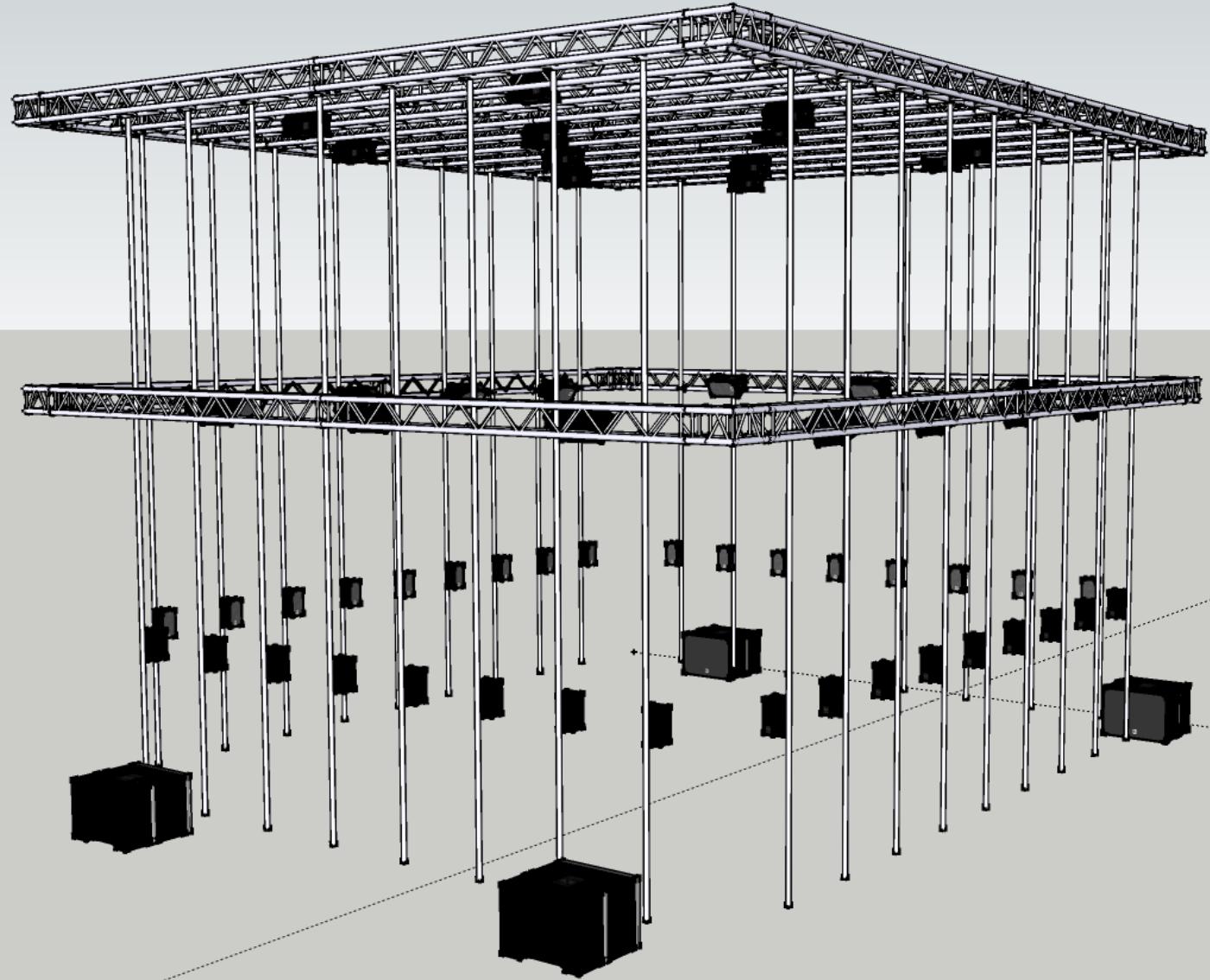


# ASIL Infrastructure – February '19

Bart Moens – [Bart.moens@ugent.be](mailto:Bart.moens@ugent.be) – 07/02/2018



# Do Tank Series

- Lots of technology => steep learning curve. Therefore: do tanks!
- Get a better understanding of the lab and its infrastructure
- Provide knowledge how to conceptualize and conduct our experiments
- Learning the skills to experiment in the lab
- 4 different sessions:
  - **Friday 15/2 - 1PM @ ASIL Labs:**
    - main concepts and ideas behind the lab
    - technological overview of the installed systems
    - hands-on session to get you started with the basics
  - **Wednesday 20/2 - 10AM @ ASIL Labs**
    - technical tour
  - **Wednesday 20/2 - 1PM & Thursday 21/2 @ 1PM (instead of 10)**
    - hands on session.
  - **Friday 22/2 - 1 PM @ ASIL Labs**
    - Presentation about the advanced topics
    - Feedback of the hands-on sessions
- Will be planned on regular basis and on-demand to keep you updated

# About this presentation...

- The lab is a work in progress...
- So is this presentation & the information
- The presentation is a ‘reference’ and documentation for the labs
- Some features are still in development
- Marked yellow in this presentation
- Presentation and documentation can be downloaded at  
<https://github.com/ArtScienceLab> (Lab Documentation)
- Also; my spelling check doesn’t work.

# Contents

- **PART 1: Introduction**
- **PART 2: Practical arrangements**
  - Layout of the Krook -2
  - Bookings & CMS
  - Partners & arrangements: IDLab, IMEC, MICT
  - Lab Rules
  - Practicalities & Documentation
- **PART 3: Basic topics**
  - Patching panels
  - KVM network: computers, screens, mobile desk
  - DANTE audio
  - The RACK: “sensor & audio connections”
- **PART 4: Basic usecases & practice**
  - Presenting in the lab
  - Playing back audio & audio recording
  - Synchronous mocap & audio recording
  - Getting data to your own computer
- **PART 5: Advanced topics**
  - DAW Applications
  - Motion capture system
  - Synchronisation
  - **Storage & Data Processing**
  - Electricity
  - Machineroom
  - IP network
  - Speaker installation
  - 3D processor IOSONO
  - 3D Processor Ambisonics
  - DMX Lights
  - Trussing
- **PART 6: Usecases & Examples**
  - Connecting laptop for presentation+audio
  - Basic audio input / output recording
  - Connecting mocap to 3D system

# TODO

- Secondary Mocap
- Projection screen
- VR installation
- EEG
- Eye tracker

# Introduction

- ASIL = Art Science Interaction Lab
- Multi-purpose room to encompass different experiments from all partners
- This implies quite a few things:
  - Easy to setup & breakdown experiments
  - Fast to switch setups
  - Minimalistic
  - High usability
  - No compromises in features/technologies
- Lab design tries to fit all technologies as a puzzle while keeping this in mind
- Goal of ASIL: integrate state-of-the-art technologies to bring *context* to experiments and performances

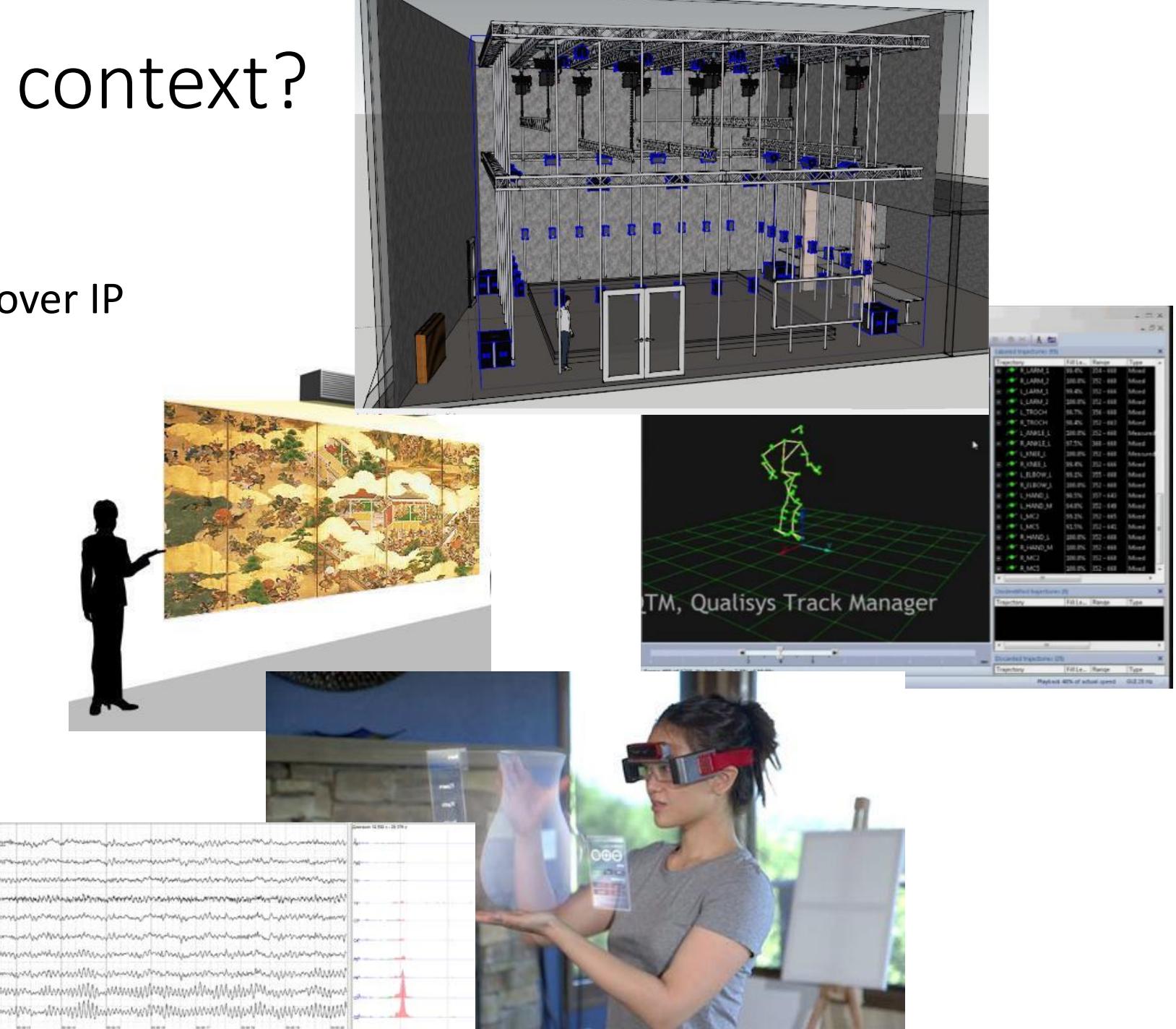
# What is context?

- Typical motion laboratories are ‘dry’
- Results are difficult to apply in real world scenarios
- Participants are influenced by this
- Immersive lab to emulate scenario’s
  - Performances
  - Theatre
  - Musea
  - Architecture
  - New contexts
  - ...

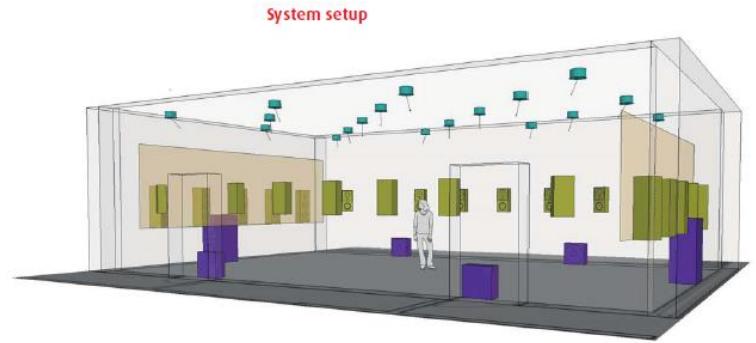


# How to deliver context? Technology

- 62-speaker setup, audio over IP
  - IPEM
- Interactivity / sensors
  - IPEM
- Qualisys mocap system
  - IDLab
- Projection system
  - IDLab
- VR/AR system
  - IDLab
- Eye Tracking, EEG
  - IPEM, MICT
- Central Data Storage
  - IDLab

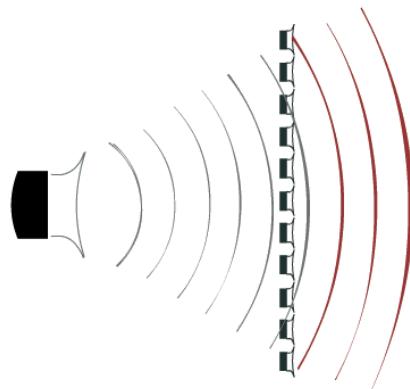


# Creating auditory context: Audio rendering technologies

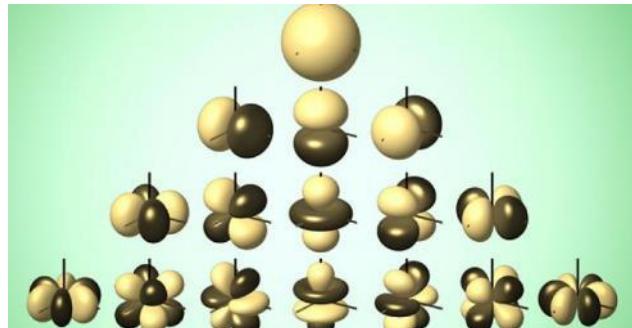


Creating different audio scenarios requires acoustically non-reverberant room.

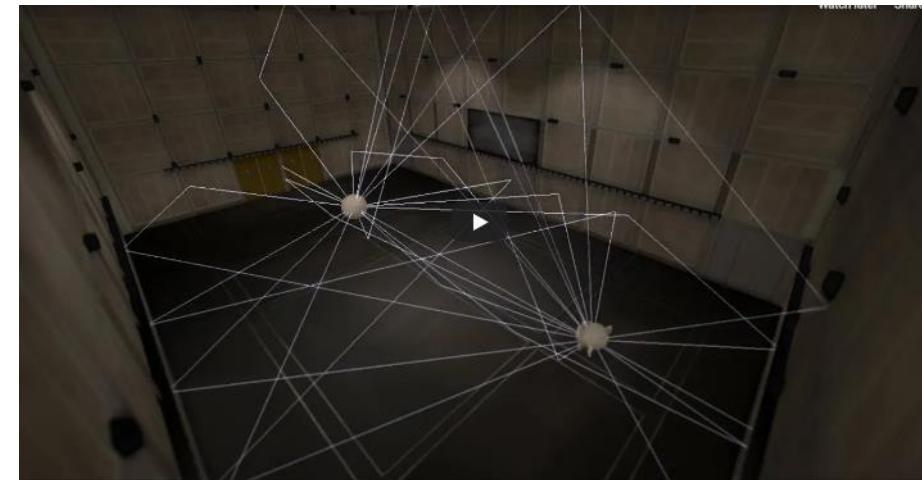
Wavefield Synthesis



Higher order ambisonics



Auralisation



Localised 3D audio

Performance oriented  
3D audio

Different acoustical settings (church,  
halls, room, ...)

# Creating auditory context: Audio rendering technologies

Auralisation  
software which  
will be upscaled  
to simulate  
room in room  
(not only  
headphones)

Simulate spaces  
(church, room,  
temple...)

System setup





# Creating visual context: Video technologies

Projection system  
(summer '19)



Provide context to groups

Virtual reality



Provide individual contexts

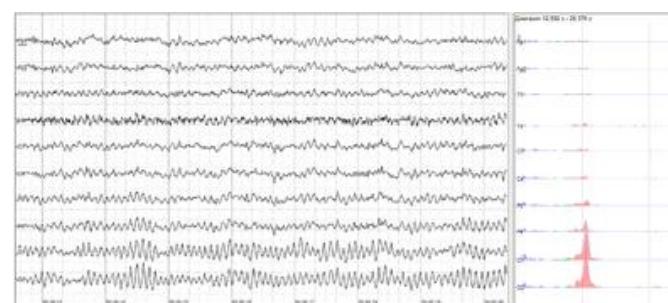
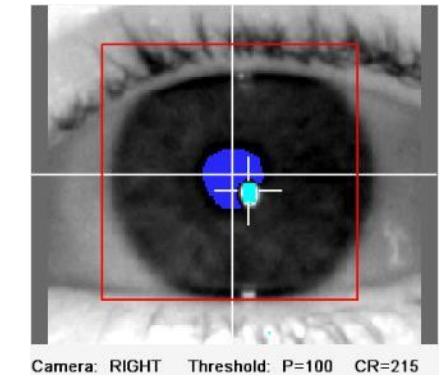
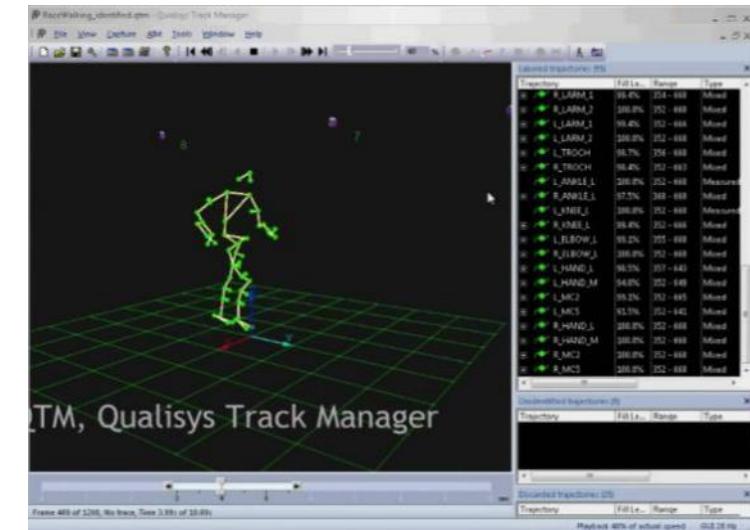
Augmented reality



Adding information to real-world

# Scientific context: Measuring technologies

- Motion capture to track movement
  - How do people move & interact?
- Different & custom sensors (eg on bikes, balance boards, etc)
  - More detailed body movement
- Eye tracking
  - Getting to know the center of their focus
- EEG
  - What's going on in the brain?



# Social context:

## Upscaling from individual experiments

- Study group interaction with and within context
- Large area in lab accommodates groups
- Audio system provides stimuli for entire group
- Motion capture allows to track 8+ participants
- Combining technologies generates group VR/AR experiences
- Groups can be a bunch of random people, a band, a tour group for a museum, ....
- Location in the Krook adequate for finding participants

# The power of the lab

Combining all technologies allows us to create diverse immersive scenarios



Interactive paintings or behaviour study



Group interaction



Having a band play in different locations

Study group interaction, eg on festivals



Emulating acoustics of a temple



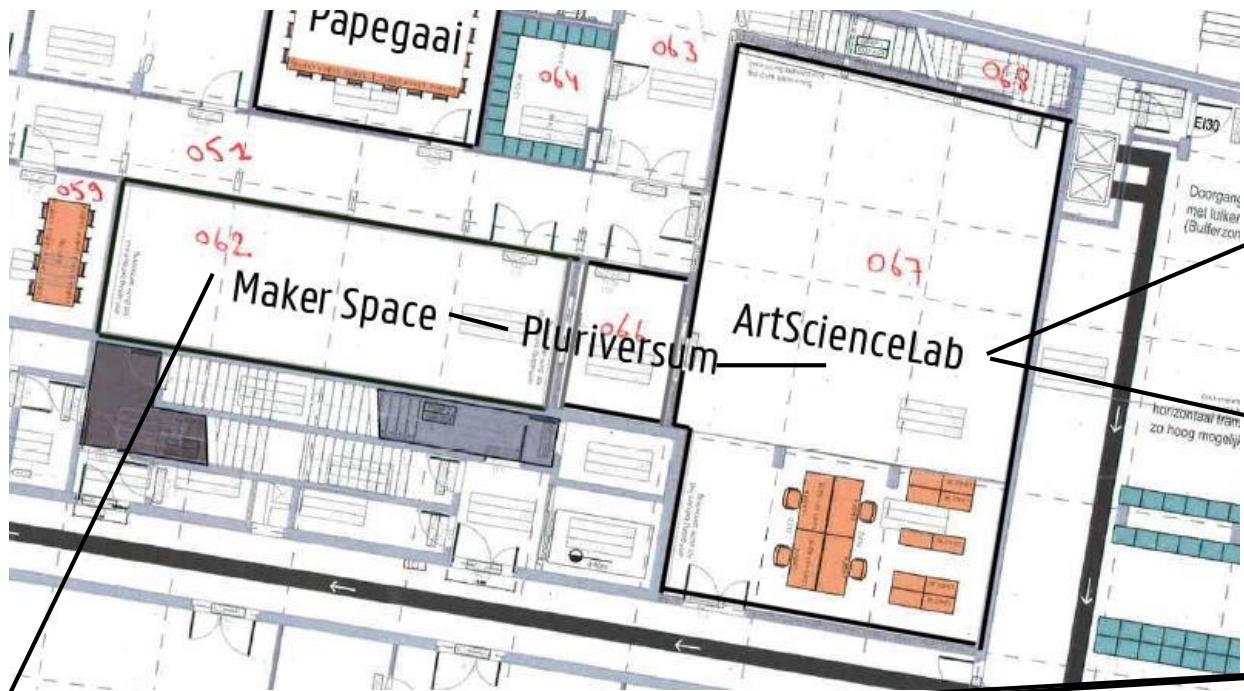
Testing gallery ideas or audience study



# Usability of the lab

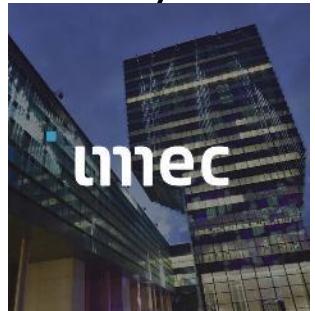
- Designed to quickly change setups
- Flexible: trussing system, everything on wheels, inter-lab compatibility
- Open-source ideology: download specs of the lab online
- Following the new GDPR EU rules for data management
- Separate room for sensitive or loud equipment/pc's
  
- Frequent workshops & training sessions
- Technical supervision & maintenance

# Extending beyond the lab

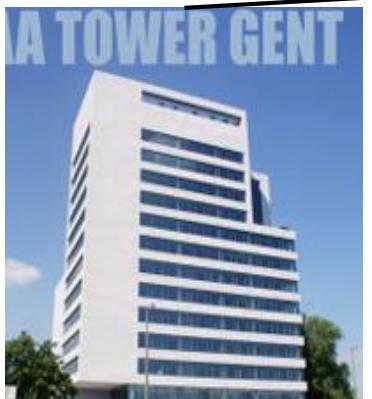


URGent Radio studio

UGhent Fiber ring



IMEC audio labs



Technologiepark



De Vooruit



Wintercircus



Minard

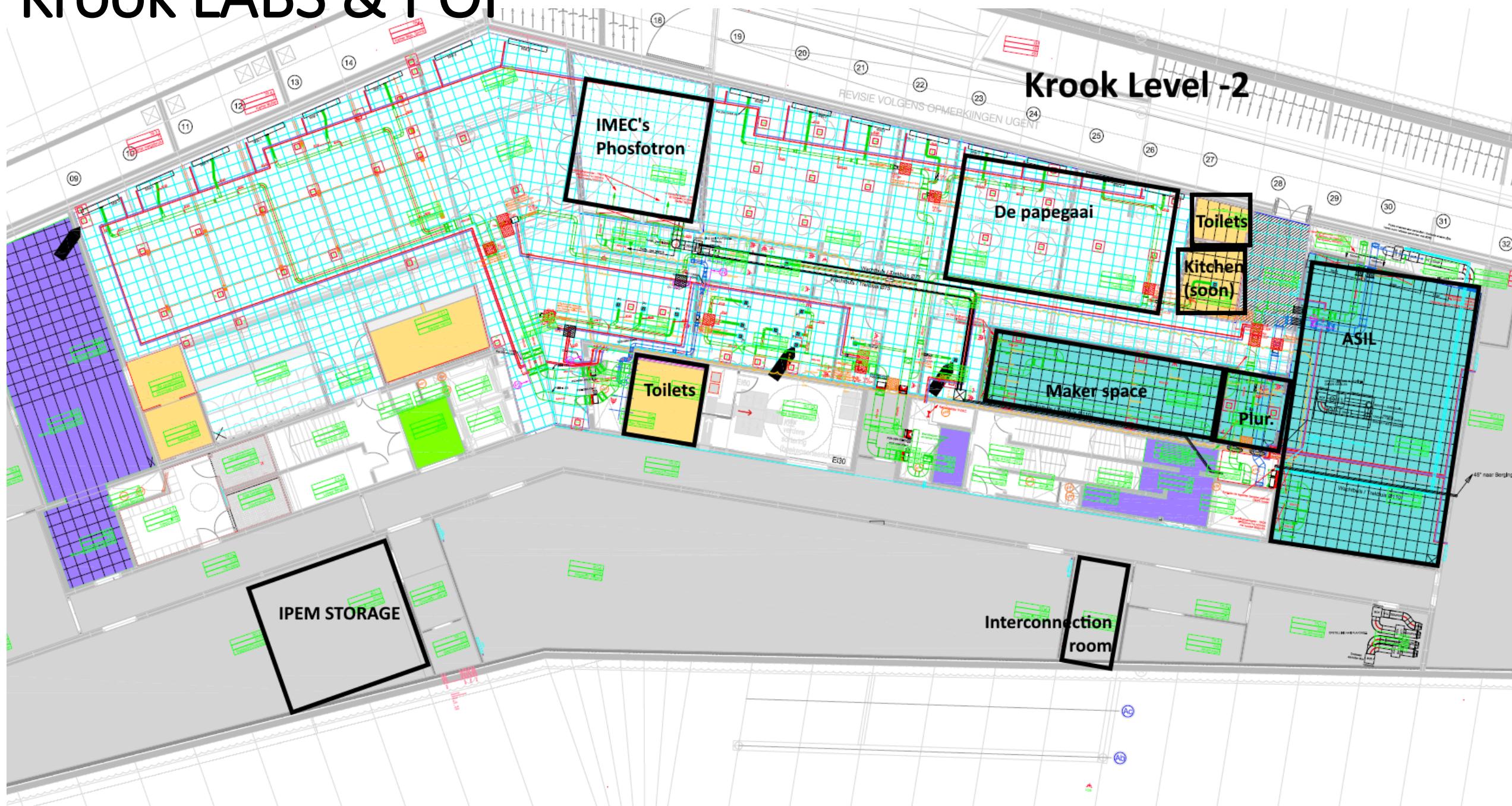
## PART 2

# Practical stuff

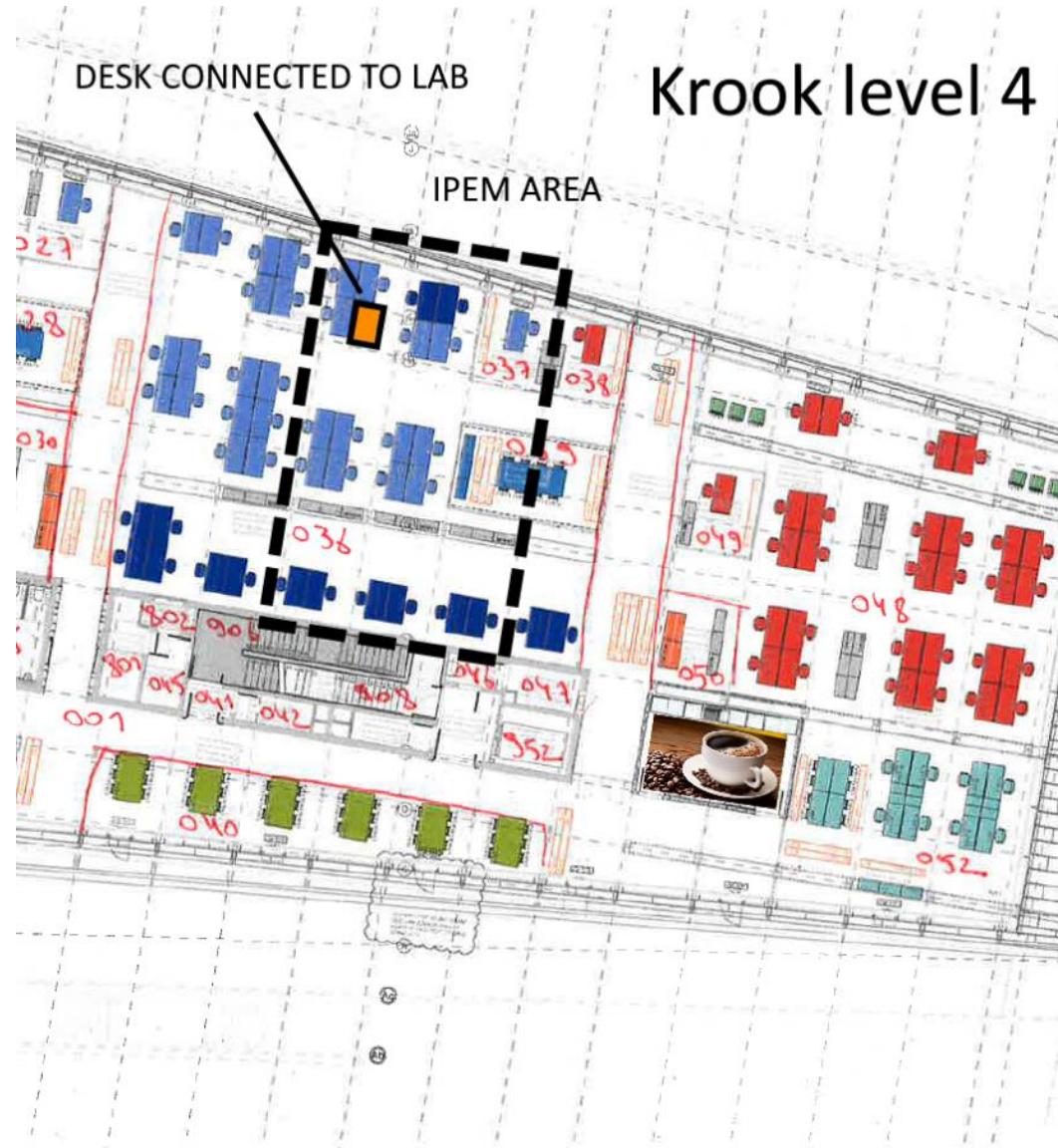
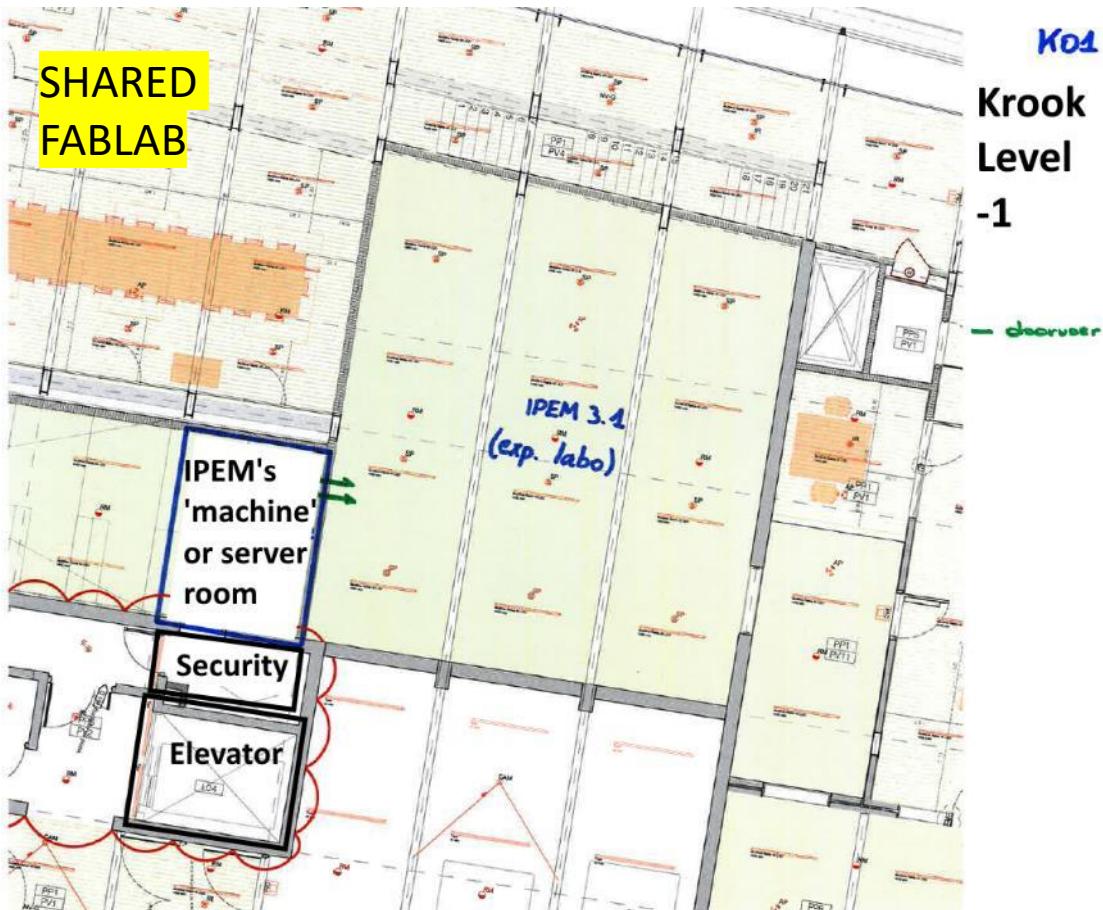
- Krook Labs
- Bookings & CMS
- Partners & arrangements: IDLab, IMEC, MICT
- Lab Rules
- Practicalities & Documentation

# Krook LABS & POI

## Krook Level -2



# Locations: other levels



# Bookings & CMS

- To reserve one of the labs, use IPEM CMS bookings
  - <https://intranet.flw.ugent.be/ipem/Lists/Bookings/calendar.aspx>
  - Use Ugent Login
  - In case of no acces: mail Aagje Lachaert <Aagje.Lachaert@UGent.be>
- Plan your experiment in “blocks”
- Important to do this well in advance!
- For special requests (or IPEM Partners), mail ([bart.moens@ugent.be](mailto bart.moens@ugent.be)).
  - (2019) Shared CMS with IMEC, IDLab & IPEM
- To reserve the meeting room of the Papegaai (-2): mail to Ann Wouters ([Ann.Wouters@imec.be](mailto Ann.Wouters@imec.be))

# Bookings & CMS

- <https://intranet.flw.ugent.be/ipem/Lists/Bookings/calendar.aspx>

The screenshot shows a SharePoint calendar page for the month of February 2019. The calendar view displays various events and bookings across the days of the week. The 'Bookings' tab is selected in the navigation bar on the left. The top navigation bar includes links for 'Booking - all items', 'Calendar Tools' (Events, Calendar), 'Site Actions', 'Browse', 'Create View', 'Current View: all items', 'E-mail a Link', 'Alert Me', 'RSS Feed', 'Connect to Outlook', 'Export to Excel', 'Open with Access', 'Caml Query', 'Edit List', 'Form Web Parts', 'Workflow Settings', 'List Settings', and 'List Permissions'. The calendar grid shows the following details:

- Monday, Feb 4:** Mocap opnames IDLab Ignace (ArtScienceLab (the big lab))
- Tuesday, Feb 5:** weight Lifting experiment (ArtScienceLab (the big lab))
- Wednesday, Feb 6:** Vakgroepdag demo's (ArtScienceLab (the big lab))
- Thursday, Feb 7:** 8:00 - 19:00 weight Lifting experiment (ArtScienceLab (the big lab))
- Friday, Feb 8:** 10:00 - 19:00 Archive IPEM CDs (Maker Space ('schuine ruimte'))
- Saturday, Feb 9:** weight Lifting experiment (ArtScienceLab (the big lab))
- Sunday, Feb 10:** weight Lifting experiment (ArtScienceLab (the big lab))
- Monday, Feb 11:** Bezoek Rik Leenknegt (ArtScienceLab (the big lab))
- Tuesday, Feb 12:** 11:00 - 17:00 weight Lifting experiment (ArtScienceLab (the big lab))
- Wednesday, Feb 13:** 10:00 - 17:00 IOSONO reserved for IMEC (ArtScienceLab (the big lab))
- Thursday, Feb 14:** 10:00 Meetstand Electriciteit (ArtScienceLab (the big lab))
- Friday, Feb 15:** 13:00 - 14:00 IPEM Do-Thank Deel 1 (ArtScienceLab (the big lab))
- Saturday, Feb 16:** weightlifting experiment (ArtScienceLab (the big lab))
- Sunday, Feb 17:** weightlifting experiment (ArtScienceLab (the big lab))
- Monday, Feb 18:** weightlifting experiment (ArtScienceLab (the big lab))
- Tuesday, Feb 19:** weightlifting experiment (ArtScienceLab (the big lab))
- Wednesday, Feb 20:** weightlifting experiment (ArtScienceLab (the big lab))
- Thursday, Feb 21:** weightlifting experiment (ArtScienceLab (the big lab))
- Friday, Feb 22:** Do Tank Practice (ArtScienceLab (the big lab), De Papegaai (unofficial), Pluriversum (central room - w))
- Saturday, Feb 23:** 10:00 Instructieve rondleiding ASILab infrastructu
- Sunday, Feb 24:** 13:00 - 17:00 IPEM Do-Thank Deel 2 (ArtScienceLab (the big lab))
- Monday, Feb 25:** 8:00 - 18:00 Ellie Nimeroski (ArtScienceLab (the big lab))
- Tuesday, Feb 26:** weightlifting experiment (ArtScienceLab (the big lab))
- Wednesday, Feb 27:** weightlifting experiment (ArtScienceLab (the big lab))
- Thursday, Feb 28:** 9:00 - 17:00 idlab reservatie (ArtScienceLab (the big lab))
- Friday, Feb 1:** weightlifting experiment (ArtScienceLab (the big lab))

# Bookings & CMS

- Best practice: be as complete as possible!
  - Booking type = the lab(s)
  - IPEM member = who to contact in case of trouble
  - Reason = course, experiment, maintenance, etc
- Also reserve for courses, demo's, etc
- Also reserve equipment (eg for remote setup) o

Booking - New Item

Edit

Save Cancel Cut Copy Attach File Commit Clipboard Actions

Booking Type

ArtScienceLab (the big De Papegaai (unofficial Maker Space ('schuine Pluriversum (central ro

Add >

< Remove

Title \*

Start date \* 12/02/2019 16: 00

End date \* 12/02/2019 17: 00

Location

Description

Click for help about adding basic HTML formatting.

All Day Event  Make this an all-day activity that doesn't start or end at a specific hour.

Recurrence  Make this a repeating event.

IPEM Member

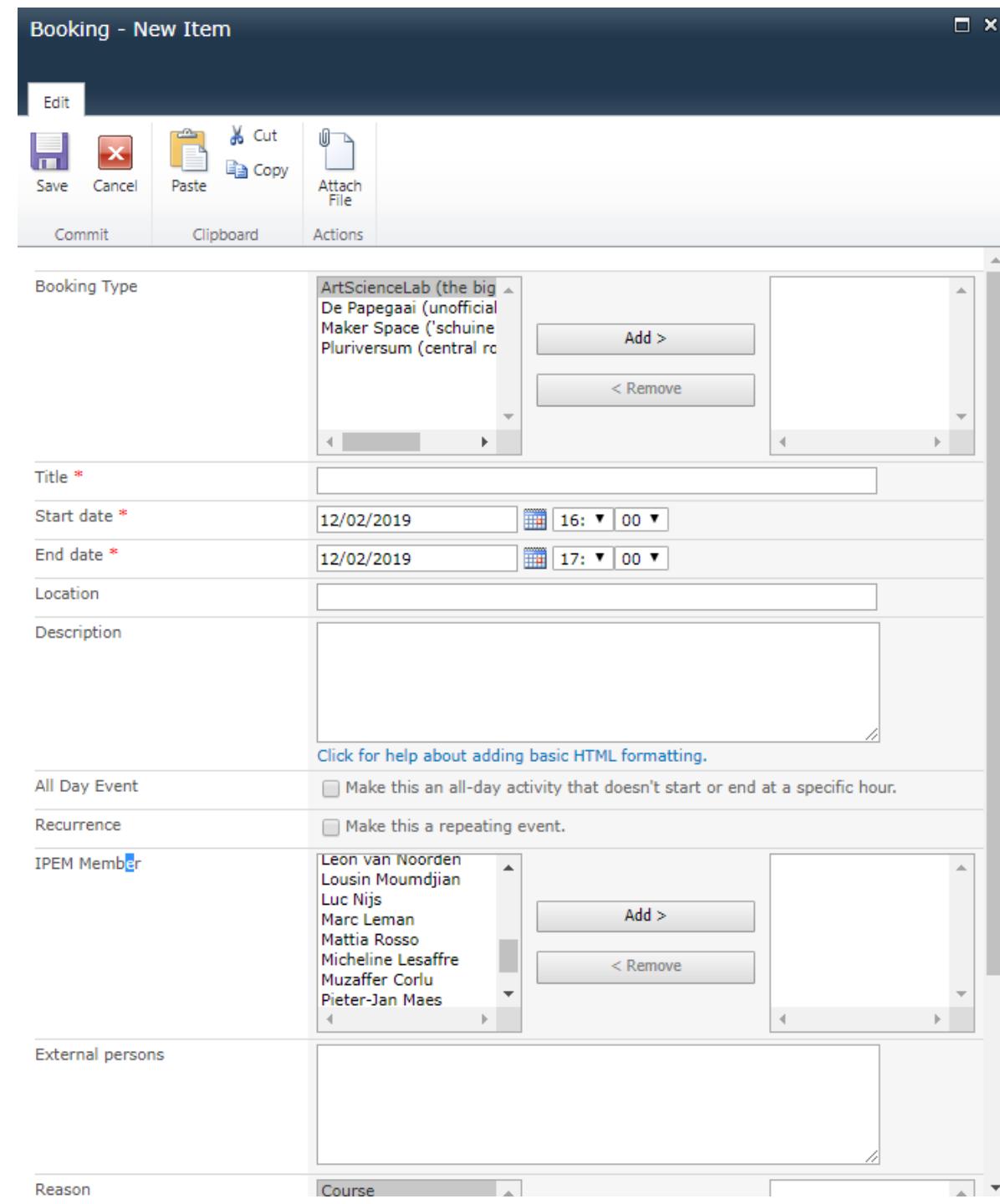
Leon van Noorden  
Lousin Moumdjian  
Luc Nijls  
Marc Leman  
Mattia Rosso  
Micheline Lesaffre  
Muzaffer Corlu  
Pieter-Jan Maes

Add >

< Remove

External persons

Reason Course



# Partnerships

- Lab is shared among IPEM, IDLab & MICT.
- IPEM focusses on audio, IDLab on mocap/video/VR.
- We share some infrastructure with IMEC
- Current “agreements”:
  - We can use the 3D IOSONO at any time. IMEC needs to reserve (entered in calendar) or call me in advance.
  - IMEC & IPEM share the same network – mistakes can happen - be careful that you don’t change *their* settings
  - IDLab doesn’t use the lab often but this will change. For now, when they need it and in case of conflict, they get priority (in reasonable terms).

# Lab Rules

- Leave the lab clean (!)
- Sort your garbage (paper, PMD & rest)
- No food or drinks at the desks or sensitive equipment
- Shut down equipment/power when leaving
- Lab coats will become mandatory
- More practical guidelines will follow...

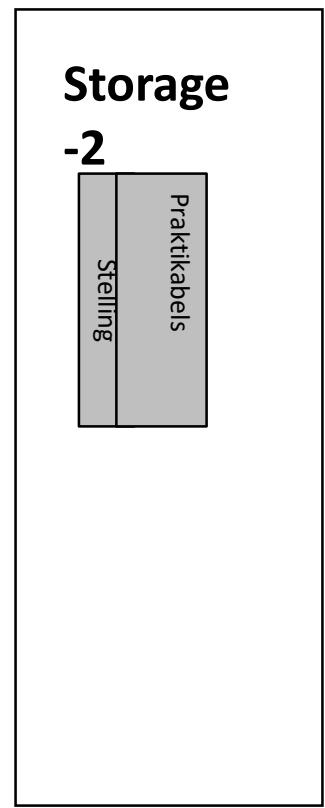
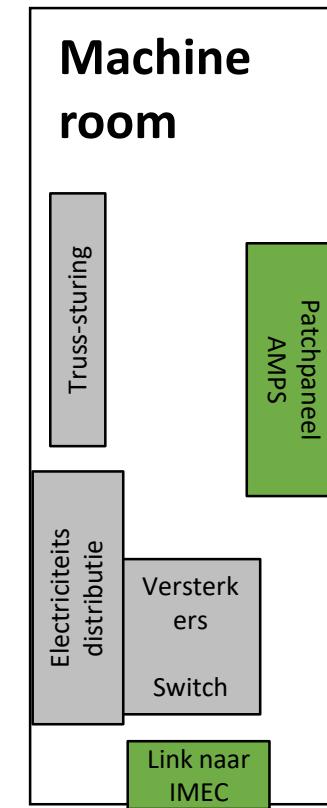
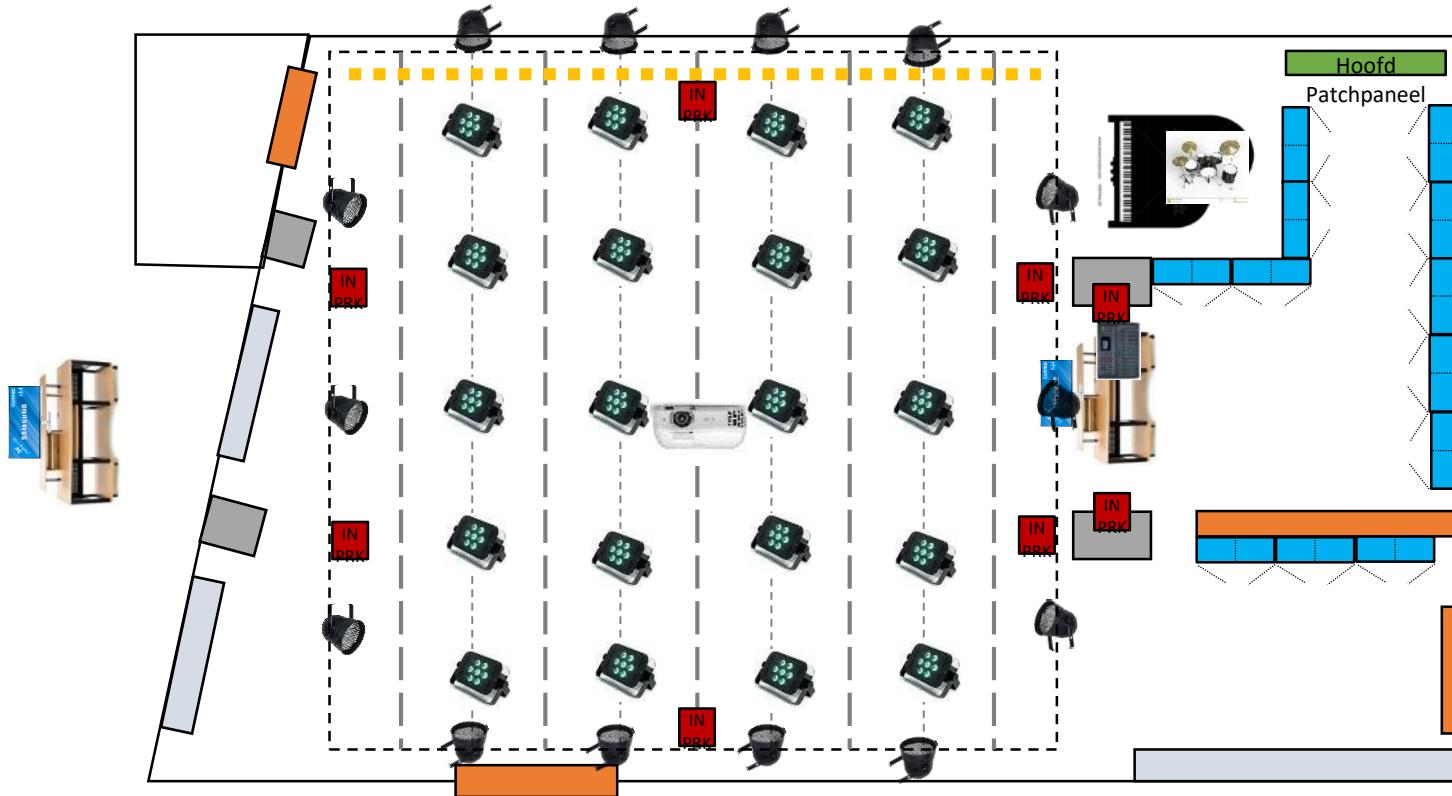


## Rules of the lab

- 1) If an experiment works, something has gone wrong.
- 2) When you don't know what you're doing, do it neatly.
- 3) Experiments must be reproduceable, they should fail the same way each time.
- 4) First draw your curves, then plot your data.
- 5) Experience is directly proportional to equipment ruined.
- 6) Always keep a record of your data. It indicates that you have been working.
- 7) To do a lab really well, have your report done well in advance.
- 8) If you can't get the answer in the usual manner, start at the answer and derive the question.
- 9) In case of doubt, make it sound convincing.
- 10) Do not believe in miracles—rely on them.
- 11) Team work is essential, it allows you to blame someone else.
- 12) All unmarked beakers contain fast-acting, extremely toxic poisons.
- 13) No experiment is a complete failure. At least it can serve as a negative example.
- 14) Any delicate and expensive piece of glassware will break before any use can be made of it.

# Practicalities & Documentation

- Still searching the right layout of the lab for all equipment, feedback welcome!



# Practicalities & Documentation

- Main source (ipem internal):  
<https://sharepoint.ugent.be/projects/201803192/SitePages/Introductiepagina.aspx> (lab documentation)
- External: <https://github.com/ArtScienceLab> (Lab Documentation)
- Reservations:  
<https://intranet.flw.ugent.be/ipem/Lists/Bookings/calendar.aspx>
- Troubles: [bart.moens@ugent.be](mailto bart.moens@ugent.be)

# Documentation: Sharepoint

<https://sharepoint.ugent.be/projects/201803192/SitePages/Introductiepagina.aspx> (lab documentation)

The screenshot shows a SharePoint 2010 interface. At the top, there's a green header bar with the title "SharePoint (2.0)". Below it is a navigation bar with tabs: "BLADEREN" (highlighted with a blue arrow), "BESTANDEN", and "BIBLIOTHEEK". To the right of the navigation bar are user information ("OneDrive@Office365", "Sites", "Bart.Moens@UGent.be") and various icons. The main content area has a dark green header with the "sf" SharePoint logo and the word "Start". Below this, the breadcrumb path "Documenten > ASIL\_Documentation" is displayed. A search bar "Zoeken in deze site" is on the right. On the left, there's a vertical navigation bar with tabs: "Start", "Notitieblok", "Documenten" (highlighted with a blue arrow), and "Inhoud van site". The main content area displays a list of documents under the heading "Alle documenten". The list includes:

Bewerken	Naam	Gewijzigd	Gewijzigd door	Versie
	ASIL-Phosfortron IP ranges	... Een paar seconden geleden	<input type="checkbox"/> Bart.Moens@UGent.be	1.0
	Manuals	... 29 augustus 2018	<input type="checkbox"/> Bart.Moens@UGent.be	1.0
	Mocap - Animation Marker Set	... 25 minuten geleden	<input type="checkbox"/> Bart.Moens@UGent.be	1.0
	Documtation	... 5 dagen geleden	<input type="checkbox"/> Bart.Moens@UGent.be	1.0
	2019 - ASIL LABS - Do Tank Part 1	... 5 dagen geleden	<input type="checkbox"/> Bart.Moens@UGent.be	1.0
	INFOSHEET - Speaker_assenstsel	... 29 augustus 2018	<input type="checkbox"/> Bart.Moens@UGent.be	1.0

## PART 3

# Basic topics

- Patching panels
- KVM network
- DANTE audio over IP
- The RACK: “sensor & audio connections”
- Motion capture system
- Synchronisation
- Storage & Data processing

# PART 3.1 PATCH PANELS



# Patching panels

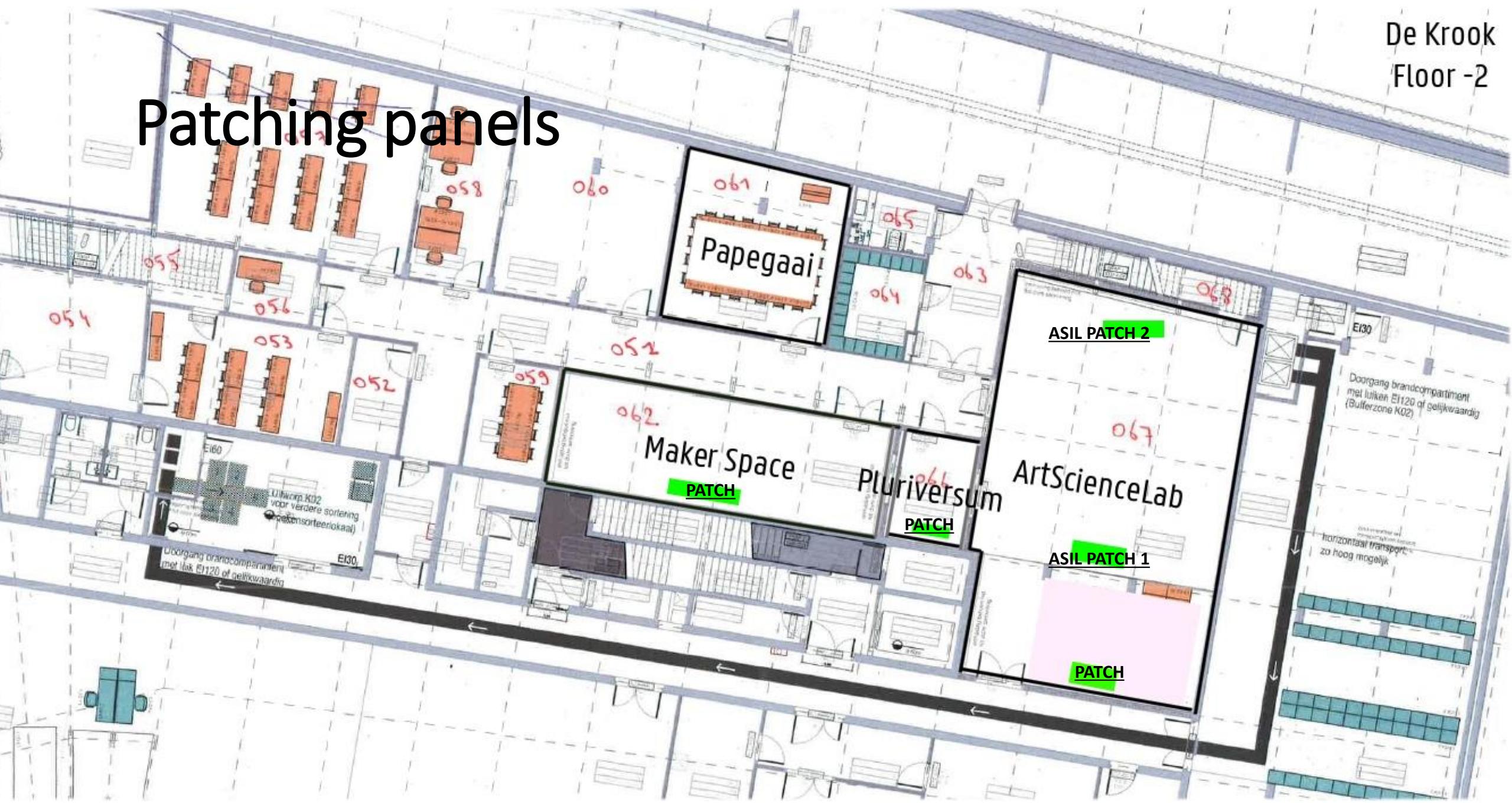
- Main infrastructure is located outside of the lab (in machineroom)
  - Reduce heat and noise
  - Better maintainability
  - Security
  - Fast reproducability of the experiments
- “Minimalism” ideology:
  - Computers upstairs, screens downstairs
  - Short cables
- How to connect to this equipment?

# Patching panels

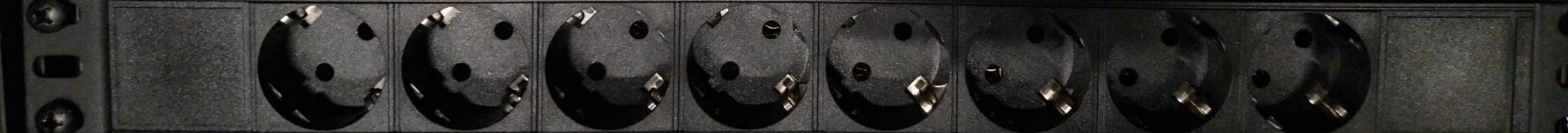
- Every setup in the lab starts with the main patching panels
- Patching panel is a “block with different connectors”
  - Power
  - Network / Dante
  - Synchronisation
  - Realtime clocks
  - Audio connections (for Maker Space & Pluriversum)
- All patching panels are directly connected to the central machineroom
- Patchers are labelled (patch name, connections...)
  - note where you connected what for the recreation of a setup!
- Currently: 5 patching points, extension to 20 in 2019



# Patching panels



## Maker Space patch panel



ASIL patch panel - 2



## PART 3.2: KVM

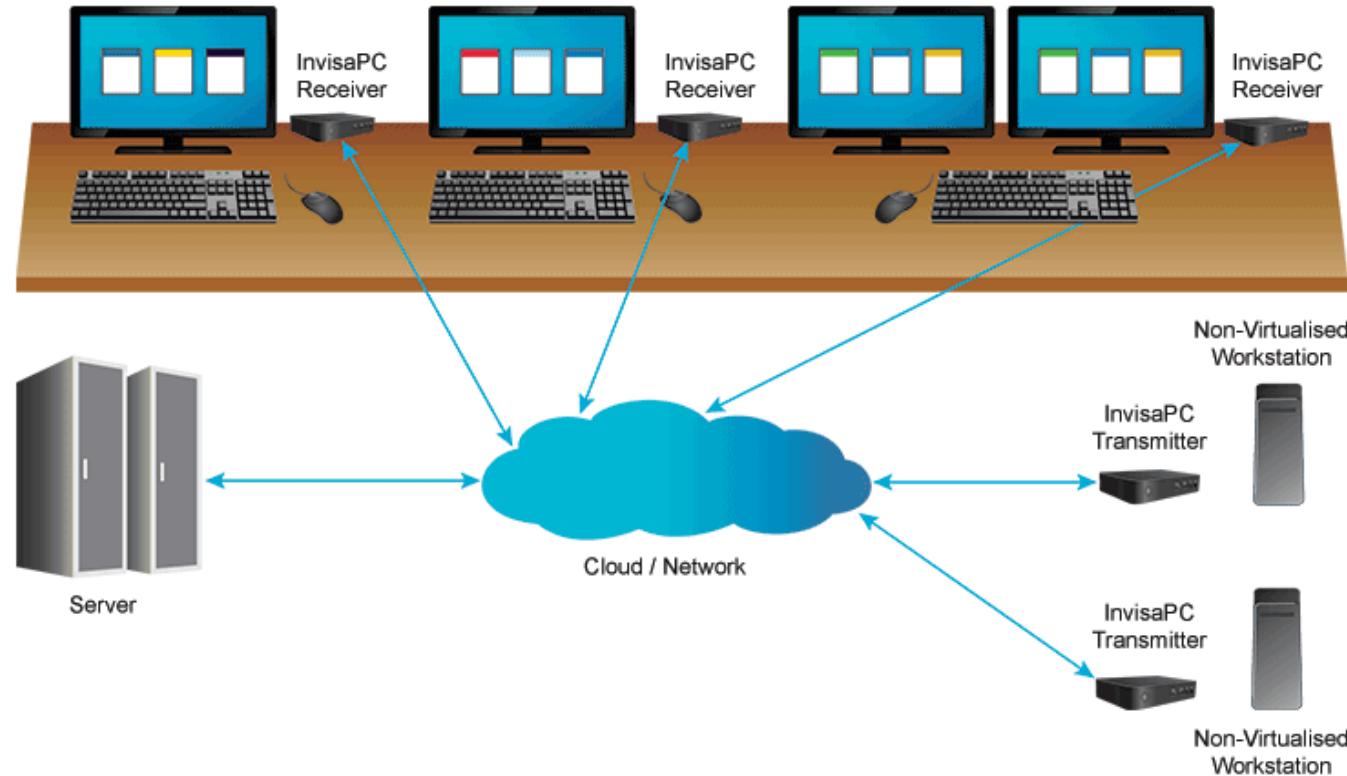
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Remote connection to computers



# KVM infrastructure

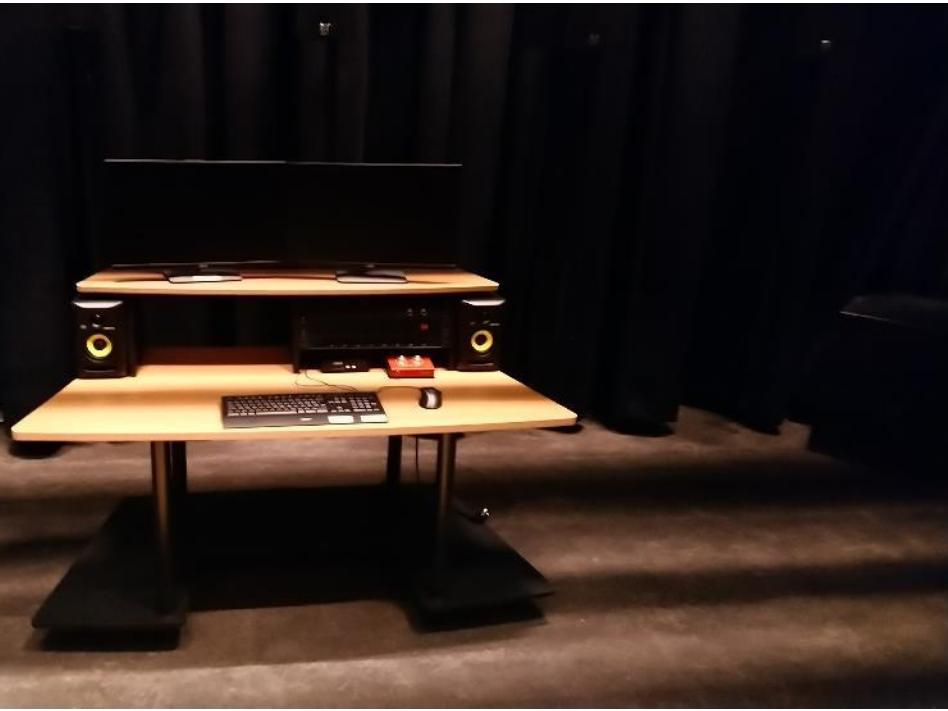
- KVM = Keyboard, video, mouse
- Splitting “computer” and “control interface”
  - Computers: in machineroom
  - Screens: in the labs
- Connected to each other over standard network



# KVM infrastructure

- Computers available:
  - “IDLAB Mocap”
  - “MACHINEROOM ambisonics”
  - “RACK PC” Sensor/ableton computer
  - External laptop input
  - Storage
  - VR computers 1 – 3
- Screens available:
  - Big TV screen in the lab
  - Big desk (2 computers at once)
  - Small desk
  - Remote desk at +4
  - Projectors
- Show any computer at any screen
- Share screens: show one computer on multiple screens
- Do data processing or preparation at the +4 desk
- Extends over the 3 labs!
- Hotkey: “CTRL – CTRL – O” to switch computers

# KVM: the mobile desks

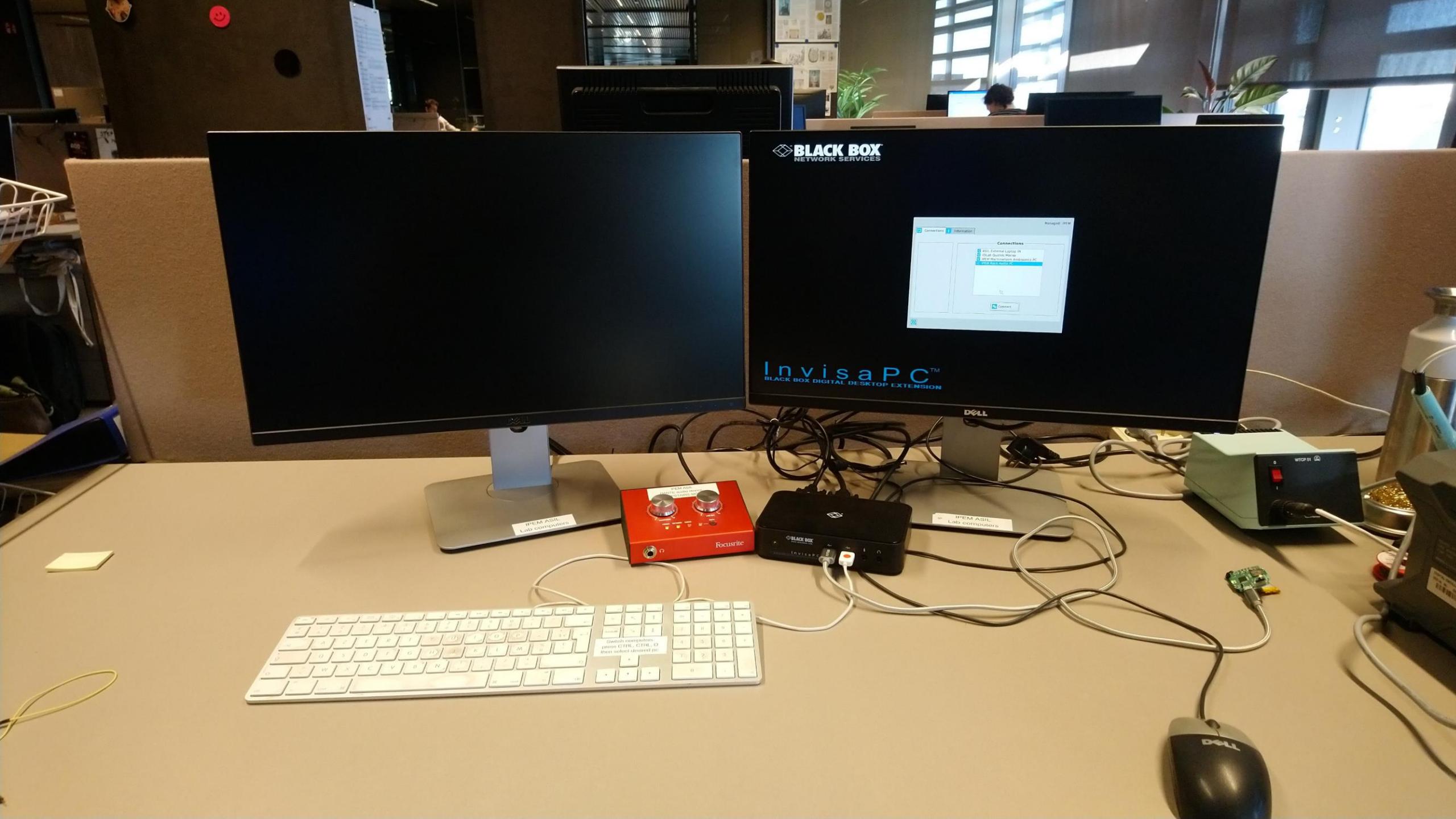


Each desk connectable with only 2 cables to **the patch panels**

Big desk controls two pcs (two left screens + left kb/m); (single right screen + right kb/m)

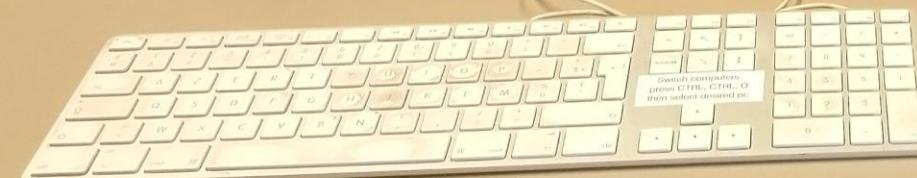
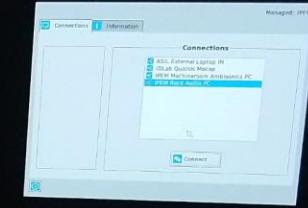
Has two audio monitors to preview audio

Big desk has two drawers for notes and stuff



BLACK BOX  
NETWORK SERVICES

InvisaPC™  
BLACK BOX DIGITAL DESKTOP EXTENSION





# Which computers for what?

- IDLAB Mocap
- “MACHINEROOM ambisonics”
  - Audio applications (eg ambisonics)
  - Secondary labs
- “RACK PC” Sensor/ableton computer
  - Main powerhouse PC
  - Recording audio, iosono, etc...
- External laptop input
  - Connecting your laptop to KVM screens
- Storage
  - Storing all data from other computers

# KVM infrastructure howto: using computers

- TV screen & upstairs: turn on screens, select computer
- Mobile desks:
  - Connect power cable
  - Connect ethernet cable (from front desk) to any patch panel ethernet
  - Power on
  - Select computer
- Switch computers: press “CTRL CTRL O”

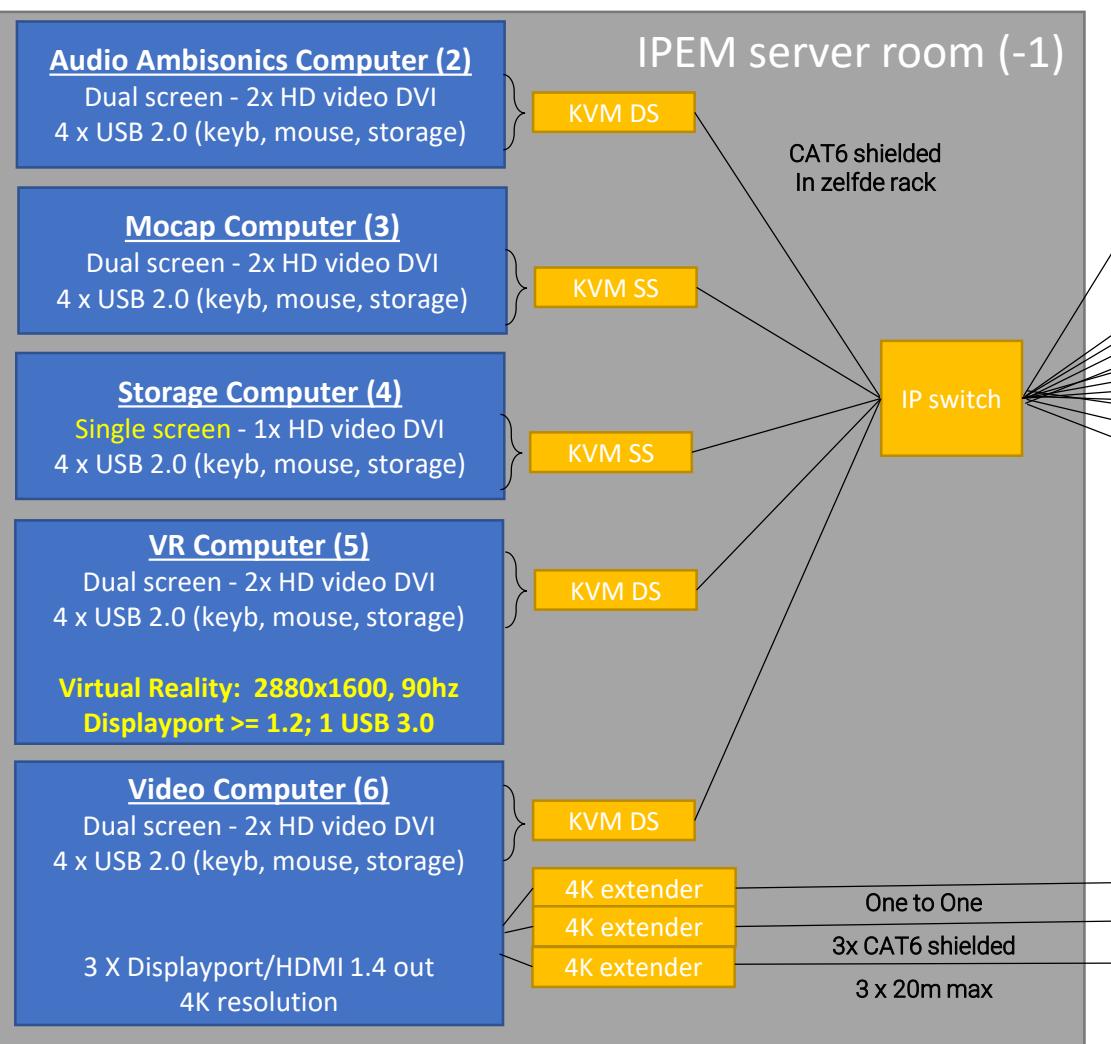


# KVM infrastructure howto: connecting laptop

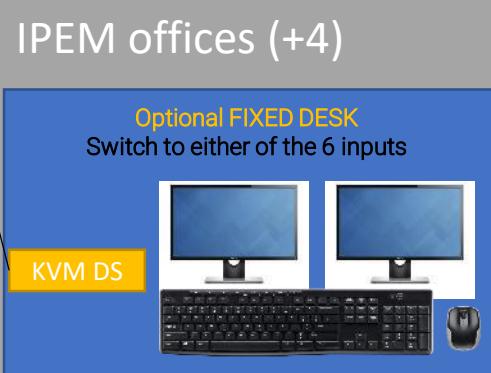
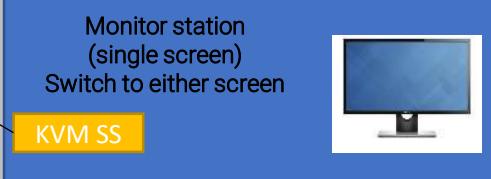
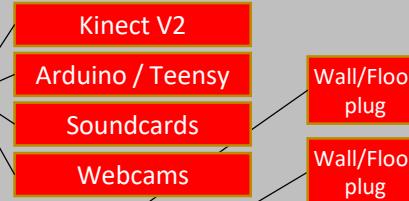
- Find the white small desk
- Connect to patch panel (power & UTP)
- Connect HDMI cable to laptop
- If remote control from other locations  
is needed, connect USB cable
- Connect dante USB for audio to the  
speakers
- Select “external laptop in” on any  
screen

# KVM infrastructure schematic

IPEM lab (-2)  
19" mobile rack



IPEM lab (-2)





## PART 3.3: DANTE Audio over IP

---

- What is DANTE?
- Why DANTE?
- Using DANTE
- Running Dante Controller
- Running Dante Virtual Soundcard
- Device naming in the lab
- The power of DANTE: presets



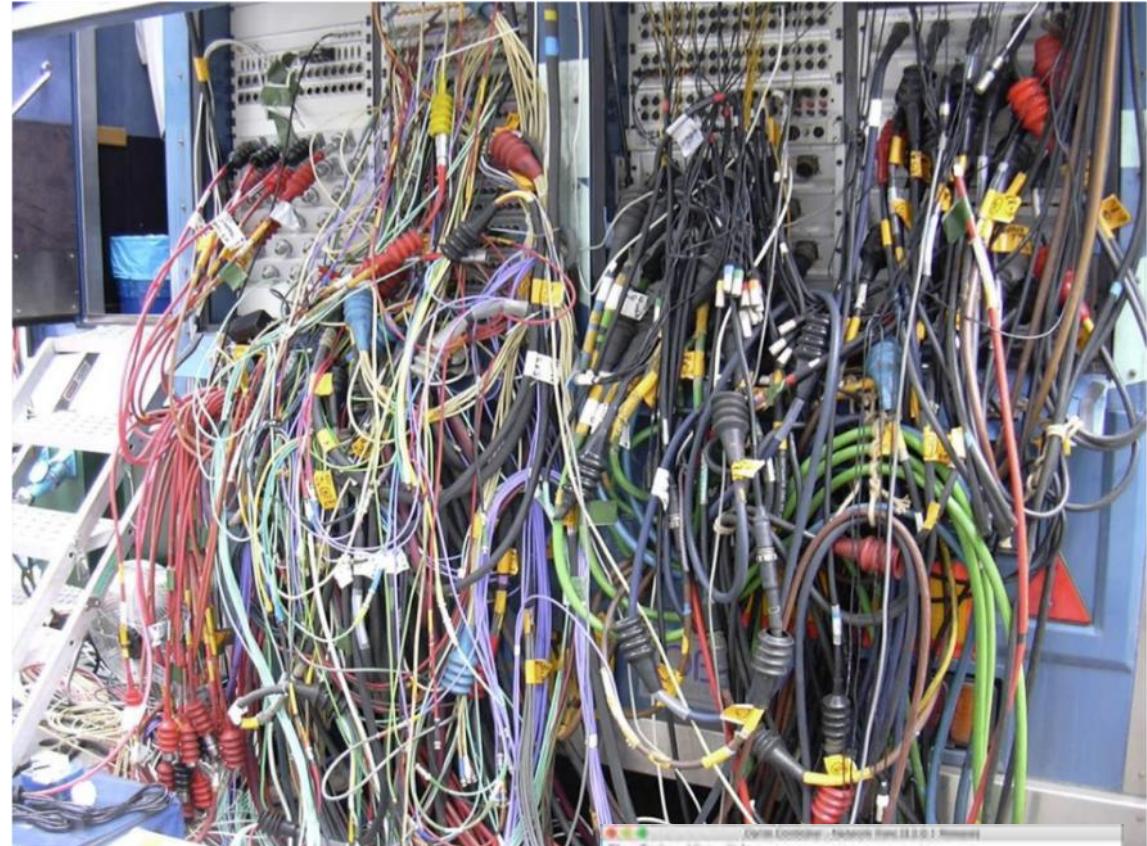
# What is DANTE?

- “Dante is a hardware and software solution that transports precisely timed digital audio between devices using standard IP networking”
  - Dante = multichannel audio **protocol** over ethernet
  - Dante is not “a device”! *Its a way to bring audio from device A to B as fast & flexible as possible.*
  - Dante replaces classical XLR cabling
- Created by Australian company Audinate
- Requires modern network infrastructure (CAT6); *wifi is not supported to transfer audio*



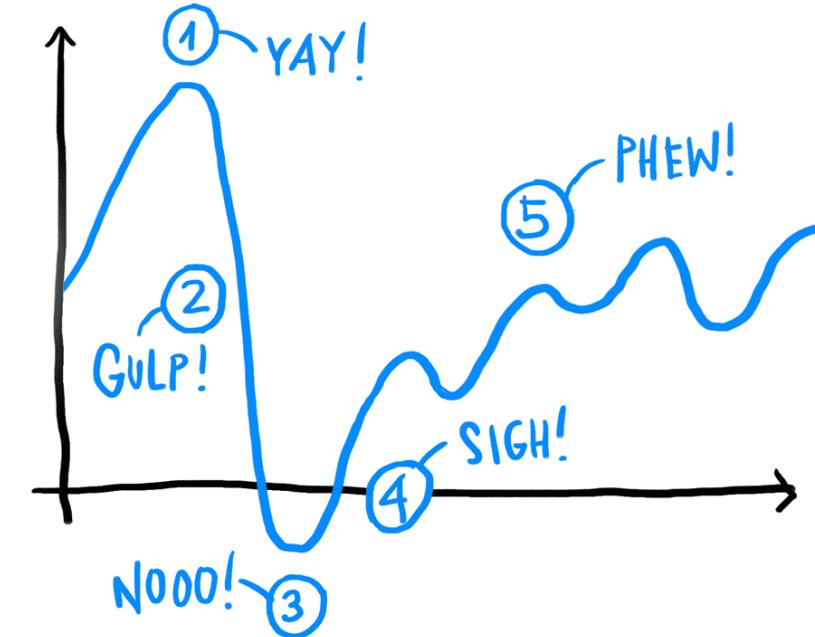
# Why DANTE?

- 64 speakers is not ‘easy’
- Flexible, patchable, extensieve
- 1-cable installation
- Agreed protocol in the Krook
  - Direct audio connections & shared infrastructure
  - Partners: IMEC – IPEM – URGENT
- Future extensions over fiber to Vooruit, Wintercircus, Minard, ..
- Krook = multimedia hub for cultural Ghent!



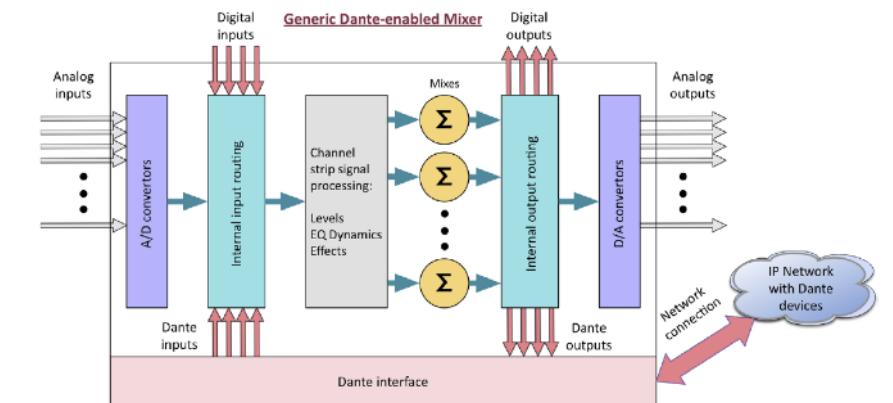
# What is DANTE?

- What does Dante NOT do?
  - Sample rate conversion (**use 48khz**)
  - Level control (**mind the volume**)
  - MIDI
  - SMPTE time code
- Downsides:
  - Not open source: proprietary licences
  - We can accidentally mess up connected labs
  - Learning curve!
  - Do not expect Plug & Play for a 64 speaker system - although I try to make it as easy as possible
  - Difficulties with linux



# DANTE Enabled devices

- Devices can implement DANTE
  - Amplifiers
  - Speakers
  - ADC's
  - DAC's
  - Mixers
  - Soundcards
  - PC's
  - ...
  - **All lab equipment**

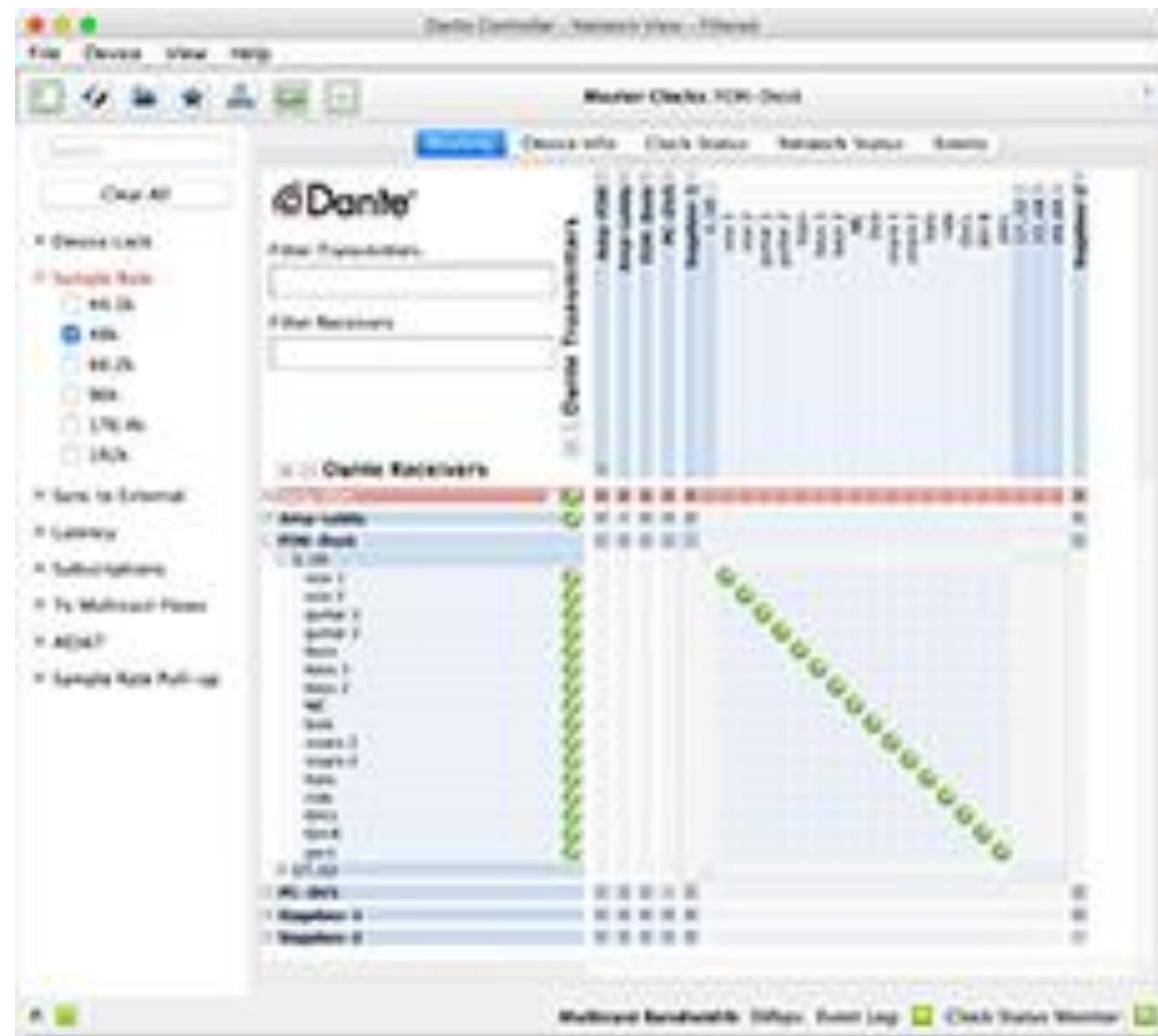


# Using Dante

- Dante requires the “routing software”: a piece of software that decide which audio channels go where
- “Dante controller” for windows & mac
- Freely downloadable at  
<https://www.audinate.com/products/software/dante-controller>

# The Dante Matrix

- Route audio singlas from transmitter to receiver
- Transmitter = on top of the screen
- Receiver = left on the screen
- Click the interconnection to make the audio line (cfr connecting the cable)



# Using Dante

- How to get sound out of your computer?
  - Dante **hardware** ‘soundcard’: High performance: dante-input card
    - Latencies < 1ms
    - Studio setup
    - **>1024 channels**
    - Enables connection to and from complete dante network!
    - **Present on both the RACK PC and AMBISONICS PC**
  - Dante **virtual** ‘soundcard’
    - Downloadable software
    - *Enable dante on normal PC hardware*
    - Latencies > 4ms, < 10ms
    - Max 64 channel
    - Enables connection to and from complete dante network!
    - Licences: mail me!



# Using Dante Virtual Soundcard (own pc)

- Connect your computer to the lab network
  - Check in dante controller if devices appear
  - Start dante virtual soundcard
    - On OSX this goes okay by default
    - On windows you have 2 choices:
      - WDM = windows sound (eg spotify -> speakers)
      - ASIO = low latency audio for DAW applications
  - Make the required routing (eg to speakers)
    - From any app (eg max, Ableton, ...)
  - Play!
- 
- **MIND THE VOLUME! Start low. Thanks.**



# Dante devices: naming conventions

- ORGANISATION – LOCATION & WHAT
- IPEM – AMP1 = First IPEM Amp
- IPEM-MACHINEROOM-SYNCMASTER = masterclock in machineroom and also audio in out for pluriversum & maker space
- IPEM-RACK-PC = pc in the rack (the dante soundcard)
- IPEM-RACK-MICINPUTS = Microphone inputs in the rack
- IPEM-RACK-ANALOG-IN-OUT = line in/out from the rack

# DANTE DEVICES

-  IDLab-Mocap-VirtualSoundcard
-  IDLab-VR-VIVEpro
-  IOSONO-RN6
-  IPEM-AMP-1
-  IPEM-AMP-2
-  IPEM-AMP-3
-  IPEM-AMP-4
-  IPEM-AMP-5
-  IPEM-AMP-6
-  IPEM-AMP-7
-  IPEM-AMP-8-MONITORS
-  IPEM-AMP-9-subs
-  IPEM-MACHINEROOM-AMBISONICS
-  IPEM-MACHINEROOM-SYNCMASTER
-  IPEM-MONITOR-BIGDESK
-  IPEM-MONITOR-UPSTAIRS
-  IPEM-RACK-ANALOG-IN-OUT
-  IPEM-RACK-MICINPUTS
-  IPEM-RACK-PC

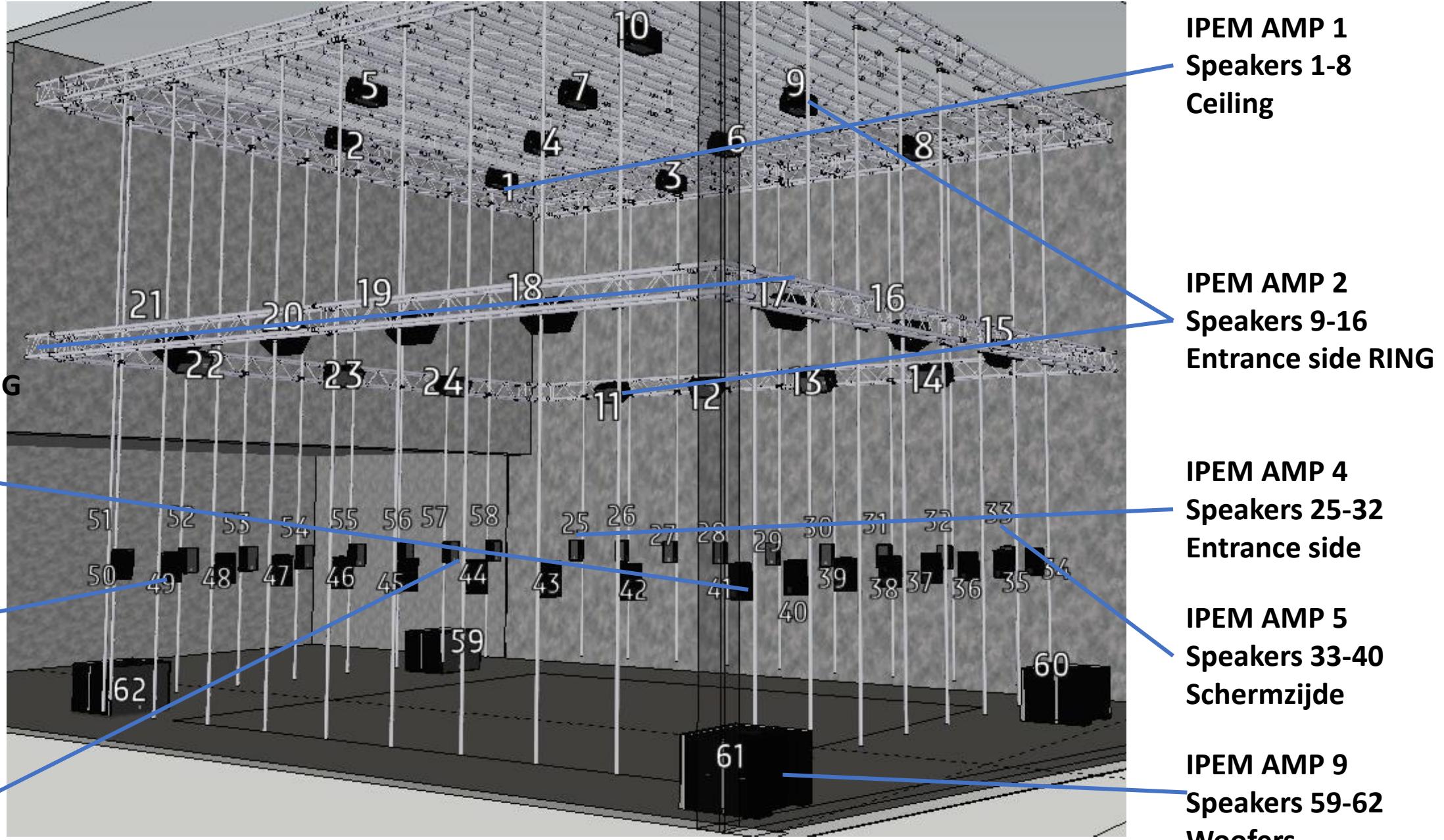
# Speaker numbering & AMPS

IPEM AMP 3  
Speakers 17-24  
URGENT side RING

IPEM AMP 6  
Speakers 41-48  
URGENT side

IPEM AMP 7  
Speakers 49-56  
Regie-zijde

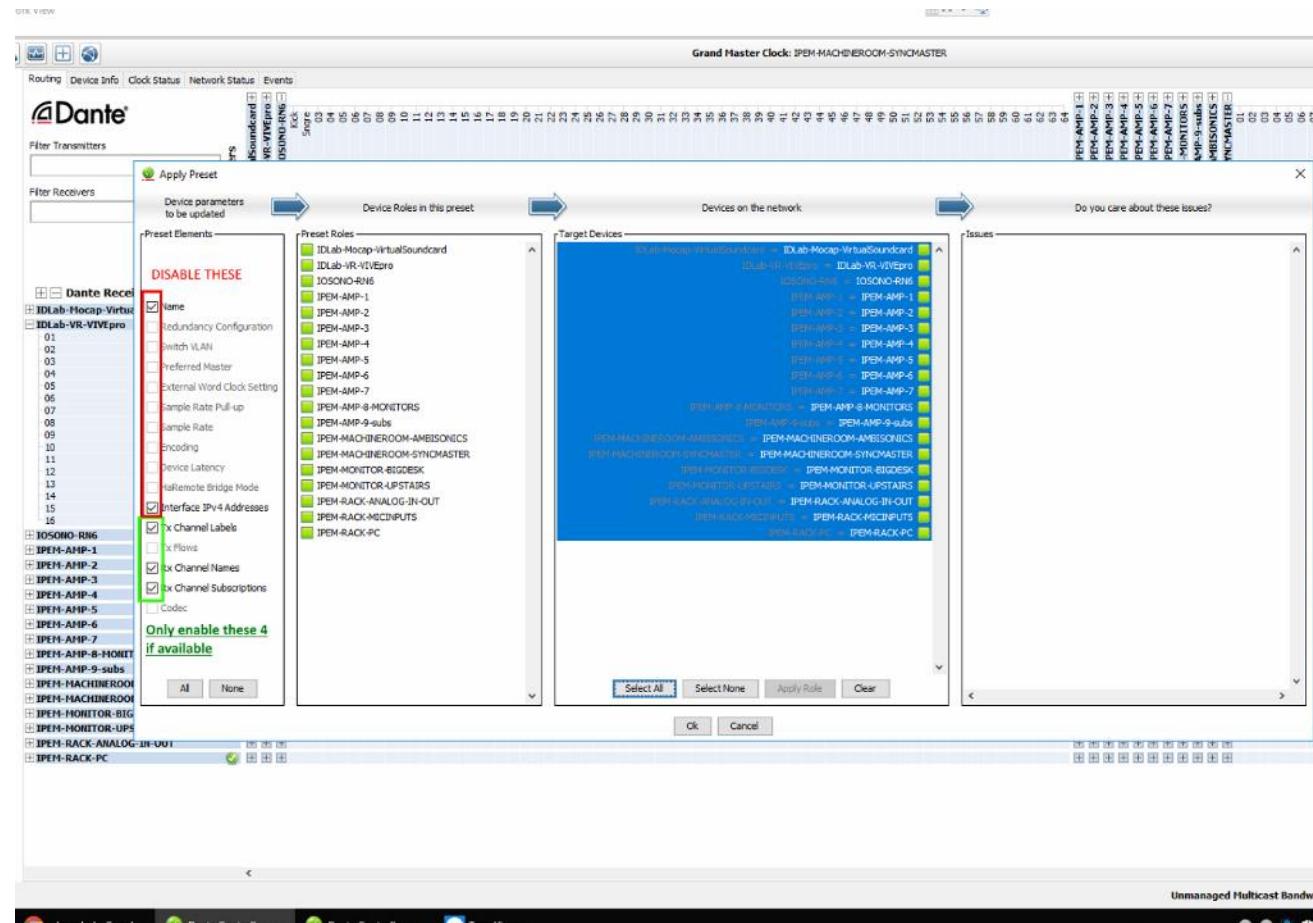
IPEM AMP 8  
Speakers 57-58  
TV Speakers



# Dante presets

- Powerful tool for easy recreation of demo's or experiments
- Saves all audio routing throughout the network in 1 file
- Can be recalled at any time to recreate the setup

# DANTE best practice: presets & storage!



# DANTE exercises

- Play sounds to a specific speaker from the operating system
- Play sounds to a specific speaker from a professional app (eg Ableton, max msp, etc)
- Route a microphone to record on your PC



## Part 3.4: The Rack

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The main central Audio component to connect audio, sensors & midi to

# “The Rack”: Why?

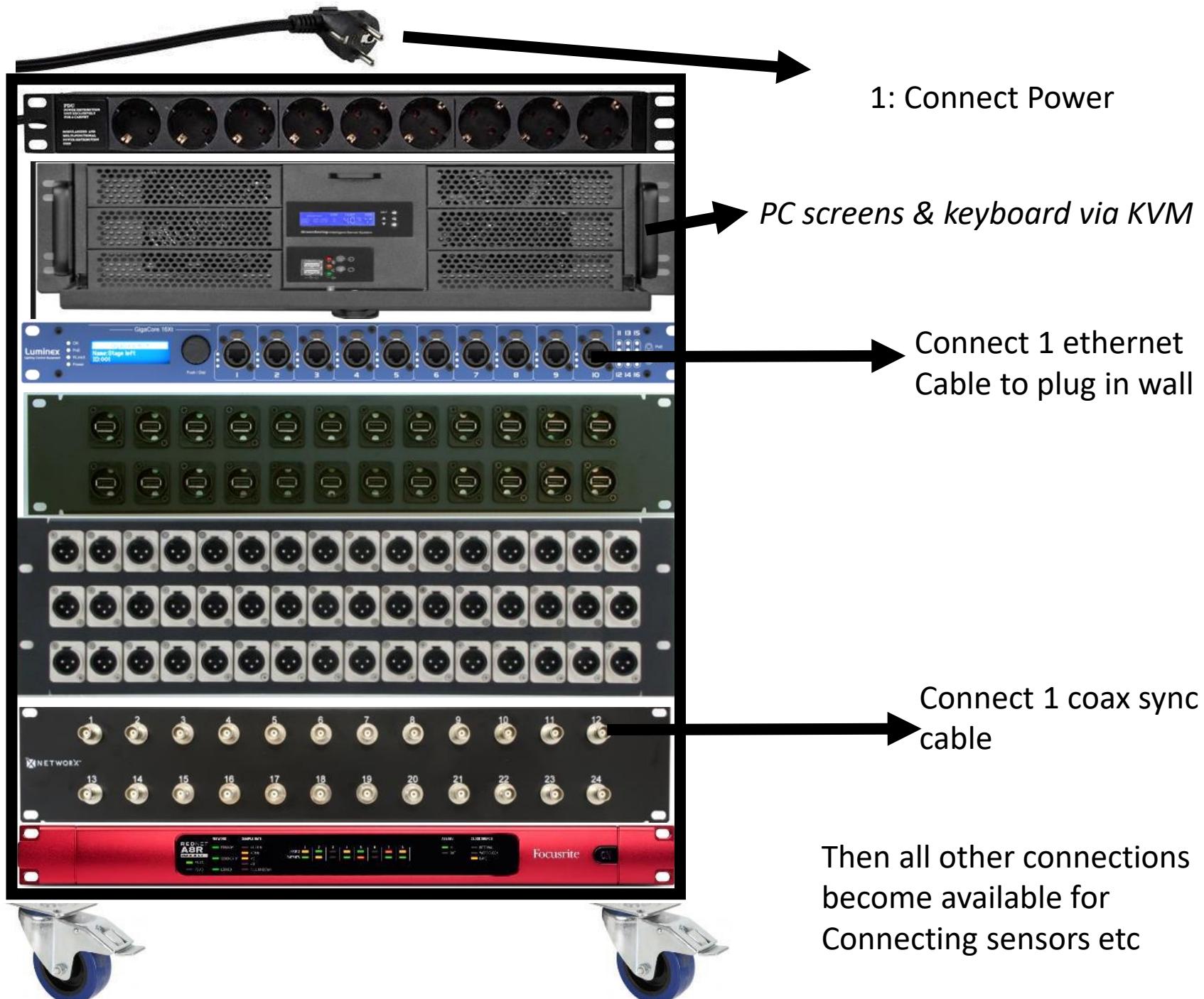
- When everything is upstairs in machineroom, why the rack?
- Problem: USB connections are not reliable over KVM network
- Then, how to connect sensors and midi devices?
- One pc (“RACK PC”) remains in the LAB
- **Basically, we want it to be close to the sensors**
- Connect to network => becomes available on the KVM & DANTE network

# The Rack: Why?

- Only requires two cables to be functional:
  - 1X Ethernet
  - 1x power
  - 1X coax for sync (optional)
- Sensors, mics etc need to be connected to this ‘rack’.
- **Experimental ‘connection hub’: setups can be recreated with a picture of these connections**
- Currently the big tower; in coming weeks a lower more transportable flightcase

# “The Rack”

- Main audio HUB
- Can be placed anywhere in the lab – ie close to the sensors
- Only ultra-silent components

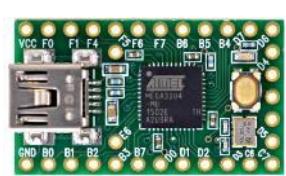


Distribute power

DANTE devices, networked devices



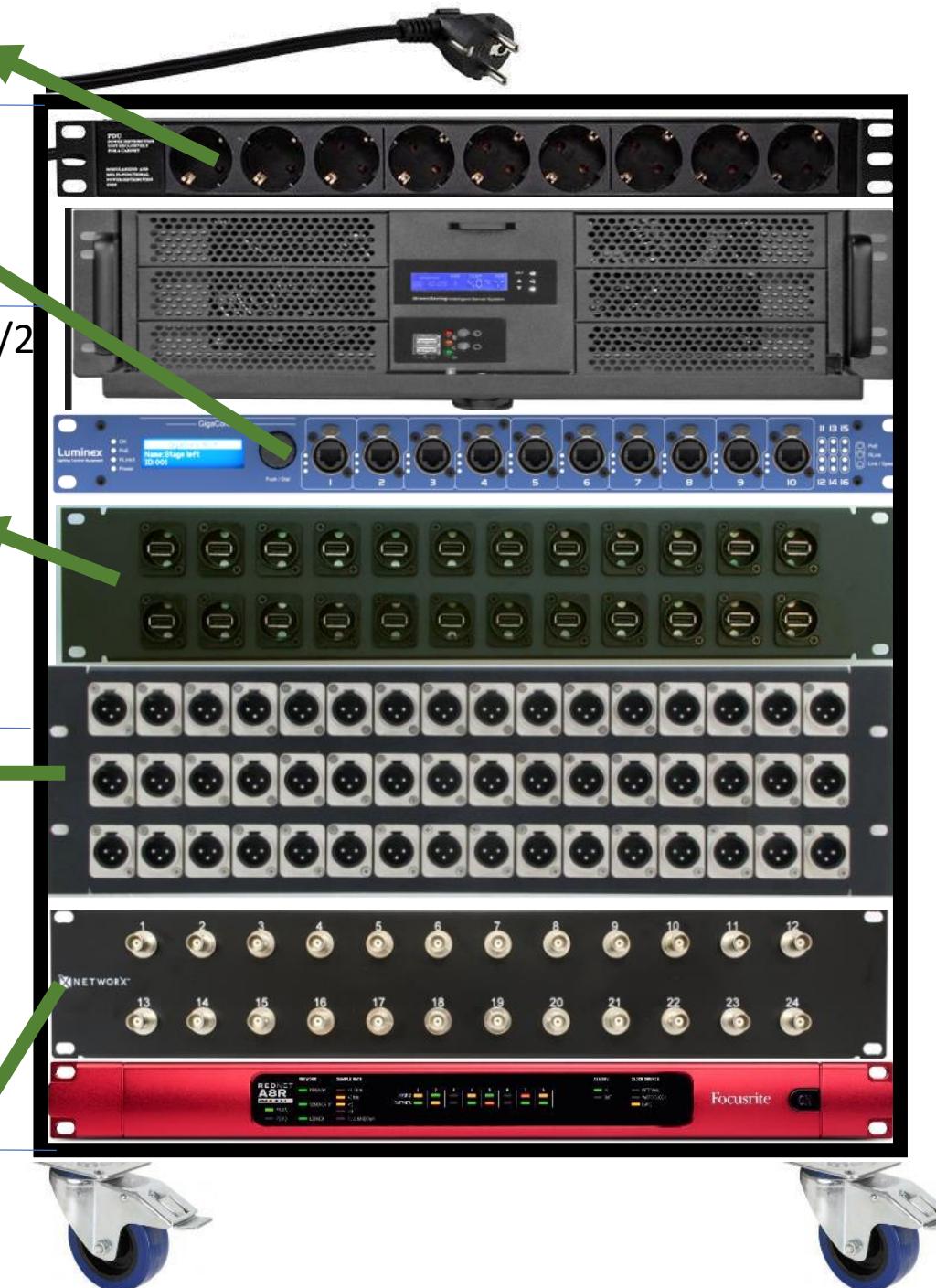
Sensors/midi USB 2.0 / 3.0 / 3.1 A/B gen1/2



Audio In/out



SYNC devices



Controlling the PC

Via KVM:

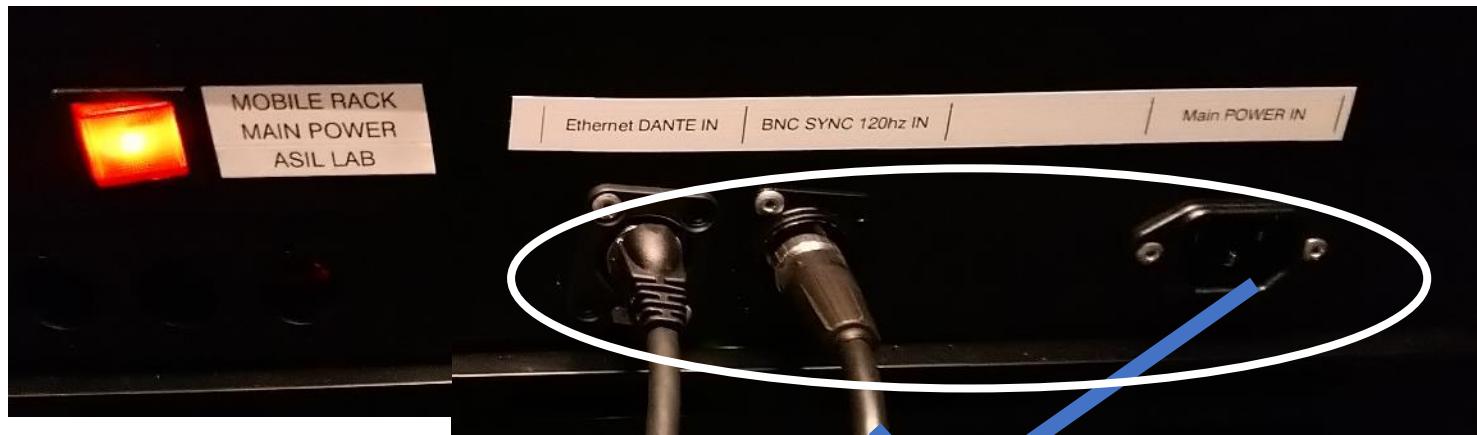
Using mobile desk,  
connect power &  
ethernet (2 cables)

Place keyboard, mouse  
& screens anywhere  
else (even at +4!)



# The Rack: how to use

- Roll it close to the sensors
  - Connect the power cable to **patch panel**
  - Connect ethernet cable to **Patch panel**
  - Connect sync to **patch panel**
  - Power on
  - Boot computer & devices
- 
- Use any screen to login
  - All equipment becomes available on the dante network automatically



## PART 4

# Basic usecases & practice

- Presenting in the lab
- Playing back audio
- Make an audio recording
- Transfer data to own computer
- Switching computer screens or sharing
- Playing the LTC clock on the speakers
- Play sounds through the monitors of the desk
- Synchronous mocap & audio recording

## PART 5

# Advanced topics

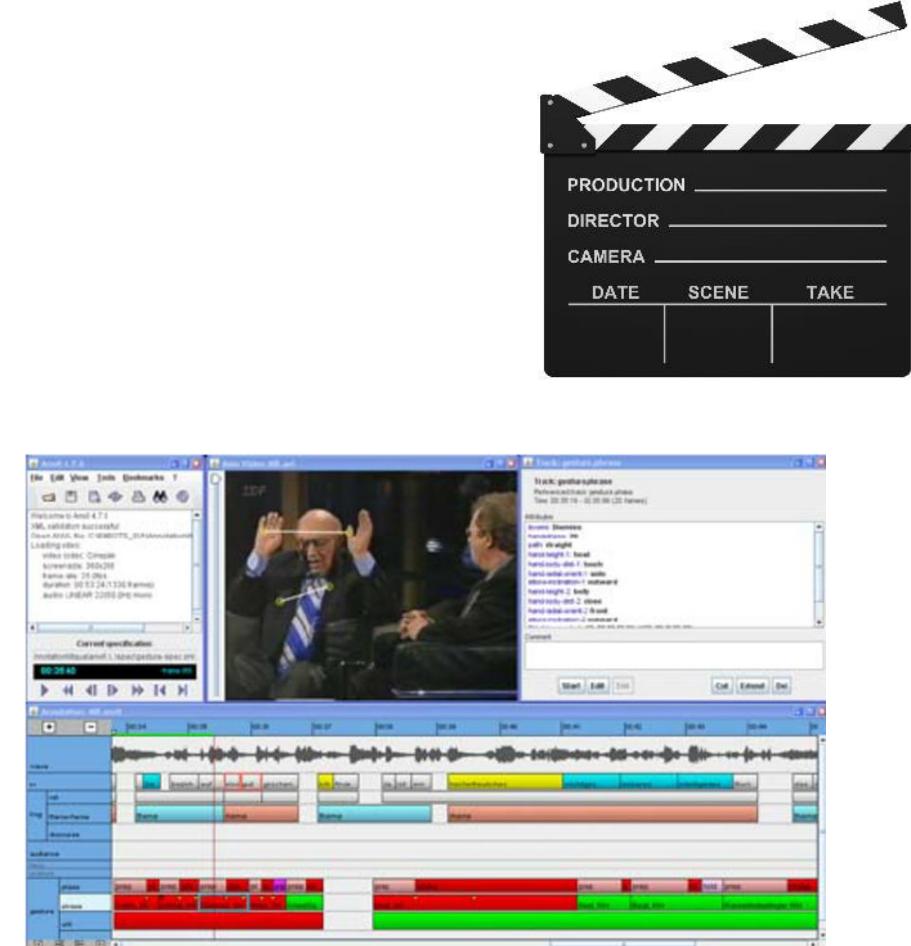
- Using Ableton or DAW's
- Mocap
- Syncing
- Storage
- Machineroom
- Electricity
- IP network
- Trussing
- DMX lights
- Speakers & Amps
- 3D IOSONO
- 3D Ambisonics
- 3D Auralisation
- Cable management



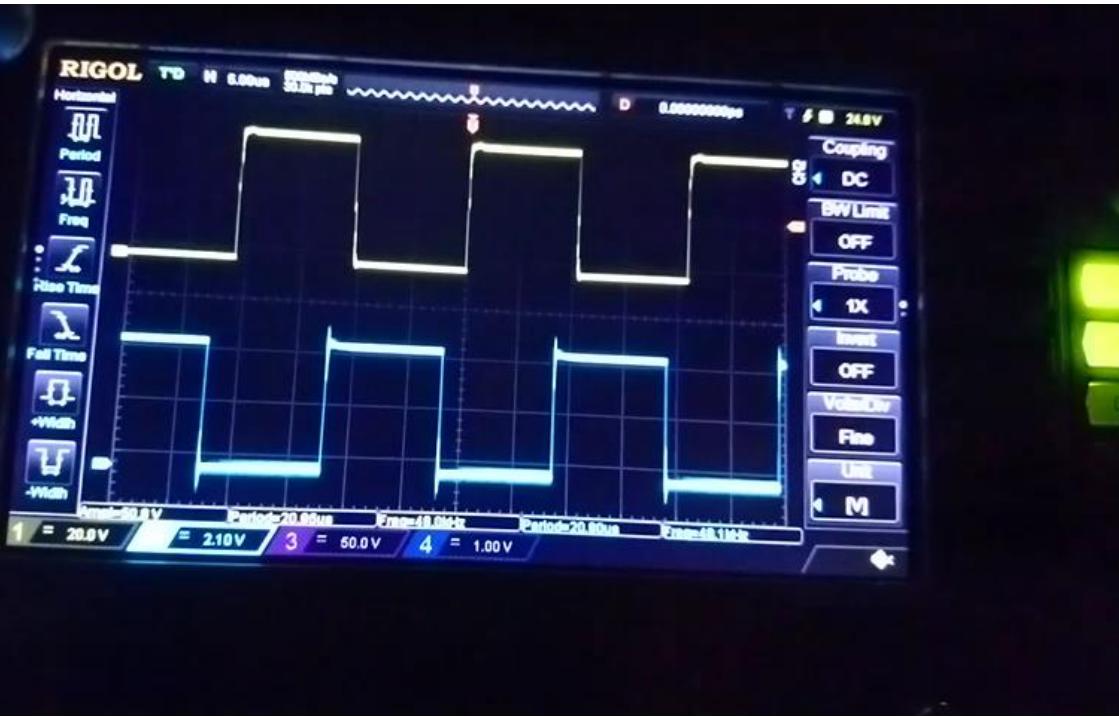
PART 5.1:  
Synchronisation

# Syncing: why?

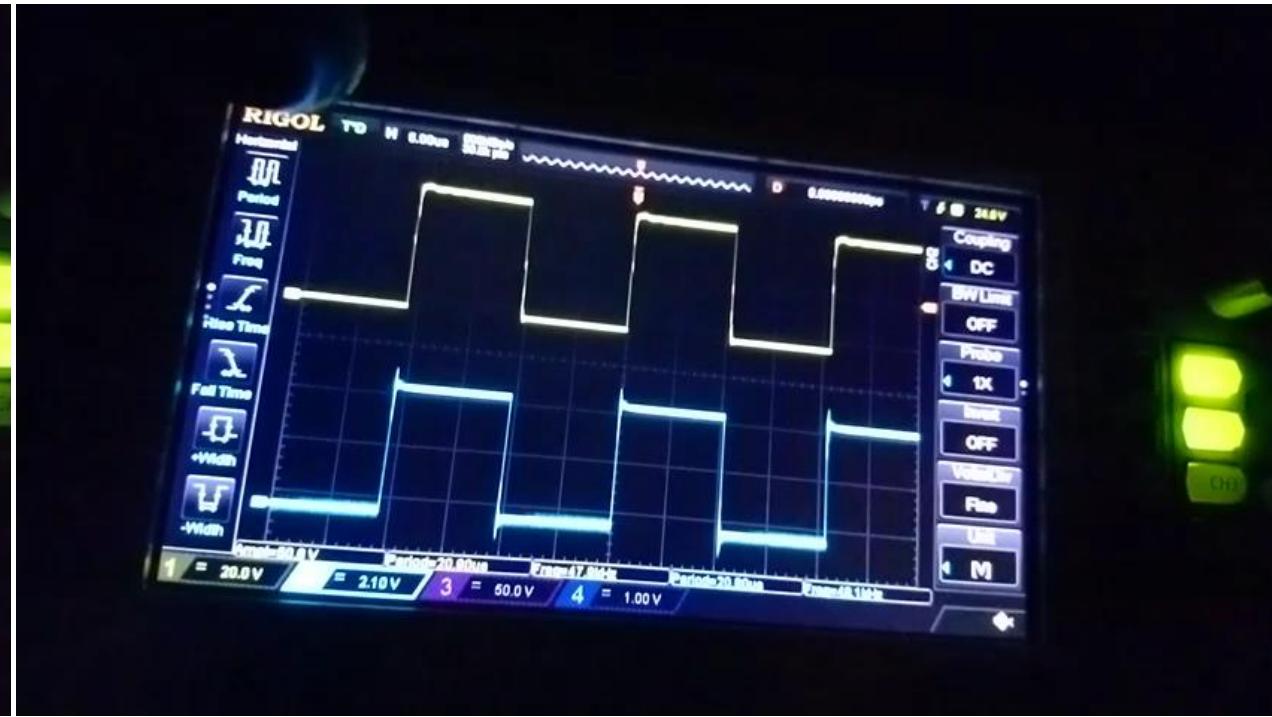
- Typical scenario: audio recording + mocap + balance board + webcam
- How to have the data “merged”?
  - All sources should capture a sample **at the same moment**
  - All sources should **share one unique time stream** (to align data)
  - Avoid sources drifting away (different time scale)
- Classical method: video clapper board to get ‘synced start’
- Sync infrastructure in ASIL solves these problems,
- New IPFM rule: we do it at 120 hz.



# Syncing: why (audio)?



Different audio devices'  
clock drift away without  
sync infrastructure



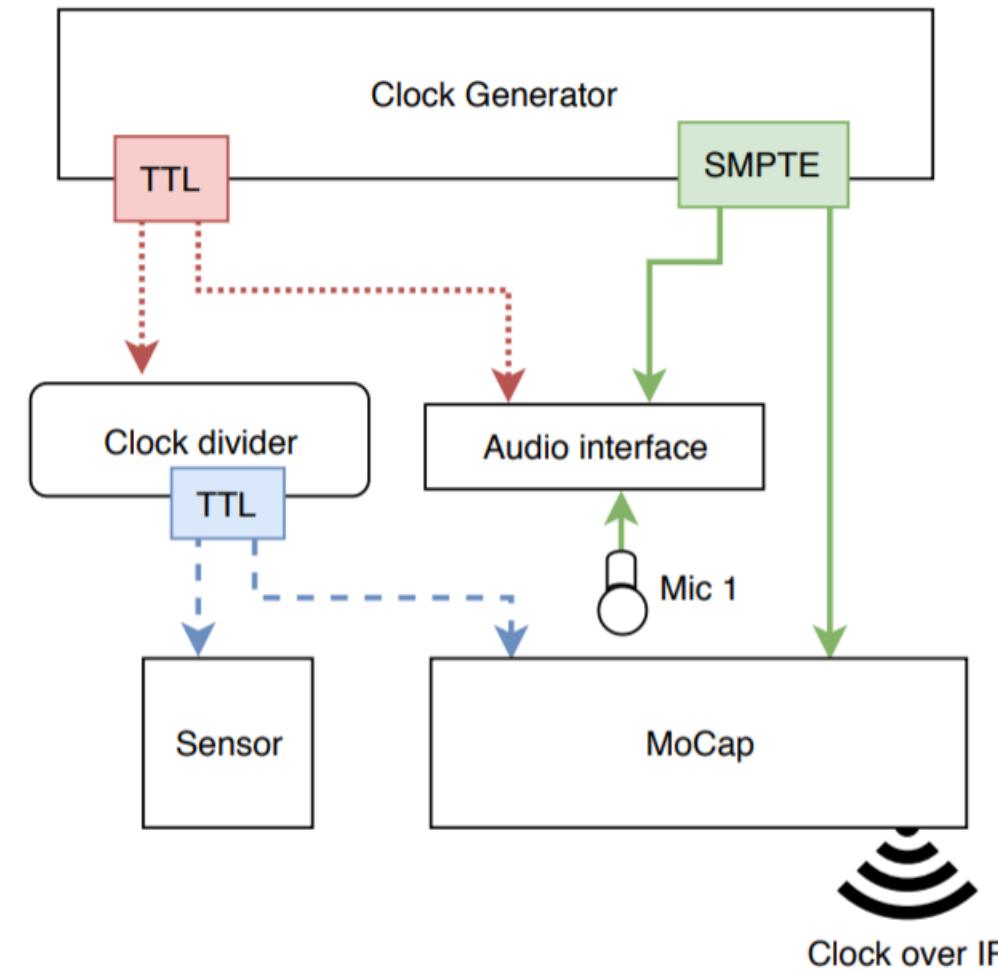
After enabling our sync  
infrastructure

# Syncing: solution:

Generate 1 shared clock (LTC & WORD) – then distribute.

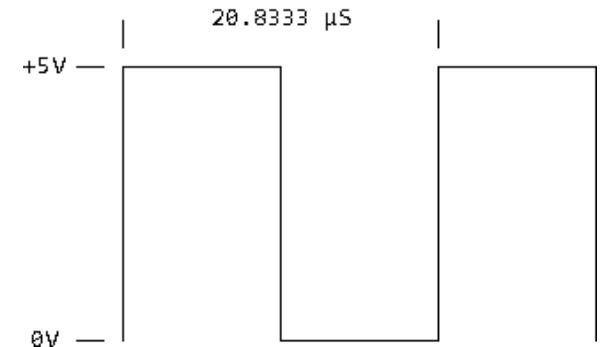


This infrastructure is always-on and standard connected to the mocap



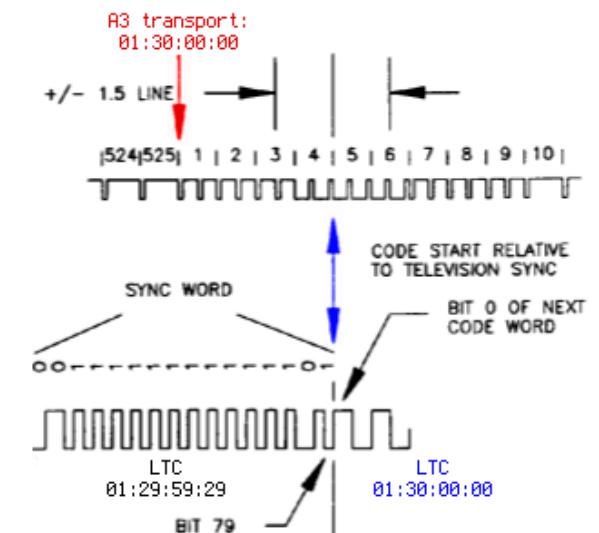
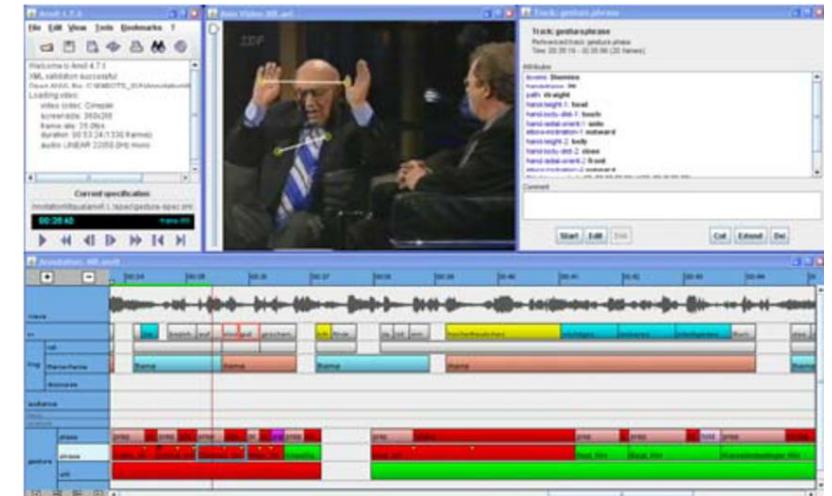
# Synchronisation: the WORD clock

- gives impulses at what moment to capture a sample
  - All sensors have a word clock in, so they know when to capture, mocap does too
  - The audio equipment does this 48.000 times per second
  - We downscale to 120 times per second
  - This is distributed throughout the **patch panels**
  - **When used correctly, all samples are taken within .1 millisecond!**
- **0 to 5V signal**
- **Transferred over BNC / COAX cables**



# Synchronisation: LTC timecode (SMPTE)

- Data is captured simultaneous, but how to align the different streams?
- Solution: record in all different systems 1 shared time signal so you can align (manual or automatically) after recording ends
- LTC is an audio signal which encodes a timecode, so matlab scripts can convert audio to “hours minutes seconds frame”
- **For audio/video recordings, record a channel with this timecode**



# Syncing data: how to align

Qualisis

Fields	Hour	Minute	Second	Frame	Missing
1	5	34	24	10	0
2	5	34	24	10	0
3	5	34	24	10	0
4	5	34	24	10	0
5	5	34	24	11	0
6	5	34	24	11	0
7	5	34	24	11	0
8	5	34	24	11	0
9	5	34	24	12	0
10	5	34	24	12	0
11	5	34	24	12	0
12	5	34	24	12	0
13	5	34	24	13	0
14	5	34	24	13	0
15	5	34	24	13	0

Ableton (midi)

	1	2	3	4	5
1	5	34	20	28	0.0271
2	5	34	20	29	0.0607
3	5	34	21	0	0.0938
4	5	34	21	1	0.1274
5	5	34	21	2	0.1605
6	5	34	21	3	0.1940
7	5	34	21	4	0.2271
8	5	34	21	5	0.2607
9	5	34	21	6	0.2938
10	5	34	21	7	0.3274
11	5	34	21	8	0.3605
12	5	34	21	9	0.3940
13	5	34	21	10	0.4271
14	5	34	21	11	0.4607
15	5	34	21	12	0.4938

Sensors

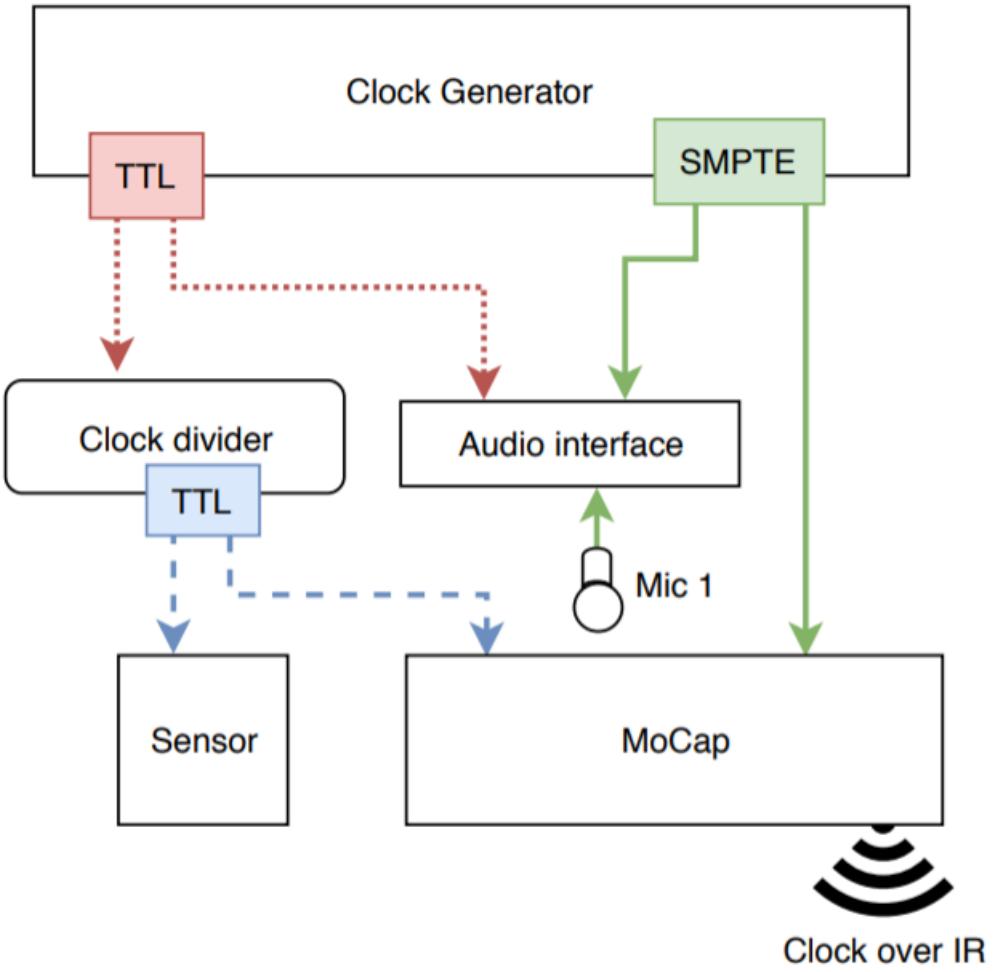
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1	0.0110
2	0.0220
3	0.0290
4	0.0360
5	0.0440
6	0.0550
7	0.0620
8	0.0690
9	0.0800
10	0.0870
11	0.0940
12	0.1020
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# How to connect the synchronisation

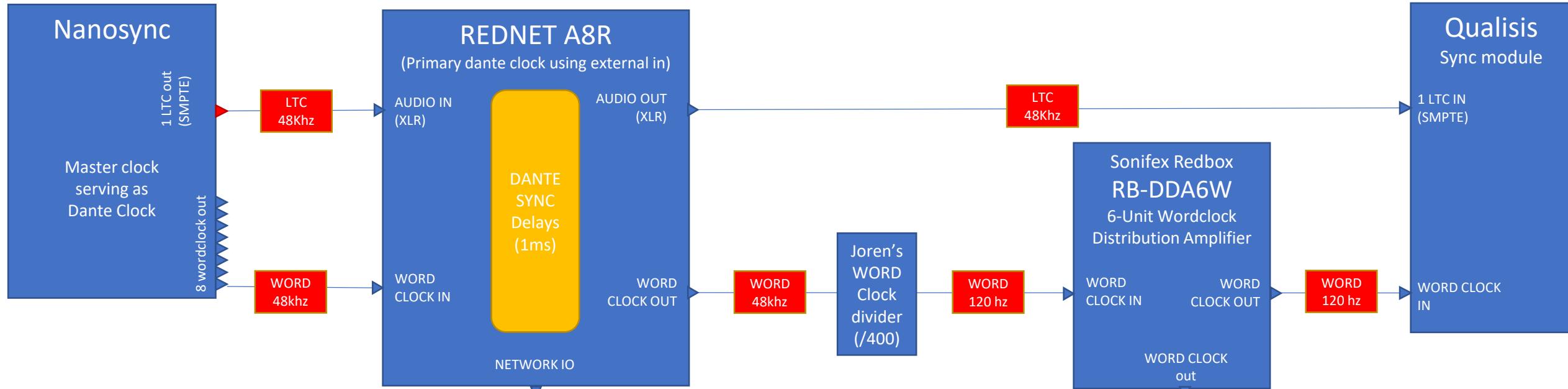
- WORD: connect coax cable from patch panel to sensor
- LTC (SMPTE):
  - MAKER space & pluriversum: connect recording to LTC OUT on the patch panel
  - ASIL: USE DANTE to route sync signal (from the syncmaster) to the recording
  - **TIMECODE is transmitted on the DANTE device SYNCMASTER on channel 16 (in)**
- Demo how this sounds...
- Paper in progress about this infrastructure
- Later: do tank about syncing & processing (when storage functionality is up to date)

# Syncing: summary

- Word clock is to capture at the same instant
- LTC / SMPTE is to align data (**transmitted on DANTE SYNCMASTER channel 16**)
- Both are required for sub-millisecond precise syncing.

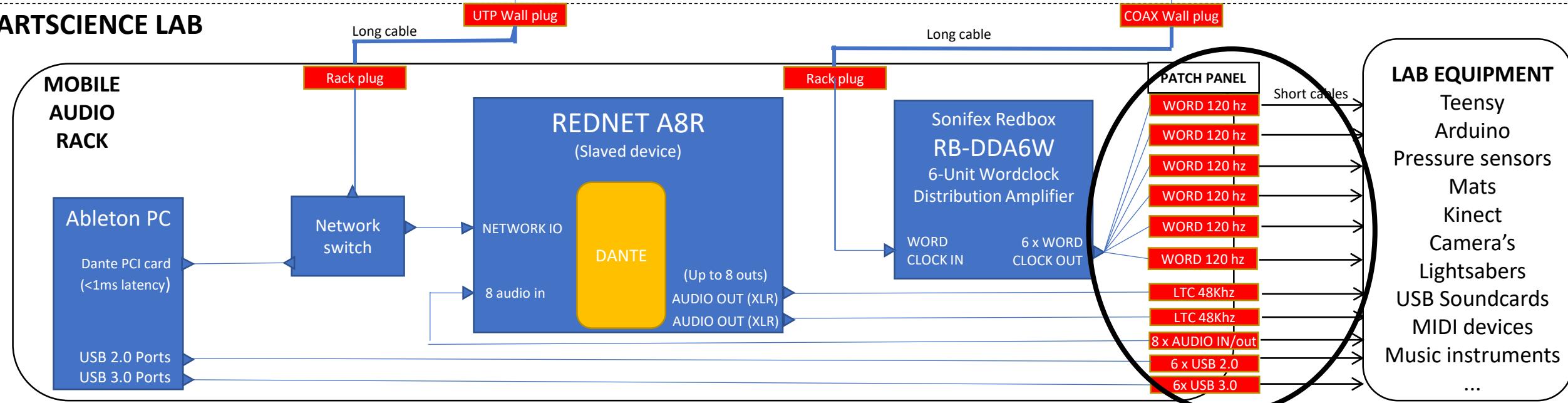


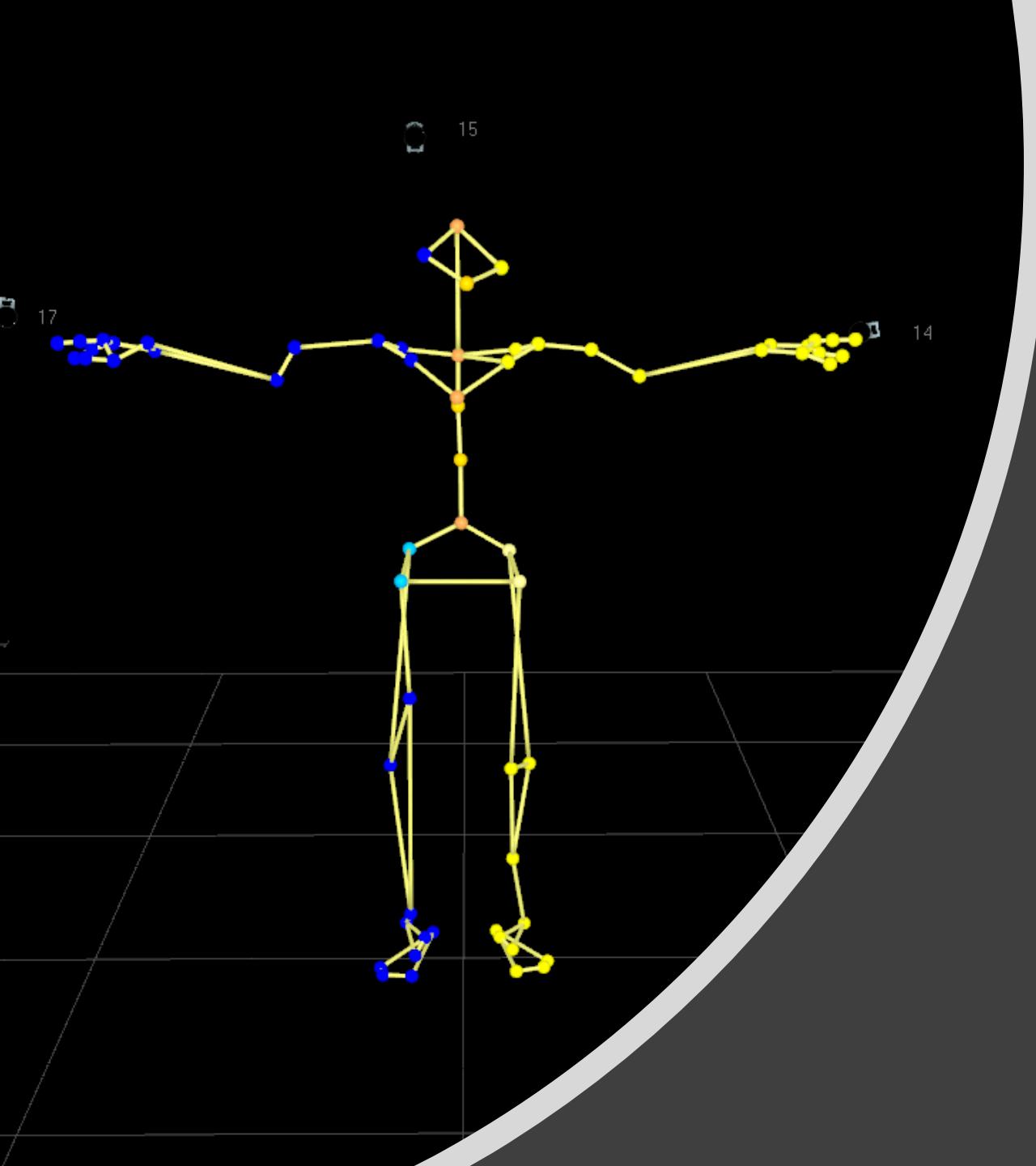
# Syncing infrastructure



## MACHINE ROOM

### ARTSCIENCE LAB

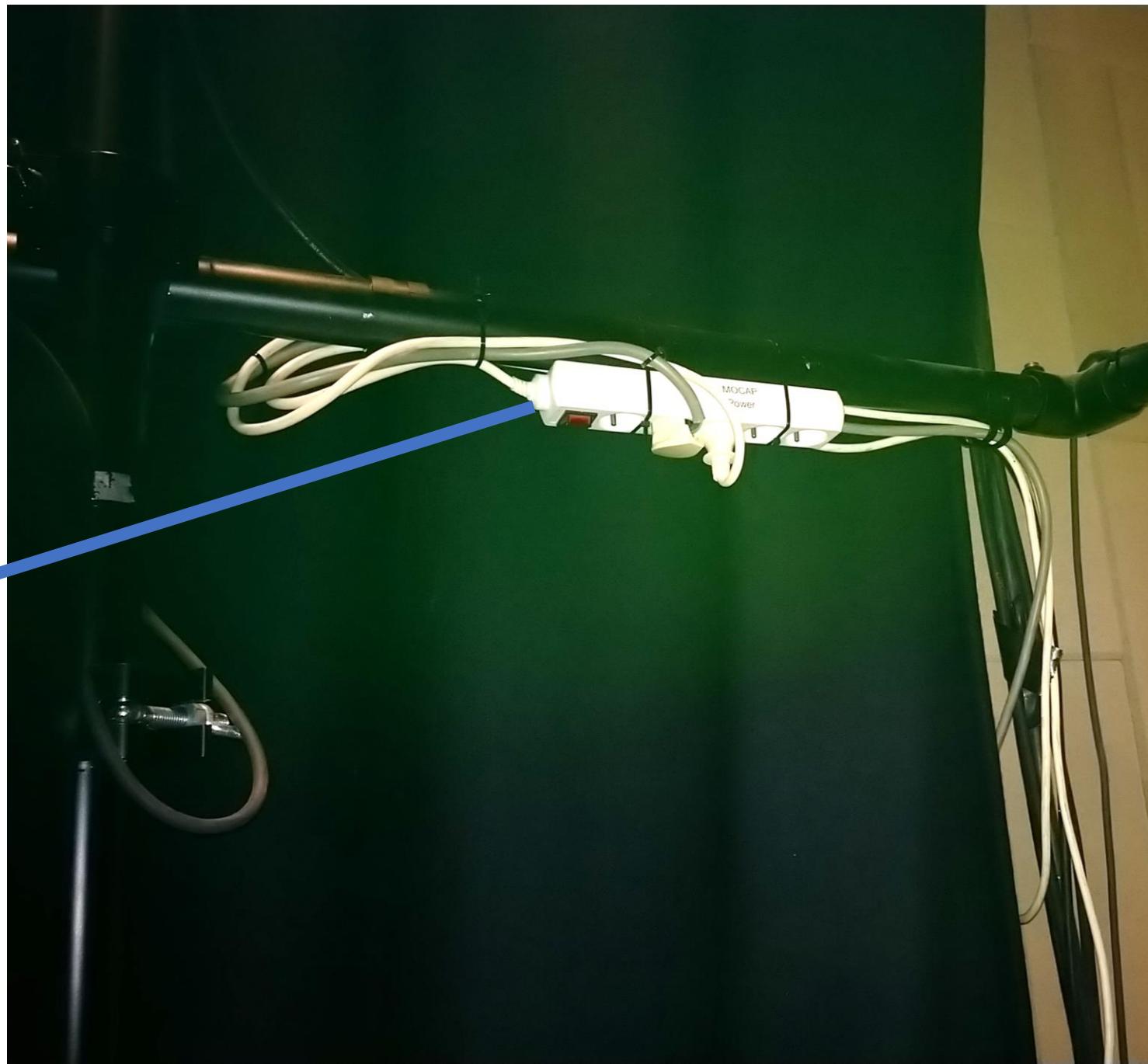
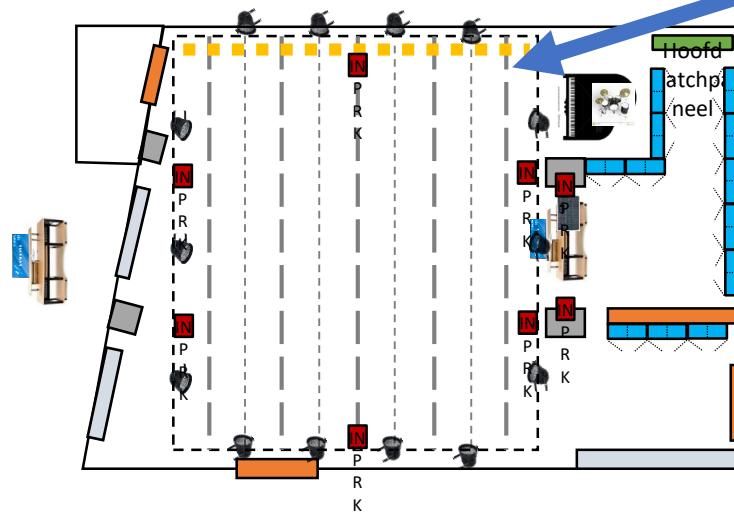




# Part 5.3: Mocap & Sync

# Mocap: Power on & off!

- Power on before opening QTM
- Wait 5 minutes till boot
- Do not forget to power off

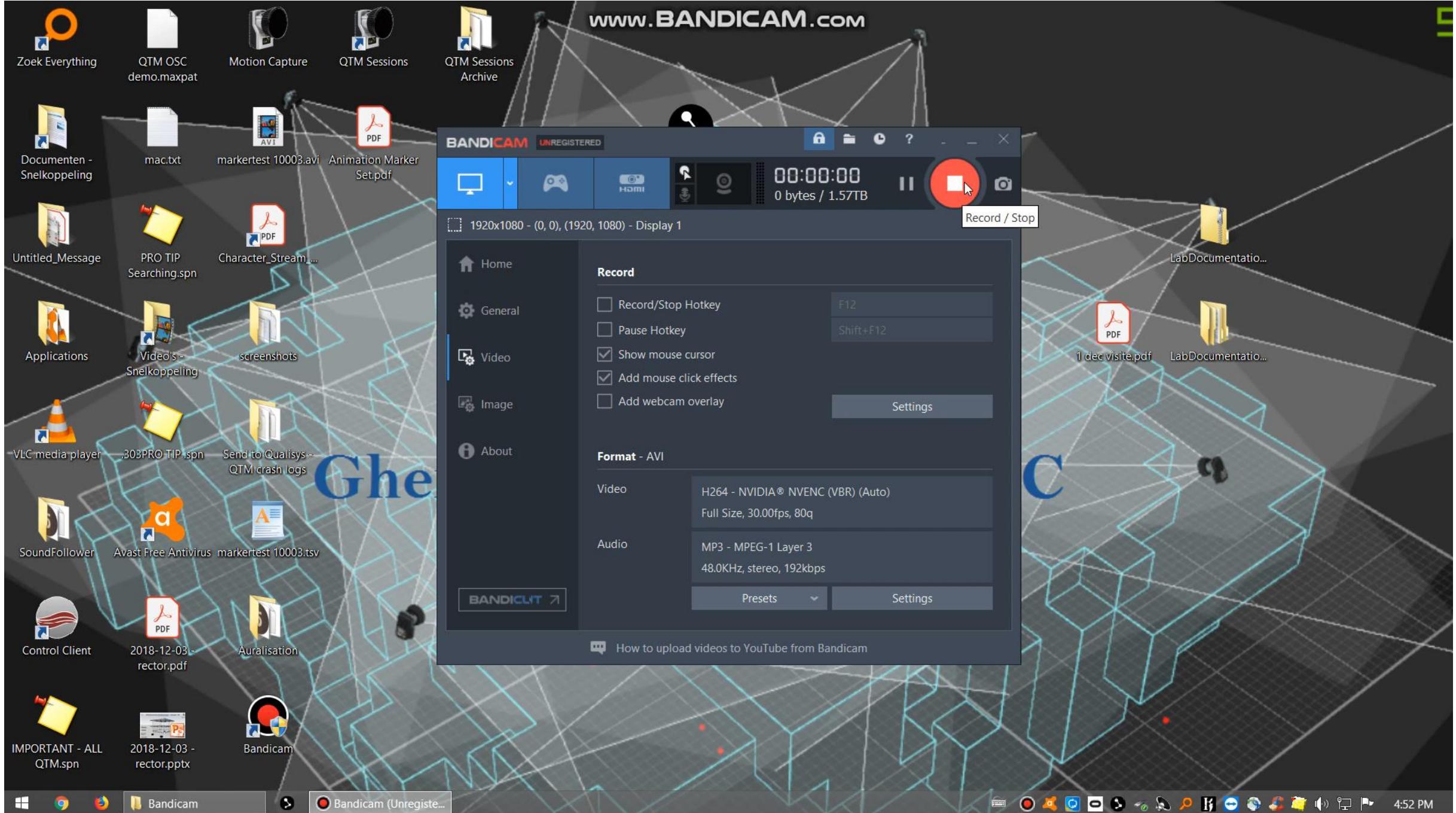


# Starting the mocap computer

- Connect any desk to network
  - Boot up
  - Select “IDLAB – mocap” computer
  - Start “QTM” software
- 
- QTM = Qualisys track manager
  - Current version: 2019
  - <https://www.qualisys.com/software/qualisys-track-manager/>

# QTM 2019: SYNC settings

- Project settings – Camera's – Sync settings
- Enable 'external timebase in"
- Enable 'SMPTE'
- Press apply & save
- Wait for the clock signal



# Mocap upgrade 2019



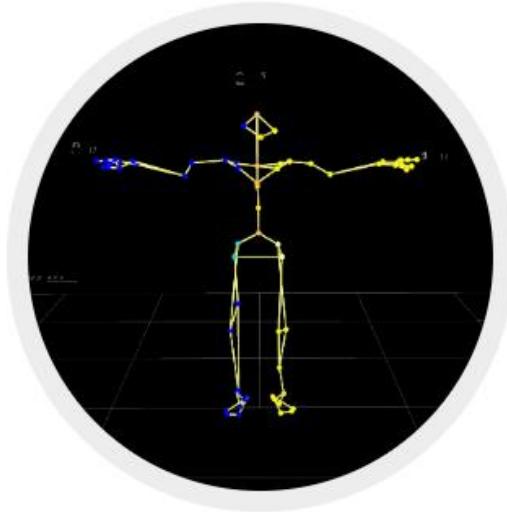
## Skeleton solving

Qualisys provides a robust skeleton solver that lets you solve one or more actors in real-time. Capturing crouching, wrestling and lying on the floor has never been this straight-forward.



## 3D video overlay

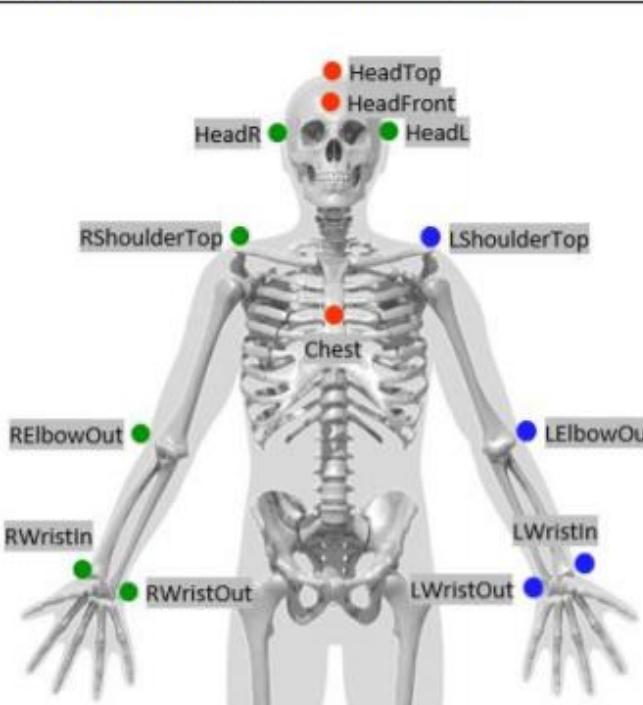
Get 3D video overlay on your reference video and view any 3D objects in QTM on top of your video, including force and gaze vectors. Video overlay works with any Qualisys video camera that's been calibrated with the mocap system.



## Automatic Identification of Markers (AIM)

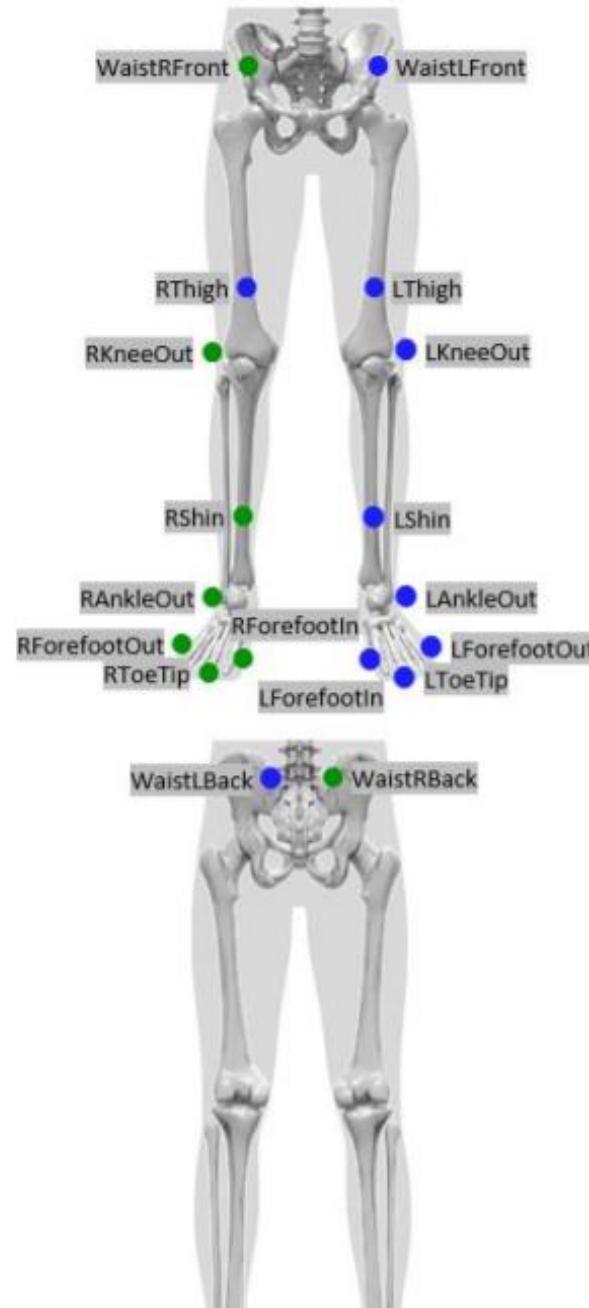
Our unique AIM system allows you to easily identify markers regardless of marker set. Just define your model, feed it with sample motion data and you are ready to go.

## Qualisys Animation Marker Set

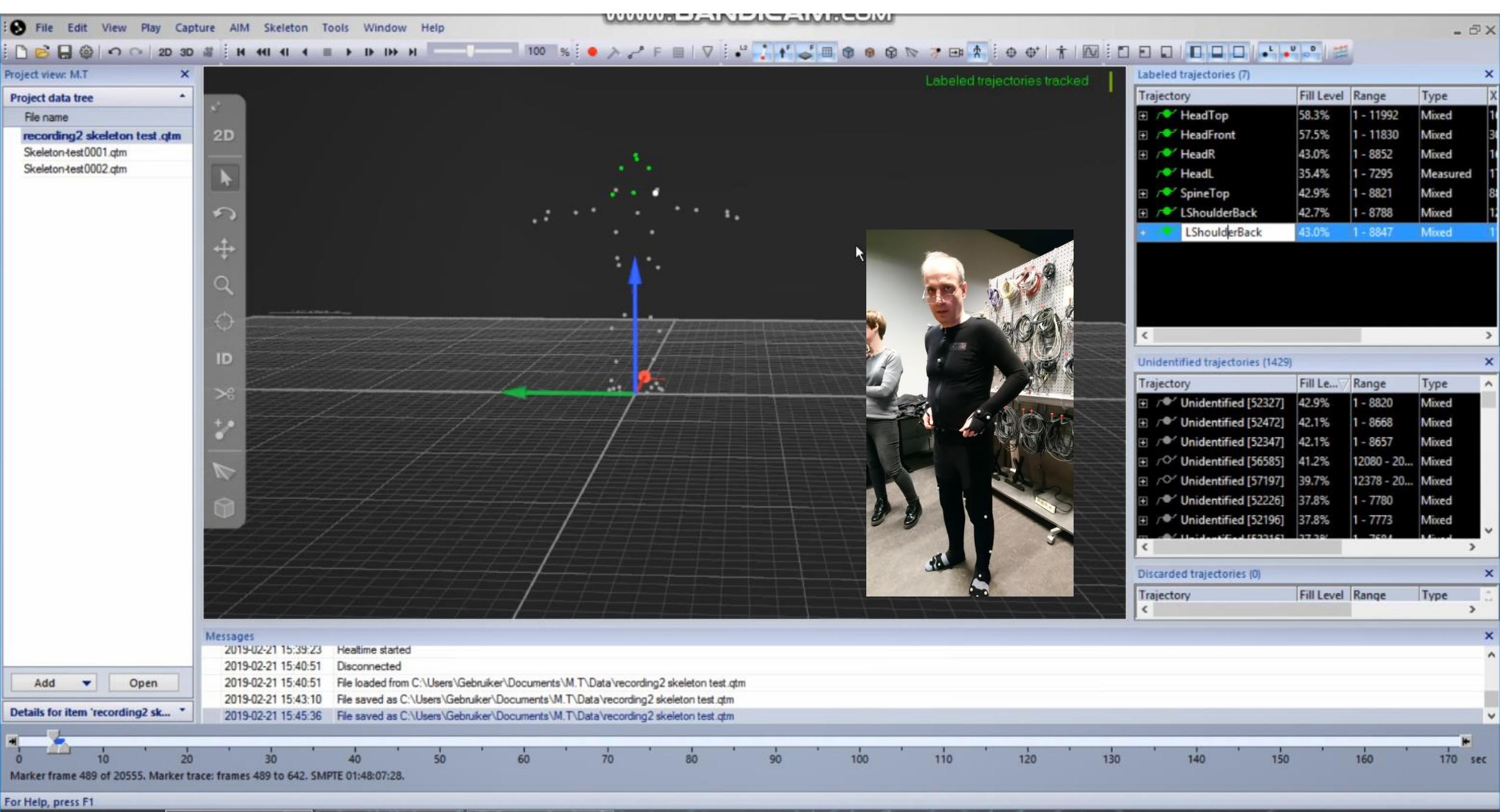


Display Name	Reference <sup>1</sup>	Location	Moveable
HeadTop	N/A	On top of the head vertically above the ears	No
HeadL	N/A	Just above the left ear centre	No
HeadR	N/A	Just above the right ear centre	No
HeadFront	SGL	Glabella (forehead)	No
Chest	N/A	Middle part of the sternum	Yes (on the sternum)
SpineTop	C7	Biggest prominence on the spine (usually C7)	No
BackL	SIA	Below the inferior angle of the scapula	Yes (underneath the scapula)
LShoulderBack	SAA	Posterior side of the acromial edge of the scapula	Yes (on the scapula)
LShoulderTop	SAE	On top of the acromial edge of the scapula	No
LArm	N/A	Posterior side of the humerus	Yes (on the arm)
LElbowOut	HLE	Lateral epicondyle of the humerus	No
LWristIn	RSP	Styloid process of the radius (thumb side)	No
LWristOut	USP	Styloid process of the ulna (pinky side)	No
LHandOut	HM5	Lateral aspect of the 5 <sup>th</sup> metacarpal head	No
BackR	SIA	Below the inferior angle of the scapula	Yes (underneath the scapula)
RShoulderBack	SAA	Posterior side of the acromial edge of the scapula	Yes (on the scapula)
RShoulderTop	SAE	Acromial edge of the scapula	No
RArm	N/A	Posterior side of the humerus	Yes (on the arm)
RElbowOut	HLE	Lateral epicondyle of the humerus	No
RWristIn	RSP	Styloid process of the radius (thumb side)	No
RWristOut	USP	Styloid process of the ulna (pinky side)	No
RHandOut	HM5	Lateral aspect of the 5 <sup>th</sup> metacarpal head	No

## Qualisys Animation Marker Set



Display Name	Reference <sup>1</sup>	Location	Moveable
WaistLFront	IAS	Anterior superior iliac spine	No
WaistLBack	IPS	Posterior superior iliac spine	No
WaistRFront	IPS	Posterior superior iliac spine	No
WaistRBack	IAS	Anterior superior iliac spine	No
LThigh	N/A	A few cm above the superior border of the patella	Yes (on the thigh)
LKneeOut	FLE	Lateral epicondyle of the femur	No
LShin	N/A	Along the tibial crest, a few cm proximally of the ankle	Yes (on the shin)
LAnkleOut	FAL	Lateral prominence of the lateral malleolus	No
LHeelBack	FCC	Aspect of the Achilles tendon insertion on the calcaneus	No
LForefootIn	FM1	Medial aspect of the first metatarsal head	No
LForefootOut	FM5	Lateral aspect of the fifth metatarsal head	No
LToeTip	N/A	Top of the foot/shoe tip (usually second toe tip)	No
RThigh	N/A	A few cm above the superior border of the patella	Yes (on the thigh)
RKneeOut	FLE	Lateral epicondyle of the femur	No
RShin	N/A	Along the tibial crest, a few cm proximally of the ankle	Yes (on the shin)
RAngleOut	FAL	Lateral prominence of the lateral malleolus	No
RHeelBack	FCC	Aspect of the Achilles tendon insertion on the calcaneus	No
RForefootIn	FM1	Medial aspect of the first metatarsal head	No
RForefootOut	FM5	Lateral aspect of the fifth metatarsal head	No
RToeTip	N/A	Top of the foot/shoe tip (usually second toe tip)	No



File Edit View Play Capture AIM Skeleton Tools Window Help

Project view: M.T

Project data tree

- File name
  - recording2 skeleton test.qtm
  - Skeleton-test0001.qtm
  - Skeleton-test0002.qtm

2D

2D

ID

+

Stop recording

View online help

Record/Stop

Image capture

F12 F11

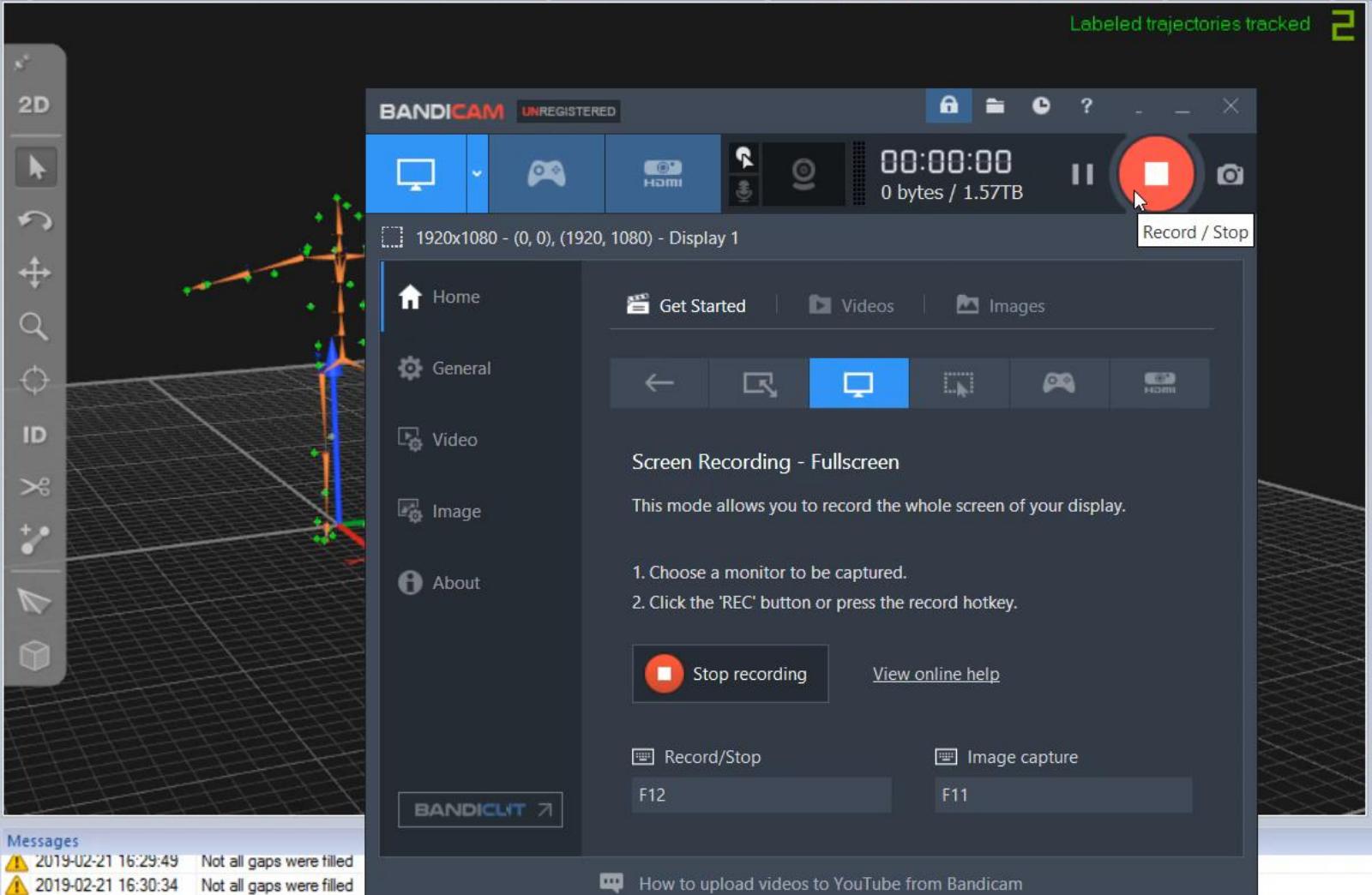
BANDICAM

Messages

- 2019-02-21 16:29:49 Not all gaps were filled
- 2019-02-21 16:30:34 Not all gaps were filled
- 2019-02-21 16:30:37 Not all gaps were filled
- 2019-02-21 16:31:14 Skeleton 'M' definition added to both the file and to the Project Options
- 2019-02-21 16:32:35 Skeleton 'M' definition added to both the file and to the Project Options

Add Open

Details for item 'recording2 sk...



Labeled trajectories tracked 2

Labeled trajectories (42)

Trajectory	Fill Le...	Range	Type
+ ✓ M_LElbowOut	67.4%	1 - 20555	Mixed
+ ✓ M_HeadR	66.8%	1 - 20555	Measured
+ ✓ M_Chest	66.6%	1 - 20555	Mixed
+ ✓ M_LWristIn	66.6%	1 - 20555	Mixed
+ ✓ M_LForefootOut	66.3%	1 - 20555	Mixed
+ ✓ M_WaistLFront	64.2%	1 - 20555	Mixed
+ ✓ M_RWristOut	63.1%	1 - 20555	Mixed
+ ✓ M_LWristOut	55.7%	1 - 20555	Mixed
+ ✓ M_RWristIn	55.1%	1 - 20555	Mixed
+ ✓ M_RHandOut	27.3%	1 - 19909	Mixed
+ ✓ M_LHandOut	25.5%	1 - 19916	Mixed

Unidentified trajectories (1093)

Trajectory	Fill Le...	Range	Type
+ ⚡ Unidentified [125365]	13.1%	12459 - 15...	Mixed
+ ⚡ Unidentified [122484]	12.1%	9638 - 12130	Mixed
+ ⚡ Unidentified [128002]	11.5%	15638 - 18...	Measured
+ ⚡ Unidentified [122771]	9.3%	9356 - 12441	Mixed
+ ⚡ Unidentified [128707]	8.4%	16451 - 18...	Mixed
+ ⚡ Unidentified [128785]	7.7%	16653 - 18...	Mixed
+ ⚡ Unidentified [122634]	7.5%	9093 - 11765	Mixed
+ ⚡ Unidentified [128849]	7.4%	16739 - 18...	Measured

Discarded trajectories (0)

Trajectory	Fill Le...	Range	Type
<			

Marker frame 1 of 20555. Marker trace: no frames. SMPTE 01:48:03:26.

For Help, press F1

Not all gaps were filled



4:33 PM

- show export

# Skeleton movie

- Note the range: -3 to +3 meters full body =  $36\text{m}^2$
- New camera install: -4 to +4m full body =  $64\text{ m}^2$

A perspective view of a long row of server racks in a data center. The racks are dark grey or black and are filled with numerous blue and white components, likely hard drives or network cards. The ceiling above is white with a grid of recessed lighting fixtures. A large, semi-transparent white circle is positioned in the lower right quadrant of the image, containing the text.

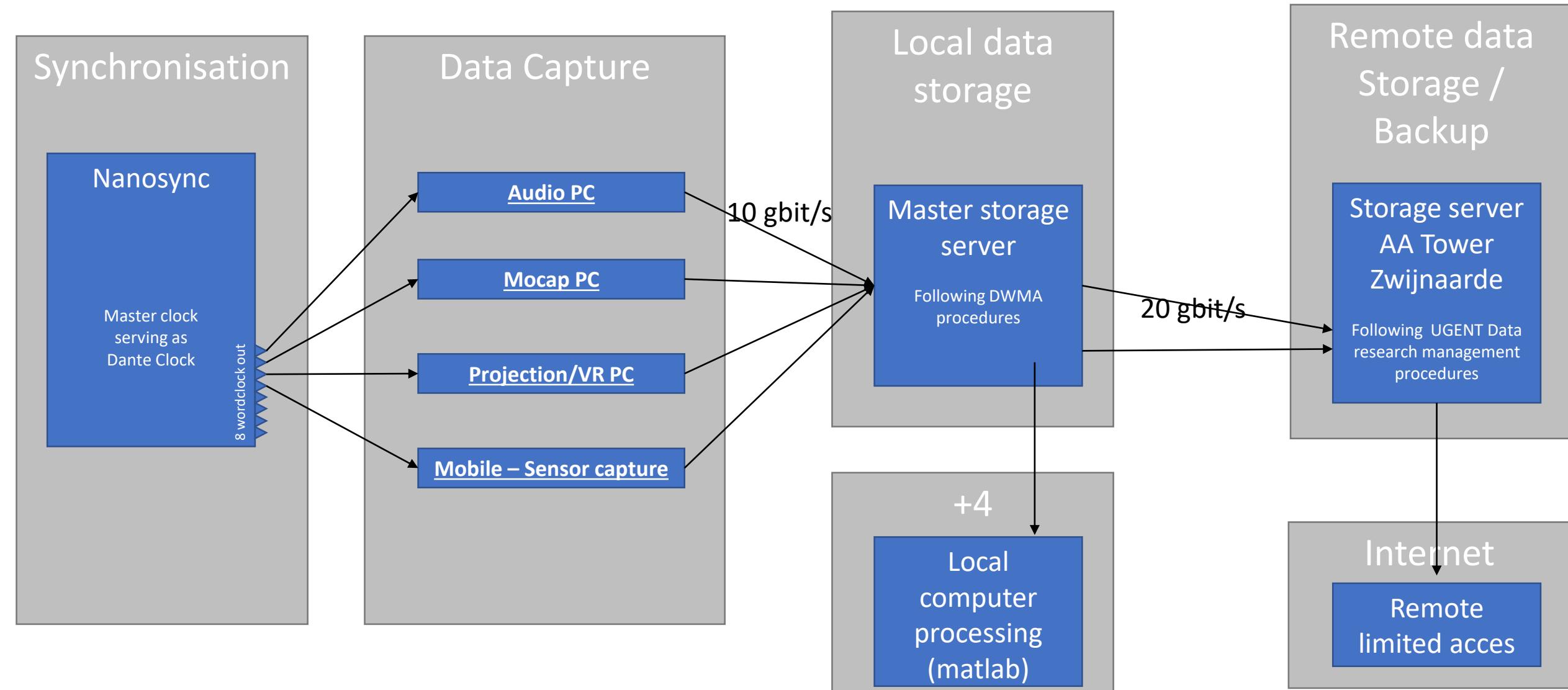
## PART 5.4: Data management & storage

---

# Data management & storage

- Work in progress!
- Current idea:
  - Local central high-speed server (remote disk on all ASIL infra)
  - Offsite 1:1 backup
  - All computers save data here
  - Connectable from offices using UGHent account to process locally
  - Connectable from internet to process at home
  - Public repo for long term storage & data publication (for papers)
  - Compliant with new EU data management policy

# Data management

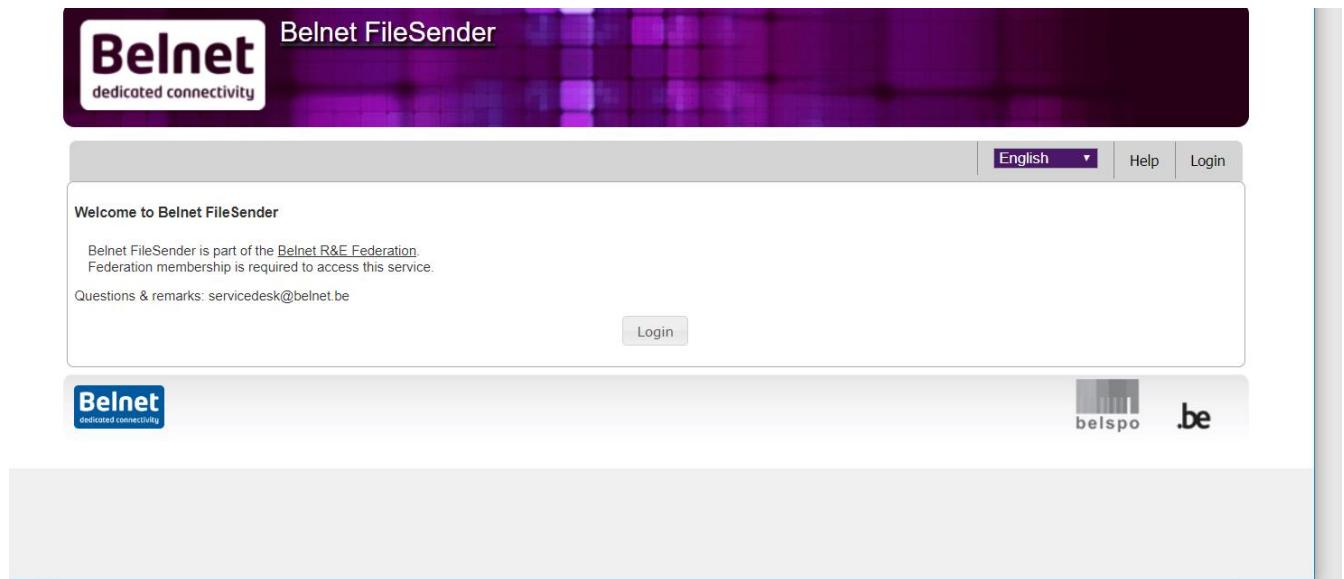


# Processing

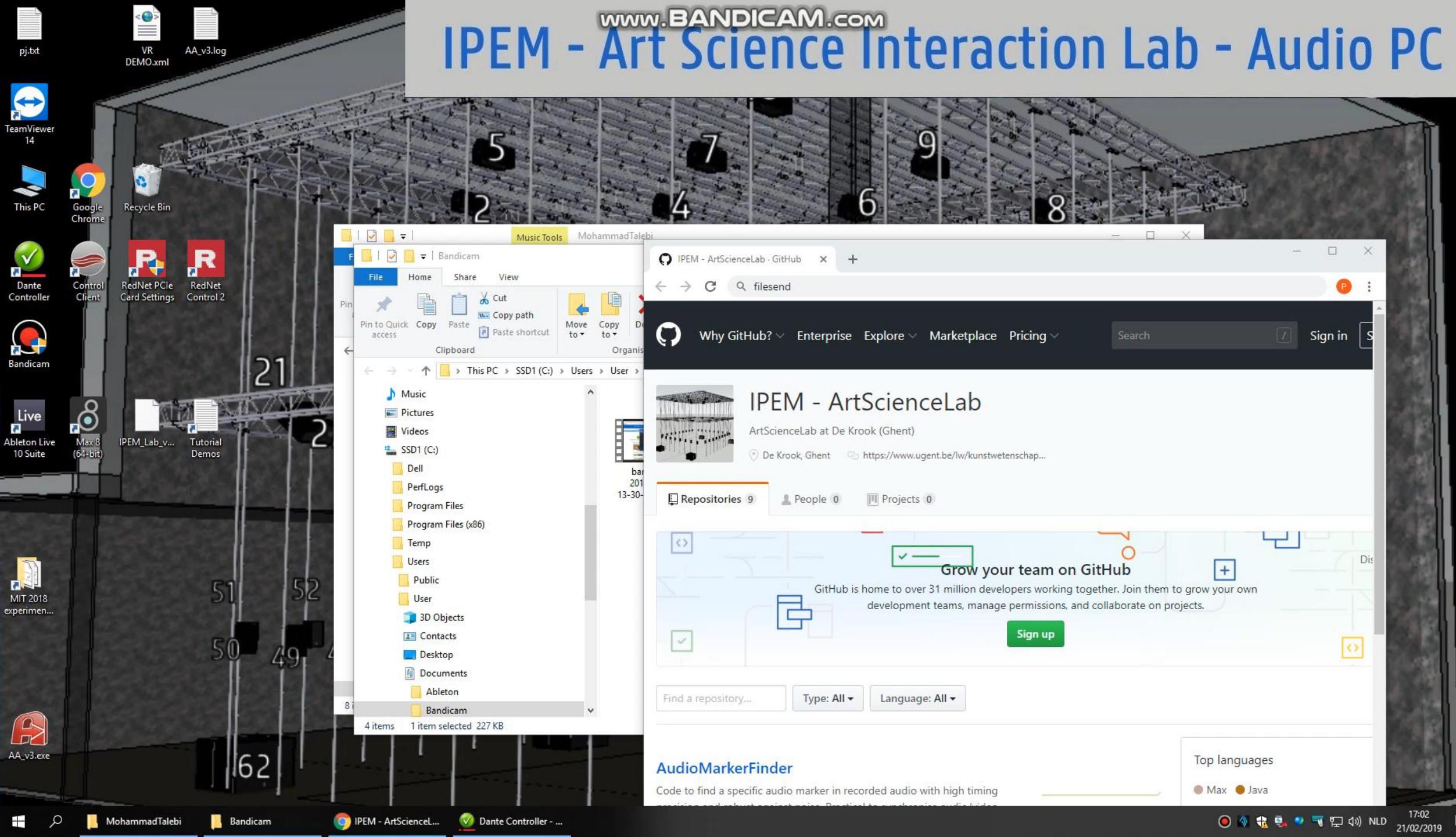
- Do tank later (with syncing)

# Current workarounds

- System will be ready in coming months
- No USB connection to computers – so how to get the data?
- Use belnet filesender for high speed transfer over internet
  - <https://filesender.belnet.be/index.php?s=upload>
  - Service from universities
  - Higspeed unlimited transfer
- Backup: use wetransfer (sorry!) for small transfers



## IPEM - Art Science Interaction Lab - Audio PC



# PART 5.5: Machine room

---



# Machine room

- Location at -1 where all computing equipment / patching is done
- 3 racks:
  - Audio
  - PC's & network
  - Amplifiers

## AMP rack (33U)

- 2U boven amps:
  - 1U Fiber breakout (1U)
  - 1U cable management
- 5U spare room
- 8U amps
- 1U spacing
- 8U amps
- 1U spacing
- 2U amps
- 6U voor spare amps
  - 1 amp voor onderste ring
  - 1 amp voor 15" woofers (oorhoogte)
  - 1 amp voor 12" woofers (4m)

## AUDIO Rack (24U)

- 6U rednet toestellen
  - 4U IOSONO
  - 1U Rednet 6
  - 1U Rednet A16R
- 5U XLR patch:
  - 2U Breakout A16R (16/16)
  - 2U Patchpanel XLR (16/16) naar labos
  - 1U patchpaneel naar PATCH ASIL (8/8)
- 2U DMX stuff
- 6U Sync
  - 1U Nanosync
  - 1U Joren clock divider
  - 2U BNC dividers
  - 2U BNC patchpanel (24) to labs
  - Evt 1U D-Clock (16+4 out) [d-clock-word-clock](#)

## PC & IP Rack (38U)

- 2U KVM trail (5 tx + manager)
- PC's:
  - 4U audio pc
  - **18U over:**
    - 4U mocap pc
    - 4U graphics processor
    - 4U VR 1
    - 4U VR 2
    - 2U storage PC
- 10U switch (5412)
- 4U 96 UTP-panel
  - 57 inkomend naar switch (of direct??)
    - 47x1G
    - 10x10G
- 20 point to point
- 19 over

# Part 5.6: Electricity

- Currently: more or less random
- Main power from a temporary station
- In 2019 this will change
  - Permanent electricity cables on the trussing
  - Separate circuits for beamers, mocap cameras, lights, pc's, etc
  - Less interference
  - Easy to 'turn off and on'
  - 7 x 20A/16A circuits will be distributed throughout the trussing:
    - BOVEN\_A = Projectie (20A)
    - BOVEN\_B = Camerasysteem & sensoren (16A)
    - BOVEN\_C = Belichting (16A)
    - BOVEN\_D = TRUSSEN reserve (16A)
    - ONDER\_E = Computer infrastruur (16A)
    - ONDER\_F = Audio infrastrucuur (16A)
    - ONDER\_G = Reserve I (16A)

# Separate power for Machineroom

- Unused 63A line
- Split to 32A for trussing enignes and 32A ( $6 \times 16A$ ) for computers
- Redundant
- Circuit breakers: one power failure will not lead to cascade failures

# “Boxes”: electricity & data on trussing

Aantal dozen	Van	STROOM per doos (220V)						DATA (min. CAT6A) per doos		BNC 75 ohm per doos
	Van → naar	→ 380V 63A distributor						→ Patchpaneel ASIL	→ Patchpaneel MACHINEROOM	→ Patchpaneel ASIL
1x	Aan patchpaneel ASIL								8	
1x	Beamer connectors (H = 6m)	A	A						4	
6x	(DOOS 1) Bovenaan truss H = 6.5m									
5x	(DOOS 1) Op trekken ASIL h=variable	B	B	C	C	D	D	1	1	
8x	(DOOS 1) Vierkante ring ASIL h=4m									
10x	(DOOS 2) op truss onderaan ASIL H=0m	E	E	F	F	G	G	1	2	1
2x	(DOOS 2) In regie ASIL H=0m									

## DOZEN

2 types:

op trussen op 4 & 6m

Op trussen onderaan

## Electriciteit

A = Projectie (20A)

rest = 16A

B = Camerasysteem & sensoren

C = Belichting

D = Truss reserve

E = Computer infrastruur

F = Audio infrastructuur

G = Reserve

# CAT6A's naar ASIL patchpaneel: 31

# CAT6A's naar machinekamer patchp: 55

# BNC's naar machinekamer patch: 12

# ASIL LAB

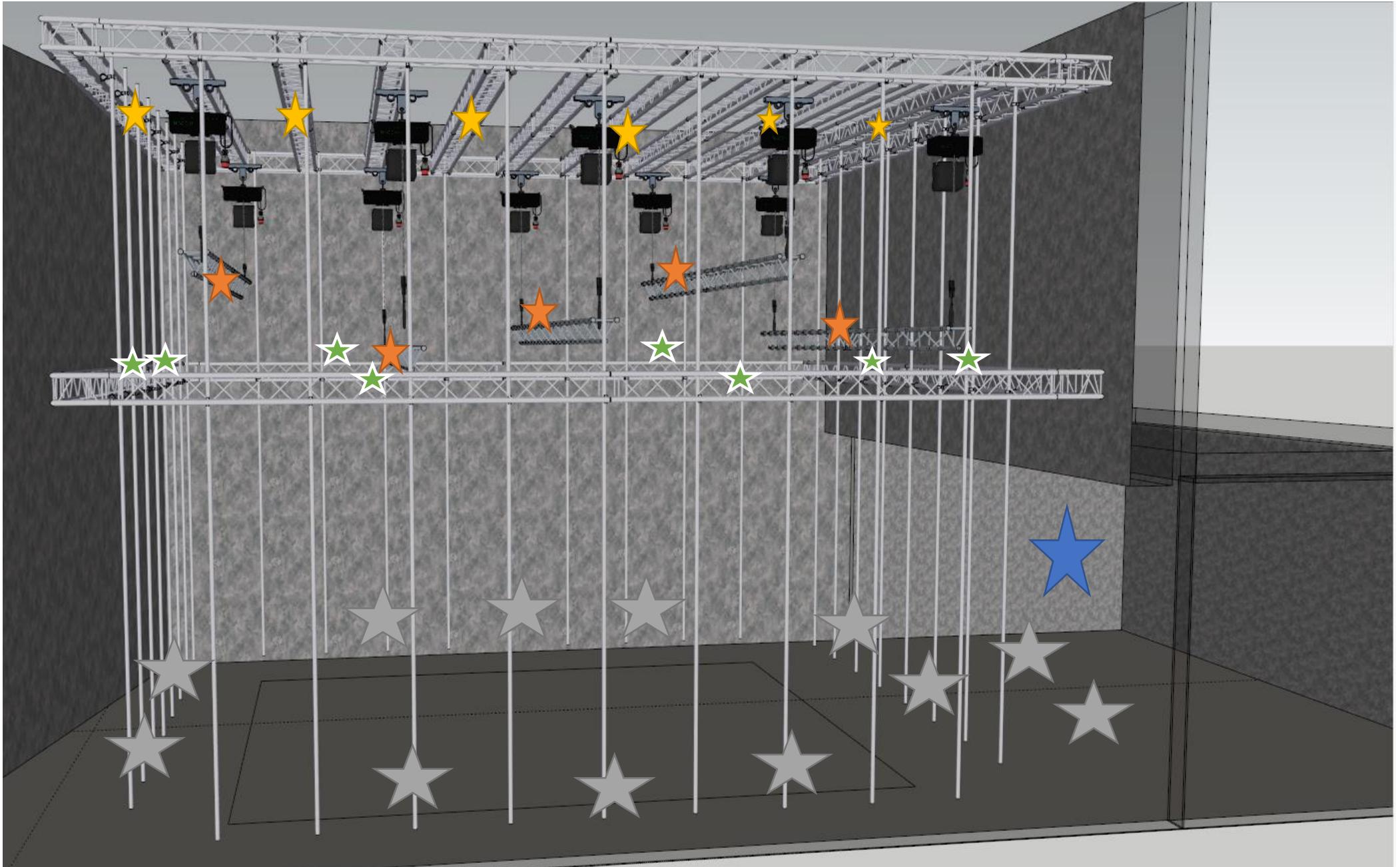
★ 6x Bovenaan  
truss H = 6.5m  
DOOS1

★ 5x op trekken  
h=variable  
DOOS1

★ 8x Vierkante  
ring h=4m  
DOOS1

★ 10x Op truss  
onderaan  
2 x in regie  
DOOS 2

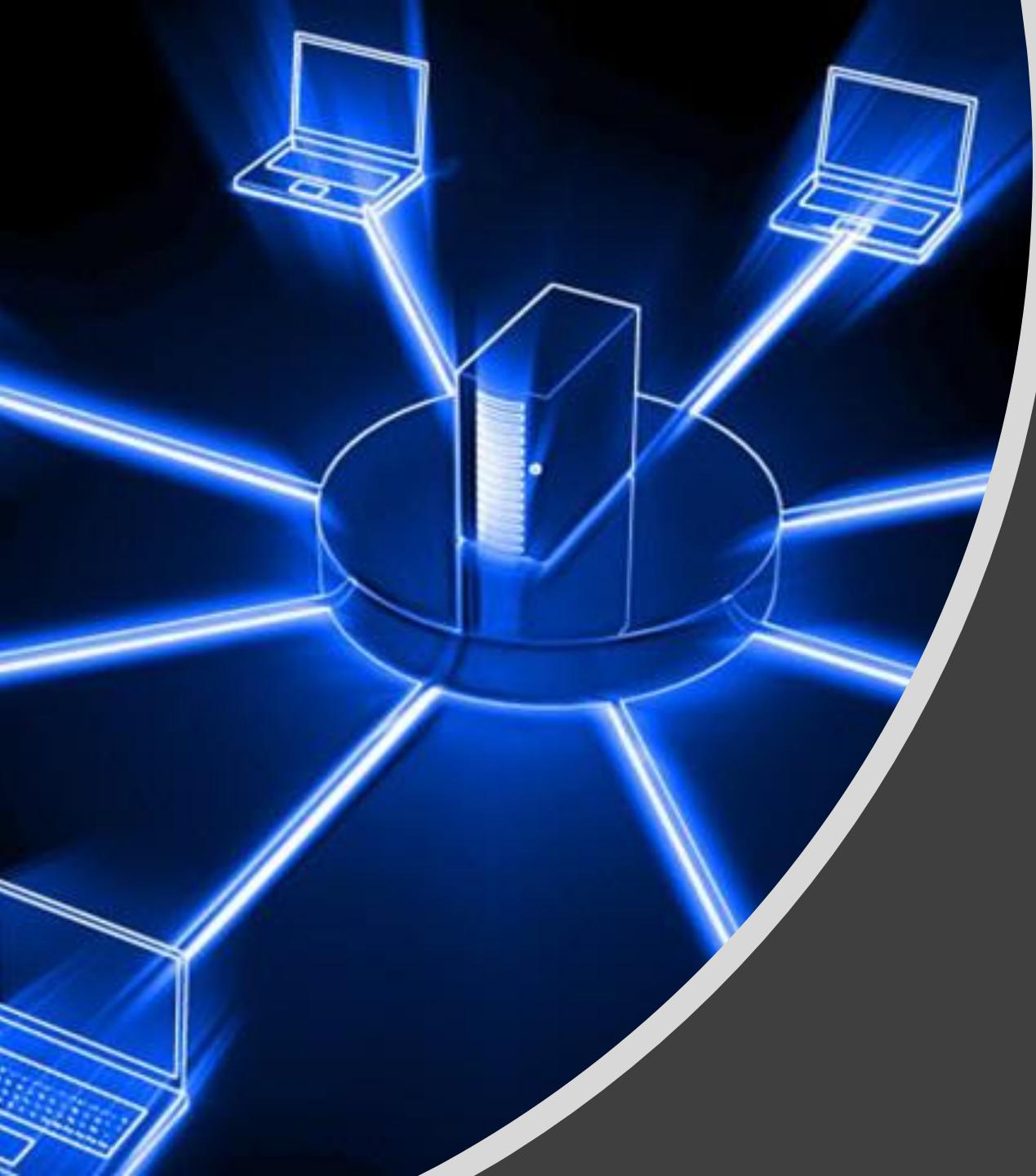
★ Voorstel  
Locatie  
patchpaneel &  
electr. paneel



# Fixed cables on trussing

- No more ugly haning cables from the trussing

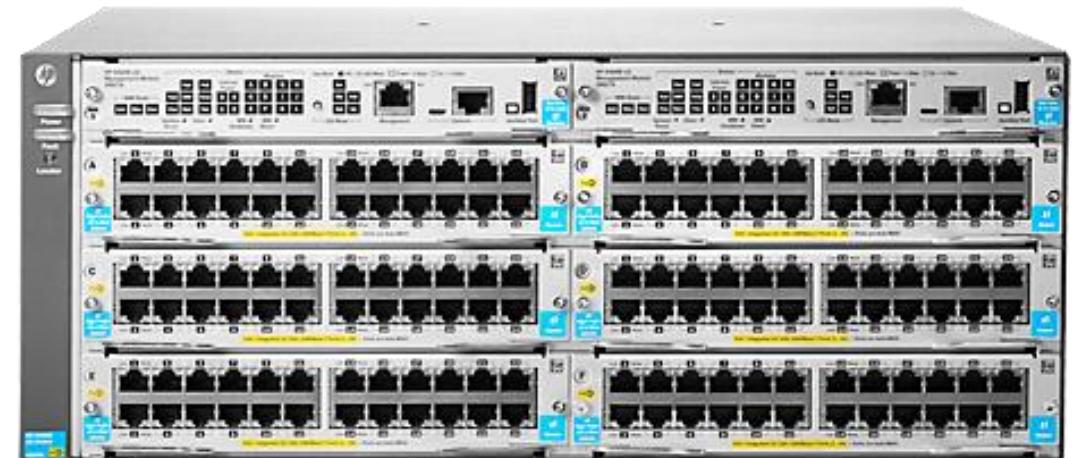




# Part 5.7: IP Network

# Network infrastructure

- 10 gbit (= 1100 mb/s transfer speed, thats 1 DVD per 4 seconds)
- 1 central network switch in machineroom:
  - **HP 5412 Switch in machineroom with modules:**
    - 8 x fiber connectors (connections to 'outside')
    - 2x 8 x 10Gbit/s UTP (for workstations & audio)
    - 3x 24 x 1Gbit UTP (for KVM, internet and other)
- Beating haert of the machineroom
- Administration by UGhent
- First line help:
  - IPEM: [Bart.moens@ugent.be](mailto:Bart.moens@ugent.be)
  - IMEC: [Kasper.Jordaens@imec.be](mailto:Kasper.Jordaens@imec.be)
  - IDLab: [Ignace.Saenen@UGent.be](mailto:Ignace.Saenen@UGent.be)
- Central administration:
  - [helpdesk@atlantis.ugent.be](mailto:helpdesk@atlantis.ugent.be)

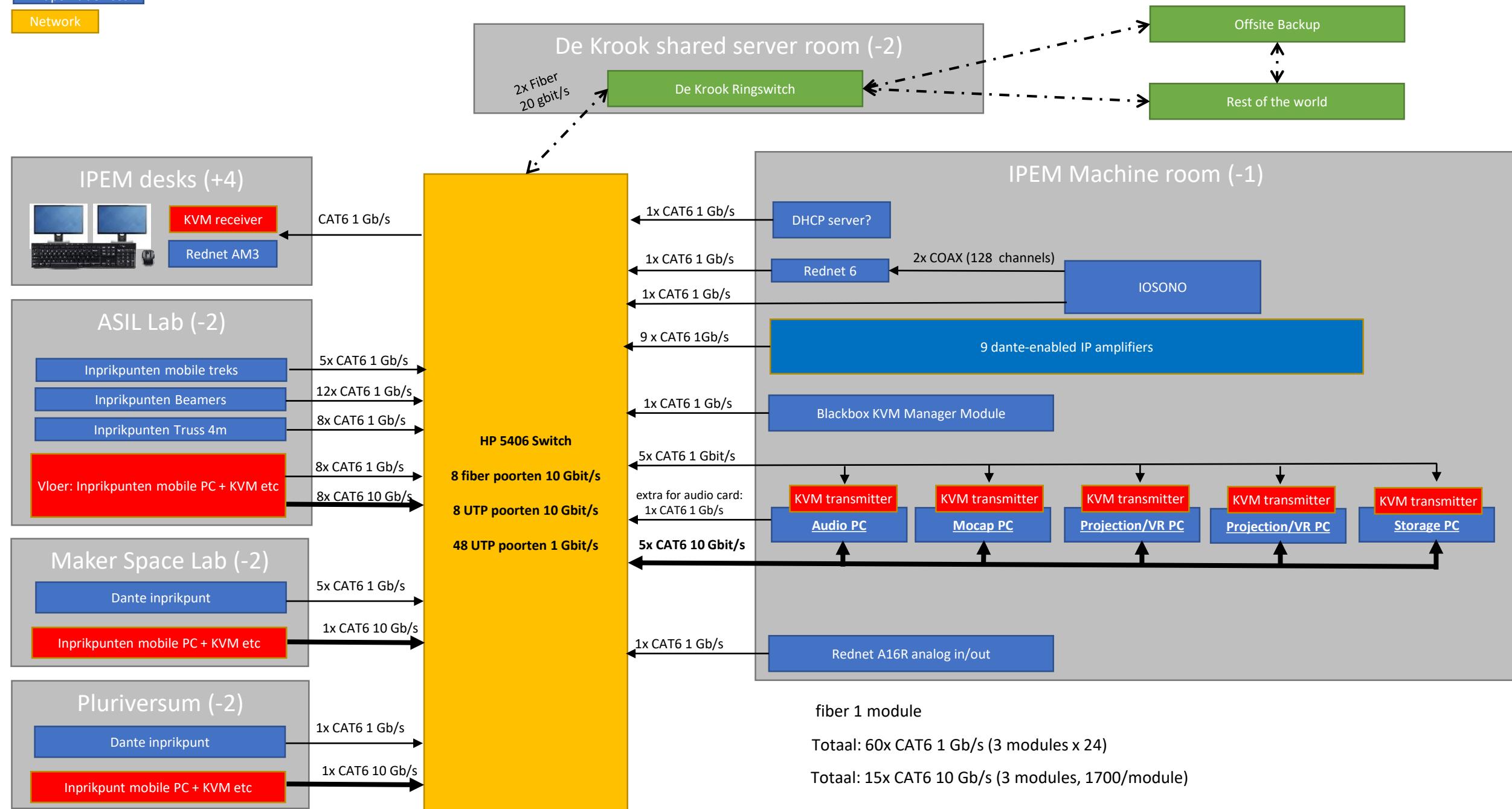


# Mobile desks (all labs, -2)

- Have 10gbit switch built in:
  - 2 ports 10 gbit (1 uplink, 1 to pc)
  - 8 ports 1gbit (KVM, dante cards, rednet AM3, etc)
- ASUS switch: XG-U2008
- <https://www.asus.com/us/Networking/XG-U2008/>
- Only 1 uplink cable required!



# IP infrastructure: IPREM/IDLab/IMEC



# IP network details

- subnet 10.10.140.0 - 255.255.252.0 (/20)
- gateway 10.10.140.1
- dns1 193.191.148.182
- dns2 193.191.148.2
- Fixed IP range: 10.10.140.11 - 255
- MAC address coupled range: 10.10.141.1 - 250
- DHCP 10.10.142.1 - 254 and 10.10.143.1-250
- Subnet for 1000 devices
- Fixed IP's for fixed devices (easy for OSC programming!)
- Mac address registration (ie for experiments with OSC routing with external devices): mail me

# Fixed IP devices

Category	Device	IP	Location
KVM Receivers	TV station, desks, ....	10.10.140.1x	-2 IPEM ASIL , +4
KVM Sender	Manager, racks, pcs, ...	10.10.140.2x	-1 Machineroom
Computers	Mobile Rack Audio PC, mocap, ...	10.10.140.3x	-2 IPEM ASIL, -1
PC	Mocap	10.10.140.33	-1 Machineroom
IOSONO	IOSONO Core	10.10.140.40	-1 Machineroom
DANTE	IOSONO Rednet 6	10.10.140.41	-1 Machineroom
DANTE	IPEM AMPs	10.10.140.50 - 69	-1 Machineroom
DANTE	IMEC REDNET 2 AMPs	10.10.140.7x	-2 Phosphortron Tech
DANTE	REDNET / audio devices	10.10.140.8x	-1 Machineroom, -2

# Complete list

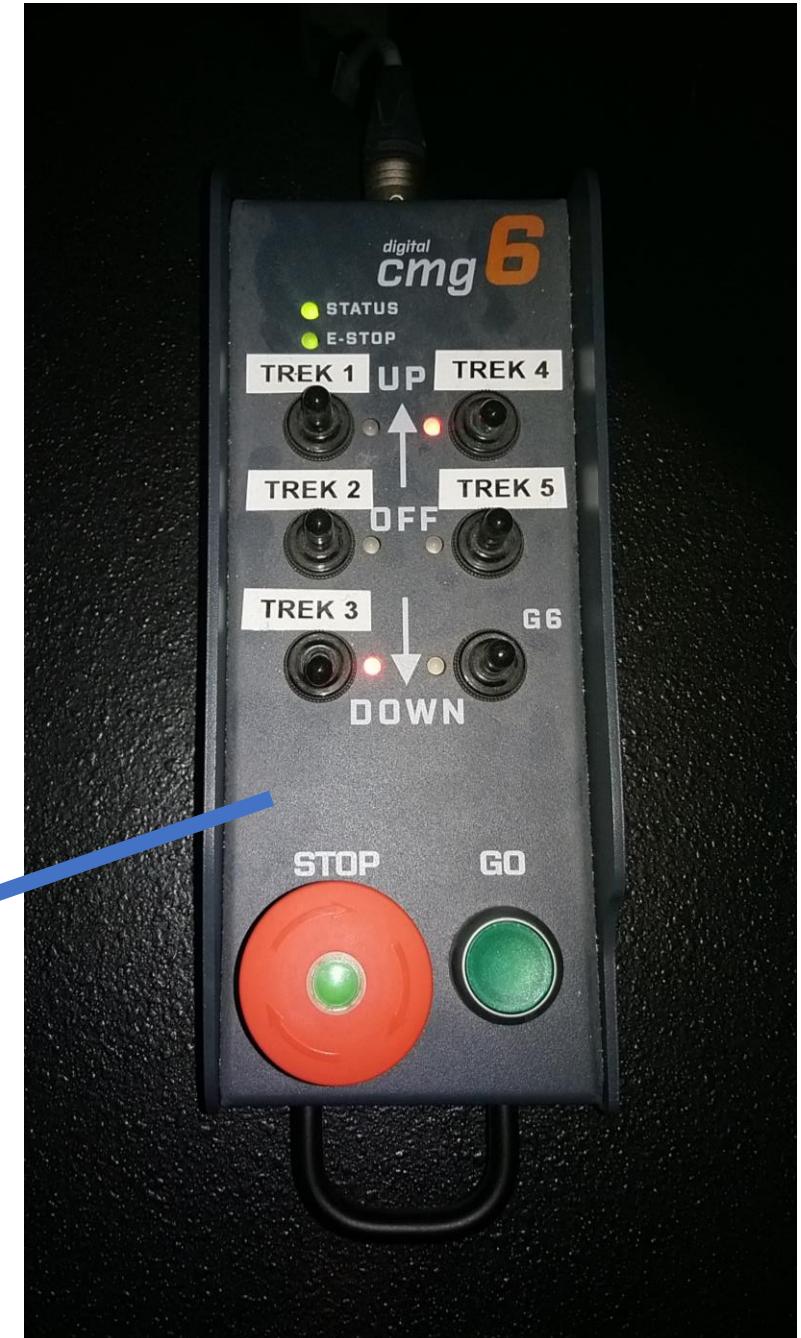
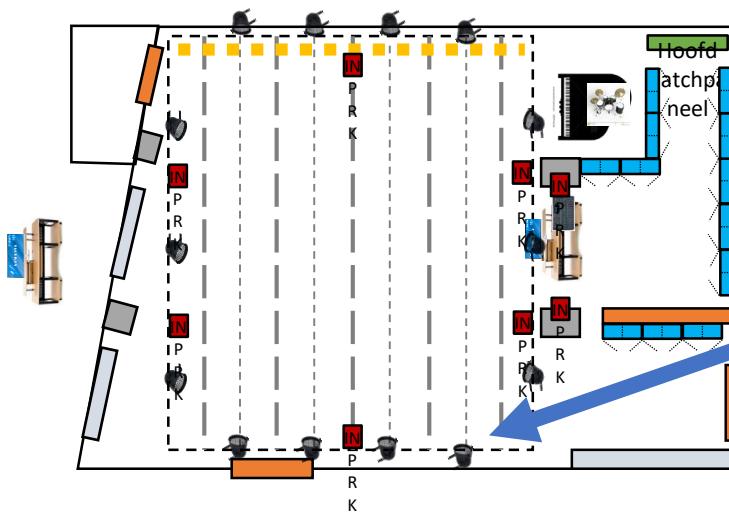
Category	Device	IP	Location	Contact
KVM Receiver	TV station	10.10.140.11	-2 IPEM ASIL	IPEM
KVM Receiver	Big Desk	10.10.140.12	-2 IPEM ASIL	IPEM
KVM Receiver	Small Desk	10.10.140.13	-2 IPEM ASIL	IPEM
KVM Receiver	Upstairs Desk	10.10.140.14	+4 IPEM Desks	IPEM
KVM Receiver	Spare	10.10.140.15	-2 IPEM ASIL	IPEM
KVM Sender	Manager	10.10.140.20	-1 Machineroom	IPEM
KVM Sender	Mobile Rack Audio PC	10.10.140.21	-1 Machineroom	IPEM
KVM Sender	Mobile Laptop Desk	10.10.140.22	-1 Machineroom	IPEM
KVM Sender	Mocap PC	10.10.140.23	-1 Machineroom	IPEM
KVM Sender	Storage PC	10.10.140.24	-1 Machineroom	IPEM
KVM Sender	Video PC	10.10.140.25	-1 Machineroom	IPEM
KVM Sender	Virtual Reality PC	10.10.140.26	-1 Machineroom	IPEM
KVM Sender	Audio Ambisonics PC	10.10.140.27 (??)	-1 Machineroom	IPEM
PC	Mobile Rack Audio PC	10.10.140.31	-2 IPEM ASIL	IPEM
PC	Mocap	10.10.140.33	-1 Machineroom	IDLab
PC	Storage	10.10.140.34	-1 Machineroom	IDLab
PC	Video	10.10.140.35	-1 Machineroom	IDLab
PC	Virtual Reality	10.10.140.36	-1 Machineroom	IDLab
PC	Audio Ambisonics PC	10.10.140.37	-1 Machineroom	IPEM
IOSONO	IOSONO Core	10.10.140.40	-1 Machineroom	IMEC
DANTE	IOSONO Rednet 6	10.10.140.41	-1 Machineroom	IMEC

# Complete list

Category	Device	IP	Location	Contact
DANTE	IPEM AMP 1	10.10.140.50	-1 Machineroom	IPEM
DANTE	IPEM AMP 2	10.10.140.51	-1 Machineroom	IPEM
DANTE	IPEM AMP 3	10.10.140.52	-1 Machineroom	IPEM
DANTE	IPEM AMP 4	10.10.140.53	-1 Machineroom	IPEM
DANTE	IPEM AMP 5	10.10.140.54	-1 Machineroom	IPEM
DANTE	IPEM AMP 6	10.10.140.55	-1 Machineroom	IPEM
DANTE	IPEM AMP 7	10.10.140.56	-1 Machineroom	IPEM
DANTE	IPEM AMP 8	10.10.140.57	-1 Machineroom	IPEM
DANTE	IPEM AMP 9	10.10.140.58	-1 Machineroom	IPEM
DANTE	Future amps	10.10.140.59-69	-1 Machineroom	IPEM
DANTE	IMEC REDNET 2 AMP 1-4	10.10.140.70	-2 Phosphortron Tech	IMEC
DANTE	IMEC REDNET 2 AMP 5-8	10.10.140.71	-2 Phosphortron Tech	IMEC
DANTE	IMEC REDNET 2 AMP 9-12	10.10.140.72	-2 Phosphortron Tech	IMEC
DANTE	IMEC REDNET 2 AMP 13-16	10.10.140.73	-2 Phosphortron Tech	IMEC
DANTE	REDNET A16R (-1)	10.10.140.80	-1 Machineroom	IPEM
DANTE	REDNET A16R (-2)	10.10.140.81	-2 IPEM ASIL	IPEM
DANTE	REDNET 4 (mic in)	10.10.140.82	-2 IPEM ASIL	IPEM
DANTE	REDNET PCIER Mob.PC.	10.10.140.83	-2 IPEM ASIL	IPEM
DANTE	REDNET PCIER Ambis.PC	10.10.140.84	-1 Machineroom	IPEM
DANTE	REDNET AM2 Big Desk	10.10.140.85	-2 IPEM ASIL	IPEM
DANTE	REDNET AM2 Small Desk	10.10.140.86	-2 IPEM ASIL	IPEM
DANTE	REDNET AM2 UpstairsDesk	10.10.140.87	+4 IPEM Desks	IPEM
DANTE	AVIO Adapter 2ch	10.10.140.88	-2 IPEM ASIL	IPEM
DANTE	AVIO Adapter 2ch	10.10.140.88	-2 IPEM ASIL	IPEM

## Part 5.8: Trussing

- Controller on subwoofer
- Select truss number and up/down
- Check safety
- Press “go button”





# PART 5.10: Speaker Setup

# Speaker setup

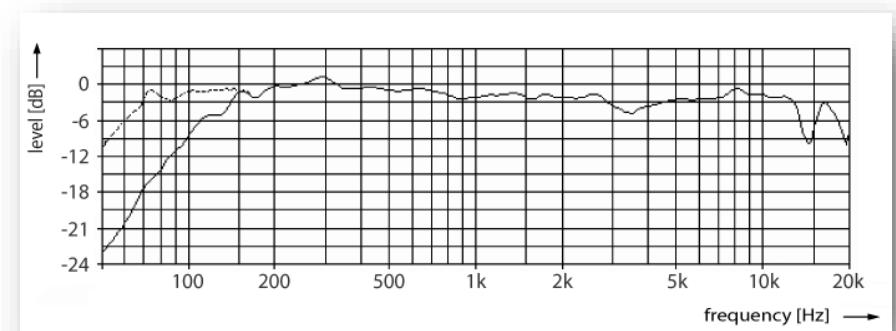
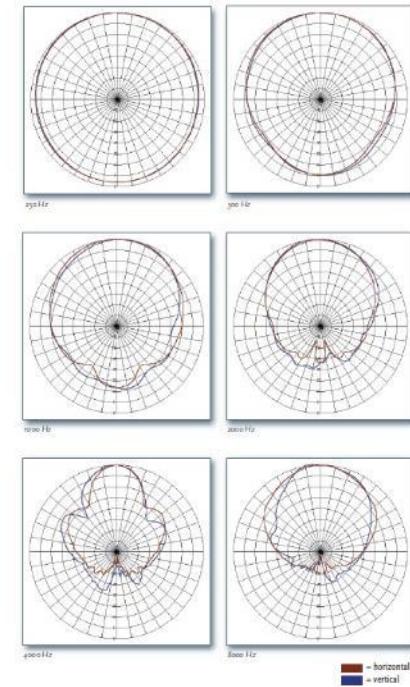
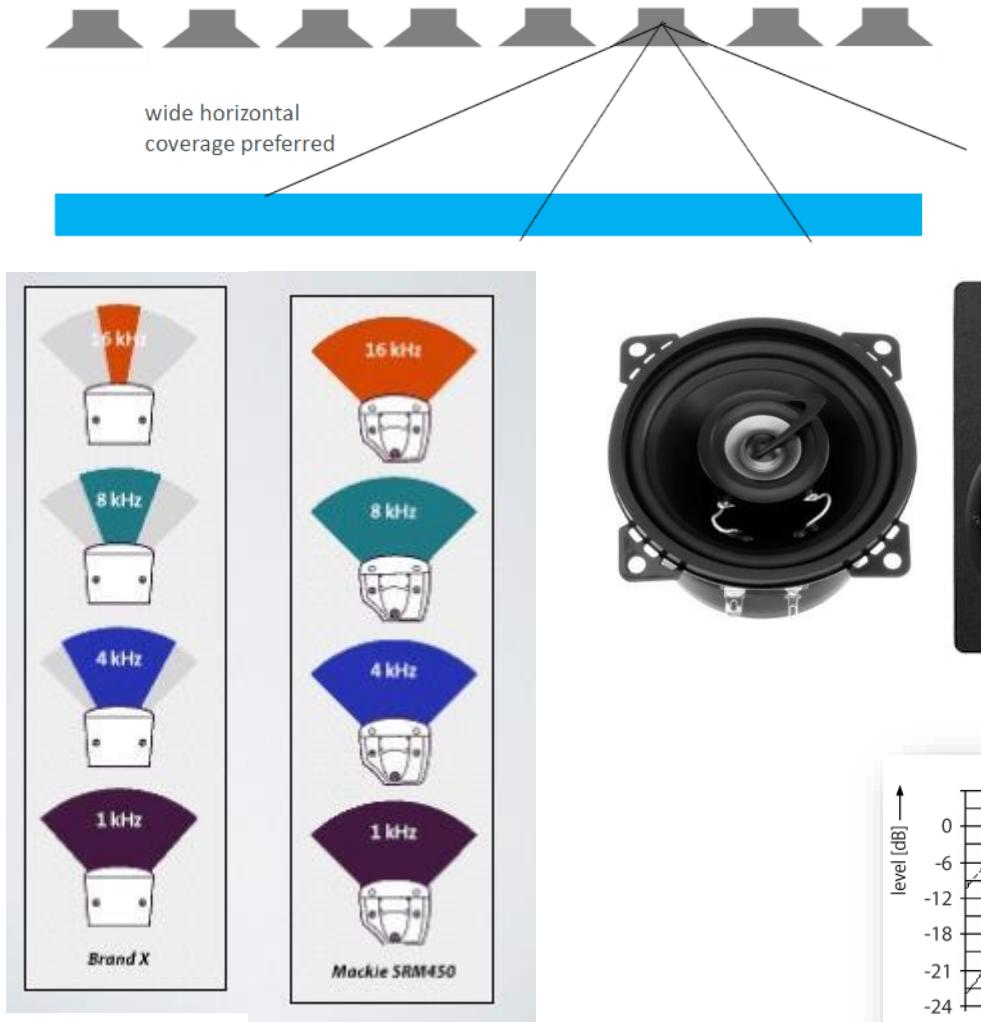
- Speaker locations and amounts based on Barco's recommendation:
  - Floor: 4 subwoofers
  - Ring 0 (ear height): 34 speakers (distance ca 92 cm)
  - Ring 1 (halfway): 14 speakers (distance ca 184 cm)
  - Planar array ceiling: 12 speakers (distance ca 240 cm)
- Discrete feeds for every speaker (64 channel)
- Speaker coordinates: at sharepoint
- <https://sharepoint.ugent.be/projects/201803192/layouts/15/WopiFrame.aspx?sourcedoc=/projects/201803192/Documenten/ASIL Documentation/Speaker%20Coordinates.xlsx&action=default>

# Speaker coordinates

- AED: azimuth, elevation, distance
  - 1, aed 1 64.14999163 64.46104391 6.649729318;
  - 2, aed 2 115.8500084 64.46104391 6.649729318;
  - 3, aed 3 14.78867761 66.68675459 6.533421768;
  - 4, aed 4 90 83.72270151 6.036190852;
  - 5, aed 5 165.2113224 66.68675459 6.533421768;
  - 6, aed 6 -45.22826883 73.52132535 6.257004075;
  - 7, aed 7 -134.7717312 73.52132535 6.257004075;
  - 8, aed 8 -51.82686234 56.01315973 7.236186841;
  - 9, aed 9 -90 62.07641028 6.790611165;
  - ...
  - Standard ambisonics format
  - See sharepoint!

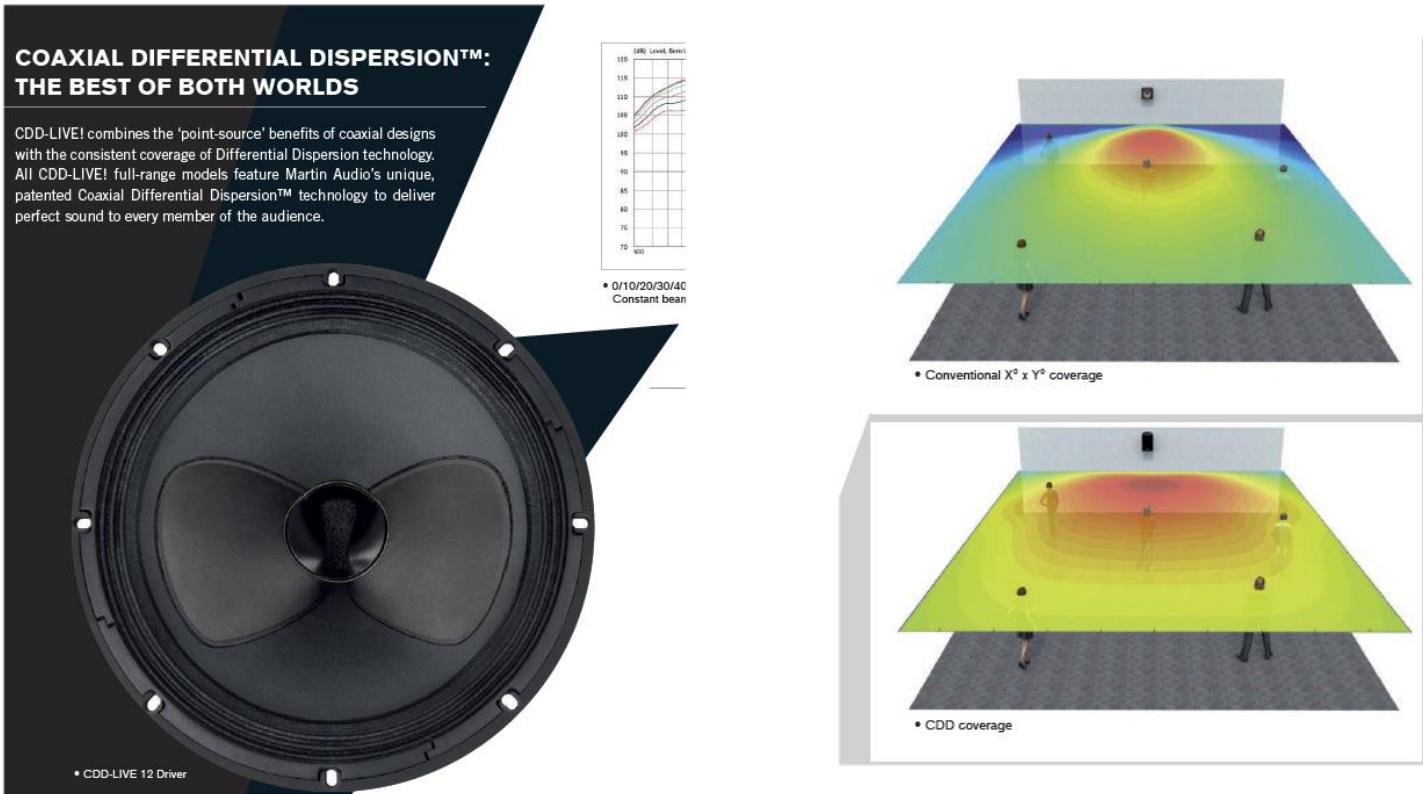
speakers	X	Y	Z'
1	1,25	2,58	6,00
2	-1,25	2,58	6,00
3	2,50	0,66	6,00
4	0,00	0,66	6,00
5	-2,50	0,66	6,00
6	1,25	-1,26	6,00
7	-1,25	-1,26	6,00
8	2,50	-3,18	6,00
9	0,00	-3,18	6,00
10	-2,50	-3,18	6,00
11	4,01	3,05	4,15
12	4,01	1,21	4,15
13	4,01	-0,60	4,15
14	4,01	-2,60	4,15
15	2,15	-4,61	4,15
16	0,00	-4,61	4,15
17	-2,15	-4,61	4,15
18	-4,01	-2,60	4,15
19	-4,01	-0,60	4,15
20	-4,01	1,21	4,15
21	-4,01	3,05	4,15
22	-2,15	4,01	4,15
23	0,00	4,01	4,15
24	2,15	4,01	4,15
25	4,10	3,64	1,90
26	4,10	2,73	1,90
27	4,10	1,82	1,90
28	4,10	0,91	1,90

# Speaker Considerations



# Type of speakers

- Martin Audio CDD 6
  - Compact, lightweight, high-powerd, coaxial



# Data sheets

- Martin Audio CDD6
- <https://martin-audio.com/downloads/datasheets/CDD6datasheet.pdf>
- Martin Audio Subwoofers CX118
- <https://martin-audio.com/downloads/datasheets/SX118datasheet.pdf>

# Amplifiers

- Powersoft ottocanali 4K4 DSP
- 8 channel amps
- Audio over ip built-in
- Internal low-latency DSP
- Software-configurable



# Data sheet amps

- <http://www.powersoft-audio.com/en/docman/1216-ottocanali-dsp-series/file>

## OTTOCANALI 4K4 DSP+D

8-Channel Power Amplifier for mid to large-scale installs

Armonia-Plus  
System Manager

DSP  
onboard

8 lo-Z  
hi-Z  
channels



SRM

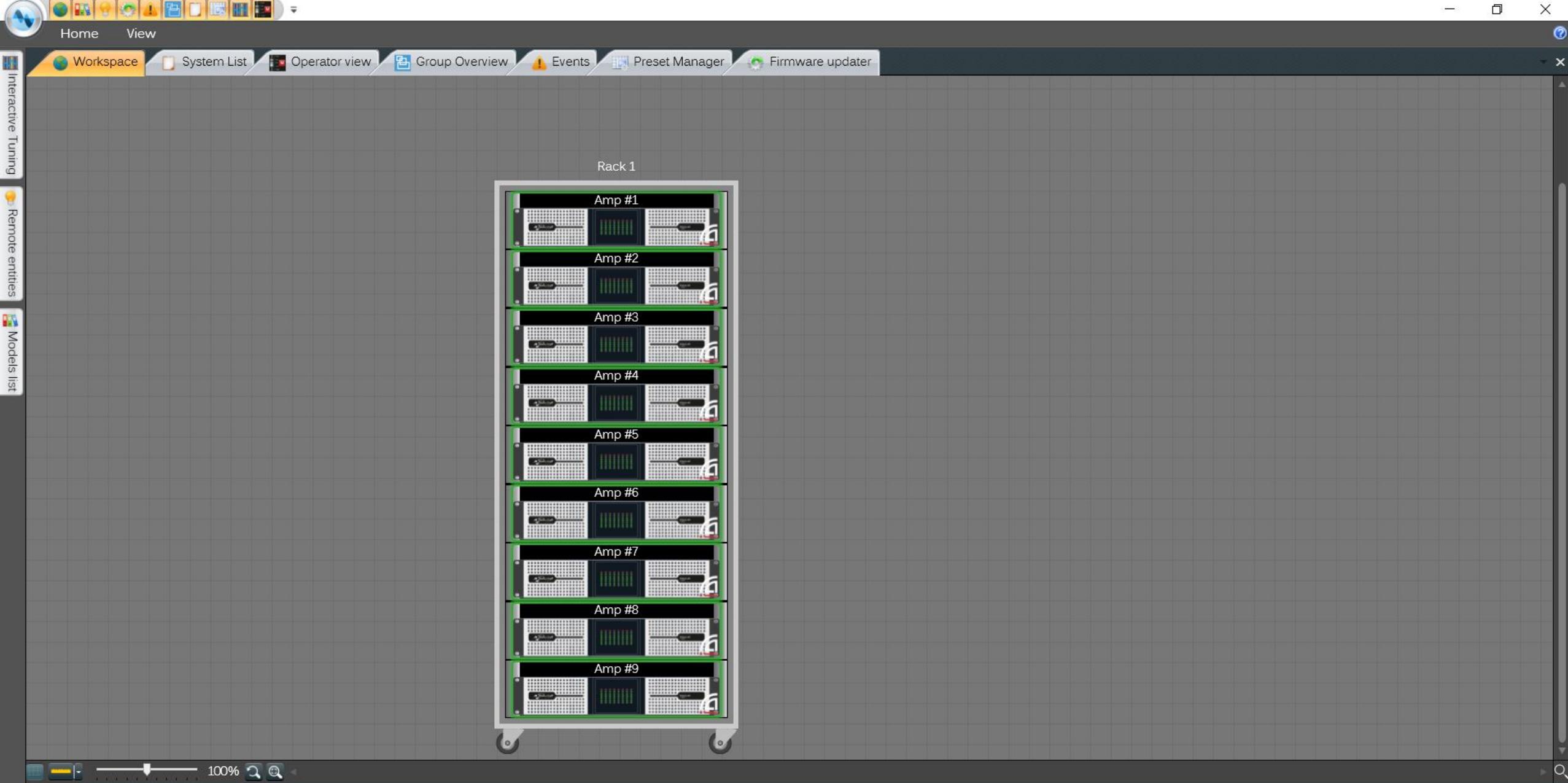
PFC



# Amp Config: Armonia

- Software to configure the Amps
- Both DSP & connection wise
- <http://www.powersoft-audio.com/en/software/armonia-pro-audio-suite>





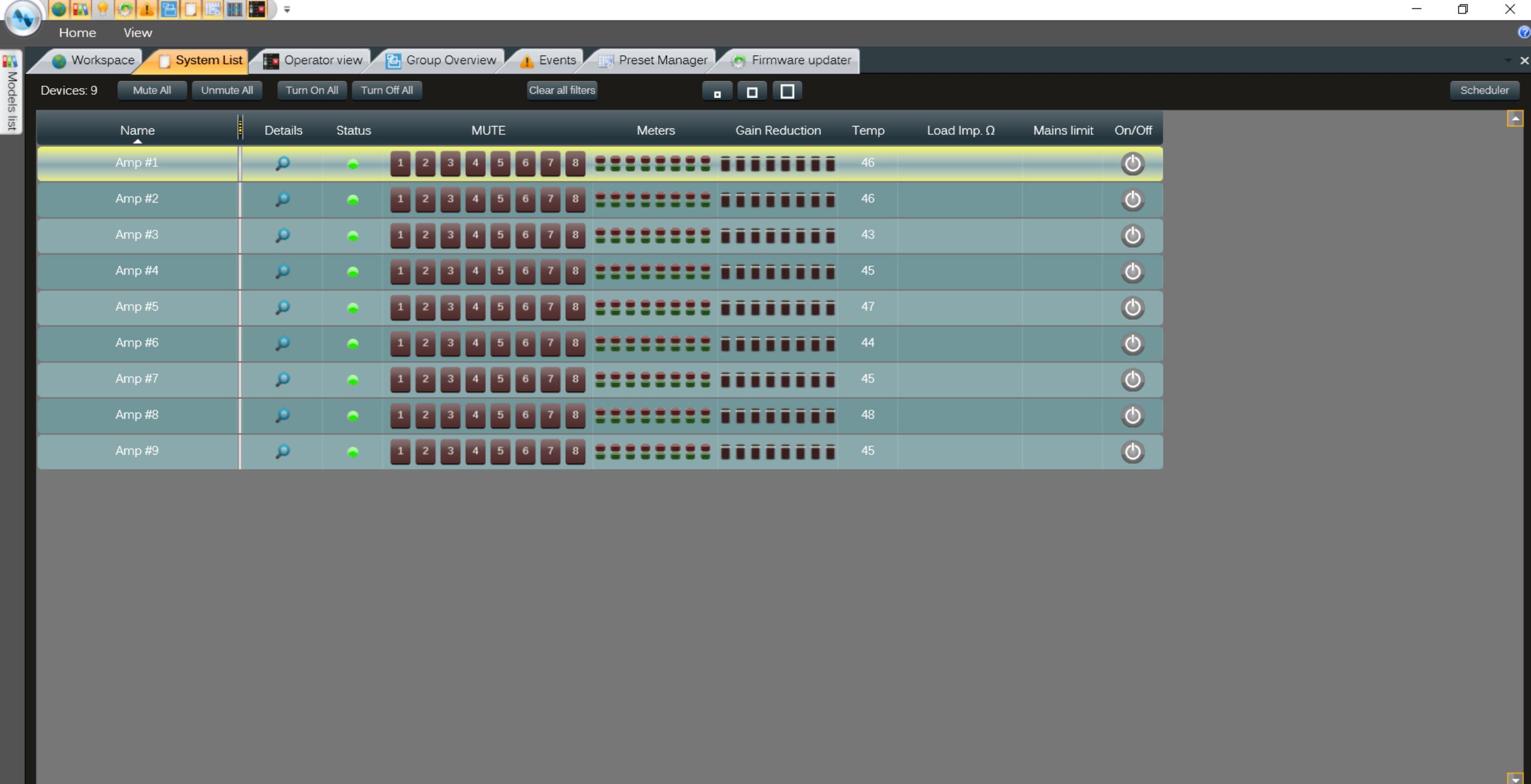
Arrow: drag an item to move current selection, or drag over an empty area to perform an area selection

Loading file 'C:\Users\Bart\OneDrive - UGent\IPEM\ASIL Labs\\_ CONSTRUCTION\Speakers & amps\Amps Configuration\Krook-Amp-config-BARCO\_IOSONO\_CALIB.pawx'... done



13:06  
22/02/2019





Loading file 'C:\Users\Bart\OneDrive - UGent\IPEM\ASIL Labs\\_ CONSTRUCTION\Speakers & amps\Amps Configuration\Krook-Amp-config-BARCO\_IOSONO\_CALIB.pawx'... done



Amps Configuration



Inbox - Bart.Moens...



2019 - ASIL LABS V...

Krook-Amp-config...

13:08  
22/02/2019

Home View

Amp #1 Workspace System List Operator view Group Overview Events Preset Manager Firmware updater

Active DSP 59%

Source sel.

Matrix

Adv EQ Spk EQ Ways

#01

#02

#03

#04

#05

#06

Inputs

SPEAKERS

Dante Ch 1

Dante Ch 2

Dante Ch 3

Dante Ch 4

Dante Ch 5

Dante Ch 6

Overall mute

Martin audio CDD CDD6

V 25 50 70 dB 20 16 12 8 4 0 Hi-Pass freq: Off LowZ/70/100 Nominal Z: N/A

M

Overall mute

Martin audio CDD CDD6

V 25 50 70 dB 20 16 12 8 4 0 Hi-Pass freq: Off LowZ/70/100 Nominal Z: N/A

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V 25 50 70 dB 20 16 12 8 4 0 Hi-Pass freq: Off LowZ/70/100 Nominal Z: N/A

M

Overall mute

Martin audio

V 25 50 70 dB 20 16 12 8 4 0 Hi-Pass freq: Off LowZ/70/100 Nominal Z: N/A

M

Loading file 'C:\Users\Bart\OneDrive - UGent\IPEM\ASIL Labs\\_ CONSTRUCTION\Speakers & amps\Amps Configuration\Krook-Amp-config-BARCO\_IOSONO\_CALIB.pawx'... done



Amps Configuration



Inbox - Bart.Moens...



2019 - ASIL LABS V...

Krook-Amp-config...

13:08  
ENG  
22/02/2019

# Armonia: presets

- Currently configured by Barco/IOSONO
- 36 db reduction (so we don't accidentally play at 120 db...)
- If you want to make the system louder, configure EQ's, change highpass/lowpass filters: use armonia
- Make presets & save configuration (PRIOR changes & AFTER changes)
- Let me know!

# 3D AUDIO

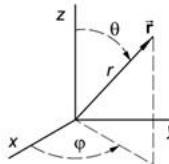
- Ambisonics
- IOSONO
- Auralisation
- Documentation will follow

# IOSONO 'Cheat Sheet'

- IP Address: 10.100.20.10
  - Configure your IP manually
  - subnet 255.255.255.0
  - Download software at core IP
- Coordinate system: Spherical, radians!
- This presentation and demo's:
  - <https://github.com/ArtScienceLab/LabDocumentation>
  - <https://github.com/ArtScienceLab/iosono4Live>
  - <https://github.com/ArtScienceLab/iosono4MaxMSP>
- OSC command: send the following at 100hz to the core at port 4243:

```
/iosono/render/v1/src channel sourcetype theha phi r volume lowpassfilter delay scaling screen spread trait
```

Input channel (int)	type (int)	Angle (float)	Radius Straal (float)	Set volume to 1.0 (float)
	4 = point	Radians! (float)	Float	Lowpass to 0.0 (float)
	5 = plane	-3.14 -> 3.14	0.0 -> 10.0 'meters'	Delay to 0.0 (float)
				Scaling to 0 (int)
				Spread to 0.0 (float)
				Trait to 0 (int)



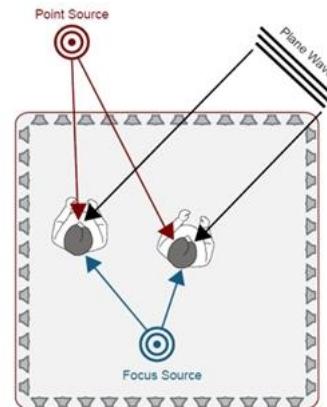
$$x = \rho \sin \varphi \cos \theta$$

$$y = \rho \sin \varphi \sin \theta$$

$$z = \rho \cos \varphi$$

$$\text{Radians} = \left( \frac{\pi}{180^{\circ}} \right) \times \text{degrees}$$

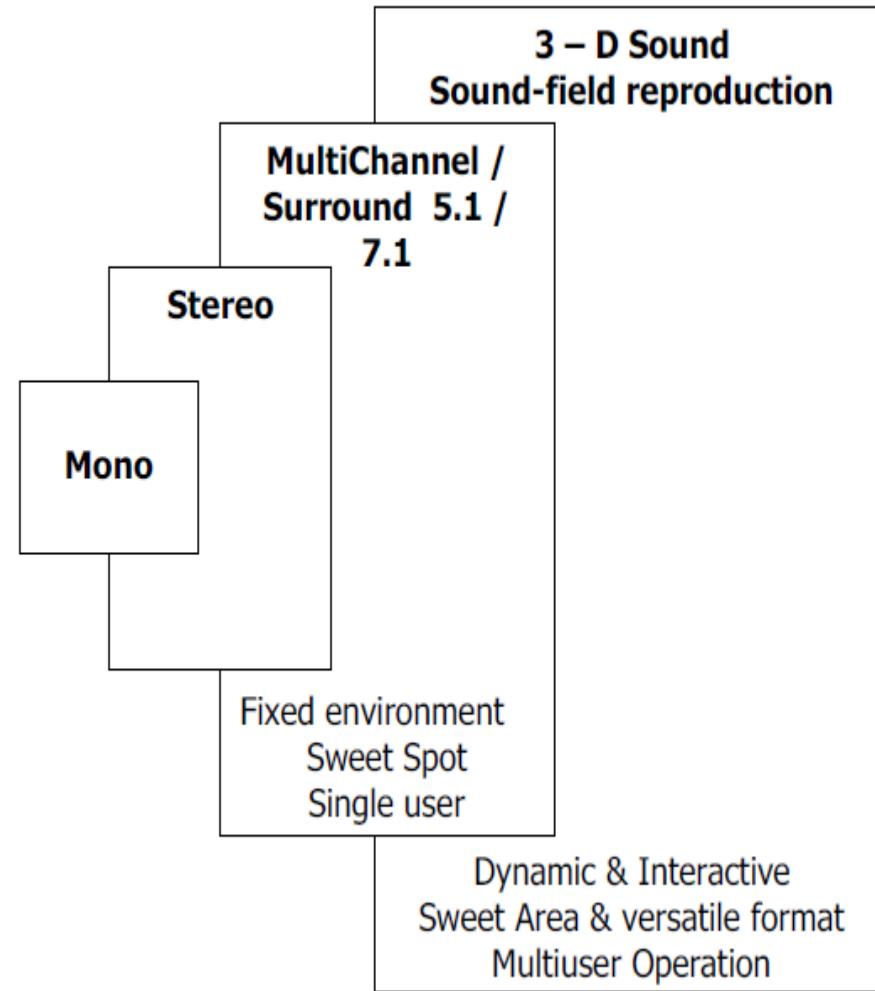
$$\text{Degrees} = \left( \frac{180^{\circ}}{\pi} \right) \times \text{radians}$$



# Goal of the workshop

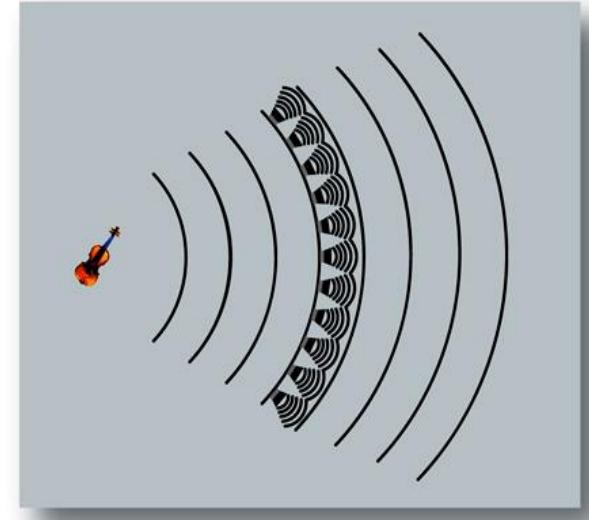
- Disclaimer: I am not an expert in WFS or 3D sound! Some of the presentation is created by IRCAM & SonicMotion.
- The goal is to showcase and share our current knowledge and the IOSONO system
- The idea is to stimulate participants into thinking in 3D sound - generating new ideas, theories, concepts and experiments for the lab

# Evolution of Sound (re)production



# Wave Field Synthesis (WFS)

- Sound sources emit certain wave fields
- WFS = Reproduction with secondary sources according to Huygens Principle (1678)

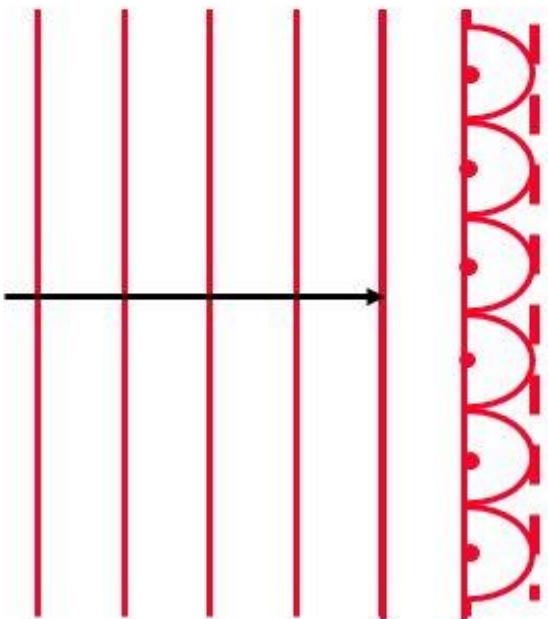


# Huygen's Principle

---

We

**Huygen first explained this in 1678 by proposing that all planar wavefronts are made up of lots of spherical wavefronts..**



**That is, you see how light propagates by breaking a wavefront into little bits, and then draw a spherical wave emanating outward from each little bit. You then can find the leading edge a little later simply by summing all these little “wavelets”**

# Wave Field Synthesis (WFS)

- Wave field synthesis (WFS) is a spatial audio rendering technique, characterized by creation of virtual acoustic environments and sources.
- Requires speakers placed adjacent to each other, typically called '*transducer array*'
- ***Results in 'holographic 'sounds***



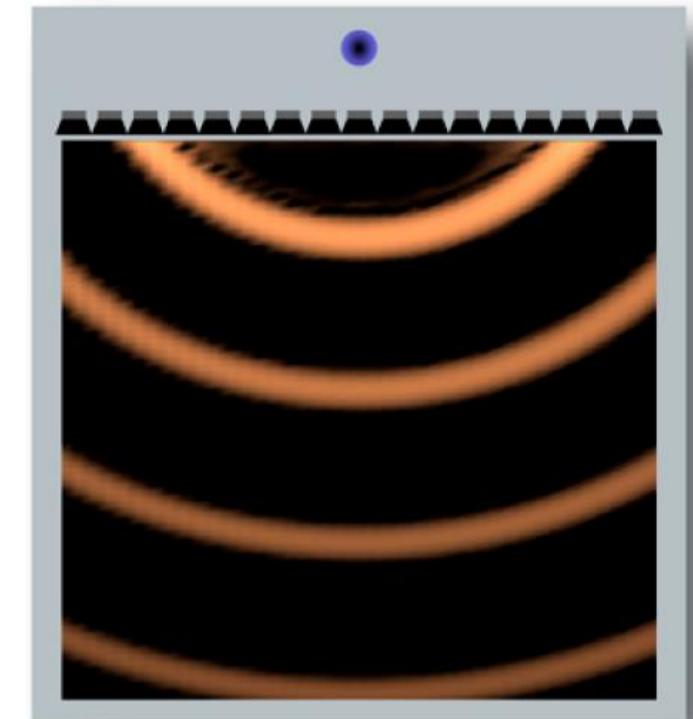
# Wave Field Synthesis (WFS)

- WFS produces artificial wave fronts synthesized by a large number of individually driven loudspeakers.



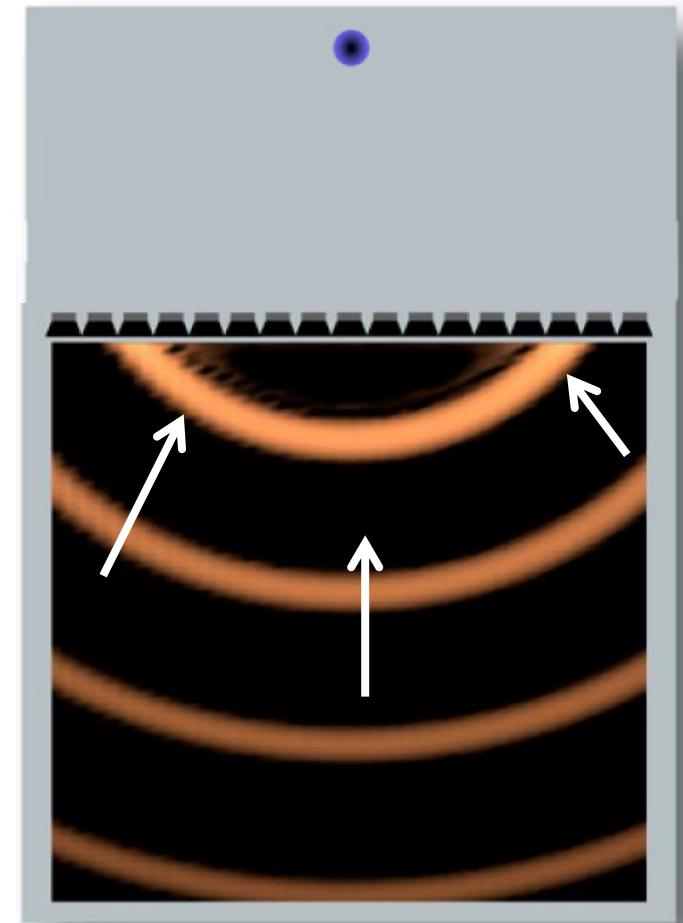
# Wave Field Synthesis (WFS)

- WFS produces artificial wave fronts synthesized by a large number of individually driven loudspeakers.
- Wave fronts seem to originate from a virtual starting point: the 'virtual source'.



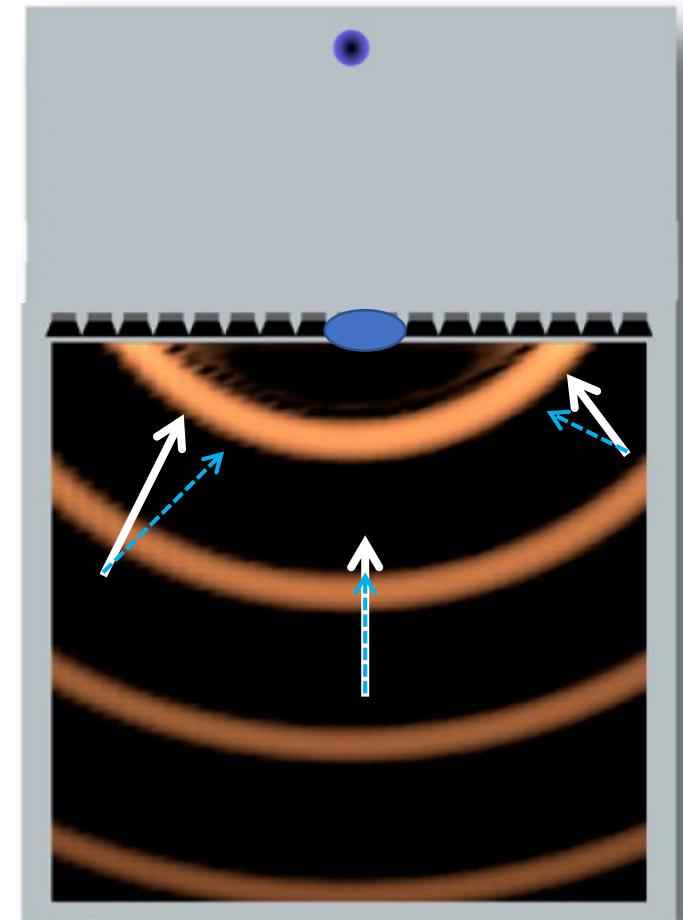
# Wave Field Synthesis (WFS)

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- Contrary to traditional spatialization techniques such as stereo or surround sound, **the localization of virtual sources in WFS does not depend on or change with the listener's position**



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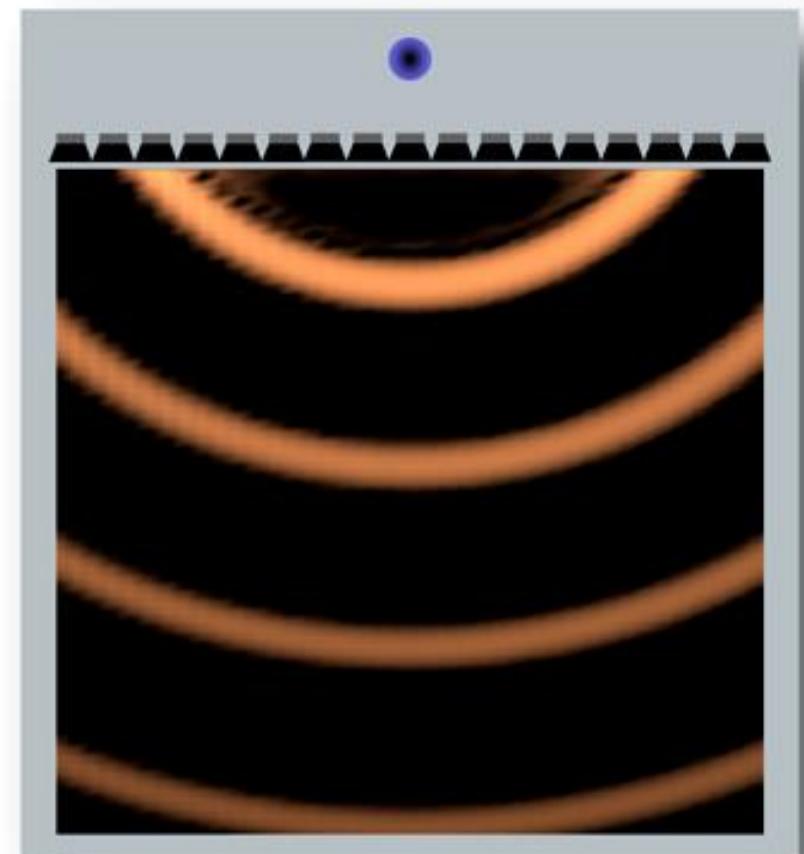


# Wave Field Synthesis (WFS)

- Think ‘sound object’ or source instead of sound.
  - The sound object includes ‘positional data’
  - [https://en.wikipedia.org/wiki/Wave\\_field\\_synthesis](https://en.wikipedia.org/wiki/Wave_field_synthesis)

# WFS: Virtual point source

- Perceived at a precise position.
- Natural variation of localization cues with listener movements



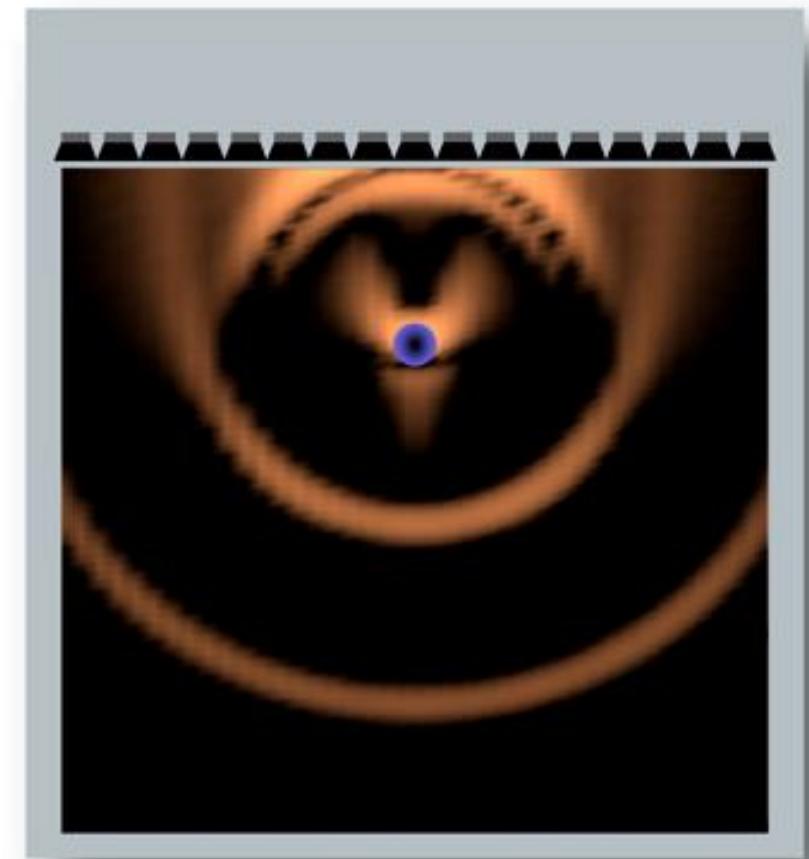
# WFS: Plane Wave

- Perceived everywhere from the same angular direction.
- Unlike point sources, monitoring of direction instead of position
- “Follows” the listener movements



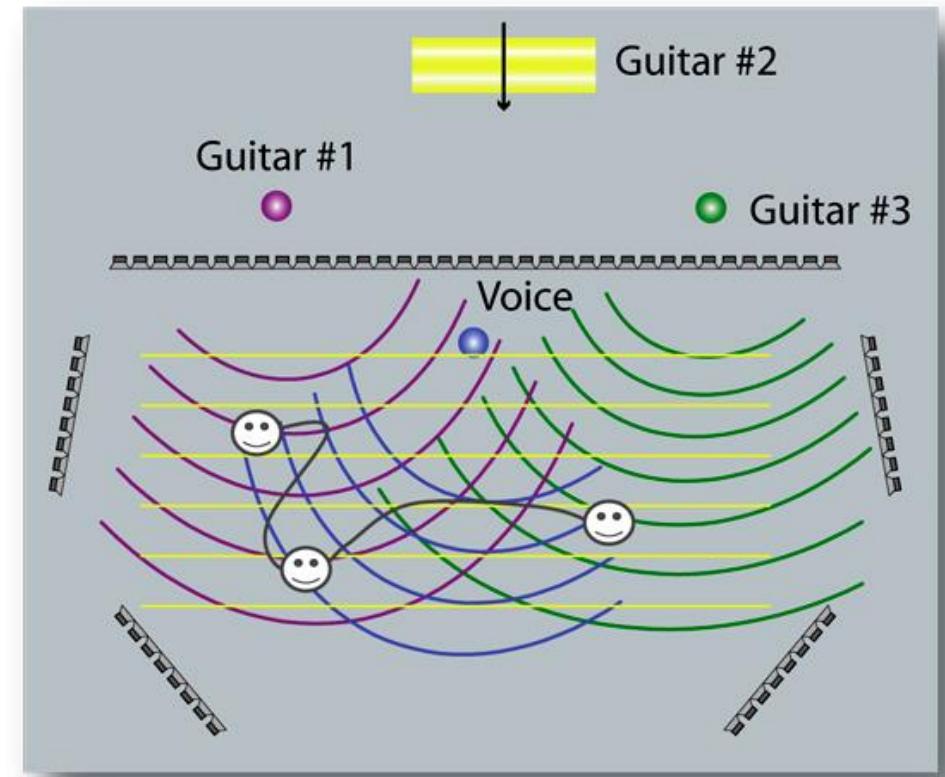
# WFS: focus source

- **Point source inside listeners area**
- Perceived everywhere from the same point in the room
- Using simulated reflections
- Most ‘tricky’ source due to unwanted acoustic interference/reflections



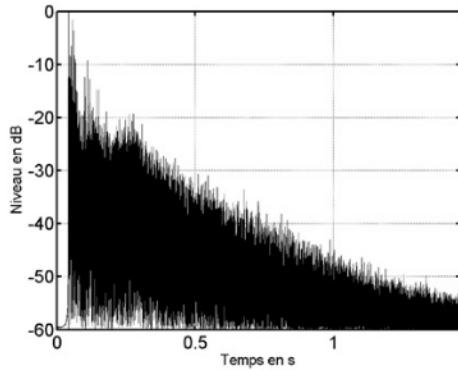
# WFS to create sound perspective

- Combine sources to create Immersive sound scene
- During navigation the listener experiences a multi-sensorial spatial situation (Augmented Reality)
- Variation of auditory cues remains coherent with listener movements throughout the sound installation.
- Elicits “presence”, learning and memorization of sound scene spatial organization

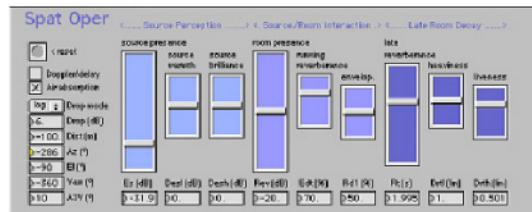


# WFS to create room effect synthesis (IRCAM showcase)

Measurements



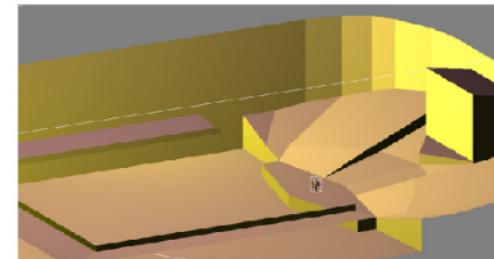
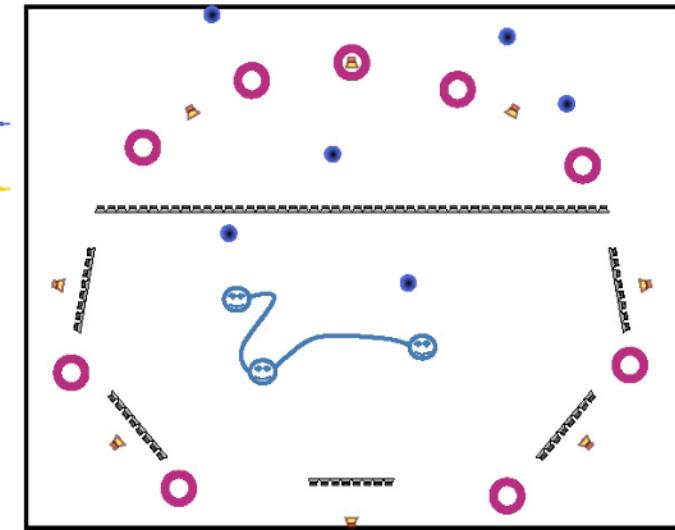
Perceptual factors



Direct sound

Room effect channels

WFS system



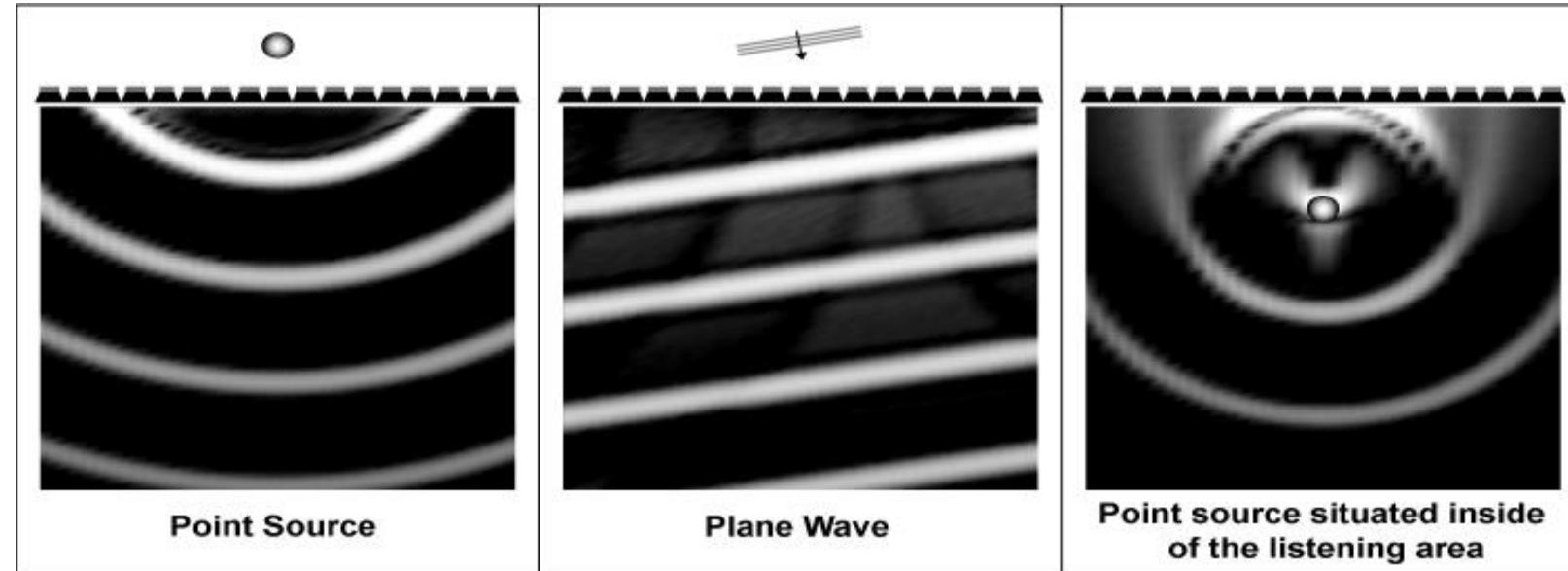
Geometrical description

# WFS: Audio format

- Impractical to store >64 individual audio channels for a simple sound stream.
- Room independant storage (play it elsewhere on WFS system)
- **Solution? Store ‘raw’ audio *and* sound type and position**

# WFS: Summary

- Holographic sound
- Different audio sources
- Audiodata includes spatial data



# Part 2: Barco's IOSONO

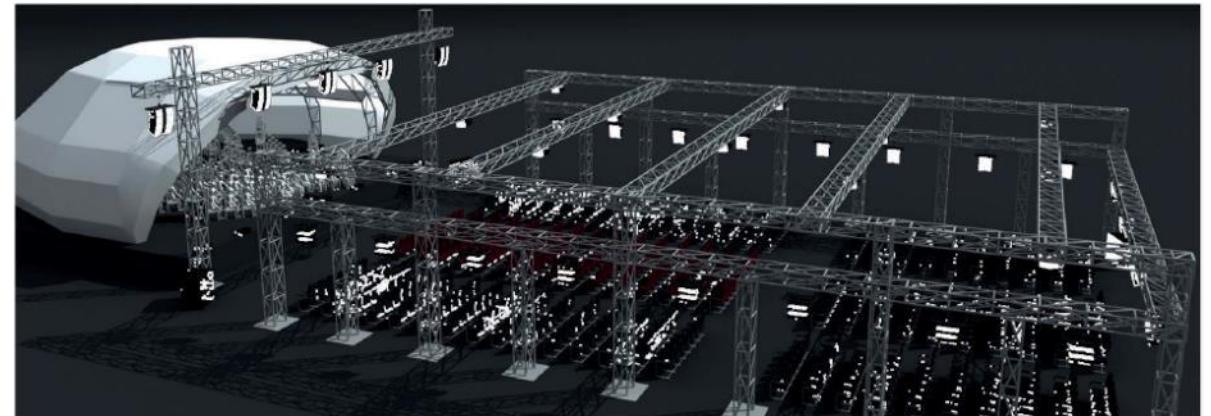
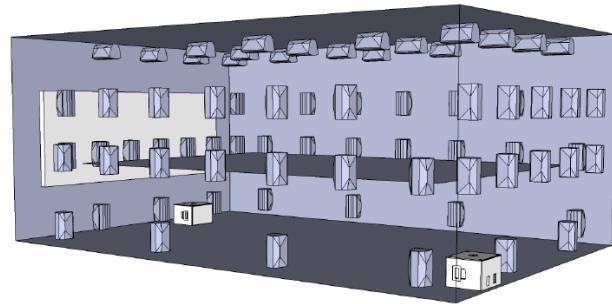
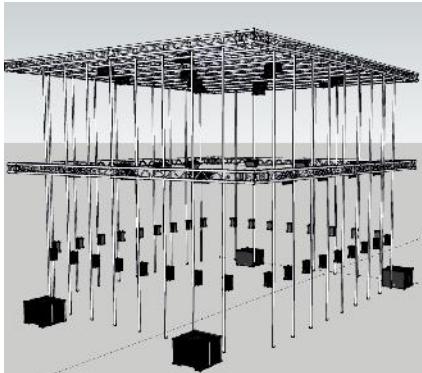


# Barco IOSONO

- ‘IOSONO Core’ is a device from Barco which implements WFS
- *IPEM & IMEC share one IOSONO core for two labs*
- IOSONO calculates all discrete speaker signals
  - Send audio and positional data and the IOSONO calculates which speaker should make which sound at what time

# IOSONO vs WFS

- WFS requires speakers placed adjacent to each other
  - IOSONO's implementation *promises* higher speakers distance
  - Larger audiences & better cost-return ratio.
- User-friendliness: 'outsource' all calculations
- Room-independent: easily transpose composition to different room by changing speaker setup



# WFS: IOSONO

## Wave| Field Synthesis

..evokes different perceptual effects  
for the listeners inside the audience

### Plane Wave

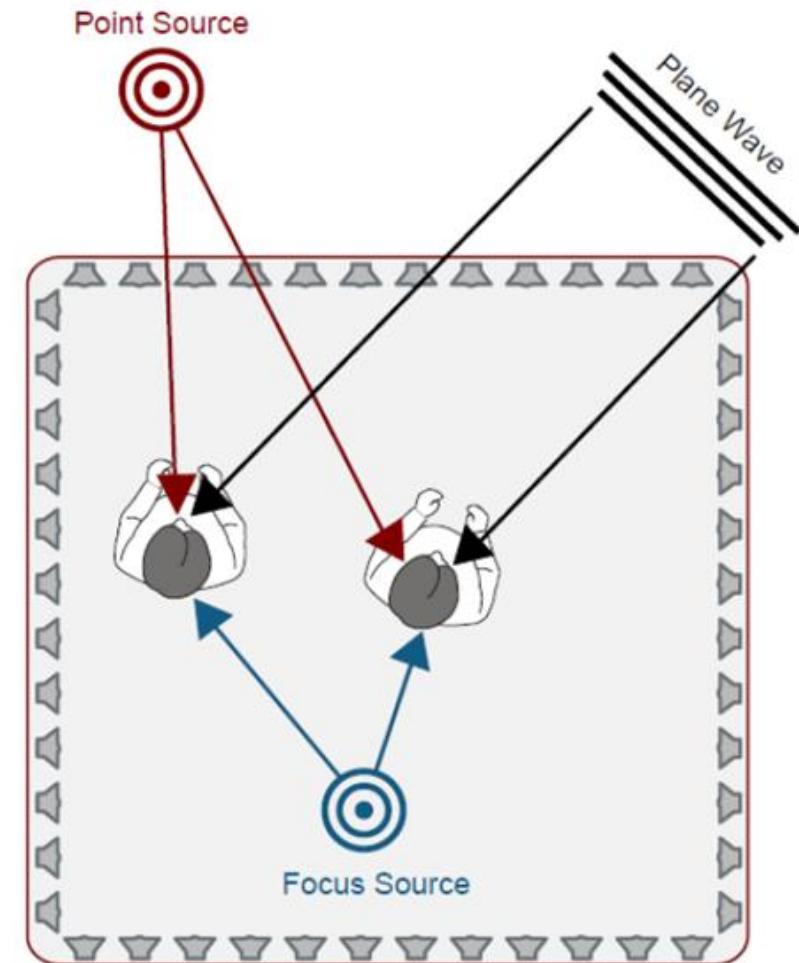
identical direction of a sound

### Point Source

identical sound location

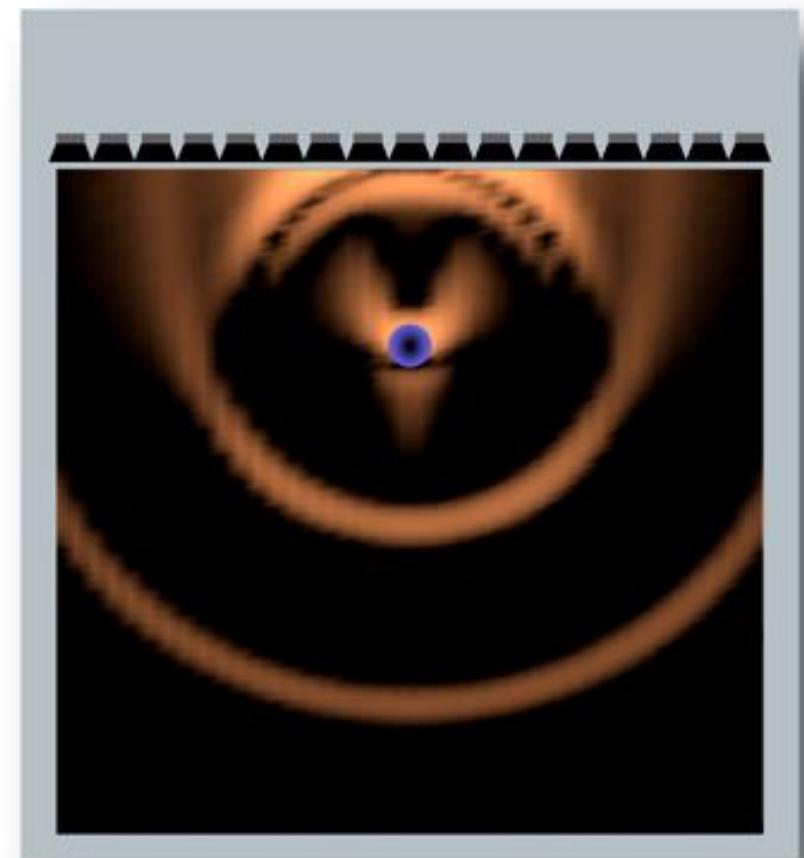
### Focus Source

energy peak inside the system



# IOSONO Delay

- Three types of delay:
  - Audio output of PC = 1 ms
  - Audio network transport = 1 ms
  - Propagation delay: acoustic delay from speaker to reference point (speed of sound)  
**= 24 ms**
- IOSONO calculation time (buffer: 64 in, 32 internal, 64 out) = 3 ms
- “Pre-delay” of focused sources: difference nearest speaker & furthest speaker (acoustic delay, wait for reflections) = 12 ms
- **TOTAL delay** = 39 ms
- **Not ideal for live bands!** Use dante routing (1ms delay)



# IOSONO plans

- **Acoustic treatment of the room (reduce reflection)**
- **Calibrate the system**
  - Matching the speakers so they sound exactly the same at central focus point (using FIR/FFR/attenuate)
- Both should improve the effect!

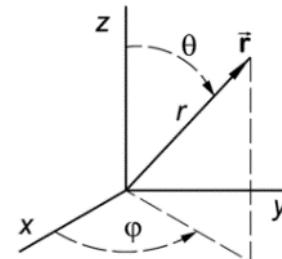
# IOSONO ‘Cheat Sheet’

- IP Adress: 10.100.20.10
  - Configure your IP manually
  - subnet 255.255.255.0
  - Download software at core IP
- Coordinate system: Spherical, radians!
- This presentation and demo's:
  - <https://github.com/ArtScienceLab/LabDocumentation>
  - <https://github.com/ArtScienceLab/iosono4Live>
  - <https://github.com/ArtScienceLab/iosono4MaxMSP>
- OSC command: send the following at 100hz to the core port **4243**:

```
/iosono/rendererversion1/src channel sourcetype theha phi r volume lowpassfilter delay scaling screen spread trait
```

Input channel (int)	type (int) 4 = point 5 = plane	Angle Radians! (float) -3.14 -> 3.14	Radius Straal Float 0.0 -> 10.0 'meters'
---------------------	--------------------------------------	--	---

Set volume to 1.0 (float)  
 Lowpass to 0.0 (float)  
 Delay to 0.0 (float)  
 Scaling to 0 (int)  
 Spread to 0.0 (float)  
 Trait to 0 (int)



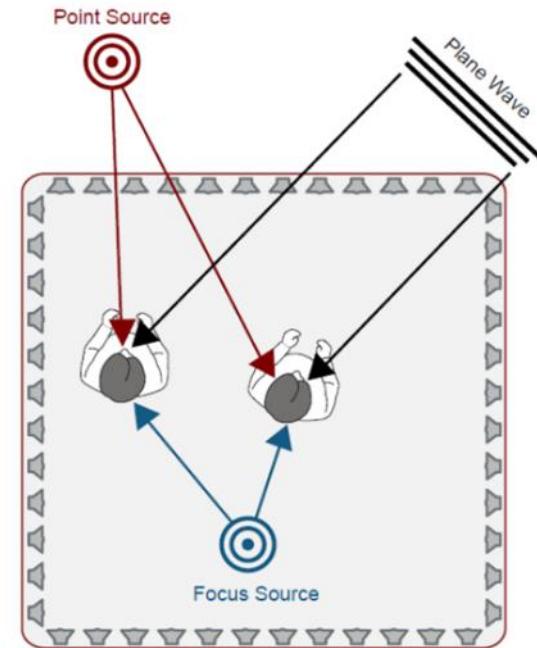
$$x = \rho \sin \varphi \cos \theta$$

$$y = \rho \sin \varphi \sin \theta$$

$$z = \rho \cos \varphi$$

$$\text{Radians} = \left( \frac{\pi}{180} \right) \times \text{degrees}$$

$$\text{Degrees} = \left( \frac{180}{\pi} \right) \times \text{radians}$$





## Part 5.14: Cable Management

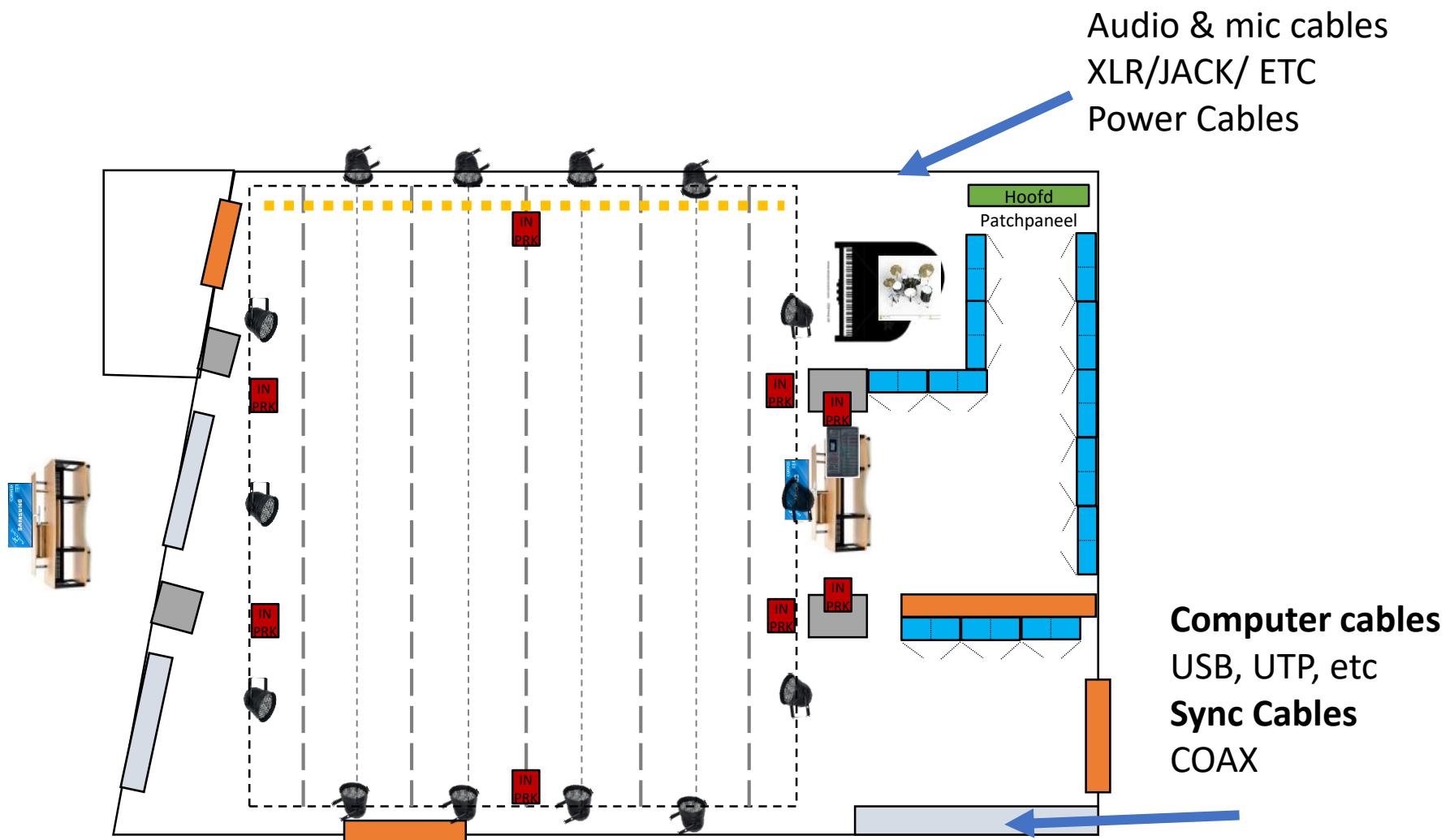
# How to roll up a cable

# Cable Rack

- Place cables back after usage
- 2 sides ...



Future Idea: split audio & digital cables



# PART 6

## Hands-on session

