

NETWORK PROGRAMMABILITY AND SDN

OPEN INNOVATION AT THE NETWORKING INDUSTRY

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Telecos.cat
enginyers de telecomunicació





JUNIPER NETWORKS OVERVIEW

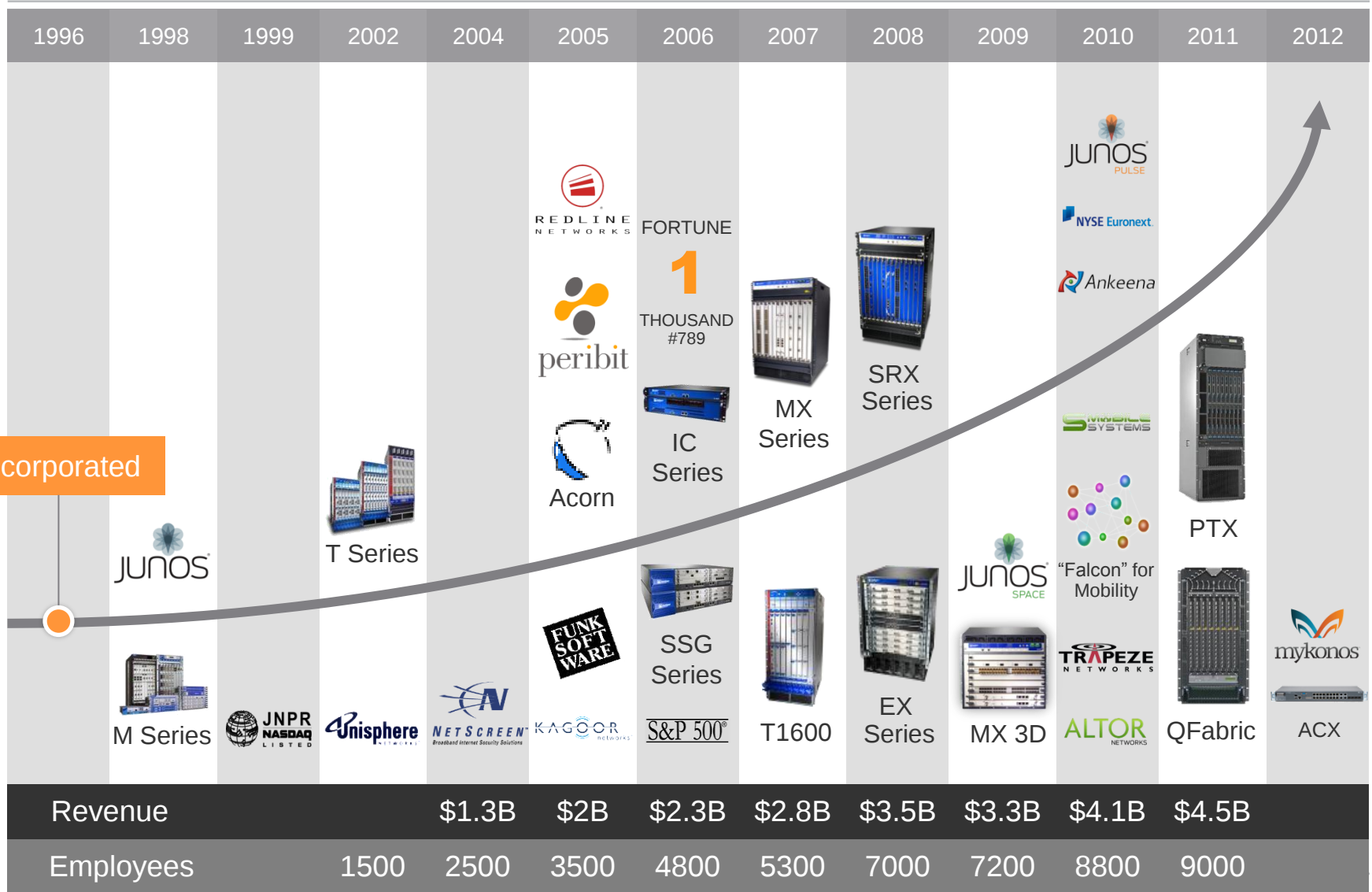


SETTING THE AGENDA FOR THE NEXT DECADE



**Juniper Networks is transforming the
experience and economics of networking**

A HISTORY OF INNOVATION



JUNIPER TODAY

2011 Revenue: \$4.5 Billion

Global Presence: Offices In 46 Countries

9400 Employees



#4 In Ethernet Switching
#3 In Edge Routing



#2 In Core
Routing, SP Routing,
Network Security



#1 In High-end
Firewall

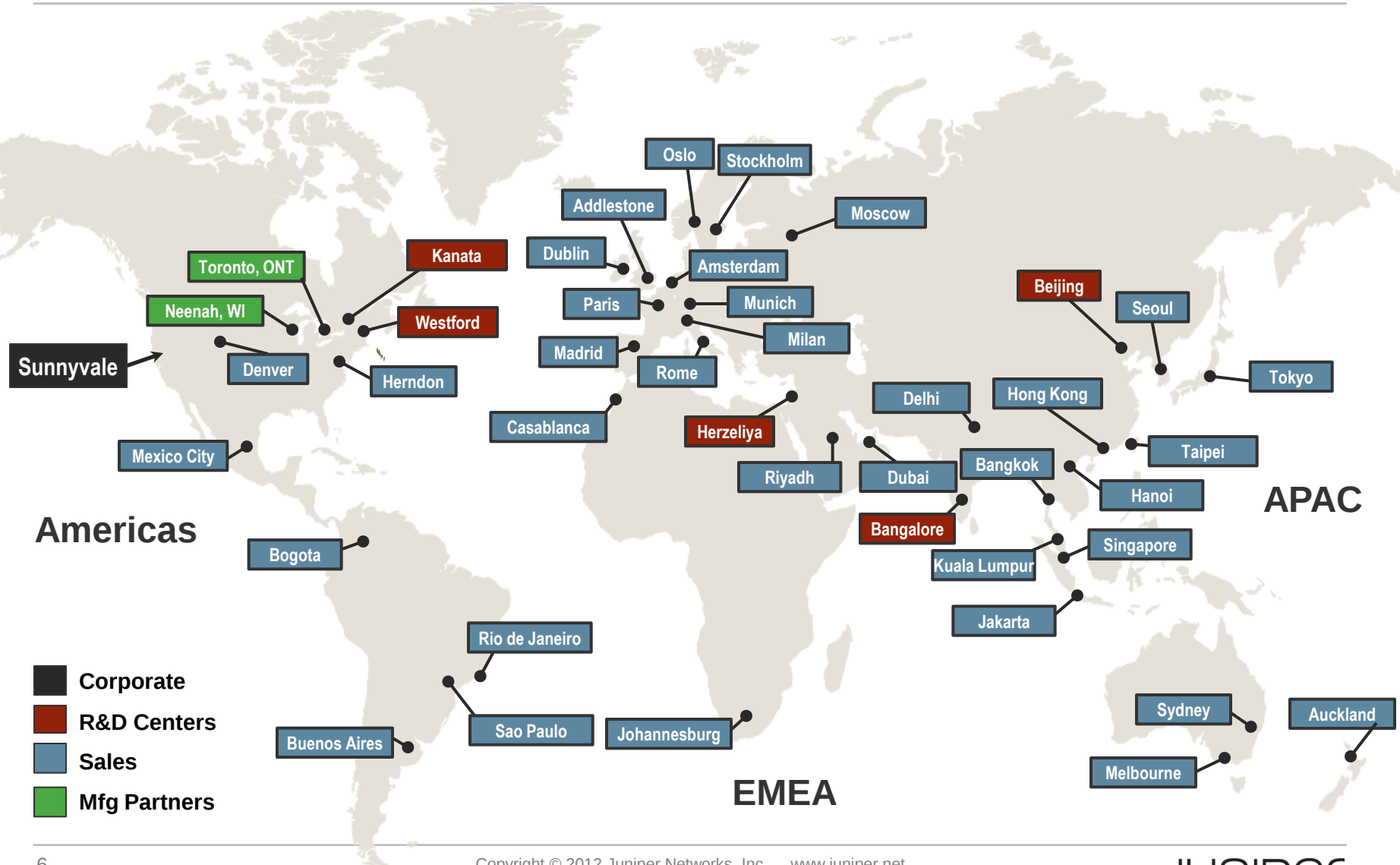
Doing Business With 100% Of Fortune 100

Powering 6 Of The World's 7 Largest Stock Exchanges

Mission: Connect Everything. Empower Everyone

JUNIPER'S GLOBAL REACH

127 OFFICES SPANNING 46 COUNTRIES



THE WORLD'S LARGEST SERVICE PROVIDERS CHOOSE JUNIPER





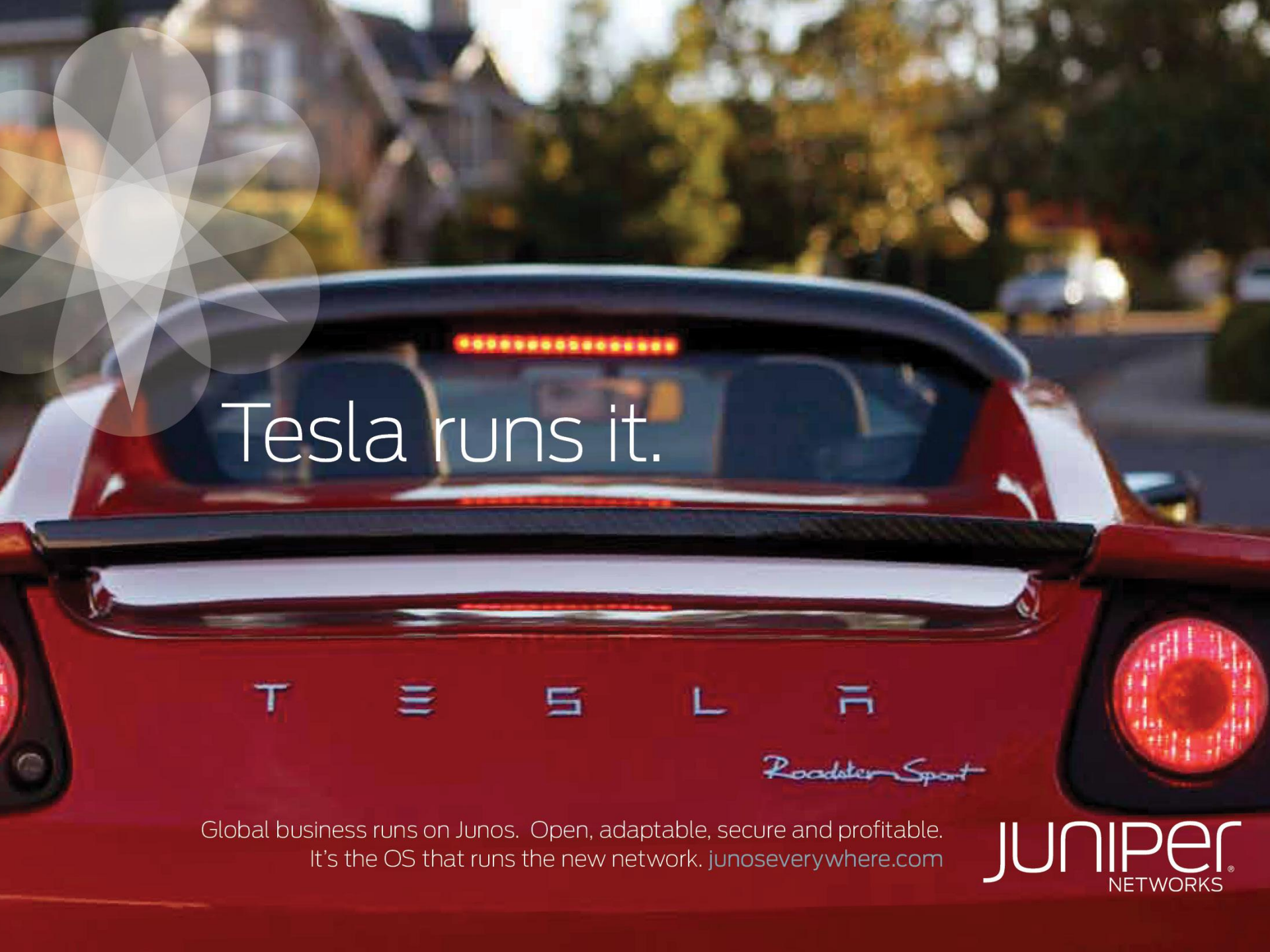
NYSE runs it.

Global business runs on Junos. Open, adaptable, secure and profitable.
It's the OS that runs the new network. junoseverywhere.com

JUNIPER
NETWORKS

SO DO MANY OF THE WORLD'S MOST SUCCESSFUL ENTERPRISES





Tesla runs it.

Global business runs on Junos. Open, adaptable, secure and profitable.
It's the OS that runs the new network. junoseverywhere.com

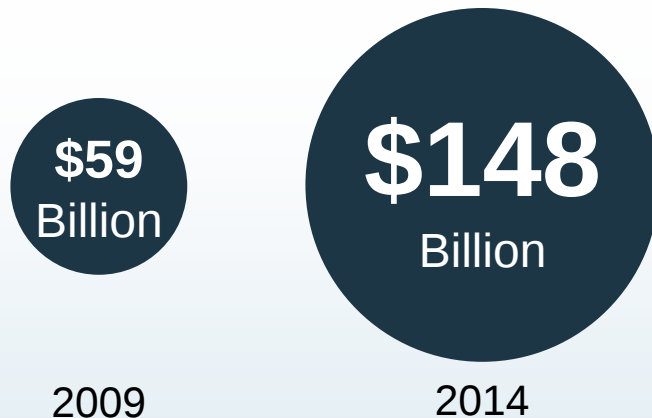
JUNIPER
NETWORKS

AND MAJOR MARKET TRENDS



Cloud Computing

Projected spend on Cloud Computing

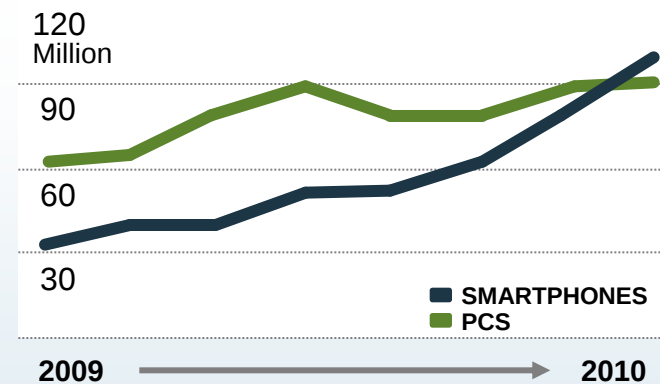


Source: Gartner



Mobile Internet

Smartphones Have Surpassed PCs — as the Mobile Experience Usurps the Desktop Model

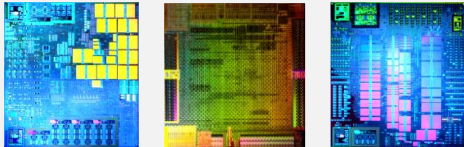


Source: IDC

CLEAR MISSION AND FOCUSED STRATEGY

Connect everything. Empower everyone.

Silicon



Systems



Software

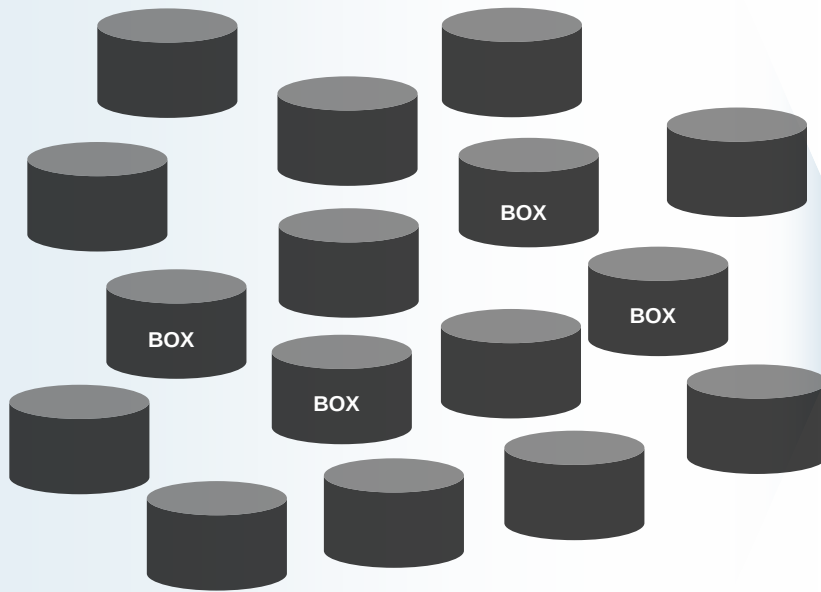


Through high-performance network and industry innovation

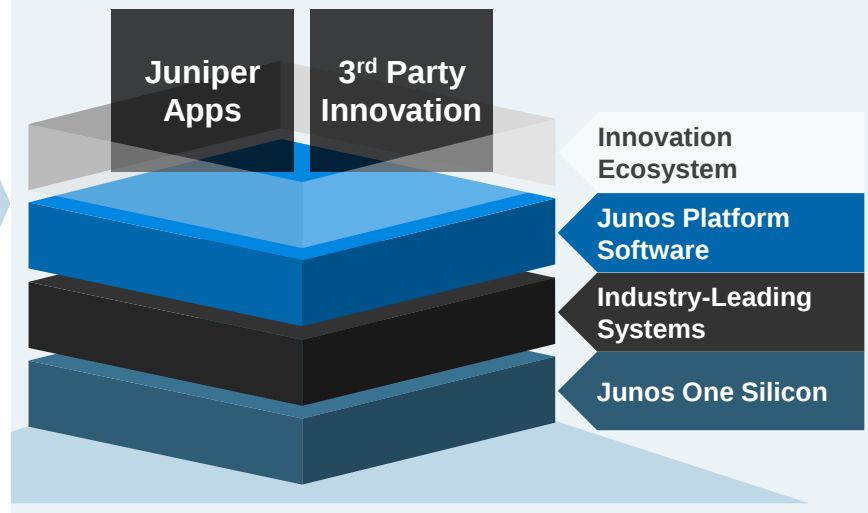
...DRIVE MAJOR MARKET CHANGES

IT'S TIME FOR A NEW NETWORK

Legacy Network: Siloed Point Solutions



The New Network



Demand Exceeding
Legacy Capabilities

It's Time to Transform
Experience & Economics

NEED FOR NEW NETWORK EQUATION

Network Innovation + Ecosystem Innovation = New Network



High Performance
Networking



Partner Solutions



Accelerated Innovation
and Competition Drives...

 Fast

 Secure

 Scalable

 Reliable

 Simple

 Profitable

 Versatile

 Dynamic

 Open

 New, better experiences

 New flexibility and agility

 New customer solutions

 New revenue sources



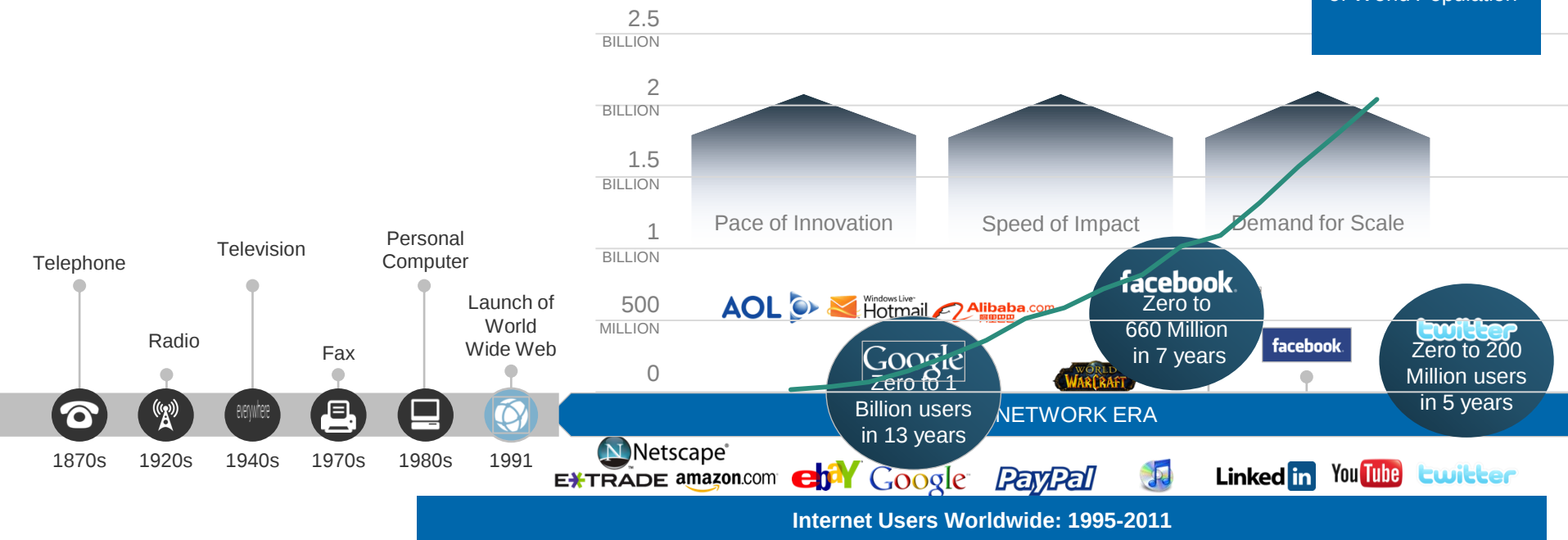
THE NEW NETWORK IS...

PROGRAMMABLE

SOFTWARE DRIVES SCALE

Managing Scale, Performance and Service Monetization

2.1 Billion People
31%
of World Population



DEPLOYERS AND DEVELOPERS

SysAdmin vs Coder

- “Why don’t we run a version of this software from this decade?”
- “Why don’t you write code that respects disks and networks?”

Issues

- Congestion, oversubscription
- Latency != Distance
- Compute-storage separation
- Public cloud ingress/egress charges

Network modeling and planning at core (*)

- More demanding, stochastic traffic
- Greater dynamic range in network flows
- No separate characterization of wireless and wireline



(*) GigaOm, 4/11/11, “How iPhone and Android are Changing the Network,” Pradeep Sindhu interview

OS AND APPLICATIONS: MOVING UP THE VALUE STACK



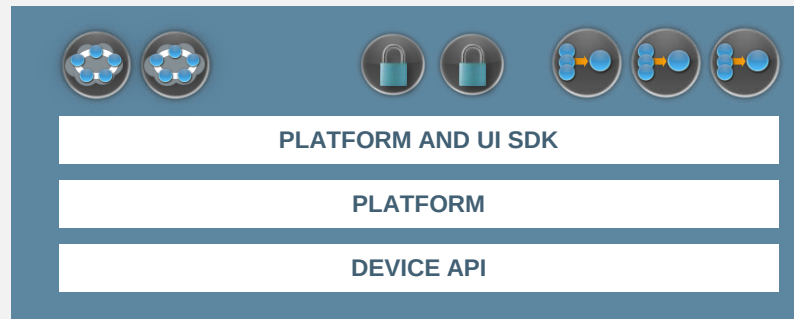
**User
application
layer**



Partner opportunity
for network end-point
innovation



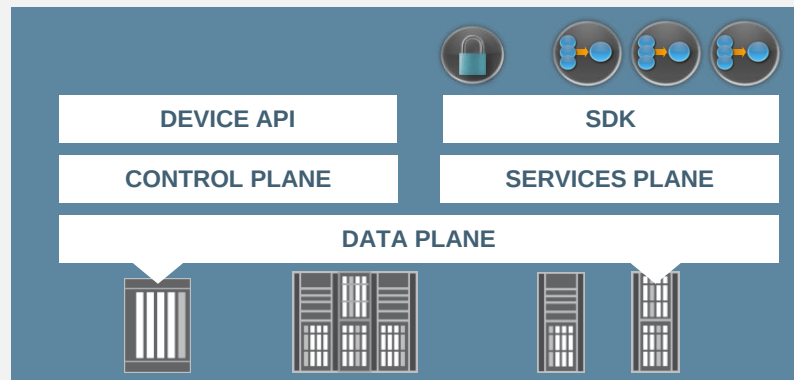
**Network
application
layer**



Developer opportunity
for cross-device
innovation



**Network
layer**



Developer opportunity
for on-device
innovation

ENGINEERING A NEW OPEN NETWORK



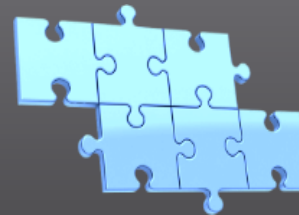
Proven &
Carrier Grade
Networking
Platform



Unified &
Programmable
Network
Platform



Extensible
Development Kit
With Secure
Device APIs and
Tools



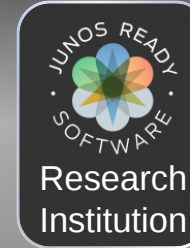
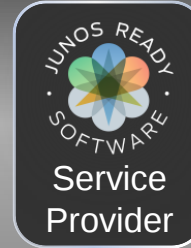
Support New
Scenarios to
Drive Your
Business



PROGRAMMABLE NETWORK PLATFORM VISION – REDUCING COMPLEXITY THROUGH SOFTWARE

Applications

Compiled & Signed
Applications



Common Tools & IDE

Juniper Programmable Network Platform

Building Blocks

Monitoring

VoIP

...

...

APIs

Control
API

Management
API

Data /
Packet API

Network
Topology

Network
Device Mgmt

Endpoint
Aggregation

Endpoint
Security

Network & Beyond

across the Network

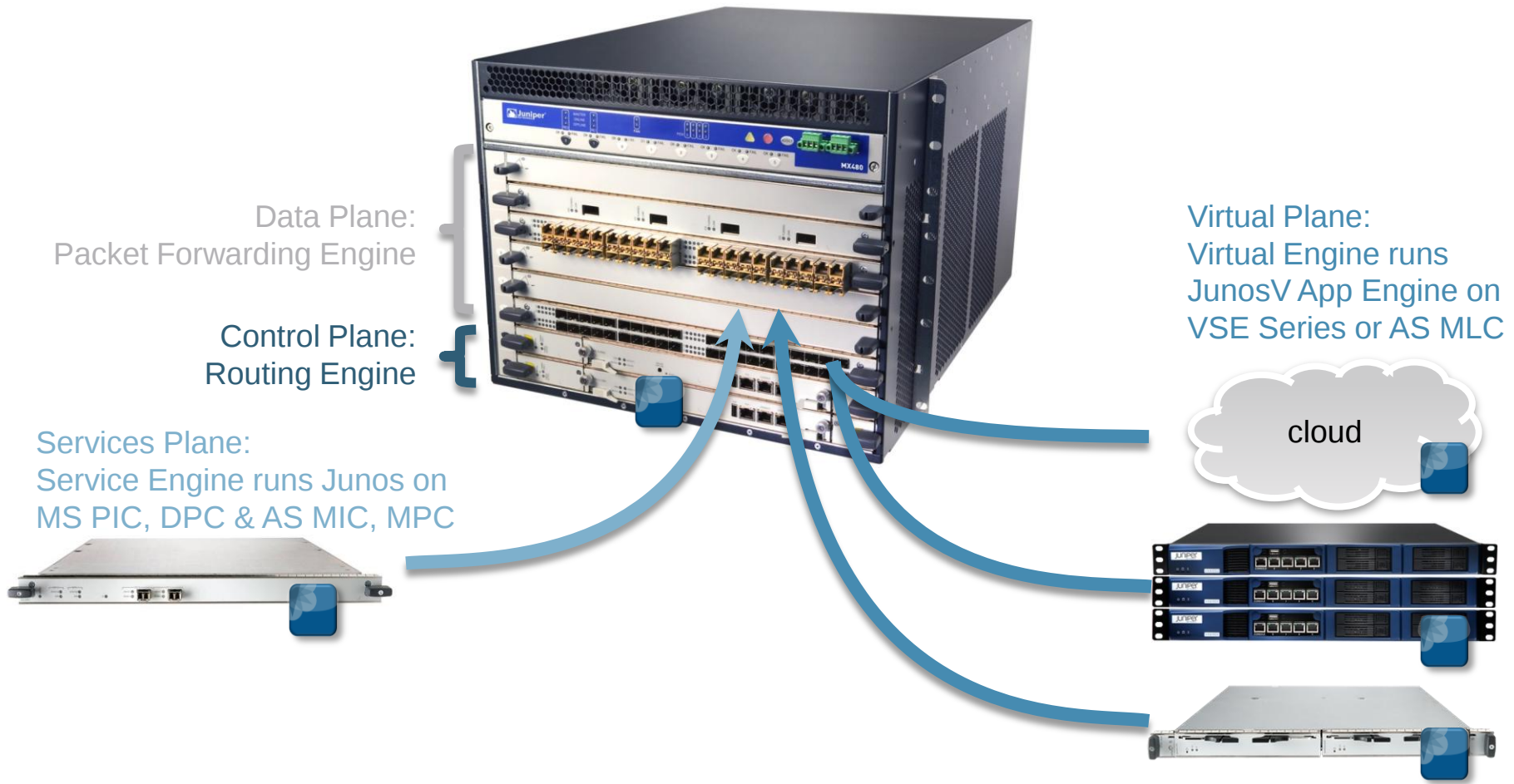
on the Client

in the Network

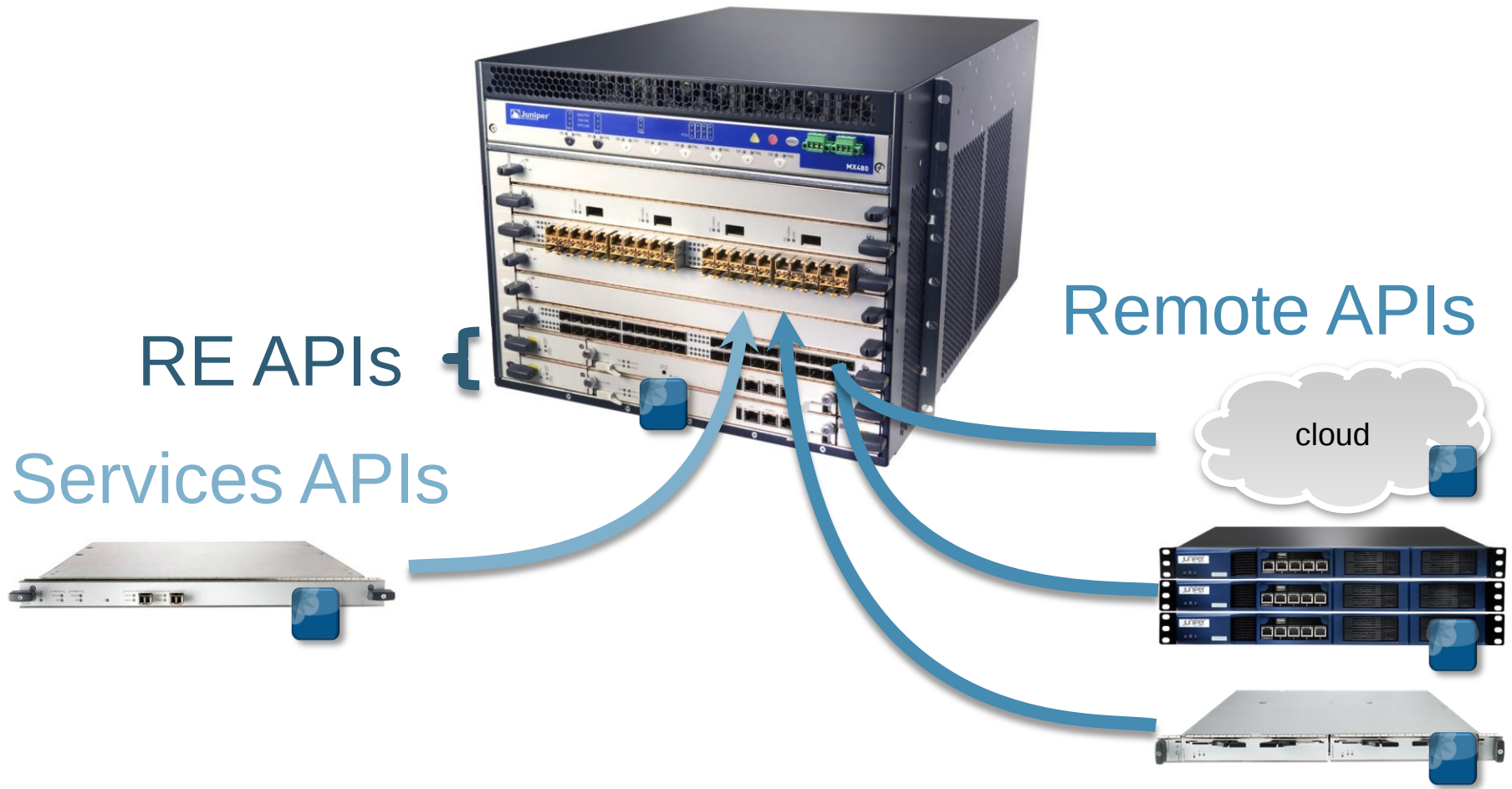


Enterprise,
Mobile,
& Home

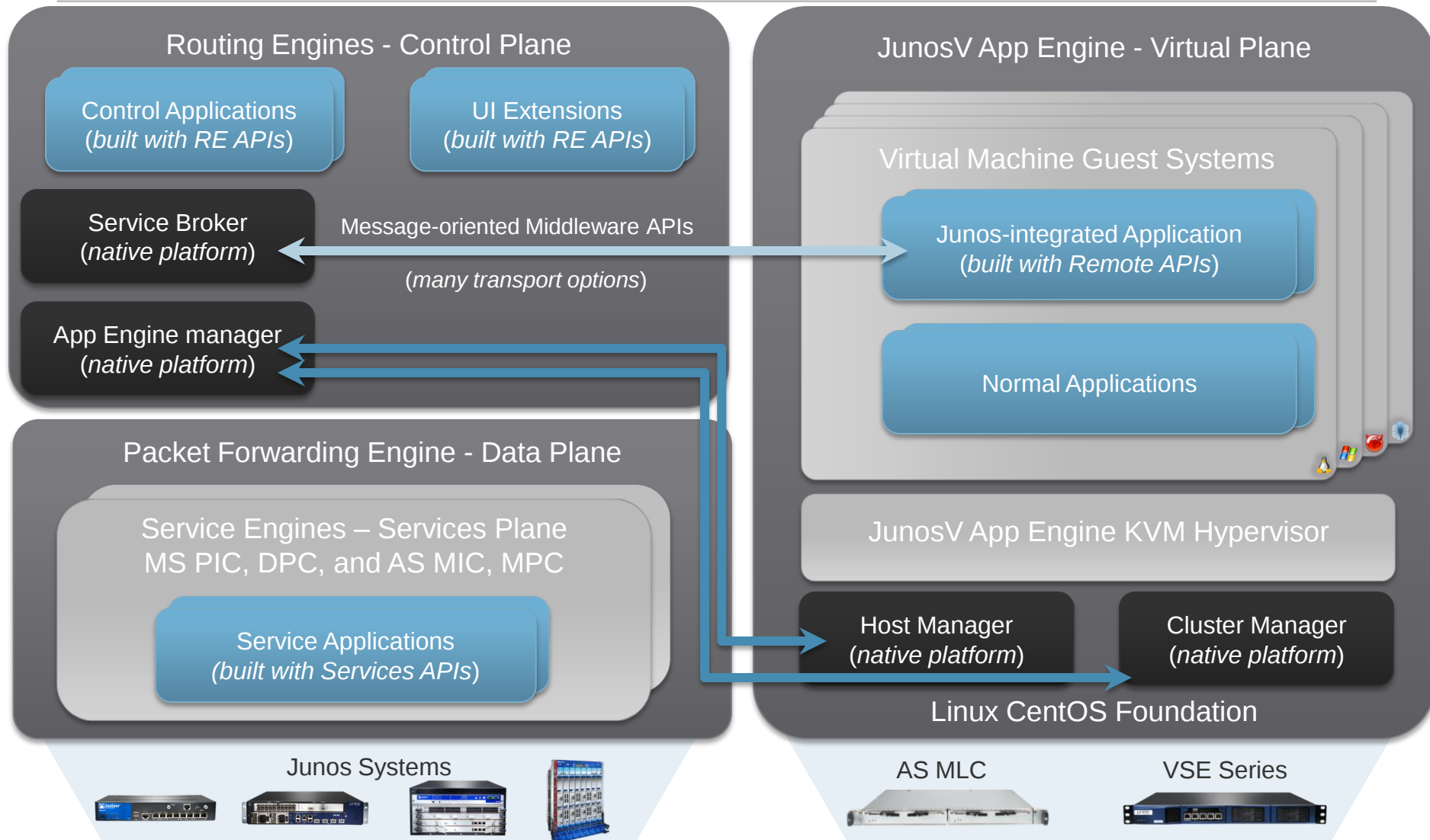
APP ENGINES



APP ENGINES AND API SETS



JUNOSV APP ENGINE + APIS IN JAVA, C, C++, MORE...



JUNOSV APP ENGINE VALUE PROPOSITIONS

CAPEX and OPEX Savings

- Software and hardware consolidation
- Lower cost options than LC
- Scaling compute and storage independently
- Reduced power consumption
- Platform and service mgmt integration
- Deploy using CLI, Space, NETCONF

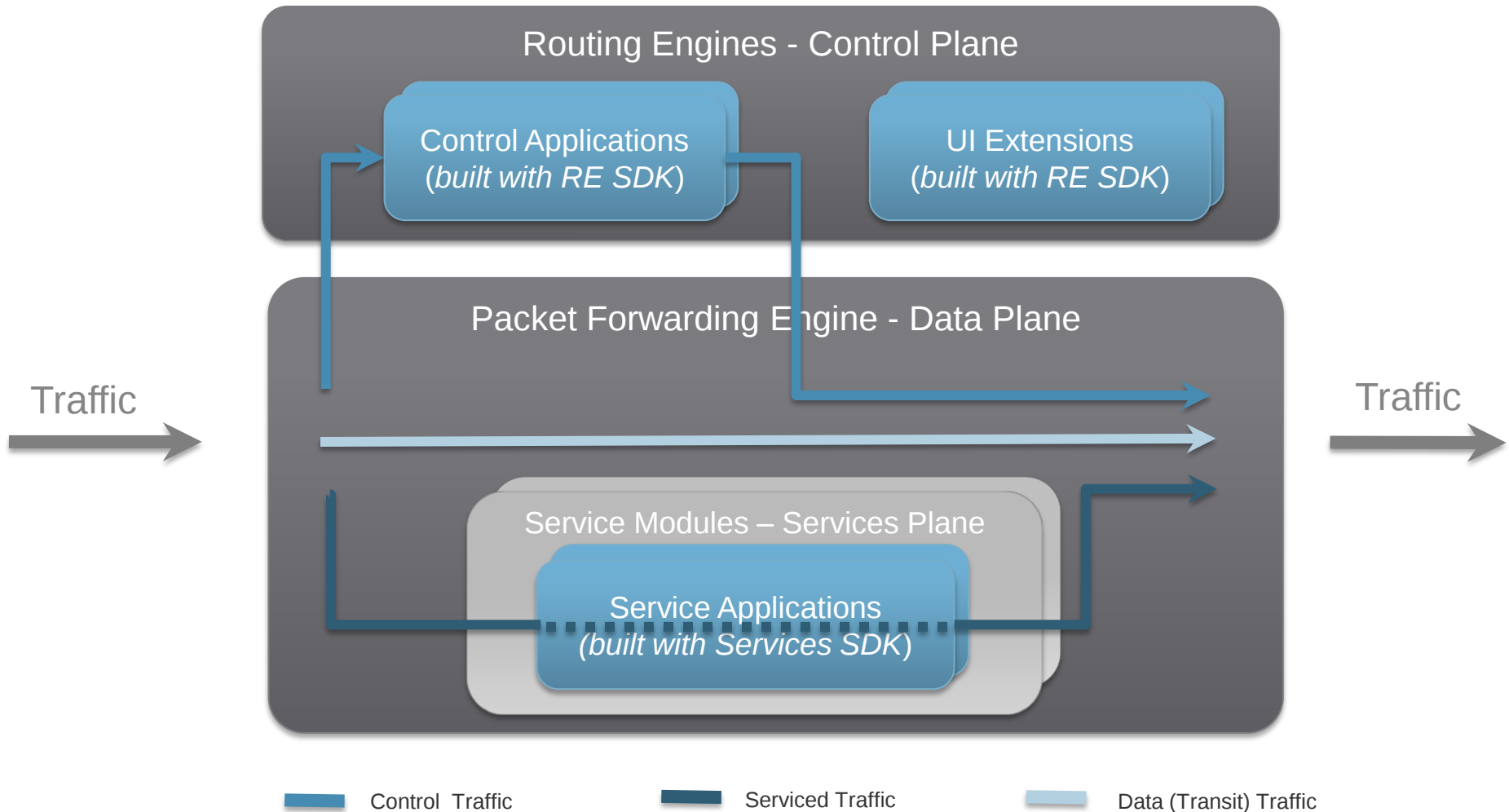
Business Agility

- No service porting, Faster TTM
- No Jnpr dependency, Faster TTM
- Any services applicable to Junos
- Junos SDK Remote APIs in multiple OS and languages
- Cloud architectures
- Efficient, Extensible, Elastic



best of breed platform for network application economics

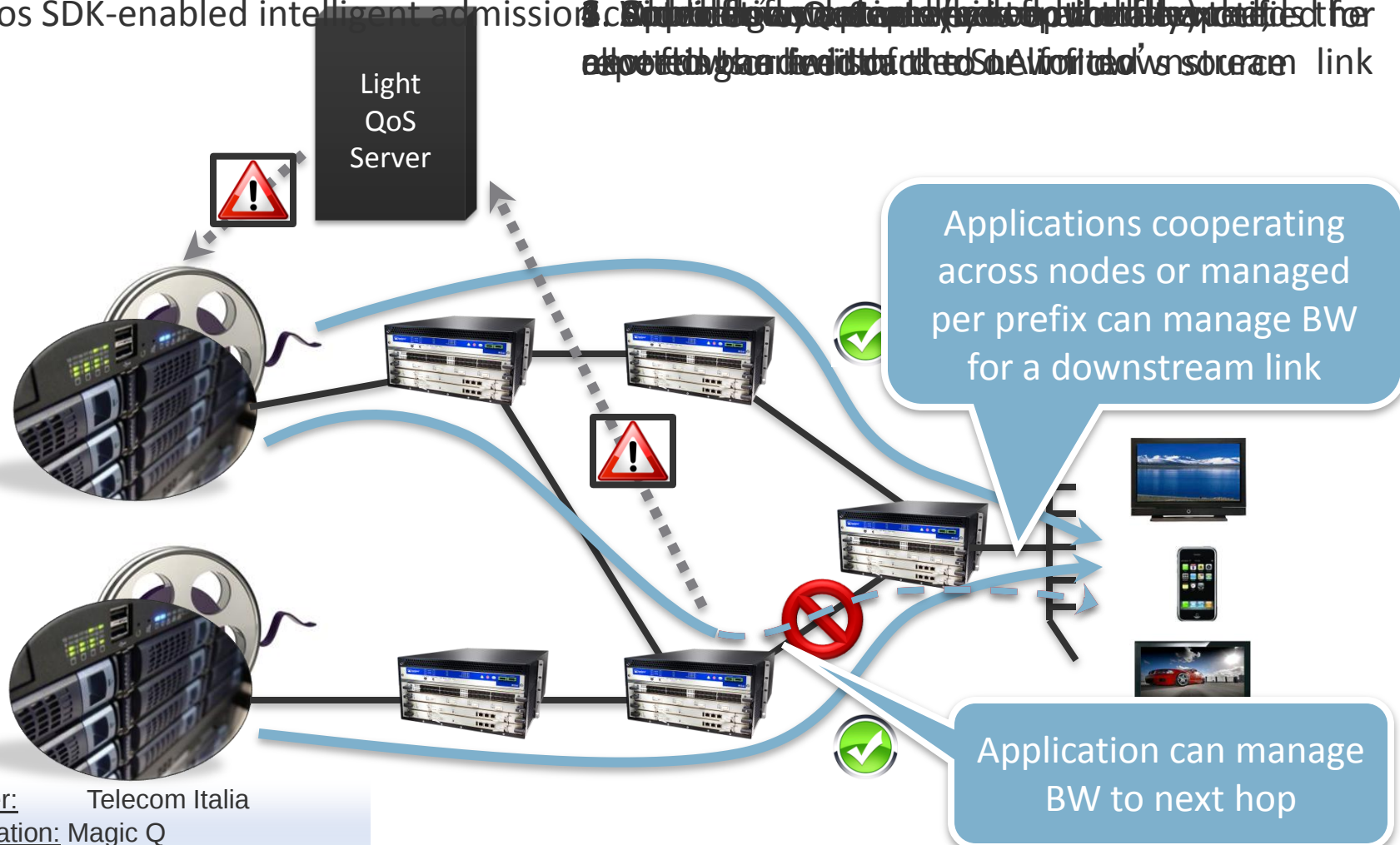
APPLICATIONS IN THE JUNOS ARCHITECTURE



EXAMPLE:MAGIC-Q BY TELECOM ITALIA

IMPLICIT ADMISSION CONTROL

Junos SDK-enabled intelligent admission control (Light QoS) can be configured for applications to manage bandwidth of the downstream link according to the needs of the service or stream



Partner: Telecom Italia
Application: Magic Q

JUNOS SDK RESOURCES

DEVELOPER TOOLS

Installer

Eclipse IDE Plug-in

Virtual Build Environment

Toolchain

Signing Server

UI Simulator

PLATFORM APIS

Common Features

Control Plane Features

Service Plane Features

Device-specific Features

LEARNING

Developer Guide

API Reference Guide

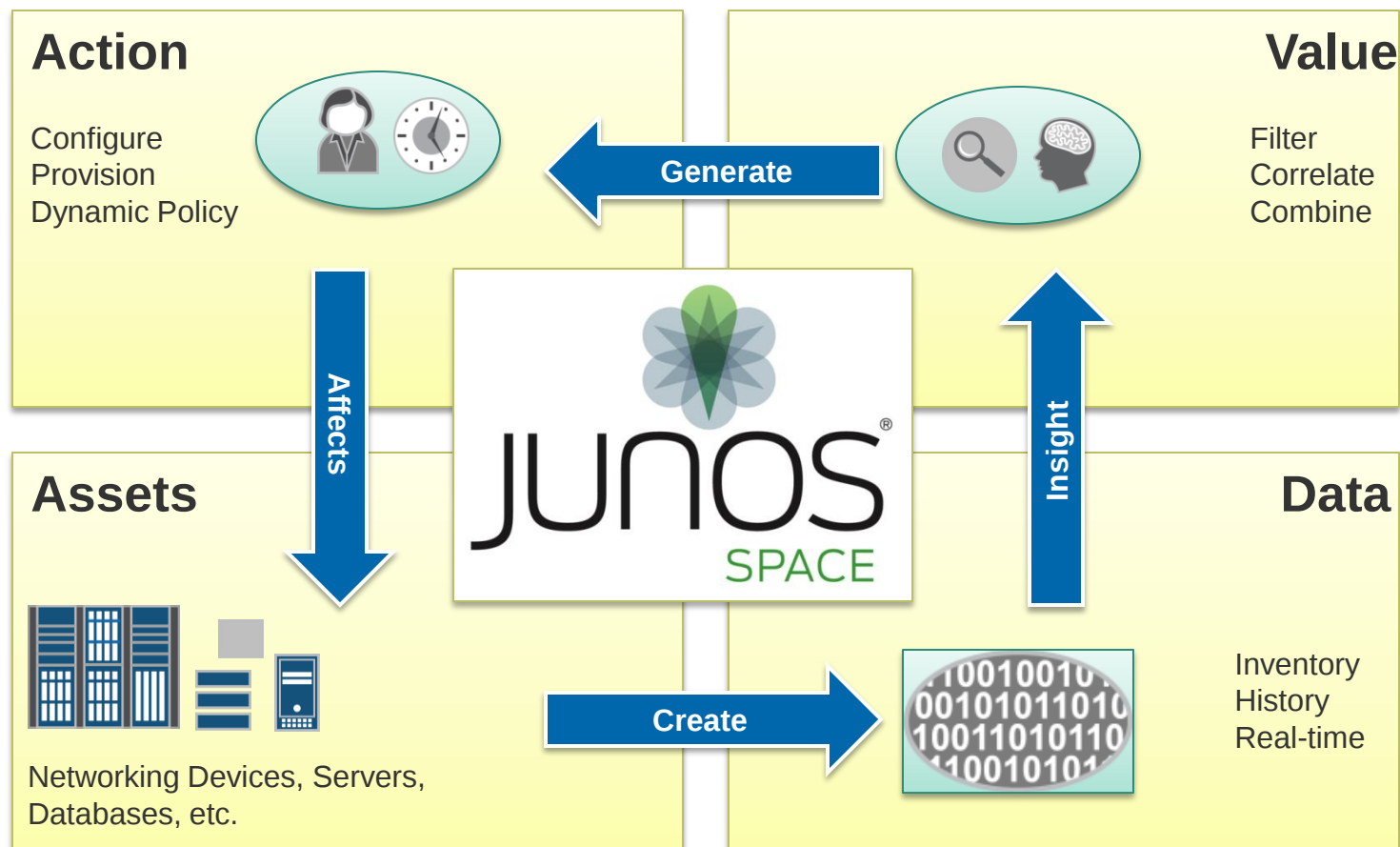
Sample Apps

Inline Help

Training

Workshops

CREATING BUSINESS VALUE FROM NETWORK ELEMENTS



OVER 125 PARTNER AGREEMENTS IN PLACE

radware



joulex



EXTRADE



ERICSSON

HCL



HARRISON
MEDICAL CENTER

SevOne

NEXTWORKS
ENGINEERING FORWARD



tufin



Comlinx

PutahGreen
Systems



Infosys
POWERED BY INTELLECT
DRIVEN BY VALUES

MITRE



Dhyan
Infotech





IT'S TIME FOR A REVOLUTION IN DEVELOPMENT.

**THE NEW NETWORK IS A PROGRAMMABLE NETWORK.
POWERED BY THE JUNOS DEVELOPER PLATFORM.**

Junos is changing the way developers build and deploy dynamic and data-driven network applications and services. Come join the revolution. Register for the Juniper Developer Network and start building today.

[REGISTER](#)

GET STARTED WITH:



JUNOS AT THE CORE

APIs and tools to create network-aware applications.



JUNOS ON THE NETWORK

APIs and tools to create apps that drive the network.



GET INVOLVED

Register for the Juniper Developer Network to access code and join the conversation.

QUICK LINKS



Register & Download

Jump-start development with Junos. Developing applications for your network just got a whole lot easier.



Application Gallery

Apps on Junos and Junos Space will provide you the solutions software components from the subscriber to the data center. Everything you need for your



Events

Join us at upcoming events to learn about apps and development for the Junos Platform.

[> Join us](#)



THE NEW NETWORK IS...

SOFTWARE DEFINED

WHAT IS SDN?



ESTABLISHING SHOT

Why is the industry talking about OpenFlow?

Why does the industry seem to think this will sink traditional networking players?

What is the hype all about? What do people think it will do?



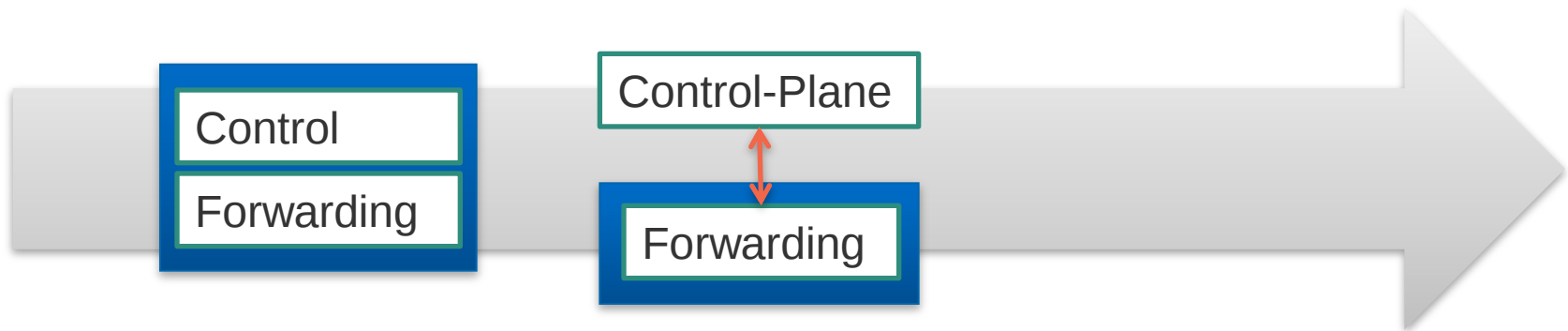
OPENFLOW – THE PROMISE

Standardizes interface above the network devices

Open protocol to allow flow-tables in switches & routers to be programmed centrally

- small set of primitives

OpenFlow: *“increases network functionality while lowering operating costs through simplified hardware, software and management.”* – Open Network Foundation



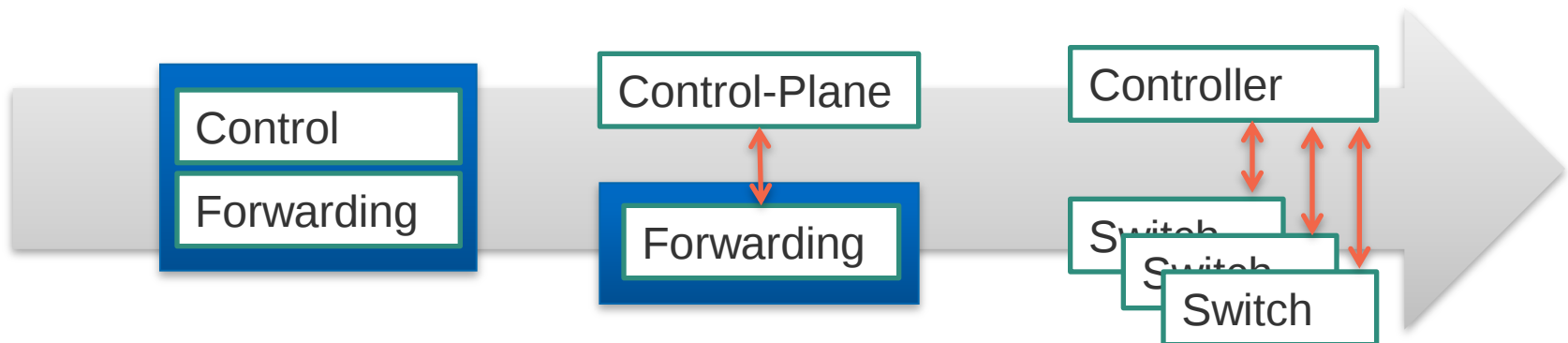
OPENFLOW – THE PROMISE (2)

Two Roles

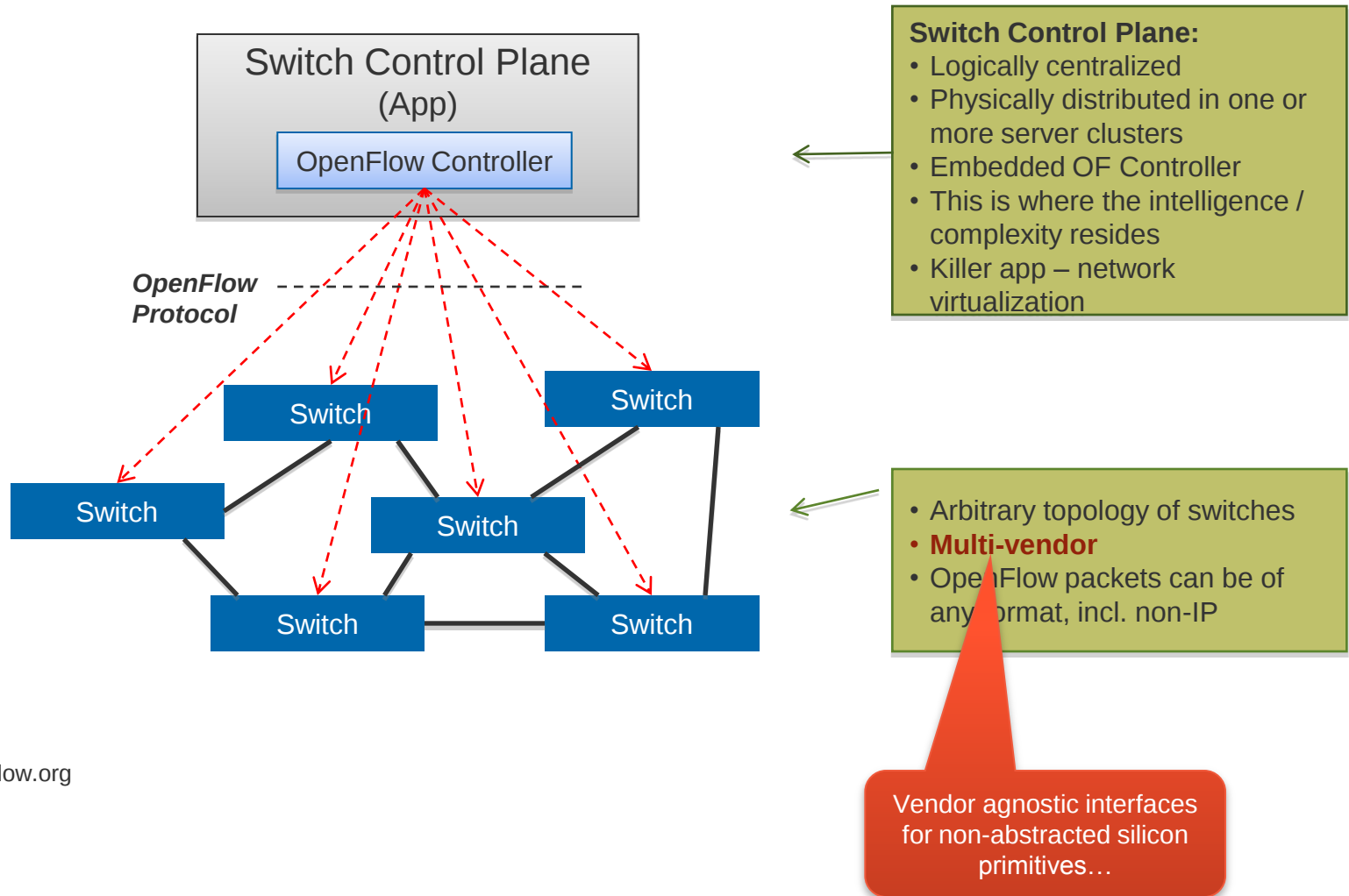
- OpenFlow controller
 - Controls one or more switches
 - Computes paths, maintains state, formulates flows and pushes to OF Switch(es)
- OpenFlow Switch
 - Takes commands (flows, stats) from OF controller
 - Holds the FIB in volatile memory (not configured)

Two modes of operation

- Reactive - Data plane driven (“Packet-in”)
- Proactive – Pre provision flows

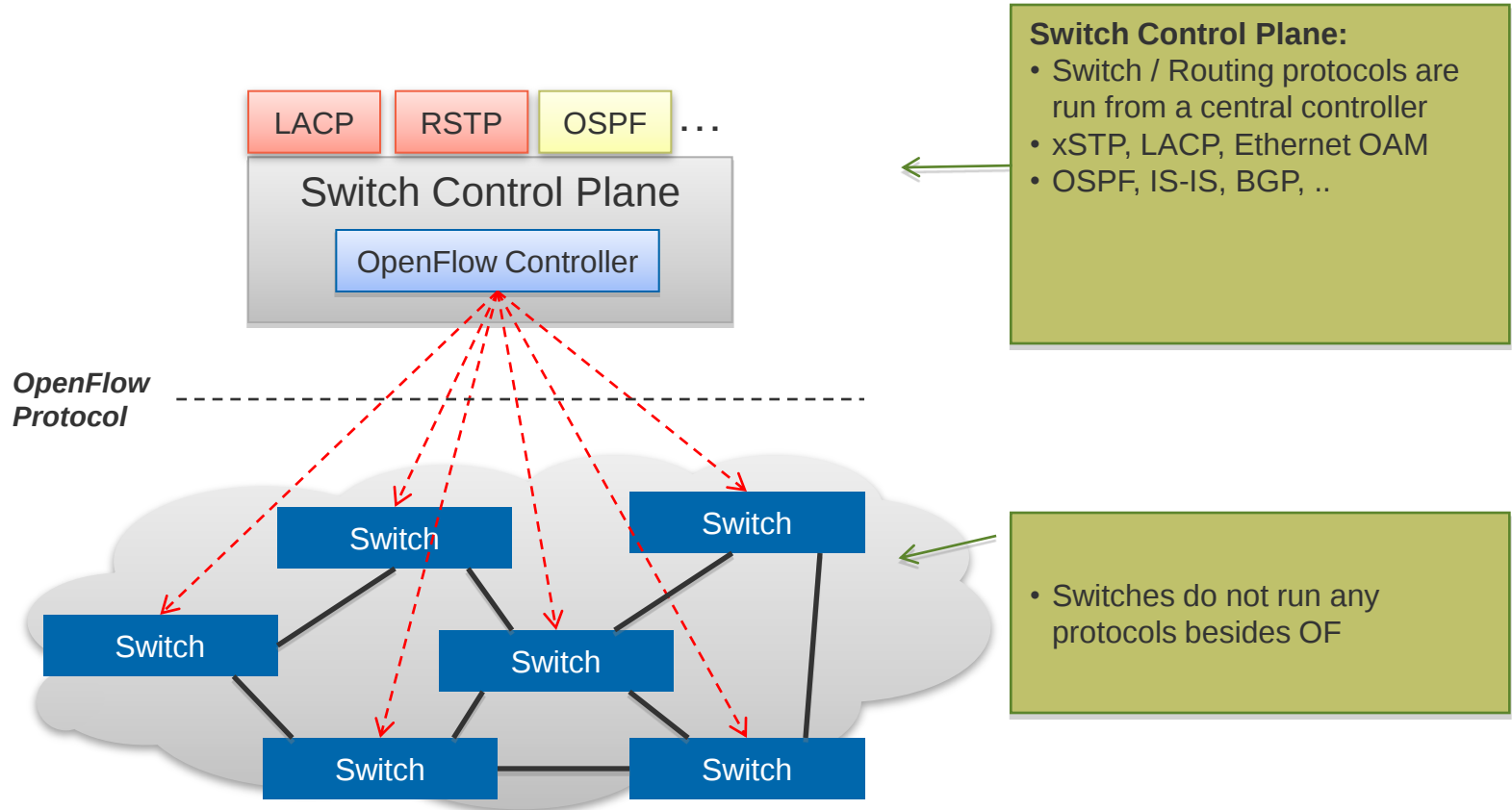


OPENFLOW SWITCH/NETWORK DESIGN



Source: OpenFlow.org

WHERE DID THE PROTOCOLS GO?



How do we establish and discover topology?
How do we get to each node?

OPENFLOW STATUS

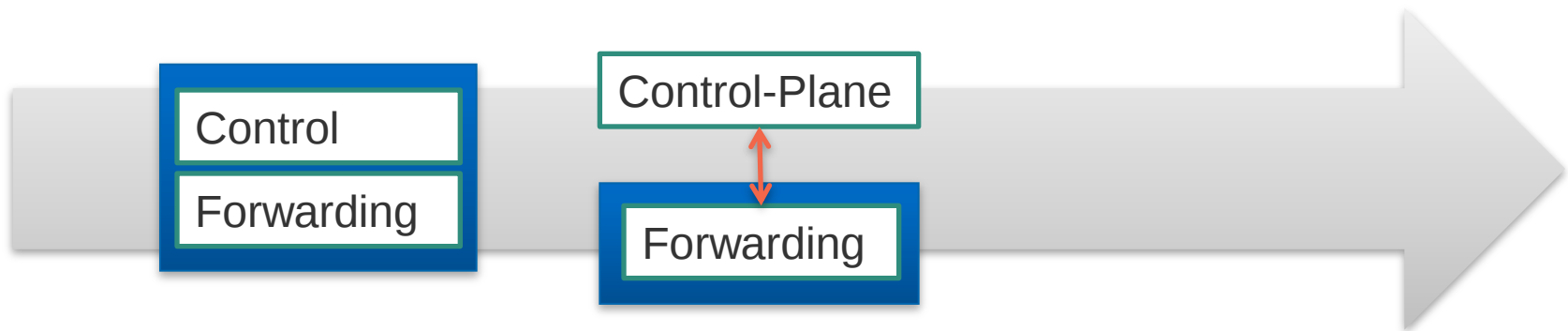
OpenFlow is a protocol and API, not a product or single feature

- Standardize interface between control and forwarding plane(s)
- Flow tables populated through OF used for forwarding packets
- Remote programming

OpenFlow is used to populate forwarding table

- Flow entries programmed through OF
- Switch performs lookups in flow table
- Forwarding table is not stored in configuration file

OpenFlow does not configure, boot or maintain a box



WHY DO WE NEED OPEN PROGRAMMABLE NETWORKS?

CHALLENGES TODAY

Network operators have constrained ability to create or seize opportunities for new business

Legacy services with complexity
• Unintegrated integration cost

Enterprise “specific” challenges

- Managing increasing complexity
 - Virtualization, Policy, Identity, Roaming, ..
- Insertion of 3rd party devices in the network
 - Firewalls, DPI, compliance, ..

network

... created as cost center
... opportunities have to conform to short-term cost gain strategies

There is a theme here...

41



CURRENT APPROXIMATION TECHNIQUES ARE BARELY SUFFICIENT

APPLICATION WORLD: GUESSING	NETWORK WORLD: DERIVING
 Applications blindly probe the network to understand what it can deliver ? Network Aware Applications ? ▪ Game ping-stats, doppler, geo-location, whois ▪ Proprietary codecs ▪ Approximate topology/location	 Networks spy on traffic to try to understand applications ? Application Aware Networking ? ▪ Deep Packet Inspection ▪ Stateful flow analysis ▪ Application fingerprinting ▪ Service specific overlay topologies

WHAT DOES THE IDEAL WORLD LOOK LIKE?



End-user



Application



Network



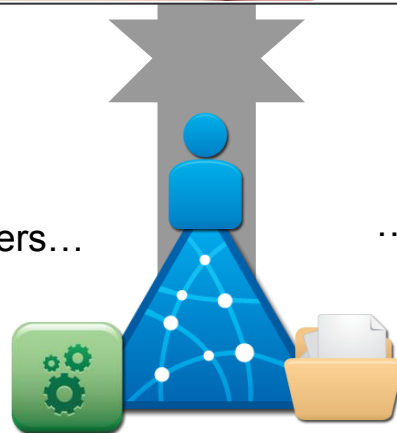
Content

**Application
World**



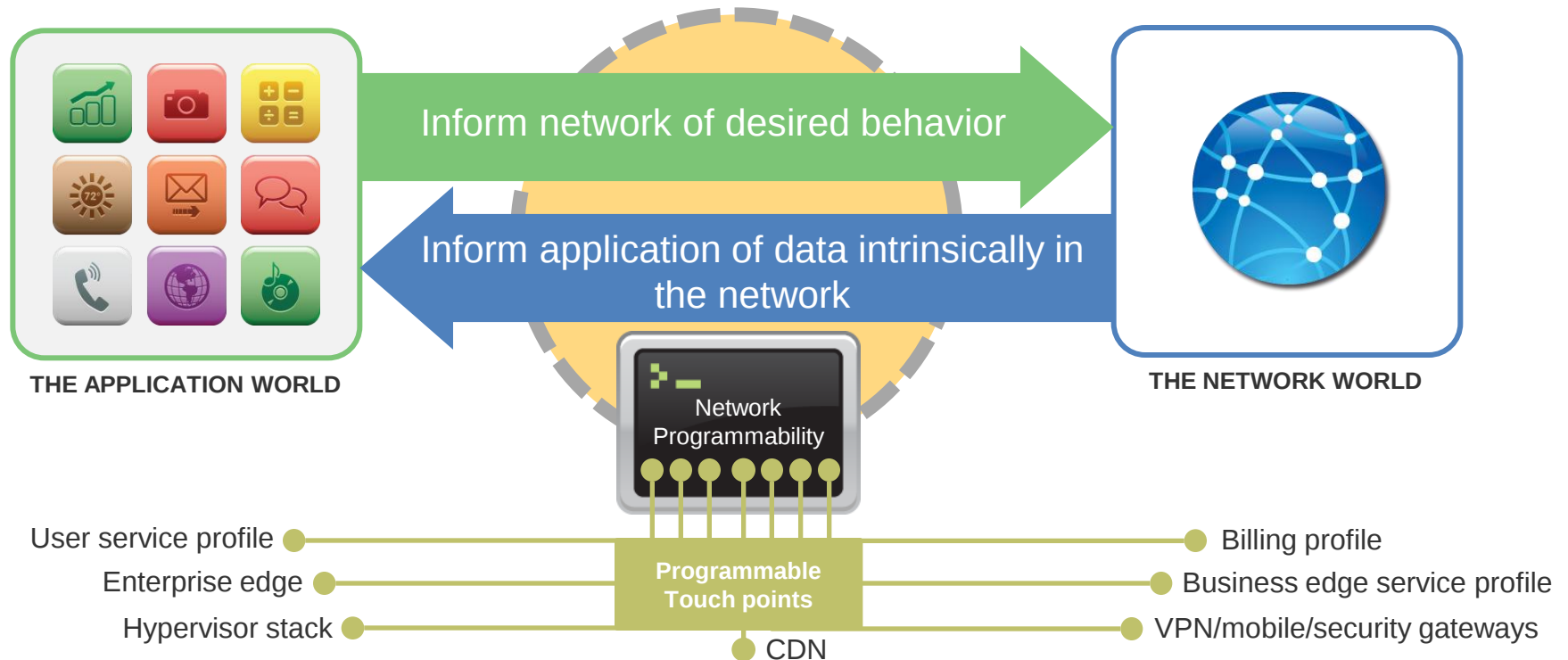
**Network
World**

Bringing together the important players...



... to enable interaction and influence the experience of the end user

WHAT BRINGS THE TWO WORLDS TOGETHER?

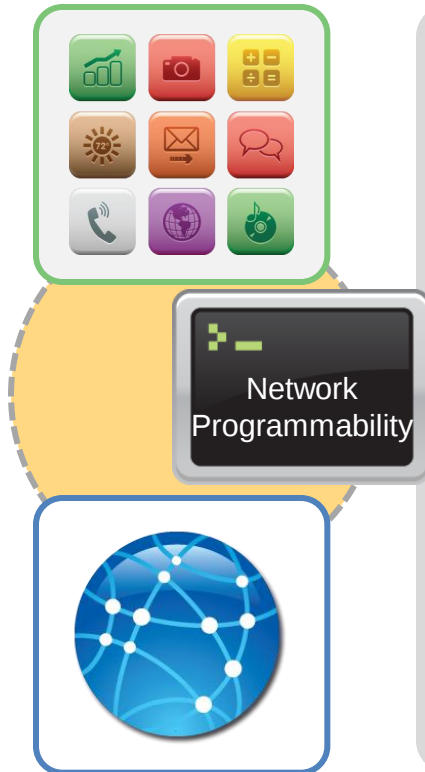


Touchpoints to extract information or influence behavior.
Platforms use touch points. Developers use platforms.

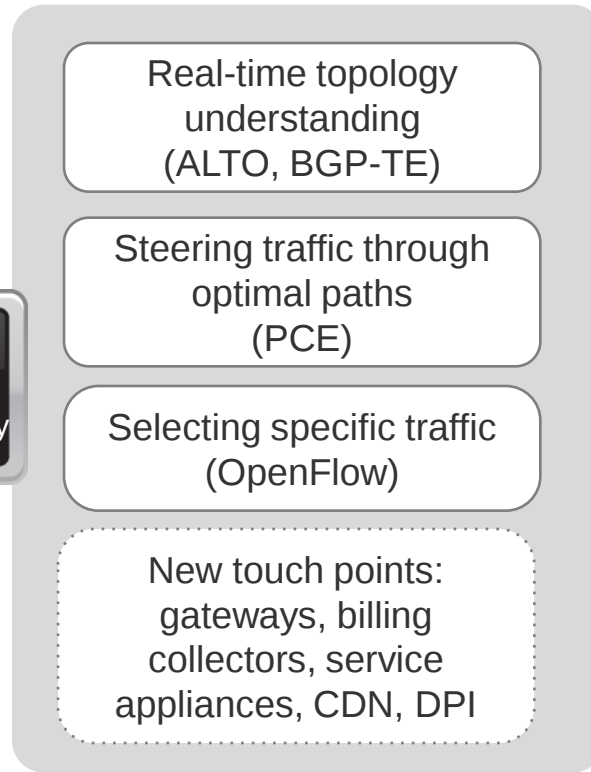
HOW DO WE MAKE THIS HAPPEN?

Without breaking everything

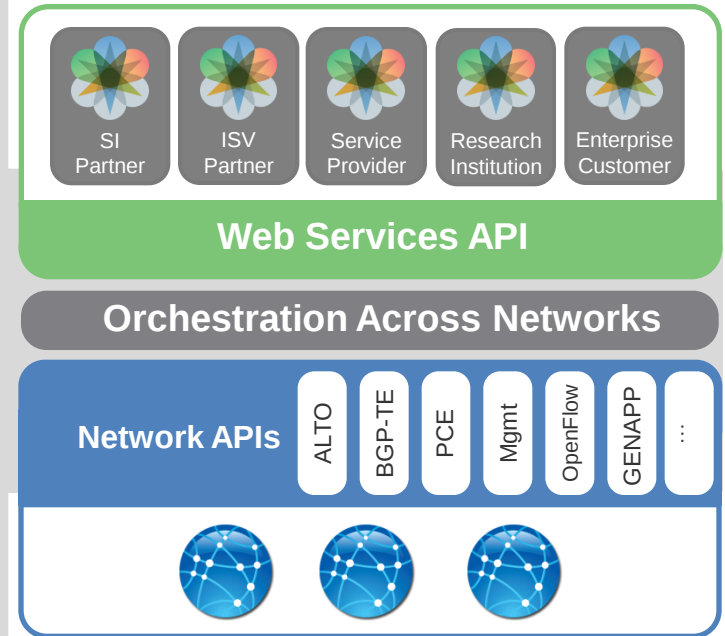
THE APPLICATION WORLD



THE NETWORK WORLD



THE APPLICATION WORLD



THE NETWORK WORLD

Abstraction is necessary to reduce complexity.
Requires infrastructure with flexible and deep touch points

WHAT ARE OUR PROOF POINTS?

Juniper has been delivering SDN solutions for a decade

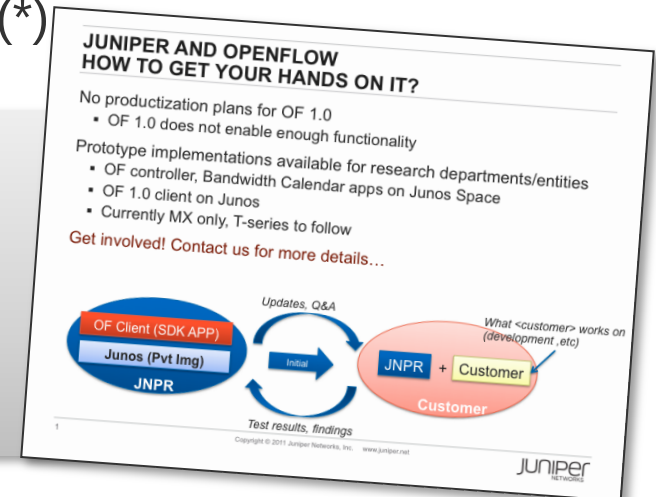
We have working prototypes demonstrating Network Programmability

- Focus on applicability to application rather than protocols
 - Bandwidth Calendaring, Cloud Bursting
- Other interesting protocols are part of this
 - OpenFlow 1.0 client on top of Junos SDK
 - Application Layer Traffic Optimization – ALTO
 - BGP-Traffic Engineering
 - Path Computation Element Protocol
- Current platform targets: MX-series, T-series (*)

We are learning together with our customers

Providers & Academics get access to prototype code (New!)

- France Telecom, Google, Comcast, DT, NTT Data, ..
- Stanford, Indiana University, i2cat, Internet2, ..



EXAMPLES OF NETWORKED APPLICATIONS

Content / Service routing	Locate best copy of content for end-user, applying custom rules
Managed content distribution	Content pre-positioning to caches Live events
Map-reduce class applications	High-end distributed computing (HPC)
Cloud OS network operations	Moving of VMs, applications and storage between locations
Cloudburst	Flexible & on-demand allocation of cloud and network capacity
Security	DDoS attack prevention Clean-pipes

WHAT IS JUNIPER OFFERING?



THE GOALS ARE THE SAME

The New Network



Software
Defined Networking



Increase the Rate of Innovation

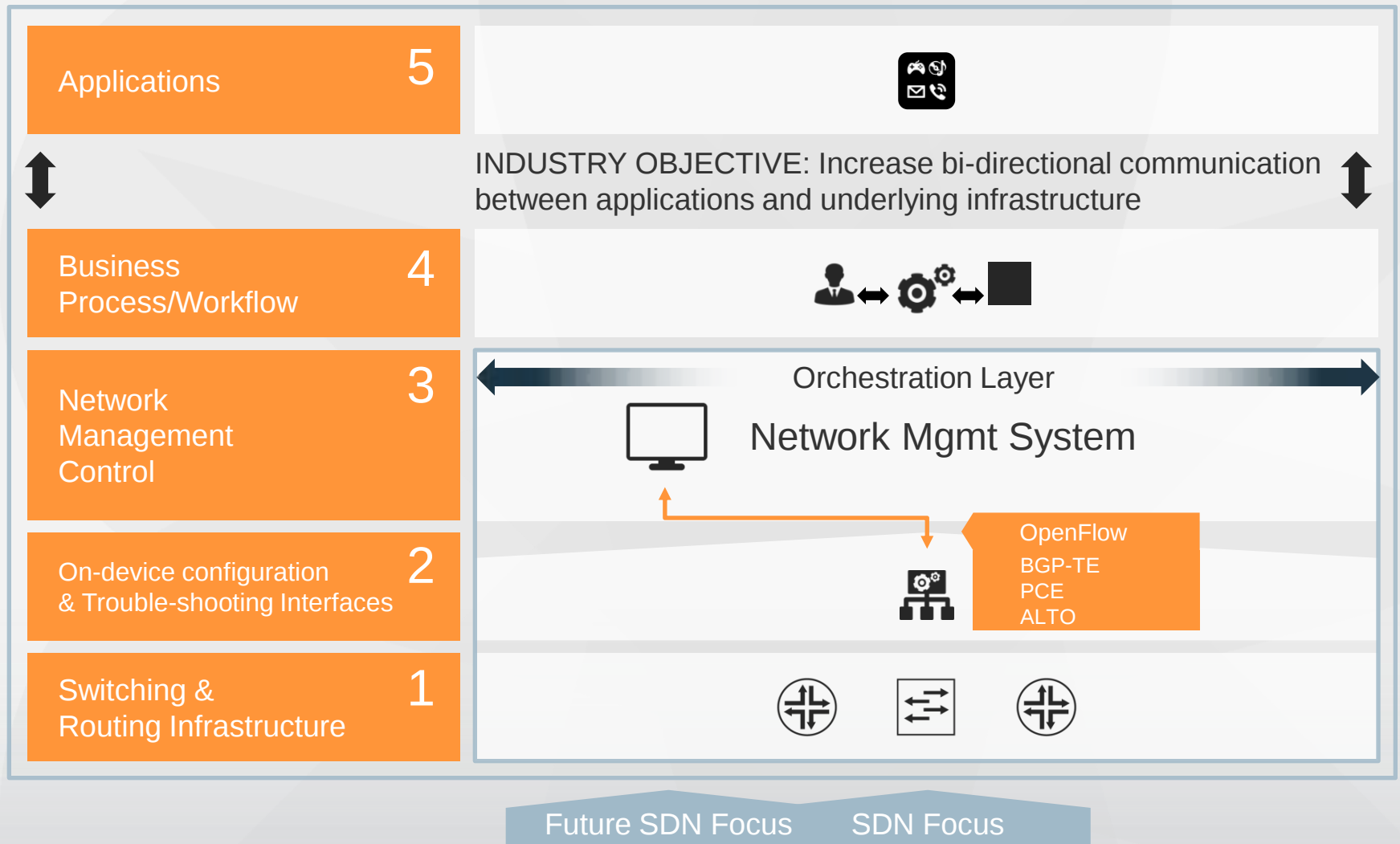


Improve Opex through Automation



Reduce Capex through Virtualization

BROADBAND SDN APPROACH



PRINCIPLES BEHIND OUR APPROACH

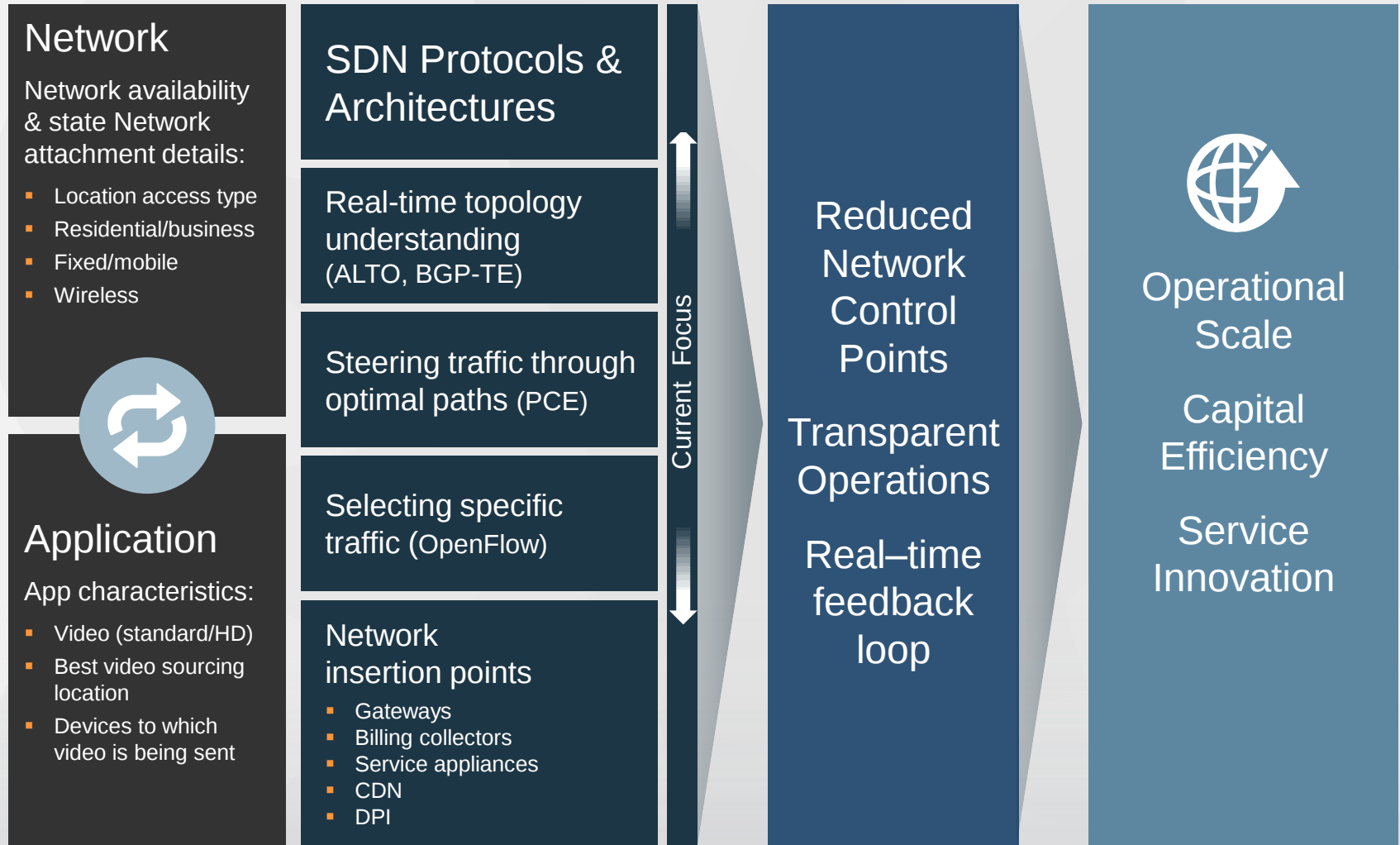
Centralize what you can, distribute what you must

Design using the smallest number of general building blocks

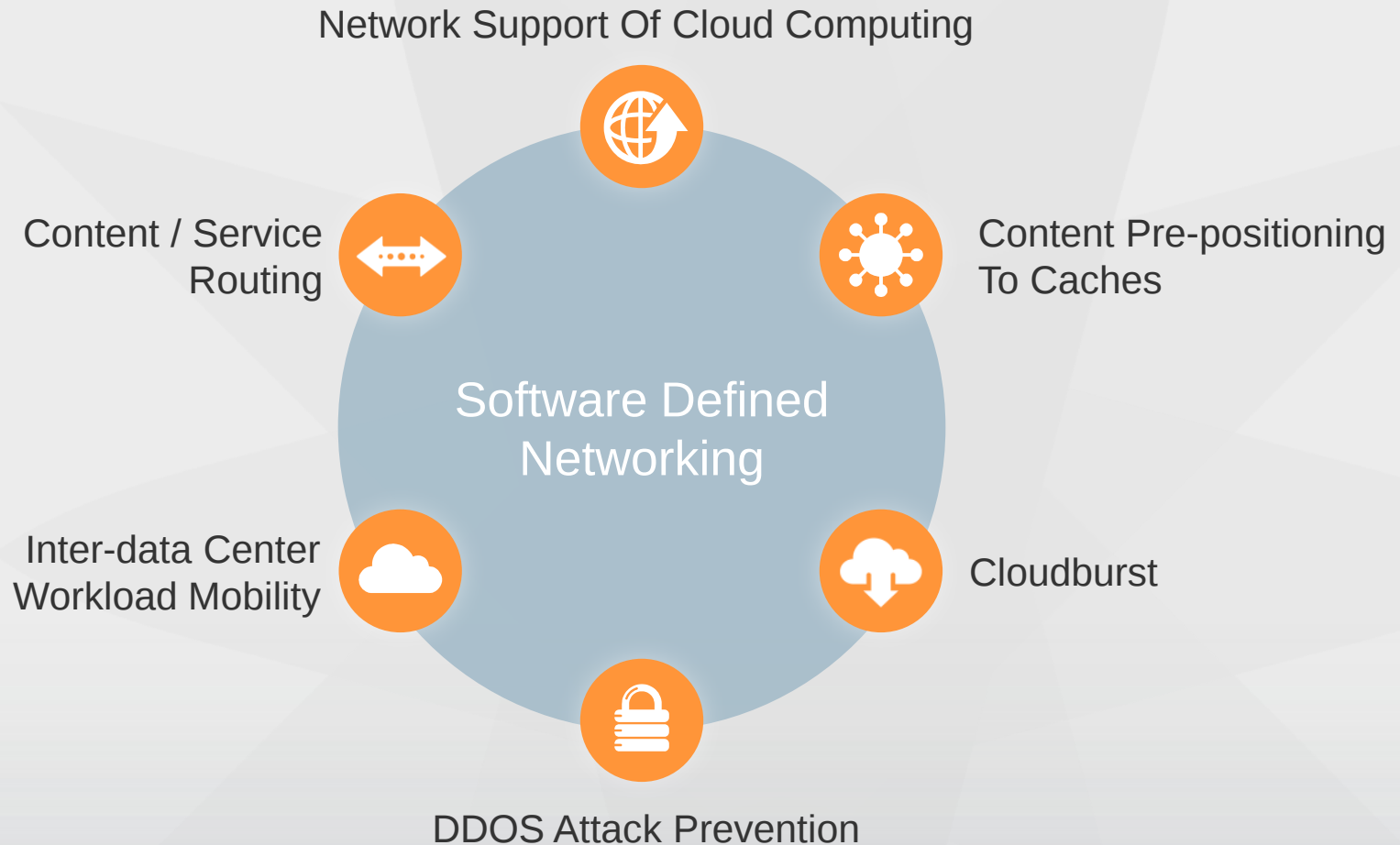
Automate anything that can be automated

Support open standards wherever possible

SDN ENHANCES OPERATOR AND APPLICATION EXPERIENCE



SDN-BASED NETWORK APPLICATIONS



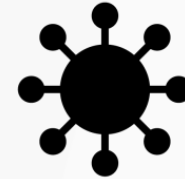
JUNIPER LEADS SDN



Active Member
Of Open Networking
Foundation



Founding Member
of ONRC



Juniper OpenLab



Standards Leadership

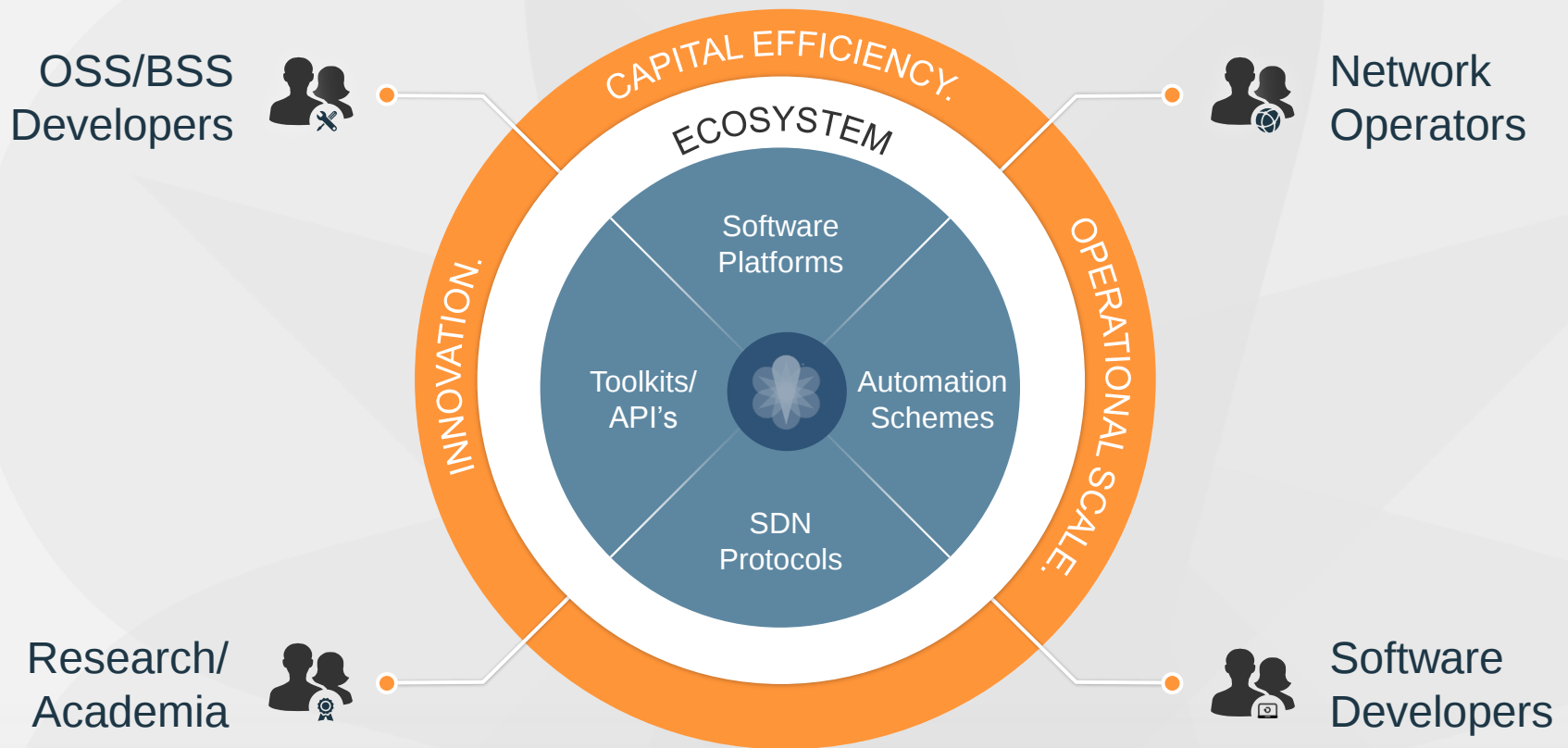


Board Member of
US Ignite



Juniper Developer
Network

THE OPPORTUNITY



Join industry dialogue

Help advance protocol standards, use cases and industry best practices



everywhere