

# HPCx Service Report

## April 2007

### 1 Introduction

This report covers the period from 0800 on 1 April 2007 to 0800 on 1 May 2007, a service month of 720 hours.

Overall utilisation of the main service fell back from the extremely high levels of the previous two months, but still exceeded 75%. At 91%, utilisation of the development service continued to be exceptionally high. For the third month running, there were no SEV1 incidents, demonstrating remarkable reliability.

### 2 Usage

#### 2.1 Availability

##### *Incidents*

During this month, there were only 3 incidents, none of which was at SEV1. The following table indicates the severity levels of the incidents, where SEV1 is defined as a *Failure* (in contractual terms). The definitions used for severity levels can be found in Appendix A.

<i>Severity</i>	<i>Number</i>
1	0
2	0
3	3
4	0

The MTBF figures for this month were as follows:

<i>SEV1</i>	<i>Incidents</i>	<i>MTBF</i>
IBM	0.0	∞
Site	0.0	∞
External	0.0	∞
<i>Overall</i>	0.0	∞

## *Serviceability*

Scheduled downtime for this month was 1.0 hours.

<i>Attribution</i>	<i>UDT</i>	<i>Serviceability</i>
IBM	0:00	100.0
Site	0:00	100.0
External	0:00	100.0
<i>Overall</i>	0:00	100.0

## 2.2 CPU Usage by Consortium

### Main Service

<i>Consortium</i>	<i>CPU Hours (Parallel)</i>	<i>CPU Hours (Other)</i>	<i>AUs charged</i>	<i>%age of charged AUs</i>
e01	114985	485	555927	8.9%
e03	242	0	1166	0.0%
e05	290347	799	1336103	21.3%
e06	9253	20	44647	0.7%
e08	42512	0	204674	3.3%
e11	6054	0	29148	0.5%
e17	19470	40	93931	1.5%
e18	1	0	4	0.0%
e24	0	0	1	0.0%
e27	13	0	58	0.0%
e33	8612	0	41460	0.7%
e35	219003	0	1054379	16.8%
e36	4358	71	19164	0.3%
e37	139918	5	673655	10.7%
e39	7475	1	35990	0.6%
e41	21795	0	104934	1.7%
e42	9752	0	46954	0.7%
e45	10048	0	48377	0.8%
e46	343	0	1651	0.0%
e48	6089	0	29313	0.5%
e49	677	76	3625	0.1%
e50	7012	0	33757	0.5%
e53	0	19	91	0.0%
e54	1792	0	8625	0.1%
<i>EPSRC Total</i>	931021	1518	4421212	70.5%

n01	845	0	4067	0.1%
n02	187353	14	902070	14.4%
n03	147219	1112	713049	11.4%
n04	11898	33	57439	0.9%
<i>NERC Total</i>	347315	1159	1676625	26.7%

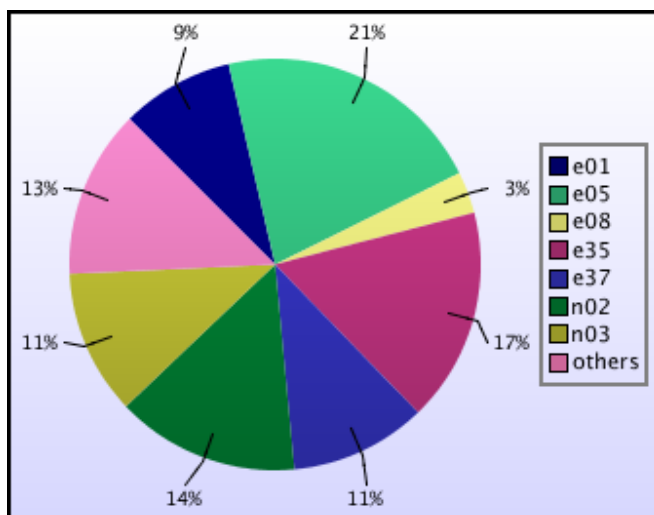
p01	6	0	28	0.0%
<i>PPARC Total</i>	6	0	28	0.0%

c01	12536	19	60443	1.0%
<i>CCLRC Total</i>	12536	19	60443	1.0%

b08	18983	0	91391	1.5%
<i>BBSRC Total</i>	18983	0	91391	1.5%

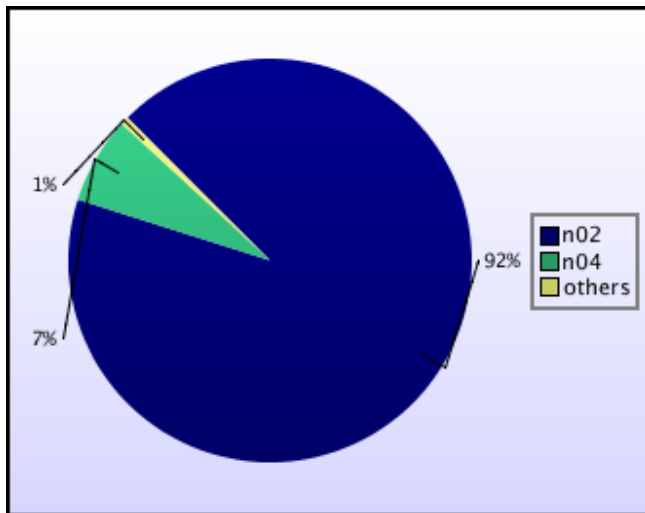
x01	810	0	3900	0.1%
<i>External Total</i>	810	0	3900	0.1%

z001	2986	10	14421	0.2%
z002	1	0	4	0.0%
z004	119	11	625	0.0%
z06	42	1	207	0.0%
<i>HPCx Total</i>	3148	22	15257	0.2%



### Development Service

Consortium	CPU Hours (Parallel)	CPU Hours (Other)	AUs charged	%age of charged AUs
n01	9	0	44	0.0%
n02	115865	304	559289	92.4%
n03	809	0	3894	0.6%
n04	8764	0	42193	7.0%
<i>NERC Total</i>	<i>125447</i>	<i>304</i>	<i>605420</i>	<i>100.0%</i>



### 2.3 CPU Usage by Job Type

The figures for *Raw AUs* given here show the number of AUs actually supplied by the system to users' jobs.

#### *Main service*

<i>Number of processors</i>	<i>Raw AUs</i>	<i>%age</i>	<i>Number of jobs</i>
≤32	752624	11.9%	3294
33–64	495956	7.8%	710
65–128	1368282	21.6%	1391
129–256	2551474	40.3%	533
257–512	637999	10.1%	179
513–1024	518975	8.2%	48

Overall utilisation of the main service was 74.2%. Capability usage was 18.3% of the total.

#### *Development Service*

<i>Number of processors</i>	<i>Raw AUs</i>	<i>%age</i>	<i>Number of jobs</i>
≤32	557945	92.4%	7793
33–64	45049	7.5%	234
65–128	964	0.2%	3
129–256	0	0.0%	0

Overall utilisation of the development service was 90.9%.

## 2.4 Slowdown and Job Wait Times

### *Slowdowns*

Slowdown is a widely used measure of the relative wait times of different classes of jobs. It is defined as:

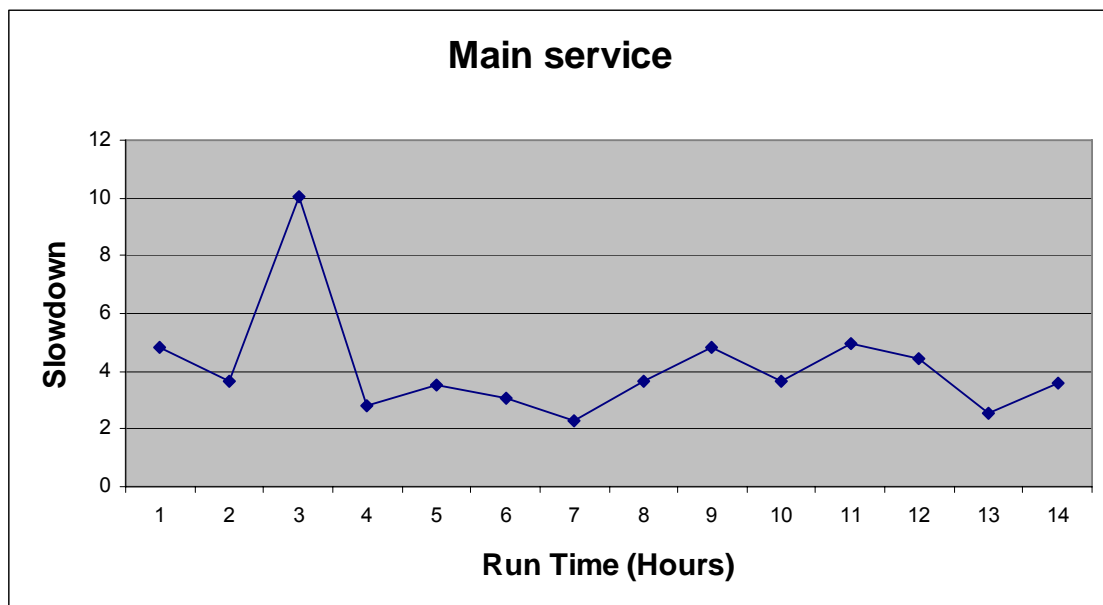
$$\text{Slowdown} = (\text{job run time} + \text{job wait time}) / (\text{job run time})$$

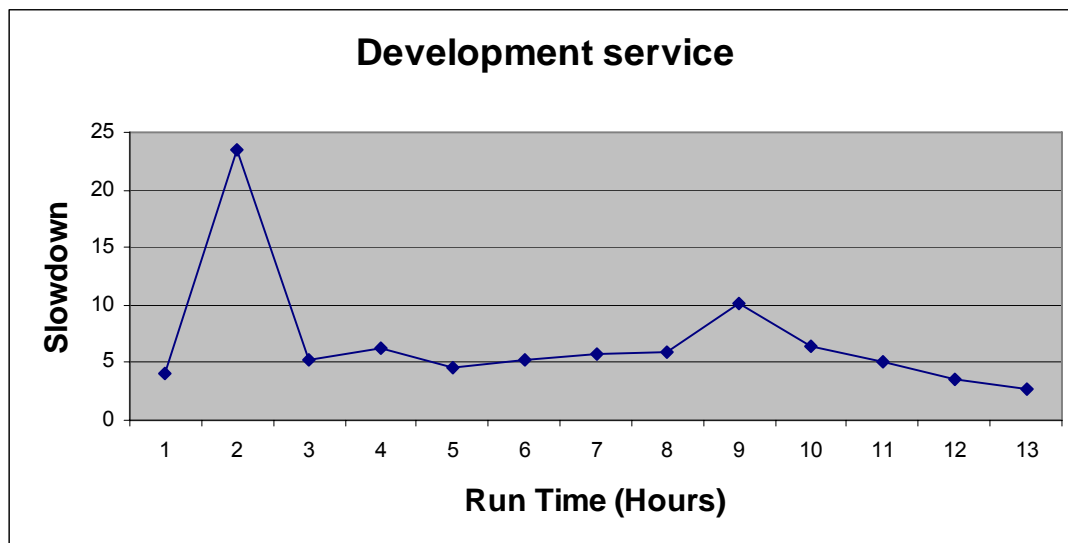
Slowdowns of less than around 10 are usually regarded as reasonable.

On both services, slowdowns are currently generally satisfactory.

### *Slowdowns by runtime*

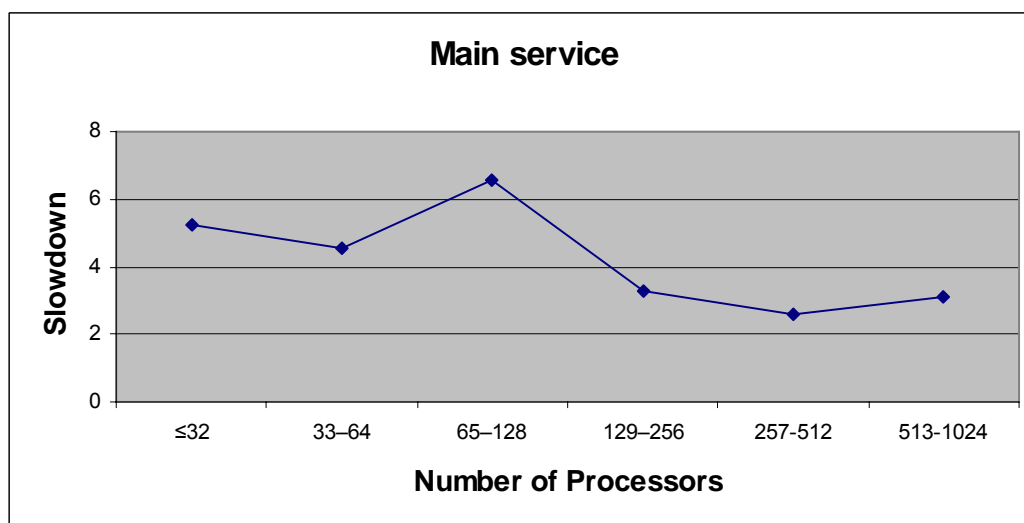
The following graphs show the slowdowns recorded for jobs of differing run times, ignoring those which ran for less than 5 minutes.



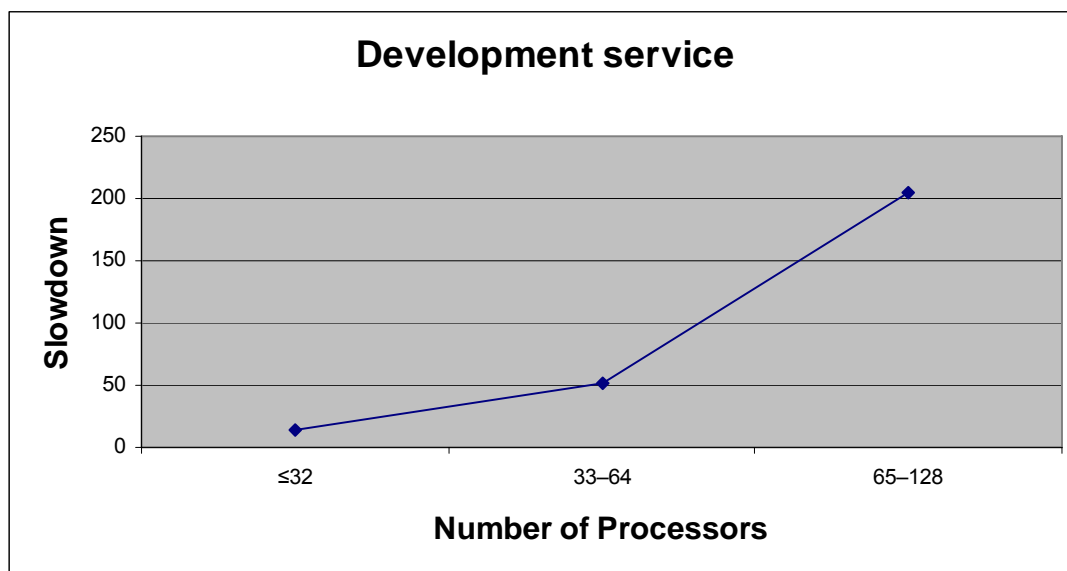


*Slowdowns by number of processors*

In the graphs below, we plot the slowdown figures against the number of processors used. Only jobs which ran for more than 1 hour are included.



The slowdown graph for the development service clearly reflects the very heavy load on the system. However, it is worth noting that the job profile was: 547 jobs at 32 processors or less; 37 at 64 processors; and just 1 at 128. Thus the slowdown for the typical 32-processor job is satisfactory, indicating that the configuration of the queues is well-matched to the workload.

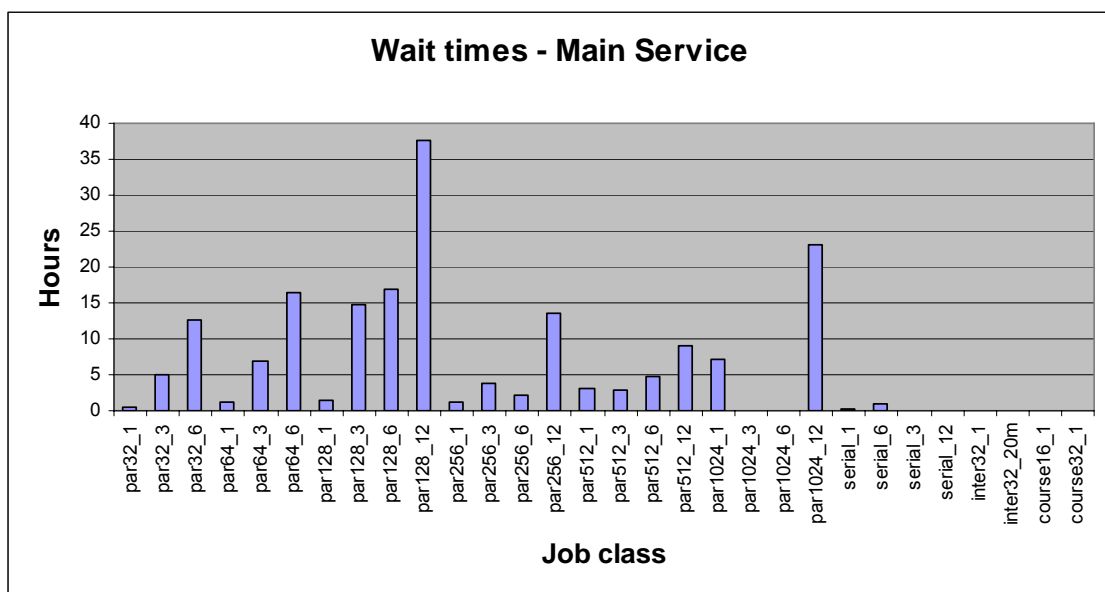


#### Job wait times – main service

The following table and graph shows the average wait time (in hours) for each class of job on the main service. The long wait times for long 128-processor jobs are attributable to the high utilisation of the capacity region.

Job Class	Category	Maximum Number of CPUs	Maximum Job length	Average wait time	Number of Jobs
par32_1	parallel	32	1	0.6	1531
par32_3	parallel	32	3	5.0	78
par32_6	parallel	32	6	12.7	1685
par64_1	parallel	64	1	1.1	350
par64_3	parallel	64	3	7.0	17
par64_6	parallel	64	6	16.4	343
par128_1	parallel	128	1	1.3	1053
par128_3	parallel	128	3	14.7	22
par128_6	parallel	128	6	16.9	70
par128_12	parallel	128	12	37.5	246
par256_1	parallel	256	1	1.1	138
par256_3	parallel	256	3	3.9	56
par256_6	parallel	256	6	2.2	51
par256_12	parallel	256	12	13.5	288
par512_1	parallel	512	1	3.0	86
par512_3	parallel	512	3	2.8	13
par512_6	parallel	512	6	4.7	60
par512_12	parallel	512	12	9.1	20
par1024_1	parallel	1024	1	7.1	32
par1024_3	parallel	1024	3	0.0	0

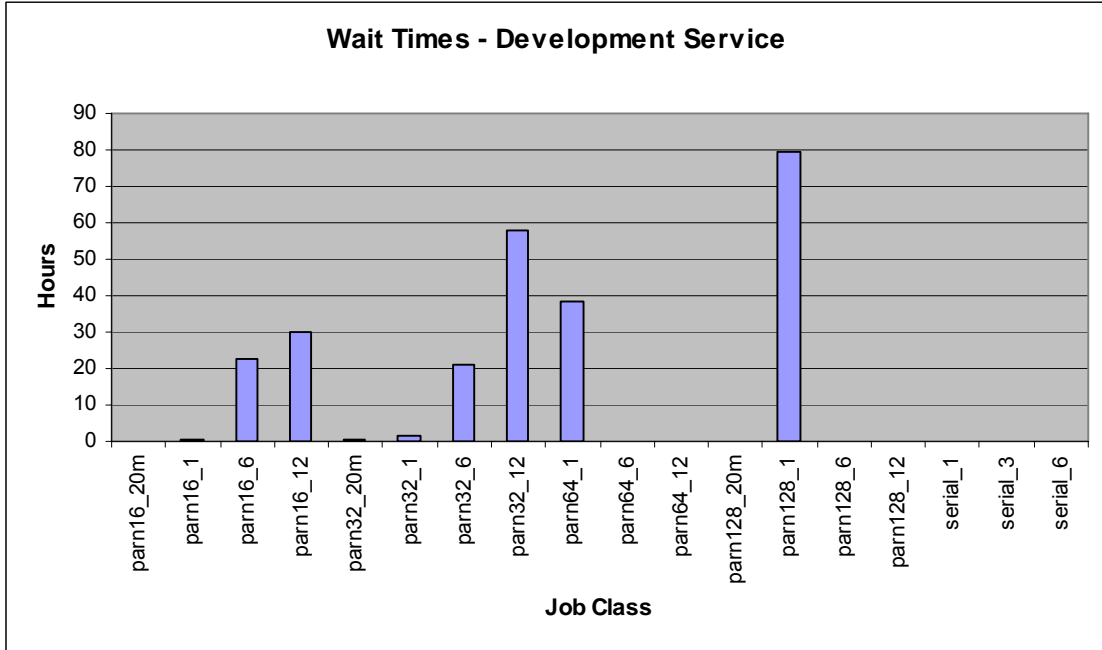
par1024_6	parallel	1024	6	0.0	4
par1024_12	parallel	1024	12	23.1	12
serial_1	serial	1	1	0.2	2622
serial_6	serial	1	6	0.9	77
serial_3	serial	1	3	0.0	8
serial_12	serial	1	12	0.1	107
inter32_1	interactive	32	1	0.1	1548
inter32_20m	interactive	32	1	0.0	660
course16_1	interactive	16	1	0.0	45
course32_1	parallel	32	1	0.0	0



### Job wait times – development service

Job Class	Category	Maximum Number of CPUs	Maximum Job length	Average wait time	Number of Jobs
parn16_20m	parallel	16	20 mins	0.1	1292
parn16_1	parallel	16	1 hour	0.3	3965
parn16_6	parallel	16	6 hours	22.7	199
parn16_12	parallel	16	12 hours	29.8	209
parn32_20m	parallel	32	20 mins	0.3	382
parn32_1	parallel	32	1 hour	1.5	1541
parn32_6	parallel	32	6 hours	21.3	111
parn32_12	parallel	32	12 hours	58.1	94
parn64_1	parallel	64	1 hour	38.6	225
parn64_6	parallel	64	6 hours	0.0	0
parn64_12	parallel	64	12 hours	0.0	0
parn128_20m	parallel	128	20 mins	0.0	0
parn128_1	parallel	128	1 hour	79.3	3
parn128_6	parallel	128	6 hours	0.0	0

parn128_12	parallel	128	12 hours	0.0	0
serial_1	serial	1	1 hour	0.0	2942
serial_3	serial	1	12 hours	0.0	19
serial_6	serial	1	12 hours	0.0	11



## 2.5 Disk Occupancy

### *Home Space*

Home space is the part of the disk space that is regularly backed up.

<i>Consortium</i>	<i>Disc Occupancy (Mb)</i>	<i>Disc Quota (Mb)</i>
b02	34058	50,000
b03	52711	50,000
b08	38988	50,000
c01	149448	150,000
e01	191951	199,995
e03	59112	225,012
e05	336797	596,050
e06	286236	300,000
e08	94244	100,000
e10	51173	150,000
e11	38690	100,000
e14	99267	100,000
e15	40791	50,000
e16	133	20,000
e17	43712	50,000
e18	32350	40,000
e19	1417	40,000
e20	59001	60,000
e21	1521	50,000
e22	5268	10,000
e23	9733	50,000
e24	123331	394,376
e25	8848	50,000
e26	18321	20,000
e27	19054	20,000
e29	20835	30,000
e30	0	40,000
e31	43633	50,000
e32	47110	50,000
e33	9991	50,000
e34	0	50,000
e35	44328	100,000
e36	45399	50,000
e37	110136	204,800
e38	11670	50,000
e39	22183	150,000
e40	18017	50,000
e41	1528	100,000

e42	27859	100,000
e45	43936	50,000
e46	6605	50,000
e47	0	50,000
e48	5	50,000
e49	28039	50,000
e50	3257	13,000
e51	4469	50,000
e52	11	50,000
e53	1747	50,000
e54	46526	50,000
e55	1664	50,000
e56	47509	50,000
e57	0	50,000
e58	21140	100,000
e60	47	50,000
e61	0	50,000
n01	103340	250,000
n02	161505	298,000
n03	79134	100,000
n04	251707	299,999
p01	42270	200,000
x01	38072	50,000
x02	8746	20,000
x03	4227	50,000
z001	473694	500,000
z002	45259	124,000
z003	0	3
z004	99613	100,000
z05	4188	30,000
z06	57802	75,000
z07	33103	50,000
z10	356	50,000

### Workspace

<i>Consortium</i>	<i>Disc Occupancy (Mb)</i>	<i>Disc Quota (Mb)</i>
b02	15	1,025
b03	47908	100,000
b08	5100	50,000
c01	89870	100,000
e01	1207522	1,249,995
e03	10	500,000
e05	358419	642,004
e06	368051	400,000
e08	141	5,000

e10	326252	400,000
e11	42640	100,000
e14	198693	250,000
e15	37597	100,000
e16	0	60,000
e17	99372	100,000
e18	26366	80,000
e19	169244	200,000
e20	941925	1,000,000
e21	1	100,000
e22	0	20,000
e23	37389	100,000
e24	2042711	2,800,000
e25	140102	150,000
e26	0	40,000
e27	2760	40,000
e29	5296	8,000
e30	0	80,000
e31	96130	100,000
e32	99998	100,000
e33	99885	100,000
e34	0	100,000
e35	131	200,000
e36	46616	50,000
e37	140120	307,200
e38	0	100,000
e39	0	100,000
e40	1	100,000
e41	111641	200,000
e42	239697	400,000
e45	0	100,000
e46	0	50,000
e47	0	160,000
e48	126625	200,000
e49	25224	50,000
e50	208370	100,000
e51	0	100,000
e52	0	50,000
e53	721	150,000
e54	0	100,000
e55	0	100,000
e56	99999	100,000
e57	0	100,000
e58	0	200,000
e60	0	100,000
e61	0	100,000
n01	150224	800,000
n02	6705799	8,499,904

n03	30336	81,002
n04	456785	750,000
p01	41764	50,000
x01	131862	160,000
x02	0	20,000
x03	178	50,000
z001	456158	500,000
z002	1617	770
z003	0	3
z004	12434	25,000
z05	4740	20,000
z06	57096	100,000
z07	31	20,000
z10	0	50,000

*Development service space*

This is the disk space reserved for users of the development service.

<i>Consortium</i>	<i>Disc Occupancy (Mb)</i>	<i>Disc Quota (Mb)</i>
n02	5053767	9,499,003
n04	315158	526,899

## 2.6 Tape Archive

<i>Consortium</i>	<i>Usage (Tapes)</i>	<i>Quota (Tapes)</i>	<i>Files</i>	<i>Data (Gb)</i>
c01	2	2	7231	65
e01	60	60	240433	5893
e03	5	5	18797	429
e14	10	10	391623	595
e15	1	3	26	6
e24	10	10	14459	1524
e26	2	2	545	27
e42	10	10	29481	447
n01	291	295	32453	31569
n02	383	410	475519	42046
n04	28	30	116775	3740
z001	7	10	11045	67
z002	3	4	5802	15
z06	1	3	833	68

Note that a tape is counted in the *Usage* column even if it is only partly occupied.

### 3 Support

#### 3.1 Helpdesk

##### *Classifications*

<i>Category</i>	<i>Number</i>	<i>% of all</i>
Administrative	39	46.4
Technical	27	32.1
In-depth	17	20.2
PMR	1	1.2
TOTAL	84	100.0

The PMR category indicates in-depth queries that result in Problem Management Reports for IBM.

<i>Service Area</i>	<i>Number</i>	<i>% of all</i>
Phase 3 platform	71	84.5
Website	4	4.8
Other/general	9	10.7
TOTAL	84	100.0

##### *Performance*

<i>All non-indepth queries</i>	<i>Number</i>	<i>%</i>	<i>Target</i>
Finished within 24 Hours	47	71.2	75%
Finished within 72 Hours	64	97.0	97%
Finished after 72 Hours	2	3.0	

<i>Administrative queries</i>	<i>Number</i>	<i>%</i>	<i>Target</i>
Finished within 48 Hours	37	94.9	97%
Finished after 48 Hours	2	5.1	

##### *Experts Handling Queries*

<i>Expert</i>	<i>Admin</i>	<i>Technical</i>	<i>In-Depth</i>	<i>PMR</i>
epcc.ed.ac.uk	34	10	10	0
dl.ac.uk	0	4	6	1
Sysadm	5	13	1	0
Other people	0	0	0	0

### 3.2 Training

<i>Title of Course</i>	<i>Start Date</i>	<i>Length (Days)</i>	<i>Place days</i>	<i>HPCx User Days</i>	<i>HPCx Staff Days</i>
Fundamental Concepts of HPC	14-Apr	3	75	48	3
Message Passing Programming	30-Apr	3	75	57	0

## 4 Staffing

### 4.1 Science Support Staffing

#### *Daresbury Laboratory*

<i>Name</i>	<i>Days</i>
Ashworth	10.8
Blake	3.6
Bush	19.0
Johnstone	8.5
Jones	1.7
Plummer	9.5
Sunderland	19.0
Thomas	6.0
Total (Days)	78.0
FTEs	4.4

#### *EPCC*

<i>Name</i>	<i>Days</i>
Simpson	17.7
Booth	9.2
Henty	10.5
Smith	6.7
Bull	7.2
Fisher	3.5
Hein	14.8
Reid	11.7
Stratford	6.6
Nowell	2.3
Nazarova	6.4
Trew	4.3
Gray	7.2
D'Mellow	12.3
Tullo	14.1
Beckett	2.8
Total (Days)	137.1
FTEs	7.7

### Overall Levels

	<i>FTEs</i>
DL	4.4
EPCC	7.7
Total	12.1

### 4.2 Systems Staffing

<i>Name</i>	<i>Days</i>
Andrews	18.0
Brown	19.0
Fisher	12.0
Georgeson	19.0
Franks	15.0
Jones	3.9
BITD	15.2
Total (days)	102.1
FTEs	5.8

*Note:* BITD covers a range of bookings from a support department who provide approximately 1 FTE to support computer room operations, electrical and mechanical site services and networking and security. Roughly a dozen staff charge time to the project in amounts which vary from month to month. We believe that it adds no value to report these individual bookings although a full listing can be provided annually if required.

## 5 Summary of Performance Metrics

<i>Metric</i>	<i>TSL</i>	<i>FSL</i>	<i>Monthly Measurement</i>
Technology serviceability	80%	99.2%	100.0%
Technology MTBF (hours)	200	300	∞
Number of AV FTEs	7.5	10	12.1
Number of training days per month	20/12	25/12	13/4
Non in-depth queries resolved within 3 days	85%	97%	97.0%
Number of A&M FTEs	3.75	5.75	5.8
A&M serviceability	80%	99.6%	100.0%

## Appendix A: Incident Severity Levels

**SEV 1** — anything that comprises a FAILURE as defined in the contract with EPSRC.

**SEV 2** — NON-FATAL incidents that typically cause immediate termination of a user application, but not the entire user service.

The service may be so degraded (or liable to collapse completely) that a controlled, but unplanned (and often very short-notice) shutdown is required or unplanned downtime subsequent to the next planned reload is necessary.

This category includes unrecovered disc errors where damage to filesystems may occur if the service was allowed to continue in operation; incidents when although the service can continue in operation in a degraded state until the next reload, downtime at less than 24 hours notice is required to fix or investigate the problem; and incidents whereby the throughput of user work is affected (typically by the unrecovered disabling of a portion of the system) even though no subsequent unplanned downtime results.

**SEV 3** — NON-FATAL incidents that typically cause immediate termination of a user application, but the service is able to continue in operation until the next planned reload or re-configuration.

**SEV 4** — NON-FATAL recoverable incidents that typically include the loss of a storage device, or a peripheral component, but the service is able to continue in operation largely unaffected, and typically the component may be replaced without any future loss of service.

## Appendix B: Projects

### B.1 Current Projects

	<i>Class</i>	<i>Title</i>	<i>PI</i>
e01	1	UK Turbulence Consortium	Dr Gary Coleman
e05	1	Materials Chemistry using Terascaling Computing	Prof Richard Catlow
e06	1	UK Car-Parrinello Consortium	Prof Paul Madden
e07	2	Turbulent Plasma Transport in Tokamaks	Dr Colin M Roach
e08	2	Organic Solid State	Prof Sarah Price
e10	1	Reality Grid	Prof Peter Coveney
e11	1	Bond making and breaking at surfaces	Prof Sir David A King
e14	1	Blade and Cavity Noise	Prof Neil Sandham
e15	2	CSAR/HPCx Collaboration	Dr Mike Pettipher
e16	1	Cardiac virtual tissues	Prof Arun V Holden
e17	1	Integrative Biology	Dr David Gavaghan
e18	1	DARP: Highly swept leading edge separations	Prof Michael A Leschziner
e19	1	Edinburgh Soft Matter and Statistical Physics Group	Prof Michael E Cates
e20	1	UK Applied Aerodynamics Consortium	Dr Ken Badcock
e21	1	Intrinsic Parameter Fluctuations in Decananometer MOSFETs	Prof Asen M Asenov
e22	1	Preconditioners for finite element problems	Prof David J Silvester
e23	1	Exploitation of Switched Lightpaths for e-Science Applications	Prof Peter Clarke
e24	1	DEISA - Distributed European Infrastructure for Supercomputing Applications	Dr David Henty
e25	1	Turbulent vortex motion in stratified flows	Dr Gary Coleman
e26	1	Simulation of Radioprobing	Dr Charlie Laughton
e27	1	SPICE	Prof Peter V Coveney
e29	1	Free-surface-piercing circular cylinders	Dr Eldad Avital

e30	1	Metal/Oxide Interfaces at the Atomic Level	Dr Nora de Leeuw
e31	1	Lateral Straining of Wall-Bounded Turbulence	Dr Gary N Coleman
e32	1	Rapid Prototyping of Usable Grid Middleware	Prof Peter V Coveney
e33	1	Engineering Functional Coatings	Prof Roger Smith
e34	1	Dissolution of Bioactive Phosphate Glasses	Dr N de Leeuw
e35	1	Non-adiabatic processes	Dr T Todorov
e36	1	Jets in Cross-Flow	Dr Y Yao
e37	1	LESUK_3	Prof J J McGuirk
e38	1	Viscoelastic deformation in 3D non-linear media	Prof Greg A Houseman
e39	1	The Supergen 5 biological fuel cells consortium	Prof FA Armstrong
e40	1	Computational Quantum Many-Body Theory	Prof R Needs
e41	1	Flow in Weapon Bays	Dr George N Barakos
e42	1	Computational Combustion for Engineering Applications	Prof K Luo
e45	1	Metals under extreme conditions	Prof Mike Gillan
e46	1	Advanced materials with complex architectures	Dr Paul Mummery
e47	1	Parallel stochastic analysis for geo-engineering	Dr Michael A. Hicks
e48	1	Organised structure in turbulent flows	Prof Sergei Chernyshenko
e49	1	Integrated Programme of Research in Aeronautical Engineering	Prof Michael Leschziner
e50	1	Biological interface with materials	Prof John Harding
e51	1	Super-computing data mining	Dr Mike Pettipher
e52	1	Spacecraft force modelling	Dr M Ziebart
e53	1	Large-scale communication networks	Prof J M Pitts
e54	1	Free surface simulation of waves overtopping during storms	Dr D M Ingram
e55	1	High-Reynolds-Number Near-Wall Flows	Prof Michael Leschziner
e56	1	Infectious disease threats	Dr Iain Barrass
e57	1	Triplex DNA Structures	Dr Hooshang Nikjoo

e58	1	Quantum Simulations for Chemical Biology	Dr Carmen Domene
e60	1	Device Electronics Based on nanoWires and NanoTubes	Dr Merlyne M de Souza
e61	1	Enhancement of droplet concentrations in clouds	Dr Alan A M Gadian

### PPARC Projects

<i>Code</i>	<i>Class</i>	<i>Title</i>	<i>PI</i>
p01	1	Atomic Physics and Astrophysics	Prof Alan Hibbert

### NERC Projects

<i>Code</i>	<i>Class</i>	<i>Title</i>	<i>PI</i>
n01	1	Large-Scale Long-Term Ocean Circulation	Dr David Webb
n02	1	NCAS	Prof Alan J Thorpe
n03	1	Computational Mineral Physics Consortium	Dr John Brodholt
n04	1	Shelf Seas Consortium	Dr Roger Proctor

### BBSRC Projects

<i>Code</i>	<i>Class</i>	<i>Title</i>	<i>PI</i>
b02	1	Modelling enzyme catalysis	Dr Adrian J Mulholland
b08	1	IntBioSim	Prof M S Sansom

### CCLRC Projects

<i>Code</i>	<i>Class</i>	<i>Title</i>	<i>PI</i>
c01	1	Daresbury Laboratory Facilities Agreement Consortium	Dr Richard J Blake

### Externally-funded Projects

<i>Code</i>	<i>Title</i>	<i>PI</i>
x01	HPC-Europa	Dr Judy Hardy
x03	IBM	Mr Derrick J Byford

## HPCx Projects

<i>Code</i>	<i>Title</i>	<i>PI</i>
z001	HPCx Support	Dr Alan Simpson
z002	Systems and Operations	Mr Mike Brown
z003	Test Project	Dr Denis Nicole
z004	HPCx Training	Dr David Henty
z05	Outreach Projects	Dr Richard Blake
z06	Application Porting	Dr David Henty
z07	Package Installation	Dr Mike Ashworth
z10	Globus	Dr Stephen P Booth

## B.2 Former Projects

<i>Code</i>	<i>Class</i>	<i>Title</i>	<i>PI</i>
b01	2	Quantum Chemistry Studies of the Rusticyanin Protein Crystal	Prof Samar Hasnain
b03	1	Towards a virtual outer membrane	Prof Mark S Sansom
b04	1	Life sciences software development	Dr Jo L Dicks
b05	1	Virtual forced evolution of catalytic transition metal complexes	Dr Marcus Durrant
b06	2	Biomolecular computational chemistry	Prof Jonathan D Hirst
e02	1	Ab-initio simulation of covalently bonded materials	Dr Patrick Briddon
e03	1	Multi-photon, electron collisions and BEC HPC consortium	Prof Ken Taylor
e04	1	Chemreact Computing Consortium	Prof Jonathon Tennyson
e07	2	Turbulent Plasma Transport in Tokamaks	Dr Colin M Roach
e09	2	Molecular Properties and their Geometry	Dr Mark R Wilson
e12	1	Parallel programs for the simulation of complex fluids	Dr Richard J Blake
e13	1	TeraGyroid project	Mr Mark Westwood
e28	1	Towards the Dynome	Dr Jonathan W Essex
z09		HECToR Benchmarking	Dr Edward Smyth
x02		OHM Ltd	Dr Lucy MacGregor
n05	2	Non-linear Wave-particle Instabilities in Plasmas	Dr Mervyn Freeman