Byzantium in Bing: Live Virtual Acoustics Employing Free Software

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the goal was simple:

how to fit this:

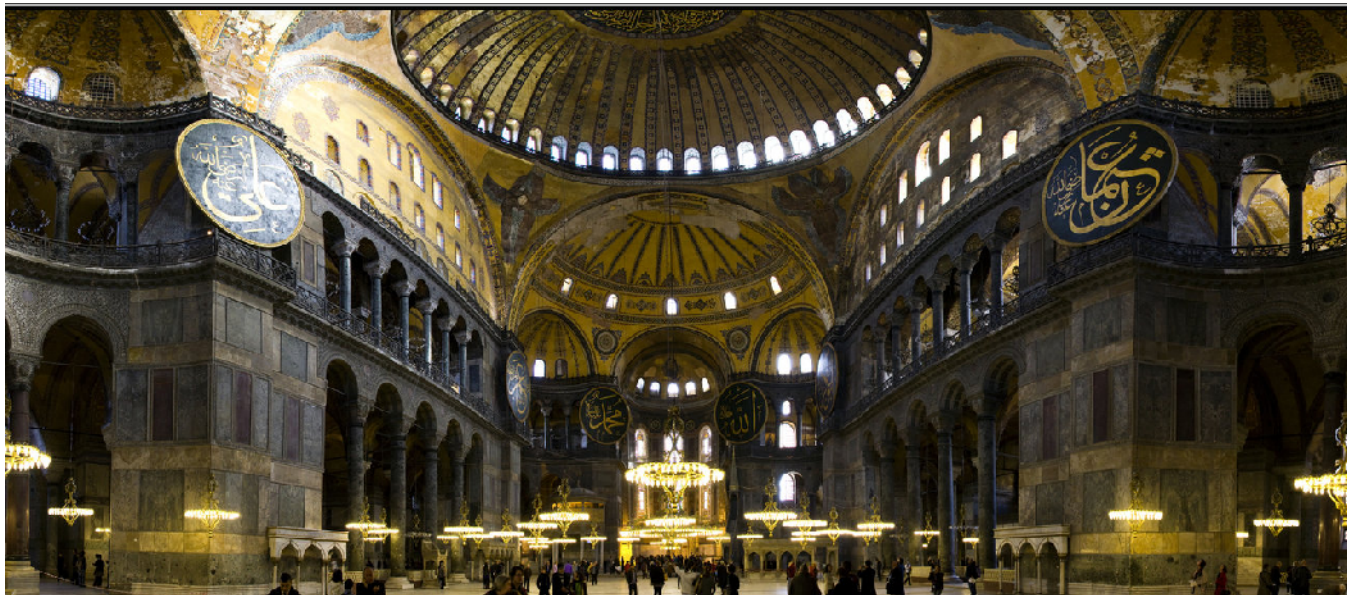
Hagia Sophia, Istambul, Turkey

into this:

Bing Concert Hall, Stanford, California, USA

or expand this:

into this:



and put singers inside!

in real-time, of course
in concert, not a demo
bonus points for using free software...
more points for using ambisonics (it is a good excuse)...
ultimate prize if the whole thing does not crash and burn

acoustic spaces

- crucial to the act of experiencing music
- singing tied to the space in which it occurs
- reverberation affects tempo
- room modes affect pitch
- music written for a particular space works best in that space

hagia sophia

- world heritage site
- 360 -> 1204: orthodox cathedral
- 1204 -> 1261: catholic cathedral
- 1261 -> 1453: orthodox cathedral
- 1453 -> 1931: mosque
- 1931: secularized... (it is now a museum)
- 55.6 m dome (182 ft), ~ 31 m diameter (~102 ft)
- more than 10 seconds of reverberation time

  (a choir performance there would be impossible today)

bing concert hall

- 2013: inauguration...
- 842 seats, terraced design
- ceiling 47 feet above the stage
- 680,000 cubic feet volume
- around 2.5 seconds reverberation time (~2 with all “variable acoustics” surfaces deployed)

previous work

- icons of sound project (abel, pentcheva, kolar & others)
- recording of ballon pops in hagia sophia, reconstruction of impulse responses
- dry recording of singers (cappella romana) with headphone provided virtual environment (CCRMA Stage)
- studio mix of dry signals with artificially reconstructed environment (Listening Room 22.4 system using Ambisonics – 32 convolutions total)

transitions 2011

- outdoor summer concert
- 16.4 system (2 rings of 8)
- playback of the prokeimenon mix using a mix of 2D and 3D Ambisonics decoders
- very successful given the limitations

bing?

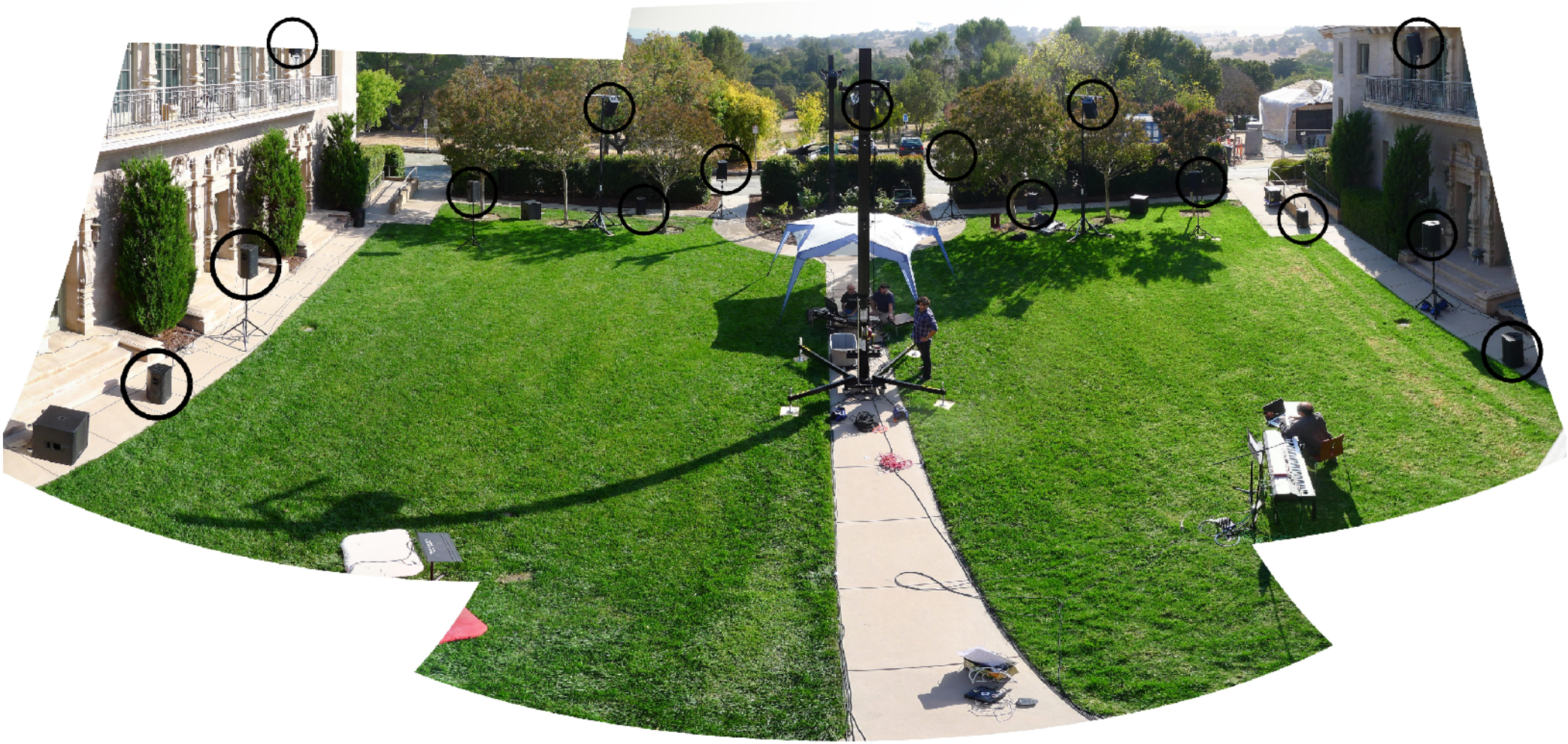
- the possibility of a concert in the inaugural season of the bing concert hall arises...

Bing Concert Hall, November 2011

transitions 2012

- outdoor summer concert
- 24.6 system (full “3D”)
- real-time Hagia Sophia recreation
  - two singers
  - jconvolver plus ardour for mixing
- validated real-time processing of live sound

transitions 2012



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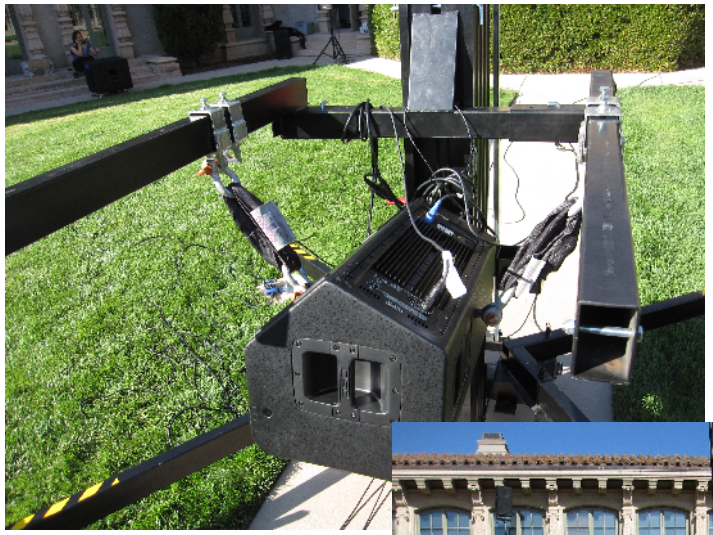


transitions 2012

back to: bing concert hall

- terraced design
- not designed for surround but for unamplified music performances
- but design incorporated “plumbling” for multichannel work
- and also enough rigging points through the “cloud” ceiling

sound system

- 24.6 system based on QSC speakers
- HPR122i + HPR181 subs
- HPRs no longer in production – could not find alternatives at that price point and performance
- NetworkSound AudioStreamer box as D/A with the jack-mamba jack client as driver (32 i/o channels – see lac2012 paper)

sound system

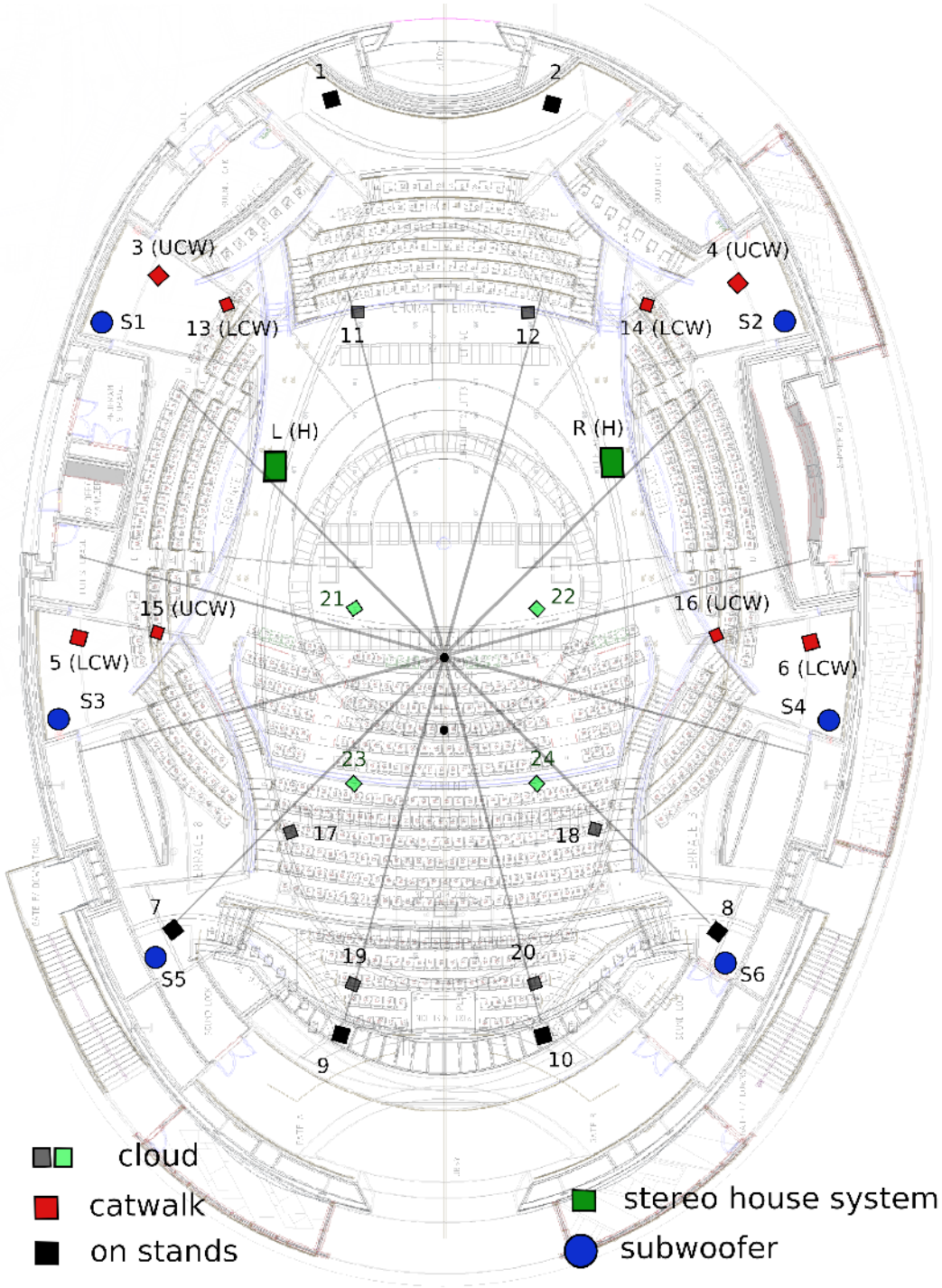
- all software is running on one of our fanless workstations (see LAC2009 paper)
- usually remoted through ethernet cables
- ardour + supercollider + ambdec + jack-mamba + misc
  - supercollider: LR4 sub crossovers and delay and level compensation
- netjack for other computers or laptops

rigging

2 day technical “rehearsal”, December 2012 (proof of concept)

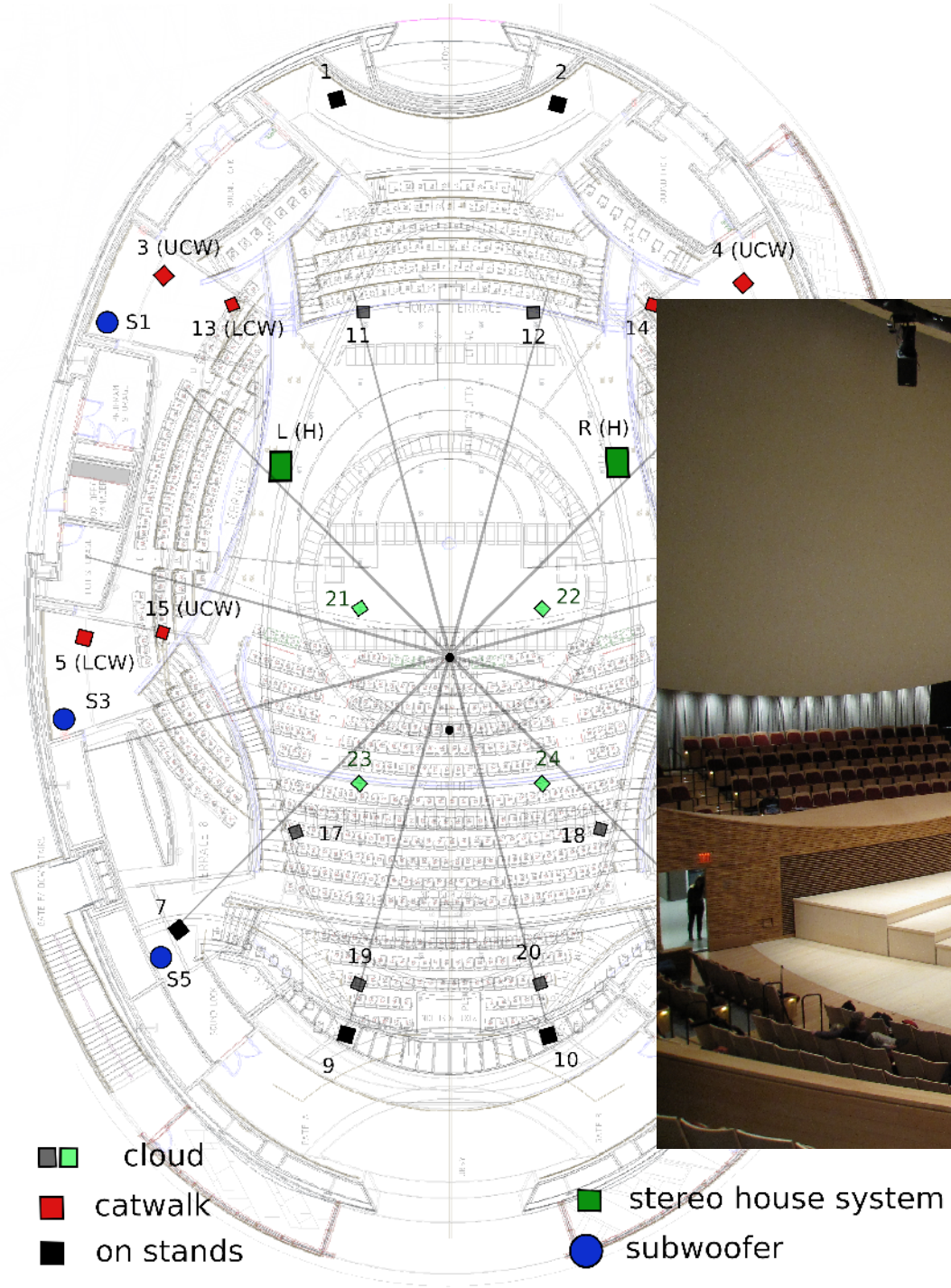
rigging

locations



cappella romana rehearsing

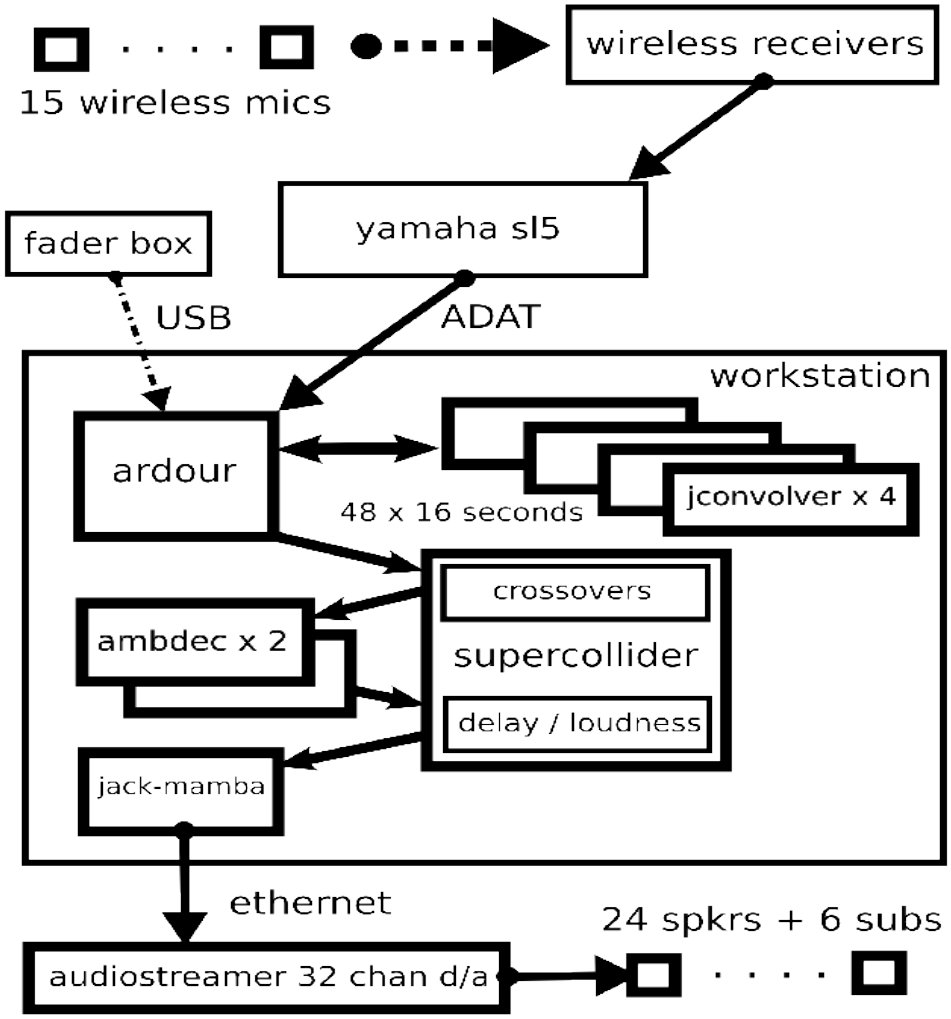
locations



cappella romana rehearsing

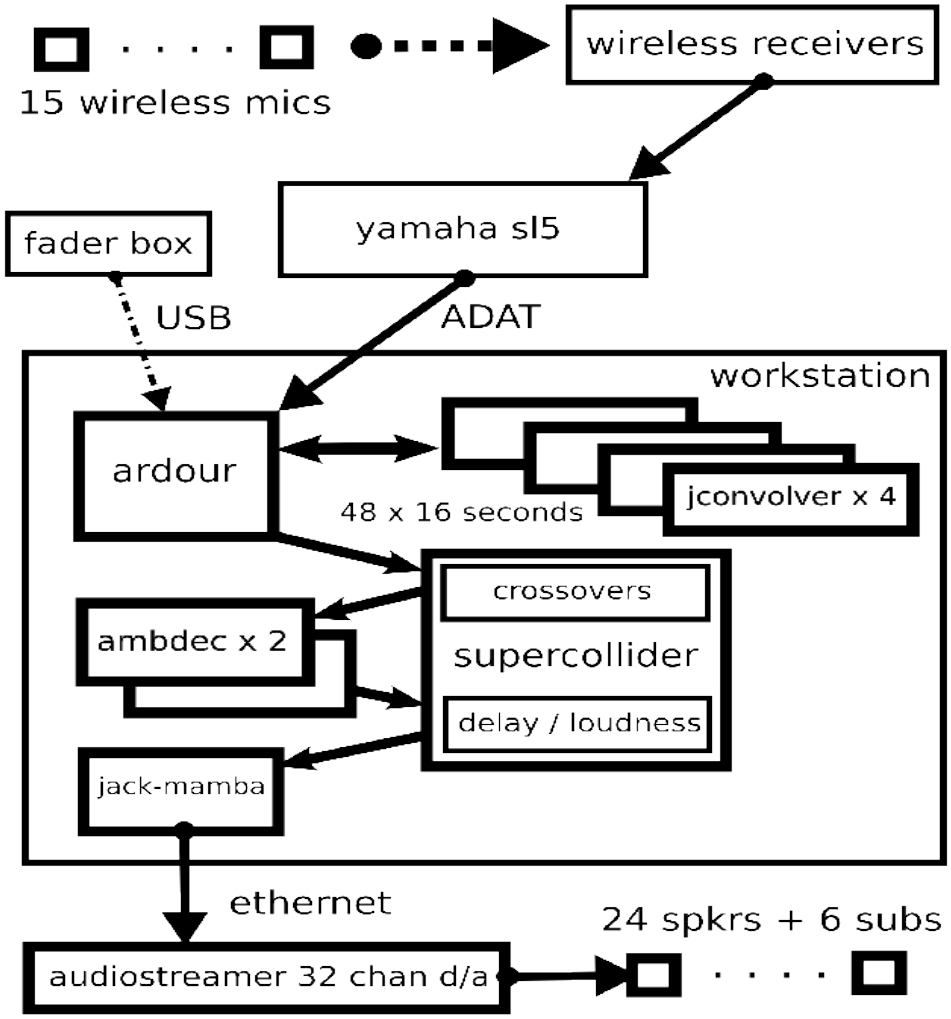
signal routing

- wireless mics
  (countryman b6)
- house mixer
- adat -> computer
  (rme raydat pcie)
- <*some processing*>
- ethernet -> D/A
- D/A -> speakers



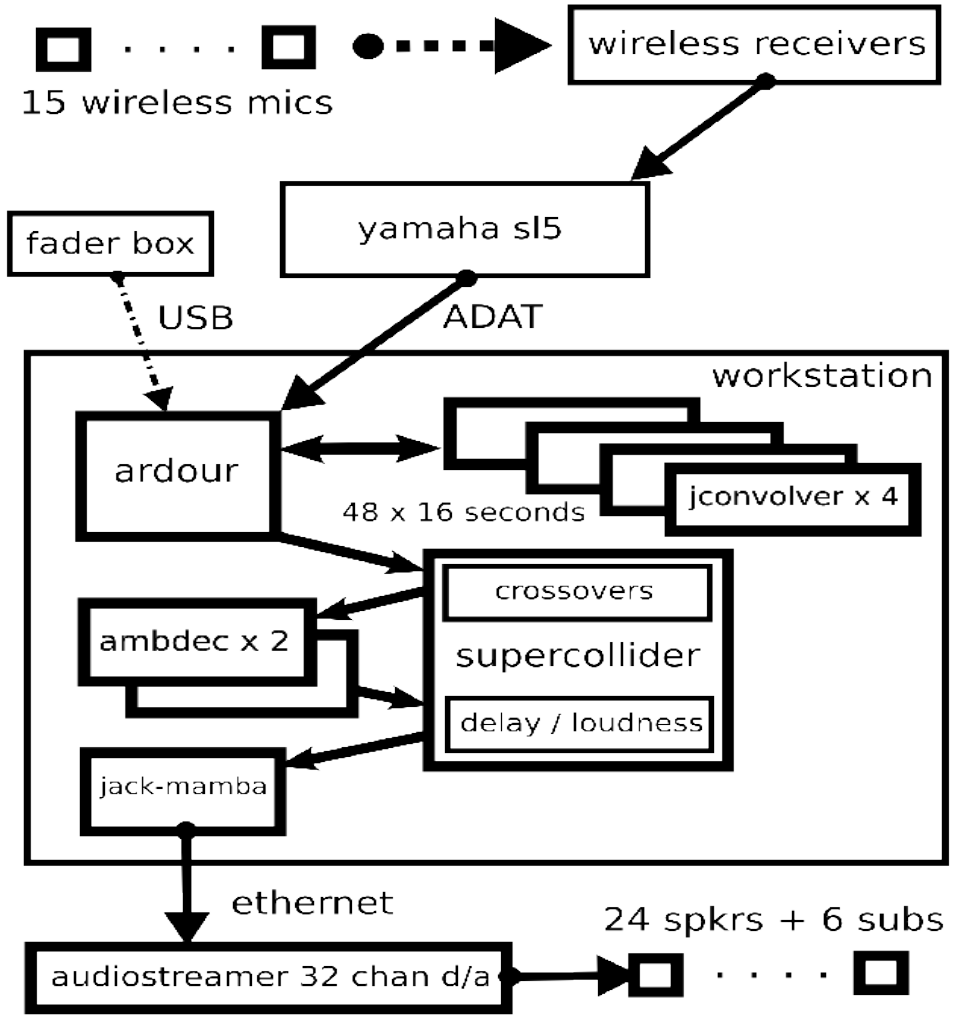
signal processing

- jack: 256x2, 48Khz
- 4 x jconvolver
- supercollider
- 2 x ambdec
  (aaron heller coeffs)
- jack-mamba



control

- bcf2000 usb fader box, in ardour:
  - master
  - hagia
  - dry



the concert

Dining Options »

Parking & Directions »

Seating Chart »

Program Notes »

Additional Information »

Links

Cappella Romana website

Video

CAPPELLA ROMANA

"FROM CONSTANTINOPLE TO CALIFORNIA"

Friday, February 1, 2013 | 8:00 pm

Bing Concert Hall

$34.00 (Adult) | $10.00 (Stanford Student)

$30.60 (Other Student)

cappella romana

- Cappella Romana is a vocal chamber ensemble dedicated to combining passion with scholarship in its exploration of the musical traditions of the Christian East and West, with emphasis on early and contemporary music.

the concert

the concert

prokeimenon

after the concert

"*the virtual Hagia Sophia created in the Bing Concert Hall responded in a very natural way, and felt like a "real space," "holding its pitch" and allowing control over the harmonic content of the ison (drone)*"

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I'm not kidding...

thanks to...

so many...

chris chafe, bissera pentcheva, jenny billfield, aaron heller, carr wilkerson, sasha leitman, jay kadis, alexander lingas, mark powell and cappella romana, fr. salmas and the byzantine chanters from the church of the holy cross in belmot, ca;

Stanford Presidential Fund for Innovation in the Humanities, the Stanford Arts Initiave, Countryman Associates for donating the B2D Directional Lavalier microphones & Christine and Reece Duca, whose generous support made possible the concert and recording sessions

questions?