KPN's Vision On and Steps to Reach On a Fully Programmable Telco Network

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Future vision on the network infrastructure architecture

A programmable network architecture

Ambitions

Business & Operations

- *Higher capacity*
- *Lower costs*
- *Increased continuity*
- *Impactless changes*
- *Realtime functionality*
- *Enhanced circularity*

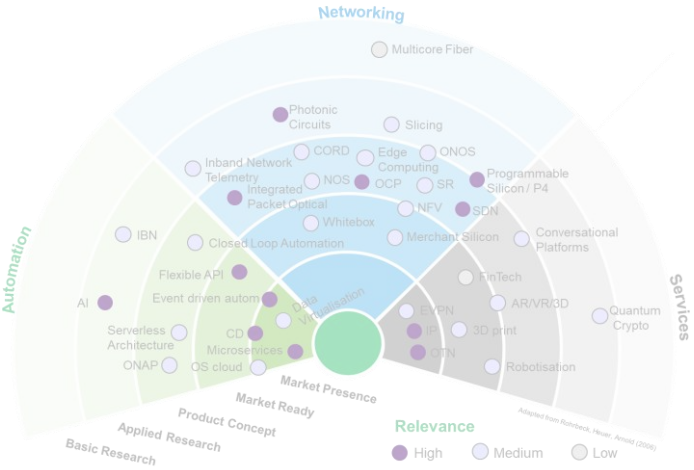
Disaggregate

Software Defined

Open

Distributed

Technology



The programmable network architecture vision

Software Defined

Fully automated

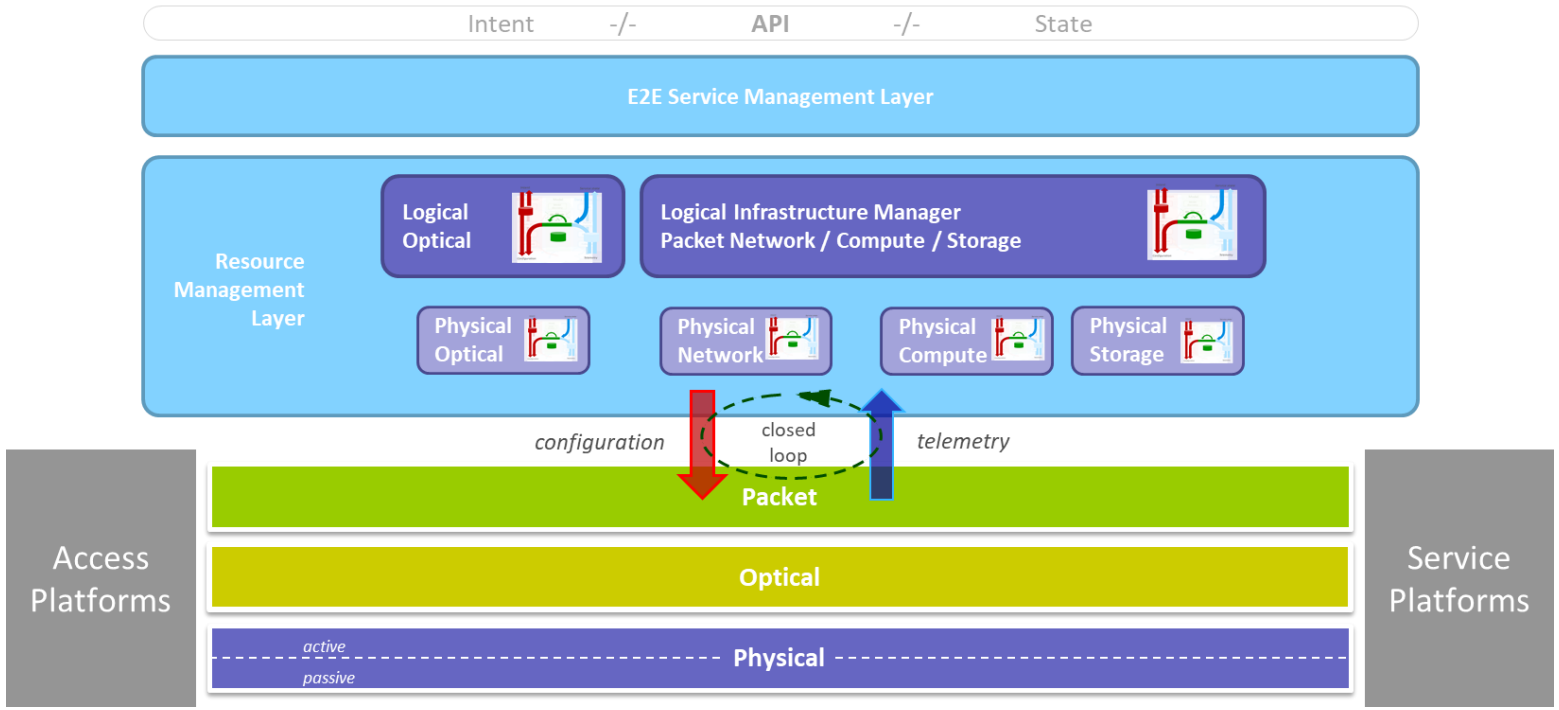
- Intent driven, model based, closed loop

Virtualised functions

- Network and application functions

Programmable infrastructure

- VNF offload



The programmable network architecture vision

Distributed

Content and services

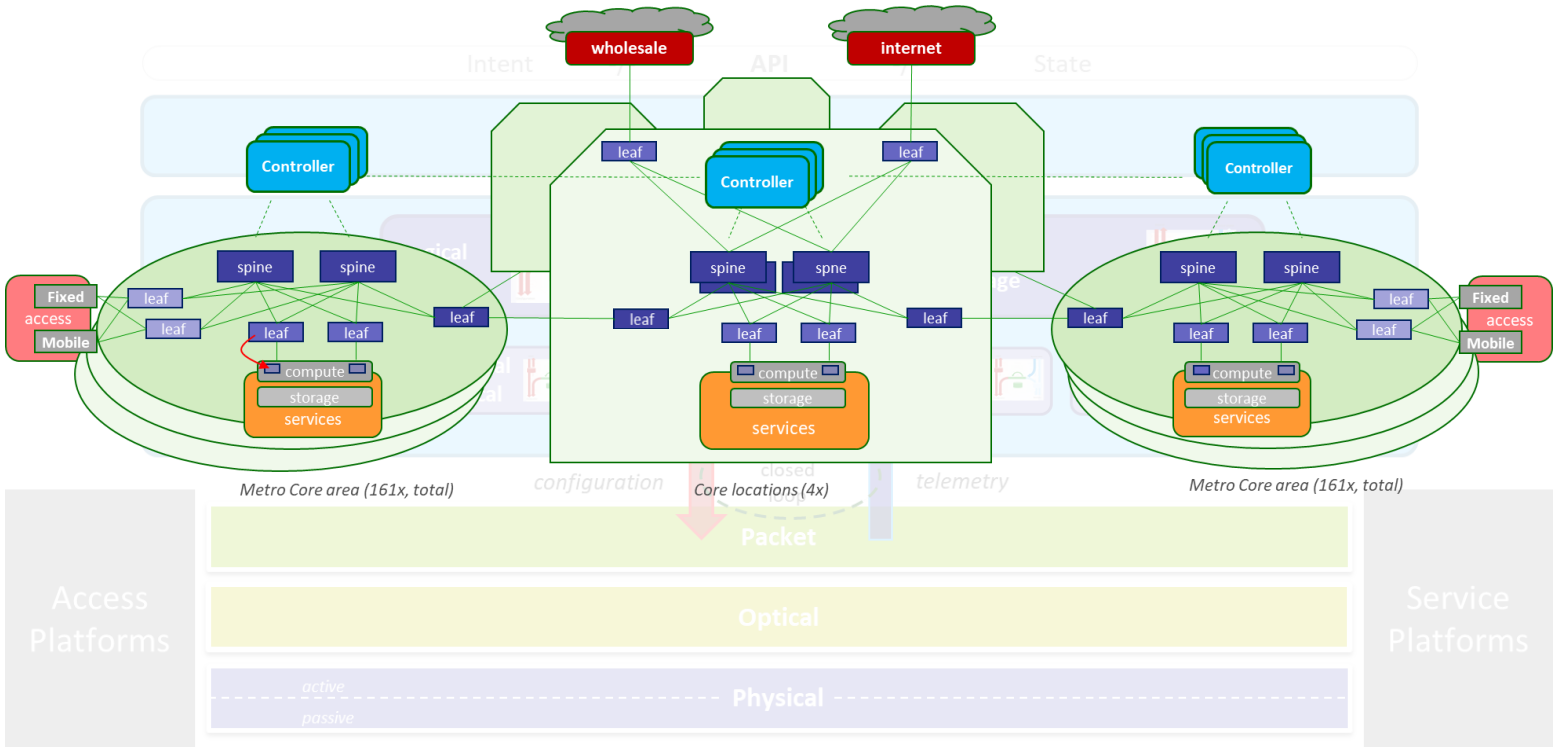
- CDN, 3rd party

Network and application functions

- Flexible placement towards the edge

Topology

- Leaf-spine



The programmable network architecture vision

Disaggregated

Hardware and Software

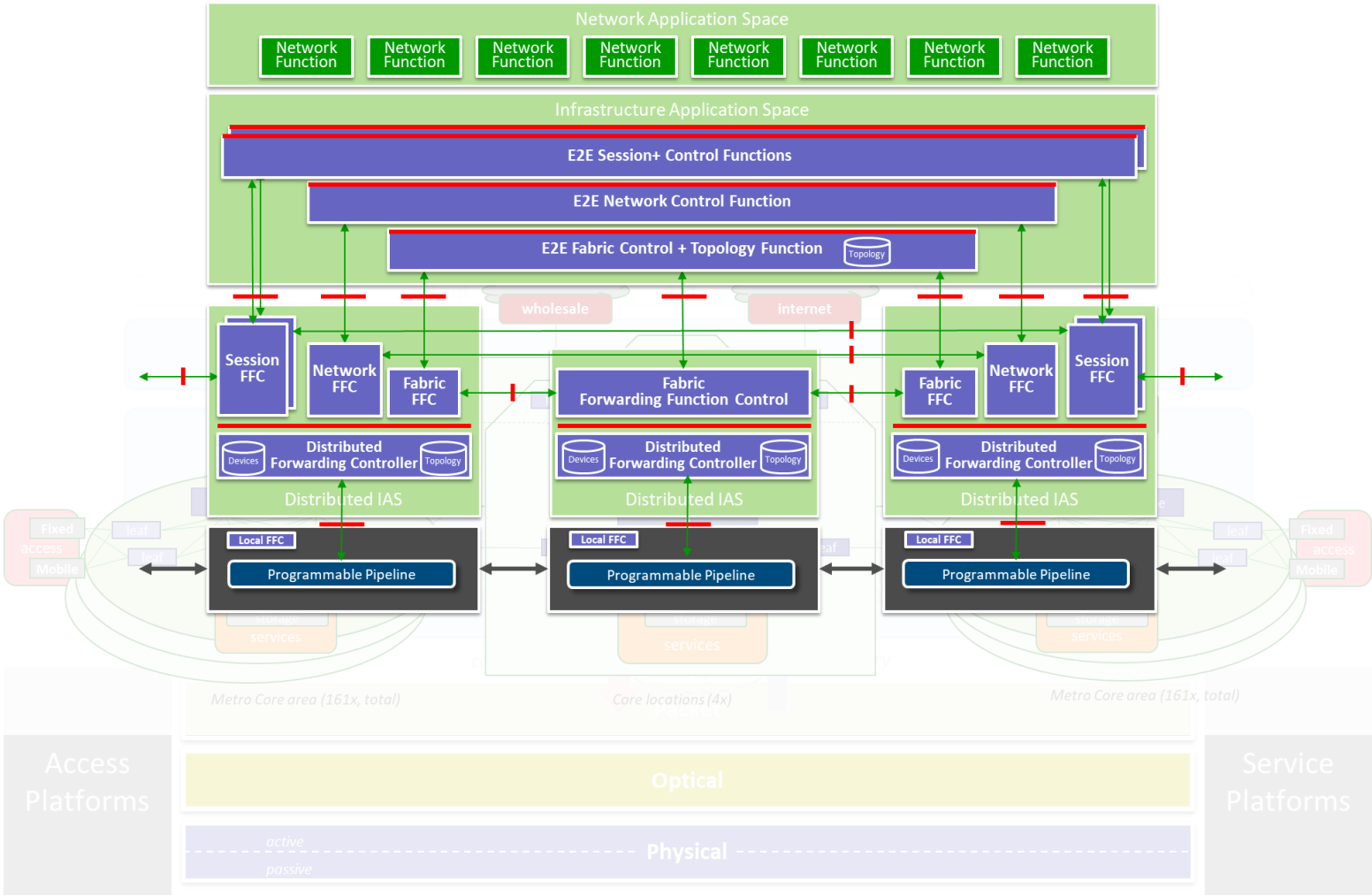
- Decoupled lifecycles

Forwarding and Control

- Independent scaling and placement

Network hardware / software

- Modularity and flexibility



The programmable network architecture vision

Open

Open interfaces

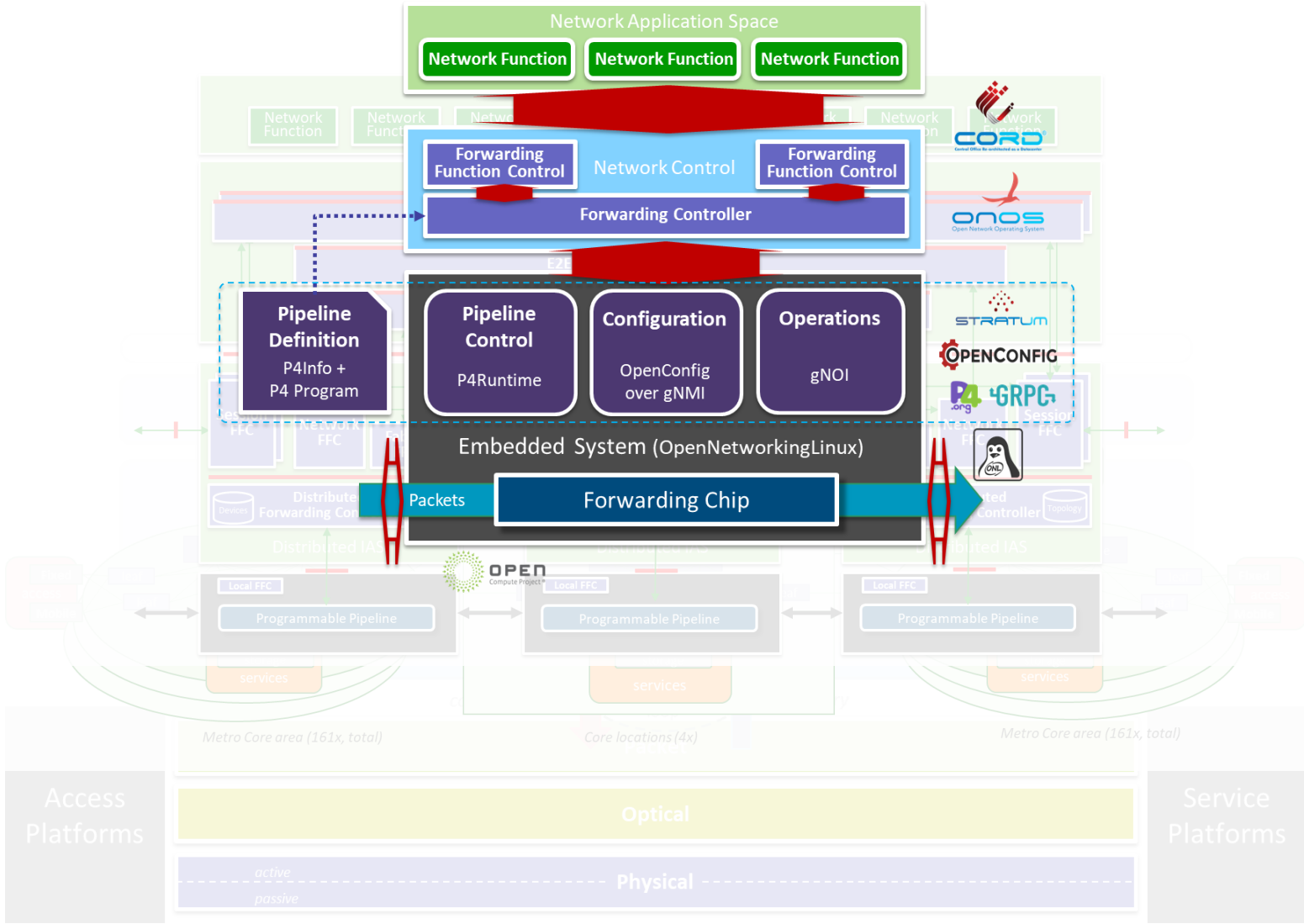
- All layers
- Standardised, public specifications

Open source

- Software and hardware
- Leverage communities

Open Networking Foundation

OPEN Compute Project®

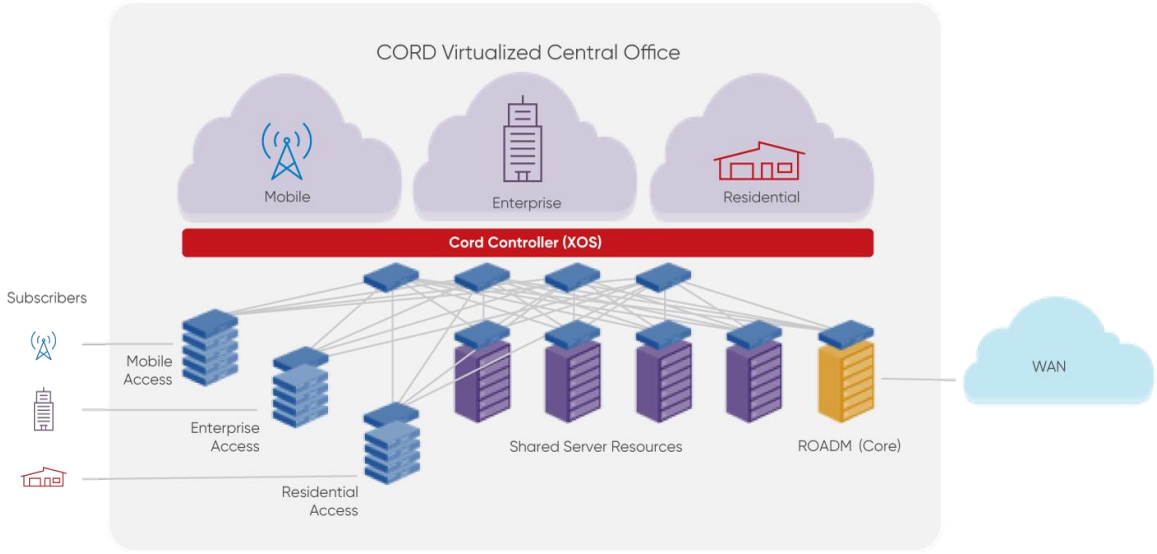


Building blocks for an open programmable network architecture

CORD / NG-SDN (Open Networking Foundation)

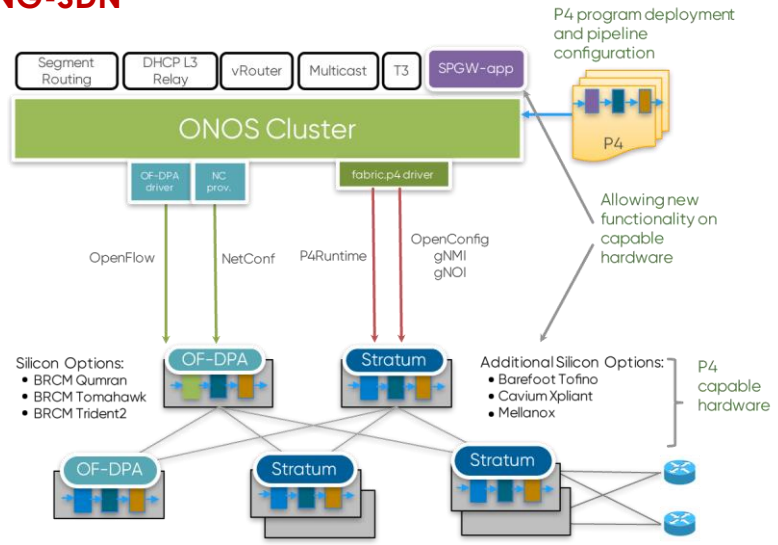
- CORD and NG-SDN are key building blocks for an open programmable network architecture
  - CORD: datacenter concepts applied to central office, flexibility in service and function placement / creation
  - NG-SDN: programmable network layer introduced => VNF off-loading and flexible data plane
    - Not only applicable to CO(RD)

CORD



www.opennetworking.org/cord/

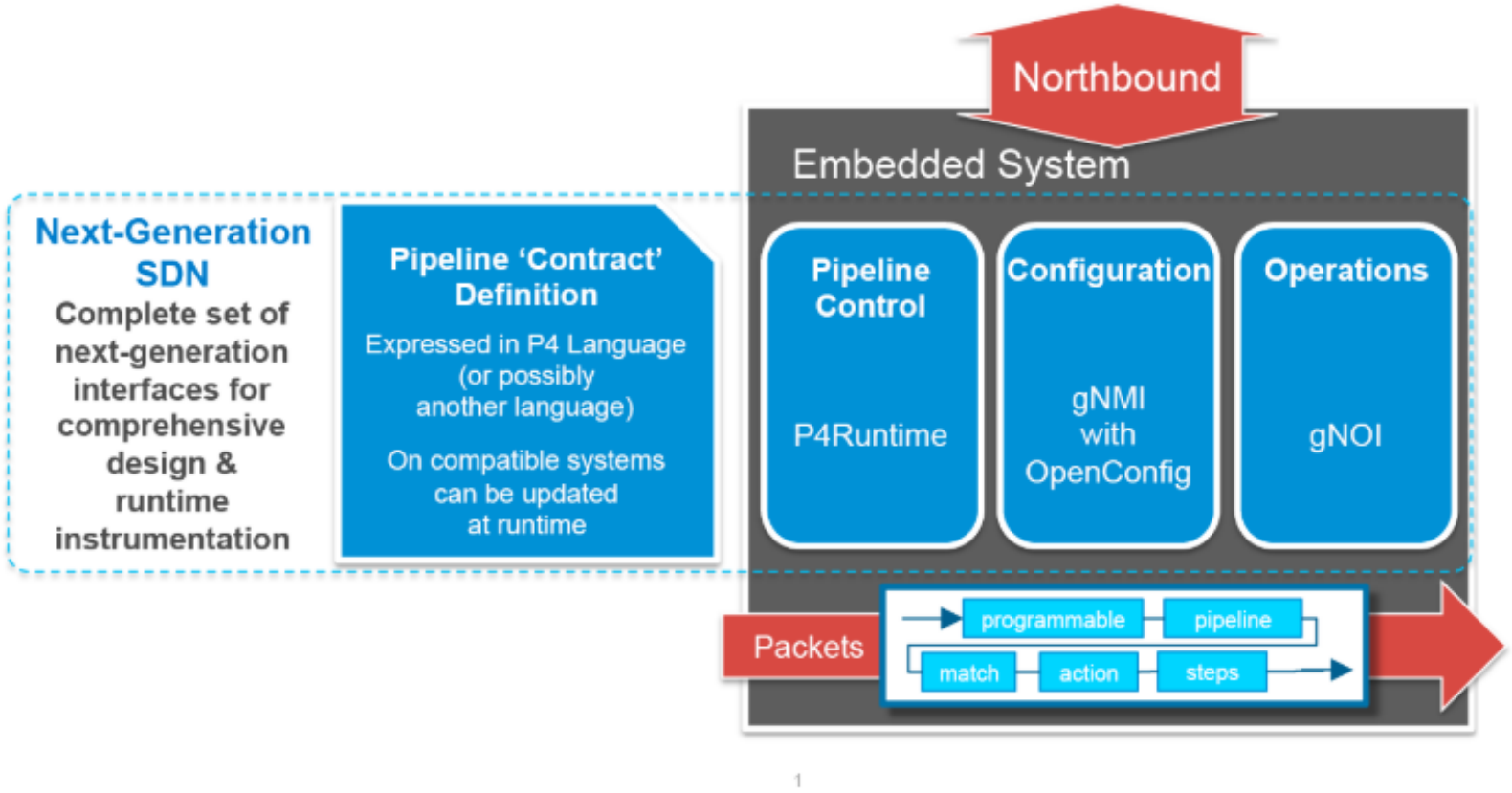
NG-SDN

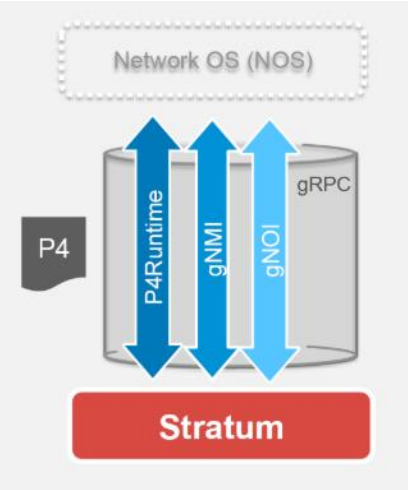


www.opennetworking.org/ng-sdn/

Building blocks for an open programmable network architecture

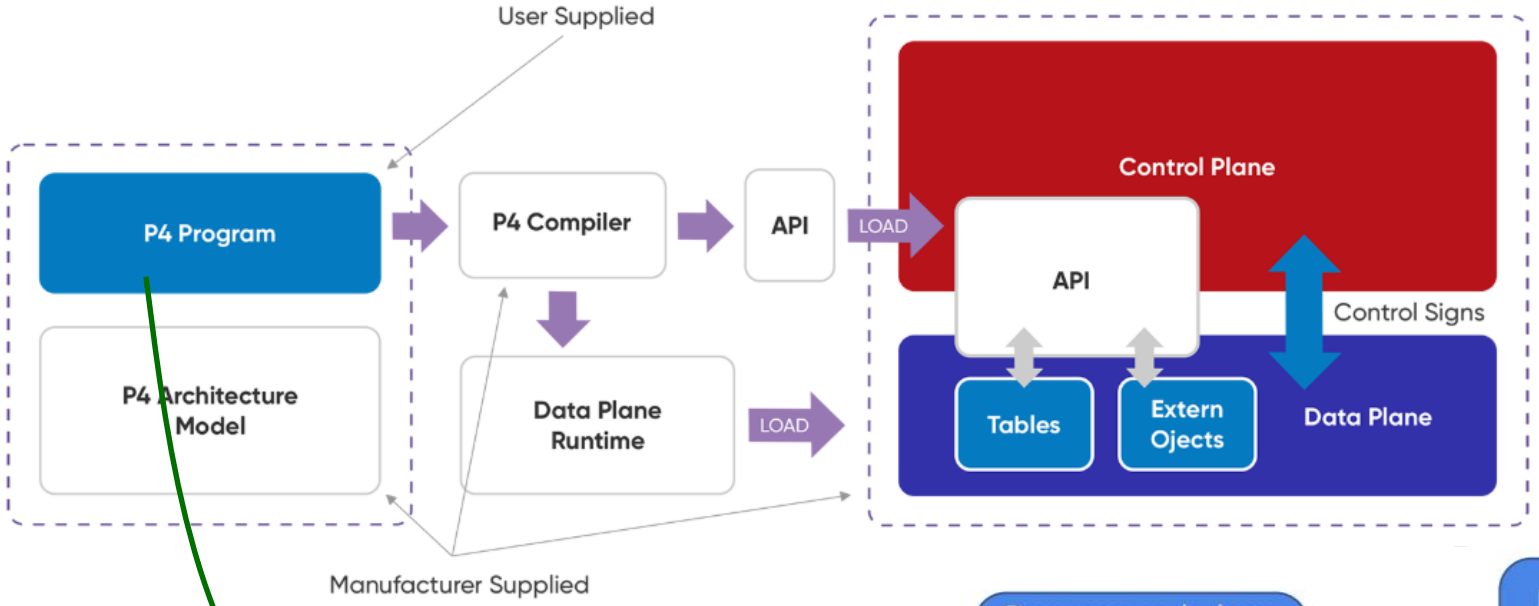
Stratum (Open Networking Foundation)



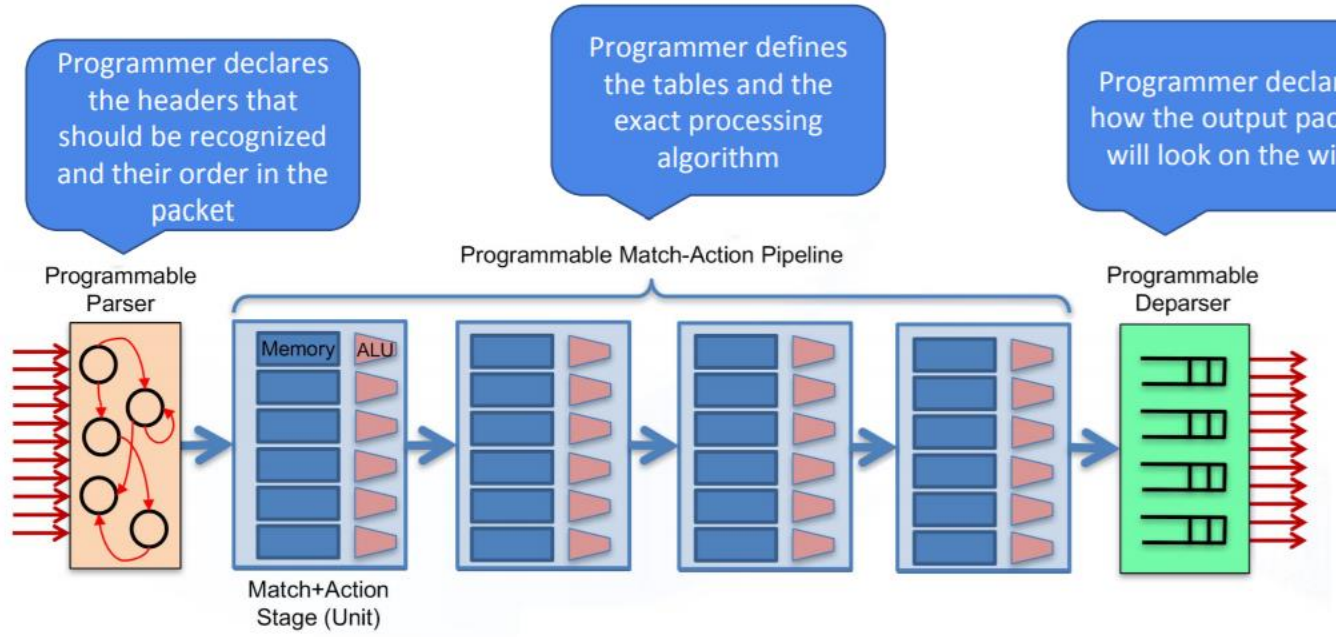


Building blocks for an open programmable network architecture

P4 (Open Networking Foundation / P4.org)



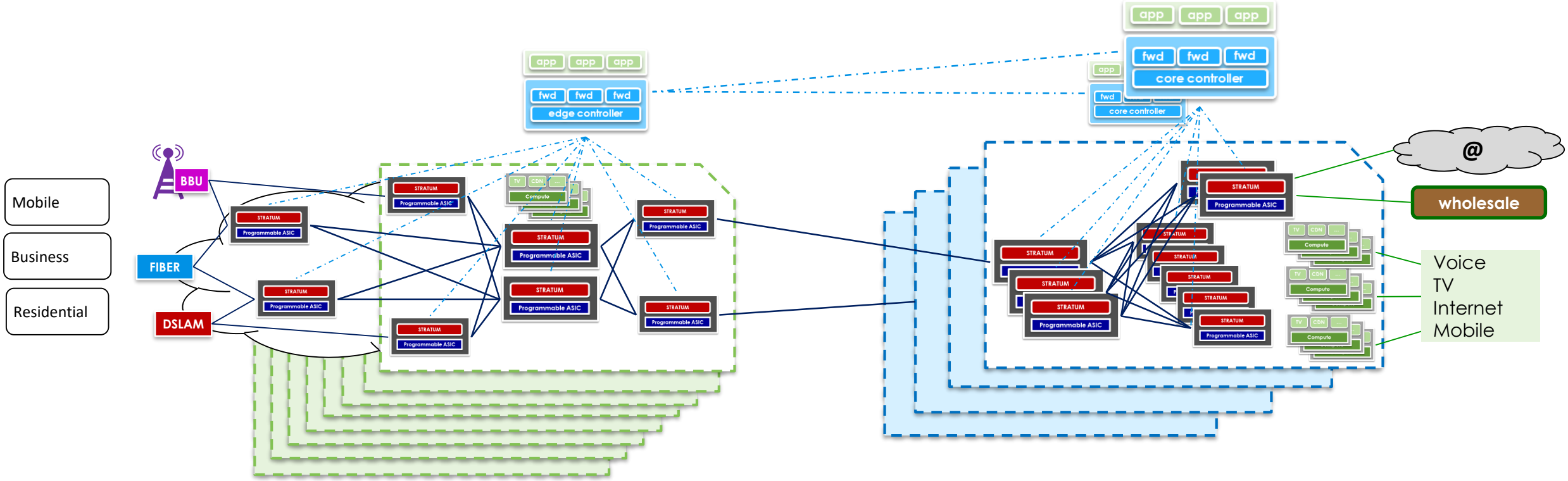

```
state start {
  transition parse_ethernet;
}

state parse_ethernet {
  packet.extract(hdr.ethernet);
  transition select(hdr.ethernet.etherType) {
    0x800: parse_ipv4;
    default: accept;
  }
}
```



A Programmable Network Architecture

Overview

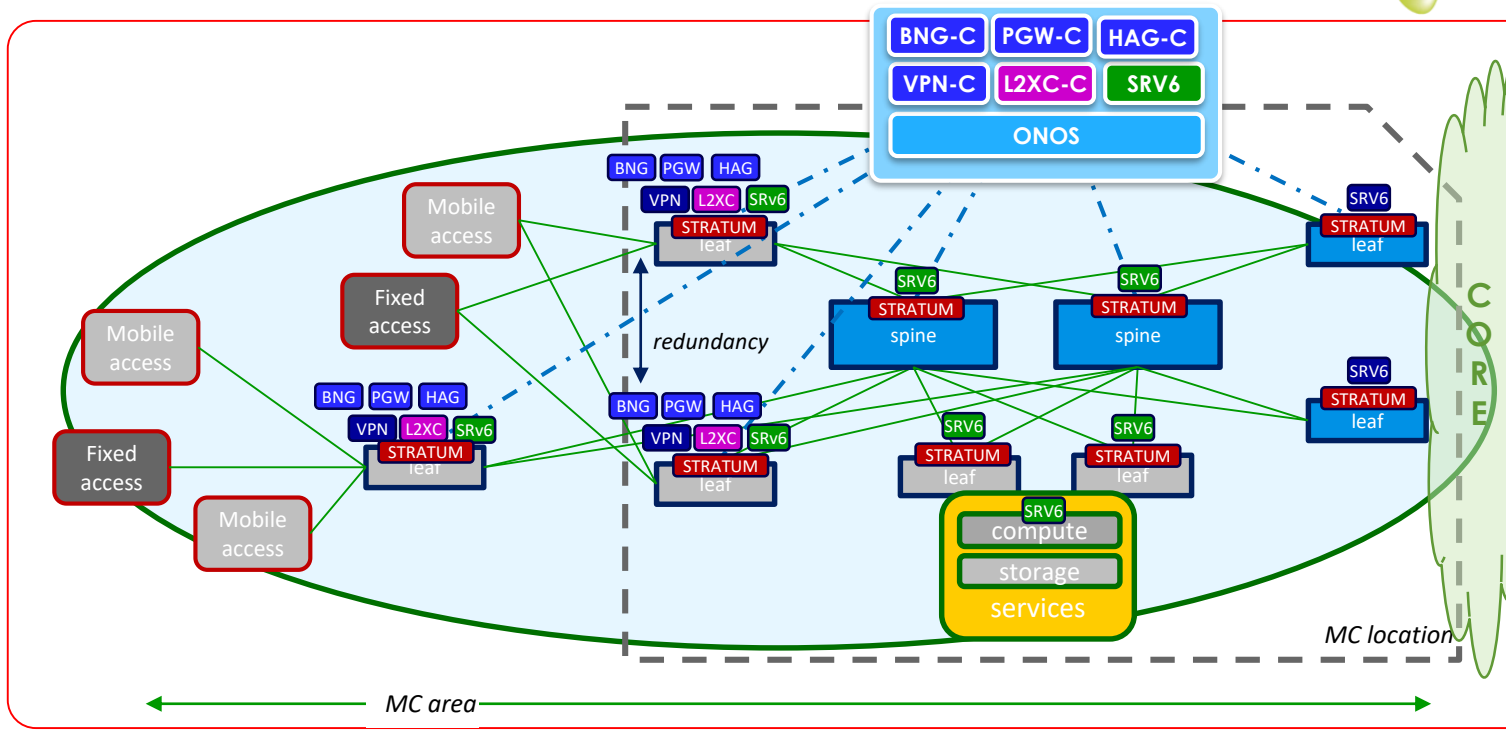
End-to-end automation of network services and operation

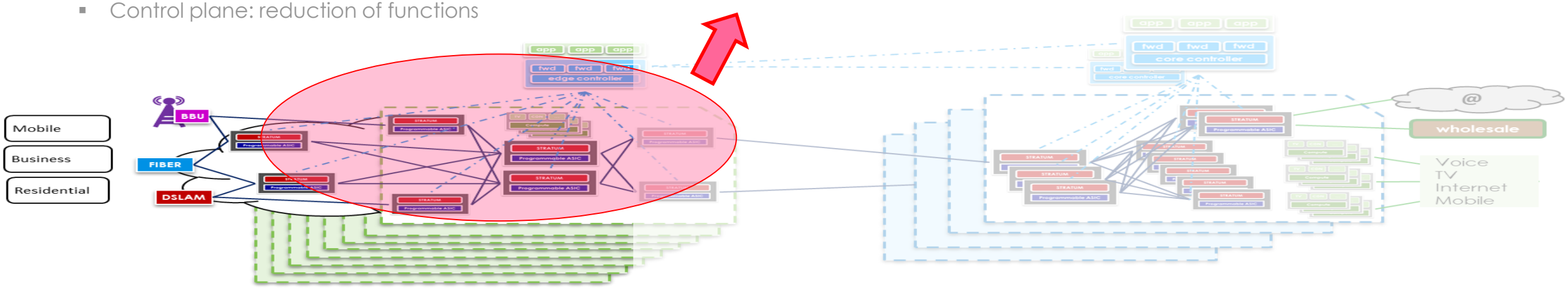


Open, automated, programmable network resource layer

A programmable 'Central Office' architecture

- Programmable, disaggregate 'CO'
  - Combines CORD and NG-SDN
  - Leaf – Spine topology (local and remote leaves)
    - Spines are service agnostic
    - Multi-homed access nodes (edge resilience)
  - Separation of control and forwarding
    - ONOS controller
  - Programmable forwarding plane (*VNF off-loading*)
    - STRATUM / P4
  - Fixed – Mobile convergence
    - Data plane: transport efficiency
    - Control plane: reduction of functions

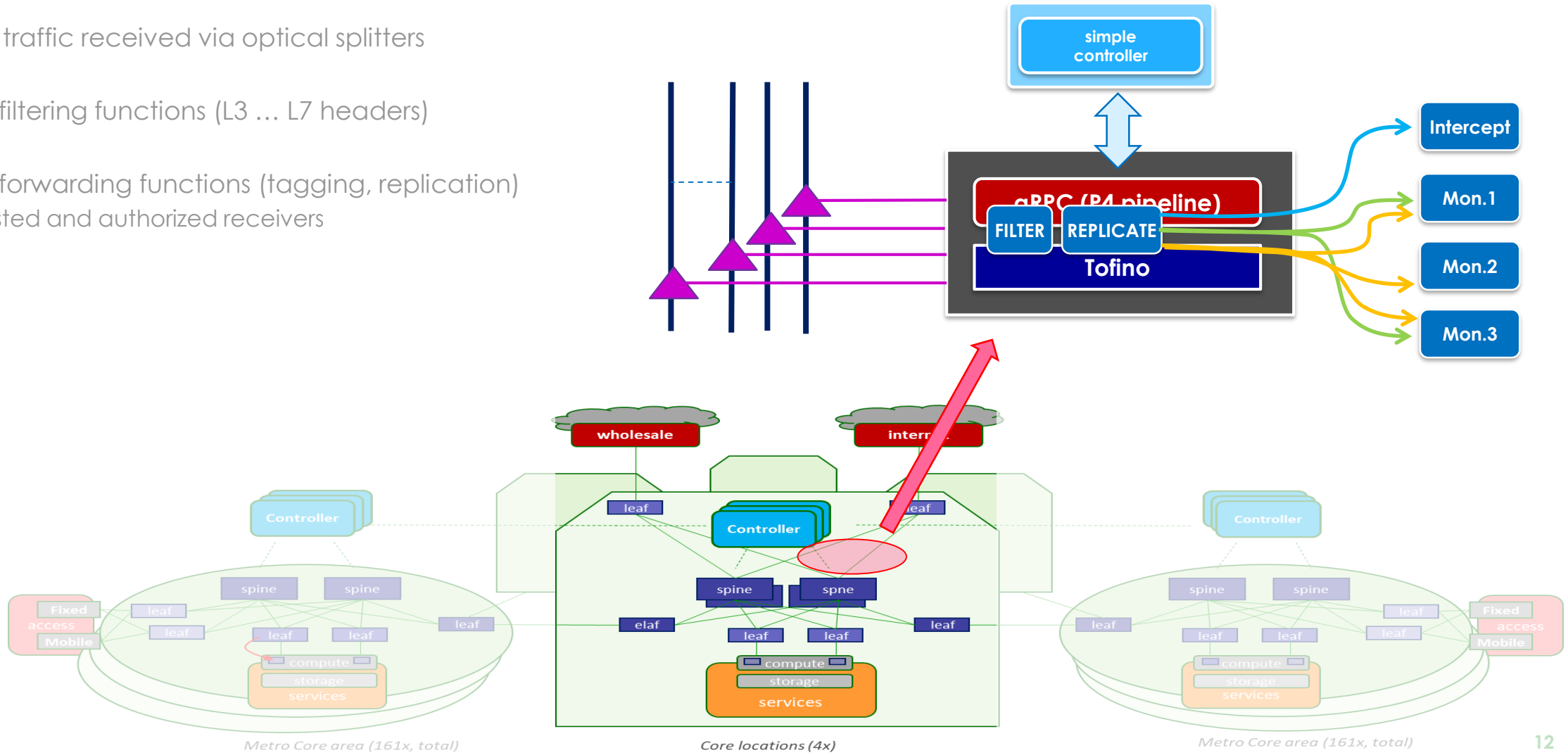




Use cases under development

Intercept & Monitoring

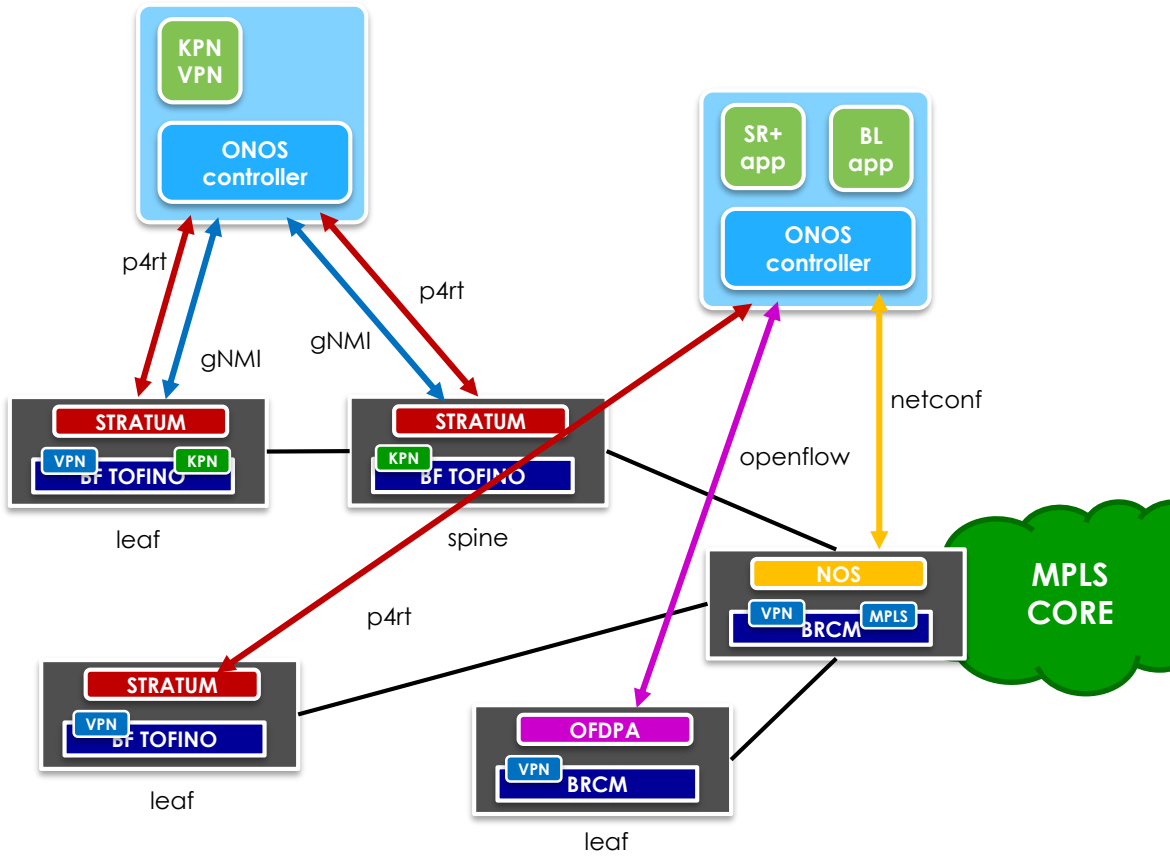
- Programmable traffic filtering & replication
  - Network traffic received via optical splitters
  - Specific filtering functions (L3 … L7 headers)
  - Specific forwarding functions (tagging, replication)
    - interested and authorized receivers



Use cases under development

Programmable ‘central-office’: IP VPN

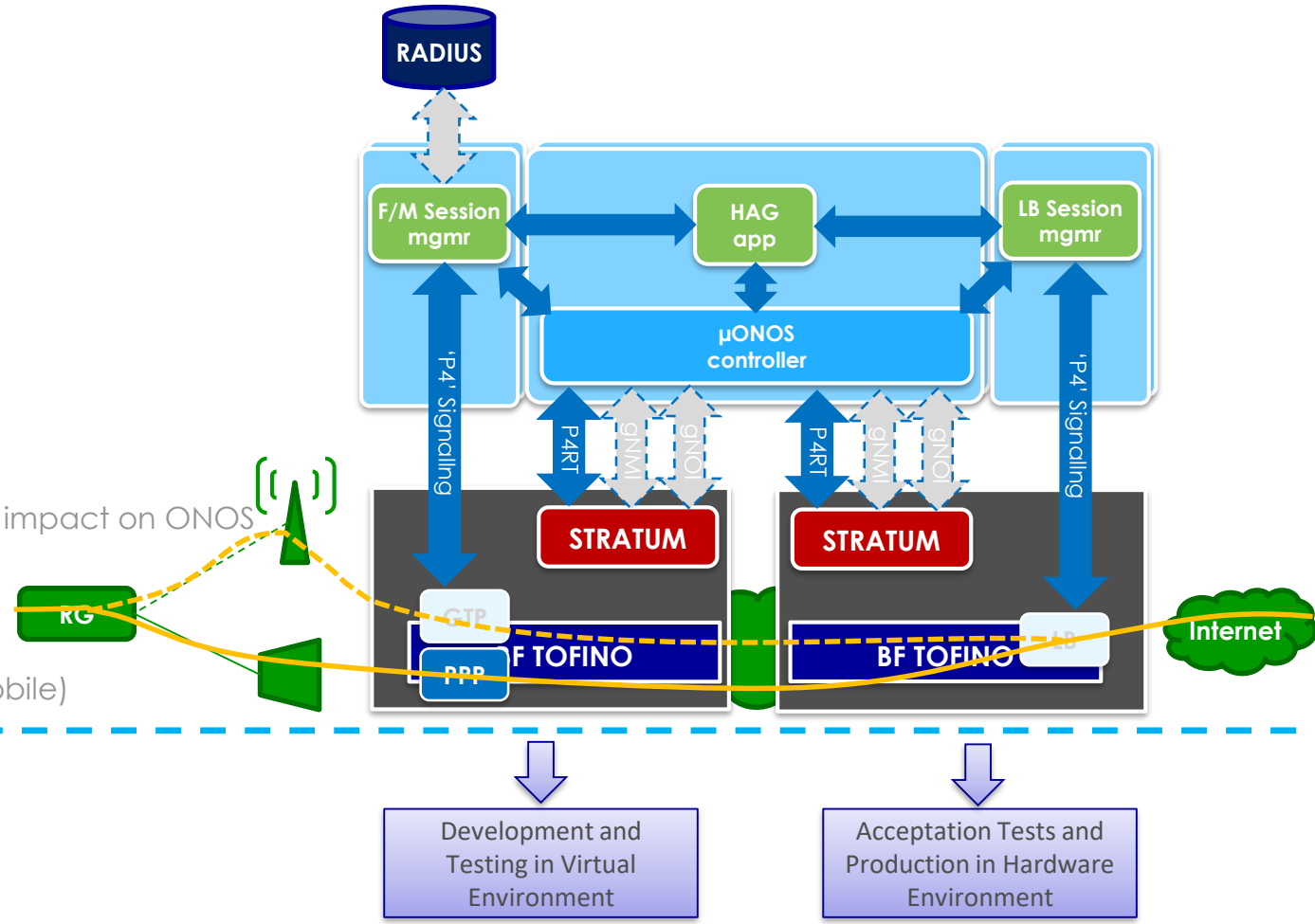
- IP VPN: baseline functionality for central office
- Multi-vendor / multi-chip setup: Barefoot Tofino + Broadcom
- Two approaches: custom pipeline + predefined pipeline
  - Separate ONOS instances to avoid conflict
  - Custom pipeline: custom app for pipeline control
  - Predefine pipeline: modified version of segment routing app
  - Separate app for configuration of NOS based border leaf
    - NetConf



Use cases under development

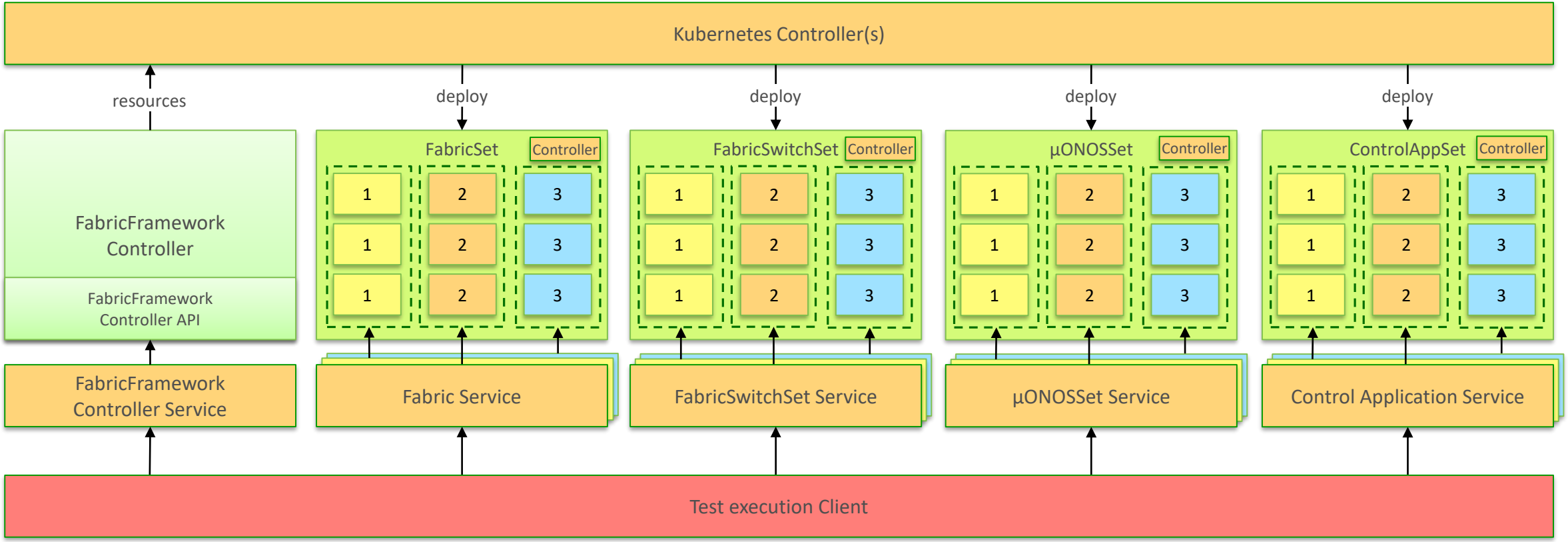
Programmable 'central-office': Hybrid Access

- Hybrid: fixed and mobile access
- Programmable forwarding plane
  - Barefoot Tofino (initial development on Tofino model)
  - STRATUM: P4RT to control pipeline
- ONOS based control plane
  - HAG app to program forwarding state
  - Separate session manager application to avoid session signalling impact on ONOS
- CUPS – like architecture
  - In band 'P4' signalling channel (to be used for both fixed and mobile)
  - State control interface (using P4RT interface of STRATUM)
- In development on Tofino model, porting to HW planned
  - SW model key in development



KPN Fabric Simulation for Fabric & Function development

Based on similar ONF developments within for example µONOS, Atomix etc



The programmable network architecture

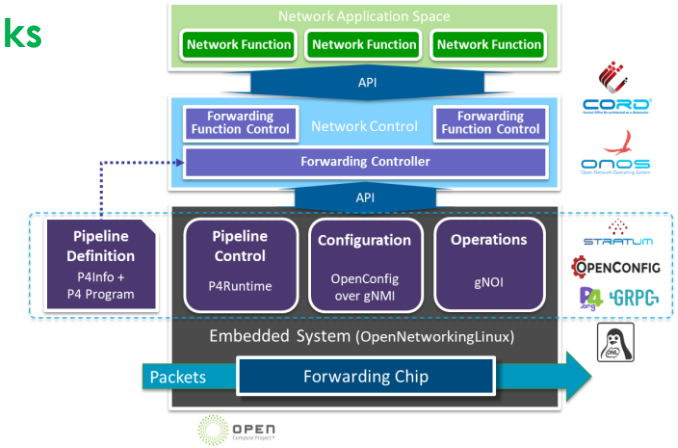
Further development through community effort

The programmable network architecture is *software defined, distributed, disaggregate* and *open* in nature.

Open interfaces and open (source) specifications are key building blocks

- ONF Open Networking Foundation
- OPEN Compute Project®

CORD, ONOS, NG-SDN, STRATUM



Development started on different of use cases

- Research / PoC stage, baseline for next steps

Thank You