AWS re:Inforce

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IAM431-R

The life of an IAM policy

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Disclaimers so they let us give this talk

- We will try, but may not be able, to answer all of your questions
- This is how things work today
- Services may have minor nuance or variation

Agenda

- Control plane and data plane
- Authentication
- Authorization
- Putting it all together

Internal architecture of IAM

Internal architecture of AWS Identity and Access Management (IAM) overview

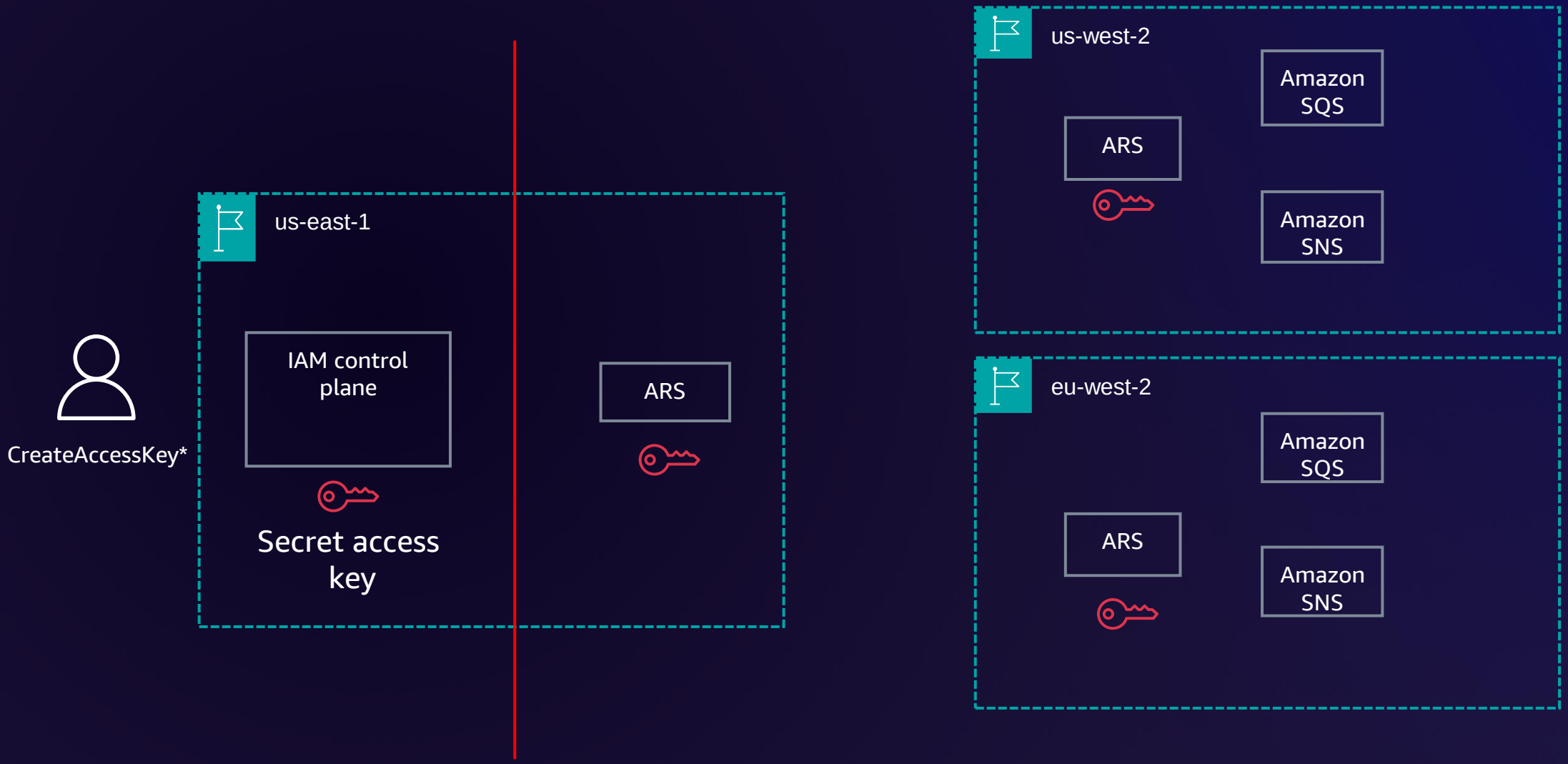
- Intentional separation of control plane and data plane
  - IAM control plane
  - Auth runtime service (ARS)

- Signature version 4's (Sigv4) hierarchical design that limits blast radius

Internal architecture of IAM

*for illustrative purposes, prefer temporary credentials instead

Internal architecture of IAM



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Internal architecture of IAM

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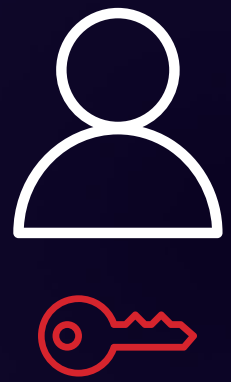
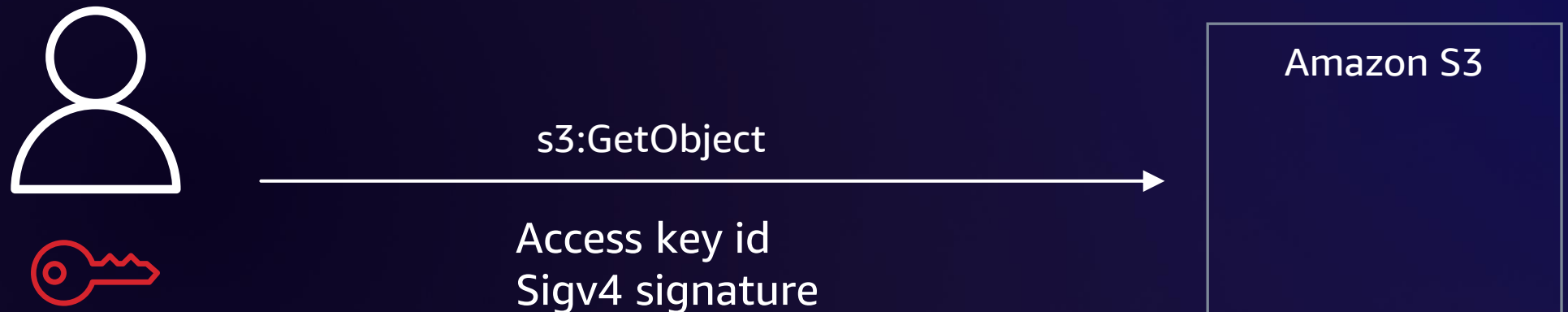
Authentication – Sigv4



Access key id
Secret access key

Amazon S3

Authentication – Sigv4



Authentication – Signature version 4 (Sigv4)

String to sign

Algorithm	AWS4-HMAC-SHA256
Request date time	20220830
Credential scope	20220830/us-east-1/ec2/aws4_request
Hashed canonical request	Hash(HTTP verb + URI + query string + headers + payload)

Authentication – Sigv4 signing key

Secret access key

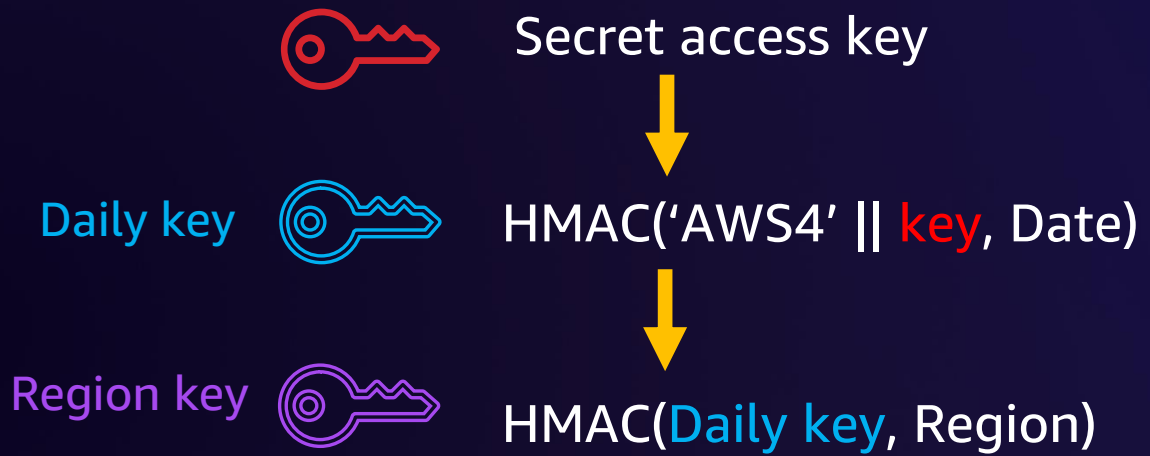
Authentication – Sigv4 signing key

Secret access key

Daily key

HMAC(‘AWS4’ || key, Date)

Authentication – Sigv4 signing key



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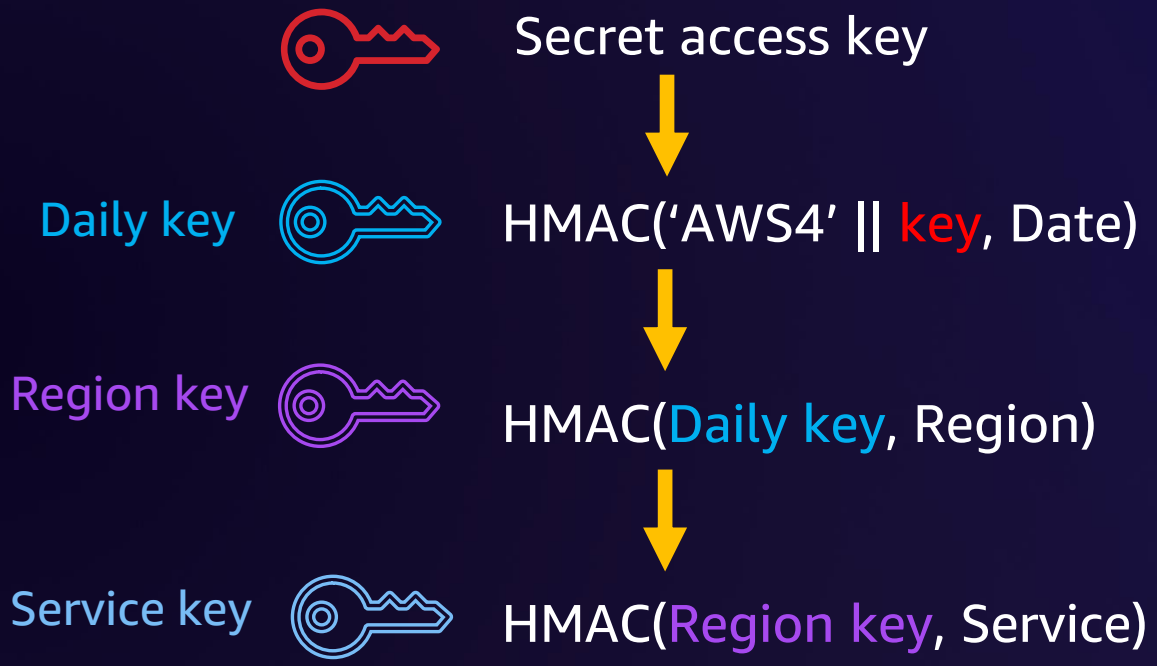

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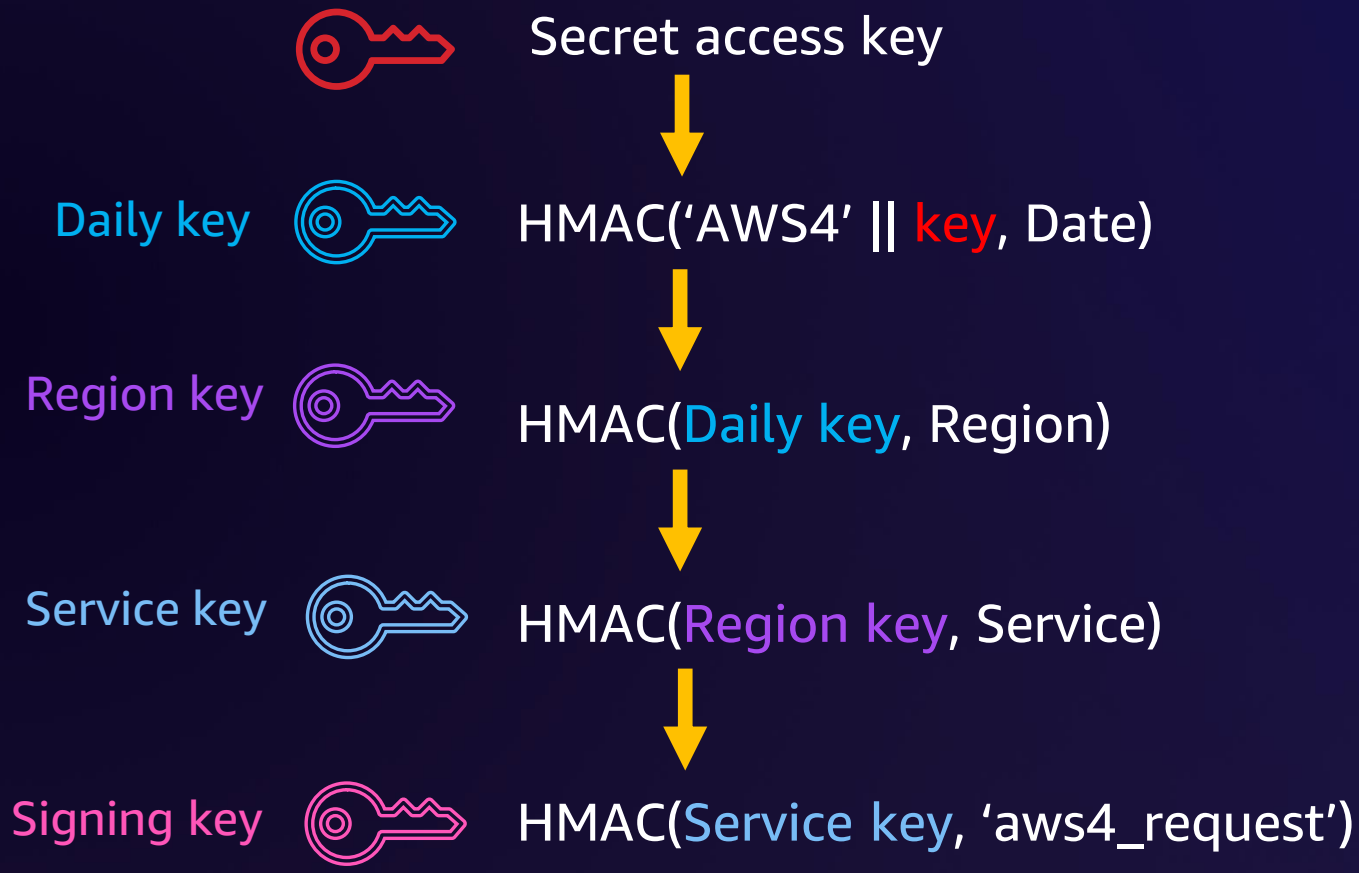


Authentication – Signature version 4 (Sigv4)

HMAC(Signing key, String to sign) = Signature

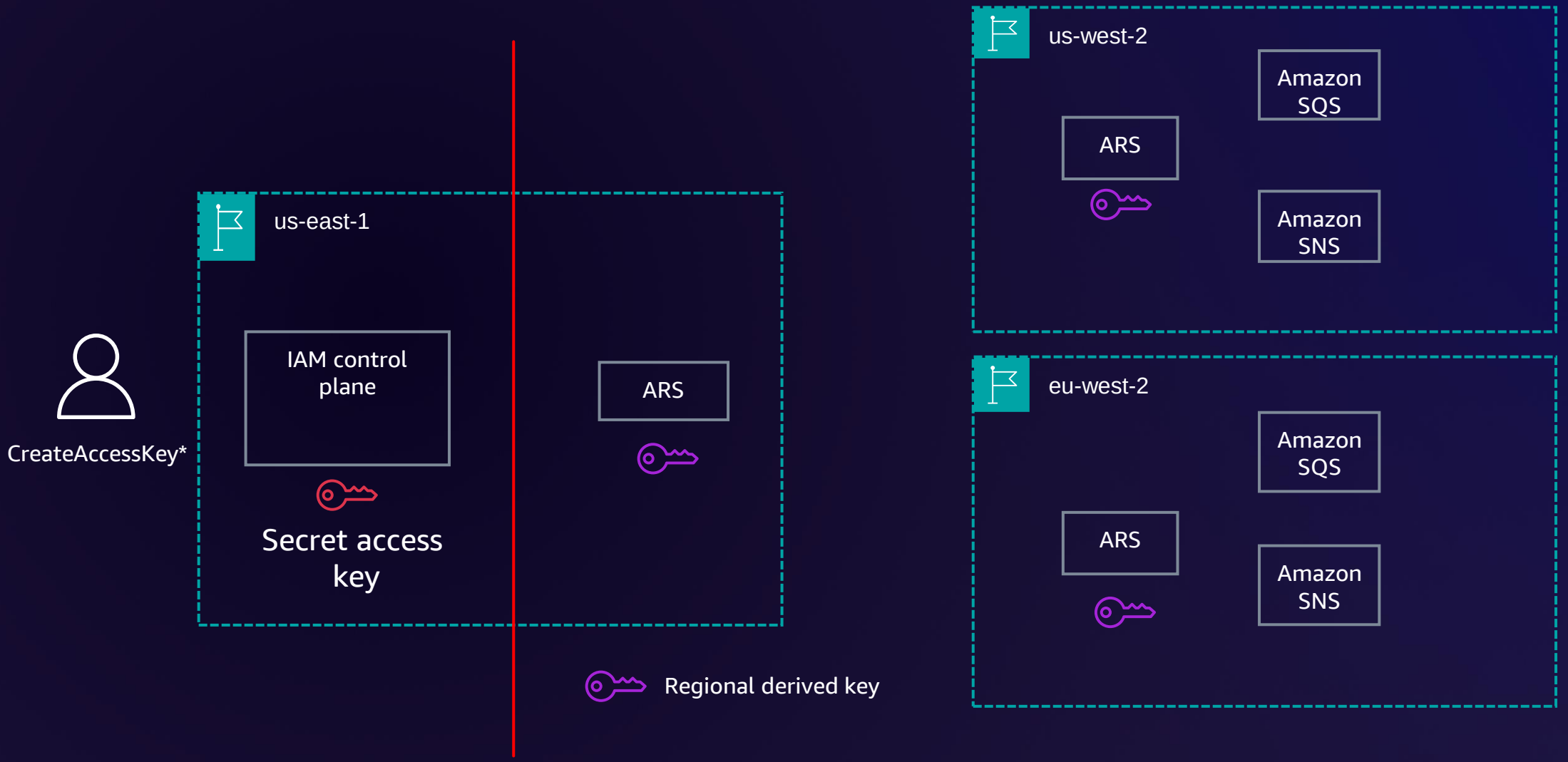
Authorization header:

AWS4-HMAC-SHA256 Credential=AKIAIOSFODNN7EXAMPLE/20130524/us-east-1/s3/aws4_request,SignedHeaders=host;x-amz-content-sha256;x-amz-date,Signature=fea454ca298b7da1c68078a5d1bdbfbbe0d65c699e0f91ac7a200a0136783543

Internal architecture of IAM – derived keys

*for illustrative purposes, prefer temporary credentials instead

Internal architecture of IAM – derived keys



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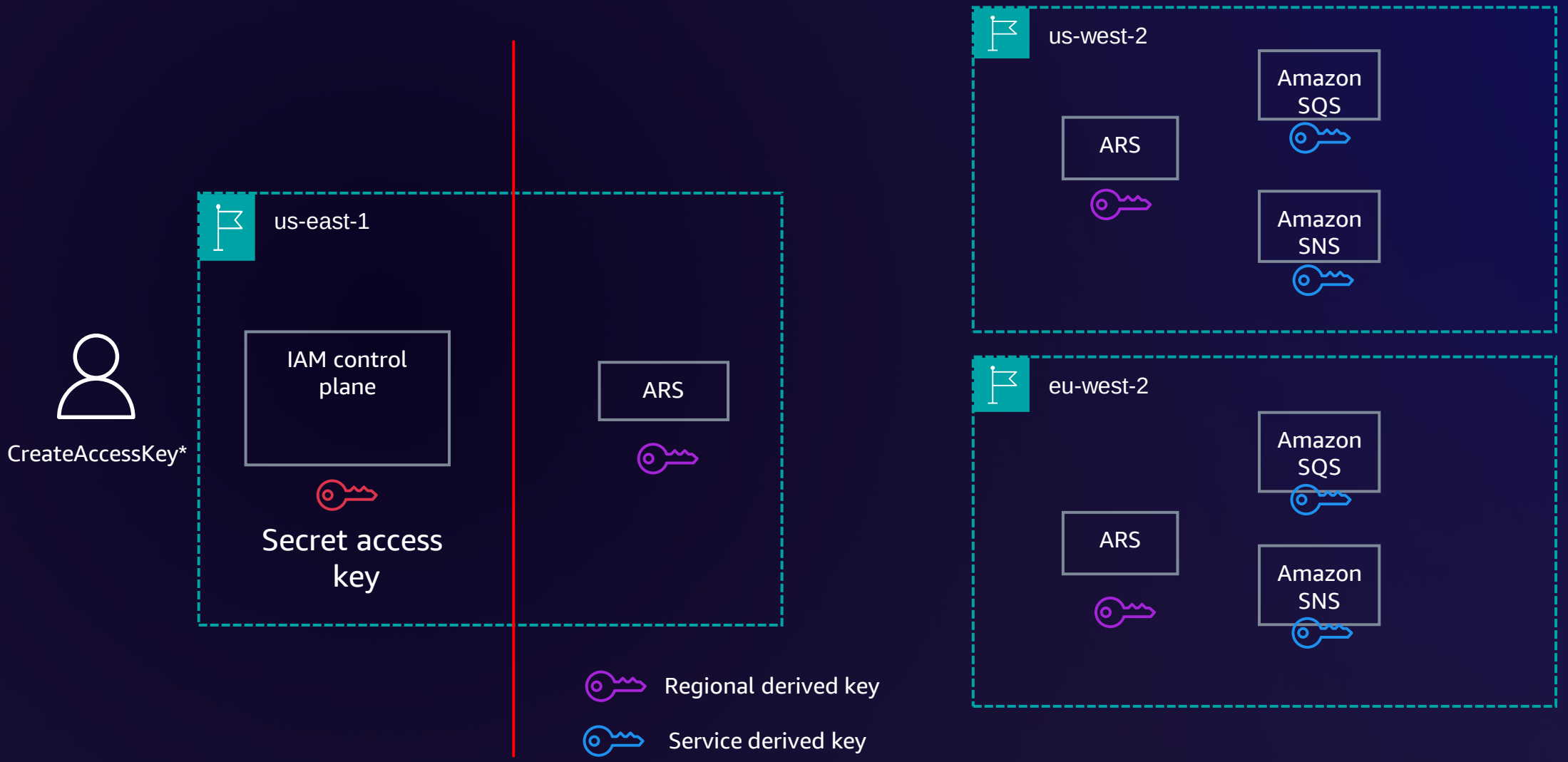
Internal architecture of IAM – derived keys



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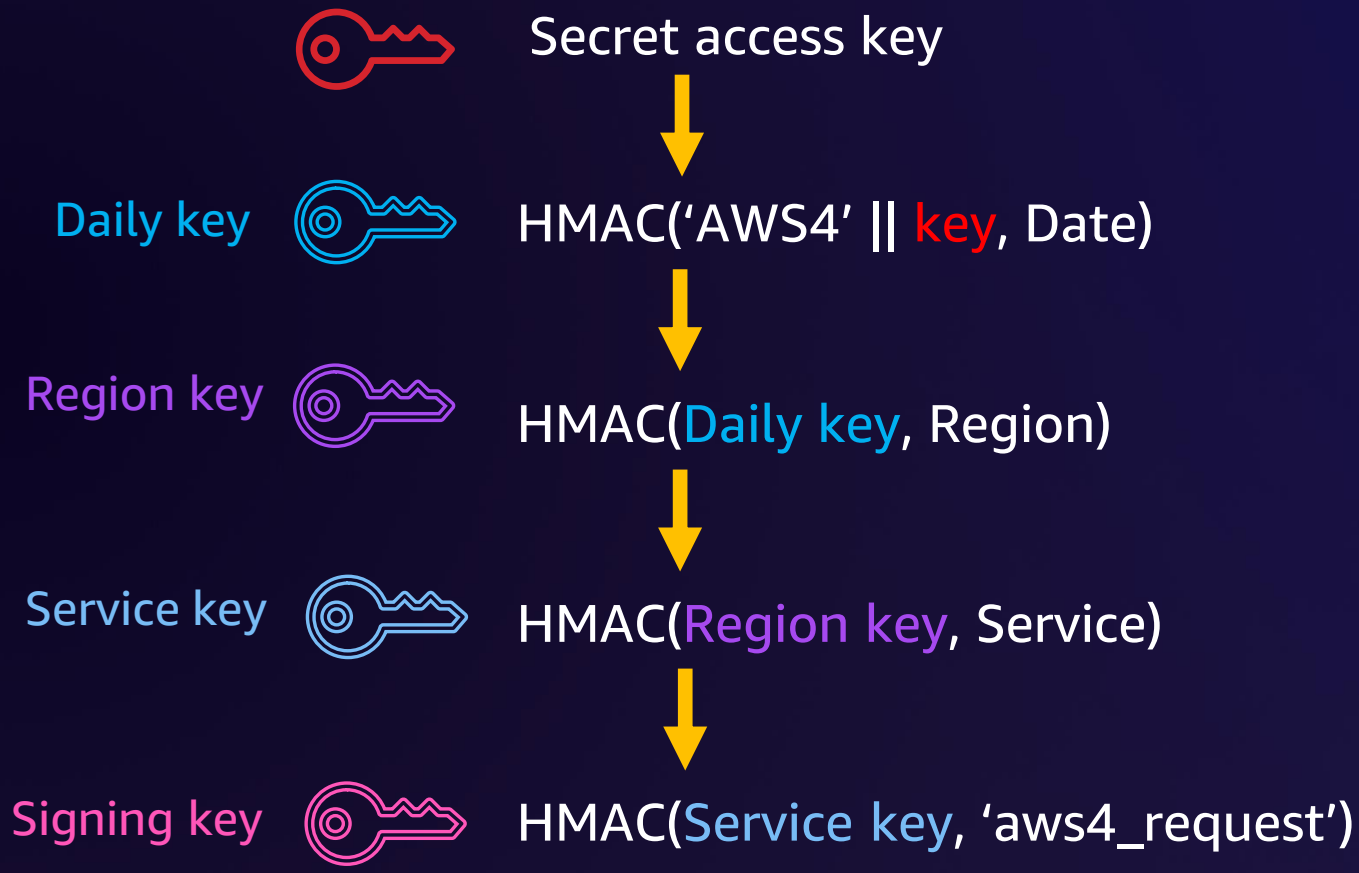

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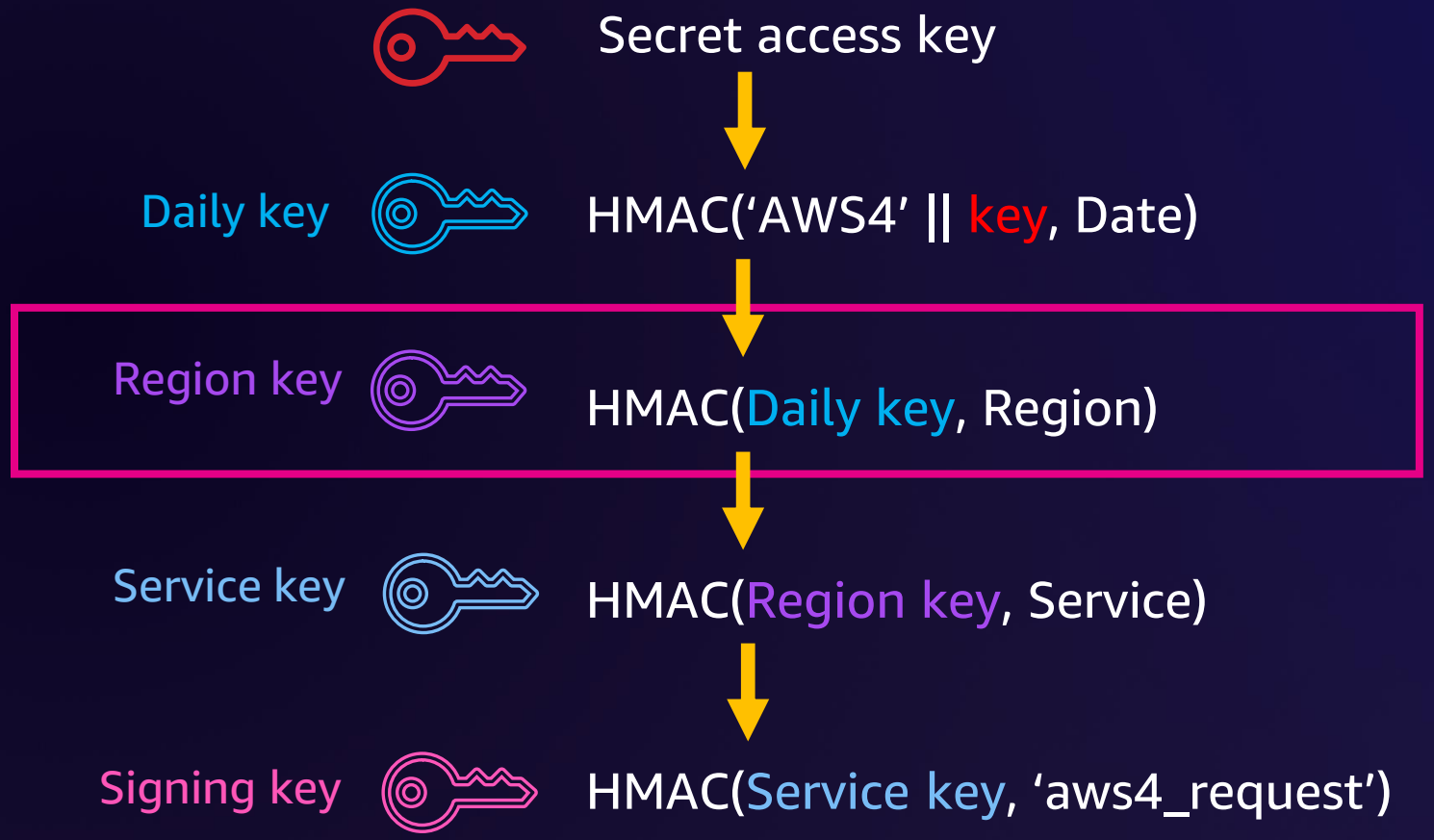

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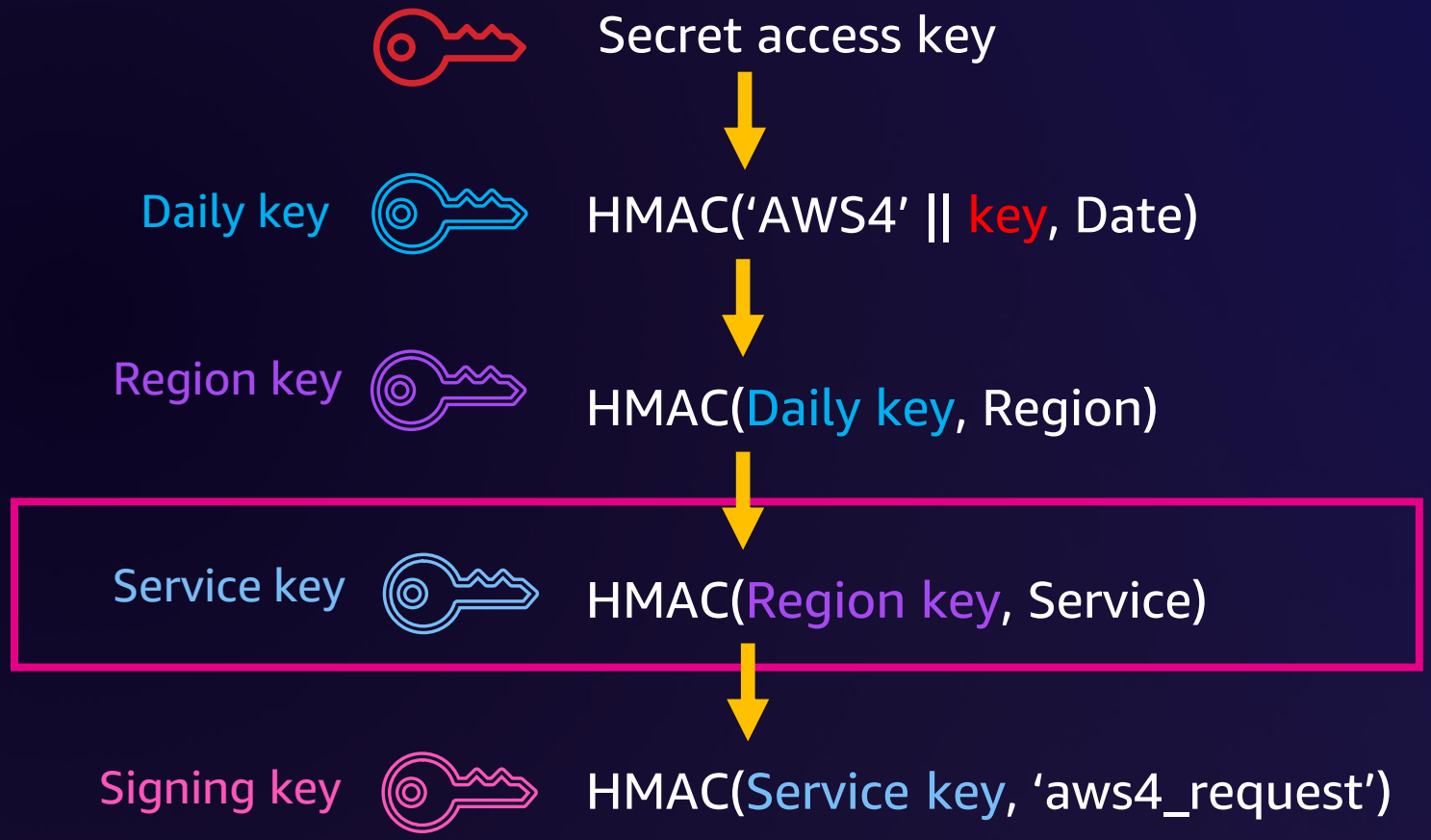


Internal architecture of IAM takeaways

- Control plane vs. data plane
  - IAM control plane
  - Auth runtime service (ARS)

- Authentication and the magic of Sigv4

But where are the policies?

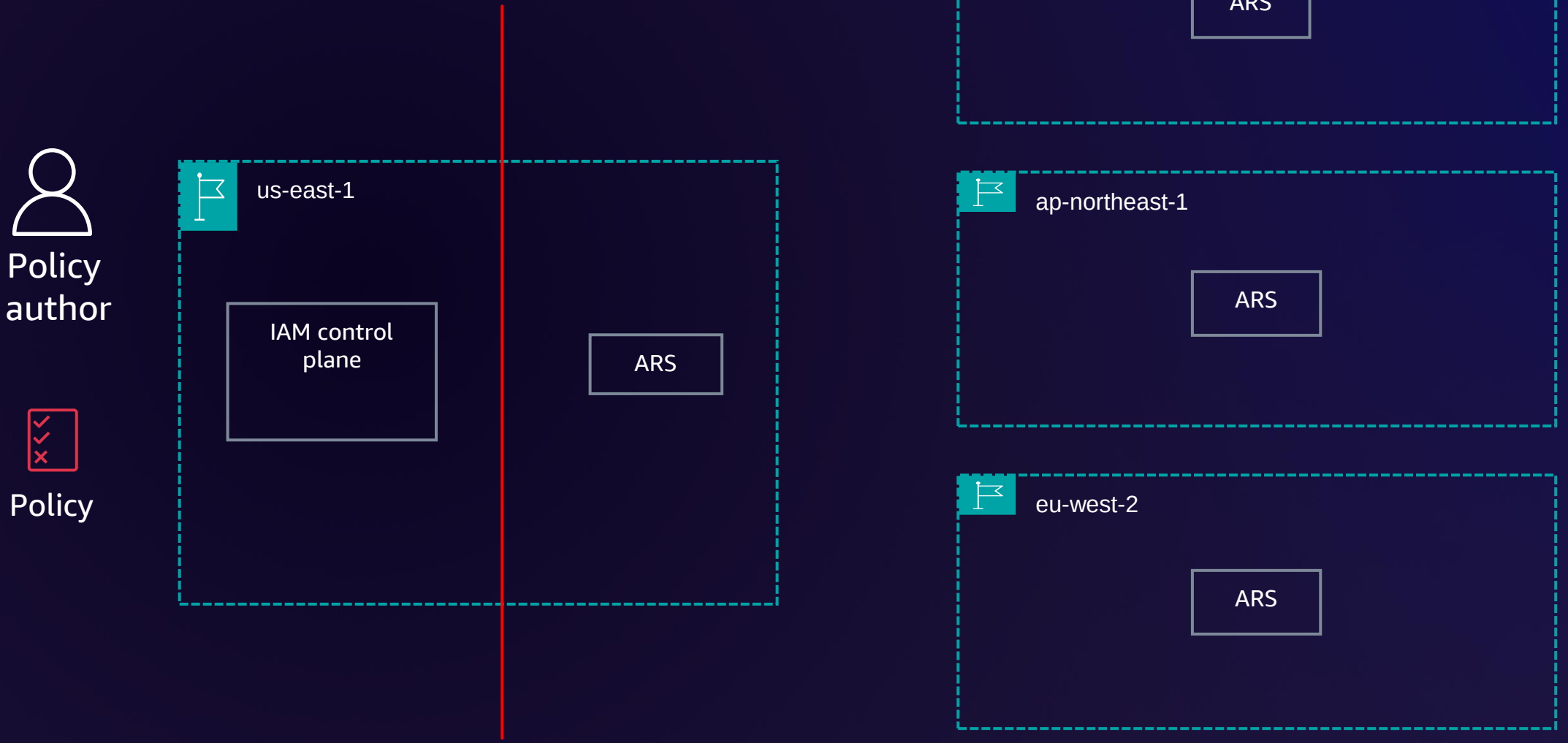
Policy type primer

- Identity-based policies
  - Managed and inline
  - Permissions boundaries
- Service control policies
- Resource-based policies
- Session policies
- VPC endpoint policies
- Forward access session (FAS) policies

Identity-based policies overview

- Propagated from the IAM control plane to a regional IAM data plane (ARS)
- AWS managed policies go through a review process before they touch the IAM control plane

Identity-based policies



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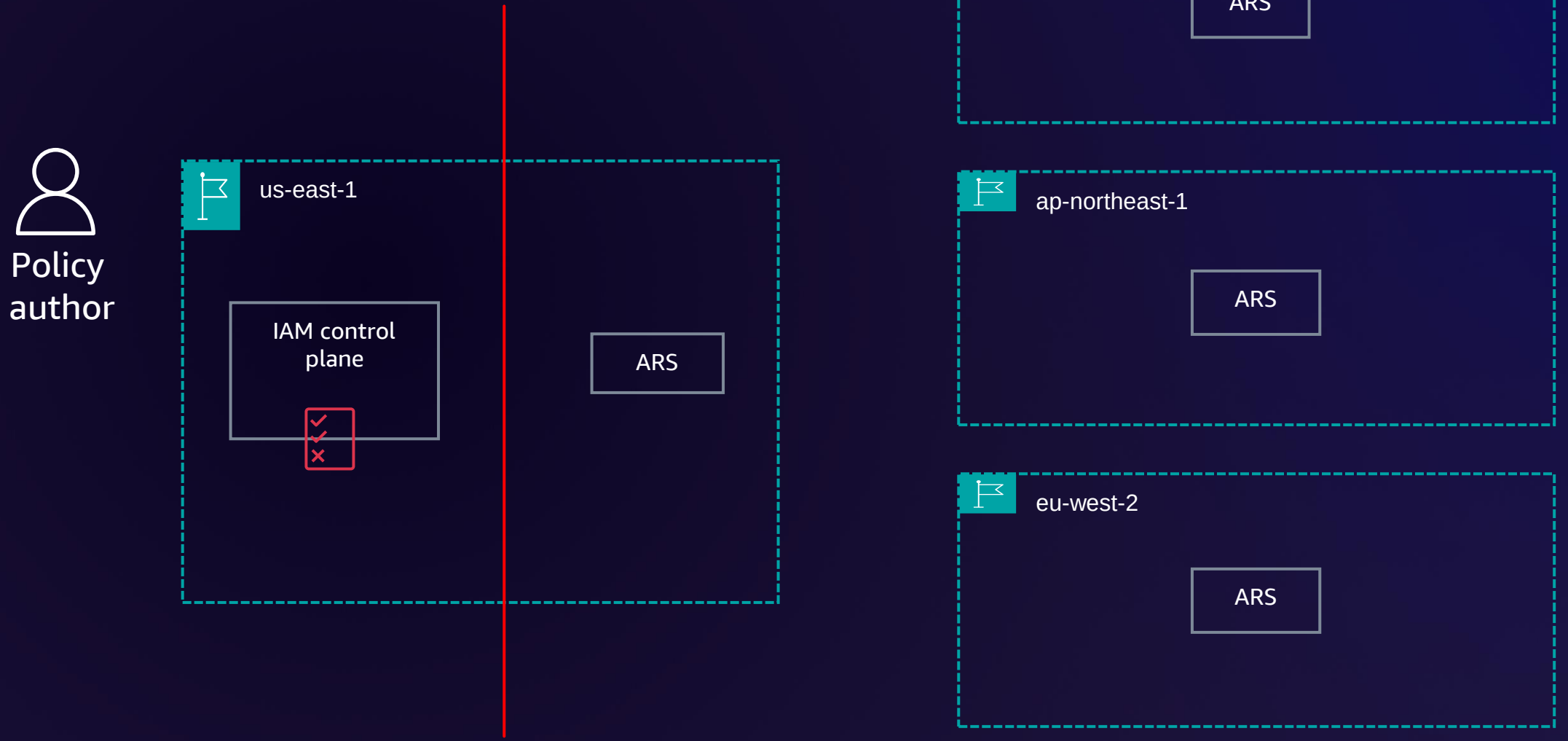
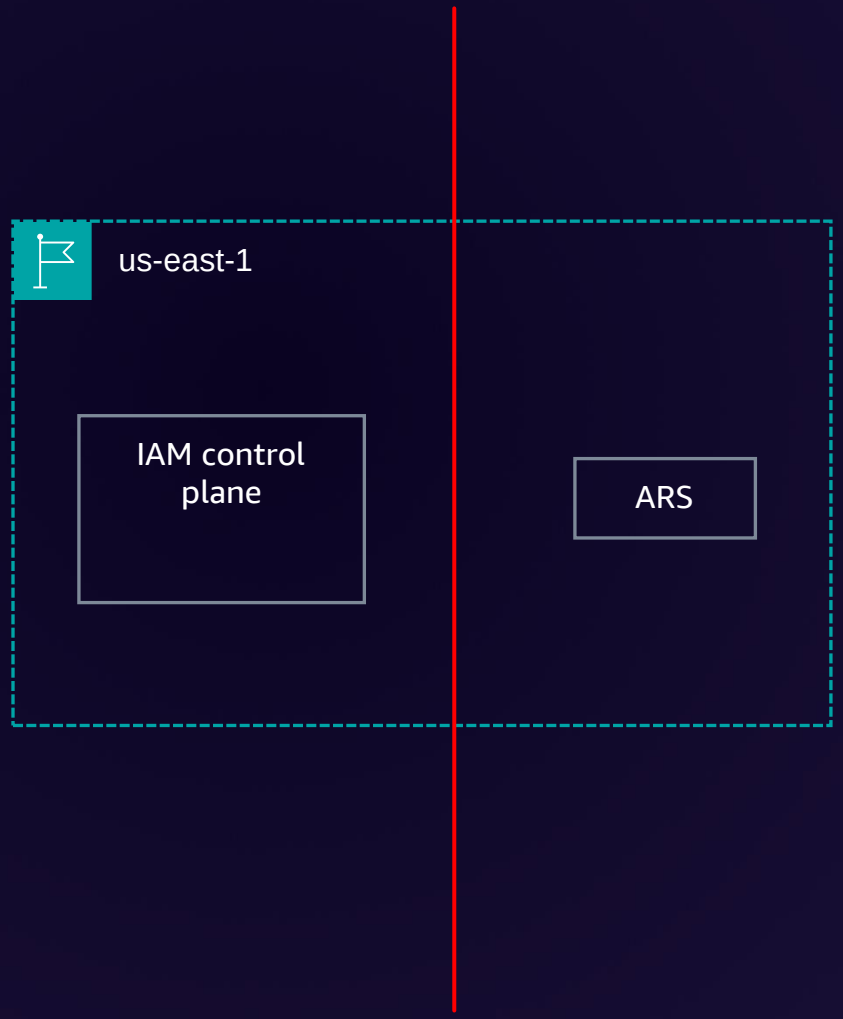
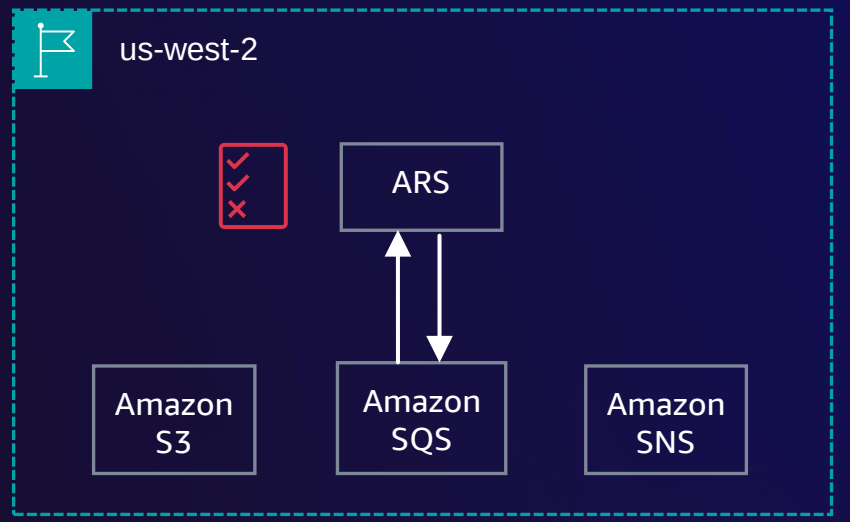


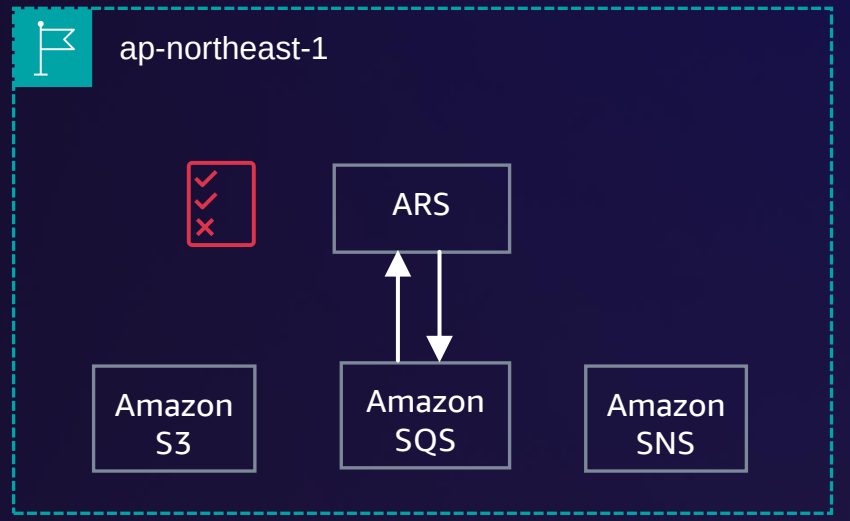
Identity-based policies

Identity-based policies

Policy







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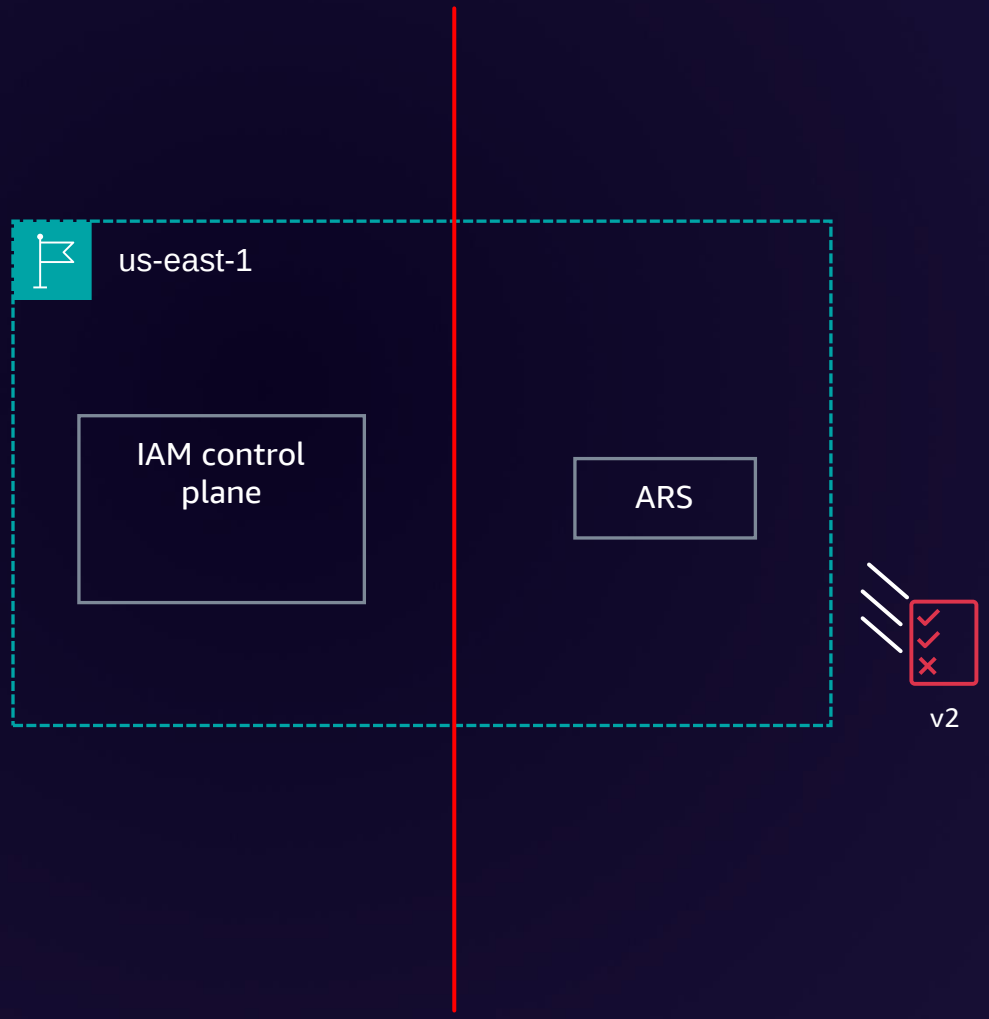
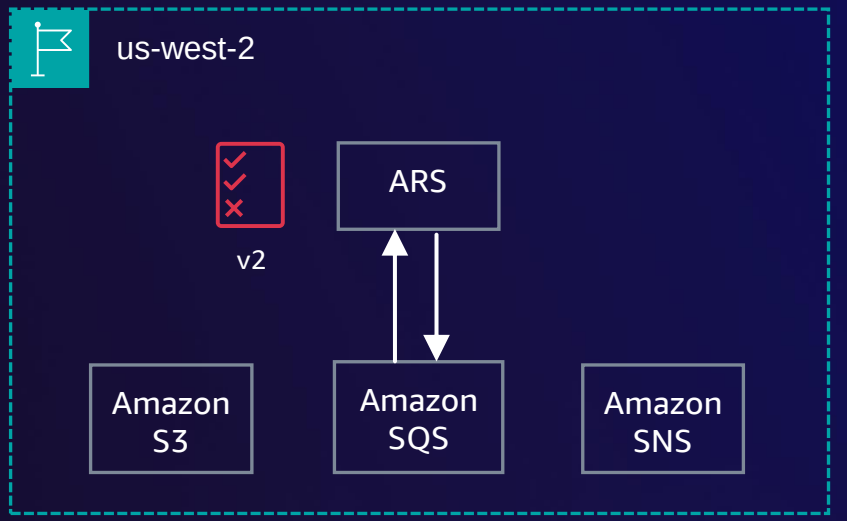
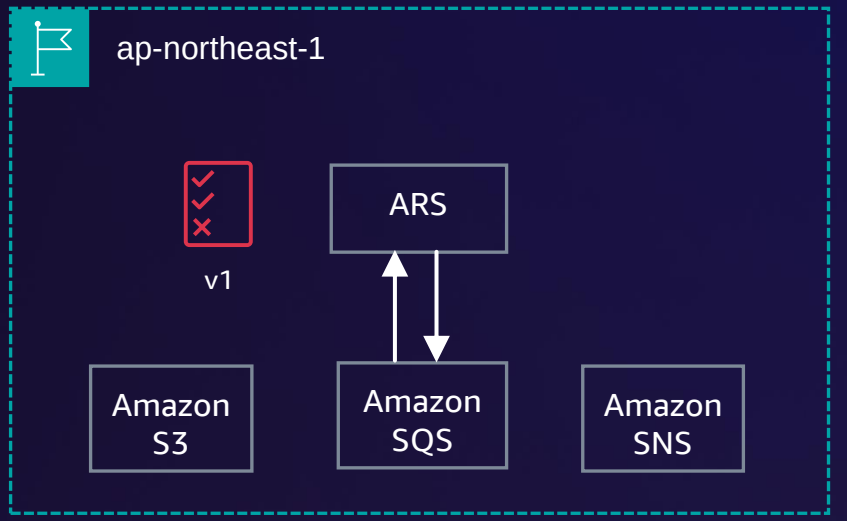


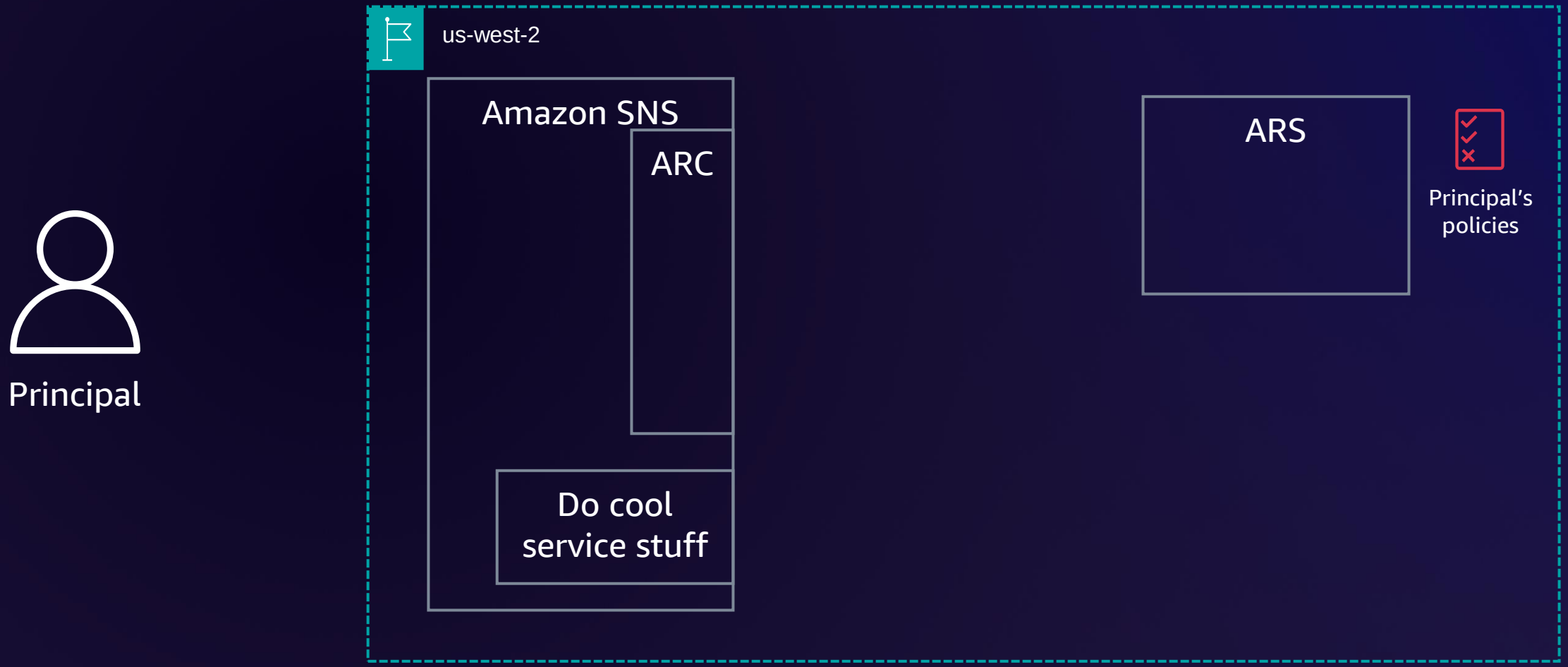




Where are policies evaluated?

- AWS services authorize their own requests
- Services use the auth runtime client (ARC) to consistently evaluate policies
- ARS performs authentication, ARC performs authorization

Identity-based policies – a sample request



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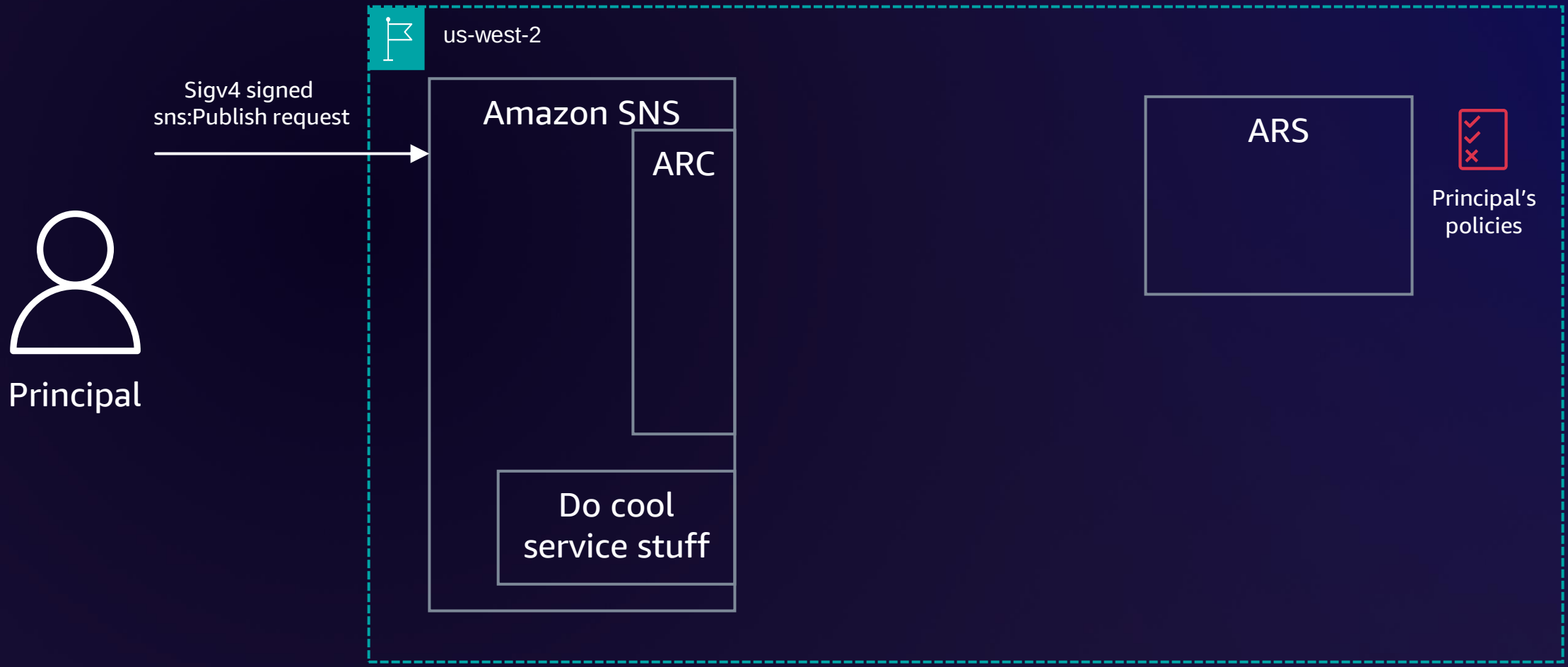

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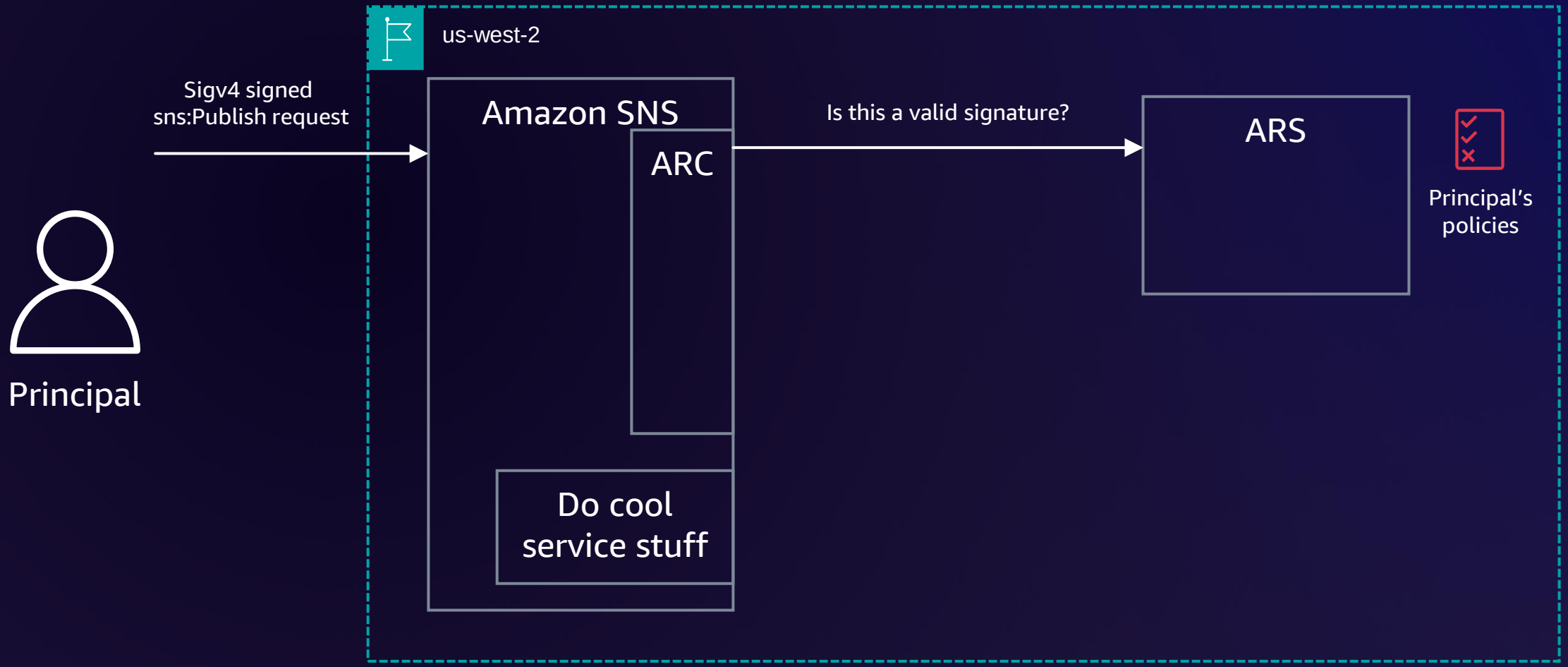

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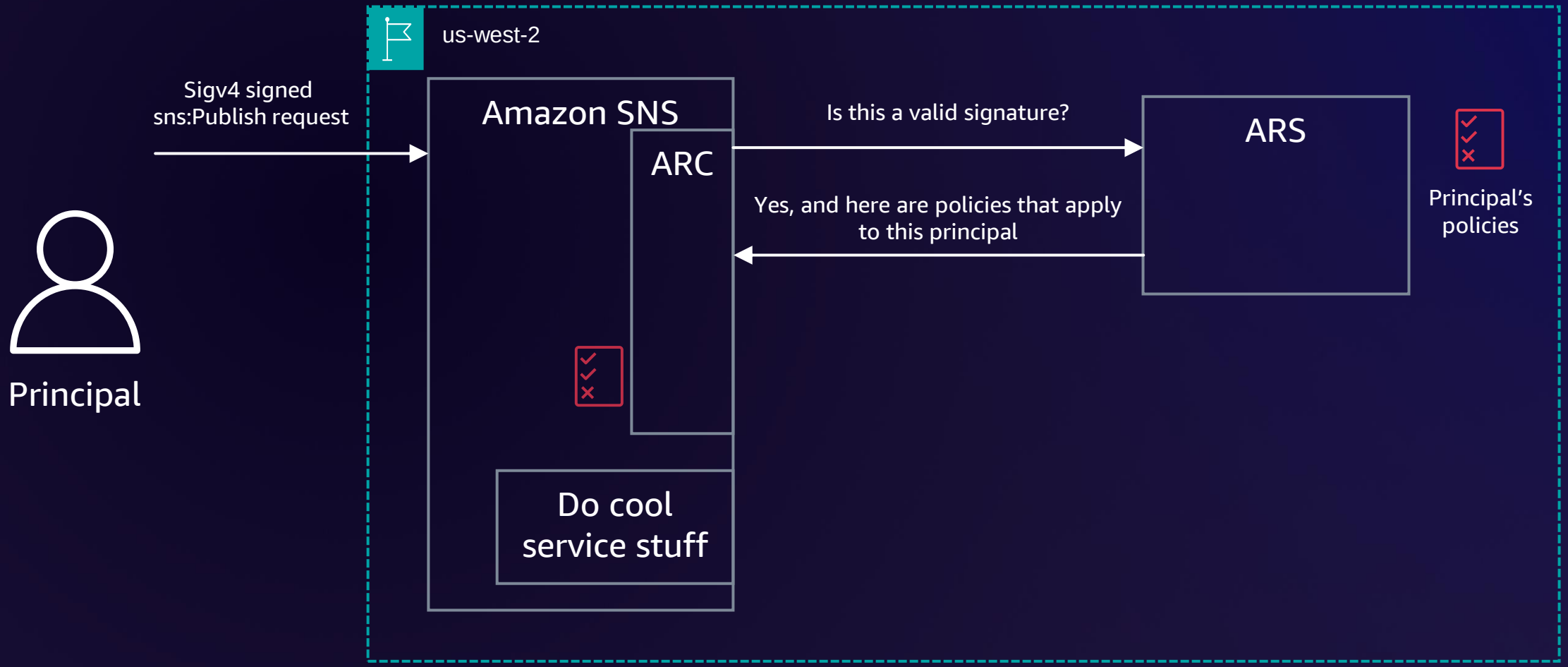

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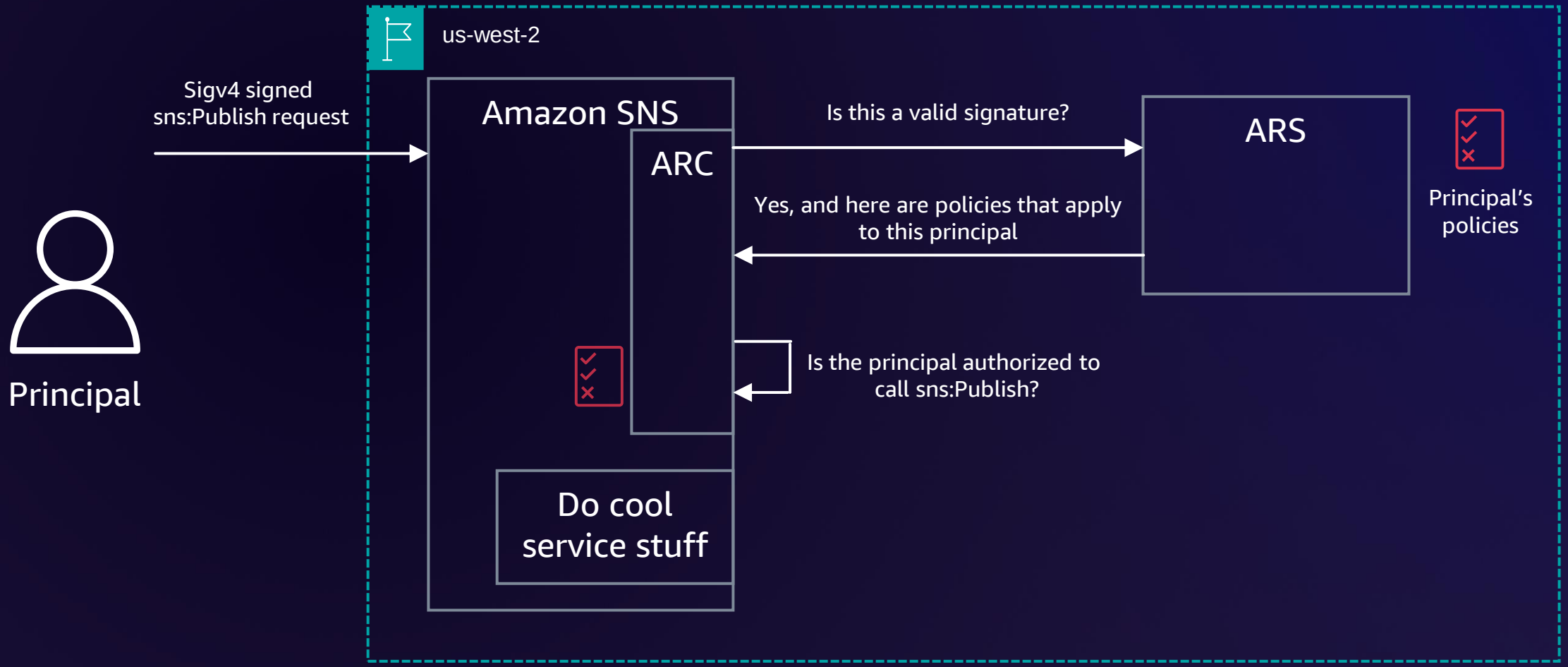

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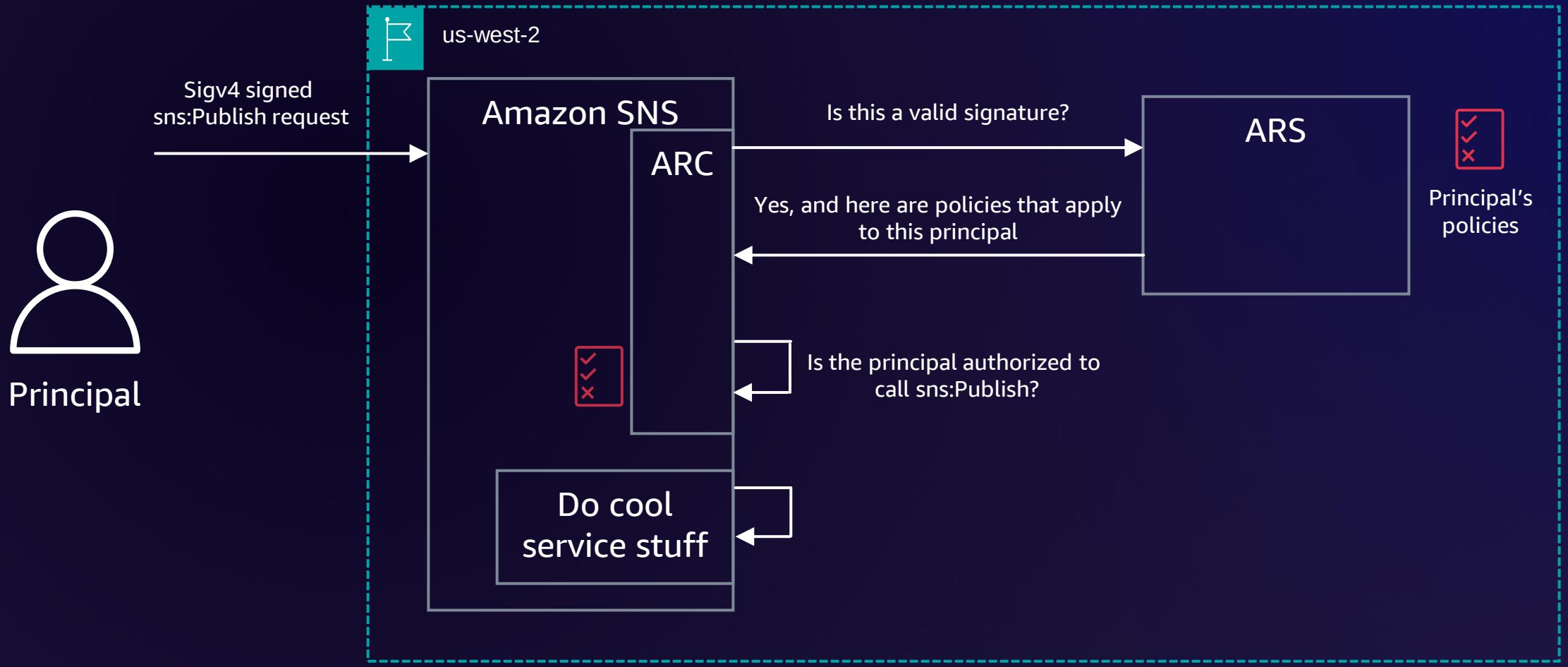

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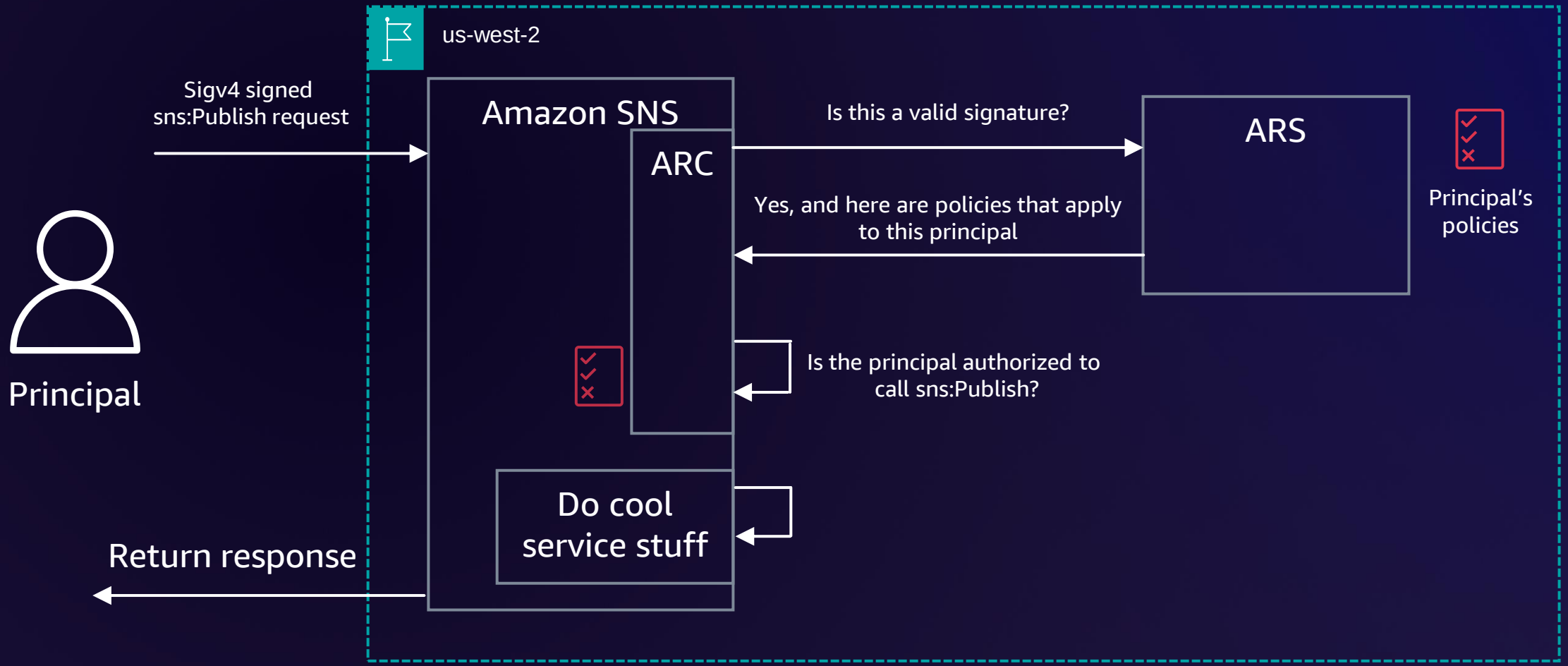
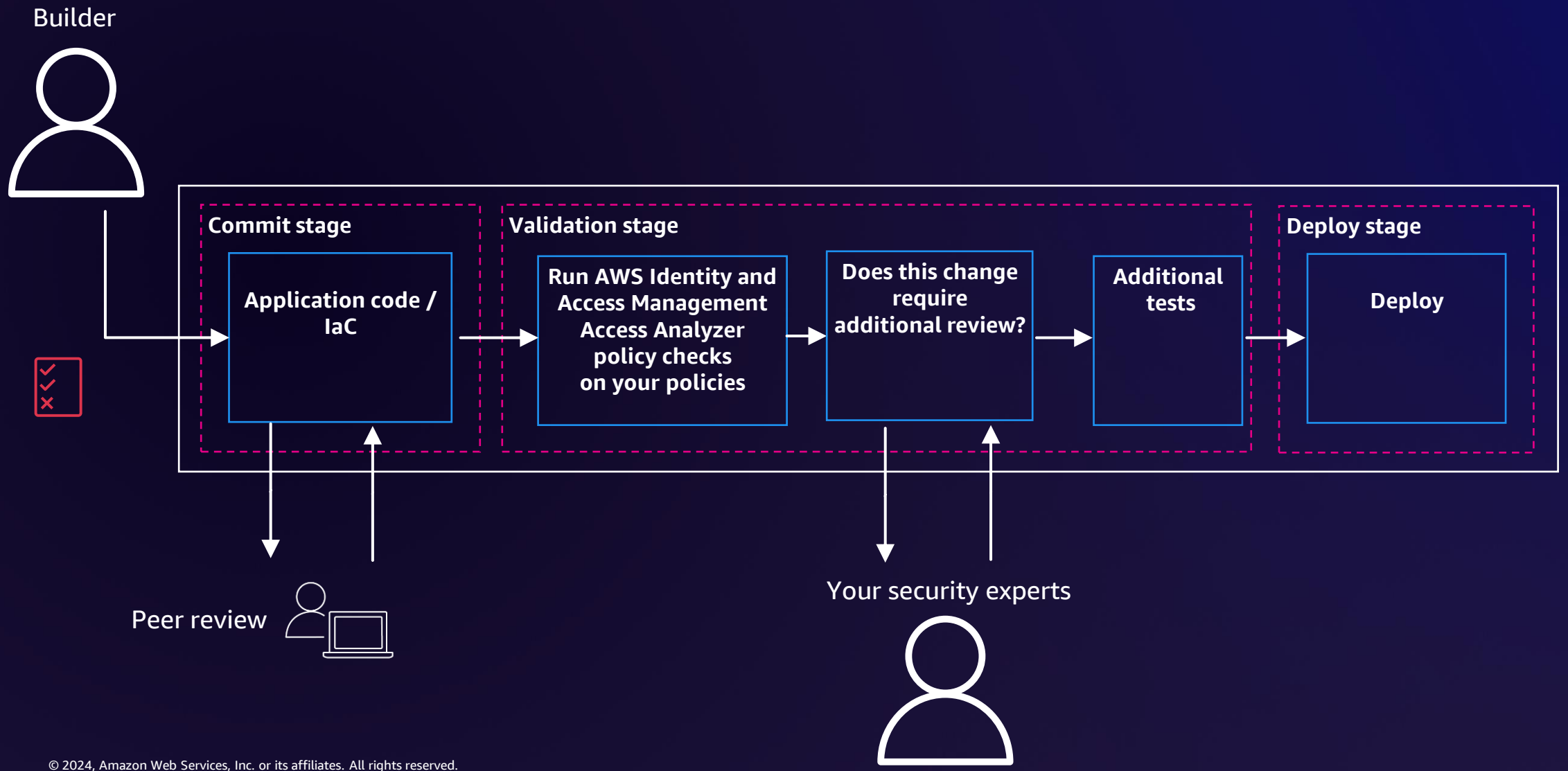


AWS managed policy review process

You can do this too



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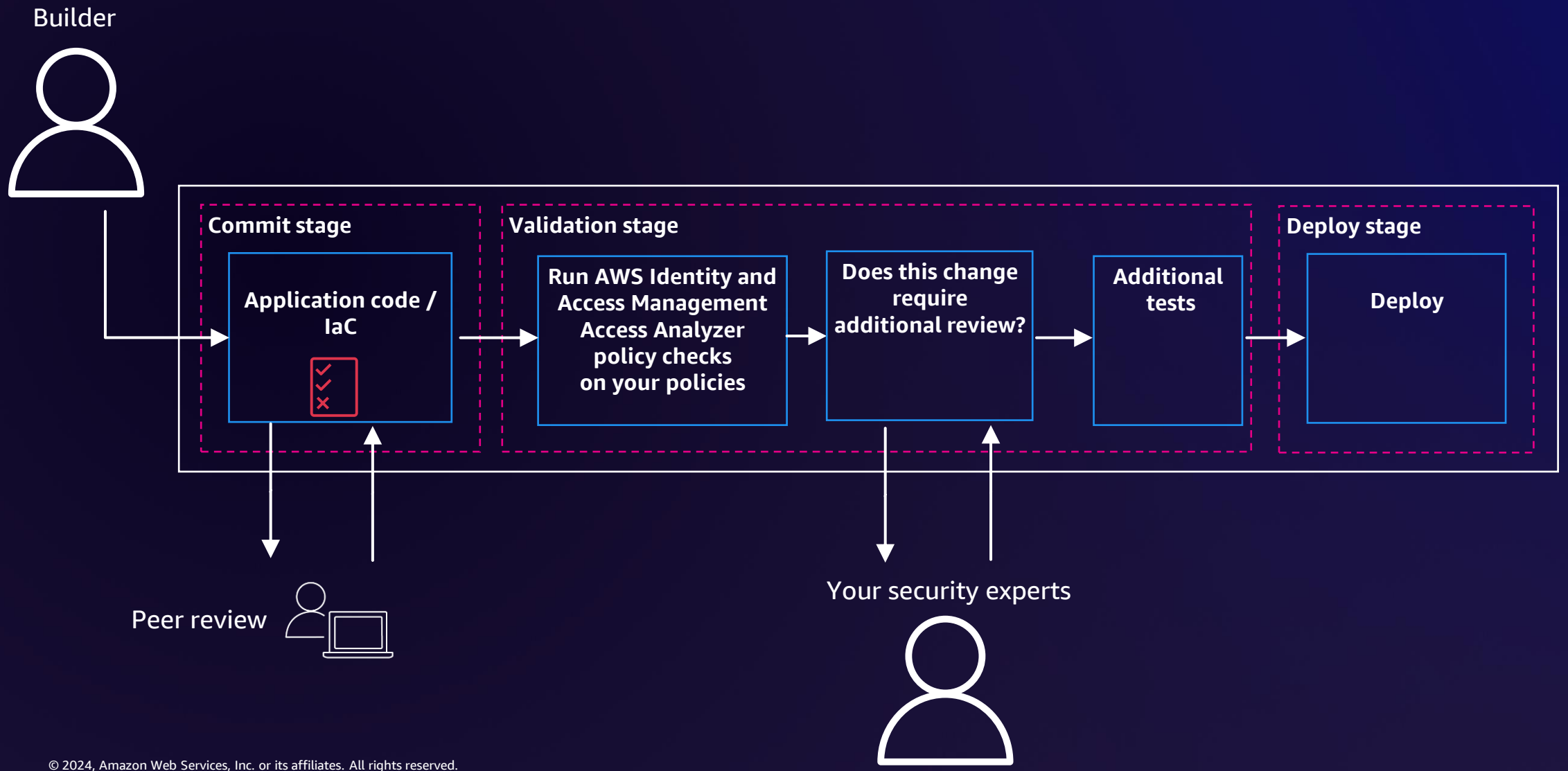

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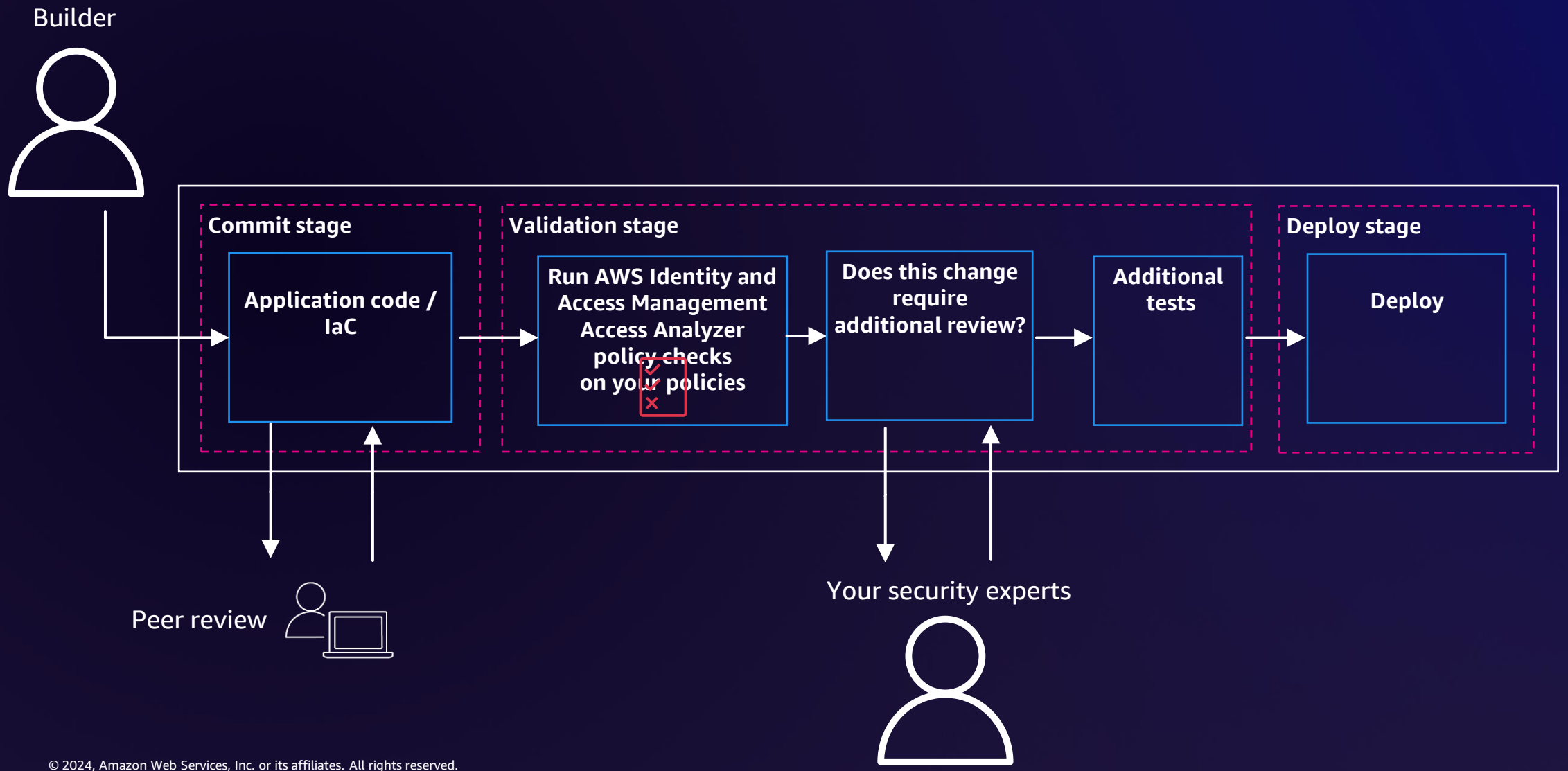

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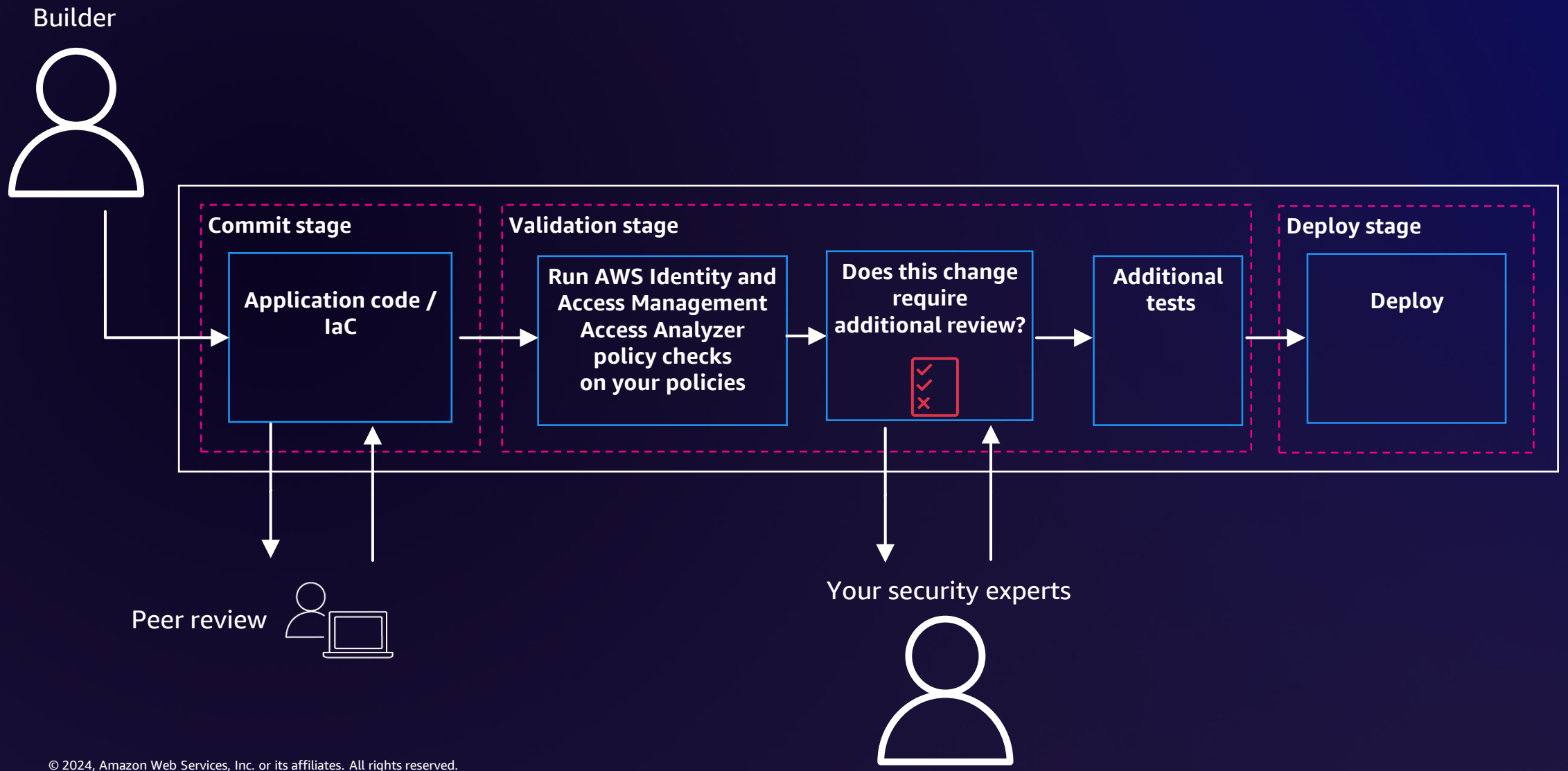

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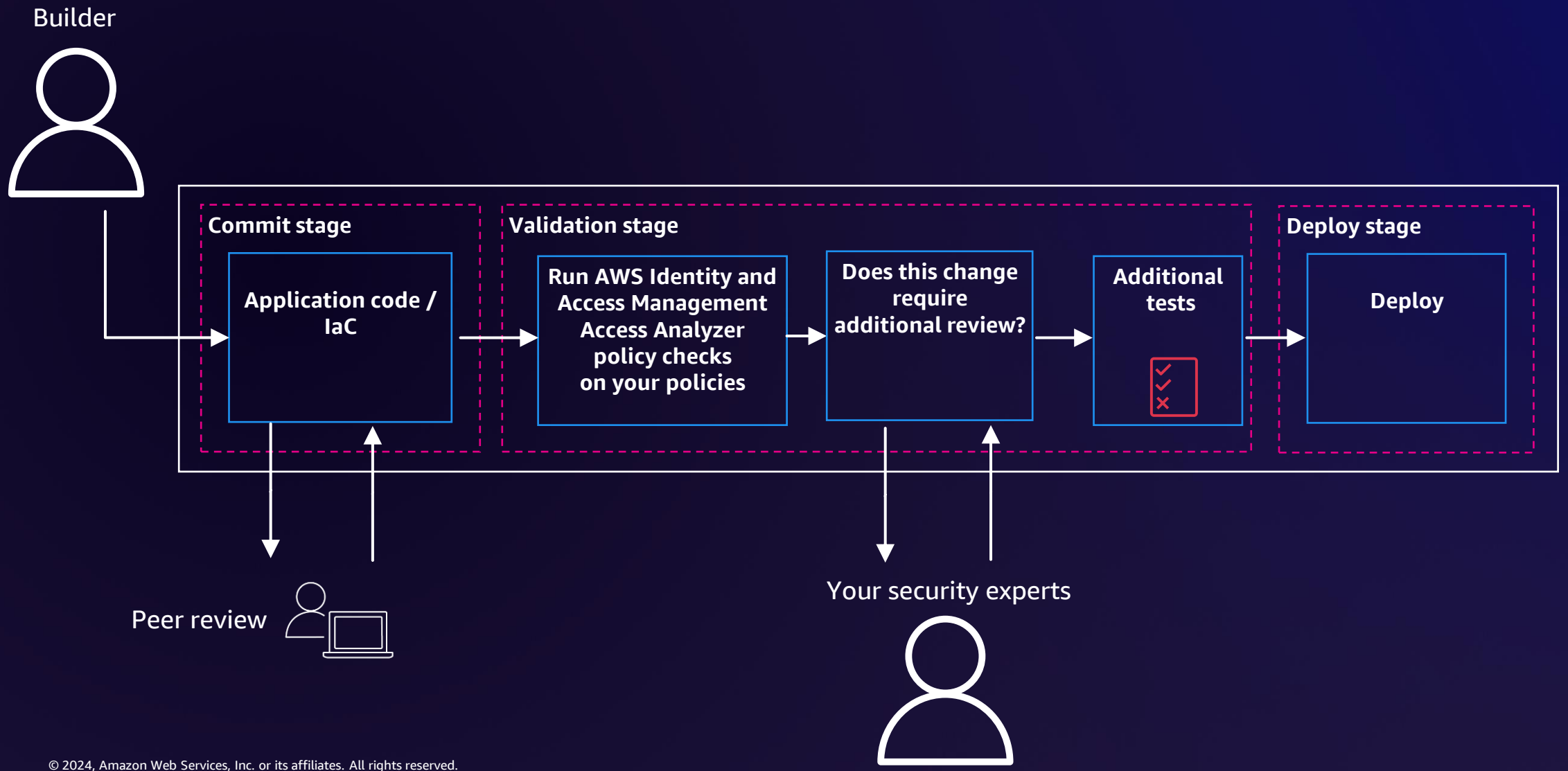

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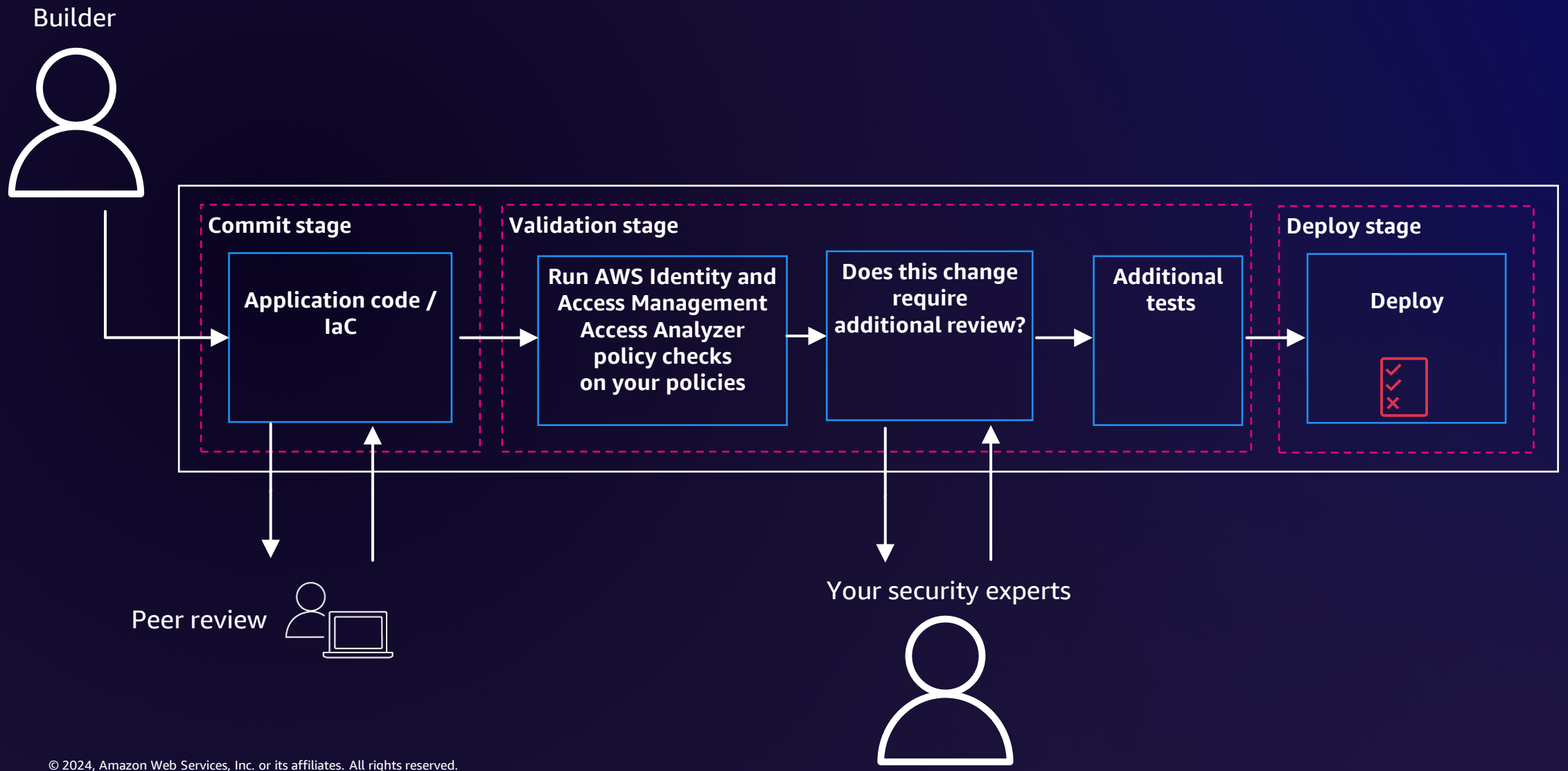
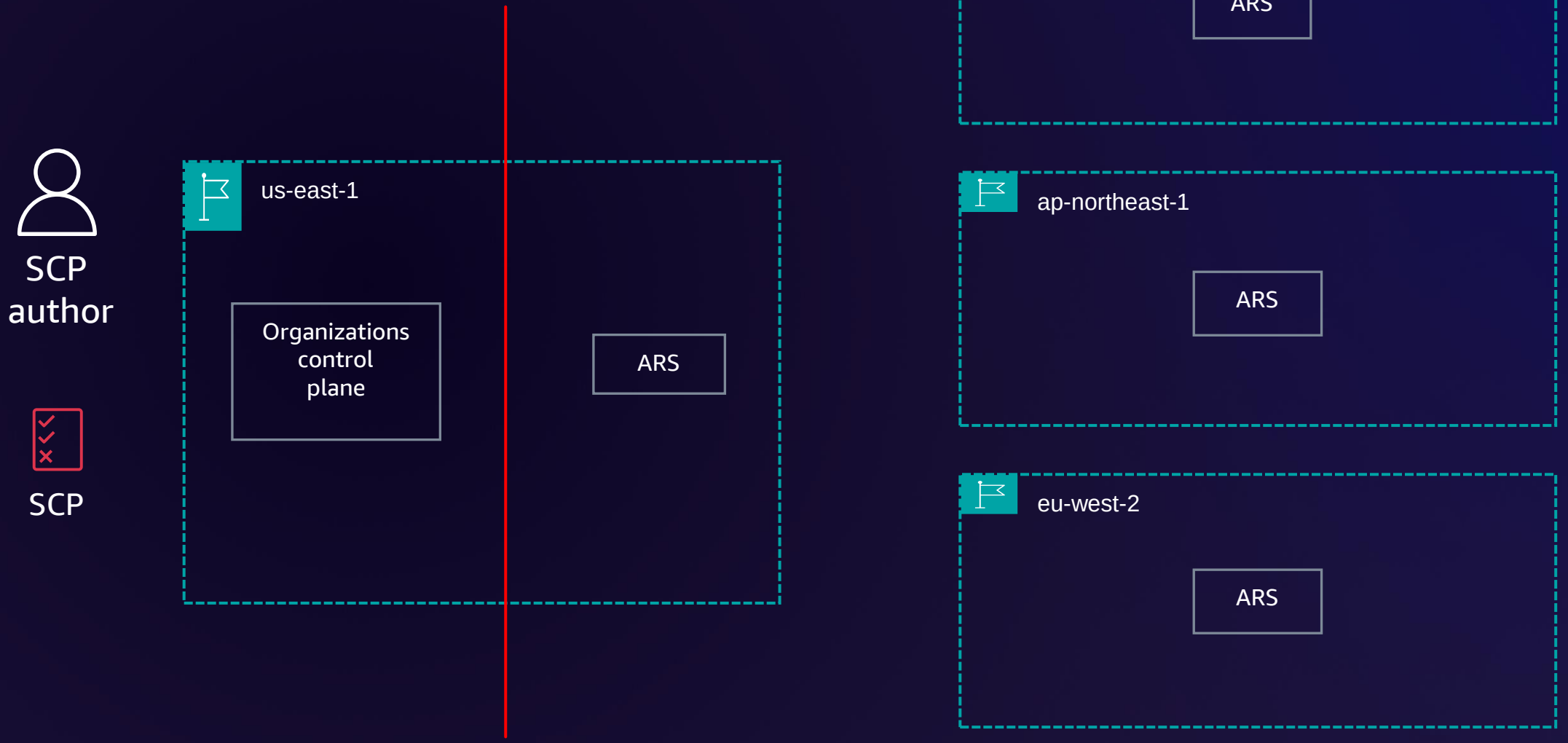


Service control policies



Service control policies

Service control policies

Identity-based policy takeaways

- Policy updates are eventually consistent for good reason
- Policy evaluation is consistently performed by a service

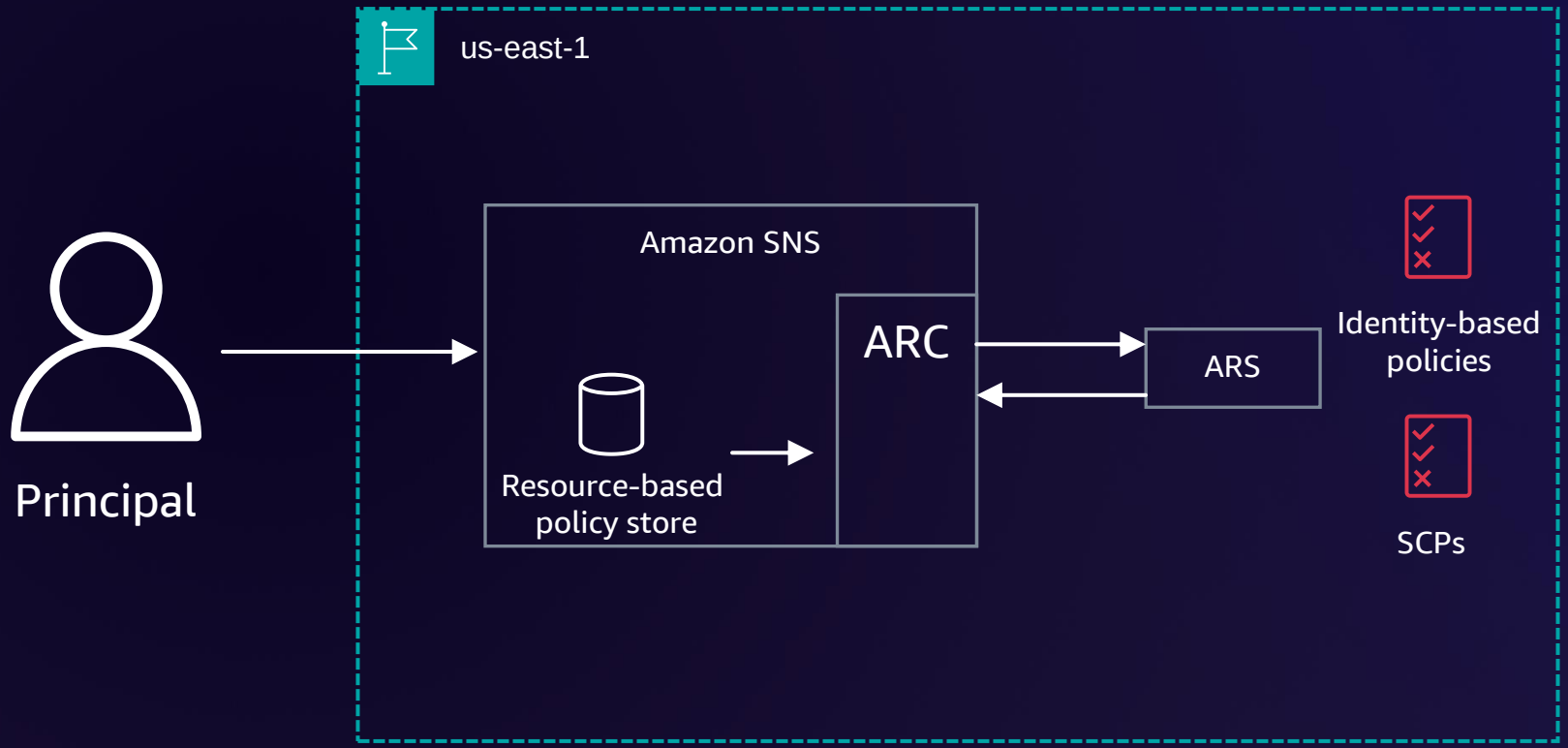
Identity-based policy takeaways

- Policy updates are eventually consistent for good reason
- Policy evaluation is consistently performed by a service
- You can build your own policy review process
- You may not need the level of review that we have

Resource-based policies overview

- Owned by an individual service
- Adhere to the IAM policy specification, but services can customize available policy elements

Resource-based policies



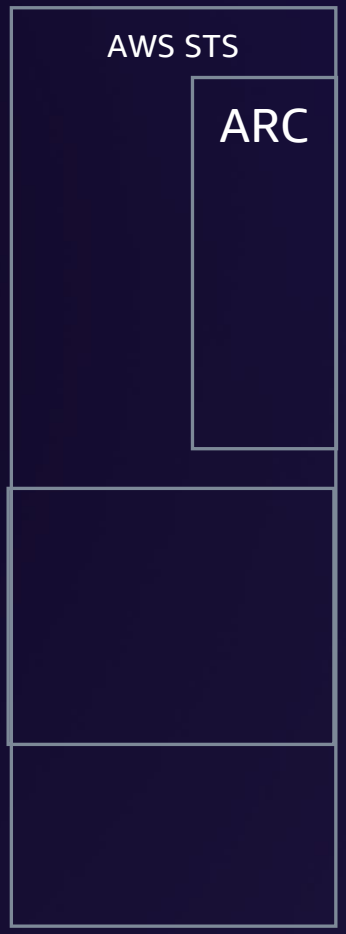
Session policies overview

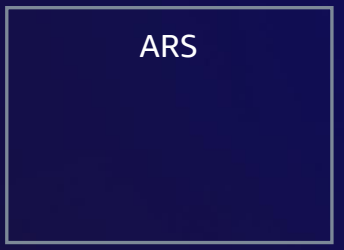
- Injected into the session token for an AssumeRole* request
- Only copy of session policy is in the token itself

* or AssumeRoleWithSAML, AssumeRoleWithWebIdentity

Session policies – creating a session with AWS STS

Principal





Session policies – creating a session with AWS STS

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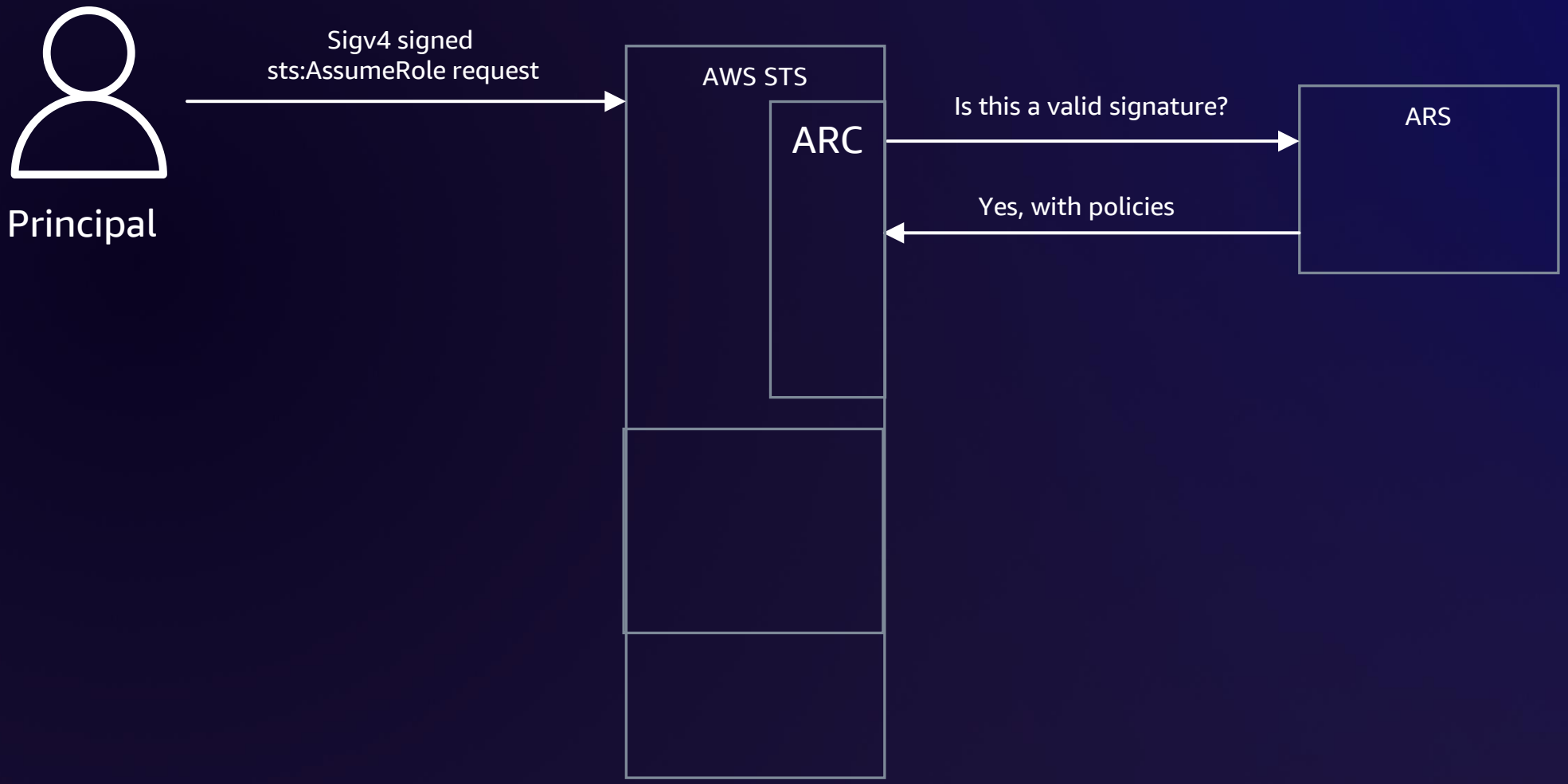

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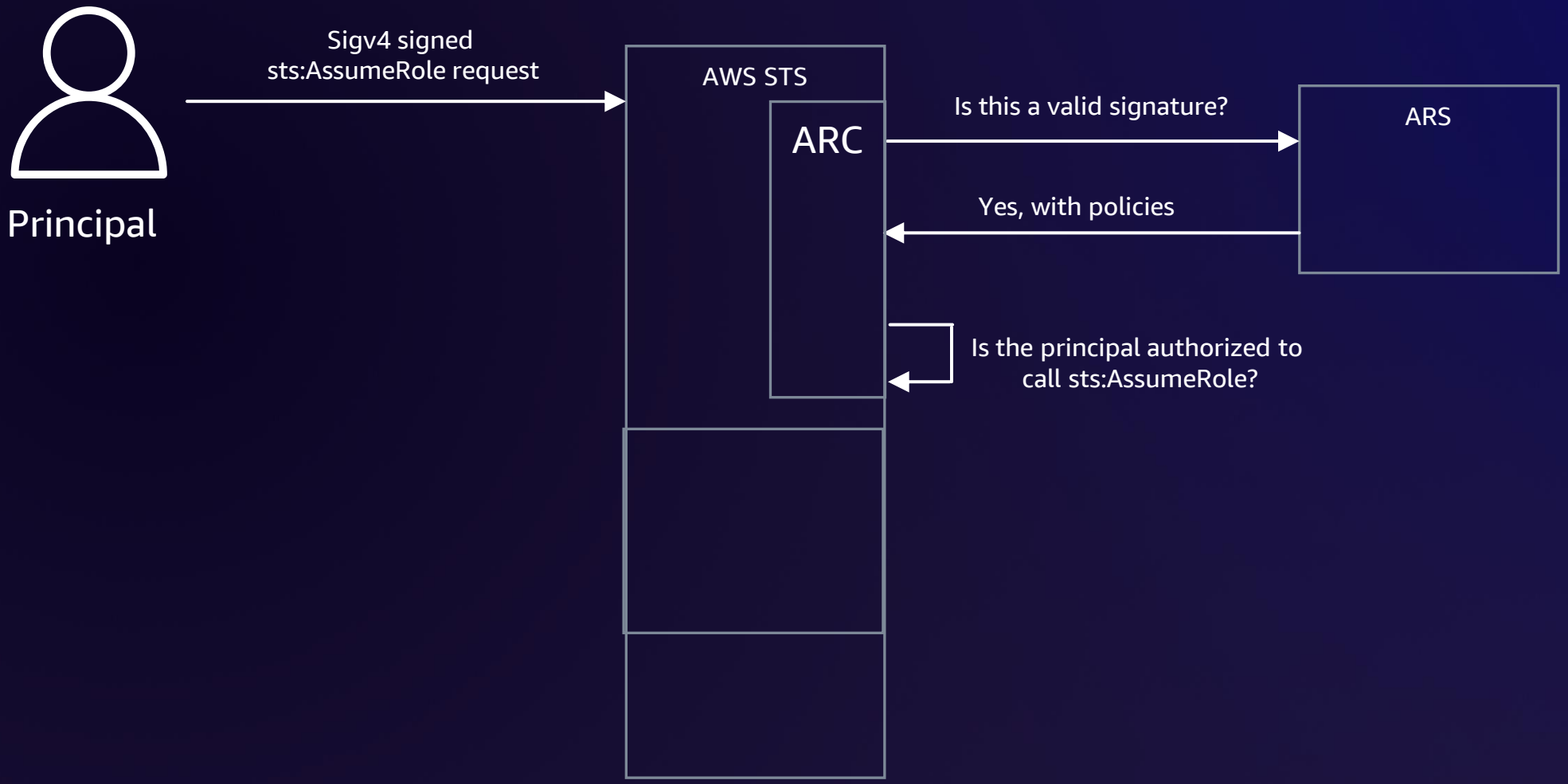

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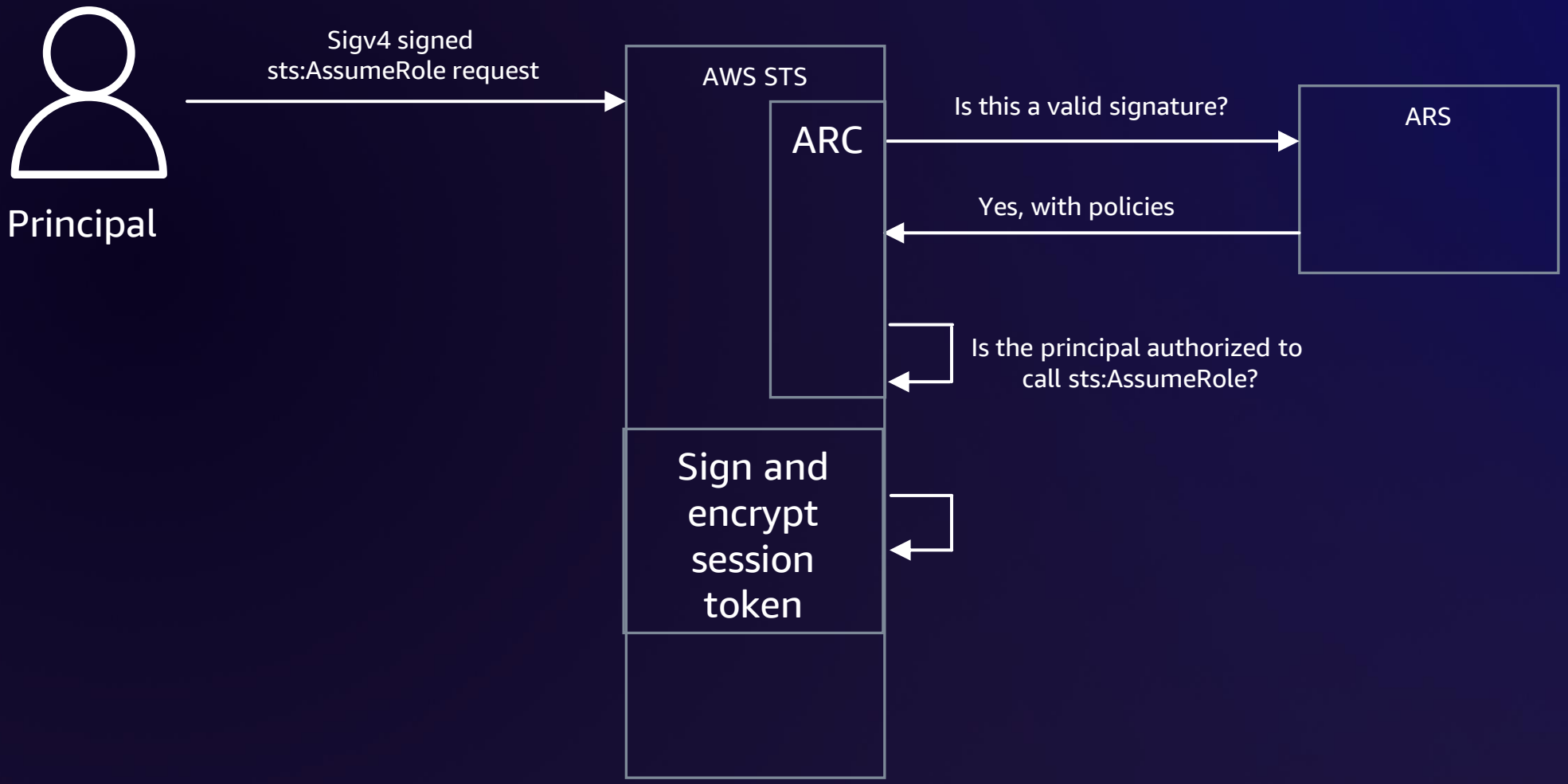

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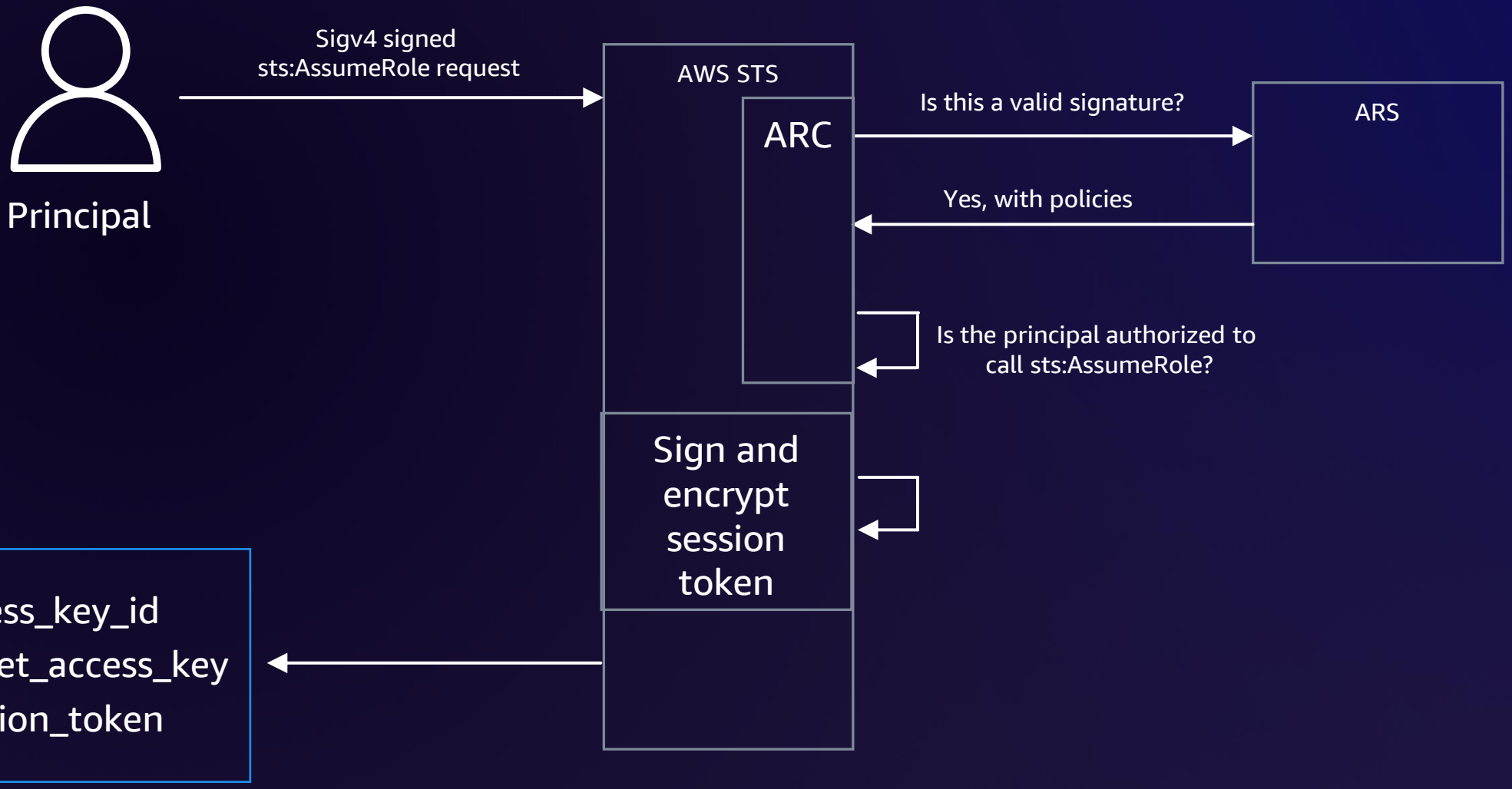


The session token

aws_session_token

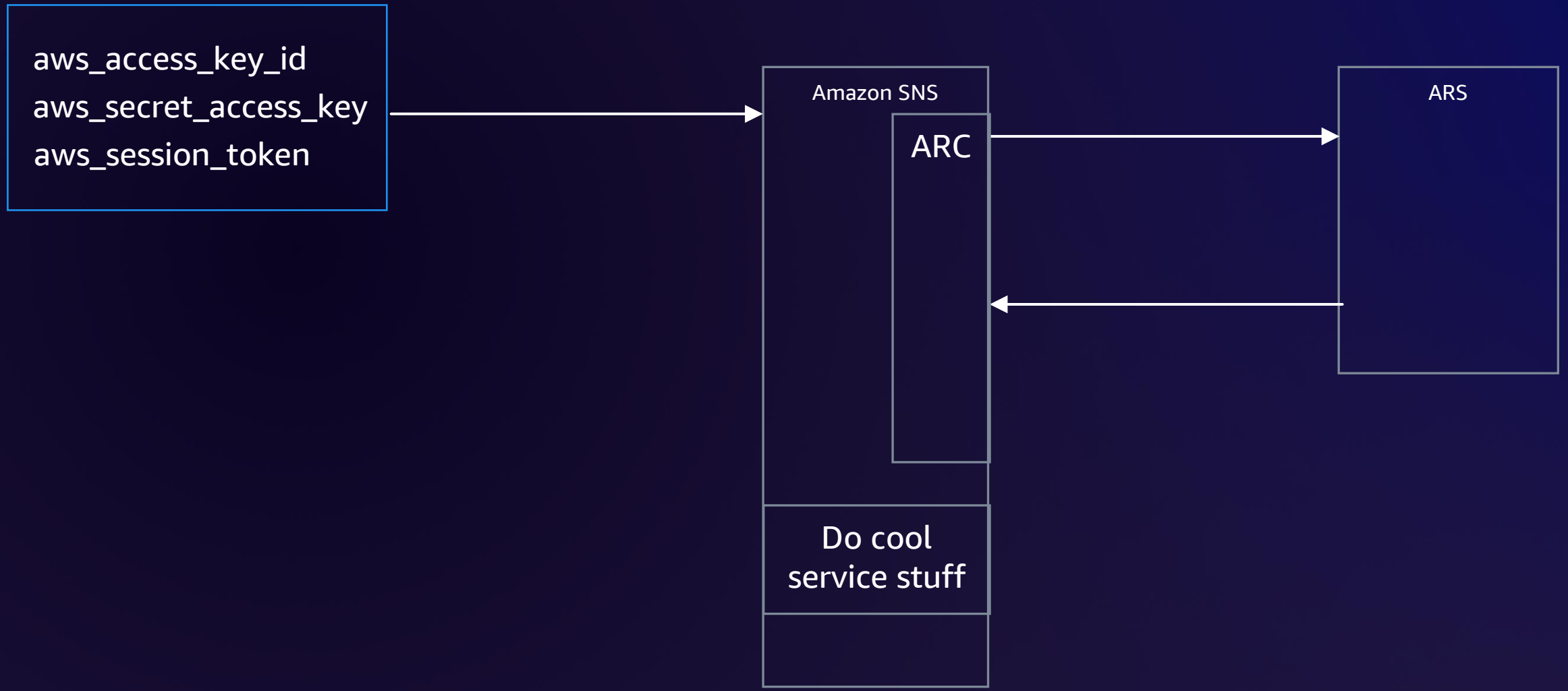
```
Issuer:              AROABCDEFGHIEXAMPLE
Name:                MySession
AccessKeyId:         ASIAJKLMNOPQEXAMPLE
SecretAccessKey:     x+0Bra63Fr+cER48CUtkHpCxLk8gFV8MawMS0RRF

Policy: {"Version":"2012-10-17","Statement":[{
         "Effect":"Allow","Action":"*","Resource":"*"}]}

ManagedPolicyArns: arn:aws:iam::111111111111:policy/MyPolicy

Context:
    ec2:RoleDelivery=2.0
    ec2:SourceInstanceArn=arn:aws:ec2:us-west-2:111111111111:instance/i-123
    aws:TokenIssueTime=2022-06-01T23:47:00Z
```

A request with temporary credentials



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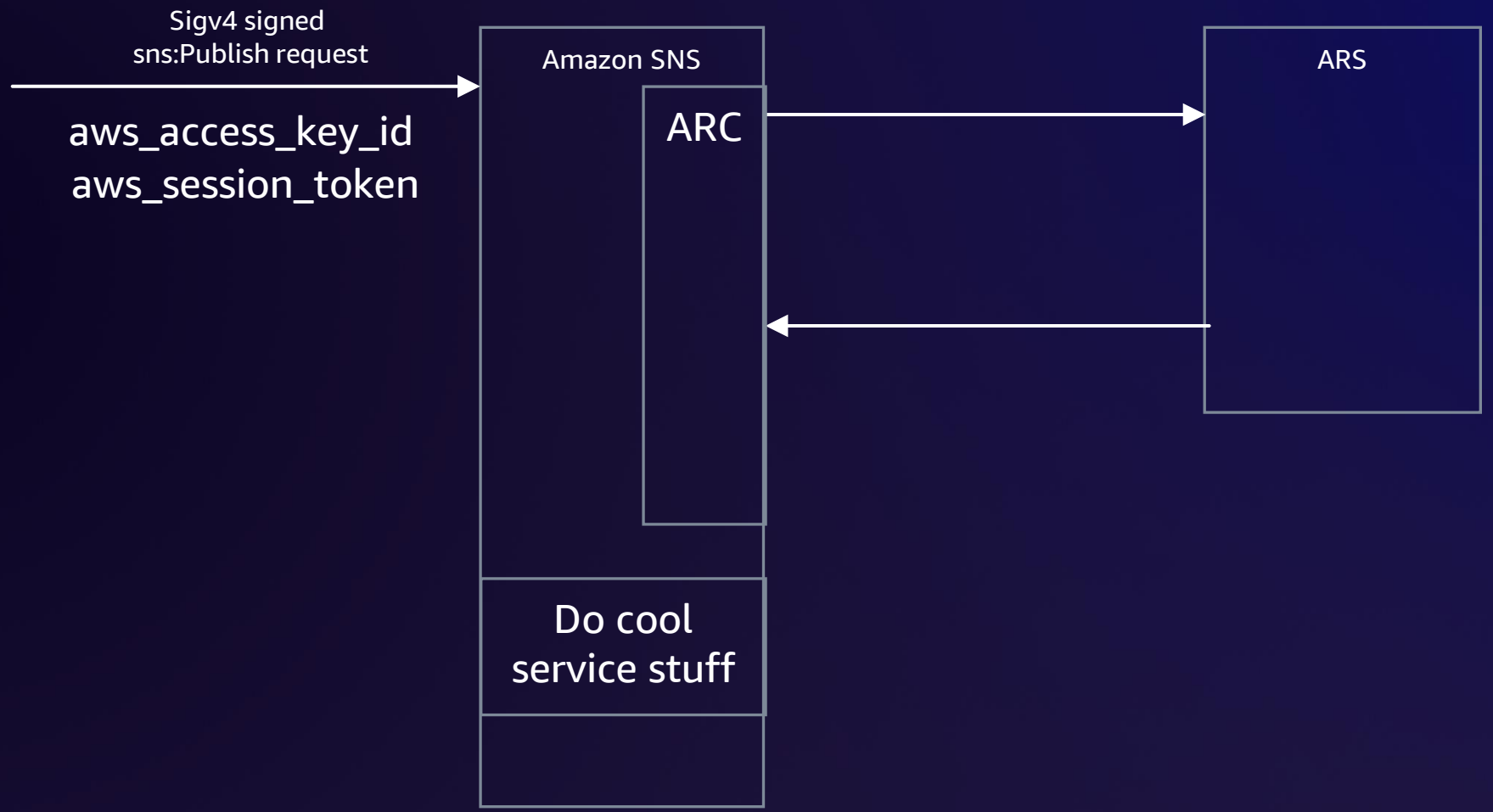

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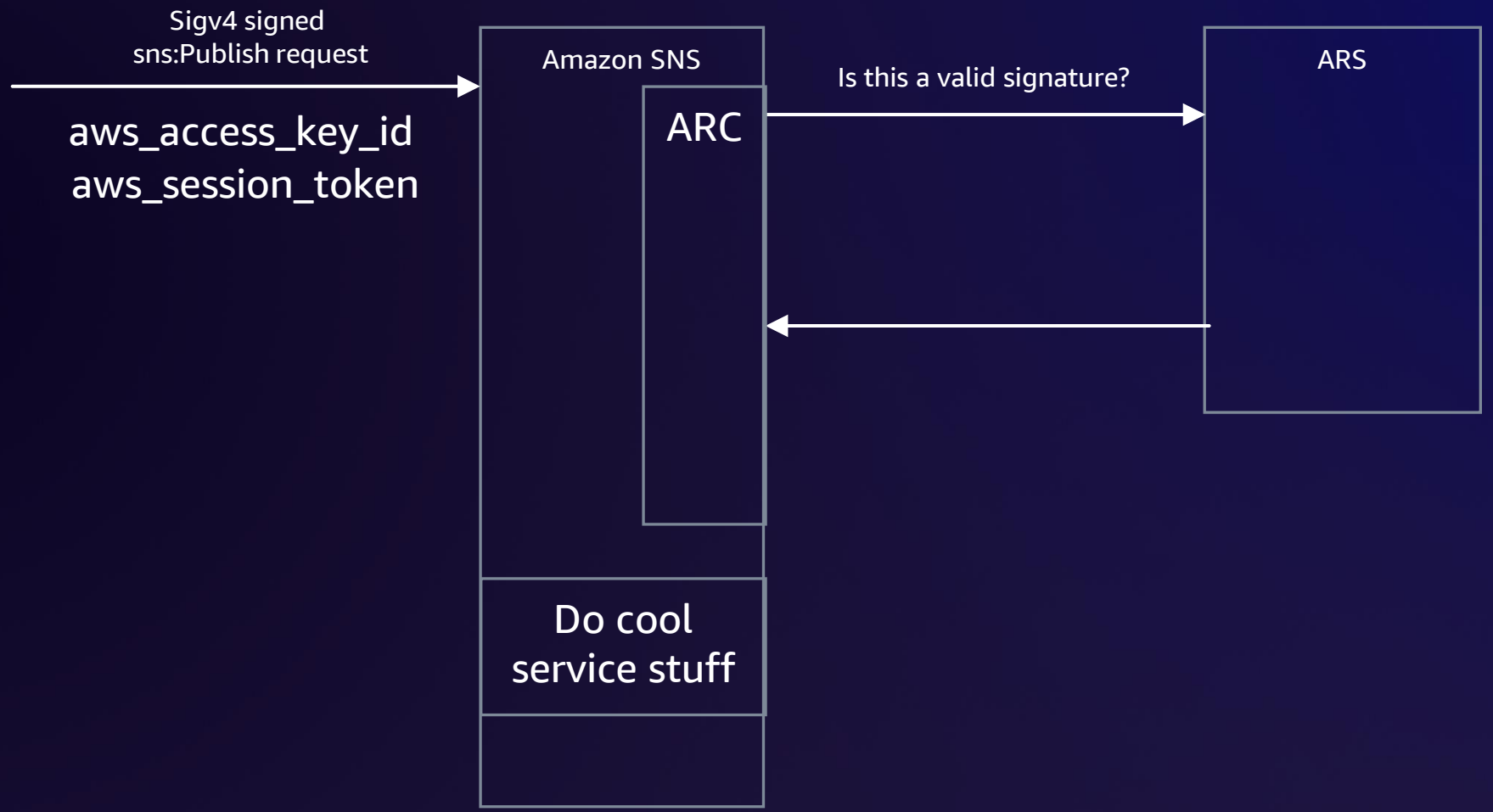

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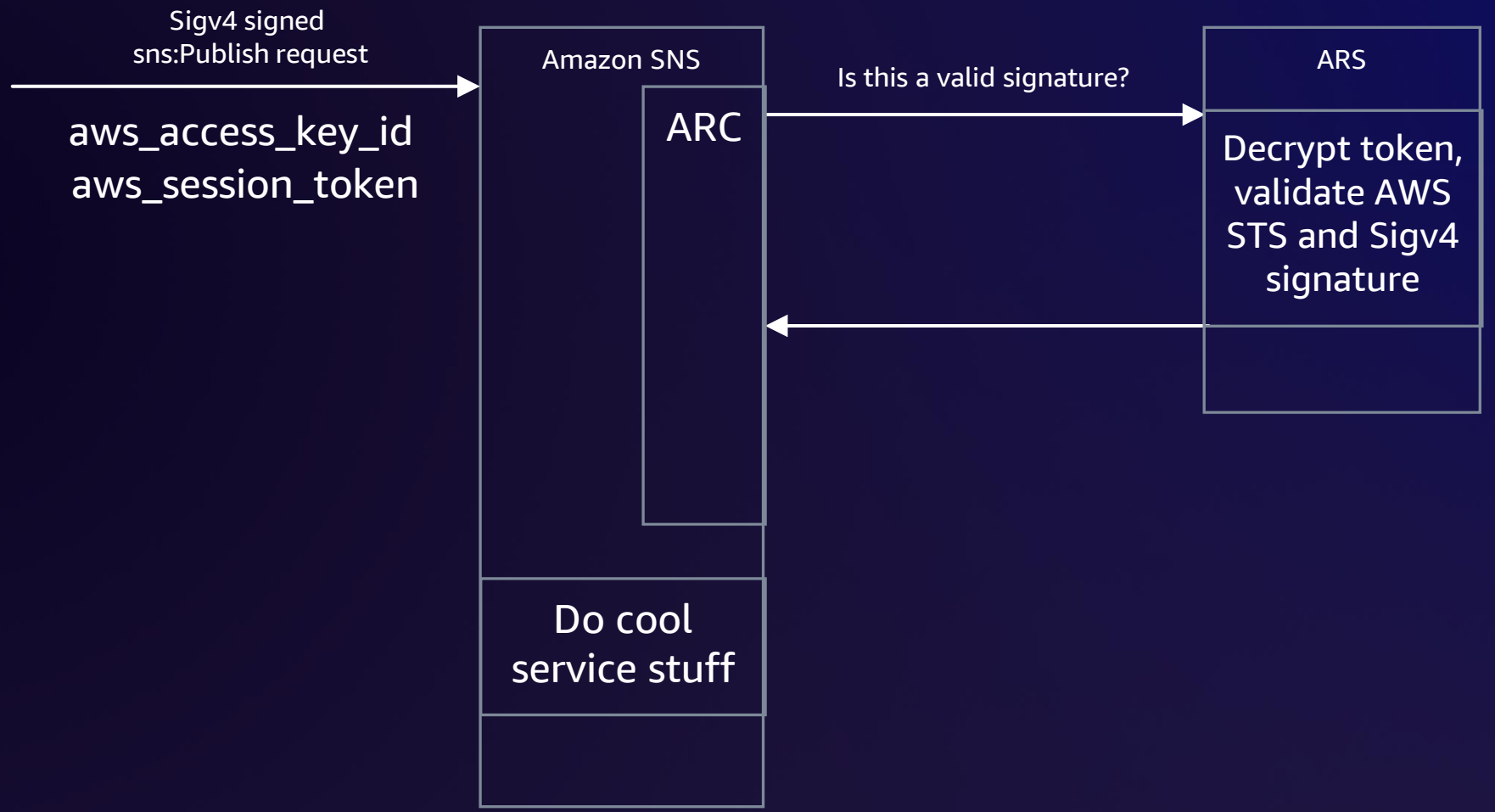

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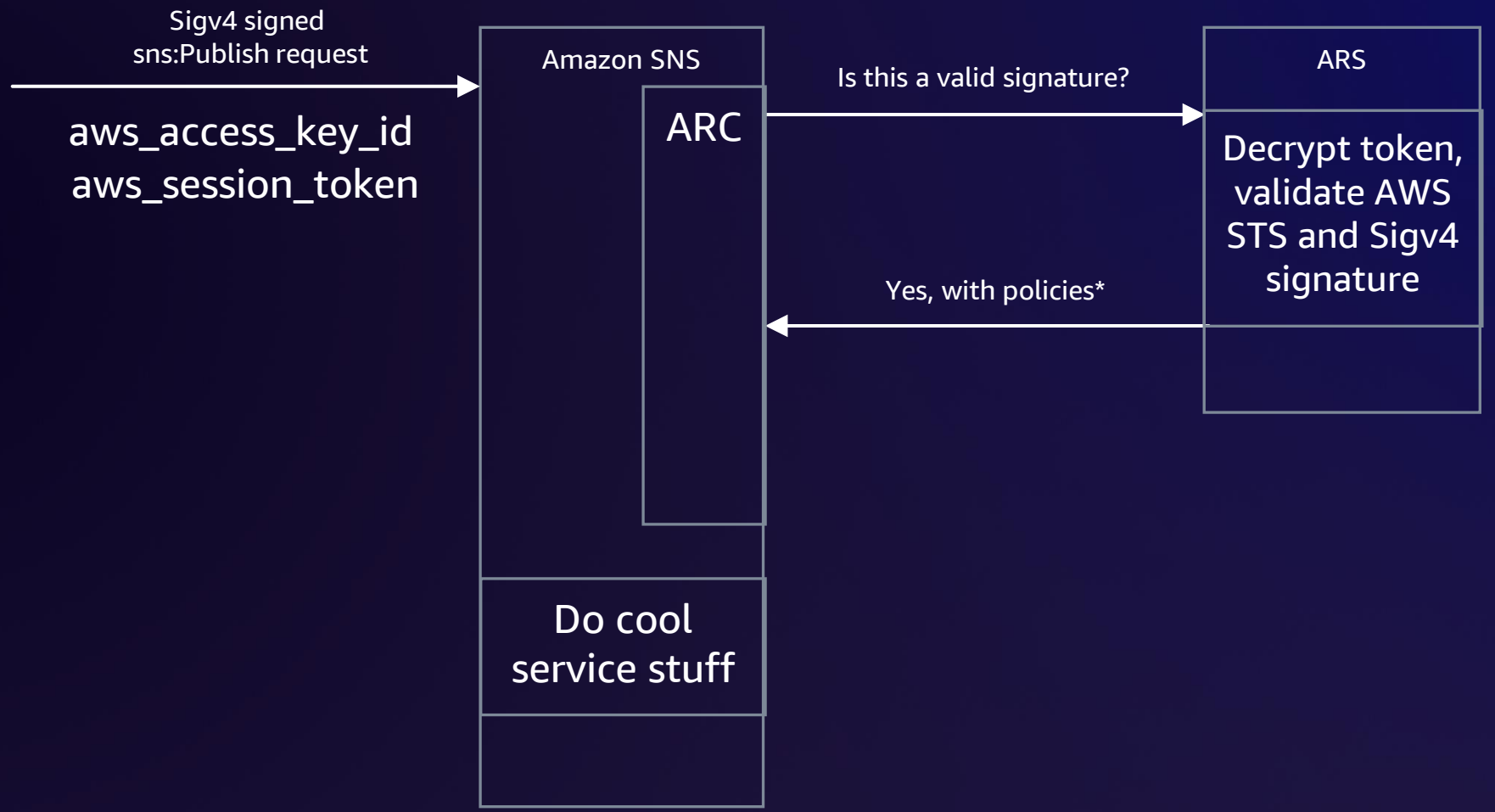

* Includes session policies

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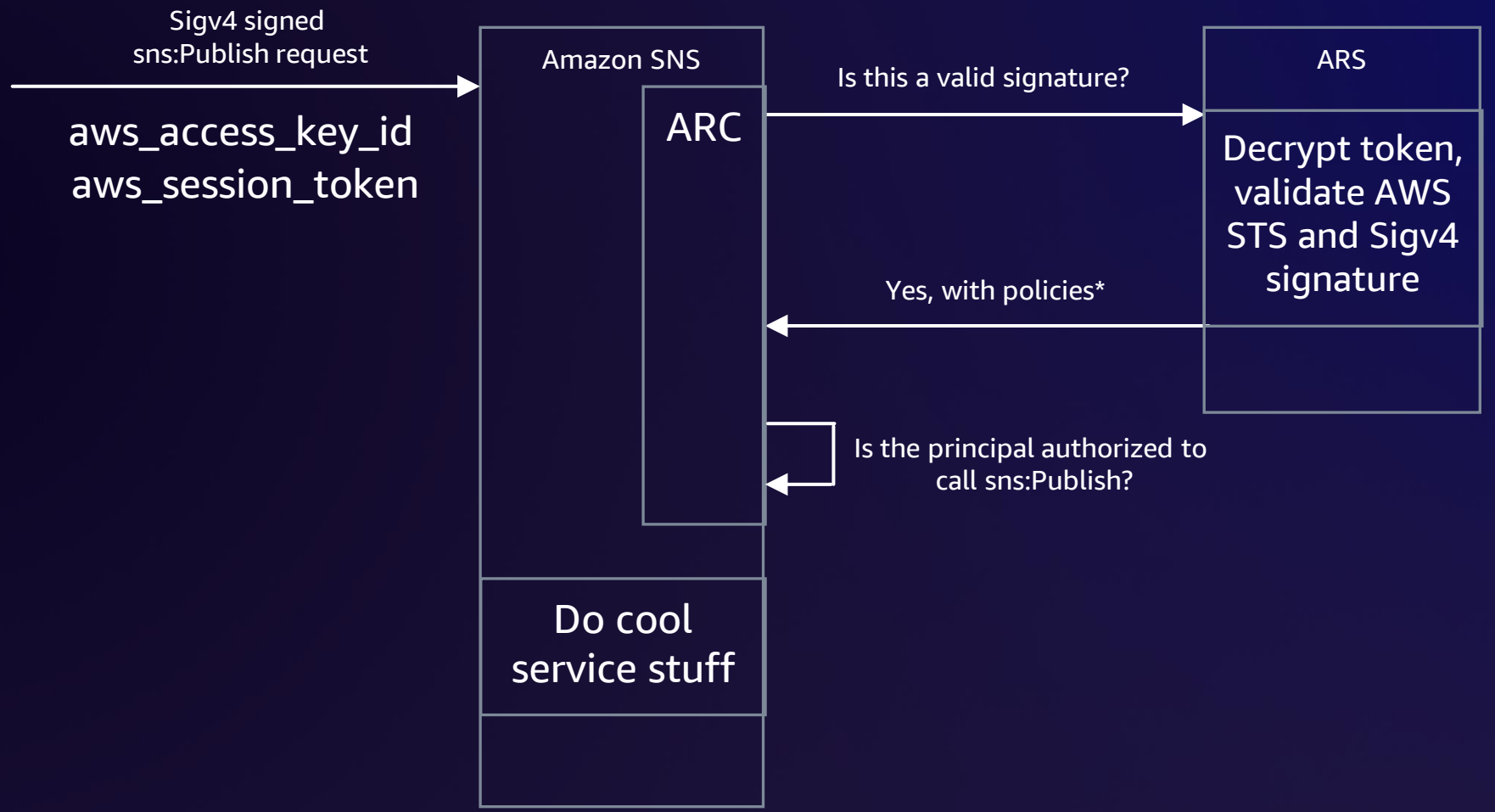

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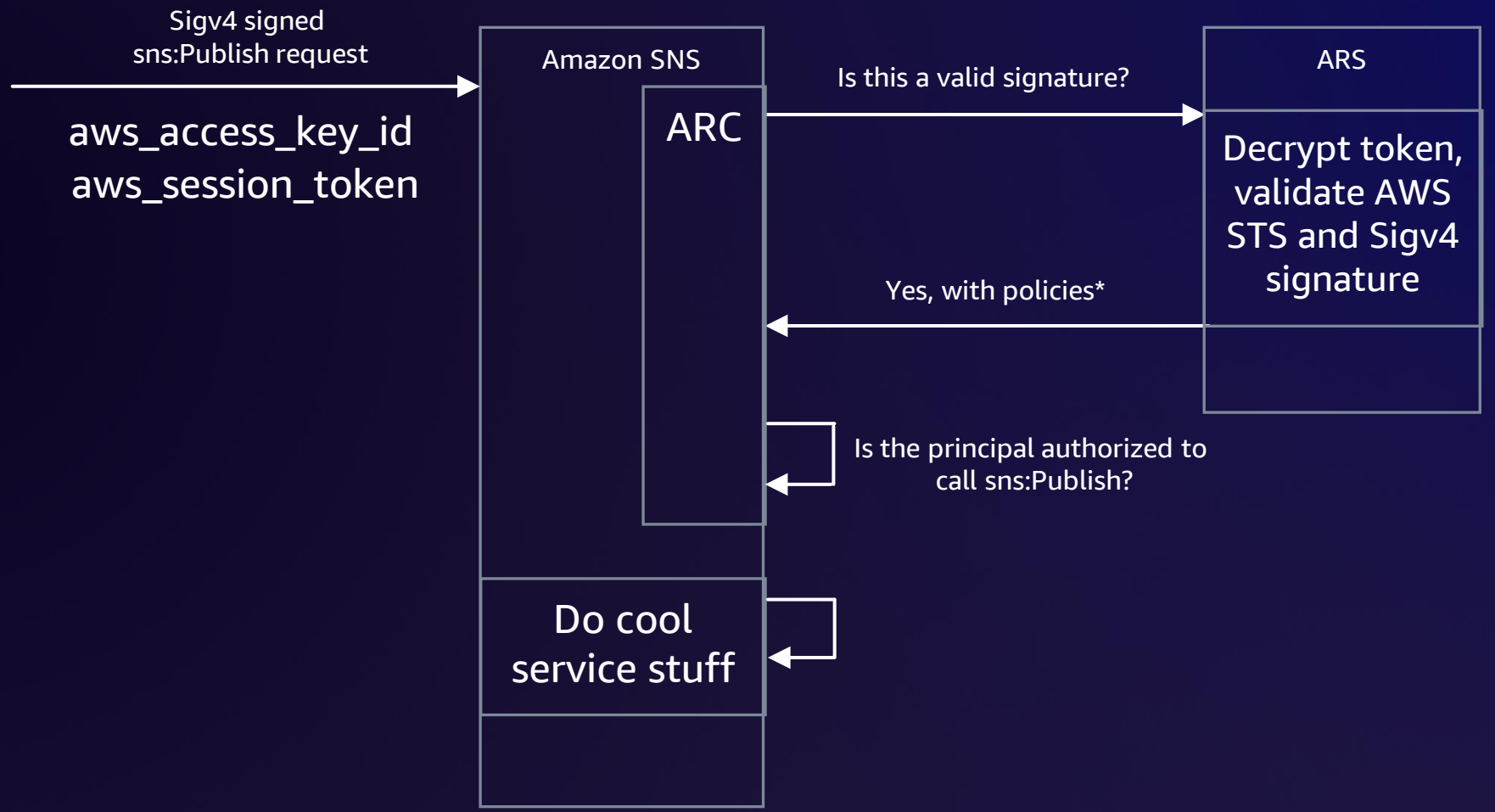

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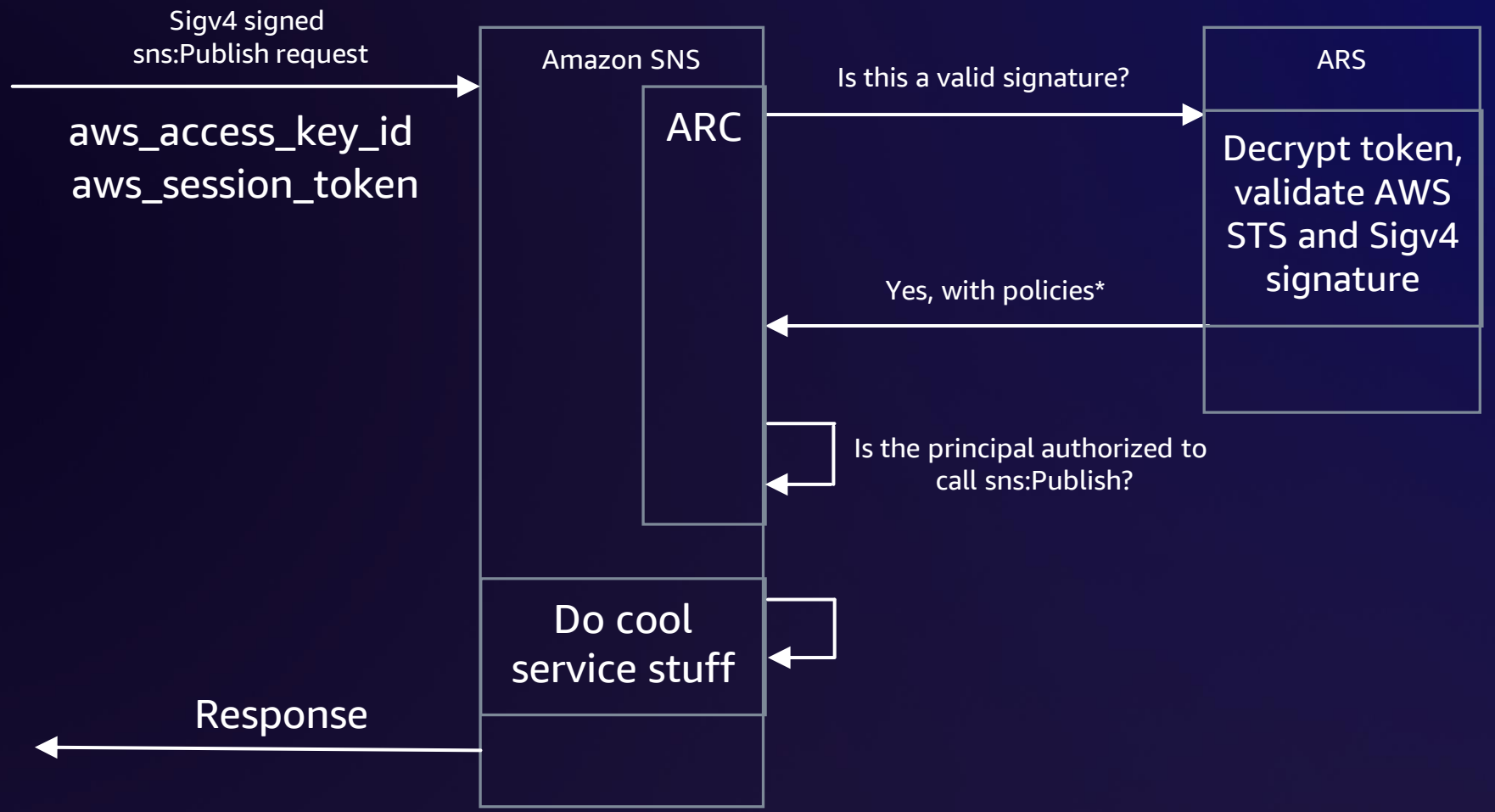

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Testing with session policies

```
#!/bin/bash

export AWS_ACCESS_KEY_ID=
export AWS_SECRET_ACCESS_KEY=
export AWS_SESSION_TOKEN=

ROLE_ARN=arn:aws:iam::111111111111:role/RoleWithAdminPermissions

POLICY=$(cat session-policy-to-test.json)
SESSION_NAME="test"

eval $(aws sts assume-role --role-arn ${ROLE_ARN} --role-session-name ${SESSION_NAME} --policy "${POLICY}" | jq -r '.Credentials | "export AWS_ACCESS_KEY_ID=\(.AccessKeyId)\nexport AWS_SECRET_ACCESS_KEY=\(.SecretAccessKey)\nexport AWS_SESSION_TOKEN=\(.SessionToken)\n"')

aws sts get-caller-identity
```

Reset env variables

Role to assume

Specify policy to test

Assume role and set env variables

Session policies – packed policy size

- Hard limit on the size of a session token

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- Includes session policies, session tags, and other session context

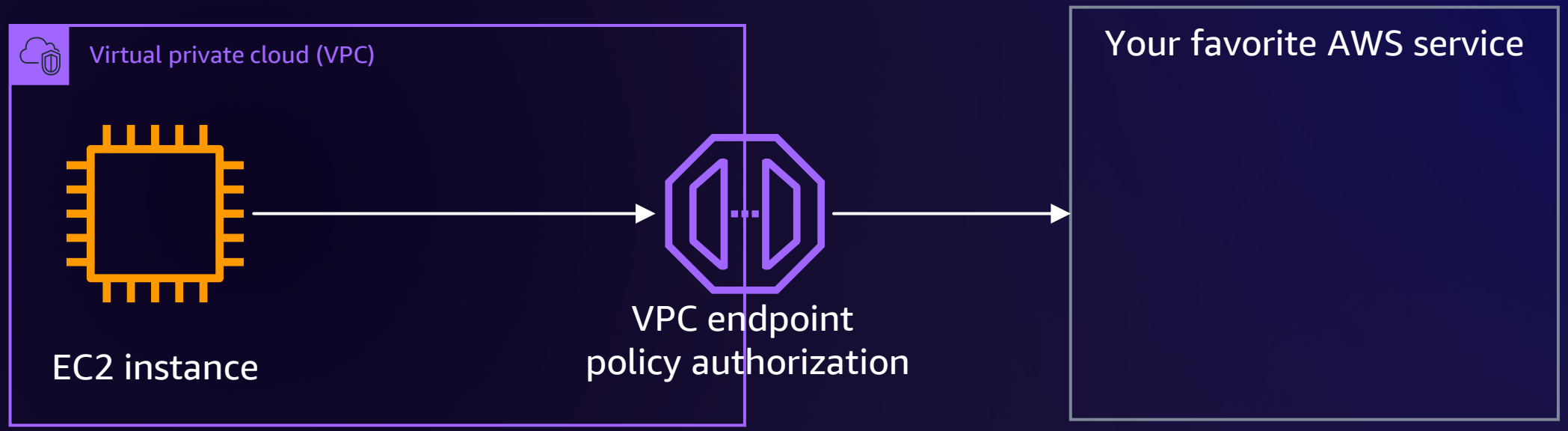
Session policies – packed policy size

- Hard limit on the size of a session token
- The token is compressed – the amount of characters you can use in a policy or number of tags is unpredictable
- Includes session policies, session tags, and other session context
- Think about what's unique to the session and only inject that into the token

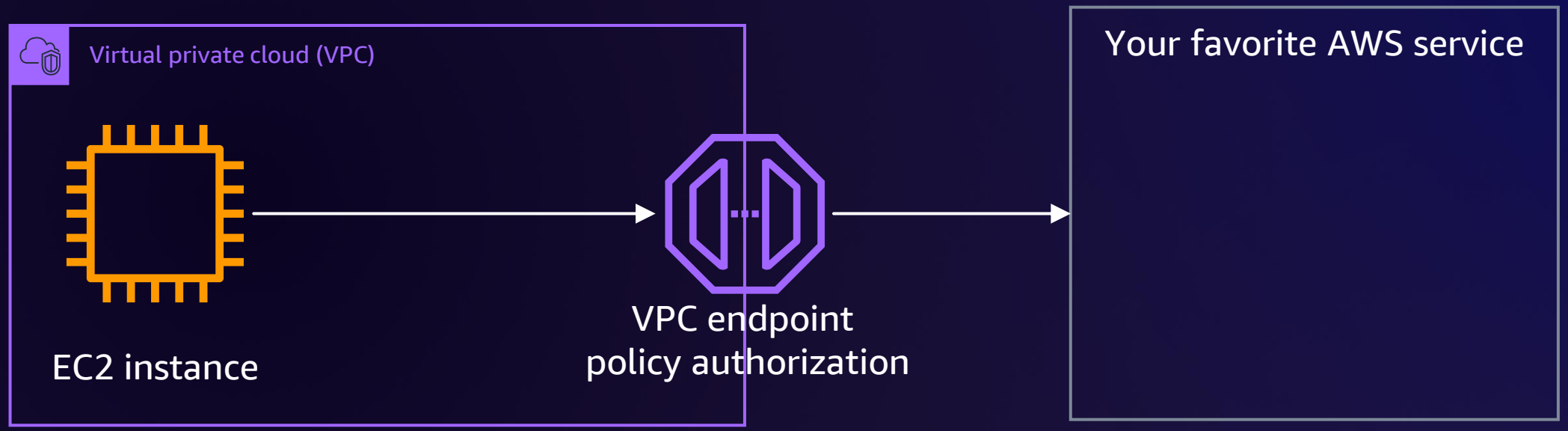
Session policies takeaways

- The policy and relevant context are embedded in the session token
- Most of the time you use the default policy
- Useful for token brokers, when a session needs unique permissions

VPC endpoint policies – logical view



VPC endpoint policies – physical view



VPC endpoint policies – physical view

VPC endpoint policies takeaways

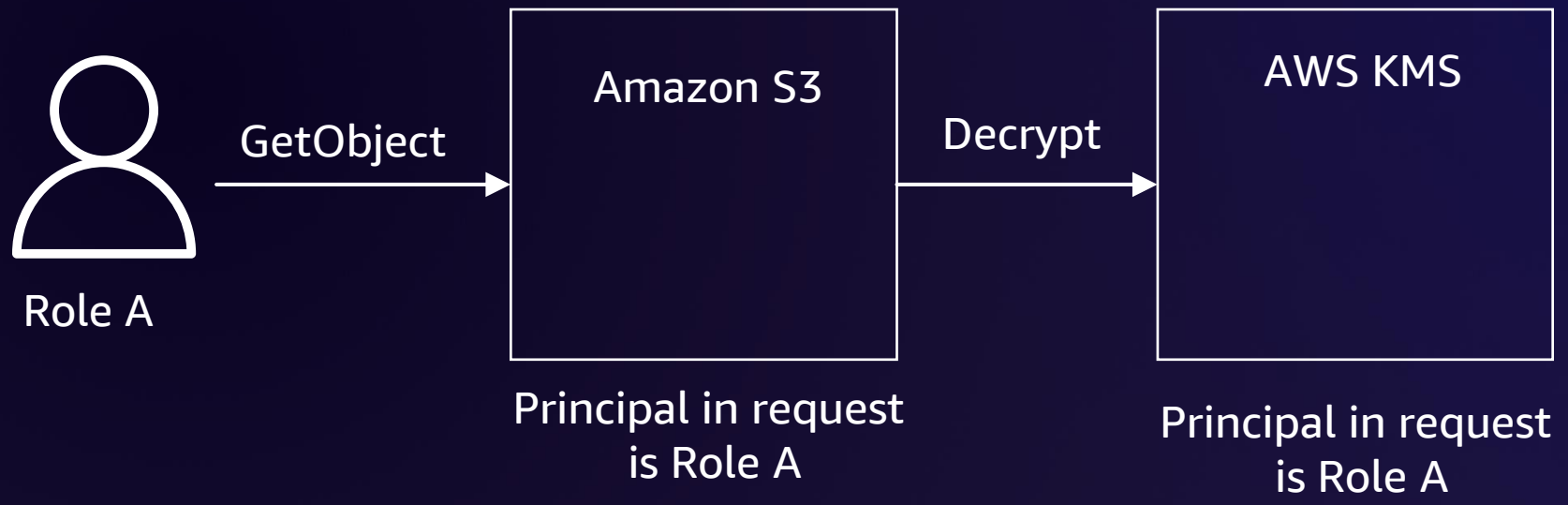
- They are the only place to prevent untrusted identities from making requests to untrusted resources

- Allow you to use the aws:SourceVpc condition key in resource and identity-based policies

FAS policies – What is FAS?

Forward access sessions (FAS) is an IAM technology that passes your identity, permissions, and session attributes when an AWS service makes a request on your behalf

FAS policies – What is FAS?



FAS policies – What is FAS?

ARS

I want to get an encrypted object

Role A

ARC

Amazon S3

AWS KMS

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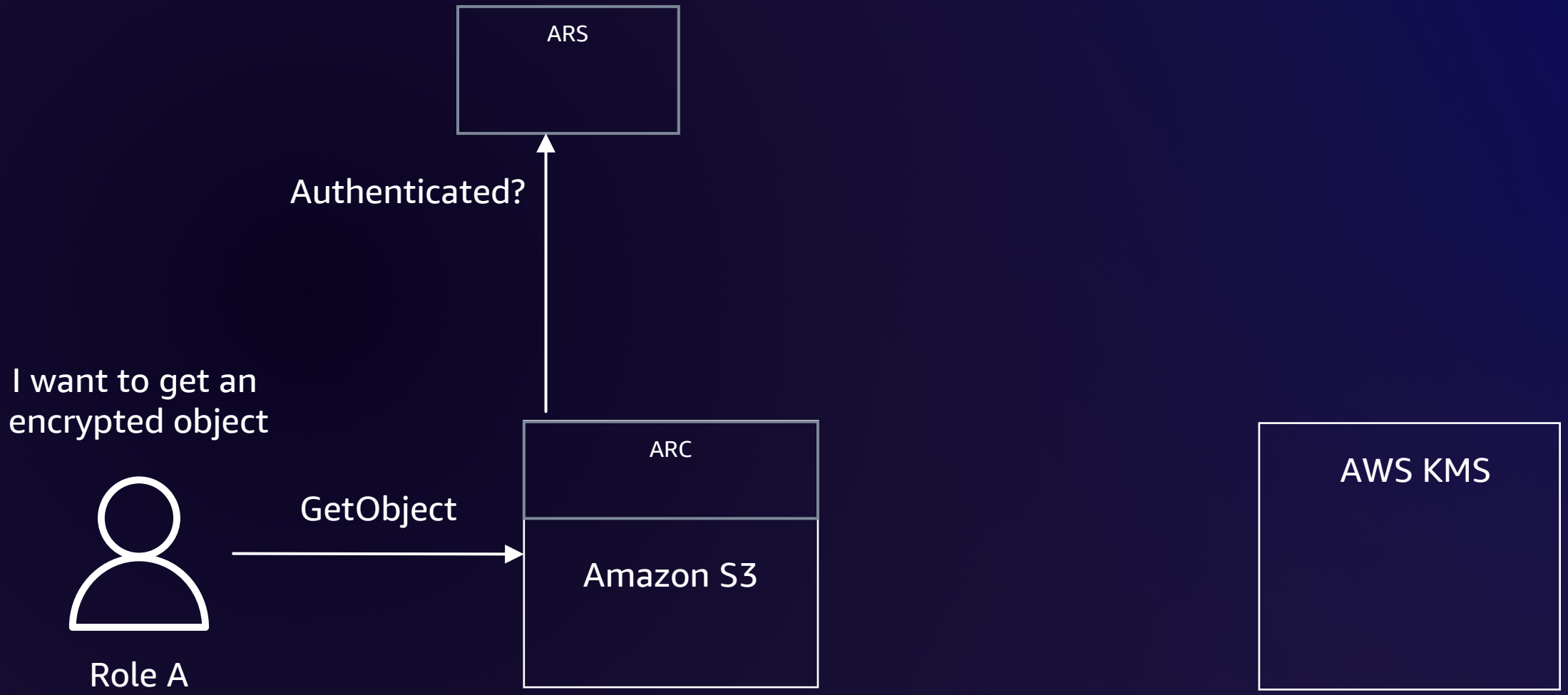

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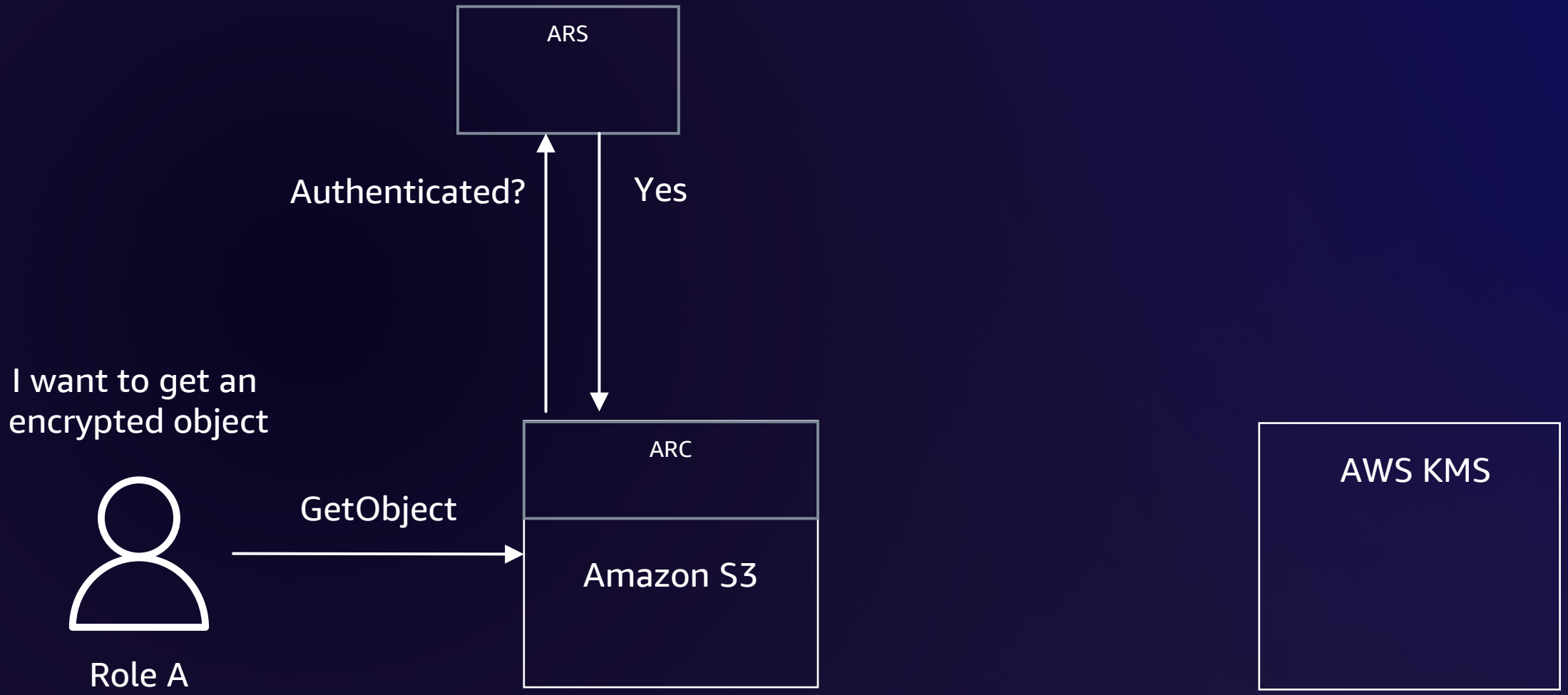

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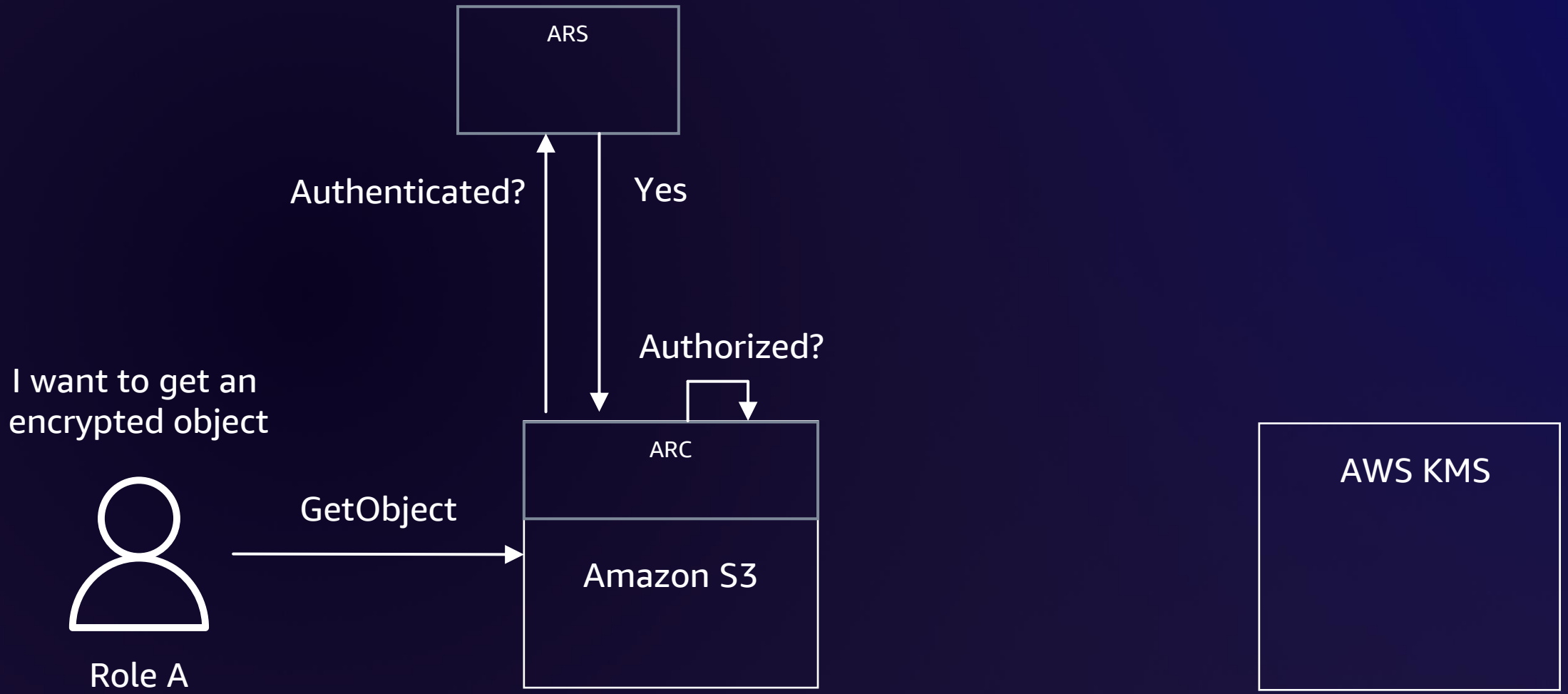

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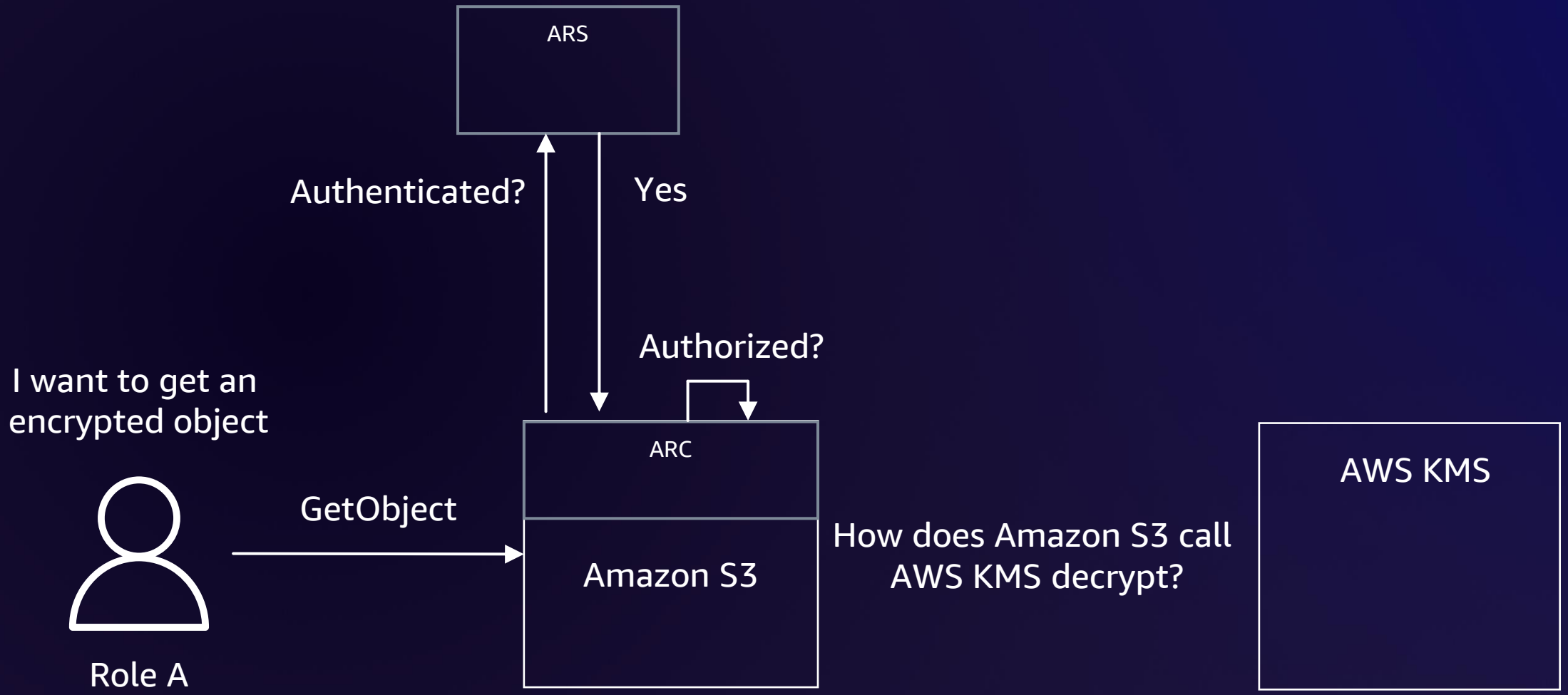

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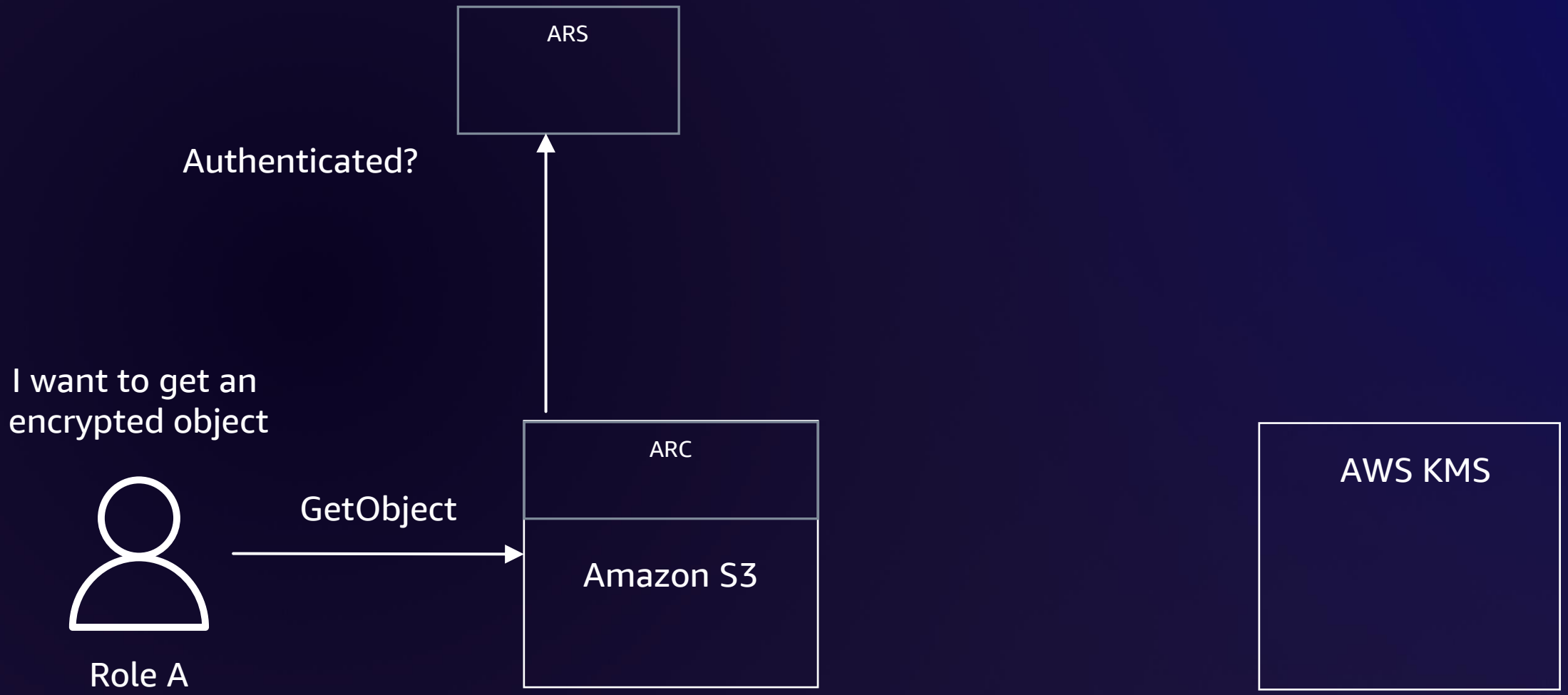

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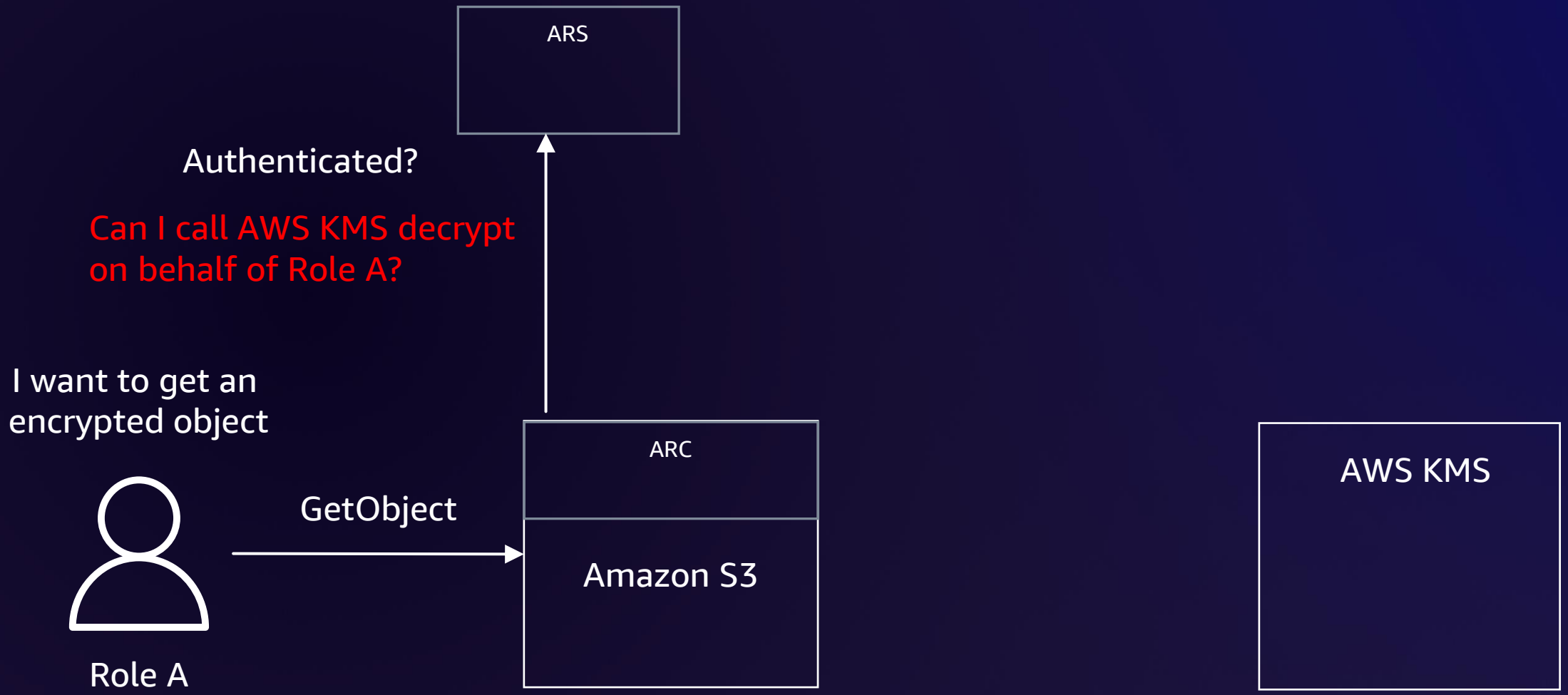

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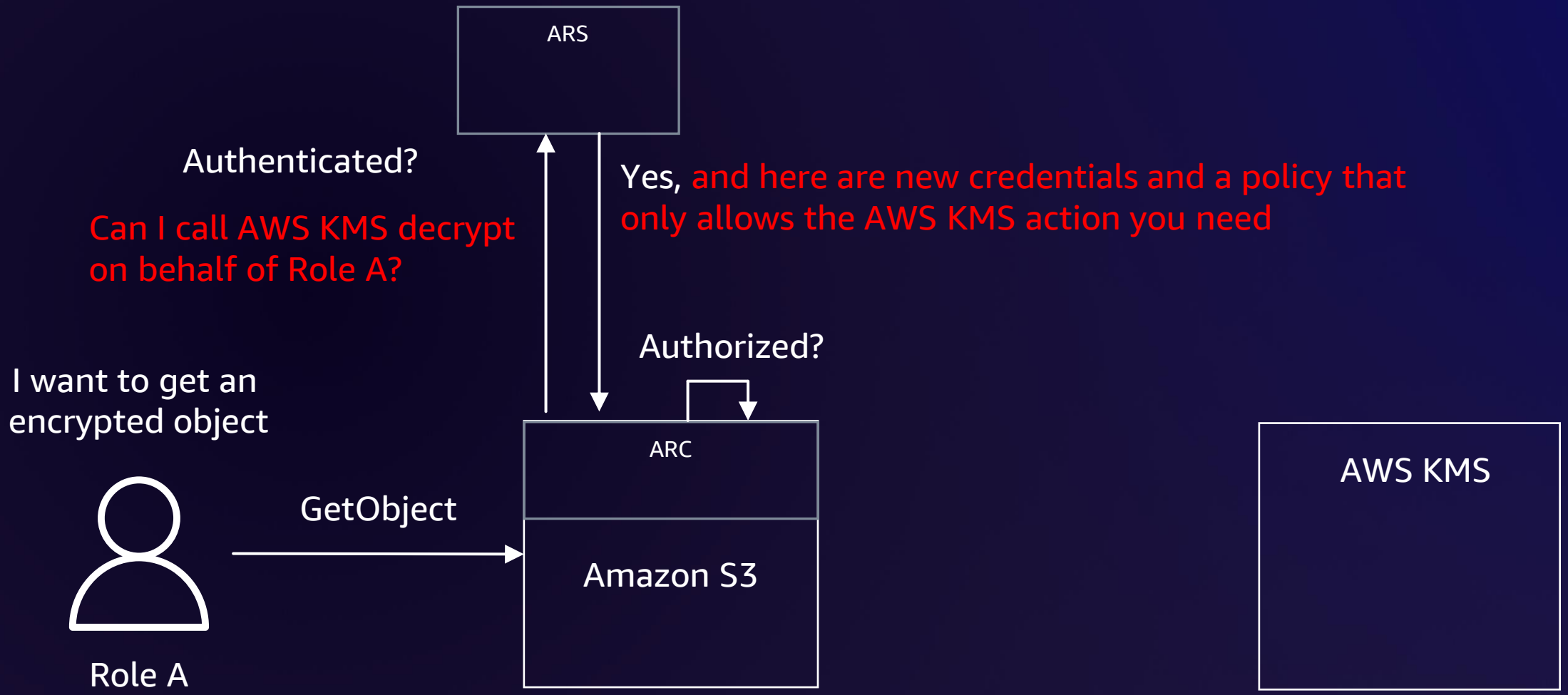

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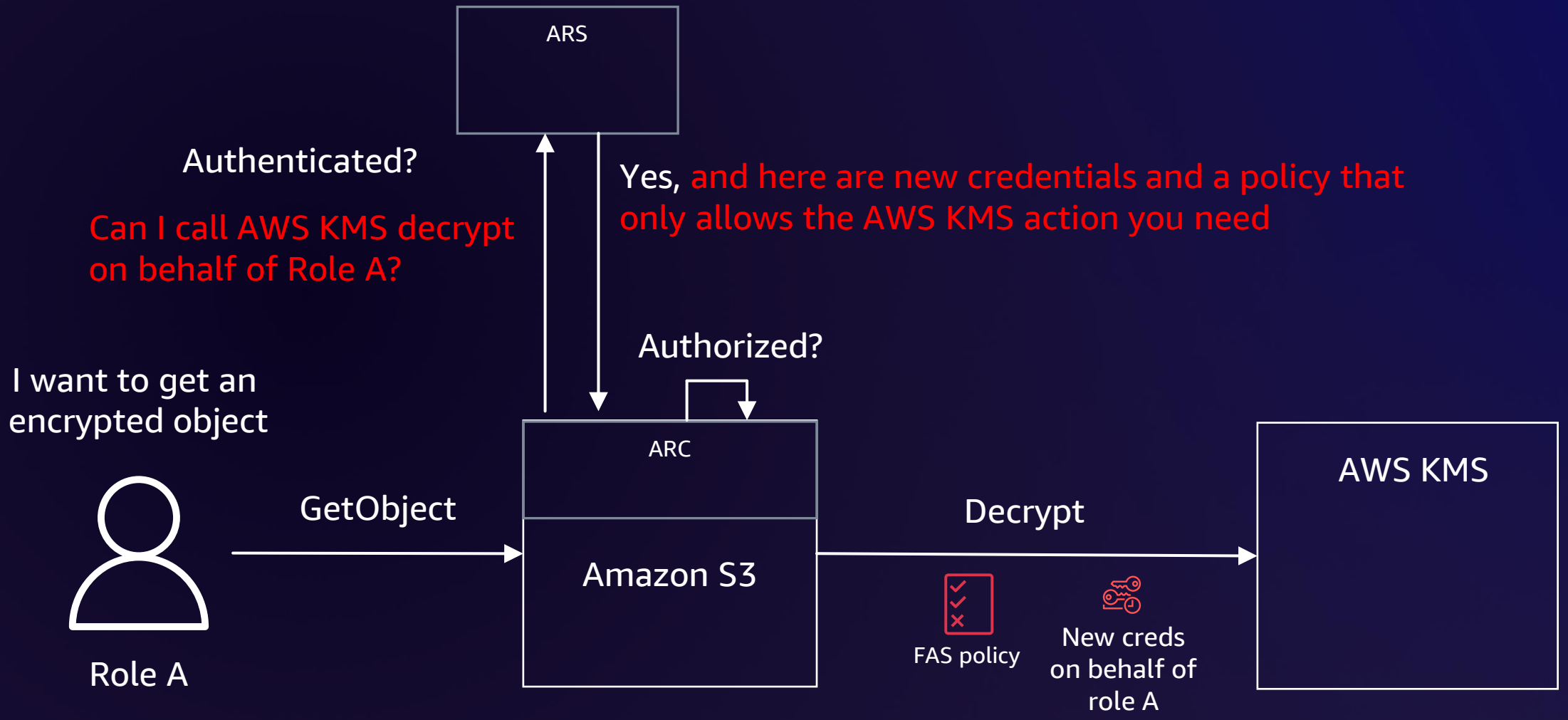


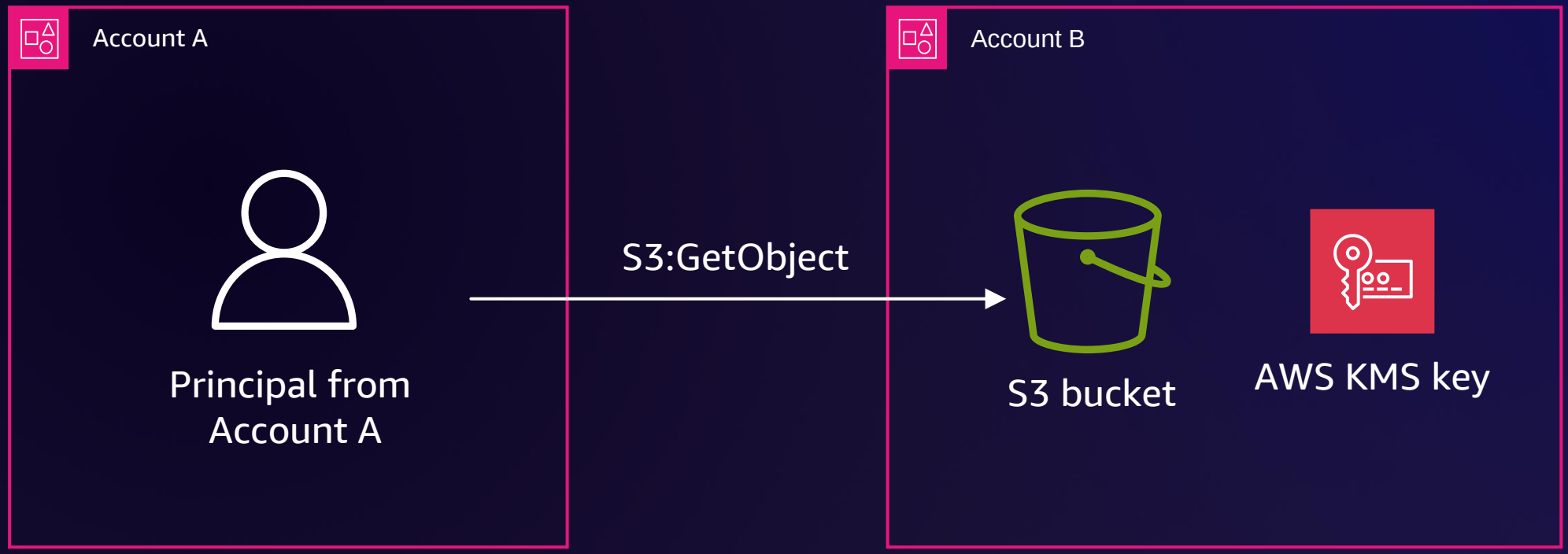
FAS policies - Takeaways

- FAS provides AWS services a scoped-down version of the calling principal’s permissions
  - Blast radius reduction
  - Avoidance of credential replay

- The aws:CalledVia and aws:ViaAWSService condition keys are set when a FAS call is made

Putting it all together

A sample cross-account request



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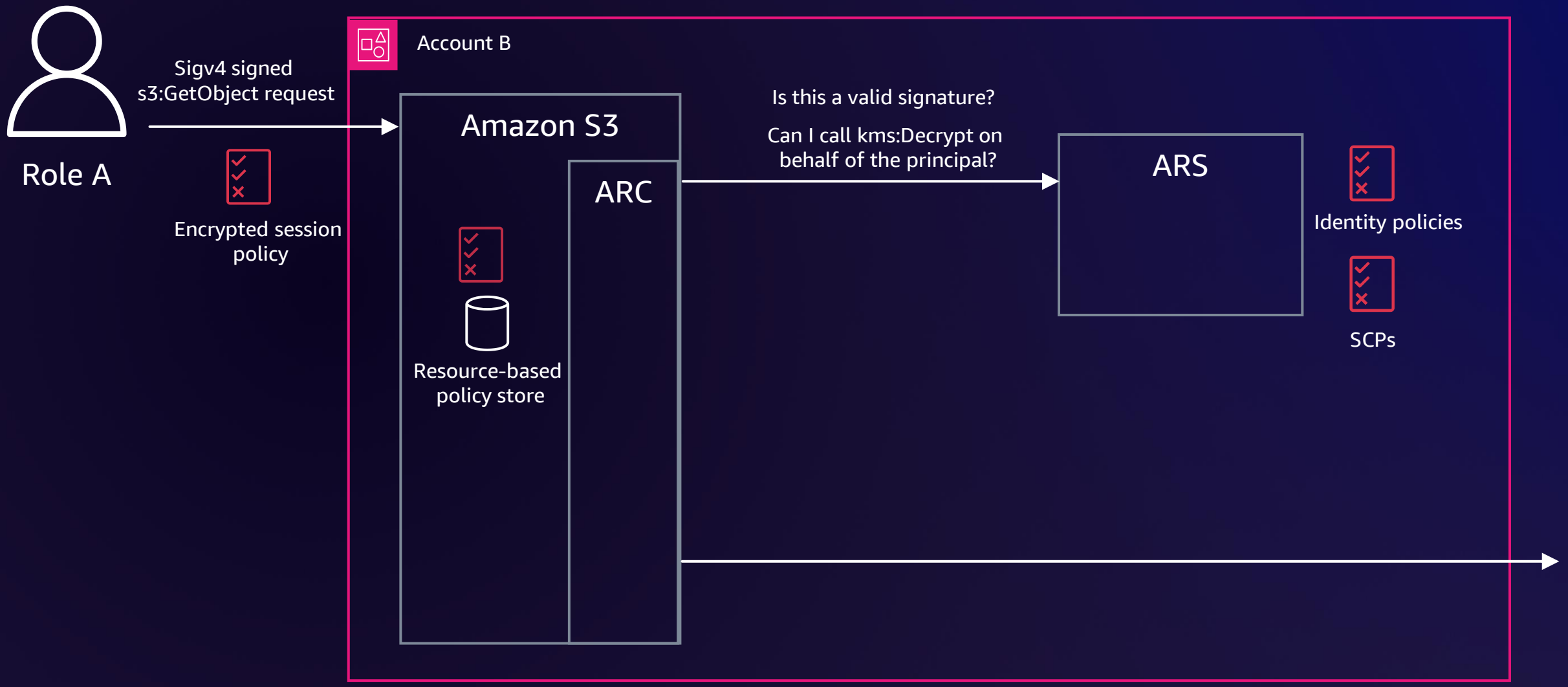

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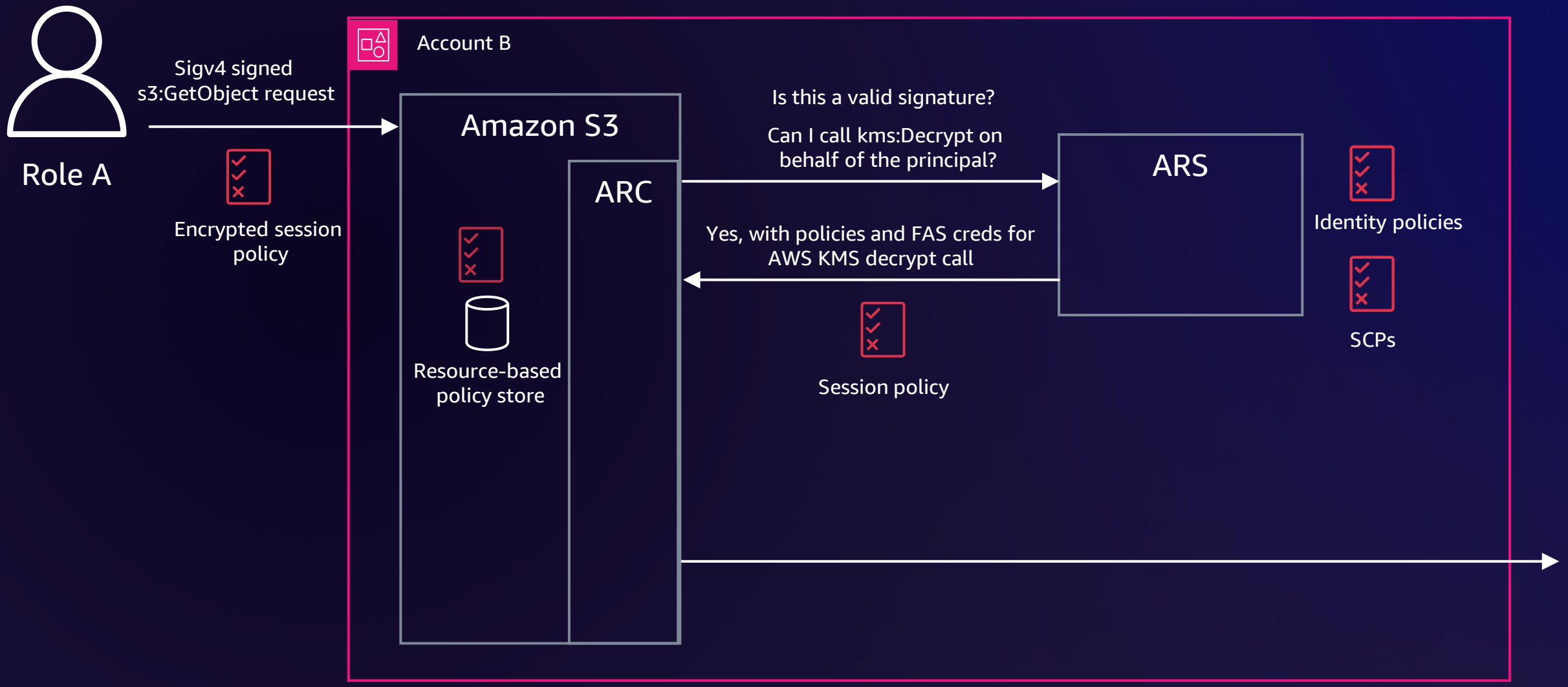

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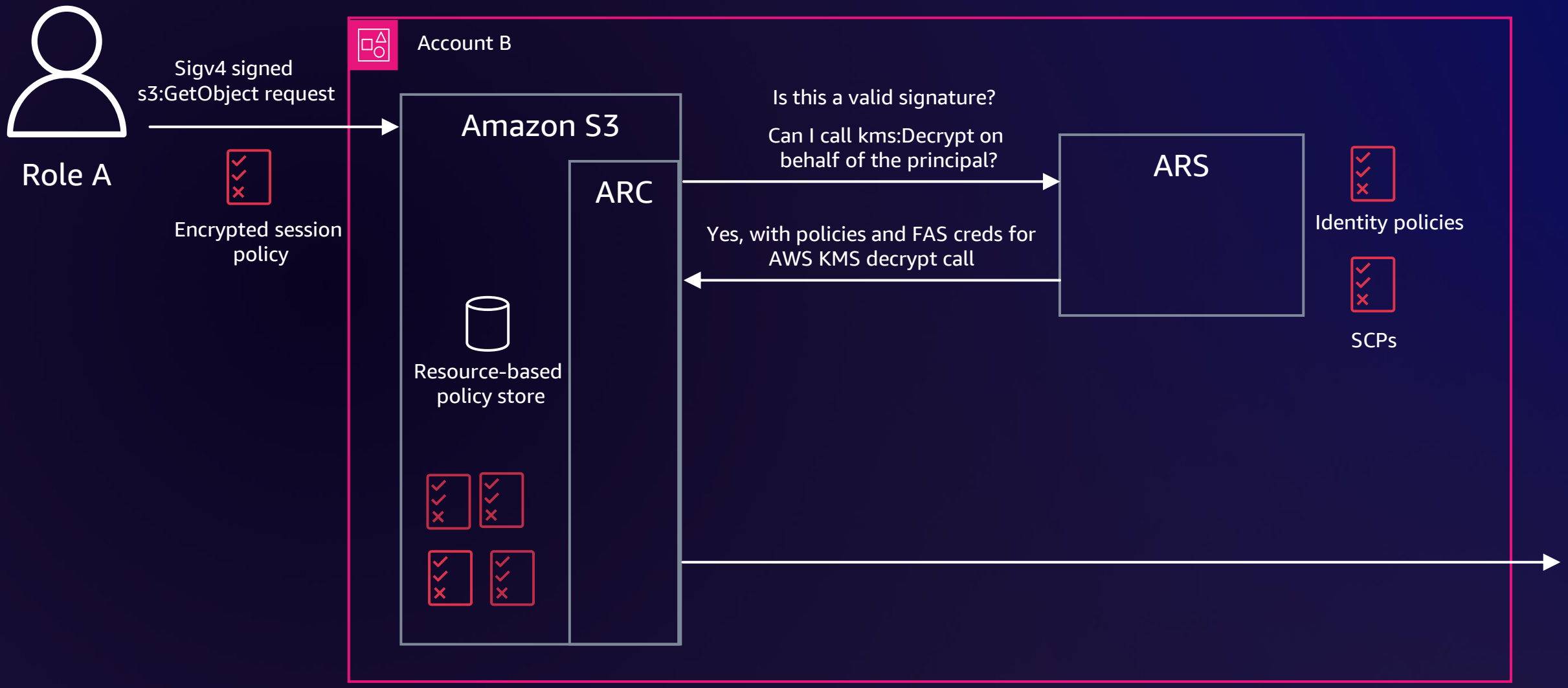
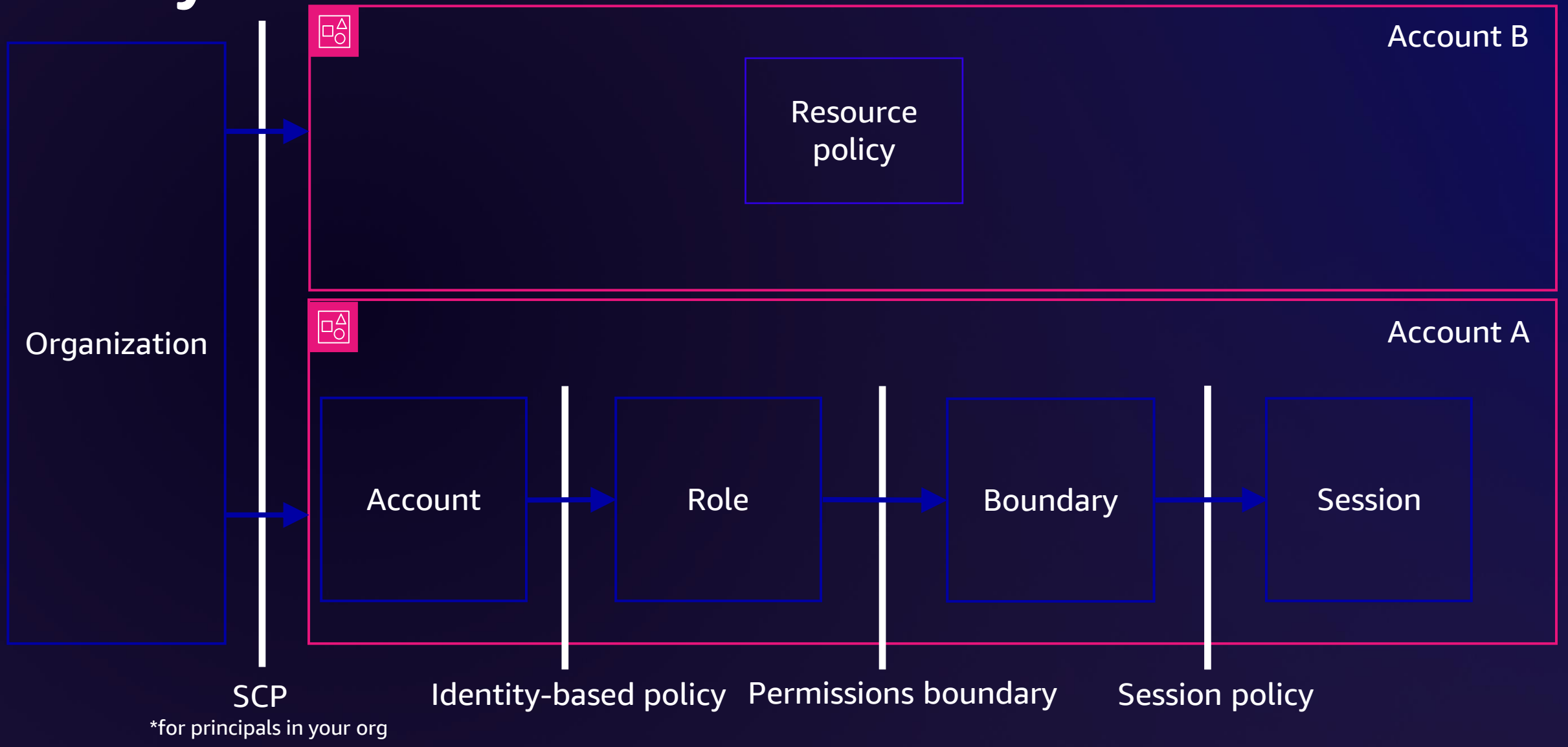


Policy evaluation: Cross-account



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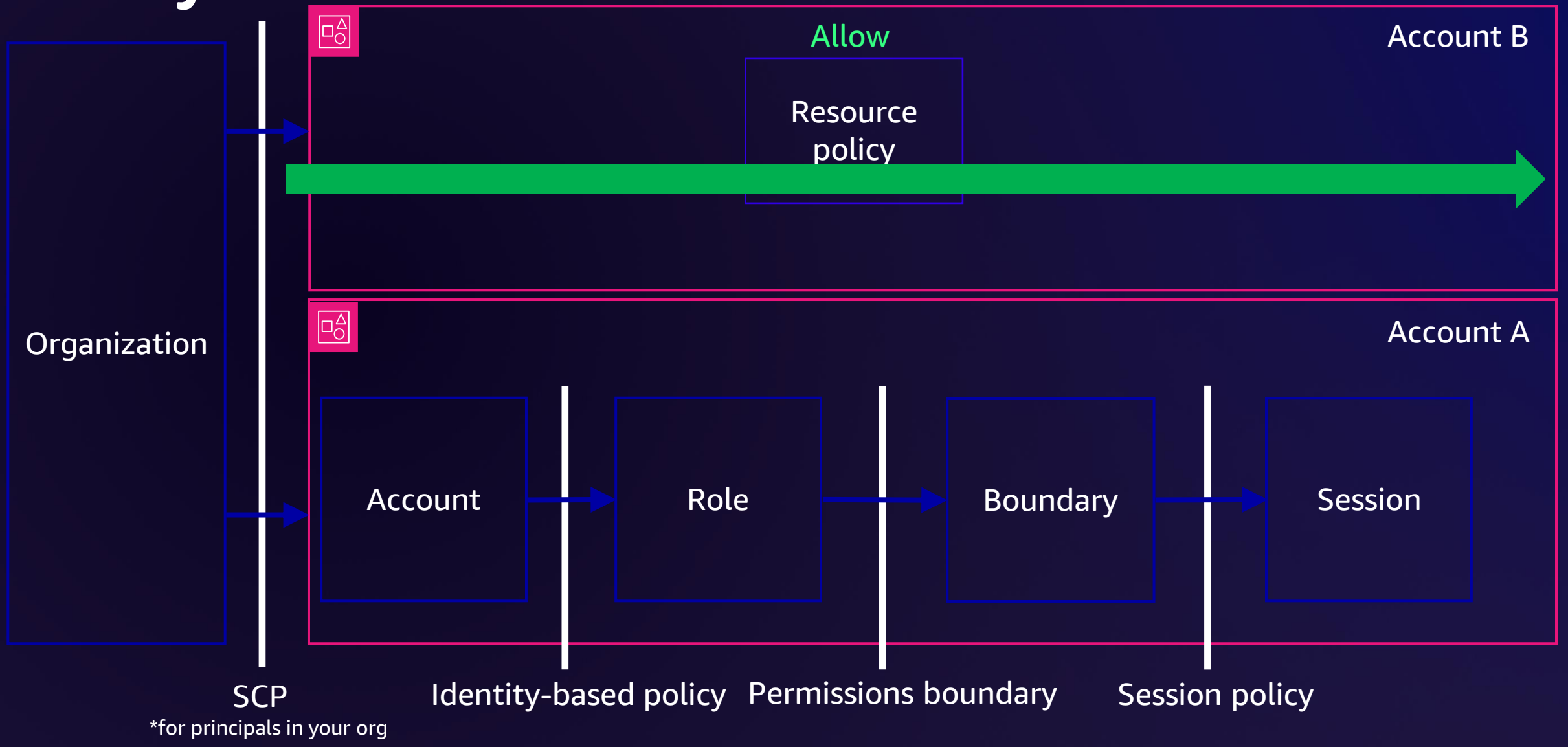

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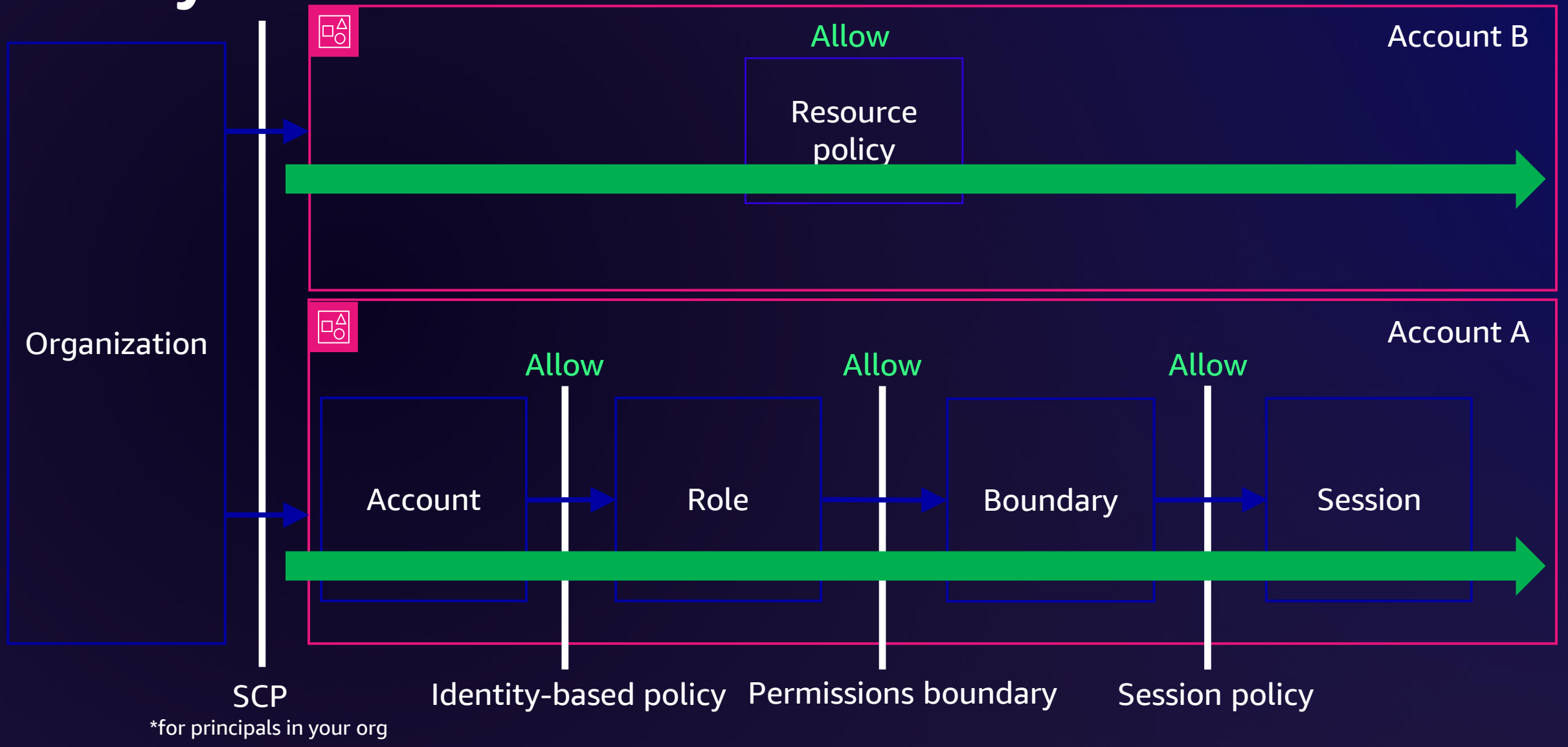

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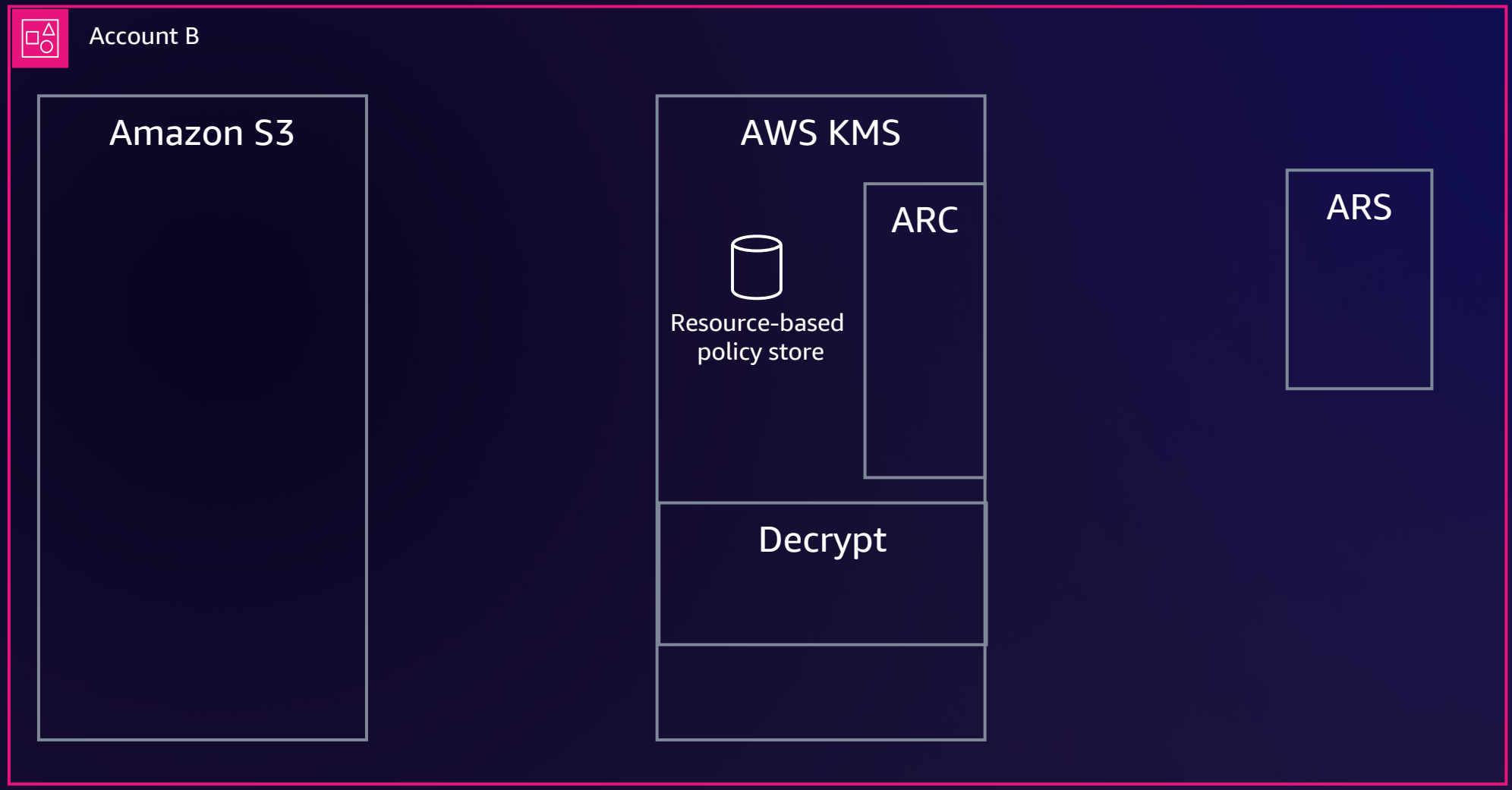

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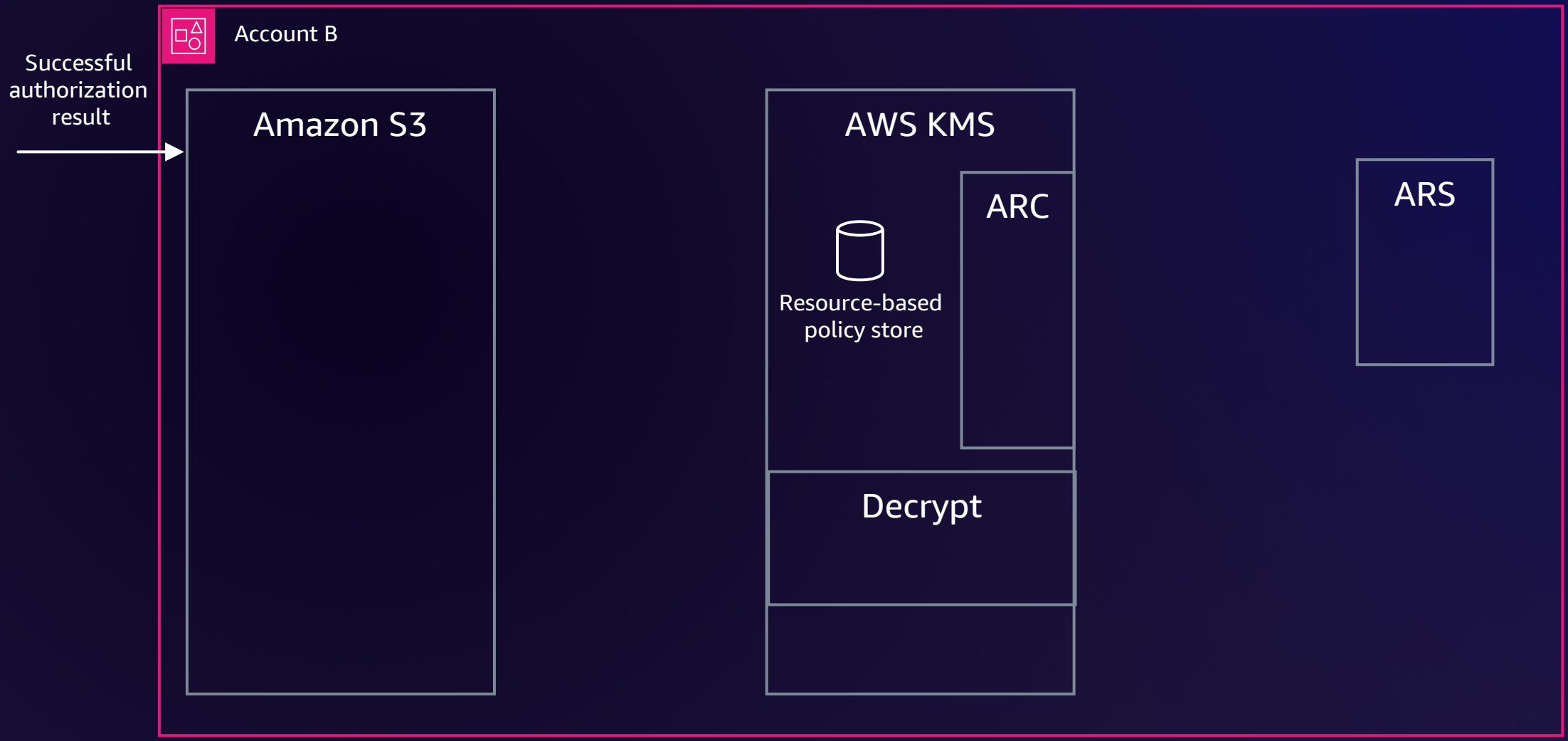

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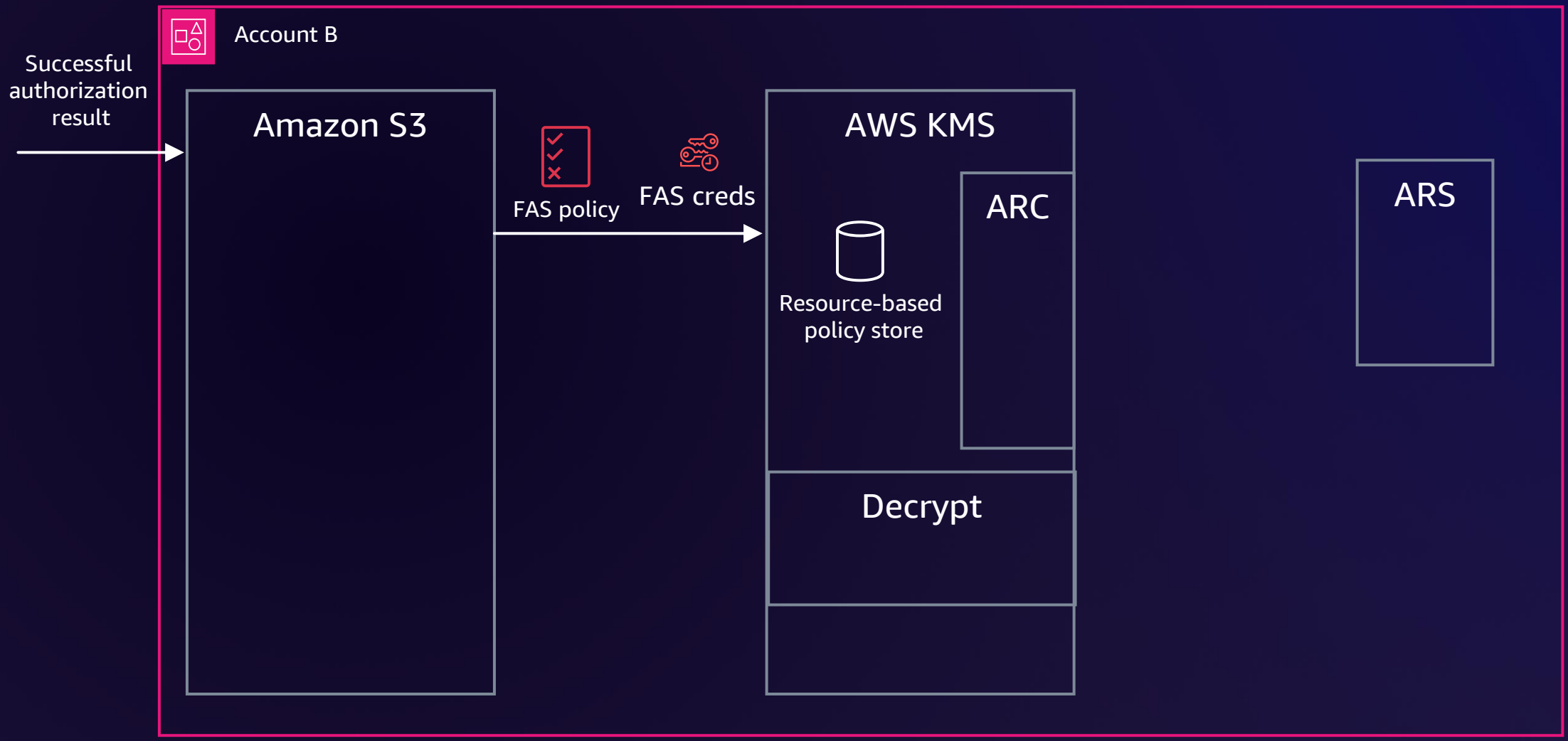

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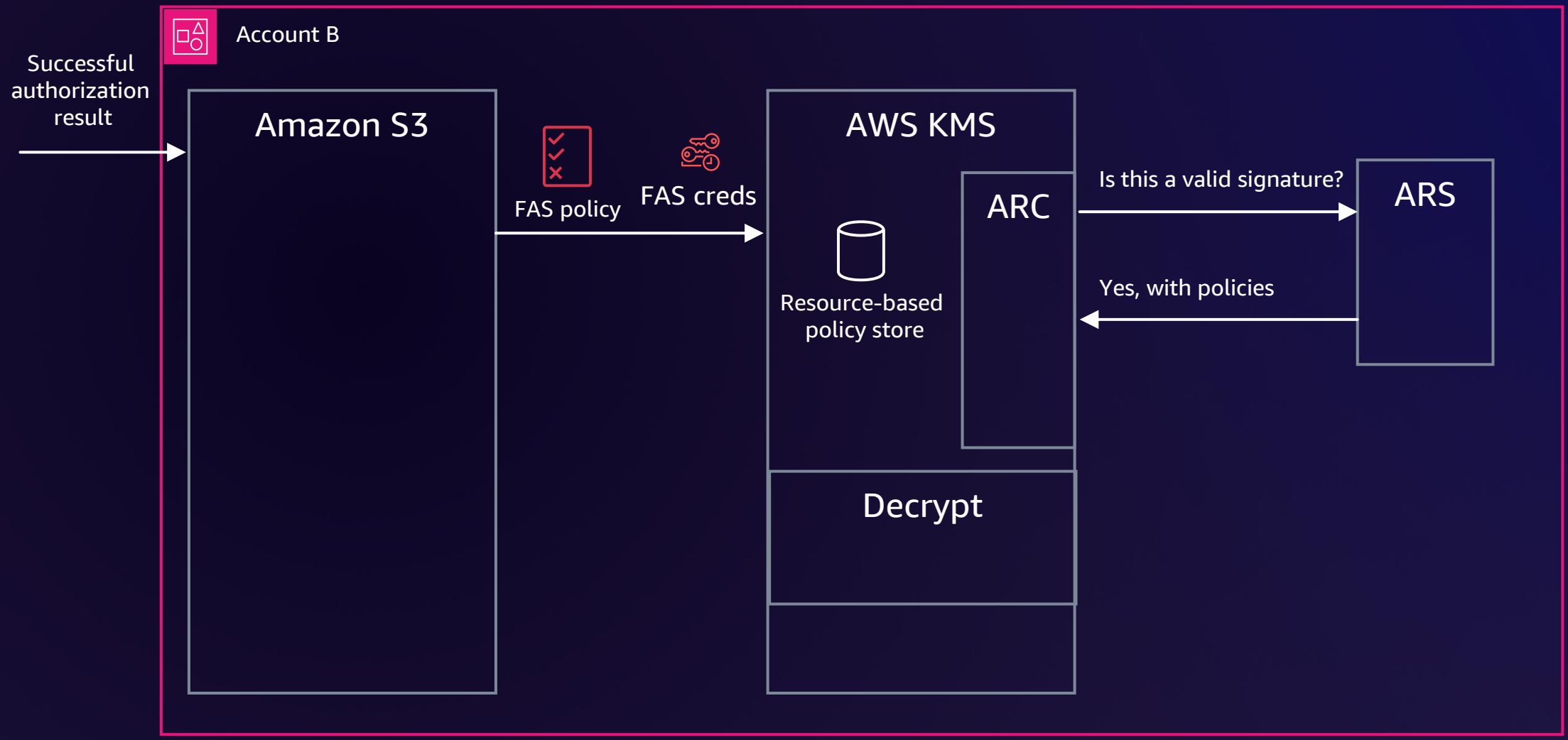

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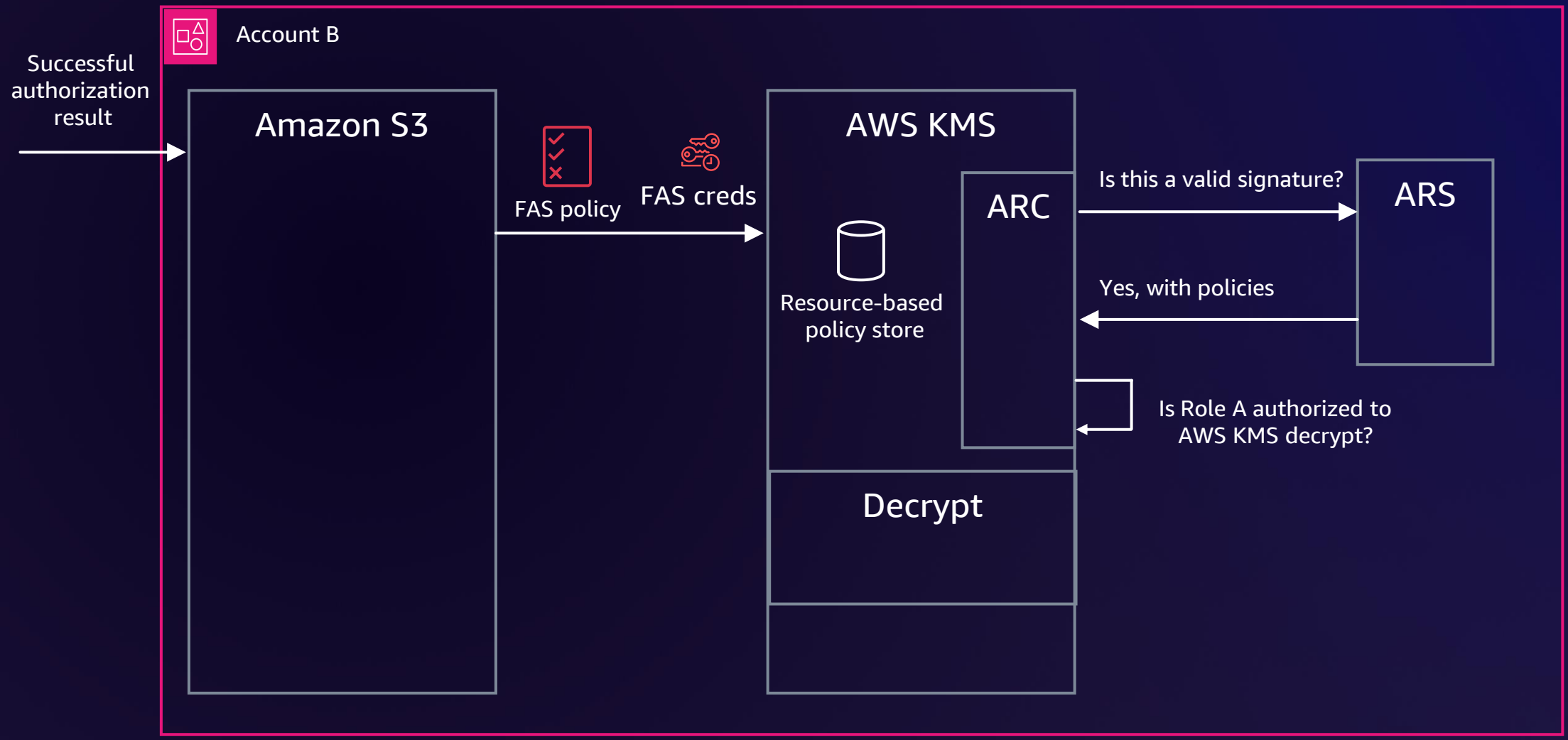

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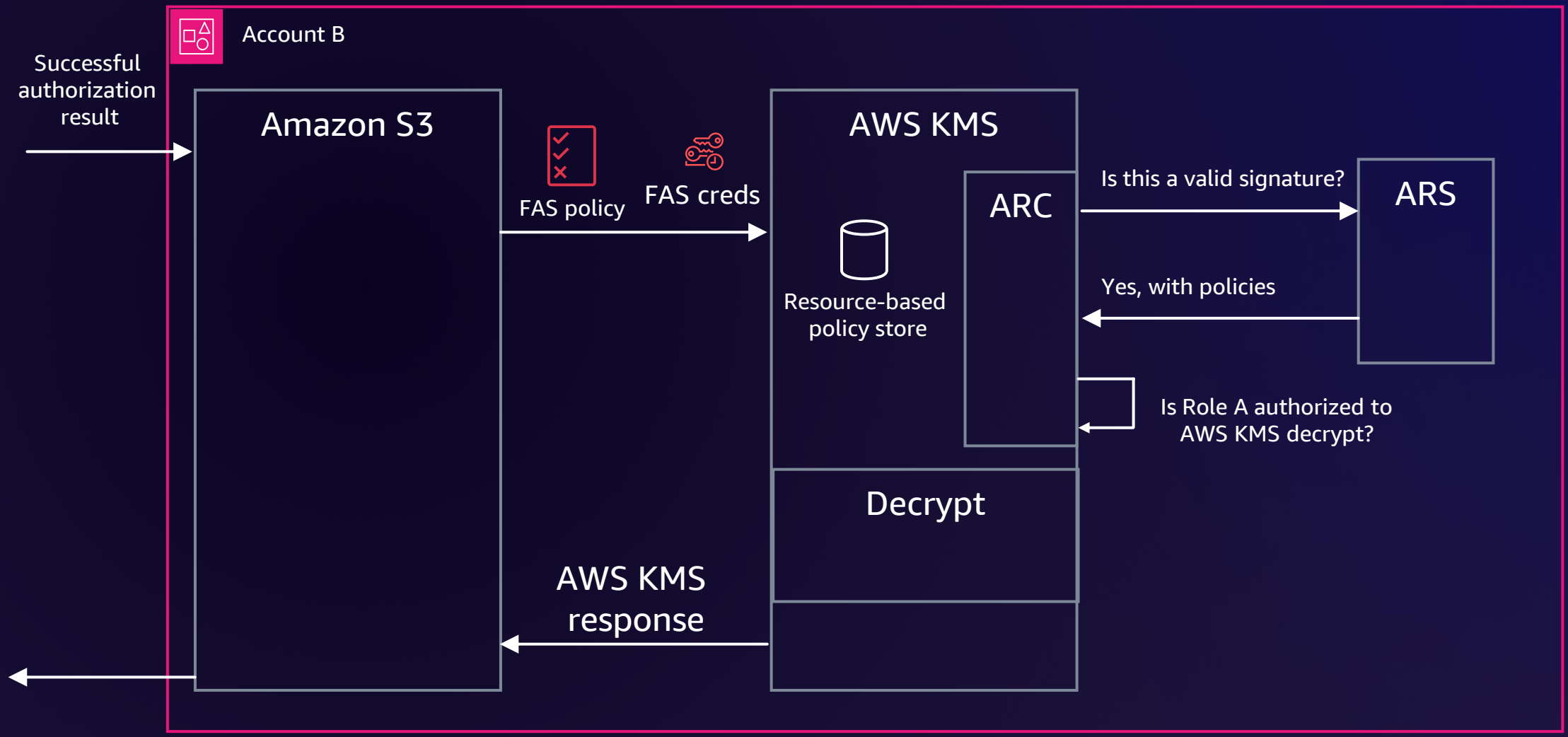

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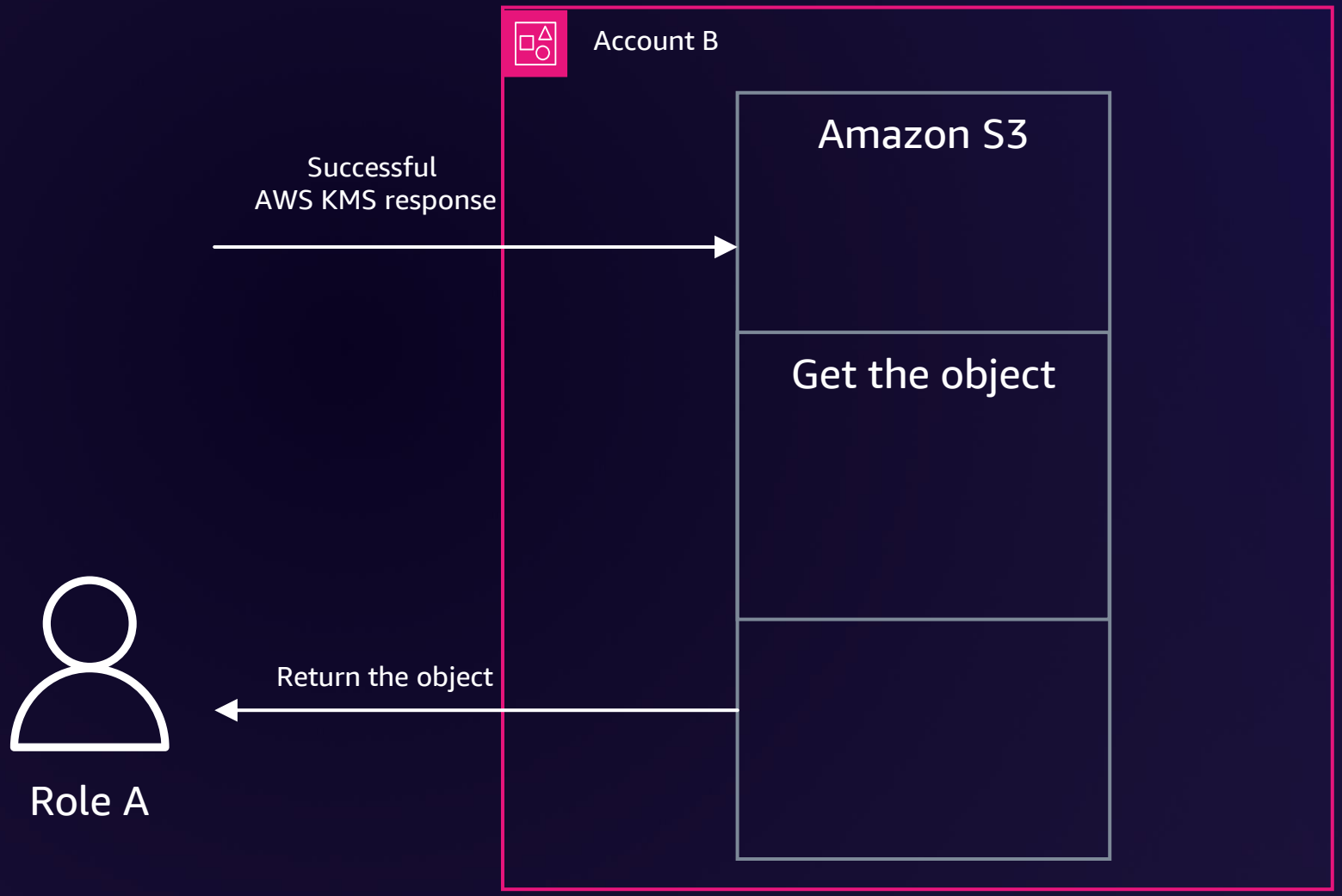
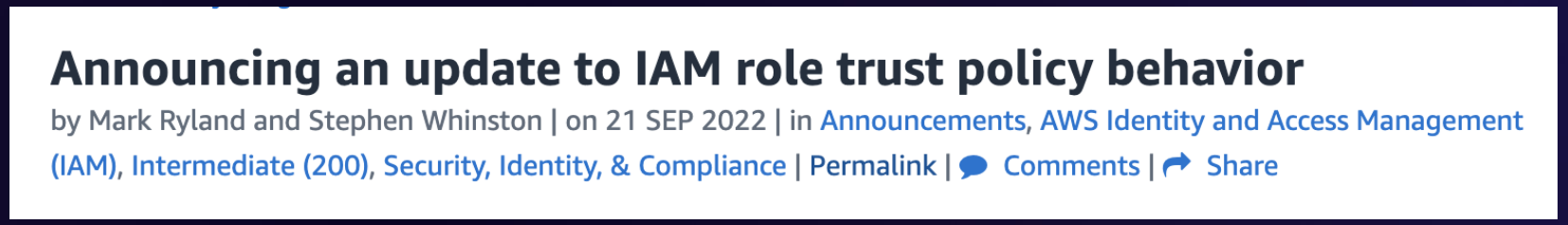


What if we need to change authorization?

- Rare but does happen, e.g.:



  - STS decided to remove implicit self-trust from AssumeRole
  - Analysis of implications and discussions
  - Cutoff dates
  - Customer messaging

What if we need to change authorization?

- Many possible reasons!
- High bar to make the change
  - Analysis of historical request patterns
  - Background analysis of impact against ongoing requests
  - Zelkova or other static analysis where relevant
  - Allowlisting of impacted customers and reach-out

Summary

- IAM is eventually consistent for good reason
- Blast radius is a core design consideration
  - Sigv4
  - FAS
- ARC for authorization, ARS for authentication