THE DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING
計算機科學及工程學系

Networked Systems for Big Data and Clouds

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System Platform Implemented

Electrical Packet Switch, 1G (x10)

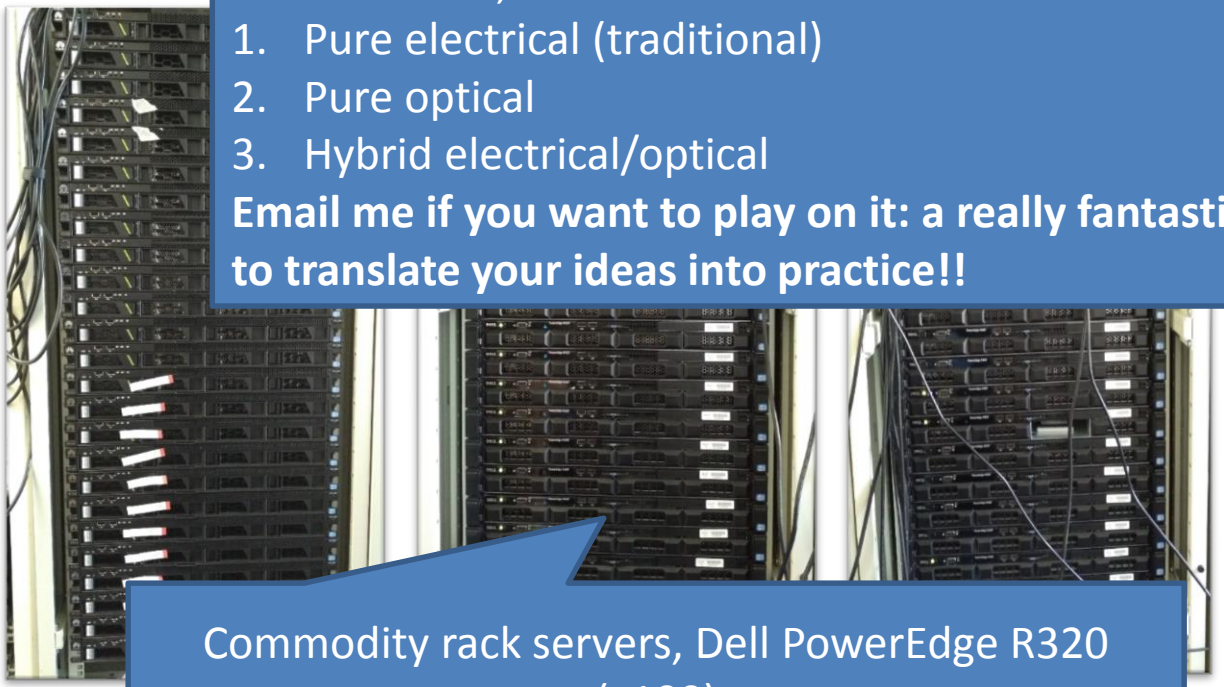
Electrical Packet Switch, 10G (x3)

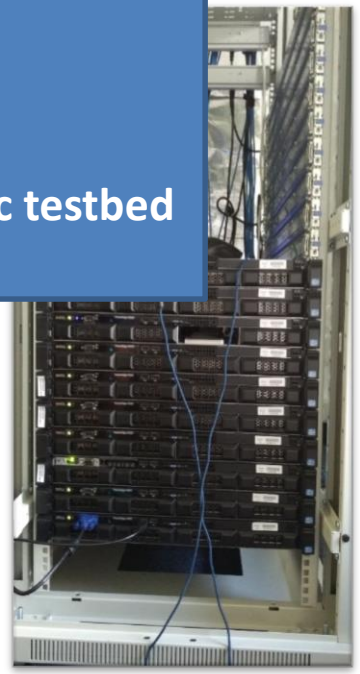
Optical Circuit Switch (x5)

All connected, can form three architectures:

1. Pure electrical (traditional)
2. Pure optical
3. Hybrid electrical/optical

Email me if you want to play on it: a really fantastic testbed to translate your ideas into practice!!





Commodity rack servers, Dell PowerEdge R320 (x100)

Research: A Bottom-up Approach

- **Infrastructure/Architecture**
  - OSA, the *first-ever* all optical datacenter architecture (ToN'14, NSDI'12)
  - BigSwitch, a massive-port (6336 ports) datacenter switch
- **Network Layer**
  - XPath, intra-datacenter routing control (NSDI'15, ToN'15)
  - Amoeba, inter-datacenter data transfers (EuroSys'15)
- **Transport Layer**
  - PIAS, practical flow scheduling (NSDI'15, HotNets'14)
  - CODA, centralized/decentralized coflow scheduling
- **Computing Platform for Applications**
  - BigComputing, network-enabled large scale distributed computing platforms for big data analytics and machine learning

Goal: simple, practical, readily-implementable solutions for real applications!

PIAS: Practical Information Agnostic Flow Scheduling

[USENIX NSDI'15]

http://sing.cse.ust.hk/projects/PIAS

- Motivation: cloud apps desire low latency for short flows/messages

- Design goal: minimize Flow Completion Time (FCT)

Not feasible for some real applications

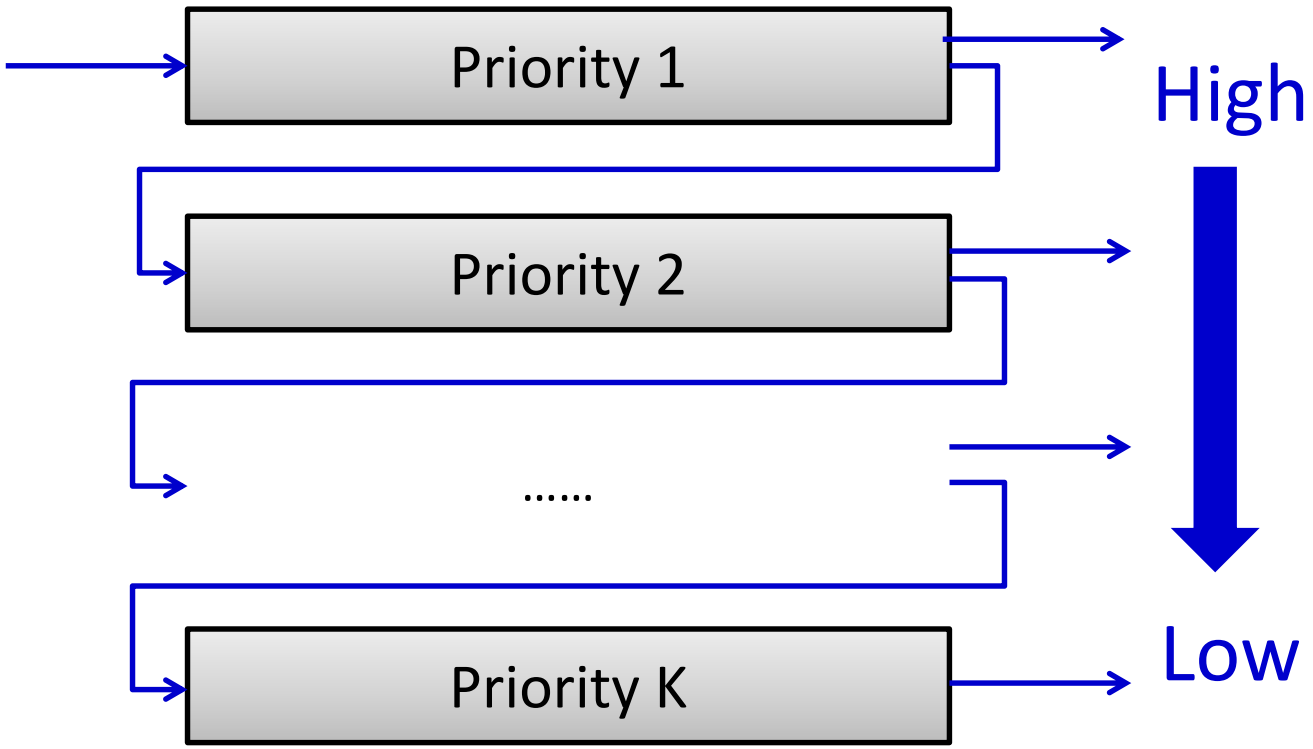
- Existing solutions: almost all ~~assume prior knowledge of flow size~~ information to approximate ideal Shortest Job First (SJF) to minimize average FCT with ~~customized network elements~~.

Hard to implement in practice

- **PIAS** makes no assumption on prior knowledge of flow size, while still emulating SJF to minimize average FCT with existing commodity switches.

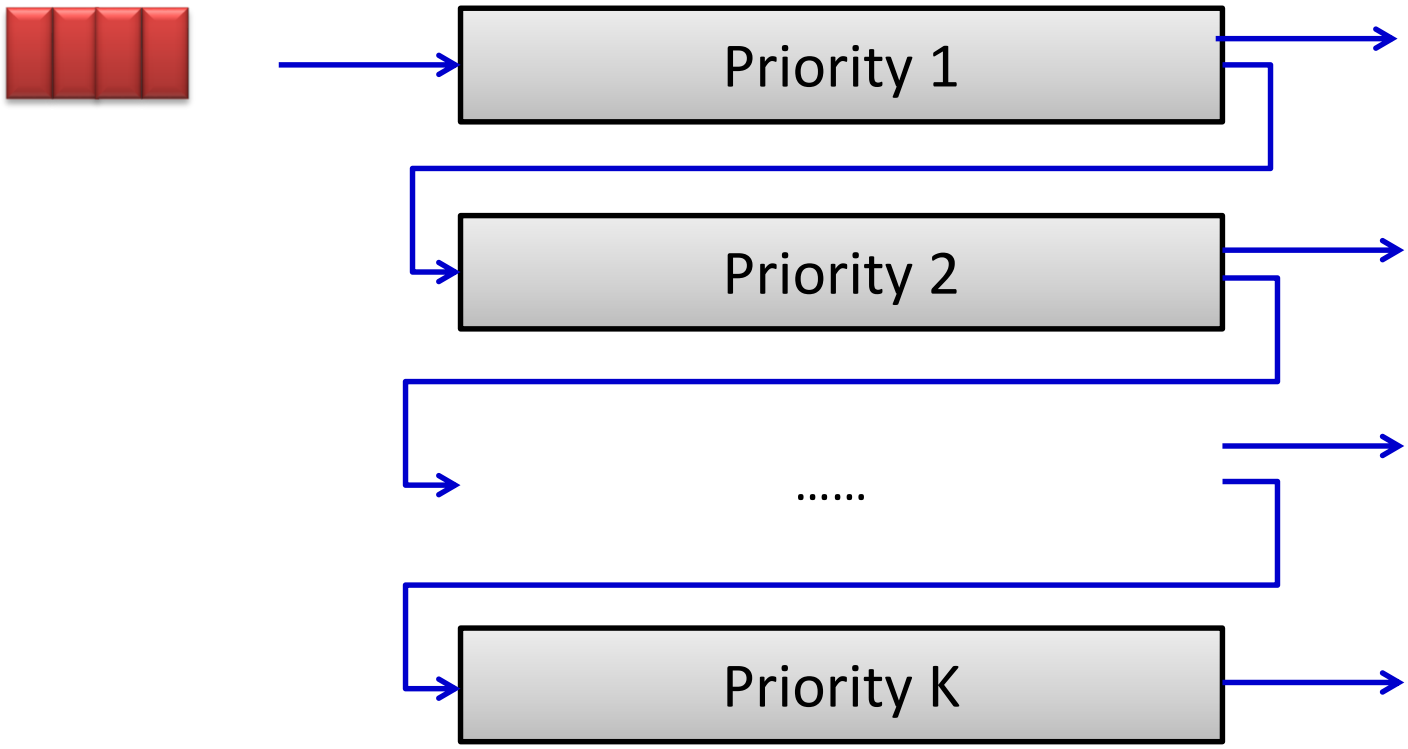
PIAS: Enabling Technique

- Today's commodity switching chips already support priority queues

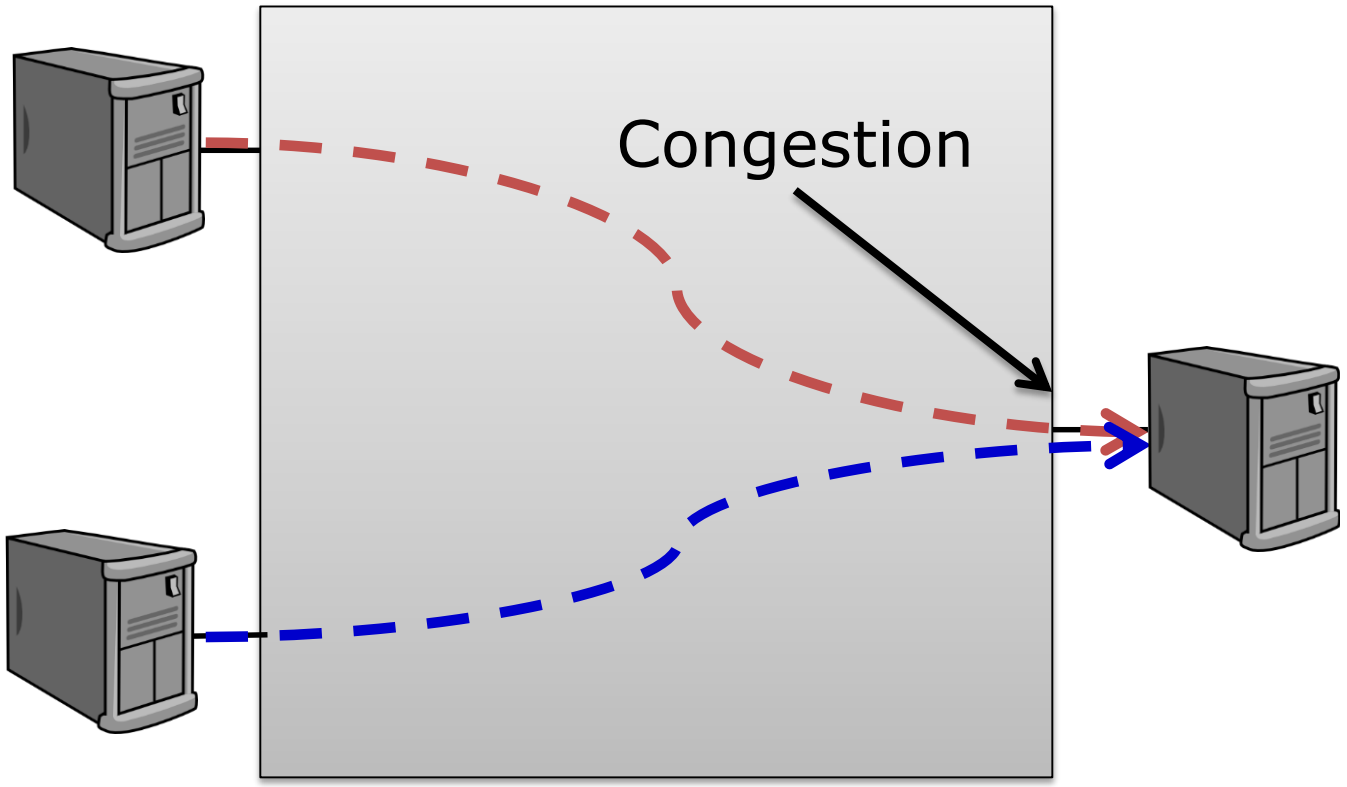


PIAS: Core Idea

- PIAS leverages the priority queues to perform Multi-Level Feedback Queue (MLFQ) scheduling to emulate SJF

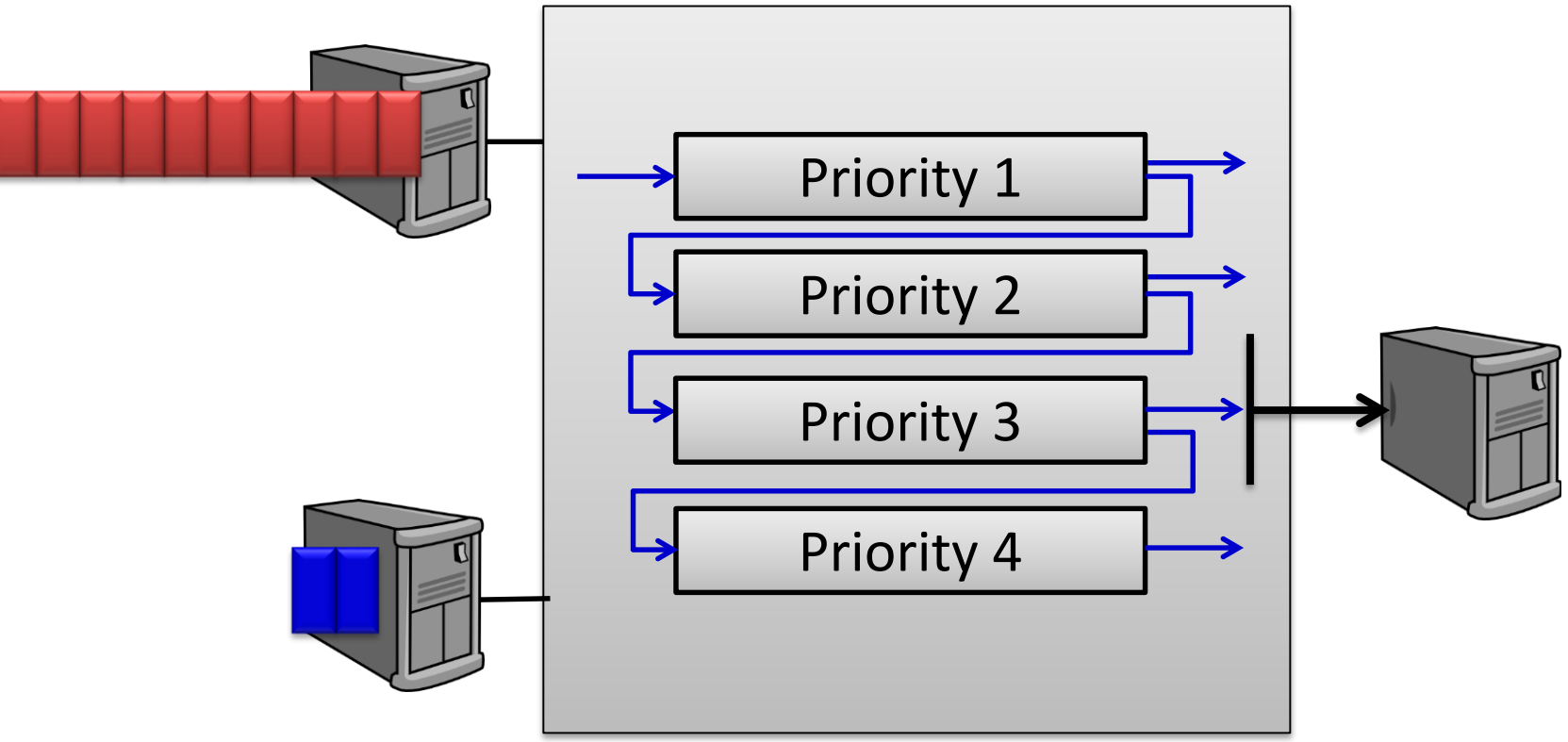


PIAS in One Animation



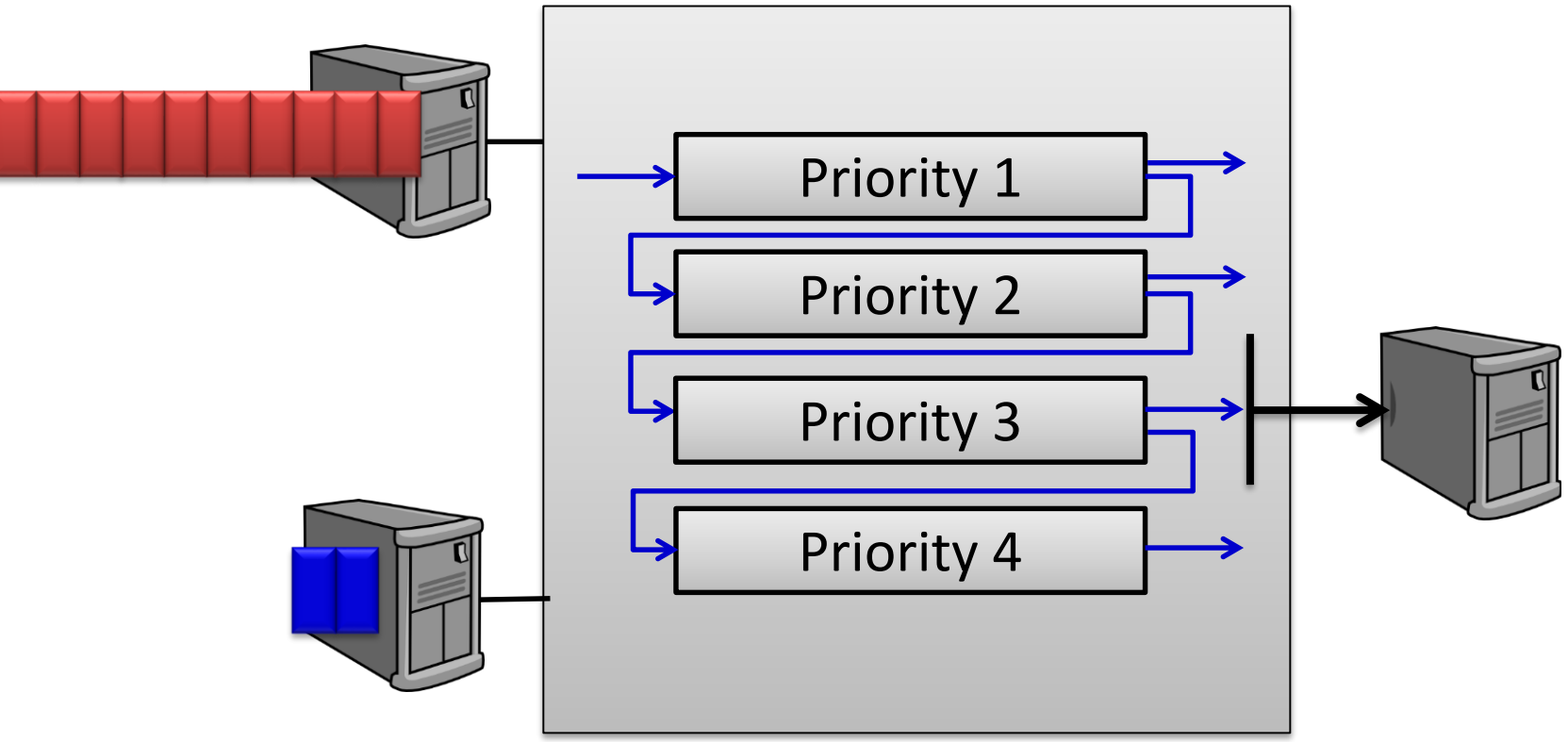
PIAS in One Animation

Flow 1 with 10 packets and flow 2 with 2 packets arrive



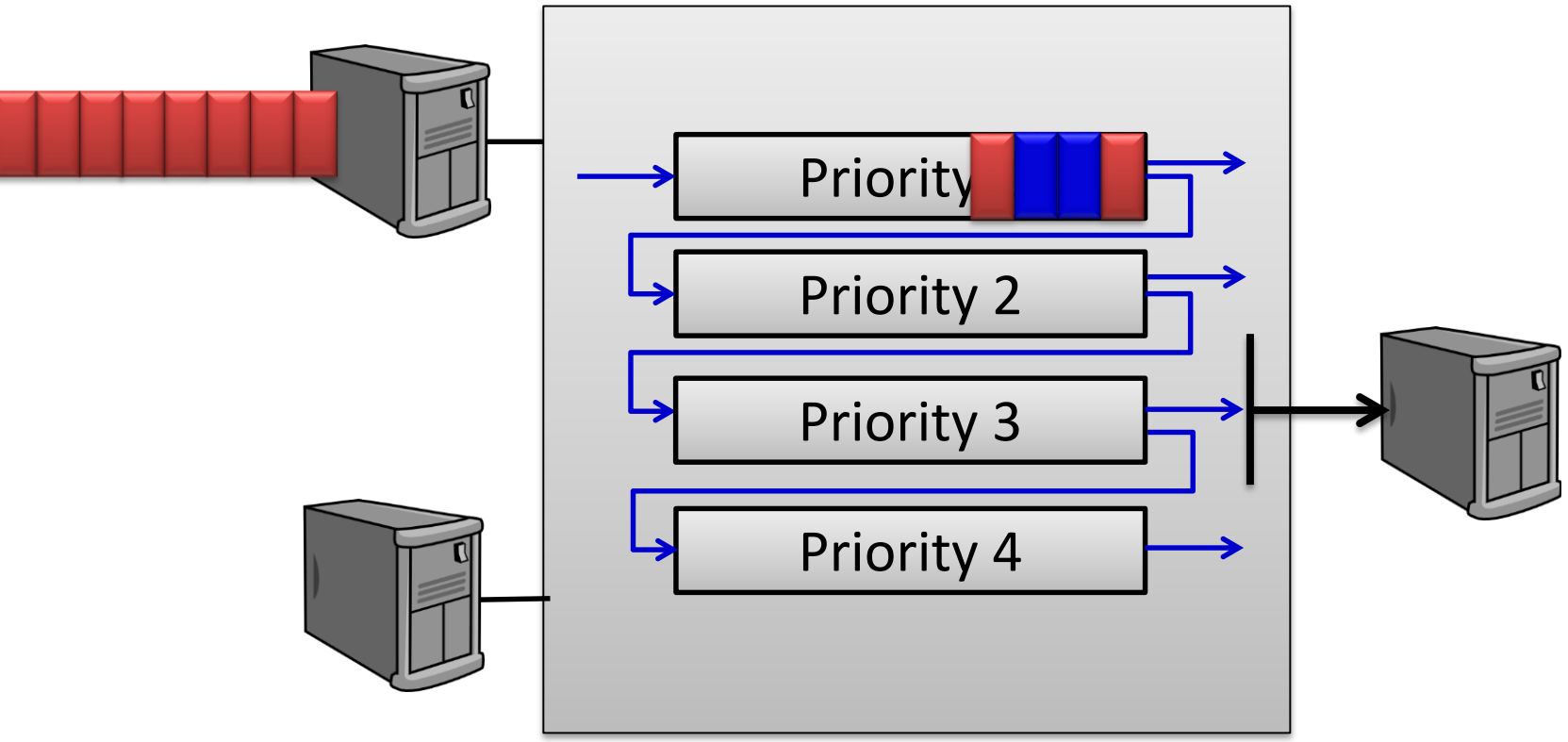
PIAS in One Animation

Flow 1 and 2 transmit simultaneously



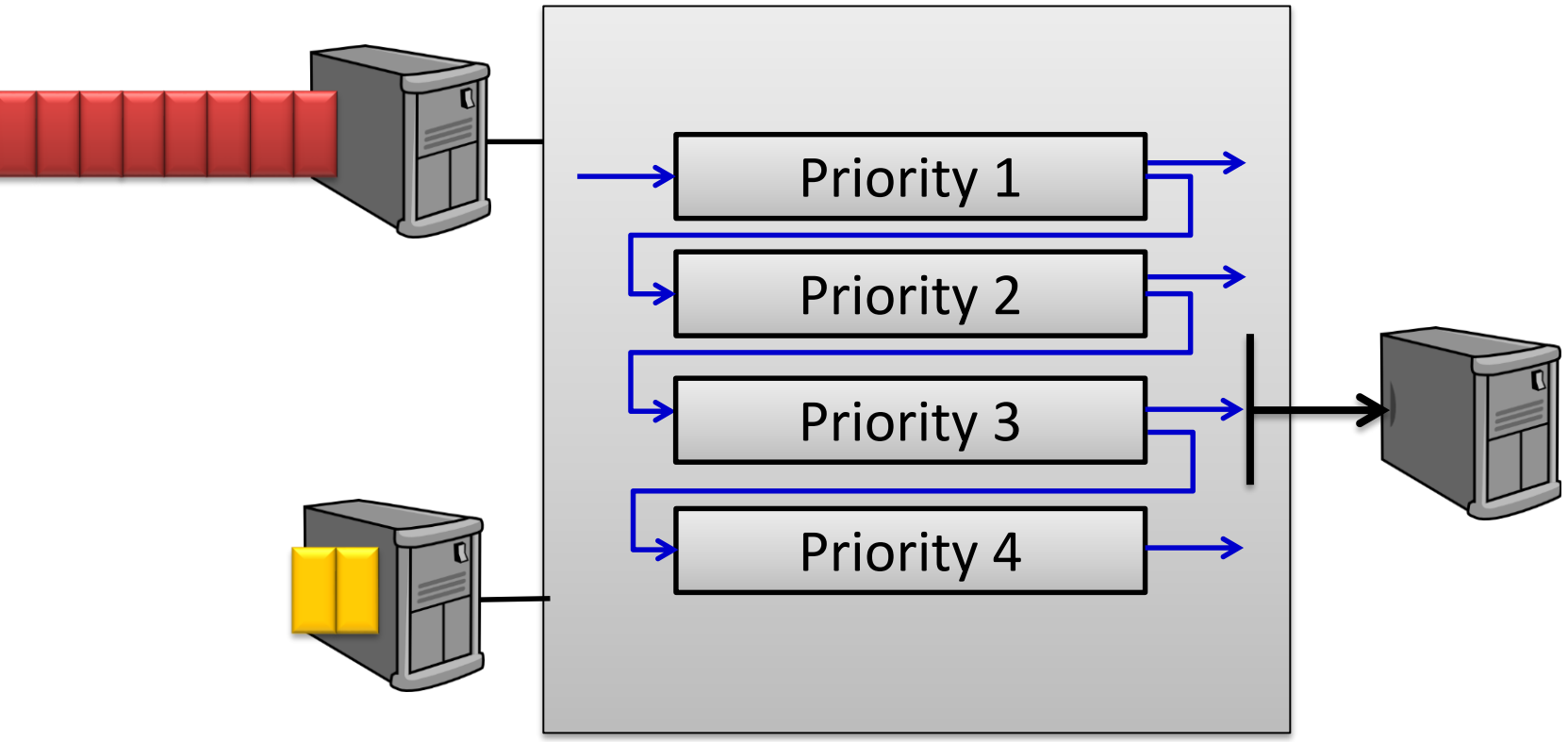
PIAS in One Animation

Flow 2 finishes while flow 1 is demoted to priority 2



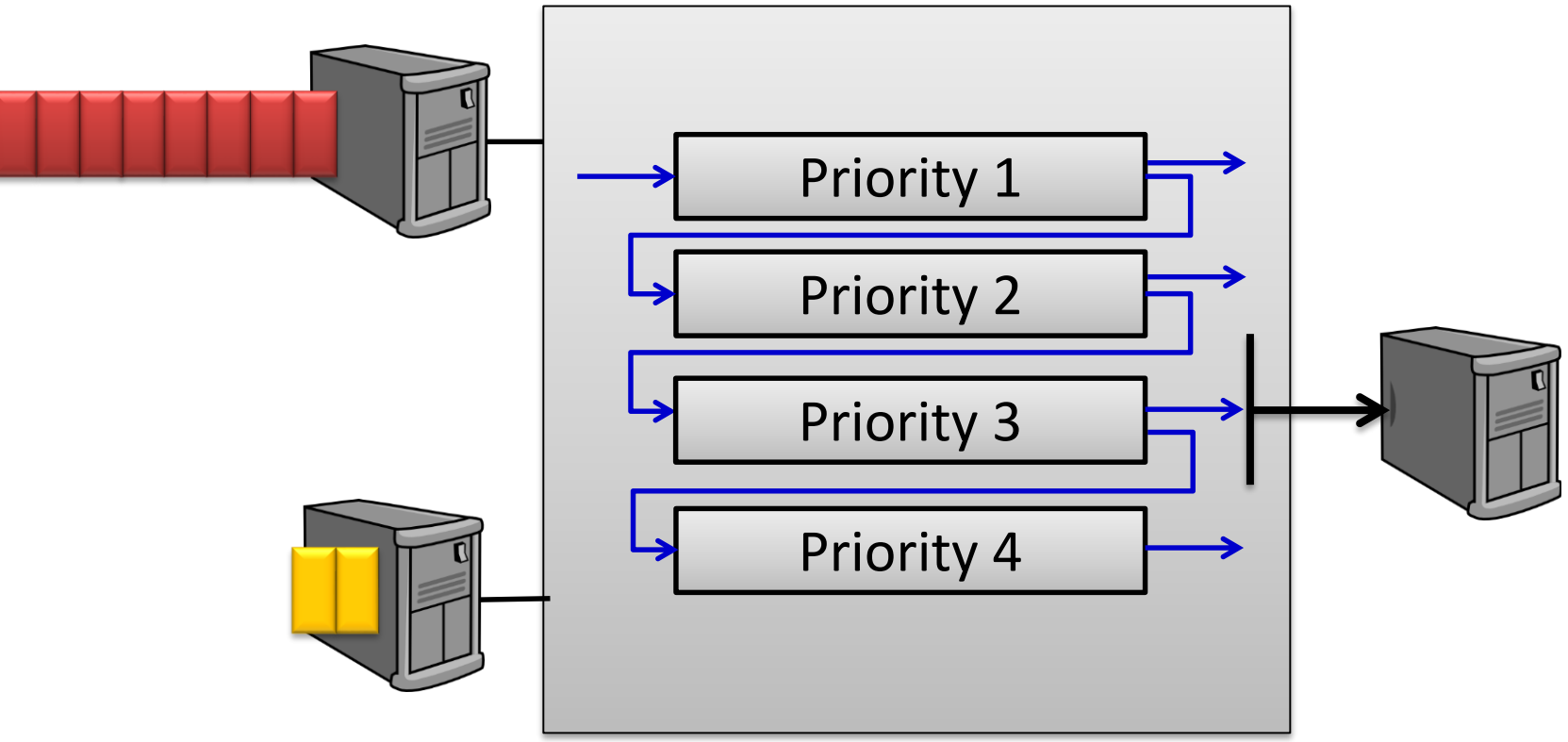
PIAS in One Animation

Flow 3 with 2 packets arrives



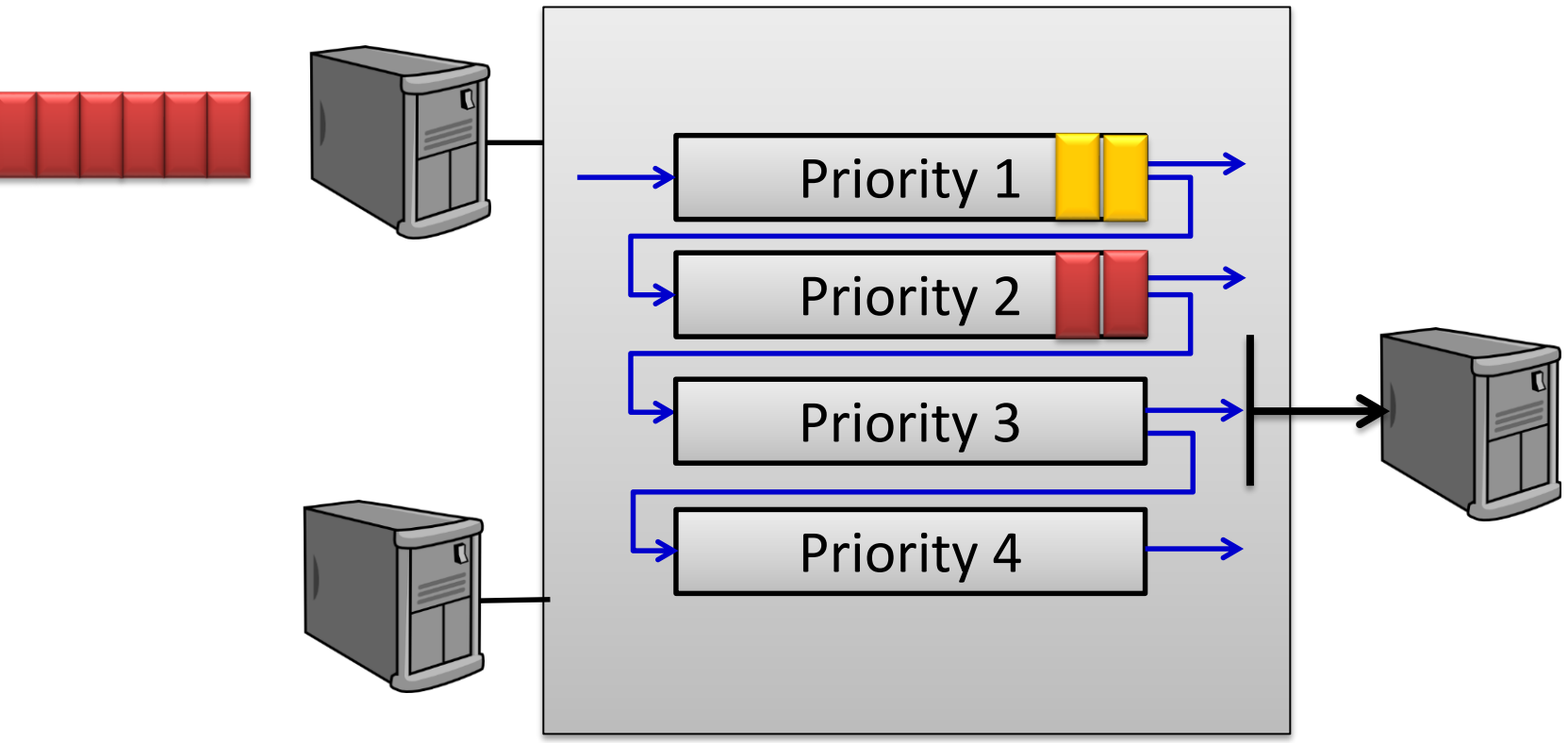
PIAS in One Animation

Flow 3 and 1 transmit simultaneously



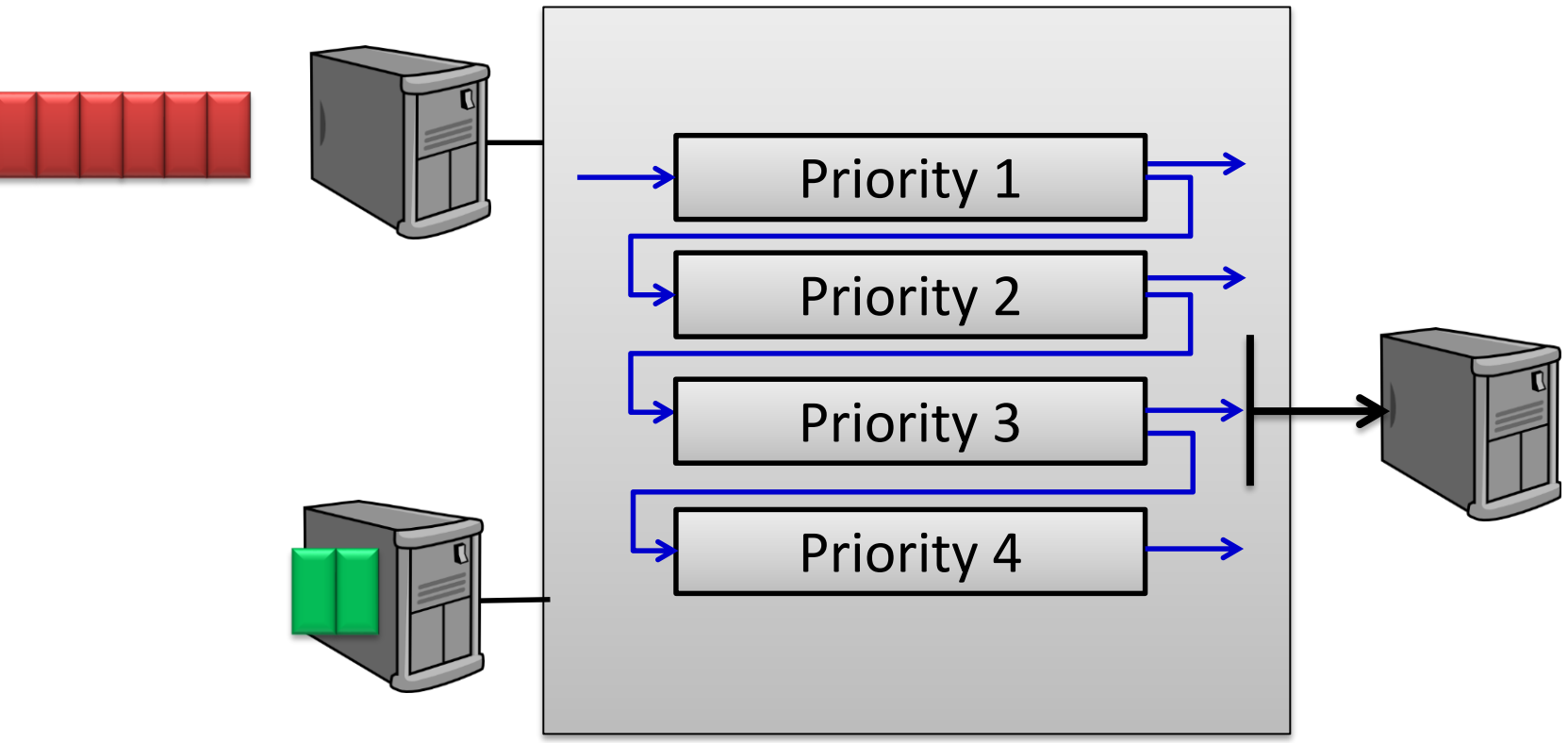
PIAS in One Animation

Flow 3 finishes while flow 1 is demoted to priority 3



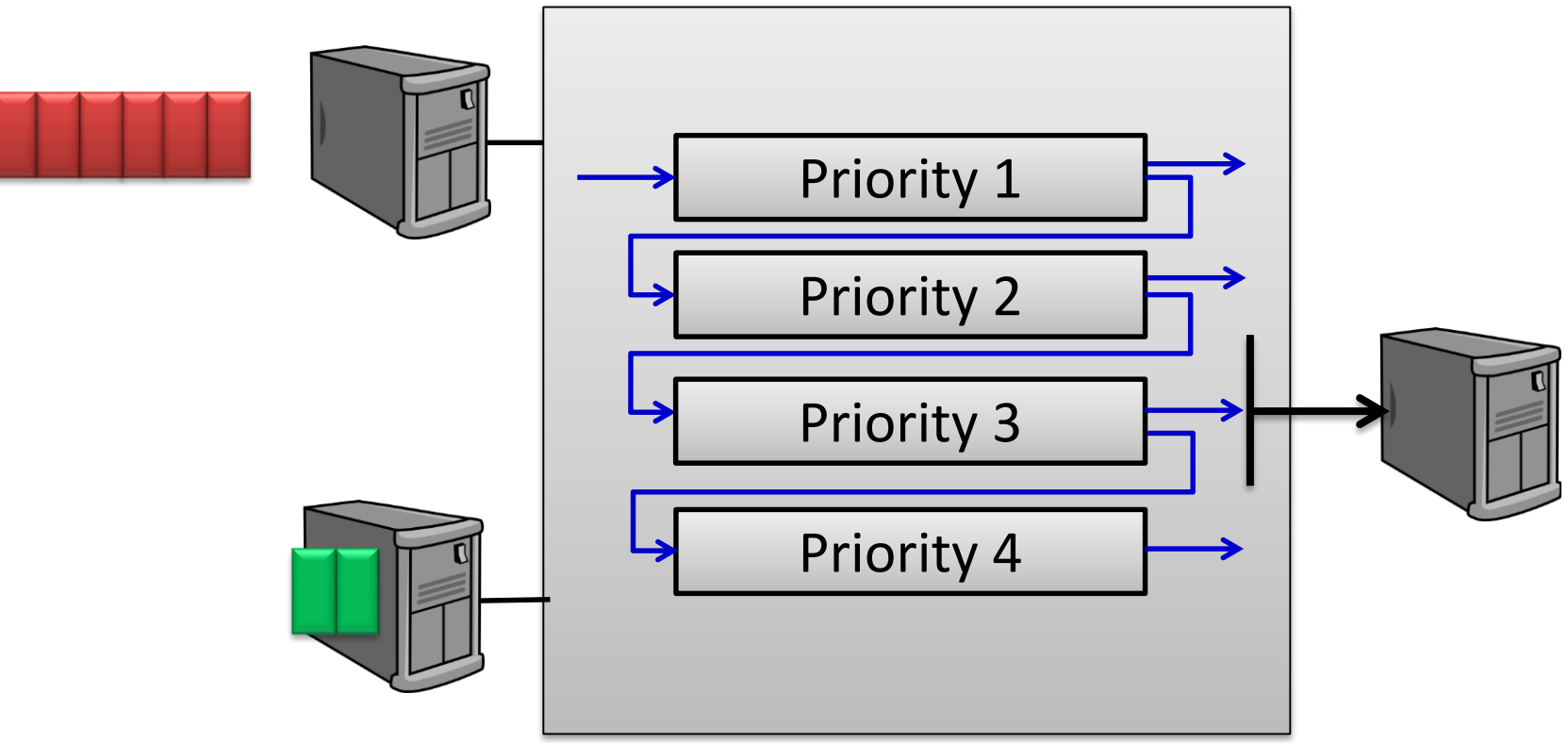
PIAS in One Animation

Flow 4 with 2 packets arrives



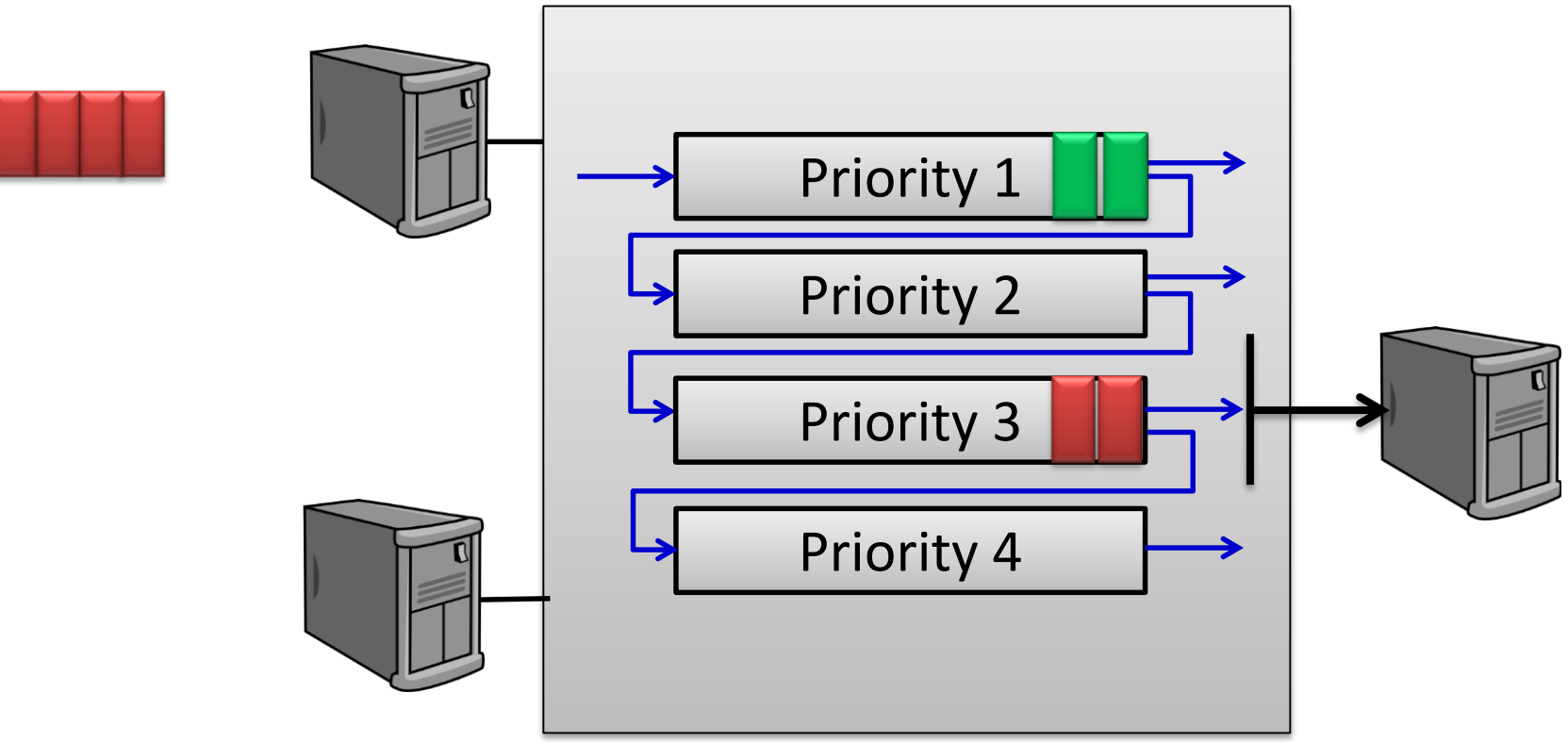
PIAS in One Animation

Flow 4 and 1 transmit simultaneously



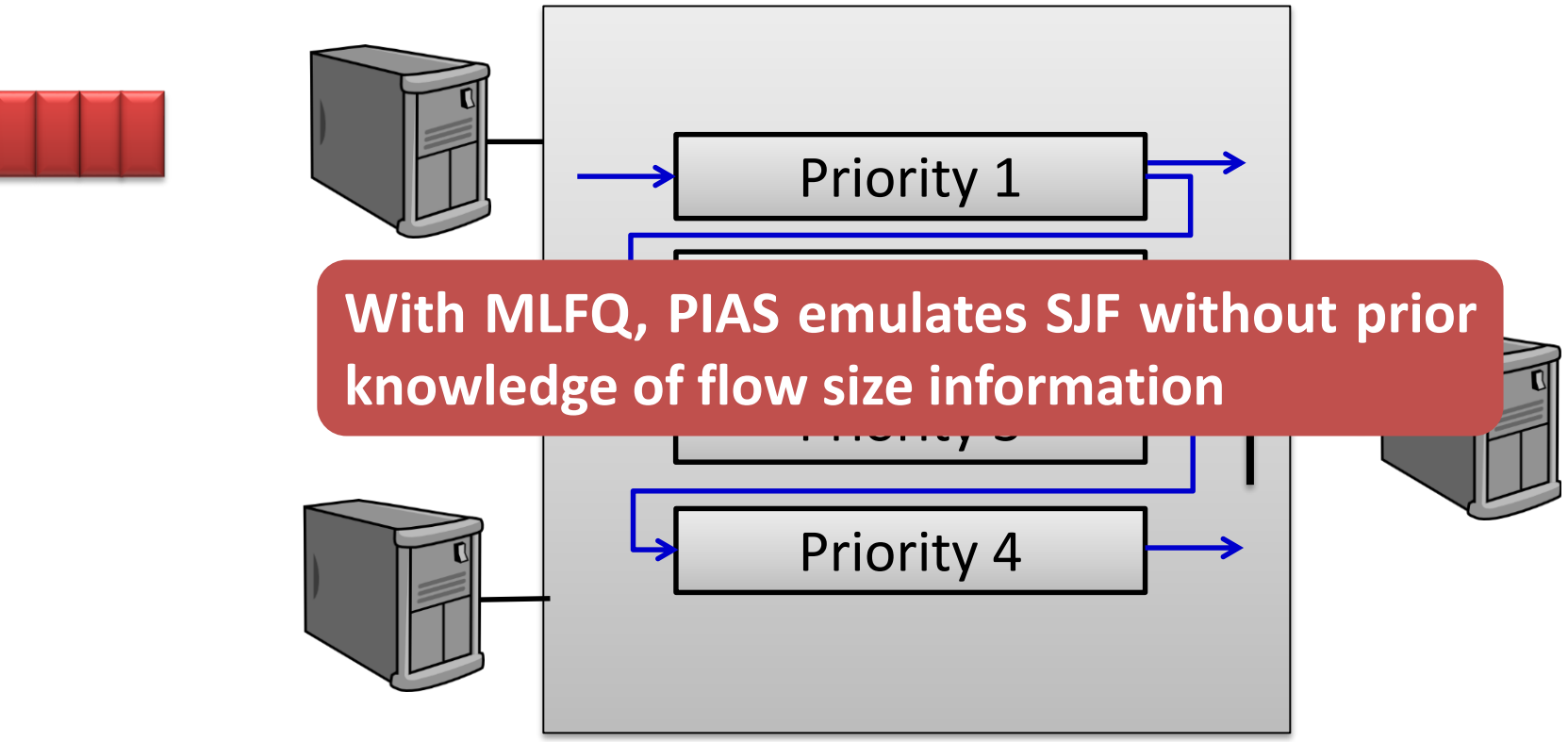
PIAS in One Animation

Flow 4 finishes while flow 1 is demoted to priority 4



PIAS in One Animation

Eventually, flow 1 finishes in priority 4



Thanks, Q&A