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Going Asynchronous with Service Broker

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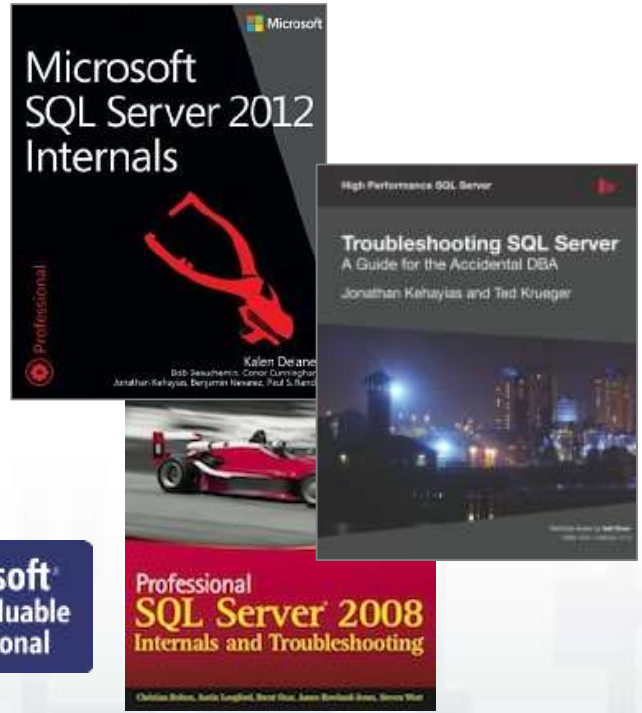

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Reminder: Intersect with Speakers and Attendees

- **Tweet tips and tricks that you learn and follow tweets posted by your peers!**
  - Follow: #SQLintersection and/or #DEVintersection
- **Join us – Wednesday Evening – for SQLafterDark**
  - Doors open at 7:00 pm
  - Trivia game starts at 7:30 pm

    Winning team receives something fun!
  - Raffle at the end of the night

    Lots of great items to win including a seat in a SQLskills Immersion Event!
  - The first round of drinks is sponsored by SentryOne and SQLskills

SQLafterDark

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SQLskills immerse yourself in sql server & SentryOne™

Overview

- Service Broker usage scenarios
- Advantages of Service Broker
- Basic Service Broker architecture
- Conversation architectures
- Understanding activation

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Usage Scenarios (1)

- **Centralized data collection**
  - Multiple sites process transactions locally and use Service Broker to send information to a central office
  - Asynchronous message delivery allows local sales transactions to continue even if a site loses connectivity to the central office
- **Asynchronous trigger execution**
  - Complex logic in DML triggers affect OLTP performance
  - Queuing a message requesting work from a Service Broker service to offload the complex logic into a separate transaction asynchronously

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Usage Scenarios (2)

- **Reliable processing of queries**
  - Single transaction is used to read a message, run a query, and return results to the initiating service
  - During a service failure the transaction would roll back, return the message to the queue, and restart processing after recovery
- **Distributed server-side processing**
  - Online ticketing application processes orders using Service Broker to exchange data between payment processing, CRM, and ticket printing applications

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Advantages of Service Broker

- **Database integration**
  - Eliminates the overhead of a separate distributed transaction coordinator
  - The message store and database are maintained at the same transactional point-in-time, eliminating the need for reconciliation processes when one of the two has to be restored
- **Ordering of messages**
  - Messages sent within the Service Broker architecture are received once and only once in the order in which the messages were sent

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Advantages of Service Broker (2)

- **Message locking of related messages**
  - Service Broker prevents out of order processing of message within the same conversation group by locking the conversation group during processing
  - Multiple threads can process different conversation groups concurrently increasing scalability and performance

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Advantages of Service Broker (3)

- **Loose coupling of applications**
  - The initiating application and target application are loosely coupled, allowing the initiating application to continue processing after sending a message to the target application
  - Loose coupling provides scheduling flexibility, allowing parallel processing
  - Background processing of requests can mitigate high load times against source and target servers through queuing requests for processing

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Advantages of Service Broker (4)

- **Automatic activation**
  - Activation allows Service Broker to automatically scale to match the volume of messages arriving in a given service queue
  - Allows programs running inside the database as well as external to the database to take advantage of queue activation
  - Automatically starts a new queue reader when there is work to be performed

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Broker and SQL Server Features

- Event Notifications – watch for Trace/DDL events and respond automatically when they occur
- Query Notifications – monitor for changes in results, and leveraged for external queue activation of Service Broker
- Database mail – implemented as an external activated application that monitors for messages being queued in msdb
- WMI Events – piggy back on Event Notifications to allow integration with Windows Management Instrumentation

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Basic Service Broker Architecture

- Single database implementation for asynchronous processing
- Enable the database for service broker
- Create request/reply message types
- Create contract specifying request messages are sent by the initiator and reply messages are sent by the target
- Create a target/initiator queues/services

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Basic Service Broker Architecture (2)

- Create the target service specifying the contract to limit conversations
- Create the initiator service with no contract
- Intra-database Service Broker requires 4 types of objects:
  - Message types, contracts, queues, and services

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Service Broker Components

- **Message types**
  - Define the name and type of data that will be in a message
  - SQL Server can validate that a message contains valid XML, XML conforming to a specific schema, or no data at all
  - SQL Server can also not validate message data, accepting any data for the message including binary data, XML, or empty messages
  - System message types exist for handling errors and dialog status Default message type used when a message type is not specified

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Service Broker Components (2)

- **Contracts**
  - Define which message types will be used for specific tasks
    - Tasks are defined in Service Broker as initiator (or sender) and target (or receiver)
  - Agreement between services about which message types each of the services will send for a given task
  - Must contain a message type sent by the initiator, otherwise there is no way for the initiator to begin a conversation using the contract

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Service Broker Components (3)

- **Queues**
  - Store messages in the database for processing by applications
  - When messages arrive at a service they are inserted into the queue associated with the service
  - Each message is a row in the queue containing:
    - Contents of the message, message type and validation performed
    - Service and contract targeted by the message
    - The conversation the message is associated with
    - Internal information to the queue

Service Broker Components (4)

- **Queues (2)**
  - Applications RECEIVE messages from the queue to get the message for processing within a transaction
    - All messages for a conversation or a conversation group can be processed at once
    - Queues return messages from each conversation in the order the messages were sent
  - May use a stored procedure for internal activation (automated processing)

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Service Broker Components (5)

- **Services**
  - Specifies the name of a specific business operation or task implemented in Service Broker
  - Service names are used to:
    - Deliver messages to the correct queue inside of a database
    - Route messages from target to initiator, and back
    - Determine security requirements for new conversations
    - Enforce appropriate contracts for conversations
  - Bound to a specific queue to store incoming messages

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Demo

- Basic Service Broker architecture

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Conversation Architecture

- **Service Broker applications communicate using a dialog conversation or persisted stream of messages back-and-forth between two services**
  - Dialogs provide exactly-once-in-order (EOIO) message delivery using a conversation identifier and sequence numbers
- **Dialogs have two participants:**
  - Initiator – starts the conversation
  - Target – accepts a conversation started by an initiator
  - Messages provide the information exchanged

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Processing Messages

- **The RECEIVE DML statement is used to process and remove messages**
  - Receive a single message into variables with TOP 1 (slowest method)
  - Receive all messages for a single conversation into table variable (faster method)
  - Receive all messages for a conversation group into table variable (faster method)
- **Messages are always received in sequence order, per conversation**

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Processing Messages (2)

- **The RECEIVE statement will lock the conversation using a Service Broker-specific internal lock in SQL Server**
  - This will be a bottleneck if a single conversation is used for all messages
- **Transactions should be used when processing messages, with error handling, to prevent poison messages from occurring**

Understanding Dialog Conversations

- **Each dialog conversation has a unique conversation handle associated with the conversation**
  - The conversation handle is created on the initiator by the BEGIN DIALOG CONVERSATION command
  - The conversation handle is retrieved by the target when it processes the message(s) with RECEIVE from the queue
  - The target uses the conversation handle to send a response message(s) back to the initiator and ends the conversation with END CONVERSATION

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Understanding Dialog Conversations (2)

- **Certain interactions may require a back-and-forth series of messages on the same conversation with different message types defined by the contract**
  - The initiator should end the conversation when it processes the final message from the target using END CONVERSATION
  - The target should end the conversation based on receipt of a specific message type to avoid orphaning the conversation
- **“Fire and forget” is good for the military but not Service Broker**
  http://bit.ly/SSB_FireForget

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Basic Conversation Example
Sending a Request Message

- **Begin a conversation at the initiator specifying (BEGIN DIALOG):**
  - The sending (initiator) service name
  - The receiving (target) service name
  - The contract name for the conversation
- **Sending a message on the conversation (SEND ON CONVERSATION) specifying the message type and the message body to be sent**

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Basic Conversation Example
Processing Request and Replying

- Receiving the message from the target queue (RECEIVE)
- Sending a response message from target to initiator (SEND ON CONVERSATION) specifying the message type and the message body to be sent

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Basic Conversation Example
Processing Reply and Ending Dialog

- **Receiving the response message on the initiator (RECEIVE)**
- **Ending the conversation on the initiator (END CONVERSATION)**
  - Sends an EndDialog message to the target to cleanup the conversation handle
  - Ending the dialog on the target (END CONVERSATION)

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- Basic intra-database conversation

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Dialog Conversation Internals

- Reliable delivery through receipt-acknowledgement from the target service
- Outgoing messages stored in the transmission queue until acknowledged by the target service
- If a service is unavailable, messages remain in the transmission queue and retries every minute until the conversation is ended, or the lifetime of the conversation expires,

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Activation

- **Allows automatic processing of messages in a queue**
- **For applications inside of the database a stored procedure can be used to process the queued messages**
  - Referred to as internal activation
  - Stored procedure is associated with a queue and starts automatically
  - Must have an owner and use EXECUTE AS for security context
  - Certificate signing should be used for cross-database access

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Activation (2)

- **Service Broker also supports activation outside of the database through an application or service monitoring the queue**
  - This can be written explicitly in the application or service
  - The External Activation feature can alternatively be configured to execute the program or service

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Demo

- Activation demo

Review

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Questions?

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Thank you!

Save the Date!

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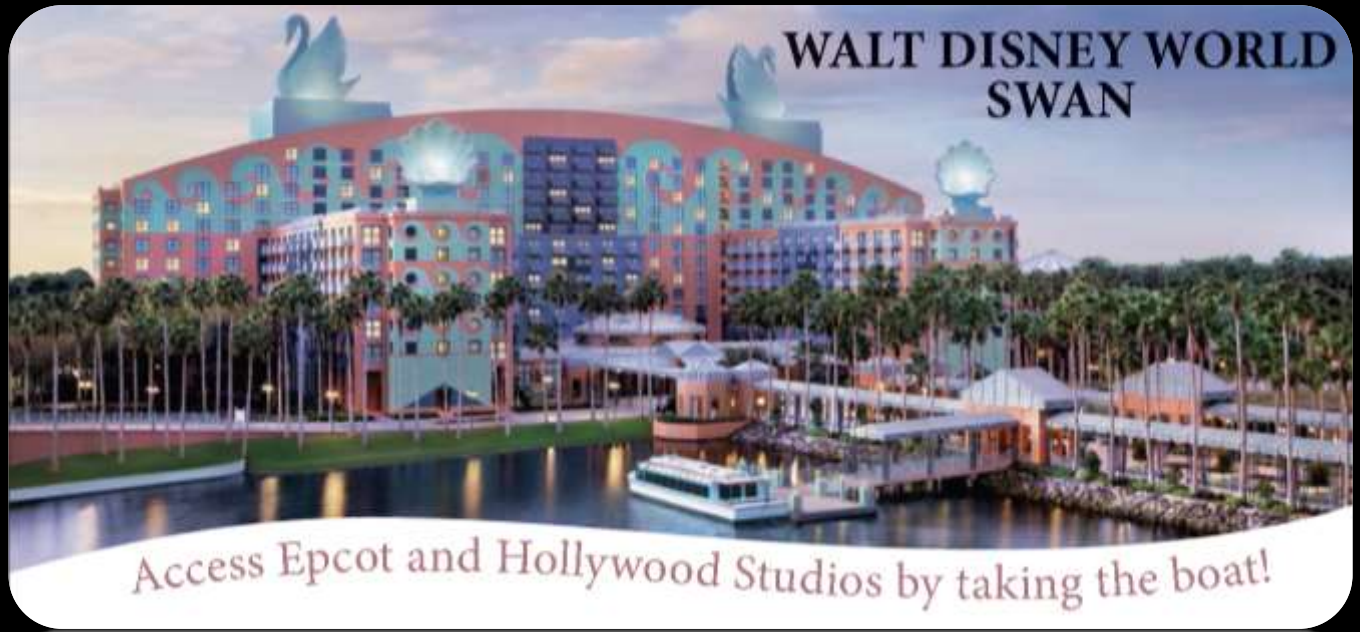

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