Postcards from a Networking Pluralist

- From: Andy Cooper, Yamaha Commercial Audio
- To: 24th AES-UK Conference,
  The Ins and Outs of Audio.

Itinerary

o Introduction

o CobraNet

o EtherSound

o Optocore

o Dante

o RockNet

o Others: present & future

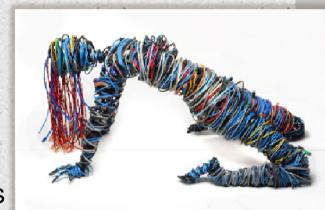o Summary & Questions…

Introduction

- o Andy Cooper
  Manager, Commercial Audio Support Centre
  Based in London, covering all of Europe.
- o Worked for Yamaha since 1999
- o Worked with audio networks since 2002
  - o Training, system design, trouble-shooting
- o Gained first-hand experience with all the major audio networking formats
  - o In small, medium, large and enormous systems!

Why do Networking?

- o Increase audio quality
  - o Reduced losses over long distance
  - o Less AD & DA conversions needed
- o Increase scalability
  - o Easily add devices to a system
  - o Modify a system for different projects
- o Reduce costs
  - o Analogue cable is a huge expense for multiple channels over long distance
- o Reduce labour
  - o Installation time & effort is lower, mainly due to thin & flexible cables
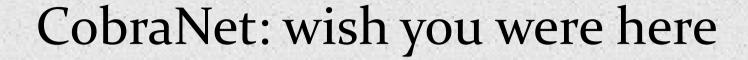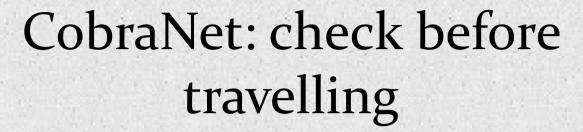
CobraNet

Welcome to CobraNet

o A licensed network protocol, Ethernet compatible

o Used in Yamaha products since 2002

o Used by more pro audio manufacturers than any other network protocol so far…

o Still the most widely used audio network…

o …but no further development in recent years.

o More details from www.cobranet.info

CobraNet: wish you were here
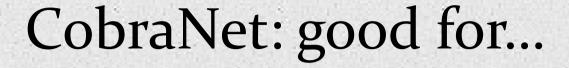
o Huge range of available devices from many manufacturers

o Fully 100MB Ethernet compatible (layer 2)
  o Use regular Ethernet switches, cables, media-converters

o Build large networks with over 200 devices

o Most devices include connections for redundancy

CobraNet: check before travelling

o Latency is normally 5.33ms, but can be less for small networks.

o Devices cannot transmit more than 32 channels, and cannot receive more than 32 channels

o Different software applications needed to program different products

o Maximum of 64 audio channels each way in each network segment (100MB bandwidth restriction)

o Channels have to be transmitted in "bundles", identified by a 5-digit number

   o Between 2 and 8 channels per bundle

CobraNet: good for...

o Lower cost network infrastructure based on 100MB equipment

o Providing complete networks with redundancy

   o Compatible with networking protocols such as Link Aggregation & Spanning-Tree.

o Transmitting a small number of channels to many destinations

o Pick & choose from a wide range of available products

A CobraNet Postcard

o Cruise Ships: used by P&O, Holland-America, Costa
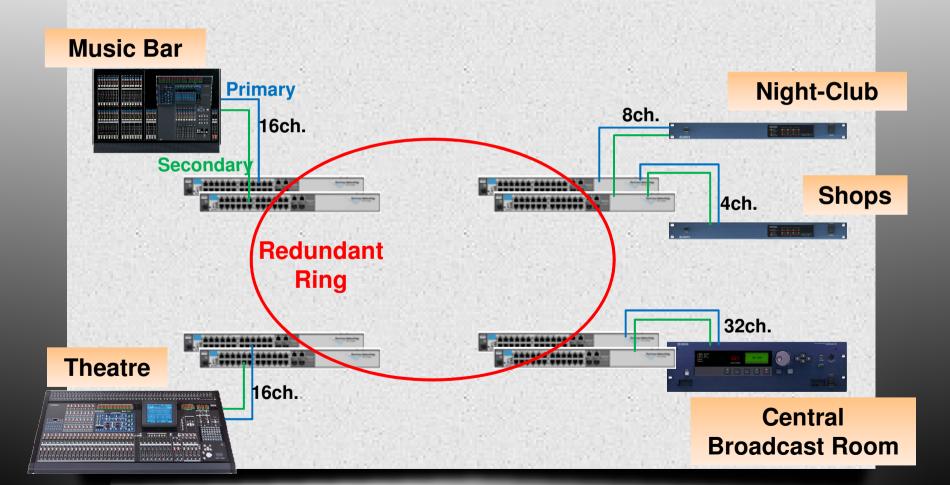
CobraNet: Case Study

o Cruise Ships:

  o Transmit background music & announcements to multiple locations

  o Link larger venues to smaller venues

  o Link mixers to speaker processors within venues

  o Provide redundancy to reduce remote maintenance needs

  o Lower the weight, size and cost of cable installation

  o Improve audio quality (compared to using long analogue cables)

CobraNet in a Cruise Ship

Music Bar

Primary

16ch.

Secondary

Night-Club

8ch.

Shops

4ch.

Redundant Ring

32ch.

Theatre

16ch.

Central Broadcast Room

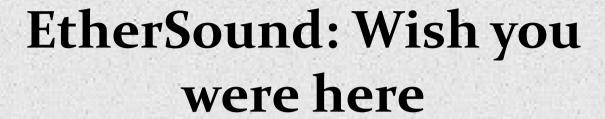# EtherSound

Welcome to EtherSound

o A licensed network protocol, semi-Ethernet compatible

o Used in Yamaha products since 2004

o Patented by Digigram in 2001

o Over 30 Pro Audio Licensees

o Popular choice for live sound: Stage-box to Console & Console to Speaker-Processor connections

o More details from www.ethersound.com

EtherSound: Wish you were here

o Very low latency: 0.125ms from device 1 to device 2, add 1.4µs for each additional device.

o Simple daisy-chain network, without the need for Ethernet switches

o Most devices use rugged Neutrik EtherCON connectors: good for touring & mobile events

o Just one software application is needed to setup and monitor devices from many manufacturers

o Continuous development & improvements have been taking place…

EtherSound: Check before travelling

o Limited to 64 channels each way (with 100MB network)

o Latency is not completely consistent (though always remains very low)

o Limited support for non daisy-chain topologies

o Redundancy is only possible in small networks (64 channels totally), by creating a ring

o Slightly higher cost than CobraNet & Dante (for low channel-count devices)
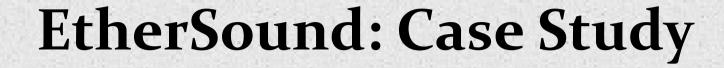
EtherSound: Good for...

o Systems that need very low latency (like stage monitors for live sound)

o Networking without the need for IT equipment (Ethernet switches are not needed)

o Systems with few devices transmitting a reasonable number of channels (up to 64 per device)

An EtherSound Postcard

o Palazzo Dei Congressi, Lugano, Switzerland

EtherSound: Case Study
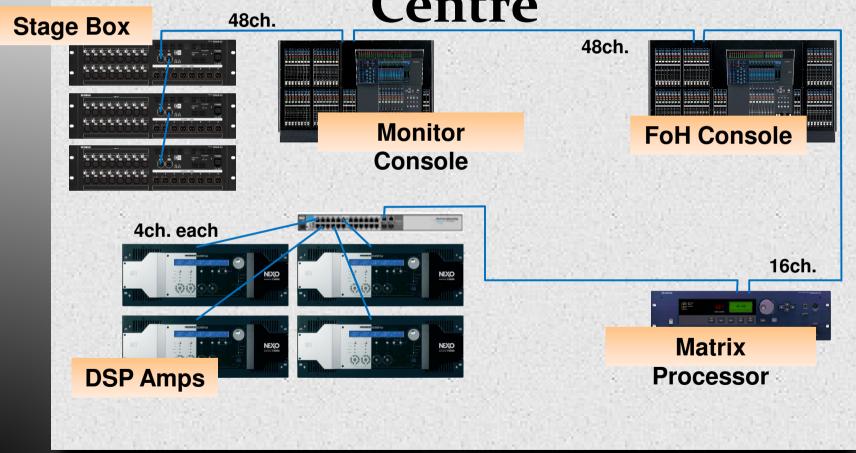
o Palazzo Dei Congressi, Lugano, Switzerland

   o 48 channels of EtherSound from Stage Boxes to Monitor & FoH mixers

   o 8 channels from FoH to Output Matrix Processor

   o From Matrix Processors t (2 & 4 channels per amp)

EtherSound in a Congress Centre

Stage Box

48ch.

48ch.

Monitor Console

FoH Console

4ch. each

16ch.

DSP Amps

Matrix Processor

Optocore

Welcome to Optocore

o A proprietary network type

   o Using fibre-optics

   o Not compatible with Ethernet

      o But can carry Ethernet data inside!

o Company founded in 2003

o Used in Yamaha products since 2006

o More details from www.optocore.de

Optocore: Wish you were here

o 2GB bandwidth for the new range of products, allowing around 1000 audio channels in the network

    o 1GB for previous range, 512 audio channels

o Synchronous audio transmission with just 41.6µs latency

o Redundant double-ring topology using fibre-optics

    o And most devices have dual power supplies for redundancy

o Interfaces with MADI, AES/EBU, Ethernet data, serial data, and analogue audio!

Optocore: Check before travelling

o Limited number of nodes per network ring (up to 24 devices in a ring)

o Products only available from Optocore distribution channels

   o Limited product & support availability

o Relatively expensive (cost per network audio channel) for smaller systems

   o Though a lower cost CAT5 solution has recently been introduced (called "SANE")

Optocore: Good for...

o Large networks carrying many audio channels over long distances

o Ring networks where redundancy is crucial

o Carrying Ethernet data with the audio signals through the fibre

An Optocore Postcard
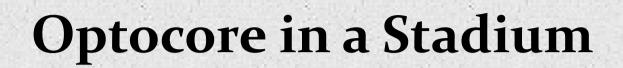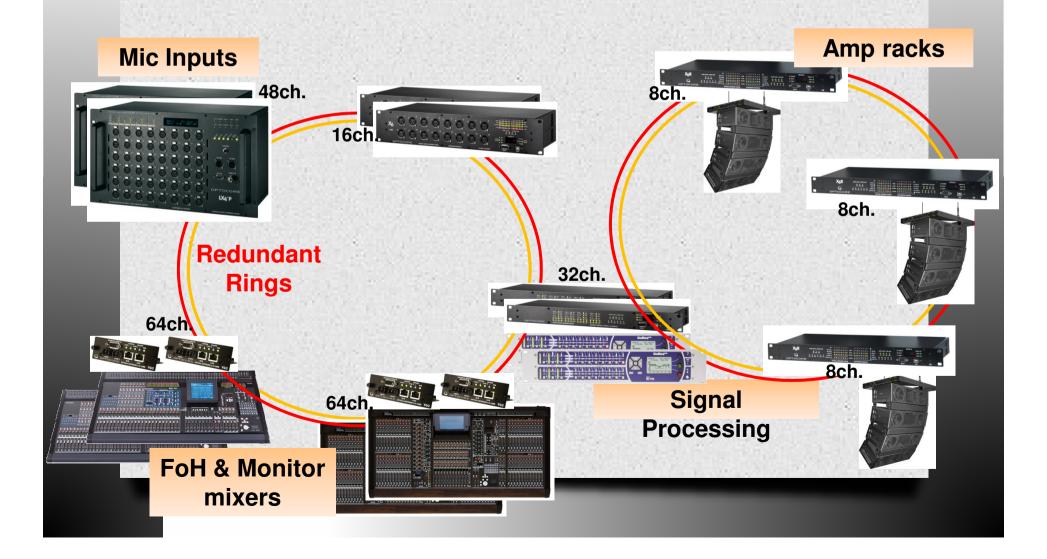
o Athens Olympics 2004
o Beijing Olympics 2008

Optocore: Case Study

o Large-scale Events:
  o Carry many audio channels long distances via fibre
  o Mic preamps in different locations around the stadium
  o Central location for mixing & signal processing
  o Separate location for broadcast sound
  o Many distributed points for PA amplification around the stadium

Optocore in a Stadium

Mic Inputs

48ch.

16ch.

Amp racks

8ch.

8ch.

Redundant Rings

32ch.

64ch.

8ch.

64ch.

Signal Processing

FoH & Monitor mixers

Dante

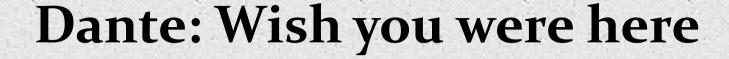# Welcome to Dante

o A licensed network protocol, Ethernet compliant

o Used in Yamaha products since 2010

o Rapidly gaining popularity throughout the last two years

o Compatible with future AVB standards

o Continuous development of new modules, software features…

o More details from www.audinate.com

Dante: Wish you were here

o Lower cost modules than CobraNet & EtherSound

o Fully 100MB, 1GB, 10GB Ethernet compatible
  o Use regular Ethernet switches, cables, media-converters
  o Integrate with existing networks

o Easy computer recording interface

o Sample accurate sync, with latency less than 1ms

o Build large networks with over 200 devices over 500 channels

o Most devices include connections for redundancy

Dante: Check before travelling

o Control software currently lacking some key features

    o Eg. Serial data tunnelling, password protection

o A limited range of devices are available so far…

Dante: most useful for...

o Integrating audio with existing IT networks
   o VoIP style QoS means separate VLANs aren't needed
o Networks demanding low latency, highly accurate sync
   o Eg. Live sound PA, recording studio monitoring…
o Designing & building temporary networks in a short space of time
   o Festivals & exhibitions

A Dante Postcard

o Winter Olympics 2010, Canada

Dante: Case Study
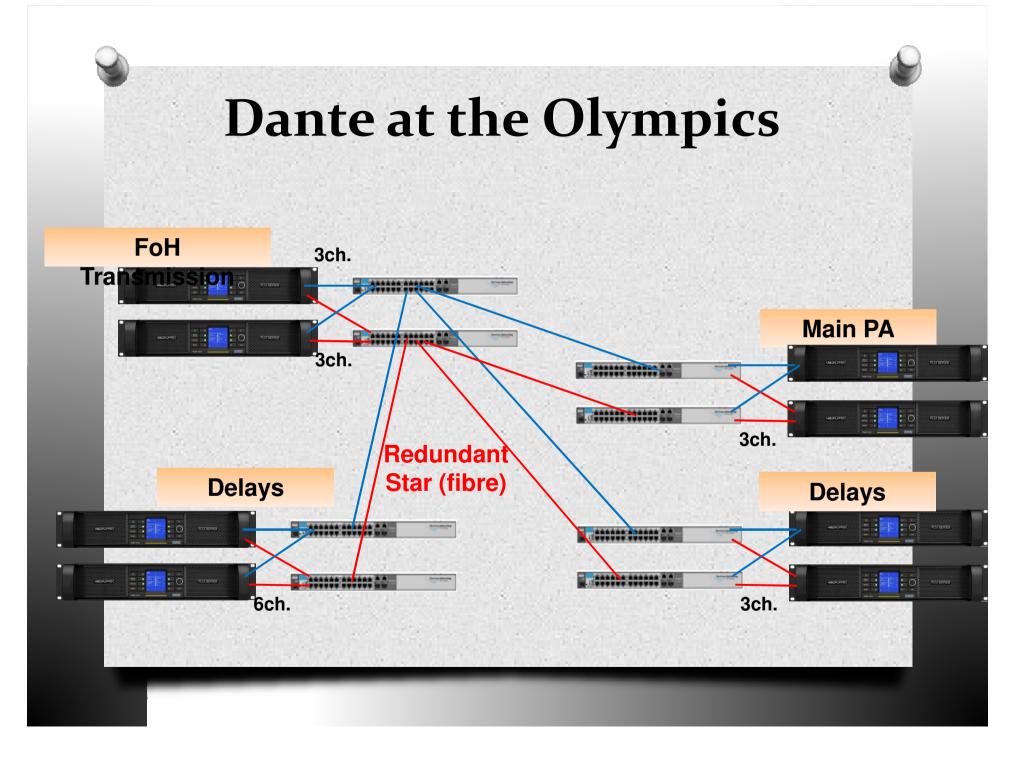
o Winter Olympics 2010: Vancouver, Canada

  o More than 100 Dante devices

    o Mostly Lab.gruppen amps with Lake processing
    o 6 transmitting devices, 104 receiving devices

  o 1GB Fibre Optic network

  o Full redundancy

Dante at the Olympics

FoH Transmission

3ch.

3ch.

Main PA

3ch.

Redundant Star (fibre)

Delays

6ch.

Delays

3ch.

Riedel RockNet

Welcome to RockNet

o A proprietary network type, using CAT5 cable

   o Not Ethernet compatible

o Audio network developed in 2006

o Used in Yamaha products since 200~~~

o More details from www.riedel.net

RockNet: Wish you were here

o 160 audio channels (48kHz) in CAT5 cable, up to 150m

   o Lower cost RockNet-100 has 80 channels

o Simple redundant ring topology, with up to 99 devices

o Less than 1ms latency, even from analogue in to analogue out

o No Ethernet networking knowledge required

o Don't need a computer to set it up

o Interfaces for a variety of mixing console manufacturers

RockNet: Check before travelling

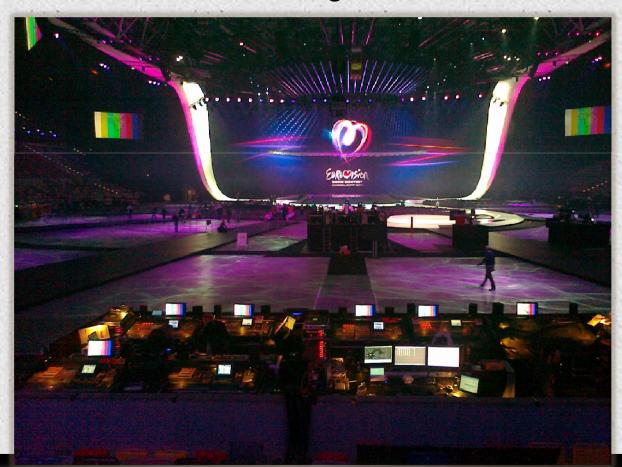o Analogue audio interfaces only come in small units: 8ch per device

o Limited range of digital audio interfaces
  o AES/EBU & MADI only

o Channels have to be patched in 4-channel bundles

o Not compatible with Ethernet switches and fibre-converters

o Small data bandwidth within the network (up t 10Mbps)

RockNet: Good for...

o Small / Medium sized networks with redundancy

o Link with Riedel MediorNet for larger applications

  o 20GB Fibre network for carrying multiple video, audio, data streams

o Link multiple mixing consoles with stage-boxes, and provide an "Independent Gain" function

A RockNet Postcard

Eurovision Song Contest 2011
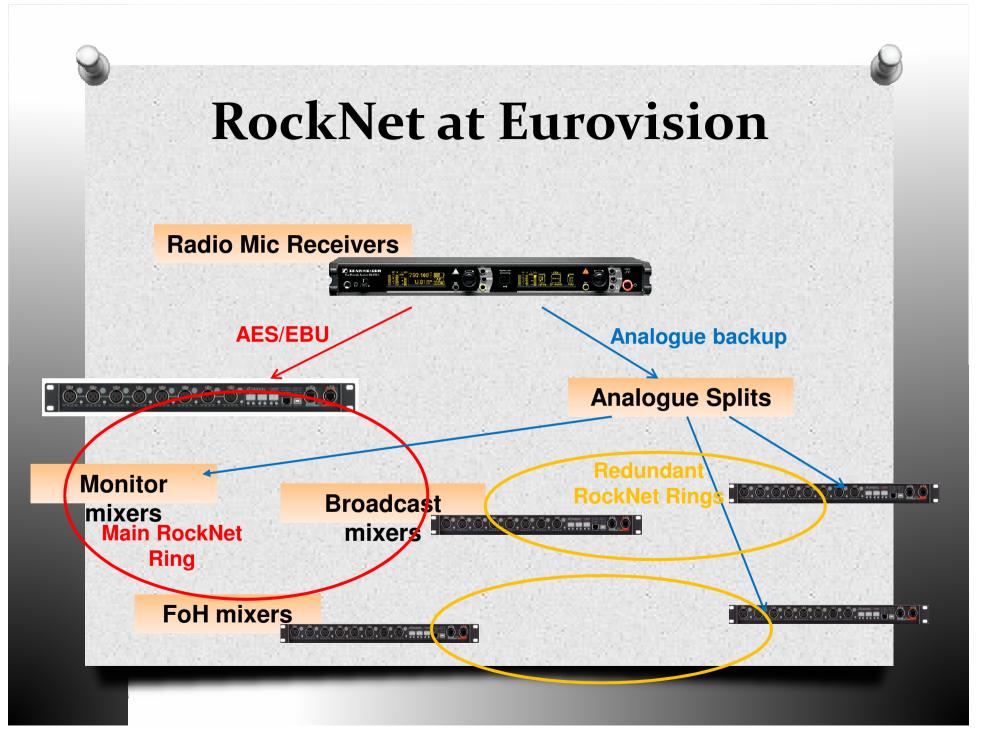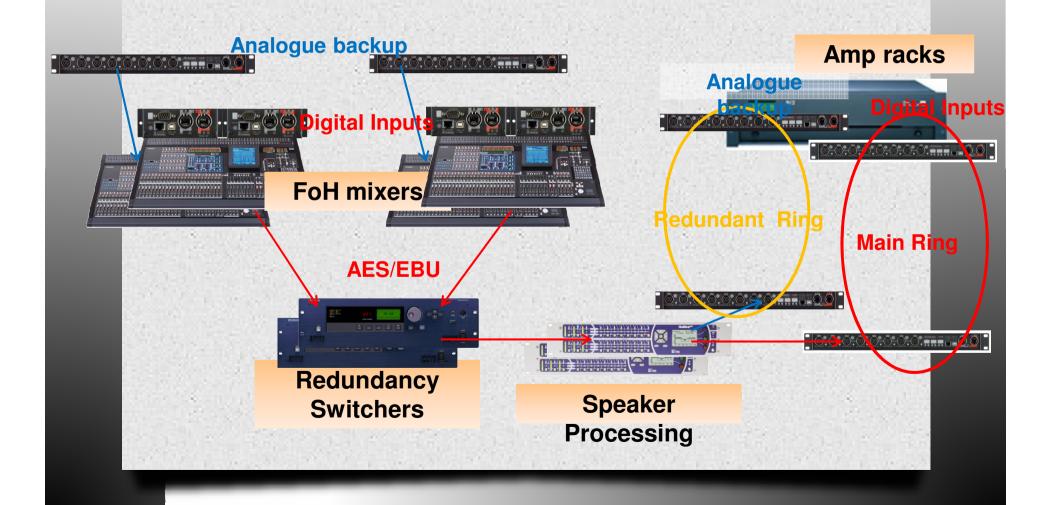
RockNet: Case Study

o RockNet at Eurovision Song Contest 2011
  o Link Stage Boxes to Monitor, FoH & Broadcast mixing consoles
  o Link FoH speaker processing to amp racks
o RockNet was planned to be used within MediorNet, to utilise the greater bandwidth of the fibre ring network
  o But the audio part was not working reliably, despite many tests
o So multiple RockNet rings were formed with dedicated fibre-optic converters for long distance links
o RockNet interface cards used inside all the Yamaha consoles

RockNet at Eurovision

Radio Mic Receivers

AES/EBU

Analogue backup

Analogue Splits

Monitor mixers

Broadcast mixers

Redundant RockNet Rings

Main RockNet Ring

FoH mixers

RockNet at Eurovision

Analogue backup

Amp racks

Analogue backup

Digital Inputs

Digital Inputs

FoH mixers

Redundant Ring

Main Ring

AES/EBU

Redundancy Switchers

Speaker Processing

Lessons Learnt:

o Integrating audio, video, light control onto the same network is a great idea…
  - o Until something goes wrong!
  - o It becomes a hassle to trouble-shoot
  - o Nobody knows the whole system!
o For large temporary events, keep the audio in a separate network
o For similar reasons, you also may prefer to keep a proprietary network out of the mixer…
  - o Having a network interface card for the console can save cost and reduce number of cables…
  - o But usually the network experts don't know the console, and the console experts don't know the network
o Alternative: use AES or MADI interfaces between the console and the network

Other Audio Networks

o Aviom

o AES-50

o Roland REAC

o Ravenna

o AVB

Aviom Pro64

o A proprietary network, not compatible with Ethernet

o Aviom A-net used in Yamaha consoles since 2004, for personal monitoring. 16 channels

o Pro64 since 2006. 64 channels, similar concept to RockNet

    o Channels routed in groups of 4

    o Wider choice of hardware devices

o Use in a daisy-chain, or with dedicated hubs

o More popular in USA, rarely seen in Europe

    o House of Worship

    o Arts Centres

    o Conference Facilities

    o Education

o www.aviom.com

AES-50

- o AES50 (also known as "SuperMAC") is actually a point-to-point technology operating over 100Mbit/s Ethernet

  - o Published in 2005
  - o Use specialist routers to create star-networks
  - o Basically only currently used by Klark-Teknik & Midas
- o 48 channels (24 at 96kHz), 3-sample latency
- o "HyperMAC" is a higher capacity equivalent
  - o 192 channels (at 96kHz) using CAT6 or Fibre cables
  - o Also carries 200Mbit/s of IP-based data
- o www.supermac-hypermac.com

REAC

o Roland Ethernet Audio Communication

o A proprietary protocol, but based on 100base-TX Ethernet, using CAT5e cable

o Use Ethernet switches for splitting, but need dedicated devices for merging

o 40 audio channels (24bit/96kHz) + some MIDI & control data

    o Just 0.375ms latency

o http://www.rolandsystemsgroup.net/en/0101.htm

Ravenna

o Announced in 2010
o Similar in concept to Dante
  o In fact, uncannily similar…
  o Using common IT equipment and standards
  o Ethernet compatible, yet license-free
o Primarily focussed on broadcast industry
o Just a handful of partners so far
  o Lawo, Innovason, Genelec, Merging…
  o No significant products yet
o http://ravenna.alcnetworx.com/

Review...

	Type	Ethernet Compatible?	Typical Latency	Channel Count
CobraNet	Licensed	Yes	5.33ms	64 bi-directional
EtherSound	Licensed	Partly	0.25ms	64 bi-directional
Dante	Licensed	Yes	0.5ms	Over 500
Optocore	Proprietary	No	0.041ms	1,000
RockNet	Proprietary	No	0.4ms	160
Aviom	Proprietary	No	0.8ms	64
REAC	Proprietary	Partly	0.375ms	40 bi-directional
Ravenna	License-free	Yes	<1ms	Over 500

Proprietary vs. licensed

o Licensed products tend to be more widely available, and its easier to find an "expert" to help with system design or trouble-shooting

o Proprietary products tend to make a more cohesive system, designed with specific applications in mind

   o Therefore, sometimes less flexible, sometimes more suitable…

o Licensed network technology has more information available to users /system designers / trouble-shooters

o With Proprietary products, if something goes wrong, at least you know who to blame!

o Sound quality?

   o Under normal conditions, its impossible to hear any difference!

AVB: a future destination?

o Audio-Video Bridging

o IEEE standardised transport protocol (primarily) for audio and video data over Ethernet

o AVnu Alliance exists to promote interoperability between devices designed & manufactured by its member organisations

o For more details see www.avnu.org

AVB: benefits

o Synchronisation to a common time-base
  o Using Precision Time Protocol (PTP) IEEE 802.1 AS
  o (actually similar to what Dante is doing now)
o Guaranteed bandwidth for important data
  o 802.1Qat Stream Reservation Protocol (SRP)
  o Particularly important in congested 100MB networks
o Priority given to the most important data
  o 802.1Qav Queuing and Forwarding Protocol
  o Regular non time-sensitive traffic will not interfere with audio & video data

AVB vs. Existing Solutions

o Off-the-shelf AVB compatible switches will be easier to use & setup than many of the current switches needed for Dante, CobraNet etc.

  o But more expensive and less readily available (at least to begin with)

  o Regular Ethernet switches will not be compatible with AVB

o Both Dante and EtherSound offer lower latency than AVB promises

  o AVB promises "2ms over 7 switch hops at 100Mbps"

o Existing Dante products will be compatible with AVB after a future firmware upgrade

o There is no license fee for manufacturers to use AVB, so future products should eventually be (slightly) lower cost

Any Questions?

o Thank you for listening…