2nd International Symposium on Ambisonics and Spherical Acoustics, IRCAM, Paris/France

General-purpose Ambisonic playback systems for electroacoustic concerts

A practical approach

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So you are organizing a concert with contemporary electro-acoustic works?

Great!

Let's publish that call for music,
and wait for contributions.

Hmm.
This quadraphonic piece would fit right in!

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This is great, too.
Oh, it's 5.1!

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We got to have this one.
Oops –
eight speakers at irregular angles and distances?

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Whee! This one needs six speakers in a regular hexagon.

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Oops –
eight speakers at irregular angles?


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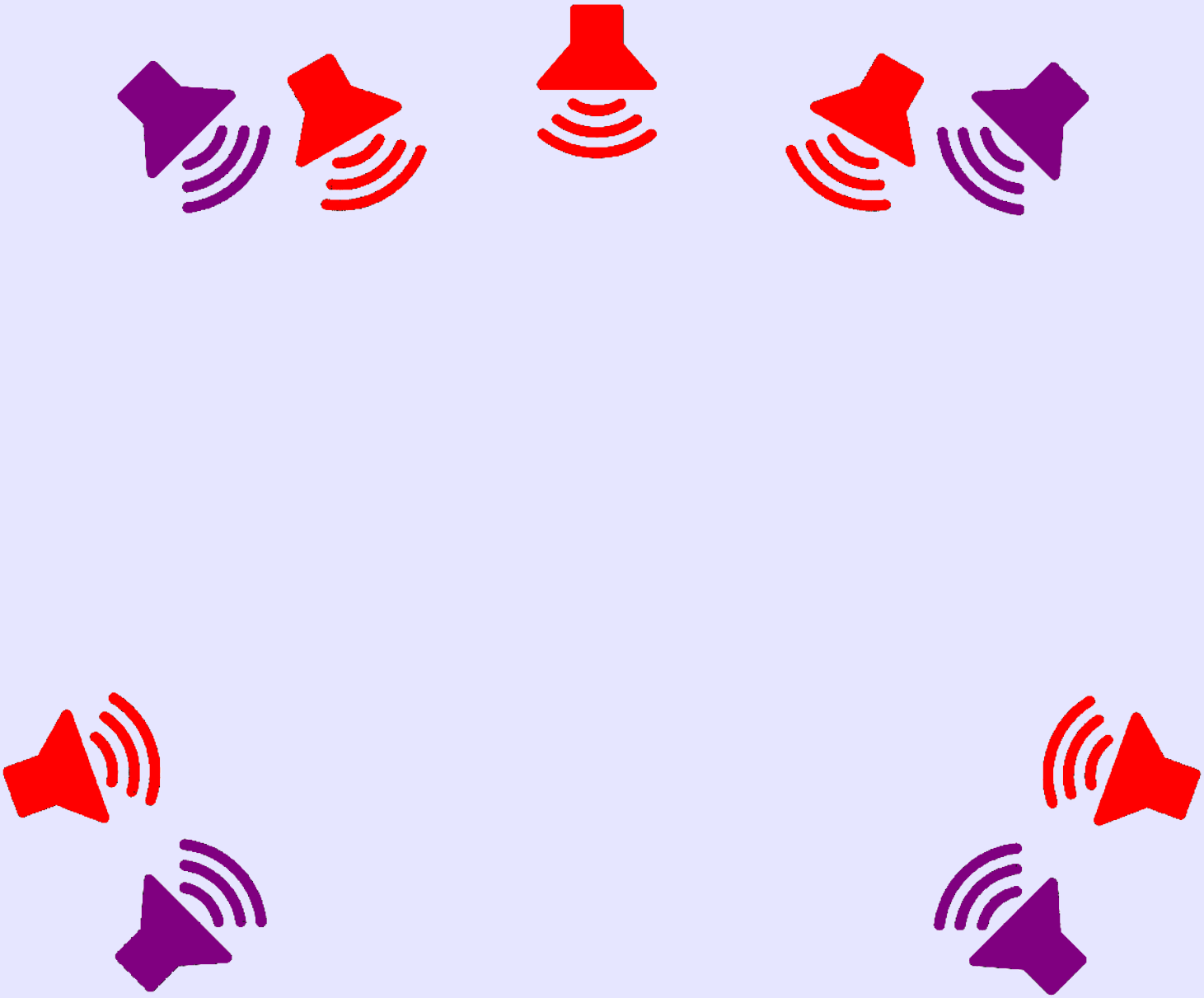
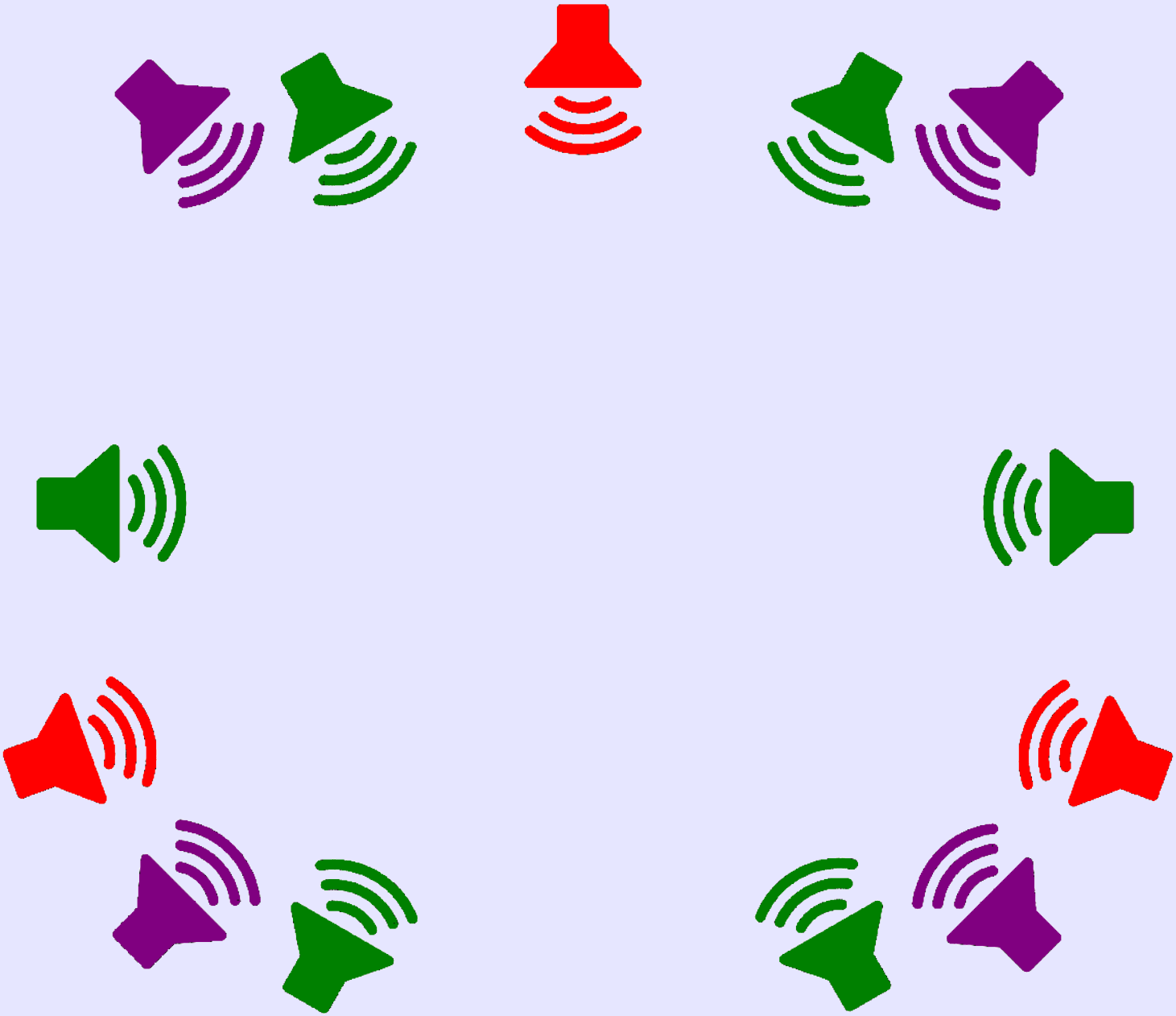
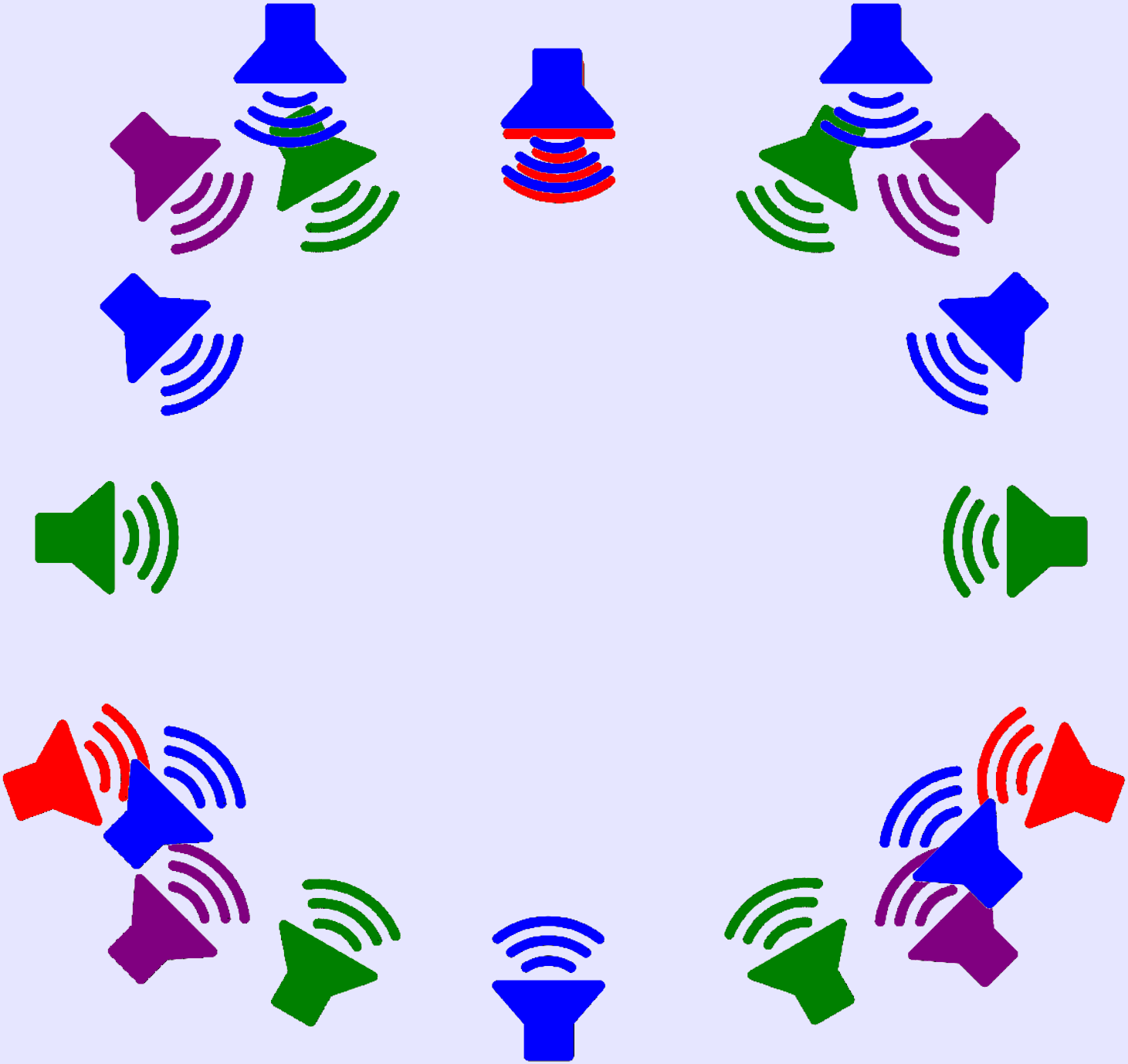
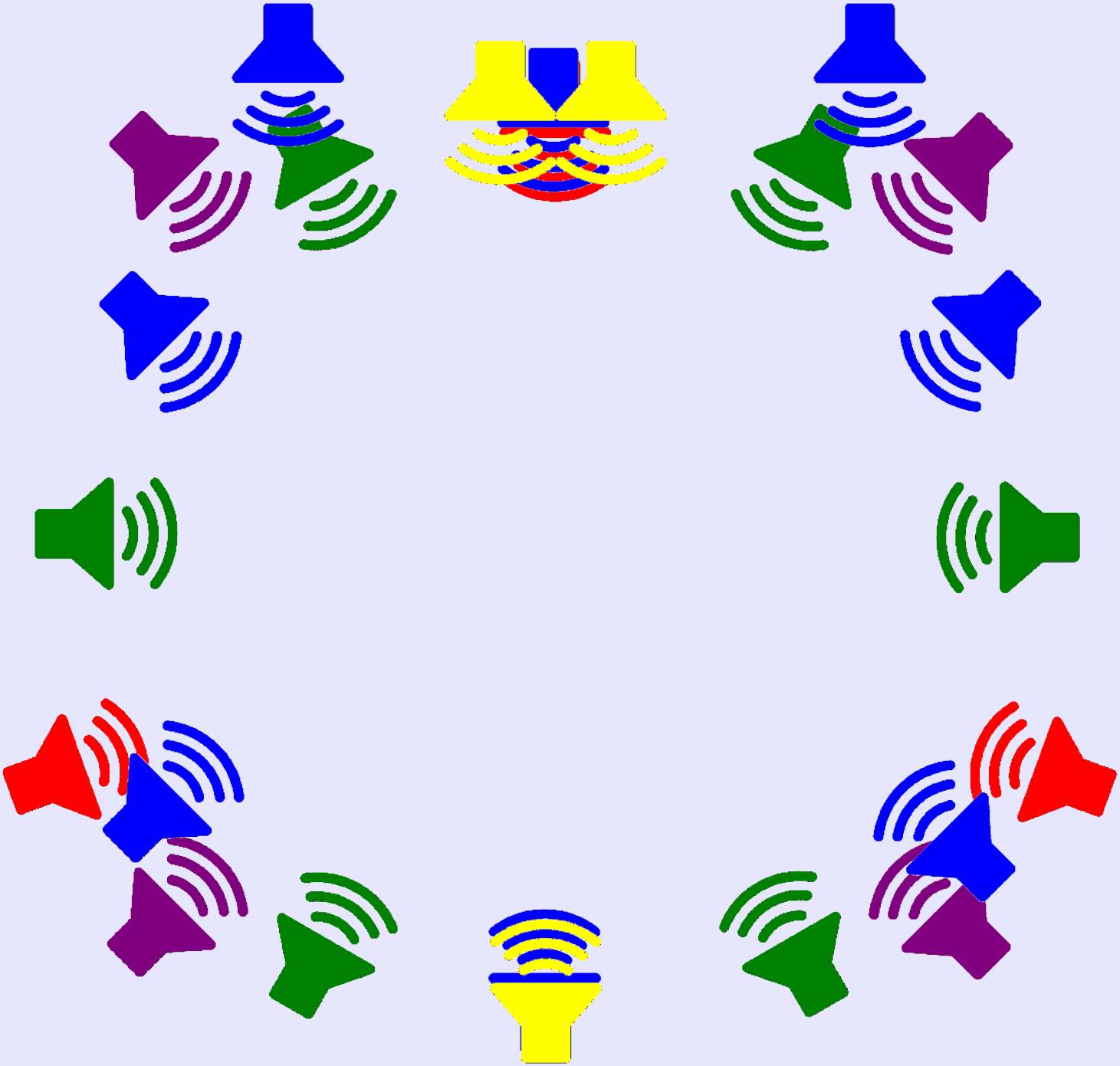
This quadraphonic piece
would fit right in!
This is great, too.
Oh, it's 5.1!
Whee! This one
needs six speakers
in a regular hexagon.
We got to
have this one.
Oops –
eight speakers
at irregular angles?
Two speakers in the front,
and one in the back? Well...



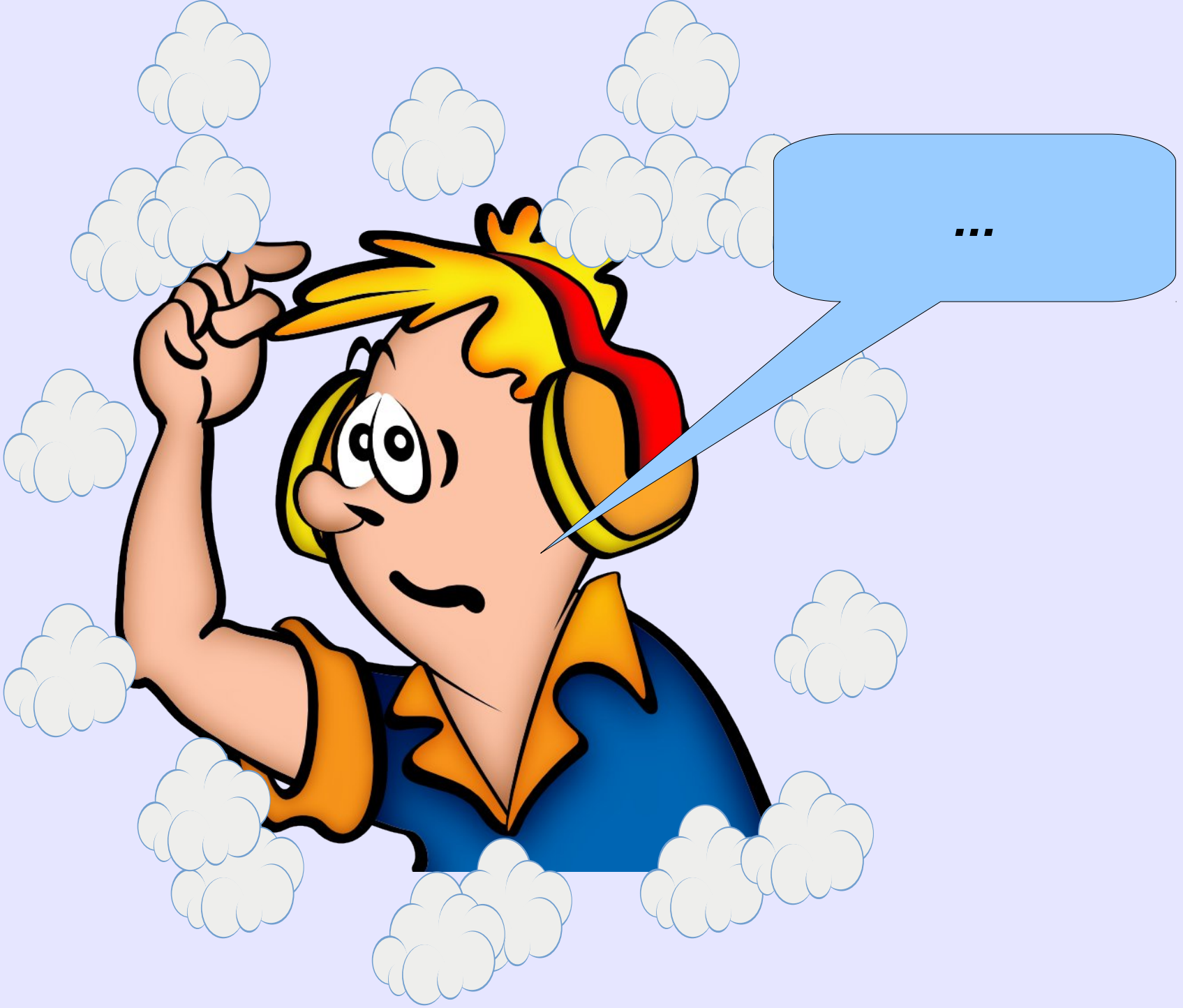







Half the show we'll be watching the crew move speakers around...


Wish I had
„virtual speakers“!



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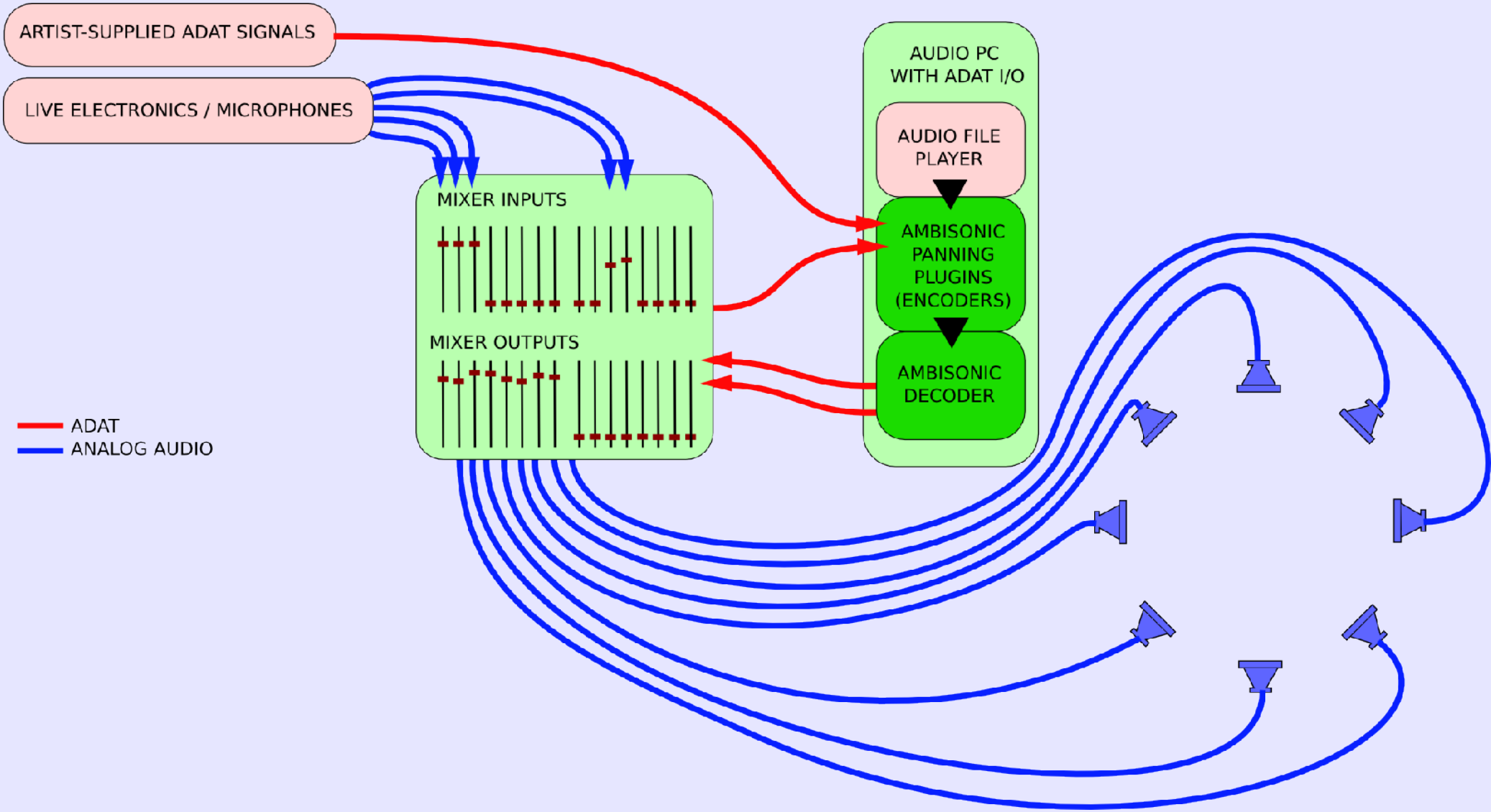
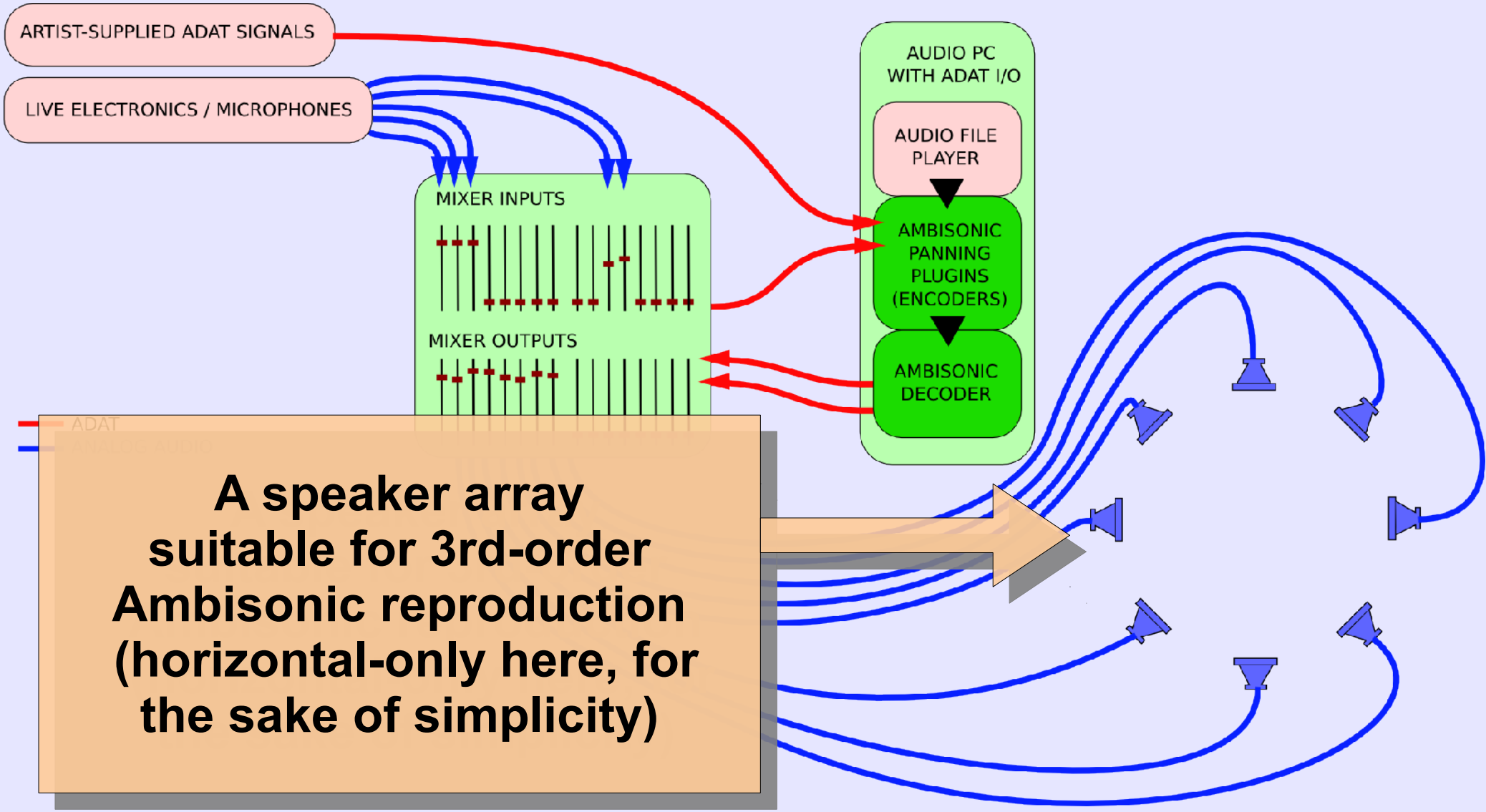
It also scales nicely to include height.

(And as a bonus, you will be able to reproduce native Ambisonic compositions at their very best.)

Components:

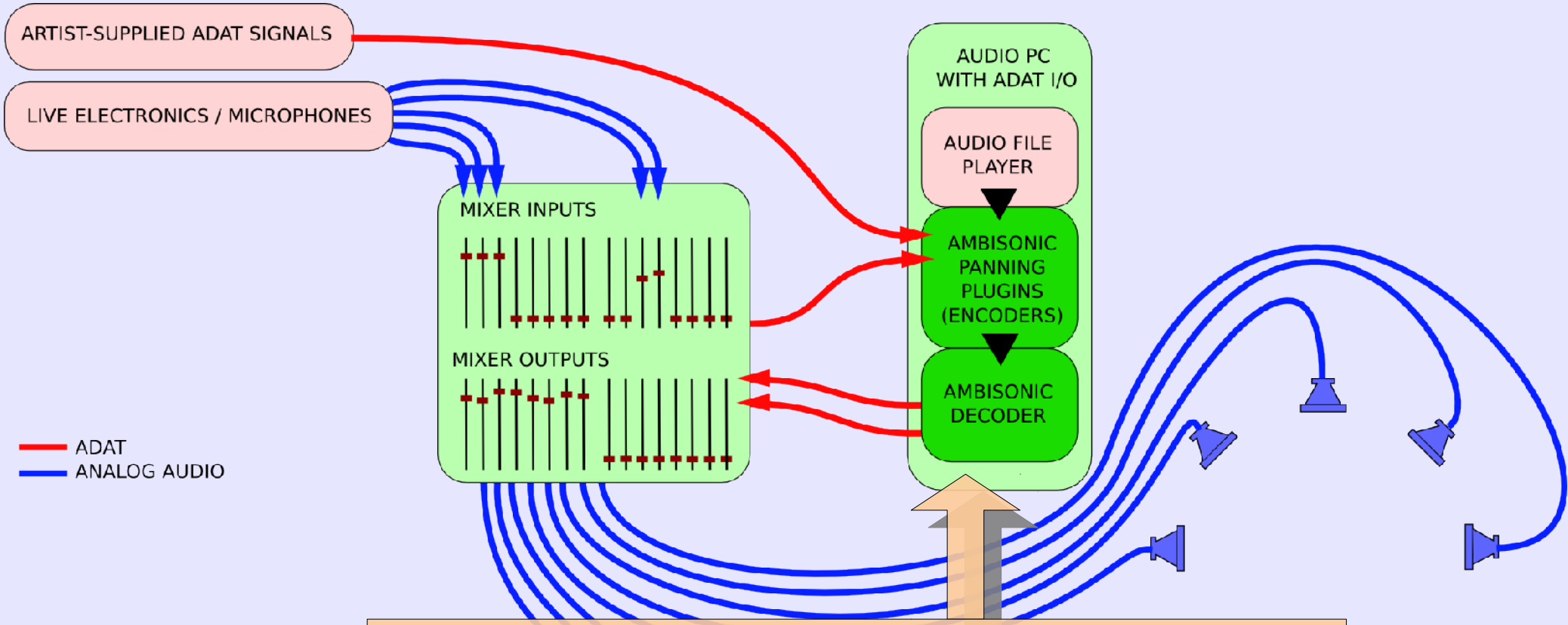

ARTIST-SUPPLIED ADAT SIGNALS
LIVE ELECTRONICS / MICROPHONES
MIXER INPUTS
MIXER OUTPUTS
AUDIO PC
WITH ADAT I/O
AUDIO FILE
PLAYER
AMBISONIC
PANNING
PLUGINS
(ENCODERS)
AMBISONIC
DECODER
ADAT
ANALOG AUDIO

Components:



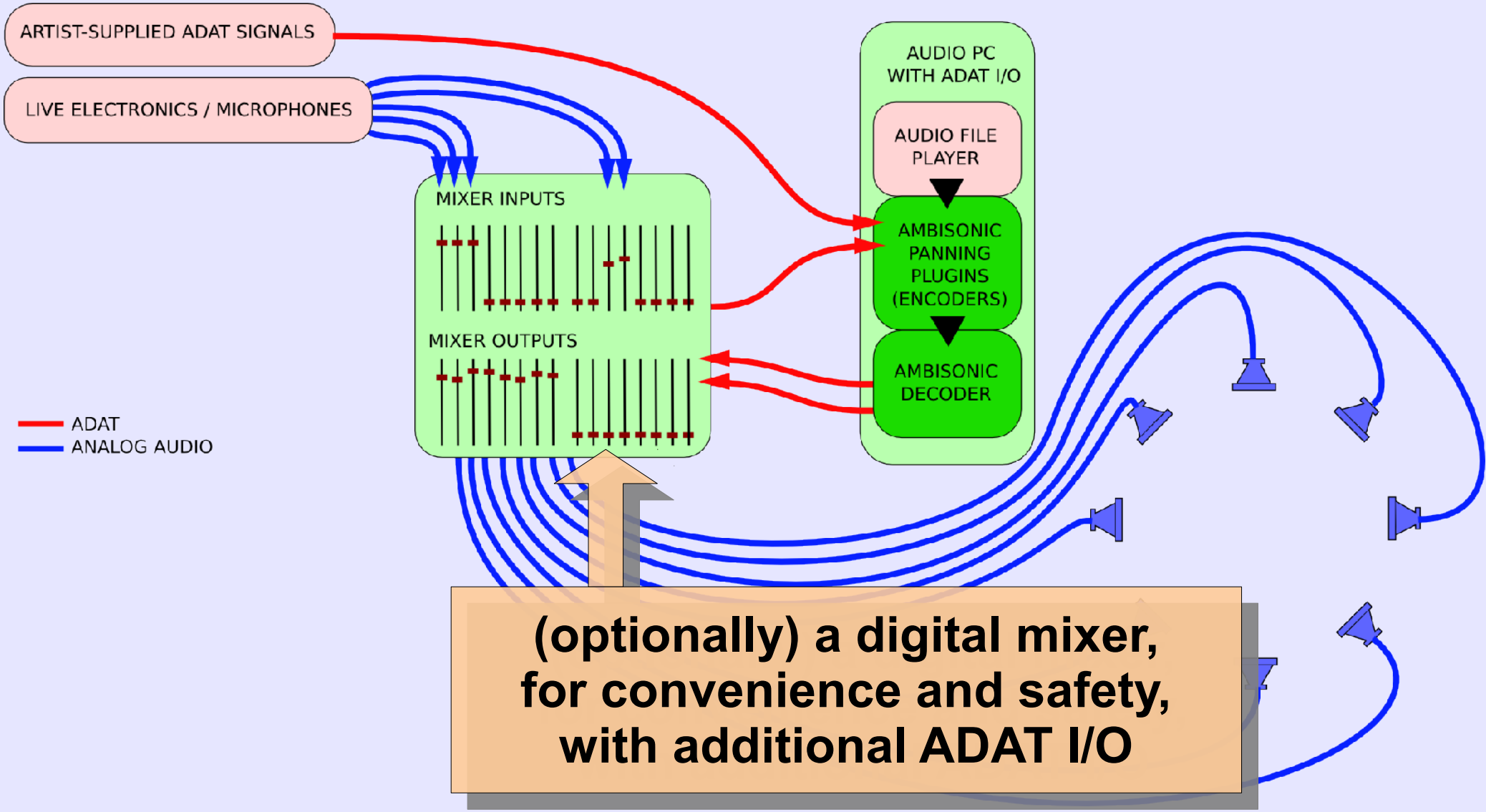
A speaker array suitable for 3rd-order Ambisonic reproduction (horizontal-only here, for the sake of simplicity)

Components:



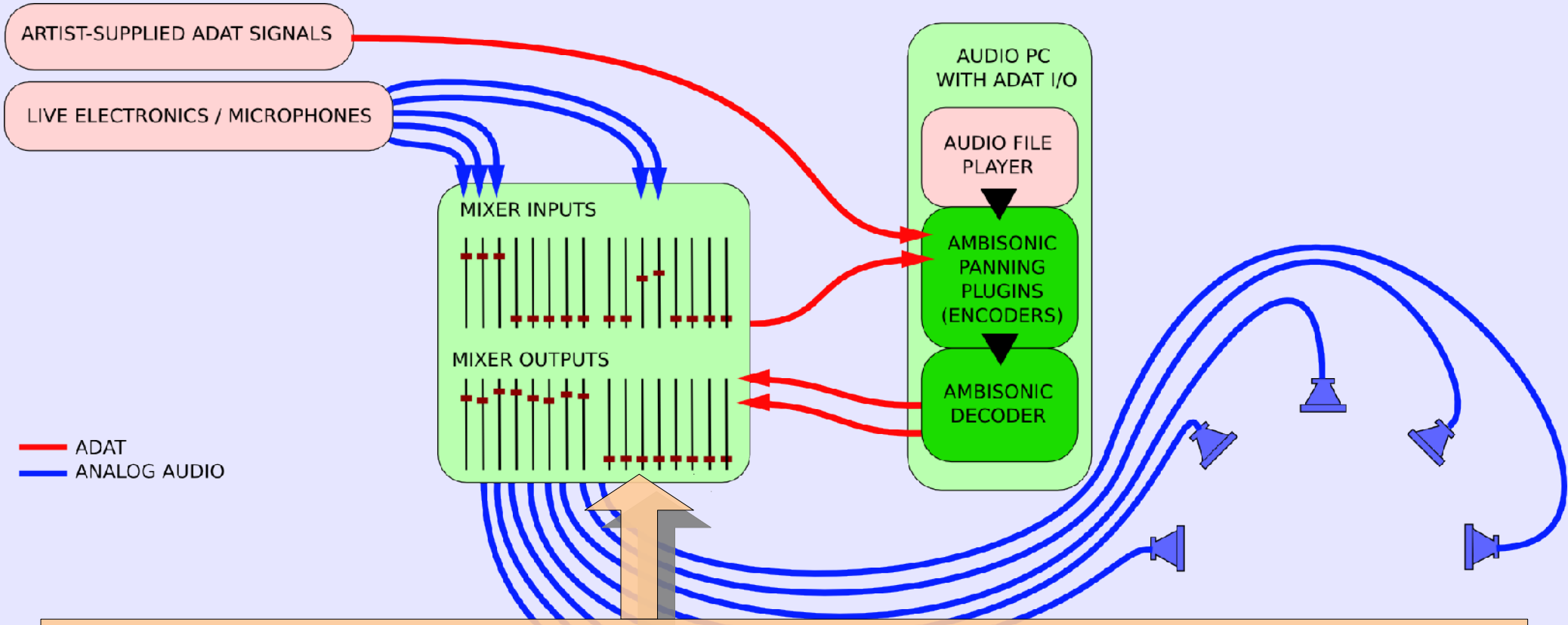
A Linux rendering PC
(or MacOS, or maybe even Windows),
with ADAT I/O,
using free software

Components:



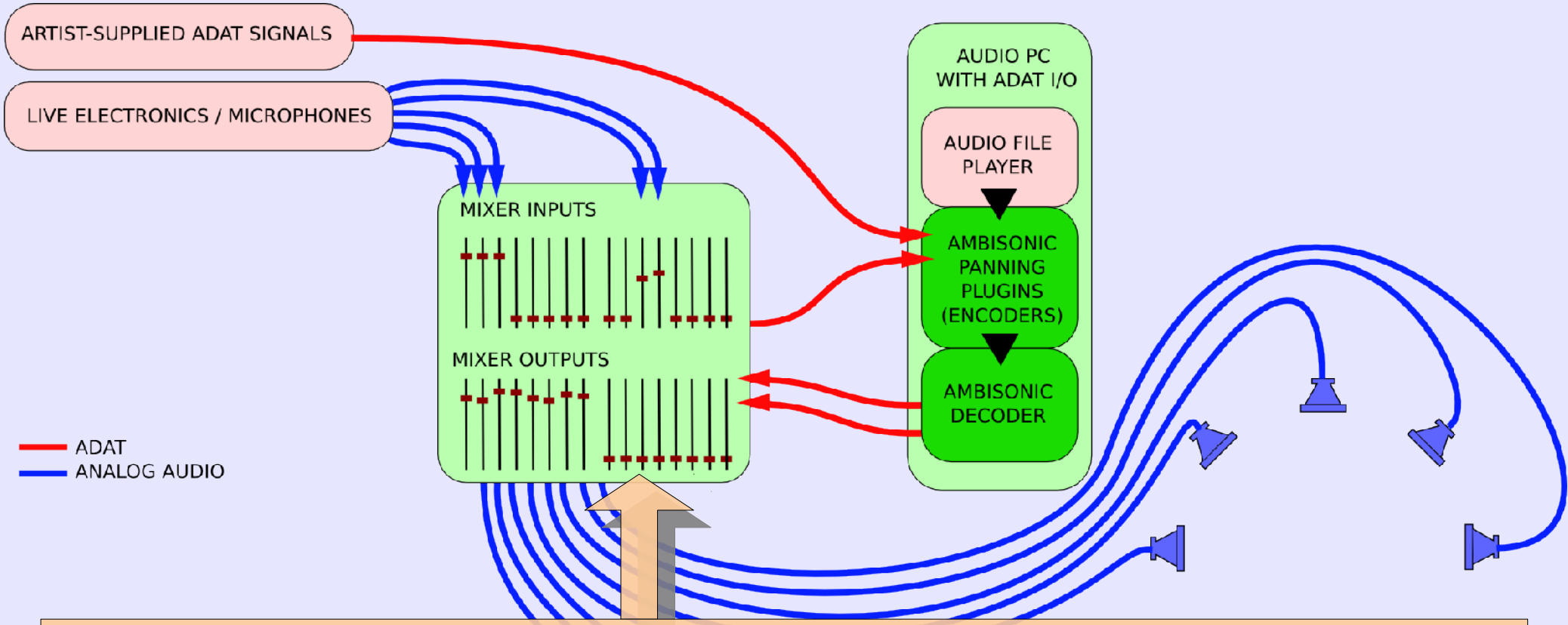
(optionally) a digital mixer, for convenience and safety, with additional ADAT I/O

Components:



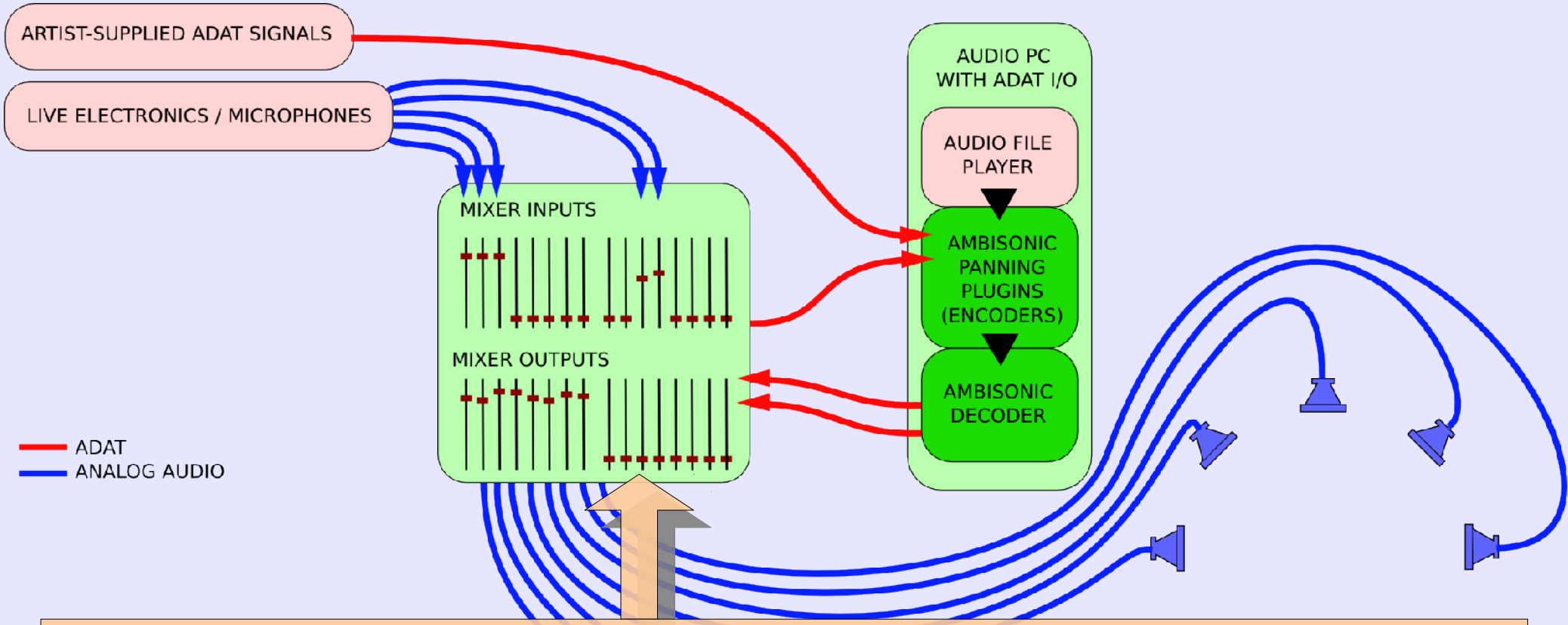
You can do without, but consider this:
If your PC gets stuck („motorboating“) or there is a sync problem, you'll get loud digital noise,
and no means to turn it off.

Components:



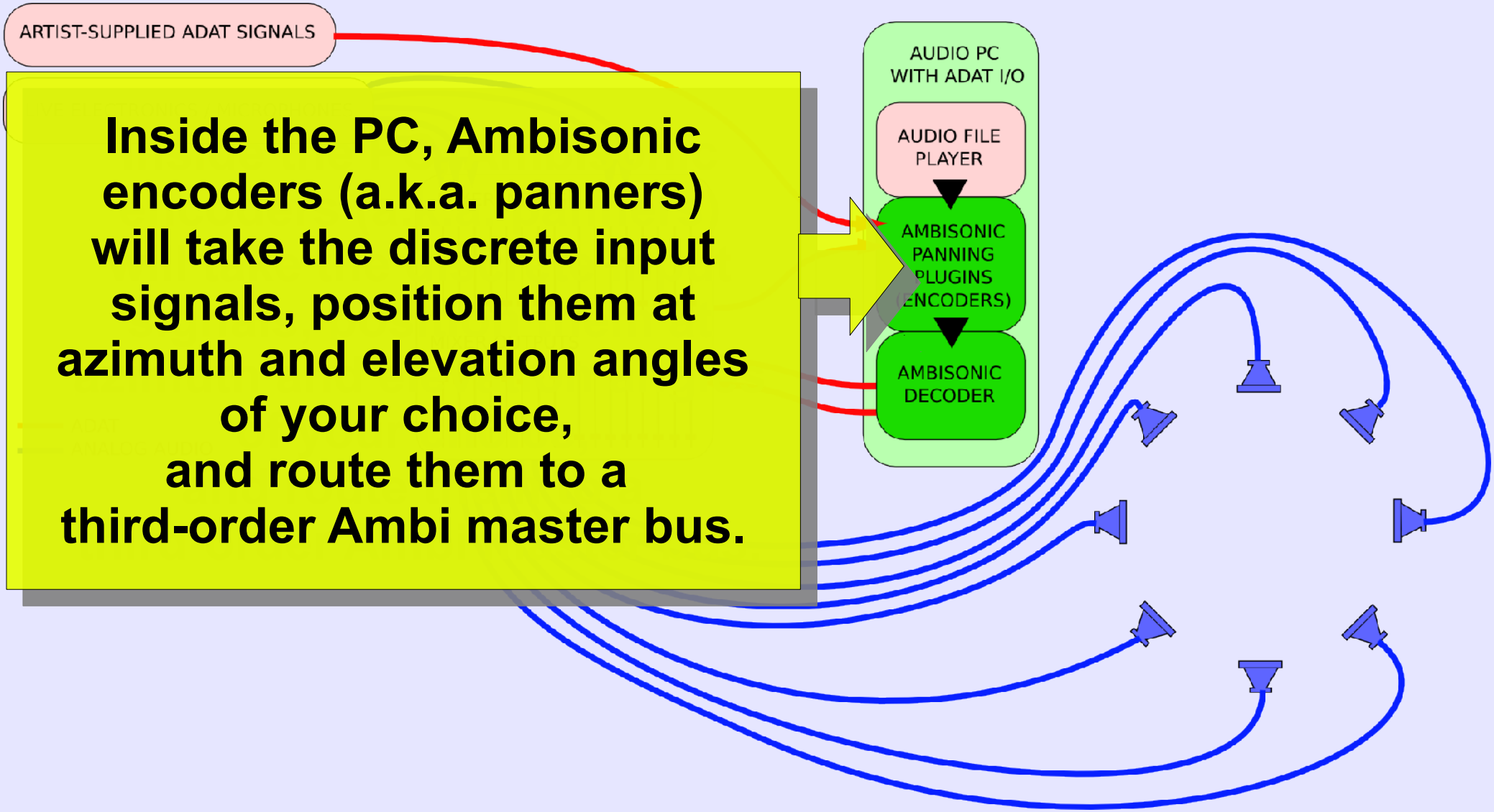
That means you're utterly hosed.

Components:



So don't be cheap, get that mixer.

Virtual speakers:



Inside the PC, Ambisonic encoders (a.k.a. panners) will take the discrete input signals, position them at azimuth and elevation angles of your choice, and route them to a third-order Ambi master bus.

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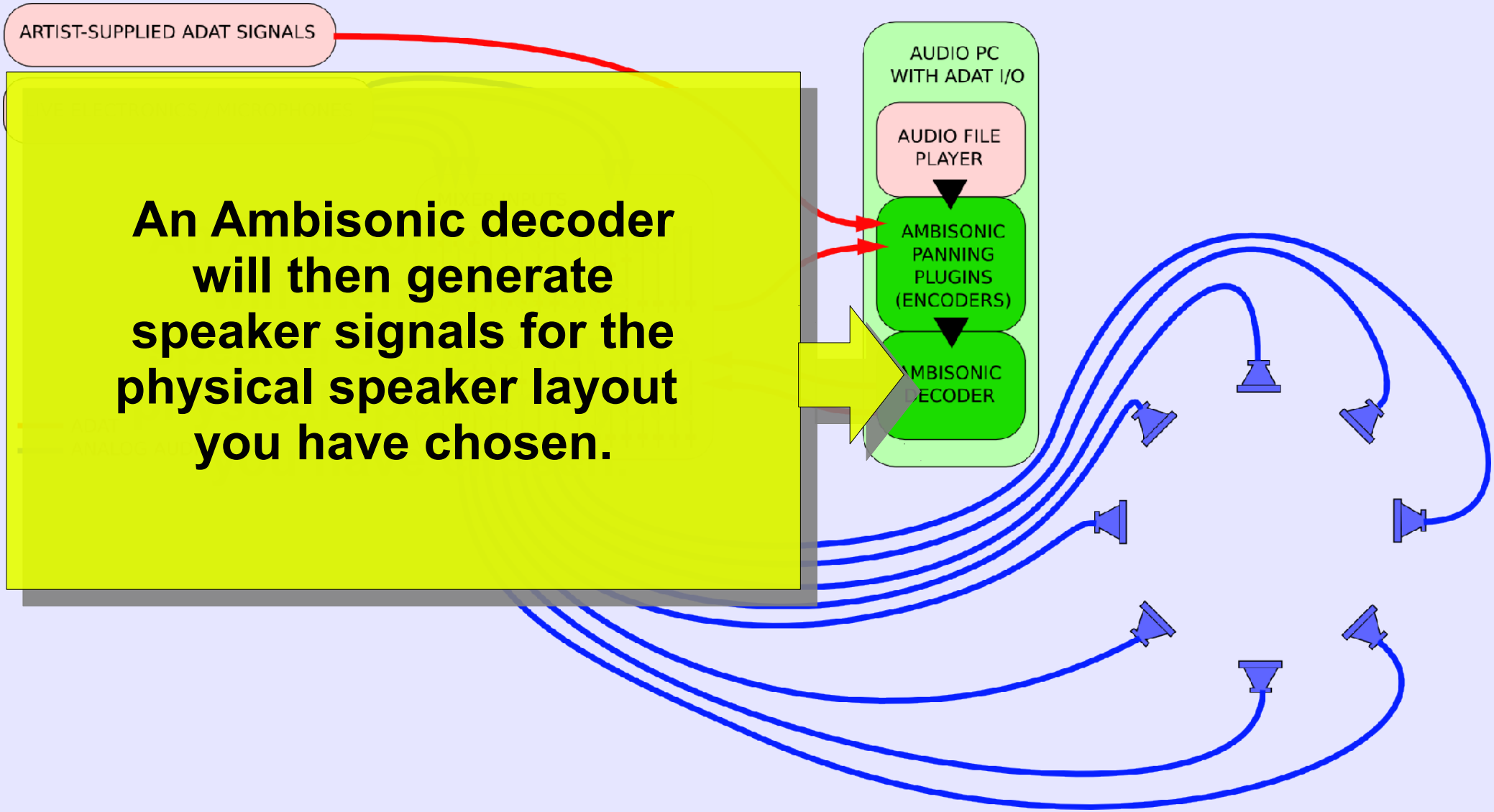

An Ambisonic decoder will then generate speaker signals for the physical speaker layout you have chosen.

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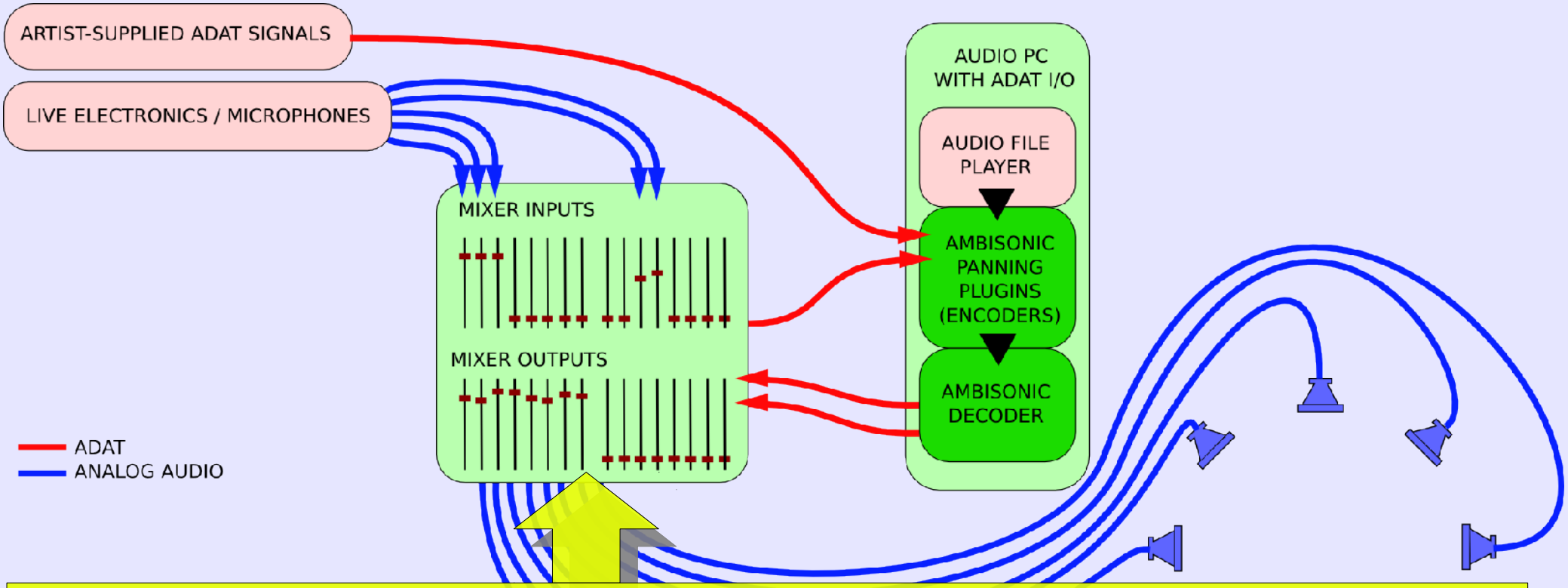
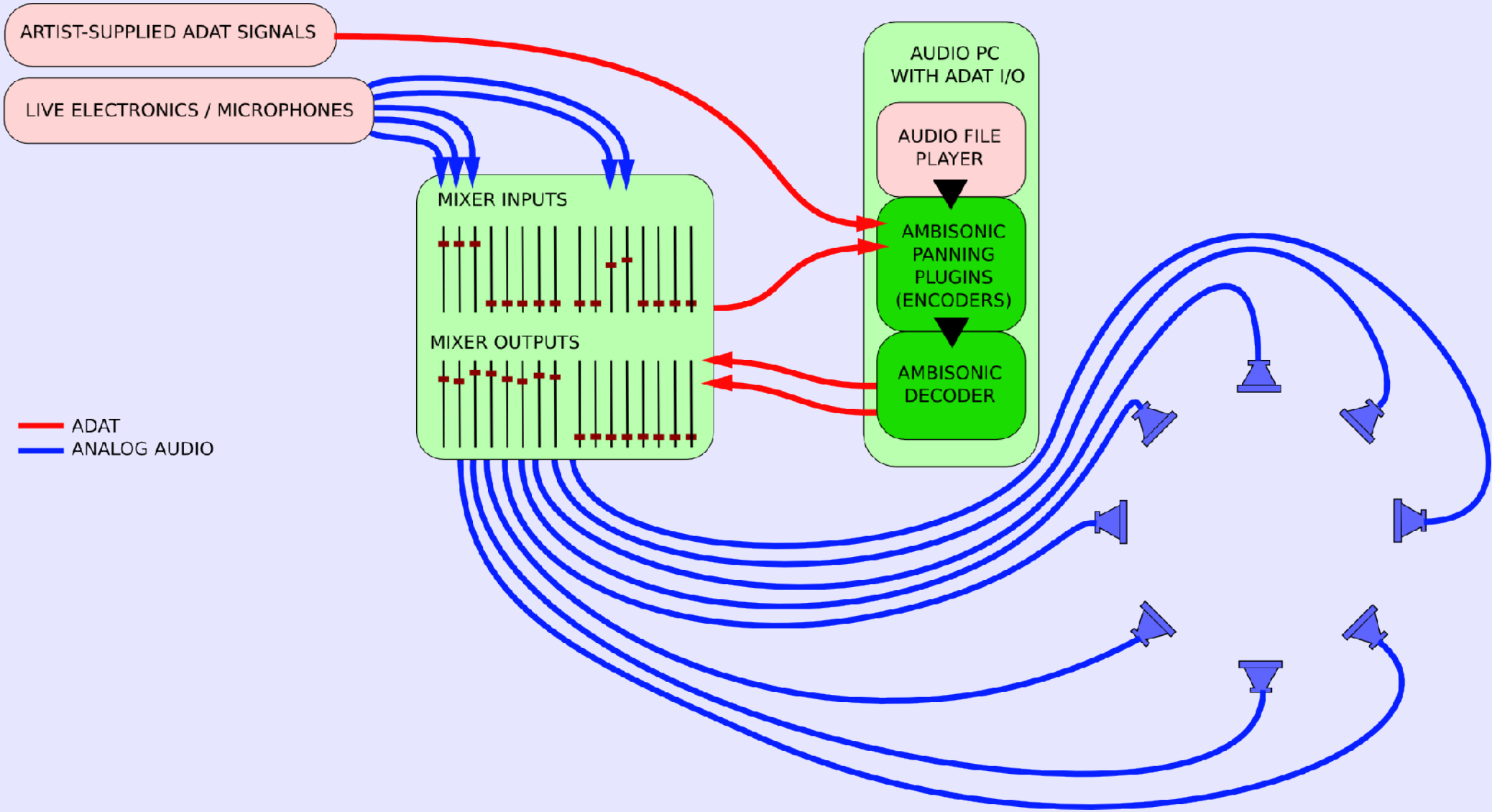


The speaker signals are routed back through the mixer, where you can calibrate each one for equal loudness, and control the master volume.

Process different sources:



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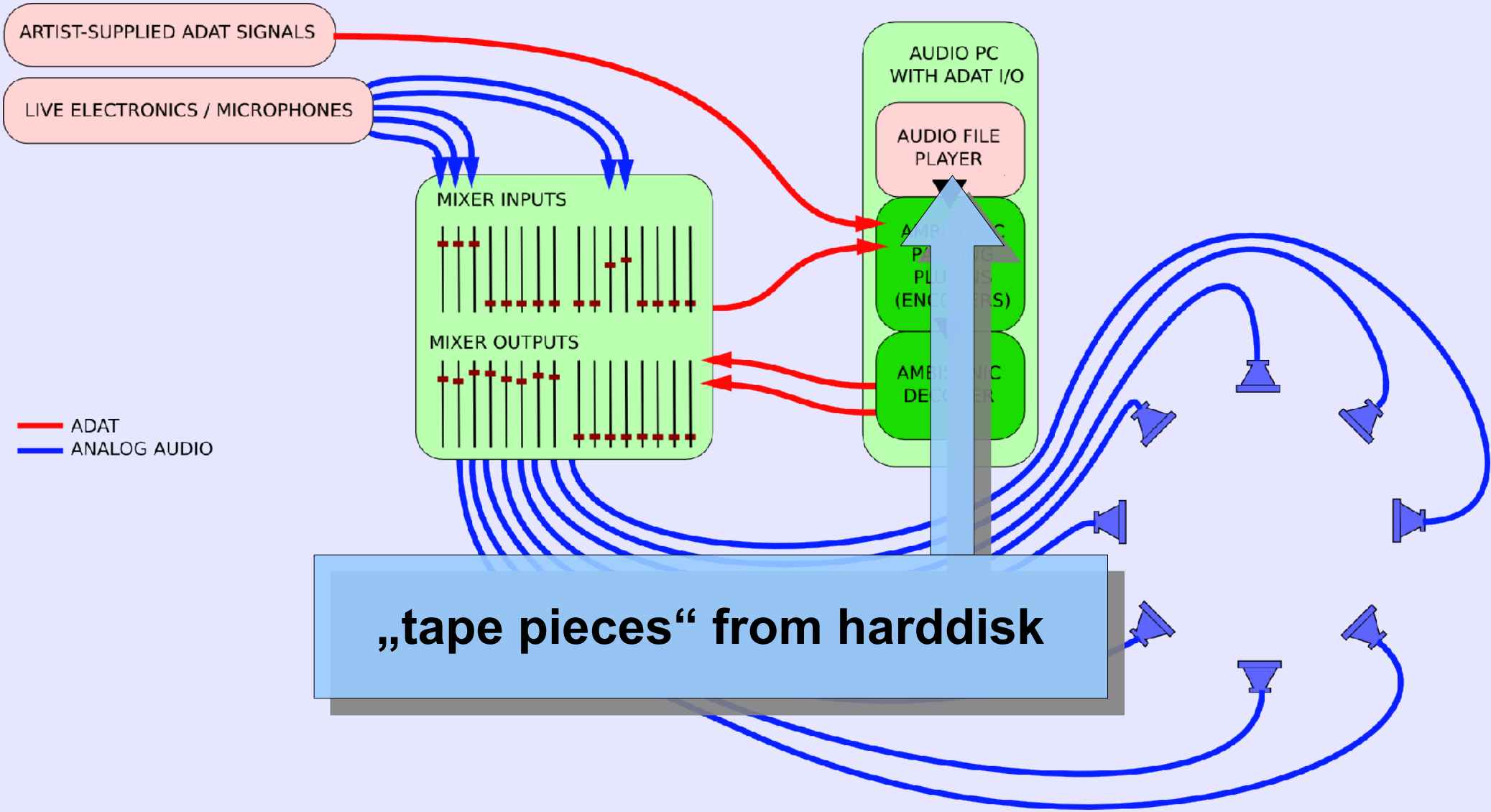

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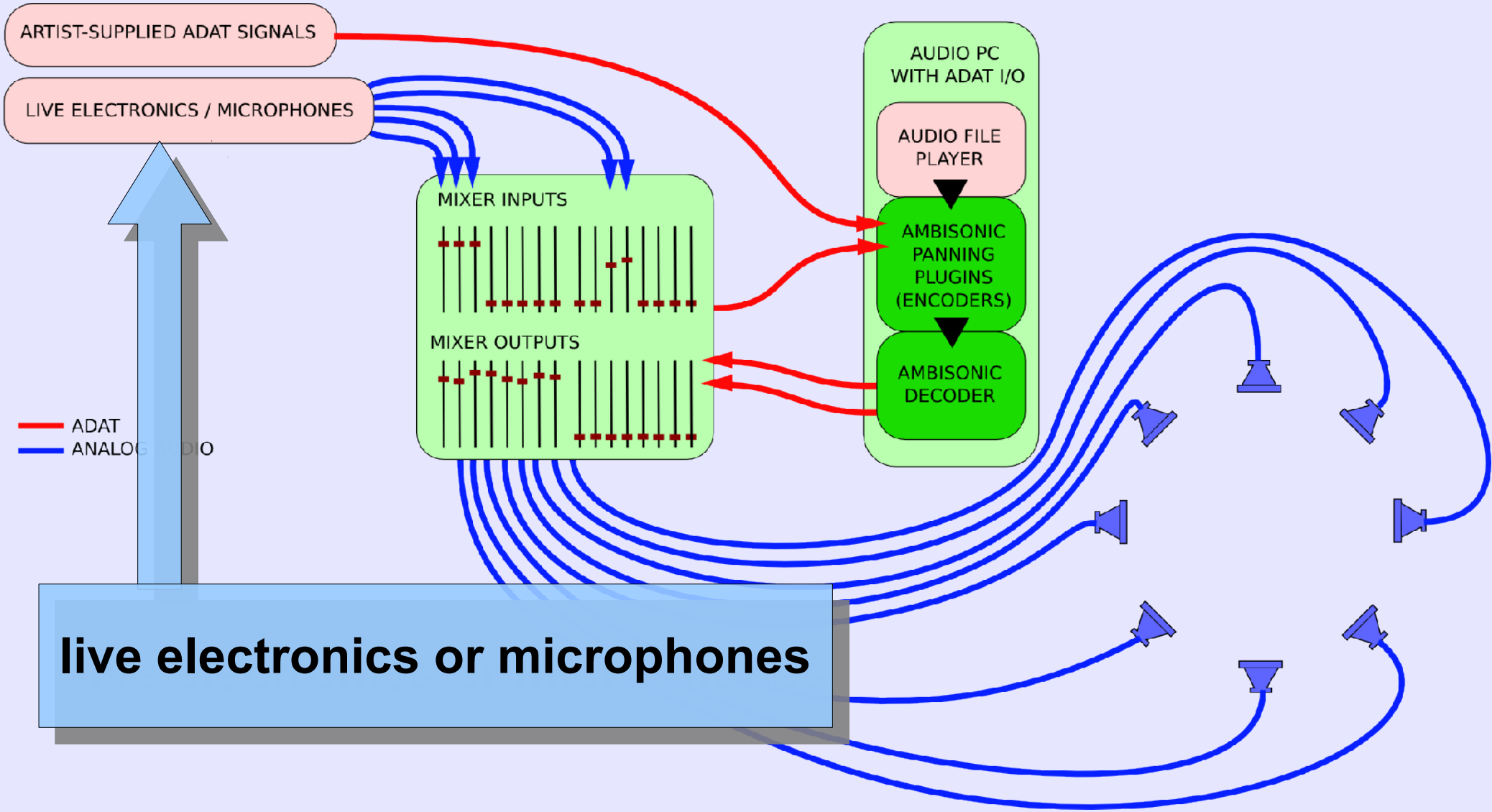

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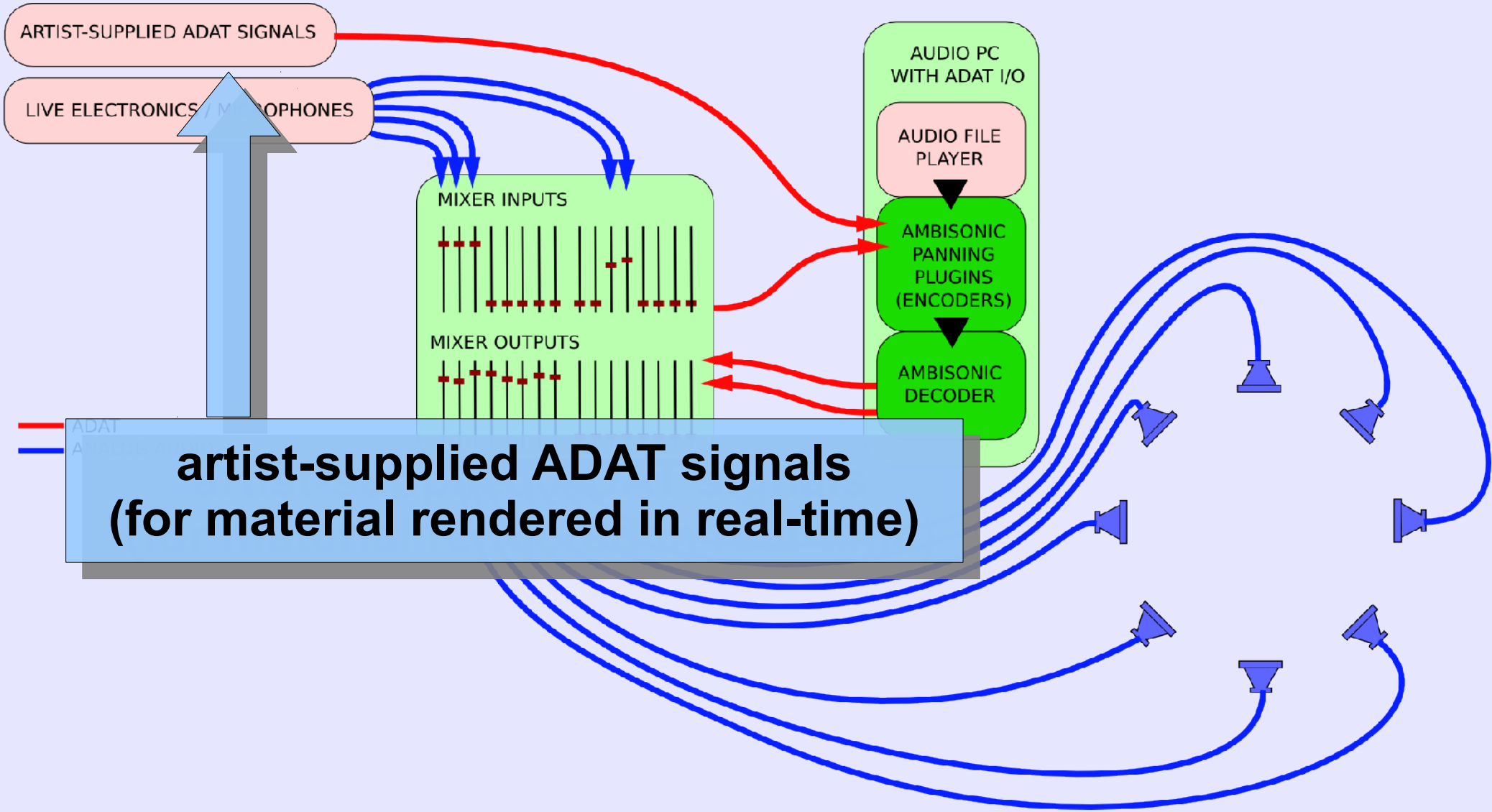

The software stack:

- Ambisonic encoding: **AMB plugin set**
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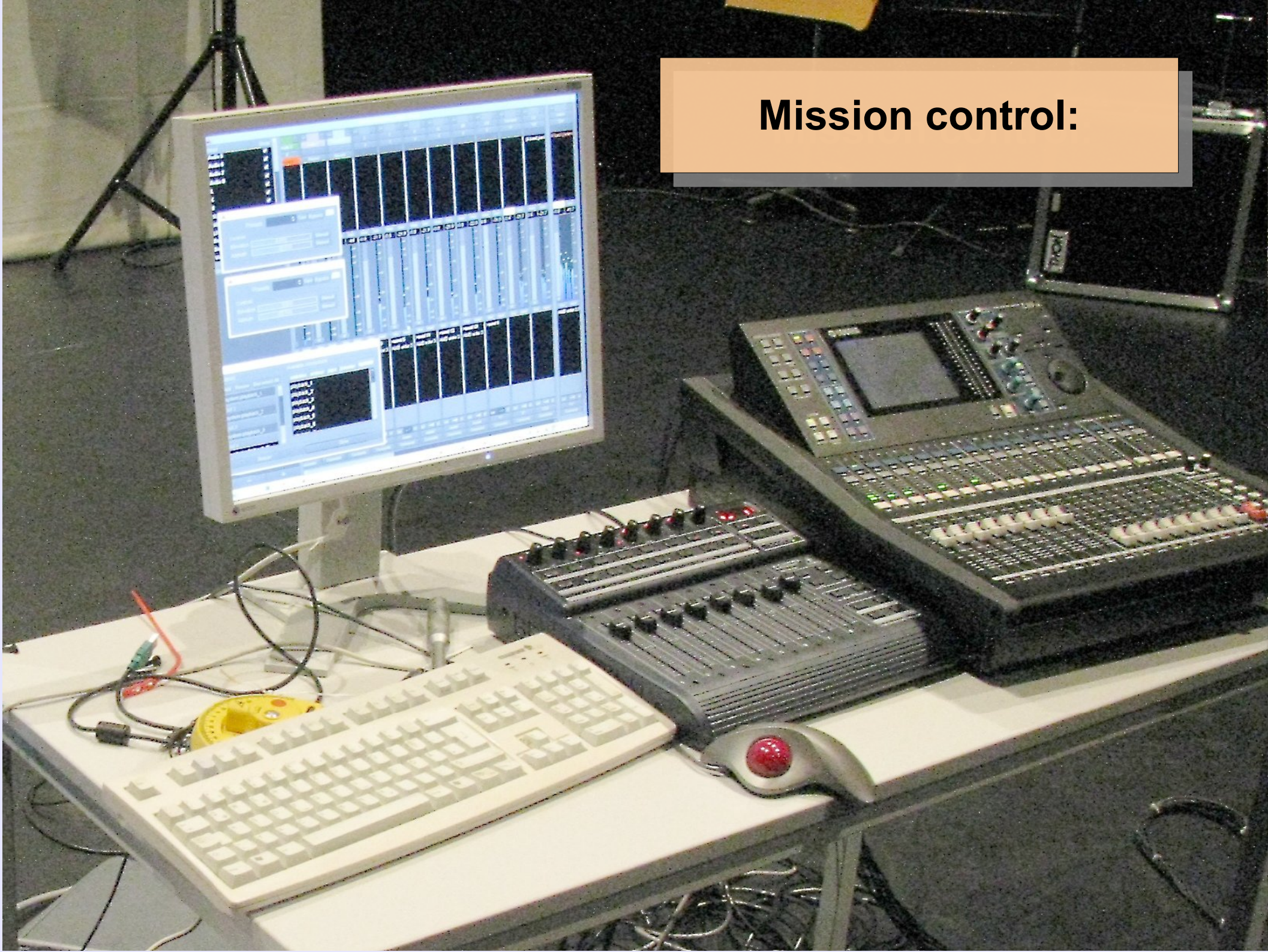
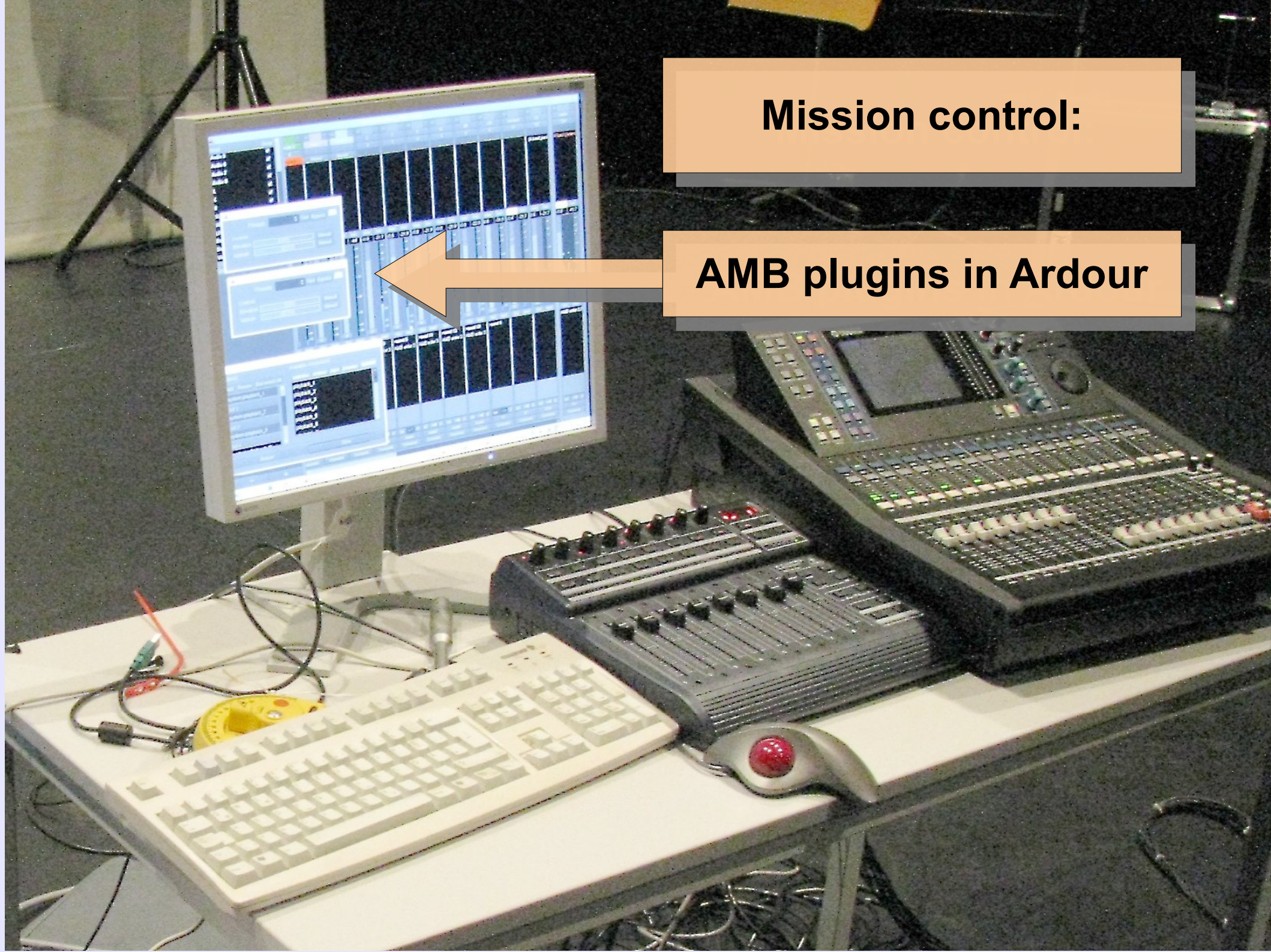
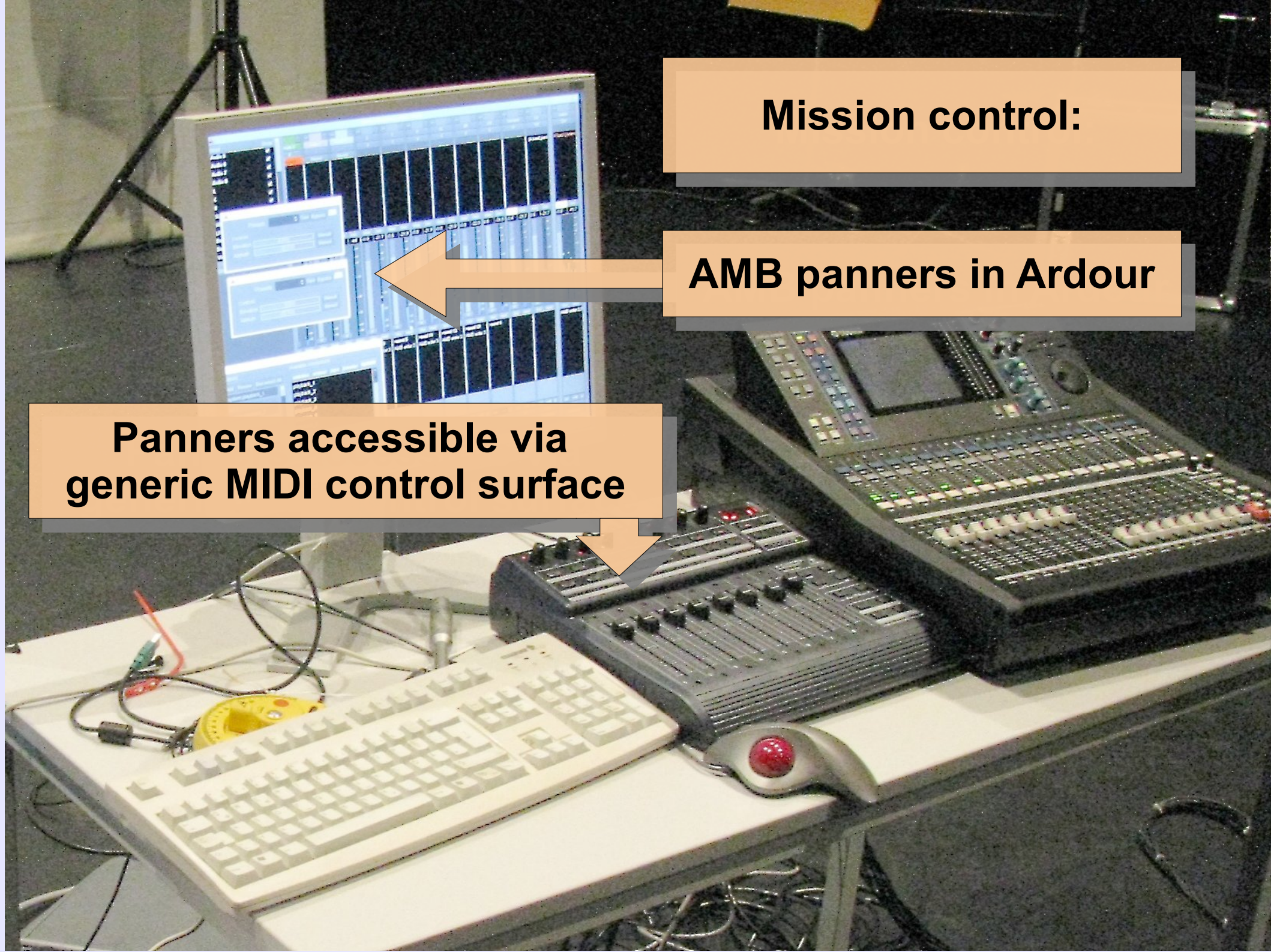
- Putting it all together: **JACK** Audio Connection Kit
  (Davis, Letz, Hohn et al.)


Mission control:


Mission control:
AMB plugins in Ardour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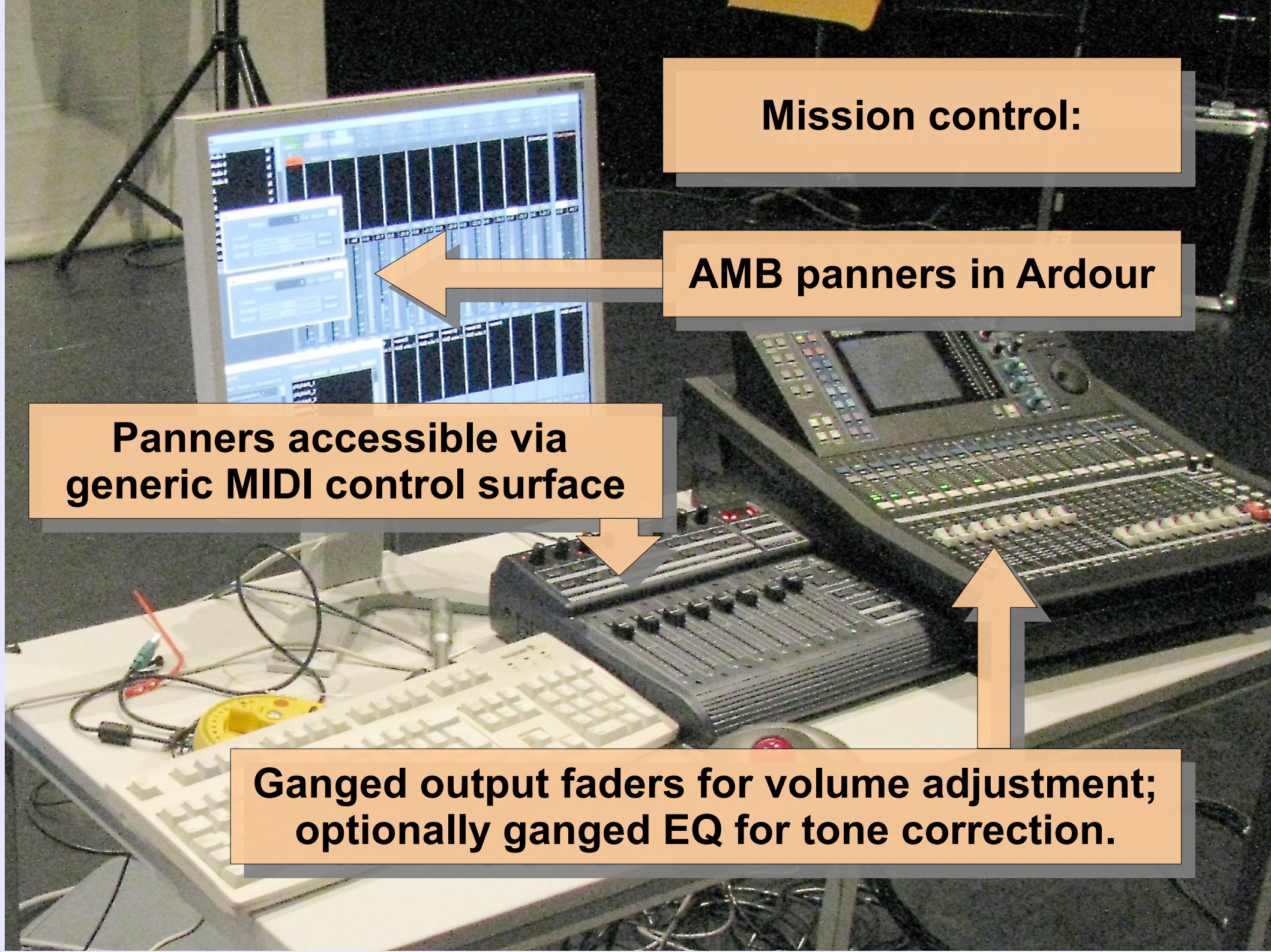
AMB panners in Ardour
Panners accessible via generic MIDI control surface


Mission control:
AMB panners in Ardour
Panners accessible via generic MIDI control surface
Ganged output faders for volume adjustment; optionally ganged EQ for tone correction.

The paper contains detailed setup information.

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- Improve the concert experience by avoiding disruptive speaker rearrangement breaks
- No errors and malfunctions caused by in-flight rewiring and reconfiguration
- Provide the performer with positional control, as an additional degree of freedom in sound diffusion

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  - Signals susceptible to comb-filtering may suffer.

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Artefacts may have different effects and severity, depending on the compositional approach.

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While artefacts may be evident in A/B comparison, they need not pose a problem in actual practice.

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- Acousmatic works (a.k.a. music for „Loudspeaker Orchestra“)
- Pathological signals with large amounts of negative correlation
- The dialogue channel(s) of movie sound tracks (workaround: use a discrete speaker for the center)

Practical experience

- Past deployments of Ambisonic concert systems have met with general approval, both by audience and performers:
  - LAC 2009 concert system, Audiorium Paganini, Parma Eight full-range QSC speakers driven in 3rd order, implemented by Fons Adriaensen

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  - CCRMA lecturer Fernando Lopez-Lezcano has reported very pleasant results in several concerts (one open-air) with a similar eight-channel 3rd order rig

Listening tests

Practical deployments were always successful.

But how does the system fare in a direct A/B comparison?

Listening tests

- Two informal listening tests have been conducted in spring 2010:
  - Kunsthochschule für Medien, Köln, with film and media artists, using direct A/B comparisons between interspersed 5.0 and 3rd-order horizontal Ambisonics rigs

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  - Kunsthochschule für Medien, Köln, with film and media artists, using direct A/B comparisons between interspersed 5.0 and 3rd-order horizontal Ambisonics rigs
  - ICEM, Folkwang Universität der Künste Essen, with electronic composers, using a 3rd-order horizontal rig, A/B-ing between Ambi and quad reproduction

Listening tests

Test setup:

5.0 or 4.0 content was played back over a virtual Ambisonic rig in 3rd order, and compared with native reproduction over 5 and 4 speakers.

Evil! It is clear that Ambi can't outperform the original. Rather, it will combine the defects of both discrete and Ambisonic playback.

Does it work? Is it a good compromise?

Listening tests – film artists

- absolute position of C is mandatory
- focus and stability over correctness and homogeneity
- no advantage in coverage area
- phasing artefacts evident in typical cinema acoustics

For film, not too impressed. For music, ok.

Listening tests – Film artists

Conjecture:

Does Ambisonic listening require training or habituation?

If so, maybe their verdict would improve over time?

But also: can it be that „us Ambi professionals“ *routinely over-estimate* the impact on casual (i.e. non-habituated) listeners?

Listening tests – Electronic composers

- shortcomings inobtrusive
- often no clear preference (very good!), but large individual deviations
- no advantage in coverage area
- subjects prefer being able to pinpoint speaker locations over homogeneity


„In the context of electro-acoustic music, any reproduction is interpretation.
Ambisonic reproduction is a valid form of interpretation (except for a few very particular works).“
- a test participant


Thank you for your attention!
I'll be happy to address your questions.