HEPiX Spring 2014: May 19th to May 23rd, 2014

LAPP, Annecy-le-Vieux, France
http://indico.cern.ch/e/HEPiX-2014spring

Trip report

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with contributions by Vincent Dore / CERN

General

The Annecy meeting was the first one in France since 2001. The local organisation team with Frédérique Challot as chair and Eric Fede and Muriel Gougerot as key players did a marvellous job, thinking about every conceivable detail and being open to questions and requests before and all the way during the meeting. With 105 registered participants, the attendance level was very high; of the 77 European registrants 26 came from nine French institutes, among them many newcomers, proving once more that locality helps to attract new participants.

A total of 71 abstracts were submitted – a very high number that required the standard slot length to be cut back from 30 to 25 minutes.

The meeting took place in a nice, comfortable and functional auditorium on the LAPP site. Network services were working flawlessly (even though many ports appeared to be blocked), and power sockets were available abundantly. The local team had arranged for Vidyo transmission; while no presentation was given remotely, there was quite some level of remote attendance including questions and comments. Coffee breaks, served in an upstairs room with access to a terrace to profit from the nice weather prevailing most of the time, were copious and varied. Lunches were served from Monday to Thursday in a nearby university canteen.

Participants will certainly remember the welcome reception in the form of a boat cruise on the Annecy lake, with beautiful, mild weather. The sunset shed beautiful lights onto the pittoresque mountains at the east side of the lake. The social dinner was also held by the lake side.

One of the main topics of the meeting was Scientific Linux, which was launched by an agreement between FNAL and CERN at the Edinburgh meeting in May 2004, ten years ago; however what to do in the future, following the close involvement of RedHat in the CentOS project announced in January 2014, was the predominant subject – more in the detailed section below. Other important recurrent topics covered during the week were IPv6, perfSONAR, CEPH, HTCondor, CPU benchmarking, Puppet etc.

Monday May 19th

Welcome address (Nadine Neyroud / LAPP)

Nadine Neyroud, the Technical Director, welcomed the participants and reminded us of the history of LAPP – founded in 1976 in Annecy because of the vicinity to CERN and the Bugey nuclear reactor. The institute was extended in 1992, and today is involved in a number of HEP and astrophysics activities. It currently employs 58 physicists and 72 engineers, technicians and administrative staff. It serves as a T2/T3 centre for the WLCG. There is also a large group of theorists (33 researchers) in a separate institute sharing the building.

LAPP was involved in the data acquisition system of the ATLAS Liquid Argon calorimeter. For HESS (Namibia) they have built the Cerenkov counter. Further contributions Nadine mentioned concern OPERA and VIRGO. MUST is a Tier-2/Tier-3 for WLCG built in collaboration with the university; it provides compute power to both, comprising 1'400 cores and 250 TB on GPFS plus 1 PB on DPM, with a dedicated 10 Gbit/s link to LHCONE. In October they opened a new computer room of 200 square meters ready for free cooling.

Workshop logistics (Frédérique Chollet / LAPP)

Frédérique explained that the campus is about 5 km away from the city centre, and how to commute, and gave details about the group photo, wireless networking, the welcome reception and the social dinner.

Site reports

PIC (Jose Flix / PIC)

Pepe gave this site report as the Tier-1 manager. The primary objective of PIC is to serve as a Tier-1 for LCG featuring 3'600 cores, 6 PB of disks and 8.5 PB of magnetic tapes. They also support some other physics projects. Like all other Tier-1s, they expect to grow significantly for the LHC Run 2. Pepe showed reliability figures pointing out PIC's excellent availability and reliability. They recently introduced remote data access via xrootd as well as HTTP/WebDAV, and were one of the first sites providing support for multi-core applications. Their CPU servers are all Intel-based, new purchases go for E5-2650v2 with 4 GB per core, 2 1TB disks and 10 GE. Disk servers use Supermicro kits with 4 TB disks providing about 200 TB per file server. Tape storage is based on T10kC and the SL8500 library. Disk is managed with dCache, with Enstore serving as the tape library manager. They use Puppet 2.7 for the configuration of the services; the modules are very PIC-specific and need to be cleaned up before being adequate for sharing. Pepe then explained the network connectivity. Internally they are replacing 3Com switches by Nexus ones. PIC actively contributes to the IPv6 efforts by the community. They deploy virtualisation based on RHEV 3.3, for which they have implemented scripts for automating tasks using RHEV's REST API. Pepe then explained the centralisation of logs targeting CE and PBS accounting logs, using Logstash, ElasticSearch and Kibana. For Run-2 they are investing significantly into free cooling, which should be available for 5'000 hours per year, aiming at a PUE of 1.3.

Holland Computing Centre (Brian Bockelman / Nebraska)

The Holland computing centre is mandated to provide computing for research in Nebraska, serving Lincoln, Omaha, and Medical Center campuses. They run three different general-purpose clusters and a dedicated Tier-2 for CMS. They have purchased Brocade MLX routers, which increased the internal bandwidth and simplified the network setup, and are preparing for a 100GE connection to Internet2. IPv6 is widely deployed on the CMS cluster, including service nodes. Software-defined networks are being investigated. Brian then explained the hardware deployment for CMS – Ivy bridge systems with 128GB of RAM, 4 TB drives into existing file servers. The worker nodes run HDFS; the nodes providing most space are progressively upgraded to 10GE. They are actively investigating RHEL7 based on the release candidate, and hope to have worker nodes upgraded by Fall 2014.

IHEP (Jingyan Shi / IHEP)

Jingyan Shi explained that due to some personnel changes, Gang Chen has moved on to other important responsibilities, and is no longer in charge of IHEP. IHEP has added 1'800 CPU cores and 200 GPU cards. The Lustre file system now provides 3.3 PB. New links have been deployed to the US. They have migrated to SHA-2 smoothly; IPv6 is in the works. They have had quite some issues with their batch scheduler related with out-of-warranty hardware, which they have addressed by developing tools to better monitor the cluster health, exclude nodes in error, and detect and kill zombie jobs. She explained in some detail the work done to optimise the batch farm occupation, and then went on to details of their Lustre setup that has suffered from long rebuild times of ageing disk arrays after three years of usage, which they have addressed by reducing the size of the RAIDs from 24 to 12 disks, by retiring old kit, and by migrating hot data to newer, more performing kit; she asked for advice on how to handle the disk storage life cycle. Services for ATLAS and CMS have been stable and reliable apart from some drops caused by hardware failures. Most services have been upgraded to EMI-3 (dCache, DPM, LFC, APEL still to be done); all nodes are running SL6.5. She then explained that a database was created for all devices, and that power accounting is applied by experiment. Half of their systems are managed via Puppet. PerfSONAR has been deployed as requested by WLCG.

LAL and GRIF (Michel Jouvin / LAL)

Michel started by highlighting that the new data centre was delivered in time and within budget. It was a shared initiative by six labs in the Paris region; the room is 100 square meters for 400 kW with a PUE of better than 1.3, and is extensible. They moved from legacy storage to Netapp for NFS/CIFS as well as iSCSI, which has proved very reliable. For performance and volume data, they are using HP blades with dense disk JBODs. Blades were chosen because of the promise to be able re-configure the front-end server on another blade. However they found that the systems are very sensitive to power cuts, the HP support was close to catastrophic, and the 10GE SFPs are very expensive; hence they have started deploying Dell systems, on which Michel will report at a future meeting. Concerning CPUs, most servers are six and more years old; new servers will be used for consolidation via virtualisation (except for worker nodes), for which they have used Dell C6100/6200, which has given rise to cooling challenges successfully addressed by rear-door cooled

racks from ATOS. While experience at LAL has been very positive, other GRIF sites report less favourable experience with their cooling challenges. The main switch has been replaced by a pair of Force10 4810 with 32 10GE ports, with a pair of Dell 6840 service as new office concentrators. For WiFi, a captive portal was introduced for visitors and internal users, and EDUROAM was deployed. Concerning OS, all Unixes have been retired, only SL and Windows are left; they are aggressively upgrading to SL6. For desktops, only Windows is centrally managed, with Windows 8 as the default, but they are still struggling with the XP phase-out. An interesting challenge is that they must ensure that all desktops and laptops must be encrypted, which they implement as much as possible, but for Linux it is hard. LAL has started to deploy automatic address allocation and subsequent configuration of related services based on an in-house development that they are willing to share.

GRIF, the distributed Paris Tier-2 site, now features 9'000 cores and 4 PB of disks, and is facing serious budget constraints. PerfSONAR has been deployed recently. The GRIF idea has now being applied at a larger scale including more labs and other sciences, establishing rotas among the participating labs.

Finally Michel covered Stratuslab and reported on the current status and progress.

KIT (Manfred Alef / KIT)

Manfred started by recalling that the batch system is based on 140 kHS06, 610 worker nodes, and 9'510 physical cores. Univa GridEngine is still working very well, they are happy with their decision. They now support multi-core jobs that are scheduled dynamically (Manfred mentioned a quirk with the current Cream CE not passing an important flag). Issues with multi-core jobs include inefficient back-filling and wave-like submissions, in particular by ATLAS. Concerning remote data access, the firewall can become a serious problem, for example when a bug was triggered in the ALICE software that preferred remote over local data access.

KIT has established LSDF (large-scale data facility) with archival, state storage, and data-intensive storage, targeted at research in Baden-Württemberg. The archive infrastructure is based on HPSS; they are in a heavy evaluation of CEPH. State-wide there is a Shibboleth AAI allowing users to connect with their home institute credentials. Some 2 PB of disk storage were added; GridKA and LSDF use the same tape infrastructure. They have met an issue with the tape libraries that can no longer be used without an expensive maintenance contract. They provide a service similar to Dropbox (bwSync&Share) based on PowerFolder; it is available to 450'000 students and scientists with clients for Windows, MacOS, Linux, iOS, and Android.

Finally Manfred announced the GridKA school to be held on 01 to 05 September in Karlsruhe, and some job openings at KIT.

FNAL (Keith Chadwick / FNAL)

Keith briefly introduced FNAL and mentioned that Rob Roser was nominated acting CIO and computing sector head (Vicky White is now acting as COO and will retire soon); Keith is now responsible of the ITIL processes in addition to his previous function. The availability of the

computer centre was rather high, with some scheduled interruptions. Previous limitations on power have been removed. Keith reported from an incident with PDU cords, which has triggered them to use thermographic imaging for providing early in-situ warning. They now enforce replacement on at least every two server cycles. Their formal ISO 20000 audit in 2013 was successful; they have upgraded to the Service-now Dublin release. Additional services are added to full ISO 20000 compliance; existing SLAs and OLAs are being reviewed. Network links were upgraded to 100GE (ESNET); failover tests have been conducted. They are managing network registration with a Service-now-based workflow. Fermilab has joined Eduroam (and is happy about this). SHA-2 certificates are coming. For HPC and lattice QCD requirements, they have a dedicated installation that is being renewed. FermiGrid is healthy, providing capacity to a number of user groups. They have tested NOvA Monte Carlo calculations via GlideinWMS on AWS; due to a change in costing model, they paid 6 cents per CPU hour. 90 PB data on tape are managed with Enstore. Security events include the Windows XP end-of-life (they have some 80 systems left), the MacOS 10.6 EOL, and of course Heartbleed – only few systems were affected, because most of the servers were still running on SL5. They are upgrading Sharepoint from 2010 to 2013, which was delayed due to several issues with the domain trust that took time to resolve. Fermilab will no longer have DOE funding for ReadyTalk teleconferencing as of the next FY. Keith then showed some results from NOvA, and the progress around the Muon g-2 experiment.

BNL (Ofer Rind / BNL)

Ofer started by giving an overview of BNL and RACF (Rhic and Atlas Compute Facility) and how it relates with RHIC running. The processor farm will see an increase of 200 servers for RHIC and 100 for ATLAS featuring 32...40 cores per server, with onboard storage for RHIC of 48 TB per server; they are using 10 GE (fibre-based) for RHIC, while ATLAS is still on 1 GE. All farm systems are running SL6.4; they are waiting for a decision on SL7. They are currently evaluating Moonshot providing high-density computing. Ivy Bridge gives 41% better performance per core, but there are other advantages for Moonshot. Concerning infrastructure, they are replacing the end-of-life overhead Liebert rack-top cooling units with traditional CRAC units. A flywheel test was conducted successfully. Then Ofer explained the follow-up of the tipping rack incident that was presented at the Ann Arbor meeting. Their facilities have been suffering from heavy rain falls causing leaks in the roof, which makes them consider cow-bags – Ofer asked for experience and advice. A test of switching off the cooling was conducted without communicating the start date, causing some disruptions and since then a higher than usual disk failure rate. Concerning networking, for ATLAS two more Arista 7508E switches were purchased that also support 100GE; three more switches were acquired for RHIC. They evaluated Infiniband FDR as a potential alternative to Ethernet and found a 50% higher price-performance ratio for IB with respect to 10GE. Ofer then explained how for RHIC they have taken advantage of file locality in Condor. Concerning mass storage, they have completed an upgrade of HPSS to 7.4.1p2; tape storage totals to 45 PB on LTO drives, which are scheduled for upgrade to LTO-6 in 2015. Previously reported BlueArc performance problems have been tracked down to a parameter change in SL6.3, and subsequently fixed. A small GPFS installation is in use as well; following positive experience, its size has been increased to 3 PB, with a projected performance of 20 GB/s. They are investigating CEPH at large

scale, with very good results so far; the total CEPH storage is about 2.2 PB. Distributed storage is using dCache and supports xrootd access for ATLAS. Other efforts are being made on Openstack Grizzly which is in use for the ATLAS Panda production. All systems have been upgraded to Puppet 3.4.3 without issues; they also use Foreman for life-cycle management.

Scientific Linux

10 years of Scientific Linux (Alan Silverman / CERN retiree)

Alan, wearing the 10-year-anniversary-of-Scientific-Linux T-shirt, started by reminding the situation of the 90s – many different Unix flavours were around, all of which were supported at CERN. Along came Linux – would it solve the problem? Well, not really, because there were different distributions around: Debian, SuSE, Red Hat, … (Ubuntu was rather new at the time). Then in 2003 Red Hat went commercial – the binary distribution needed to be licensed. The DoE had negotiated a deal of $55 per node, SLAC managed to negotiate them down to $25. CERN and FNAL started discussions with Red Hat around the same time, but there was very little echo at Red Hat until Spring 2004, by which time it was too late – Fermilab had already started rebuilding from sources and supporting their users. The CERN team had similar ideas, and the two teams talked to each other. In Spring 2004 Connie Sieh presented the idea of Scientific Linux, Jarek Polok gave a similar presentation, at which time Alan tried to make the two teams share the work – with all the support by management both at CERN and at FNAL. Even though the builds are done independently, it made for a binary compatible distribution. Now the interesting discussion arises about the future...

CentOS and Red Hat (Karanbir Singh / CentOS)

Karanbir, speaking freely and without slide support, started with a historic review of CentOS similar to Alan's Scientific Linux one. CentOS started for similar reasons at a similar point in time as SL and has reached very significant market share, even though there have not been any full-time developers working on it – the project was driven by everyday's needs of people using Linux, striving to remain fully compatible with Red Hat Enterprise. Red Hat became more aware in 2013, and then Red Hat and CentOS decided to join forces – Red Hat agreed to sponsor and to back CentOS, in return the CentOS trademark went to Red Hat. Red Hat have since contributed hardware and five people, and have granted access to Red Hat engineering – there are first examples of the benefits. Within Red Hat, the CentOS developers are not intimately linked with Red Hat Enterprise, but attached to the open-source unit.

CentOS strives to provide a stable platform that people can use. Due to the much increased interest by Red Hat, it is hoped to have a PowerPC and an ARM release together with the x86 one for CentOS 7. Red Hat gains a free platform that developers around the world can use that is much more stable than Fedora.

Karanbir then explained the governance structure and the way the CentOS work is organised – even though there is a CentOS board (initially with three Red Hat people on), the actual work is done within Special Interest Groups, including a core SIG. He explained how other projects have chosen

to become involved.

Status and future of Scientific Linux (Connie Sieh / FNAL)

Connie gave the usual review of the last six months of Scientific Linux, covering SL 5.11, 6.5, SL6 Devtoolset 2.1, software collection, … Devtoolset 2.1 features a newer Eclipse, added a newer Git etc. Connie then described the work around SL 7. Re-building the RHEL 7 beta revealed 36 bugs that were bugzilled, many of which were fixed by Red Hat. Then in January there was the announcement of the Red Hat – CentOS agreement; the main impact is that some day the sources of Red Hat Enterprise Linux will not be available as source RPMs from Red Hat any longer, but as a Git repository of CentOS. The FNAL SL team have had many contacts with Red Hat, CentOS, CERN and others, but still there are many open questions. The proposal basically is not to change anything for 5 and 6; for 7 the first idea was to become a CentOS variant. There have been a lot of exchanges and opinions expressed emphasising the value of SL. In April the RHEL 7 release candidate became available; the SL team rebuilt as usual, which went much more smoothly than with the beta. Recently there have been some questions on the variant solution – perhaps a hybrid model would give the SL community more control and only very little extra work.

Then Connie turned to www.scientificlinux.org – a site that is beginning to show its age, featuring a lot of content for SL3, much less for SL5 and SL6. A new Web page is in preparation. Future items of work of the team include SL7, Software Collections 1.1, SL 5.11, and SL6.6.

On a question what the sticking points are to become a CentOS variant, Connie explained that it was about being a variant or part of the Core, but not both; also it appears as if the CentOS infrastructure may not be ready in time for the RHEL 7 release.

Several participants in the discussion emphasised the importance of a timely SL7 release; Connie explained that technically and legally there is no problem, but management approval at FNAL is still awaited.

The next Linux version at CERN (Jarek Polok / CERN)

Jarek referred to Alan's history talk and reminded us of RH 6 and RH 7 and the first rebuild of RHEL 3 that was given up soon after in favour of Scientific Linux. The Red Hat-CentOS deal offers the possibility to become part of a larger community. Then Jarek listed the options, from carrying on as before, over a hybrid solution, being a CentOS variant up to adopting CentOS (and just adding a few RPMs). Jarek expressed a clear preference for the latter, presented the CERN arguments against being a CentOS variant, and discussed the impact on the HEP community.

Discussion

The four presentations gave rise to a vivid and passionate discussion. There was agreement that the Scientific Linux project has served the community extremely well over the past 10 years; the discussion was less consensual when it came to being part of a very large community versus having our own dedicated, targeted distribution. There were also very different views on the risk of depending on a commercially sponsored (by Red Hat) distribution (CentOS).

My personal interpretation of the discussion is that the community present in the meeting had a strong preference for a common approach across HEP.

Follow-up

On the day after the discussion, I invited Connie Sieh (FNAL), Jarek Polok (CERN) and Tim Bell (CERN) to discuss the next steps. The result from this very constructive discussion was presented to and approved by FNAL and CERN management; it can be summarised as follows:

- CentOS is currently evolving rapidly, both in terms of the technical choices and in terms of governance. It would be unwise to take a firm choice about the future relationship of SL and CentOS now.
- On the other hand, there is a vital interest both by FNAL and CERN to be able to contribute to the discussion and decision processes within CentOS on technical and governance matters.
- The CentOS involvement will include requesting a "Scientific SIG" from CentOS, with both FNAL and CERN participating in it. Its main goal as of now is to "build" applications that are of use to the scientific community.
- Both teams (FNAL and CERN) will observe the situation, maintain an active dialogue, and try to influence it for the benefit of the SL community.
- RedHat EL 7 (and CentOS 7) are expected to be released in the next few weeks. Each team will decide for themselves how to build the respective SL release, understanding that the choices made may not be final.
- At HEPiX Fall 2014 the teams will get together and re-evaluate the situation.
- Both teams acknowledge the preference of the community for a common approach on Scientific Linux.

End-user services and operating systems

Version control and issue tracking services at CERN (Alvaro Gonzalez Alvarez / CERN)

Alvaro started by stating that the CVS service has been shut down as announced previously; a read-only copy of the repositories is available on AFS to librarians only. SVN is the main work horse for version control with almost 2'500 projects and steady growth until Git was introduced. Git has proved very popular; already some 1000 projects have been created, half of which are active. Alvaro explained the service architecture, and presented the access methods; ssh is currently being added. He then explained that Gitlab had been looked at in some detail as a possible in-house equivalent of Github. Jira by Atlassian is used as the tool to implement issue tracking; licence restrictions mean that they cannot scale out the service as would be desirable. There are two central and four private instances hosted in the central infrastructure. Jira is integrated with CERN SSO,

Git and SVN, Fisheye and Crucible. A common portal for requests for software development tools, CERNforge, has been released and has reduced support load very considerably.

Windows 8 integration at CERN (Sebastien Dellabella / CERN)

At CERN there are more than 11'000 Windows machines registered, 8'500 of which are centrally managed. Out of those, 70% are running Windows 7, and 21% are Windows servers; currently the fraction of Windows 8 machines is low (2%), but rising rapidly. Reasons for being interested in Windows 8 include MS Office 2013, MS system center endpoint protection, an improved system imaging process, power savings, and support for a larger range of devices. Windows 8 had a rough start, as the market was not ready yet, which caused Windows 8 not to be received enthusiastically. Now, one year after the Windows 8 launch, Windows 8.1 has improved the situation significantly, and can hence be considered the real launch of Windows 8. The team has selected standard laptop models for the CERN stores equipped with 12”, 14” and 15.6” screen, with touch functionality if so desired. In addition, a 11” hybrid tablet is being tested. Among the issues found are some software incompatibilities (Forefront client security, Corel draw X5 etc); a poor integration of Modern UI app; lack of GPO to boot to desktop, etc. At CERN, some aspects have been customised: the start screen (using a non-documented feature that allows for subsequent modifications); power saving has been enabled by switching off performance mode by default (resulting in savings of 55 W); Windows imaging (customisation of Windows images, which has cut down the installation time from more than two hours to less than one hour). While the pilot of Windows 8 was only moderately successful, the 8.1 one has been well received; issues found have meanwhile been addressed. While it is expected to ramp up and be used a lot for suitable hardware, Windows 7 will remain the main workhorse for Windows desktops and (non-touchscreen) laptops.

Site reports

ASGC (Felix Lee / ASGC)

ASGC is still targeting high-density solutions, as the data centre space is very limited. They have procured Dell C6220 systems with 648 cores and Dell switches, HP HPC systems, Dell storage systems etc. The network connection (via Chicago and Amsterdam to CERN) has been upgraded to two 10GE links. The NTP DDoS vulnerability remains a pain, several stratum 1 NTP servers in Taiwan are affected. They are migrating most services to virtual machines, and are evaluating EOS. Unfortunately they had to stop acting as a CMS Tier-1, and are looking for alternative means of supporting CMS. Their 108 Openstack hypervisors have been upgraded from Grizzly to Havana; OpenNebula systems (960 cores) are being retired. CEPH is used as a block storage back-end to Cinder. They found an issue with the Dell 10GE switch, as traffic to the core switch could achieve only 100 kB/s throughput due to compatibility issues across vendors. ASGC is leading an effort to build a national cloud service. For HPC they have the choice between 10GE and IB; they went for IB on cost basis (the procurement did not include a large non-blocking IB switch). However, they have found that integrating an IB cluster into an Openstack cloud is a challenge. In addition the delivered switch hardware was not compatible with the host interfaces, and needed to be replaced. ASGC collaborates on software with ATLAS on Panda, and on hardware with Supermicro, Trend

Micro and some local manufacturers - a first prototype was presented to HEPiX spring 2013, and a second prototype is ready now; Felix showed a number of pictures and sketches of the equipment.

QMUL (Chris Walker / QMUL)

Chris explained that QMUL is an important Tier-2 site mainly supporting ATLAS, SNO+ and T2K. They run about 3'500 job slots; the disk and compute servers are mixed in the racks. All services are running the latest EMI or UMD releases. In 2013, 35 PB of data were processed, which was more than in 2012, even though the number of events was less than in 2012. The network is 10GE for now, which is expected to suffice for ATLAS. They are collecting experience with federated access to storage, and have faced issues with high job memory requirements. Their Lustre installation is running 1.8.9; they anticipate using 2.5 or 2.6 with the new procurement, and would like to move 1.5 PB from the old installation over, but there is an issue with copying the POSIX ACLs.

Tuesday May 20th

Site reports

RAL (Martin Bly / RAL)

The Tier-1 hardware now comprises 13'000 cores and 13 PB of disk storage as well as 10'000 slots in a SL8500 library. New procurements were based on Supermicro Twin2 with Intel CPUs and 36-bay Supermicro chassis with LSI controllers and 4 TB WD disks. They manage their own LAN and have enabled a mesh network. Concerning the campus network, migrations to new firewalls and new core switching infrastructure are ongoing. They have a dual 30 Gb/s active/passive fail-over link to Janet6. They have replaced Torque/MAUI by HTCondor, using ARC CEs. Most services have been migrated to virtual machines running SL6. They have set up a production instance of FTS3, and are using Quattor with Aquilon. The CVMFS deployment at RAL is supported by GridPP; 11 repositories are published at RAL. For virtualised services, they run two production clusters with Windows Server 2008 and Hyper-V, which have recently given rise to stability issues that have triggered a re-configuration of the storage. Castor will be upgraded in June to 2.1.14 with various improvements such as disk rebalancing, xroot internal protocol etc. CEPH evaluations are continuing. Issues encountered recently with storage systems include a batch of disk servers procured in 2010 that must be de-commissioned early due to an undue amount of catastrophic failures; they have not been able to isolate the problem between the Supermicro chassis, Adaptec controller, 2 TB WD disks and the backplane. They have shut down the UPS in November for circuit testing. Windows XP has been 'banned' from site networks; the roll-out of a new telephony system is imminent. They have closed their RAL AFS cell.

INFN Tier-1 (Andrea Chierici / CNAF)

CNAF had had a problem with the cooling system, which required the whole centre to be switched off. They took about a week to fully recover, even though most services for the LHC experiments were back after 36 hours. Andrea presented a new dashboard for their services based on Kibana,

which looks nice and provides rich functionality. CNAF are seriously evaluating moving to Puppet and Foreman to potentially replace Quattor, which would remain active for as long as is needed. They have no indications of any compromised nodes due to Heartbleed, and have replaced all affected certificates. Core services have all been updated to EMI-3. The link to LHCOPN has been upgraded to 40 Gbit/s. The worker nodes have been reduced in number (old kit has been retired) due to the fact that they had overprovisioned with respect to their pledges; the whole farm is running on SL6. The 2014 tender for worker nodes has been delayed due to funding issues; they are striving to take TCO into account. Andrea emphasised that it would be very useful to share more regularly the documents and procedures sites use for tendering. He then showed examples from the monitoring and accounting. The project to move to GridEngine has been abandoned, they will continue with LSF INFN-wide. They are testing Zabbix as a platform for monitoring, and are evaluating APEL as an alternative to DGAS for accounting. Other new activities include the configuration of an Ovirt cluster, the upgrade to LSF 9, the setup of a new HPC cluster with Nvidia GPUs and Intel MICs, the multicore task force, the implementation of a log analysis system, the move of some core grid services to Openstack etc. Storage resources comprise 15 PB net of disk on line with EMC and DDN, an SL8500 tape library with 16 PB and 35 T10k drives on line. The disk storage is organised as GPFS clusters, which is coupled with TSM to provide for a complete managed storage solution. Research activities include studies on more flexible methods for accessing storage over the WAN. They are involved in long-term data preservation.

DESY (Yves Kemp / DESY)

Yves started by stressing that photon science is becoming ever more important at DESY, and mentioned construction work for increasing the number of beam lines. Experiments are very different from HEP – data taking lasts for a few days at most, and a single data set can easily reach tens of Terabytes. The aggregate data rate for the 30 beam lines can go up to 50 GB/s. They hence focus on multiple access rather than random access, and fast data distribution systems rather than fast file systems. He explained the architecture of the system that pipes the data into a burst buffer, from which they fork for immediate and online analysis as well as offline analysis and archival. DESY are hence upgrading their archive capacity to 20...30 PB in the short term and 50 PB until 2016/2017 (scalable up to 200 PB), for which they are investigating several technologies. They need to upgrade the computer room, for which they will benefit from a cold-water ring being built on campus that will provide 8.4 MW of cooling capacity, of which they can use 2 MW for IT equipment. Tenders for water-cooled racks are in preparation. They are preparing for a third computer room in addition. Much effort was spent on a business optimisation project, for which IBM software was chosen (security identity management, business process management) that is run on a virtualisation layer using VMWare on CISCO hardware. Very few Windows XP systems are still running that are all isolated; Windows 7 is the standard for desktops, 2012R2 is starting to be used for servers. They offer Windows 8 and 8.1 only on specific devices as needed. They are facing a business scope change on Microsoft's part that puts the campus conditions for the major labs at risk, hence they have started to consider alternatives to Microsoft products. They are replacing NetInstall from FrontRange by a newer product of the same company. Heartbleed also affected DESY – all concerned systems were patched, users were required to change passwords that has

triggered negative reactions by users. Is username/password still the right way to go? Concerning hardware purchases, they go for Dell C6145 and R815 as well as M520 blade systems; they are increasingly interested in ARM architectures. NAF is being re-designed; they have re-tendered the support for 600 network printers, and are still in their migration from Exchange 2003 and Dovecot to Zimbra. They provide CVMFS Stratum 0 and Stratum 1 services, and are continuing their efforts for data preservation. Zeuthen and HH are linked via two 10GE links; they have procured the Atlassian toolkit, and have upgraded RequestTracker.

Tokyo Tier-2 (Tomoaki Nakamura / ICEPP)

The centre started in 2007 and is providing support for ATLAS in WLCG as a Tier-2 as well as a national analysis facility. They have exchanged all their kit every three years, which has created problems during the transition phase, and required 1 PB of data to be copied. They currently run 10'000 cores and 6.7 PB of disk storage. They contribute about 5% to ATLAS' total compute capacity. For 2016 they envisage using disk drives with more than 4 TB capacity. Disk storage is managed by DPM, and integrated with Rucio. Their DPM pool is one of the largest (with 10 million entries in the catalog), which puts high demand on the database server that they are addressing by using SSD drives. The worker nodes have all been upgraded to SL6, gaining some 5% in HS06, and have increased the memory to 4 GB/core for half of their worker nodes. Networking is consistently based on 10GE both for the internal backbone and the WAN connection. The connections to Europe are passing via the US (BNL, LA). Nakamura then presented performance comparisons of worker nodes with SSDs versus spinning drives.

IFRU (Pierrick Micout / IFRU)

Pierrick, in his last site report for IFRU, first mentioned Apache, their security project that will be explained in more detail in a dedicated presentation. Saclay now provides Eduroam service. The convention between DSM, IRFU and IN2P3 has been extended by three years, which means that CC-IN2P3 remains the prime computing resource for HENP researchers from IFRU. They have established a new cluster that is managed by Puppet. Windows clients are installed with 8.1 by default, but Windows 7 remains supported. XP machines have been isolated on a restricted network. A third water-cooled room has been installed with five 20kW racks and four 40 kW racks. For backup, they use a new SL3000 robot with LTO drives.

CERN (Arne Wiebalck / CERN)

Arne started by mentioning progress with the Wigner remote centre, which is now the prime target for new installations; it currently hosts 780 servers and 17 PB of raw storage. CERN runs Openstack and EOS there. The remote hosting centre in Geneva will be discontinued in Spring 2015. The facilities group is testing high-density racks (by CERN's standards – 7 kW instead of 3.5 kW). Planning for an additional network hub is progressing, several options are being investigated. Finally Remedy has been shut down. For collaboration services, Arne mentioned Indic8r, the new JACoW server, Indico, and Vidyo. Eduroam is now in full production status at CERN; an lxplus-alike dual-stack node has been set up, Wifi rollout across the site continues. The TETRA project is proceeding nicely, and IT is involved in the potential use of WiFi technologies within a future FCC

detector. The database-on-demand service has proven very popular and is serving many production services already. Arne also mentioned the migration of database servers to the Barn, and the DB replication infrastructure. The storage group has introduced T10kD drives that required fixing default time-outs in Castor; the repacking is progressing nicely. A new version of EOS has been deployed. CernBOX based on ownCloud is in beta, more details will be presented at the autumn meeting. The European Kerberos and AFS conference was organised at CERN in March with lively discussions. CEPH is providing a production volume storage for Openstack, with good uptake and satisfactory results; per-volume IO throttling has been enabled. The cloud infrastructure service is growing; it is now running on 64'000 cores and runs 6'000 VMs. Preparations for Lync 2013 are on-going, offering new attractive features to smartphones. The “Social” platform has been moved to production. Windows XP is being phased out; for Windows 8, see Sebastien Dellabella's talk on Monday. The batch service has moved 80% of its capacity to SLC6; studies on the impact of the remote data centre on job efficiencies have shown no significant dependence on the physical location. The migration from Quattor to Puppet is ongoing; it is planned to shut down the Quattor service in 4Q2014. The AI work-flows have been substantially refined; snapshots are now supported, automatic notification of upcoming changes has been introduced, and there is a framework for continuous integration. For version control and issue tracking, see Alvaro's talk on Monday. Heartbleed also affected CERN and required SSL to be upgraded, certificates to be renewed, and all passwords to be changed. CERN also participated in the Windigo operation. The disconnection test of the technical network revealed some dependencies that have been resolved meanwhile. A pastebin-like service was opened.

Wigner (Szabolcs Hernath / Hungarian Academy of Sciences)

The facility comprises four identical computer rooms of 300 square meters each with 1 MW of power. There are independent power feeds, transformers, diesel generators and UPS as well as 14 400kW chillers. The infrastructure operation provides 24/7 coverage; the hosting operation runs on a working hour basis (9/5). The first block was ready just at the end of 2012; a formal inauguration ceremony was held in June 2013, the commissioning started soon after. By May 2014 all permits were obtained. Shipments from CERN started in January 2013 and have continued since. A number of issues have been met: hosting during construction; infrastructure risks during construction; continuous issues with EBI; poor PUE; continuous issues with the 100 GE Dante/Geant link; lifts out of spec; racks, the doors of which could not be opened widely enough etc. Efforts are still going on concerning balancing power consumption and optimising power factors. The PUE is currently around 2, while they strive for 1.5.

At Wigner there is also a Tier-2 site for CMS and Alice featuring 520 worker node, 125 service nodes and some storage.

JLAB (Sandy Philpott / JLAB)

Sandy started by mentioning that the accelerator upgrade from 6 GeV to 12 GeV is completed; a new experimental hall has also been built. They had an external computing review in June 2012 and again in November 2013 with good results. Sandy then gave details about their clusters and farm

nodes; the latter are 120 worker nodes only running single-core jobs. The Kepler-based cluster has made it into the top-500 list. Since the Fall 2013 meeting, they have introduced resource sharing – clusters and farm nodes can take each other's workload when not fully used for their primary destination. Concerning storage, they run 1 PB under Lustre with 1, 2 and 3 TB disks, and ZFS servers of 250 TB; the latter are in the process of being moved from Solaris to Linux. They use an IBM TS3500 library with LTO drives, and are in a process of upgrading and partitioning Lustre as a rolling upgrade, targeting version 2.5; Sandy asked for advice on procurements for this upgrade. In 2014 they will double the capacity of the farm, and will test ZFS on Linux as well as Puppet as a configuration management tool. Eventually (by 2017) the farm will grow to 20'000 cores, which is an order of magnitude more than its current size.

AGLT2 (Shawn Mc Kee / U Michigan)

Shawn explained the basics of the distributed Tier-2 featuring 5'300 single-core jobs, 10 dedicated eight-core slots, and 3.5 PB of storage. Most services are virtualised in VMware. He showed the home-built monitoring interface. They have started to use a new monitoring system OMD (Open Monitoring Distribution) bundling Nagios variants and related tools. They have organised the nodes by host groups, and have replaced syslog-ng by logstash, Elasticsearch and Kibana, which after some tuning is working well; Shawn showed nice examples. For provisioning, they are currently using Cobbler and cfengine3 as a configuration management system, with well set-up work-flows. They are supporting multi-core jobs in a transparent fashion with 10 slots reserved. They are running their own AFS cell and have moved to ZFS as file system on the underlying storage servers; however they have come across an issue causing vos release not to work. They will document the problem and report it to the OpenAFS mailing list. Most Tier-2 service nodes are on VMware, using iSCSI or DAS storage. They are still working on site resiliency details. The network is being upgraded, taking advantage of a 100 GE connection between Chicago and UMich. Shawn briefly mentioned the proposal to work on software-defined storage.

Basic IT services

Managing secrets (Sven Sternberger / DESY)

Sven started by defining secrets – they comprise passwords, certificates, private keys, Kerberos keytabs etc. The objective is to ensure the quality of the password, to control life times, the distribution, and the access. For the store, it is desirable to have a central place which is a controlled environment accessible to the administrators; it should support delegating rights to groups of administrators. At DESY, they are using Escrow; it is a PGP wrapper to manage passwords, which makes the secrets readable by a defined set of users. The tool is secure and simple to set up and extend; however there is no management, no groups, and a shared file system is required. Another tools is HKD; it saves and restores secrets, it can create Kerberos credentials and control the status of secrets; it is implemented as a client/server shell script. Security is guaranteed only in controlled networks; it is simple to set up and extend; however it does not manage nor deploy, and does not support groups. Then Sven discussed the new approach at DESY: encrypted Puppet/Hiera. Secrets are stored in Hiera, and accessed via Puppet and Hiera. The Puppet master can read the encrypted

secret, which can be read and written by DevOps. In order to address the issues, they have started to develop Secure Management Tool, for which a prototype has been developed. Sven explained how the new system protects against the attack described before. As a result, together with Puppet the tool provides good management capabilities, it can be used without Puppet, and is very flexible; however it is rather complex. Puppet unfortunately limits what can be achieved by way of securing the keys.

Computing and batch systems

Batch system review (Michel Jouvin / LAL)

Michel started by explaining that this review was based on a full-day pre-GDB meeting held in Bologna in March 2014. Naturally the attendance was Europe-centric. The goals of the meeting were to share experience, identify strengths and weaknesses, and discuss the middleware support. Michel then covered the main systems discussed during the pre-GDB: Most sites are (still) using Torque/MAUI. Torque is reasonably well maintained, while MAUI has been unmaintained over many years. PIC and NIKHEF both reported successful usage at the 3k job slot level. Univa GridEngine has all the features of a major batch system; several big Tier-1 and Tier-2 sites migrated to it (in particular CC-IN2P3 and KIT); successful usage has been reported at the 15k...20k job slot level. Confusion when Sun was acquired by Oracle has been clarified meanwhile. LSF is used at CERN and CNAF up to the 50k job slot scale. HTCondor is a very old system, and has been used successfully in the US. Recently RAL migrated with good results at the 30k job slot level; in addition it is very dynamic when it comes to adding and removing worker nodes. Slurm is modern and highly scalable; it is widely adopted in the Nordic countries, but is known for a varying release quality, and the enforcement of identical configuration files on all nodes at any time. Multi-core jobs are becoming increasingly important for WLCG; hence using the same resources for multi-core and single-core jobs would be very advantageous. Michel then reported in some more detail about multi-core jobs in Univa Grid Engine, MAUI, and HTCondor. To conclude, Michel presented the WLCG Wiki on the batch system comparison, and commented on remarks that this kind of work would be better conducted within the HEPiX context.

A year of HTCondor at the RAL Tier-1 (Ian Collier / RAL)

Ian gave credit to Andrew Lahiff, who has done most of the work. Ian reminded us that RAL serves as Tier-1 for all four LHC experiments; it also supports 12 non-LHC VOs. They started looking at alternatives when their Torque/MAUI installation became increasingly brittle. They considered and rejected LSF and Univa GridEngine because of their preference of open-source solutions; open-source Grid Engines, because it appeared that they were not well alive; SLURM because of scalability issues. In contrast, everything they tested with HTCondor just worked, and they found it to be very configurable. They started investigating in August 2012, and in May 2013 they started significant testing with ATLAS and CMS (using the ARC CE). By August 2013 the choice of HTCondor was approved, and half of the farm was migrated; in November the rest was migrated. The experience so far was that the system has been running very stably; no changes were needed as the HTCondor pool size increased from 1'000 to 14'000 cores. Issues found include a hung job

submission when one of an HA pair of central managers was down; a problem affecting Condor-G job submission to HTCondor; and jobs dying following a network outage between worker node and the CEs. All these issues have meanwhile been fixed. All job submission at RAL goes via the Grid and hence implies CEs; they are currently running two CREAM CEs and three ARC ones. Their ARC CE experience has been very positive; they have run almost 9 million jobs without issue. Currently only ALICE is not able to submit to ARC, but are committed to work on this. RAL hence intends to de-commission their CREAM CEs later this year. Based on the positive experience at RAL, quite some more UK sites are considering moving to HTCondor (or Slurm); Puppet modules are being shared. Multi-core jobs have not been easy; they only support 8-core jobs, and want to move to an entirely dynamic and transparent workload management. Ian then explained how HTCondor is being used to decide which worker nodes to drain from single-core jobs in case of requests for multi-core jobs. They have implemented a worker node health-check probing for disk full/read-only, CVMFS, swap, … in a granular way (an issue with the ATLAS CVMFS will block the node for ATLAS jobs only). They monitor the jobs with an ELK (Elasticsearch-Logstash-Kibana) stack, of which Ian showed some examples. They found job monitoring very easy to set up and able to cope with the load. In summary Ian reiterated that they are extremely happy with their choice of HTCondor.

The future of batch processing at CERN (Daniel Pek / CERN)

Daniel started by referring to Jérôme Belleman's presentation given at the meeting in Ann Arbor. Reasons to move away from LSF include scalability issues – LSF can support up to 6'500 nodes only –, as well as dynamism of the cluster configuration, dispatch rate and query scaling. They have considered LSF 8 and 9, SLURM 2.6.4, Son of Grid Engine, and HTCondor – the latter is currently the focus of their investigations. For the scaling tests, they have established a test bed basically formed as a shadow cluster on the current large-scale LSF cluster; dedicated resources (virtual machines) are used for the two central managers and 20 scheduler and submission nodes. Tests were executed with more than 60'000 single-core job slots. They found the configuration choices very fine-grained, nicely structured, and documented – in some areas it is just abundant. Condor can be largely automated and puppetised. Daniel showed a number of examples demonstrating the large potential of HTCondor; however there is a concern about large-scale queries across all submission hosts. HTCondor was found to be fault-tolerant, mature, and well supported by the developers and the community. Daniel then described some of the integration issues at CERN.

The art of running HTCondor as a batch system (Brian Bockelman / Nebraska)

Brian started by stating that HTCondor is a Swiss Army knife of high-throughput computing – using it as a batch system is just one way of taking advantage of it. He then presented the top 10 best practices: Live monitoring; condor_ssh_to_job allows the user to ssh directly to the job's runtime environment. Scalable job updates: every n minutes (default n=5), an update is pushed out of some standard statistics from the worker node to the scheduler; users can now invoke condor_chirp to push custom attributes. Flexible accounting: HTCondor provides a number of accounting files; for integration with the site accounting, HTCondor can write a single file per job

on the scheduler. Security friendly: HTCondor has a lot of flexibility for authentication and authorisation including FS, CLAIMTOBE, GSI, krb5, IP based, …; the authentication can then be used to define scheduling policies. Firewall friendly: All daemons choose random ports by default, which makes firewalling a headache. A daemon condor_shared_port will force all traffic thorugh port 9618. Customisable output formats: Starting in 8.1.6, the output of condor_q and condor_status outputs can be customised. Hooks: Condor can invoke scripts at various parts of the job life-cycle, which can be used for custom monitoring or setup/cleanup of the job environment; there are also hooks for scripts outside the job life-time, and there is a hook for benchmarking a worker node on startup. Ganglia integration: automatically polls collector for various metrics and push them into Ganglia (or any other command-line compatible system). Python bindings: basically all client functionality is accessible through a Python module that invokes the C++ code directly without forking or execing. Containers: HTCondor creates a unique cgroup for each job allowing for operations to be applied safely; it also supports namespaces and chroot.

Linux cgroups in Univa Grid Engine (Daniel Gruber / UNIVA)

Daniel reviewed the history of Grid Engine and the quibble during the Oracle period. Univa started to develop on their own based on the open-source release of 2011, and have acquired all sources and rights from Oracle in 2013. He then introduced cgroups, which are a Linux kernel enhancement aggregating and partitioning sets of tasks into hierarchical groups. This is interesting for Grid Engine, as it provides for irrevocable CPU isolation, safer job suspension, job reaping, limiting main memory etc. The currently supported subsystems are cpuset, memory and freezer. He then showed the syntax for the Grid Engine commands making use of cgroups, and how to configure Grid Engine to support cgroups. Jobs submitted to a Grid Engine instance configured accordingly automatically make use of these features. He then described the RSMAP resource type introduced in Univa Grid Engine 8.1, which allows for managing co-processors and other per-host or global resources; he showed an example how co-processor usage is scheduled. Locality of PCIe devices (attachment to sockets) can be taken into account.

Univa Grid Engine status at CC-IN2P3 (Suzanne Poulat / CC-IN2P3)

Suzanne started by explaining that the team comprises 7 people, but is equivalent to one FTE only. In 2010 they have conducted tests with Sun Grid Engine, and made a test cluster available in 2011 just before Sun was acquired by Oracle. The subsequent experience with Oracle support was very disappointing, which is why early in 2013 they decided to cancel the Oracle contract and conclude a contract with Univa instead. They found that the change was more like a version change rather than a change of product. Experience with the Univa support is good, patches are supplied rapidly by Univa. Only minor changes and adaptations were needed for monitoring and accounting, operations etc. Hence they consider the migration successful; it has allowed them to provide stable service with good support. They are currently running UGE version 8.1.6 on SL6. The master is configured to restart the qmaster process if unresponsive; it uses a PostgreSQL database on an external machine. The accounting files are stored in AFS. The active-passive fail-over setup was given up after two major outages, which has turned out to be the right decision. They use two levels of fair-share on 200 projects using 20 queues, and are making intensive use of resource quota sets. All requirements

are covered by a single instance administering a total of 20k virtual cores, including parallel jobs, single-core jobs, multi-core jobs, interactive jobs, local and grid jobs. The typical queue length is of the same order as the executing jobs; some 110k jobs are handled per day. Multi-core jobs are supported on dedicated machines, which are currently ramped up to 1'024 cores; however they would like to merge the resources with the rest of the cluster, and have tested various configurations, none of which was found to be working satisfactorily, hence they continue with split resources. Suzanne then reported about tests on cloud integration in GE with UniCloud software, which they found to be rather poorly documented. She finished with a wish list to Univa – mix multi-core and single-core resources, get improved monitoring in case of problems, improve qacct, qstat, provide for possibility to set number of maximum pending jobs per user. There are also a number of requests by the users.

Scheduling multi-core jobs (Nathalie Rauschmayr / CERN)

Nathalie (from the LHCb computing group in CERN-PH) introduced the motivation for multi-core jobs and emphasised that the main problem is the memory footprint. Efforts are going on in a number of areas: Gaudi, Athena, CMS, Geant4 etc. However these efforts may not be sufficient to fully exploit the potential of many-core machines. There are several problems that Nathalie listed, among them whether the VO or the site is responsible for addressing the problem. The experiment schedulers can take care of runtime prediction, job properties, optimised scheduling decisions, and backfilling. She suggested a scheduler that chooses the appropriate degree of parallelism for a job depending on certain criteria. Nathalie proposed a model taking all these constraints into account, breaking the problem down into steps: predict runtime, memory demand etc.; define degree of parallelism; order list of jobs; define schedule; implement scheduling decision. She has found a commercial program, IBM Cplex Solver, that allows for realising the model, and suggested two alternative algorithms for the optimisation step. She showed how the model would optimise the usage of CPUs. For the model to work well, the prediction of runtime, memory and speed-up must be precise. A lot of improvement is possible by taking previous experience into account; Nathalie showed which parameters are most important for a precise prediction. The run-time predictions can even be improved beyond maximum likelihood by linear regression.

Wednesday May 21st

Security and networking

IPv6 deployment at FZU in Prague (Marek Elias / FZU)

At FZU they run the DPM headnode, all production disk nodes, and all except 2 sub-clusters of worker nodes on dual stack. DPNS between disk nodes and the head node, SRM between the worker nodes and the head node, and the actual data transfer via Gridftp go over IPv6; Webdav access was tested as well. There has been very little WAN traffic over IPv6 so far. Marek described the configuration of a Linux interface, and concluded that adding IPv6 connectivity and configuring the firewall did not break anything. He then described the IPv6 setup for DPM, which was complicated when they added the second disk node; he advised an easier procedure. For SL5

machines, they use static IPv6 addresses; SL6 needs a fix to gai.conf that the HEPiX working group provided. He then described how the worker nodes were configured, including for VLANs. They monitor the network using Nagios, but don't have any ping6 sensor yet, and netflow monitoring isn't ready for IPv6 yet either. Other activities include the GridFTP testing, the HEPiX IPv6 perfSONAR mesh etc.

IPv6 status and perfSONAR testing in the UK (Chris Walker / QMUL)

Chris started by explaining why IPv6 is needed, and that the solution is dual stack for world-facing services. At QMUL, they are running an IPv4 in 6 tunnel to China. They have deployed RIPE probes for ATLAS as well as perfSONAR probes. For the latter, the default setup will test IPv6 if available, IPv4 otherwise; they needed to reconfigure to ensure both IPv4 and IPv6 were tested. This revealed that IPv6 was working with a much reduced performance in Oxford, which they found to be due to IPv6 being implemented in software in the router. Other issues they found concern the routing and ICMPv6 blocking. Chris then explained the status of IPv6 deployment in the UK; in general things are progressing well. Finally, Chris pointed out the pre-GDB on IPv6 on 10 June, and that the HEPiX IPv6 working group is still looking for active members to take maximum advantage of the LHC shutdown.

PerfSONAR update (Shawn Mc Kee / U Michigan)

Shawn first reminded the audience why network monitoring is required, and how perfSONAR is addressing this need. The goals are to find and isolate network problems, and alert in a timely way; to characterise network use; and to provide a source of network metrics. WLCG has set up a dedicated task force in Autumn 2013 to steer the deployment. Sites are organised in regions. Shawn described what kind of tests are run at what frequencies. The task force was terminated in April, as most sites have properly deployed version 3.3 as required. There is a dashboard, which OSG will take the maintenance over for. Shawn showed examples of mashes pointing out latency and/or bandwidth issues. Experiences from the task force are that deployment has been hard, in particular as it faced an NxN problem; perfSONAR is a special service; the software was a moving target during deployment; getting the firewalls right was a significant part of the effort. Remaining issues include getting sites to upgrade to the right level, verify that results are delivered as requested, fix firewalls etc. To follow up, WLCG has created a network and transfer metrics working group, the mandate of which Shawn discussed. The group is chaired by Shawn and Marian Babik; Shawn invited active participation. The perfSONAR metrics are around throughput, latency, and diagnosis; multiple perfSONAR instances at a site can be used to debug intra-site issues. For debugging network problems, a number of metrics need to be correlated, which needs a lot of work for automating (it is currently a manual process). The experience from the deployment is being fed back to the perfSONAR-PS developers, who have been very receptive. OSG is setting up a centralised service for gathering, viewing and providing network information to users and applications; hence the plan is to migrate the existing dashboards to OSG, which would also ensure that the data would be persistent.

Measuring WLCG data streams at job level (Eileen Kühn / KIT)

Eileen, a PhD student of computer science at KIT, is working on data stream identification of WLCG jobs, and the related anomaly detection; she collaborates with the CMS group. The motivation is the lack of monitoring of network usage by the batch system. She started with a wish-list featuring network monitoring per process, grouping of processes by batch jobs, and the integration into the batch system. She has implemented a network traffic monitoring tool that logs network traffic, network-related processes, matching of traffic to processes, categorisation into internal and external network traffic. The tool is composed of a packet watcher, an inode watcher, a process watcher, and the logging itself; she presented the overall architecture, and described the components in detail including basic libraries used, and the integration of the tool with UGE. They are currently performing long-term measurements that started mid March on 32 worker nodes plus one dedicated ALICE worker node; she collects 16 variables each 20 seconds. She showed graphs of the measurements taken, which has revealed clearly the remote access pattern ALICE jobs have caused. Future improvements will address optimisations; the development is likely to be split for purposes of production, and for her PhD thesis.

Emergency suspension in WLCG (Vincent Brillault / CERN)

Vincent explained that emergency suspension is the idea to block given DNs from submitting jobs. The suspension must be automatic, “rapid” (configurable, predictable delays), and with a uniform response. Unbanning must also be automated in the same way. The previous handling of such situations did not comply with these requirements. It is proposed that automatic suspension kicks in after a rapid analysis and before a full forensic analysis. The automatic suspension will rely on a hierarchical infrastructure with central servers hosted at CERN that feed relays hosted by each NGI; sites contact these relays run by their NGI. The tool proposed is Argus, the support of which is currently under discussion. The proposal includes monitoring by banning a dedicated (invalid) DN every day. The suspensions will be communicated at the same time to the VOs for further follow-up. Ideally it would be possible to kill the workload running under the banned DN, but the current structures do not allow for this in an automated fashion.

New Windows security at CEA and IRFU (Joel Surget / IRFU)

Because of some significant attacks in France in 2011 and 2012, CEA had to introduce additional security measures. White PCs (end-user workstations) have two browsers installed: IE9 with all plugins for the intranet and some white-listed sites, and Google Chrome with very limited plugins, no toolbars etc. for the internet. Admin rights have been cut down – the network AD account has no privilege, there is a local admin account if necessary, and user account control is activated. Disk and print shares are disabled, remote control to a PC is restricted to the admin group. Official software is forced to be up to date, unauthorized software is automatically de-installed – alternative browsers, remote tools, toolbars, Skype, MS OnDrive, Google Docs, Dropbox, … PCs not compliant with these rules, for example XP computers, must be in a special VLAN that does not provide any internet access. These “white” PCs are managed by “green” PCs; they serve to manage the standard accounts, set up remote connections etc., and have no internet nor mail access; they can only been accessed locally (hard keyboard). The “yellow” PCs control the software configuration and manage

important servers such as SCCM, WSUS, antivirus server etc. On these machines there is no mail, no intranet/internet, … The “red” PC is used to administer the AD, with even more restrictions. At the same time, they have migrated from AD 2003 to AD 2012; the AD has been cleaned; logs have been centralised; proxy servers have been established for internet access. More measures may be taken later. Problems encountered with this scheme include remote connections (access to desktop PC from home or while on travel); remote management is now impossible; the hardened Chrome browser with no plugins is not always sufficient, hence the white list is growing fast; it is not entirely clear how to include MAC and Linux computers into this project.

Security update (Vincent Brillault / CERN)

Vincent started his list of threads with crypto-currencies, which are uncontrolled; there is no balance, but only transactions. The use of bitcoins has significantly increased over the last two years, which has triggered malware that produce hashes on all sorts of devices; “interesting” transactions include SilkRoad, forced encryption of all files on your PC's drive etc. EGI and WLCG forbid any mining activities; however there is an increasing number of incidents costing CPU time and a lot of forensic effort. For the Grid, VOs should be reminded of the rules, sites should look for standard mining software and to monitor the network. However, virtualisation will make the detection a lot harder.

Concerning SSL and X.509, Apple suffered from a wrong certificate validation, there was a GNUTLS issue, and then there was Heartbleed. The root cause was that OpenSSL was not really maintained; the cost was that all passwords needed to be changed, and all certificates needed to be renewed. The impact on the Grid was limited, as lots of services were protected by old versions, most vulnerable sites were fixed promptly, client certificates can't be leaked on servers, …

Vincent moved on to Windigo, a large-scale malicious operation targeting mainly servers. The attackers built a botnet using Ebury. There are two versions, one with a malicious sshd binary, one with a malicious libkeyutil library. This is then used to exfiltrate credentials including private ssh keys from compromised servers. Sophisticated mechanisms around DNS queries and shared memory are being used. Once built, the botnet is used for sending spam from the back-door, to re-direct users to malicious Web sites, to infect clients etc. So far, no infection has been observed in the Grid; CERN anyway participates in the countermeasures. As a protection, two-factor authentication is recommended; the vulnerability can be detected by the verify functionality of RPM.

Then Vincent turned to new threads – attacks (NSA) against the centre for Theoretical Physics in Italy, tampering with networking equipment, man-in-the-middle attacks with intermediate CAs etc.

Facilities and business continuity

Open compute at CERN (Olof Bärring / CERN)

Olof gave an overview of the Open Compute Project (OCP) and presented the results of the first test of Open Compute hardware at CERN. OCP (http://www.opencompute.org/) was launched by Facebook in 2011 with the objective of building efficient computing infrastructures at lowest

possible cost. Several other companies have joined OCP and have different membership levels. The Open Compute hardware design follows the model traditionally associated with open source software projects (http://www.opencompute.org/wiki/Motherboard/SpecsAndDesigns). Interested by the savings, ease of serviceability and energy efficiency announced by Facebook for OCP hardware, CERN has acquired 2 OCP servers (Hyve-1500 - 1.5U enclosure for 19" rack) and has compared them with standard servers (S2600JF) with same components (2 CPUs E5-2650, 64GB of memory). In the same testing conditions, the OCP server has delivered ~5% less performance than the standard one but with a ~25% power gain. The power gain is expected to be higher for a server in an OCP Open Rack with DC distribution. An OCP rack is divided in 6 areas (3 power areas and 3 server areas) and includes 3 12V DC bus bars. Each server area has 10 OpenU (48mm) slots. Despite some issues with the OCP servers, in particular with limited disk configuration and console access, CERN considers acquiring a few fully populated OCP racks as part of its 2015 capacity. Finding qualifying bidders for OCP racks will however be challenging because of unclear certifications, complex rack cabling and lack of European manufacturers.

First experience with a shared data centre in Orsay (Michel Jouvin / LAL)

Michel gave an update on the new shared Data Centre in Orsay University. In 2009 all HEP, NP and Astrophysics labs in Orsay-Saclay joined in the P210 initiative and projected to build a common shared computing platform. After 3 major incidents in the main Orsay labs, it was agreed end 2011 to build, in an existing building, a modular and energy-efficient facility that would become available quickly. The new computing room was delivered on time and on budget the 1st of October 2013. The final capacity of the facility is 1,5MW in 220m2 with 400kW and 28 racks (up to 15kW per rack) in 100m2 available in the initial phase. Passive and active regulated water-cooled racks, able to cope with high density, have been purchased from ATOS after tendering. Fans in an active rack need 280W. However, the measured power consumption of a passive rack, populated with 39 1U servers, exceeds by 1kW the consumption of an active rack populated with the same servers. This is explained by the higher server fan-speed in a passive rack caused by the rack overpressure. The temperature inside passive racks reaches 40-45°C, which is not an issue. As there is no fan in the computing room, hot air tends to remain confined on top of the hot passive racks. This has been remedied by adding 3 active racks in a row of passive racks and by isolating the top of the racks. Because of the large number of sockets needed per rack, it was decided to equip the racks with 32A three-phase PDUs. To be compliant with the French regulation and protect each socket with a 30mA differential breaker and a 16A breaker, pricy custom Raritan PDUs were installed, hoping that the PDU market will soon evolve. The facility is equipped with redundant and well-monitored infrastructure. Tuning the monitoring has taken longer than expected. In principle, the new room should allow to address the computing needs for the next 2 years. Because of increasing interest on the Orsay campus, it is time to prepare the extension of the facility. The preferred scenario is to equip the entire available surface and have the extension available in 12...18 months. After 6 months of operations, the shared Data Centre is a success and offers the good resiliency and efficiency that a single lab could not afford.

Operational experience with Wigner data centre (Szabolcs Hernath, Hungarian Academy of Sciences)

Szabolcs presented the Wigner Data Centre and gave some feedback on the first year of operation of the data centre. The Wigner institute is strongly involved in computing since 2000, is a Grid Tier-2 since 2004, and is involved in supercomputing since 2008. In 2012, the Wigner institute won a CERN hosting tender aiming at increasing the capacity of the CERN Tier-0. The new Wigner Data Centre was inaugurated in June 2013 and immediately started to host CERN equipment. CERN and Wigner are connected by 2 dedicated 100Gb/s links. The computing hosting space in the Data Centre is divided into four 300m^2 rooms; three of the four rooms are reserved for CERN. The Data Centre is powered by 2 independent high-voltage feeds and protected by UPS and diesel generators. More details on the Data Centre are available in the Wigner site report. Wigner started to install CERN IT equipment during Spring 2013. At this time, one computing room only was completed. The three other rooms and some other parts of the building were still under construction. Running a computing room in a building in construction was delicate but went well. For Wigner, the installation and operation of CERN equipment in their Data Centre have so far only faced minor issues (one of the most delicate one was dealing with the VAT rules for CERN equipment). They would however recommend defining very precisely what is expected from the hosting site.

CNAF's cooling incident and lessons learnt from it (Andrea Chierici / CNAF)

Andrea detailed the cooling incident that occurred in March 2014 in the INFN computer centre and the lessons learnt from this incident. On the 9th of March at 1:08AM, a fire alarm was raised. At 2:45AM, the fire that affected the control unit of one of the six chillers of the computing room, was fixed by the fire brigade. At 4:40, as the cooling was not working properly and as the temperature in the room was too high, the on-call staff decided to shut down the Computing Centre. At 17:00PM, the cooling was fixed. The batch farm was up at 21:00PM but batch production restarted only on the 10th at 06:00PM after the storage system was back. After investigation, it appeared that the control units of five out of the six chillers shared a common power supply that caused their stoppage. It also appeared that one of the chillers was still running unnoticed when the Computing Centre was stopped. The on-call arrangements worked as expected. The support teams timely fixed the cooling and restarted the IT equipment. They also took the opportunity to apply the latest patches and kernels on the batch farm. Some storage controllers and 1% of the PCI cards failed and had to be replaced but disks, power supplies and networks switches were only little affected. Many old worker nodes were seriously affected (their BIOS battery was exhausted and/or they lost their IPMI configuration) and were restarted with a locally attached keyboard. This cooling incident emphasized the need for a better separation between the chillers, for a better monitoring of the cooling infrastructure, for a better understanding of the SLAs for hosted services and for an emergency shut-down procedure. The control units for the chillers are now independently powered. The monitoring of the chillers will be included in the service dashboard. A task force is preparing a controlled shut-down procedure that will be capable to orderly switch off the IT equipment in the Computing Centre. Naturally, this procedure will be difficult to test. INFN wonder how far the procedure should be tested and how other sites address this testing issue. They also wonder if the

BIOS batteries should be periodically replaced.

Business continuity at DESY (Yves Kemp / DESY)

Yves presented a collection of themes, thoughts and measures covering Business Continuity at DESY. DESY yearly perform a risk assessment that covers all possible fields including IT. Despite IT not being neglected, accelerators and experiments have the priority in terms of power and cooling. DESY have started to work to conform to ISO 27001: first impression is that many requirements concerning setup and workflows are met, but formal documentation of processes should be enforced. In order to protect their computing services, DESY closely monitor their networks (ports scans, pattern checking, IDS on Linux systems). The operations control room as well as the User Consulting Office address operational issues and users problems, in particular during emergency situations. The IT equipment in the Computing Centre, like the cooling infrastructure in the Computing Centre, is powered by two independent good-quality power lines and protected by UPS. A cold-water ring (not yet closed) provides the cold water for the Computing Centre (8.4MW total, 2MW for IT). DESY are optimizing the cooling infrastructure in the Computing Centre as well as their readiness to address cooling problems. Important servers and services are redundant and spread over two separated rooms (500m apart). The configuration and management tools tend to be more and more standard and automated with some emphasis on security. Backup data is duplicated and saved at different locations. Human continuity is difficult to achieve because of the high workload and scarce resource. This issue is addressed by standardizing and by preparing up-to-date and accurate documentation. However, despite IT experts at DESY aim at running with stable and well-documented infrastructures and workflows, they offer a flexible environment that bypasses procedures when needed in order to efficiently serve scientists.

Computing and batch systems

Evaluation of Intel Ivy Bridge versus AMD Opteron (Tony Wong / BNL)

The BNL data centre is about 1'400 square meters in size, of which about 70% are used. There are 2 MW of usable UPS power available, of which 55% are currently used – for a number of reasons, one cannot go beyond 80%. The cooling has a capacity of 2 MW as well. They have equipped the machine room with wireless environmental sensors that Tony learned about at HEPiX in 2011. Requirements for RHIC and ATLAS are quite different – RHIC needs disk-heavy worker nodes, a 10GE connection, and 2 GB per (physical or virtual) core, while ATLAS doesn't need that much disk space. Tony then described the equipment used for the evaluation – three Ivy Bridge processors with 10 and 12 physical cores, two Opteron processors with 8 and 16 physical cores, and disk configurations as needed for RHIC and ATLAS. The Ivy Bridge provides about the same per-core performance in HS06 as the Opteron, while per system the Intel boxes have a clear advantage. The measurements are mostly confirmed when running the full ATLAS simulation, but the Opteron systems scale better for multi-job throughput, presumably because of SMT on the Intel platform. Even with the optimal choice of SMT usage, the purchase price per HS06 is lower for the Opteron-based systems; the picture does not change significantly when taking into account the slightly higher power consumption per HS06 of an Opteron-based system. Tony finished by expressing

concerns over servers becoming an expensive niche market.

Beyond HS06: toward a new HEP benchmark (Manfred Alef / KIT)

Manfred recalled the history of HS06 – vendors had been looking up performance at www.spec.org (for SPECint95, SPECint2000) which used different and optimised operating systems, compilers, flags, … HEP reacted to that by providing rules to run SPEC CPU2000 under Linux compiled with gcc with fixed flags, running one benchmark copy per core of the system under test, similar to what is happening with batch jobs. This allowed for comparing the performance of various systems. We then created HS06, based on the widely used SPEC CPU2006 (not free, but inexpensive for non-commercial use); vendors have proved to be familiar with it. A subset of seven tests (all tests written in C++, which means three tests of the integer suite and four tests of the floating-point one) matched the behaviour of the experiments' applications at the time well. The benchmark was compiled as a 32-bit application, again matching the experiment applications of the time. However, HS06 has shown to be ageing, in particular as 32-bit applications are no longer used. Manfred still emphasised that the replacement is not that urgent, as the increase of single-core performance and cache size were not that significant since HS06 was introduced; yet the 32-bit applications are a problem. The group considers a number of candidates: They will have a good look at the forthcoming release of SPEC CPU (expected by end 2014) as well as at free alternatives such as Geant4-based benchmarking jobs, and are open to other suggestions. The benchmark will be used as a metric for installed capacity, accounting and pledges, as well as to describe the performance of the assigned job slot. The requirements are similar to the time when HS06 was introduced: the benchmark should be well established and inexpensive, or free altogether, and must be easy to use; it should also feature an acceptable execution time (the current HS06 suite takes about three hours). Users are also interested in a rough, but rapid guess for the performance of an assigned job slot, which the working group will consider. Manfred showed a list of volunteers, who have already indicated that they are interested to participate, and explained a rough time line.

Evaluation of Avaton CPU (Andrea Chierici / CNAF)

Andrea started by remarking that some of the work is covered by an NDA and can hence not be presented in this talk. An analysis of the CNAF power bill shows tat 62% are used for IT equipment, while 22% and 13% go into the cooling and power infrastructures, respectively. As expected, newer platforms are more power-efficient than older ones. CNAF was hence wondering to what extent low-power CPUs could be interesting. The Avoton is an Atom SoC (system-on-chip) manufactured in 22 nm technology; it combines up to eight 64-bit Atom processor cores, I/O controllers, QuickAssist technology etc., and was developed to address the needs of microservers, cloud storage etc. They tested a mini-1U server featuring four SODIMM slots (max. 64 GB), four GE ports, IPMI with dedicated LAN, one PCIe x8 slot etc. An alternative implementation is the HP Moonshot, a 4.3U chassis with 42 server cartridges and an integrated switch. HS06 results are in the vicinity of 55 for 8 processes, about a factor three less per core than for modern Xeon processors. However, Avoton has an advantage of about a factor three in terms of HS06 per watt. After about three years of running there would be a break-even point in terms of TCO, afterwards the Avaton would become more cost-effective than the Xeon. Initial measurements of performance of real

applications need to be confirmed and understood.

Thursday May 22nd

Storage and file systems

Batch system data locality via managed caches (Max Fischer / KIT)

Max started by reminding the audience that GridKa does not only provide the multi-VO Tier-1, but is also an analysis centre for Germany with its own dCache installation. At the campus south (former university), there is a former CMS Tier-3 with 200 cores and some local storage. CMS analysis at KIT is about low-frequency official data pre-procsessing, manual transfer of data to the analysis centre, and high-frequency data processing for analysis. While so far the Tier-1 and the analysis centre are separate resources, the plan is now to merge them into a single facility. A possible stumbling block is the data rate. User analysis usually accesses about 1 TB of data per day, 2...8 TB total phyics data, 50 MB of source code, and 1 MB of unrecoverable calibration data. In order to cope with the issue, they propose to have all data in storage/file servers, and to copy the most regularly used files to the worker nodes. Max then presented the concept in detail, including the mechanism to ensure cache consistency and the way the cache is exposed to jobs, making sure jobs are preferentially directed to nodes that hold the required data in the cache. Caches of multiple worker nodes are combined to form pools, within which file access is being tracked.

CEPH at CERN – one year on (Dan van der Ster / CERN)

Dan gave an overview of the CEPH architecture, pointing out that there is no central manager, that all components can scale, and that the system is self-healing. On top of block storage (RADOS), there is access via librados, radosgw (for S3/Swift), RBD (block device access), Ceph FS (a Posix-compliant file system). Ceph is a very nice match with Openstack – CERN uses it for Glance images, Cinder volumes and Nova ephemeral disks, offering CoW clones, layered volumes, snapshots, boot from volume, live migration etc. in a cost-effective way due to thin provisioning. Ceph has turned out to be the most popular network block storage for Openstack. Investigations at CERN started in January 2013 for block storage for Openstack (alternatives were Netapp and GlusterFS) and storage consolidation for AFS, NFS, …, and were considered successful, hence a larger 3 PB prototype was set up in July consisting of 47 disk servers and 1128 OSDs (of 3 TB each). They set it up with 5 monitors with the help of an existing Puppet module, such that new machines can be added and maintained automatically; mcollective is used for bulk operations on the servers. A simple monitoring (dashing dashboard) is available, as is information about service availability and the evolution of its usage. Apart from Openstack, they consider Ceph for Castor and EOS (via librados), Zenodo (via Radosgw), OpenAFS (via RBD). RADOS is unfortunately not a drop-in storage system for HEP data, as there is no namespace, no X.509/Kerberos, …, and CephFS is NFS-like, but is lacking strong authentication. Dan then presented some benchmarking results showing the good performance of the system. Some 400 Cinder volumes have been created, 100 TB have been allocated, more than 45 TB are being used, with peaks up to 8'000 OPS. The system allows for setting a per-client limit of IOPS that they plan to scale down from 400 to 100; most

write operations in cinder have been for small amounts of data. The (rather high) latency can be explained by the synchronous writes into the OSD journals, which they will address using SSD caches. In terms of scalability, of the order of 1000 OSDs seem to be feasible, perhaps more – but how far can it go? Other topics they looked into include a 250 million object test, levelDB troubles, backup, object reliability, slow requests, and last not least the impact of the Red Hat acquisition of InkTank (the company driving CEPH development), which raises questions on the relation between GlusterFS and Ceph.

CEPH at the UK Tier-1 (George Ryall / RAL)

RALs use cases were to provide a storage backend for their departmental cloud, and a non-domain specific storage solution for Grid data. They like Ceph because of its improved resilience over other solutions, its open-source character, and the fact the Linux kernel as of release 2.6.34 supports CephFS. A development cluster has been set up with 6 nodes and 100 TB disk space based on the 'Emperor' release. There are Quattor components to configure Ceph. Following successful tests for providing storage for machines instantiated in OpenNebula and for storing machine images, hardware for a 1 PB cluster has been ordered and is being installed. They have started testing the grid storage use case with CephFS clients running on 114 worker nodes, which requires running with an upgraded kernel. The test setup has a queue within Panda that submits jobs to the ARC CE, which has CephFS mounted; HTCondor directs jobs to the worker node with a flag requesting a node with CephFS mounted. Future plans include the upgrade to the 'Firefly' release and testing of its new features. They found optimisation procedures to be poorly documented, and the configuration tools to require a somewhat inconsistent syntax; a student will be working on optimisations and their documentation, in particular investigating the benefits of using SSDs for journals.

Update on CERN tape status (German Cancio / CERN)

CERN currently curates 100 PB on tape, most of it is physics (94 PB on Castor), some backup (6 PB on TSM). 60'000 tapes are used, there are 200 tape drives in 9 libraries, which in turn are a mixture of IBM and STK/Oracle. The team has spent significant effort on improving the tape efficiency, which has been addressed by re-engineering the tape middleware, and the development of buffered tape marks. Read efficiency has been addressed by reducing tape mounts, for which kicking out end users was essential. In addition, there have been many other improvements in various areas. All this has resulted in significant cost saving, as the number of drives could be reduced by some 40. They are currently in the middle of a major repack exercise – 4 and 5 TB tapes are re-written to higher density ones, 36'000 1 TB cassettes will then be liberated and sold. The re-engineering of the repack software has resulted in much less impact on the infrastructure. The team now systematically verifies the archive data for bit errors; 35 PB have been verified already in 2014. All these measures have resulted in significantly improved data reliability over the last five years, even though there appears to be some further potential in view of the vendor quotes. In order to improve further, they are developing support for SCSI-4 logical block protection supported by the high-end drives, which adds a four-byte checksum per block that is checked at all possible stages. In addition, for small experiments dual tape copies are re-introduced. They have successfully

validated a third library type, SpectraLogic T-Finity, but did not purchase it because there was no need. 40 Oracle T10kD drives supporting 8.5 TB cartridges at 250 MB/s are in production, with very good experience apart from a Castor issue that took some time to find. They have been investigating alternatives to parts of the Castor software stack; they looked at Amazon Glacier, which was found to have too limited functionality (in addition Amazon was not too keen on communicating with CERN), and LTFS, which was found to be of low maturity and high complexity. Hence they have decided to re-engineer the Castor tape layer, and to replace code that has been serving for more than 20 years. German described the roadmaps of high-end vendors; some evolution is still to be expected, including significant improvements in areal density. LTO also has a healthy roadmap, even though it looks less aggressive. German would expect 15...20 TB cartridges by 2017 or 2018. Concerning market shares, tape has seen a certain drop, but is now stabilising. The slower pace of LTO is most likely due to market forces rather than technology. Enterprise tape appears healthy, but will probably face more and more competition by disk-based solutions. German finished by explaining that for Run 2, they expect some 50 PB per year, for which they are well prepared.

The DESY big-data cloud service (Peter van der Reest / DESY)

Photon science is taking a much more important role at DESY than before, hence they have some special requirements concerning data handling; in addition there are more non-HEP communities emerging. The DESY management has decided that DESY data should remain at DESY, hence they needed to find replacements for Dropbox, GoogleDrive, etc. rather quickly. Current systems provide access via POSIX semantics and sharing via ACLs; new communities are rather requesting cloud storage semantics. Users pointed out that for them, cloud means big data management, support for scientific life cycles, and a modern look-and-feel; they are prepared to pay, but want it to be virtually unlimited and not constrained by quotas; they want an indestructible data store (many nines of reliability); they want several choices of cost versus quality of service (access latency, retention policy); and they want extremely high availability of the service. Concerning the Web 2.0 experience, users want easy sharing with registered users and groups as well as the public, bidirectional synchronisation with all relevant OS, Web browser access and configuration etc. Clearly dCache is not enough, hence they looked around and have settled on ownCloud, like other places in Germany and elsewhere (CERN, HEPiX, UN, …) From ownCloud they needed the sync clients, upload and download clients for mobile devices, sharing of data, and web browser access and configuration. Peter then gave an overview of the features and usage of dCache; in order to use it as a backend, they need massive scale-out, managed space, multi-protocol access, and service classes. They found the setup of ownCloud on top of dCache very easy and straightforward; even the immutability of files in dCache is not a problem; however file ownership is. Ideally ownCloud would support Webdav redirection, or instead of requiring a mounted file system (POSIX) for ownCloud, it would support some simpler network API. Concerning deployment status, they have installed two systems, one connected to DESY LDAP for DESY account holders, and one with the dCache.org private cloud. They currently provide 100 TB, and will add 200 TB soon. They are still missing access to ownCloud from the DESY user registry, the platform adapter, integration with external users and federations, customisation of the ownCloud name space, and an evaluation of an

ownCloud sync client directly working against dCache, as well as the definition of an all-encompassing test suite. They will have a pre-production system in the next 6...8 weeks.

Update on the bit preservation working group (German Cancio / CERN)

The purpose of the working group is to provide for collecting and sharing knowledge on bit preservation as input to DPHEP in the form of technical advice. Already by the fall 2013 meeting, the group had conducted a survey of large sites with 19 replies; it showed a lack of SLAs, metrics, best practices, and long-term costing projections. The group has since focused on the latter two areas – best-practice recommendations and long-term costing evaluations. For the former, work is going on, some progress is expected over summer. Concerning costing, the group has evaluated a number of scenarios over periods of 10, 20 and 30 years – starting small (10 PB) and growing by 50 PB per year (a variant with 15% more every year has been studied as well), and starting large (100 PB) without any new data. They made a number of assumptions: the permanent storage is tape (single copy, not compressible/deduplicable) with a disk front-end; about 30% of the archive is read per year, high latencies are acceptable; hardware cycles are three years long; tape media are kept for two cycles; the disk front-end serves as cache for 10% of the archive, without any disk redundancy; both disk and tape servers are run with a 30% duty cycle; the current model with both tape and disk will remain valid. The group based estimates on the prices for a public US contract alliance; person-power is not included, nor are software development, licence costs, basic data centre operation costs, inflation, nor revenues from potential hardware and media re-sales. They assumed a 20% and 30% increase per year per disk and tape capacity, respectively, for the same price. These assumptions would lead to 550 TB disks and 10 PB tapes in 2044! In scenario A (steady growth), the data volume in 2044 reaches 1510 PB, for which less than 300 disks and less than 200 tapes would be required. The cost is initially very high ($10 M in the first period), but becomes much lower over time, totalling to $31.6 M (about $1 M per year on average). In scenario B with a constant increase of 15% of the yearly growth, the final data volume is 17'000 PB, requiring more than 3'000 disks and almost 2'000 tapes. The cost per period is similar initially, but does not decrease as rapidly as in scenario A, and totals to $60 M ($2 M per year). For scenario C (long-term stable archive of 100 PB), the cost decreases even much more rapidly than in scenario A, for a total over 30 years of $12 M ($400 k per year).

Basic IT services

Lavoisier: A data aggregation framework (Sylvain Reynaud / CC-IN2P3)

Sylvain explained how Lavoisier works – what data sources it accepts, how it converts them into a common representations and processes them, how the processed data are presented and made available. The system is perfectly modular, using plugins for the various steps, which he explained walking through a complete example, during which he showed the interface to configure the application. Lavoisier comes with its own HTML template generator, as no existing generator provided the functionality needed. He then showed an example how to aggregate data over multiple measurements, and presented a real use case, the EGI operations' portal. The framework addresses the key issues: maintainability, performance, availability, security, which he all explained in some

detail.

Agile Infrastructure monitoring (Pedro Andrade / CERN)

Pedro referred to presentations given at HEPiX previously, and reminded of the goals of the AI project and in particular the monitoring. Metrics and logs are fed into a Flume gateway, from where they are forked to be archived on HDFS, and to be processed by ElasticSearch and presented by Kibana. Data are stored by hostgroup/cluster without any expiry so far, and are aggregated daily. The experience with Flume has been very positive, even though it needed some customisation. Hadoop HDFS is running on five nodes and receives some 50 GB per day. The Flume gateway runs on 20 nodes that provide a buffer for 8 hours on Ceph. ElasticSearch and Kibana have also proven to be the right choices; deployment was rather easy, even though starting the full ES cluster is lengthy (more than one hour). Kibana is now fully integrated into ES and provides excellent functionality, but does not yet exploit the ES aggregation framework; it is difficult to create and share private dashboards. The Flume ES sink is running on ten nodes; ES runs on two master, two search, and 16 data nodes. Next to the IT services, there are also smaller non-IT use cases. They plan to use Hadoop MapReduce jobs, querying and plotting will be done with ES and Kibana, and real-time streaming use Hadoop Spark/Shark. He then described the alarm setup – they are like metrics, but come with some additional metadata. The alarm flow is different from what it used to be – alarms reach the responsible person directly instead of being routed to the CERN computer centre operators. He finished with a presentation of the milestones for the rest of 2014.

Scaling Agile Infrastructure, development and change management (Ben Jones / CERN)

Ben explained that the effort towards a new configuration management system started small, people fitted into a single room, but that's no longer the case; new methods and communication channels were required. Choke points they have come across include the compilation on the masters, submissions to PuppetDB, and ENC (Foreman). Initially the architecture was very simple, but adding machines did not address the needs – people were unhappy about spikes in puppet compilation times, which they have addressed by splitting interactive and batch puppet use, making sure the interactive part is sufficiently responsive. PuppetDB had performance problems, because it insisted to store almost all results of Puppet runs, even though in many cases nothing had changed. In addition, they found an issue with useless stat() calls that was fixed upstream, leading to very significantly improved performance. The original development practices were found to be too simple – the concept of a single repository for all configuration stuff did not prove practical, at which point in time one git repository was created per module. Each repository must at least feature a master and a QA branch, which are administered by a librarian tool called jens. A strong QA process was put in place mandatorily for shared modules; there are procedures for emergency situations. He also explained the concept behind snapshotting, and presented the tools for continuous integration testing.

An updated overview of IaaS at CERN (Stefano Zilli / CERN)

Stefano, completing the round of presentations of Agile Infrastructure providers, started by

reminding the audience of Openstack, referred to the 6-monthly release cycle and the various components, and mentioned the pre-production and production deployment at CERN. Of the components available, they use Nova, Glance, Keystone, Horizon, Cinder, and Ceilometer; they are investigating Neutron and Heat. He explained the projects, the roles and the quota as well as the life cycle. They run almost 3'000 hypervisors and almost 6'000 virtual machines, of which a fraction is located at Wigner. He then described the architecture, in particular the breakdown into cells, to some detail. New features they deployed for Nova include live migration, enabling of IPv6, updating network settings via Nova metadata, and improvements in cell scheduling. For Glance, they now use Ceph and have enabled shared images. The Cinder service was opened for production. In Keystone, task delegation to project managers has been enabled. Concerning Ceilometer, they added enabling polling on compute nodes, a specific role for WLCG accounting user etc. PowerShell support for Windows was added, too, as was Piwik for the dashboard. Currently they are working on re-factoring the configuration, to further automate common operations, to better manage hardware issues, and to migrate from CVI to Openstack. Further activities concern Cinder volumes for Windows, Kerberos support in Keystone etc. An upgrade to Icehouse is foreseen, as is the introduction of sub-projects. The team is contributing to upstream developments, too.

Field experience in the Agile Infrastructure (Jérôme Belleman / CERN)

His talk on AI was given from a different perspective, the one of a service manager using the components of AI – IaaS, Foreman, Puppet, monitoring. As an example, he showed a command that creates a VM, puts it into Puppet and Foreman, and activates monitoring in a single go. The virtual machines are creating console dumps in a much more reliable fashion than was the case previously with physical machines; similarly rebooting machines has become much more reliable. Indeed, it is sometime easier to delete and re-create a machine than fixing it. Jérôme showed a screen shot of Foreman, explaining how malfunctioning machines can be tracked down. Server life cycles are also managed with commands, of which Jerome showed the ones for retiring machines and changing environments. Service managers have experienced that Puppet allows for very fast-pace configuration with satisfactory response time. He appreciates that Puppet comes with readable configuration history, and that monitoring provides large-scale overviews as well as the capability to drill down on problems. They have set up notifications allowing them for example to grep for problematic strings in the console lots. A large list of services provided by PES-PS have already been migrated, which in some cases has been easier than fixing the Quattor-managed machines. Among the issues he listed, he mentioned that two nodes installed in the same way are not necessarily the same; sometimes Puppet runs fail; they have seen a corrupted DB. There is still a need for remote command execution in bulk, for which he mentioned a few tools. Some queries can be inefficient; they need to be improved, automated, and made more flexible. Even though creating a new machine is rather fast, further improvements would be desirable. Jérôme appreciated the centralised logging and access control and other tools, and pointed out that more workflows are needed.

From Quattor to Puppet – a Tier-2 point of view (Frédéric Schaer / IRFU)

Frédéric started by reminding the audience that IRFU is part of GRIF, a distributed Tier-2 of six

sites in the Paris region. Even though there is significant Quattor expertise at LAL, they had started looking at Puppet after HEPiX 2012 (referring to CERN's talk on AI), because at the time they felt increasingly uncomfortable with Quattor – things were hacked, compile times were too long, debugging was very time consuming, and there was no control on security updates. In addition, Quattor at GRIF suffered from several single points of failure; the Quattor documentation was rather poor. They didn't like SPMA at all. They were (and still are) under increasing person-power pressure. As a Tier-2 they needed to take control. They chose Puppet, because CERN chose it, the documentation is good, the community is huge, the developers are reactive, … but they did not find the migration easy, it took them two years, most of the time under strong pressure. They started with base configurations of virtual machines, then set up the Foreman and Puppet masters, then PerfSONAR, NFS servers, … Only then they dared to touch Grid services, from WMS over CREAM CE to DPM. Issues they found included missing documentation and sub-optimal quality of CERN-provided modules... and they made errors! They learned Puppet as they were using it, trying to avoid Hiera, but CERN used it, and had hard-linked its usage into many Puppet modules. They patched stuff that evolved afterwards; they put passwords and md5 hashes into git; and perhaps git is an error in the first place... But finally they managed to completely migrate from Quattor to Puppet, moving to SL6 and EMI-3 at the same time, with very little downtime. They are managing a Debian server with the exact same manifests with little or no extra work. They now offer to help other sites and get them started with Puppet. Next they will replace Yaim, test HTCondor (they had initially intended to test SLURM, but reports at HEPiX convinced them otherwise), … He finished with a detailed overview of the architecture and a comment on dependencies.

Quattor and Aquilon update (Ian Collier / RAL)

Ian started by recalling that the RAL Tier-1 adopted Quattor in 2009 for life-cycle and configuration management; the tool has improved significantly since then. A key point is to verify consistency before deployment. Being part of a community is definitely advantageous. The first generation of Quattor used CDB with PAN code stored in CVS; the second generation uses SCDB with PAN code stored in Subversion. CDB and SCDB have similar principles, and are basically an environment for writing PAN. In 2007 Morgan Stanley joined the community with the plan to deploy 20'000 hosts, to which (S)CDB did not seem to stand up. Hence Aquilon, the third generation, was devised. Git serves as VCS for PAN code. Ian briefly described the architecture – the broker is the source of all power. It is written in pure Python and uses SQLAlchemy as object-relational mapper. Changes are first released into sand boxes, only after testing are the pushed into production. They distinguish inventory items (location, hardware, network) from configuration items (feature, personality, host). Particularly powerful are services and service maps – Ian explained this with an example that also included requirements. At RAL they were the first to try Aquilon outside Morgan Stanley; they have spent a very significant time from the first tries until production on 250 nodes alongside SCDB (but the latter feels painful) – they are very satisfied with their decision. Highlights during the last year include a yum-based package management, regular release, … All code has been moved to Github, which has allowed for a much more effective collaboration. There are regular releases every two...three months; packaging is done automatically using Jenkins. It was a lot of work, but it was worth it. Using YUM has also been major progress – the handling of dependencies had been a

major issue before. There are new components, among them ncm-puppet that allow Puppet modules to configure modules in Quattor, for which Puppet modules exist; and ncm-metaconfig for writing structured configuration file formats on the fly. The community is small, but very engaged; there are several active mailing lists, short weekly developer meetings, twice-yearly workshops etc.

The HEPiX configuration management working group (Ben Jones / CERN)

Ben started by stating the objectives of the group: foster sharing of information, experiences, and where possible code and effort, but not to replace the wider Puppet community. There were two pre-existing repositories on Github: cernops and hep-puppet. For Puppet module development, standard modules can be submitted to forge.puppetlabs.com, where a CI structure (travis) is available. The group has decided to use this infrastructure as much as possible; a number of modules for Grid middleware are already on the forge, either contributed by CERN or by the developers themselves. Issues with this model include the fact it takes time to get used to it and gain confidence; perceived barriers to share code, contribute to github, … The group has also discussed secrets handling and YAIM. For the latter, an intermediate step of combining Puppet and YAIM could be considered, but long-term modules will need to be re-written. As far as the community is concerned, the mailing list is working well, and there is collaboration. Ben plead to inform the group whenever somebody feels that important modules are missing. “Where do I put my development” is not only a technical, but also a psychological question.

Cluster consolidation at NERSC (Larry Pezzaglia / LBNL)

Larry briefly introduced NERSC serving 5'000 users of 400 projects on two supercomputers and three data-intensive clusters. In 2012 a new cluster (Mendel) was added consisting of more than 500 Sandy Bridge nodes and IB FDR interconnects. Tools crucial for the operation include open-source software (xCat, cfengine 3) as well as NERSC-developed software (avs_image_mgr, CHOS, minimond). Larry then explained the model of cluster operation. They needed to consolidate, as was illustrated by the ease of operating Mendel as compared with the effort to run the previous clusters, which triggered them to start a consolidation effort. In spring 2014, they merged one of the legacy clusters into Mendel, resulting in a cluster with more than 1'000 heterogeneous nodes with common management tools; some particular challenges had to be overcome, including different OS on the bare metal, different interconnects, different PXE interfaces etc. They handled this by software changes to the base OS and xCat, and then shut down the legacy cluster to reboot its nodes into Mendel. Different configurations were reflected in the management tools and applied automatically. They found that the combined cluster is rather complex – there are many different configurations of hardware and software within a cluster; however they needed to keep in mind that they manage a single integrated system rather than a collection of nodes. They recently did a number of developments including ones on CHOS. Minimond is a NERSC development to systematically collect trending data for historical analysis; it currently collects 1'000 statistics per node in the form of absolute counter values only.

Friday May 23rd

Grids, clouds, virtualisation

Big data transfer over Internet (Andrey Shevel / St Petersburg Nuclear Physics Institute)

Andrey started by putting 'big data' into perspective – the term is a moving target. Scientific sources currently include the Large Synoptic Survey Telescope, the Square Kilometre Array, LHC, FAIR, ITER, CTA. Networks such as ESNET have seen an exponential growth of data traffic. In order to get a feeling for the needs in 10 years' time, it is useful to look back 10 years – basically a factor 100 in all respects. Data preservation also will play an important role. Big data are characterised by data flow velocity, data volume, and data variety. Data transfers may take many hours or days. A research project on big data transfers has been launched in St Petersburg; it will address software-defined networks in context with big data transfers. The primary protocol is TCP/IP, which is highly configurable; the optimum configuration must be investigated. Andrey then summarised the current status of the project, and invited advice and contributions.

FermiCloud on-demand services: data-intensive computing on public and private clouds (Steve Timm / FNAL)

Steve started by showing the structure and staffing, mentioning the collaborations with KISTI and Illinois Institute of Technology. The landscape at FNAL has changed – there isn't two large experiments any more, but many smaller ones with their own schedules and peak requirements, calling for sharing resources as much as possible. Steve then described the specific requirements of the neutrino programme, the computing requirements of which were almost entirely met at Fermilab until 2013. CVMFS is in widespread use; OSG runs a central CVMFS server. NOvA code has been ported (it needed to be made re-locatable). They use GlideinWMS as an interface between the VO and grids as well as clouds. Tests with NOvA and MicroBoone have been successful, including using commercial clouds (on Amazon they paid about 7 cents per CPU-hour); however they have found a few quirks (assumptions on hostnames matching external IP, unavailability of active-mode GridFTP, autofs and fuse required by CVMFS, lack of Squid proxies etc.). He then presented the present and near-future work on cloud services, mentioning in particular the future of X.509 for authentication and authorisation. They are setting up a facility to launch a virtual batch farm on demand.

RAL Tier-1 cloud and virtualisation (Ian Collier / RAL)

Ian started by explaining why the previous approach was lacking dynamism, a much more dynamic provisioning system was required. One cornerstone at RAL was replacing the configuration management system; their change to Quattor was very beneficial. Over the last three years, they have started to deploy virtualisation on Hyper-V, which transformed the provisioning – they offer a self-service tool for VM requests. Initially they only used local storage, but started a year ago to use Equallogic iSCSI arrays. Currently three production clusters provide VMs with shared storage, additional clusters only have local storage; the clusters are distributed over two buildings. Issues

they observed include migration problems triggered when they shut down a cluster for power interventions. They are now in the process of re-building the clusters with shared storage with Windows server 2012. Most services are virtualised now; exceptions include the top BDII, Ganglia, and the Oracle servers. Moving the VMs to production was fairly smooth. However they have suffered from the fact Linux experts needed to administer Windows systems; initially support for Linux guests was poor; meanwhile open-source tools have progressed, hence at some point in time they may wish to re-consider their choice of Hyper-V. They have also set up a cloud platform for the scientific computing department; it uses Stratuslab, which has been a moving target. It was deployed by graduates on six-month rotations. In summer 2013 they decided to move from best-effort prototype to a service for multiple users – LHC VOs, SDC projects, other STFC departments, self-service IaaS across STFC. There is an agreed budget until April 2015 for one FTE. They are currently re-evaluating their choice of StratusLab, and are currently favouring OpenNebula, even though no final decision has been made yet. Finally Ian explained how they burst the batch system into the cloud, for which they are using the power management feature of HTCondor (they extended condor_rooster). They did have an issue with Nagios monitoring, but then realised that for virtual worker nodes, most of the standard monitoring was not useful anyway. Without any special tuning effort, they achieved some 93% CPU efficiency with respect to physical worker node.

Enabling multi-cloud resources at CERN within HelixNebula (Domenico Giordano / CERN)

Domenico recalled the basics of HelixNebula – a project initiated by ESA and CERN, funded by the European Commission, to create a public-private partnership for accessing cloud resources. Initially four commercial European cloud providers were integrated; a broker (SlipStream) was deciding which resource to use. Domenico then described the flagship use cases from ESA, EMBL, and CERN; for the latter, ATLAS standard (simulation) production jobs administered via the PanDA framework have been chosen. Data access used the EOS instance at CERN; the VMs were equipped with CVMFS clients. For the VMs, they have chosen a configuration based on CentOS 6 with one CPU, 2 GB RAM etc. A single deployment would typically launch 25 virtual machines, which took between 5 and 25 minutes depending on the provider; the payload started about 5 minutes after the VM was started. Termination was much faster, it took some 60 seconds. The deployment turned out to be stable over a long time (several weeks). However, there is still considerable heterogeneity between providers, and the costs are still high and/or not well defined with respect to in-house resources.

Experiences with ATLAS and LHCb jobs in Vac virtual machines (Andrew Mc Nab / Manchester University)

Andrew explained how the experiment pilot jobs interact with IaaS models; while there are several mechanisms possible, there are always multiple layers and multiple queueing systems involved. The Vacuum model radically simplifies this, asking the sites to just create VMs running pilot jobs. This only requires a small user_data file at the sites; CVMFS and pilot jobs do the rest. This mechanism is implemented as Vac, which acts as a VM provisioning system on each physical worker node, creating VMs on it as required and configured on the worker node. The factories communicate

amongst each other via UDP; they support CernVM 2 and CernVM 3. It assumes that the VM shuts itself down whenever there is no work to do. Target shares are taken into account by the factories communicating with each other and reporting accounting information. The Vac daemons re-read their configuration file regularly (by default once every 60 seconds); documentation is complete and comprehensive. Andrew then showed examples from Manchester U about ATLAS PanDA jobs running on Vac as well as the Ganglia monitoring; he also showed examples from LHCb. Accounting is provided compliant with the APEL and EGI requirements. Efficiency measurements with real production workload show an average of over 99% for LHCb MC jobs. Multi-processor VMs are supported as well, as are the machine/job features. Andrew finished by stating that he is looking for more sites to deploy Vac.

Closing session

Workshop wrap-up (Helge Meinhard / CERN)

Helge started with some statistics on attendance and talks, some of which are mentioned in the introduction to this report. Once again, a HEPiX meeting has attracted a number of new participants from the local community, France in this case. Even though the length of the standard slot needed to be shortened, the scheduled total duration was almost 27 hours of very interesting presentations of high standard and vivid discussions. The highlights Helge briefly mentioned include IPv6, perfSONAR, CEPH, cloud storage, bit preservation, private clouds in production status, HTCondor, CPU benchmarking, alternative CPU architectures, OpenCompute, business continuity, Puppet, and first and foremost of course the past and future of Scientific Linux; he informed about the discussion that had been held between FNAL and CERN experts (see report above). His report from the board meeting mentioned the status of the working groups, the Web site and hepix.org infrastructure, and the forthcoming election of the North-American co-chair. The next meetings will be held from 13 to 17 October 2014 at the University of Nebraska-Lincoln (USA) and from 23 to 27 March 2015 at the Oxford University in the UK. He finished with thanks to all participants, speakers, track convenors and session chairs, the sponsors, and in particular the local organisers and helpers, which triggered warm applause.