Open Network Environment: Software Defined Networking And Beyond

Pradeep Kathail
Chief Software Architect

Network Operating Systems Technology Group, Cisco Systems Inc.

March 4th, 2014

What is SDN?

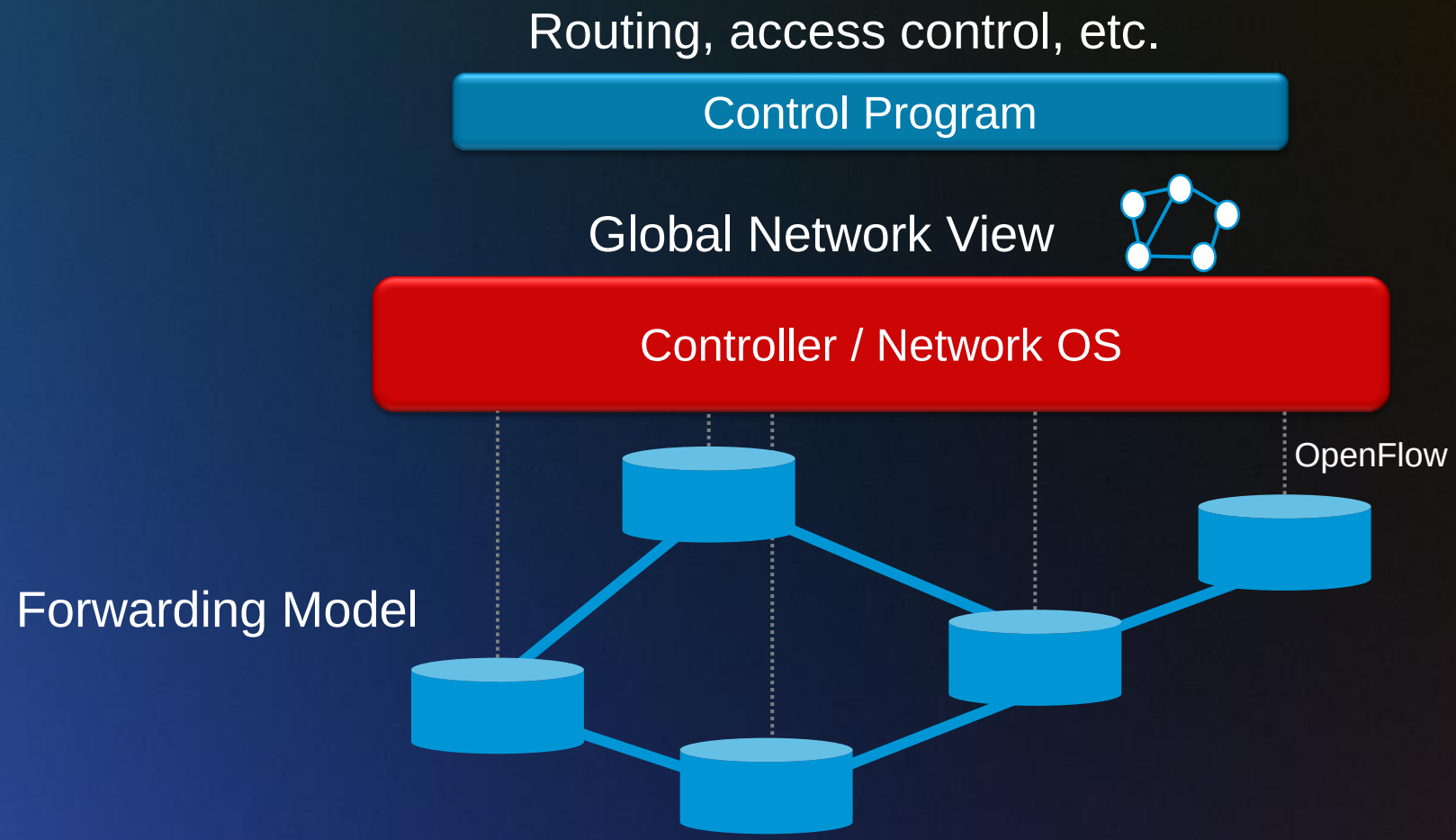
"…In the SDN architecture, the control and data planes are decoupled, network intelligence and state are logically centralized, and the underlying network infrastructure is abstracted from the applications…"

https://www.opennetworking.org/images/stories/downloads/white-papers/wp-sdn-newnorm.pdf

"…open standard that enables researchers to run experimental protocols in campus networks. Provides standard hook for researchers to run experiments, without exposing internal working of vendor devices……"

http://www.openflow.org/wp/learnmore/

Original SDN Architecture



What is SDN for you?

"A way to optimize link utilization in my network enhanced, application driven routing"

"An open solution for customized flow forwarding control in and between Data Centers"

"A platform for developing new control planes"

"An open solution for VM mobility in the Data-Center"

"Develop solutions at software speeds: I don't want to work with my network vendor or go through lengthy standardization."

"A solution to automated network configuration and control"

"A way to reduce the CAPEX of my network and leverage commodity switches"

"A means to get assured quality of experience for my cloud service offerings"

"A solution to build a very large scale layer-2 network"

"A means to do traffic engineering without MPLS"

"A solution to build virtual topologies with optimum multicast forwarding behavior"

Diverse Drivers

Common Concepts

Different Execution Paths

"A means to scale my fixed/mobile gateways and optimize their placement"

"A way to optimize broadcast TV delivery by optimizing cache placement and cache selection"

"A way to build my own security/encryption solution"

"A way to scale my firewalls and load balancers"

"A way to distribute policy/intent, e.g. for DDoS prevention, in the network"

"A way to configure my entire network as a whole rather than individual devices"

"A solution to get a global view of the network – topology and state"

Simplified Operations – Enhanced Agility – New Business Opportunities

Classes of Use-Cases

"Leveraging APIs and logically centralized control plane components"

Federating different Network Control Points
(DC-WAN-LAN, Virtual-Physical, Layer-1-3, IaaS+VPN)

Consistent Network Policy,
Security, Threat Mitigation

Custom Routing
Online Traffic Engineering

Network Virtualization,
Service Chaining

Custom Traffic Processing
(Analytics, Encryption)

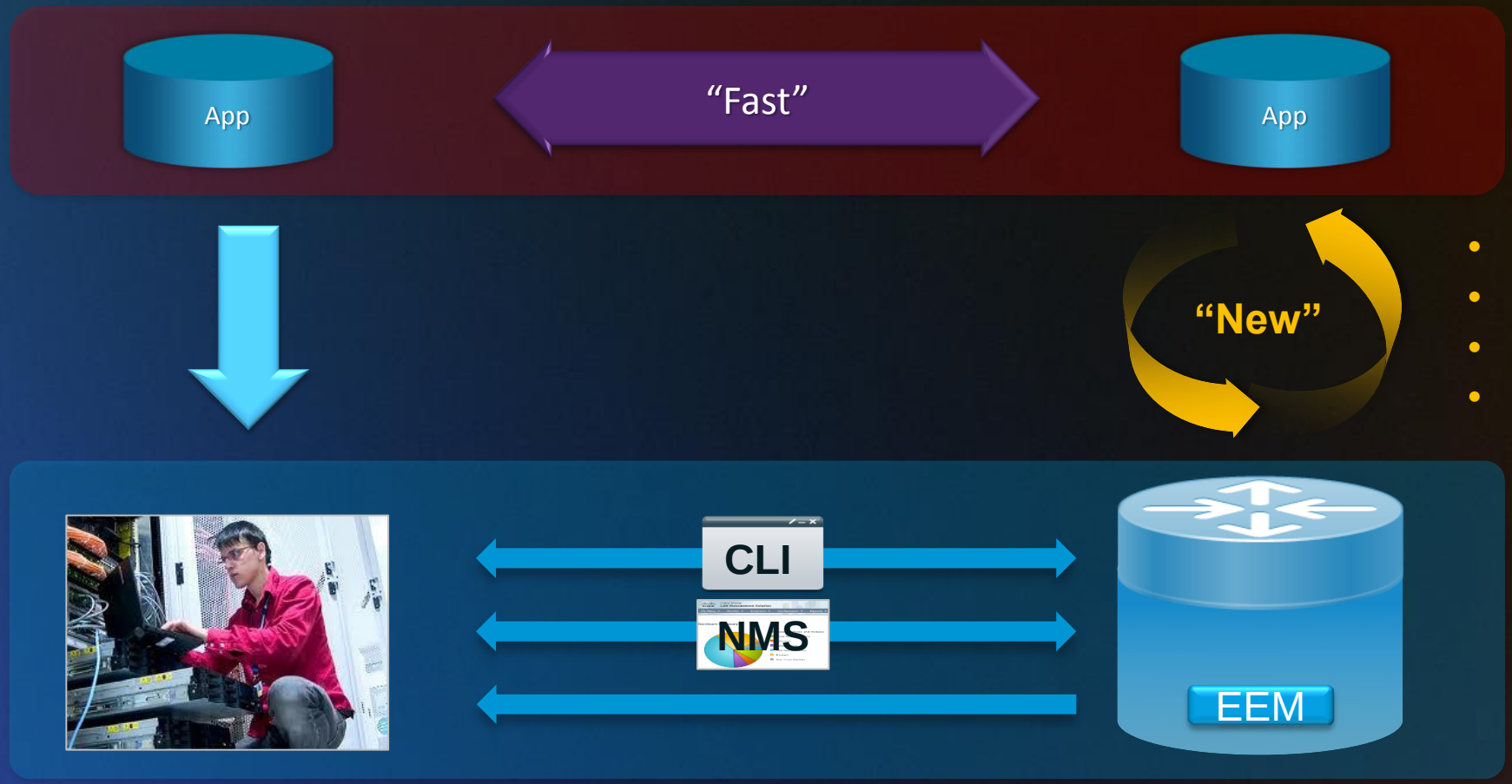
Network Function
Virtualization (NfV)

SDN origin

Fast IT:
Automation of
Network Control
and Configuration
(Fulfillment and Assurance
– Virtual & Physical)

Towards Programmatic Interfaces to the Network

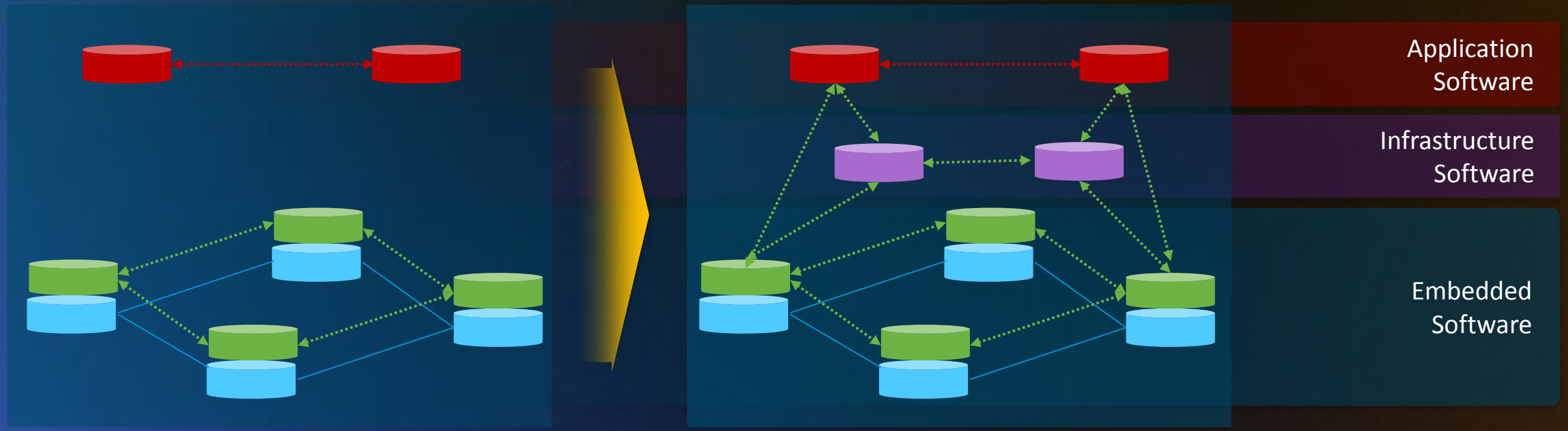
Approaching Today's Dilemma



- Simple
- Application-friendly
- Integrated
- Bi-directional

A New Programming Paradigm is Needed

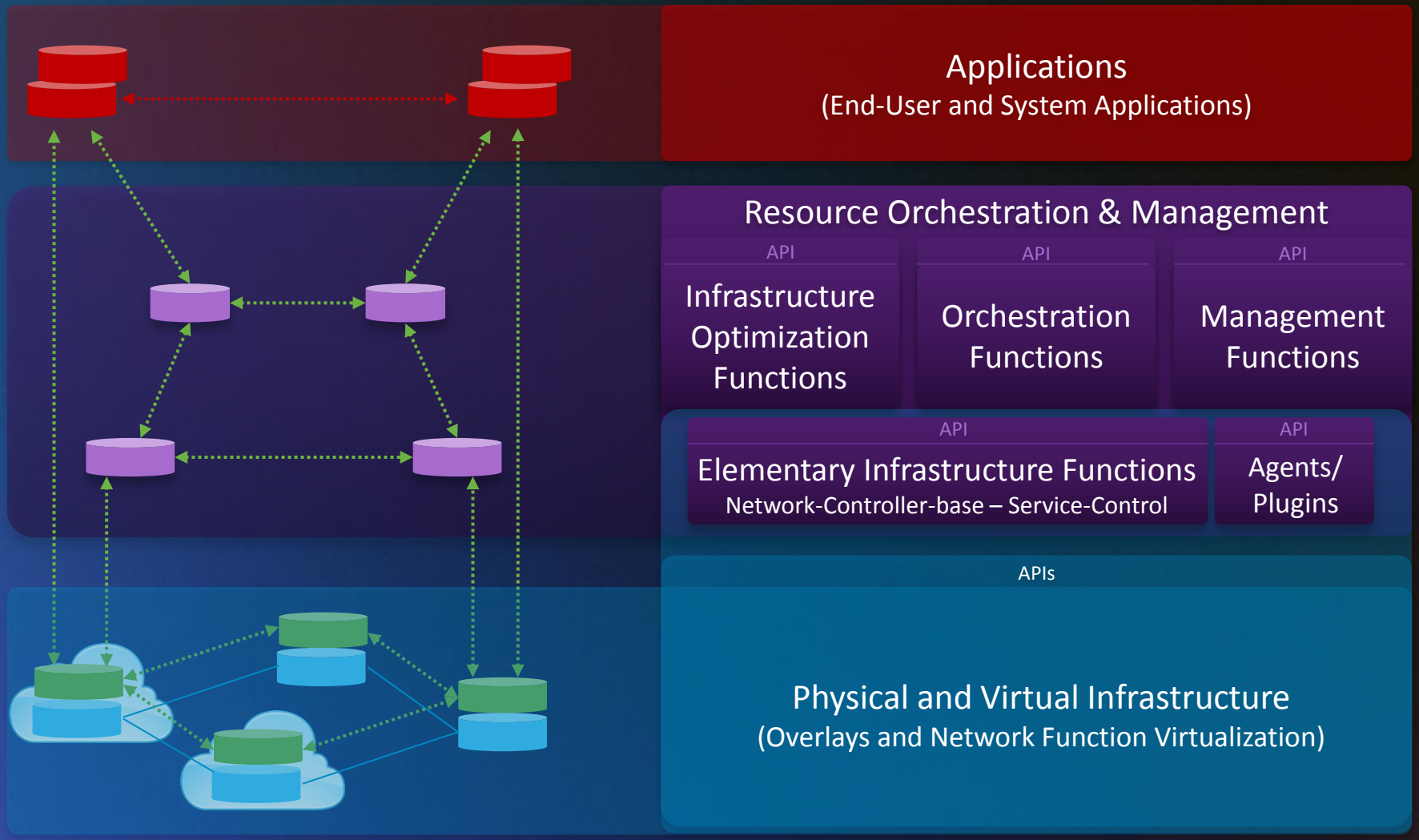
Towards an Open Network Environment
Evolve the Control- and Management Plane Architecture



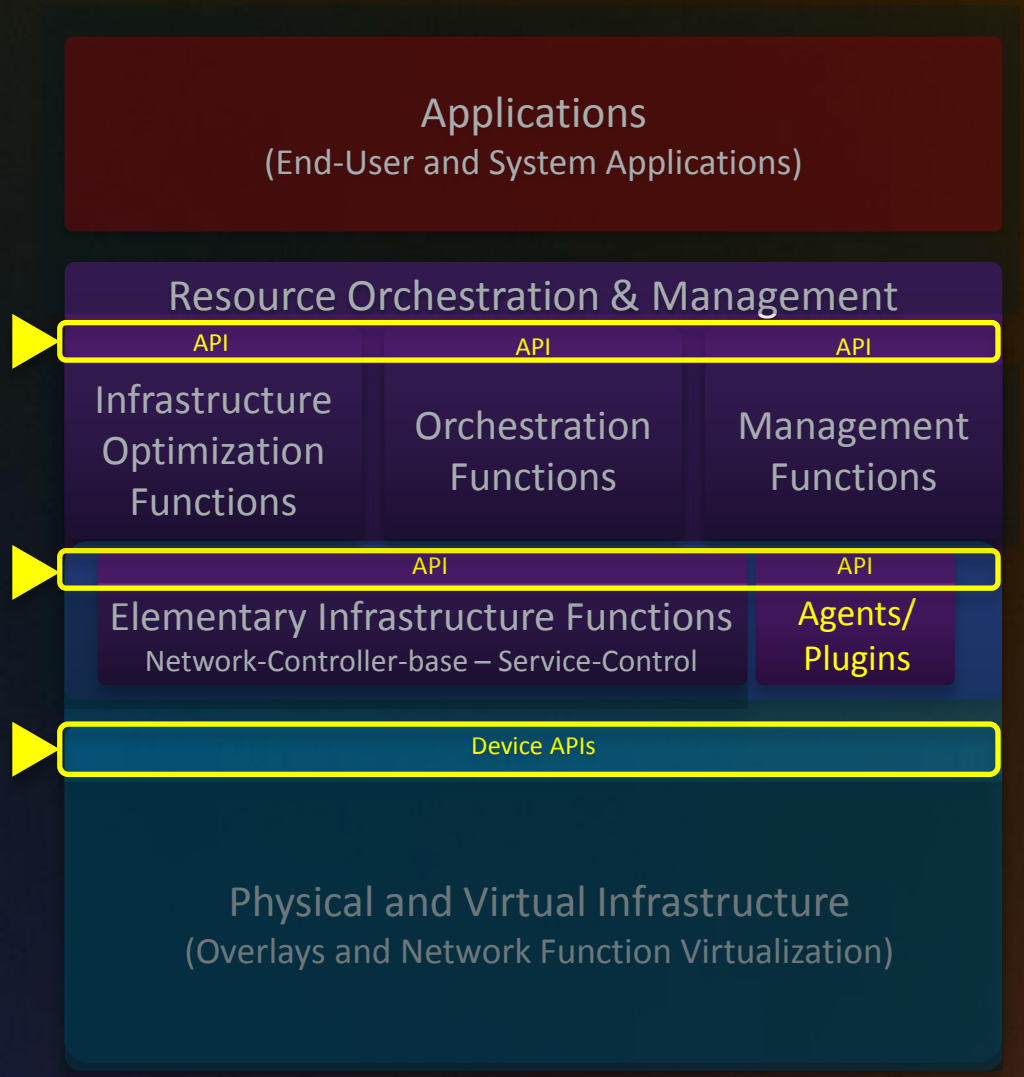
Fully Distributed Control Plane:
Optimized for reliability

Hybrid Control plane:
Distributed control combined with logically centralized control for optimized behavior
(e.g. reliability and performance)

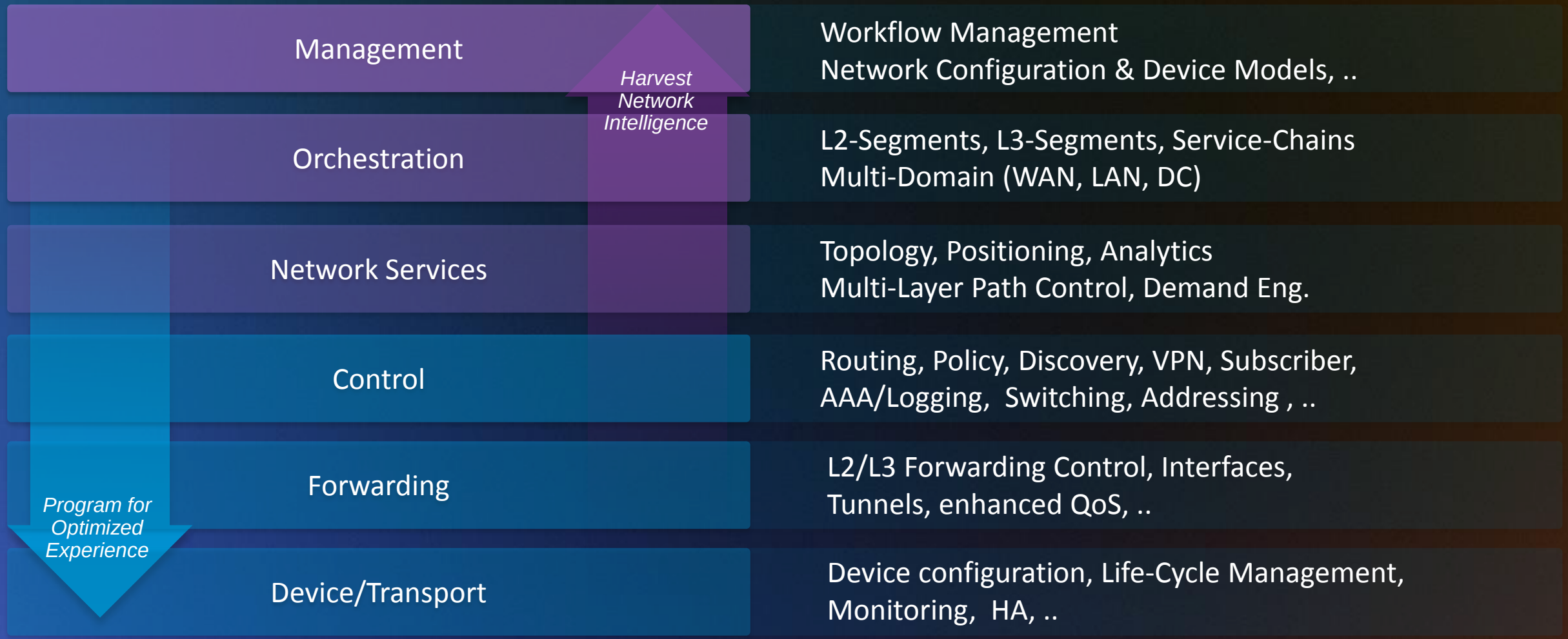
Open Network Environment
Infrastructure Software Platform



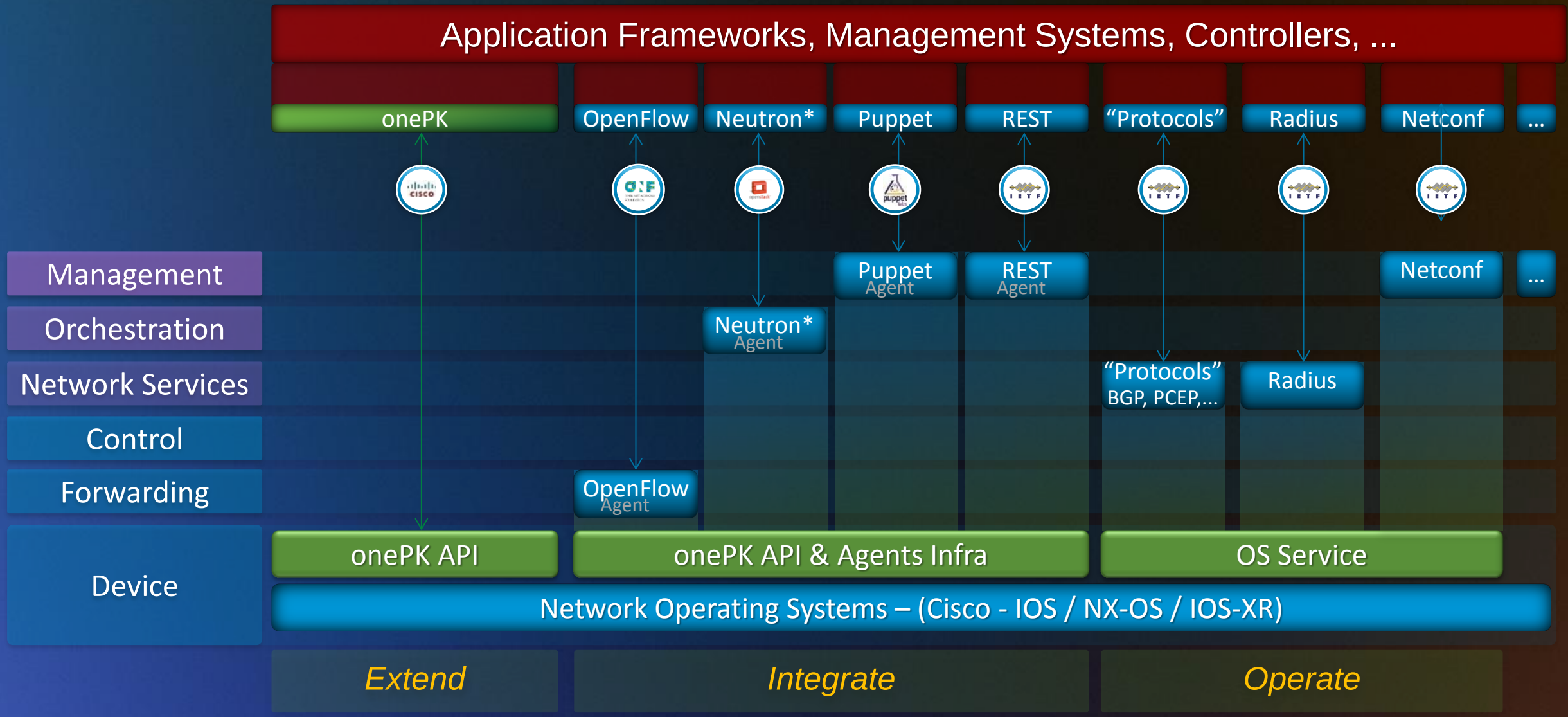
APIs and Plugins Overview



Full-Duplex, Multi-Layer/Multi-Plane APIs



Programmatic Network Access
Plug-ins/Agents as Flexible Integration Vehicles



*a.k.a. Quantum

Programmatic Network Access
Foundation for Cisco Platforms: onePK

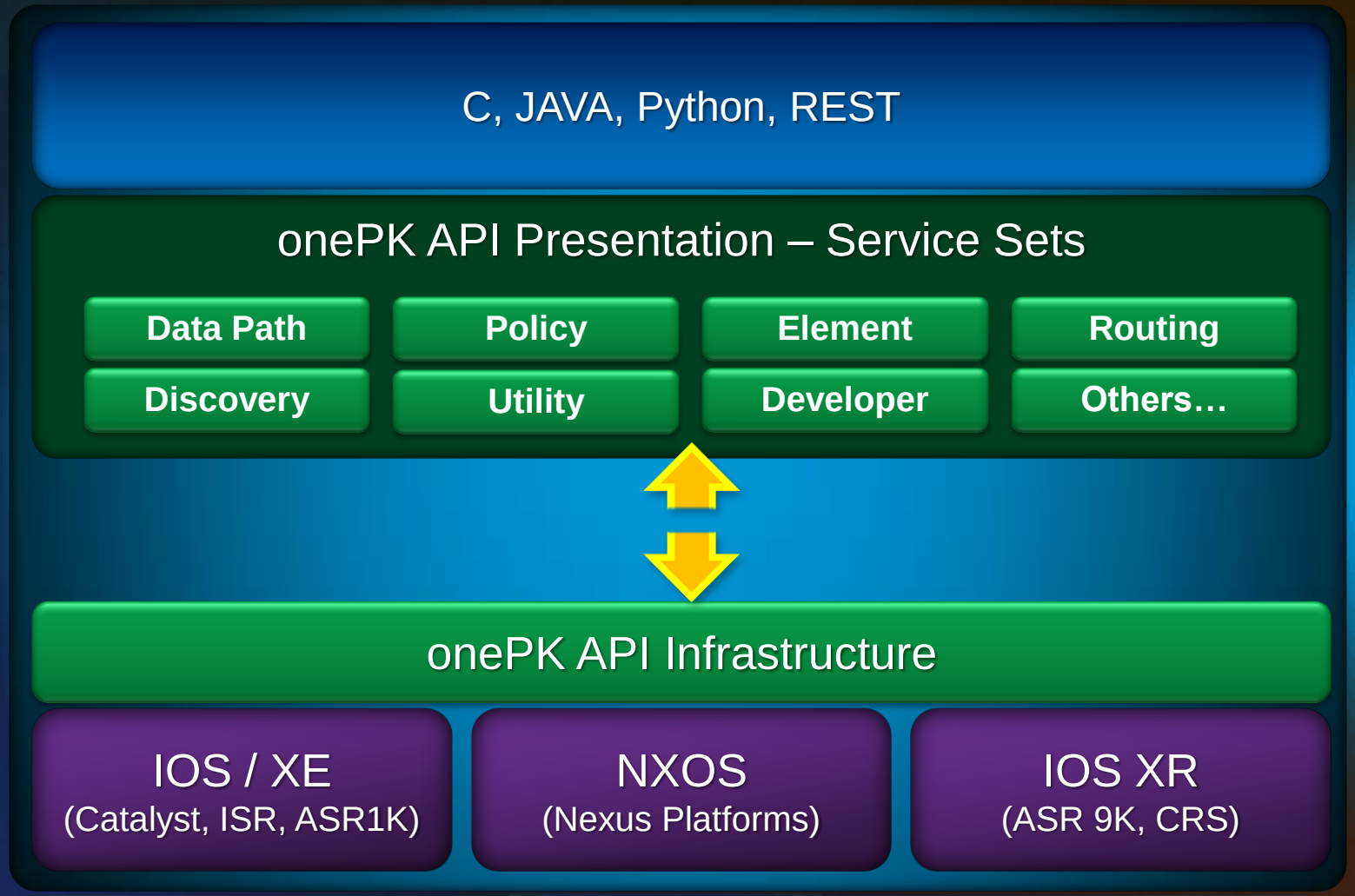
onePK

Developer Environment
- Language of Choice
- Programmatic Interfaces
- Rich Data Delivery via APIs

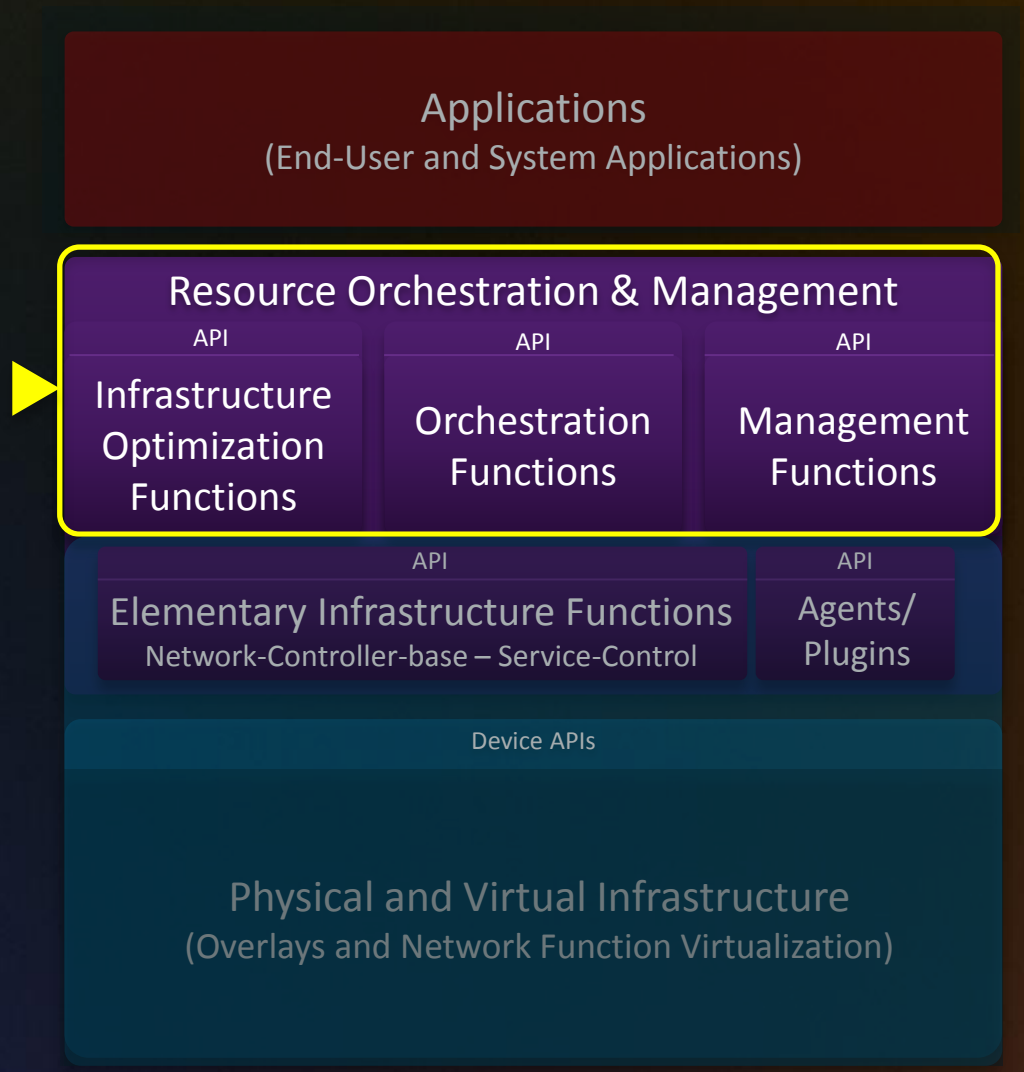
Comprehensive Service Sets
- Flexible Apps;
- New Services Monetization Opportunity

Flexible Application Deployment
- On a Service Blade
- On an External Server
- Directly on the Device

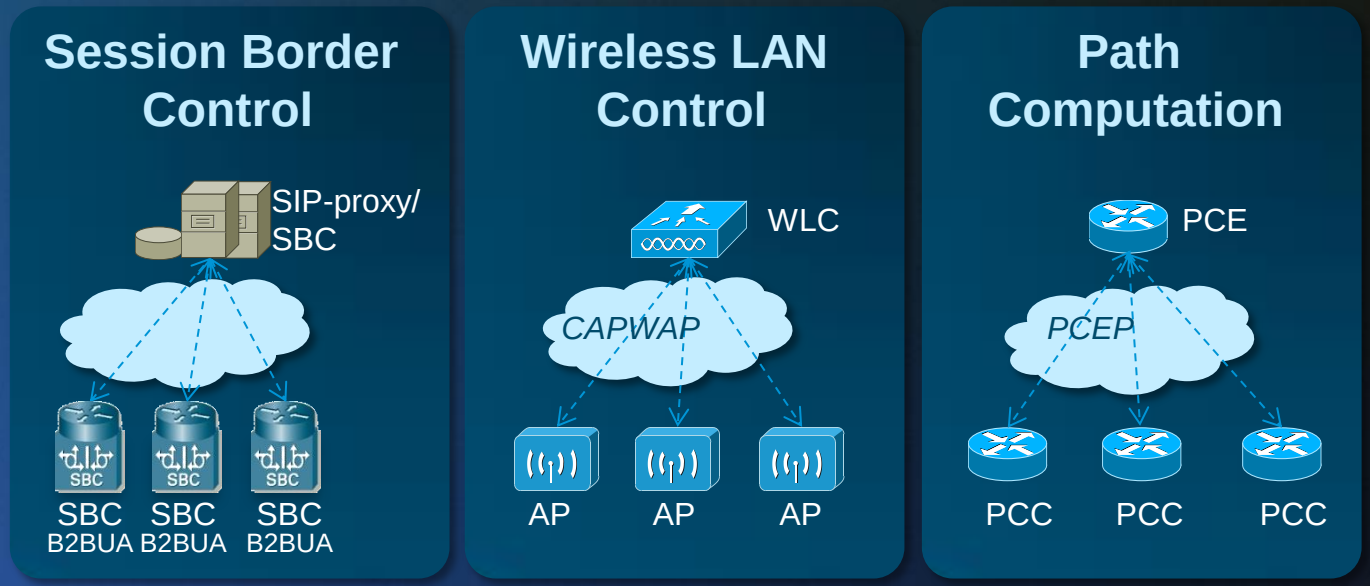
Comprehensive and Consistent Platform Support:
- IOS/XE, NX-OS, IOS-XR

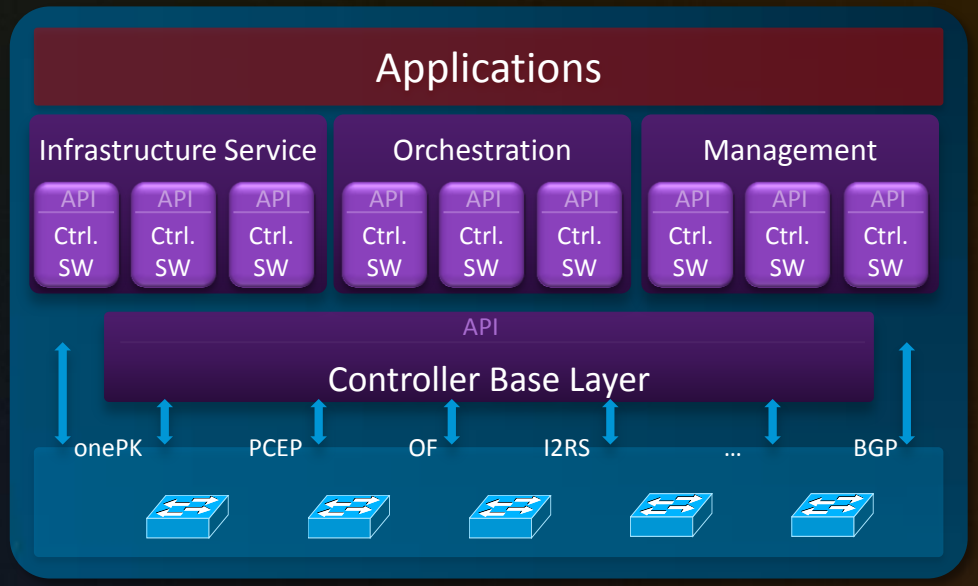


Resource Orchestration and Management "Controllers"



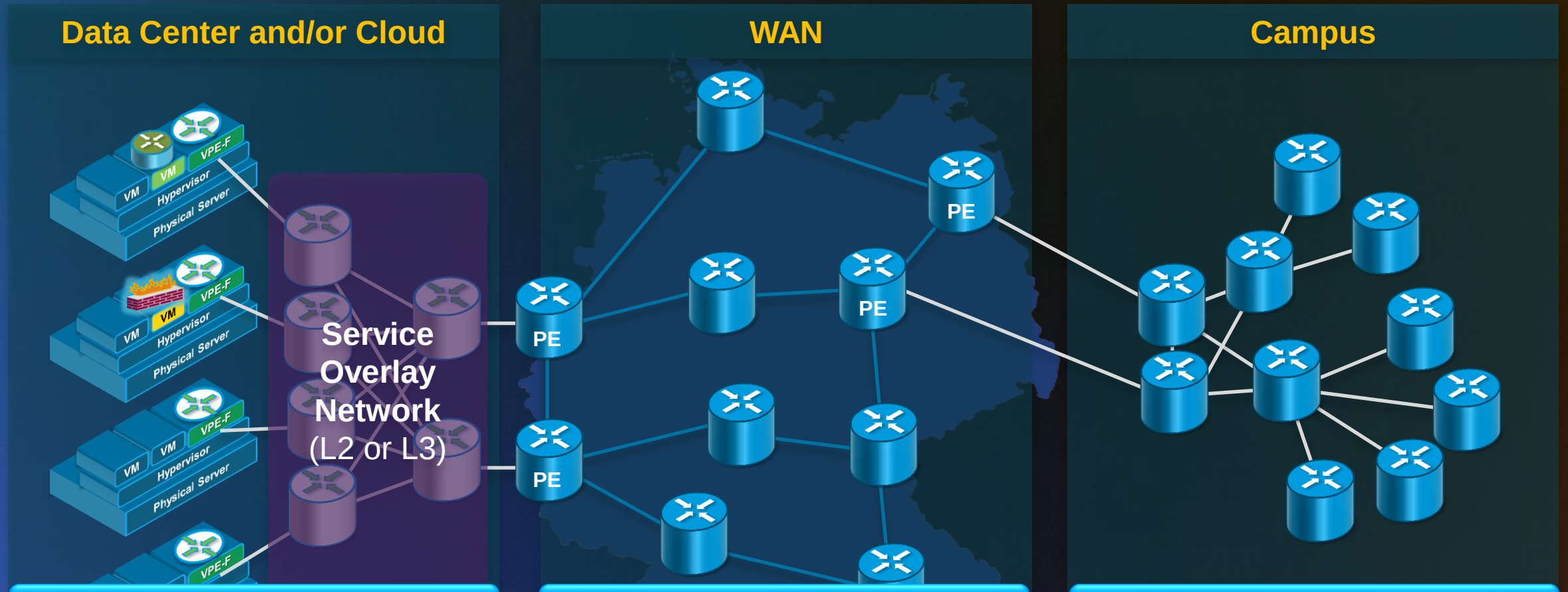
Resource Orchestration and Control Software
Task Specific Solutions and Generic Controller Infrastructure





- Networking already leverages a great breath of Agents and Controllers
  - Current Agent-Controller pairs always serve a specific task (or set of tasks) in a specific domain
- System Design: Trade-off between Agent-Controller and Fully Distributed Control
  - Control loop requirements differ per function/service and deployment domain
  - “As loose as possible, as tight as needed”
  - Latency, Scalability, Robustness, Consistency, Availability

Multi-Domain Resource & Service Orchestration

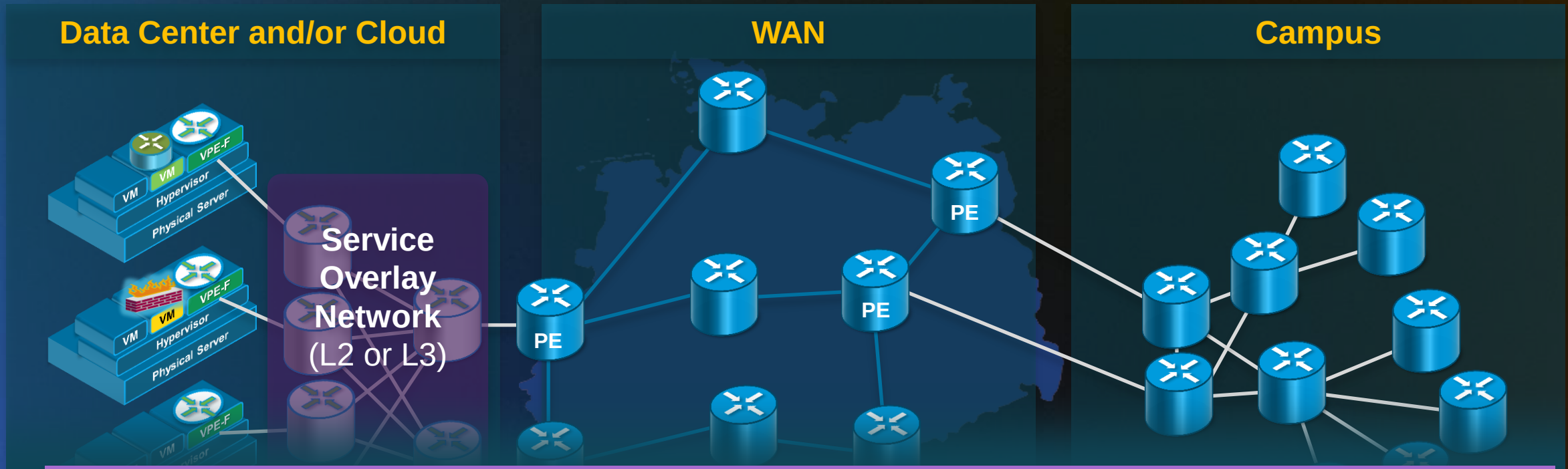


Un-Constrained Bandwidth
Regular Topology

Constrained Bandwidth
Un-Constrained Topology

Un-Constrained Bandwidth
Partially Un-Constrained Topology

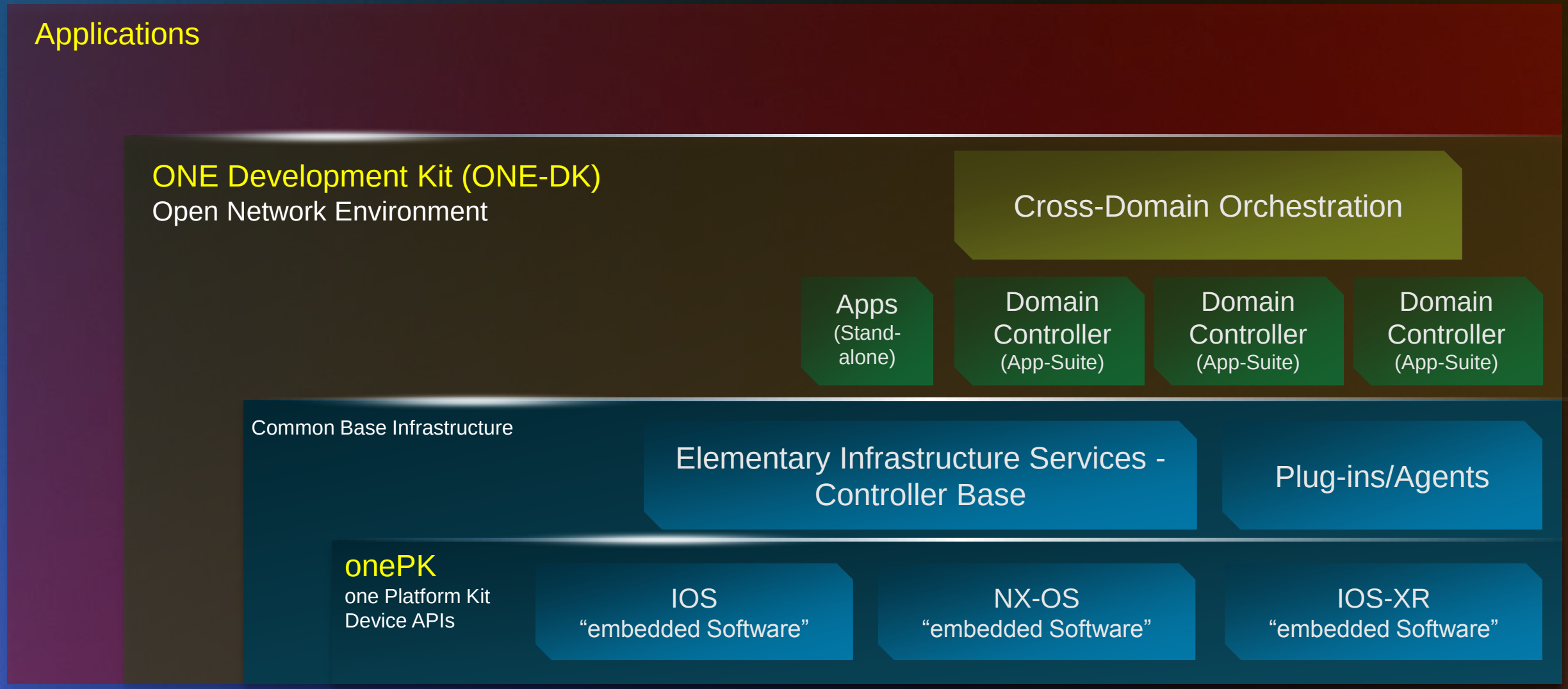
Multi-Domain Resource & Service Orchestration



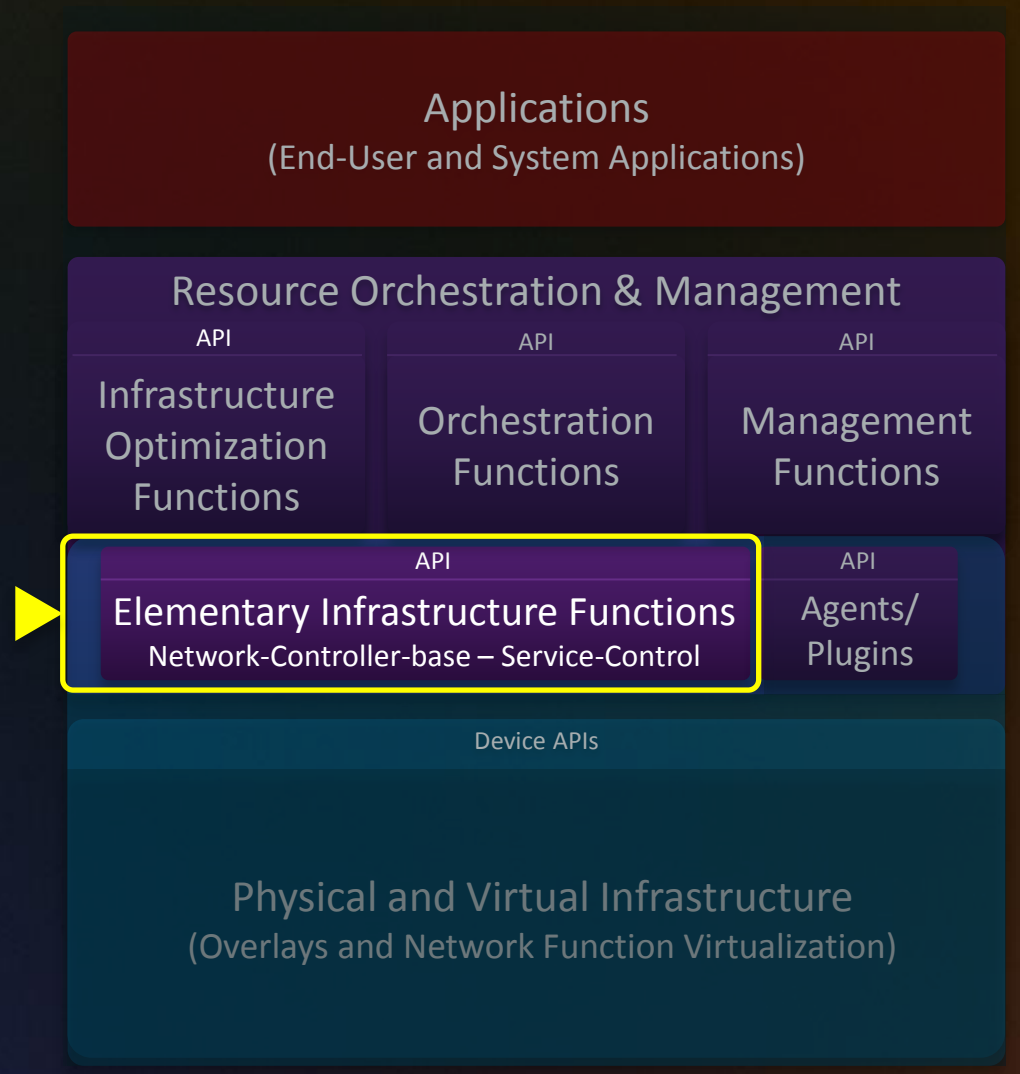
Workflow Management & Orchestration

Network Service & DC Controller – Elastic Services, Service Chains, Fabric/Overlay Control	WAN-Controller – Traffic Optimization, Demand Engineering	Enterprise App Suite – Fixed & Wireless: ZTD, QoS-Mgr, ACL-Mgr,…
Controller-base	Controller-base	Controller-base
NfV: vPE, N1kV, CSR, .. vASA, vNAM,.. / L2/L3 Switching/Routing	L2/L3 Overlay – L2VPN/L3VPN Edge/Core Routing	L2/L3 Overlay – L2VPN/L3VPN Campus Routing/Switching

Network Software Stack



Controller Base Layer
OpenDaylight Controller

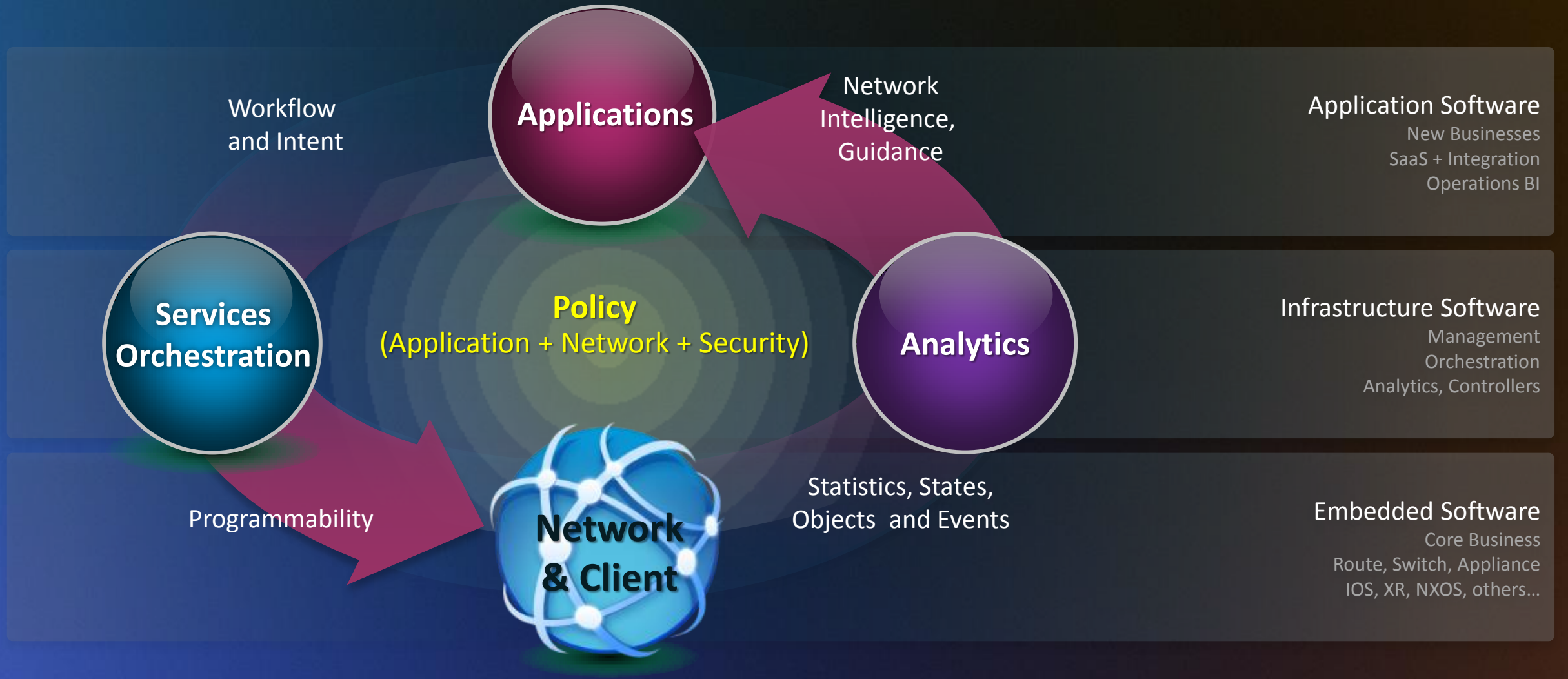


Project OpenDaylight

Daylight is an open source project formed by industry leaders and others under the Linux Foundation with the mutual goal of furthering the adoption and innovation of Software Defined Networking (SDN) through the creation of a common vendor supported framework.

for more on the Linux Foundation visit http://www.linuxfoundation.org/

Summary: Open Network Environment
Leverage Network Value



For More Information

Cisco Open Network Environment
www.cisco.com/go/one

Cisco onePK
www.cisco.com/go/onepk

Cisco Developer Network
http://developer.cisco.com/web/onepk

Thank you.