



## 1. Introduction

This report has been prepared for the last C-RRB meeting during Phase 1 of the LCG Project. Even if the 2005 book closing will bring some minor adjustments to the figures in the following tables, it is now the right moment to present a summary of the LCG Phase 1 resources at CERN.

## 2. Personnel Resources for LCG Phase 1 at CERN

Table 1 gives an overview of the externally funded LCG personnel at CERN and the externally funded experiment members participating in LCG application software projects. As in the last reports, the FTE numbers shown have been weighted according to the experience of the provided personnel. Students and Doctoral Students are counted at a 50% level, people with less than 2 years of professional experience at 85%, between 2 and 5 at 100%, with more than 5 years at 120%.

The cost column has been established in the following way: For personnel paid via accounts at CERN the actual cost figures are given. For people paid directly by funding agencies in their respective countries, standardised values are given: (50 kCHF per person-year for students and trainees, 120 kCHF per person-year for those at established engineer level). This approach is similar to that adopted for reporting established CORE costs for in-kind contributions to the detectors.

The C-RRB7 SUM column shows for comparison the total FTEs reported to the last C-RRB meeting in April 2005.

It should be noted that the impressive amount of 223 FTE-years, valued at 26.5 MCHF, has been provided during the years 2002 to 2005 as voluntary contribution to Phase 1 of the LCG Project at CERN. This corresponds to 33% of the overall manpower invested into Phase 1 of the LCG Project at CERN.

**Table 1: Externally Funded LCG Personnel at CERN (status 15/9/2005)**

Source of Funding	Personnel in FTE				SUM FTE	Cost kCHF	C-RRB7 SUM FTE
	2002	2003	2004	2005			
LCG Assoc. <sup>1</sup>	2.2	3.0	3.9	6.4	15.4	1560	12.9
France	2.6	5.9	5.4	4.5	18.4	2106	18.5
Germany <sup>2</sup>	0.3	2.5	3.8	5.4	12.0	1466	10.9
Hungary	0.4	1.6	1.0	1.6	4.6	295	4.4
India <sup>2</sup>				0.7	0.7	84	
Israel	2.0	2.2	2.3	0.8	7.3	575	7.4
Italy-INFN <sup>2</sup>	1.4	6.8	8.4	13.0	29.5	3233	28.8
Portugal <sup>2</sup>		2.1	0.9	1.6	4.6	455	3.6
Russia		1.9	3.0	4.4	9.3	1112	8.3
Spain	1.6	2.5	1.9	0.6	6.7	665	7.5
Sweden	0.6	1.1	1.5	0.7	3.9	257	4.4
Switzerland	0.5	1.8	1.6	1.2	5.1	612	5.1
Taipei <sup>2</sup>	0.3	2.6	3.2	3.4	9.5	1135	8.6
UK-EP SRC	0.8	1.0	0.2		2.0	227	2.0
UK-PPARC	10.9	24.0	22.6	13.9	71.4	9945	71.4
UK-EXP	1.7	1.7	0.5	0.1	4.0	482	4.1
USA	5.1	5.2	5.0	3.6	18.9	2266	20.0
<b>SUM</b>	<b>30.3</b>	<b>65.7</b>	<b>65.2</b>	<b>61.9</b>	<b>223.1</b>	<b>26476</b>	<b>217.9</b>

  

India <sup>3</sup>	0.6	8.0	10.0	7.0	25.6
Russia <sup>4</sup>		3.0	6.0	6.0	15.0

### Notes

1. The LCG Associates are paid from the materials funds, mostly provided externally.
2. In addition to what is shown in this table, Germany, India, Italy, Portugal and Taipei have committed personnel contributions extending into Phase 2. Their size and schedule is contained in Annex 6.6 of the WLCG MoU.
3. Effort provided in India, therefore not included in the totals.
4. Effort provided in Russia, therefore not included in the totals.

### 3. Material Resources

Table 2 lists the funds for LCG Phase 1 materials at CERN provided as voluntary contributions. Their overall amount is finally arriving at 10.3 MCHF. This covers nearly half the materials expenditure for both the LCG prototype at CERN and the preparation of the CERN Computer Centre for Phase 2.

Given this result and the equally impressive numbers for the voluntary personnel contribution shown above, one can only conclude that the call for contribution of voluntary resources for the development and testing phase of the LCG Project at CERN has been a full success. One should not forget that all these contributions have been given on top of the major efforts required for the preparation of the regional centres of the Worldwide LHC Computing Grid.

**Table 2: Summary of External Funding - Materials at CERN (status 15/9/2005)**

Source of Funding	Materials in kCHF				SUM of Materials	Type of Funding <sup>1</sup>	C-RRB7 SUM Materials
	2002	2003	2004	2005			
Belgium		200	100	100	400	cash	400
Finland		50	50		100	cash	100
Germany	3742				3742	computing	3742
Italy-INFN		642	489	456	1587	cash	1537
Japan		190	101	100	391	in kind comp.	391
Spain		450	0	150	600	cash	600
Sweden		109	52		160	cash	160
Taipei		30			30	in kind comp.	30
UK-PPARC		1584		1271	2855	computing	2855
US-LHC			323		323	in kind comp.	323
Enterasys <sup>2</sup>		85			85	in kind comp.	85
<b>SUM comm.</b>	<b>3742</b>	<b>3340</b>	<b>1115</b>	<b>2077</b>	<b>10273</b>		<b>10223</b>

**Notes**

1. cash - cash to be used for all LCG budgeted costs,  
 computing - cash to be used exclusively for computing equipment,  
 in-kind computing - provision of computing materials to be installed for LCG at CERN.
2. Enterasys delivers equipment for 10 Gbit LAN R&D. The amount shown is the value of the equipment that has been counted as a contribution to LCG.

**4. Prototype and CC Preparation Expenditure 2001 – 2005**

Table 3 lists the amounts spent by LCG at CERN for materials during 2001 - 2004 and the spending plans for 2005. This table shows the totals per year for the LCG prototype at CERN and the costs per year for preparing CERN's computer centre for Phase 2.

**Table 3: LCG Materials Expenditure at CERN 2001 - 2005 (kCHF)**

	2001	2002	2003	2004	2005	TOTAL	C-RRB7
<b>PROTOTYPE</b>	2472	3434	1074	2098	4790	13868	11798
<b>PREPARING CC for PHASE 2</b>	150	1665	2083	3371	1380	8649	9504
<b>TOTAL PROTOTYPE OPERATION</b>	<b>2622</b>	<b>5099</b>	<b>3157</b>	<b>5469</b>	<b>6170</b>	<b>22517</b>	<b>21302</b>

Spending for preparing the Computer Centre at CERN for Phase 2 will be this year 855 kCHF less than planned. The new electrical substation needed additional work to make it fully compliant to the contract specifications, shifting payment for this item into 2006. In addition the plans for cooling and ventilation of the Computer Centre had to be changed in a major way, delaying the tendering for this item. Contract adjudication is scheduled for November 2005, shifting again payments into next year.

The 2005 cost reductions for the Computer Centre were over-compensated by increases in spending for the Prototype (plus 2070 kCHF). Building up storage capacities for Service Challenge 4 turned out to require investments in 2005, which were originally only planned for 2006. In addition, investments for the LAN infrastructure, which were planned to be paid from the 2006 budget are now also included already in the 2005 materials expenditure.

## 5. Materials Budget Evolution for LCG Phase 1 and Base Physics Computing

Table 4 shows the balance between the estimated costs and the committed funding of materials for physics computing at CERN.

**Table 4: Costs and Funding for Physics Computing Materials at CERN in MCHF**

	2001	2002	2003	2004	2005	Totals	Totals C-RRB7
<b>Estimated Costs</b>							
Sum Physics Comp.	8.4	9.9	9.9	9.6	10.6	48.5	48.3
Base Physics	5.8	4.8	6.7	4.2	4.5	26.0	27.0
LCG Phase 1 at CERN	2.6	5.1	3.2	5.5	6.2	22.5	21.3
<b>Funding</b>							
Income per Year	8.5	9.9	10.9	9.4	9.8	48.5	48.3
Base Physics	5.8	4.8	6.9	5.4	4.9	27.9	28.0
Addn. CERN Funding	2.6	1.4	0.7	2.1	2.5	9.3	9.3
Special Income	0.0	0.0	0.0	0.8	0.3	1.1	0.8
External Income	0.0	3.7	3.3	1.1	2.1	10.3	10.2
<b>Annual Balance</b>	0.0	0.0	1.1	-0.2	-0.9		
<b>Cumulative Balance</b>	0.0	0.0	1.1	0.9	0.0		0.0

Rental costs for evaluation tape systems, which were budgeted under Base Physics, can now only be paid in 2006. The 1 MCHF becoming available in 2005 in this way covers the major part of the increase of 1.2 MCHF, compared to the April 2005 C-RRB figures, in spending for the materials of LCG Phase 1 at CERN in 2005. The remaining 0.2 MCHF are covered by a corresponding increase in funding.

In other words: payment of 1.86 MCHF was delayed into 2006 and payment of 2.07 MCHF was pulled forward into 2005. The gain of 0.21 MCHF for the 2006 budget is covered by the increase in the 2005 budget reported above.

## 6. Regional Centre Resources for LHC Computing

Collecting the capacity plans of the WLCG Tier1 and Tier2 centres all over the world required many iterations and clarifications. I want to thank the many representatives of these centres and their Funding Agencies, which provided these numbers, for their patience.

At the last C-RRB in April 2005 the plans for Tier1 capacity were already largely announced, but very little was known about the Tier2 capacities, which would be finally made available. It shows a very strong commitment from the many involved Funding Agencies to have now data from 28 Tier2 centres listed in Annex 6 of the draft WLCG MoU.

Detailed capacity numbers for the different centres are contained in Annex 6 of the MoU. Table 5 shows a summary of the planned capacity for the first full year of LHC operation. This table contains only numbers for “external” centres and does not include the capacities for the Tier0 and the CERN Analysis Facility listed in Annex 6.1 and 6.2 of the MoU. For each experiment the sum of the capacities planned to be pledged for the year 2008 is given together with required capacities as listed in the Computing Technical Design Reports (TDR) of the experiments. The Balance rows give the percentage still lacking to fulfil the TDR requirements completely. The SUM column gives the overall offers in the different categories (CPU, Disk, Tape) and their comparison with the total of the TDR requirements.

**Table 5: Tier1 and Tier2 Planning for 2008**

<b>Tier-1 Planning for 2008</b>		<b>ALICE</b>	<b>ATLAS</b>	<b>CMS</b>	<b>LHCb</b>	<b>SUM 2008</b>
<b>CPU - MSI2K</b>	Offered	6.7	22.7	12.5	4.4	46.3
	TDR Requirements	12.3	24.0	15.2	4.4	55.9
	Balance	<b>-46%</b>	<b>-5%</b>	<b>-18%</b>	<b>-0%</b>	<b>-17%</b>
<b>Disk - PBytes</b>	Offered	2.8	12.5	5.7	2.2	23.2
	TDR Requirements	7.4	14.4	7.0	2.4	31.2
	Balance	<b>-62%</b>	<b>-13%</b>	<b>-18%</b>	<b>-10%</b>	<b>-25%</b>
<b>Tape - PBytes</b>	Offered	3.2	9.1	8.1	1.9	22.3
	TDR Requirements	6.9	9.0	16.7	2.1	34.7
	Balance	<b>-54%</b>	<b>1%</b>	<b>-51%</b>	<b>-9%</b>	<b>-36%</b>

Includes current planning for all Tier-1 centres

<b>Tier-2 Planning for 2008</b>		<b>ALICE</b>	<b>ATLAS</b>	<b>CMS</b>	<b>LHCb</b>	<b>SUM 2008</b>
<b>CPU - MSI2K</b>	Offered	5.6	20.1	17.4	4.4	47.5
	TDR Requirements	14.4	19.9	19.3	7.7	61.3
	Balance	<b>-61%</b>	<b>1%</b>	<b>-10%</b>	<b>-42%</b>	<b>-22%</b>
<b>Disk - PBytes</b>	Offered	1.5	6.2	4.5	0.8	13
	TDR Requirements	3.5	8.7	4.9	0.023	17.1
	Balance	<b>-58%</b>	<b>-29%</b>	<b>-8%</b>	<b>n/a</b>	<b>-24%</b>
<b># Tier-2 federations - included(expected)</b>		13 (14)	22 (29)	17 (20)	10 (11)	30 (39)

The last line of Table 5 lists for each experiment the number of Tier2 centres or federations, which have their capacity plans already announced and in brackets the overall number of Tier2s including centres which have stated that they plan to provide capacity and are listed in Table 6 below. Numbers for Tier2s in Australia and Romania are included in Table 5, but not yet in the WLCG MoU. It can

be seen below the SUM column that 30 Tier2s have provided already data and that this number is expected to grow to 39.

**Table 6: Planned Additional Tier2 Centres or Federations**

<i>Institution</i>	<i>Experiments served with priority</i>			
	<i>ALICE</i>	<i>ATLAS</i>	<i>CMS</i>	<i>LHCb</i>
Australia, Univ. of Melbourne		X		
Austria, UIBK, Innsbruck		X		
Belgium, Belgian Tier-2 Federation - UA - UCL - ULB - UMH - VUB			X	
Brazil, Brazilian Tier-2 Federation - CBPF - UERJ - UFRJ - UNESP		X	X	X
Canada, Canada East Tier-2 Federation		X		
Canada, Canada West Tier-2 Federation		X		
Germany, Freiburg Univ.		X		
Germany, Univ. Wuppertal		X		
Hungary, Hungarian Tier-2 Federation - KFKI, Budapest - SZTAKI, Budapest - Eotvos Univ., Budapest - Debrecen Univ.	X		X	
Israel, HEP-IL Federation - Technion, Haifa - Weizmann, Rehovot - Tel Aviv Univ.		X		
Romania, Romanian Tier-2 Federation - NIPNE - PUB - ISS - ICI - IIMT	X	X		

Australia and Romania have already announced capacities for their Tier2 centres, but are not yet included in the WLCG tables.

## 7. Resources for LCG Phase 2 at CERN

Table 7 shows the cost and funding estimates for LCG Phase 2 at CERN.

**Table 7: LHC Computing Budget Estimates in MCHF**

	2005	2006	2007	2008	TOTAL
<b>Funding</b>					
From CERN Budget					
- Personnel	0.00	16.52	17.70	16.30	50.52
- Physics		11.17	11.9	12.2	35.27
- Additional personnel		5.35	5.80	4.10	15.25
- Materials	0.00	24.85	16.10	22.50	63.45
- Physics Operations		4.54	4.40	4.50	13.44
- Tier 0 and CERN Analysis Facility		20.31	11.70	18.00	50.01
Contributions via Team Accounts*					
- Personnel		1.79	1.65	1.12	4.56
- Material		0.13	0.13		0.26
In-kind Contributions*					
- Personnel		0.91	0.95	0.12	1.98
<b>Total</b>					
- Personnel	0.00	19.22	20.30	17.54	57.06
- Materials	0.00	24.98	16.23	22.50	63.71
<b>Total Funding</b>	<b>0.00</b>	<b>44.20</b>	<b>36.53</b>	<b>40.04</b>	<b>120.77</b>
<b>Planned Expenditure</b>					
- Personnel **	1.54	18.79	19.56	16.19	56.08
- Materials***		25.34	25.30	28.75	79.39
- Physics Operations		4.54	4.40	4.50	13.44
- Tier 0 and CERN Analysis Facility		20.80	20.90	24.25	65.95
<b>Total Planned Expenditure</b>	<b>1.54</b>	<b>44.13</b>	<b>44.86</b>	<b>44.94</b>	<b>135.47</b>
<b>Balance Personnel</b>	<b>-1.54</b>	<b>0.43</b>	<b>0.74</b>	<b>1.35</b>	<b>0.98</b>
<b>Balance Materials</b>		<b>-0.36</b>	<b>-9.07</b>	<b>-6.25</b>	<b>-15.68</b>
<b>Balance</b>	<b>-1.54</b>	<b>0.07</b>	<b>-8.33</b>	<b>-4.90</b>	<b>-14.70</b>

\* As pledged and planned to be pledged in the WLCG MoU (Annex 6.6)

\*\* - Personnel from EGEE and EGEE-II (under negotiation with the EU) at a cost of 2.9 MCHF will participate in LCG at CERN during the years 2006 - 2008

- Operators Support from Computer Centre at a cost of 1.4 MCHF (already insured via a budget transfer) will participate in LCG at CERN during the years 2006 - 2008  
These resources are not included in this Table.

\*\*\* The planned budget exchange between 2005 and 2006 is anticipated.

The budget exchange discussed under Section 5 above is already included in this table. The major difference to the equivalent table shown at the last C-RRB is the prioritised allocation of available funds to personnel. Personnel resources are now fully funded and show actually a positive balance of 1 MCHF. This is due to a second important change in this table. Italy (INFN) has increased its voluntary contribution to common WLCG resources at CERN. INFN pledges for 2006 and planned pledges until 2010 come now to 58.4 FTE-years, of which 43.5 FTE-years fall into the period 2006 – 2008 reported in Table 7.

Pledges by Funding Agencies for Common WLCG Resources at CERN are now reported in Annex 6.6 of the WLCG MoU. All Funding Agencies are strongly invited to evaluate joining the five Agencies listed in Annex 6.6 at this moment.

A certain amount of re-profiling of funds over time is already included in Table 7 in order to balance the materials budget of 2006. Further adjustments will be done after the book closing of 2005, including adjustments of the balance between personnel and materials.

## 8. Materials Budget of LCG Phase 2 for 2006 and Outlook for 2007 - 2008

The materials budget for LCG Phase 2 at CERN for 2006 shows at the moment a small negative balance of -0.36 MCHF. It is planned to cover this by cuts elsewhere in the IT Department.

**Table 8: Costs and Funding for Physics Computing Materials at CERN in MCHF**

<b>Funding</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>TOTAL</b>
From CERN Budget				
- <i>Materials</i>	24.85	16.10	22.50	63.45
- Physics Operations	4.54	4.40	4.50	13.44
- Tier0 and CERN Analysis Facility	20.31	11.7	18	50.01
Contributions via Team Accounts				
- Material	0.13	0.13		0.26
<b>Total Materials Funding</b>	<b>24.98</b>	<b>16.23</b>	<b>22.50</b>	<b>63.71</b>
<b>Planned Expenditure</b>	<b>2006</b>	<b>2006</b>	<b>2006</b>	<b>2006</b>
- Physics Operations	4.54	4.40	4.50	13.44
- <i>Tier0 and CERN Analysis Facility</i>	20.80	20.90	24.25	65.95
- Basic Infrastructure	6.20	8.40	3.70	18.3
- Tier0	11.10	6.50	13.30	30.9
- CERN Analysis Facility	3.50	6.00	7.25	16.75
<b>Total Materials Expenditure</b>	<b>25.34</b>	<b>25.30</b>	<b>28.75</b>	<b>79.39</b>
<b>Balance</b>	<b>-0.36</b>	<b>-9.07</b>	<b>-6.25</b>	<b>-15.68</b>

The planned expenditure for Basic Infrastructure and Tier0 Materials corresponds fully to the original spending profile. Spending for the CERN Analysis Facility (CAF) has been re-profiled by postponing purchases to the years 2007 and 2008, still leading to full functionality of the CAF in 2008.