Cloud Design Patterns

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Design Patterns

A generally reusable solution to a recurring problem

- A template to solve the problem
- Best practices in approaching the problem
- Improve developer communication

Cloud Application Development Issues

Availability

- The guaranteed proportion of time that the system is functional

SLA – Service Level Agreement

Availability (%)	Downtime per year
99	3.7 days
99.9	9 hours
99.95	4.4 hours
99.99	1 hour
99.999	5 minutes

Cloud Application Development Issues

- Data Management
  - Typically hosted in different locations and across multiple servers for performance, scalability and availability
  - Maintaining consistency and synchronizing

- Design and Implementation
  - Consistent and coherent component design
  - Improves ease of deployment and maintenance
  - Reusability of components

Cloud Application Development Issues

- Messaging
  - Messaging infrastructure to connect distributed components and services
  - Asynchronous messaging
- Design and Implementation
  - Consistent and coherent component design
  - Improves ease of deployment and maintenance
  - Reusability of components

Cloud Application Development Issues

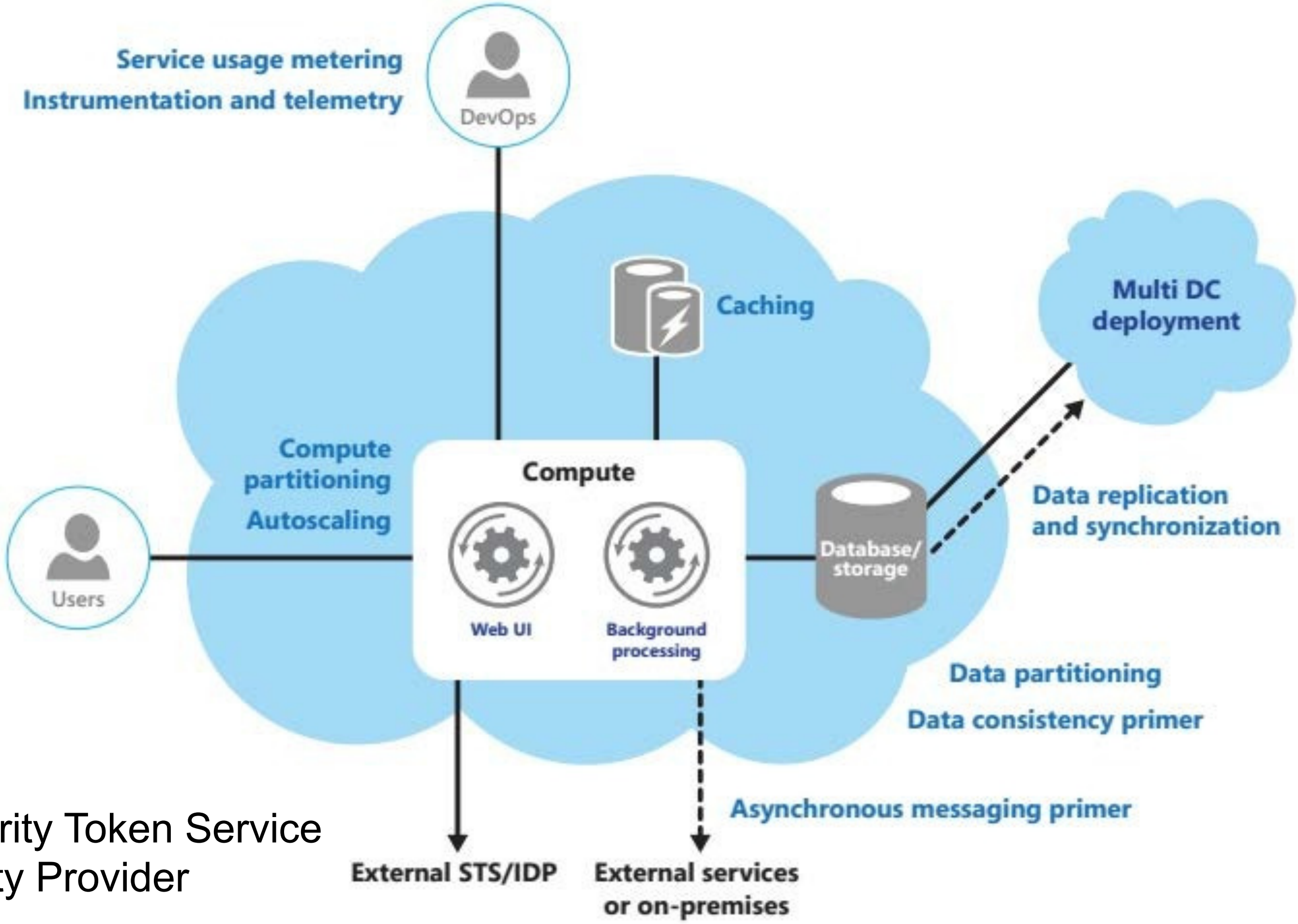
- Management and Monitoring
  - Cloud applications run in in a remote servers with limited control

- Performance and Scalability
  - Responsiveness of a system to execute any action within a given time interval
  - Handle increases in load without impact on performance
  - How to handle variable workloads?

Cloud Application Development Issues

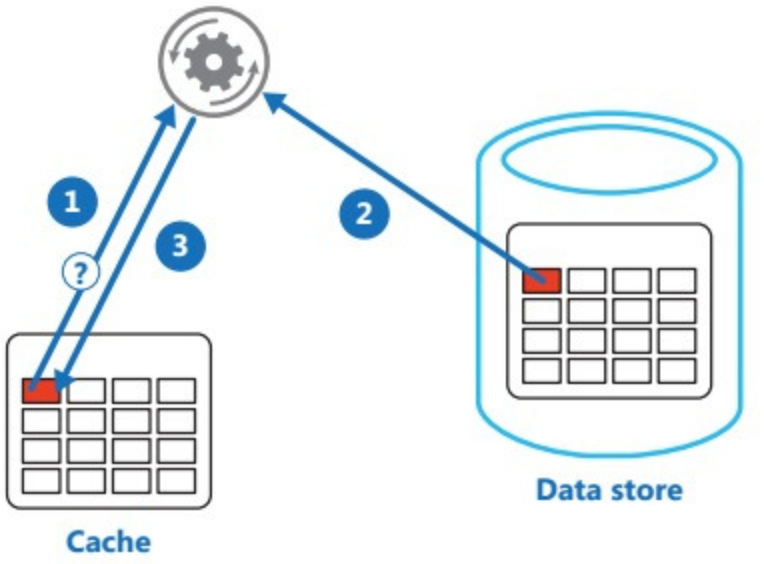
- Resiliency
  - Ability of the application to gracefully handle and recover from failures
  - Applications are more prone to failure in cloud environments
- Security
  - Prevent malicious or accidental actions outside of the designed usage
  - Prevent disclosure or loss of information

High-Level Model



STS – Security Token Service
IDP – Identity Provider

Cache-Aside Pattern



1: Determine whether the item is currently held in the cache.
2: If the item is not currently in the cache, read the item from the data store.
3: Store a copy of the item in the cache.

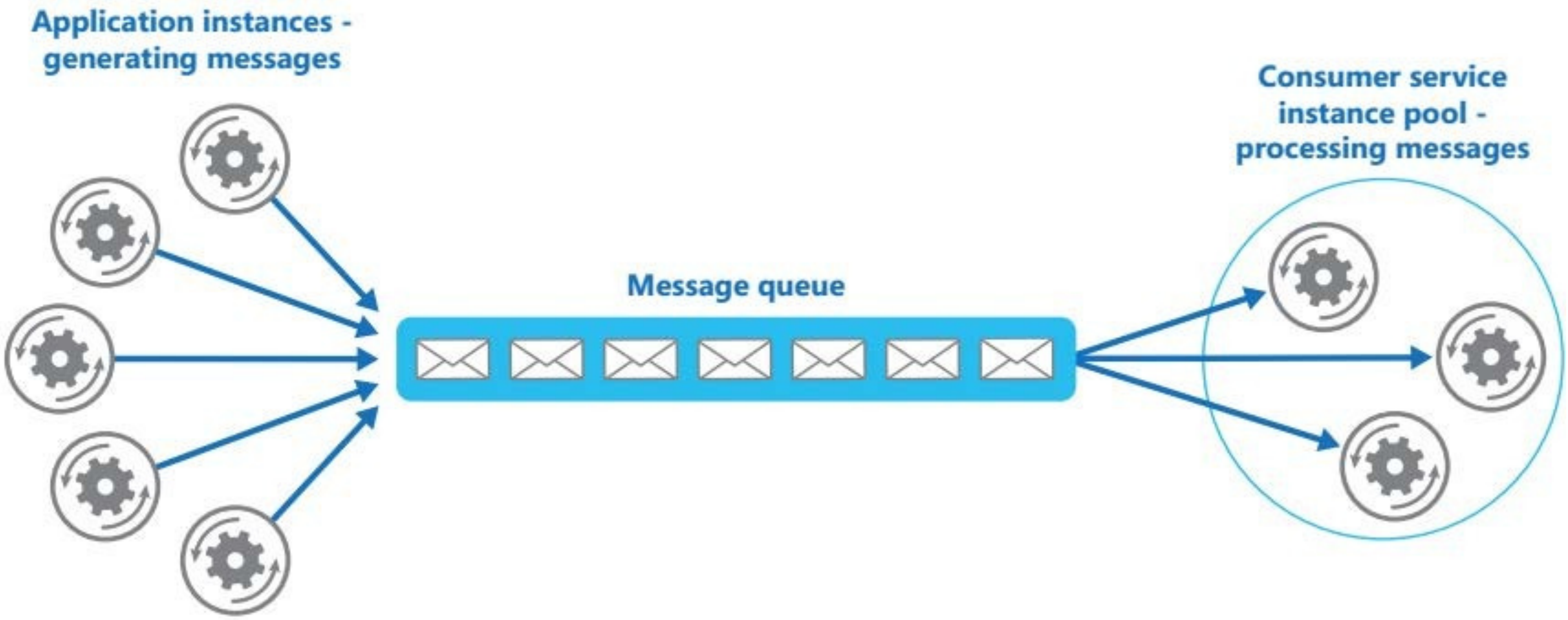
- Load on demand data into a cache from a data store
- Pros
  - Increased performance
- Cons
  - Maintaining consistency between data in cache & data in underlying data store
- Solutions
  - Azure Cache AWS ElastiCache
  - Google App Engine memcache
  - Redis Cache

Cache-Aside Pattern (Cont.)

- When
  - Read/write performance

- Parameters
  - What to cache
  - Lifetime of cached data
  - Cache size
  - Evicting data In Memory
  - Caching

Competing Consumers Pattern


Application instances - generating messages
Message queue
Consumer service instance pool - processing messages

- Multiple concurrent consumers to process messages received on same channel
- Goals
  - Optimize throughput, improve scalability & availability, load balancing

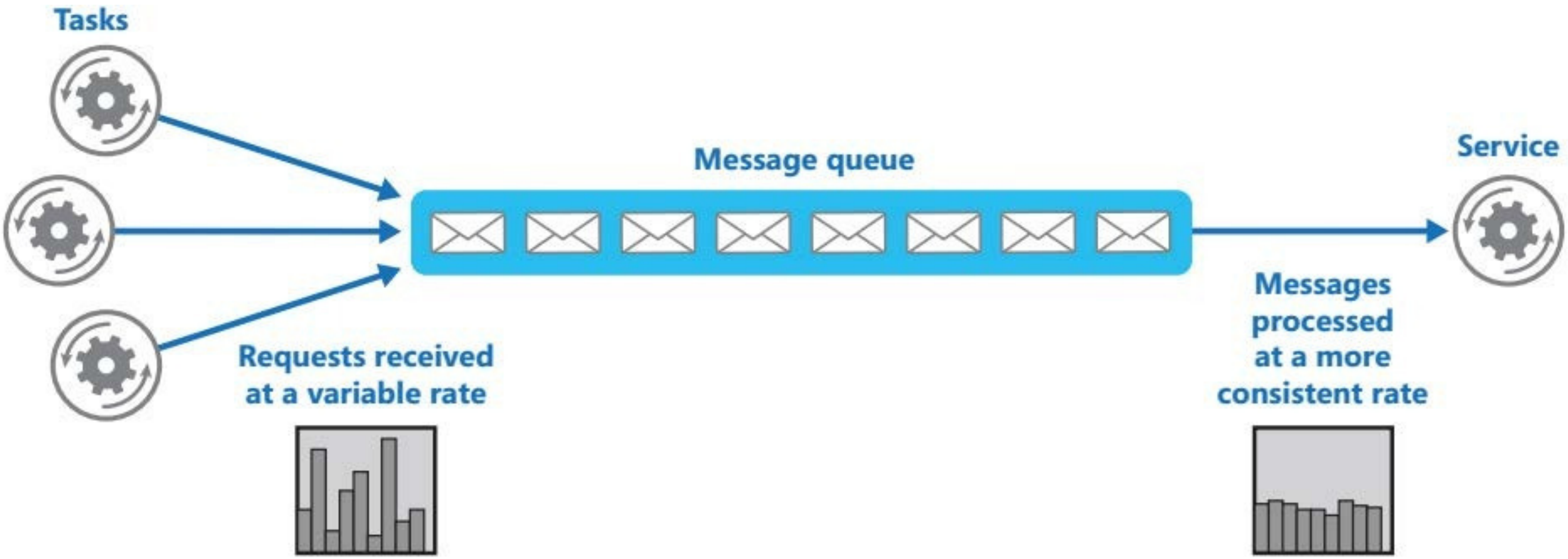
Competing Consumers Pattern (Cont.)

- When
  - Independent tasks that can be processed parallel
  - Volume of work is highly variable
  - High availability

Competing Consumers Pattern (Cont.)

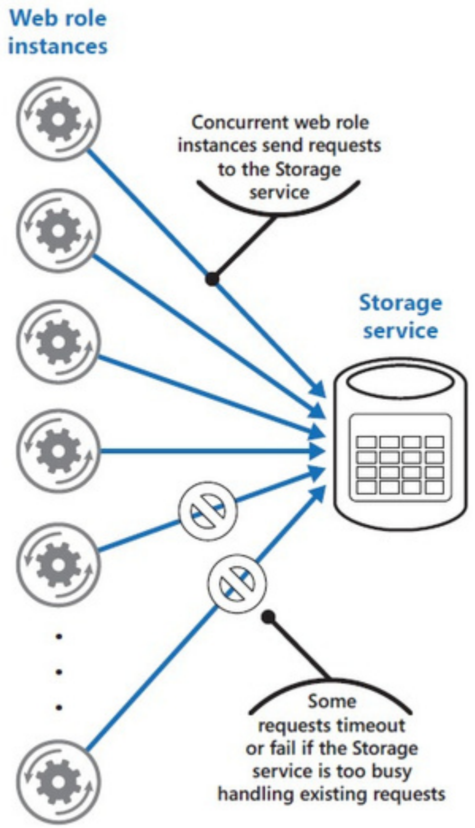
- Parameters
  - Queue size
  - Scaling
  - Not loosing messages
  - Preserving message ordering
  - Resiliency
  - Poison/malformed messages
  - Returning results

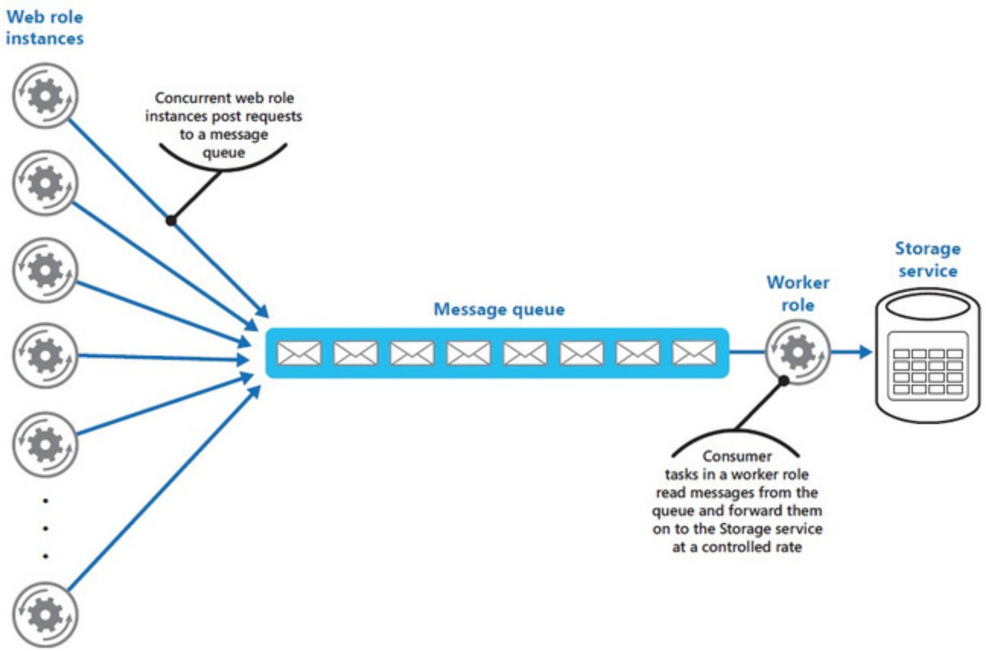
Queue-Based Load Leveling Pattern


Tasks
Message queue
Service
Requests received at a variable rate
Messages processed at a more consistent rate

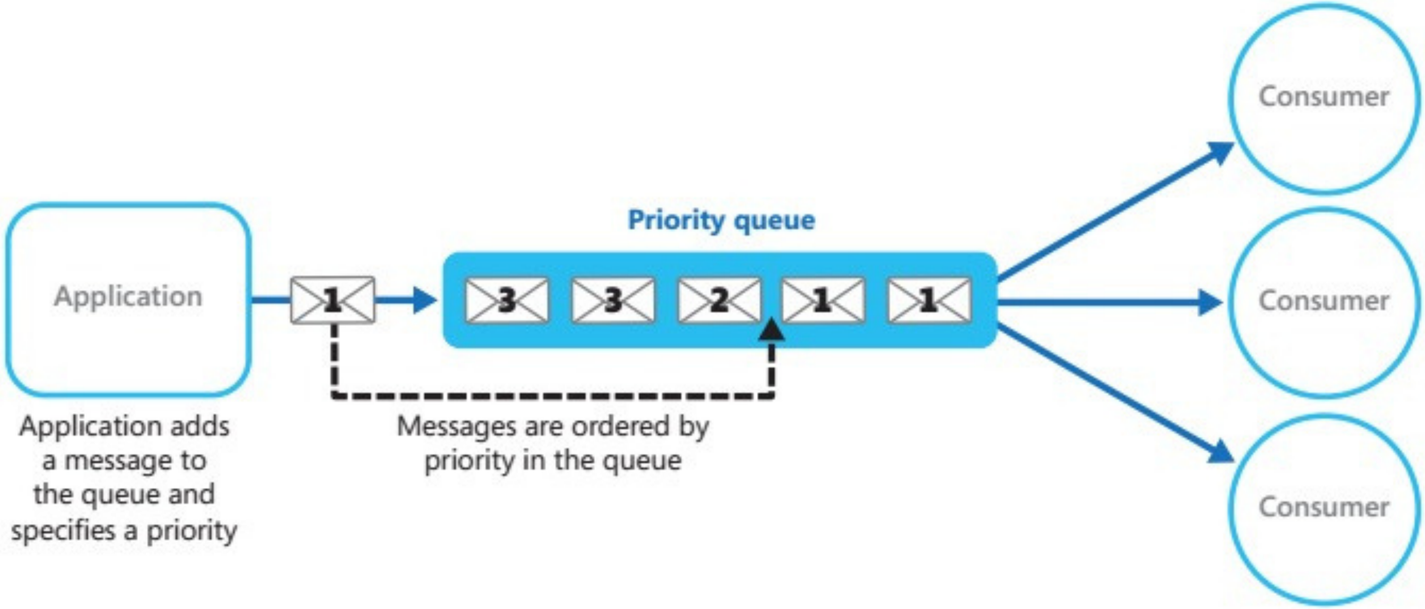
- To smooth intermittent heavy loads that may otherwise cause the service to fail or the task to time out

Queue-Based Load Leveling Pattern


Web role instances
Concurrent web role instances send requests to the Storage service
Storage service
Some requests timeout or fail if the Storage service is too busy handling existing requests


Web role instances
Concurrent web role instances post requests to a message queue
Message queue
Worker role
Storage service
Consumer tasks in a worker role read messages from the queue and forward them on to the Storage service at a controlled rate

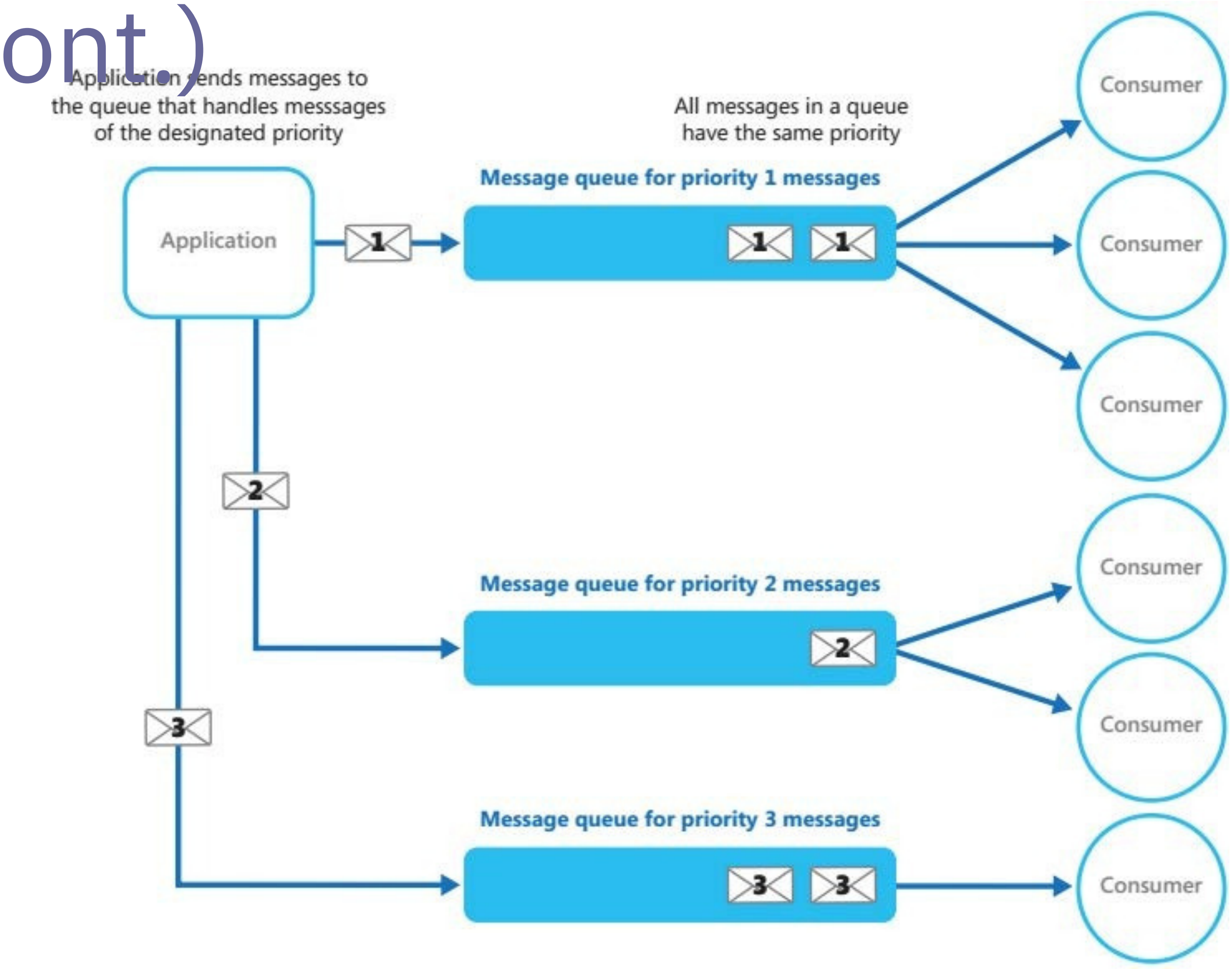
Priority Queue Pattern



Application
Application adds a message to the queue and specifies a priority
1
Priority queue
3
3
2
1
1
Messages are ordered by priority in the queue
Consumer
Consumer
Consumer

- Prioritize requests sent to services so that requests with a higher priority are received & processed quickly

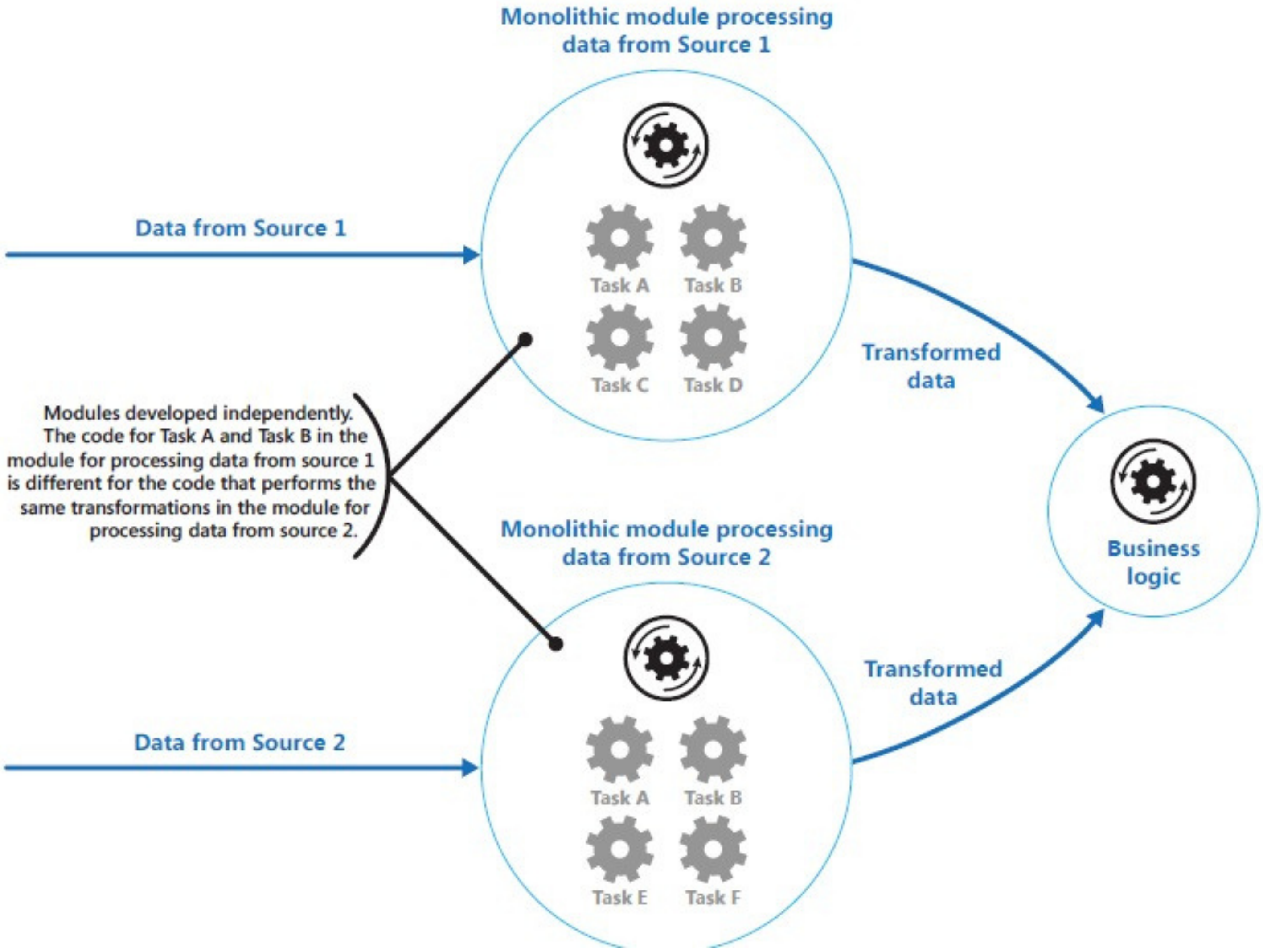
Priority Queue Pattern (Cont.)


Application sends messages to the queue that handles messsages of the designated priority
All messages in a queue have the same priority
Application
1
Message queue for priority 1 messages
1
1
Consumer
Consumer
Consumer
2
Message queue for priority 2 messages
2
Consumer
Consumer
3
Message queue for priority 3 messages
3
3
Consumer

Priority Queue Pattern (Cont.)

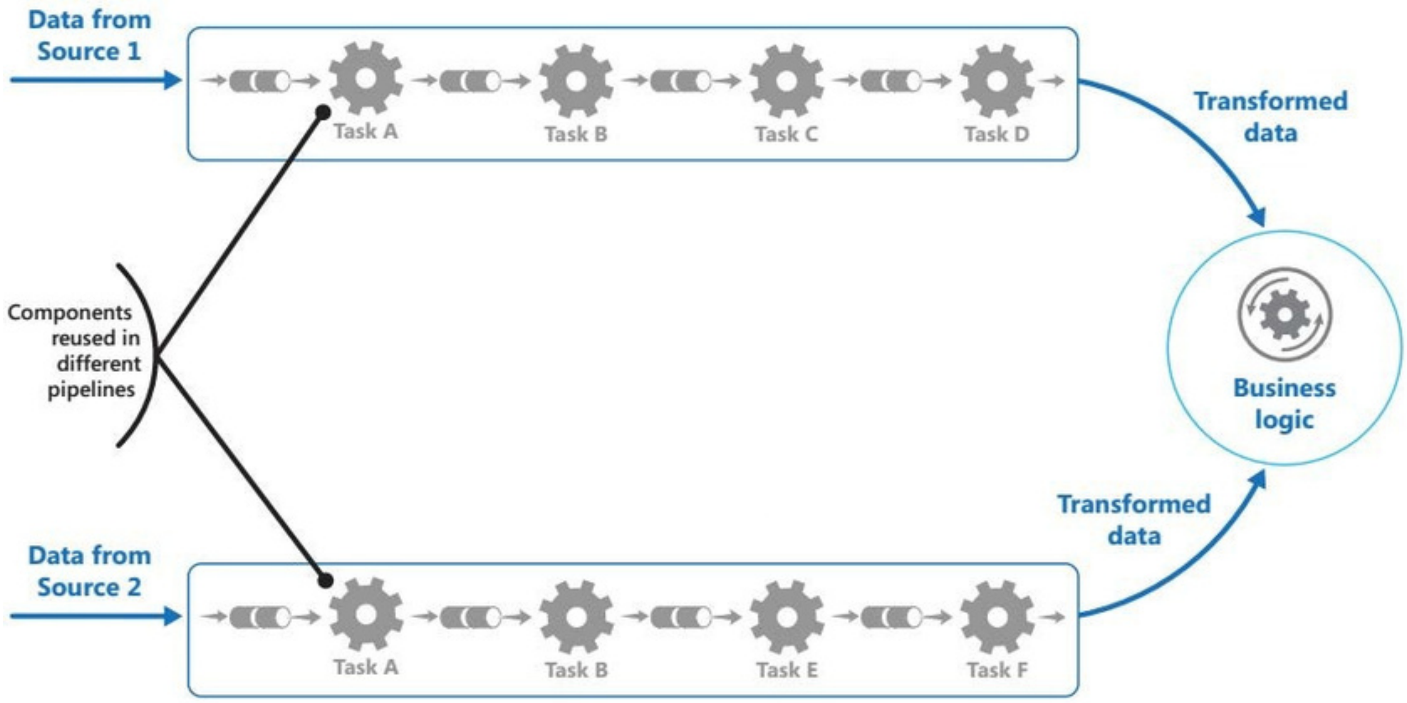
- When,
  - The system handles multiple tasks that have different priorities
  - Different users should be served with different priorities

Pipes & Filters Pattern



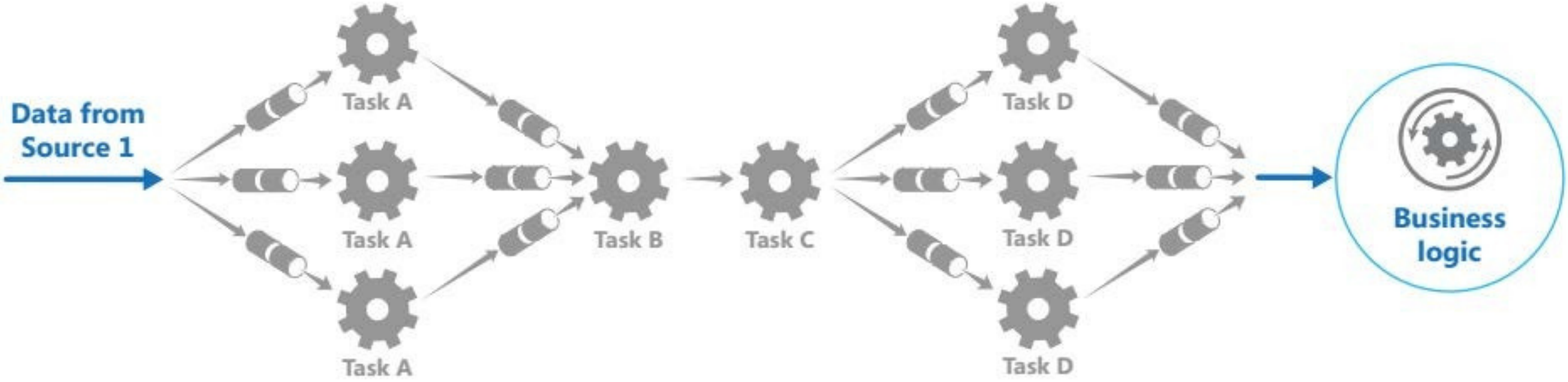
Monolithic module processing data from Source 1
Data from Source 1
Task A
Task B
Task C
Task D
Transformed data
Modules developed independently. The code for Task A and Task B in the module for processing data from source 1 is different for the code that performs the same transformations in the module for processing data from source 2.
Business logic
Monolithic module processing data from Source 2
Transformed data
Data from Source 2
Task A
Task B
Task E
Task F

Pipes & Filters Pattern (Cont.)



- Decompose a task that performs complex processing into a series of discrete elements that can be reused

Pipes & Filters Pattern – With Load Balancing



- When,
  - Application can be decomposed to steps
  - Steps have different scalability requirements
  - Flexibility of processing
  - Need distributed processing