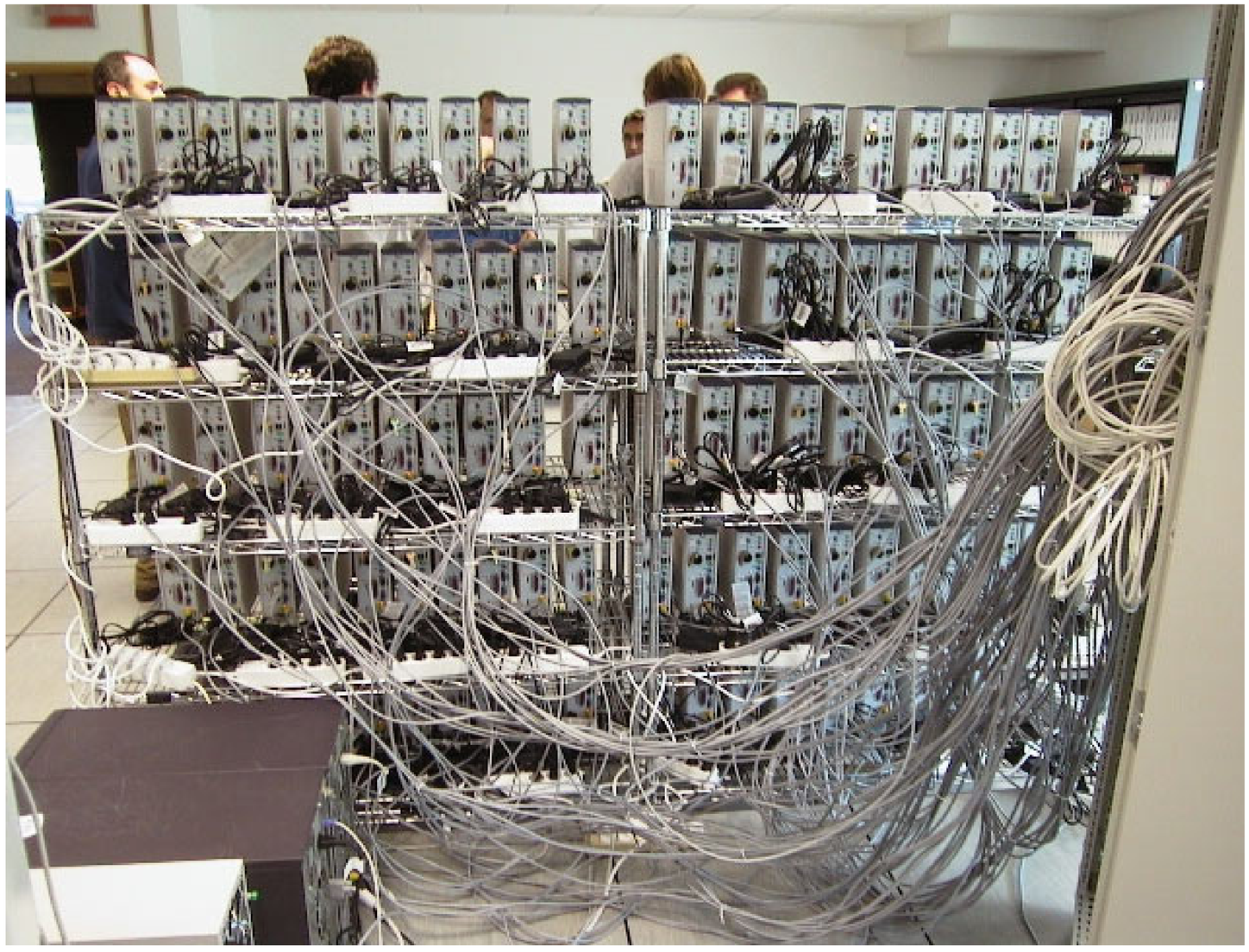
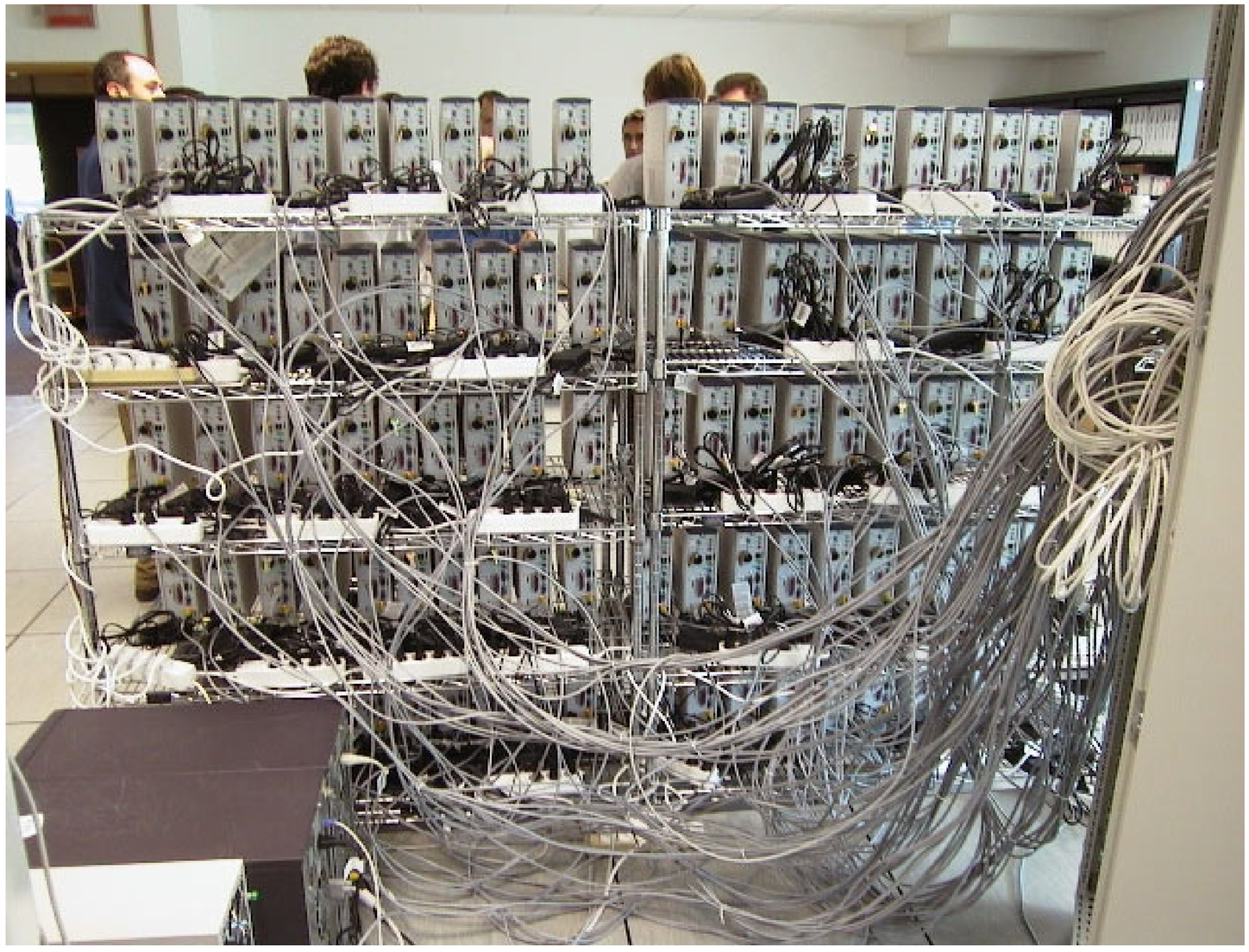
Yandex

Distributed Systems

Unreliable Components v2

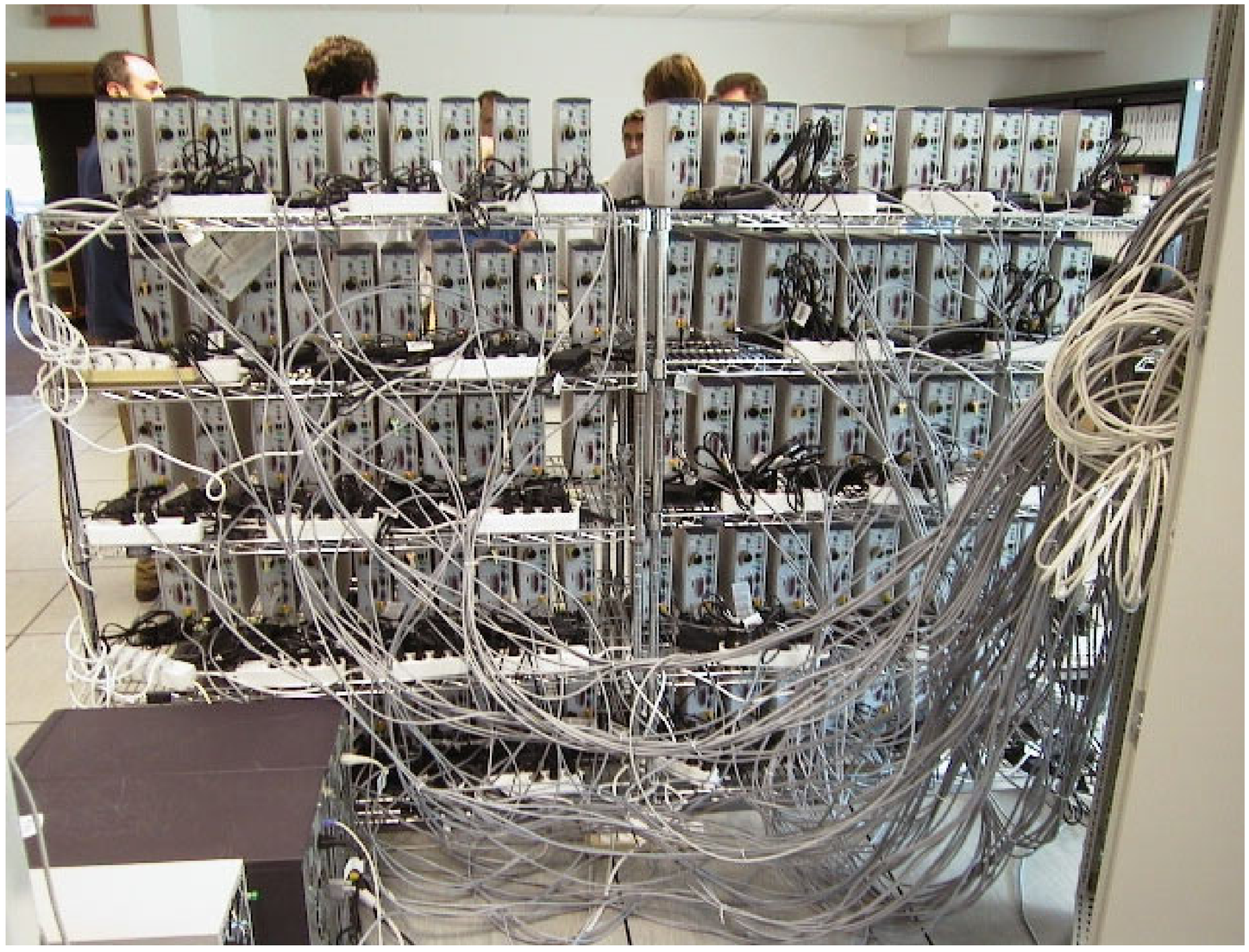


Link Failures:



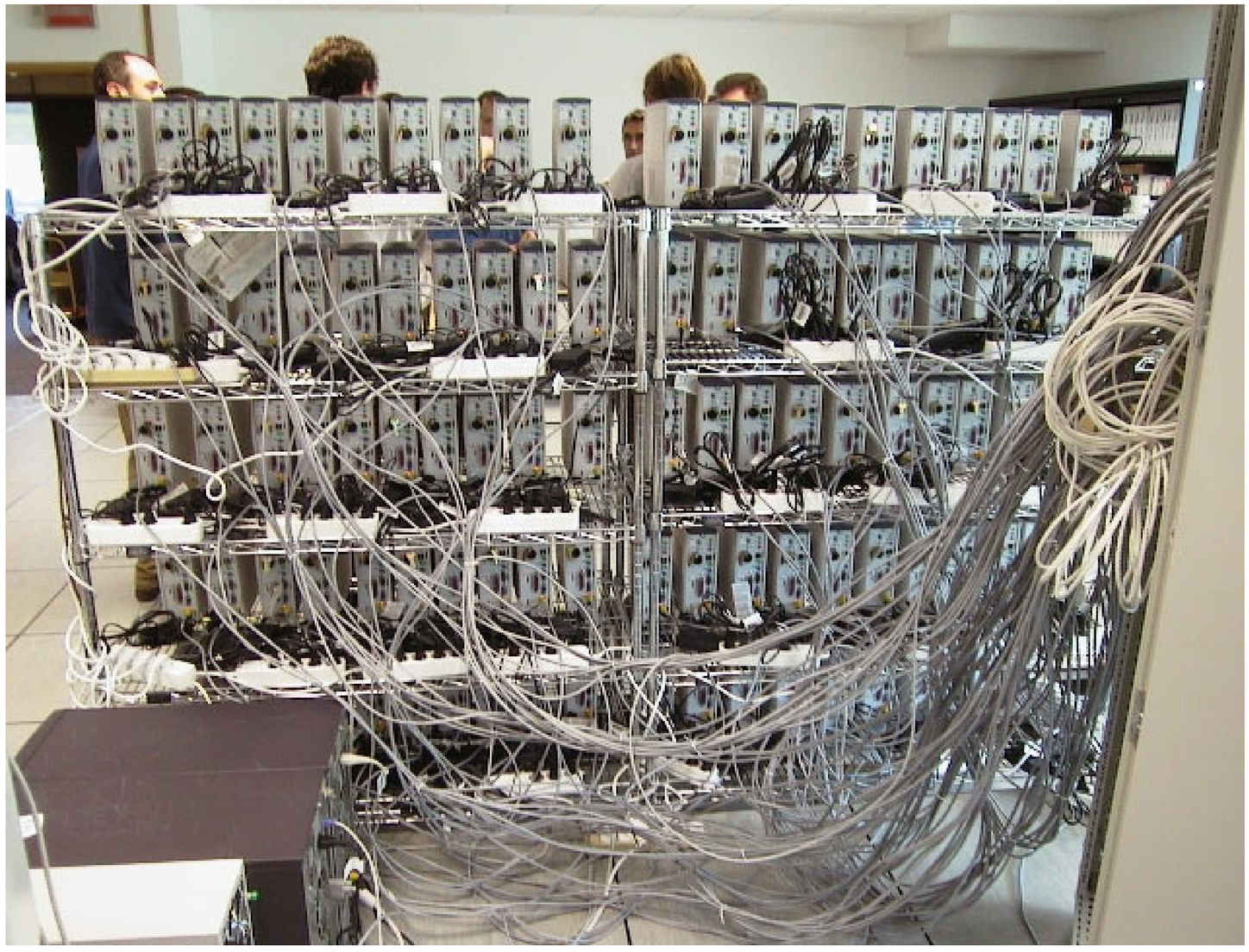
Link Failures:

- Perfect Link



Link Failures:

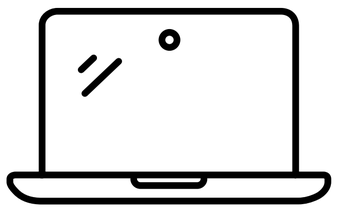
- Perfect Link
- Fail-loss Link



Link Failures:

- Perfect Link
- Fail-loss Link
- Byzantine

Perfect Link



send $(a_1, a_2, ..., a_k)$

receive $(b_1, b_2, ..., b_k)$

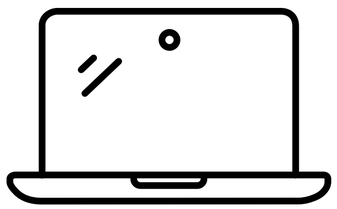
$b_1 = a_1$

$b_2 = a_2$

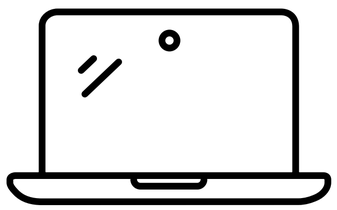
...

$b_k = a_k$

Fair-Loss Link



send $(a_1, a_2, ..., a_k)$

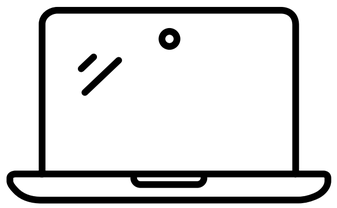


receive $(b_1, b_2, ..., b_l)$

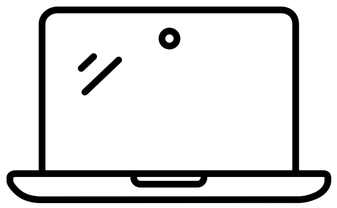
$l \leq k$

$\{b_i\} \in \{a_j\}$

Fair-Loss Link



send $(a_1, a_2, ..., a_k)$



receive $(b_1, b_2, ..., b_l)$

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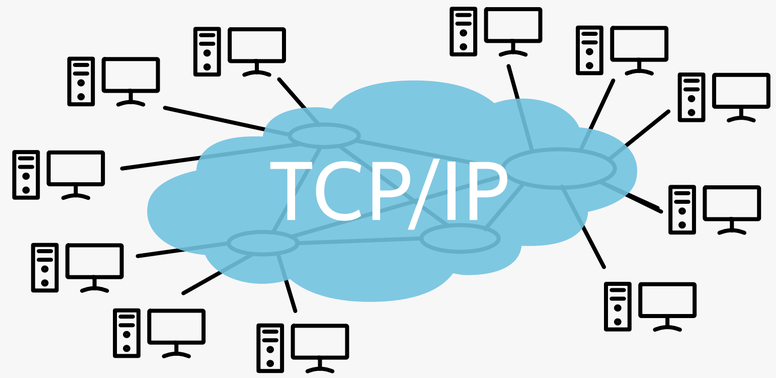
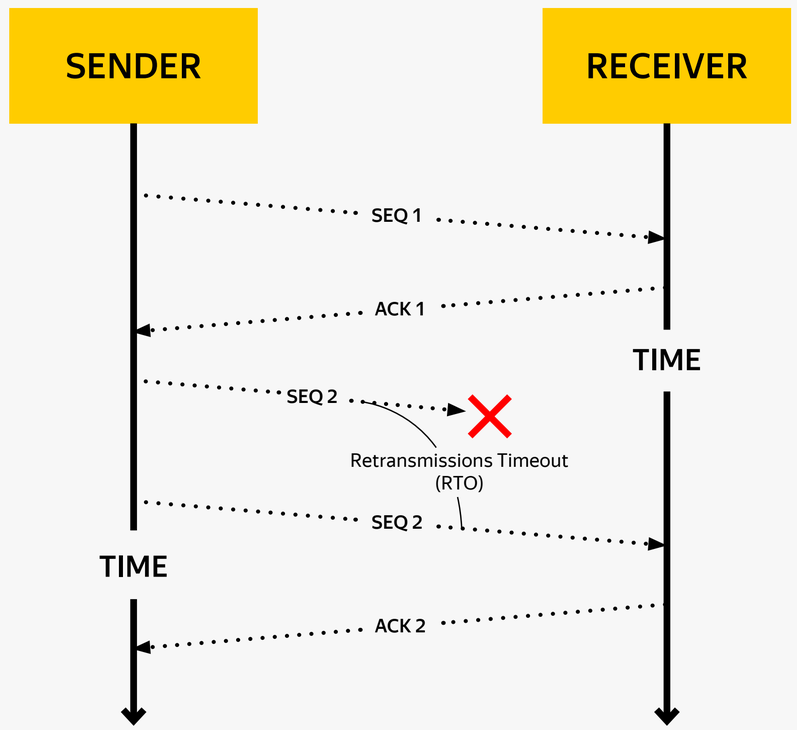
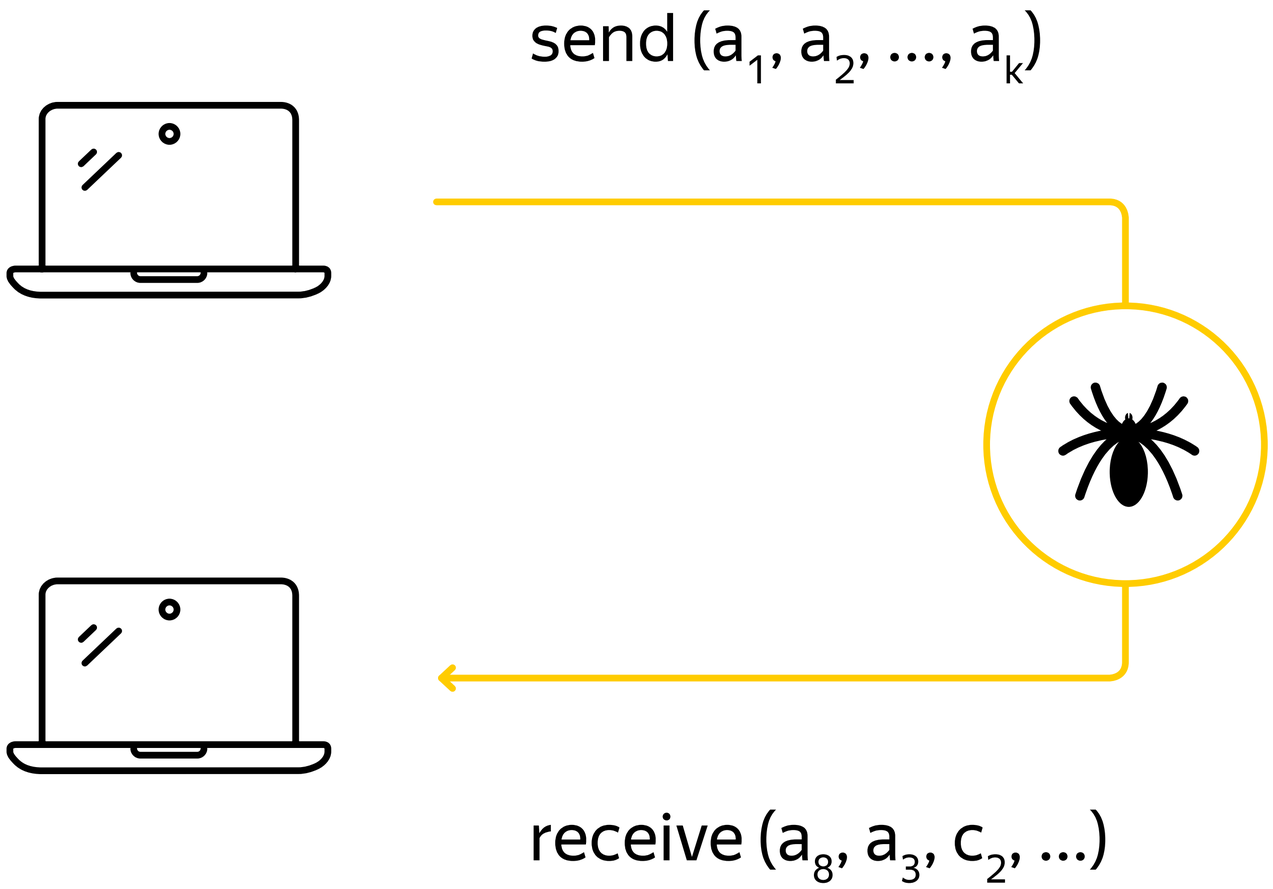




Fair-Loss Link



The Two Generals Paradox

1975

SOME CONSTRAINTS AND TRADEOFFS
IN THE DESIGN OF
NETWORK COMMUNICATIONS*

E. A. Akkoyunlu
K. Ekanadham
R. V. Huber†
Department of Computer Science
State University of New York at Stony Brook

Notes on Data Base Operating Systems

Author: Jim Gray

1978 Article

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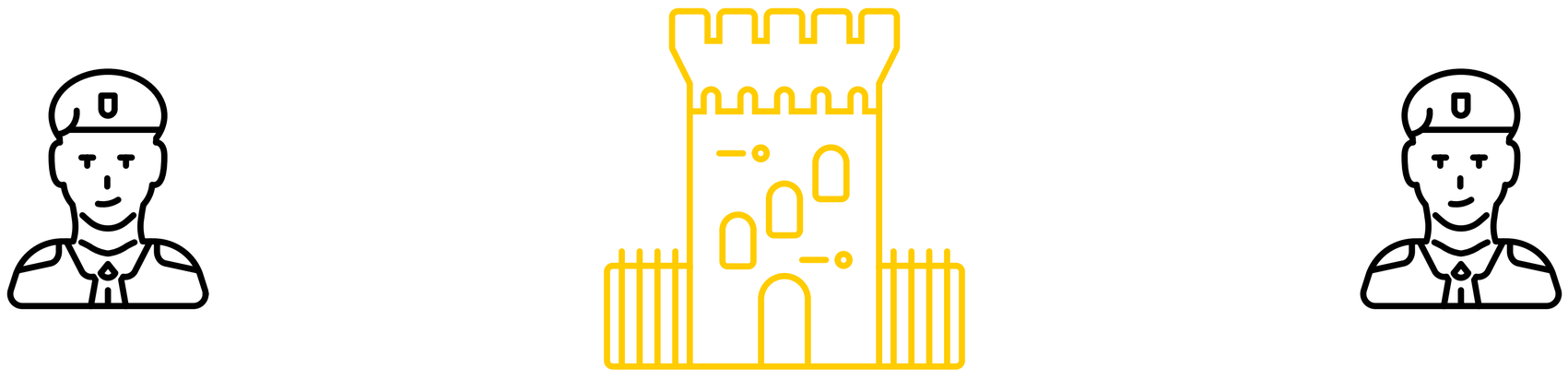
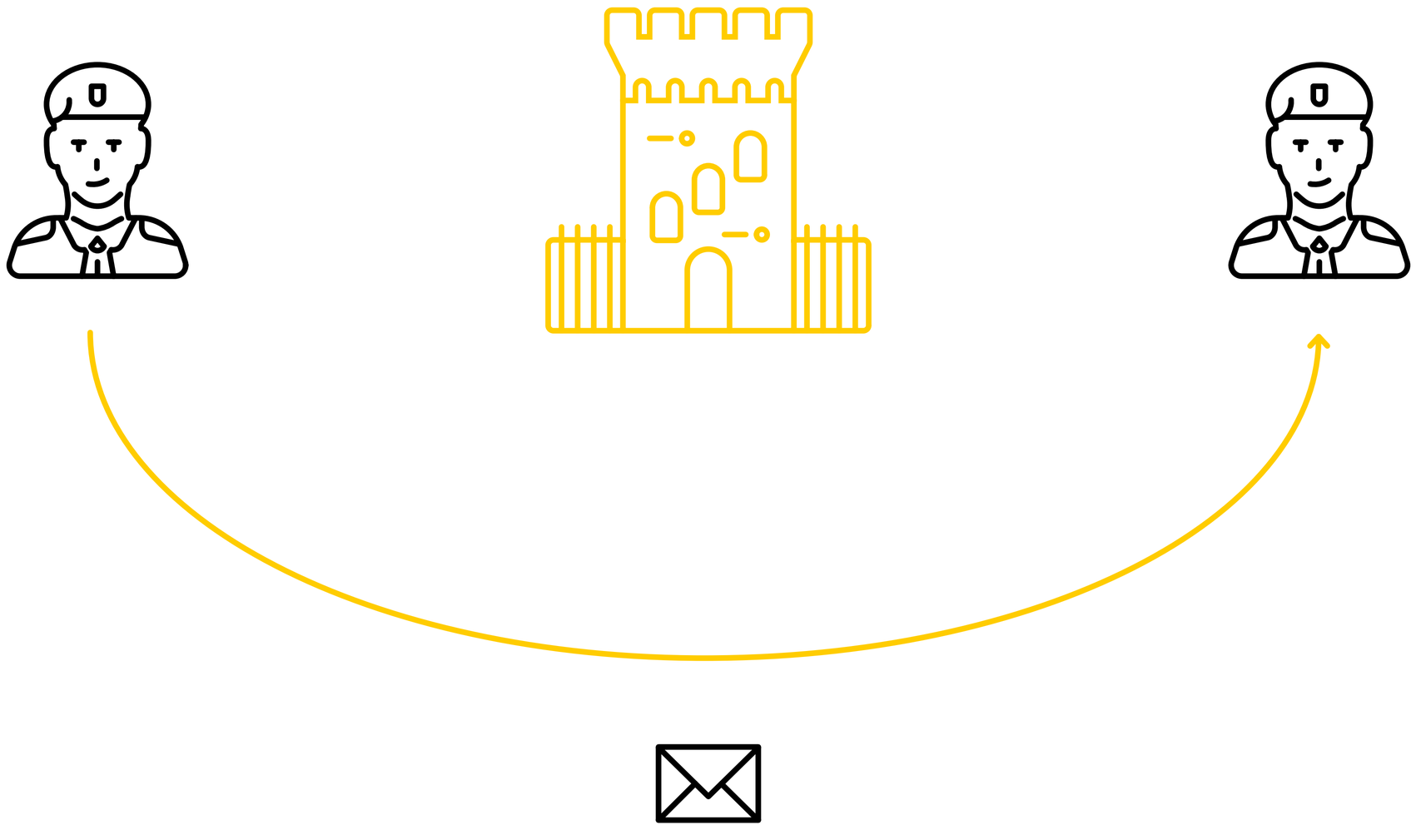
· Downloads (cumulative): n/a
· Downloads (12 Months): n/a
· Downloads (6 Weeks): n/a

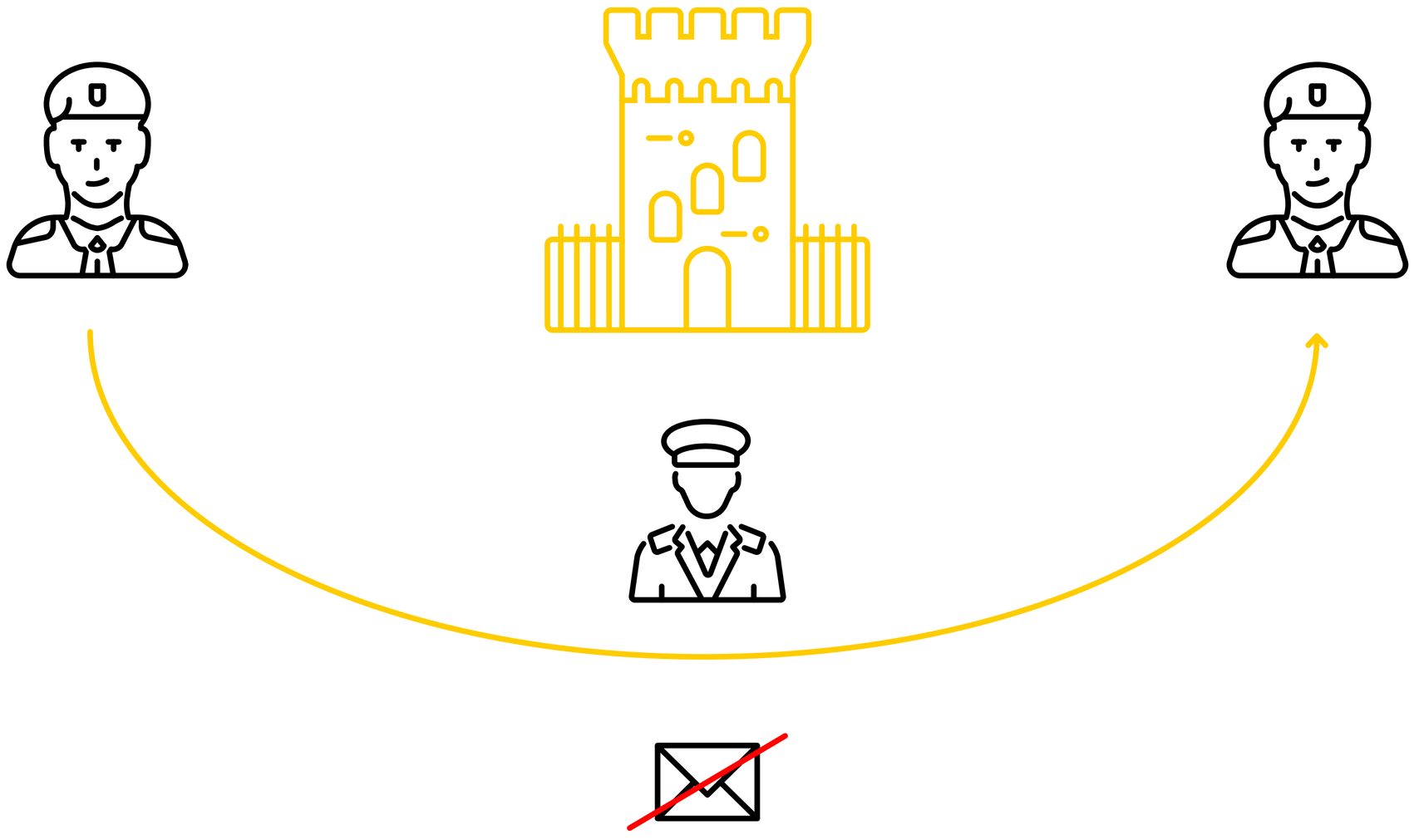
The Two Generals Problem



The Two Generals Problem



The Two Generals Problem



The Two Generals Problem

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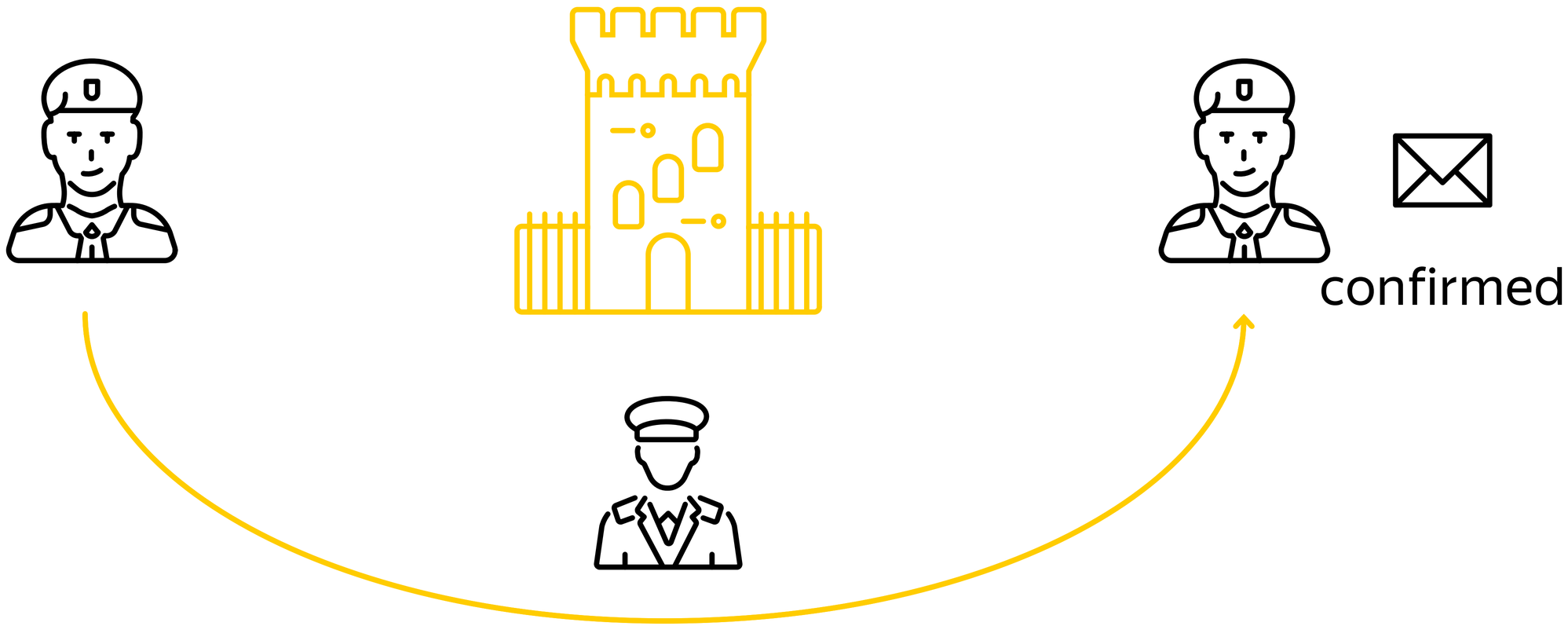
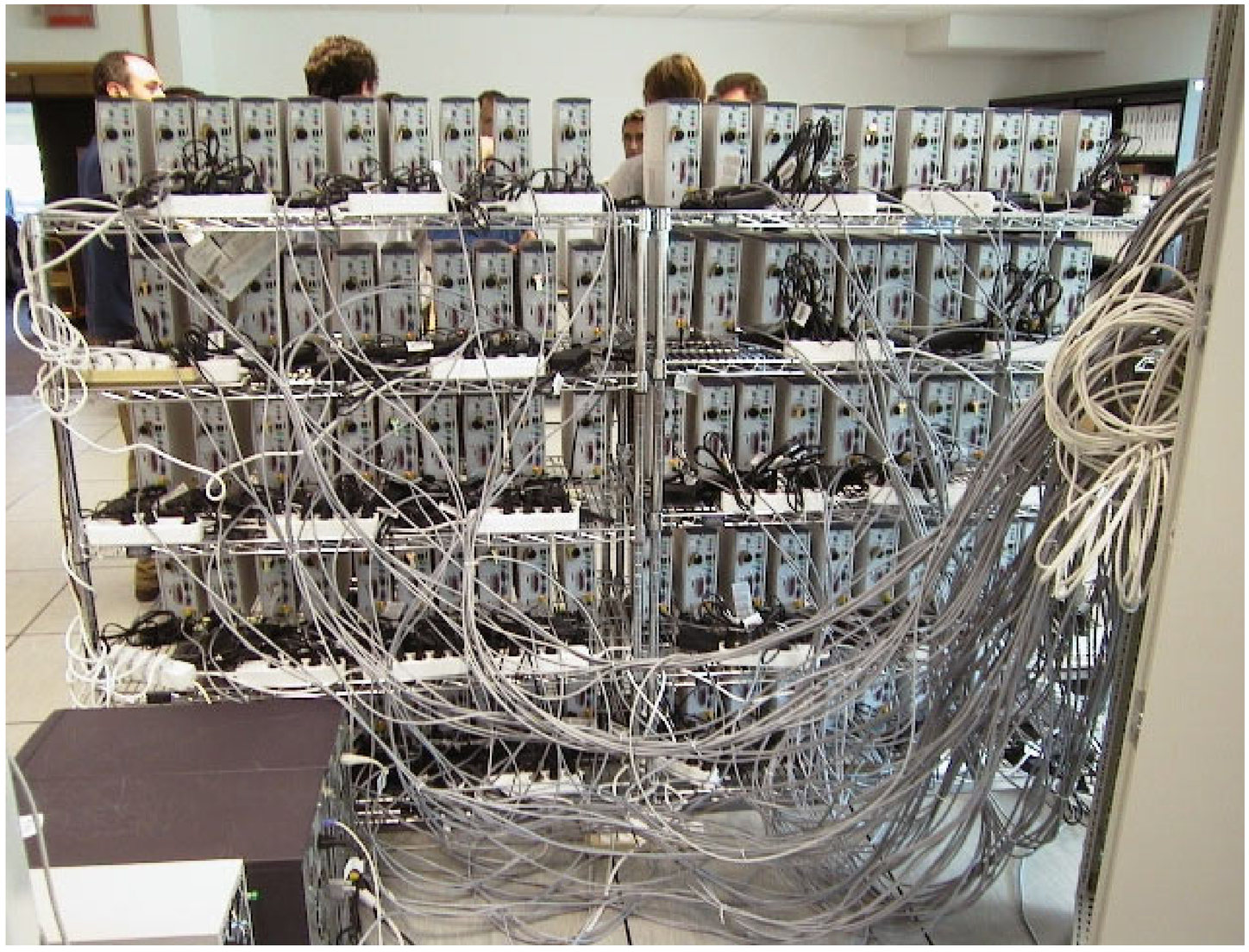
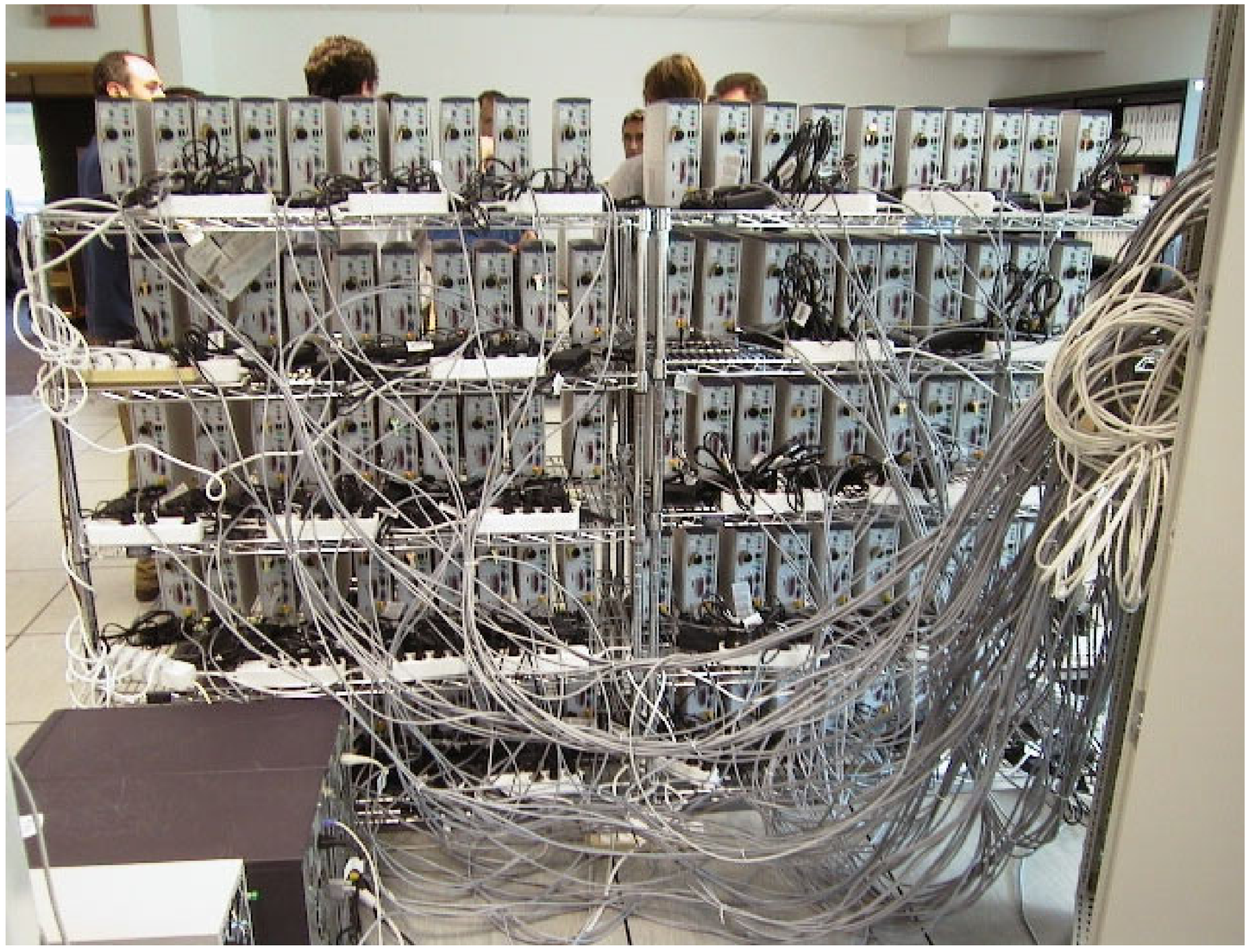


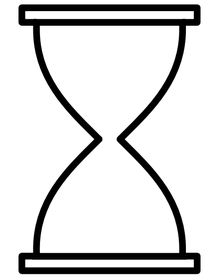
The Two Generals Problem



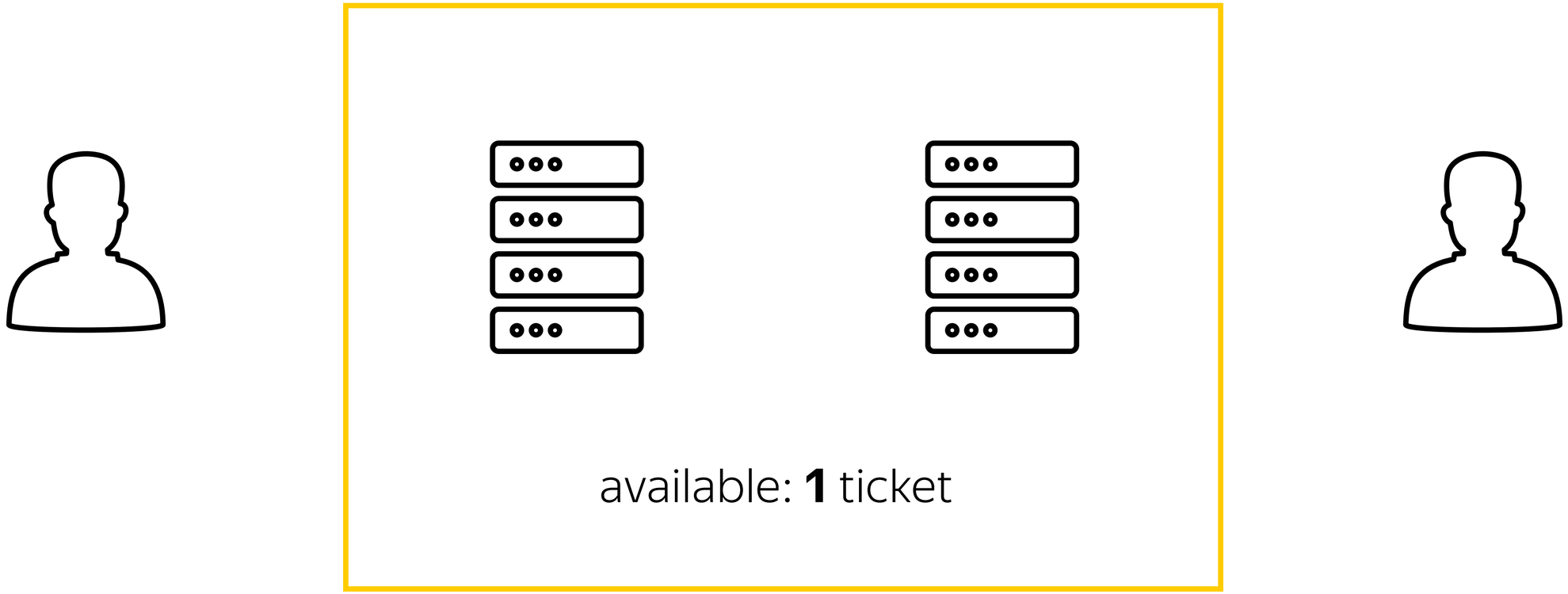
- Nodes
- Links
- ???



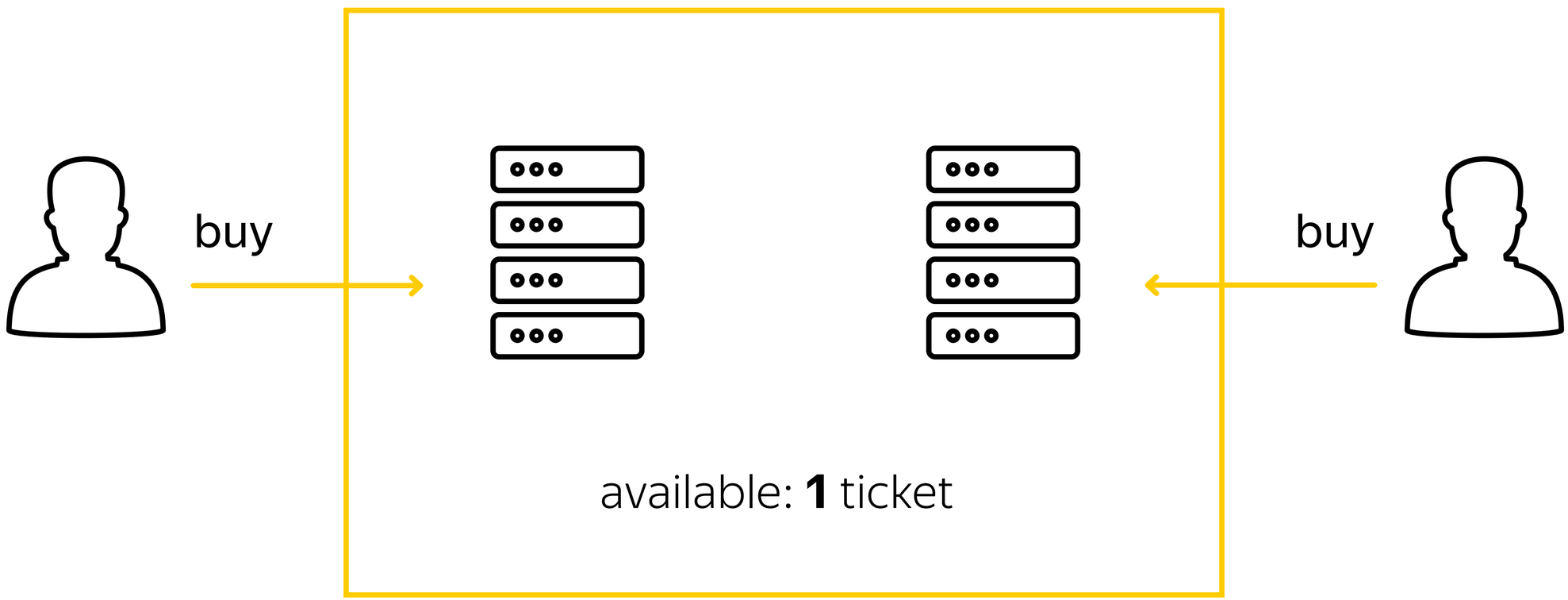
- Nodes
- Links
- Clock



Distributed Booking System



Distributed Booking System



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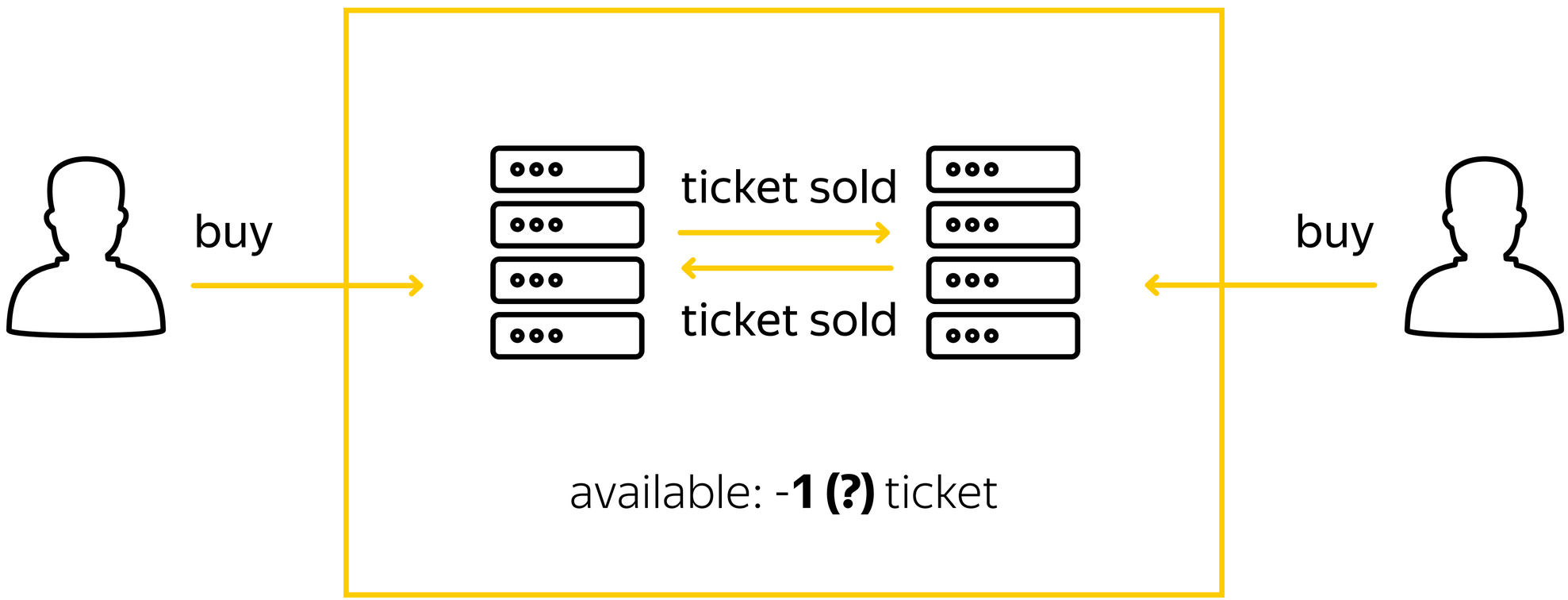

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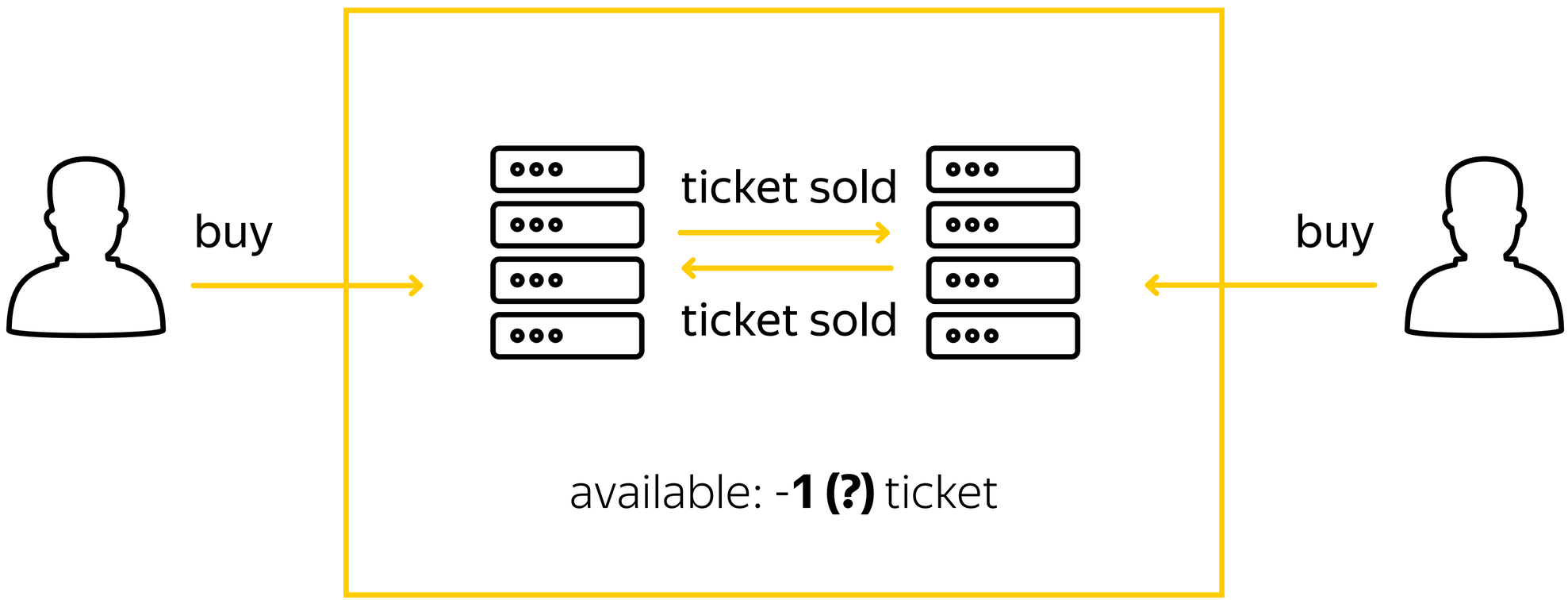
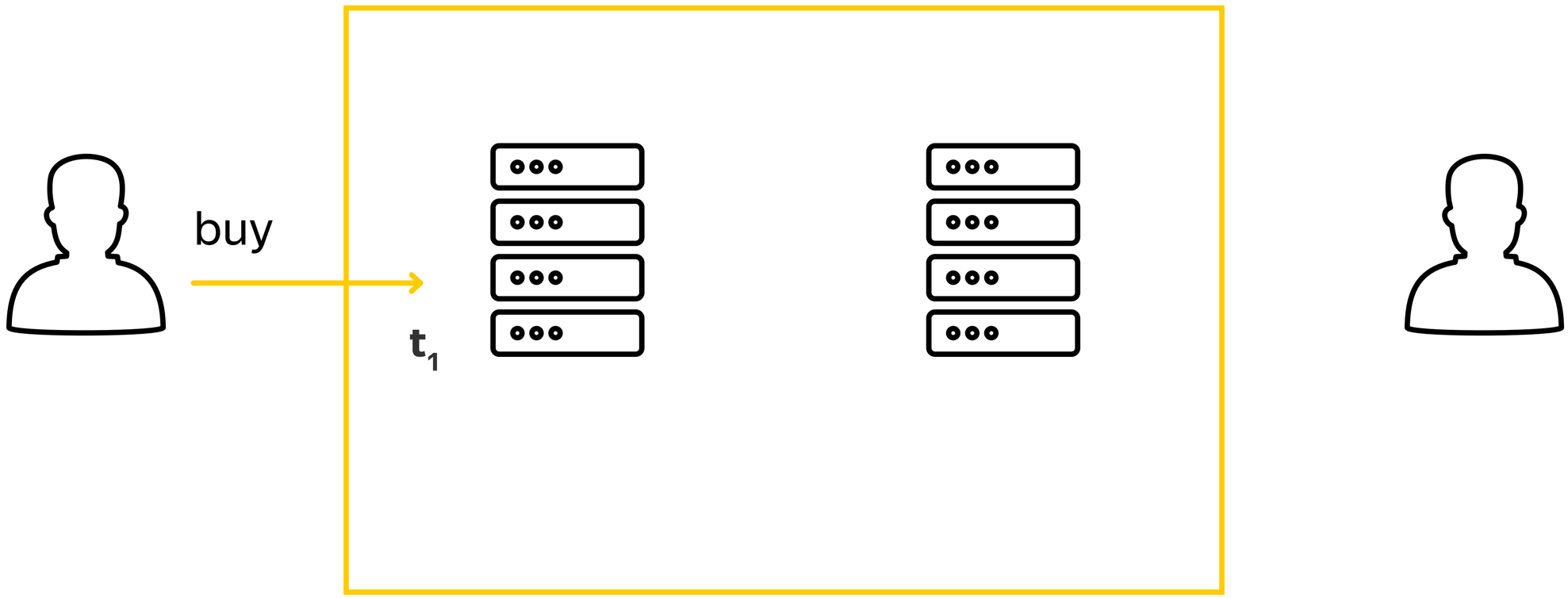


idea: add unix timestamp
to the query time

Distributed Booking System



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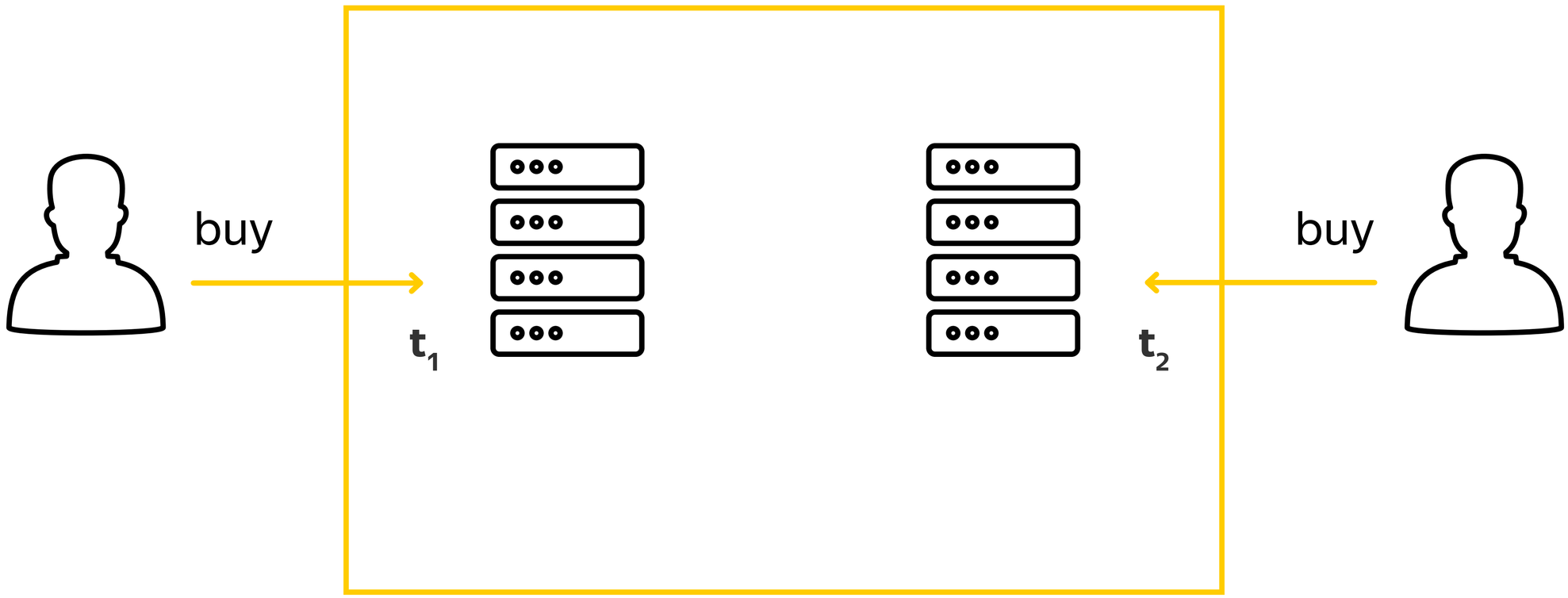

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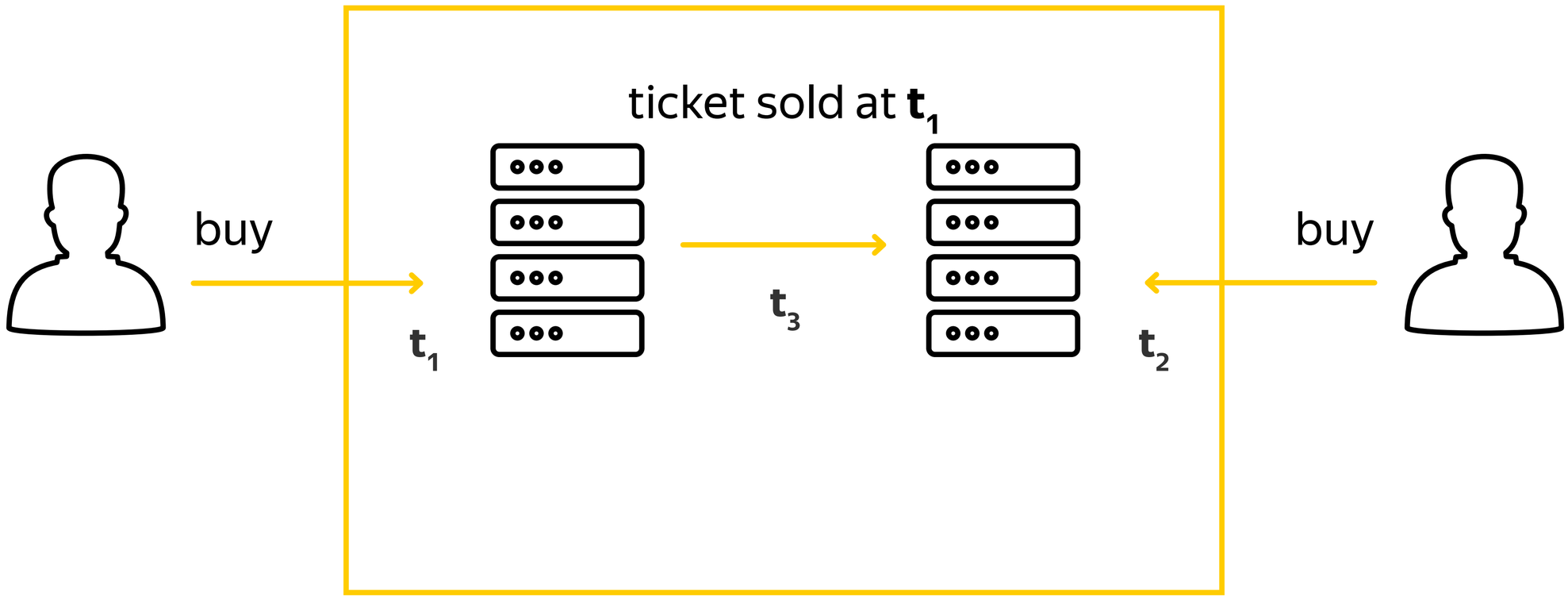

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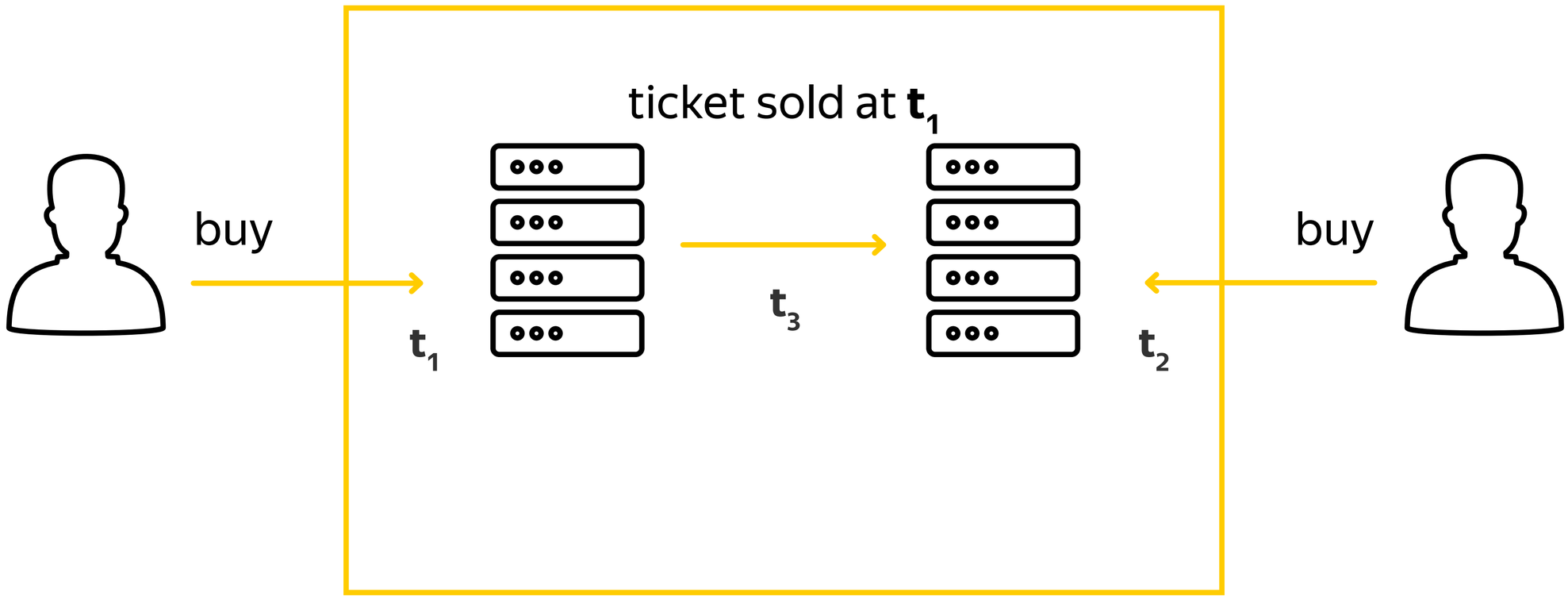
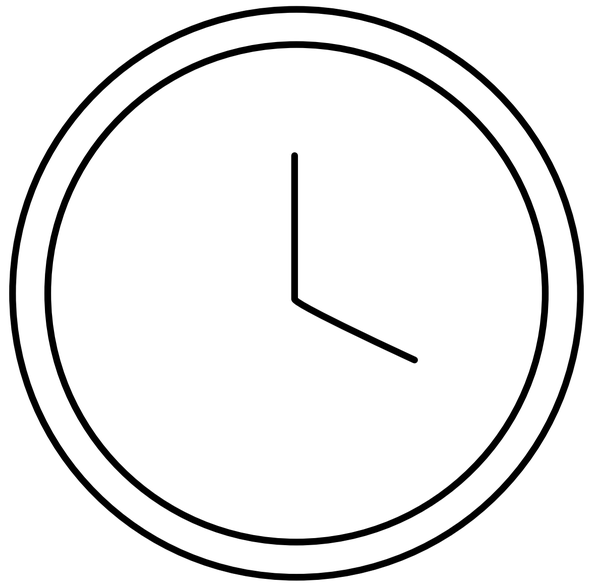
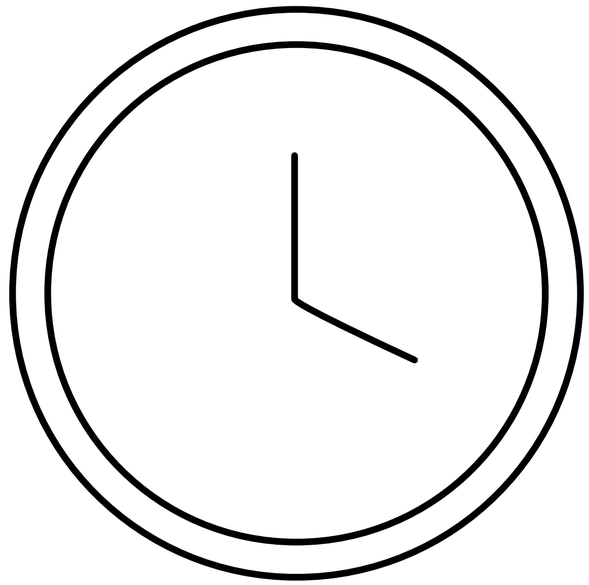


$t_2 < t_3 < t_1$



1 clock skew

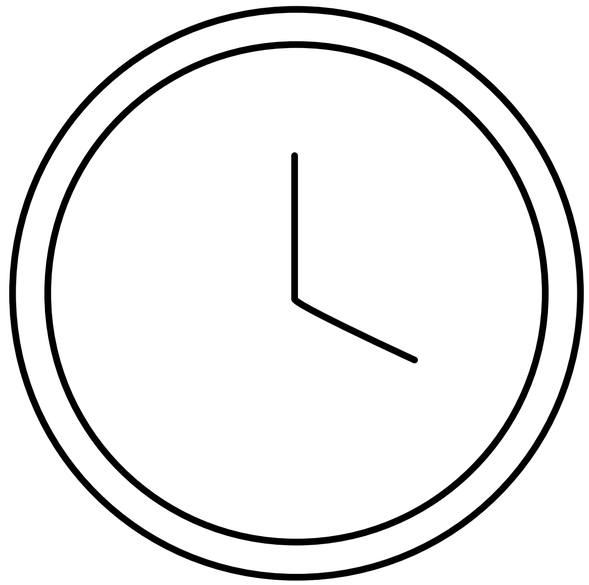
2 clock drift



1 clock skew

2 clock drift

idea: use logical clocks

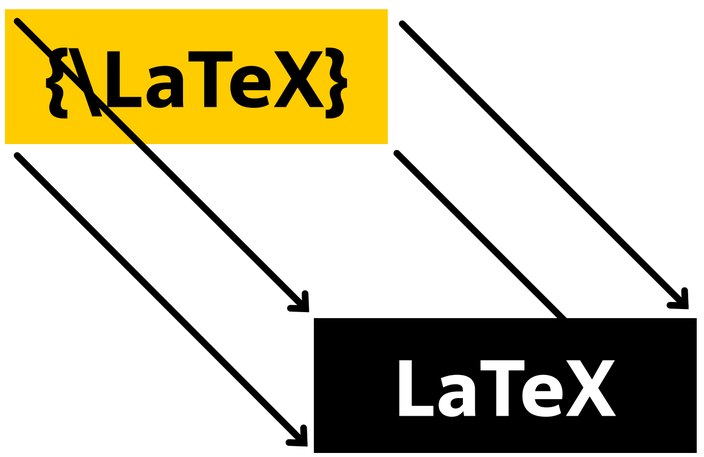


1 clock skew

2 clock drift

Lamport logical clocks

Leslie Lamport



[A] Synchronous Systems

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- Every message between nodes is delivered within limited time;

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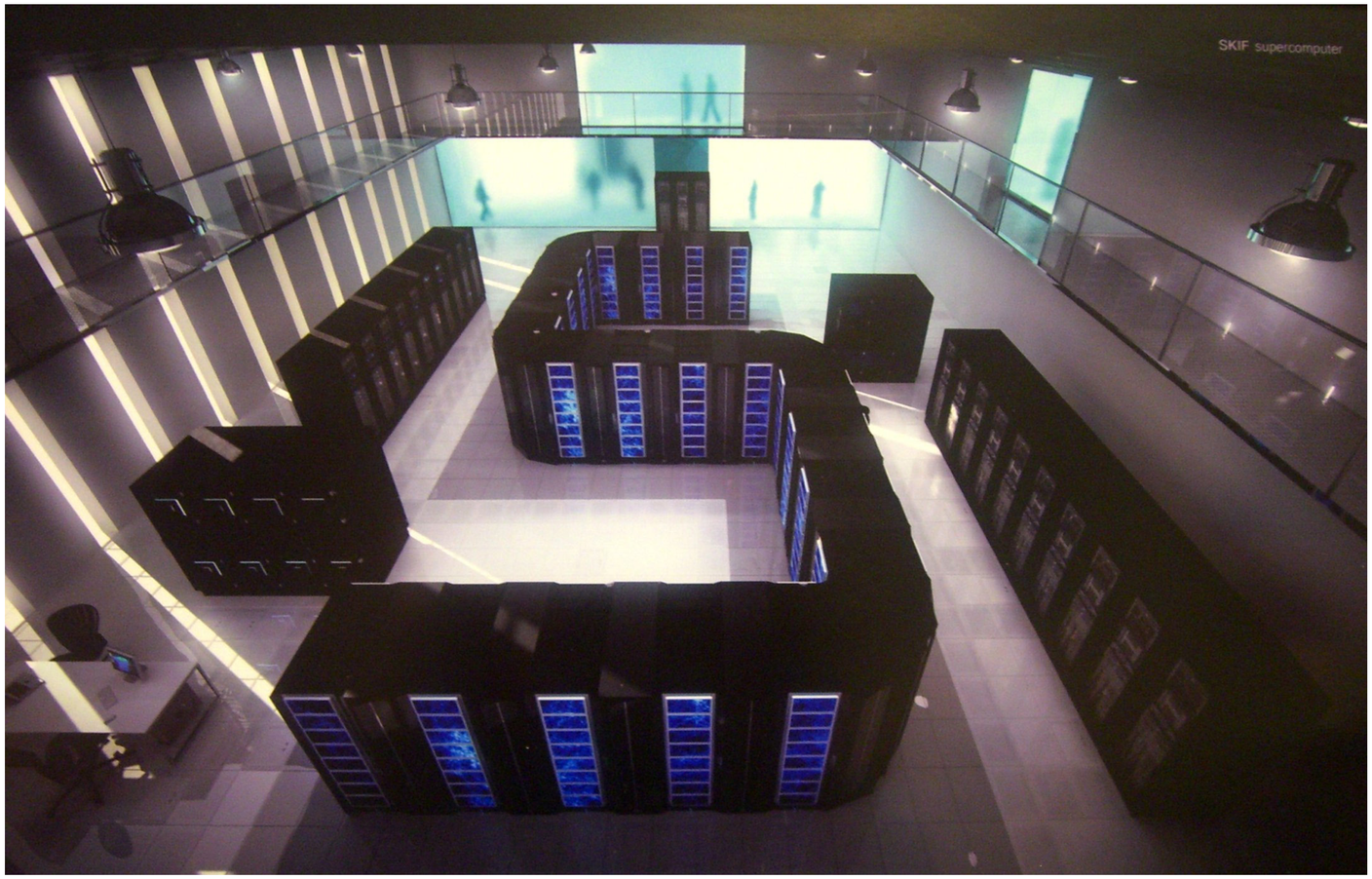
- Every message between nodes is delivered within limited time;
- Clock drift is limited;

[A] Synchronous Systems

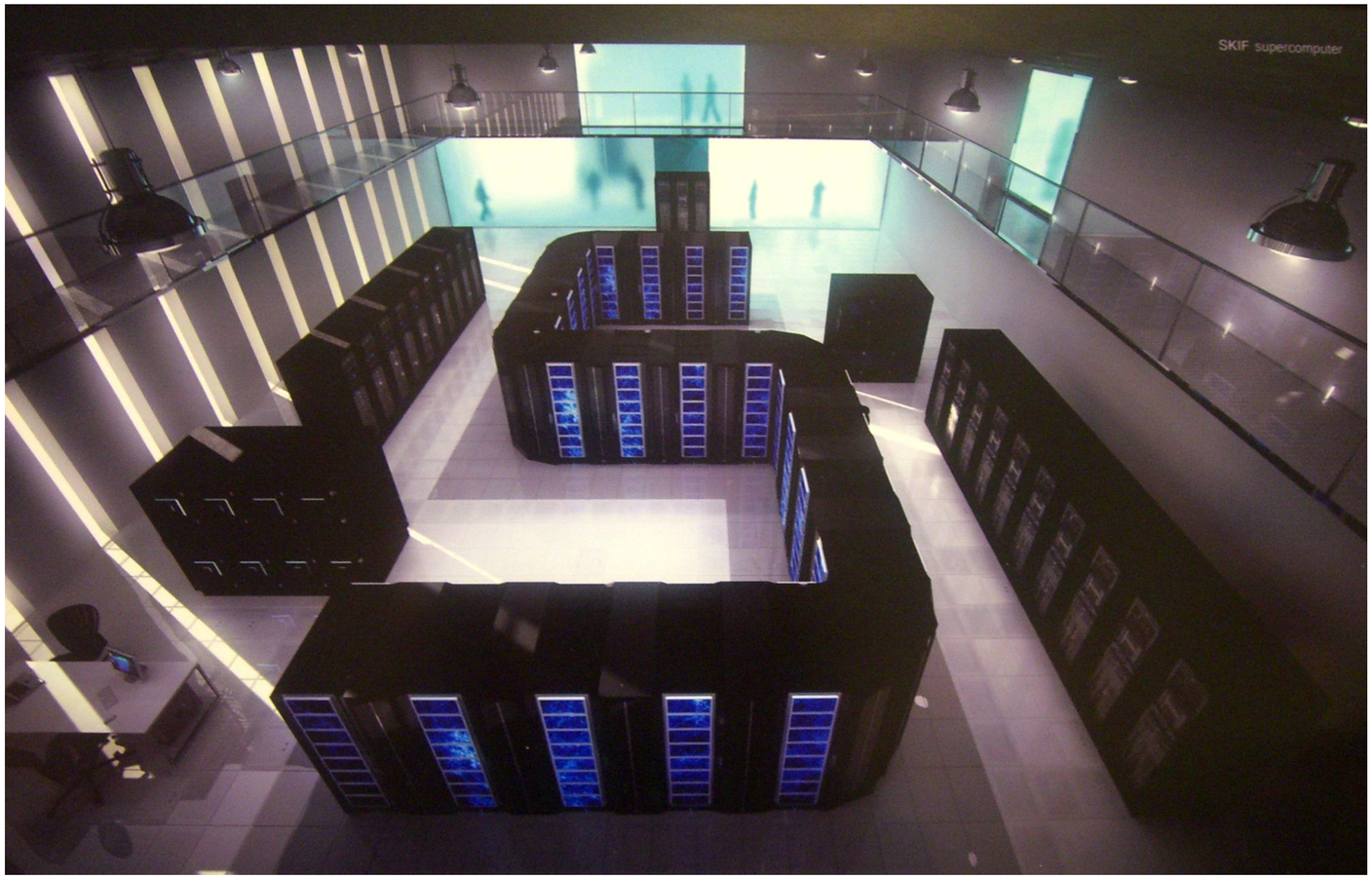
- Every message between nodes is delivered within limited time;
- Clock drift is limited;
- Each instruction execution is also limited.

Fail-Stop + Perfect Link + Synchronous

Fail-Stop + Perfect Link + Synchronous



Fail-Stop + Perfect Link + Synchronous

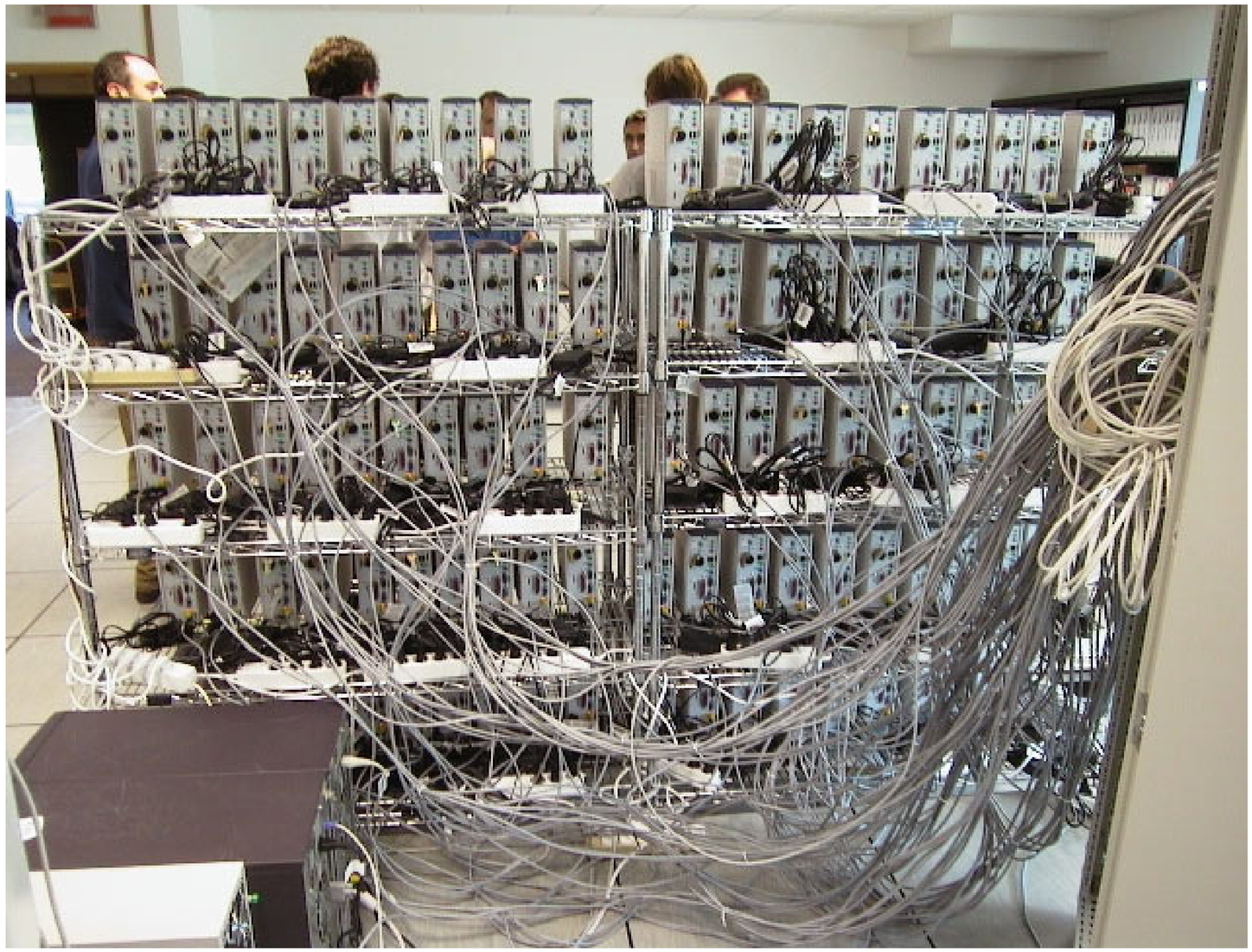


OpenMP

MPI

Fail-Recovery + Fair-Loss Link + Asynchronous

Fail-Recovery + Fair-Loss Link + Asynchronous

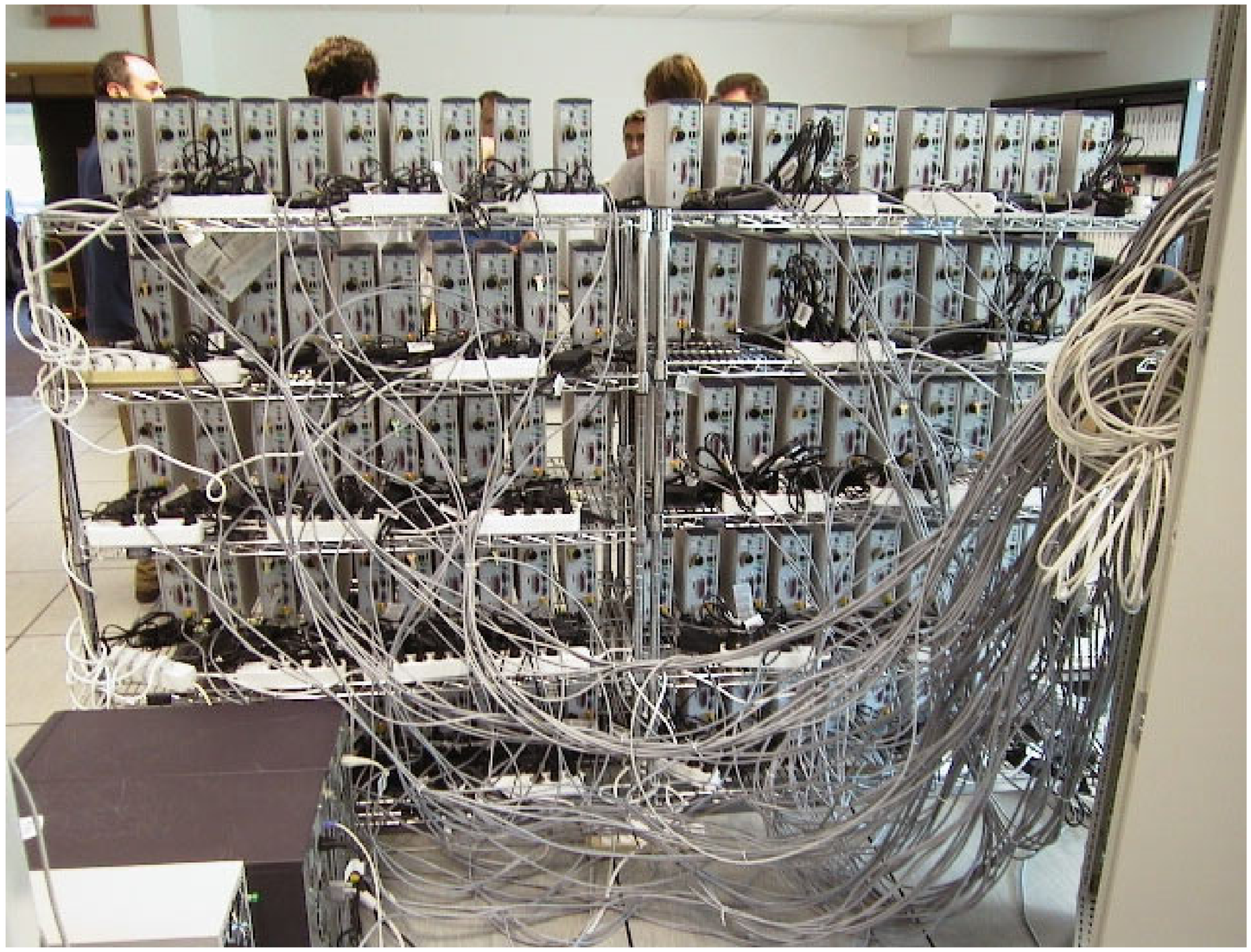


Byzantine-Failure + Byzantine Link
+ Asynchronous

Byzantine-Failure + Byzantine Link + Asynchronous

Grid Computing

Summary



You can provide a thorough description of a distributed system according to its robustness to node failures, link failures and clock synchronization model used in the system.

BigDATAteam