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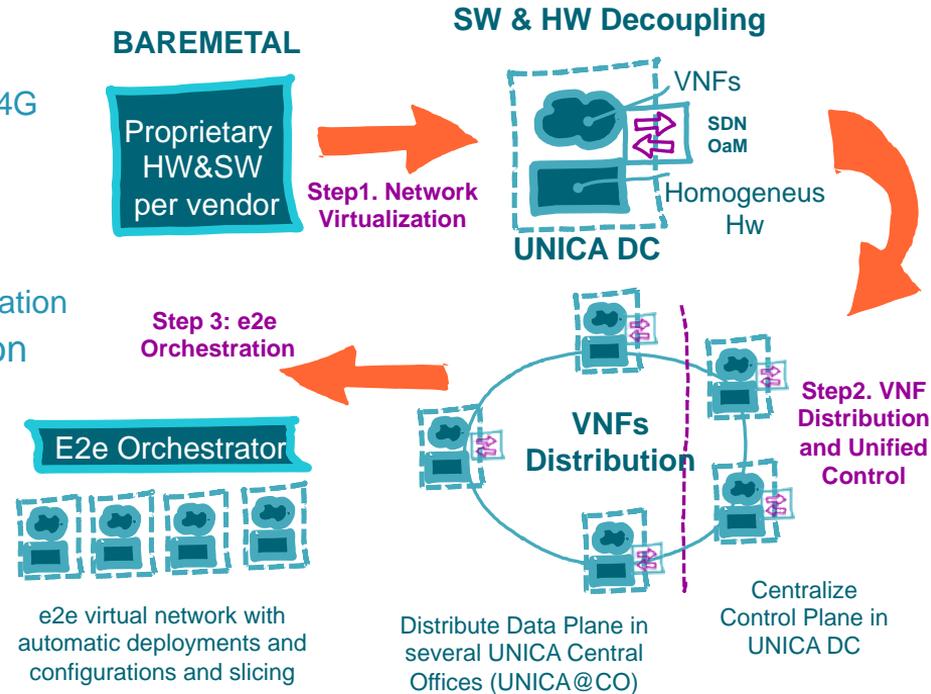
Building the Golden Closed Loop – AI and Networking

Diego R. López
Telefónica

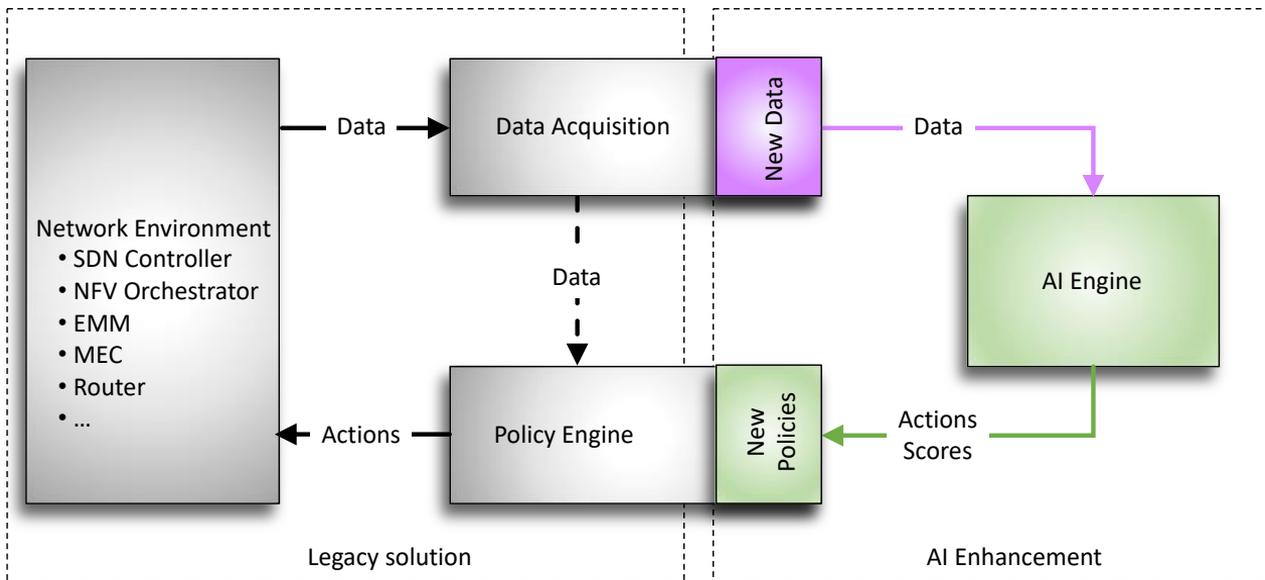


Addressing the Complexity Challenge

- Networks becoming increasingly complex
 - 5G foresees a x10 densification of sites compared to 4G
 - Best user experience demands heterogeneity in access technologies
 - The continuous challenge of centralized proposals, way beyond the usual OTT
 - And not suitable to be managed using traditional operation
- Adapt results from the IT experience in virtualization
 - Acknowledging the differences
 - Topology awareness
 - The conservation principle
 - Openness
 - Integrity and auditability
 - Isolation
 - Exploring new paths
- Towards zero-touch service management



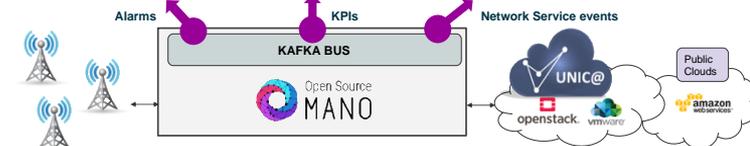
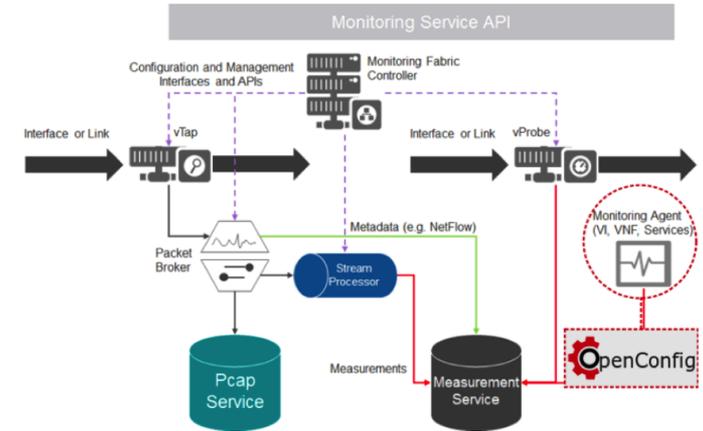
The Essential Automation Closed Loop



- Not such a radical change
 - Automatics have been around for a long time
 - AI as a tool to derive further insights from data and improve policies
 - Extended capabilities, but do not expect Skynet
- The key issues are not in the engine(s)
 - But in the data and action flows
 - Including distribution and placement of the engine(s)
- And in flow management and application

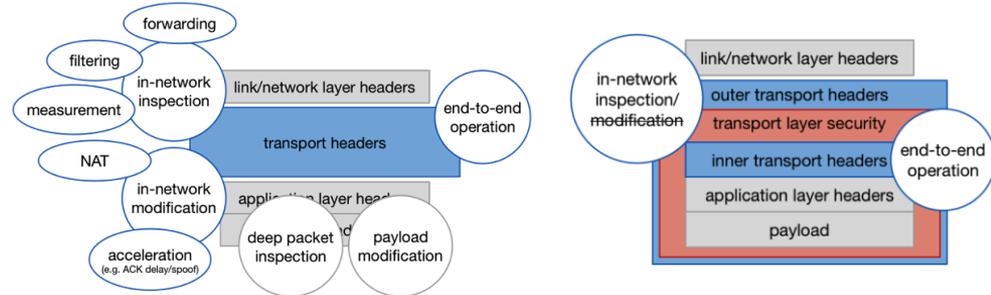
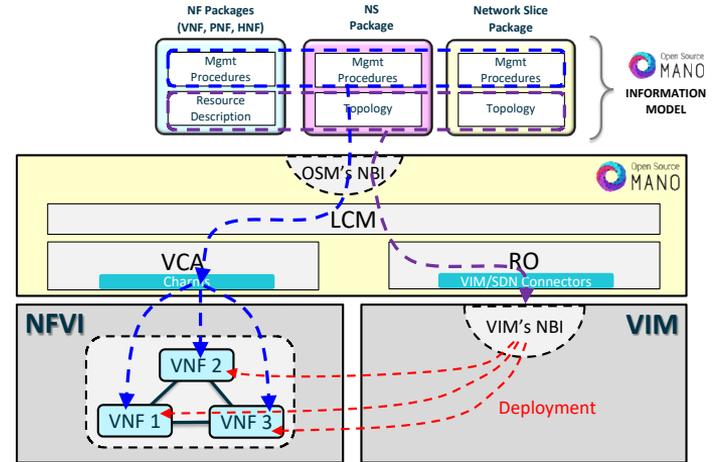
The Data Stream

- No matter how intelligent: Crap in means crap out
 - Usable: Adaptation (formats, scales...)
 - Sufficient: Topology (sources, aggregators...)
 - Safe: Provenance (origin, timestamps...)
 - Steady: Continuity (pace, availability...)
- Not just data
 - Metadata becomes essential, including semantic mappings
 - What seems to claim for a data stream ontology
 - Not that far away: data modeling is a first step
- An enhanced data fabric seems the logical approach
 - Supporting resource, orchestration and function sources
 - Combining current network monitoring tools and recent telemetry developments



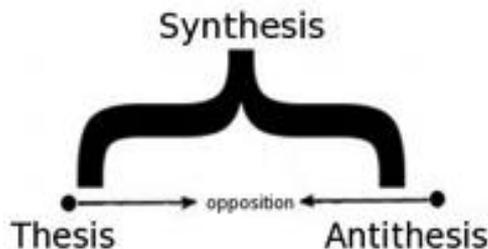
The Action Stream

- OAM actions at a wide variety of different domains
 - Challenging, given the current state-of-the-art
- Initial strategies
 - Domain specific
 - Recommendation systems
 - Autonomic protocols
- Capability models
 - Reusable functionality description
 - Abstractions of network element functionalities usable as building blocks
 - Combined to provide more powerful features
 - Registration mechanisms to support CI/CD
 - Inter-domain collaboration for E2E management



The Process in the Loop

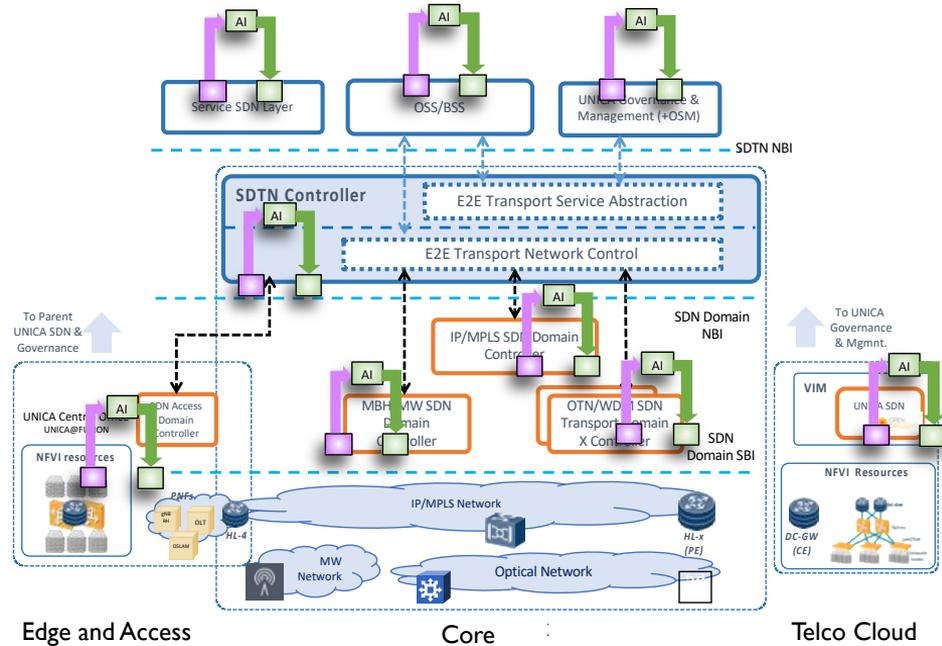
- The dialectic way
 - Thesis: Translate intent into action
 - Understanding intent statements
 - Mapping onto technologies
 - Antithesis: Support environment constraints
 - Policies provided by network management
 - The archetypal SLA enforcement
 - Synthesis: Conflict resolution
 - Among action requests
 - And with management constraints



- Audit track and intelligibility
 - The who, the what, the when
 - And the why
- And security
 - Deal with adversarial AIs
 - And consider circuit breakers

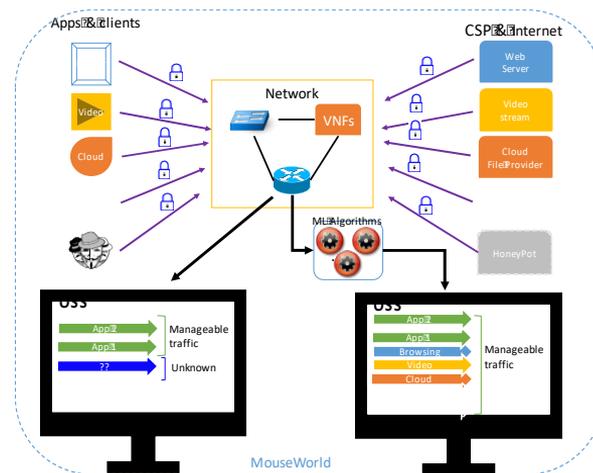
The Architectural Mapping

- Networks are critical and naturally distributed systems
 - A distributed AI for managing them
- The nature of distribution
 - Aggregation of knowledge
 - Accumulation of decisions
 - Cooperative vs independent vs selfish
 - Fixed vs mobile vs roaming
- Topologies
 - The mapping on the network topology
 - Depth and breadth
 - Nervous system approaches
- Protocols
 - Specific knowledge and policy exchanges
 - Reuse stream mechanisms
 - Apply good-ole BGP and others of its kin



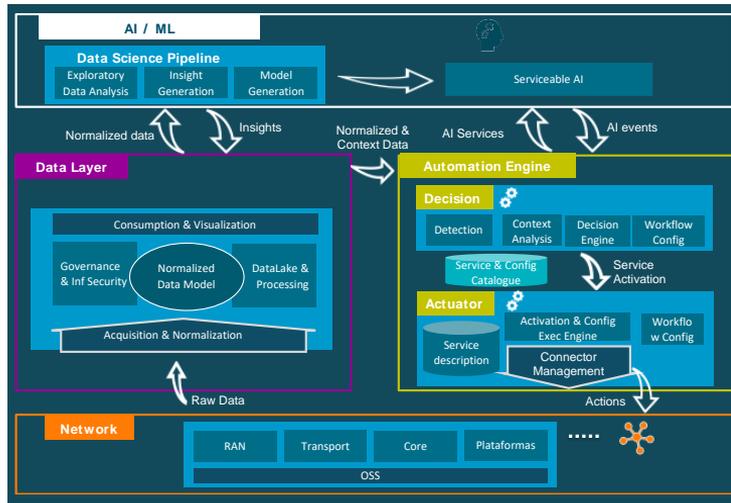
Trustworthy Datasets

- A serious lack of usable datasets
 - For training or validation
 - Data as an asset
 - Privacy concerns
 - None or limited tagging
- Generation of synthetic datasets
 - Traffic samples generated in a controlled way
 - Configurable mixes of synthetic and real traffic
- And metadata management
 - Different scenarios, from high loads to security threats
 - Training and validation loops
- Relying on Software Network principles
 - Repeatability and reproducibility
 - Controlled variations



A Global Framework for Automation

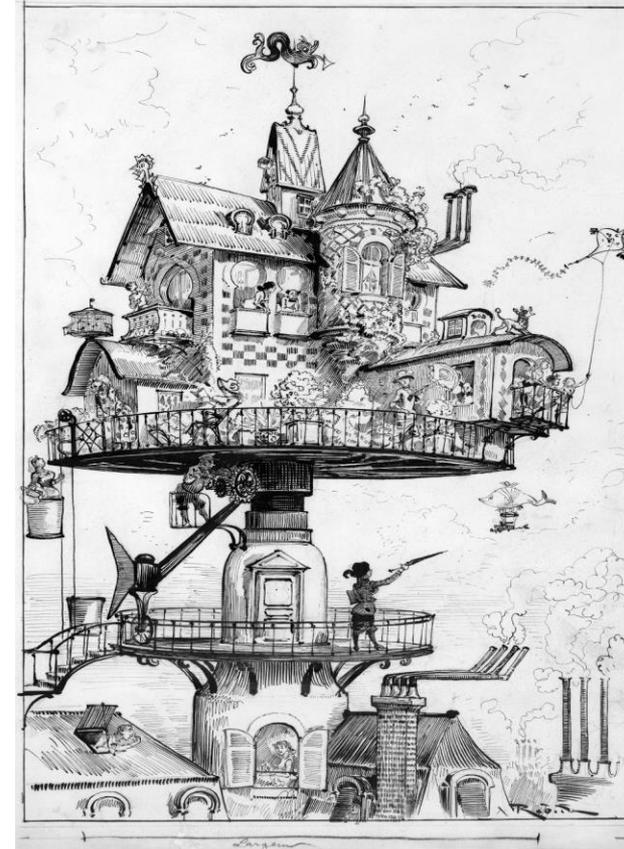
- Consider zero-touch in new technologies to be deployed: 5G-NR, slicing, edge...
- Integrate existing data and action infrastructures to support streams
- Incorporate processes to support conciliation, auditability, adaptation and security



- A use-case-driven strategy
 - Automated service and network capacity delivery
 - New service modelling and creation
 - Assisted network assurance
 - AI-based issue and fault management
 - Network optimization

A Matter of Balance

- Network heterogeneous and distributed nature and a holistic view of services and infrastructure
 - Topologies, protocols and models for distributed AI elements
- User requirements and operational policies
 - Intent dialectics and elastic policy enforcement
 - Compositional mechanisms to combine requests in multi-tenant environments
- Regulatory matters and security
 - Data sovereignty and identity management for all entities
 - Non-repudiation and accountability
- Closed loop operation and infrastructure criticality
 - Keep humans in the loop, retaining ultimate understanding and control
 - AI intelligibility and security mechanisms to guarantee proper operation
- Sensing and acting
 - Open and extensible mechanisms for data and action streams
 - Converged data models for definition and monitoring
 - Converged control action representations



WE ONLY PAY YOU
BECAUSE MONKEYS
ARE HARD TO TRAIN
AND ROBOTS ARE
EXPENSIVE.

