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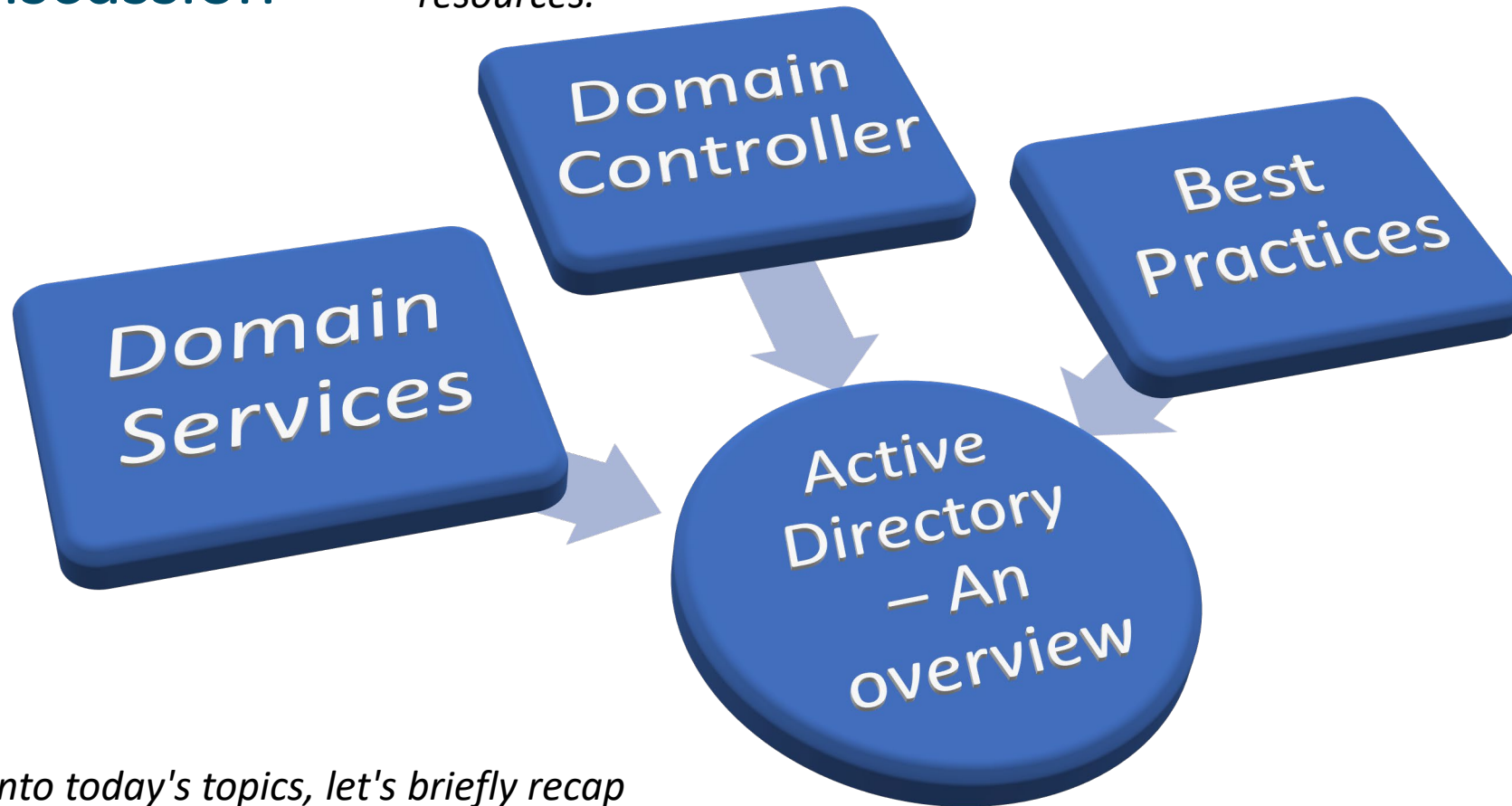
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Directory Services

Network Operating Systems and Services ACCA5023

Today's Discussion

During this week, we shall focus on Directory Services! we will delve into the Active Directory Infrastructure concepts, overviewing directory services, understand its environment and apply the learning to deploy and later manage network services and resources.



Before we dive into today's topics, let's briefly recap what we covered so far.



Last week

How does the choice of Hypervisor affect the Topology?

Great ASK!!! Good Question!!! A PIZZA Definitely



Resources required for your Coursework – Worksheets

- ✍ Download from Microsoft Evaluation Center
- ✍ Download from <https://www.debian.org/distrib/>



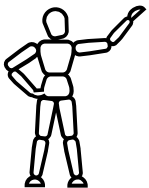
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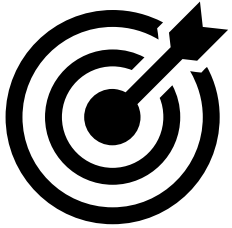
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Have you done this?

How does the choice of Hypervisor affect the Topology?

- ✍ detailed research into different types of hypervisors used in virtualization.
- ✍ Selected your choice of Hypervisor!!! *(I haven't had any request for Type 1 Hypervisor)*
- ✍ *Labstats should be working now!!! (Check and Let me know)*
- ✍ During your Tutorials, you might have worked downloading, installing VM's. So, with that experience, have you considered,
 - ✍ **the performance, scalability, and management of virtualized environment – and its impact on your coursework?**
 - ✍ Good luck!



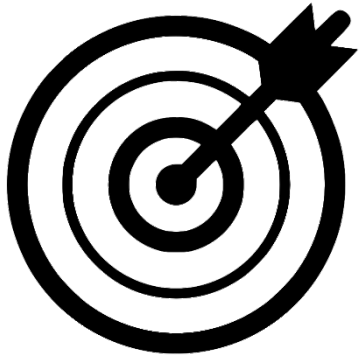


Coursework 1:

- ✍ Choose your Hypervisor based on your research (Q.2.1)
- ✍ Download (use Evaluation Copy) and Setup your Virtual Machines – as per the topology (Q. 2.2)
- ✍ Research on IP Address (Based on the Group Discussion earlier)
- ✍ Download Debian Linux
- ✍ **Configure IP Address for Windows Server and Client – Successful Ping**
- ✍ Install Debian Server and Client
- ✍ Configure IP Address for Debian Server and Client – Successful Ping
- ✍ Test and Troubleshoot (if required) your network.
- ✍ Research on Routing and Network Services.
- ✍ Submit your Coursework 1 – **03/03/2026**



Objectives



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- ✍ Understand the Active Directory Infrastructure
- ✍ Continue with your Coursework 1, prepare your report
- ✍ Submit your report – **03rd March 2026 @ 1500**

Introduction

- Network Operating Systems!!!
 - Manage and facilitate communication, resource sharing across a network of interconnected devices.
 - Offer services for network connected entities to effectively communicate, access shared resources, perform network related task efficiently.
- Features
 - Resource Sharing
 - User Authentication
 - Access Control
 - Centralized Management
 - Scalability
 - Reliability

Introduction

- Types of NOS
 - Server-Centric
 - Device Specific
 - Hypervisor Based

Introduction

- Microsoft Windows Server is one of the most widely used network operating systems.
- Offers a range of features for:
 - ↪ Managing network services.
 - ↪ Facilitating file sharing.
 - ↪ Handling user authentication.
 - ↪ Providing directory services - **Active Directory Domain Services**
- Active Directory Domain Services
 - ↪ enables centralized user and resource management.
 - ↪ facilitates efficient administration of network resources.
 - ↪ supports features such as group policy management and user access control.

Introduction

- Linux-based Servers (e.g., Ubuntu Server, CentOS, Red Hat Enterprise Linux) is known for stability, security, and flexibility.
- Provide a wide range of networking services including:
 - ↳ DNS (Domain Name System).
 - ↳ DHCP (Dynamic Host Configuration Protocol).
 - ↳ File sharing (using protocols like Samba).
 - ↳ Web hosting (using Apache or Nginx).
- FreeBSD, Unix-like operating system known for reliability and performance.
 - ↳ Can be used as a network operating system to provide services such as
 - ↳ DNS, DHCP, FTP.
 - ↳ Firewalling.
 - ↳ Supports advanced networking features like IPsec and virtualization.

Introduction

- Cisco IOS (Internetwork Operating System)
 - ↪ Operating system used on Cisco networking devices (routers, switches).
 - ↪ Features for:
 - ↪ Configuring, managing, and securing network infrastructure.
 - ↪ Including routing protocols, VLAN configuration, access control, and more.
- Juniper Junos:
 - ↪ Operating system used on Juniper Networks devices (routers, switches, firewalls).
 - ↪ Offers advanced networking features such as:
 - ↪ MPLS (Multiprotocol Label Switching).
 - ↪ BGP (Border Gateway Protocol).
 - ↪ Firewall policies.
 - ↪ Network virtualization.

Introduction

- Apple macOS Server:
 - ↪ Network operating system developed by Apple for Macintosh computers.

Provides services such as:

 - ↪ File sharing.
 - ↪ Centralized user authentication.
 - ↪ DNS, DHCP.
 - ↪ VPN (Virtual Private Network) services.
 - ↪ Many server features have been deprecated in recent years.
- VMware ESXi:
 - ↪ Hypervisor-based operating system used for virtualization.
 - ↪ Primarily for virtualizing server infrastructure.

Includes networking features such as:

 - ↪ Virtual switches, VLAN support, Network traffic management.

Introduction

- NetWare:

- ↪ Legacy network operating system developed by Novell.

Used for functions such as:

- ↪ File and print services.

- ↪ Directory services.

- ↪ Usage has declined over the years but may still be present in some organizations.???

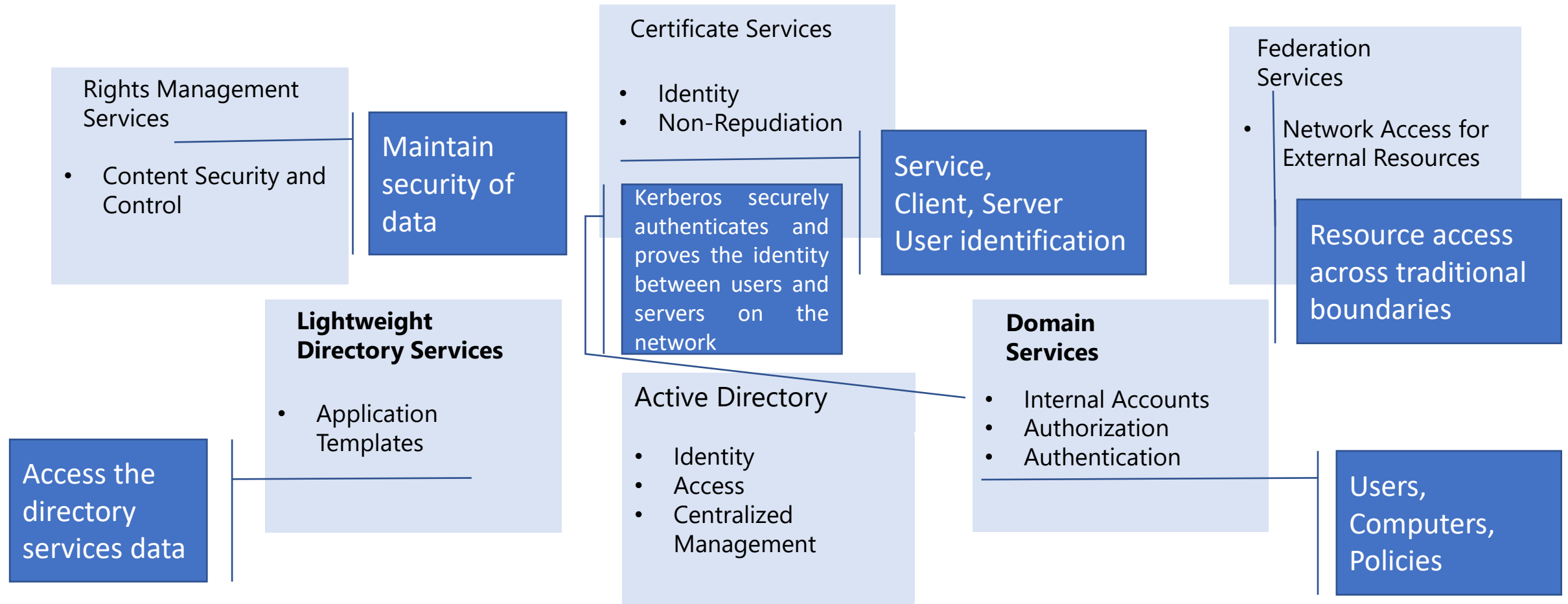
Active Directory: Introduction

- **Active Directory (AD)** is a directory service developed by Microsoft for managing network resources in a Windows environment.
- It provides a centralized repository for storing information about objects such as **users, computers, groups, and resources** within a network.
- AD uses a **hierarchical structure** called a **domain**, which organizes objects into logical containers for easier management.
- Domains can be further organized into **trees and forests**, forming a hierarchical namespace that reflects the organization's structure.
- The primary function of AD is to **authenticate and authorize users** and computers to access network resources.
- AD integrates with other Windows services such as **DNS** (Domain Name System) and **DHCP** (Dynamic Host Configuration Protocol) to provide a comprehensive networking solution.

Active Directory: Introduction

- It supports features such as **group policy management**, which allows administrators to **enforce security settings and configurations** across multiple devices.
- AD enables **single sign-on (SSO)**, allowing users to access multiple resources with a single set of credentials.
- Overall, there are three main operations
 - ↪ One is to **manage identity** of the resources on the network.
 - ↪ Two is to **facilitate access** to and for the resources on a network.
 - ↪ The Third is to **Centrally manage** the network.

Active Directory: Introduction



Active Directory: Domain Services

- Active Directory Domain Services: A directory service is the combination of the directory information source & the service that the information offers.
 - ↪ which in turn makes the resources available and usable
 - ↪ Typical/ Old School Example: A phone book...
- The Network Management (for managing user and group accounts) could be achieved
 - ↪ in a Single location
 - ↪ With a set of tools
- Capable of
 - ↪ assigning access to shared network resources
 - ↪ Directory service for AD DS enabled applications
 - ↪ Configuring security policies to all users and computers
 - ↪ Group policies to manage user desktops and security settings

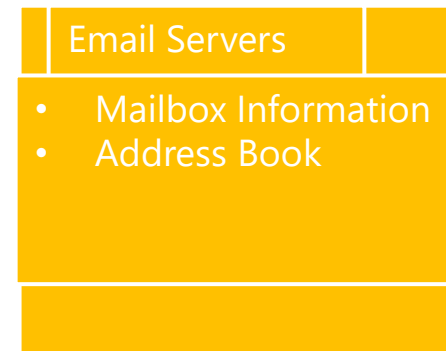
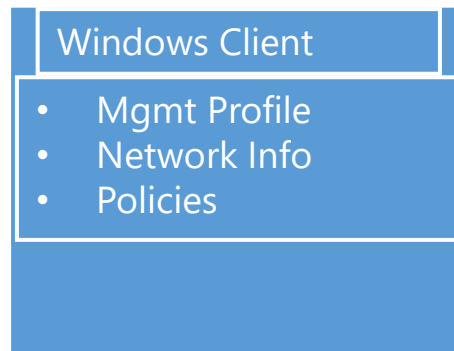
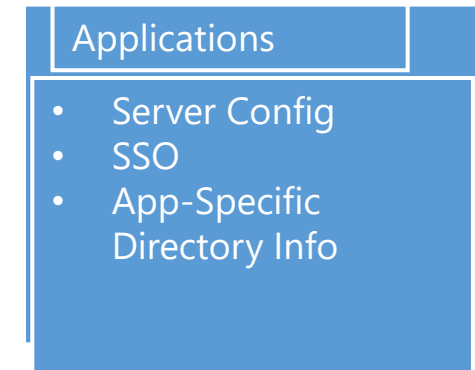
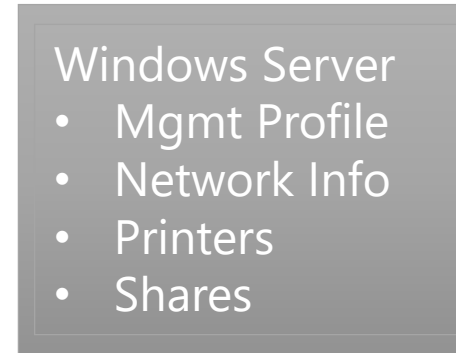
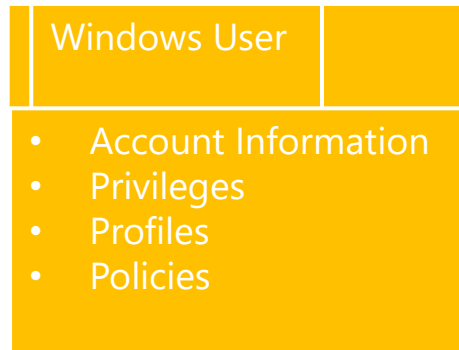
Active Directory: Domain Services

- Centralized directory
- Single sign-on access
- Integrated security

Active Directory Domain Services

- **Manageability**
- **Security**
- **Interoperability**

- Scalability
- Common management interface

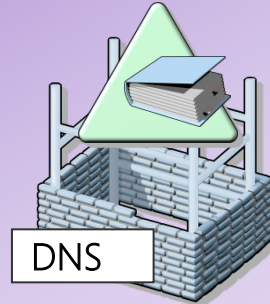


Active Directory: Domain Services

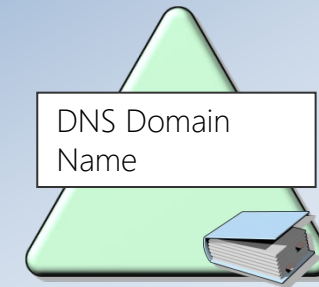
- Scalable, secure, and manageable infrastructure for user and resource management
 - ↪ stores and manages information about network resources
 - ↪ provides support for directory-enabled applications such as Microsoft® Exchange Server
 - ↪ allows for centralized management
- LDAP is used to access the directory services data (like Active Directory, OpenLDAP etc)
- Kerberos securely authenticates and proves the identity between users and servers on the network
- DNS translates the Domain names into IP Addresses.

Active Directory: Domain Services

- AD DS requires a DNS infrastructure

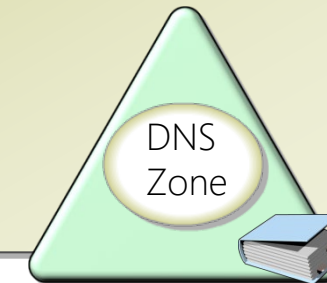


- AD DS domain names must be DNS domain names



- AD DS domain controller records must be registered in DNS to enable other domain controllers and client computers to locate the domain controllers

- DNS zones can be stored in AD DS as Active Directory integrated zones



Active Directory: Domain Services

○ Physical Components

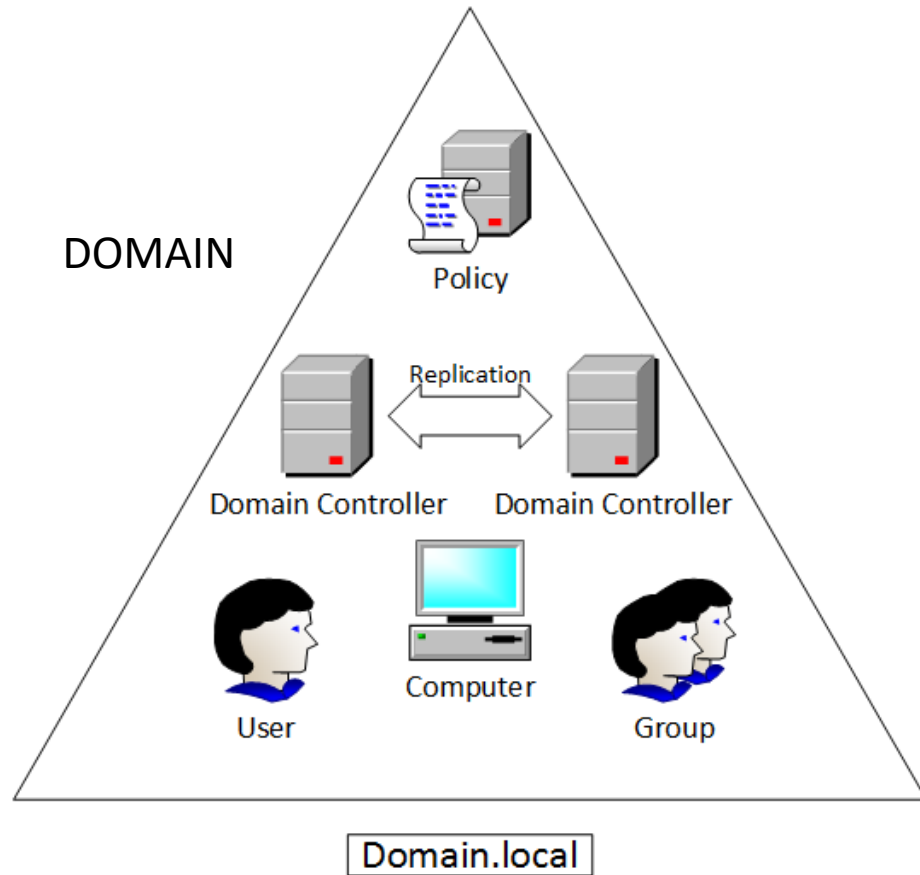
- ↪ Data store
- ↪ Domain controllers
- ↪ Global catalog server
- ↪ Read-Only Domain Controller (RODC)

○ Logical Components

- ↪ Partitions and Schema
- ↪ Domains and Domain trees
- ↪ Forests and Sites
- ↪ Organizational units (OUs)

Active Directory: Domain Services

- **Domain Controller** *A domain controller is a server with the AD DS server role installed that has specifically been promoted to a domain controller*
 - ↪ Host a copy of the AD DS directory store
 - ↪ Provide authentication and authorization services
 - ↪ Replicate updates to other domain controllers in the domain and forest
 - ↪ Allow administrative access to manage user accounts and network resources
- ↪ The AD DS data store contains the database files and processes that store and manage directory information for users, services, and applications



- Domains are used to group and manage objects in an organization
 - ↪ An administrative boundary for applying policies to groups of objects
 - ↪ A replication boundary for replicating data between domain controllers
 - ↪ An authentication and authorization boundary that provides a way to limit the scope of access to resources

- **A domain tree is a hierarchy of domains in AD DS**
 - ↪ Share a contiguous namespace with the parent domain
 - ↪ Can have additional child domains
 - ↪ By default, create a two-way transitive trust with other domains

- **A forest is a collection of one or more domain trees**
 - ↪ Share a common schema
 - ↪ Share a common configuration partition
 - ↪ Share a common global catalog to enable searching
 - ↪ Enable trusts between all domains in the forest
 - ↪ Share the Enterprise Admins and Schema Admins groups

TREE

AD-DS: Lightweight Directory Services

Active Directory LD Services

- Manageability
- Security
- Interoperability

Windows User

- Account Information
- Privileges
- Profiles
- Policies

Application

- Server Config
- SSO
- App-Specific Directory Info

Network Devices

- Config
- QoS Policy
- Security Policy

Email Servers

- Mailbox Information
- Address Book

- AD LDS is a **hierarchical file-based directory store**
- AD LDS is both the **directory information source** and the **service that makes the information available and usable**



Active Directory: Authentication & Authorization

- Authentication: **Verification – Local vs Network**
- Authorization: The authenticated user's permission to execute the required task.
 - **SECURITY IDENTIFIER (SID)**
 - **ACCESS CONTROL LIST (ACL)**
 - ↪ A discretionary access control list (DACL) identifies the security principals that are allowed or denied access to an object.
 - ↪ When a person or process tries to access an object, the system checks the ACEs in the object's DACL to determine whether to grant access to it.
 - ↪ If the object does not have a DACL, the system grants full access to everyone.
 - ↪ If the object's DACL has no ACEs, the system denies all attempts to access the object because the DACL does not allow any access rights.

Active Directory: Authentication & Authorization

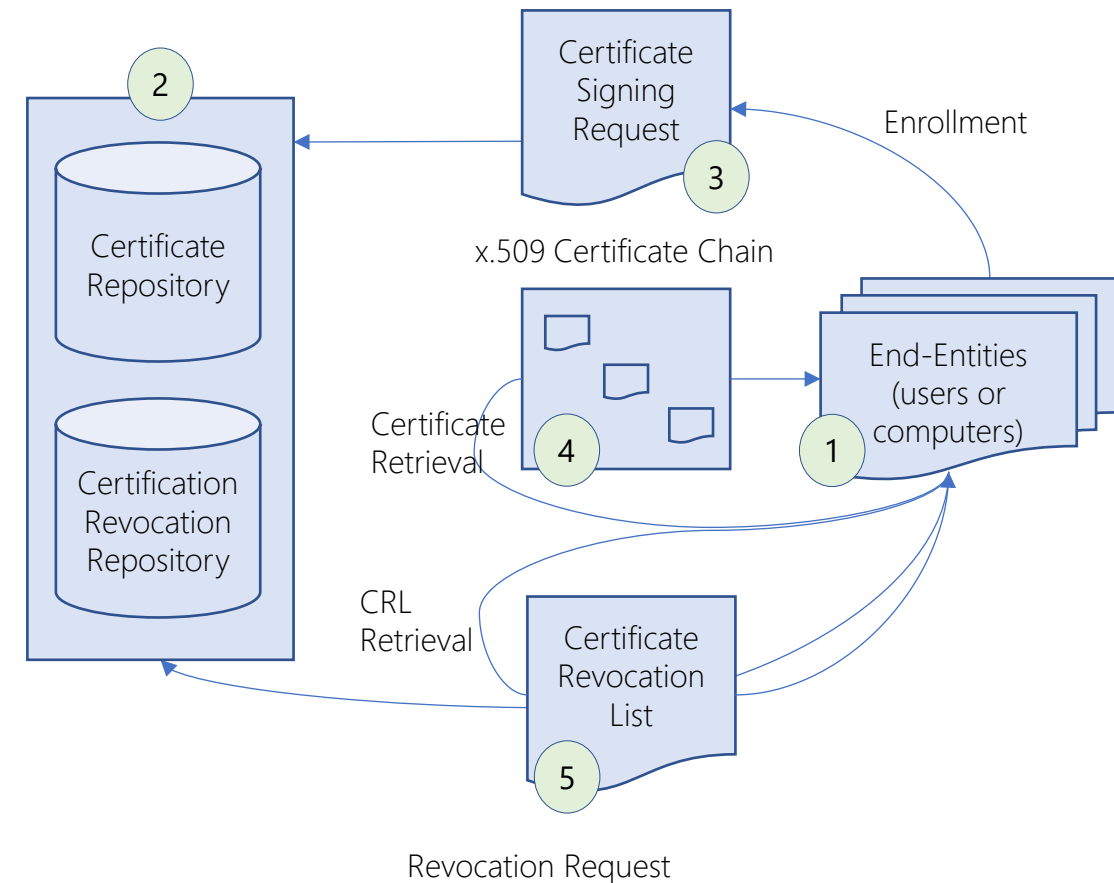
- Authentication: **Verification – Local vs Network**
- Authorization: The authenticated user's permission to execute the required task.
 - **SECURITY IDENTIFIER (SID)**
 - **ACCESS CONTROL LIST (ACL)**
 - ↪ A system access control list (SACL) enables administrators to log attempts to access a secured object.
 - ↪ Each ACE specifies the types of access attempts by a specified principal that cause the system to generate a record in the security event log. An ACE in a SACL can generate audit records when an access attempt fails, when it succeeds, or both.

Active Directory: Domain Services

- **OUs are Active Directory containers that can contain users, groups, computers, and other OU's**
 - ↪ Represent your organization hierarchically and logically
 - ↪ Manage a collection of objects in a consistent way
 - ↪ Delegate permissions to administer groups of objects
 - ↪ Apply policies
- **Active Directory is managed by the Microsoft Management Console (mmc.exe)**
 - ↪ Active Directory Administrative Center (dsac.exe)
 - ↪ Active Directory Users and Computers (dsa.msc)
 - ↪ Active Directory Domains and Trusts (domain.msc)
 - ↪ Active Directory Sites and Services (dssite.msc)
 - ↪ Active Directory module for Windows Powershell

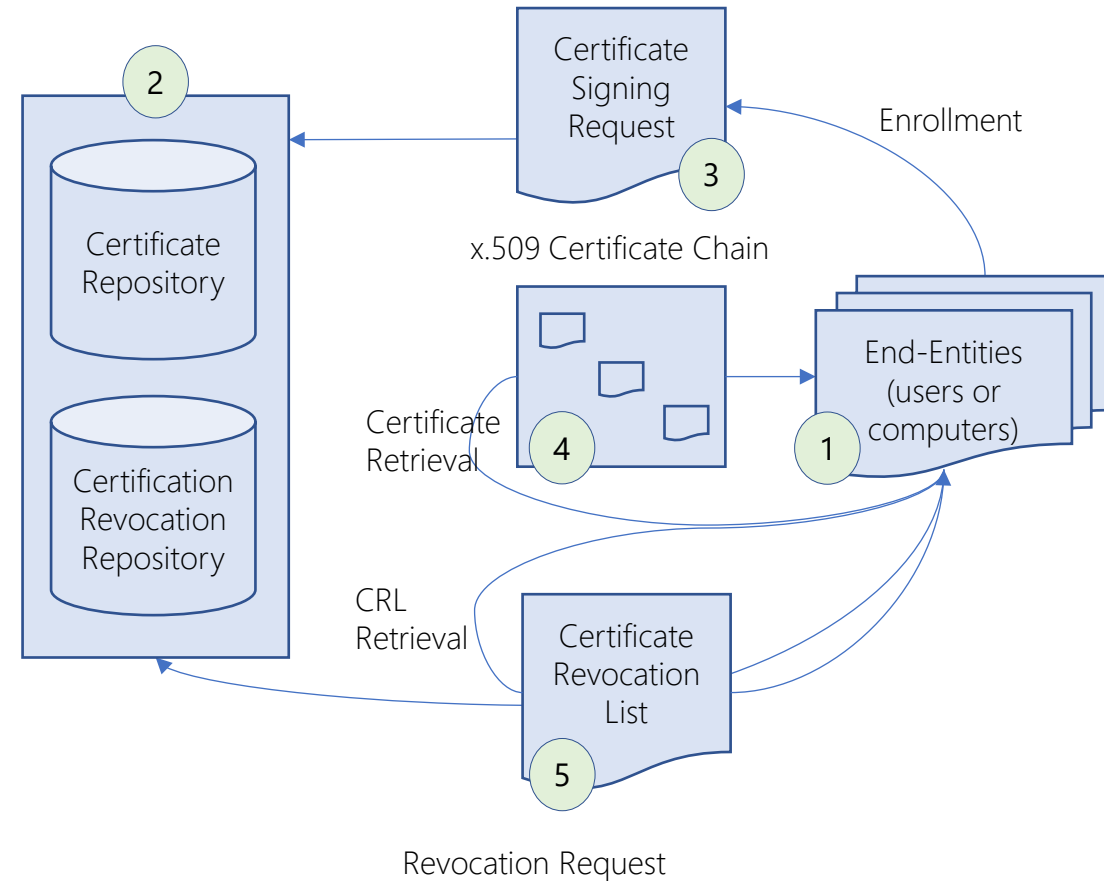
Active Directory: Certificate Services

- AD CS is the Microsoft implementation of Public Key Infrastructure (PKI)
- PKI is a set of hardware, software, people, policies, and procedures needed to create, manage, distribute, use, store, and revoke digital certificates
- **AD CS provides customizable services for issuing and managing digital certificates**
 - ┌ Certification authorities (CAs) CAs issue certificates to users, computers, and services, and manage certificate validity
 - ┌ CA Web enrollment Web enrollment allows users to connect to a CA by means of a Web browser in order to request certificates and retrieve certificate revocation lists (CRLs)
 - ┌ Online Responder The Online Responder service sends a signed response containing requested certificate status information to clients



Active Directory: Certificate Services

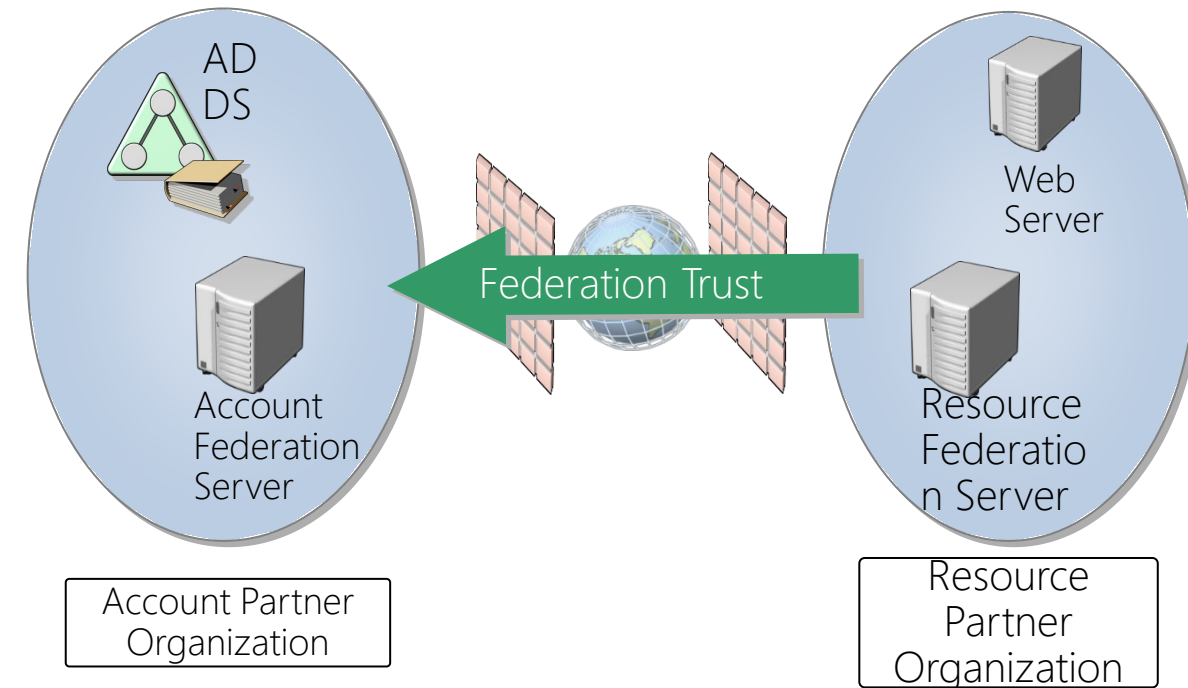
- AD CS is the Microsoft implementation of Public Key Infrastructure (PKI)
- PKI is a set of hardware, software, people, policies, and procedures needed to create, manage, distribute, use, store, and revoke digital certificates
- **AD CS provides customizable services for issuing and managing digital certificates**
 - ✦ Network Device Enrollment Service The Network Device Enrollment Service allows network devices to obtain certificates when they don't have domain accounts
 - ✦ Certificate Enrollment Web Service The Certificate Enrollment Web Service allows for certificate enrollment by users and computers using SSL to enables policy-based certificate enrollment for disconnected or non-domain-joined computers and users
 - ✦ Certificate Enrollment Policy Web Service Delivers certificate enrollment policy information to computers and users to enable the Certificate Enrollment Web Service



Active Directory: Federation Services

Software Component that facilitates the cross-organizational access of systems and applications

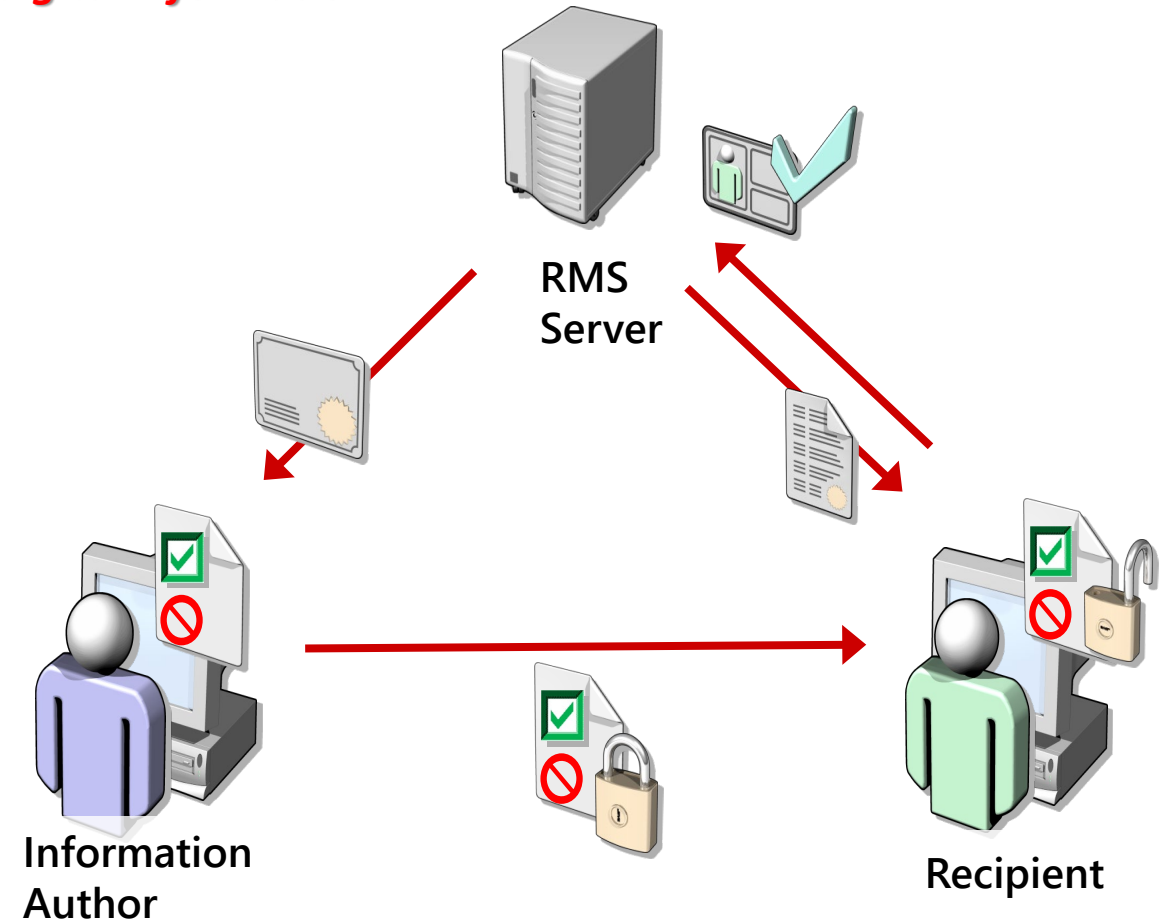
- The AD FS server role provides simplified, secured identity federation and Web single sign-on (SSO) capabilities.
 - ↪ enables the creation of trust relationships between two organizations
 - ↪ provides access to applications between organizations
 - ↪ provides Single Sign-on (SSO) between two different directories for Web-based applications



Active Directory: Rights Mgt Services

Active Directory Rights Management Services (AD RMS) is an information protection technology that works with applications to safeguard digital information

- Allows individuals and administrators to specify access permissions to documents, workbooks, and presentations
 - ┐ prevent sensitive information from being printed, forwarded, or copied by unauthorized people
 - ┐ access and usage restrictions are enforced no matter where the information is located



Summary

- Active Directory
 - **Rights Management Services, Certificate Services, Federation Services**
 - **Lightweight Directory Services, Authentication & Authorization, DNS**
 - **Domain Services**
 - Manageability
 - Security
 - Interoperability
 - Physical and Logical Components
 - **Domain Controller**
 - DOMAINS
 - TREE
 - FOREST
 - OUs are Active Directory containers that can contain users, groups, computers, and other Ous

Any Questions?