Audio over IP - how can it work?

Peter Weitzel

peter@weitzel.com

AES

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Motivation

Need to share knowledge and provoke discussion

"My" audio over IP systems have been in service for 10 years
but there is not the general acceptance on AoIP
as being a practical and well used technology.

Try to kick start acceptance and use of AoIP
by passing on what I and my team at BBCT/Siemens learnt
- so that you do not make the same mistakes ….

Pay tribute to the team
and what groups of broadcasting experts can produce…

And perhaps be a bit philosophical (as it is end of the season!) … .

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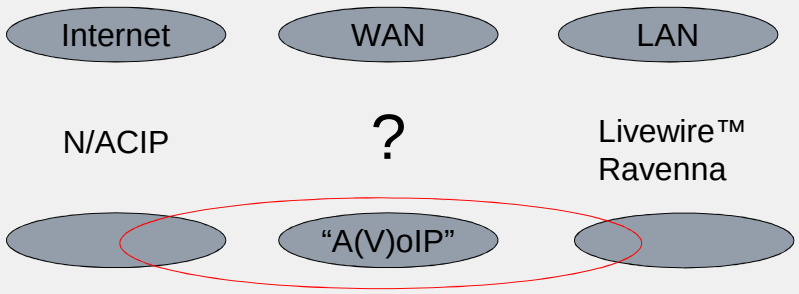
The scope



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Topics covered

1. What is the ONE thing we are trying to achieve
2. Outline TWO working systems
3. The THREE Rules
   Some examples – basics
4. The Team success & failures
   Illustrations
5. Some IP features
   Some examples – more complex
6. Sum up
7. Q&A

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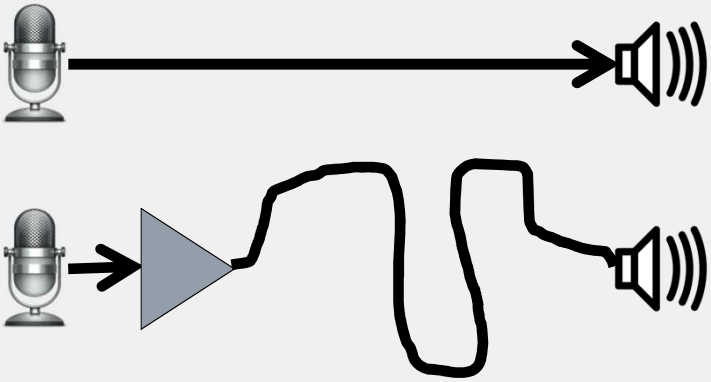
What are we trying to achieve?

Getting sound from one place to another



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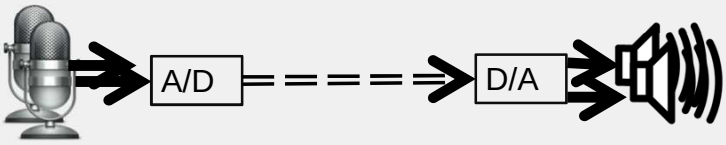
Digits – AES3



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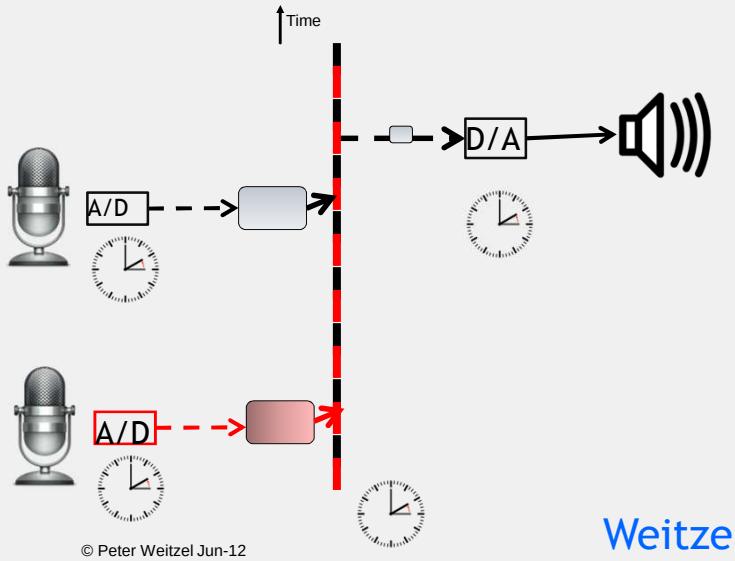
Sharing Telco with others
- and need for some buffers



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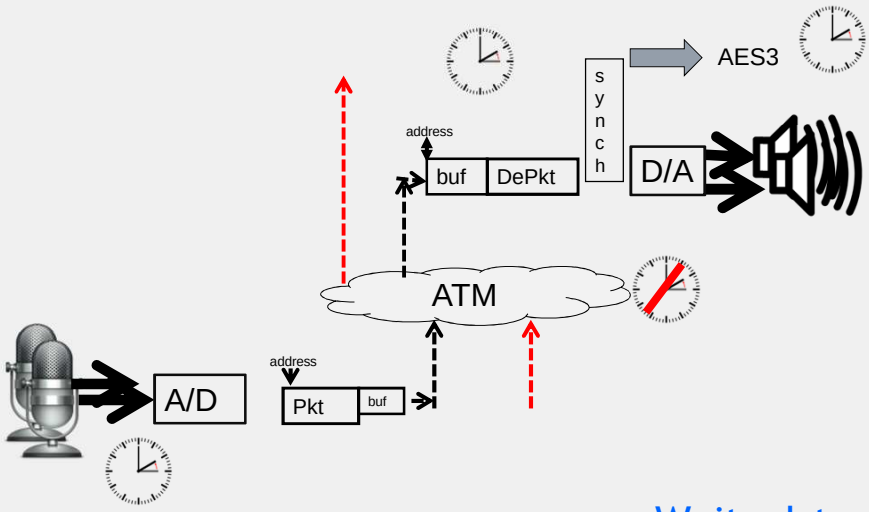
Packetisation – sharing with others AES47



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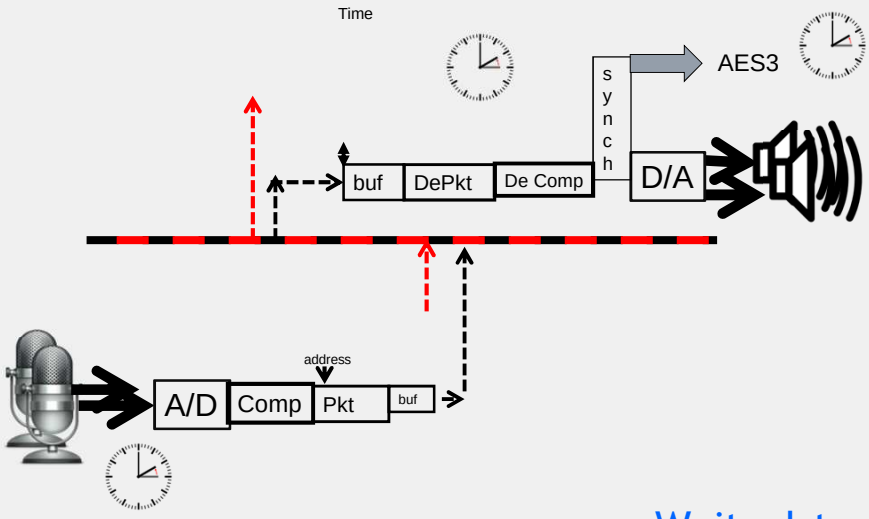
Compression



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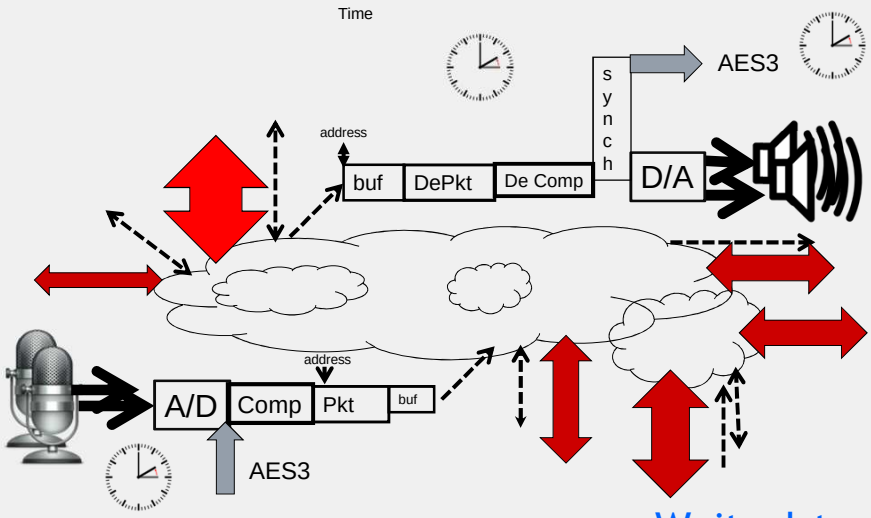
Typical Audio over IP



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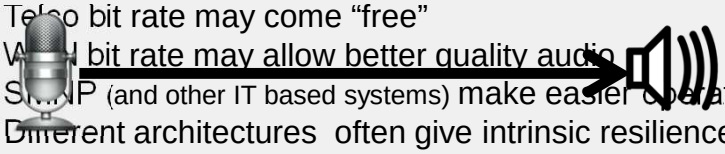
Why IP

Why
- Cheap
- Accountants heard of it
- Universal
- Ubiquitous

Why not for Audio/video
- Non deterministic
- Lossy
- Latency
- "Strange"
- IT Dept. own it

Why Audio over IP ? (WAN)
- Telco bit rate may come "free"
- W[illegible] bit rate may allow better quality audio
- S[illegible]P (and other IT based systems) make easier operation
- Different architectures often give intrinsic resilience
- (may be) Routing comes free / low cost



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Disclaimer

"The passage of time and the separation from official records may have clouded his memory…

Bill Pritchard (Press secretary) in Yes Prime minister Ser2 – "Official Secrets" TX 10 Dec 87

… Not more than you would expect from a man of his age"

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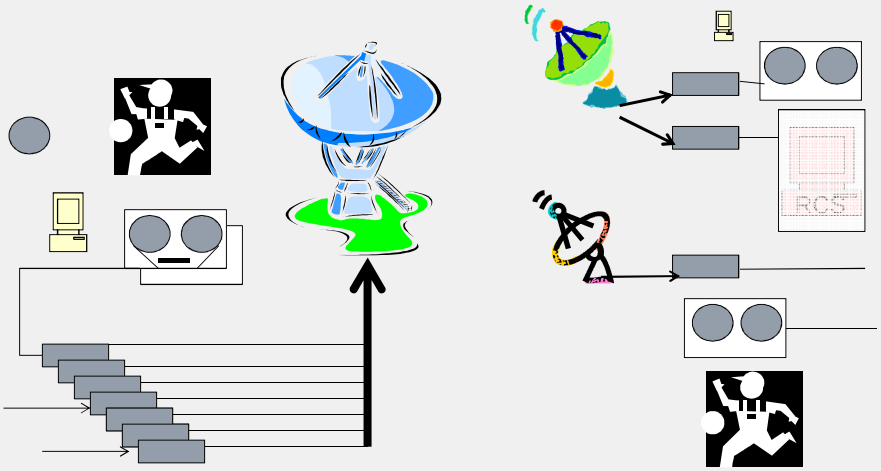
Why IP - NPR PRSS in 2002

http://www.prss.org/contentdepot-index.html



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Why IP = NPR Proof of Concept

Content depot® - to drop Program Files to the subscribing stations .
_ replacing physical tape and Feeds to remotely controlled tape machines

Why use a different way of getting streaming audio over ???

- Penetration into the Stations play out systems
- Need for more/better Control monitor / scheduling etc. … "EPG"
- Feeling for integration - and IP is (sort of) the future

Solution

Complete end to end test rig of

MPEG1 LII over IP over DVB Over Satellite (L band)

(And the DVB /MPEG TS Was both ASI and ASI over IP)

Mainly Private network -

Much education of the NPR staff (and ourselves)

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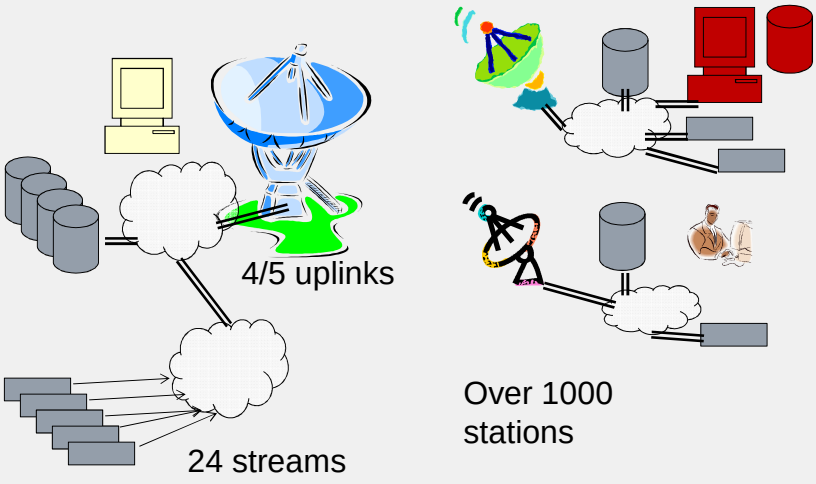
Why IP - NPR PRSS in 2004/5

http://www.prss.org/contentdepot-index.html



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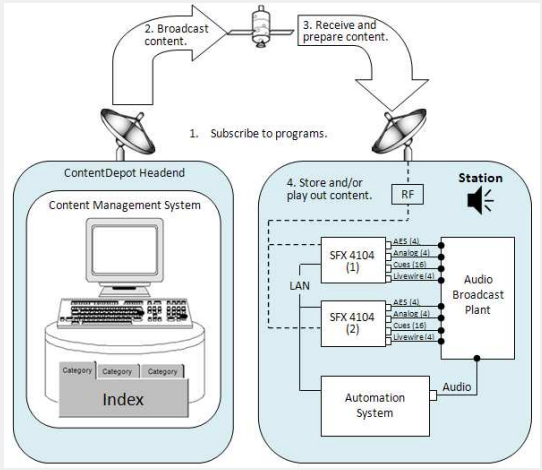
Why IP - NPR PRSS in 2012

http://www.prss.org/contentdepot-index.html



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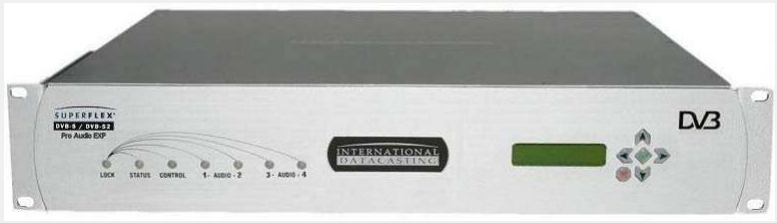
One box - IDC SFX4104 – Storage receiver



Audio output
- Analogue
- AES 3
- Livewire

L –Band in

IP out ….

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BBC case study -

BBC Audio Carriage

London (dark fibre network) - MADI or AES3

RAMAN 26 sites with dual STM64 - Audio as AES 47 (ATM)
plus some legacy J51- intraplex NICAM etc.

Rest UK (Nations, English Local Radio)

- **moved to IP and carrying 20 bit 48KHz Audio**
  E APT-X 576kbit/sec 512byte pkts. 650Kbit/sec IP buffer20ms
  Typically latency c <30ms

The world – increasingly MPLS with E APT-X or MPEG c 128 or 256 Kbit/sec

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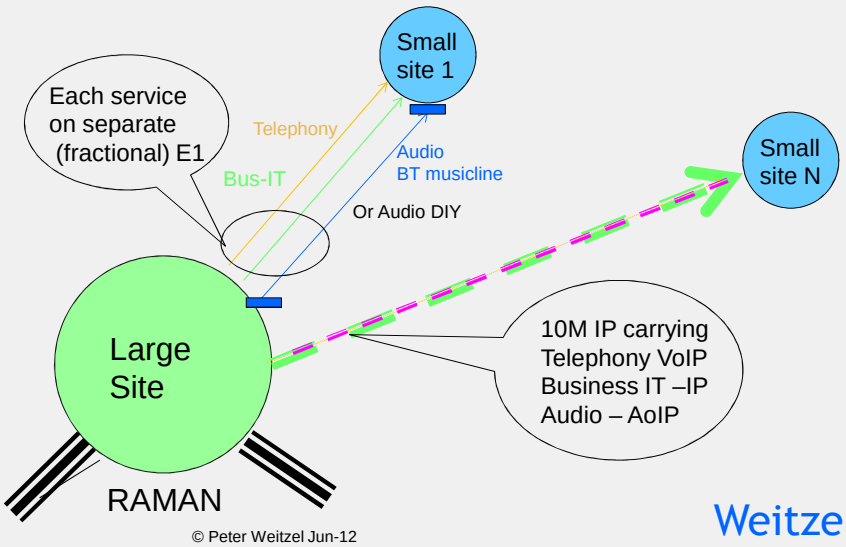
BBC Transformation
…… multiple E1 PDH to 10M IP



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BBC using AoIP- about 60 sites 200 Audio codecs

Nations -and non LR England (Siemens) "redefined requirements"

Scotland about 14 sites - support for Avid and VCS almost anywhere
so some 100M IP circuits … (ISDN backup) c60+ codecs
Video added for BBC Alba (JPEG2000 and H.264)

Wales - 6 sites - 100M/10M - IP network more ring-like c 30- codecs
Video JPEG2000 to and from Bangor and from others to Cardiff

NI - 3+ sites - 100M/10M hub and spoke c 18 codecs

England Odd AoIP . E.g.Rich mix Caversham etc. ..
Video JPEG2000– Northampton and Luton to Cambridge

England LR (C&W Provision) "like for like" mono c 80+ codecs
36 Local radio stations each homed to its regional centre.
(ISDN backup) - many on 100M RS1000D analogue video

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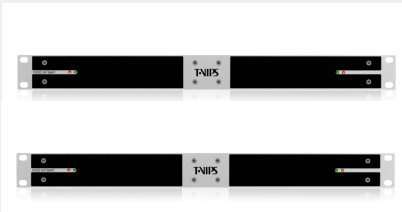
The Kit ….



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Fundamentals

1 In the beginning God created the Heuen , and the Earth.
2 And the earth was without forme , and voyd, and darkenesse was vpon the face of the deepe: and the spirit of God moued vpon the face of the waters.

The FIRST BOOKE of MOSES chap1 vv 1-2

1 In the beginning was the Word, & the Word was with God, and the Word was God.
2 The same was in the beginning with God .
3 All things were made by him and without him was not any thing made that was made

The gofpel according to S. Iohn chap1 vv1-3

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3 rules

Every packet counts

All it needs is just best practice

It is complex because of interrelationships

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Every Packet counts -

What contains your content ???

It is the atomic entity - it is NOT M bits/secs

It may be packets per time interval/window
Or a packet every (milli) Second

BBC Standard AoIP is 20 bit 48Khz E-AptX (=576kbit/sec) In 512 byte packets

140.625 packets/sec – or a packet is 7.1 ms

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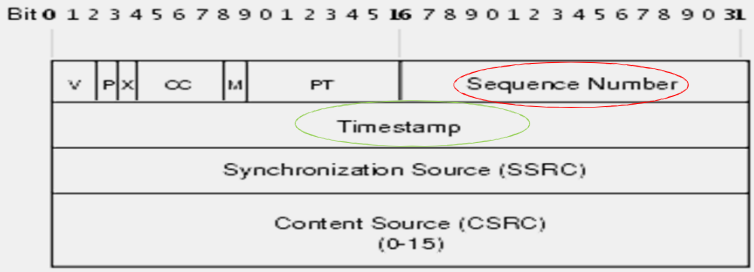
RTP Packets count themselves (RFC1889)



Real time Protocol RTP –described in RFC1889 has a sequence number –so you can see that your packets are out of sequence – and a tiemstamp …
Both very useful for diagnostics and monitoring.

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Every Packet counts
If you loose things …..

It will be a whole packet - not just an odd bit …

So there is a gap in the audio ….

…… and MPEG video can be knocked out for the whole GOP
– sometimes seconds at each lost packet

What causes packet loss???

The Telecom WAN not being 10/100/1000 – Solution- set a terminating router.

Switches / Routers ignoring QOS tagging – Solution - set it up and test it !

Too bursty contending traffic - solution - perhaps limit its max rate
and set up (And test) QOS rules in the switch/Router

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3 rules

Every packet counts

All it needs is just best practice

It is complex because of interrelationships

This is looking after the packets !!!!

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Practical - Contention

Issue
Contention is where two packets are trying to get out at the same time – thus one has to wait.
It happens wherever packet share a resource.

Result is that regular spaced packets have jitter added - because some have to wait longer than others.
Nothing can be done to stop contention

Semi Avoidance – put AoIP in at the terminating router ….

Other Solutions – set up switches / routers with the "right" QOS handling
- noting the other traffic…. You may even make it better! (hint Port limiting)

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Practical - decoder input buffering

As the decoder always need to have something to decode - needs to store some data so that it is not affected by jitter - thus at least two packets ideally - one packet being just processed and one just received
Actually it makes sense to have a minimum of three packets

And as packets can travel by different routes and thus come out a different times - they may not be in the right order?
thus even more buffering is needs to ensure that they are in the right order - say 6 packets ? -
OR ensure that the packets tend to flow the same route all the time …..

Solution - Plan a network for most consistency
then remember and allow for buffer **and the added latency** -
and also when looking at packet size and data rates ….
And look at how the **network may reconfigure**

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Practical Clocks

Issue

As the data is coming in packets which arrive randomly - there is a need to be able to reconstitute the sending coder clock so that the decoder can faithfully reconstitute the signal.

Solution - if possible have a stable (external) frequency reference at the sending end - this could be the incoming stream ….
Ideally this needs to have a good relationship with the receiving end.

Note this is what is the reference source for the sending end
- the receiving end has to cope with what it gets ..

Ensuring that Clocks are on the right domain and understanding the difference between frequency and phase are very important …

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Practical Audio data rate/ Packet size

If the packets are small - there is less latency in the buffering and a more frequent "kick" to lock the clocks ...

But at encapsulation into IP
The whole packet has to be available before it can be launched onto the network...

- This packetisation time is also the amount in time of audio data in the packet -

- Trade off - large packets mean
  - longer packetisation delay
  - More lost if the packet is lost

AND .....

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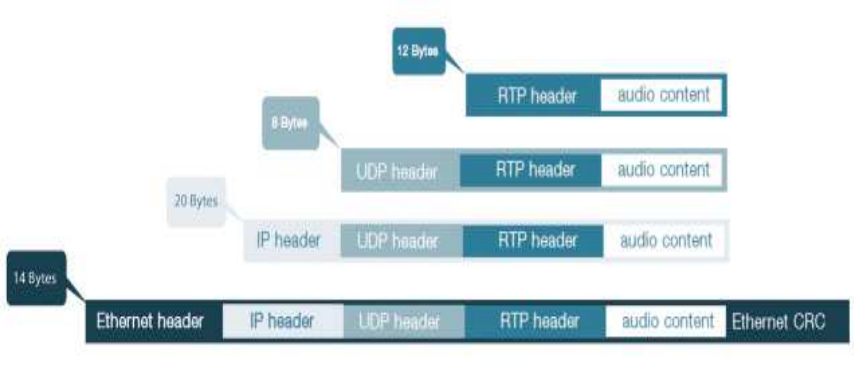
Practical - IP rate > audio rate



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Practical - IP rate > audio rate
The RTP/UDP/IP/Ethernet Overhead

Audio packet size
Plus RTP of 12 bytes
Plus UDP of 8 bytes
Plus IP of 20 bytes
Plus Ethernet of 14 bytes
And a 12 byte CRC
66 Bytes of Header = Overhead

This takes the "BBC stream" 512byte content
from 576kbit/sec Audio to 650Kbit/sec Ethernet
But it is still a packet every 7.1 ms

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IP stats monitoring

Most IP network monitoring looks at Flows over (a long) time
But Every packet counts

What matters is the near instantaneous packet rate
Audio is easy - it is a constant bit rate - MPEG Videos streams are not …
(unless they are buffered ..)

And are there packets
- getting lost - missing
- Or arriving out or sequence
- Or arriving too late to be decoded - missed

Only the decoder can tell you this

Thus the AoIP decoder has to have good diagnostics
on what is being received. (and coder on what is being sent)

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Monitoring & Configuration…. & control?

IP gives a bidirectional path to and from the (remote) equipment -
Thus easy to control and monitor the equipment .

Monitoring

- Basic instantaneous - SNMP
- Checking all OK - Web/XML
- Logging and trends - XML

Configuration

- IP/network - Web SNMP
- Audio -Web XML
- Monitoring /System - Web XML

Control

- Stop start- SNMP Web
- Pre-sets-- Web XML
- Diagnostics -Web XML
- ….. Routing - XML SIP RTSP …..

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3 rules

Every packet counts

All it needs is just best practice

It is complex because of interrelationships

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It all starts with configuration

Every IP device needs to have its IP addresses set before it will work.

Thse must be set (more or less right) or it will not work at all-or worse stop other things working -and other things must be told these addresses ….

These IP addresses are numbers given by the Network manager/ designer (think of a signal traversing a whole building on Tie cables between PO Blocks) - but you need it just to connect the two codecs together …on the bench

Also Codec need other parameters setting - just think of the setting algorithm data rate packets size buffer dimensions etc. .. When has it failed??? all inter relate and make a great difference on how "it works"

Do "analogue" audio devices need all of this doing ??? Or your PC???

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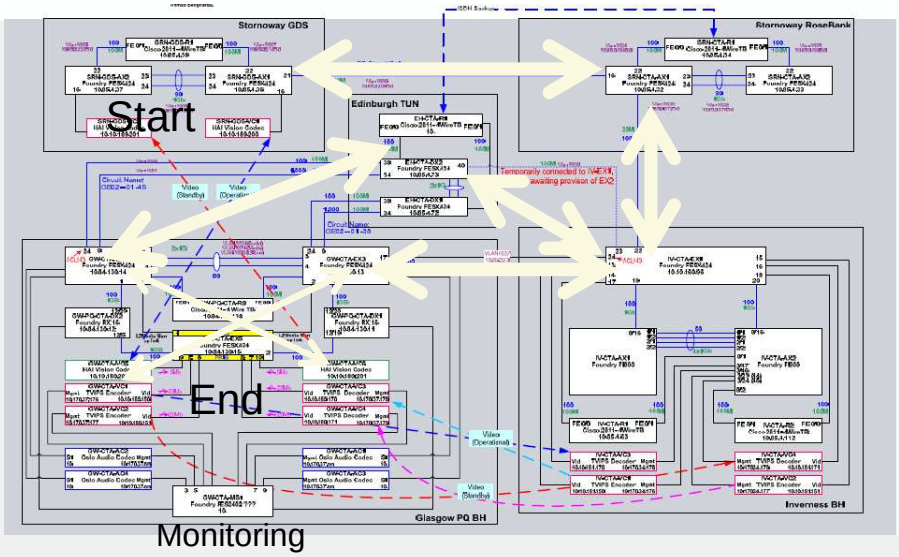
The "real" world with "real interconnections"



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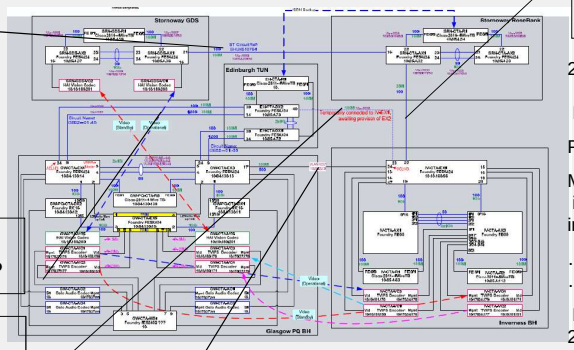
Just looking at the interconnects

100M
Lan extn.



20M circuit
pres on 100M

20/100M lan extn

Imux to 11 / 12 E1

PDH diversity radio link

Mux to 20/100M
into fractional E3
in fractional VC3

… other fraction change
…….

End presentation –
20/100M

Path1 – 2* 100M
circuits GE mux?

Path 1 “100M”
2VC3

Path 2 “100M”
2VC3

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The Team

In our business, one person cannot do anything any more
You create a team of people around you.
You have a responsibility of integrity of work to that team.
Everybody does try to turn out the best work that they can

Steve Jobs – Smithsonian Institution Oral and Video histories 10 Ap. 95

All we are is our idea or people
That’s what keeps us going to work in the morning,
to hang around these great bright people.

Steve Jobs @ Do all things Digital conference 30 May 07

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The Team Key people

BBCT/ Siemens

The Oldies
Peter Weitzel
Peter Calvert Smith
Chris Harrison

The middies
Bob Handscomb
Richard Vodden

The youngsters
Peter Daniel
Lynden Potter
Robyn Smith
Tim Harrison
Andy Clark
James Witham

Plus …..

Siemens Projects
David Seditas and John Chessher
Mike Littlewood, Stephen Redburn

And more ….

BBC client
Steve Westlake and Nigel Adams

Partner - C&W -project team
Nick Jupp Stephen Hope

Suppliers
Techex (TVIPS) Broadcom (APT)

BBC R&D
Chris Chambers
Peter Stevens
Yuan Xing Zhang

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The back story

1999 - Chris Drouet BBC LR – looking for a Programme Share solution –
……..
2002/3 NPR – Proof of Concept

2005/6 to 8/9

- BBC Transmitter OJEC
- Low bit rate video coding .. H.264
- Scotland (and Wales NI) WAN planning
- Scots implementation and C&W England
- High bitrate Video coding JPEG2000 –
- Jerusalem & BBC Alba video – and Wales, Cambridge (& Perivale)
- Wales & NI implementation
- Streaming previews from Beijing
- Super Hi vision First international transmission IBC2008 (with Bidirectional HD and lots of audio co-ord)
- Plus …. SOCA , VSAT SNG …. LR backhaul

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Success factors

"Virtual Technology teams" - as everyone was doing other things
Range of related Projects – so lessons can be learnt from others
Client who understood technology & Broadcasters needs
Working in both Audio and Video – **and managed service**

Enthusiastic Colleagues who were "doing" the Project work

Related experience from wide range of skills & broadcasting backgrounds

More than a critical mass of work – so great economies of scale

Some who understood the need for documentation - Template designs

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What was the cause when it was going wrong?

Not remembering the Three Rules

A great focus on the codec hardware not on anything around it – i.e. the End to End service.

- The choice /config
- …the AV Glue
- …….the network /circuit
- ……..or service wrap –how is it to be operated
- ……..or the overall requirements/aspirations/usage

Lack of Planning, Due Diligence, Communication
Documentation, Process

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Why did it not get off the ground?

Well its IP therefore it is cheap!

BUT

- When requirements were discovered /written down
  …… **it turned out a bigger job than first thought** …. Lots of non IP kit
- It moves costs somewhere else ….
  Move from Capex only to continuing Opex +transformation costs
- It needs a wider view -
  Economy of scale comes from co-operation (which is often not there!)
- "Local Pilots" sort of worked - but were not scalable/ manageable

Finally

- **General lack of money**!!!! Or part of a bigger job which ……..
  Move from doing 250% function for 110% Cost - to needing 99% for 70% cost

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Hot staging/ Lab tests

Set up equipment & configurations to be used in the field .

- Minimal reconfiguration required on site
- Statistical and other data can be recorded in "ideal" conditions
- Opportunity for familiarisation and training of operational staff
- Easy to get the experts around the systems
- Helpful to have contending traffic generators !
- Easy to create/ check documentation.

Lab / Proof of concept testing -

- Document what you are going to do and why and expected results -
  and then what the actual results are -
  why they are not what as expected and what are the next steps….
- Run Standard Regression tests regularly … A bug fix or config change can change other parameters.
- Look/ listen to what is going on - do not just rely on instrumentation…

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Lissajous

Scenario -in the early days
A Test Contribution Circuits had glitches – but no obvious IP Packet loss….
Action
Replicate in lab ….
Thought
Clocks not being locked thus buffer control lost ?
So set up a Lissajous figure between what was being sent and what was returned on a loop back
Result
Interesting patterns and often a constant drift – and glitches
A quick test for any contribution circuit is to loop back and do a lissijous figure

NOTE
In the lab we would test Codec 1 to Codec 2 to Codec 3 looping through the audio …. We always demanded Three codecs for all testing .

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The Glitch recorder

Scenario
How do you do acceptance test with a criteria of <1 glitch /24 hr.?

Action
Define what a glitch was !?
Thought
“It was not normal audio”
Result
Use a 1Khz tone and a 1Khz notch filter …..
– anything else must be noise or a glitch - thus detect the glitch and log it
Solution
Set up the tone source and filter - with sampling scope to record the shape of the glitch and trigger a looping recorder to hear the glitch ….
This also linked glitching to packet loss and enabled acceptance test on what the decoder packet loss was rather than listening/ logging audio.

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Glitch set up

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The replug test

See what happens if

1. Unplug Power then replug it
2. Unplug Input and then replug it
3. Unplug Output and then replug it
4. Power up with no input and then replug input
5. Power up with no output and then replug output

et cetera

What about having a physical input but no signal???
Or Unplug = depower the unit which is source or sink????
Or what is effect on downstream kit ????

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Test equipment

IT kit
Monitoring on the codecs
(hence lots of Web browsers PCs)
Wireshark and Wireshark ….
It's free

Some IPTV kit (Bridgetech)
Means of monitoring on routers

A circuit tester – (JDSU)
good for Contending traffic if no Generator

Odd small switch/ hubs etc…
May be some WAN emulators

Audio / video
All the usual-
but always more than you think
(In lab testing minimum of 3 codecs are always in use.)
Hence e.g . 24 way Bar graphs etc. -
and Loudspeakers (picture monitors))

Perhaps a glitch tester

Lip sync testing – also does latency .

And a scope for Lissajous
And some trustworthy recorders …

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Technology understanding

Fundamentals were learnt fast (but amnesia could set in)

We were finding out –often quicker than our suppliers ….
But things could be counter intuitive -until investigated
Having a view as an **end to end** user was helpful
- but sometimes infuriating to others!

We saw vast improvements in what can be supplied …

But still a lack of understanding on user interfaces,
and work on control and monitoring needed.
- AoIP kit has to work with other things and the Telco
…… and that operational staff may not be (broadcast) savvy ….

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Understanding Different worlds

IT	Broadcast
Siloed no E2E view	Integrated see E2E
But expert in their silo	(but sometimes not in the middle)
Do not test & rarely check	Test and check things
Do not worry about it working	Devoted to getting it working
Do not understand packets	Do not understand IP packets
(Very few understand networks)	(but do DVB/MPEG)
Driven by Process	Driven by intuition and reason
Say they document things	Tend not to write much down

These are just different cultures - both are right (or wrong)

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Project management understanding

Rules 2 and 3 apply!!!
Infrastructure projects are complex - they have at least 2 sites! -and tend to have dead lines given by others ….. The PM is not always as in control ….
Introduction of new technology is not straightforward ….
Getting the best of broadcasting and IT techniques is near impossible
Remember deliverable is a **managed service** ….. Not a working installation

Need skilled and informed staff - >> basic knowledge plus documentation.
"I understand IP therefore I can do it … just busking it!!!..
When there were skilled staff it was magically easy!

Needs work done at the start - Requirement capture and documentation - expectation management and then "due diligence" when the project starts up (often years later)
Things change- and you are never starting from where you ought to or should be

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What for a managed service?

Getting Broadcasters (and IT) folk to think define and agree
What are the deliverables and (K)PIs ?

Audio Quality, Availability,
Presentation and demarcation
Specification of what is input – and what is output?
What happens and who does what when it goes wrong ?
Who is looking to see all is well ???

Is it fit for purpose? – bearing in mind (all) costs

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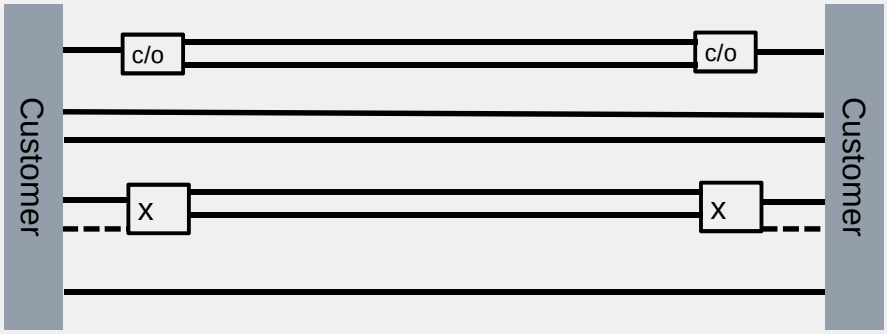
Example - a single circuit may be….



What are the requirements ? what is the contracted SLA?
Will the customer require/pay/ afford the level of service?
How is the required resilience achieved inside
(and outside) the IP domain? –and will it work?

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Operational understanding…

AoIP need “buy in” from both IT and broadcasting teams
… and “sell out” of some monitoring from IT to broadcast

The users need education about managed service –
and expectations managed….. As AoIP is cost effective not perfect

The equipment can be remote – and yet control and monitored
remotely – in exactly the same way as it is “across the room”

Complexity means that there needs to be some process/ check lists .

When it all works for weeks on end without even a glitch ..
Is the underlying Telco circuit still within spec ??

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Non Modo …sed etiam

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Some IP features

QOS
Multicast
Routing in the fabric
Control & Monitoring
LAN systems
N/ACIP
ISDN replacement
FEC (And its latency)
Error free with minimum delay
Some Ideas …….

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QOS

Quality of service - tagging the outputs (and the router ports) so that the Audio over IP packets get handled appropriately through the network. Assumes that all switchers routers etc. are set to recognise the tagging… !

Gold - for the fastest packets in the network - nothing must delay them - like IGMP ….. But has limited bit rate with hard boundaries

Silver - has some priority over Bronze - has a more flexible bit rate limits with Bronze - but will delay packets … may be used for media file transfers.

Bronze - the lowest of the low …. Has the greatest bit rate allocated - and is ideal for file transfers of a general type … as well as media files.

So where do you put AoIP ???

https://tech.ebu.ch/docs/techreview/trev_2012-Q1_all-ip_network_nicholson.pdf

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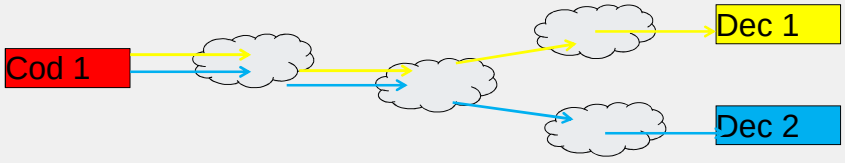
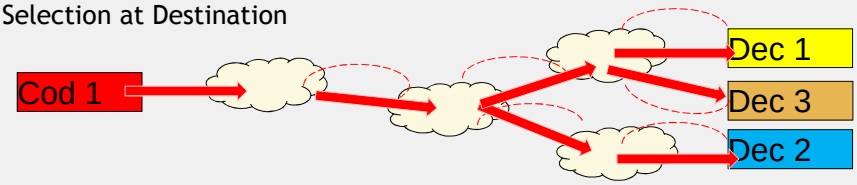
Multicast /Unicast basics

Unicast - point to point connection from source to destination
Selection at Source



Multicast - point to Multi-point connection from source to destination
Selection at Destination



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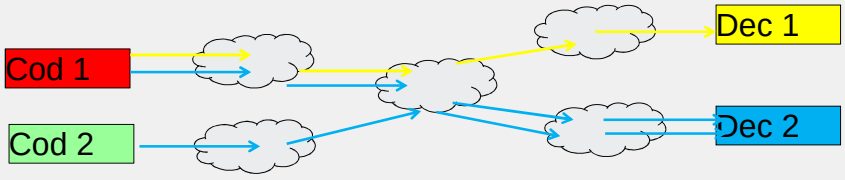
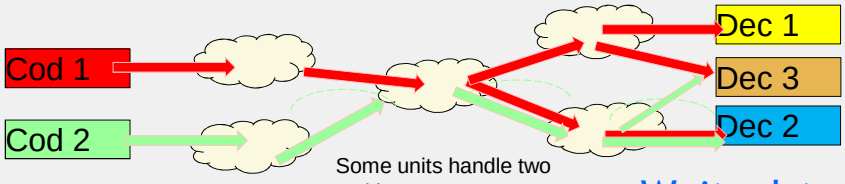
Multicast /Unicast switching to a second source

Unicast - point to point connection from source to destination
Selection at Source



Multicast - point to Multi-point connection from source to destination
Selection at Destination



Some units handle two
Multicast streams

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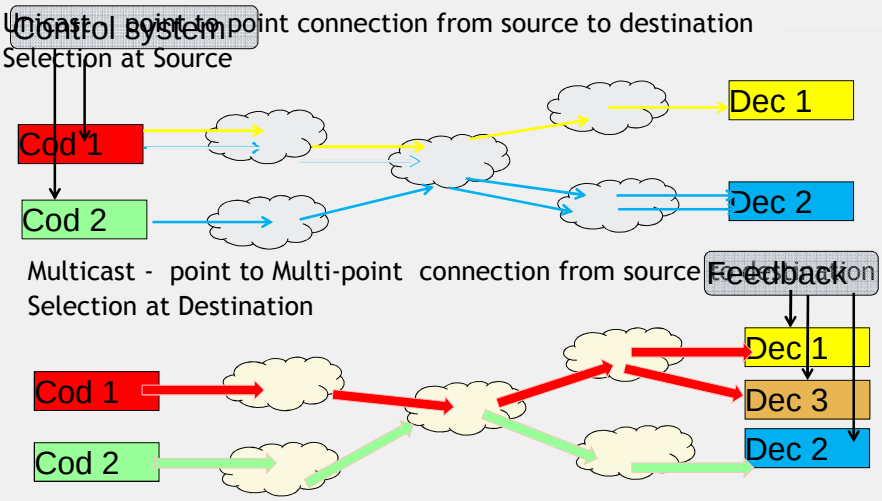
Multicast /Unicast – Routing issues

Unicast - point to point connection from source to destination
Selection at Source



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Routing control

To route over the IP fabric …
- Explicit commands to the codecs
- Implicit network protocols to set up and breakdown the route.

Many ways of commanding units
– and SNMP /Web interface can **monitor** what has happened …

The network protocols take time to reconfigure and sometimes do not breakdown routes – hence reserving capacity where there is no need or not knowing what has happened to terminal devices.
Protocol may reconverge the network in a way which is not Audio friendly!

Do you use a separate physical network or VLAN or ?? for routing Control
As usually a separate physical "Monitoring configuration and (tech ops) control".

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Early Audio over ????? In the studio centre

Live wire – packetized Audio – firstly at layer 2 (Ethernet) more latterly at Layer 3 IP
Many others typically over Ethernet – and some just using CAT5 cables!

Makes it easy to connect and route audio in a station using cheap kit – like Layer 2 switches and RJ45 double enders
But **was** separate network - replacing (as it is USA) lots of screened pair funny connectors and generally wired spaghetti.

Europe
notably Lawo - AES47 with Media devices and routers etc. – another separate (ATM) network

MADI routing and transports

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Ravenna (linear audio)

Real-time Audio Video Enhanced Next-generation Network Architecture

Streaming *MUST support multicast and SHOULD also support unicast.*

Time Synchronization & Media Clock Generation PTPv2

Transmit Operation - time stamped at buffer entrance
Receive Operation - put in buffer according to time stamp and then clocked out at the appropriate time

Routing

Stream Description SDP - IP address and port numbers ,synchronization source payload format ,channel count, sampling rate etc. ….
Connection RSTP - Transmitting nodes act as RTSP servers,
- receiving nodes as RTSP clients *(HTTP SHOULD be also available)*
Service Discovery DNS-SD Service discovery requires a net-wide database that can be queried for available services.

Live wire is now compatible with Ravenna

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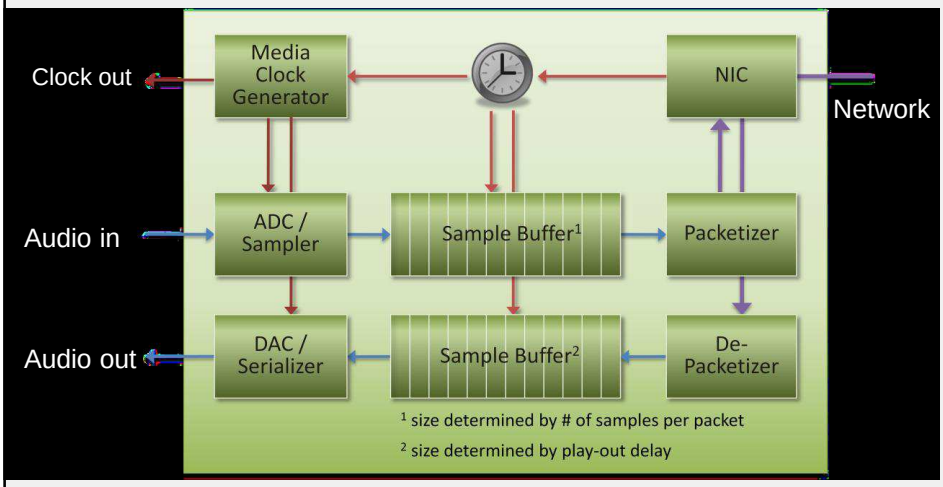
Ravenna Node



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EBU N/ACIP
Audio Contribution over IP EBU Tech 3326

Got interoperability imposed at the Start (unlike ISDN!)
.. And was very timely !!!

Not just the theory - but Plug fests -
and helpful "hand book" Tech 3329

…. And spawned a range of other ..oIP Groups
like VCIP and I3P (tech 3347)

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ACIP – (compressed audio)

Streaming *SHOULD support multicast and MUST support unicast.*
NO Time Synchronization & Media Clock Generation
Defines mandatory and optional codecs

Routing
Stream Description SDP - fields 'v', 'o', 's', 'c', 't' and 'm' are mandatory
plus usually a=rtpmap:<MIMEtype> ..etc. .
Session announcements SAP -
Session management SIP. - codec negotiation to set up the link .. port5060

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ISDN

ISDN is good –

But will it not be available?
what does it cost to do new?

Think service – ad hoc,
regular use, back up …
Then Audio quality and
reliability ……

There is NO single replacement…
- Phone
- Mobile phone
- IP over Mobile Phone
- Fixed AoIP
- Audio over single DSL (ACIP)
- Skype
- IP over Satellite

But EBU N/ACIP has done so much to get AoIP interworking
But it needs public SIP servers to emulate the function of ISDN

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Practical FEC generation

If you are going to lose packets – how about adding a few so that you can reconstitute the lost packets …..

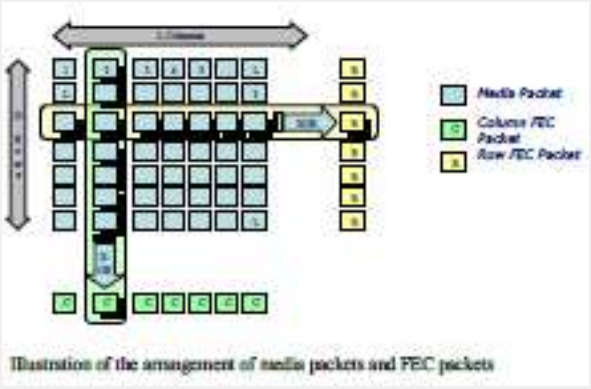

Illustration of the arrangement of media packets and FEC packets

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But it adds latency …..

At some point you need all [7] packets buffered into an array …
Plus the two FEC packets

So this is say another >7 packet delay – and then the decoder buffer –
Say 10 packets latency and a minimum ??? 70 ms – (think missing and missed)
may be OK on Distribution….

Also IP data rate is non constant … C….C….C….C….C….C….CFF.C ….C,….
Routers might not like that !!!

Also adding more data – thus more chance of overloading and loss …

Get your IP path good enough so you do not need FEC

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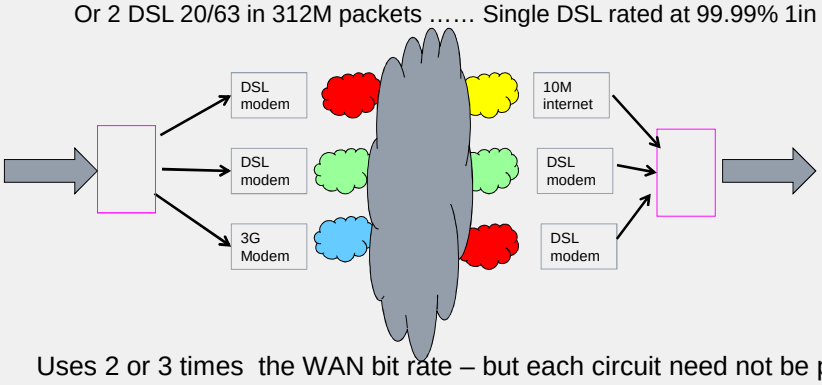
Or replicate over many cheap circuits…

Typical losses 32/35 packets over 50 days – c545M packets – 3 DSL:

Or 2 DSL 20/63 in 312M packets …… Single DSL rated at 99.99% 1in 10K



Uses 2 or 3 times the WAN bit rate – but each circuit need not be perfect …… so long as the same packet is not dropped all at once …

….And there is no buffering …..– thus lowish latency

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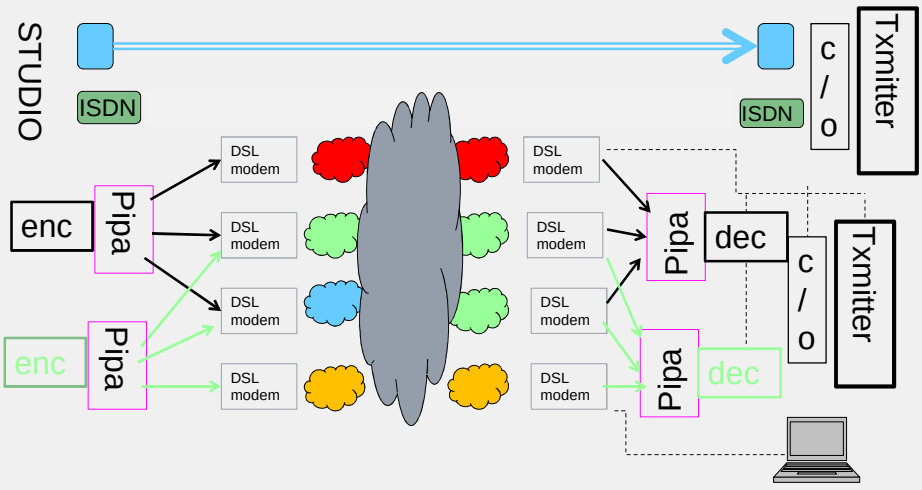
Use as an STL



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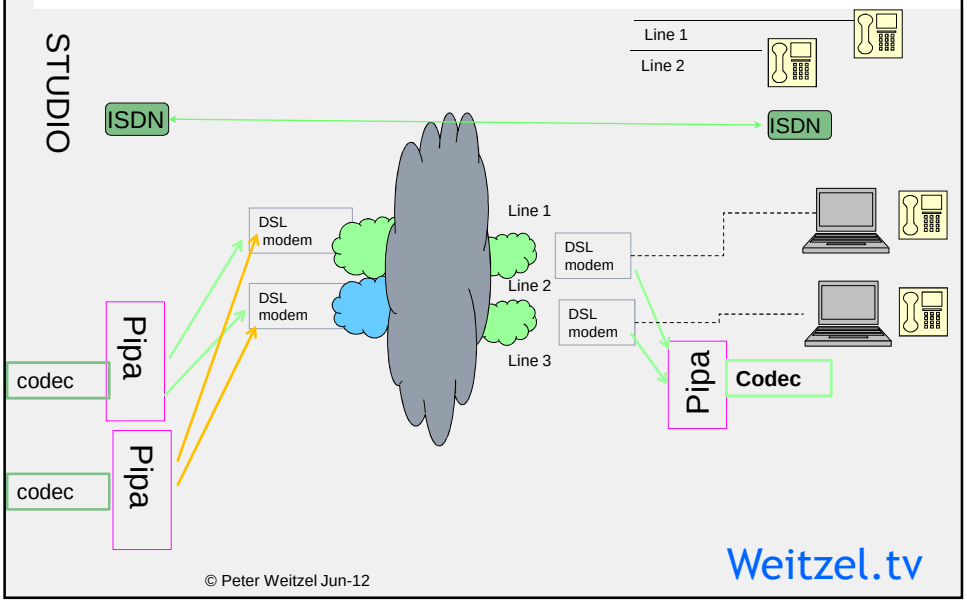
Or to a Regional office



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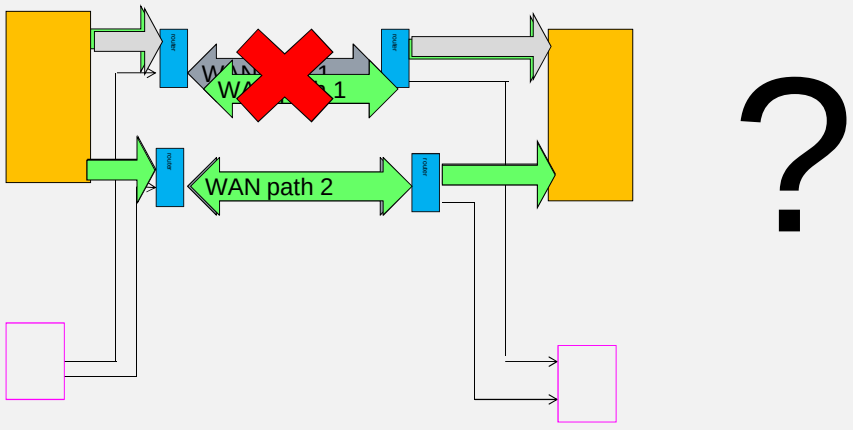
Resilience - Hitless switching



Resilience models are not simple
– and often N+N is cheaper than N+1 due to audio routing costs

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Some more BBC work NGN pilot

The BBC recently carried out a Next Generation Network (NGN) pilot to examine the feasibility of providing a single IP network for both broadcast and enterprise traffic. (using MPLS)

Although the **pilot was a success** and a useful learning experience for the teams involved, they **identified various hardware problems** that need to be solved and **the limitations of the control system.**

So, although the **NGN pilot did not provide all the answers**, it certainly was a good starting point.

Can we carry broadcast traffic reliably over IP to match the current SDH platform?
Can we do "anywhere-to-anywhere" routing in the IP domain?
Can we successfully mix enterprise and broadcast traffic in a single network?

EBU TECHNICAL REVIEW – 2012 Q1
https://tech.ebu.ch/docs/techreview/trev_2012-Q1_all-ip_network_nicholson.pdf

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Summing up

Life is a complex whole. It can only artificially be separated into parts, analysed.

Introduction to Group Analytic Psychotherapy SH Foulkes 1948

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Sum up

Why Audio over IP ? (WAN)

- Telco bit rate may come “free”
- WAN bit rate may allow better quality audio
- SMNP (and other IT based systems) make easier operation
- Different architectures often give intrinsic resilience
- (may be) Routing comes free / low cost

None of this is definite – like IP it is all non deterministic

IP circuits can be very cheap … but they are very different and need to be handled differently and carefully

Audio over IP Works and is very cost effective
BUT is does have some limitations

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How to do it – a Project Check list

The **Requirements** – levels of service and **expected** performance must be acquired, agreed and documented at the earliest opportunity.

Then

IP router and broadcast experts need to work together in the design and testing of equipment and systems

- Network configuration has to deliver:
  - Interference free media over guaranteed bandwidth
  - Redundancy with manual or automatic failover
  - Safety of other traffic – wrong coder settings can swamp network
  - Special provision for encryption
- Broadcast configuration has to deliver:
  - Reliable, synchronous pictures and sound
  - Broadcast quality signals
  - Routing(AV Glue) and monitoring for maintenance and control

Both have to hand over documented working systems to Operations

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Installing a media network

Plan your network
- Physical, Capacity, VLANS/ ACLs/ Address ranges

Know
- your IP network equipment Codecs, Switches, Routers etc.
- your Telco and its equipment- Test and monitor all Telco links

…and inform your users – **Audio over IP has Limitations**

Test a network model configuration first

Ensure the network is well managed
- Ensure a QoS structure is set and maintained
- Use good planning and Change control to add codecs
- Monitor the network for unauthorised additions.

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Other things learnt

Many things are counter intuitive ….
……. Until you work out what is actually happening.
Think what "service" is required – and the Resilience model
– not the Technology solution to deliver it

The different worlds of Enterprise IT and Broadcast engineering
and the need for BOTH
"interesting implementations" result of "**Being your own Telco**"

Planning, Requirements/Criteria, Expectations, Documentation, Process

Work still needed on Monitor and Control – and Routing

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And do not forget …….

Every packet counts

All it needs is just best practice

It is complex because of interrelationships

?

ANY QUESTIONS

Peter@weitzel.com
www.weitzel.tv

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Some web addresses

Overall description of Audio over IP –there are others
http://www.aptcodecs.com/radio-32.html (look for AoIP guide)
http://www.mayah.com/support/support-downloads.php

PRSS http://www.prss.org/contentdepot-index.html

ACIP

http://tech.ebu.ch/docs/tech/tech3326.pdf and http://tech.ebu.ch/docs/tech/tech3329.pdf

http://downloads.bbc.co.uk/rd/pubs/whp/whp-pdf-files/WHP170.pdf

Ravenna http://ravenna.alcnetworx.com/technology/about-ravenna.html

Pipa
http://www.broadcom.co.uk/pages/files/spec_sheets/broadcom_specs/Pipa/PIPA_Datasheet.pdf

Wireshark http://www.wireshark.org/download.html

BBC NGN Trials https://tech.ebu.ch/docs/techreview/trev_2012-Q1_all-ip_network_nicholson.pdf

This presentation on my website www.weitzel.tv Peter@weitzel.com

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