What is the Raspberry Pi?

Model B

- SoC Broadcom BCM2835 (CPU, GPU, DSP, and SDRAM)
- CPU: 700 MHz ARM1176JZF-S core (ARM11 family)
- GPU: Broadcom VideoCore IV, OpenGL ES 2.0, 1080p30 h.264/ MPEG-4 AVC high-profile decoder
- Memory (SDRAM): 512 Megabytes
- Video outputs: Composite RCA, HDMI
- Audio outputs: 3.5 mm jack, HDMI
- Onboard storage: SD, MMC, SDIO card slot
- 10/100 Ethernet RJ45 onboard network
- 2 x USB
- General Purpose Input Output Port (GPIO)

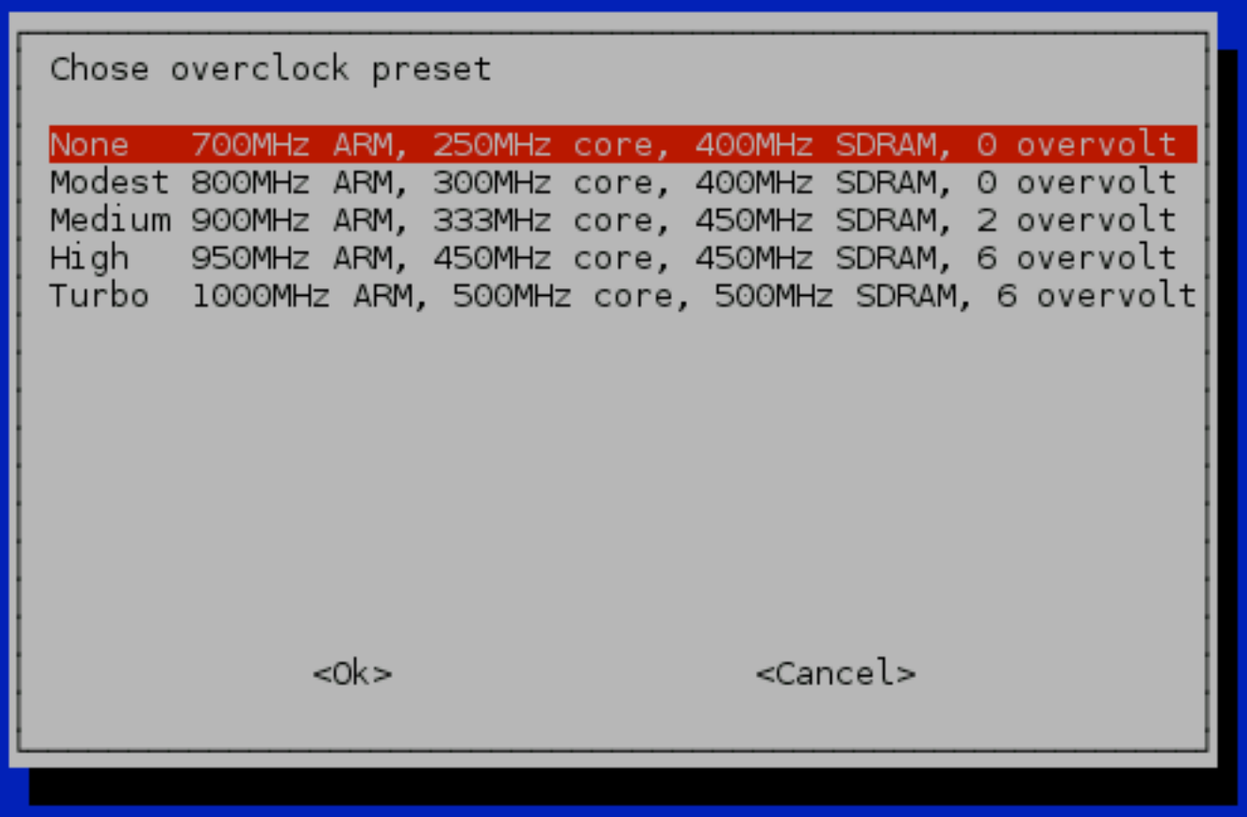
CPU 700 Mhz but overclockable safely to 900-950.
Media Player SoC, which is why the CPU is fairly weak, but the GPU is pretty fast.
512Mb of RAM on the Model B.
RCA and HDMI
3.5mm jack and HDMI
SD card for storage.
Ethernet.

GPIO port for low level hardware hacking.
No analogue to digital converter on the GPIO, i.e you can't just connect a potentiometer to it and read it.

Runs Linux (+ others)

CPU and GPU memory.

- There is 512Mb total of memory, you can choose how to split it between the CPU and GPU.
- You'll want the GPU to have at least 64MB, preferably 128MB available, but depending on your app this can vary.



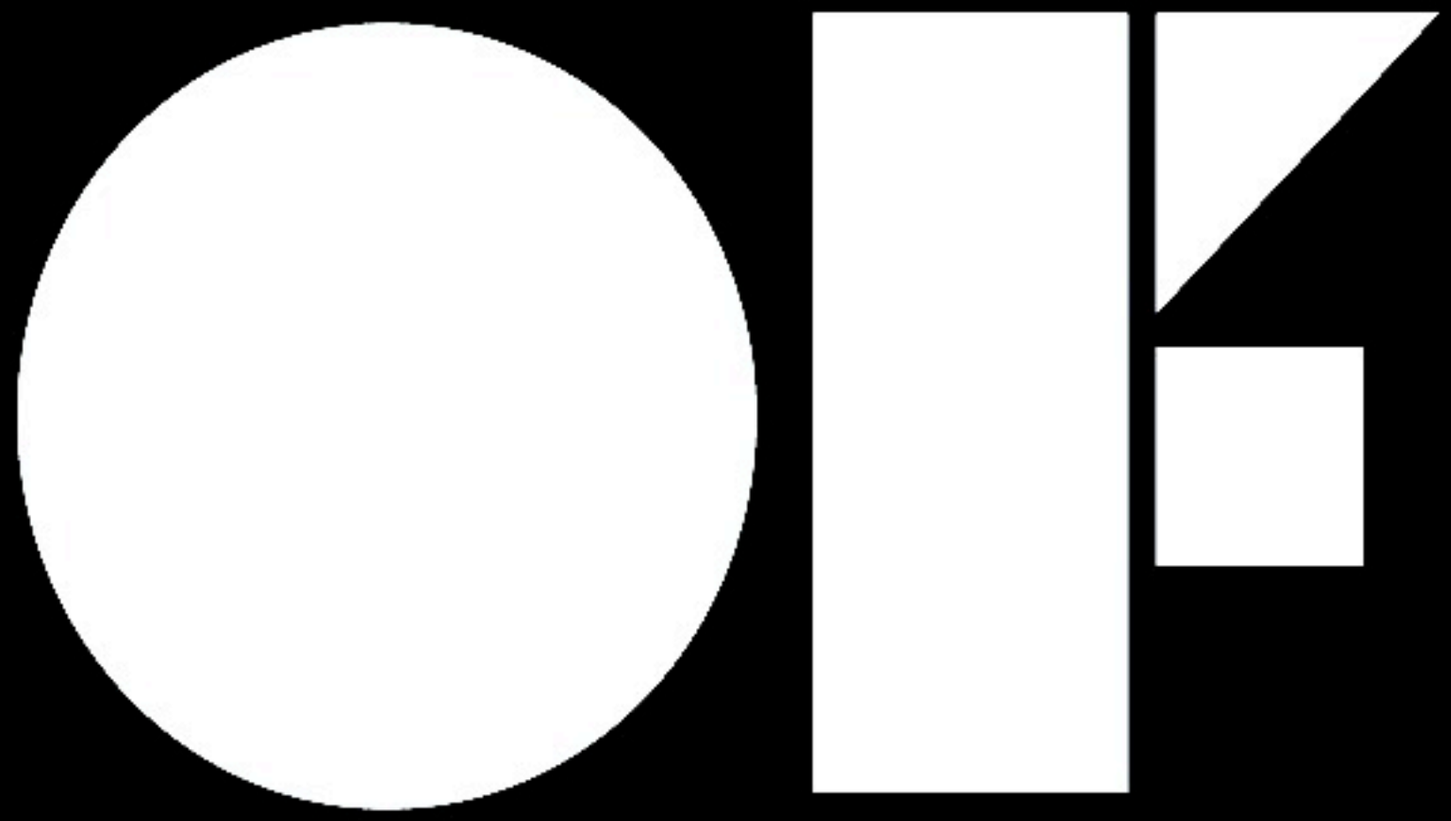
- It’s easy to overclock the Pi.
- Make sure you have a reliable power source if you intend to do so.

Here be dragons.

- It’s early days, but most Of stuff already works.

Programming options.

C/C++
Python
Java
JavaScript/NodeJS
C# (Mono)
Perl
PHP



C++ with OF!

Setting up your work environment.

SMB + Text Editor + SSH

- Often people will develop on another machine and sync up and check on the Pi from time to time.
This will save you a lot of aggravation.

- Tips for this working smoothly? Turning off ARB texture rectangle is the only one I can think of.

(Slide of basic Linux commands)

Also introduce ‘screen’.

Cross compiling.

Linux

Linux users and permissions

sudo

ssh

ls = list files

$ls

$ls -al list all files (including hidden) with details

ssh

$ssh pi@yourpi.local

Usually pi@raspberrypi.local, but we changed it as we would have multiple ones on the network.

cd = change directory

go to home directory
$cd

go up a directory
$cd ..

go into bin directory
$cd bin

To run an application

$ ./yourAppName

You must cd into the bin directory to run an application

$ ./some/path/to/myApplication won't work

Makefiles

Makefiles are the recipes of your applications

config.make
addons.make

make = Builds your project from Makefile
build your app

$make

start from scratch (like erasing cache)
$make clean

necessary for debugging crashes
$make Debug

New! helper option to run app without $cd bin
$make run

Feeling lucky?
$make && make run

Cross compiling

Hello World!

Limitations / Possibilities.

(Something running slow.)

examples/3d/advanced3DExample

(Something running fast.)

examples/gl/vboExample

Shaders!

- GPU is obviously pretty fast.

OpenGL ES 1.1, Fixed function pipeline (old and busted).

- No shaders in this mode, but this will be closer to the OpenGL you are used to.

- Essentially we are on a mobile platform.

OpenGL ES 2.0, Programmable pipeline (new hotness).

- Here we have shaders, but..

- We have to write a shader for everything we want to do. If you want a red triangle, you need to write a shader.

- OF now has the beginnings of a ES 2.0 renderer, it doesn't do much yet, but it does let you use the internal OF drawing commands.

- Stick with OF drawing commands and you'll be fine.

- Does not support lighting etc, you'll have to write a shader for that.

(Shader Example)

ShaderLiveCoding, first to show shaders, then edit shaders to show that they are compiled separately.

Raspberry Pi and video.

omxplayer

Explain OMX

ofVideoPlayer

(Explain GStreamer).
videoPlayerExample

ofVideoGrabber

ofVideoGrabberExample
ps3EyeExample

ofxOMXPlayer

(Video + Shaders example)

Raspberry Pi as a digital art platform.

- Great potential, cheap, abundantly available, standard, will not change for quite a while (in computer terms)
- Obviously it's not the most powerful machine in the world, but will be fine for some use cases.

- Show booting straight into an App.

Watchdog

Autobooting

Strength in numbers. (Networking)

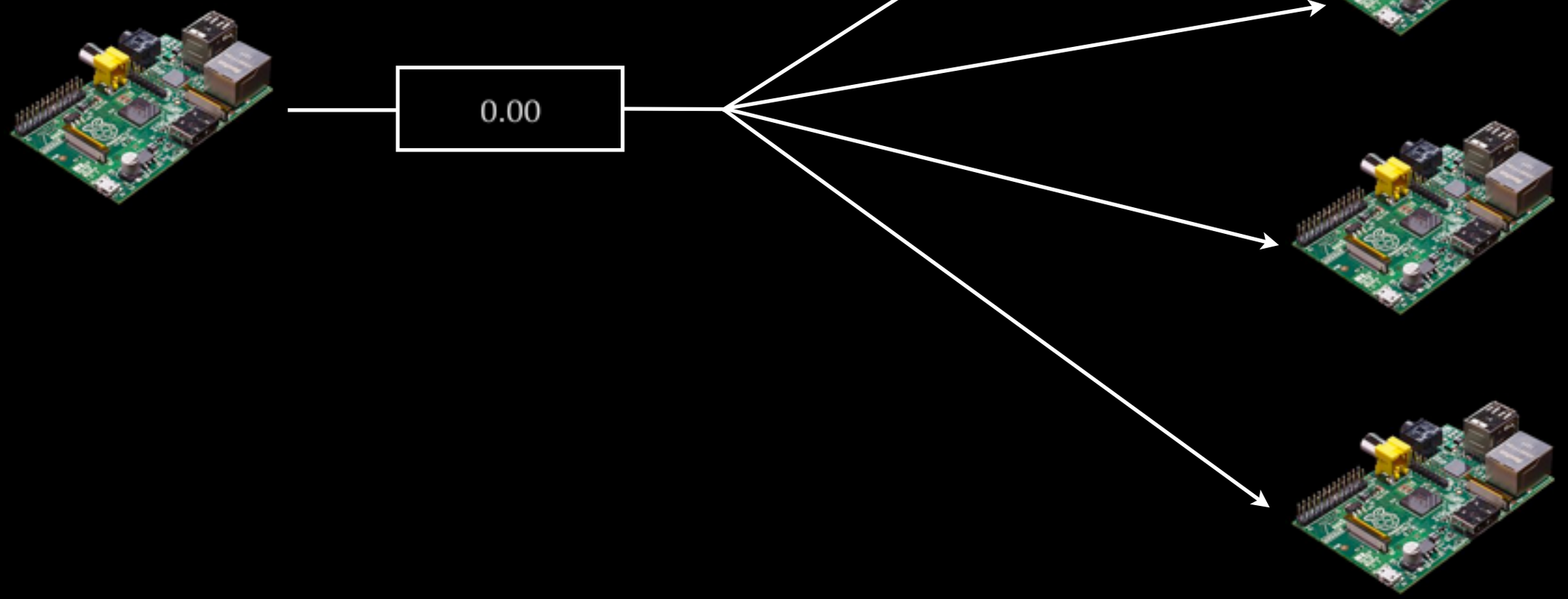
- The Pi has a lot of potential as a cheap node in a network.

Show NetworkedCV.

Multiscreen application basics.

0.00

- The only thing we really need to make a multi screen application.
- But obviously it needs to be the same across all computers.
- Similar approach is taken by MPE.

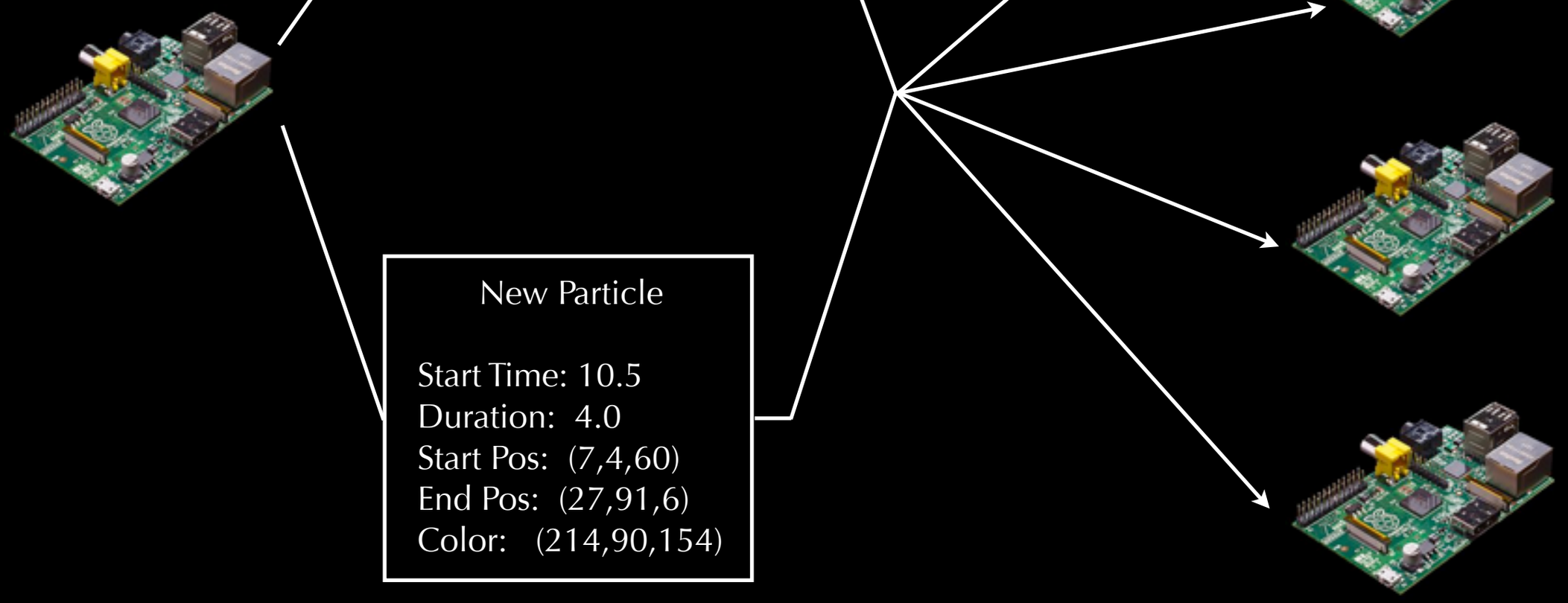


- Pi can be client and server. Server isn't doing all that much.
- OSC is good for transporting this data.

(demo MultiScreenSimpleSync)

Master and servant.

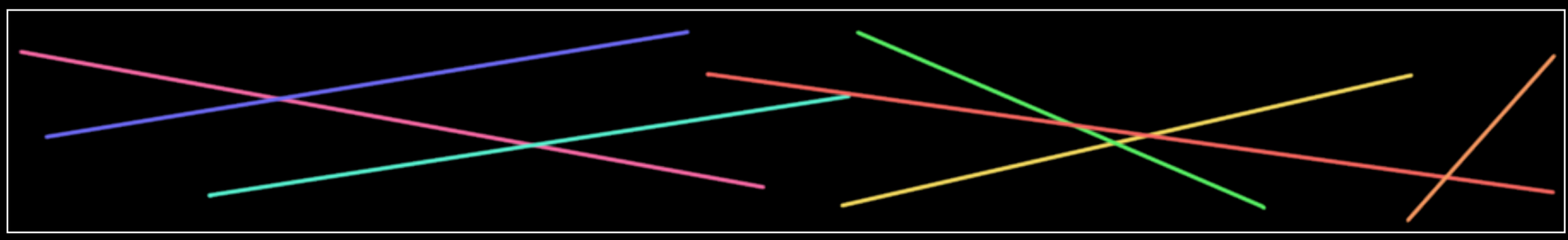
- To do slightly more interesting things we'll need the server to send other commands every now and then.



- Time is updated.
- Periodically the server will send out a message to spawn particle at a time in the future.

Updating and drawing in a multi screen app.

(info on next slide)



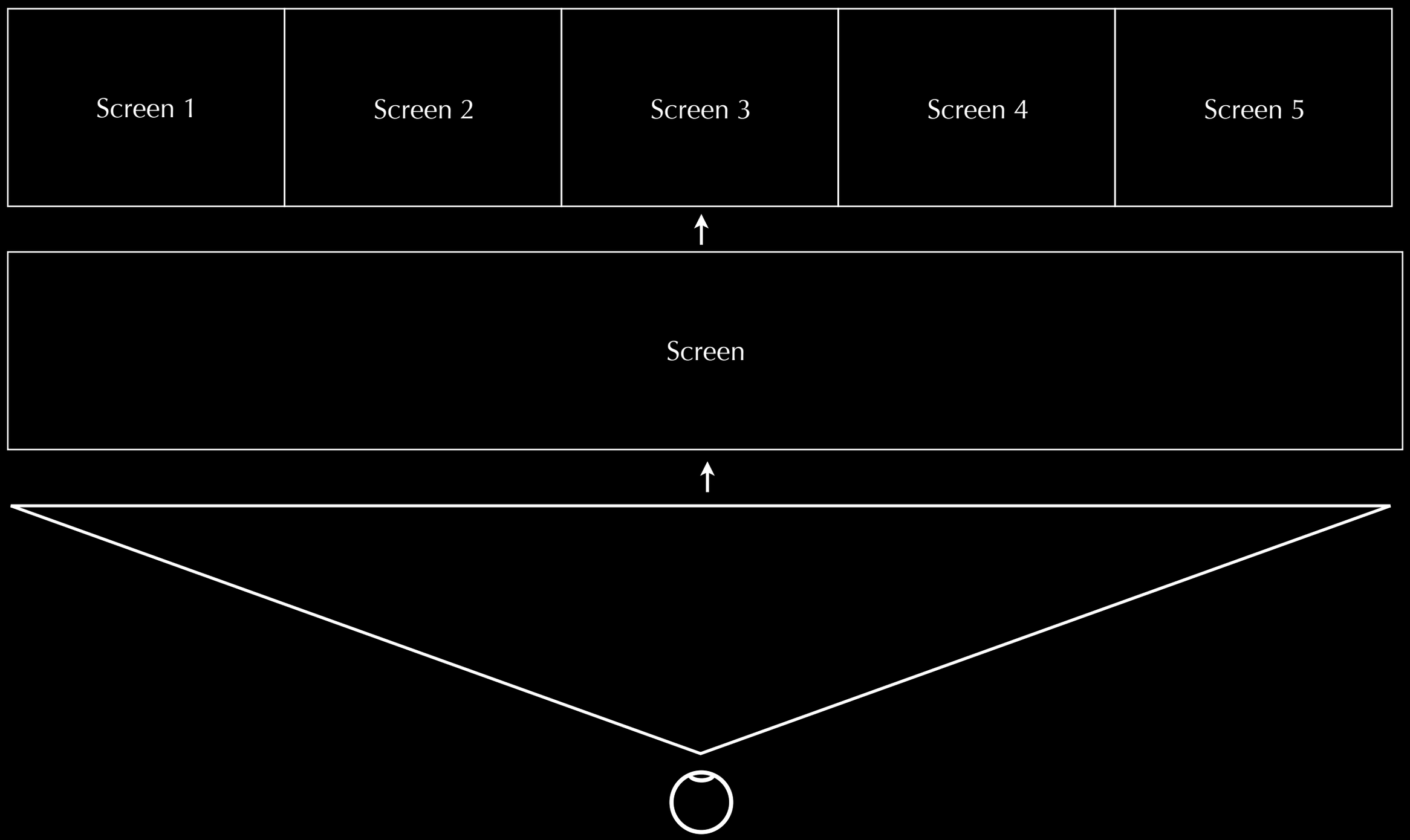
Screen 1	Screen 2	Screen 3	Screen 4	Screen 5

- All clients simulate everything, draw their own slice.
- Drawing commands that are fully outside will get rejected at some point in the chain, but simple culling is worth it and can save a lot of CPU work.
- Note that we don’t need to allocate any bitmaps of the virtual canvas size, we just offset to the side depending on which screen we are and draw.

(demo MultiScreenExample2D)

3D

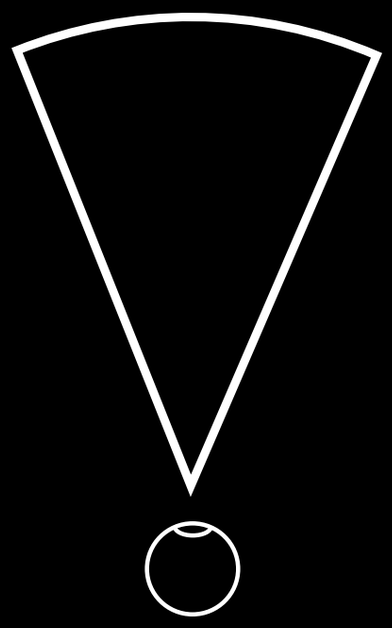
- Several ways to do 3D, depends a little bit on what you need.

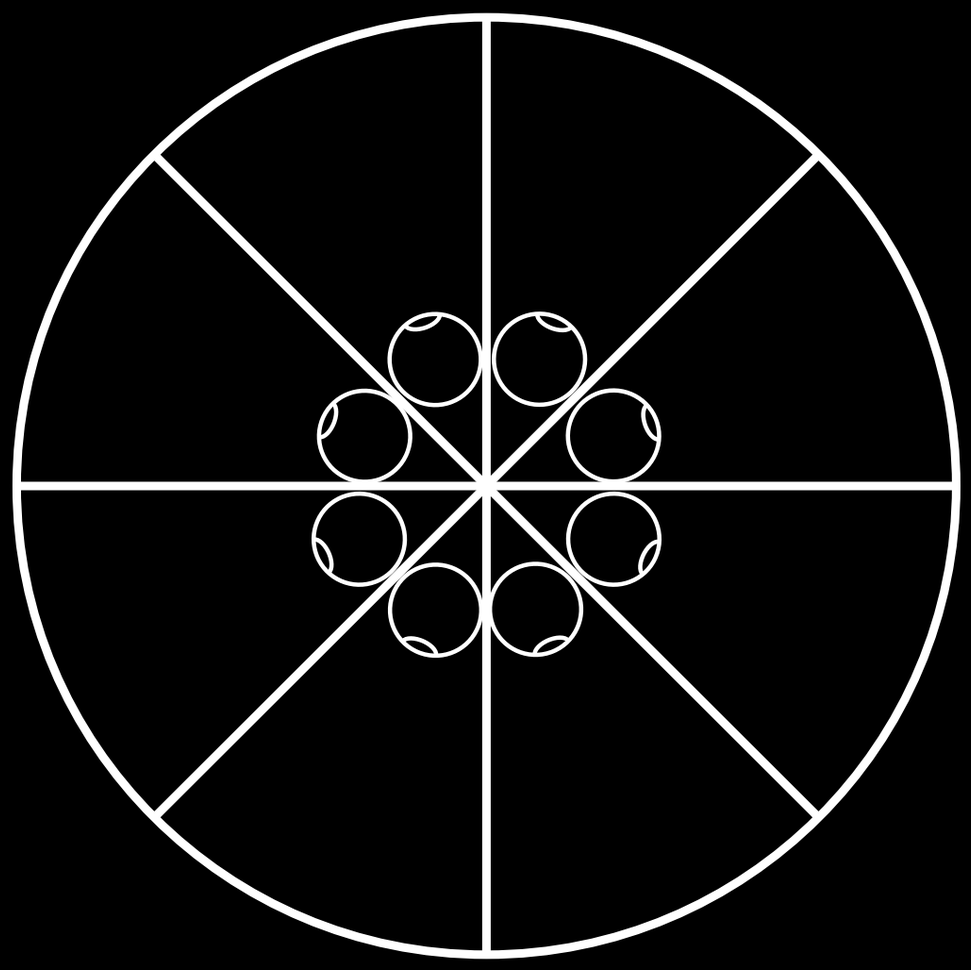


- In this case we intend to have a 3D camera that can roam around and split the view up over several screens.

- Disadvantage of this is that we get some distortion around the edges. But you can set up your view carefully to minimize it.

(demo MultiScreenExample3D)





- Another way is to split up a circle into as many cameras/screens are you have and look around.

- Disadvantage of this is that you need to keep things pointing at the camera, not a huge problem.

- Bezel saves you most of the time.

Networked Computer Vision

- We were talking about the Pi as a cheap node in a network earlier.

GPIO

3.3V	1	2	5V
I2C0 SDA	3	4	DNC
I2C0 SCL	5	6	GROUND
GPIO4	7	8	UART TXD
DNC	9	10	UART RXD
GPIO 17	11	12	GPIO 18
GPIO 21	13	14	DNC
GPIO 22	15	16	GPIO 23
DNC	17	18	GPIO 24
SP10 MOSI	19	20	DNC
SP10 MISO	21	22	GPIO 25
SP10 SCLK	23	24	SP10 CE0 N
DNC	25	26	SP10 CE1 N

- Pinout of the GPIO

- Does not have an analogue to digital converter.

OpenNI

Thanks to:

@bakercp
@arturoc
@julapy
@theDANtheMAN