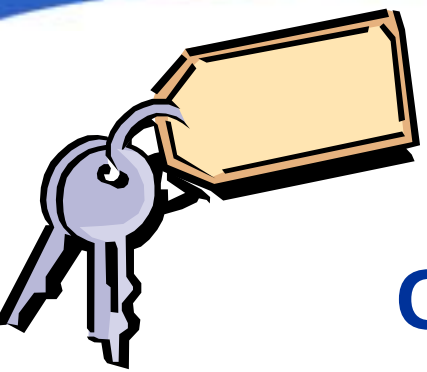
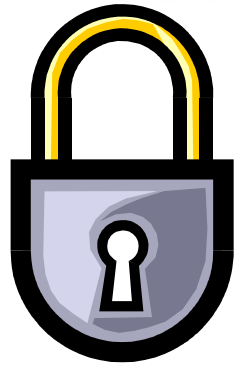


Credential Management
in the
Grid Security Infrastructure



GlobusWorld Security Workshop
January 16, 2003

Jim Basney

jbasney@ncsa.uiuc.edu
http://www.ncsa.uiuc.edu/~jbasney/

NCSA

Credential Management

- **Enrollment**: Initially obtaining credentials
- **Retrieval**: Getting credentials when and where they're needed
- **Renewal**: Handling credential expiration
- **Translation**: Using existing credentials to obtain credentials for a new mechanism or realm
- **Delegation**: Granting specific rights to others
- **Control**: Monitoring and auditing credential use
- **Revocation**: Handling credential compromise

We need tools to cope with the complexity of credential management on the Grid.

Grid Credentials

- Identity credentials
  - **Different mechanisms (X.509, Kerberos, .NET)**
  - **Different authorities (CAs, KDCs)**
  - **Different purposes (authentication, signing, encryption)**
  - **Different roles (project-based, security levels)**
- Authorization credentials
  - **X.509 attribute certificates**
  - **SAML/XACML/XrML assertions**
- Trusted credentials
  - **CA certificates and policies**
  - **Other certificates and public keys (SSH, PGP)**

Accessing Credentials

- Ubiquitous access to the Grid
  - **Initiate secure Grid sessions from desktops, kiosks, PDAs, cell phones, etc.**
  - **Requires access to needed credentials, including trusted credentials (CA certificates, etc.)**
  - **Bootstrap from password**
- Delegating credentials to transient services
  - **May need to retrieve additional credentials and/or renew existing credentials at run-time**
  - **Need access to trusted credentials and policy information**

Traditional PKI Enrollment

1. End entity generates public/private key pair & submits certificate request to CA
2. CA approves/denies certificate request & signs certificate if request is approved
3. End entity retrieves signed certificate from the CA

Traditional PKI Enrollment

- **Can be cumbersome for users and CA operators**
  - May require a trip to a Registration Authority or some other out-of-band identity verification
  - CA operators must examine each request and sometimes investigate further before deciding to approve or deny
  - Process may take hours or days to complete

End Entity Key Management

- **Typical practice in GSI is to store private keys in files encrypted by a passphrase**
  - Security depends on well-chosen passphrases and well-secured filesystems
- **Users copy private keys to the different systems they use to access the Grid**
- **Not all Grid users are PKI experts**
  - Just want to do their computing securely
  - Can we improve usability and security of end entity key management on the Grid?
- **Alternatives: Smart Cards, Online CAs, Online Credential Repositories**

Smart Cards

- **User-managed, portable credential storage**
- **Security analogous to car keys or credit cards**
- **Private keys stay in hardware**
- **Card standards are mature**
- **Costs are decreasing but still significant**
  - $20 readers, $2 cards
  - Government ID card deployments
- **Can pre-load credentials on the card before distributing it**
- **Some support already in GSI libraries**

Online CA

- **User authenticates to CA to obtain credentials immediately**
- **Leverage existing authentication mechanisms (password, Kerberos, etc.)**
- **Identity mapping:**
  - Simple transformation (i.e., include Kerberos principle name in X.509 certificate subject) or administrator-managed mapping
- **Signs long-term and/or short-term credentials**
  - If long-term, then credentials are user-managed
  - If short-term, credentials retrieved on demand, without need for user key management

Online CA Security

- CA machine must be well-secured
- Signing key must be well-protected (i.e., stored in hardware crypto module)
- Key compromise allows attacker to create arbitrary credentials
- CA compromise may allow attacker to manipulate user authentication or identity mapping info
- If compromised, must revoke CA certificate and change CA signing key
- Short-term credentials don't need to be revoked

Online Credential Repository

- **Store encrypted credentials and access policy in an online repository**
  - Repository may be mechanism-aware or may simply hold opaque credentials
- **Authenticate to repository to retrieve opaque or delegated credentials**
- **Separates credential creation from credential management**
- **Can be deployed by individuals, small groups, VO managers, or CA operators**
- **Credentials can be pre-loaded to leverage existing authentication mechanisms**

Credential Repository Security

- Credentials individually encrypted with user's passphrase
- Compromise requires offline attack on each credential
- Centralized storage of credentials may violate policies (CA CP/CPS)
- If compromised, credentials in repository must be revoked

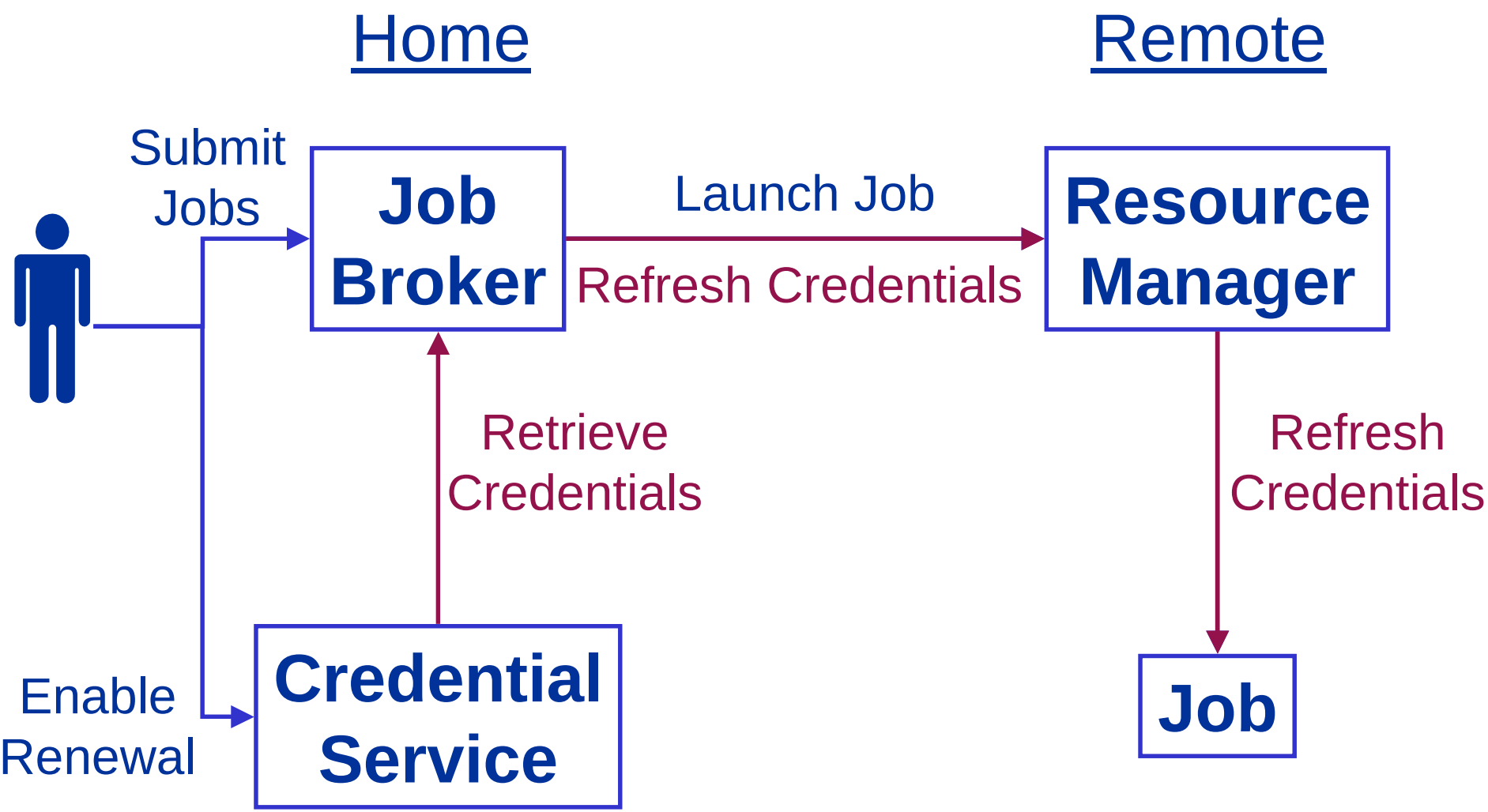
Who Holds The Keys?

- **Viewpoint #1: End entities should have sole possession of their long-term keys**
  - Administrator access to end entity keys voids non-repudiation
- **Viewpoint #2: End entities can't be trusted to secure their long-term keys**
  - Centralized key distribution enforces password policies and credential lifetime limits
- **Will this issue hinder cross-site collaboration?**

Credential Renewal

- **Long-lived tasks or services need credentials**
  - Task lifetime is difficult to predict
- **Don't want to delegate long-lived credentials**
  - Fear of compromise
- **Instead, renew credentials as needed during the task's lifetime**
  - Renewal service provides a single point of monitoring and control
  - Renewal policy can be modified at any time
  - For example, disable renewals if compromise is detected or suspected

Credential Renewal



Multiple Credentials

- Will a single identity credential per user suffice?
  - **A lot of work is being done to vet and/or cross-certify Grid CAs**
  - **How is that different from Kerberos cross-realm authentication?**
- Alternative: Provide tools to manage multiple credentials
  - **Single sign-on unlocks all credentials**
  - **Grid protocols negotiate for required credentials (WS-SecurityPolicy)**
  - **Authorization decision between individual and resource provider, rather than between realms**

Credential Wallet

- Consolidated view of my credentials
- Credential management interface
  - **Add, remove, or modify credentials**
  - **Associate policies with credentials**
  - **Create authorization credentials**
- One-stop credential access point
  - **Single sign-on unlocks credentials for a session**
  - **Contains pointers to available credential services**
- Manage credentials on my behalf
  - **Example: renew credentials as needed**
- Notify when events occur or action is required