Immersive Network AV at the KPMG Data Observatory

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Data Science Institute

- Opened in April 2014 at Imperial College, London
- Aims to provide a focal point at Imperial College for data-driven research
- Opened the KPMG Data Observatory – a visualisation environment, in November 2015

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KPMG Data Observatory

- Largest of its kind in Europe
- Enveloping 313 degree circular wall of 64, 46” video-wall class monitors
- Gives a total resolution of 130 megapixels
- Powered by a cluster of over 40 computers, inc. 32 “nodes”
- Supports various modes to allow a variety of uses, including data driven research and presentation

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Basic Infrastructure

- 40 computers and blade server giving over 250 physical CPU cores of processing power
- Backed by a 10Gbit over RJ45 network
- Uses at peak around 30kw of power
- Breaks into 5 sections for completely independent usage (Yes, it has wheels!)
- And it has an audio system…

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The requirements

- Requirement to create an immersive, “surround-sound” audio system in the space
- To compliment the visualisation environment by being unobtrusive and with directional audio
- Highly stable with low maintenance
- Limited budget and more importantly space

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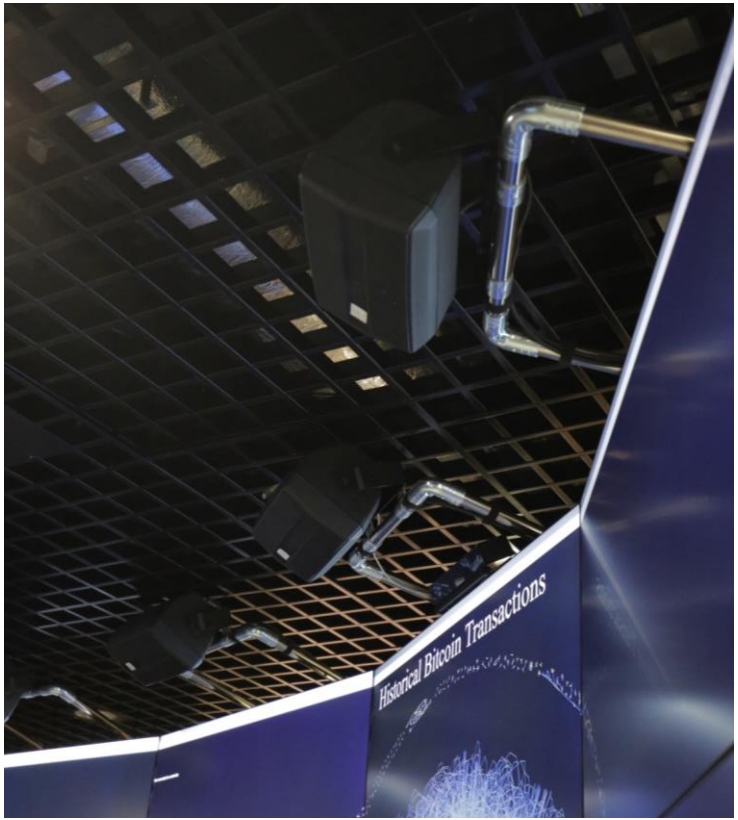
The proposal

- To use an “off the shelf” standard 5.1 surround sound
- To use a custom 16.3 surround sound to match the design on the environment
  - Each speaker should be individually addressable from any source
- Each section can be run independently

- Each column of screens contains an active speaker at the top, with a fairly narrow horizontal dispersion and fairly wide vertical dispersion.

- This was done by mounting a more typical speaker side-ways!

- In addition to this, 3 downwards firing sub-woofers were mounted around the room



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The problem

- 25 independently driven speakers – i.e. busses
  - 16 top speakers (active)
  - 4 ceiling speakers (passive)
  - 3 sub woofers (active)
  - 2 conference room speakers (passive)
- Up to 32 simultaneous, and 40 total sources (all stereo)
- Must be able to cope with 30kw of power around it!

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The options

- Pure hardware approach
  - USB DAC to balanced XLR (x40)
  - Hardware mixing desk with at least 24 busses
  - A lot of wiring!
- Pure software approach
  - Route all audio from the computers below a speaker to the one above, then try and stream to the correct computer

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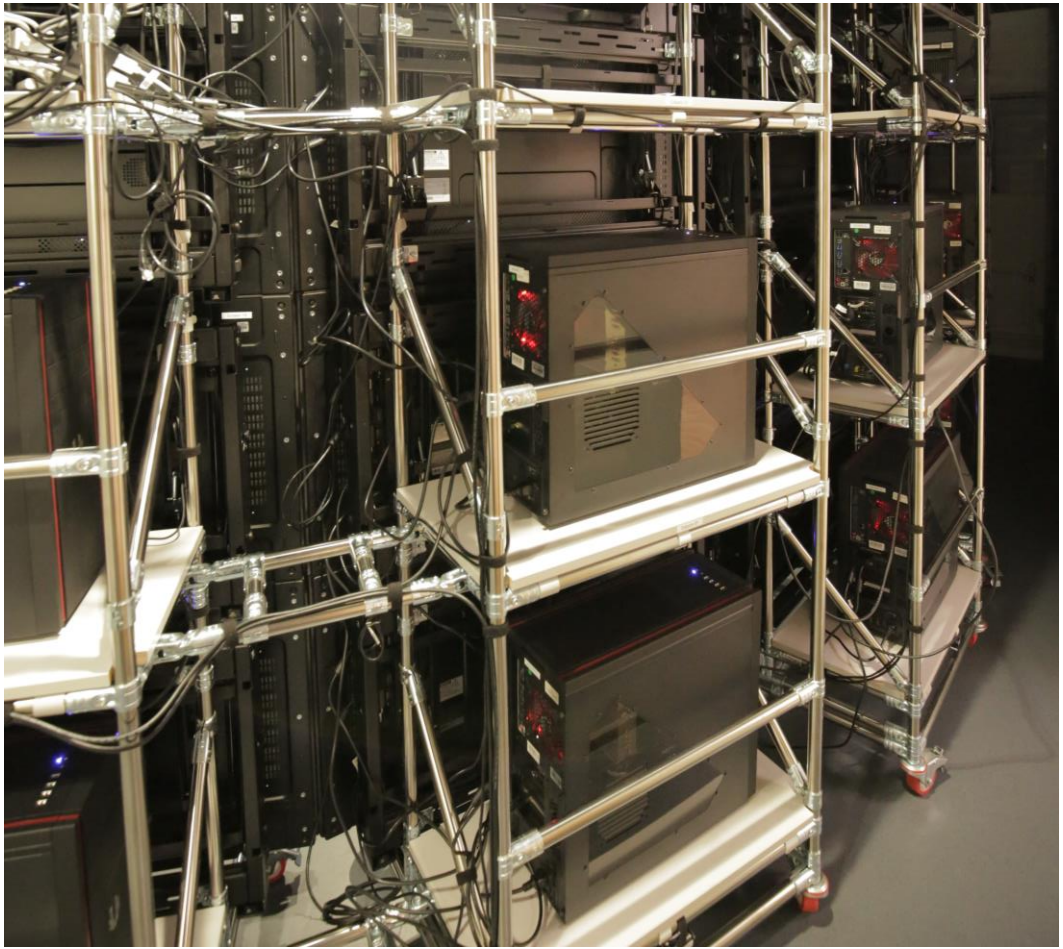

The solution

- A mixed hardware and software approach
  - Each speaker has its own signal
    - Can be changed completely in software
  - Each computer sends via network audio to a processing “hub”
    - No additional cabling required per computer
    - Zero noise or ground problems – pure digital
  - Analogue out to each speaker
    - Low cost

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Speaker wiring (the easy bit)

- Balanced input into each speaker connects to a ceiling box per section – with space for a further 16 speakers
- Each section contains a movable snake that can be re-arranged across the room for any configuration
- All speakers are active, so that they can me moved independently
- All snakes lead back to the “hub” (a MOTU audio interface)

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The network problem

- Network audio must support at least 32 inputs (all cluster machines simultaneously), or ideally more
- Must be STABLE
- Must run natively on Windows machines
- Must be low latency – sub 20ms (Immersive!)

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The server problem

- Must be able to output 24 independent channels of audio
- Must be able to receive 32 or more channels of audio
- Must be low latency

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The solution - Dante Via

- Installs straight into Windows with almost zero configuration
- Outputs stereo channels from some **or** all applications
- Low latency
- Requires no additional wiring – uses existing 10Gbe NIC
- STABLE

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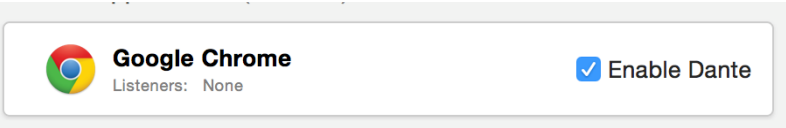
Dante Via configuration



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Dante Virtual Sound Card

- Accepts 64 inputs (32 stereo to match the environment)
- Allows saved configurations
- Low latency
- Uses Dante Via as a clock

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Audio server – Apple Mainstage

- Allows near unlimited inputs and buses
- Fairly low latency
- Fully customisable (EQ, Compressor, Delay (effects)) with easy scene change
- Compact – runs on a Mac Mini

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Audio server – Dante Via

- Lower latency
- Easy routing to other applications e.g. Skype
- Interface supports basic EQ and mixing
- Compact – runs on a Mac Mini

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Potential Improvements

- Introduce full mixer with Dante card for lower latency
- Completely digital using a Dante Receiver
- “Scriptable” scene change – change configuration at the push of a button!

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