Day 2 - 8th February

Multi-Cloud – BiBiGrid

09.00 - 09.30 (EET)

ELIXIR Germany

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Motivation

- **Resource availability**
  - scaling beyond one cloud site
  - making special cloud resources (databases, hardware) available
- **Security** - keep confidential data on a trusted cloud

Why BiBiGrid?

- **Easy to use** - simple tool for cluster setup; multi-clouds become more accessible for research

Our Usecase

- OpenStack on physically separated clouds
- BiBiGrid setup on an authorized machine
- Direct network access to master node
- distributed Nextflow workflows

For this project we used two locations of de.NBI Cloud

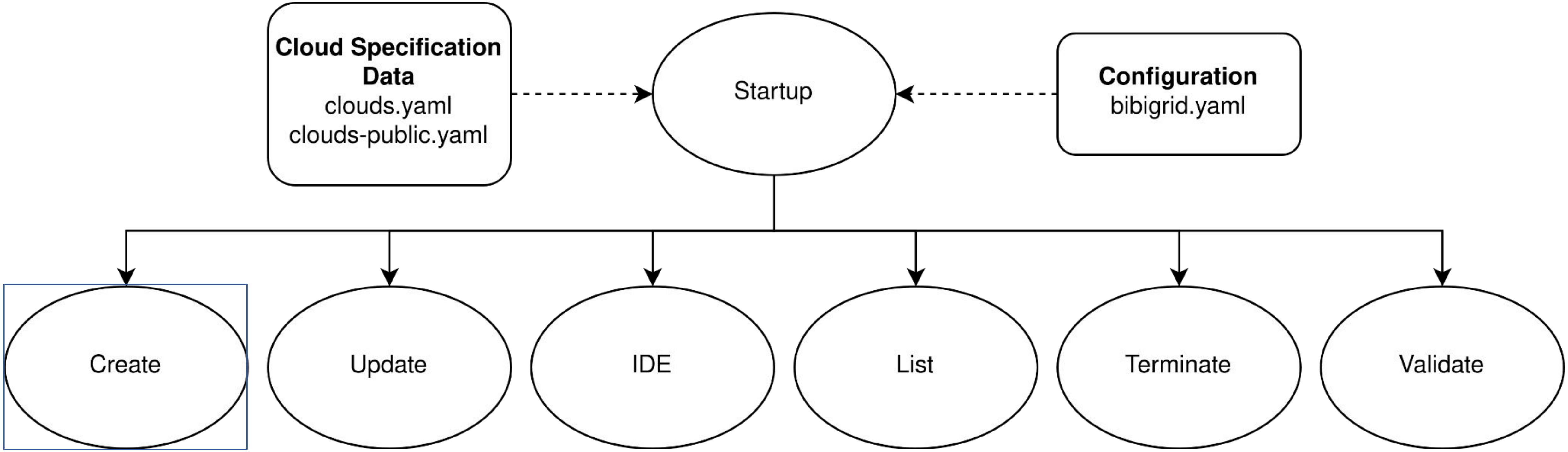
- Giessen
- Bielefeld

BiBiGrid

BiBiGrid is a cloud cluster creation and management tool for OpenStack (others to come)

- Easily **shareable cluster configurations**
- Uses **clouds.yaml** (provided by many infrastructures like OpenStack, AWS, …)
- **“On demand”** node scheduling bounded by the initial BiBiGrid configuration
- Has a Hands-on tutorial (currently without multi-cloud)

BiBiGrid


Cloud Specification Data
clouds.yaml
clouds-public.yaml
Startup
Configuration
bibigrid.yaml
Create
Update
IDE
List
Terminate
Validate

BiBiGrid Provides

Ansible – simple server **configuration**

Slurm – cluster management and **job scheduling** system

NFS (Network File System) – **shared file access**

Docker – **run** applications **independent** of the device they run on using **containers**

Theia Web IDE – easy, intuitive and abstract **server web access**

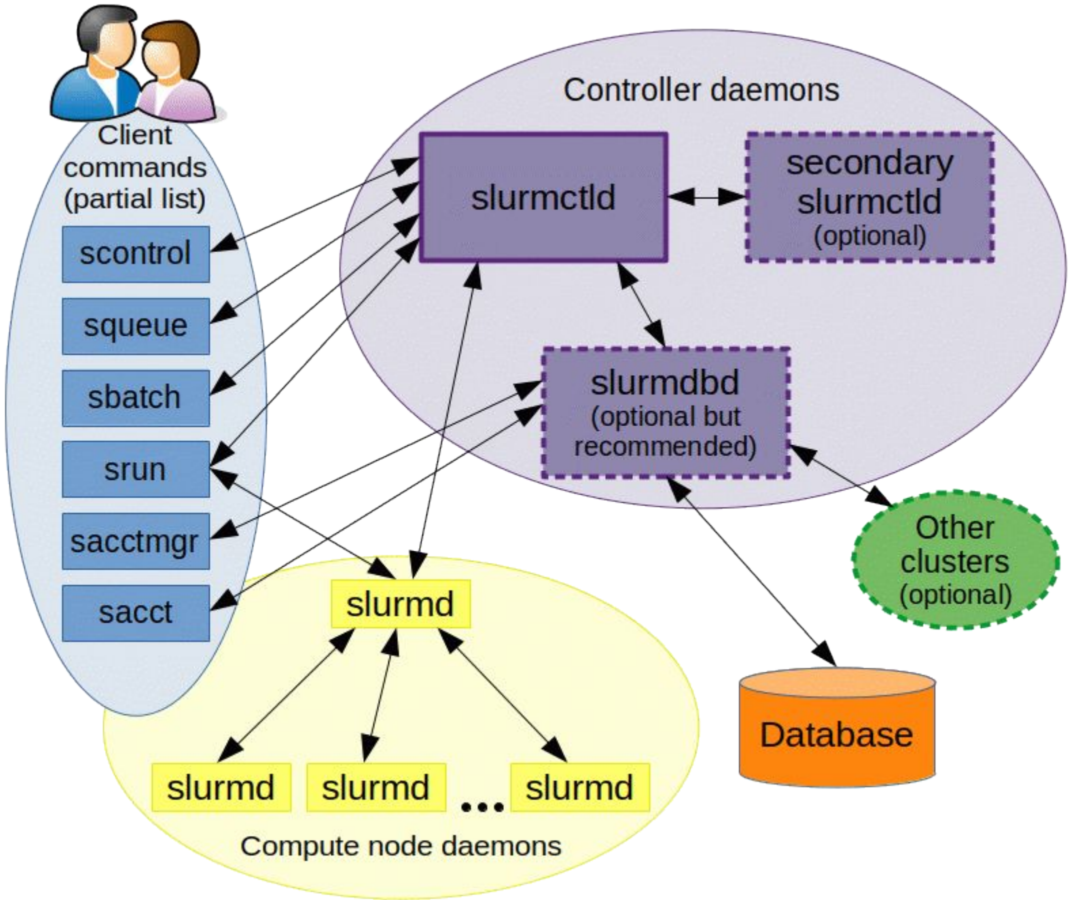
Zabbix – **monitoring** solution for servers and more

Slurm

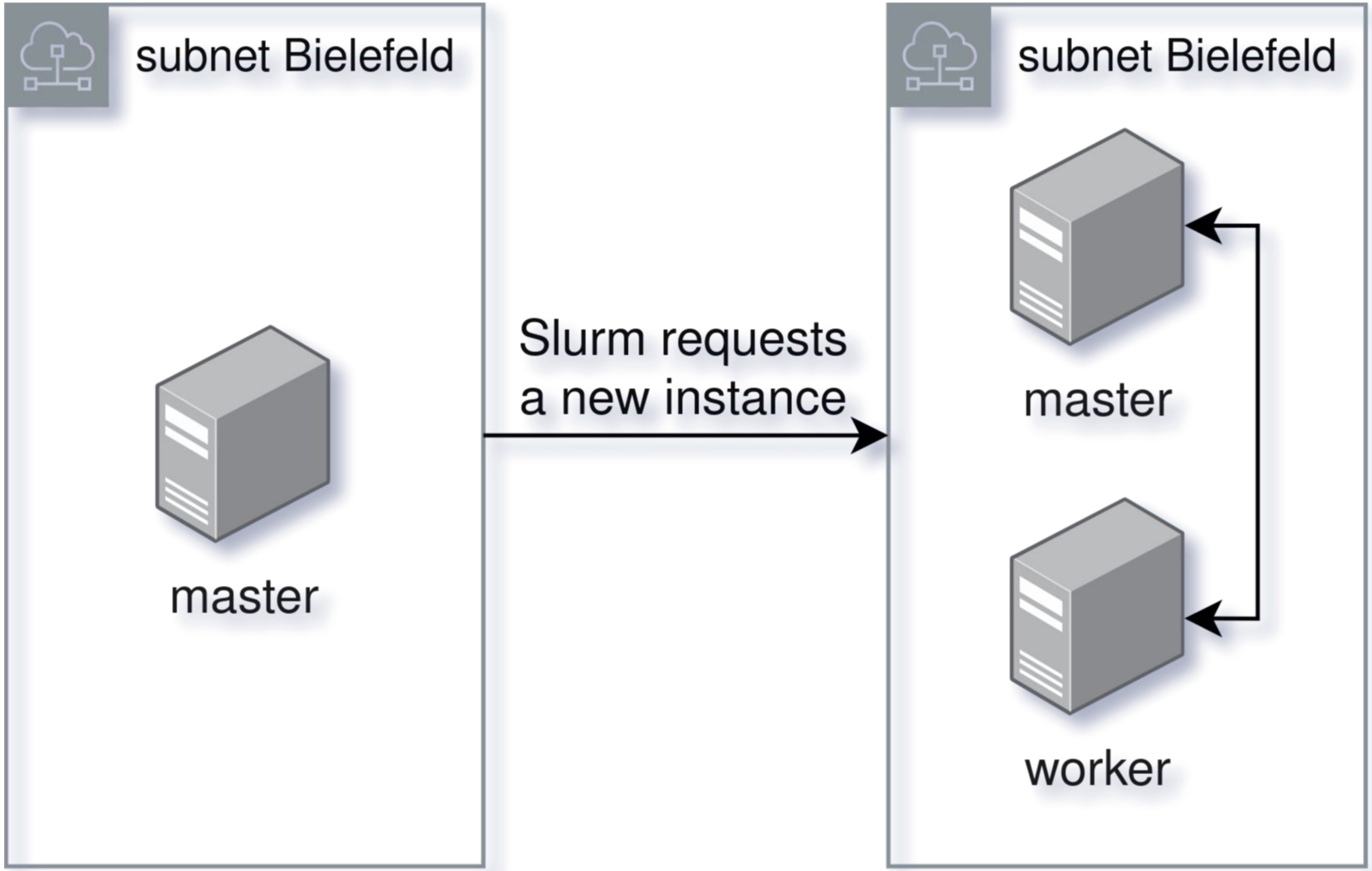
Slurmctld: Management Daemon on master node

Slurmd: Compute Node Daemons running on workers

`srun`: Submits a job for execution passing along resource and job information


Client commands (partial list)
scontrol
squeue
sbatch
srun
sacctmgr
sacct
Controller daemons
slurmctld
secondary slurmctld (optional)
slurmdbd (optional but recommended)
Other clusters (optional)
Database
slurmd
slurmd
slurmd
...
slurmd
Compute node daemons

BiBiGrid: “On Demand”



Multi-Cloud – BiBiGrid

- Cloud locations must be able to **communicate**
- Slurm must be able to request server instances for jobs “on demand” **on all clouds**
- Slurm must be able to schedule jobs to **specific clouds**
- Communication between clouds must be **secure**

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- Go easy on resources
- Working on multiple clouds should not complicate use

Slurm - Scheduling Jobs to specific clouds

```
srun job.py
```

→ Command `job.py` executed wherever possible

```
srun --partition Bielefeld job.py
```

→ `job.py` runs in **Bielefeld**

```
srun --partition Giessen job.py
```

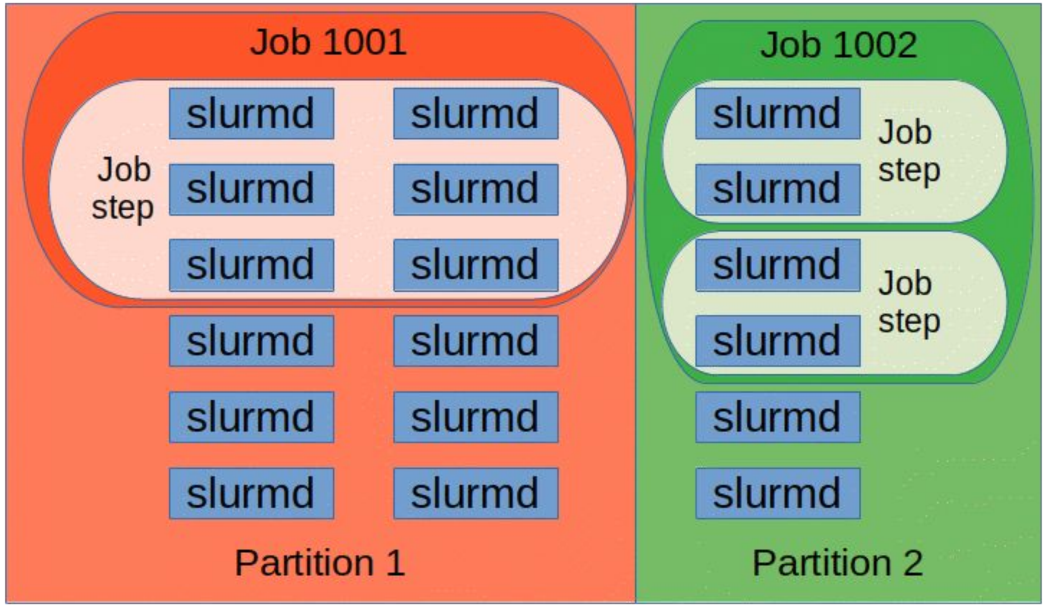
→ Command `job.py` executed in **Giessen**

```
srun --mem 2048G job.py
```

→ runs on a node with at least 2 TB memory

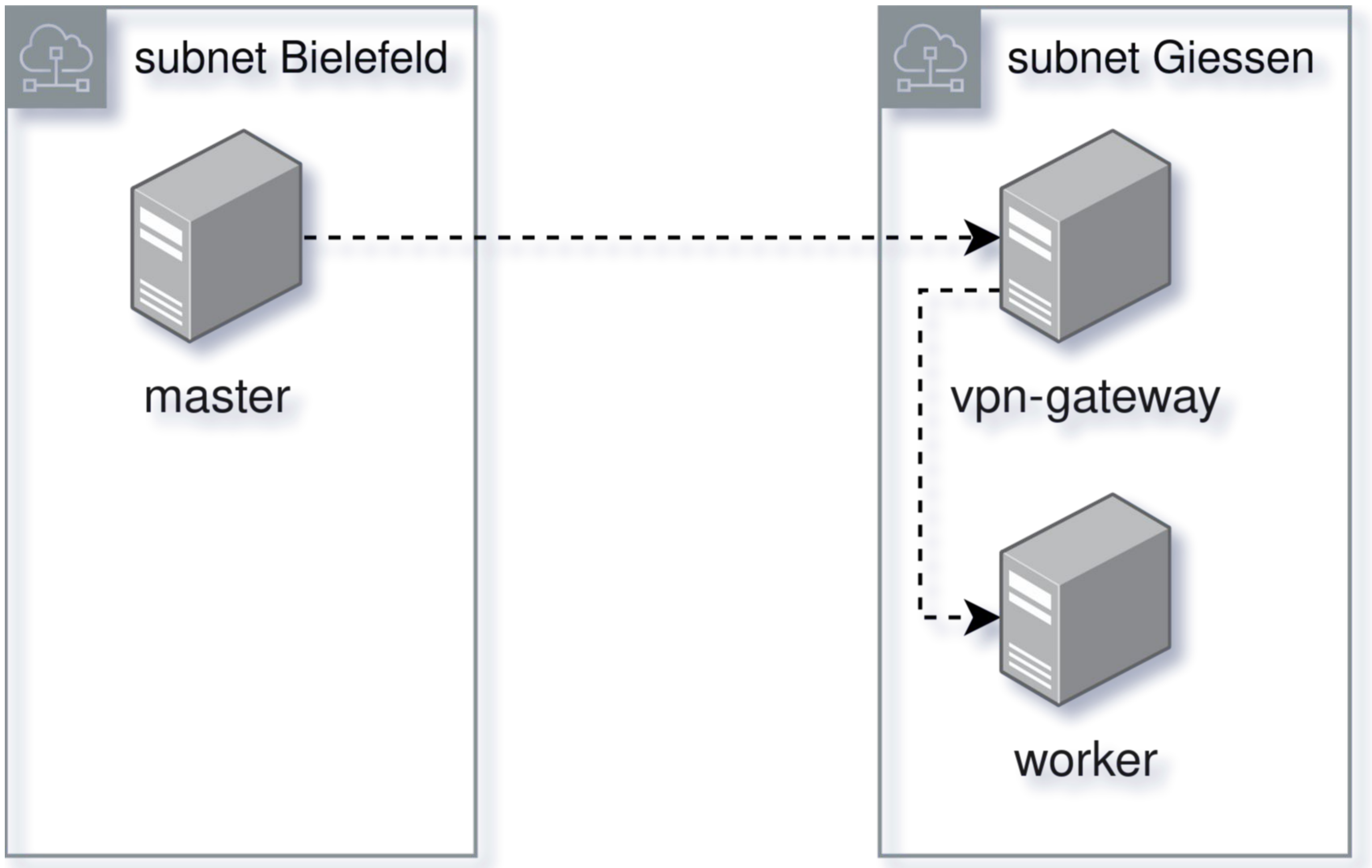
```
srun --cpus-per-task 64 job.py
```

→ tasks require 64 cpus



Bielefeld   Giessen

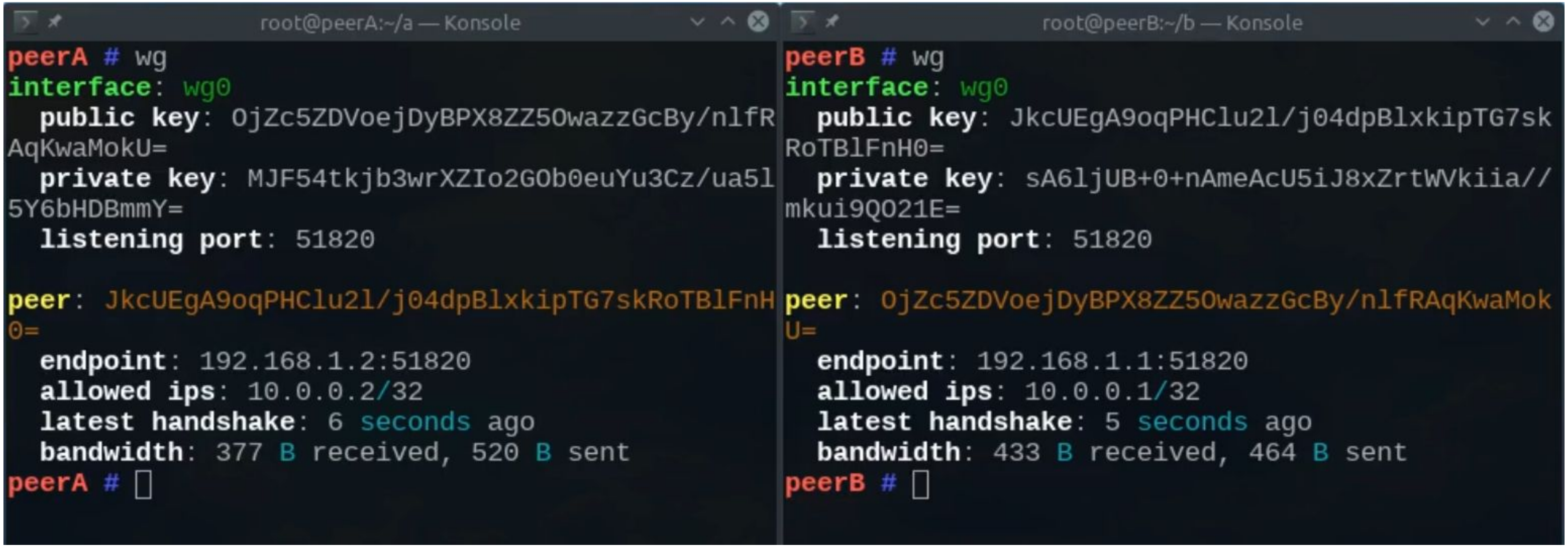
Idea: Virtual Private Network



Wireguard

WIREGUARD

FAST, MODERN, SECURE VPN TUNNEL



```
peerA # wg
interface: wg0
  public key: OjZc5ZDVoejDyBPX8ZZ5OwazzGcBy/nlfR
AqKwaMokU=
  private key: MJF54tkjb3wrXZIo2GOb0euYu3Cz/ua5l
5Y6bHDBmmY=
  listening port: 51820

peer: JkcUEgA9oqPHClu2l/j04dpBlxkipTG7skRoTBlFnH
0=
  endpoint: 192.168.1.2:51820
  allowed ips: 10.0.0.2/32
  latest handshake: 6 seconds ago
  bandwidth: 377 B received, 520 B sent
peerA # 
```

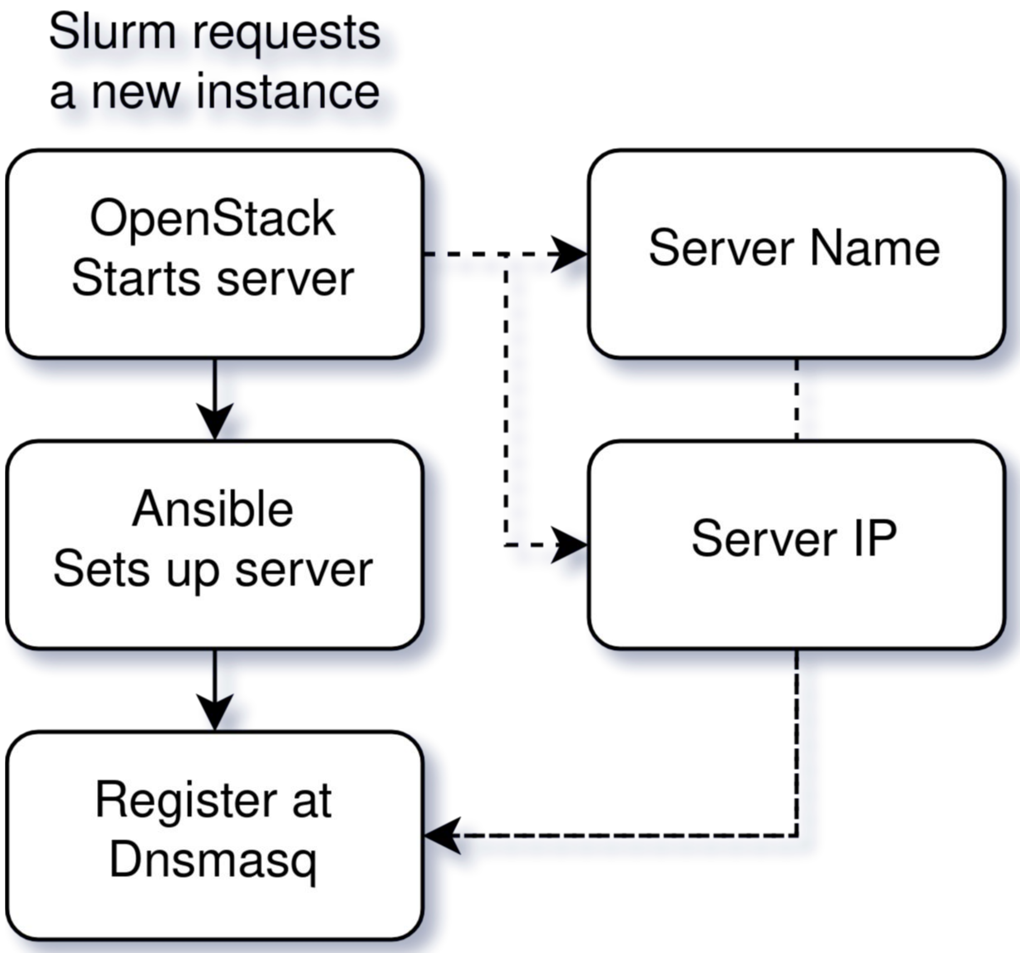
```
peerB # wg
interface: wg0
  public key: JkcUEgA9oqPHClu2l/j04dpBlxkipTG7sk
RoTBlFnH0=
  private key: sA6ljUB+0+nAmeAcU5iJ8xZrtWVkiia//
mkui9QO21E=
  listening port: 51820

peer: OjZc5ZDVoejDyBPX8ZZ5OwazzGcBy/nlfRAqKwaMok
U=
  endpoint: 192.168.1.1:51820
  allowed ips: 10.0.0.1/32
  latest handshake: 5 seconds ago
  bandwidth: 433 B received, 464 B sent
peerB # 
```

Dnsmasq - DNS subsystem for a local DNS

BiBiGrid needs to **provide name resolution** itself – as OpenStack's name resolution only works on its own location.

Name resolution must adapt **"on the fly"** as BiBiGrid provides "on demand" node scheduling using Slurm's [Elastic Computing]

=> Configure [Dnsmasq] whenever a new instance is requested



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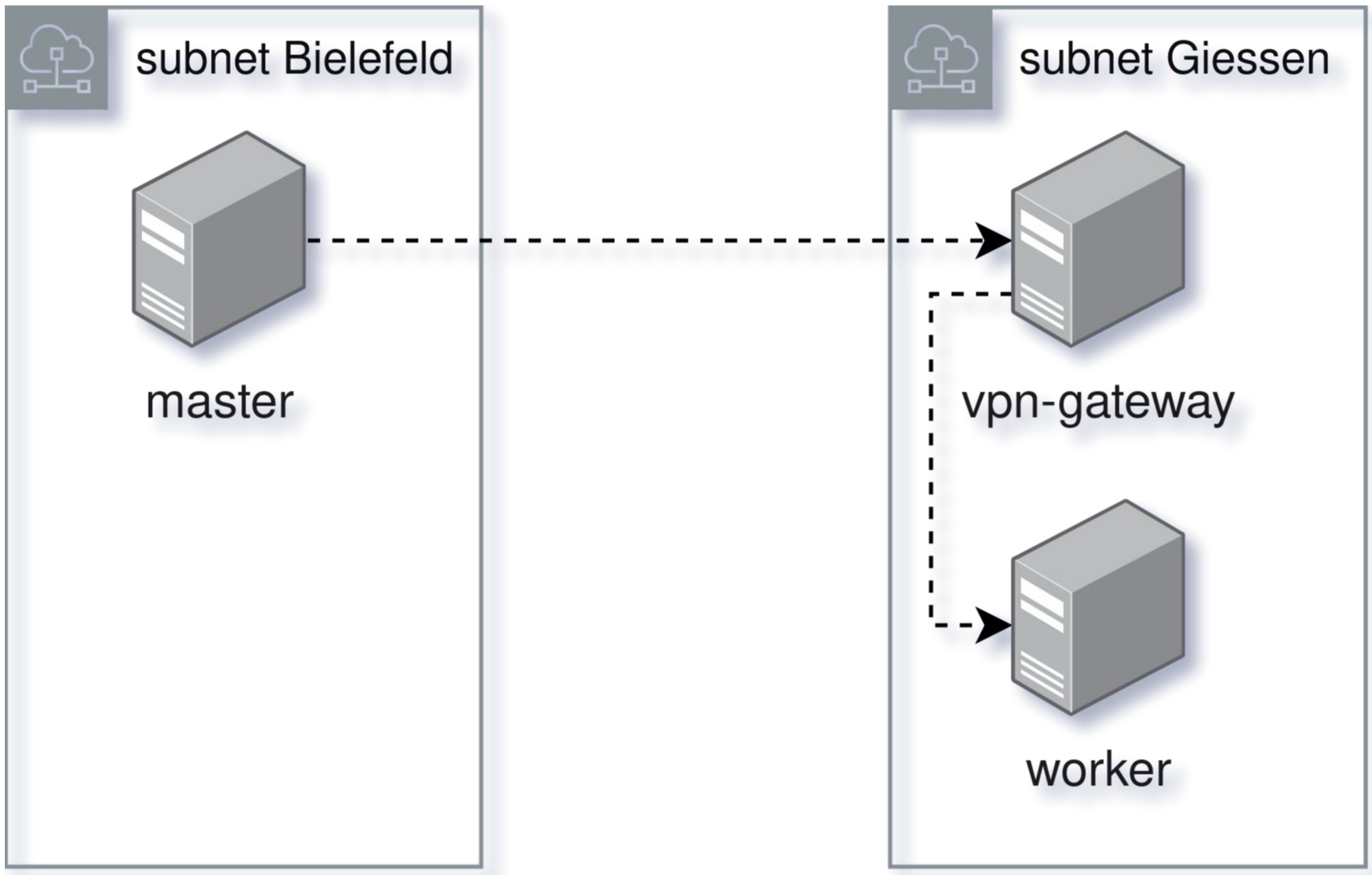


Routing

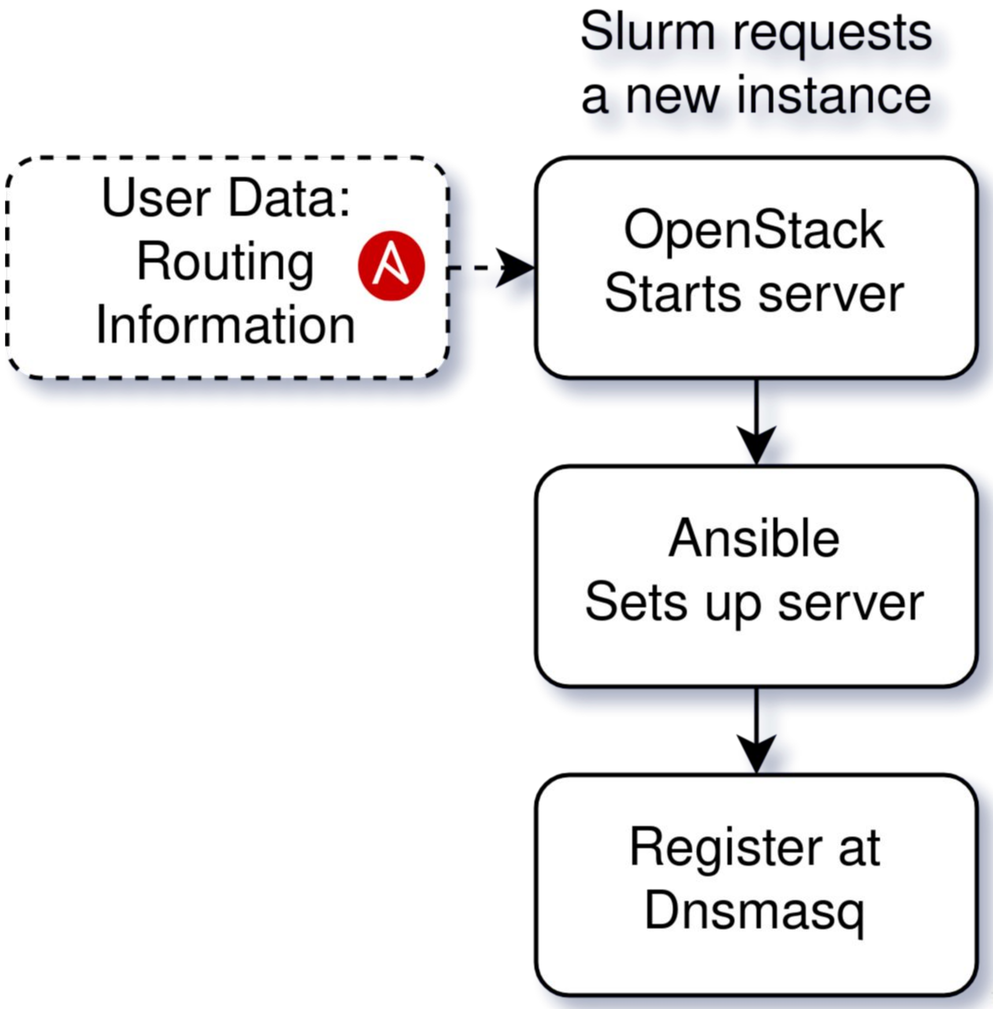
- Workers from foreign clouds must "learn" how to communicate with the cluster's master

=> **Add ip routes** over the respective vpn-gateway to reach the master

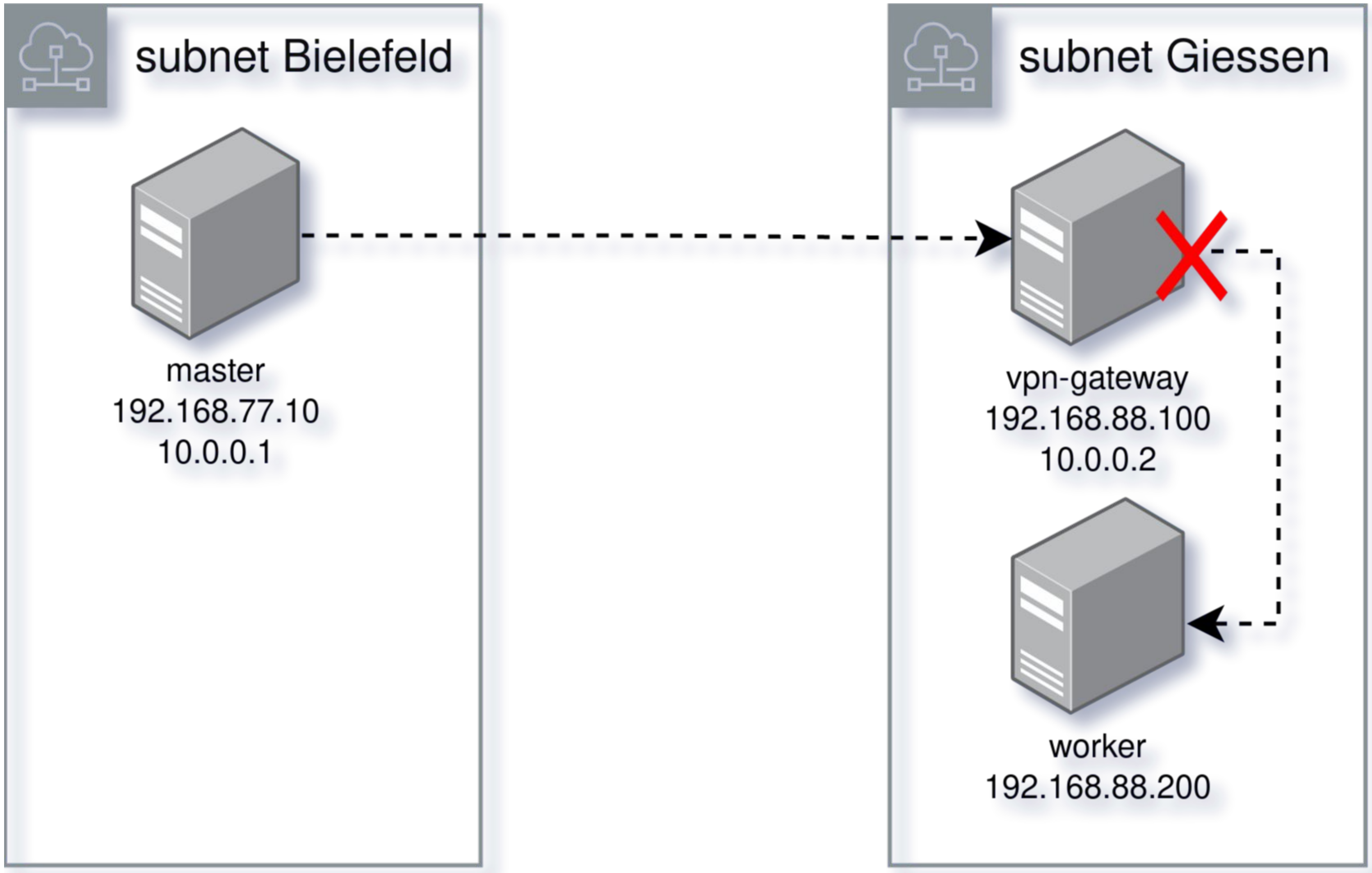
- These routes must be injected **before Ansible** is executed as a route back must already exist at that point

=> Add ip routes using **User Data**

Vpn-gateways must **forward** ips forward over the default network



OpenStack: Port Security & VPN



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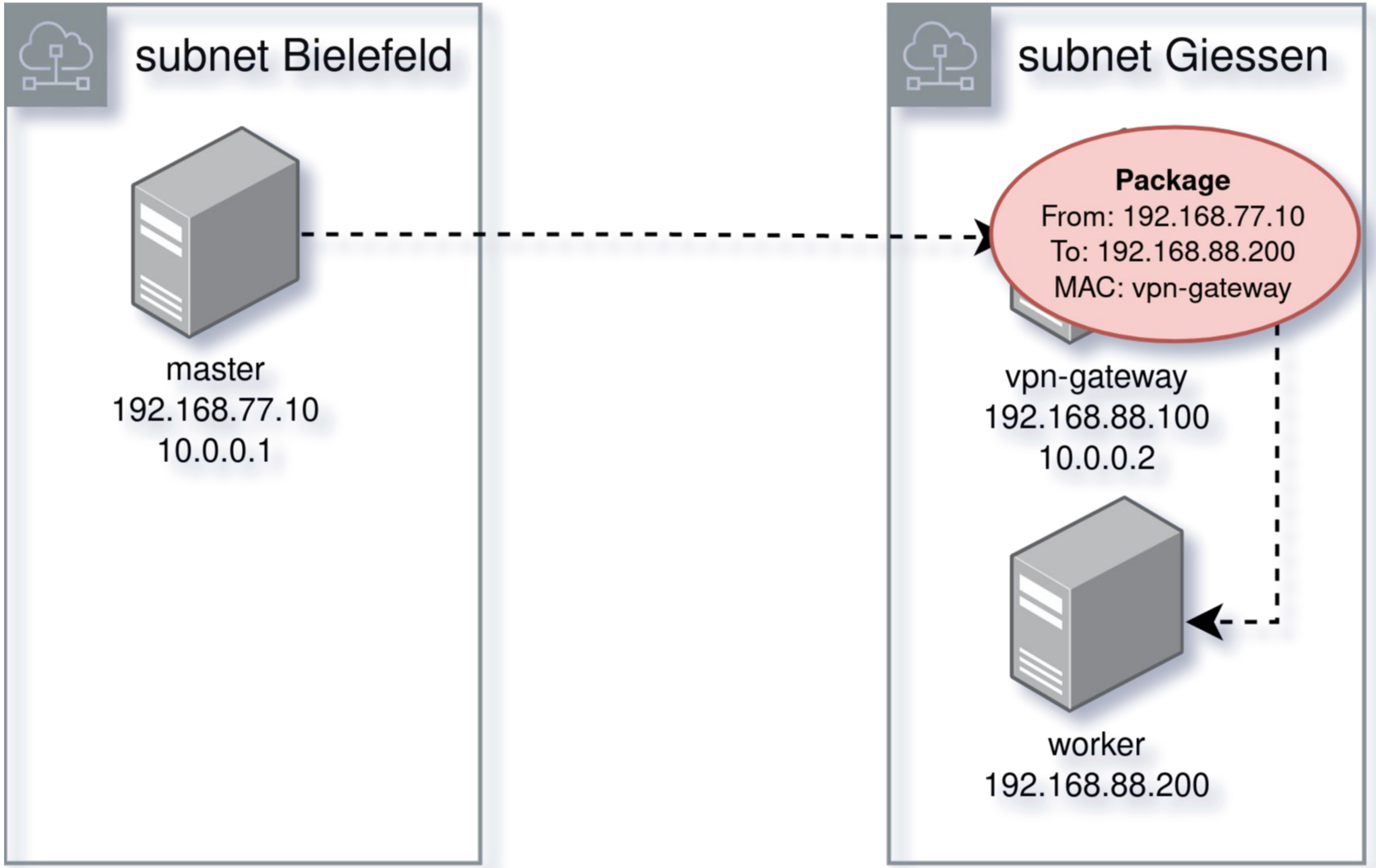

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Multi-Cloud – BiBiGrid

- Cloud locations must be able to **communicate** – **Routing (User Data), Port Security, Security Groups**
- Slurm must be able to request server instances for jobs “on demand” **on all clouds** – **VPN**
- Slurm must be able to schedule jobs to **specific clouds** – **Partitions**
- Communication between clouds must be **secure** – **Wireguard**

- Go easy on resources – Only one vpn-gateway for every cloud
- Working on multiple clouds should not complicate use – DNS, VPN

Outlook

- **Finalize** multi-cloud setup automation
- Test BiBiGrid’s multi-cloud solution on an **actual use case** using **nextflow**
- Investigate **more efficient file sharing**

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=> Publish a BiBiGrid multi-cloud **Hands-on**

Multi-Cloud – BiBiGrid

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