Active Network Node in Silicon-Based L3 Gigabit Routing Switch

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Active Networks Workshop 1999

Outline

- Bridge between research and marketplace
- Implementation of Commercial Grade Active Networks node on Silicon-Based Gigabit L3 Routing Switch
- Demo1 - ANTS on Accelar
- Demo2 - Dynamic Filtering & Configuration
- Demo3- Packets Capture
- Future: Active Networks Routing Protocols

Bridge between research and marketplace

- Bridges the gulf between theory and practice
- Active Networks - industry participation
- Publish the Accelar JVM and development environment
- Publish Linux simulator, tools, and docs
- Scaling up Active Networks Routing Protocol to commercial networks
  - Heterogeneous Topology - AN/Non AN

Accomplishments

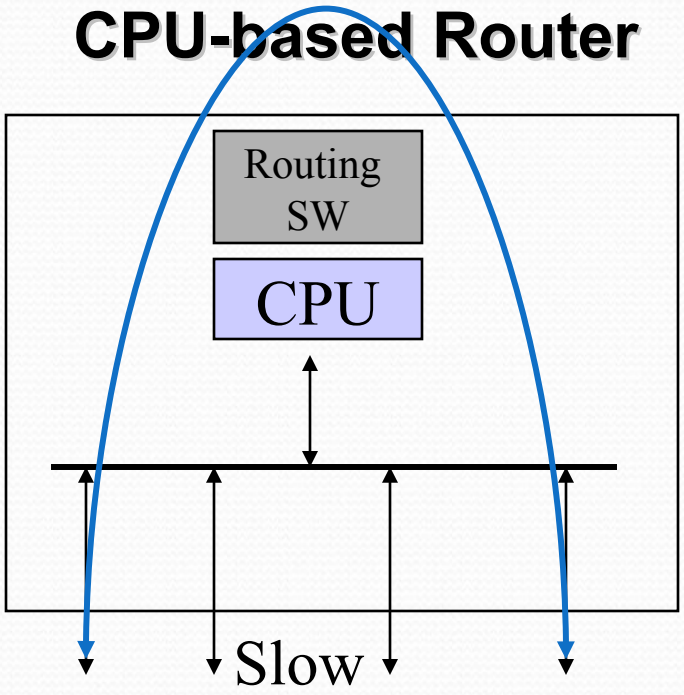
- JVM on a silicon-based L3 Routing Switch
- ORE - Oplet Run-time Environment
- Java-enabled Device Architecture
- Active Networks apps that dynamically control and modify Silicon-Based Forwarding
- Packet Interception
- Implementation of Network Forwarding API

Accelar - Industrial Strength Active Networks Implementation

- Up to 96 Gigabit ports
  - (or 384 10/100Mbs + combinations)
- 50Gbps L3 Switching capacity
  - Scaling up to 256Gbps
- Natural Migration - 10Gbs
  - WAN OC-192
- Wire speed - low latency
- High availability
- LAN/MAN/WAN
  - 5km multi mode, 50km single mode

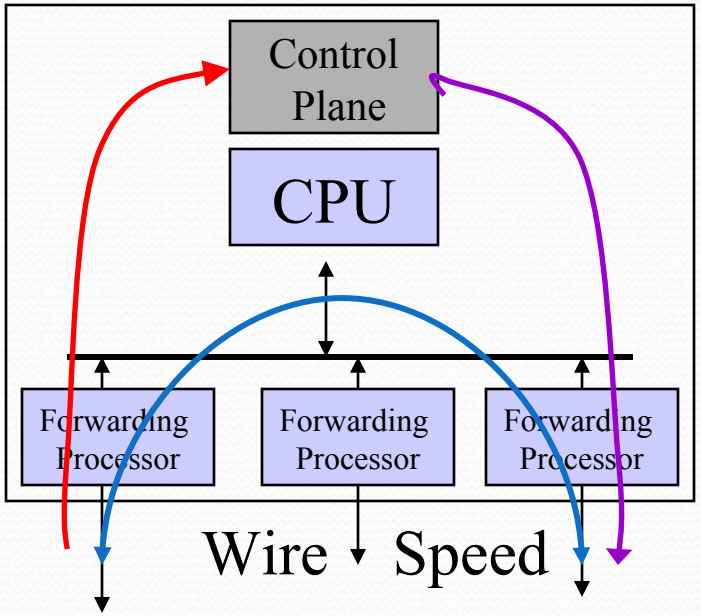
Separation of Control and Forwarding Planes

Centralized, CPU-based Router



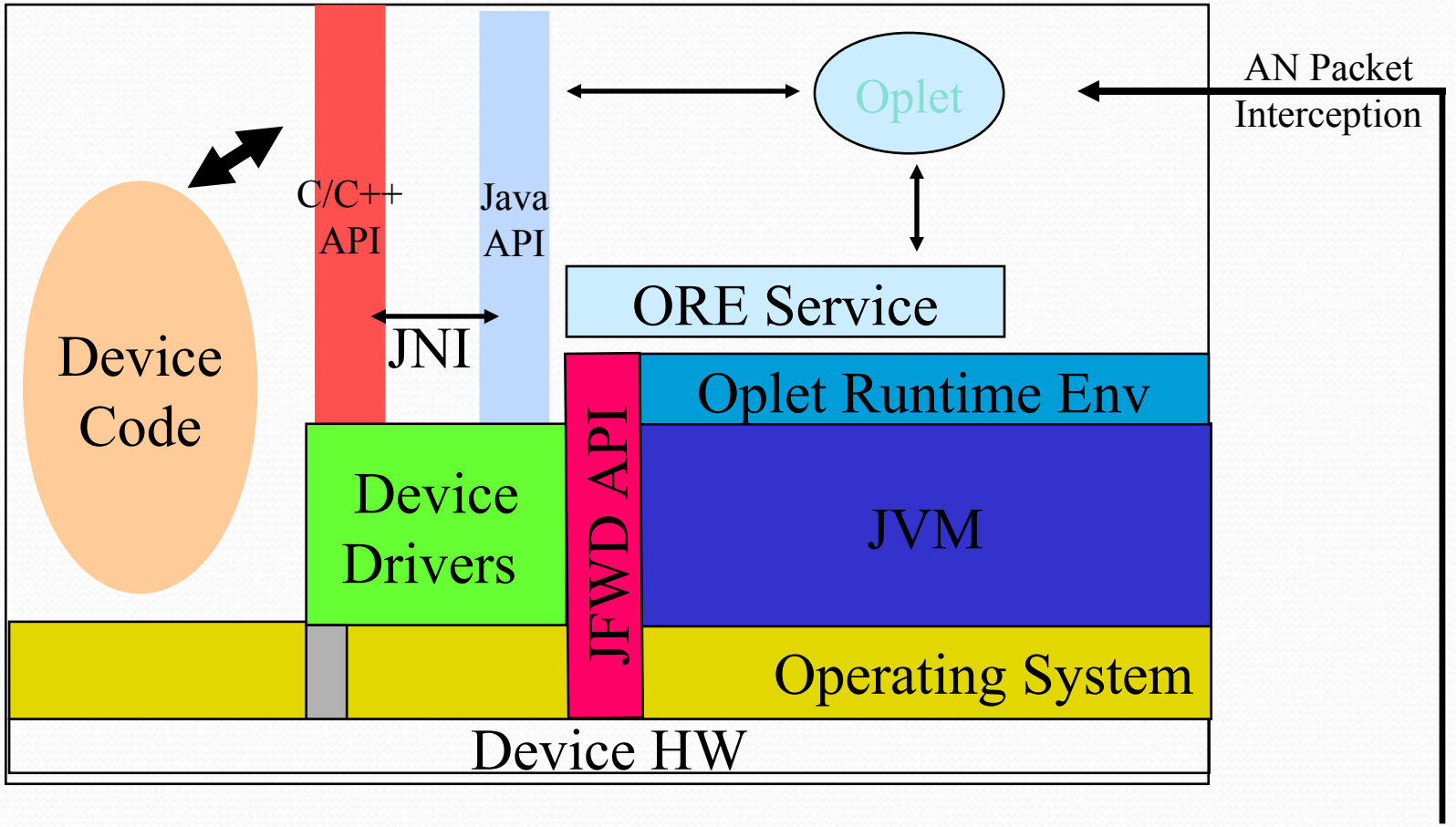
Control + Forwarding Functions combined

Forwarding-Processors based Router



Control separated From forwarding

Active Networks - Node Architecture



ORE - Oplet Run-time Environment

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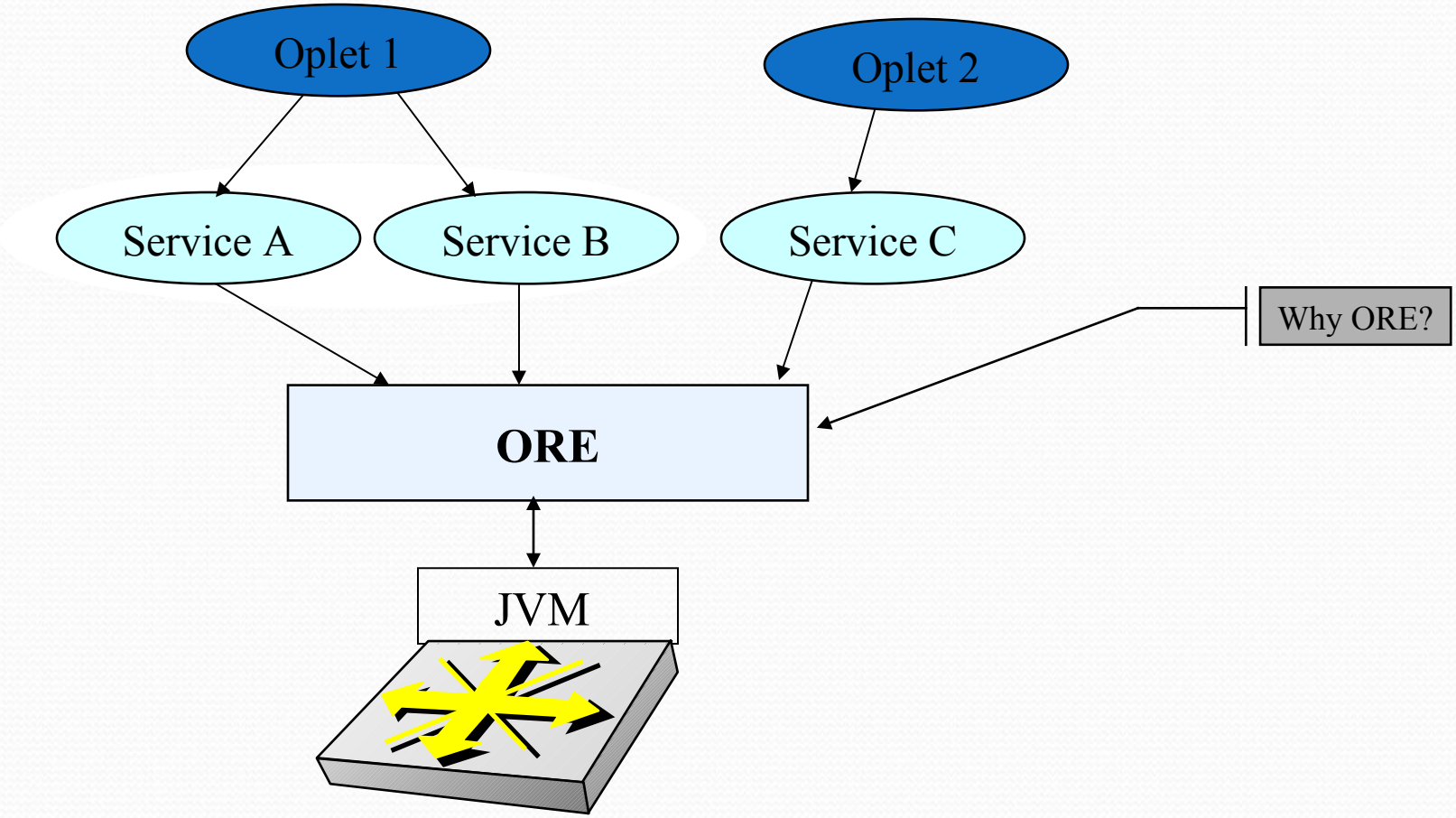


ORE Protection

- ORE uses JVM mechanisms to:
  - protect itself from the Oplets
  - protect Oplets, one from another
- Mechanisms include features of the Java
  - type safety, access control, ByteCode verification
  - built-in sandbox security manager support
  - signed code
  - strong cryptography infrastructure

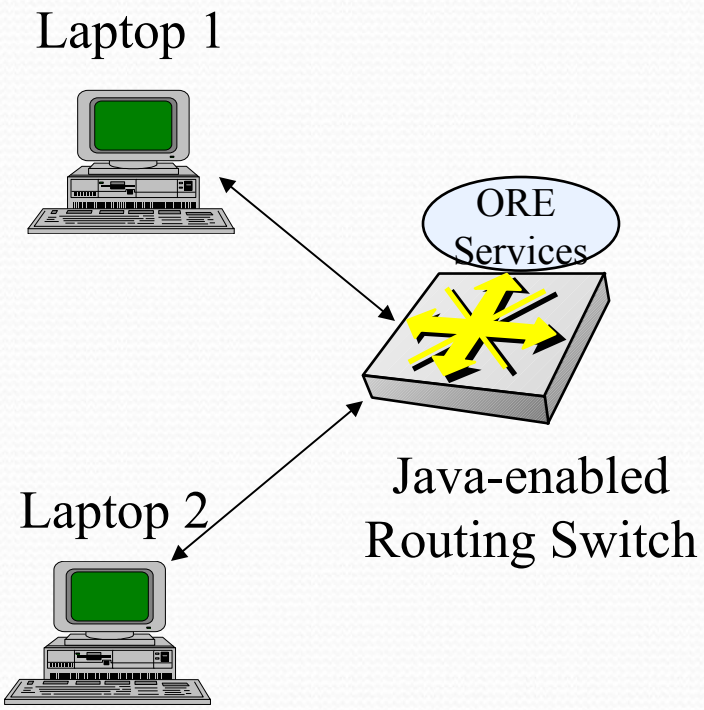
ORE Protection

- Java facilities are buttressed by ORE control over the allocation of as many of the system resources as possible
- Extra JVM support is necessary to protection against misbehavior by Oplets
  - Accounting of memory and CPU consumption
  - Promising possibility for memory accounting:
    - the ability to partition the object heap to enforce limits on the memory usage by an Oplet

ANTS on Gigabit Router
Demo - 1

ANTS Demo Configuration

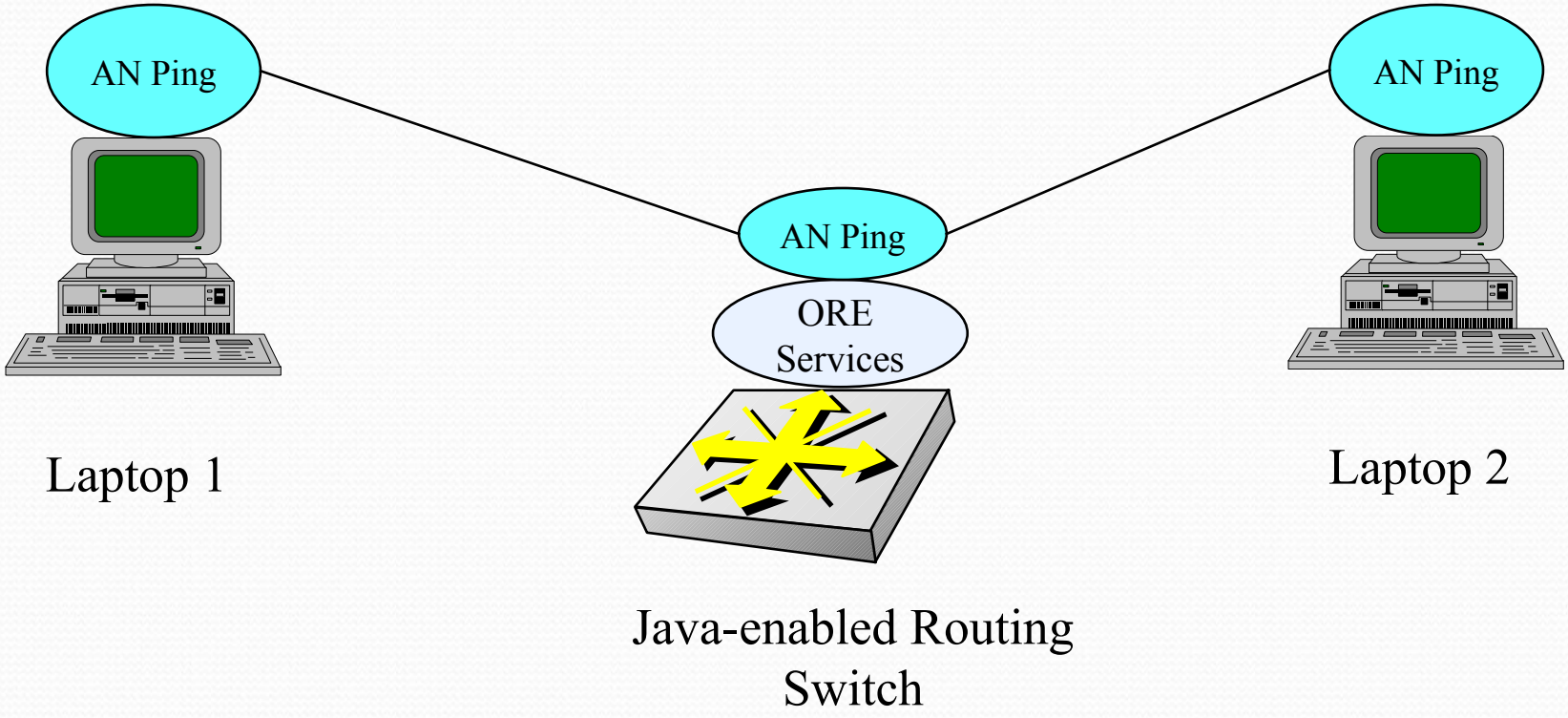
- RoutingSwitch loads boot image from TFTP server
- RoutingSwitch dynamically loads Oplets from the Class Server
    - Laptop 1 originates the ping
- Router gets Ping code from Laptop 1.
- Router "evaluates" ping
- Ping forwarded to Laptop2
- Laptop 2 requests code
- Laptop 2 perform ping reply



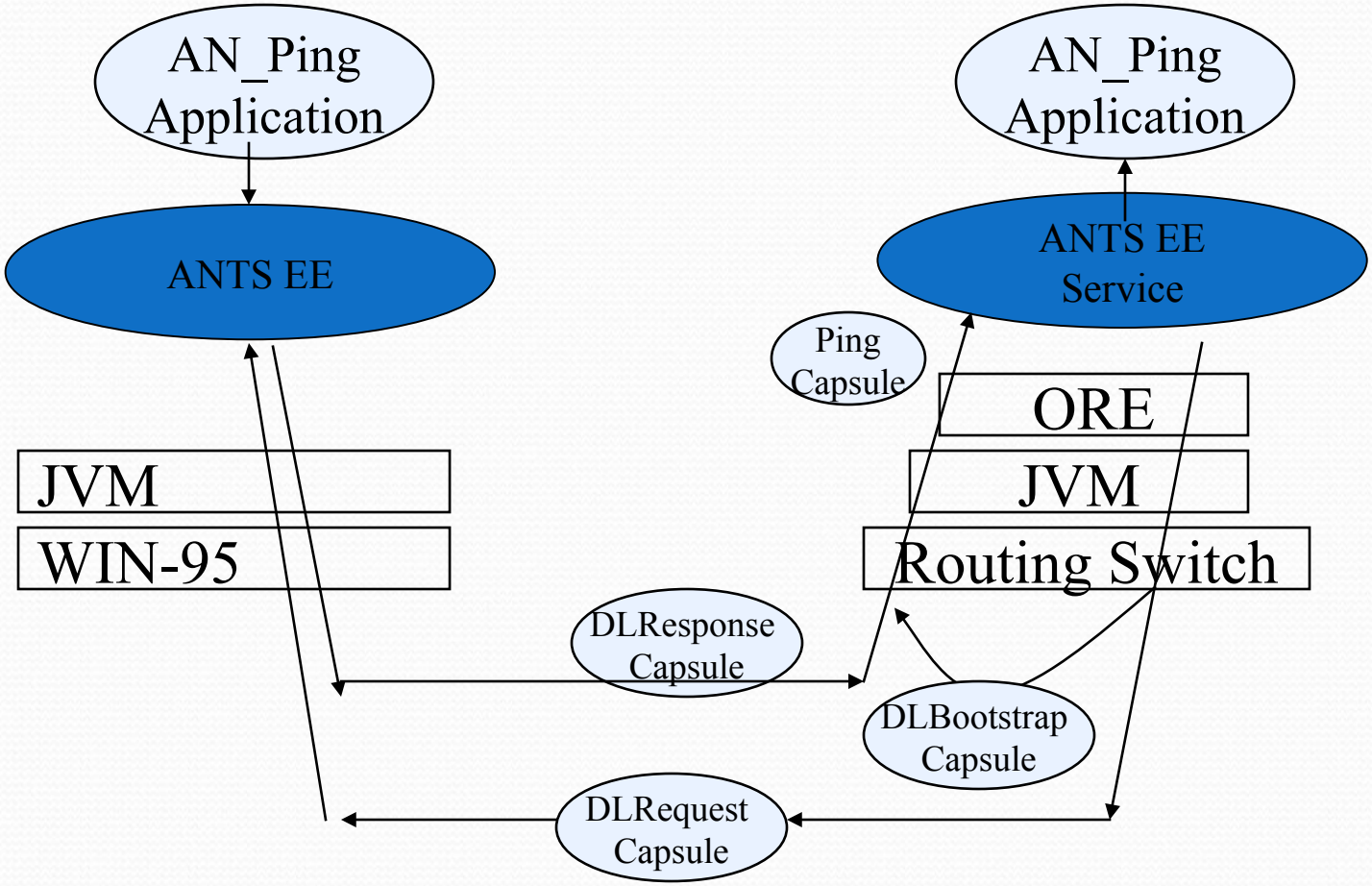
1. Class Server
2. TFTP Server

ANTS Demo

Demo 1



ANTS Demo


AN_Ping Application
ANTS EE
JVM
WIN-95
AN_Ping Application
ANTS EE Service
Ping Capsule
ORE
JVM
Routing Switch
DLResponse Capsule
DLBootstrap Capsule
DLRequest Capsule

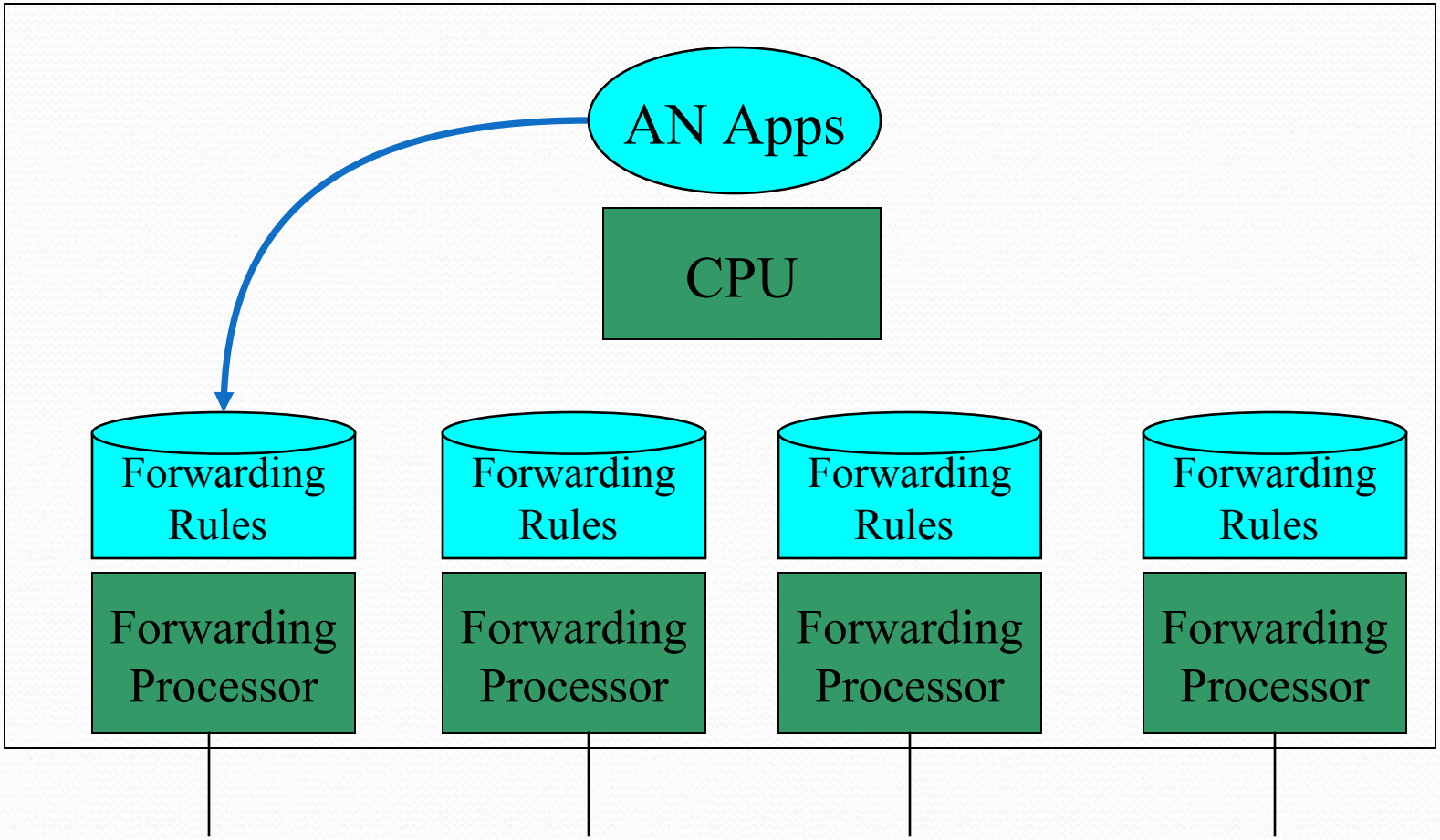
ANTS Demo

- Java application running on the router
- ORE facilitate downloading services
- Interoperable with ANTS Distribution
- Minimum changes to make it conform to ORE service specification

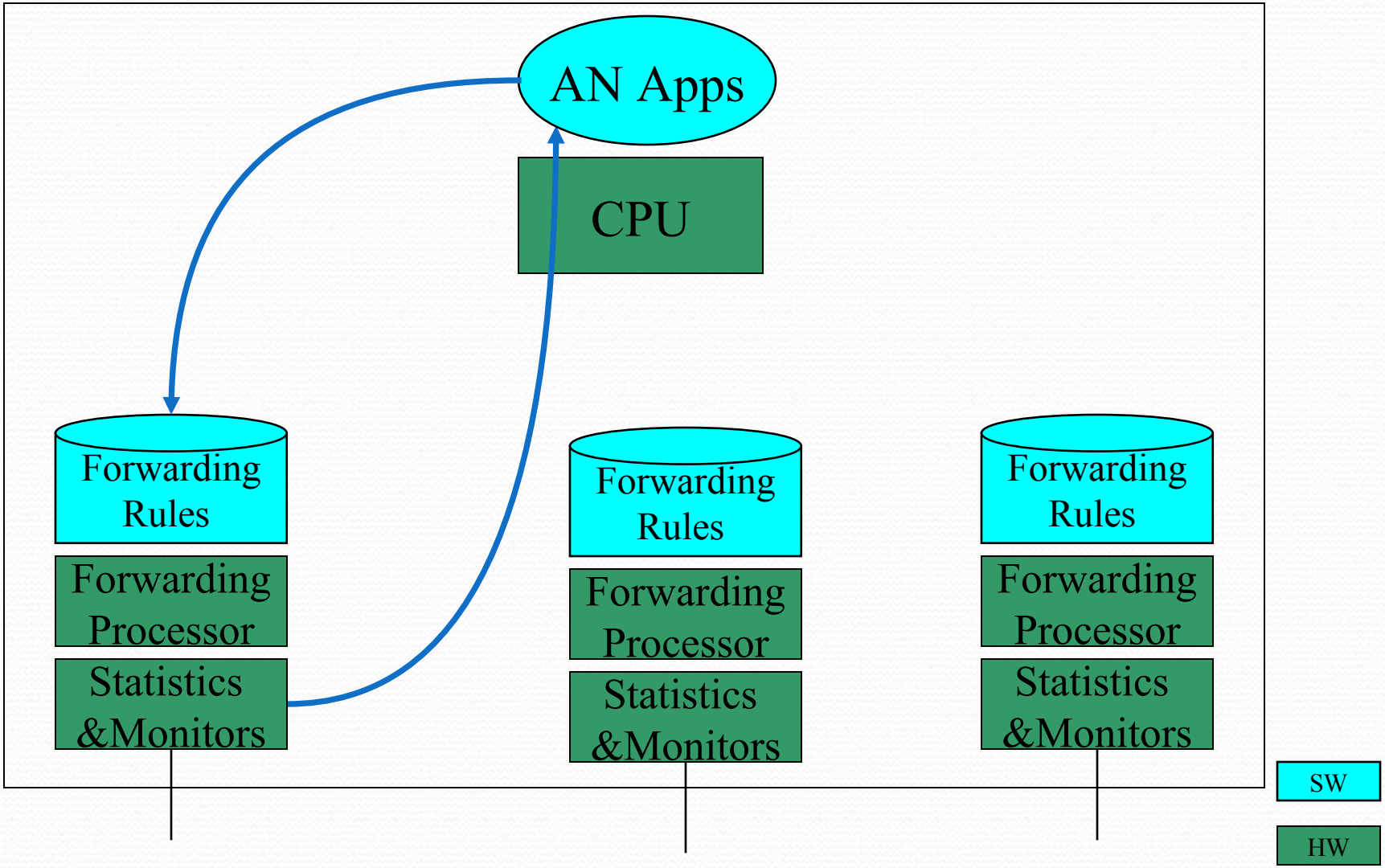
Dynamic Filtering & Configuring

Demo - 2

Dynamic Configuration of Forwarding Rules

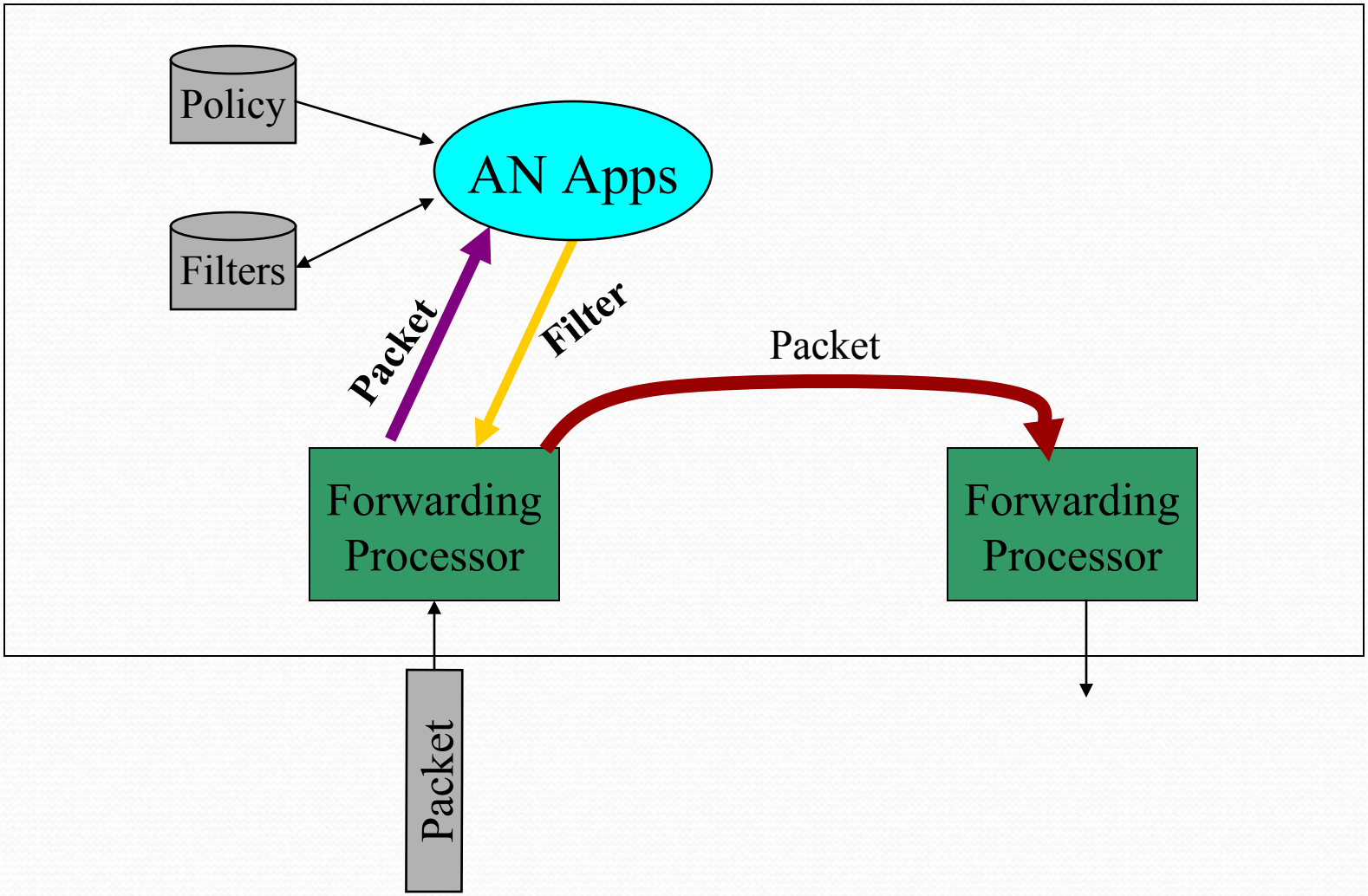


Real-time forwarding Stats and Monitors



Demo 2

Dynamic - On the Fly Configuration



Dynamic - On the Fly Configuration

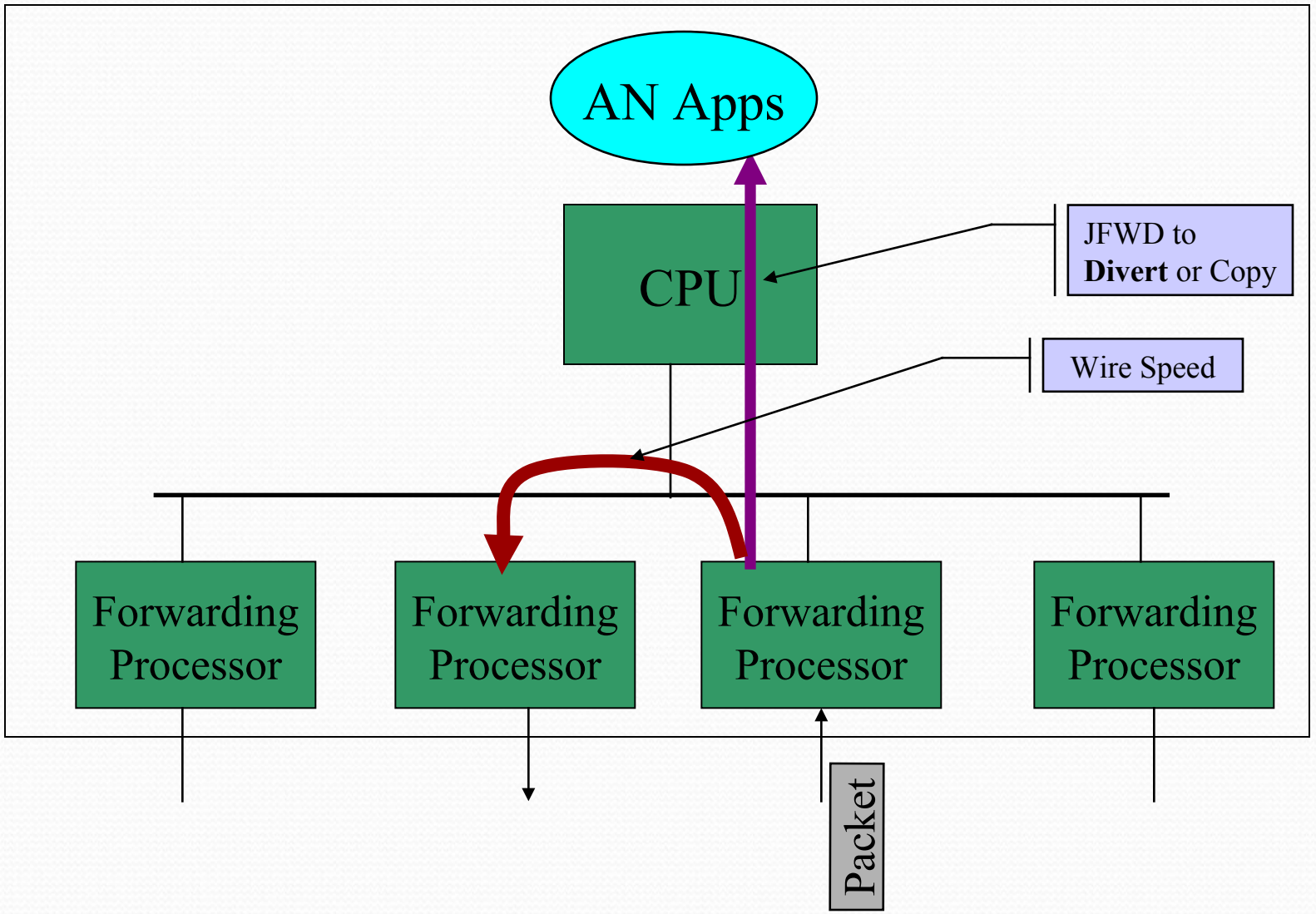
- From downloadable Java application, we can dynamically modify the behavior of the Forwarding Processors (ASICs)

Active Networks Packets Interception

Demo 3 -

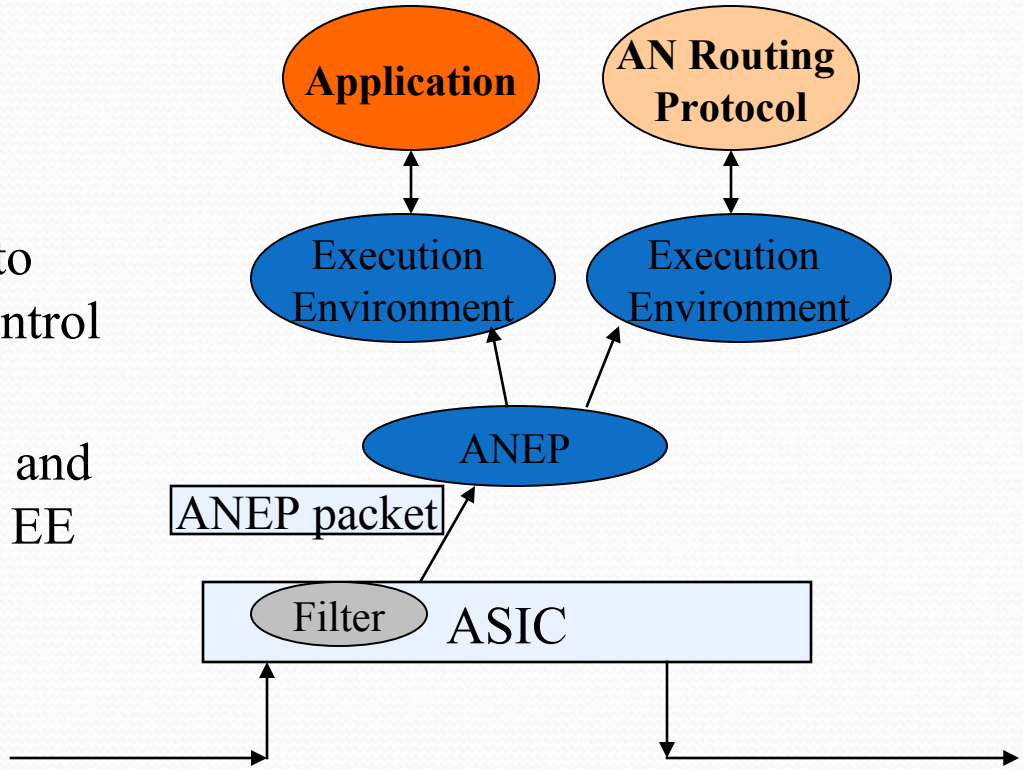
Active Networks Packet Capture

Demo 3



Packet Divert

- Active Network topology is unknown
- ANEP packets NOT addressed to this node are delivered to the control plane for processing
- ANEP daemon receives packets and delivers them to the appropriate EE based on TypeID



Active Networks Packet Capture

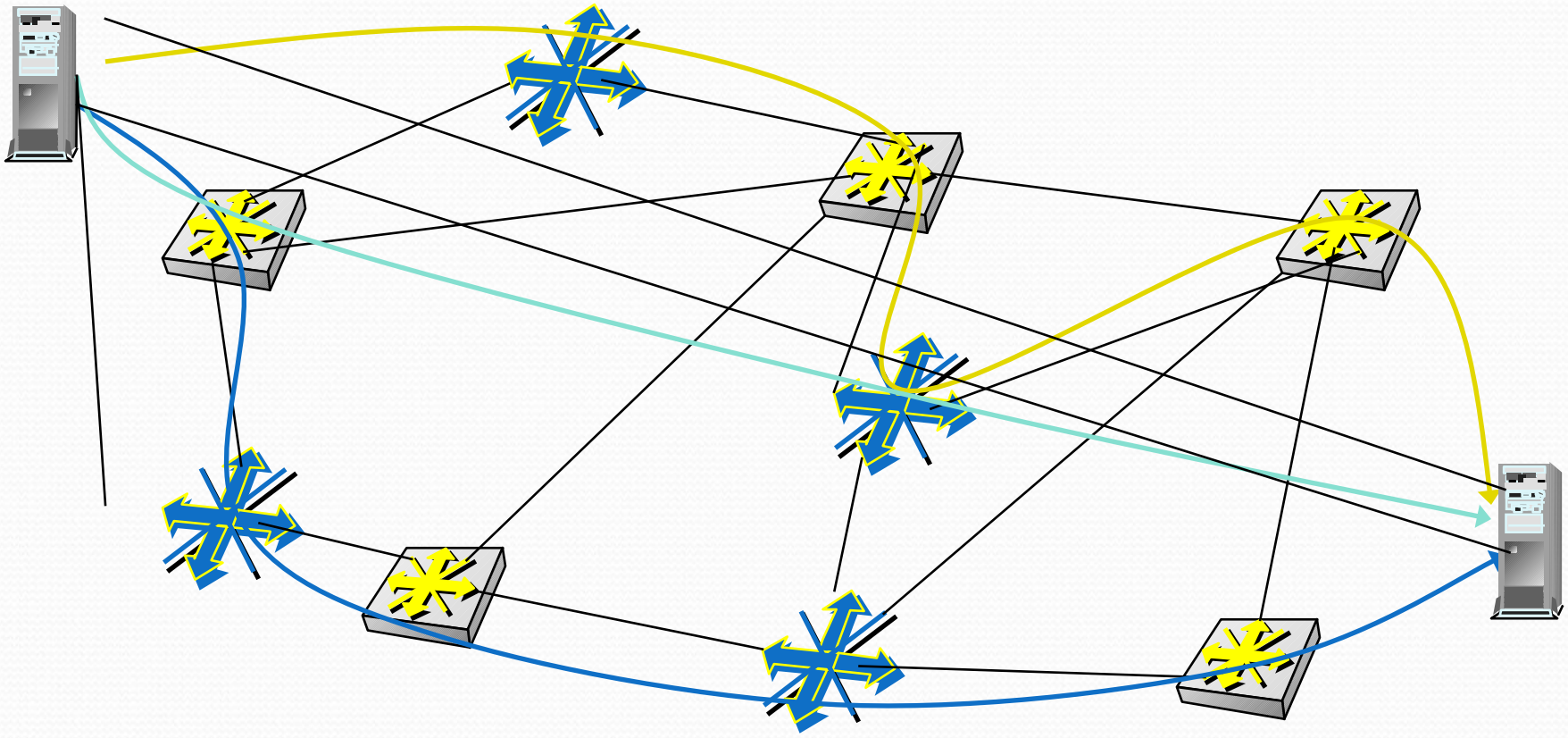
- Be able to get the packets from the forwarding plane to the control plane
- Process Active Networks packets in the control plane
- Enabler for Active Network routing protocols

Scaling up Active Networks Routing Protocol to commercial networks

Scaling up Active Networks Routing Protocol to commercial networks

- Overcome the need to predefine the next hop
- No need to know AN topology a head of time
- Divert/CarbonCopy specific packets to control plane (e.g. packets on ANEP port)
- Wire speed of all other packets
- End to end forwarding
- Future: Active Networks Routing Protocols

Mixed Topology of AN system

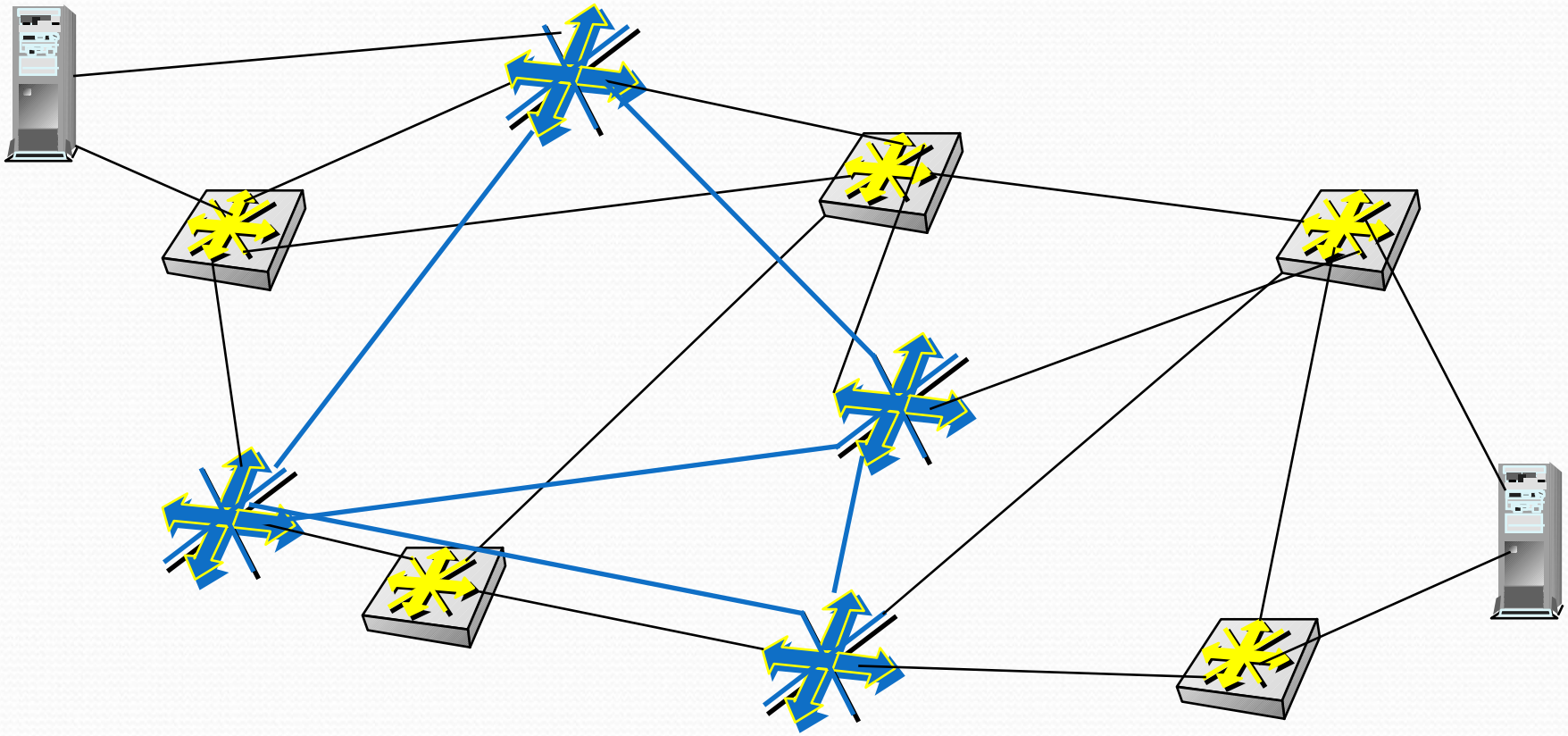


NO need to know the AN topology ahead of time

 - AN Node

 - Non AN Node

Virtual Topology of AN system



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Summary

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- Demo 3 - Packets Capture to control plane
- Future : Enables Active Networks Routing Protocols