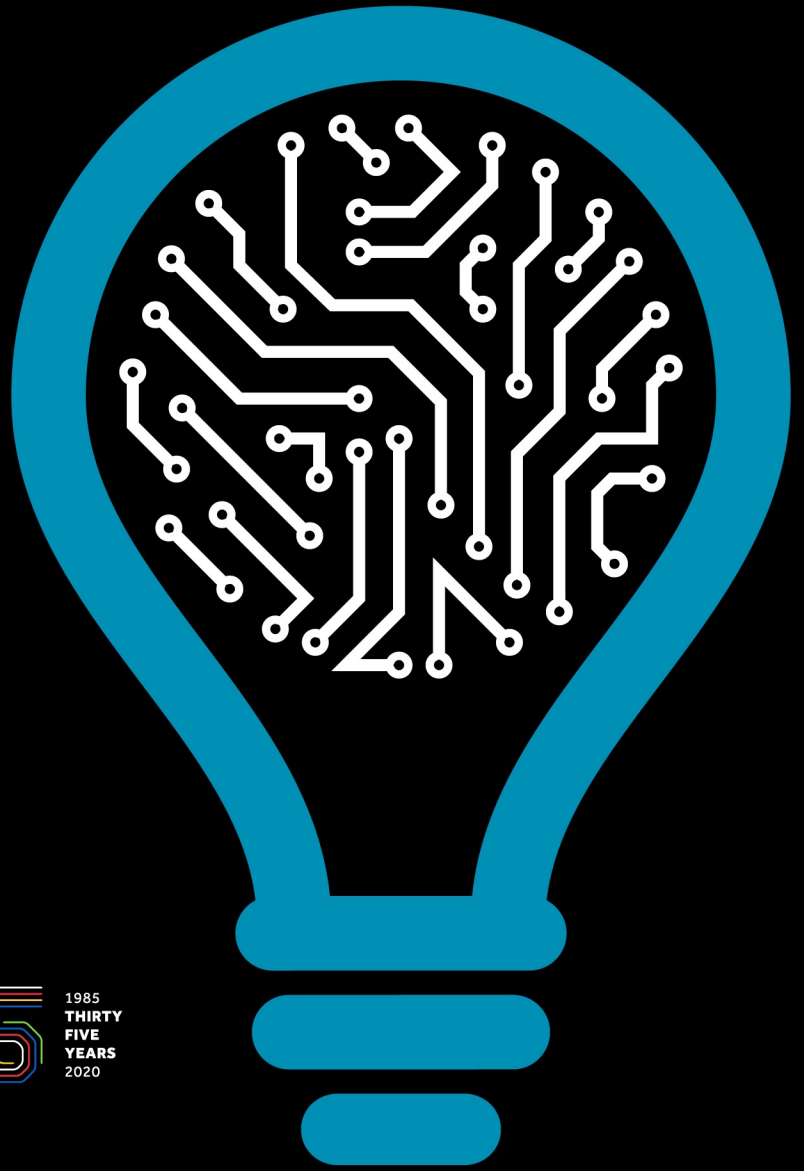
from knowledge generation to science-based innovation



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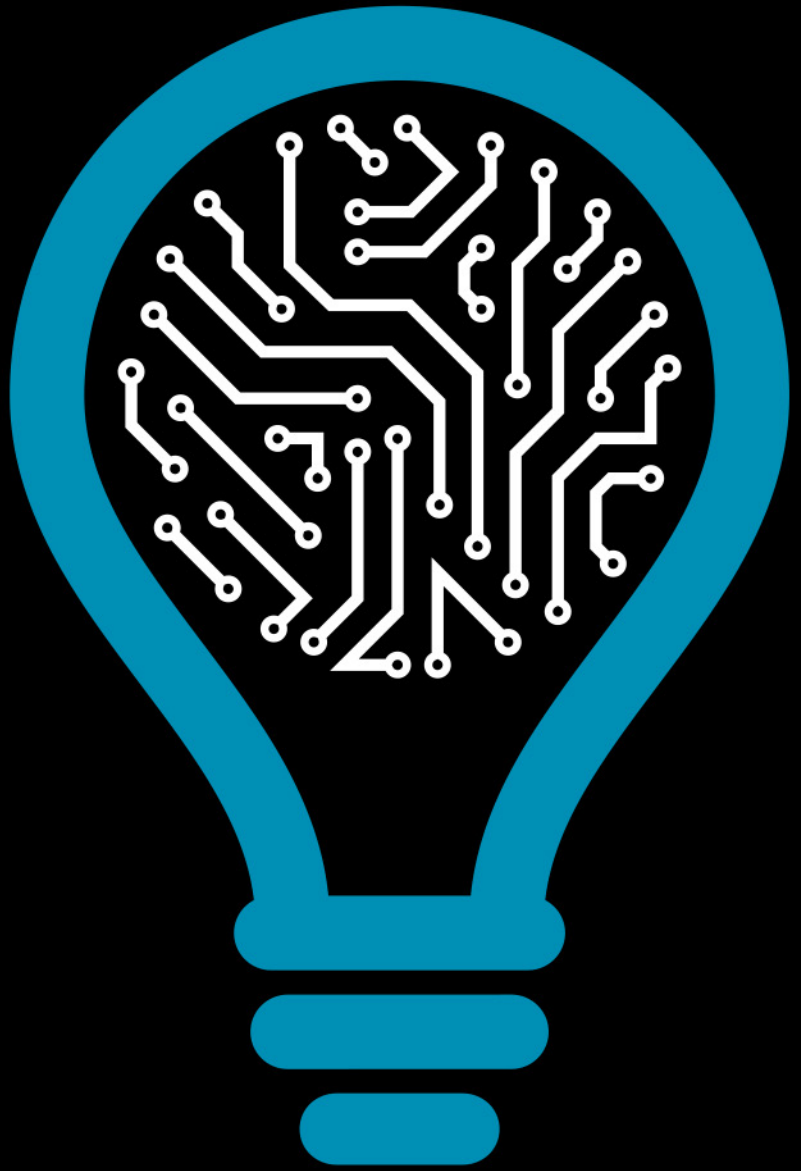
Towards IoT in multimedia : A look at research and standardisation efforts



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May 4th, 2021

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What will we address?

- IoMMT concept and how it compares to IoT
- Typical IoMMT entities
  - Bandwidth, computing resources and security requirements
  - Application domains
- On-going standardisation efforts
- Real world use cases associated to IoMMT
- On-going research efforts and still open challenges

What is IoMMT and where does it stand?

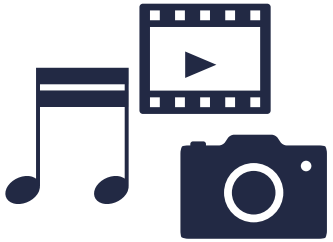
- Refers to the (eventually) connected set of digital equipment, services, interfaces and resources that produce, process, store and consume specifically multimedia content
  - Media-centric services and devices in a connected world, where information resources are limited to media
- An extension to the IoT concept driven by the growing ubiquity of multimedia enabled connected devices and sensors

Why bothering to define it?

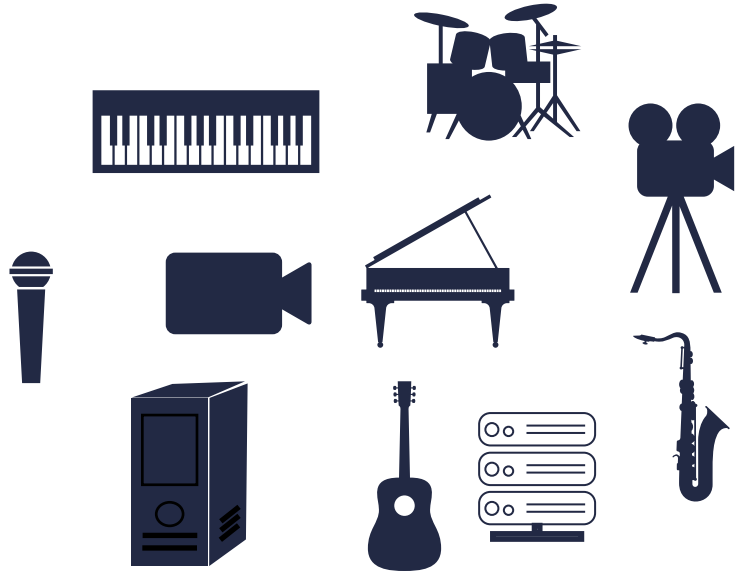
- Whilst intimately associated with IoT, it still presents specific characteristics that justify its separated definition
  - Most notably due to the resource demanding nature of the produced data and involved processes
- The recent spread of AI tools for processing MM data and infer high-level knowledge (semantics) has also played a crucial role
  - Sensors or intermediate devices can be called upon to perform such processing and consequently take decisions on further actions and trigger local processes
- Common IoT devices offer limited functionality (e.g., on/off actuations, acquire and read sensory data, etc.)

IoMMT entities (examples of …)

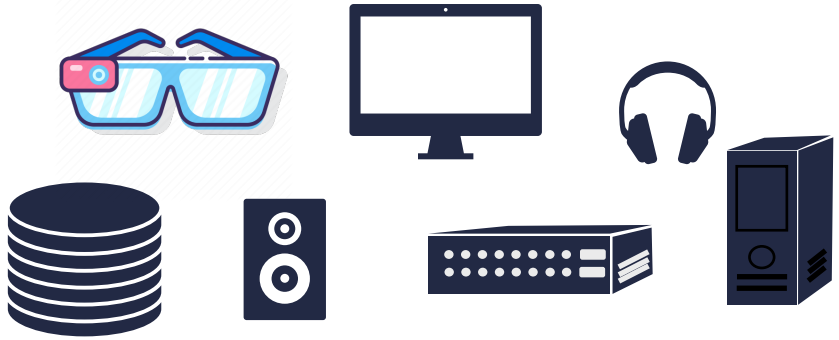
- Information sources (the data)



- Sources of data (including sensors)



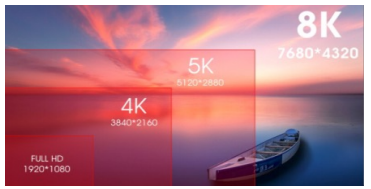
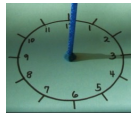
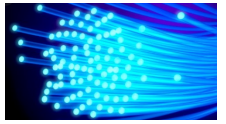
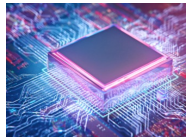
- Receivers of data



IoMMT requirements

- Bandwidth, computing resources and security
  - IoMMT information sources consume typically large bandwidth
  - Considerable computing resources are needed for real-time encoding and other processing tasks
  - More pressure in put on the networks to achieve real-time transmission and minimal latencies
  - Many times, privacy issues are at stake as well as integrity of data and IPRs

Comparing plain IoT and IoMMT characteristics

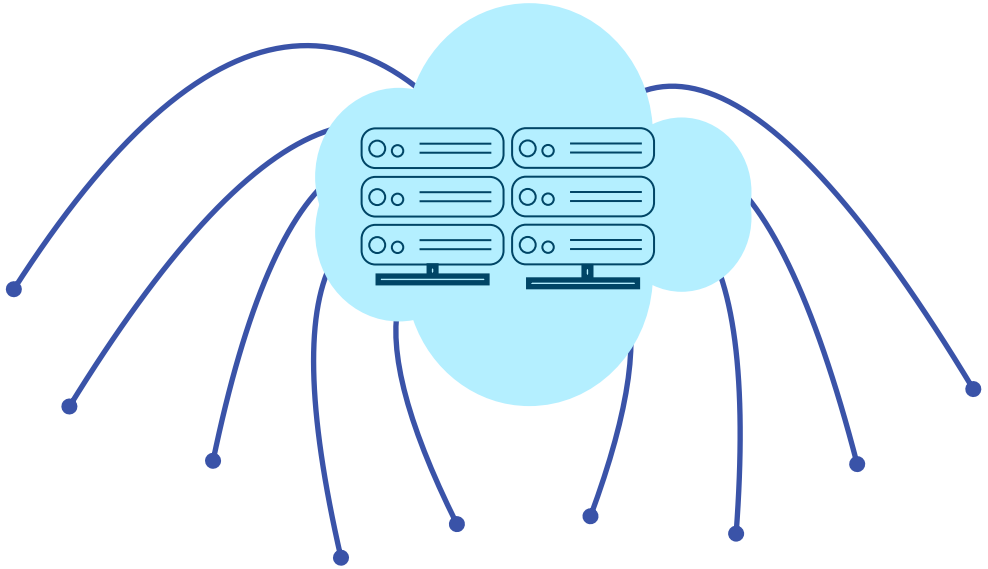
IoT		vs	IoMMT	
Linear scalar data				Non-linear, bulky data
Delay tolerant				Delay sensitive
Low bandwidth				Large bandwidth
Low processing power				High processing power
Low storage				Massive storage
Low power consumption				Energy starving

Is it the same as for traditional MM applications?

- Traditional multimedia applications
  - The focus is mostly on point-to-point and point-to-multipoint transmission
  - Heavy processing and decision taking is typically conducted at the server side or in the cloud, with humans involved
- IoMMT applications
  - Massive multipoint-to-point is expected
  - Data generation quickly outpaces network capacity
  - Distributed processing through edge and/or fog computing

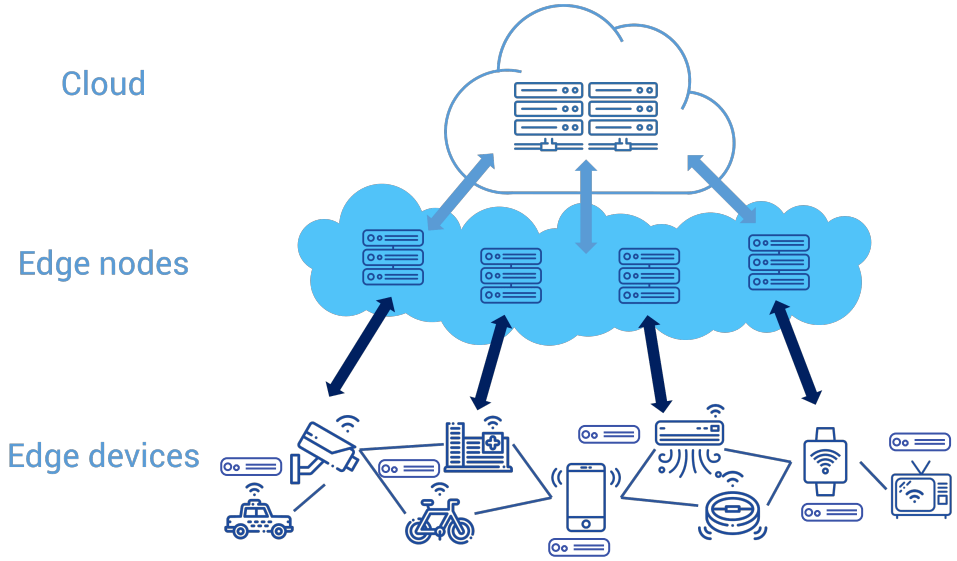
Comparing traditional MM with IoMMT

Cloud computing / data center / central server



Point-to-multipoint / point-to-point

Distributed computing - fog and edge

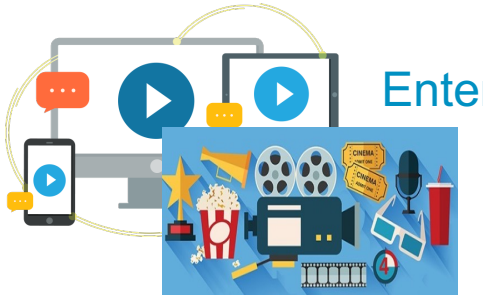


Multipoint-to-point / point-to-point

IoMMT Fields of application

Smart Home

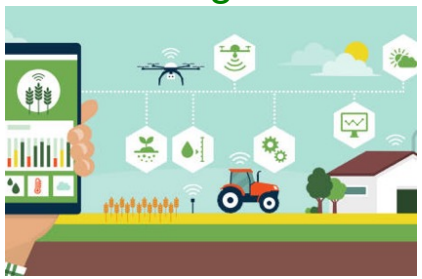
Entertainment



Smart Health

MM

Smart Agriculture



Smart Cities

Smart Sports

Smart Industries

Smart Security

Towards mitigating the burden on IoT

- IoMMT aims to ensure that, regardless such demanding requirements, the co-existence of media things with common (non-media) things in an IoT world is feasible
- Media analytics at the edge is crucial to implement predictive and prescriptive solutions on the spot and in real-time directly from the IoMMT devices
  - for example, embedding in cameras the capability of analyzing locally acquired data and retain/send only the meaningful information, or only metadata, or trigger some event, or …
- Common solutions are needed to enable locating, accessing and remotely interacting with such IoMMT devices

IoMMT standardisation efforts

- ISO/IEC 23093, Internet of Media Things (IoMT)
  - With the mandate of defining interfaces, protocols and formats for establishing communication and interaction between media things and between these and humans
    - User commands
    - Media Information packing formats for exchange data
    - Syntax and semantics of control data
    - Protocols and procedures for announcement and discovery of media things
  - Divided in 4 parts and available since 2020

Standardisation efforts towards media production in IoT

- ISO/IEC 23093 is driven by the need to process and store large amounts of media data produced by media devices in an IoT world

- Does not address needs specific to media production environments, notably,
  - discovery and configuration of available media equipment
  - operation in real-time, time-precise control of cameras and switches
  - parameterisation of ingest equipment and encoders
  - routing of media flows

Media Production standardisation

- Joint Task Force on Networked Media (JT-NM) group managed within the Advanced Media Workflow Association (AMWA)
  - Networked Media Open Specifications
    - Application Programming Interfaces (APIs) to allow software-based systems to find, connect and configure media devices, enabling controlled transport of video and audio on IP networks
  - Not yet connoted with the IoMMT stamp but in reality, will enable to implement such concept within the media production industry

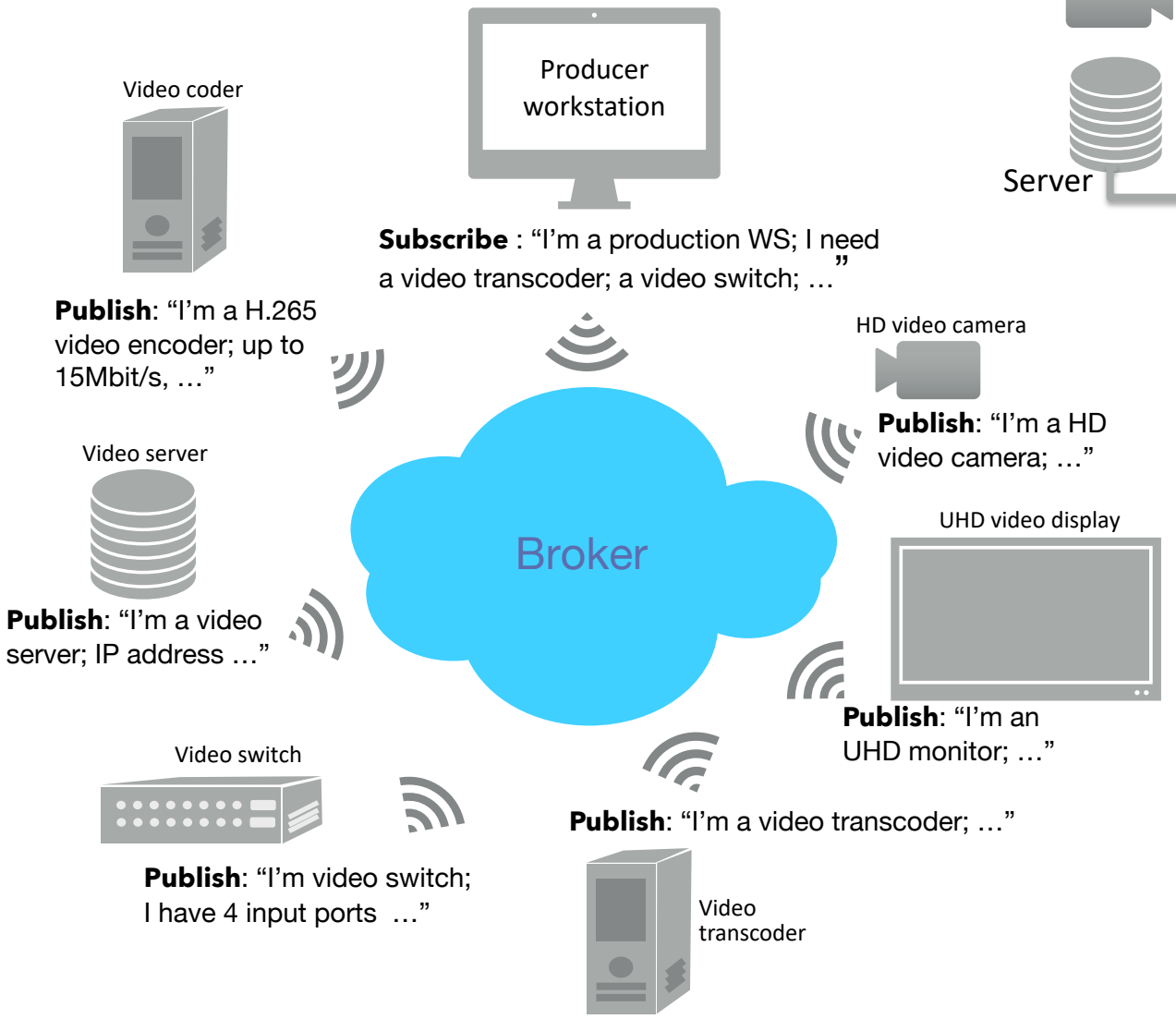
Some IoMMT use cases - video surveillance

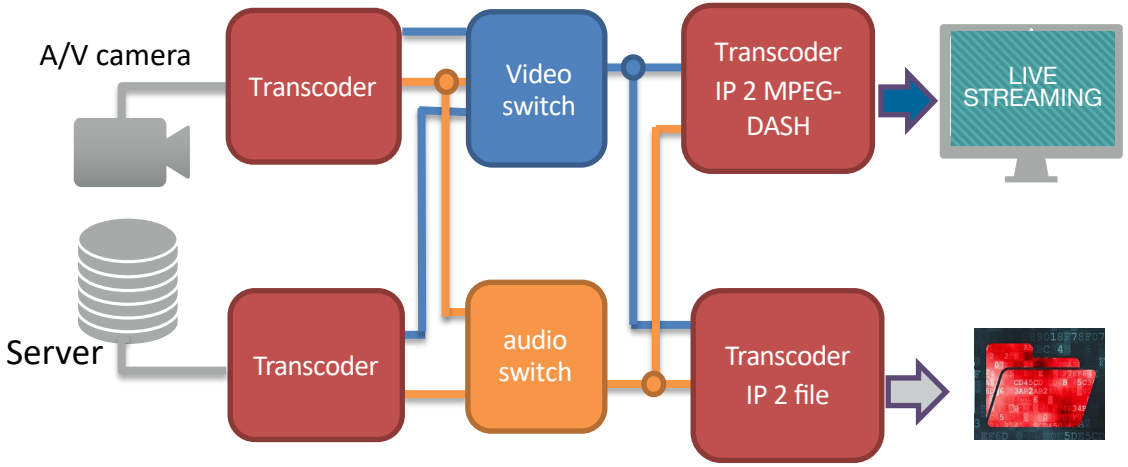
- Using a digital camera with processing capabilities in a video surveillance scenario
  - Commands may be issued to the camera to control its settings, namely, frame rate, bit rate, aperture and exposure, focus, orientation and zoom
  - It can be instructed to process locally the acquired images to detect events and entities, recognize persons, gestures
  - Intelligence can be embedded to automatically decide and trigger actions based on inferred knowledge
    - Actuating an alarm, locking/opening accesses, start streaming with low/high quality, etc.

Some IoMMT use cases - video production

- Using media production equipment to set up and run remotely a post-production TV studio
  - Cameras, servers, switches, transcoders, etc., are all media things as well as the information sources they produce, deliver or consume
  - Protocols for announcing their existence and their capabilities, for discovering MM things, for configuring MM things are required

Remote MM Post-production





Example of a production line configured through the Producer Workstation and using the Broker

Research efforts relevant to IoMMT

- Video traffic prioritisation
- Virtualisation of network elements
- Mobility management
- Security issues

Open Challenges 4 IoMMT

- Provision of QoS and QoE, especially due to limited energy and communication resources in IoT environments
  - Ensure low latencies and higher throughputs
  - Further research to optimize the trade-off between coding efficiency, performance and coding/encoding complexity and energy consumption
  - Efficient power management policy to extend battery lifetime
- Wireless access networks alternatives such as IEEE 802.11.ah
  - Or to enable the use of cellular networks
- IPv6 and mobility management
- Security aspects to enable certified identification of MM things and to secure the access to MM resources and devices

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Thank very much for your attention

Will be glad to try to answer to any question you may have

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