To be smart or not to be?
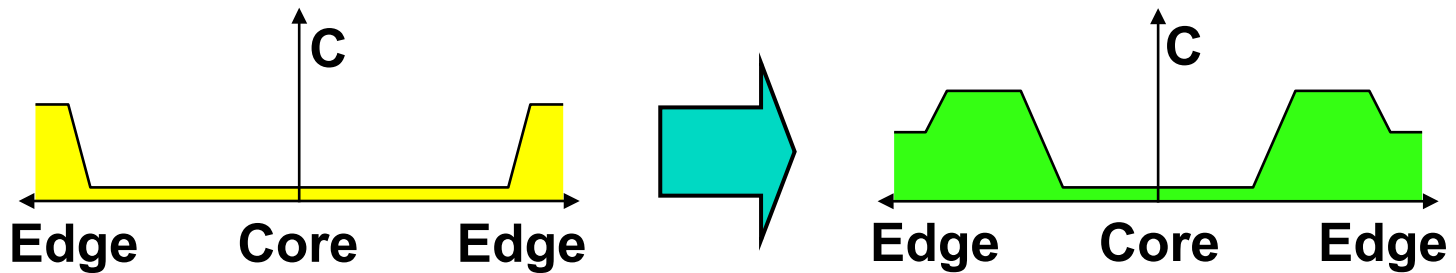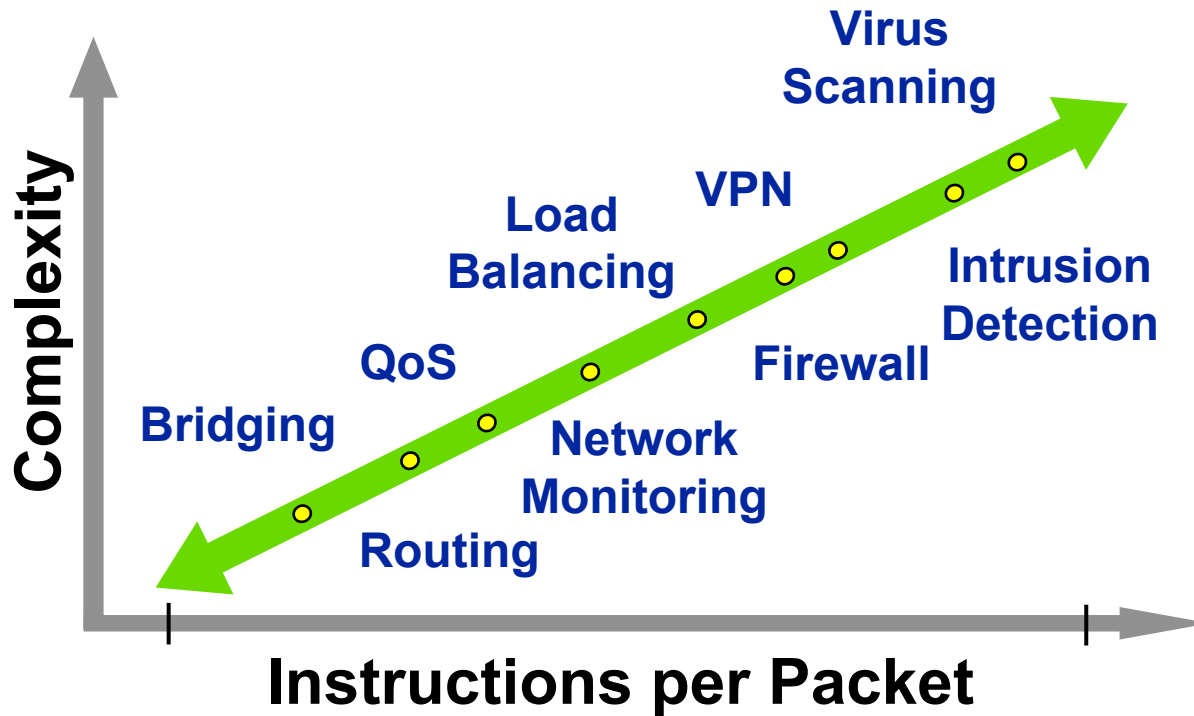
Siva Subramanian
Polaris R&D Lab, RTP

Tal Lavian
OPENET Lab, Santa Clara

State of the network

- **Plenty of bandwidth**
  - **Optical core**
- **Increasing demand for services**
  - **Gateways**
  - **Network Service nodes**
  - **Content Switches**
  - **Network Caches**
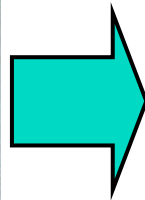- **Evolving network**

Evolution of the network
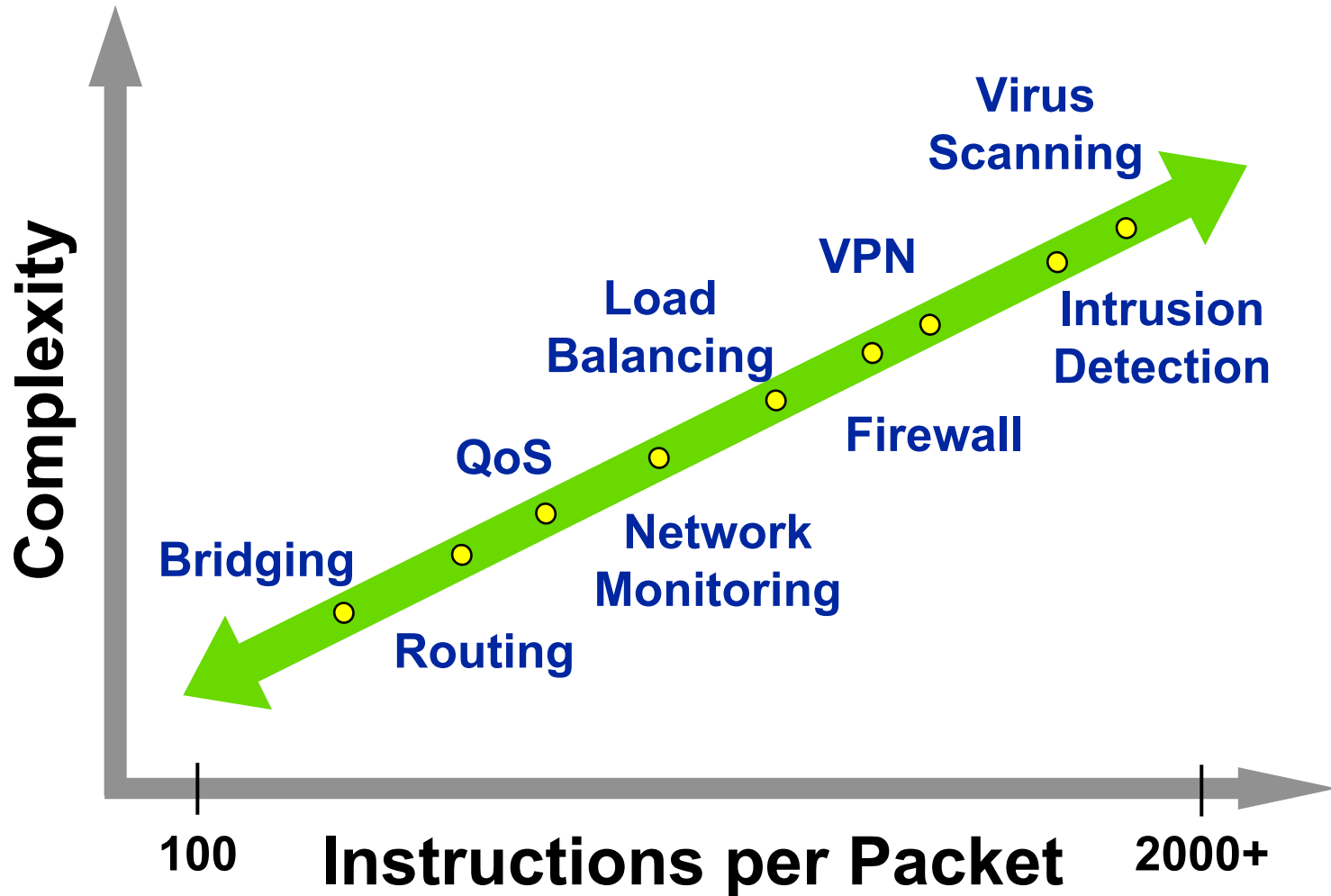
Current Mode of Operation

- **Application specific solutions**
- **Hardware/Software design and deployment cycles takes years**
- **Ad-hoc solutions create complex networks**
- **Multiple network management solutions**

Answer – Part I

- **Flexibility**

- **Programmability (open interfaces)**

Skybolt
in
robot mode

Skybolt in fighter mode

Processing Requirements

Need for Power

- **Computational Complexity**
- **32-bit Processor @ 500 MIPS**
- **How much can you do with it?**

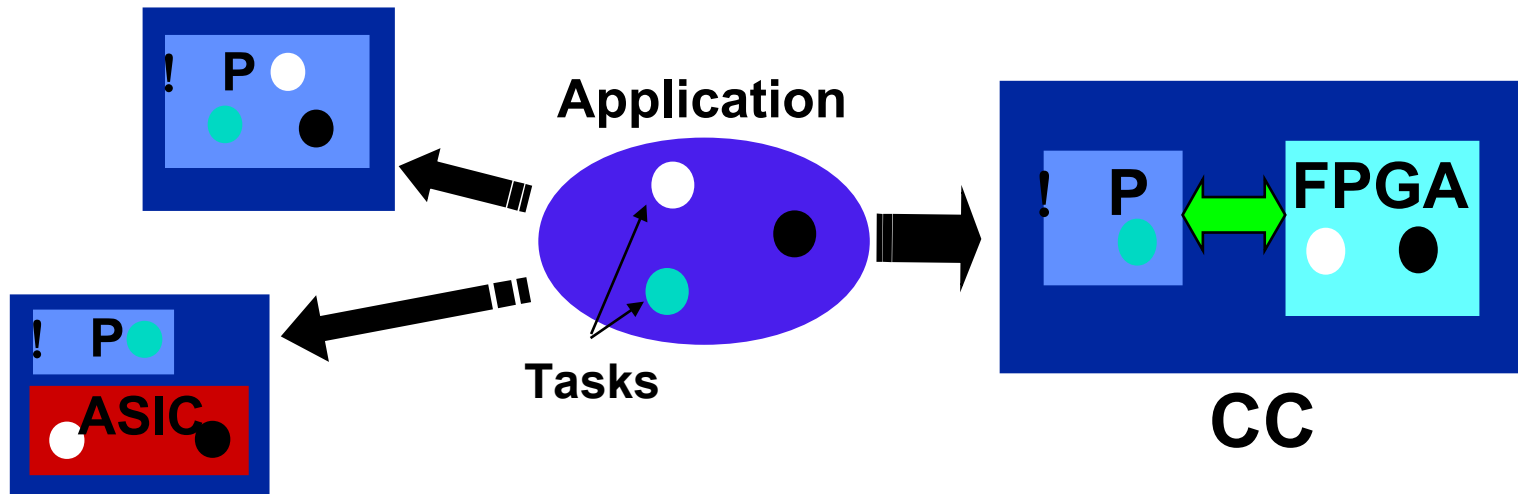|	**Time/Word**	**# Insts**
100BaseT	**320ns**	**160**
OC48	**13ns**	**7**

- **Need for high performance computing technology deeper in the network**

Answer – Part II

- **High Performance Computing Technologies**
  - **Configurable Computing**
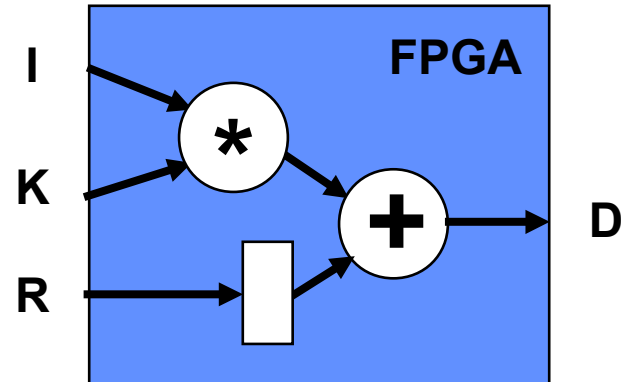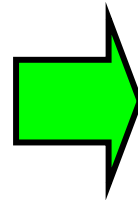 - **Parallel Processing**
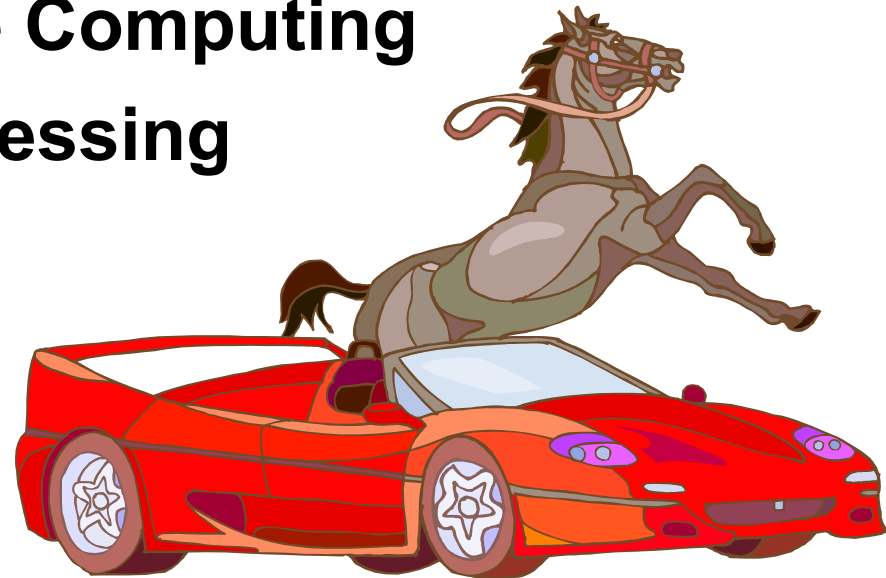
Configurable Computing

- **Configurable Computing: Programmable logic (FPGA) coupled to Processor (! P)**
- **Customized for each application**

How does CC work?

```
float D, I, K, R;
int A = 100;

   . . .
   while ( A != 0 ) {
     temp = I * K;
     D = R + temp;
     A - - ;
   }
```
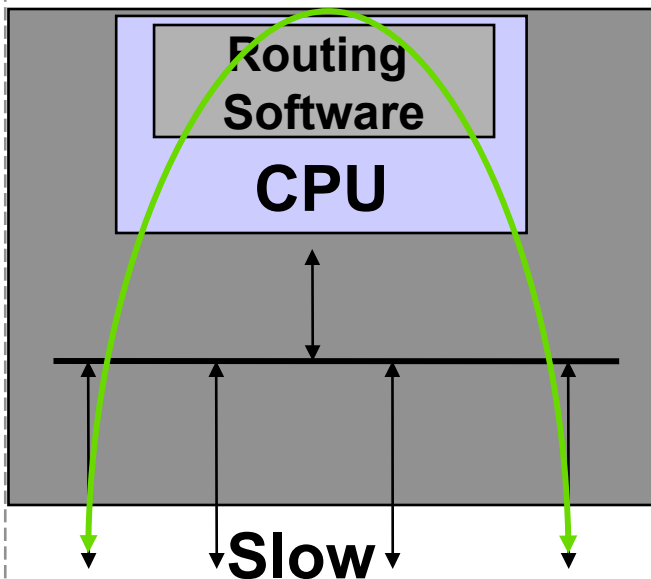

- **Customised hardware operations**
- **Concurrent operations**

The power of CC

- **DCT implementation**
  - **Xilinx FPGA 180 times faster than 32-bit processor @ 266MHz**
- **Vector computations**
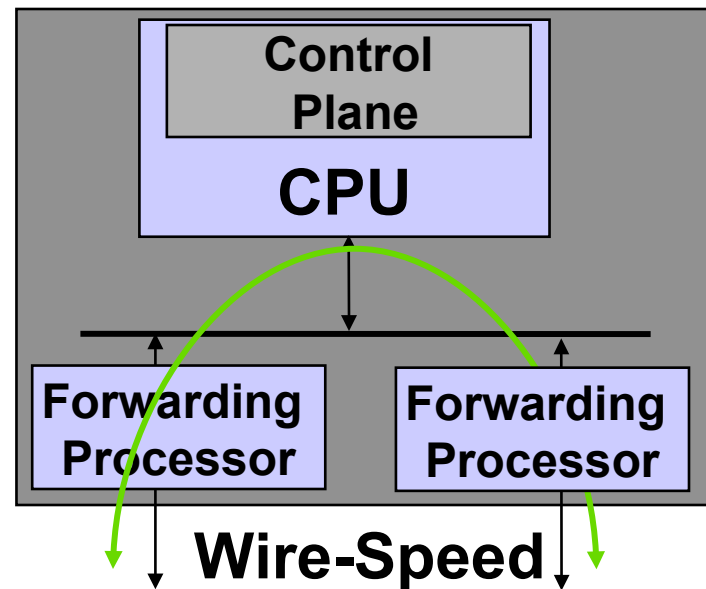 - **50MHz FPGA roughly 10 times faster than 300MHz Pentium CPU**

Evolution of routers – Phase I
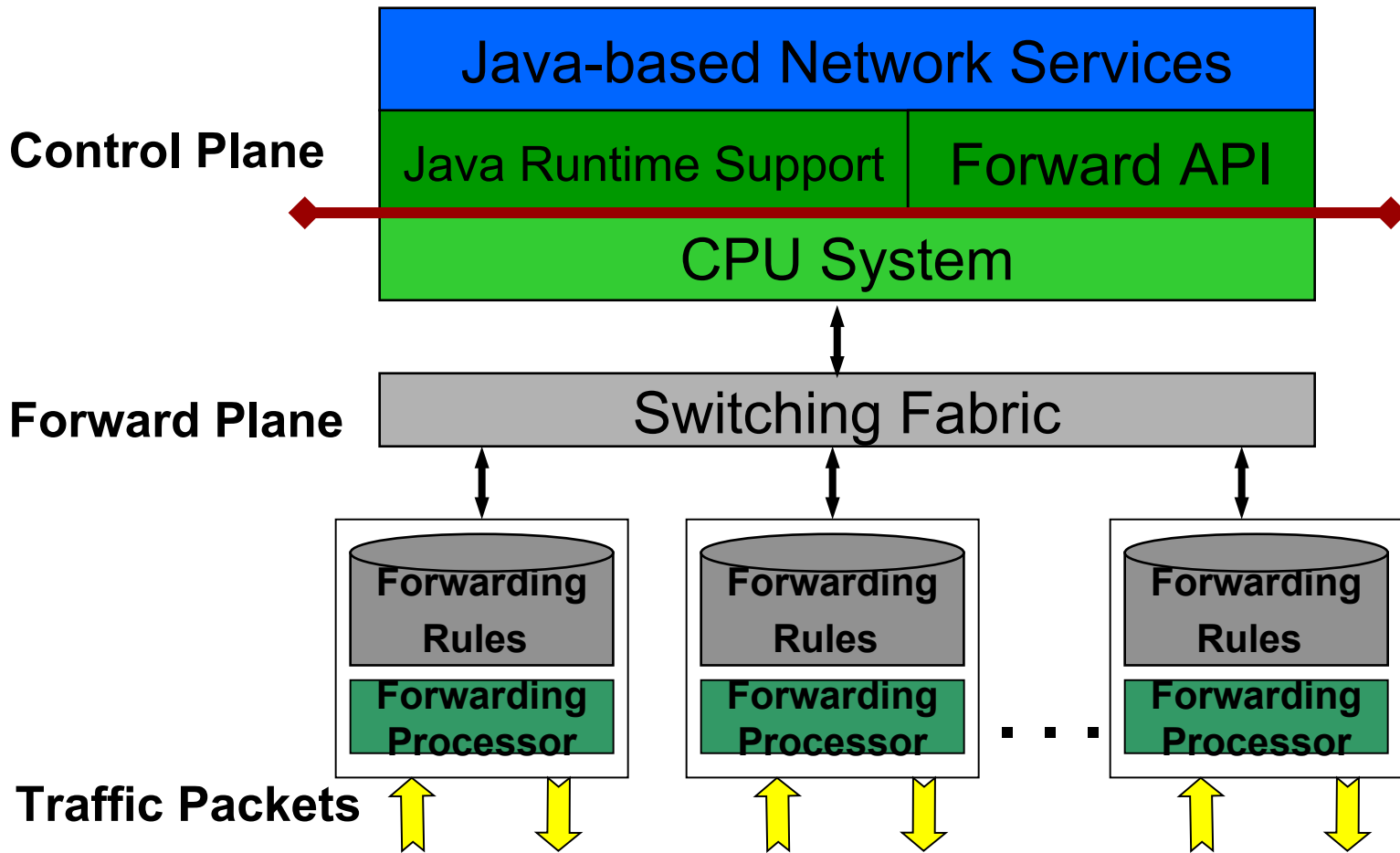
Centralized CPU-based Router

Forwarding Processor based Router

Slow

Wire-Speed

Control + Forwarding functions combined

Control separated from Forwarding

Towards Open Networking

Control Plane

Java-based Network Services

Java Runtime Support | Forward API

CPU System

Forward Plane

Switching Fabric

Forwarding Rules

Forwarding Processor

Forwarding Rules

Forwarding Processor

Forwarding Rules

Forwarding Processor

Traffic Packets

Node Architecture

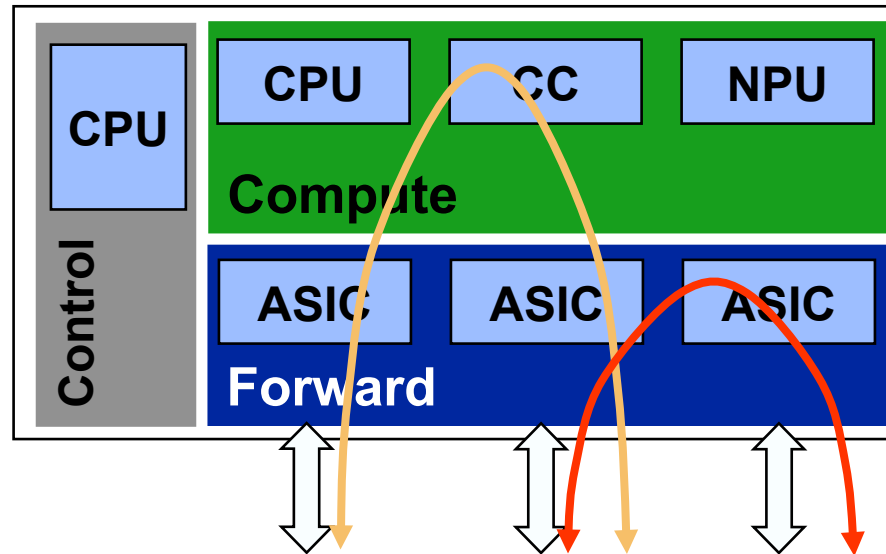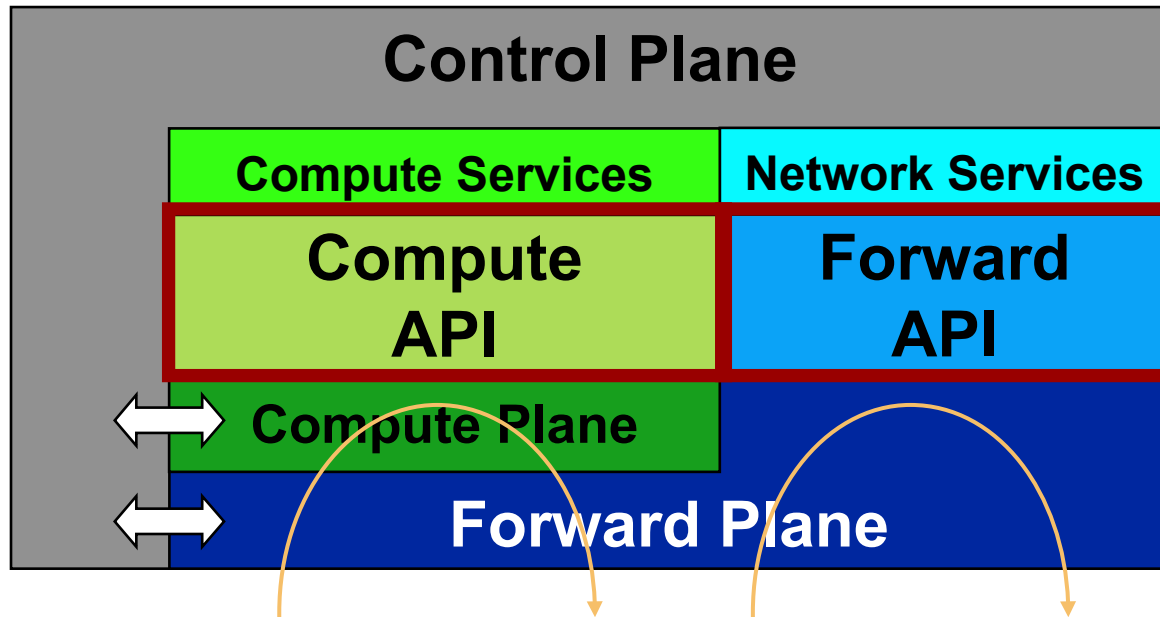| Control Plane	
Compute Services	Network Services
Compute API	Forward API
Compute Plane	Forward Plane
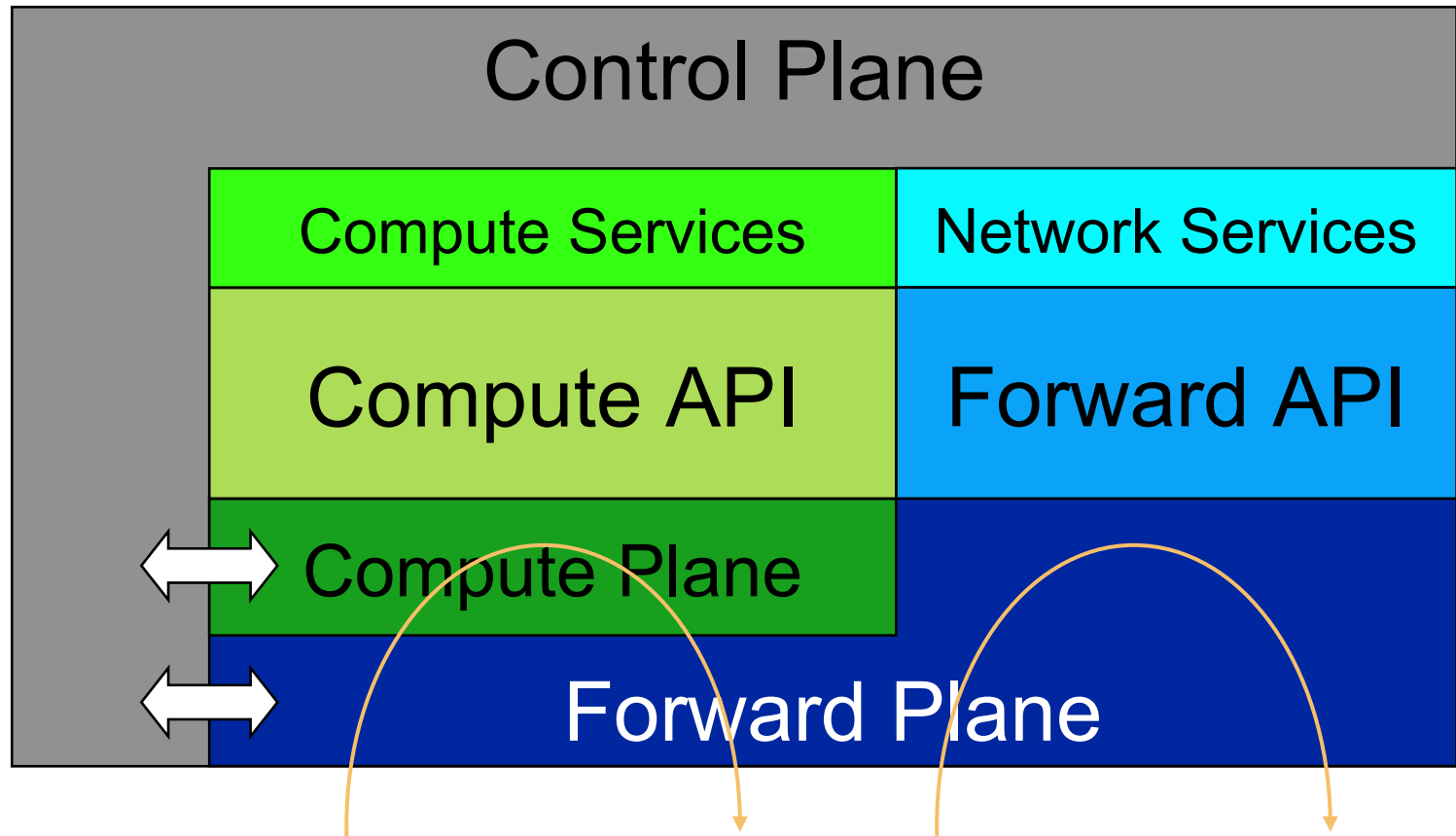
Evolution of Routers – Phase II

- **Control, Compute and Forward planes**
- **Forward-only flows are not seen by Compute plane**
- **Control plane can modify behavior of Compute and Forward planes**

Open Networking

- **Abstract Compute & Forward Plane interfaces**
- **Technology reuse over a range of NORTEL platforms**

Work in progress…

- **NORTEL R&D activities**
  - **POLARIS lab**
  - **OPENET lab**
- **Research Target**
  - **"Smart" node architectures**
  - **Open architectures**
  - **High Performance Computing technologies**

Summary

- **Future network node architecture**
  - **Open networking**
  - **Programmable networking**
  - **High performance computing**

- **Benefits to NORTEL**
  - **Rapid service deployment**
  - **Third-party value-added services**
  - **Increased market penetration**

To learn more …

- **http://www.openetlab.org/**
- **http://www.ieee-pin.org/**
- **http://comet.columbia.edu/openarch**
- **http://comet.columbia.edu/opensig**
- **http://www.cpixforum.org/**