1.Remote Production Facilities

Over the next five years it is expected that Remote Production facilities will provide the bulk of processing power for the DØ collaboration. It is envisaged that there will be three major tasks to be carried out by these sites:

1.Monte Carlo (MC) Production

2.Reconstruction and Secondary reprocessing of the data.

3.CPU intensive user Analysis Jobs.

Each of these modes of operation will have different requirements. The simplest is MC Production which is essentially self contained and does not require database access. Reconstruction of data for analyses requires database access and careful book-keeping for specific binaries. User analyses jobs require that we can run a generic binary with any appropriate input.

Currently there are several remote production sites with the following capabilities

Site	***CPU's***	***CPU Type***	***Disk Store***	***Mass Storage***
Current Sites				
BU	10			
CCIN2P3	XX% of 200			
Lancaster	200	750 MHz	1.5 TB	30 TB plus
Nikhef	150	750-800 MHz		TB
Prague	30	700 MHz		
UTA	100	750 MHz		
Total Current	440			
Planned Future Sites				
University of Michigan	100	?	?	?
Manchester University	64	1.9 GHz	2.5 TB	?
Oklahoma	25% of 256	2 GHz	500 GB	
UCD Ireland				
Total Future	~600			

The minimum required capability of these production facilities must be sufficient to meet all of the needs for MC production. The planned rate of MC production over the net five years is planned to 35 Hz. For a standard 750 MHz CPU the time per event of the various stages of MC processing are:

Process/Time per Event	***Generation***	***Døgstar***	***Døsim***	***Døreco***	***Analyze***	***Total***
0.5 Events Overlaid, Plate Level Geant						
WW inclusive	0.5	186	13.1	12.6	3	215.7

If we assume that the duty cycle of any given node is 80% then we require 9.5k 750MHz CPU's to fulfil our MC generation requirements before we consider the other requirements, such as reprocessing. Currently we have approximately 500 CPUs available so we clearly need to increase the number of CPUs available for these tasks.

If we assume that by 2003 we will have available to us 4 GHz CPUs instead of the 750 MHz machines caurrently available then we will obtain a factor of five reduction in the number of required CPUs for remote production to a minimum of 2k. It is important to note that this number of remote processors

does not include a contribution for remote data analysis and reprocessing.

If we require >10k CPU's in near constant use to meet our processing requirements there is an obvious need to maximise our possible resources. This will probably require making use of as many university machines as possible. This only makes sense in terms of fully implemented GRID options within SAM.

a)Hardware Upgrades

The Remote Production Facilities will be made up of standard Linux PC units with the following minimum requirements:

- 1GB Memory
- 50 GB Hard Disk
- XXX CPU's
- XX TB disk space
- Mass Storage.

Each of the remote processing sites will need to upgrade and renew the hardware on a rolling basis every three years.

i.Hardware Cost

We will assume that the cost of a dual processor PC suitable for running DØ software will cost US$3000. If we provide a minimum number of 4GHz procesors off site to meet our stated goal of 30 Hz rate for MC production then we will require 1k units, resulting in a total initial cost of US$3M exclusing maintinence costs.

Note we will need to include costs for disk storage, mass storage etc. The Lancaster facility cost £400k, corresponding to £4M for 2k processors with no scaling. Note this included a robot, this gives rough agreement for the above numbers.

b)Software

ii.Operating Systems

We are currently upgrading to Fermi Redhat Linux 7.1 or the equivalent.

It is assumed that all remote production sites will be running the current version of Fermi Redhat Linux or a similar Redhat release. It is expected that Fermilab will support official builds for the Fermi Redhat Releases or equivalent used on remote production sites. It is understood that the remote production sites will in many cases be shared facilities, in most cases with CERN experiments and will not be able to upgrade operating systems purely to meet DØ software requirements.

iii.Required Software for DØ production

Each remote production facility must be able to run a minimal set of DØ software. These minimal requirements are as follows:

- A fully functional SAM station, capable of storing and retrieving data from any location.

- mc_runjob, the DØ Monte Carlo job submission software
- The full MC suite of software, including but not limited to: The generators Pythia, Herwig, and Isajet; Døgstar; Døsim; Døreco; Trigsim; and the equivalent of Recoanalyze (releasd as tarballs, the full software distribution is not required).

To be able to run reconstruction of data the production facilities will also be required to be able to access the appropriate DØ calibration, and luminosity databases. It is assumed that these will be accessed via a server interface and not require a local copy of the database.

iv.Software requirements

The Remote Production Facilities will not be required to run any software produced by a user. The user will be required to meet several mandatory conditions:

- A software package to be run at a remote facility must be part of an official production release.
- The software must be built using Dørte to ensure that the package can run without the full DØ release.
- Any input/output data must be stored in SAM.
- That the jobs can be fully described and submitted to a SAJM queue.

v.Database Access

Not sure what to put here. If we are to reconstruct data this is a requirement. Should be done via a database server.

vi.Grid Enhancements

It is assumed that Remote Production Jobs will make full use of the current DØGrid project. Use of the Grid is not specific to remote analysis, but rather is a coherent part of the overall computing plan.

c)Production Models

For the purposes of describing the processing that will take place at remote sites I would like to define different phases of software production. These will all be slightly different for each of the types of processing but will have several common points.

1. **Development** : This is the period during which we are developing the software. In this period programs are changing rapidly and almost all of the output produced will become obsolete as new versions of the code is produced.
2. **Steady State:** Once the code becomes stable and only minor improvements are made. In this state we may be able top reprocess the output of programs rather than fully reprocessing the data/MC.
3. **Run IIB**: At this point in time we will introduce new detector elements and will have two sets of data. Run IIA data which will be in the steady state and the Run IIB data which will be in the development phase.

4. **Run IIB Steady State:** At tis point in time the software will be mature and change infrequently.

For each of the above phases the processing requirements will differ.

vii. MC Production

For MC Production we assume that until the steady state mode is reached that all MC data is disposable and will need to be fully regenerated after each major software release. For this reason no intermediate stages of the MC production will be saved.

The steady state will be reached once we have a stable detector simulation with all detector components fully simulated and a close to final simulation of the magnetic field. Once this stage has been reached the limiting process is obviously the Geant simulation of the detector. At this point in time the experiment will wish to accumulate a standard MC event sample for comparison with the data. Since the processing after the Geant simulation only takes 10% of the total processing time, and the requirement of modelling several different luminosity bins, we will be storing the Døgstar output as well as the final output of each event. This output will be reprocessed after each improvement in reconstruction, or to simulate different luminosities.

viii. Data Reprocessing

Currently data reprocessing on the remote production facilities is not necessary. It will not be necessary until the central processing facilities are over loaded and can no longer (re)-process the data. At this time any reprocessing of data will need to take place a remote facilities./

ix. Generic User Analysis Jobs

TBA

General Principles:

- In most cases we will attempt to move the jobs to the data
- Require GRID queuing system to make this available at all sites.
- Need Mass Storage close to processing centres.

d) Storage

x. Disk Storage

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xi. Remote Mass Storage

Need to calculate amount of remote storage required.

e) Network

Minimal Requirements