Multimedia Search Engines & the Future Internet

Petros Daras

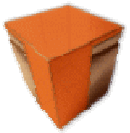
Centre for Research and Technology Hellas

Informatics & Telematics Institute

www.iti.gr

Outline

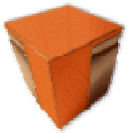
- Future Internet
- Networked Media – Future Content Networks
- Multimedia Search Engines – facts & figures
- Current European Research
- Research Challenges



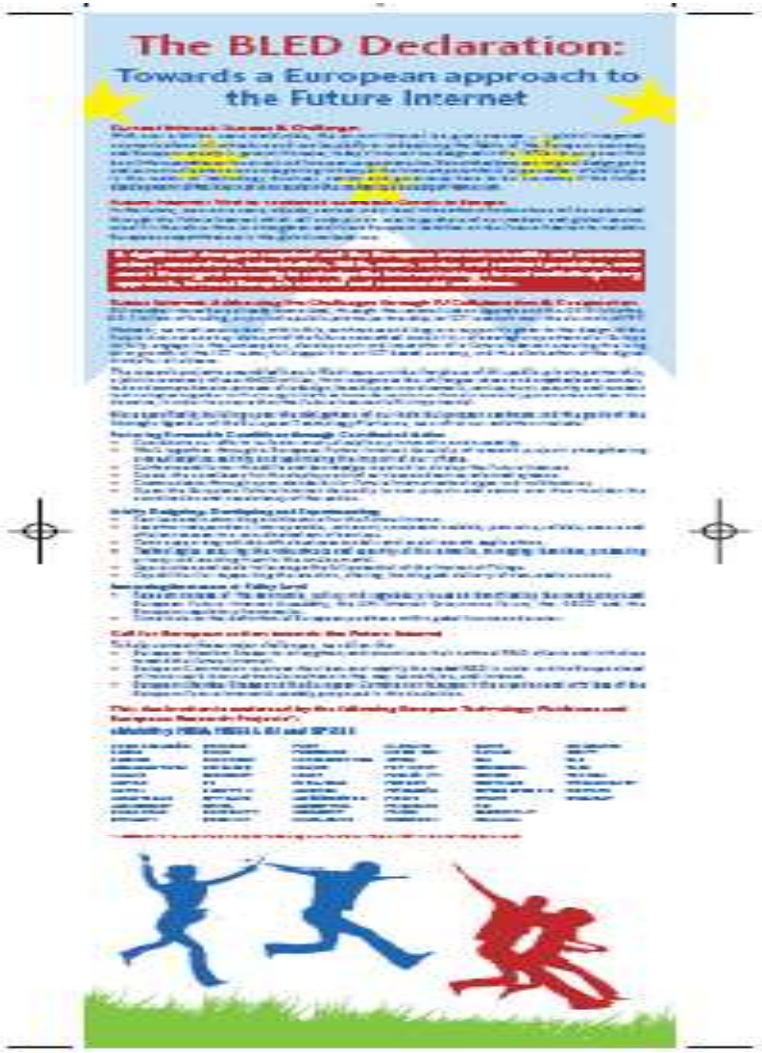
The Future Internet

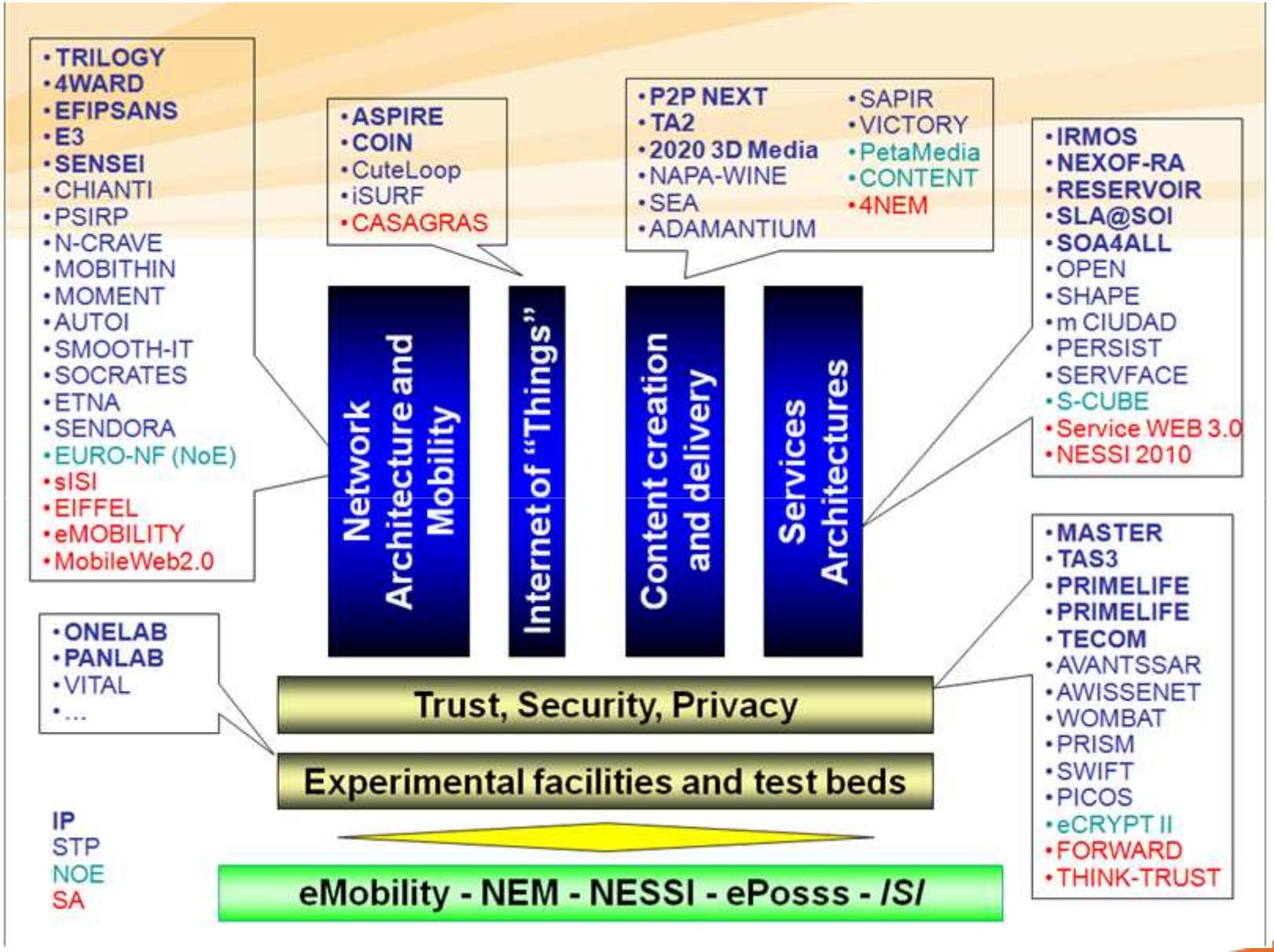
- Current Internet: was developed in the 70s without considering the challenges of today, like mobility and scalability, and it struggles to cope with the explosion of wireless access by billions of users and objects, broadband evolution, exponential growth of rich media, multiplicity of services and contexts and the demands of trust, privacy and security.
- **Future Internet is vital to continued economic growth in Europe**

  In the future, even more users, objects and critical information infrastructures will be connected to the Future Internet and it will become a critical factor for supporting and improving the European economy. It is therefore time to strengthen and focus European activities on the Future Internet to maintain Europe's competitiveness in the global marketplace.



BLED Manifesto: Towards an European approach to the Future Internet, 31 March 2008

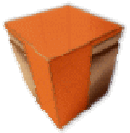



• TRILOGY
• 4WARD
• EFIPSANS
• E3
• SENSEI
• CHIANTI
• PSIRP
• N-CRAVE
• MOBITHIN
• MOMENT
• AUTOI
• SMOOTH-IT
• SOCRATES
• ETNA
• SENDORA
• EURO-NF (NoE)
• sISI
• EIFFEL
• eMOBILITY
• MobileWeb2.0
• ASPIRE
• COIN
• CuteLoop
• iSURF
• CASAGRAS
• P2P NEXT
• TA2
• 2020 3D Media
• NAPA-WINE
• SEA
• ADAMANTIUM
• SAPIR
• VICTORY
• PetaMedia
• CONTENT
• 4NEM
• IRMOS
• NEXOF-RA
• RESERVOIR
• SLA@SOI
• SOA4ALL
• OPEN
• SHAPE
• m CIUDAD
• PERSIST
• SERVFACE
• S-CUBE
• Service WEB 3.0
• NESSI 2010
Network Architecture and Mobility
Internet of "Things"
Content creation and delivery
Services Architectures
• ONELAB
• PANLAB
• VITAL
• ...
Trust, Security, Privacy
Experimental facilities and test beds
• MASTER
• TAS3
• PRIMELIFE
• PRIMELIFE
• TECOM
• AVANTSSAR
• AWISSENET
• WOMBAT
• PRISM
• SWIFT
• PICOS
• eCRYPT II
• FORWARD
• THINK-TRUST
IP
STP
NOE
SA
eMobility - NEM - NESSI - ePosss - ISI

Future Internet Assembly

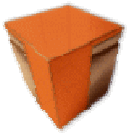
The Future Internet Assembly is currently working in clusters addressing the following areas:

- Management and Service-aware Networking Architectures - MANA
- Services and Software - FISO
- Future Content Networks - FCN
- Security, Privacy and Trust
- Internet of Things - Real world Internet
- Future Internet Research and Experimentation
- Future Internet Socio-Economics



FIA workshops

- March 2008, Bled, Slovenia
- December 2008, Madrid, Spain
- May 2009, Prague, Czech rep
- November 2009, Stockholm, Sweden
- April 2010, Valencia, Spain
- …



What we expect/demand from the Future Internet?

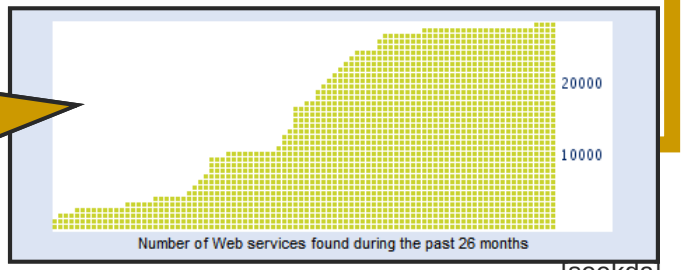
...and create new markets...

"We're beyond globalization. We'd like to present a case for universalization."

The main pillars of FI

“Internet of Services”

Billions of software **services** will be accessible via the Web



[seekda]

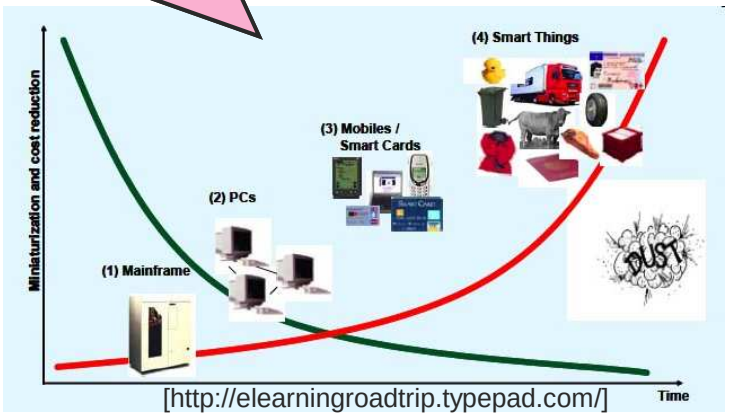
“Internet of Contents”

Abundance of user generated, digital **content & media**

Year 2006: 160 Exabyte
(= 12 book stacks from earth to sun)
Year 2010: 990 Exabyte

“Internet of Things”

Multitude of **connected devices** and **“smart” objects**

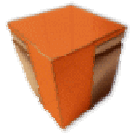


[http://elearningroadtrip.typepad.com/]

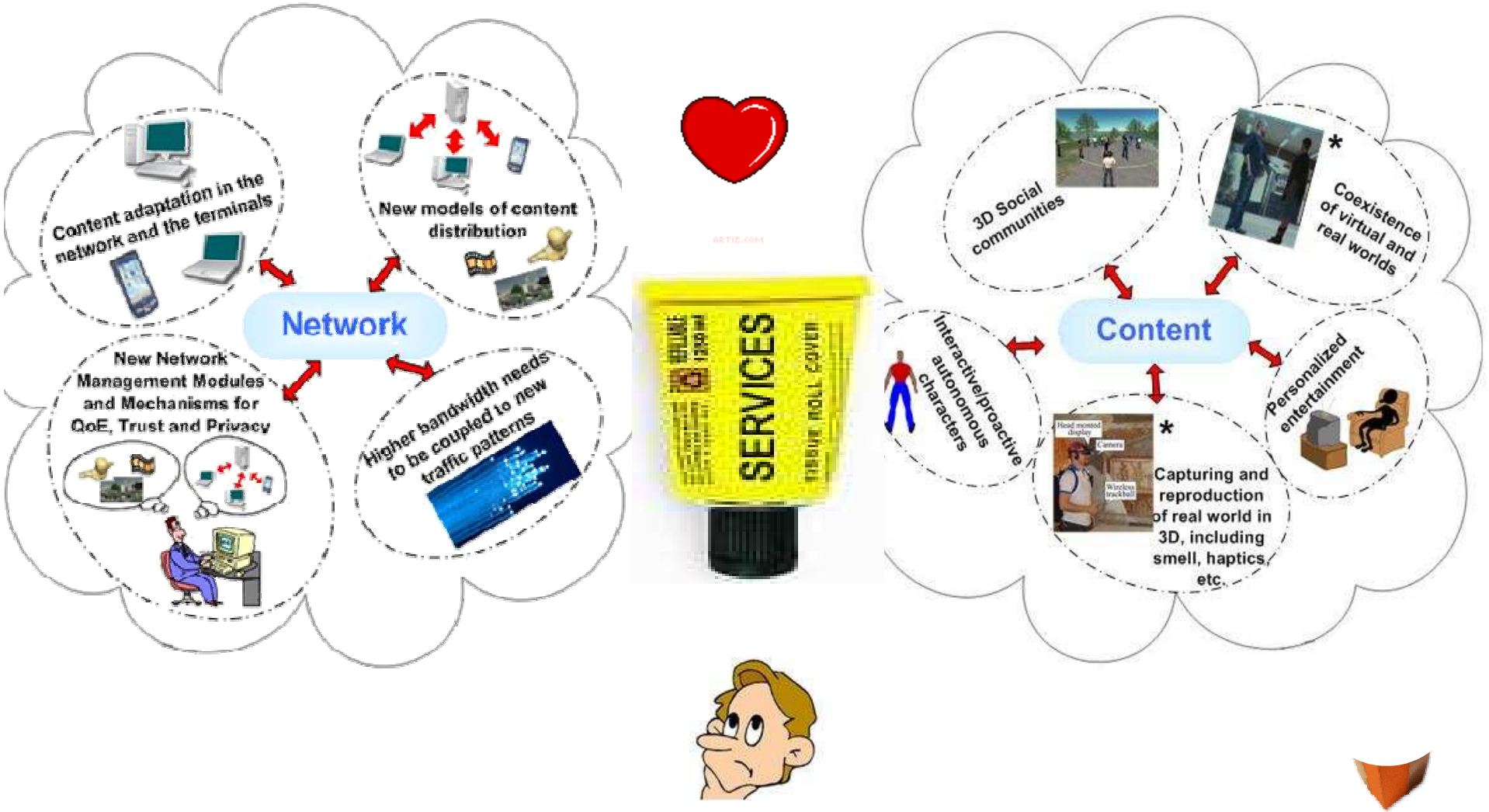
Source (in parts): Presentation by Joao Da Silva (European Commission Director Converged Networks and Services) at the NESSI General Assembly

Networked Media – Future Content Networks

- **Networked Media** rely on the technological process known as **Convergence**, thanks to which all kinds of media including text, image, 3D graphics, audio and video produced can be distributed, shared, managed and consumed through various networks, like the Internet, be it via Fiber, WiFi, WiMAX, GPRS, 3G and so on, in a convergent manner.
- **FCNs** refer to the evolution of both the content and the network (Future Media Internet, 3D Internet, etc)

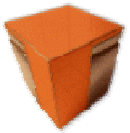


Future Content Networks



Future Content Networks

Visionary Scenarios & Challenges



The Mobile will be the primary connection tool to the Internet

John leaves home, goes to the metro station and is riding the metro to the office. While on the way, he checks and replies to the most important emails. Wearable devices (e.g. glasses with screen monitors) help him to read the emails in a simpler way.

The Mobile will be the primary connection tool to the Internet

When reading the newspaper, John can also get related videos from the BBC. The videos are projected on the newspaper next to the corresponding printed news article and he can start playing them using natural gestures (e.g. pressing on the projected “Play” button).

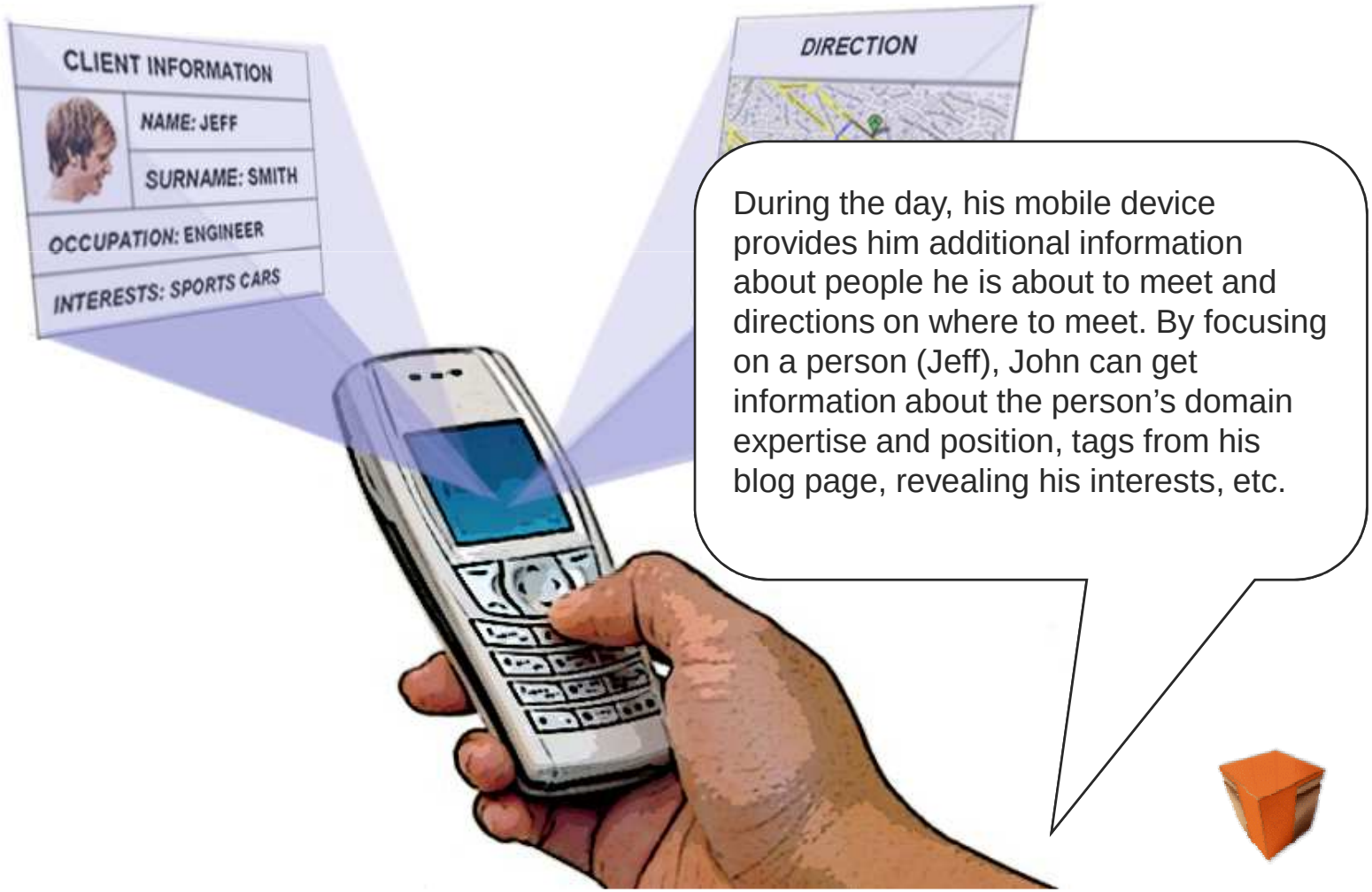
The Mobile will be the primary connection tool to the Internet

John needs to fly to London for meeting a business partner and he is on his way to the airport. His device projects additional information about his flight: gate number, expected delay time, etc. In addition, when looking at a small travel guide for London, he gets recommendations for musicals now playing in London.

The Mobile will be the primary connection tool to the Internet

Today, John has to join a meeting, but he is late due to some delays in the metro schedule. While on the way to the office he connects to the meeting room. He can exchange documents and presentations with the other participants. As the discussion is about a new product, he may watch the 3D representation at his mobile phone.

The Mobile will be the primary connection tool to the Internet

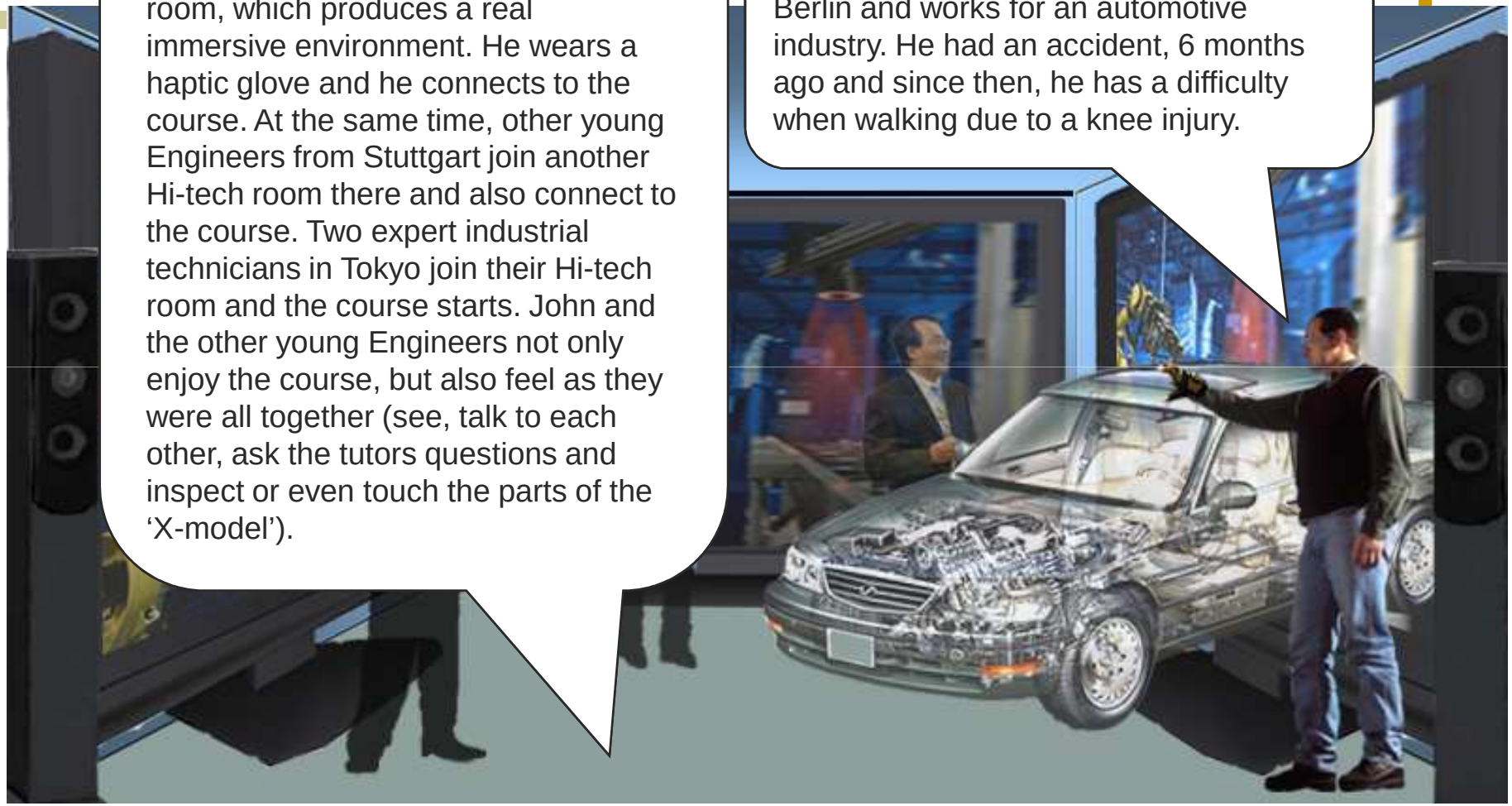


During the day, his mobile device provides him additional information about people he is about to meet and directions on where to meet. By focusing on a person (Jeff), John can get information about the person's domain expertise and position, tags from his blog page, revealing his interests, etc.

The Mobile will be the primary connection tool to the Internet

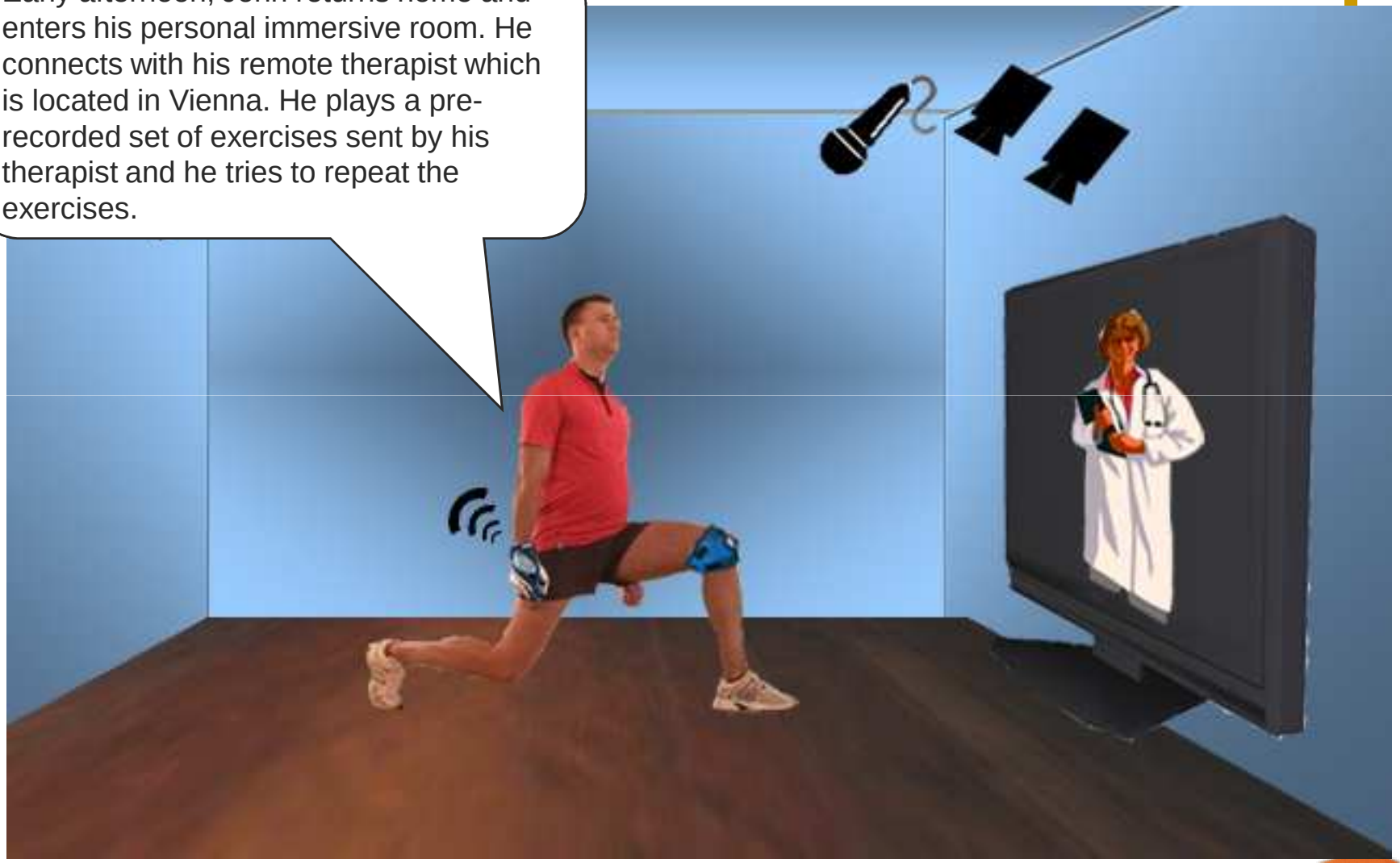
John meets Jeff and presents him some new designs using holographic projection providing also haptic possibilities from his mobile device

Augmented reality/Interacting in artificial spaces

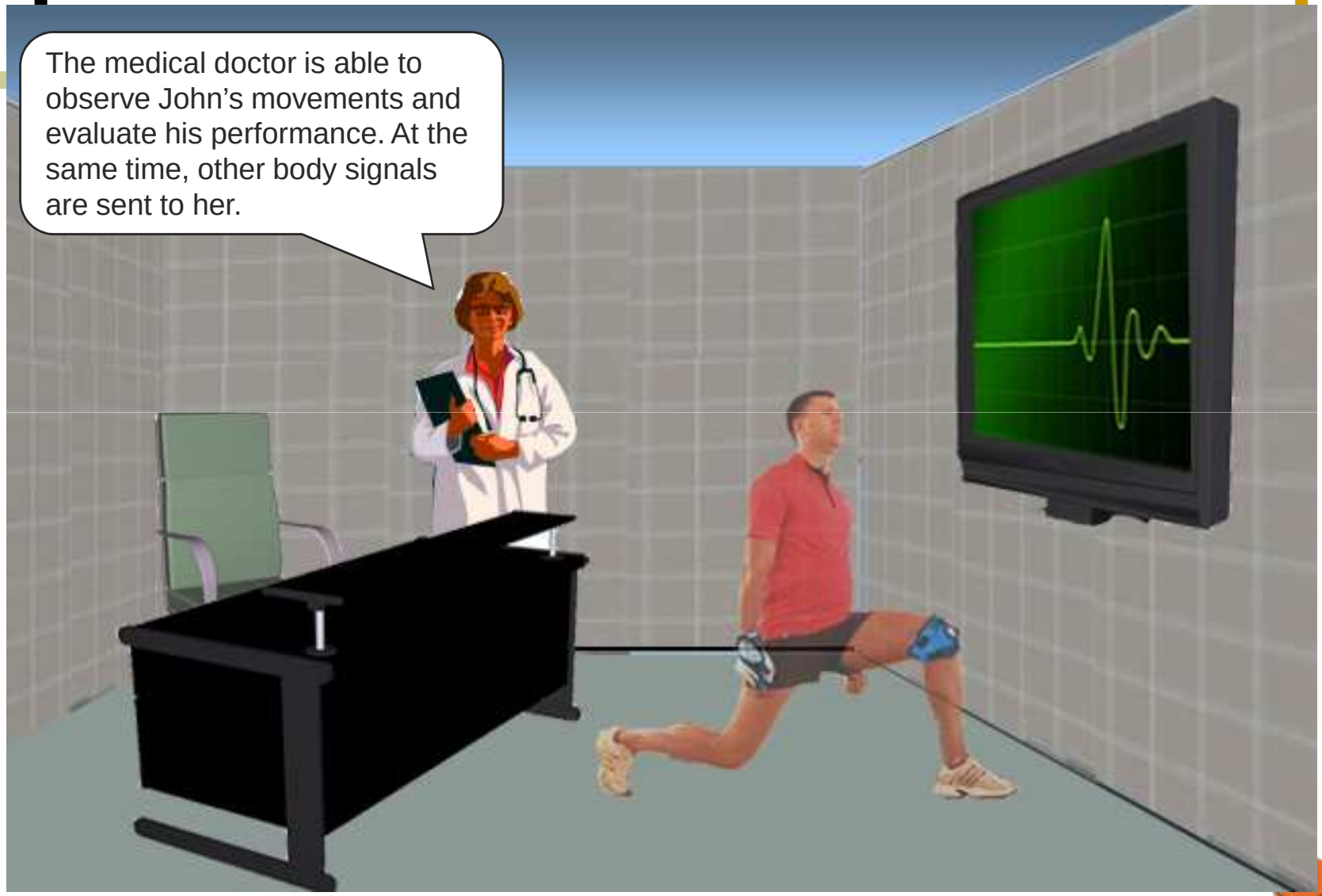


Augmented reality/Interacting in artificial spaces

Early afternoon, John returns home and enters his personal immersive room. He connects with his remote therapist which is located in Vienna. He plays a pre-recorded set of exercises sent by his therapist and he tries to repeat the exercises.



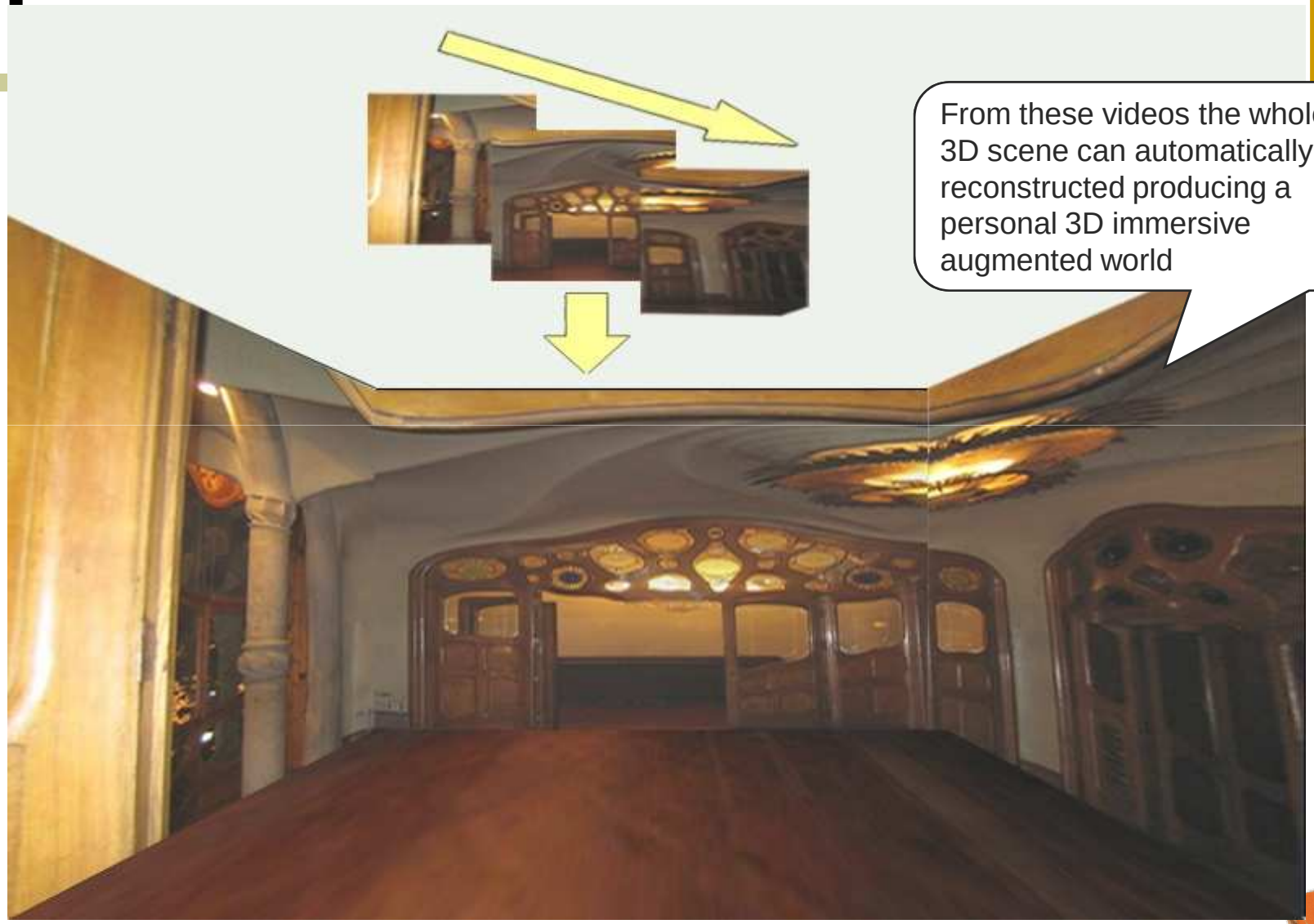
Augmented reality/Interacting in artificial spaces



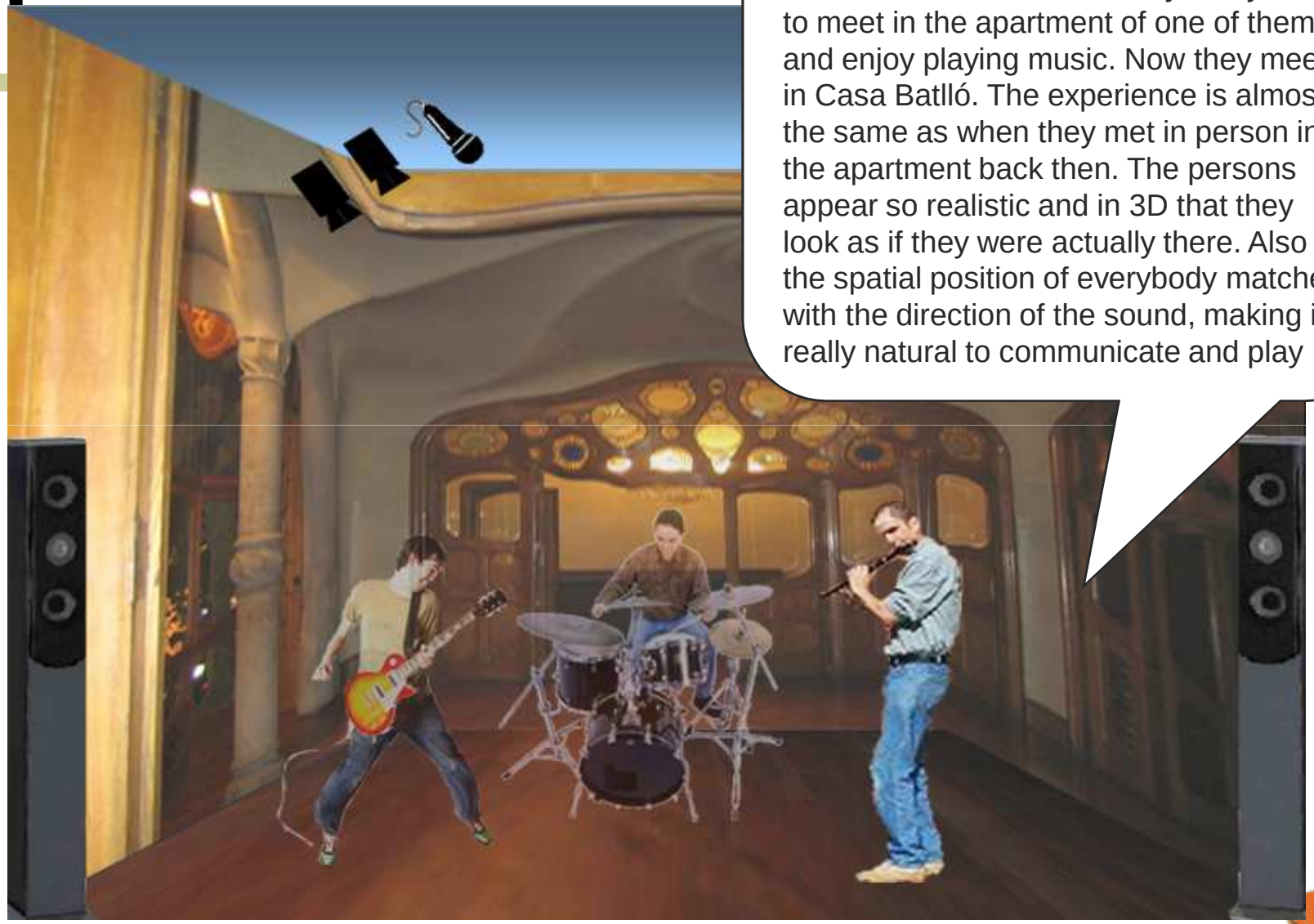
Augmented reality/Interacting in artificial spaces

John recently went to Barcelona for vacation. He took videos of some of the most famous touristic attractions of the city including Casa Batlló. The videos are directly downloaded from his handycam to his Internet page. These videos can automatically reconstruct in 3D the scenes he took producing 3D immersive augmented worlds

Augmented reality/Interacting in artificial spaces



Augmented reality/Interacting in artificial spaces

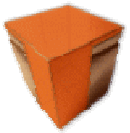


Later, John decides to tele-meet with his old friends from the university. They used to meet in the apartment of one of them and enjoy playing music. Now they meet in Casa Batlló. The experience is almost the same as when they met in person in the apartment back then. The persons appear so realistic and in 3D that they look as if they were actually there. Also the spatial position of everybody matches with the direction of the sound, making it really natural to communicate and play

Augmented reality/Interacting in artificial spaces

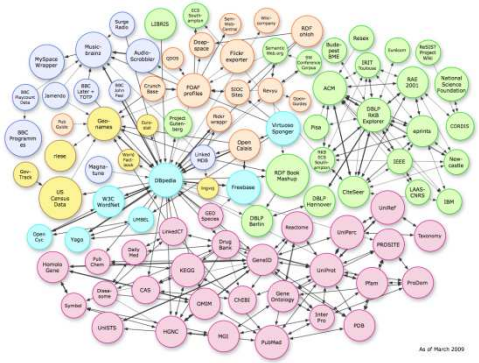
Multimedia Search Engines

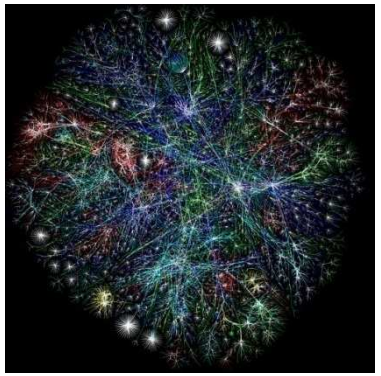
18 November 2009, Thessaloniki

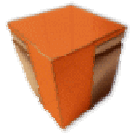


Search Definition

‘Best’ use of available (human or machine generated) knowledge to provide the user with meaningful information even if his/her request is poorly formulated and typically unanticipated.

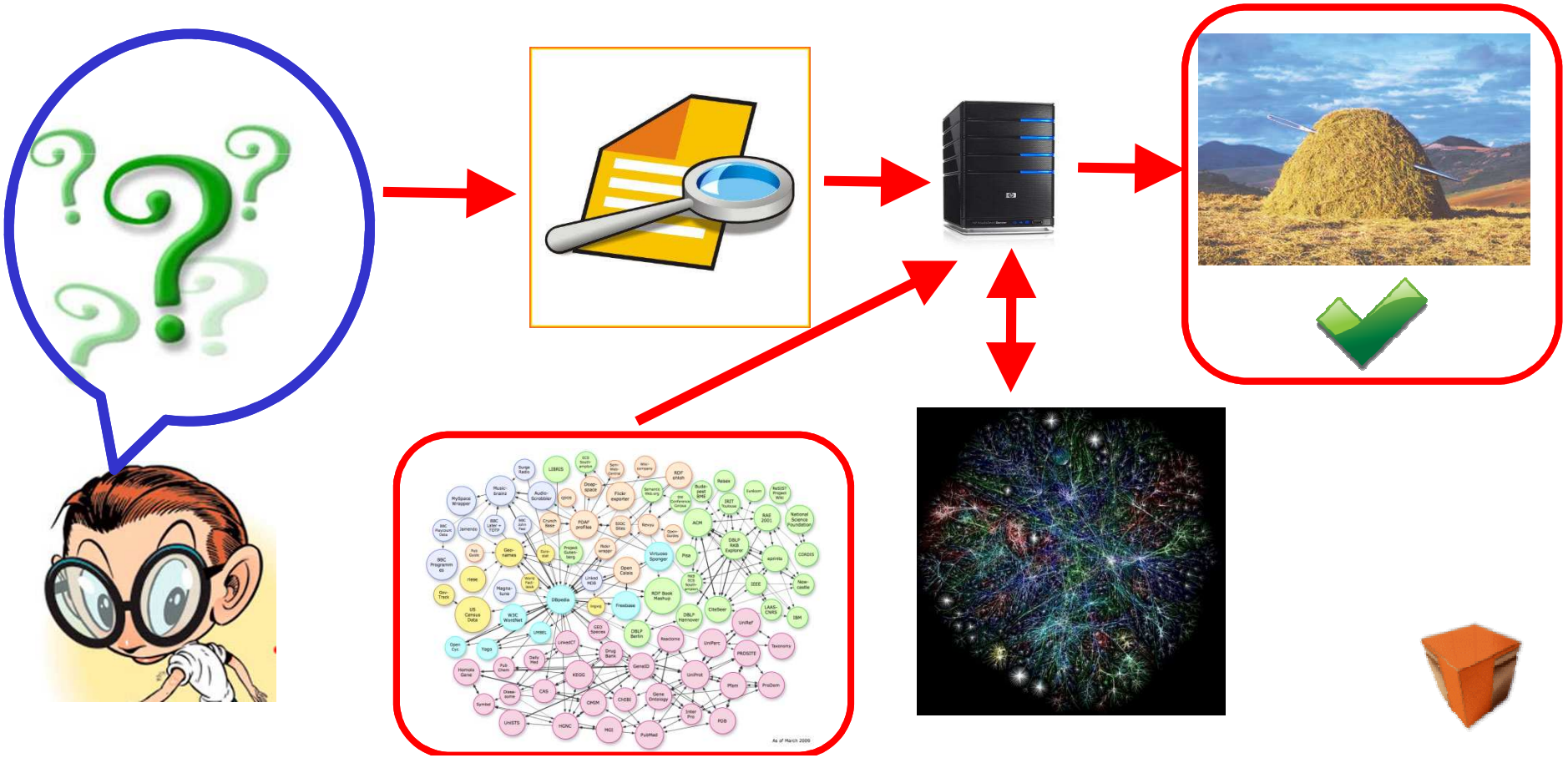






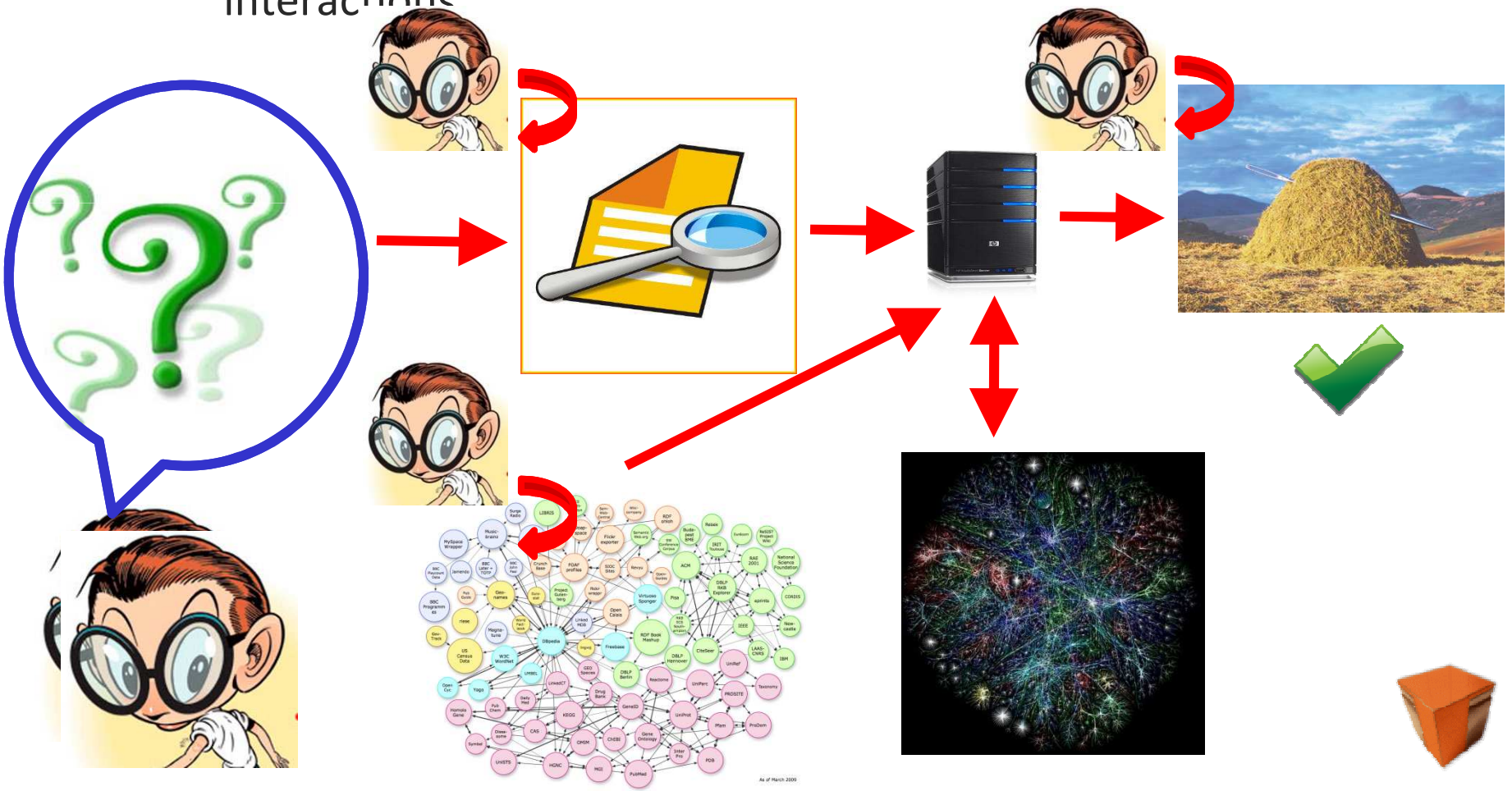
Value and Efficiency

The value of a search engine depends on how efficiently the knowledge is managed and how easily the information is accessed and understood by the end user.



User in the Loop

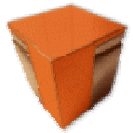
- Maximises a SE's efficiency when it can learn and accommodate user preferences (through online and off-line learning) from user interactions



Search: a cross-disciplinary topic

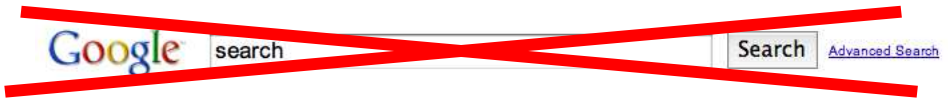
Search involves a number of different disciplines within the FI, including:

- **FCNs:** a) content as the main ingredient of media, and b), networks in terms of improving the user's experience and satisfaction;
- **IoTs:** resource and information discovery from a sea of heterogeneous devices and sensors;
- **IoSs:** service discovery approaches range from keyword search over service directories to semantic approaches which delineate between a service capability (what the service does), non-functional properties, and descriptions of service behaviour.

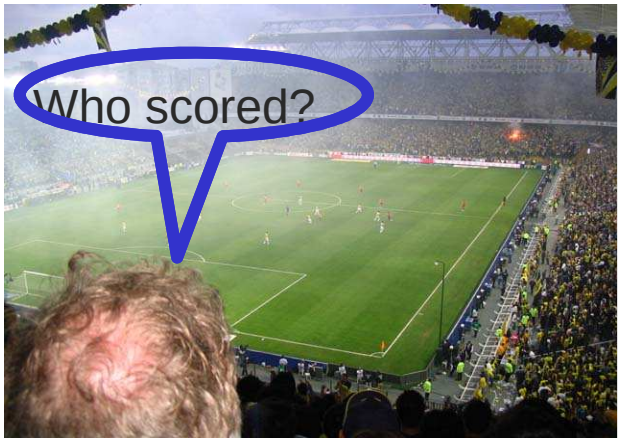


Search and the FI

- Internet evolution: rich content, immersive experiences, interaction, networked sensors, services, new applications...
- Text-based search is not any more the best choice...



- Content/context-based search seems to be a solution...
- FI Search viewpoint of media, physical objects and/or services.

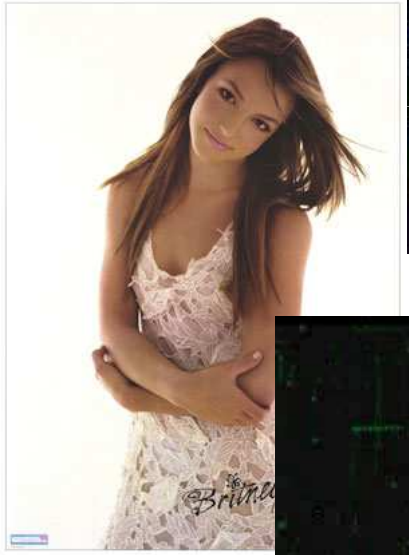


Search Engines - Some facts (1/2)

- 85% of Internet users use search engines to get to where they want to go
- Content downloading and searching are the 2 dominant actions of the Internet users today
- Typing “Google” is easier than remembering a specific website spelling, its toolbar is by far the most dominant interface to today’s WEB information.
- Google indexed 26 Million pages in 1998 – today it indexes 1 Trillion pages

Personal – UG – content

Sport - News

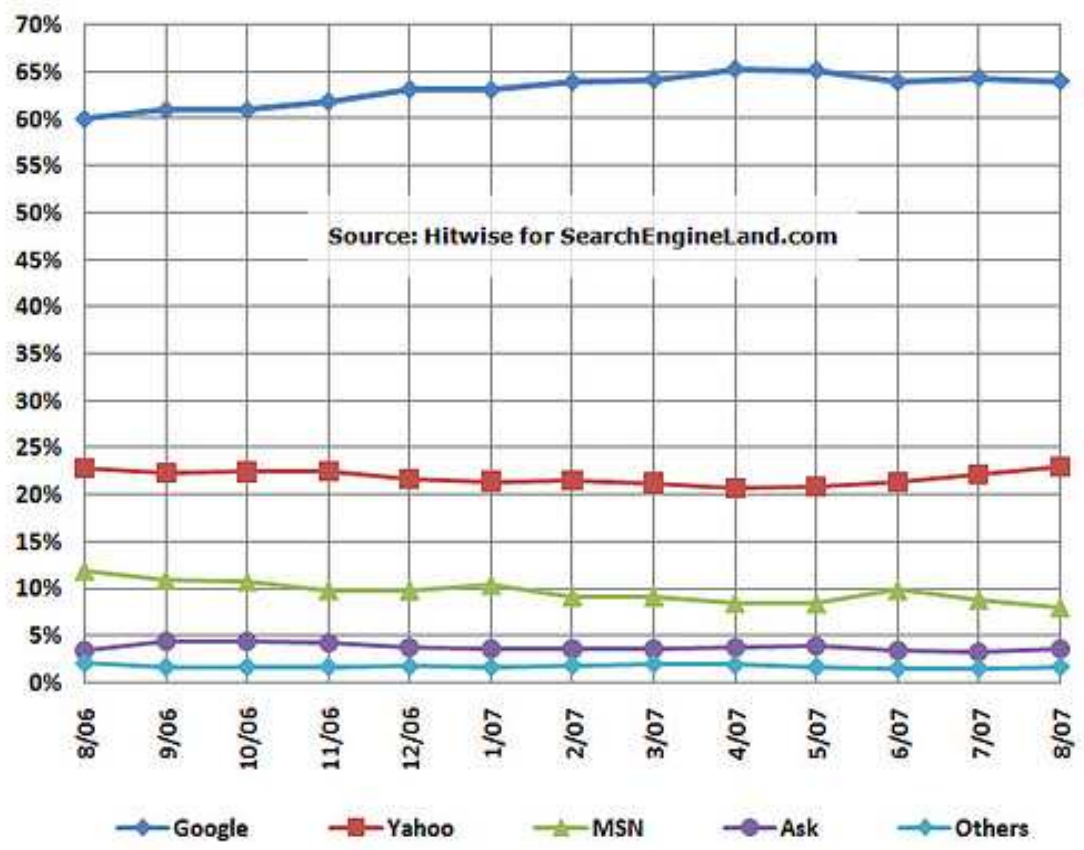


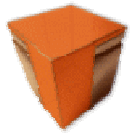
Web- Mobile

Films

Search Engines - Some facts (2/2)

- There are currently 210 billion emails per day
- In October 2008, 12.6 total billion searches (US alone) were made
- Facebook has over 200 million users (search within will gradually replace search outside)
- Every minute, 15 hours worth of video are uploaded to YouTube — the equivalent of 86,000 new full length movies every week.
- 3.7 Million pictures uploaded every day in Flickr

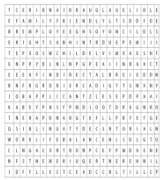
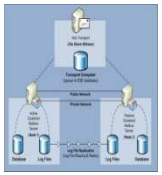




Multimedia Search: The Challenge



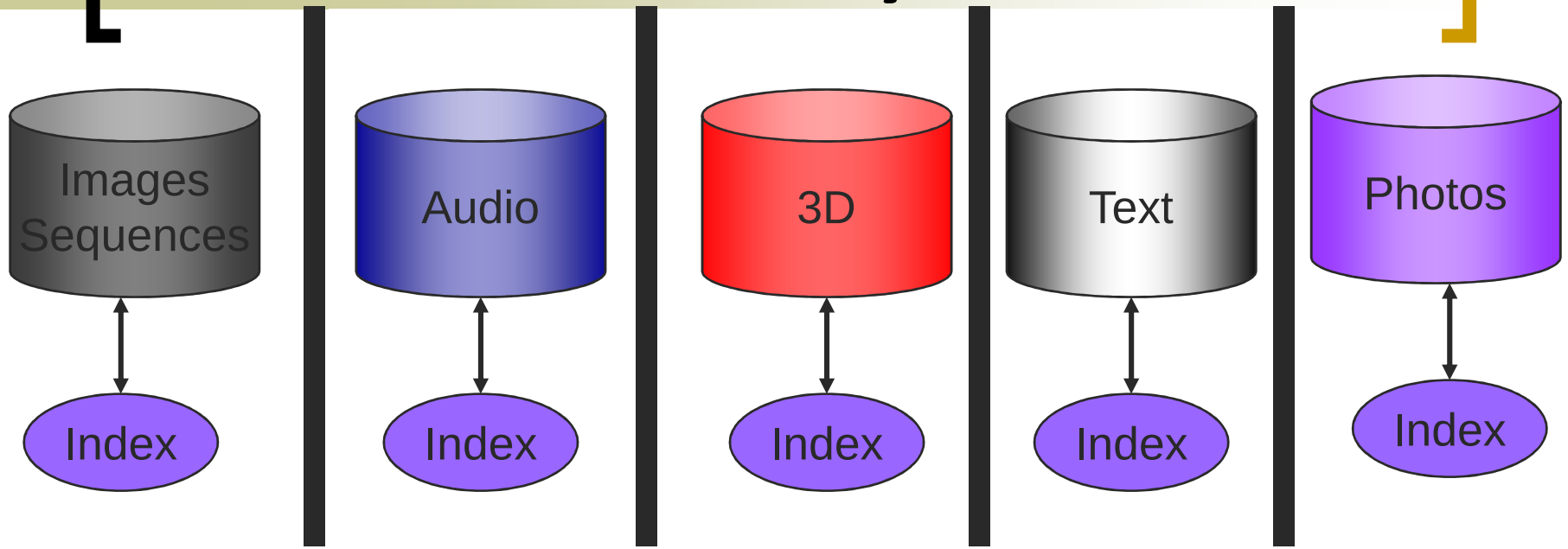
Data

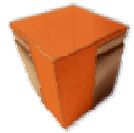
Connecting

Users

Multimedia Information: Retrieval Today



- The value of information depends on how easily it can be found, retrieved, accessed, filtered or managed
- Multimedia (content-based) indexing and retrieval is needed that understands the meaning of the content and associates it with the actual meaning of the user's query



Facebook ... | Watchitoo | Twitter / H... | Copyright ... | TinyURL.co... | Important ... | iuci / Ques... | Companio... | Visual Sea...

http://www.searchme.com/#/&vs=web

Business News, Fi... | Convert MS Word ... | Cricinfo.com - Th... | Dr. Ramesh Jain | EMMa | Electronic Educati... | EventWeb Demo | Facebook Home | Other bookmarks

all | web | video | images | music | news | shopping

searchme lite | stacks | tools | preferences | about us

searchme: web

search

Welcome | Latest News | Featured | Sports | Entertainment | Music | Videos

Searchme, the first multimedia search engine

Search for information, videos, music, images, news and more, and find the most relevant results displayed in a comprehensive blend of multimedia and non-multimedia web pages.

Find exactly what you're looking for next

EU projects

CHORUS

Networking and co-ordination of research and innovation activities
Dissemination of 'good practices', information systems
R&D roadmap: expert groups, think tank

SAPIR

P2P SE

VITALAS & PHAROS

Generate the new knowledge: fill the "semantic gap"
"generic plug-in platform). Both IPs integrate a **critical mass** of activities and resources
Achieve **ambitious, clearly-defined S&T objectives**
Collaborative European dimension.

RUSHES

Raw images

TRIPOD

GIS SE

SEMEDIA

AV files

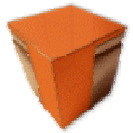
VICTORY

3D P2P SE

DIVAS

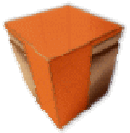
Direct search
(no meta-data)

VIDIvideo



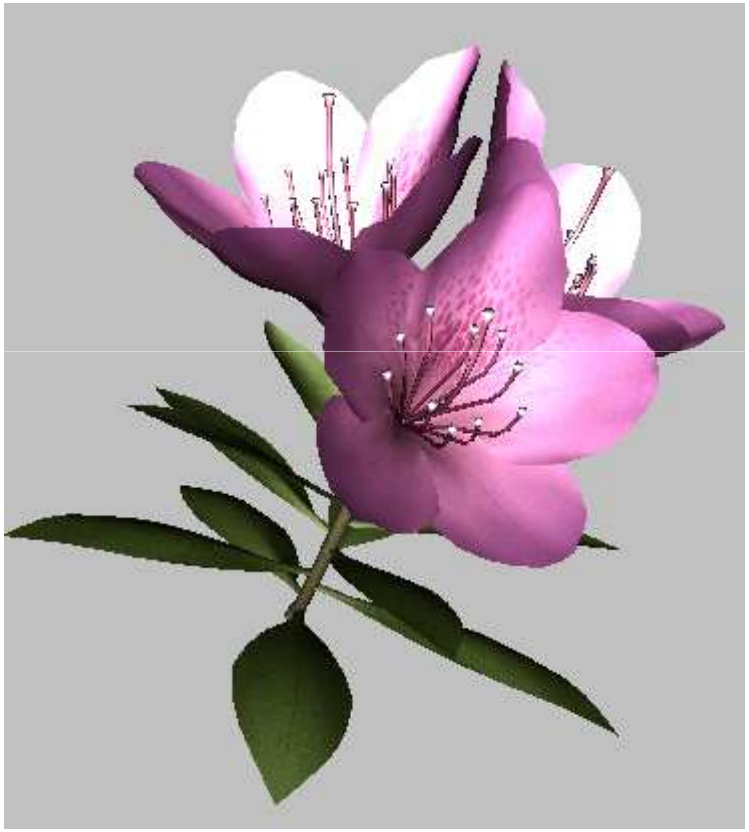
Current EU Research

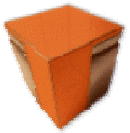
- Indexing, searching and accessing large scale of non previously (or partly) annotated content (images)
- Media-specific automatic feature extraction and content classification/understanding (images)
- Scalable and distributed (P2P) index structures supporting similarity search (images)
- 3D object search and multimodal search (2D-3D, sketch-3D)
- Video and audio characterisation, fingerprint extraction, segmentation (video/audio)



3D content: the king…

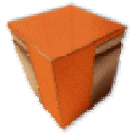
- “A picture is worth a thousand words”





3D content: the king…

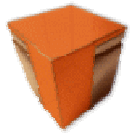
- A 3D Object?



Dominant Multimedia Applications

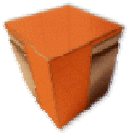
- Name the 3 most popular companies that emerged in the last 3 years.
  - YouTube
  - Facebook
  - Twitter
- Name 3 most popular Internet concepts in the last 3 years.
  - Social Networks
  - Micro-blogging (Ambient Awareness)
  - Virtual worlds

What does this tell us?



Message for Multimedia Search Community

- **People want:**
- Socialisation: Family and friends remain a strong influence in all facets of life.
  - Family and friends are closer to each other today than ever!!!
- New media: Text-based media is not enough.
- Experiences: People want to experience and share experiences – with minimal latency.



Emerging applications

Wh

- How
- See t
- Find
- Find

Citysense™

Live San Francisco Nightlife Activity

Citysense was built to show you where the action is, right now.

Using a billion points of GPS and WiFi positioning data from the last few years – plus real-time feeds – Citysense sees S.F. from above and puts the top live hotspots in your hand. You don't even need to sign up, just go to citysense.com on your BlackBerry, download, and open.

ve overall activity & top hotspots

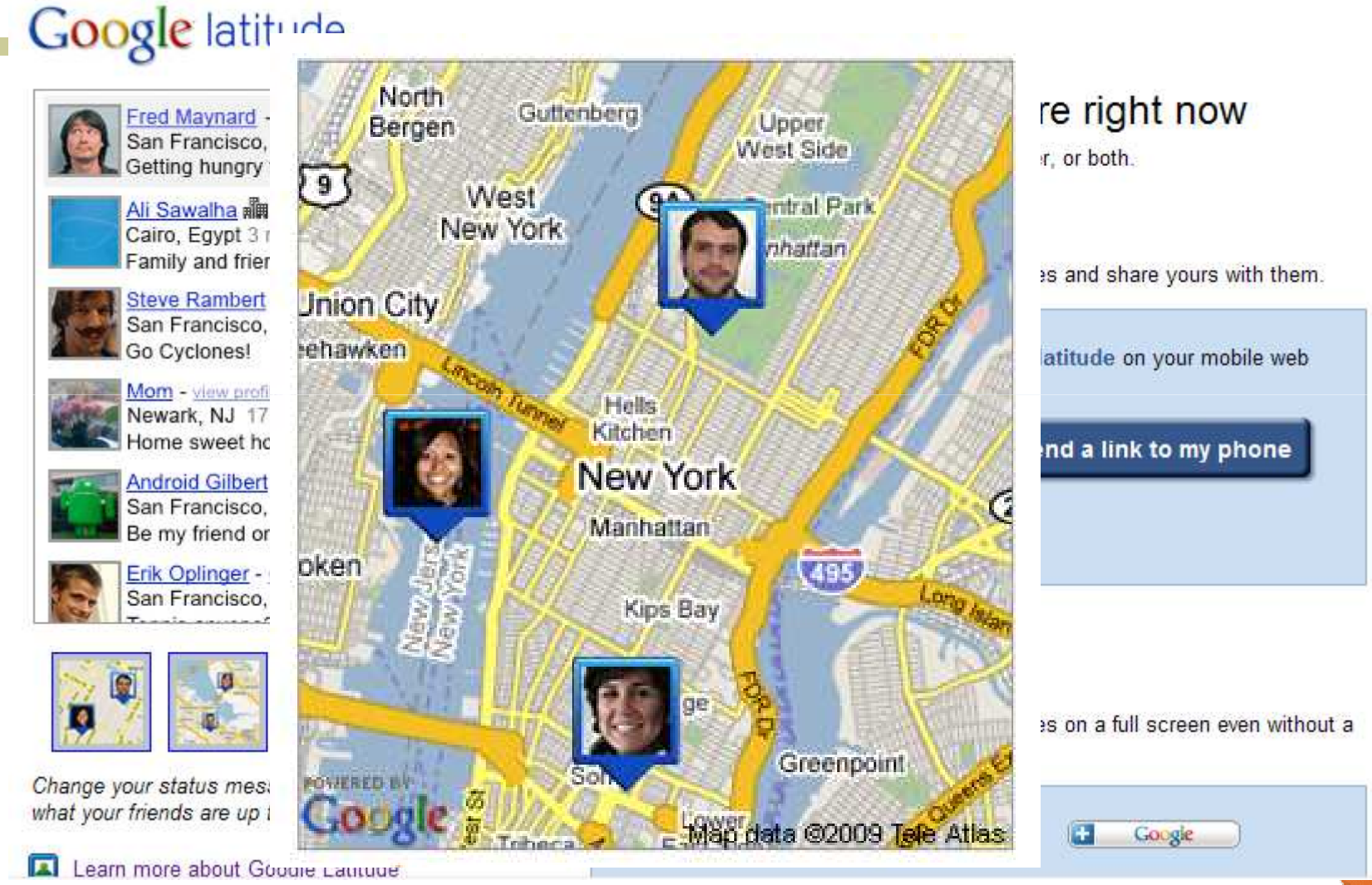
st of all see if it's a good night to go out. The city is 21% sier than normal for right now? Let's go. But where to? eck out the top hotspots in real-time and head out.

hat's at hotspot #1?

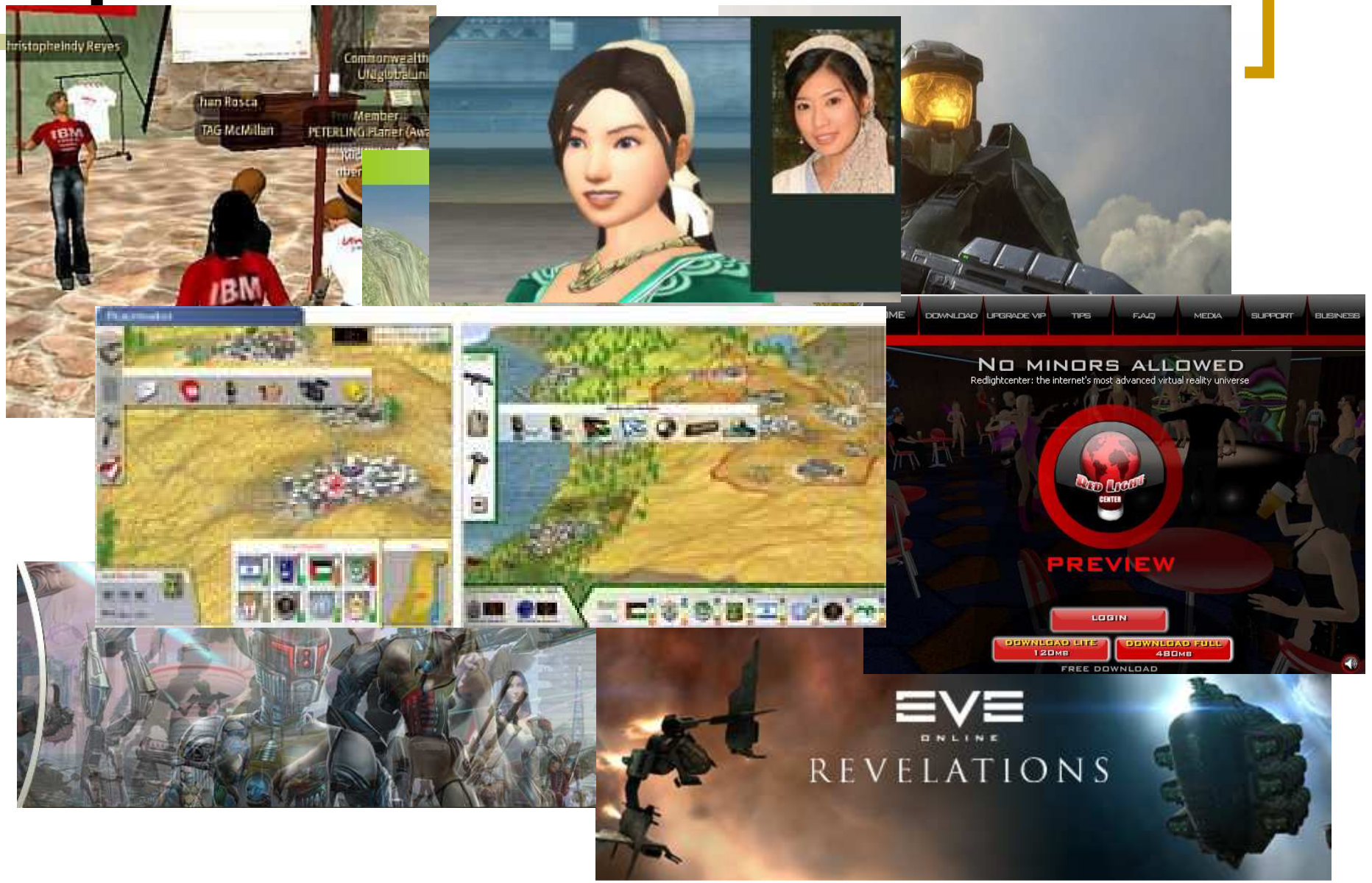
ck over to Yelp or Google and find out what's going on at #1 hotspot: Bars? Clubs? Restaurants? Then check out at's at #2.

http://www.citysense.com

Location sharing



Socialisation

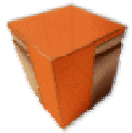


New (Immersive) Media

New communication experiences

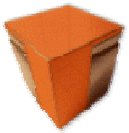
Research Challenges (1/2)

- FI and search must move in parallel. The FI cannot exist without **powerful MM Search engines**
- Create new forms of 3D content (suitable for immersive environments' development, mixing virtual with real)
- Extract everything from the web on a particular person, place, or thing to auto create a wikipedia entry (e.g., extract and interpret all the graphics, audio, video on a topic such as crime, disease, art)
- Extract (in real time) and interpret multimedia and multiparty communication (speech, posture, gesture)
- Perform automatic, content-based large scale MM indexing



Research Challenges (2/2)

- Unify MM content search + RWI + social descriptions into one single descriptor (retrieve MM content of the available types – mixed MM search)
- Enable Mobile MM content search using cameras, and other kind of RWI (place, date info, etc)
- Develop MM Search algorithms in virtual worlds, MMORPGs, MM social networks
- Develop Recommender Systems (web, TV)
- Create search services allowing for discovery of the best available algorithms and give it to all (“white box” approach)



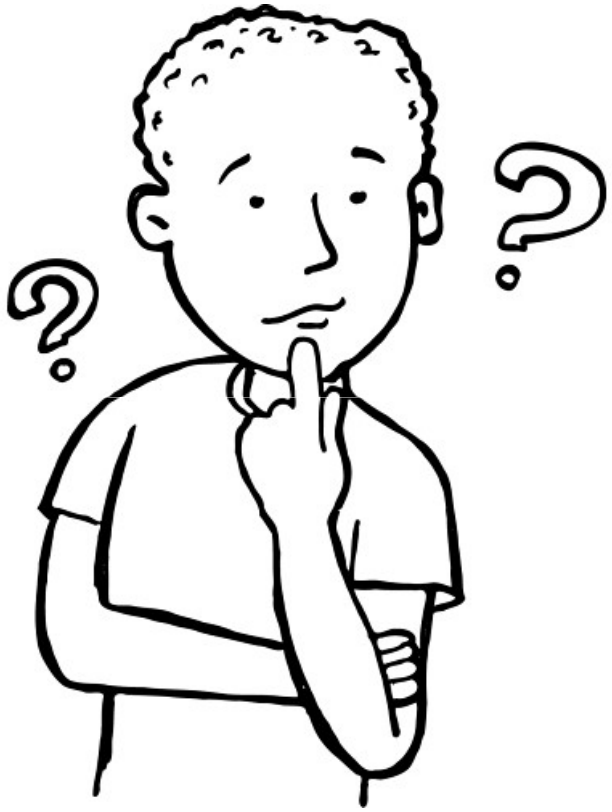
The Question of Discovery and Search in the Future Internet

Caretakers: **John Domingue** — OU and STI

Petros Daras — CERTH/ITI

EC Contacts: **Anne-Marie Sassen** **Isidro Laso-Ballesteros**

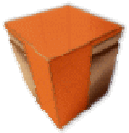
Questions?



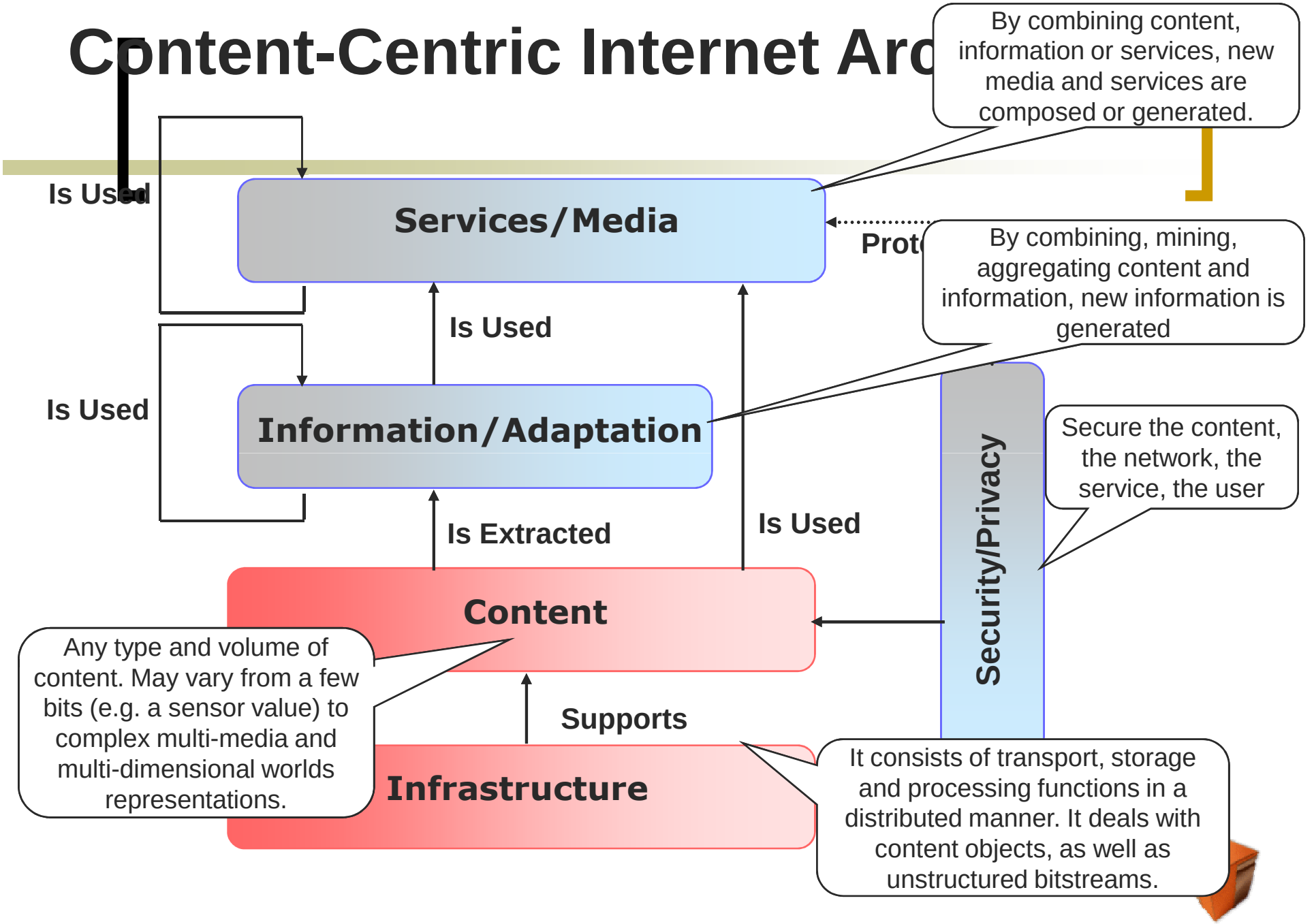
daras@iti.gr

References

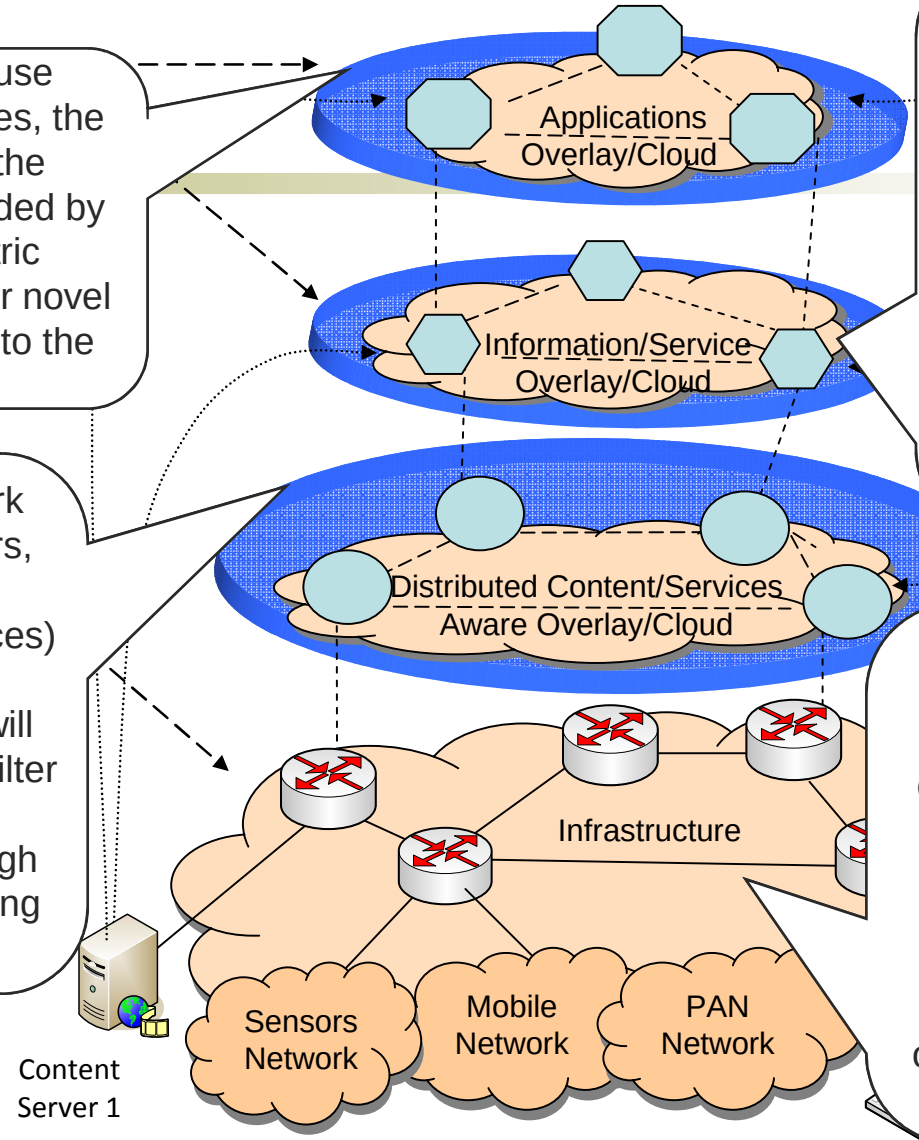
- Hendrik Speck, “The Future of Web Search”, Chorus. Advancing Search Technology for Audio Visual Content, May 26-27, 2009, Brussels, Belgium
- Ramesh Jain, “Prospective in Multimedia Search”, Chorus. Advancing Search Technology for Audio Visual Content, May 26-27, 2009, Brussels, Belgium
- Joao Schwarz Da Silva, “The role of Multimedia Search in the Future Internet”, Chorus. Advancing Search Technology for Audio Visual Content, May 26-27, 2009, Brussels, Belgium
- Petros Daras, “The user centric role and challenges in networked search and retrieval in the Future Media Internet”, ICT Event, November 26, 2008, Lyon, France
- Petros Daras, “3D Content search”, FIA Event, December 9-10, 2008, Madrid, Spain
- Petros Daras, “Future Content Networks, Visionary Scenarios & Challenges”, FIA Event, May 11-13, 2009, Prague, Czech Rep.



Content-Centric Internet Arc



Applications will use efficiently the services, the information and the media/content provided by the content-centric architecture and offer novel media experiences to the users



It will consist of intelligent nodes or servers that have a distributed knowledge of both the content/web-service location/ caching and the (mobile) network instantiation/conditions. these nodes may vary from unreliable peers in a next-P2P topology to secure corporate routers or even data centres in distributed carrier-grade cloud networks

Content-Aware Network Nodes (e.g. core routers, edge routers, home gateways, terminal devices) will be located at this overlay. These nodes will have the intelligence to filter the content and Web services that flow through them or identify streaming sessions and traffic

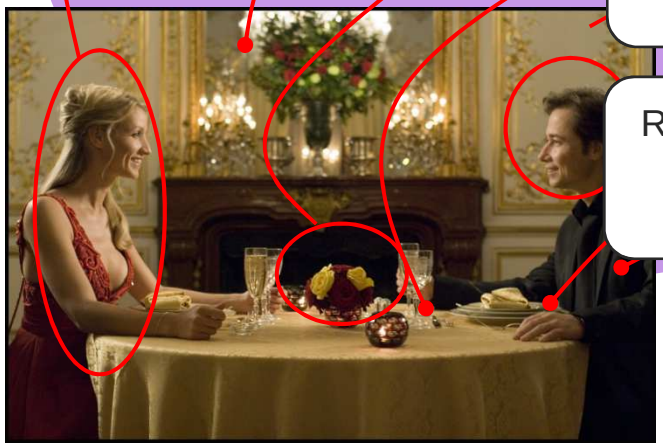
It will consist of nodes with limited functionality and intelligence. Users are connected to the infrastructure (Prosumers). Content will be routed, assuming basic quality requirements and if possible cached to some degree in this layer. Progressively this overlay will be reduced or even eliminated.

Beyond FCN Evolution
Autonomo

Ann

Interpolated stream from camera array

Live 3D of Versa



Media can be anything that a human can perceive/experience with his/her senses (a speaking person, a violin, a tear on your cheek, etc.)

Rules can refer to the way an object is treated and manipulated by other objects or the environment (discovered, retrieved, casted, adapted, delivered, transformed, presented)

Behaviour can refer to the way the object affects other objects of the environment

Relations between an object with other objects can refer to time, space, synchronisation issues.

Characteristics meaningfully describe the object.

Object

- Media
- Rules
- Behaviour
- Relations
- Characteristics