HTCondor Security Basics

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Zach Miller (zmiller@cs.wisc.edu)

Center for High Throughput Computing
Department of Computer Sciences
University of Wisconsin-Madison

Overview

- What are the threats?
- Who do you trust?
- What are the mechanisms?
- Other security concerns?

Threats

- The purpose of HTCondor is to accept arbitrary code from users and run it on a large number of machines

Threats

- The purpose of HTCondor is to accept arbitrary code from users and run it on a large number of machines

- The purpose of a botnet is to take arbitrary code and run it on a large number of machines

Threats

- So what’s the difference?
- You wish to prevent unauthorized access
- Ultimately, it just comes down to who can use your pool, and how they can use it.

Basic Concepts

- “Who can use your pool” is really two concepts:

- The “Who” is authentication

- The “can use” is authorization

Basic Concepts

- Authentication is finding out WHO some entity is.

- How is this done?
  - Common methods:
    - Present a secret that only you should know
    - Perform some action that only you can do
    - Present a credential that only you could have

Basic Concepts

- Authorization is deciding what someone is allowed to do.

- You must know who they are before you can decide this!

Basic Concepts

- I’m using “they” pretty loosely here.

- “They” could be:
  - A user
  - A machine
  - An agent/daemon/service

Basic Concepts

- In the context of an HTCondor pool:
  - You want only machines that you trust to be in the pool
  - You want only people you trust to submit jobs

Assumptions of Trust

- HTCondor relies on trusting the “root” user of a machine
- If this is compromised, all bets are off

- HTCondor daemons trust each other

- You need to trust your friendly HTCondor administrator

Assumptions of Trust

- How about users?

- HTCondor places some restrictions on users:
  - zmiller cannot submit, remove, or manipulate jobs belonging to another user
- But ”bad” users can still cause problems
  - Running fork bomb: while(1) { fork() }
  - Intentionally interfering with the system

Assumptions of Trust

- So, users are trusted to some degree
- Preventing every possible bad behavior makes the system too cumbersome for good users
  - Security is always a balancing act with usability
- Decide how much you want to prevent versus punish

Restricting Users

- SUBMIT_REQUIREMENT allows the administrator to restrict what jobs are able to enter the queue
- Can be used to prevent users from lying about what groups they belong to:

```
SUBMIT_REQUIREMENT_NAMES = GROUP1

SUBMIT_REQUIREMENT_GROUP1= (AcctGroup =!= “group1”) ||
   (AcctGroup =?= “group1” && (Owner==“zmiller” || Owner==“tannenba”))

SUBMIT_REQUIREMENT_GROUP1_REASON=“User not in group1”
```

Restricting Users

- SUBMIT_REQUIREMENT allows the administrator to restrict what jobs are able to enter the queue
- Can be used to allow only certain executable files, number of CPUs requested for a job, anything else that is part of the Job ClassAd

Authentication

- When users submit jobs, HTCondor authenticates them

- The HTCondor SCHEDD daemon now “owns” the jobs, and acts on their behalf.

Authentication

- So how can we trust the SCHEDD?

- Daemon-to-daemon authentication

Authentication

- For a secure pool, both users and HTCondor daemons must authenticate themselves
- HTCondor supports several mechanisms:
  - File System
  - Password
  - Kerberos
  - SSL
  - GSI

Other Security Mechanisms

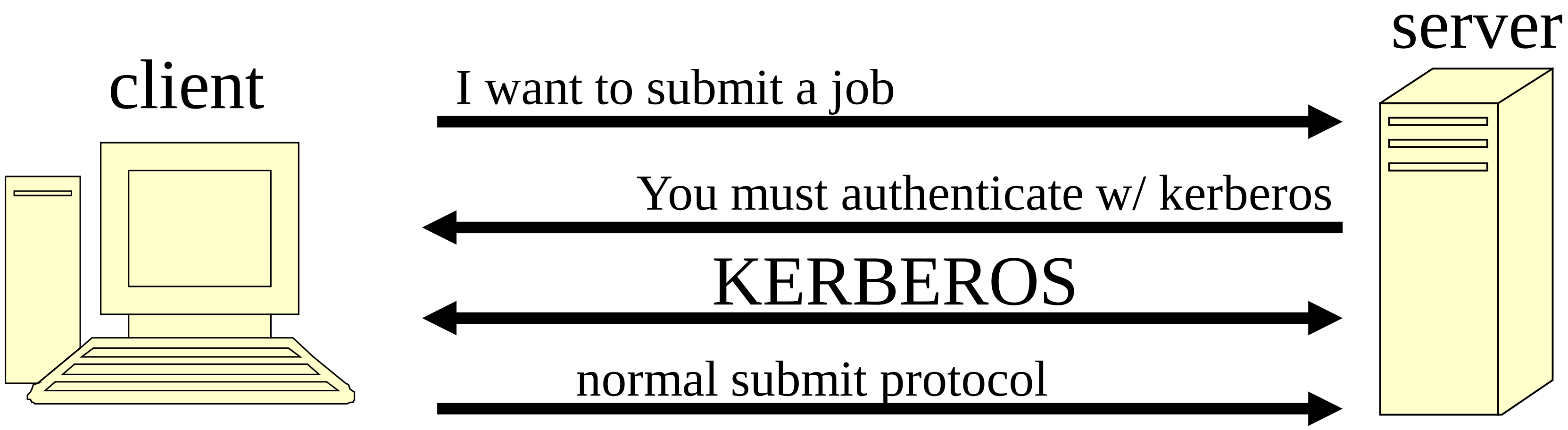
- In addition to authenticating network connections, you may also wish to use:
- Integrity Checks (MD5)
  - Allows HTCondor to know if traffic has been tampered with
- Encryption (3DES, Blowfish)
  - Allows HTCondor to transmit encrypted data so it cannot be spied on while in transit

Example “Strong” Configuration

```
SEC_DEFAULT_AUTHENTICATION = REQUIRED
SEC_DEFAULT_AUTHENTICATION_METHODS = Kerberos
SEC_DEFAULT_ENCRYPTION = REQUIRED
SEC_DEFAULT_INTEGRITY = REQUIRED
```

Security Negotiation

- When first contacting each other, HTCondor daemons have a short negotiation to find out which mechanisms are support and what features are required for the connection



Security Negotiation

- Policy Reconciliation Example:

CLIENT POLICY

```
SEC_DEFAULT_ENCRYPTION = OPTIONAL
SEC_DEFAULT_INTEGRITY = OPTIONAL
SEC_DEFAULT_AUTHENTICATION = OPTIONAL
SEC_DEFAULT_AUTHENTICATION_METHODS = FS, GSI, KERBEROS, SSL, PASSWORD
```

SERVER POLICY

```
SEC_DEFAULT_ENCRYPTION = REQUIRED
SEC_DEFAULT_INTEGRITY = REQUIRED
SEC_DEFAULT_AUTHENTICATION = REQUIRED
SEC_DEFAULT_AUTHENTICATION_METHODS = SSL
```

RECONCILED POLICY

```
ENCRYPTION = YES
INTEGRITY = YES
AUTHENTICATION = YES
METHODS = SSL
```

Security Configuration

- I’m going to skip the detailed configuration of each particular security mechanism.
- Security is not one-size fits all
- If you are interested in details, please schedule some “office hours” with me to discuss.

Configuration Security

- Are your condor_config files secured?
- They should be owned and only modifiable by root.
- If you use a config directory, make sure only root can create files in it

Configuration Security

- HTCondor can allow configuration changes using a command-line tool:
  - condor_config_val –set Name Value

- However, this behavior is off by default and needs to be enabled on a case-by-case basis for each config parameter… use carefully only if you really need it

HTCondor Privilege

- HTCondor typically runs “as root”

- Why?
  - Impersonating users
  - Process isolation
  - Reading secure credentials

- When it isn’t actively using root, it switches effective UID to another user (“condor”)

HTCondor Privilege

- HTCondor will never launch a user job as root. There is a “circuit breaker” at the lowest level to prevent it.
- If not using system credentials, the Central Manager can run without root priv
- Let’s examine some different Startd configurations

StartD Configurations

- Startds have a few different options for running jobs:
- Run jobs as the submitting user
- Run jobs as the user “nobody”
  - Allows jobs to interfere with one another
- Run jobs as a dedicated user per slot
  - Keeps jobs running as a low-privilege user
  - Isolates jobs from one another
  - Makes it easy to clean up after a job

glexec

- Allows HTCondor daemons to be run without root privilege, yet running jobs can still assume the UID of the submitting user

- Uses GSI credentials to authenticate

- Very useful for glidein jobs

Encrypted File Transfer

- Even if that admin has not required encryption for all network connections, user jobs can specify per-file for both input and output if the files should be encrypted:
  - Encrypt_Input_Files = file1, *.dat
  - Encrypt_Output_Files = data.private

Encrypt Execute Directory

- If you are using Linux with *ecryptfs* installed, you can have HTCondor encrypt the execute directory on disk, offering extra protection of sensitive data.
- Can be enabled pool-wide by the admin:
  - ENCRYPT_EXECUTE_DIRECTORY = True
- Per-job in the submit file:
  - Encrypt_Execute_Directory = True

Vulnerabilities

- HTCondor has been assessed by an independent research group.
- That was many years ago. Another audit will be coming “soon”

- Our vulnerability reporting process is documented and vulnerability reports publicly available:
- http://research.cs.wisc.edu/htcondor/security/

Questions?

- Schedule “office hours” this week
- Email the htcondor-users mailing list and if your question is security related I will (likely) respond
- Email me directly