Internet of Things

Introduction

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October, 21 2008

Internet Systems

- **The design approaches**
  - 1. from Architecture

    to high level layer protocols
  - 2. from Mechanisms

    to low level layer protocols

- **Design Classes : the design dificulty**
  - Best-Effort
  - QoS Internet &
  - Guaranteed Internet

Internet : Best Effort

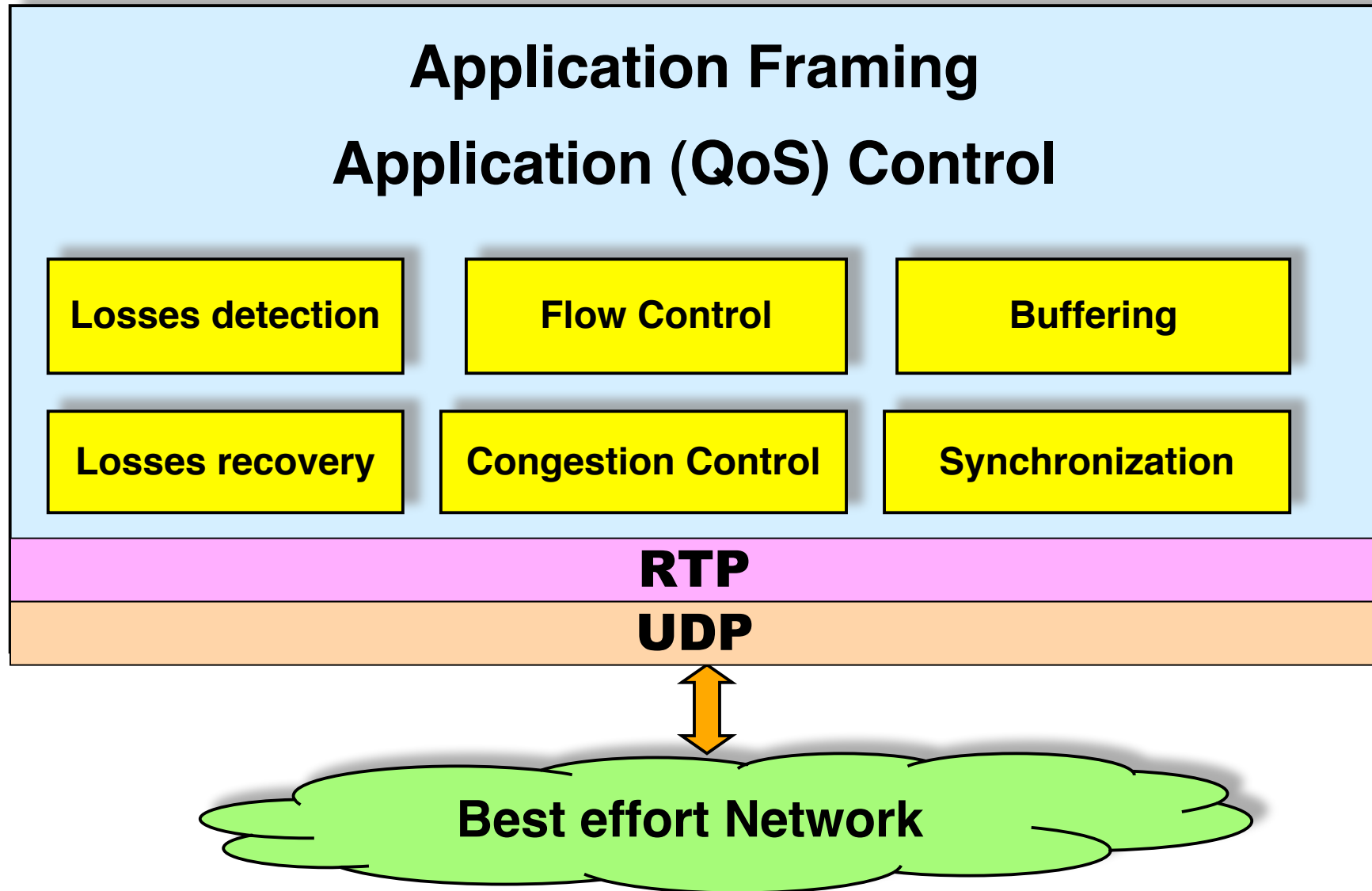## UDP : no service

TCP :

➡ No QoS => No Multimedia

➡ Reliable Pt to Pt : No MultiCast

➡ Not Efficient with different networks

➡ but Fair (and started many year ago)

EX: MULTIMEDIA APPLICATIONS
Present Architecture

Application Framing

Application (QoS) Control

Losses detection	Flow Control	Buffering
Losses recovery	Congestion Control	Synchronization

RTP

UDP

Best effort Network

The QoS Internet

- **From QoS requirements of the Applications,**
- **How to derive networks and architectures**
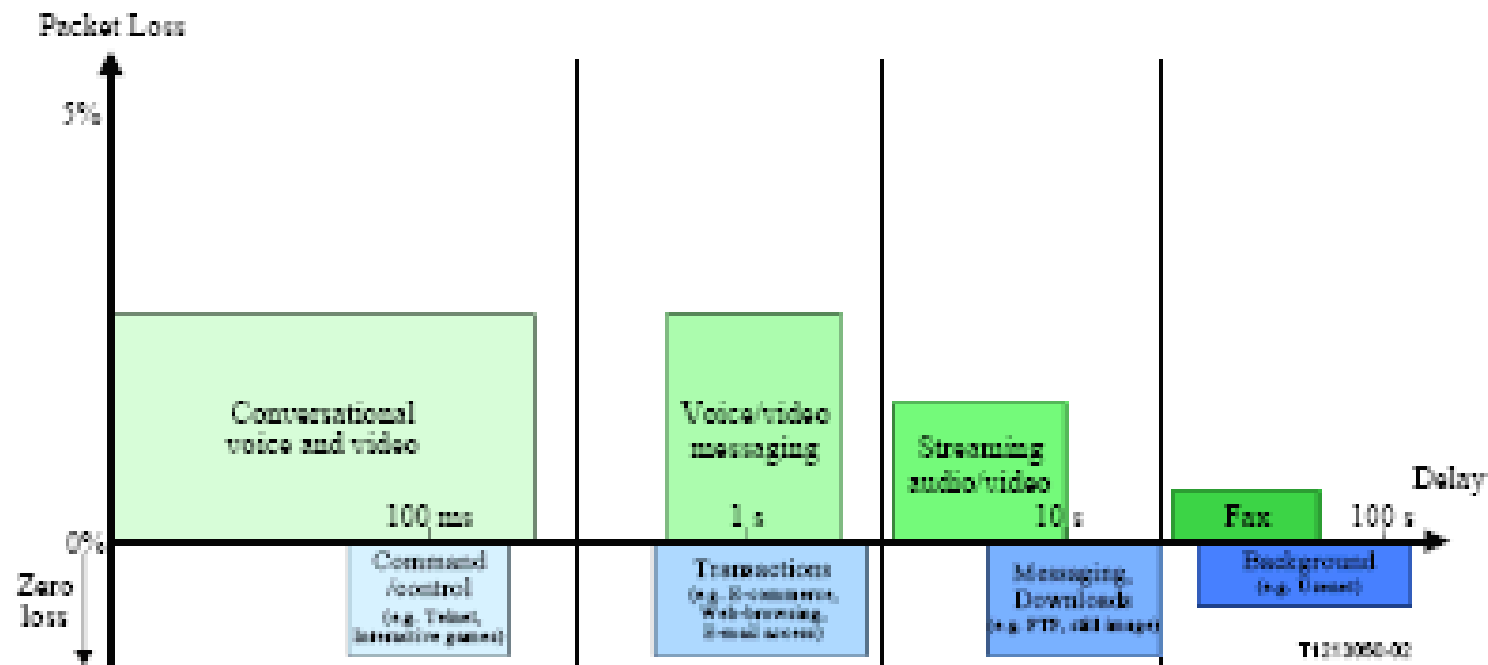- **To satisfy QoS Bandwidth and Time constraints**

Figure 1/G.1010 – Mapping of user-centric QoS requirements

The 3 QoS internet Approaches

1. **Network Overprovisionning**

2. **Optimised Best-Effort mechanisms, protocols and architectures**

3. **New Internet Architectures to guarantee the QoS**

QoS Optimisation

- **Start from Best-Effort Internet**
  - without modifying the architecture principles
  - using resources/bandwidth available
  - analysing and improving present solutions

- **Modify mechanisms and protocols**
  - modify applications (adaptativity, new codecs,…)
  - optimise architecture (proxys,…)
  - define new protocols (Transport Layer: DCCP,…)

- **But still Best-effort (No guarantee)**
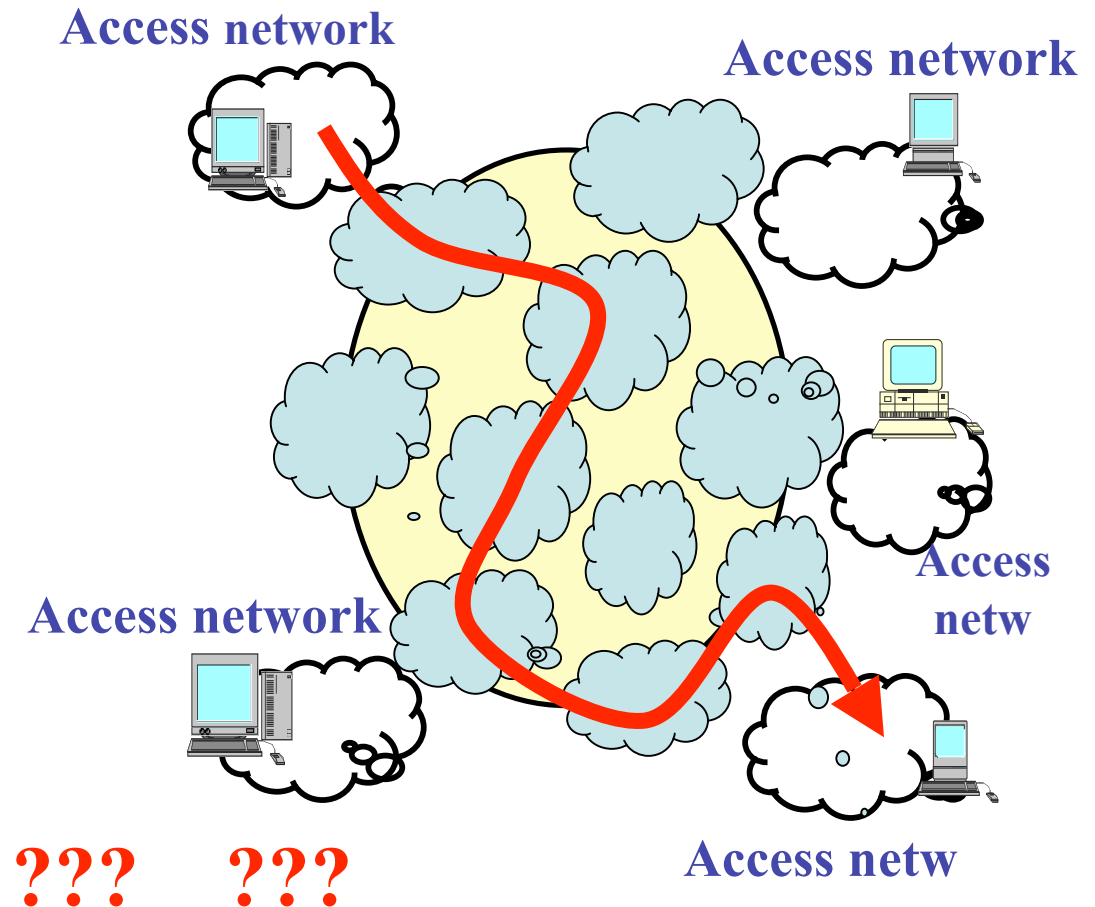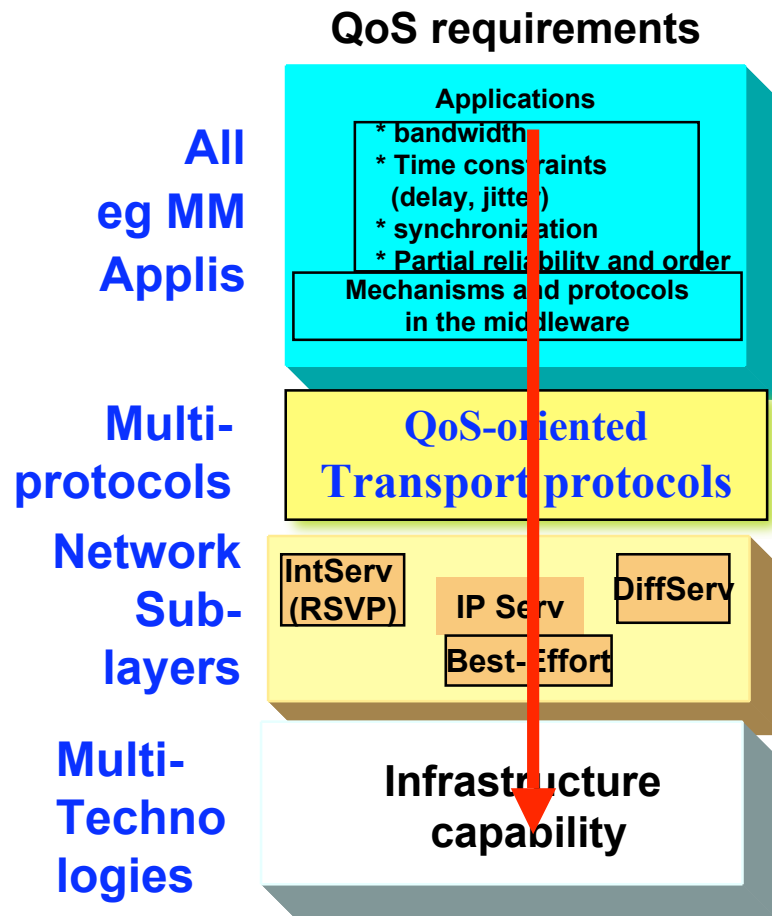
QoS Guarantee

New requirements

- **Master** the Internet
- **Be as General and Open as** the present Internet
- **Propose** new mechanisms, protocols, architectures
- **Handle** sessions and resources

Main problems

- **Resulting Complexity ?**
- **Difficulty of Deployment wrt the present internet ?**

Vertical (Applis-to-Networks) and Horizontal (Host-to-Host) problems

QoS requirements

All eg MM Applis

Applications
* bandwidth
* Time constraints (delay, jitter)
* synchronization
* Partial reliability and order

Mechanisms and protocols in the middleware

Multi-protocols

QoS-oriented Transport protocols

Network Sub-layers

IntServ (RSVP)

IP Serv

DiffServ

Best-Effort

Multi-Technologies

Infrastructure capability

Access network

Access network

Access network

Access netw

Access netw

Access network

??? ???

The EuQoS Project

- 5 network providers (Prime Contractor is Telefonica)
- 5 Corporates
- 5 SMEs (consultants, small development companies)
- 9 Research Institutes

Main Design Steps

1.   **Independence** of :
    - Applications wrt Virtual networks wrt
    - Virtual networks wrt Technologies
    - Signaling wrt Data Plane

2.   **Integration of Applis**
    - QoS Request and Admission Control
    - Define a global Architecture
    - extending the main present solutions
    - with to scalability

3.   **Three main Phases (with Classes of Services)**
    - QoS Network layer
    - QoS Transport layers
    - QoS Signalling

QoS Network Layer: Classes of Services

Classes of Service	EQ-CoS CoSs
RT	Maximum Bandwidth = B
NRT	Minimum Bandwidth = b
BE	No guarantee

EuQoS EQ-ETP services

Network Classes of Service \ Application profile	Streams *Error tolerant e.g. VoD*	Non-Streams *Error intolerant e.g. file transf*
RT	ETP=UDP[RC]	ETP[EC]
NRT	ETP[gTFRC]	ETP[gTFRC+EC]
BE	ETP[TFRC+DT]	ETP[TFRC+DT+EC]

QoS EuQoS SIGNALING (EQ)

- **Appli-to-Appli coding: EQ-SDP**
- **Appli-to-Appli QoS: EQ-SIP**
- **Appli-to-Virtual network : EQ-QoD**
- **Virtual Network CoS: EQ-NSIS**
- **Virtual-to-Real networks: COPS**
- **3 classes QoS Routing: EQ-BGP**
- **End-to-End path: EQ-path**
- **Telcos MPLS integration: EQ-PCE**
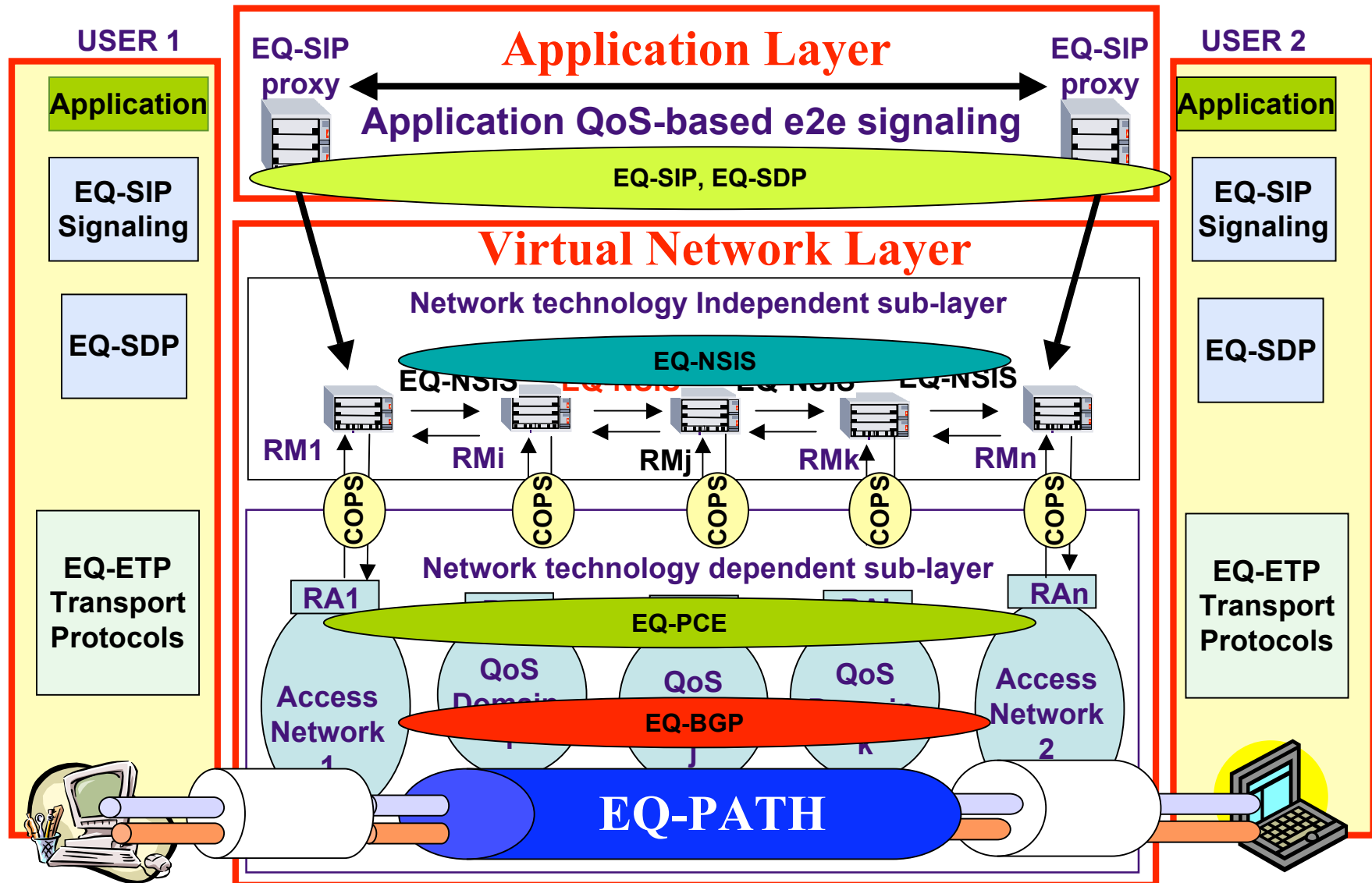
What Future

- **Internet Virtualisation**
  - **E.g. Virtualised routers able to run in parallel a set of different protocols**

- **Internet of the Things**

  => importance of the sensors (values, etc) in the things
  - **Sensor networks and ad-hoc networks**
  - **Requirements (mobility, etc)**
  - **Application-aware networking**
  - **Real-Time internet ?**

  =>What services in what layers