Network Virtualization as an enabler for Cloud Computing: a telco perspective

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Orange Labs

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France Telecom / Orange

- Orange: unified brand of France Telecom for Internet, television and mobile services
- France Telecom
  - Number #1 broadband Internet service in Europe: 13 millions (ADSL) customers
  - Number #3 mobile operator: 122 millions mobile customers
- Orange Labs:
  - Innovation network of France Telecom
  - 3,800 researchers in 18 laboratories
    - 4 labs located in Asia: China, Japan, South Korea
  - Participation to collaborative projects
    - Future Internet, Grid Computing, Autonomics

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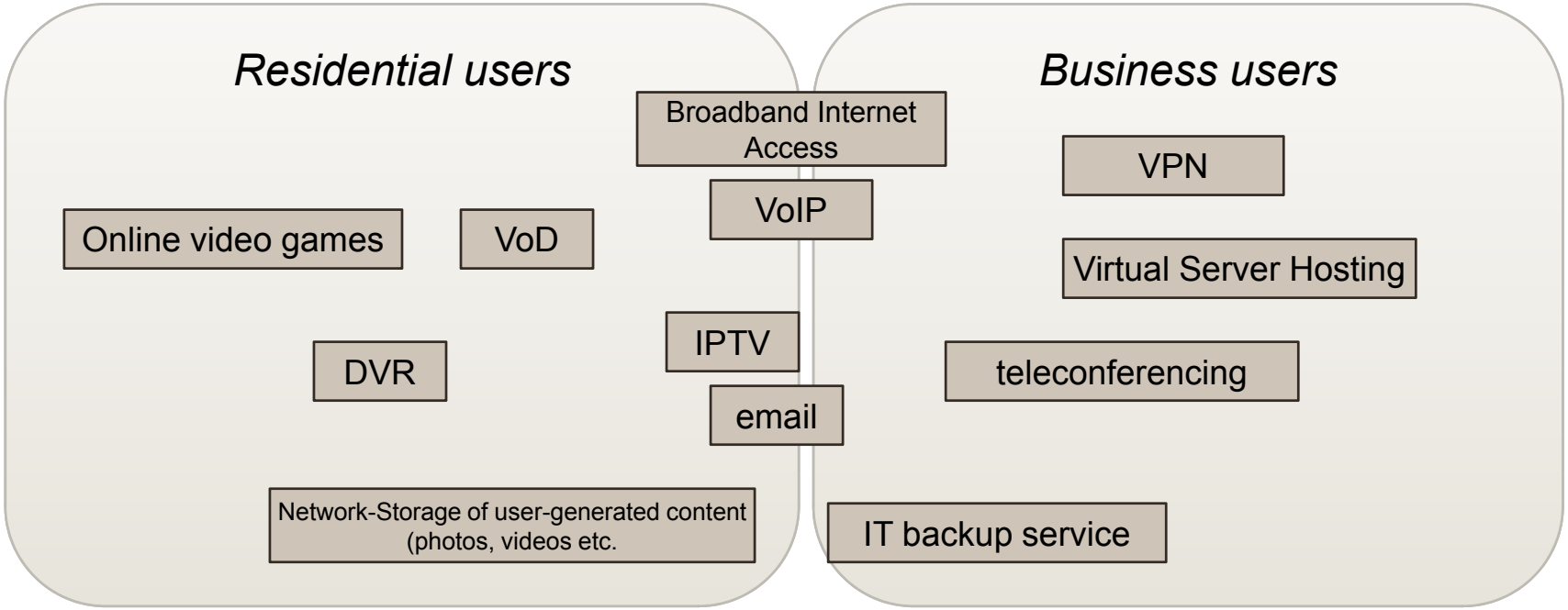
Outline

- Context:
  - Telecommunications service landscape
  - IT and Network infrastructucture
- Network virtualization meets Cloud Computing
- Service-oriented virtualized resource management framework
- Conclusion

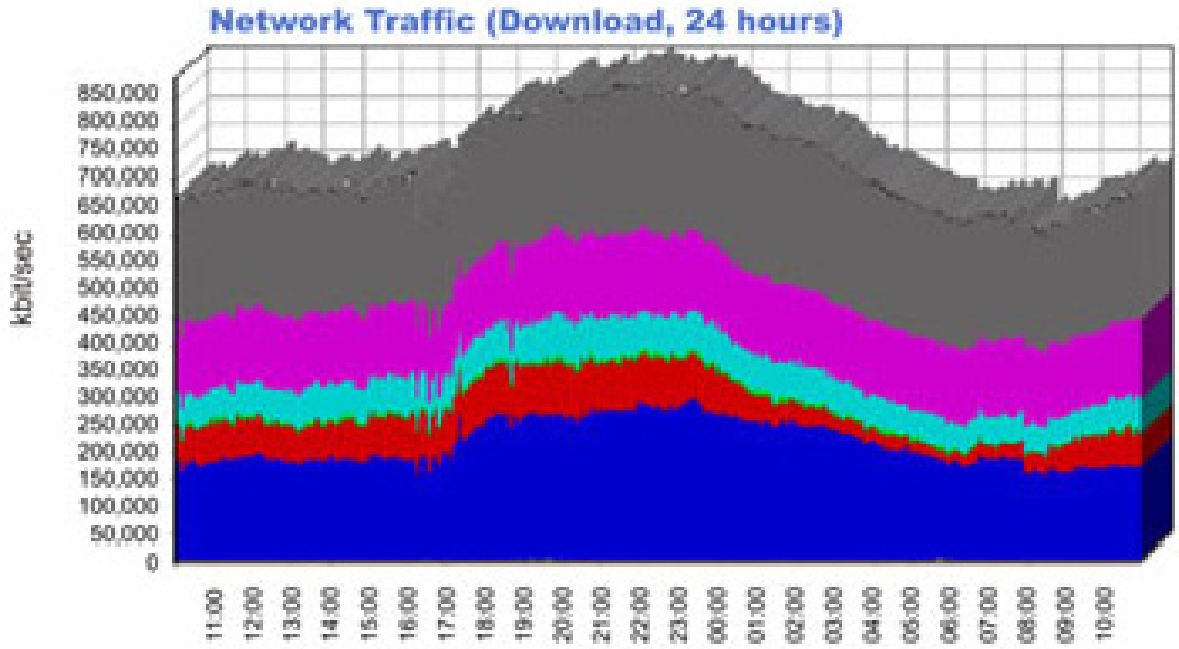
Telco service landscape



- Different QoS requirements:
  - Latency, throughput, loss
- Different communication patterns
  - Unicast streaming, multicast streaming
- New usages and traffic patterns difficult to anticipate

And traffic telcos are less happy with…

- P2P traffic largest bandwidth consumer on the Internet
- Huge strain on the network infrastructure



BitTorrent
eDonkey

non P2P traffic

Challenges for a Service Provider & Network Operator

- Reduce time-to-market for new telco services
- Better Quality of Experience for end-users
- Cost reductions
  - CAPEX + OPEX
  - Green IT
- Flexible network architecture
  - Should adapt itself to the service requirements
- Automation: self-* infrastructures

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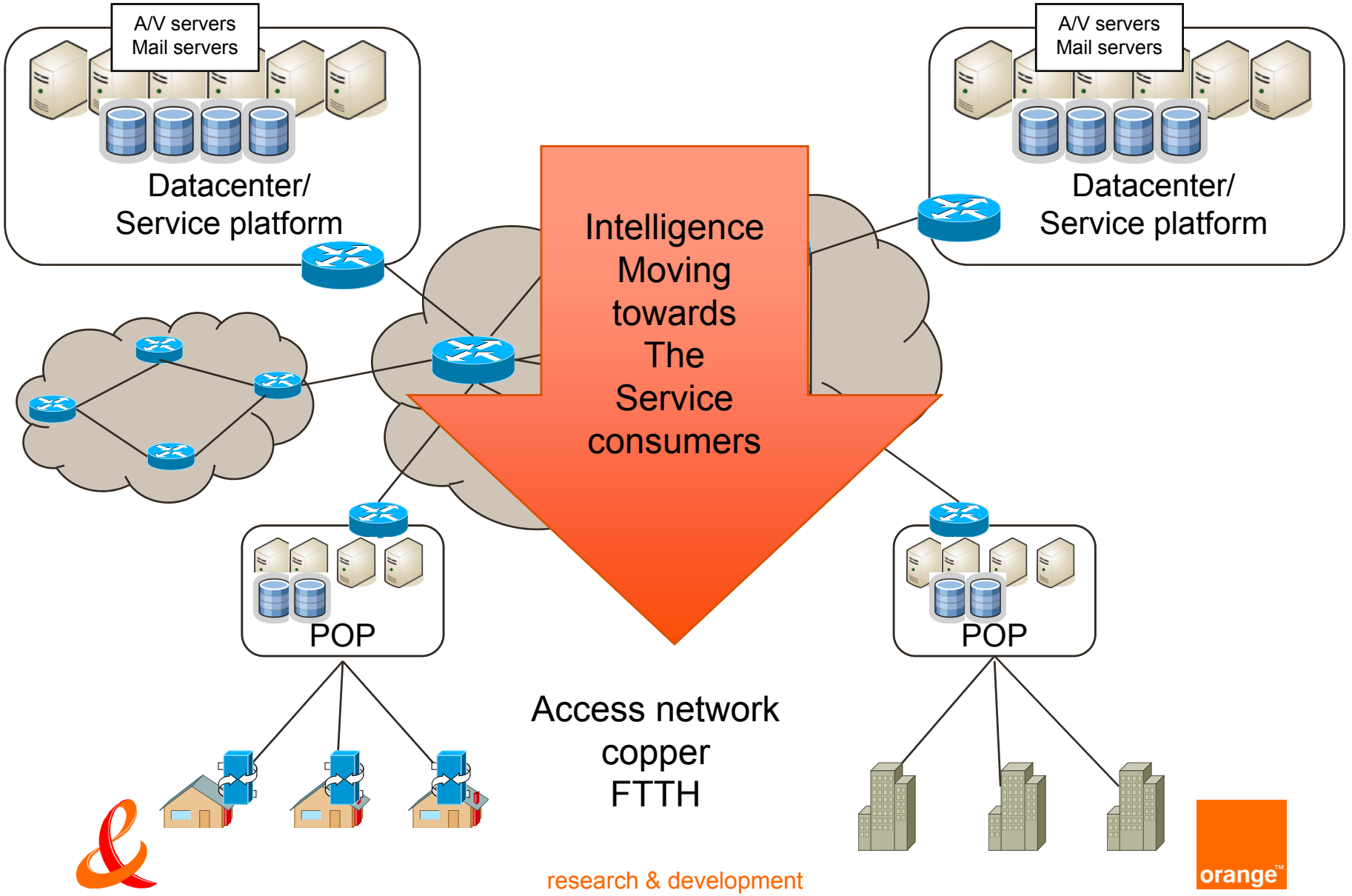
End-to-end IT&N infrastructure



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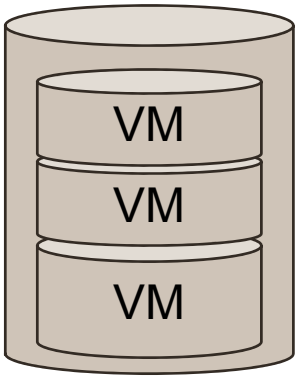
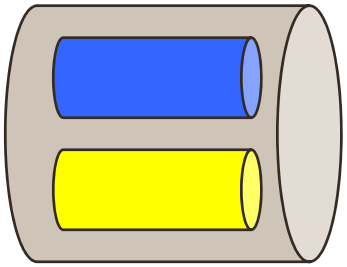
Element virtualization

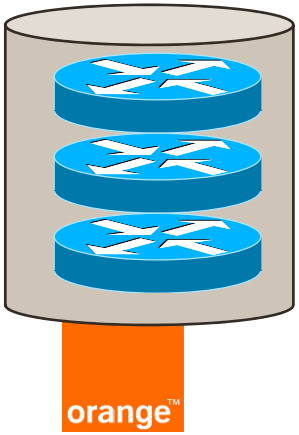
- **Server virtualization**
  - Several virtual machines each hosting a full application stack co-executing on a single physical server
  - Server virtualization technologies (hypervisors) are now a commodity



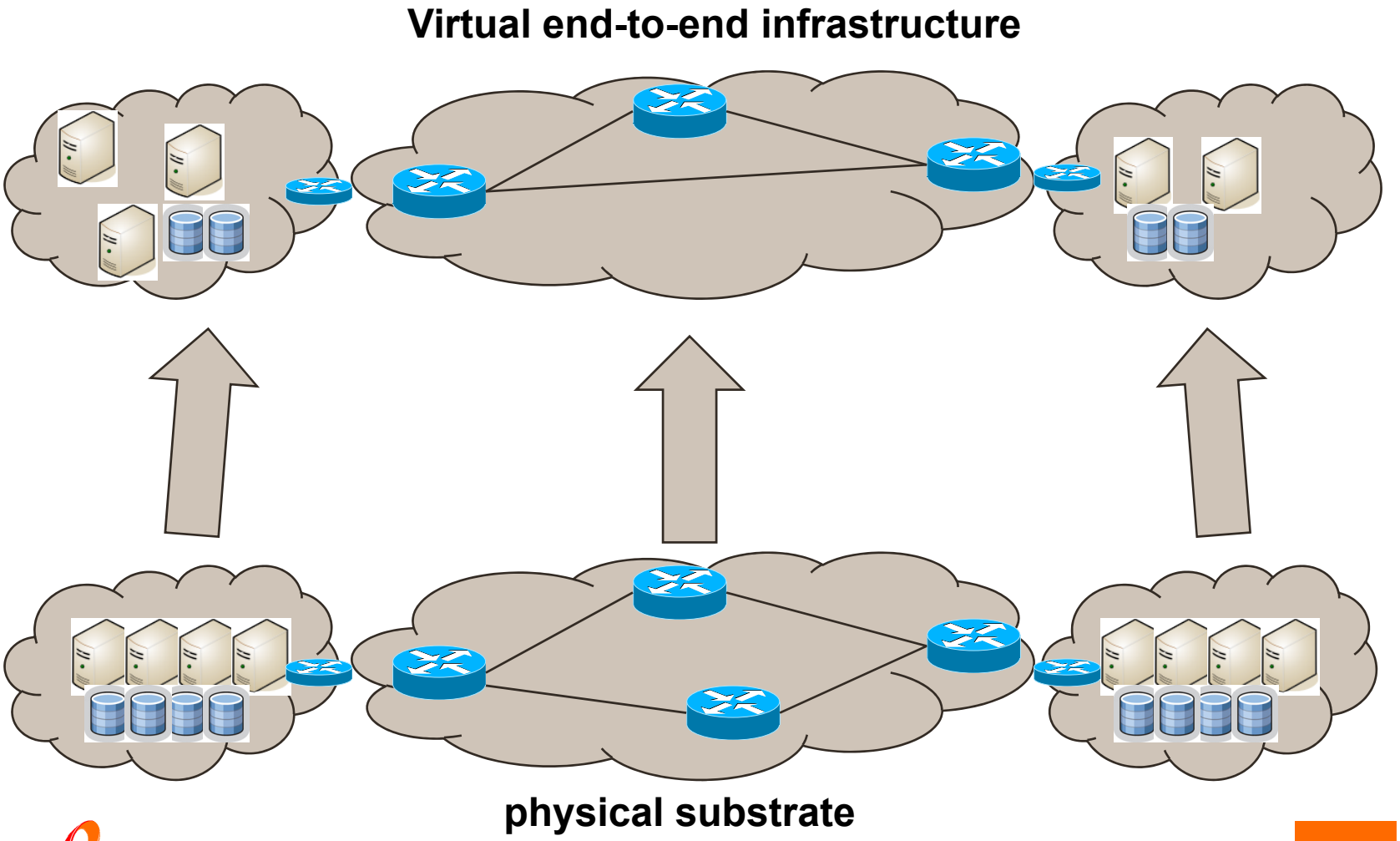
- **Link virtualization**
  - Mature techniques: VLAN, MPLS, Lambda…



- **Network router virtualization**
  - Commercial Virtual Routers
  - Software Virtual routers on commodity hardware, viable and cost-effective solution



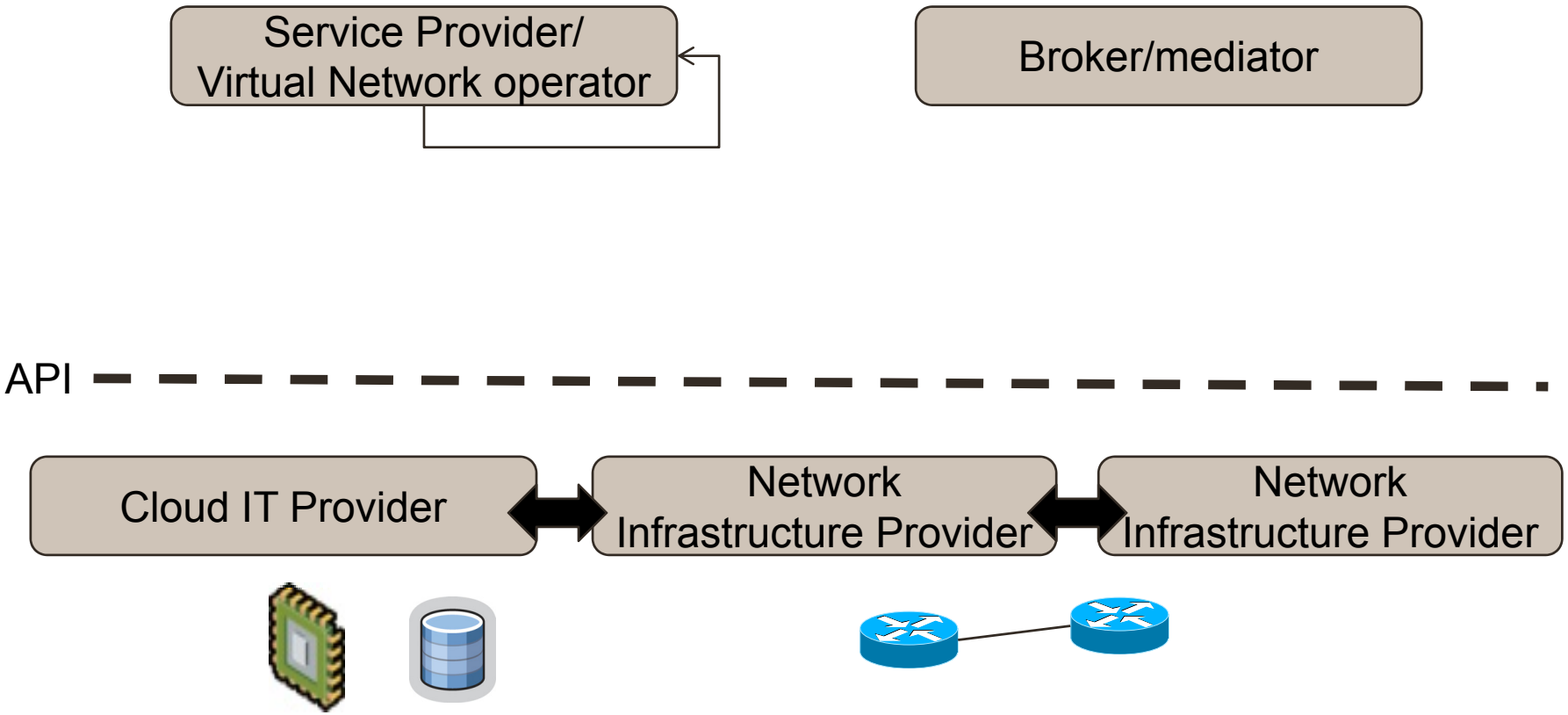
Virtualization process



Cloud Computing, XaaS

- Infrastructure-a-service
  - On-demand provisioning of IT resources
  - Programmatic access through “cloud API”
  - Public/commercial cloud vs private cloud
  - Usage-based pricing model
  - Network support if any limited to the provisioning of VPNs
- Towards a Network-as-a-Service model
  - Provisioning of virtual networks along with IT resources
  - Dynamic reconfiguration of the virtual network

NV & Cloud Computing: players



Service provider use cases

- Content Delivery Network revisited
  - Custom virtual network optimized for live streaming
  - Processing capacity at the edge (POPs)

- Massively Multiplayer online game service
  - Intelligent application-specific routing
  - Game server CPU capacity spread across multiple service platforms

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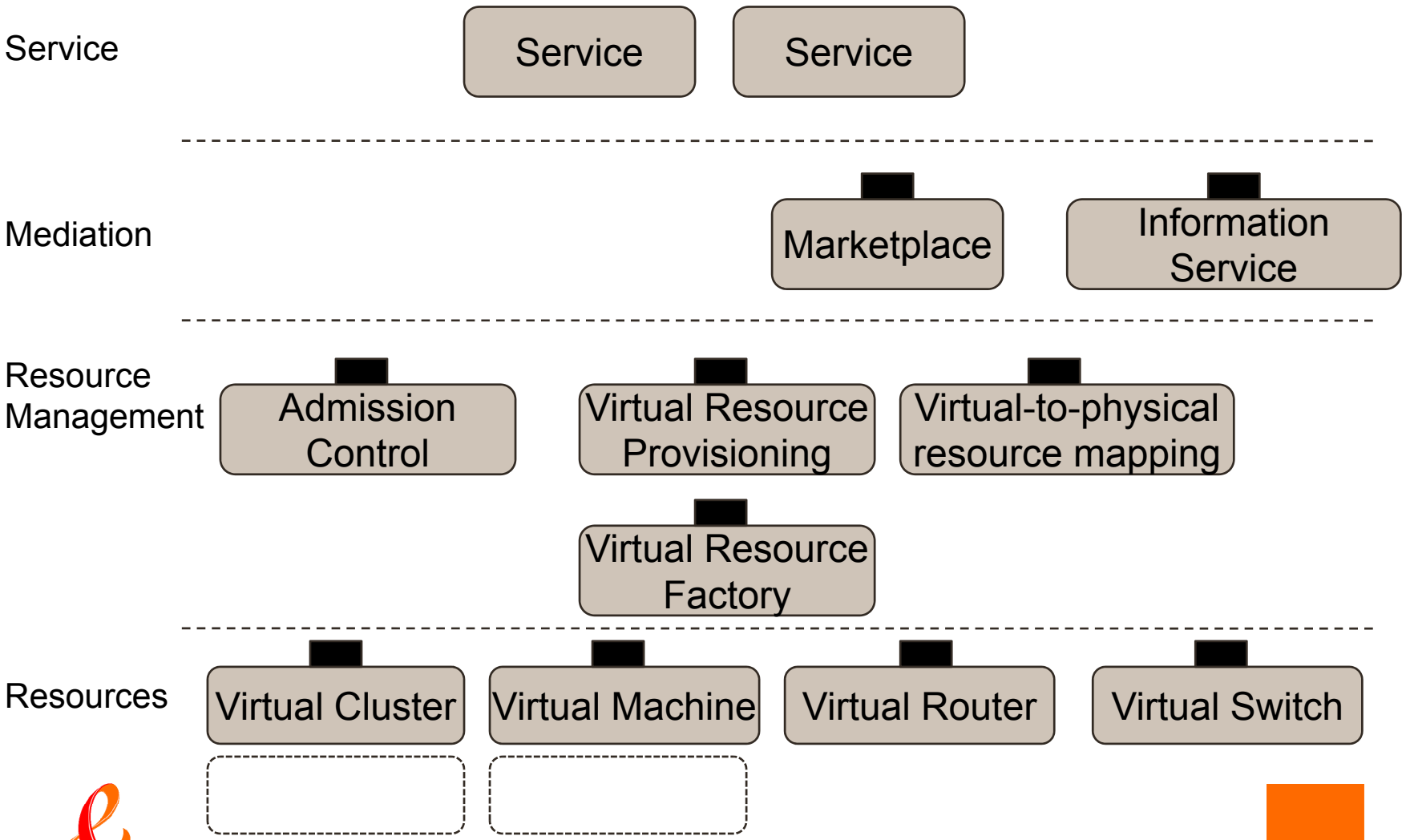
Virtual Resource Management

- A generalized architectural & service-oriented approach for virtual resource management
- Requirements:
  - Clear policy/mechanism separation
  - Technology dependence encapsulated
  - Virtual resources as first-class entities
  - Focus of services with end-to-end QoS
  - Provisioning of end-to-end (virtual) resources:
    - Network
    - Computational
    - Storage

Framework building blocks

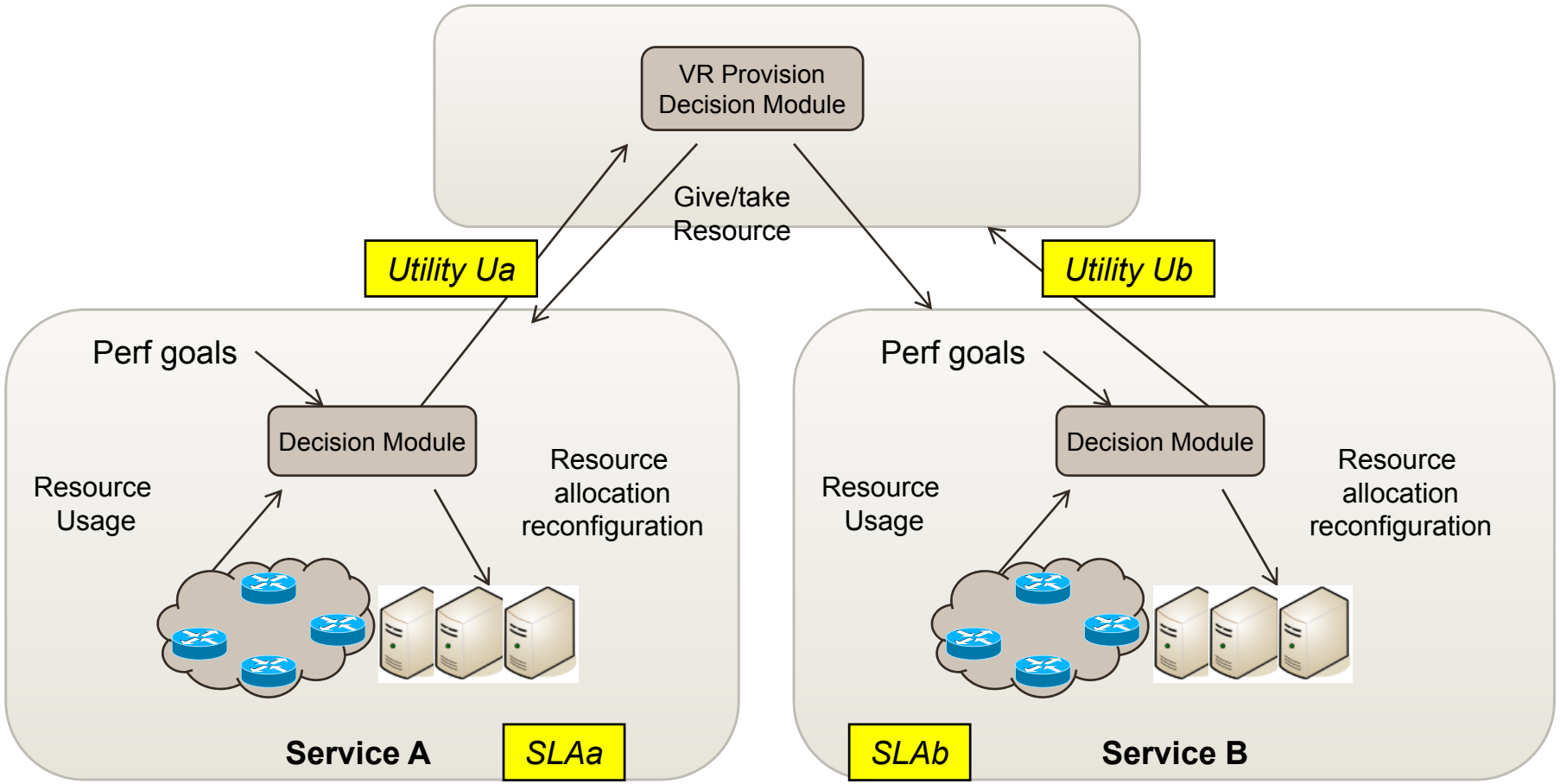


Utility-based VR provisioning

- Dynamic resource (re)allocation across services according to actual demand
- Service information:
  - Business-level Service Level Objectives (SLO), e.g.
    - Max time to download a video file + nb of downloads /s
  - Performance model provides the amount of resources (net+cpu) required to meet a given SLO
  - Service-specific utility function:

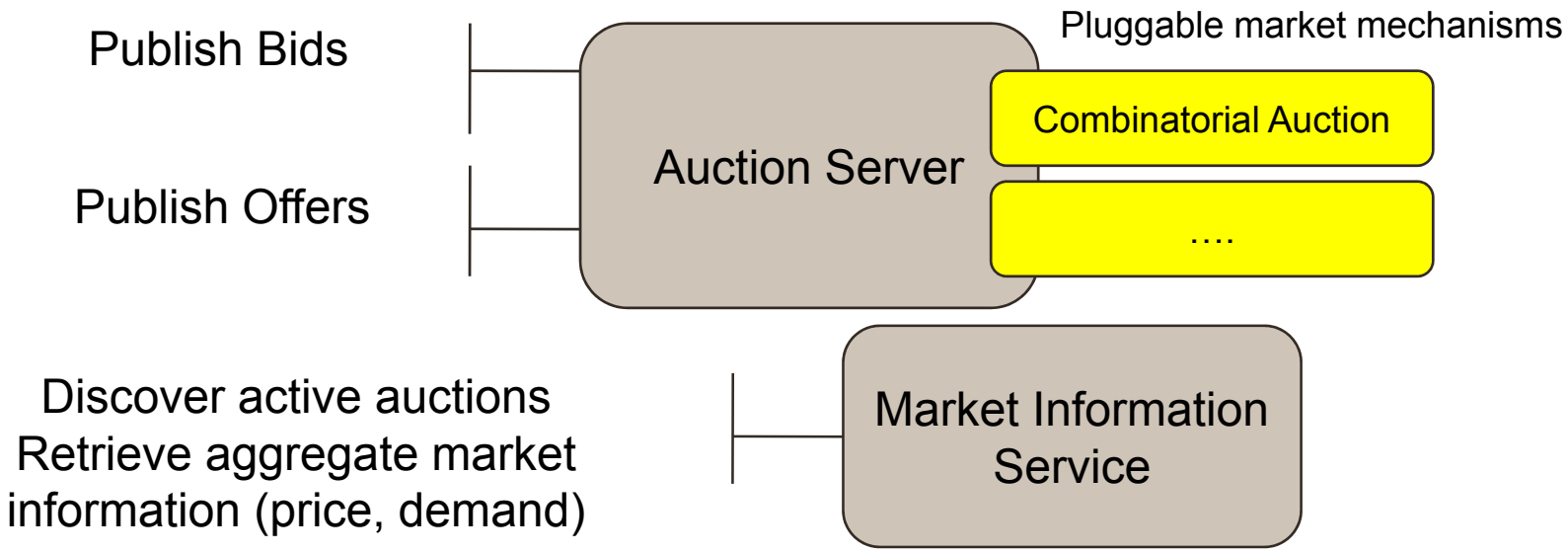
U=f(service demand, resource capacity)

$$U_{global} = \max \sum_{i=1}^{m} (w_i.U_i - \cos t_i)$$



Resource marketplace

- Open resource marketplace supporting
  - multiple providers and buyers
  - multiple market mechanisms



Combinatorial auctions for trading virtual network resources

- Allow buyers to place bids on a package of items:
  - Multiple virtual link bandwidth and nodecapacity
  - Combination of network, CPU and storage capacity
- Bidding language
  - Buyers bids: XOR statements:
    - { P_1 XOR P_2 XOR P_3 … XOR P_j }
    - Resources = {price,LINKa-b(bw=100Mbps) } AND {price,$NODE_a$(cpu=40%)}…
  - Sellers bids
    - Price, capacity of {links, nodes}

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- Towards a telco cloud:
  - Integrated virtualization of service plaforms & networks
  - Self-provisioning of services along with their customized IT&N architecture
  - Cost reduction for an operator internal infrastructure
  - New business opportunities & revenue streams

- Key issues:
  - Right level of exposition of the physical infrastructure (Infrastructure Provider API)
  - Reliability, security, isolation of virtual services

Thank you

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