Security and Token Auth Debugging

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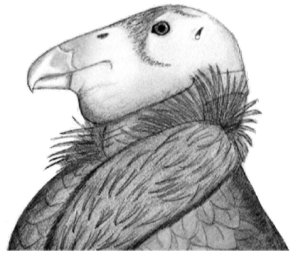
Goals for today:

- Learn the fundamental ‘jargon’ associated with access control in HTCSS.
- Understand the parts of the authorization handshake between client and server.
- Get a few debugging tips specific to token authentication.
- Learn the how security credentials are mapped into HTCondor identifiers and then authorized

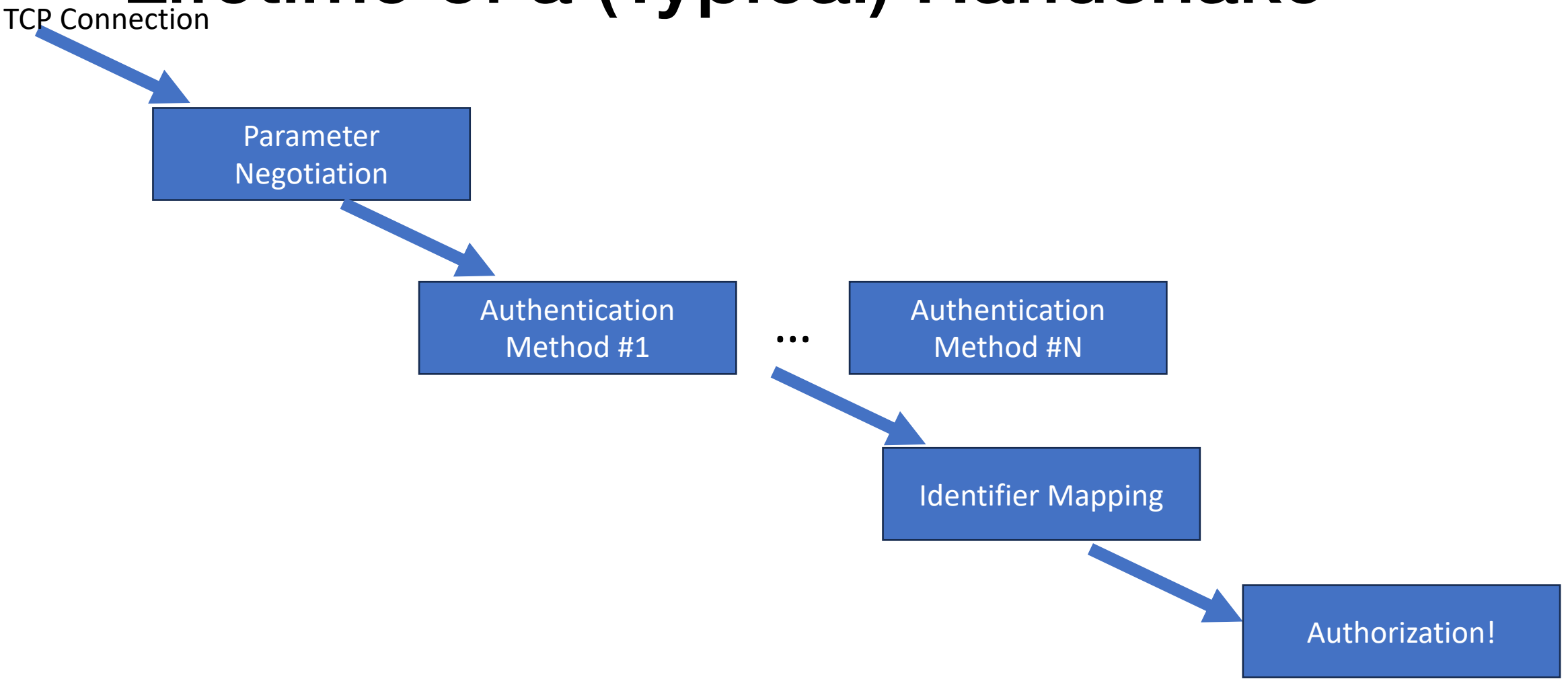
The Basic Vocabulary



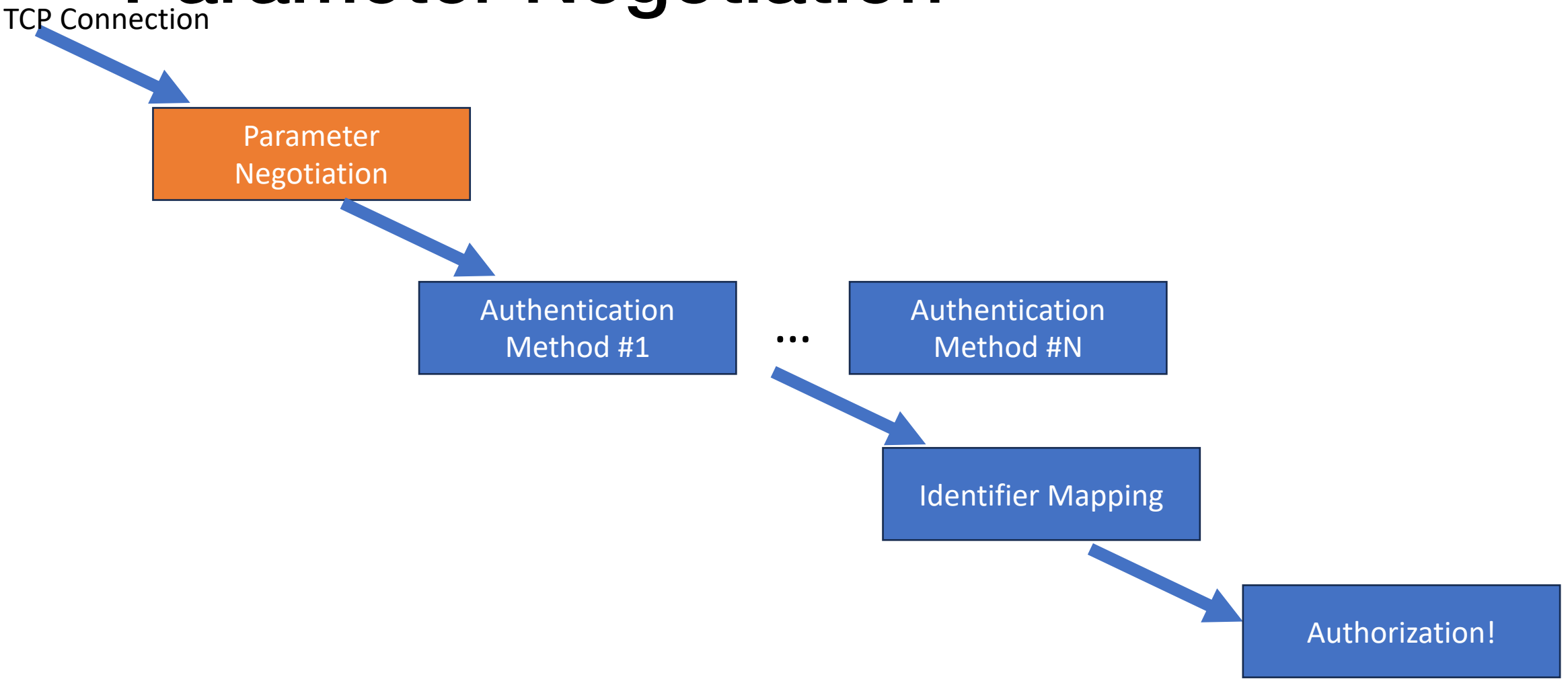
HTCondor Software Suite

- Authentication: Establishing an ‘identifier’ for a remote entity.
- Identity Mapping: Mapping between identifiers, such as from a Kerberos credential to a HTCondor identifier.
- Authorization: Determining whether an entity is permitted to perform a certain operation.
- Encryption: Maintaining confidentiality during a session.
- Integrity: Detecting modifications to a session done during transit.

Lifetime of a (Typical) Handshake

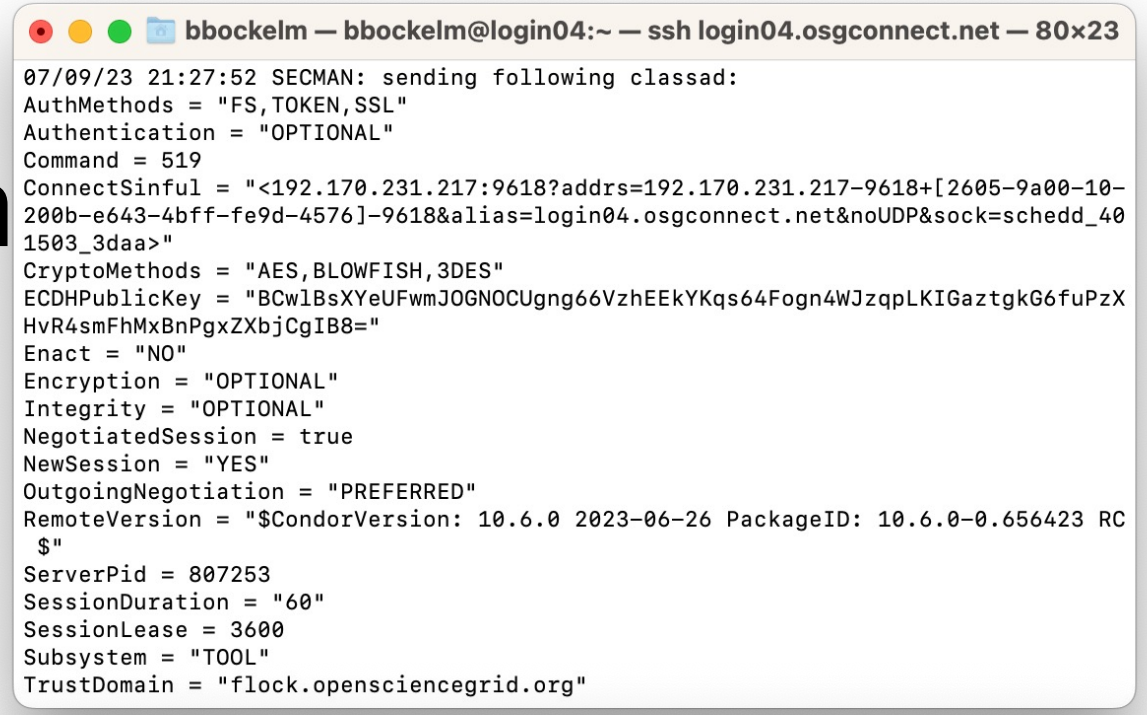


Parameter Negotiation

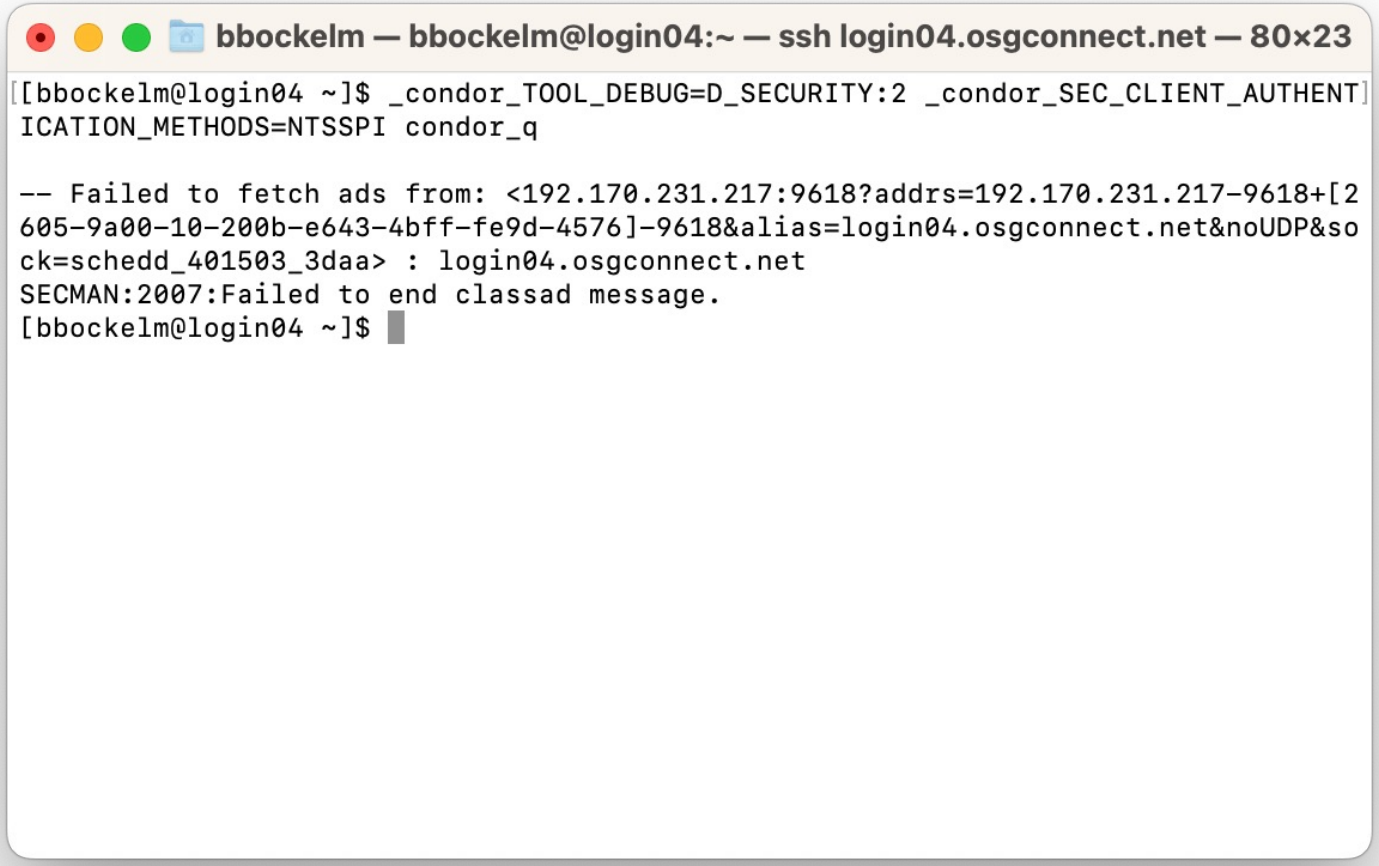


Parameter Negotiation

- Parameter negotiation consists of a ClassAd sent from client to server followed by one from server to client.
- Each side states their policy on topics like:
  - Is authentication required?
  - What authentication methods should be used?
  - Should encryption / integrity checking be used?



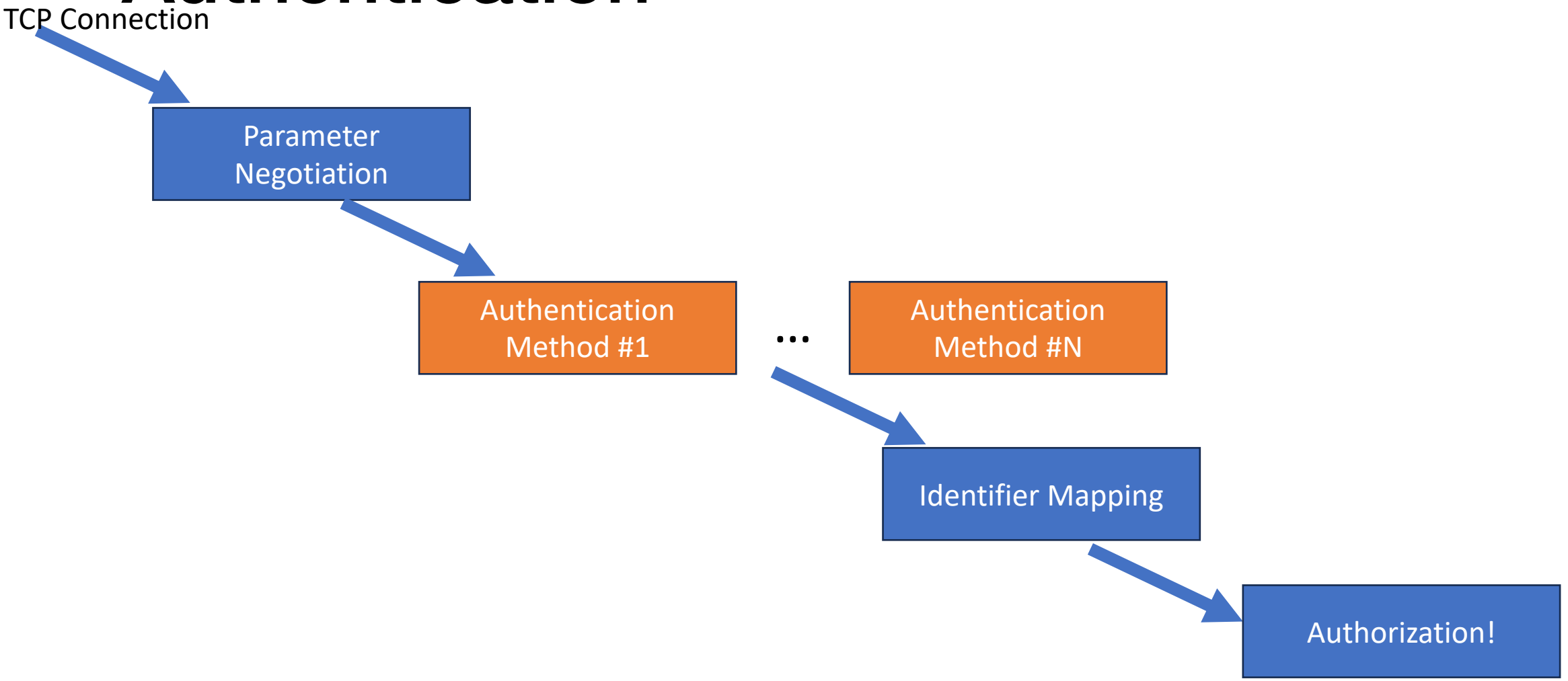
Parameter Negotiation



- It is possible for the client and server to have incompatible policy (example: no common methods).
- In this case, the server will abruptly close the socket. The client will report the dreaded

```
SECMAN:2007:Failed to end
classad message
```

Authentication



Authentication Methods

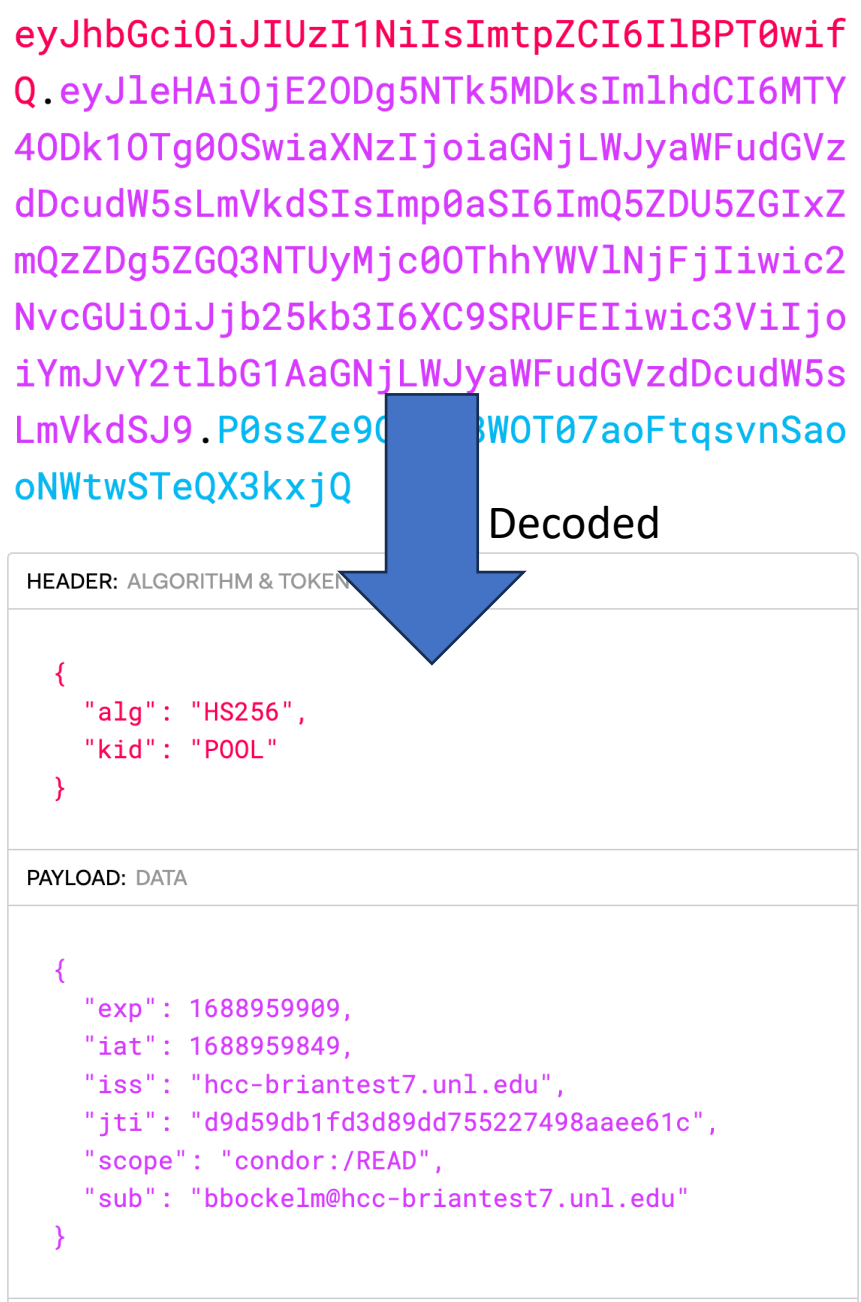
Will be covered today

- IDTOKENS: Client authenticates with a JSON Web Token (JWT) signed by the server.
- SCITOKENS: Client authenticates with a SciToken (https://scitokens.org/) JWT, signed by a trust third party.
- SSL: Client and server uses the venerable TLS protocol, same as HTTPS.
- KERBEROS: Client and server use Kerberos authentication.
- And other, less-commonly-used options:
  - NTSSPI, PASSWORD, CLAIMTOBE, ANONYMOUS, FS_REMOTE

Authentication: IDTOKENS

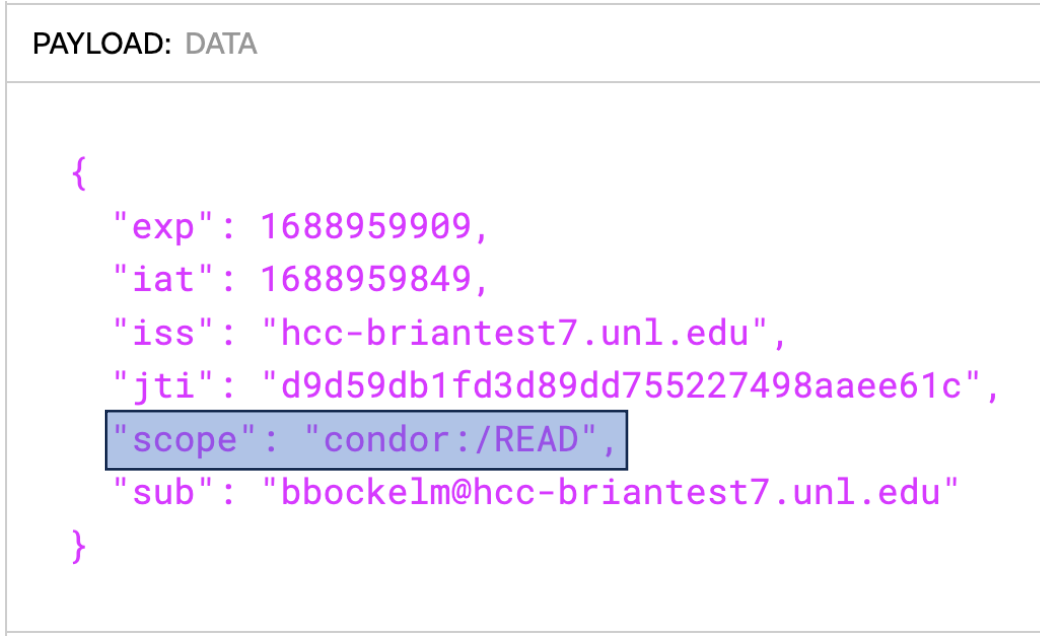
Authentication Protocol

- The IDTOKEN is used to establish a shared secret. The public portion is sent to the server; if the server has the right key, then it can regenerate the signature.
- Now, both sides have a shared secret (the token signature) and can use a key exchange protocol (AKEP2) to demonstrate possession to the other side.
- The client is identified by the subject in the token.



IDTOKENS - Authorizations

- As the IDTOKEN is generated by HTCondor, the ‘subject’ in the token is considered an HTCondor identifier
  -> No mapping step!
- Tokens *can* contain restrictions on allowed authorizations.
  - Can only act as a *restriction* on what the token can otherwise do – does not *grant* access beyond what’s configured.

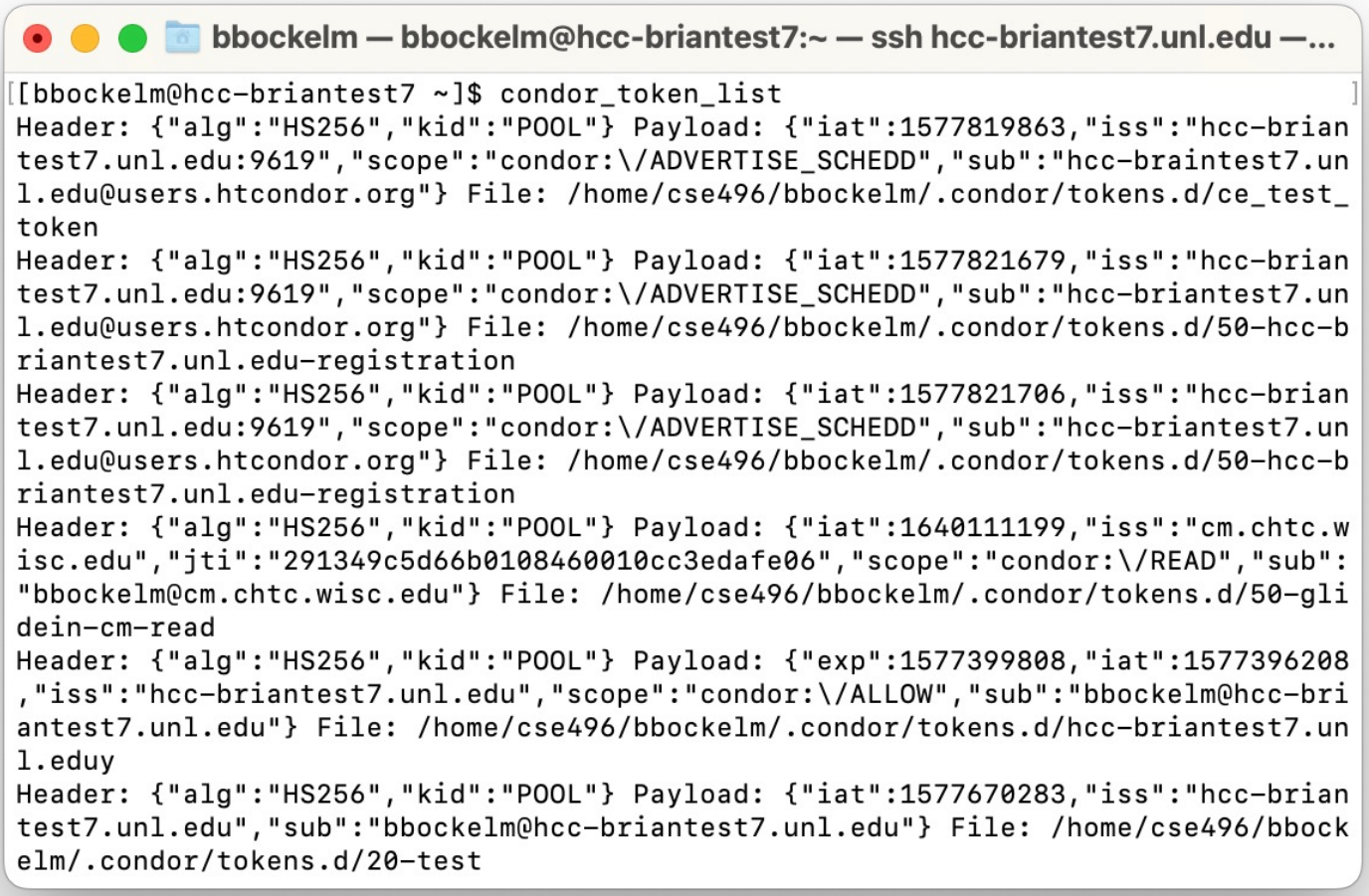


Key Concept – Trust Domains

- If the IDTOKEN subject is “native” to HTCondor, which instance?
  - After all, my identifier (“bbockelm”) for CHTC is different than for the OSPool (“brian.bockelman.1”)!
- We have added the concept of “Trust Domain” – the set of all services that are run by the same administrators.
  - We assume a named signing key in a trust domain always has the same value.
- Each server belongs to a given trust domain. It’ll ignore tokens from a different trust domain.

Trip Hazard: In 10.0.0, the default value of TRUST_DOMAIN changed! Check your tokens are still valid if you started using tokens in 9.x.

Finding the IDTOKEN



- There's a defined directory that holds tokens for a client (typically, `~/.condor/tokens.d`). The client iterates through each token in the directory, using the first one that "matches":
  - "Matches" means the token is in the same trust domain as the server and signed with a key the server knows.

Authentication: SciTokens

Authentication Protocol

- A TLS connection is established between client and server.
- The client verifies the server's host certificate.
- The client sends the SciToken across the secure channel.
- The server verifies the token was signed using the issuer's public key.
- Note:
  - The client authenticates the server via TLS.
  - The server authenticates the client using the token.

Finding the SciToken

- The client will send the token it finds in its environment using the Bearer Token Discovery protocol.
- Short version:
  - Look at the contents of the $BEARER_TOKEN environment variable.
  - Look at the contents of the file referred to by $BEARER_TOKEN_FILE.
  - Look at the contents of $XDG_RUNTIME/bt_u$UID
  - Look at the contents of /tmp/bt_u$UID
- The first token discovered is used; no matching is performed as in IDTOKENS.

Compare and Contrast: Token Auth'n

IDTOKENS-Specific

- Signed by the server (or whoever holds the symmetric key).
- Only verified by the same symmetric key.
- Discovery in a well-known user directory.
- Not sent to server; used to establish a shared secret.

Common

- Token format is JWT; can be introspected with any common JWT tools.
- Token contains common JWT attributes: expiration, validity time, subject/identifier.

SCITOKENS-Specific

- Signed by third-party JWT issuer.
- Verified by anyone who can download the public key.
- Discovered via WLCG Bearer token discovery protocol.
- Sent to server over TLS (Server needs host certificate)

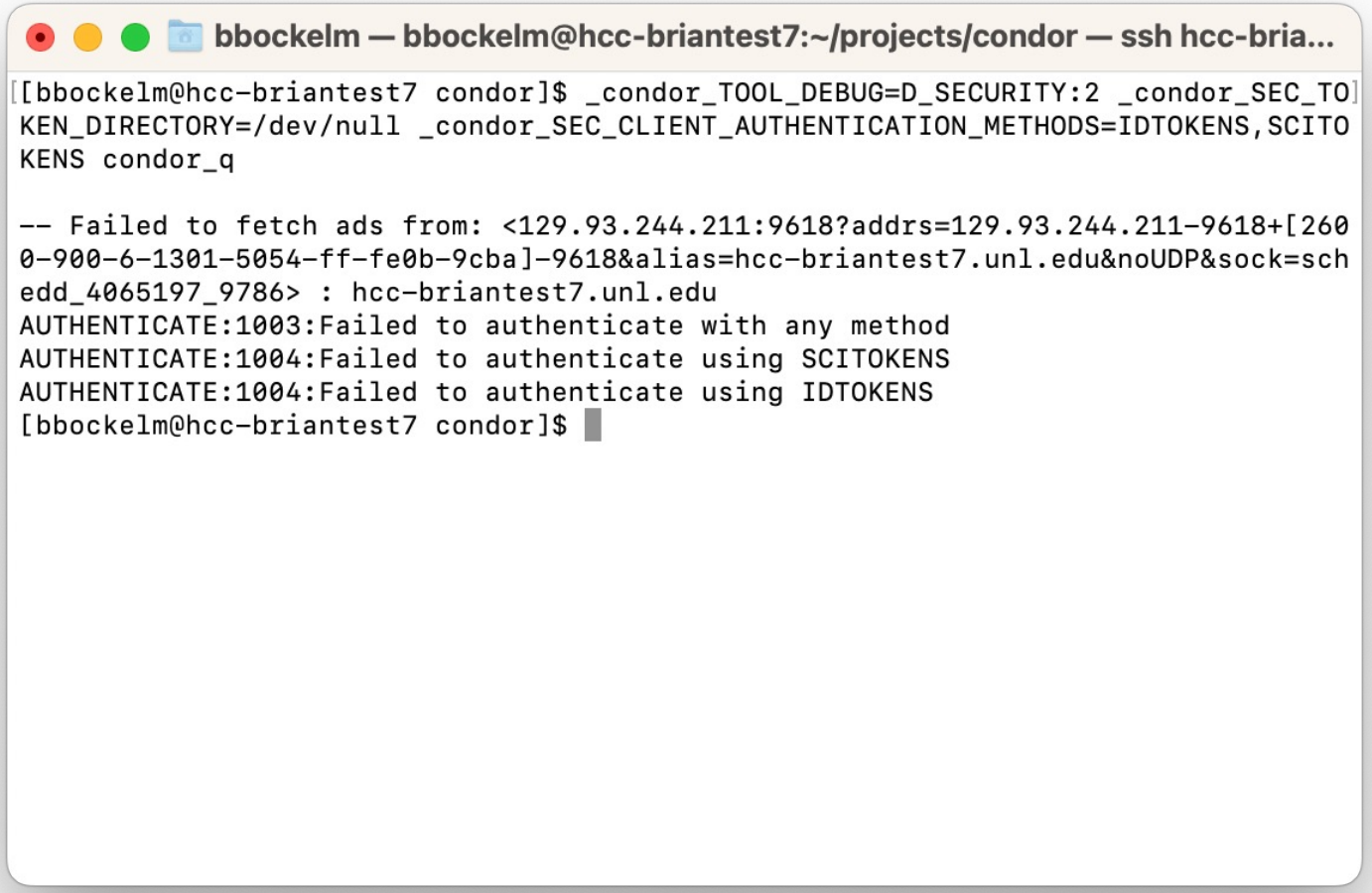
Authentication: SSL

Authentication Protocol

- Well … you know … TLS!
  - It is framed using HTCSS's CEDAR protocol, not raw TCP sockets. Cannot debug this with "openssl s_client".
  - About every 2 years we review the TLS crypto parameters to ensure they are modern (e.g., no MD5!).
- Client certificate / RFC 3820 proxy certificate is optional; the server can be configured to require one, however.
- Client certificate is discovered only using the value of AUTH_SSL_CLIENT_CERTFILE/AUTH_SSL_CLIENT_KEYFILE; does not follow Globus conventions

Authentication Failures

- When authentication fails, the client tool prints out every method it tried.
- It does not print out the failure reason for any of the protocols.
  - Sometimes this is because the server provides no error message about the rejection.
- Enabling security debug logging (D_SECURITY:2) is necessary to debug authentication failures.



Authentication Failures

bbockelm — bbockelm@hcc-briantest7:~ — ssh hcc-briantest7.unl.edu —...

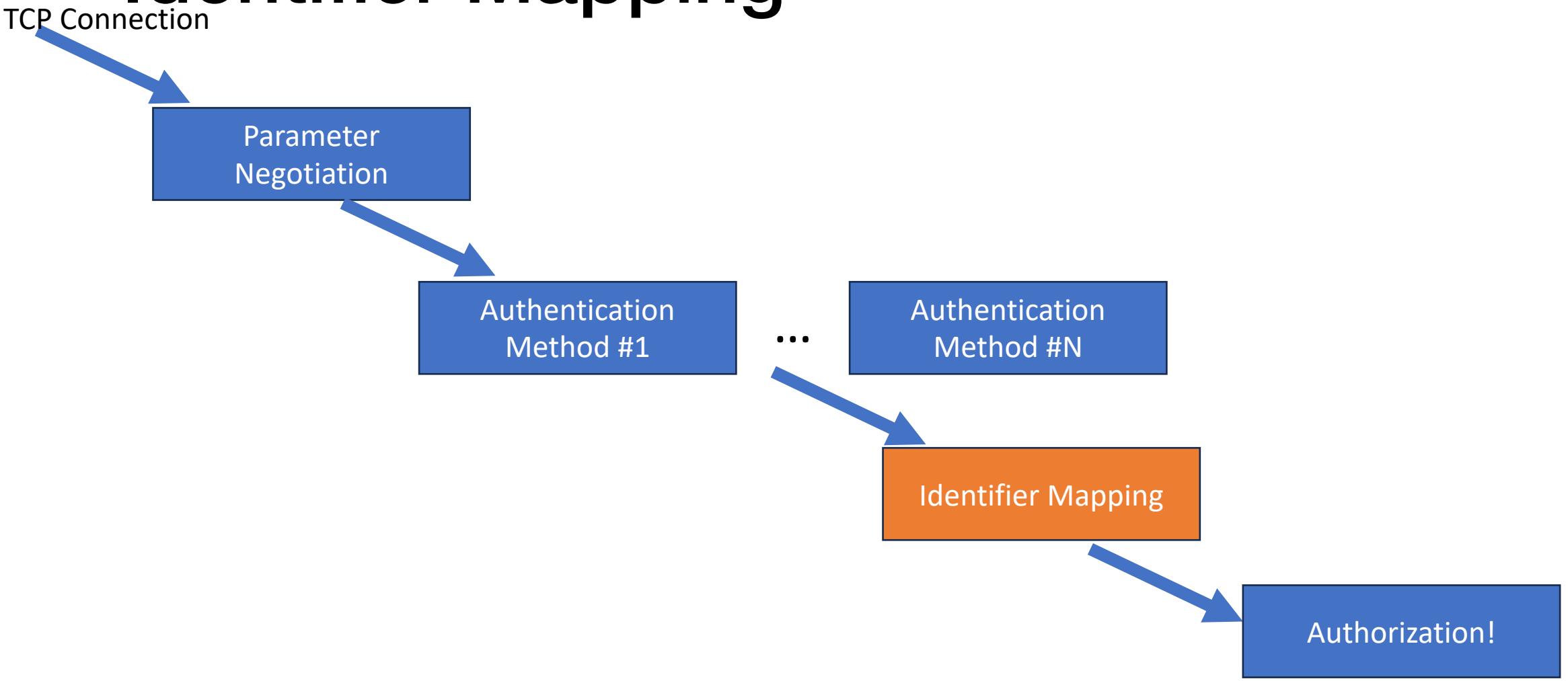
```
[bbockelm@hcc-briantest7 ~]$ _condor_TOOL_DEBUG=D_SECURITY:2 _condor_SEC_CLIENT_
AUTHENTICATION_METHODS=SSL condor_q

-- Failed to fetch ads from: <129.93.244.211:9618?addrs=129.93.244.211-9618+[260
0-900-6-1301-5054-ff-fe0b-9cba]-9618&alias=hcc-briantest7.unl.edu&noUDP&sock=sch
edd_1778306_94d1> : hcc-briantest7.unl.edu
AUTHENTICATE:1003:Failed to authenticate with any method
AUTHENTICATE:1004:Failed to authenticate using SSL
[bbockelm@hcc-briantest7 ~]$
```

bbockelm — bbockelm@hcc-briantest7:~ — ssh hcc-briantest7.unl.edu —...

```
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) SSL Auth: Trying to connect.
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) -Error with certificate at dept
h: 0
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY)   issuer   = /C=US/O=Let's Encr
ypt/CN=R3
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY)   subject  = /CN=hcc-briantest7
.unl.edu
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY)   err 20:unable to get local is
suer certificate
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) Tried to connect: -1
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) SSL: library failure: error:140
90086:SSL routines:ssl3_get_server_certificate:certificate verify failed
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) Round 3.
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) Send message (3).
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) Status (c: 3, s: 2)
07/11/23 22:26:19.814 (pid:1780000) (D_SECURITY) SSL Auth: SSL Authentication fa
iled
07/11/23 22:26:19.815 (pid:1780000) (D_SECURITY) AUTHENTICATE: method 256 (SSL)
failed.
07/11/23 22:26:19.815 (pid:1780000) (D_SECURITY) AUTHENTICATE: can still try the
se methods:
07/11/23 22:26:19.815 (pid:1780000) (D_SECURITY) HANDSHAKE: in handshake(my_meth
ods = '')
07/11/23 22:26:19.815 (pid:1780000) (D_SECURITY) HANDSHAKE: handshake() - i am t
he client
```

Compare output with debug disabled (left) versus enabled (right)

Identifier Mapping



Identity Mapping & Authorization

HTCSS has an ‘Identifier Mapfile’

- For identity-based schemes, the mapfile is an important tool to translate between authentication credentials and a HTCondor identifier.
- This mapfile has 3 columns: authentication method, authentication identifier, target HTCondor identifier.
  - By default, authentication identifier is a regexp.
- Sadly, this is known as the “CERTIFICATE_MAPFILE”.

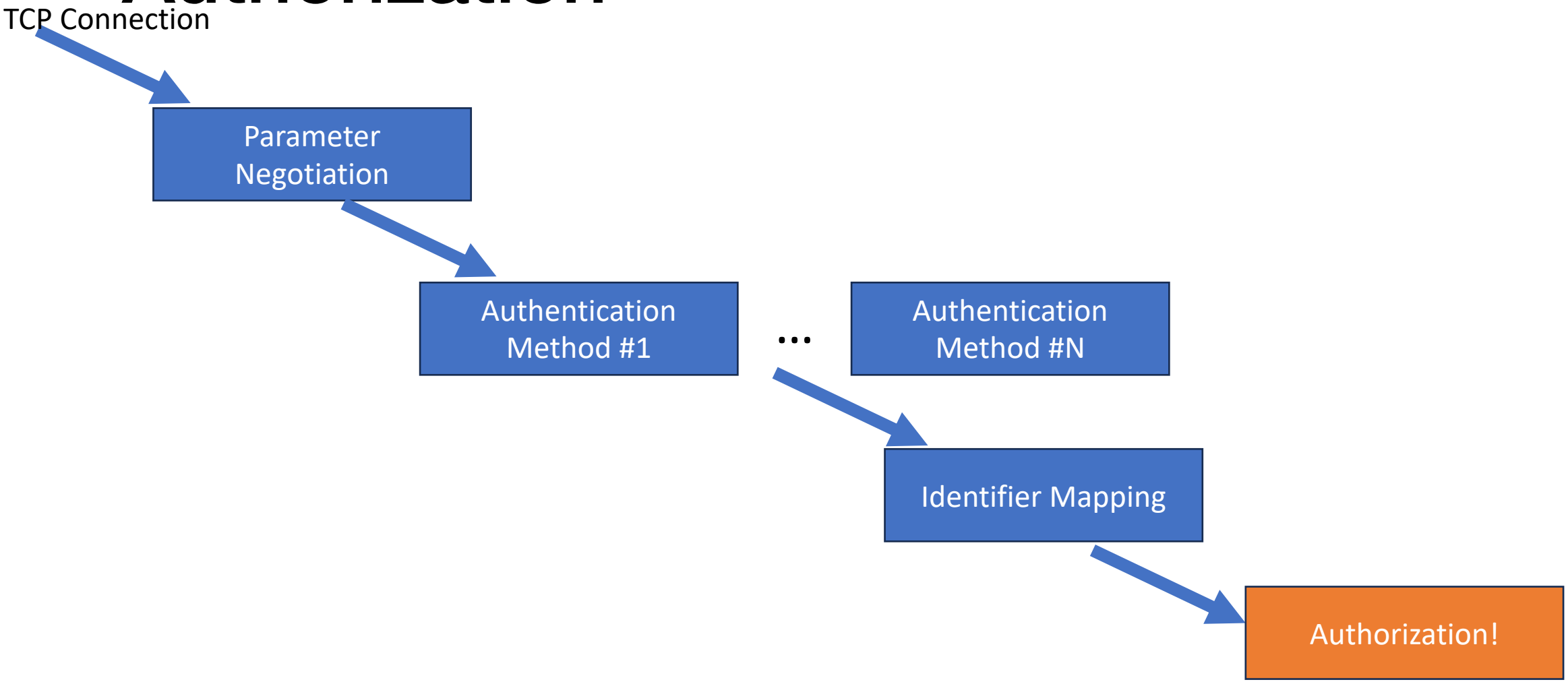
Identifier Mapfile Example

```
SCITOKENS "https://demo.scitokens.org" bbockelm@test.wisc.edu
SCITOKENS "https://wlcg.cloud.cnaf.infn.it/,27234843-fedf-42c8-bb81-
a1695bbd7c28" bbockelm@test.wisc.edu
SCITOKENS /^https\:\/\/osg\-htc\.org\/osdf,OSDF-(.*)@osg-htc.org$/ $1@osg-
htc.org
SSL "/DC=ch/DC=cern/OU=Organic Units/OU=Users/CN=bbockelm/CN=659869/CN=Brian
Paul Bockelman" bbockelm@test.wisc.unl.edu
INCLUDE /etc/condor/mapfile.d
```

Anonymous Identifiers

- If no HTCondor identifier can be established, protocols will default to an anonymous one.
- Unfortunately, we spell ‘anonymous’ as…
  - ‘unauthenticated@unmapped’ if no authentication is used.
  - ‘unauthenticated@unmapped’ if SSL is used but no client certificate is presented.
  - ‘ssl@unmapped’ if SSL is used, a client certificate is presented, but no mapping is available.
  - CONDOR_ANONYMOUS_USER@CONDOR_ANONYMOUS_USER if the ANONYMOUS method is used.
  - scitokens@unmapped if SCITOKENS is successful but no mapping is available.

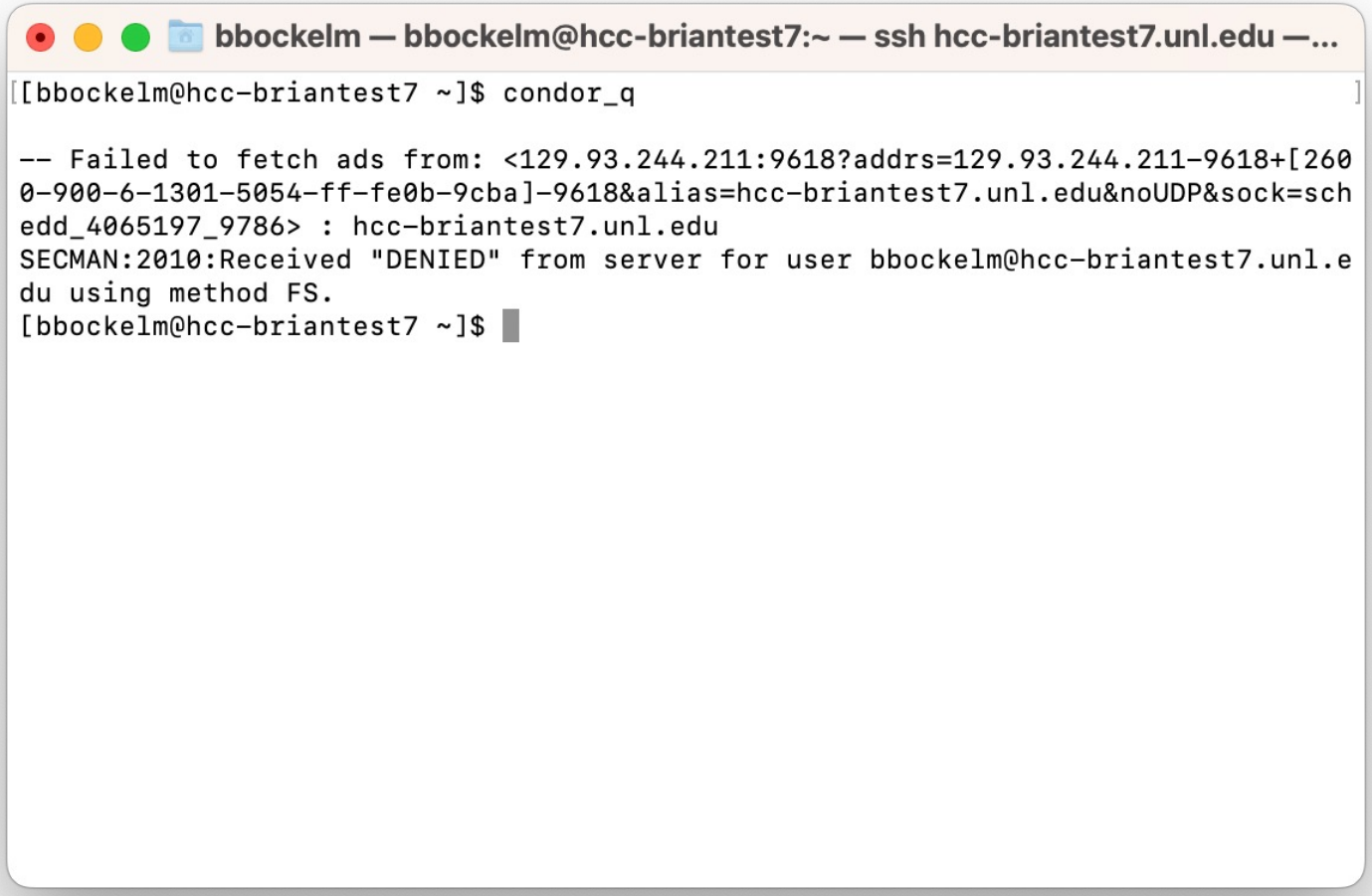
Authorization



Authorizations

- Once a HTCondor identifier is established, we finally determine whether the action is allowable.
- These are controlled by the ALLOW_* / DENY_* configurations.
- The ALLOW/DENY configurations are a list of identifiers of the form “$identifier/$host_restriction”. Examples:
  - *@wisc.edu/124.104.3.*
  - bbockelm@unl.edu
  - */*.wisc.edu
- DENY entries take precedence. If no matches for ALLOW, then the authorization is denied.

Authorization Failures



- Finally! We have an error message.

If in doubt – condor_ping it!

bbockelm — bbockelm@hcc-briantest7:~ — ssh hcc-briantest7.unl.edu — 103×17

```
[bbockelm@hcc-briantest7 ~]$ condor_ping -table ALL -type SCHEDD
          Instruction Authentication Encryption Integrity Decision Identity
                ALLOW             FS         AES       AES    ALLOW bbockelm@hcc-briantest7.unl.edu
                 READ           FAIL        FAIL      FAIL     FAIL FAIL  (use -verbose for more info)
                WRITE             FS         AES       AES    ALLOW bbockelm@hcc-briantest7.unl.edu
            NEGOTIATOR           FAIL        FAIL      FAIL     FAIL FAIL  (use -verbose for more info)
         ADMINISTRATOR           FAIL        FAIL      FAIL     FAIL FAIL  (use -verbose for more info)
                OWNER            FAIL        FAIL      FAIL     FAIL FAIL  (use -verbose for more info)
               CONFIG            FAIL        FAIL      FAIL     FAIL FAIL  (use -verbose for more info)
               DAEMON              FS         AES       AES    ALLOW bbockelm@hcc-briantest7.unl.edu
     ADVERTISE_STARTD              FS         AES       AES    ALLOW bbockelm@hcc-briantest7.unl.edu
     ADVERTISE_SCHEDD            FAIL        FAIL      FAIL     FAIL FAIL  (use -verbose for more info)
     ADVERTISE_MASTER              FS         AES       AES    ALLOW bbockelm@hcc-briantest7.unl.edu
[bbockelm@hcc-briantest7 ~]$
```

Final Thoughts / TODO list

- This was a fun overview to write!
- Please view this as a framework for understanding security handshake failures; impossible to enumerate all the possible reasons.
- Some observations from my side:
  - Incompatibility of settings is indecipherable from a network error.
  - The failure messages never say what part of the security handshake failed.
  - Authentication failure reasons are not in the failure messages, only the failure logs.
- Some great TODOs for the dev team!

Acknowledgements

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