

## 8 Technical Specifications

### 8.1 PARAM Shavak High Performance Computing (HPC)

Sr.No	Items	Description
A	<b>"PARAM Shavak" (Qty:1)</b>	
	Processor	Dual Socket Intel Xeon E5-2680 v4 series with 14 cores each with 2.4GHz Clock speed
	RAM	64 GB ECC DDR4 2133 MHz RAM in balanced configuration
	Network	Two 1GbE network port
	Accelerator/port	2 x 16 PCI-E Gen3 slots for co-processors
	DVD	One number internal 8x DVD +/- RW/DVD combo
	HDD	4* 2TB SATA -3.5" 7200rpm SATA HDD with SATA/SAS Hardware RAID controller (1GB cache) - Hardware RAID 0,1,5,10
	Graphics	On board or Add on card for visualization
	OS Support	Open Source Linux OS. Certified with RHEL 6.x, SUSE Linux Operating system
	Power Supply	80 plus or better certified power supply
	Monitor	19" TFT LCD monitor with USB keyboard and Mouse
B	<b>PARAM Shavak Software Environment</b>	
	PARAM Shavak Installer	<ul style="list-style-type: none"> <li>• Single image across all the deployment.</li> <li>• Linux based OS, drivers and development tools customized as per the Hardware.</li> <li>• Modular approach to integrate newer tools or upgraded version of applications seamlessly.</li> <li>• Integrated packages for OFED, MPICH, Ganglia, torque, Intel Cluster Studio, IDE and HPC Applications.</li> <li>• Integrated with indigenous tools CHReME and ONAMA.</li> <li>• Rescue image for recovery.</li> <li>• Fast system provisioning and ready to be used with minimal system configuration requirement from users.</li> </ul>

	ONAMA (C-DAC HPC Solution for Academic Community)	<ul style="list-style-type: none"> <li>• A well selected set of parallel as well as serial applications and tools across various engineering disciplines such as computer science, mechanical, electrical, electronics, civil, chemical engineering, etc.</li> <li>• It also provides access to various libraries like parallel libraries, performance libraries and engineering domain specific libraries that can be used to develop programs to solve the user's problems.</li> <li>• Provides an intuitive GUI that launches the applications available as a package</li> <li>• ONAMA comprises of Application Execution Model and the Command Line Interface.</li> </ul>
	CHReME (C-DAC High Performance Computing Resource Management Engine)	<ul style="list-style-type: none"> <li>• <i>Comprehensive monitoring:</i> Through CHReME, administrator can collect, monitor, visualise and analyse data pertaining to resource consumption, jobs, users, etc, thus empowering admins with actionable information.</li> <li>• <i>Extensive runtime environment:</i> This provides an extensive HPC runtime environment for parallel applications including compilers, scientific libraries, etc.</li> <li>• <i>Security:</i> Users access remote cluster resources from any location using a Web browser through HTTPS encryption and the SSH network protocol, which provides a secure data</li> <li>• <i>Easy Job Submission and Management:</i> CHReME portal provides the functionality of Job Submission, Job Management and Monitoring tool that can work with different schedulers or workload managers viz, Torque, Load Leveler, PBS etc. By default the portal uses Torque as resource manager for efficient utilization of HPC system</li> <li>• <i>Workload manager integration:</i> CHReME is integrated with Torque, a resource manager, and with Maui, a cluster scheduler that helps users get optimal and efficient cluster resources.</li> <li>• <i>Resource registry and management:</i> The portal allows the creation; management and monitoring of various cluster resources like queues, parallel environments, users, nodes, etc.</li> <li>• <i>Alerts and reporting:</i> Users can receive automated notifications via e-mail, based on events such as job</li> </ul>



		<p>completion, changes in resource availability, job suspension, etc.</p> <ul style="list-style-type: none"> <li>• <i>Credential management</i>: This function is used to create new roles, new users, to assign/un-assign roles to users, and to disable/enable users from the HPC system.</li> <li>• <i>Uploading and downloading files and folders</i>: The portal offers a Web interface for file uploading and downloading from the client or HPC system. Errors and output files of the applications and jobs can be downloaded onto the client machine.</li> <li>• <i>Centralized application and data access: CHReME</i>: Provides the convenience of accessing users applications and corresponding data from a remote location, along with empowering the administrator with centralised management of all cluster resources. CHReME guides the user throughout the application execution process. With CHReME in place, the researcher is not burdened with the 'How' and 'Why' of running the HPC system.</li> </ul>
	Intel Tools	<p>Intel Software Development Suite student Edition for Linux:</p> <ul style="list-style-type: none"> <li>• Intel® Fortran Composer XE,</li> <li>• Intel® C/C++ Composer XE, Intel® Trace Analyzer and Collector,</li> <li>• Intel® MPI Library,</li> <li>• Intel® MPI Benchmarks,</li> <li>• Intel MKL,</li> <li>• Intel IPP,</li> <li>• Intel V Tune Amplifier,</li> <li>• Intel Inspector)</li> </ul>
	User Documents	Training materials and User manuals
	Application Support	1 year remote application support from the date of installation.

## 8.2 PARAM Shavak Deep Learning (DL GPU)

Sr.No	Item Name	Technical Specifications
A - I	"PARAM Shavak DLGPU System" (with one NVIDIA P5000)	

	Processor	Dual Socket Intel Xeon E5-2680 v4 series with 14 cores each with 2.4 GHz Clock speed
	RAM	64 GB ECC (8GB x 8) DDR4 2400 MHz RAM in balanced configuration
	HDD	8 TB SATA/NL-SAS disks with support for hardware RAID 0,1 and 5
	OS	Open Source Linux OS. Certified with RHEL 6.x, SUSE Linux Operating system
	Accelerator cards	1 X NVIDIA P5000 (16 GB, 2560 cores)
<b>B</b>	<b>PARAM Shavak DLGPU Software Environment</b>	
	NVIDIA Deep Learning GPU Training System	DIGITS
	NVIDIA Deep Learning SDK	<ul style="list-style-type: none"> <li>• Deep Learning Primitives (cuDNN): High-performance building blocks for deep neural network applications including convolutions, activation functions, and tensor transformations</li> <li>• Deep Learning for Video Analytics (DeepStream SDK): High-level C++ API and runtime for GPU-accelerated transcoding and deep learning inference</li> <li>• Linear Algebra (cuBLAS): GPU-accelerated BLAS</li> <li>• Sparse Matrix Operations (cuSPARSE): GPU accelerated linear algebra subroutines for sparse matrices</li> <li>• Multi-GPU Communication (NCCL): Collective communication routines, such as all-gather, reduce, and broadcast that accelerate multi-GPU deep learning training on up to eight GPUs</li> <li>• Deep Learning Inference Engine (TensorRT): High-performance deep learning inference runtime for production deployment</li> </ul>
	CUDA Toolkit (The Deep Learning SDK requires CUDA Toolkit). GPU-accelerated libraries and development tools included in the	<ul style="list-style-type: none"> <li>• GPU-Accelerated Libraries <ul style="list-style-type: none"> <li>▪ Fast Fourier Transforms (cuFFT)</li> <li>▪ Basic Linear Algebra Subroutines (cuBLAS)</li> <li>▪ Sparse Matrix Routines (cuSPARSE)</li> <li>▪ Dense and Sparse Direct Solvers (cuSOLVER)</li> </ul> </li> </ul>



CUDA Toolkit	<ul style="list-style-type: none"> <li>▪ Random Number Generation (cuRAND)</li> <li>▪ Image &amp; Video Processing Primitives (NPP)</li> <li>▪ NVIDIA Graph Analytics Library (nvGRAPH)</li> <li>▪ Templated Parallel Algorithms &amp; Data Structures (Thrust)</li> <li>▪ CUDA Math Library</li> </ul> <ul style="list-style-type: none"> <li>• Development Tools               <ul style="list-style-type: none"> <li>▪ NVIDIA CUDA C/C++ Compiler (NVCC)</li> <li>▪ Nsight Integrated Development Environments</li> <li>▪ Visual Profiler</li> <li>▪ CUDA-GDB Command Line Debugger</li> <li>▪ CUDA-MEMCHECK Memory Analyzer</li> </ul> </li> <li>• Reference Materials               <ul style="list-style-type: none"> <li>▪ CUDA C/C++ code samples</li> <li>▪ CUDA Documentation</li> </ul> </li> </ul>
Support for installations or technical for installations or re-installation of the above software on PARAM SHAVAK DLGPU	Remote Support (One year from the date of installation)
Deep Learning and GPU Teaching kit	Faculty from Each end user Institute must subscribe online to avail this at: <a href="https://developer.nvidia.com/teaching-kits">https://developer.nvidia.com/teaching-kits</a>
User Documents	Training materials and User manuals
Hardware Warranty	3 years standard from date of delivery