

AsterNetwork: efficient large-scale datacenter network for AI/ML

Tencent Datacenter Network Architect

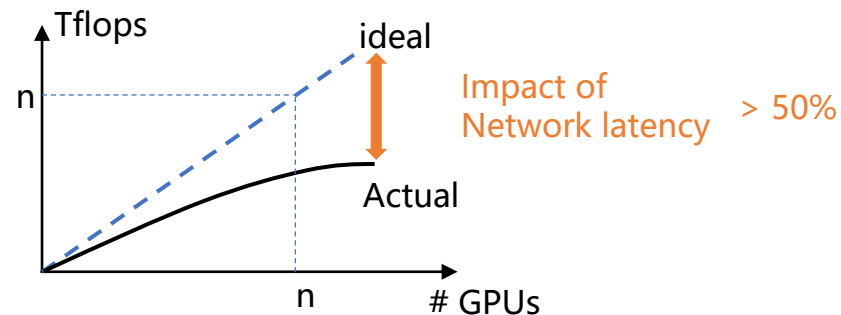
Baojia Li

July 25 2023

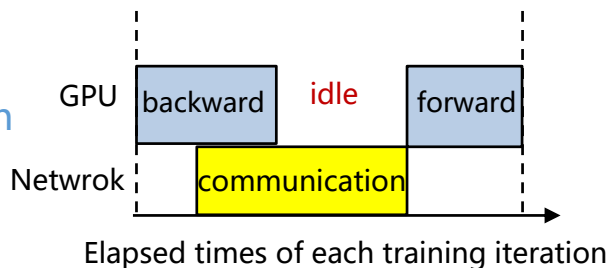
Network Requirements of AI: Large Bandwidth, High Load and Zero Packet Loss

Large Cluster Size \neq Effective Flops

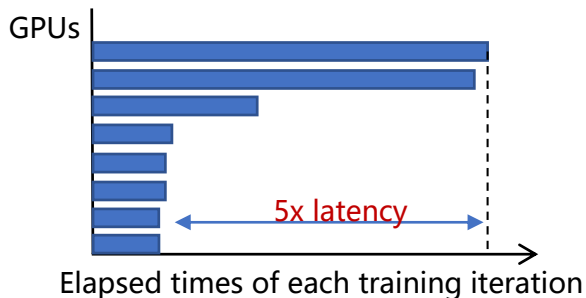
Network Performance constrains effective flops of GPU clusters



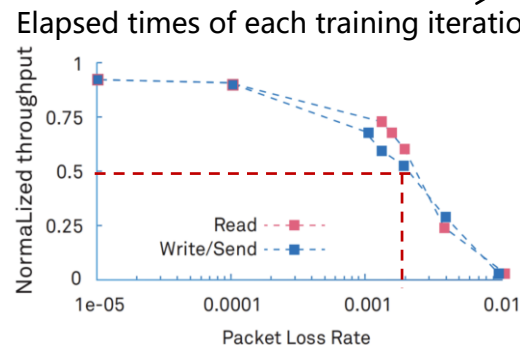
Impacts of Bandwidth
(TB magnitude)



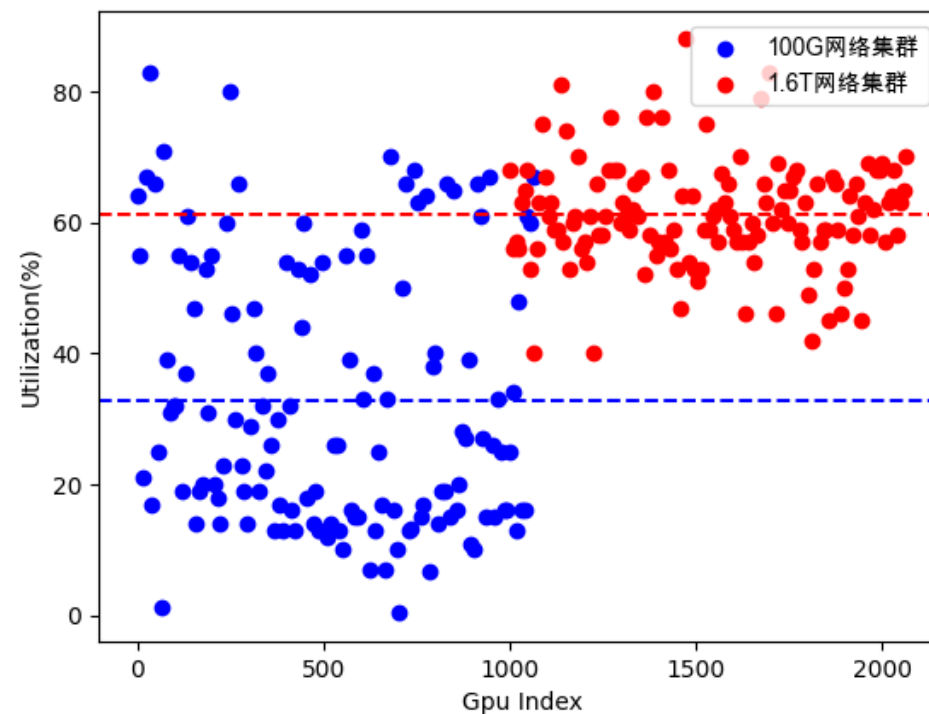
Impacts of Latency
(5x)



Impacts of packet loss
(0.1% packet loss incur 50%)



GPU usage **32%→61%**

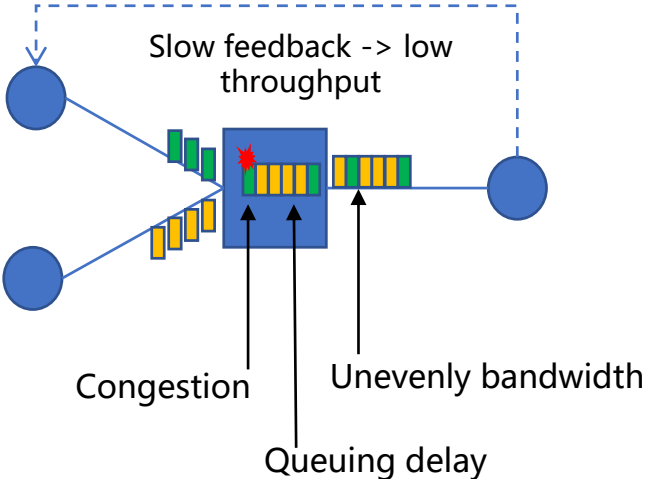


Challenges: Tradition Protocols Restrict GPU Cluster' s Operating Efficiency

Network Protocol

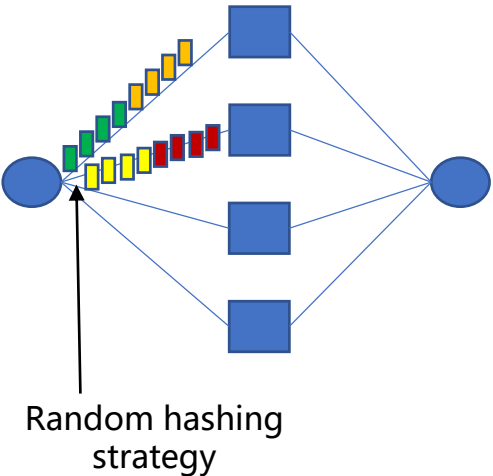
Congestion control

Congestion: low utilization, high delay, packet loss



Multi-path Load balancing

Random path selection: hash polarization, low utilization

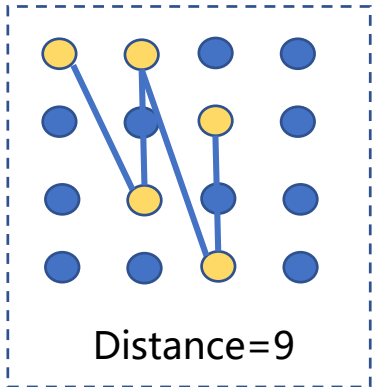


Collective Communication Library

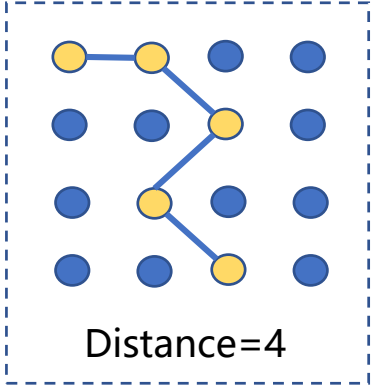
Collective Communication optimization

Topology-unaware: detours, sub-optimal paths

● Involved GPU



Topology-unaware

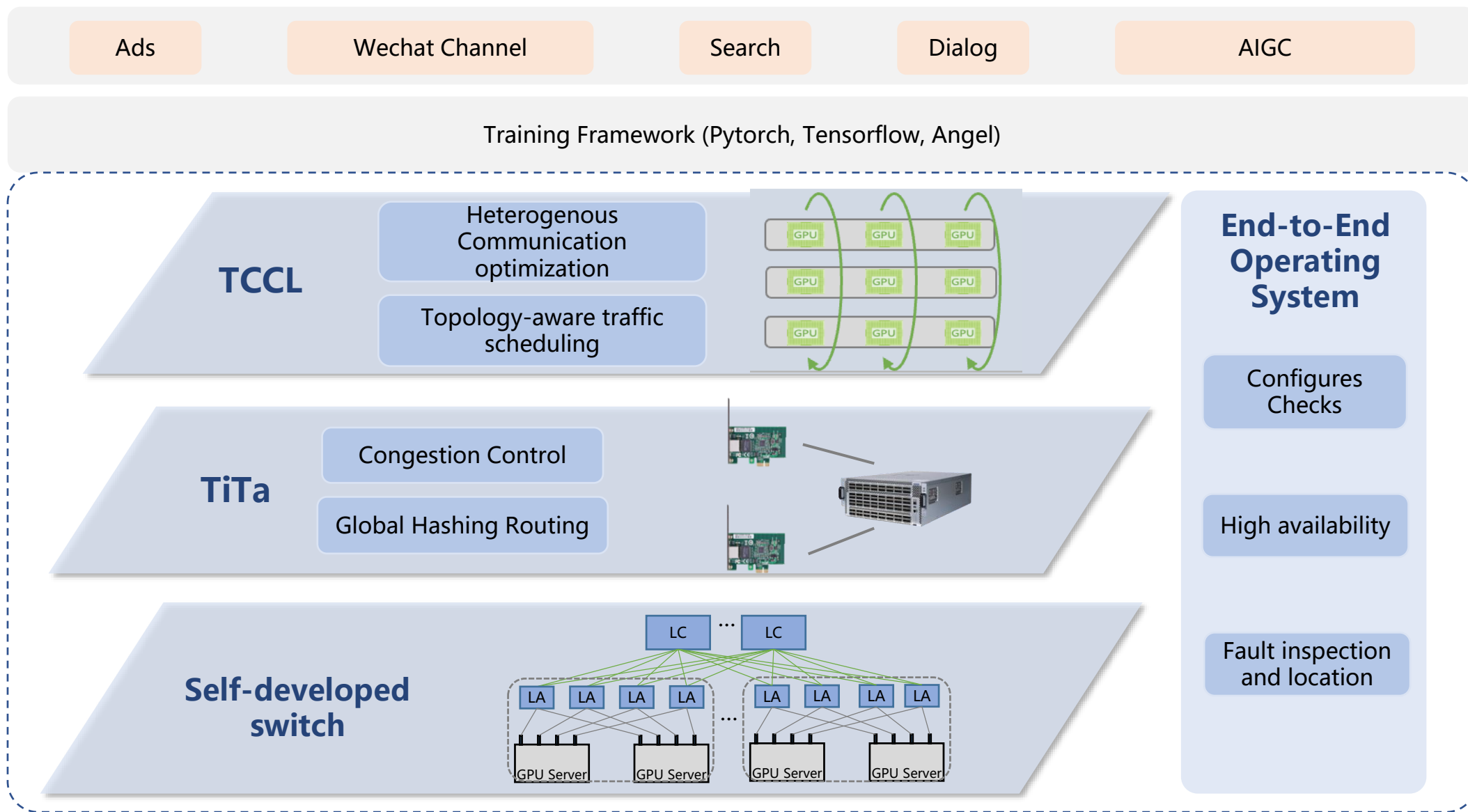


Topology-aware

	Congestion Control	Load Balancing Bias	Packet Loss	Collective Communication
Tradition Protocol	500us ~ 1ms	~ 40%	0.1% ~ 1%	Topology-unaware
Self-developed Protocol	10us ~ 40us	~ 5%	0	Topology-aware

AstralNetwork: 1.6T/3.2T、Self-developed TiTa and TCCL Protocols

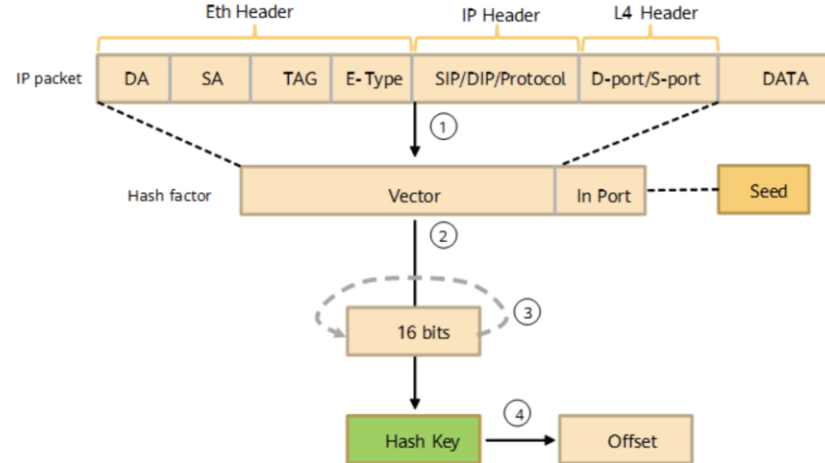
Extreme cluster performance and intelligent operation



Global Hash Routing (GHR)

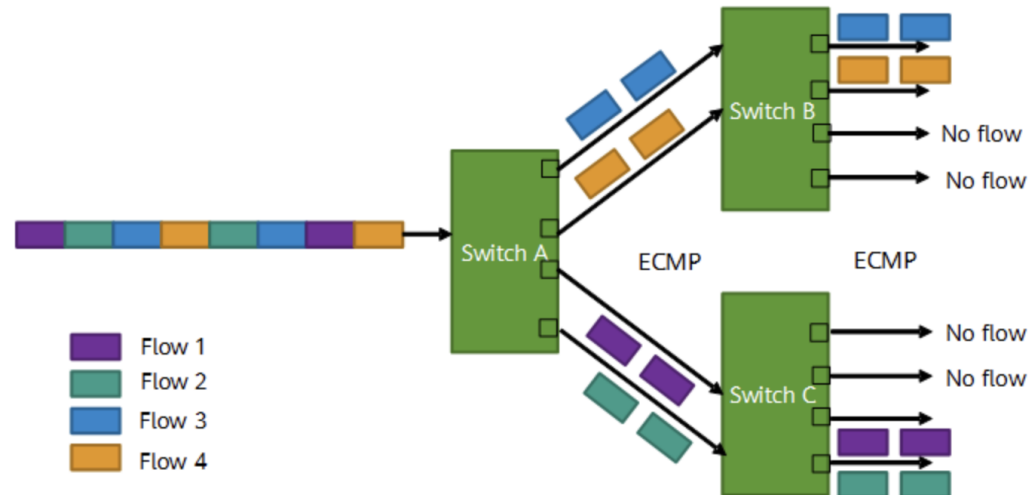
➤ Hash process

Figure 1-1 Hash algorithm process

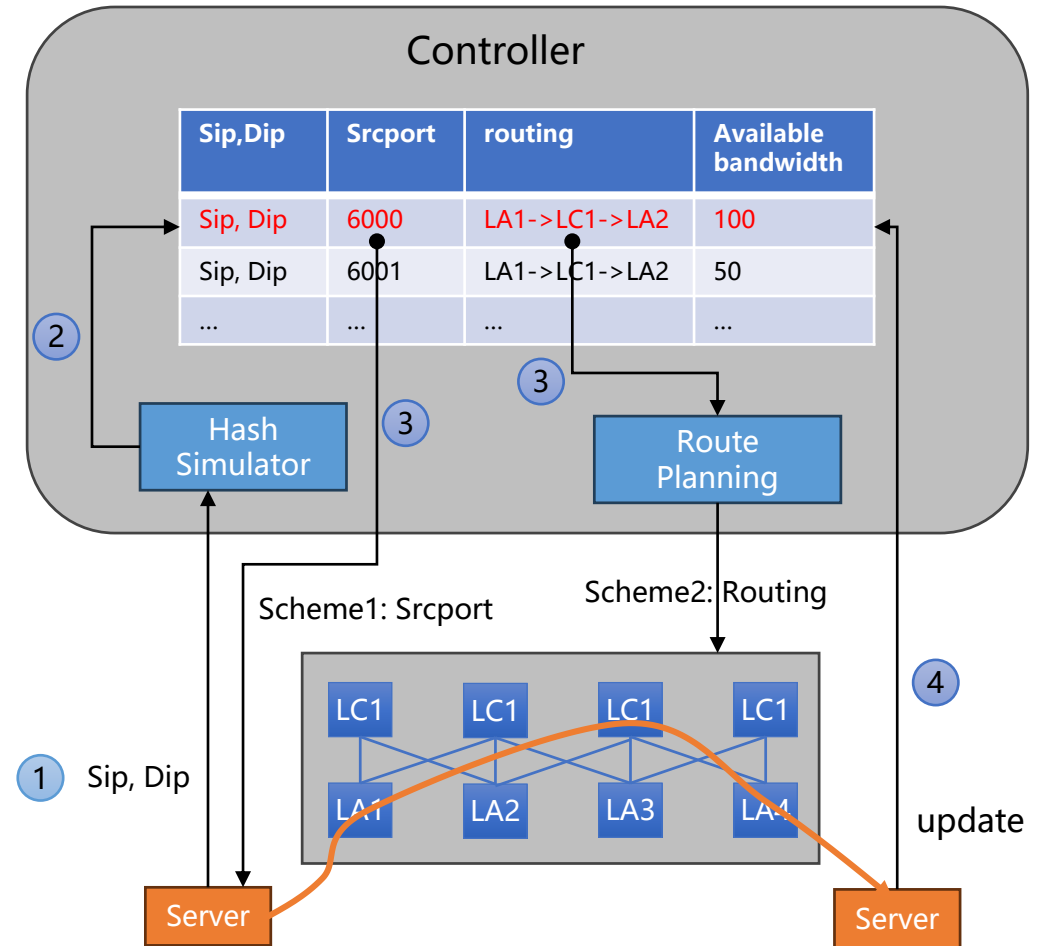


➤ Hash polarization

Figure 1-2 Hash polarization



➤ Solution: Global Hash Routing



Tencent Intelligent Traffic Aware protocol (Tita)

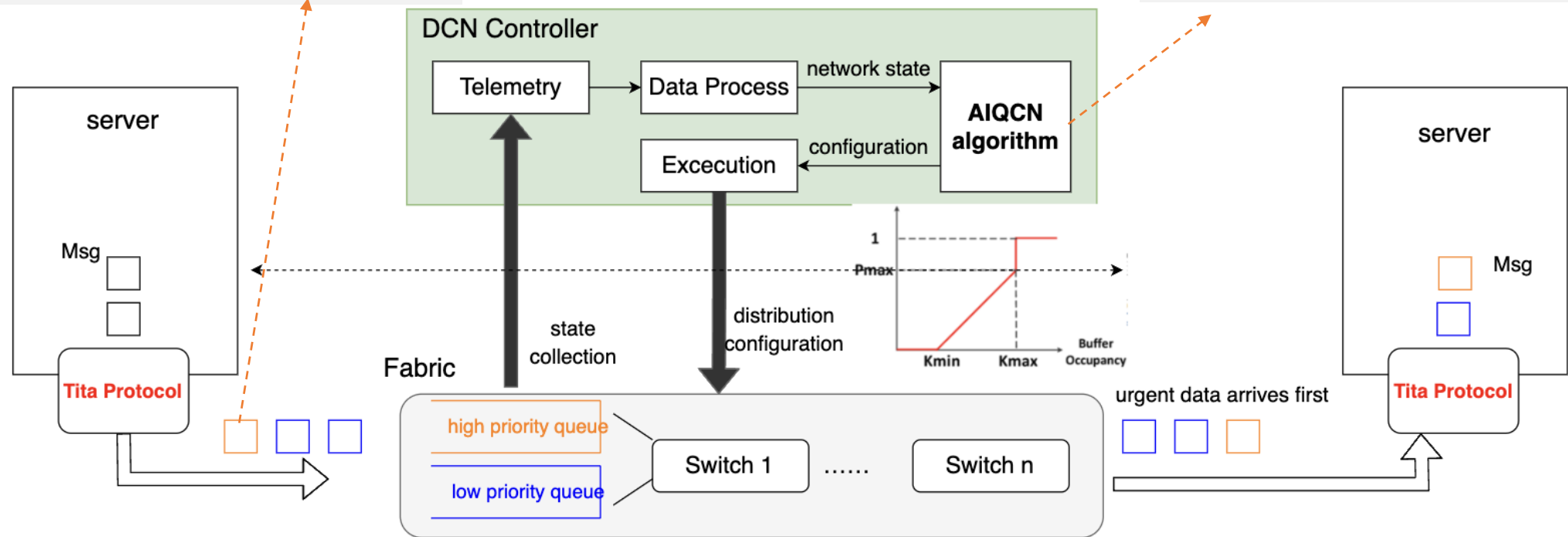
Congestion control based on end-network coordination

End

Set the message transmission priority according to the communication flow status

Network

According to the degree of traffic conflict, control the sending rate of the source end

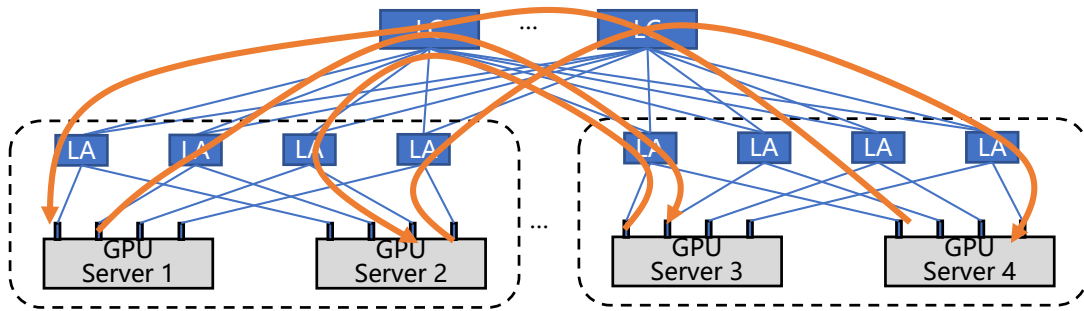


Effective load of the whole network reaches more than 90%

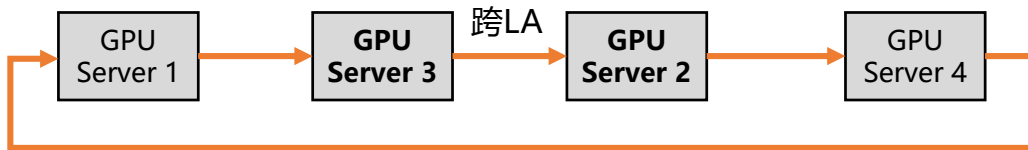
Tencent Collective Communication Library (TCCL)

Topology-aware affinity scheduling: minimizing traffic detours

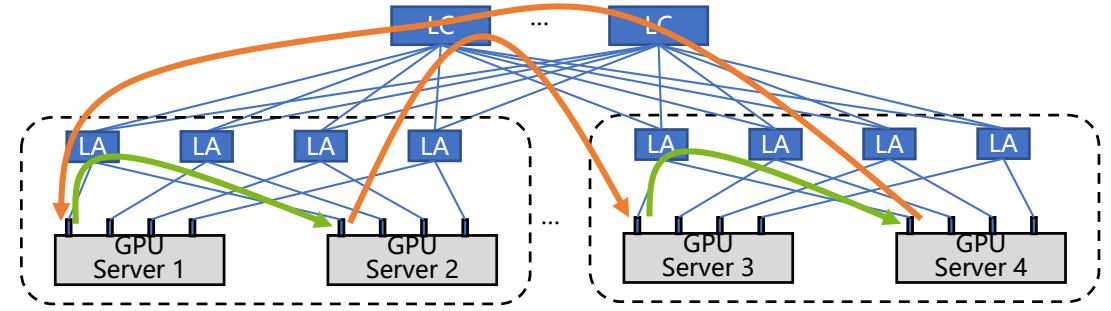
➤ Suboptimal traffic scheduling



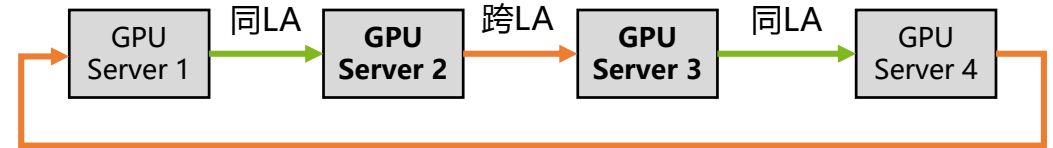
➤ Suboptimal collective communication sequence



➤ Optimal traffic scheduling



➤ Optimal collective communication sequence



Traffic cross LA groups was reduced by 50%~80%

A blue arrow pointing right, centered on a white background. The arrow has a dark grey outline and a light grey shadow. The word "Thanks" is written in white, bold, sans-serif font inside the arrow.

Thanks