

Greening the Networks of Large-Scale Distributed Systems

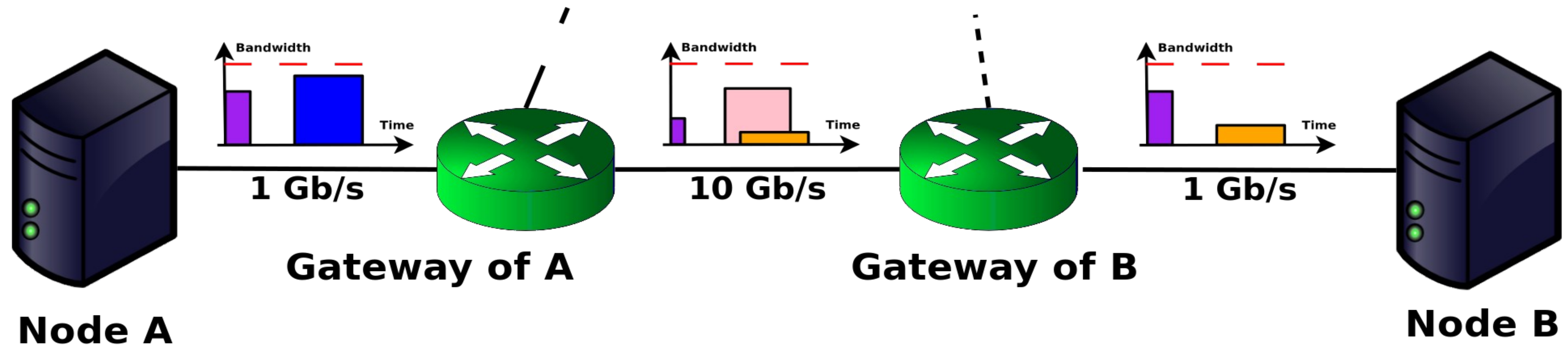
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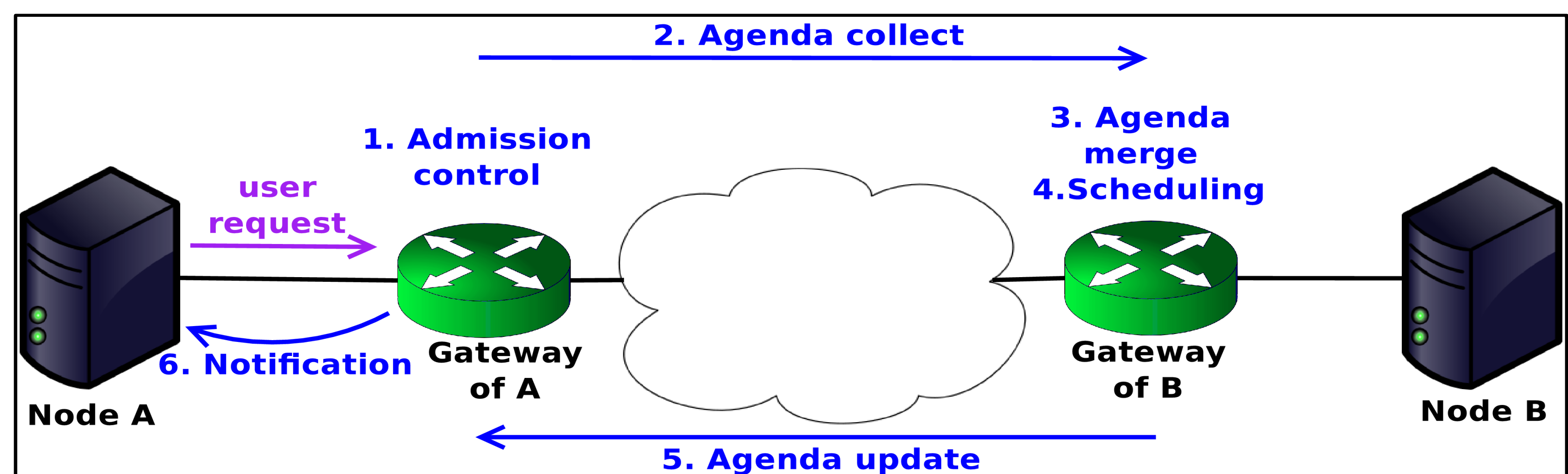
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HERMES : High-level Energy-awaRe Model for bandwidth reservation in End-to-end Networks



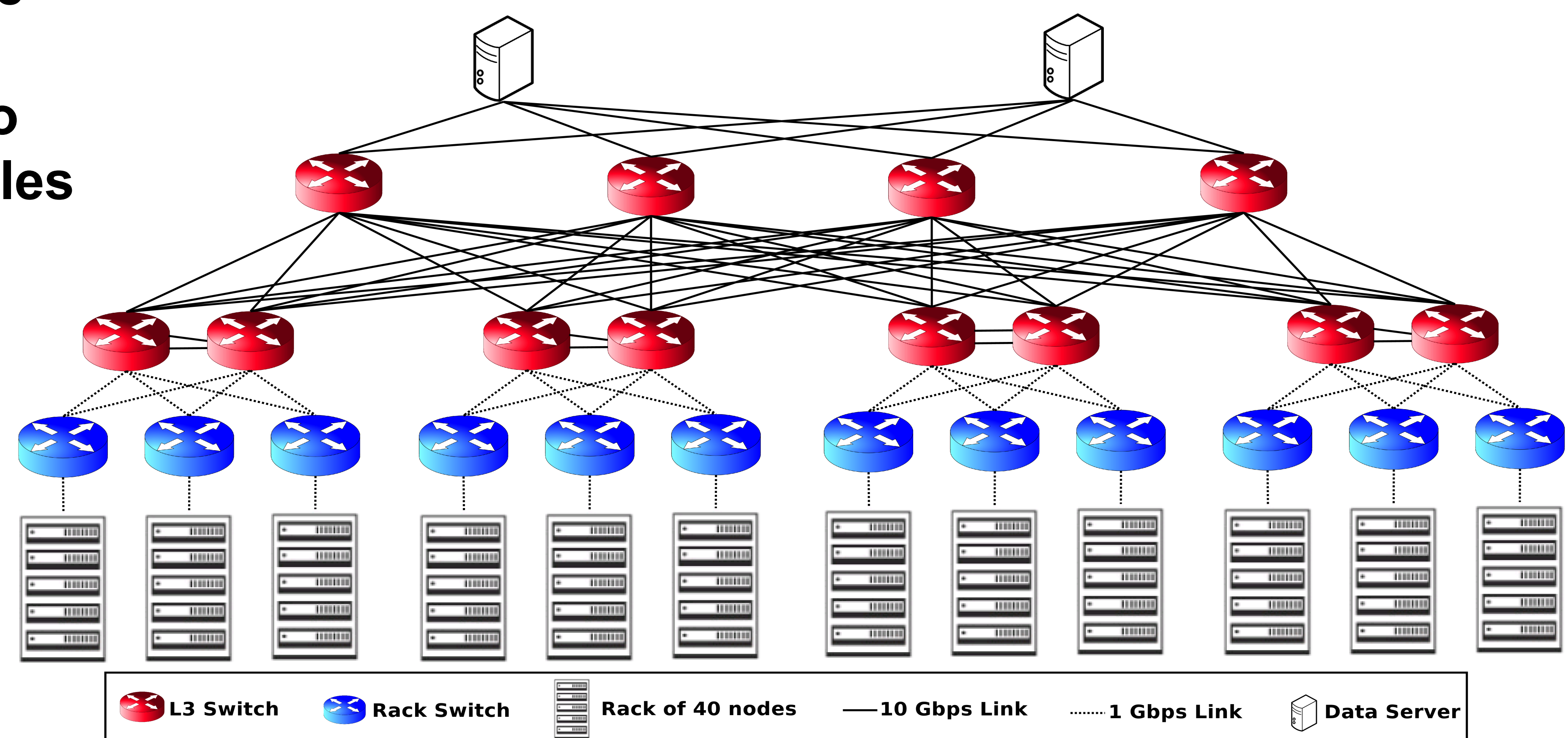
- Unused network components are put into sleep modes
- Energy optimization of the reservation's scheduling by reservation aggregation
- Minimization of control messages
- Usage of DTN to manage the infrastructure
- Network-usage prediction to avoid too-frequent on/off cycles



Reservation process

Component	State	Power
Chassis	ON	150 W
	OFF	10 W
Port	1 Gbps	5 W
	100 Mbps	3 W
	idle, 10 Mbps	1 W

1Gbps-Router power consumption



Three-tier fat-tree architecture

Scheduling	First	First green	Last	Last green	Green	No off
Average (Wh)	6 111	6 039	5 684	5 625	5 944	21920
Standard deviation	97	93	76	70	84	371
Accepted volume (Tb)	141.98	141.54	120.24	113.70	141.97	141.98
Cost in Wh per Tb	43.04	42.66	47.27	49.47	41.87	154.39

ENERGY CONSUMPTION IN WH FOR 20% WORKLOAD

Scheduling	First	First green	Last	Last green	Green	No off
Average (Wh)	7 111	6 973	6 300	6 285	6 590	20 463
Standard deviation	362	335	100	106	305	809
Cost in Wh per Tb	42.18	41.37	40.21	41.25	39.09	121.37

COST IN WH PER TB FOR 60% WORKLOAD

Energy savings of Green compared to No off :
 - 73% for a 20% workload
 - 68% for a 60% workload