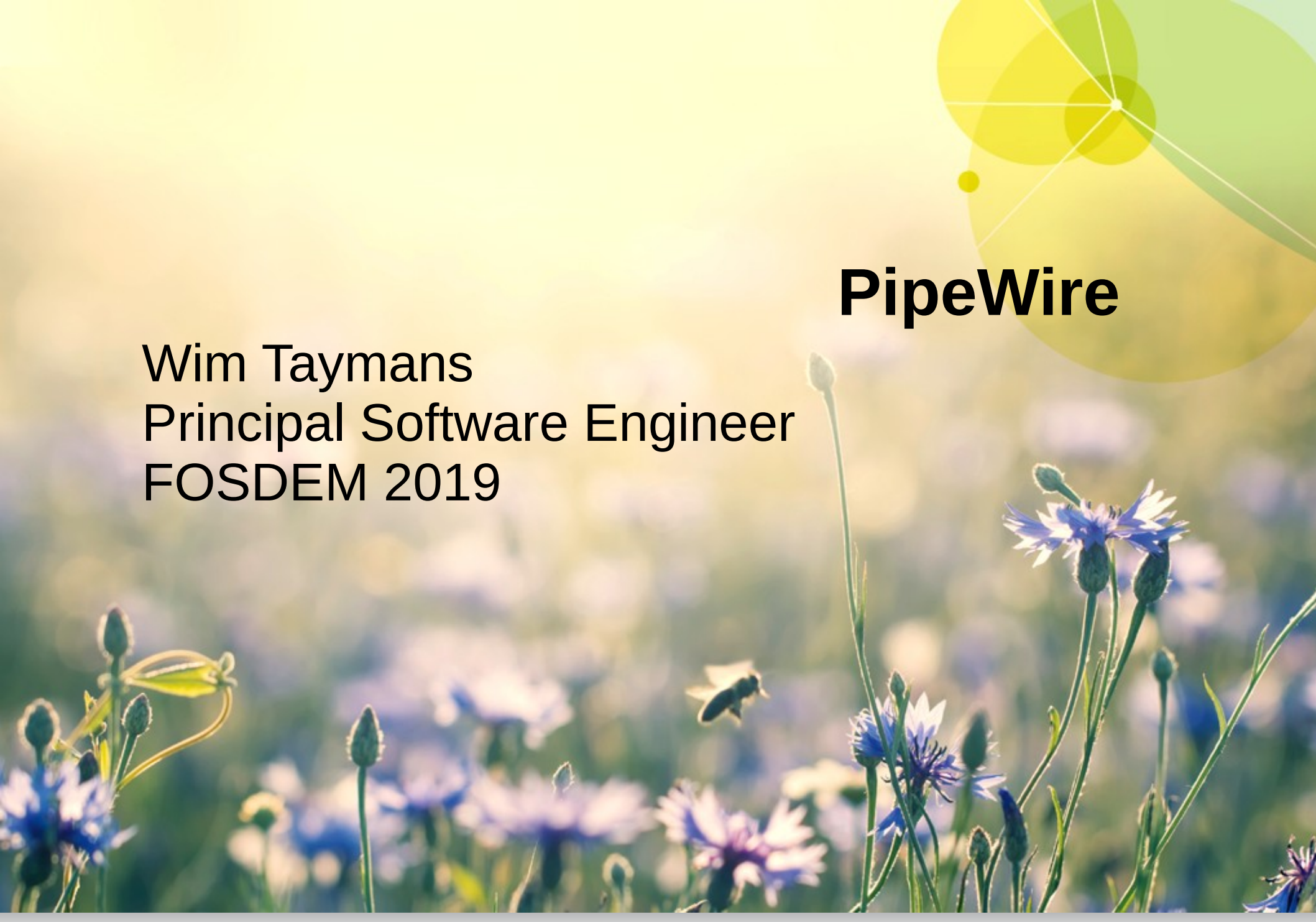


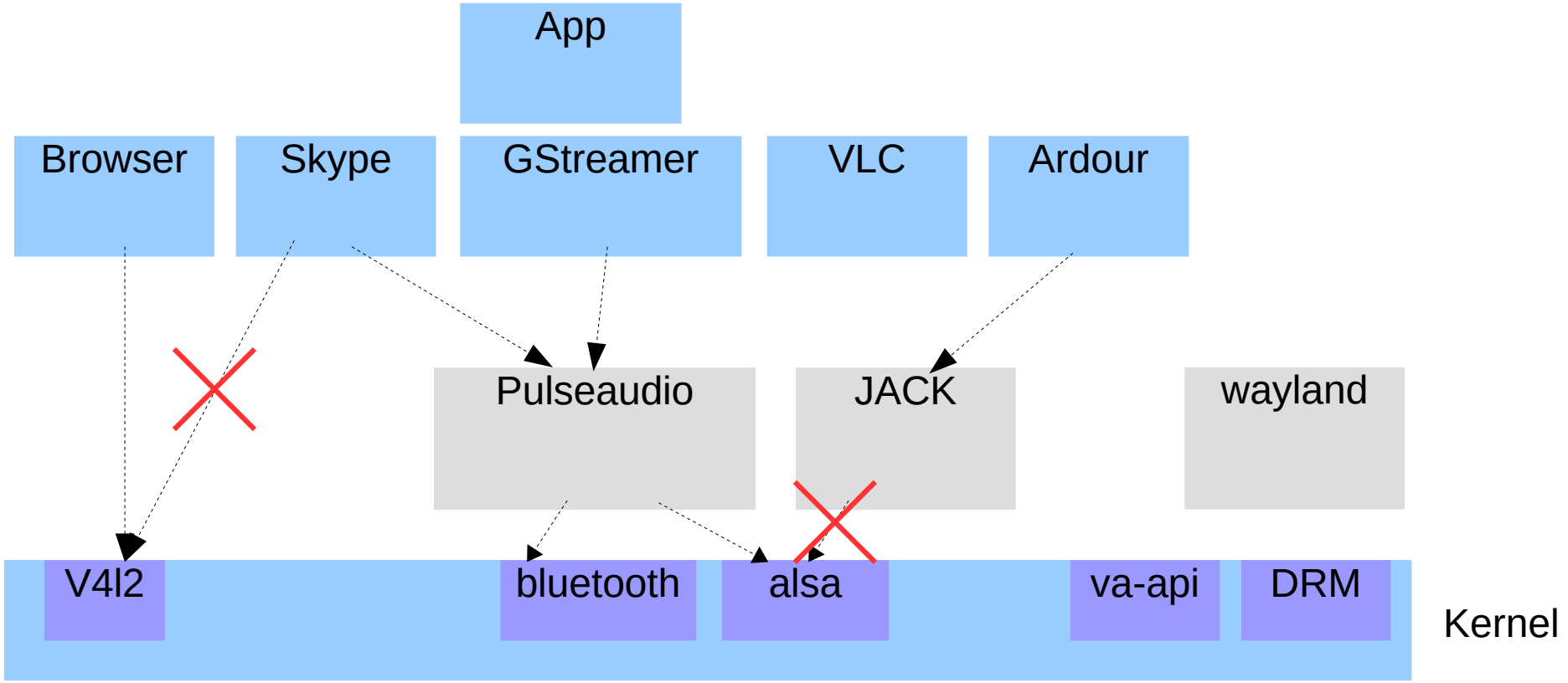
PipeWire

Wim Taymans
Principal Software Engineer
FOSDEM 2019

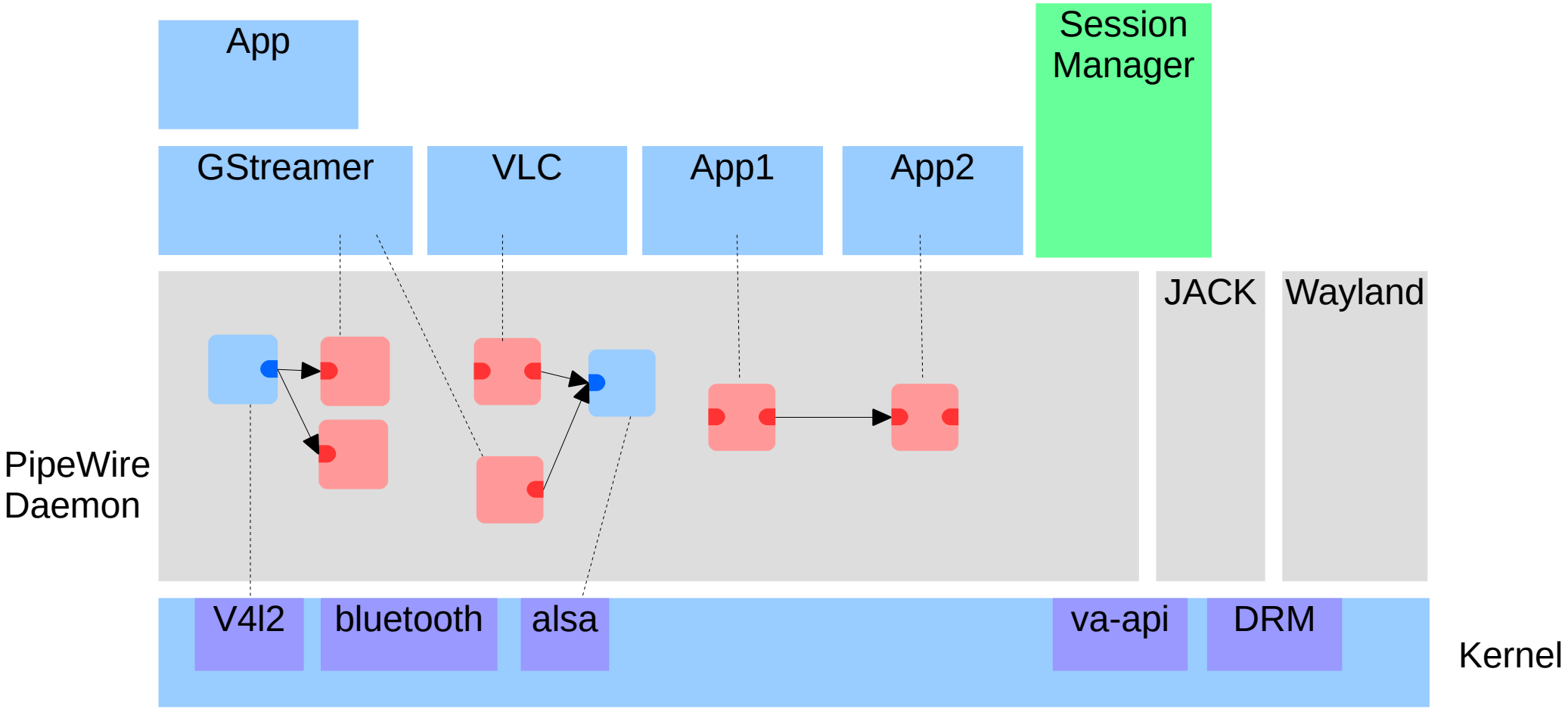
What is it

Multimedia sharing and processing engine

The multimedia stack



PipeWire


App
Session Manager
GStreamer
VLC
App1
App2
JACK
Wayland
PipeWire Daemon
V4l2
bluetooth
alsa
va-api
DRM
Kernel

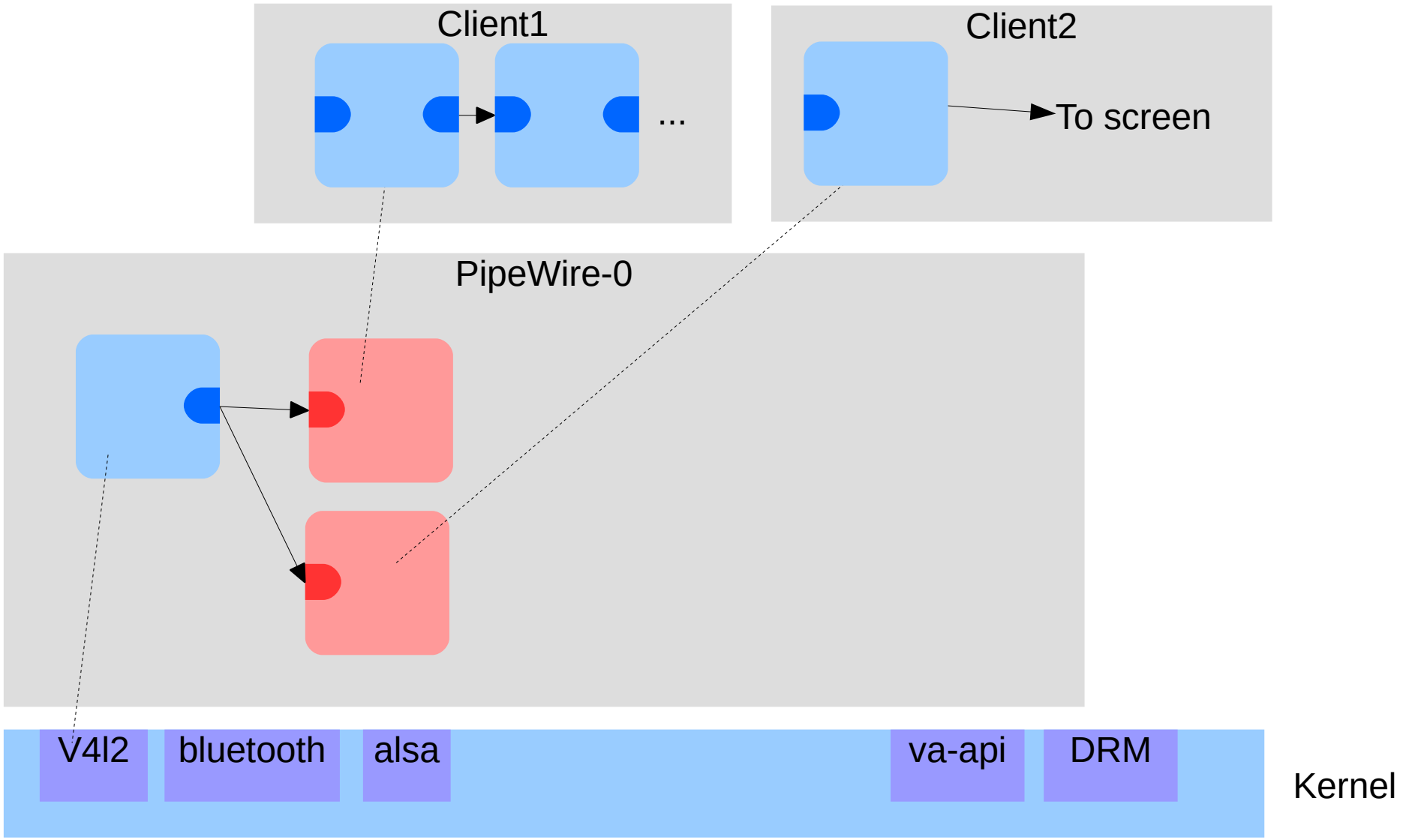
Features

- Exchange media with devices and other apps
  - Zero copy, shared memory, memfd, dmabuf, eventfd
- Security per application
  - Visible objects (R), methods (WX), ..
- RT capable, low latency (<1.5ms)
- All media types + generic control streams
- Simple JACK-like scheduler + feedback loops
- Extensible: types, protocol, ...
- External session manager implements policy

Session manager

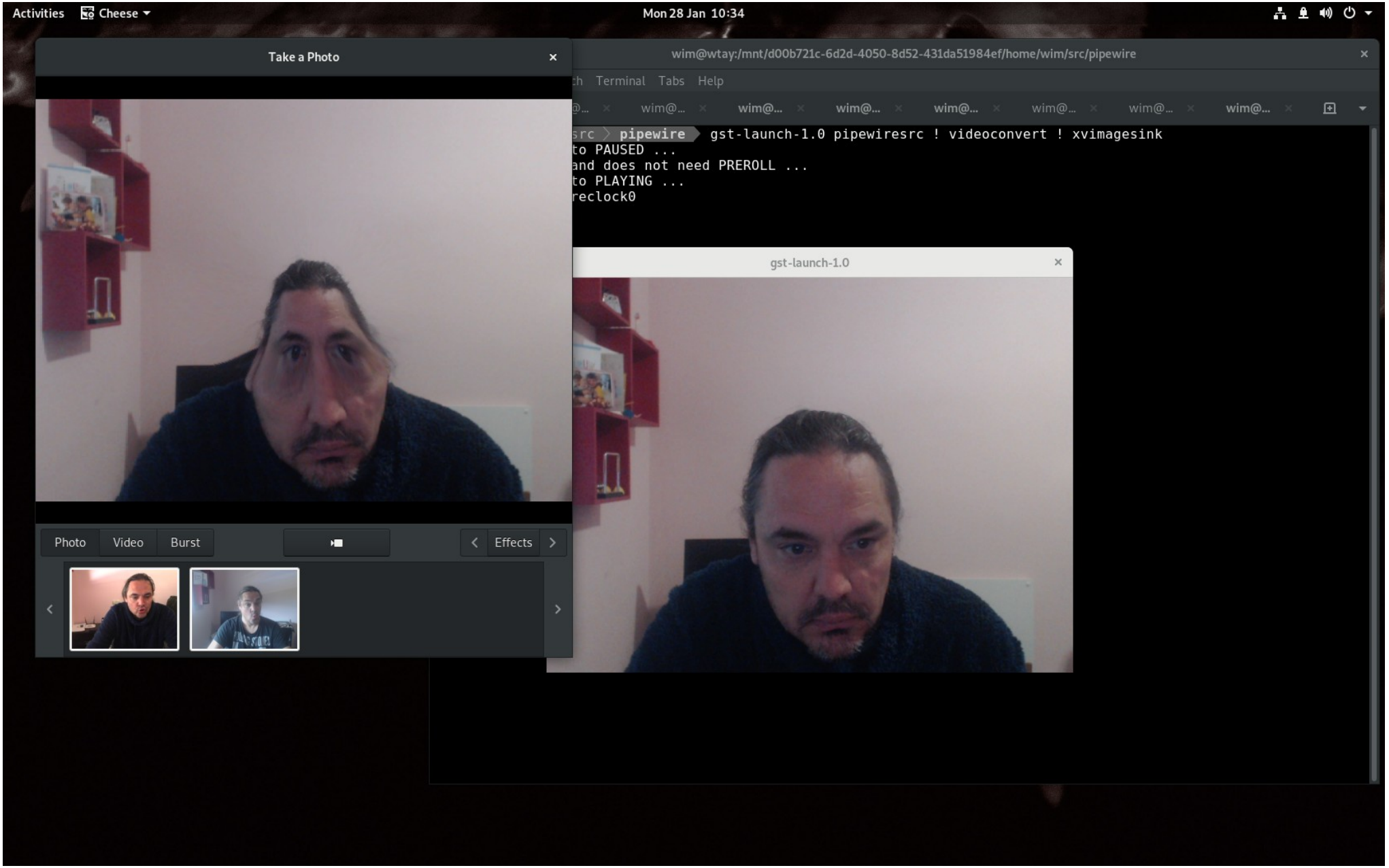
- Setup of devices
  - DSP processing, effects, mixers, ..
- Security of clients
  - What they can see, default permissions
- Management of links/nodes in the graph
  - What nodes and effects to link to (profiles, roles, ..)
  - Suspend of idle devices, volume restore, …
- The things you want to configure

V4l2 capture/sharing

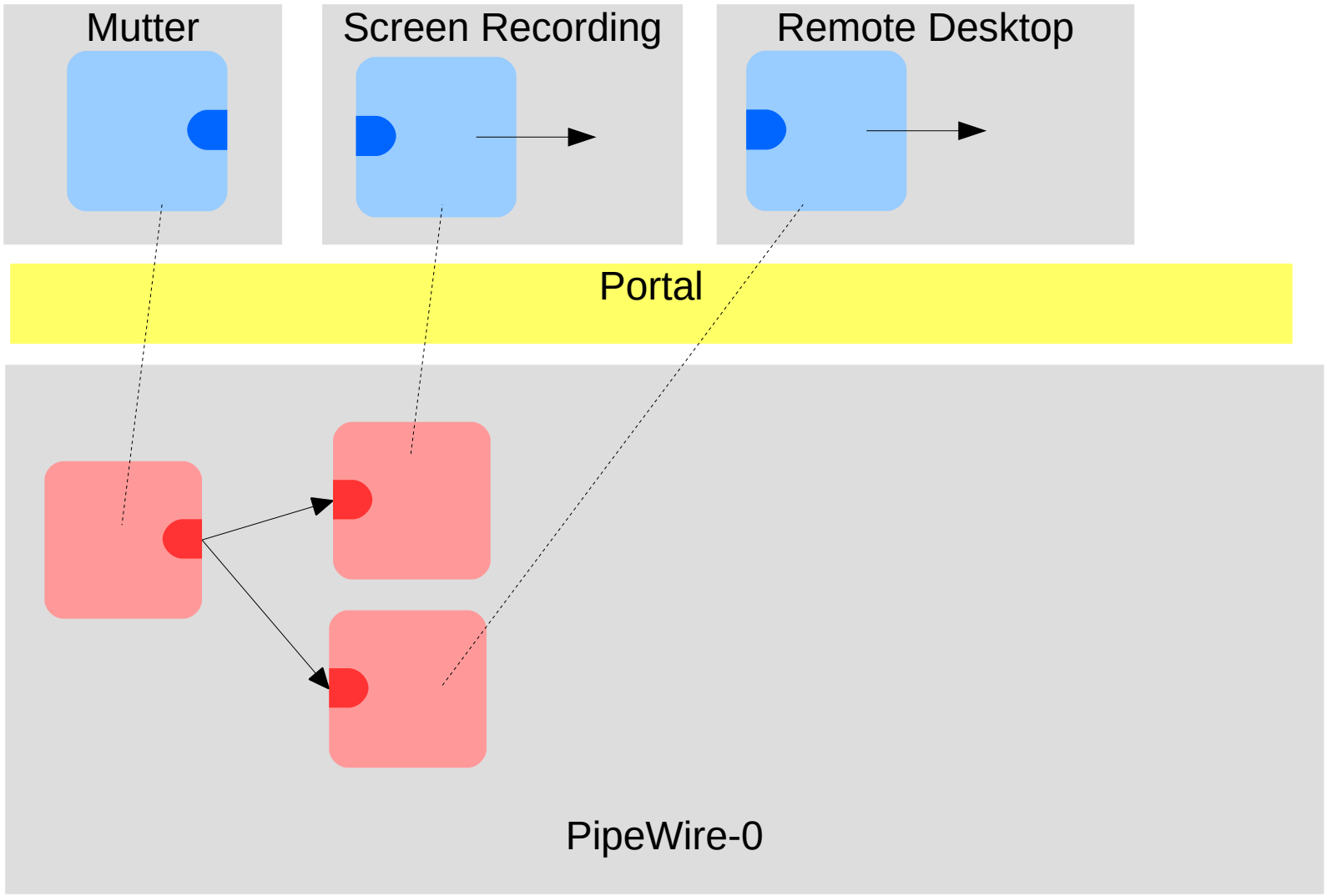


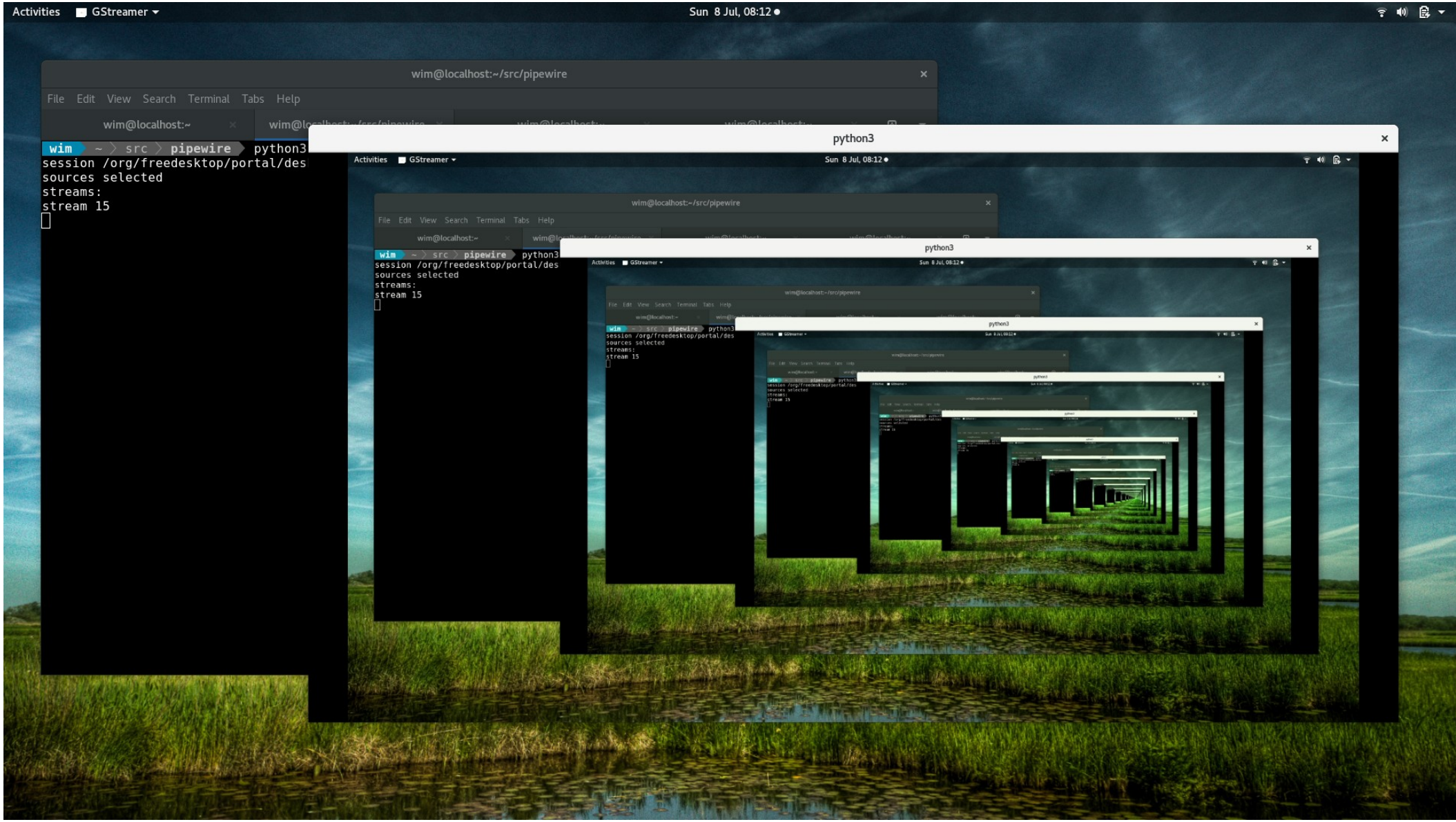
Video capture

- Systemd socket activation in Fedora 29
- Gstreamer pipewiresrc
- Device Monitor
- Autovideosrc → Should work in cheese


Activities
Cheese
Mon 28 Jan 10:34
Take a Photo
Photo
Video
Burst
Effects
wim@wtay:/mnt/d00b721c-6d2d-4050-8d52-431da51984ef/home/wim/src/pipewire
Terminal
Tabs
Help
pipewire
gst-launch-1.0 pipewiresrc ! videoconvert ! xvimagesink
to PAUSED ...
and does not need PREROLL ...
to PLAYING ...
reclock0
gst-launch-1.0

Wayland screen sharing

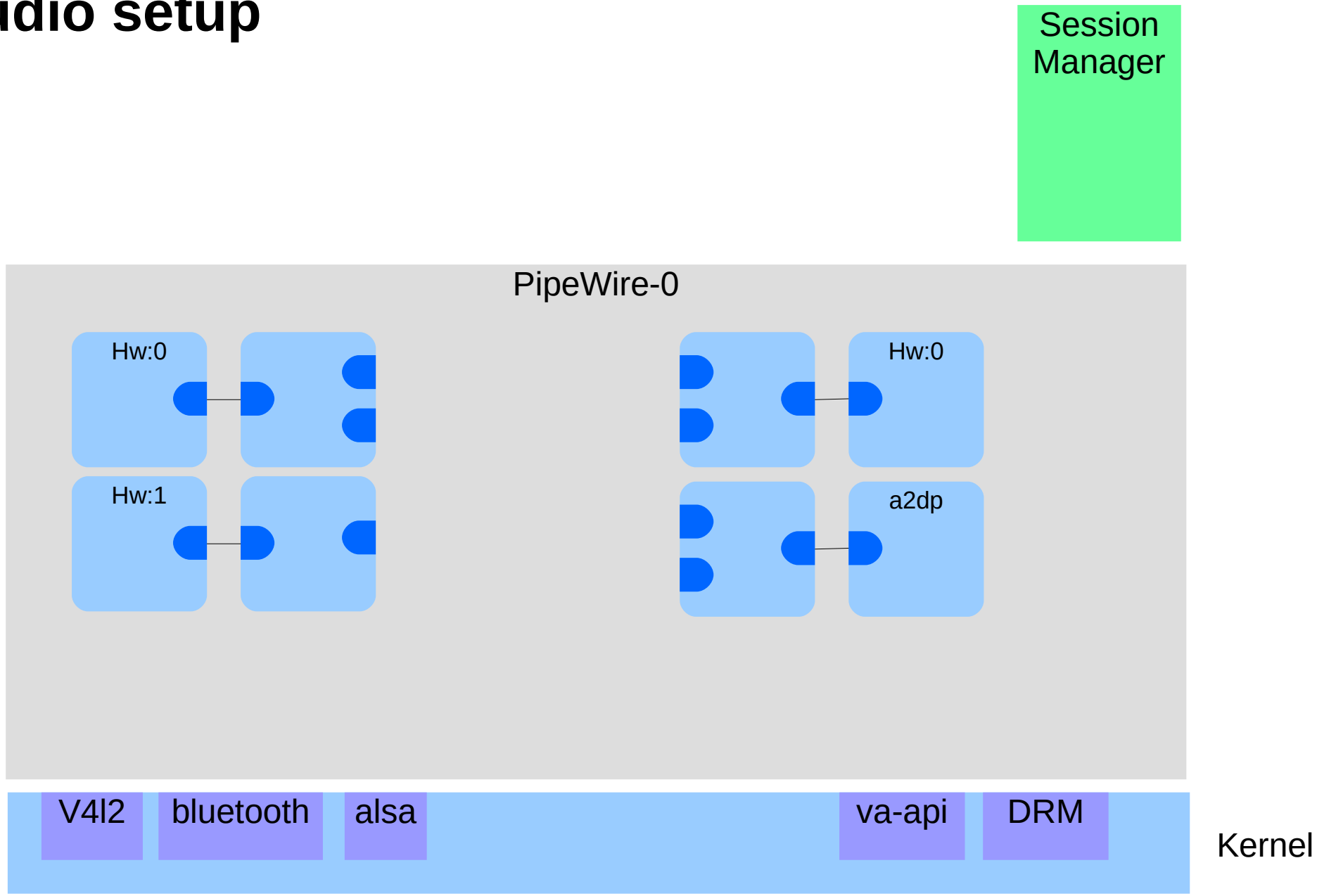



Activities
GStreamer
Sun 8 Jul, 08:12
wim@localhost:~/src/pipewire
File Edit View Search Terminal Tabs Help
wim@localhost:~
wim ~ src pipewire python3
session /org/freedesktop/portal/des
sources selected
streams:
stream 15
python3

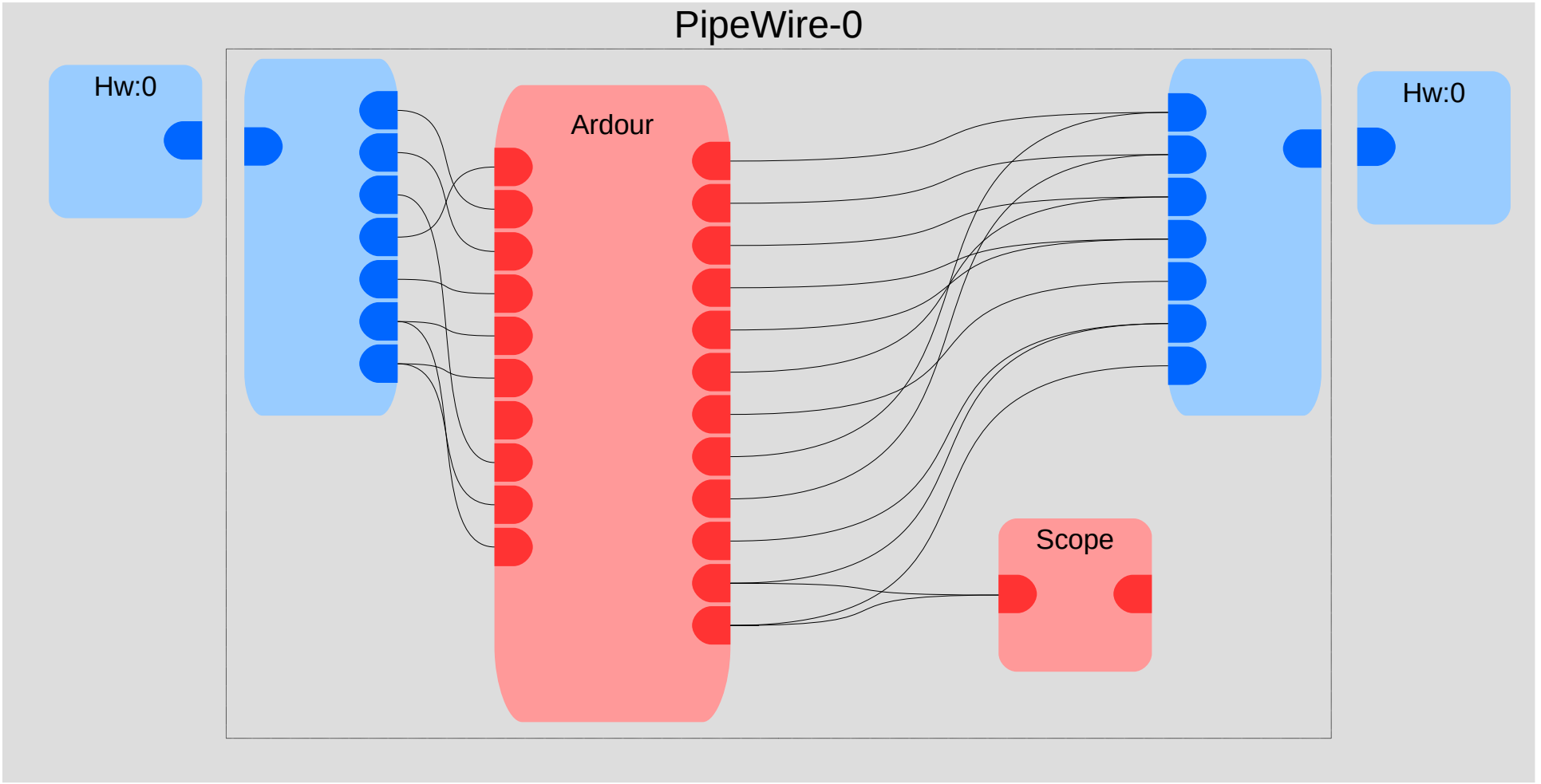
Audio Support

- Pro Audio model like JACK is choosen
  - 1 format (float32)
  - 1 buffer size (but is dynamic in PipeWire)
  - Channels are split into mono streams
  - All nodes are woken up in each cycle in turn
  - Sinks have an audio adapter in front to mix, merge, resample, split and convert the channels
  - Sinks are created/destroyed dynamically
    - Multiple sinks/sources
    - Automatic clock slaving

Audio setup


Session Manager
PipeWire-0
Hw:0
Hw:1
Hw:0
a2dp
V4l2
bluetooth
alsa
va-api
DRM
Kernel

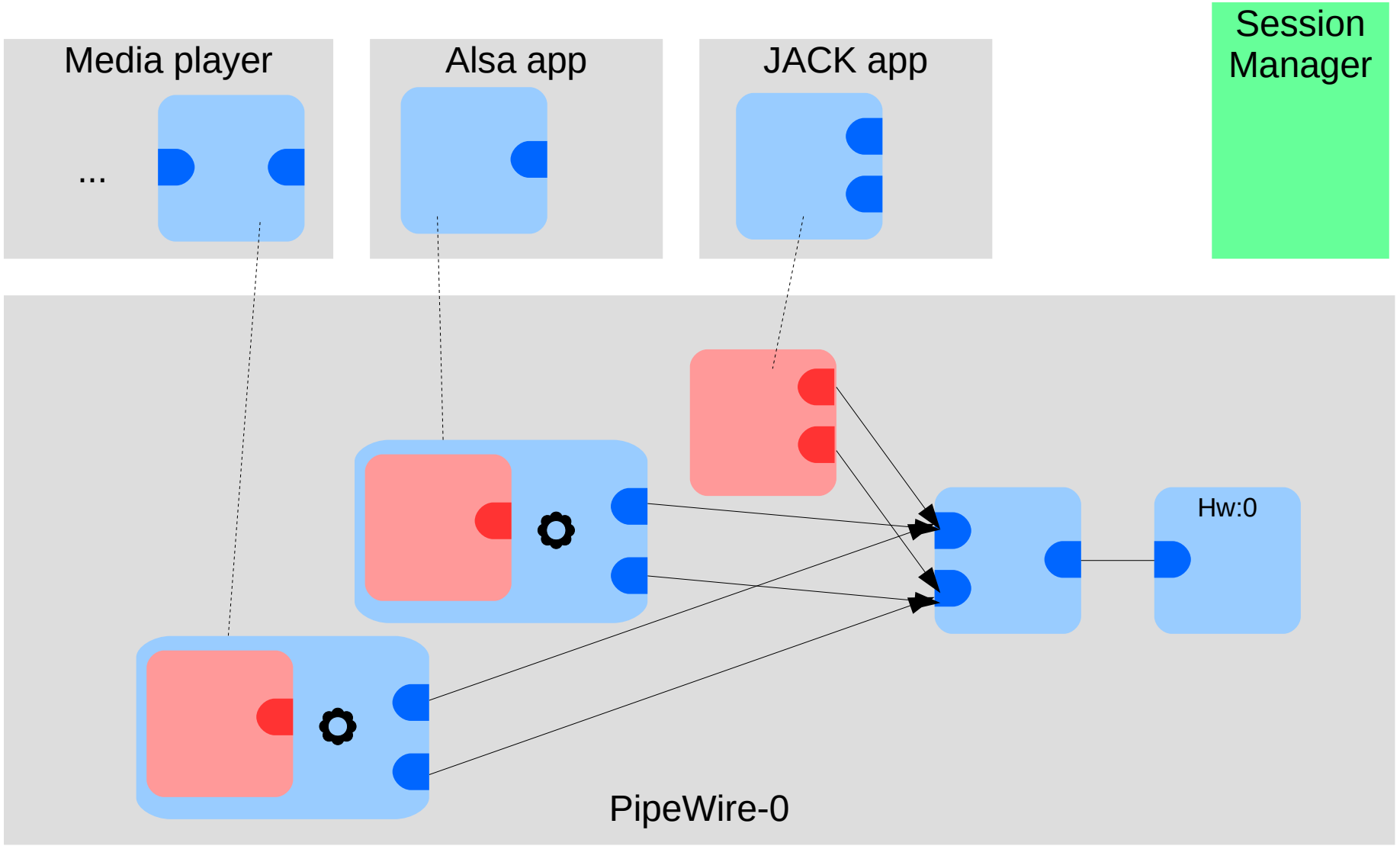
Pro audio



Audio stream

- Takes input from client (asynchronously)
- Does conversion
  - Resample
  - channelmix/volume
  - Format conversion
  - Channel splitting into DSP
  - Decouples server buffer size from client requested latency
- Flush/drain

Audio server

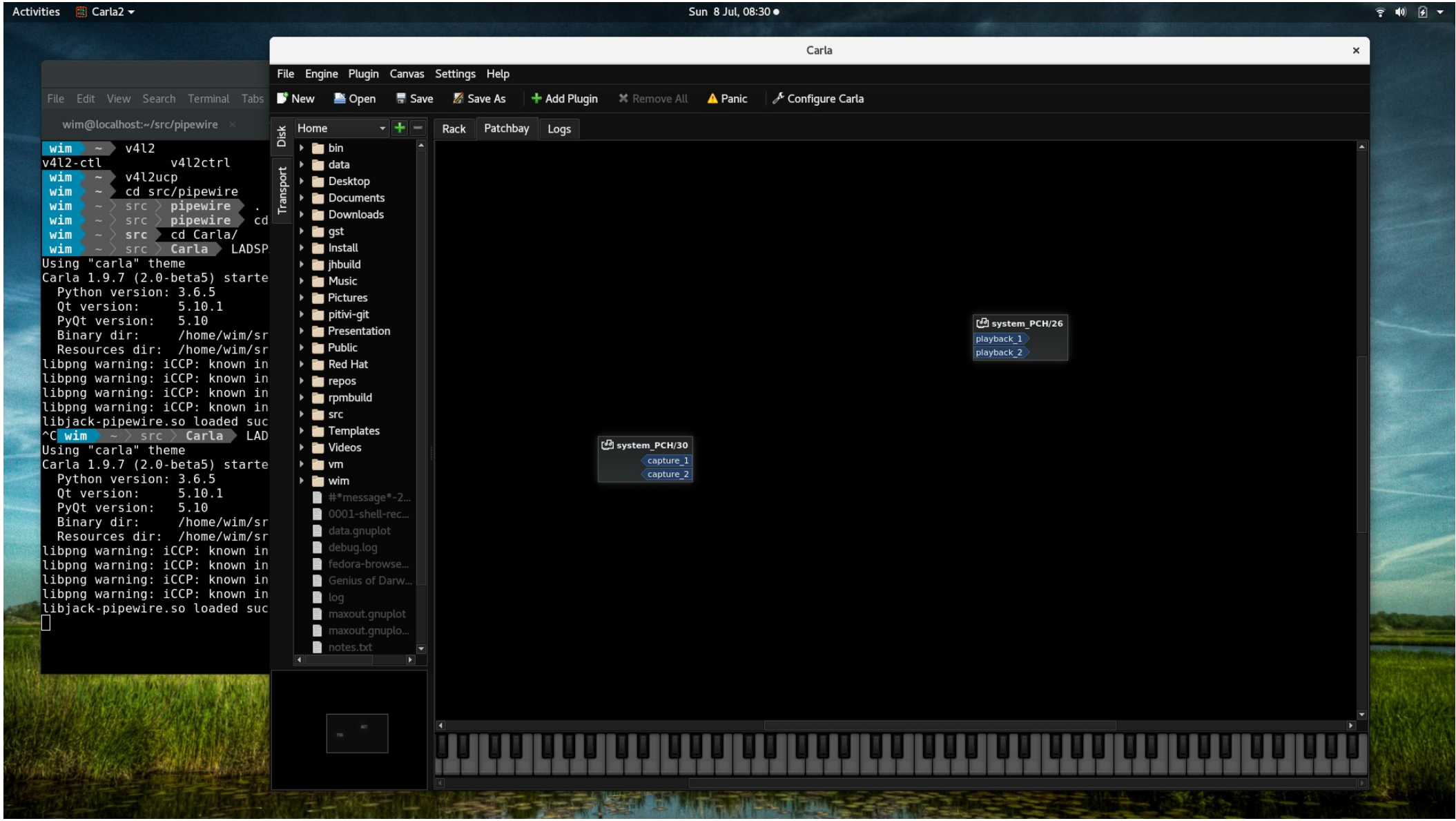


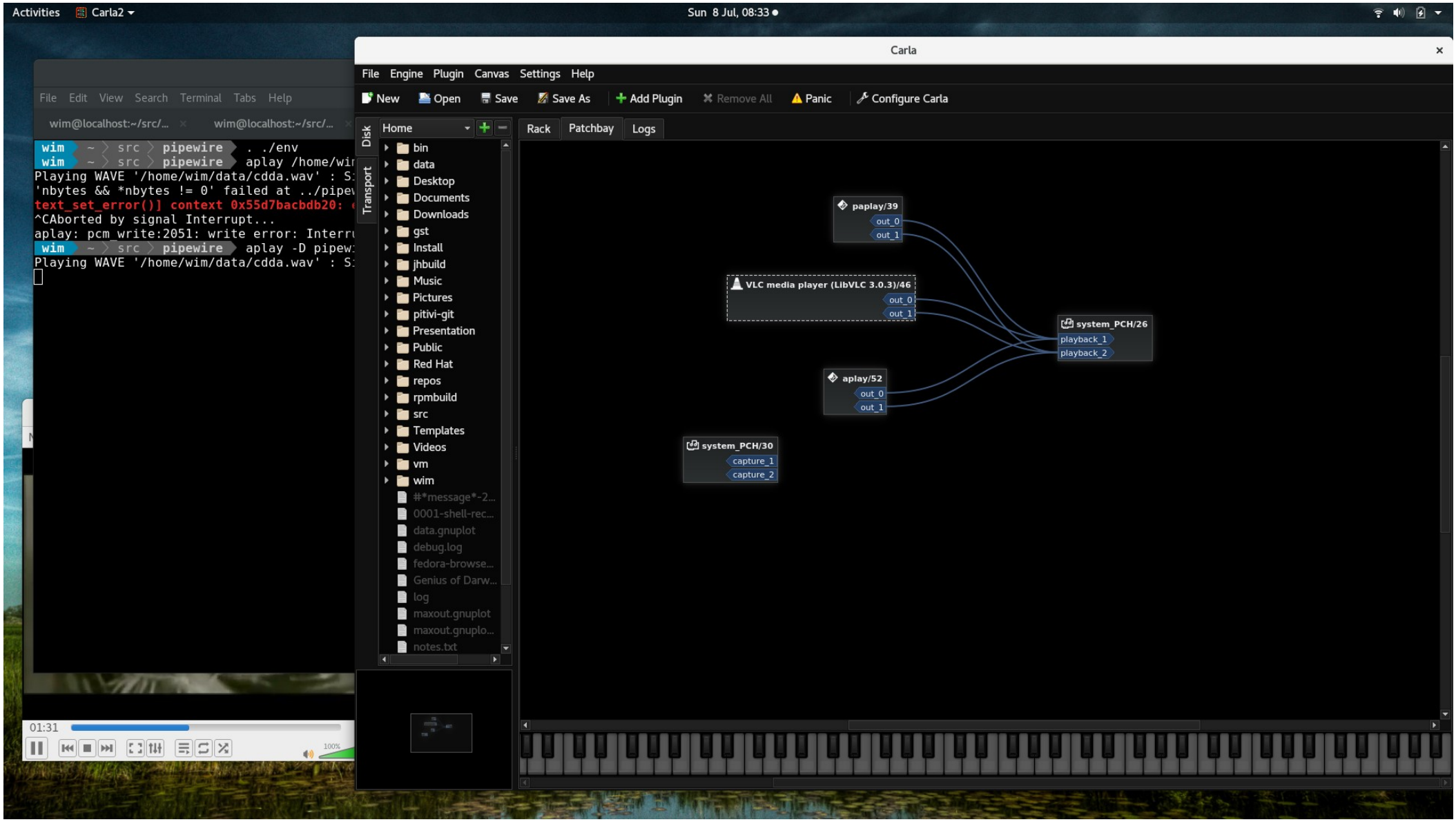
API support

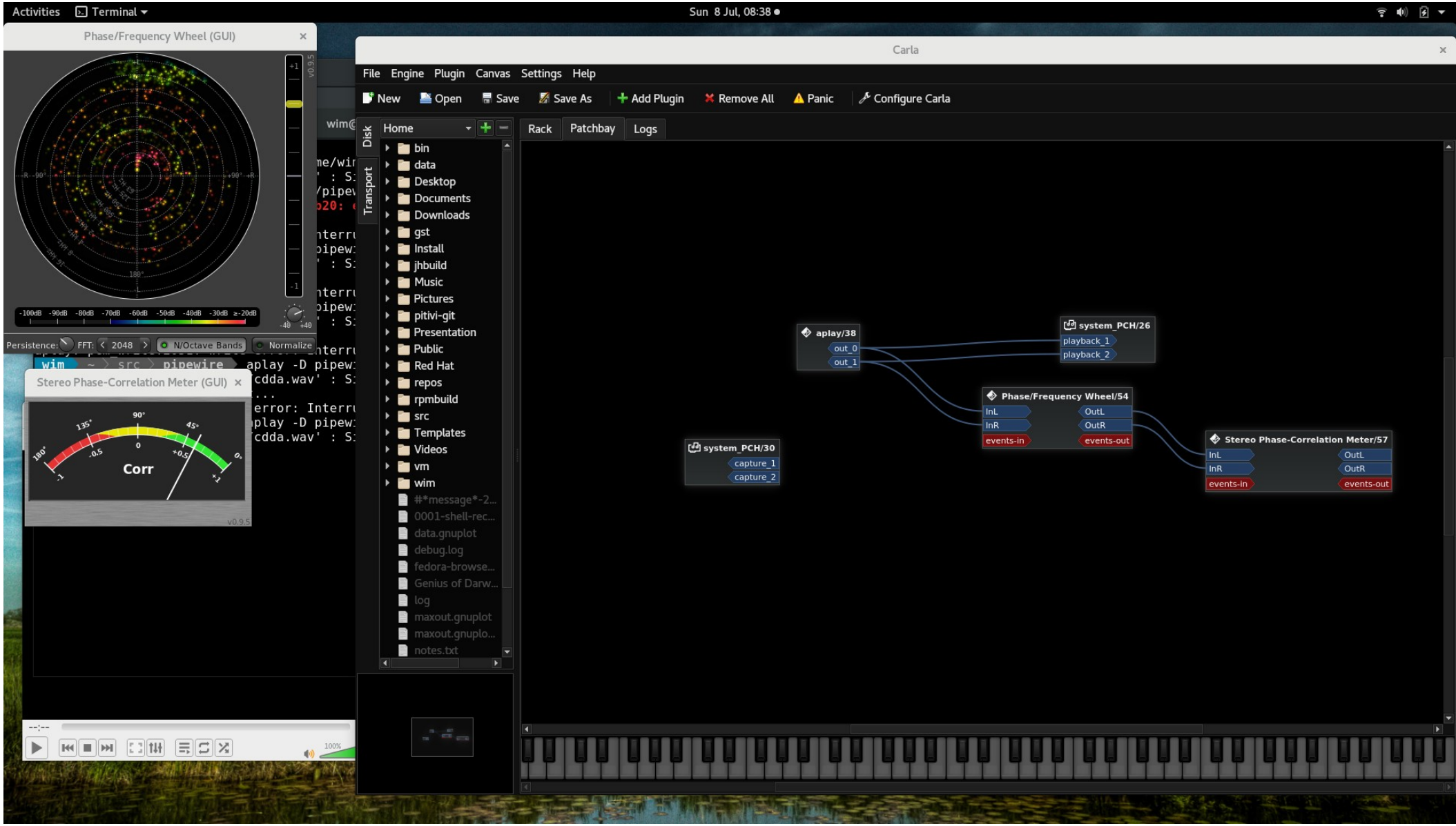
- PulseAudio apps
  - Replacement libpulse.so, libpulse-mainloop-glib.so
  - Built with streams API
- ALSA apps
  - PipeWire plugin
  - Built with streams API

JACK support

- Integration with device reservation API
  - When JACK claims device, replace our device with JACK client and we simply become a jack client.
- For sandboxed apps
  - Replacement libjack.so
  - Built on top of native PipeWire


Activities
Carla2
Sun 8 Jul, 08:30
Carla
File Engine Plugin Canvas Settings Help
New Open Save Save As Add Plugin Remove All Panic Configure Carla
Disk
Transport
Home
Rack Patchbay Logs
bin
data
Desktop
Documents
Downloads
gst
Install
jhbuild
Music
Pictures
pitivi-git
Presentation
Public
Red Hat
repos
rpmbuild
src
Templates
Videos
vm
wim
system_PCH/26
playback_1
playback_2
system_PCH/30
capture_1
capture_2
File Edit View Search Terminal Tabs
wim@localhost:~/src/pipewire
wim ~ v4l2
v4l2-ctl v4l2ctrl
wim ~ v4l2ucp
wim ~ cd src/pipewire
wim ~ src pipewire .
wim ~ src pipewire cd
wim ~ src cd Carla/
wim ~ src Carla LADSP
Using "carla" theme
Carla 1.9.7 (2.0-beta5) starte
Python version: 3.6.5
Qt version: 5.10.1
PyQt version: 5.10
Binary dir: /home/wim/sr
Resources dir: /home/wim/sr
libpng warning: iCCP: known in
libpng warning: iCCP: known in
libpng warning: iCCP: known in
libpng warning: iCCP: known in
libjack-pipewire.so loaded suc
^C wim ~ src Carla LAD
Using "carla" theme
Carla 1.9.7 (2.0-beta5) starte
Python version: 3.6.5
Qt version: 5.10.1
PyQt version: 5.10
Binary dir: /home/wim/sr
Resources dir: /home/wim/sr
libpng warning: iCCP: known in
libpng warning: iCCP: known in
libpng warning: iCCP: known in
libpng warning: iCCP: known in
libjack-pipewire.so loaded suc


Activities
Carla2
Sun 8 Jul, 08:33
Carla
File Engine Plugin Canvas Settings Help
New Open Save Save As Add Plugin Remove All Panic Configure Carla
Disk
Transport
Home
bin
data
Desktop
Documents
Downloads
gst
Install
jhbuild
Music
Pictures
pitivi-git
Presentation
Public
Red Hat
repos
rpmbuild
src
Templates
Videos
vm
wim
Rack
Patchbay
Logs
paplay/39
out_0
out_1
VLC media player (LibVLC 3.0.3)/46
out_0
out_1
system_PCH/26
playback_1
playback_2
aplay/52
out_0
out_1
system_PCH/30
capture_1
capture_2
File Edit View Search Terminal Tabs Help
wim@localhost:~/src/...
wim@localhost:~/src/...
wim ~ src pipewire . ./env
wim ~ src pipewire aplay /home/wim
Playing WAVE '/home/wim/data/cdda.wav' : S
'nbytes && *nbytes != 0' failed at ../pipew
text_set_error()] context 0x55d7bacbdb20:
^CAborted by signal Interrupt...
aplay: pcm_write:2051: write error: Interru
wim ~ src pipewire aplay -D pipew
Playing WAVE '/home/wim/data/cdda.wav' : S
01:31


Activities
Terminal
Sun 8 Jul, 08:38
Phase/Frequency Wheel (GUI)
Persistence:
FFT:
2048
N/Octave Bands
Normalize
Stereo Phase-Correlation Meter (GUI)
Corr
Carla
File
Engine
Plugin
Canvas
Settings
Help
New
Open
Save
Save As
Add Plugin
Remove All
Panic
Configure Carla
Disk
Transport
Home
bin
data
Desktop
Documents
Downloads
gst
Install
jhbuild
Music
Pictures
pitivi-git
Presentation
Public
Red Hat
repos
rpmbuild
src
Templates
Videos
vm
wim
Rack
Patchbay
Logs
aplay/38
out_0
out_1
system_PCH/26
playback_1
playback_2
Phase/Frequency Wheel/54
InL
InR
events-in
OutL
OutR
events-out
system_PCH/30
capture_1
capture_2
Stereo Phase-Correlation Meter/57

Latest changes (work branch)

- Unit tests + benchmarks + api cleanups
- Client permission API
- MIT relicensed
- DLL for resampling and audio timing in devices
- Cursor and bitmap metadata
- Device objects + profiles
- Work on pavucontrol (peaks resampler, profiles, volumes,...)

Future plans

- More Latency/timing handling between nodes
- More session policy (dynamic samplerate, compressed formats, ...)
- Merging devices/clock slaving
- Transport
- Video path/effects…
- JACK handover
- Implement missing pulseaudio features
  - See https://github.com/PipeWire/pipewire/wiki/TODO

http://pipewire.org
https://github.com/PipeWire/pipewire
Questions?