# Identity and Access Management

IAM

Chandra Lingam

Cloud Wave LLC

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# AWS Cloud Security

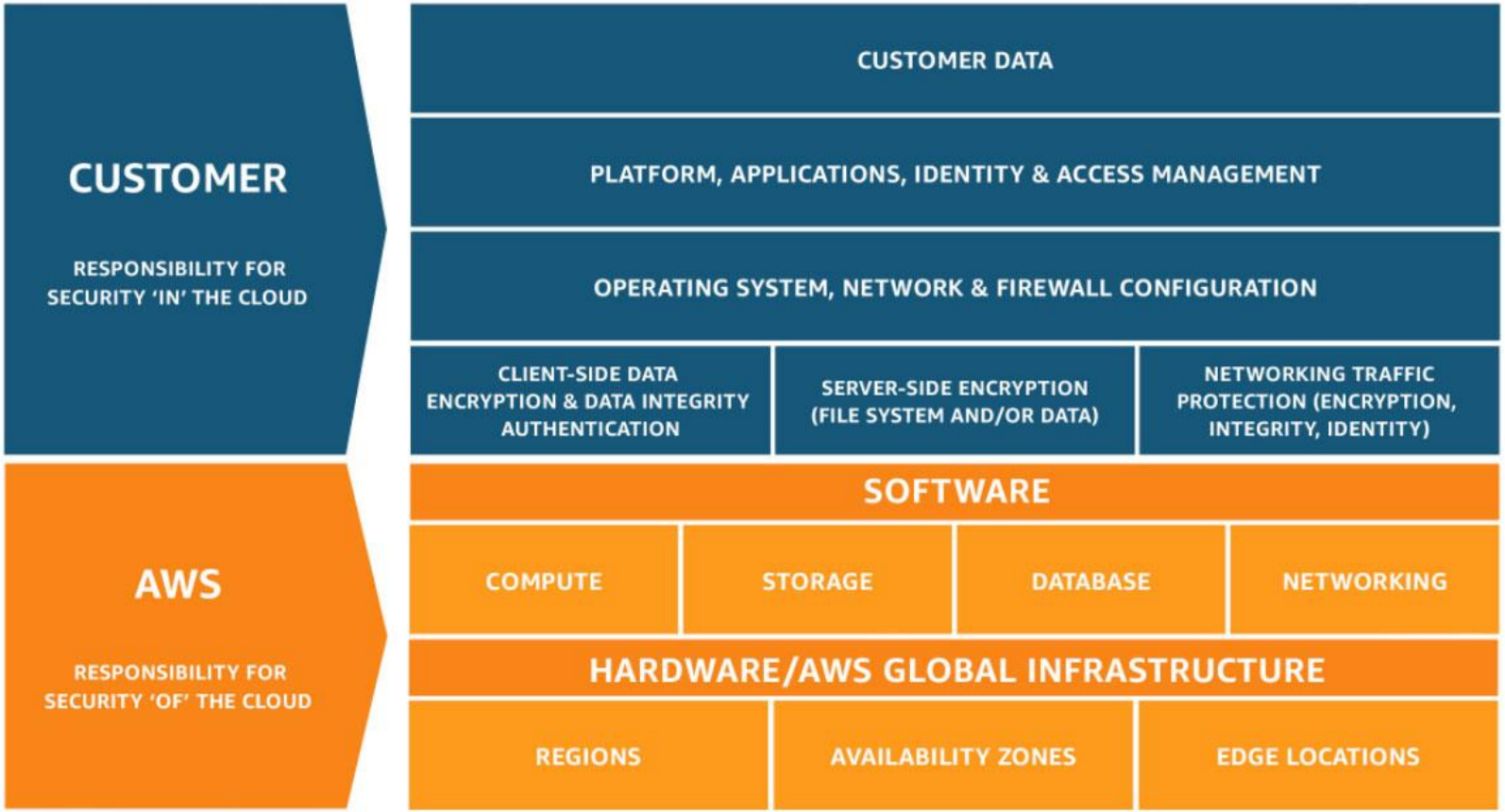
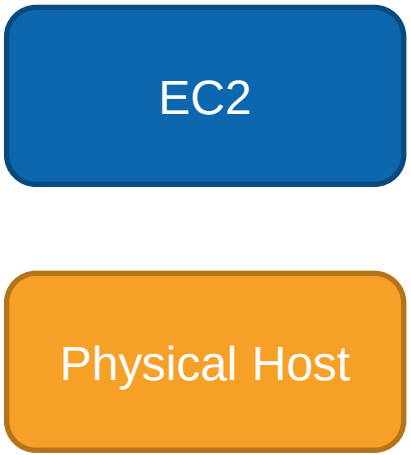



Image Source: [Shared Responsibility Model]

# EC2




Customer Responsibilities

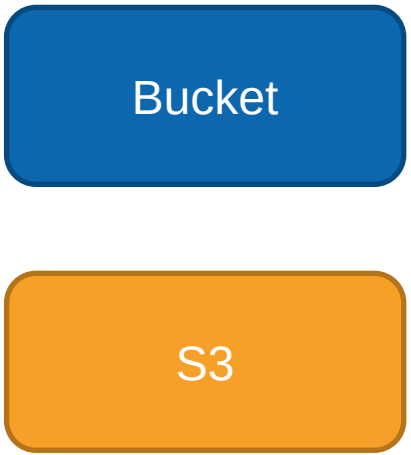
- Guest OS, Patching
- Firewalls (Security Group, Network ACL)
- Availability, Scalability, Monitoring

AWS Responsibilities

- Physical Host
- Virtualization

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# S3




Customer Responsibilities

- Storage Class
- Access Controls
- Data Encryption

AWS Responsibilities

- Hardware, Software
- Scalability

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# AWS Compliance Programs

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Useful Resources

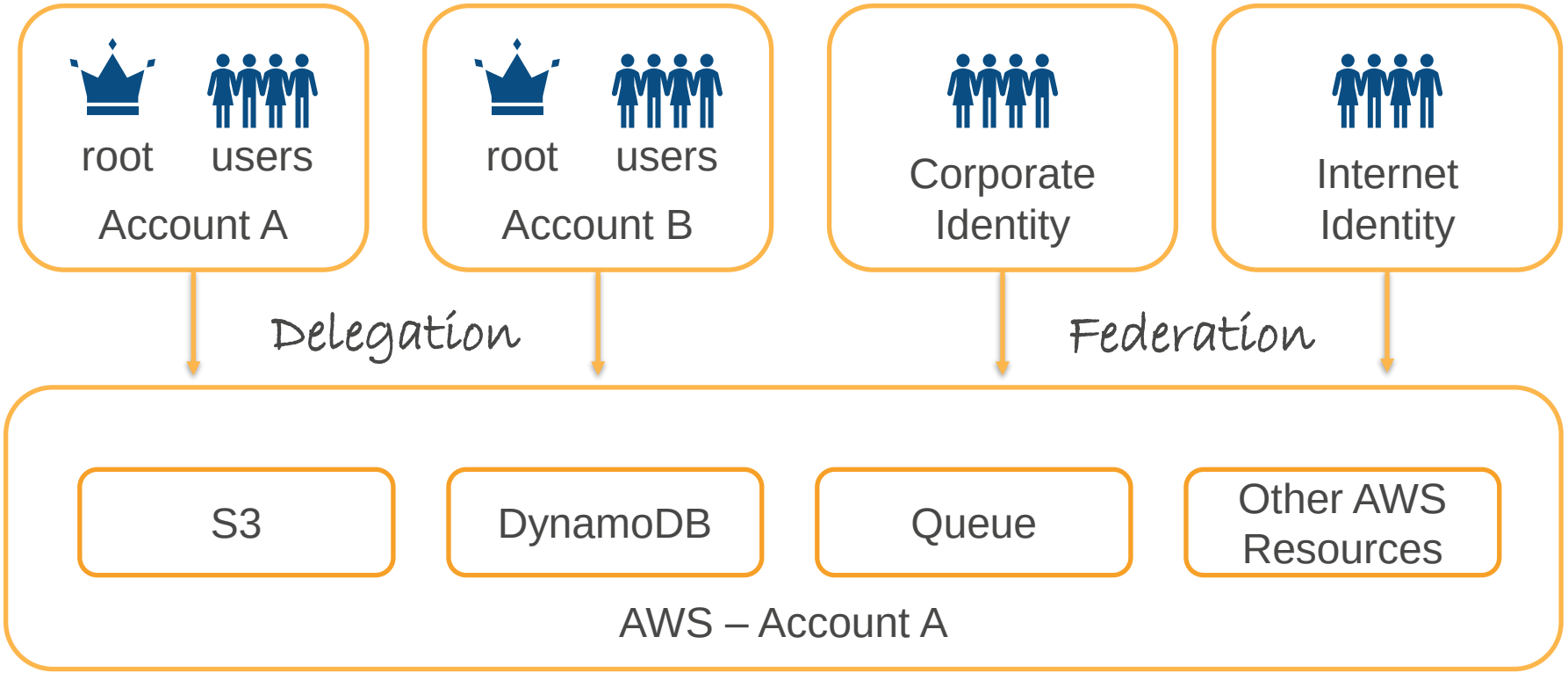
Security is Job Zero | AWS Public Sector Summit 2016

Steve Schmidt

CISO, AWS

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Types of Identities




Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Zero Trust

AWS operates on principle of zero trust

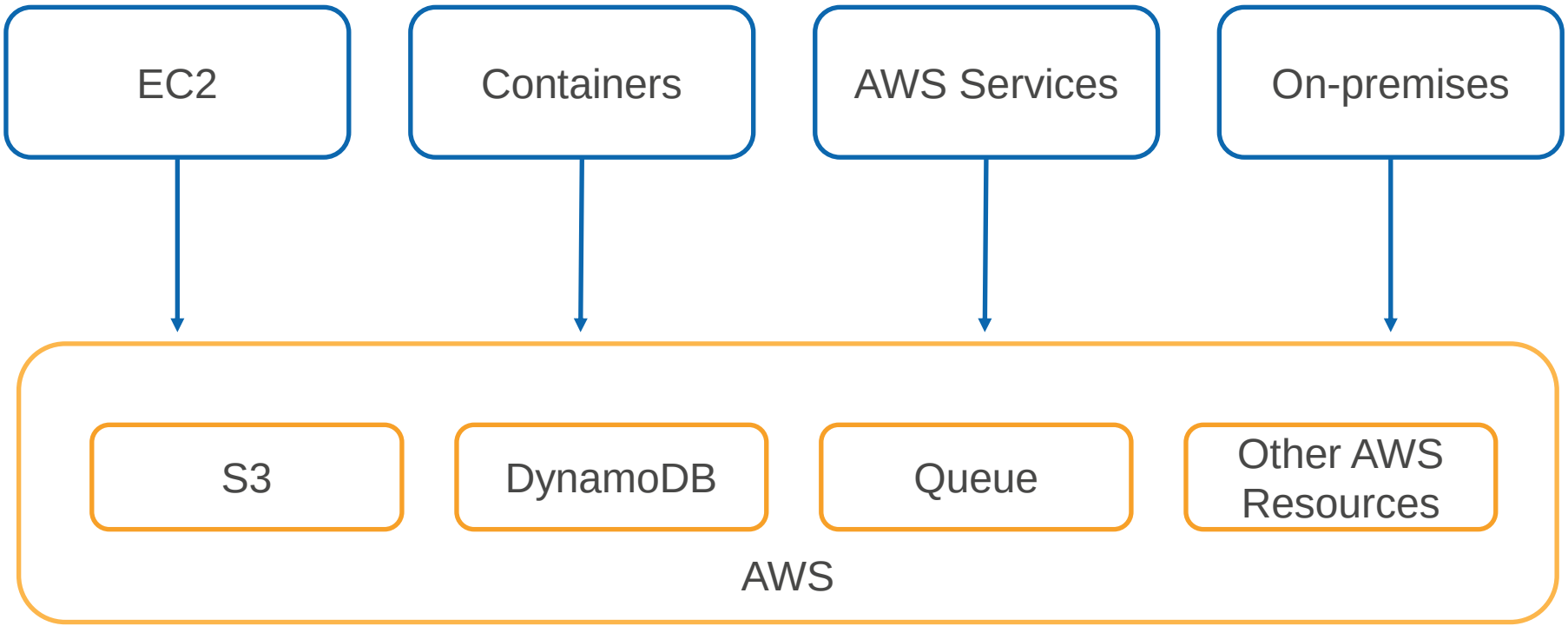
- Authentication – caller needs to prove identity
- Authorization – caller needs permission

- Some services allow anonymous access
    - S3 bucket with Public Access

Reference: AWS re:Invent 2019: Getting started with AWS identity (SEC209-R1) by Becky Weiss

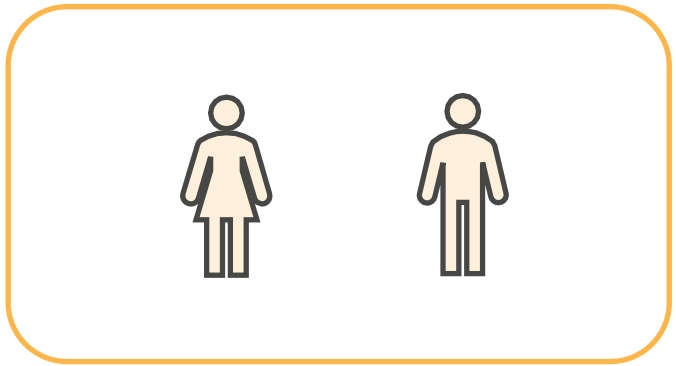
Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Types of Applications




Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

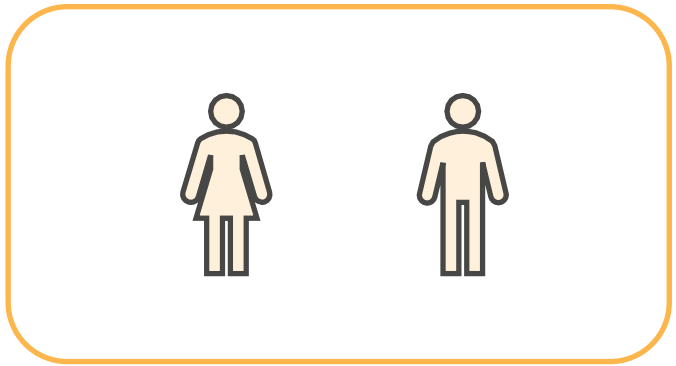
# IAM User Sign-in Credentials



- No sharing of credentials
- User ID and Password for Management Console Access
- Access Key and Secret Access Key for CLI, Programmatic Access
- Optional Multi-Factor Authentication (MFA)

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# IAM User Access Management



- No resource access by default
- Identity-based policy - Attach Policy to the User
- Resource-based policy - Attach Policy to the resource (only for supported AWS resources like S3, SQS, Lambda and so forth)
- IAM Roles - Grant temporary access to resources (and user gains privileges assigned to that Role)

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Sample Identity-based Policy

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:Get*",
                "s3:List*"
            ],
            "Resource": "*"
        }
    ]
}
```

Reference: arn:aws:iam::aws:policy/AmazonS3ReadOnlyAccess

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

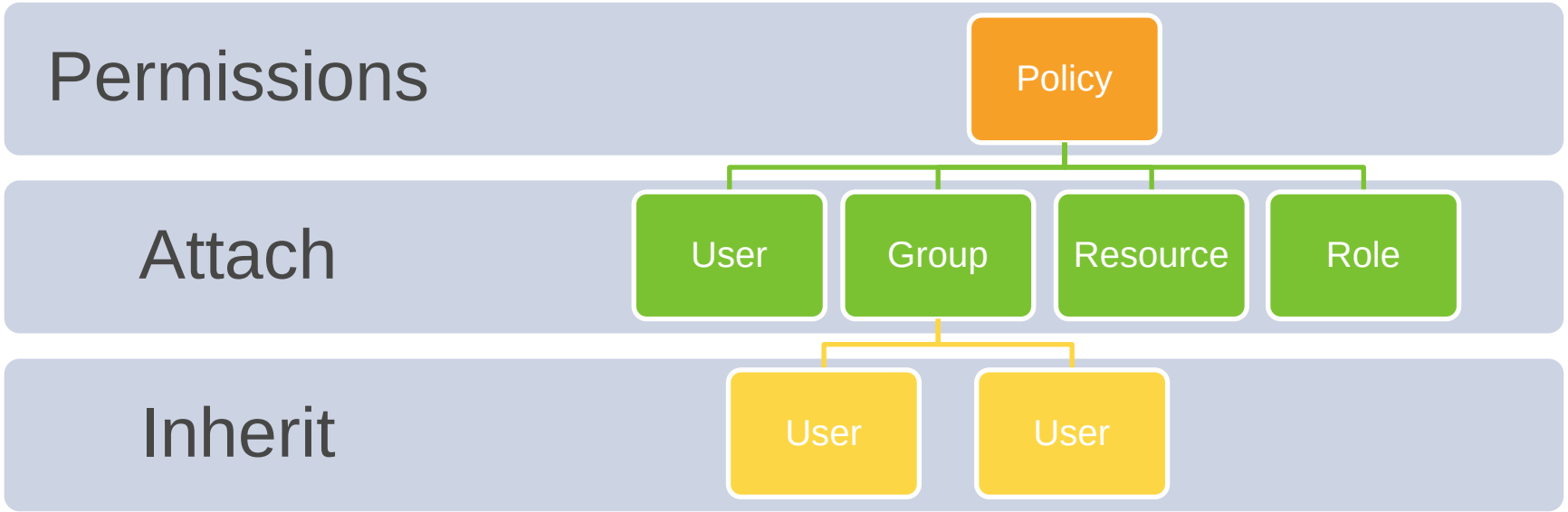
# Sample Resource-based Policy

```
{"Version": "2012-10-17",
 "Statement": [
    {
        "Effect": "Allow",
        "Action": ["s3:Get*","s3:List*"],
        "Resource": [
            "arn:aws:s3:::bucket_name",
            "arn:aws:s3:::bucket_name/*"],
        "Principal": {
            "AWS": [
            "arn:aws:iam::AWS-account-ID:user/alice",
            "arn:aws:iam::AWS-account-ID:user/bob"]}
    }
    ]
}
```

NOTE: Groups are not supported as principals in any policy

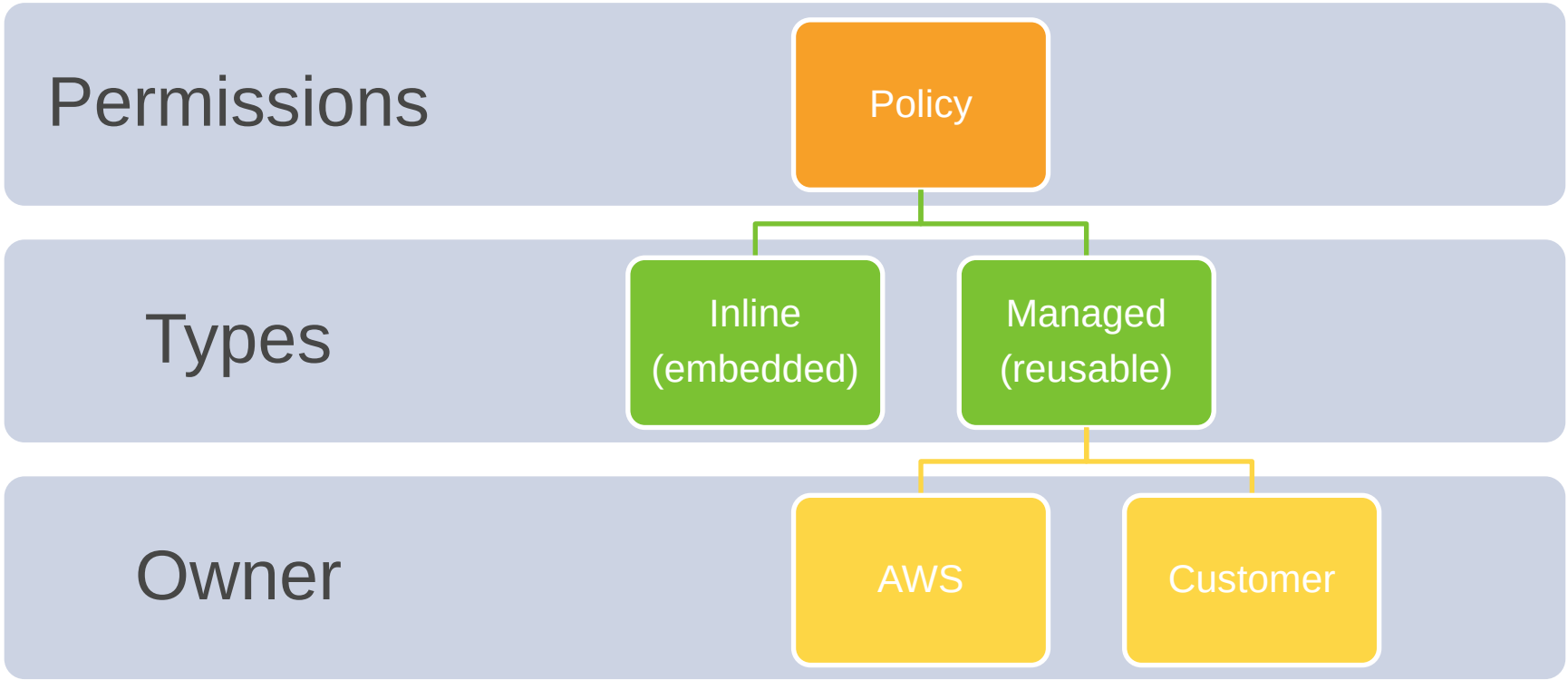
Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Access Management Concepts




Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Policy Types




Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

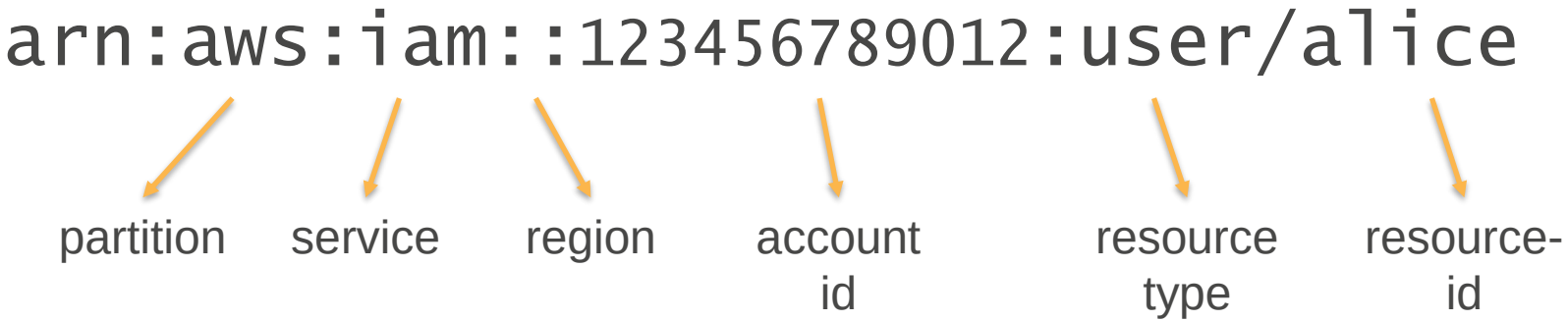
# Policy Development and Testing

- Policy Visual Editor
- Policy Examples
  https://docs.aws.amazon.com/IAM/latest/UserGuide/access_policies_examples.html
- Policy Simulator to Test Policy
  https://docs.aws.amazon.com/IAM/latest/UserGuide/access_policies_testing-policies.html

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Amazon Resource Name (ARN)

Uniquely identify resource and principal in AWS




Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Amazon Resource Name (ARN)

Uniquely identify resource and principal in AWS

```
arn:aws:iam::123456789012:user/alice

arn:aws:iam::123456789012:policy/db_admin

arn:aws:s3:::my_bucket

arn:aws:sqs:us-east-2:123456789012:order
```

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# ARN – Structure and Examples

## Structure

```
arn:partition:service:region:account-id:resource-id

arn:partition:service:region:account-id:resource-
type/resource-id

arn:partition:service:region:account-id:resource-
type:resource-id
```

## Examples

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Policy Document Structure (1/3)

| Element | Description |
|---|---|
| Version | Current version of the policy language. You should always set the version element.<br>Current version is "2012-10-17". |
| Statement | Permissions are allowed or denied using Statements.<br>A policy document can have one or more statements |
| Effect | Specifies if a statement allows or denies permission<br>Valid Values: Allow, Deny |
| Principal | Identity for which the statement applies.<br>Implied when attached to the identity-based policy (for example, a user)<br>Needs to be specified in resource-based policy and IAM Role trust policy<br>Groups are not supported as principals in any policy |

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Example of Principal

| Principal | Example |
|---|---|
| AWS account, root user | "Principal”:{"AWS":"arn:aws:iam::123456789012:root"}<br>"Principal”:{"AWS":"123456789012"} |
| IAM Users | "Principal":{"AWS":”arn:aws:iam::123456789012:user/alice"} |
| IAM Roles | "Principal":{"AWS":"arn:aws:iam::123456789012:role/cross-acct"} |
| AWS Services | "Principal":{"Service":"elasticmapreduce.amazonaws.com"} |
| Anonymous users | "Principal": “*” |
| Federated Users | "Principal":{"Federated":"www.amazon.com"} |
| Assumed-role sessions | Use the role session name to uniquely identify a session when the same role is assumed by different principals or for different reasons<br>"Principal":{"AWS":"arn:aws:sts::123456789012:assumed-role/role-name/role-session-name"} |

Copyright © 2019 Chandramohan Lingam. All Rights Reserved.

# Policy Document Structure (2/3)

| Element | Description |
|---|---|
| Action | Service API actions for which statement applies<br>Example:<br>“Action”:”s3:Get*” - All S3 API Calls that have a Get Prefix<br>“Action”:”s3:*” - All S3 API Calls |
| Resource | Resource for which the statement applies<br>Example:<br>“Resource”:"arn:aws:s3:::bucket_name“ – Actions apply to specified bucket<br><br>“Resource”:"arn:aws:s3:::bucket_name/*“ – Actions apply to objects stored in the specified bucket |
| Conditions | Additional conditions for fine grained access<br>Example: IP Address, Authentication Mechanism |

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Sample Identity-based Policy

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:Get*",
                "s3:List*"
            ],
            "Resource": "*"
        }
    ]
}
```

Reference: arn:aws:iam::aws:policy/AmazonS3ReadOnlyAccess

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Sample Resource-based Policy

```
{"Version": "2012-10-17",
 "Statement": [
    {
        "Effect": "Allow",
        "Action": ["s3:Get*","s3:List*"],
        "Resource": [
            "arn:aws:s3:::bucket_name",
            "arn:aws:s3:::bucket_name/*"],
        "Principal": {
            "AWS": [
            "arn:aws:iam::AWS-account-ID:user/alice",
            "arn:aws:iam::AWS-account-ID:user/bob"]}
    }
    ]
}
```

NOTE: Groups are not supported as principals in any policy

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Policy Document Structure (3/3)

| Element | Description |
|---|---|
| NotAction | Matches everything except specified API action<br>Example:<br>“NotAction”:”s3:DeleteBucket” – All S3 actions except for deleting a bucket |
| NotResource | Match everything except the specified resource<br>Example:<br>“NotResource”:[<br>"arn:aws:s3:::bucket_name“,<br>"arn:aws:s3:::bucket_name/*”] |
| NotPrincipal | Match all principals except for specified principal<br>Example:<br>“Effect”:”Deny”,<br>“NotPrincipal”:["AWS": “123456789012”] |

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Sample – Limit access to S3 by Source IP

```
"Statement": [
 {
    "Effect": “Deny",
    "Action": "s3:*",
    "Resource": [
        "arn:aws:s3:::bucket_name",
       "arn:aws:s3:::bucket_name/*"],
    “Principal": "*",
    "Condition": {
        “NotIpAddress": {
          "aws:SourceIp": “151.29.0.0/16"
        }
```

Reference: https://docs.aws.amazon.com/IAM/latest/UserGuide/reference_policies_examples_aws_deny-ip.html

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Sample Conditional Variables – VPC Endpoint Only Access

```
"Statement": [
 {
    "Effect": “Deny",
    "Action": "s3:*",
    "Resource": [
        "arn:aws:s3:::bucket_name",
       "arn:aws:s3:::bucket_name/*"],
    “Principal": "*",
    "Condition": {
        "StringNotEquals": {
          "aws:sourceVpce": "vpce-0f143973exyzabcdef"
        }
```

Reference: https://docs.aws.amazon.com/AmazonS3/latest/dev/example-bucket-policies-vpc-endpoint.html

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Improved VPC Endpoint Only Access

```
"Statement": [
 {
    "Effect": “Deny",
    "Action": "s3:*",
    "Resource": [
        "arn:aws:s3:::bucket_name",
       "arn:aws:s3:::bucket_name/*"],
    “NotPrincipal": {
      "AWS": [
          "arn:aws:iam::AWS-account-ID:root",
          "arn:aws:iam::AWS-account-ID:user/myadmin"]},
    "Condition": {
        "StringNotEquals": {
          "aws:sourceVpce": "vpce-0f143973exyzabcdef"
        }
```

Reference: https://docs.aws.amazon.com/AmazonS3/latest/dev/example-bucket-policies-vpc-endpoint.html

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Global Environment Data (request context)

| Key | Description |
|---|---|
| aws:CurrentTime | Data and time of the request – use it for timebased restrictions |
| aws:RequestedRegion | AWS Region used in the request – use it to limit access only to specific region(s) |
| aws:PrincipalTag | Compare the tag attached to the principal making the request |
| aws:SecureTransport | Check if request was sent using SSL. Values: True or false |
| aws:SourceIP, aws:SourceVpc, aws:SourceVpce | Check if request comes from whitelisted IP, VPC or VPC Endpoint |

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Attribute Based Access Control (ABAC)

Allow actions only when cost center match

```
"Statement": [
 {
    "Effect": "Allow",
    "Action": ["ec2:startInstances", "ec2:stopInstances“],
    "Resource": "*",
    "Condition": {
        "StringEquals": {
          “ec2:ResourceTag/CostCenter":
                  "${aws:PrincipalTag/CostCenter}"
        }
 }
```

Reference: https://docs.aws.amazon.com/IAM/latest/UserGuide/reference_policies_examples_ec2-start-stop-match-tags.html

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Role Based Access Control (RBAC)

- “Traditional authorization model used in IAM is called role-based access control.  This is based on a person's job-role.” [in AWS context, role refers to IAM-role]
- “In RBAC model, you implement different policies for different job functions.”
- “As best policy, you grant the minimum permissions necessary for the job function.  this is known as "granting least privilege".”
- “The disadvantage of RBAC model is that when employees add new resources, you must update policies to allow access to those resources.”

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Attribute Based Access Control (ABAC)

- “ABAC is an authorization strategy that defines permissions based on attributes (also known as Tags)”
- “Tags can be attached to IAM Principals (users or roles) and to AWS resources”
- “With ABAC, policies can be designed to allow operations when the principal's tag matches the resource tag.”
- “ABAC is useful in environments that are growing rapidly and helps with situations where policy management becomes cumbersome”
- “With ABAC, permissions scale - it is no longer necessary for administrator to update existing policies.”
- “ABAC requires fewer policies”

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Policy Evaluation

- Implicit Deny – By default, all requests are implicitly denied
- Explicit Allow – Overrides this default
- Explicit Deny – Overrides explicit allow
- Permissions Boundary, Organization Service Control Policy, Session Policy – it might override the allow with an implicit deny

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Maximum Permissions

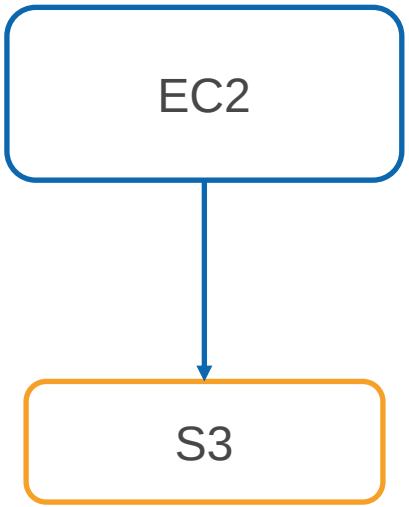
- IAM Permission Boundaries – Sets maximum permissions that an identity-based policy can grant to an entity (user or role)
    - When Set, an entity can perform only the actions that are allowed by identity based policies and permission boundaries
- Session Policy – When you assume role for temporary credentials, you can include a policy as a parameter – this is helpful when you want to limit what the temporary credential can do

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# IAM Roles

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Application Access to AWS Resources




Access Key Credentials (Treat the server as a user):

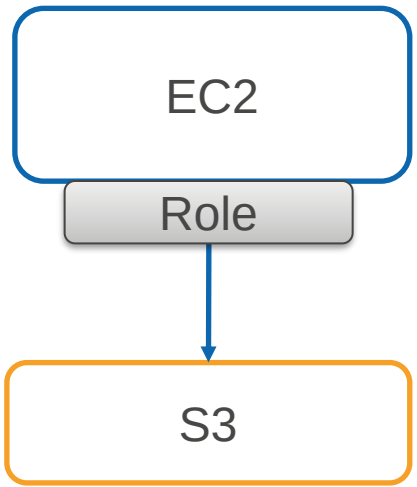
- Generate Access Key, Secret Access Key
- Store the key in the EC2 instance
- EC2 uses the credentials to talk to services

Issues:

- Access Key Credentials are long-term (several days to months)
- Security risks due to long term credentials (accidental leakage, malicious users)
- Credential rotation is a problem at scale

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Application Access to AWS Resources




IAM Roles:

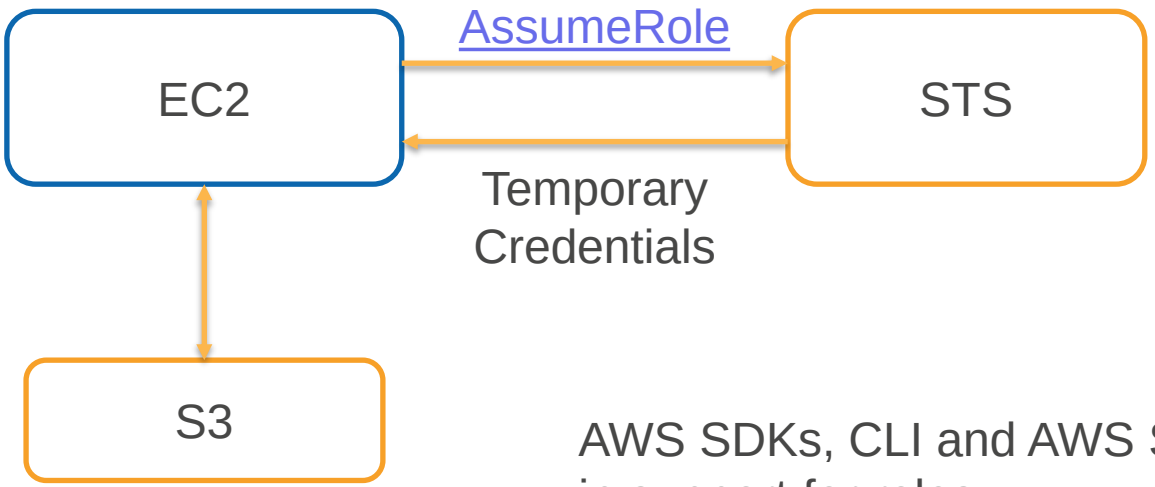
- Attach an IAM Role to the instance
- EC2 instance talks to metadata service to get temporary credentials for the role
- EC2 uses the temporary credentials to talk to services

Benefits:

- No need to maintain credentials in the server
- Automatic Credential rotation – Credentials are valid only for a few hours (configurable)
- Reduced impact due to accidental leakage (credential is replaced every few hours)

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

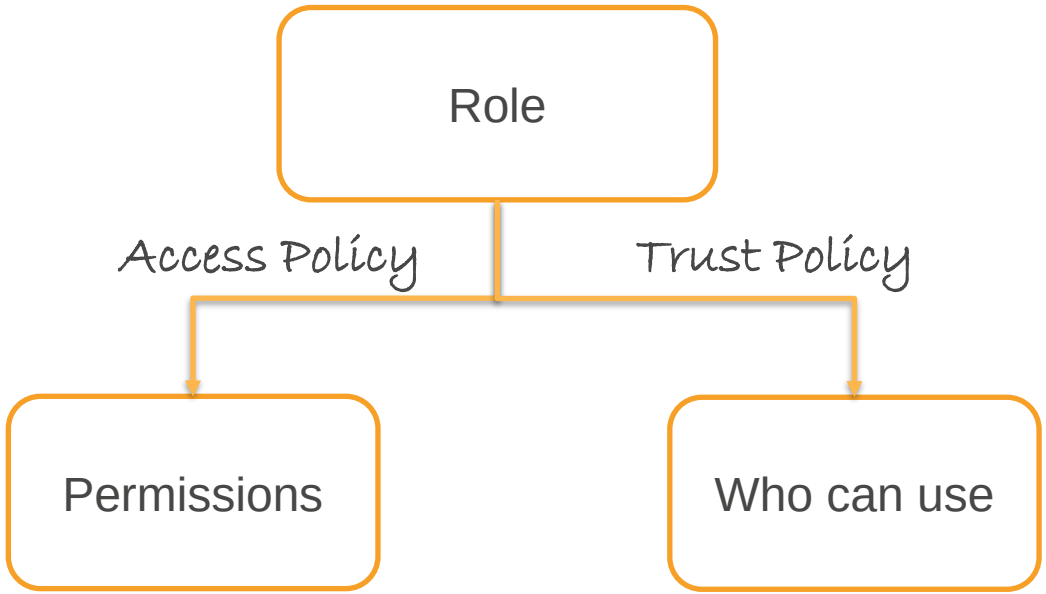
# Security Token Service (STS)




AWS SDKs, CLI and AWS Services have built-in support for roles

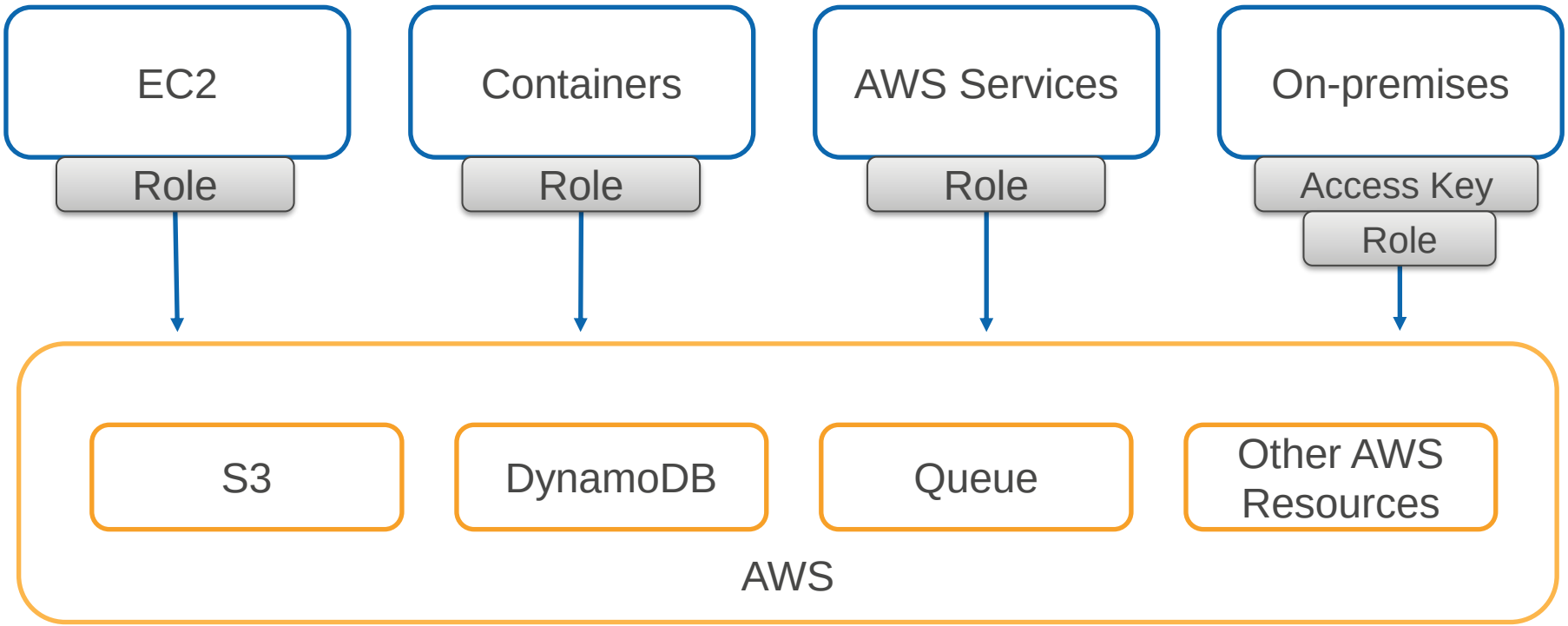
Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Role Concepts



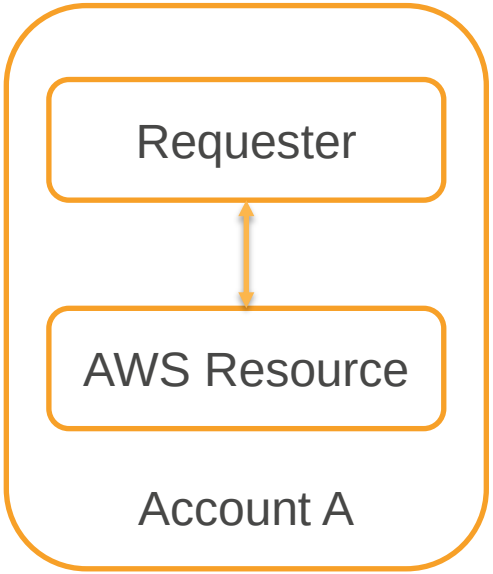

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Application Access To Resources




Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

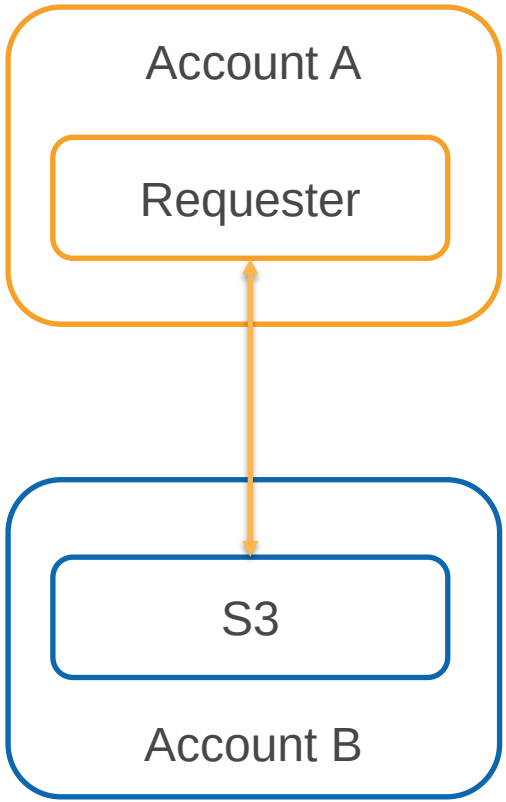
# Same Account Access




- Identity-based policies – for access to any AWS resource
- Resource-based policies – for access to supported resources
- Roles - for EC2 and Service integration

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

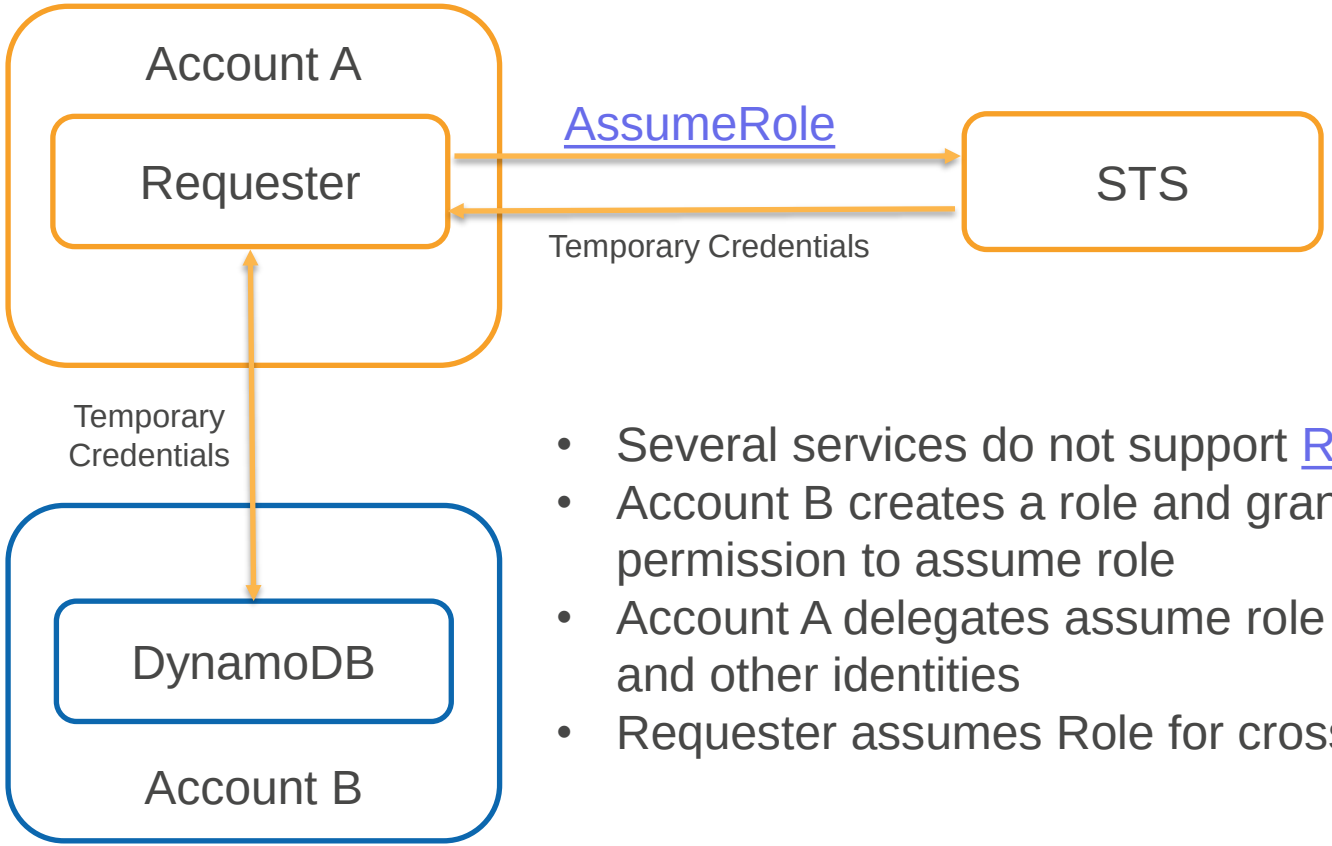
# Cross Account Access using Resource Based Policy




- Resource Based Policies (for supported resources like S3, SQS, SNS, Lambda)
- Identity in Account A needs access to resource in Account B
  - Resource owner (Account B) grants permission to Account A
  - Account A delegate's permission to the other identities in the account (user, role)

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

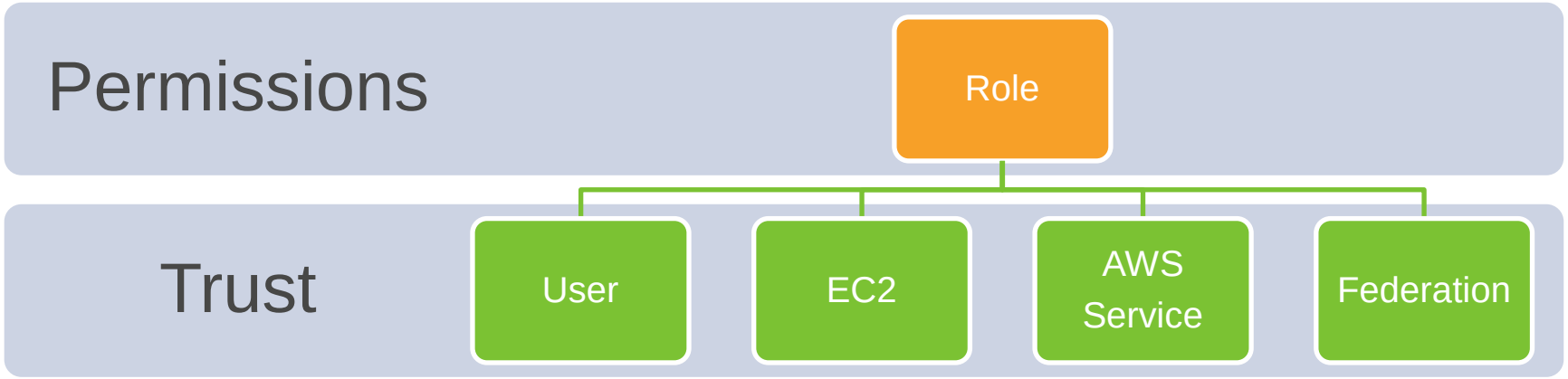
# Cross Account Access Using Roles




- Several services do not support Resource Based Policy
- Account B creates a role and grants Account A permission to assume role
- Account A delegates assume role permission to users, and other identities
- Requester assumes Role for cross account access

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Role

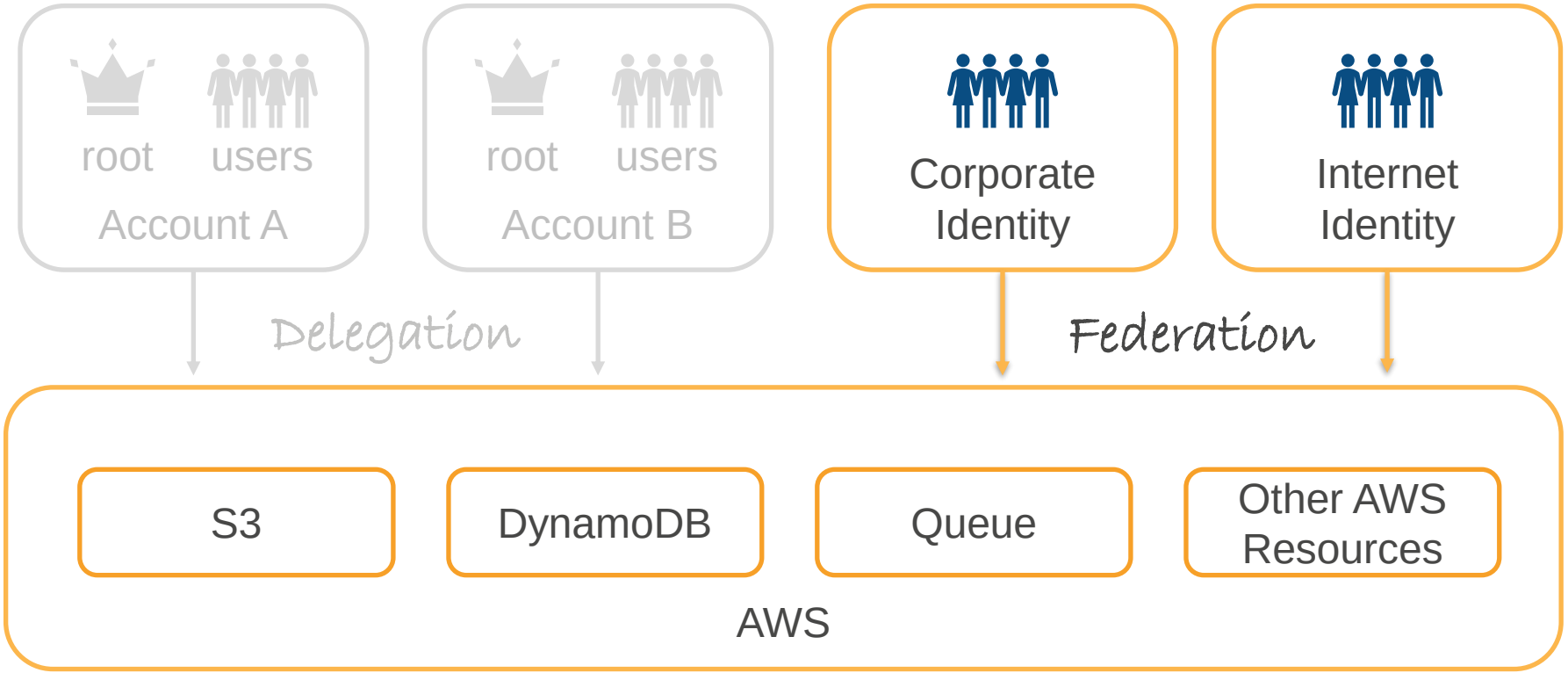



Role has two parts:

1. Who can assume the role (trust relationship) and
2. What access is allowed (permissions)

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

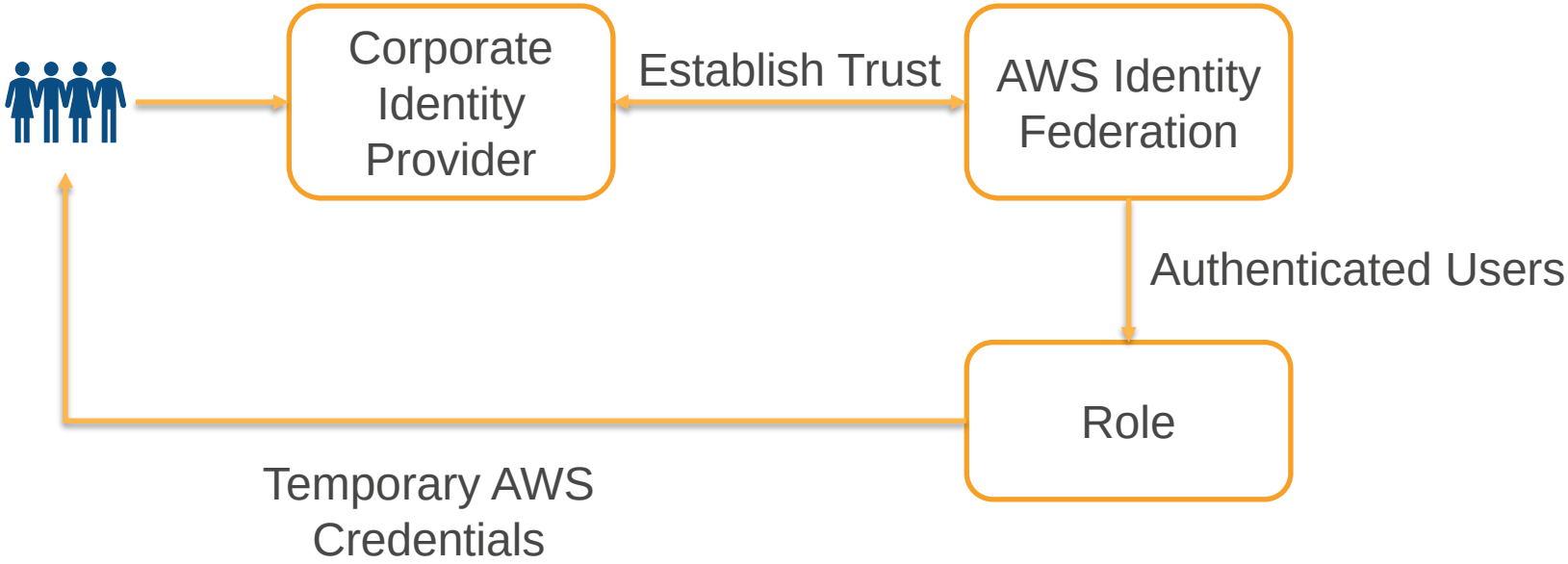
# Types of Identities




Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Corporate Identity Federation

SAML 2.0, Microsoft Active Directory



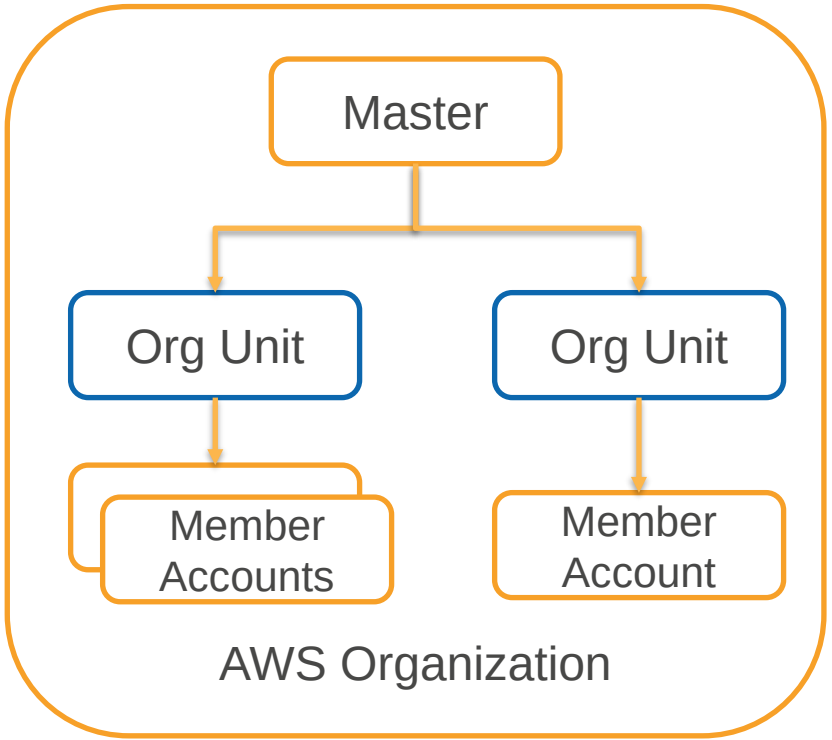

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Corporate Identity Federation

- SAML 2.0 (Security Assertion Mark Up Language) to exchange identity and security information between identity provider and application
- AWS IAM Federation – enables users sign-in to their AWS account with existing corporate credentials
- Non-SAML options – AWS Directory Service for Microsoft Active Directory
- AWS Organizations – Use AWS Single Sign On (SSO) to scale to multiple AWS Accounts (centrally manage access)

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

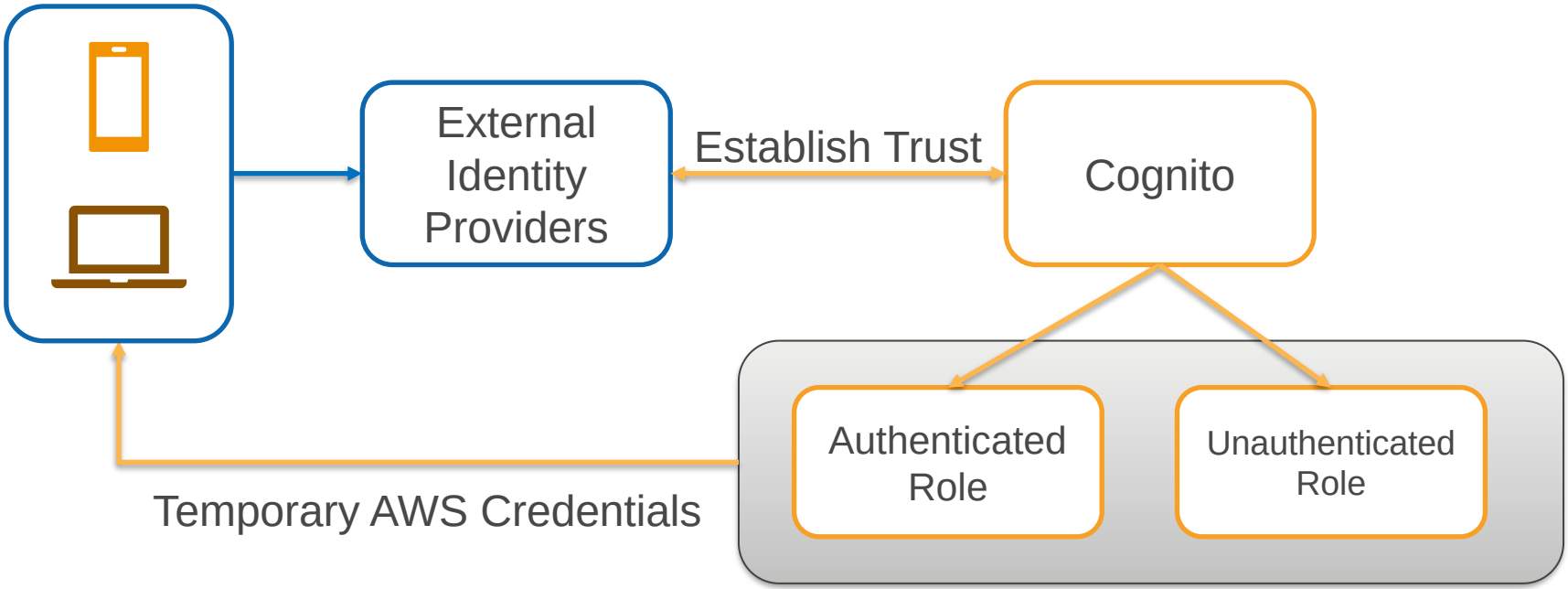
# AWS Organizations




- Centrally manage costs and billing
- Service Control Policy – control services, resources, regions used by member account
- Share resources across accounts
- AWS Single Sign-on – manage access to employees and accounts
- Centralize identity management and federation

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Internet Identity Federation




SAML 2.0, OAuth 2.0, OpenID Connect

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Cognito Identity Federation

- Users can sign-in to mobile and web apps using social identity providers like Facebook, google, amazon
- Support for corporate identity federation using SAML 2.0
- Open Standards Support - Oauth 2.0, SAML 2.0, OpenID Connect
- Map users to roles and limit access to resources

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Useful Resources

AWS re:Invent 2019: Getting started with AWS identity (SEC209-R1) by Becky Weiss

AWS re:Invent 2015: How to Become an IAM Policy Ninja in 60 Minutes or Less (SEC305) by Jeff Wierer

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Lab – Identity-based Policy

- IAM Users, Groups
- Programmatic Access and Management Console Access
- Implicit Deny
- Explicit Allow
- Managed Policy

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Lab – Resource-based Policy

Explore resource-based policy

Configure principals, resources and actions

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Lab – IP Based Restriction

Policy with conditional variable

Limit access to S3 Bucket based on requester IP

For this lab, we use the `IPRestrictionPolicy` file available under resources

Reference
https://docs.aws.amazon.com/IAM/latest/UserGuide/reference_policies_examples_aws_deny-ip.html

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Lab – VPC Endpoints

Allow access to the bucket only from VPC

Route traffic internally on AWS network using VPC Endpoint

For this lab, we use the policy file available under resources: `VPCEndPointRestrictionPolicy`

Reference: https://docs.aws.amazon.com/vpc/latest/userguide/vpc-endpoints-s3.html#vpc-endpoints-policies-s3

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Lab – Cross Account Access using Resource Policy

- Bucket and the user are in separate accounts
- You need two accounts for this lab
- Manage permission using resource-based policy

For this lab, we use the policy file:
`ResourceBasedCrossAccountAccessPolicy`

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

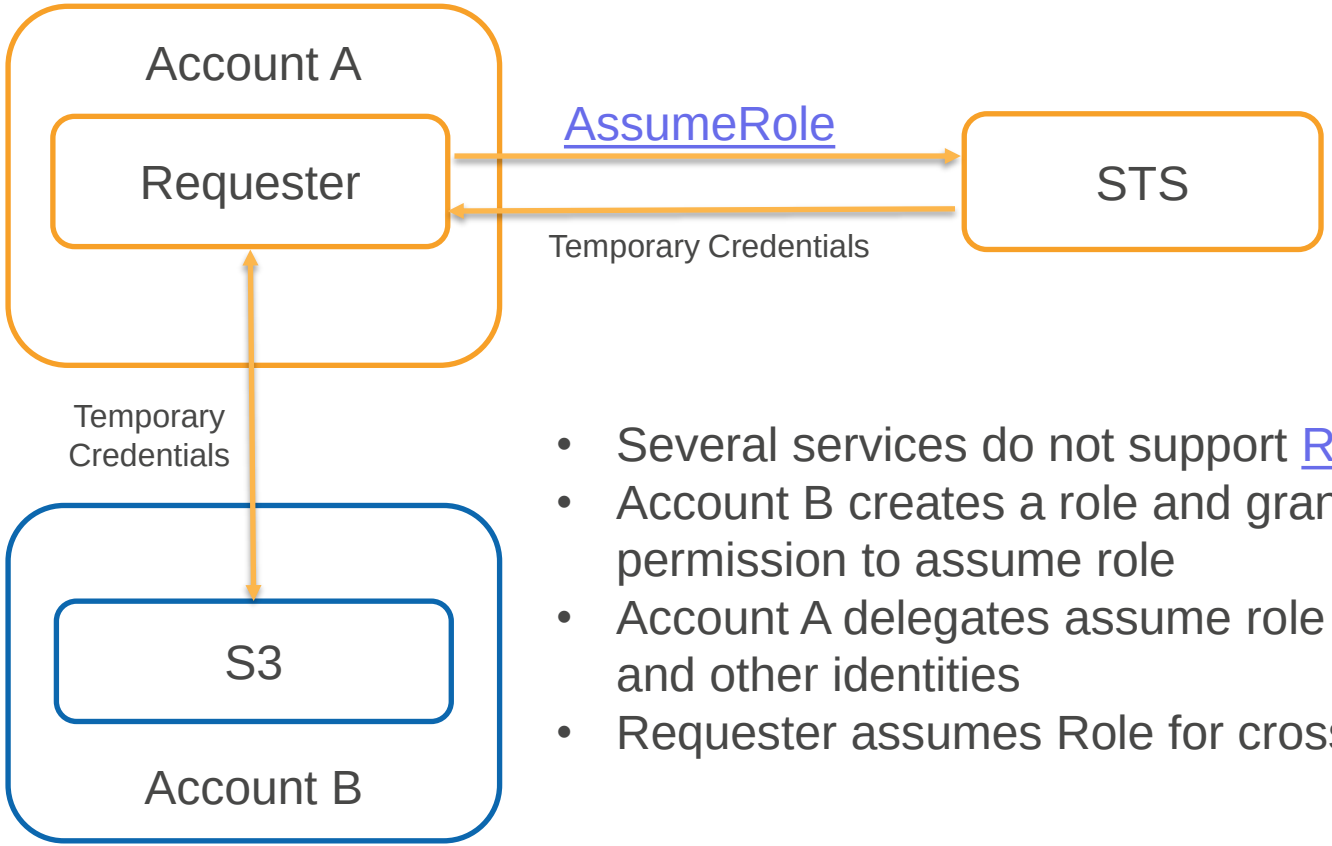
# Lab – Cross Account Access using IAM Roles

- Explore cross-account resource sharing using IAM Roles
- Temporary Credentials using Assume Role
- Demonstrate access from browser, laptop and from EC2 instance

For this lab, we use the policy file:
`RoleBasedCrossAccountAccessPolicy`

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Lab - Cross Account Access Using Roles




- Several services do not support Resource Based Policy
- Account B creates a role and grants Account A permission to assume role
- Account A delegates assume role permission to users, and other identities
- Requester assumes Role for cross account access

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.

# Chandra Lingam

57,000+ Students


For AWS self-paced video courses, visit:

https://www.cloudwavetraining.com/

Cloud Wave LLC

Copyright © 2019 ChandraMohan Lingam. All Rights Reserved.