Request for Proposal – 2027 and Beyond
FIRST® Robot Controller

FIRST® **is a global robotics community that prepares young people for the future.**

www.firstinspires.org

Contents

1. Executive Summary

FIRST is seeking a new Mobile Robot Controller (MRC) to serve the needs of both the *FIRST* Tech Challenge and *FIRST* Robotics Competition programs. The supply agreements/lifespans for the existing Mobile Robot Controllers (MRC) for each program expire around the conclusion of the 2026-2027 seasons, and *FIRST* is searching for a solution for the 2027 - 2030 seasons (or longer). The chosen controller will need to support a team population of approximately 20,000-35,000 teams serving approximately 250,000+ youth and 50,000+ mentors per year across both programs over the lifetime of the system. *FIRST* seeks a partner or suite of partners to provide design, manufacturing, documentation, software, sales, and RMA support for all devices.

Respondents to this Request for Proposals (RFP) must propose a Mobile Robot Controller (MRC) and Low Current Actuator Power Distribution (LCAPD) solution. The proposal should be compatible with existing devices in the remaining categories, provide those capabilities within the MRC, or propose new alternative devices to fulfill those capabilities.

As this RFP is primarily seeking an MRC and LCAPD solution, detailed requirements for other devices are not included. They can be requested from *FIRST* if needed (see *Section 17* for contact information). A summary of system devices and capabilities is included below.

1.1 Complete Control System Capabilities

FIRST requires a Robot Control System (RCS) that consists of the following devices/capabilities:

- **Mobile Robot Controller (MRC)** – Main robot controller capable of controlling motor controllers and other actuators and receiving sensor data inputs (I2C, SPI, CAN, Serial, USB, and analog/digital inputs). Should be capable of receiving and processing camera images at a minimum of 30 fps at 320x240.
- **Low Current Actuator Power Distribution (LCAPD)** – Used in *FIRST* Tech Challenge only, a device capable of splitting the main battery power feed into individual connections for powering motors and other devices and providing regulated power for servos.
- High Current Actuator Power Distribution (HCAPD)– Used in *FIRST* Robotics Competition only, a dedicated device capable of splitting the main battery power feed into a large number of individually protected (auto-resetting) connections supporting approximately 20-40A continuous current per channel.
- Driver Station (DS) – Device which allows teams to plug in USB joysticks to operate the robot, select operating modes, and view robot video and diagnostics
- Wireless – Communication device(s) to communicate between the MRC and DS. This system must be capable of operating in a wide variety of venues, with up to

10 co-located fields of 6 teams. Teams must be able to operate wirelessly in their individual shop environments in addition to at the competition.

- Motor Control Module – Motor controllers must be full H-bridge devices capable of controlling motors.
- High Current Servo Support - A device capable of regulating and providing 5V power to high current (greater than 2.5A) servos. The device should pass through a PWM signal from the MRC, or generate a PWM signal based on other MRC communication (e.g. CAN).
- Pneumatics – Used in *FIRST* Robotics Competition only, the Pneumatics system should be capable of automatically controlling a compressor (~20A) based on pressure switch input and independently commanding at least 6 solenoid channels.

2. Schedule

The immediate proposal-specific timeline for this project is outlined below. A detailed proposed schedule for efforts leading up to the 2027 season is included in *Appendix A - Detailed Schedule*. Respondents are encouraged to include added detail or proposed adjustments as required by their business models, as well as a general schedule to support all seasons of the proposal.

RFP published/distributed:	November 10, 2023
Letter of Intent due to *FIRST*:	March 8th, 2024
Proposals due to *FIRST*:	May 31st, 2024
Final Selection (no later than):	June 28th, 2024

FIRST allows and encourages respondents to ask questions or seek preliminary feedback on aspects of their proposal while it is being developed, however note that *FIRST* staff availability and responsiveness may be limited while executing the 2024 competition season. In order to improve the information available to all respondents, *FIRST* reserves the right to publish questions and answers publicly, unless otherwise noted when submitting the question.

3. Project Requirements

FIRST needs a partner that will develop and support a system to service approximately 20,000 – 35,000 teams across both programs over the lifetime of the system. More detailed information about the total potential impact of this project including student and

team estimates by year, program, and region will be made available after Letters of Intent and NDAs are received.

3.1 Manufacturing Capability

In the first 12 months of the new controller's use, *FIRST* may need up to 30,000 units. These would not all be needed at the same time. An initial portion must be available to support distribution via the *FIRST* Robotics Competition Kit of Parts in October of 2026. Additional quantity for team sales and RMAs must be available no later than the end of 2026. The remaining quantity must be available no later than July 2027 to support the 2027-28 *FIRST* Tech Challenge season. Future seasons would need fewer controllers to service new teams and those teams needing replacement, spare, or backup units.

Any and all manufacturing efforts must include NRE efforts, material sourcing, production, testing, and quality assurance.

3.2 Software/Firmware support

FIRST requires a system of tools and software libraries to support team interaction with the RCS. Proposals should include, at minimum, details on support for firmware, operating systems, and other low-level software. Support for user libraries, development environments, and other tools described in the paragraph below may be included or may rely on support from *FIRST* identified resources including WPI and the WPILib volunteer development team (providers of the existing text-based language support for *FIRST* Robotics Competition).

The next generation MRC must support at least C++, Java, and Python as user programming languages. The MRC must facilitate the use of a robot-hosted web-based software environment for Java, Python, or both to allow at least basic user code development without installing a development environment. Support for a graphical or guided code generation experience is preferred. In order to support this development, the system should use a Linux OS with real-time support, preferably kernel version 5.4 or newer of a Debian or Ubuntu based distribution. Interfaces to low level hardware should be C\C++ to facilitate compatibility with required languages. Proposals which intend to deviate from one or both of these requirements are encouraged to reach out to WPILib developers (contact information available from *FIRST* upon request) to verify the feasibility of WPILib support.

3.3 Sales

To comprehensively support team competition needs, all components must be available to teams for purchase in the event that a team needs additional devices for their program, replacements for damaged units, or spare inventory. *FIRST* strongly prefers a partner that can own and house inventory, host a store front, and process orders in a timely manner (shipping within, at most, two business days of a placed order).

For respondents who may not be able to provide this capability, *FIRST* has identified a partner that is interested in providing this support to any proposal. Contact information for this partner is available from *FIRST* upon request. Respondents are responsible for engaging with this partner and negotiating any terms related to providing this service prior to submitting a proposal.

3.3.1 Export

FIRST currently has teams in many different countries and expects to continue to expand moving into the future. The chosen system will need to meet any regulations or certifications necessary to be exported to and used in those countries. Any questions or concerns about this should be directed to Erin Weinelt, eweinelt@firstinspires.org.

3.4 Technical Support/Documentation

FIRST is seeking a partner that can provide device technical support for both *FIRST* Robotics Competition and *FIRST* Tech Challenge teams. A preferred support structure includes the following components:

a) development support for *FIRST* for any changes required for hardware, firmware, or software
b) support for incorporating any changes into software libraries
c) support for manufacturing efforts (approval of alternate components, updates to relevant files, etc.)
d) support for teams
    i. updates to documentation that provide clean, concise instruction and information
    ii. accessibility for teams that needed additional help via phone, forum, and/or email (preferably all)
e) Presence at the *FIRST* Championship event (at minimum) for triage and technical support during competitions

3.5 Warranty/RMA support

A product warranty with rapid replacement for devices during the high volume season is required. This period runs at minimum from December through March and ideally covers at least October to March.

4. General MRC Requirements

There are a number of considerations for the next generation MRC/LCAPD that must be addressed in any proposal. The overall objective is to provide a platform that supports an easy-to-use, satisfying experience for teams while enabling them to tackle the

challenges of the competition in new and exciting ways. Generally, *FIRST* desires to *minimize* the following parameters:

a) system complexity (wiring, configuration, etc.)
b) user set up time (2-3 hours maximum)
c) cost
d) size
e) fragility

With every system, there are tradeoffs which must be made; to that end, the following criteria are detailed in this document to elaborate on *FIRST's* priorities and expectations for a comprehensive proposal.

The Mobile Robot Controller (MRC) is the "brain" of the robot. Team created user code runs on the MRC, which then monitors/ controls the various input and output devices on the robot. The MRC also receives data from the DS and sends status and diagnostic information back. The MRC can be a single device or consist of a central module with accessory modules.

4.1 Safety

Safety must be foremost in the design and operation of all aspects of the Robot Control System.

Safety features must prevent all run-away conditions. The most basic level of safety for every system level is to prevent robot operation in the event of loss of communications or code malfunction. The MRC must be able to disable all actuator outputs by (at minimum):

- disabling PWM signaling. Ideally send a single neutral pulse before disabling.
- ceasing the CAN heartbeat or, ideally, continuing the CAN heartbeat with the appropriate flag set in the CAN heartbeat message
- providing appropriate information about robot disabled status to vendor CAN libraries via API call

These safety features must not be able to be easily disabled by the user and should be "built into" the modules in a secure manner. The user should be clearly informed when a safety system is engaged. The safety features should engage in the following scenarios (at minimum):

- The robot is disabled via the Driver Station
- Communication with the Driver Station is lost (~100ms with no new data)
- User code crashes or hangs
- The system crashes or hangs

- As part of a load shedding scheme to prevent controller reboot

4.2 User Experience

FIRST teams present a wide range of technical capacity with diverse backgrounds. It is important for the MRC/LCAPD to provide intuitive interfaces and streamlined setup for users. Features promoting system convenience, e.g. the user may deploy code via a wireless interface, are encouraged.

4.2.1 Architecture

The design should aim for minimal module counts. Devices must be simple to wire and configure with an intuitive user setup. Section *5 MRC Component Specific Requirements* details the interfaces that must be integrated as part of a core module to support basic robot operation. These interfaces should be easily accessible with no additional modules or breakouts.

The additional interfaces specified in *5.7 Expanded System Interface Requirements* may be, in order of preference, integrated into the controller via easy to access connectors, integrated via dense connectors broken out by additional simple modules or provided via smart extender devices.

Section *6 Power Distribution Requirements* contains additional information regarding the architecture of the Moderate Current Power Distribution solution.

4.2.2 Simplicity of setup

A user should be able to configure the MRC components for use in 45 minutes or less. This setup time includes:

1. Firmware/software upgrade on the MRC.
2. Configuration of any team-specific settings on the MRC.
3. Compilation and download of default code to the MRC.

The purpose of this requirement is to provide teams with the ability to quickly verify the MRC operation and to enable programming teams to start with a working electrical control system.

The MRC must provide for programming and image updates that are non-bricking and can be recovered via a factory settings reset.

4.2.3 Documentation and User Resources

The submission must include a proposed portfolio for comprehensive, yet concise information dissemination to teams. Content shall include, but not necessarily be limited to device specifications, a quick-start guide, a detailed user guide, etc.

A strong bias toward graphical information representation is encouraged. Information distribution that accommodates teams with all levels of resources is crucial, but assumption that each team has access to a computer and the internet is appropriate.

Existing documentation of text-based software libraries and some documentation regarding setup and configuration of hardware are provided using Read The Docs sites (https://docs.wpilib.org and https://ftc-docs.firstinspires.org). Proposals may choose to leverage this platform for documentation but must include plans to contribute appropriate information to support the new device(s).

4.2.4 Technical System Diagnostics

The MRC must have diagnostics to aid in both system setup and troubleshooting.

The module level diagnostics should include the ability to verify basic operation and configuration of the various modules including software and hardware revisions. Missing or failed modules should not cause the system to lock up, outside of safety features noted in *4.1 Safety*. The diagnostics should point the users towards module or connection level issues as an aid for debugging.

The MRC should make available to user code and log or provide to the DS to log:

- Connection status information (latency, missed packets, etc.)
- System voltage
- MRC Electrical fault information
- CAN bus usage and fault information

4.3 Robustness

The robot environments (at a home shop, in a team pit, and on the competition field) are a particularly harsh environment with mechanical, electrical, and environmental conditions that stress the devices significantly. Devices must be designed to withstand these conditions, assuming at least 4-5 events per season and provide multi-year reliable service. A failure of a device causing a lost match is a negative user experience, the need to maintain the operation of the core components of the system and logging of status is critical.

4.3.1 Environmental

Devices must operate under a wide range of temperatures (0C to 50C) and humidities (10% RH - 90% RH) with no fans or forced airflow. Operation in these conditions is expected and must not reduce the lifetime of the devices. Devices must survive a wider range of storage temperatures (-20C to 70C) to facilitate robot shipping and transport in uncontrolled conditions.

4.3.2 Debris

Small metallic debris (swarf) is prevalent during use and devices must be protected from damage from this debris to the extent possible. While no formal IP rating is required, device components should be constructed to an equivalent of approximately IP60 with respect to the PCB and should strongly consider conformal coating.

4.3.3 Mechanical

The mechanical conditions include shock, vibration, and stress due to repeated insertion/removal of module connections. It would not be unusual for devices installed on a competition robot to experience up to 50Gs during operation and significant vibration (including inverted falls of the robot).

4.3.4 Terminals

The modular nature of the system facilitates swap out of components with the expectation that the connectors will not fail nor become loose or disconnected during operation and be able to sustain thousands of insertion/removals over the expected lifetime of the modules. Terminals used should facilitate tool-free wiring (e.g. lever or push-button style) or the use of pre-fabricated cables, while also allowing teams to fabricate custom cables with minimal expertise and inexpensive tooling.

4.3.5 Electrical

The electrical environment is harsh both during robot operation and assembly. Reverse battery protection is required to prevent damage to components due to mis-wiring of power connections. The robots will encounter significant ESD events both from interaction with the field and humans. ESD protection must be designed in and tested for all devices with particular concern for IOs. Short circuit and overcurrent protection is required to ensure that mis-wired, cut, or shorted lines will not damage the module.

4.3.6 Electro-Magnetic Interference

The control system must be able to withstand the EMI generated by the onboard DC motors. Due to the limited space on the robot, control system components will be in close proximity to the DC motors.

4.4 Volume Requirements

The size and weight of the MRC must be kept to a minimum to ease integration onto robot platforms and enable teams to meet the strict robot weight requirements. Consideration should be made for how wiring expands the functional volume of the system, keeping connectors to 1-3 sides of the device helps minimize this.

Core system functionality should be achieved in approximately 45 in^3 or less and weigh less than 2 lbs. Combined volume for achieving all required interfaces and power distribution should be less than 60 in^3 and weigh less than 3 lbs.

4.5 Costing

The MRC is meant to be easy to implement on robots and affordable for teams. Teams will need at least one full MRC setup while many will likely demand more than one complete setup. The cost of the full MRC and sub-components will be a major factor considered when evaluating proposals.

- Target cost per MRC sold directly to teams: < $450
- Target cost per MRC + LCAPD sold directly to teams: < $500

A substantial number of MRC units (and potentially LCAPD units) will be acquired directly by *FIRST* for distribution via the *FIRST* Robotics Competition Kit of Parts, stocking event spare parts cases, etc. There is a likely chance that *FIRST*, working with the Electronics Component Industry Association, ECIA, and other Suppliers, may minimize material costs for units provided to *FIRST*. In submitting proposals, please itemize material costs as a separate line item. Also, the manufacturing partner will likely need to incorporate/accommodate donated material (but is invited to include the material commitment and due dates needed to accommodate the manufacturing timeline). *FIRST* assumes that any donated components/materials will be removed from any/all invoiced costs to *FIRST*.

5. MRC Component Specific Requirements

To elaborate on the general requirements from Section *4 General MRC Requirements*, specific requirements for the MRC are detailed below. Component specific requirements for other devices may be found in supplementary documentation.

5.1 Power Requirements

MRC1. Input power requirements
   a) Minimum input voltage: 4.5V
   b) Maximum input voltage: >=24V
   c) Maximum power draw: <180W

MRC2. Onboard Real Time Clock (RTC) Supported by onboard battery or capacitor preferred

MRC3. All logic, sensor power, USB power and actuator control must remain active over full operating range.

MRC4. Load shedding should be triggered at 6.5V or lower, sending a neutral signal to all actuators.

MRC5. Servo power output must maintain voltage down to 6.5V input. Below this the rail may dip or be disabled as part of load shedding.

5.2 Mechanical Robustness Requirements

MRC6. Operating temperature 0C to 50C. Storage temperature -20C to 70C

MRC7. Operating and storage humidity 10% RH – 90% RH
MRC8. Vibration – 5g RMS, 10Hz to 500Hz random vibration, all axes
MRC9. Rough handling – IEC 60068-2-31 free fall, 1000mm height or similar
MRC10. Operational shock – IEC 60068-2-27 100g half-sine, all axes or similar
MRC11. Provisions for robust mechanical mounting
MRC12. Provisions for strain relief on all connections that do not have positive retention

5.3 Electrical Robustness Requirements

MRC13. Reverse polarity protected input power
MRC14. All I/O short circuit protected
MRC15. All I/O 14V tolerant (i.e. battery voltage applied to any pin). 24V tolerant preferred.
MRC16. Ground isolation (DC) of case > 100k ohm
MRC17. Must meet FCC/CE requirements for radio emission
MRC18. ESD protection – IEC 61000-4-2 to class 4 or similar.

5.4 Computing Requirements

MRC19. CPU – 64 bit (ARM64, 64-bit RISC-V, or x86-64), 1GHz+, Dual core. Quad core preferred
MRC20. RAM – 4GB minimum, at least 3GB available to user code. 8GB+ preferred.
MRC21. Storage: OS/User code – 8GB minimum, prefer non-removeable
MRC22. Storage: Log Data – 16GB or greater removeable (e.g. micro-SD) storage preferred. 10 MB/s bi-directional speed minimum, 100 MB/s write speed preferred.
MRC23. Image Processing – Should be capable of 30 FPS AprilTag processing at 640x480 while user code is running.
MRC24. OS – Real-time Linux OS (non-Android). 5.4 or newer kernel, Debian or Ubuntu based preferred.
MRC25. C\C++ interface to all hardware

5.5 General Device Requirements

MRC26. External reset button to trigger device reboot. Must not reboot during shock and vibration specified in *MRC8* and *MRC10*.
MRC27. Diagnostic tool for basic robot state (power, connected) viewable from at least 50 feet. May choose to utilize existing light solution by providing 12V switching source that can provide at least 60mA.
MRC28. LED status lights for basic diagnostics. Must be color blind friendly.
    a) Link status

b) Power status
c) Enable/disable state
d) Teleoperated/autonomous state
e) Fault conditions or common error indicator

MRC29. Volume to implement all requirements excluding *5.7 Expanded System Interface Requirements* and *6 Power Distribution Requirements* not to exceed 45 in^3

MRC30. Volume to implement all requirements including *5.7 Expanded System Interface Requirements* and *6 Power Distribution Requirements* not to exceed 60 in^3

5.6 Core Interface Requirements

MRC31. At least 6 PWM channels available for supporting hobby servos and motor controllers
   a) drive strength of 330 Ohms @ 5V
   b) 500uS to 2500uS pulse width range, 5ms period
   c) Minimum 8-bit resolution, 11-bit preferred
   d) Preferred – PWM pulses are periodic and falling edge aligned across channels. Time when falling edge occurs accessible from code

MRC32. At least 2 of above PWM channels with servo power supply
   a) 5V output. minimum 2.5A total output current, 4A total preferred.

MRC33. At least 12 general purpose digital I/O
   a) 5V tolerant, 3.3V logic signaling
   b) 150kHz sampling
   c) At least 4 quadrature decoders, 250k cycles/sec, 4 counts/cycle
   d) At least 4 pins capable of duty cycle measurement. Minimum 12 bit resolution, fundamental frequency up to 1khz.
   e) Integrated weak pull up resistors.
   f) 5V 1A supply for sensor power. Preferred 3.3V supply selectable or also available.

MRC34. At least 4 analog inputs
   a) 10 bit or higher resolution
   b) Minimum 1kHz sampling rate per channel. <10 uS read latency.
   c) 0V to 3.3V (can be larger range, but must still have 10 bit over this range)
   d) 5V 1A power supply (can be shared with digital). Supply voltage measured at same rate for computing ratiometric values.

MRC35. USB 3.0 host port – 2x required, up to 4x preferred.

a) Must support USB hubs, USB mass storage, USB webcams, USB wireless adapters

MRC36. Ethernet – 1x 10/100 port, Gigabit preferred. TSN support preferred.

MRC37. USB device port – 1x or other equivalent non-Ethernet way for user to connect and configure device.

MRC38. CAN - 2x separate buses, 2.0B 1Mbit. CAN-FD 8Mbps (2.0B compatible) preferred. Up to 4x total buses preferred.

MRC39. I2C – 1x Controller

a) V2.1 compliant
b) 100kbits/s into 400pF bus load

MRC40. SPI – 1x Controller

a) 100kbits/s minimum

MRC41. Serial – Preferred but not required

a) 115200 baud support
b) No arbitration signals necessary
c) May be TTL or RS232

MRC42. 6 axis low noise IMU - Detailed requirements and examples of IMUs commonly used by teams in both programs are available to potential respondents upon request.

a) Resolution – 16 bit
b) Minimum peak measurable angular velocity - 2000 degrees per second
c) Minimum peak measurable linear acceleration – 8g

5.7 Expanded System Interface Requirements

MRC43. 12 additional PWM ports, 18 total (same specifications as *MRC31*)

MRC44. 8 additional digital I/O, 20 total. 4 additional quadrature decoders, 8 total (same specifications as *MRC33*)

MRC45. 3 additional I2C Controller interfaces, 4 total (same specifications as *MRC39*).

6. Power Distribution Requirements

As power distribution in the current *FIRST* Tech Challenge system is handled by the MRC, any proposed replacement system must also encompass this functionality. While *FIRST* will consider any topology (i.e. integrated, “shield” style add-on, separate device, etc.) for accomplishing this capability, preference will be given to proposals which best minimize the following criteria:

- Individual module count/complexity
- Connection failure points

- Size/cost penalty to *FIRST* Robotics Competition teams who may not need this functionality
- Overall system volume

Power distribution capability should meet all of general requirements from *5.1 - 5.3* above (with the exception of the maximum input current) in addition to the requirements specified below.

6.1 Power Distribution Specific Requirements

PD1. Provide a minimum of 10 individual outputs.
   a) Maximum expected output current - 10A per port.
   b) Expected continuous current - ≤ 6A per port

PD2. Total input current capacity – 30A

PD3. Per-port current monitoring capability preferred (with ability to communicate that information back to the MRC)

7. Ownership of Materials

All materials submitted in response to this RFP shall become the property of *FIRST*. Proposals and supporting materials will not be returned to suppliers.

8. Letter of Intent

Letters of Intent (LOI) are due via e-mail to all contacts listed in Section *17 Contacts* by March 8, 2024. LOIs are a non-binding indicator of intent to submit a proposal and should contain the following:

a) The supplier's legal company name and address for the office submitting the letter as well as the address of the company's legal headquarters.
b) The names, title, email and telephone numbers of persons to be contacted for clarification of the LOI if needed.
c) A statement expressing intent to submit a proposal prior to the proposal deadline.

9. Proposal Elements

Proposals, in PDF form, are due via e-mail to all contacts listed in Section *17 Contacts* by May 31st, 2024 and must accommodate the following layout and content:

9.1 Cover Page

9.2 Transmittal Letter

The supplier shall prepare a brief transmittal letter on their letterhead. The transmittal letter should provide all of the following:

d) The supplier's legal company name and address for the office submitting the proposal as well as the address of the company's legal headquarters.
e) A statement that the person signing this proposal is authorized to make decisions regarding the proposal and the prices quoted.
f) The name, title, e-mail, and telephone numbers of the persons authorized to negotiate the contract on behalf of the organization.
g) The names, title, e-mail, and telephone numbers of persons to be contacted for clarification of the proposal if needed.

9.3 Section I – Executive Summary

The executive summary shall serve to familiarize *FIRST* executives and evaluators with the key elements and unique features of your proposal by briefly describing what you are proposing to do and how you intend to accomplish the work.

The executive summary shall contain the following:

a) A summary of your approach to the project, including the main points of all sections. Material should include the business features that make your proposal attractive and different.
b) A master milestone schedule of all major efforts to be undertaken in the project. Dates shall begin as listed in Appendix A of this RFP.
c) A list of exceptions taken against this RFP and the reason these exceptions were taken. If an alternative solution or product is being proposed, it should be briefly described.

9.4 Section II – General Company Information

a) Full legal company name.
b) Year business started.
c) State of incorporation.
d) Are you a public or private corporation?
e) Tax identification number.
f) Brief company history.
g) Current number of employees.
h) Is your company currently involved in any litigation in which an adverse decision might result in a material change in the company's financial position or future viability?
i) Most recent annual audited company financial report including balance sheet, if not available, please provide a public annual report.

9.5 Section III – Technical Commitments

The technical component of the proposal shall address the requirements listed in this document. Responses shall indicate the specifications they intend to preserve,

as well as any they propose to modify. If modifications are proposed, this section must include detail regarding any proposed modifications.

9.6 Section IV – Management Section

In this section, the supplier shall provide information organized into the following sections.

a) Project Management. Suppliers shall present their company's approach and ability to provide experienced project managers and resources to successfully execute this project.
b) Maintenance. Supplier shall provide a detailed description of all maintenance activities, daily or monthly support activities and principal period of maintenance.
c) Education and Training. Supplier shall provide a detailed description of all education and training required for this project.

9.7 Section V – Supplier References

Suppliers shall include a minimum of three references where related contracts have been awarded within the last three years.

9.8 Section VI – Additional Information

Suppliers may submit additional information that is relevant but was not requested in the RFP. This information should clarify or enhance the proposal or provide information about areas in the RFP that are deficient and need to be corrected.

9.9 Section VII - Pricing

Provided that the service or product is not a donation, suppliers are to provide firm, fixed pricing proposals for this project. The pricing section shall include detailed line items and to provide detailed explanations where required.

a) Manufacturing
    - Any NRE costs
    - Unit material cost
    - Unit production cost
b) Sales
    - Projected sales price
c) Software/Firmware Support
    - Cost of support
d) Technical Support
    - Cost of team support during the season

10. Proposal Costs

FIRST is not responsible for any costs incurred by the supplier in the preparation of the proposal, site visit or prototype production and/or demonstrations.

11. Available Project Resources

Upon granting of the bid, *FIRST* will be able to provide the following resources:

a) Existing system architecture documentation
b) Detailed usage reporting data for *FIRST* Robotics Competition 2024 season
c) Engineering support/collaboration on any remaining design questions

12. Recognition Opportunities

Partner(s) selected to participate in the Control System effort will be eligible for recognition by *FIRST* within the *FIRST* Community. Opportunities for recognition are as follows:

a) Recognition, based on in-kind contribution value (as stated by the supplier) per the Supplier Opportunities document (may be updated for following seasons, but the 2024 version provides the general content).
b) Opportunity to interface directly with end users/customers at *FIRST* Robotics Competition and *FIRST* Tech Challenge events to build your brand recognition/appreciation.
c) In-kind contributions to *FIRST* may be tax deductible depending on current U.S. tax law
d) Networking access to other *FIRST* Suppliers via *FIRST* events

13. Proposal Evaluation Criteria

FIRST is interested in a solution that addresses the requirements contained in this RFP. Proposals that meet the instructions and requirements will be given a thorough and objective review. Proposals that are late and do not comply with proposal instructions or take exception to mandatory requirements may be eliminated without further consideration.

FIRST will evaluate proposals based on criteria including, but not necessarily limited to, the following (no one criterion will “make or break” a proposal):

a) Overall value to teams
b) Minimized cost to *FIRST* (both Year 1 and year-over-year, including any donation)

c) Minimized cost to teams (both Year 1 and year-over-year)
d) Quality of the user experience including boot time, configuration experience, module count, connector choice, etc.
e) Confidence in meeting quality standards, including but not limited to process for FOD prevention in components
f) Confidence in meeting schedule
g) Comprehensiveness of support proposed to *FIRST* and for end users
h) Past experience/relationship with organization
i) Breadth of *FIRST* support
j) Company health and reputation
k) Strength of product warranty
l) Replacement part turn-around time during the build season

14. Non-Disclosure

FIRST requires all suppliers responding to this RFP sign and return a nondisclosure agreement (NDA), provided after receipt of an LOI, to the address specified in Section 17, Contacts.

15. RFP Amendments

FIRST reserves the right to amend this RFP at any time prior to the submission date.

16. Offer Expiration Date

Proposals in response to this RFP shall be valid for 60 days from the proposal due date.

17. Contacts

FIRST contacts for questions about this proposal are listed below:

Logistics Questions:
Director, Strategic Sourcing
Erin Weinelt
eweinelt@firstinspires.org
603-666-3906 x226

Technical Questions:
Senior Robotics Engineer, FIRST Robotics Competition
Kevin O'Connor
koconnor@firstinspires.org
603-666-3906 x108

18. Appendix A - Detailed Schedule

	Begin	End	Duration
RFP Released		11/10/2023	
LOI Due		3/8/2024	17 weeks after RFP
Proposals Due		5/31/2024	12 weeks after LOI
Proposal Evaluation	5/31/2024	6/28/2024	4 weeks
Final Selection (no later than)		6/28/2024	
Prototypes available for testing/development		5/1/2025	10 months after proposal selection
Prototype internal software development/testing	5/1/2025	7/1/2025	2 months
Alpha Testing (~15 or less select teams)	7/1/2025	10/1/2025	3 months
Revision + Manufacturing	10/1/2025	9/1/2026	11 months
FRC Beta Testing (~100 or less teams)	9/1/2026	12/30/2026	4 months
Delivery for 2027 FRC KOP (~4500 units)		9/30/2026	
Delivery for FRC spare parts/RMAs/team purchases (no later than)		12/1/2026	
FTC Beta Testing (25-50 units)	5/1/2026	7/30/2026	3 months
FTC device delivery (no later than)		7/1/2026	

19. Appendix B – Acronym Listing

CAN - Controller Area Network

DS: Driver Station

EMI: Electro-Magnetic Interference

ESD: Electro-Static Discharge

FMS: Field Management System

FOD - Foreign Object Damage

FRC: *FIRST* Robotics Competition

FTC: *FIRST* Tech Challenge

I2C - Inter - Integrated Circuit

IO: Input/Output

MRC - Mobile Robot Controller

NRE – Non Recurring Engineering

PWM - Pulse Width Modulated

QOS - Quality of Service

RCS: Robot Control System

RMA - Return Material/Merchandise Authorization

SPI - Serial Peripheral Interface