

Informatics Computing Plan 2018

School of Informatics

July 3, 2018

Contents

1. Long-term vision and strategic objectives	2
2. Pressing issues for 2018	3
3. Report on 2017	5
4. Revised plan for 2018	11
5. Plan for 2019	16
A. Evaluation	17
B. Staffing and Resources	17
C. Categories and activities	20

1. Long-term vision and strategic objectives

Informatics Computing serves around 340 staff (240 teaching and research), 375 research students, 520 taught postgraduate students, 1350 undergraduates, and 280 visitors and associates.

The aim of the Informatics Computing staff is to ensure that members of the School of Informatics (staff, students and visitors) receive computing services necessary for their research, teaching and knowledge transfer activities. These services should be efficient, fit to users' requirements, good value for money and use open standards. Appendix A outlines the evaluation processes that we have established to ensure that we are fulfilling this aim.

Strategic objectives

We have five principal aims underpinning the Informatics Computing Strategy:

- S1** Maintenance, review and update of a computing environment fit for the purposes of all members of the School.
- S2** Providing added value over services offered by College and IS.
- S3** Maintaining an optimum level of interoperability of Informatics Computing with College and IS services.
- S4** Provision of expertise to support the teaching and research activities of the School.
- S5** Engagement with international best practice.

We have specific objectives relating to the computing infrastructure and to the activities of the School: research, teaching and knowledge transfer :-

Infrastructure We are committed to providing an infrastructure that ensures that members of the School get those services that they need. These services may be provided by the School, by IS or by external organisations.

- I1** Review and evaluate computing infrastructure change taking account of changing user needs and general computing trends.
- I2** Development of new services.
- I3** Provision of Informatics know-how and technologies to college and university level, and beyond.

Research In addition to providing a flexible, responsive environment for research in the School, we must meet the specific research requirements across our research institutes, and structure research computing support to be well-matched to the ways researchers propose and carry out research projects.

- R1** Continued development of lightweight, responsive support for research computing that is fully compatible with full economic costing of research
- R2** Ensuring that Informatics users get efficient, responsive access to high performance research computing and storage facilities
- R3** Provision of support for interdisciplinary and collaborative research projects

R4 Development of prototype services from R&D projects

Teaching In addition to providing a stable environment for the School's teaching activities, we shall

- T1** Support research-led teaching by providing support for the transfer of research tools to our standard teaching platform.
- T2** Support appropriate assessment of students (eg online examinations).
- T3** Provision of expertise to support teaching activities

Commercialisation and knowledge transfer Informatics Computing can support the School's knowledge transfer activities by providing a bridge between research and use

- C1** Using the School's commercialisation infrastructure as a driver to develop prototype services from applied research in Informatics.

Management Information We shall support the ISS business processes. We also aim to support planning and decision making through the timely and effective maintenance and provision of Management Information.

Interaction with IS

We shall focus :-

- on being early adopters of services that may or may not become commodity
- on developing new services that are specific to, or inspired by, our environment

We shall use IS services wherever possible, unless there are sound academic reasons for not doing so. However, we shall take a careful approach when considering migration from a School service to the equivalent IS service.

2. Pressing issues for 2018

We have identified a number of strategic strands for consideration in 2018. We shall produce :-

- a strategy for improving the efficiency of teaching admin support. This will cover the effective use of central systems, identifying which of our remaining manual processes can be automated and how we might support the admin processes for online teaching.
- a strategy for promoting the use of the VLE (and other related tools) and to support the transition of courses to the VLE. This will, at least, define the scope of our Learn pilot, identify potential tools (other than Learn) and consider whether we have good reason not to use Learn as a home for teaching related systems (as done in other Schools).
- a strategy for resourcing the compute and data intensive needs of the School. The demand for compute resources from compute and data-intensive courses continues to grow, particularly with increasing interest in machine learning. There is also increasing demand

for compute resources from the research postgraduate community. We are currently projecting that undergraduate and taught postgraduate numbers will continue to rise over the next few years.

3. Report on 2017

Mandatory Goals

1. **Goal** Re-occupation of Appleton Tower from Forrest Hill and Wilkie
Progress This was completed in time for the start of academic session 2017/2018.
2. **Goal** Produce a register of medium and high risk data and a mechanism for users to self populate the register
Progress We have continued to wait on the College wide solution. We have recently (February 2018) received documentation for this system and are currently assessing whether the system will fit our needs.
3. **Goal** Take remaining steps to implement College security action plan
Progress RedHat have made available a technology preview of a system which should make it relatively simple to full disk encrypt DICE machines. We have decided to await this technology instead of “re-inventing the wheel”.
4. **Goal** Continue to engage with University Network Strategic Review
Progress The strategic project (CIS004) has been completed. The procurement project (CIS009) is well under way.
5. **Goal** Adapt processes and systems for migration of assessment from Theon to APT
Progress Completed.

High priority goals

1. **Goal** Consideration of how best to make use of the new central RDM services
Progress No progress.
2. **Goal** Continued consideration of appropriate use of central data storage facilities
Progress No progress.
3. **Goal** Engage in requirements capture for and design of proposed central archiving service
Progress The DataVault service will shortly enter service. We were never asked to provide our requirements, despite promises that this would happen. Our understanding is that DataVault only supports research needs.
4. **Goal** Complete the documentation for the School Database back-end (database engine and client)
Progress Completed.
5. **Goal** Migrate existing Institute web sites off Plone CMS service to School Drupal service (based on IS Drupal distribution)
Progress Work on making sure EdWeb distribution is suitable for our needs is complete. Four out of six institute sites have been migrated, with the remaining two sites in progress.

6. **Goal** Investigate whether the existing network file system is still appropriate for the School's requirements and identify possible alternatives
Progress No progress
7. **Goal** Complete the move of administrative home and group filespace from AFS to Datastore
Progress Will be completed by the end of April.
8. **Goal** Consideration of email provision given that fewer Schools are now using Staffmail
Progress An open meeting of the School staff will be called in 2018 to discuss.
9. **Goal** Complete the migration of School services to Scientific Linux 7 platform
Progress Completed.
10. **Goal** Perform a review of the future of the DICE desktop platform
Progress No progress.
11. **Goal** Investigate options for a more reliable and sustainable virtual Linux desktop service
Progress Completed. A prototype XRDP service (developed in School of Engineering) has been delivered. Should that prove successful, a full XRDP service will be deployed replacing the existing NX service.
12. **Goal** Continue full review of requirements and options for videoconferencing, particularly with external organisations in order to reduce travel. Including holding an innovation meeting
Progress Review completed and published. Equipment in process of being commissioned in IF-5.02. Other equipment has been installed in some smaller Forum meeting rooms. The School is investigating meeting pods.
13. **Goal** Implement upgrade of AV facilities in Forum G.07/G.07A, in collaboration with IS LTS
Progress The sound system has been upgraded. Further progress has been blocked by the availability of space and the pressure on LTS project management resources.
14. **Goal** Establish a target of maintaining energy consumption (by computing equipment) at 2016 level, or lower. Possible approaches include increased use of cloud services for computation work
Progress No progress.
15. **Goal** Review policies with respect to self-managed servers (due to space, energy and security concerns)
Progress We have established a space management policy and have started a project on producing training material for the managers of self-managed servers.
16. **Goal** Improved management of Commercial tenants, with respect to network provision and user support
Progress Have been waiting on the results of the IS/MVM joint project on improving tenancy agreements for Roslin. This has recently been published and we are looking at basing our agreements on the model produced for Roslin.
17. **Goal** Complete the audit of all research data within the School (depends on Mandatory Goal 2)

Progress This will be completed by the end of June.

18. **Goal** Implement separate backup streams for MHR and non-MHR data to meet differing retention policies (dependent on data audit)

Progress No progress.

19. **Goal** Investigate options for additional disk encryption on DICE desktops

Progress RedHat have produced a technology preview of a system that should make this simple to achieve. We are hoping that this will soon become fully supported in a future point release of RedHat 7.

20. **Goal** Second factor authentication for system administrator accounts

Progress A review was completed and actions agreed. Implementation will be carried out in 2018.

21. **Goal** Produce user security training materials (supplementing IS material)

Progress A project has recently started.

22. **Goal** Migrate to https

Progress A project has recently started. An audit of http sites has been completed.

Discretionary goals

1. **Goal** Continue engagement with the PURE project to meet identified requirements for knowledge management functions other than those related to teaching administration (eg use of PURE to capture impact and improve public engagement)

Progress No action.

2. **Goal** Provide significant development support to the revised System Design exercise

Progress No progress.

3. **Goal** Investigate streaming lecture slides to teaching lab desktops

Progress No progress.

4. **Goal** Complete feasibility study and cost/benefit analysis for deploying Cloud based printing within the School.

Progress Cloud based printing was introduced in Appleton Tower. It will be introduced in the Forum in April 2018.

5. **Goal** Update existing CVS/SVN based web content to current University style

Progress No progress.

6. **Goal** Produce guidance on resources available for research projects (eg software repositories, wikis, VMs for software preservation, DIY DICE, etc)

Progress No progress.

7. **Goal** Review, and where required refresh, the AV facilities of the Forum other than G.07/G.07A

Progress No progress (other than introducing facilities in new meeting rooms)

8. **Goal** Improve end-of-life account management

- Progress** An account life-cycle system now in service. A project to deal with the cleanup of expired accounts is in progress.
9. **Goal** Complete redevelopment of new equipment inventory system
Progress System complete. Aiming to enter service early 2018.
 10. **Goal** Investigate 802.1X for some or all of School network ports
Progress No progress.
 11. **Goal** Investigate improved storage platform for virtualisation service
Progress No progress.
 12. **Goal** Continue work on migration to IPv6 - support for self-managed machines
Progress Further progress on this has been hampered by the inability of the current network switches to provide the required features. Refreshing of these network switches is in hand.
 13. **Goal** Review energy usage of research servers - perhaps sleeping idle servers and virtualising little used servers
Progress No progress.
 14. **Goal** Develop and document policies and procedures for physical security
Progress A project is in progress.
 15. **Goal** Investigate whole disk encryption of DICE machines
Progress RedHat have produced a technology preview of a system that should make this simple to achieve. We intend to deliver whole disk encryption during the upgrade to Scientific Linux 8.
 16. **Goal** Consider firewalling self-managed machines (from rest of School)
Progress Consideration in progress.
 17. **Goal** Improve security of package distribution system
Progress No progress.
 18. **Goal** Improve security of LCFG profile access
Progress A project has recently been started.
 19. **Goal** Further improve standard web configuration (LCFG headers)
Progress No progress.
 20. **Goal** Produce a risk register, covering staff and equipment resources, financial processes and systems
Progress No progress.
 21. **Goal** Consolidate internal computing documentation
Progress No progress.
 22. **Goal** Appoint a Learning Technologist
Progress A Learning Technologist was appointed in February 2018.

Recurring goals

1. **Goal** Aim for a minimum of 20% of development time to be dedicated to user submitted projects
Progress We have achieved 10% (excluding time spent on teaching software requests)
2. **Goal** Further promote School developed solutions to the rest of the University and beyond
Progress No progress.
3. **Goal** Ring-fencing 5% of individual computing staff's time for staff development, including user support staff.
Progress As for last year, not all units achieved this figure.
4. **Goal** Consideration of ways to minimise our energy footprint, eg identifying under-used research servers
Progress No progress.
5. **Goal** Assess system security and identify potential improvements
Progress Ongoing, but no major improvements.
6. **Goal** Further consideration of migration to central services (big ticket items only)
Progress No progress.
7. **Goal** Review impact of University activities wrt. teaching - VLEs, Distance Learning (including MOOCS) , EUCLID developments (assessment).
Progress The Informatics Teaching Office (ITO) have been engaging with the replacement VLE project, with the EUCLID assessment project and with central timetabling initiatives.

Unplanned activities

1. A dramatic increase in the number of students taking our Machine Learning Practical necessitated the urgent procurement and commissioning of a cluster providing 200 GPUs. The procurement of such a cluster in a very compressed timeframe proved challenging.

Activities to be considered for de-commissioning

1. **Goal** Legacy web sites
Progress No progress.
2. **Goal** Legacy email domains
Progress Some options were determined and discussed. The favoured option is to give users some notice that mail to legacy mail domains will stop. It is likely that this action will be rolled up with the forthcoming migration off Staffmail.
3. **Goal** Legacy filespace
Progress This will be completed once the move of administrative data to Datastore has been completed.

Collaboration with others

We would like to register our continued appreciation of the assistance of Angus Rae and Victoria Dishon, who have acted as very responsive and effective interfaces with IS.

We are very keen to collaborate with other Schools and IS on development and even service delivery.

1. We continue to provide the base LCFG Linux platform to other schools (via IS) and host the monthly LCFG deployers meeting.
2. Network Strategy and Procurement projects
3. A member of our team is on Enterprise APIs steering group
4. We are working with other Schools and IS to deliver the Bayes building

4. Revised plan for 2018

Each project has a cost effort estimate, where small is 1 to 3 FTE weeks, medium is 4 to 7 weeks and large is 8+ weeks.

Information on computing projects is available at <http://computing.projects.inf.ed.ac.uk>

Mandatory goals

1. Migrate the Robotics teaching and research and Commercialisation to the Bayes building
Who: School, Cost: medium, Project(s):
2. Produce a register of medium and high risk data and a mechanism for users to self populate the register
Who: School, Cost: small, Project(s): 307
3. Take remaining steps to implement College security action plan
Who: School, Cost: small, Project(s): 372
4. Continue to engage with University Network Strategic Review
Who: School, Cost: small, Project(s): 404
5. Prepare for GDPR
Who: School, Cost: medium, Project(s): 443
6. Upgrade administrative staff desktops to Windows 10
Who: Admin, Cost: medium, Project(s):
7. Migrate off Staffmail
Who: School, Cost: small, Project(s):
8. Implement separate backup streams for MHR and non-MHR data to meet differing retention policies
Who: School, Cost: medium, Project(s): 346

High priority goals

1. Consideration of how best to make use of the new central RDM services
Who: Research, Cost: small, Project(s): 386
2. Continued consideration of appropriate use of central data storage facilities
Who: Research, Cost: small, Project(s): 387
3. Engage in requirements capture for and design of proposed central archiving service
Who: Research, Cost: small, Project(s):
4. Produce a strategy for improving the efficiency of teaching admin support
Who: Teaching, Cost: small, Project(s):
5. Produce a strategy for supporting the transition to use of VLE (and other tools)
Who: Teaching, Cost: small, Project(s):
6. Produce a strategy for resourcing the School's compute and data intensive requirements
Who: Teaching/Research, Cost: small, Project(s):

7. Migrate existing Institute web sites off Plone CMS service to School Drupal service (based on IS Drupal distribution)
Who: School, Cost: medium, Project(s): 388
8. Investigate whether the existing network file system is still appropriate for the School's requirements and identify possible alternatives
Who: School, Cost: medium, Project(s): 445
9. Perform a review of the future of the DICE desktop platform
Who: School, Cost: small, Project(s): 379
10. Implement upgrade of AV facilities in Forum G.07/G.07A, in collaboration with IS LTS
Who: University, Cost: small, Project(s):
11. Introduce Docker under DICE
Who: Research and Teaching, Cost: medium, Project(s):
12. Produce a production Slurm service
Who: Research and Teaching, Cost: medium, Project(s): 418
13. Produce a production Gluster (or equivalent) service
Who: Research and Teaching, Cost: medium, Project(s): 419
14. Establish a target of maintaining energy consumption (by computing equipment) at 2016 level, or lower. Possible approaches include increased use of cloud services for computation work
Who: University, Cost: small, Project(s):
15. Review policies with respect to self-managed servers (due to energy and security concerns)
Who: Research, Cost: small, Project(s):
16. Improved management of Commercial tenants, with respect to network provision and user support
Who: Research, Cost: small, Project(s):
17. Continue to improve end-of-life account management.
Who: Infrastructure, Cost: medium, Project(s):
18. Consider how to deal with growing server estate, given limited scope for increasing server room space
Who: School, Cost: small, Project(s):
19. Investigate and deploy technology to improve certificate management
Who: School, Cost: small, Project(s):
20. Complete the audit of all research data within the School
Who: School, Cost: medium, Project(s):
21. Implement agreed steps to improve security of system administrator accounts
Who: School, Cost: medium, Project(s): 399
22. Produce user security training materials (supplementing IS material)
Who: School, Cost: small?, Project(s): 403
23. Migrate to https
Who: School, Cost: large?, Project(s): 454

Discretionary goals

1. Provide significant development support to the revised System Design exercise
Who: Teaching, Cost: small/medium?, Project(s):
2. Investigate streaming lecture slides to teaching lab desktops
Who: Teaching, Cost: small?, Project(s):
3. Update existing CVS/SVN based web content to current University style
Who: School, Cost: small, Project(s):
4. Produce guidance on resources available for research projects (eg software repositories, wikis, VMs for software preservation, etc).
Who: Research, Cost: small, Project(s):
5. Review, and where required refresh, the AV facilities of the Forum other than G.07/G.07A
Who: University, Cost: small, Project(s):
6. Consider producing a live chat service
Who: School, Cost: small, Project(s): 392
7. Produce a Limesurvey service
Who: Administrative, Cost: small, Project(s): 451
8. Produce a production Hadoop service
Who: Research and Teaching, Cost: small, Project(s): 420
9. Produce an A5 introductory booklet for new staff and students
Who: School, Cost: ?, Project(s): 446
10. Investigate 802.1X for some or all of School network ports
Who: School, Cost: medium, Project(s):
11. Investigate improved storage platform for virtualisation service
Who: Infrastructure, Cost: medium, Project(s):
12. Continue work on migration to IPv6 - support for self-managed machines
Who: School, Cost: medium, Project(s): 368,366
13. Review energy usage of research servers - perhaps sleeping idle servers and virtualising little used servers
Who: Research, Cost: small, Project(s):
14. Identify a more sustainable procurement path for GPU servers
Who: Research and Teaching, Cost: small, Project(s):
15. Develop and document policies and procedures for physical security
Who: School, Cost: small, Project(s): 394
16. Consider firewalling self-managed machines (from rest of School)
Who: School, Cost: small, Project(s): 397
17. Improve security of package distribution system
Who: School, Cost: small, Project(s): 401
18. Improve security of LCFG profile access
Who: School, Cost: medium, Project(s): 402
19. Further improve standard web configuration (LCFG headers)
Who: School, Cost: medium, Project(s): 400

20. Produce a risk register, covering staff and equipment resources, financial processes and systems
Who: School, Cost: small, Project(s):
21. Consolidate internal computing documentation
Who: School, Cost: medium, Project(s): 391

Recurring goals

1. Aim for a minimum of 20% of development time to be dedicated to user submitted projects
2. Further promote School developed solutions to the rest of the University and beyond
3. Ring-fencing 5% of individual computing staff's time for staff development, including user support staff.
4. Consideration of ways to minimise our energy footprint, eg identifying under-used re-search servers
5. Assess system security and identify potential improvements
6. Further consideration of migration to central services (big ticket items only)
7. Review impact of University activities wrt. teaching - eg. VLEs, Distance Learning (including MOOCS)

Activities to be considered for de-commissioning

- Legacy web sites
- Legacy school database
- Plone CMS

IS services critical to Informatics

As far as we are aware, these are the IS services that are critical to the School. It is possible that there are other IS services that are widely used by our users; presumably IS maintains usage statistics that could be used to identify these. The following are in a rough priority order.

1. EdLAN / eduroam - delegated, fine-grained control would make IS management of the School's internal network more attractive
2. A standards compliant IMAP mail service (eg Staffmail)
3. Managed Windows Desktop
4. ECDF GPU cluster (based on expected use)
5. Phones and Access Control
6. Central authentication and directory services
7. Central administrative services (and feeds from) such as EUCLID/HR/BIS/PURE/EUGEX etc.
8. DataStore
9. Office365 mail (for students)
10. ECDF subversion service
11. Public PC labs - we would like to investigate more effective use of these labs for our 1st and 2nd year students.

12. ECDF Eddie cluster
13. EdWeb distribution
14. EdWeb hosted service
15. Learn
16. WIKI
17. IDM (Identity management system)
18. Lecture capture service (currently using HSS panopto service)
19. IS printer service (including pcounter and cloud)
20. SSL certificate signing service
21. MOOC
22. Software purchasing
23. Visitor Registration Service

Additional services we would like

1. Improved computational facilities for taught students
2. Provision for data archiving and, perhaps, curation. Note that this archiving should not be limited to research data.
3. We are interested in the proposed ECDF cloud virtualisation service, particularly for taught students.
4. Support for secure, open standards based, email.
5. Additional programmatic interfaces to central administrative systems, as documented in Colin Higg's note on "Arguing for Authorised APIs". eg SOAP to EUCLID, SAT and VRS.
6. An API to "upload" assessment data to central systems instead of manual copy/paste processes.
7. An API to apply for Janet SSL certificates
8. The ability to feed into Grouper, from our School Database, would reduce the barrier to the School making more use of central IS services
9. The ability to make more use of centrally provided group data but this remains dependent on the quality and accuracy of the data and suitable APIs
10. Replacement for ESISS scanning service
11. A more pervasive attitude, particularly with respect to increasing provision and access, to the use of video conferencing across the University

In order to achieve the aforementioned improvements and additional services, we are very keen to collaborate with both IS and other CSE schools on development and even service delivery.

5. Plan for 2019

Goals

1. Any required actions resulting from review of DICE desktop platform
2. Any required actions resulting from research server energy review
3. Any required actions resulting from network file system review
4. Any required actions resulting from EdLAN procurement
5. Any required actions resulting from IS authentication and authorisation review
6. Any required actions resulting from the Student personal calendar initiative
7. Establish a target of reducing 2019 energy consumption by computing devices by 10%
8. Any additional work required to refresh the Forum AV
9. Start work on porting LCFG and DICE to Scientific Linux 8
10. Produce an Information Architecture plan

De-prioritised areas

- To be identified

A. Evaluation

We have established a number of evaluation processes, to ensure that we are delivering a service in line with our strategic objectives.

- **Fit to requirements** User requirements are captured using various mechanisms. Any member of the School can submit a project proposal via a web form. Each project is categorised into one of three prioritised categories - Mandatory, Strategic (meets one of the goals in Section 2 of this document) or Objective (meets one of the Strategic Objectives in Section 1). Projects are resourced in priority order when effort becomes available. There is a target of 20% of development time to be dedicated to user submitted projects. Teaching software requirements are met through a stable and well established system. Specific requirements are also captured in depth via focused innovation meetings, which all members of the school may attend.
- **Value for money** This is a criterion for the annual review document, and is related to transparent support for research computing, centralised procurement that remains close to academic needs, and official audits of various research project expenditure.
- **Objective evaluation** Each computing team provides a triannual report, which reports on activities in the past four months and future plans for work in the forthcoming four months. It includes figures on effort spent on development activities.

The School's Computing Strategy Committee (Head of School, Director of Research, Director of Teaching, Head of Computing, Deputy Head of Computing, Director of Professional Services) provides oversight of the above processes.

B. Staffing and Resources

The school employs 22 computing staff (21.8 FTE). This figure includes the Learning Technologist, appointed in early 2018.

There are 652 managed DICE (Linux) desktops; 310 personal machines for staff and research students, and 342 in 9 undergraduate teaching labs and 9 tutorial rooms. There are a further 70 managed Windows desktops for administrative staff.

In addition there are several hundred self-managed Linux, Mac OS and Windows desktops and laptops.

There are 363 managed DICE (Linux) servers (202 physical, 161 virtual) and a further 85 cluster nodes. There are an additional 100 physical self-managed servers. Many servers are used to host GPUs - we now have over 450 GPUs with over 1,000,000 cores.

Trends :-

- There has been a continued reduction in the number of managed DICE desktops used by staff and research postgraduates. This is probably mainly due to desktop Linux becoming much more easy for end users to install and configure, and also a significant shift to Apple Mac equipment by academic staff.
- There has been an further increase in the number of managed DICE desktops in student labs (with the increase in lab space in Appleton Tower). It is expected that this increase will continue into academic year 2018/2019.

- The number of GPUs doubled this year, largely due to the addition of a 200 GPU node cluster for taught students.

Our servers are housed in 5 air-conditioned machine rooms, with a total area of around 170 m².

(Figures as of 15/02/2018).

C. Categories and activities

Support	Front Line	Documentation	General Web	Online Exams	Procurement
	User accounts	AV and VC	Inventory	Exam prep	
File	Web	Admin	Misc	Desktop	Compute
AFS	Web (CVS)	Theon	ssh servers	DICE desktop	DICE compute
Samba (admin)	EdWeb	ISS desktop	Printing	Teaching s/w	Grant servers
Backups (user)	Wiki	IGS desktop	Mailing lists	Research s/w	Hadoop
iFile	Group web	HR desktop	Licence servers	MDP	Gridengine
SVN	Homepages	ISS and KM RT	Postgresql	DICE virtual desktop (NX)	CDT clusters
GIT	Plone	Room Booking	Coltex	Virtual DICE image	MSc cluster
Gluster	Legacy		Forums		GPU cluster
	Wordpress				
Infrastructure	Linux platform	LCFG	Kerberos	Directory	Network
	S/W repository	pkgforge	Cosign + Certs	Authorisation	Network services
	Server rooms	Consoles	Monitoring	Prometheus	System backups
	Virtualisation				