

ASICLab IT Upgrades

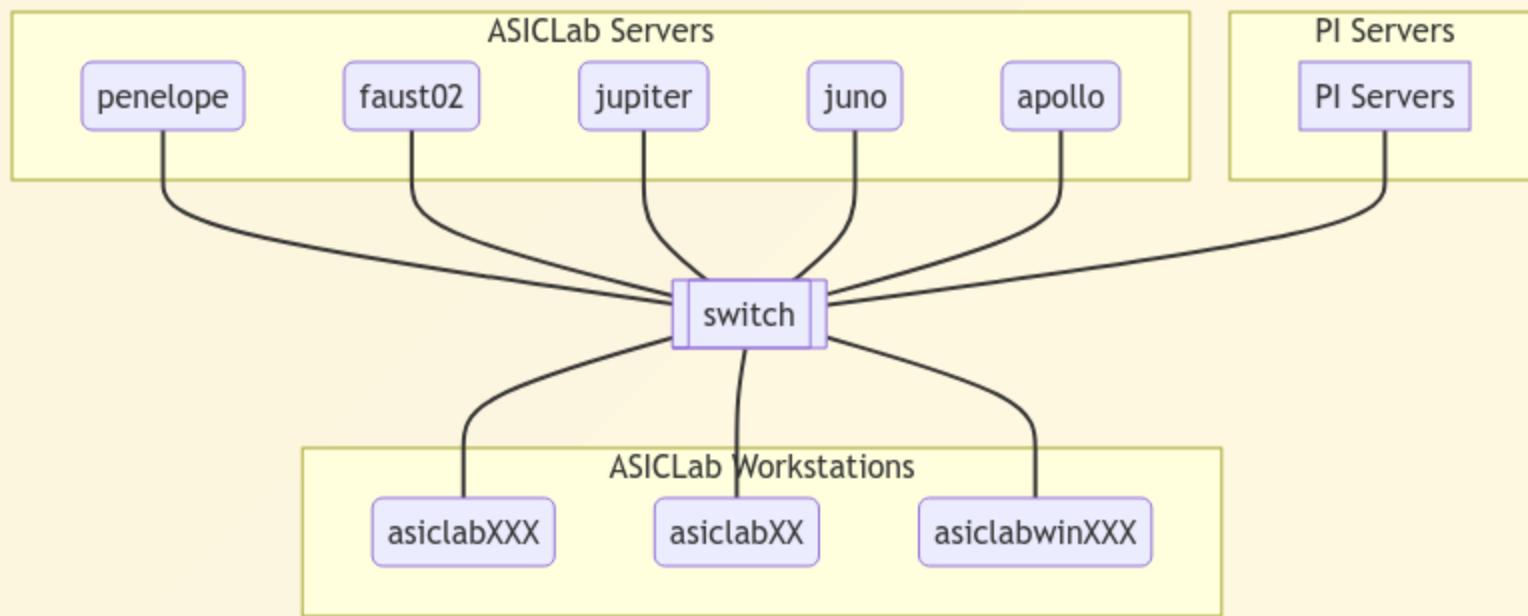


Kennedy Caisley

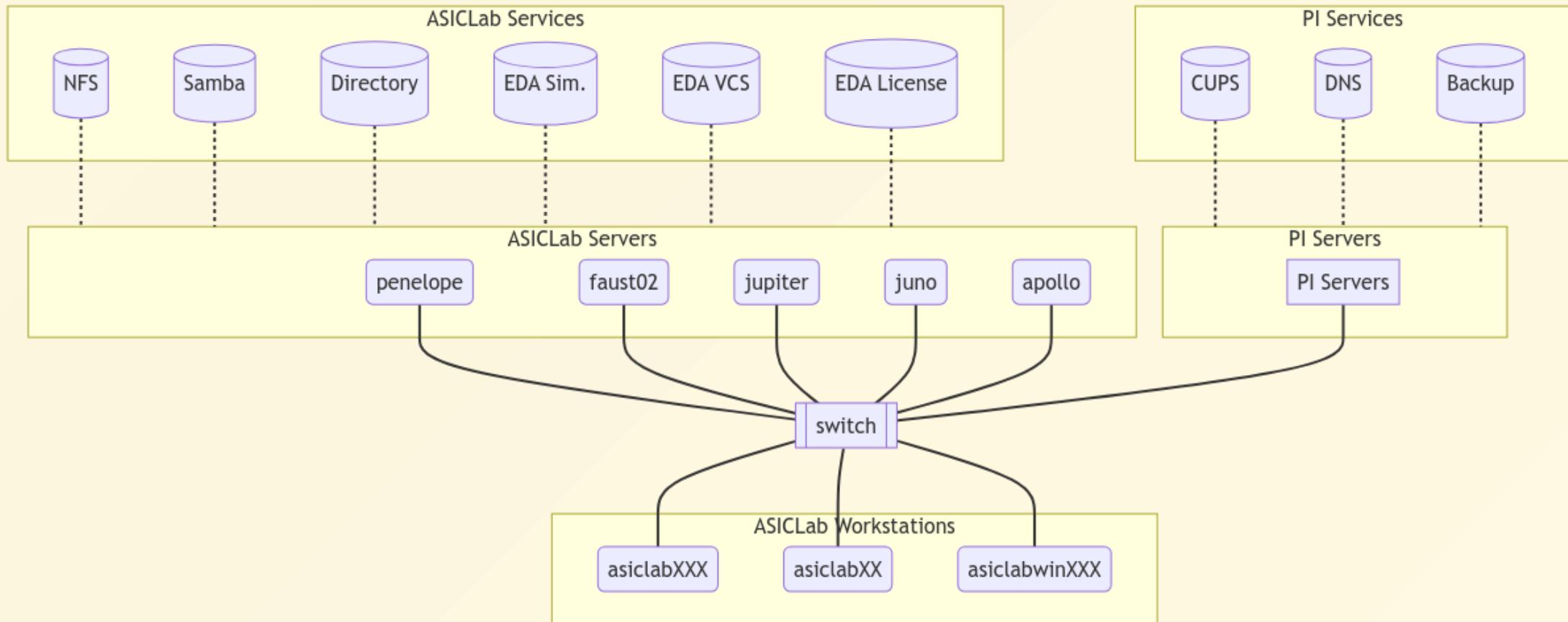
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26 July 2023

The physical network...



...with services running on top



Motivations

-  CentOS 7 reaching EOL with no upgrade path
-  Drive failures & low storage in file server
-  Workstations failing to boot & softwares outdated
-  Config management opaque and slow
-  Docs not maintain-ed | able

Project #1: An OS Upgrade

	Distribution	Design	Services	Desktop	Pricing	Future
 Red Hat Enterprise Linux						
 Rocky Linux						
 SLES 						
 OpenSUSE 						
 ubuntu 						
 fedora 						

fedora^f, I choose you!

- ✓ Installed across 14 workstations and 2 servers
- ok Some EDA tools run; work-around for the rest
- ✓ Enterprise services are well-supported & documented (RHEL)
- ✓ Desktop apps mostly available: i.e `zoom`, `slack`, `code`
- ✓ Automatic driver & firmware upgrades
- ✓ Successful version updates: **36 ➔ 37 ➔ 38 ➔ 39 (soon)**

Project #2: Workstation Setup

`clonezilla` isn't the right tool for *Configuration Management*:

“ The art of setting and maintaining a machine in its desired state. ”



Ansible provides a simple, *idempotent* approach

1. `dnf install ansible` on a machine not being configured
2. `ssh-copy-id` to all target machines
3. List target machines in `inventory.yaml`:

```
workstations:  
  hosts:  
    asiclab001.physik.uni-bonn.de:  
      mac: 54:BF:64:98:25:D4  
    asiclab002.physik.uni-bonn.de:  
      mac: 54:BF:64:98:25:CC  
    asiclab003.physik.uni-bonn.de:  
      mac: 54:BF:64:98:25:BAs
```

4. List desired state in `playbook.yaml`:

```
- name: Send a wake-on-LAN magic packet
  community.general.wakeonlan:
    mac: '{{ mac }}'
- name: Ensure client.conf exists & contains CUPS hostname
  ansible.builtin.lineinfile:
    path: /etc/cups/client.conf
    line: ServerName cups.physik.uni-bonn.de
    create: yes
- name: Check development tools are installed
  ansible.builtin.apt:
    name:
      - gcc
      - tmux
      - git-lfs
    state: latest
```

5. Run playbook on target inventory:

```
[asiclab@penelope ~]$ ansible -K playbook.yaml -i inventory.yaml
```

Some additional useful options:

- ⚙ Only `--limit` to specific subset of machines
- ⚙ Only run playbook tasks with certain `--tag`
- ⚙ Be more `--verbose`

Ansible output log:

```
PLAY [Workstation Configuration] ****
TASK [Send a wake-on-LAN magic packet] ****
ok: [asiclab001.physik.uni-bonn.de]
ok: [asiclab002.physik.uni-bonn.de]
ok: [asiclab003.physik.uni-bonn.de]

TASK [Ensure client.conf exists & contains CUPS hostname] ****
ok: [asiclab001.physik.uni-bonn.de]
ok: [asiclab002.physik.uni-bonn.de]
changed: [asiclab003.physik.uni-bonn.de]

TASK [Check development tools are installed] ****
ok: [asiclab001.physik.uni-bonn.de]
changed: [asiclab002.physik.uni-bonn.de]
changed: [asiclab003.physik.uni-bonn.de]
```

Project #3: Fixing the File Server

1. Copied `/tools` and `/users` (~3 days)
2. Built `raid6` array with **5** new 16 TB drives:
 - Capacity: 48 TB
 - Speed gain: 3x read, but no write
 - Fault tolerance: 2-drive failure (double parity)
3. Copied back data (another ~3 days)

Raid array details, seen from penelope server

```
[asiclab@penelope ~]$ sudo mdadm --detail /dev/md127  
  
/dev/md127:  
      Creation Time : Sat Jan 14 14:46:26 2023  
      Raid Level   : raid6  
      Array Size   : 46877242368 (43.66 TiB 48.00 TB)  
Used Dev Size : 15625747456 (14.55 TiB 16.00 TB)  
      Raid Devices : 5  
      Chunk Size  : 512K  
  
Number  Major  Minor  RaidDevice State  
     0      8      16          0  active sync  /dev/sdb  
     1      8      32          1  active sync  /dev/sdc  
     2      8      48          2  active sync  /dev/sdd  
     3      8      64          3  active sync  /dev/sde  
     4      8      80          4  active sync  /dev/sdf
```

4. Enable new incremental backups with HRZ using IBM `dsmc`
5. Enable automatic array checks with `raid-check.timer`
6. Enable `nfs4` server for `/users` and `/tools`.

A sanity check from `asiclab001` workstation:

```
[asiclab@asiclab008 ~]$ showmount -e penelope.physik.uni-bonn.de
```

Export list for penelope.physik.uni-bonn.de:

```
/export/disk/tools    asiclab*, juno.physik.uni-bonn.de, noyce.physik.uni-bonn.de,  
jupiter.physik.uni-bonn.de, faust02.physik.uni-bonn.de, apollo.physik.uni-bonn.de
```

```
/export/disk/users    asiclab*, juno.physik.uni-bonn.de, noyce.physik.uni-bonn.de,  
jupiter.physik.uni-bonn.de, faust02.physik.uni-bonn.de, apollo.physik.uni-bonn.de
```

7. Use `ansible` to auto-mount NFS shares on all workstations:

```
- name: Create mount points and mount /users
  ansible.posix.mount:
    src: penelope.physik.uni-bonn.de:/export/disk/users
    path: /users
    opts: rw
    state: mounted
    fstype: nfs4
- name: Create mount points and mount /tools
  ansible.posix.mount:
    src: penelope.physik.uni-bonn.de:/export/disk/tools
    path: /tools
    opts: ro
    state: mounted
    fstype: nfs4
```

Project #4: Identity Management

Next, we want user accounts to match our directories:

```
[kcaisley@asiclab008]$ ls /users  
dschuechter kcaisley krueger mvogt skahn szhang ...
```

Fedora includes a `ldap` + `nss` suite called **FreeIPA** 

1. Simply `ipa-server-install`, and browse to machine address:

Identity Management X +

← → C https://asiclabwin001.physik.uni-bonn.de/ipa/ui/#/e/user/search ☆ ⌂ ⌂

FreeIPA

Administrator

Identity Policy Authentication Network Services IPA Server

Users Hosts Services Groups ID Views Automember Subordinate IDs

User categories

Active users >

Stage users

Preserved users

Active users

Search Refresh Delete Add Disable Enable Actions

	User login	First name	Last name	Status	UID	Email address	Telephone Number	Job Title
<input type="checkbox"/>	admin		Administrator	✓ Enabled	1070800000			
<input type="checkbox"/>	dschuechter	Dominic	Schüchter	✓ Enabled	38737			
<input type="checkbox"/>	guest	Guest	Guest	✓ Enabled	1001			
<input type="checkbox"/>	kcaisley	Kennedy	Caisley	✓ Enabled	2002			
<input type="checkbox"/>	krueger	Hans	Krüger	✓ Enabled	2000			
<input type="checkbox"/>	mvogt	Marco	Vogt	✓ Enabled	17279			
<input type="checkbox"/>	skhan	Saqlain	Khan	✓ Enabled	57985			

Showing 1 to 7 of 7 entries.

2. Connect workstations to server with `ansible`'s `inventory.yaml`:

```
ipaservers:  
  hosts: faust02.physik.uni-bonn.de  
  vars:  
    ipaadmin_principal: admin  
    ipaadmin_password: NotSoSecretPassword123  
ipaclients:  
  hosts:  
    asiclab001.physik.uni-bonn.de  
    asiclab002.physik.uni-bonn.de  
    asiclab003.physik.uni-bonn.de
```

3. Run `ansible` to cache LDAP users on all machines ✓

Project #5: Running EDA tools?

EDA tools, are mounted ...

```
$ ls /tools  
cadence clio containers designs kits mentor synopsys xilinx ...
```

... but some, like `virtuoso`, don't work on Fedora.

The solution:

*OS-level virtual environments aka "**Containers**"*



Docker is a popular tool, but..



Apptainer is designed for high-performance apps with GUI

To build a container:

1. Create a `.def` file, for target application. Add the following:
2. Select a starting OS base image (Docker compatible!)

```
Bootstrap: docker
From: centos:7
```

3. Create mount points for external locations; `$HOME` is already done:

```
%setup
mkdir ${APPTAINER_ROOTFS}/tools
mkdir ${APPTAINER_ROOTFS}/users
```

4. List packages to install on top of OS base image:

```
%post
yum -y update && yum clean all
yum install -y csh tcsh glibc gdb
```

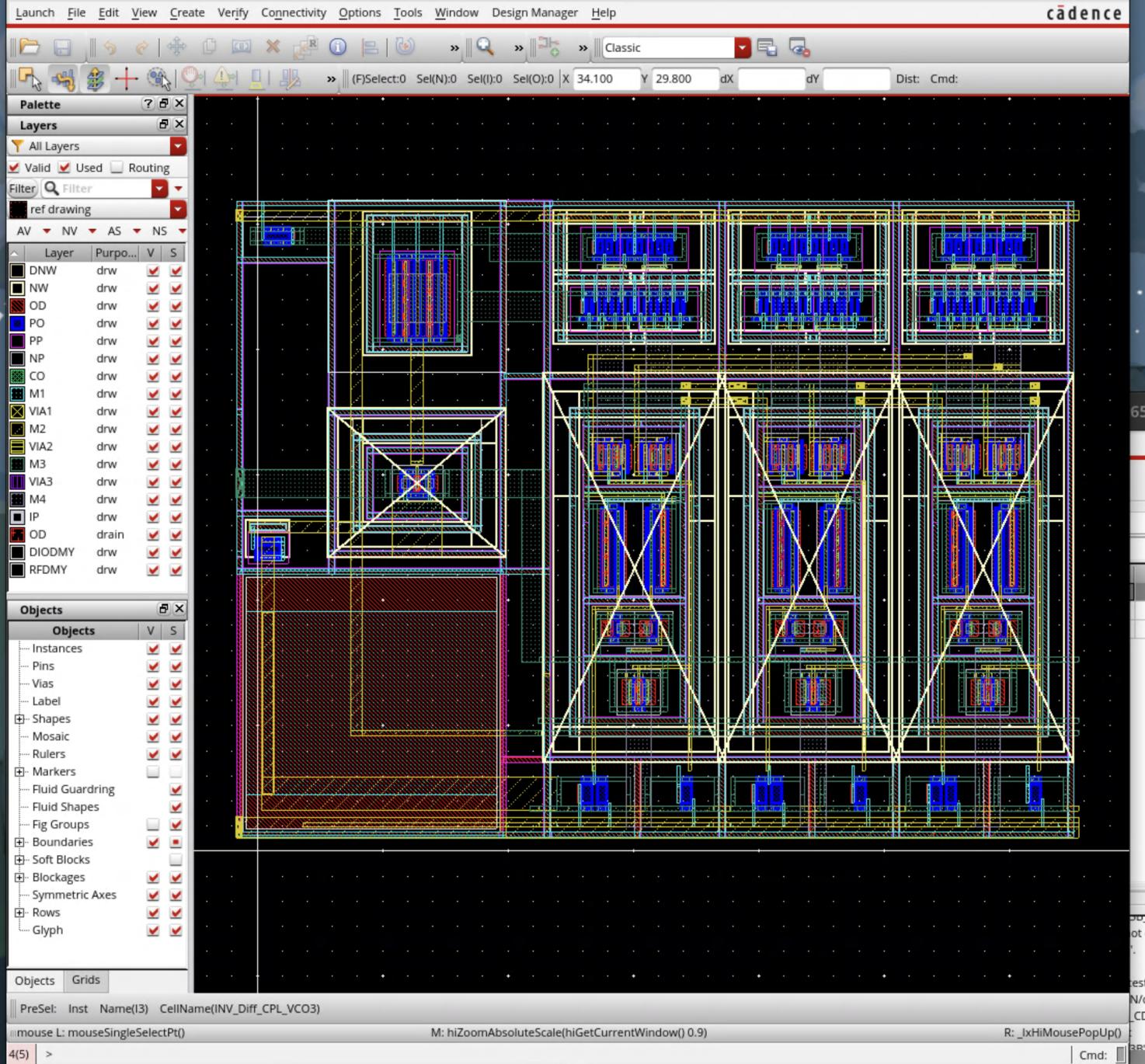
5. Compile the container image:

```
[kcaisley@asiclab008]$ sudo apptainer build demo.img demo.def

INFO: Starting build...
Getting image source signatures
INFO: Running setup scriptlet
INFO: Running post scriptlet
INFO: Adding environment to container
INFO: Creating SIF file...
✓ Done!
```

Virtuoso® Layout Suite L Reading: PLL VCO3 layout

cadence

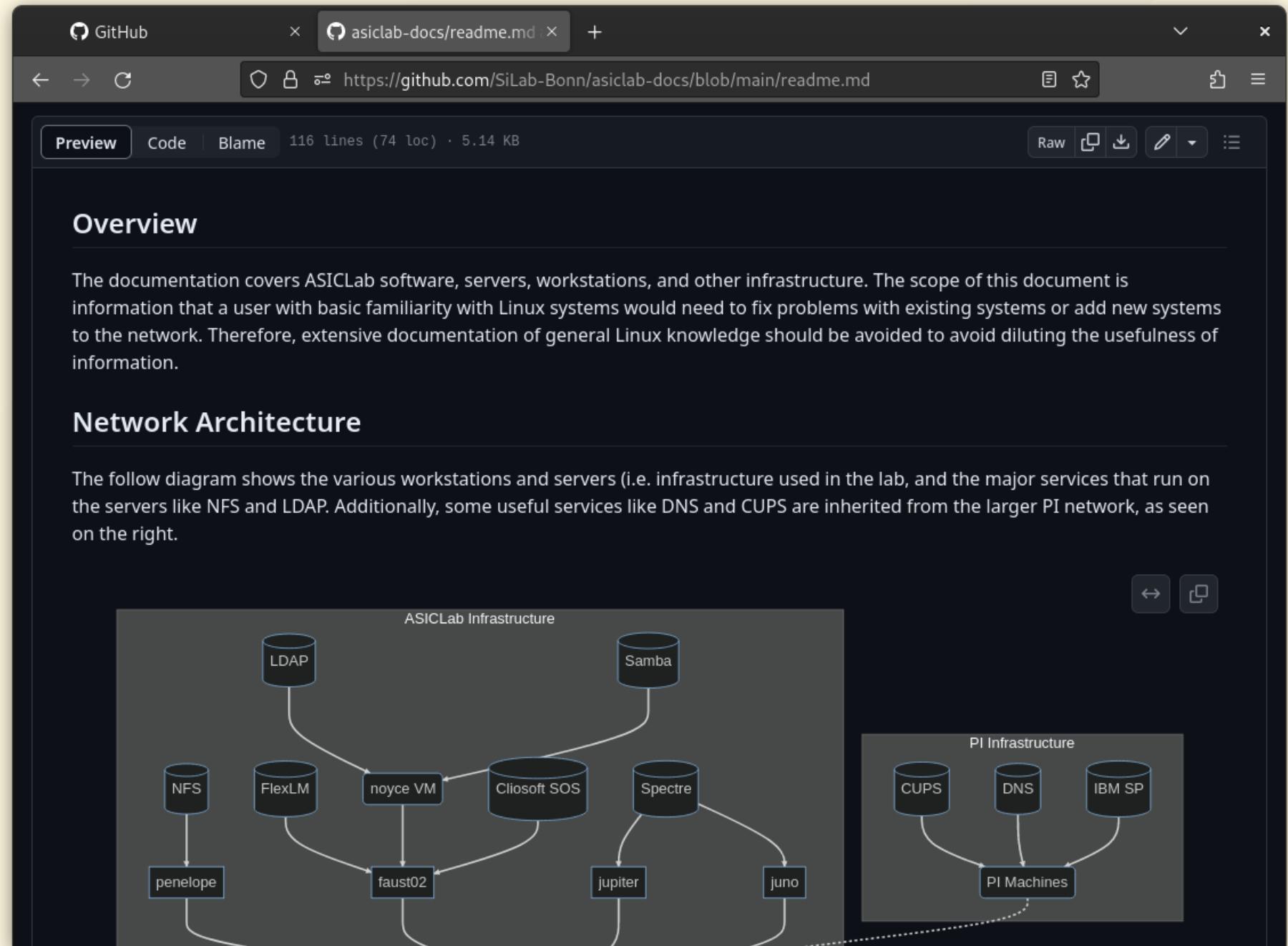


Project #6: Write the docs

Tool criteria:

confluence.atlassian.com is 

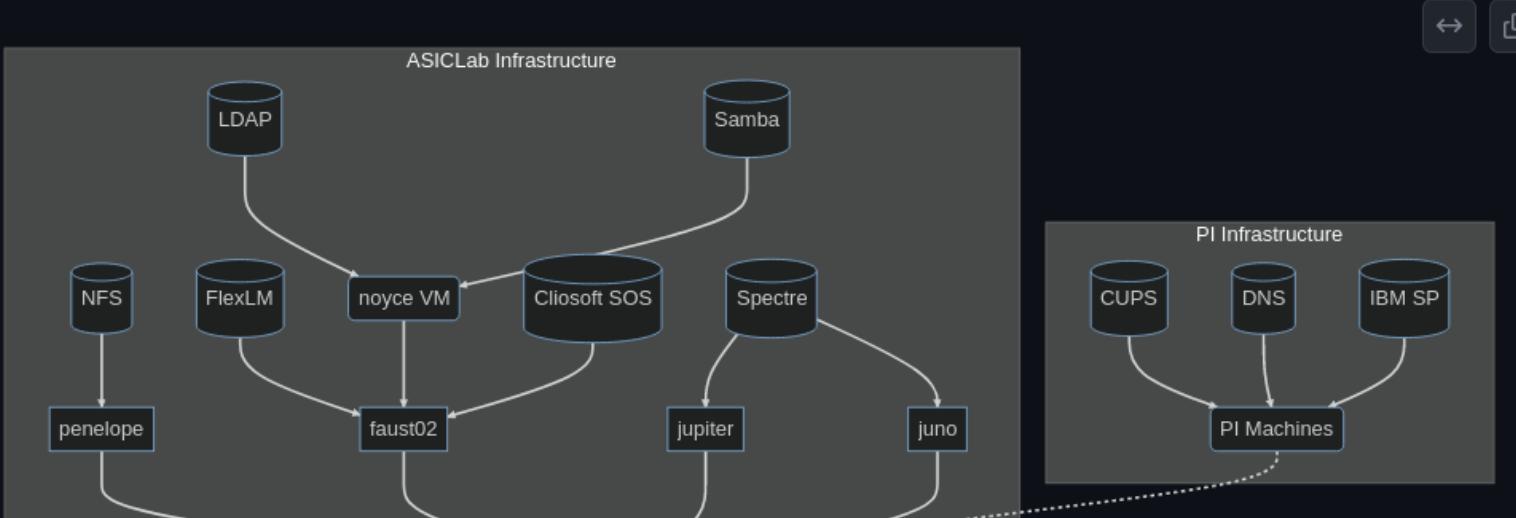
.md + github.com is 

A screenshot of a GitHub README.md page titled "Overview". The page contains text about the scope of the documentation and a section on Network Architecture with a diagram.

The documentation covers ASICLab software, servers, workstations, and other infrastructure. The scope of this document is information that a user with basic familiarity with Linux systems would need to fix problems with existing systems or add new systems to the network. Therefore, extensive documentation of general Linux knowledge should be avoided to avoid diluting the usefulness of information.

Network Architecture

The follow diagram shows the various workstations and servers (i.e. infrastructure used in the lab, and the major services that run on the servers like NFS and LDAP. Additionally, some useful services like DNS and CUPS are inherited from the larger PI network, as seen on the right.



The diagram illustrates the network architecture of ASICLab. It is divided into two main sections: ASICLab Infrastructure and PI Infrastructure.

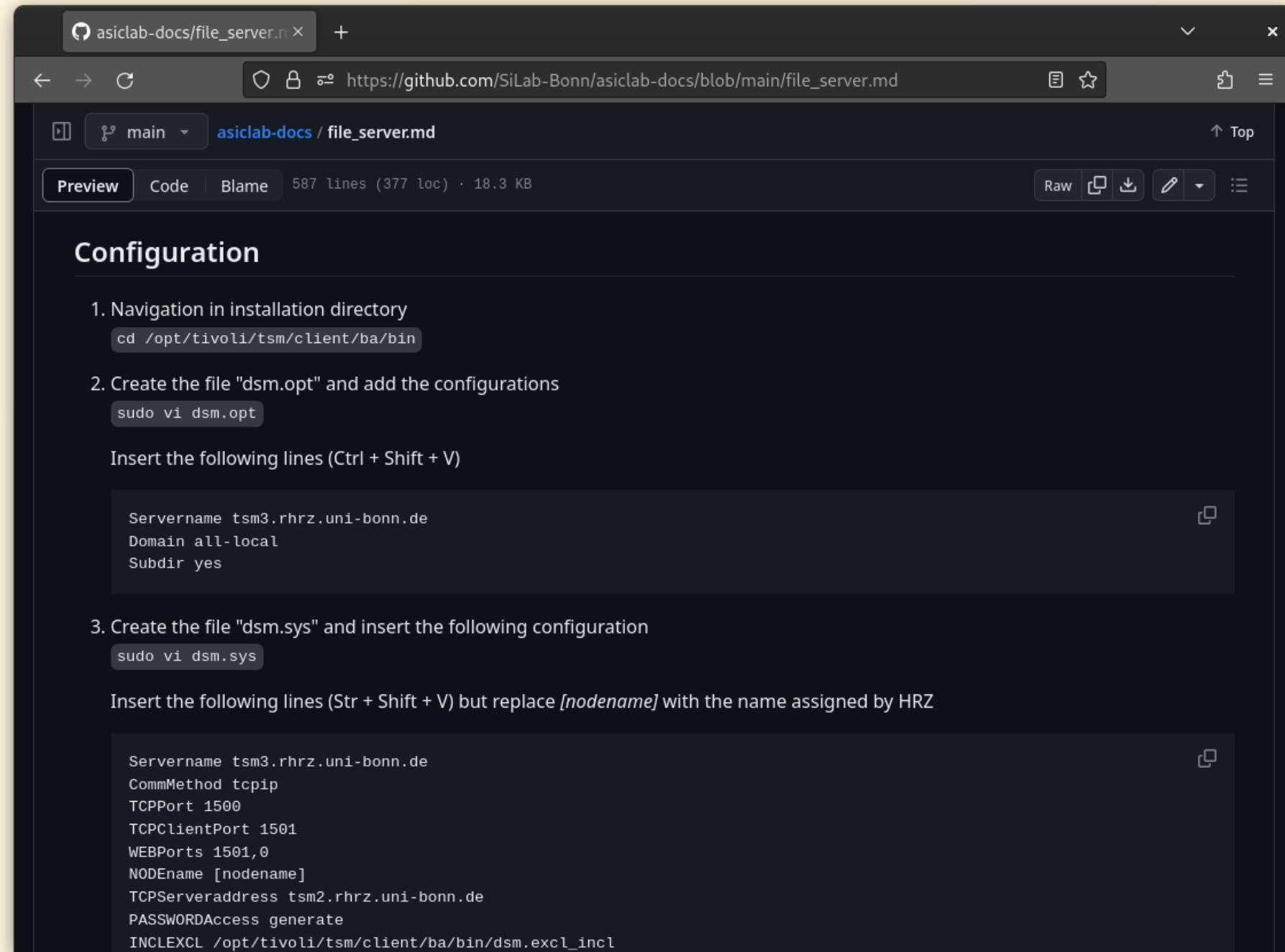
ASICLab Infrastructure:

- LDAP and Samba are central services.
- NFS, FlexLM, and Cliosoft SOS are also present.
- Workstations include penelope, faust02, noyce VM, Spectre, jupiter, and juno.
- Connections show dependencies between these components, such as NFS serving penelope and FlexLM interacting with faust02.

PI Infrastructure:

- CUPS, DNS, and IBM SP are shown.
- They are interconnected and connected to a group of machines labeled "PI Machines".

```
graph TD; subgraph ASICLab [ASICLab Infrastructure]; LDAP --> noyceVM; LDAP --> faust02; Samba --> faust02; NFS --> penelope; FlexLM --> faust02; CliosoftSOS --> faust02; Spectre --> jupiter; Spectre --> juno; penelope --> faust02; faust02 --> noyceVM; faust02 --> jupiter; faust02 --> juno; end; subgraph PI [PI Infrastructure]; CUPS --> DNS; DNS --> IBMSP; end; DNS --> PIMachines; IBMSP --> PIMachines;
```



Takeaways:

 fedora^f is a good distro for EDA environments

 **Ansible** is useful for workstations (but less so servers)

`raid + nfs` can serve `$HOME` directories and tools (with some limits)

 **FreeIPA** makes LDAP user management easy

 **Apptainer** can run EDA apps on unsupported distros

`.md` in a `git` repo simplifies documentation