Audio Management in Tizen IVI

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Introduction

Some personal data

- Working for Intel OTC in Finland
- Currently working with Tizen IVI profile
- Past work history in mobile development
- A Member of Murphy team http://01.org/murphy

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What audio management means in Tizen IVI?

- **Policy controlled routing**
  - Routing audio streams to their allowed destinations (or possibly to many destinations)
- **Policy controlled volume**
  - Volume ramping
  - Muting
  - Static volume change for audio stream's life time
- **Policy controlled stream pre-emption**
  - Stopping/pausing/killing and possibly restarting conflicting audio streams

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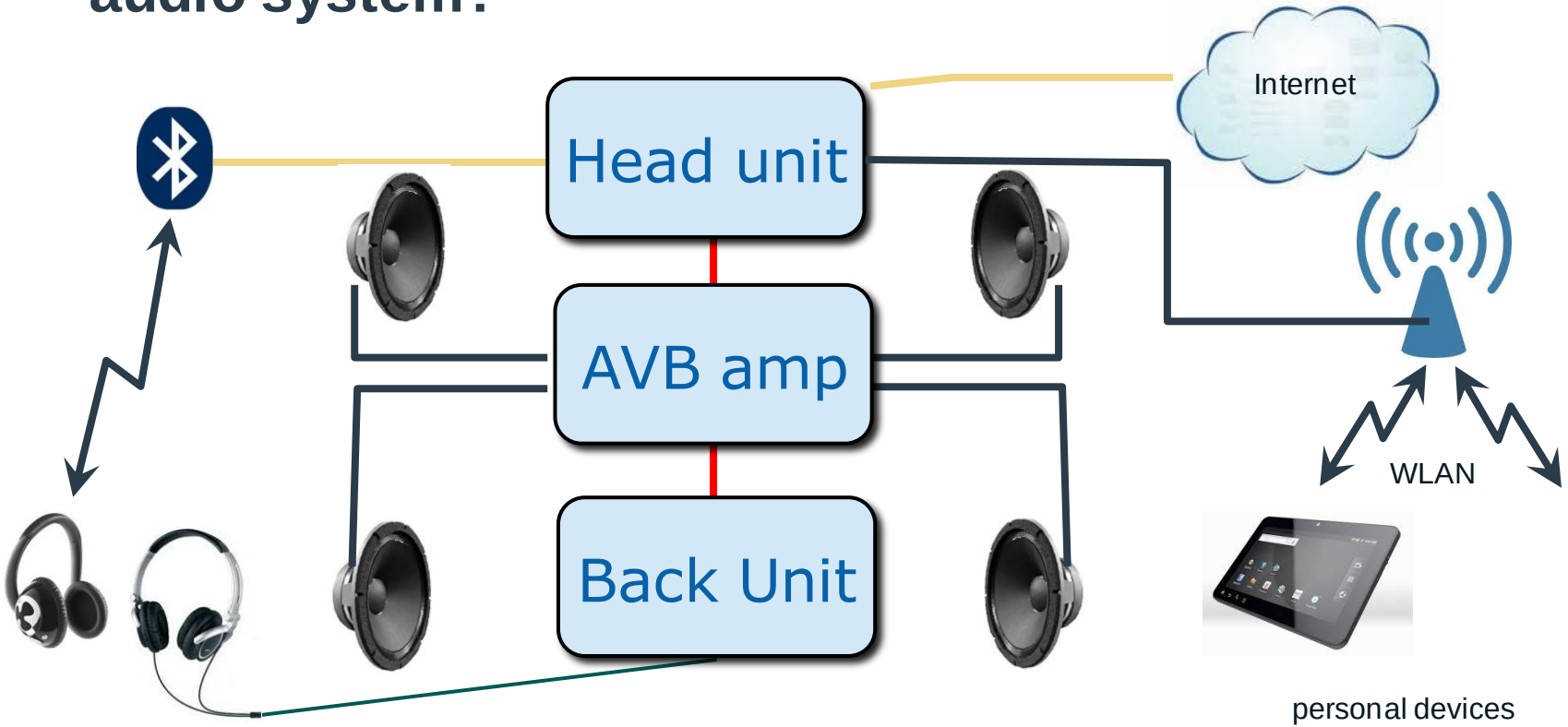
Overview

What kind of HW configuration could constitute an IVI audio system?



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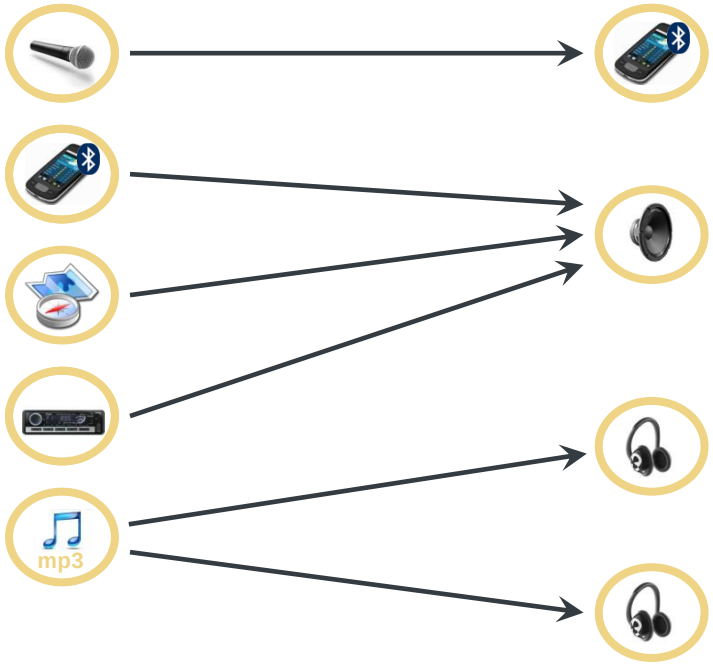
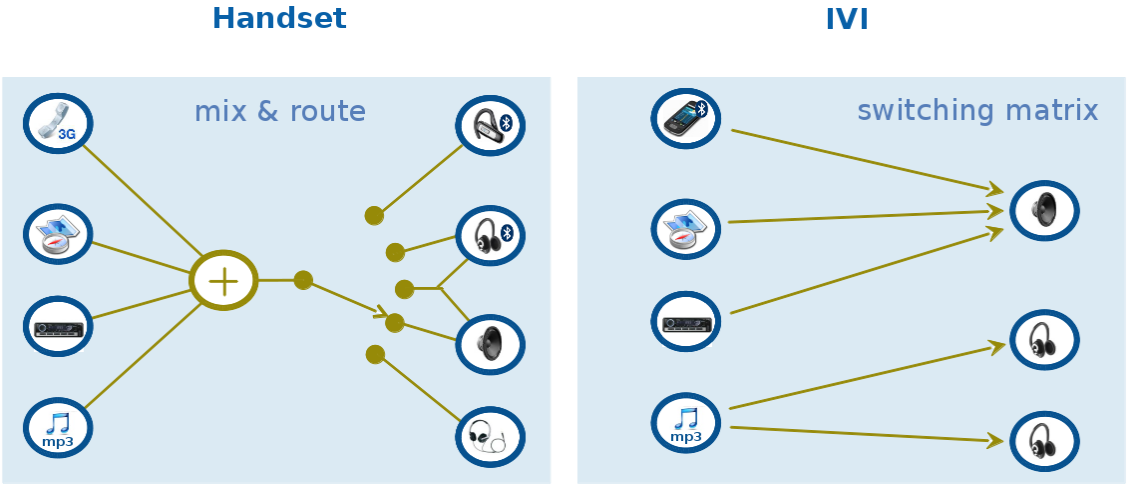
What kind of audio use cases we could have in IVI?

- The driver listens to radio
- Voice guided navigation is on
- Backseat passengers listen to the same mp3 music using headphones
- The drivers personal phone is connected to the car's handsfree gateway via bluetooth.
- The driver's phone is ringing and the incoming call is accepted



Conclusion: IVI and mobile audio systems are different

- Many simultaneously used outputs
- Possibly multiple users (in different zones)
- Possibly multiple computing units connected via network



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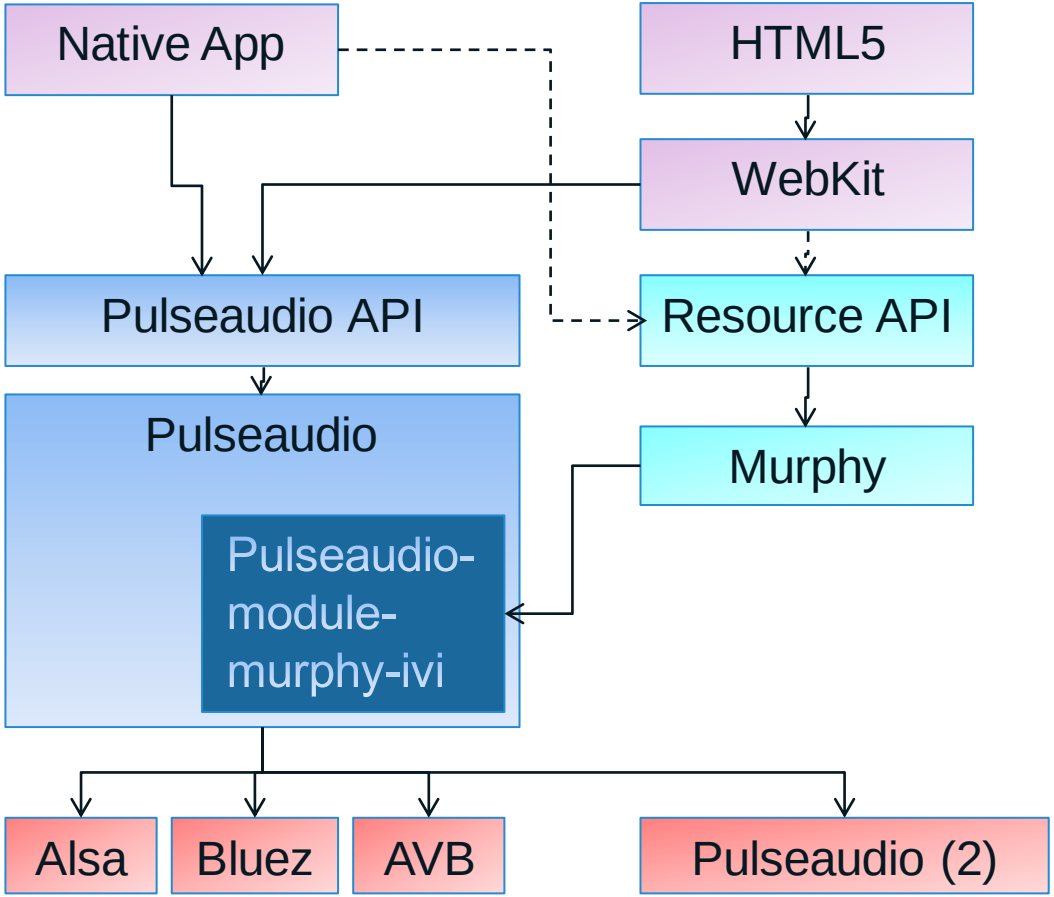
Design & Implementation

High-level SW design

- Audio domains centralized in pulseaudio
- Independent audio management module inside pulseaudio
- Applied policies are based on stream tagging
- Basic html <audio> and <video> tags are integrated to the policy
- For more fine grained policy handling Murphy resource API can be used



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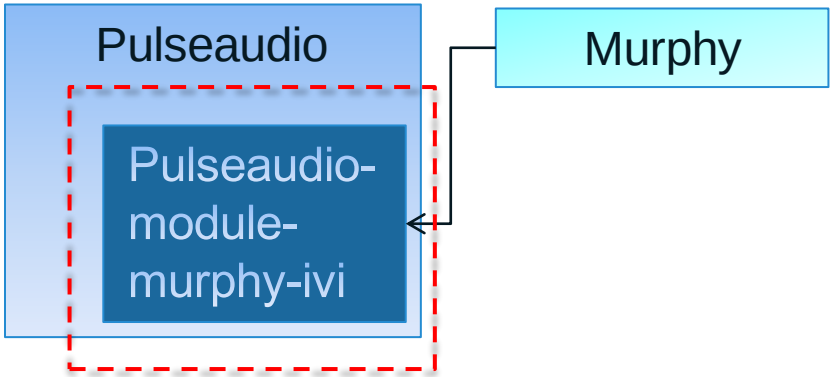
Features in pulseaudio-module-murphy-ivi

- Routing with priority queues
- Volume control with constraints
- Configuration and scripting
- Resource allocation through Murphy



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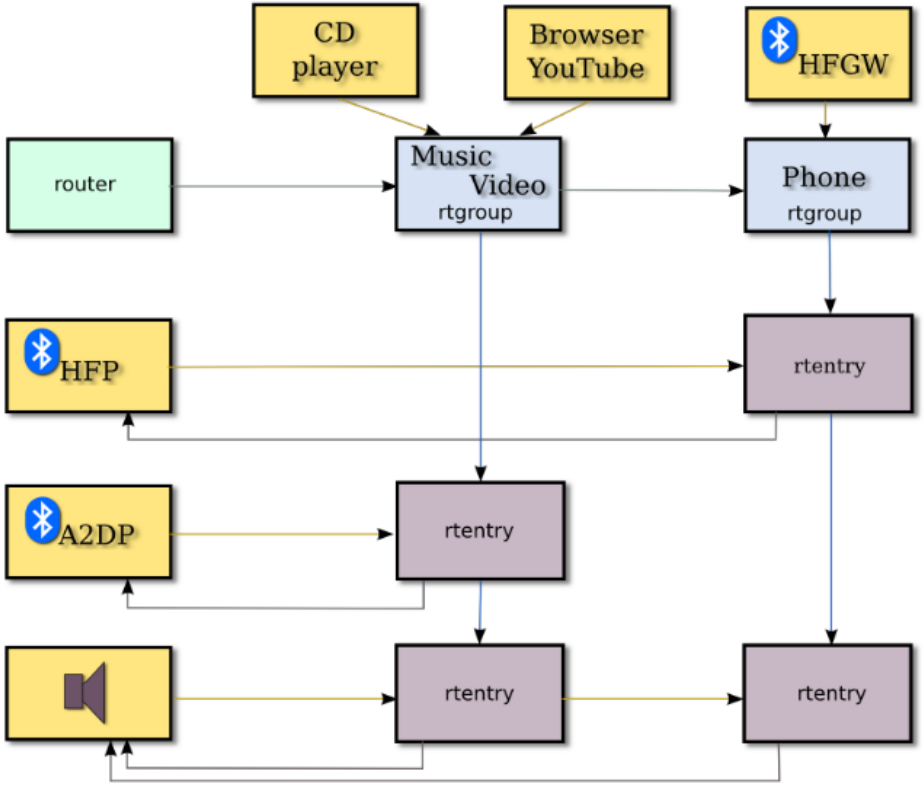
Routing

Nodes

- **New logical model in pulseaudio – Nodes**
  - Correspond to pulseaudio sinks and sources
  - Input and output nodes can be freely connected – for e.g. 1:N
  - Nodes are dynamically appearing and reappearing
  - Nodes might have HW limitations
- **Nodes can be used for *explicit* or *default* routing**
  - Explicit route is requested by the user
  - New events will not affect an explicit route
  - Default route is automatic and created at stream creation
  - Default route is dynamic and class based

Priority based conflict resolution

- Explicit routes have always priority over default route
- Default routes use class based stream priorities
- Class based routing target lists
- Walking through the streams in decreasing priority order to make the routing decision
- In case of conflict explicit routes are disabled and for default route the next available target on the list is chosen



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Volume control

Volume control implementation

- **Volume control is based on an independent mechanism**
  - smooth volume ramp up/down of streams or entire devices
  - usual volumes left untouched
  - real enforcement mechanism, ie. clients can't override it
- **Control points**
  - Streams
  - Devices
- **Scriptable**
  - for configuration, ie. what and how to link together to achieve the desired effect

Volume constraints

- **Class based volume constraints**
  - For e.g. telephony stream is attenuating music but not navigator
- **Generic constraints**
  - Can be used for e.g. noise dependent master volume level
  - However generic limits can depend on device type or other conditions
  - From all the applicable generic limits the highest attenuation will be used
- **Constraints are combined**
  - If the **generic limit** would be **-12dB** and
  - The **class limit** would be **-20dB** then the
  - **Actual limit** for the stream would be **-32dB**

Configuration and scripting

Configuration and scripting

- **Proper configuration and scripting is an essential because**
  - We want to run same software in different verticals
  - Different manufacturers want different policies
  - Fast prototyping is essential for product programs
- **Pulseaudio-module-murphy-ivi configuration is done with Lua**
  - Configuration done at initialization, after that Lua is not executed
- **There is also possibility to script some of the functionality**
  - Lua is executed also at run time

LUA configuration example

- **Routing groups**
  - Default
  - Phone
- **Application classes**
  - Belong to a routing group
  - Have priorities

```
routing_group {
    name = "default",
    node_type = node.output,
    accept = builtin.method.accept_default,
    compare = builtin.method.compare_default
}

routing_group {
    name = "phone",
    node_type = node.input,
    accept = builtin.method.accept_phone,
    compare = builtin.method.compare_phone
}

routing_group {
    name = "phone",
    node_type = node.output,
    accept = builtin.method.accept_phone,
    compare = builtin.method.compare_phone
}

application_class {
    node_type = node.event,
    priority = 6,
    route = {
        output = routing_group.default_output
    },
    roles = { event = no_resource }
}

application_class {
    class = "phone",
    node_type = node.phone,
    priority = 5,
    route = {
        input = routing_group.phone_input,
        output = routing_group.phone_output
    },
    roles = { phone = no_resource, carkit = no_resource }
}
```

Connection to Murphy policy manager

Connection to Murphy database

- Module-murphy-ivi can subscribe to Murphy database events
- Based on the events LUA scripting or internal C functions can be invoked
- This way cross domain policies can be nicely handled
- Example would be speed dependent volume

```
mdb.select {
          name = "vehicle_speed",
          table = "amb_vehicle_speed",
          columns = {"value"},
          condition = "key = 'VehicleSpeed'"
}

element.lua {
   name    = "speed2volume",
   inputs  = { speed = mdb.select.vehicle_speed, param = 9 },
   outputs = {  mdb.table { name = "speedvol",
                            index = {"zone", "device"},
                            columns = {{"zone", mdb.string, 16},
                                       {"device", mdb.string, 16},
                                       {"value", mdb.floating}},
                            create = true
                           }
            },
   oldvolume = 0.0,
   update  = function(self)
               speed = self.inputs.speed.single_value
               if (speed) then
                   volume = (speed - 144.0) / 7.0
               else
                   volume = 0.0
               end
               diff = volume - self.oldvolume
               if (diff*diff > self.inputs.param) then
                   print("*** element "..self.name.." update "..volume)
                   self.oldvolume = volume
                   mdb.table.speedvol:replace({zone = "driver", device = "speakers", value = volume})
               end
             end
}
```

```
mdb.import {
    table = "speedvol",
    columns = {"value"},
    condition = "zone = 'driver' AND device = 'speaker'",
    maxrow = 1,
    update = builtin.method.make_volumes
}
```


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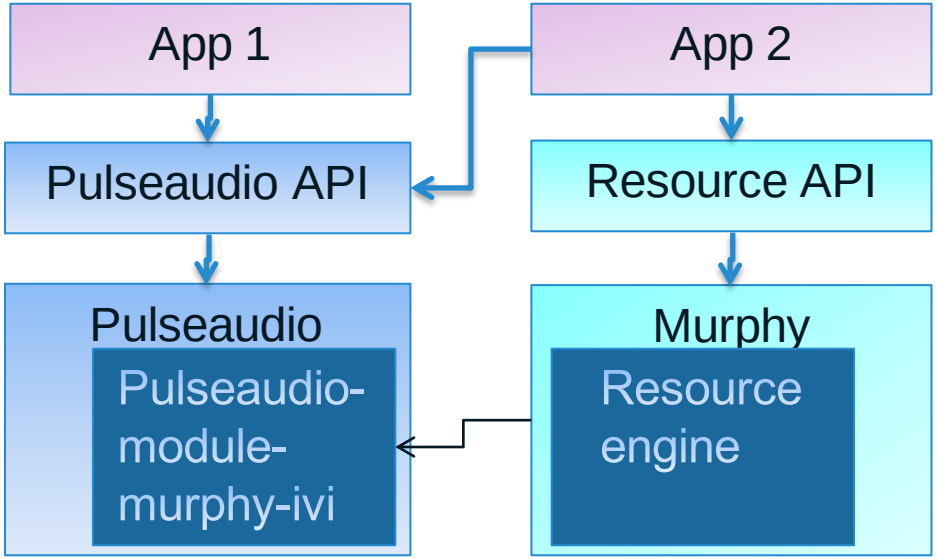
Resource allocation through Murphy

- Pulseaudio-module-murphy-ivi can reserve a resource for you if configured to do so
- Stream pre-emption works then automatically, although not so fine grained as through Murphy resource API



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THANK YOU!

- Pulseaudio-module-murphy-ivi can be found from http://github.com/otcshare/pulseaudio-module-murphy-ivi
- Murphy and some documentation can be found from http://01.org/murphy