

TECHNICAL SPECIFICATION

THE PURCHASE OF HIGH-RESOLUTION NUMERICAL WEATHER PREDICTION COMPUTING SYSTEM

1. INTRODUCTION

- 1.1. Numerical weather prediction (NWP) models require a huge amount of computing resources. Complex physical processes and air mass movements are computed both vertically and horizontally, and the need for computational capacity increases depending on the selected geographic area and the resolution of the models. The need for computing resources is even more important when data is used for operational weather forecasting when the speed of NWP results' presentation can affect anticipation and quality of made decisions.
- 1.2. The subject of this public procurement (hereafter – Procurement) is the purchase of High-resolution numerical weather prediction computing system (hereafter – Compute system), optimized for WRF and Cosmo models' operational weather forecast.

2. GENERAL REQUIREMENTS

- 2.1. Before the delivery of the product, the Supplier is required to run performance tests on the offered vendor's Compute nodes and provide tests results. Compute system's performance values should be not worse than specified in the Procurement's Technical specification. If the required minimum performance values are not achieved on the provided Compute system, the Supplier will be obliged to provide additional hardware and software free of charge to ensure that the performance of the Compute system meets the required performance values.

3. TECHNICAL REQUIREMENTS

Minimum technical characteristics of the equipment required for a high-performance cluster

3.1. Compute system

N	Name	Technical requirements		Q-ty
1	Computing Server	2 pieces Processor	Frequency 2GHz Number of cores 64 Number of threads 128 Cache memory 256 Mb	6
		RAM	512 Gb, 3200 MT / s	
		Network port	2 pieces 1Gb Rj-45	
		Infiniband port	2 pieces 200 Gb QSFP56	
		Power supply	Duplicated, 1400 W	
		Management	Fully licensed	
		Accessories	Rack mounting kit	
2	Data server	2 pieces Processor	Frequency 2.5GHz Number of cores 32 Number of threads 64 Cache memory 128 Mb	1
		RAM	128 Gb, 3200 MT / s	
		Raid controller	1 piece, 4Gb cache, each port speed 12 Gbp/s	
		System hard drive	2 pieces of 480 Gb SSD (RAID 1 compatibility)	
		Data hard drive	6 pieces 3.84 Tb 12Gbps SAS SSD	
		Network port	2 pieces 1Gb Rj-45	
		Infiniband port	2 pieces 200 Gb QSFP56	
		FC Port	2 pieces 16Gb HBA	
		Power supply	Duplicated, 750 W	
		Management	Fully licensed	
		Accessories	Rack mounting kit	

3	Management server	2 pieces Processor	Frequency 3.1GHz Number of cores 8 Number of threads 16 Cache memory 64 Mb	1
		RAM	64 Gb, 3200 MT / s	
		Hard drives	2 pieces of 480 Gb SSD (RAID 1 compatibility)	
		Network port	2 pieces 1Gb Rj-45	
		Power supply	Duplicated, 750 W	
		Management	Fully licensed	
		Accessories	Rack mounting kit	
4	Infiniband Switch	Ports	40 ports, 200 Gb QSFP56	2
		Control port	100/1000 RJ45 RS232 console port USB port	
		Management	CLI, WebUI, SNMP, JSON	
		Bandwidth	16 Tb/s	
		Delay between ports	130 nanoseconds	
		Additional functionality	Adaptive Routing Congestion control Port Mirroring VL2VL mapping	
		Cooling	Rear-to-Front	
		Power supply	Duplicated	
		Accessories	Rack mounting kit	
		Cables	3 meters long 7 pieces of active optical cable with 200Gb/s throughput, terminated with QSFP ports Manufacturer of the cables and switch should be the same	
5	Extension of existing Dell EMC Unity 300 disk array	LFF expansion rack	3 pieces of 15 LFF disc rack	1
		HDDs	41 pieces of 12 TB LFF NLSAS disc	

		Cables	All the necessary cables to connect to the existing disk array	
		Accessories	Rack mounting kit	
6	Software	Operating system	On all Compute system servers must be installed CentOS or Scientific Linux OS (or equivalent).	
		Central management software	Must be provided software with such features (or equivalent): - Centralized management and monitoring (health and performance) for the offered Compute system; - Support for offered processor microarchitecture nodes and network technologies; - Centralized OS image preparation and deployment on Computing servers using PXE boot (or equivalent); - Support for offered Linux OS distribution centralized deployment on Computing servers; - Centralized user management; - Centralized software packets deployment on Computing servers; - Parallel execution of commands/file copy to any managed server; - Reboot of the complete Compute system or individual servers with one command; - Must feature GUI and CLI management interfaces.	
		Job queuing software	Must be provided software with such features (or equivalent): - Manage centralized access to x86 64bit CPU, GPU and co-processor resources, provide jobs scheduling and prioritization based on defined/ customized policies; - Support for Infiniband and Ethernet network technologies; - Submission of MPI and OpenMP jobs; - Job checkpointing and preemption functions.	
		Specialized software	Must be provided software with such features (or equivalent): - All specialized software (compilers, MPI, maths libraries, etc) which was used for Compute system WRF performance testing (see clause 3.2. WRF Performance testing) must be offered and deployed on the provided Compute system.	

7	Services	Installation	The supplier must provide: - Delivery goods onsite; - Install all the equipment into the Purchaser's rack cabinet; - Do cabling/marking of power and data cables; - Compute system hardware installation and configuration; - OS installation on Compute system nodes; - Centralized management software installation; configure and deploy OS images on Compute nodes; - Job queuing software installation; - Specialized software installation; - Compute system configuration documentation.	
		Performance testing	The supplier must do testing according to clause 3.2. WRF performance testing.	
		Training	The supplier must provide: - Training about installed Compute system hardware, software, management and monitoring tools; - Provide WRF code optimization techniques (see clause 3.2. WRF performance testing) to the Purchaser.	

- The Supplier shall install the equipment at the following address: Marshal Gelovani ave. 6, 0159, Georgia, Tbilisi;
- The purchased products must be delivered in the above mentioned location, by Incoterms 2020, DDP – Delivered Duty Paid (named place of destination);
- The system shall be delivered within 120 calendar days after signing the contract;
- The offered products must have at least a 3-year manufacturer's warranty.
- The supplier must guarantee that the provided system will be new, without any damages (no signs of defects). In case of failure of a defect within the warranty period occurred in the system supplied by the contractor, the contractor shall take necessary actions to fix the problem/failure or replace the defective products within the reasonable period but not more than 30 calendar days;
- The offered commercial software must have at least 3-year manufacturer's support and updates.
- The technical requirements are minimum and Supplier can provide better technical characteristics

3.2. WRF performance testing

No.	Requirement
1.	General part
1.1.	Before the delivery of the product, the Supplier must run WRF performance test on offered vendor's Compute nodes and provide the test. WRF performance test must be executed on the offered quantity of Compute nodes.
1.2.	Compute nodes, used for WRF performance testing, must comply with the Procurement's Technical requirements.
1.3.	Compute system's performance values should be not worse than specified in the Procurement's Technical specification.
1.4.	Supplier at our own expense must provide official conclusion issued by the LEPL Levan Samkharauli National Forensics Bureau or other accredited authority that ensures provided computing system's compliance with the technical requirements. (A copy of a certificate of accreditation from the accrediting authority must be provided with the conclusion)
1.5.	Purchaser is authorized to participate in the WRF performance testing process. At least 5 days before the commencement of the performance testing the Supplier is required to inform the Purchaser about the dates.
2.	Testing system
2.1.	The supplier must provide information about a compute system, used for WRF performance testing (hereafter – Testing system), and submit it before the delivery: a) Compute node vendor/model/quantity b) CPU model/quantity/core number/frequency c) RAM type/quantity per Compute node d) Compute network protocol/speed e) Used Specialized software (compiler, MPI library, math library, etc)
2.2.	It's required to describe briefly WRF code optimization techniques, used for WRF performance testing.
3.	Obtaining WRF code for testing
3.1.	WRF performance testing must be done with WRF 4.2 version.
3.2.	WRF code is available for download at https://github.com/wrf-model/WRF
3.3.	The supplier must fulfil all the procedures, required to get access to the code, by itself.
4.	Installing and configuring WRF code
4.1.	Supply must install and configure WRF code on a Testing system by itself.
4.2.	The purchaser will provide the input files, needed to run WRF performance test.
5.	WRF code optimization
5.1.	WRF test No.1 It is allowed to do only such WRF code optimizations, which do not affect the quality of the generated result, do not change the purpose of WRF code and do not reduce the accuracy of the calculation.
5.1.1.	Typically permitted WRF code optimizations for WRF test No.1:

	- Use of compilers directives; - Use of math libraries; - Use of optimization libraries; - Use of different CPU quantity, MPI/OpenMP process quantity; - OpenMP directives modification; - Modification of WRF code part, which is related to input/output (I/O) operations, without changing the final amount of generated/calculated/transmitted data.
5.1.2.	Forbidden changes: - Modification of WRF code (except that what is permitted in clause 5.1.1); - Modification of input files (indicated in clause 7.1).
5.2.	WRF test No. 2 It is allowed to do only such WRF code optimizations, which do not affect the quality of the generated result, do not change the purpose of WRF code and do not reduce the accuracy of the calculation.
5.2.1.	Permitted WRF code optimizations for WRF test No.2: - WRF code optimizations described in clause 5.1.1; - Modification of parameters in „@dynamics“ section of „namelist.input“ file, targeted to improve model stability for higher resolution cases that cover geographic regions with steep terrain.
5.2.2.	Forbidden changes: - Modification of WRF code (except that what is permitted in clause 5.1.1); - Modification of input files (indicated in clause 7.1)(except that what is permitted in clause 5.2.1).
5.3.	The supplier will have to provide used WRF code optimization techniques to the Purchaser and install it on the delivered Compute system.
6.	WRF performance tests values
6.1.	WRF test No.1: - Forecast duration: 6 hours - Test execution time (wall time): ≤380 seconds
6.2.	WRF test No.2 - Forecast duration: 6 hours - Test execution time (wall time): ≤180 seconds
7.	WRF input files
7.1.	The purchaser will provide to Supplier such input files needed to run WRF performance tests: - namelist.input - namelist.wps - gfs_down.sh