Step-by-Step Guide to Building a Truly Composable Infrastructure for 5G/Edge

Tejas Nevrekar, July 2019
Level Set: 5G Opportunities

Most Talked About 5G Services

- IoT
- Broadband Everywhere
- Critical Remote Devices
- Smart Transportation
- Media Everywhere

Customers want customized, context-driven, secure, on-demand experiences.
Trajectory

- Clouds
- Edge
- Self-organizing Networks
- DevOps
The 5 Factors of 5G

- Physical Legacy Matters
- Intent Matters
- Culture and Talent Matters
- Open Source Matters
- United Orchestration Matters
Transformation to Enable Opportunity

Service Innovation is changing in a 5G World

- Agile/DevOps will Create Services Faster
- Service Composition Needs will Increase in Variation
- Improve Service Delivery Times

Digital Transformation Requires Dynamism

- Intent-based
- No Silos
- Reduce Complexity

Optimization Needed to Improve Bottomline

- Efficiencies
- Commoditize Resources
- Scale in Heterogeneous Environments
What are we working towards?
5G and the Future

Ingredients

1. **URLLC** – ultrareliable low latency communication
2. **EMBB** – enhanced mobile broadband
3. **mMTC** – massive machine-type communications

Enabling Capabilities

1. Network will have to be composable based on the intent
2. Intent requires software architecture which is cloud-enabled and microservices based
What will a Next Generation Network Look Like?

- Adaptable
- Mass Scale-Ready
- Open, vendor-agnostic
- Programmable
- Cloud-Ready
- Self-Organizing and Intent-Based
- RESTful interfaces & Data Models
- Agile Development-Enabled
- Standardized north & southbound interfaces

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Multi-Domain SDN-R Controller

Information Models for ONF-TAPI Optical, Microwave and Ethernet

ONAP

OSS / Applications

ONF Models
TR-545
TR-512

Optical

Microwave

Ethernet

TR-532
TR-541

Mediator
Mediator
Mediator

API
API
API
Network Slicing
Intent Driven Architecture
Current Infrastructure Operations

Static Investment

Dynamic Use Cases

1 Decision
Multiple Intended Uses

- Cargo
- Occupants
- Weather
- Transit Time
- Destination

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Future Infrastructure Operations

Flexible Investment

Dynamic Use Cases

Composition Based on Intent

Cargo
Occupants
Weather
Transit Time
Destination

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Custom Built for Custom Experiences
Microservices

A monolithic application puts all its functionality into a single process...

... and scales by replicating the monolith on multiple servers

A microservices architecture puts each element of functionality into a separate service...

... and scales by distributing these services across servers, replicating as needed.

- Componentization via Services
- Organized around Business Capabilities
- Products not Projects
- Smart endpoints and dumb pipes
- Decentralized Governance
- Decentralized Data Management
- Infrastructure Automation
- Design for failure
- Evolutionary Design

https://martinfowler.com/articles/microservices.html
Composable components
Kubernetes Service Deployment - CRD

**Intent** - Setup Fixed Broadband for "x" customers

- vBNG.yml
- vAAA.yml
- vDHCP.yml
- vDNS.yml
- vGateway.yml

- Configmap
- Secrets
- Deployment
- Statefulset

Node 1..N

Controller

Pod
Pod

Current State

Desired State
Kubernetes Service Deployment - CRD

**Intent** - Setup Fixed Broadband for “x” customers

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- Custom Res Def

Current State

Desired State

Custom Controller

Node 1..N

Pod
Pod
Kubernetes and Network Service Mesh

Kubernetes Cluster

Kubernetes API Server
(Network Service Registry via CRDs)

Node (Network Service Manager Domain)

Network Service Mesh Dataplane (NSMD)
(kernel/vswitch)

Network Service Manager (NSM)
(Daemonset)

Network Service Endpoint (NSE)
(Pod)

Network Service Endpoint (NSE)
(Pod)

Node (Network Service Manager Domain)

Network Service Mesh Dataplane (NSMD)
(kernel/vswitch)

Network Service Manager (NSM)
(Daemonset)

Network Service Endpoint (NSE)
(Pod)

Network Service Endpoint (NSE)
(Pod)
Network Service Mesh CRD

kind: NetworkService
apiVersion: V1
metadata:
  name: my-cnf
spec:
  selector:
    app: my-cnf
  channels:
  - name: my-ip-channel
    payload: IP
  - name: my-ethernet-channel
    payload: ethernet
  - name: my-mpls-channel
    payload: mpls
Network Service Mesh for ODL

- ODL participates in gRPC
- All ODL networks/devices/services can be defined as endpoints
- End-users can point from their containers to these services
Kubernetes as Network Service Orchestrator

**Design**
Network Service Versioning/Upgrade/Rollback
- K8S Ecosystem Helm Charts/Manager

**Deploy**
Initial NF Configuration
- Helm Charts for initial configuration

NF Config Store
- K8S Config Map/Secret in Central/Edge/Regional Cloud(s)

NF Placement
- K8S RM/QoS for performance-aware NF placement in K8S Central/Edge/Regional Cloud

Multi-Cloud Support
- K8S Ecosystem KubeVirt etc. - VMs besides Containers

**Operate**
NF Monitoring
- K8S Ecosystem Prometheus etc.

NF Auto Healing
- K8S Replica Set

Incremental NF Configuration - Config Mgr./Dispatcher
- Track app config changes; dispatch changes using K8S API CRD; use app specific config operators to effect app config change
Network Transformation Enables a New Tomorrow

Moving to intent-based automation provides a flexible foundation for 5G innovation creation

**BENEFITS**

- **Virtualization**: Use API to separate functions from hardware
- **Normalization**: Service abstraction creates common interface powered by business intent
- **Programmability**: Open programmability of data plane enables real-time control of decisions & easy service creation and deployment

**CHANGE**

- **Orchestration**: Integration with end to end orchestration closes automation loop and creates resource efficiencies
- **Closed-loop Feedback**: Monitoring and Assurance
- **Predictability**: Predictive analytics enabled by machine learning for self-managed networks

**Operations & Culture**

- **Flexibility and lower opex/capex**
- **Freedom of choice – solution options**
- **Faster fixes, better agility, greater speed**
- **Reduces dependency in human, enables on-demand**
- **High response, competitive agility**
- **Fault and cost reduction**
LEAP Enables Next Generation Networks

1. Microservices Architecture
2. Makes network applications aware and cloud-ready
3. Enable one-click service provisioning
4. Industry proven large scale production deployments
5. Wide array of standardized southbound & Northbound interfaces
6. Pure Play Open Source-based with No Vendor Lock-in

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Take Action

Service Providers

- Implement agile software practices
  - Shorten the process between trial and production deployment
- Move to PoCs with open source software
  - Include brownfield components
- Reduce or eliminate slow legacy paperwork processes
  - e.g. RFIs, RFPs,…

Vendors

- Embrace open source platforms
  - Work toward interoperability especially for existing widely-deployed equipment
- Increase contribution toward open source projects
  - Intellectual property, time, money, and people

Developers

- Simplify architectures
  - Make 5G and related technologies easier to deploy
- Increase focus on scale, stability, and interoperability testing
  - Automation and document key
Thank you.

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