

LHC's RUN2 and RUN3 will produce a greatly increased amount of data and require increasing amounts of computing power, more than most computing centres may provide. Dynfarm will take advantage of remote cheap computing resources from third-party providers and integrates them into the local centre, so that they become indistinguishable from internal resources.

## Architecture

### Requirements

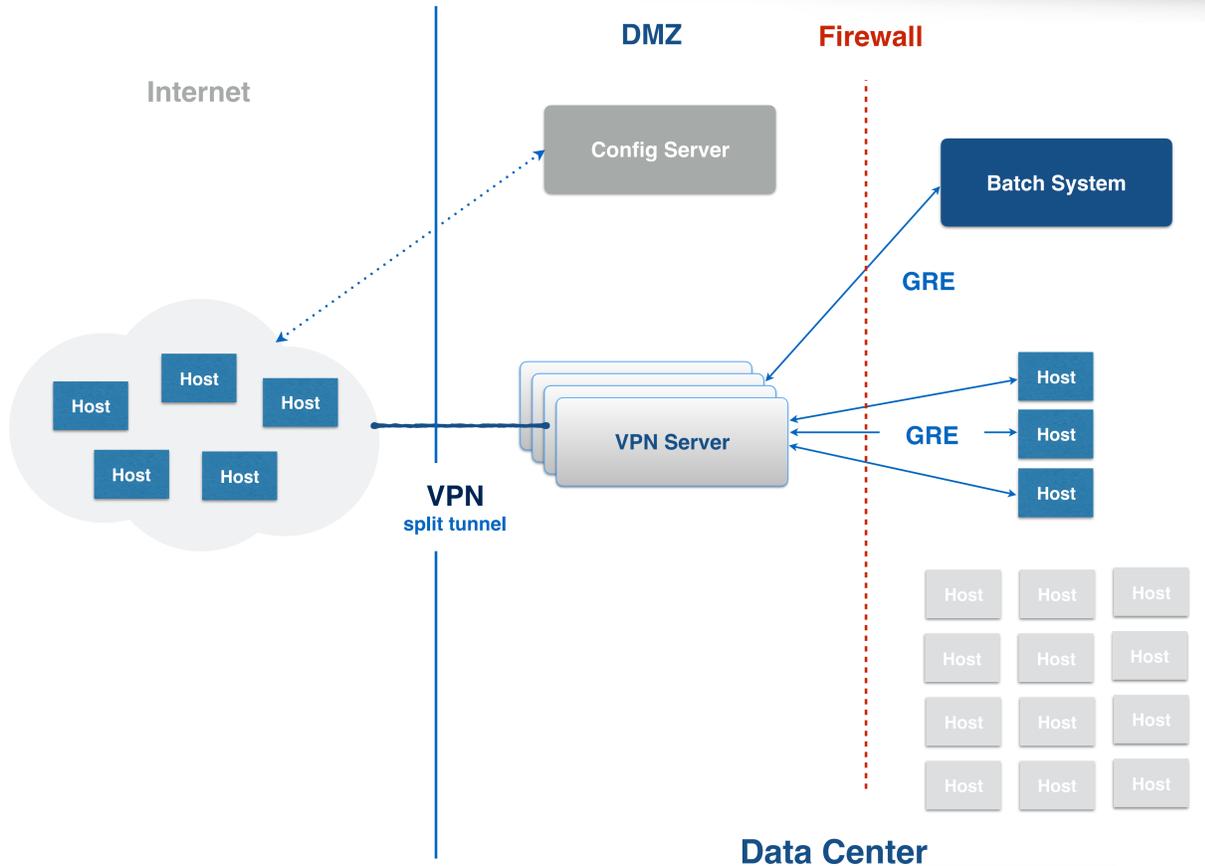
The remote computers must have unconstrained outgoing connectivity and must accept ingoing UDP connections for the creation of the VPN split tunnel.

A service (typically, one RPM) must be installed on it and must be able to run with root privileges to setup the machine. A public IP address is NOT required.

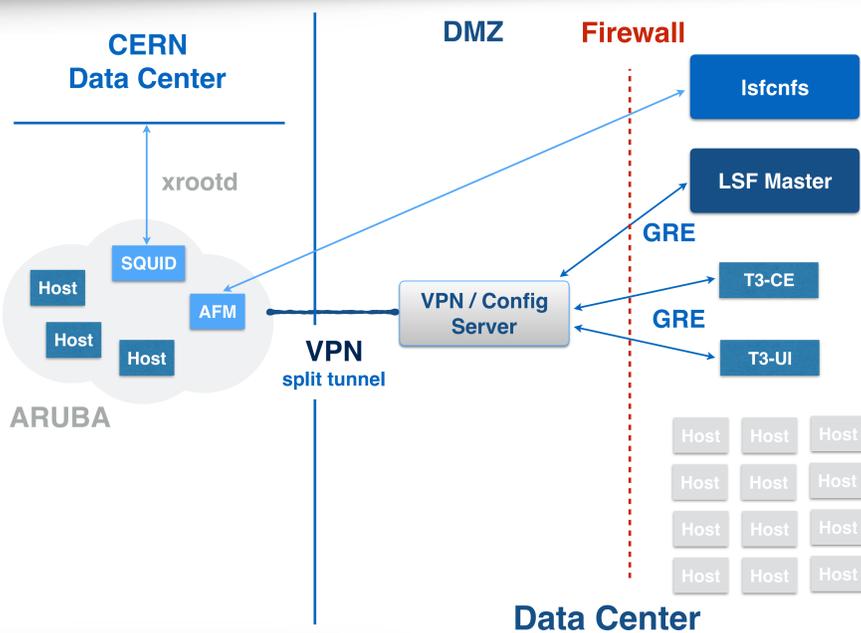
### Setup

A service is running on the remote host which establishes a VPN tunnel between it and one of a set of VPN servers internal to the center, and afterwards takes care of local configuration needs.

Any local resources that MUST be accessible to the remote host is reachable from the remote host has a GRE tunnel connecting it with the VPN server, which acts as an hub.



## A Practical Setup



### Site extension for CMS

When CNAF obtained some resources on loan from Aruba (Italian Cloud Provider) CMS's representative agreed to experiment using these resources with dynfarm.

We choose to access all data via Xrootd, which means that data requests did not go through CNAF's network. However, we chose to dedicate one of the remote machines to a Squid cache for performance reasons. Inside CNAF, the only resources which were made visible were the Computing Element (CE) and the batch master (LSF).

Details and results have already been presented in ISGC 2016.

## Other capabilities

### Full Control

CNAF's administrators have full control of the remote machines, and can run commands on them with full administrative privileges, without requiring the root password.

### Dynamic Setup

Once the image or container has been properly configured, adding or removing machines is as easy as starting/stopping them.

### Conservation of Bandwidth

Only traffic that MUST go through CNAF passing through it. The remote machines by default use their own network to access resources through the Internet.

Queue	Nodetype	Njobs	Avg_eff	Max_eff	Avg_wct	Avg_cpt
Cms_mc	Aruba	2984	0.602	0.912	199.805	130.482
Cms_mc	T1	41412	0.707	0.926	117.296	93.203