CSY3010 Media Technology

Hello

Introduction

Module outline

Some details

Assessment

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Who, Where and When?

- Teaching
- Research
- Dissertation: drmu.net/dissertation
  - Research
  - Development

VR, AR, and MR related projects

- Equipment (Dev PC, FOVE, Oculus Rift, Google Daydream, etc.)
- Lab
- Industry

Multisensory media and Multimedia IoT

ntscapes/

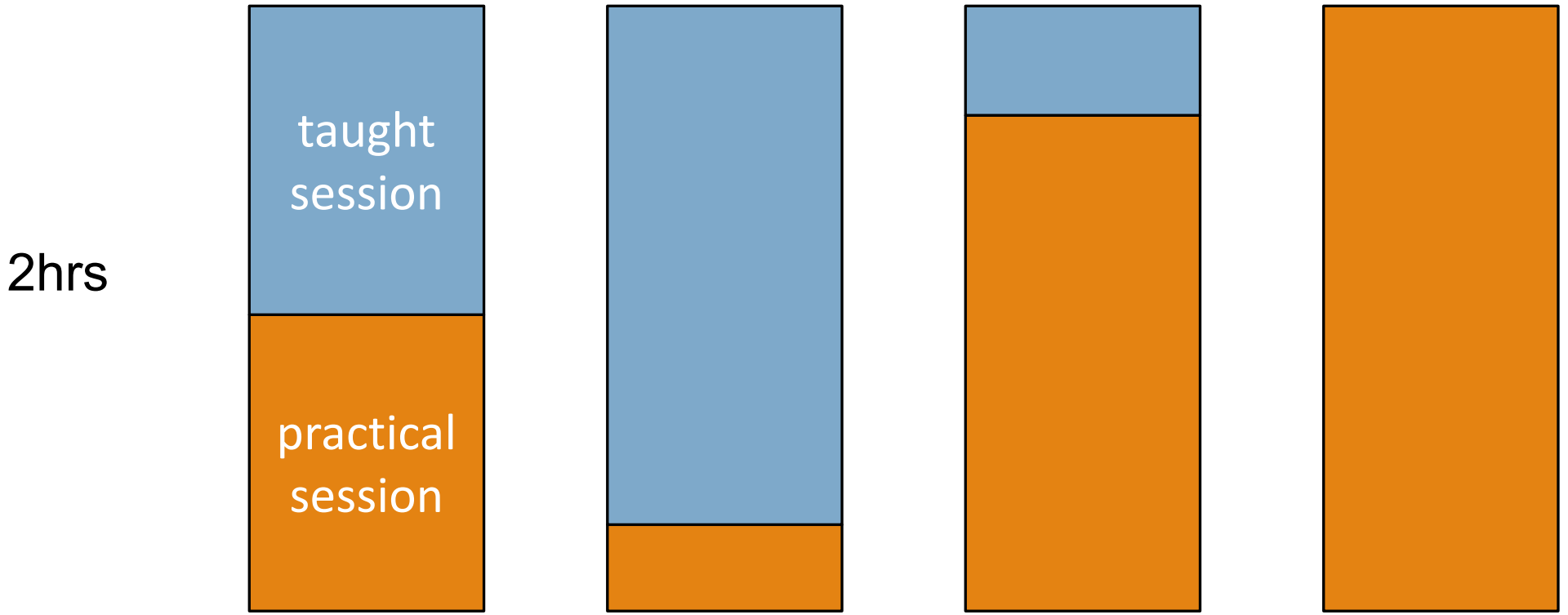
Module outline (last year)

Topic 1 Introduction
Topic 2 Numbering systems and Matlab Intro
Topic 3 Digital Audio
Topic 4 MIDI
Topic 5 Graphics
Topic 6 Concept of images
Topic 7 Colour
Topic 8 Colour images
Topic 9 Graphic manipulation
Topic 10 Digital image processing 1
Topic 11 Digital image processing 2
Assignment (50%)

Topic 12 Lossless compression
Topic 13 Lossy image compression
Topic 14 MPEG video
Topic 15 H.264/AVC
Topic 16 FFMPEG and HTML5 video streaming
Topic 17 Quality of Experience
Topic 18 Adaptive media streaming (MPEG DASH)
Topic 19 Intelligent online media streaming
Topic 20 Media synchronisation
Revision
Time-constrained assessment (50%)

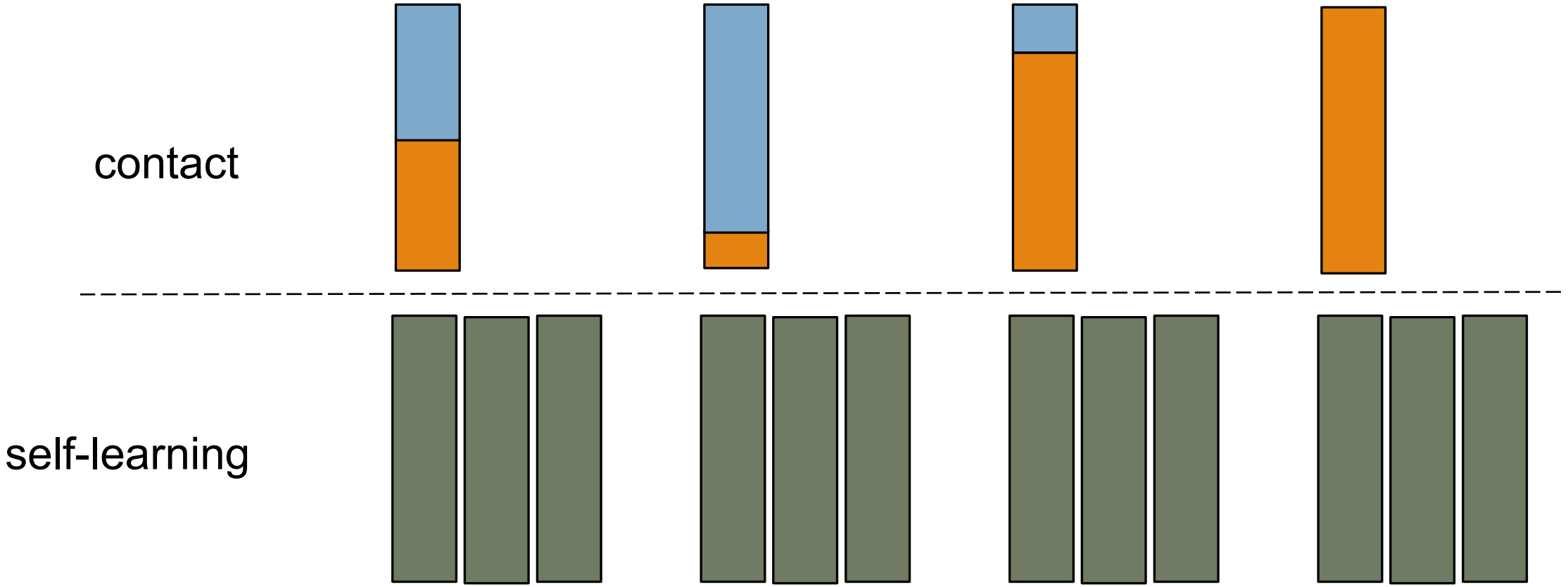
Module outline

How do we spend the 2hrs.



Module outline

"I can't fully understand everything in the classroom."

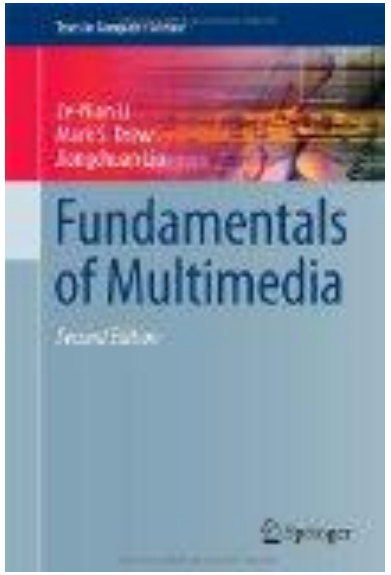


Reading list

Fundamentals of Multimedia
Ze-nian Li, Mark S. Drew, Jiangchuan Liu 2014
http://link.springer.com/book/10.1007/978-3-319-05290-8

Digital Multimedia
Nigel Chapman, Jenny Chapman 2009

Multimedia Systems
Ralf Steinmetz, Klara Nahrstedt 2014

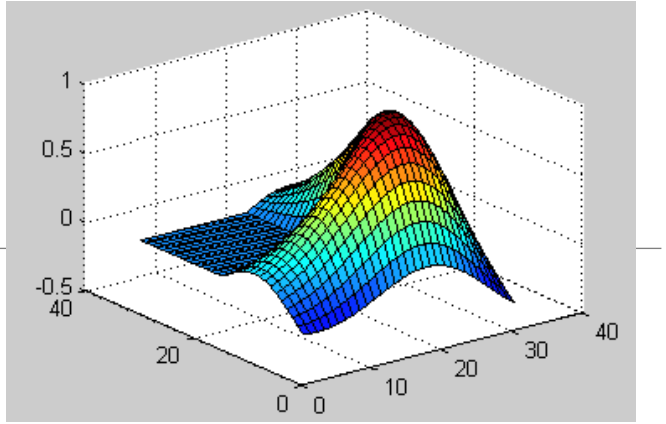


How is it taught? (Hello Matlab)

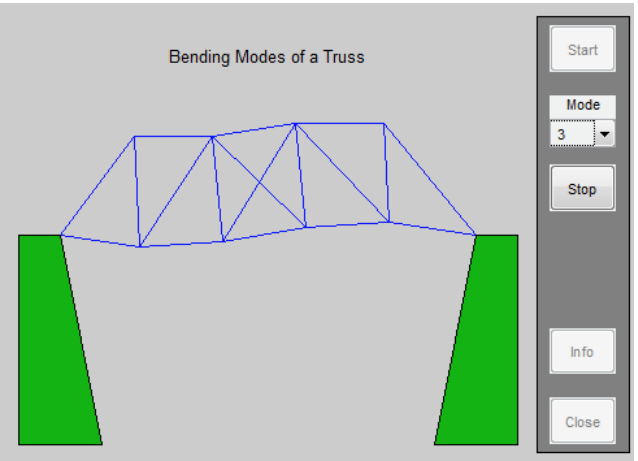
- We use Matlab for video and audio.
- Matlab is high level and we can look at audio and video media without having to do a lot of programming (which we would otherwise need).
- Matlab uses standard programming constructs.
- It is new to you, so you have to learn the syntax. So that's fair to everyone.
- The university cannot supply you with a personal copy, so if you want it at home you will have to "obtain" it.
  - MATLAB Student

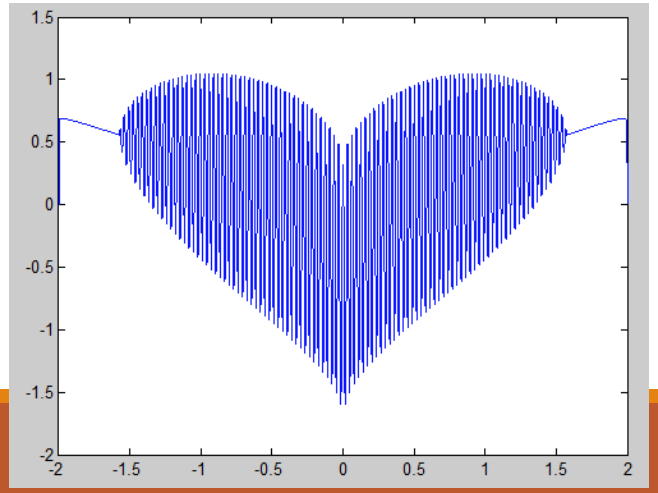
How is it taught?

(Hello Matlab)



- Matlab is widely used in the scientific world.
- It is normal to start off hating Matlab, before you see the benefits of using it.
- This is not intended as a Matlab course.





http://www.divilabs.com/2013/10/some-matlab-unusual-commands-that-you_19.html

Is there any/much maths?

- Yes, because all media involves representation by numbers and manipulation will involve some maths.
- Any maths used will be explained (principle).
- Matlab will do most necessary calculations for you.
- So don’t be scared off.
- At the same time accept that you will need some maths for this course.

Media Technology

- We will see how media is represented in file formats and in the computer.
- How to manipulate and process images, sound and video files as done in commercial software.
- Why compression is needed and how it works.

What use is all of this?

Any applications involving media.

- Sound / Video / Image editing (number plate recognition, intrusion detection, voice recognition / control, image stabilization, …)
- Online photo library (Google photo, Instagram, …)
- Online media streaming (Netflix, BBC iPlayer, BT TV, YouTube, Spotify, …)

NETFLIX

http://www.aertia.com/docs/capvidia/LPRS.jpg

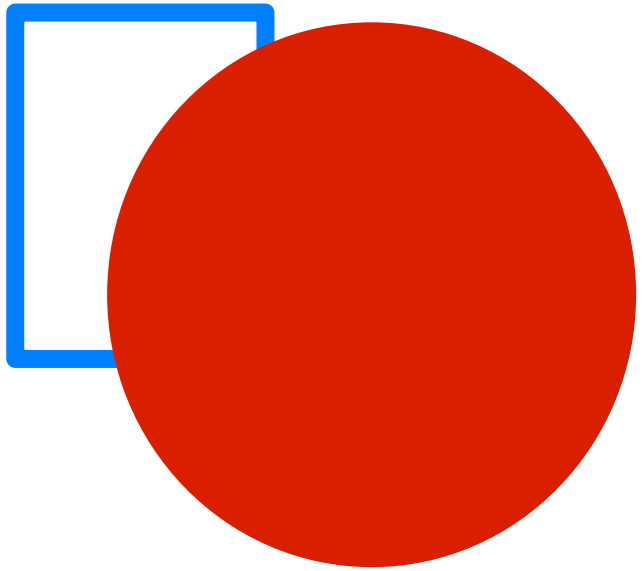
Media Technology (outlook)

Primarily concerned with the following digital media:

- Graphics
- Digitised Sound
- Digitised Images
- Video

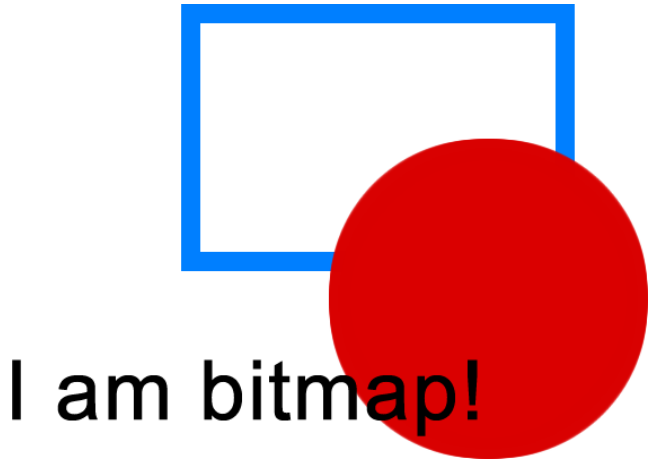
Graphics

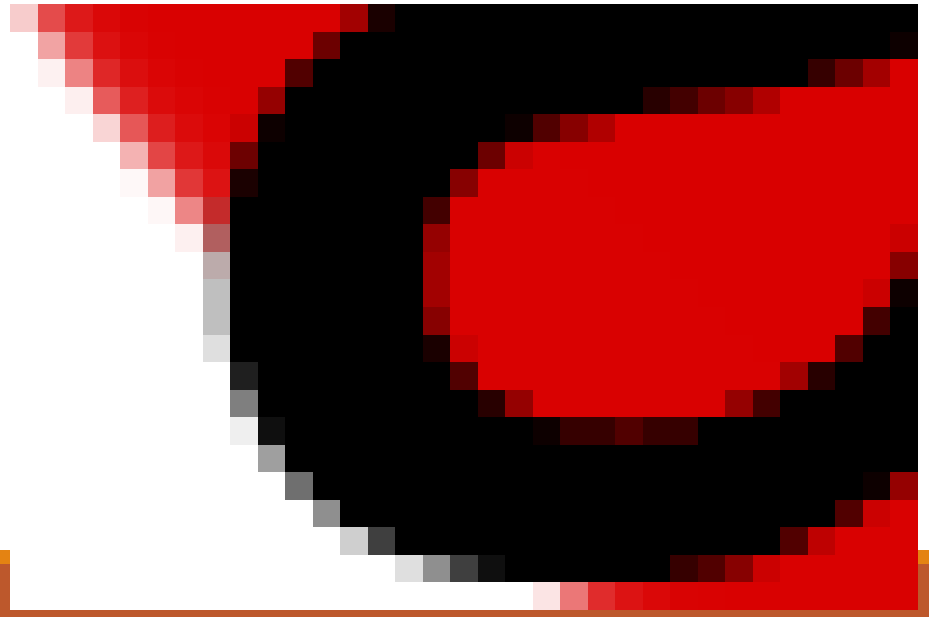
- How would you store and send this image?



Bitmaps - Raster Images

- Does not use individual shapes.
- Whole image contains many pixel elements (pixels).
- So every pixel (about 300,000 in a 480 x 640 image) is described by position and colour.





Bitmaps - Raster Images

- We cannot edit or change any shape drawn without changing all of the pixels concerned.
- Microsoft Paint produces Bitmap images.
- We can manipulate/create the bitmaps in the computer.

Graphics - Vector Images

- Image composed and stored as a sequence of pre-set shapes or objects.
- Lines, rectangles, ellipses, text etc.
- Described in terms of size, position, drawing colour, fill colour.
- Each object's characteristics can be edited independently while in this graphical form.

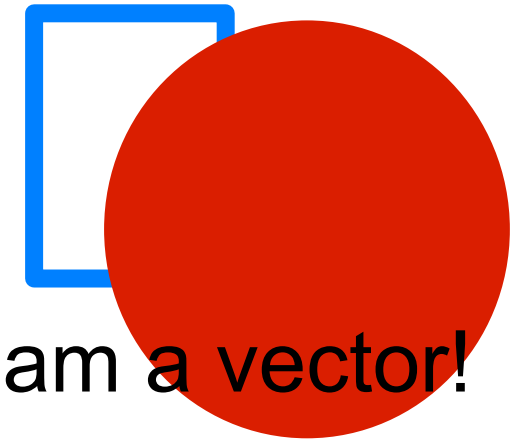
Graphics – Vector Images

- Often called vector graphics.
- Common drawing packages allow the creation of this form of image.
- Compactly storable in files.PDF
- We will look at typical commands and file editing.

Graphics – Vector Images

- Example of a graphic vector image created using “Autoshapes”.
  - Other popular vector graphic tools are Paint shop pro, Adobe Fireworks, Photoshop.

DEMO



Bitmaps or Vector?

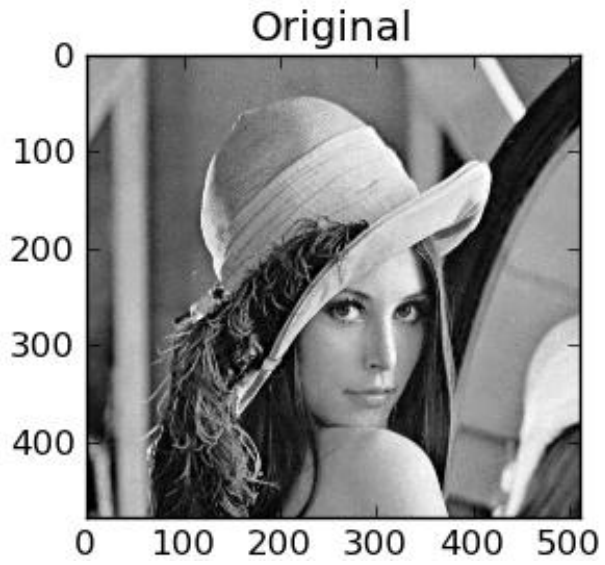
	Bitmap graphics	Vector graphics
Format of presentation?	Pixels of diff. colours	Objects
What can be edited?	Individual pixels	Individual objects
Mostly used for?	Photos 	Cartoons 
What happens when they are resized?	They lose quality	They do not lose quality
Common file formats	.bmp, jpeg, gif, tiff	.svg, .odg, .eps, .xml

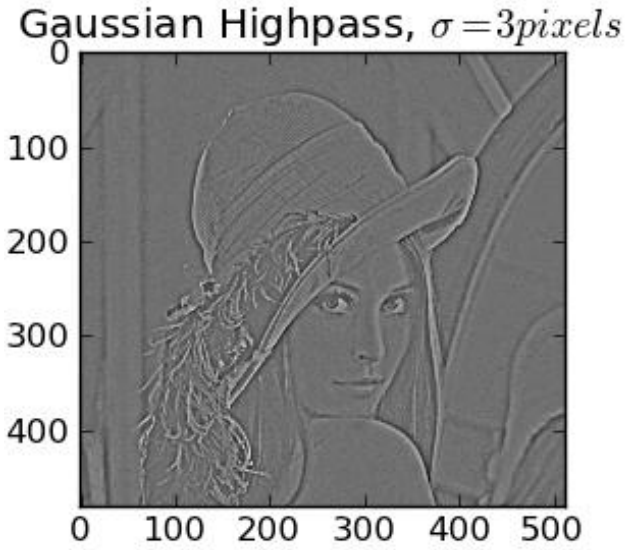
Colour


Apple iPhone 6
HTC One (M8)
Samsung Galaxy S5
LG G3
Apple iPhone 5s
Reference image

Image Processing

- A short introduction to image processing.
- Filters.
- Convolution or complications.
- Simple applications
  - Sharpening
  - Softening
  - Edge detection

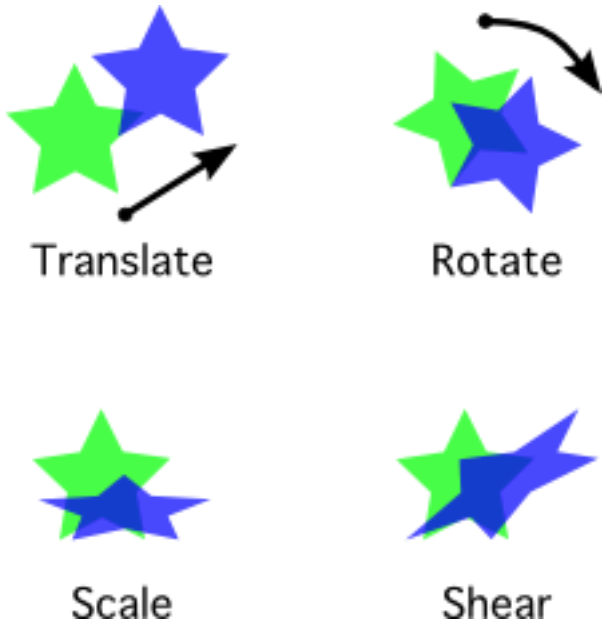




http://stackoverflow.com/questions/6094957/high-pass-filter-for-image-processing-in-python-by-using-scipy-numpy

Image Manipulation

- Affine transformations
- Scaling
- Rotating
- Translating images
- Compound transformation



Sound (midi)

- Just like images we can have two forms in the computer.
- One form remembers the pitch, duration and loudness and individual sound of the notes.
- This is stored as MIDI (musical instrument digital interface) form.
- Like vector graphics the sound can be edited by changing the individual characteristics of the notes.

Sound (midi)

- We can edit a MIDI file to change:
  - Instruments
  - Timing
  - Notes
  - Loudness

Online Sequencer

Sound

- The other form relies on digitisation of real life sounds.
- Sampled sound.
- A common example of this are “wav” sound wave sounds.
- Like bitmap images we cannot edit individual notes without changing all of the samples which the note is comprised of.

Sound

But we can manipulate it.

- Speed it up.
- Make it louder.
- Join sounds.
- Mix sounds.

Using Matlab

Sample rates and Bandwidth.

The bandwidth of audio and video signals can be considered to be the highest frequency carried by the signal.

- In sound “crispness”.
- In vision “sharpness”.

8,000 Hz	Telephone, walkie-talkie
44,100 Hz	Audio CD
192,000 Hz	DVD-Audio

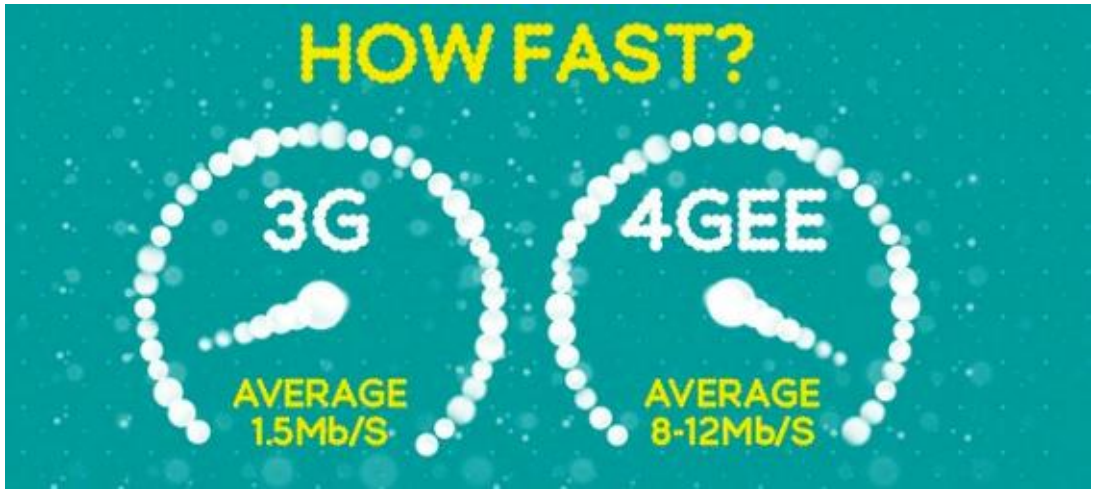
Compression

- Digitised sound and video produces a lot of data.
- In particular digitised television quality pictures produce data at over 1000 Mbits/second* which is faster than many hard disks, CD ROMs and networks devices can accommodate.
- We need to compress data for use on computers.

*720p HDTV uncompressed;
10 bit @ 1280 x 720 @ 59.94 field = 140 MB per/sec, or 494 GB per/hr.

Compression.

- Original CD ROM could only deliver data at 1.2 Mbps.
- 40x is therefore 48 Mbps.
- DVD data rate (single speed) 11 Mbps.
- 16x DVD gives 176 Mbps.
- Online streaming?



http://www.store-4g.co.uk/sites/store-4g.co.uk/files/article_images/ee-3g-compared-to-4g.jpg

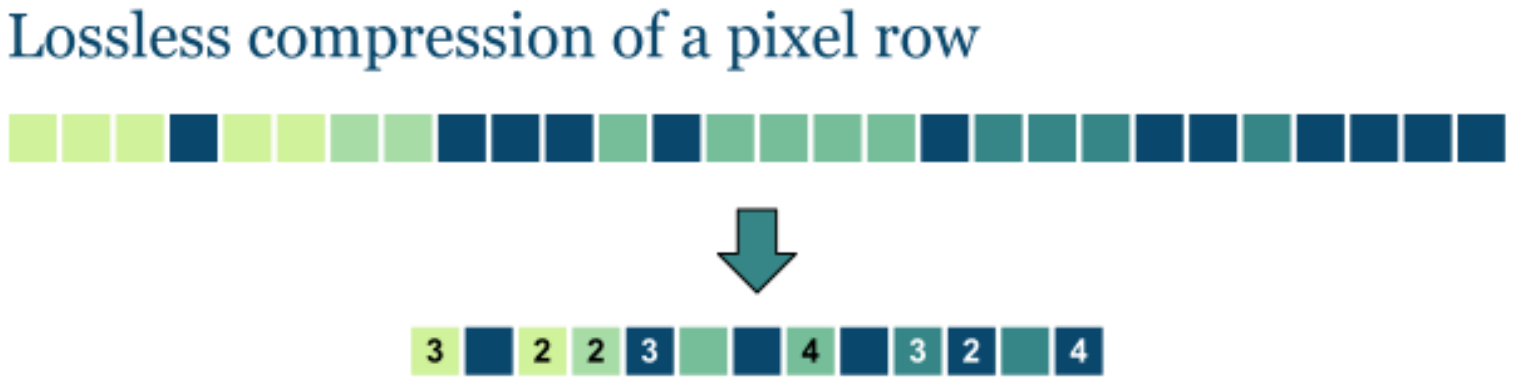
Compression

We have two types of compression.

Lossy compression and lossless compression.

As the names suggest lossy compression loses some of the original signal, while lossless does not.

Lossless techniques such as run-length encoding and Huffman coding achieve compression by creating shorter codes. This is not always possible.



Compression

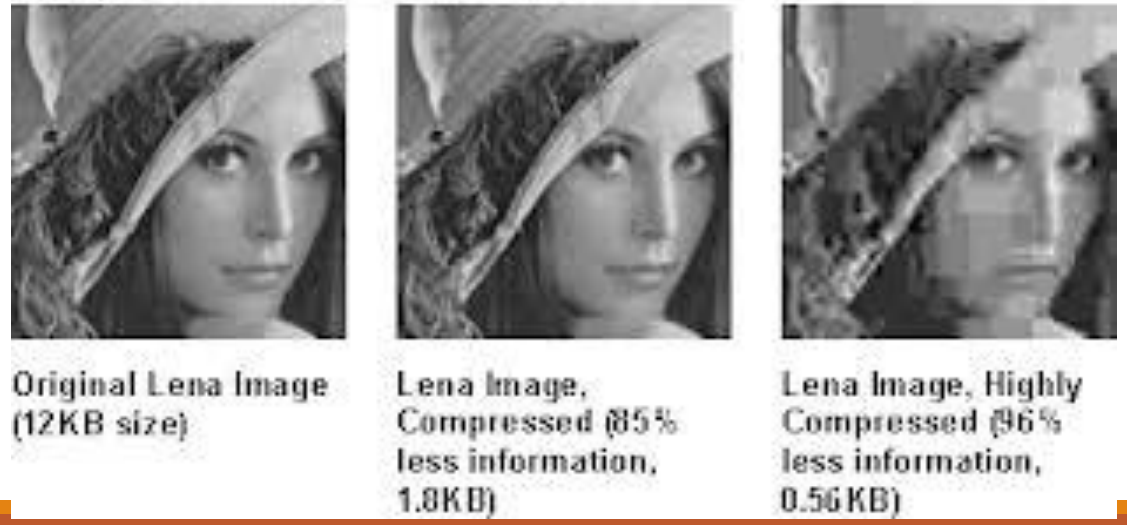
Lossy techniques rely on throwing away some information which the viewer or listener will not notice too much.

Involves changing the data to some other form.

Most lossy techniques are noticeable.

The more lossy compression that is applied, the more the compression effect will be noticeable.

Example of Lossy Compression



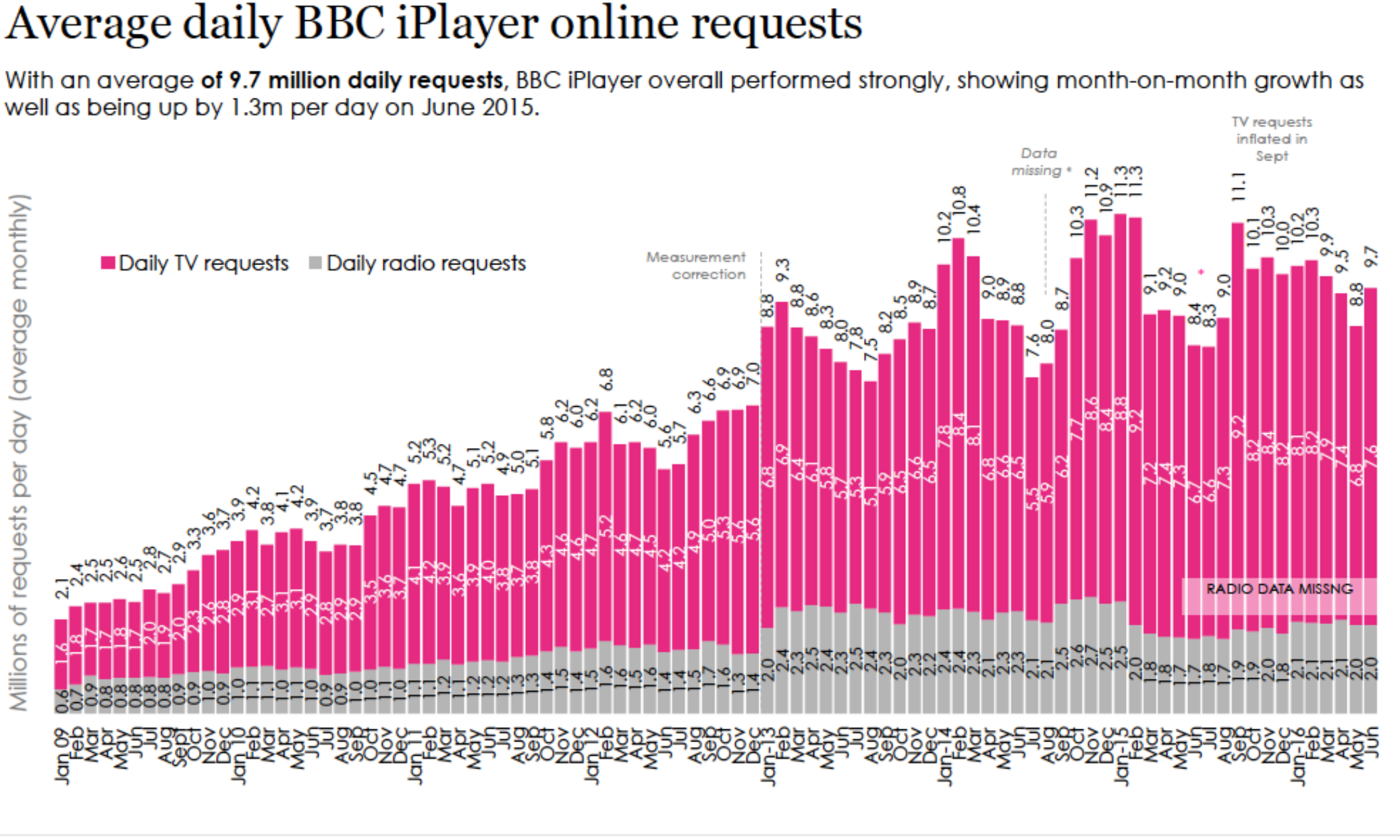
Original Lena Image (12KB size)

Lena Image, Compressed (85% less information, 1.8KB)

Lena Image, Highly Compressed (96% less information, 0.56KB)

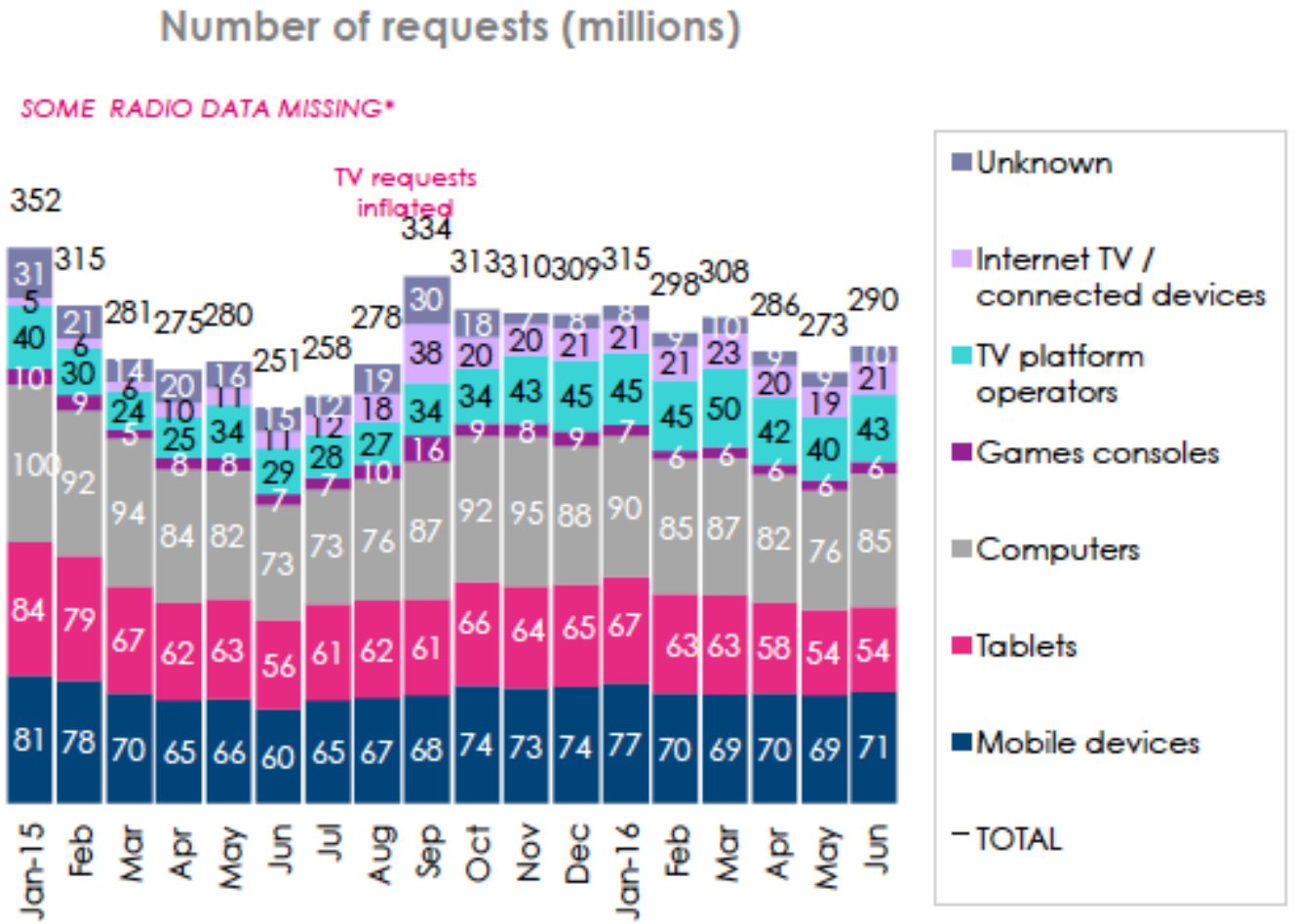
https://proxish.wordpress.com/2013/02/07/learning-outcome-1-compter-graphics-graphic-compression-systems/

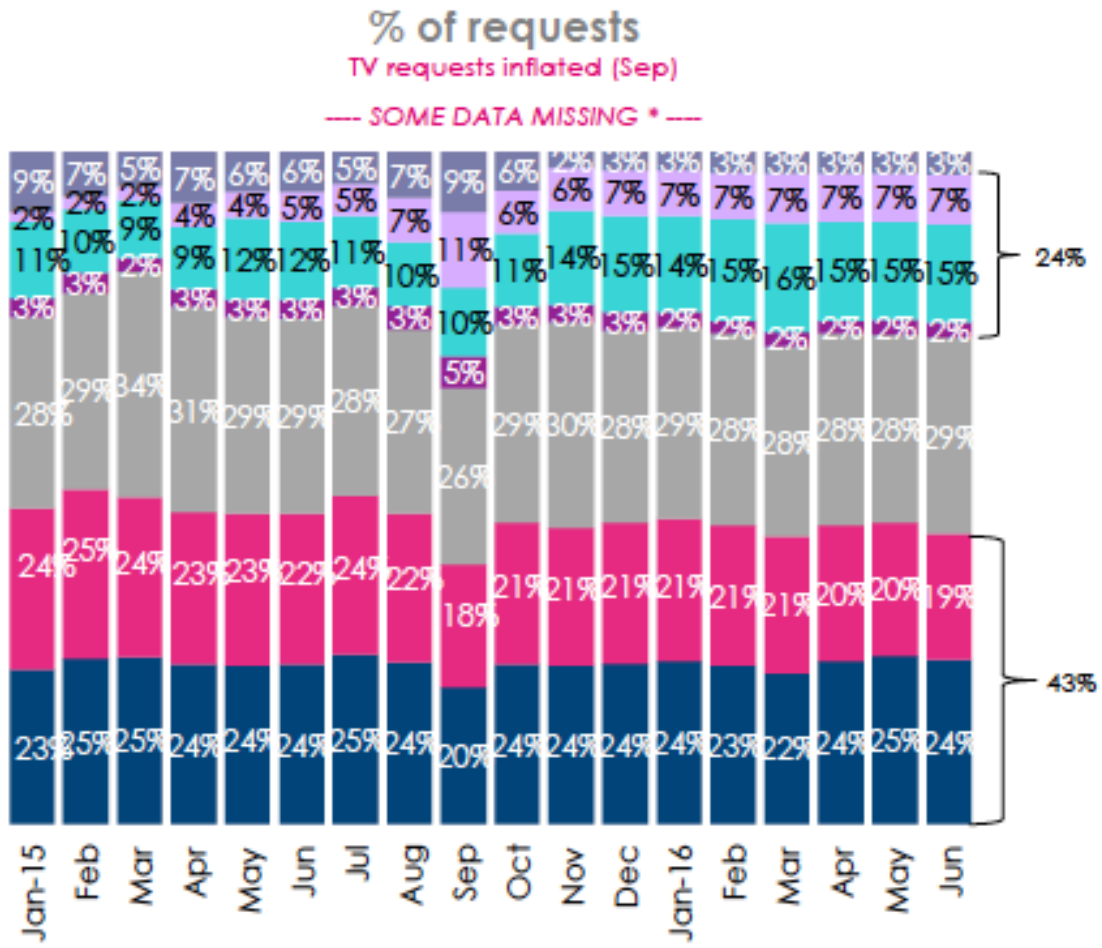
Let’s not forget video streaming

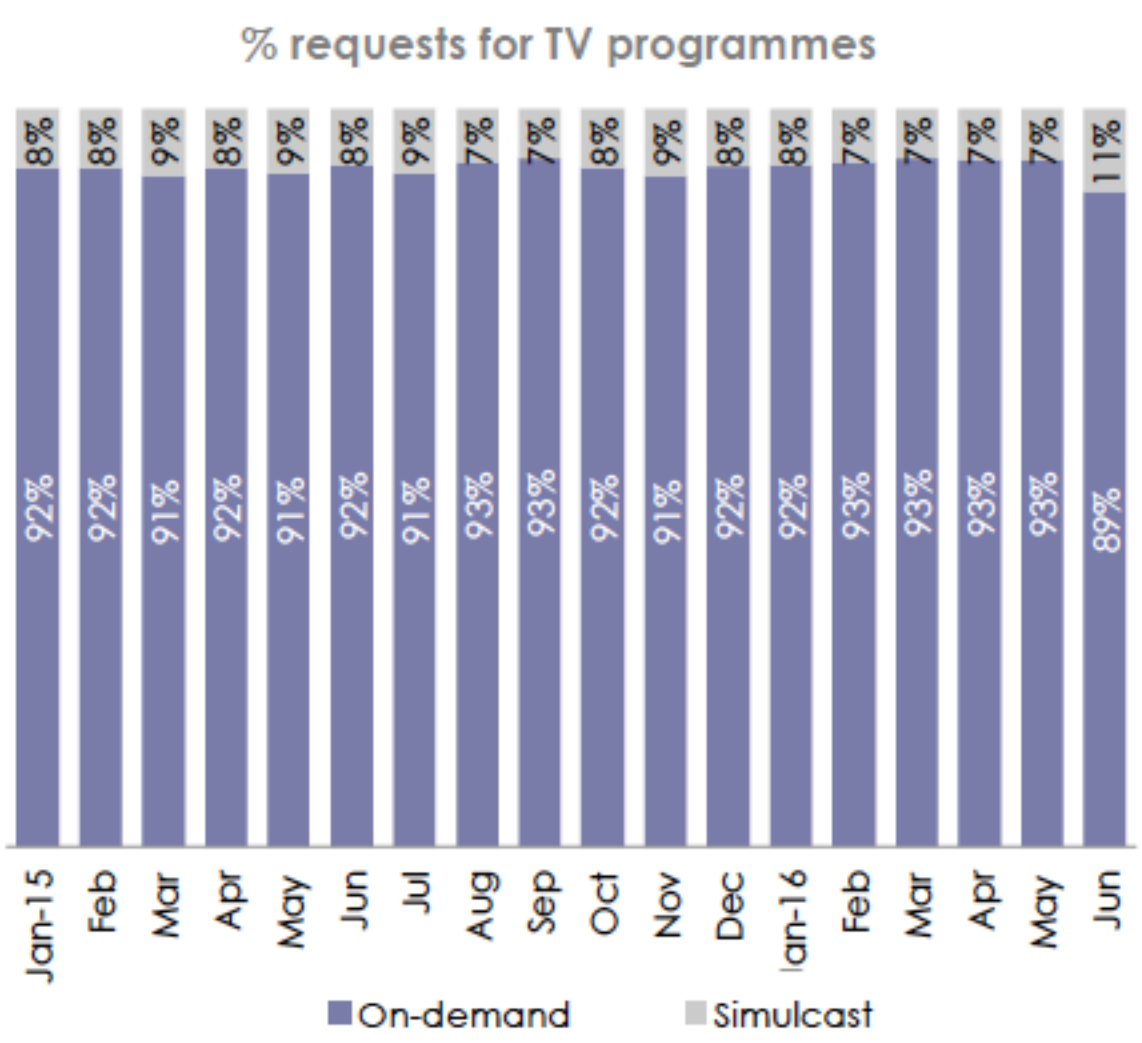


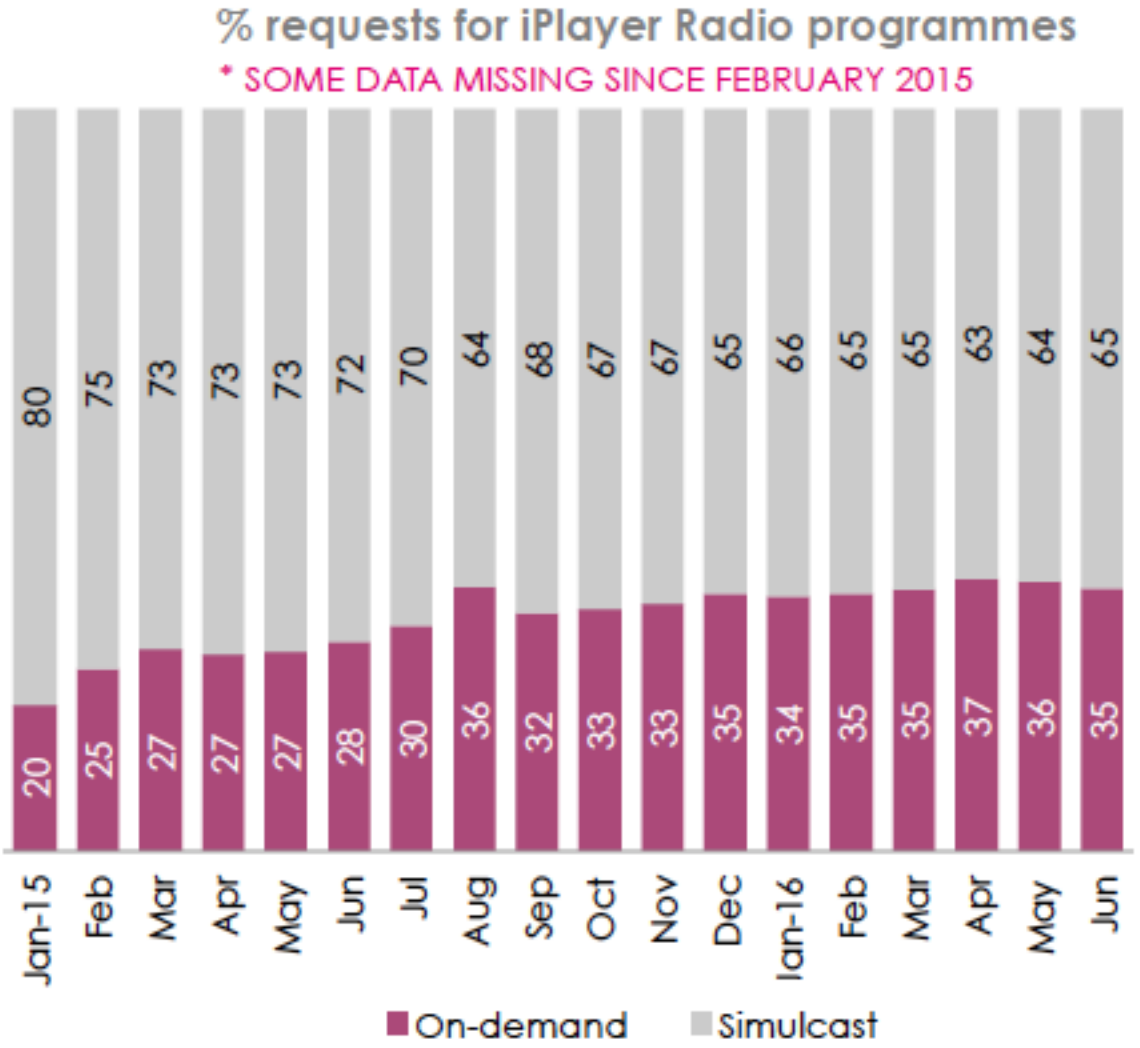
TV and radio: Requests for programmes by device type

The month-on-month increase from May to June was seen across all device types. The increase was most noticeable on computers, with requests from those devices increasing from 76m to 85m month-on-month.



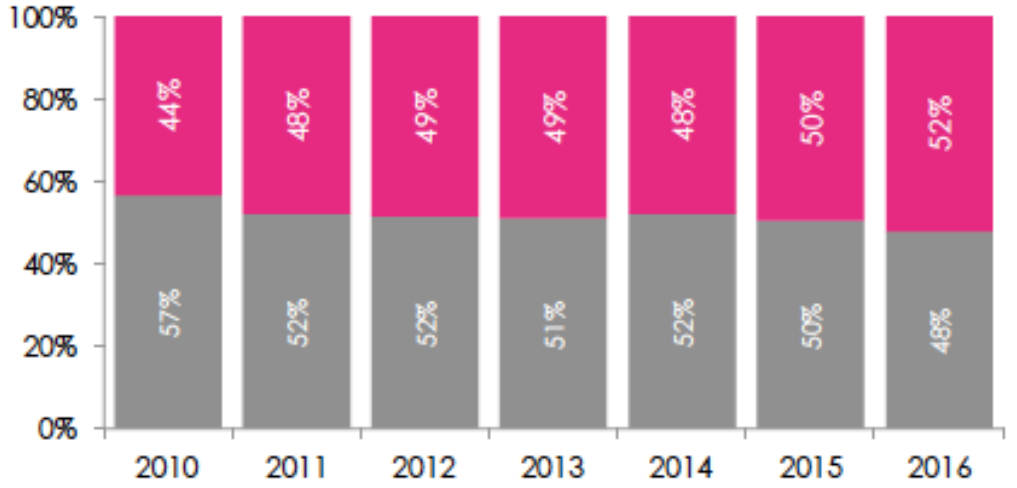


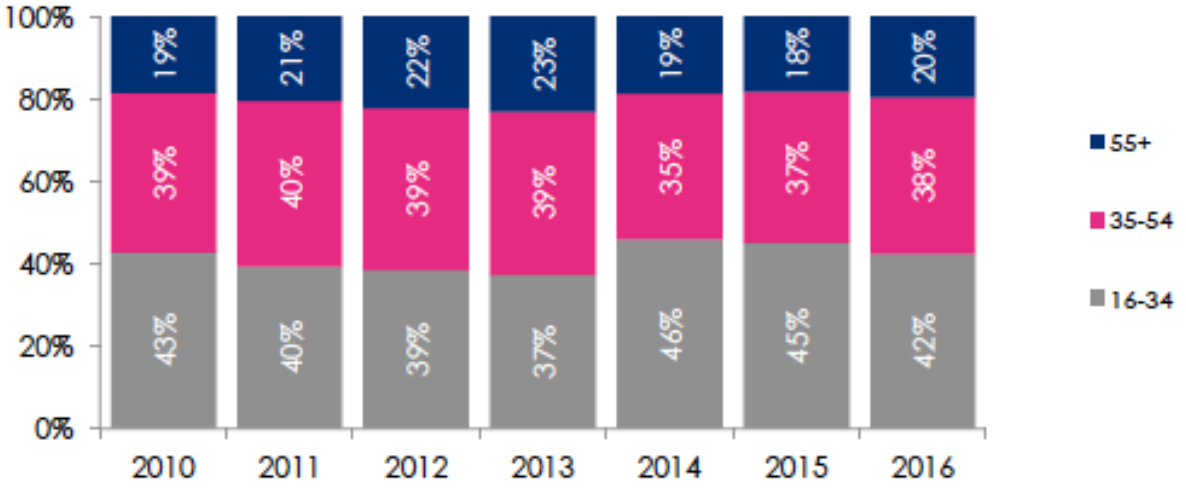

% requests for TV programmes
92% 8%
92% 8%
91% 9%
92% 8%
91% 9%
92% 8%
91% 9%
93% 7%
93% 7%
92% 8%
91% 9%
92% 8%
92% 8%
93% 7%
93% 7%
93% 7%
89% 11%
Jan-15
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan-16
Feb
Mar
Apr
May
Jun
On-demand
Simulcast


% requests for iPlayer Radio programmes
* SOME DATA MISSING SINCE FEBRUARY 2015
20 80
25 75
27 73
27 73
27 73
28 72
30 70
36 64
32 68
33 67
33 67
35 65
34 66
35 65
35 65
37 63
36 64
35 65
Jan-15
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan-16
Feb
Mar
Apr
May
Jun
On-demand
Simulcast

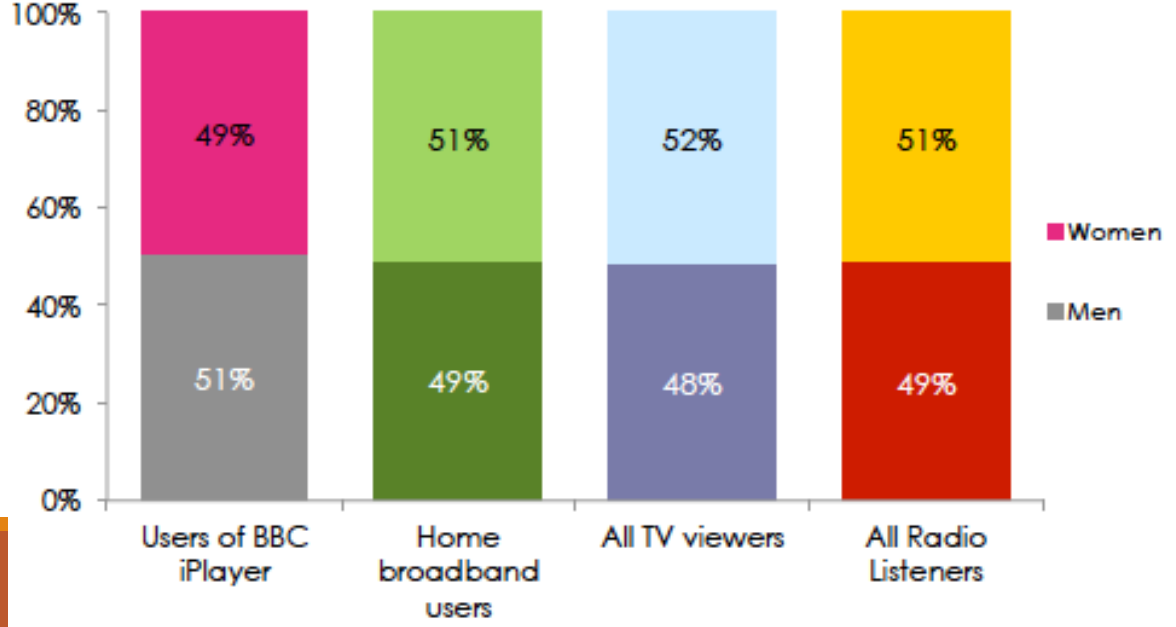
TV & iPlayer Product: demographics of BBC iPlayer users

BBC iPlayer usage is equally balanced between men and women across the last 4 quarters, with the largest share of audience aged 16-34.

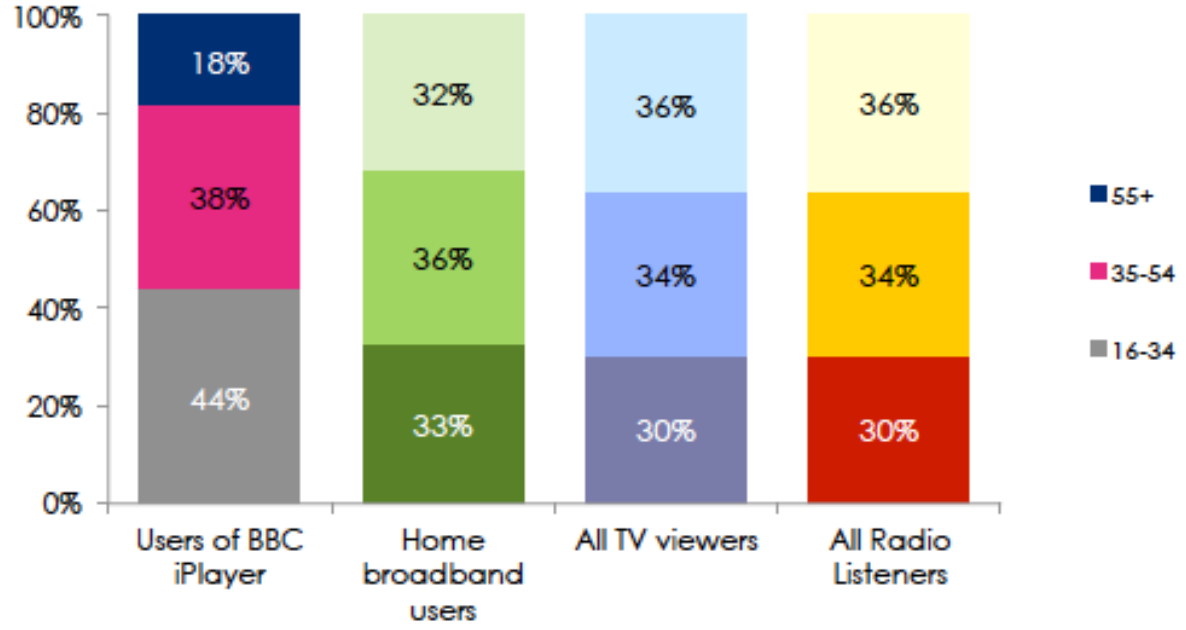




Gender (latest 4 quarters)



Age (latest 4 quarters)



Let’s not forget video streaming

Cisco VNI – Visual Networking Index:

Following this trend, global IP video traffic is estimated to be 82% of all consumer Internet traffic in 2020, up from 70% in 2015, with nearly a million minutes of video content crossing the network every second.

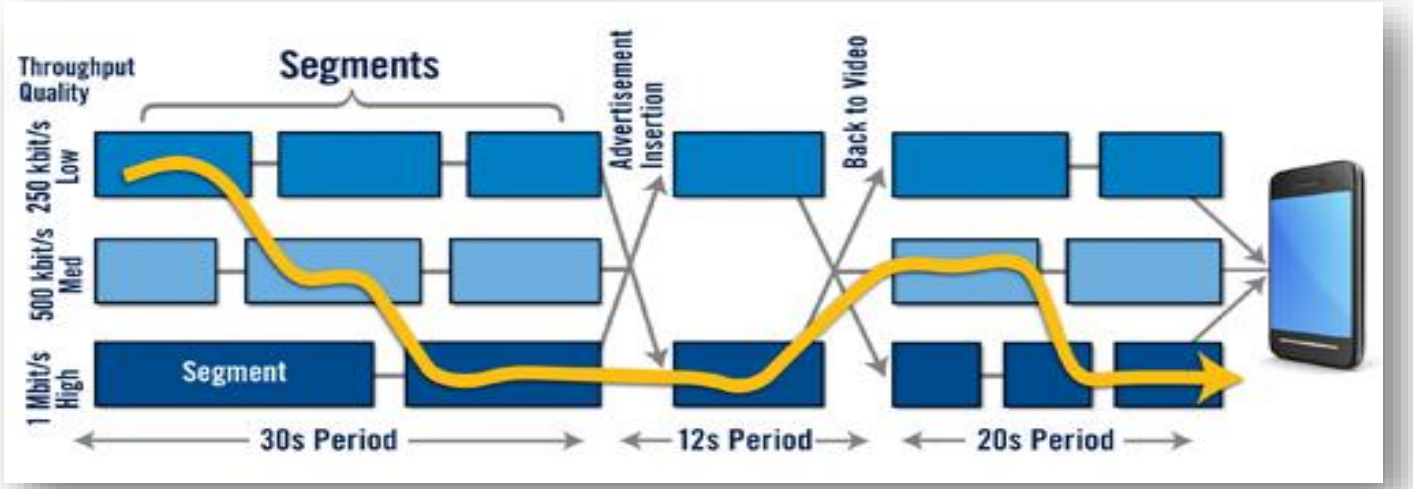
Examples of research topics

High definition online TV over adaptive streaming

Adaptive media streaming is becoming the most popular vehicle for online video services.
Content providers and network operators carried out trials that broadcast live sports events in ultra HD and 35Mbit/s.

http://nem-initiative.org/wp-content/uploads/2014/10/5-Phil-Layton-Barry-Crabtree-NEM-BT-BBC-keynote.pdf

HAS and MPEG-DASH



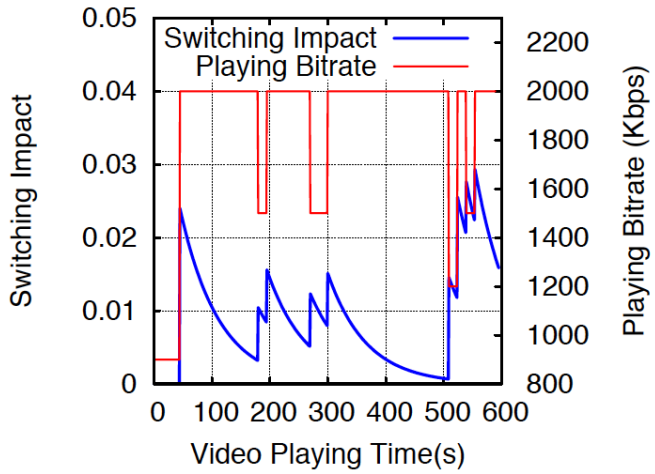
Thomas Stockhammer,
Qualcomm Incorporated

- HTTP adaptive streaming (HAS)
  - Adobe Dynamic Streaming for Flash, Apple HTTP Adaptive Streaming, Microsoft Smooth Streaming
- MPEG-DASH: Dynamic Adaptive Streaming over HTTP
  - Chunked media facilitates swapping between bitrates.
  - Standardised and has support from industry.
  - Works in browsers (with Media Source Extension support)
- A Media Presentation Description (MPD) file describes segments information:
  - Timing, URL, resolution, bit rates.
- Clients request appropriate bitrate chunk according to estimated bandwidth, buffer level, QoE, etc.

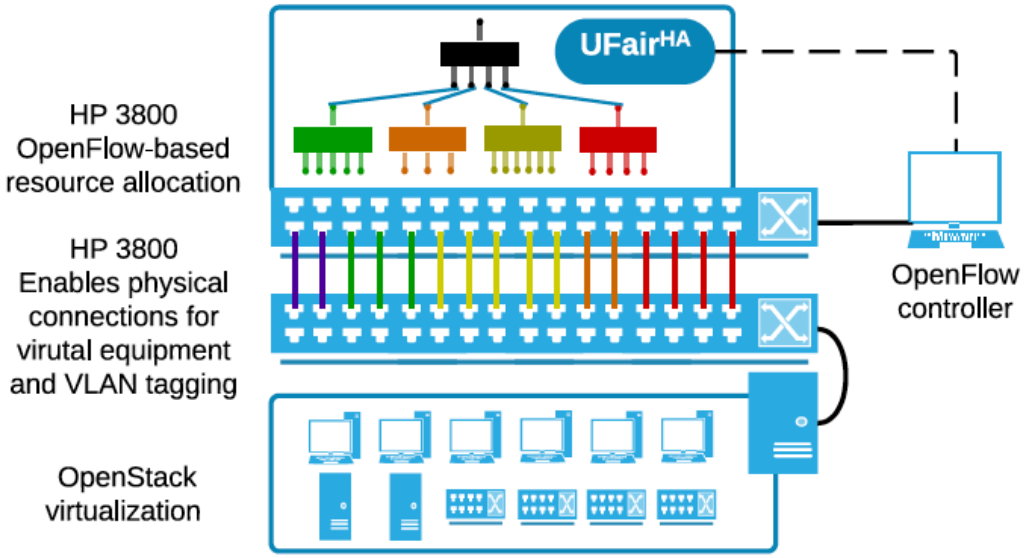
Multimedia networking

QoE-aware adaptive media streaming and resource allocation

- HTTP adaptive streaming optimisation
  - MPEG-DASH ABR using buffer occupancy, impact of quality adaptation, HTTP/2 server push, QUIC, ICN, etc.
- User-level fairness in resource provisioning
- Software defined networking (Openflow) applications



"Forgiveness effect" in quality adaptation

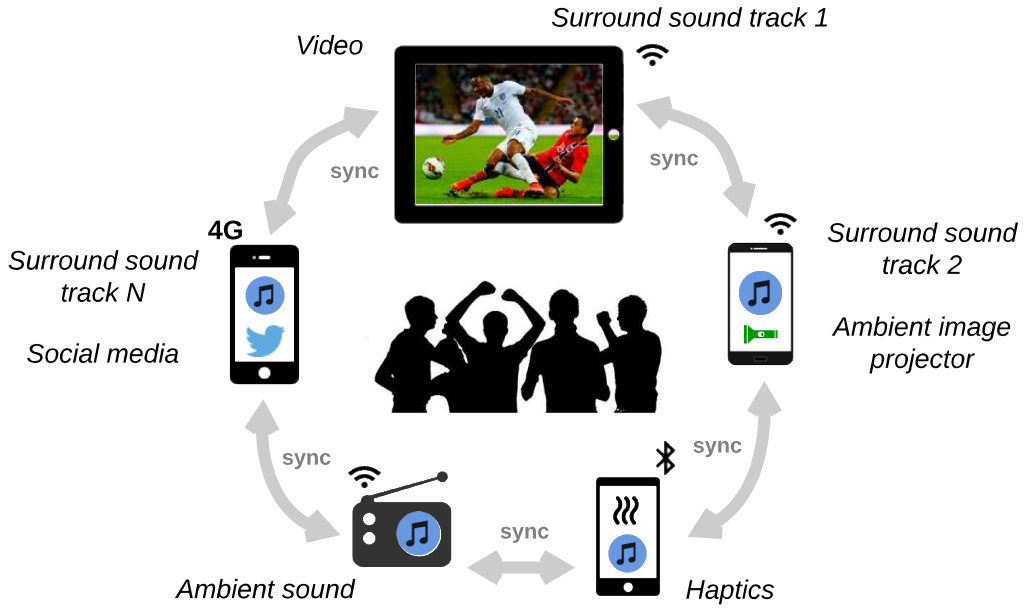


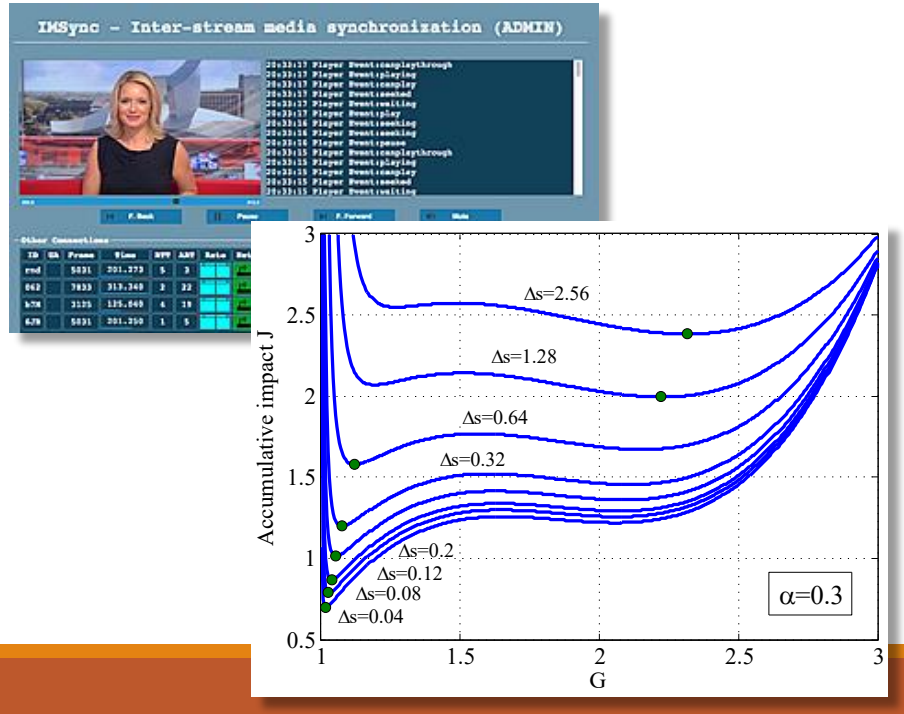
SDN/Openstack testbed

Multimedia networking

Immersive experience through media orchestration

- Inter-device media synchronization in N-screen device cloud.
- Open Javascript framework (WebSocket, timing elements, latency measurement, etc.) integrating a perception model.

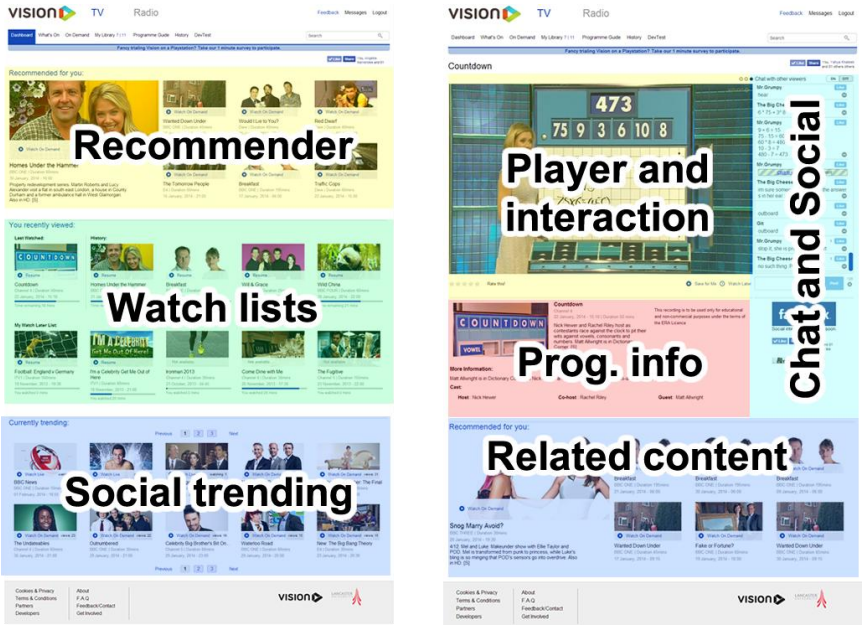




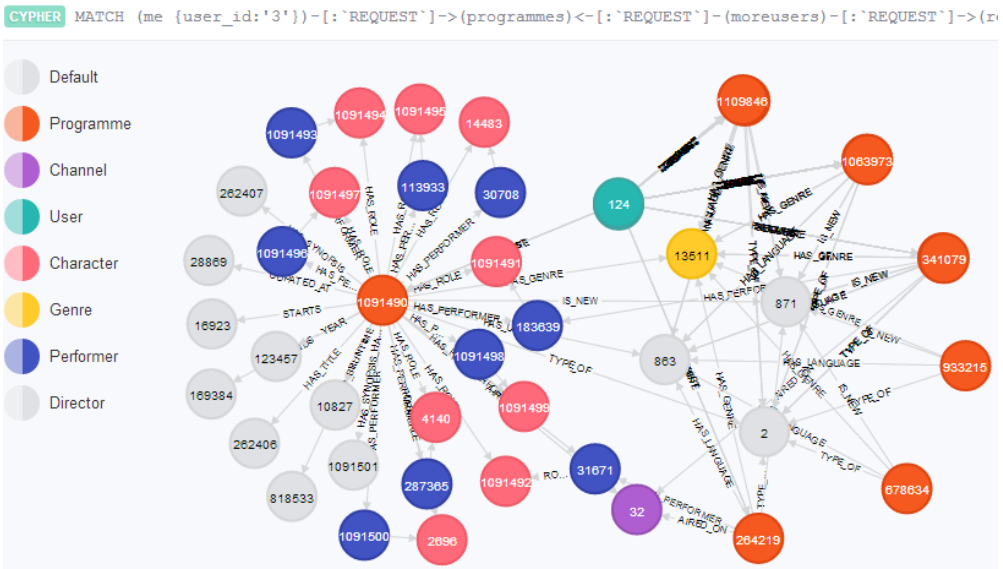
Social TV and data mining

Vision Online TV

- Research and experimentation platform
- Personalized media service, data mining of user activity data
- Collaboration with the BBC (on iPlayer features), Bell Labs, and TU-Berlin



Vision online TV



Graph database (Neo4j)

end of slides