Modern Network Hardware

Akshay Narayan, MIT CSAIL

Papers

FreeFlow: Software-based Virtual RDMA Networking for Containerized Clouds

Direct Universal Access: Making Data Center Resources Available to FPGA

Stardust: Divide and Conquer in the Data Center Network

Blink: Fast Connectivity Recovery Entirely in the Data Plane

Where is this hardware?

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Where is this hardware?

FreeFlow

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Stardust

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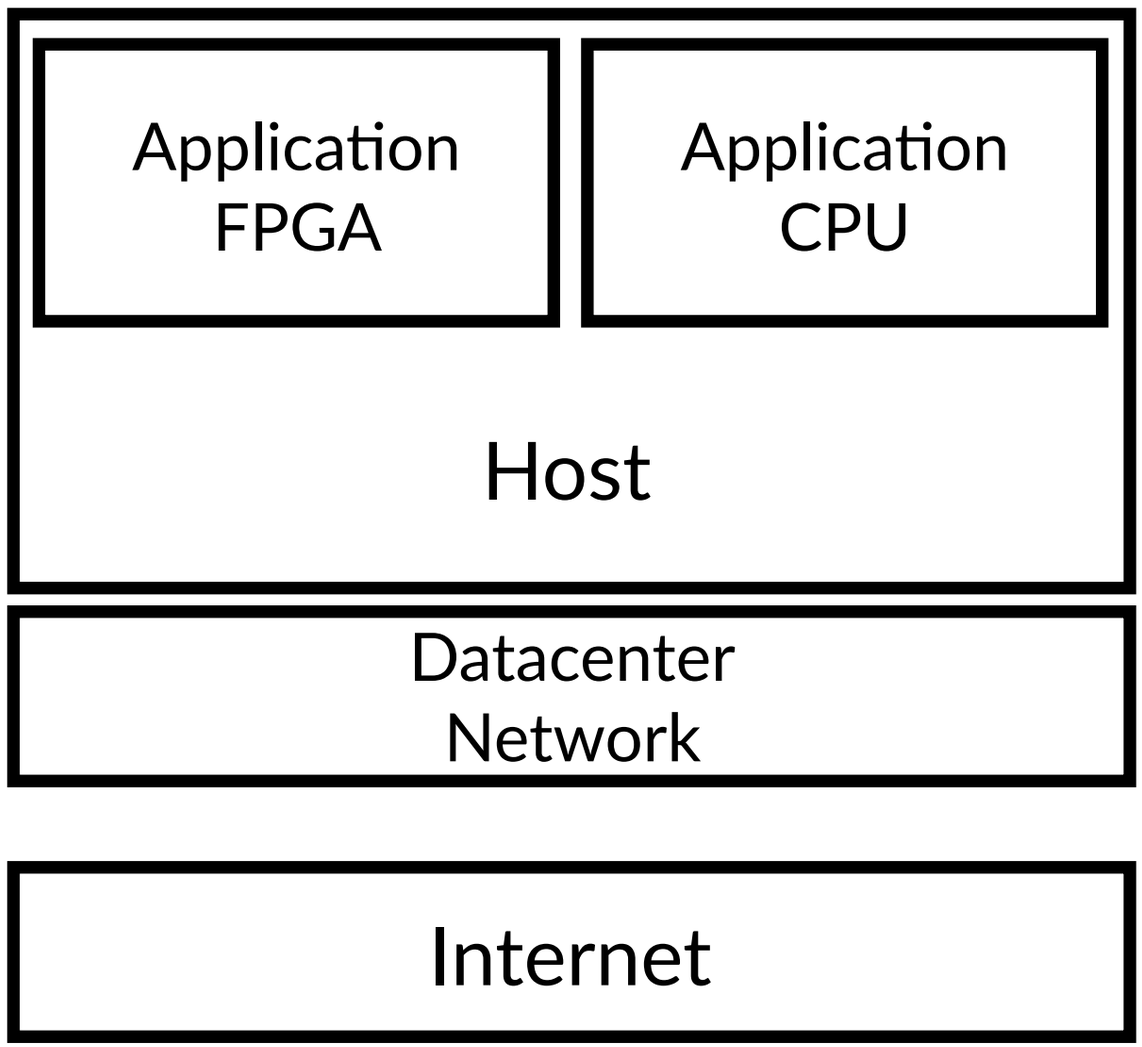


What are people doing with datacenters?

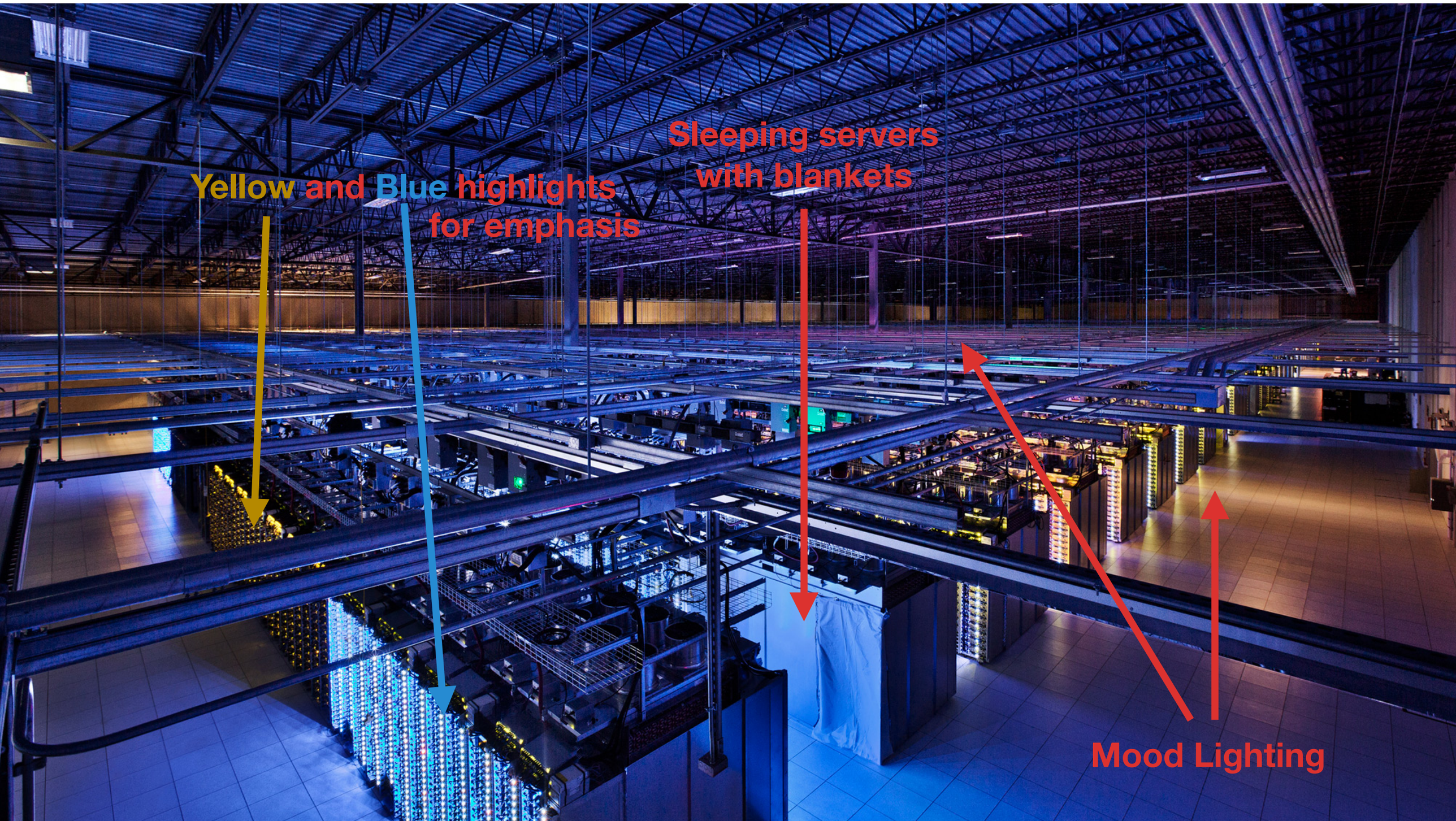
FreeFlow: Software-based Virtual RDMA Networking for Containerized Clouds

Direct Universal Access: Making Data Center Resources Available to FPGA

Stardust: Divide and Conquer in the Data Center Network

"With modern switches pushing at the boundary of manufacturing feasibility, being able to build suitable, and scalable network fabrics becomes of critical importance."

What do datacenters look like?



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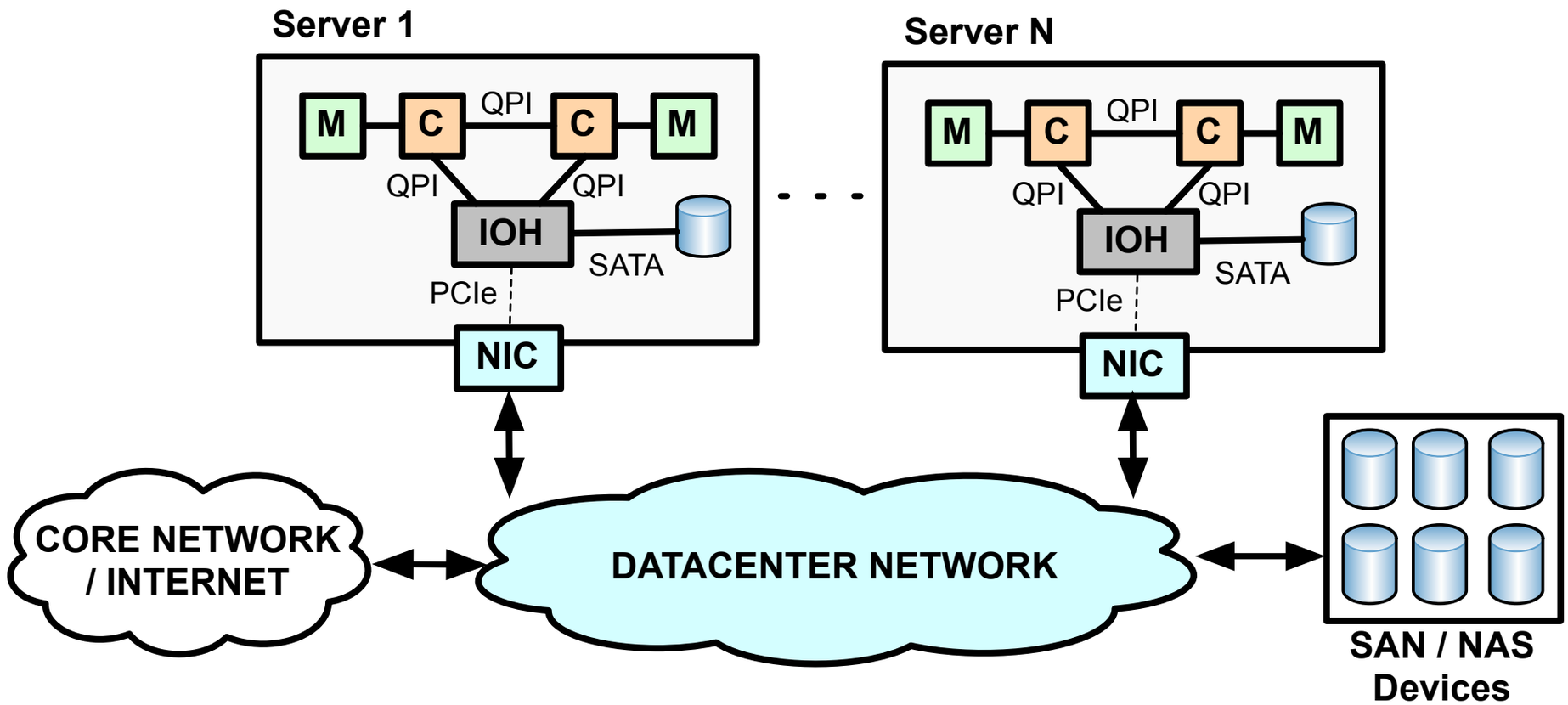

"Server-centric architecture"

Image from P. Gao et al., OSDI 2016

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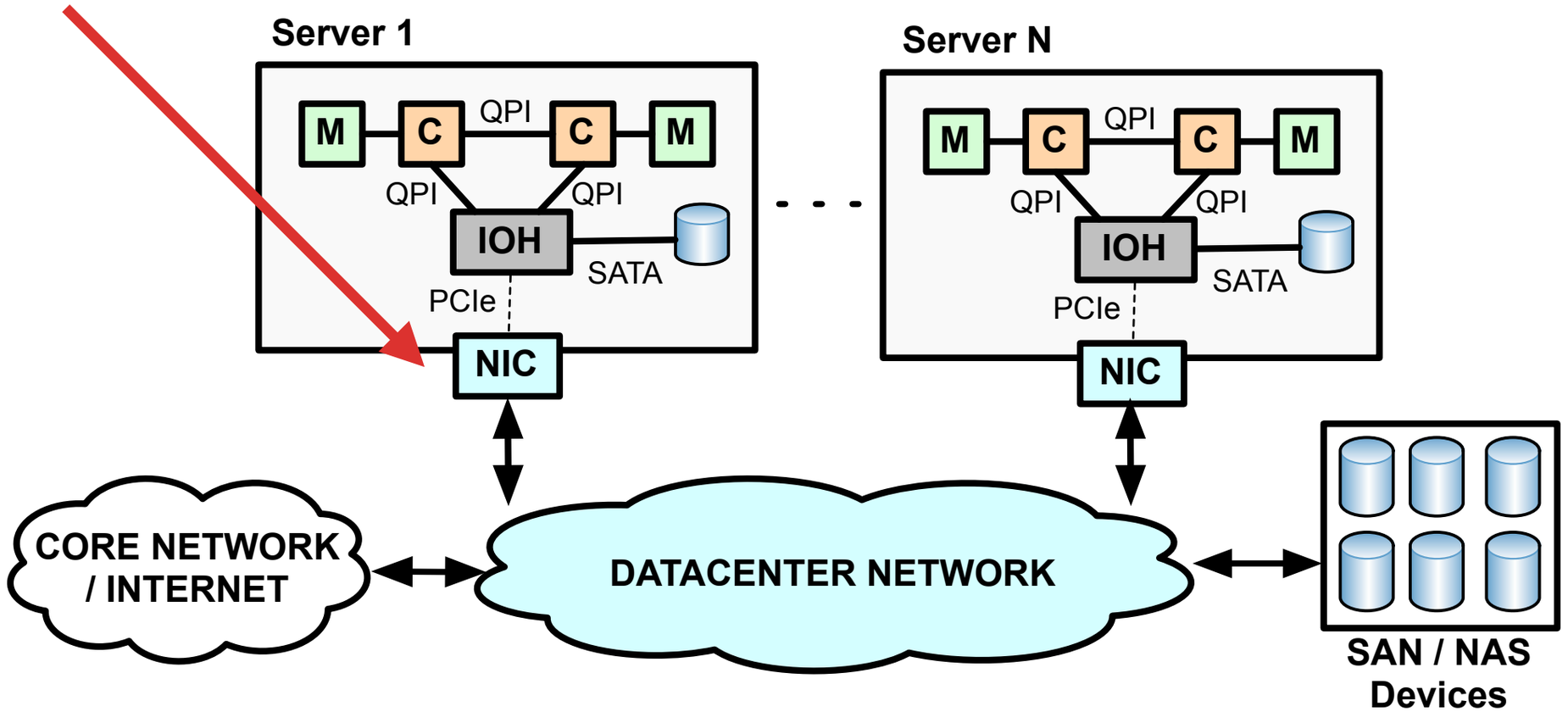

"Server-centric architecture"

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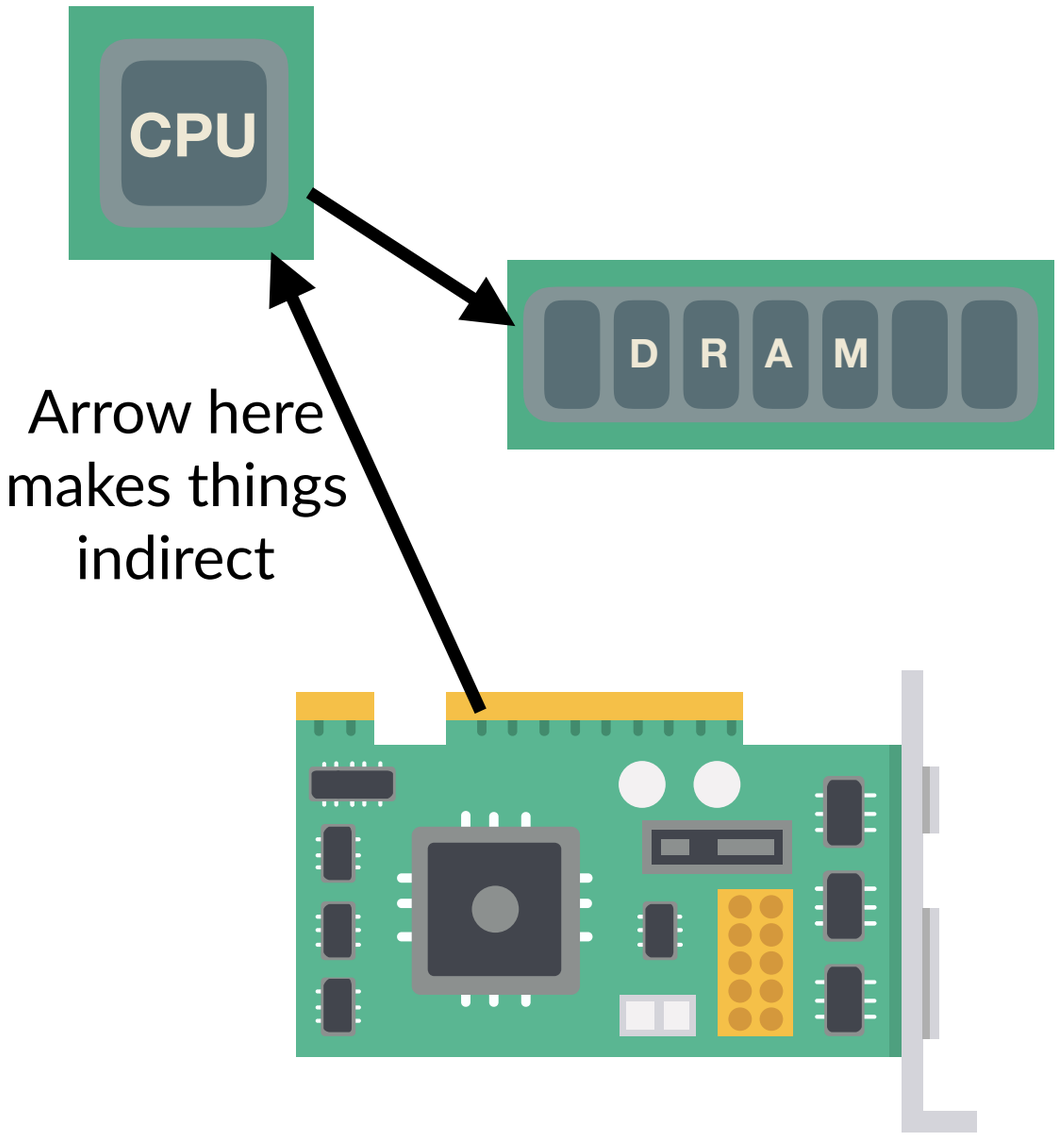
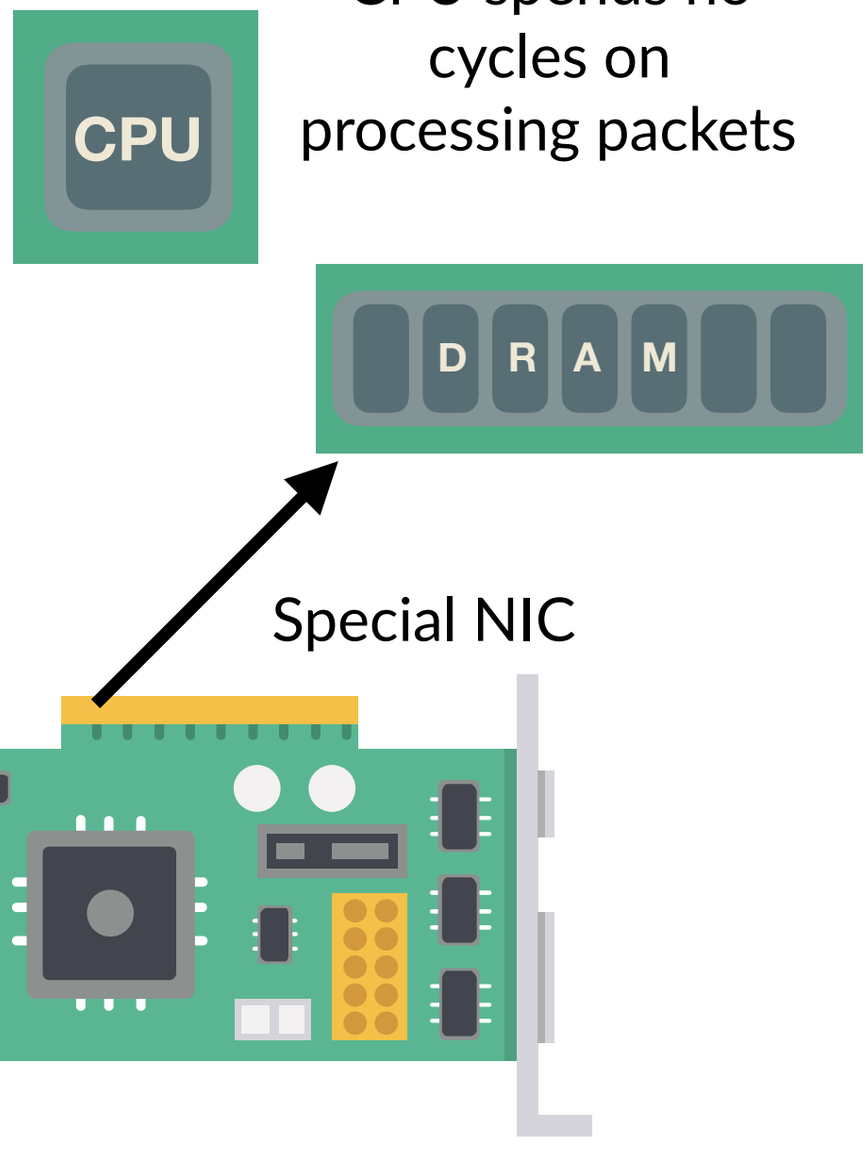
What is RDMA?

"Remote, Direct Memory Access"





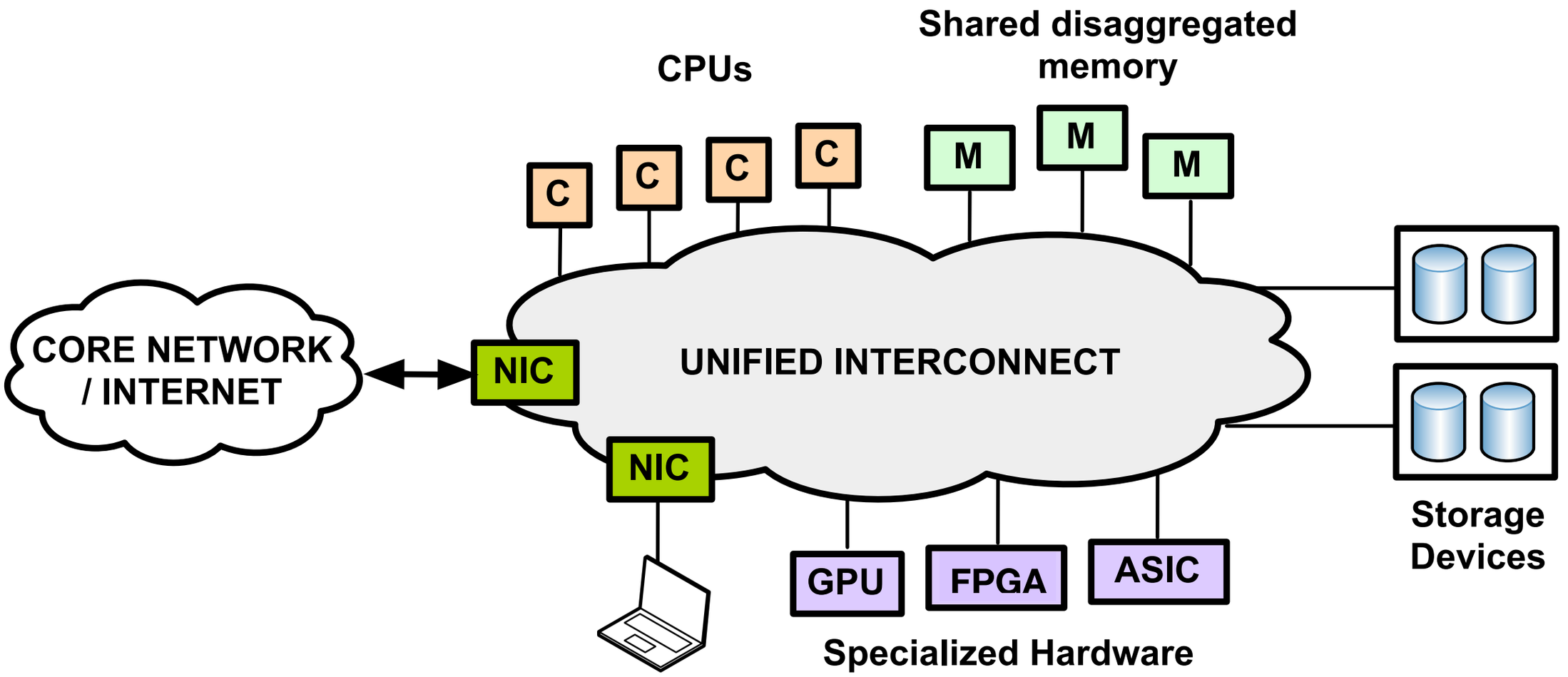
NIC Image from @graziaprato via Justine Sherry

Ok, so “Virtual RDMA for Containerized Clouds”?

“Virtual RDMA Networking” ⇨ Software pretending to be a RDMA NIC which talks to the real RDMA NIC

“Container” ⇨ cgroups (compute isolation) + chroot (file isolation) + netns (network isolation) for processes

What might a future datacenter look like?



"Disaggregated architecture"

Image from P. Gao et al., OSDI 2016

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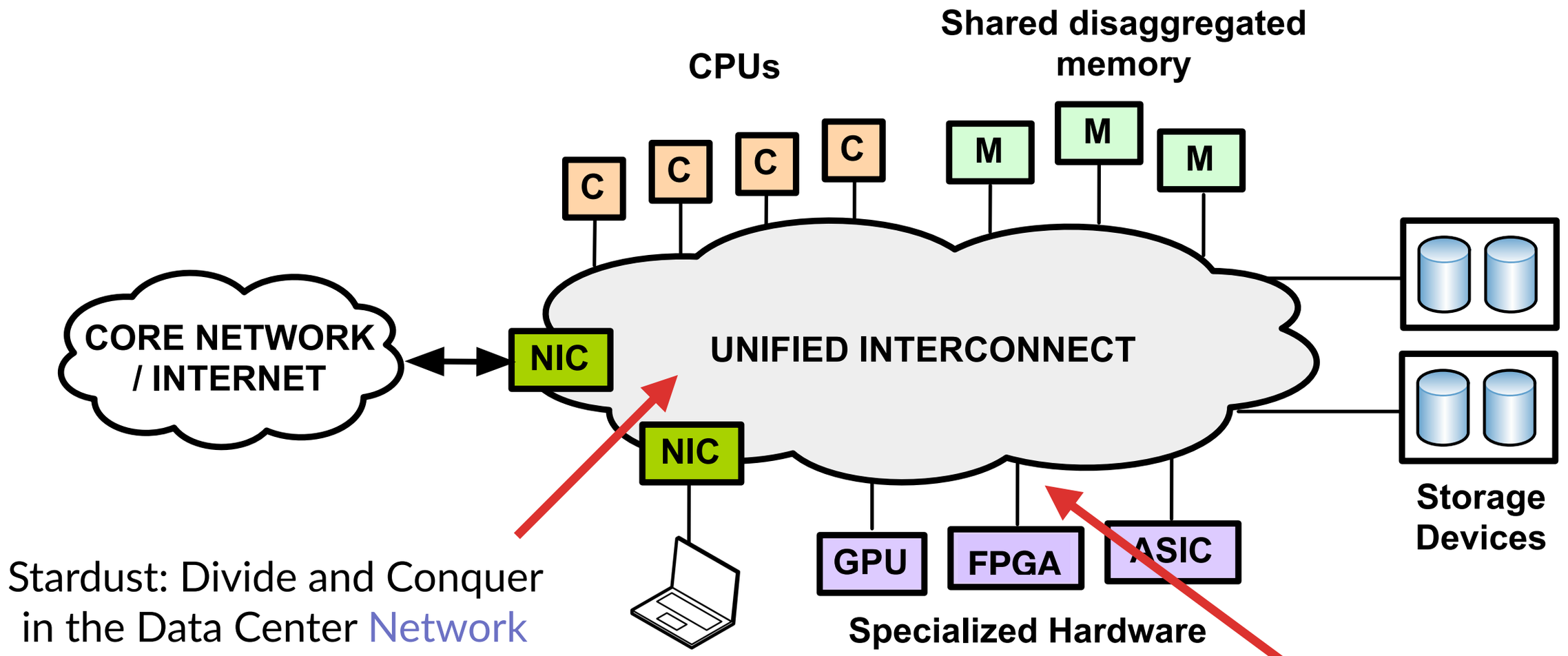


Stardust: Divide and Conquer in the Data Center Network

Direct Universal Access: Making Data Center Resources Available to FPGA

Image from P. Gao et al., OSDI 2016

What is an FPGA?

"Field Programmable Gate Array"

"Temporal Computing"

Do one thing at a time

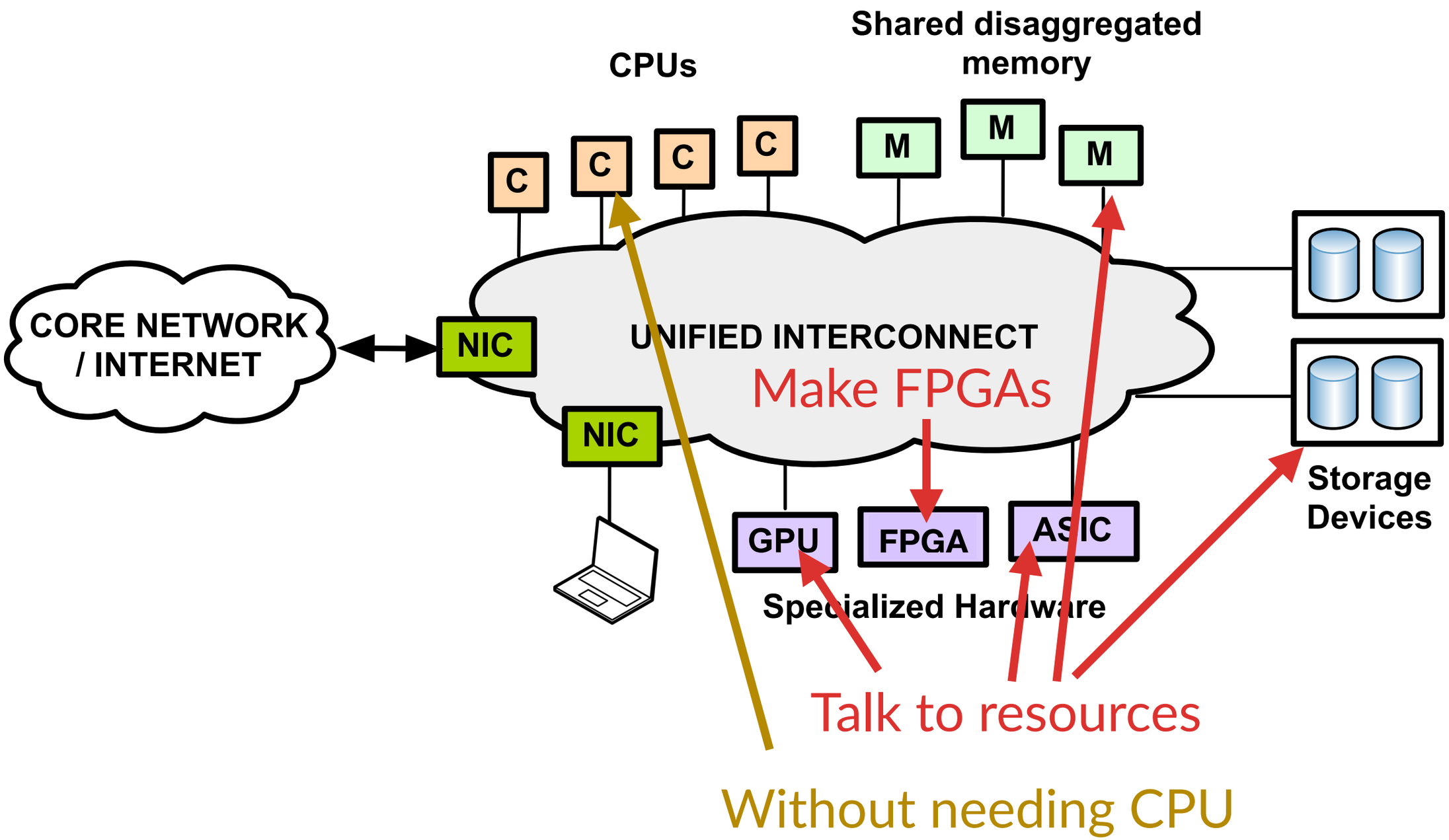
Switch to doing different things quickly

"Spatial Computing"

Do many things at a time

As long as all of those things are the same

“Make DC Resources Available?”



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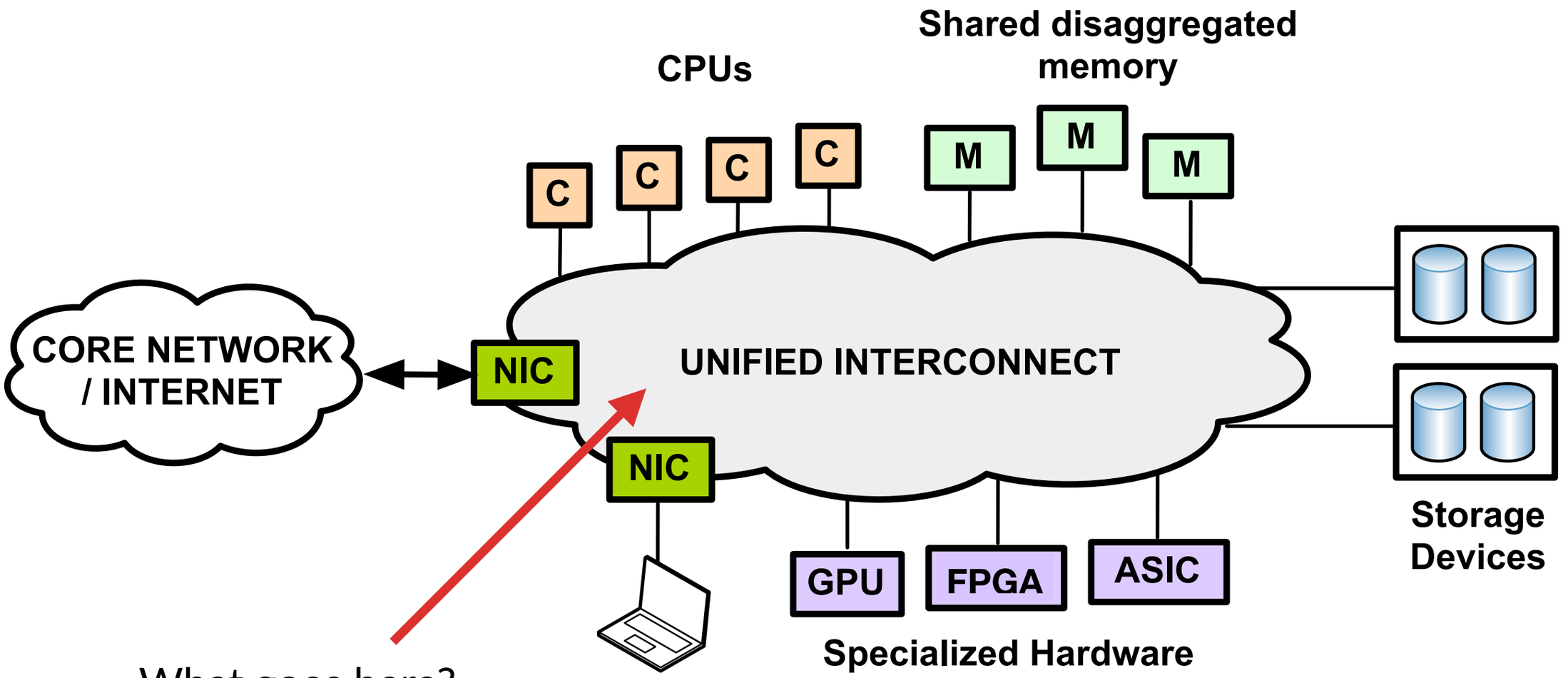
Data Center Network



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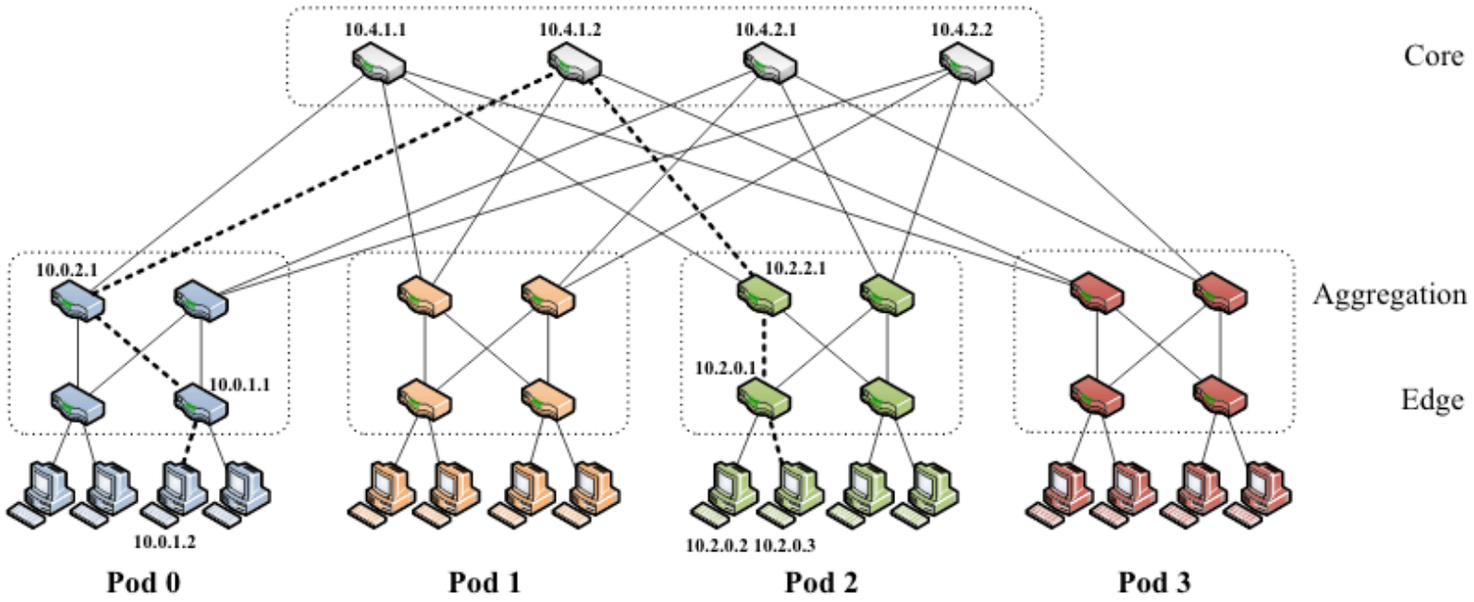
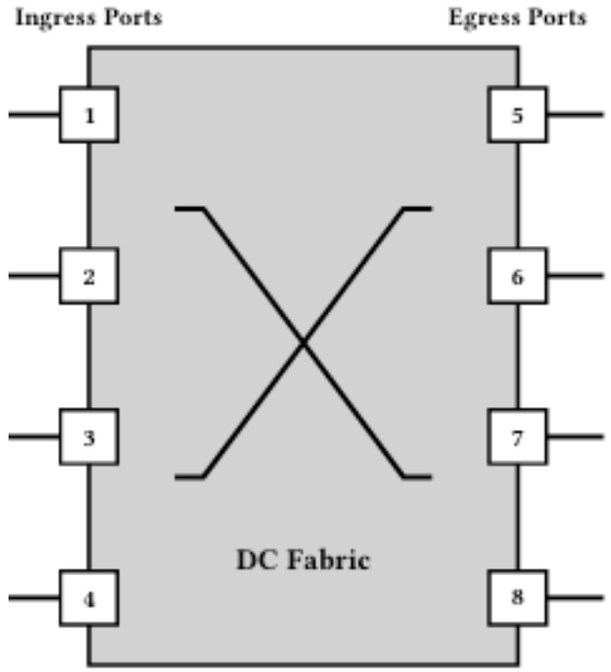


Conventional design: fat-tree network

Each switch implements a full packet processing pipeline



What users want: “One Big Switch”

Image from M. Al-Fares et al., SIGCOMM 2008

Image from S. Agarwal et al., SIGCOMM 2018

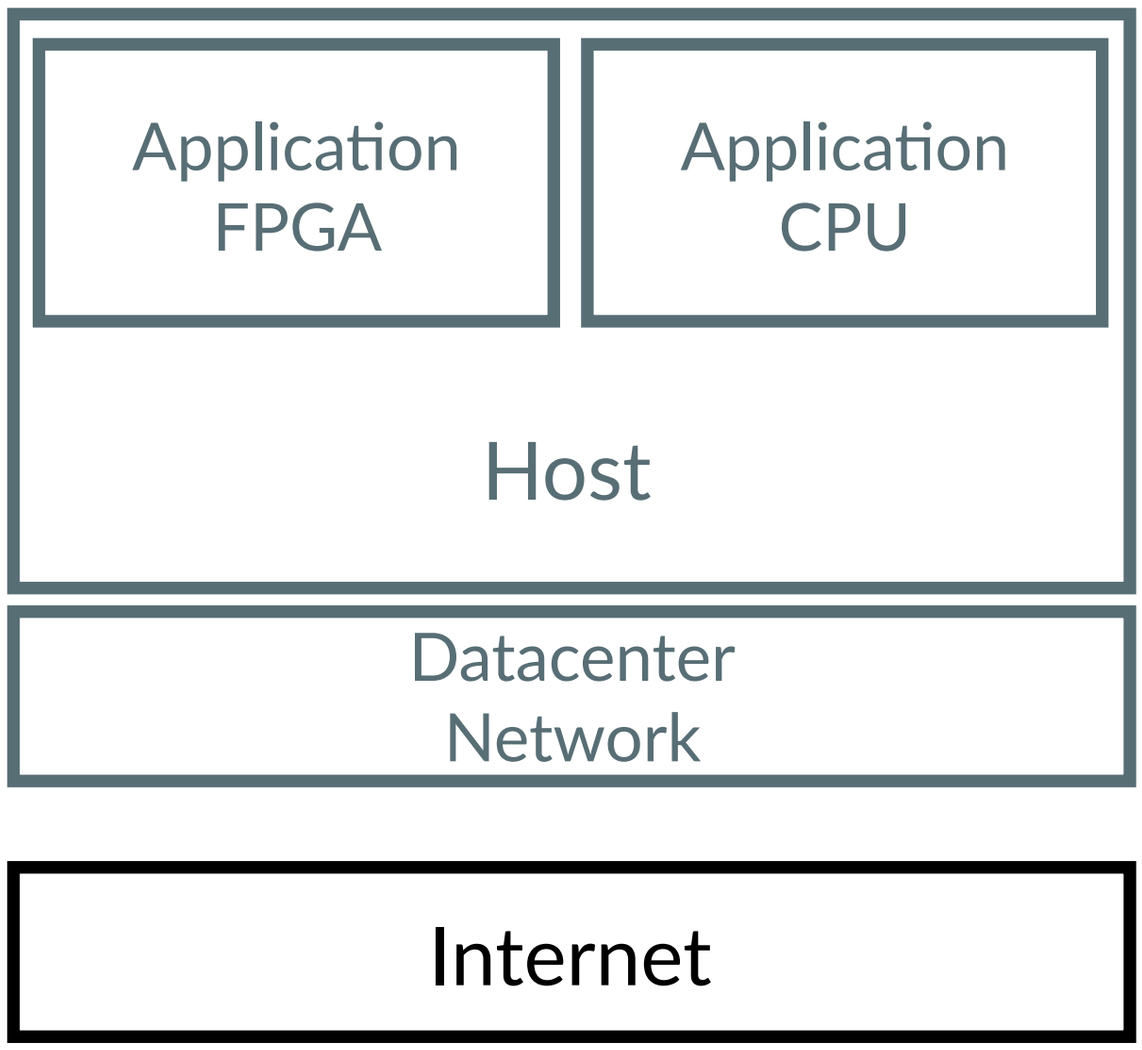
The Internet

FreeFlow

Direct Universal Access

Stardust

Blink



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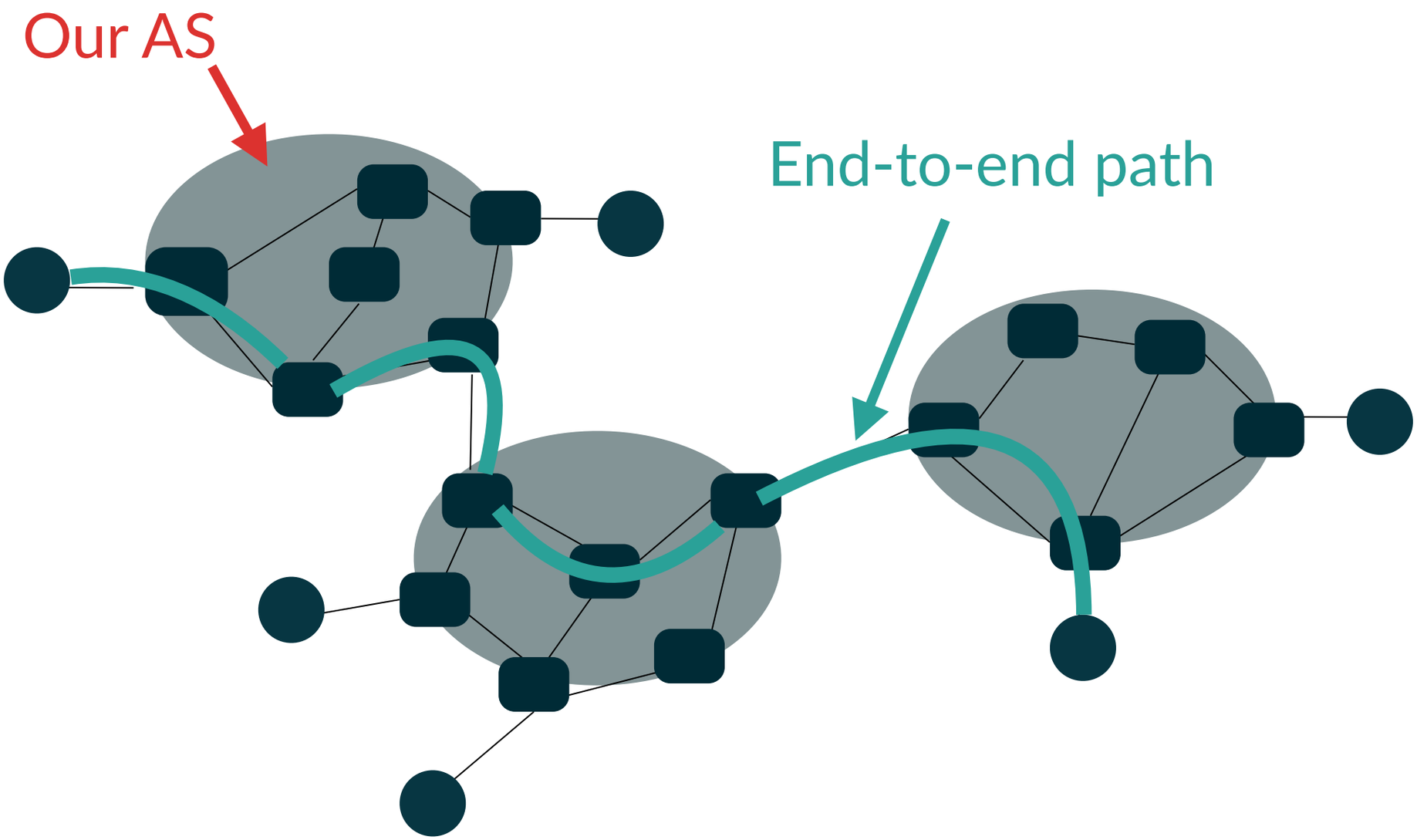

Image adapted from S. Ratnasamy, UC Berkeley CS 168

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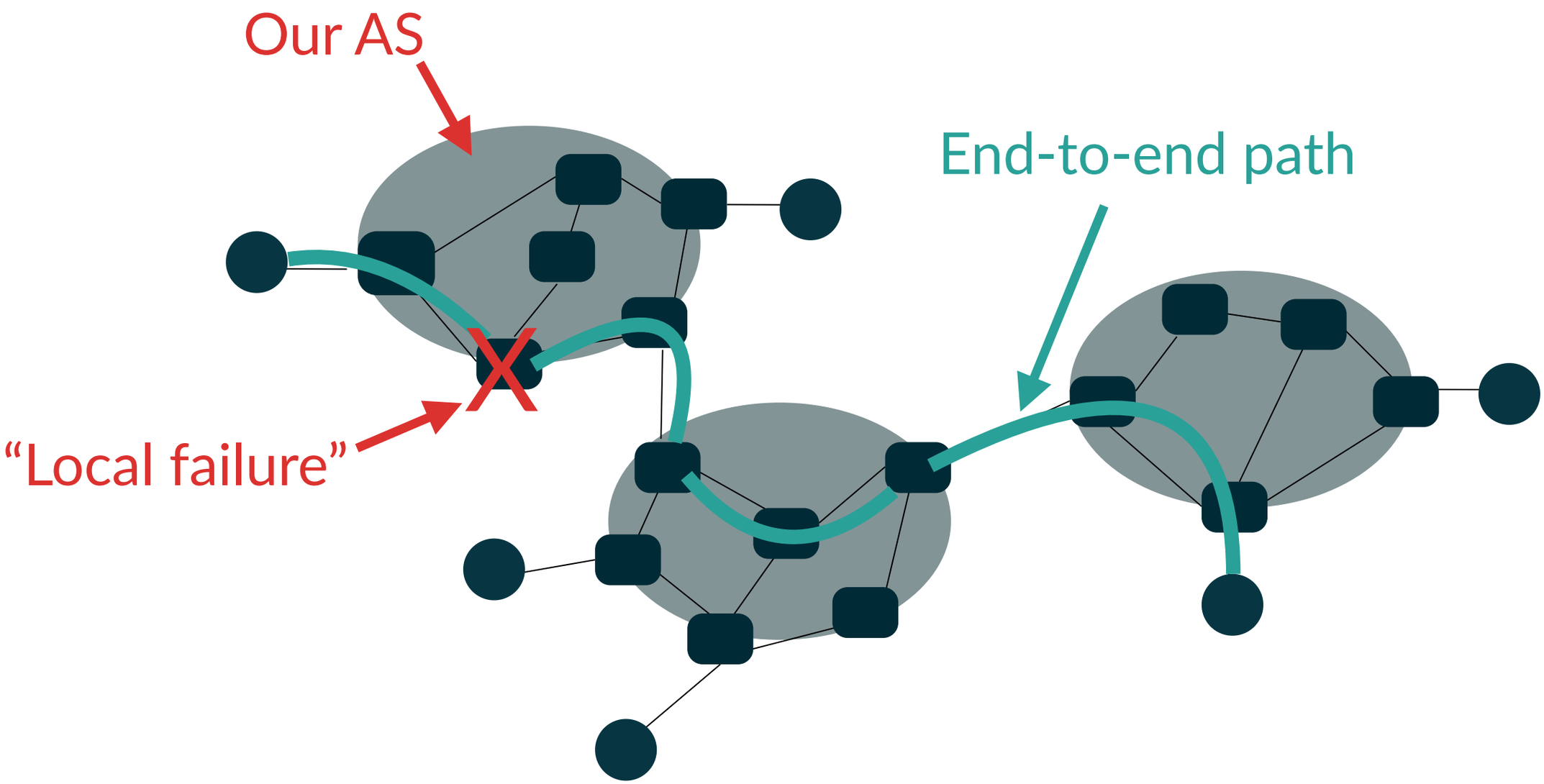

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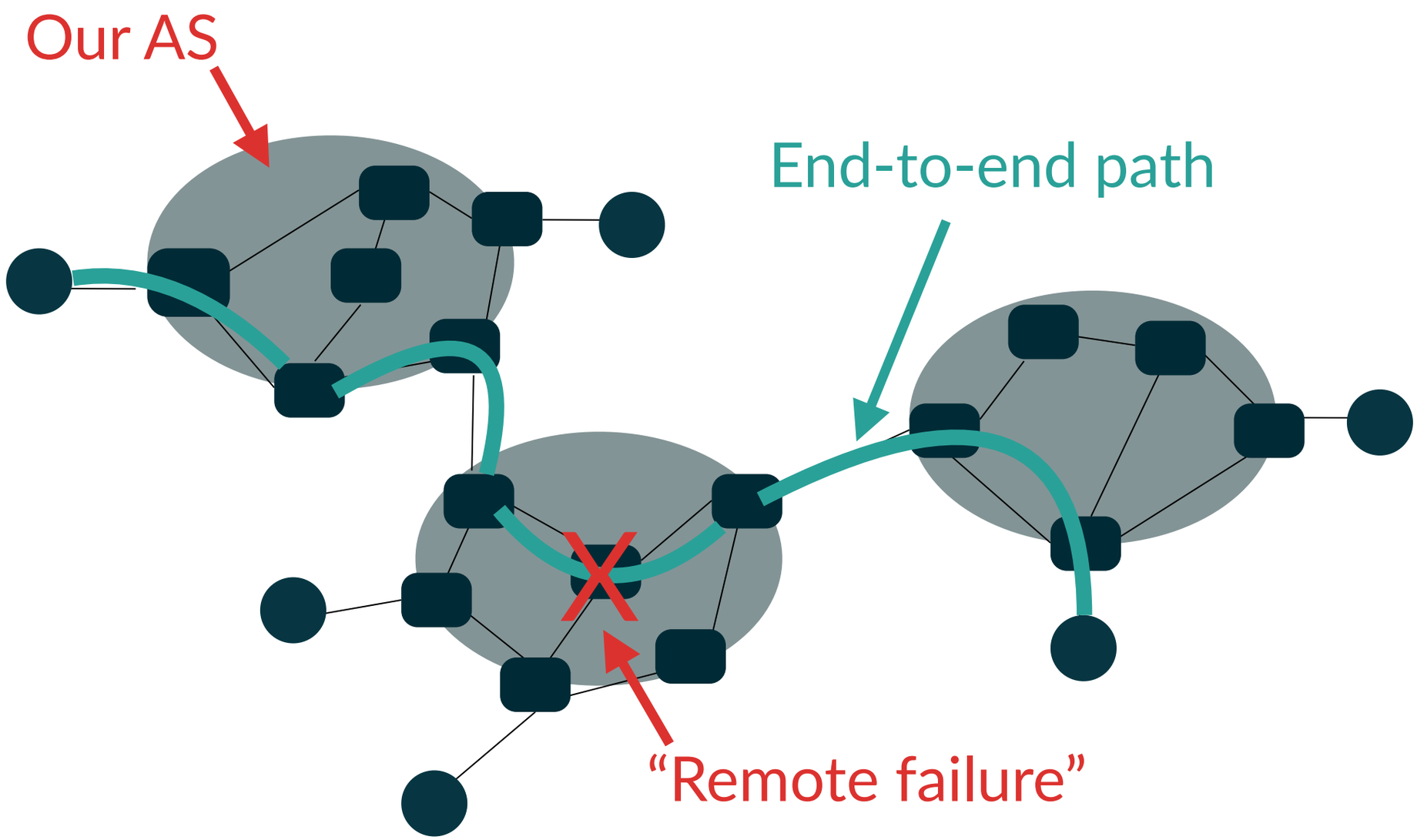

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