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Software Will Eat the Networks

Welcome to the Blue SDN !

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Innovation Dilemma...

- ▶ First Companies, Innovators, in an industry must eventually enable new ecosystems “destroying” their own business before someone else does it
- ▶ We’ve learnt from history that real “change of paradigms” can only happen “at the right time” from bottom up massive efforts.
- ▶ Tomorrow, we’ll see one of these “change of paradigms” in the Telco-ICT context thanks to technology performance and open crowdsourcing s/w

connectivity becoming a commodity

pressure of competition

need of creating or enabling services ?

risks of instability

need of new biz models

**Telco-ICT context driven by multiple intertwined variables
as in a Complex System near to a tipping point !**

traffic growth

need of reducing costs

technology acceleration

0 Opex or 0 Capex ?

increasing complexity

Which way to future biz ?

▶ Bit Carrier

- ▶ Transporting bit. The network should be architected to ensure the minimum OPEX. CAPEX are less important (provided there is money to support the investment).

▶ Service Enabler

- ▶ Enabling services developments. To provide platforms, based on high virtualization and programmability, to Third Parties.

▶ Service Provider

- ▶ Providing end-Customers services. CAPEX should be as limited as much as possible since services are volatile. OPEX are less important since it can be recouped based on the sale of services.

Which way to future biz ?

- ▶ Three evolutionary roles in the arena for a variety of competing Players, each one creating value and driving revenues.
- ▶ Investment required, biz models associated, boundaries and the rules of the game will be significantly different in each role so it unlikely to see a single company dominating all of them.
- ▶ Who of the three is looking for SDN ? One, two, all of them ?
- ▶ It depends on how we define SDN !
 - ▶ behind the hype, there is a spectrum of declinations...
- ▶ ...but SDN is not only about technology, it is also about new biz

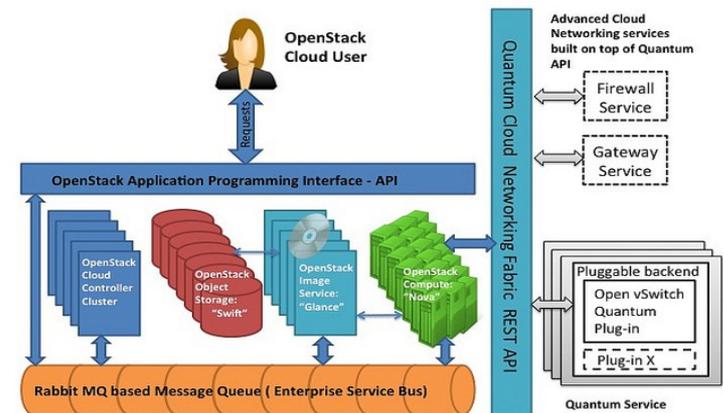
SDN

- ▶ *“In the SDN architecture, the control and data planes are decoupled, network intelligence and state are logically centralized, and the underlying network infrastructure is abstracted from applications” (*)*.

(*) ONF White Paper

- ▶ Does this mean decoupling S/W development from H/W ?
- ▶ If yes, Open Source Software will have a key role !
 - ▶ “change of paradigms happen always from the bottom”

- ▶ Examples: OpenStack is an Open Source project developing: OpenStack Compute and OpenStack Object Storage. Quantum is an application-level abstraction of networking



OpenStack + Quantum Integration Architecture

Some “Pros and Cons” of SDN

Pros

- ▶ Decoupling H/W from S/W (same evolution of PC)
- ▶ Network OS: logically centralized control
- ▶ Network programmability (API)
- ▶ Opportunity of complementing with network virtualization
- ▶ H/W consolidation
- ▶ Reducing time to market
- ▶ Saving Capex and Opex

Cons

- ▶ Scalability and performance ? (h/w speedup required in core nodes)
- ▶ Consistency of network states (data) when logically centralizing the control ?
- ▶ Signaling overhead ?
- ▶ Availability, Complexity, Stability ?
- ▶ Major Vendors are trying to kill it !
- ▶ Quite convincing for the Edge, not for the Core...

A change of paradigm...

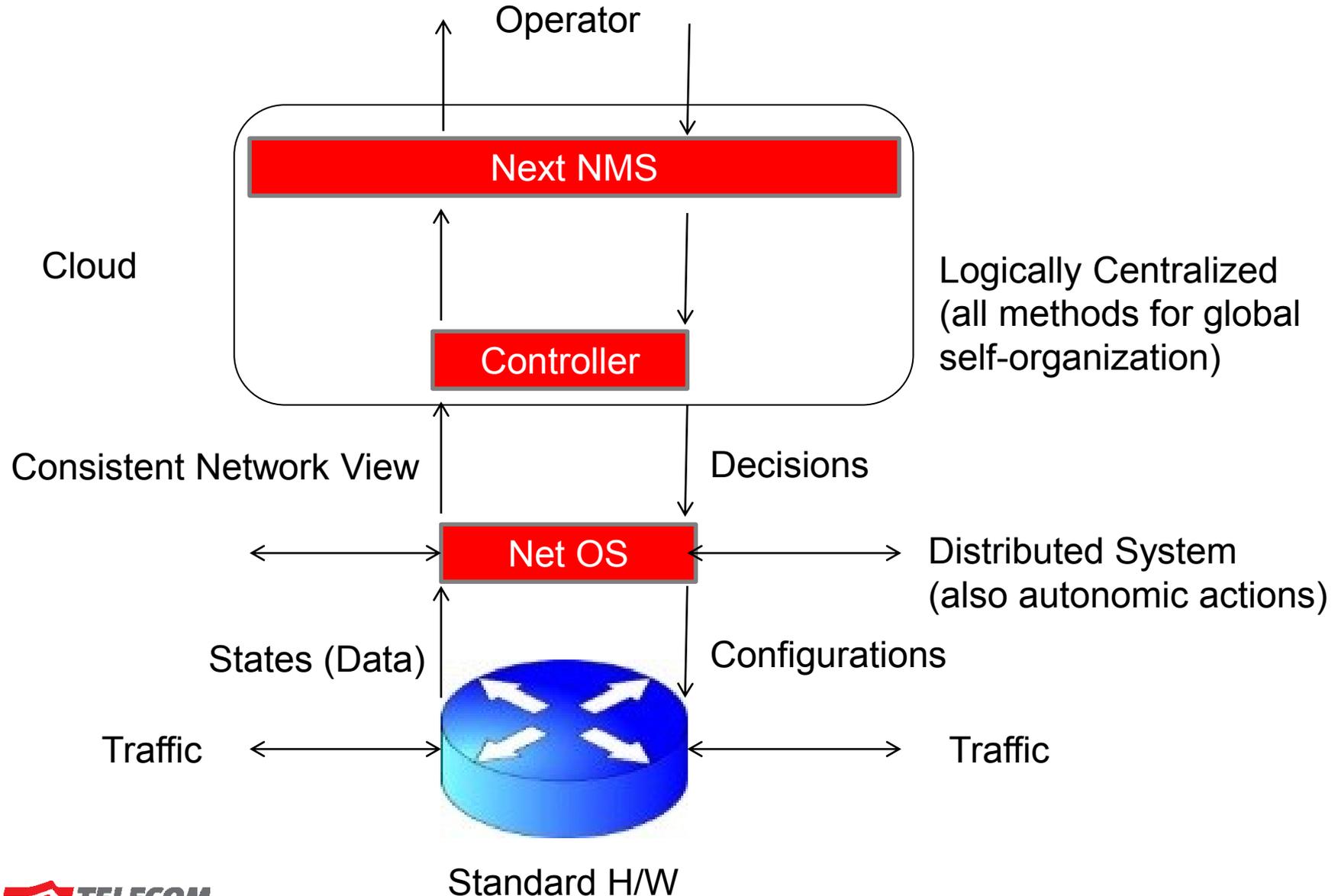
- ▶ Decoupling S/W development from H/W is not new...
- ▶ *Processing/Storage (and Bandwidth) have reached such performance levels that it is possible re-thinking profoundly networks and services (starting by the Edge)*
- ▶ *This - together with OpenSource S/W - have the potentiality of changing Telco-ICT biz equilibria and creating new ecosystems (mutations or new species are appearing !)*

The two colours of SDN

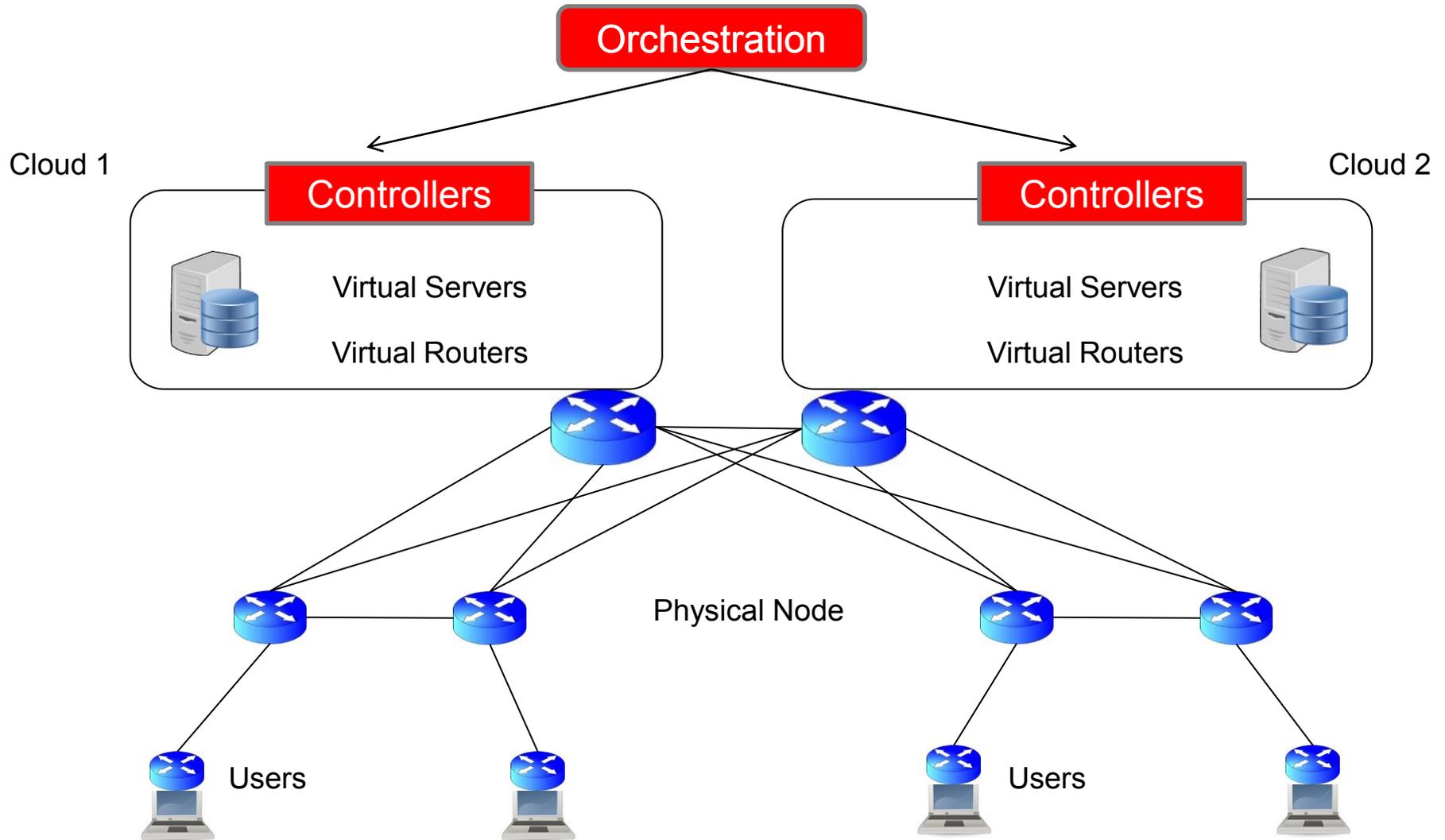
- ▶ **RED**: for the evolution of **current networks** (at least some segments)
 - ▶ Seamless integration, compatibility with legacy,...
 - ▶ Solutions from **traditional Vendors** (or even Start-ups) ...
 - ▶ Costs Reductions (CAPEX, OPEX) but Competition
- ▶ **BLUE**: for the potential development **new networks and new service**
 - ▶ Disruptive low cost net architectures, exploiting at most Cloud processing
 - ▶ **Open Source Software** (for Carriers' Class nodes)
 - ▶ New markets
 - ▶ Open Innovation

Red Ocean Strategy Focus on current customers	Blue Ocean Strategy Focus on noncustomers
• Compete in existing markets	• Create uncontested markets to serve
• Beat the competition	• Make the competition irrelevant
• Exploit existing demand	• Create and capture new demand
• Make the value-cost trade-off	• Break the value-cost trade-off
• Align the whole system of a firm's activities with its strategic choice of differentiation <u>OR</u> low cost	• Align the whole system of a firm's activities in pursuit of differentiation <u>AND</u> low cost

A SDN Node Concept



A SDN Use Case (simulations and emulations)



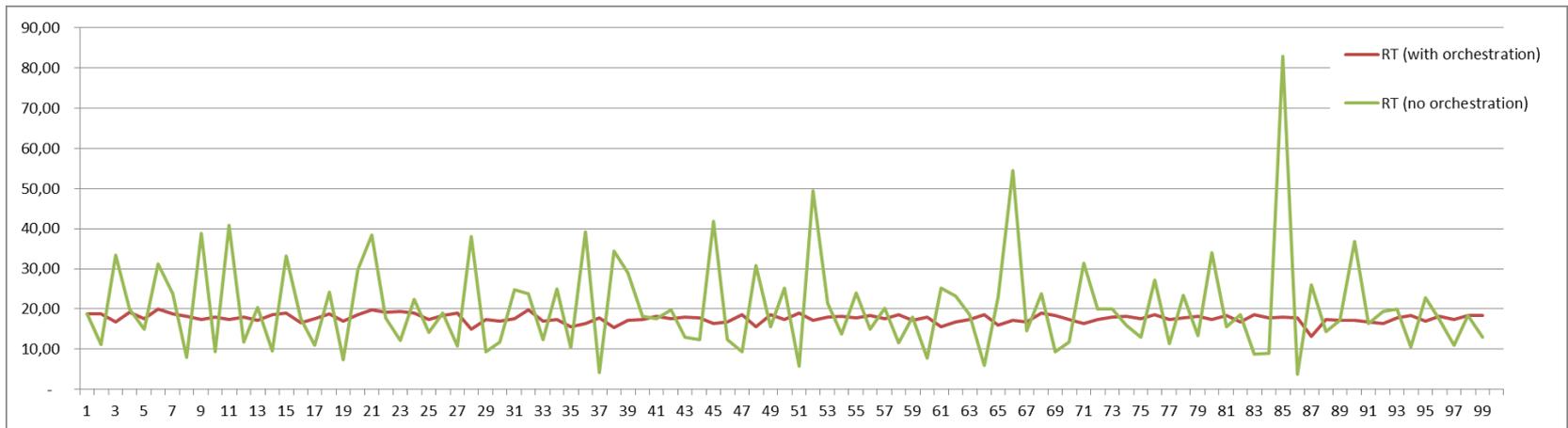
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Problem: network states consistency ?

- ▶ How “**centralization vs distribution**” impacts network states consistency ?
 - ▶ **CAP** Theorem: it is impossible for a distributed computing system to simultaneously provide all three of the following features:
 - ▶ **Consistency** (all nodes see the same data at the same time)
 - ▶ **Availability** (a guarantee that every request receives a response about whether it was successful or failed)
 - ▶ **Partition tolerance** (the system continues to operate despite arbitrary message loss or failure of part of the system)
- ▶ SDN flexibility passes through the dynamic allocation/migration of ensembles of VMs and the associated data (e.g. configurations, rule) whilst keeping **network states consistent**

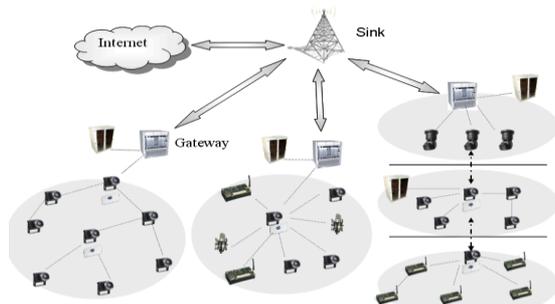
Problems: how orchestrating multiple «control loops» ?

- ▶ VMs (virtualizing servers and routers) can freely move from one physical node to another (the physical node merely serve as the carrier substrate on which the actual virtual node operate)
- ▶ Problem: minimizing response time of IT servers whilst minimizing the consumption of energy (of both IT servers and physical routers)
 - ▶ Simulating the interactions of two control loops making the VM and VR movements
 - ▶ Although the two control loops would be stable if operating alone, without a proper coordination, the combination of the two may cause a positive feedback loop



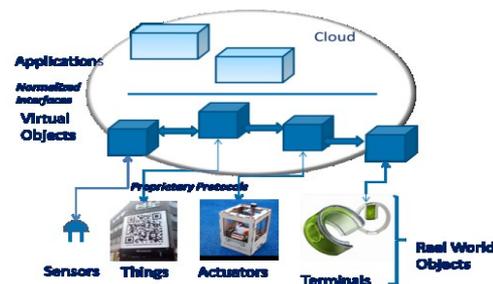
A New Network for New Ecosystems...

Internet of Things



**Billions of “things”
communicating and
interacting with each
other**

Internet with Things



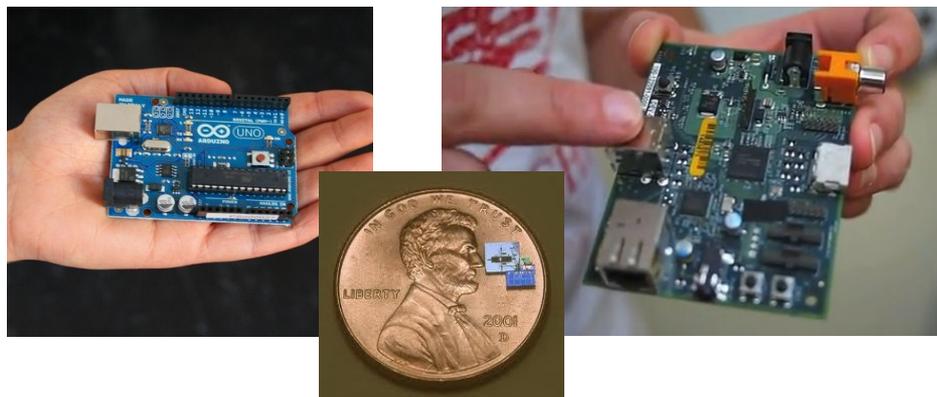
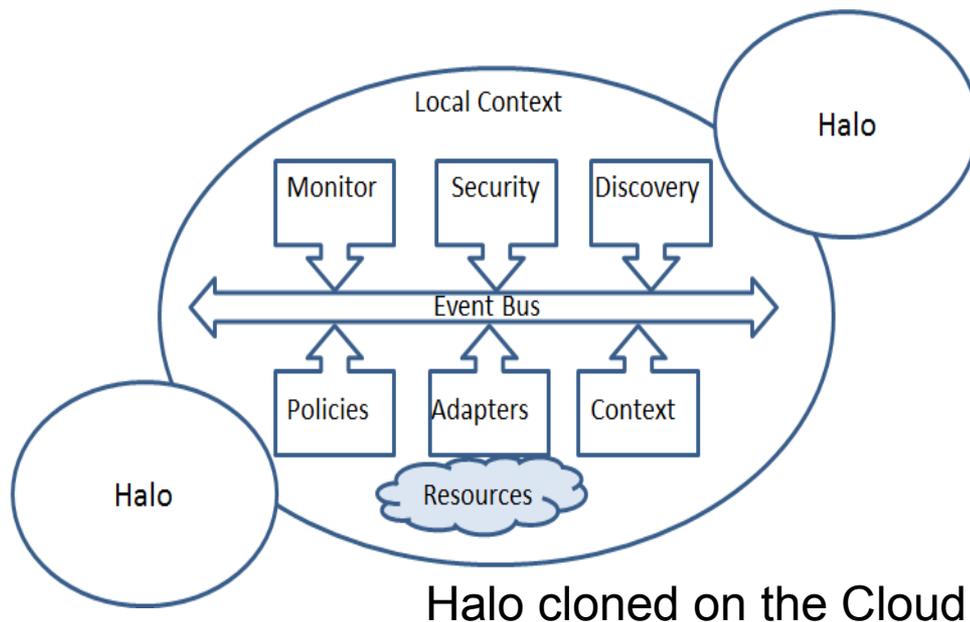
**Cloning things in the
Cloud: billions “virtual
objects” becoming
accessible to people
through the Internet**

**“Anything” becomes a gate to access
associated “services” on the Cloud**

Importance of the Edge (the last few meters...)

▶ Halos Nets of Self-Managed Virtual Router (SMVR)

- ▶ Imagine “halos” centered around people, vehicles, street lamps, kiosks etc, embedding communication, storage and processing resources
- ▶ A critical density of halos is creating suddenly a fully connected edge network emerging spontaneously through “overlapping” halos



Conclusions

- ▶ **Processing/storage** capability (and bandwidth) have reached such performance levels that it is possible to **re-think networks architectures and services exploiting at most the Cloud**
- ▶ This - together with **OpenSource S/W** - will have the potentiality of creating entirely new ecosystems
 - ▶ When **s/w will eat the network**, OPEX and CAPEX reductions will be followed by similar **revenues reductions** (i.e. commoditization of traditional network services...like electricity) but...
 - ▶ **...a Blue SDN will enable new service ecosystems (e.g. IwT) !**

Arrivederci!



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