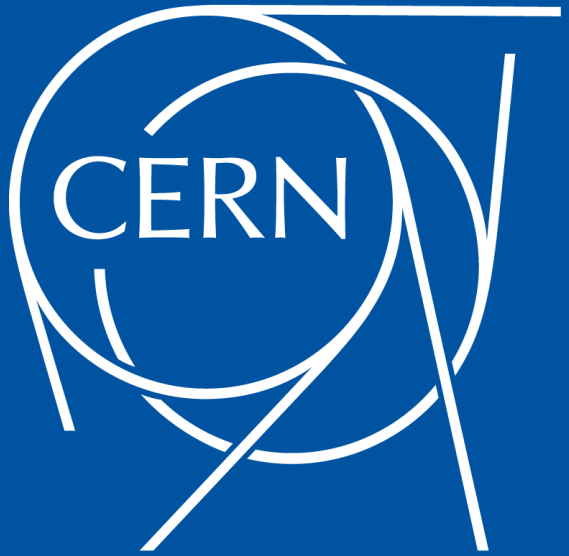

CERN

How to manage 10’000+ servers: Automation in CERN IT

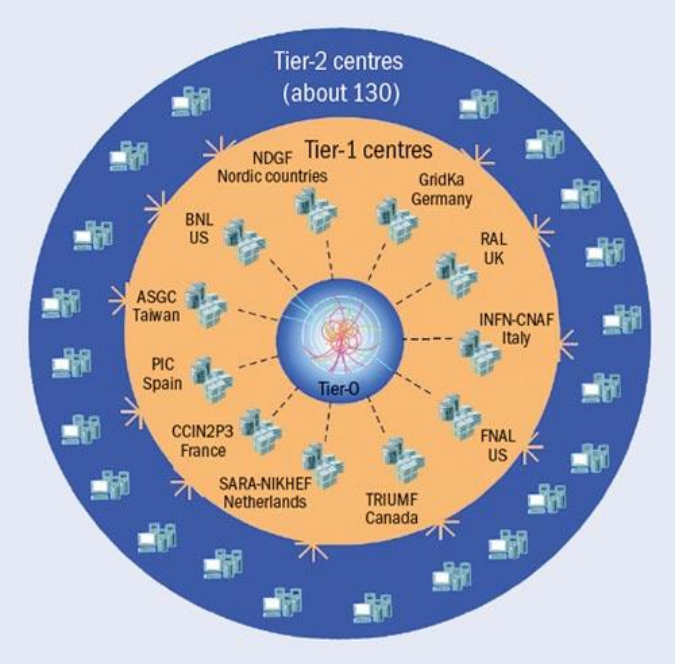
Arne Wiebalck / Benoit Clement
Computing Engineer

CERN Open Days 2019

What is the role of the CERN IT data center?

The heart of the
World Wide LHC Computing Grid (WLCG)

- Initial analysis for data quality assurance
- Permanent storage of all LHC data
- Distribution of the LHC data in the WLCG



Supports also ...

… the non-LHC experiments
… services for the accelerator complex
… infrastructure & administrative services

Where are all the 10’000+ servers?

Distributed over three data centres!

Meyrin (CH)

~12800 servers

Budapest (HU)

~2200 servers ↓

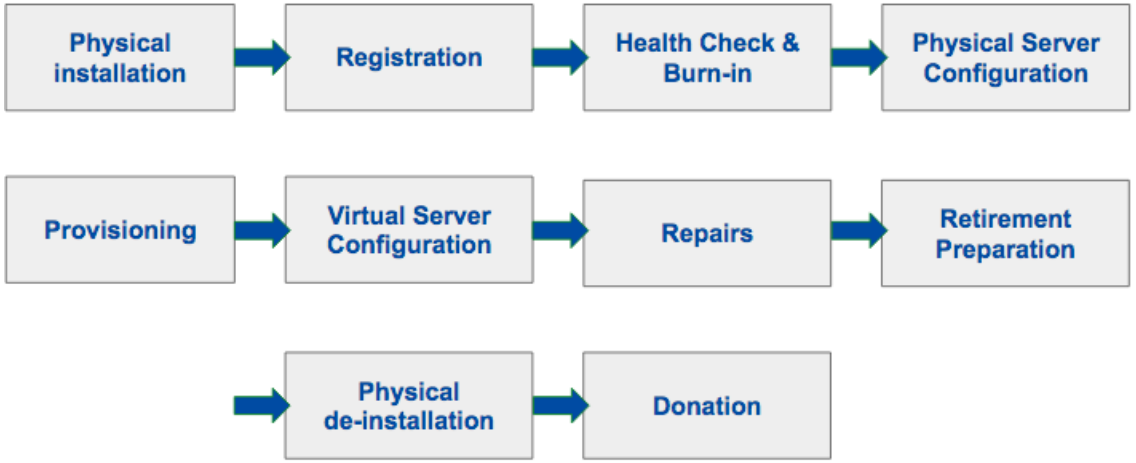
LHCb Point-8 (FR)

~800 servers ↑

Why do we need automation?

Managing 10’000+ servers is challenging! Servers need to be ...

- … purchased
- … rack-prepared
- … installed & cabled
- … registered
- … configured
- ... provisioned
- … monitored & repaired
- … eventually retired



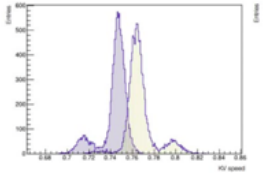
Performing these tasks continuously and at scale is hard!

Purchasing already supports automation!

We buy 100s or even 1000s identical ones in one go!

This helps with:

- **Physical installation**
  - **same dimensions, component placement, connectors, power consumption, …**
- **Testing & initial burn-in**
  - **easier to find outliers**



Example of a “slow” CPU

The same servers may also have the same issues!

Mitigated by buying large chunks from different suppliers.

How are servers physically installed?

Rack preparation and physical installation is manual, but:

Nodes register themselves with the data centre infrastructure!

Upon first boot ...

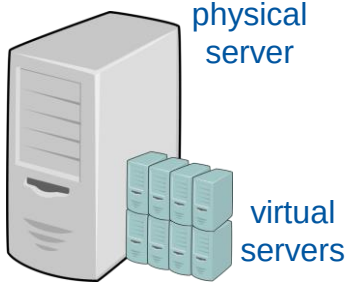
- **... the nodes sent out a discovery request**
- **… get access to the network**
- **… boot into an initial system which automatically**
  - **checks the inventory**
  - **benchmarks CPUs, disks, RAM, network**

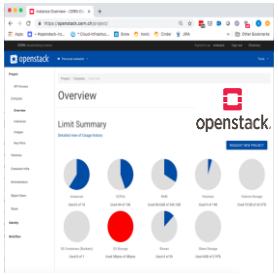
How are the resources provisioned to users?

“Users” == physicists or engineers which need servers for their work.

Via an additional abstraction layer: virtual servers!

Virtual servers are basically programs that pretend to be a “normal” server.





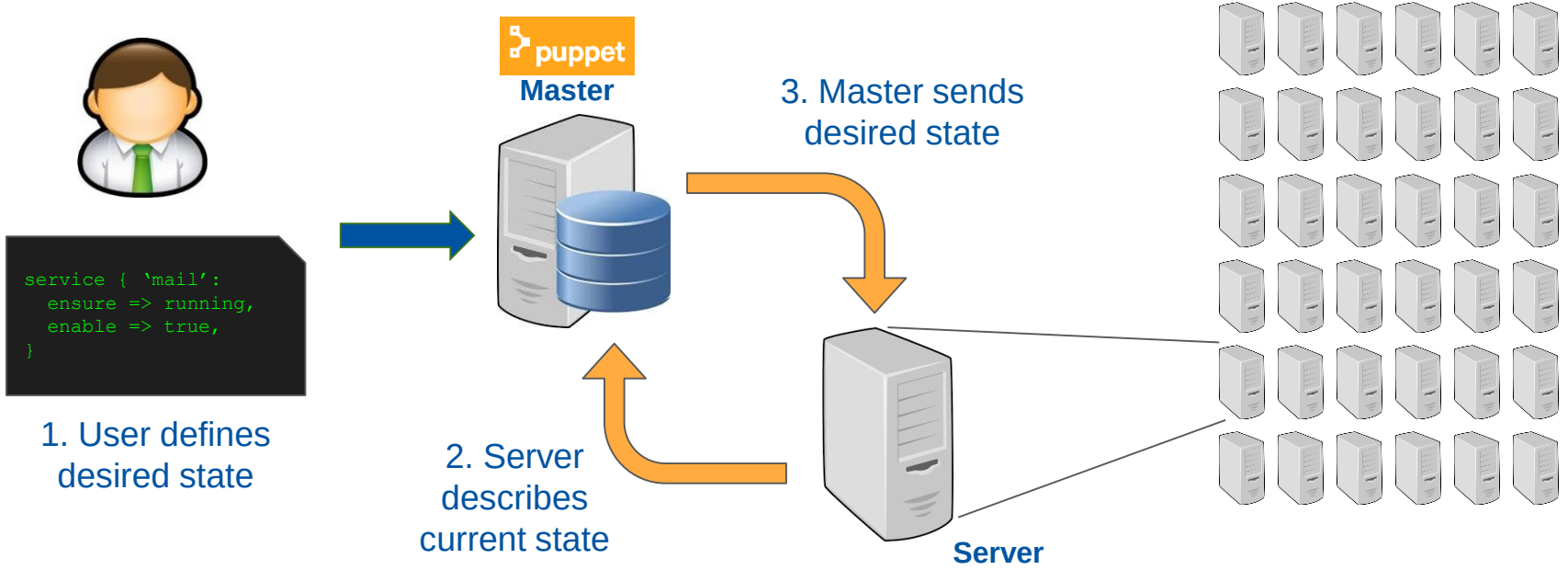
Since they are software programs, they can be started quickly on-demand.

Resource provisioning can be automated:

- **Assignment of resources**
- **Creation of virtual servers**

How are the servers installed and configured?

Via a configuration management system!



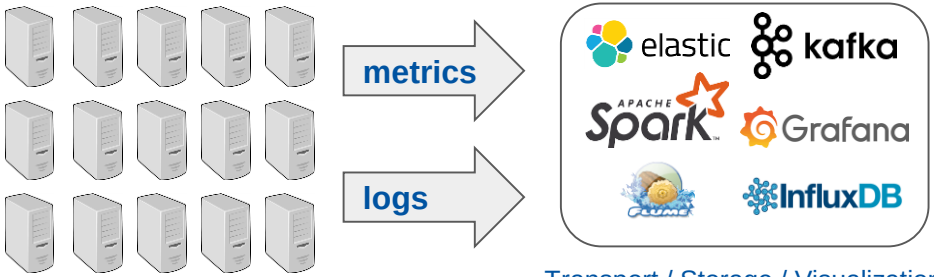
What happens when something breaks? (1/2)

With 10’000+ servers, things break constantly ...

Hardware (e.g. disks, memory, ...)

Software (e.g. programs crash ...)

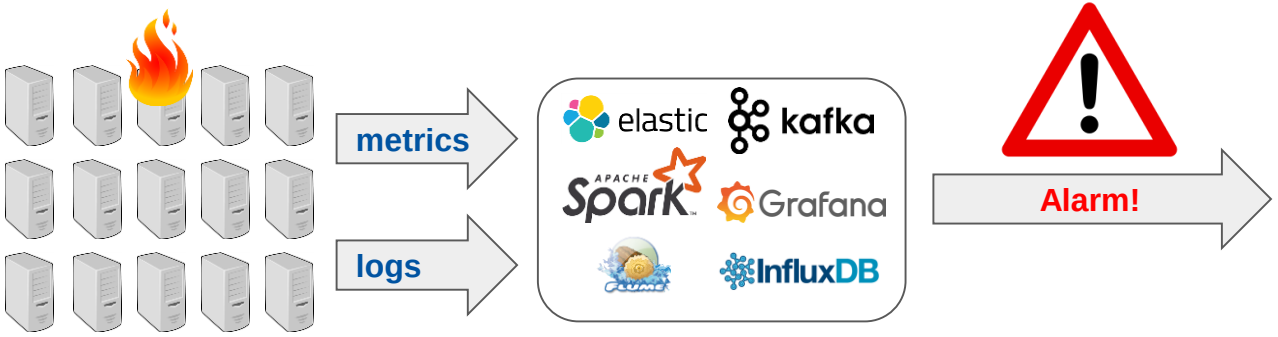
→ **Centralised Monitoring!**

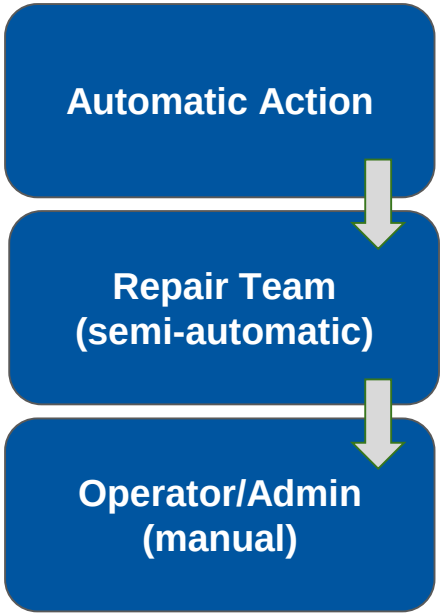


Transport / Storage / Visualization

What happens when something breaks? (2/2)

Automatic failure handling is key!





Most errors are handled automatically and transparent for users!

How do we automate server retirements?

After several years of service, servers need to be removed.

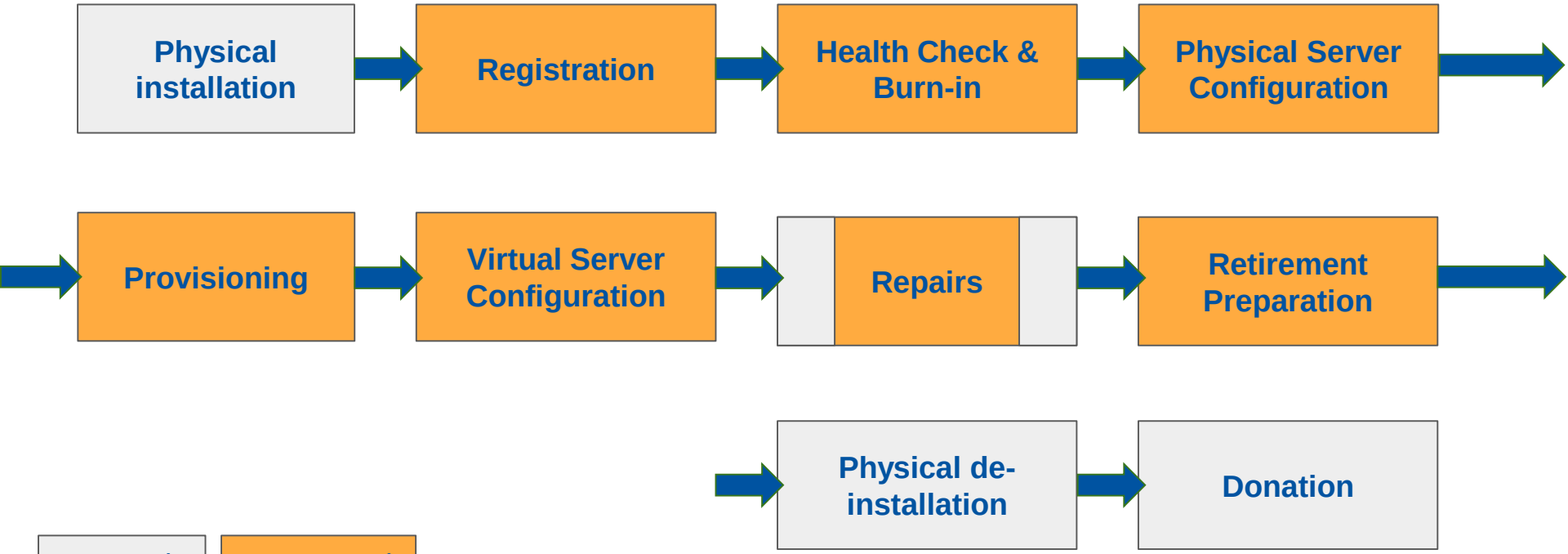
Process is similar to the initial burn-in.

The nodes are marked to boot into a special system ...

- **... which makes sure all data is securely erased**
- **… and re-checks the system in case of donation**

Physical de-installation is again manual.

Automation for the CERN IT Server Life-cycle



Questions?

www.cern.ch