

CERN Site Report*

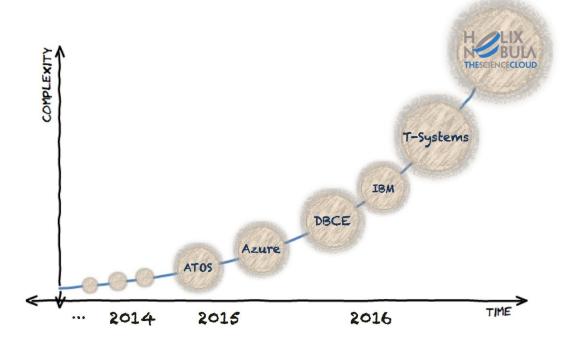
Oliver Keeble & Andrea Manzi on behalf of the DPM team

* Yes, really!

Helix Nebula & CERN cloud

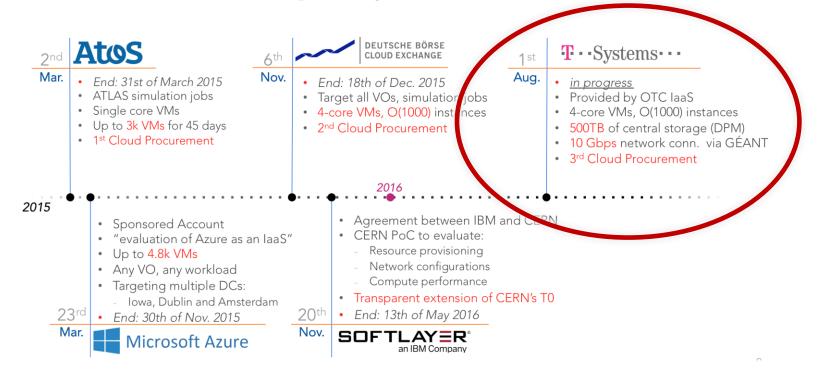
Started in 2011 with the EC funded project Helix-Nebula

Since 2015, series of short CERN procurement projects of increasing size and complexity





CERN cloud projects





The procurement

- 90 days
- 4000 cores
- 1000 VMs
- 500TB block storage
- 10Gb/s uplink to CERN



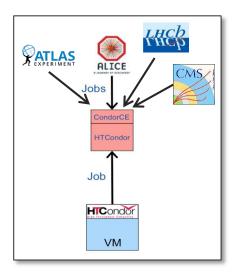
Transparent Extension of CERN Resources

Consolidate the strategies adopted in the past cloud activities

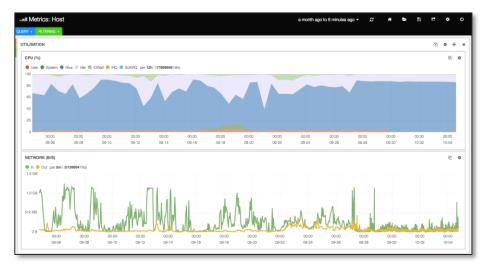
- Manage and exploit external resources using same toolset and entry points as CERN on premises resources
 - *Puppet* configuration
 - HTCondor for scheduling and match-making
 - Infrastructure monitoring

[see CHEP p-22]

- Adopted *Terraform* for VM lifecycle management (N.B.: looking for long VM lifetime)
 - Open source toolkit, supports several cloud providers



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The standard VM

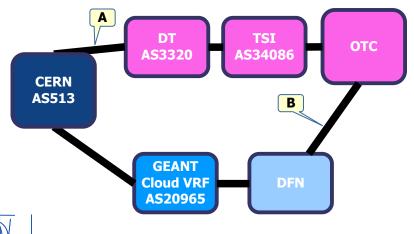
- 4 cores
- 100GB disk (networked block device)
 - 1k iops, 50MB/s streaming
- 1Gb/s "east-west" (ie LAN to workers)
- 500Mb/s inbound from CERN
- 300Mb/s outbound to CERN
- For data, "SSD"s were available
 - 20k iops, >200MB/s streaming

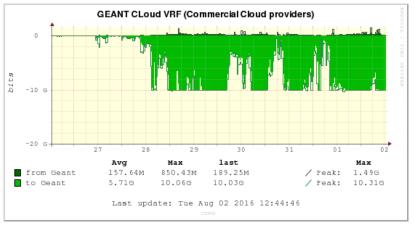


WAN connectivity over GÉANT

Requirement for CSP since the first procurement (early '15) <u>GÉANT Cloud VRF</u> is currently connecting CERN and T-Systems (via DFN)

- 10 Gbps of total reserved peak bandwidth available
- The VRF is configured to only allow traffic between CPs and NRENs; no CP-CP traffic is allowed





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Dimensioning the service

- Assume ¾ of WNs access data
- 48 disk servers ~ 16Mb/s per WN core
 - ~2MB/s
 - ~ The largest figure we had been quoted was 2.5MB/s (Alice)
- 500TB/48 per disk server
 - 2 4.9TB block devices
- IOPS...
 - Hmm, put the db on an SSD and hope for the best
- Alice
 - Needed special monitoring (apmon) so a separate instance for them



xdpmhn01 cpu %

ሮካ UTILISATION 20 CPU (%) ÷ ● User ● System ● Nice ● Idle ● IOWait ● IRQ ● SoftIRQ per 12h | (19047 hits) 100 80 60 40 20 0 00:00 00:00 00:00 00:00 23:00 00:00 00:00 00:00 23:00 23:00 10-12 10-15 10-18 10-21 11-01 11-04 10-24 10-27 10-30 11-07



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Commissioning

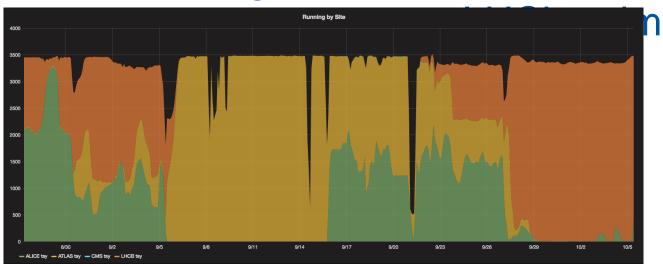
- Everything puppetised
 - gridFTP redirection ON
 - Ext4 (was this the right choice)?
 - Single head node with everything on it
 - SSD for db
 - Still some final tweaks required
 - Atlas STs, ACLs etc



The use cases

- Alice sim + reco
- Atlas sim + digireco

CMS – sim +
 digireco





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Challenge #1: subdomains

CERN Certification Authority



Help

Support

New Grid Host Certificate

Home My User Certificates My Host Certificates

Request a new Grid Host certificate

You can request a certificate for an host if either:

• You are declared as responsible or main user of the device in LanDB (http://network.cern.ch)

• The responsible or main user of the device in LanDB is a mailing list, and you are a member of the mailing list.

New Grid User Certificate

Certificate Subject

Insert or select the host name (host.cern.ch), optionally preceded by a service name (servicename/host.cern.ch):

Subject Alternative Names

Select

If required, you can specify Subject Alternative Names for your certificate, in DNS format, in the text box below (one per line).

The same restrictions for host names apply, i.e. you must be either responsible or main user of the subject alternative name in LanDB, or be part of a group that is declared as responsible or main user.

Network Connection Request Forms - Register Compute

PLEASE READ THIS CAREFULLY

You want to register a Device at CERN that can be used either connected to outlets or to wireless networks; You will not get any dedicated IP address, nor any dedicated outlet on the network! If you need to register a dedicated IP or register into a dedicated network you will have to fill in a New fixed IP interface after having registered your device.

If you do not understand what this all means, please consult NETOPS

Mandatory fields are marked with (*). Please do not forget to submit your request by selecting the **'Send Request'** button at the end of this page. HELP is available by selecting the links on this page. For any questions or comments, please contact NETOPS.

Device Information

Desired Device Name:(*) Usual Location:(*)	(Zone:)
Manufacturer: (*)	Please Select Not in the list
Model/Type:(*)	Please Select V Not in the list
Generic Type:	Not defined
Operating System:(*)	Please Select Not in the list
Op. Syst. Version:(*)	Please Select V Not in the list
Description:	
Serial Number:	
CERN Inventory number:	
• Tag:	
Responsible for the device:	• Name:(*) • First

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Challenge #2 : NAT

- T-systems implemented one-to-one NAT
 - Each host has its own public/private mapping
- xrootd
 - gfal-ls root://xdpmhn01.tsy.cern.ch/dpm/tsy.cern.ch/home/dteam
 - xrdfs root://xdpmhn01.tsy.cern.ch/ ls /dpm/cern.ch/home/dteam
 - kXR_locate request, which results in their redirection to a private IP address
- GridFTP
 - Extra config for redirection



Challenge #3 : reverse DNS

- GSI (Globus security) requires reverse DNS to be configured for servers
- We needed 4 DNS services in 3 places
 - Forward and reverse private IP
 - -> deployed in the cloud
 - Forward public IP
 - -> CERN DNS
 - Reverse public IP
 - -> T-systems
 - ...they weren't expecting this!



Challenge #4 : Configuration

- Reboots of services had side effects
 - Losing hostname
 - Frontends didn't start
 - Related to learning the VM management API, tackling cloud-init, managing DNS...
- Stabilised in the end
 - ... but puppet doesn't erase history
 - Nodes are only "eventually identical"



Challenge #5 : Monitoring



MonALISA Repository for ALICE



er by predic	ate : %/ALICE::CERN::DPM%	Filter				
Last values dump						
Farm	Cluster	Node	Parameter	Value	Time	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	cpu_usage	0.31206441009424346	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	eth0_in	0.07782389322916666	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	eth0_out	0.3142171223958333	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	load1	0.0	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	no_CPUs	4.0	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	processes	208.0	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	sockets_tcp	24.0	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	total_traffic_in	0.07782389322916666	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata127.tsy.cern.ch	total_traffic_out	0.3142171223958333	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	cpu_usage	0.3038058971637847	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	eth0_in	0.07776692708333334	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	eth0_out	0.29910481770833336	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	load1	0.04	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	no_CPUs	4.0	08 Nov 2016 1	
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Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	sockets_tcp	24.0	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	total_traffic_in	0.07776692708333334	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata129.tsy.cern.ch	total_traffic_out	0.29910481770833336	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata130.tsy.cern.ch	cpu_usage	0.3994673768308921	08 Nov 2016 1	
Itaria	ALICE::CERN::DPM_xrootd_Nodes	xdpmdata130.tsy.cern.ch	eth0_in	0.06336263020833334	08 Nov 2016 1	
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Itoria	ALICE-CEDN-DDM vrootd Nodes	vdnmdata130 tev cern ch	nrocaceae	207.0	08 Nov 2016 1	



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Challenge #5 : Monitoring

- Both apmon and xrootd send UDP packets
- These were disappearing – traced to corruption from virtual switch on hypervisor
- Fixed with hypervisor patch

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Eth	ernet II, Src:	Procurve_	e6:24:00 (00:16:b9:e6:2	4:00), Dst: Ca	admusCo_4d:16:0			
		Version 4	, Src: xdp	omdata127.tsy.	cern.ch (46.29	9.96.43), Dst:	voboxalic	e4.cern.ch (18	8.
	a (572 bytes) Data: 6574735f	74634cc943	4c4f534544	000000000000000000000000000000000000000	000000				
	[Length: 572]								
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Challenge #6 : network i/o

- Why does xdpmdata104 have hundreds of clients connected while the others have 1 or 2?
- Why is its network throughput 50MB/s rather that 100MB/s?
- Something happened to this node previously and it built up a huge queue... but what?
- ...unresolved



Challenge #7 : checksums

 Atlas reported checksum problems copying from DPM to the Worker

!!WARNING!!2990!! Remote and local checksums (of type adler32) do not match for HITS.09458365. 000184.pool.root.1 (cd88ab28 != a522d6aa)

 There were around 20 problematic files, all had been transferred in during the week before (via both gridFTP & xroot)



Challenge #7 :

- We could verify
 - File was transferred successfully with checksum
 - mtime on disk is the same as upload time
 - mtime in DPM db is the same as upload time
- But...
 - A single 4096 byte block was different!
- Status: traced to defective SSD



2	3/	1	1/	2	0	1	6

Discover - Kibana	× +	
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Google 🔋 Google Cale	endar 👖 Google Calendar 📄 CER	NY ■EDHY ■OpsY ■GGUSY ■ReposY ■ADY ■T-systemsY »
12.649	Time	_source
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t data.dst_hostname	# data.chk_timeout	
t data.dst se	t data.dst country	Q Q 🔲 Switzerland
t data.dst_site	<pre>t data.dst_experiment_site</pre>	Q Q II CERN-EXTENSION
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t_data.dst_url	t data.dst_se	Q Q Ⅲ srm://xdpmhn01.tsy.cern.ch
t data.endpnt	t data.dst site	Q Q II CERN-PROD
# data.f_size	t data.dst srm v	Q Q II 2.2.0
t_data.file_id	# data.dst tier	Q Q II 3
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t data.file_metadata.adl		ch/home/atlas/atlasdatadisk/rucio/mc15_13TeV/9e/cc/HITS.09473395 003588.pool.root.1
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# data.file_metadata.file	<pre>t data.file_metadata.activity</pre>	Q Q II Recovery
? data.file_metadata.md5	<pre>t data.file_metadata.adler32</pre>	Q Q III 77b6f69e
t data.file_metadata.na	<pre>t data.file_metadata.dest_rse_id</pre>	Q Q II 316488643efc413384c22df1070ca3f3
t data.file_metadata.req	t data.file metadata.dst rse	
t data.file_metadata.req		· · -

Things I didn't mention

- Experiment experience integrating a new system
 - A slightly different kind of thing, as compute was transparently extended, storage was not
- All the work done by IT-CM to integrate batch, puppet, monitoring...



Conclusions

- DPM is deployable in the cloud
 - Even with NAT, subdomains etc it's possible
- However, a cloud is not your own computer centre
 - Debugging can involve numerous parties
- It takes a while to amortise the overheads of commissioning a storage system
 - One has to consider carefully how best to spend "cloud money" on CPU/storage/network

