CSCI 5105

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Today

- Structured Naming
  - LAN environment: NFS
  - WAN environment: DNS

Structured Naming

- Structural organization of names
  - Names are not independent
  - Names are related to each other
  - E.g.: file names, URLs

Name Space

- Typically hierarchical
  - Can be trees, acyclic graphs, etc.
  - E.g.: file systems, DNS
- Name types:
  - Global name: Name that can be used anywhere in the system
  - Local name: Name that requires context
  - Alias: Another name for an entity

Name Space Implementation

- Name space for a distributed system is itself distributed
  - Consists of multiple name servers
  - Each is responsible for one part of the name space
- Questions:
  - How to partition the name space?
  - How to provide good performance?

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Name Resolution

- Converting names to addresses
- Names are distributed
  - How do we locate appropriate name server?
- Closure mechanism: Selecting an initial node in the name space to start name resolution
- Two approaches:
  - Iterative
  - Recursive

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LAN Environment

- Fewer, tightly-coupled machines
- Low latency, homogeneous network
- E.g.: NFS

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NFS: Name Space

- Very similar to Unix file system
  - Files, links, directories
- File operations carried out using file handles
  - Similar to inodes
  - Each file has a unique system-wide file handle
- File operations performed at the server
  - Client caching allowed

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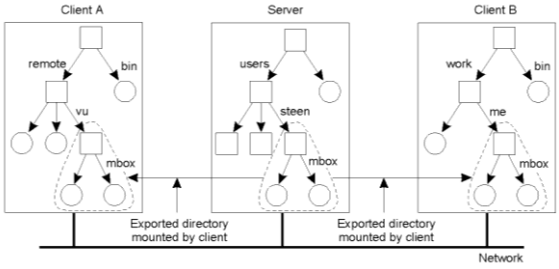
Name Space Implementation

- Servers export directories from local FS
- Clients mount remote directories within local FS



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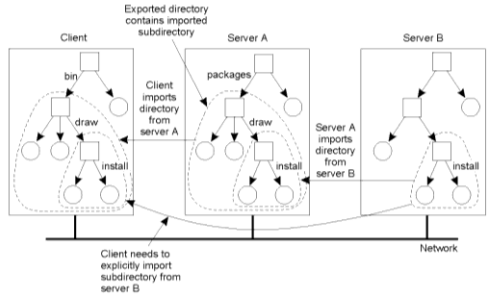
Crossing Mount Points

- A mounted remote directory is not exported



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Name Resolution

- NFSv3: Iterative
  - Client responsible for resolving each component of the path name
- NFSv4: Recursive
  - Server can resolve whole path name

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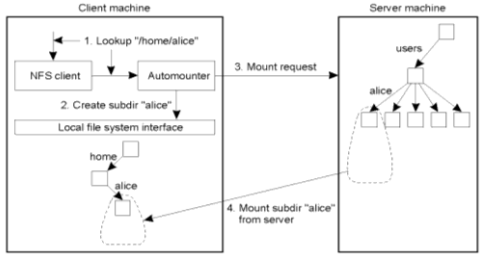
Automounting

- When and what to mount?
- Automounting: Mounting-on-demand



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WAN environment

- Many geographically distributed nodes
- Heterogeneous environment
- Large latencies, different node capabilities
- E.g.: DNS

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Hierarchical Name Space Distribution

- Global layer: Root and its children
  - Organizations and groups of organizations
  - Relatively stable and long-lived
- Administration layer
  - Intra-Organization nodes
  - Departments, users, servers, etc.
- Managerial layer
  - Low-level nodes
  - Local hosts, filenames, usernames, etc.
  - Short-lived and frequently updated

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Name Space Implementation

- Consists of multiple name servers
- Zone: part of name space maintained by a single name server
- Distribution of names is done hierarchically
  - Different layer for different levels in the hierarchy

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Domain Name System (DNS)

- Used for Internet host names
- Domain:
  - Subtree in the hostname space
  - Domain name: path to domain root
- Each DNS name server contains resource records
  - Name server address
  - Host IP address
  - Mail server address
  - Other information

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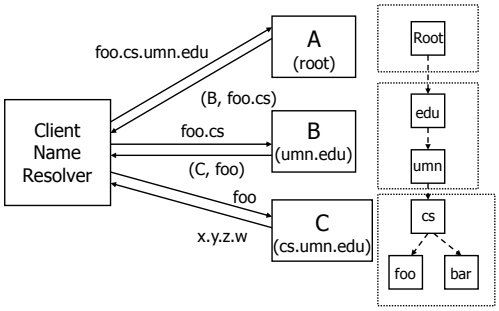
Iterative Name Resolution



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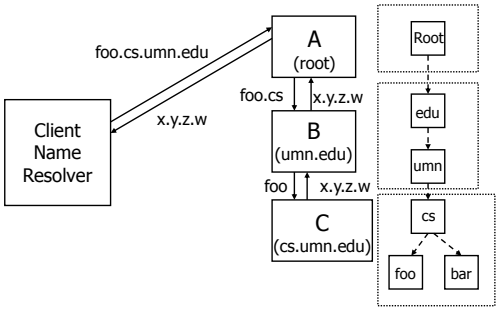
Recursive Name Resolution



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Example DNS Entry

Name	Record type	Record value
cs.vu.nl	SOA	star (1999121502,7200,3600,2419200,86400)
cs.vu.nl	NS	star.cs.vu.nl
cs.vu.nl	NS	top.cs.vu.nl
cs.vu.nl	NS	solo.cs.vu.nl
cs.vu.nl	TXT	"Vrije Universiteit - Math. & Comp. Sc."
cs.vu.nl	MX	1 zephyr.cs.vu.nl
cs.vu.nl	MX	2 tornado.cs.vu.nl
cs.vu.nl	MX	3 star.cs.vu.nl
star.cs.vu.nl	HINFO	Sun Unix
star.cs.vu.nl	MX	1 star.cs.vu.nl
star.cs.vu.nl	MX	10 zephyr.cs.vu.nl
star.cs.vu.nl	A	130.37.24.6
star.cs.vu.nl	A	192.31.231.42
zephyr.cs.vu.nl	HINFO	Sun Unix
zephyr.cs.vu.nl	MX	1 zephyr.cs.vu.nl
zephyr.cs.vu.nl	MX	2 tornado.cs.vu.nl
zephyr.cs.vu.nl	A	192.31.231.66
www.cs.vu.nl	CNAME	soling.cs.vu.nl
ftp.cs.vu.nl	CNAME	soling.cs.vu.nl
soling.cs.vu.nl	HINFO	Sun Unix
soling.cs.vu.nl	MX	1 soling.cs.vu.nl
soling.cs.vu.nl	MX	10 zephyr.cs.vu.nl
soling.cs.vu.nl	A	130.37.24.11
laser.cs.vu.nl	HINFO	PC MS-DOS
laser.cs.vu.nl	A	130.37.30.32
vucs-das.cs.vu.nl	PTR	0.26.37.130.in-addr.arpa
vucs-das.cs.vu.nl	A	130.37.26.0

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DNS Implementation

- Hierarchical layer-based implementation
- Each zone has a primary name server
  - Updates made at primary server
  - Secondary servers transfer updates from primary
- Uses iterative name resolution
  - Caching at client name resolver

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Decentralized DNS Implementation

- Could use DHT
  - Flatten name space
  - Map each name to a key
- Benefits?
- Limitations?