AUDIOVISUAL COMMUNICATIONS

Fernando Pereira

Relation and Logistics

Nothing great was ever achieved without enthusiasm.

Ralph Waldo Emerson

US essayist & poet (1803 - 1882)

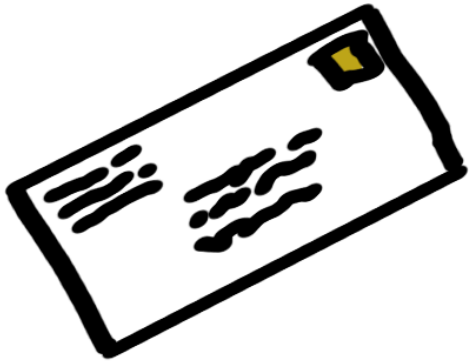
Professor-Students Interaction …

MEEC: Web Page and Mailing List

http:\\www.img.lx.it.pt\~fp\cav\Welcome_CAV.htm

To subscribe the course mailing list send a message to fp@lx.it.pt

Mailing list address: CAV_MEEC@lx.it.pt

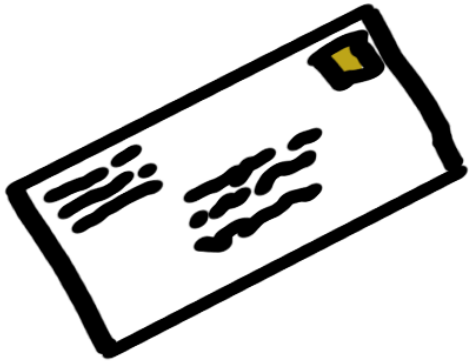


MERC: Web Page and Mailing List

http:\\www.img.lx.it.pt\~fp\cav\Welcome_CAV.htm

To subscribe the course mailing list send a message to fp@lx.it.pt

Mailing list address: CAV_MERC@lx.it.pt



MEEC: Lectures Schedule

THEORETICAL LECTURES

- **2 lectures of 90 minutes per week - Wednesday and Friday at 3.30pm (Auditorium EA2)**

PRACTICAL LECTURES (in weeks with no lab)

- **1 lecture of 90 min per week – Wednesday at 11am (E4), 5pm (E8) and Friday at 11am (E2)**

LABORATORY SESSIONS (in weeks with no practical)

- **1 lecture of 90 min per week – Wednesday at 11am and 5pm and Friday at 11am (LT4)**

MERC: Lectures Schedule

THEORETICAL LECTURES

- **2 lectures of 90 minutes per week – Monday at 3:00pm and Tuesday at 1:30pm in Auditorium A5**

PRACTICAL LECTURES (in weeks with no lab)

- **1 lecture of 90 min per week – Monday at 4:30pm (0.23) or Tuesday at 3:00pm (0.23)**

LABORATORY SESSIONS (in weeks with no practical)

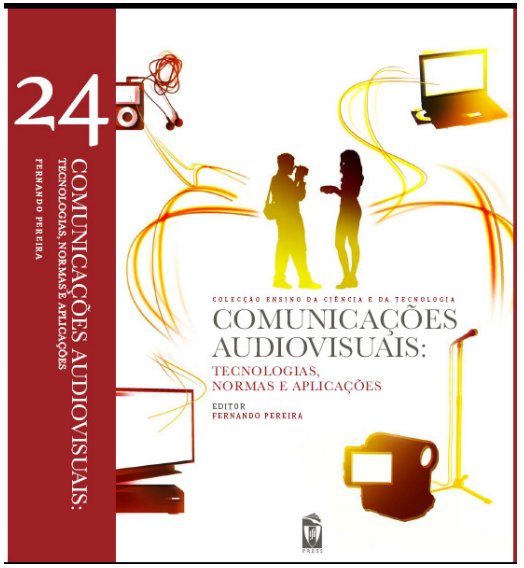
- **1 lecture of 90 min per week – Monday at 4:30 pm or Tuesday at 3:00 (1.28)**

CAV Studying Material

Studying material made available consists in:

- **Book "Comunicações Audiovisuais: Tecnologias, Normas e Aplicações", IST Press, 2009 (details at the CAV Web Page)**
- **Slides from theoretical lectures (available at CAV Web Page)**
- **Additional supporting texts for each topic (available at the CAV Web Page)**
- **Collection of exercises with the corresponding solutions (available at CAV Web Page)**
- **Laboratory guides (available at CAV Web Page)**
- **Exams from previous years with solutions (available at CAV Web Page)**

Book … *Ma Non Troppo …*



✶ Introduction	Cap. 1
✶ Analogue TV	Sec. 3.1, 3.4, Cap. 4
✶ From Analogue to Digital	Cap. 5
✶ Facsimile	Sec. 8.1, 8.2
✶ Digital Images	Sec. 8.3, 10.4
✶ Videotelephony and Videoconference	Sec. 9.1, 9.2, 9.3, 9.6 (brief), 11.3-5 (brief)
✶ Digital Video Storage	Sec. 3.3, Sec. 7.1-7.5, Sec. 9.4, 11.6
✶ Digital Television	Sec. 9.5, 10.1, 10.3, 11.7
✶ Advanced Multimedia Coding	Sec. 9.7 e 11.8 (brief), 9.8

Note: The book authors gave up on any royalties to reduce the price of the book.

Evaluation Method

The CAV evaluation method includes three components, notably:

1. **<u>FINAL WRITTEN EXAM</u> held after the end of the lecturing period (weight 70%) – 11th June and 29th June, 8 am;**
2. **<u>SCIENTIFIC DIVULGATION PAPER</u> (in groups of 3) about a selected topic, to provide until <u>25th May</u> (weight 30%);**
3. **<u>LABORATORY PARTICIPATION</u> (in groups of 2) to be checked through the filling of a form during the laboratory session.**

The final mark is computed by:

$$Final\_Mark = round\ [(0.7 \times Exam + 0.3 \times Paper) \times Lab]$$

where *Lab* is 1 if the student participated in, at least, *N-1* out of the *N* lab sessions, and 0.95 otherwise.

Evaluation Method: Some Rules …

- **Exam**
  - The minimum mark for the exam is 9.5.
- **Divulgation paper**
  - The minimum mark for the divulgation paper is 9.5.
  - The divulgation paper should be written in groups of 3 students.
  - The divulgation paper mark is individual even if the paper is a group work.
  - The evaluation of the divulgation paper may include a self-assessment component.
  - The evaluation of the divulgation paper may include a presentation and/or discusson if found necessary.
- **Final mark**
  - The students with a final mark higher than 17 may have to make an oral exam to confirm the mark; not making this oral exam, if requested, implies getting a mark of 17.

Evaluation Method: Paper Self-Assessment

- By the paper deadline date, each student (not each paper) will provide to a previously identified student representative, his/her 'estimate' of the score for his/her paper. The professor will have NO access to these 'score estimates'.

- The professor will score the papers in a 0-20 scale.
- The students which estimated score is the same as the professor's score will get a bonus of 1 point in the paper mark.

- The students which estimated score is ± 1 point regarding the professor's score will get a bonus of 0.5 point in the paper mark.

About the Divulgation Paper

- **The divulgation paper consists in a tutorial text about a relevant topic related to audiovisual communications.**
- **This paper has the target to stimulate in the students the contact with bibliographical research and also with relevant companies and industry.**
- **The paper will be produced in two versions:**
  1. **Paper version** which shall not have more than **8 PAGES** using the template made available at the CAV Web Page.
  2. **HTML version** with a similar content of the paper version but exploiting HTML capabilities typical of Web content, e.g. including video and audio material and interactivity.

For 2011/2012, the deadline for the divulgation paper is 25th May 2012 (Friday).

Example Topics for the Divulgation Paper

- A Imagem onde menos se espera
- Aquisição e visualização de imagem
- Blu-ray
- Codificação de áudio: a guerra dos formatos
- Codificação de música
- Codificação de vídeo: a guerra dos formatos
- Descrição e procura de informação visual
- Descrição e procura de música
- Digital Video Broadcasting
- Digital Video Disc
- iPhone
- iPod
- IPTV
- MP3 versus AAC
- Protecção de conteúdos multimédia
- Sistemas de videovigilância
- Tablets
- Televisão interactiva
- TV Anytime
- TV digital em Portugal: comparação dos serviços disponíveis
- TV digital terrestre
- TV digital: a competição das alternativas
- Vídeo de alta definição
- Vídeo na Internet
- Video on demand
- Videotelefonia e videoconferência
- YouTube
- …

MEEC: Assigning the Divulgation Paper Topics

Starting today at 5pm (E8) and also next Friday, at 11:00am (E1) !

MERC: Assigning the Divulgation Paper Topics

Starting today at 4.30 pm and also tomorrow at 3:00 pm in Room 0.23 !

MEEC: Lab Registration

Send message to fp@lx.it.pt choosing between Wednesday (11:00am and 5pm) and Friday (11:30am) with 2 names and numbers/group.

Assignment by order of arrival !

MERC: Lab Registration

Send message to fp@lx.it.pt choosing between Monday, 4:30pm and Tuesday, 3:00pm with 2 names and numbers/group.

Assignment by order of arrival !

The Context

Audiovisual Communications

Transference of image, audio and video information through space, time, or space and time simultaneously.

facebook

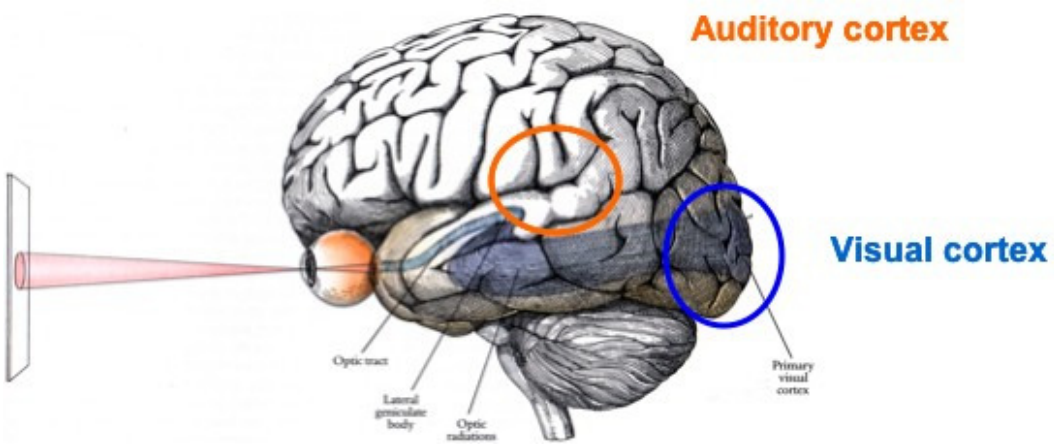
flickr

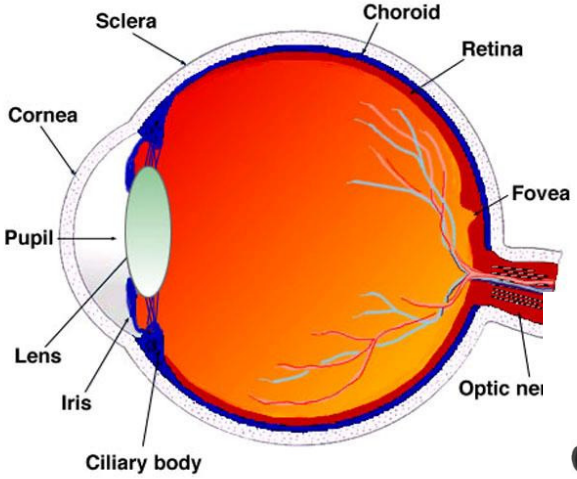
YouTube
Broadcast Yourself

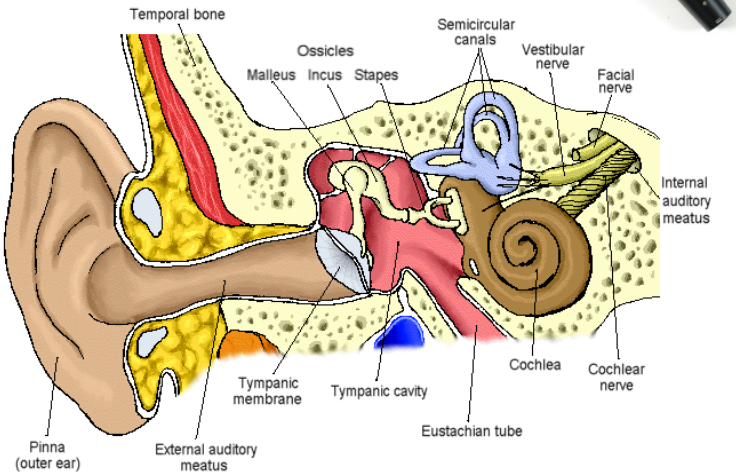
The Importance of the User …

We All Communicate …

Sensations, Perceptions and Emotions …







Communicating Since a Long Time Ago …

And After Telecommunicating …

What do the Users Want ?

- ✶ Information
- ✶ Entertainment
- ✶ Communication
- ✶ Games
- ✶ Education
- ✶ Shopping
- ✶ …

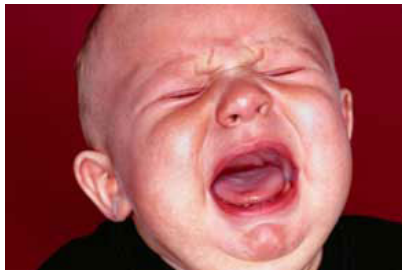
How can Clients be Convinced ?

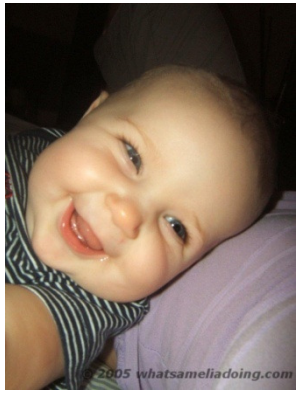
- ✶Satisfaction of personal needs
- ✶Added value, new capabilities
- ✶Interoperability
- ✶Quality and robustness
- ✶Content variety
- ✶(Low) cost of equipment and usage
- ✶Easy usage

Satisfaction: Quality versus Service

The minimum required quality of service depends on the service in question:

- **Facsimile**
- **Digital image (bi-level, grey or colour)**
- **Analogue TV**
- **Videotelephony**
- **Videoconference**
- **Digital television**
- **High definition digital television**

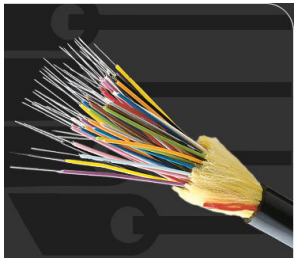


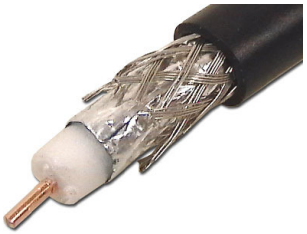


Quality ? What Quality ?

- **What is and determines 'good quality' ? What 'quality' ? Quality of the multimedia experience ?**
- **YouTube video and audio quality are sometimes quite poor … still, this does not prevent some of this content to be very popular …**
- **Which are the components determining quality ?**
  - Signal fidelity
  - User profile
  - User involvement
  - Context, e.g. train, abroad
  - Natural environment, e.g. noisy, dark
  - …

Service Paradigms: (Conventional) Broadcasting





- Unidirectional
- Point to multipoint
- Real-time or not
- Low delay but not critical
- High quality
- Generic content
- Centralized content production model
- Several channels and networks
- …

Service Paradigms: Interactive Broadcasting

- ✶ **Bidirectional but asymmetric**
- ✶ **Point to multipoint and point to point**
- ✶ **Real-time or not**
- ✶ **Critical reaction delay**
- ✶ **High quality**
- ✶ **Generic content**
- ✶ **Centralized content production model**
- ✶ **Several channels and networks**
- ✶ **…**

Service Paradigms: Storage

- Local, no transmission
- High storage capacity
- Very high quality
- Low delay
- Generic content
- Centralized content production model
- Mainly optical storage
- …

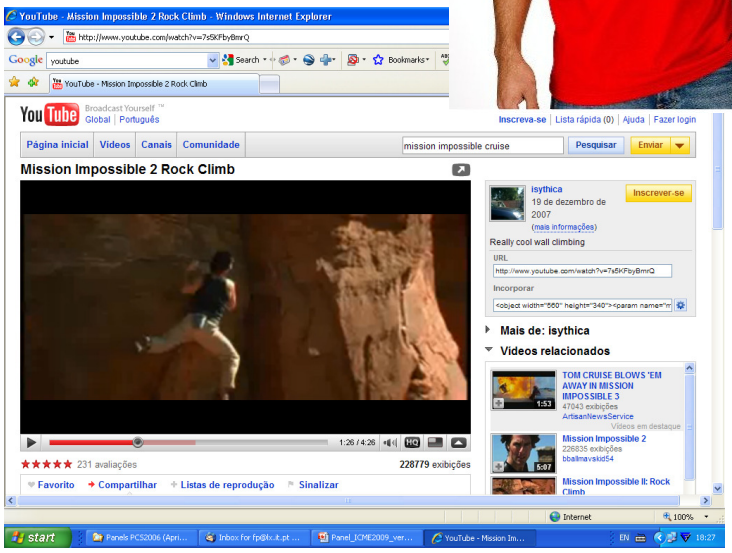
Service Paradigms: Personal Communications

- ✶ **Bidirectional and symmetric**
- ✶ **Point to point**
- ✶ **Real-time**
- ✶ **Critical delay**
- ✶ **Low or medium quality**
- ✶ **Specific content**
- ✶ **Several channels and networks**
- ✶ **…**

Service Paradigms: Games

- ✶ Storage (or bidirectional)
- ✶ Point to point (or multipoint)
- ✶ Real-time
- ✶ Critical delay
- ✶ High quality/realism
- ✶ Synthetic and natural content mix
- ✶ Centralized content production model
- ✶ Mainly optical storage
- ✶ …

Service Paradigms: Monocasting Sharing



- ⋆ Bidirectional but asymmetric
- ⋆ Downloading and streaming
- ⋆ Point to point
- ⋆ Real-time (down) and no real-time (up)
- ⋆ Critical delay
- ⋆ Large range of qualities
- ⋆ Distributed content production model (prosuming)
- ⋆ Sharing approach
- ⋆ Social networking
- ⋆ Several channels and networks

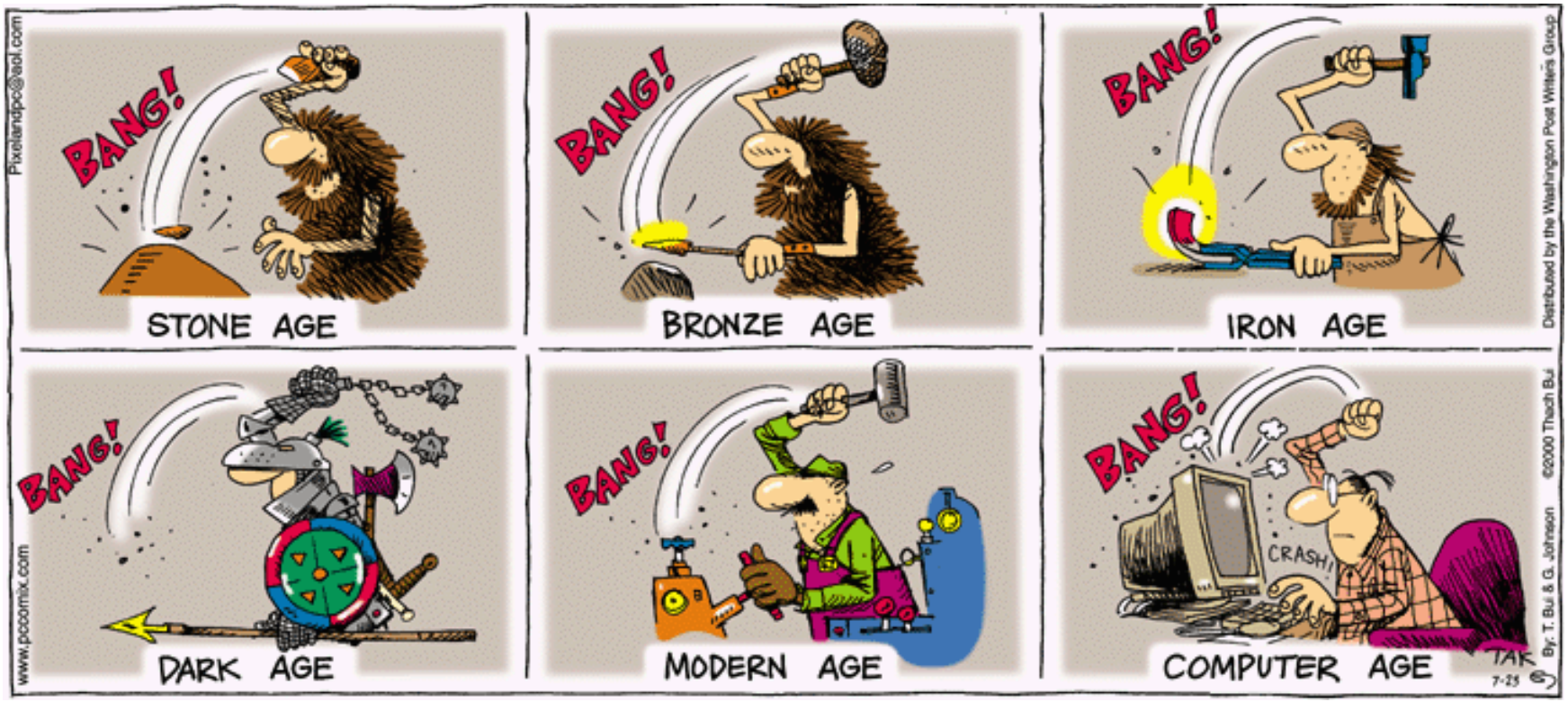
The Contents

Non scholae, sed vitae discimus

Seneca

We do not learn for the school, but for life

Program: an Evolutive Perspective



Program: a Summary

1. Introduction

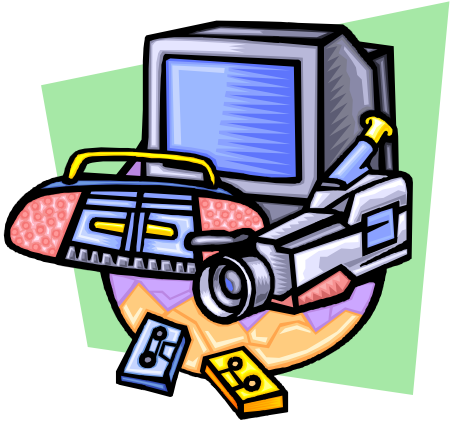
2. Analogue Audiovisual Communication Systems

- 2.1 Black and white analogue TV
- 2.2 Colour analogue TV

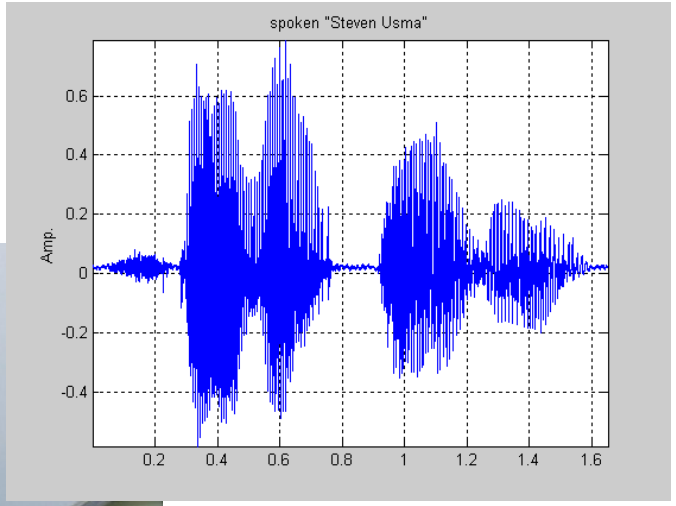
3. Analogue to Digital Transition

4. Digital Audiovisual Communication Systems

- 3.1 Facsimile
- 3.2 Digital imaging
- 3.3 Videotelephony and videoconference
- 3.4 Digital video storage
- 3.5 Digital television
- 3.6 Advanced audiovisual communication systems



An Analogue World …

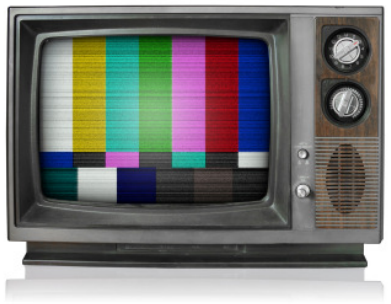


Analogue Communications World …

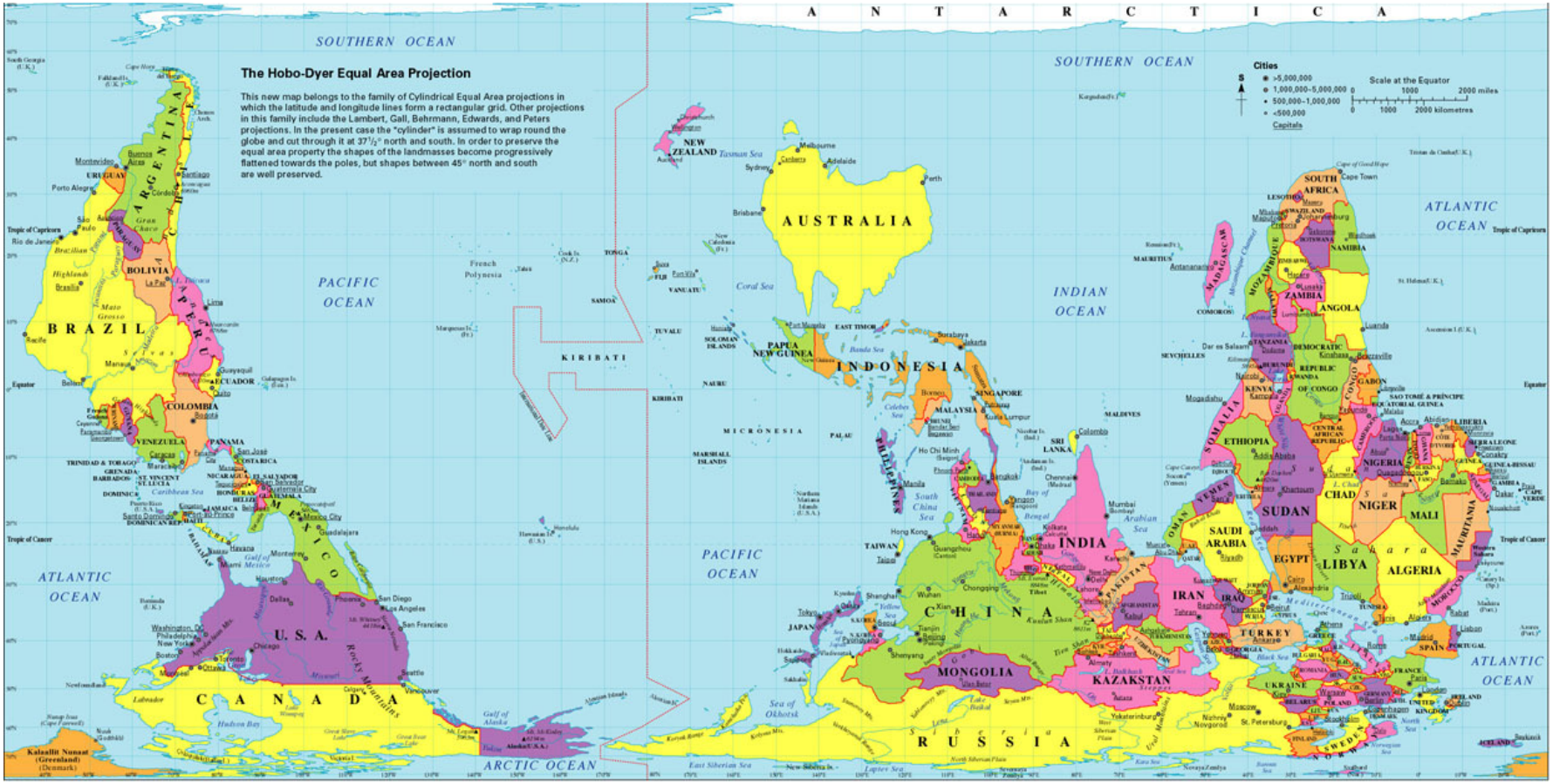
±1880

±1905

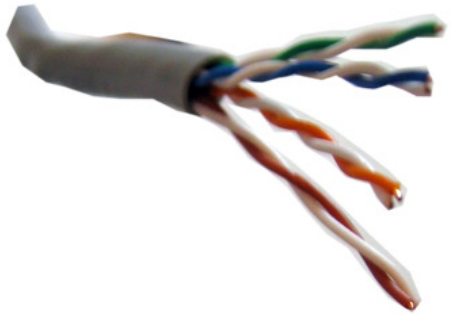
±1920

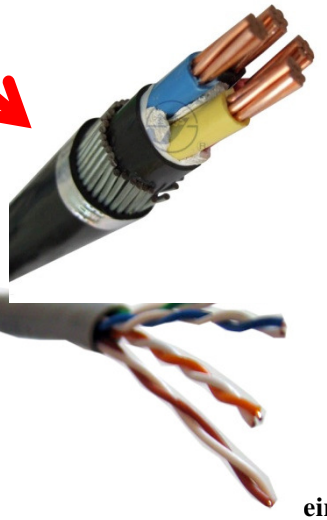


The World Up Side Down ...

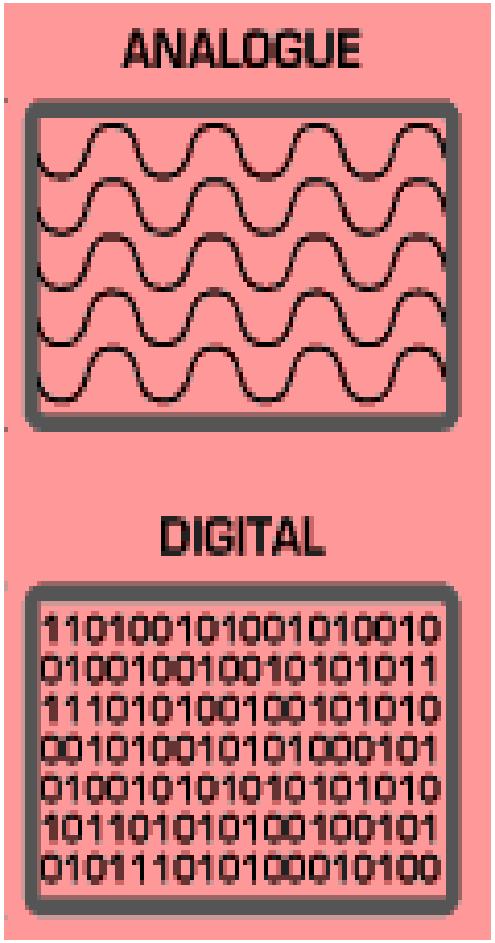


The World is Made of Change…





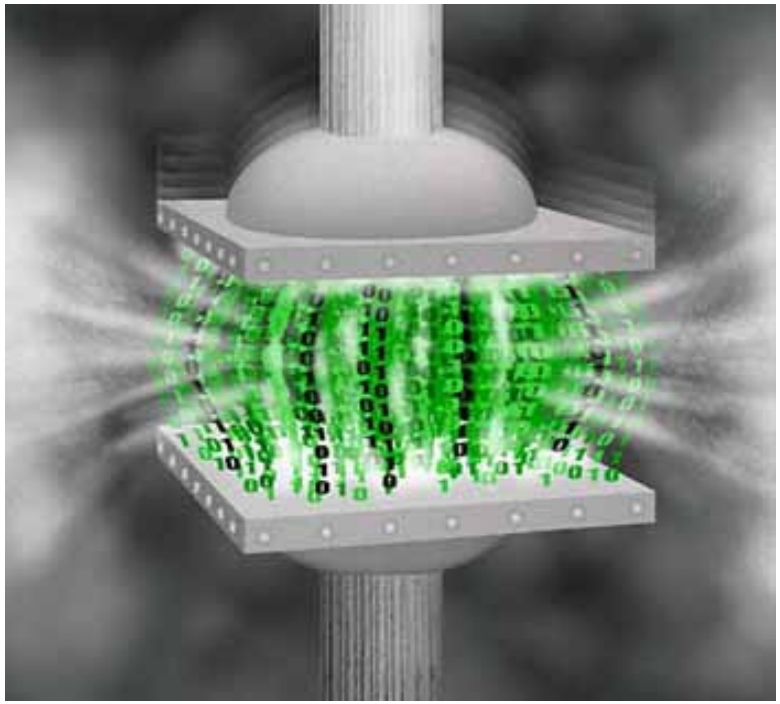
Bit Jumping …


ANALOGUE
DIGITAL
11010010100101001010
01001001001010101011
11101010010010101010
00101001010100010101
01001010101010101010
10110101010010010101
01011101010001010100

Many, Really Many, Bits …

- **Speech – 2×4000 samples/s with 8 bit/sample – 64000 bit/s = 64 kbit/s**
- **Music – 2×22000 samples/s with 16 bit/sample – 704000 bit/s=704 kbit/s**
- **Video – (576×720+2×576×360)×25 (20736000) samples/s with 8 bit/sample – 166000000 bit/s = 166 Mbit/s**
- ***Full HD* 1080p - (1080×1920+2×1080×960)×25 (103680000) samples/s with 8 bit/sample – 829440000 bit/s = 830 Mbit/s**

We Need a Miracle !



Digital TV: Only an Example

- **ITU-R 601 standard: 25 images/s with 720 × 576 luminance samples and 360 × 576 samples for each chrominance, at 8 bit/sample**

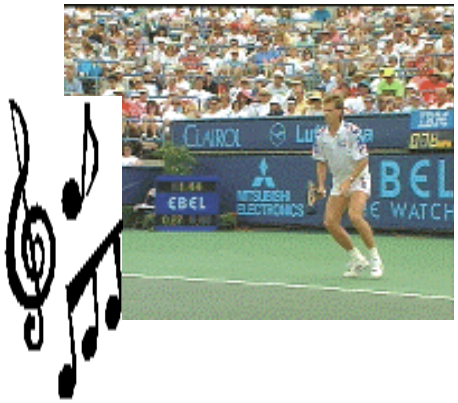
$$[(720 \times 576) + 2 \times (360 \times 576)] \times 8 \times 25 = \textbf{166 Mbit/s}$$

- **Practical bitrate with H.264/MPEG-4 AVC codec: 2 Mbit/s**

=> Required Compression Factor: 166/2 ≈ 80

The difference between coding or not implies the existence or not of many largely used services.

The Coding Miracle …



Non Compressed Bits

Encoder

Compressed Bits

Much less bits !!!

Decoder

The Consequences of the Miracle (1) …

The Consequences of the Miracle (2) …

The Multimedia Babel Tower …

4 billion (June 2009)

- **~4000** uploads/minute
- 128 years to view all of them (1s per image)
- 2% Internet users visit
- Daily time on site: 4.7 minutes

120 million (July 2009)

- **~20 hours** uploaded/minute
- 600 years to see all of them
- 20% Internet users visit
- Daily time on site: 23 minutes

- 2007 bandwidth = entire Internet in 2000
- March 2008: bandwidth cost US$1M a day

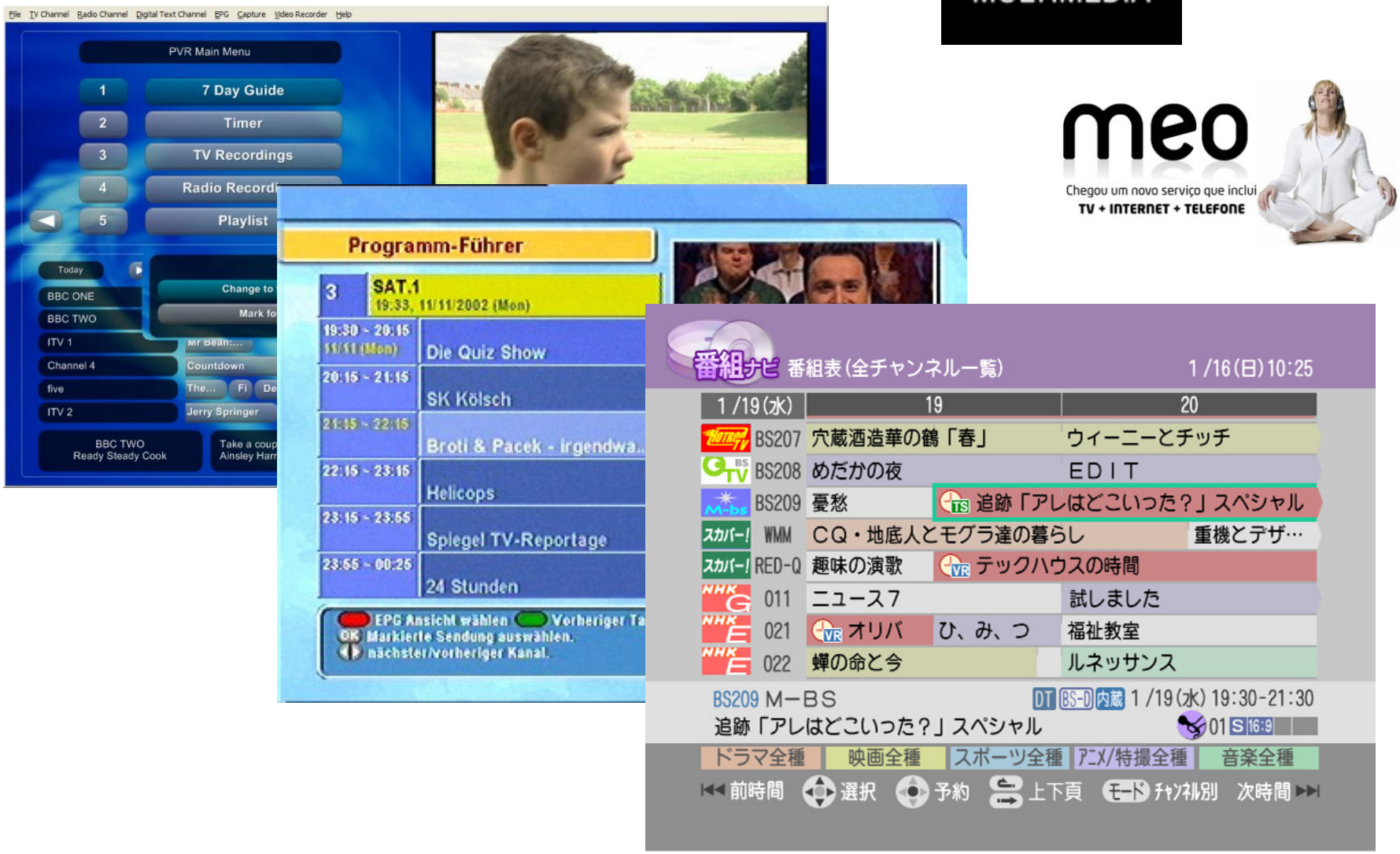
15 billion (April 2009)

- **~22000** uploads/minute
- 480 years to view all of them (1s per image)
- 24% Internet users visit
- Daily time on site: 30 minutes

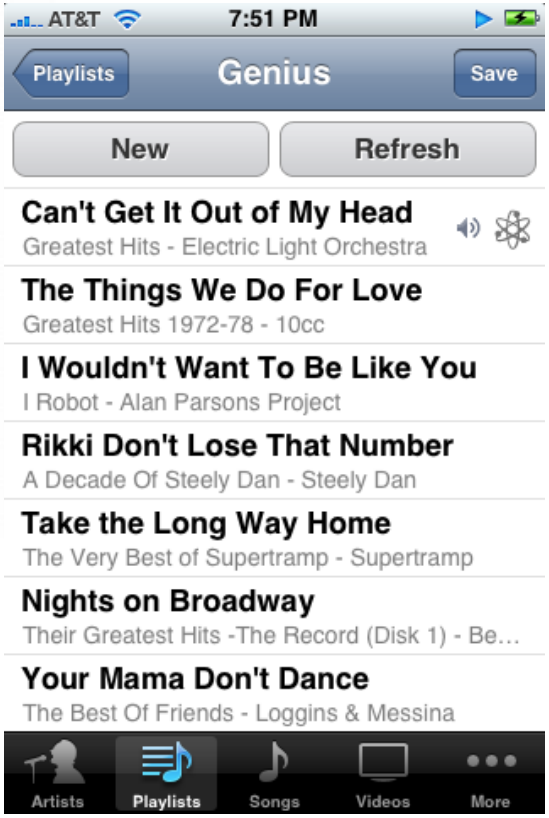
Audiovisual Communications, Fernando Pereira, 2012

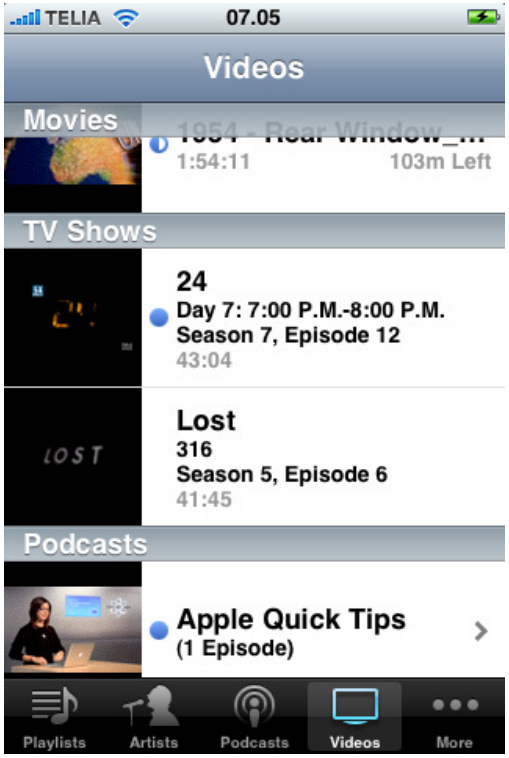
From Hunger to Plenty or Drowning in Data ...

Filtering TV …



Managing iPods Data …





YouTube: Metadata, Searching …

YouTube considers metadata fields such as

- **Title**
- **Description**
- **Category**
  - ***Autos & Vehicles, Comedy, Education, Entertainment, Film & Animation, Gaming, Howto & Style, Music, News & Politics, People & Blogs, Pets & Animals, Science & Technology, Sports, Travel & Events, …***
- **Date of upload**
- **Number of views**
- **Scores**
- **…**

YouTube
Broadcast Yourself™

Data and Metadata Make a Great Couple ...

Piracy: The Snowball Effect

Patents and Copyright …

Intellectual property (IP) enjoys legal protection and stems from the exercise of the mind. IP regards patents, trademarks, copyright, design protection and some minor rights.

- **A patent for an invention is granted to the applicant, and gives him the right for a limited period to stop others from making, using or selling the invention without permission.**

- **Copyright is a legal right (usually of the author or composer or publisher of a work) to exclusive publication production, sale, distribution of some work.**

Business Model: The Key to Success ...

A business model is the method of doing business by which a product/service can sustain itself - that is, generate revenue.

Some business models are quite simple. Other models can be more complex such as free television. The broadcaster is part of a complex network of distributors, content creators, advertisers, and listeners or viewers. Who makes money and how much is not always clear at the outset.

- **Digital representations and networks give rise to new kinds of business models, since acquiring, transmitting, and storing information (now just bits) became much easier.**
- **But it is also likely to reinvent 'old' models such as auctions. New and interesting variations of old models should be expected in the future.**

New Systems and … New Business Models …

iPod
Vídeos, Músicas, Fotos.
30GB, 80GB

iPod nano
Totalmente novo.
2GB, 4GB, 8GB

iPod shuffle
Leve suas músicas.
1GB

iPod may play the following audio formats: MP3, WAV, AAC, Protected AAC, AIFF and Apple Lossless.

Multimedia in Portugal

- **It is today much easier than before to create and sell audiovisual communication related products (mainly software based).**
- **Internet helps the success of small, innovative companies created without much investment.**
- **The competition between companies may stimulate also the operators to embrace more innovative challenges.**
- **Users are increasingly open to new services.**
- **International contact is changing old habits and prejudices …**

Moreover, multimedia technology is an interesting field for Portuguese young engineers with initiative to launch their own companies !