Tackling User-Centric Media Demands through Adaptable Software Defined Infrastructures

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The Invisible Infrastructure?

Over-the-top content (OTT) refers to delivery of audio, video, and other media over the Internet without the involvement of a [network] operator in the control or distribution of the content
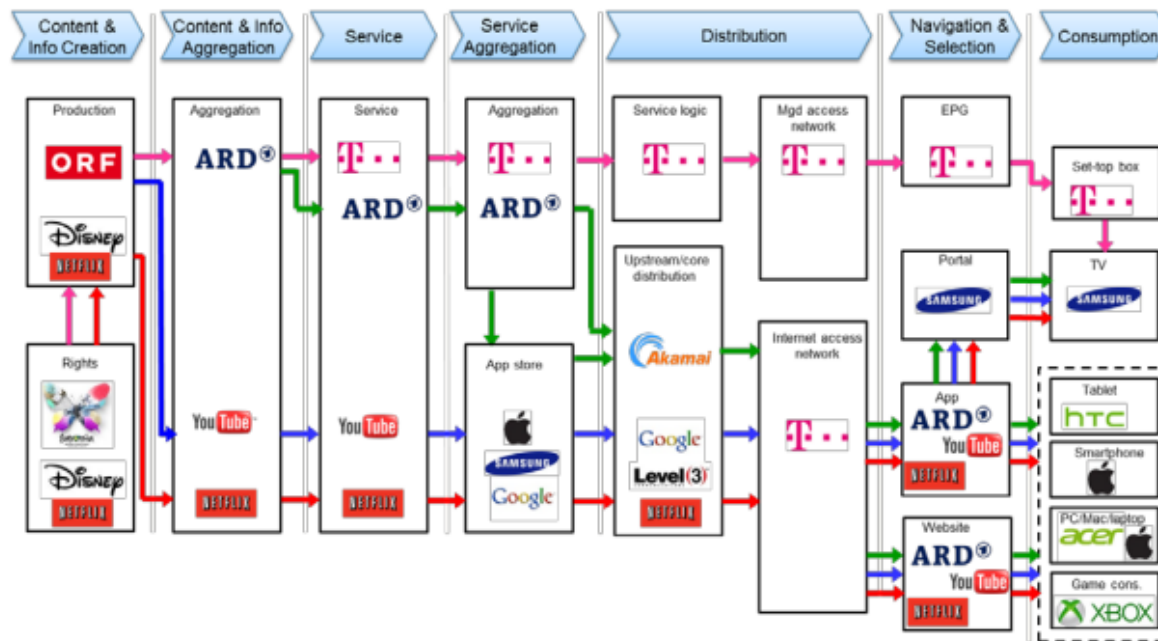
Current Online Media Services

Future Online Media Services

source: ottsource.com/ott-blog

Linear Content Distribution

OTT providers unmanaged services (no control over access networks) do increasingly take measures to enhance service performance by investing in content distribution infrastructure (clouds and CDNs)

source: TNO, 2015 – Distribution of Eurovision Song Contest

- Scalability the Internet essentially breaks the end-to-end and neutral nature of the original IP architecture
  - e.g. one company (Akamai) serves 30% of the Internet
- Large bodies such as Google cache data very close to users' Internet service providers (ISPs)
  - 85% of Internet users are one-hop away from an Akamai cache
- Only "large-players" can afford to invest in caches placed in ISPs – what does this say about "net neutrality"?
- DNS redirection or HTTP redirection (needing deep packet inspection) are needed – messy

Demand continues to be...more demanding

Personalisation

Localisation

Digitisation of Humans & Things

Interactivity

Mobility
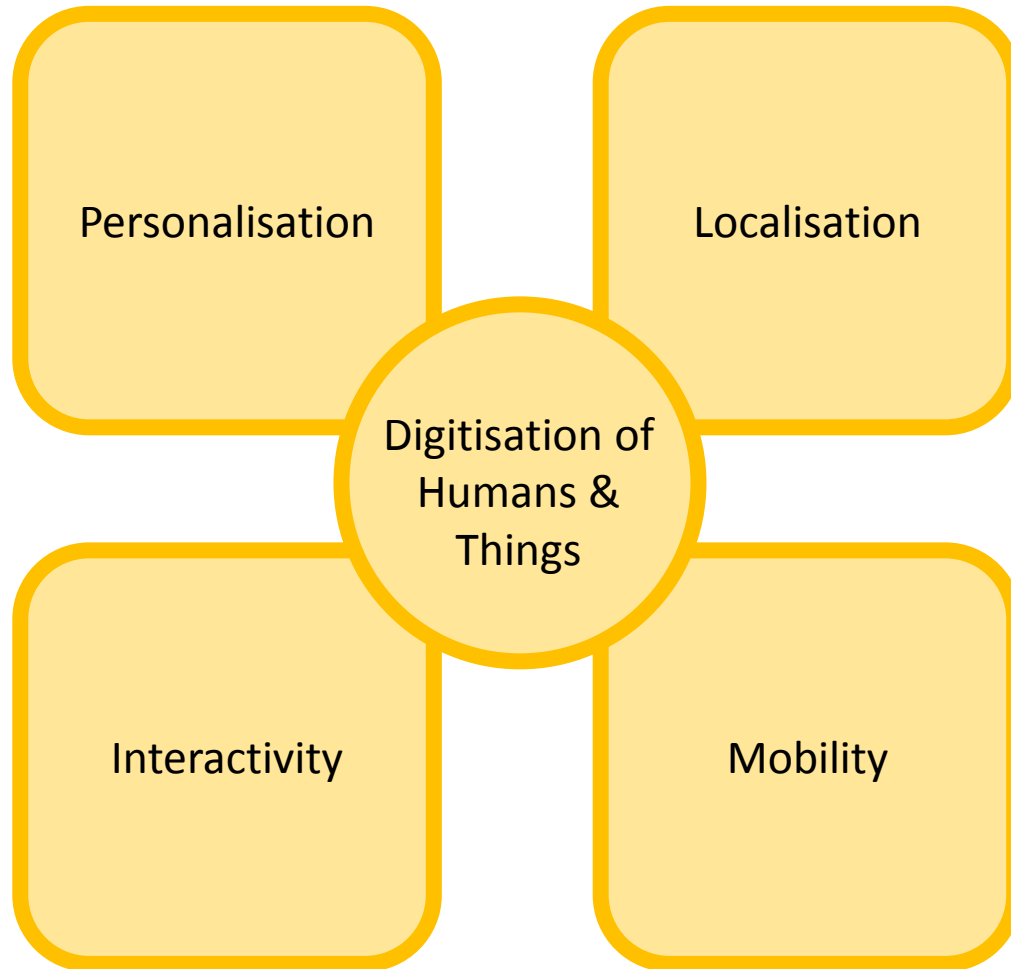
Increased connectivity, speed and reach

Increased participation and generativity

Unprecedented dynamics and structural changes in business models, content production and delivery processes

# Reinventing media ecosystems to resource creativity

- A new dynamic content production and delivery platform
  - layered modular architecture with cross layer optimisation, analytics and control
  - distributed computing models that combine media cloud with mobile edge
  - software-defined infrastructure (NFV, ICN, SDN) to support service endpoint management, routing and switching
  - VSN defines a network of media services utilising infrastructure

Application Management	Service Composition	Service Composition	Service Repository	Credential Management	Application Knowledge and Actions
Compute and Storage Management	CDN Services	Resource Broker	Resource Repository	Orchestrator and Resource Governance	Compute and Storage Knowledge and Actions
Service Endpoint Management	Network Operator Cloud Services	ISP Cloud Services	Virtual Instance Management	Surrogate Service Management	Endpoint Knowledge and Actions
Service Routing And Switching Management	Network Function Virtualisation	SDN Controller	Path Computation		Routing Knowledge and Actions

Optimisation Models

Control Models

Media Data Analytics

Cross Layer Optimisation and Control

- Generative media ecosystems using smart cities infrastructures
  - ground-breaking creative industry trials with industry and SMEs
  - build cross-layer knowledge through experimentation

source: BIO, 2015
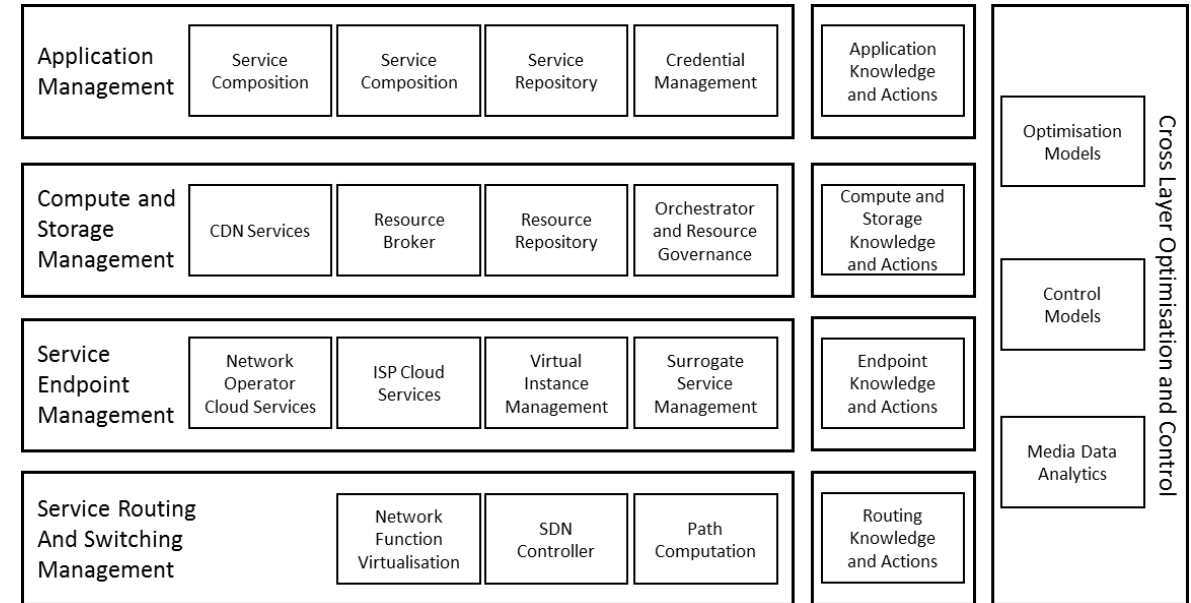
HTTP over ICN over SDN

- We adopt novel software defined approaches to support highly flexible virtualised service networks describing CDNs
    - HTTP over ICN (Information Centric Networking) over SDN (Software-Defined Networks)
    - Surrogate information service management using NFV-exposed resources

- Information networking promotes information as the premier item in the network – rather than the host that it is stored on
    - a relatively new concept with a number of solutions
    - information (video, document, picture etc.) is given a unique name/number and the "network" stores and manages this naming
    - network gets the item for users wherever (or maybe whenever) it is available

- HTTP is layered over ICN to ensure legacy compatibility with existing IP clients and services
    - HTTP-level traffic transfer as a routing problem rather than redirecting through DNS indirection as in today's CDN solutions
    - Service endpoints are managed by the network providing multiple authoritative surrogates acting under the fully qualified domain
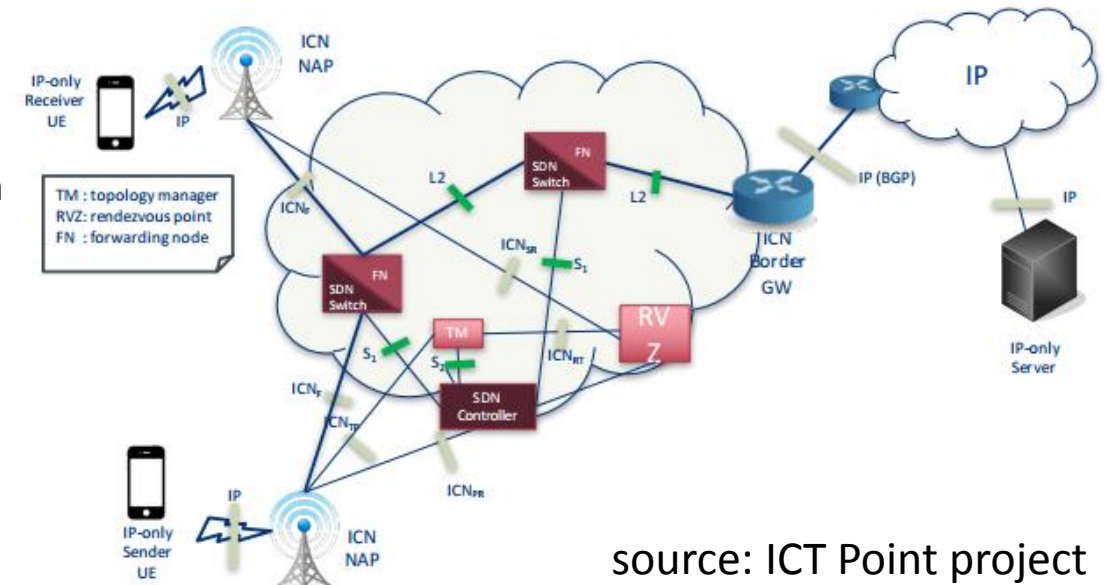
source: ICT Point project

Personalisation

- **Cost reduced for personalised viewing services via HTTP-based services (e.g. DASH) stemmed using multicast delivery capabilities of ICN**

- Interpret HTTP-level exchange as an exchange of information objects enables opportunistic multicast delivery to the same requests within a time window
- Personalized video streaming services with statistical temporal correlation of viewers can be assumed (e.g. YouTube or NetFlix)
- 10x increase in network capacity

Localisation

- **Cost reduced for localised interaction between hyper local consumers, interactors, aggregators and broadcasters**

- Flexible service endpoint placement according to service-specific constraints
- VSNs linked to software defined infrastructure requirements with an edge/data centre capacity ratios supporting spatial/temporal flows
- Local experience benefits from opportunistic multicast (e.g. an immersive stadium scenario)

Interactivity

- **Reduction in service latency through optimal provisioning of surrogate services**

- Provision at the edge of the network to achieve the goal of always having a service "one hop away" with an average service latency of 5mS
- Handle complex content production and pipelines can be managed, coordinated and synchronization among distributed service endpoints
- Shift from video streaming to large populations to managing live streaming of 3D and IoT content for interactive mixed reality (AR/VR)

Mobility

- **Faster access to content for highly mobile users (e.g. train and car travel)**

- Dynamic placement of surrogate services utilizing computing resources deep in the network and close to the edge and end user
- Real-Time Control (Reconfiguration) Functions Response Time of a few 10s of seconds
- Information centric routing provides direct path routing of content rather than triangular IP routing in today's solutions

The Cross-Layer Meta Experiment

- Cross-layer optimization and control aims trade offs between efficiency, performance, experience
  - allows decisions at the compute and storage layer to optimally exploit service endpoint management and service routing decisions

- The approach has commercial and technological challenges
  - What are the knowledge and action points at each layer?
  - How is cross-layer knowledge sharing is necessary between different stakeholders?
  - What optimisation models will ultimately lead to holistic and coherent control decisions?
  - What performance considerations are needed in the management framework itself?

- The answers will be explored through experimentation
  - 30+ trials of content production and delivery pipelines
  - generate the evidence for appropriate cross-layer knowledge sharing, analytics and control
  - Understand how such a layered modular architecture can be deployed and operated viably
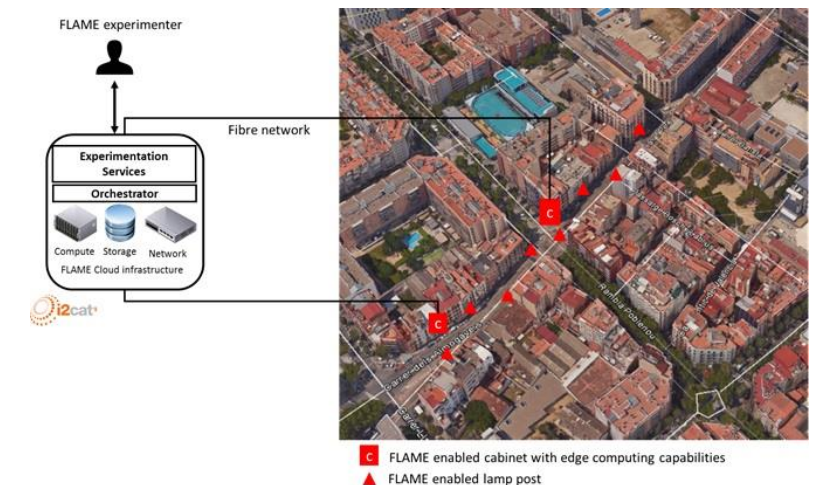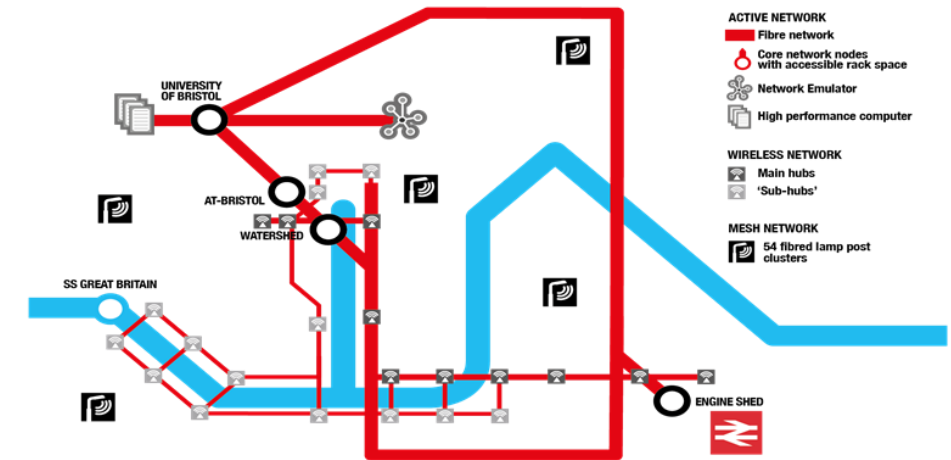
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experimentation

Future Work

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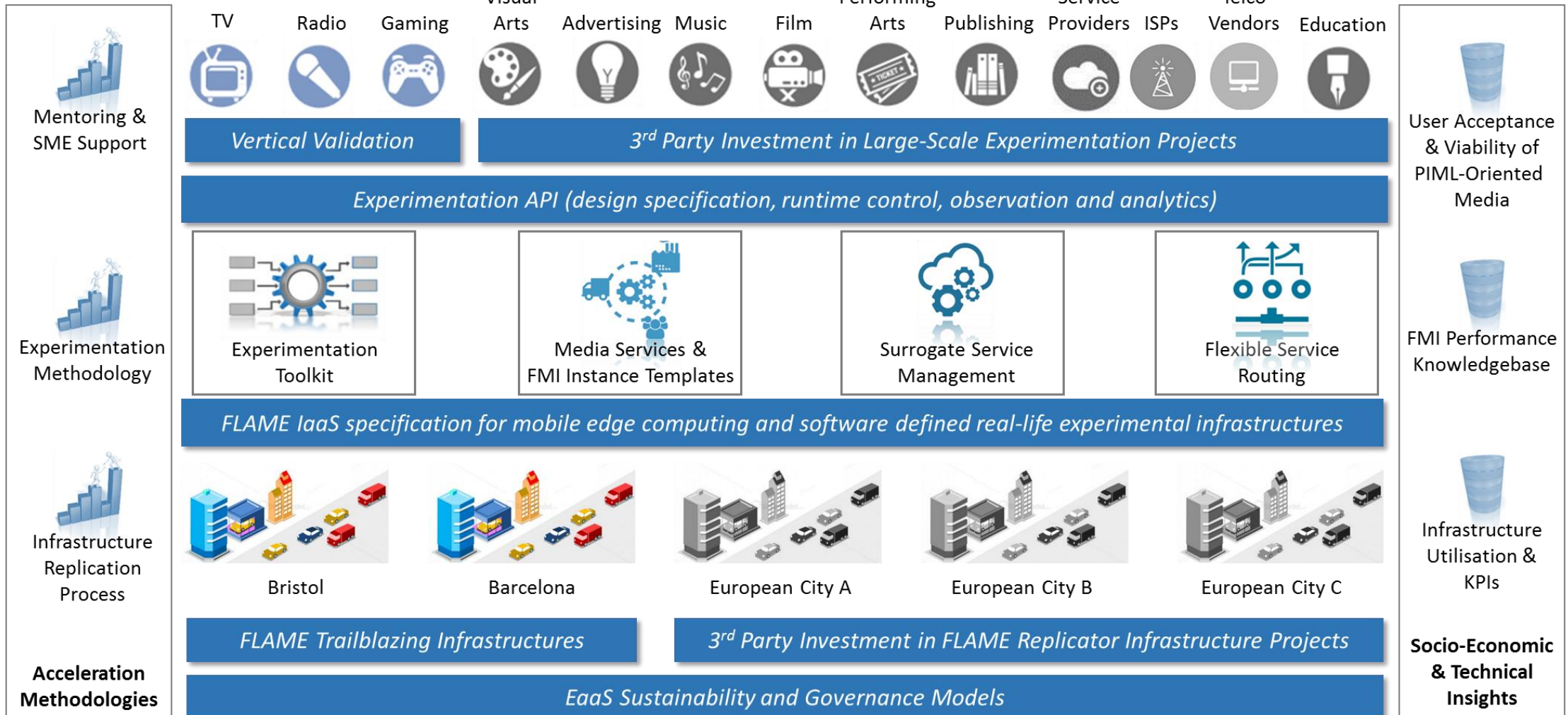
Get Involved – Ecosystem Building

- FLAME will invest 2.2 Million Euros in the creation of media ecosystems
  - 3 new cities and ecosystems
  - 3 large industry CAP trials
  - 20 SME/Start Ups CAP trials

- Investment is planned (Jul-18 to Dec-20)
  - FLAME Replicators (390K Euros : 3 projects)
  - Industry Trials (360K Euros : 3 projects)
  - SME Trials (980K Euros : 14 projects)
  - Start Up Trials (300K Euros : 6 projects)

ACTIVE NETWORK
- Fibre network
- Core network nodes with accessible rack space
- Network Emulator
- High performance computer

WIRELESS NETWORK
- Main hubs
- 'Sub-hubs'

MESH NETWORK
- 54 fibred lamp post clusters

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FLAME experimenter

Experimentation Services
Orchestrator
Compute Storage Network
FLAME Cloud infrastructure

Fibre network

i2cat

C FLAME enabled cabinet with edge computing capabilities
▲ FLAME enabled lamp post

Watch this space

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