Software packet processing and Hardware packet processing

The advantages and disadvantages

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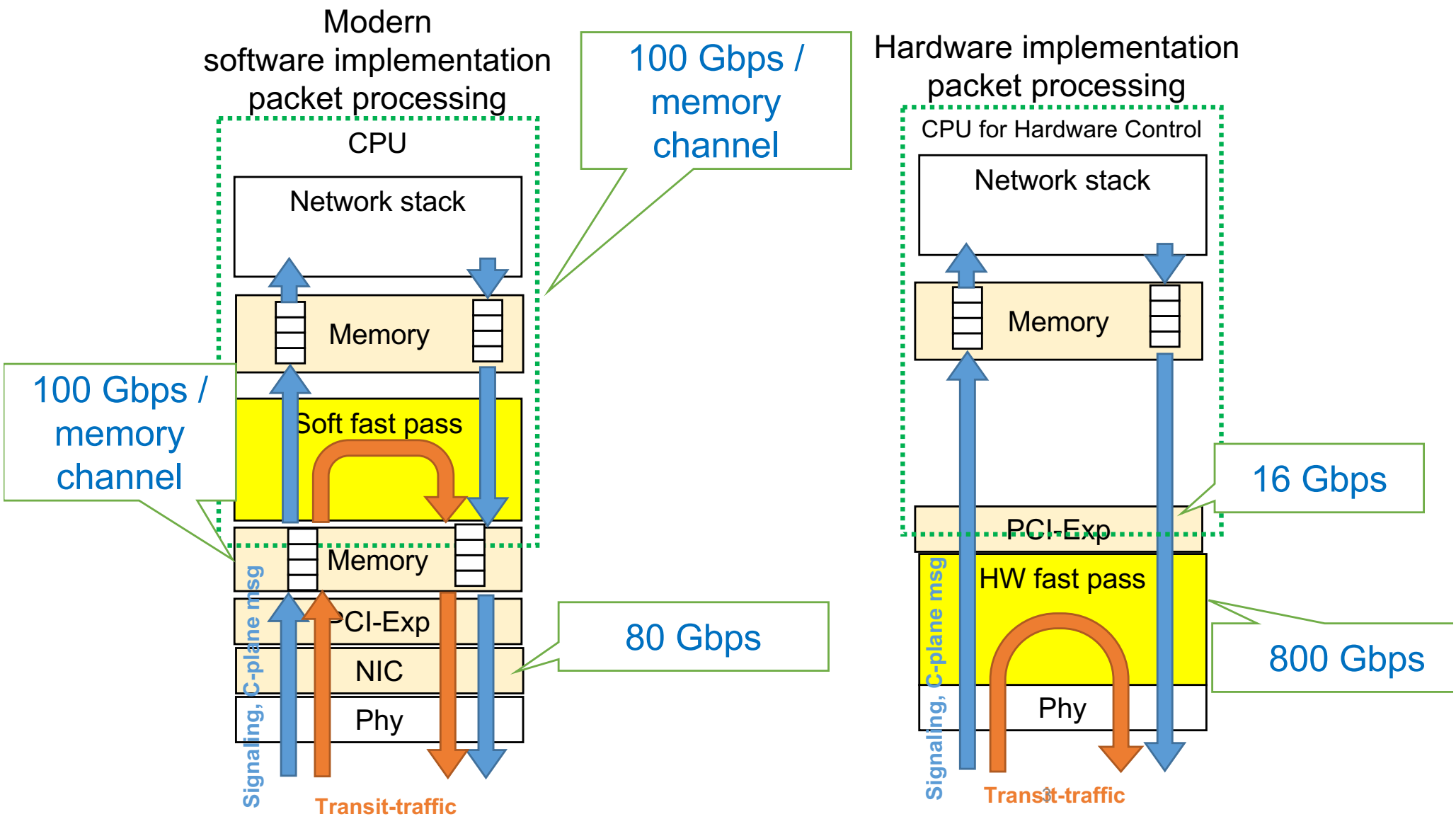
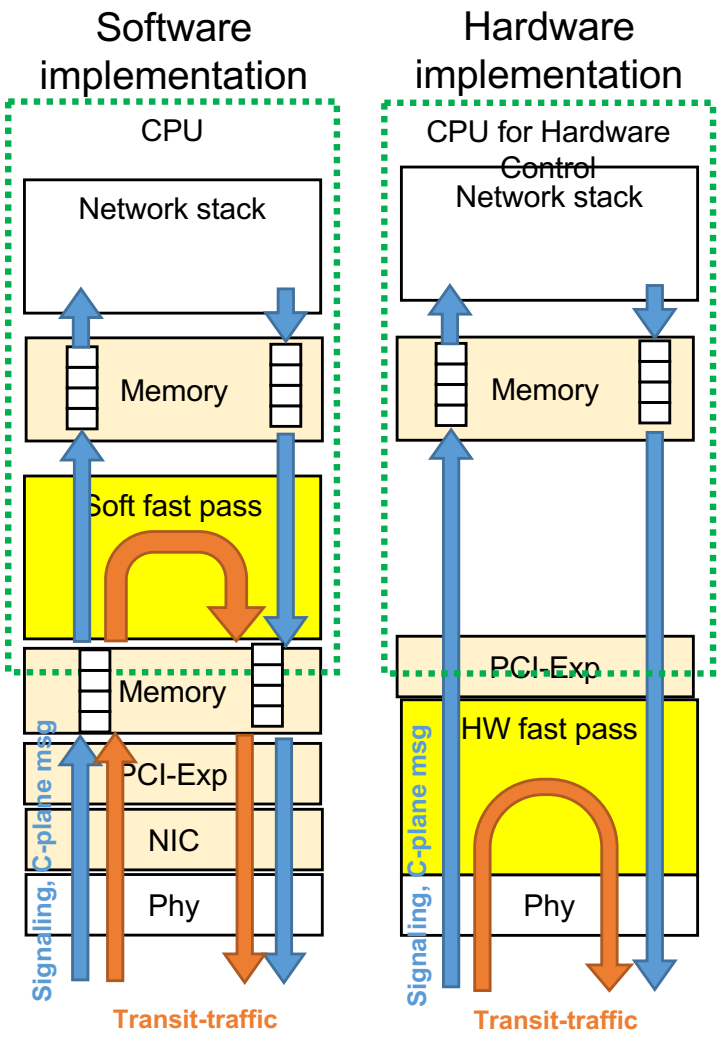
Self Introduction: Yoshihiro Nakajima

- While at regional university
  - University information education computer management (2000–2005)
  - Research and development of High-performance computing and distributed processing middleware (2003–2008)
- NTT Network Innovation Laboratories
  - Operation of experimental networks (AS173, AS2511) (2008–present)
  - Research and development of IP network transmitter of high-definition video (2008–2011)
  - Research and development of software switch “Lagopus“ (2012–present)

Prerequisite knowledge

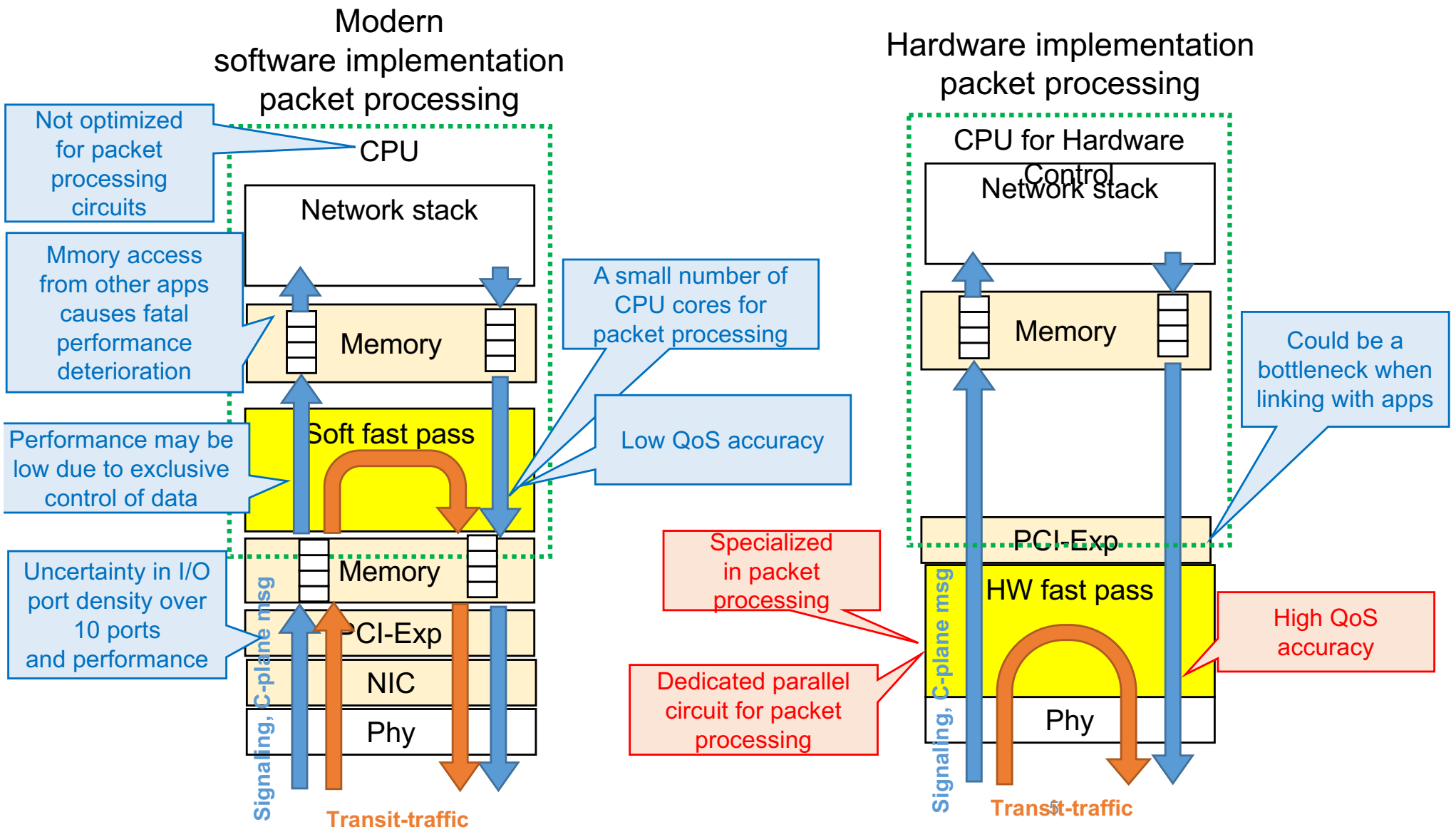


Specifications for each implementation

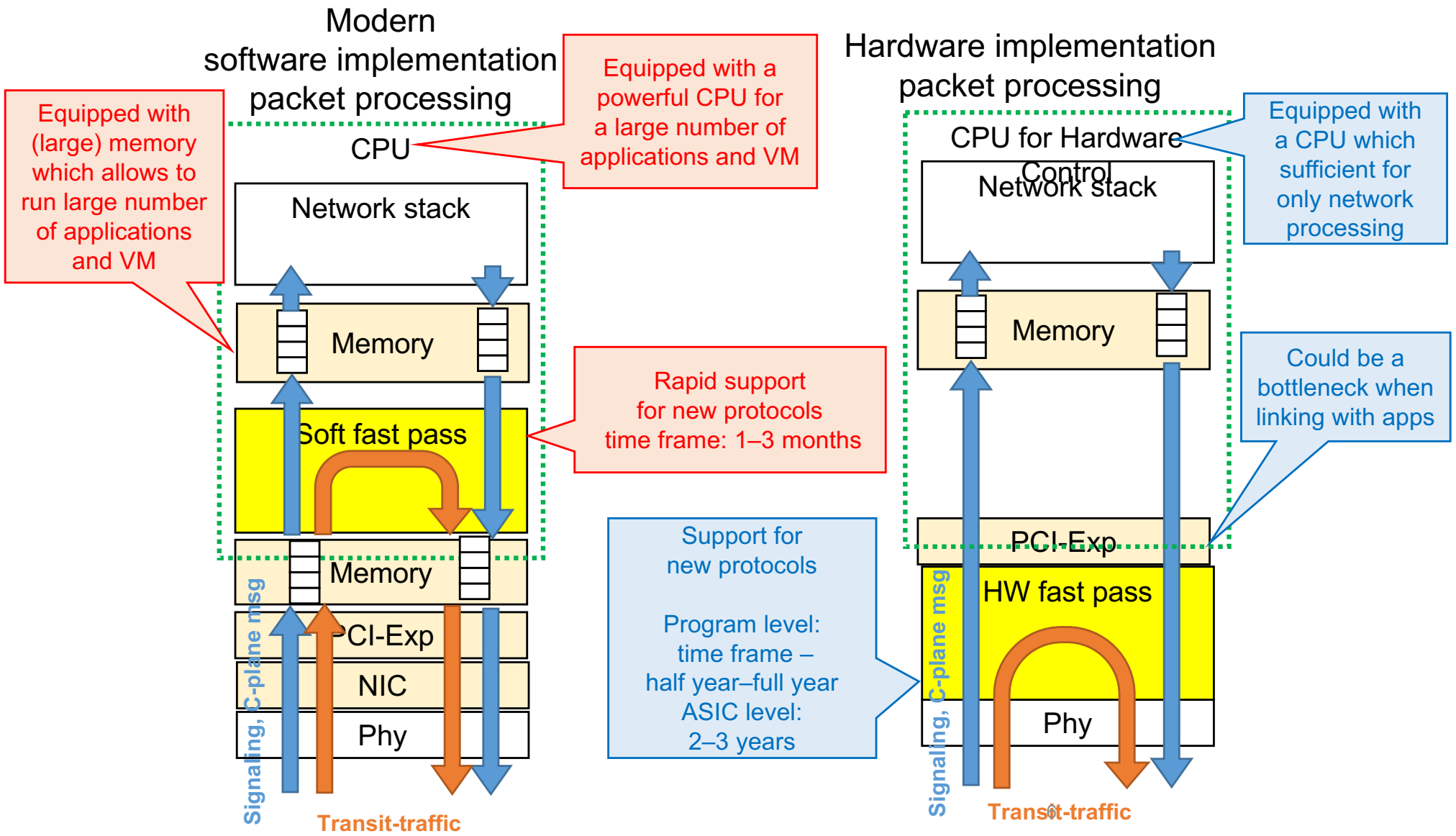


	Type	Software implementation	Hardware implementation
C-plane	CPU	Latest Xeon class CPU can be used (TDP 150 W, 22 core)	Embedded low-power CPU (TDP 90 W, 8 core)
	Memory	16 GB or more	8-16 GB
	Storage	TB class also possible	100 GB class
Communication between C/D-planes		Inter-memory communication (400 Gbps class)	Via PCI-Exp
D-plane	Packet processing	Software processing via CPU	implemented by dedicated packet processing processor (NPU), FPGA, ASIC
	Throughput/chip	80 Gbps	800 Gbps/ASIC (BCM88670)
	Throughput/system	80 Gbps	3.2 Tbps/System (BCM88770)
	Latency	Tens of microseconds (ms)	Several microseconds (ms)
	IF speed	40Gbps	100Gbps
	Number of ports	10 ports/10GbE	100 ports/100GbE
	Phy	Via NIC/PCI-Exp	implemented by dedicated packet processing processor (NPU), FPGA, ASIC
	Power consumption	10–20 W/10GbE	Several watts/10GbE

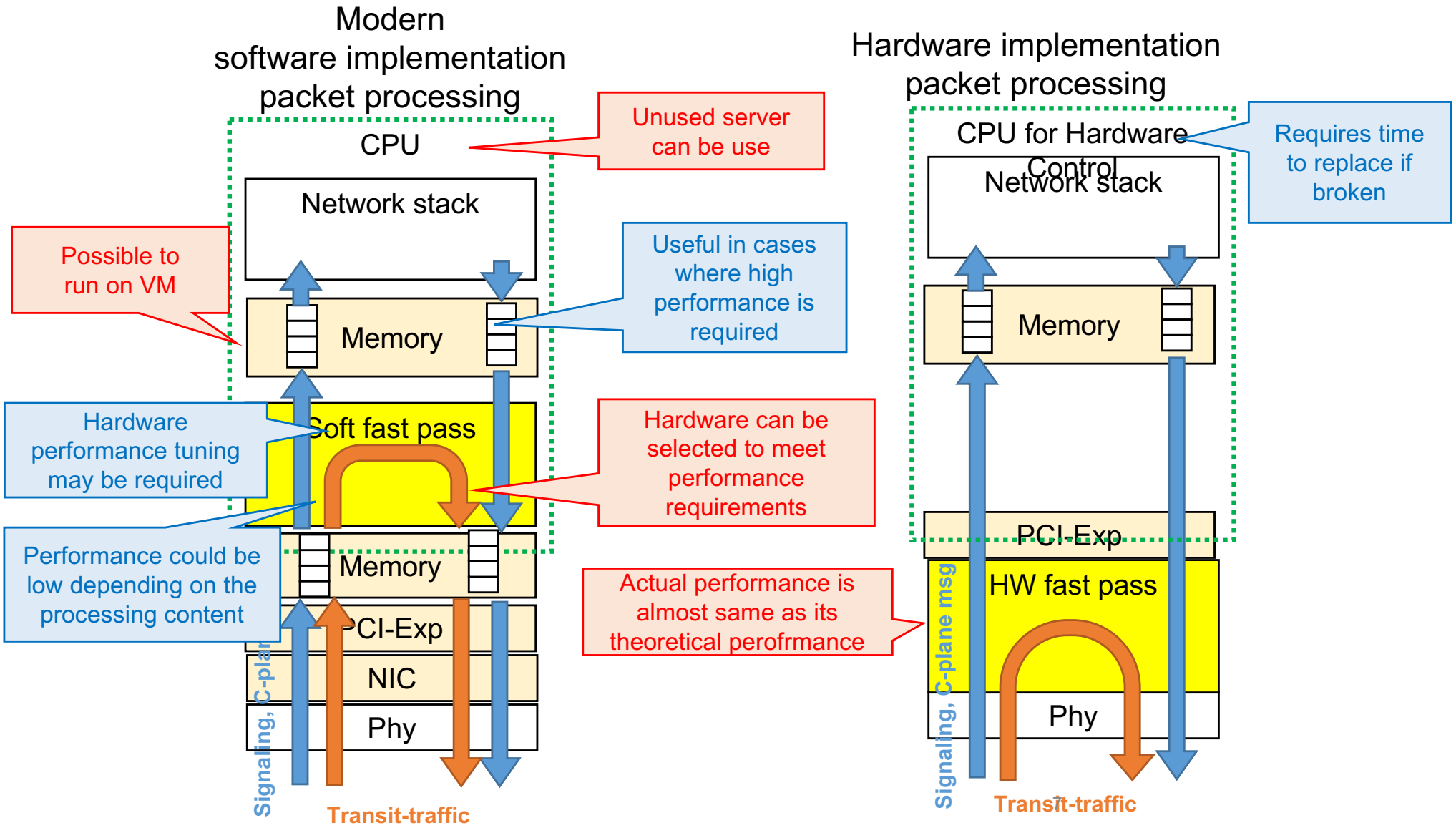
Advantages and disadvantages from a performance point of view



Advantages and disadvantages from an expandability point of view



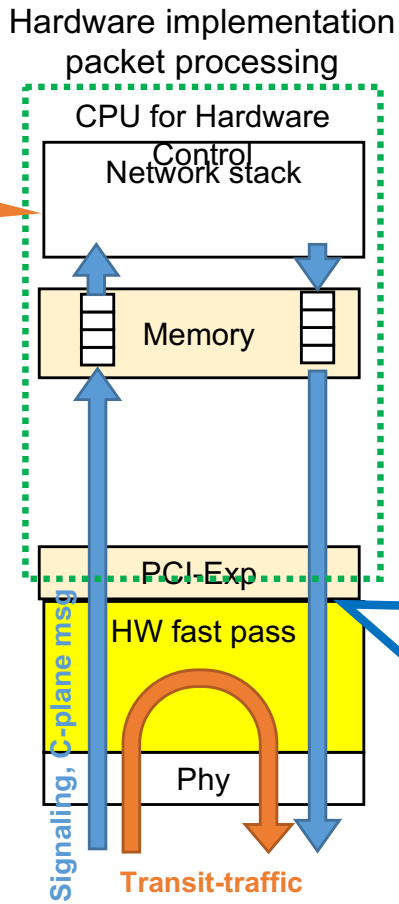
Advantages and disadvantages from an operational point of view



Back to original question #1
White-box switches (hardware implementation)

- Run a server/switch monitoring agent -> Yes
- Build a content cache server on Linux! -> No

CPU and memory can support monitoring agent

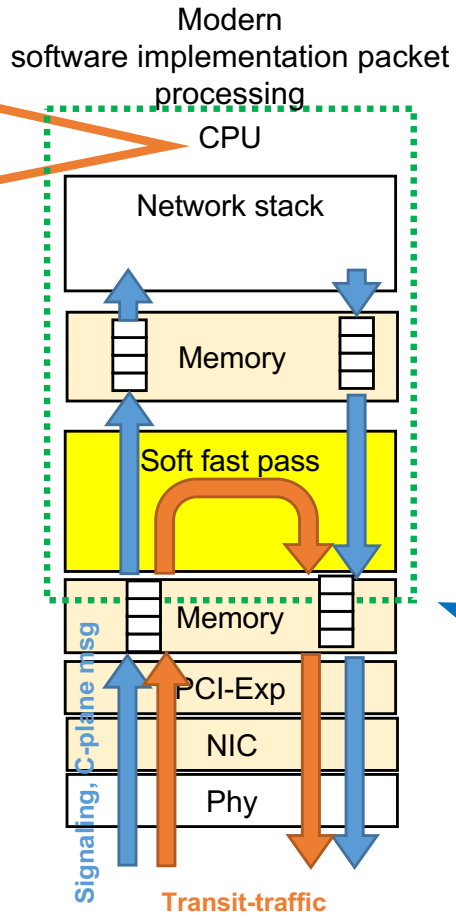


Bus connecting a C/D-planes is narrow (16 Gbps)
&
Amount of memory and CPU performance are insufficient to run a cache

Back to original question #2
Software router (software implementation)

- Run a content cache server together with the router -> Yes
- Run as a 48 ports ToR switch by plug in lots of NICs -> No

CPU performance and memory are sufficient to run a content cache server



Network I/O is limited by PCI-Exp bus bandwidth
&
CPU cores are not enough for 48-ports

Summary

- Software implementation adaptive area
  - Adaptive area
    - Small to medium-sized edge routers
    - Gateways
  - Requirements:
    - Moderate performance (about 10 Gbps)
    - Number of ports: 6 ports
    - Number of required routes: 1 million or more
    - Advanced feature

- Hardware implementation adaptive areas
  - Adaptive area
    - ToR SW, aggregator SW
    - Core routers
  - Requirements:
    - Number of ports required
    - Tbps-class throughput
    - Low latency
    - Low power consumption