Telefónica

A Jabberwocky on Cloud Networks

Diego R. López - Telefónica

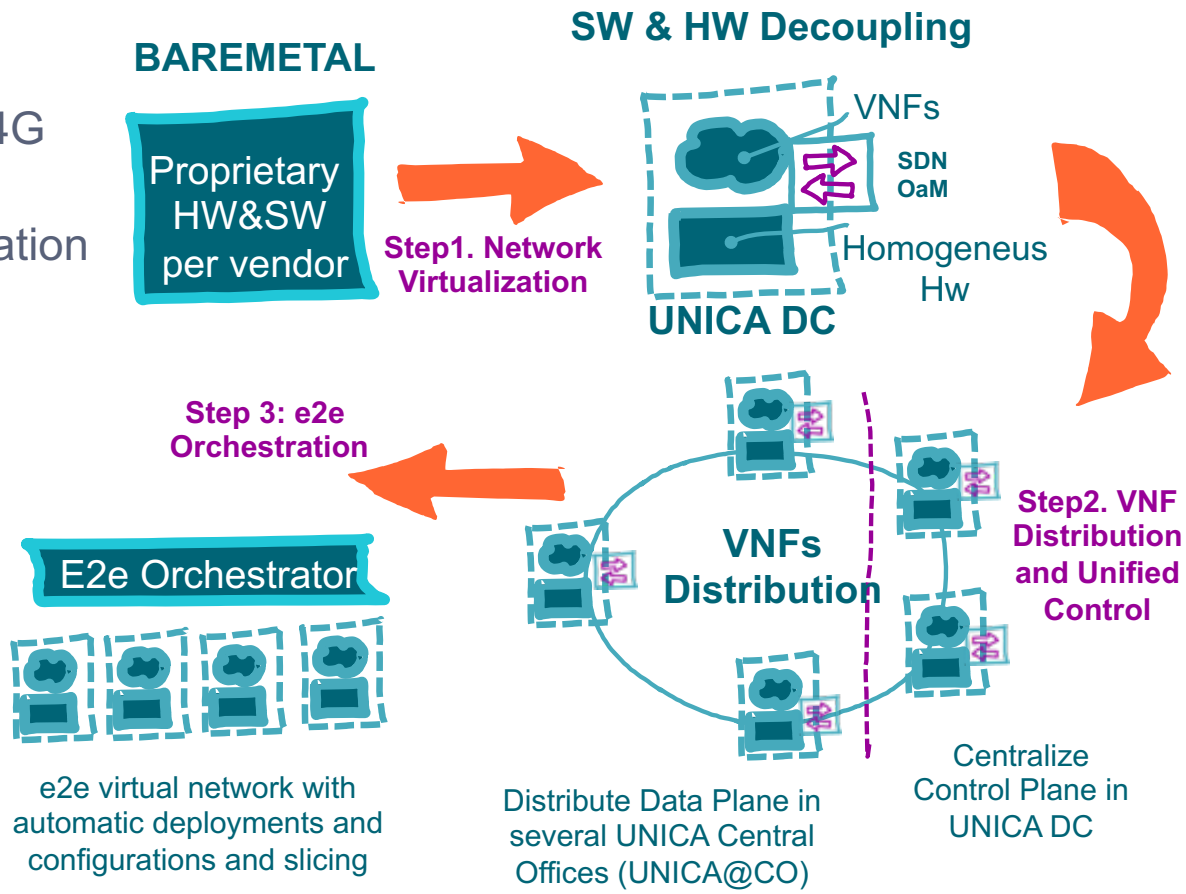
Twas Brillig and the Slithy Noves…

- In the last decade, networks are being built on many principles set by the current practices in cloud infrastructures
  - Can take a great advantage of them
  - Sustainability, agility, usability…
- But the requirements of networks go beyond
  - And in different directions
- What is not new, anyway
  - Think on general-purpose computers and routers
  - And the layering principles
- And goes well beyond the telco vs hyperscaler issue
  - No one size fitting all cases and scenarios

Beware the Jubjub regulations, my son!

Addressing the Complexity Challenge

- Networks becoming increasingly complex
  - User experience demands access heterogeneity
  - 5G foresees a x10 densification of sites compared to 4G
  - The continuous challenge of centralized proposals
  - And not suitable to be managed using traditional operation
- Working along a few paths
  - Containerization and microservices
  - XaaS
  - Functional integration
  - Extended security
- Exploring new goals
  - DevOps
  - In-network computing
  - Intent and zero-touch service management

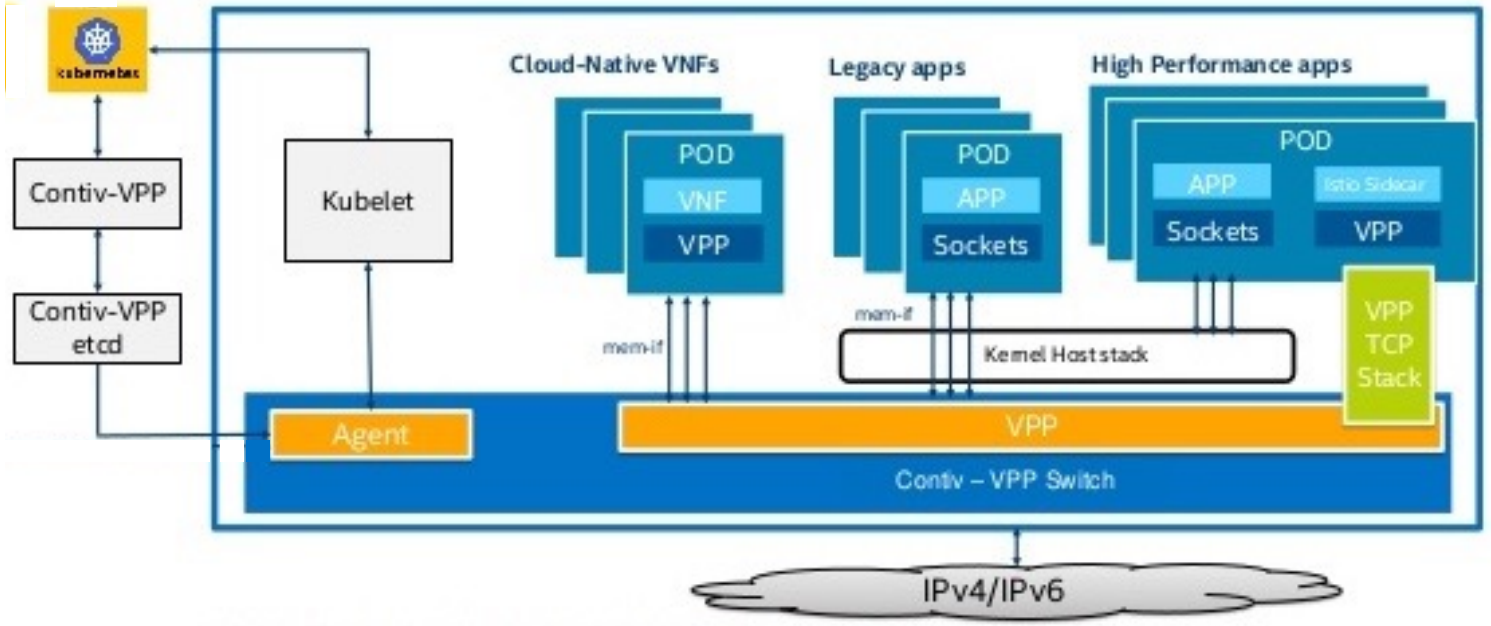


Taking the vorpal software in hand

Cloud Nativeness - The Promised Land

- Evolving along with the IT industry
  - In despite of circular definitions: “Cloud native is the name for an approach to building applications and services specifically for a cloud environment”
  - A moving target, in several directions
- Adapt results from the IT experience in virtualization, acknowledging the differences
  - Topology (and geometry!) awareness
  - The conservation principle
  - Openness
  - Integrity and auditability
  - Isolation

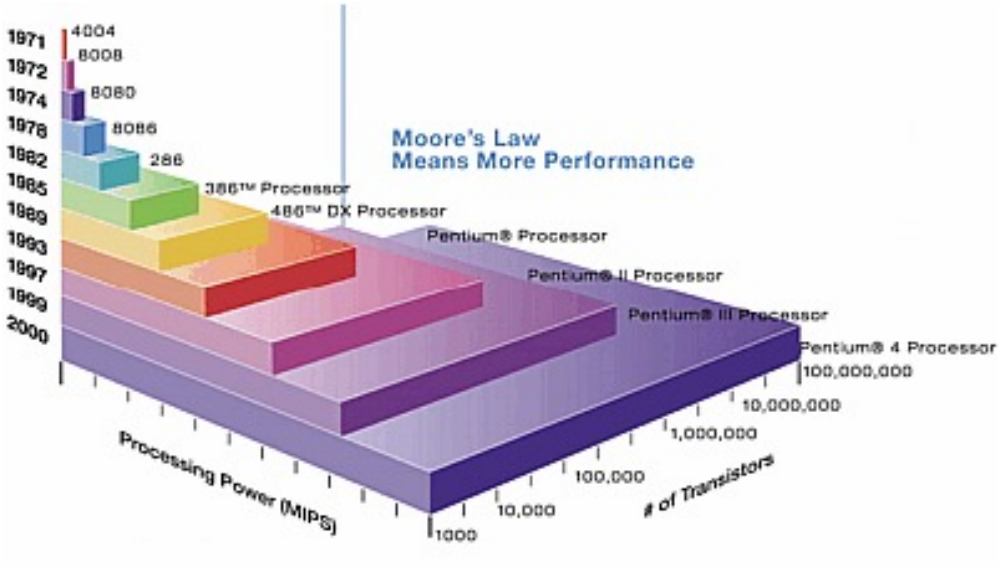
So rested he by the Tumtum orchestrator



Boxes to Think out from

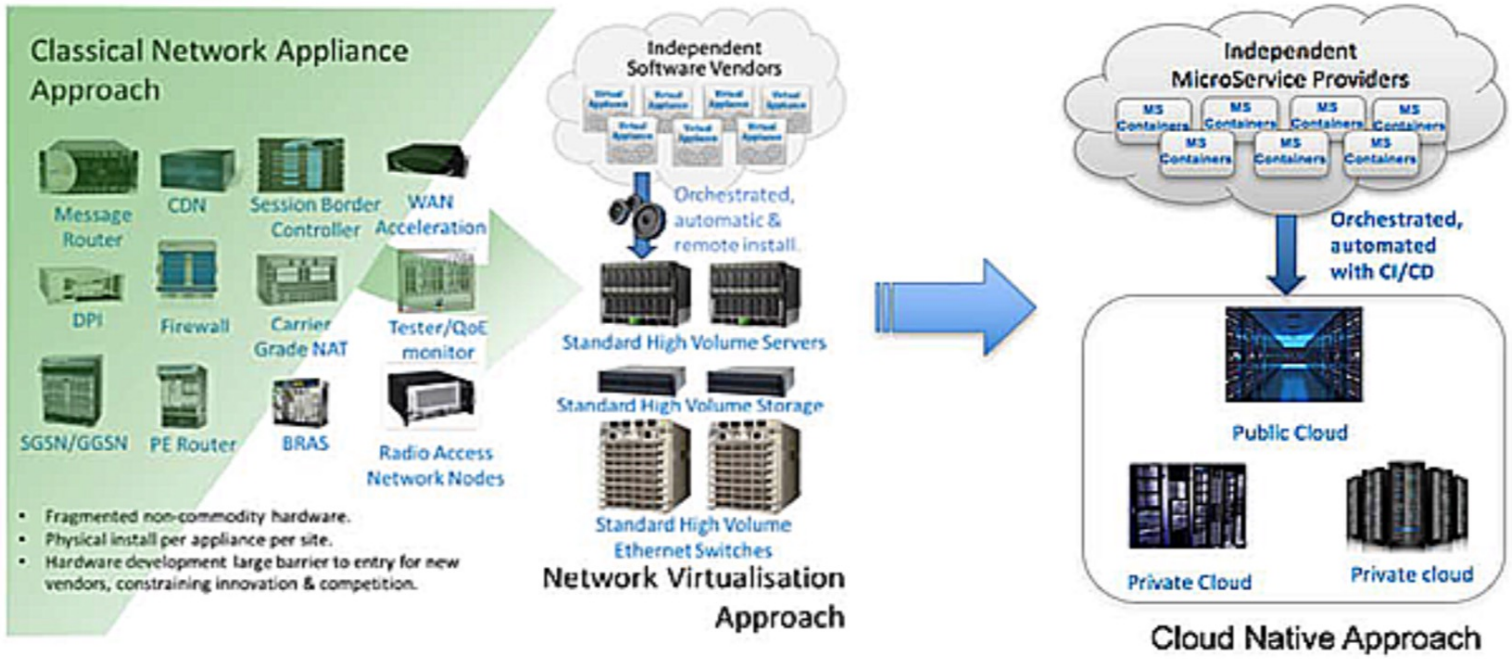
- The cloud equivalent to Moore's law does not hold for networks
  - And probably will cease to work in other areas soon
- *Entia non sunt multiplicanda*
  - Avoid over-architecting
  - Layering vs interfacing
  - Functions vs services
  - Hierarchies vs autonomy
- The identity issue all over the infrastructure
  - The services
  - The tenants
  - And the users
  - Decentralization and the quantum threat

And stood awhile in cloud



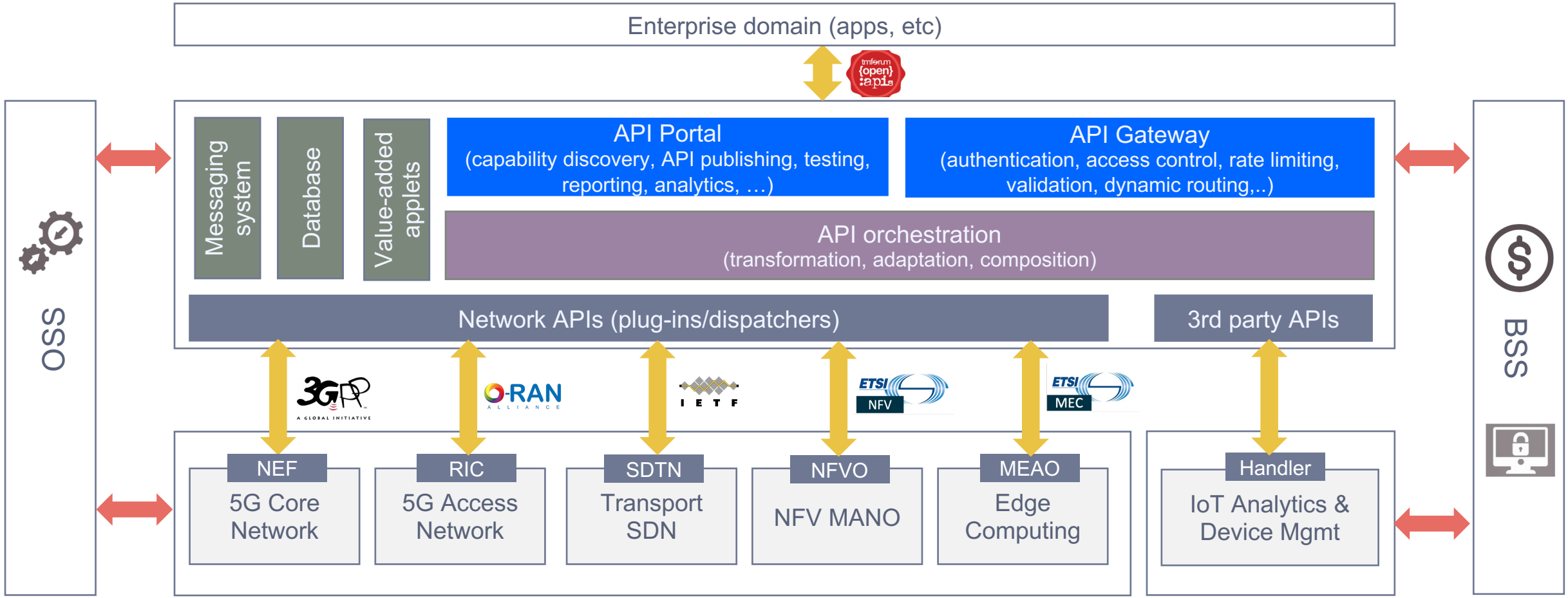
One More Step on the Network Virtualization Trail

- Beyond the initial VM-focused approaches
  - Towards microservice support
- Enhance
  - Deployment time
  - Image footprint
  - Adaptability to tenants and end users
  - Function and service performance
- Different approaches feasible, and necessary
  - Not only containers
  - Tinified virtual machines
  - Unikernels
- Radical disaggregation
  - Beyond physical approaches
  - Path awareness and packet extensions
  - A few steps beyond segment routing



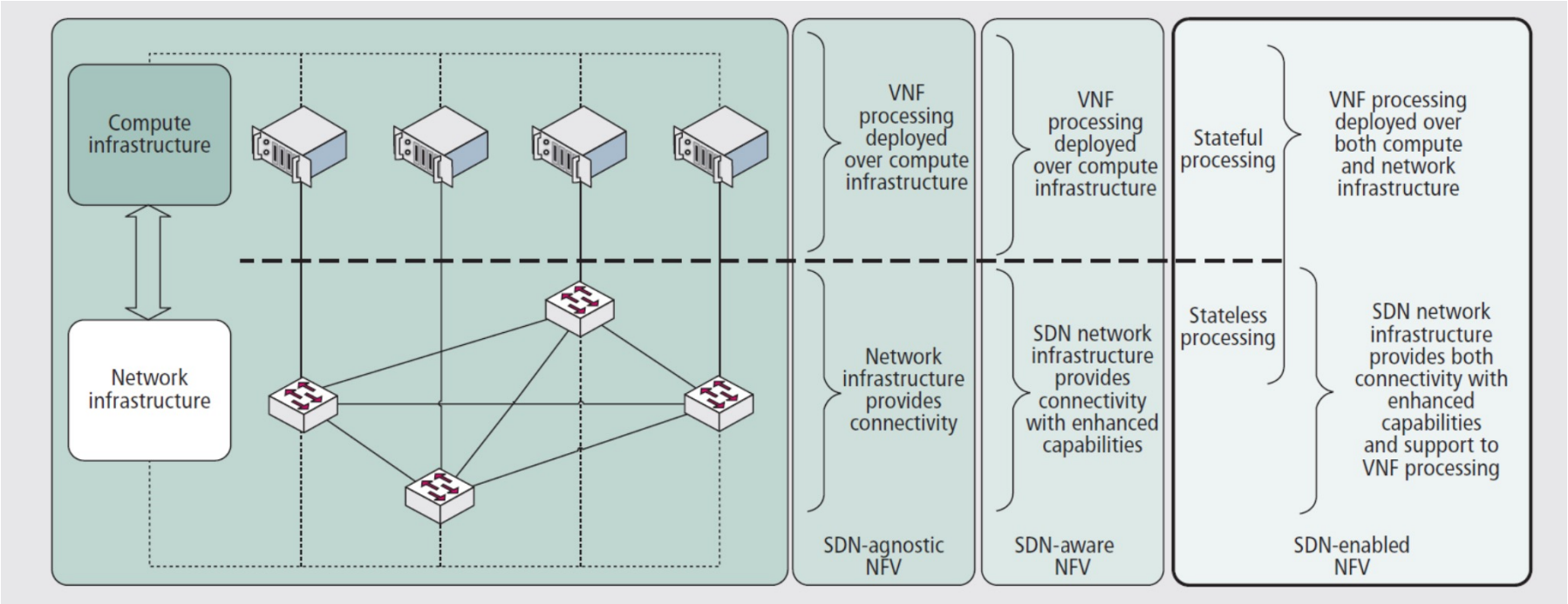
- Addressing the serverless paradigm
  - New architecture principles, decoupling service and interface locations
  - ICN, RINA…
- Implications at the orchestration layer
  - On the data plane: serverless service access
  - On the control plane: dynamic control composition
- Acceleration awareness
  - Functional decomposition for acceleration
  - Connectivity pattern selection and evolution of virtual network mechanisms

E2E XaaS Fabrics – Vertical Programmability



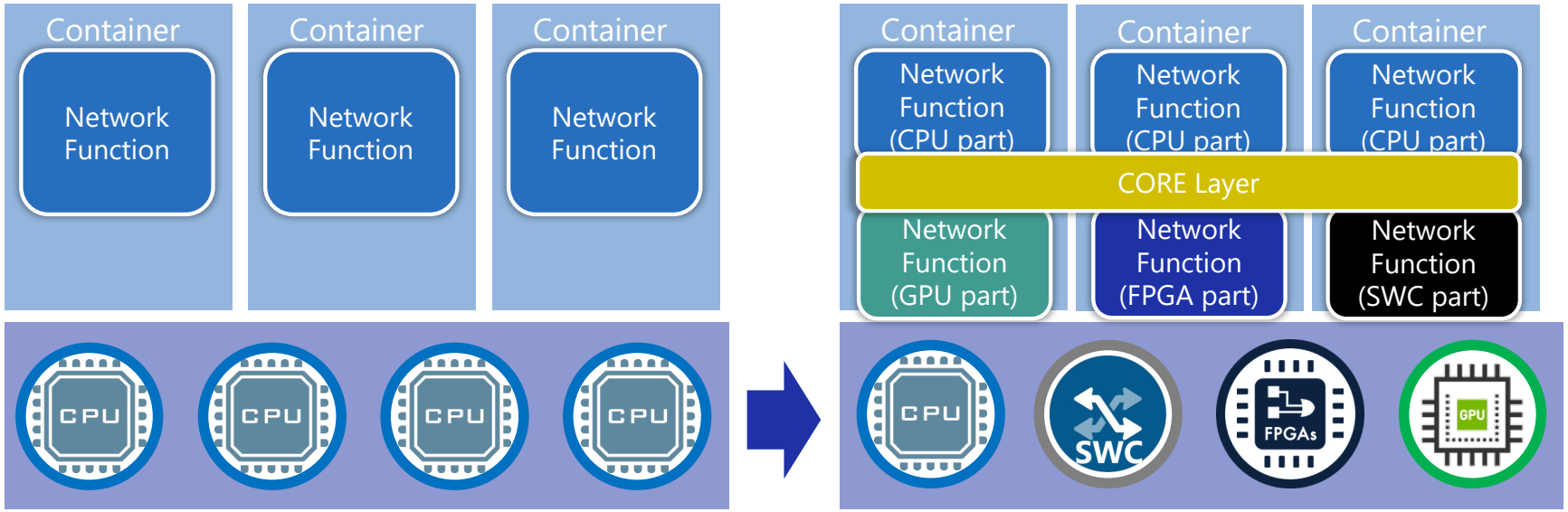
- Open capability exposure at all levels and network segments
  - Suitable to be consumed in different collaboration patterns

Full SDN NFV Integration – Horizontal Programmability



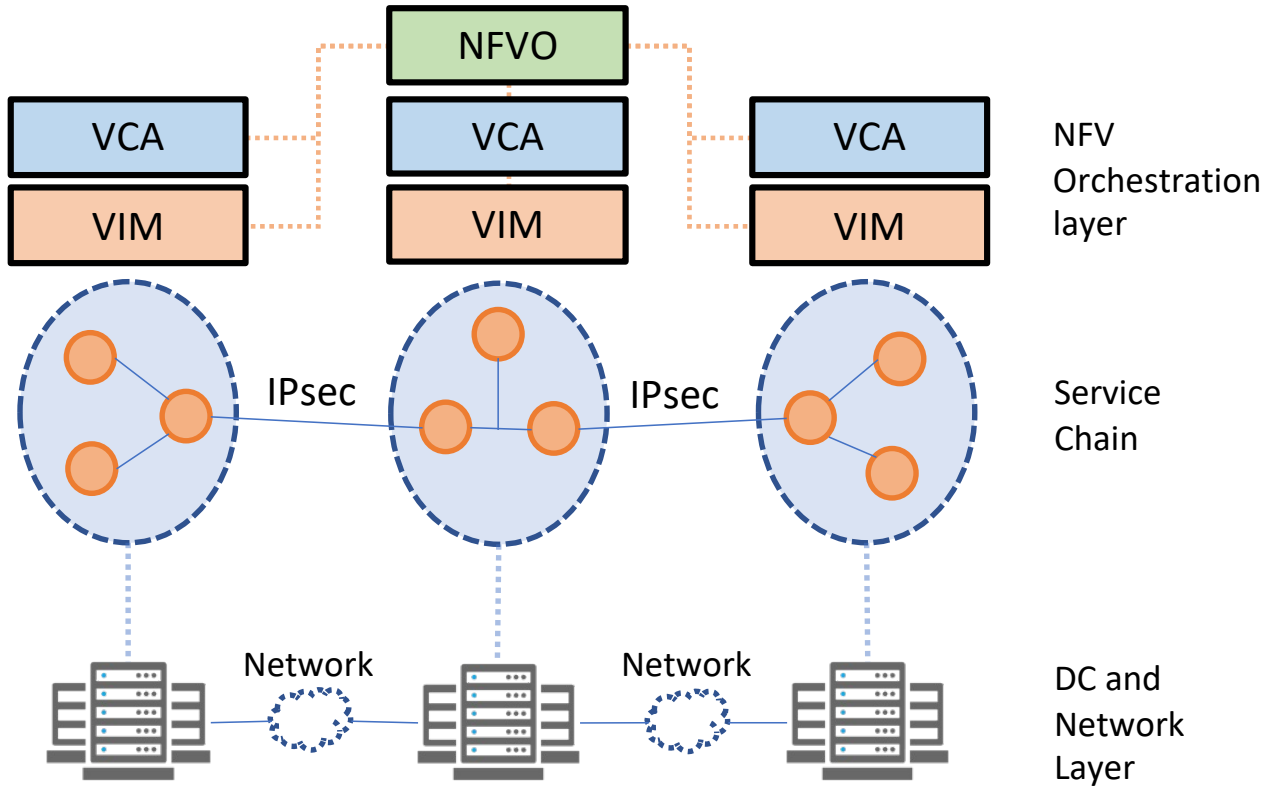
- Rely on data plane programmability to address functional efficiency
- Orchestration becomes essential beyond compute/storage resources
- Moving in the two directions
  - From application layer overlays to native support: Pushing down the stack
  - From per-packet matching and decisions to larger application data units: Moving up the stack

The Homogenization Challenge



- Functions will require a heterogeneous infrastructure
  - But homogeneous mechanisms
- Common language constructs
  - Avoiding lowest common multiples
- Orchestration for the full lifecycle
  - And support for graceful adaptation to infrastructure
- Communication patterns between the container and offloaded functionality
  - Supported by packet and/or flow extensions

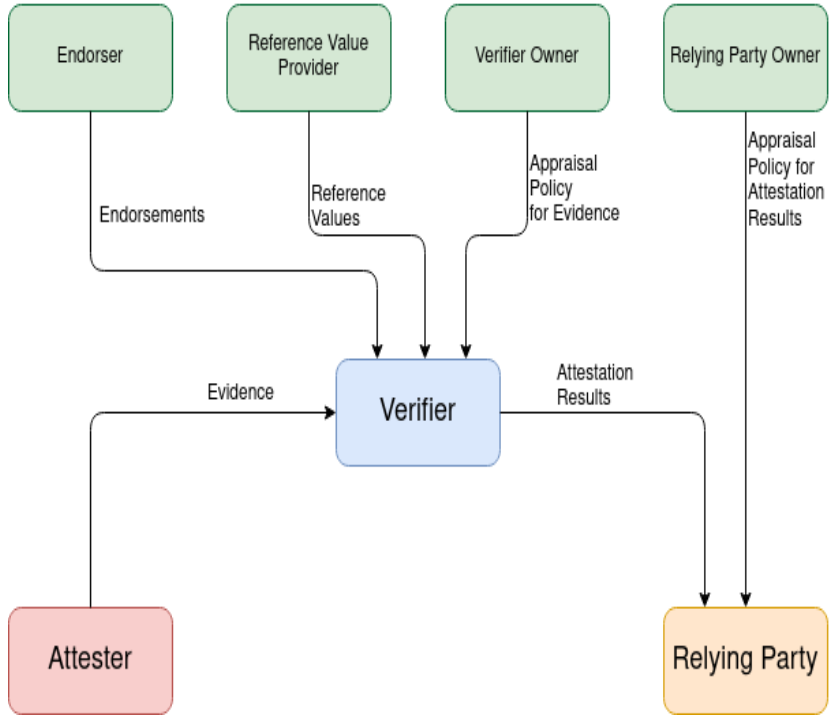
Securing the New Network Environments

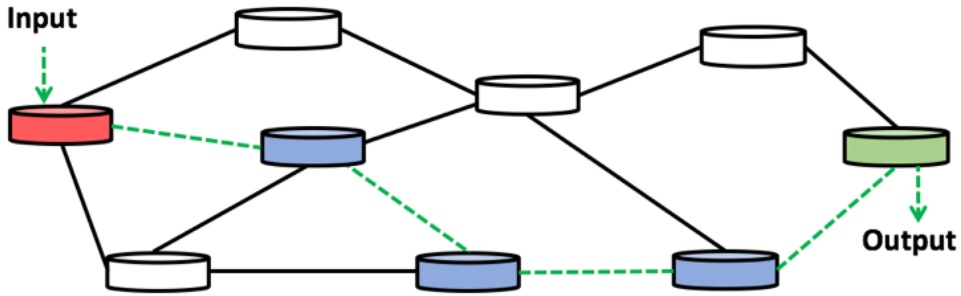


- Securing the control plane
  - Service chain deployment
  - Network configuration across different PoPs
  - Orchestration interfaces
    - VCAs: Network control
    - VIMs: Cloud orchestration
  - Secure WAN SDN control
- Securing the data plane
  - VNF-to-VNF encryption and authentication
  - Functional security, as required
- The transition to quantum-safe
  - Not only an algorithmic run
  - The importance of early standards
  - Rethink identity and key management procedures

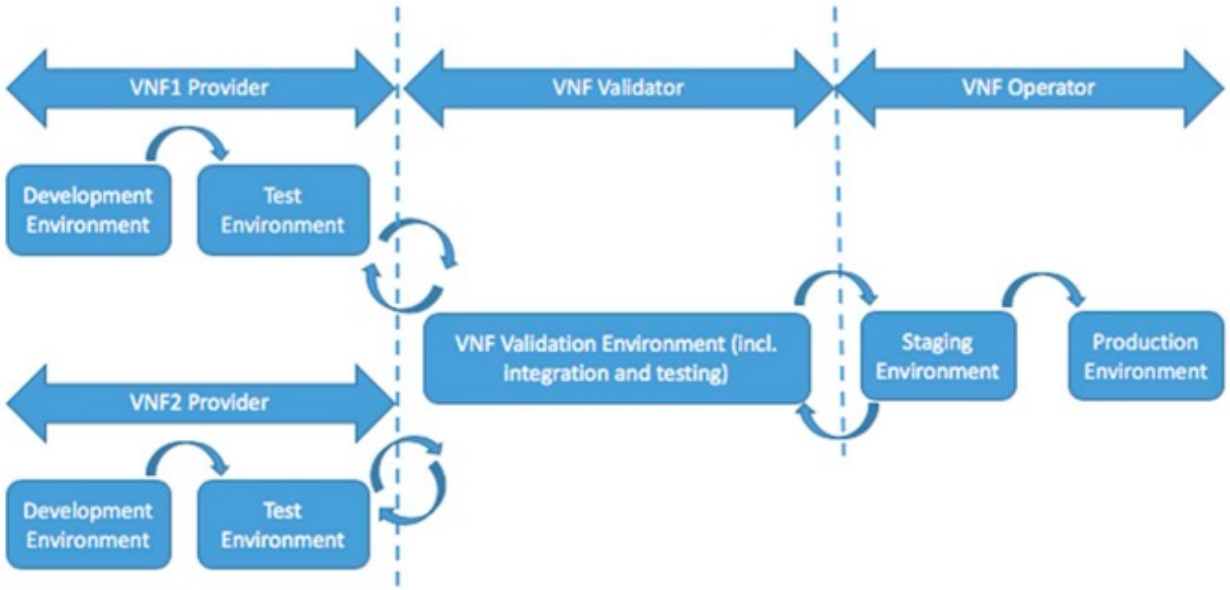
The Trust Issue

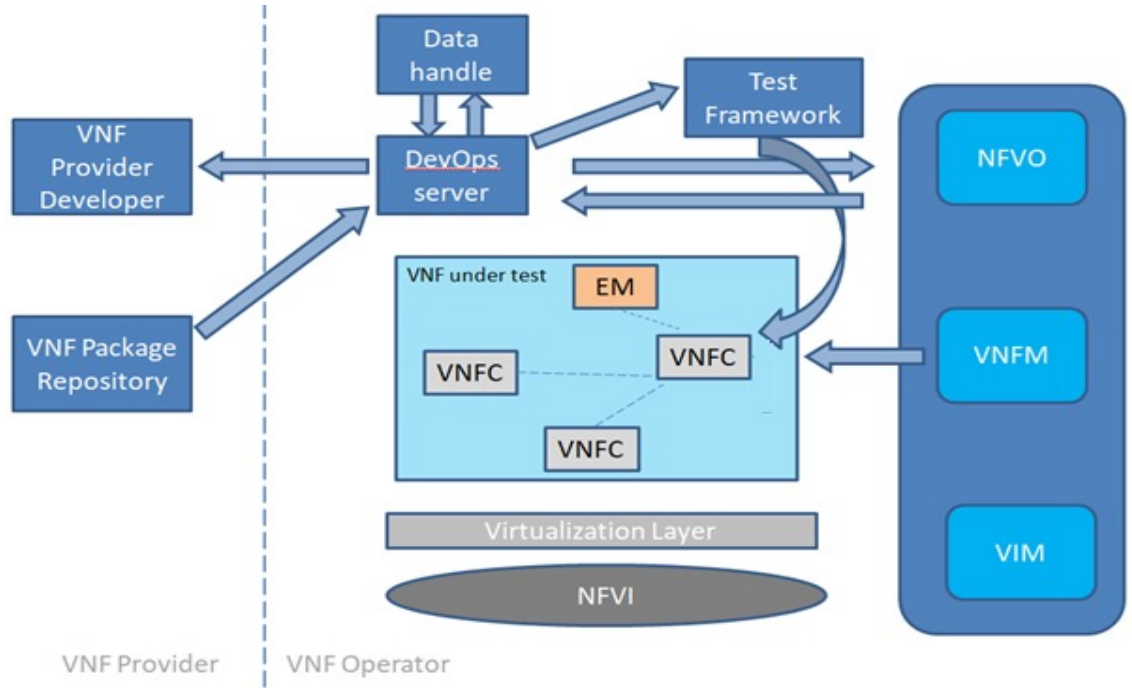
- Attestation mechanisms to evaluate evidences
  - Bidirectional: infrastructure and function policies to be correctly enforced
- Support for TEEs to protect sensitive code and data
  - And their attestation
- The issue with network attestation
  - Topology verification
  - The PoT approach
- Addressing the whole supply chain
  - From smartphones to datacenters
  - Support chain integrity, transparency, and trust
  - Informed decisions
  - Support for automation and DevOps
- Never forget the regulatory side
  - Oblivious control for LI
  - Retained data policies





Serious Science for Serious Engineering: Enabling DevOps



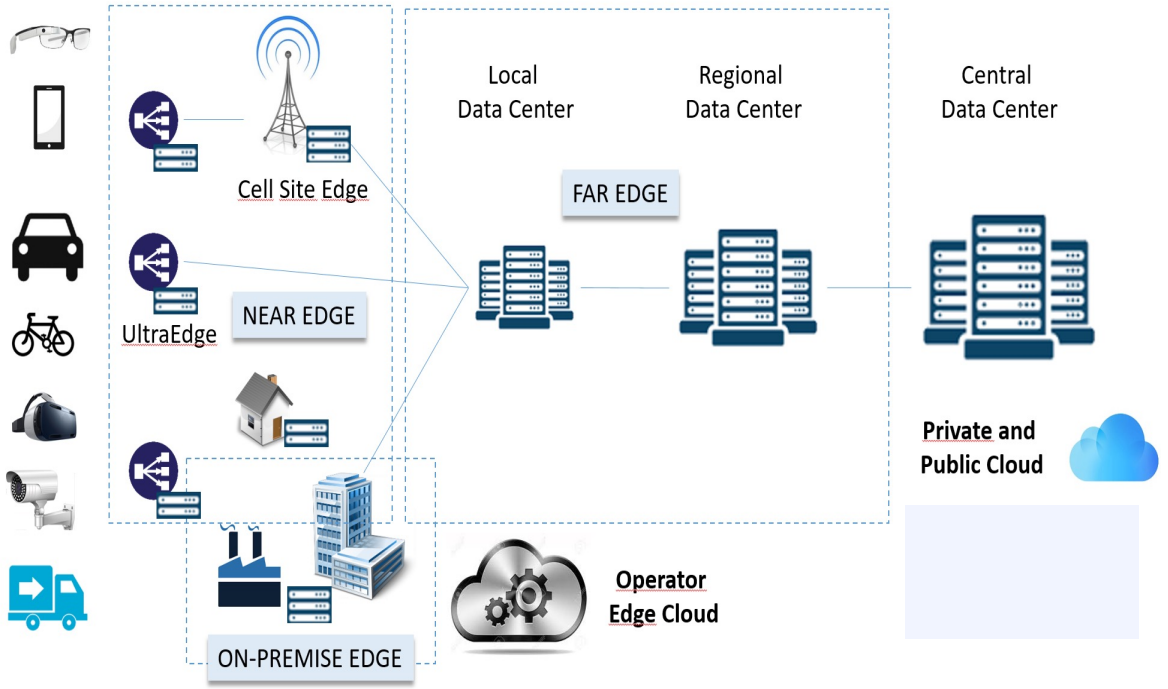


- One pipeline between the validator and the operator
- And even between the different operator environments
- Rethink certification processes

- Consistent definition of experiments and experimental environments
  - Reproducible methods
  - Repeatable results

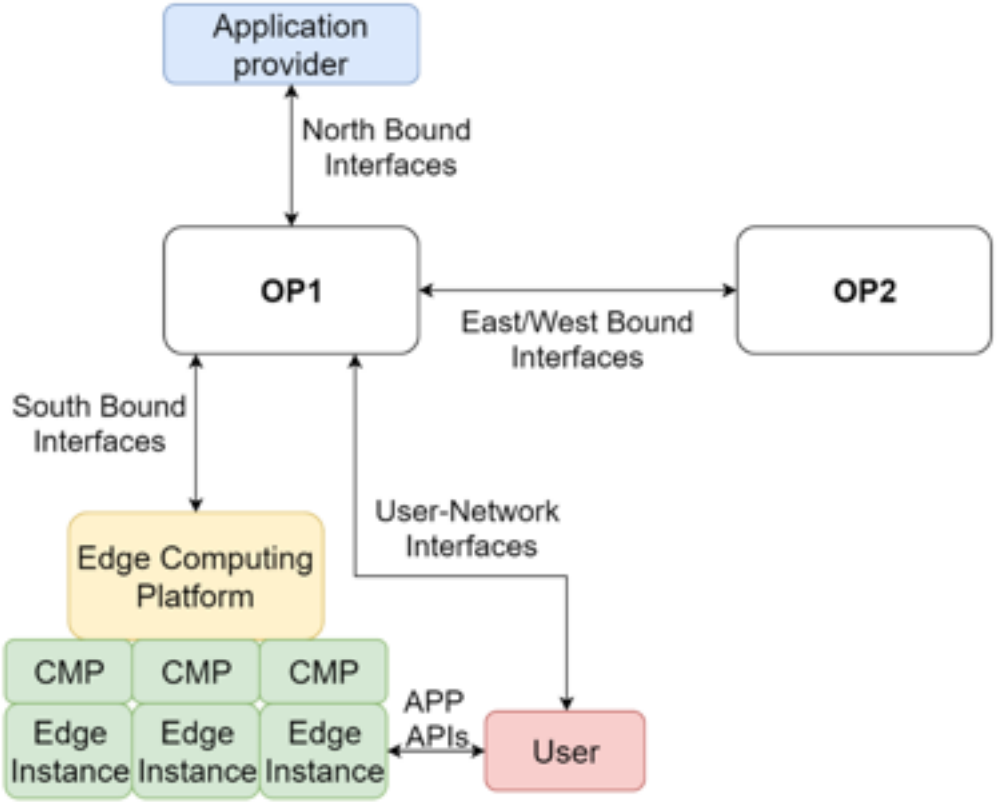
Living at the Edge

- The limit of the management domain of a network provider
  - Usually, with respect to the user access
  - But other providers could be considered as well
- Use cases related to latency, pervasiveness, resiliency...
  - Next-generation CDNs: VR/AR/haptic/…
  - Enterprise NFV: Richer SD-WAN
  - Industrial distributed clouds: Elastic real-time analytics and control
  - Extending commercial cloud reach: Cache contents of any nature
  - Next-generation distributed clouds: Pervasive, location-aware
- The relevance of openness
  - Confront the temptation of “classical” one-headed solutions



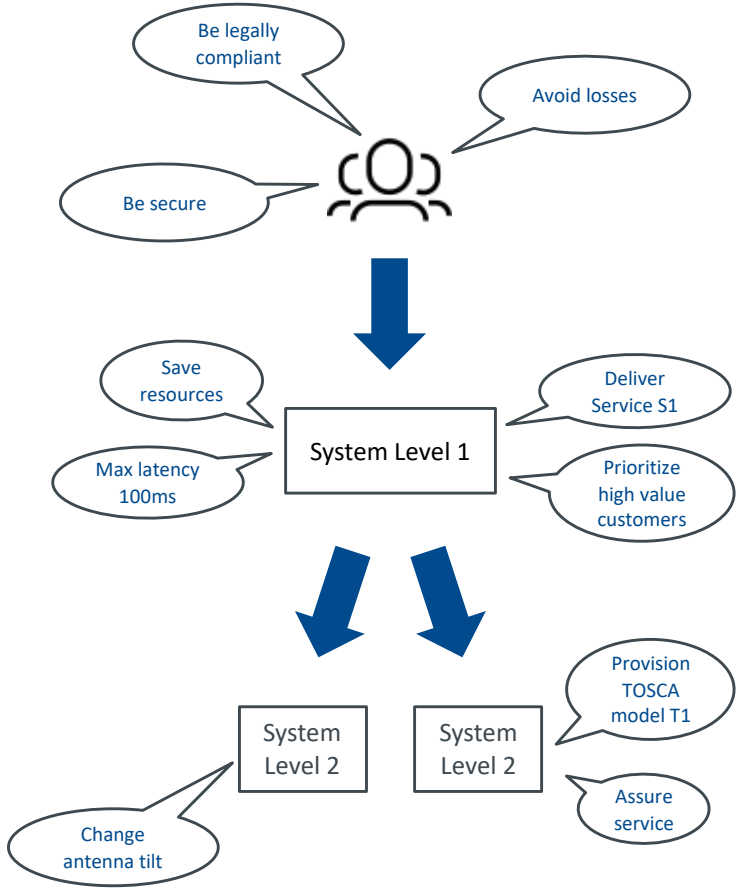
The Unified Edge Theory towards In-Network Computing

- Make edge environments work as a single cloud provider
- Consistent APIs for developers: *Build once, run anywhere*
- Support for different deployment styles
- One stop shop for users
- Multi-dimensional openness
  - Across providers
  - Across segments
  - Across application environments
- Make the network, compute and storage resources work jointly
  - Servicing data-intensive distributed applications
  - Integrating all environments: DC, and far, near and extreme edges
  - Address a common architecture for DC and edge computing
  - Programmable networks
  - API and interchangeable functionality
- A service continuum based on
  - Programmable network devices
  - Languages and abstractions to implement network functions
  - Data-plane abstractions and new network protocols to efficiently federate decentralized computing
  - Decentralized security and discovery mechanisms



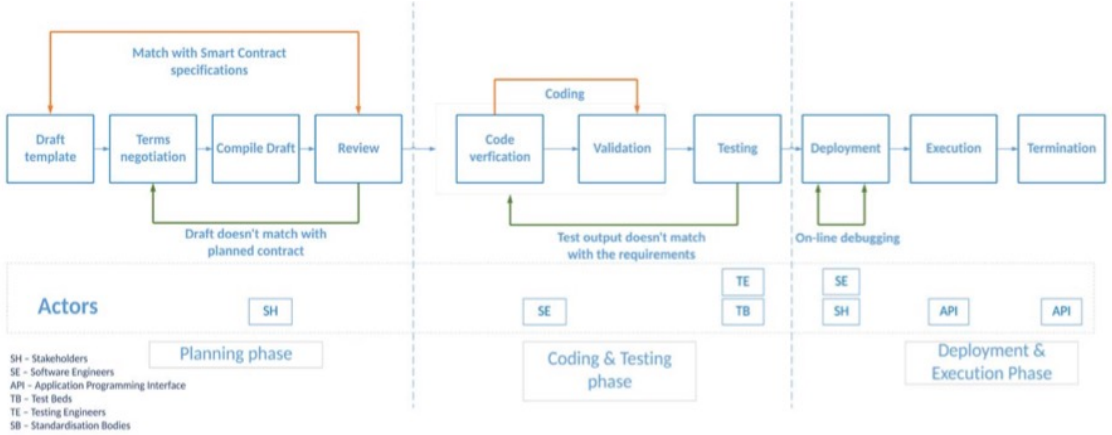
Another Turn of the Intent Wheel

- As a reminder
  - Intent defines expectations
  - Intent is the terminal goal given to a system
  - Intent is abstract for humans to understand
  - Intent is formally specified for machines to use
  - Intent span from abstract concepts to technically detailed requirements
- And a new way forward
  - Associate intent to the application of smart contracts
  - Use of smart contracts to circumscribe intent
    - Intent language is captured in the smart contract itself
    - Application environments defined by providers and consumers



The Next Programmability Level

- Provider publishes a set of smart contracts
  - Proposing available service
- Consumer selects one or more smart contracts
  - Among provider offerings
- Selection includes a parametrization
  - Topologies, time frames, security…
  - Vocabulary to express composition
- Provider checks intent declarations
  - Verifying feasibility and identifying applicable policy directives
- Once the smart contracts are signed and registered, the intent can be declared as “compiled” or ”assimilated”



- Facilitate intent declarations
- Provide a formal framework for intent/policy translation, controlled by service providers
- Support automated, independent monitoring and verification of intent declarations
- Enable a more open, decentralized environment to support intent

Concluding

- Networks are evolving towards incorporating cloud technologies
  - Incorporating recent IT evolution, to be more precise
- We started with a transformation path
  - Rooted at the NFV and SDN advents
- And are moving along a convergence path
  - Full programmability
  - Service orchestration
  - Pervasive DevOps
  - In-network computing

Up to slain the Jabberwock and see the netjous day

Reference Material

Jabberwocky
by Lewis Carroll

’Twas brillig, and the slithy toves
    Did gyre and gimble in the wabe:
All mimsy were the borogoves,
    And the mome raths outgrabe.

“Beware the Jabberwock, my son!
    The jaws that bite, the claws that catch!
Beware the Jubjub bird, and shun
    The frumious Bandersnatch!”

He took his vorpal sword in hand;
    Long time the manxome foe he sought—
So rested he by the Tumtum tree
    And stood awhile in thought.

And, as in uffish thought he stood,
    The Jabberwock, with eyes of flame,
Came whiffling through the tulgey wood,
    And burbled as it came!

One, two! One, two! And through and through
    The vorpal blade went snicker-snack!
He left it dead, and with its head
    He went galumphing back.

“And hast thou slain the Jabberwock?
    Come to my arms, my beamish boy!
O frabjous day! Callooh! Callay!”
    He chortled in his joy.

’Twas brillig, and the slithy toves
    Did gyre and gimble in the wabe:
All mimsy were the borogoves,
    And the mome raths outgrabe.