



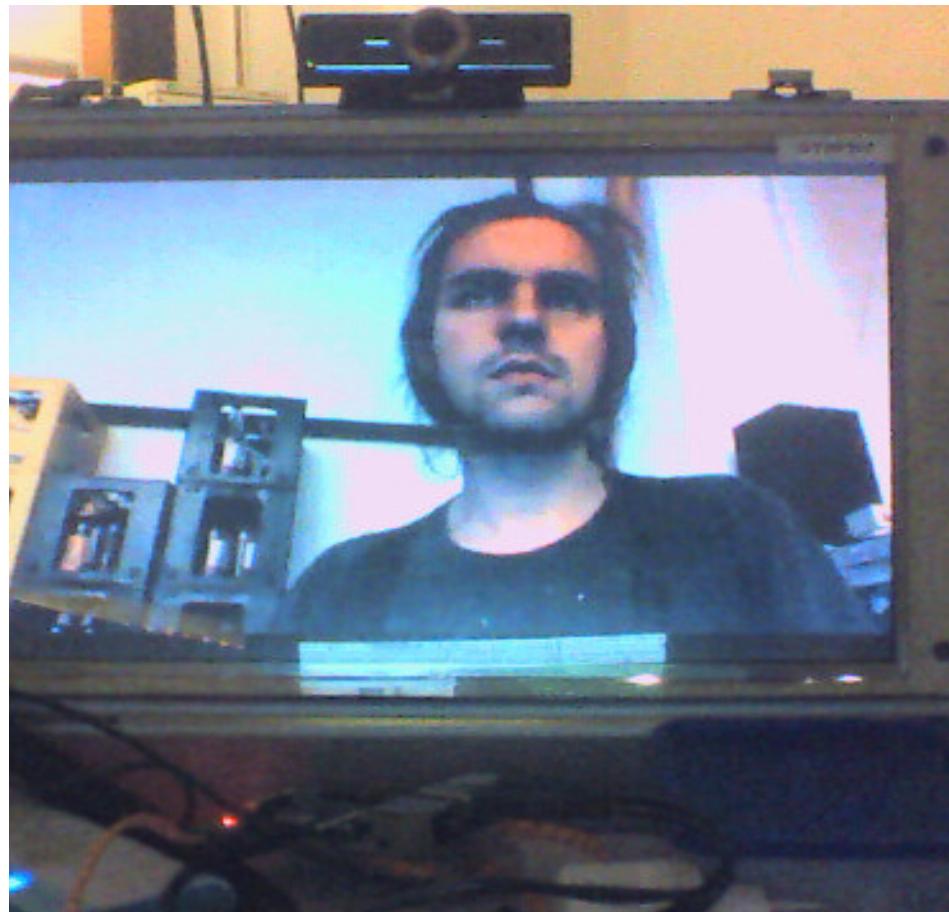
Blinkenwalls, Electronic Windows, and other "magical" portals

Liberating Telepresence from the Conference Room

strfry & zoff at ToxCon 2018 12.-14.10.2018



About Us



@strfry

**Software Engineer,
Hardware Hacker and
Raspberry Pi Enthusiast**

**Built Experience from
Linux Game Development**



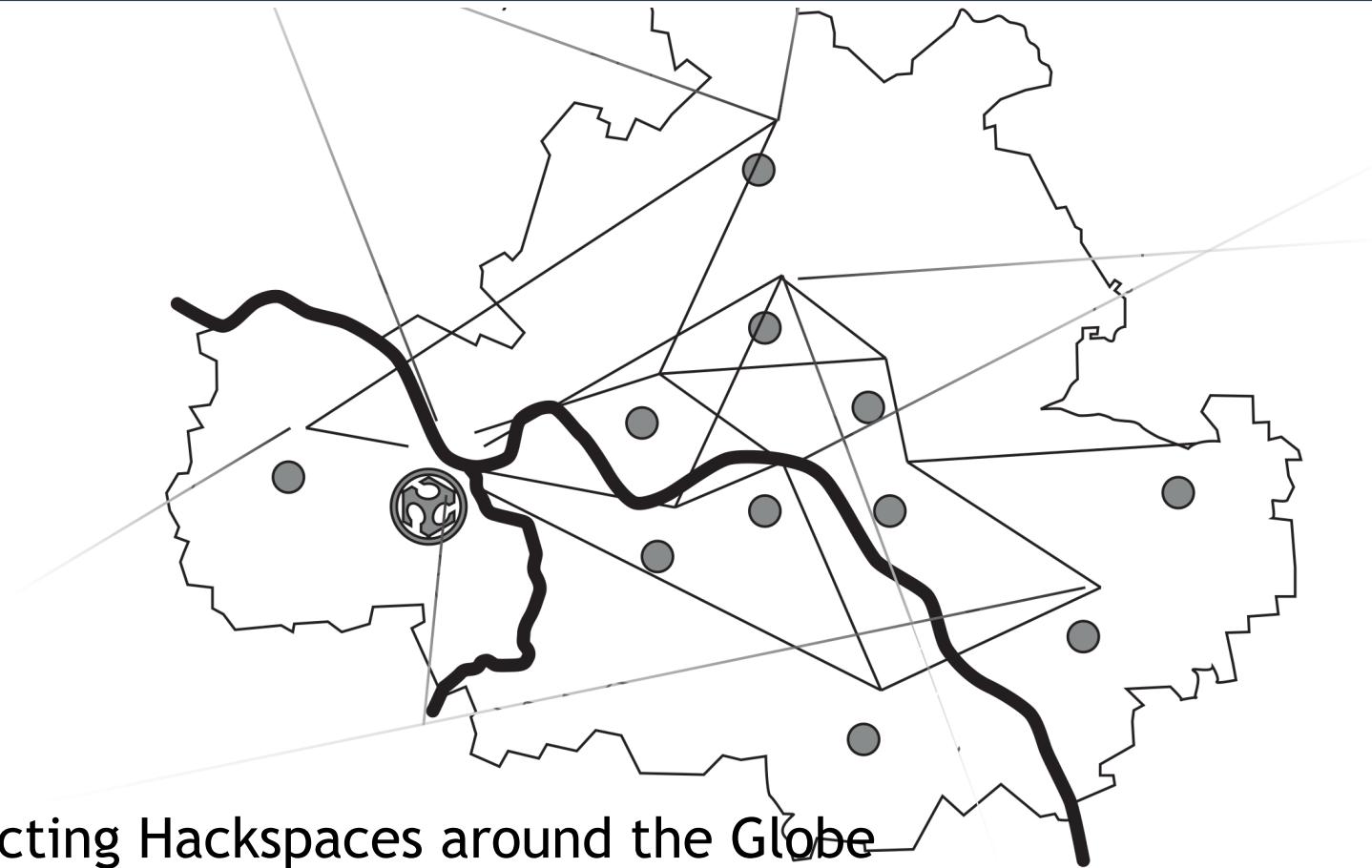
About Us

Zoff

- Programmer
- IT Worker
- System Administrator (Linux, Solaris)
- Projectmanager



Our Goal



- Connecting Hackspace around the **Globe**
- Interconnect Hackspace, as well as non-technological collaborative spaces



Our Goal



(Fablab Munich)

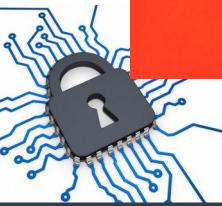


Should be easy, right?



BOM:

- Raspberry
- Camera
- Microphone
- Monitor
- Speakers
- Cables



Not so

Video

Camera support
Zero-Copy Buffers
HW Encoding

Hardware

Enclosure
Custom PCBs?
Sourcing &
Assembling

Audio

Echo Cancellation
Beamforming
Microphone Arrays

Network

Encryption
Peer Discovery
Bandwidth Management

Build

Diskless Distro
CI
Packaging

User Interface

Initial Setup
Call Setup

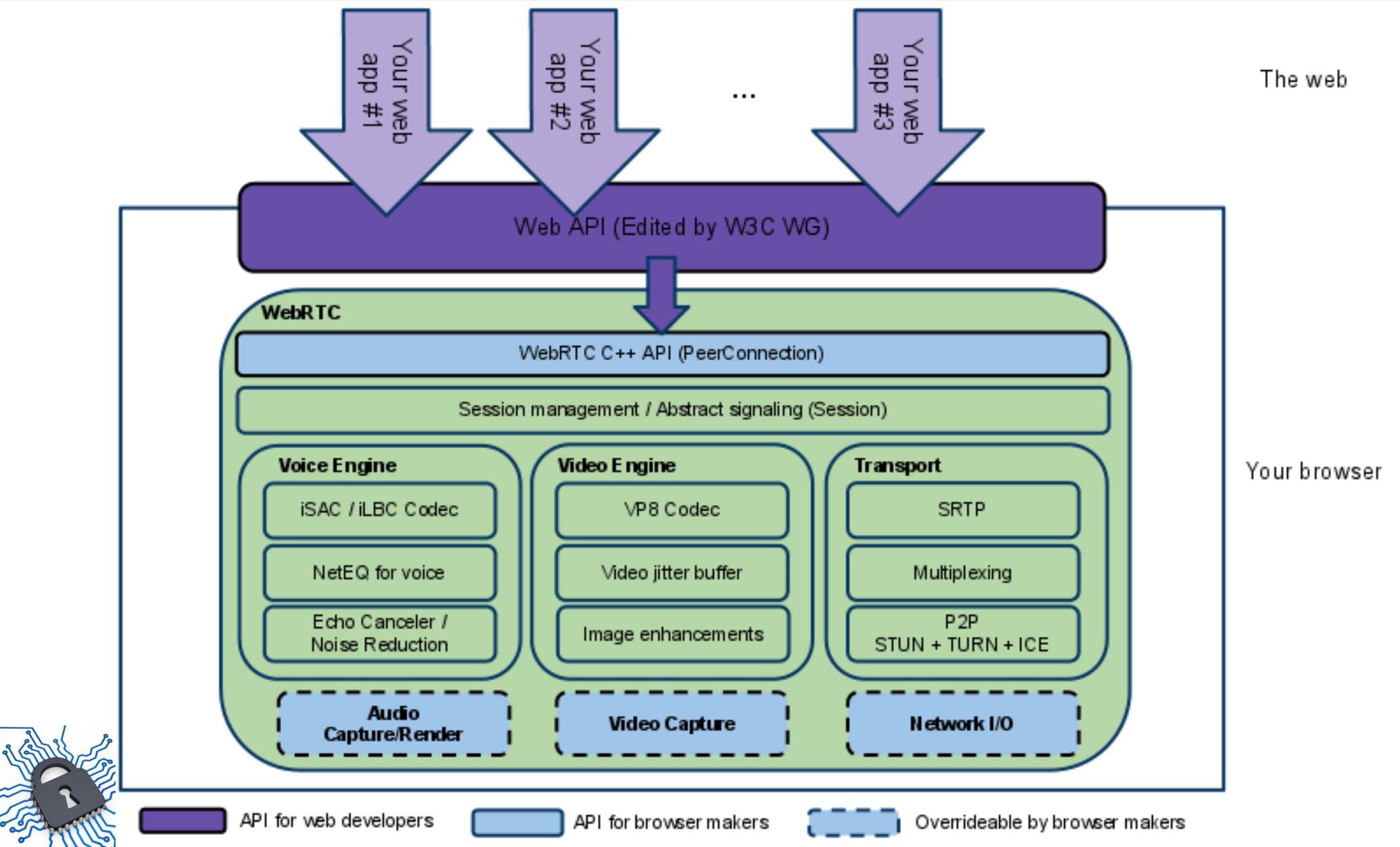


Existing Protocols

- SIP
- XMPP (Jingle)
- WebRTC
- Tox



WebRTC Stack



Video Codecs

- Old Stuff: MPEG-2, MPEG-4 (DivX), Theora
- State of the Art:
 - H.264 (aka MPEG-4 Part 10 / AVC)
 - VP8
- Next-Gen: H.265, VP9
- Next-Next: AV1, Daala, ...



H.264 Patenting Issues

- **MPEG-LA Organization sells licenses on >1000 H.264-related Patents**
 - Patents in Jurisdictions around the world
 - <http://www.mpegla.com/main/programs/avc/pages/PatentList.aspx>
- **Google et. al are pushing VP8/VP9**
- **Cisco provides license OpenH264**
- **General Fear&Doubt around the Topic**



H264 vs. VP8

VP8

Google Reference Encoder
HQ Profile @ 1Mbps, 2pass



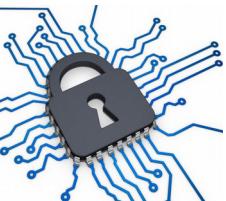
AVC

x264 r1594
Profile 4.0, 1Mbps, 2pass



Solutions to H264 Patents

- 1) Ignore the Issue
- 2) Pay royalties
- 3) Use licensed implementation:
 - Cisco OpenH264
 - Broadcom VideoCore
 - Intel QuickSync



Bandwidth Control gone bad



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Bandwidth Control

- Video Codecs don't like it when packets get lost...
- Deal with bad network:
 - Congestion => Lower Bitrate
 - Lossy Link (Wifi) => Add Redundancy (FEC)
- Recommended Talk:

„Improving WebRTC Call Quality with Machine Learning“
https://youtu.be/SIH0YD-Od_I



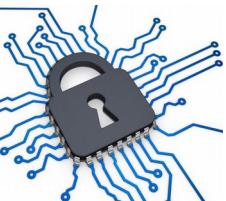
Hardware Video Codecs

- Entangled Mess of APIs:
 - PC: Vaapi, vdpa, dxva ...
 - RaspberryPi: OpenMAX, mmal, ...
 - Android: OpenMax, MediaCodec
- Bonus Points for Zero-Copy-Buffers

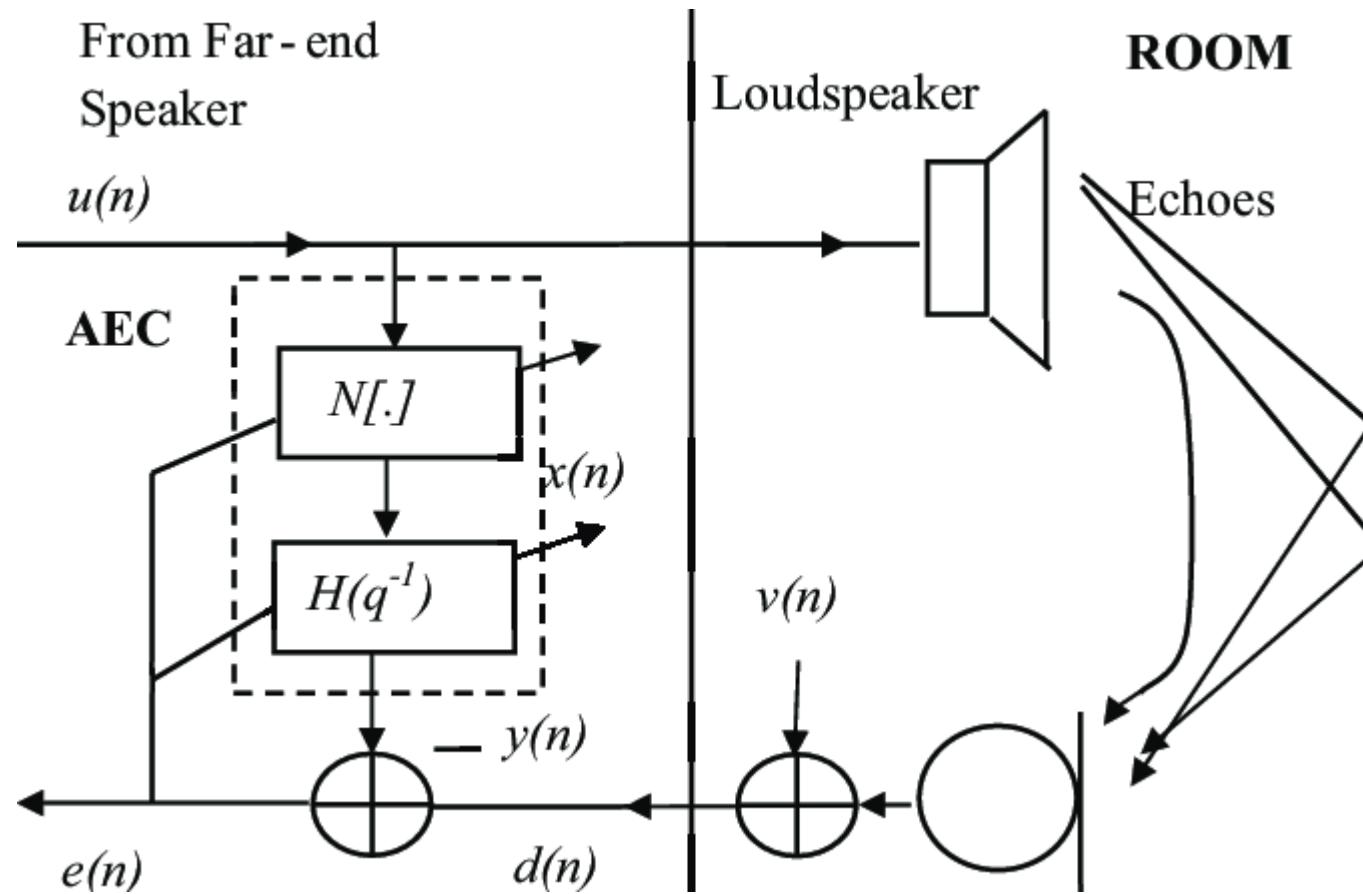


Audio Challenges

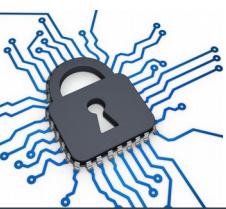
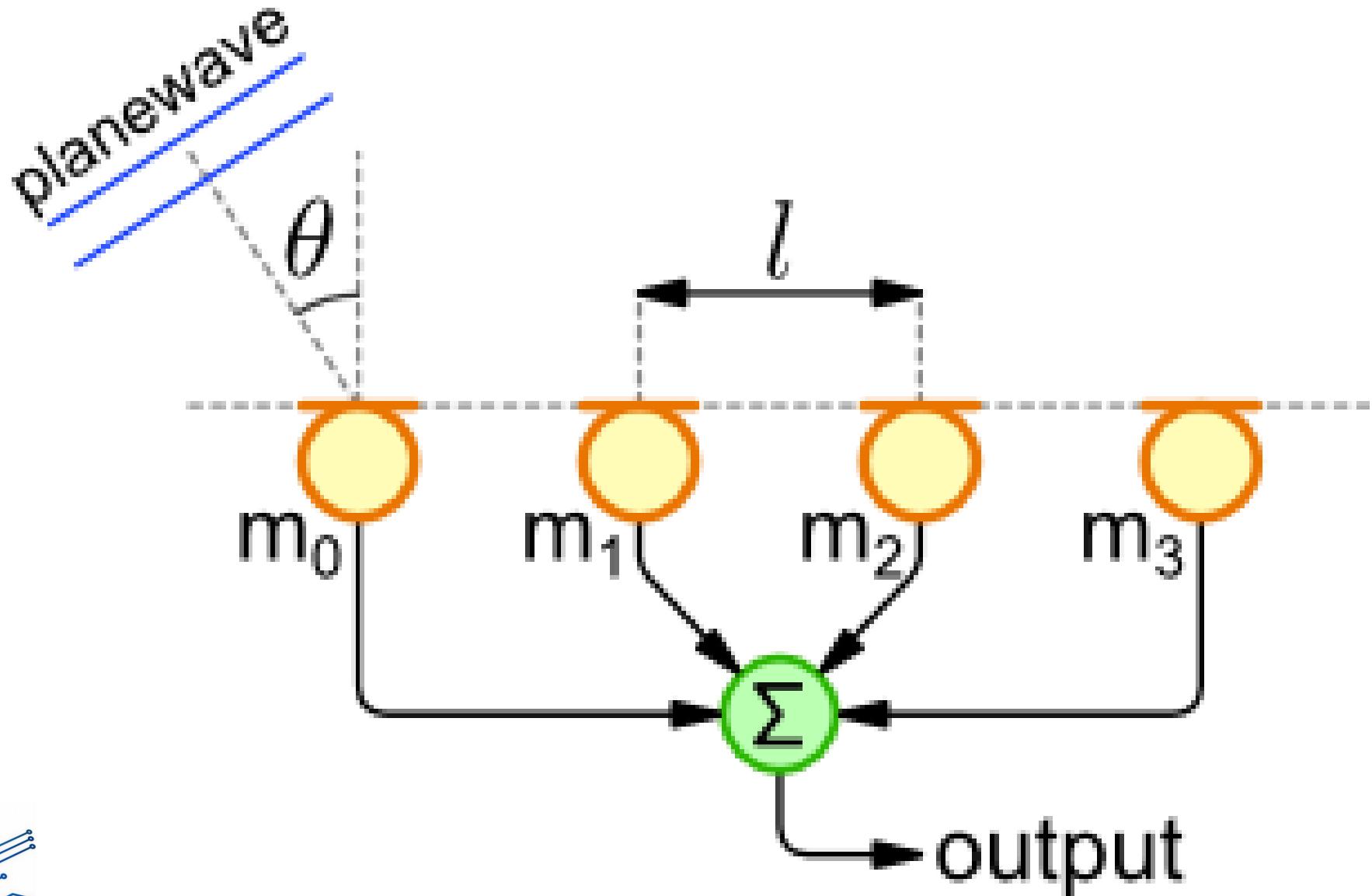
- Echo Cancelling
- Gain Control
- De-noising, De-Reverberation
- Intelligibility Enhancement



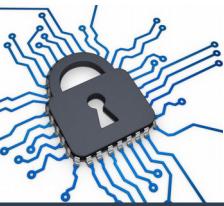
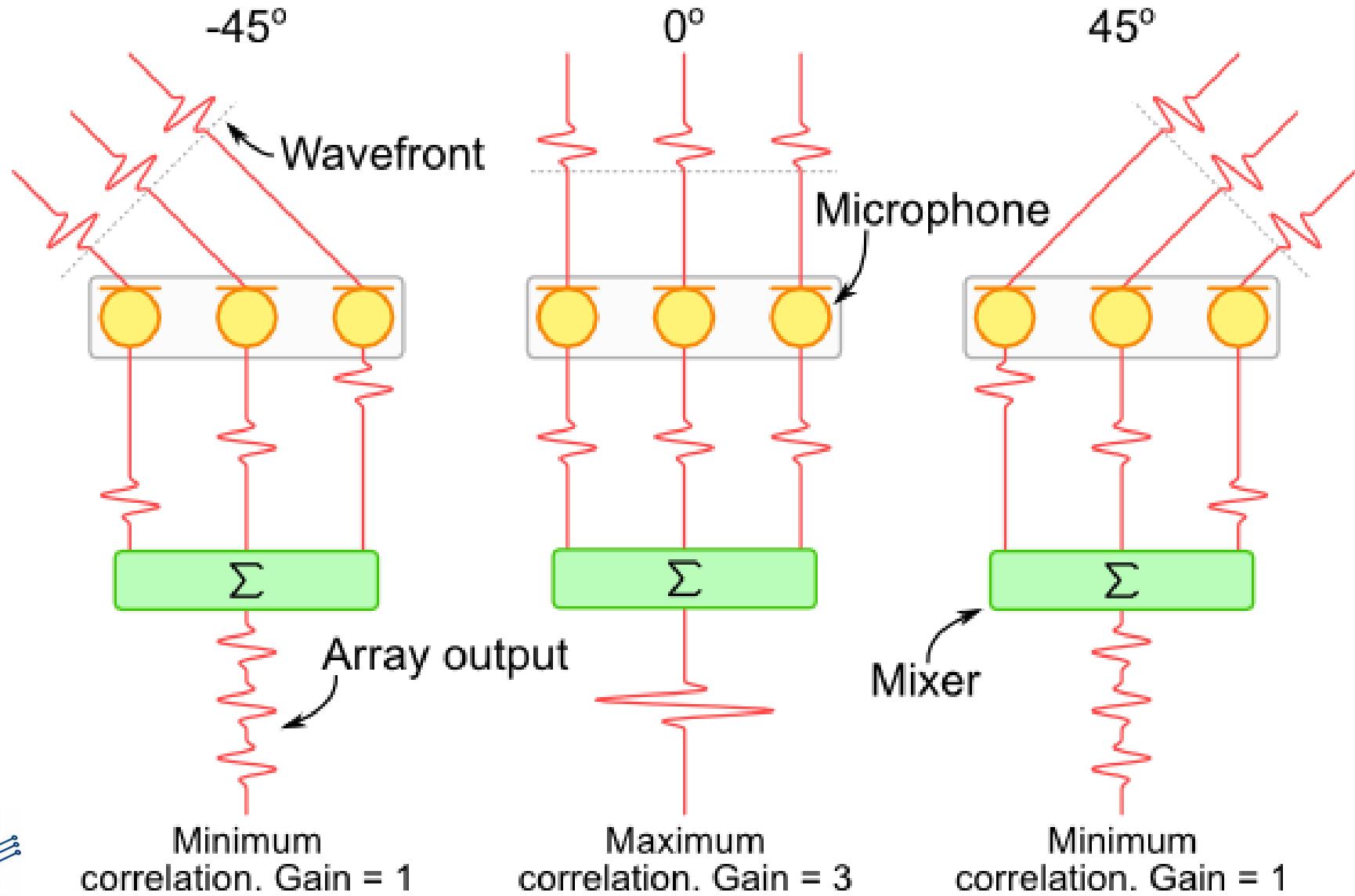
Acoustic Echo Cancellation



Beamforming

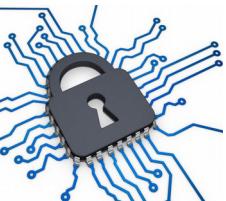


Beamforming



Existing AEC Code

- **libspeexdsp**
- **WebRTC Audio Processing**
 - libfilter_audio (by irungentoo)
 - libwebrtc-audio-processing (from PulseAudio project)
- **Proprietary DSPs...**



Speakerphones



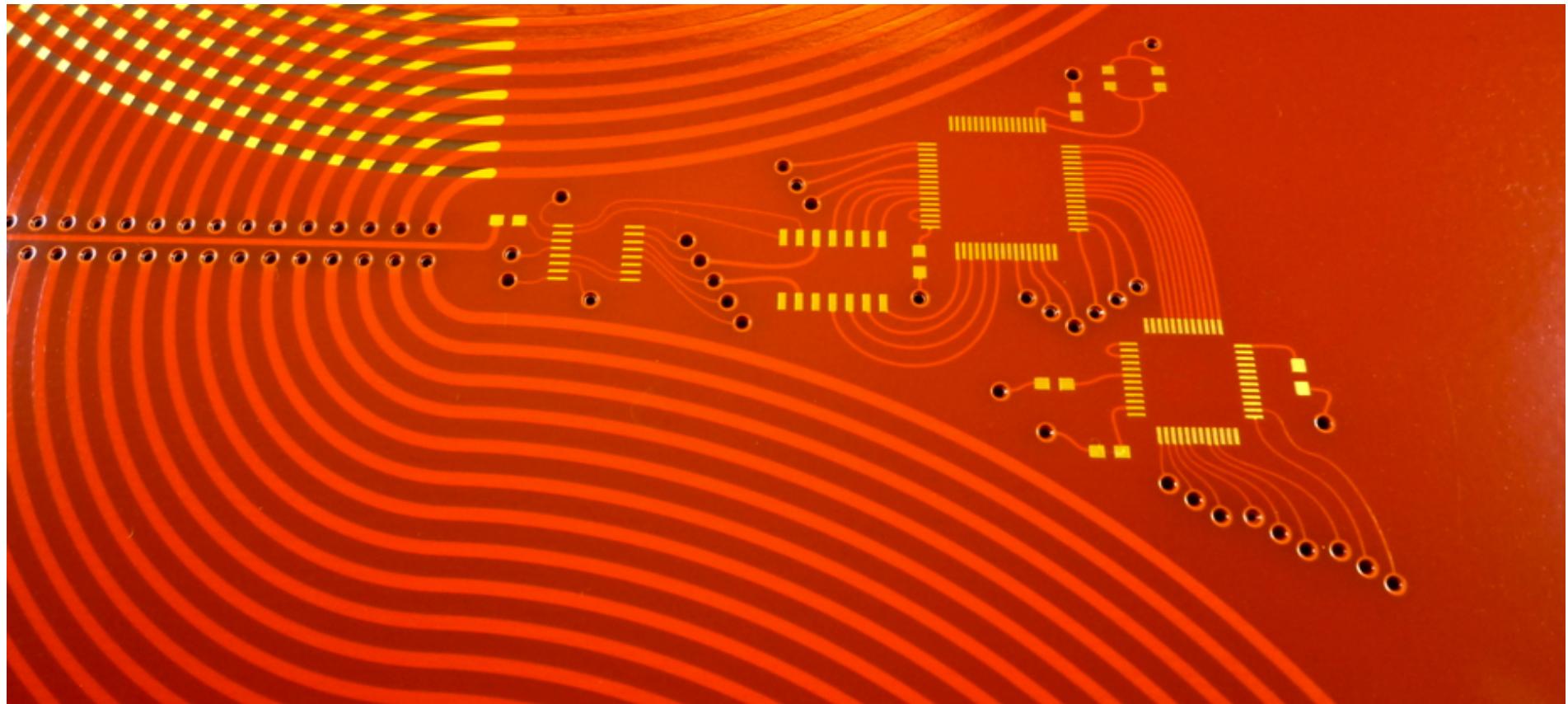
Antimatter Research Acusis



XMOS DSP (XVF3000) based



Custom Solutions?



- Part 2 -

