Programmable WAN Networking is SFW

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The Developer and The Network

Improving user experience by programming the network

Real Problems. Real Revenue. Real Attention.

Beyond ferreting the information

Current approximation techniques are barely sufficient and inefficient

APPLICATION WORLD: GUESSING

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

NETWORK WORLD: DERIVING

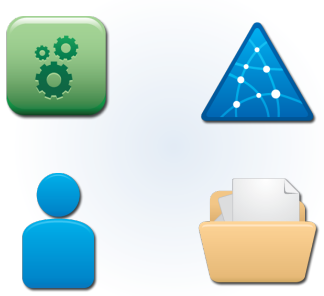
Networks spy on traffic to try to understand applications

? Application Aware Networking ?

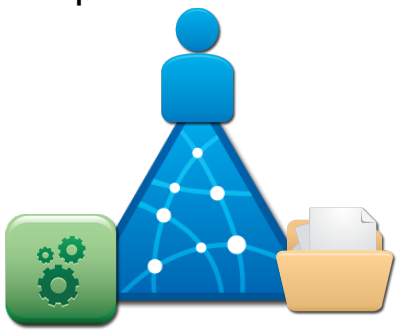
- Deep Packet Inspection
- Stateful flow analysis
- Application fingerprinting
- Service specific overlay topologies

How to ensure the best experience?

Bringing together the important elements …



… enabled via real-time interaction to influence the experience of the end user



Application: Knows end-device capabilities. Proximity of end-user to content. Controls resources.

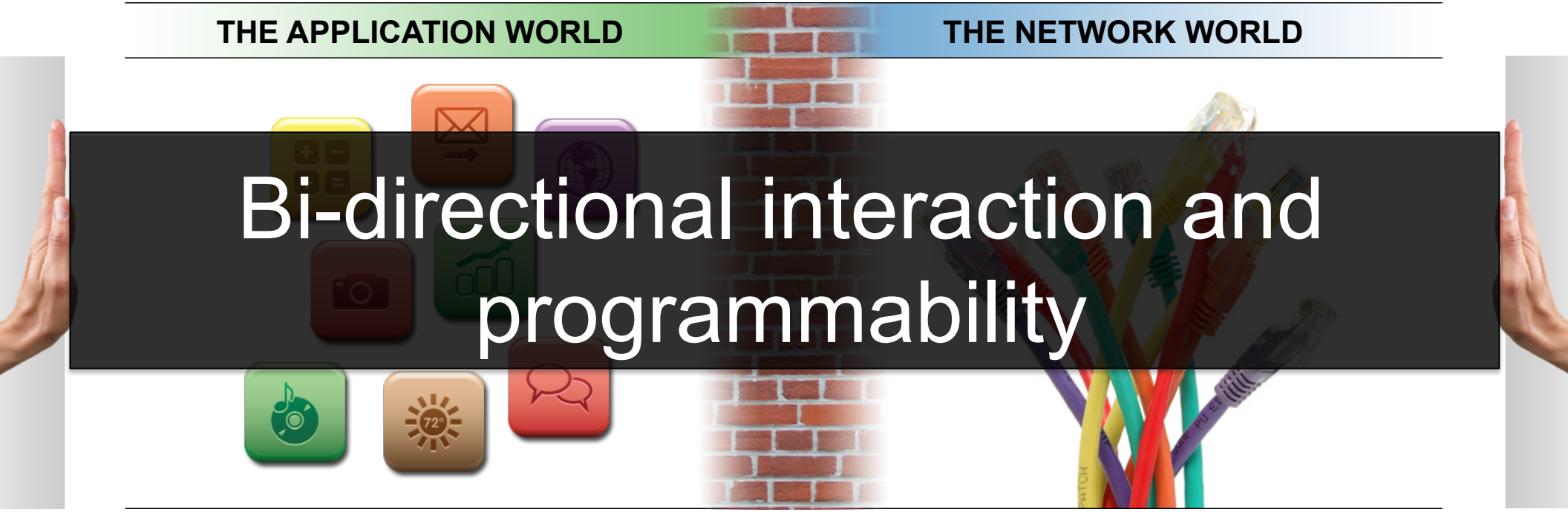
Content: Adjusts placement, selection & insertion of content from analytics.

End-User: Knows what it wants and is directed there

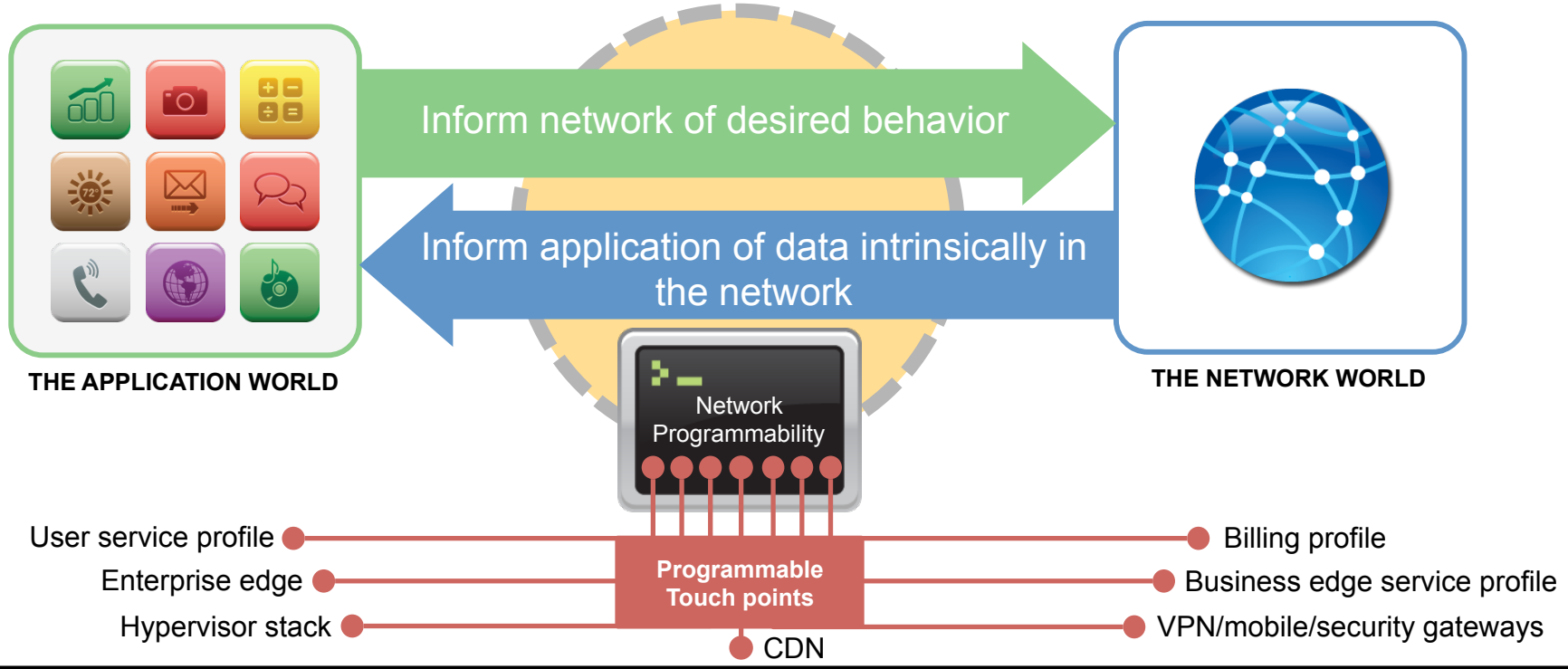
Network: Real-time interaction between application, content and end-users.

Let's talk about why networks & applications need to work together

What brings the two together?

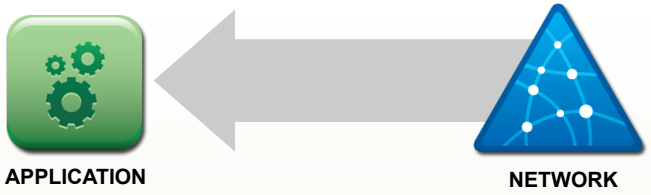


Interaction at multiple touch points



Extract information or program desired behavior

What is possible in this new world?



Applications made better by <u>information</u> from network

- Understanding of end-device capabilities
- Real location / topology
- Adjust behavior to real-time usage
- Billing granularity

Flexibility of service placement

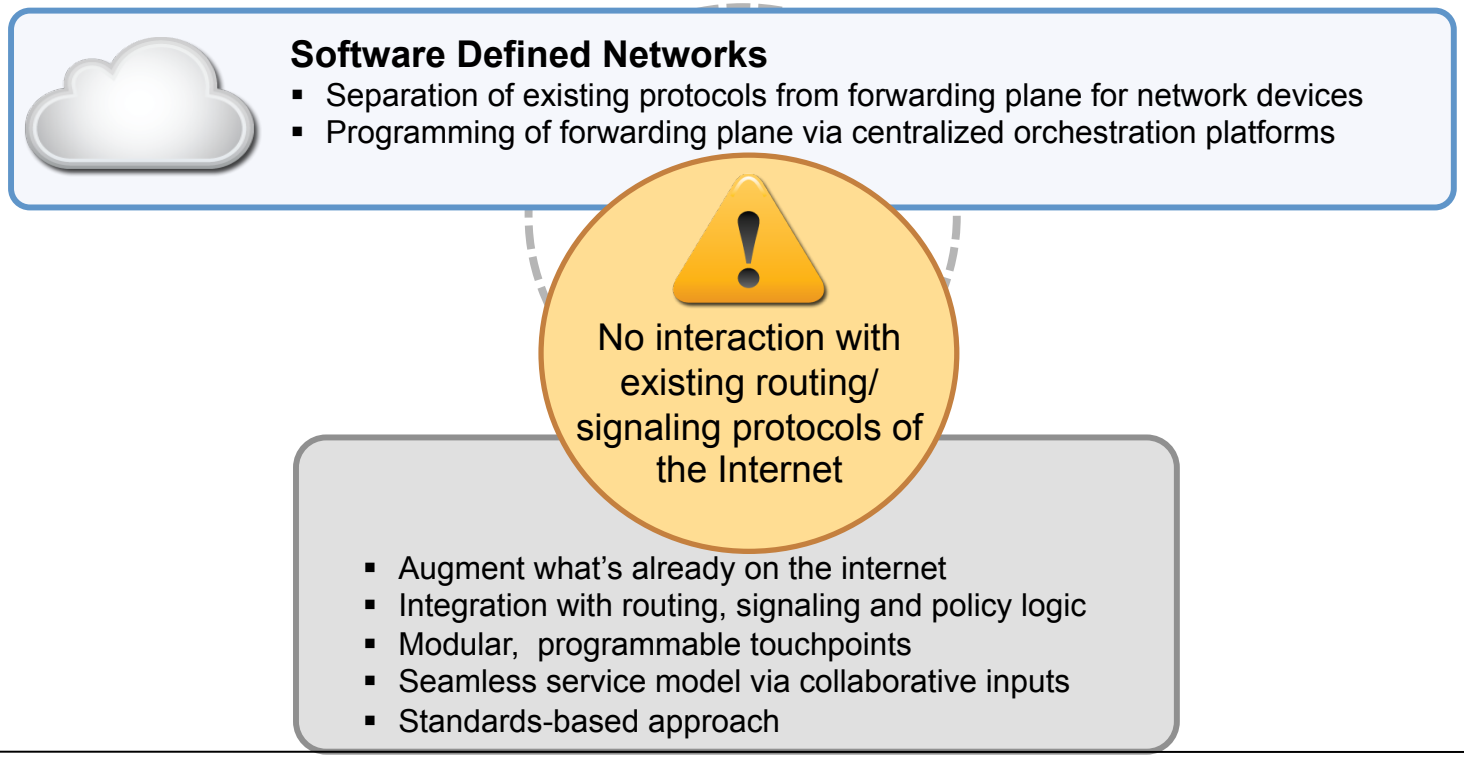
Networks made better by <u>information</u> from application

- Bandwidth and resource optimization
- New service topologies
- Security identification
- Service-specific packet treatment

Control of resources from applications

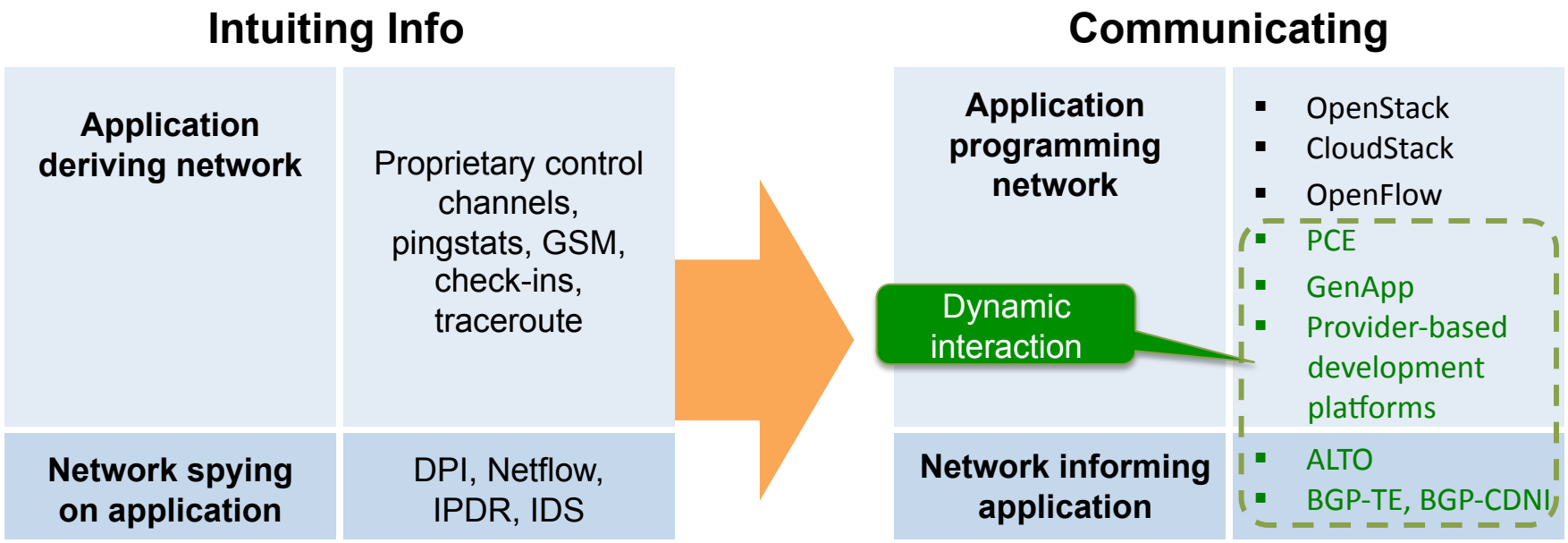
How do networks & applications work together?

There's more than what you are hearing



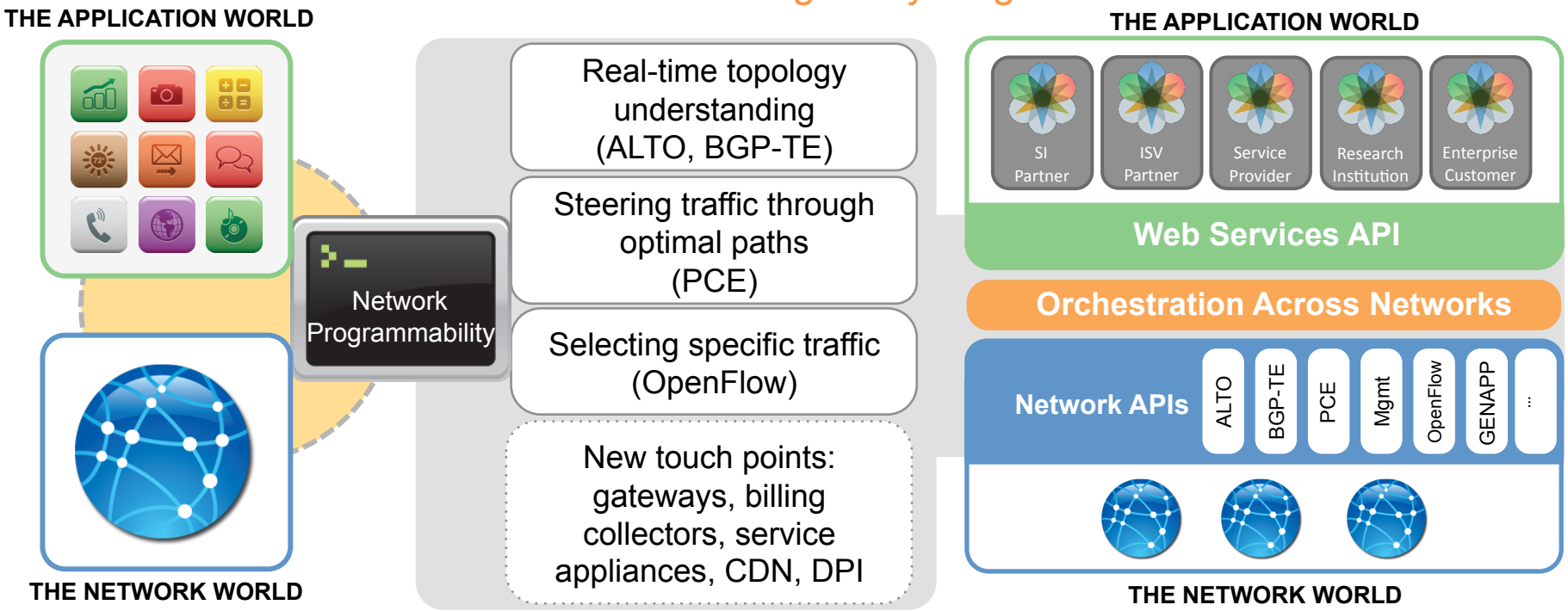
Application and network interaction

As a developer you will have many ways to influence the network or application
Choices depend on your touch point to the network

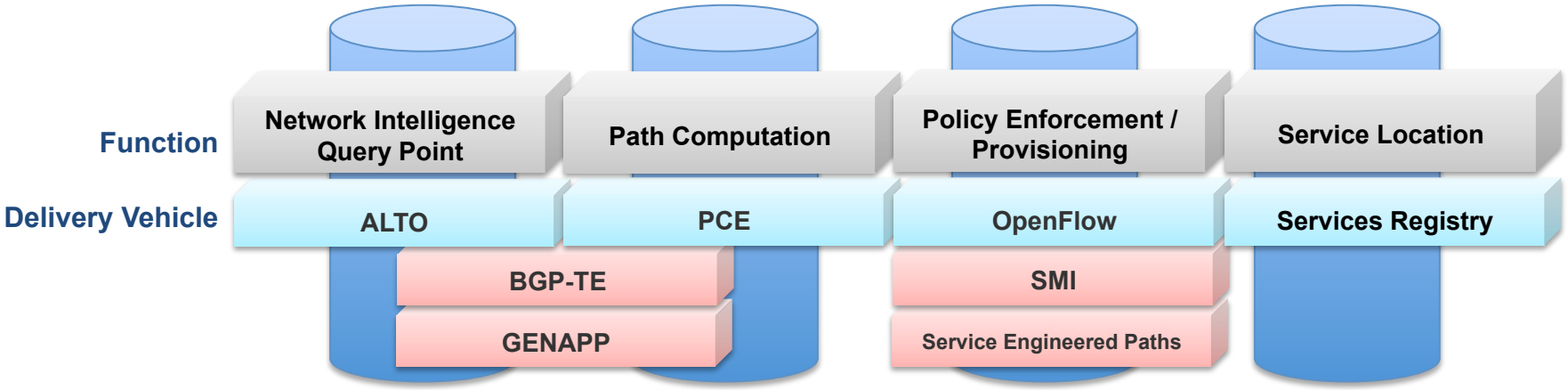


How do we make this happen?

Without breaking everything …

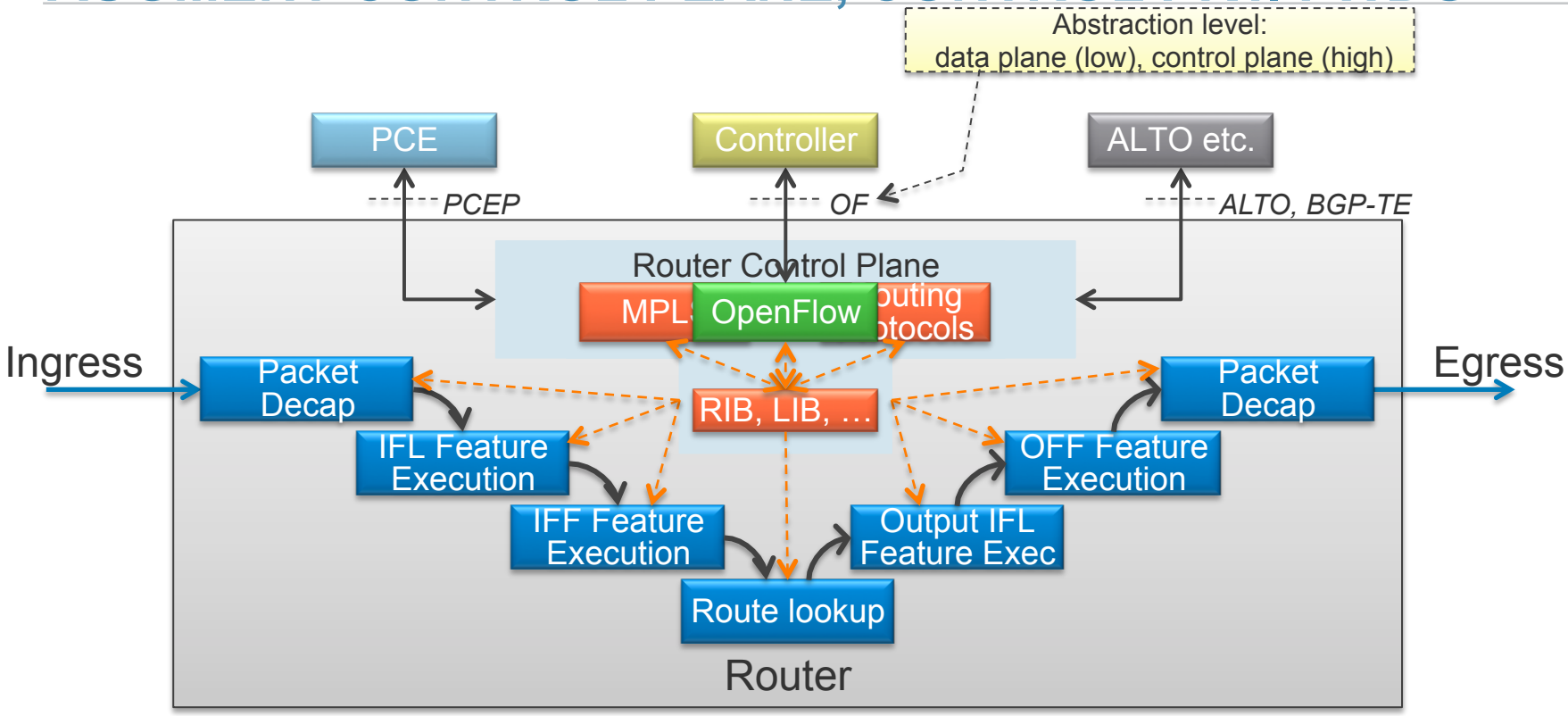


The protocols



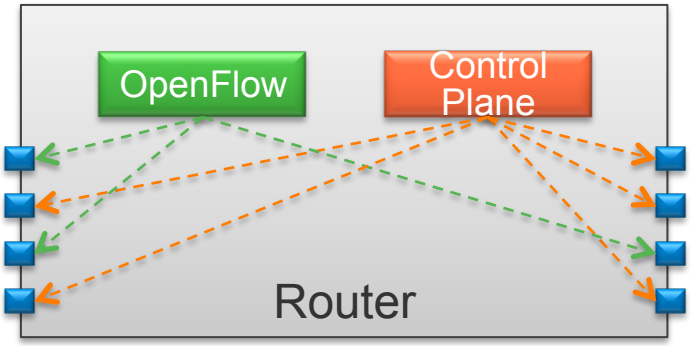
Network intelligence query point	Path computation and establishment	Policy enforcement	Service location
Where is “it” in the network	Path Computation Element (PCE) for determining traffic path and setup	Permit/Deny policy enforcement through programmable flow filters (OpenFlow) / SMI	Centralize/Distributed registration for services, application resources and content cache locations

ROUTER: CONTROL AND DATA PLANES
AUGMENT CONTROL PLANE, CONTROL PKT. FWDG



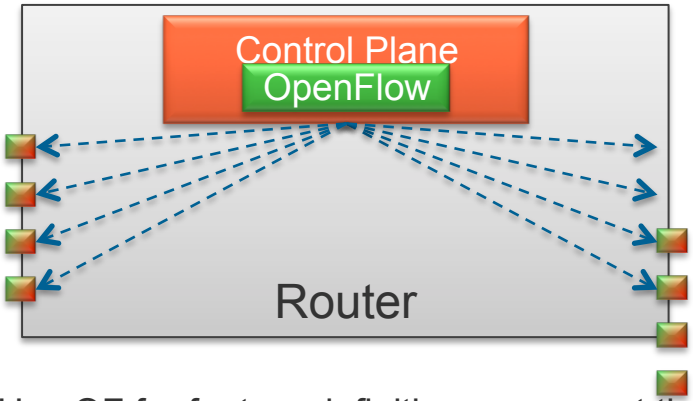
SHIPS IN THE NIGHT VS. INTEGRATED

"Ships-in-the-Night"



- A subset of ports controlled by OF, another subset controlled by router's native CP – physical resources are partitioned
- Some level of integration: "OF_NORMAL":
  - Implementer free to define what "normal" is
  - May not be what router normally does

"Integrated"



- Use OF for feature definition – augment the native control plane
- No longer partitioning of resources
- Can operate at different abstraction levels (low-level like OK1.0 or higher level)

INTEGRATED FORWARDING ZONES

Using a common API, we to have multiple programming entities sharing the same Layer 1-7 devices

Layer-3 device could have

- IGP/BGP zone (default)
- OpenFlow zone
- PCE/LSP zone
- ALTO zone

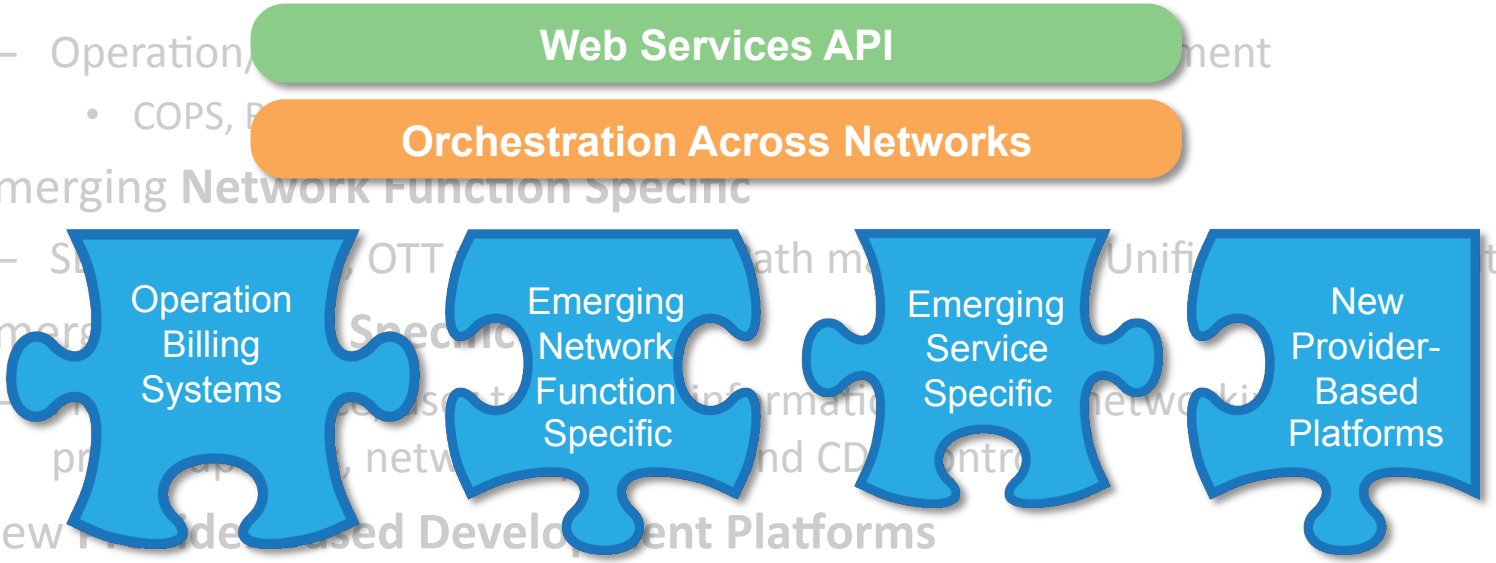
Only one zone permitted per logical port with ability to ‘drop through; to default zone

- The way VRFs work today

Arbitration function necessary to ensure clean resource split – no deadlock states permitted

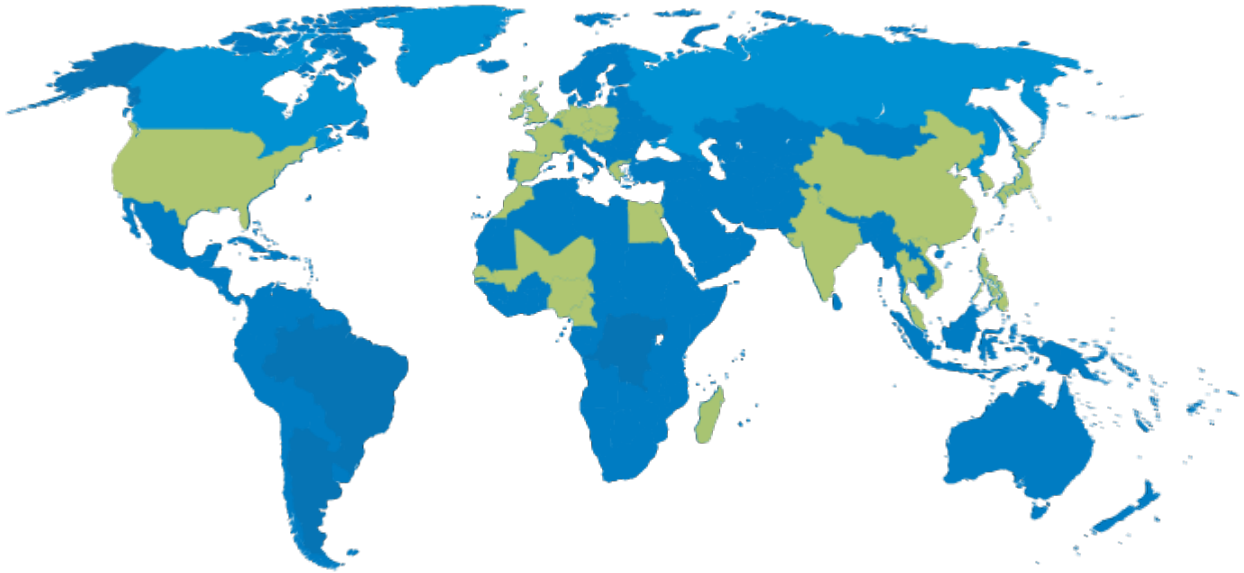
Orchestration and Development Platforms

- **Traditional IT:**
  - Operation/
    - COPS, P
- Emerging **Network Function Specific**
  - S OTT
- Emerg **Specific**
  - pr netw
- New **Provider-Based Development Platforms**
  - Specific functionality for a specific customer set: mobile phone, STB



Network Operators Building Development Platforms

Network operator innovation centers around the world



at&t
comcast
Sprint
verizon
NTT
orange
Deutsche Telekom
CHINA MOBILE
中国电信 CHINA TELECOM

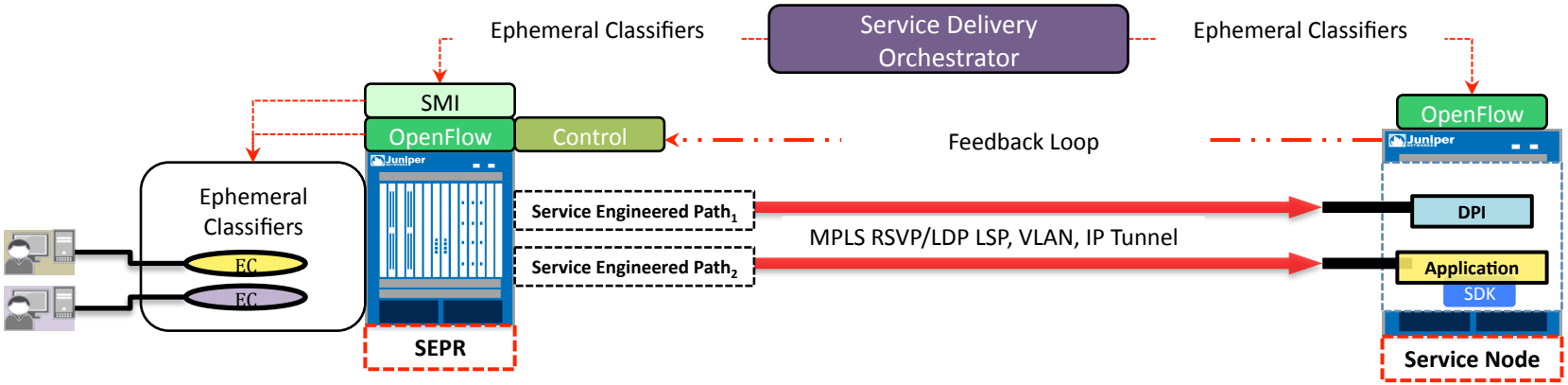
Platform potential: Reaching ~53% of world population; Equals ~64% of world GDP

Networked application examples

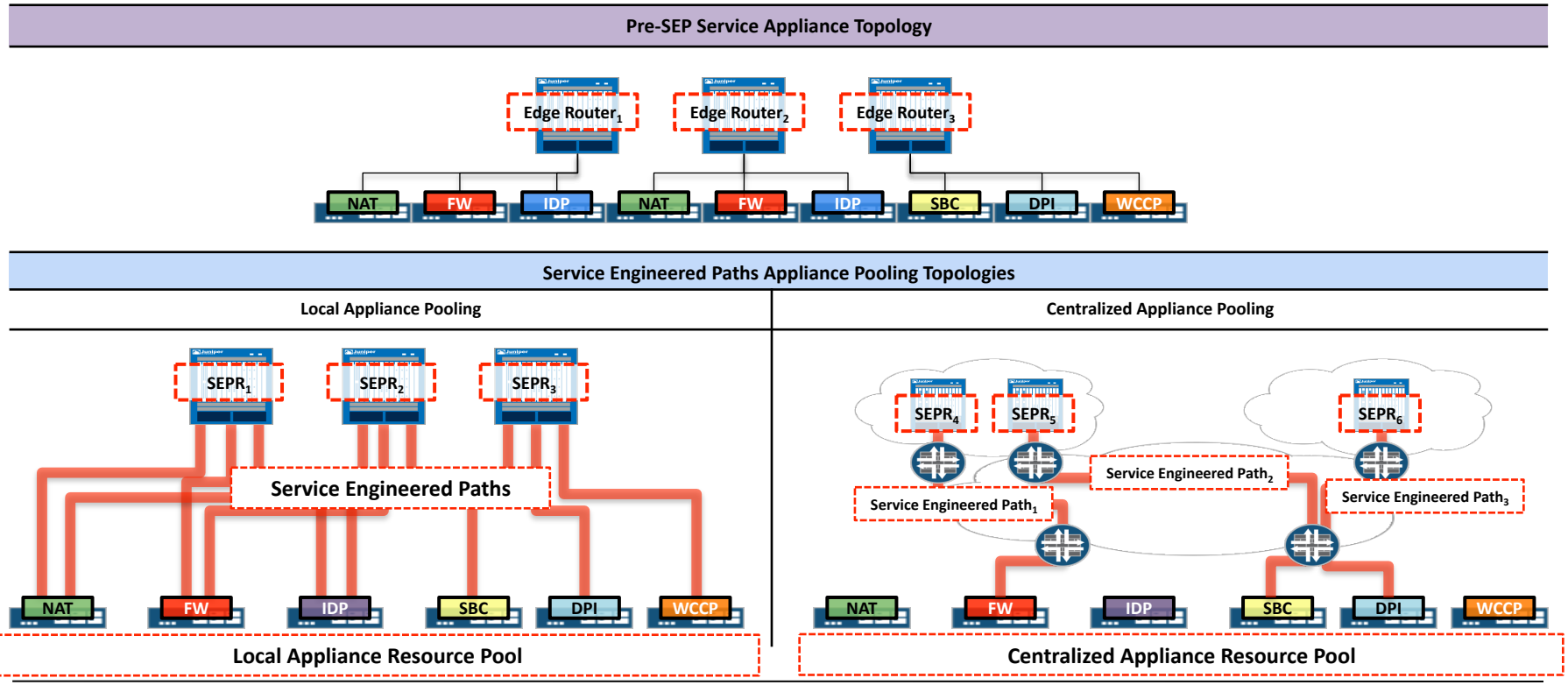
- **Content / Service Routing**
  - Locate best copy of content for the end user, using customer rules
- **Managed content distribution**
  - Content prepositioning to caches
  - Live events
- **Map-Reduce class of applications**
  - High-end distributed computing
- **Cloud OS network operations**
  - Move VMs / Apps / Storage between locations
- **Cloudburst**
  - Flexibly, on-demand allocate cloud & network capacity to customers
- **Security**
  - DDoS attack prevention

What is a Service Engineered Path?

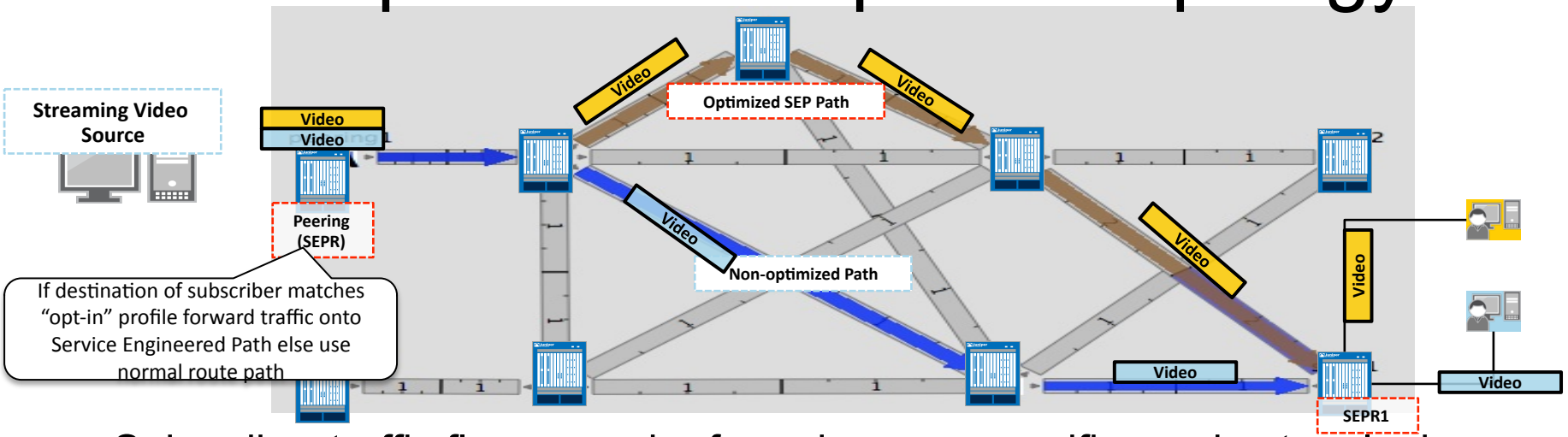
- Tunneling/switching technology that provides a path to specific service functions
- Enables selective traffic redirection based upon ephemeral classifiers
- Signaled paths requested via PCE – Path Computation Element
  - Standardized API



Example: service appliance pooling



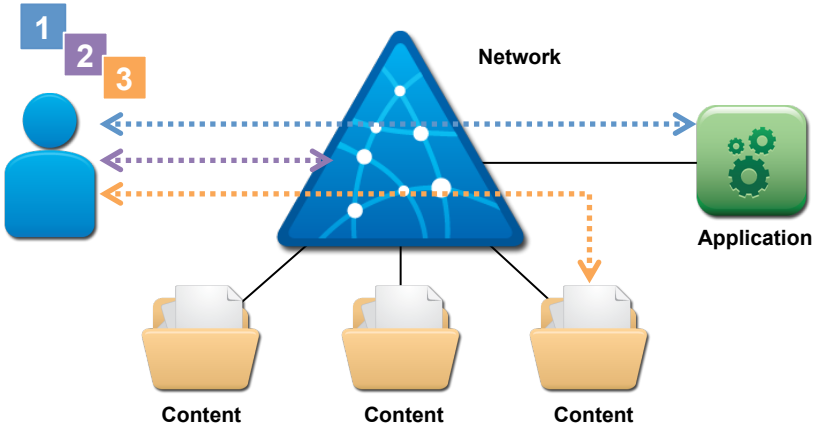
Example: service specific topology



- Subscriber traffic flows may be forced across specific service topologies as dictated by policy
  - Video traffic for one set of subscribers follows a specific path that is engineered to provide the optimal video experience
    - Path enabled using Service Engineered Path technology
  - Non-subscribing enhanced video traffic follows the normal routed path

Example:
Content Request Routing

From where the user is connected…



This is new because:

- Uses information of the network infrastructure
- Runs across multiple service providers
- Mobile & broadband subscribers

… to where the content is best served

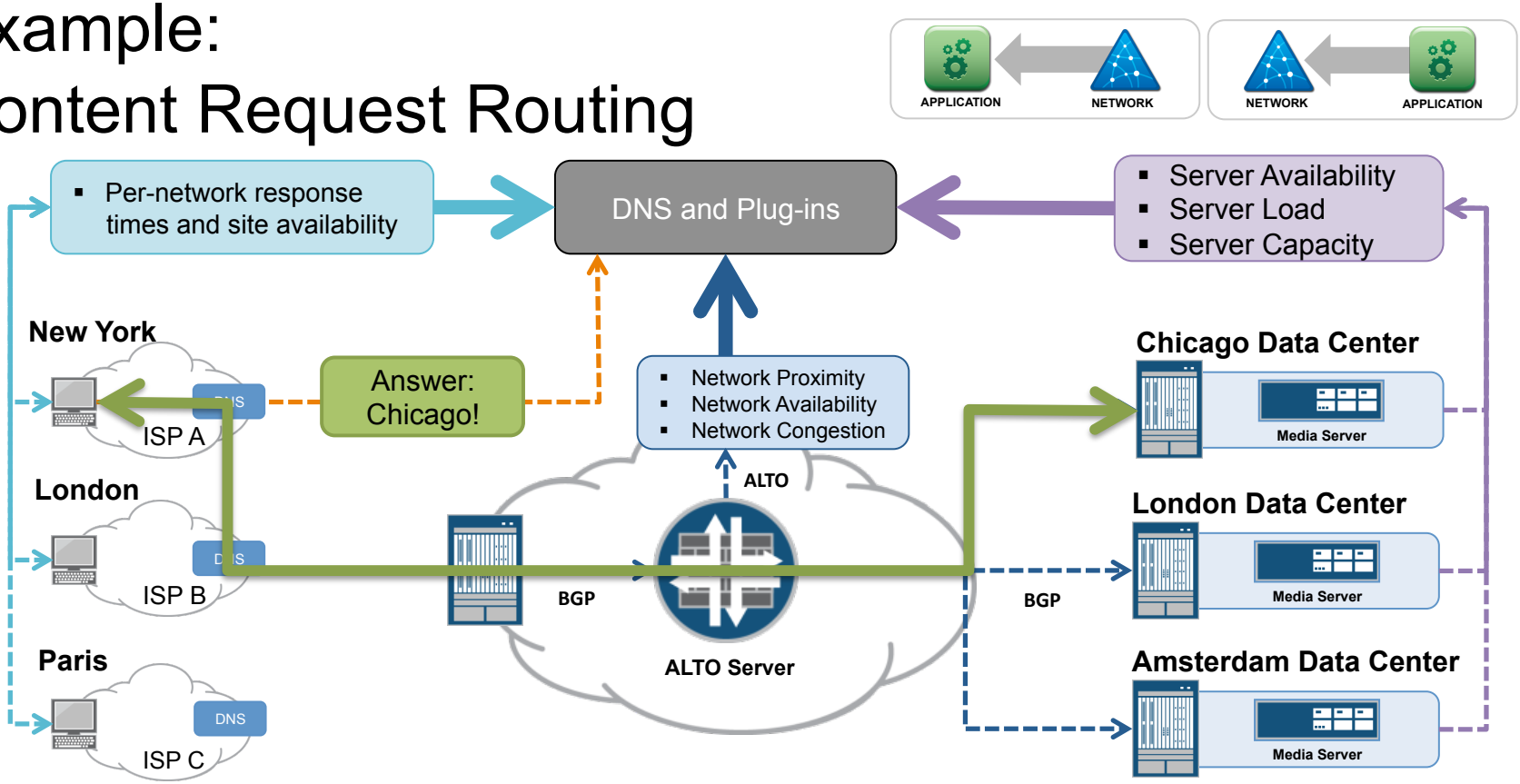
Based on:

- Network proximity
- Network availability
- Network congestion
- Content availability
- Content load
- Content capacity

I E T F®

Open standard: **ALTO** Application Layer Traffic Optimization

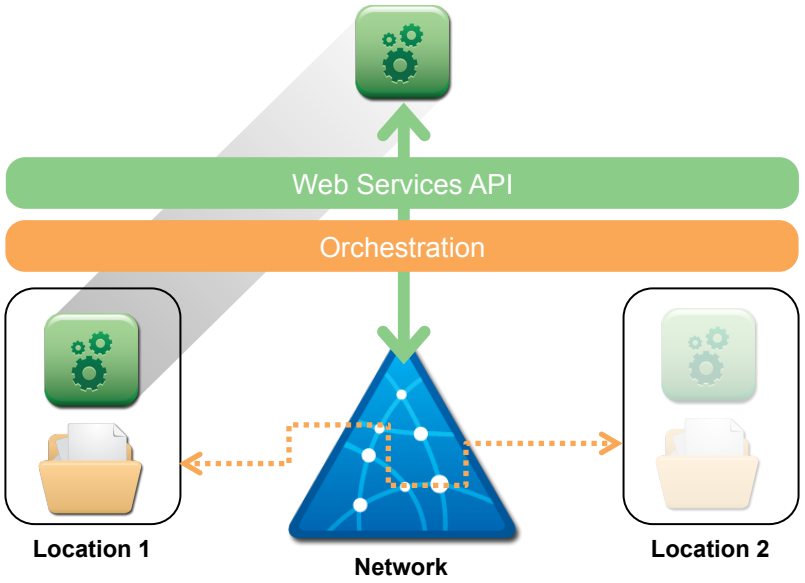
Example:
Content Request Routing



Mapping The Traffic Delivery

Example:
Bandwidth Calendaring

Schedule a reserved path for your session…



Scheduled application/session specific path in the network

… without having to know the network

Technology used:

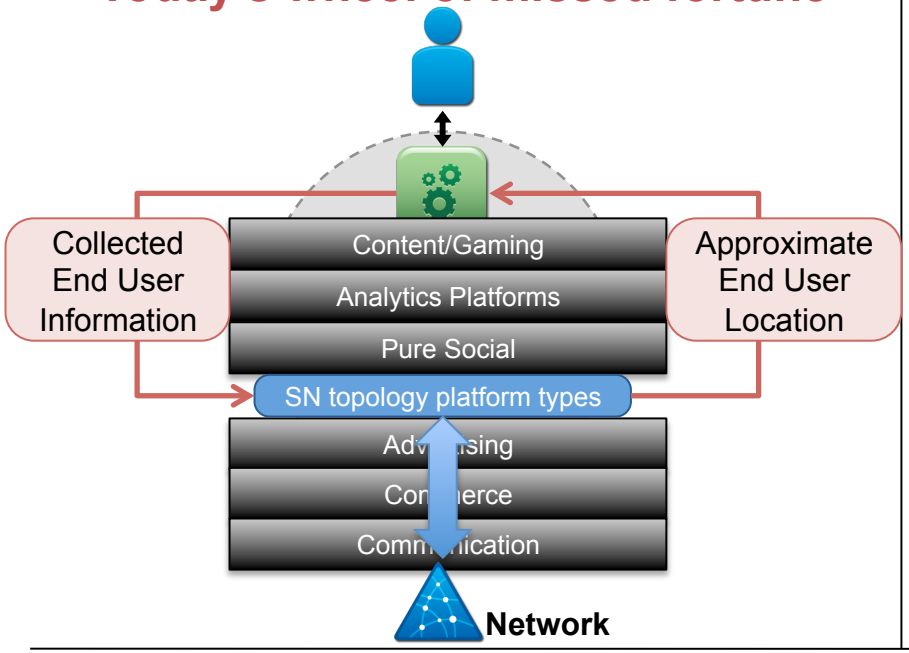
- Real-time topology understanding (ALTO, BGP-TE)
- Steering traffic through optimal paths (PCE)
- Reservation transaction (WebServices API)
- Selecting specific traffic (OpenFlow)

What would I use this for?

- Flexibility of service placement
- Scheduled data center backups
- Managed content distribution
- Cloud orchestration

Example: Social Networking

Today's wheel of missed fortune

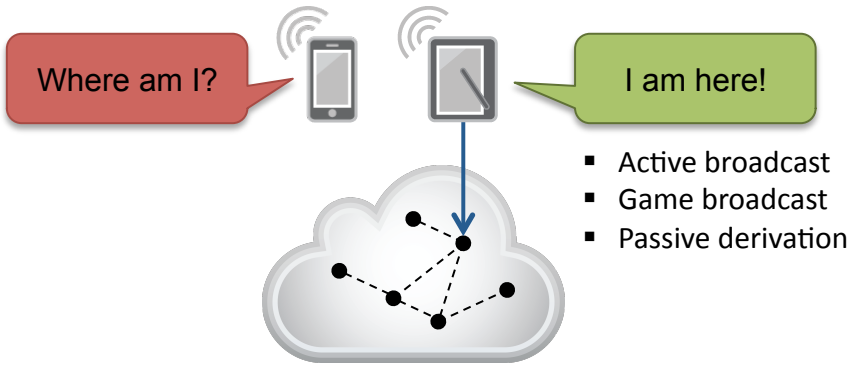


Untapped mine of information

- Access technology and capability
  - Mobility events
  - Bandwidth, utilization
- Capabilities of device and network
- Network location
- Proximity to caches / servers
- Bandwidth / billing / usage caps
- Security profile

Tune in - turn on: Be “in the topology”

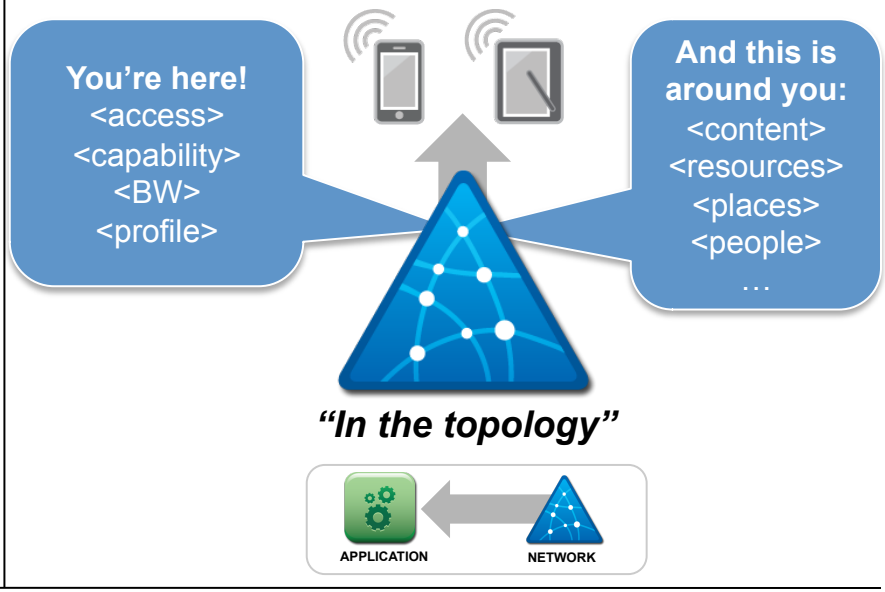
Weak architecture = one-legged tap dancing



! “Above the topology”
“Visualize the topology”
“Below the topology”

Low value in navigational coordinates

Continuous, real-time streaming of surrounding content, resources, places, people

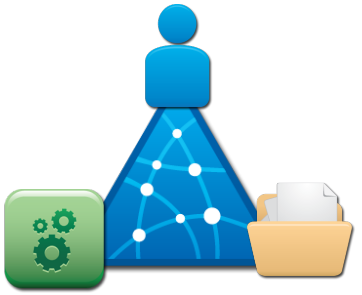


What did he just say?

UNLEASH THE POTENTIAL!

Today the two worlds are not interlocked

PROGRAMMABLE NETWORKING



DEVELOPMENT PLATFORMS EMERGING AND GETTING A LOT OF VC

Enables:

- Flexibility of service placement
- Fungibility of assets
- Control of resources
- Derivation of telemetry and proximity

Decisions that impact your applications are being made by:

- IT departments
- Network equipment vendors
- Providers delivering your application
- Application developers

Network Programmability

This is not a lottery

This is a game of skill

Enhance your skills

Enhance your applications

JOIN THE REVOLUTION

CREATE. CODE. DEPLOY. EVERYWHERE THE NETWORK WORKS.