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Lecture 2: Security

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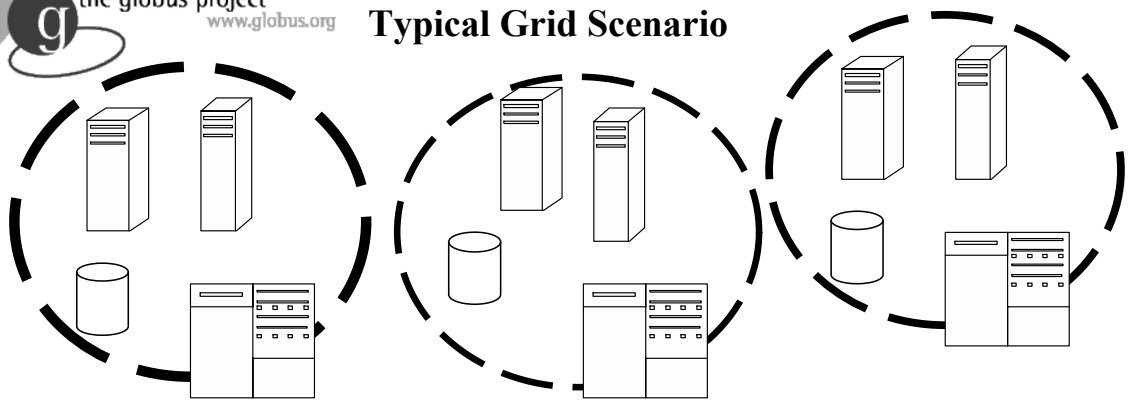
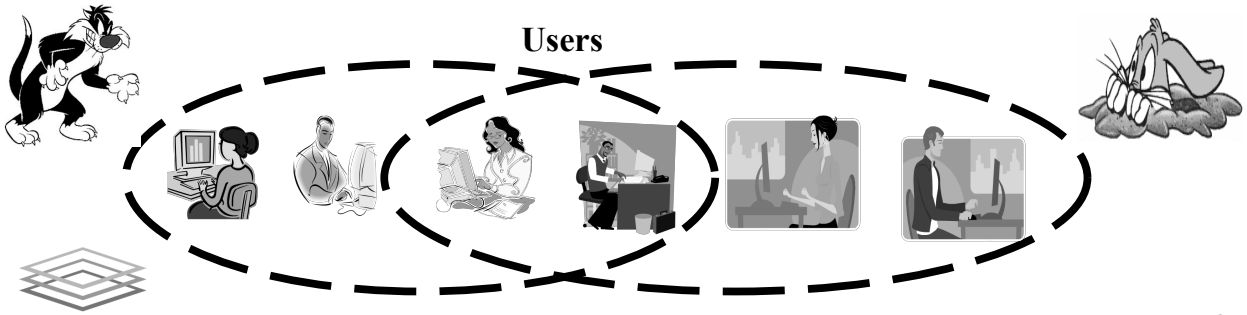
Typical Grid Scenario



Resources

Users



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What do we need ?

- Identity
- Authentication
- Message Protection
- Authorization
- Single Sign On

Identity & Authentication

- Each entity should have an identity
- Authenticate: Establish identity
  - Is the entity who he claims he is ?
  - Examples:
    - > Driving License
    - > Username/password
- Stops masquerading imposters

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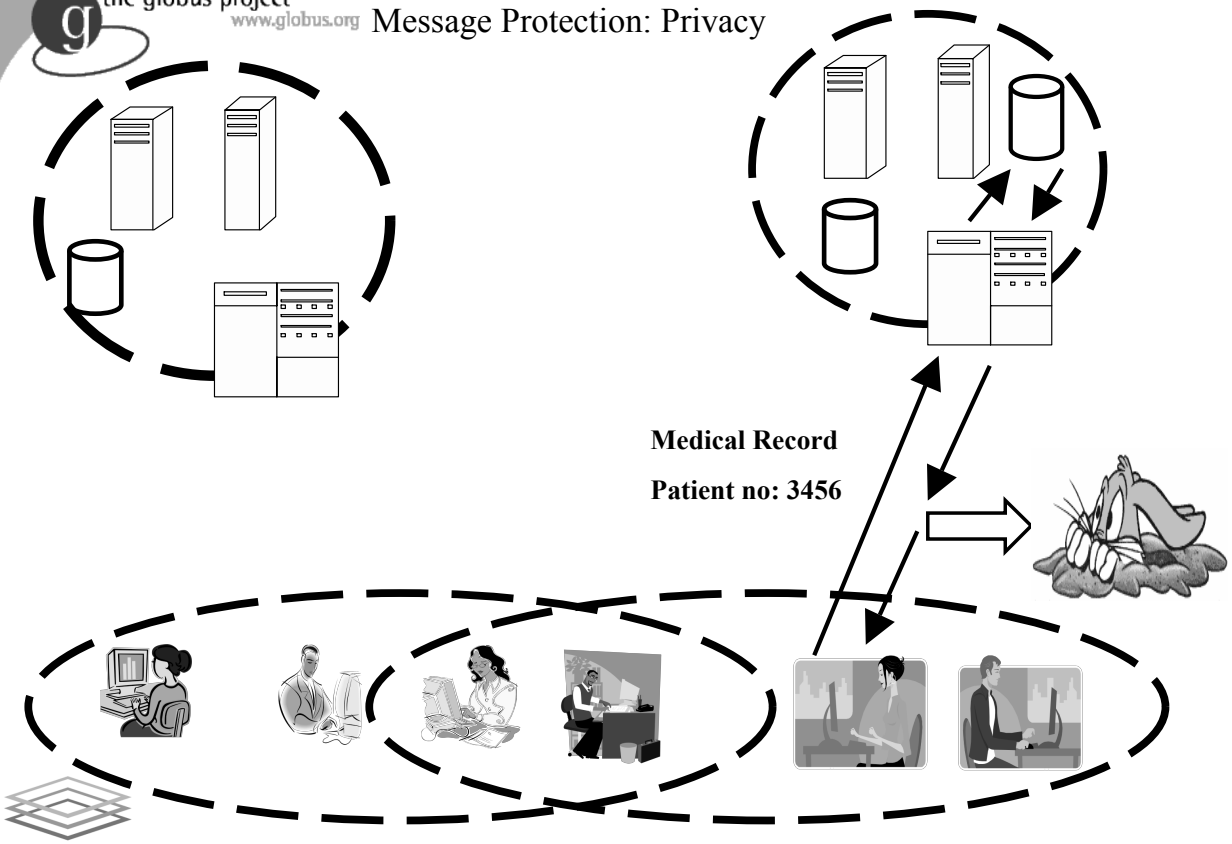
Message Protection: Privacy



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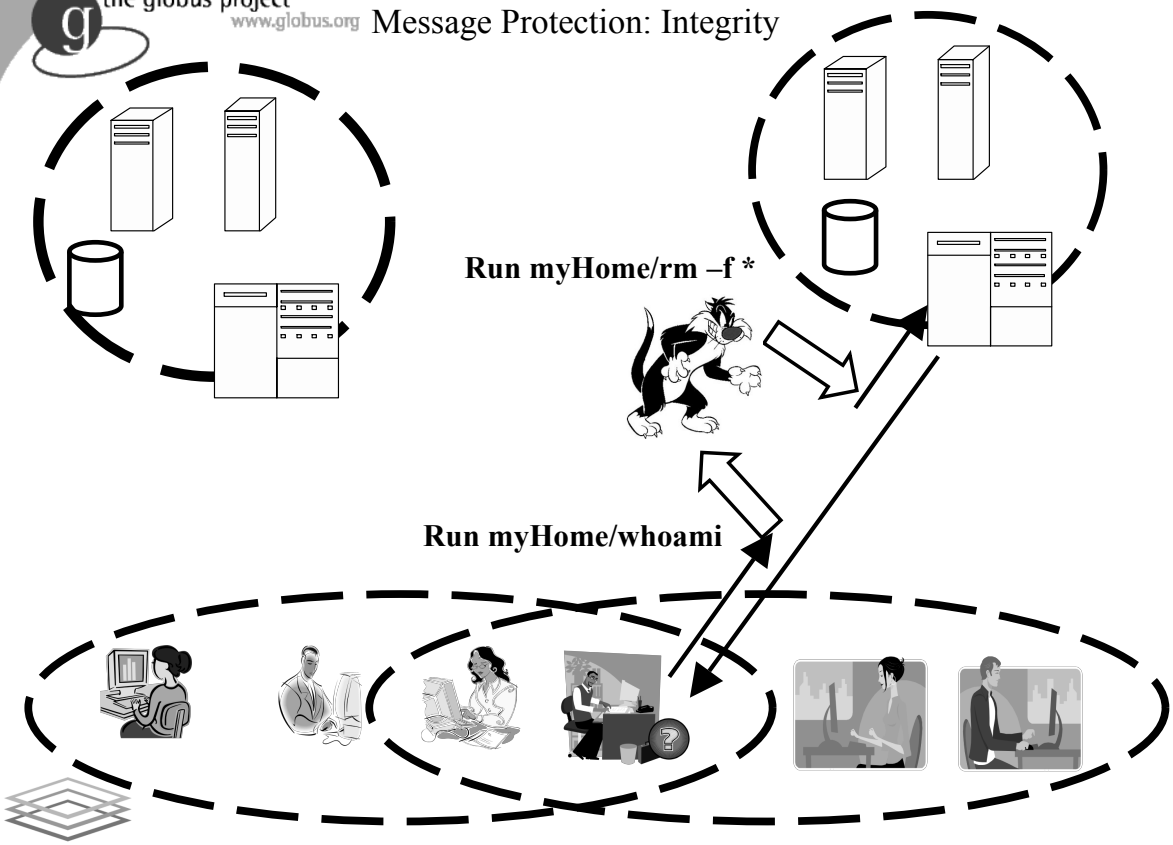
Message Protection: Integrity



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Authorization

- Establishing rights
- What can a said identity do ?

Examples:

  - Are you allowed to be on this flight ?
    - > Passenger ?
    - > Pilot ?
  - Unix read/write/execute permissions

- Must authenticate first

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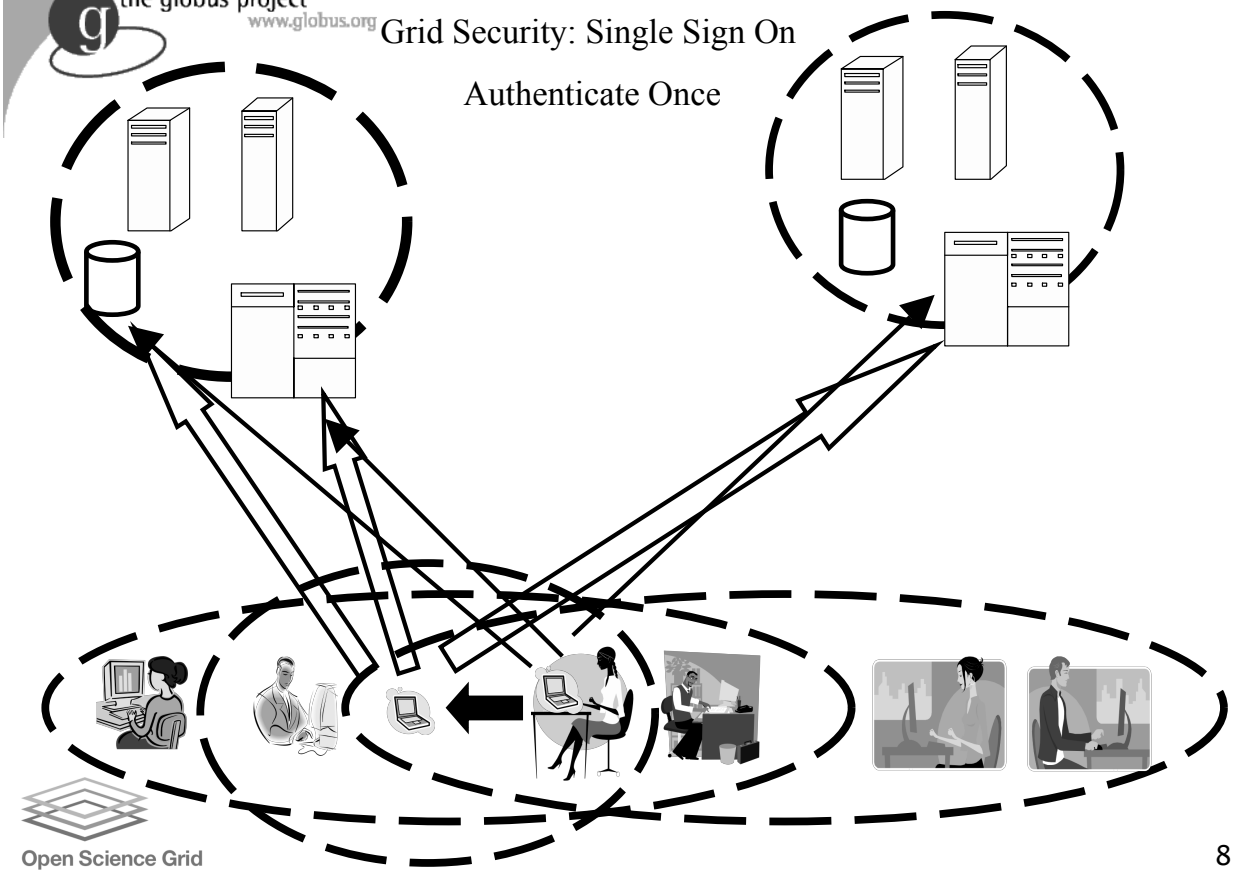
Grid Security: Single Sign On

Authenticate Once



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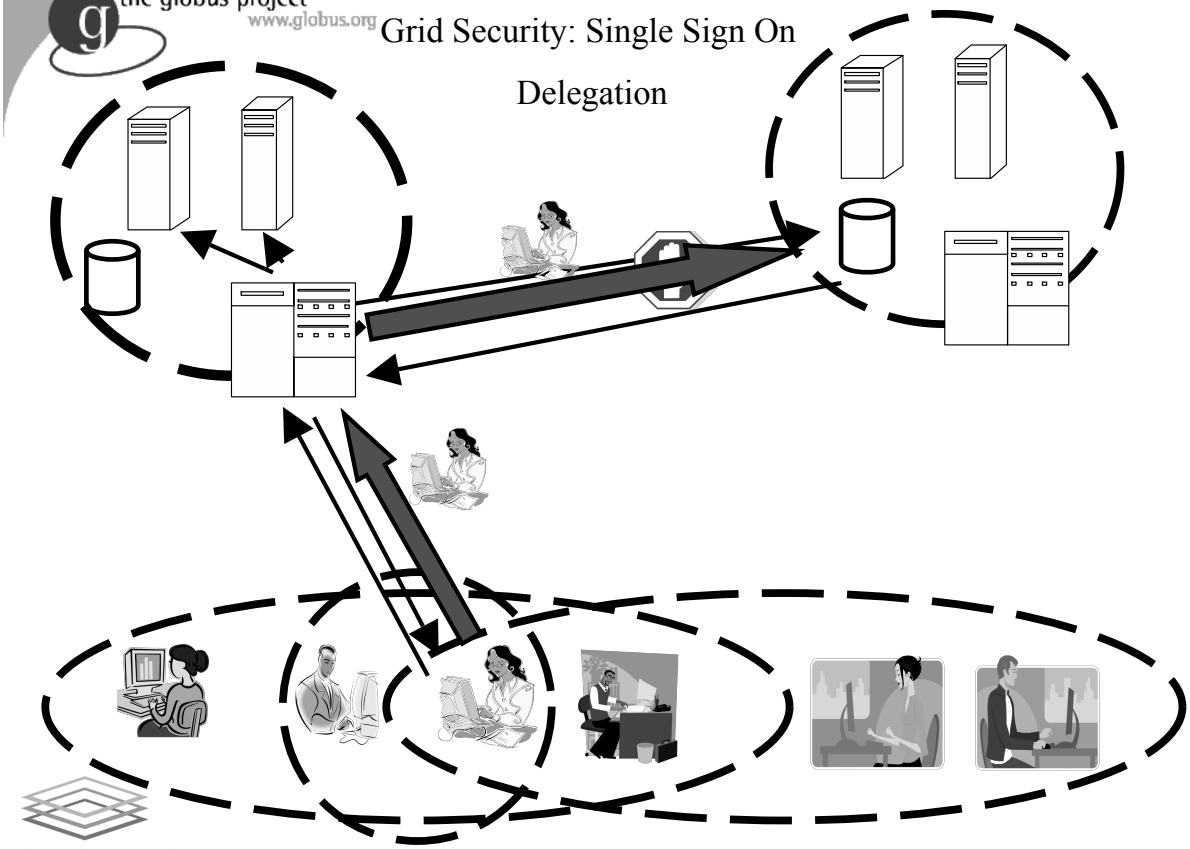
Grid Security: Single Sign On

Delegation



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Single Sign-on

- Important for complex applications that need to use Grid resources
  - Enables easy coordination of varied resources
  - Enables automation of process
  - Allows remote processes and resources to act on user's behalf
  - Authentication and Delegation

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Solutions

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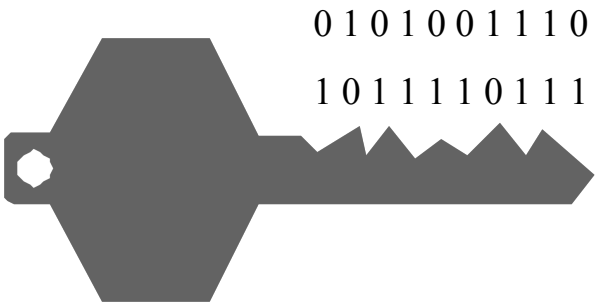
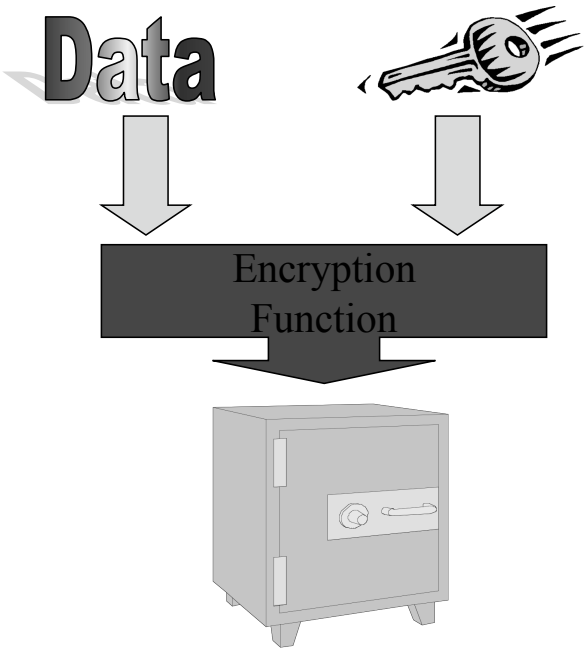
Cryptography for Message Protection

- Enciphering and deciphering of messages in secret code
- Key
  - Collection of bits
  - Building block of cryptography
  - More bits, the stronger the key



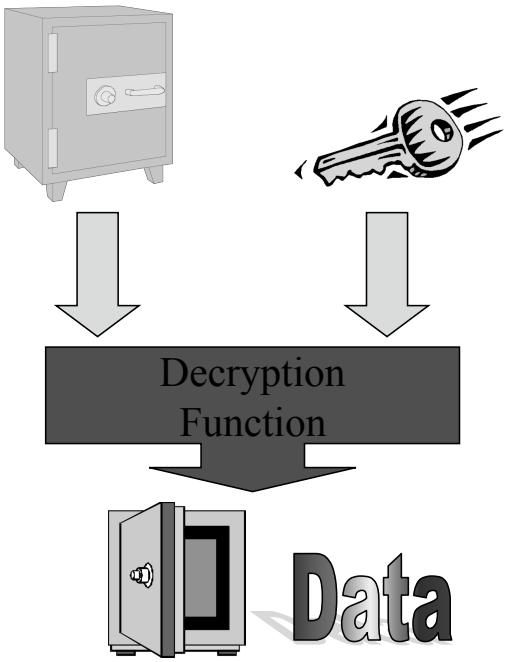
Encryption

- Encryption is the process of taking some data and a key and feeding it into a function and getting encrypted data out
- Encrypted data is, in principal, unreadable unless decrypted



Decryption

- Decryption is the process of taking encrypted data and a key and feeding it into a function and getting out the original data
  - Encryption and decryption functions are linked



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Asymmetric Encryption

- Encryption and decryption functions that use a key pair are called asymmetric
  - Keys are mathematically linked

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Public and Private Keys

- With asymmetric encryption each user can be assigned a key pair: a private and public key

Private key is known only to owner

Public key is given away to the world

- Encrypt with public key, can decrypt with only private key
- Message Privacy

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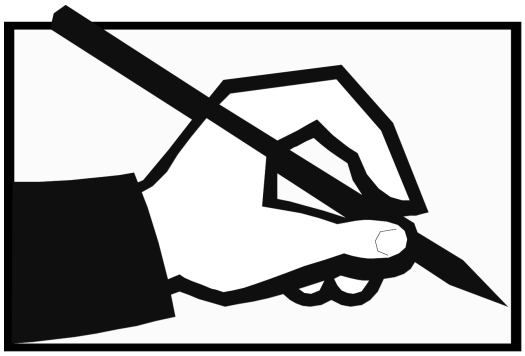
Digital Signatures

- Digital signatures allow the world to
  - determine if the data has been tampered
  - verify who created a chunk of data
- Sign with private key, verify with public key
- Message Integrity



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Public Key Infrastructure (PKI)

- PKI allows you to know that a given public key belongs to a given user
- PKI builds off of asymmetric encryption:
  - Each entity has two keys: public and private
  - The private key is known only to the entity
- The public key is given to the world encapsulated in a X.509 certificate

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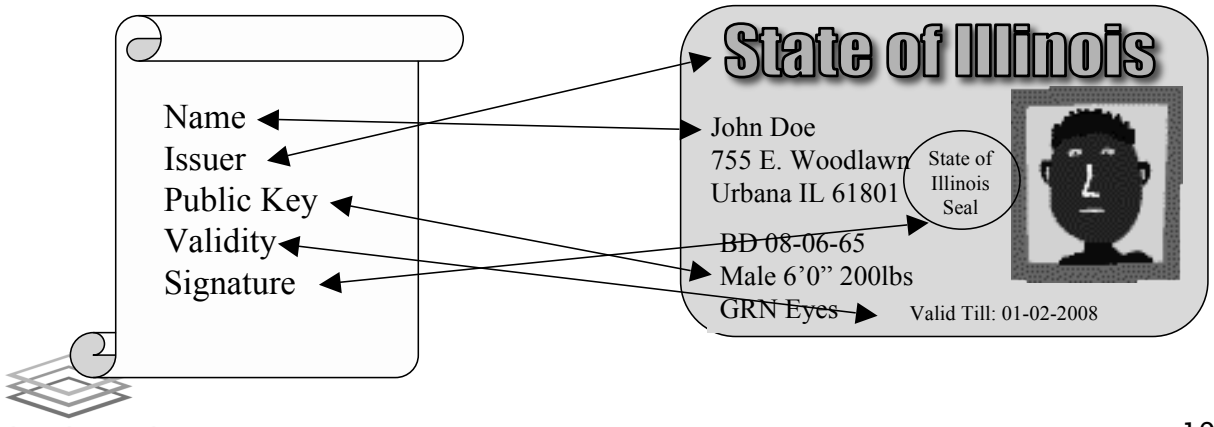
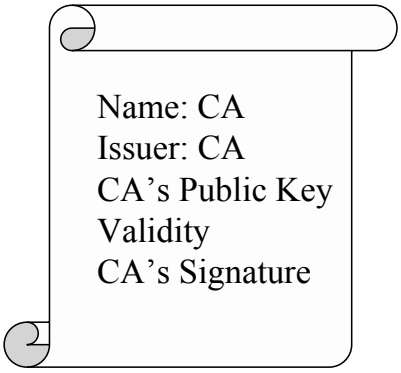
Certificates

- X509 Certificate binds a public key to a name.
- Similar to passport or driver's license



Certification Authorities (CAs)

- A Certification Authority is an entity that exists only to sign user certificates
- The CA signs it's own certificate which is distributed in a trusted manner
- Verify CA certificate, then verify issued certificate



Certificate Policy (CP)

- Each CA has a Certificate Policy (CP) which states
  - who it will issue certificates to
  - how it identifies people to issue certificates to
- Lenient CAs don't pose security threat, since resources determine the CAs they trust.

Certificate Issuance

- User generates public key and private key
- CA vets user identity using CA Policy
- Public key is sent to CA
  - Email
  - Browser upload
  - Implied
- Signs user's public key as X509 Certificate
- User private key is never seen by anyone, including the CA

Certificate Revocation

- CA can revoke any user certificate
  - Private key compromised
  - Malicious user
- Certificate Revocation List (CRL)
  - List of X509 Certificates revoked
  - Published, typically on CA web site.
- Before accepting certificate, resource must check CRLs

Authorization

- Establishing rights of an identity
- Chaining authorization schemes
  - Client must be User Green and have a candle stick and be in the library!
- Types:
  - Server side authorization
  - Client side authorization

Gridmap Authorization

- Commonly used in Globus for server side
- Gridmap is a list of mappings from allowed DNs to user name

"/C=US/O=Globus/O=ANL/OU=MCS/CN=Ben Clifford" benc
"/C=US/O=Globus/O=ANL/OU=MCS/CN=MikeWilde" wilde

- ACL + some attribute
- Controlled by administrator
- Open read access

Globus Security: The Grid Security Infrastructure

- The Grid Security Infrastructure (GSI) is a set of tools, libraries and protocols used in Globus to allow users and applications to securely access resources.
- Based on PKI
- Uses Secure Socket Layer for authentication and message protection
  - Encryption
  - Signature
- Adds features needed for Single-Sign on
  - Proxy Credentials
  - Delegation

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GSI: Credentials

- In the GSI system each user has a set of credentials they use to prove their identity on the grid
  - Consists of a X509 certificate and private key
- Long-term private key is kept encrypted with a pass phrase
  - Good for security, inconvenient for repeated usage

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GSI: Proxy Credentials

- Proxy credentials are short-lived credentials created by user
  - Proxy signed by certificate private key
- Short term binding of user's identity to alternate private key
- Same effective identity as certificate

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GSI: Proxy Credentials

- Stored unencrypted for easy repeated access
- Chain of trust
  - Trust CA -> Trust User Certificate -> Trust Proxy
- Key aspects:
  - Generate proxies with short lifetime
  - Set appropriate permissions on proxy file
  - Destroy when done

GSI Delegation

- Enabling another entity to run as you
- Provide the other entity with a proxy
- Ensure
  - Limited lifetime
  - Limited capability

Grid Security At Work

- Get certificate from relevant CA
- Request to be authorized for resources
- Generate proxy as needed
- Run clients
  - Authenticate
  - Authorize
  - Delegate as required

Numerous resource, different CAs, numerous credentials

MyProxy

- Developed at NCSA
- Credential Repository with different access mechanism (e.g username/pass phrase)
- Can act as a credential translator from username/pass phrase to GSI
- Online CA
- Supports various authentication schemes
  - Passphrase, Certificate, Kerberos

MyProxy: Use Cases

- Credential need not be stored in every machine
- Used by services that can only handle username and pass phrases to authenticate to Grid. E.g. web portals
- Handles credential renewal for long-running tasks
- Can delegate to other services

Lab Session

- Focus on tools
  - Certificates
  - Proxies
  - Gridmap Authorization
  - Delegation
  - MyProxy

Slide Acknowledgements

- Von Welch
- Frank Siebenlist