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Broker Overlay Architecture for Decentralized Grid Management

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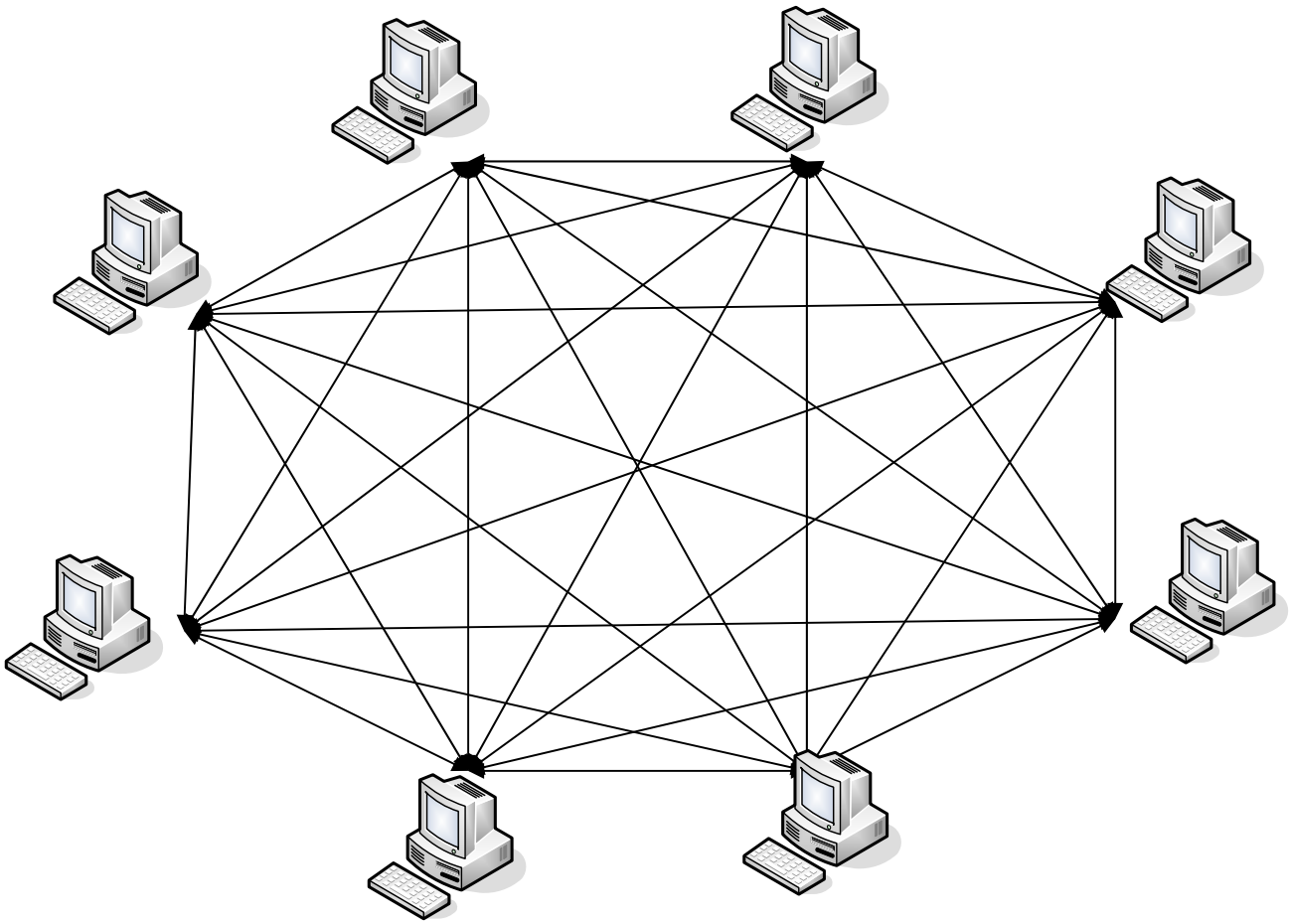
Issues of Large Scale Grid Computing - 1

- **Machine Organization** - Flat



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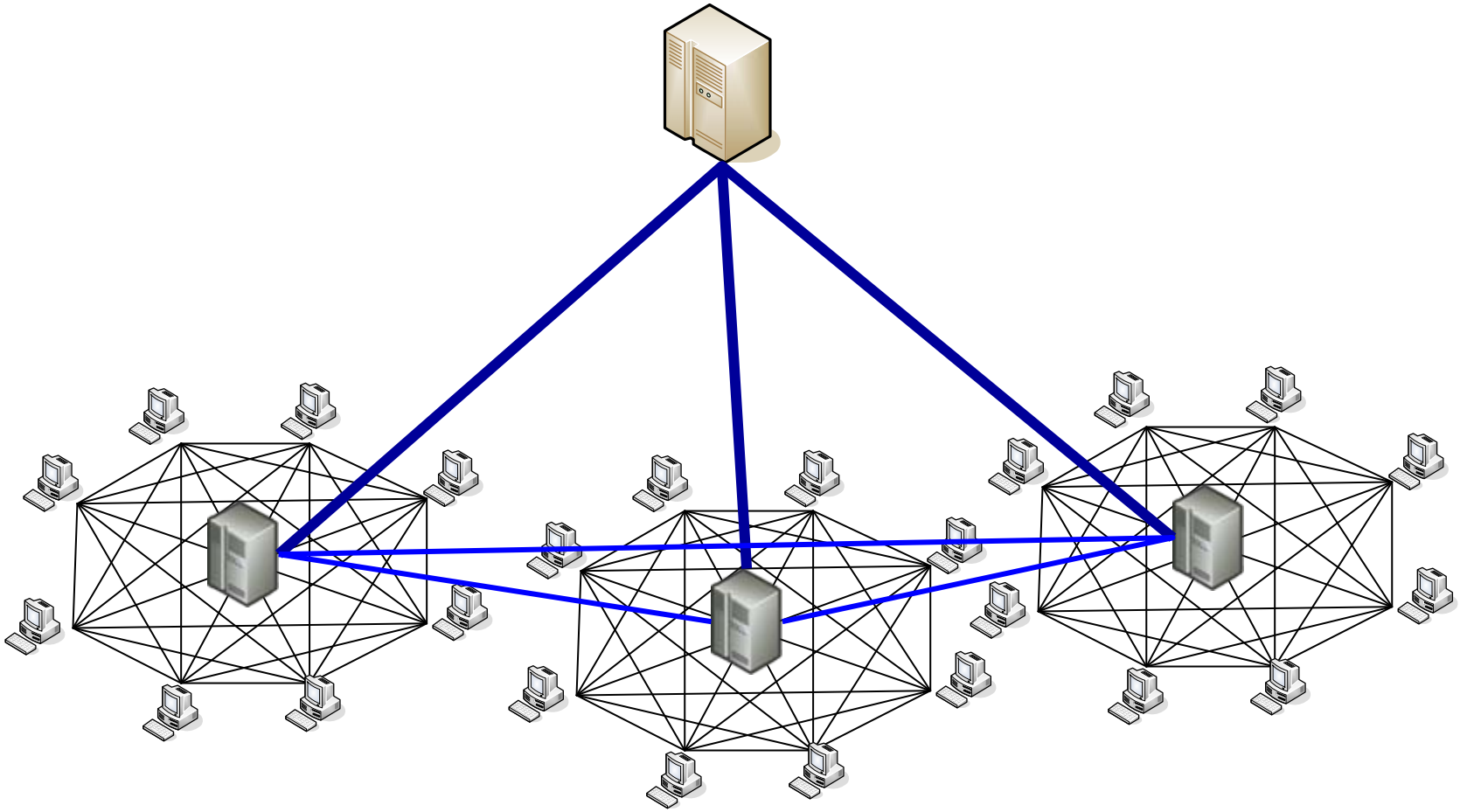
Issues of Large Scale Grid Computing - 2

- **Machine Organization** - Hierarchical



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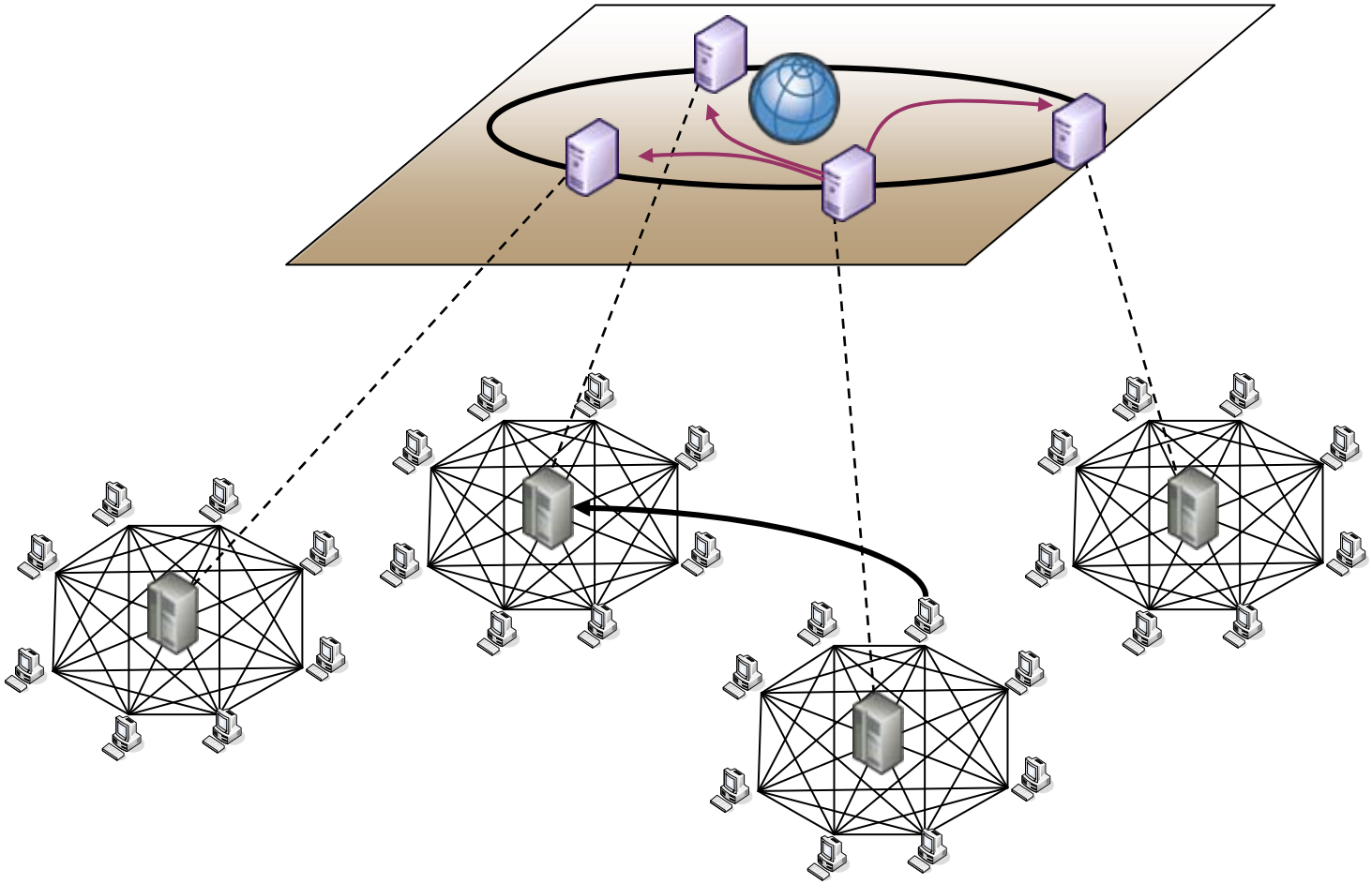
Issues of Large Scale Grid Computing - 3

- **Machine Organization** - Cell



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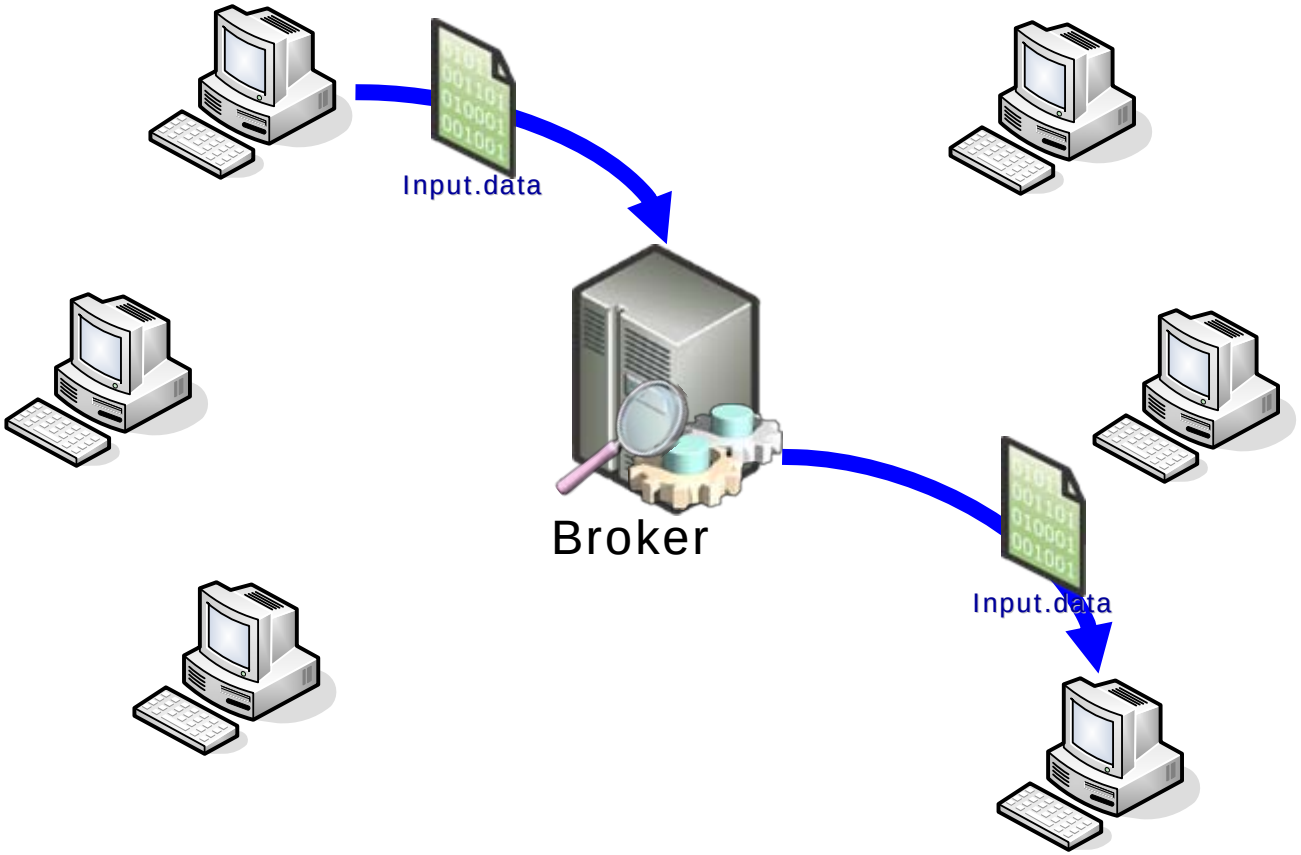
Issues of Large Scale Grid Computing - 4

- **Scheduling** - Centralized



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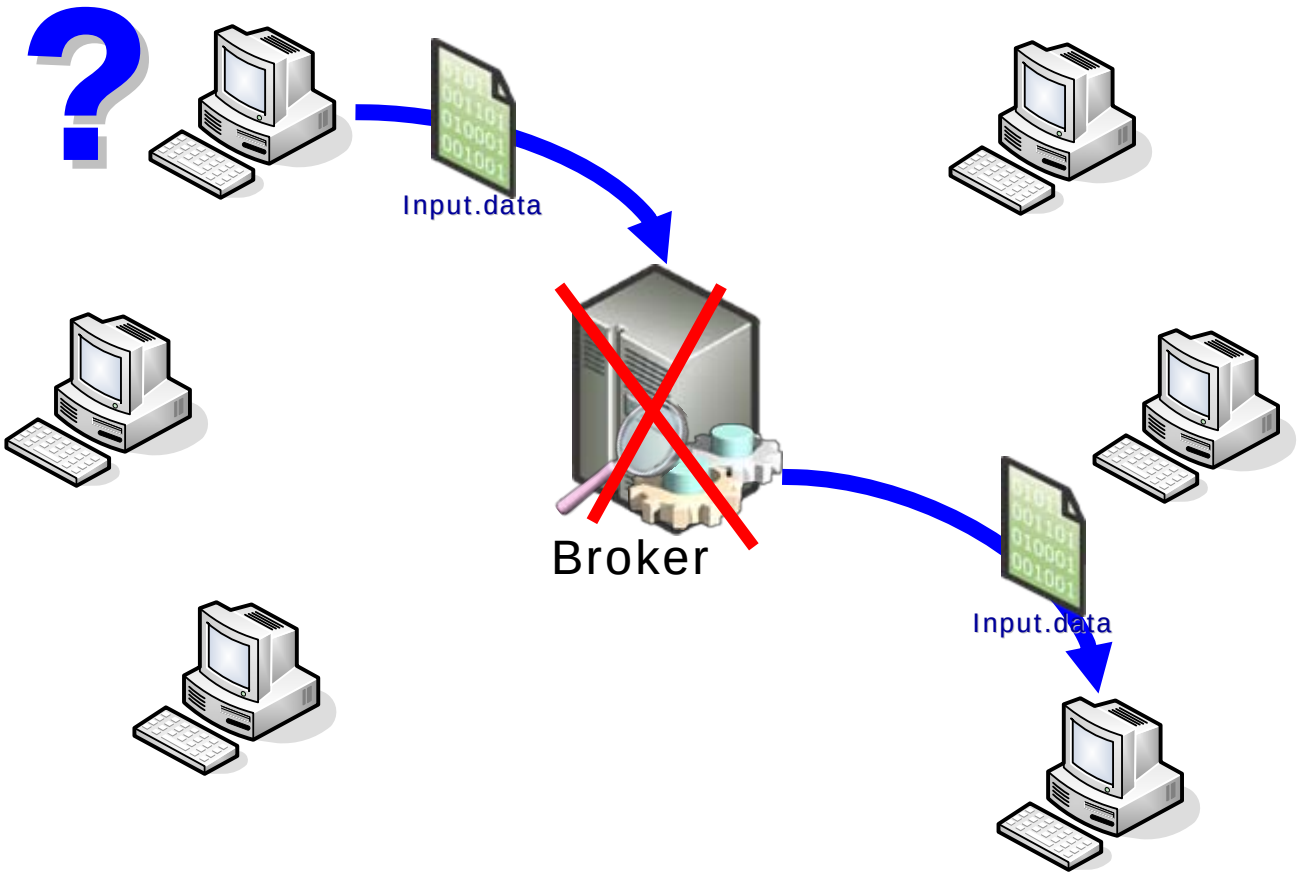
Issues of Large Scale Grid Computing - 4

- **Scheduling** - Centralized



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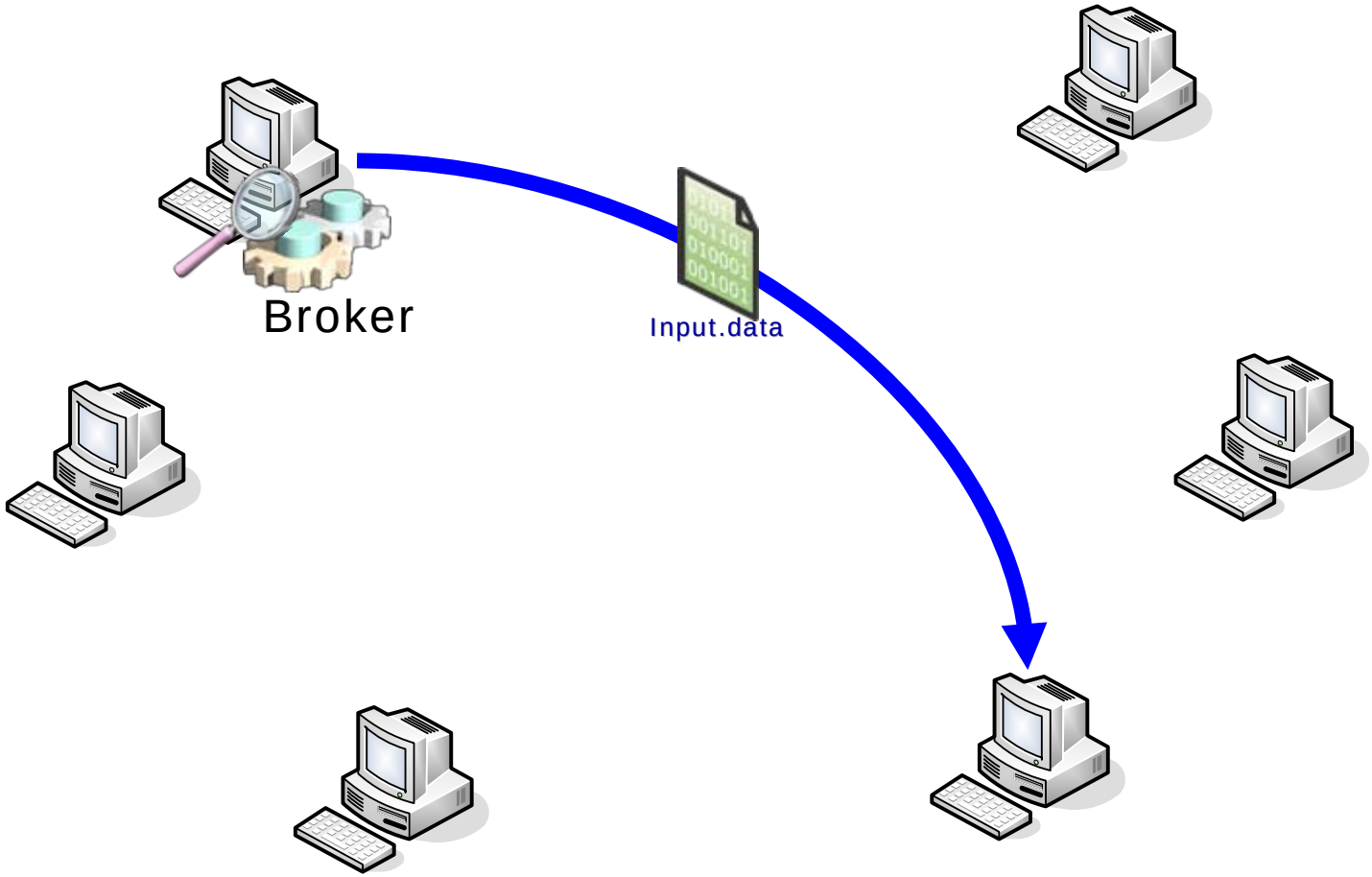
Issues of Large Scale Grid Computing - 5

- **Scheduling** - Decentralized



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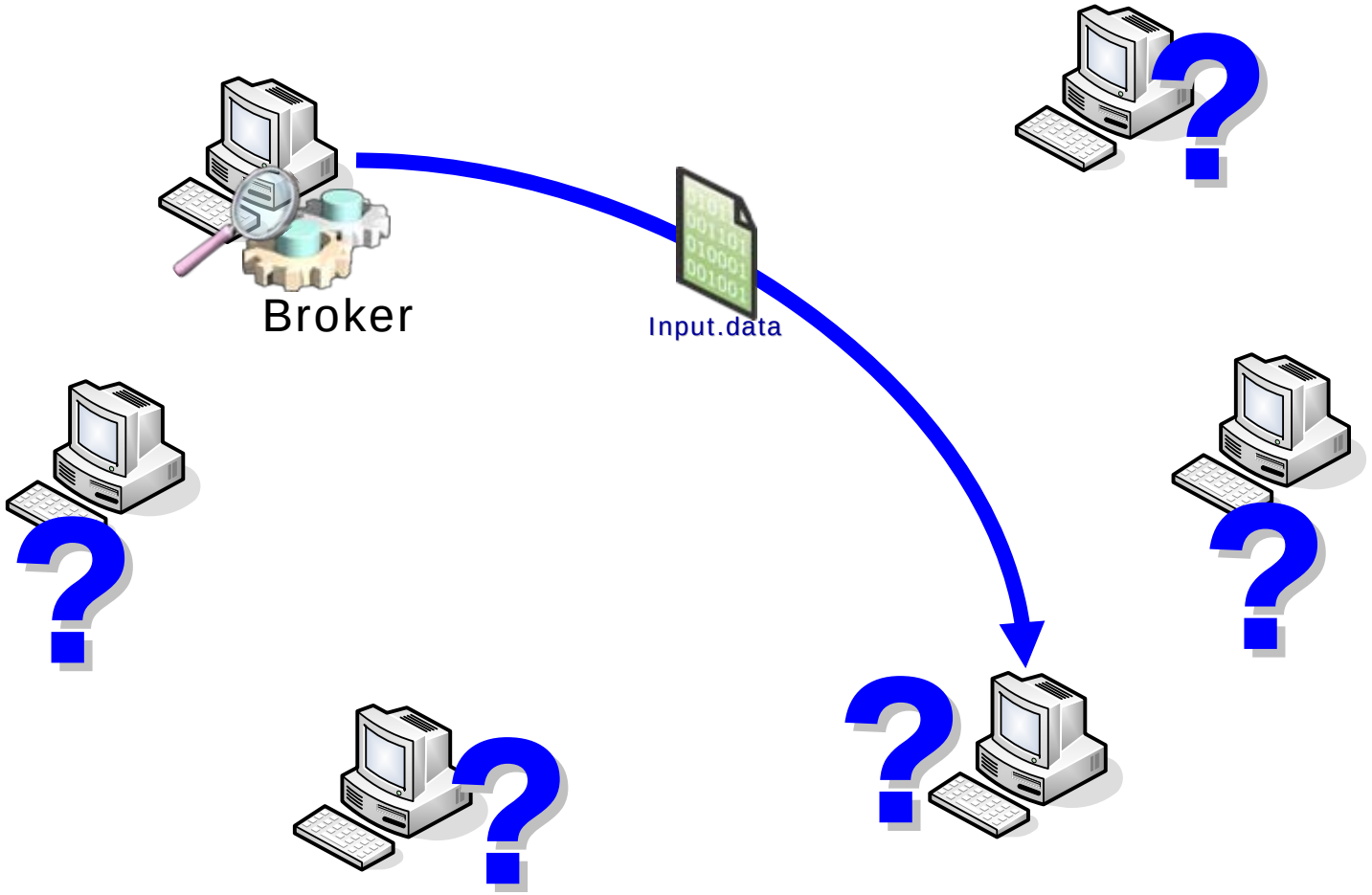
Issues of Large Scale Grid Computing - 5

- **Scheduling** - Decentralized



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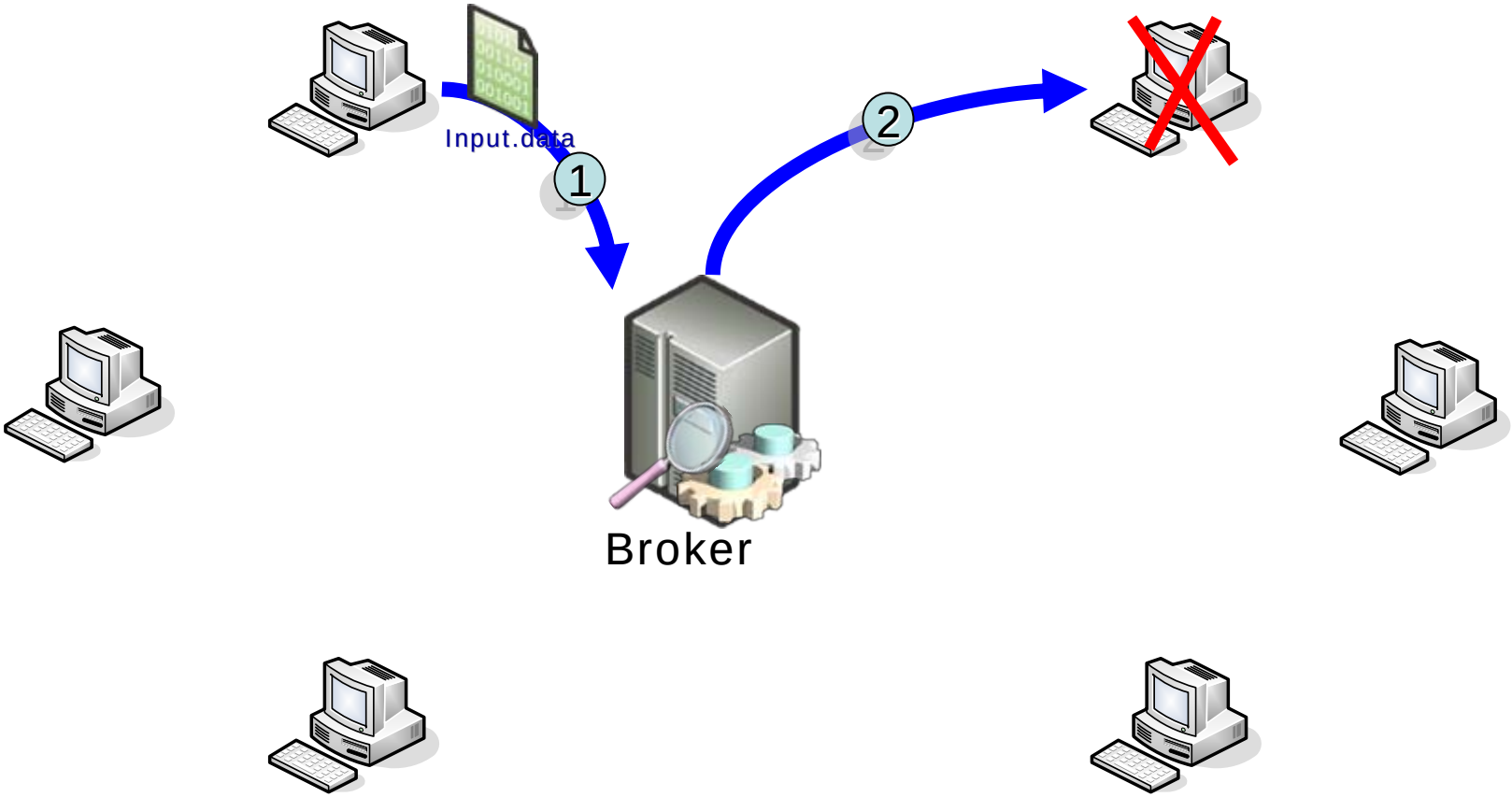
Issues of Large Scale Grid Computing - 6

- **Failure Handling** – Worker Failure



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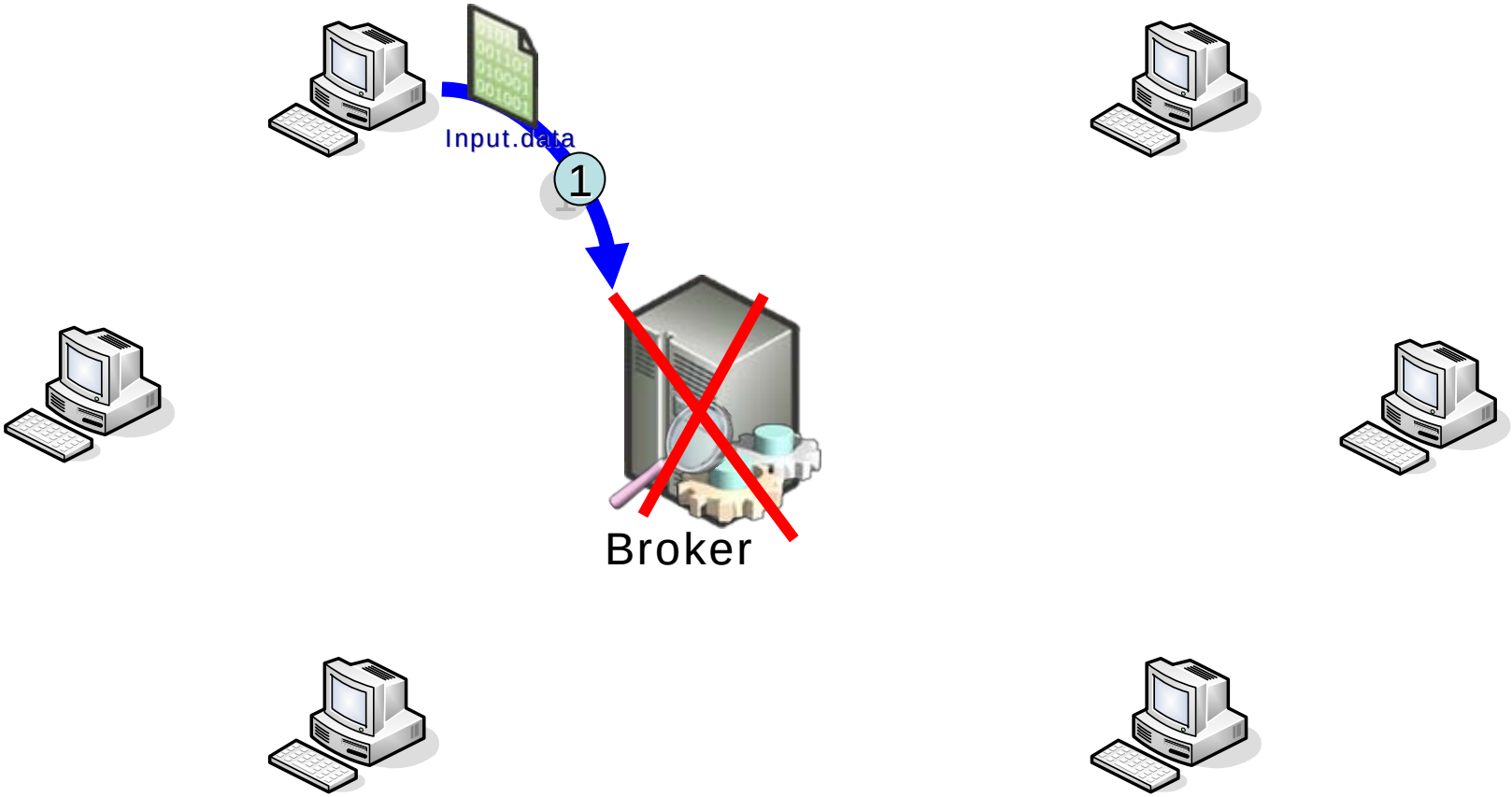
Issues of Large Scale Grid Computing - 7

- **Failure Handling** – Broker Failure



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Related Work

	Condor	BOINC	gLite	UNICORE	NorduGrid
Machine Organization	Flat	Hierarchical	Hierarchical	Hierarchical	Hierarchical
Scheduling	Centralized	Centralized	Centralized	Centralized	Centralized
Handling Worker Failures	Y	Y	Y	Y	Y
Handling Broker Failures	Y	N	N	N	N

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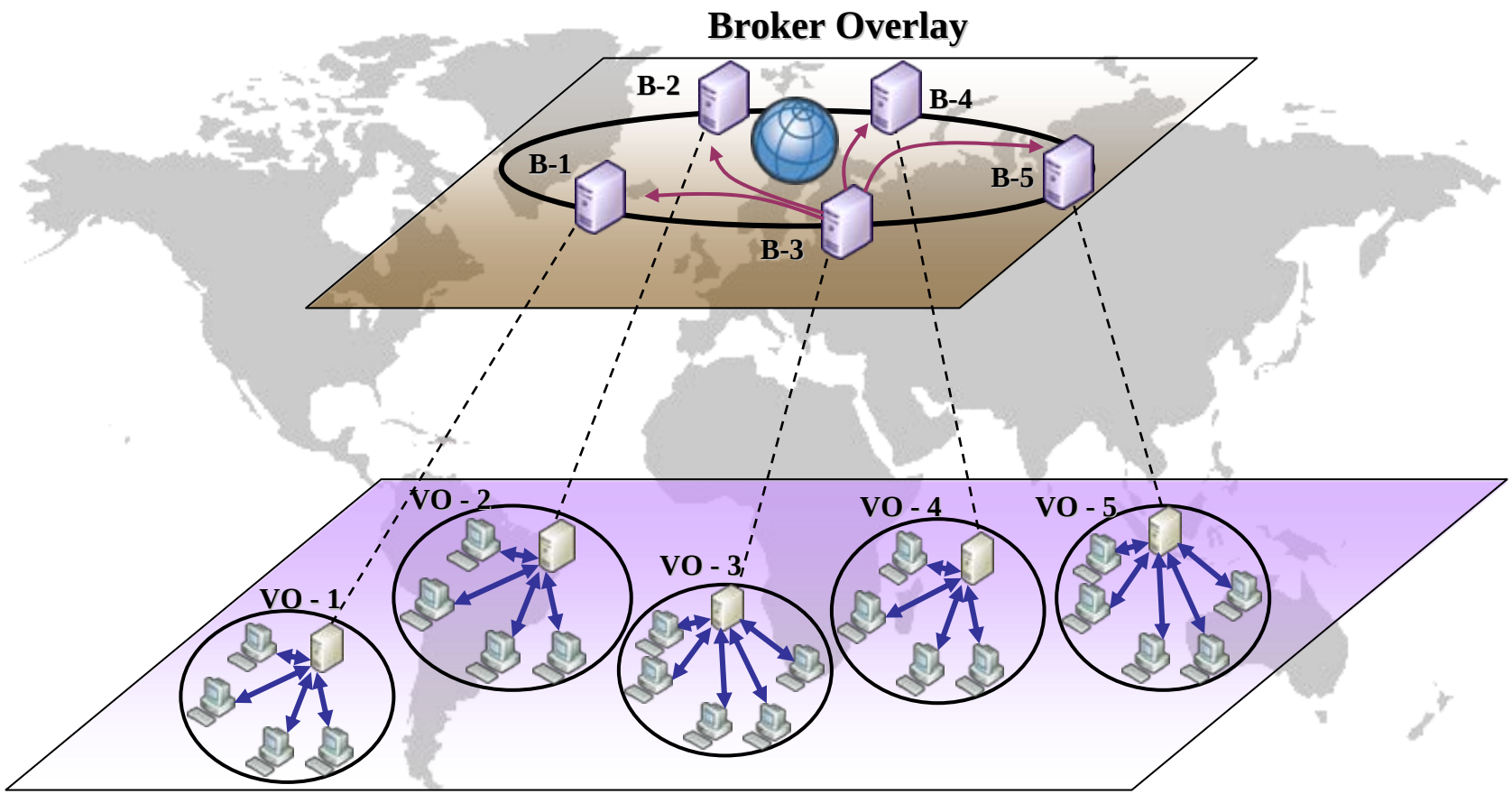
Proposed Architecture



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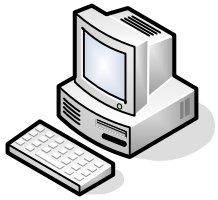
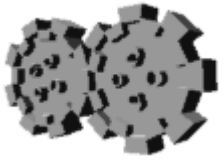
Proposed Architecture

- Consider:

Grid as bus



Grid node as bus seat



Grid job as passenger

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Problem

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Problem

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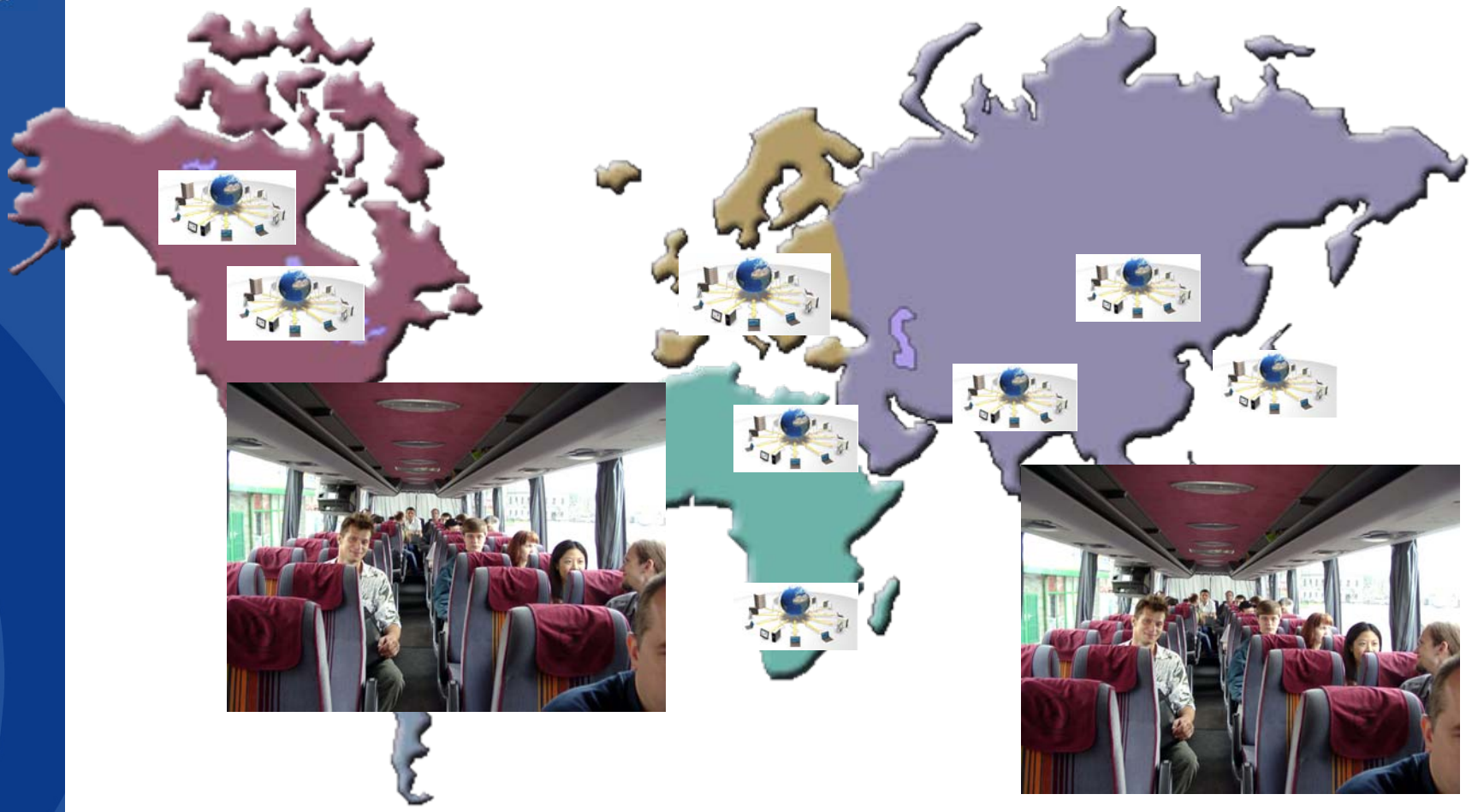
Problem



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Problem

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Problem

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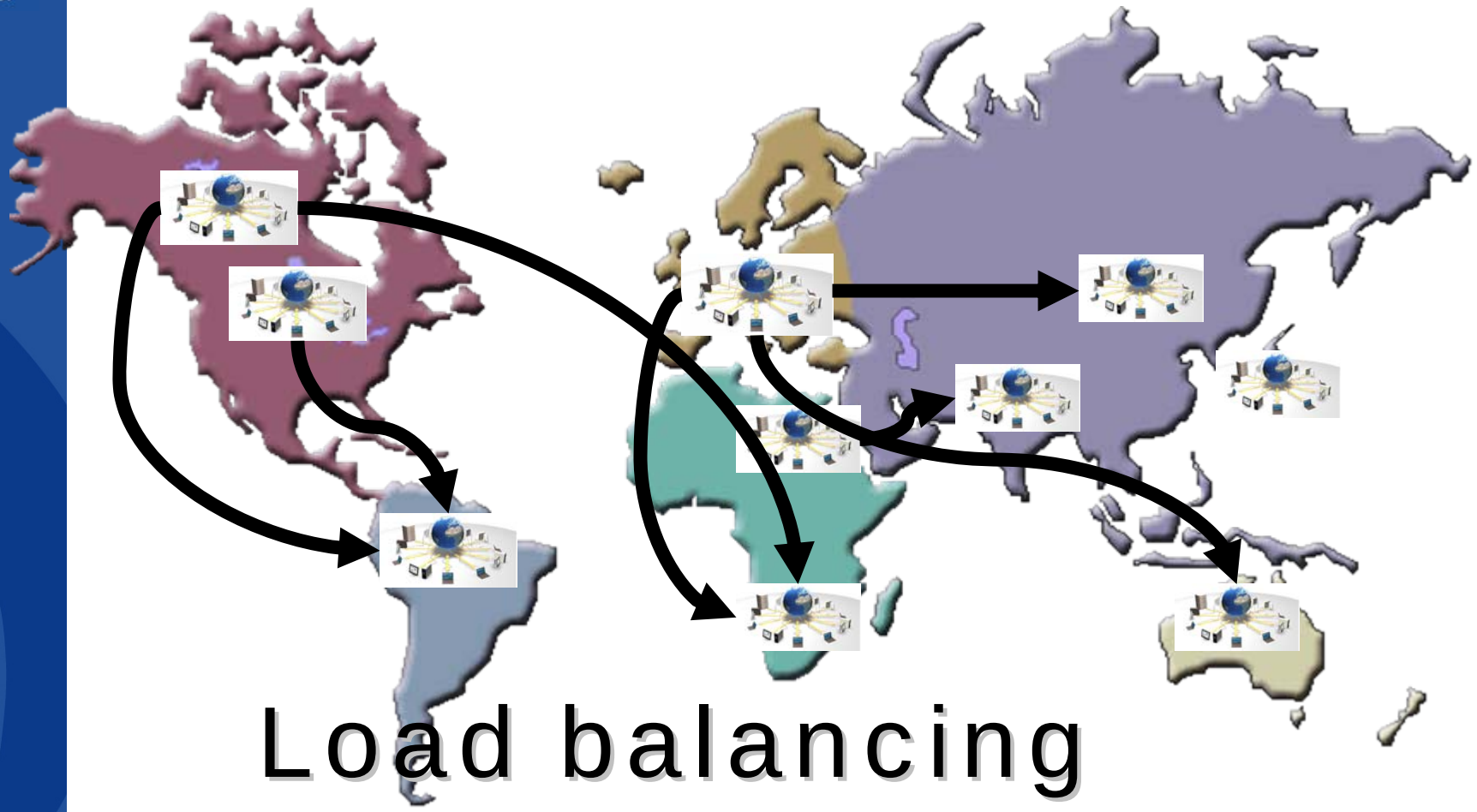
Solution



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Solution

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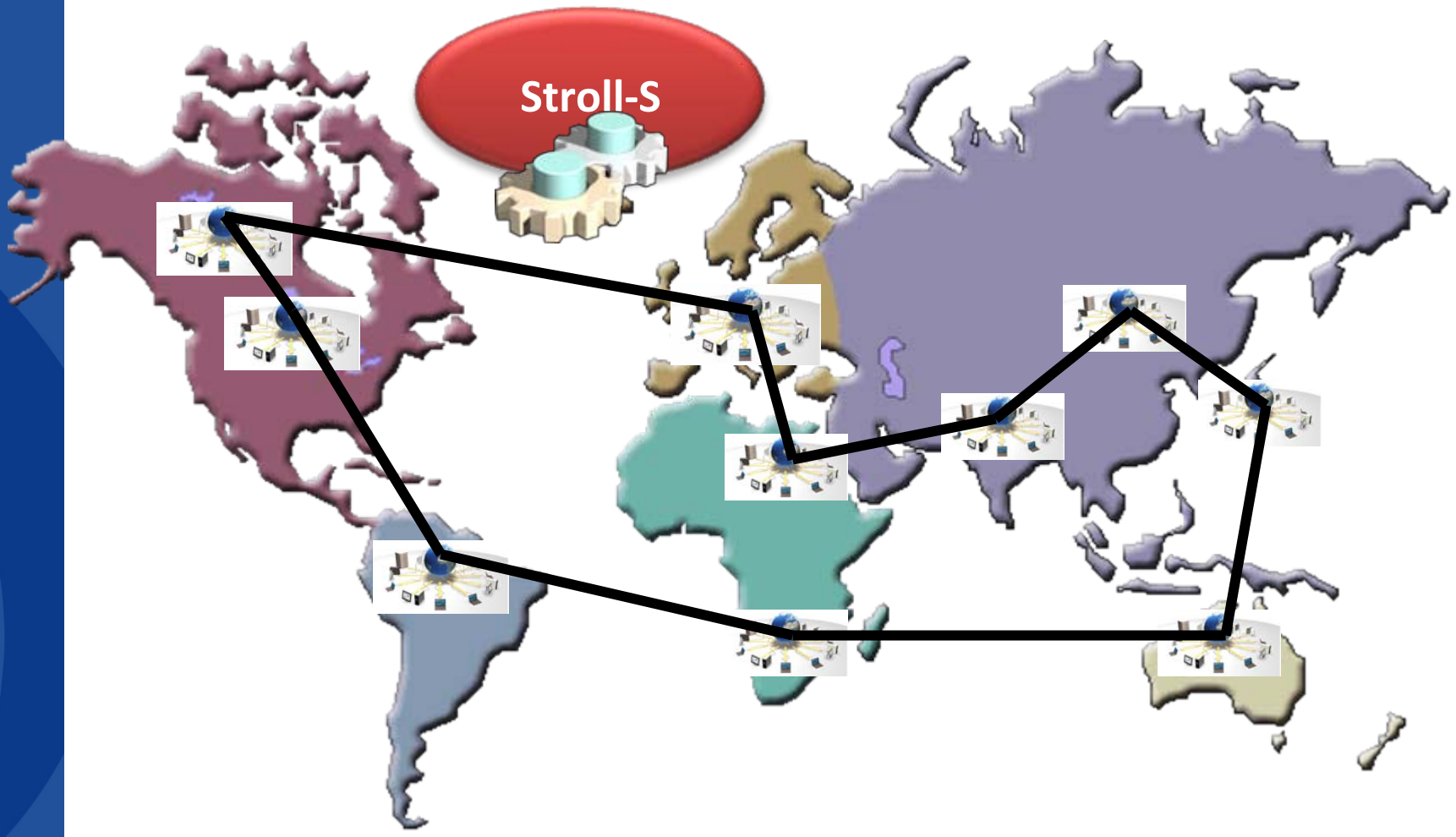
How to achieve load balancing?



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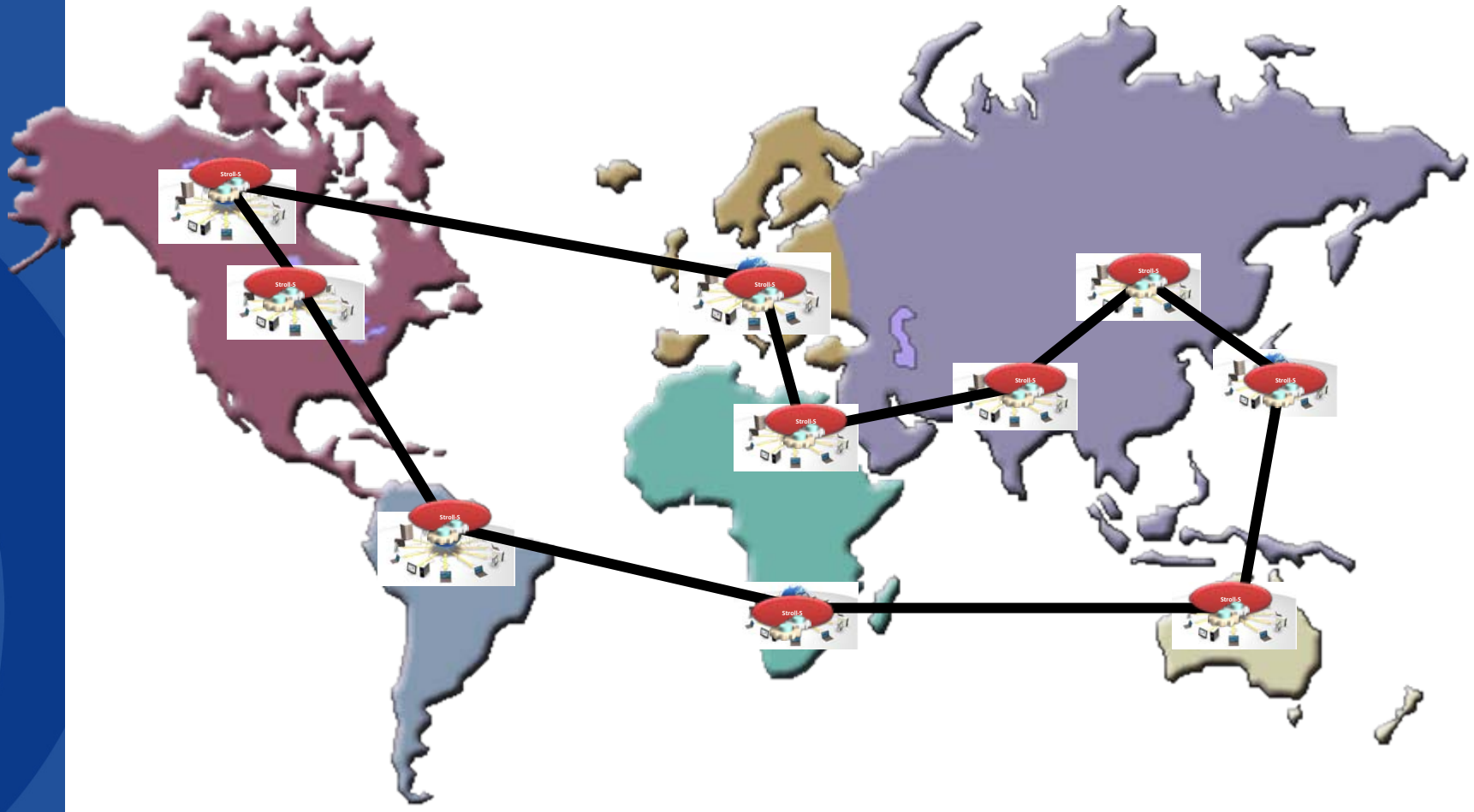

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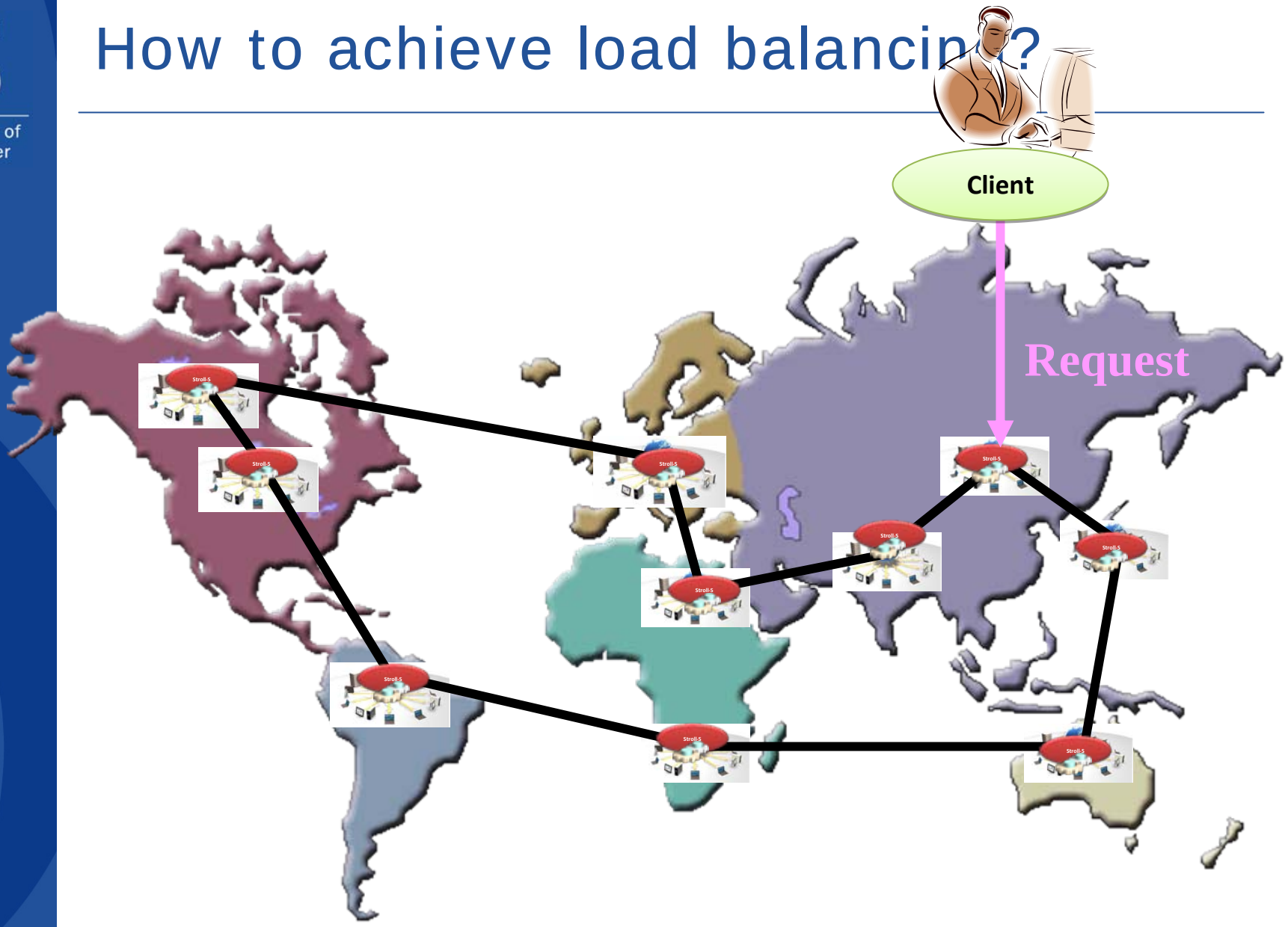

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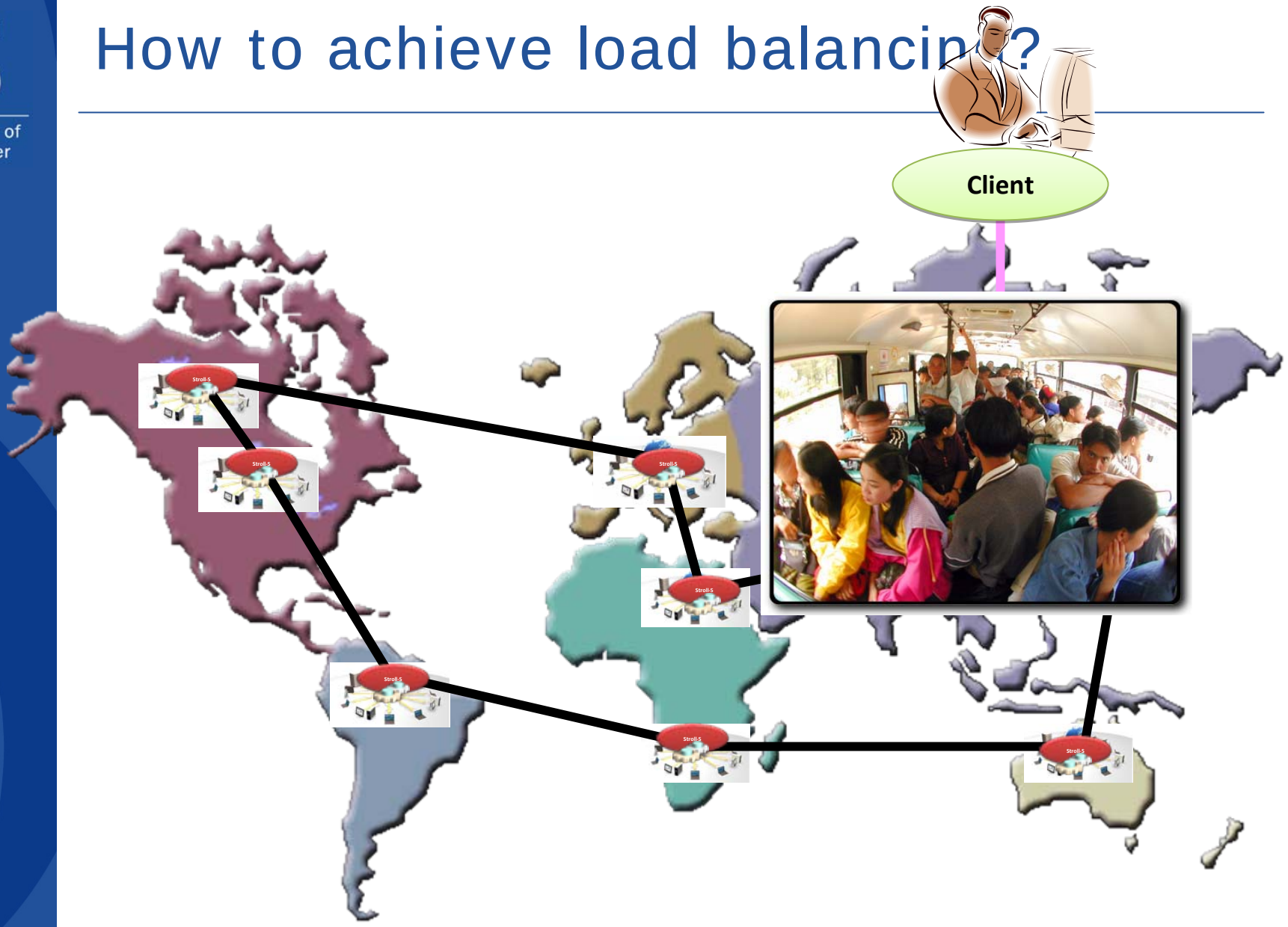

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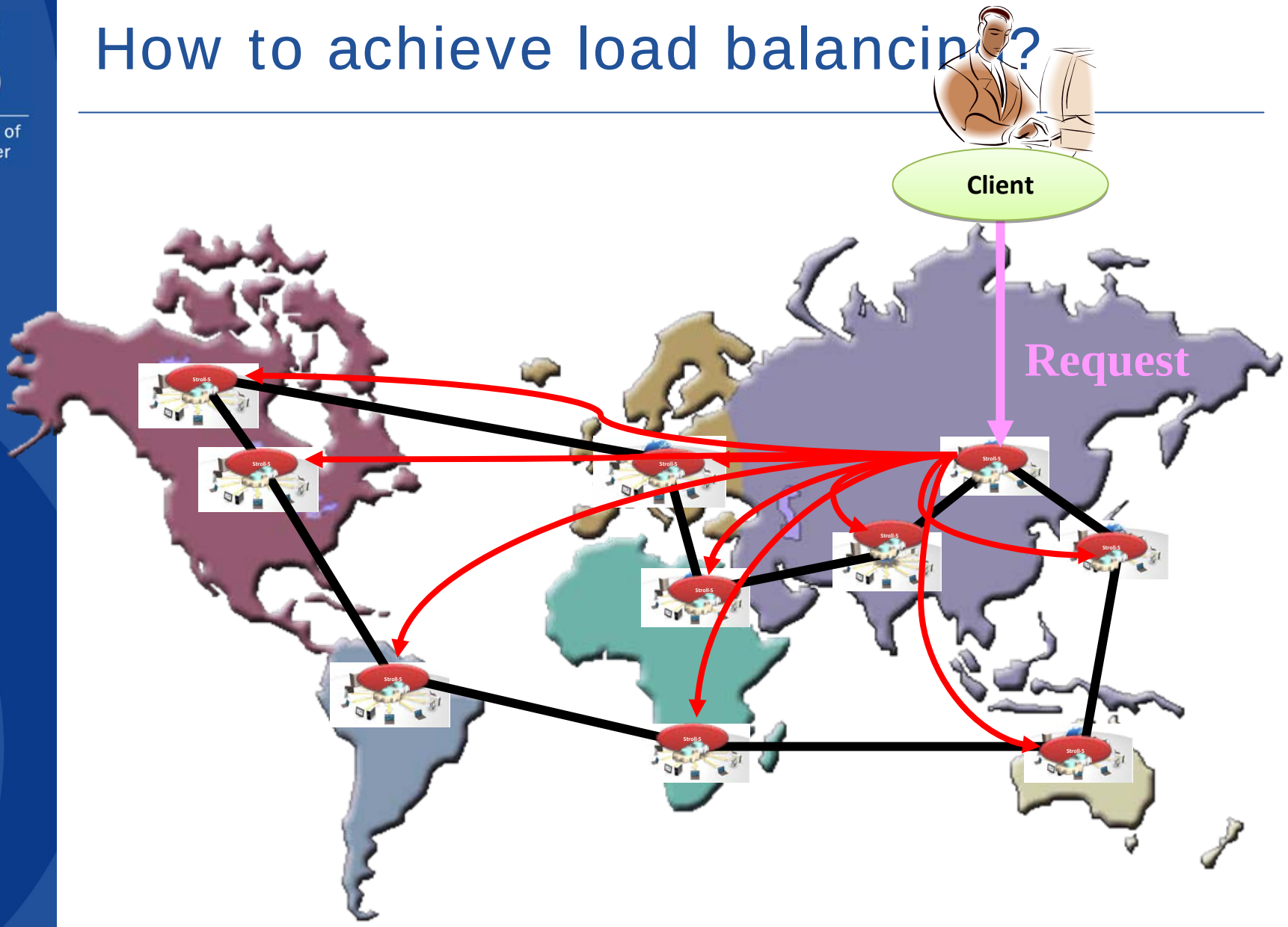

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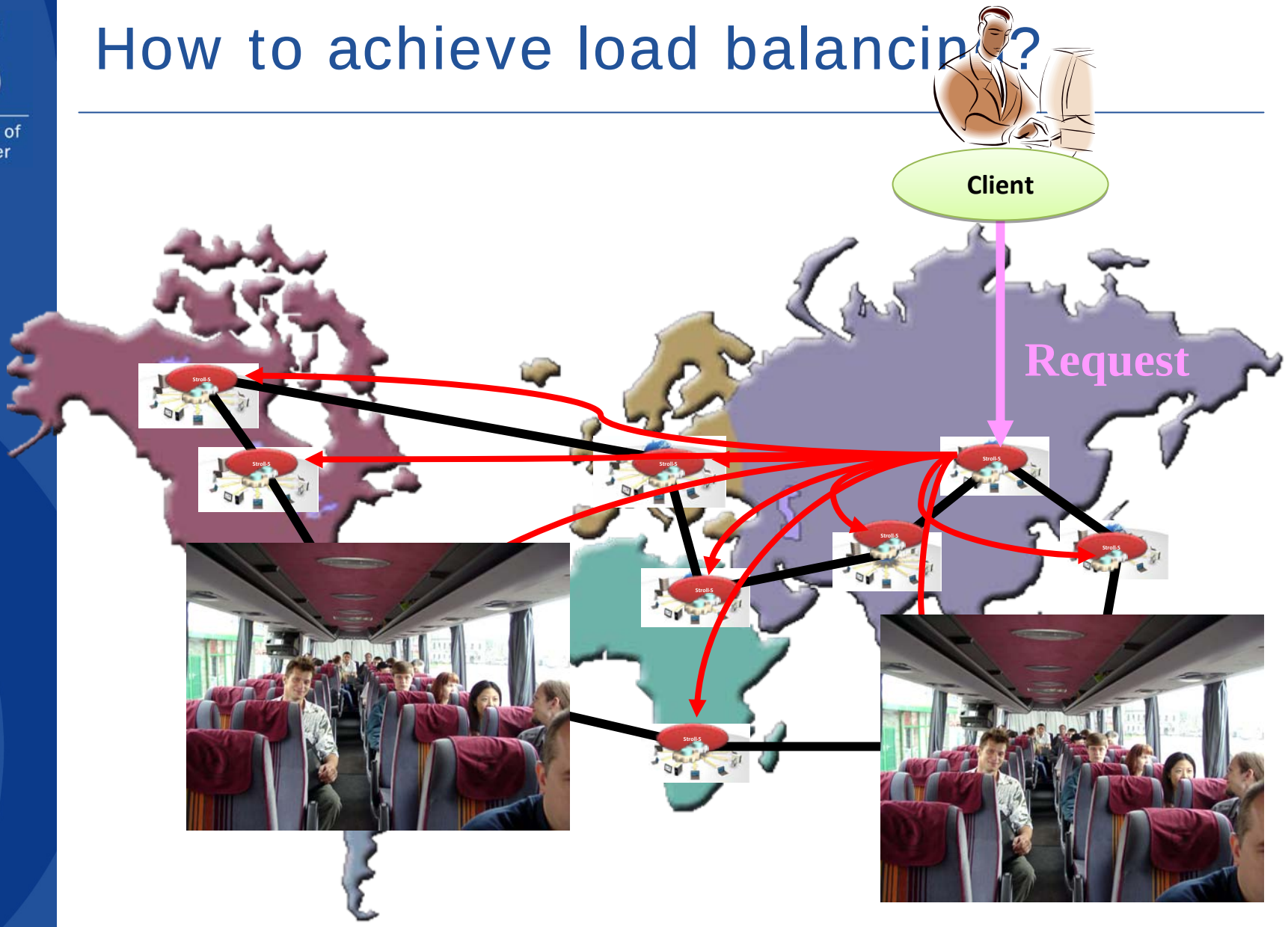

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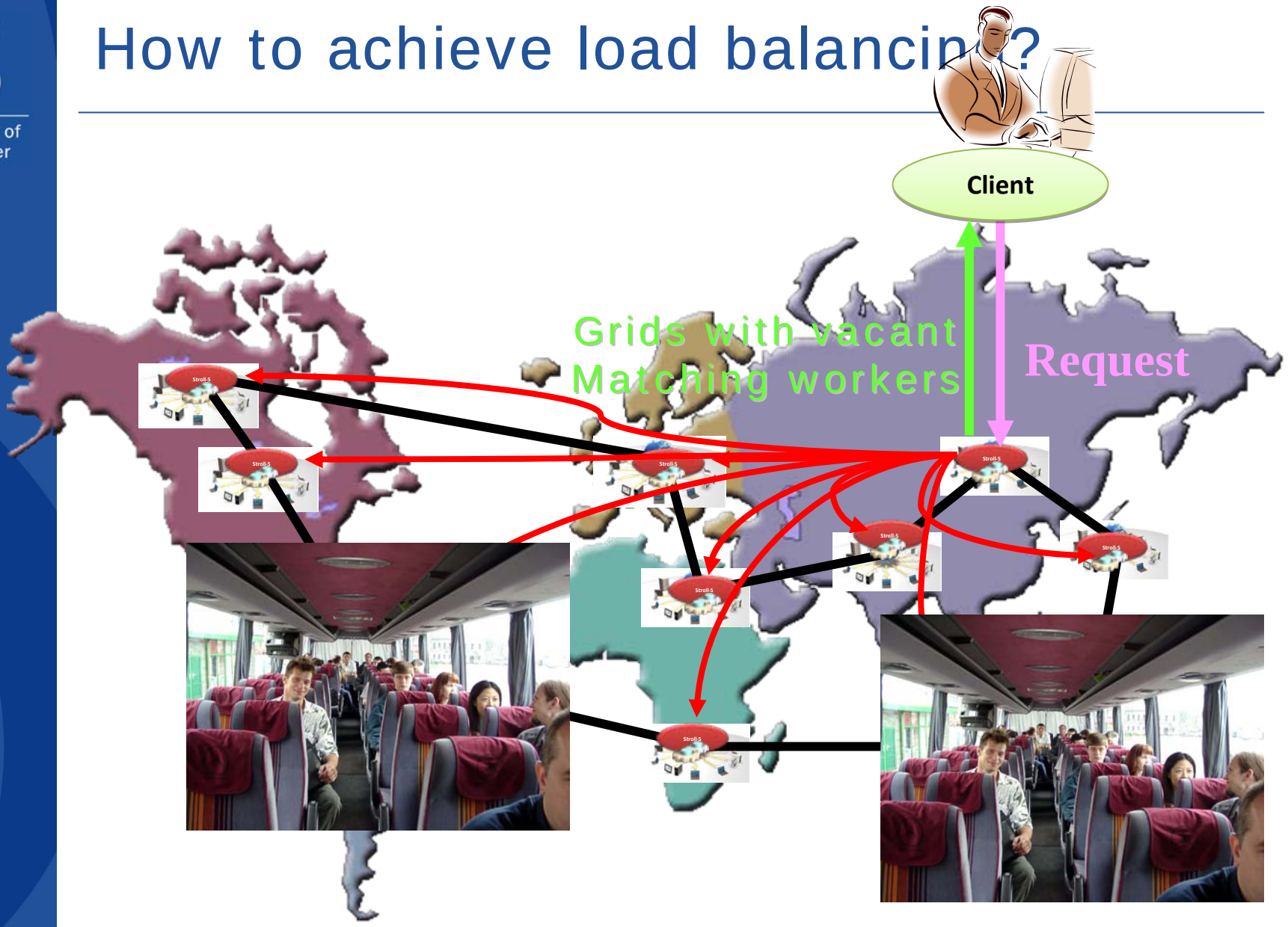

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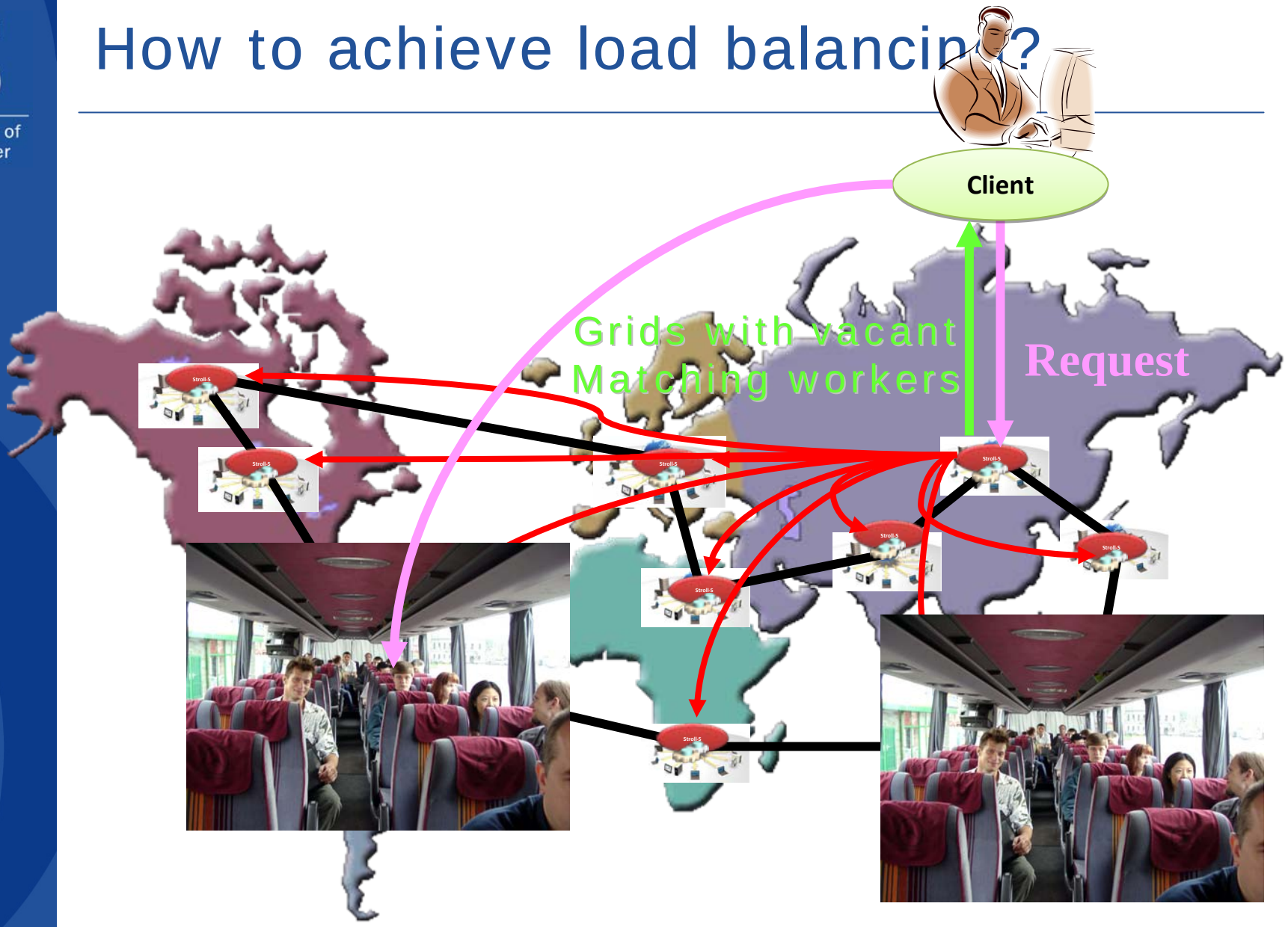

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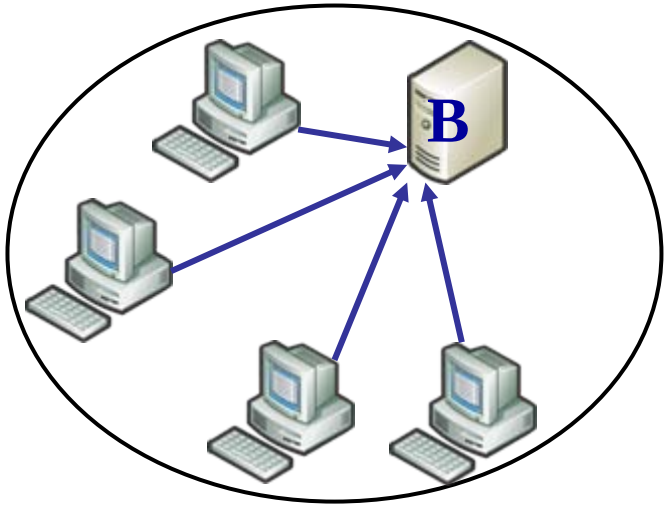
Resource Information Exchange - 1

- Resource information for nodes is stored in a three field Resource Information Data Block, **RIDB**.
- Each broker maintains a set of RIDBs for all nodes in the system.

Resource Index	# information	Time of Last Read



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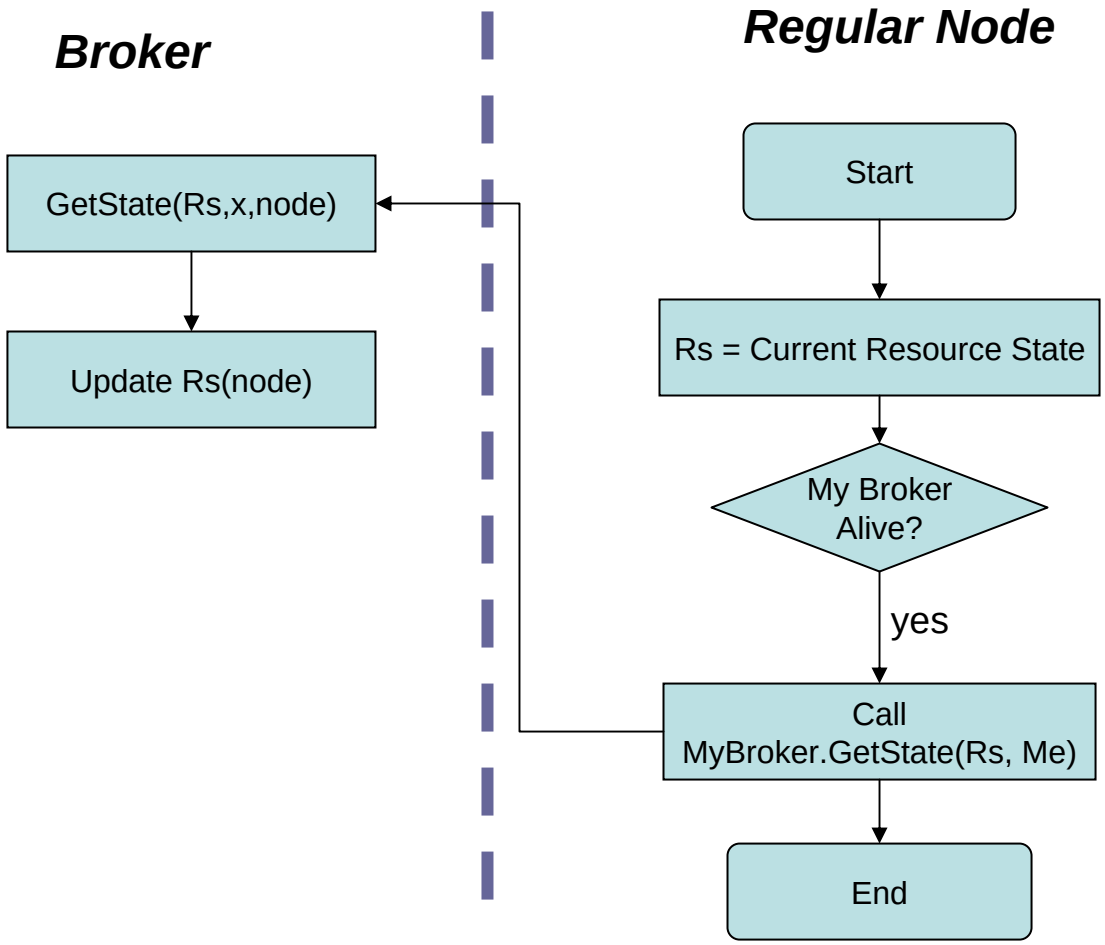
Resource Information Exchange - 2



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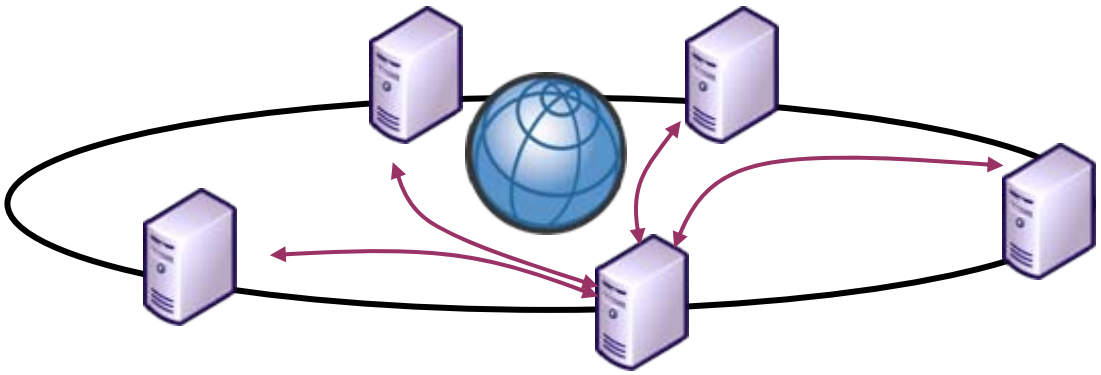
Resource Information Exchange - 3

- Each broker performs one exchange operation with a single neighbor broker each time unit. The exchange operation is done by updating each resource information data set in each of the two brokers with the newest data blocks.



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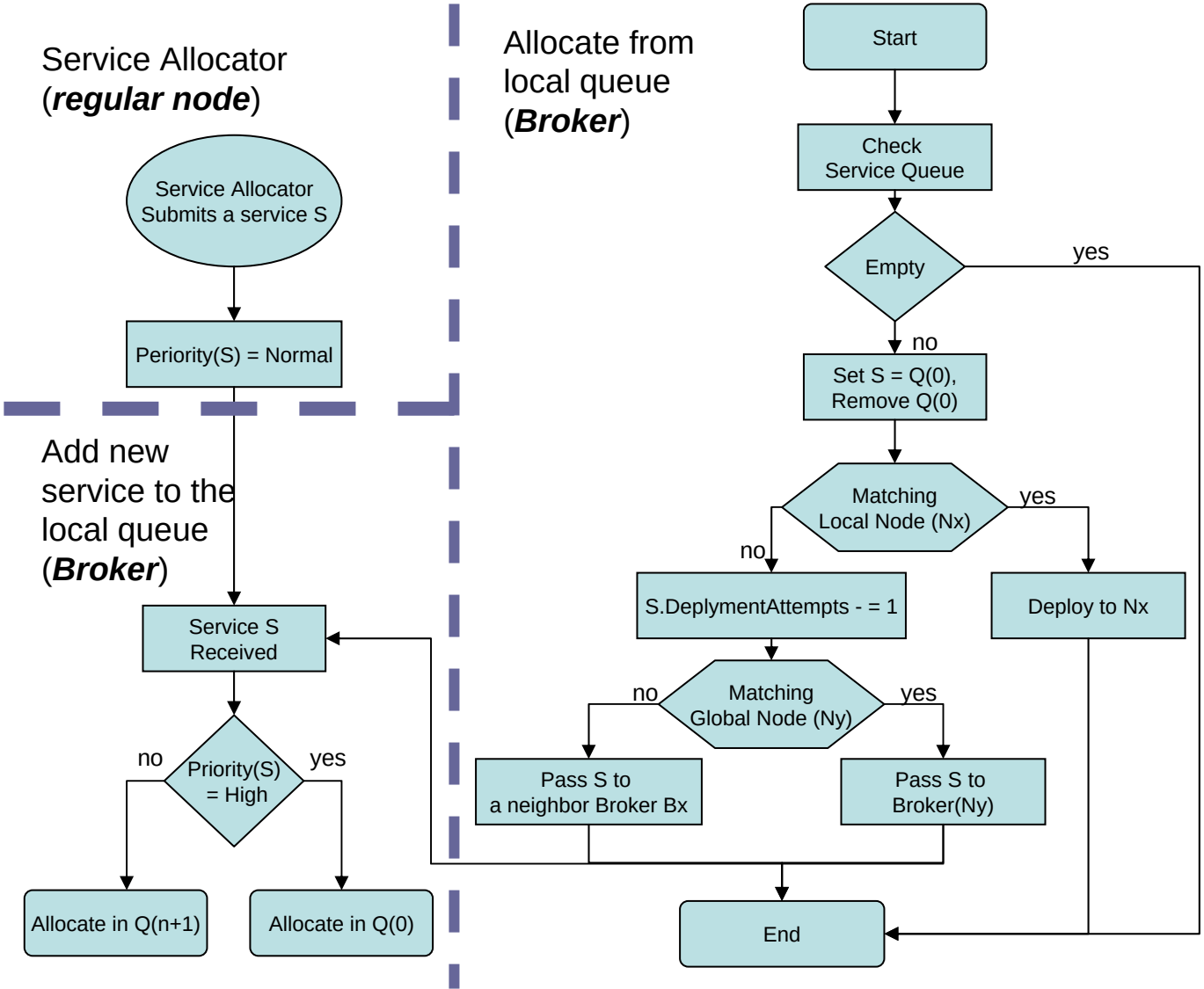
Service Allocation (Scheduling) - 1



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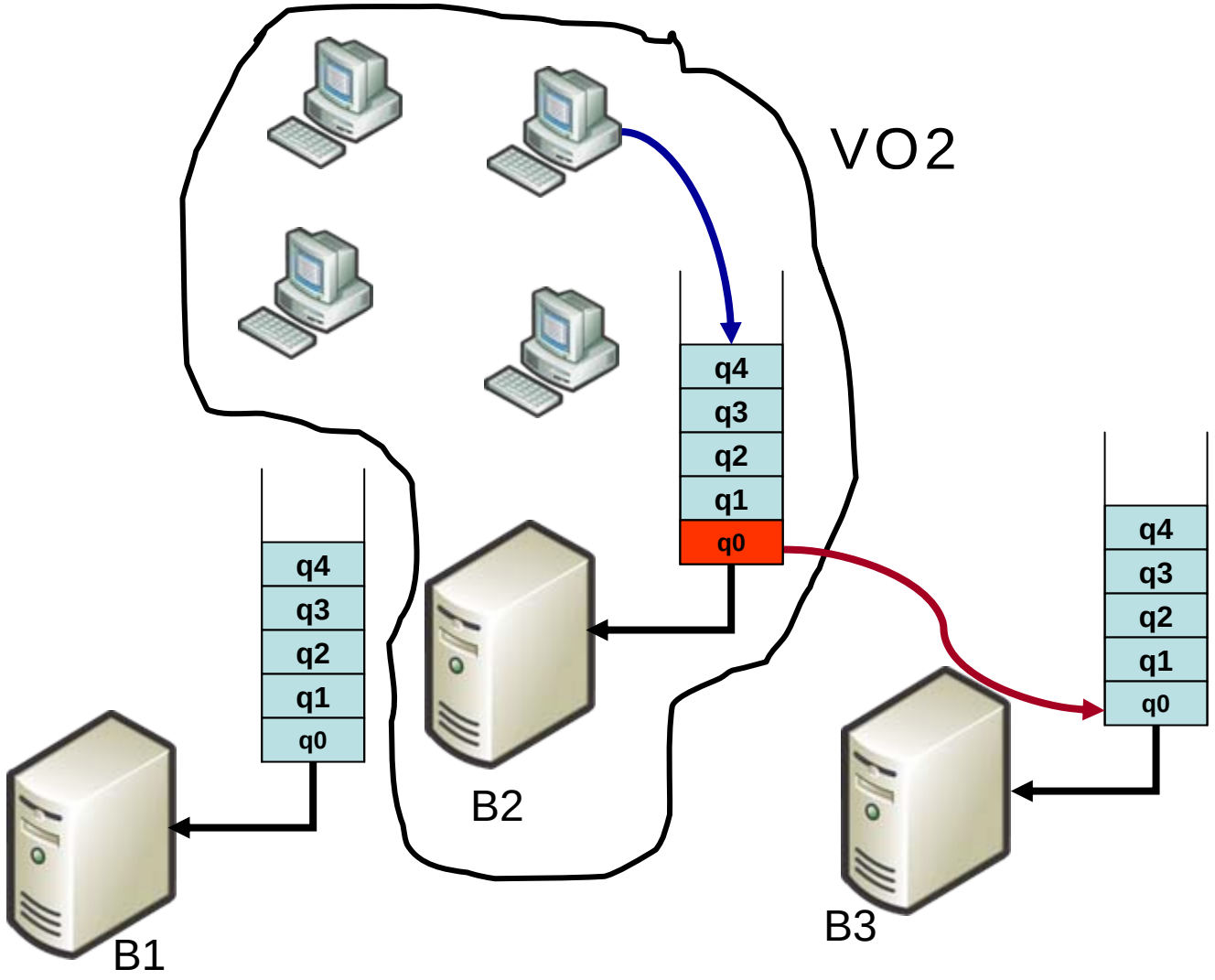
Service Allocation (Scheduling) - 2



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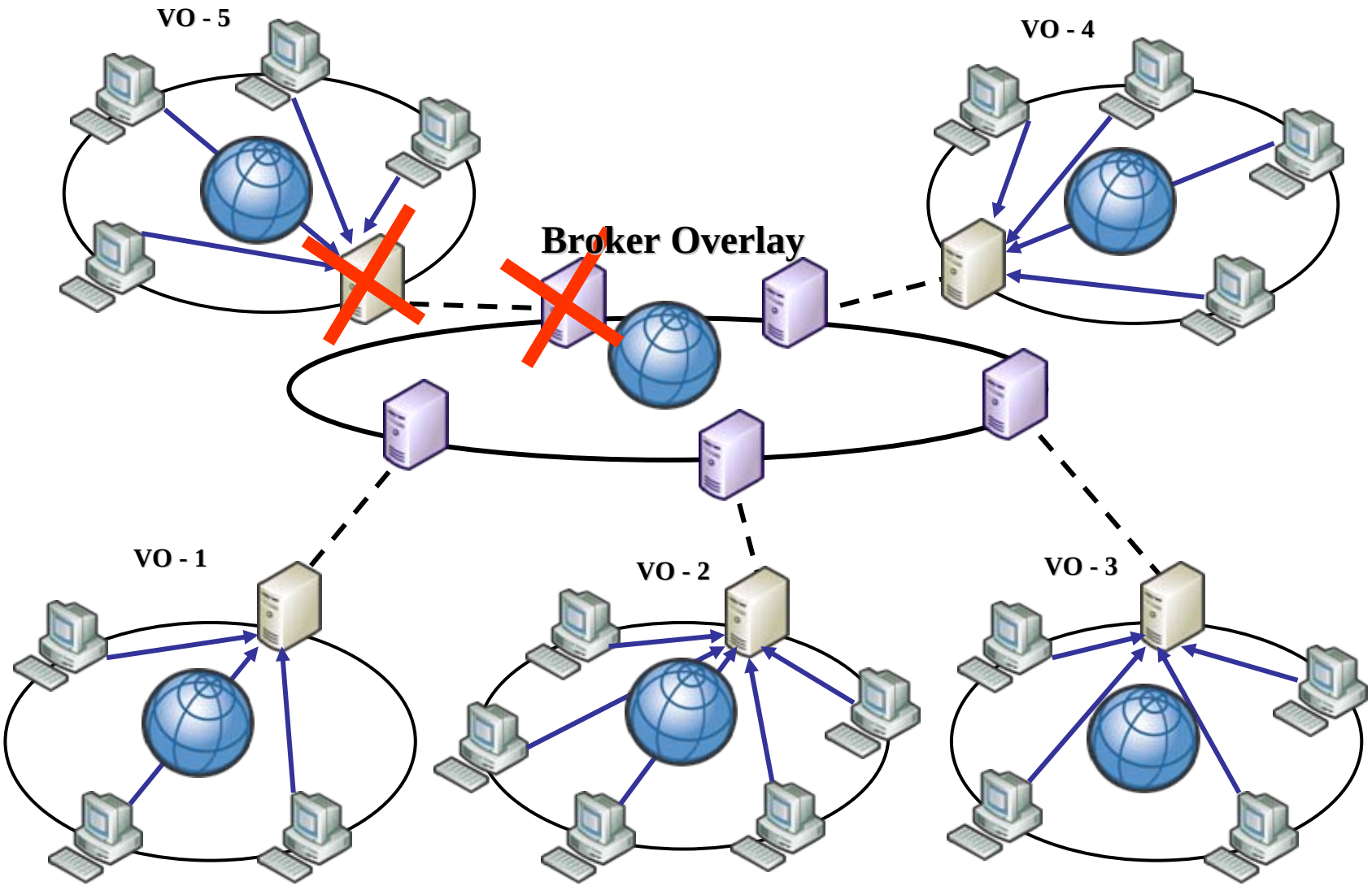
Failure Handling – Broker



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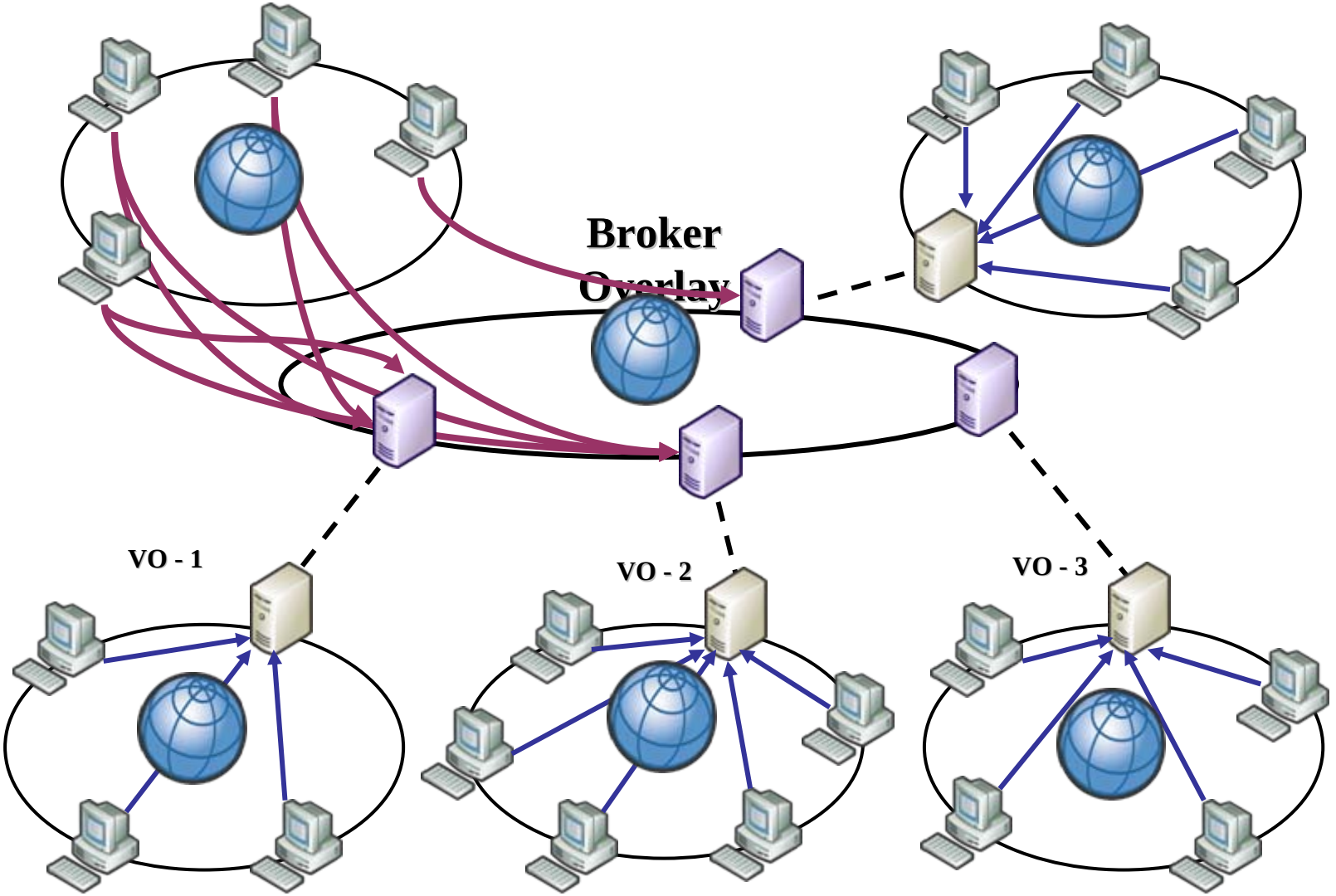
Failure Handling – Broker



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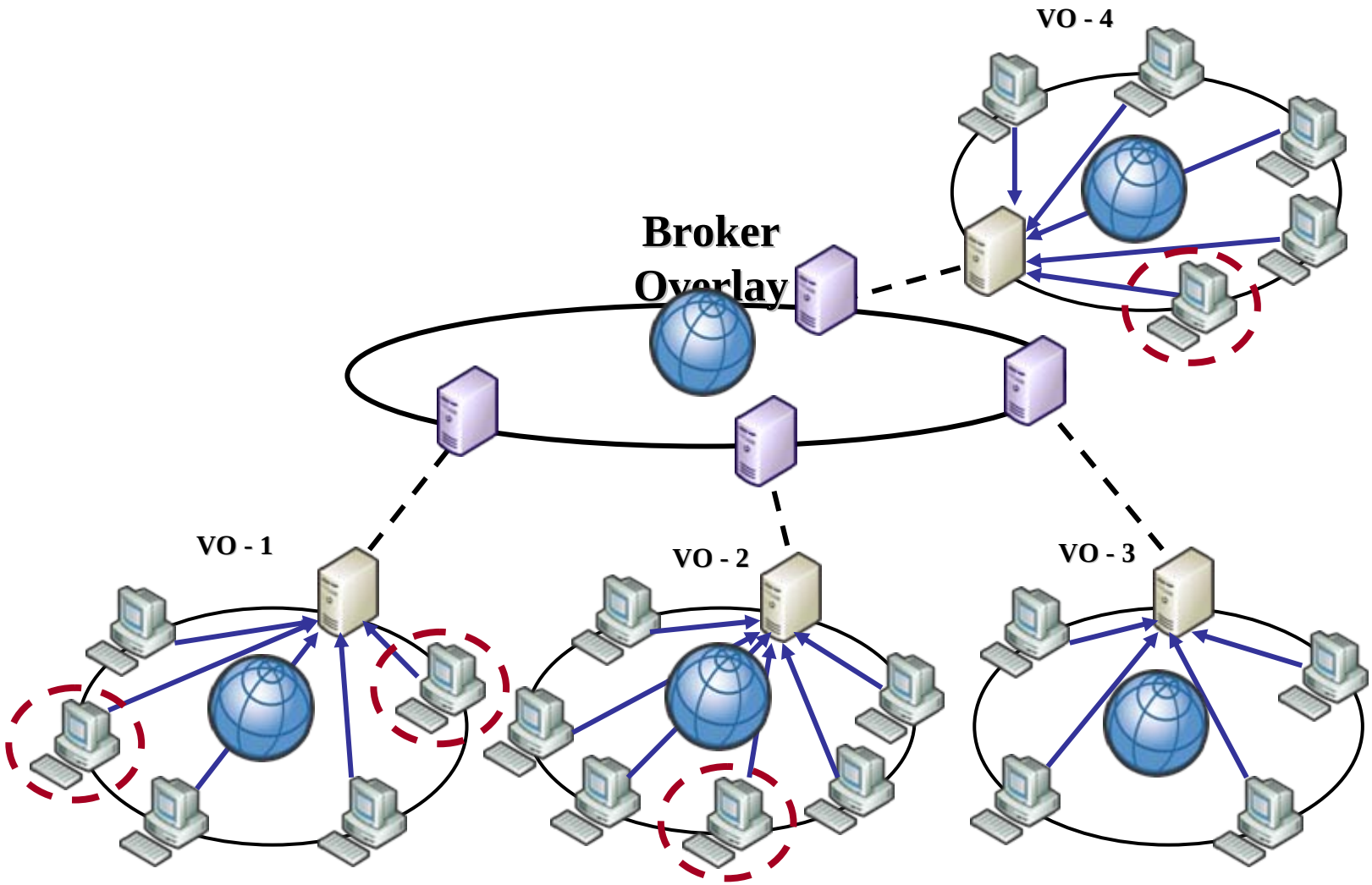
Failure Handling – Broker



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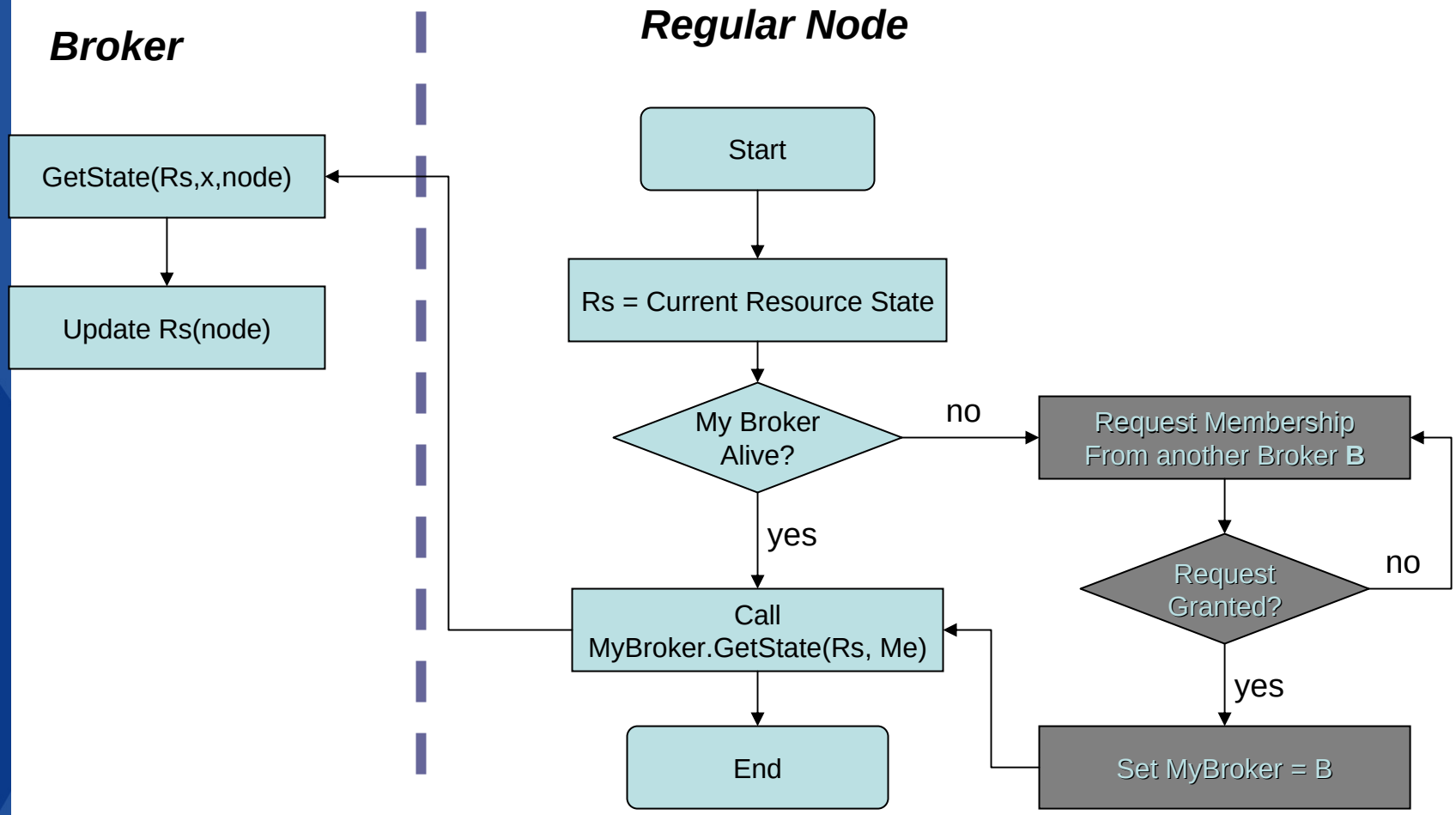
Failure Handling – Broker



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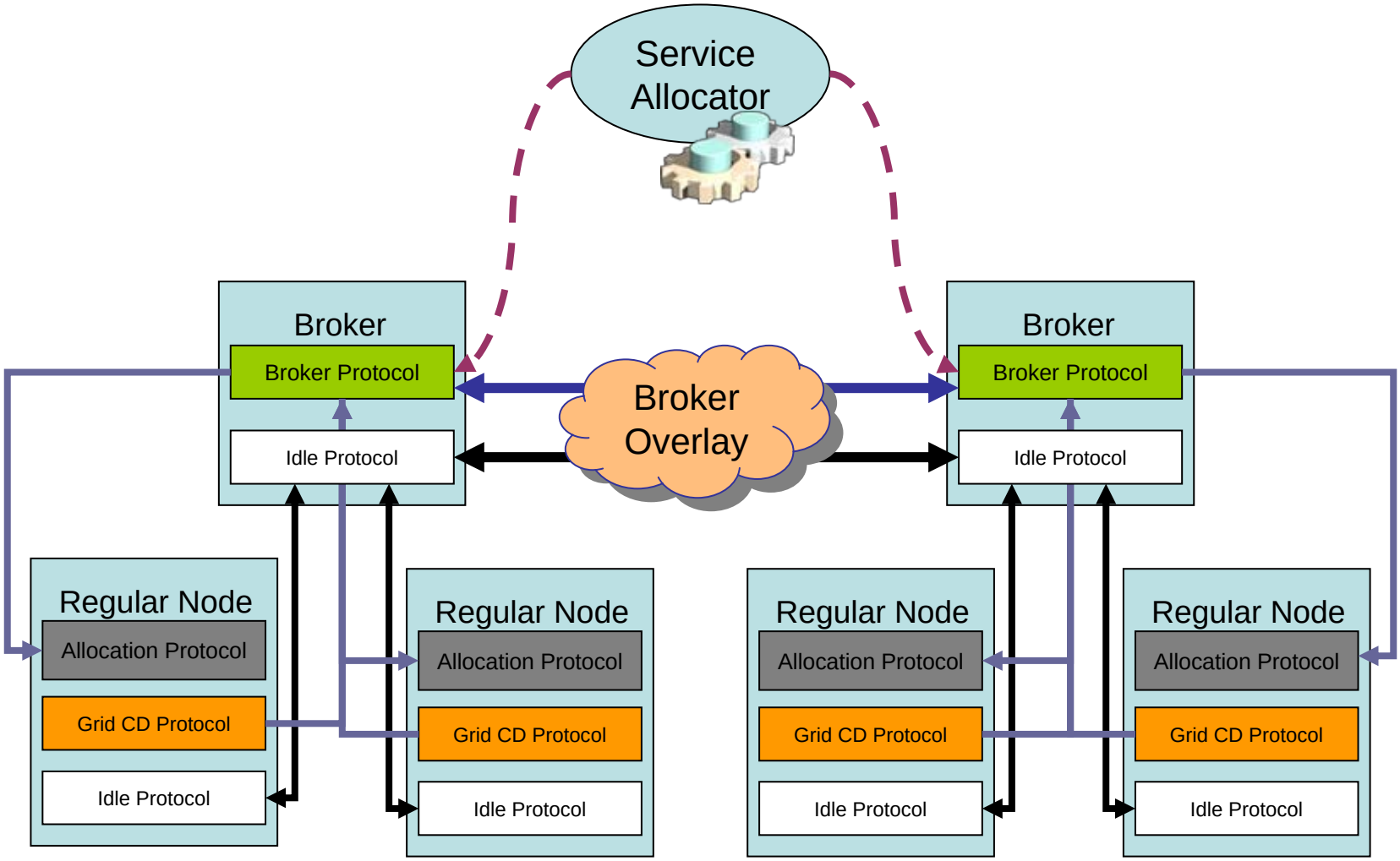
Simulation Model



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Performance Evaluation

- Validity of the stored resource information.
- Efficiency of service allocation.
- Impact of broker failure on resource information updating.

N → Total Grid size, M → Number of VOs

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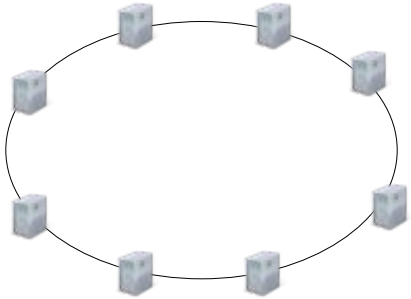
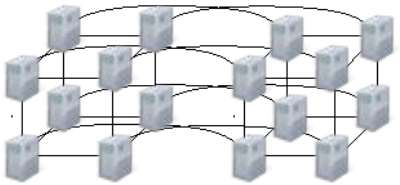
Performance Evaluation

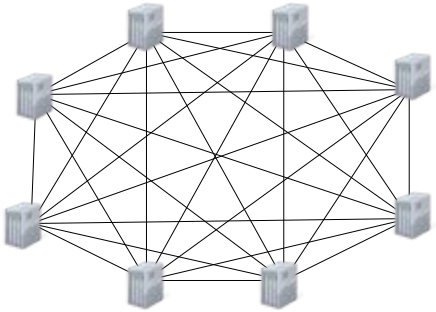
- Broker Overlay Topologies



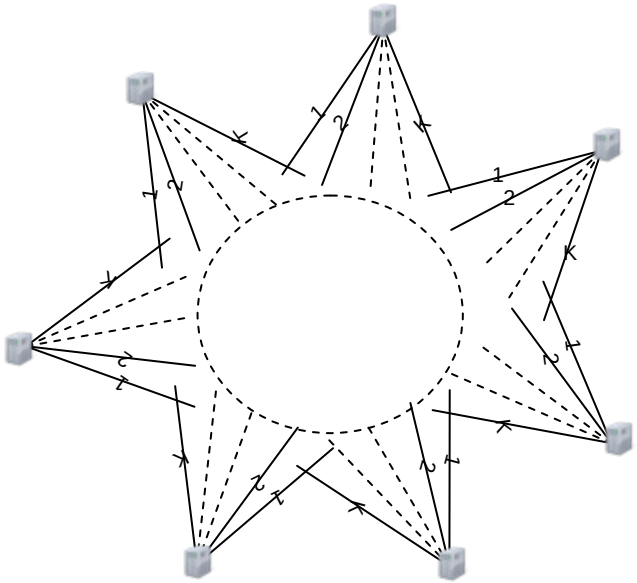
Ring



Hyper-Cube



Fully connected



Wire-*k*-out

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Validity of the stored resource information

- The deviation of the reading time values of resource information data blocks, **RIDB**s, stored in the resource information data set, from the current cycle in a broker, with the simulation cycles.

- The deviation value for cycle (c):

$$D(c) = \sqrt{\sum_{i=1}^{N} \frac{\left(Time(RIDB(i)) - c\right)^2}{N}}$$

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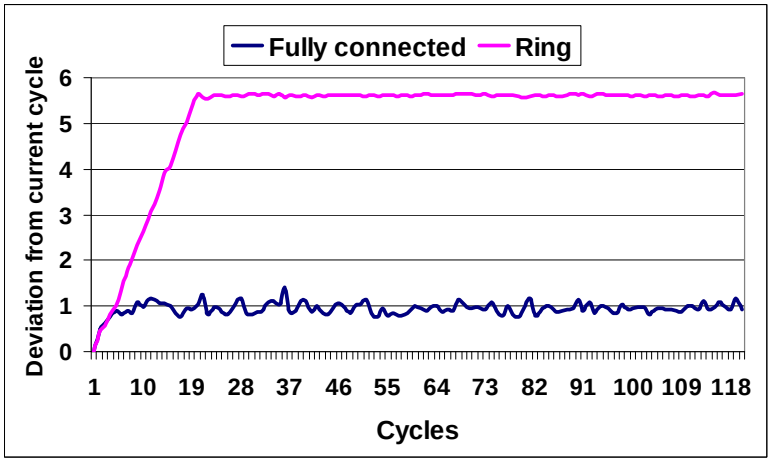
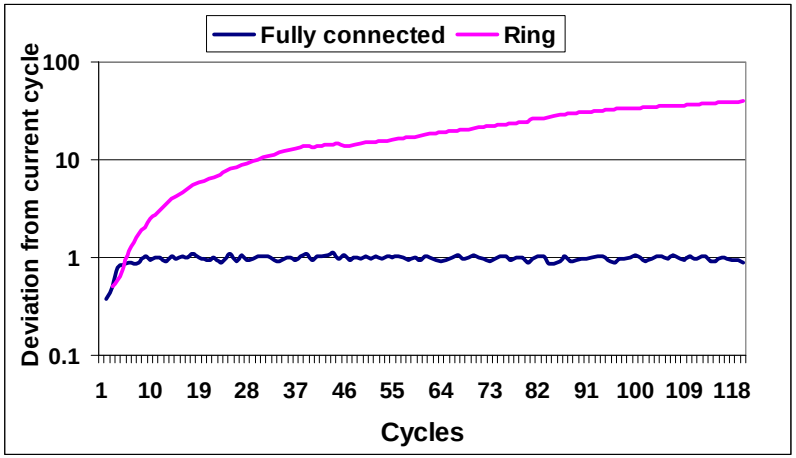
Validity of the stored resource information



N = 100, M = 20



N = 500, M = 100 (log scale)

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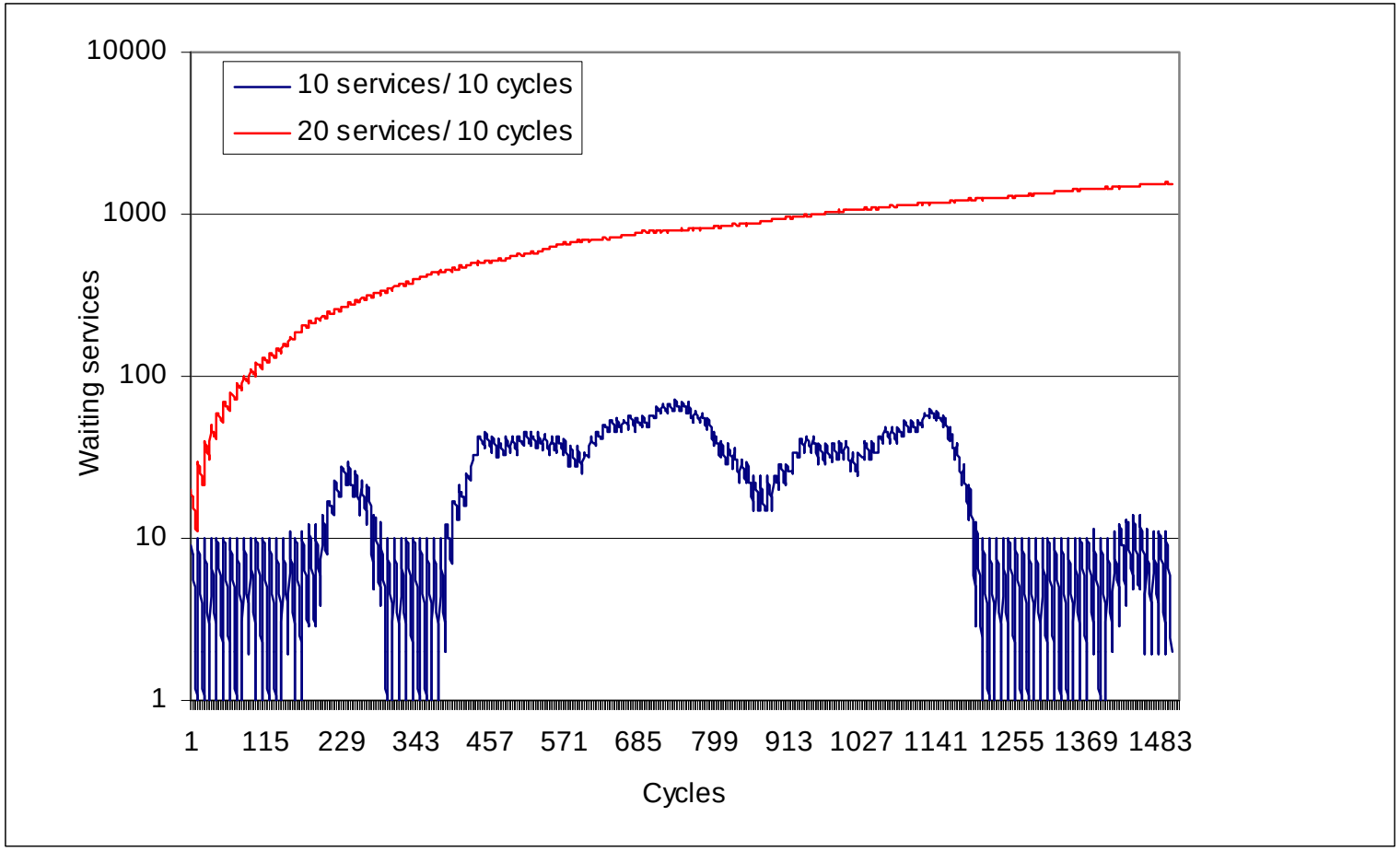
Efficiency of Service Allocation

- One broker periodical allocation.



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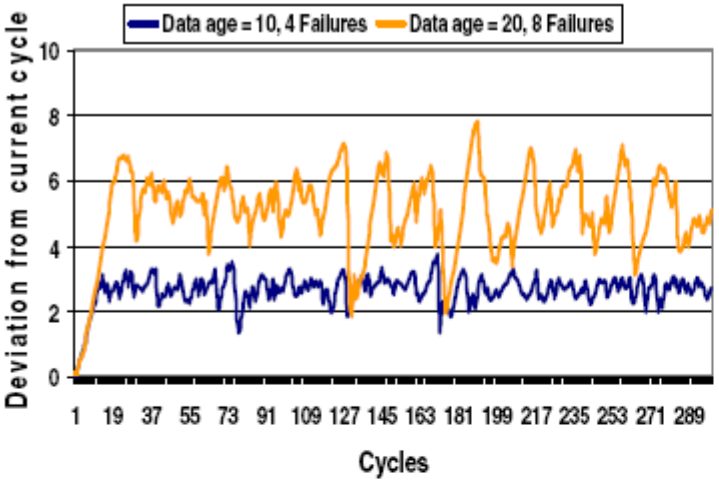
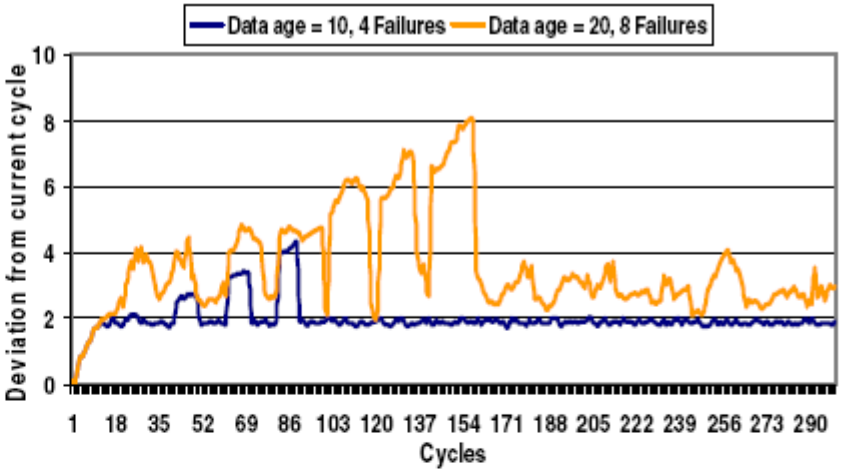
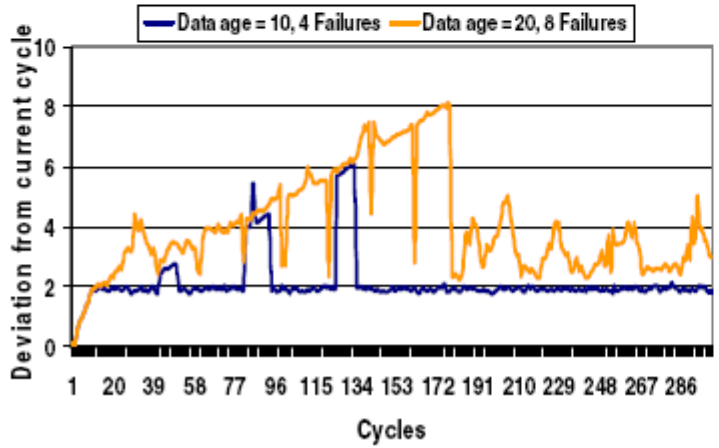
Impact of Broker Failures on Resource Information Updating **(N = 500, M = 100)**



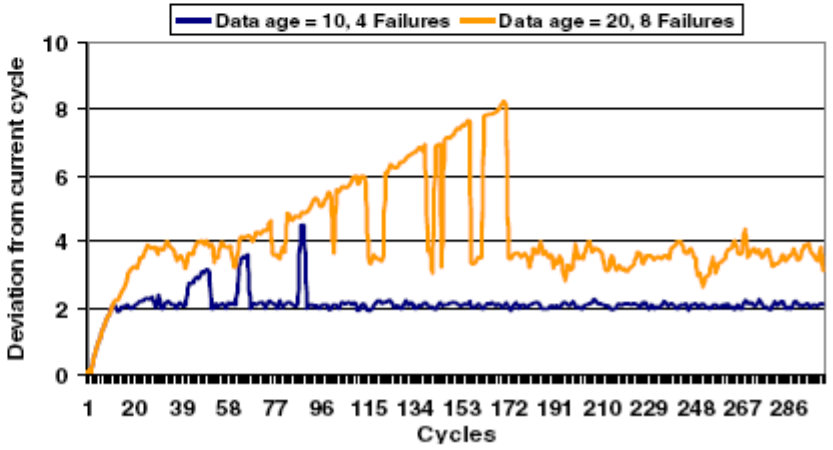
a) Ring broker overlay topology



b) Fully Connected broker overlay topology



c) Wire-*k*-Out broker overlay topology, $k = 60$



d) Hyper-cube broker overlay topology

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Conclusions and Future work

- Broker overlay Grid management model retains the system decentralization and increases the scalability.
- Hyper-cube topology provides scalability similar to the fully connected topology. Ring topology is not applicable in case of broker failures.
- As a future work, other collaboration aspects in a multi-virtual organization environment (e.g. security and rules of sharing) will be considered.

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Questions

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