Example: DCE

- vendor-independent distributed computing environment (OSF 1992)
- integrated set of services and tools (*middleware*)
- organises distributed system into cells of related machines with common administrator

DCE components

component	**imported components**
threads	*none*
remote procedure call (RPC)	threads, name, security
dist. time service (DTS)	threads, RPC, name, security
name, includes:	threads, RPC, name, security
cell directory service (CDS)	
global directory service (GDS)	
global directory agent (GDA)	
security	threads, RPC, DTS, name
dist. file service (DTS)	threads, RPC, DTS, name, security

DCE directory service

- **CDS:** intra-cell naming
- **GDS:** inter-cell naming
  based on X.500 (CCITT & ISO standard)
  also supported is *internet domain name system* (DNS)

DCE implements single, global name space:

<*prefix*> / <*cell name*> / <*local name*>

prefix:	`/...`	global
	`/.:`	local
local name:		UNIX-like

X.500 names

Hierarchy of *type*=*value* specifications separated by `/`

- Country (US, UK, AU, ...) [*Note: US is **not** the root of everything!*]
- OrgType (EDU, COM, GOV, ...)
- OrgName (DEC, UNSW, ASIO, ...)
- Dept (SALES, ADMIN, ENG, ...)
- Person

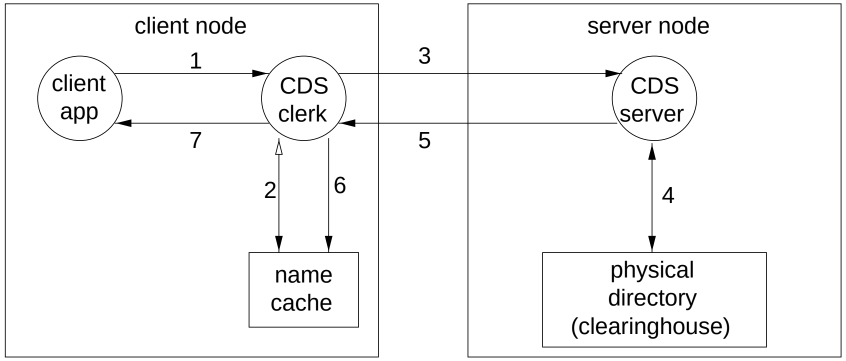
Resulting DCE names:

```
/.../Country=AU/OrgType=EDU/OrgName=UNSW/Dept=CSE/gernot/dir/file
/.../CSE.UNSW.EDU.AU/gernot/dir/file
/.:/gernot/dir/file
```

CDS: DCE intracell naming

- CDS is responsible for naming within a cell
- hierarchical directory of all object names and attributes, incl protection
- directories are replicated: several CDS *servers* per cell
- one CDS *clerk* per node, caches lookups
- clerks find servers by: sysadmin command,
  side effect of (incomplete) name resolution, or
  broadcast
- servers contain part (or all) of directory hierarchy
- every server keeps copy of root directory
- each directory has a *primary copy*, on which all updates are performed
- updates are propagated either immediately or in batch (*skulking*)

CDS name resolution



- partial lookup:
  server may return name of other server to continue lookup

Global name resolution