Request for Proposal – 2015 FRC® Control System

1. Contents

2. *FIRST*® Robotics Competition Overview

The *FIRST* Robotics Competition, FRC®, is a unique varsity Sport for the Mind™ designed to help high-school-aged young people discover how interesting and rewarding the lives of engineers and scientists can be. FRC stages short games played by robots. The robots are designed and built in a limited time frame (from a common set of parts) by a team of high-school-aged young people and Mentors. FRC teams program and remotely control the robots in competition rounds on a competition field.

Teams are formed in the fall. The annual FRC Kickoff in early January starts the short "build" season. Competitions take place in March and April. FRC Regional events are typically held in arenas. They involve 40 to 70 teams cheered by thousands of fans over three days. A championship event caps the season. Referees oversee the competition. Judges evaluate teams and present awards for design, technology, sportsmanship, and commitment to *FIRST*. The Chairman's Award is the highest honor at *FIRST* and recognizes a team that exemplifies the values of *FIRST*.

3. Project Overview

The current FRC control system is a custom configuration of devices from various suppliers used by teams to program and wirelessly control actuators and sensors on their robots. Details about the 2012 FRC control system are hosted on the *FIRST* website here.

The current control system, to be used through the 2014 season, is based on Ethernet and PWM protocols, but can also accommodate CAN, SPI, and I2C.

Given the end-of-life nature of the existing system, *FIRST* is searching for solutions and a partner, or suite of partners, with which to implement such solutions for the 2015 - 2019 seasons. This document outlines the requirements and preferences for such a system.

RFP specific terms and acronyms are defined in *Appendix B – Acronym Listing*.

4. Schedule

The immediate proposal-specific timeline for the 2015 FRC Control System project is outlined below. A detailed proposed schedule for efforts leading up to the 2015 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 five seasons of the proposal.

RFP published/distributed:	August 28, 2012

Letters of Intent due to *FIRST*:	September 21, 2012
Proposals due to *FIRST*:	December 14, 2012
Selection Progress, Round 1:	December 28, 2012
Selection Progress, Final Selection:	January 25, 2013

5. Project Requirements

FIRST needs a partner that will develop and support a system per the team populations expected below.

2015: 3,600

2016: 4,000

2017: 4,700

2018: 5,400

2019: 6,200

5.1 Manufacturing

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

This effort also requires the back-end support for RMAs and warranty support.

5.2 Software/Firmware support

FIRST needs a partner that can recommend, execute, test, and support any firmware or software changes needed to support the next-generation control system.

5.3 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 designs, replacements for damaged units, or spare inventory. *FIRST* does not host a store front to accommodate this and needs a partner that can own inventory, house inventory, host a store front, and process orders in a timely manner (shipping within, at most, two days of a placed order).

Sales may or may not require a passive royalty paid to *FIRST* to be mutually agreed upon by all parties affected.

5.4 Technical Support/Documentation

FIRST is seeking a partner that can provide Robot Control System (RCS) technical support for both FRC and FRC 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 the FRC software libraries
c) support for manufacturing efforts (approval of alternate components, updates to relevant files, etc.)
d) support for FRC teams
    i. updates to documentation that provide clean, concise instruction and information
    ii. accessibility for teams that needed additional help via phone, forum, email (preferably all)
e) Presence at FRC events for triage and technical support during competitions

A product warranty with rapid replacement for critical components during the build season is required.

6. General RCS Requirements

There are a number of considerations for the next generation RCS that must be addressed in any proposal. The overall objective is to provide a challenging and satisfying experience to for FRC teams. Generally, the FRC desires to *minimize* the following parameters:

a) system complexity (wiring, 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 FRC's priorities and expectations for a comprehensive proposal.

The RCS shall function in accordance with the top-level block diagram illustrated below in Figure 1.

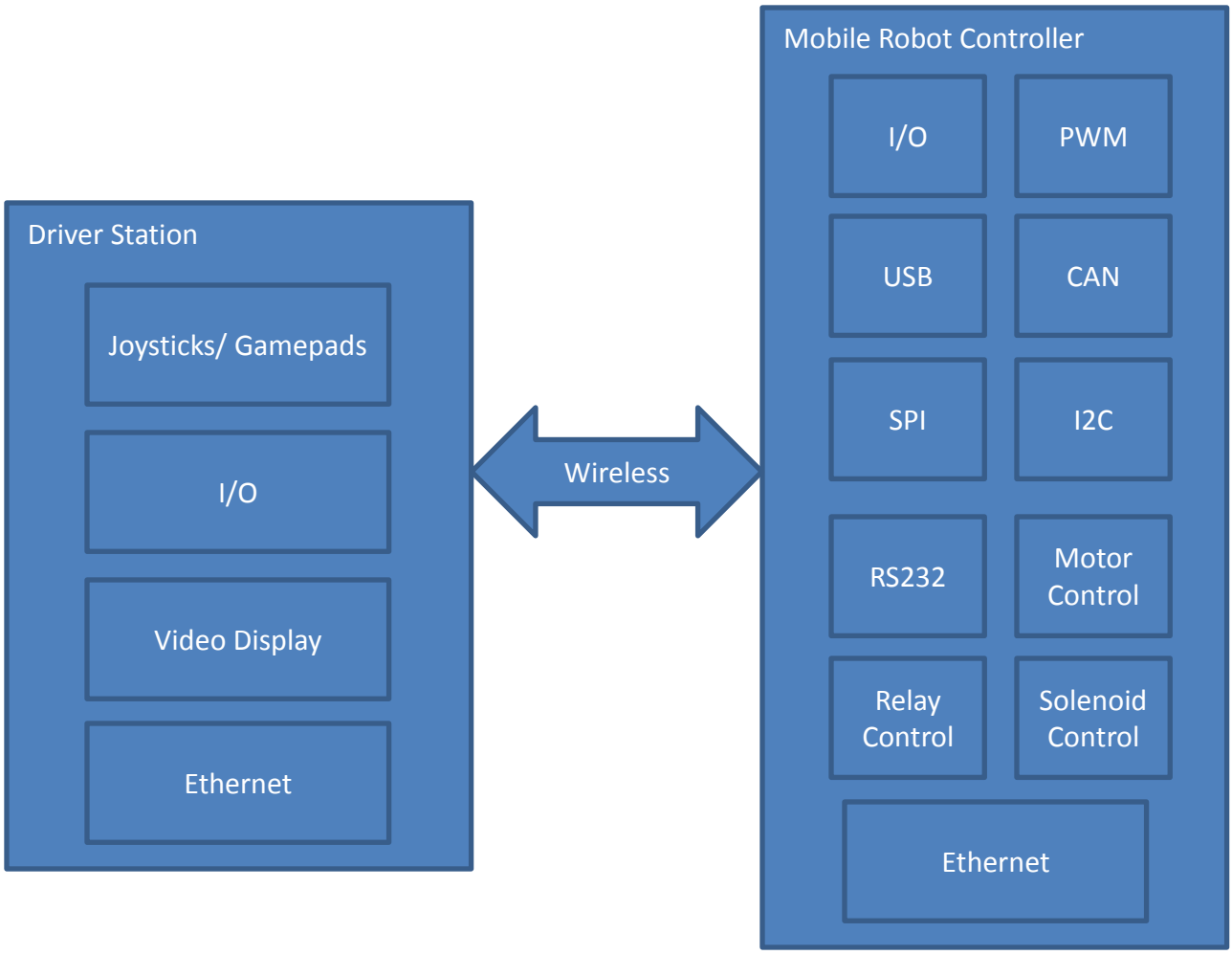


Figure 1: General block diagram for RCS functionality.

The RCS is composed of the following elements:

1. The Driver Station (DS) is used by teams to remotely control and monitor the robot during the competitions and at practice via wired or wireless connection. The DS collects input from user devices, such as USB joysticks, and sends the control data to the robot. The DS receives status information from the robot, and displays the data for the users. The DS also receives instructions from the FMS and relays those instructions to the MRC.
2. The Mobile Robot Controller (MRC) is the “brain” of the robot. Teams load user code onto 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.

3. Secondary Components provide additional modules in the robot control system, including devices to provide power distribution and wireless communication. The functionality of these modules may be integrated into the MRC, but is not required.
4. Wireless Robot Control (WRC) modules facilitate wireless communication between the DS and the MRC over a secure network – both “at home” and at competition events. The wireless functionality may be integrated into the system or as a separate component.
5. The RCS components on the robot accommodate a main 12V sealed lead acid battery power source.
6. The RCS supports camera/vision.
7. All devices must have mounting points for securing to the robot.
8. The overall boot time for the system, from cold boot to wirelessly connected (assuming an at-home configuration) shall be minimized, but shall not exceed 40 seconds. Individual boot times for individual component shall be minimized.

6.1 Safety

Safety must be foremost in the design and operation of all aspects of the RCS.

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. Redundancy at both the top system level and the power module levels (motor controllers, relays, etc.) is preferred.

Basic timeout failsafe features are required (in the event of locked code, etc.), and users must be able to enable and disable device operation on their robot from their DS. These safety features must not be able to be 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.

6.2 User Experience

FRC teams present a wide range of technical capacity with diverse backgrounds. It is important for the RCS 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.

6.2.1 Complexity / Integration Level

The RCS design should aim for minimal module counts for basic robot operation. Basic robot operation includes the following: DS, MRC, 4-motor variable speed/direction control, I/O, WRC, Relay, Vision, and all supporting power distribution. The MRC must be simple to wire and configure with an intuitive user setup. The MRC must provide expansion capacity and flexibility for FRC teams.

6.2.2 Simplicity of setup

A user should be able to configure the RCS 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.
4. Firmware/software upgrade on the DS.
5. Configuration of any team-specific settings on the DS.

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

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

6.2.3 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. Information distributed by additional methods (smart phone app, etc.) are encouraged.

6.2.4 Technical System Diagnostics

The RCS must have diagnostics to aid in both system setup and troubleshooting. At the system level, a diagnostics system that maps the connected system and reporting missing components or failed modules is preferred.

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 *6.1, Safety*. The diagnostics should point the users towards modules or connection level issues as an aid for debugging.

The RCS should also track and log, for later review, the quality of service (QOS) information for the connection to the MRC. Live access to the QOS numbers or other important diagnostics via the DS display is required.

6.3 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 RCS significantly. The RCS must be designed to withstand these conditions, assuming at least 4-5 events per season and provide multi-year reliable service. The events are played out in 2 minute 15 sec matches with between 9 and 18 matches (including playoffs) spanning a 2-3 days. A failure of a module 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.

6.4 Environmental

The robots must operate under standard commercial operating conditions. Industrial operating conditions capacity is desired as robots are operated throughout the summer and in non-air-conditioned venues. Operation in these conditions is expected and must not reduce the lifetime of the devices.

6.5 Mechanical

The mechanical conditions include shock, vibration, and stress due to repeated insertion/removal of module connections. It would not be unusual for the RCS components installed on a competition robot to experience up to 50Gs during operation and significant vibration (including inverted falls of the robot). 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. RCS modules must be protected from metal debris induced failures and come with a rugged case.

6.6 Electrical

The electrical environment is harsh both during robot operation and assembly. Reverse battery protection is desired to prevent damage to components due to an oversight or miss 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 preferred to ensure that mis-wired, cut, or shorted lines will not damage the module.

6.7 Electro-Magnetic Interference

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

6.8 User-Programming Language Support

The next generation RCS must support at least two programming languages (but not require that teams use both). One language must support a graphical programming environment (e.g. LabVIEW, EasyC). The current RCS supports LabVIEW, C++, and Java. It is preferred that the new RCS support as many of these currently used languages as possible. Installation and update times must be kept to a minimum for library, language updates and for software development tool installation.

6.9 RCS-Field Management System (FMS) Interface

The DS must be capable of interfacing with the FMS via an Ethernet interface. The user experience between use on and off the competition field shall be as identical as practically possible.

For background information, the communication between the DS and MRC is currently routed through a central wireless access point on the field. The new RCS may continue to use this format or use a new format such as point-to-point wireless communication between each DS/ MRC pair. Figure 2 and Figure 3 illustrate the existing architecture.

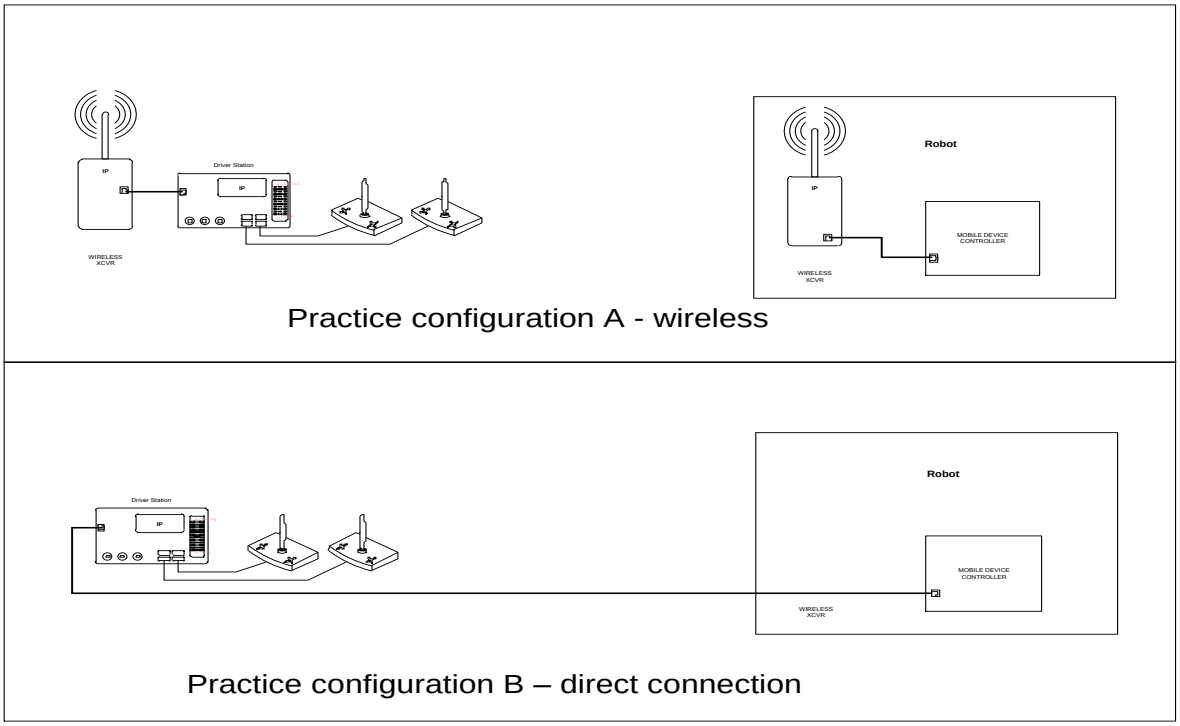
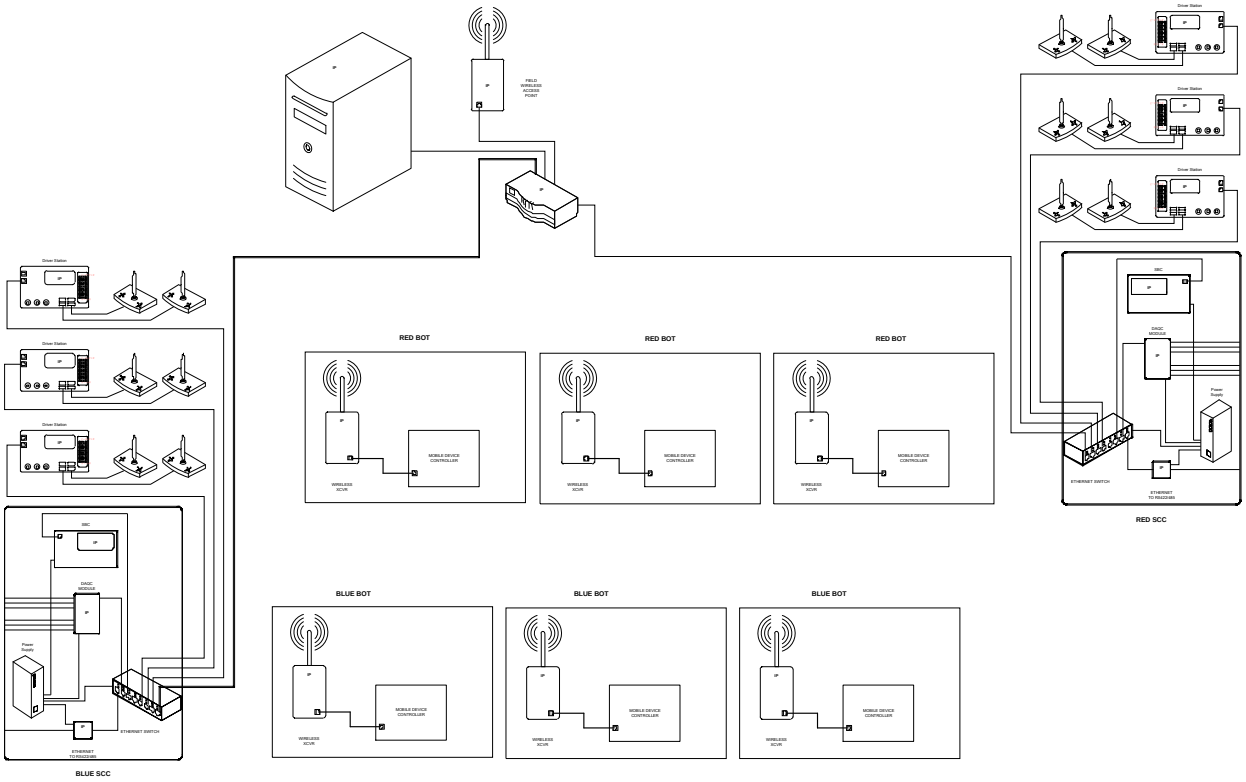


Figure 2: Illustration of current setup for wired and wireless "home" use.



Current Field Setup

Figure 3: Illustration of current field setup.

6.10 RCS Volume Requirements

The size and weight of the RCS must be kept to a minimum to ease integration onto robot platforms and enable teams to meet the strict robot weight requirements. The basic RCS for size and weight considerations will consist of following components: DS, MRC, 4-motor variable speed/direction control, I/O, WRC, Relay, Vision, and all supporting power distribution.

The combined footprint for these functional blocks should be less than 220 square inches and no taller than 6 inches. The weight should be less than 7 lbs.

6.11 RCS Costing

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

- Target cost per system to *FIRST*: $0
- Target cost per system to sold directly to FRC teams: $600

There is a likely chance that *FIRST*, working with the Electronics Component Industry Association, ECIA, and other Suppliers, may minimize material costs. 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*.

7. RCS Component Specific Requirements

To elaborate on the general requirements from *Section 6, General RCS Requirements*, component specific requirements are detailed below.

7.1 DS Feature Set

The DS provides teams with an interface for robot control and feedback. The DS will provide user-to-robot commands in control packets and receives status and live video back from the robot for display. Teams must be able to customize the display (adapting the robot feedback to the game and their control/status needs). User input device flexibility is also a requirement as teams may choose to use a wide range of joysticks, gamepads, and specialized user interfaces. Required technical specifications for the DS solution are listed below.

DS1. Battery operated 3-hour capacity with plug in power supply for charging.
DS2. Support for at least 4 USB 2.0 joysticks or gamepads (but not off the same USB chip)
DS3. 8 digital IO and 4 analog inputs (in addition to USB requirements noted in DS2), integrated or supported by external DAQ
DS4. 10/100 Ethernet
DS5. Wireless communication with robot, external or integrated
DS6. Capable of supporting video display from robot
DS7. Quick boot from power up not to exceed 30 seconds
DS8. Software to provide communications with MRC and FMS
DS9. Capability to display real-time system diagnostics, with ability for teams to customize which data is displayed
DS10. Sufficient non-volatile storage capable of rough environment / handling to provide user code and logging storage (“sufficient” is dependent on the solution, but ultimately presents no perceptible delay or performance issues to the user).

7.2 MRC Feature Set

The MRC provides all the needed control and sensing on the robot for the teams. Minimum requirements are listed below.

MRC1. Battery brown out protection and ride through without loss of state/reboot
MRC2. Control of actuators remains active to 6V
MRC3. Control logic remains active and not lose state to 4V
MRC4. At least 16 PWM channels available for supporting hobby servos and motor controllers
    a) capable of supporting at least 2 x 6V hobby servos (~1.1A/servo)
    b) drive strength of 330 Ohms @ 5V
    c) 150kHz timer resolution
MRC5. At least 18 digital I/O, with user able to add at least 10 more if needed
    a) of which are dedicated for relay control (≥4mA, ≥3V)
    b) 3.3V native
    c) 5V compatible
    d) 150kHz sampling
    e) Integrated weak pull up resistors.
MRC6. Able to drive at least 4, 8 preferred, pneumatic solenoid valves with 500mA minimum, 24V (12V *and* 24V preferred, but not required)
    a) At least 4 analog inputs, with user able to add at least 8 more if needed
    b) 10 bit or higher resolution
    c) sampling at 250 kS/s
    d) 0V to 5V
MRC7. USB 2.0 host port
MRC8. Support for Ethernet 10/100 devices
MRC9. Overall target for system latency of 10ms joystick to motor controller command under typical communication conditions (assumptions include running system in “home” configuration and running default code).
MRC10. Onboard non-volatile storage sufficient for storing user code and logging data (up to 3 event-days) with no perceptible performance issues by the user
MRC11. Ability for user to remove storage is preferred, but not required.
MRC12. Self-diagnostics with reporting of device status and failure modes to DS.
MRC13. Diagnostic tool for basic robot state (power, connected) viewable from at least 50 feet.
MRC14. A display providing basic diagnostics is preferred, but not required. Examples of such diagnostics include, but are not limited to:
    a) team number,
    b) IP address;

c) Link status
d) Enable disable state
e) Teleoperated/autonomous state
f) Common error codes

MRC15. CAN 2.0B
MRC16. I2C Master
a) V2.1 compliant
b) 100kbits/s into 400pF bus load
MRC17. SPI Master
a) 100kbits/s minimum
b) Drives minimum of 4 devices
MRC18. RS232
a) 115200 baud
b) No arbitration signals necessary
MRC19. Preferred but not required support for 3D-Gyroscope and 3D-Accelerometer

7.3 Wireless Robot Control (WRC) Feature Set

This feature set is derived based on experience during the 2009, 2010, 2011, and 2012 FRC competition seasons. To date, the best performing radio has been the Linksys WGA600N. An ideal radio would have all the features of the WGA600N, as well as include the capability to function as an access point, and have a four port 10/100 Ethernet switch.

Other radios used/tested:

- Linksys WET610N (2010 season),
- Dlink DAP-1522 (2011 & 2012 seasons), and
- Linksys WES610N
- Dlink DIR-825 running DD-WRT firmware

WRC1. Capable of controlling 4 co-located active fields with up to 6 robots on each field.
WRC2. <15ms latency
WRC3. Secured communication, 128-bit with no known breaks.
WRC4. Automated setup for competitions and at home use.
WRC5. Boot and acquisition within 20 seconds.
WRC6. Locking / secured power connection
WRC7. Communication QoS reported and recorded from each member in the network.
WRC8. Reliable, robust functionality in hostile wireless environments (> 150 other access points, cell phones, etc.)
WRC9. Target size approximately 5” x 6” x 2.”

WRC10. Factory/initial default setup recovery required (via external but protected button)

WRC11. Wireless module must remain active to an robot supply battery voltage of 4.5V. A dedicated power supply for the radio is preferred (to protect diagnostic information/tools in the event of a robot power outage).

WRC12. Data logging in the device is preferred.

7.4 Power Distribution Feature Set

PD1. Stand alone, rugged On/Off switch able to be mounted in accessible spot on the robot, likely a separate device.

PD2. Power distribution system providing 120A main supply protection.

PD3. Multi-channel power distribution board with configurable current limiting per channel (via fuse, breaker, etc.)

PD4. At least 16 12V channels (beyond what is required by RCS components), 20 are preferred. At least 8 capable of 40A continuous, nominal.

PD5. The PDS should provide secondary voltage supplies as needed, including, but not limited to:

PD6. 3.3V supply

PD7. 5V +/- 5%, regulated, for custom logic circuits

PD8. 24V for pneumatic solenoid valves, et al

PD9. Power budget and current logging capacity preferred, but not required.

PD10. Regulated supplies for the MRC and WRC (unless built-in to MRC and WRC devices)

7.5 Motor Control Module (MCM) Feature Set

MCM1. Compatibility with Victor and Jaguar motor controllers is required (use of any/all of these controllers in the RCS solution proposal is acceptable even if they don't meet all requirements outlined here).

MCM2. Any new controller must have a safety shut off to prevent catastrophic failure. Such an event must be communicated to the user.

MCM3. Full H-bridge motor controller forward/reverse; capable of 60A continuous operation (100A burst 2.5 sec).

MCM4. Motor controller must provide EMI suppression from the motor(s) via optical isolation or comparable buffer.

MCM5. Low voltage (6V) brownout state preservation is preferred, but not required.

MCM6. If 3-pin analog interface, a ground-power-signal convention is preferred

MCM7. If proposing a "smart" motor controllers (non-PWM), controller must have:

a) current limiting,
b) voltage control,
c) PID features with analog input,
d) 0-5V quadrature encoder support,

e) forward/reverse limit switch support
f) (preferred) robust daisy chain capability

MCM8. Linear output is preferred, but not required.

MCM9. If the user is expected to update device firmware, a common interface shall be used.

MCM10. Simple, complete error code indication and short-term storage is preferred

MCM11. Safe dissipation of motor generated voltages and currents when power off and motor is mechanically driven is required.

7.6 Vision Feature Set

V1. Capable of 30 Frames Per Second

V2. Capable of color

V3. Must be capable of a 320x240 resolution (higher resolution as a user option is acceptable)

V4. RCS must support at least 1 camera; support for 2 cameras is preferred.

V5. Vision processing either on MRC, in camera, or DS is required. User ability to use their co-processor is preferred, but not required.

V6. Cold boot to operation in less than 20 sec is desired

V7. User ability to turn off auto settings in the vision device(s) is preferred (i.e. manually set/fix white balance and exposure).

8. 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.

9. Proposal Elements

Respondents to this Request for Proposals, RFP, have the option of bidding on all requirements outlined in this document alone, with a suite of partners, or one or more subsets defined below, as they feel appropriate per their business model.

Supplier Letters of Intent to Bid shall be sent to Kate Pilotte, kpilotte@usfirst.org, no later than September 21, 2012.

Proposals are due by December 14, 2012 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 business stationery with a company logo. The transmittal letter should provide all of the following:

a) The supplier's legal company name and addresses for the office submitting the proposal as well as the address of the company's legal headquarters.
b) A statement that the person signing this proposal is authorized to make decisions towards the proposal and the prices quoted.
c) The name, title and telephone numbers of the persons authorized to negotiate the contract on behalf of the organization.
d) The names, title 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 Section 4 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 or headquarters.
d) Are you a United States corporation?
e) Tax identification number.
f) Brief company history.
g) Current number of employees.
h) Are you a public or private corporation?

i) 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?
j) Most recent annual audited company financial report or 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
- Proposed passive royalty to *FIRST*

c) Software/Firmware Support
   - Cost of support

d) Technical Support
   - Cost to team support during the season
   - Cost of team support per event

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) Existing *FIRST*-owned source & object code for product operation & test/programming
c) Existing *FIRST*-owned plastic injection mold(s) & test/programming fixture(s)

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 2013 version provides the general content).
b) Co-branding opportunity on the Control System components (per proof approval by *FIRST*)
c) Opportunity to interface directly with end users/customers at FRC events to build brand recognition/appreciation.
d) In-kind contributions to *FIRST* are tax deductible
e) Networking access to other FRC Suppliers via FRC events

13. Proposal Evaluation Criteria

FIRST is interested 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 will 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) Minimized cost to *FIRST*
b) Minimized cost to teams
c) Quality of the user experience (Please note: *FIRST* has bias for neither a custom FRC solution nor a system which integrates various components. Both architectures have their own strengths and weaknesses and the solutions presented will be evaluated based on the criteria listed here.)
    i. Minimized MRC boot time (target < 5 seconds)
    ii. Minimized cold boot to connection time (target < 30 seconds)
    iii. Devices are electrically isolated (cases are not ground)
    iv. Connector retention is present, robust, and easy to use.
d) Confidence in meeting quality standards, including but not limited to process for FOD prevention in components
e) Confidence in meeting schedule
f) Comprehensiveness of support proposed to *FIRST* and for end users
g) Past experience/relationship with organization
h) Breadth of *FIRST* support
i) Company health and reputation
j) Strength of product warranty
k) Replacement part turn-around time during the build season
l) Boot time (complete system and for individual components)

14. Non-Disclosure

FIRST requires all suppliers responding to this RFP sign and return a nondisclosure agreement (NDA), included as a separate document, 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.

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:

Kit of Parts Manager
Kate Pilotte
kpilotte@usfirst.org
603-666-3906 x108

Director of Procurement
Ron Falcone
rfalcone@usfirst.org
603-666-3906 x465

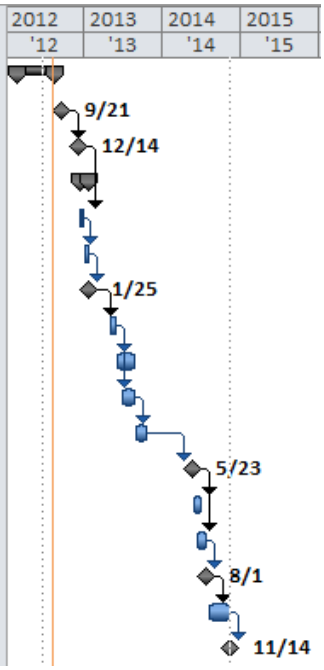
18. Signatures

_____ Date: 8/27/12
Ron Falcone, Director, Procurement

_____ Date: 8/27/12
Frank Merrick, Acting Director, FRC

19.Appendix A - Detailed Schedule

Task Name	Duration	Start	Finish	Predecessors
RFP Effort	**130 days**	**Mon 2/27/12**	**Fri 8/24/12**	
Letter of Intent due	0 days	Fri 9/21/12	Fri 9/21/12	6FS+1 mon
Proposals Due	0 days	Fri 12/14/12	Fri 12/14/12	7FS+3 mons
Selection Process	**30 days**	**Mon 12/17/12**	**Fri 1/25/13**	
Round 1	2 wks	Mon 12/17/12	Fri 12/28/12	8
Round 2	4 wks	Mon 12/31/12	Fri 1/25/13	10
Final Selection	0 days	Fri 1/25/13	Fri 1/25/13	11
Prototype evaluation	4 wks	Mon 5/6/13	Fri 5/31/13	12FS+14 wks
Beta testing w/ teams	13 wks	Mon 6/3/13	Fri 8/30/13	13
Beta testing at events	9 wks	Mon 7/1/13	Fri 8/30/13	13FS+4 wks
Prototype review	8 wks	Mon 9/2/13	Fri 10/25/13	15
Final Verions due	0 days	Fri 5/23/14	Fri 5/23/14	16FS+30 wks
Final testing w/ teams	6 wks	Mon 5/26/14	Fri 7/4/14	17
Final testing at events	8 wks	Mon 6/9/14	Fri 8/1/14	17FS+2 wks
Purchase Order	0 days	Fri 8/1/14	Fri 8/1/14	19
Manufacturing	15 wks	Mon 8/4/14	Fri 11/14/14	20
Delivery for 2015 KOP	0 days	Fri 11/14/14	Fri 11/14/14	21



20. Appendix B – Acronym Listing

CAN - Controller Area Network

DAQ: Data AcQuisition

DS: Driver Station

EMI: Electro-Magnetic Interference

ESD: Electro-Static Discharge

FMS: Field Management System

FOD - Foreign Object Damage

FRC: *FIRST* Robotics Competition

I2C - Inter - Integrated Circuit

IO: Input/Output

MCM – Motor Controller Modules

MRC - Mobile Robot Controller

NRE – Non Recurring Engineering

PDS - Power Distribution System

PWM - Pulse Width Modulated

QOS - Quality of Service

RCS: Robot Control System

RMA - Return Material/Merchandise Authorization

SPI - Serial Peripheral Interface

VS – Vision System

WRC - Wireless Robot Control