

|Annex 3 : Minimal Computing Resource and Service Levels to qualify for membership of the WLCG Collaboration

This Annex describes the qualitative aspects of the Computing Resource and Service Levels to be provided by the Host Laboratory (CERN), Tier1 Centres and Tier2 Centres in order to fulfil their obligations as Parties to this MoU. Further details are described for each Party in Annex 6. Only the fundamental aspects of Computing Resource and Service Levels are defined here.

Detailed service definitions with key metrics will be elaborated and maintained by the operational boards of the WLCG Collaboration. All centres shall provide & support the services, and associated software, as requested by the experiments and agreed by the WLCG Collaboration. A centre may also support additional services as requested by an experiment but is not obliged to do so.

Annex 3.1 Host Laboratory Services

The Host Laboratory shall supply the following services in support of the offline computing systems of all of the LHC Experiments according to their computing models.

- i. Operation of the Tier0 facility providing:
 - 1. high bandwidth network connectivity from the experimental area to the offline computing facility (the networking within the experimental area shall be the responsibility of each Experiment);
 - 2. recording and permanent storage in a mass storage system of one copy of the raw data maintained throughout the lifetime of the Experiment;
 - 3. distribution of an agreed share of the raw data to each Tier1 Centre, in-line with data acquisition;
 - 4. first pass calibration and alignment processing, including sufficient buffer storage of the associated calibration samples for up to 24 hours;
 - 5. event reconstruction according to policies agreed with the Experiments and approved by the C-RRB (in the case of pp data, in-line with the data acquisition);
 - 6. storage of the reconstructed data on disk and in a mass storage system;
 - 7. distribution of an agreed share of the reconstructed data to each Tier1 Centre;
 - 8. services for the storage and distribution of current versions of data that are central to the offline operation of the Experiments, according to policies to be agreed with the Experiments.
- ii. Operation of a high performance, data-intensive analysis facility with the functionality of a combined Tier1 and Tier2 Centre, except that it does not offer permanent storage of back-up copies of raw data. In particular, its services include:
 - 1. data-intensive analysis, including high performance access to the current versions of the Experiments' real and simulated datasets;
 - 2. end-user analysis.
- iii. Support of the termination of high-speed network connections by all Tier1 and Tier2 Centres as requested.

- iv. Coordination of the overall design of the network between the Host Laboratory, Tier1 and Tier2 Centres, in collaboration with national research networks and international research networking organisations.
- v. Tools, libraries and infrastructure in support of application program development and maintenance.
- vi. Basic services for the support of standardⁱ physics “desktop” systems used by members of the LHC Collaborations resident at CERN (e.g. mail services, home directory servers, web servers, help desk).
- vii. Administration of databases used to store physics data and associated meta-data.
- viii. Infrastructure for the administration of the Virtual Organisation (VO) associated with each Experiment.
- ix. Provision of the following services for Grid Coordination and Operation:
 - 1. Overall management and coordination of the LHC grid - ensuring an effective management structure for grid coordination and operation (e.g. policy and strategy coordination, security, resource planning, daily operation...);
 - 2. The fundamental mechanism for integration, certification and distribution of software required for grid operation;
 - 3. Organisation of adequate support for this software, generally by negotiating agreements with other organisations;
 - 4. Participation in the grid operations management by providing an engineer in charge of daily operation one week in four (this service is shared with three or more other institutes providing amongst them 52-week coverage).
- x. Coordination of WLCG security. Participation in security incident response.

The following parameters define the minimum levels of service. The performance of the services and the compliance with the minimum levels will be reviewed by the operational boards of the WLCG Collaboration.

Service	Maximum delay in responding to operational problems			Average availabilityⁱⁱ measured on an annual basis	
	Service interruption	Degradation of the capacity of the service by more than 50%	Degradation of the capacity of the service by more than 20%	During accelerator operation	At all other times
Raw data recording	4 hours	6 hours	6 hours	99%	n/a
Event reconstruction or distribution of data to Tier-1 Centres during accelerator operation	6 hours	6 hours	12 hours	99%	n/a
Networking service to Tier-1 Centres during accelerator operation	6 hours	6 hours	12 hours	99%	n/a
All other Tier-0 services	12 hours	24 hours	48 hours	98%	98%
All other services ⁱⁱⁱ – prime service hours ^{iv}	1 hour	1 hour	4 hours	98%	98%
All other services ⁱⁱⁱ – outside prime service hours ^{iv}	12 hours	24 hours	48 hours	97%	97%

Annex 3.2 Tier-1 Services

Each Tier1 Centre^v forms an integral part of the central data handling service of the LHC Experiments. It is thus essential that each such centre undertakes to provide its services on a long-term basis (initially at least 5 years) and to make its best efforts to upgrade its installations steadily in order to keep pace with the expected growth of LHC data volumes and analysis activities.

Tier1 services must be provided with excellent reliability, a high level of availability and rapid responsiveness to problems, since the LHC Experiments depend on them in these respects.

The following services shall be provided by each of the Tier1 Centres in respect of the LHC Experiments that they serve, according to policies agreed with these Experiments:

- i. acceptance of an agreed share of raw data from the Tier0 Centre, keeping up with data acquisition;
- ii. acceptance of an agreed share of first-pass reconstructed data from the Tier0 Centre;
- iii. acceptance of processed and simulated data from other centres of the WLCG;
- iv. recording and archival storage of the accepted share of raw data (distributed back-up);
- v. recording and maintenance of processed and simulated data on permanent mass storage;
- vi. provision of managed disk storage providing permanent and temporary data storage for files and databases;
- vii. provision of access to the stored data by other centres of the WLCG and by named facilities as defined in paragraph 1.4 of this MoU;
- viii. operation of a data-intensive analysis facility;
- ix. provision of computing/processing and other services according to the needs of the experiments as agreed by WLCG;
- x. ensure high-capacity network bandwidth and services for data exchange with the Tier0 Centre, as part of an overall plan agreed amongst the Experiments, Tier1 and Tier0 Centres;
- xi. ensure network bandwidth and services for data exchange with Tier1 and Tier2 Centres, as part of an overall plan agreed amongst the Experiments, Tier1 and Tier2 Centres;
- xii. administration of databases required by Experiments at Tier1 Centres.
- xiii. participation in security incident response.

All WLCG storage and computational services shall be accessible through the protocols agreed to by the Collaboration.

The following parameters define the minimum levels of service. The performance of the services and the compliance with the minimal levels of service will be reviewed by the operational boards of the WLCG Collaboration.

Service	Maximum delay in responding to operational problems			Average availabilityⁱⁱ measured on an annual basis	
	Service interruption	Degradation of the capacity of the service by more than 50%	Degradation of the capacity of the service by more than 20%	During accelerator operation	At all other times
Acceptance of data from the Tier-0 Centre during accelerator operation	12 hours	12 hours	24 hours	99%	n/a
Networking service to the Tier-0 Centre during accelerator operation	12 hours	24 hours	48 hours	98%	n/a
Data-intensive analysis services, including networking to Tier-0, Tier-1 Centres outwith accelerator operation	24 hours	48 hours	48 hours	n/a	98%
All other services ⁱⁱⁱ – prime service hours ^{vi}	2 hours	2 hours	4 hours	98%	98%
All other services ⁱⁱⁱ – outside prime service hours ^{vi}	24 hours	48 hours	48 hours	97%	97%

The response times in the above table refer only to the maximum delay before action is taken to repair the problem. The mean time to repair is also a very important factor that is only covered in this table indirectly through the availability targets. All of these parameters will require an adequate level of staffing of the services, including on-call coverage outside of prime shift.

Annex 3.3 Tier-2 Services

Tier2 services shall be provided by centres or federations of centres as provided for in this MoU. In this Annex the term Tier2 Centre refers to a single centre or to the federation of centres forming the distributed Tier2 facility. As a guideline, individual Tier2 Centres or federations are each expected to be capable of fulfilling at least a few percent of the resource requirements of the LHC Experiments that they serve.

The following services shall be provided by each of the Tier2 Centres in respect of the LHC Experiments that they serve, according to policies agreed with these Experiments.

- provision to the experiments of disk storage providing permanent and temporary data storage;
- acceptance of processed and simulated data;
- Operation of a facility supporting simulation and data-intensive analysis;
- provision of computing/processing and other services according to the needs of the experiments as agreed by WLCG;
- ensure network bandwidth and services for data exchange with other centres, as part of an overall plan agreed amongst the Experiments and WLCG centres.
- participation in security incident response.

All storage and computational services shall be “grid enabled” according to standards agreed between the LHC Experiments and the regional centres.

The following parameters define the minimum levels of service. The performance of the services and the compliance with the minimal levels of service will be reviewed by the operational boards of the WLCG Collaboration.

Service	Maximum delay in responding to operational problems		Average availabilityⁱⁱ measured on an annual basis
	Prime time^{vii}	Other periods	
End-user analysis facility	2 hours	72 hours	95%
Other services ⁱⁱⁱ	12 hours	72 hours	95%

ⁱ The standard supported desktop systems are agreed periodically between CERN and its user community.

ⁱⁱ (time running)/(scheduled up-time)

ⁱⁱⁱ Services essential to the running of the Centre and to those who are using it.

^{iv} Prime service hours for the Host Laboratory: 08:00-18:00 in the time zone of the Host Laboratory, Monday-Friday, except public holidays and scheduled laboratory closures.

^v The term "Tier1 Centre" includes a distributed Tier1 Centre according to the provisions of this MoU. In terms of services and levels of service a distributed Tier1 Centre shall be indistinguishable from a single-location Tier1 Centre.

^{vi} Prime service hours for Tier1 Centres: 08:00-18:00 in the time zone of the Tier1 Centre, during the working week of the centre, except public holidays and other scheduled centre closures.

^{vii} Prime service hours for Tier2 Centres: according to local working hours in the time zone of the Tier2 Centre, during the working week of the centre, except public holidays and other scheduled centre closures.