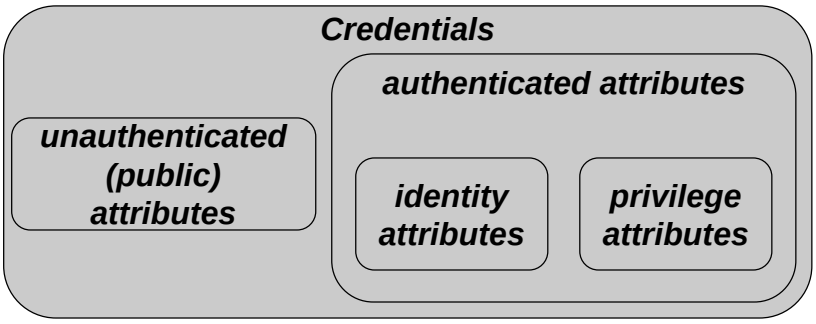
Authentication, Access Control, Auditing and Non-Repudiation

Principals

- ***Humans or system components that are registered in and authentic to a distributed system.***
- ***Principal has an identity used for:***
  - ***Making principal accountable for its actions***
  - ***Obtaining access to a protected component***
  - ***Identifying the originator of a message***
  - ***Identifying who to charge for service provision.***

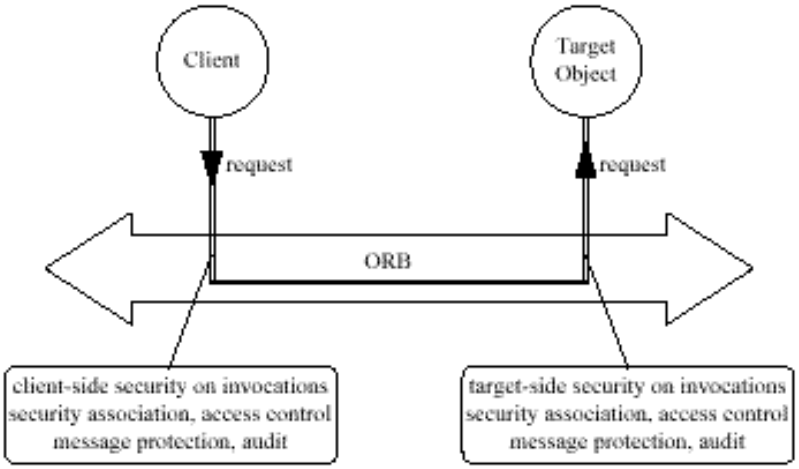
Credentials

- *Information the system has about principals:*



Secure Requests

- *Principals (or objects acting on their behalf) make requests*



What's needed for secure requests?

- *Establishing security association between client & server (authentication)*
- *Deciding whether principal may perform this operation (access control)*
- *Making the principal accountable for having requested the operation (auditing)*
- *Protecting request and response from eavesdropping in transit (encryption)*

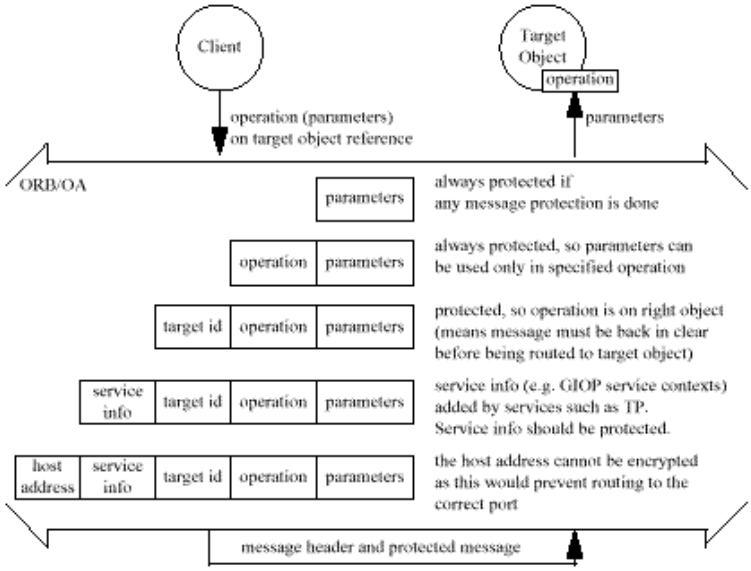
Establishing Security Association

- *Involves*
  - *Establishing trust in one another's identities*
    - *Client authenticating server's identity*
    - *Server authenticating client's identity*
  - *Making client credentials available to server*
  - *Establishing the security context used for protecting requests and replies in transit (e.g. distributing private keys)*

What is Authentication?

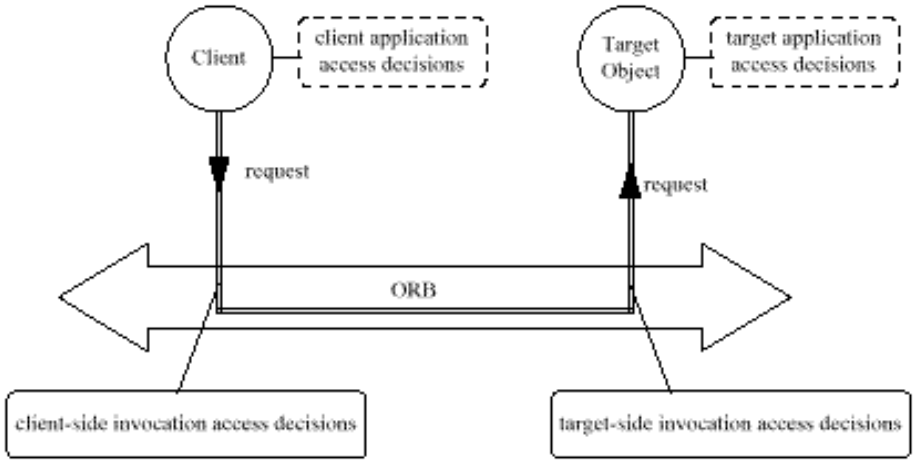
- ***Authentication: Proving you are who you claim to be.***
- ***In centralised systems: Password check at session start.***
- ***In distributed systems:***
  - ***Use of authentication server***
  - ***Usually based on ability to encrypt/decrypt a message (c.f. Needham/Schroeder Protocol)***

Message Protection



Access Control

- *Object invocation access control*
- *Application level access control*



Object Invocation Access Policies

- *Access decision functions enforce object invocation access policies:*
  - *client-side access decision functions and/or*
  - *server-side access decision functions*
- *Decisions are based on*
  - *operation to be performed*
  - *privilege attributes of principal*
  - *control on principal's privilege attributes (e.g. time valid)*
  - *server control attributes*

Application Access Policies

- *In previous case access control is transparent to client and server objects*
- *In this case client and/or server objects implement access control themselves*
- *Application access policies*
  - *can take into account the particular data being accessed*
  - *can take into account the semantics of request parameters*

Access Control Privilege Attributes

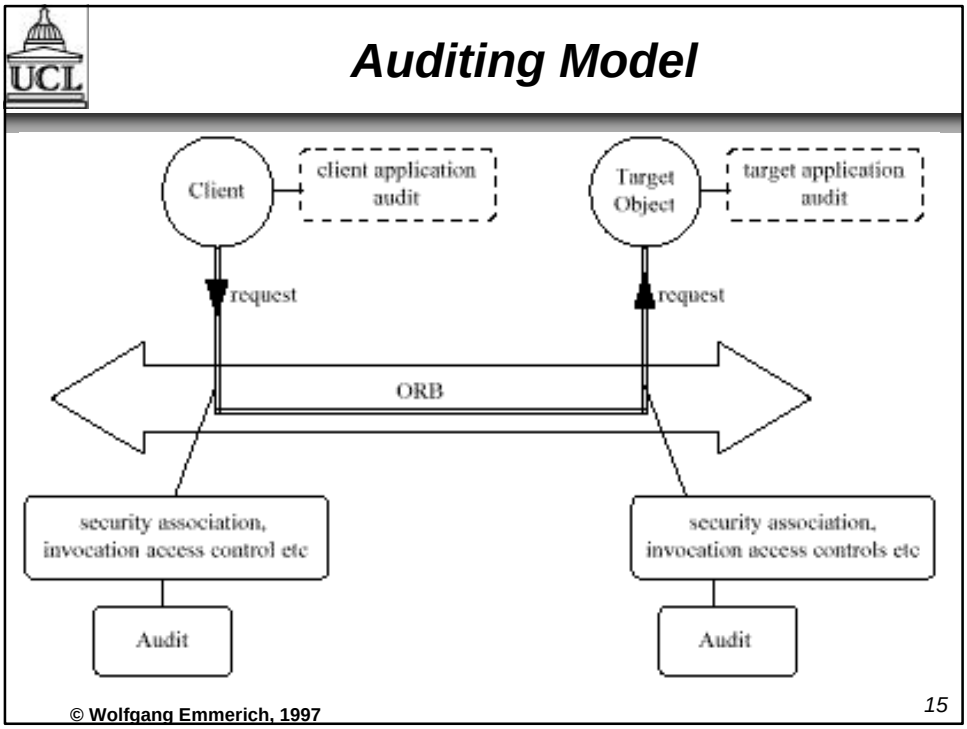
- *Privilege attributes of principals for access control include:*
  - *principal's identity*
  - *roles (related to the principal's job functions)*
  - *groups (related to organizational structure in which principal is embedded)*
  - *security clearance*
  - *capabilities of server objects that the principal is allowed to use*
  - *others...*

Server Control Attributes

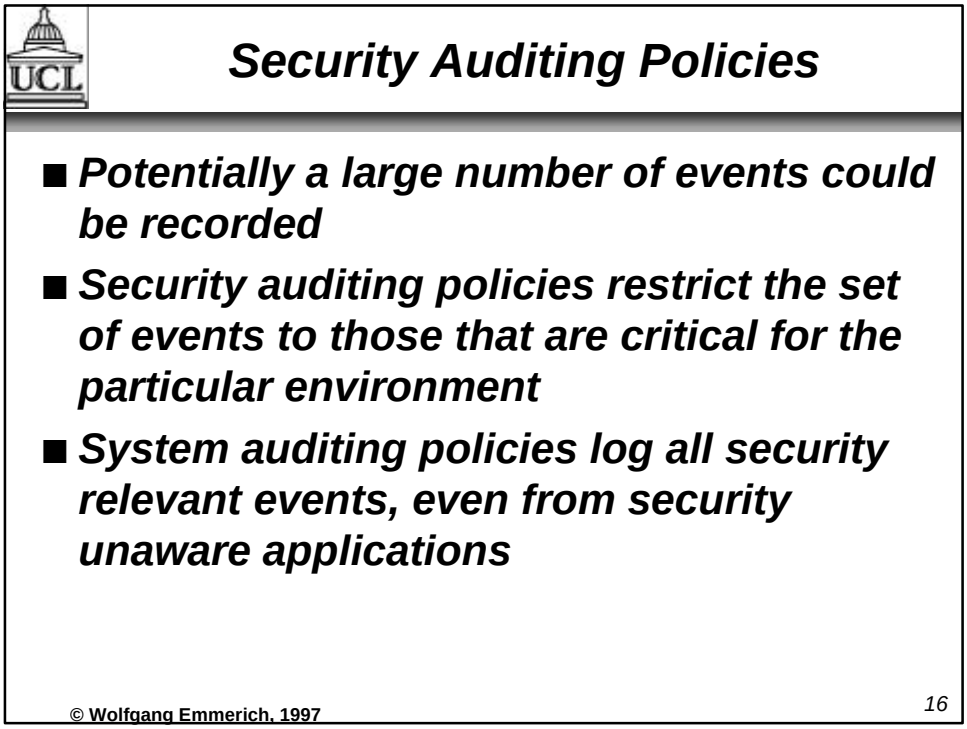
- *Access Control Lists (ACLs) identifying permitted users by*
  - *name or*
  - *privilege attributes*
- *Information for label-based schemes*
- *Control attributes are generally shared by groups of operations of an object or even by groups of objects*

Auditing

- *Assists in detection of attempted or actual security breaches*
- *By recording details of security relevant events*
  - *Writing event details into a log file*
  - *Generating a security alert*
  - *Taking other actions*
- *Two levels of auditing*
  - *system-level*
  - *application-level*



Auditing Model



Security Auditing Policies

- ***Potentially a large number of events could be recorded***
- ***Security auditing policies restrict the set of events to those that are critical for the particular environment***
- ***System auditing policies log all security relevant events, even from security unaware applications***

Non-Repudiation

- *Makes principals accountable for their actions*
- *Irrefutable evidence about events/actions is generated*
- *Used to settle disputes about the occurrence or non-occurrence of an event*
- *Example: Electronic commerce*

Components of Evidence

- *Depend on non-repudiation policy.*
- *Examples include:*
  - *Type of action or event*
  - *A timestamp obtained from a trusted authority*
  - *Parameters related to action or event*
  - *Proof of origin of parameters*

Common Types of Evidence

- **Proof of creation of a message**
  - **Protects against originator's false denial of having created a message**
- **Proof of receipt of a message**
  - **Protects against receiver's false denial of having received a message**