Fermilab

TECHNICAL SCOPE of WORK

Between

The MicroBooNE Collaboration

and

The Fermilab Computing Sector

for

Support of Computing used in the Operation of the MicroBooNE Experiment

16-Jan-2015
Version 1.3

Abstract:

This document is the Technical Scope of Work (TSW), formerly known as a Memorandum of Understanding (MOU), between the Fermilab Computing Sector (CS) and the MicroBooNE collaboration for support of the Computing Systems used by the MicroBooNE experiment. This document is intended to clarify the roles and responsibilities of the two parties in supporting the computing resources based upon the requirements agreed to at the time of publication.

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1 Introduction

This document is the Computing Sector – MicroBooNE Technical Scope of Work (TSW) that describes in more detail than the MicroBooNE –Fermilab TSW, the responsibilities of the Fermilab Computing Sector (CS) and the MicroBooNE collaboration personnel for computing services used by the MicroBooNE experiment. The TSW:

- Will be reviewed on a yearly basis by all the parties to the agreement and amended as requirements change.
- Shall be valid until the end of data analysis for the MicroBooNE experiment.
- Shall cover the long-term computing needs of the experiment including any data preservation needs.
- Shall reflect the computing requirements provided each year in the Computing Sector Strategic and Tactical plans, to which the MicroBooNE experiment provides substantial input (via the yearly SPPM Review process)[1].
- Shall refer to the requirements for computing capacity and hardware covered in separate MicroBooNE Computing Requirements documents.
- Shall not include activities funded under the MicroBooNE experiment project funds.

The following organizational units are involved in support activities under this TSW:

- The Computing Sector (CS), including the Office of the Chief Information Officer (OCIO), the Core Computing Division (CCD), and the Scientific Computing Division (SCD).
- The MicroBooNE Collaboration. MicroBooNE analysis tools groups, MicroBooNE online/data acquisition group, MicroBooNE Database support group, the MicroBooNE commissioning coordinator, the MicroBooNE physics coordinator and the MicroBooNE physics analysis groups.

Contacts:

- MicroBooNE: Steve Wolbers - Computing Sector Liaison to the MicroBooNE collaboration.
- Computing Sector: Rolando Ramos - Business Relationship Manager, Brian Mckittrick - Service Level Manager; OCIO.

1.1 Overview of Computing Sector Support

Computing Sector service support is provided as specified in the *FNAL Foundation Service Level Agreement (SLA)* [1], which applies to all Computing Sector supported services, except as amended by service-specific Service Level Agreements (SLAs). It is important to note that in general:

- Computing Sector support is provided on an 8x5 basis unless otherwise specified and agreed.
- Additional Service Level Agreements apply for specific services (such as Networking, Database, Grid and Cloud Computing, Storage, Engineering, etc.). These additional SLAs are published in the Service Level Management (subtopic of ITIL Processes and Functions) topic in CS-DocDB.

[1] The FY2014 SPPM Review Documents are available at: https://indico.fnal.gov/conferenceDisplay.py?confId=8437

- All services provided by the Computing Sector are managed through the Computing Sector Service Desk (http://servicedesk.fnal.gov/, or 630-840-2345).

In the event of issues with any service, MicroBooNE collaboration personnel shall utilize the Service Desk interface to report any issues. For off hours (outside of the standard 8x5 business hours of Monday-Friday, 8AM to 5PM), the support escalation procedure is to telephone the service desk at 630-840-2345 and select the option to page the on-call service desk personnel.
Computing at Fermilab is governed by the *Fermilab Policy on Computing.*[2] This policy covers all Fermilab-owned computers and any computer, regardless of ownership, when it is connected to the Fermilab network (and/or showing a Fermilab address).
Significant Computing Sector change and maintenance activities shall be coordinated with the MicroBooNE collaboration so as not to adversely affect MicroBooNE experiment operations. Similarly, the collaboration shall advise and consult with the Computing Sector prior to performing activities that might result in unusual usage patterns or impose unusually large loads on computing systems.

1.2 Overview of MicroBooNE Experiment Services and Activities

The details of the MicroBooNE systems are documented in *The MicroBooNE Technical Design Report (TDR).*[3] Below we summarize the major points to provide a context for the set of services that require operational support.

2 Core Computing Services

2.1 Authentication and Directory Services[4]

The MicroBooNE collaboration will utilize the standard Authentication and Directory Services offerings:

- Kerberos Certificate Authority (KCA)
- Active Directory (FERMI.WIN.FNAl.GOV)
- LDAP Authentication (SERVICES.FNAL.GOV)

These services will be provided under the standard Authentication and Directory Services SLA.

2.2 Central Web Hosting[5]

The MicroBooNE collaboration has its main web pages on the standard Central Web Hosting Services and these will be supported. Thus MicroBoone depends on the Apache Web service offering and no others.

Note this SLA provides 24x7 support for this offering. MicroBooNE has the following websites covered by this SLA:

http://www-microboone.fnal.gov

The MicroBooNE collaboration may have additional web pages that are hosted outside of the central web hosting series.

2.3 Database Hosting[6]

The MicroBooNE collaboration will utilize the standard Database Hosting Services together with the following enhanced services:

2.3.1 Enhanced postgres:

MicroBooNE online DB's (ChannelMapping DB, SlowMon DB, CryoDB, RunConfiguration DB, ProcessDB)

The ChannelMapping database is a collection of tables which allows one to map channels from one point to another in the readout and to determine all characteristics of the electronics for a given channel. For example one may specify a pin on a flange and discover the wire and ASICs channel or the FEM board channel that it belongs to, for example. One may use this DB to find serial numbers of the intermediate amplifier or mother board too on that signal path.

The SlowMon Epics DB holds quantities measured at the few Hz time scale or larger, including the relevant archiving of the cryoDB quantities. Temperatures and fan speeds on the servers are held here. Electronics backplane monitoring will be archived here too by grabbing up round-robbin database files left by the Ganglia system (Ganglia described elsewhere in this document).

The RunConfiguration DB holds the information that is queried from and inserted to with the start and stopping of runs and subruns. Each subsystem has its own dedicated table, and the selected configurations of these subsystems are then assembled into a run configuration specified in a higher level table. That configuration fully specifies a run and is assigned to a run number at runtime.

The Process DB is what allows for a fully modular set of processes that move the various data streams within the DAQ and out to Enstore to tape. There is a master process table that lists all the tables, which each have their own individual tables. Those processes run scripts that move the data, create and tack-on metadata, et cetera. There are run/subrun tables for each stream whose statuses are updated until the files for that stream are moved through their desired processing.

MicroBooNE offline DB's (Calibration DB)

The Calibration DB is where calibrations constants are stored, as they are calculated by processes which read the data from designated ASICs and Flasher diode calibration runs.

It will be filled by offline processes using the results of dedicated calibration runs. This DB uses the SCD developed http proxy server system and currently resides on dbdata0.fnal.gov, allowing it to be intelligently served to LArSoft processes.

Of the above, only the SlowMon DB and Calibration DBs are the most likely to grow to significant size. Current estimate is that SlowMon DB should not excede 1TB and the Calibration should not exceed 10s of TB (depending on necessity and method of storing electric field maps - under development/discussion).

We would like to investigate using Postgres replication to backup the configuration and SlowMon databases to the CD administered DB servers (their main location is on the DAQ machines). The other DBs are already resides on these servers. The need for DB replication to other sites has not, as of yet, been requested.

2.4 Desktop Services[7]

The MicroBooNE collaboration will utilize the standard Desktop Services.

2.5 FermiMail Services

The MicroBooNE collaboration will utilize the standard FermiMail services:

- Chat (Jabber/XMPP)
- Email
- MailLists

2.6 Enterprise Support Services

The MicroBooNE collaboration will utilize the standard Enterprise Support Services.

In particular, DocDB is critical to MicroBooNE operations and therefore the MicroBooNE collaboration requests 24x7 service availability with 8x5 service support for the MicroBooNE instance of the document management system.

2.7 Network Services[8]

The MicroBooNE collaboration will utilize the standard Network Services together with the following enhanced services:

- Configuration, monitoring and support of the network switches deployed at the LArTF building
- Configuration and monitoring the site connections for MicroBooNE at LArTF building
- Configuration, monitoring and support of wireless access point and associated FGZ network at the LArTF building
- Configuration of public IPV4 address blocks with mapping to the fnal.gov domain
- Configuration of private vlans in support of the DAQ, Event Builder and IPMI networks at the LArTF building
- Configuration of access control lists (ACL) for the MicroBooNE DAQ
- Configuration, monitoring and support for DNS, NTP and DHCP networking services utilized by MicroBooNE collaboration
- Access to the shared pool of cold spares for replacing failed networking hardware and hardware components deployed for MicroBooNE
- Maintain a dedicated pool of hardware spares for MicroBooNE if requested and corresponding funds are provided

Support levels for these enhanced services are listed in Table 2.

Table 1 Network switches supported for the MicroBooNE experiment

Service Area: Network		
Use	**Responsible**	**Devices**
MicroBooNE DAQ Network at LArTF	Networking	r-uboone-lartf-1 (a stack of 4 switches)
Connections from MicroBooNE LAN to the Site	Networking	r-uboone-lartf-1
MicroBooNE LAN: End-System Connections	Networking	r-uboone-lartf-1, GS110TP switches

MicroBooNE Wireless LAN	Networking	w-lartf-pit-1.dhcp.fnal.gov
MicroBooNE VLAN(s)	Networking	
LArTF building control	Networking	r-uboone-lartf-1

Table 2 – Network Service Level Commitments for the MicroBooNE experiment

Service Area: Network	Service Level Commitments					
Use	Service Availability Schedule	Support Availability	Incident Response	Incident Resolution	Request Response	Notes
MicroBooNE DAQ Network at LArTF	24 x 7[	24x7	Foundation	~~Cold Spare router/switches - 4 hours~~ Foundation	Foundation	Exclude travel time needed to reach the site by primary on-call
Connections from MicroBooNE LAN to the Site	24 x 7	24 x 7	Foundation	(15 minutes) Uplinks are redundant		
MicroBooNE LAN: Server Connections	24 x 7	24x7	Foundation	Foundation	Foundation	
MicroBooNE Wireless LAN	8 x 5	8x5	Foundaton Foundation	~~Cold Spares (24 hours)~~ Foundation	Foundation	
MicroBooNE VLAN(s)	8x5	8x5	Foundation	Foundation	Foundation	Experiment must provide change procedure/process approval.
LArTF building control	24x7	24x7	Foundation	~~Cold spares up to 4 hours~~ Foundati	Foundation	Exclude travel time needed to reach the site by primary on-call

				on		

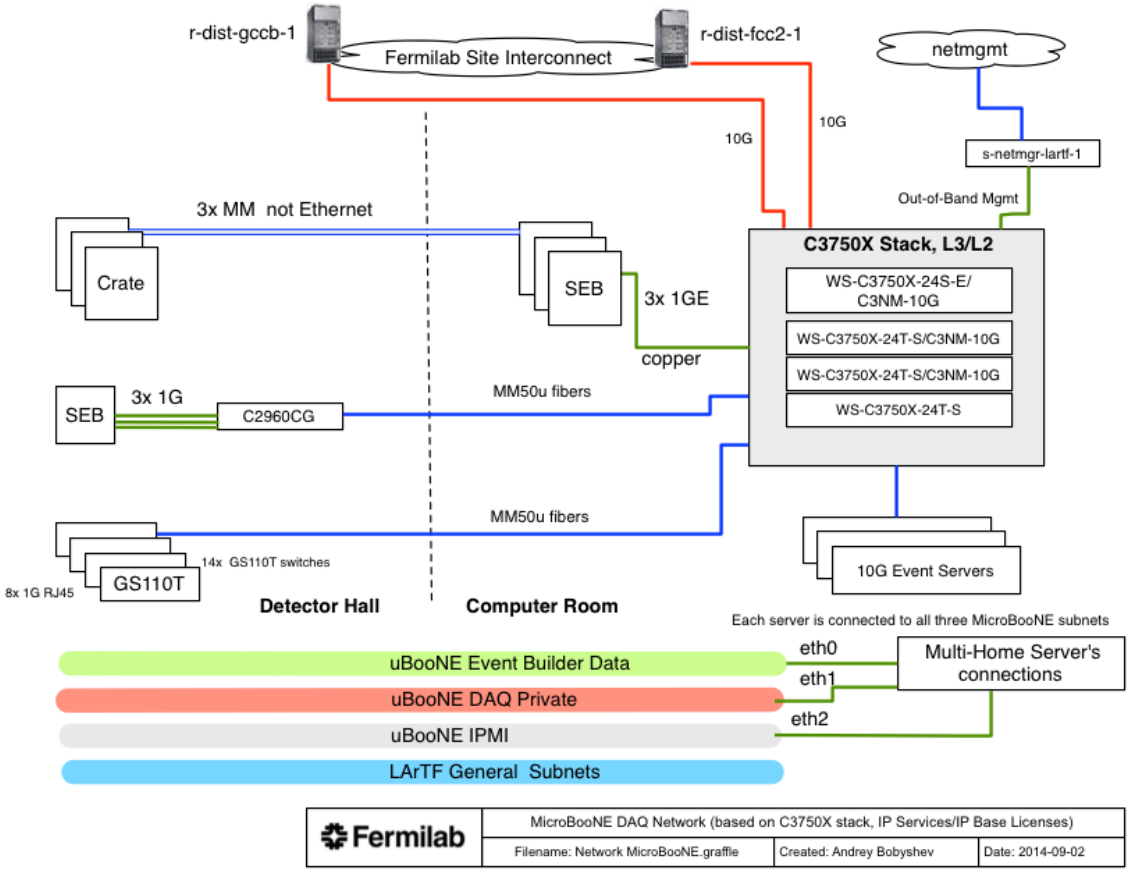

Figure 1 – MicroBooNE DAQ Network

MicroBooNE must provide a 24x7 point of contact for any services that are required to have 24x7 support availability.

MicroBooNE is responsible to notify the Fermilab Computing Sector of changes to MicroBooNE's requirements or new computing deployments as early as possible. MicroBooNE should be aware that significant lead-time may be necessary should there be a need to change an existing service or current infrastructure to accommodate MicroBooNE's needs.

Particular networking expertise is needed in some cases to ensure the functioning of the DAQ's internal 10 Gbit/sec network. This is the network that connects the Assembler process to the 10 to 12 so-called sebApp processes. We have worked with the networking experts to demonstrate that the relevant NICs and Switch can in principle deliver the 10 Gbit/sec with simple network tool diagnostics. Further, we have tuned many system parameters on all the relevant servers in order to achieve almost the advertised throughput with fake DAQ data in the fully setup system; we may need further consultation to ensure that any optimization is robust and well-understood.

2.8 Networked Storage Hosting[9]

The MicroBooNE collaboration will utilize the standard Networked Storage Hosting Services listed below.

2.8.1 NAS

2.8.1.1 BlueArc

The MicroBooNE collaboration uses the following BlueArc volumes:

- Blue2:/uboone/data
- Blue3:/nusoft/data
- If-nas-0:/uboone/app
- If-nas-0:/nusoft/app
- Blue2:/fermigrid-fermiapp
- Blue2:/fermigrid-app
- Blue2:/fermigrid-data
- Sci-win-nas-0:/lartpc/daq
- Sci-win-nas-0:/lartpc.ana

2.8.1.2 (AFS)

The MicroBooNE collaboration uses the standard (/afs/fnal.gov/files/home/*) AFS space for the home directories of its members.

2.9 Service Desk[10]

The MicroBooNE collaboration will utilize the standard Service Desk Services. The Service Desk Service SLA describes the expectations and responsibilities of the customer (MicroBooNE) and the Computing Sector. MicroBooNE depends on all service desk offerings including enhanced:

- Call-in support - The Fermilab Service Desk can be reached at 1-630-840-2345.
- Service Desk email support - Contact the Fermilab Service Desk at servicedesk@fnal.gov for support.

- Service Desk Enhanced – Requested for the MicroBoone Spokespeople.
- ServiceNow Self Service - Self service allows Fermilab associates, contractors and vistors to request assistance and search for knowledge.
- Walk-in support - Visit the Service Desk on the ground level of Wilson Hall.

2.10 Video Conferencing[11]

The MicroBooNE collaboration will utilize the standard Video Conferencing Services, including support for conference rooms and Control Room Video conferencing for remote collaborators. The relevant offerings are:

- General Video Conferencing
- Video Conferencing Consulting
- Video Conferencing Enhanced - for the Control Room
- Video Conferencing Training

3 Scientific Services

3.1 DAQ & Controls

The MicroBooNE DAQ and online systems are a mix of "reused" NOvA software and MicroBooNE specific software. It is expected that Fermilab will provide development and integration work in FY2014 and that afterwards Fermilab will provide consulting but not support for the DAQ/online software systems. The MicroBooNE collaboration will take over all aspects of the DAQ software over time.

3.1.1 DAQ components built under the MicroBooNE Project that will be supported by other groups

The areas of responsibility that will transition to groups outside of SCD include the following:

A few isolated software pieces from artdaq are being used in the MicroBooNE DAQ, but MicroBooNE is not using the artdaq framework as the basis for their DAQ.

MicroBooNE is not using art in the primary DAQ system, but it will be run very shortly after the data is written to disk to A) convert it into Root format, and B) possibly do some initial reconstruction. Whether we say that art will be used "online" or "nearline" is probably just semantics, but the fact that it is not run in the Assembler is a big distinction since it allows the art release used by MicroBooNE to be decoupled from the primary DAQ.

The MicroBooNE DAQ is making significant reuse of high-level control and monitoring applications from NOvA. The majority of the work to update and modify these applications for use in MicroBooNE is being performed by MicroBooNE collaborators, and SCD people are providing guidance and technical help.

During the transition phase, members of SCD will provide documentation, mentoring, consultation, and continued development effort as agreed upon with members of the collaboration.

Once the transition phase is complete, members of SCD will be available for consultation on design and implementation details, and available to provide guidance for debugging issues, on an 8x5 basis.

3.1.2 SCD-built components that will continue to be supported by SCD

MicroBooNE needs continued access to SCD consulting as it relates to the state machines in the event-building process, assemblerMain, and in the process that moves the data from each crate to assembler, known as sebApp. This is the broader C++ class structure that allows moving the system through configuring hardware and software to running and stopping the run, etc. MicroBooNE also needs continued SCD access to consulting with respect to the OpenSplice Data Distribution Service (DDS) message passing system. The messages cause the state machine transitions. MicroBooNE DAQ use a third party, open source server monitoring system called Ganglia, which occasionally requires SCD consulting to configure. The windriver used to interact with the Nevis PCIe cards is a package for which MicroBooNE purchased a 3-seat license, one of which seats is occupied by an SCD DAQ member (Gennadiy Lukhanin); if it is decided to update the driver software and re-build that code, MicroBooNE would like his participation. (The hope is to never have to update that code; it has not been done in 2 years.)

Run Control, built for NOvA, re-purposed for MicroBooNE has also been forked into the MicroBooNE DAQ code base. Nevertheless access to SCD consulting here may be intermittently necessary. We have decoupled from the artdaq package, forking off just the bits we need, so our dependence there is minimal.

In general, the build system has a deep dependence on which version of the compiler gcc we use; we may need continued SCD access to any package-dependency issues gcc updates may cause. Boost is another package to which we have some update vulnerability. There may be others.

3.1.3 Components that will be supported by the MicroBooNE Collaboration

The areas of responsibility that will remain with members of the MicroBooNE collaboration include the following:

The DAQ experts on MicroBooNE maintain all the readout and event building code. MicroBooNE have control over and expertise in the threading structure in use by the DAQ. The hardware that configures and pulses ASICS configuration boards and optical flashers are controlled by software that MicroBooNE have authored and maintain.

MicroBooNE have written a package holding the DAQ data structures and access methods needed by both the DAQ and the “swizzling” process — namely the very first LArSoft module that needs to be run on MicroBooNE binary DAQ data. This, along with a MicroBooNE DAQ installation of LArSoft, allows orthogonality from the greater LArSoft code base while still ensuring downstream use of it offline. The LArSoft processes that do the swizzling may also exercise the Huffman decoding and other necessary decompression and apply early modules of the reconstruction on the DAQ condor compute cluster. The extent of the online LArSoft processing is to be determined after doing performance tests.

MicroBooNE own the processes to do the concatenation of beam data to the DAQ data, as well as the reaping scripts and the processes to build the vast Supernova mode data. MicroBooNE own the processes to launch the swizzling on the condor cluster and ship metadata-wrapped raw binary as well as ART ROOT swizzled data to SAM/Enstore.

MicroBooNE have an exported area of ups-packaged libraries and binaries on which the main processes rely, much of which MicroBooNE builds and updates. This will continue going forward, with SCD advisement as suggested in 3.1.2.

MicroBooNE now has a local run control, as mentioned above in 3.1.2. MicroBooNE knows how to add processes to that system and are doing that actively now as data-taking approaches. These include online monitoring and beam data collection processes.

The DAQ has many databases for which it is responsible. The DAQ will run calibration-dedicated and laser-dedicated runs, as well as ordinary data-taking runs. A configuration database will live on a DAQ machine and allow configuring each run. Computing Sector processes will back this up. DAQ calibration constants will be calculated periodically and stored in an offline database, which isn't discussed further, except to note that, from there, those data will be served intelligently to offline LArSoft processes. This ensures a barrier to the DAQ machines from potentially large traffic from processes running on external grid nodes. MicroBooNE also maintain a channel-lookup database.

Slow monitoring and control processes are entirely MicroBooNE owned. This ranges from reading cryo data and ganglia lrrda and and ganglia lia om reading cryo data and ganglia d ganglia ed. This ranges from temperatures to fan speeds. All is inserted into EPICs dB records. Historical EPICs data will be viewed and archived and alarmed in near real time. EPICs also allows control over such things as power supply settings and control. MicroBooNE will exercise that control for SlowMonCon experts for the many power supplies in the MicroBooNE DAQ.

3.1.4 Ongoing SCD development efforts

In addition to the transition and support activities that will be provided by SCD personnel, there are several areas in which SCD folks will continue to contribute development and deployment effort as the collaboration commissions the DAQ and slow controls systems. These include:

SCD has developed foundation libraries for MicroBooNE's daq, which include the hardware support library, shared library used by seb and assembler libraries and their corresponding processes. Also SCD developed a wrapper library around the generated windriver code.

These efforts will proceed on an 8x5 basis, similar to the construction effort that has taken place so far.

Additional requests may arise as the commissioning of the detector and DAQ continue. The breakdown of responsibilities, and schedule for addressing each request, will be negotiated on a case-by-case basis.

3.1.5 Computing Sector Responsibilities

SCD support for DAQ and controls software in year 1 will include the effort required to bring the system to full operation. Designated representatives of the MicroBooNE collaboration may request additional consulting services for major changes or upgrades, subject to agreement by the relevant scientific service area managers together with the appropriate SCD line management.

- Provide consulting services to MicroBooNE online support personnel regarding best practices, technical issues, or specific issues related to system administration of online computing systems. CS will provide limited technical assistance to deal with major system administration issues. All such services will be provided on an 8x5 basis;
- Provide ongoing development and support effort as outlined above.
- Provide system administration and support for DAQ/online systems in a manner consistent with the 24x7 nature of data taking and the high value of beam time and data taking.

3.1.6 MicroBooNE Responsibilities

- Continuing to maintain and support the software components that were developed outside of SCD.
- Assume responsibility of the maintenance and support of the software components that will no longer be the responsibility of SCD, as outlined above.
- Comply with security requirements outlined in the MicroBooNE Minor Application Plan;
- Support of Glomation GESBC-9G Single Board Computers.

3.1.7 Joint Responsibilities

- Communicate feature requests, issues, and the availability of new versions of core packages in a timely way.

3.2 Engineering and Electronics

The MicroBooNE collaboration is not planning to utilize the standard Engineering and Electronics Services.

3.3 Grid and Cloud Computing

The MicroBooNE collaboration depends on the standard Grid and Cloud Computing Services. Scientific Computing System, Scientific Data Storage and Access, and Grid and Cloud Services provide support for MicroBooNE data analysis and processing systems under the Foundation SLA with 8x5 support. The number of batch slots, experiment data storage size and performance, and common job submission and monitoring tools are provided as part of these services. The needs for each year are proposed and agreed to through the Fermilab Scientific Portfolio Management process.

MicroBooNE is developing the simulation, reconstruction, and analysis code and this will continue and will be better understood. We can assume support needs for:

- Grid computing resources for simulation, production, and analysis (FermiGrid).
- Disk storage for processed data.
- Tape storage for processed data.
- Support for specialized service machines (i.e. VMs handling the MicroBooNE SAMweb server and similar services)

3.3.1 FermiGrid

The MicroBooNE collaboration uses the standard FermiGrid Services. The MicroBooNE collaboration relies on FermiGrid as the ensemble of interfaces and services to access local and distributed resources, including the Fermilab computing infrastructure (Fermilab Campus Grid), the Open Science Grid, and Clouds. The collaboration is in the process of targeting different computing platforms for different computing tasks. The data-intensive computing activities, such as reconstruction, target mostly Fermilab local resources; purely compute-intensive tasks, such as monte-carlo production, target a mix of local and distributed resources, such as OSG or public and commercial clouds. CS takes responsibility to manage the ensemble of the services that allow access to the computing infrastructure at Fermilab at the level described in the SLA.

3.3.2 FermiCloud

The MicroBooNE collaboration is discussing with the Computing Sector use of Virtualized and Cloud Services.

3.3.3 GridFTP

The MicroBooNE collaboration uses GridFTP Services. For transferring the output of Grid jobs, MicroBooNE relies on a Globus GridFTP server configured to maintain both user and *group* id file ownership. The group id ownership is particularly relevant for this service because other data transfer services do not necessarily preserve it.

3.3.4 Accounting Service

The MicroBooNE collaboration will use the standard Gratia Accounting Services.

3.3.5 Jobsub

The MicroBooNE collaboration will utilize the standard FIFE Jobsub Services. JobSub is an ensemble of services to submit and manage jobs to local and remote resources. The ensemble includes a user-facing interface for job management, which encapsulates the semantic of experiment-specific use cases, job queuing and resource matching services, basic provisioning services, as well as input / output sandbox transfer service. MicroBooNE relies on this service for the submission of all jobs to resources, either local or remote, dedicated or opportunistic, public or private or commercial.

3.3.6 Fifemon

The MicroBooNE collaboration will utilize the standard FIFEmon Services. Fifemon is the service that monitors the status of submitted jobs. Fifemon shows the status of the jobs as they go through their lifecycle e.g. submitted, idle, running, and completed. The service allows the user to “drill down” at an increasing level of detail for those jobs of particular

interest. As MicroBooNE undertakes increasingly complex computational campaigns, it will rely on this service more and more.

3.3.7 Responsibilities

3.3.7.1 Computing Sector responsibilities

1. Operation and support for use of the Interactive/Batch Analysis Cluster GPCF.
2. Operation and support for use of local Grid accessible resources agreed to with the collaboration.
3. Support and consulting for the use of offsite resources through the Open Science Grid and Clouds.
4. Provide consultation with offline personnel from the collaboration on issues related to grid utilization.
5. Develop and provide training and documentation in the recommended use patterns of the above resources.

3.3.7.2 MicroBooNE responsibilities

6. Validate users authorized to access MicroBooNE grid computing resources. The collaboration will further provide personnel for the roles of "Group Managers", "Operations Contact", "Security Contact" and "Spokesperson", pursuant to the "Establishing Grid Trust with Fermilab" document [3].
7. Document the local grid and interactive CPU resources required to meet the physics goals of the collaboration.
8. Ensure that MicroBooNE users are informed as to the appropriate usage patterns for all CPU resources[2]. Work with CS personnel as needed to investigate and address operational issues or utilization efficiency issues.
9. Perform job submission and data processing tasks.
10. Provide user support for job submission and job tracking, and user documentation and education on the use of MicroBooNE computing resources.
11. Provide those components of a job submission layer to the batch and grid resources that is specific to MicroBooNE.
12. Specify and develop any monitoring capabilities that are needed to effectively utilize CPU resources, but that are not provided by available monitoring tools. Instrumentation of MicroBooNE executables or glide-ins are possible examples where joint effort may be required.
13. Provide feedback on the training and documentation provided by the Computing Sector.

[2] Experiments that use Grid resources must establish the appropriate Grid Trust Agreements [3] prior to use of the Fermilab Campus Grid resources through the FermiGrid services. In addition to the Fermilab Policy on Computing, specific additional policies apply to Grid computing activities on FermiGrid [4] and further policies apply to Grid resources accessed via the Open Science Grid (OSG) collaboration [5].

3.3.7.3 Joint responsibilities

14. Meet as needed to discuss operational issues affecting the use of computing systems, best practices for using the systems, user support issues, utilization strategies, or other items of mutual interest with respect to the computing systems.
15. Investigate and deploy suitable mechanisms for transferring executables, database information, etc., to remote worker nodes for the purpose of Monte Carlo generation or data processing, and for transferring generated files back to Fermilab.

3.3.8 GPCF

The MicroBooNE collaboration uses servers in GPCF for interactive analysis and for testing batch jobs. The Computing Sector is responsible for operation and support of GPCF.

3.4 PREP

The MicroBooNE collaboration will utilize the standard PREP Services

3.4.1 Prep Logistics

The MicroBooNE collaboration will utilize the standard PREP Logistics Services. PREP support is through standard replace and repair procedures with the availability of the Prep service window being 9.30am -4pm 5 days a week. All PREP loans are authorized under a TSW. Experiments sign full TSW's with the division heads organized by the Directorate Office of Program Planning. Test beam experiments do the same, save that the CS signature has been delegated by the Division head to the PREP Scientific Manager.

3.4.2 PREP Electronics

The MicroBooNE collaboration will utilize the standard PREP Electronics Services, together with the following list of additional enhanced services:

There is a TSW template for offsite loans signed by the User, PREP Scientific Manager, and Associate Director for Program Planning. Expansions beyond the "PREP list" in a TSW are normal, expected, and by negotiation. There are no explicit Service Level Agreements (SLA's). Implicit in the pool model is that working spares are available to replace failures and diagnose issues. PREP, when asked, will do whatever it can to get a running experiment that is down, back to taking data. This includes spares, replacements, and technical consulting with the Techs and managers as required.

The MicroBooNE experiment will utilize a broad array of electronics in the development, commissioning, and operation of the DAQ system and the experiment as a whole. The equipment required includes standard test and laboratory equipment (e.g., oscilloscopes, voltage meters, current load boxes, NIM crates and associated modules), basic data acquisition systems needed to interface with other laboratory systems, and MicroBooNE-specific hardware procured from outside vendors or built in-house.

3.5 Scientific Collaboration Tools

The MicroBooNE collaboration will utilize the standard Scientific Collaboration Tools Services.

3.5.1 Redmine

The MicroBooNE collaboration depends on the standard Redmine Services.

3.5.2 CVS/Subversion/GIT

The MicroBooNE collaboration will utilize the standard CVS/Subversion/GIT Services. MicroBooNE code repositories are hosted through cdcvs.fnal.gov redmine core repository and collaboration management system.

3.5.3 ECL

The MicroBooNE collaboration will utilize the standard ECL Services together with the following enhanced services.

Support for the database servers Support is needed round the clock during data taking. Service Desk requests for off-hours support for ECL database servers will be generated by the PPD Experimental Operations support organization (IFTBG).[12]

See PPD support documentation for enhanced support levels.

3.5.4 UPS/UPD

The MicroBooNE collaboration will utilize the standard UPS/UPD Services

3.6 Scientific Computing Systems

The MicroBooNE collaboration will utilize the standard Scientific Computing Services. The Scientific Computing Systems offerings will be DAQ and Control Room System Management Services.

3.6.1 Experiment Desktops and Control Room Workstations

The MicroBooNE collaboration will utilize the standard Experiment Desktop Services. The MicroBooNE experiment utilizes a set of 5 workstation class desktop computers that are used in the MicroBooNE control room in WH12 for control and monitoring of the experiment. These machines are designed and configured to be generic display stations (i.e. any machine can display any DAQ desktop or interface) and no single machine is considered a critical system for operations. These control room workstations are supported under the DAQ and Control Room System Management Service Offering under the Scientific Workstation Service SLA.

3.6.2 DAQ Computing Clusters

The MicroBooNE DAQ computing is configured with infrastructure to provide each system with:

- Serial console port access,
- Remote power on/off via network controllable PDUs,
- Full access (to the bios level) via console servers accessible via TCP/IP.

3.6.2.1 MicroBooNE Detector Computing Systems:

- Hardware support (replacement under warrantee) for approximately 15 server nodes
- Hardware support (replacement under warrantee) for 12 disk arrays
- Hardware support (replacement under warrantee) for support infrastructure (consoles, PDUs, etc.)
- System administration for approximately 14 SLF6 systems, including configuration management, software updates and security Patches

3.6.2.2 SLA and deviations

1.The Full SLA for scientific servers can be found from the Service Manager.

2.The computer security details are provided in the Minor Application Plan

3.6.2.3 Computing Sector responsibilities

- Installation of, updates, security and other patches for the Scientific Linux OS
- Monitoring and system administration services
- Installation and support of the PUPPET configuration management software.
- The hardware is under maintenance contract with the corresponding equipment's vendor

3.6.2.4 MicroBooNE responsibilities

- Install and support of all online application software, and Fermilab supported physics toolkits and utilities needed.
- Provide schedules for deploying security patches to all systems that are consistent with Lab security policies and the MicroBooNE Minor Application Plan.
- Provide an expert from the collaboration who can assist system administrators.

3.6.2.5 Joint responsibilities

Any system or support level Change planning, requests and documentation

3.6.3 CVMFS

The MicroBooNE collaboration will utilize the standard CVMFS Services of OSG and/or Fermilab.

3.6.4 Build Service

The MicroBooNE collaboration will utilize the standard Build Service Services, if necessary.

3.7 Scientific Data Management

Scientific Data Management was on-boarded to ITIL/IOS20K in FY14. CS-DocDB #5032 contains the ITIL process files for the Scientific Data Storage and Access services that are provided by the Data Movement and Storage Department.

The Scientific Data Management services involve management of the experiment's event data files and include the following service offerings:

- SAM/IFDH
- File Transfer Service (FTS)
- Data handling

The guiding principle is to provide data handling and management services to an experiment that are robust, efficient, innovative, easy to use, and easy to maintain and operate, and low cost.

The suite of offerings enables the MicroBooNE experiment to catalog and store event files in the Fermilab central storage system and retrieve such files for processing by jobs running at Fermilab and at remote sites.

Note that the term "event data files" is used here to describe the type of files handled by these services. These files generally contain event information originated by the MicroBooNE detectors or simulation. They may be Root files or based on a private format. Individual log files, histogram files, documents, and such are generally not handled by SDM services. There are exceptions listed here,

- *art* configuration (FHICL) files for simulations are handled by SDM services. Such files are used to initiate simulation jobs and serve as the top "ancestor" of files produced by the simulation run

- Log file bundles (e.g. tarred and compressed) may be handled by SDM services for archival purposes. Such bundles should be large (>2 GB) if possible.

- Other file types may be handled by SDM services upon mutual agreement by MicroBooNE offline management and the SDM services management and should be listed above.

SDM services are generally geared for access to data from batch jobs. There are situations described below where interactive access to data may be possible.

3.7.1 SAM/IFDH

SAM is a system that catalogs, moves, and tracks event data from a central storage facility to caches world-wide. IFDH is a complementary system that handles the "last mile" of data transfer from a nearby cache to the worker node hosting the running job. SAM provides an interface (SAMWeb) for the user and administrators to configure, communicate with, and monitor the data management system.

The current configuration of MicroBooNE's data access system is to use Fermilab's Enstore tape system for archival storage and the central cache system with dCache for cache management. The SAM system involves software as well as several physical services including SAM stations, stagers, and other servers. SCD will maintain such software as well as operate the physical services. There are two types of incidents that may be raised against the SDM services: regular incidents are those with either low impact or low urgency (as defined in the CS Foundation SLA). Critical incidents are those with both high impact and high urgency and must be initiated by the MicroBooNE offline manager or delegate and called into the Service Desk. Examples of incidents are

- an outage of a critical SAM physical component that halts data handling for all jobs at all sites is a critical incident
- an outage of a web service that prohibits access to all of data management for the experiment is a critical incident
- a software bug that causes a race condition halting all data handling for all jobs at all sites is a critical incident
- because the Fermilab Campus Grid is the primary site for MicroBooNE processing, an issue that halts data handling for all jobs on FermiGrid is a critical incident
- a remote site issue that causes data handling to fail at that particular site is a regular incident

- an issue that halts interactive access to files but leaves jobs unaffected is a regular incident
- issues of low impact (affecting only a few people) or low urgency are regular incidents
- in special circumstances, a regular incident may be elevated to critical with mutual agreement between the MicroBooNE offline manager and SDM service managers.

As mentioned above, SAM and IFDH are geared for data deli+-+

+0very to batch jobs. For some situations, IFDH will have capabilities to deliver files to interactive sessions. Currently, these situations include:

- Interactive sessions on Fermilab MicroBooNE GPCF interactive nodes (e.g. MicroBooNEgpvmXX) with the file resident or accessible to the central public dCache.

Data transfer rates and requirements are specified in SPPM presentations.

SCD Responsibilities:

- Provide the Scientific Data Management services that enable MicroBooNE to catalog, store, and retrieve event data as described in this section.
- Support SAM and IFDH software, interfaces, and libraries at a 8x5 level except in the case of bug that causes a critical incident. Such critical incidents are handled at an 8x7 level.
- Support SAM physical services and servers at an 8x5 level except in the case of an outage that causes a critical incident. Such critical incidents are handled at an 8x7 level.
- If a remote site experiences no or under-performing file delivery, the site will be investigated and debugged by SCD. Note that cooperation with site administrators may be necessary and MicroBooNE managers may need to assist.
- Respond in a timely manner to requests generated by MicroBooNE.
- Monitor the system for operations and performance at an 8x5 level. As practical as possible, critical incidents generate an automated page to SDM service operations personnel. Note that not every issue can be anticipated nor covered by automation. In the case of a critical incident page due to or resulting in a critical service outage, the SDM service operator will notify the MicroBooNE offline manager or delegate of the outage.
- Perform maintenance on systems and software as necessary. Such maintenance may incur a service outage or degradation during the maintenance window. Such maintenance windows must be negotiated with MicroBooNE offline management in advance. SDM service management will make every attempt to minimize the occurrence of unplanned emergency maintenance windows.

MicroBooNE Responsibilities:

- Open Service Desk incidents when issues are noticed. Critical incidents as described above need to be initiated by the MicroBooNE offline manager and called into the Service Desk.
- Open Service Desk requests for new metadata fields or advice about metadata fields.
- Open Service Desk requests for new use cases or anticipated unusual increase in demand as early as possible. The SDM service management and operators will respond to the request and if possible, adjust the services configuration accordingly.

- While the SDM systems will be as robust as practical, MicroBooNE offline management should prevent, as much as practical, user abuse of SDM systems that cause unwanted increases in demand or unusual use cases.
- Negotiate with SDM service management for maintenance windows. Note that unplanned emergency maintenance windows may be necessary in special circumstances.

3.7.2 File Transfer Service (FTS)

The File Transfer Service (FTS) is a robust system for uploading files into the SAM catalog and central Fermilab storage. Its main use is for transferring event files from the MicroBooNE DAQ systems into SAM as well as the output of Simulations. The FTS uses many SAM components and thus SCD and MicroBooNE responsibilities detailed in the SAM/IFDH section apply here. FTS also introduces its own software and physical server components and those are supported at a level similar to the SAM software and services. Both SDM service management and MicroBooNE operations will monitor the FTS system through its built in web monitoring service.

Since files produced by the detector DAQ systems are irreplaceable, MicroBooNE will provide enough "spool" disk area to allow for the storing of at least a week's worth of data in case of a full and long term outage of FTS, SAM, or Enstore (such an outage is not anticipated, of course).

MicroBooNE will create Service Desk incidents if issues are noticed with FTS. Critical incidents may be initiated by the MicroBooNE online or offline management and called into the Service Desk. An incident that stops all storage of data (from DAQ or simulation jobs) is critical and will be handled at an 8x7 level.

3.7.3 Data Handling

Data handling is a service offering where SDM experts provide consultation and advice for an experiment's data handing needs aligned with the principle stated above. Examples of topics include:

- Definition of file meta-data
- Exploring new data handling use cases and paradigms
- Exploring data handling technology

MicroBooNE may initiate consultation by opening a Service Desk request. SDM experts may approach MicroBooNE offline management for discussions as well.

3.8 Scientific Data Storage and Access[13]

The MicroBooNE collaboration will utilize the standard Scientific Data Storage and Access Services. The Scientific Data Storage and Access services are described in the related SLA. Support for MicroBooNE falls within the standard service categories. The responsibilities of each of the parties is described in the SLA. The expected scale and performance of the systems is described in the submission to the Laboratories Scientific Portfolio Management process, and is summarized in the FY2014 SPPM Presentations available at:

https://indico.fnal.gov/conferenceDisplay.py?confId=8437

The disk and tape storage needs of the MicroBooNE experiment are categorized below.

3.8.1 Raw Data

The MicroBooNE experiment records data related to the operation of the detector corresponding to the BNB and NuMI beam spills as well as additional data for calibration and for non-accelerator analysis topics. The data rates for the MicroBooNE detector depend on the operational parameters of the detectors (such as noise floors and compression factors). With the current detector configurations the MicroBooNE detector is estimated to produce a minimum of 20 TB/year of BNB + NuMI beam trigger data along with an additional 100 TB/year of SuperNoVA and calibration data.

Under the current MicroBooNE computing model, raw data from the detector is transferred using the FNAL developed "File Transfer Service" (FTS) between the DAQ and a set of data handling stations (MicroBooNEsamgpvm01-0X) located at Fermilab. The data is stored temporarily on the BlueArc central disk system, where it is checked for transmission errors and cataloged by the SAM data catalog system. The data is then copied to the enStore tape system for archival storage as well as to the central dCache pools for general processing and analysis access. For raw data, two copies are made of the data (on different physical tapes) to ensure against data loss in the advent of media failure.

Under this raw data model, when the detector enters full production, a raw data volume of at least 20 TB/year will be written to the FNAL tape systems. In addition the system will require an allocation of dCache write pool sufficient to handle the writing of the raw data stream to the enStore system. This size of the pool is estimated at 5 TB and is sized to accommodate both the nominal [steady state] transfer of data from the far detector, as well as the non-standard flow of data that would be required after a prolonged network outage of the far site (i.e. catch up processing). The system currently also requires 5 TB of central BlueArc storage to serve as a buffer for doing the data integrity checks which are performed by the FTS. This storage can be retired when the FTS is upgraded and integrated directly with the dCache pools.

3.8.2 Monte Carlo Simulation Files

The MicroBooNE experiment needs to generate significant amounts of simulation to perform different analysis. This simulation is broken down into different Monte Carlo sets depending on the analysis being performed. The Monte Carlo simulations are generated through the use of neutrino interaction generator packages combined with a GEANT4 based detector simulation package. The output of the initial Monte Carlo generation/simulation step is saved to disk/tape for further processing. For the initial FY14 first analyses the amount of simulation that is required is estimated at 30 TB. This simulation set corresponds to 2.0E6 event triggers.

3.8.3 Production Data Analysis

Data analysis is driven by many factors, including the size of the data sample, the number of analyzers, the number of topics, the size of simulation samples required, etc. Experience from other experiments at colliders and in the neutrino program is that the data analysis needs are likely to exceed the production needs. They will increase as the total integrated data sample increases during the next few years as MicroBooNE continues to integrate data.

3.8.4 End User Data Analysis

3.8.4.1 Computing Sector Responsibilities

1. Install and maintain a central disk pool capable of serving MicroBooNE data to the GP Grid Cluster, CPCF cluster, and other on-site MicroBooNE computers via data handling tools or NFS. Data serving rates must be sufficient to meet the demands of reconstruction and analysis on the GP Grid cluster, GPCF, and other on-site computers. It is expected that the majority of the data will be accessed via cache disk. BlueArc disk will primarily be used for user code and small test or analysis samples.
2. Install and maintain NFS-mounted disk serving software releases to the GPCF cluster, GP Grid cluster, and other on-site interactive machines, and machines with disk for building software releases. This will be complemented and in many ways replaced by a cvmfs repository that is used as the main code access on many of the systems at Fermilab and on grid sites and local clusters around the world. The OSG cvmfs depository may serve the role required for all MicroBooNE use.
3. Install and maintain project disk to support analysis activity. At present, this disk is provided as part of the GPCF plan.
4. Provide a tape data archive accessable via Enstore. All raw detector data, processed data, and Monte Carlo data will be archived to tape. The FY2014 volume is expected to be about 200 TB.
5. Provide AFS-mounted home area disk. Regular backups of this space will be performed.
6. Except as specified below, monitor performance of tape and disk storage systems.
7. Provide tools for archiving analysis data.

3.9 Scientific Databases

The MicroBooNE collaboration will utilize the standard Scientific Database Services. Scientific Databases and Database Hosting Services are both relevant to the support levels for the experiment systems. Unless otherwise stated the support level is 8x5 as stated in the Fermilab Foundation SLA.

The MicroBooNE experiment employs databases that are used to store information regarding the operations of the detectors and the conditions of beams the detectors see. These databases are used by both online and offline systems with different access patterns, replication needs and uptime requirements. Details of all databases used only by the MicroBooNE Project and Experiment is found in MicroBooNE-doc-xxxx. The relevant information for this documents are characterized in the sections below.

The major database applications include the data management catalog, the conditions database, the Online Database and experiment logbook. In the following summary of responsibilities, support for a database application by an organization implies support at all three levels unless specified otherwise.

CS provides tiered levels of support for database services ranging from 8x5 to 24x7, the choice depending upon the application and the type of underlying database. For support under the Database Hosting SLA, it is required that each production database instance will be accompanied by corresponding development instances (required at a minimum for maintenance testing) and integration instances (optional for additional QA testing), both of which receive the lowest available tier of support.

3.9.1 Database Descriptions

The web-based "Conditions Database" service is an application that is also used by the MicroBooNE offline. The Conditions Database web server and application require 24x7 support. The Online Database on CS managed servers will hold a copy of the online MicroBooNE Database server. Regular backups and access updates via service tickets are required.

MicroBooNE also uses the IFBEAM and the SAM data management databases. The IFBEAM database is used by the MicroBooNE experiment in both real-time and in an offline capacity. The IFBEAM monitoring web application is used in real-time and is important for detector operations. Both of these databases and web services require 24x7 support.

Tickets for off-hours support for ECL database servers will be generated by the PPD Experimental Operations support organization (IFTBG).[14]

The general operational parameters for these sets of databases are summarized in the table below:

Table 2 - MicroBooNE Database Properties

Database	Type	Access Types	Support Requirement
ECL	**Postgres**	**CS Web App**	**24x7**
IFBEAM	**Postgres**	**CS Web App**	**24x7**
OFFLINE CONDITIONS	**Postgres**	**CS Web App**	**24x7**
Run Config , SlowMon	**Postgres**	**Postgres queries**	**uBooNE**
Run Config, SlowMon Replicas	**Postgres**	**Postgres queries, hosted on CD machines**	
Mapping DB, Production DB	**Postgres**	**Queries, uBooNE developed web app., hosted on CD machines**	**24x7**

3.9.2 Responsibilities

3.9.2.1 Computing Sector responsibilities

Install and maintain databases, database servers and applications needed to store and utilize the following mission critical data:

- Install and maintain a copy of the MicroBooNE Online Database server.
- Install and maintain an instance of the MicroBooNE conditions database web server.
- Install and maintain an instance of the Control Room Logbook as needed by the experiment.

3.9.2.2 MicroBooNE responsibilities

- Enter the content of all databases;
- Interfacing MicroBooNE software with the database applications;
- Ensuring that users are informed as to appropriate usage patterns, and otherwise assisting CS personnel in investigating and addressing operational issues.
- For cases in which there is no existing schema or database application, specify and document the requirements, the use cases and queries needed, etc., as requested by the CS.
- Provide time windows during which regular database maintenance may be performed and security patches applied in a manner consistent with Fermilab security policies and the MicroBooNE Minor Application Plan.

3.9.2.3 Joint responsibilities

- Developing and approving the specifications for user access, the database applications and schemas.
- Participate in annual "Taking Stock" meetings to long-term operational issues and resource planning. CS will coordinate these meetings.

3.10 Scientific Frameworks

The MicroBooNE collaboration depends on the art software suite for their offline production (simulation and reconstruction) applications. The entire suite appears as external packages to MicroBooNE. The suite can roughly be broken up into three areas: the art framework, support libraries, and external products.

The MicroBooNE experiment requires support for the following packages:

- Art suite releases: CS will create, host, and maintain release distribution of the entire art suite. Distributions may include bug fixes, features, or changes build parameters as required by the MicroBooNE experiment release manager. CS will provide support through the standard support systems for integration issues and questions. Platform support will be primary SLF6. SLF5 will be supported as a secondary platform at low priority.
- Art suite software: CS will provide support for the art framework and underlying support software libraries. Support will include bug fixing, issue analysis, answering questions concerning functionality and usage, and providing upgrades to accommodate platform and external product changes. CS will accept feature requests through the redmine system.

- UPS: CS will provide support for the UPS package. This includes answering questions, investigating issues, and providing bug fixes when issues are encountered.

3.10.1 Supported by the experiment

Git/mrb is a package is used to build software releases from the MicroBooNE repositories. It is used in the compiling and the running of the offline and online experiment code developed by the experiment.

The experiment shall provide necessary support for the following packages:

- Experiment offline release builds and distributions, including integration with external products.

3.11 Scientific Software

The MicroBooNE collaboration is part of the joint LArSoft project and uses this software for offline simulation, and reconstruction. The Computing Sector coordinates the joint LArSoft project, with experiments contributing Librarians, algorithm codes, and as key partners. LArSoft depends on art as the underlying software framework. The software and its libraries are central to all of the current software of the experiment, including event simulation, event reconstruction, event display and analysis.

The Scientific Computing Division provides support for:

- LArSoft releases: CS will create, host, and maintain the release distribution of the common LArSoft code. CS will provide for MicroBoone to make releases of the MicroBoone specific code that is part of the LArSoft package. CS will provide support through the standard support systems for integration issues and questions. Platform support will be primary SLF6. MACOSX will be supported at a lower priority. SLF5 will be supported as a legacy platform at lower priority.
- LArSoft support will include bug fixing, issue analysis, answering questions concerning functionality and usage, and coordinating and providing upgrades to accommodate platform and external product changes. The project accepts feature requests through the redmine system.
- As a collaborative project the priorities for LArSoft work are discussed and decided in the bi-weekly LARSoft Librarian and Partner/Project meetings. MicroBoone will be a regular attendee at these meetings to ensure there is good coordination across the experiments and core support teams.

The details of the LArSoft service agreement, organization, commitments, etc. are being developed and will supersede the details in this section.

The MicroBooNE collaboration depends on ROOT and TotalView.

3.12 Simulation Software

3.12.1 GEANT4

MicroBooNE depends on the Geant4 detector simulation toolkit to simulate the beam line associated with the experiment and the interaction of particles with the detector material after the

first neutrino-nucleus interaction. As such, Geant4 is a core part of the MicroBooNE software stack and essential to the success of the experiment.

Fermilab will provide consultation services to MicroBooNE on topics such as how to install and configure Geant4 and how to use it to develop detector and beam applications. Fermilab will also partner with the experiment to help improve the physics of Geant4 using the framework established by the Geant4 Collaboration for community contributions. This may include the addition of physics models, their validation and the composition of Geant4 physics lists to achieve the best possible physics description for the particles, materials, configurations, and kinematic ranges involved specifically in the MicroBooNE experiment. Fermilab will also communicate to the Geant4 Collaboration any requests from MicroBooNE for new features or bug fixes. Additionally, Fermilab will invite MicroBooNE representatives to report during the Geant4 Technical Forum meetings that the Geant4 Collaboration holds periodically with the users community to receive general input and specific requests. Fermilab will also offer to represent Microboone at Technical Forum meetings in case they cannot or do not wish to attend.

The Geant4 Collaboration is an independent entity Fermilab contributes to but does not control. Fermilab has responsibilities and representation within the Geant4 Collaboration. Even though neither Fermilab nor any other institution can unilaterally decide on Geant4 software strategy, planning, or prioritization, Fermilab will represent Microboone interests within the Geant4 governance structure and lobby for Microboone requests.

3.12.2 GENIE

MicroBooNE depends on the GENIE Monte Carlo event generator to simulate neutrino-nucleus interaction physics and to study associated systematic uncertainties. As such, GENIE is a core part of the MicroBooNE software stack and essential to the success of the experiment.

Fermilab will provide consultation services to MicroBooNE on topics such as how to install and configure GENIE and how to use it within their beam and detector simulation software. Fermilab will also partner with the experiment to help improve the physics of GENIE using the framework established by the GENIE collaboration for community contributions. This may include the addition of physics models, their validation, and the composition of GENIE tunes to achieve the best possible physics description for the particles, materials, configurations, and kinematic ranges involved specifically in the MicroBooNE experiment. Additionally, Fermilab will provide a public line of communication to the GENIE Collaboration in the form of regular meetings with GENIE authors, hosted by the laboratory. Finally, Fermilab will reserve space for MicroBooNE to participate in GENIE schools and developer's workshops hosted at the laboratory and provide consulting expertise to independent GENIE software projects within MicroBooNE.

The GENIE Collaboration is an independent entity Fermilab contributes to but does not control. Fermilab has responsibilities and representation within the GENIE Collaboration. Even though neither Fermilab nor any other institution can unilaterally decide on GENIE software strategy, planning, or prioritization, Fermilab will represent Microboone interests within the GENIE governance structure and lobby for Microboone requests.

4 Miscellaneous

This section is used for miscellaneous items not covered above.

5 References

[1] FNAL Foundation Service Level Agreement, CS-DocDB #4042

http://cd-docdb.fnal.gov/cgi-bin/ShowDocument?docid=4042

[2] Fermilab Policy on Computing http://security.fnal.gov/policies/cpolicy.html

[3] "Establishing Grid Trust with Fermilab", CS-DocDB #3429 http://cd-docdb.fnal.gov/cgi-bin/ShowDocument?docid=4042

[4] The Fermilab Campus Grid (FermiGrid) Computing Policy Page http://fermigrid.fnal.gov/policy.html

[5] The Open Science Grid http://www.opensciencegrid.org/

[6] "Technical Design Report for CD-2/3a," MICROBOONE Document 2678-v8, October 8, 2007.

[7] MicroBooNE Minor Application Plan (in progress), MicroBooNE DocDB #4250.

[8] The following MicroBooNE documents describe the DAQ system requirements: DAQ Monitor (#3769), Data Concentrator Module (Software) (#3664), Data Logger (#3683), Data Quality Monitoring (#3799), Dispatcher (#3944), Event Builder (#1168), File Transfer System (#3786), Global Trigger (#2631), Spill Server (#4529), Message Logging System (#2332), Message Passing System (#1210), Resource Manager (#3678), Run Control (#1877). These documents are in the MICROBOONE-DocDB.

6 Document Revision History

Date	Version	Author(s)	Comments
13-Sep-2013	V0.00	Keith Chadwick	Template
30-Sep-2013	V0.1	Keith Chadwick	Import MicroBooNE information from prior MOU

26-Feb-2014	V0.1	Stephen Wolbers	Edit for MicroBooNE
10-Mar-2014	V0.2	Keith Chadwick	Edits “experiment” -> “collaboration”
24-Apr-2014	V0.3	Stephan Wolbers	Edits for MicroBooNE based on the feedback received from many people in MicroBooNE and some in Computing Sector.
28-Apr-2014	V0.4	Keith Chadwick	Minor edit to replace “problem” with “issue” where appropriate
8-May-2014	V0.5	Keith Chadwick	Following consultation with Steve Wolbers, replace “expertise” with “consulting”, add pointer to SPPM, modify request process.
8-May-2014	V0.6	Keith Chadwick	Fix formatting in network service table
27-May-2014	V0.7	Ruth Pordes	Address Brian and CCD comments to date.
6-Jun-2014	V0.8	Keith Chadwick	Address external comments, make ready a draft for review by MicroBooNE collaboration members.
24-Jun-2014	V0.9	Keith Chadwick	Add LarSoft statement of support, address comments from Adam Lyon.
15-Dec-2014	V1.2	Stephen Wolbers	Roll up of all changes from networking, GEANT, GENIE, Databases, LArSoft
16-Jan-2015	V1.3	Stephen Wolbers	Add a sentence about future developments in the LArSoft agreements which are in process.

7 Bibliography

[1] http://cd-docdb.fnal.gov/cgi-bin/ShowDocument?docid=4042
[2] Fermilab Policy on Computing http://security.fnal.gov/policies/cpolicy.html
[3] The MicroBooNE Technical Design Report http://microboone-docdb.fnal.gov:8080/cgi-bin/ShowDocument
[4] http://cd-docdb.fnal.gov/cgi-bin/ShowDocument?docid=4314
[5] http://cd-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=4321
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[14] PPD support documentation to be completed