



Cloud Design Patterns

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Load Balancing

- Improves the distribution of workloads across multiple computing resources
 - Some resources will be busy while others are idle

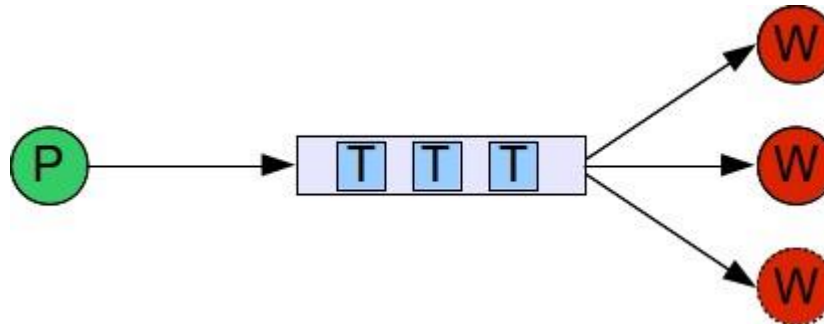
- Aims to
 - Optimize resource use
 - Maximize throughput
 - Minimize response time
 - Avoid overload of any single resource

Load Balancing

- Counter by distributing load equally
 - When cost of problem is well understood (e.g., matrix multiplication, known tree walk) this is possible
- Some other problems are not that simple
 - Hard to predict how workload will be distributed
 - dynamic load balancing used
 - But require communication between tasks
- 2 methods for dynamic load balancing
 - Task queues vs. work stealing

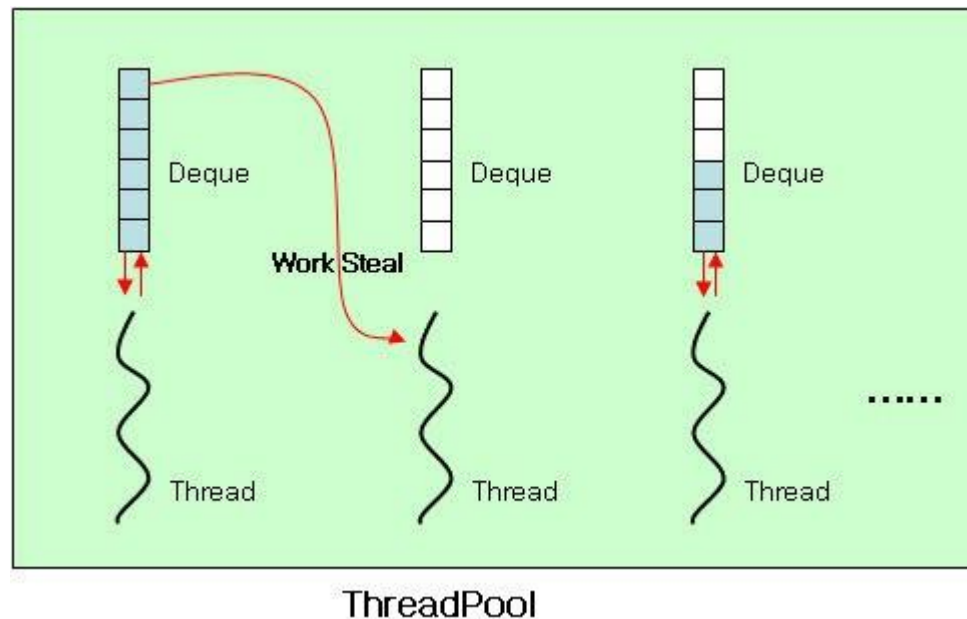
Task Queues

- ❑ Multiple instance of task queues (producer consumer)
- ❑ Threads comes to the task queue after finishing a task & grab next task
- ❑ Typically run with a pool of workers



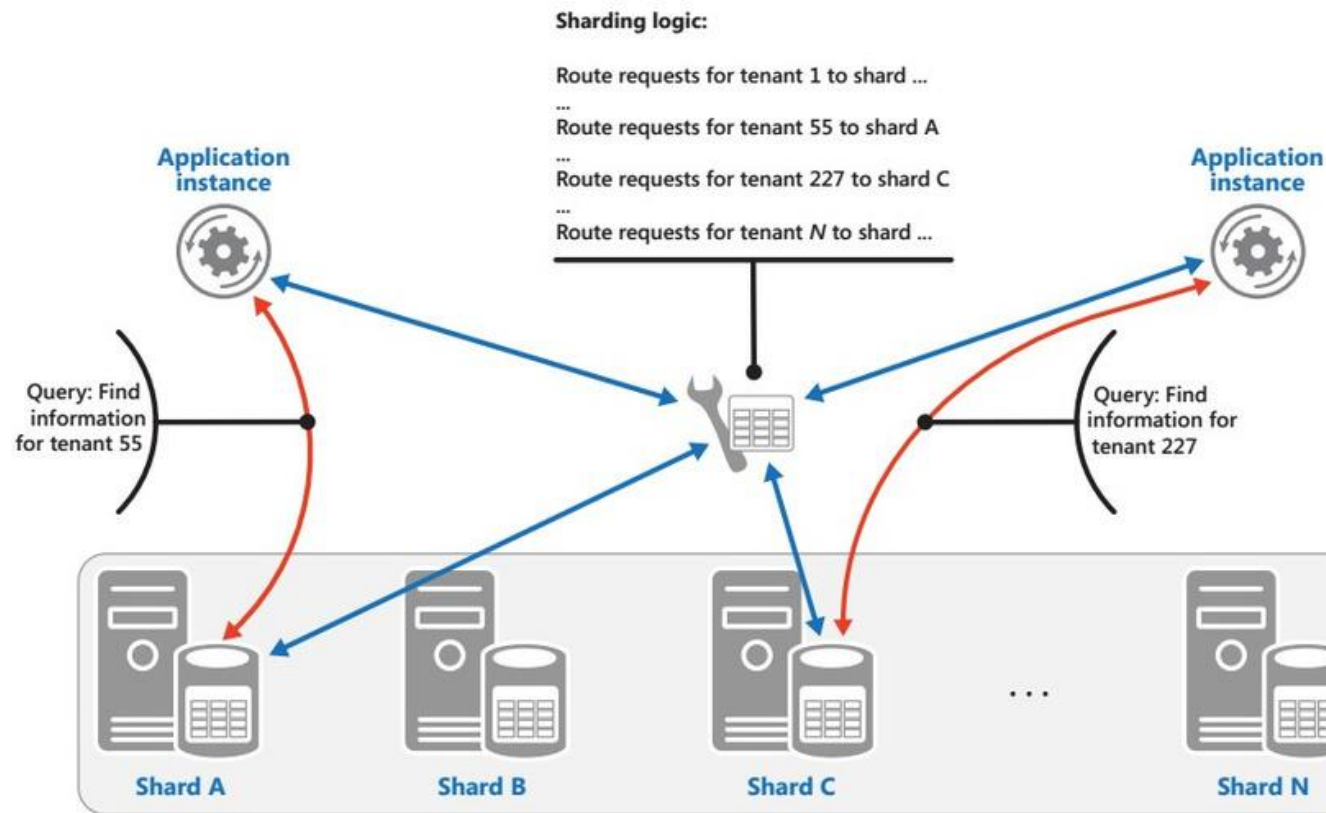
Work Stealing

- Every worker has a task queue
- When 1 worker runs out of work, it goes to other worker's queue & “steal” the work



Source: <http://karlsenchoi.blogspot.com>

Sharding Pattern



- Divide a data store into a set of horizontal partitions or shards to improve scalability

Sharding Pattern (Cont)

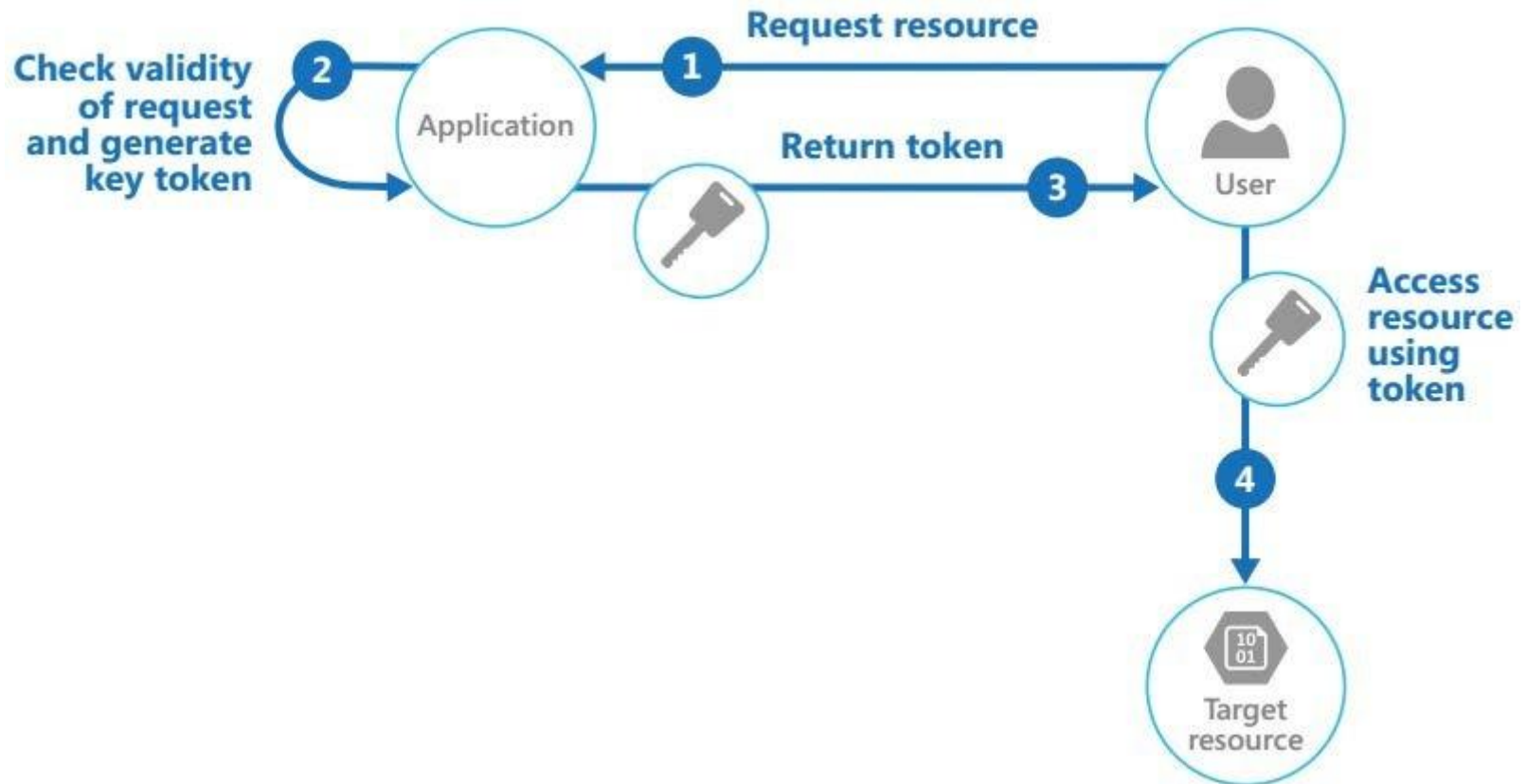
□ When

- Limited storage space
- Large computation requirement
- Network bandwidth
- Geographical constraints

□ Sharding Strategies

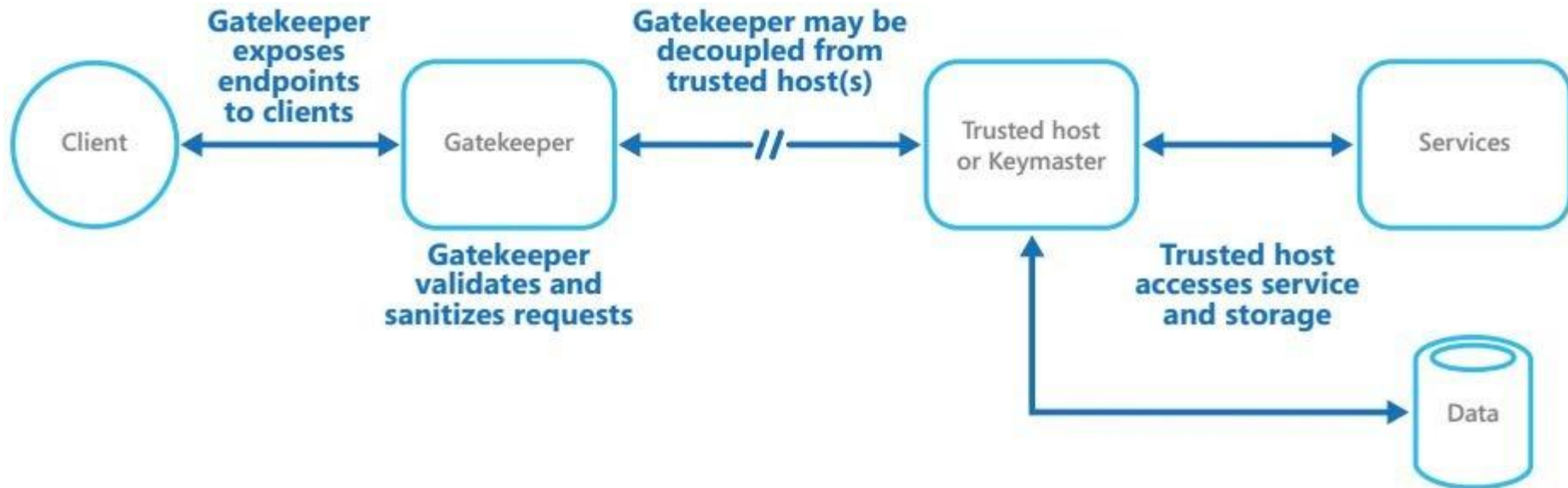
- Lookup Strategy – map request using a shard key
- Range Strategy – groups related items together in the same shard
- Hash Strategy – shard decided based on hashing data attributes

Valet Key Pattern



- Use a token or key that provides client with restricted direct access to a specific resource or service

Gatekeeper Pattern

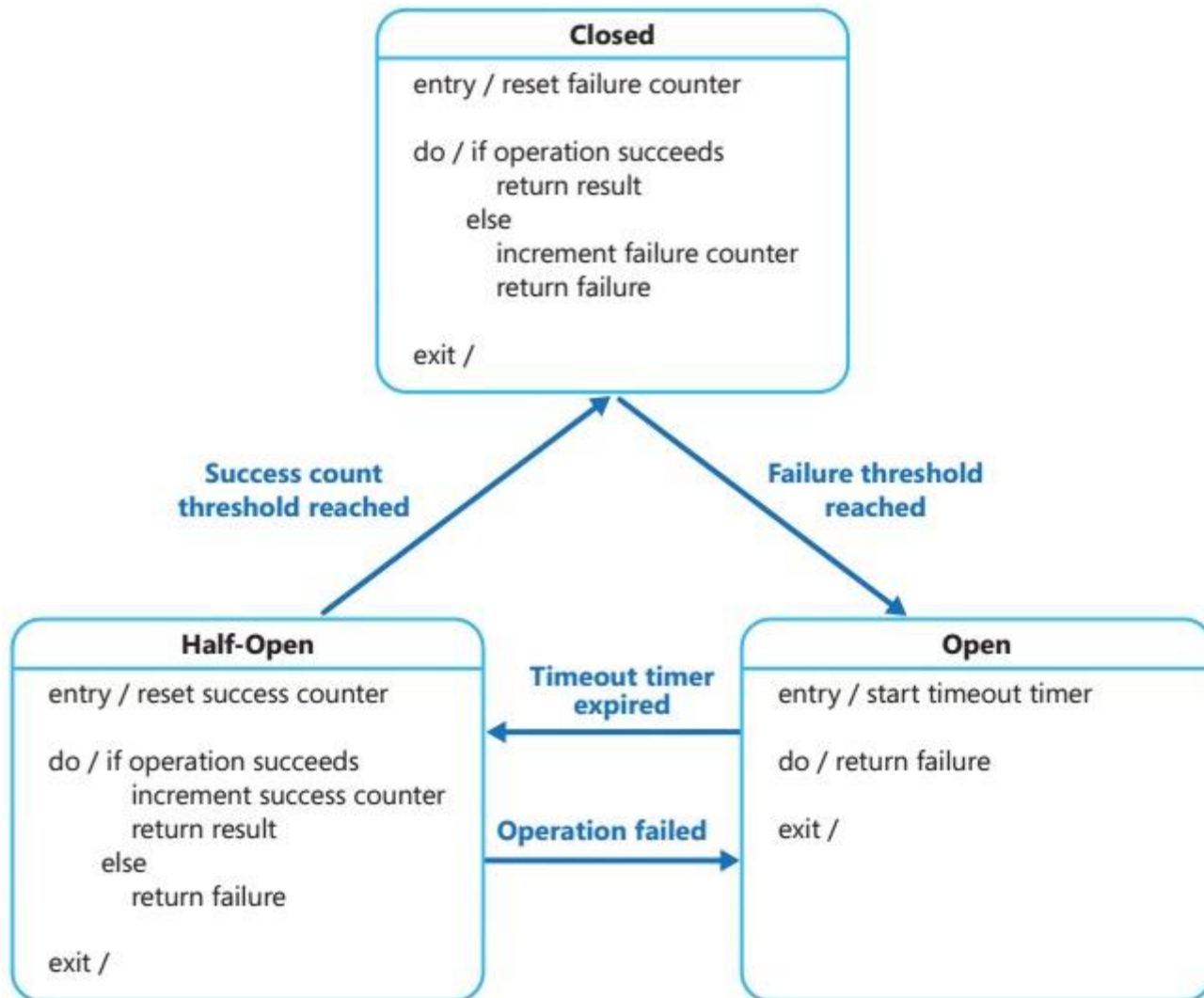


- Protect applications & services using a dedicated host instance that acts as a broker
 - Validates & sanitizes requests
 - Passes requests & data between them

Gatekeeper Pattern (Cont.)

- ❑ Only function is to validate & sanitize requests
- ❑ Should use secure communication between gatekeeper & trusted hosts
- ❑ Internal end point must connect only to gatekeeper
- ❑ Gatekeeper must run in limited privilege mode
- ❑ May use multiple gatekeepers for availability

Circuit Breaker Pattern



Circuit Breaker Pattern (Cont.)

□ When

- Handle faults that may take a variable amount of time to rectify when connecting to a remote service/resource
- When a simple retry will not work
- Prevent application from getting tied-up due to retry

□ Half-Open State

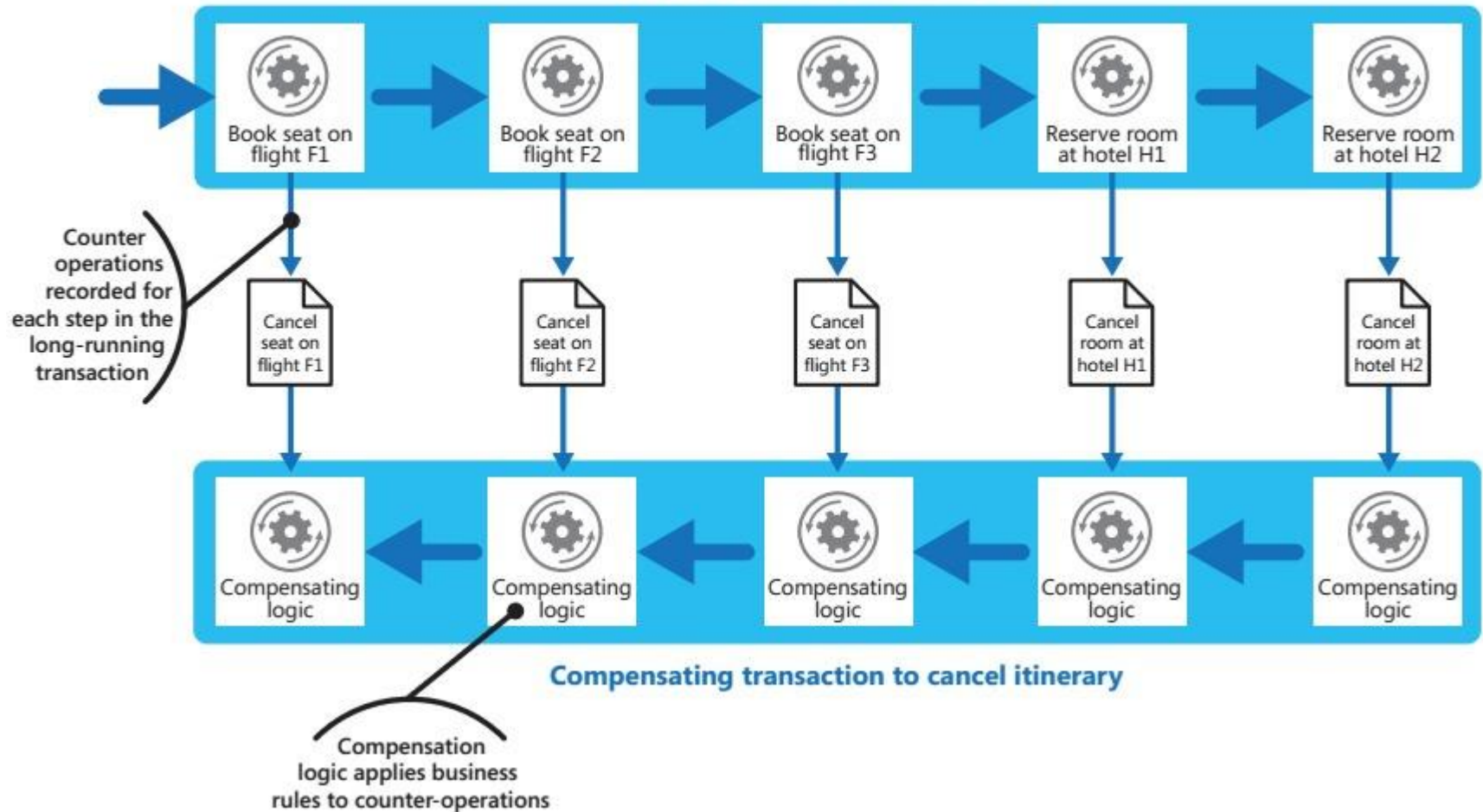
- Allow checking whether service is responding by issuing a limited set of requests
- Prevent repeated system failures due to rapid load/volume

Circuit Breaker Pattern (Cont.)

- Parameters
 - Types of exceptions
 - Handling exceptions
 - Logging & replay
 - Testing failed operations
 - Manual reset

Compensating Transaction Pattern

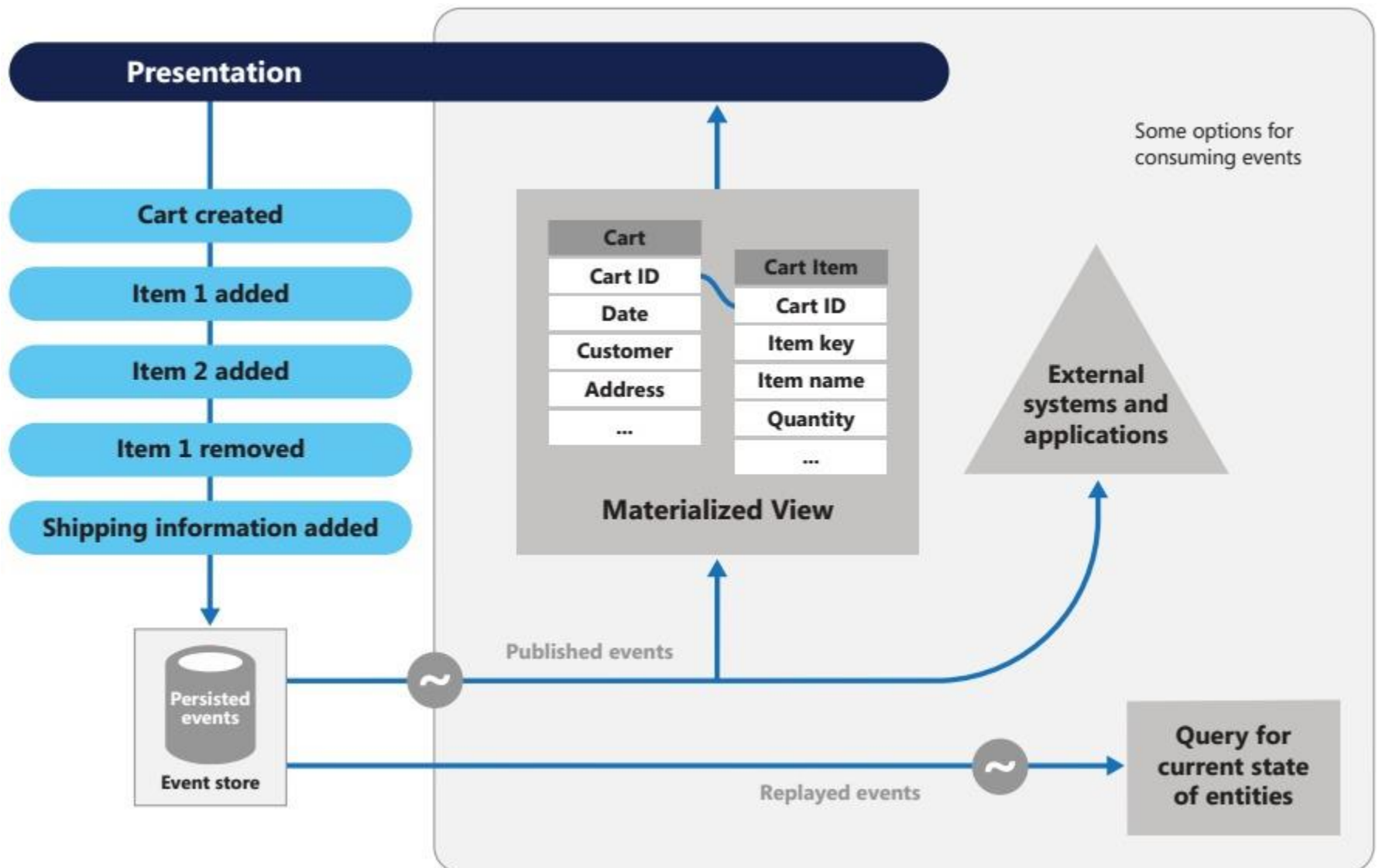
Operation steps to create itinerary



Compensating Transaction Pattern (Cont.)

- Undo work performed by a series of steps, which together define an eventually consistent operation
- Implement a workflow
 - As operation proceeds, system records information about each step & how the work by that step can be undone
 - If operation fails at any point, workflow rewinds back through steps it has completed while performing work that reverses each step

Event Sourcing Pattern



Event Sourcing Pattern (Cont.)

- Record full series of events than current state

- Pros

 - Avoid requirement to synchronize data

 - Traditional Create, Read, Update, & Delete (CRUD) model too slow

 - Improve performance with eventual consistency

 - Scalability

 - Responsiveness

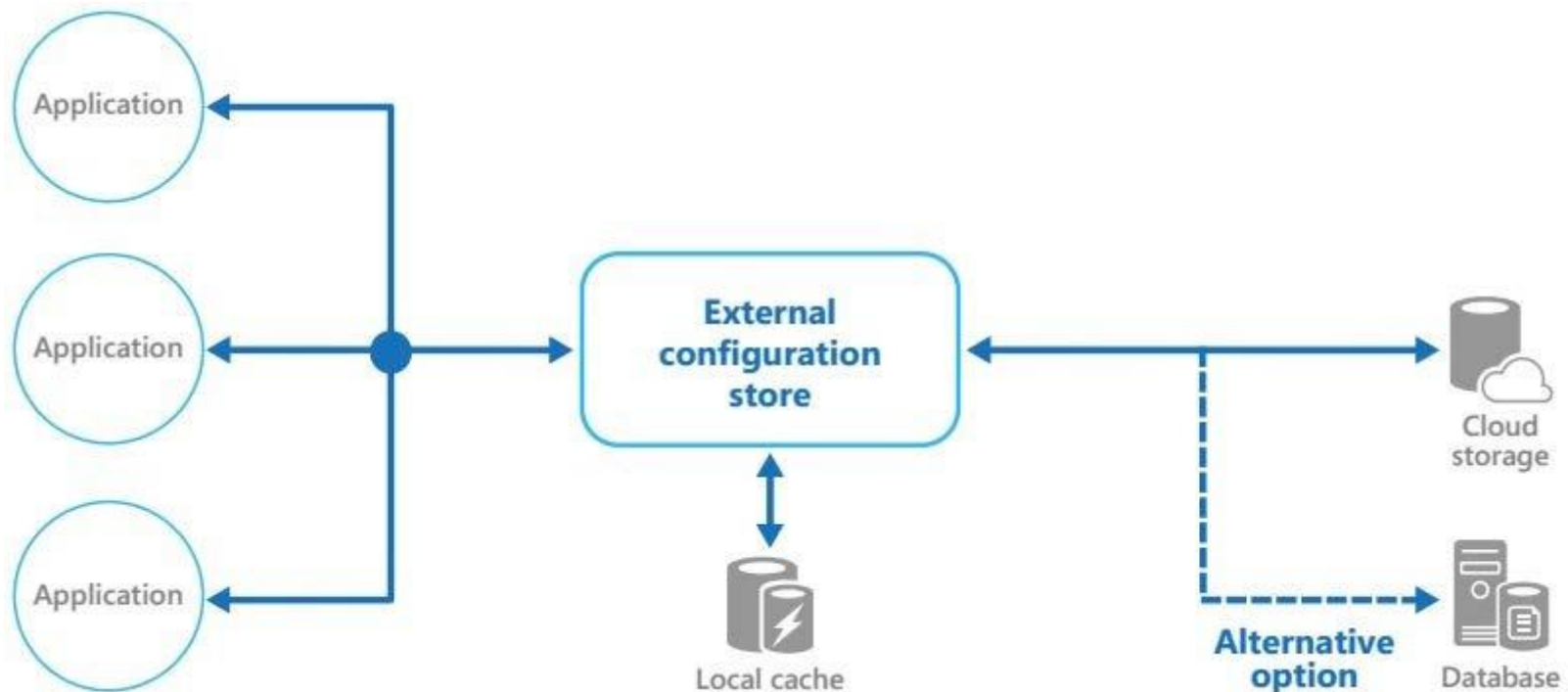
 - Provide consistency for transactional data

 - Full audit trails

- Cons

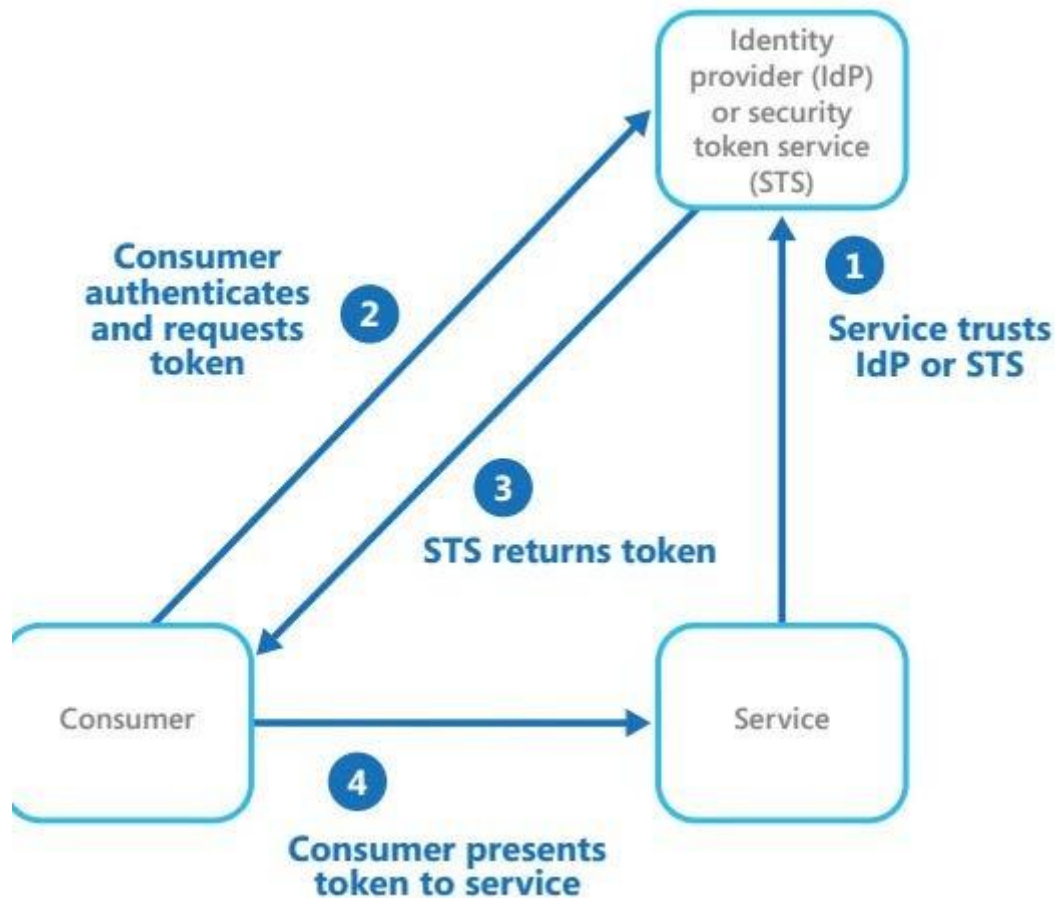
 - Consistency relaxed

External Configuration Store Pattern



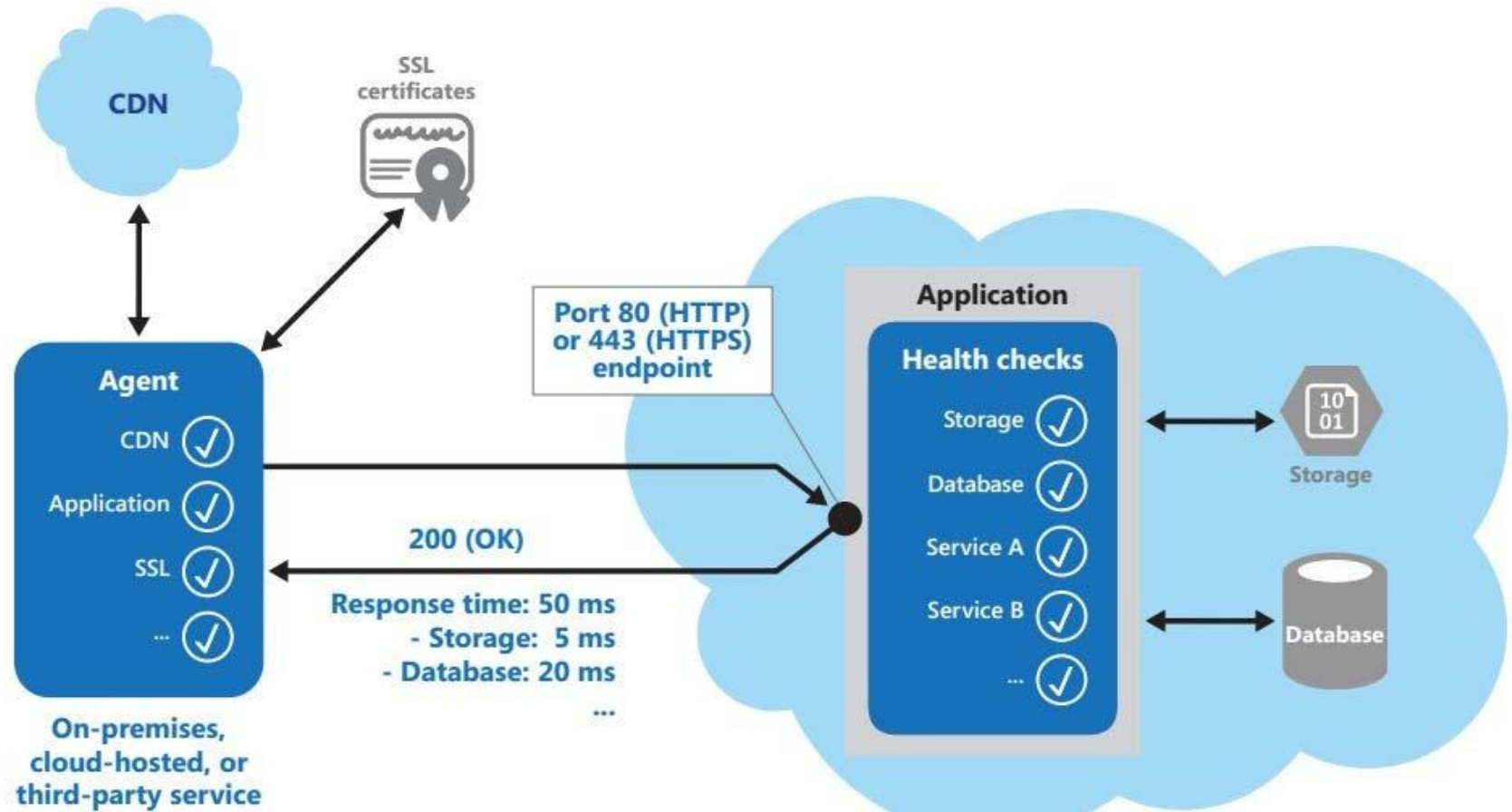
- Move configuration information out of application deployment package to a central location

Federated Identity Pattern



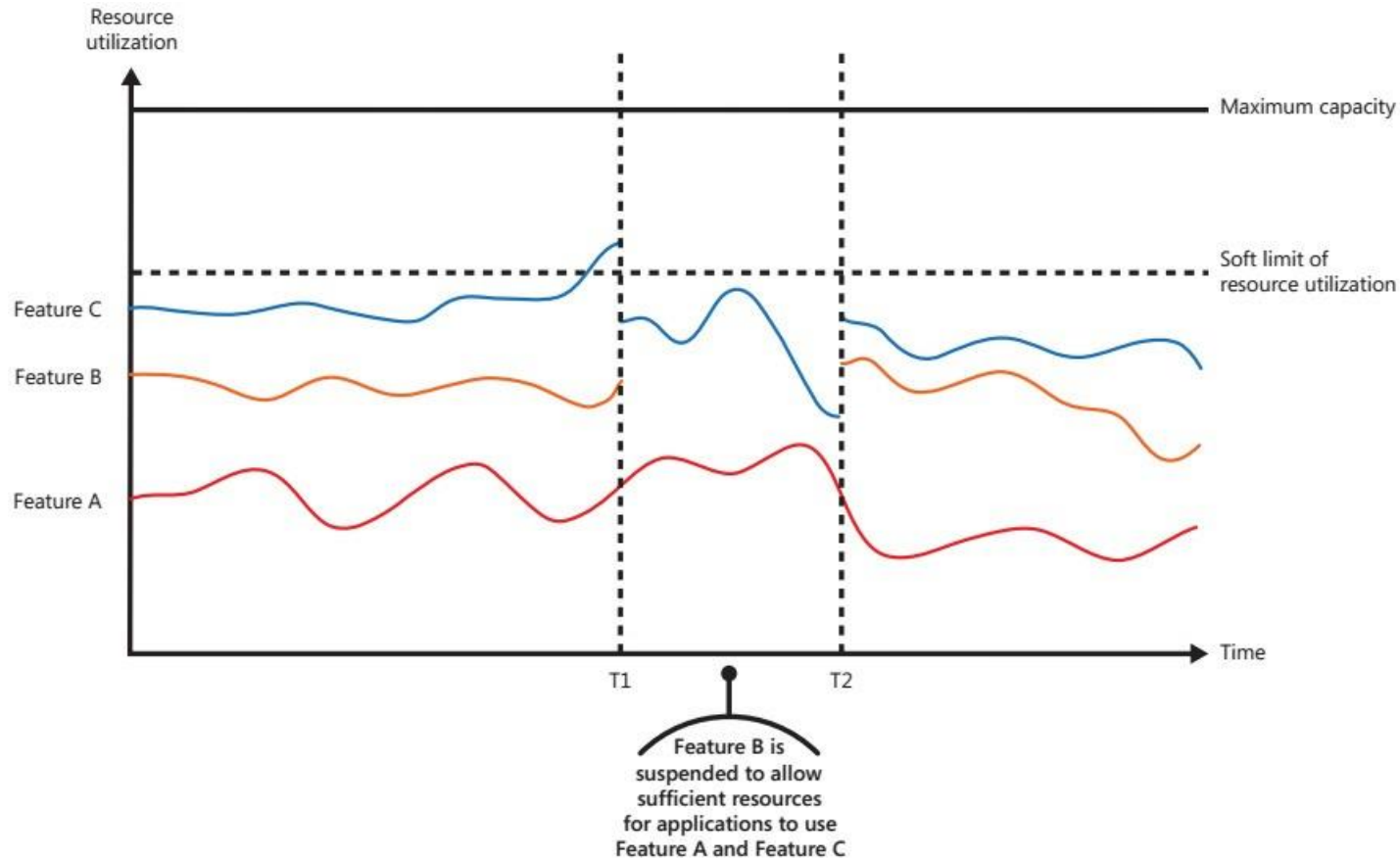
- Delegate authentication to an external identity provider

Health Endpoint Monitoring Pattern



- Functional checks within an application that external tools can access through exposed endpoints at regular intervals

Throttling Pattern



- Control consumption of resources used by an instance
- Allow system to continue to function & meet SLA even when an increase in demand places an extreme load on resources