Greening of Streaming

LESS Accord Project Introduction

Members of Greening of Streaming

idbas

HELP ME RESEARCH FOUNDATION STREAM

Akamai

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ATEME

AXELLO MAKING MEDIA MOVE

MAINSTREAMING

RADIANT [MEDIA] PLAYER

VARNISH SOFTWARE

Synamedia

broadpeak

AMD

V-NOVA

einbliq.io

G & L

DAZN

iSIZE

LUMEN

cognizant

Coherent Logix

Microsoft

Agama

QUANTEEC

Humans Not Robots

Affiliate Members

SVTA Streaming Video Technology Alliance

EBU

arte

DTG THE CENTRE OF UK DIGITAL TV

iabm

Fraunhofer FOKUS

Agenda

3pm Quick intro to GoS and LESS Accord - Dom + Barbara

3.10 - Project 1 - Simon Jones

3.20 - Project 2 - Sam Orton-Jay

3.30 - Project 3 - Arian Koster

3.40 - Project 4 - Dom Robinson

3.50 - How to get involved with GoS and Keep up with sustainability and emerging policy in the industry - Neil Howman (’The Flint’) + Janet Greco (Media Media And Greet) + Lisa Collins (MTSS)

4pm to the Beach!

What is Greening of Streaming?

A members association formed from the stream encoding and distribution operators and technology service providers with the intention to make real changes through education and engineering, through the development and propagation of best practices.

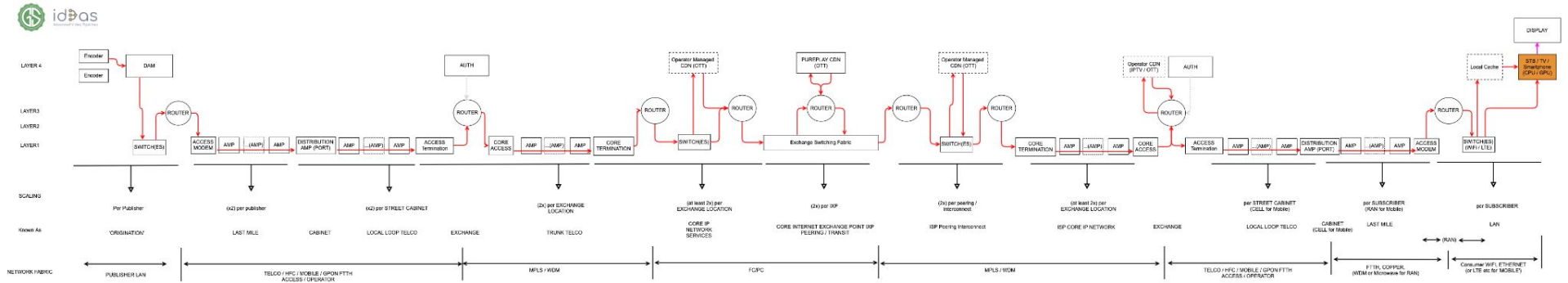
We are a forum for our members to discuss internally and externally issues focussed primarily on energy efficiency in the streaming sector.

As a key growing use of the Internet, Streaming has become the ‘tail that wags the dog’ of large telco and broadcast infrastructures. Greening of Streaming is ensuring there is a focus on energy, and fundamentally also on the sustainability of the sector.

We do this by forming and driving working group activities led by our members.

We have also introduced the LESS Accord projects which are open to non-member participation by invitation from the membership. These focus on specific areas that the industry as a whole feel need collective attention.

Scope - From Origination to Consumption



Workflow Engineering

WG4
Distribution
(Stream Delivery)

WG6
Transcoding
(Stream Origination)

WG8
Decoding
(Stream Consumption)

LESS

Greening of Streaming

Working Group & LESS Accord Project Alignment

Scope of activities in key WGs and how they interlock with LESS Accord projects

WGs are private to GoS. White areas are key areas of focus. Red are primary objectives, Grey are secondary objectives, with orange boxes showing the overall aim of the working groups.

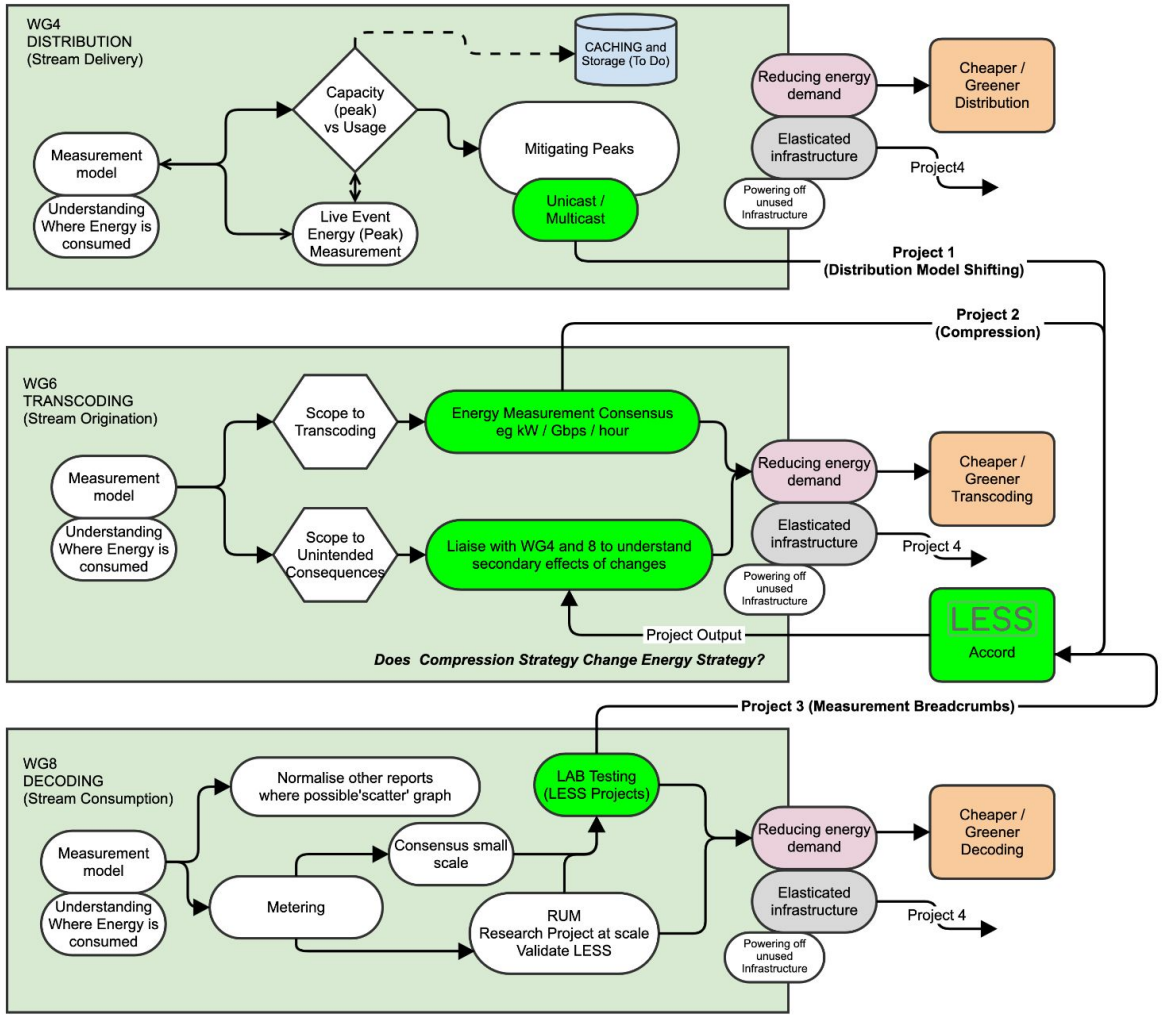
LESS ACCORD Projects (bright green) may involve non-members.

Notes:

Project 4 is 'stubbed' because while it should be considered, at this stage, without any data, most of the options around hardware and resource deployment are constrained to basic operational and economic decisions. In time these stubs will open up as the data in the model shown can be used to inform those discussions.

At the moment the workflows being explored are focussing on live / linear. Storage and caching (blue cylinder) of data mid-stream adds time-shift complexity and more, and is viewed as a second stage of exploration once the core linear streaming models are understood.

There are many other interconnections with other working groups and external activities that are not shown in this diagram.



The Projects

- **Intelligent Distribution Model Shifting**
  Can we better define when each of 3 distribution models (Unicast / P2P / Net Layer Multicast) is the most energy efficient, and implement decisioning to help CDNs seamlessly move among models based on energy efficiency, much the way a car shifts gears to optimize performance?
- **‘Good Enough’ Codec / Ladder Configuration**
  Can we save energy through codec choices and optimisation and demonstrate real-world energy reduction while maintaining ‘good enough’ quality for audience consumption?
- **Energy ‘Breadcrumb’ Metadata Stamps (to drive energy aware workflows)**
  Can we obtain useful energy information from streaming systems to intelligently determine workflow strategy based on ‘energy context’ and create a container / manifest layer control plane for such decisions?
- **Hardware and Infrastructure Optimisation**
  Can we combine technologies such as optimised silicon, immersion cooling, relocation etc. to move existing workloads (encoding / caching) to different hardware environments to realise significant energy efficiencies?

Project 1 : Simon Jones

Low Energy Sustainable Streaming (LESS) Accord

Intelligent Distribution Model Shifting
Project One Introduction

Dr Simon T Jones
BT Distinguished Engineer
SMPTE Fellow

LESS Accord Project One

Intelligent Distribution Model Shifting

- Can we better define when each of 3 distribution models (Unicast / Peer-to-Peer / Net Layer Multicast) is the most energy-efficient?
- Can we implement decisioning to help CDNs seamlessly move among the distribution models based on energy efficiency, much the way a car shifts gears to optimise performance?

Unicast

- Unicast uses origin servers and ‘CDN proxies’ to create a distribution tree.

Peer-to-Peer (P2P)

- P2P uses leaf nodes to create a distribution tree. Can look like ad-hoc unicast ‘CDN’. Lacks QoS but reduces ‘cache commitment’.

Network Layer Multicast

- Configures the network itself to stream-replicate, reducing / removing the number of application servers but adding network configuration, particularly at inter-domain interfaces.

LESS Accord Project One

Key Activities

- Define the Distribution Models and Content Types
- Define Energy Models for each distribution model
- Identify what needs to be measured
- Identify the parameters that influence which ‘gear’ is best for each ‘road’ condition

Key takeaways from June discussions

- We should scope to identify different energy demands of the three distribution models of unicast, multicast and explore P2P at different scales of distribution
- We should be clear about the target devices, understand the support for the different models of distribution in reach to those devices, and any model should take this into account
- QoS is an important factor - each should have a defined redundancy strategy. It is acceptable to use other distribution models as failovers.
- We should be considerate of how any such distribution model choices impact other traffic on the networks, and understand who is in control at each layer of operations.

Distribution and Replication

Distribution Models

Unicast Distribution

- Open Internet unicast
  - Transactional web data
  - User to user communications
- CDN managed unicast
  - Volume web data; static data, images, …
  - Video delivery

Peer to Peer Distribution

- Open Internet P2P
  - File distribution
- Managed P2P - *Not widely deployed?*

Multicast Distribution

- Open Internet Multicast - *Not widely deployed*
- Operator Managed Multicast
  - Live trading data
  - Video delivery

Replication points

CDN Managed Unicast Distribution

- Caches at
  - Internet peering
  - ISP Core (ISP metro)

P2P distribution

- Distribution distributed throughout network

Operator Managed Multicast

- Redistribution at switch onto downstream links
  - Static multicast
    - Redistributed onto every downstream link
  - Dynamic multicast
    - Distributed when stream required downstream

Content Types and Mapping

Content Types

Video Streaming

- Live Streaming
  - Viewing with seconds of live
- Channel Streaming
  - Content selection by channel

Video on Demand

- Individual selection and viewing by item

Download

- Distribution without viewing

Content Type Mapping

CDN managed unicast

- Live Streaming
- Channel Streaming
- Video on Demand
- Download

Operator Managed Multicast

- Live Streaming
- Channel Streaming

Peer to Peer Distribution

- Streaming
- Video on Demand
- Download

Hypotheses to test

Number of network elements carrying streams will differ between methods

- Will drive total network tragi and hance network capacity required

Individual stream bandwidth will equally impact the methods

- Will equally drive capacity of an element carrying a stream

Relationship between network traffic and energy consumption is a non-linear function

- More likely a step function based on installed capacity
  - Capacity is install to meet peak demand

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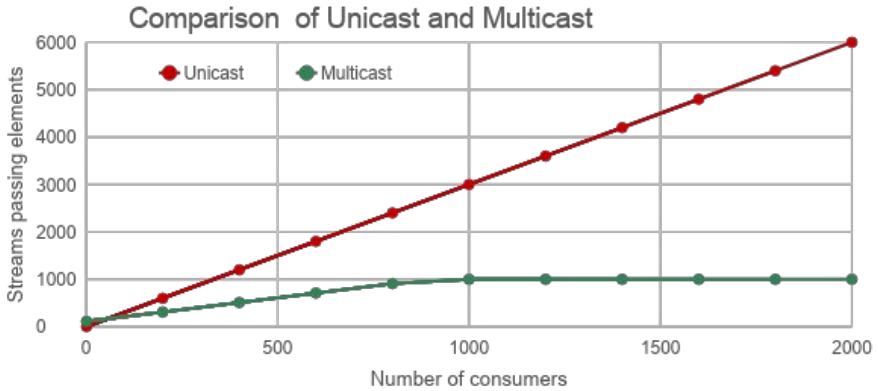
Operator Multicast and Operator CDN Network Traffic



Model for typical network hierarchy

- 10 Core, 100 Metro, 1,000 Access interconnect
- Static multicast in Core, dynamic in backhaul

Simplifications

- No consideration of access network
- No counting of origin to CDN or multicast root
- Consumers evenly distributed across Access

Network capacity demand

- Multicast requires one video stream
  - from Core to each Access network
  - Traffic scales by number of channels
- Unicast requires one video stream
  - from CDN cache, at core, to each consumer
  - Traffic scales by number of consumers

Questions

- Impact of static multicast?
- How to model Peer-to-Peer?
- When is multicast appropriate?

Closing

Next steps

- Get the key activities underway
  - Model, measure, review and recommend

Invitation to participate

- Participation is welcome from all members
- Inputs accept from everyone

Low Energy Sustainable Streaming (LESS) Accord

End

Dr Simon T Jones
BT Distinguished Engineer
SMPTE Fellow

Project 2 : Sam Orton-Jay

Low Energy Sustainable Streaming (LESS) Accord

Project 2:

‘Good Enough’ Codec / Ladder Configuration

Sam Orton-Jay
VP Product, V-Nova

Can we save energy through codec choices and optimisation and demonstrate real-world energy reduction while maintaining ‘good enough’ quality for audience consumption?

Key activities

- Development of a measurement framework for calculating the energy used in transcoding for a wide range of common use cases/formats.
    - Primarily defining an approach to measuring power usage per hour for common compression formats on a range of commonly deployed hardware/software configurations
    - Participants can then submit numbers (anonymously if necessary)
- Leveraging WG8 work for decoding/playback power measurements across a range of devices
- Incorporate a survey element to estimate energy profile of a range of services based on the indicative data from the real measurements in steps 1&2. E.g. for a service to record:
    - No. of hours of output content transcoded
    - Resolution/codecs/bitrates used
    - Hours of playback on different device types
    - etc.
- Drive a discussion with academia/vendors/groups to evaluate the potential energy savings due to deferred infrastructure investment over time should peak traffic be reduced by employment of different compression strategies to significantly reduce bandwidth needs.

Next steps

- Drafting activities on transcoding measurement framework to begin immediately in working group 6
  - Target initial data collection from participants by end of 2023
- All encoder software/hardware vendors and contributors are welcome to get involved
- Also calling out for participants who can contribute to the analysis of potential infrastructure investment deferral based on compression-lead traffic reduction

Project 3 : Arian Koster

Low Energy Sustainable Streaming (LESS) Accord

Breadcrumbs
Project Three Introduction

Arian Koster
TNO Green ICT
Greening of Streaming secretariat member

LESS Accord Project Three

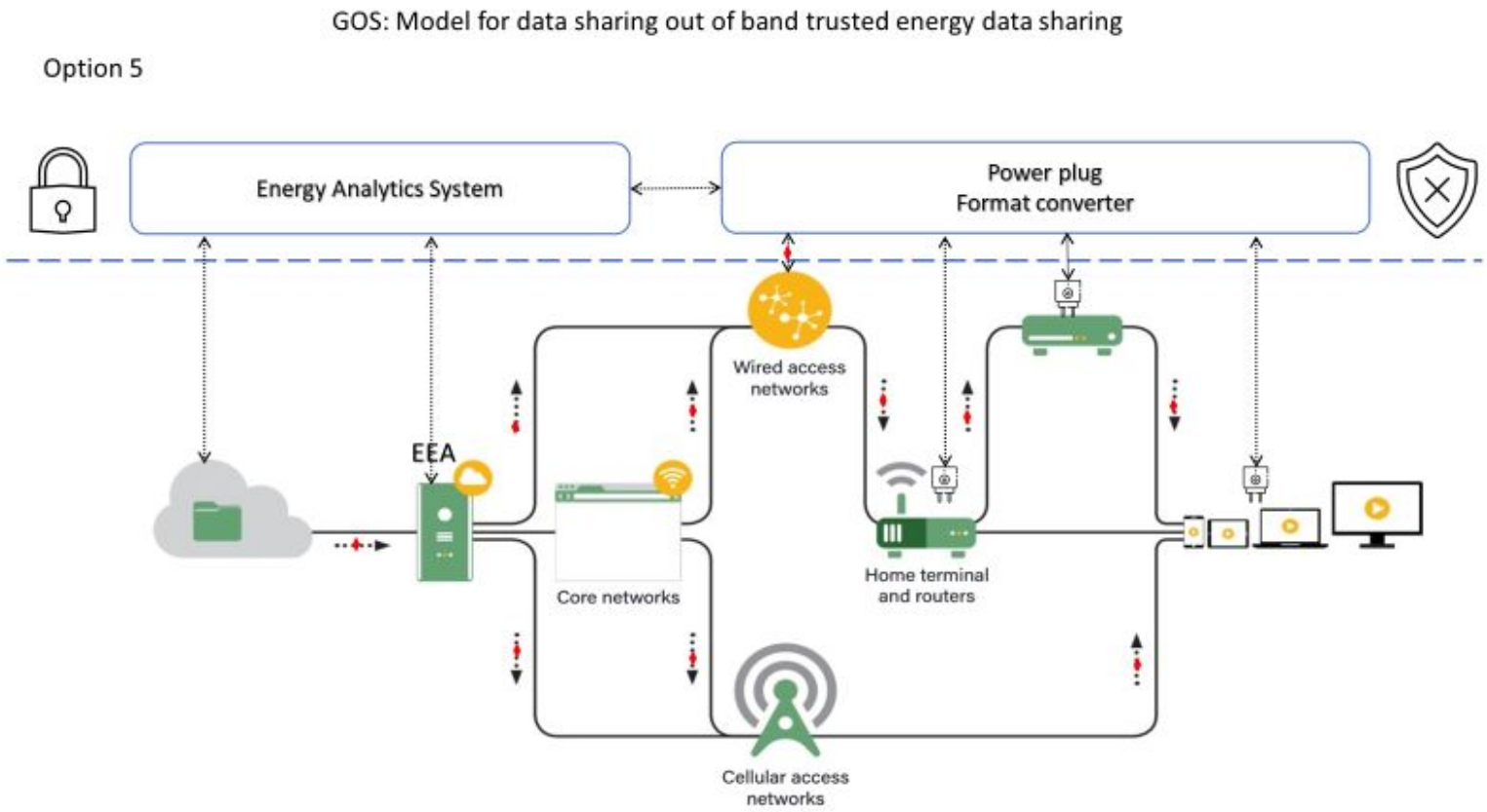
Energy ‘Breadcrumb’ Metadata Stamps

- Can we obtain useful energy information from streaming systems to intelligently determine workflow strategy based on ‘energy context’ and create a container / manifest layer control plane for such decisions?
- Can we surface this in (for example) the DASH and HLS manifests as a ‘decoration’ to the extent information that players use to decide on which video fragment to request and from where?

Key Activities

- Identify what needs to be measured
- Include measurements in manifests available for clients and overall energy analytics system
- Adapt clients towards the lowest energy path
- Forward concepts to appropriate SDO’s

LESS Accord Project Three



Project 4 : (Dom Robinson)

Hardware and Infrastructure Optimisation

Immersion Cooling of Workloads

Moving Workloads **TO** Renewable Energy

Source: windCORES case study, Paessler website: https://www.paessler.com/company/casestudies/windcores

Q&A

(And more input and ideas!)

Staying Connected / Getting Involved

Touch Points

Direct

- Membership
- Blog
- LinkedIn (Going live)
- Volunteer Secretariat
- Affiliate Programme
- LESS Accord involvement

- App (Members Only)

www.greeningofstreaming.org
info@greeningofstreaming.org

PR and Media

- Media Meet and Greet (Sponsors) - Interactive - Sustainability and Policy focus
- MTSS (Sponsors) - Media Tech Sustainability Summit - Significant participation
- The Flint (Sponsors) - New focussed media platform (‘Diary’ by Ben to appear here)

- Numerous 3rd party webinars

- Also kudos to Faultline who we don’t sponsor or pay (beyond the odd beer!) but who keep us honest!

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