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The NSF Cybersecurity Center of Excellence

Jupyter Security

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Introduction: Agenda, etc.

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Our mission: to provide the NSF community a coherent understanding of cybersecurity's role in producing trustworthy science and the information and know-how required to achieve and maintain effective cybersecurity programs.

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https://trustedci.org/

What is Cyberinfrastructure (CI)?

"The comprehensive infrastructure needed to capitalize on dramatic advances in information technology has been termed cyberinfrastructure (CI). Cyberinfrastructure integrates hardware for computing, data and networks, digitally-enabled sensors, observatories and experimental facilities, and an interoperable suite of software and middleware services and tools. "

-NSF Cyberinfrastructure Vision for 21st Century Discovery

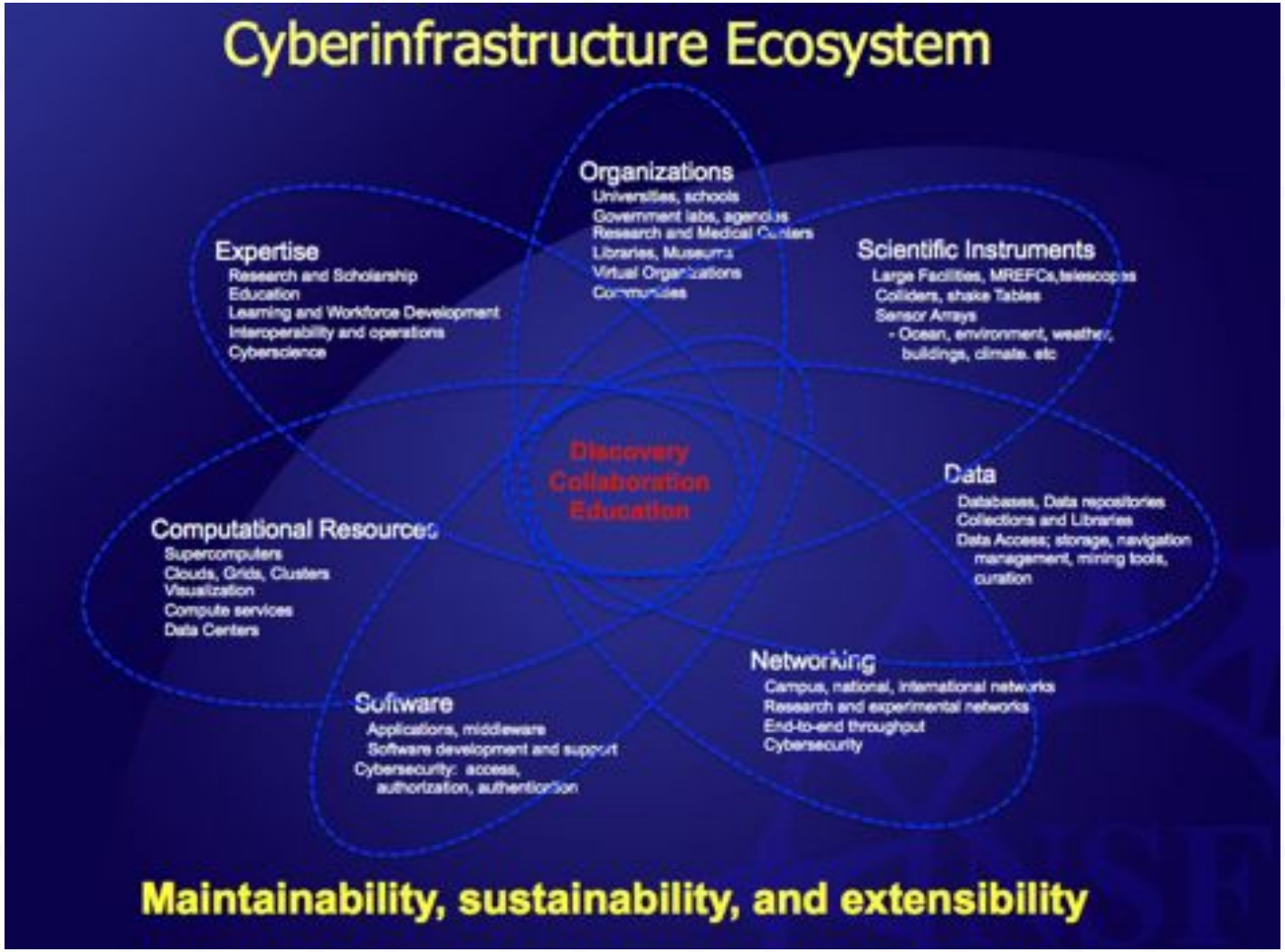

Image credit: NSF

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Today's Agenda

30 minutes:

- Taking questions: What do you want to know about Jupyter & Jupyter security?
- What are the gaps in the current documentation and understanding?
- We'll try to answer some of these questions at the end.

30 minutes:

- What is Jupyter?
- The landscape: Project Jupyter; notebooks; notebook server; IPython; JupyterHub; etc.
- Architecture, where things run and how they communicate.

90 minutes, with a 30 minute break at 4:00 p.m:

- Running Jupyter notebooks.
- Viewing un-encrypted traffic.
- Configure and run JupyterHub.
- Configure security options & recheck traffic.
- Set up external authentication

60 minutes:

- Answer questions from the beginning
- Discussion of Jupyter use cases and needs around security best practices.

Taking questions

- Who are you?
- What is your experience with Jupyter?
- What are you hoping to get out of this workshop/which questions do you have?

Introduction to Jupyter
&
Jupyter Security

Where to ask for help & contribute

- Jupyter.org/community
- Mailing list and security repositories.
  - security@ipython.org (Google Group, You can request access)
  - More concern contact core dev of relevant projects or steering council
- https://discourse.jupyter.org/
- GitHub
- gitter.im
- Jupyter at Research Facilities google groups

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Overview of Jupyter architecture & nomenclature

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Jupyter Notebook

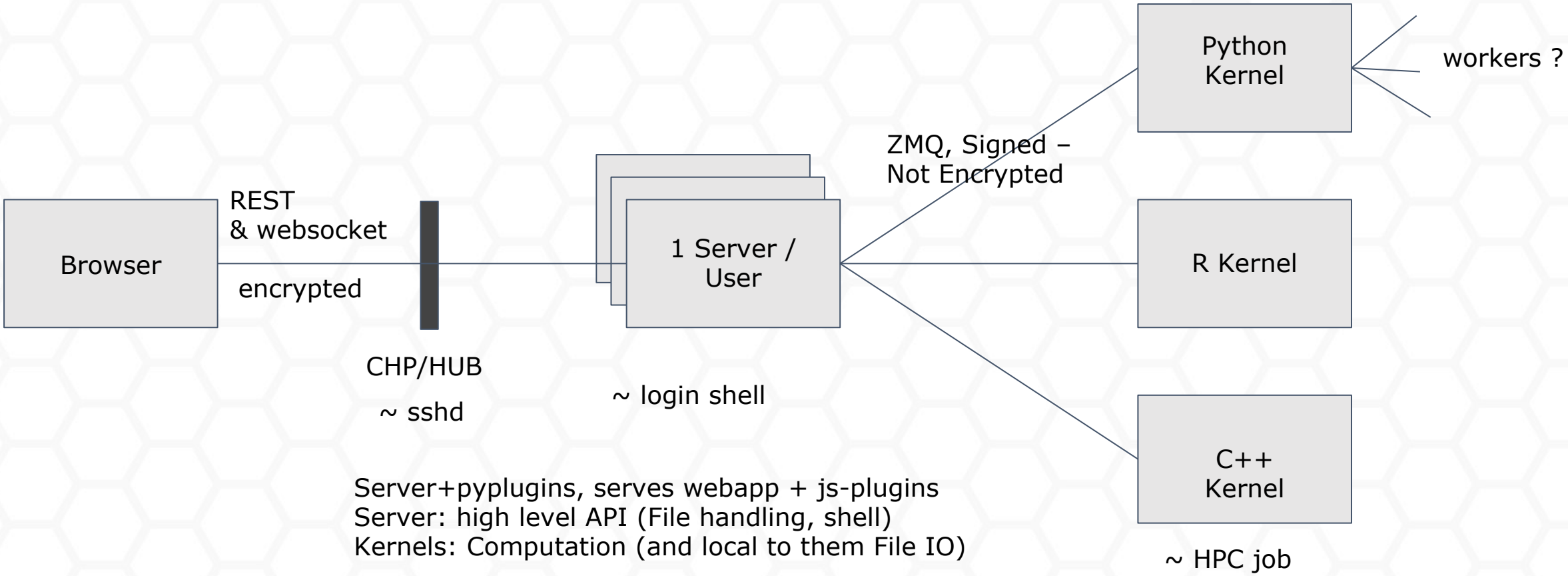
- Notebook **documents** are produced by Jupyter Notebook **App** which contain both computer code and rich text elements.
- The jupyter Notebook app is a server-client application that allows editing and running notebook documents via web browser.
- Notebook can be **executed** on a local desktop requiring no internet access or can be installed on a remote server and accessed through the internet.
- You will notice the **Jupyter** and **Notebook** terms are highly overloaded.

Running a Notebook Server

- By default, a notebook server runs locally at 127.0.0.1:8888 & accessible only from localhost
- By default use unique token authentication on filesystem to protect from other processes from other users accessing the API
- Understanding Single-User threat model is critical to understand multi-user deployment threat-model.

- Multi-user deployment should use JupyterHub

Jupyter Architecture



Server+pyplugins, serves webapp + js-plugins
Server: high level API (File handling, shell)
Kernels: Computation (and local to them File IO)

Name / Nomenclature

- **IPython** : Python package that handle executing the User-defined Python code. Historically all the **Jupyter-(.+)** where into IPython repo and named **IPython-\1.** Now only the CLI to execute Python
- **IPykernel**: Small Wrapper around IPython that talk the Jupyter ZMQ Protocol.
- **Kernel:** A process that execute user code.
- **Notebook Server:** Single user web server that serve the html/js for the browser app handles files and some plugins. Websocket/ZMQ bridge.
- **Notebook App:** JS app running in user's browser
- **Notebook document/file:** the actual json file on disk, or as loaded in the above JS APP
- **JupyterHub:**
  - Set of processes, plugin and configuration to do **Multi-User deployment**
  - **Hub itself** (jupyter aware) **+ CHP**(generic software defined networking)
- **Binder:** Authentication-less, w/ ephemeral users JupyterHub.
- **Zero-To-JupyterHub:** Hands on Deploy your own JupyterHub

Note: Many of these are *defaults* there are a number of alternatives implementations.

Threat Model vs Functionality

Avoid: Arbitrary Code Execution

Allow: Arbitrary Code Execution

Venn Diagram

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Threat Model

- **Kernel: Ensure request come from identified source (signature). Beyond that arbitrary code execution is the goal. Even modifying kernel itself. Use other mechanisms to prevent issues: Quotas, Docker, Cgroup...**

- **Server: Run as the unprivileged user. Gateway to all the functionality. Equivalent to shell. Largest attack surface. Most API need authentication (cookie). Target of enumeration attacks; bruteforce… Rarely interprets any user supplied data – though plugins can.**

- **CHP/HUB: Proxy credentials; delegate some services; allow impersonation; privileged user. Smallest attack surface; ONLY PRIVILEGED PROCESSES**

- **Browser: Arbitrary JS extension; interprete user input; opened files; Display embedded HTML/JS.**

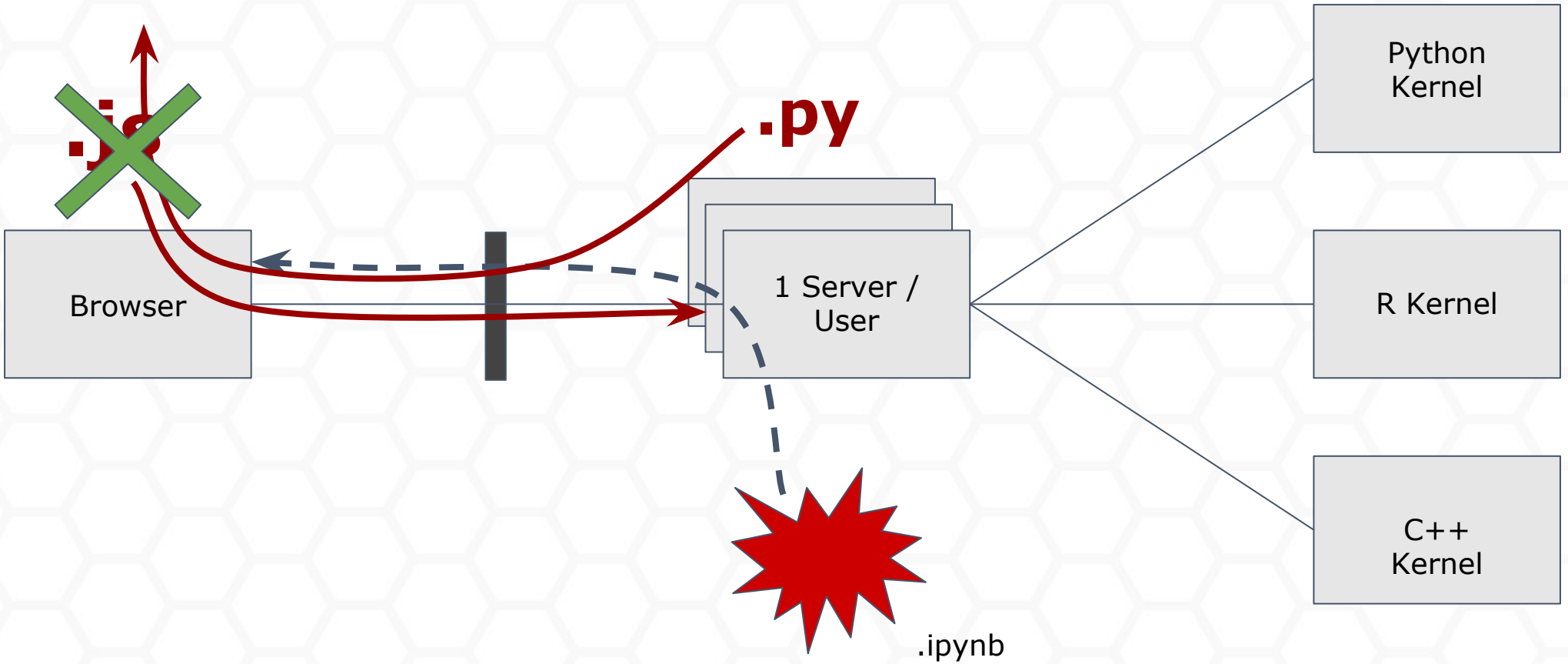
Threat Model Example of Attacks

- **Kernel:**
  - **Malicious Library (pip install panda <- no s, and import panda)**
  - **Sniff ZMQ request; user code has sensitive input (password in clear ?)**

- **Server:**
  - **Rogue Plugin can access all files / executions.**
  - **Token with in World-Writable location, impersonate user.**

- **CHP/HUB:**
  - **MITM Admin user**

- **Browser:**
  - **XSS, Phishing incite user to “trust”**



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Jupyter core security model

From https://jupyter-notebook.readthedocs.io/en/latest/security.html

Our security model

- Untrusted HTML is always sanitized
- **Untrusted** Javascript is never executed
- HTML and Javascript in Markdown cells are never trusted
- **Outputs** generated by the user are trusted
- Any other HTML or Javascript (in Markdown cells, output generated by others) is never trusted
- The central question of trust is “Did the current user do this?”

Trusted JS/HTML

HTML which is or **has been** explicitly requested by the user

Example:

- **Shift Enter**
- **Run All**
- **Trust This notebook**
  - **Once trusted, hash of the file stored on disk in LRU cache with random eviction.**

The rest of the security is pluggable

Example:

- Authentication PAM/LDAP
- Direct CHP or NGINX
- Kubernetes Spawner/Slurm Spawner/SUDO spawner.
- Resource limitation by cgroup.
- Single managed environment or per-user environment.

Securing an Installation

STEP -1

- If you don’t provide system wide install user will use ssh-tunnel and old versions. You want **control** and **monitoring** of how users use Jupyter.

- I’m assuming your users are not actively hostile toward each other

Securing an Installation

STEP 0

- You should use **JupyterHub**, and google for JupyterHub for any security related questions in **multi-user** scenario

“Secure Config Jupyter == Secure Config Bash”

“Secure Config Jupyter**Hub** == Secure Config sshd”

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Securing an Installation

STEP 1

- Mailing list and security repositories.
  - security@ipython.org (Google Group, You can request access)
  - More concern contact core dev of relevant projects or steering council
- https://discourse.jupyter.org/

Securing an Installation

STEP 2

- Securing Privileged processes. CHP/HUB
  - Run behind Nginx/Apache
  - Run as unprivileged (opt-in users)
    - Sudo Spawner (limit process privileges)
    - Slurm, Kubernetes Spawner (limit/isolate servers)

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```
Cmnd_Alias JUPYTER_CMD = /home/jupyterhub/miniconda3/bin/sudospawner

jupyterhub      ALL=(%jupyter)      NOPASSWD:JUPYTER_CMD
```

Securing an Installation

STEP 2

- None of Jupyter(Hub) processes are privileged
- Known SSL termination/vetted endpoint.
- per-user server isolated potentially even more.

- ADMIN/Sudoers weak link to elevated privileges
- Can run them in container/VM if you wish.

Securing an Installation

STEP 3

- Use OAUTH/LDAP authenticator/2FA

Securing an Installation

STEP 3

- Reduce User friction and possibility for Phishing.
- Reduce possibility to use social engineering to get access.
- Directly hook into monitoring, fail2ban...

Securing an Installation

STEP 3

- SSL all the way (CHP to single-user servers)
- and/or , Spawn in containers...

Securing an Installation

STEP 3

- Reduce possibility for attacker that got access to 1 account to potentially see traffic between CHP/Single-users

Not worse than SSHD at that point

At that point we are about as secure as we can be than SSH.

Admin users still sensitive targets, but Oauth/LDAP passwd != System password (hopefully).

Admin could still impersonate and access some services other can’t.

Securing an Installation

STEP 4

- Restrict and Configure Jupyter itself.

- By default we assume users are not malicious once logged-in but you might want to control environment.

STEP N+

- Spawn kernels on remote machine (Enterprise Gateway)
- Use non-file based storage backend (can control “trusted” state of files).
- Monitor/Cull idle kernels, Servers.
- …

At that point Hub is **more restrictive** than user install + ssh tunnel

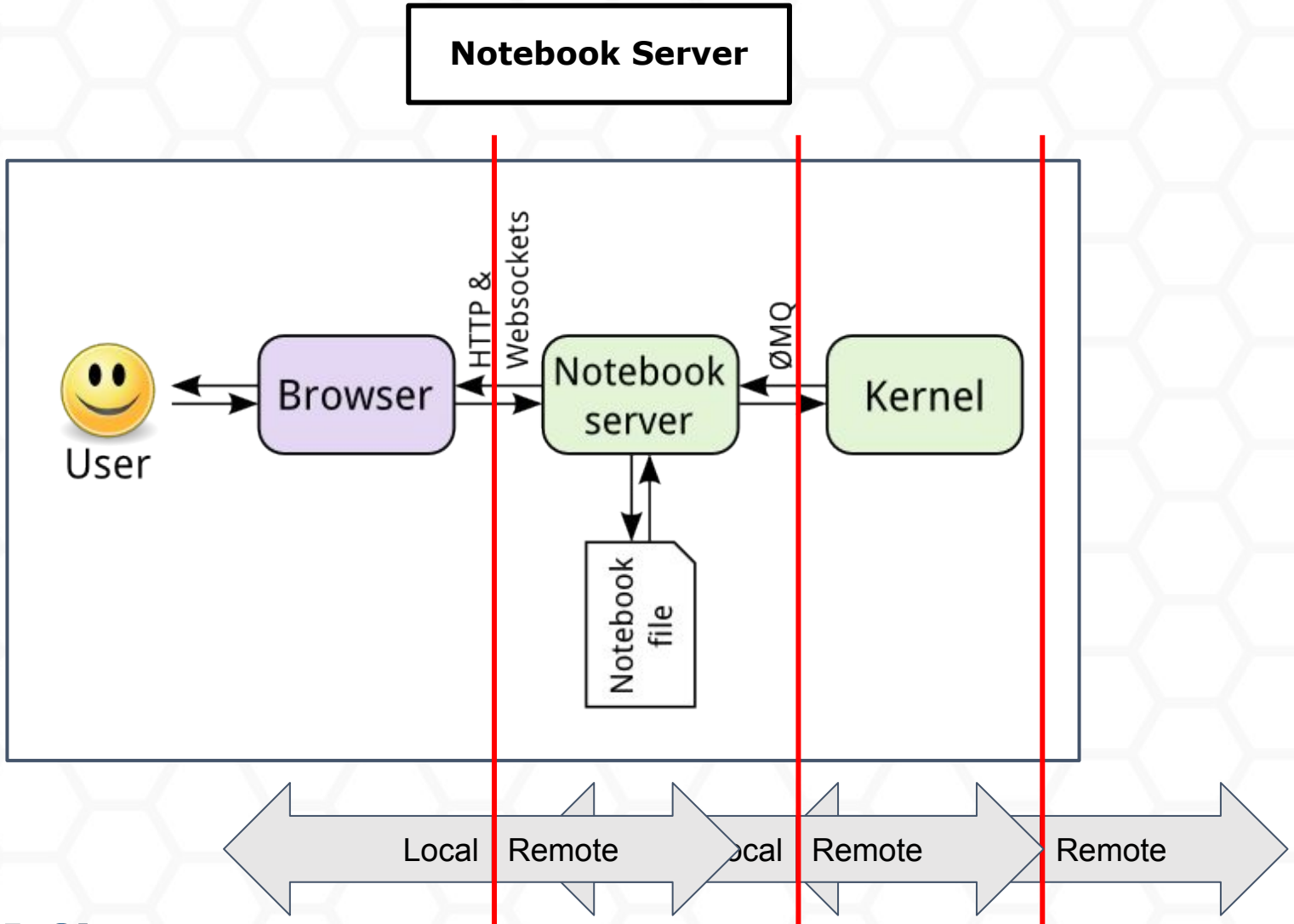
- Control/Limit plugin installation
- Monitor
- (Auto) start and stop user’s servers

Risk awareness

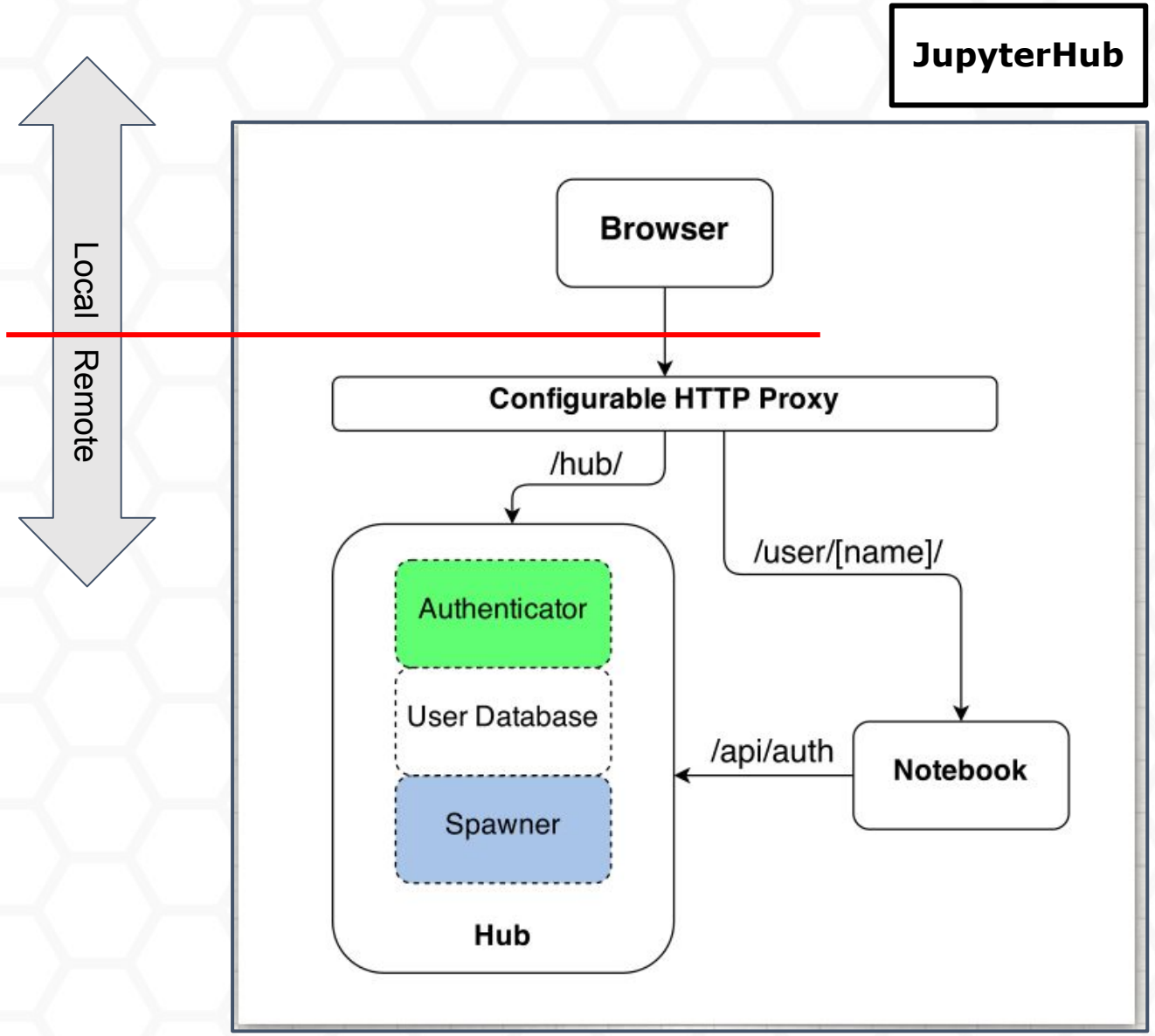
- Notebooks allow arbitrary code to be run by those you provide access to.
- Notebooks are often shared between colleagues.
- It is important to restrict access to the notebook server.
- Jupyter 4.3+ has token based auth enabled by default. Token passed in URL, Header or via login form.
- Projects are setting up the Jupyter server to be run in novel ways, such as on a supercomputer cluster.
-

Hands-On Exercises

Jupyter Security Boundaries



Jupyter Security Boundaries



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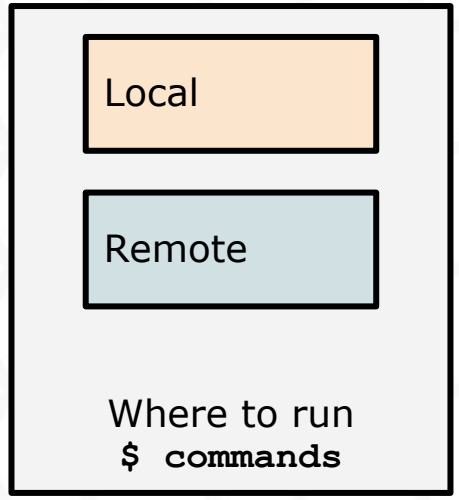
Hands on Exercises

Hosts:

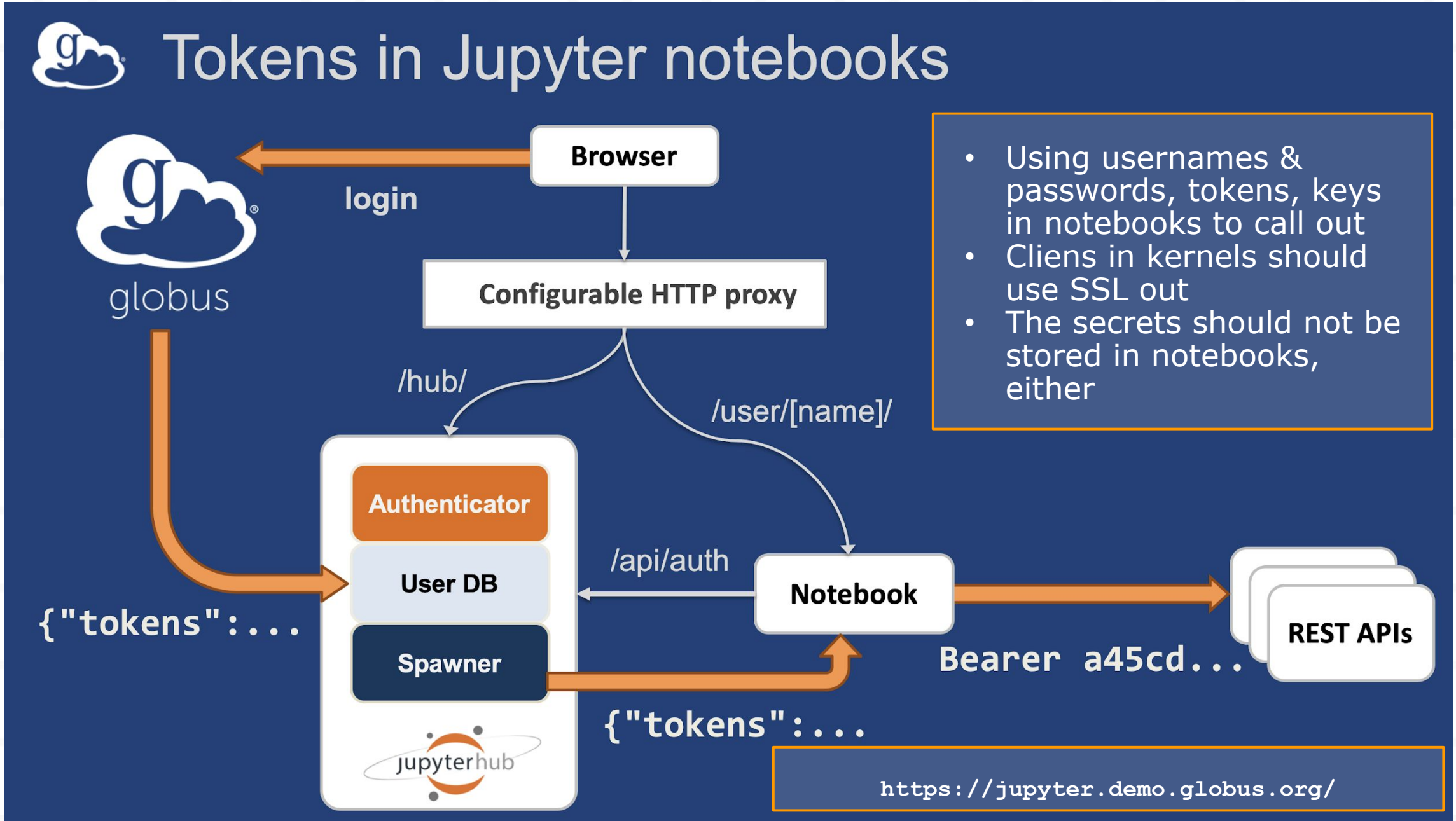
- Go to spreadsheet and pick a hostname and IP, put your name down
- Ubuntu 18.04 LTS
- Hostnames are `trusted-ci[1-N].globus-training.net`

User accounts:

- "`campusadmin`" (passwordless sudo permissions) is for configuring Jupyter
- "`researcher`" (unprivileged) is intended to demonstrate user access
- Password will be on the whiteboard

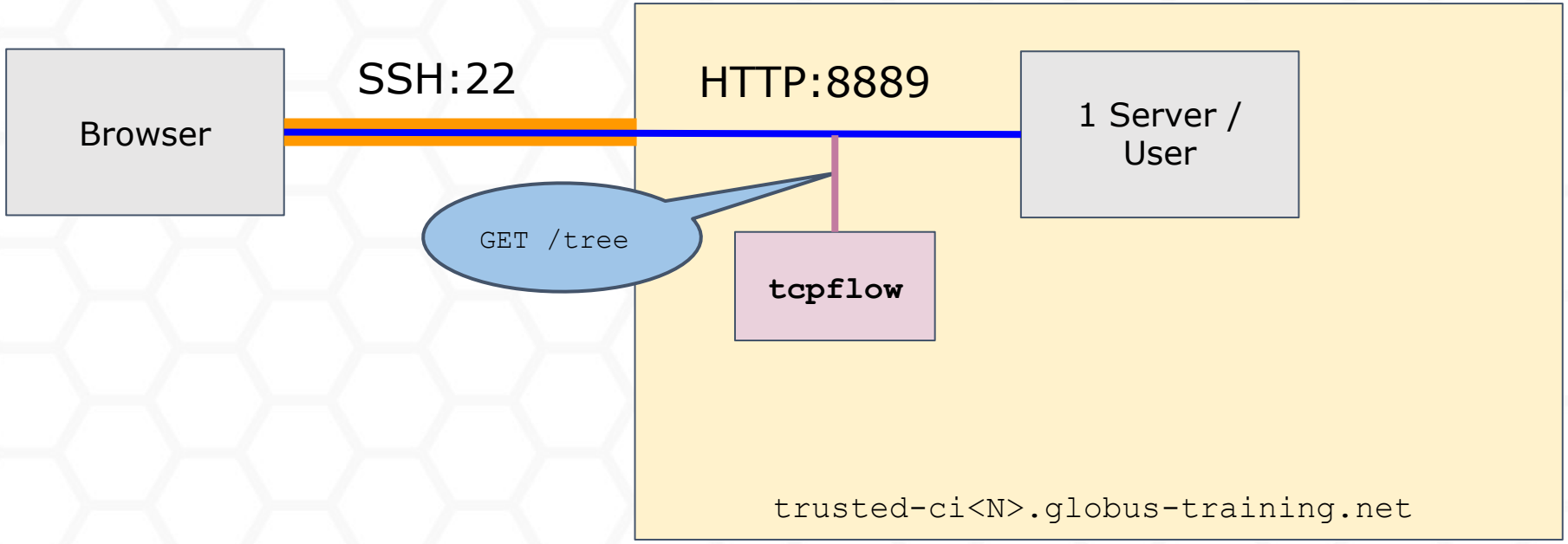


Driving Security Motivation: Calling APIs



- Using usernames & passwords, tokens, keys in notebooks to call out
- Cliens in kernels should use SSL out
- The secrets should not be stored in notebooks, either

Single User Notebook Server



Access Remote Notebook Server

SSH to the server

```
local:~$ ssh campusadmin@trusted-ci<N>.globus-training.net
```

Start a single user Jupyter notebook server

```
campusadmin@trusted-ci<N>:~$ jupyter notebook --no-browser --port=8889
```

Run `tcpflow`

"**`tcpflow`** is a program that captures data transmitted as part of TCP connections (flows), and stores the data in a way that is convenient for protocol analysis and debugging."

It's like `tcpdump` with readable text output. --Rick

Basic command

```
campusadmin@trusted-ci<N>:~$ sudo tcpflow -p -c -i lo port <port>
```

I don't recommend leaving this running

Let's run this on the HTTP port

```
campusadmin@trusted-ci<N>:~$ sudo tcpflow -p -c -i lo port 8889 | grep 'password='
```


https://github.com/simsong/tcpflow

Access Remote Notebook Server

Port forward from your laptop the server

```
local:~$ ssh -N -f -L localhost:8888:localhost:8889 \
  campusadmin@trusted-ci<n>.globus-training.net
```

Look for this line in your Jupyter server output:

```
http://localhost:8889/?token=a0fac14de491e7eb80ba8ab0e6e1ee16ad6ef4532d1316ca
```

Change 8889 to 8888 & put that line in a browser

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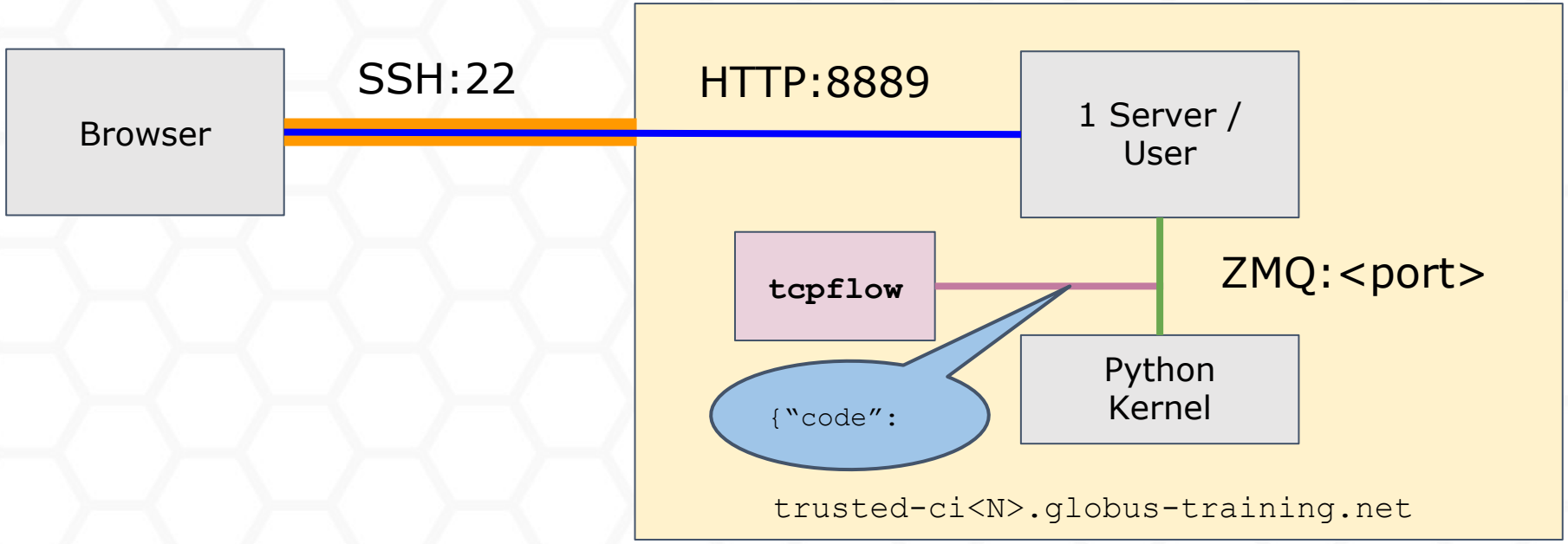
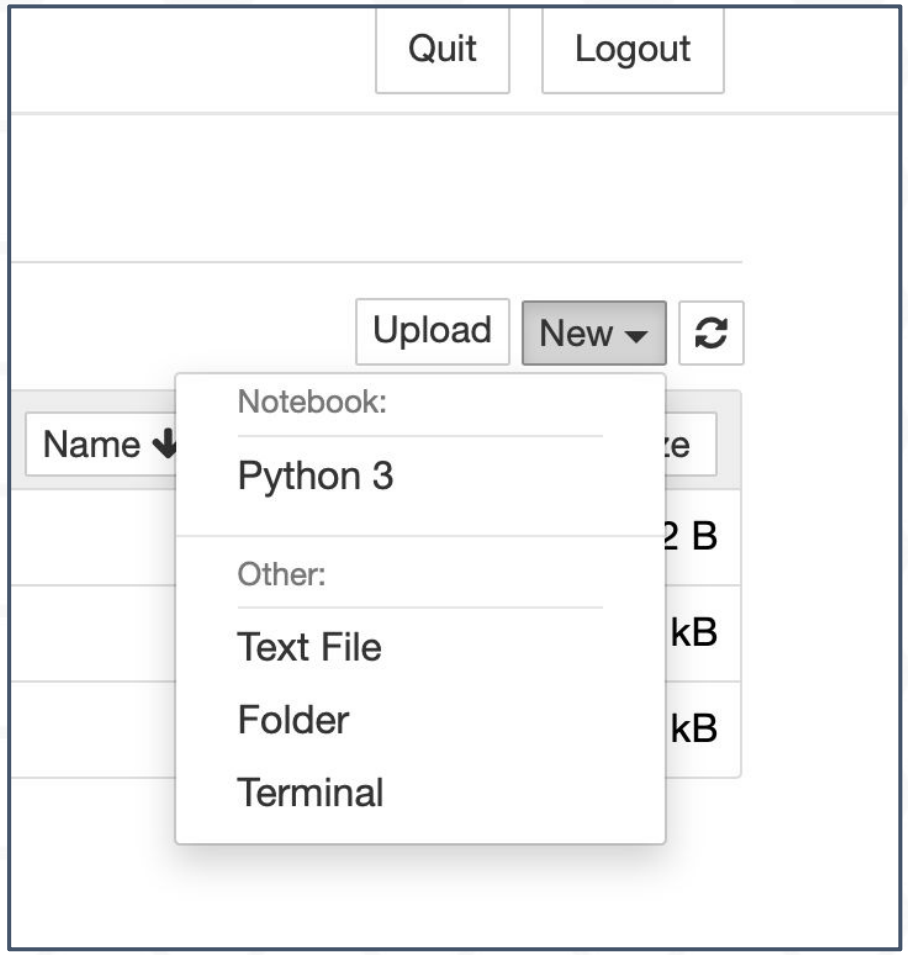
tcpflow HTTP Capture

```
campusadmin@trusted-ci1:~$ sudo tcpflow -p -c -i lo port 8889
tcpflow: listening on lo
127.000.000.001.43882-127.000.000.001.08889: GET
/?token=1297a2b4dc6e3d7ec8a95f6443acff930f1f1920f3172ac8 HTTP/1.1
Host: localhost:8888
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Upgrade-Insecure-Requests: 1
Cookie:
username-localhost-8888="2|1:0|10:1571099165|23:username-localhost-8888|44:MzlkZTk1NjNhYjBmNDU2MWEyYmV
mOWE5MjhlNzlmOTE=|8a9b04bf9af42ef7d84da55c9f3cc06ac1b91a330608ca2378a1743d7ed617cb";
_xsrf=2|25101594|37f123c20fef78ecf3cb7bb75bb7b5f1|1569445998
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15) AppleWebKit/605.1.15 (KHTML, like Gecko)
Version/13.0.2 Safari/605.1.15
Accept-Language: en-us
Accept-Encoding: gzip, deflate
Connection: keep-alive


127.000.000.001.08889-127.000.000.001.43882: HTTP/1.1 302 Found
Server: TornadoServer/6.0.3
Content-Type: text/html; charset=UTF-8
Date: Tue, 15 Oct 2019 05:04:56 GMT
Location: /tree?token=1297a2b4dc6e3d7ec8a95f6443acff930f1f1920f3172ac8
Content-Length: 0
```

Notebook Server <-> Kernel Traffic



Start a Kernel & Notebook
Find its Ports



Connection information is in the notebook

```
In [1]: %connect_info
{
  "shell_port": 33479,
  "iopub_port": 49461,
  "stdin_port": 40731,
  "control_port": 37079,
  "hb_port": 49495,
  "ip": "127.0.0.1",
  "key": "f81be3e1-ac51af8526582e50f89670f0",
  "transport": "tcp",
  "signature_scheme": "hmac-sha256",
  "kernel_name": ""
}
```

Start a Kernel & Notebook Find its Ports

On host, connect info also in file.

Keep file ACLs limited to user

If “you” get connect info and **key**

“you” can connect and execute code as user

Connection information is also in the user home directory

```
campusadmin@trusted-ci1:~$ cd .local/share/jupyter/runtime/
campusadmin@trusted-ci1:~$ ls -1tr
notebook_cookie_secret
nbserver-8485.json
nbserver-8485-open.html
nbserver-9738.json
nbserver-9738-open.html
kernel-e6757c17-0699-4e15-8ac7-4596c7178844.json
campusadmin@trusted-ci1:~$ cat kernel-*
{
  "shell_port": 33617,
  "iopub_port": 56051,
  "stdin_port": 52759,
  "control_port": 55021,
  "hb_port": 50873,
  "ip": "127.0.0.1",
  "key": "1a917676-c05a83835fc282317c41975d",
  "transport": "tcp",
  "signature_scheme": "hmac-sha256",
  "kernel_name": ""
}
campusadmin@trusted-ci1:~$
```

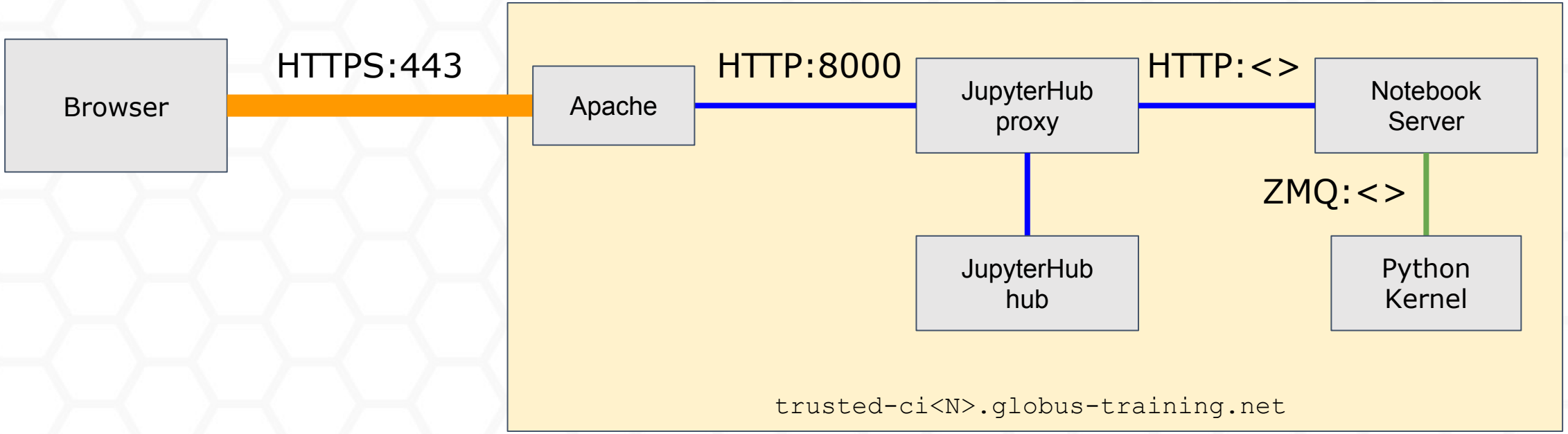
Listen to Kernel Input and Output

```
In [9]: import os
        print('because no one ever stores secrets in the environment')
        for k in ('USER', 'PWD', 'HOME'):
            print('{}: {}'.format(k, os.environ[k]))

        because no one ever stores secrets in the environment
        USER: campusadmin
        PWD: /home/campusadmin
        HOME: /home/campusadmin
```

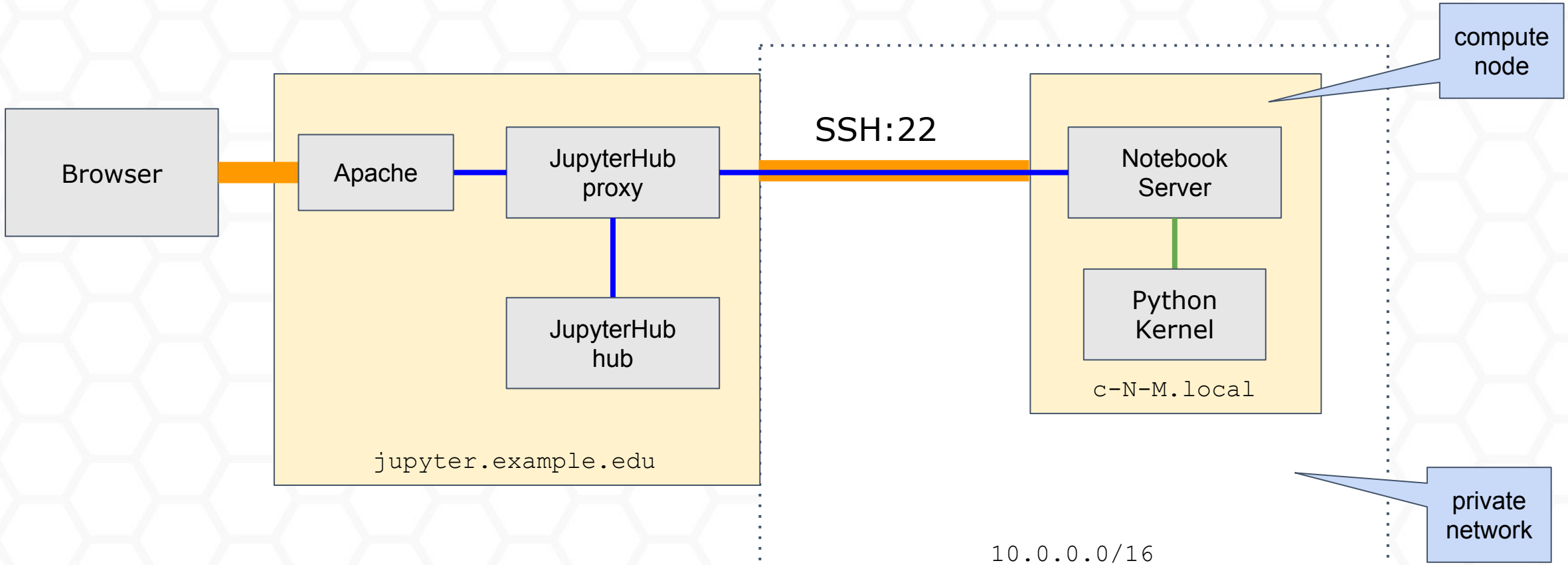
```
$ sudo tcpflow -p -c -i lo port 56051
tcpflow: listening on lo

127.000.000.001.56051-127.000.000.001.43522:
... .snip. ...
{"code":"import os\nprint('because no one ever stores secrets in the environment')\nfor k
in ('USER', 'PWD', 'HOME'):\n    print('{}: {}'.format(k,
os.environ[k]))","execution_count":10}
... .snip. ...
{"name":"stdout","text":"because no one ever stores secrets in the environment\nUSER:
campusadmin\nPWD: /home/campusadmin\nHOME: /home/campusadmin\n"}
```

JupyterHub Starting Point

<> = “random” ports



JupyterHub HPC/Cluster Model



Setting Up JupyterHub

Going to set up JupyterHub available at

`https://trusted-ci<N>.globus-training.net/jhub/`

These hosts have Let’s Encrypt certs enabled

Apache config /etc/apache2/sites-enabled/000-default-le-ssl.conf

Apache Rewrites & Proxies

Add to `/etc/apache2/sites-enabled/000-default-le-ssl.conf`
Add to

```
RewriteEngine On
RewriteCond %{HTTP:Connection} Upgrade [NC]
RewriteCond %{HTTP:Upgrade} websocket [NC]

RewriteRule /jhub/(.*) ws://127.0.0.1:8000/jhub/$1 [P,L]
RewriteRule /jhub/(.*) http://127.0.0.1:8000/jhub/$1 [P,L]

<Location "/jhub/">
  # preserve Host header to avoid cross-origin problems
  ProxyPreserveHost on
  # proxy to JupyterHub
  ProxyPass         http://127.0.0.1:8000/jhub/
  ProxyPassReverse  http://127.0.0.1:8000/jhub/
</Location>
```

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Bounce Apache

```
sudo systemctl restart apache2.service
```

JupyterHub Config & Start

SSH to the server

```
local:~$ ssh campusadmin@trusted-ci<N>.globus-training.net
```

Create default JupyterHub config and start JupyterHub

```
$ cd /etc/jupyterhub
$ sudo jupyterhub --generate-config -f \
   /etc/jupyterhub/jupyterhub_config.py
$ sudo jupyterhub --ip 127.0.0.1 --port 8000 --base-url \
  '/jhub/' --config=/etc/jupyterhub/jupyterhub_config.py
```

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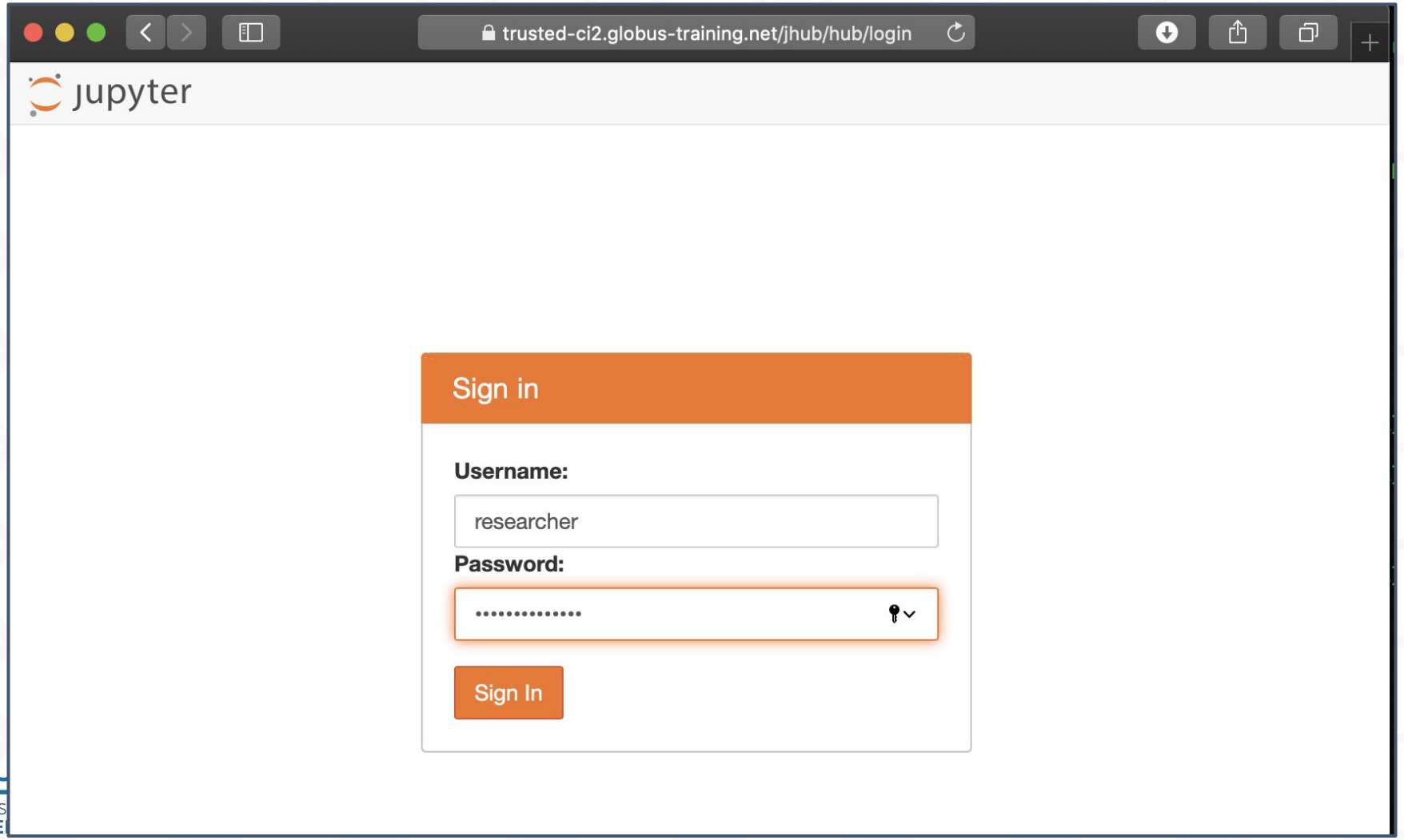
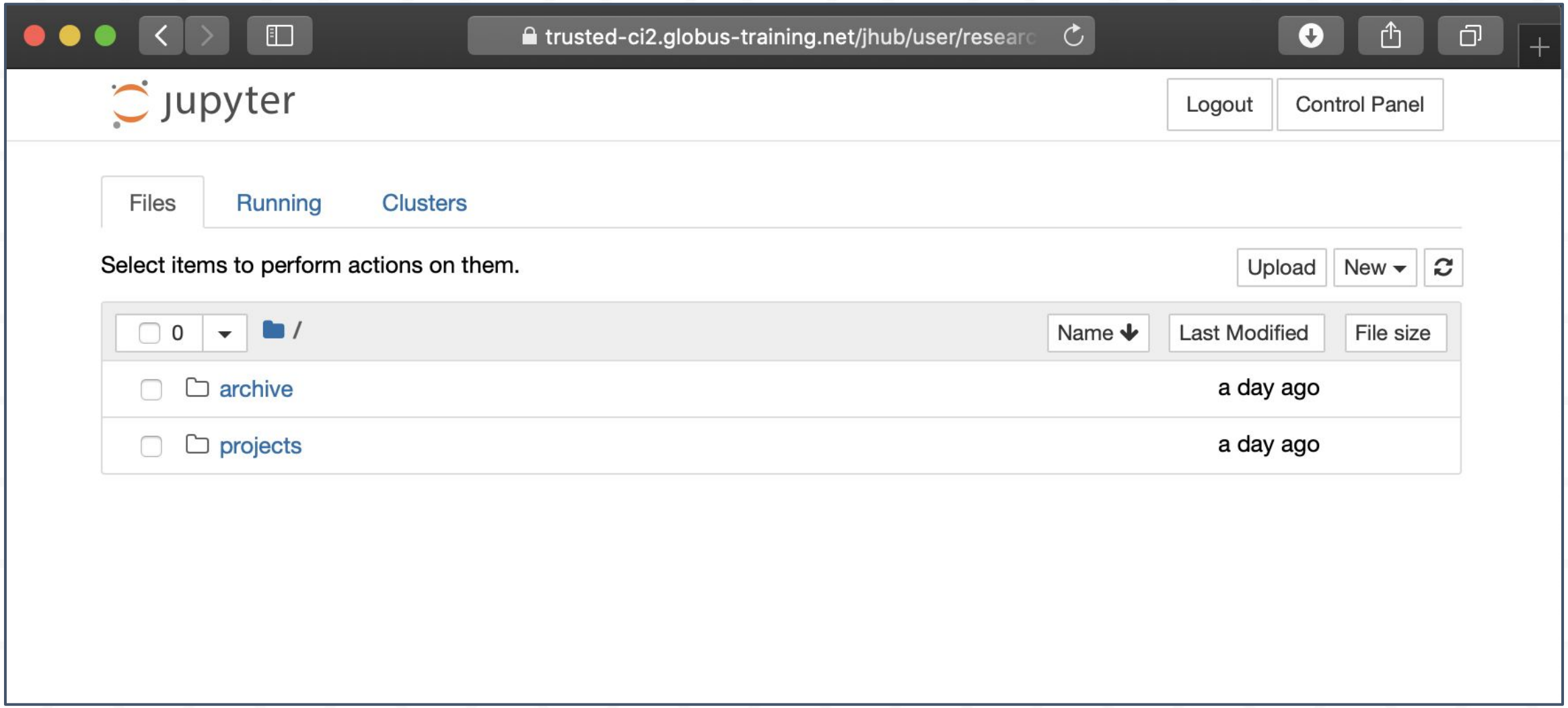
- We're going to be changing the JupyterHub config a lot.
- Should go into a service script.

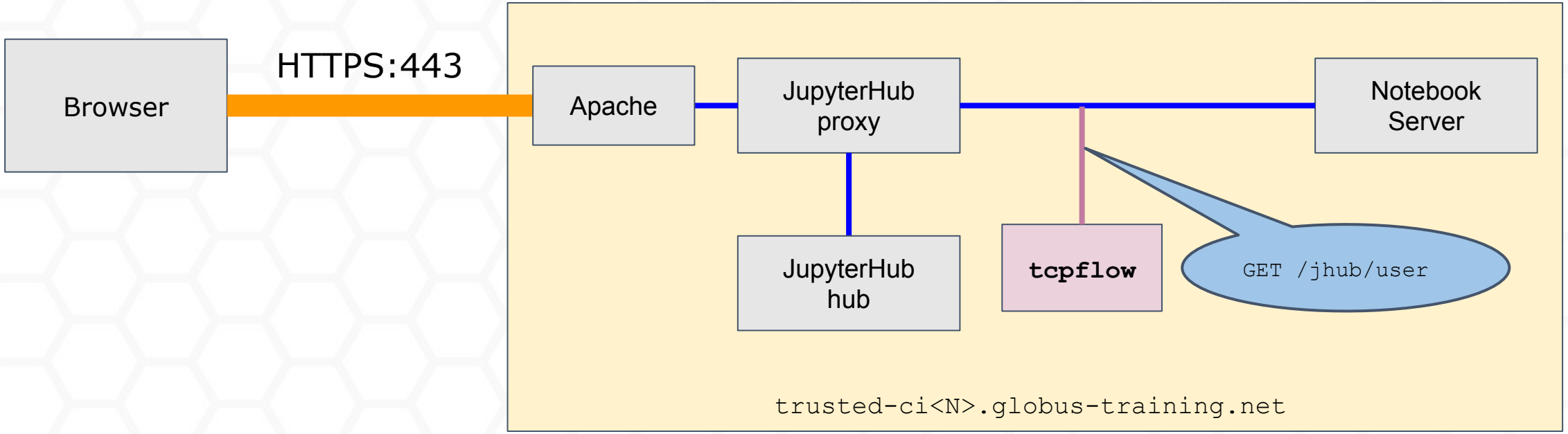
Login As Researcher



Login As Researcher



JupyterHub Internal Traffic



<> = “random” ports

Find the Proxy Port

```
[I 2019-10-15 01:49:24.982 JupyterHub proxy:261] Adding user researcher to proxy /jhub/user/researcher/
=> http://127.0.0.1:41009
01:49:24.984 [ConfigProxy] info: Adding route /jhub/user/researcher -> http://127.0.0.1:41009
01:49:24.985 [ConfigProxy] info: Route added /jhub/user/researcher -> http://127.0.0.1:41009
```

Listen...

```
campusadmin@trusted-ci2:~$ sudo tcpflow -p -c -i lo port 41009
tcpflow: listening on lo

127.000.000.001.50114-127.000.000.001.41009: GET /jhub/user/researcher/api/sessions?_=1571122288275
HTTP/1.1
x-forwarded-proto: http
x-forwarded-port: 80
```

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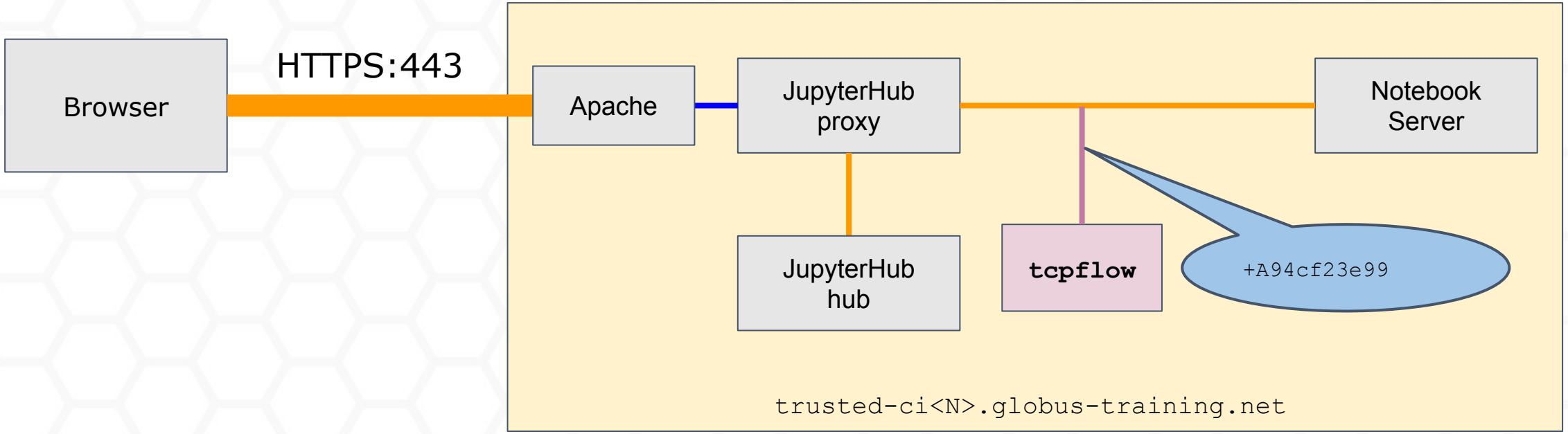
JupyterHub Internal SSL



<> = “random” ports

Update Config and Create Certs

Add to `/etc/jupyterhub/jupyterhub_config.py`

```
c.JupyterHub.trusted_alt_names = ['DNS:trusted-c<N>.globus-training.net', 'DNS:trusted-ci<N>']
c.JupyterHub.internal_certs_location = '/etc/jupyterhub/internal-ssl'
c.JupyterHub.internal_ssl = True
```

In `/etc/jupyterhub/`

```
$ sudo jupyterhub --ip 127.0.0.1 --port 8000 --base-url '/jhub/' \
    --config=/etc/jupyterhub/jupyterhub_config.py --generate-certs
[I 2019-10-15 02:16:07.663 JupyterHub app:1363] Adding CA for hub-internal:
IP:127.0.0.1;DNS:localhost;DNS:ec2-54-67-48-138.us-west-1.compute.amazonaws.com;DNS:trusted-c2.globus-tr
aining.net;DNS:trusted-ci2
[I 2019-10-15 02:16:07.889 JupyterHub app:1383] Generating signed pair for proxy-api:
IP:127.0.0.1;DNS:localhost;DNS:trusted-c2.globus-training.net;DNS:trusted-ci2
[I 2019-10-15 02:16:07.978 JupyterHub app:1383] Generating signed pair for proxy-client:
IP:127.0.0.1;DNS:localhost;DNS:trusted-c2.globus-training.net;DNS:trusted-ci2
[I 2019-10-15 02:16:08.143 JupyterHub app:2301] Certificates written to directory
`/etc/jupyterhub/internal-ssl`
```

Update Config and Create Certs

Start JupyterHub

```
$ cd /etc/jupyterhub
$ sudo jupyterhub --ip 127.0.0.1 --port 8000 --base-url \
  '/jhub/' --config=/etc/jupyterhub/jupyterhub_config.py
```

Browse to

```
https://trusted-ci<N>.globus-training.net/jhub/
```

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Me or JH Bug? User Cert Di rship

```
    'certfile "%s" does not exist' % self
ValueError: certfile "/home/resea                    does not exist
```

```
$ sudo ls -al /ho
total 40
drwxr-xr-x 7 resea
drwxr-xr-x 6 root
-rw-r--r-- 1 resear
-rw-r--r-- 1 researc
drwx------ 2 researc                                  ache
drwx------ 3 root                                  .27 .jupyterhub
drwx------ 3 research                              15 01:49 .local
-rw-r--r-- 1 researche                            807 Oct 13 22:45 .profile


$ sudo chown researcher:researcher /home/researcher/.jupyterhub
```

FIXED!

chown jupyterhub dir in user home #2785

Merged minrk merged 1 commit into jupyterhub:master from rpwagner:master 14 hours ago

https://github.com/jupyterhub/jupyterhub/pull/2785

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Find the Proxy Port

```
[I 2019-10-15 02:31:20.224 JupyterHub proxy:261] Adding user researcher to proxy /jhub/user/researcher/
=> https://127.0.0.1:36193
02:31:20.231 [ConfigProxy] info: Adding route /jhub/user/researcher -> https://127.0.0.1:36193
02:31:20.231 [ConfigProxy] info: Route added /jhub/user/researcher -> https://127.0.0.1:36193
```

Listen...

```
$ sudo tcpflow -p -c -i lo port 36193
tcpflow: listening on lo
```

Success!

```
$ sudo tcpflow -p -c -i lo port 36193
tcpflow: listening on lo
127.000.000.001.47846-127.000.000.001.36193: ]!='3|DqyUn/+0,'g(k$
jih98762.*&=5#@?>32101-)%</i$"trusted-ci2.globus-training.net
 3t
127.000.000.001.36193-127.000.000.001.47846: =9w*=b;g
0H1013073119Z010Uuser-researcher0"0
vWF%i<
EVK-z$FN}
-/qB/)~F5/|~S@|[HbUxRd`zj694cQUf'L|=Z}]#g/C3I|4FRL@<o*fTUj=P]_[O`UsHMgx4}4v\Ky?of%g]Ne?n0l0
U%0++0HUA0?localhosttrusted-ci2.globus-training.net:0%Ied`0V,;?.i^akNLp[?B.$rh$7IWc4Sus~=BOaMIAV74mdb=e>
4W|Ai^^=8;q1KFztPiPOk>{r:[<^3;5b5e8M9k%
6@.o:g[wGa-3*#mLkYc#pecT>`qQ#E;x9rhq_Z*!.#1>x.O3),N[Z=BZi])7DFm$;9{`6%W2G3"$T8C-A=`#C!Go:

0H1013072429Z010Uproxy-client0"00.001.36193: #000
B#\ <=LWBX3?lyW=v}jT-C@[&SxUnFl+zk\zw|q[PFlkMk$Xvk=#Th=-s_?d{8w0w^}$k@ck0W?]h-"mT4.SX`+S#wQ9C
```

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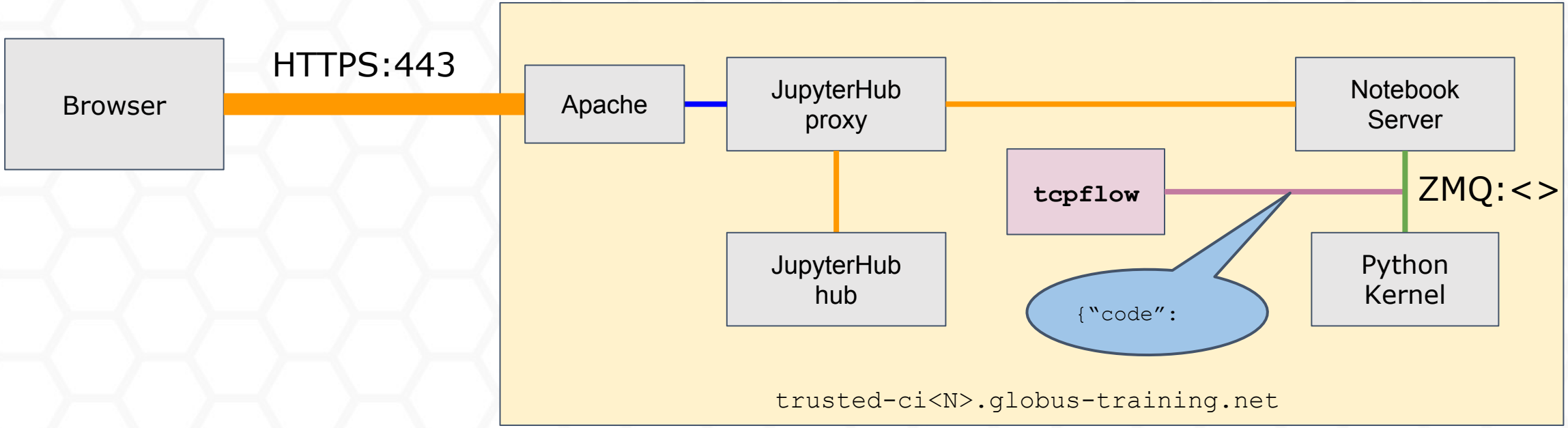
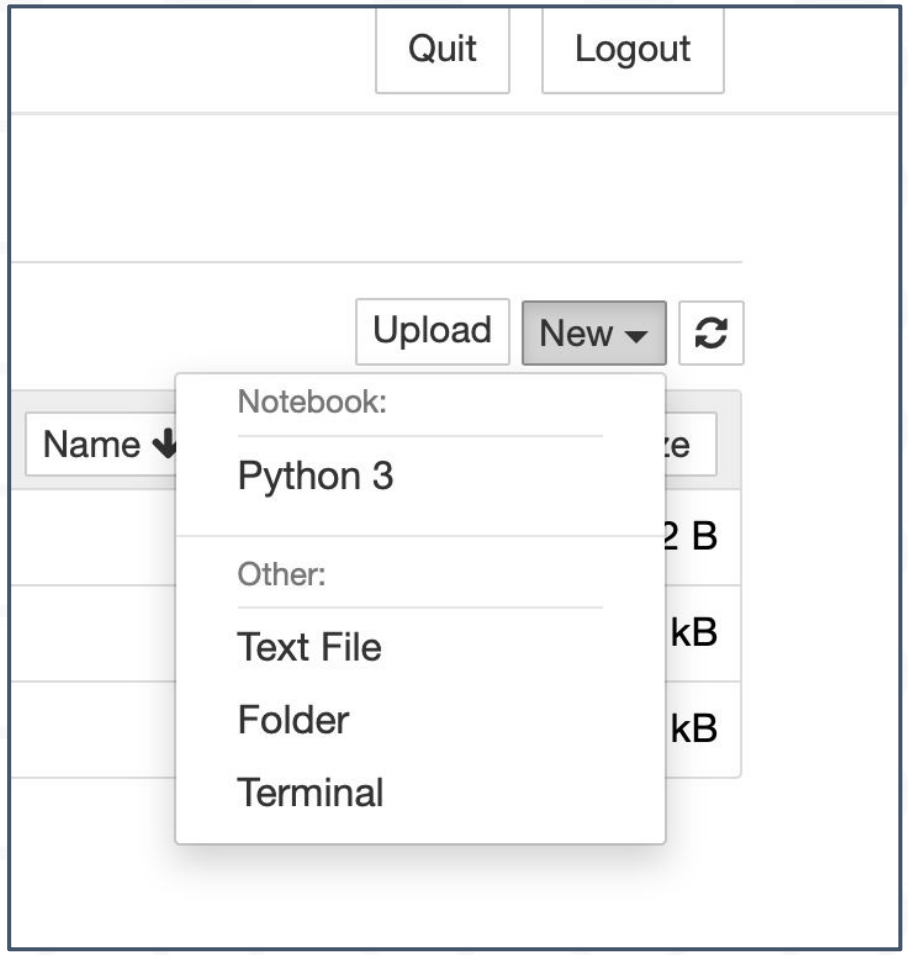
JupyterHub Internal SSL



<> = "random" ports

Start a Kernel & Notebook
Find its Ports




```
$ sudo ls -1tr /home/researcher/.local/share/jupyter/runtime/
nbserver-8485.json
nbserver-8485-open.html
nbserver-9738.json
nbserver-9738-open.html
kernel-e6757c17-0699-4e15-8ac7-4596c7178844.json
$ sudo cat \
  /home/researcher/.local/share/jupyter/runtime/kernel-...
{
  "shell_port": 45317,
  "iopub_port": 54279,
  "stdin_port": 47461,
  "control_port": 58485,
  "hb_port": 46187,
  "ip": "127.0.0.1",
  "key": "92b993fc-759de490904af0c952884cbd",
  "transport": "tcp",
  "signature_scheme": "hmac-sha256",
  "kernel_name": ""
}
```

{"code":

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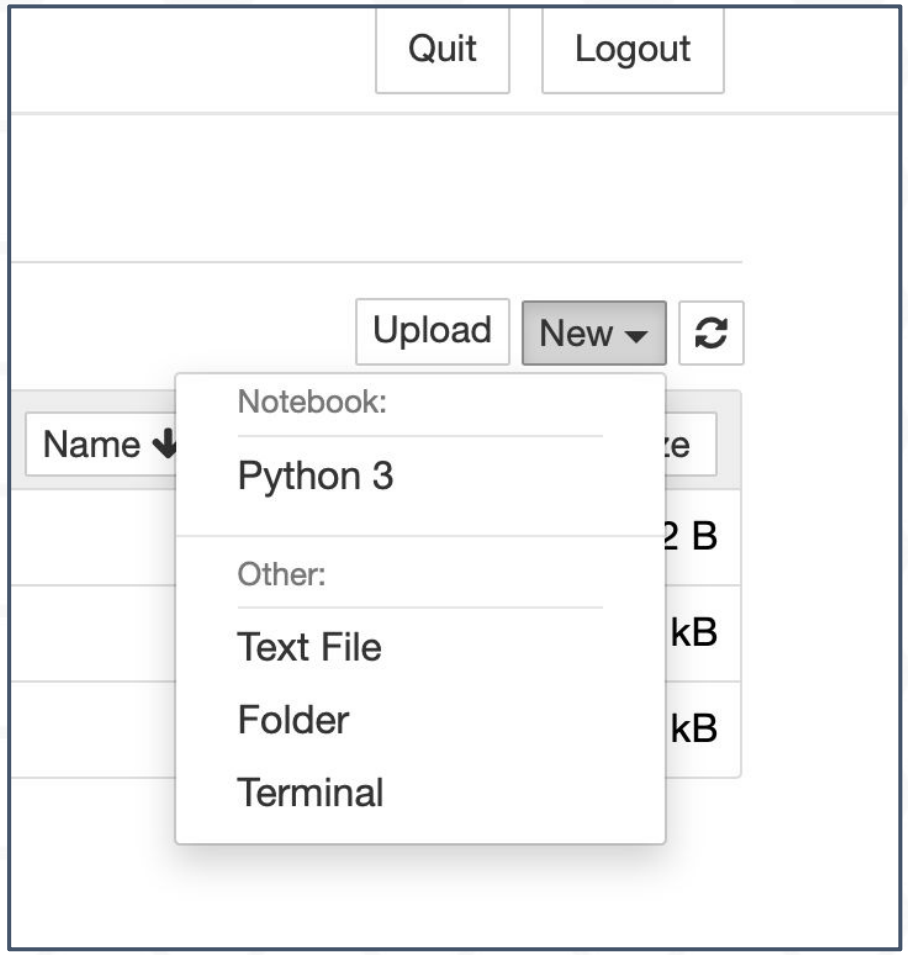
Change Kernel Communication to IPC

Add to /etc/jupyterhub/jupyterhub_config.py

```
c.Spawner.args = ['--transport="ipc"']
```

- IPC uses file descriptors to pass data
- Hard to intercept traffic
- Does not work between hosts
- ZeroMQ config for TLS available, in Jupyter soon
- Also good for single user notebook server

Start a Kernel & Notebook
Find its Ports




```
$ sudo ls -1tr /home/researcher/.local/share/jupyter/runtime/
nbserver-11237.json
nbserver-11237-open.html
kernel-0746a014-a85a-4959-8572-637bfcaef64d-ipc-4
kernel-0746a014-a85a-4959-8572-637bfcaef64d-ipc-3
kernel-0746a014-a85a-4959-8572-637bfcaef64d-ipc-2
kernel-0746a014-a85a-4959-8572-637bfcaef64d-ipc-1
kernel-0746a014-a85a-4959-8572-637bfcaef64d.json
kernel-0746a014-a85a-4959-8572-637bfcaef64d-ipc-5
$ sudo cat
/home/researcher/.local/share/jupyter/runtime/kernel-...
{
  "shell_port": 1,
  "iopub_port": 2,
  "stdin_port": 3,
  "control_port": 4,
  "hb_port": 5,
  "ip":
"/home/researcher/.local/share/jupyter/runtime/kernel-0746a014-
a85a-4959-8572-637bfcaef64d-ipc",
  "key": "1bc70c05-808f5bec9272a64f66967ac3",
  "transport": "ipc",
  "signature_scheme": "hmac-sha256",
  "kernel_name": ""
}
```

{"code":

{"code":

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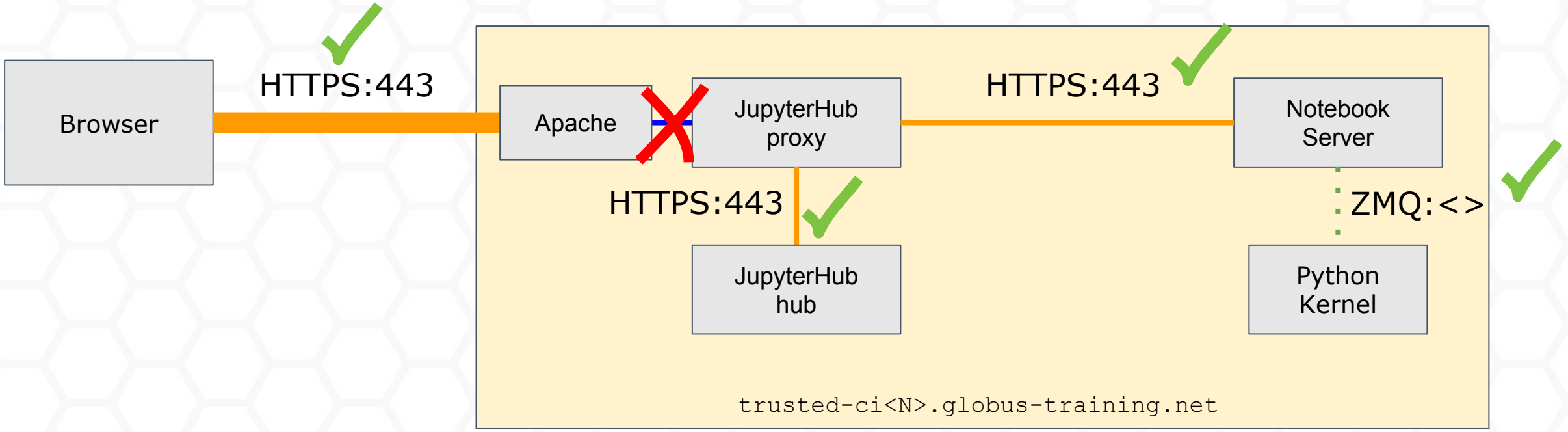
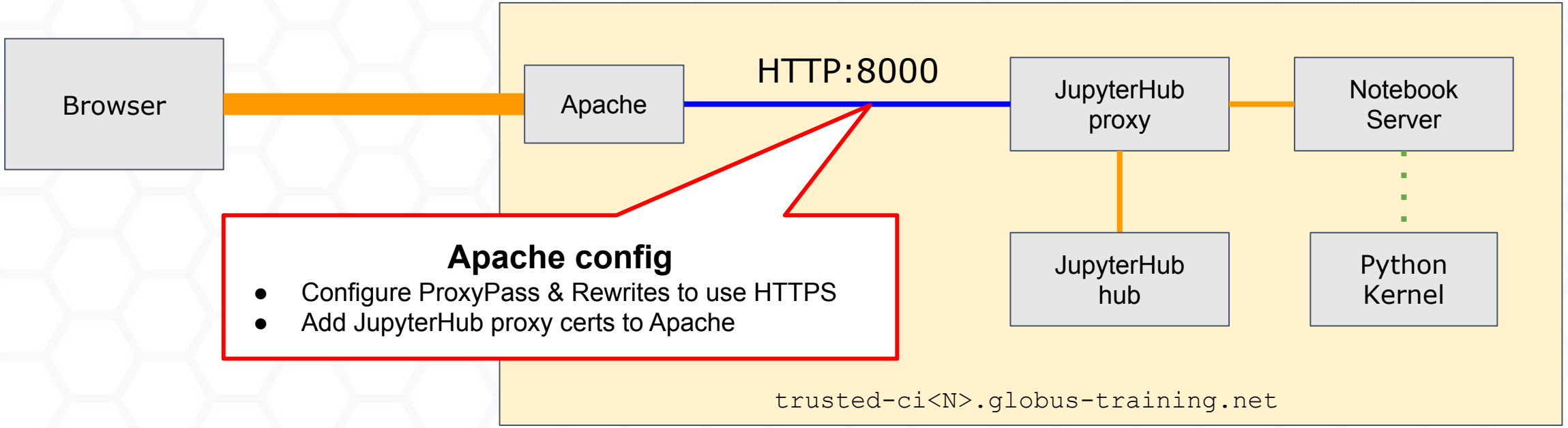
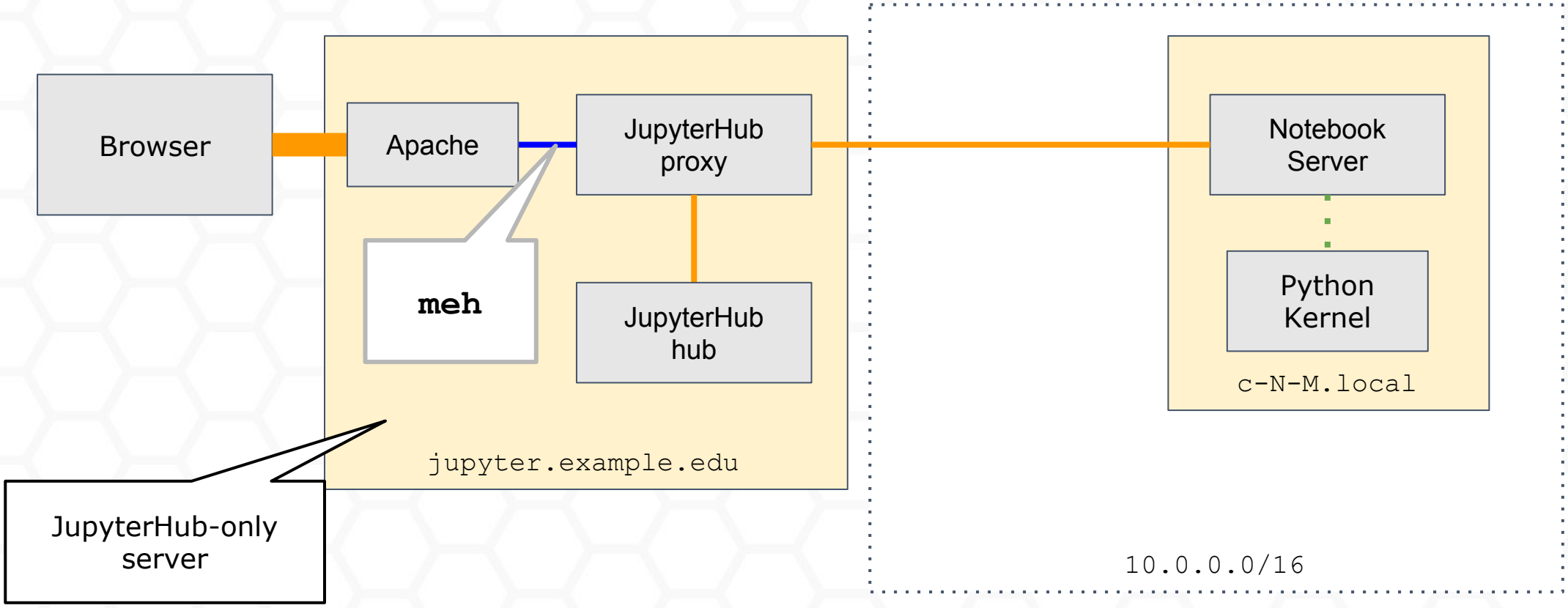
JupyterHub Internal SSL



Homework: Apache <-> JupyterHub



JupyterHub HPC/Cluster Model



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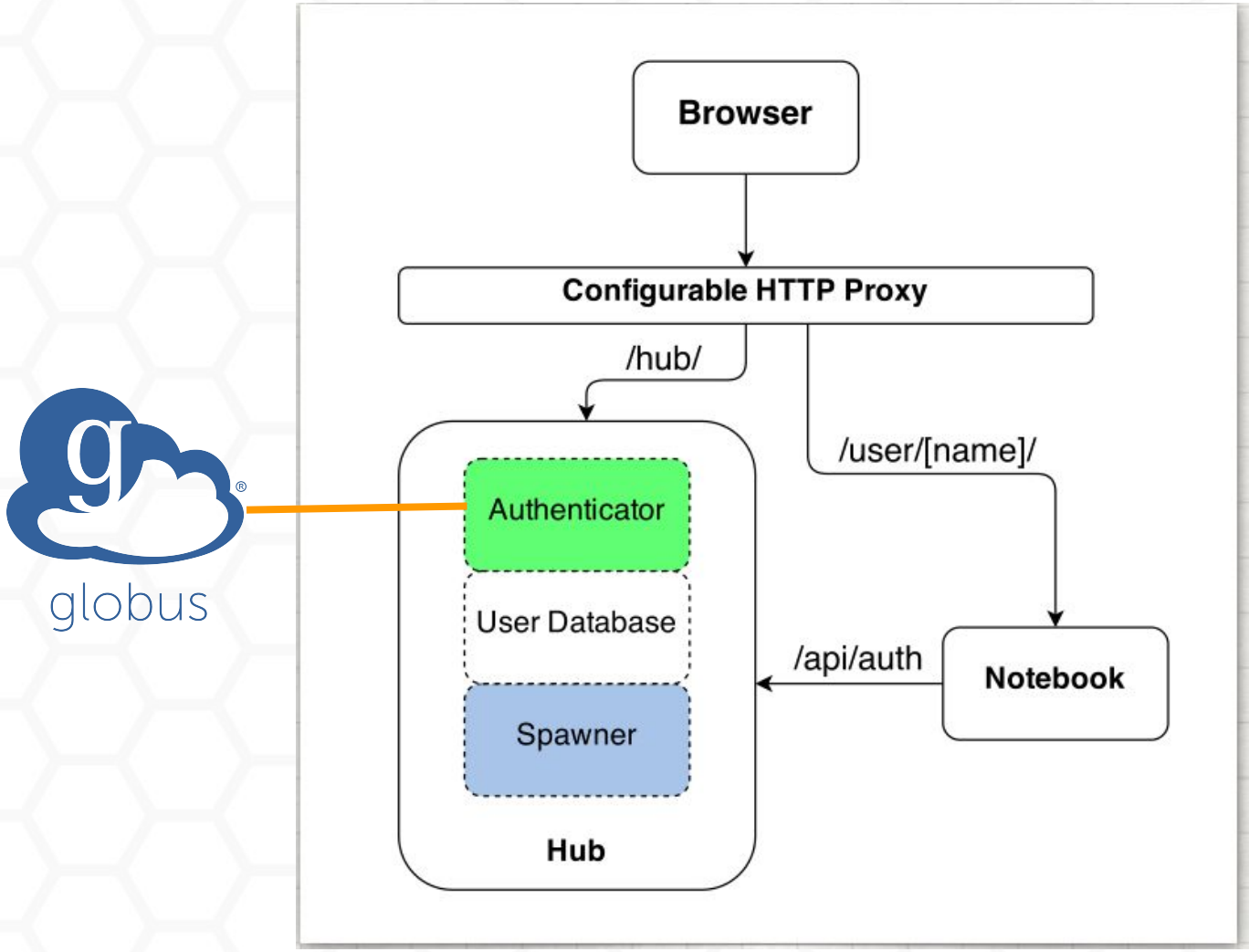
JupyterHub Authenticators

Default is PAM (system username & pass)

Outsource authentication to OAuth

- Auth0
- Bitbucket
- CILogon
- GitHub
- GitLab
- Globus
- Google
- MediaWiki
- Okpy
- OpenShift
- Generic (campus)

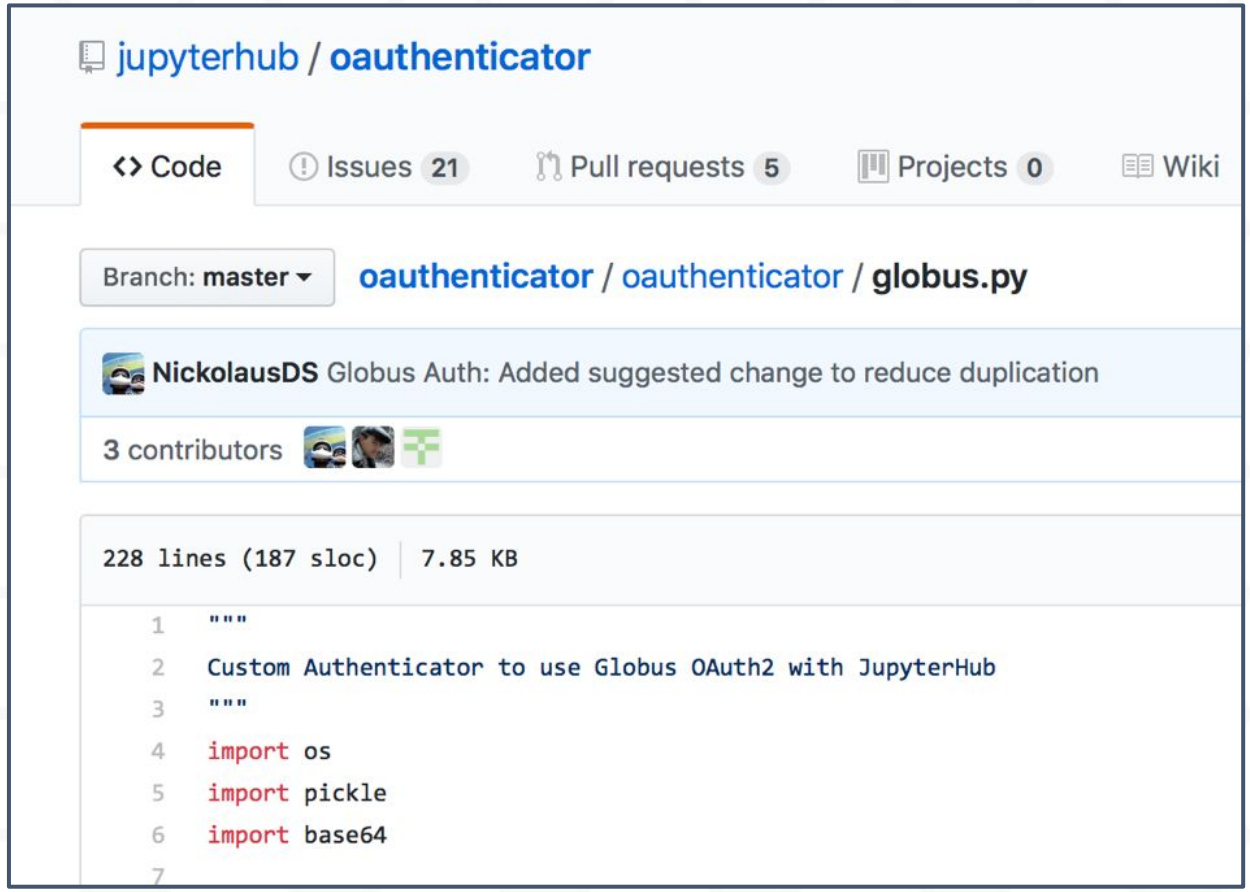


JupyterHub Globus OAuthenticator

- Steps are very similar for all OAuth providers:
- Register app, get client ID and secret

For this demo:

- Go to https://developers.globus.org
- Set name, callback URL
- Get client ID, client secret



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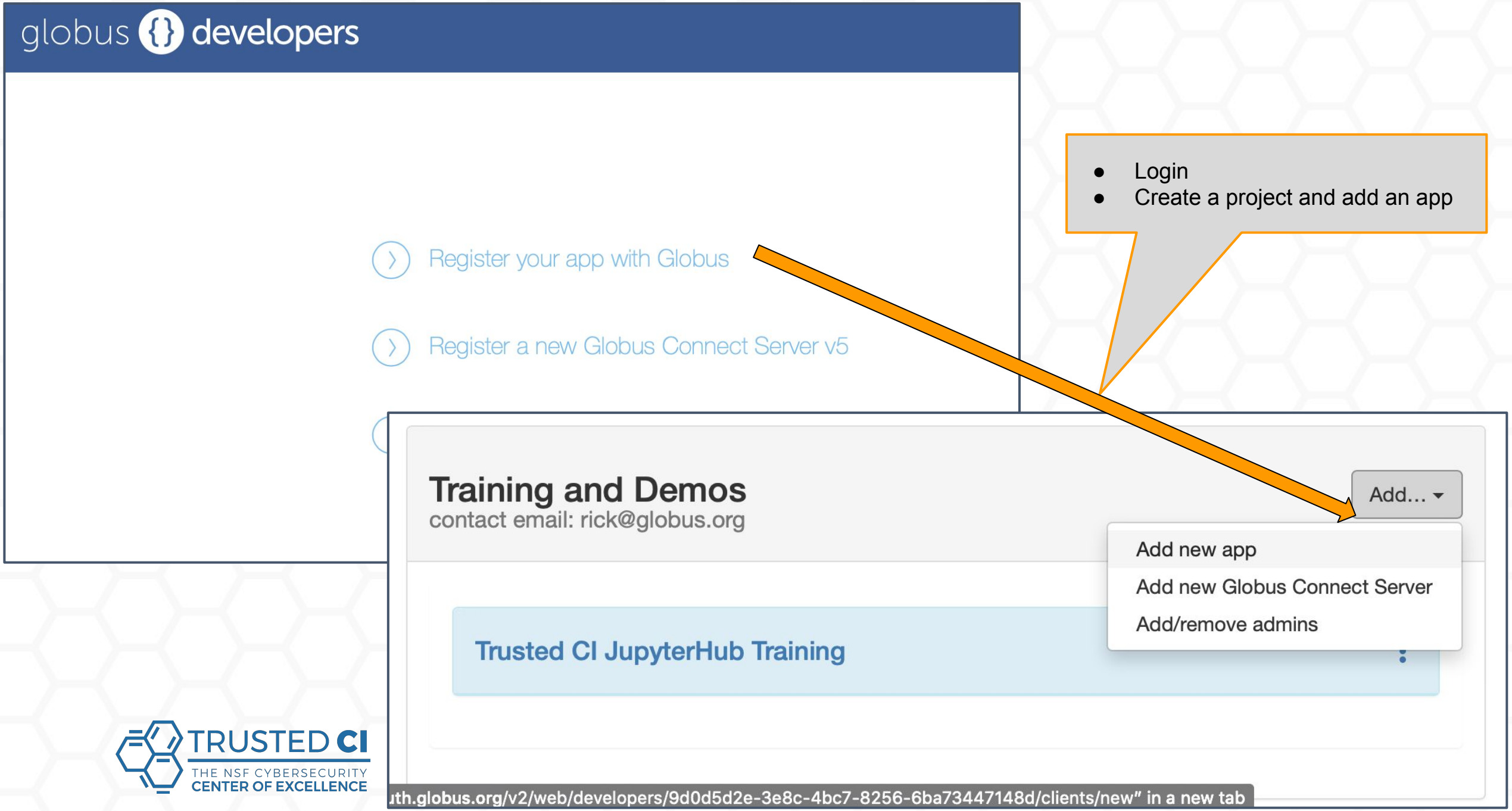

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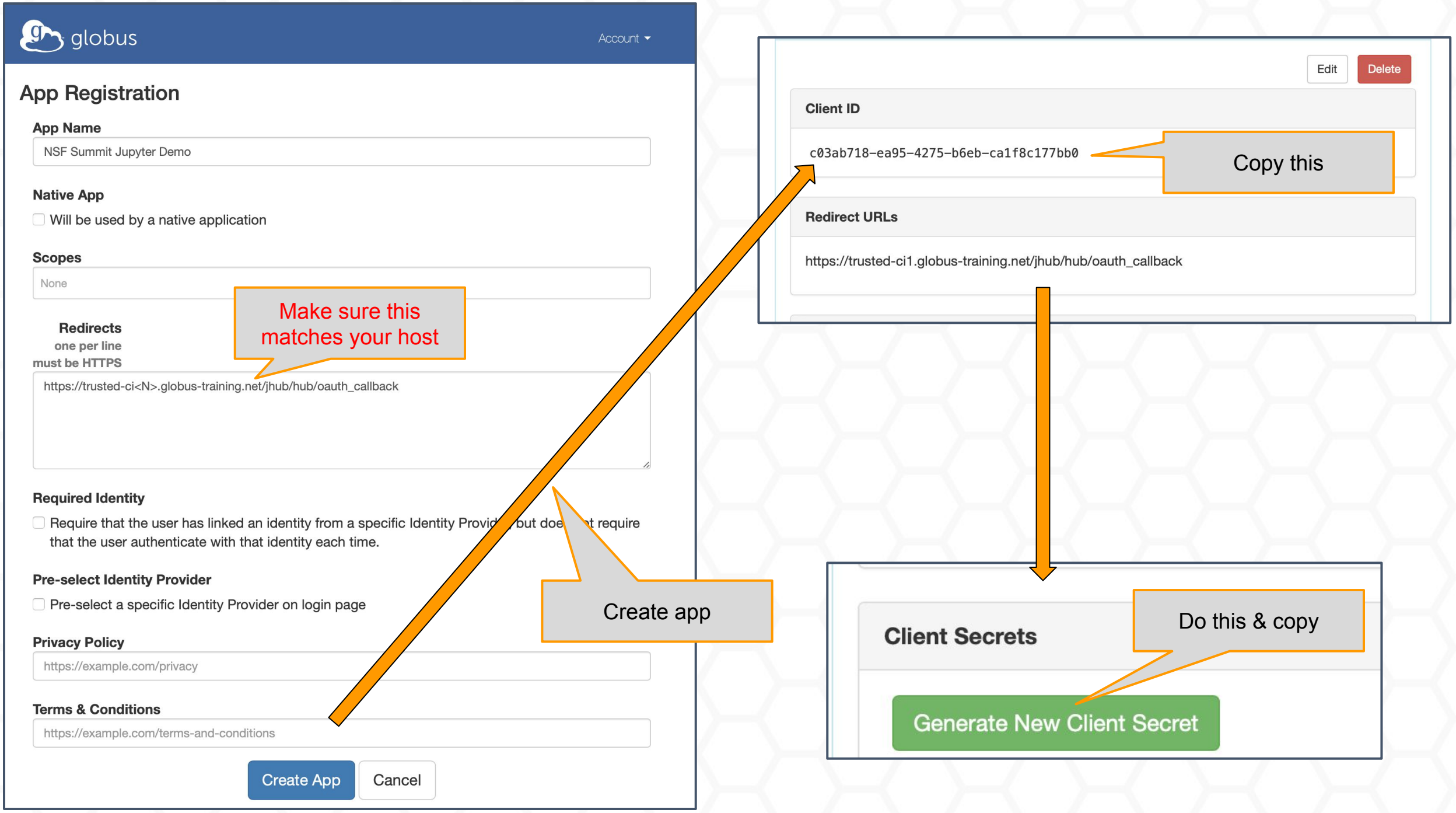
globus
Account
App Registration
App Name
NSF Summit Jupyter Demo
Native App
Will be used by a native application
Scopes
None
Redirects
one per line
must be HTTPS
https://trusted-ci<N>.globus-training.net/jhub/hub/oauth_callback
Make sure this matches your host
Required Identity
Require that the user has linked an identity from a specific Identity Provid but doe t require that the user authenticate with that identity each time.
Pre-select Identity Provider
Pre-select a specific Identity Provider on login page
Privacy Policy
https://example.com/privacy
Terms & Conditions
https://example.com/terms-and-conditions
Create App
Cancel
Create app
Edit
Delete
Client ID
c03ab718-ea95-4275-b6eb-ca1f8c177bb0
Copy this
Redirect URLs
https://trusted-ci1.globus-training.net/jhub/hub/oauth_callback
Client Secrets
Do this & copy
Generate New Client Secret

JupyterHub Globus OAuthenticator

Add to /etc/jupyterhub/jupyterhub_config.py

```
from oauthenticator.globus import LocalGlobusOAuthenticator
c.JupyterHub.authenticator_class = LocalGlobusOAuthenticator
c.LocalGlobusOAuthenticator.enable_auth_state = True
c.LocalGlobusOAuthenticator.oauth_callback_url = \
     'https://trusted-ci<N>.globus-training.net/jhub/hub/oauth_callback'
c.LocalGlobusOAuthenticator.client_id = '<>'
c.LocalGlobusOAuthenticator.client_secret = '<>'
c.LocalGlobusOAuthenticator.create_system_users = True
```

We're going to create a new system account for each user
Can also explicitly map users to system accounts

```
c.Authenticator.username_map  = {
  'service-name': 'localname'
}
```

New start command to pass key for user secrets

```
sudo JUPYTERHUB_CRYPT_KEY=$(cat /etc/jupyterhub/crypt.key) jupyterhub \
   --ip 127.0.0.1 --port 8000 --base-url '/jhub/' \
  --config=/etc/jupyterhub/jupyterhub_config.py
```

JupyterHub database will get an encrypted area

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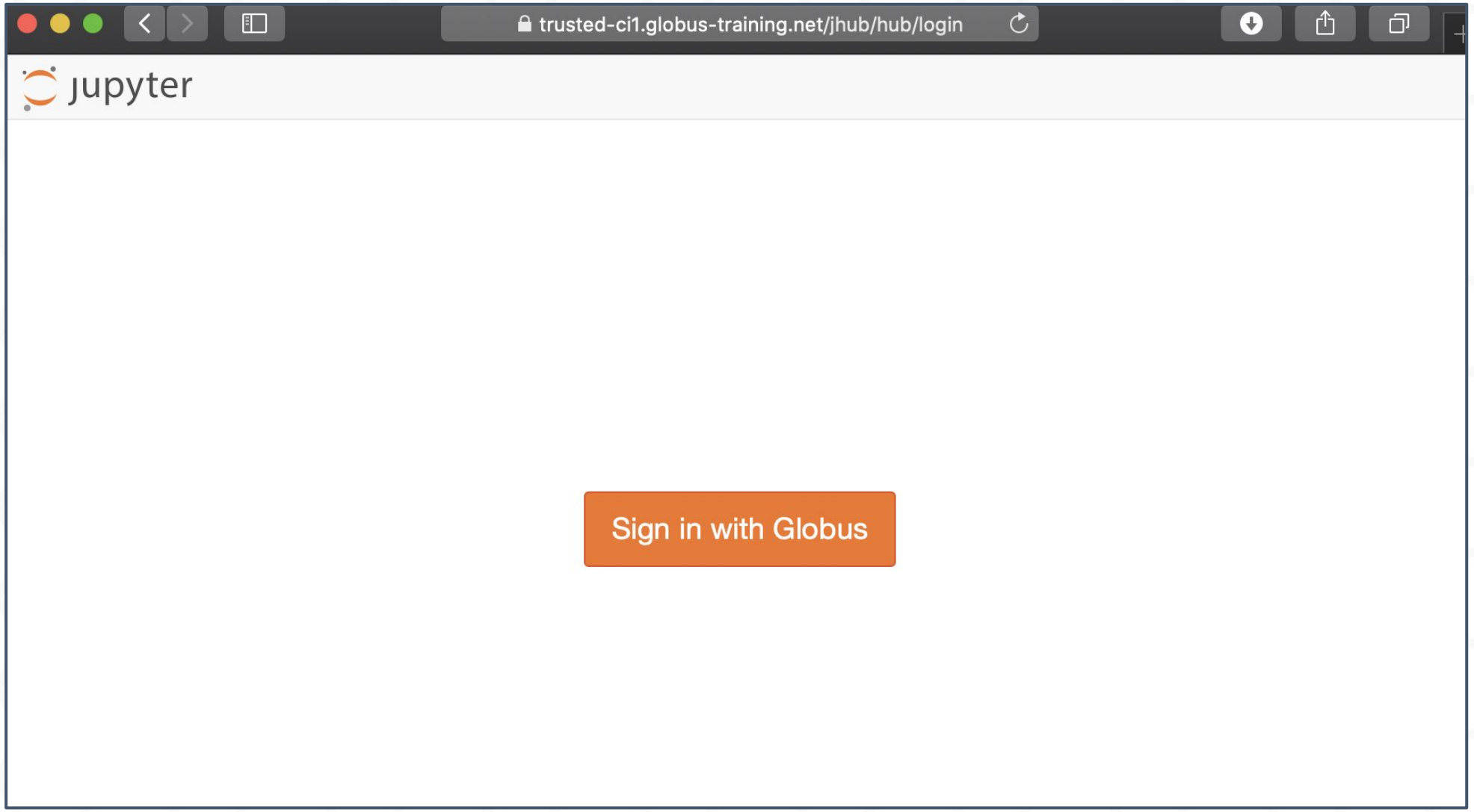
https://trusted-ci<N>.globus-training.net/jhub/



Wrap Up:
Answers to Earlier Questions
Defining Jupyter Security Best Practices

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What can be done to improve security in the Jupyter Community?

- Who are the stakeholders?
- What are the use cases?
- Let's start with you...
  - Why are you running Jupyter?
  - How do you run Jupyter?
  - What are the challenges?