Enabling Active Flow Manipulation In Silicon-based Network Forwarding Engines

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Outline of the talk

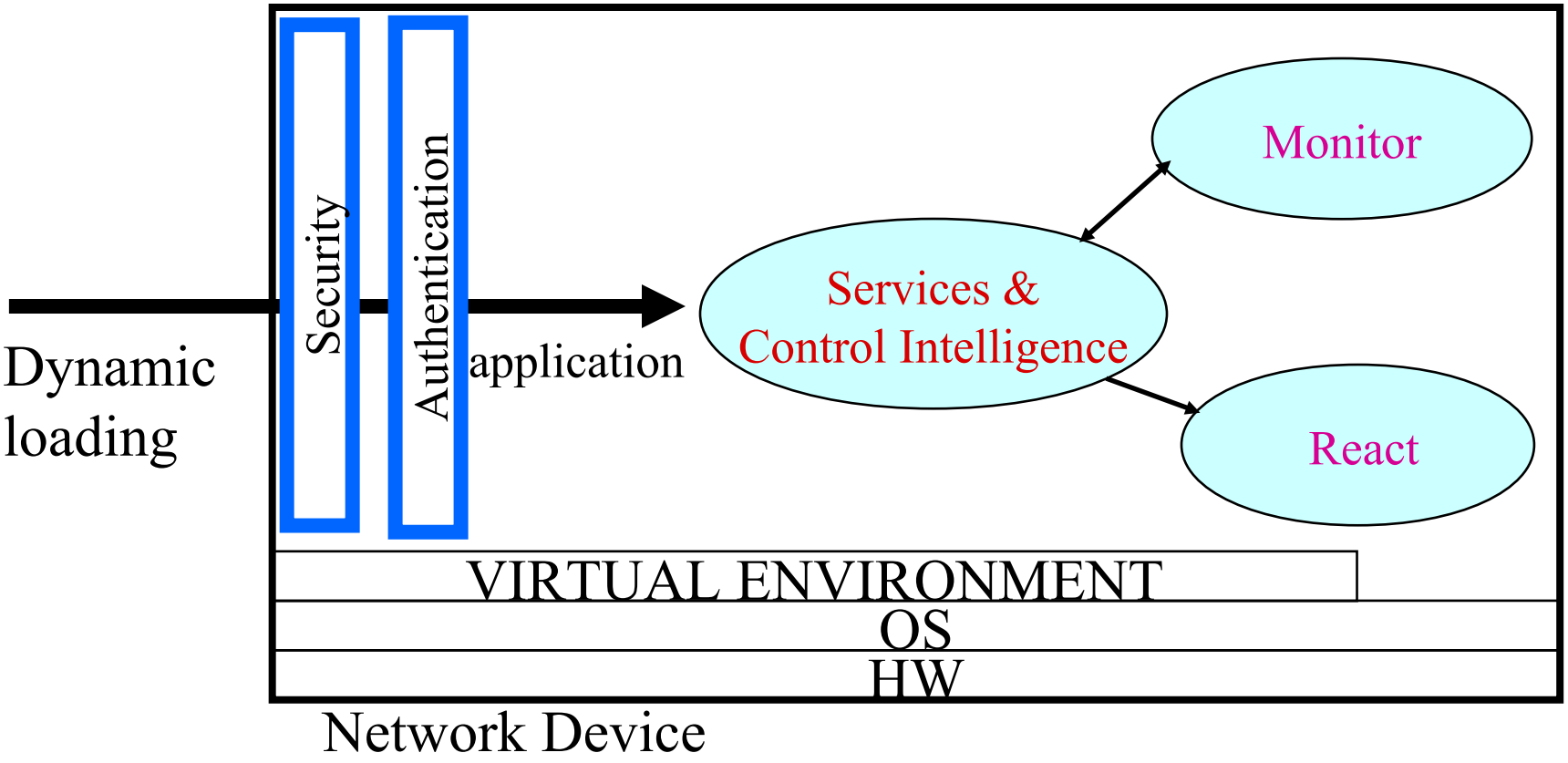
- Driving Forces
- Openet
- AFM Enabling Mechanism
- Realization with Openet Passport
- Application Examples
- Openet Alteon: AN platform
- Next step
- Conclusion

Driving Forces

Users – Service Providers – Network Providers

- **Introducing services on-demand**
- **Assuring Quality of Service**
- **Addressing Impedance Mismatch**
- **Demanding Programmability**

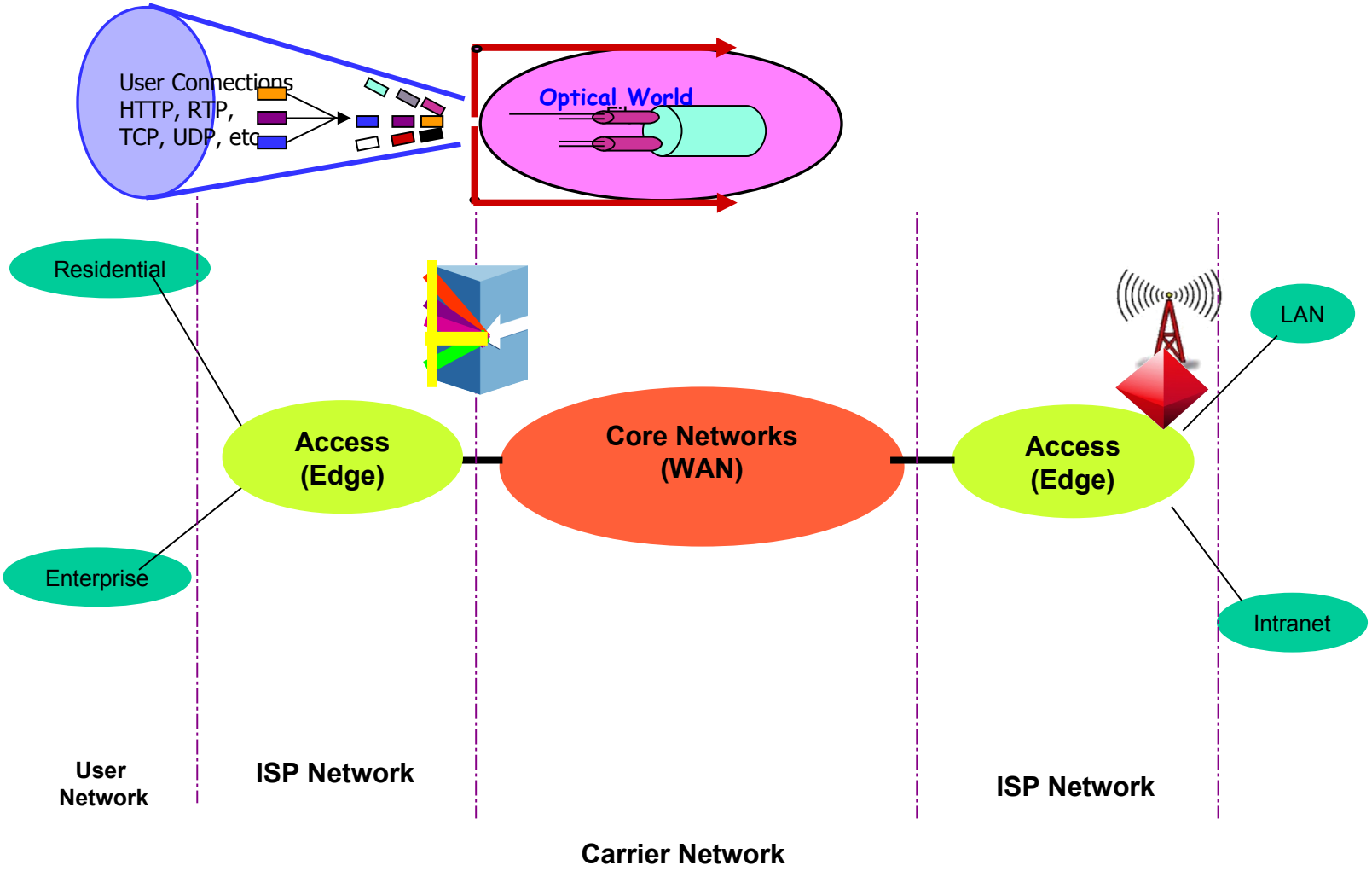
Introducing Services on-demand



Programmability

- **A significant challenge in today's Internet is the ability to efficiently incorporate customizable network intelligence in commercial high performance network devices.**
  - Framework for introducing services
  - API for programming network devices

Impedance Mismatch



AN Solution

- Active networks (AN) approach opens an exciting opportunity for individual applications to define the service provided by the network through programmability.
- Active Networks technologies expose a novel approach that allows customer value-added services to be introduced to the network “on-the-fly”.
- Active Nets program has produced a new network platform flexible and extensible at runtime to accommodate the rapid evolution and deployment of network technologies.
- The exciting opportunity exists for network service providers and third parties, not just the network device providers, to program the network infrastructure and services.

AN issues

Lack of industrial-strength Active Network devices that dispel major concerns:

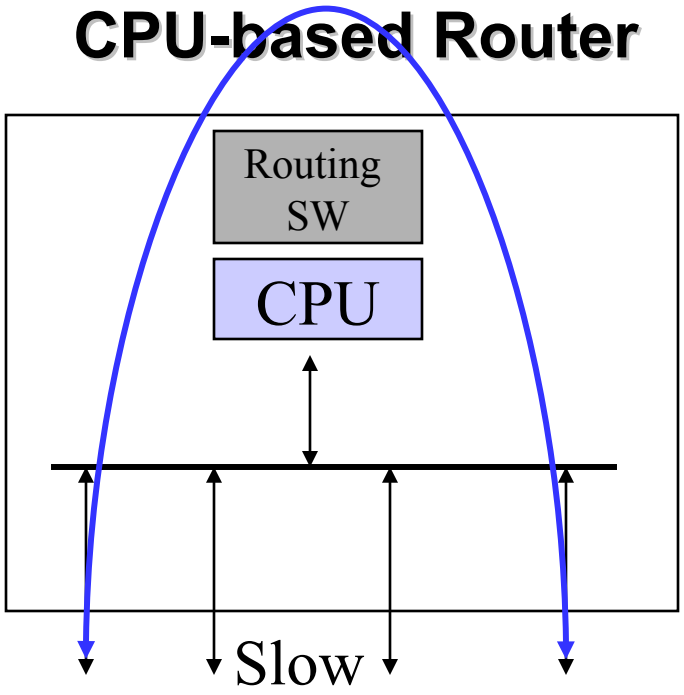
- **AN requires substantial supports from a NOS**
- **AN introduces substantial software component, hence delay on the data path**
- **AN lacks adequate measures to addressing integrity and security of network devices.**

Openet Platform
= Active Nets Enabling Platform
= Programmable Networking Solution

- **Passport Router**
- **Openet**
- **Active Flow Manipulation (AFM)**
- **Programmable Openet Passport Platform**

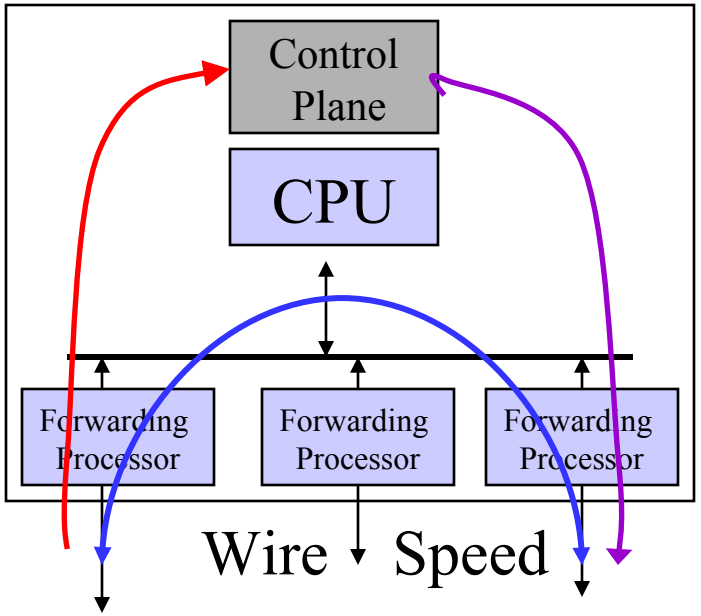
Passport Router - Separation of Control and Forwarding Planes

Centralized, CPU-based Router



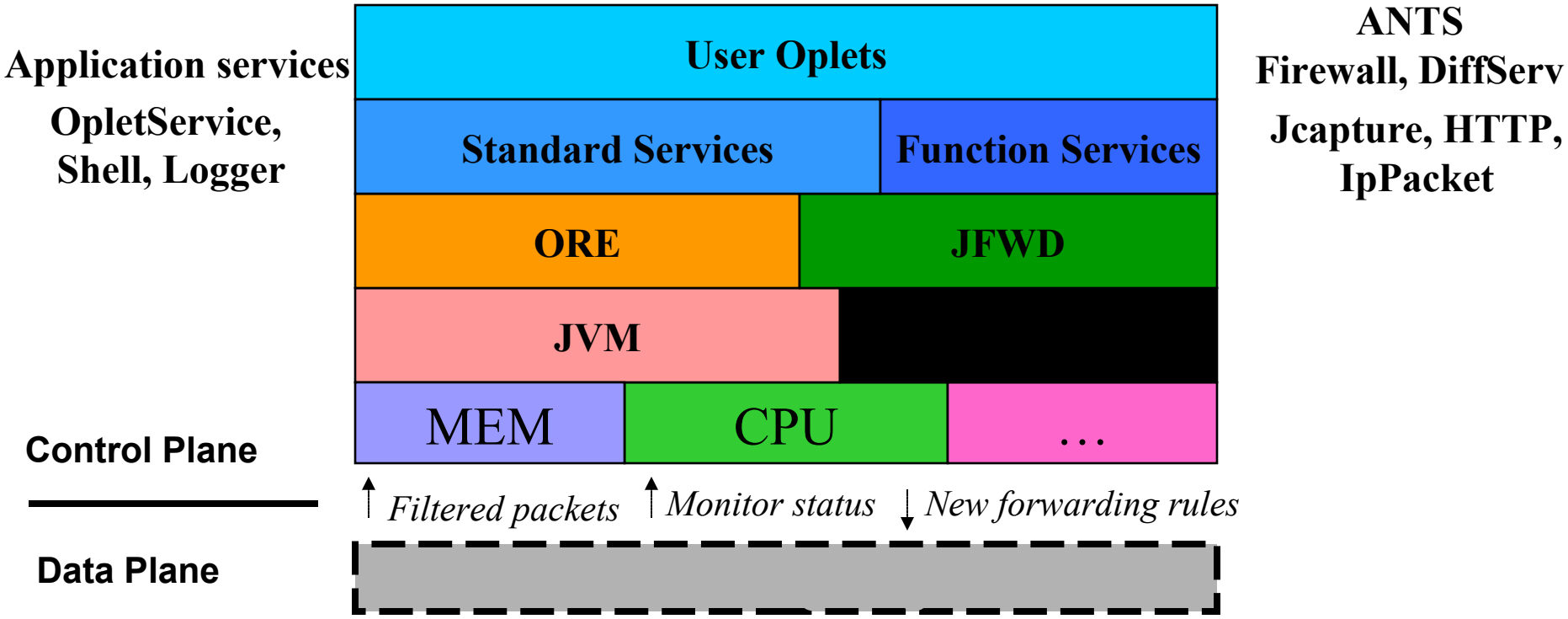
Control + Forwarding Functions combined

Forwarding-Processors Based Router



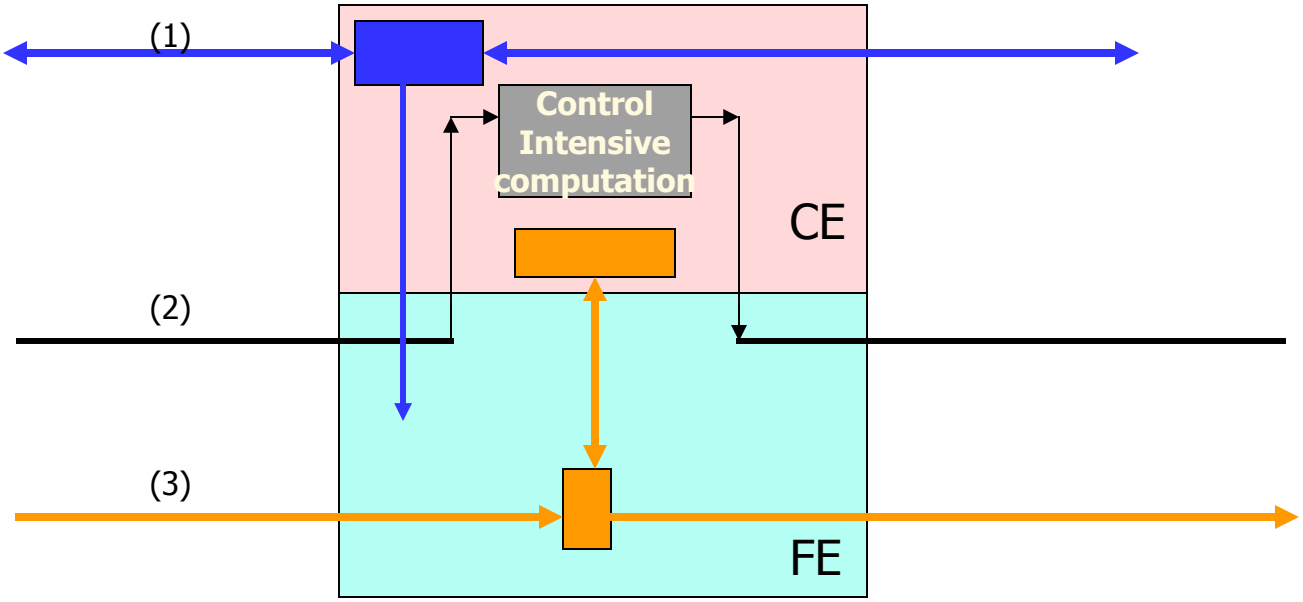
Control separated from forwarding

Openet: a view from a node



Control Functions

CE: Control Element
FE: Forwarding Element

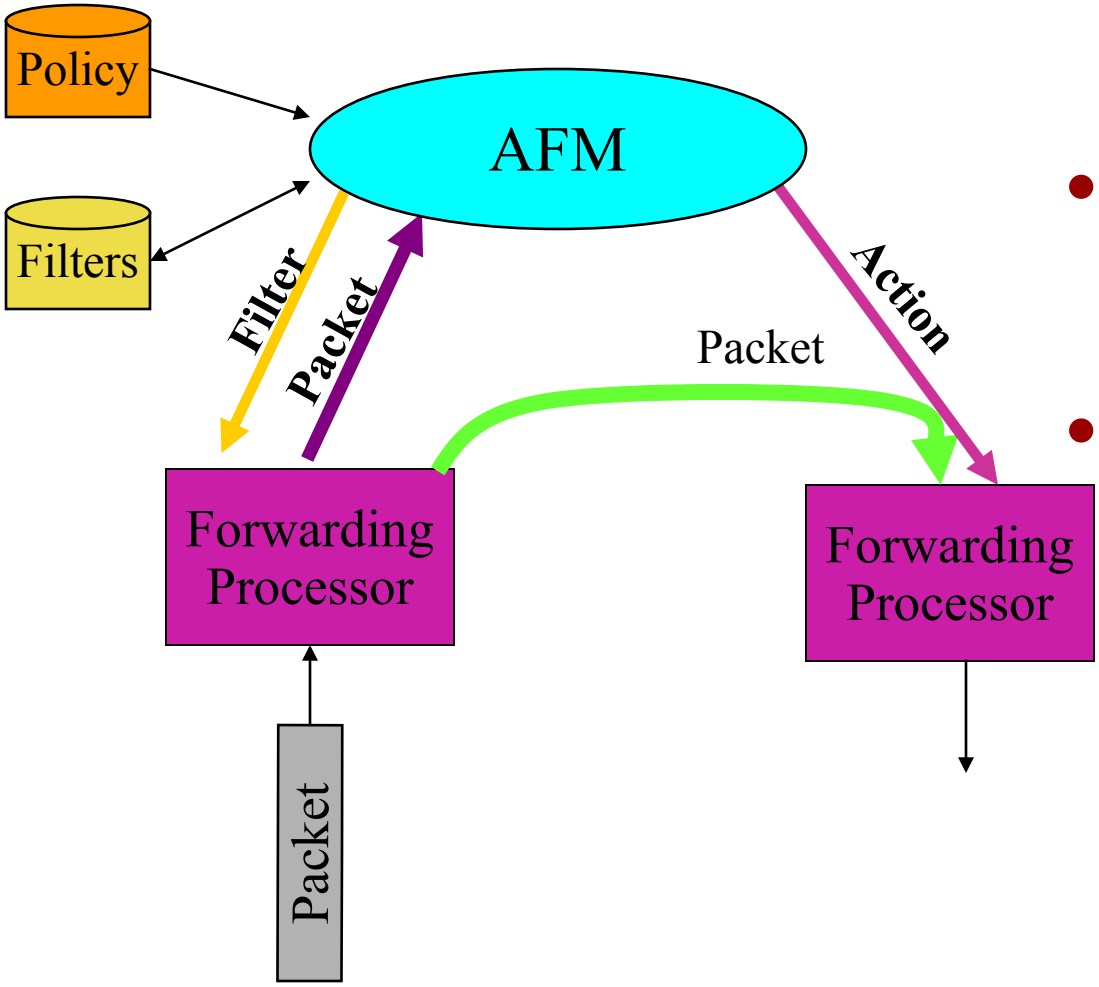


1) **Control functions that reside wholly in the control plane**
2) **Control functions that insert software in the critical data path**
3) **Control functions that allow control entities to act both in the control plane and in the data forwarding plane without adding software in the data path**

Active Flow Manipulation Abstractions

- **Aggregate data into traffic flows**
  - Flows whose characteristics can be identified in real-time
  - E.g., "all UDP packets to a particular service", "all TCP packets from a particular machine".
- **Actions to be performed in the traffic flows**
  - Actions that can be performed in real-time
  - E.g., "Change the priority of all traffic destined to a particular service on a particular machine", "Stop all traffic out of a particular link of a router".

Active Flow Manipulation



- **A key enabling technology of Openet**
- **Two abstractions**
  - Primitive flows
  - Primitive actions
- **Customer network services exercise active network control**
  - Identifying specific flows
  - Apply actions to alter network behavior in real-time

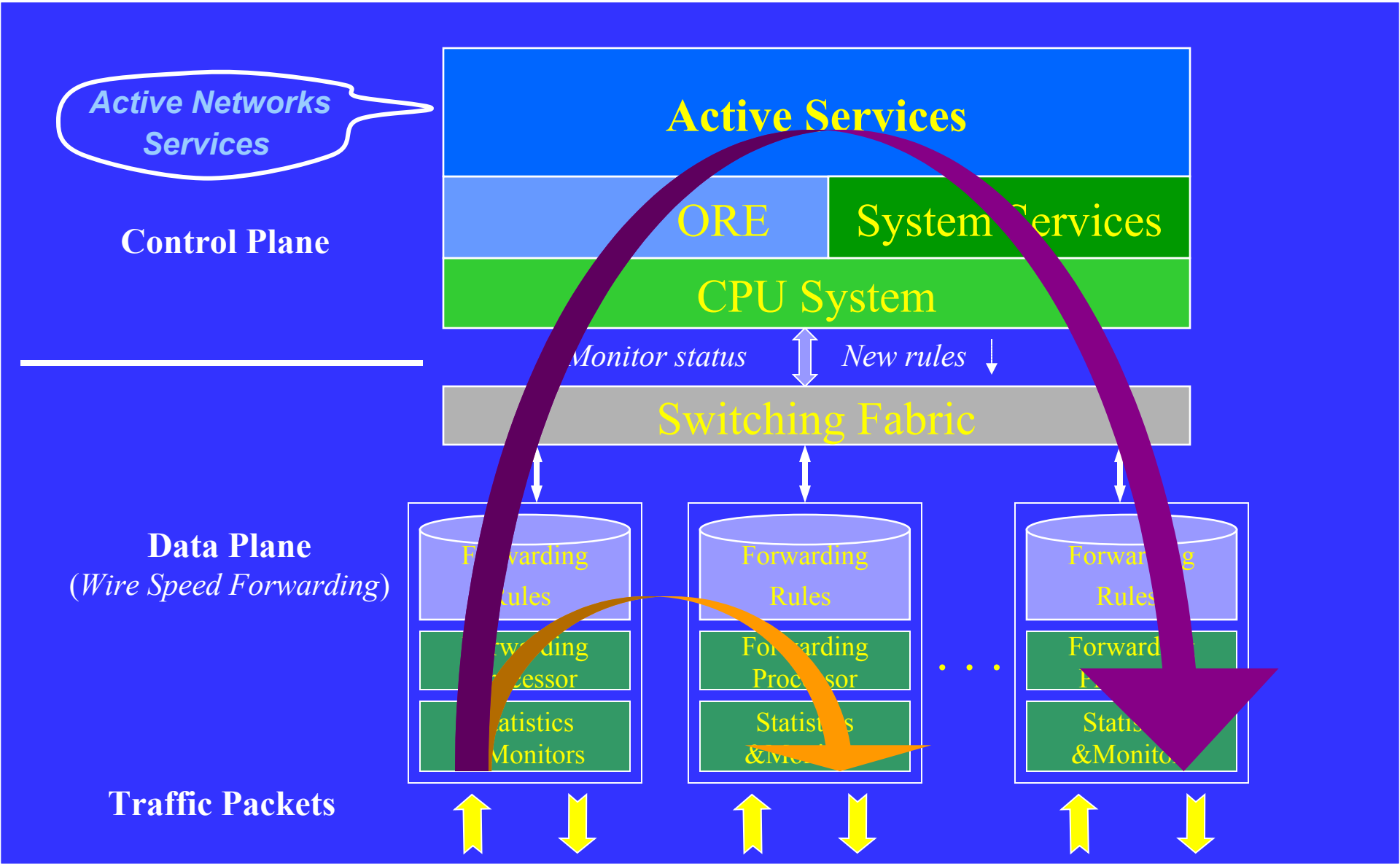
Identifiable Elements of Primitive Flows

Destination Address (DA)
Range of Destination Address (RDA)
Source Address (SA)
Range of Source Address (RSA)
Exact TCP protocol match (TCP)
Exact UDP protocol match (UDP)
Exact ICMP protocol match (ICMP)
Source Port number, for both TCP and UDP (SP)
Destination Port number for both TCP and UDP (DP)
TCP connection request (TCPReg)
ICMP request (ICMPReg)
DS field of a datagram (DS)
IP Frame fragment (FrameFrag)

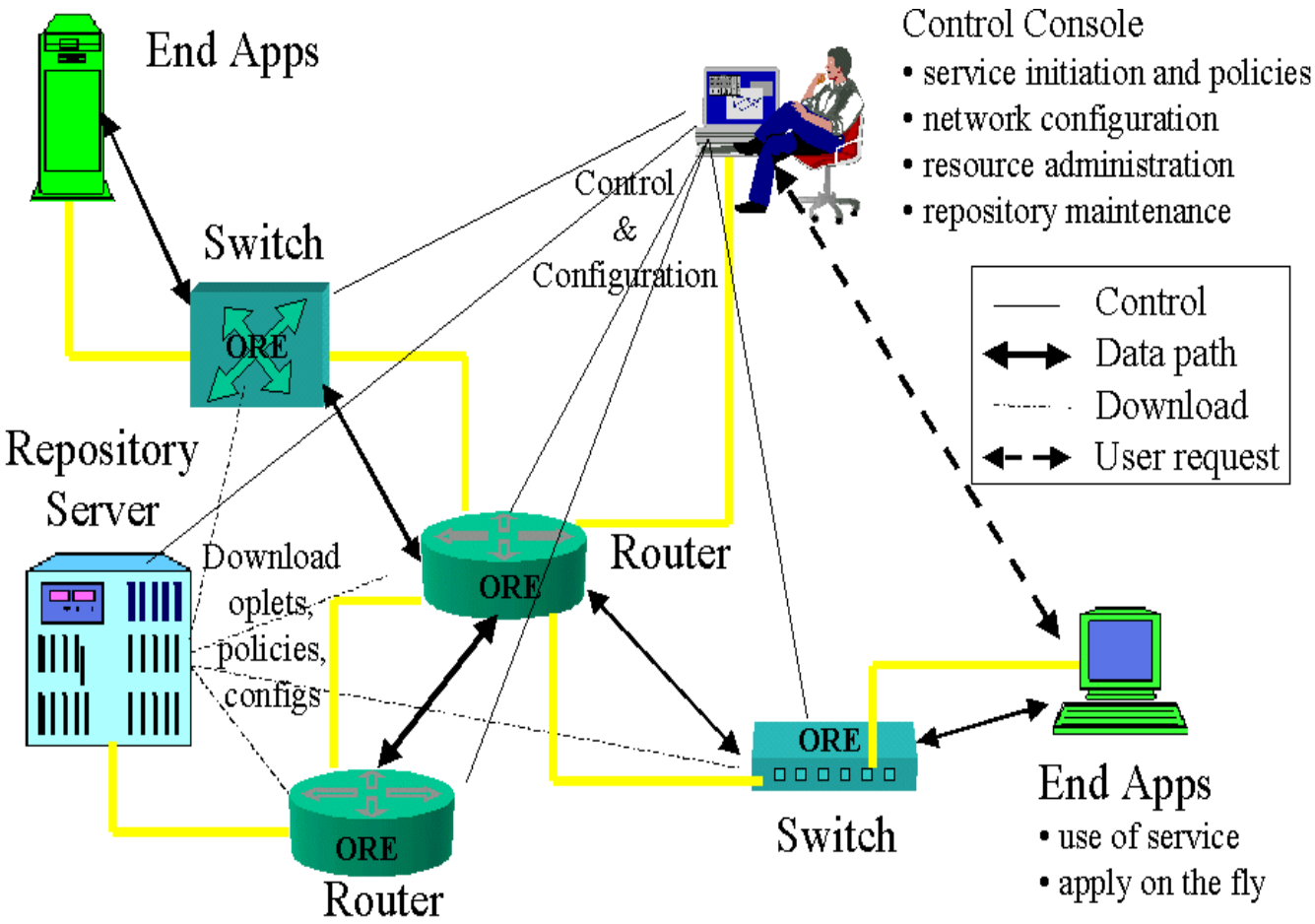
Primitive Permissible actions

Drop
Forward
Mirror
Stop on Match (SOM)
Detect Out of Profile behaviour (Out)
Change DSCP value (DSCP)
Prevent TCP Connect Request
Modify IEEE 802.1p bit

Openet on Passport Router

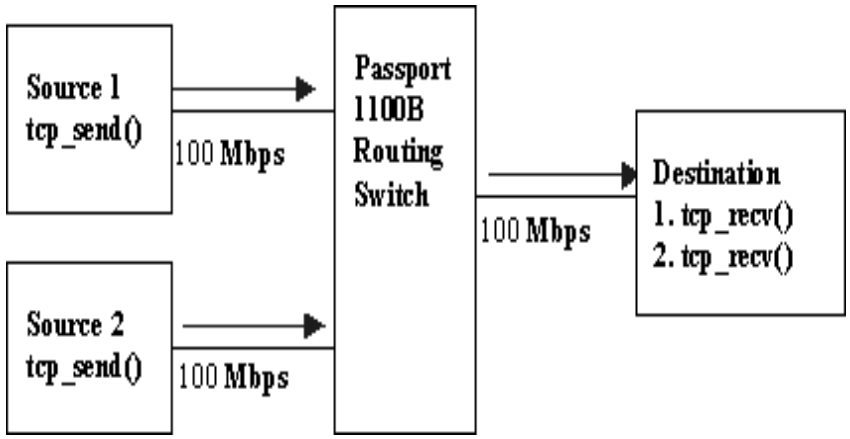


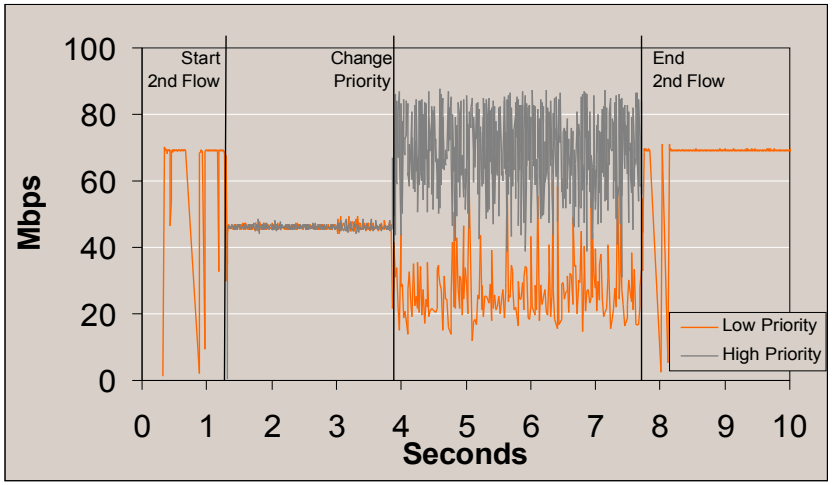
Openet Framework



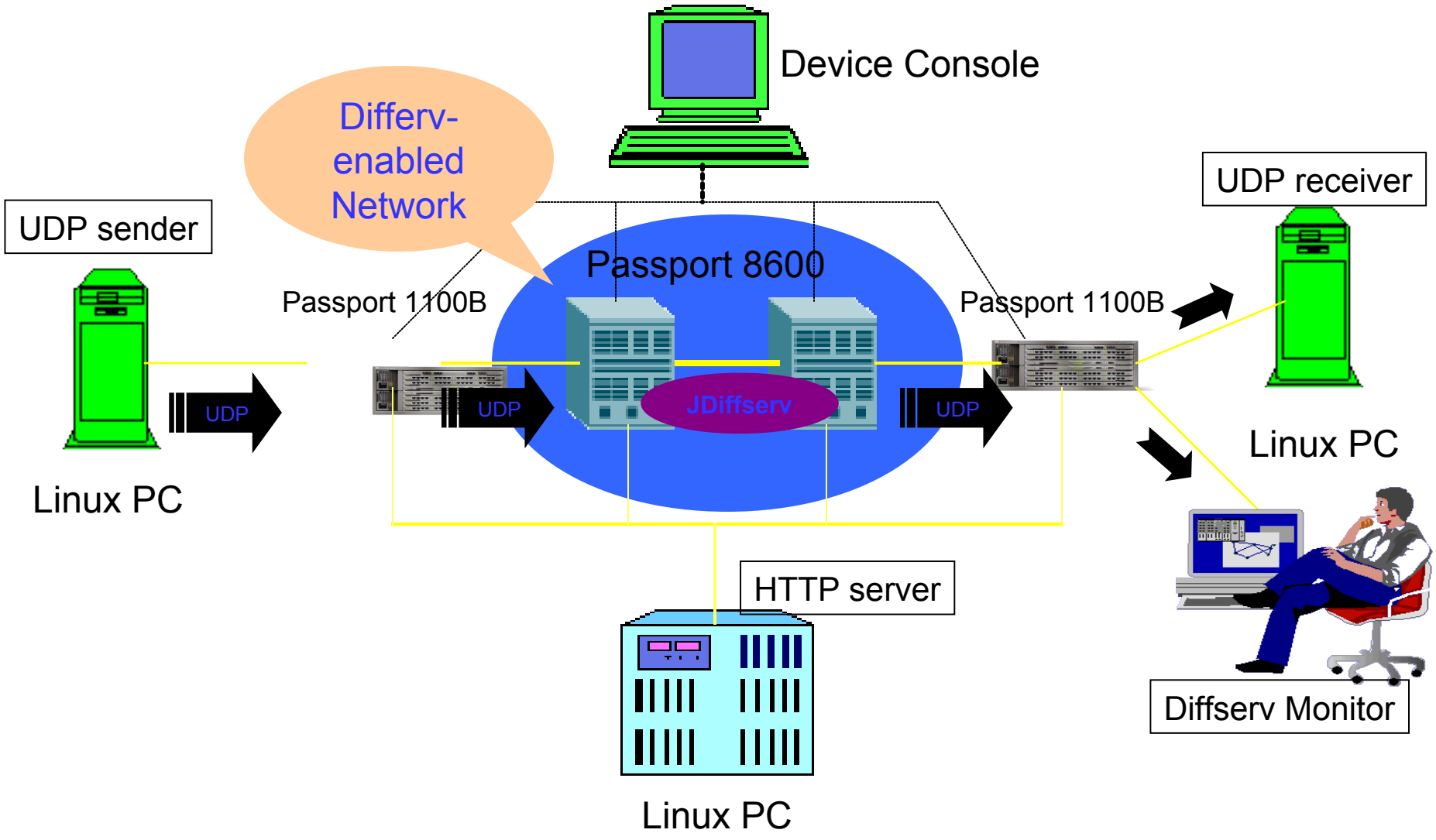
- **Openet Architecture with Passport Switches**

Example 1: Active Flow Priority Change in Real-time



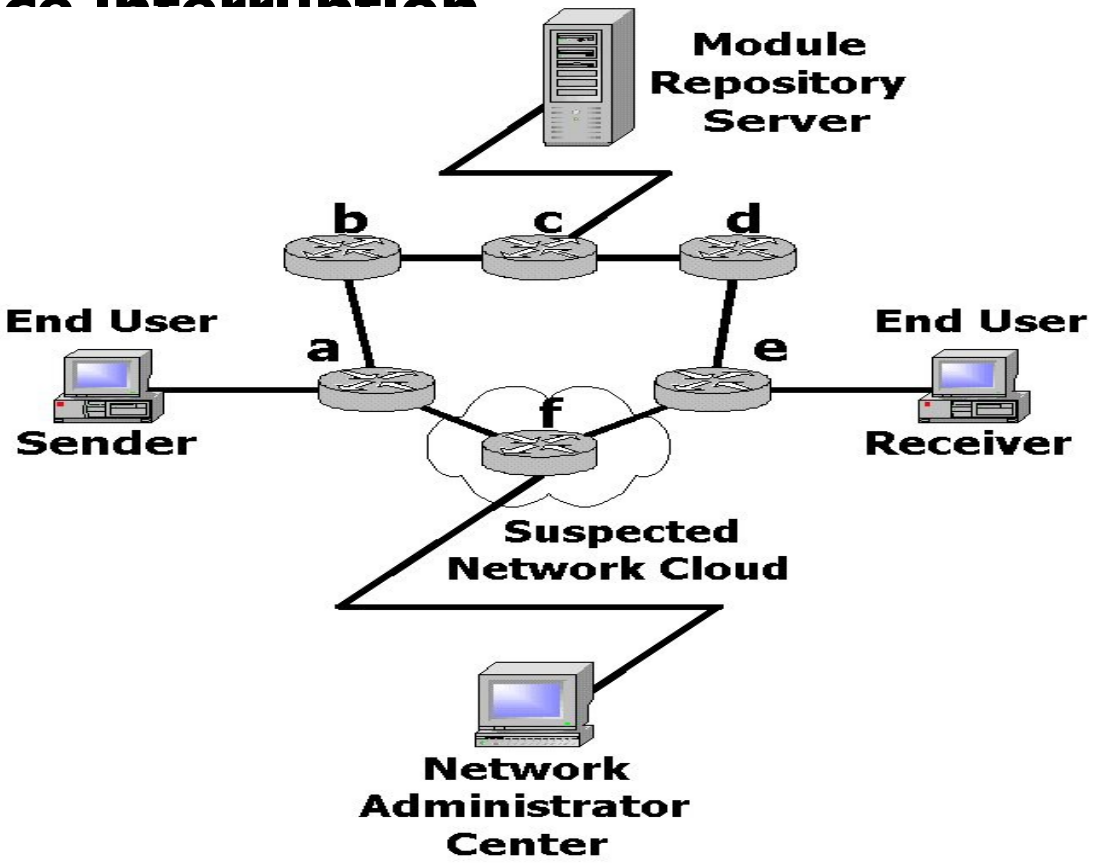


Example 2 : JDiffserv on Passport



Example 3 : Regatta - Fault Recovery

- **Automated supervision**
- **Minimal service interruption**
- **Heartbeats**

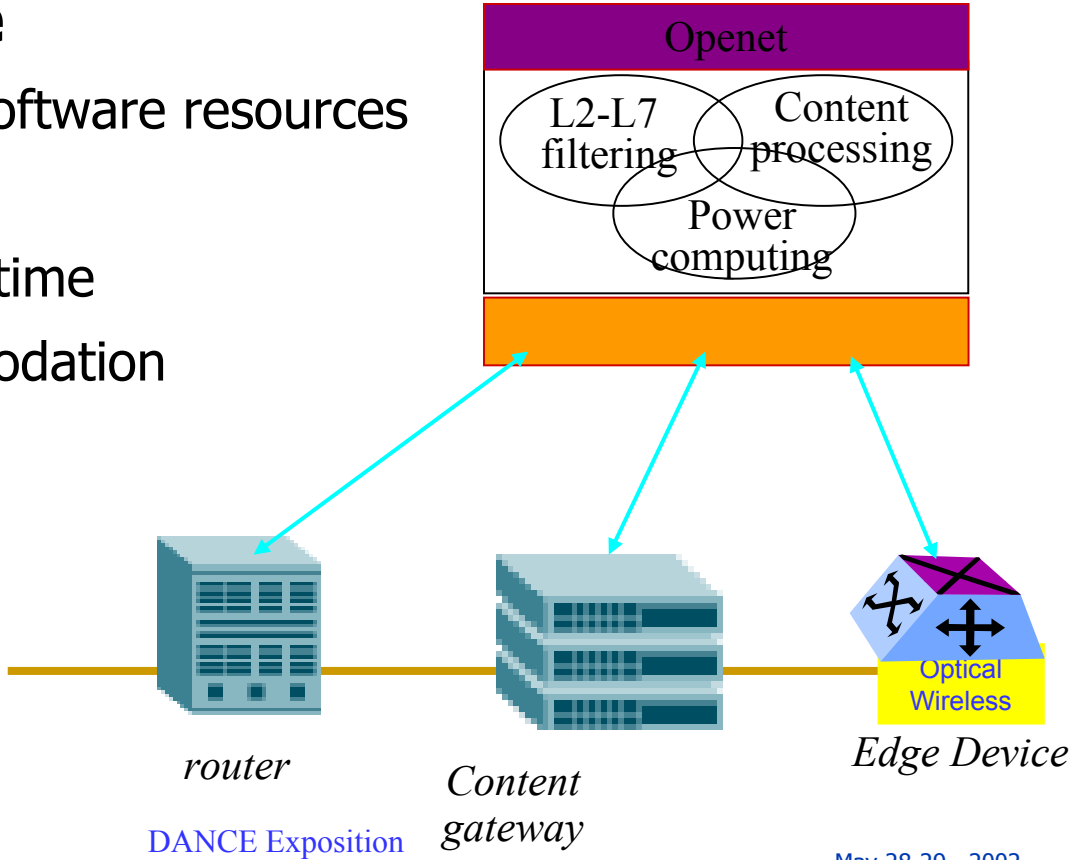


Current Development: Programmable Services Solution

- **Alteon-iSD**
- **Openet**
- **Extended Active Flow Manipulation (AFM)**
- **Openet Alteon-based Active Nets Platform**

Openet Alteon Active Nets Platform = A Powerful Platform for AN Technologies Transfer

- **A powerful and extensible control and computational plane**
  - Partitioning hardware/software resources
  - Active service enabling
  - content filtering in real-time
  - active services accommodation



Solutions' Features

- **Real-time Filtering**
  - Ability to poke at the device's data flows
- **Processing Power**
  - Ability to perform intensive processing
- **Enabling Services**
  - Introducing services on-demand
- **Programmable Services**
  - Enabling active and adaptive services
- **Impedance Matching**
  - Addressing mismatches between disparate domains, disparate technologies

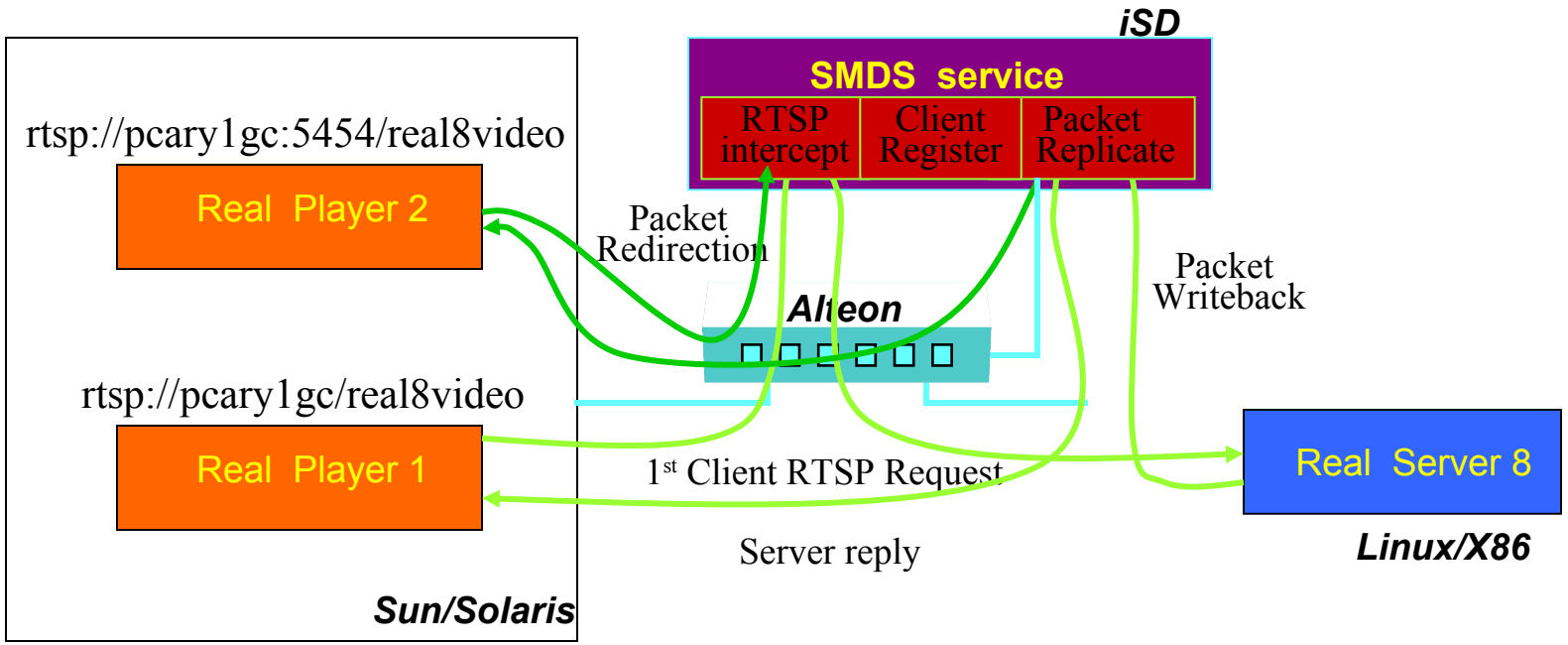
Streaming Media Distribution Service

Openet Alteon AN Platform for SMDS

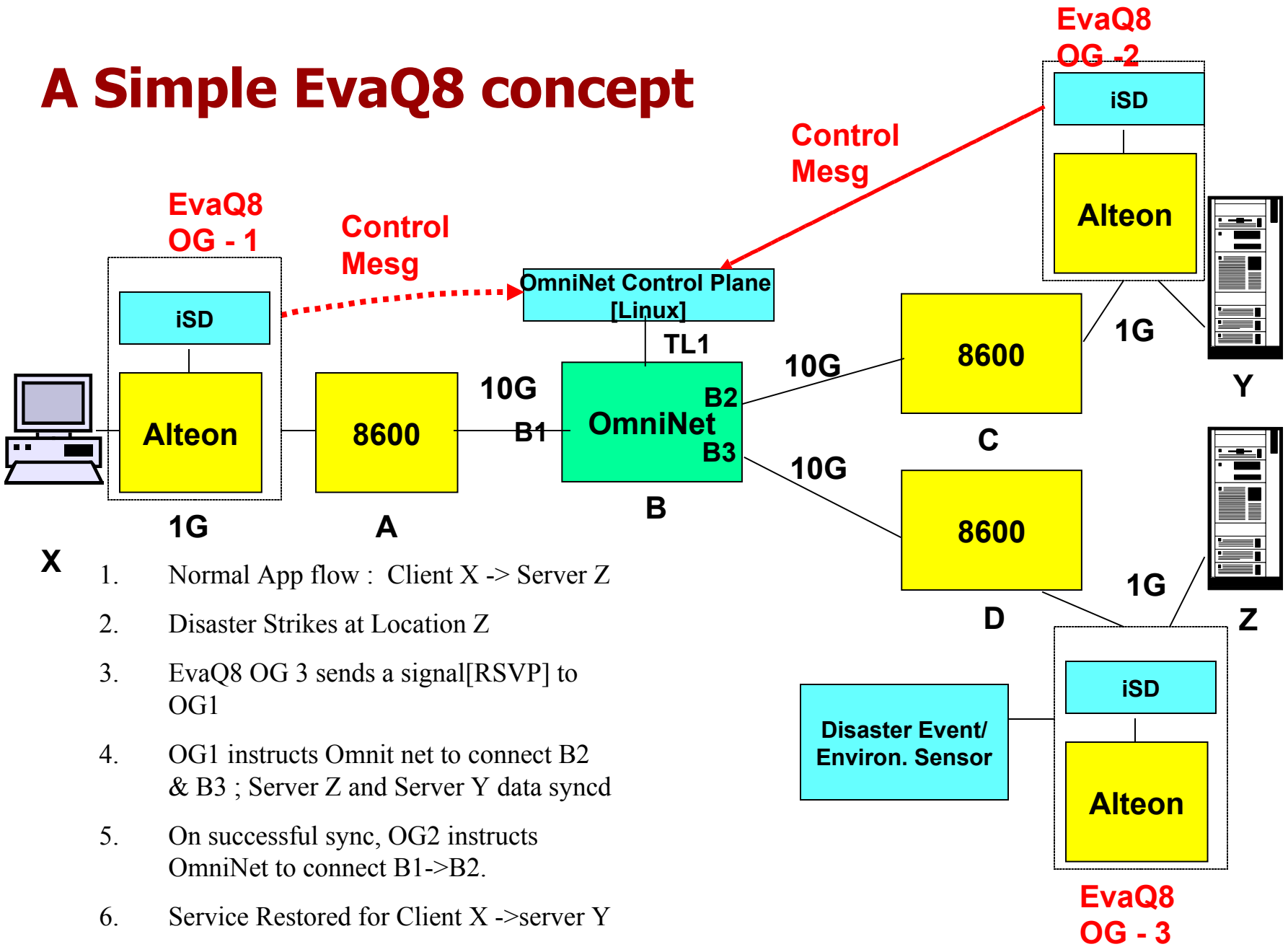
1 Real server on Linux or NT, 2~8 Real Players on Solaris

SMDS on iSD

- Real Player RTSP request filter and interception
- Real Server reply real-time stream filter and replication
- RTSP session setup by replicating first 16 packets cached



A Simple EvaQ8 concept

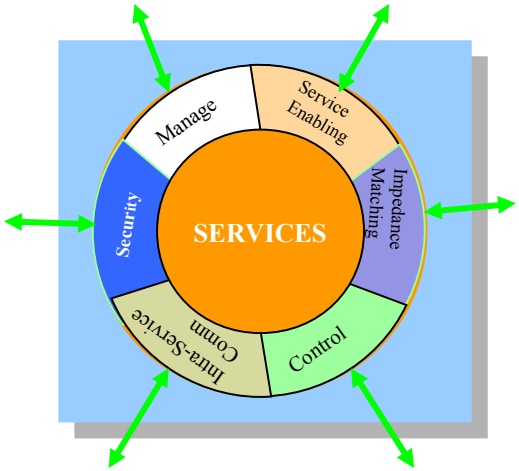


1. Normal App flow : Client X -> Server Z
2. Disaster Strikes at Location Z
3. EvaQ8 OG 3 sends a signal[RSVP] to OG1
4. OG1 instructs Omnit net to connect B2 & B3 ; Server Z and Server Y data syncd
5. On successful sync, OG2 instructs OmniNet to connect B1->B2.
6. Service Restored for Client X ->server Y

What next?

Service-centric Active Nets Platform

- Service Enabling API
- Control API
- Impedance Matching API
- Security API
- Management API
- Intra-service Communications API



Summary

- **Openet – our Networking Programmability**
- **Commercial network programmable hardware**
- **New AN platform: Openet + Alteon + iSD**
  - Alteon: AN platform on an advanced content switch
  - iSD: powerful & extensible computation plane
- **Enables AN technologies transfer** ☺
- **Promoting an edge device service-centric platform** ☹

OpenetLab – Nortel Networks: http://www.openetlab.org/

Q&A