

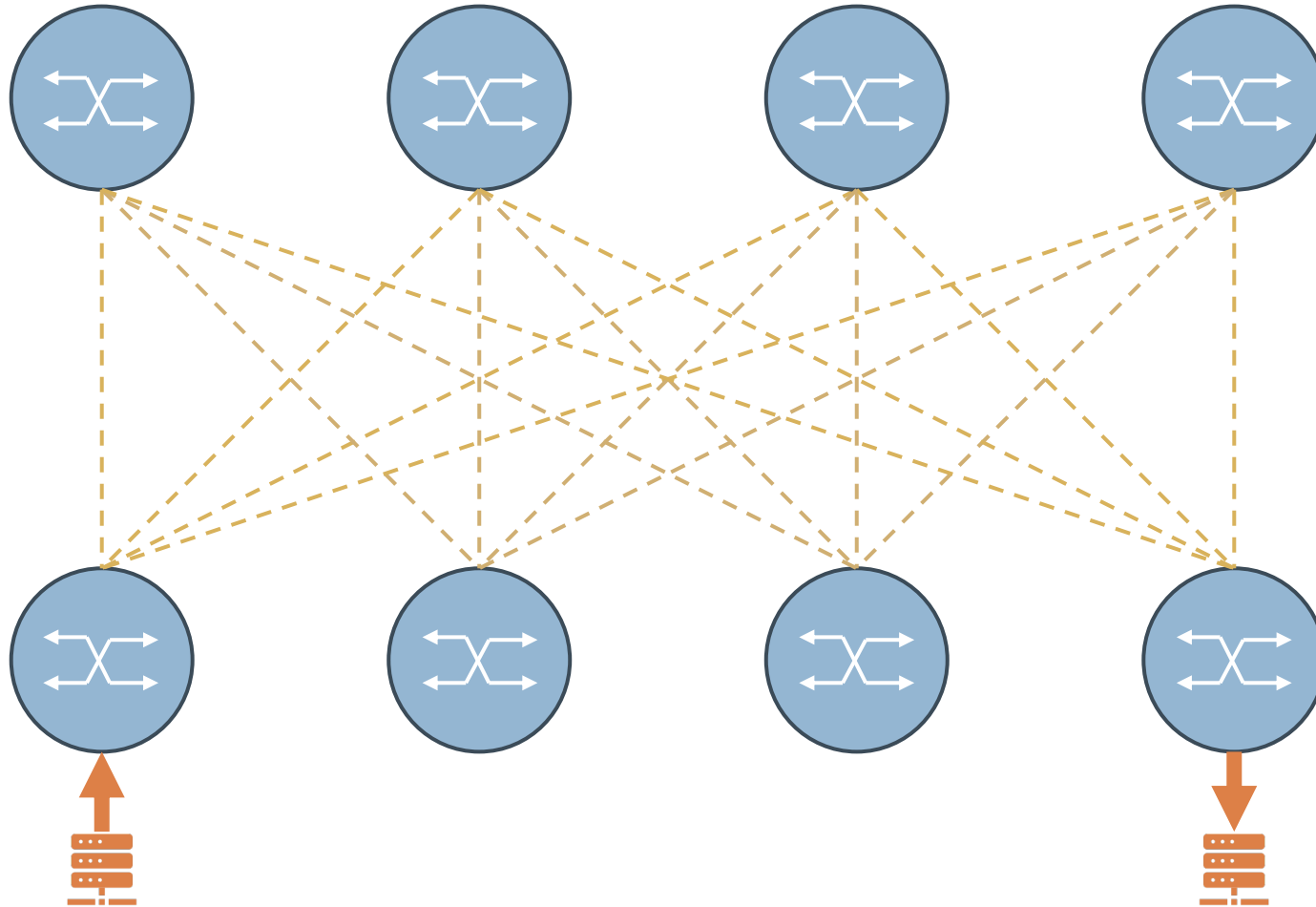
FlowPulse: Catching Network Failures in ML Clusters

Jakob Krebs, Dmitry Gavrilenko, Daniel Amir, Shir Landau-Feibish, Mark Silberstein

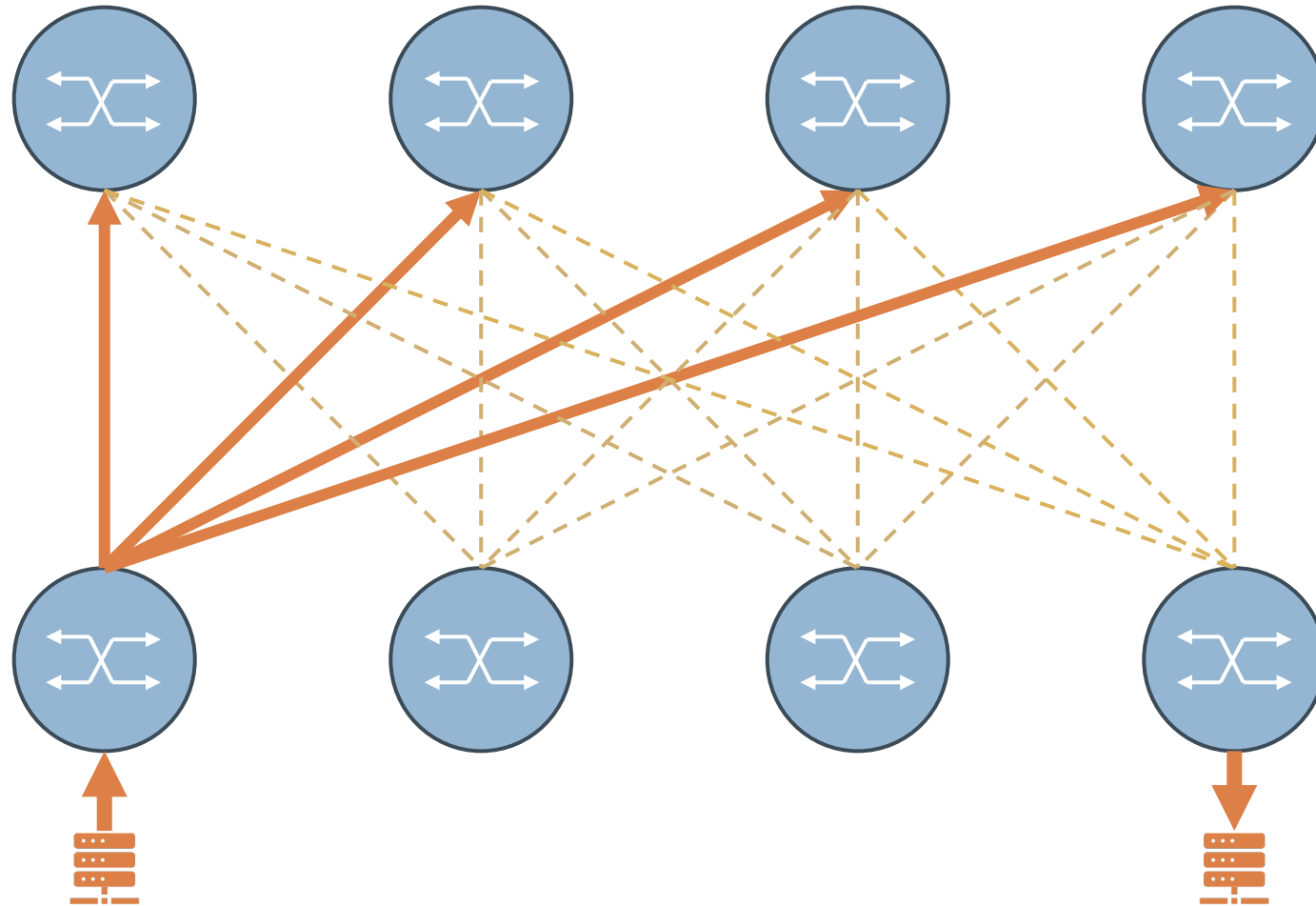


אוניברסיטת חיפה
UNIVERSITY OF HAIFA
جامعة حيفا

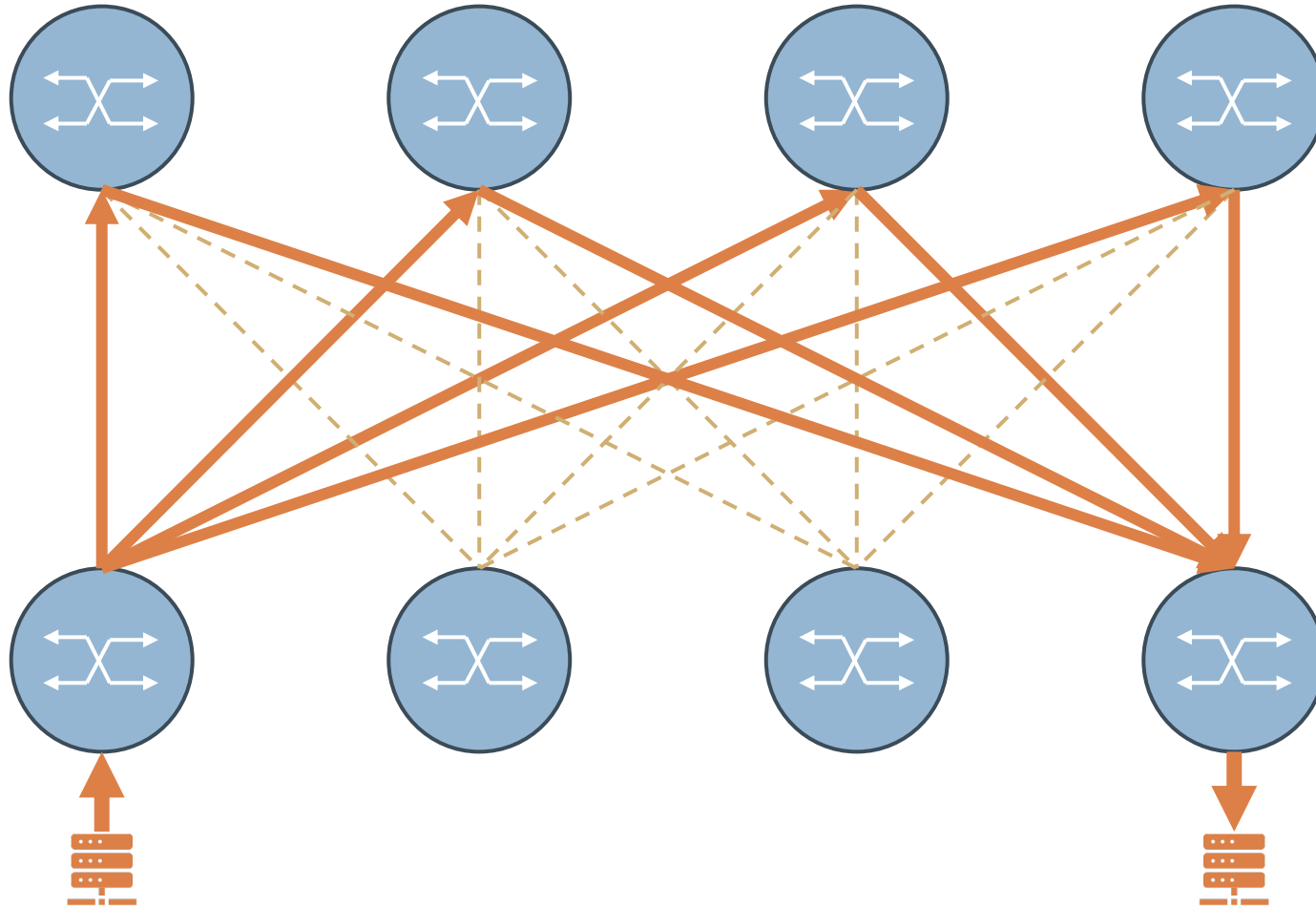
Adaptive Packet Spraying



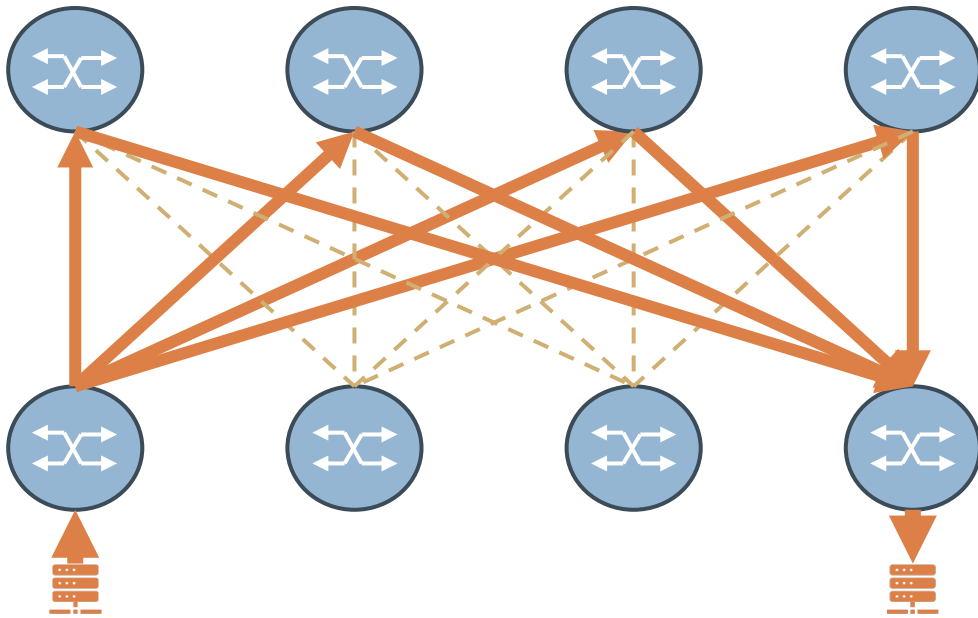
Adaptive Packet Spraying



Adaptive Packet Spraying



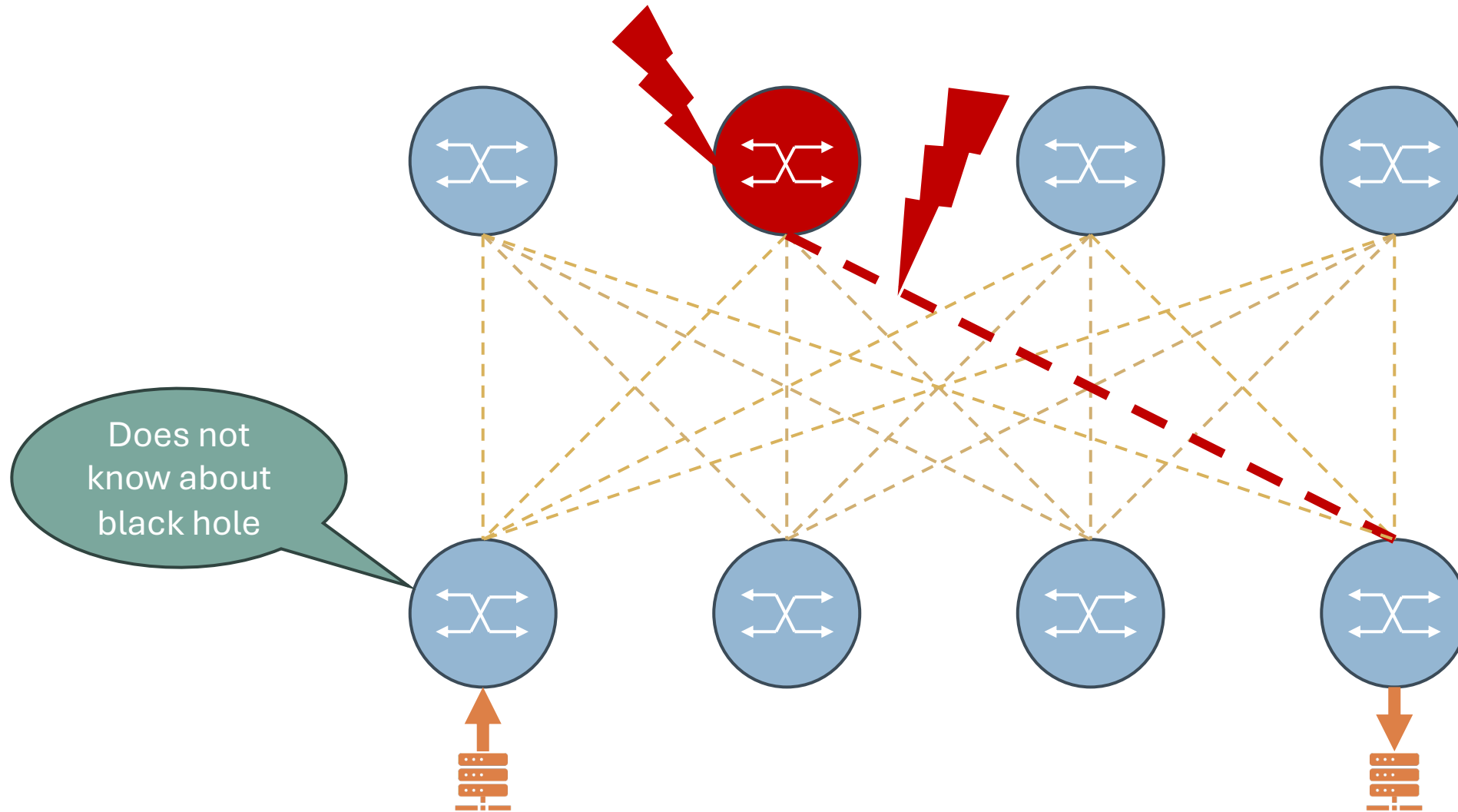
Adaptive Packet Spraying



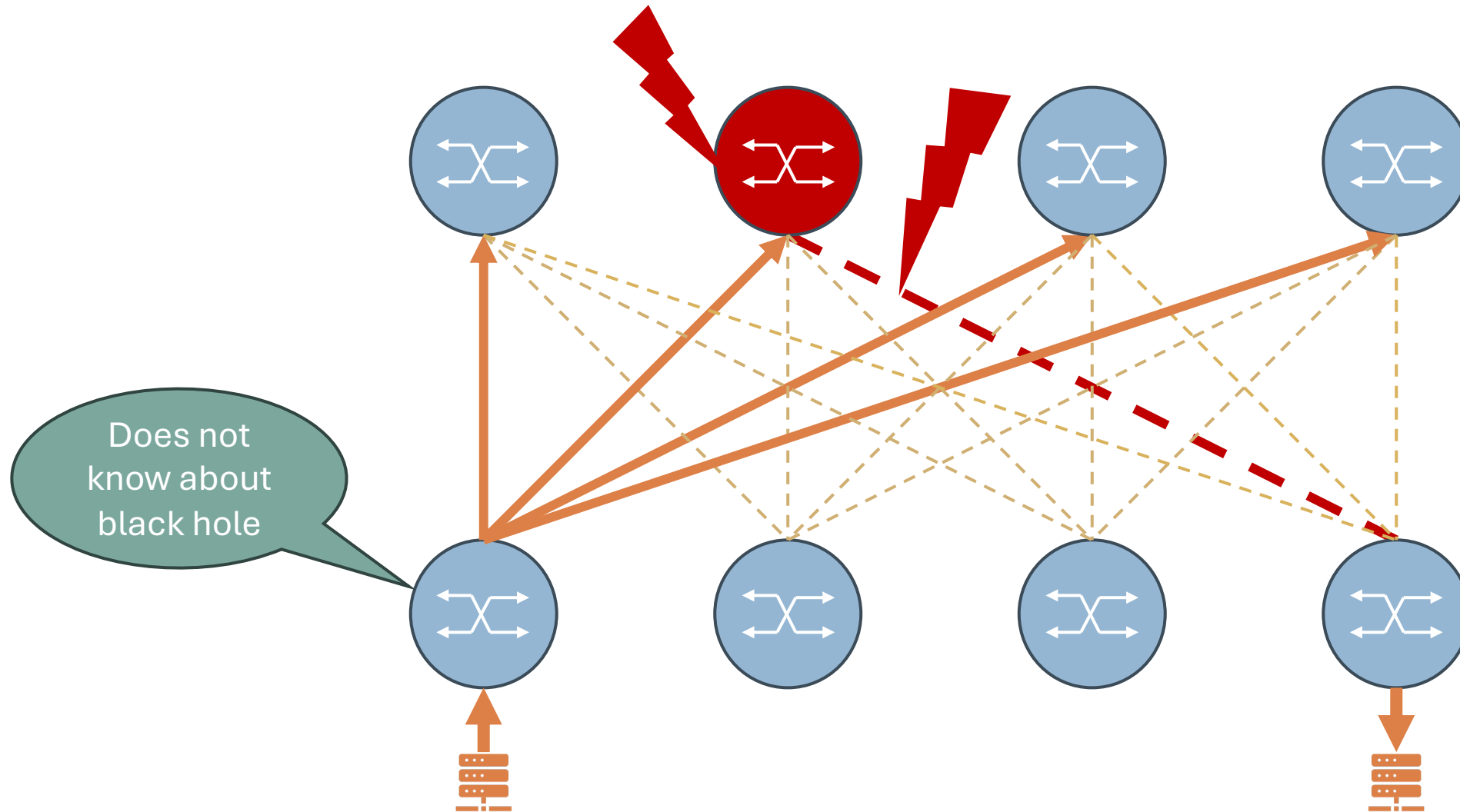
Company Logos
removed due to
Copyright

APS is very popular and widely deployed

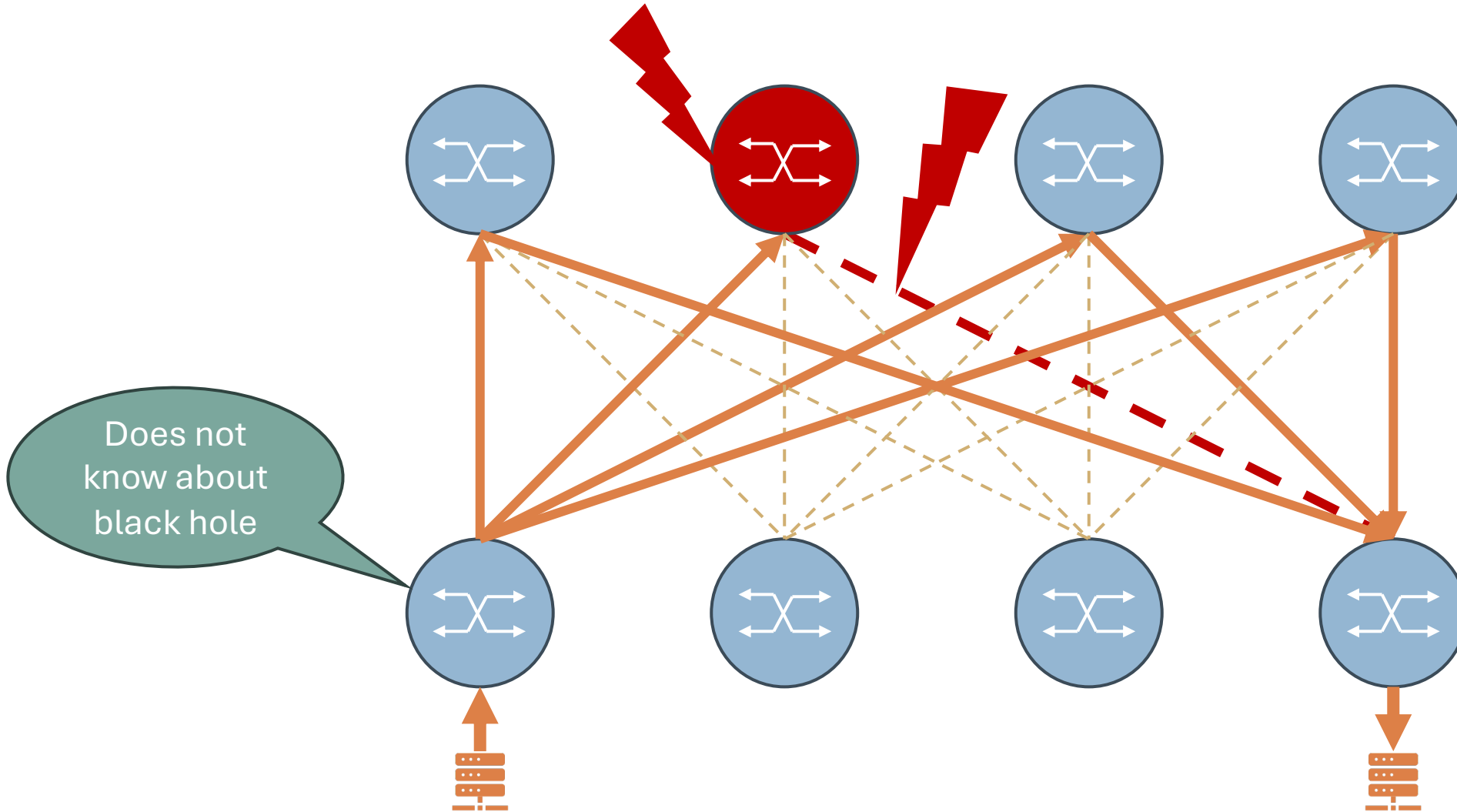
Silent Failures are a Problem for APS



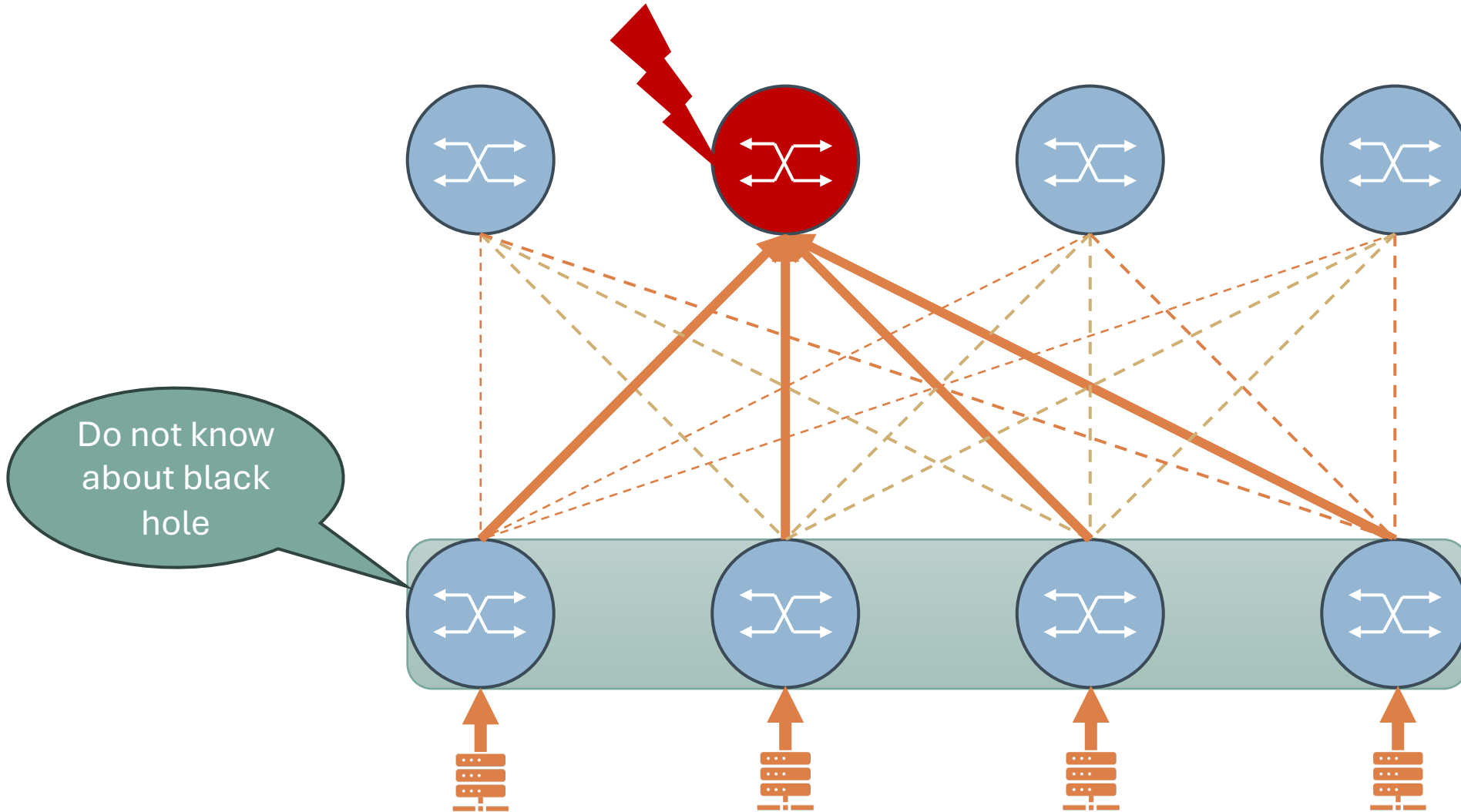
Source Switch is Unaware of Failure!



Source Switch is Unaware of Failure!



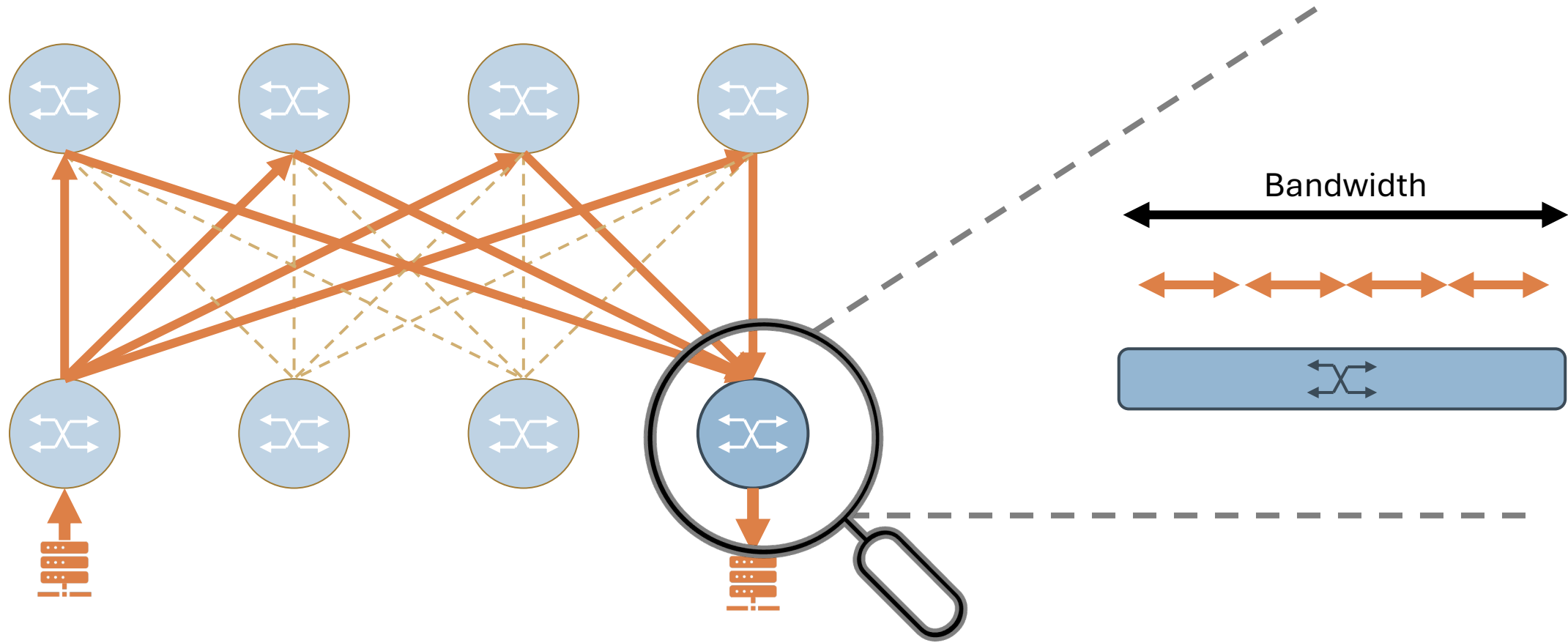
All Cross-switch Flows affected!



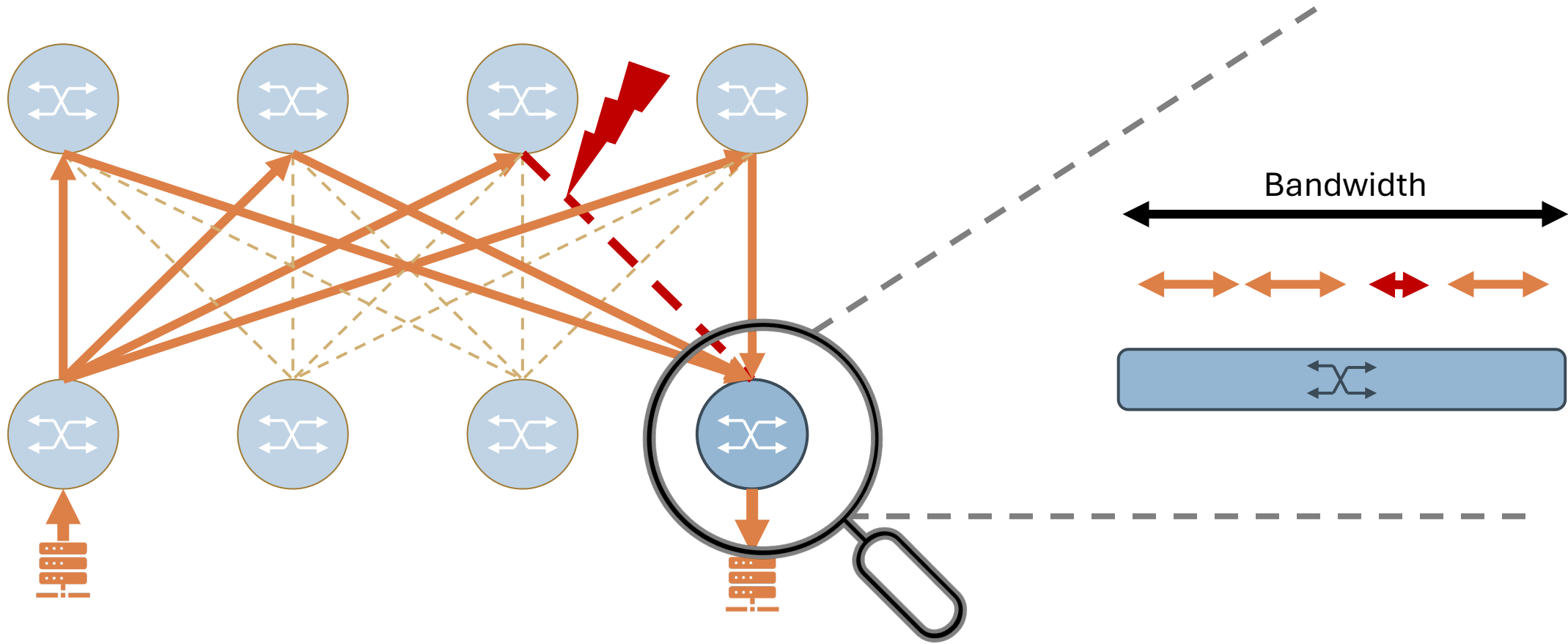


How do we identify silent failures in APS networks?

Spatial Symmetry of Pristine Network



Spatial Asymmetry of faulty Network





How do we identify silent failures in APS networks?



Look at Asymmetries





How do we identify silent failures in APS networks?

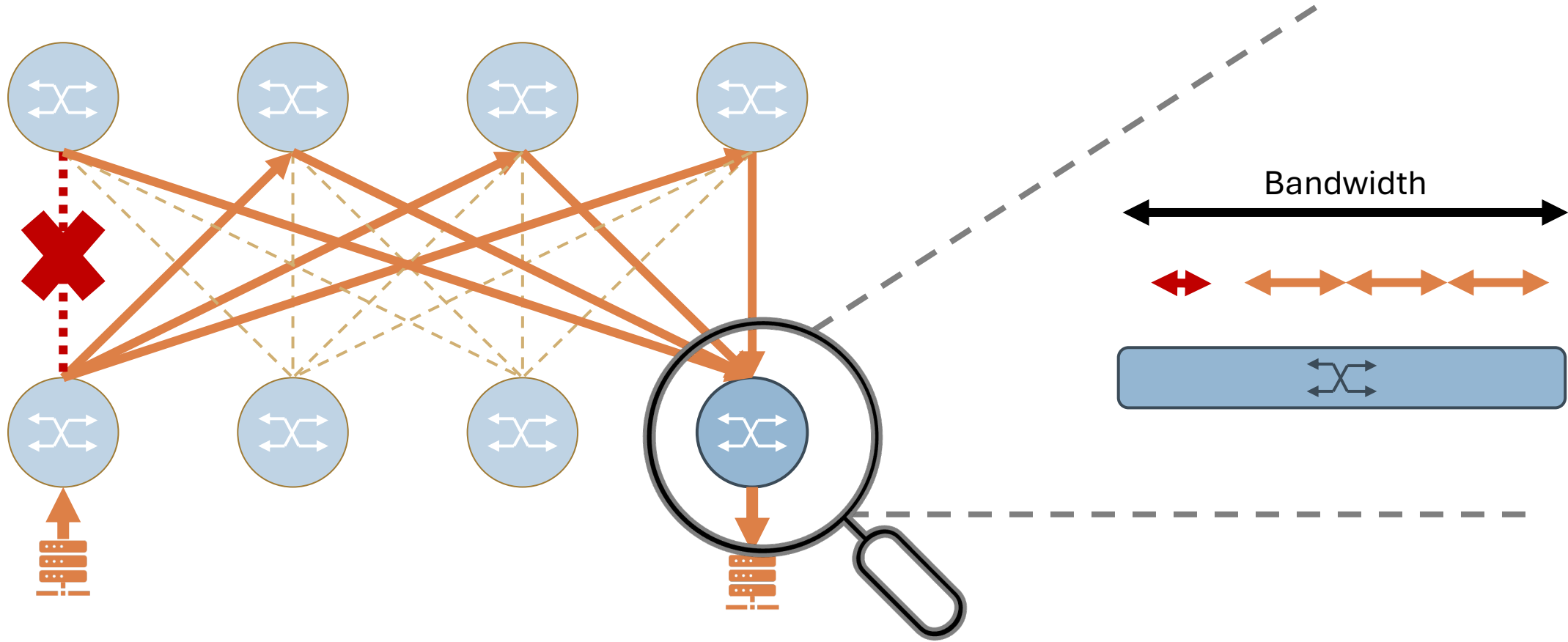


Look at Asymmetries



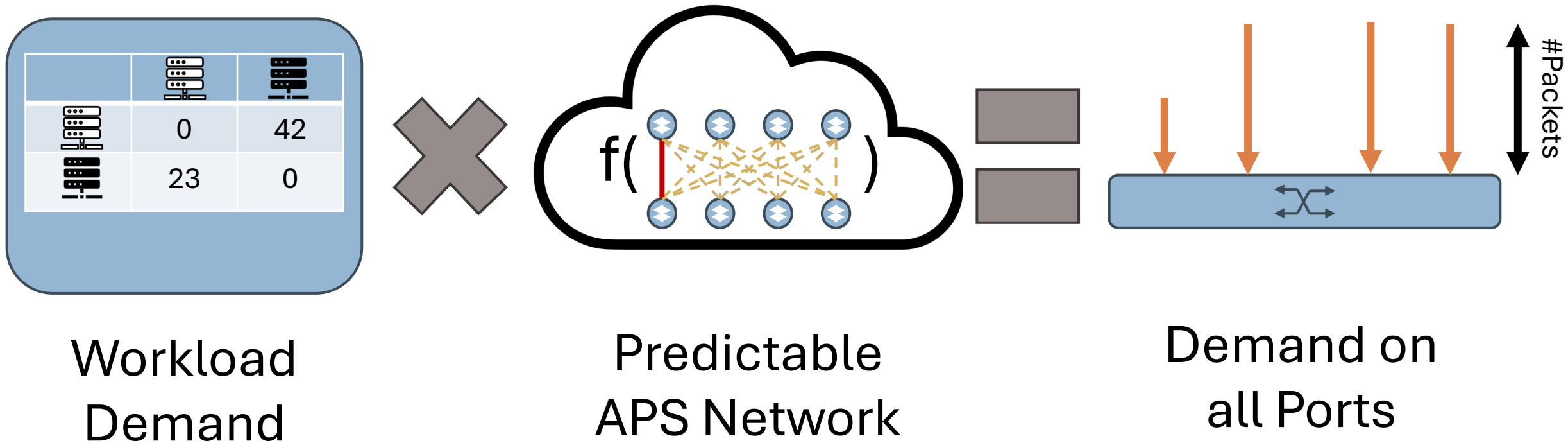
Not really...

Large networks are never pristine. There is **No Spatial Symmetry**

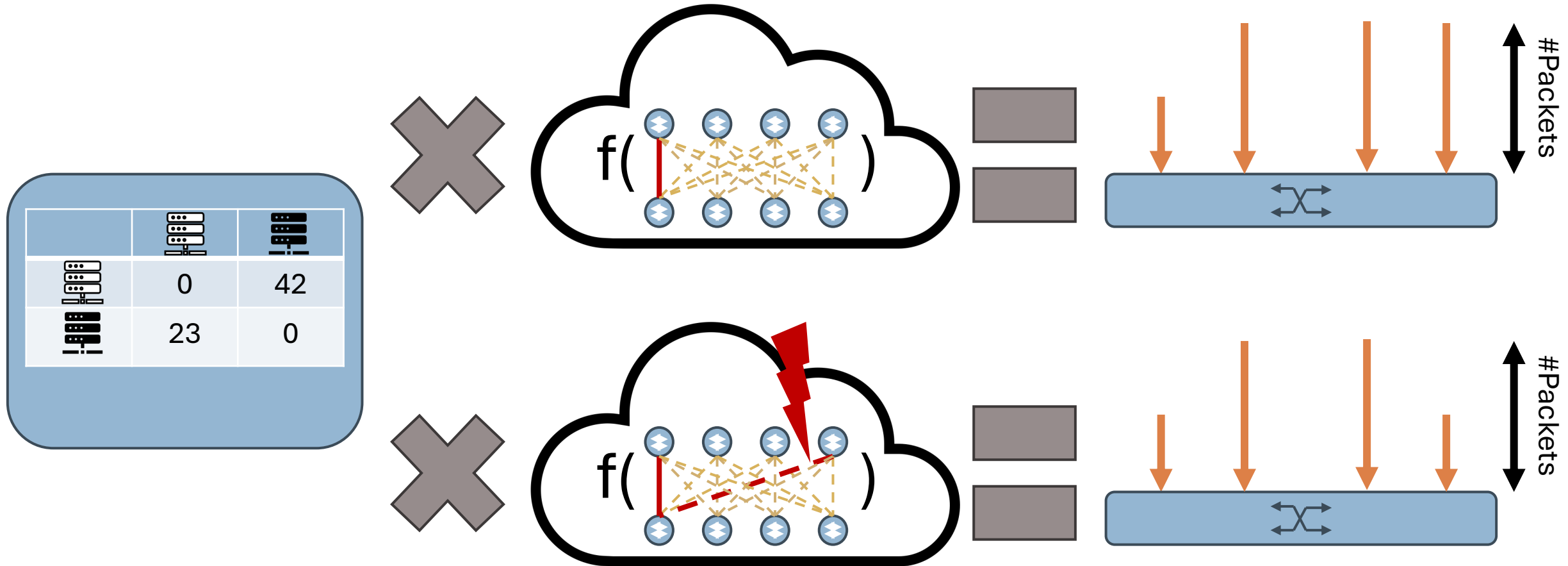


Preexisting failures are **indistinguishable** from new ones

Insight: APS Networks are Predictable



Silent Failures change the Topology



How do we know the demand?

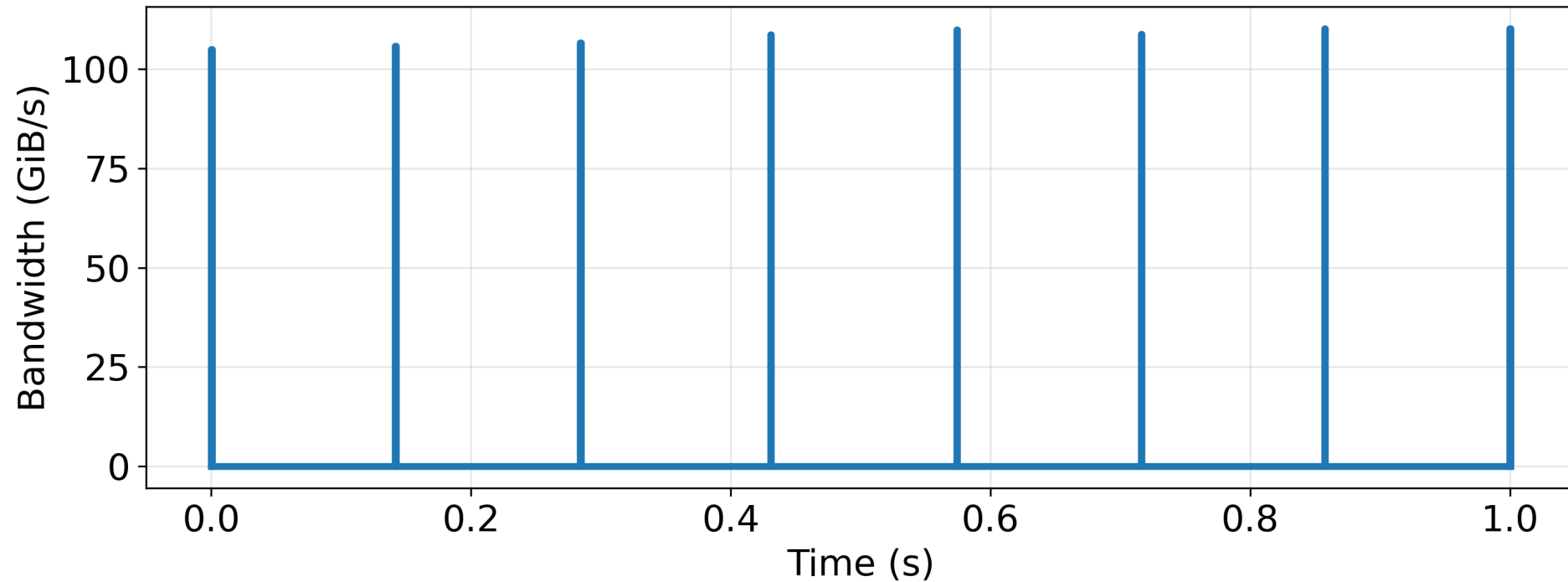
AI Training is Predictable

Demand explicitly declared in CCL

Example: Data Parallel AllReduce

Known Traffic Matrix

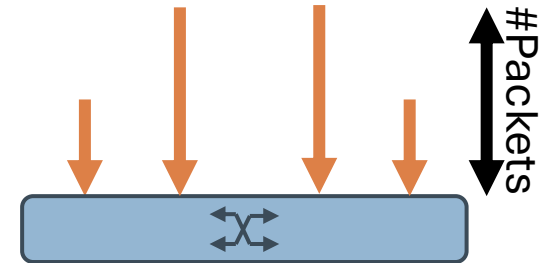
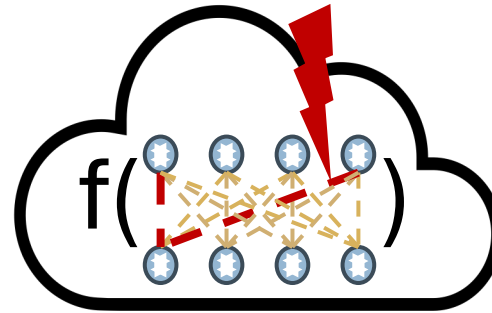
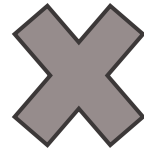
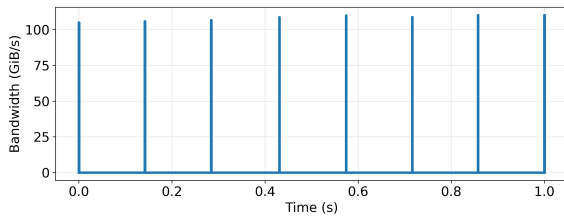
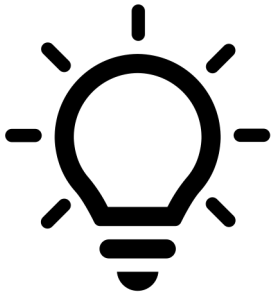
We know demand over time



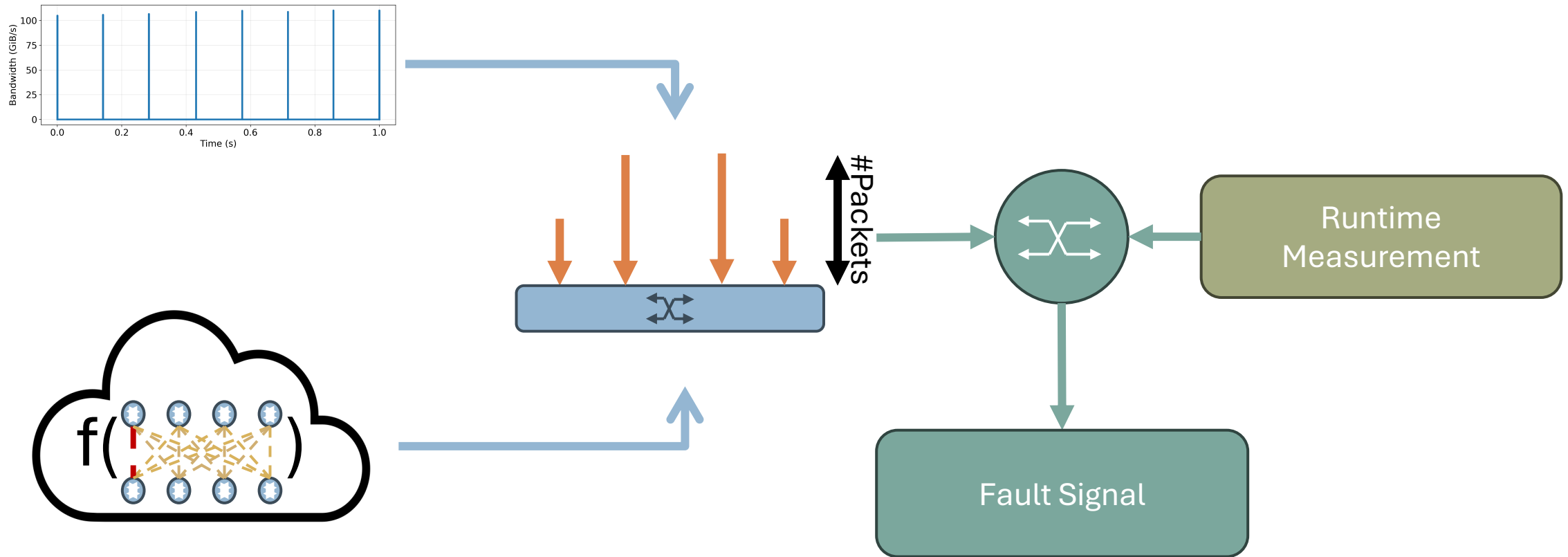
DP AllReduce repeats in every Iteration



How do we identify silent failures in APS networks?

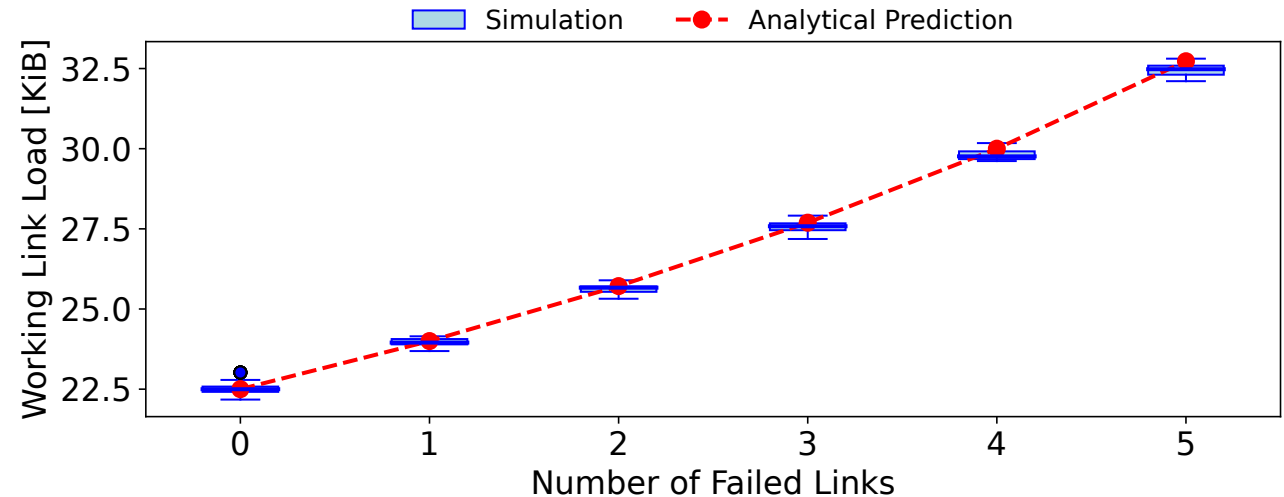


FlowPulse



Highlight: Analytical Prediction matches Simulation

- 2 Level FatTree
- 32 Leaf Switches
- 1.5% Packet loss



0% FPR @ 1.5% Packet Loss per Link

Conclusions

- APS amplifies effect of silent fault
- APS are predictable
- FlowPulse leverages **Workload** and **Network Predictability** to detect **silent failures**



Thank You



jakob.krebs@campus.technion.ac.il