IBM MQ Security: Deep dive including AMS

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Agenda

- **AMS**
  - Recap
  - Important considerations
  - Message format
  - When will my message be protected?
  - Errors
  - Implementation

- **Channel Authentication**
  - Details
  - Configuration
  - Relation to connection authentication
    - Channel authentication recap
  - Relation to Authorization
    - Authorization recap

AMS

Introduction

- **AMS means Advanced Message Security**

- **Provides message level security for messages**
  - Protects messages in transit and at rest
  - Protects messages from creation until destruction
  - Uses TLS features (encryption/signing) to protect message

- **Available as a separate license or in IBM MQ Advanced**

- **MQ has three options for AMS protection**
  - Integrity – Signing protection
  - Privacy – Signing and Encryption protection
  - Confidentiality – Encryption protection – MQ v9+ Only

Important considerations

- **Performance**
  - Increase in CPU requirements (but in relation to MQ CPU requirements)
  - Cryptographic operations cause a decrease of message throughput
  - Impact depends on protection level (Integrity, Confidentiality, privacy)

- **Message size**
  - To accommodate AMS properties, overall message size will increase.
  - New message size = 1280 + [Old Message Length] + (200 x [# of recipients])

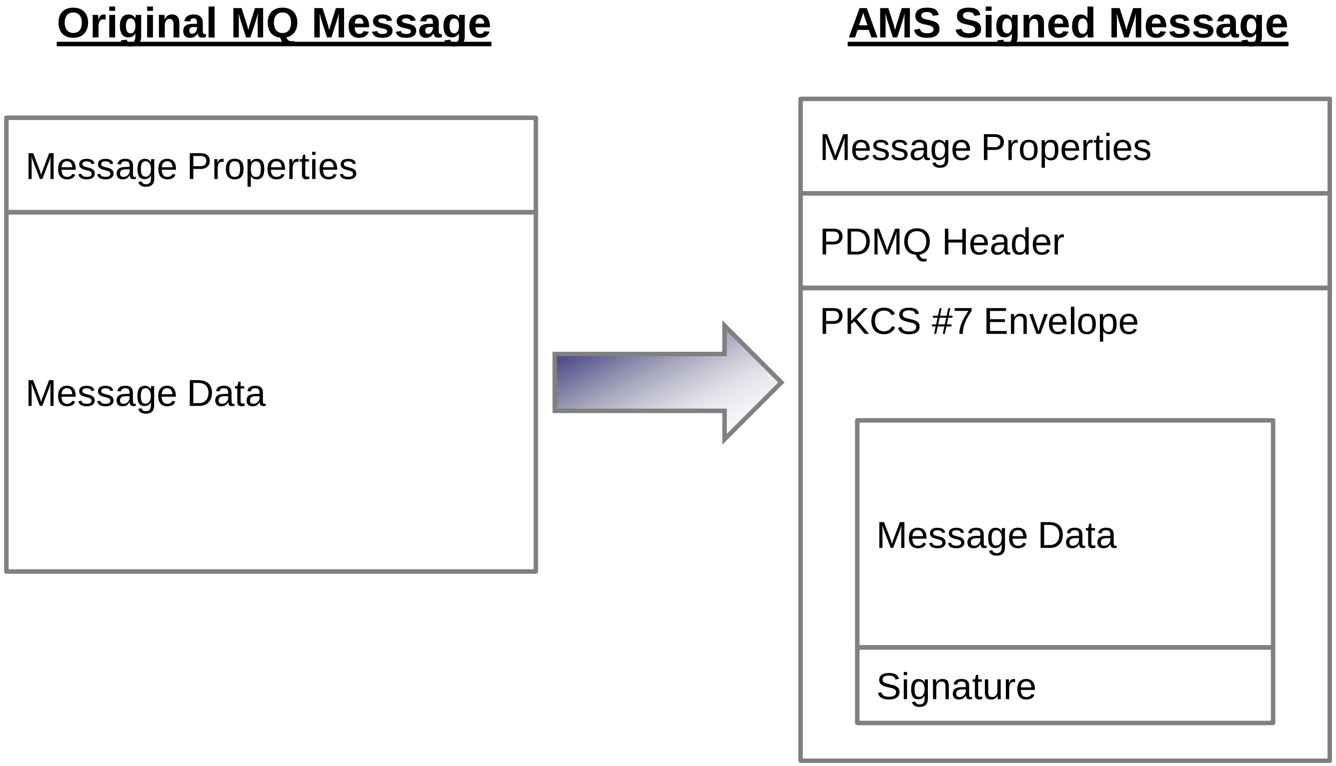
- **AMS does not perform access control**
  - It just protects the message contents from change and/or reading

Important considerations

- **The following MQ Options are not supported with AMS**
  - Publish/Subscribe
  - Channel Data Conversion – message data conversion still supported
  - Distribution lists
  - IMS Bridge nor IMS programs in SRB mode (Only Pre MQ v8 AMS)
  - Non-Threaded applications using API exit on HP-UX
  - Java (JMS and Java “base” classes) only supported with MQv7
  - MQ message properties on z/OS
  - Only the IBM JRE is supported in MQv8 and before.

- **Unlike TLS, the entire certificate chain must be present in the keystore**
  - The sender must also have a copy of all the recipients public certificates

Message format – Integrity policy



Original MQ Message

Message Properties

Message Data

AMS Signed Message

Message Properties

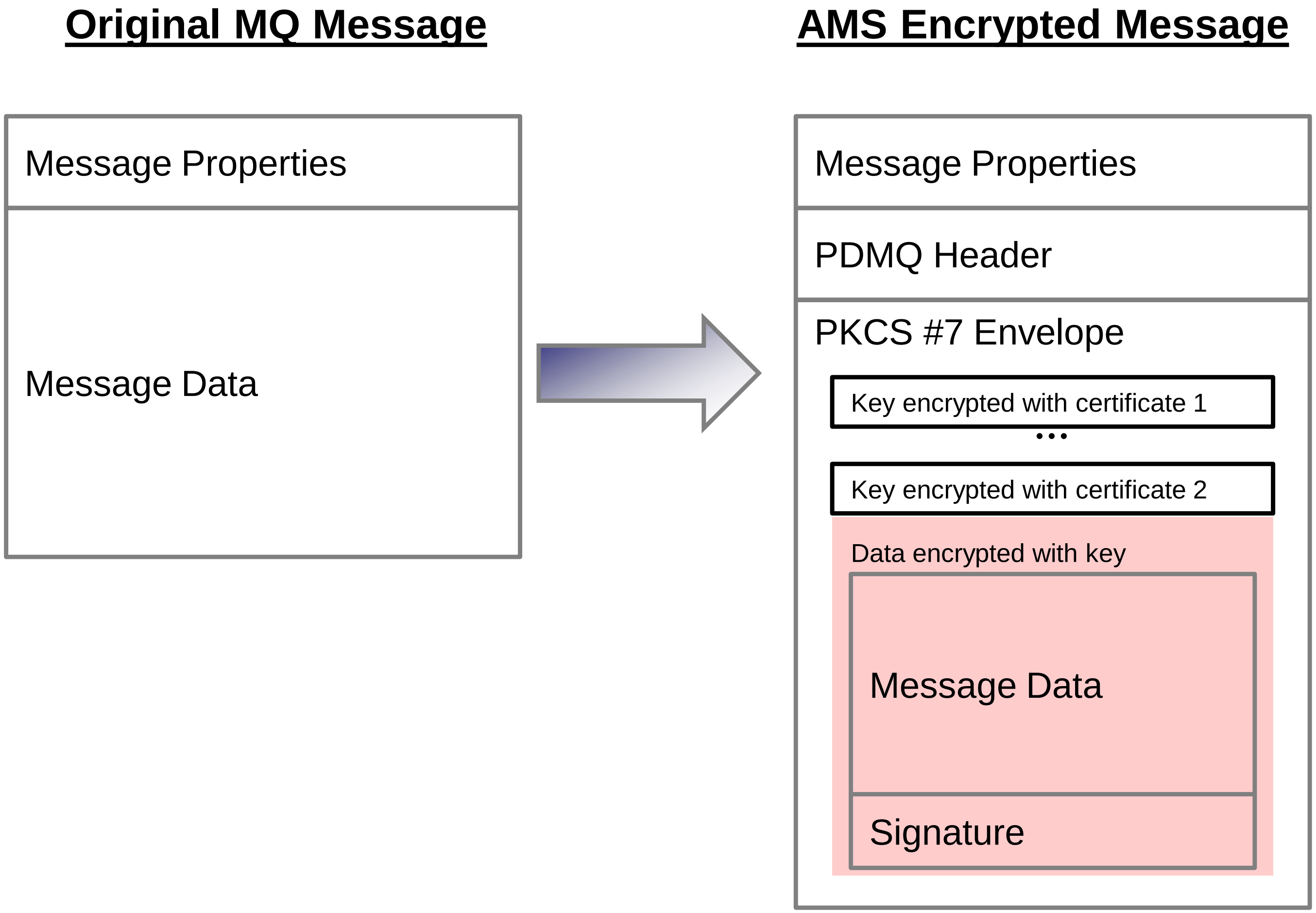
PDMQ Header

PKCS #7 Envelope

Message Data

Signature

Message format – Privacy policy



Original MQ Message

Message Properties

Message Data

AMS Encrypted Message

Message Properties

PDMQ Header

PKCS #7 Envelope

Key encrypted with certificate 1

…

Key encrypted with certificate 2

Data encrypted with key

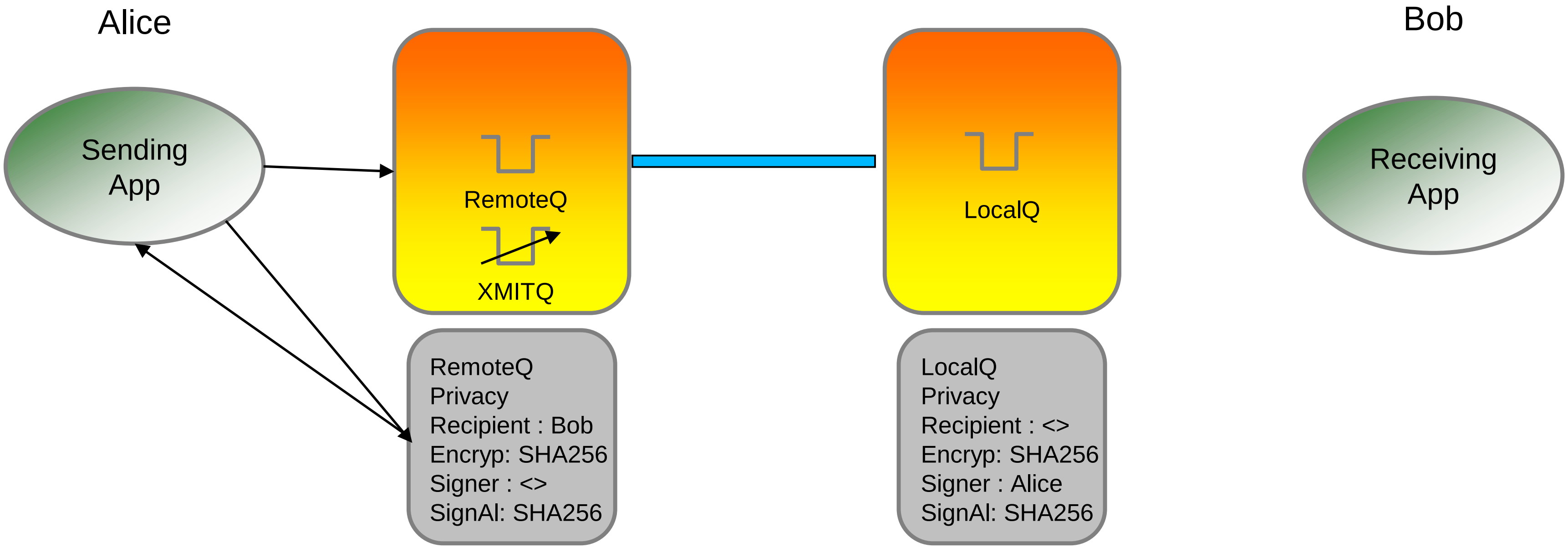
Message Data

Signature

When will my message be protected?

- **Messages are protected when they are created**
  - Level of protection depends on Policy: None, Integrity, Privacy, Confidentiality
  - Policies apply to all Queue Types: Remote, Alias, Local
- **During MQOPEN call, policies are queries**
  - IBM MQ looks for policies named the same as the Object being opened.
- **Once protected, the message retains the policy for its lifetime.**
- **At MQPUT:**
  - If there is a policy (regardless of type) we sign the message data
  - If it is a privacy policy we encrypt for the specified recipients
- **At MQGET**
  - If there is a privacy policy we will decrypt the using our certificate or error
  - If there is a policy we check the message was signed by a signer listed in the policy

When will my message be protected

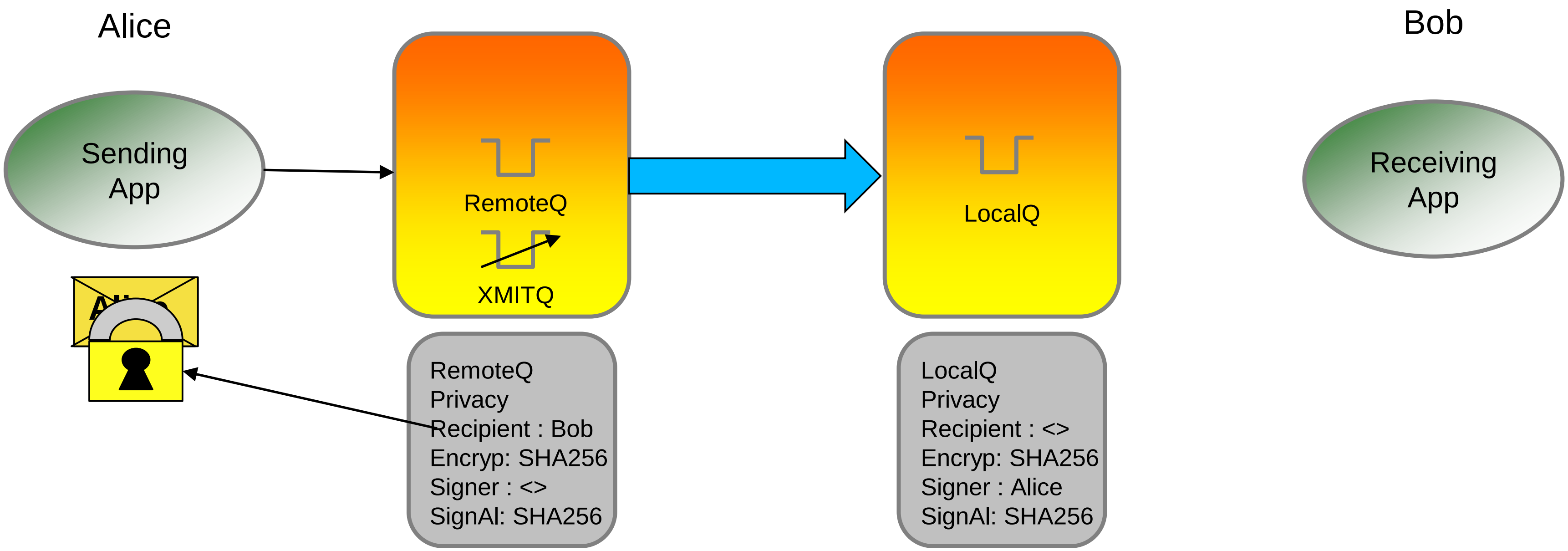


RemoteQ
Privacy
Recipient : Bob
Encryp: SHA256
Signer : <>
SignAl: SHA256

LocalQ
Privacy
Recipient : <>
Encryp: SHA256
Signer : Alice
SignAl: SHA256

1. Alice's Application Calls MQOPEN on RemoteQ
2. MQOPEN Queries for Policy called RemoteQ and passes info back

When will my message be protected

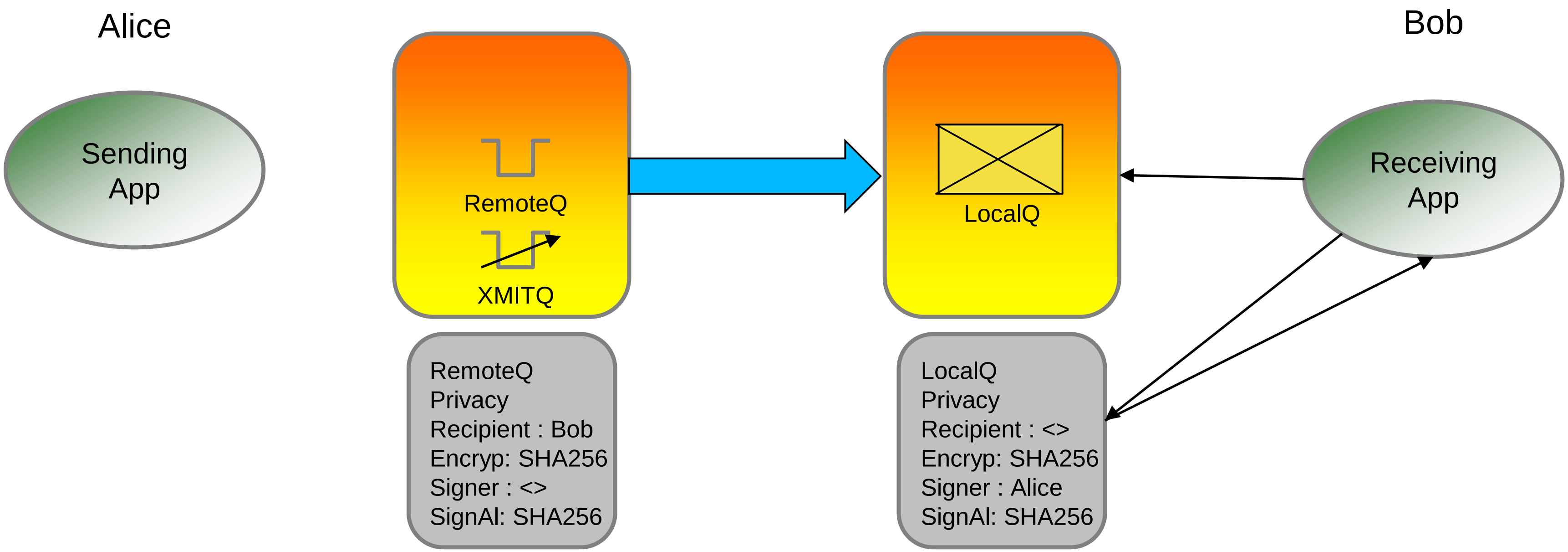


RemoteQ
Privacy
Recipient : Bob
Encryp: SHA256
Signer : <>
SignAl: SHA256

LocalQ
Privacy
Recipient : <>
Encryp: SHA256
Signer : Alice
SignAl: SHA256

3. Alice issues a MQPUT to RemoteQ
   a) Because there is a policy AMS signs the message data
   b) If the policy is a Privacy policy it also encrypts it for the recipients
4. The message is put to RemoteQ and flows over to the LocalQ

When will my message be protected

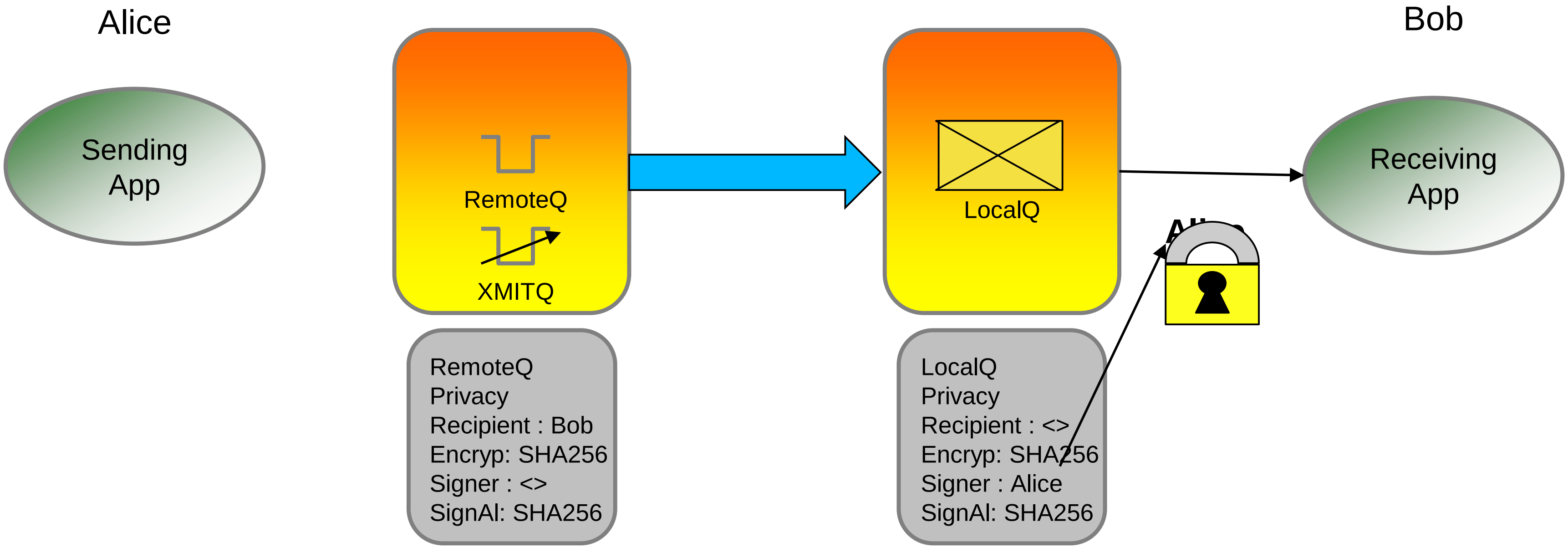


RemoteQ
Privacy
Recipient : Bob
Encryp: SHA256
Signer : <>
SignAl: SHA256

LocalQ
Privacy
Recipient : <>
Encryp: SHA256
Signer : Alice
SignAl: SHA256

5. Bob Issues an MQOPEN call to LocalQ
6. MQOPEN queries for any policies called LocalQ and returns the info

When will my message be protected



RemoteQ
Privacy
Recipient : Bob
Encryp: SHA256
Signer : <>
SignAl: SHA256

LocalQ
Privacy
Recipient : <>
Encryp: SHA256
Signer : Alice
SignAl: SHA256

7. Bob Issues MQGET
    a) Checks the Encryption Algorithm used is same or stronger
    b) Checks Bob can decrypt the message
    c) Checks the Signing Algorithm used is same or stronger
    d) Checks the message was from an authorised signer listed in the policy

8. Bob reads his message

Errors

- **AMS uses the same error codes as security but interpreted differently**

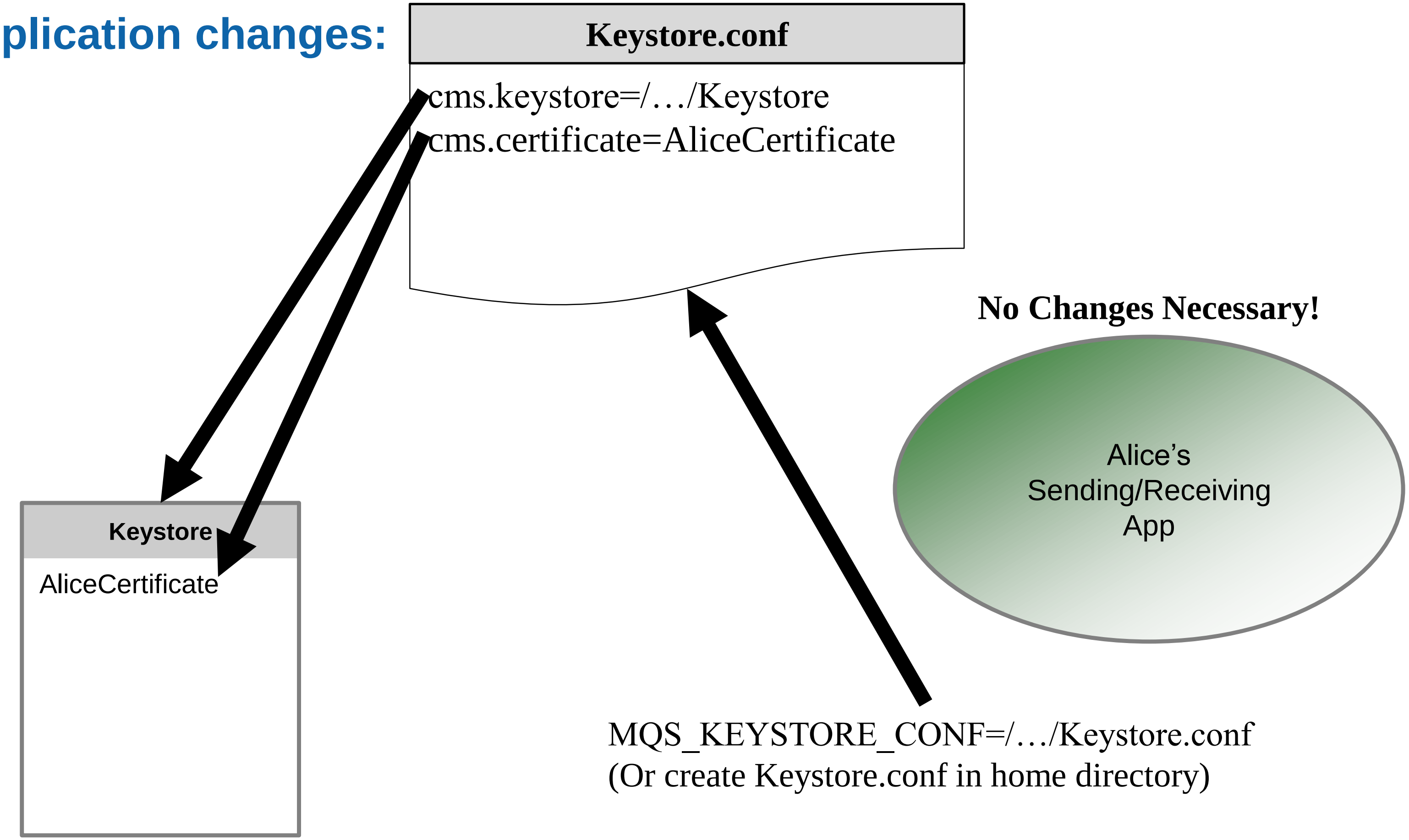
- **Several scenarios where something could go wrong:**
  - Putting to a protected Queue without Client AMS setup
  - GET/BROWSE a message you are not a recipient for
  - GET/BROWSE a message signed by someone not authorized
  - GET/BROWSE a message that has NOT been protected (got onto Q via AliasQ/RemoteQ etc)
  - Signing or encryption Algorithm in message is weaker than policy dictates during GET/BROWSE
  - Do not have correct certificates for the all listed Recipients
  - Misspelt Distinguished names for Authorized Signers or Recipients
  - Recipient does not have the signers certificate
  - Unlike TLS - full trust chain is not supplied. E.g. Signer cert, Intermediate CA cert, CA cert, etc
  - Error with Key Store configuration – Key Store Permissions, stanzas, etc

Errors

- **What happens depends on operation being performed:**
  - MQPUT – 2063 error returned and message not accepted.
  - MQGET – 2063 error returned, message gains a DLQ header and is moved to SYSTEM.PROTECTION.ERROR Queue.
  - MQBROWSE – 2063 error returned.
  - Key Store related problems 2035 error returned.

Implementation

- We will assume the necessary certificates have already been exchanged
- Application changes:



Keystore.conf

```
cms.keystore=/…/Keystore
cms.certificate=AliceCertificate
```

Keystore

AliceCertificate

No Changes Necessary!

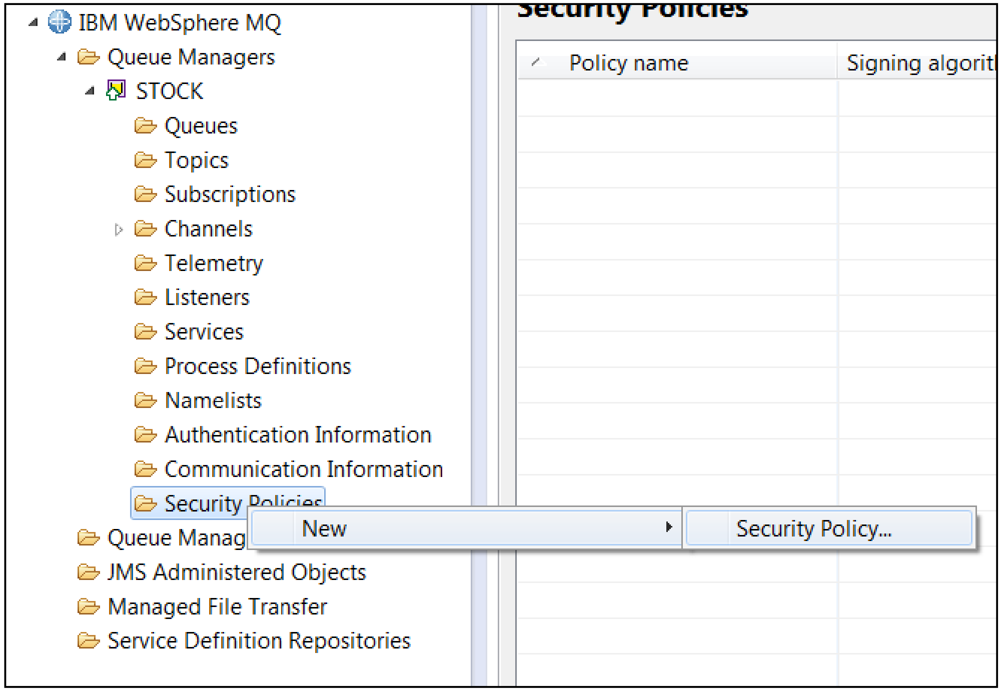
Alice's Sending/Receiving App

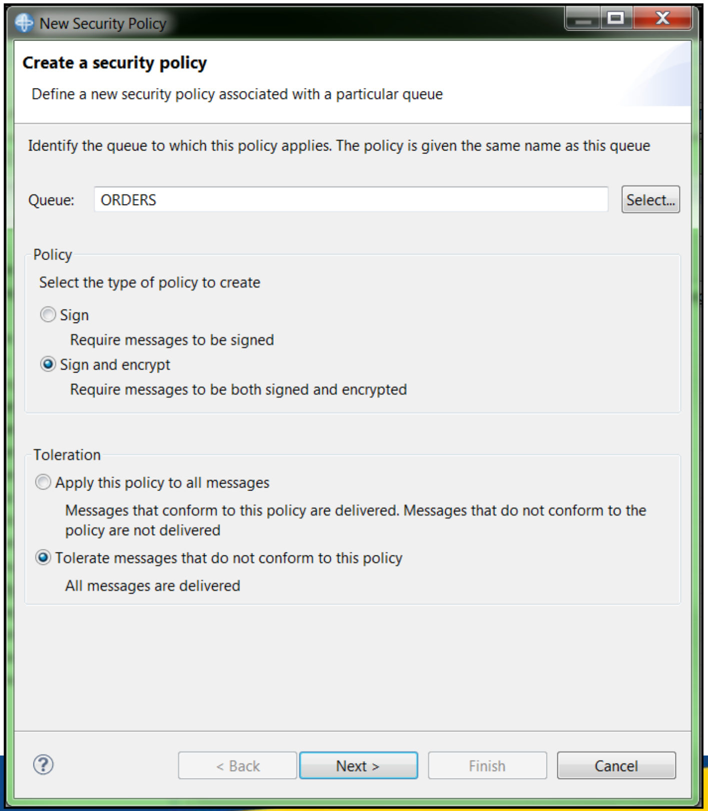
MQS_KEYSTORE_CONF=/…/Keystore.conf
(Or create Keystore.conf in home directory)

Implementation

- Set Security Policy using setmqspl, runmqsc or MQ Explorer

-
```
setmqspl –m STOCK –p ORDERS –s SHA256 –a “CN=ALICE,O=IBM,C=UK” –e
AES256 –r “CN=BOB,O=IBM,C=UK”
```





Create a security policy

Define a new security policy associated with a particular queue

Identify the queue to which this policy applies. The policy is given the same name as this queue

Queue: ORDERS

Policy

Select the type of policy to create

○ Sign

Require messages to be signed

● Sign and encrypt

Require messages to be both signed and encrypted

Toleration

○ Apply this policy to all messages

Messages that conform to this policy are delivered. Messages that do not conform to the policy are not delivered

● Tolerate messages that do not conform to this policy

All messages are delivered

CHANNEL AUTHENTICATION

Details

- **Channel authentication rules are filters that can be applied for incoming connections**
  - Whitelisting – Allow connections based on a filter
  - Blacklisting – Block a connection based on a filter

- **The filters are applied on channels and are applied to all incoming connections for that channel**
  - The filter can be either very specific or generic. (Exact channel name or wildcard)

Details

- **There are four types of filters:**
  - TLS Distinguished name (Issuer and Subject)
  - Client User ID name
  - Remote Queue Manager name
  - IP/Hostname

- **For IP/Hostname the connection can be allowed/blocked at the listener or channel**

- **For Client user ID, the userid blocked can be the userid connected with or the final adopted userid**

Details

- **Channel Authentication rules have an order of checking:**
  1. BLOCKADDR
  2. ADDRESSMAP
  3. SSLPEERMAP
  4. QMGRMAP
  5. USERMAP
  6. BLOCKUSER

- **In addition if a connection matches two CHLAUTH rules where one has a specific filter and one has a generic filter then the CHLAUTH that is SPECIFIC will be acted on.**

- **For example two ADDRESSMAP:**
  - Block where address=*
  - Allow where address=129.12.9.9
  - Connection from 129.12.9.9 will be allowed through.

Details

- **When you create a CHLAUTH rule you can specify what it should do when triggered.**

- **The options are:**
  - CHANNEL – Use the userid set in the channel MCAUSER for the future checks
  - MAP -Use the userid set in this CHLAUTH MCAUSER for the future checks
  - NOACCESS – Block the connection

- **In addition you can raise the security of the channel by setting a higher CHCKCLNT value on the CHLAUTH.**
  - If a user connects to CHANNEL.1 they are required to pass valid credentials
  - If a user connects to CHANNEL.2 they don't have to pass valid credentials.

Configuration

- **Channel Authentication rules are created or modified in:**
  - MQ Explorer
  - runmqsc

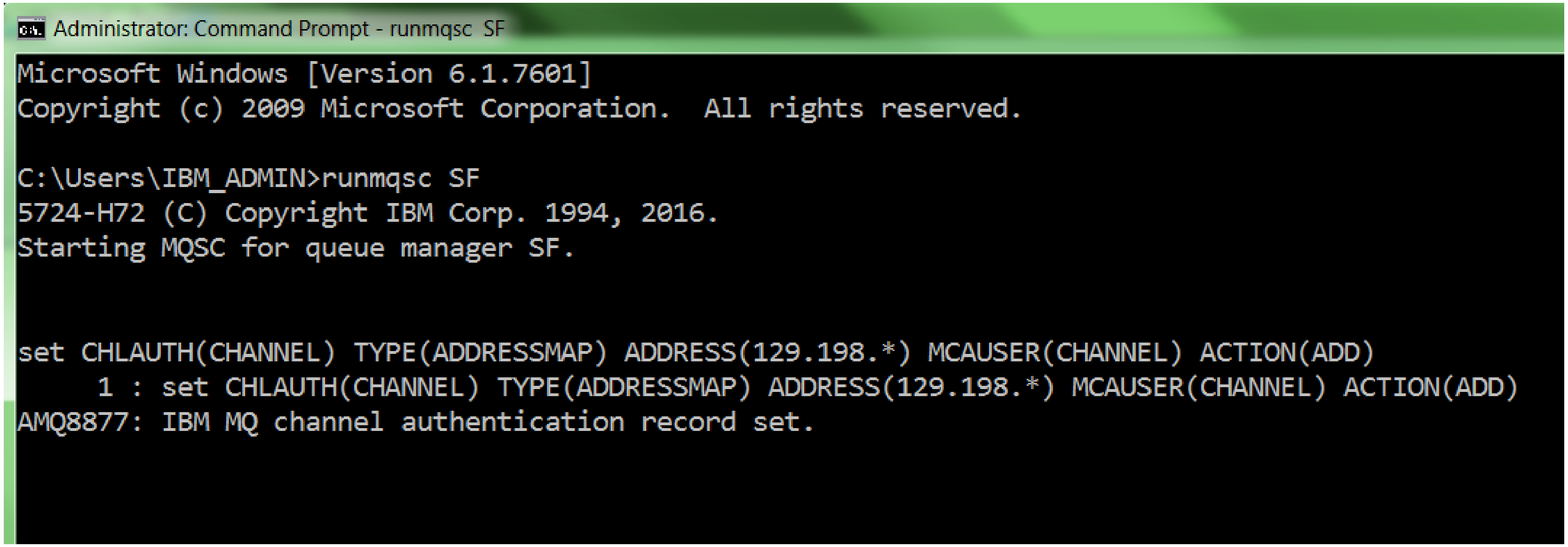
- **Channel Authentication can be enabled/disabled from a queue manager property:**
  - `ALTER QMGR CHLAUTH(ENABLED|DISABLED)`

- **There is also the ability to enable rules that only print warnings**
  - `SET CHLAUTH(*) … WARN(NO|YES)`

- **Upon creation of a queue manager 3 default channel authentication rules**
  - Block all users who are MQ administrators
  - Block access to all SYSTEM channels
  - Allow access to SYSTEM.ADMIN.SVRCONN channel

Configuration

```
SET CHLAUTH(<Channel name>) TYPE(<channel authentication type>)
<extra parameters> ACTION(ADD|REMOVE|REMOVEALL|REPLACE)
```



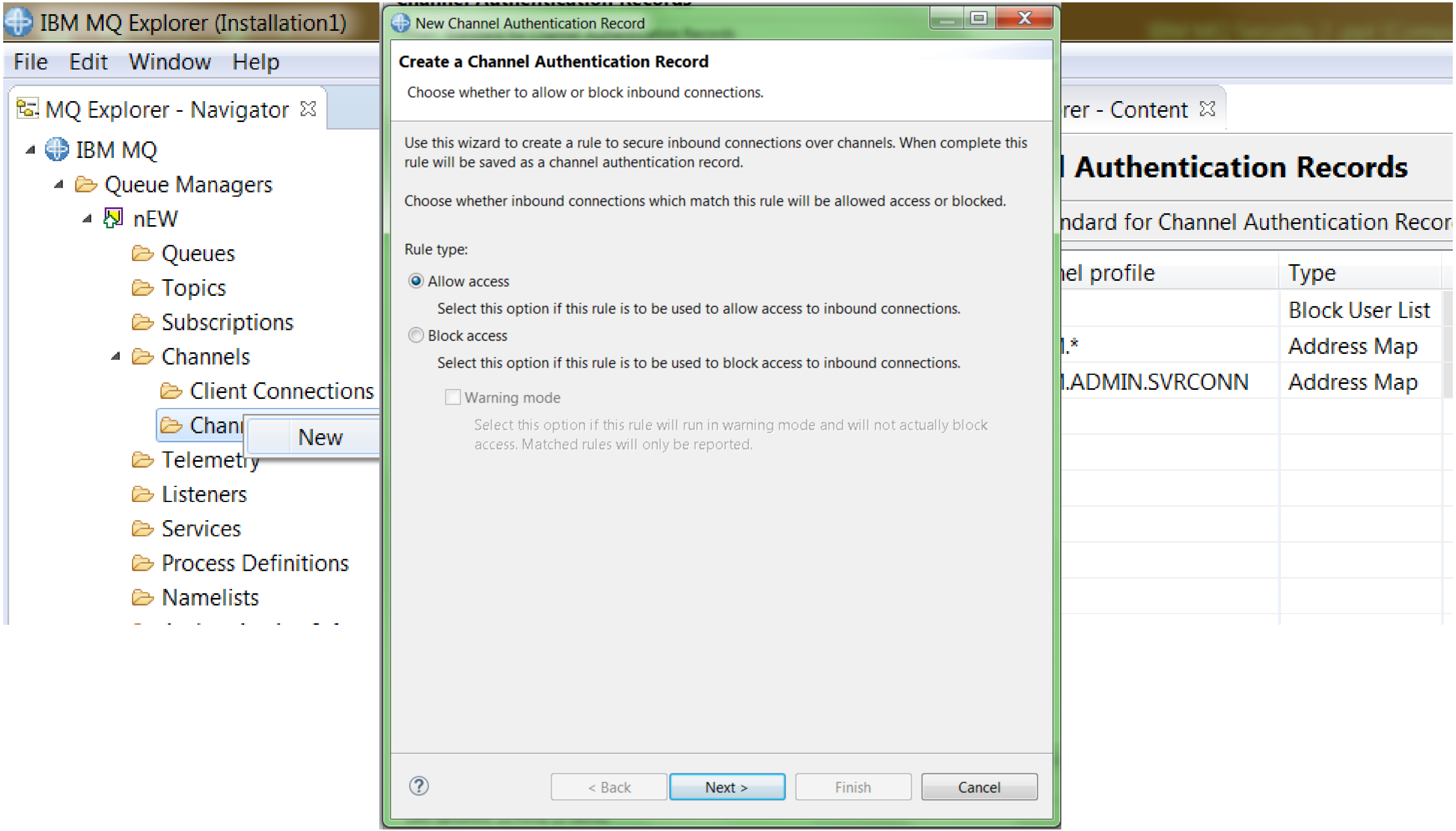
Administrator: Command Prompt - runmqsc SF

```
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

C:\Users\IBM_ADMIN>runmqsc SF
5724-H72 (C) Copyright IBM Corp. 1994, 2016.
Starting MQSC for queue manager SF.


set CHLAUTH(CHANNEL) TYPE(ADDRESSMAP) ADDRESS(129.198.*) MCAUSER(CHANNEL) ACTION(ADD)
     1 : set CHLAUTH(CHANNEL) TYPE(ADDRESSMAP) ADDRESS(129.198.*) MCAUSER(CHANNEL) ACTION(ADD)
AMQ8877: IBM MQ channel authentication record set.
```

Configuration



nel profile	Type
	Block User List
l.*	Address Map
l.ADMIN.SVRCONN	Address Map

Create a Channel Authentication Record

Choose whether to allow or block inbound connections.

Use this wizard to create a rule to secure inbound connections over channels. When complete this rule will be saved as a channel authentication record.

Choose whether inbound connections which match this rule will be allowed access or blocked.

Rule type:

● Allow access

Select this option if this rule is to be used to allow access to inbound connections.

○ Block access

Select this option if this rule is to be used to block access to inbound connections.

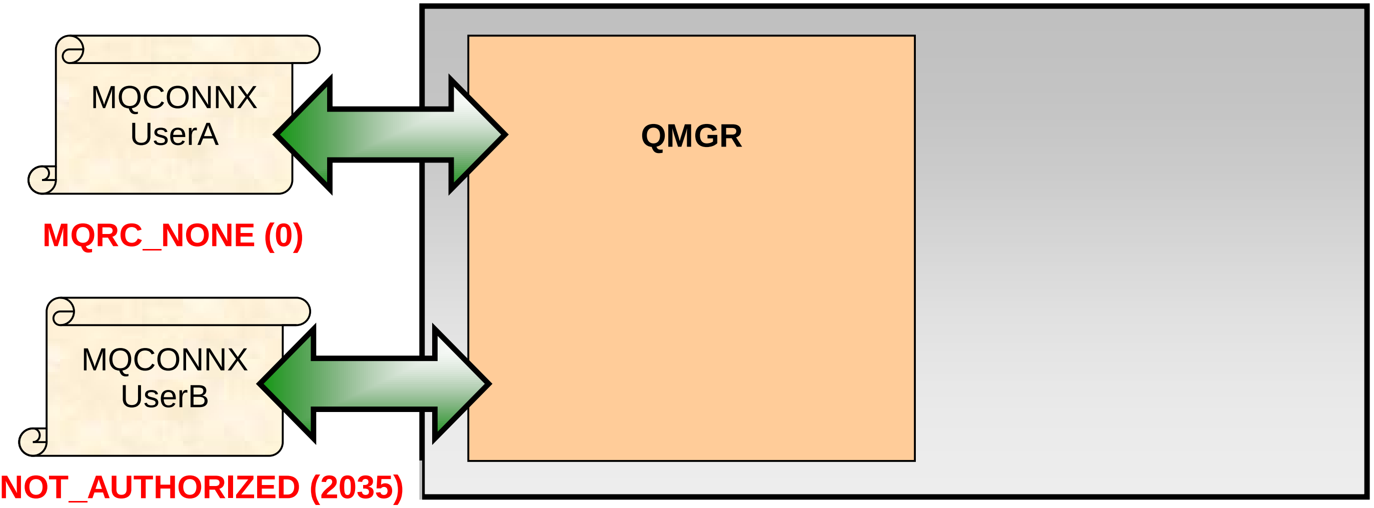
□ Warning mode

Select this option if this rule will run in warning mode and will not actually block access. Matched rules will only be reported.

Configuration

```
SET CHLAUTH(*) TYPE(USERMAP)
               CLNTUSER(*)
               USERSRC(NOACCESS)
               ACTION(ADD)

SET CHLAUTH(*) TYPE(USERMAP)
                CLNTUSER(‘UserA’)
                USERSRC(CHANNEL)
                ACTION(ADD)
```



MQCONNX
UserA

MQRC_NONE (0)

MQCONNX
UserB

MQRC_NOT_AUTHORIZED (2035)

QMGR

CHLAUTH & CONNAUTH

Introduction

- **We use Authentication to ask clients connecting to prove they are who they say they are.**
  - Usually used in combination with authorisation to limit user's abilities.
- **Connection authentication feature available in MQ v8 and above.**
  - Allows authentication user credentials supplied by client applications.
- **There are 4 levels of connection authentication security**
  - None – no authentication performed security (code disabled)
  - Optional – credentials do not have to be supplied, but if supplied must be valid
  - Required – credentials must be supplied and valid
  - REQDADM – If the user is a MQ administrator they must supply credentials, if not they follow optional level.
- **For channel authentication records there is one attribute that can impact connection authentication:**
  - CHCKCLNT

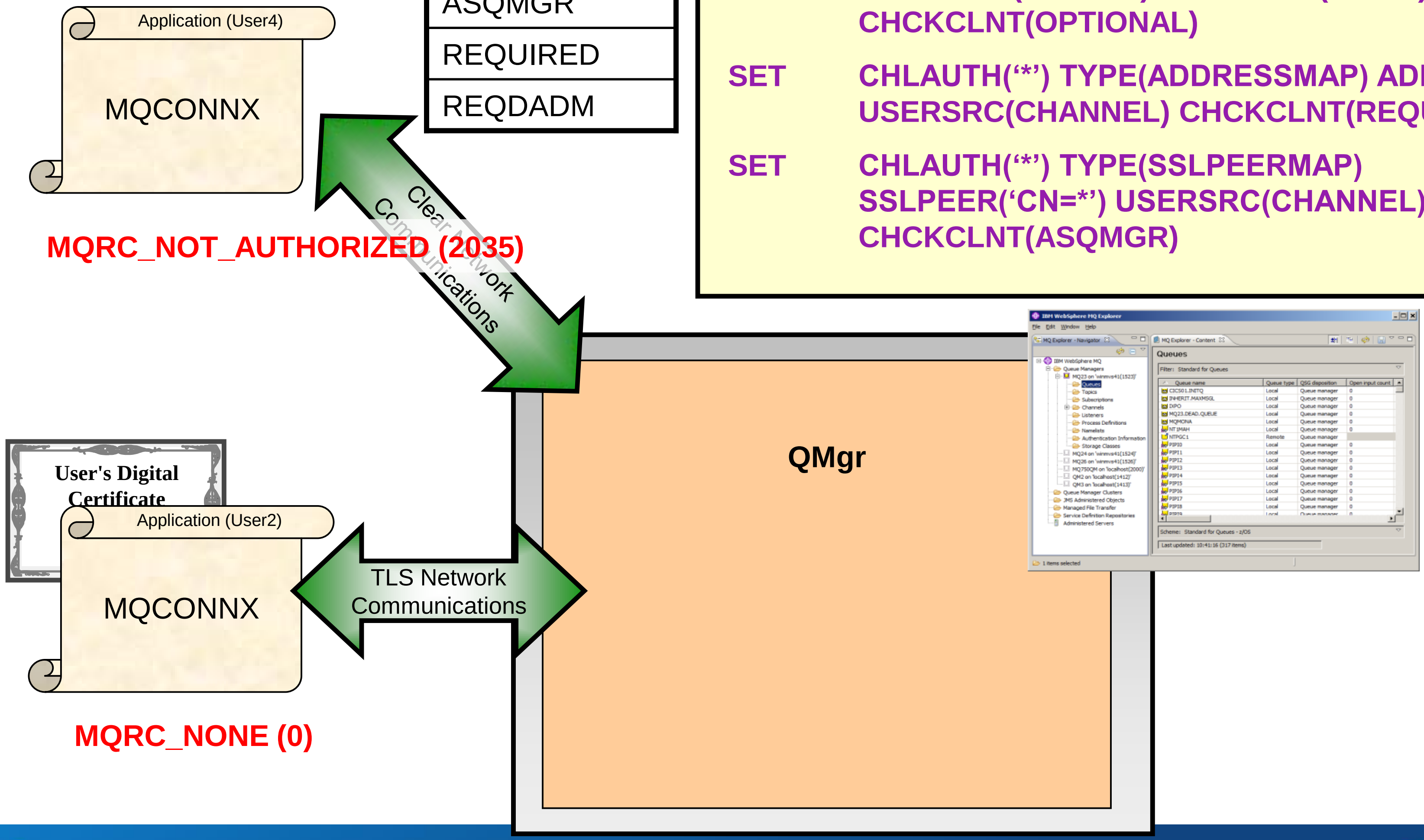
CHCKCLNT

CHCKCLNT
ASQMGR
REQUIRED
REQDADM

```
DEFINE  AUTHINFO(USE.PW) AUTHTYPE(xxxxxx)
        CHCKCLNT(OPTIONAL)

SET     CHLAUTH('*') TYPE(ADDRESSMAP) ADDRESS('*')
        USERSRC(CHANNEL) CHCKCLNT(REQUIRED)

SET     CHLAUTH('*') TYPE(SSLPEERMAP)
        SSLPEER('CN=*') USERSRC(CHANNEL)
        CHCKCLNT(ASQMGR)
```



IBM WebSphere MQ
Queue Managers
MQ23 on 'winmvs41(1523)'
Queues
Topics
Subscriptions
Channels
Listeners
Process Definitions
Namelists
Authentication Information
Storage Classes
MQ24 on 'winmvs41(1524)'
MQ26 on 'winmvs41(1526)'
MQ750QM on 'localhost(2000)'
QM2 on 'localhost(1412)'
QM3 on 'localhost(1413)'
Queue Manager Clusters
JMS Administered Objects
Managed File Transfer
Service Definition Repositories
Administered Servers

Queues

Filter: Standard for Queues

Queue name	Queue type	QSG disposition	Open input count
CICS01.INITQ	Local	Queue manager	0
INHERIT.MAXMSGL	Local	Queue manager	0
IXPO	Local	Queue manager	0
MQ23.DEAD.QUEUE	Local	Queue manager	0
MQMONA	Local	Queue manager	0
NT1MAH	Local	Queue manager	0
NTPGC1	Remote	Queue manager	
PIPI0	Local	Queue manager	0
PIPI1	Local	Queue manager	0
PIPI2	Local	Queue manager	0
PIPI3	Local	Queue manager	0
PIPI4	Local	Queue manager	0
PIPI5	Local	Queue manager	0
PIPI6	Local	Queue manager	0
PIPI7	Local	Queue manager	0
PIPI8	Local	Queue manager	0
PIPI9	Local	Queue manager	0

Scheme: Standard for Queues - z/OS

Last updated: 10:41:16 (317 items)

1 items selected

CHLAUTH & AUTHORIZATION

Introduction

- **We use Authorization to limit what connected users can and cannot do.**

- **This is performed by creating authority records**
  - We create authority records for a specific user or group.
  - User level authority records not available on Linux.

- **A channel or channel authentication rule can change the userid used for authority checks**

- **For channel authentication records there is one attribute that can impact authorization:**
  - MCAUSER

MCAUSER

- **USERSRC(MAP) allows you to specify a new userid to adopt for authorization checks.**

- **It is available on most channel authentication records.**

- **You specify the user id to use by using the MCAUSER attribute**
  - If you specify USERSRC(MAP) then MCAUSER is required

```
SET CHLAUTH(‘*’) TYPE(ADDRESSMAP) ADDRESS(‘*’) USERSRC(MAP)
MCAUSER(‘UserA’)
```

Which user will be used for authorization?

Method	Notes
Client machine user ID flowed to server	This will be over-ridden by anything else. Rarely do you want to trust an unauthenticated client side user ID.
MCAUSER set on SVRCONN channel definition	A handy trick to ensure that the client flowed ID is never used is to define the MCAUSER as 'rubbish' and then anything that is not set appropriately by one of the next methods cannot connect.
MCAUSER set by CHLAUTH rule	To allow more granular control of MCAUSER setting, rather than relying on the above queue manager wide setting, you can of course use CHLAUTH rules
MCAUSER set by ADOPTCTX(YES)	The queue manager wide setting to adopt the password authenticated user ID as the MCAUSER will over-ride either of the above.
MCAUSER set by Security Exit	Although CHLAUTH gets the final say on whether a connection is blocked (security exit not called in that case), the security exit does get called with the MCAUSER CHLAUTH has decided upon, and can change it.

Questions & Answers

Other IBM MQ security sessions

- **Integrating MQ with Directory Services – Mark Taylor**
  - Wednesday 09:50 – 11:00, Indigo Bay
- **Authentication in MQ – Morag Hughson**
  - Tuesday 09:50 – 11:00, Leopardwood room
  - Wednesday 13:00 – 14:10, Salon E
- **Securing your z/OS Queue – Morag Hughson**
  - Monday 14:30 – 15:40, Rosewood room
  - Tuesday 14:30 – 15:30, Aloeswood room
- **Check list of MQ top MQ security outstanding bugs/issues/gotchas – T.Rob**
  - Monday 16:00 – 17:10, Aloeswood room
  - Wednesday 08:30 – 09:40, Salon E

Trying Something New

MQ Labs Experiment

Booth next to Aloeswood

MQ for z/OS Images

MQ for Distributed Image

Monday & Tuesday Morning – drop in