TERRAFORM

POUR PROXMOX ET NETBOX

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OÙ L'ON VA PARLER DE ...

- Terraform beaucoup
  - notions de base
  - providers
  - comment bâtir une interface au dessus

Pour cela, des exemples en direct d'un labo :

- Proxmox/ceph
- Ipam netbox

Pour finir : retours sur le tout et suites prévues

TERRAFORM

- permet de décrire en json/hcl l'état désiré des resources d'un système
- utiliser des API pour trouver l'état courant du système
- utiliser des API pour changer l'état courant vers l'état désiré

=> machine à états, assure la transition entre état par appel à des API

EXEMPLE

```
# resource "provider" "id"
resource "local_file" "demo" {
# attr     = value
  filename = "servers.json"
  content  = "blah blih bloh"
}
```

Le *provider* `local_file` doit s'assurer que le fichier identifé par «demo» corresponde aux attributs donnés.

```
❯ terraform apply # plan for the plan only

Terraform used the selected providers to generate the following ex
actions are indicated with the following symbols:
  + create

Terraform will perform the following actions:

  # local_file.demo will be created
  + resource "local_file" "demo" {
      + content              = "blah blih bloh"
      + content_base64sha256 = (known after apply)
      + content_base64sha512 = (known after apply)
      + content_md5          = (known after apply)
      + content_sha1         = (known after apply)
      + content_sha256       = (known after apply)
      + content_sha512       = (known after apply)
      + directory_permission = "0777"
      + file_permission      = "0777"
      + filename             = "servers.json"
      + id                   = (known after apply)
    }

Plan: 1 to add, 0 to change, 0 to destroy.
```

```
Do you want to perform these actions?
  Terraform will perform the actions described above.
  Only 'yes' will be accepted to approve.

  Enter a value: yes

local_file.demo: Creating...
local_file.demo: Creation complete after 0s
[id=1512f9ea9e6dbeb8fb27b79aba25db2c8480d0f4]

Apply complete! Resources: 1 added, 0 changed, 0 destroyed.
```

Remarques :

- l'id est ici le sha1 du fichier.
- le provider rajoute des attributs à la ressource

```
--- a/file.tf     2024-03-14 04:00:21.173652007 +0100
+++ b/file.tf     2024-03-14 04:00:48.004884882 +0100
@@ -1,5 +1,5 @@
 resource "local_file" "demo" {
   filename = "servers.json"
-  content = "blah blih bloh"
+  content = "changed !"
 }
```

```
terraform apply
local_file.demo: Refreshing state... [id=1512f9ea9e6dbeb8fb27b79ab

Terraform will perform the following actions:

  # local_file.demo must be replaced
-/+ resource "local_file" "demo" {
      ~ content              = "blah blih bloh" -> "changed !" # f
      ~ content_sha1         = "1512f9ea9e6dbeb8fb27b79aba25db2c84
        -> (known after apply)
      ~ id                   = "1512f9ea9e6dbeb8fb27b79aba25db2c84
        -> (known after apply)
    }

Plan: 1 to add, 0 to change, 1 to destroy.
```

```
Do you want to perform these actions?
  Terraform will perform the actions described above.
  Only 'yes' will be accepted to approve.

  Enter a value: yes

local_file.demo: Destroying... [id=1512f9ea9e6dbeb8fb27b79aba25db2
local_file.demo: Destruction complete after 0s
local_file.demo: Creating...
local_file.demo: Creation complete after 0s [id=2470a477193a952c4b

Apply complete! Resources: 1 added, 0 changed, 1 destroyed.
```

Certains providers permettent de modifier sans détruire

Ex : le provider proxmox permet de changer la RAM allouée à une VM sans la détruire

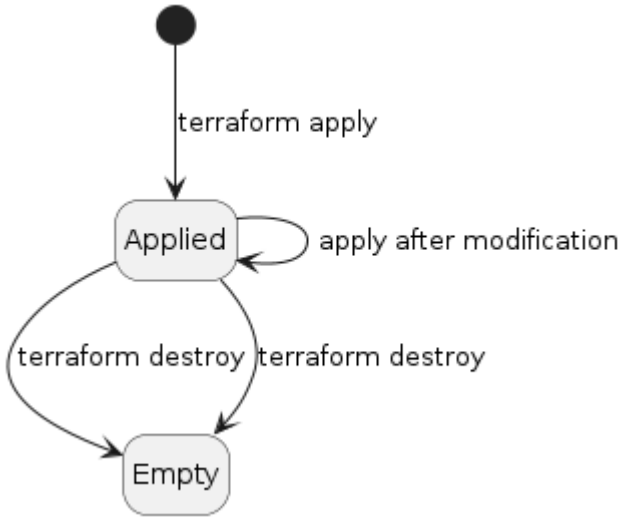
```
❯ terraform destroy
local_file.demo: Refreshing state...
[id=1512f9ea9e6dbeb8fb27b79aba25db2c8480d0f4]

Terraform used the selected providers to generate the following ex
actions are indicated with the following symbols:
  - destroy

Terraform will perform the following actions:

 # local_file.demo will be destroyed
 - resource "local_file" "demo" {
     - content              = "blah blih bloh" -> null
     # some hash content deleted
     - content_sha1         = "1512f9ea9e6dbeb8fb27b79aba25db2c848
         -> null
     - directory_permission = "0777" -> null
     - file_permission      = "0777" -> null
     - filename             = "servers.json" -> null
     - id                   = "1512f9ea9e6dbeb8fb27b79aba25db2c848
         -> null
   }

Plan: 0 to add, 0 to change, 1 to destroy.
```

```
Do you really want to destroy all resources?
  Terraform will destroy all your managed infrastructure, as shown
  There is no undo. Only 'yes' will be accepted to confirm.

  Enter a value: yes

local_file.demo: Destroying...
  [id=1512f9ea9e6dbeb8fb27b79aba25db2c8480d0f4]
local_file.demo: Destruction complete after 0s

Destroy complete! Resources: 1 destroyed.
```

AUTOMATE À ÉTATS

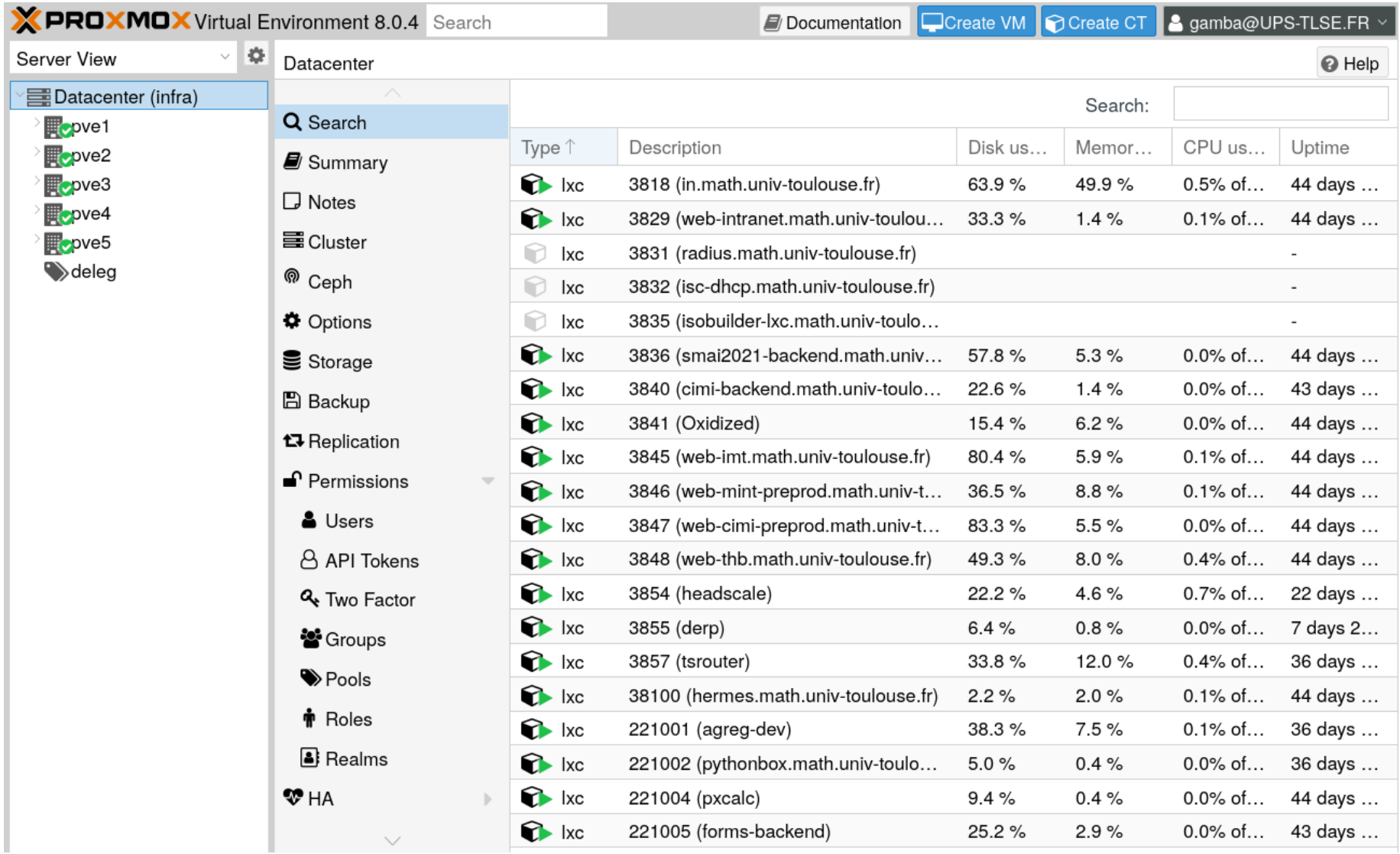
Par défaut : état stocké en local,

collaborer : partager l'état ! => stockage gitlab



IMT

- cluster proxmox/ceph de 5 nœuds/60To
- 1 réseau IP public, 1 privé, géré avec netbox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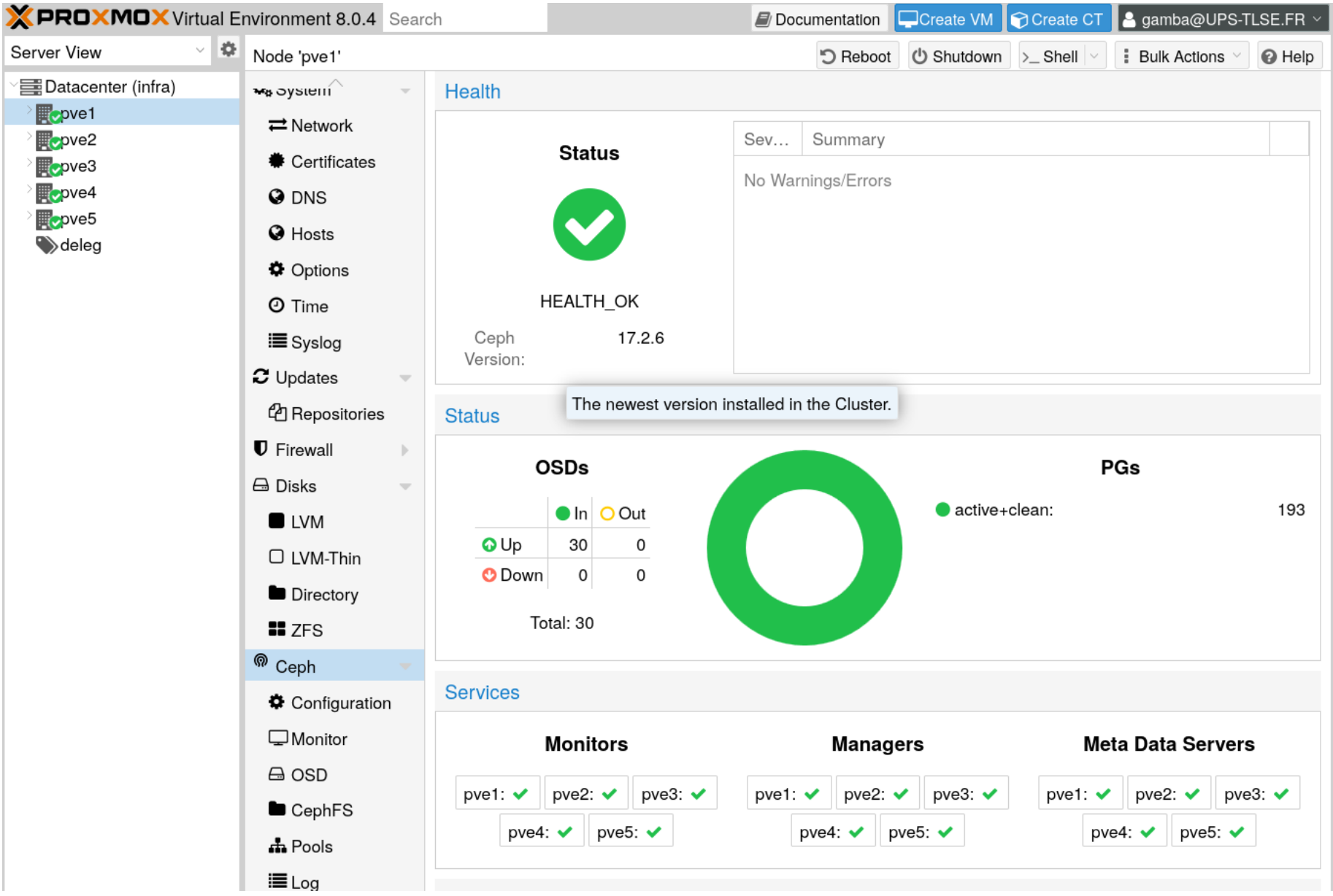
Uptime
lxc 3818 (in.math.univ-toulouse.fr) 63.9 % 49.9 % 0.5% of… 44 days …
lxc 3829 (web-intranet.math.univ-toulou… 33.3 % 1.4 % 0.1% of… 44 days …
lxc 3831 (radius.math.univ-toulouse.fr) -
lxc 3832 (isc-dhcp.math.univ-toulouse.fr) -
lxc 3835 (isobuilder-lxc.math.univ-toulo… -
lxc 3836 (smai2021-backend.math.univ… 57.8 % 5.3 % 0.0% of… 44 days …
lxc 3840 (cimi-backend.math.univ-toulo… 22.6 % 1.4 % 0.0% of… 43 days …
lxc 3841 (Oxidized) 15.4 % 6.2 % 0.0% of… 44 days …
lxc 3845 (web-imt.math.univ-toulouse.fr) 80.4 % 5.9 % 0.1% of… 44 days …
lxc 3846 (web-mint-preprod.math.univ-t… 36.5 % 8.8 % 0.1% of… 44 days …
lxc 3847 (web-cimi-preprod.math.univ-t… 83.3 % 5.5 % 0.0% of… 44 days …
lxc 3848 (web-thb.math.univ-toulouse.fr) 49.3 % 8.0 % 0.4% of… 44 days …
lxc 3854 (headscale) 22.2 % 4.6 % 0.7% of… 22 days …
lxc 3855 (derp) 6.4 % 0.8 % 0.0% of… 7 days 2…
lxc 3857 (tsrouter) 33.8 % 12.0 % 0.4% of… 36 days …
lxc 38100 (hermes.math.univ-toulouse.fr) 2.2 % 2.0 % 0.1% of… 44 days …
lxc 221001 (agreg-dev) 38.3 % 7.5 % 0.1% of… 36 days …
lxc 221002 (pythonbox.math.univ-toulo… 5.0 % 0.4 % 0.0% of… 36 days …
lxc 221004 (pxcalc) 9.4 % 0.4 % 0.0% of… 44 days …
lxc 221005 (forms-backend) 25.2 % 2.9 % 0.0% of… 43 days …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No Warnings/Errors
The newest version installed in the Cluster.
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30
0
Down
0
0
Total: 30
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active+clean:
193
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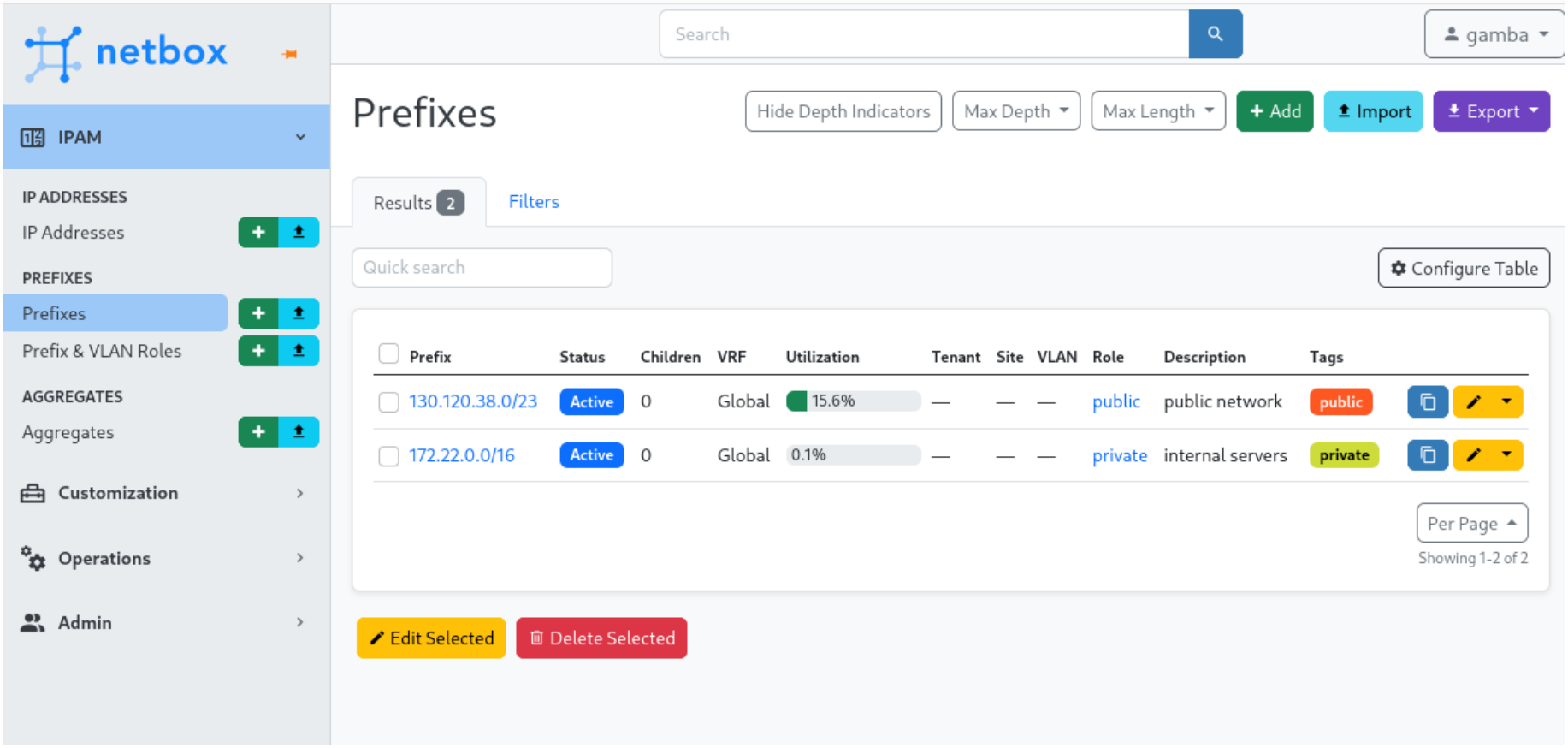
netbox
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Description
Tags
130.120.38.0/23
Active
0
Global
15.6%
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public network
public
172.22.0.0/16
Active
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Global
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Showing 1-2 of 2
Edit Selected
Delete Selected

MATHRICE + CALCUL

ANF Mathrice 2022, ANF UST4HPC 2023 :
convaincu par terraform

- terraform pour décrire les vm/ct créés ?

PROVIDER E-BREUNINGER/NETBOX

```
locals {
  nets = {
    public  = {
      ipRangeMsg = "130.120.38.0/23"
    }
    private = {
      ipRangeMsg = "172.22.0.0/16"
    }
  }
}
# data : read only access
data "netbox_prefixes" "nets" {
  for_each = {for k,v in local.nets: k => v}
  filter {
    name = "prefix"
    value = each.value.ipRangeMsg
  }
}

resource "netbox_available_ip_address" "want-an-ip" {
  prefix_id = netbox_prefixes.nets["private"]
}

resource "netbox_ip_address" "ips-static" {
  ip_address = "172.22.1.2/32"
}
```

PROVIDER TELMATE/PROXMOX

```
resource "proxmox_lxc" "basic" {
  target_node  = "pve3"
  hostname     = "myct"
  ostemplate   = "cephfs:vztmpl/ubuntu-20.04-standard_20.04-1_amd64.tar.gz"
  ssh_public_keys     = "ssh-ed255#19 …"
  unprivileged = true

  // Terraform will crash without rootfs defined
  rootfs {
    storage = "vms"
    size    = "8G"
  }

  network {
    name   = "eth0"
    bridge = "vmbr0"
    ip     = "172.22.1.2/32"
  }
}
```

La combinaison des deux devient vite complexe :

- ct ou vm ?
- choix du prefixe
- ip fixe ou automatique ?
- erreurs en cas de collision d’IP ?

DÉFINITION DE L'INTERFACE VOULUE

À partir d'un projet template sur plmlab, un·e ASR va

- plmlab : fork
- local : `git clone`
- local : fichier de config avec les token API
- local : modifier un fichier : spécifier les vm/ct à créer
- local : `terraform apply`

=> vm et/ou ct créés, avec ip, joignable(s) par ssh

La phase de provisionning est alors terminée.

Le fichier `servers.json` est généré, et contient les noms/ip des machines construites.

- local : modifier fichiers de configuration os (ansible, nix ...)
- local : `configure` : agit sur l'os par ssh

`=>` os configuré

- après test, `git add/commit/` et `git push`

On obtient un dépôt décrivant entièrement la machine et sa configuration.

PROJET INITIAL À FORKER

Basé sur devenv, présenté lors des JM Bordeaux 2023

- fournit la procédure à suivre dans le README
- installe les outils nécessaires
- définit des scripts pour gérer la configuration terraform
  - providers proxmox et netbox
  - vérifie la validité des token des API
  - gère l'état terraform : `tf-gitlab-init`

DÉMO

TERRAFORM : RETOURS D'EXPÉRIENCE

- `terraform apply` multiples parfois nécessaires : info provenant de la réalisation des ressources

Solution : décider de l'orde de création des ressources par des gestions de dépendances.

Ex : allouer une IP fixe ET une IP dynamique

```
# static ip
resource "netbox_ip_address" "ips-static" {
  for_each = { for s in module.servers: s.server.name => s if s.server.netIsIP}
  ip_address = "${element(split("/",each.value.server.ip),0)}/${module.net[each.value.server.net].net.mask}"
  status = "active"
  lifecycle {
    precondition {
      condition = can(regex("${module.net[each.value.server.net].net.ipRangeRegex}",
        "${element(split("/",each.value.server.ip),0)}" ))
      error_message = "${element(split("/",each.value.server.ip),0)} must be in
         ${module.net[each.value.server.net].net.ipRangeMsg}"
    }
  }
}

# dynamic ip
resource "netbox_available_ip_address" "dynamic_ips" {
  for_each = { for s in module.servers: s.server.name => s if !s.server.netIsIP}
  prefix_id = local.ipPrefix2Id[each.value.server.net]
  depends_on = [ netbox_ip_address.ips-static ] # force AFTER static ips
  status = "active"
}
```

HCL ~ MOTEUR DE TEMPLATE AU DESSUS DE JSON, PAS UN VRAI LANGAGE.

- boucle par attribut `for_each/count`, peu compréhensible
- pas de création de fonction ! contraint de passer par un module
  - validation des entrées
  - transformation ip en vmid

Passé les usages basiques, cela rend le code HCL peu lisible.

```
locals {
  proxmox-vm_servers = { for s in var.servers: s.name => s if s.terraform && s.type == "proxmox-vm" }
}

# proxmox_vm_qemu.vm_servers_${each.key} !
resource "proxmox_vm_qemu" "vm_servers" {
  for_each = local.proxmox-vm_servers
  clone             = each.value.template
  name              = each.key
  target_node       = each.value.pve_node
  vmid = module.ip2vmid[each.key].vmid
  # other attributes removed …

  # Cloud Init Settings
  ipconfig0         = "ip=${module.ip2vmid[each.key].ipWithoutMask}/32,
    gw=${module.net[each.value.net].net.gateway}" # beurk syntax
  sshkeys = each.value.ssh_public_keys
  provisioner "local-exec" {
    command = <<EOF
      ssh ${each.value.pve_node} -- qm set ${module.ip2vmid[each.key].vmid} --hookscript \
        local:snippets/priv_static_route.sh
      ssh ${each.value.pve_node} -- qm start ${module.ip2vmid[each.key].vmid}
    EOF
  }
}
```

```
# exemple de module terraform
# in
variable "ip" {
  description = "ipv4 with mask, e.g. 10.2.3.5/16"
  type = string
}
# out
output "vmid" {
  value = local.vmid
  description = "vmid"
}

output "vmidElems" {
  value = local.vmidElems
}

output "ipWithoutMask" {
  value = local.ipWithoutMask
}
# module code
locals {
  elems = split(".",element(split("/",var.ip),0))
  private = slice(local.elems,0,2) == tolist(["172","22"]) ? true : false
  vmidElems = local.private ? slice(local.elems, 1,4) : slice(local.elems, 2,4)
  vmidFormat = local.private ? "%s%s%.3d" : "%s%s"
  vmid = local.private ? format(local.vmidFormat, element(local.vmidElems,0),element(local.vmidElems,1),elemen
  ipWithoutMask = join(".",local.elems)
}
```

V

PERSPECTIVES

- rajouter des fonctionnalités dans le projet `deployment-template` :
  - activation des backups par Proxmox Backup Server. L'api existe, mais pas de provider terraform.
  - reconfigurer à partir d'un disque contenant des données initiales, e.g. dump base de données
- limite provider proxmox
- rendre le code terraform plus maintenable

UN «VRAI» LANGAGE POUR GÉNÉRER DU TERRAFORM

- pulumi : clone de terraform, moins de providers disponibles. Tous les providers ne sont pas dispo dans tous les langages :-(, communauté restreinte
- terraform CDKTF : code java/python/typescript/c#/go — synth —> conf terraform en json
- terranix : code nix –> terranix –> conf terraform en json

BOUCLE AVEC TERRAFORM

```
locals {
  myfiles = {
    f1 = { name = "first"
      content = "this is a file"
    },
    f2 = {
      name = "second"
      content = "and another one"
    }
  }
}

resource "local_file" "fileloop" {
  for_each = local.myfiles
  filename = each.value.name
  content = each.value.content
}
# resource "provider" "id"
```

Le json équivalent, généré par `hcl2json` :

```
{
    "locals": [
        {
            "myfiles": {
                "f1": {
                    "content": "this is a file",
                    "name": "fist"
                },
                "f2": {
                    "content": "and another one",
                    "name": "second"
                }
            }
        }
    ],
    "resource": {
        "local_file": {
            "fileloop": [
                {
                    "content": "${each.value.content}",
                    "filename": "${each.value.name}",
                    "for_each": "${local.myfiles}"
                }
            ]
        }
    }
}
```

BOUCLE AVEC NIX

```
# files.nix
{lib, ...}:

let myfiles = [
      {
        name = "first";
        content = "this is a file";
      }
      {
        name = "second";
        content = "and another one";
      }
    ];
    mkResourceLocalFile = f: s: (s // {
      "${f.name}" = {
        filename = f.name;
        content = f.content;
      };
    });
in

{
  resource.local_file =  lib.lists.foldr mkResourceLocalFile {} myfiles;
}
```

```
terranix files.nix > files.tf.json
terraform apply
```

```
{
  "resource": {
    "local_file": {
      "first": {
        "content": "this is a file",
        "filename": "first"
      },
      "second": {
        "content": "and another one",
        "filename": "second"
      }
    }
  }
}
```