REQUIREMENTS DOCUMENT

Title: Low-Jitter Time Distribution Switches

Requesting Lab: Communication Technology Laboratory

I. BACKGROUND INFORMATION

We are requesting two low-jitter time distribution switches for remote synchronization across remote sites, and a programmable quantum instrumentation control system that can interoperate with our current high-precision time distribution infrastructure. The control system provides programmable reconfigurability for data acquisition, experimentation with low-latency machine learning algorithms, and instrumentation control.

Purpose/Objective: The objective of the acquisition is to enable programmable control system that can interoperate with our current White Rabbit Precision Time Protocol (WR-PTP) to enable absolute time synchronization to sub-nanosecond precision between sites at NIST Gaithersburg laboratories, the University of Maryland JQI, and other DC-QNet partners.

II. SCOPE

The Contractor shall deliver (1) a quantity of **two** White Rabbit Z16 (WR-Z16) low-jitter (LJ) switches, (2) a quantity of **one** Quantum Instrumentation Control Kit (QICK), and (3) a quantity of **one** High-Accuracy Timing IP (HATI) Core license activated on one port of one WR-Z16. All equipment purchases are inclusive of FOB Destination delivery, installation, warranty and training, and option line items.

III. MINIMUM REQUIREMENTS

The Contractor shall provide a system that meets all technical specifications identified below. All items must be new. Used or remanufactured equipment will not be considered for award. Experimental, prototype, or custom items will not be considered. The use of "gray market" components are not authorized for sale in the U.S. by the Contractor is not acceptable. All line items shall be shipped in the original manufacturer's packaging and include all original documentation and software, when applicable.

Line Item 0001: White Rabbit Z16 low-jitter switches

Description: The WR-Z16 provides sub-1 nanosecond time distribution via IEEE 1588-2008 Precision Time Protocol (PTP) in all its optical interfaces and supports the network time protocol (NTP). Picosecond-level frequency distribution is available through the clock outputs. The WR-Z16 includes failover mechanisms which combine multi-source redundancy and holdover capabilities.

Quantity: Two

A. Technical Specifications

a. WR-Z16-LJ-01 hardware version 5.0 or greater.
b. Supports the following time sources: WR-PTP, PTP, and NTP.

c. Optical fiber time distribution via WR-PTP and PTP.
d. Supports PTP telecommunications, power substation, and enterprise profiles
e. Supports HATI
f. Sub-100 ps peak-to-peak time error between the two WR-Z16-LJ 10 MHz and pulse per second (PPS) clocks.

Line Item 0002: Quantum Instrumentation Control Kit (QICK)

Description: QICK is a network control platform for scalable quantum systems, based on a field programmable gate array (FPGA). QICK is based on an open-source platform created by Fermilab.

Quantity: One

A. Technical Specifications

a. Radio frequency (RF) main FPGA development board.
b. AMD Zynq UltraScale+ RFSoC ZCU216
c. DC out and DC-in
d. Time tagger capability with sub-10 ps jitter rms.
e. Installation and integration.
f. Compatible with HATI, WR-Z16.
g. Digital to analog convers (DAC) outputs up to 10 GHz.

Line Item 0003: High-Accuracy Timing IP (HATI) Core license

Description: The HATI (High Accuracy Timing IP) is a FPGA core for QICK integration and interoperability with the WR-Z16 switches using optical fiber links.

Quantity: One

B. Technical Specifications

a. Permanent license on one port of one WR-Z16.
b. License supports integration of WR-PTP, PTP, and NTP time distribution to the QICK platform.
c. HATI training and support for use.

IV. DELIVERABLES

Description	*Quantity or Format*	*Due Date*
WR-Z16s are time distribution network switches provide sub-1 nanosecond time distribution via WR-PTP.	Two WR-Z16 low-jitter switches.	12 Weeks ARO
QICK is a network control platform for quantum systems, based on a field programmable gate array (FPGA).	One QICK with programmable control.	12 Weeks ARO

HATI (High Accuracy Timing IP) is a FPGA core for WR end node integration.	One HATI license.	12 Weeks ARO

Standards of Acceptance: The NIST TPOC or COR shall review the WR-Z16s, the QICK, and a HATI license, and respond with an acceptance or request for revision email to the Contractor Point of Contact (POC) within 14 days of receipt of deliverable. This section applies to deliverables which must be reviewed and approved for acceptances (draft plans, drawings, etc.)

V. PLACE OF PERFORMANCE

NIST 100 Bureau Drive MS8970 Gaithersburg, MD 20899

VI. PERIOD OF PERFORMANCE/LEAD TIME

Lead time up to 12 weeks.

VII. DELIVERY TERMS

Delivery shall be F.O.B Destination and shall occur in accordance with the delivery due dates provided in the above table.

FOB Destination means: The contractor shall pack and mark the shipment in conformance with carrier requirements, deliver the shipment in good order and condition to the point of delivery specified in the purchase order, be responsible for any loss of and/or damage to the goods occurring before receipt and acceptance of the shipment by the consignee at the delivery point specified in the purchase order; and pay all charges to the specified point of delivery. The contractor shall deliver all Line Items to:
National Institute of Standards and Technology
Shipping and Receiving
100 Bureau Drive, Building 301
Gaithersburg, MD 20899
POC (Ya-Shian Li-Baboud and Building 222)

*****Due to ongoing limited site access of the NIST facilities, the Awardee SHALL confirm with the Designated Government Official and the Contracting Officer prior to ANY shipment to NIST*****

VIII. TRAINING

The contractor shall conduct training session for up to 5 users at NIST. The training shall provide a thorough demonstration of all system/solution functions, maintenance, data administration, and basic troubleshooting. The training may be completed at NIST Monday – Friday during the operating hours of (provide hours or revise to remote) immediately after installation and demonstration of specifications and must be completed no later than (number of days after installation) after installation. Further training requirements are identified below (complete if applicable, if not applicable please delete):
1.

IX. INSPECTION & ACCEPTANCE

In addition to the inspection and acceptance terms articulated in 52.212-4, the Government reserves the right to perform such performance tests and evaluations as defined below to verify specified system performance. Such tests and evaluations, if performed, shall be conducted within the environment that the system is to be operated. The Contractor has the right to be present during the tests and evaluations, if performed, at the Contractor's expense.

Performance Tests:

1. List performance tests here

NIST may choose at its discretion to forego this part of acceptance testing.

A visual inspection of the equipment will be performed by the NIST TPOC to identify surface defects or any form of indication that any equipment was damaged during transport to NIST. The Government shall have sole discretion to require repair or replacement of damaged and/or nonconforming supplies at no cost to the Government. The Government at any time prior to acceptance shall reject the equipment due to defects and/or nonconformance. The vendor is responsible for latent defects discovered any time after final inspection. However, the extent of its liability shall be prorated over the useful life of the equipment.

Ownership of the equipment shall transfer to NIST upon acceptance by the Government.

The Government will test, inspect, and accept or reject the equipment within 30 of the receipt of the equipment unless otherwise indicated above. The Government reserves the right to conduct quality assurance testing to confirm that a given instrument(s) meets the manufacturer's and/or the Government's performance specifications. It is anticipated that the equipment will meet all manufacturer's specifications and/or the Government's performance specifications identified in the most recent operations and maintenance manual for each piece of equipment and/or in this document.

X. WARRANTY

The contractor shall warranty the entire system for a period of a minimum of five years after receipt of the equipment and shall be in accordance with terms in FAR 52.212-4. Warranty shall commence upon acceptance of the system by the Government and at a minimum shall include the following:

XI. PAYMENT SCHEDULE

Advance payment is not authorized. The Contractor must invoice in arrears according to the payment schedule. The Contractor shall be paid, in accordance with Net 30-day payment terms, upon receipt and acceptance of a proper invoice, in accordance with the following schedule:

1. 100% after installation and acceptance by the TPOC of fully installed system, AND
2. After the successful completion of the testing requirements set forth in this document under section set forth in this document, AND
3. After successful demonstration by the instrumentation that it performs IAW the technical requirements set forth in this document AND

4. After receiving an invoice submitted properly, IAW the purchase order terms and conditions.

NOTE: Partial shipments and partial invoices will not be accepted, unless otherwise requested and accepted by the Contracting Officer prior to award offer. Proposed payment schedules shall be submitted with vendor's response to the RFQ for consideration.