# PROJECT CHARTER

**(DRAFT Version 1.0, 16-AUG-07)**

**PROJECT NAME…** Next Generation, Common User NRAO Pulsar Backend
(AKA "Scott Ransom's Dream Pulsar Machine")

**PROJECT PERSONNEL…**

| | |
|---|---|
| **Project Sponsor…** | Scott Ransom |
| **Project Manager…** | Randy McCullough |
| **Project Scientist…** | Scott Ransom |
| **Project Engineer…** | Randy McCullough |
| **Project Team…** | Randy McCullough, John Ford, Glen Langston, Jason Ray, Ray Creager, Mike McCarty, Paul Demorest, Rich Lacasse, Rick Fisher |

**PRIMARY STAKEHOLDERS (AND THEIR ROLES)…**

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|---|---|
| Scott Ransom | NRAO, Charlottesville (Sponsor, Project Scientist) |
| Ingrid Stairs | Dept. of Physics and Astronomy, University of British Columbia (User community collaborator) |
| Duncan Lorimer | Dept. of Physics, West Virginia University (User community collaborator) |
| Maura McLaughlin | Dept. of Physics, West Virginia University (User community collaborator) |
| Joeri van Leeuwen | Dept. of Astronomy, University of California, Berkeley (User community collaborator) |
| Richard Prestage | NRAO, Green Bank Site Director (GBT program management) |
| Karen O'Neil | NRAO, Green Bank GBT Program Manager (GBT program management) |
| Randy McCullough | NRAO, Green Bank Electronics Division (Project Manager, Project Engineer, Project Team) |
| John Ford | NRAO, Green Bank Electronics Division Head (Project Team… engineering support as required) |
| Glen Langston | NRAO, Green Bank Scientific Division (Project Team… scientific support as required) |
| Jason Ray | NRAO, Green Bank Electronics Division (Project Team… engineering support as required) |
| Ray Creager | NRAO, Green Bank Software Development Division (Project Team… software development as required) |
| Mike McCarty | NRAO, Green Bank Software Development Division (Project Team… software development as required) |
| Paul Demorest | NRAO, Charlottesville (Project team… scientific and development support as required) |
| Rich Lacasse | NRAO, Charlottesville (Project Team… engineering support as required) |
| Rick Fisher | NRAO, Charlottesville (Project Team… scientific support as required) |
| Electronics Division | NRAO, Green Bank (Additional engineering and technical support as required) |
| Software Development Division | NRAO, Green Bank (Additional software support as required) |
| Operations Division | NRAO, Green Bank (Additional support as required) |
| CASPER Group | University of California, Berkeley (Principal collaborator on toolflow, design blocks, etc.) |

**PROJECT JUSTIFICATION…**

The GBT Spectrometer, which took approximately 10 years to design and build, is now more than 15 years old. Owing to the complex nature of its design, any significant enhancements to its pulsar search and precision timing capabilities (i.e., increased dynamic range) would prove to be prohibitive both in terms of hard costs and manpower requirements.

When Scott Ransom first introduced his concept of the ultimate "Dream Pulsar Machine" during the GBT Future Instrumentation Workshop held at Green Bank in the fall of 2006, it was clear that we needed a new approach. As luck would have it, at that same workshop, Dan Werthimer of U.C. Berkeley's CASPER Group (Center for Astronomy Signal Processing and Electronics Research) introduced their open-source, platform independent approach to FPGA-based instrument design for astronomy applications.

Subsequent NRAO efforts aimed at evaluating the suitability of CASPER's approach to our applications all yielded positive results and the decision was made to launch a comprehensive program for the design and development of advanced digital backends based upon CASPER's hardware and software platforms. The Next Generation Common User NRAO Pulsar Backend is actually the second such backend to be developed under this program (the first being the "Transient Event Capture 3000" which was designed for capturing transient events with the 43m Telescope).

**PROJECT SCOPE…**

To design, implement, test, document, and deploy a new cutting-edge digital pulsar backend for use on the GBT utilizing the hardware and software platforms developed by U.C. Berkeley's CASPER group. The resultant machine will reside in the GBT Equipment Room and will be readily re-configurable and utilizable (within minutes) to perform either pulsar search or pulsar precision timing missions by means of a "Lite RPC Server" with appropriately defined parameters, etc.. Its capabilities will include: dual polarization, power, full stokes, coherent dedispersion, pulsar period folding (on multiple sources if possible), and data output streaming in standard PSRFITS format to a large capacity data collection machine (or cluster of machines).

**SCOPE MANAGEMENT PLAN…**

Changes in the project scope will be accepted only by the project manger in consultation with GBT Program Management (currently Karen O'Neil and Richard Prestage), along with the project team members. Any requests for increases in scope must be accompanied by supplemental documentation clearly identifying sources of any additional resources required.

**OVERVIEW OF DELIVERABLES…**

1.0) Interim deliverables…

1.1) Detailed specifications document(s)
1.2) Detailed test plan document(s)
1.3) Detailed deployment plan document(s)
1.4) NRAO's version of CASPER's "Pocket Spectrometer" (design only)
1.5) Next Generation **EXPERT** User NRAO Pulsar Backend including: dual polarization, detected power, PSRFITS formatter, "Lite RPC Server", and test / demonstrator data collection machine (scaled down)
1.6) Next Generation **EXPERT** User NRAO Pulsar Backend (same as 1.5 with full stokes added)
**NOTE:** Item 1.6) will most likely be released as a primary deliverable (see below) for **EXPERT** users only
1.7) Next Generation **EXPERT** User NRAO Pulsar Backend (same as 1.6 with coherent dedispersion added)
1.8) Next Generation **EXPERT** User NRAO Pulsar Backend (same as 1.7 with pulsar period folding added)
1.9) Next Generation **COMMON** User NRAO Pulsar Backend (same as 1.8 with full-blown data collection machine having large disk storage capacity and control software integration into the GBT M&C System)
**NOTE:** Item 1.9) represents what is intended to be the final version of the pulsar backend and will be released as a primary deliverable (see below) once the test and deployment plans are successfully completed

2.0) Secondary deliverables…

2.1) "RFI Rejection Spectrometer" suitable for use on the 43m Telescope (design only)
2.2) Release of all relevant hardware and software designs back to U.C. Berkeley's CASPER Group

3.0) Primary Deliverables…

3.1) Next Generation **EXPERT** User NRAO Pulsar Backend (dual polarization, power, full stokes, PSRFITS formatter, "Lite RPC Server"; along with a scaled down test / demonstrator data collection machine)
**NOTE:** This version is roughly equivalent to the existing GBT Spectrometer Spigot System
3.2) Next Generation **COMMON** User NRAO Pulsar Backend (dual polarization, power, full stokes, coherent dedispersion, pulsar period folding (on multiple sources if possible); along with a full-blown data collection machine having large disk storage capacity and control software integration into the GBT M&C System)
3.3) Detailed documentation for 3.2) above

**SPECIFIC OBJECTIVES & SUCCESS CRITERIA…**

This project will be deemed successful if the following objectives are successfully completed…

1) The end product meets (or exceeds) all specifications included in the detailed specifications document(s)
2) The end product satisfactorily passes all tests included in the detailed test plan document(s)
3) The end product is successfully deployed according to the detailed deployment plan document(s)
4) The end product is deployed on (or before) schedule
5) The end product is fully documented on (or before) schedule
6) The overall project remains on (or under) budget
7) All relevant hardware and software designs are effectively contributed back to U.C. Berkeley's CASPER Group

**KEY ASSUMPTIONS…**

1) Sometime during the month of September 2007, a second development / test machine (including all requisite software) will be made available in order to facilitate simultaneous design simulations, builds, and testing. This will serve to significantly reduce iterative development cycle times.

2) Deployment of the primary deliverables will occur in two phases…

2.1) Phase One…

During this phase, we will deploy an EXPERT USER ONLY version of the pulsar backend which will be roughly equivalent to the existing GBT Spectrometer Spigot System. This version will include: dual polarization, power, full stokes, PSRFITS formatter, "Lite RPC Server" and a scaled down test / demonstrator data collection machine

2.2) Phase Two…

During this phase, we will deploy the COMMON USER version of the pulsar backend which will include the same features released during Phase One plus: coherent dedispersion, pulsar period folding (on multiple sources if possible), a full-blown data collection machine (or cluster of machines) with large disk capacity, seamless integration into the GBT M&C System, and comprehensive user documentation.

**PROJECT CHARTER APPROVALS:**

**Project Sponsor...**

Scott Ransom _____

**Project Manager…**

Randy McCullough _____

**Project Scientist…**

Scott Ransom _____

**Project Engineer…**

Randy McCullough _____

**Project Team…**

Randy McCullough _____
John Ford _____
Glen Langston _____
Jason Ray _____
Ray Creager _____
Mike McCarty _____
Paul Demorest _____
Rich Lacasse _____
Rick Fisher

**GBT Program Management…**

Karen O'Neil _____
Richard Prestage _____