



# Cloud Design Patterns

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SLIIT | March 2025

# Design Patterns

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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

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## 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

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## 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

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## □ 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

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## □ 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

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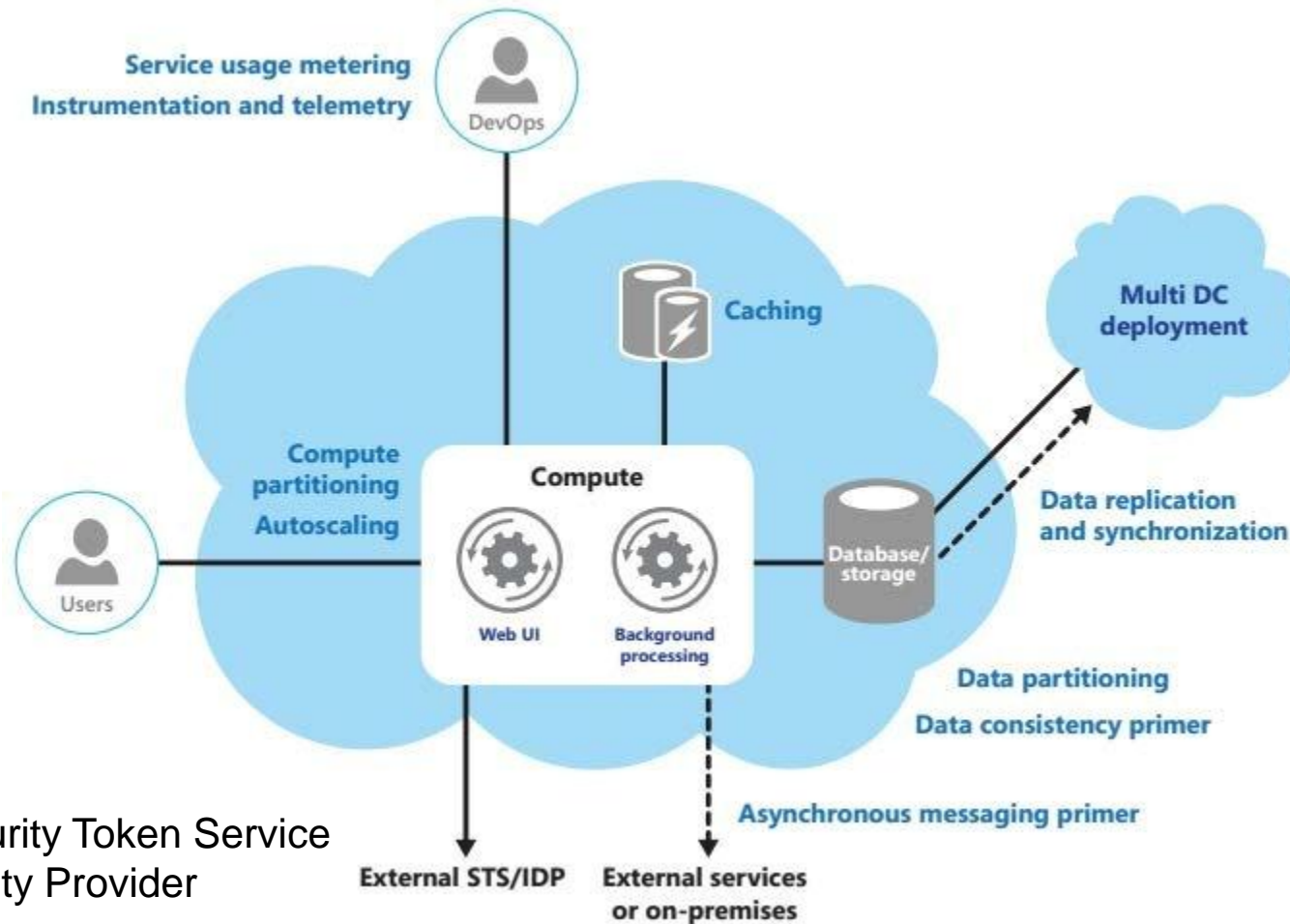
## □ Resiliency

- Ability of the application to gracefully handle and recover from failures
- Applications are more prone to failure in cloud environments

## □ Security

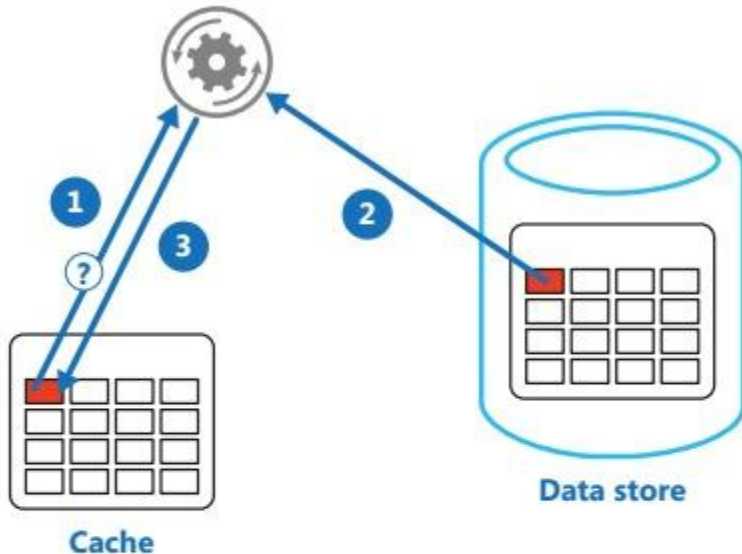
- Prevent malicious or accidental actions outside of the designed usage
- Prevent disclosure or loss of information

# High-Level Model





# 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.

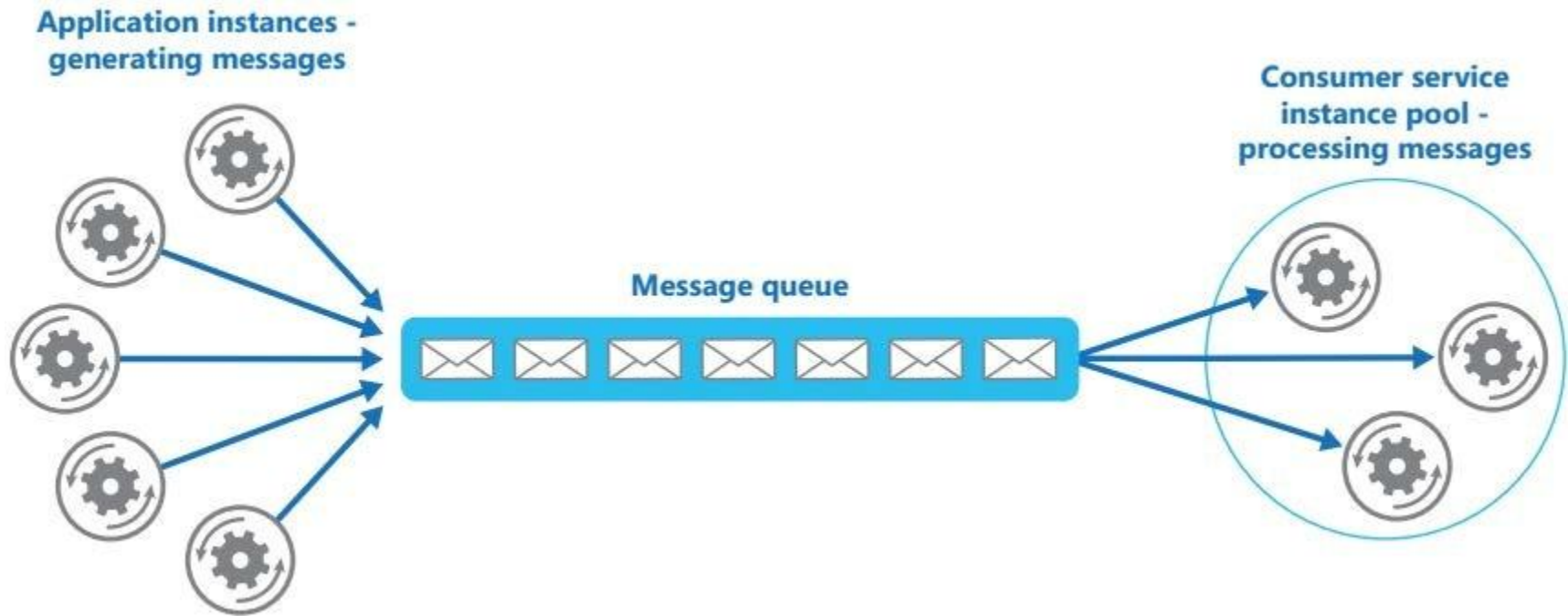
- Load on demand data into a cache from a data store
- Pros
  - Increased performance
- Cons
  - Maintaining consistency between data in cache & data in underlying data store
- Solutions
  - Azure Cache AWS ElastiCache
  - Google App Engine memcache
  - Redis Cache
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#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

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- When
  - Read/write performance
  
- Parameters
  - What to cache
  - Lifetime of cached data
  - Cache size
  - Evicting data In Memory
  - Caching

# Competing Consumers Pattern



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

# Competing Consumers Pattern (Cont.)

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## □ When

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

# Competing Consumers Pattern (Cont.)

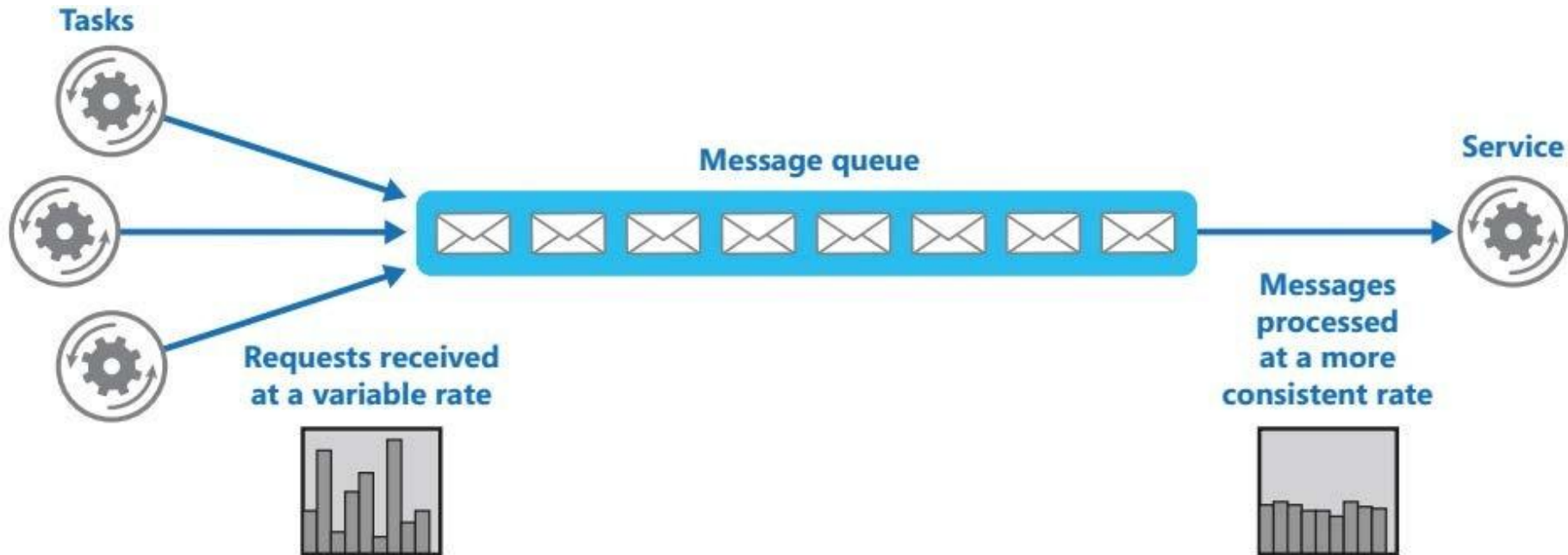
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## □ Parameters

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

# Queue-Based Load Leveling Pattern

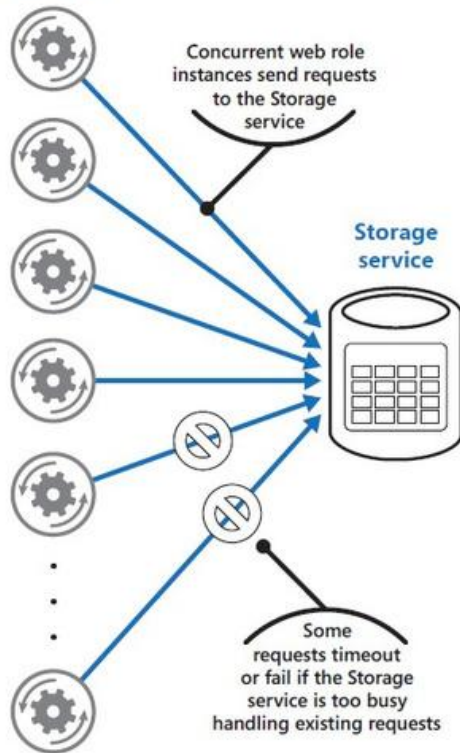
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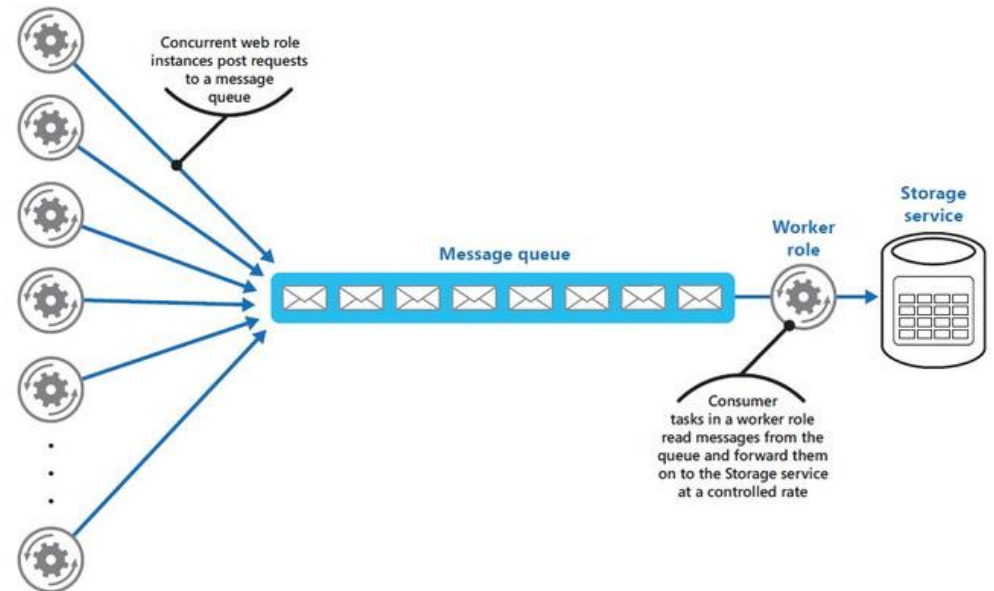
- To smooth intermittent heavy loads that may otherwise cause the service to fail or the task to time out

# Queue-Based Load Leveling Pattern

Web role instances

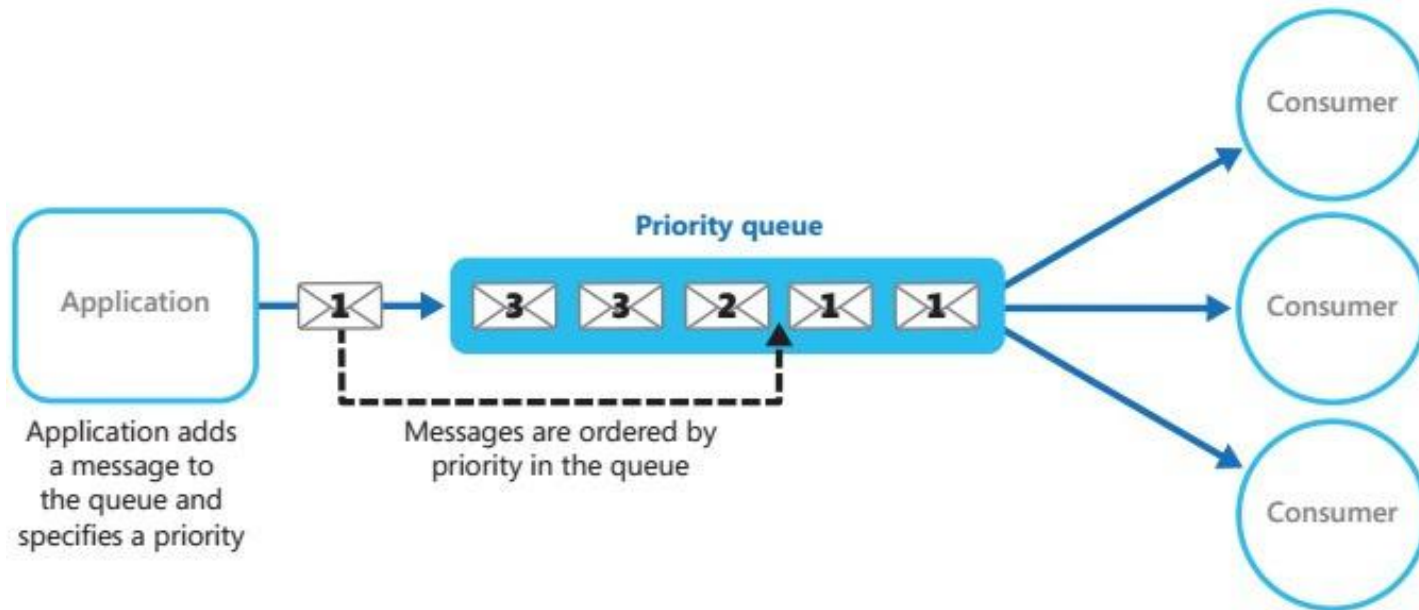


Web role instances



# Priority Queue Pattern

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

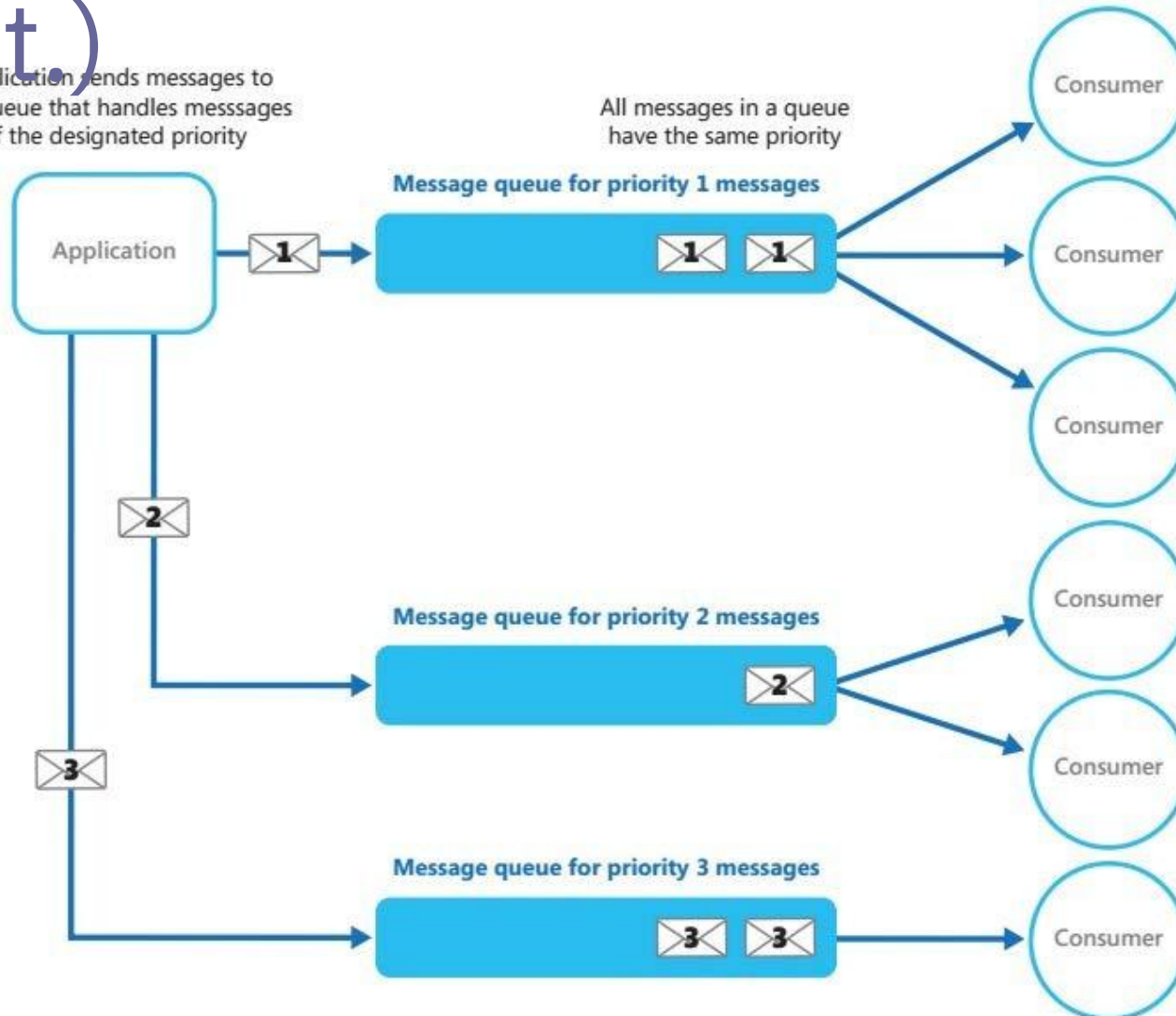


# Priority Queue Pattern

(Cont.)

Application sends messages to the queue that handles messages of the designated priority

All messages in a queue have the same priority

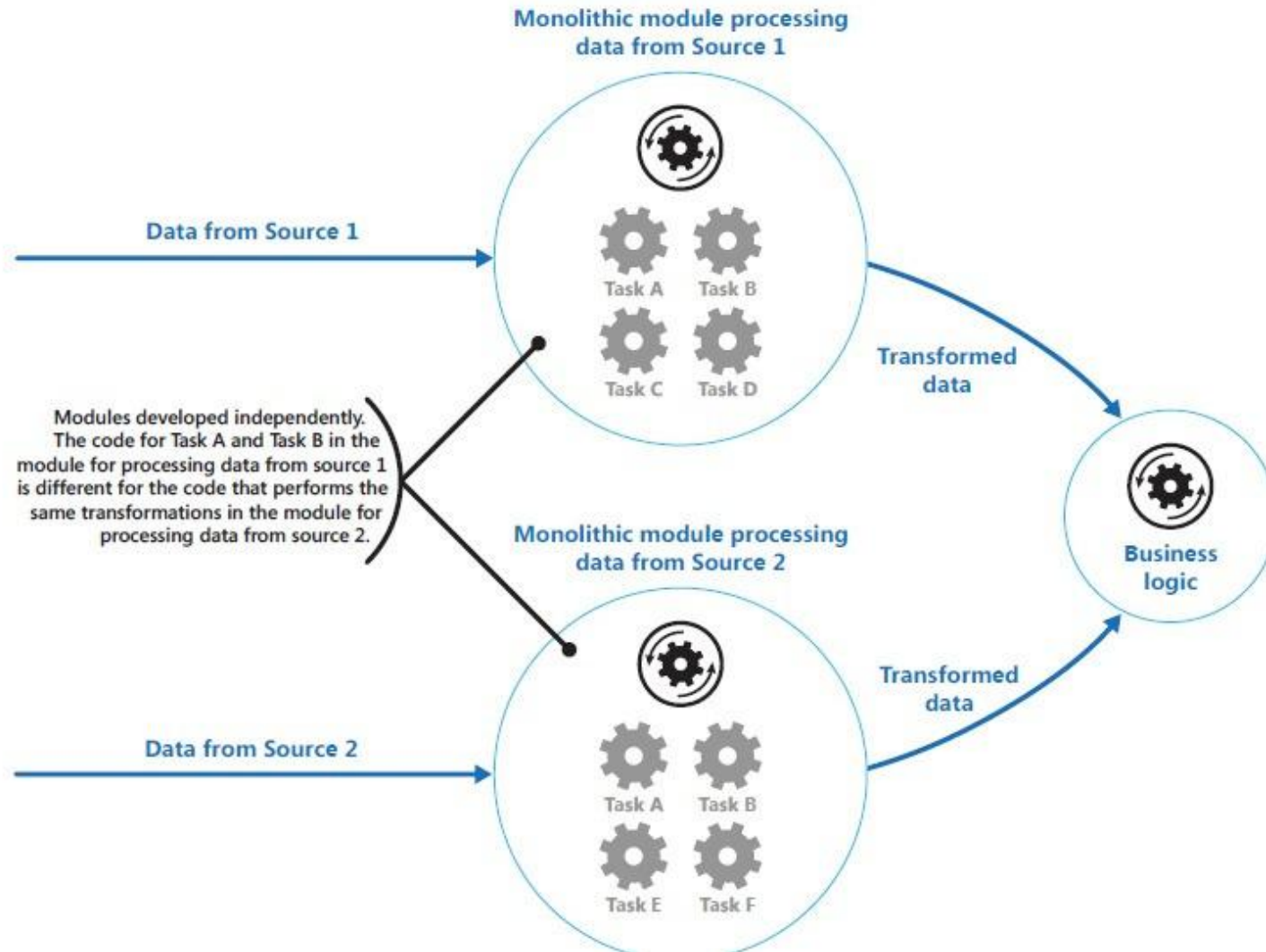


# Priority Queue Pattern (Cont.)

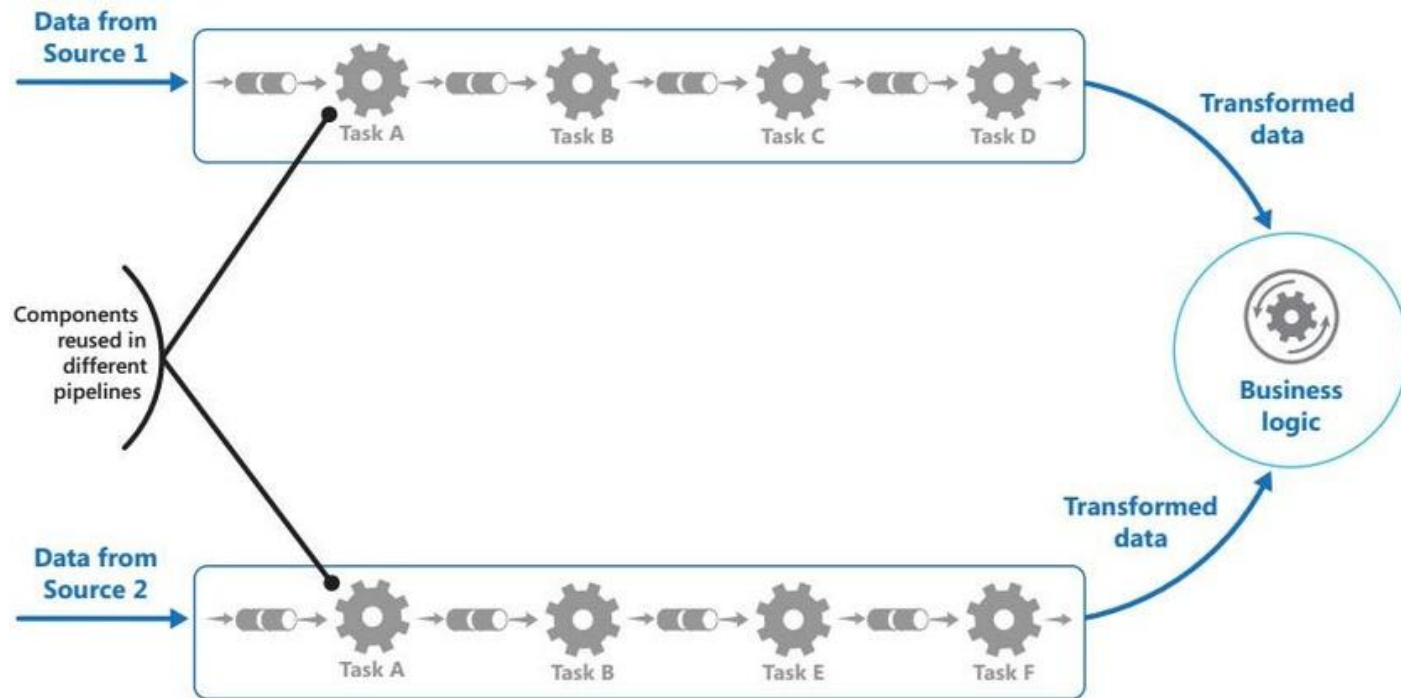
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- When,
  - The system handles multiple tasks that have different priorities
  - Different users should be served with different priorities

# Pipes & Filters Pattern

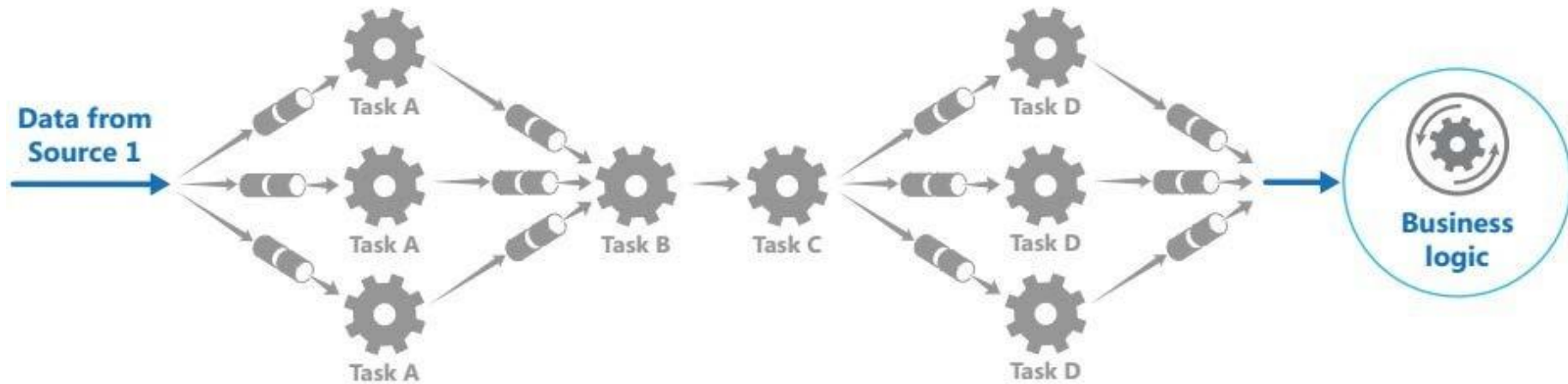


# Pipes & Filters Pattern (Cont.)



- 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