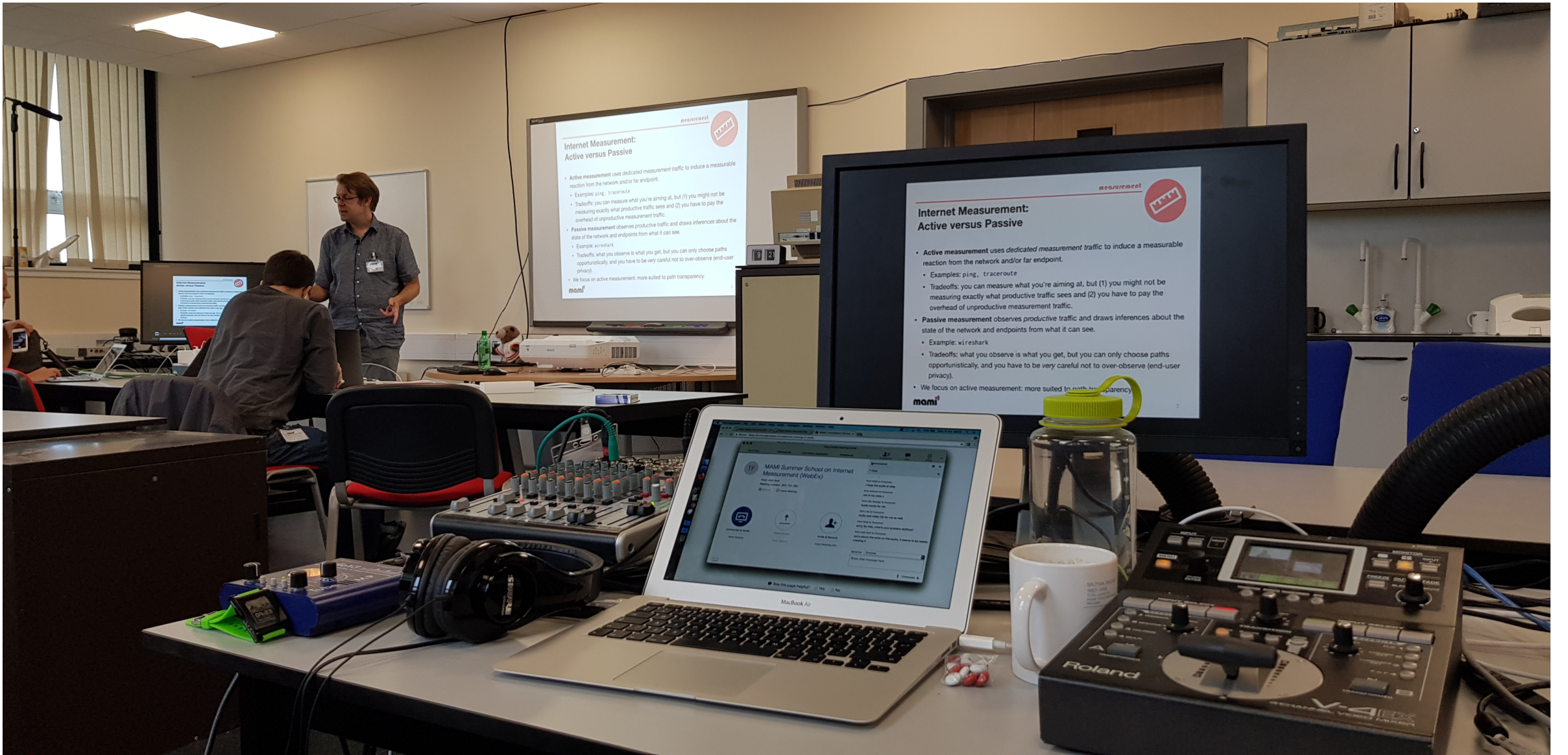
Typical Box



Iron Age Smelting



ERG Summer School

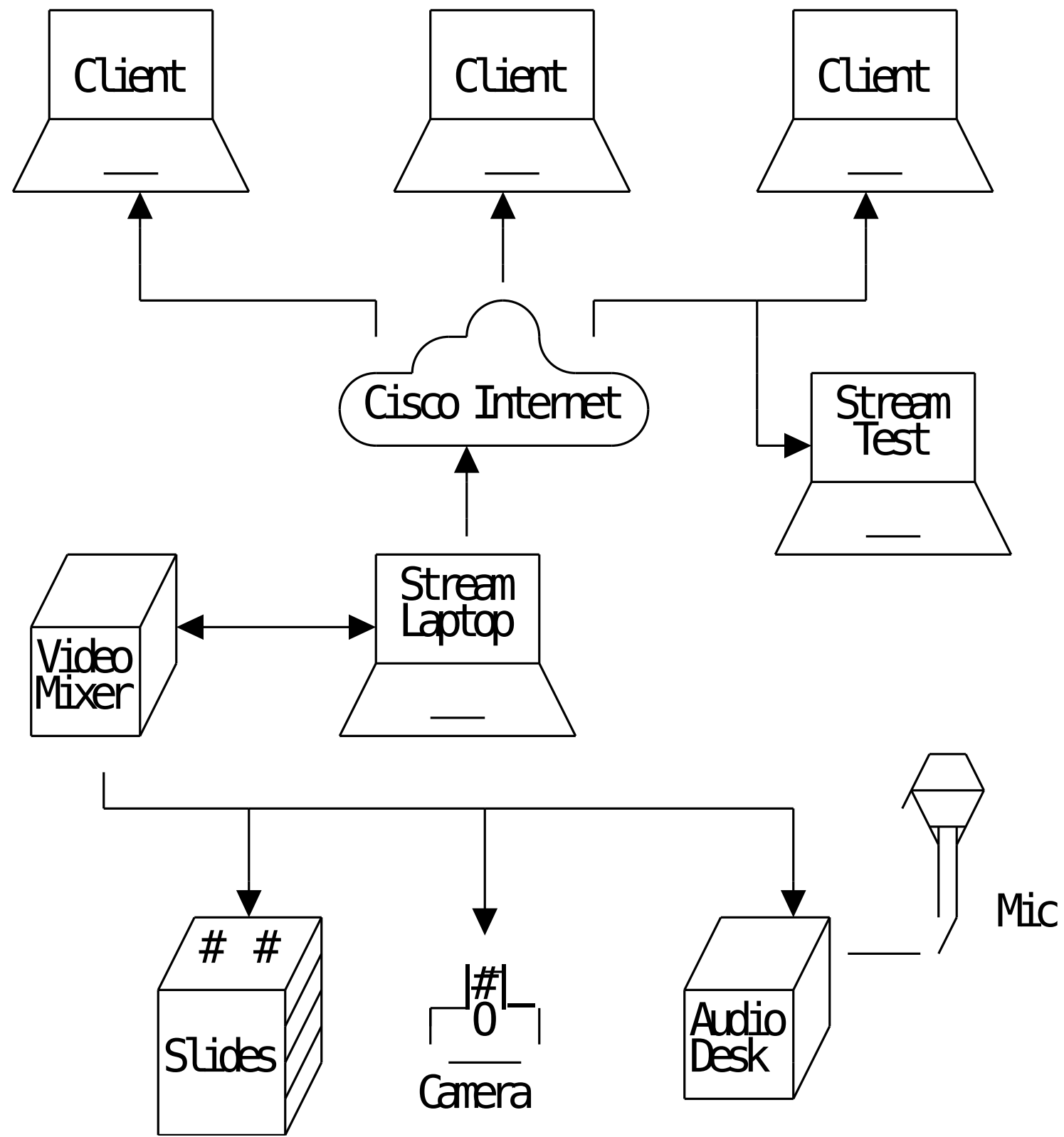


ERG Summer School

ERG Summer School

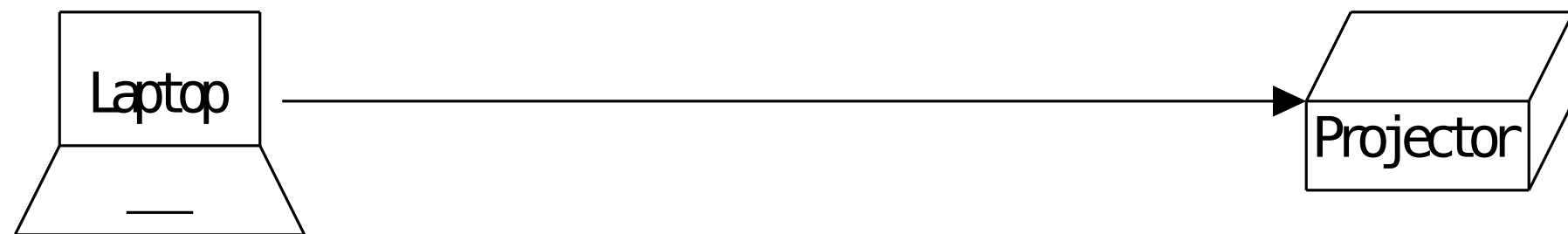


Summer School Architecture



What are we doing right now?

- My laptop is connected to this projector, you can see my slides
- I am standing up here talking
- **You** are listening to me (I hope) and watching stuff from my laptop



- Ideally we would share this experience far beyond this room

Requirements

- Capture the output from the laptop
- Capture the audio from speaker

- Send our capture to the internet
- Distribute it as far as possible

The Solution

- Self contained
- Plug and play

- Cheap enough for the event to own it
 - Less that £100 would be ideal

- Components **MUST** be generally for sale

- **Run FreeBSD**

What we don't get

- Video of the speaker
- Audience participation (repeat the question!)

Components

- Capturing Slides
- Capturing Audio
- Mixing
- Streaming Out
- Recording Video

Capturing Slides

- Screen Capture software
- HDMI Capture Card
- Hacked up HDMI thing

Capturing Slides

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[Absolute FreeBSD, 2nd Edition: The Complete Guide to FreeBSD](https://books.google.co.uk/books?isbn=1593272219)

<https://books.google.co.uk/books?isbn=1593272219>

Michael W. Lucas - 2013 - Computers

The Complete Guide to FreeBSD Michael W. Lucas ... Either your network card or its device driver separates the data intended for your computer ... Some failures are obvious, such as those where the magic black smoke is leaking out of the ...

Capturing Slides

- ~~Screen Capture software~~
- ~~HDMI Capture Card~~
- **Hacked up HDMI thing**

HDMI Ethernet Extender

- NOT 60m HDMI CAT6 Ethernet extenders
- LKV373 based HDMI Ethernet extender

[Your Account](#) > [Your Orders](#) > [Search results](#)

Search results

Search Orders

10 orders matching "hdmi"



[Order details](#) | Ordered on 11 April 2018 (2 items)

HDMI Extender, AGPtek LKV373 100M over Ethernet Network Routers/Switchers LAN RJ45 CAT5 CAT6-Single Source from 1080P Full HD STB,DVD,PS3 - w/DLP,LCD,

AGPTEK

Sold by: Nice wealth



[Order details](#) | Ordered on 28 March 2018 (2 items)

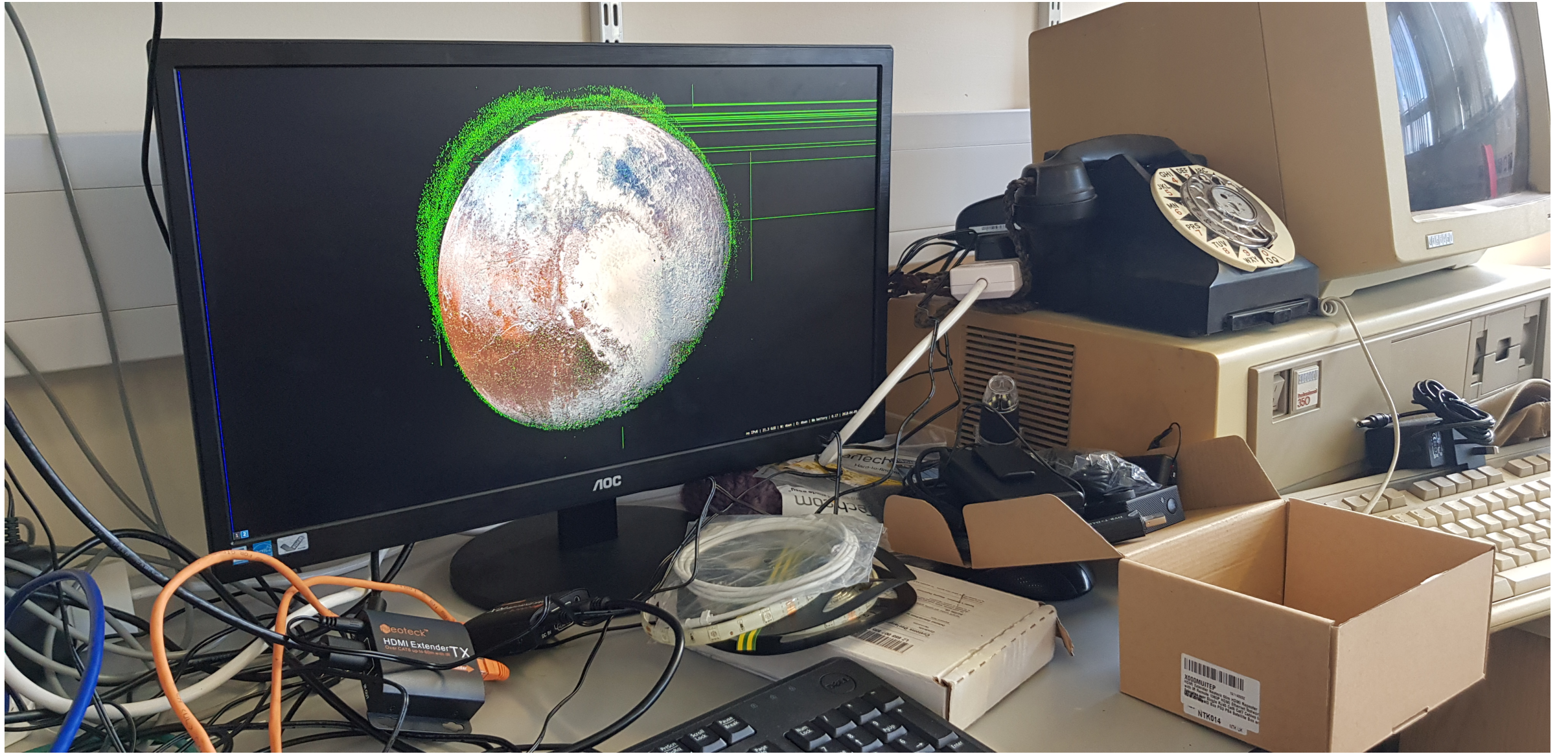
HDMI Extender Neoteck 60m HDMI Repeater with IR Remote 1080P HDMI Ethernet Network Extender over Single RJ45 Cat6 Cat7 Cables for PC DVD Sky HD Box PS

Neoteck

Sold by: Neoteck

HDMI Ethernet Extender

- NOT 60m HDMI CAT6 Ethernet extenders
- LKV373 based HDMI Ethernet extender



HDMI Ethernet Extender

- LKV373 HDMI Extender
- MPEG2 Multicast
- Fully reverse engineered [1]



1: <https://blog.danman.eu/new-version-of-lenkeng-hdmi-over-ip-extender-lkv373a/>

HDMI Ethernet Extender

HDMI Ethernet Extender

The image shows a Wireshark network traffic capture. The top pane displays a list of 18 packets. Packet 5 is selected, and the bottom pane shows its detailed structure:

- Frame 5: 1358 bytes on wire (10864 bits), 1358 bytes captured (10864 bits)
- Ethernet II, Src: 00:a3:33:5d:24:37 (00:a3:33:5d:24:37), Dst: IPv4mcast_7f:2a:2a (01:00:5e:7f:2a:2a)
- Internet Protocol Version 4, Src: 192.168.1.238, Dst: 239.255.42.42
- User Datagram Protocol, Src Port: 5004, Dst Port: 5004
- ISO/IEC 13818-1 PID=0x7d1 CC=5
 - Header: 0x4707d115
 - 0100 0111 = Sync Byte: Correct (0x47)
 - 0... .. = Transport Error Indicator: 0
 -0.. .. = Payload Unit Start Indicator: 0
 -0. = Transport Priority: 0
 -0 0111 1101 0001 = PID: Unknown (0x07d1)
 -00.. = Transport Scrambling Control: Not scrambled (0x0)
 -01 = Adaptation Field Control: Payload only (0x1)
 -0101 = Continuity Counter: 5
 - [MPEG2 PCR Analysis]
 - ISO/IEC 13818-1 PID=0x7d1 CC=6
 - ISO/IEC 13818-1 PID=0x7d1 CC=7
 - ISO/IEC 13818-1 PID=0x7d1 CC=8
 - ISO/IEC 13818-1 PID=0x7d1 CC=9
 - ISO/IEC 13818-1 PID=0x7d1 CC=10
 - ISO/IEC 13818-1 PID=0x7d1 CC=11

The packet bytes pane shows the raw data in hexadecimal and ASCII. The status bar at the bottom indicates: Packets: 412798 · Displayed: 412798 (100.0%) · Load time: 1:7.44 · Profile: Default

HDMI Ethernet Extender

! Please check the TX input signal

Bridging multicast to unicast

bridge.sh

Components

- Capturing Slides
- **Capturing Audio**
- Mixing
- Streaming Out
- Recording Video

Capturing Audio

Interfaces

- USB Desk (\$\$)
- USB Interface (\$)
- Built-in Audio Interface (0)

Microphones

- Lavalier
- Cardioid
- Boundary/Area

Capturing Audio



Capturing Audio



Capturing Audio

- sox is netcat for audio
- check your levels:

Record and play back

Check that time is progressing at the correct rate

If your test is fast or slow you may need to manually sync the rate

Aside: Software Defined Radio

- A wireless lavalier mic made the most sense
- It says 229.7M on it
- could we just grab it from the air?



Aside: Software Defined Radio



Aside: Software Defined Radio



Aside: Software Defined Radio



Aside: Software Defined Radio

- AM Voice
- 229.7MHz center freq
- ~15KHz wide

Playing audio with rtl_sdr

Test SDR with FM radio

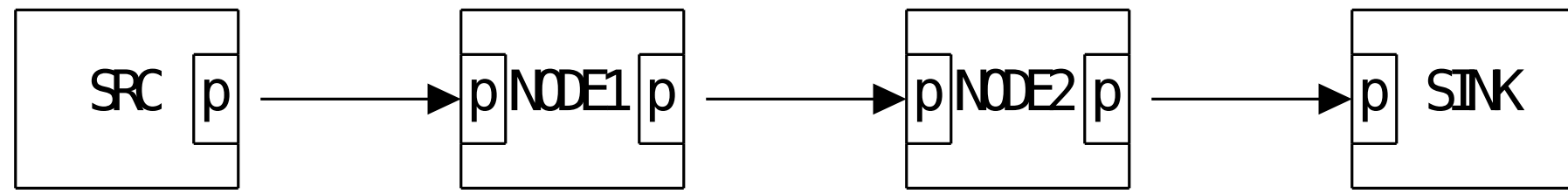
Capturing the wireless mic with rtl_sdr

Components

- Capturing Slides
- Capturing Audio
- **Mixing**
- Streaming Out
- Recording Video

Mixing: gstreamer

Everything assemblerizer for video and audio

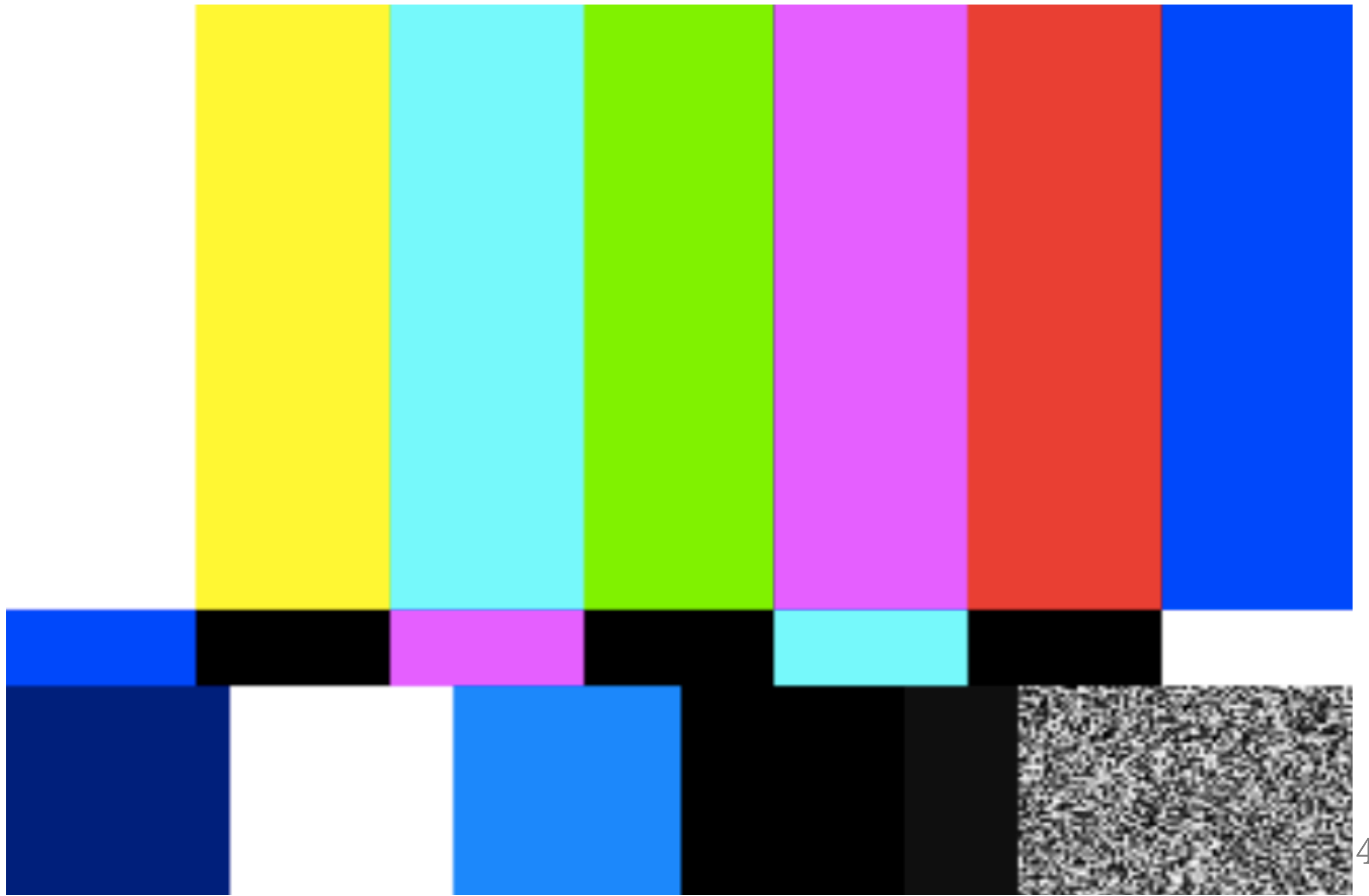


Mixing: gstreamer audio

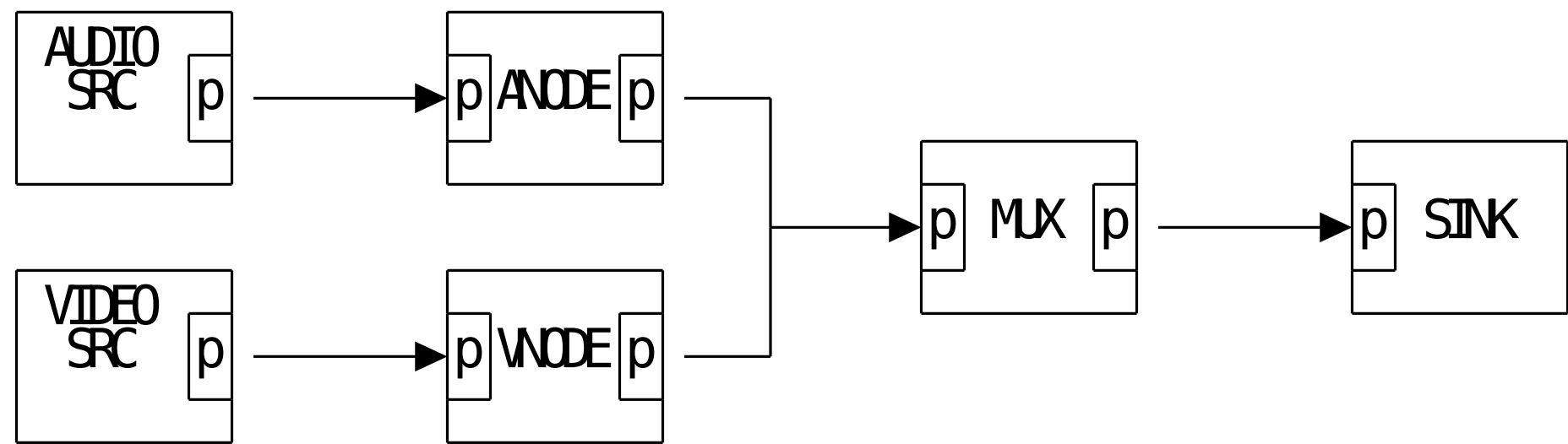
BEEEEEEEEEEEP!

Mixing: gstreamer video

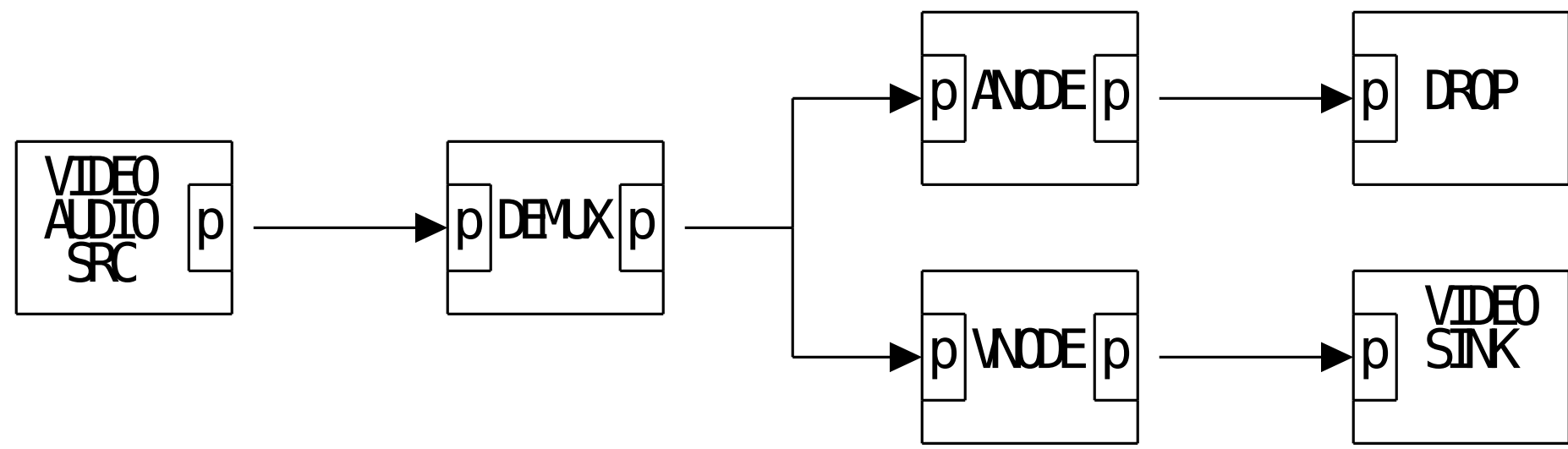
Mixing: gstreamer video



Mixing: gstreamer muxing



Mixing: gstreamer demuxing



Playing video from the feed

recvfeed.sh

Playing Audio

Components

- Capturing Slides
- Capturing Audio
- Mixing
- **Streaming Out**
- Recording Video

Streaming Out

- Streaming Service handles:
 - Ingestion (accepting our feed)
 - Distribution
 - Recording
 - Fan out
- Scale Engine
 - **FreeBSD** Streaming CDN
 - Free streaming for BSD events (ask Allan)
 - Other streaming services are available

Streaming Out

- Service accepts a Real-Time Messaging Protocol (RTMP) stream
- RTMP
 - TCP protocol on port 1935
 - H264 Video
 - AAC Audio

Streaming box



Streaming out

Mux it together

Streaming out

Audio

Streaming out

Video

Streaming out

In full we get

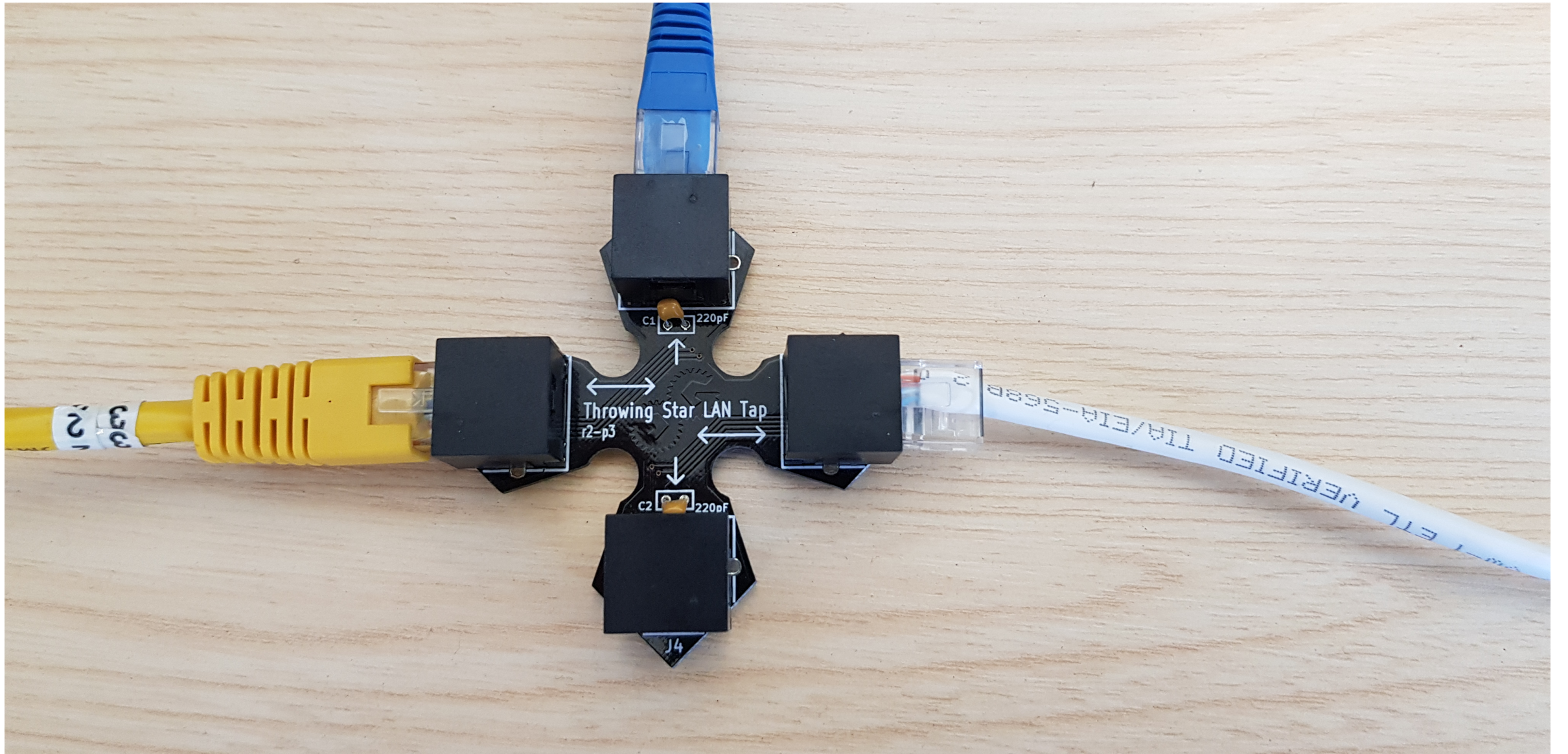
Components

- Capturing Slides
- Capturing Audio
- Mixing
- Streaming Out
- **Recording Video**

Recording

- Scale Engine defaults:
 - Start a recording at rtmp publish
 - Stop recording at rtmp unpublish
- Recordings recoverable from Scale Engine file store

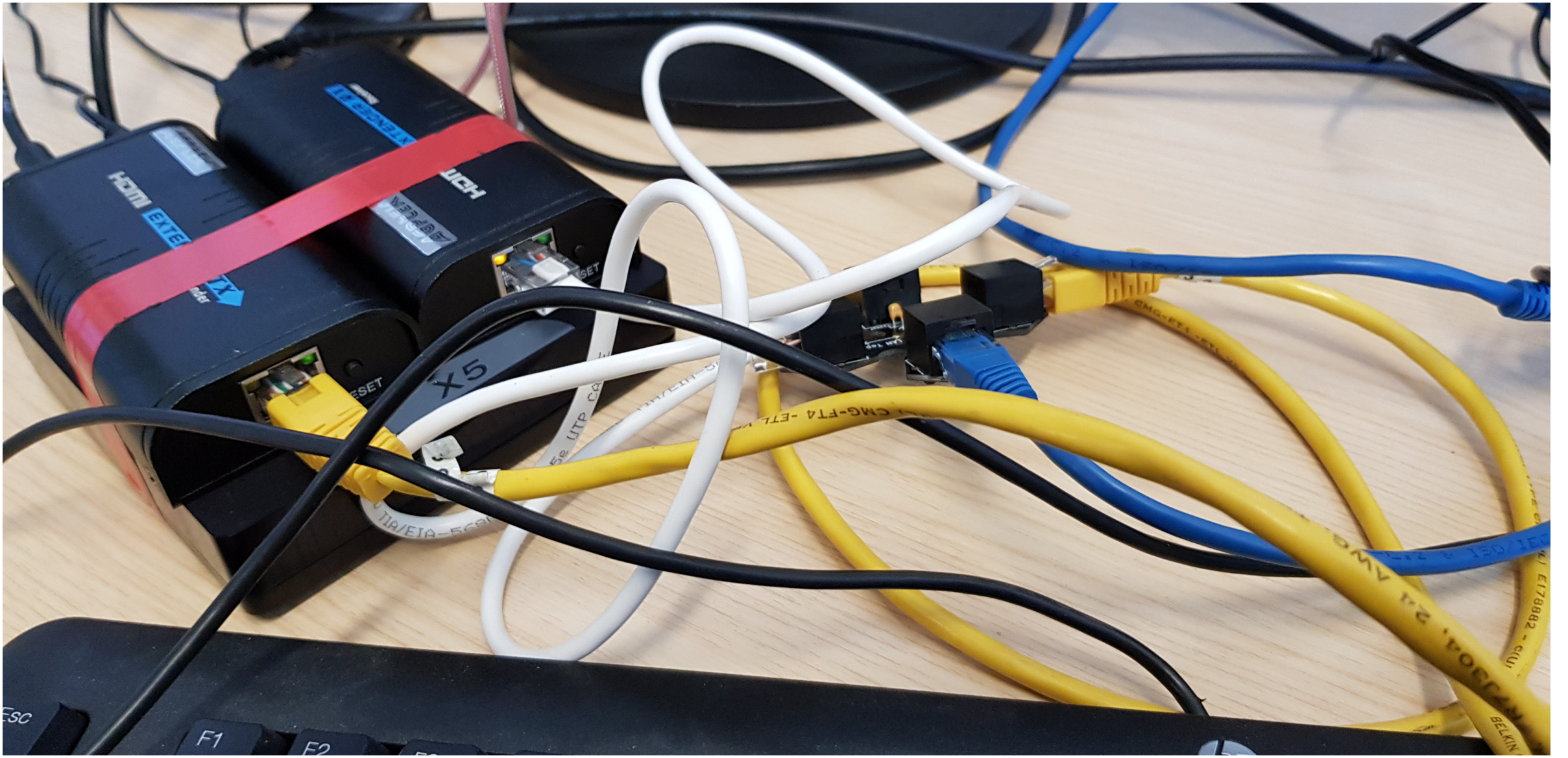
Pulling it all together



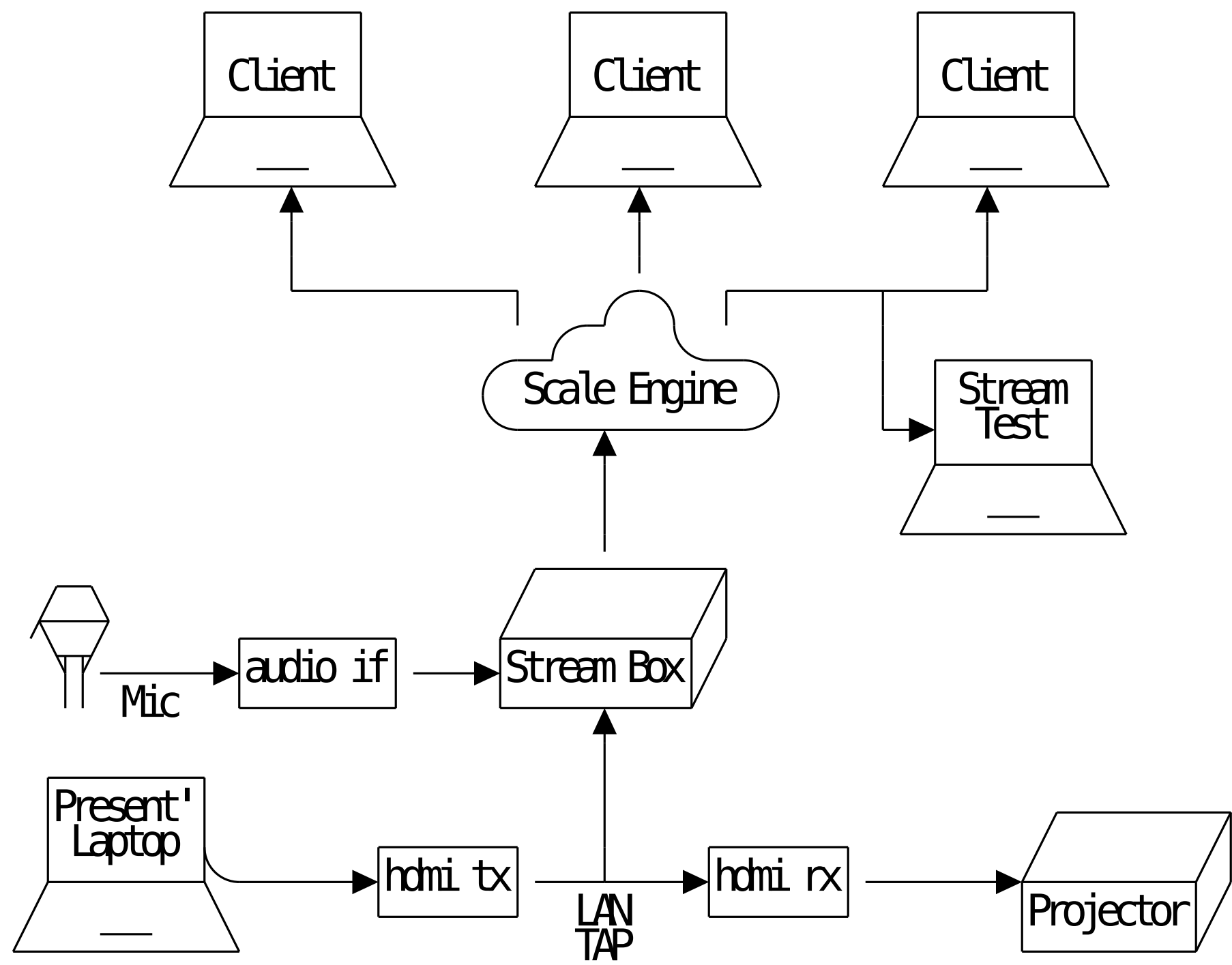
Pulling it all together



Pulling it all together



Architecture



Using it

- Find scaleengine dashboard demo feed
- Launch stream.sh
- Launch bridge.sh

Final System

Thank you for listening

Questions?



Colophon

This presentation is open source software and was made with open source software. Open tools were used to build the system presented and the final system is open source.

- FreeBSD
- wireshark
- gstreamer
- socat

- SOX

- vim

- remark.js
- goat
- firefox

Saving the video feed to a file

recordfeed.sh

Capturing AAC Audio

gststreamer audio pipeline

Feeding the rtl_sdr into gstreamer