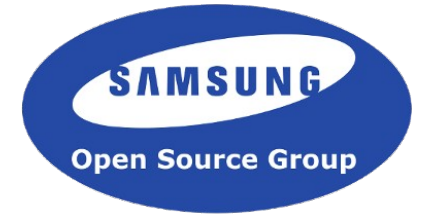


Media Resource Sharing Through The Media Controller API

Korea Linux Forum, October 26th 2015

Shuah Khan
Samsung Open Source Group
shuahkh@osg.samsung.com

Abstract

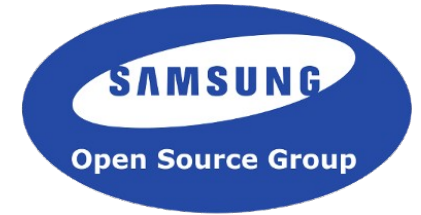


Media devices have hardware resources that are shared across several functions. However, media drivers have no knowledge of which resources are shared. For example, accessing DVB and ALSA at the same time, or the DVB and V4L analog video at the same time results in video and audio stream errors.

At the root of this problem is a lack of a common locking mechanism that can provide access control. As a result, it is necessary to create a locking construct at the master device level for all drivers that share a device to facilitate resource sharing. A common managed media device created at the parent USB device level can function as this locking construct.

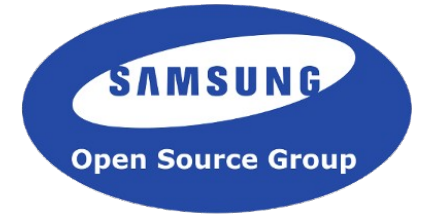
In this talk, Shuah will discuss the Managed Media Controller API and how ALSA and au0828 use it to share media resources. In addition, she will show how `media-ctl/mc_nextgen_test` tool can be used to generate media graphs for a media device.

Agenda ...



- Media Devices
- Media vs. Multi-function Devices
- Shared Media Functions Nicely - Challenges
- Exclusive Access Use-cases
- About Win-TV HVR 950Q
- Media Controller API
- Managed Media Controller API
- HVR 950Q Drivers with Managed Media Device
- HVR 950Q Device Media Graphs
- HVR 950Q Drivers Sharing Resources

Media Devices ...



**Hauppauge Win TV HVR 950Q
Hybrid USB TV Stick**

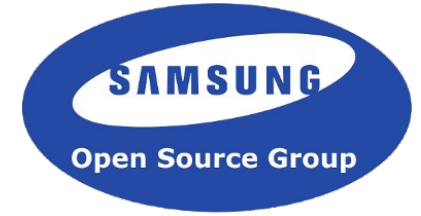


Kworld UB435-Q V3



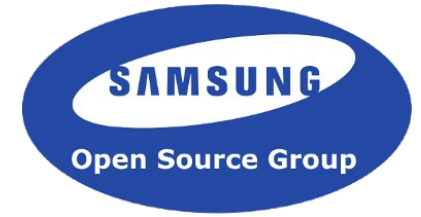
Hauppauge 80e PCTV HD Mini Stick

Media vs. Multi-function Devices ...



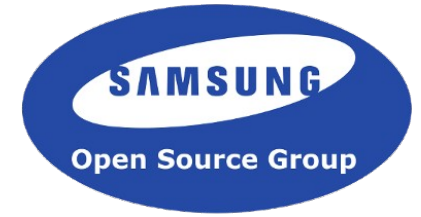
- A group of independent devices.
 - Each device implements a function.
 - Sharing is not limited to attach point.
- A single device.
 - MFD framework helps identify functions as discrete platform devices.
 - Sharing is limited to attach point – sub-devices attached to a shared bus.

Media vs. Multi-function Devices ...



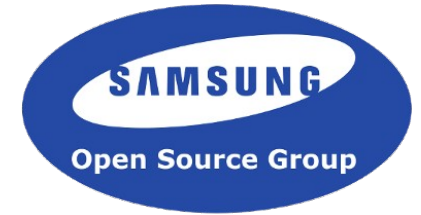
- Functions can be shared.
 - Media drivers have to coordinate sharing.
 - Fine grain locking.
 - Leverage non-media drivers.
e.g: snd-usb-audio for audio function.
- Each function is independent.
 - Drivers don't need to coordinate sharing.
 - Fine grain locking.

Sharing Media Functions Nicely - Challenges ...



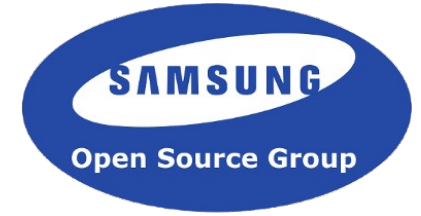
- Drivers are unaware of shared resources.
- Drivers don't have a way to ensure exclusive access to shared resource/function.
 - e.g: Starting Digital application disrupts Video streaming.
- Drivers can access/change modes while resource is in use by another.
- Existing fine grain locks don't ensure exclusive access.
- Existing locks are local to function drivers. No global locks that span all drivers.

Exclusive Access Use-cases ...



- Starting Digital application ...
 - should not disrupt active Video and Audio streams.
- Starting Video application ...
 - should not disrupt active Digital and Audio streams.
- Starting Audio application ...
 - should not disrupt Video and Digital streams.
- Querying current configuration (read only access) should work.

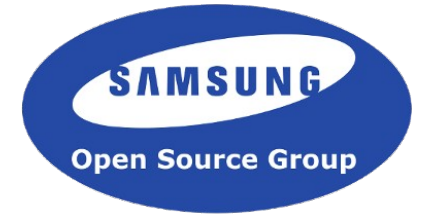
About Win-TV HVR 950Q ...



Hardware:

- USB bus – attach point
- Tuner on I2C bus
- Audio Processor
- Decoder
- Video
- Digital
- No Radio
- IR receiver (No transmitter)

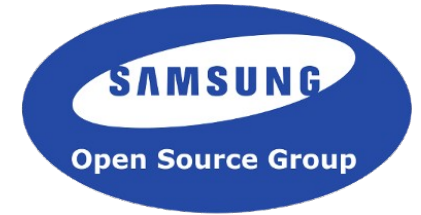
About Win-TV HVR 950Q ...



Drivers:

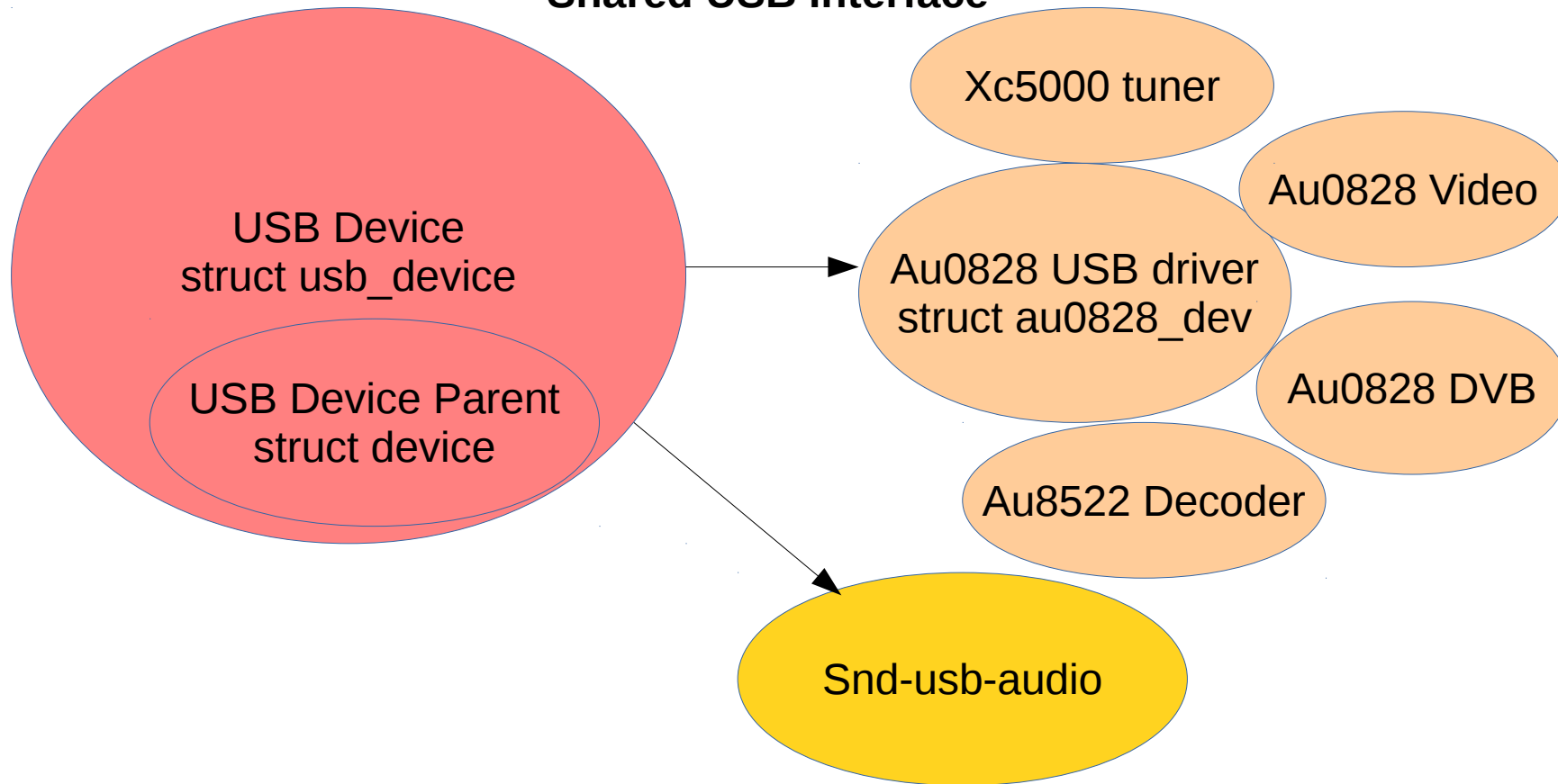
- au0828 usb driver
- au0828 dvb extension
- au0828 analog (v4l2) extension
- i2c Hauppauge eeprom decoder driver
- Xceive xc5000 silicon tuner driver
- snd-usb-audio

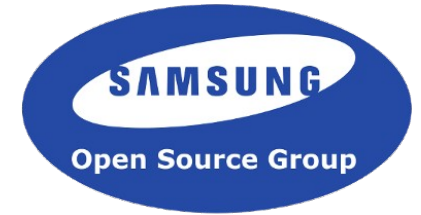
About Win-TV HVR 950Q ...



Device/Driver view:

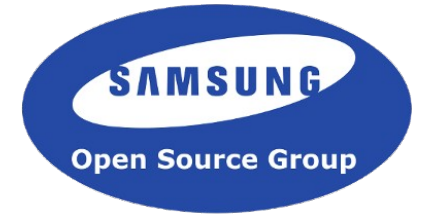
Shared USB Interface





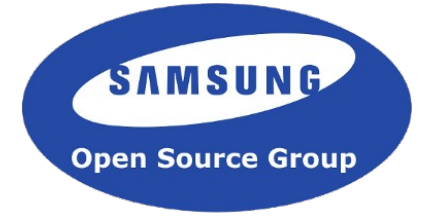
Shared Resource Exclusive Locking ...

Media Controller API ...



- Relational media graph framework
- Media functions/resources represented as nodes on a graph
- Media Device serves as the root node
- Allows creating links between nodes
- Allows active/inactive links between nodes
- Allows start/stop pipelines between nodes

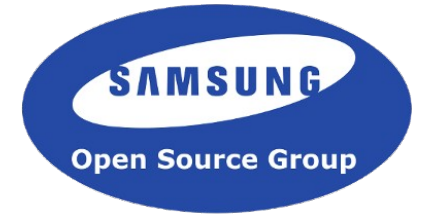
Managed Media Controller API ...



Media Device as a device resource

- `media_device_get_devres()`
- `media_device_find_devres()`

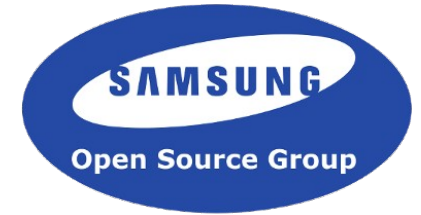
Managed Media Controller API ...



Allows au0828 and snd-usb-audio share media device

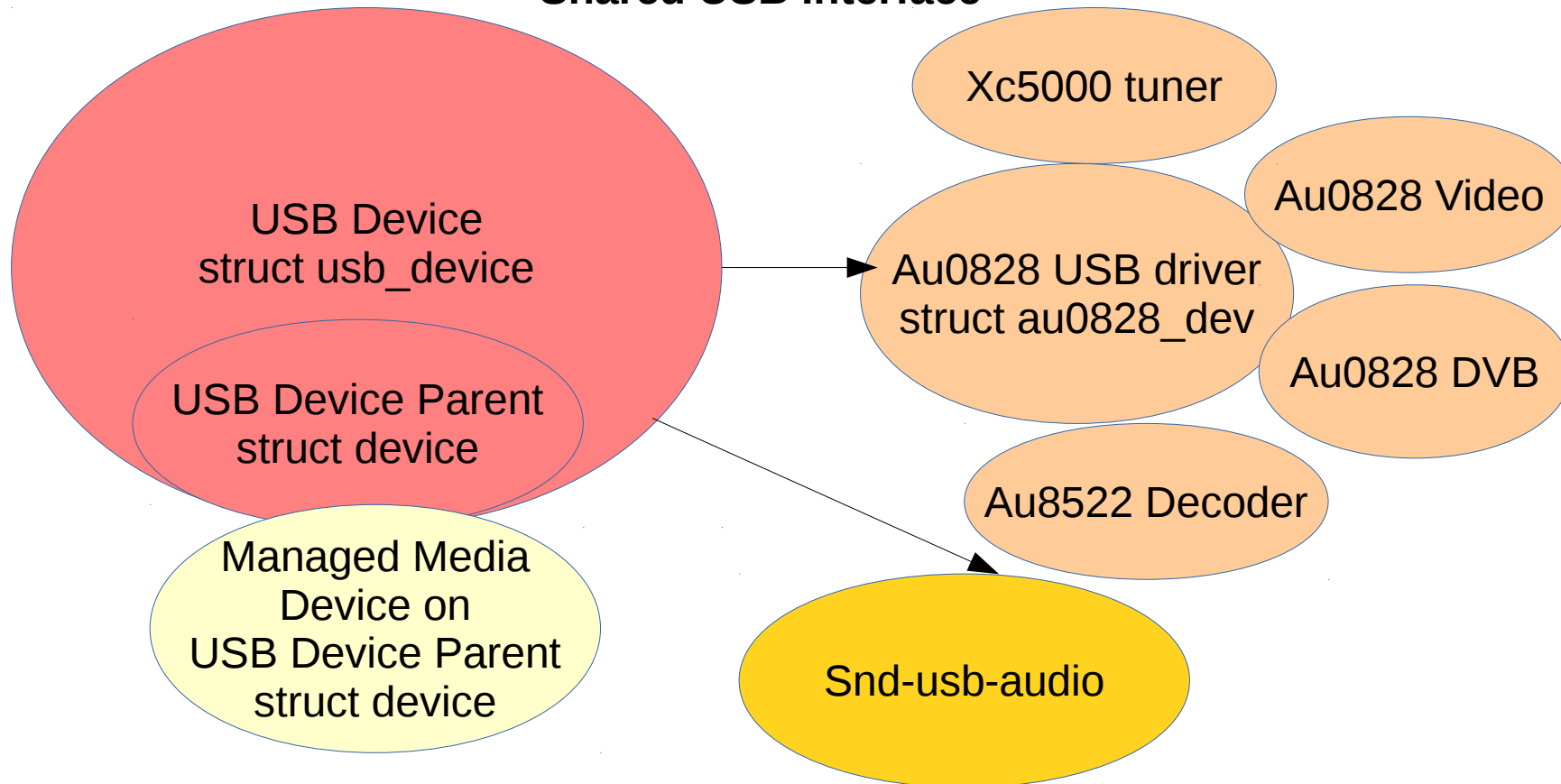
- Media Device is a managed device resource at the parent USB device.
- Media Device is the root node for the shared media graph.
- Media Device gets created by either au0828 or snd-usb-audio – first one to run probe wins.

HVR 950Q drivers with Managed Media Device ...



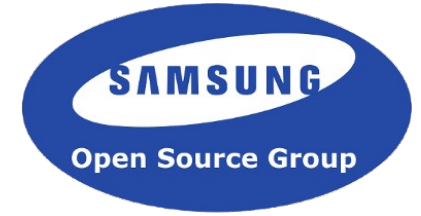
Device/Driver view:

Shared USB Interface



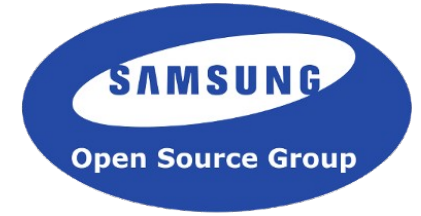
Shared Media Device

Media Controller Entity Notify API ...



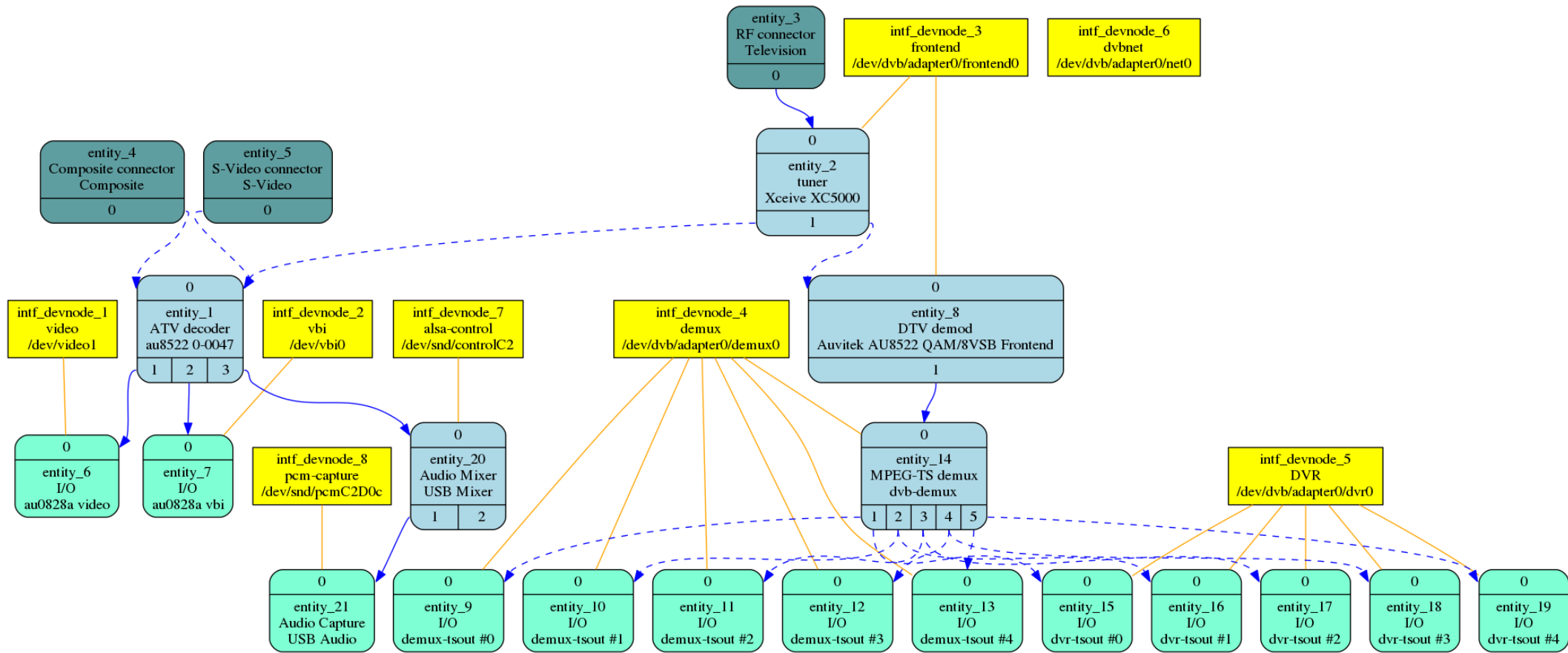
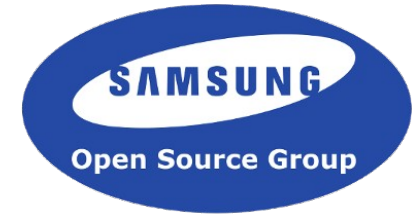
- `media_device_register_entity_notify()`
- `media_device_unregister_entity_notify()`
- Enables drivers to register callbacks to take action as entities get added by other drivers.

Shared Media Graph Creation ...

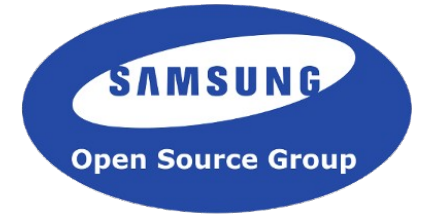


- Drivers (au0828, and snd-usb-audio) add entities for their functions.
- Bridge driver (au0828) creates links between entities via entity_notify API.

HVR 950Q Media Graph ...

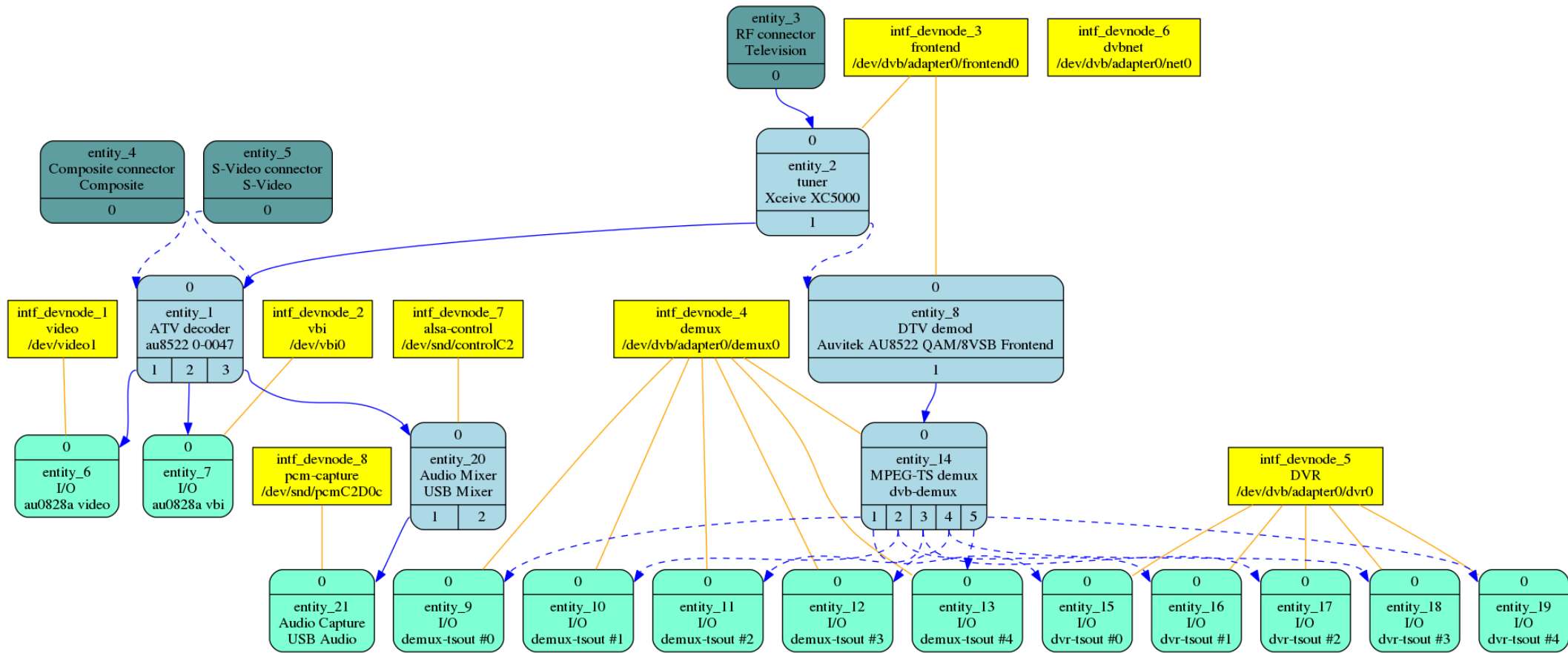
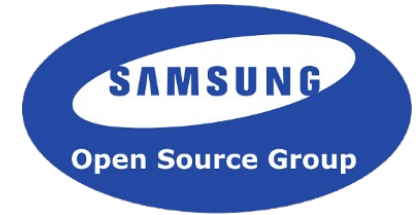


Media Controller Enable/Disable Source handlers ...

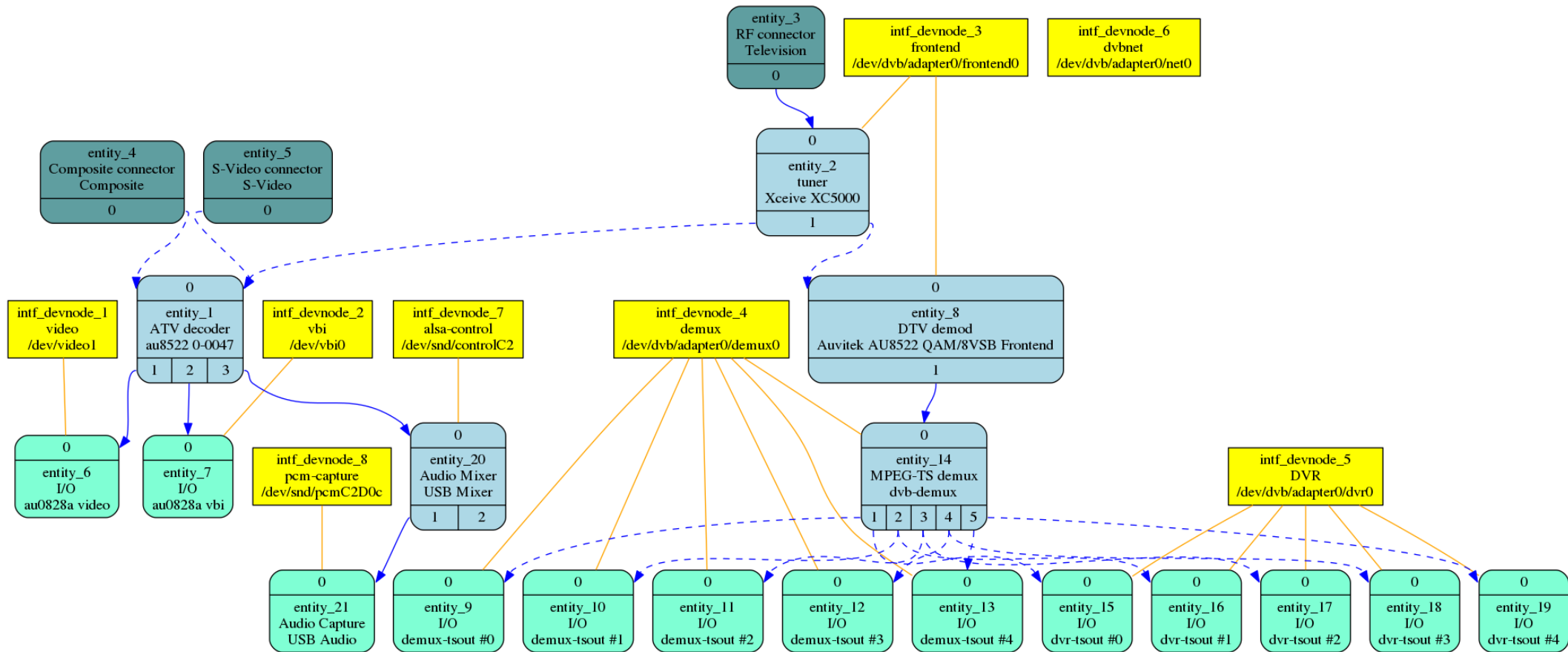
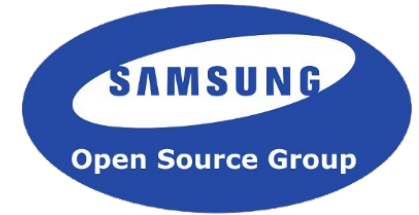


- Media Device - enable/disable source handlers.
- Enable source grants access to shared resource or returns -EBUSY.
- Disable source marks shared resource free.
- Bridge drivers (e.g au0828) implement and register enable/disable source handlers to manage access to shared resources.

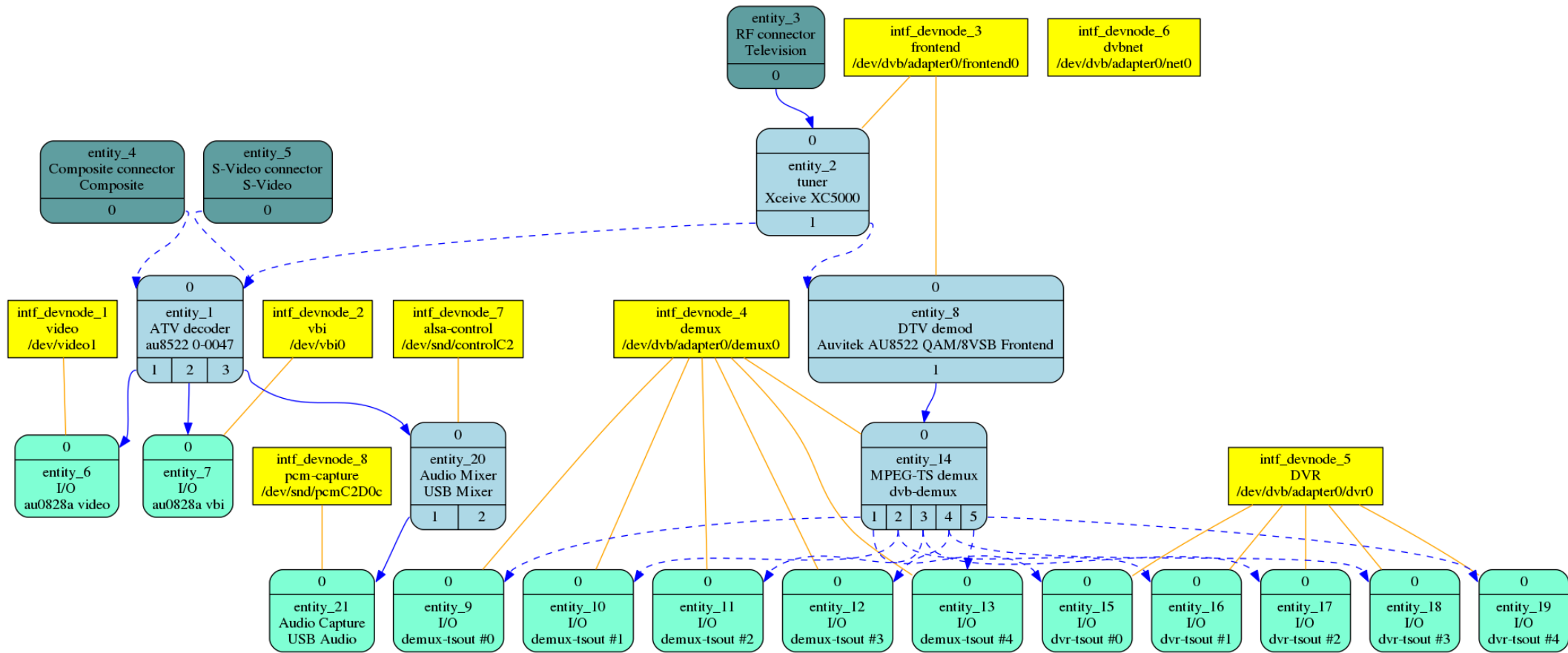
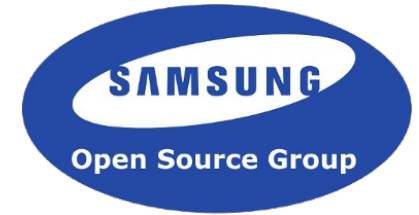
Audio owns tuner ...



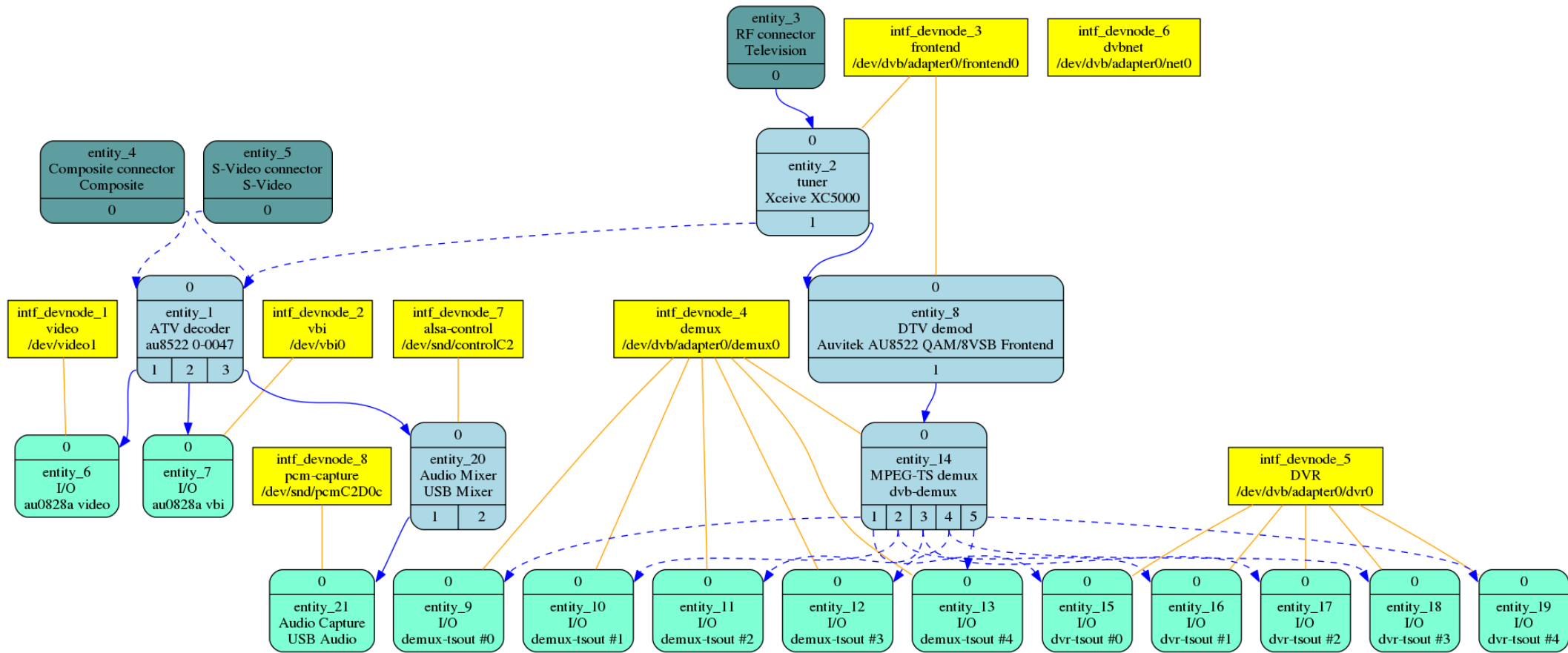
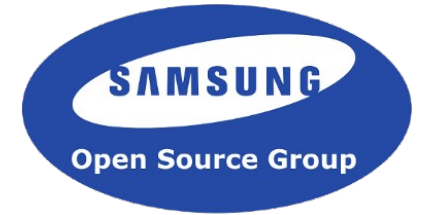
Audio releases tuner ...



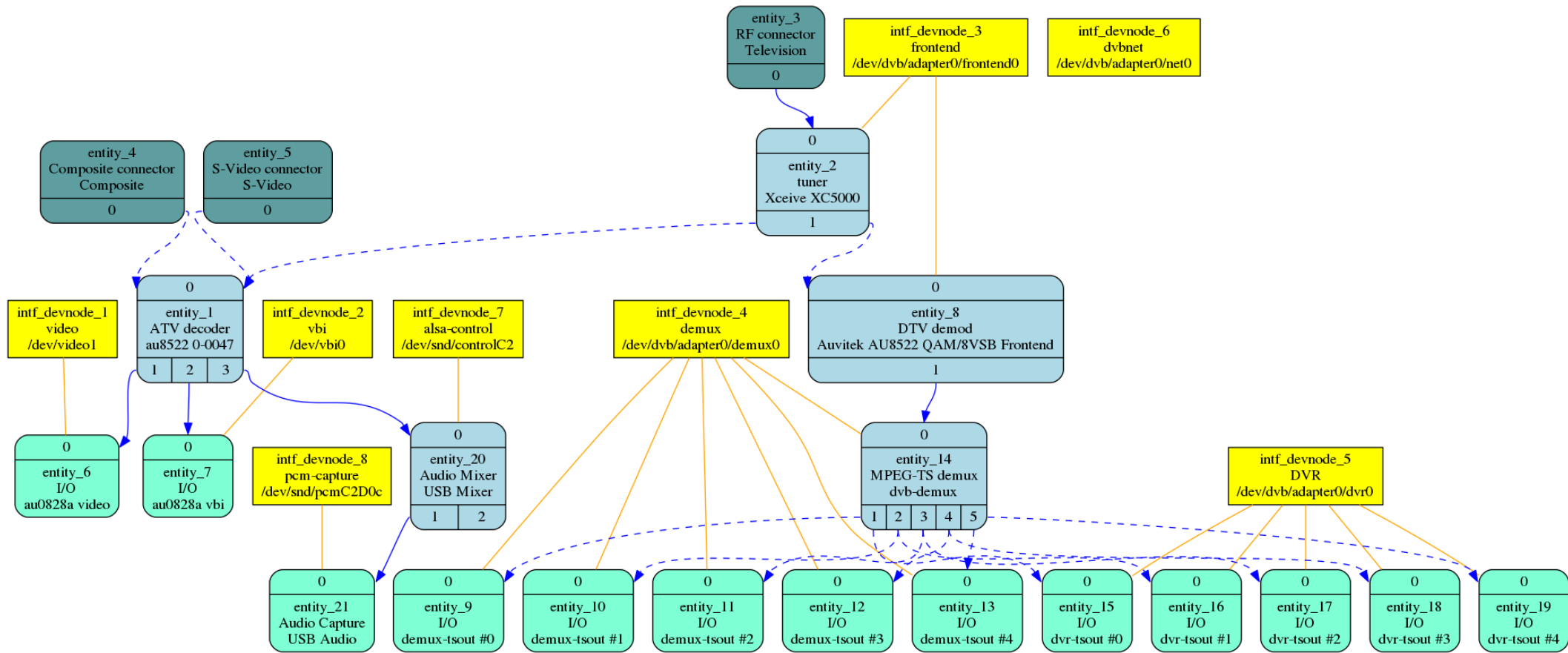
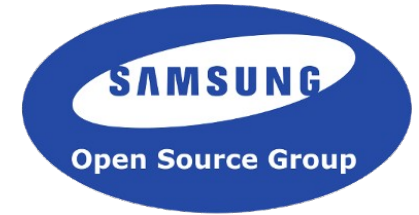
Video releases tuner ...



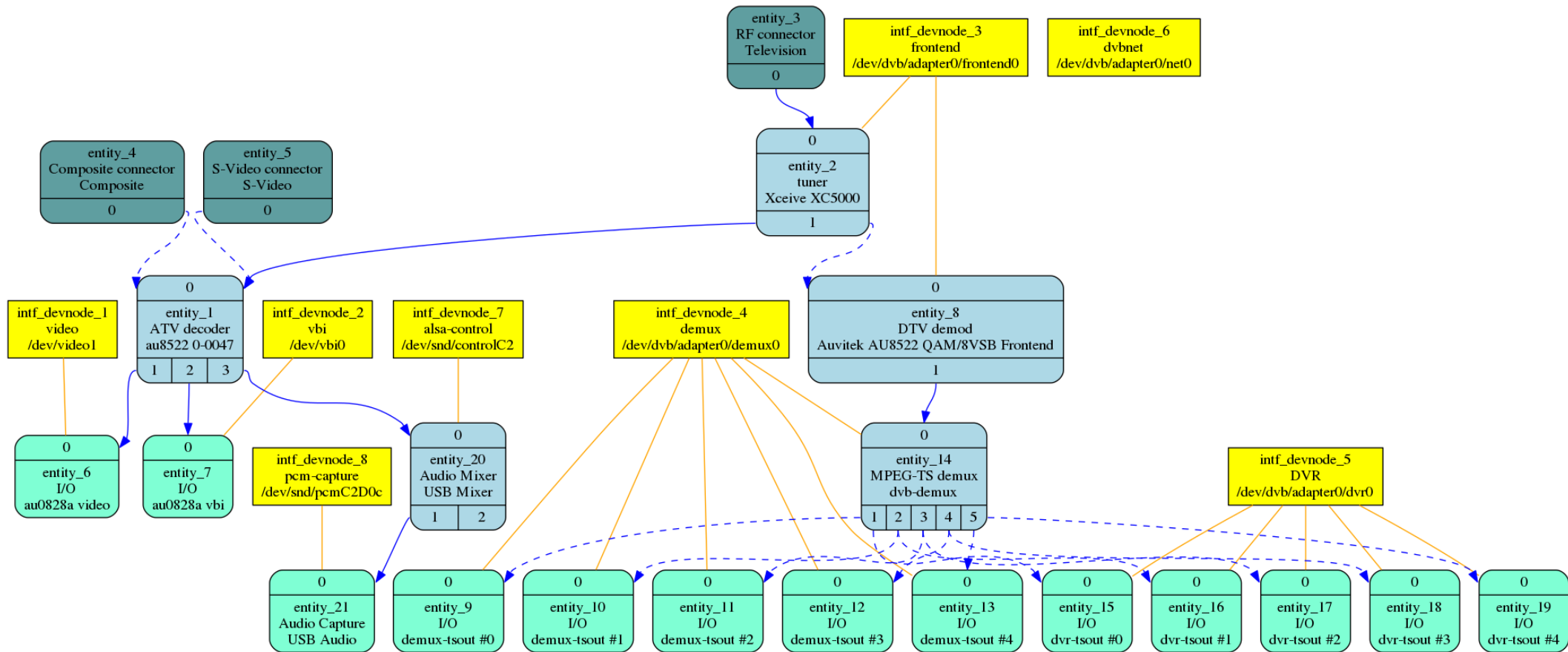
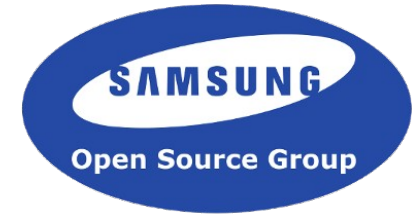
Digital owns tuner ...



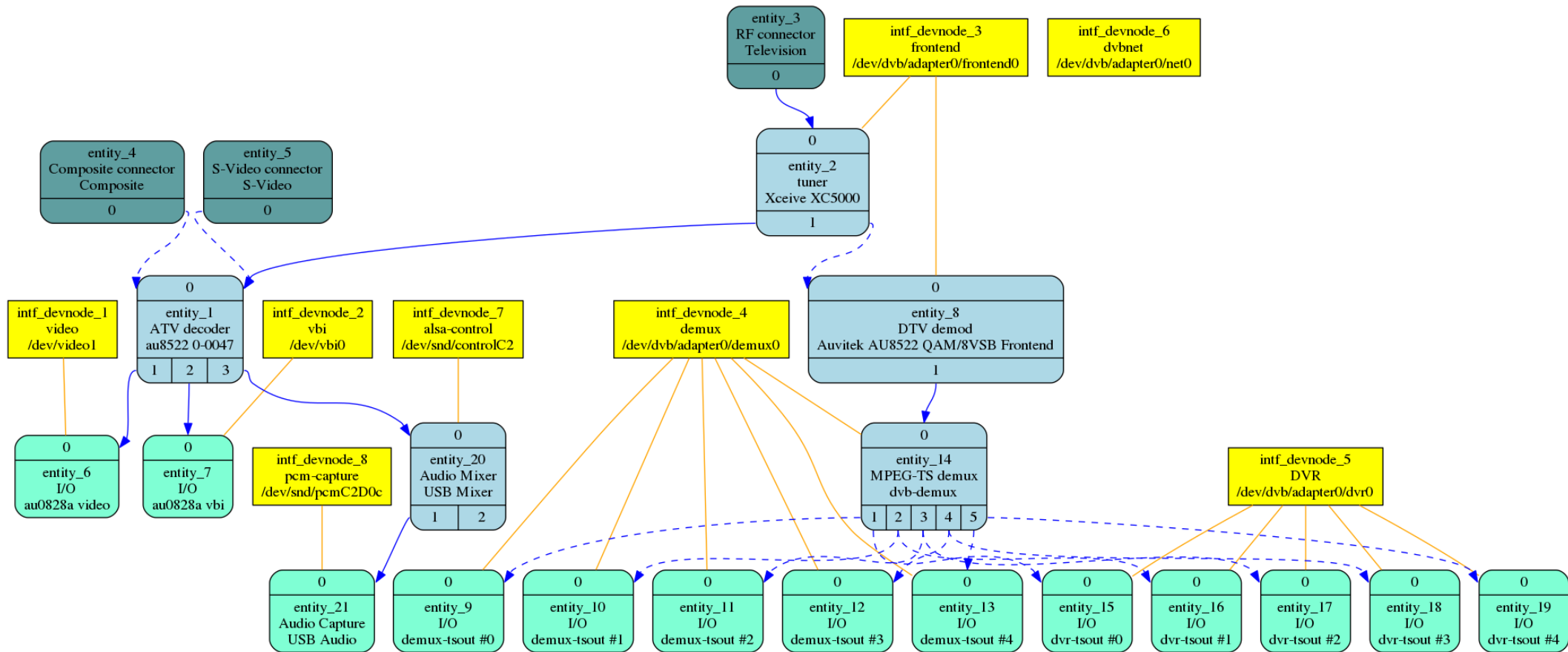
Digital releases tuner ...



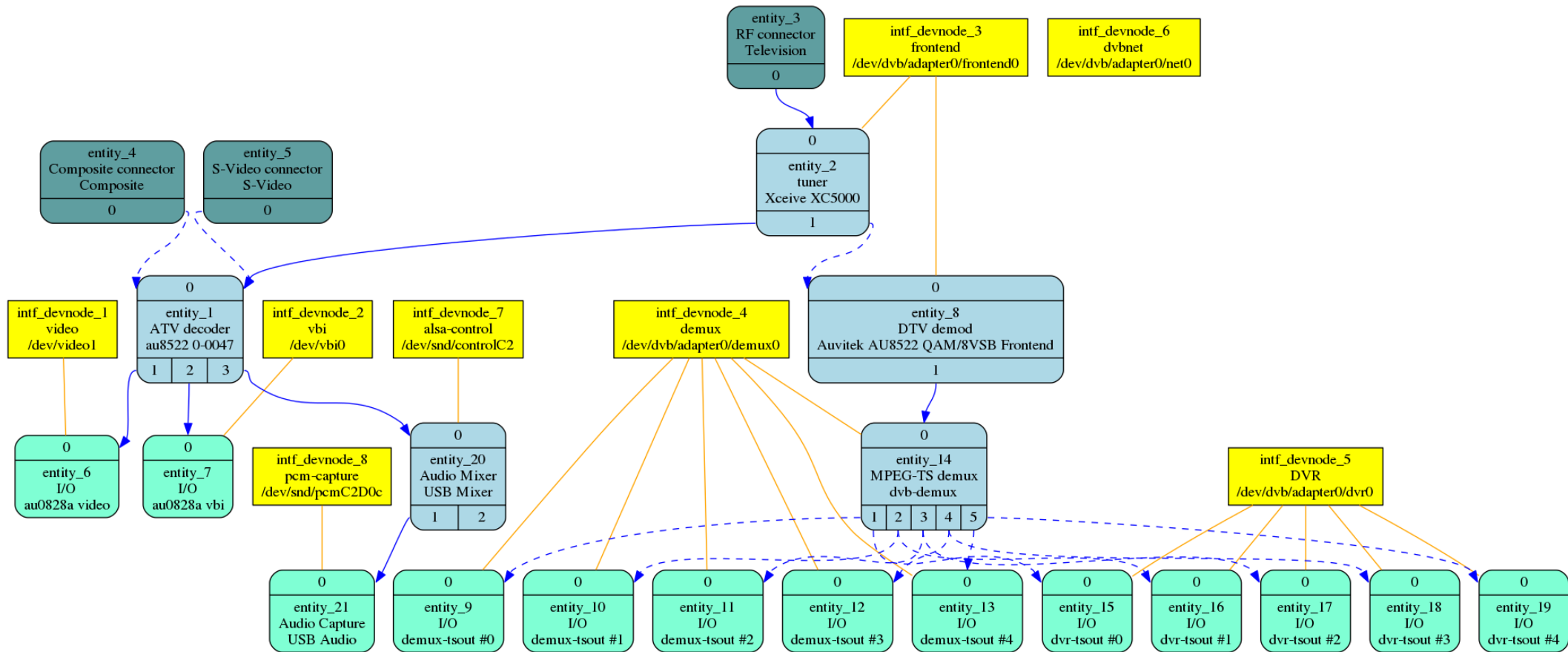
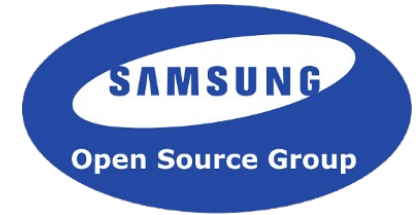
Audio owns tuner – Digital start/stop ...



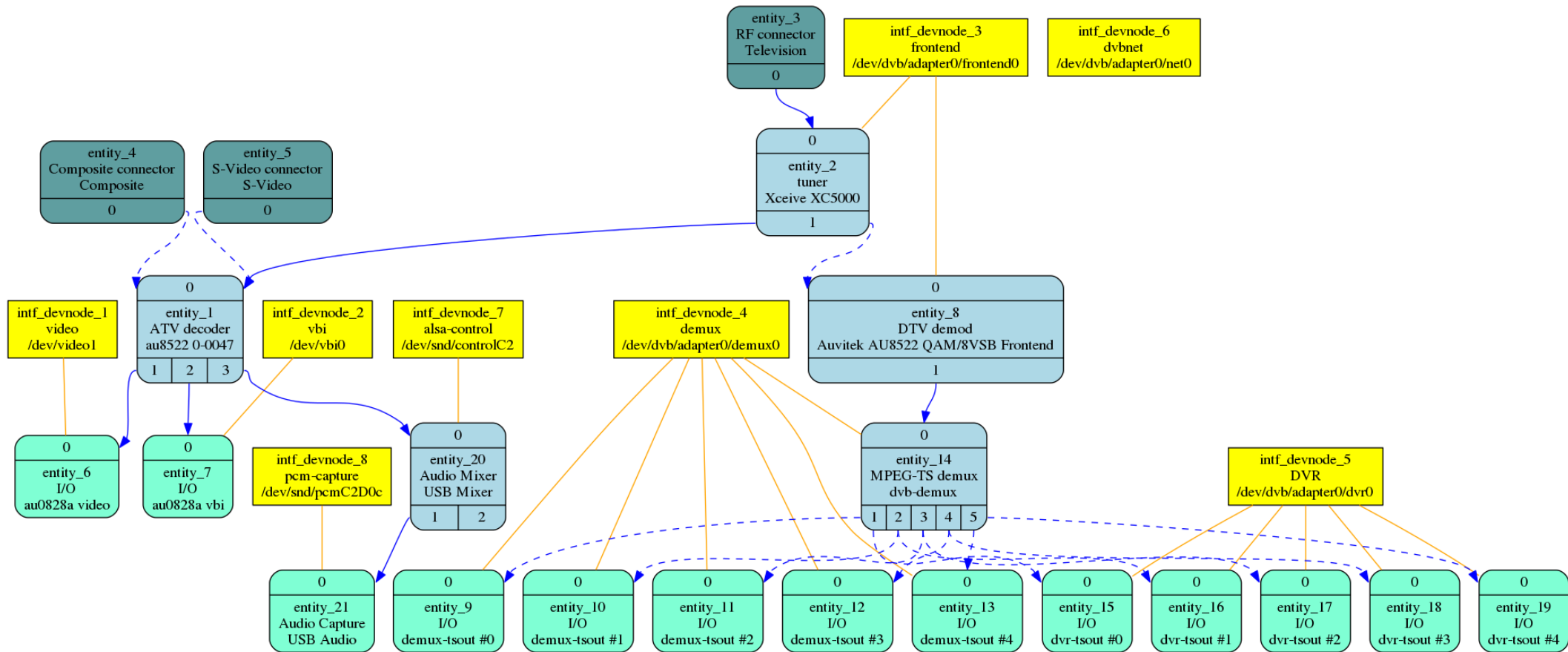
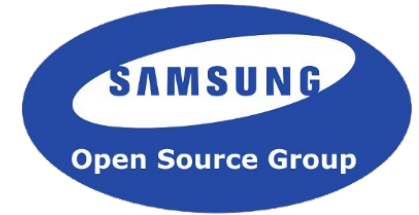
Audio owns tuner – Video start/stop ...



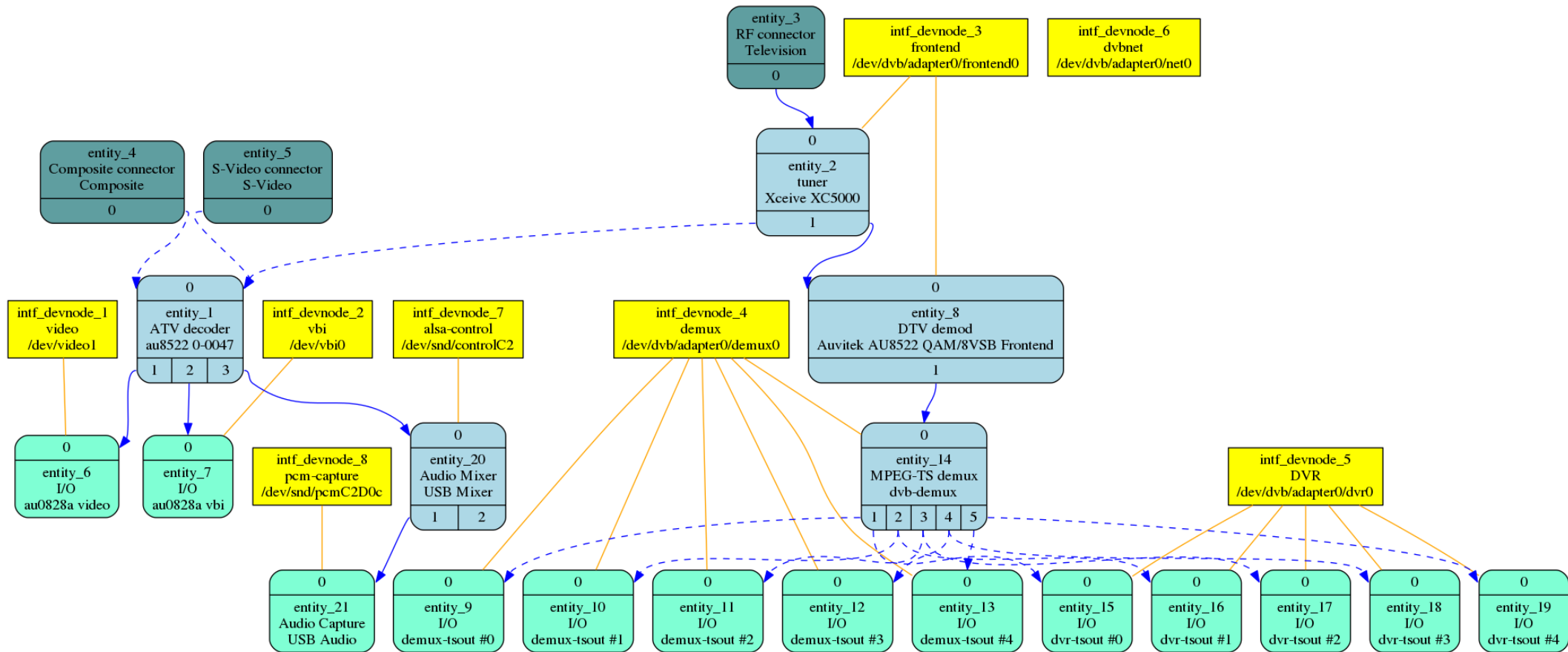
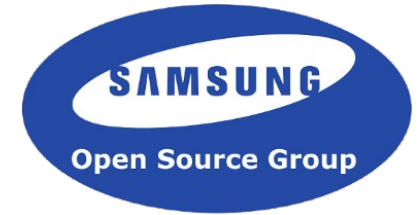
Video owns tuner – Audio start/stop ...



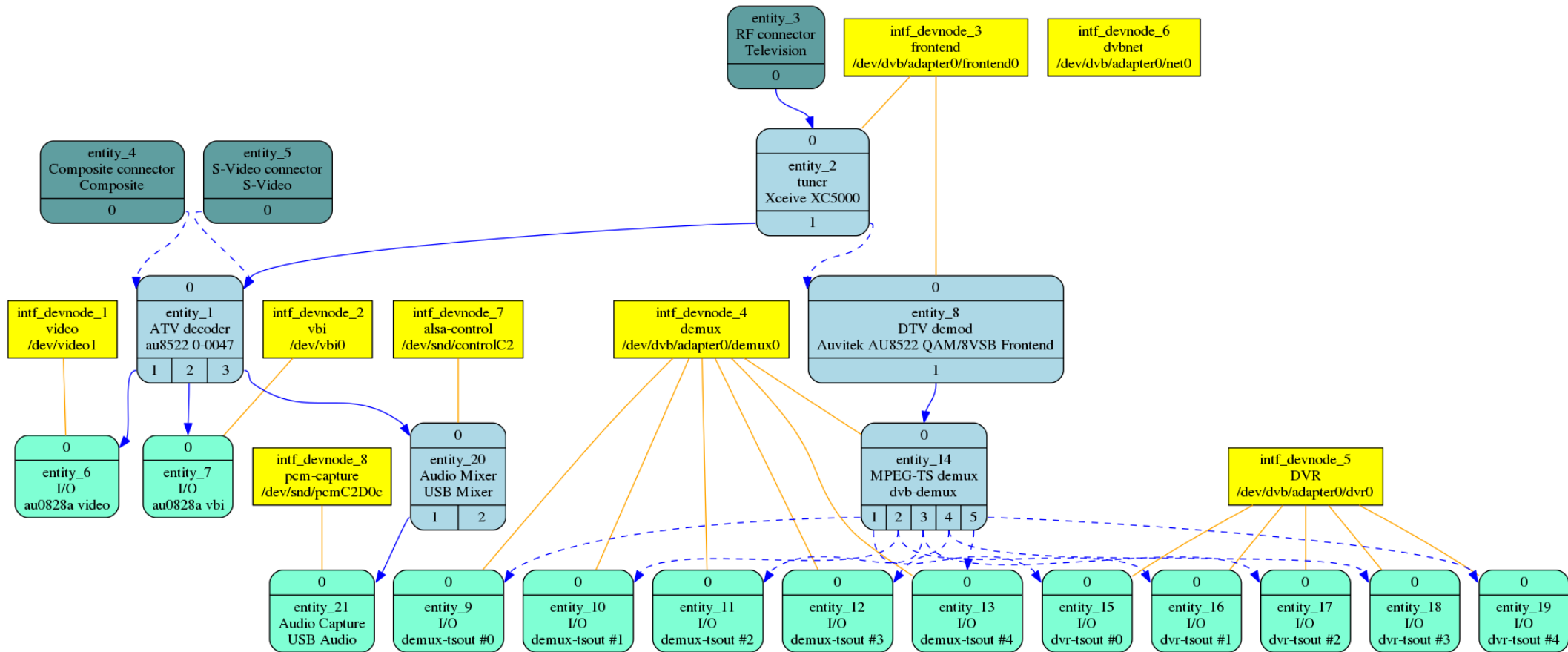
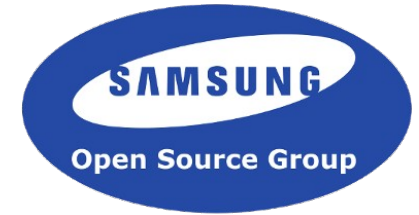
Video owns tuner – Digital start/stop ...



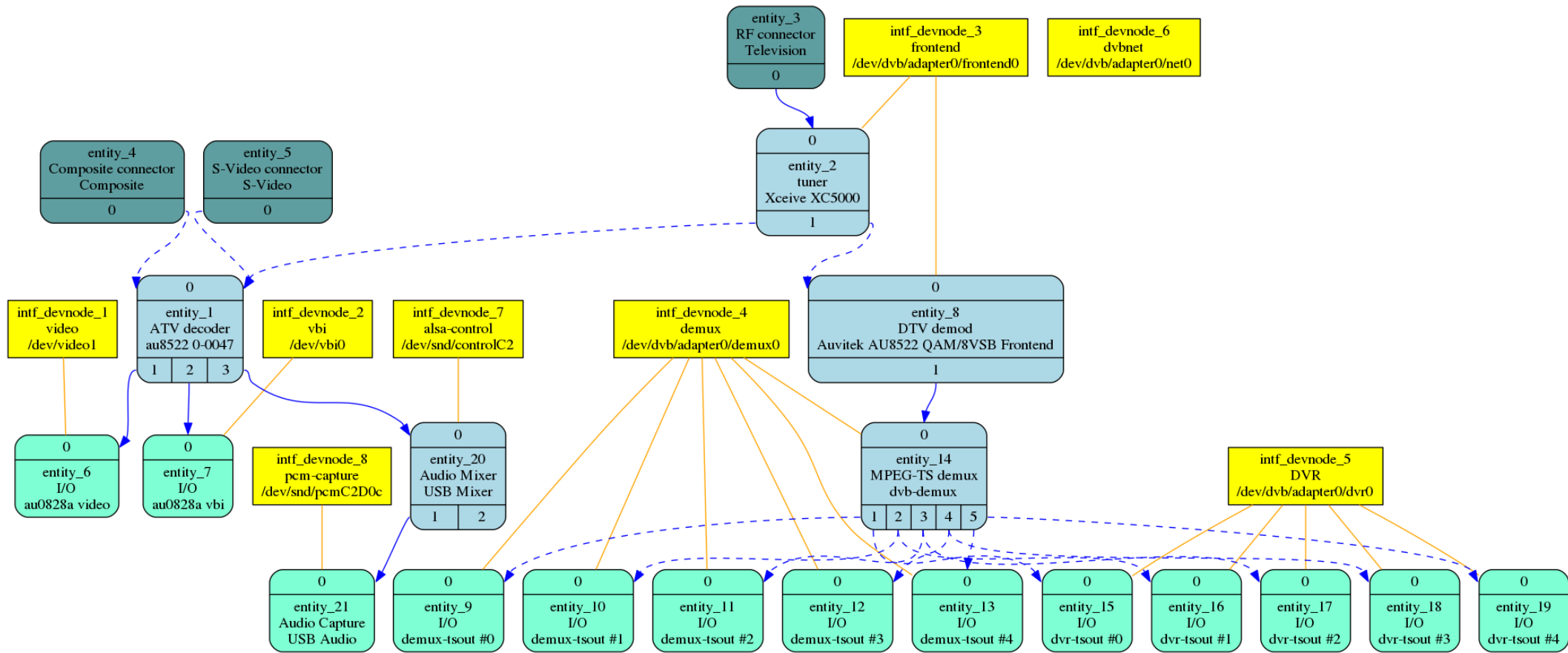
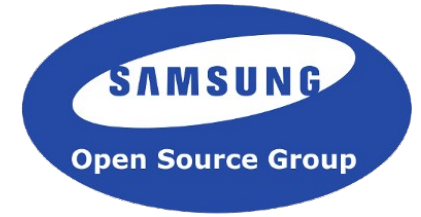
Digital owns tuner – Audio start/stop ...



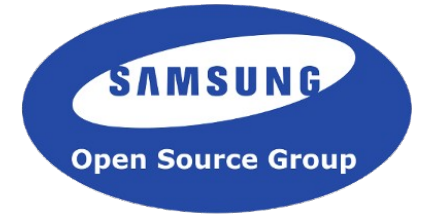
tvtime owns tuner ...



After v4l2-ctl -all run ...



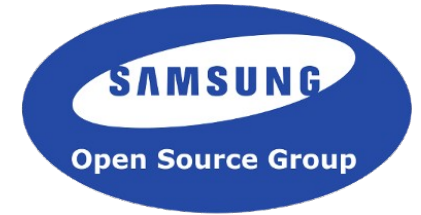
mc_nextgen_test tool ...



Usage: mc_nextgen_test [OPTION...]

A testing tool for the MC next generation API

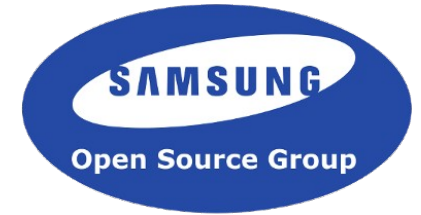
- d, --device=DEVICE** media controller device (default: /dev/media0)
- D, --dot** show in Graphviz format
- e, --entities** show entities
- i, --interfaces** show pads
- l, --intf-links** show interface links
- l, --data-links** show data links
- ?, --help** Give this help list
- usage** Give a short usage message
- V, --version** Print program version



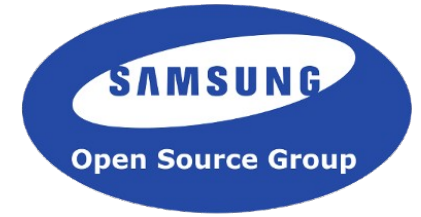
Links to patches ...

- Update ALSA, and au0828 drivers to use Managed Media Controller API – patch series links:
 - <https://www.mail-archive.com/linux-media@vger.kernel.org/msg92752.html>
- Mixer and Control Interface support
 - <https://www.mail-archive.com/linux-media@vger.kernel.org/msg93084.html>
- mc_nextgen_test tool patch to add ALSA entity support
 - <https://www.mail-archive.com/linux-media@vger.kernel.org/msg93086.html>

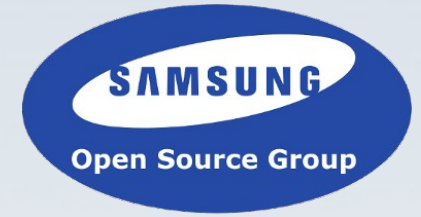
Links to media graphs ...



- Media graphs generated using mc_nextgen_test tool at various points during testing at
 - <https://drive.google.com/open?id=0B0NIL0BQg-AILWE3SzAxazBJWm8>

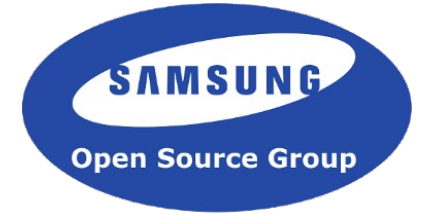


Questions ?



Thank You!

About Kworld ATSC TV Stick ...



- Hardware:
 - USB bus – attach point
 - Tuner on I2C bus
 - Digital TV
 - Audio
- Drivers:
 - em28xx usb driver
 - em28xx dvb extension
 - dvb frontend adapter: demux, dvr, net
 - tda18212