

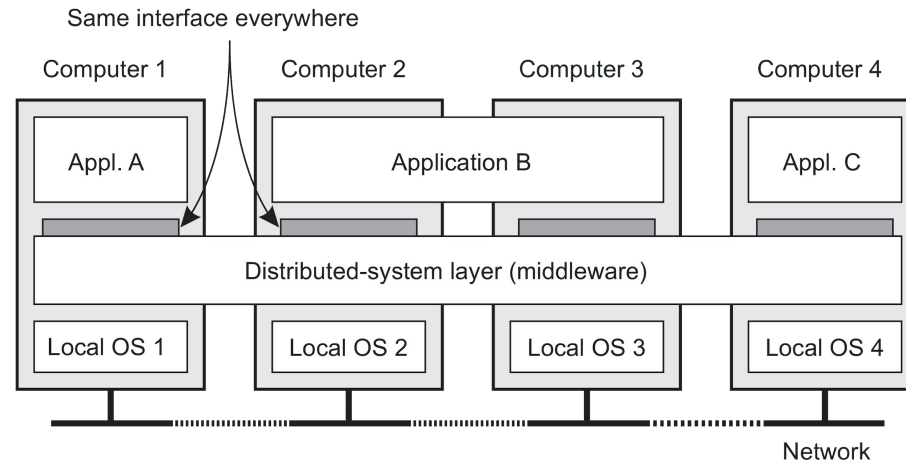
# Distribution Transparency Lab

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# Middleware

- Distributed system often have separate layer of software logically placed on top of operating systems.
- Middleware is to a distributed system what an operating system is to a computer.



# Distribution transparency

- Achieving **distribution transparency** is an important goal of a distributed system.
- Aim is to make the distribution of processes and resources transparent, that is invisible, to users and applications.

Type of transparency	Description
Access transparency	Hide differences in data representation and how an object is accessed.
Location transparency	Hide where an object is located.
Migration transparency	Hide that an object may be moved to another location.
Replication transparency	Hide that an object is replicated.
Concurrency transparency	Hide that an object may be shared by several independent users.
Failure transparency	Hide the failure and recovery of an object.

*Different forms of transparency in a distributed system. An object can be a resource or a process.*

# WebSockets

- Sockets are a fundamental method for performing network communication.
- Sockets are a communication method offered by the operating system.
- They are not a type of middleware and do not offer distribution transparency.
- Many middleware communication methods are build using sockets.

# Port

- An address consists of an (IP address, port number)-pair.
- Each computer has a unique IP address.
- Messages are send to an *end point* called a *port*.
- A port number is a 16-bit entity.
- Of the  $2^{16}$  possible ports, some (0–1023) are reserved for standard services (port number 21 is for FTP).