The Abstraction Track

Bringing the SDN Promise
beyond Box Limits

Telefónica

Telefónica I+D
06.11.2012

Out of the Boxes

- The network does not need to be seen any longer as a composition of individual elements
- User applications interact with the network controller(s)
- The network becomes a single entity
  - Suitable to be programmed
  - Aligned with current IT practices
- We can apply different levels of abstraction
  - Network Stored Program Model
  - Network Operating System
  - Network Abstract APIs
  - Network Abstract Orchestration
- And think of a network design flow
  - And even an IDE

Telefónica
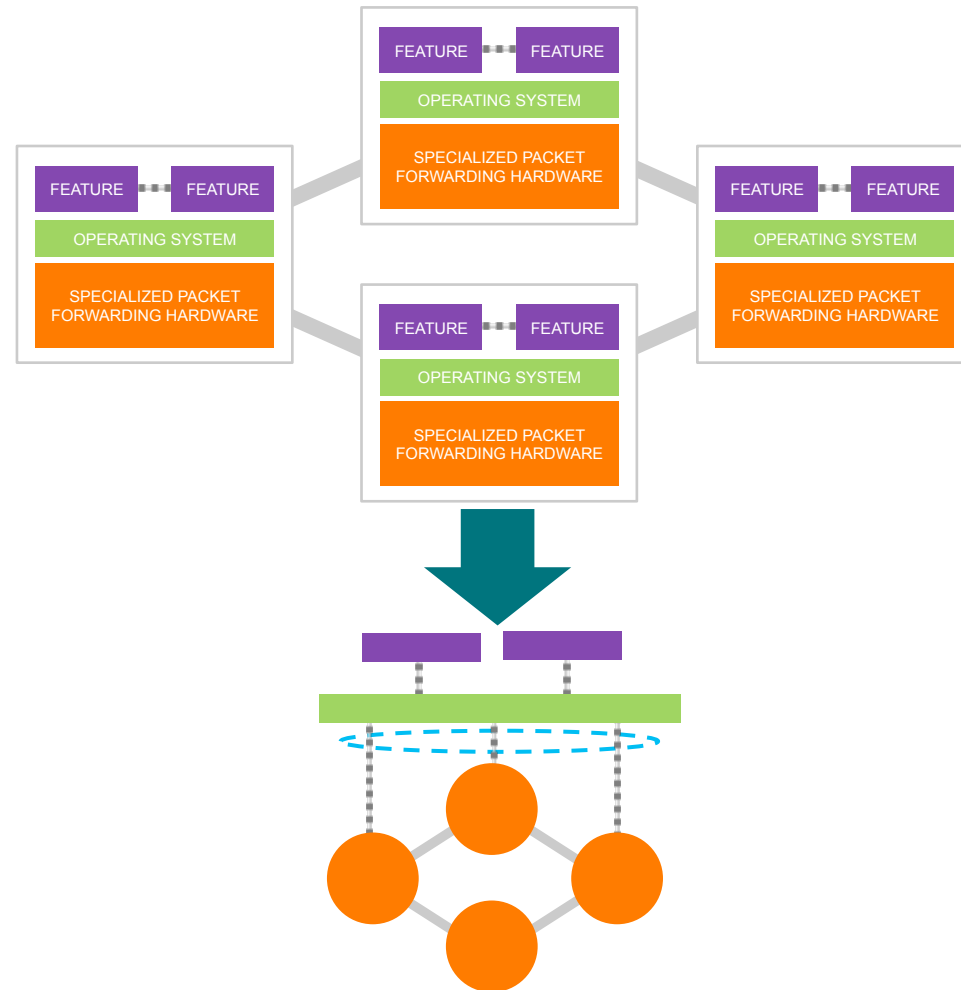
Stored Program. The Network Is *A* Computer

- So we can apply software development techniques and tools
- Software development and operation being multifaceted
  - Different tools for different tasks
  - Some already on their way
- Static and dynamic verification
- Translation, dynamic composition and linking
- Testing and debugging
- Version and configuration control
- Development flows
- And abstraction capabilities

OpenFlow Controller

OpenFlow Switch

OVS

OVS

OVS

OVS

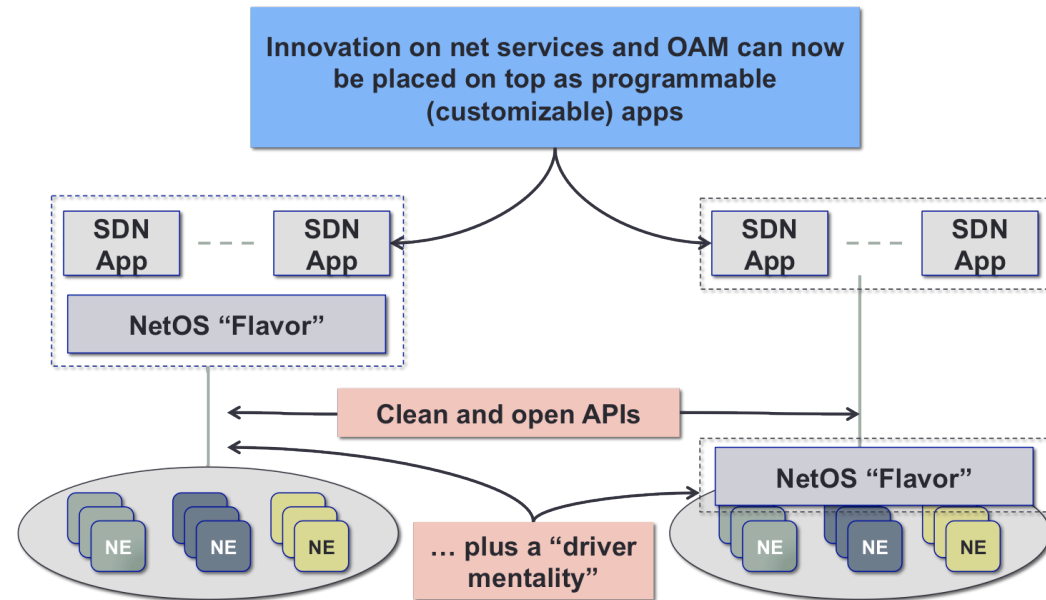OpenFlow
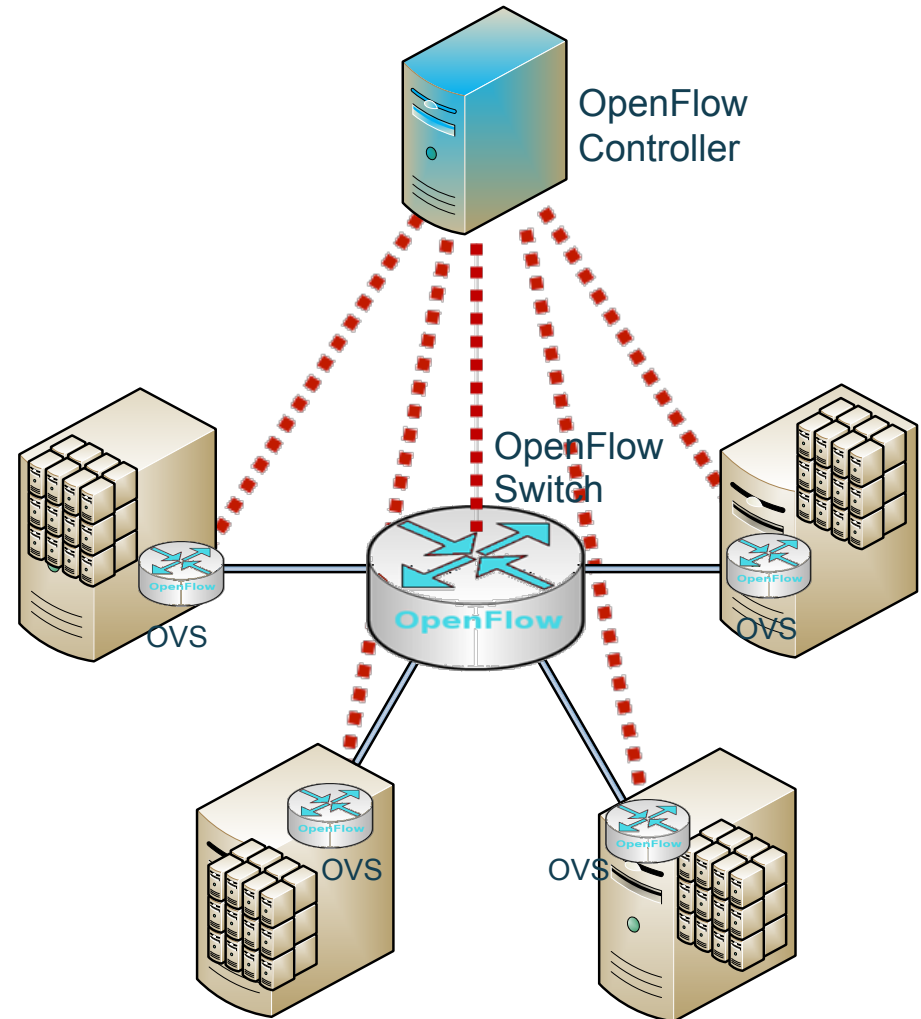
Network OS. SDN in the Widest Sense

- Providing a consistent interface to control, data and management plane
  - A layered model
  - The first take could follow an analogy with existing OSes
- The kernel is realized by control plane mechanisms
- Data plane is associated with the file system
- The management plane is mapped to the system tools
  - Remember the shell
- Specific services to enforce policy and security
  - PAM is a reference
- And the APIs

user app.
daemons

CLI
sequencing

Hardware
Scheduler
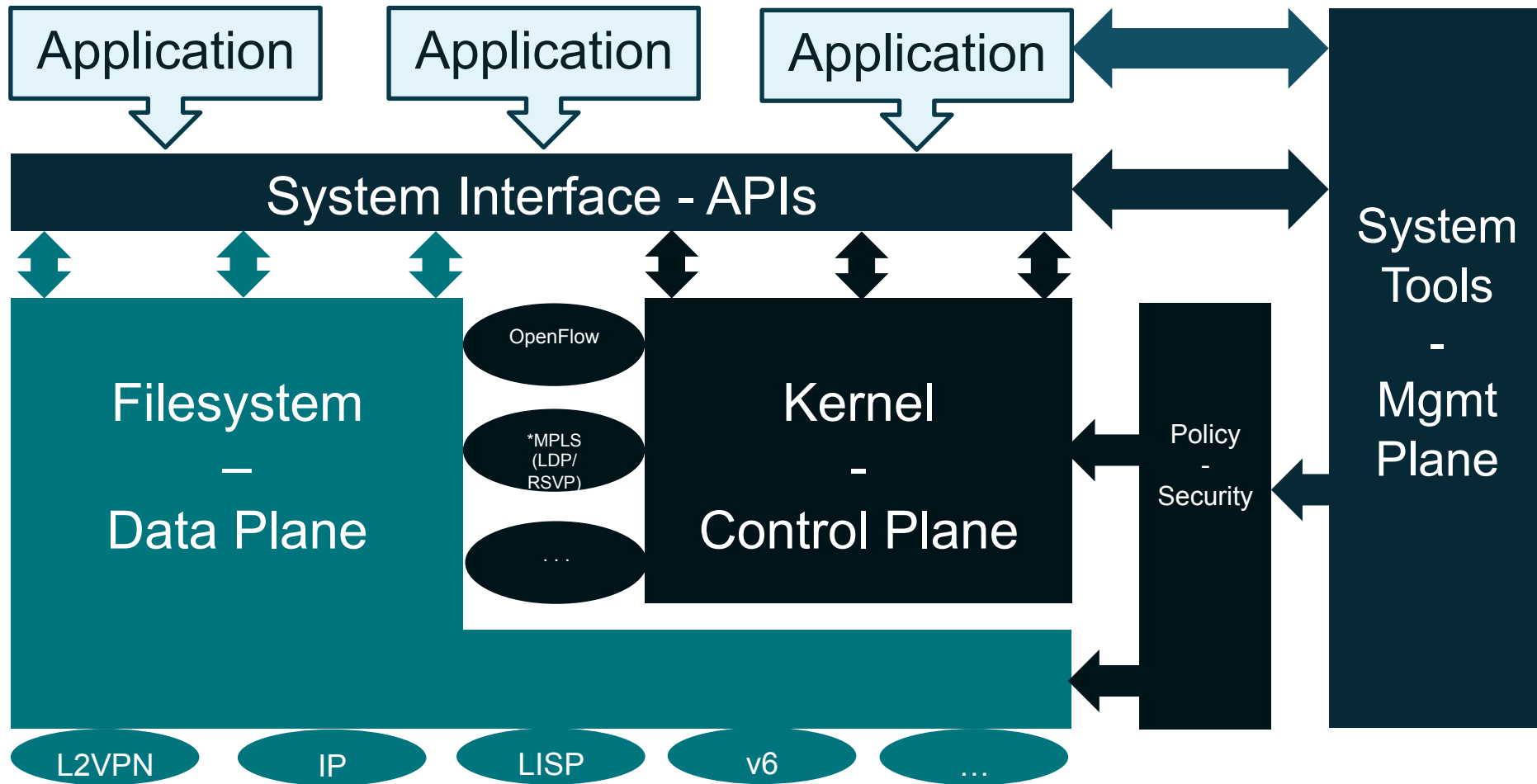Memory

Application

Shell

Kernel
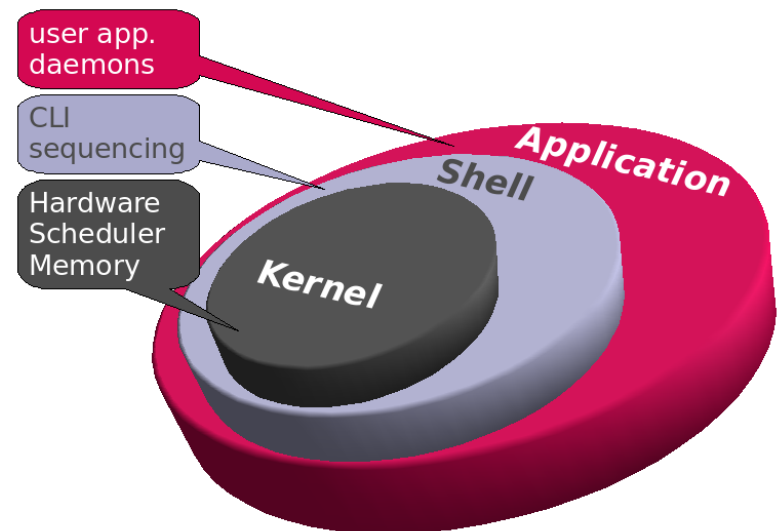
The Network OS Ecosystem

- The users
  - Network operators
    - Manage the network, create services and locate problems in a more efficient manner
  - Application providers
    - Reduced time to market for new applications, value added services, abstracted view of the network
- The networks
  - Need to address a wide variety of devices and protocols
- The goal
  - To simplify use and management of heterogeneous E2E networks
  - Access, core, datacenter….
- The POSIX reference model

Innovation on net services and OAM can now be placed on top as programmable (customizable) apps

SDN App — — SDN App → SDN App — — SDN App

NetOS "Flavor"

Clean and open APIs

NetOS "Flavor"

NE NE NE

… plus a "driver mentality"

NE NE NE

Net-wide, POSIX Style

Network APIs. Upper Layers of Abstraction

- NaaS beyond itself
  - Current models are still very much box-oriented
  - Virtual view of current elements
- And beyond OpenFlow
  - An excellent practical base
  - As much as processor instruction sets
- A first step: consider the fabric
  - Extend OpenFlow to deal with overlay control
- And start thinking of the equivalents to
  - SQL
  - OO
  - Garbage collectors
 - <YourPreferredITConstruct />
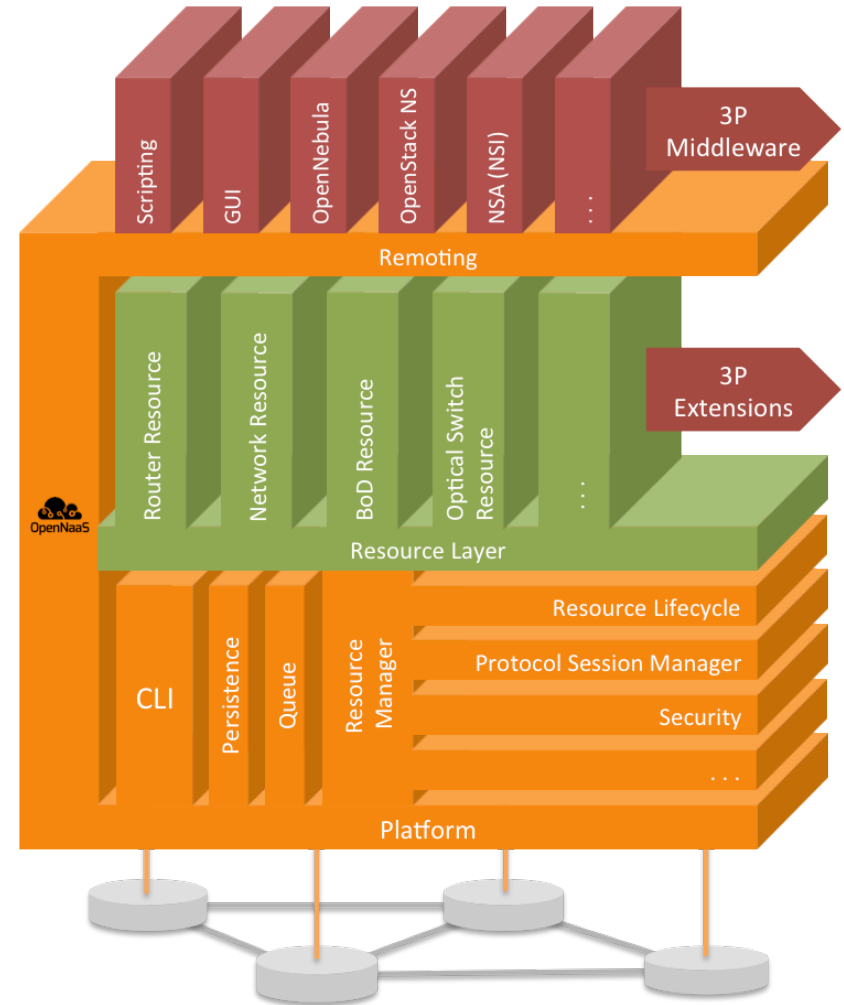
The Road to a Network IDE

- The natural consequence of applying concepts and tools related to software development
- Supporting a complete design flow
  - High-level definition and manipulation
  - Validation from simulation to actual debugging
  - Beta versions by slicing
  - Phased deployment
  - Integrated with parallel IT development
- Proof of concept
 - OpenFlow-in-a-Box
  - More to come
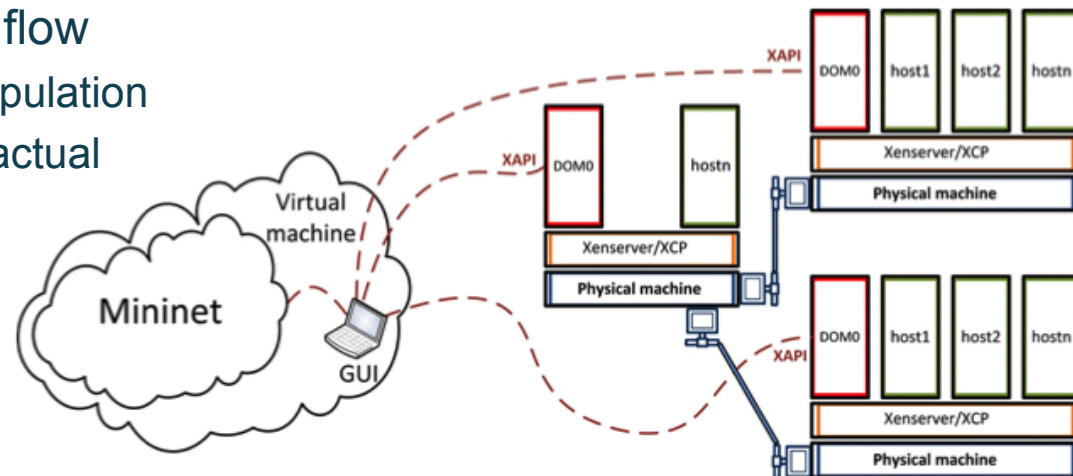
Abstract Orchestration. SDN Realm Partitioning
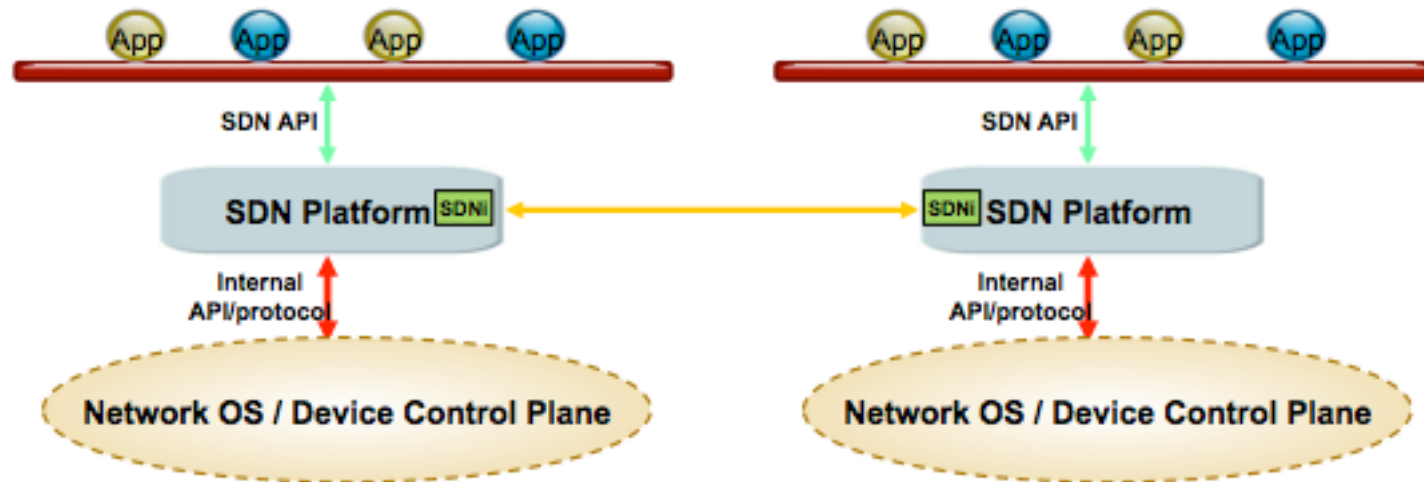
- SDN partitioning is inevitable
    - A large network is likely to be divided into multiple SDN realms
    - Each SDN realm with its own controller
- Some reasons
    - Scalability
    - Manageability
    - Privacy
        - Privacy policies applied to tenants or special applicable policies
    - Incremental deployment
- Partitioning is already a common practice
    - FlowVisor-enabled slices

Applying ALTO to SDN Realm Orchestration

- SDN controllers communicate by exporting and importing network information through an ALTO server
- Information exchange is subject to realm-specific policies
- The ALTO server acts as network data orchestrator
  - Control decisions are autonomously taken by controllers
- ALTO as part of an evolved Eastbound (North-East-bound?) API

Policed (aggregated) information

ALTO Server

Policy   Policy   Policy

SDN controllers

Telefónica
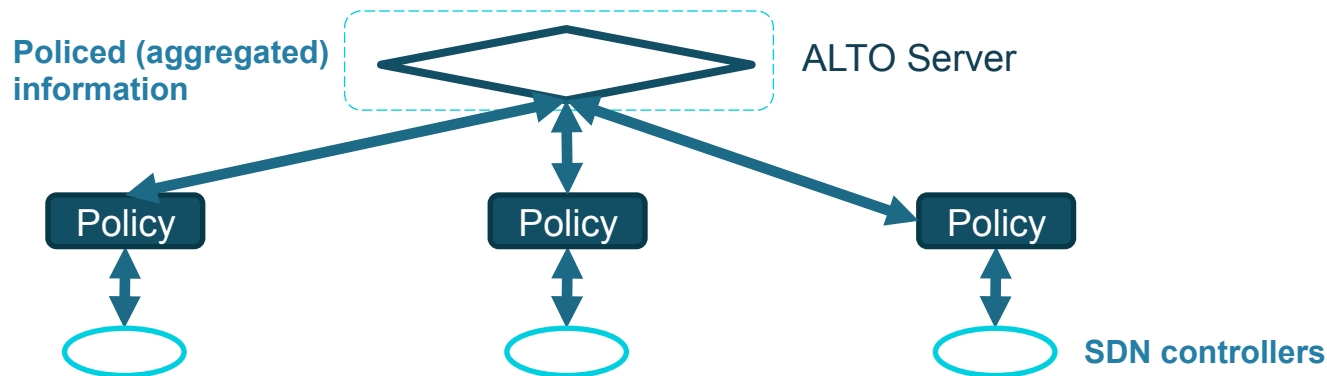
Making Orchestration Happen

- The ALTO server becomes a "soft" orchestrator
  - No need for a controller hierarchy, mesh, chain, or…
  - Policy driven
- Flexible arrangements
  - Controllers retain autonomy
  - "Multi-homing" is possible
  - And different policies at each attachment link
- Neutrality
  - With respect to positioning in the realm(s)
  - With respect to SDN flavor
- But we need to
  - Decide on extensions to ALTO data models
  - Enhance two-way interactions, session management and timely updates
  - Explore mechanisms for security, discovery, policy declaration, attachment modes…

The Struggle for the Right Abstractions

- We are witnessing a paradigm shift in networking
  - The possibility of interacting with the network as a whole
  - And to reason about that
- Taking the first steps
  - IT is an interesting source of inspiration
  - Its models are limited as well
  - And convergence requires additional effort
- The future of network design and operation lies in building the right abstractions
  - Validation and acceptance are not short processes
  - You can only learn to walk by walking

Telefónica