

# Programmable Networking is SFW



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# The Developer and The Network

We should care about each other

YOU ARE DEVELOPERS

WE ARE THE NETWORK

Experience

Connecting everybody to everything

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# The Developer and The Network

Improving user experience by programming the network

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**Real Problems. Real Revenue. Real Attention.**

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# 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

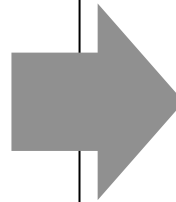
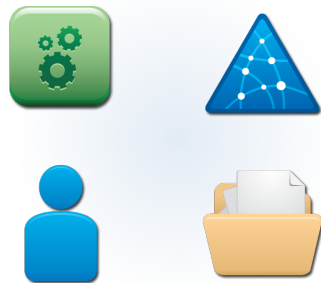
### ? *Application Aware Networking* ?

- 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?

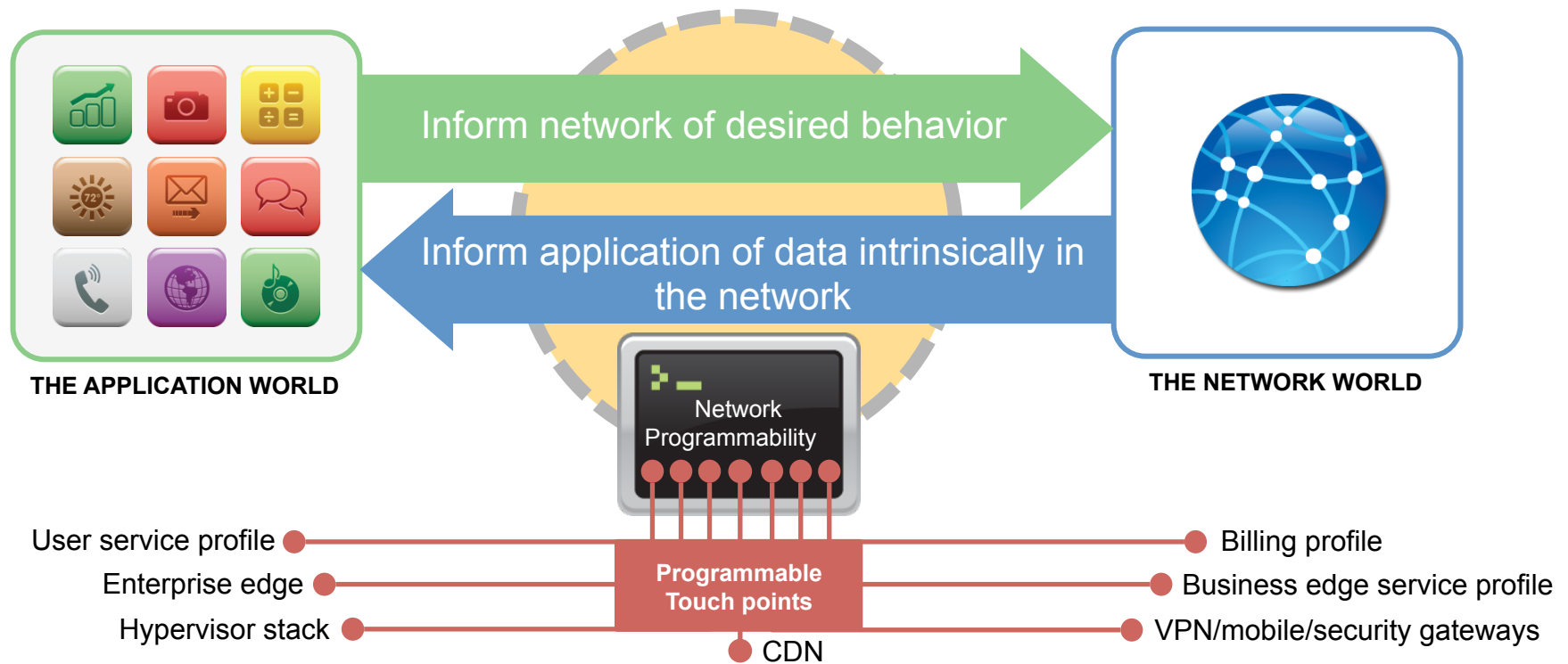
THE APPLICATION WORLD

THE NETWORK WORLD



Bi-directional interaction and  
programmability

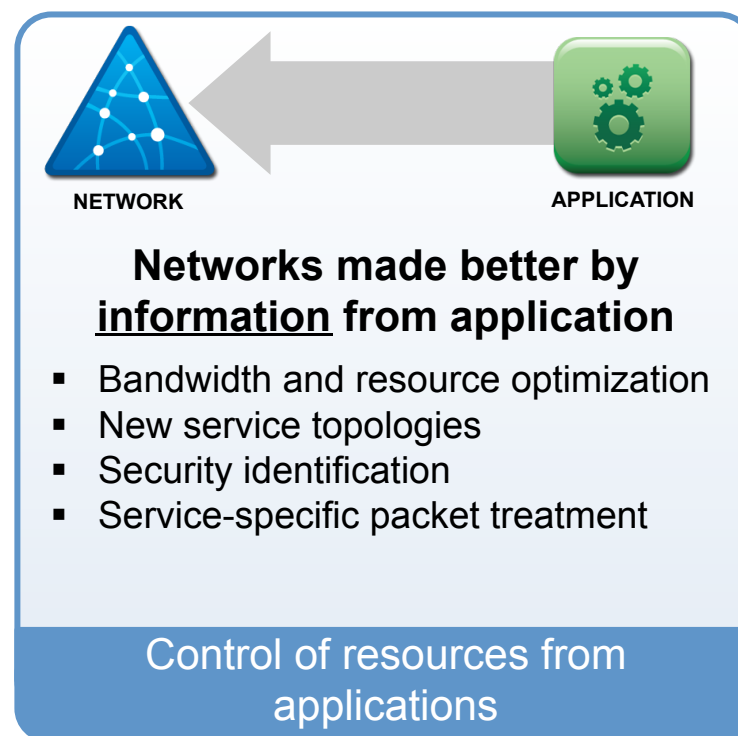
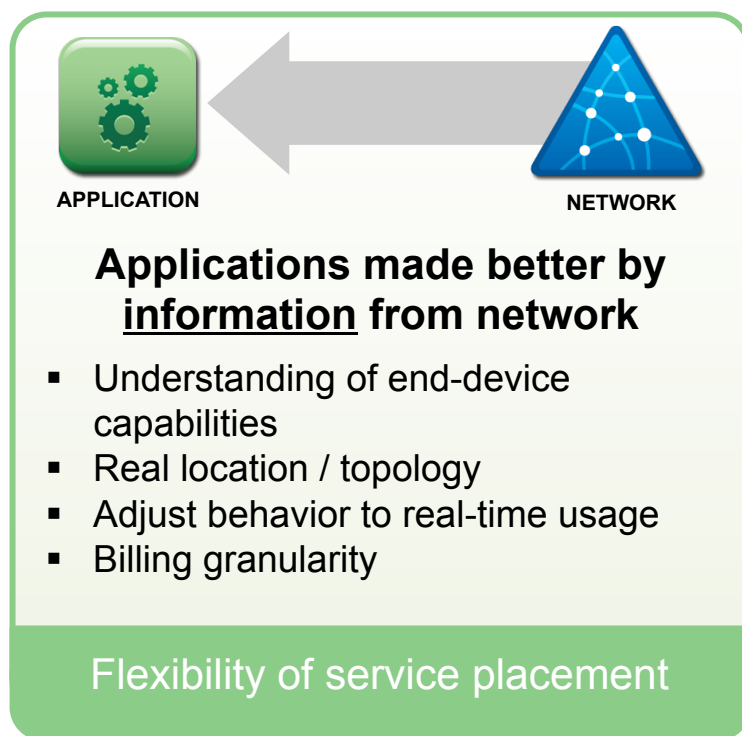
# Interaction at multiple touch points



**Extract information or program desired behavior**



# What is possible in this new world?



# How do networks & applications work together?

# There's more than what you are hearing



## Software Defined Networks

- Separation of existing protocols from forwarding plane for network devices
- Programming of forwarding plane via centralized orchestration platforms



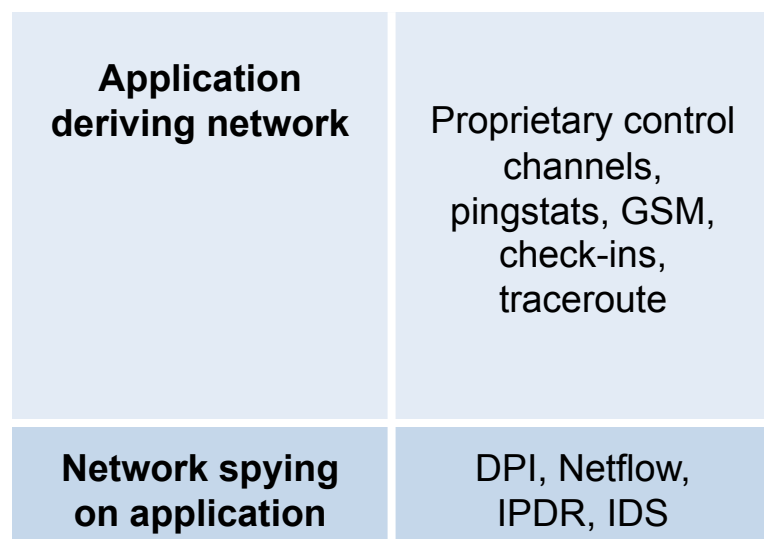
No interaction with existing  
routing/signaling protocols  
of the Internet

- Augment what's already in the Internet
- Integration with routing, signaling and policy logic
- Modular, programmable touchpoints
- Seamless service model via collaborative inputs
- Standards-based approach

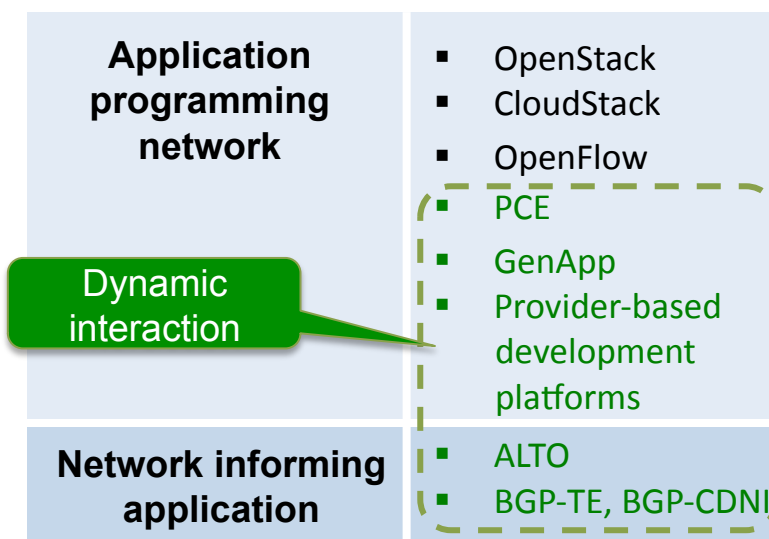
# Application and network interaction

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

## Intuiting Info



## Communicating



# How do we make this happen?

Without breaking everything ...

## THE APPLICATION WORLD



## THE NETWORK WORLD

Network  
Programmability

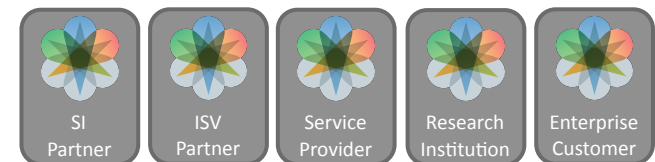
Real-time topology  
understanding  
(ALTO, BGP-TE)

Steering traffic through  
optimal paths  
(PCE)

Selecting specific traffic  
(OpenFlow)

New touch points:  
gateways, billing  
collectors, service  
appliances, CDN, DPI

## THE APPLICATION WORLD



Web Services API

Orchestration Across Networks

Network APIs

ALTO

BGP-TE

PCE

Mgmt

OpenFlow

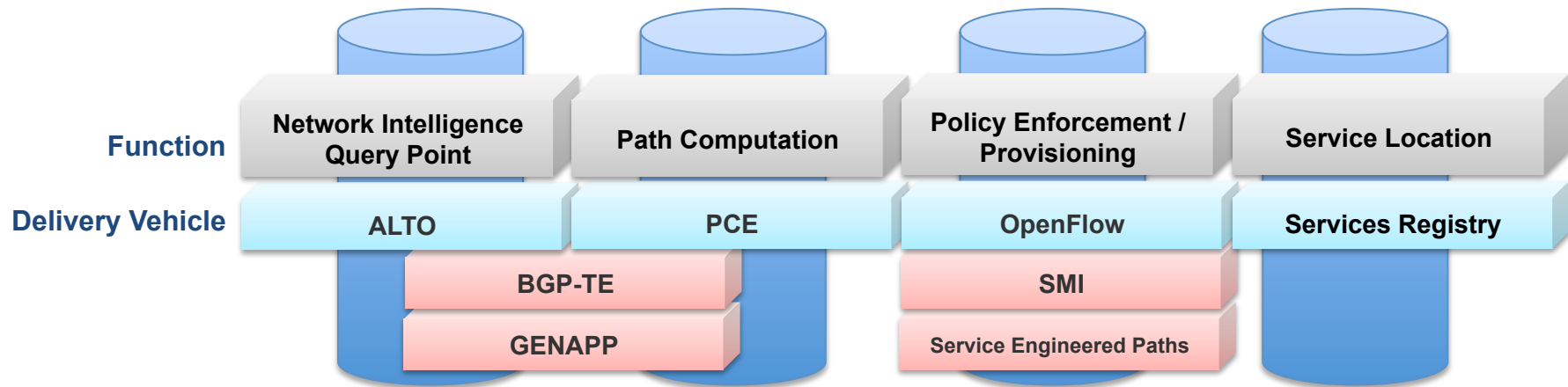
GENAPP

...



## THE NETWORK WORLD

# 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

# Orchestration and Development Platforms

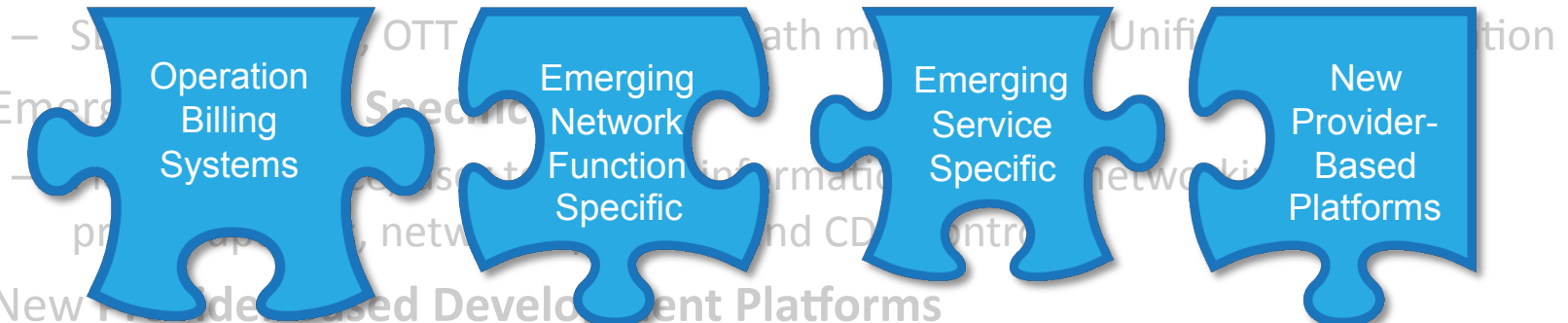
- Traditional IT:

- Operation, Management
  - COPS, F...

Web Services API

Orchestration Across Networks

- Emerging Network Function Specific



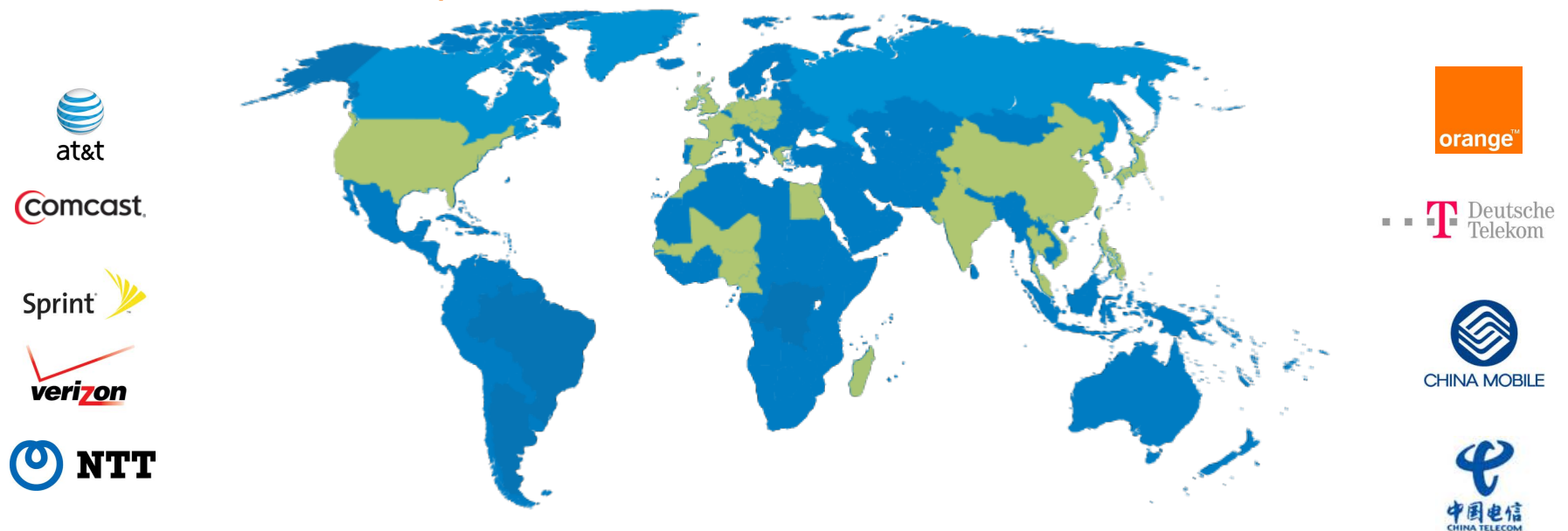
- New Provider-Based Development Platforms

- Specific functionality for a specific customer set: mobile phone, STB

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# Network Operators Building Development Platforms

Network operator innovation centers around the world



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



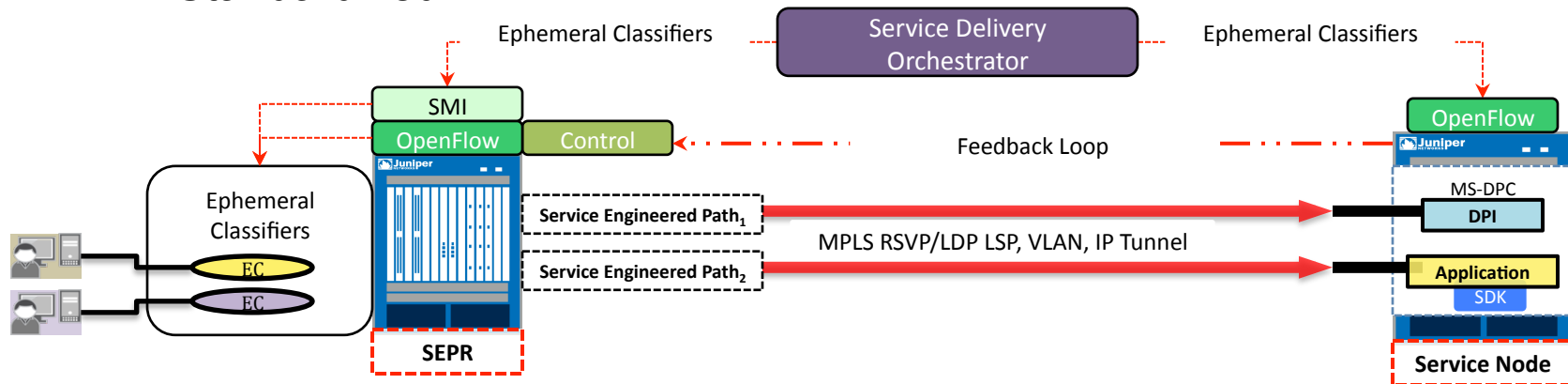
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# Networked application examples

- **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

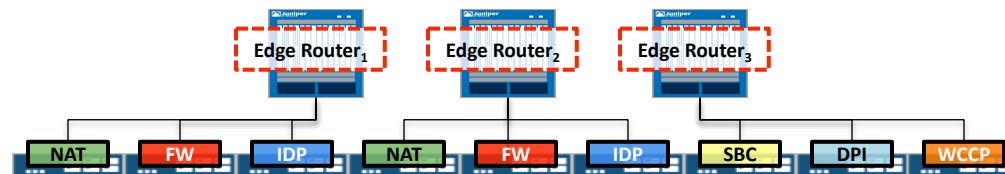
# What is a Service Engineered Path?

- Packet tunneling/switching technology that provides a pre-established forwarding path to specific service functions
- Technology enables selective traffic redirection based upon ephemeral classifiers
- Signaled paths requested via PCE – Path Computation Element
  - Standardized API



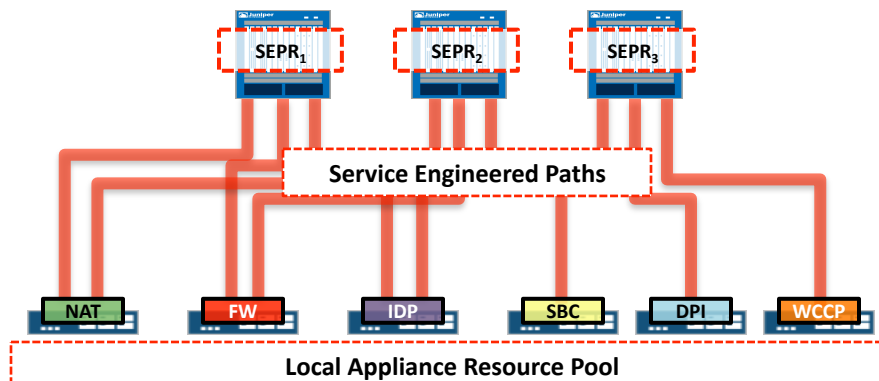
# Example: service appliance pooling

Pre-SEP Service Appliance Topology

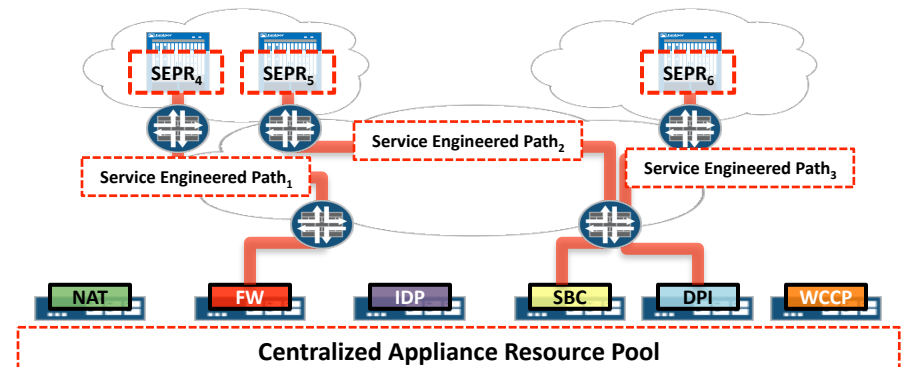


Service Engineered Paths Appliance Pooling Topologies

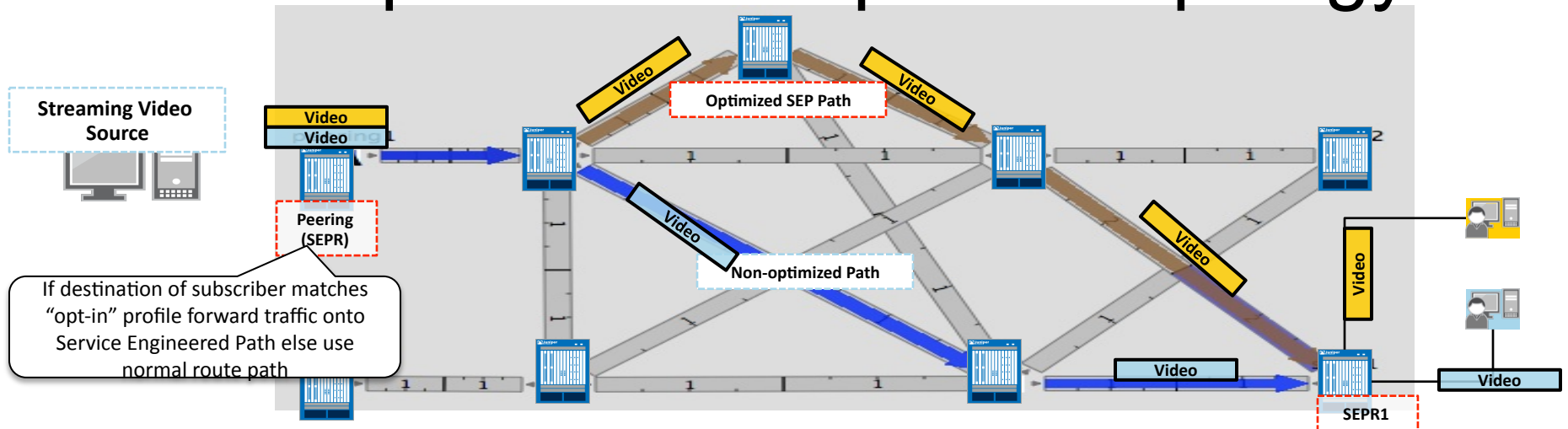
Local Appliance Pooling



Centralized Appliance Pooling



# Example: service specific topology

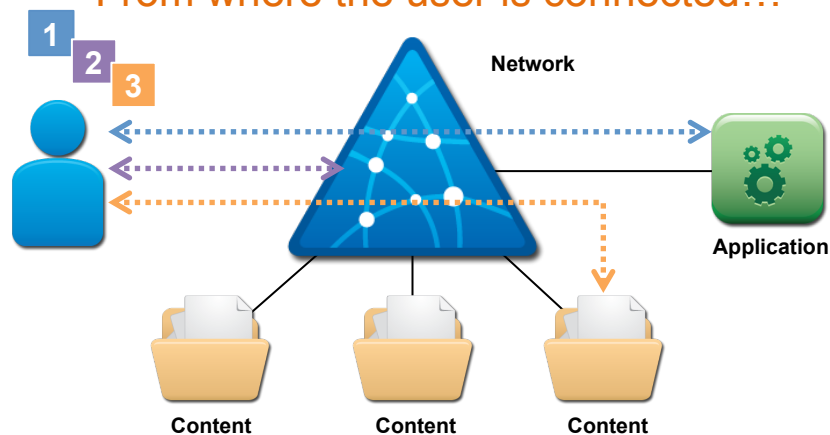


- Subscriber traffic flows may be forced across specific service topologies as dictated by policy
  - Video traffic for one set of subscribers follows a specific path that is engineered to provide the optimal video experience
    - Path enabled using Service Engineered Path technology
  - Non-subscribing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

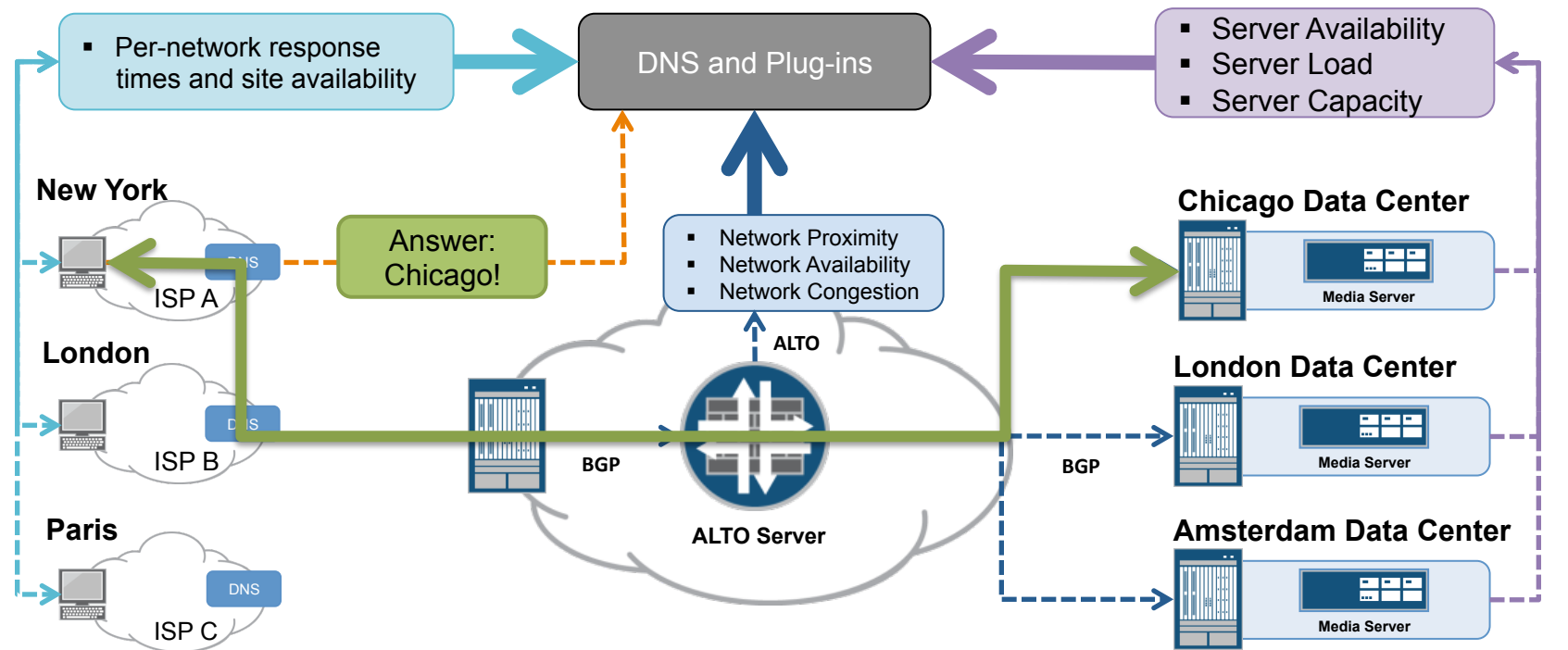
- Network proximity
- Network availability
- Network congestion
- Content availability
- Content load
- Content capacity



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

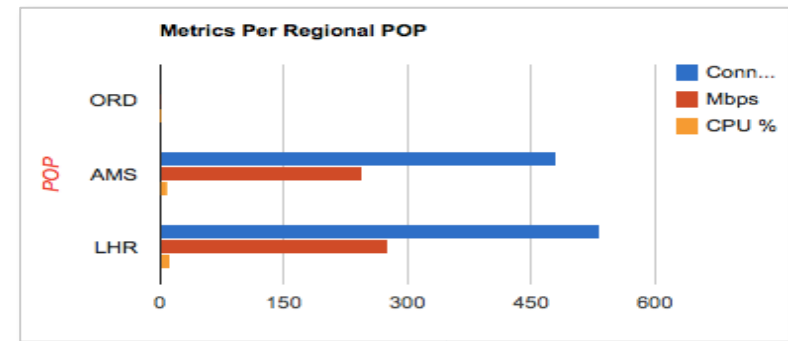


# Example: Content Request Routing



## Demo Scoreboard – Alto directs traffic based on network Proximity & conditions

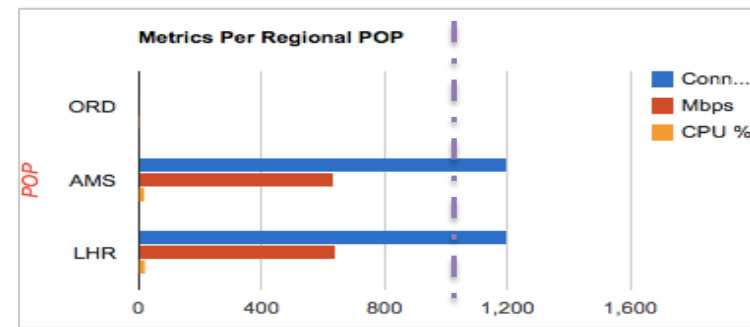
Content Routing Demo Scoreboard			
Subscriber Location:	Service Requested:	ALTO Based Network Cost Maps:	Cedexis ADNS Resolves to Location:
 <b>New York</b>	Mobile	Chicago - 10 London - 50 Amsterdam - 200	Chicago
	Video	Chicago - 10 London - 50 Amsterdam - 200	Chicago
	Downloads	Chicago - 10 London - 50 Amsterdam - 200	Chicago
 <b>London</b>	Mobile	London - 10 Amsterdam - 50 Chicago - 200	London
	Video	Amsterdam - 10 London - 50 Chicago - 200	Amsterdam
	Downloads	Chicago - 10 Amsterdam - 50 London - 200	Chicago
 <b>Paris</b>	Mobile	Amsterdam - 10 London - 50 Chicago - 200	Amsterdam
	Video	Amsterdam - 10 London - 50 Chicago - 200	Amsterdam
	Downloads	Chicago - 10 Amsterdam - 50 London - 200	Chicago



Datacenters are under normal load

## Demo Scoreboard – Alternate datacenter chosen based on Media Flow load metrics

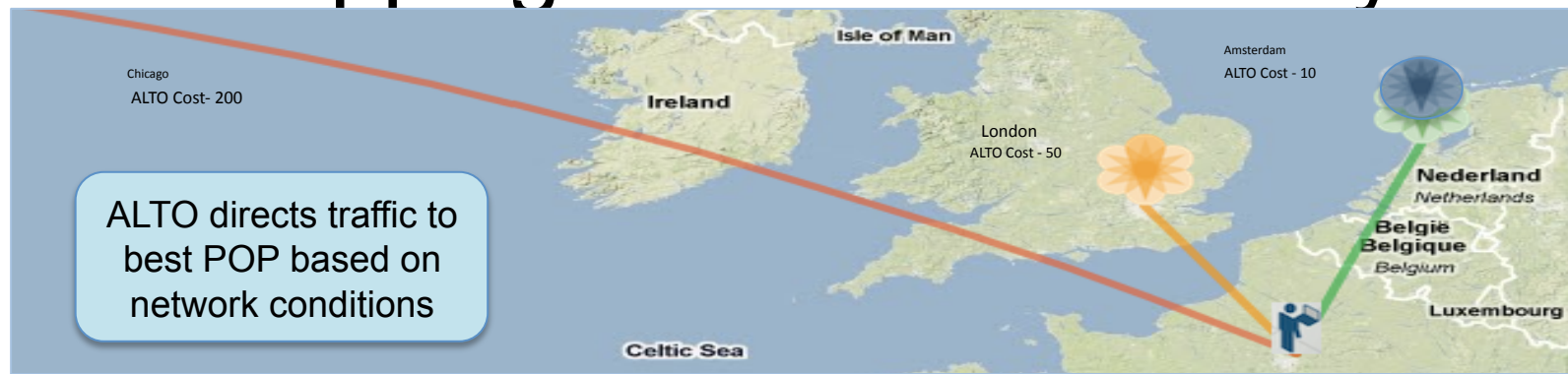
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	Video	Amsterdam - 10 London - 50 Chicago - 200	Chicago
	Downloads	Chicago - 10 Amsterdam - 50 London - 200	Chicago



London and Amsterdam have exceeded the load threshold:  
Traffic is diverted to Chicago



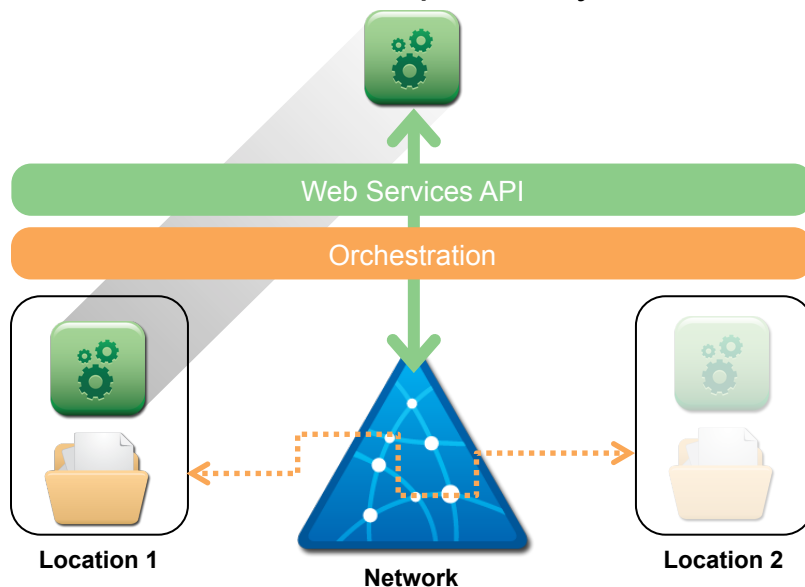
# Mapping The Traffic Delivery



# Example: Bandwidth Calendaring



Schedule a reserved path for your session...



**Scheduled application/session specific path in the network**

**... without having to know the network**

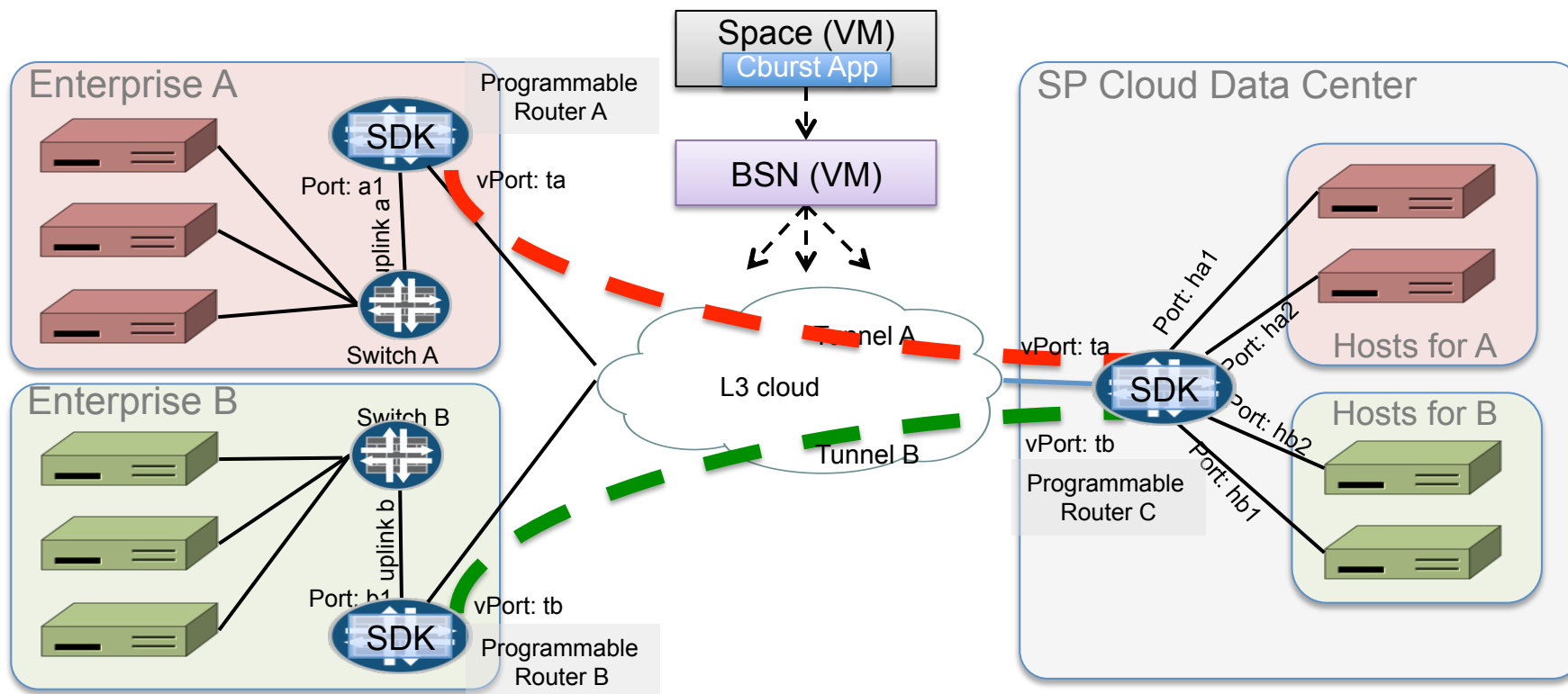
Technology used:

- 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?

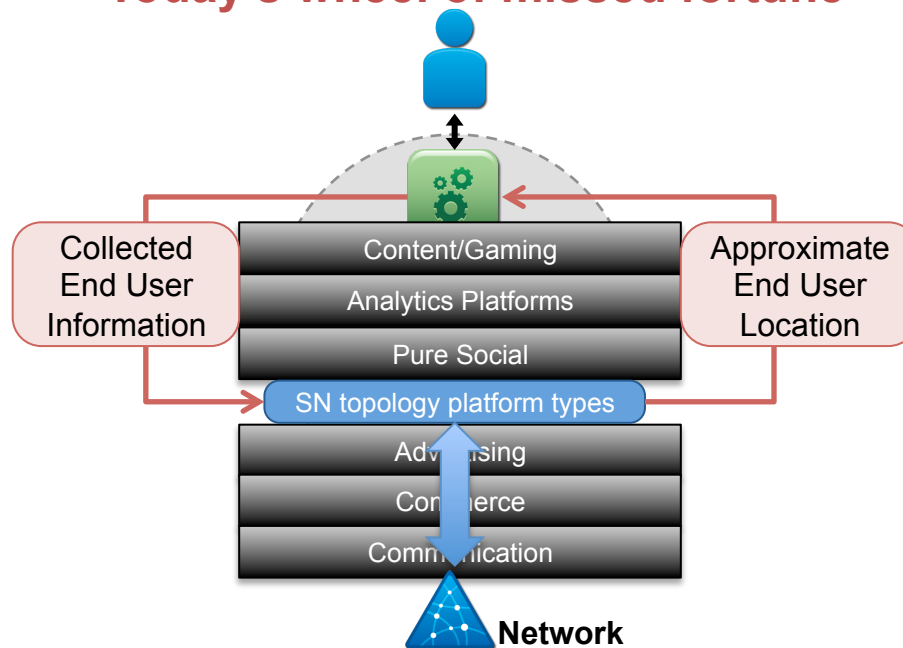
- Flexibility of service placement
- Scheduled data center backups
- Managed content distribution
- Cloud orchestration

## Example: Cloud Bursting



# Example: Social Networking

## Today's wheel of missed fortune

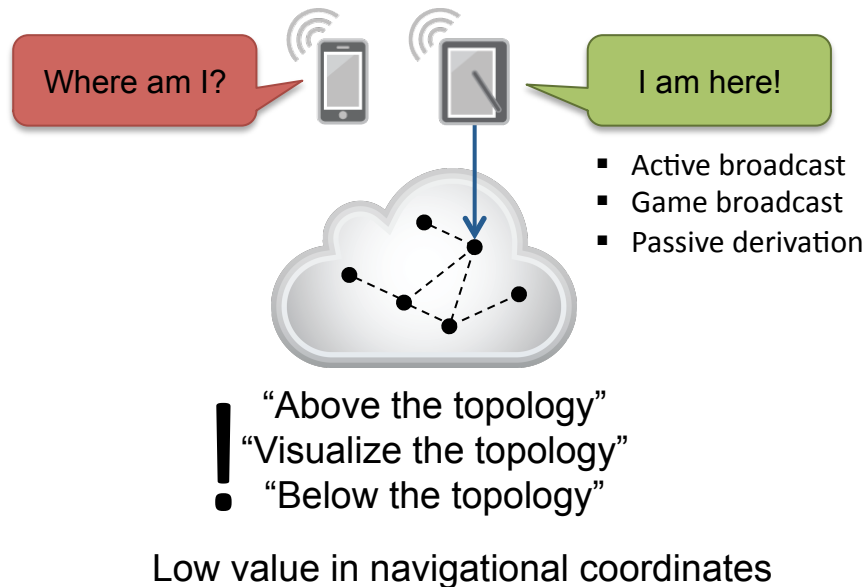


## Untapped mine of information

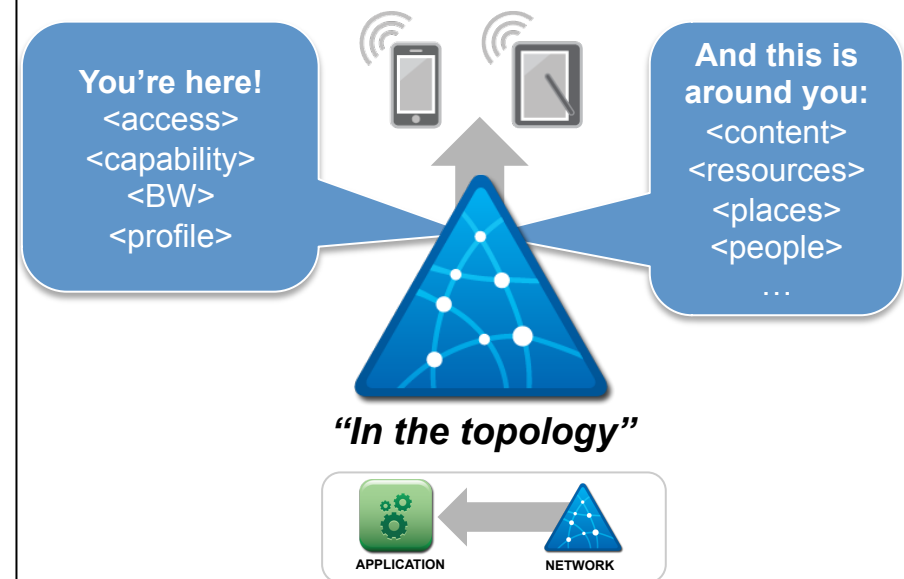
- Access technology and capability
  - Mobility events
  - Bandwidth, utilization
- Capabilities of device and network
- Network location
- Proximity to caches / servers
- Bandwidth / billing / usage caps
- Security profile

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

Weak architecture = one-legged tap dancing



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



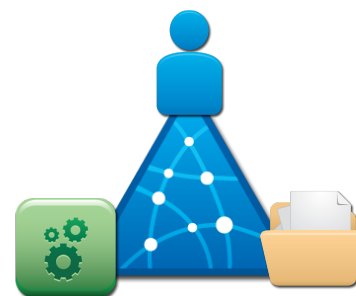
# What did he just say?

## 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

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# Network Programmability

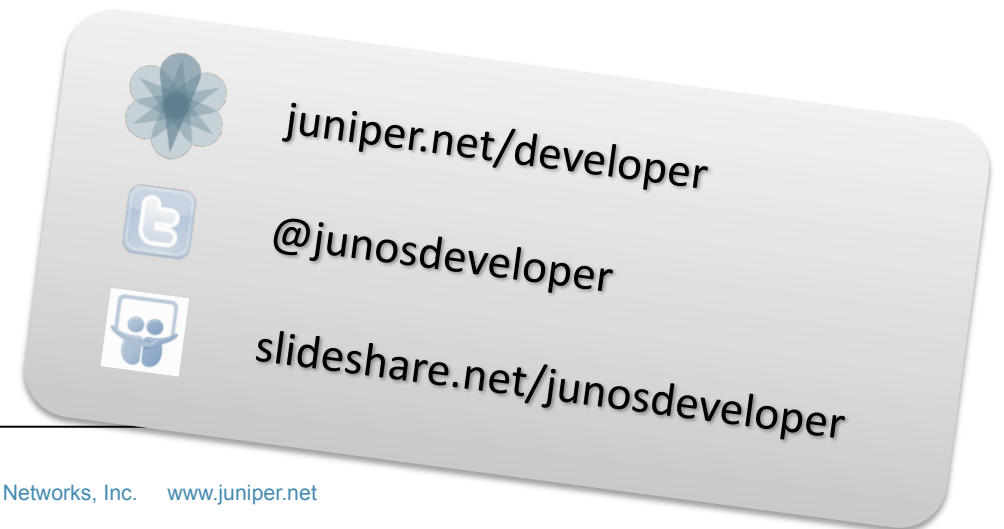
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This is not a lottery

This is a game of skill

Enhance your skills

Enhance your applications





# **JOIN THE REVOLUTION**

CREATE. CODE. DEPLOY. EVERYWHERE THE NETWORK WORKS.