# DISTRIBUTED
# SYSTEM
## SERVICES

# ROY  RITTHALER
# SCOTT SNYDER

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## The LAN System



OTHER LAN SYSTEMS

Interoperability

Enterprise

Interoperability

LOCAL LAN SYSTEM
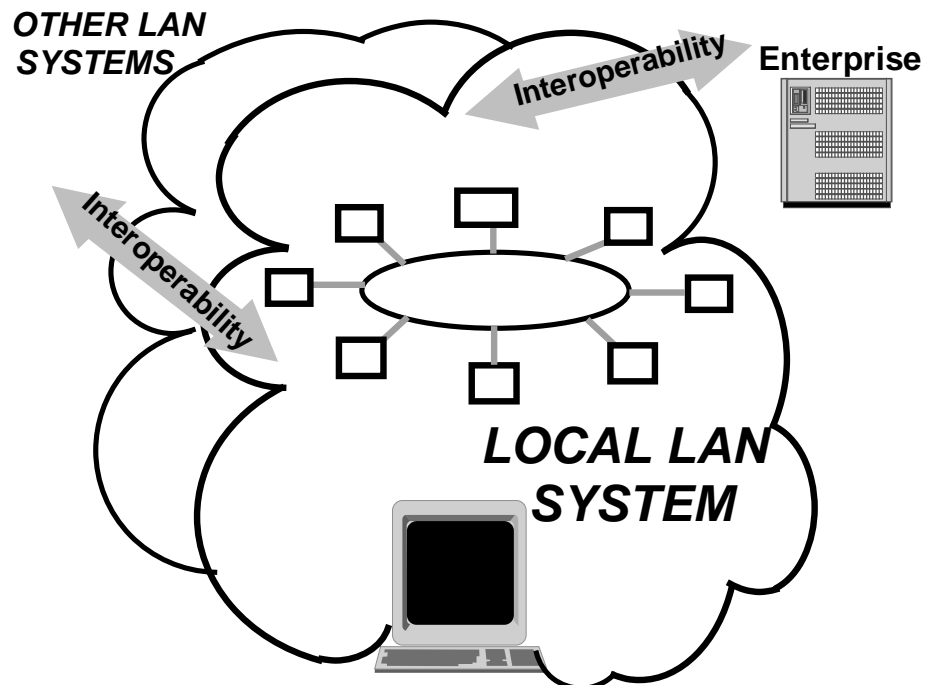
# Distributed System Services

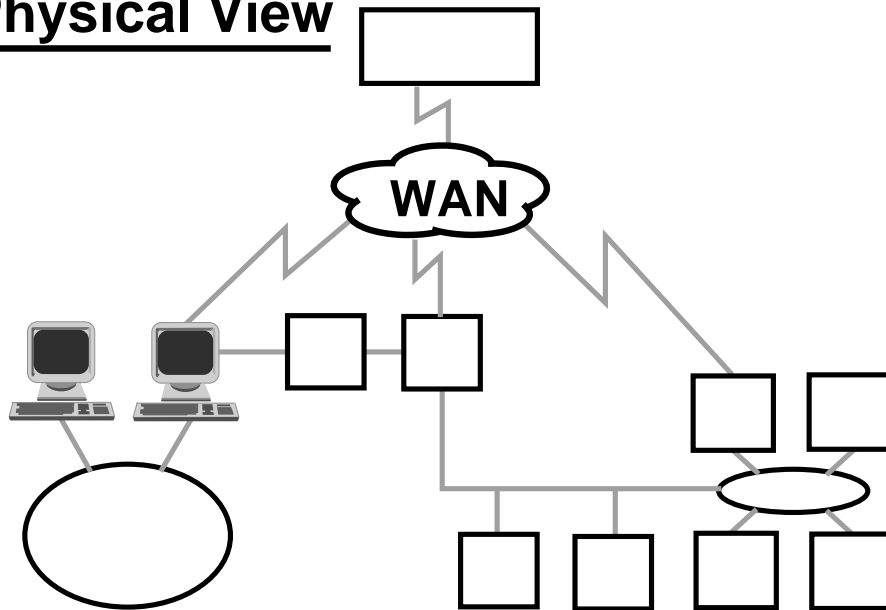## Physical View

WAN

# Distributed System Services

## User's View

Files/Databases

Printers

Applications

Mail Boxes

Users
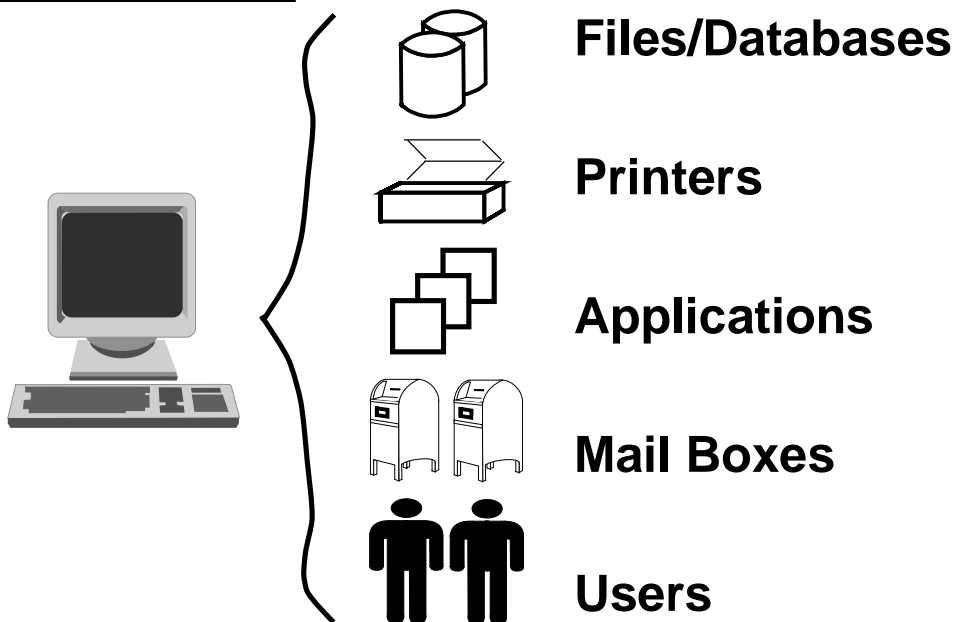
# Distributed System Services

## Administrator View

**Domain/Cell**

**Distributed Services**

**PRINT**

**MAIL**

**FILE**

**DATABASE**

**APP' NS**

**Domain/Cell**

**Domain/Cell**

**Administrative Workstation**
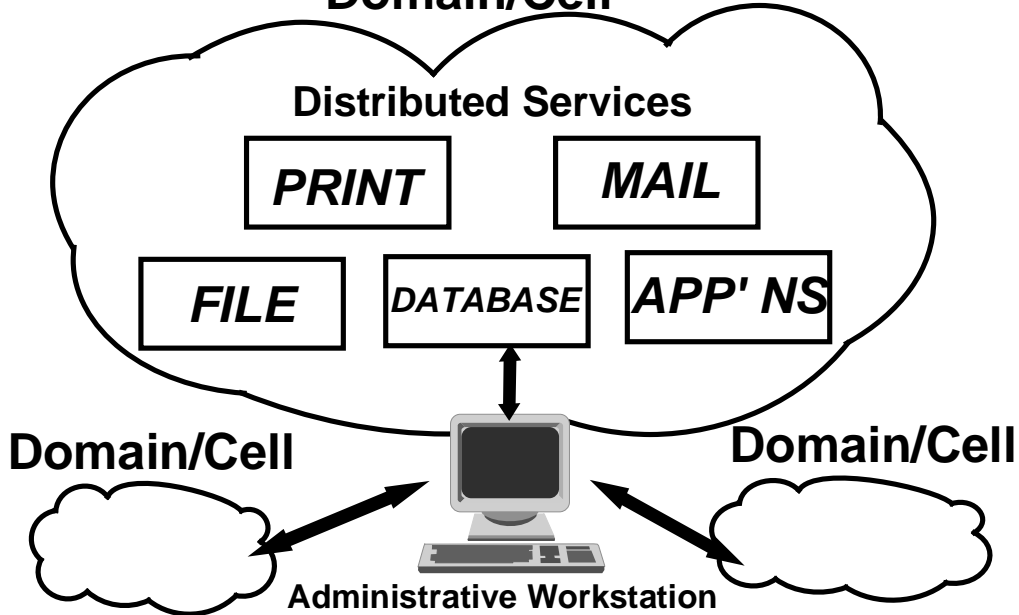
# Distributed System Services

## Developer View

**Distributed Resources**

**Development Environment**

**Application**

**Data**

**APP'n**

**Device**

**Standard Consistent APIs and Access**
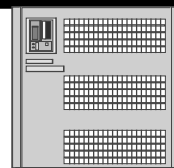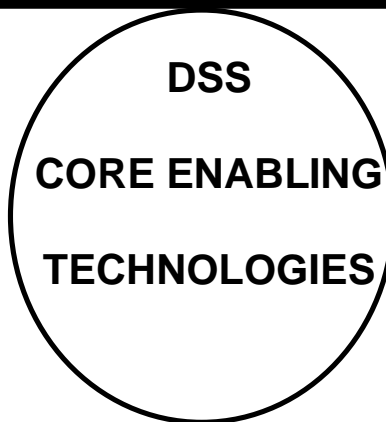
# Distributed System Services

## Distributed System Model

- **Consistent System Image**

- **Location/Network Transparency**

- **Support for Heterogeneity**

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# Distributed System Services



**DSS**

**CORE ENABLING**

**TECHNOLOGIES**

**PC WORKSTATION**

**MAINFRAME**

**MINI**

**PC WORKSTATION**

**Provides: Single View of Resources**
**Uniform and Reliable Access**

**Enables:  Single User Interface**
**System Management**
**Distributed Applications**
**and Resource Managers**

# Benefit Summary of IBM' S DSS

## *User*

- *easier access to enterprise information*
- *data integrity and security*
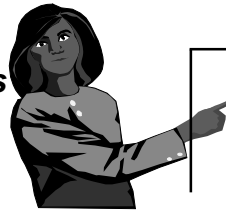- *resource availability*
- *more applications*

## *Programmer*

- *open set of productive tools*
- *hardware and network independence*
- *comprehensive integrated services*

## *Administrator*

- *easy to use administrative tools*
- *global single systems image*
- *seamless growth*

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# Distributed LAN System Strategy

**IBM LEADERSHIP TECHNOLOGY**

**IBM USER INTERFACE**

| IBM RESOURCE MANAGERS | INDUSTRY RESOURCE MANAGERS | SYSTEM MANAGEMENT | DISTRIBUTED APPLICATIONS |
|---|---|---|---|

**DISTRIBUTED SYSTEM SERVICES**

COMMON INDUSTRY BASE ← **IBM EXTENSIONS**

**TRANSPORT INTERFACE**

TRANSPORTS

COMMON IBM WORKSTATION DISTRIBUTED PLATFORM

WIN CLIENT

**OS/2**   **AIX**
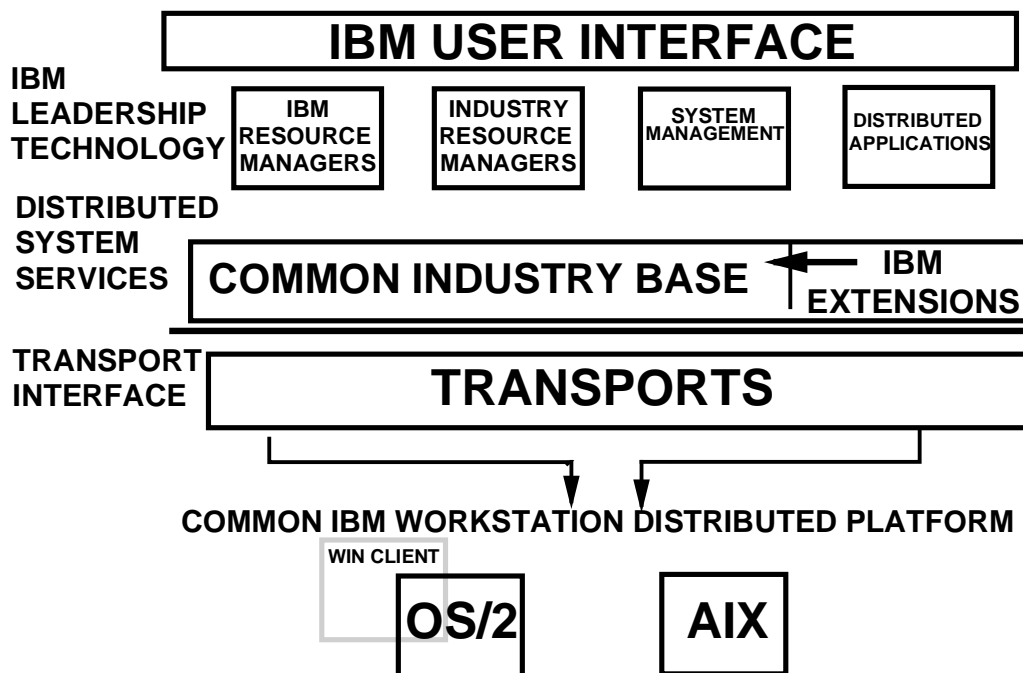
# The Open Software Foundation

## MEMBERS

Ideas, $$$
Source Code
Resources

OSF

Spec. Documents
Source Code
Validation Suites

Members

Non-members
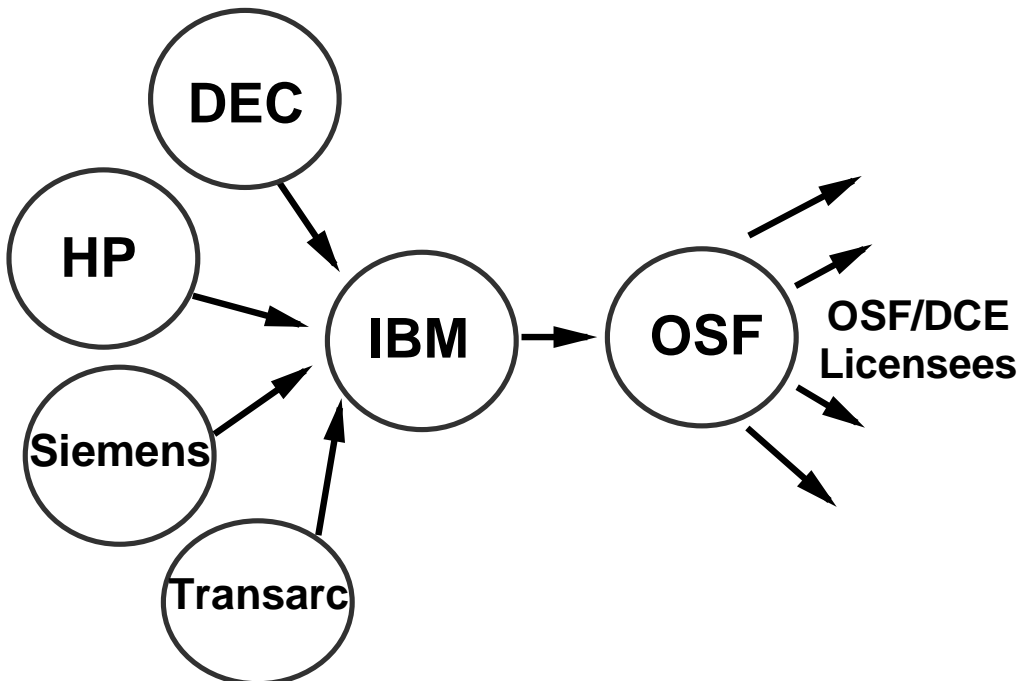
Standard
Organizations

Universities and
Research
Organizations

## NON-MEMBERS

Source Code

---

# OSF DCE Integration Process

DEC

HP

IBM

OSF

OSF/DCE
Licensees

Siemens
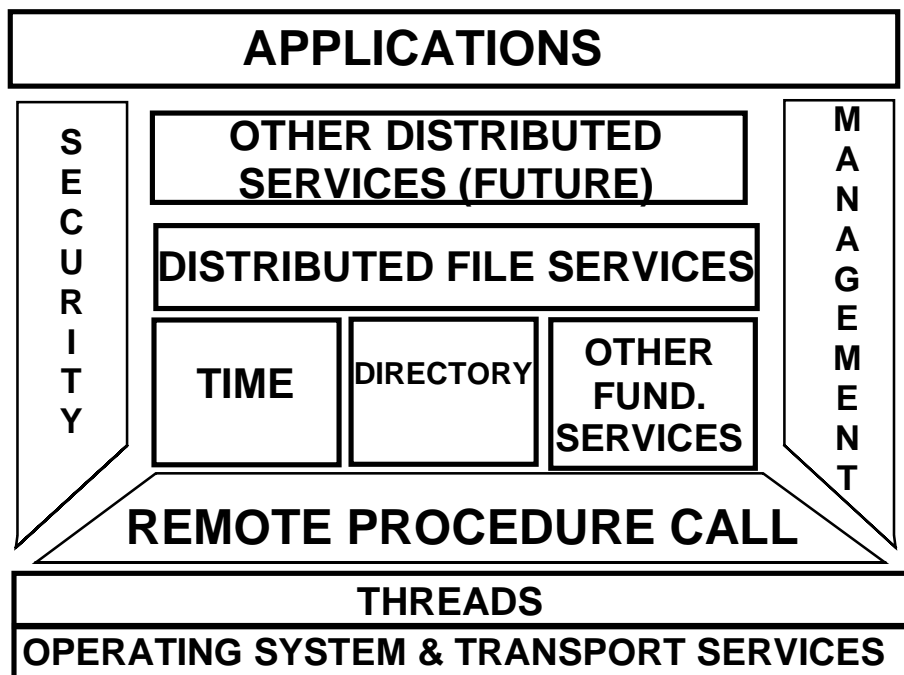
Transarc

# DCE Request for Technology

" A Comprehensive set of Integrated, Modular Technologies to support *Transparent Interworking* and *Resource Sharing* in *Heterogenous, Networked Computing Environments* "

# OSF DCE Architecture

| APPLICATIONS | | |
|---|---|---|

| S E C U R I T Y | OTHER DISTRIBUTED SERVICES (FUTURE) | M A N A G E M E N T |
| | DISTRIBUTED FILE SERVICES | |
| | TIME \| DIRECTORY \| OTHER FUND. SERVICES | |

**REMOTE PROCEDURE CALL**

| THREADS |
|---|
| **OPERATING SYSTEM & TRANSPORT SERVICES** |

# Distributed System Services Structure

**Other Distributed Applications**

**Encina & CICS**

**Distributed File System**

| Cell Directory Service | X.500 Directory Service | Security Service | Time Service |
|---|---|---|---|

**Remote Procedure Call**

**Threads**

**Operating System and Transport Interfaces**

---

# IBM Distributed Systems Strategy

**Applications**

| Database File | Directory |
|---|---|
| | Security |
| | Recovery |
| | Time |
| | ........ |

CPI-C  RPC

| APPC | DCE | FTAM X.400 | ........ |
|---|---|---|---|

**Common Transport Services**

| SNA | TCP/IP | OSI | NETbios | IPX | ....... |
|---|---|---|---|---|---|

**DATALINK**

*\* on MVS/ESA*
*\* on OS/2*
*\* on OS/400*
*\* ON AIX/6000*
*\* on AIX/ESA*

# Distributed System Services

## Remote Procedure Call

| Procedure |
| Application |
| Procedure |

| Procedure |
| Application | Network |
| Procedure |

---

# Distributed System Services

## Remote Procedure Call

- **Familiar Programming Model**
  - ► **Easy to Use**
  - ► **Extensions for Distributed Operations**
- **Application Independence from Communications**
- **Hides Differences in Data Representation**
  - ► **Codes: ASCII<-->EBCDIC**
  - ► **Machines:Intel<-->RS6000<-->S/390**

# Distributed Application Development

## Traditional View

APPLICATION

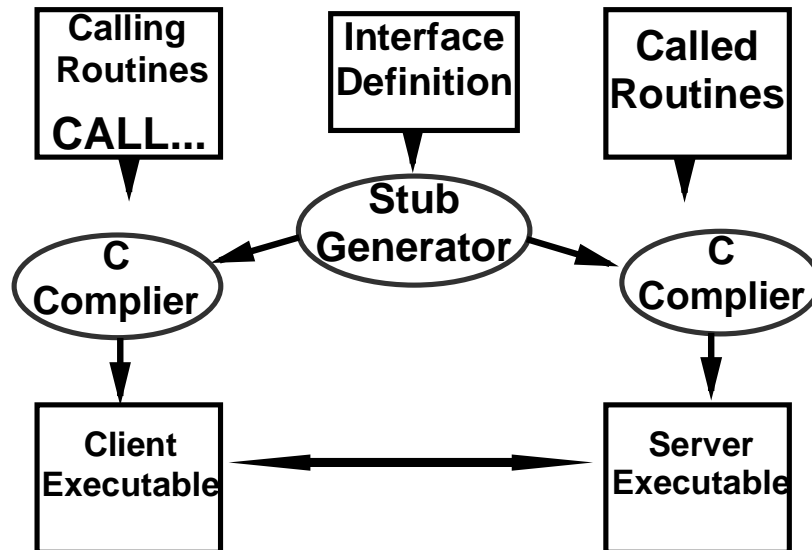COMMUNICATION SUBSYSTEM

APPLICATION

## Modern View

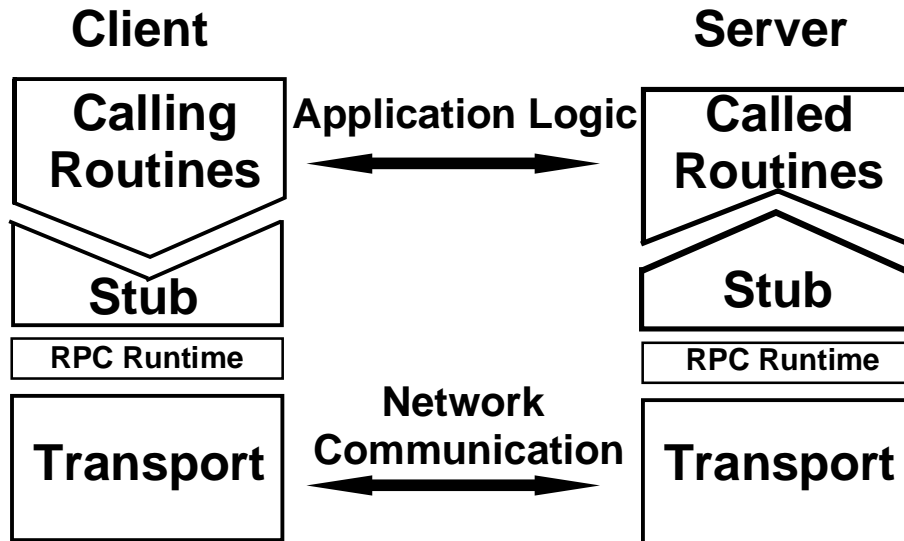APPLICATION

NETWORK OPERATING SYSTEM

COMMUNICATION SUBSYSTEM

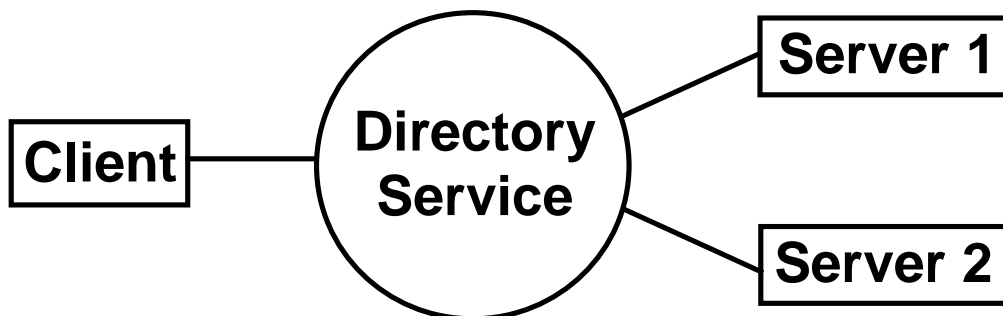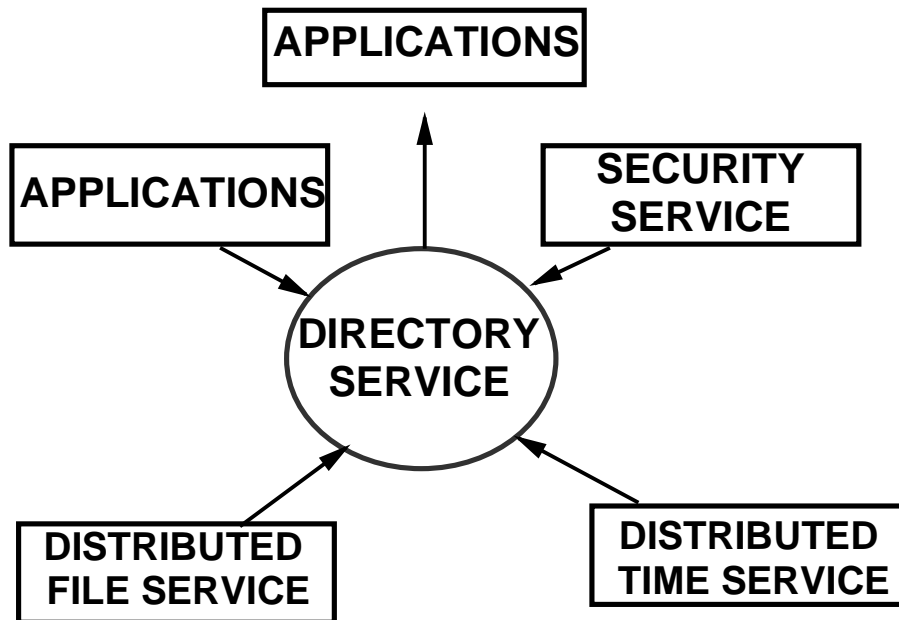NETWORK OPERATING SYSTEM

APPLICATION

# DCE RPC Development

Calling Routines
CALL...

Interface Definition

Called Routines

C Complier

Stub Generator

C Complier

Client Executable

Server Executable

# DCE RPC Development

## Client

**Calling Routines**

**Application Logic** ⟷

**Stub**

| RPC Runtime |

**Transport**

## Server

**Called Routines**

**Stub**

| RPC Runtime |

**Transport**

**Network Communication** ⟷

---

# Distributed System Services

## Directory Services

**Client** — **Directory Service** — **Server 1**

**Server 2**

- **Maintains Information About System Objects**
- **Provides for Location Transparency**

# DCE Directory Services

**APPLICATIONS**

**APPLICATIONS**

**SECURITY SERVICE**

**DIRECTORY SERVICE**

**DISTRIBUTED FILE SERVICE**

**DISTRIBUTED TIME SERVICE**

# DCE Directory Example

## Administrative Cell

**CELL ROOT**

**CELL DIRECTORY SERVICE**

**FS**

**AUTH**

**SRC**     **DCE**

**DISTRIBUTED FILE SYSTEM**

**Other Objects**

**SECURITY SYSTEM**

# DCE Directory Example

## GLOBAL NAMESPACE

**GLOBAL DIRECTORY SERVICE**

**GLOBAL ROOT**

C=US

O = OSF

C=UK

O = IBM

L=CAMBRIDGE

L=AUSTIN

CELL     CELL     CELL     CELL

---
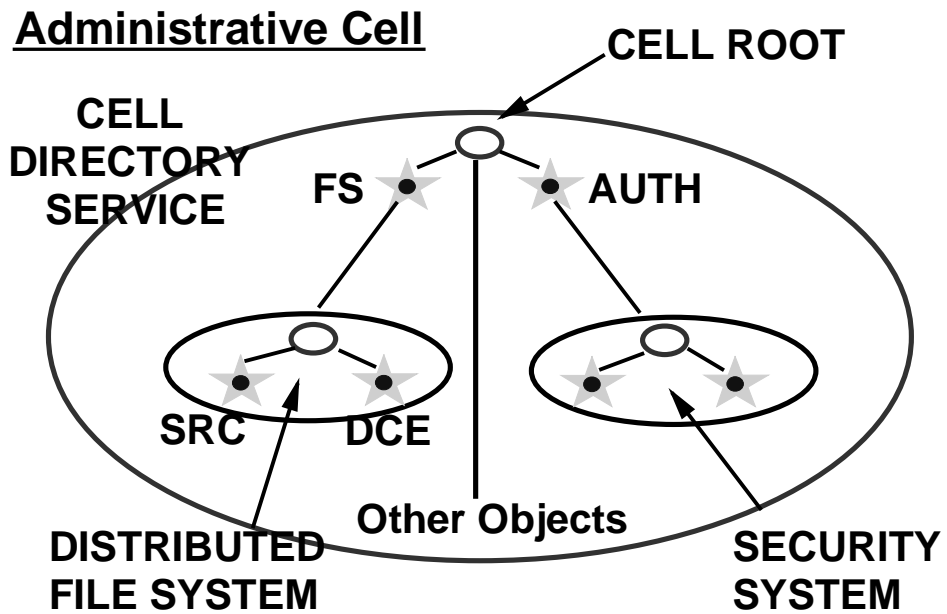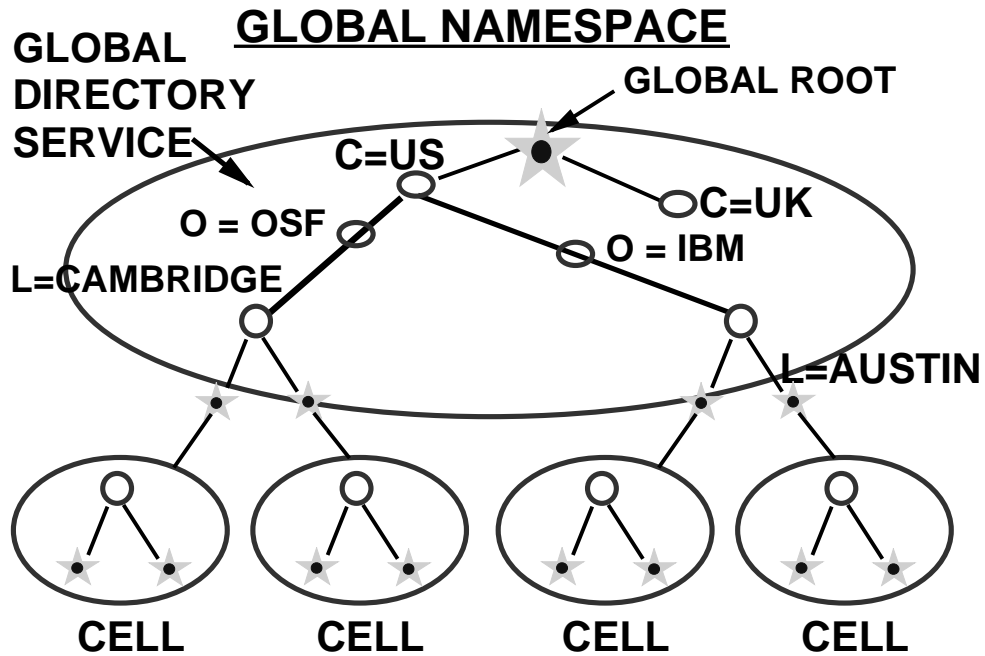
# Directory Programming Interfaces

## TWO APIS AVAILABLE
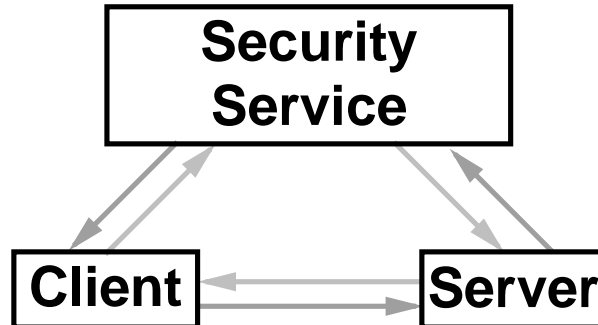
| NSI | XDS |
|-----|-----|

- **More specialized interface**
- **Provides access to binding info. held in the CDS namespace**

- **General directory service**
- **Provides full access to CDS and GDS namespaces**
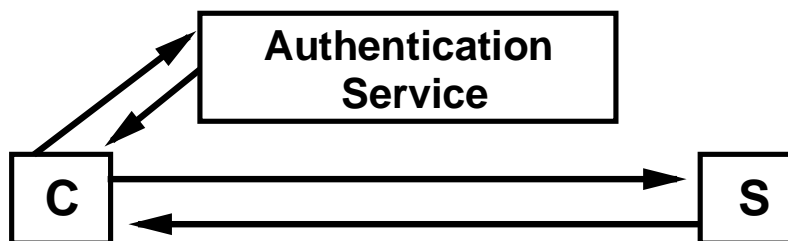
# Distributed System Services

## Security

**Security Service**

**Client** **Server**

- **Securely Identify Users and Servers**
- **Guarantee Integrity/Privacy of Communications**
- **Control Access to Resources**

---

# Security Service

**Authentication - Trusted Third Party**

**Authentication Service**

**C** **S**

1) **Client requests authentication ticket**
2) **Trusted third party provides ticket**
3) **Client passes unopened ticket to server**
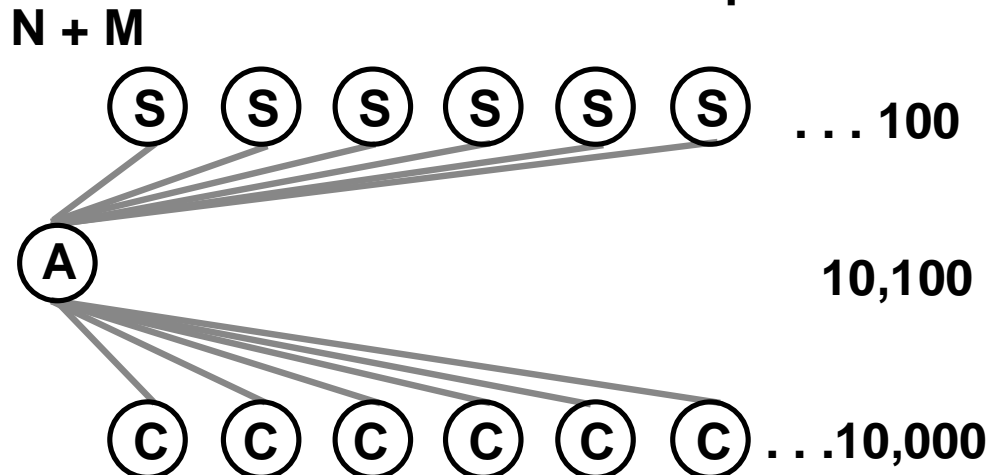4) **Server provides access to requested service**

# Security Service
# Third-Party Authentication

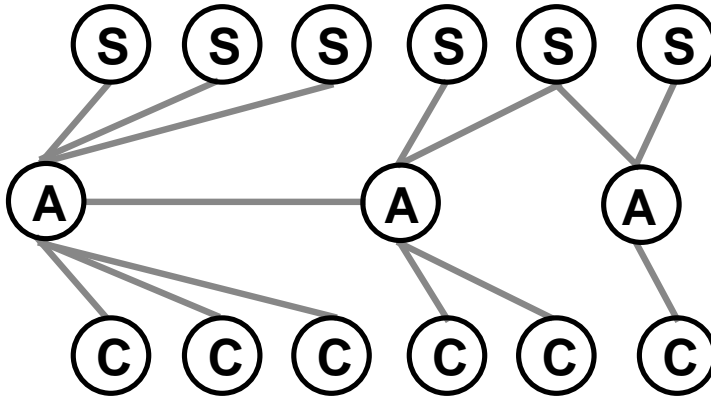## Two-Party: Relationships, Passwords, Administration Operations

**S** **S** **S** **S** **S** **S** . . .100

**NxM** **1,000,000**

**C** **C** **C** **C** **C** **C** . . . 10,000

---
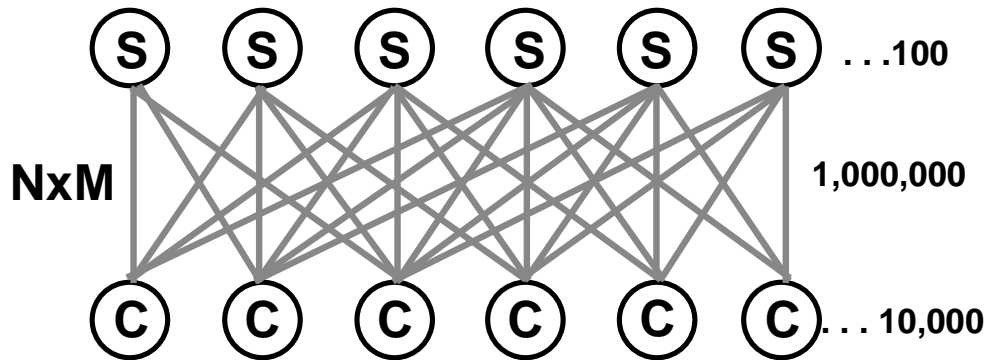
# Security Service
# Third-Party Authentication

## Three-Party: Relationships, Passwords, Administration Operations

**N + M**

**S** **S** **S** **S** **S** **S** . . . 100

**A** **10,100**

**C** **C** **C** **C** **C** **C** . . .10,000

# Security Service
# Third Party Authentication

## Three-Party: Delegated Administration, Autonomous Domains



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# Security Service

user X
open file y

Verify X & password

OK

Can X open File Y?

Yes

**Authentication**  **Authorization**