WiLMA - Wireless Largescale Microphone Array

Christian Schörkhuber, Markus Zaunschirm
& IOhannes m zmölnig

presented by Winfried RITSCH

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Outline

Motivation

Spatial Audio

- *higher-order ambisonics*
- some playback systems
  - e.g. IEM Cube, MuMuth,...
- few recording systems
  - Eigenmike
    - expensive
    - black box: not good for experimenting beyond the eigenmike specs

use cases

multichannel recording

- spatial recordings
  - higher-order ambisonics
- *large-scale recordings*
  - recording of urban landscapes. . .

auditory scene analysis

- multichannel source separation
- event detection
- source tracking
- acoustical planning
- acoustical surveillance

Scenarios

Decentralized Soundcard

- traditional multichannel recording
- easy setup
  - no cabling
  - automatic microphone localisation
- centralized recording
- centralized processing

Autonomous Recording

- synchronous, unsupervised recording
  1. hit 'start'
  2. leave the scene
  3. later collect the data

Autonomous Processing

- source separation
- source identification
- meta-data extraction
- ...
- processing on remote units

Requirements

we care for

- scalability
- high quality audio
- sample synchronicity
- "ease of use"

we don't care for

- latency (for now)

System

- *Sensor Module*
  - Microphone(s) (up to 4 channels)
  - Pre-amplifier
  - AD-Converter
  - Sync-Module
  - „Digital Signal Processer”
  - Transmitter
  - Battery Pack
- *Central Unit*
  - off-the-shelf PC
  - controls multiple SMs

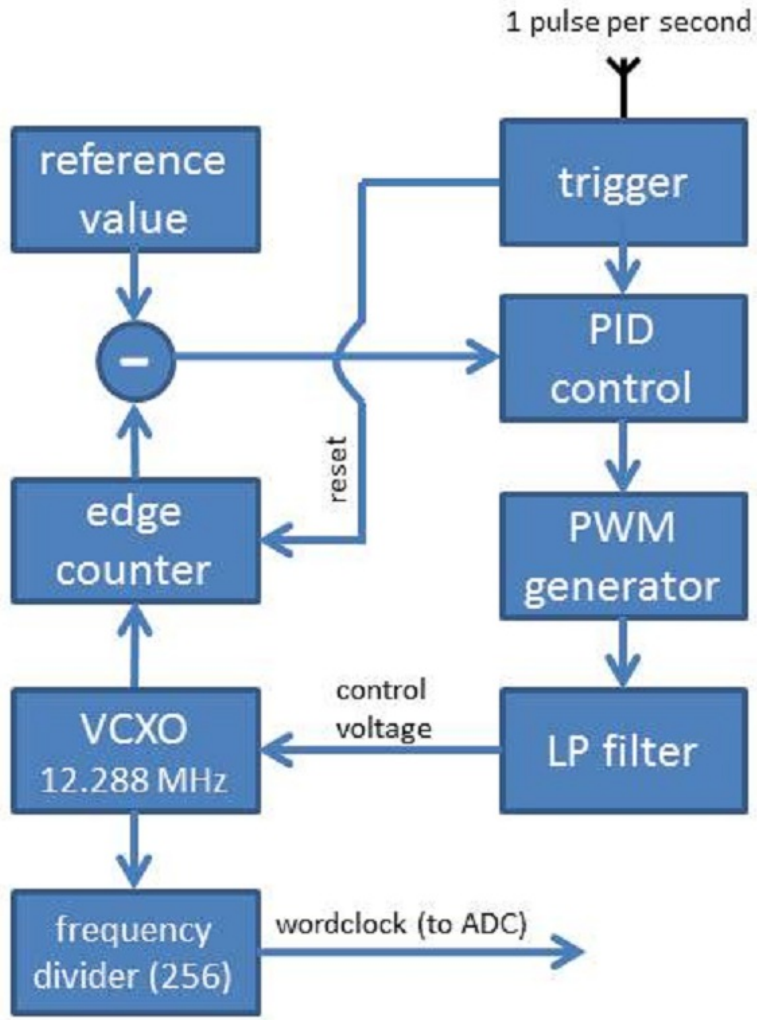
Hardware (Sensor Module)

- Microphone Input
  - `THAT1570` pre-amplifier
    - controlled by `THAT5173` via SPI
  - `AD1974` analog/digital converter
    - integrated PLL
    - 24bit
    - 4 channels
    - additional (digital) AUX input is multiplexed into channel#5..channel#8
  - (optional) 48V phantom power

Synchronisation

- 32bit timestamp
- broadcast
  - sub-GHz ISM
  - @1Hz

  ⇓
- Voltage Controlled Oscillator (VCXO)
  - controlled by FLL
- timestamp multiplexed into audio stream (AUX)



Transmitter

- using trusted **network** stack
  - Ethernet
  - WLAN
    - `802.11n`

(Operating) System

- Beaglebone A6
  - no FPU!
    - ~~Beaglebone Black~~ (not yet available at time of design)
- Ubuntu-11.10 (Oneiric)
  - *linux-3.2.30*
    - custom ALSA-drivers for `AD1974`

Software Architecture

Controller

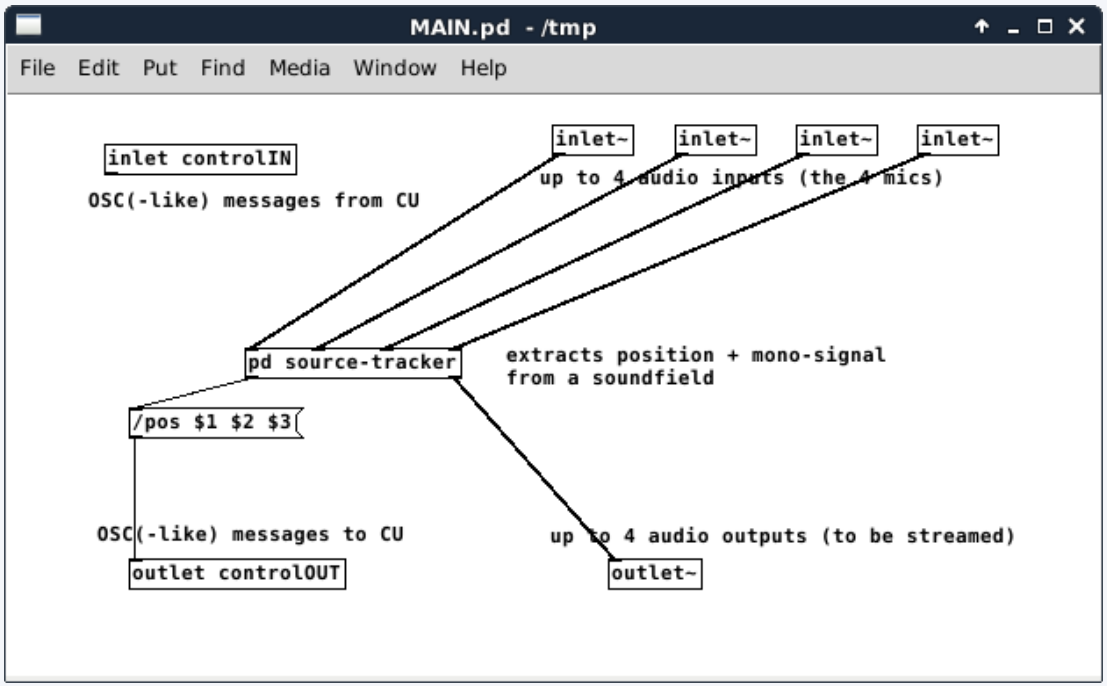
- handles **all** communication between CU and SMs
- user interface (on CU)
- system monitoring (on SM)
- implemented in `Python/Qt`

Audio Processor

- forked off (and watched by) *Controller*
- control-communication proxied via *Controller*
- streaming handled directly
- implemented in `Pure Data`

Processing Plugins

- implementations for autonomous processing
- simple Pd-patch
  - well-defined interface (1 `iolet~`, up to 4 `iolet~` s)
  - no need for compilation to native code
    - easy deployment



Communication

- using standard communication protocols

Service Discovery

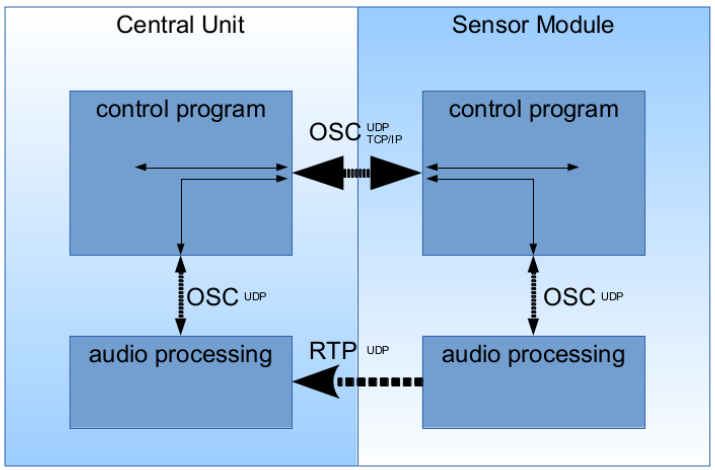
- Sensor Modules announce themselves via ZeroConf/Avahi
- `_wilma-sm._udp`

Audio Stream

- Real-time Transport Protocol (RTP)
  - provides timestamps
  - supports multiple profiles/codecs
  - congestion control (via RTCP)

Inter-Process Communication

- **all** communication via *OSC*
  - SMs $\Leftrightarrow$ CU
  - infrastructure $\leftrightarrow$ audio number cruncher
- CU sends `/ping` to SMs to query current state



People involved

Team

- Christian Schörkhuber
- Markus Zaunschirm
- IOhannes m zmölnig

Advisory Board

- Bernhard Auinger
- Winfried Ritsch
- Alois Sontacchi
- Franz Zotter

Availability

Software

- GPLv2

`http://github.com/iem-projects/WILMix`

Circuitry

- no decision regarding licenses yet ☹

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