

Request for Services (RFS)

Project: VoIP Gateway
Design Evaluation

Creation Date: 2015-11-18

Last Revision Date: 2025-10-28

Version: 15

Status: Proprietary and
Confidential

Request for Services (RFS)	Version 1.4
Class Confidential	Page 1 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

Table of Contents

1	INTRODUCTION AND BACKGROUND	3
1.1	Purpose	3
1.2	Administrative.....	5
1.2.1	TECHNICAL CONTACT	5
1.2.2	CONTRACTUAL CONTACT.....	5
1.3	DUE DATES	5
1.4	SCHEDULE OF EVENTS	5
1.5	Reference Documents.....	6
1.6	Scope	6
2	GUIDELINES FOR REPORT PREPARATION	7
2.1	REPORT SUBMISSION.....	7
3	DETAILED PATTON PRODUCT REQUIREMENTS	8
3.1	SCHEDULE.....	8
3.2	BUDGET	8
3.3	PERFORMANCE (FEATURES).....	8
4	EVALUATION FACTORS	11
4.1	CRITERIA.....	11
5	SCOPE OF WORK	12
5.1	EVALUTION	12
5.2	DELIVERABLES	12
6	ACRONYMS AND DEFINITIONS	13

Request for Services (RFS)	Version 1.4
Class Confidential	Page 2 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

1 Introduction and Background

1.1 Purpose

Patton is all about connections. It is our joy and mission to connect real-world customer challenges with high-quality, right-priced solutions—complemented by unrivaled customer service and technical support. Incorporated in 1984, Patton has built everything from micro-sized widgets that connect "this-with-that," to carrier-grade Telecom gear that connects subscribers to service providers. Patton's specialty is interconnecting legacy TDM and serial systems with new-generation IP-based voice, data, and multimedia technologies.

Headquartered in Gaithersburg, Maryland, USA, Patton equipment—including [VoIP](#), [Ethernet extension](#), and [high availability router](#) technologies—is up-and-running in carrier, enterprise and industrial networks worldwide. Patton works in connection with a growing network of technology, business, and sales-channel partners. To connect with local-market requirements, Patton operates training and support centers in Switzerland, Hungary, Lebanon, India, Vietnam, and the USA. | *Patton... Let's Connect!*

Patton requires hardware development services in support of a new product development. Specifically, the company requires embedded system design evaluation for the proposed e911 IP-PBX VoIP Gateway. Implementation of pre-production prototypes is a desirable follow-on contract. The scope of the work required includes evaluation, and testing of the proposed embedded system platforms.

In particular, Patton wants a result better than the competitive product pictured here, making reuse of the product shown in the next picture:



Request for Services (RFS)	Version 1.4
Class Confidential	Page 3 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	



1.2 Administrative

1.2.1 TECHNICAL CONTACT

Any questions concerning technical specifications or Statement of Work (SOW) requirements must be directed to:

Name	Damini Gowda, Aysvarya Gopinath
Address	1111 Engineering Drive, Boulder CO, 80309
Phone	NA
FAX	NA
Email	Damini Gowda Damini.Gowda@colorado.edu , Aysvarya Gopinath Aysvarya.Gopinath@colorado.edu

1.2.2 CONTRACTUAL CONTACT

Any questions regarding contractual terms and working conditions or report format must be directed to:

Name	Tim Scherr
Address	ECOT 340, 1111 Engineering Drive, Boulder CO, 80309
Phone	303-735-7633
FAX	NA
Email	Timothy.scherr@Colorado.edu

1.3 DUE DATES

All Reports are due by 11:59 pm MST on 2025/12/06 Any Report received at the designated location after the required time and date specified for receipt shall be considered late and receive a 10% per day penalty. Any late reports will not be evaluated for the Top Prize.

1.4 SCHEDULE OF EVENTS

Event	Date

Request for Services (RFS)	Version 1.4
Class Confidential	Page 5 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

1. RFS Distribution to Vendors	2025/10/28
2. Platform Evaluation begins	2025/10/29
3. Questions from Vendors about scope or approach due	2025/11/03
4. Approximate Completion of Module 1	2025/11/09
5. Approximate Completion of Module 2	2025/11/16
6. Approximate Completion of Module 3	2025/11/22
7. Approximate Completion of Module 4	2025/12/04
8. Report and Deliverables Due Date	2025/12/05
9. Awarding of Prizes	2025/12/10

1.5 Reference Documents

1. Project 2 Guide, which describes the 4 Test Modules to be completed.
2. Raspberry Pi 4 Model B User's Guide
3. Broadcom BCM2711 ARM Peripherals Guide
4. Others, yet to be determined.

1.6 Scope

The scope of this document concerns the requirements for the Patton e911 IP-PBX VoIP Gateway product and work to evaluate a potential MPU to meet those requirements. It describes the product function, criteria for evaluating the performance of the product, and performance requirements to guide the evaluation work. It does not describe how the design is to be done, only what the outcome should be. The work required is limited to evaluation of potential solutions to the embedded system implementation for the product.

Request for Services (RFS)	Version 1.4
Class Confidential	
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

2 Guidelines for Report Preparation

2.1 REPORT SUBMISSION

Award of the Top Prize resulting from this RFS will be based upon the most responsive Vendor whose evaluation results will be the most advantageous to Patton in terms of cost, functionality, and other factors as specified elsewhere in this RFS.

Vendor's Report shall be submitted in several parts as set forth below. The Vendor will confine its submission to those matters sufficient to define its Report and to provide an adequate basis for Patton's evaluation of the Vendor's Report. In no case should the report exceed **5** pages long.

Vendor's Report(s) in response to this RFS must include a system block diagram and links to code, images and diagrams. We recommend storage of these items in a GIT repository. The submitted Reports are suggested to include each of the following sections:

1. Executive Summary
2. Problem Statement and Objectives
3. Approach and Methodology for Evaluation
4. Module Test Results
5. List of Project Deliverables
6. Recommendations
7. Appendix: References
8. Appendix: Project Team Staffing

The detailed requirements for each of the above-mentioned sections are outlined below.

Request for Services (RFS)	Version 1.4
Class Confidential	Page 7 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

3 DETAILED PATTON PRODUCT REQUIREMENTS

3.1 SCHEDULE

This product must be developed within the next 18 months, ready for market. It is an evolution of existing products.

3.2 BUDGET

Budget for the embedded system is not to exceed \$50 in production. This includes the PCB and connectors. Cost for the MPU should not be greater than \$15.

3.3 PERFORMANCE (FEATURES)

Capacity**

- 64 calls with Transcoding
- 128 calls with RTP Relay
- 20 cps

Gateway Capacity

Up to 120 (PRI), 16 (BRI), 8 (FXS) simultaneous VoIP or T.38 fax calls (depending on the model).

BRI Voice Connectivity

- 2/4/8 BRI So ports, RJ-45
- Built-in line power on each port (total 4W)
- DSS1, Q.921, Q.931, NTT-64

FXS/FXO Voice

Connectivity

- Up to 4 FXS and FXO ports
- 2-wire Loopstart on RJ-11/12
- Caller-ID FSK and ITUV.23/Bell 202 generation
- FSK & stuttering dial tone
- MWI

PRI Voice Connectivity

- 1 or 4 T1/E1 PRI port(s) (NT/TE)
- Signaling support (ISDN DSS-1, NI-2, Q.SIG, CAS Robbed bit loop and ground start, E&M, immediate, wink, double wink)
- ISDN speech, audio & data (Fax Gr 4, UDI 64, RDI64)
- CAS protocols: RBS (Loop start, ground start, E&M

Request for Services (RFS)	Version 1.4
Class Confidential	
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	Page 8 of 13

wink, intermediate, doublewink)
and R2/MFC-R2

(Q.400–Q.490 and

Configurable country profiles)

LAN/WAN Connectivity

- 2 x 10/100/1000 TX Ethernet ports or 4 x 10/100Base-T Ethernet ports (depending on the model)
- Auto-MDI-X • DHCP Client
- PPPoE Client (multi-session)

Voice Processing

- Codec G.711 a-law/mu-law, G.723, G.729ab, G.726, G.727, T.38 fax relay (9.6 k, 14.4 k)
- G.711 transparent fax and bypass

Call Routing and Services

- Regular expression call routing and manipulation
- Number blocking
- Short-dialing
- Digit collection, distribution and hunt groups

IP Quality of Service

- Voice priority
- Traffic management
- IEEE 802.1p, TOS, DiffServ labeling
- IEEE 802.1Q, VLAN tag insertion/deletion 4,096

Management

- Web/HTTP, CLI with local console & remote Telnet access
- TFTP configuration & firmware loading
- Built-in diagnostic tools (trace, debug, call generator)

Processor?

Memory

- DDR2 RAM 1GB
- 250 GB HDD

Ethernet

2 10/100/1000 Ethernet Ports

External Power Supply

12 VDC, 8.5 A (102 W max)

Operating Environment

- Operating Temperature: 32 to 104° F (0 to 40°C)

Request for Services (RFS)	Version 1.4	
Class Confidential		Page 9 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.		

- Operating Humidity: up to 90%, non-condensing

Dimensions

- 19W x 1.7H x 12D in.
(48.3W x 4.4H x 30.5L cm)

- Rack mountable chassis

Compliance

- EMC: EN55022 and EN5502
- Safety: EN 60950
- CE
- FCC Part 15 Class A; Part

Inputs:

1. 1 switch
2. 1 T1/E1 PRI Port (RJ45)
3. 4 10/100 Ethernet Ports (RJ45)
4. 2 USB 2.0/3.0

Outputs

1. 1 LED
2. VGA display
3. HDMI
4. 8 BRI ports for up to 4 FXS and 4 FXO lines
5. Audio out
6. 2 10/100 Ethernet Diagnostic Ports (RJ45)

Processing Requirement

Estimated 500 DMIPs, 1000 MMACs

Power: 12VDC input.

Request for Services (RFS)	Version 1.4
Class Confidential	Page 10 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

4 EVALUATION FACTORS

4.1 CRITERIA

Any award to be made pursuant to this RFS will be based upon the proposal with appropriate consideration given to technical, spelling, grammar, and management requirements. Evaluation of projects will be based upon the Vendor's responsiveness to the RFS. The following elements will be the primary considerations in evaluating all submitted Reports and in the selection of a Vendor or Vendors for Top Prizes:

25% Technical Report
5% Executive Summary & Recommendations
20% TA Review
5% Deliverables for Module 1
15% Deliverables for Project Module 2
10% Deliverables for Module 3
20% Deliverables for Project Module 4
2-10% Bonus for each optional module as indicated

Request for Services (RFS)	Version 1.4
Class Confidential	Page 11 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

5 SCOPE OF WORK

5.1 EVALUTION

At a minimum, the work to be performed includes:

- **Evaluate the hardware and software** capabilities of the **Broadcom BCM2711 MPU** by using the Raspberry Pi 4 Model B platform to perform a series of tests and also by design calculations. Evaluation is of the MPU, not the platform.
- Draw a **system block diagram** showing the inputs, processor, and outputs for this device, the VoIP Gateway. Include this in the technical report.
- **Evaluate software performance by completion of the 4 assigned modules.** See the Project 2 Guide for details. In particular, Patton wants a comparison of QNX and Linux using QNX versus Fedora Embedded Linux, Debian Embedded Linux, and/or Raspian for this purpose. Compatibility with the Asterisk IP-PBX stack is desired. If after the software evaluation, a better processor choice is available, please recommend it.
- **Evaluate hardware suitability by suggesting possible I/O interfaces** including, 1 T1/E1 PRI Port, 6 10/100 Ethernet Ports, 2 USB 2.0 or 3.0, VGA, HDMI, 8 BRI telephone ports, Audio out, and LED drivers and calculating required I/O current drive and voltage levels for the processor I/O. **Create a Bill of Materials (BOM)** of key parts needed for the final hardware design. Provide an analysis of the power consumption of these parts with the processor to determine if the power requirements can be met.
- **Produce a Technical Report** showing results of the evaluation.
- Provide recommendations for circuit design and MPU selection.

5.2 DELIVERABLES

At the conclusion of the project, PATTON requires written documentation of the approach, findings, and recommendations associated with this project to be delivered to the contracting agent through Canvas. An informal presentation of the findings and recommendations to senior management may also be required as part of a peer evaluation. The documentation should consist of the following:

1 DETAILED TECHNICAL REPORT

A document developed for the use of PATTON's technical staff which discusses: the evaluation methodology employed, detailed technical findings, and recommendations as indicated in section 2 of this document.

2 EXECUTIVE SUMMARY REPORT

A document developed to summarize the scope, approach, findings and recommendations, in a manner suitable for senior management (3 paragraphs or less).

3 SOFTWARE DESIGN FILES AND DOCUMENTATION

Deliverables should include

- All drawings, images, and design documents in Word or PDF electronic
- Source code in zip format
- Any source code you write copied into report Appendix
- Test Data and Screenshots

Request for Services (RFS)	Version 1.4
Class Confidential	Page 12 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	

6 Acronyms and Definitions

Item	Description
ATP	Acceptance Test Plan
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
LED	Light Emitting Diode
PWM	Pulse Width Modulation
RFS	Request For Services
PTSN	Public Switched Telephone Network
ITSP	Internet Telephony Service Provider
RTP	Real-time Transport Protocol
PRI	Primary Rate Interface (ex. T1 carrier)
BRI	Basic Rate Interface (ex. 64 kbps PCM voice)
PCM	Pulse Coded Modulation
FXS	Foreign Exchange Subscriber
FXO	Foreign Exchange Office
PBX	Private Branch Exchange
FSK	Frequency Shift Keying
POTS	Plain Old Telephone Service
VoIP	Voice over Internet Protocol
QoS	Quality of Service
HTTP	Hypertext Transfer Protocol
DHCP	Dynamic Host Configuration Protocol
TOS	Type of Service
TFTP	Trivial File Transfer Protocol
CLI	Command Line Interface
EMC	Electro-Magnetic Compatibility
FCC	Federal Communications Commission

Request for Services (RFS)	Version 1.4
Class Confidential	Page 13 of 13
This document is exclusive property of University of Colorado, Boulder. Its contents must not be reproduced or communicated in any form to unauthorized persons or the persons outside the organization without written consent.	